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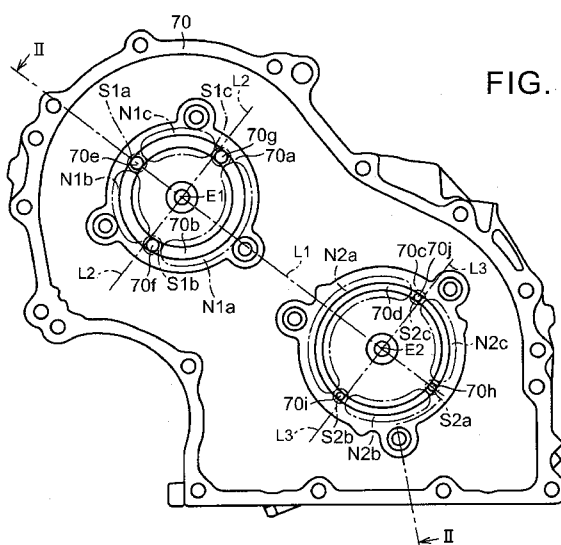


FIG. 3

(57) Abstract: A belt-type CVT includes a pair of pulley shafts, a pair of variable pulleys, and a transmission belt. The pair of pulley shafts includes a first / a second pulley shaft. The pair of variable pulleys is provided in the pair of pulley shafts, respectively, and each of the pair of variable pulleys has a variable effective diameter. The transmission belt is wound around the pair of variable pulleys. One end portion of the first pulley shaft is supported by a case via a first bearing, and a thrust load of the first pulley shaft is supported by the case via a first side surface of an outside peripheral wheel of the first bearing. The first side surface includes a first contact region, which is in contact with the case. The first side surface includes a first non-contact region, which faces the case via a gap.

VEHICLE AND BELT-TYPE CONTINUOUSLY VARIABLE TRANSMISSION

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

[0001] The invention relates to a vehicle and a belt-type continuously variable transmission, which suppress noise.

2. Description of Related Art

[0002] Japanese Patent Application Publication No. 2010-242951 (JP
10 2010-242951 A) discloses a belt-type continuously variable transmission which is provided with (a) a pair of variable pulleys that are provided in a pair of pulley shafts, respectively, and have variable effective diameters, and (b) a transmission belt wound on the pair of variable pulleys, in which (c) one end portion of at least one of the pulley shafts is supported by a case through a first bearing, and a thrust load of the one of the pulley shafts
15 is supported by the case through a side surface of an outside peripheral wheel of the first bearing.

[0003] In the belt-type continuously variable transmission stated above, for example, driving power of an engine is transmitted to the belt-type continuously variable transmission through a gear, and a thrust load of one of the pulley shafts is supported by
20 the case through the side surface of the outside peripheral wheel of the first bearing. In this case, vibration generated in the gear is transmitted to a case, which is, for example, a rear cover, located on an opposite side of the engine, through the first bearing that supports the one of the pulley shafts. Therefore, gear noise is generated from the case, and silence of a vehicle may not be improved.

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SUMMARY OF THE INVENTION

[0004] The invention provides a vehicle and a belt-type continuously variable transmission, in which gear noise generated from a case is suppressed, thereby improving silence of the vehicle.

[0005] The inventors have repeated various studies based on the above-mentioned
5 circumstances, and carried out experiments and so on for measuring sound pressure from a plurality of microphones provided in a plurality of locations in, for example, a rear cover of a belt-type continuously variable transmission. In the belt-type continuously variable transmission, for example, one end portion of a pulley shaft, which is one of the above-mentioned pair of pulley shafts, is supported by a case through a first bearing, and
10 one end portion of the other pulley shaft of the pair of pulley shafts is supported by the case through a second bearing. As a result, the inventors found that vibration, which is main gear noise generated from the case, that is the rear cover, is generated largely from a region of the rear cover between a part that supports the one of the pulley shafts and a part that supports the other pulley shaft.

[0006] A first aspect of the invention is a belt-type continuously variable
15 transmission, which includes a pair of pulley shafts including a first pulley shaft and a second pulley shaft, a pair of variable pulleys provided in the pair of pulley shafts, respectively, each of the pair of variable pulleys having a variable effective diameter, and a transmission belt wound around the pair of variable pulleys. One end portion of the first
20 pulley shaft is supported by a case via a first bearing, and a thrust load of the first pulley shaft is supported by the case via a first side surface of an outside peripheral wheel of the first bearing. The first side surface has a circular shape and includes a first contact region. The first contact region is in contact with the case, on an opposite side to the second pulley shaft side of the first contact region. The first side surface includes a first non-contact
25 region on the second pulley shaft side, the first non-contact region facing the case via a gap.

[0007] According to the above structure, in one of the pulley shafts, a gap is formed in a generating region of vibration, which is main gear noise generated from the case, in a thrust direction path in which the gear noise is transmitted. Thus, vibration

transmitted from a gear to the case in the thrust direction is suitably suppressed. As a result, gear noise generated from the case is reduced, and silence of a vehicle is improved.

[0008] In the belt-type continuously variable transmission, one end portion of the second pulley shaft is supported by the case via a second bearing, a thrust load of the
5 second pulley shaft is supported by the case via a second side surface of an outside peripheral wheel of the second bearing, the second side surface has a circular shape and includes a second contact region, the second contact region is in contact with the case, on an opposite side of the first pulley shaft side, and the second side surface includes a second non-contact region on the first pulley shaft side, the second non-contact region facing the
10 case via a gap. According to the above structure, in the other pulley shaft, a gap is formed in a generating region of vibration, which is main gear noise generated from the case, in a thrust direction path in which the gear noise is transmitted. Therefore, vibration transmitted from the gear in the thrust direction is suitably suppressed.

[0009] In the belt-type continuously variable transmission, the first contact region
15 is in contact with the case via a first shim, and the second contact region is in contact with the case via a second shim.

[0010] A second aspect of the invention is a vehicle, which includes an engine, a driving wheel and a transaxle. The transaxle includes a case, a first bearing provided in the case, a belt-type power transmission system housed in the case. The belt-type power
20 transmission system includes a pair of pulley shaft, a pair of variable pulleys and a transmission belt. The pair of pulley shaft includes a first pulley shaft and a second pulley shaft. The pair of variable pulleys is provided in the pair of pulley shafts respectively. Each of variable pulleys has a variable effective diameter. The transmission belt is wound around the pair of variable pulleys. One end portion of the
25 first pulley shaft is supported by a case via a first bearing, and a thrust load of the first pulley shaft is supported by the case via a first side surface of an outside peripheral wheel of the first bearing. The first side surface includes a first non-contact region on the second pulley shaft side, the first non-contact region facing the case via a gap.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Features, advantages, and technical and industrial significance of exemplary embodiments of the invention will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

5 FIG. 1 is a view for explaining a rough structure of a vehicle according to an example of the invention;

FIG. 2 is a view for explaining a structure of a belt-type continuously variable transmission of a transaxle provided in the vehicle shown in FIG. 1, and is a sectional view taken along the line II – II in FIG. 3 described below;

10 FIG. 3 is a view only showing a rear cover provided in the transaxle shown in FIG. 2, and is a sectional view taken along the line III – III in FIG. 1;

FIG. 4 is an enlarged view in which F1 surrounded by an alternate long and short dash line in FIG. 2 is enlarged;

FIG. 5 is a view showing a first shim provided in FIG. 4;

15 FIG. 6 is an enlarged view in which F2 surrounded by an alternate long and short dash line in FIG. 2 is enlarged;

FIG. 7 is a view showing a second shim provided in FIG. 6;

FIG. 8 is a sectional view taken along the line VIII – VIII in FIG. 4;

FIG. 9 is a sectional view taken along the line IX – IX in FIG. 6;

20 FIG. 10 is an enlarged view in which F3 surrounded by an alternate long and short dash line in FIG. 2 is enlarged;

FIG. 11 is an enlarged view in which F4 surrounded by an alternate long and short dash line in FIG. 2 is enlarged;

25 FIG. 12 is a view corresponding to FIG. 3 for explaining another example of the invention;

FIG. 13 is a view showing a first shim provided in a transaxle in the example shown in FIG. 12;

FIG. 14 is a view showing a second shim provided in the transaxle in the example shown in FIG. 12;

FIG. 15 is a sectional view for explaining a first contact region in FIG. 12, which corresponds to FIG. 4, according to the example shown in FIG. 12;

FIG. 16 is a sectional view for explaining a first non-contact region in FIG. 12, which corresponds to FIG. 10, according to the example shown in FIG. 12;

5 FIG. 17 is a sectional view for explaining a second non-contact region in FIG. 12, which corresponds to FIG. 11, in the example shown in FIG. 12;

FIG. 18 is a sectional view for explaining a second contact region shown in FIG. 12, which corresponds to FIG. 6, according to the example shown in FIG. 12;

10 FIG. 19 is a sectional view for explaining a pin positioning structure in which the second shim shown in FIG. 14 is positioned at a given position in the rear cover by using a pin provided in the rear cover of the transaxle according to the example shown in FIG. 12;

FIG. 20 is a view for explaining another example of the invention, and is a sectional view for explaining a spigot structure in which the second shim is positioned at a given position of the rear cover by using a protrusion formed in the rear cover and a depressed
15 portion that is depressed in the second shim for fitting the protrusion;

FIG. 21 is a view for explaining another example of the invention, and is a view showing a first shim provided in a transaxle; and

FIG. 22 is a view showing a second shim provided in the transaxle in the example shown in FIG. 21.

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DETAILED DESCRIPTION OF EMBODIMENTS

[0012] Examples of the invention are explained in detail below with reference to the drawings. In the following examples, the drawings are simplified or modified as appropriate, and a dimension ratio, a shape and so on of each part are not necessarily
25 depicted accurately.

[0013] FIG. 1 is a view for explaining a rough structure of a vehicle 10 according to a first example. In FIG. 1, the vehicle 10 includes an engine 12, driving wheels 14, and a transaxle 16. The engine 12 functions as a driving power source for running. The transaxle 16 is a power transmission system provided between the engine 12 and the

driving wheels 14. Inside a transaxle case 18 serving as a non-rotary member, the transaxle 16 includes a torque converter 20, an input shaft 22, a belt-type continuously variable transmission 24, a steering reverser 26, a gear mechanism 28, an output shaft 30, a countershaft 32, a mechanical reduction gear 34, a differential gear 36, a pair of axles 38, and so on. The torque converter 20 is a fluid transmission device connected with the engine 12. The input shaft 22 is provided integrally with a turbine shaft that is an output rotary member of the torque converter 20. The belt-type continuously variable transmission 24 is a continuously variable transmission serving as a first transmission mechanism connected with the input shaft 22. The steering reverser 26 is connected with the input shaft 22. The gear mechanism 28 is connected with the input shaft 22 through the steering reverser 26 and provided in parallel with the belt-type continuously variable transmission 24. Therefore, the input shaft 22 is an input rotary member common to the belt-type continuously variable transmission 24 and the gear mechanism 28. The output shaft 30 is an output rotary member common to the belt-type continuously variable transmission 24 and the gear mechanism 28. The mechanical reduction gear 34 includes a pair of gears 34a and 34b, which mesh with each other and are provided in the output shaft 30 and the countershaft 32, respectively, so as not to rotate relative to the output shaft 30 and the countershaft 32, respectively. The differential gear 36 is connected with the gear 34a that is provided in the countershaft 32 so as not to rotate relative to the countershaft 32. The pair of axles 38 is connected with the differential gear 36. In the transaxle 16 structured as above, power (including torque and force unless otherwise distinguished) of the engine 12 is transmitted to the pair of driving wheels 14 through the torque converter 20, the belt-type continuously variable transmission 24 or the gear mechanism 28, the mechanical reduction gear 34, the differential gear 36, the axles 38, and so on sequentially.

[0014] As stated above, in the transaxle 16, the belt-type continuously variable transmission 24 and the gear mechanism 28 are provided in parallel between the engine 12 or the input shaft 22 and the driving wheels 14 or the output shaft 30. The transaxle 16 is structured so that a power transmission path from the engine 12 to the driving wheels 14 is

switched in accordance with a running state of the vehicle 10. In short, the transaxle 16 is structured to be able to switch between a first power transmission path and a second power transmission path. The first power transmission path is a path for transmitting power of the engine 12 from the input shaft 22 to the driving wheels 14 side, in other words, to the output shaft 30, through the belt-type continuously variable transmission 24. The second power transmission path is a path for transmitting power of the engine 12 from the input shaft 22 to the driving wheels 14 side, in other words, to the output shaft 30, through the gear mechanism 28. Therefore, the transaxle 16 is provided with a belt running clutch C2, which serves as a first clutch mechanism that intermits power transmission in the first power transmission path, and a positive clutch D1, which serves as a second clutch mechanism that intermits power transmission in the second power transmission path.

[0015] The steering reverser 26 is structured mainly by the double pinion-type planetary gear 26p, a forward clutch C1, and a reverse brake B1. A carrier 26c of the planetary gear 26p is connected integrally with the input shaft 22. A ring gear 26r of the planetary gear 26p is selectively connected with a later-described case 68 of the transaxle case 18 through the reverse brake B1. A sun gear 26s of the planetary gear 26p is connected with a small-diameter gear 40 that is provided about the input shaft 22 so as to be coaxial with and rotatable to the input shaft 22. The carrier 26c and the sun gear 26s are selectively connected with each other through the forward clutch C1. The forward clutch C1 and the reverse brake B1 are examples of a connection/disconnection device. Both of the forward clutch C1 and the reverse brake B1 are hydraulic frictional engagement devices that are frictionally engaged by a hydraulic actuator. According to the steering reverser 26 structured as above, when the forward clutch C1 is engaged and the reverse brake B1 is released, the input shaft 22 is coupled with the small-diameter gear 40, and a forward power transmission path is established in the second power transmission path. When the reverse brake B1 is engaged and the forward clutch C1 is released, the small-diameter gear 40 is rotated in a direction opposite to the input shaft 22, and a reverse power transmission path is established in the second power transmission path. When both of the forward clutch C1 and the reverse brake B1 are released, the second power

transmission path becomes a neutral state (a power transmission interrupted state) in which power transmission is interrupted. Since the steering reverser 26 is interposed in the second power transmission path, the forward clutch C1 and the reverse brake B1 function as a third clutch mechanism that is provided in the transaxle 16 and intermits power
5 transmission in the second power transmission path.

[0016] The gear mechanism 28 is structured by including the small-diameter gear 40, and a large-diameter gear 44 provided so as not to rotate to a gear mechanism countershaft 42. An idler gear 46 is provided around the gear mechanism countershaft 42 so that the idler gear 46 is able to coaxially rotate to the gear mechanism countershaft 42.

10 The positive clutch D1 is provided around the gear mechanism countershaft 42 between the gear mechanism countershaft 42 and the idler gear 46, and selectively connects and disconnects the gear mechanism countershaft 42 and the idler gear 46 with each other. To be specific, the positive clutch D1 is structured by including a first gear 48 formed in the gear mechanism countershaft 42, a second gear 50 formed in the idler gear 46, and a hub
15 sleeve 52 in which inside peripheral teeth are formed, which are able to fit with the first gear 48 and the second gear 50. In the positive clutch D1 structured as above, as the hub sleeve 52 is fitted with the first gear 48 and the second gear 50, the gear mechanism countershaft 42 and the idler gear 46 are connected with each other. The positive clutch D1 further includes a synchromesh mechanism S1 that synchronizes rotation when the first
20 gear 48 and the second gear 50 are fitted with each other. The idler gear 46 meshes with an output gear 54 that has a diameter larger than that of the idler gear 46. The output gear 54 is provided around the same rotation axis as that of the output shaft 30 so as not to rotate relative to the output shaft 30. When one of the forward clutch C1 and the reverse brake B1 is engaged, the positive clutch D1 is engaged, and the belt running clutch C2 is
25 released, the second power transmission path is established, in which power of the engine 12 is transmitted from the input shaft 22 to the output shaft 30 sequentially through the steering reverser 26, the gear mechanism 28, the idler gear 46, and the output gear 54.

[0017] The belt-type continuously variable transmission 24 is provided on a power transmission path between the input shaft 22 and the output shaft 30. The belt-type

continuously variable transmission 24 is provided with a primary shaft (an example of a first pulley shaft) 56, a primary pulley (an example of a first variable pulley) 58, a secondary shaft (an example of a second pulley shaft) 60, a secondary pulley (an example of a second variable pulley) 62, and a transmission belt 64. The primary shaft 56 is
5 connected coaxially with the input shaft 22. The primary pulley 58 is a variable pulley that is provided in the primary shaft 56 and has a variable effective diameter. The secondary shaft 60 is coaxial with the output shaft 30. The secondary pulley 62 is a variable pulley that is provided in the secondary shaft 60 and has a variable effective diameter. The transmission belt 64 is wound between the primary pulley 58 and the
10 secondary pulley 62. In the belt-type continuously variable transmission 24, power is transmitted through frictional force between the primary pulley 58 and the secondary pulley 62, and the transmission belt 64. In the belt-type continuously variable transmission 24, V-groove widths of the primary pulley 58 and the secondary pulley 62, which serve as a pair of variable pulleys, change, and a winding diameter (an effective
15 diameter) of the transmission belt 64 is thus changed. Accordingly, a transmission gear ratio (a gear ratio) γ (= input shaft rotation speed N_i / output shaft rotation speed N_o) is continuously changed. For example, when the V-groove width of the primary pulley 58 is narrowed, the gear ratio γ is reduced (in short, the belt-type continuously variable transmission 24 is upshifted). When the V-groove width of the primary pulley 58 is
20 widened, the gear ratio γ is increased (in short, the belt-type continuously variable transmission 24 is downshifted). The output shaft 30 is arranged around the secondary shaft 60 so as to be able to coaxially rotate relative to the secondary shaft 60. The belt running clutch C2 is provided to the driving wheels 14 side more than the belt-type continuously variable transmission 24 (in short, the belt running clutch C2 is provided
25 between the secondary pulley 62 and the output shaft 30), and selectively connects and disconnects the secondary pulley 62 and the output shaft 30 with each other. When the belt running clutch C2 is engaged and the positive clutch D1 is released, the first power transmission path is established (connected), in which power of the engine 12 is

transmitted from the input shaft 22 to the output shaft 30 through the belt-type continuously variable transmission 24.

[0018] As shown in FIG. 1, the transaxle case 18 is a non-rotary member made of three case members, that are a housing 66, a case 68, and a rear cover (case) 70, and so on.

5 The housing 66 defines a first housing space A that houses, for example, the torque converter 20 and so on. The case 68 is cylindrical and is adjacent to the housing 66 on the opposite side of the engine 12. The rear cover 70 is adjacent to the case 68 on the opposite side of the engine 12. These case members are fastened to each other by, for example, bolts 72 and so on, and thus structured as one case. The transaxle case 18 has a
10 second housing space B surrounded and thus defined by the housing 66 and the case 68, and a third housing space C surrounded and thus defined by the case 68 and the rear cover 70. The second housing space B houses, for example, the steering reverser 26, the gear mechanism 28, the positive clutch D1, the mechanical reduction gear 34, the differential gear 36, and so on. The third housing space C houses, for example, the belt-type
15 continuously variable transmission 24 and so on.

[0019] As shown in FIG. 1, in the belt-type continuously variable transmission 24, an end portion of the shaft-shaped primary shaft 56 on the opposite side of the engine 12 is supported by the rear cover 70 through a first bearing 74 that is provided in the rear cover 70. An end portion of the primary shaft 56 on the engine 12 side is supported by the case
20 68 through a bearing 76 provided in a partition 68a that is formed in the case 68 and separates the second housing space B and the third housing space C. Therefore, the primary shaft 56 is supported by the transaxle case 18 so as to be able to rotate about a first axis E1 of the primary shaft 56. An end portion of the shaft-shaped secondary shaft 60 on the opposite side of the engine 12 is supported by the rear cover 70 through the through a
25 second bearing 78 that is provided in the rear cover 70. An end portion of the secondary shaft 60 on the engine 12 side is supported by the housing 66 through, for example, a bearing (not shown) that is provided in the housing 66. Thus, the secondary shaft 60 is supported by the transaxle case 18 so as to be able to rotate about a second axis E2 of the secondary shaft 60.

[0020] As shown in FIG.1 and FIG. 2, the primary pulley 58 includes a driving-side fixed sheave 56a, a driving-side movable sheave 80, and a driving-side hydraulic cylinder 82. The driving-side fixed sheave 56a is integrally fixed to the primary shaft 56. The driving-side movable sheave 80 is provided so as to be able to rotate relative to the primary shaft 56 about the first axis E1 of the primary shaft 56 and also move in the first axis E1 direction. The driving-side hydraulic cylinder 82 is structured so as to provide thrust to change the V-groove width between the driving-side fixed sheave 56a and the driving-side movable sheave 80. The secondary pulley 62 includes a driven-side fixed sheave 60a, a driven-side movable sheave 84, and a driven-side hydraulic cylinder 86. The driven-side fixed sheave 60a is integrally fixed to the secondary shaft 60. The driven-side movable sheave 84 is provided so as to be able to rotate relative to the secondary shaft 60 about the second axis E2 of the secondary shaft 60 and also move in the second axis E2 direction. The driven-side hydraulic cylinder 86 is structured to provide thrust to change the V-groove width between the driven-side fixed sheave 60a and the driven-side movable sheave 84.

[0021] As shown in FIG, 2, the first bearing 74 is provided with a circular outside peripheral wheel 74a, a circular inside peripheral wheel 74b arranged on an inner side of the outside peripheral wheel 74a, spherical rolling elements 74c arranged between the outside peripheral wheel 74a and the inside peripheral wheel 74b, and so on. The second bearing 78 is provided with a circular outside peripheral wheel 78a, a circular inside peripheral wheel 78b arranged on an inner side of the outside peripheral wheel 78a, spherical rolling elements 78c arranged between the outside peripheral wheel 78a and the inside peripheral wheel 78b.

[0022] As shown in FIG. 2, the driving-side hydraulic cylinder 82 is provided with a bottomed cylinder-shaped cylinder member 90, which is fixed to the end portion of the primary shaft 56 on the engine 12 side by being fastened by a first nut 88, and an annular oil chamber D that is surrounded and thus formed by the cylinder member 90 and the driving-side movable sheave 80. As shown in FIG. 2, the cylinder member 90 is integrally provided with a bearing fitting portion 90a that projects to the opposite side of

the engine 12 in order to install the first bearing 74 on an inside peripheral portion of the cylinder member 90. As shown in FIG. 2 and FIG. 3, a first step portion 70a is integrally provided in the rear cover 70. The first step portion 70a is formed so as to be circularly depressed to the opposite side of the engine 12 in order to install the first bearing 74 in a peripheral portion of the rear cover 70 around the first axis E1. In other words, the first bearing 74 is fitted to the bearing fitting portion 90a of the cylinder member 90 and the first step portion 70a of the rear cover 70. As shown in FIG. 2, in the first bearing 74, the outside peripheral wheel 74a is fixed to the first step portion 70a of the rear cover 70 as a circular first plate material 94, which is screwed with a first fastening bolt 92 provided in the rear cover 70, is fastened by the first fastening bolt 92 toward the rear cover 70 side.

[0023] As shown in FIG. 2 and FIG. 3, the first step portion 70a of the rear cover 70 is provided with a circular thrust bearing surface 70b that is perpendicular to the first axis E1. As shown in FIG. 4, a first shim 96 which has a circular shape shown in FIG. 5 is arranged between the thrust bearing surface 70b of the first step portion 70a of the rear cover 70, and a circular side surface 74d of the outside peripheral wheel 74a of the first bearing 74 on the opposite side of the engine 12.

[0024] As shown in FIG. 2 and FIG. 3, a second step portion 70c is integrally provided in the rear cover 70. The second step portion 70c is formed so as to be circularly depressed to the opposite side of the engine 12 in order to install the second bearing 78 in a peripheral portion of the rear cover 70 around the second axis E2. The second bearing 78 is arranged between the second step portion 70c of the rear cover 70, and an end portion of the secondary shaft 60 on the opposite side of the engine 12. As shown in FIG. 2, the outside peripheral wheel 78a of the second bearing 78 is fixed to the second step portion 70c of the rear cover 70 as a circular second plate material 100, which is screwed with a second fastening bolt 98 provided in the rear cover 70, is fastened by the second fastening bolt 98 towards the rear cover 70 side. The inside peripheral wheel 78b is fixed to an end portion of the secondary shaft 60 on the opposite side of the engine 12 by being fastened by a second nut 102 that is screwed with the end portion of the secondary shaft 60 on the opposite side of the engine 12.

[0025] As shown in FIG. 2 and FIG. 3, a circular thrust bearing surface 70d, which is perpendicular to the second axis E2, is formed in the second step portion 70c of the rear cover 70. As shown in FIG. 6, a second shim 104 which has a circular shape shown in FIG. 7 is arranged between the thrust bearing surface 70d of the second step portion 70c of the rear cover 70, and a circular side surface 78d of the outside peripheral wheel 78a of the second bearing 78 on the opposite side of the engine 12.

[0026] As shown in FIG. 3, FIG. 4 and FIG. 8, a plurality of (in this example, three) round-shaped first projections 70e, 70f, 70g are integrally formed on the thrust bearing surface 70b of the first step portion 70a of the rear cover 70. The first projections 70e, 70f, 70g project to a certain height to the first shim 96 side in a thickness direction of the rear cover 70. As shown in FIG. 3, in the thrust bearing surface 70b of the first step portion 70a of the rear cover 70, the first projection 70e is arranged on the opposite side of the secondary shaft 60 and on a first straight line L1 that connects the first axis E1 of the primary shaft 56 with the second axis E2 of the secondary shaft 60. In the thrust bearing surface 70b of the first step portion 70a of the rear cover 70, the first projection 70f and the first projection 70g are arranged on the secondary shaft 60 side and at locations adjacent to a second straight line L2 that is orthogonal to the first straight line L1 and passes through the first axis E1 of the primary shaft 56.

[0027] As shown in FIG. 3, FIG. 6, and FIG. 9, a plurality of (in this example, three) round-shaped second projections 70h, 70i, 70j are integrally formed on thrust bearing surface 70d of the second step portion 70c of the rear cover 70. The second projections 70h, 70i, 70j project to a certain height to the second shim 104 side in the thickness direction of the rear cover 70. As shown in FIG. 3, in the thrust bearing surface 70d of the second step portion 70c of the rear cover 70, the second projection 70h is arranged on the opposite side of the primary shaft 56 and on the first straight line L1. In the thrust bearing surface 70d of the second step portion 70c of the rear cover 70, the second projection 70i and the second projection 70j are arranged on the primary shaft 56 side and at locations adjacent to a third straight line L3 that is orthogonal to the first straight line L1 and passes through the second axis E2 of the secondary shaft 60.

[0028] As shown in FIG. 3, FIG. 4, and FIG. 10, in a state where the first bearing 74 is installed between the first step portion 70a of the rear cover 70 and the cylinder member 90, first contact regions S1a, S1b, S1c and first non-contact regions N1a, N1b, N1c are provided at a plurality of locations in the circular side surface 74d of the outside peripheral wheel 74a of the first bearing 74. The first contact regions S1a, S1b, S1c are regions in the side surface 74d, which come into contact with the thrust bearing surface 70b of the first step portion 70a of the rear cover 70, in other words, the first projections 70e, 70f, 70g formed in the thrust bearing surface 70b, indirectly through the first shim 96. The first non-contact regions N1a, N1b, N1c are regions in the side surface 74d, which face the thrust bearing surface 70b of the first step portion 70a of the rear cover 70 through a gap G1. As shown in FIG. 3, in the side surface 74d of the outside peripheral wheel 74a of the first bearing 74, the first contact region S1a is provided on the opposite side of the secondary shaft 60. In the side surface 74d of the outside peripheral wheel 74a of the first bearing 74, the first non-contact region N1a is provided on the secondary shaft 60 side.

[0029] As shown in FIG. 3, FIG. 6, and FIG. 11, in a state where the second bearing 78 is installed between the second step portion 70c of the rear cover 70 and the end portion of the secondary shaft 60 on the opposite side of the engine 12, second contact regions S2a, S2b, S2c and second non-contact regions N2a, N2b, N2c are provided at a plurality of locations in the circular side surface 78d of the outside peripheral wheel 78a of the second bearing 78. The second contact regions S2a, S2b, S2c are regions in the side surface 78d, which come into contact with the thrust bearing surface 70d of the second step portion 70c of the rear cover 70, in other words, the second projections 70h, 70i, 70j formed in the thrust bearing surface 70d, indirectly through the second shim 104. The second non-contact regions N2a, N2b, N2c are regions in the side surface 78d, which face the thrust bearing surface 70d of the second step portion 70c of the rear cover 70 through a gap G2. As shown in FIG. 3, in the side surface 78d of the outside peripheral wheel 78a of the second bearing 78, the second contact region S2a is provided on the opposite side of the primary shaft 56. In the side surface 78d of the outside peripheral wheel 78a of the

second bearing 78, the second non-contact region N2a is provided on the primary shaft 56 side.

[0030] The vehicle 10 structured as above runs in gear as, for example, the forward clutch C1 and the positive clutch D1 are engaged and the belt running clutch C2 and the reverse brake B1 are released so that driving power of the engine 12 is transmitted to the output shaft 30 through a gear of the steering reverser 26 and a gear of the gear mechanism 28. Then, a thrust load of the primary shaft 56 is supported by the thrust bearing surface 70b of the first step portion 70a of the rear cover 70, in other words, by the first projections 70e, 70f, 70g formed in the thrust bearing surface 70b, through the side surface 74d of the outside peripheral wheel 74a of the first bearing 74. At the same time, a thrust load of the secondary shaft 60 is supported by the thrust bearing surface 70d of the second step portion 70c of the rear cover 70, in other words, by the second projections 70h, 70i, 70j formed on the thrust bearing surface 70d, through the side surface 78d of the outside peripheral wheel 78a of the second bearing 78.

[0031] Further, in the vehicle 10, for example, vibration generated in the gear (a helical gear) of the steering reverser 26 and a gear (a helical gear) of the gear mechanism 28 is transmitted to the rear cover 70 as thrust load vibration through the first bearing 74 that supports the primary shaft 56 and the second bearing 78 that supports the secondary shaft 60. Thus, gear noise is generated from the rear cover 70. However, in the vehicle 10 stated above, the gap G1 of the first non-contact region N1a and the gap G2 of the second non-contact region N2a are formed in a noise generating region along a path in a thrust direction where gear noise is transmitted. The gear noise is mainly generated in the noise generating region which is located between a part of the rear cover 70 that supports the primary shaft 56 and a part of the rear cover 70 that supports the secondary shaft 60, such as a region in the rear cover 70 between the second straight line L2 and the third straight line L3. Therefore, vibration transmitted in the thrust direction from, for example, the gear of the steering reverser 26 and the gear of the gear mechanism 28 to the rear cover 70 is suppressed suitably by the gap G1 and the gap G2, thereby reducing the gear noise.

[0032] As stated earlier, according to the belt-type continuously variable transmission 24 according to this example, the first contact region S1a is provided in the circular side surface 74d of the outside peripheral wheel 74a of the first bearing 74, on the opposite side of the secondary shaft 60. The first contact region S1a is in contact with the rear cover 70 indirectly through the first shim 96. In the circular side surface 74d of the outside peripheral wheel 74a of the first bearing 74, the first non-contact region N1a is provided on the secondary shaft 60 side by the gap G1 that is formed between the side surface 74d and the rear cover 70. Therefore, in the primary shaft 56, the gap G1 is formed in the generating region of vibration, which is main gear noise generated from the rear cover 70, in the thrust direction path where the gear noise is transmitted. Hence, vibration transmitted from, for example, the gears of the steering reverser 26 and the gear mechanism 28 to the rear cover 70 in the thrust direction is suitably suppressed. Thus, gear noise generated in the rear cover 70 is reduced, thereby improving silence of the vehicle 10.

[0033] According to the belt-type continuously variable transmission 24 of this example, the end portion of the secondary shaft 60 on the opposite side of the engine 12 is supported by the rear cover 70 through the second bearing 78, and a thrust load of the secondary shaft 60 is supported by the rear cover 70 through the side surface 78d of the outside peripheral wheel 78a of the second bearing 78. Further, in the circular side surface 78d of the outside peripheral wheel 78a of the second bearing 78, the second contact region S2a is provided on the opposite side of the primary shaft 56. The second contact region S2a is in contact with the rear cover 70 indirectly through the second shim 104. In the circular side surface 78d of the outside peripheral wheel 78a of the second bearing 78, the second non-contact region N2a is provided on the primary shaft 56 side by the gap G2 formed between the side surface 78d and the rear cover 70. Therefore, in the secondary shaft 60, the gap G2 is formed in the generating region of vibration, which is main gear noise generated from the rear cover 70, in the thrust direction path where the gear noise is transmitted. Hence, vibration transmitted from, for example, the gears of the

steering reverser 26 and the gear mechanism 28 in the thrust direction is suitably suppressed.

[0034] Next, a second example is explained in detail based on the drawings. In the explanation below, the same reference numerals are used for parts common to the examples in order to omit explanation.

[0035] As shown in FIG. 12 to FIG. 18, a transaxle of this example is approximately the same as the transaxle 16 according to the first example except that the first projections 70e, 70f, 70g are not formed in the thrust bearing surface 70b of the first step portion 70a of the rear cover 70, the second projections 70h, 70i, 70j are not formed in the thrust bearing surface 70d of the second step portion 70c of the rear cover 70, and shapes of a first shim 106 and a second shim 108 are different from those of the first shim 96 and the second shim 104 according to the first example.

[0036] As shown in FIG. 13, the first shim 106 is a semicircular plate material, which is formed into a semicircular shape by removing a part of the first shim 96 shown in the first example so that a region between both end portions 106a about the center E3 of the first shim 96 has a given angle $\theta 1$ (for example, 180° or larger). As shown in FIG. 12, the first shim 106 is arranged so as to cover the thrust bearing surface 70b of the first step portion 70a of the rear cover 70 on the opposite side of the secondary shaft 60 of the thrust bearing surface 70b.

[0037] As shown in FIG. 14, the second shim 108 is a semicircular plate material, which is formed into a semicircular shape by removing a part of the second shim 104 shown in the first example so that a region between both end portions 108a about the center E4 of the second shim 104 has a given angle $\theta 2$ (for example, 180° or larger). As shown in FIG. 12, the second shim 108 is arranged so as to cover the thrust bearing surface 70d of the second step portion 70c of the rear cover 70 on the opposite side of the primary shaft 56. As shown in FIG. 19, a fitting hole 108b is formed in the second shim 108 for fitting a columnar pin 70k that is formed in the thrust bearing surface 70d of the second step portion 70c of the rear cover 70. When the pin 70k is fitted into the fitting hole 108b, the position of the second shim 108 in the thrust bearing surface 70d of the second step

portion 70c of the rear cover 70 is determined. At the same time, the pin 70k prevents the second shim 108 from rotating. Although not shown, a fitting hole is also formed in the first shim 106 for fitting a pin that has the functions stated above and is formed in the thrust bearing surface 70b of the first step portion 70a of the rear cover 70.

5 **[0038]** As shown in FIG. 12, FIG. 15, and FIG. 16, in a state where the first bearing 74 is installed between the first step portion 70a of the rear cover 70 and the cylinder member 90, a first contact region S1a1 and a first non-contact region N1a1 are provided in the circular side surface 74d of the outside peripheral wheel 74a of the first bearing 74. The first contact region S1a1 is in contact with the thrust bearing surface 70b
10 of the first step portion 70a of the rear cover 70 indirectly through the first shim 106. The first non-contact region N1a1 is provided by a gap G3 formed between the circular side surface 74d and the thrust bearing surface 70b of the first step portion 70a of the rear cover 70 because the first shim 106 is not placed between the circular side surface 74d and the thrust bearing surface 70b. As shown in FIG. 12, in the side surface 74d of the outside
15 peripheral wheel 74a of the first bearing 74, the first contact regions S1a1 is provided on the opposite side of the secondary shaft 60. In the side surface 74d of the outside peripheral wheel 74a of the first bearing 74, the first non-contact region N1a1 is provided on the secondary shaft 60 side.

20 **[0039]** As shown in FIG. 12, FIG. 17 and FIG. 18, in a state where the second bearing 78 is installed between the second step portion 70c of the rear cover 70 and an end portion of the secondary shaft 60 on the opposite side of the engine 12, a second contact region S2a1 and a second non-contact region N2a1 are provided in the circular side surface 78d of the outside peripheral wheel 78a of the second bearing 78. The second contact region S2a1 is in contact with the thrust bearing surface 70d of the second step portion 70c
25 of the rear cover 70 indirectly through the second shim 108. The second non-contact region N2a1 is provided by a gap G4 that is formed between the circular side surface 78d and the thrust bearing surface 70d of the second step portion 70c of the rear cover 70 because the second shim 108 is not placed between the circular side surface 78d and the thrust bearing surface 70d. As shown in FIG. 12, in the side surface 78d of the outside

peripheral wheel 78a of the second bearing 78, the second contact region S2a1 is provided on the opposite side of the primary shaft 56. In the side surface 78d of the outside peripheral wheel 78a of the second bearing 78, the second non-contact region N2a1 is provided on the primary shaft 56 side.

5 **[0040]** In the transaxle according to this example structured as above, when running in gear is carried out, in which driving power of the engine 12 is transmitted to the output shaft 30 through, for example, a gear of the steering reverser 26 and a gear of the gear mechanism 28, a thrust load of the primary shaft 56 is supported by the thrust bearing surface 70b of the first step portion 70a of the rear cover 70 through the outside peripheral
10 wheel 74a of the first bearing 74 and the first shim 106. At the same time a thrust load of the secondary shaft 60 is supported by the thrust bearing surface 70d of the second step portion 70c of the rear cover 70 through the outside peripheral wheel 78a of the second bearing 78 and the second shim 108. Both of the first shim 106 and the second shim 108 have semicircular shapes, in which regions between the both end portions 106a, 108a have
15 angles of 180° or larger. Therefore, when the thrust load acts, the side surface 74d of the outside peripheral wheel 74a of the first bearing 74 is suitably prevented from tilting relative to the thrust bearing surface 70b of the first step portion 70a of the rear cover 70, and the side surface 78d of the outside peripheral wheel 78a of the second bearing 78 is suitably prevented from tilting relative to the thrust bearing surface 70d of the second step
20 portion 70c of the rear cover 70, compared to shims, in which regions between the both end portions 106a, 108a have angles smaller than 180°.

[0041] In the transaxle stated above, almost similarly to the first example, the gap G3 of the first non-contact region N1a1 and the gap G4 of the second non-contact region N2a1 are formed in a noise generating region along a path in a thrust direction where the
25 gear noise is transmitted. The gear noise is mainly generated in the noise generating region that is located between a part of the rear cover 70 that supports the primary shaft 56 and a part of the rear cover 70 that supports the secondary shaft 60, such as a region in the rear cover 70 between the second straight line L2 and the third straight line L3. Therefore, vibration transmitted in the thrust direction from, for example, the gear of the steering

reverser 26 and the gear of the gear mechanism 28 to the rear cover 70 is suppressed suitably, thereby reducing the gear noise.

[0042] A third example is explained below. As shown in FIG. 20, a transaxle according to this example is approximately the same as the transaxle of the second example except that a spigot structure is provided instead of the pin positioning structure of the second example in which the second shim 108 is positioned at a given location on the thrust bearing surface 70d of the second step portion 70c of the rear cover 70 by using the pin 70k formed in the thrust bearing surface 70d. In the spigot structure, the second shim 108 is positioned at a given location on the thrust bearing surface 70d by using a protrusion 70l and a depressed portion 108c. The protrusion 70l integrally protrudes to the second shim 108 side from the thrust bearing surface 70d of the second step portion 70c of the rear cover 70, and the depressed portion 108c is depressed in the second shim 108 in order to fit the protrusion 70l. The spigot structure has generally the same function as that of the pin positioning structure. Although not shown, a spigot structure is provided in the transaxle according to this example. The spigot structure positions the first shim 106 at a given location on the thrust bearing surface 70b by using a protrusion and a depressed portion. The protrusion integrally protrudes to the first shim 106 side from the thrust bearing surface 70b of the first step portion 70a of the rear cover 70, and the depressed portion is depressed in the first shim 106 for fitting the protrusion.

[0043] A fourth example is explained. As shown in FIG. 21 and FIG. 22, a transaxle according to this example is approximately the same as the transaxle according to the second example except that a first shim 110 and a second shim 112 are used. The first shim 110 and the second shim 112 have circular shape. The first shim 110 is integrally provided with a semicircular first thick portion 110a, which has, for example, the same thickness as the first shim 106 according to the second example, and a semicircular first thin portion 110b, which has a thickness smaller than that of the first thick portion 110a. The second shim 112 is integrally provided with a semicircular second thick portion 112a, which has, for example, the same thickness as that of the second shim 108 according to the

second example, and a semicircular second thin portion 112b, which has a thickness smaller than that of the second thick portion 112a.

[0044] A region of the first thick portion 110a in the first shim 110 is the same as that of the first shim 106 according to the second example. When the first shim 110 is arranged between the thrust bearing surface 70b of the first step portion 70a of the rear cover 70, and the side surface 74d of the outside peripheral wheel 74a of the first bearing 74, a first contact region S1a2, which is approximately similar to the first contact regions S1a1 according to the second example, and a first non-contact region N1a2, which is approximately similar to the first non-contact region N1a1 according to the second example, are provided in the circular side surface 74d of the outside peripheral wheel 74a of the first bearing 74. The first contact regions S1a2 is in contact with the thrust bearing surface 70b of the first step portion 70a of the rear cover 70 indirectly through the first shim 110. The first non-contact region N1a2 is provided by a gap that is formed between the first thin portion 110b of the first shim 110 and the thrust bearing surface 70b of the first step portion 70a of the rear cover 70.

[0045] A region of the second thick portion 112a in the second shim 112 is the same as that of the second shim 108 which has a semicircular shape according to the second example. When the second shim 112 is arranged between the thrust bearing surface 70d of the second step portion 70c of the rear cover 70, and the side surface 78d of the outside peripheral wheel 78a of the second bearing 78, a second contact region S2a2, which is approximately similar to the second contact region S2a1 according to the second example, and a second non-contact region N2a2, which is approximately similar to the second non-contact region N2a1 according to the second example, are provided in the circular side surface 78d of the outside peripheral wheel 78a of the second bearing 78. The second contact region S2a2 is in contact with the thrust bearing surface 70d of the second step portion 70c of the rear cover 70 indirectly through the second shim 112. The second non-contact region N2a2 is provided by a gap formed between the second thin portion 112b of the second shim 112, and the thrust bearing surface 70d of the second step portion 70c of the rear cover 70.

[0046] The examples of the invention have been explained in detail based on the drawings. However, the invention is applied in other forms.

[0047] In the examples, the side surface 74d of the outside peripheral wheel 74a of the first bearing 74 is in contact with the thrust bearing surface 70b of the first step portion 70a of the rear cover 70 indirectly through the first shims 96, 106. However, the side surface 74d of the outside peripheral wheel 74a of the first bearing 74, and the thrust bearing surface 70b of the first step portion 70a of the rear cover 70 may be in direct contact with each other without using the first shims 96, 106. The side surface 78d of the outside peripheral wheel 78a of the second bearing 78 are in contact with the thrust bearing surface 70d of the second step portion 70c of the rear cover 70 indirectly through the second shims 104, 108. However, the side surface 78d of the outside peripheral wheel 78a of the second bearing 78, and the thrust bearing surface 70d of the second step portion 70c of the rear cover 70 may be in direct contact with each other without using the second shims 104, 108.

[0048] As shown in FIG. 3 and FIG. 12, in the examples, a major part of the side surface 74d of the outside peripheral wheel 74a of the first bearing 74 on the secondary shaft 60 side serves as the first non-contact regions N1a, N1a1. However, for example, as long as a part of the side surface 74d of the outside peripheral wheel 74a of the first bearing 74 on the secondary shaft 60 side becomes the first non-contact regions N1a, N1a1, gear noise generated from the rear cover 70 is reduced. A major part of the side surface 78d of the outside peripheral wheel 78a of the second bearing 78 on the primary shaft 56 side serves as the second non-contact regions N2a, N2a1. However, for example, as long as a part of the side surface 78d of the outside peripheral wheel 78a of the second bearing 78 on the primary shaft 56 side becomes the second non-contact regions N2a, N2a1, gear noise generated from the rear cover 70 is reduced. Further, by providing at least one of the first non-contact regions N1a, N1a1 and the second non-contact regions N2a, N2a1, gear noise generated from the rear cover 70 is reduced.

[0049] The examples stated above are one embodiment only, and it is possible to carry out the invention in forms with various changes and improvements based on the knowledge of a person skilled in the art.

CLAIMS:

1. A belt-type continuously variable transmission comprising:
 - a pair of pulley shafts including a first pulley shaft and a second pulley shaft;
 - a pair of variable pulleys provided in the pair of pulley shafts, respectively, each of the pair of variable pulleys having a variable effective diameter; and
 - a transmission belt wound around the pair of variable pulleys,wherein one end portion of the first pulley shaft is supported by a case via a first bearing, and a thrust load of the first pulley shaft is supported by the case via a first side surface of an outside peripheral wheel of the first bearing,
 - the first side surface has a circular shape and includes a first contact region, the first contact region is in contact with the case, on an opposite side of a second pulley shaft side, and
 - the first side surface includes a first non-contact region on the second pulley shaft side, the first non-contact region facing the case via a gap.
2. The belt-type continuously variable transmission according to claim 1 wherein
 - one end portion of the second pulley shaft is supported by the case through a second bearing,
 - a thrust load of the second pulley shaft is supported by the case through a second side surface of an outside peripheral wheel of the second bearing,
 - the second side surface has a circular shape and includes a second contact region, the second contact region is in contact with the case, on an opposite side of a first pulley shaft side, and
 - the second side surface includes a second non-contact region on the first pulley shaft side, the second non-contact region facing the case via a gap.
3. The belt-type continuously variable transmission according to claim 2 wherein
 - the first contact region is in contact with the case via a first shim, and

the second contact region is in contact with the case via a second shim.

4. The belt-type continuously variable transmission according to claim 2 wherein the first contact region is in contact directly with the case, and the second contact region is in contact directly with the case.

5. A vehicle comprising;

an engine;

a driving wheel; and

a transaxle including:

a case;

a first bearing provided in the case; and

a belt-type power transmission system housed in the case, the belt-type power transmission system including:

a pair of pulley shafts including a first pulley shaft and a second pulley shaft;

a pair of variable pulleys provided in the pair of pulley shafts, respectively, each of the pair of variable pulleys having a variable effective diameter; and

a transmission belt wound around the pair of variable pulleys;

wherein one end portion of the first pulley shaft is supported by the case via the first bearing, and a thrust load of the first pulley shaft is supported by the case via a first side surface of an outside peripheral wheel of the first bearing,

the first side surface has a circular shape and includes a first contact region, the first contact region is in contact with the case, on an opposite side of a second pulley shaft side, and

the first side surface includes a first non-contact region on the second pulley shaft side, the first non-contact region facing the case via a gap.

6. The vehicle according to claim 5 wherein

the transaxle further includes a second bearing provided in the case,
one end portion of the second pulley shaft is supported by the case via the second bearing,

a thrust load of the second pulley shaft is supported by the case via a second side surface of an outside peripheral wheel of the second bearing,

the second side surface has a circular shape and includes a second contact region, the second contact region is in contact with the case, on an opposite side of a first pulley shaft side, and

the second side surface includes a second non-contact region on the first pulley shaft side, the second non-contact region facing the case via a gap.

7. The vehicle according to claim 6 wherein

the first contact region is in contact with the case via a first shim, and
the second contact region is in contact with the case via a second shim.

8. The vehicle according to claim 6 wherein

the first contact region is in contact directly with the case, and
the second contact region is in contact directly with the case.

FIG. 1

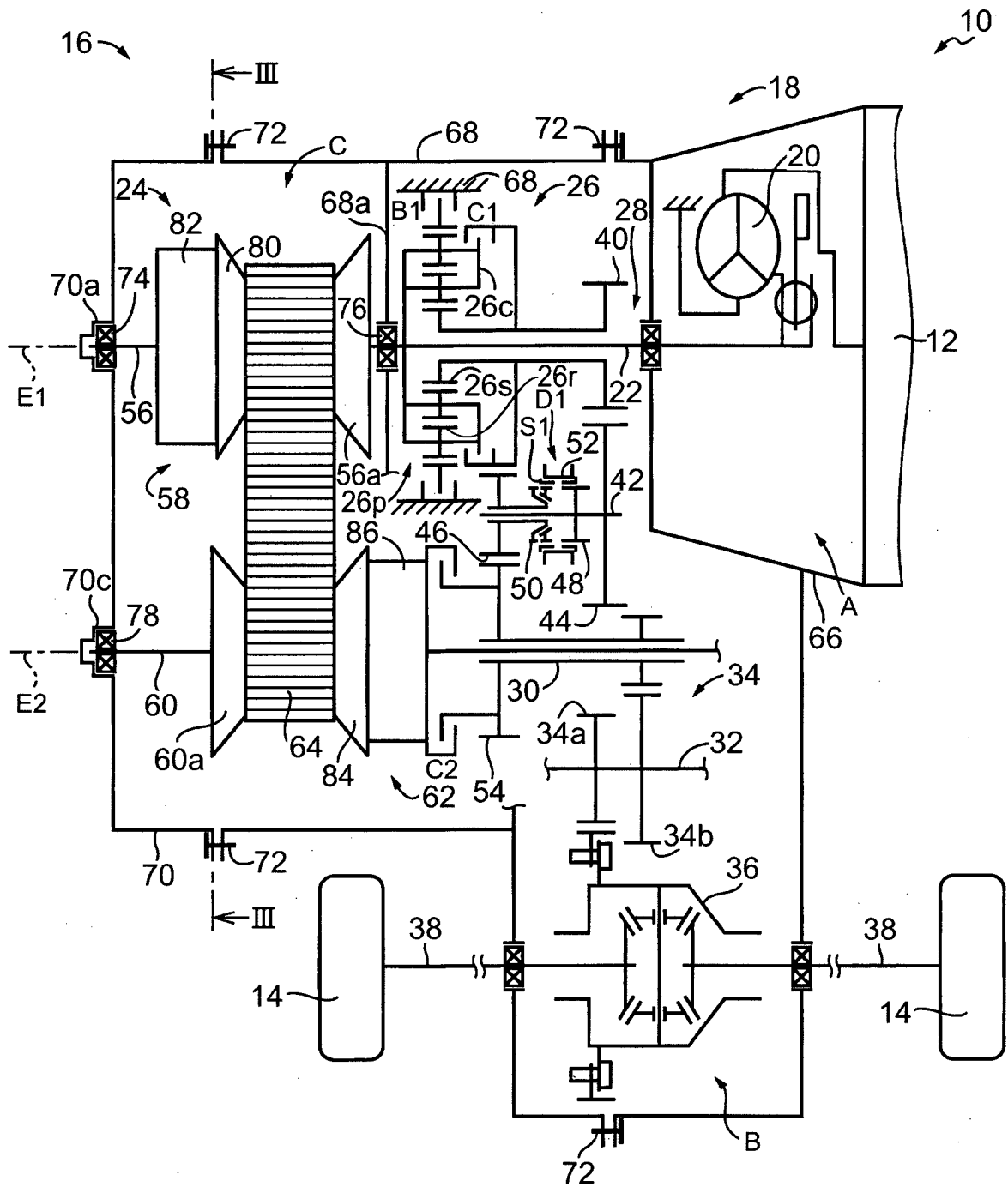


FIG. 2

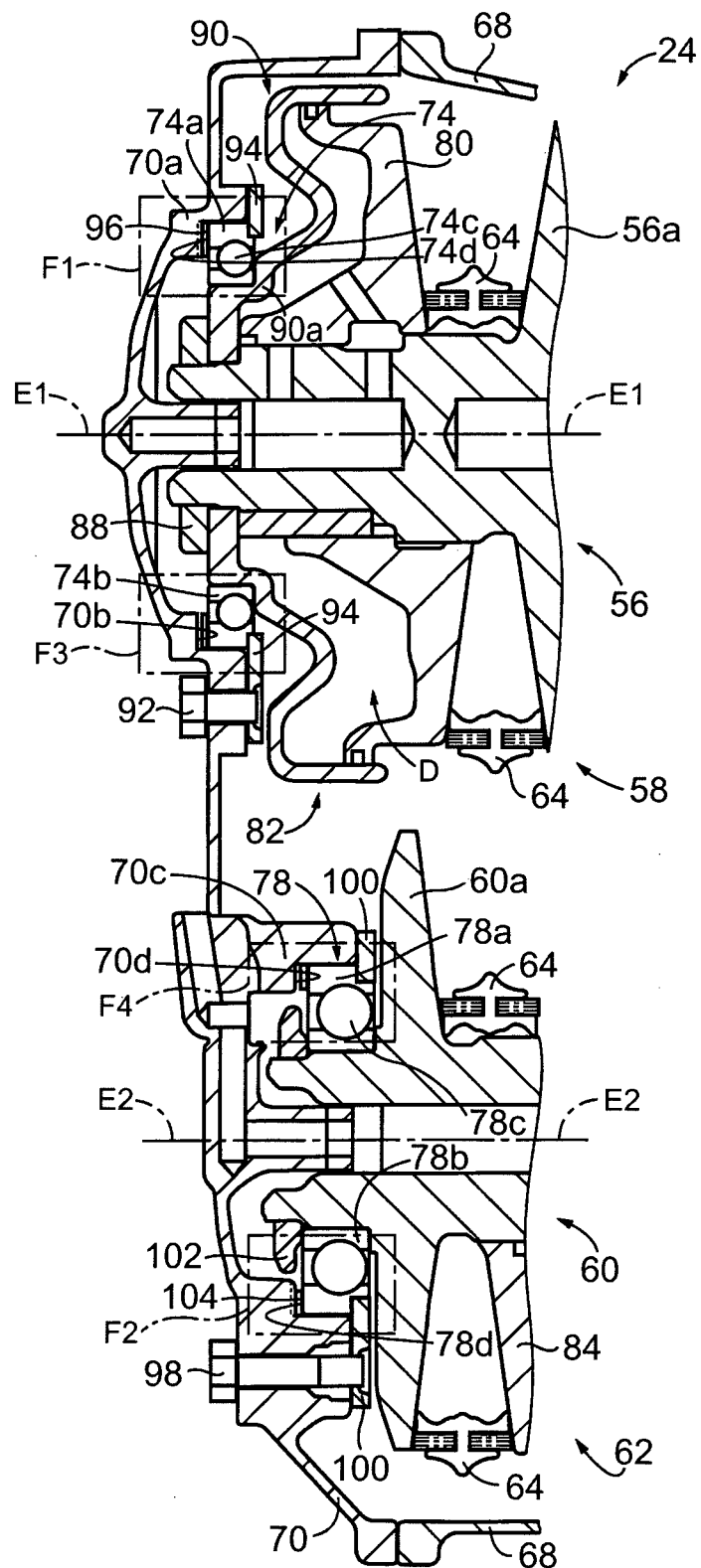


FIG. 3

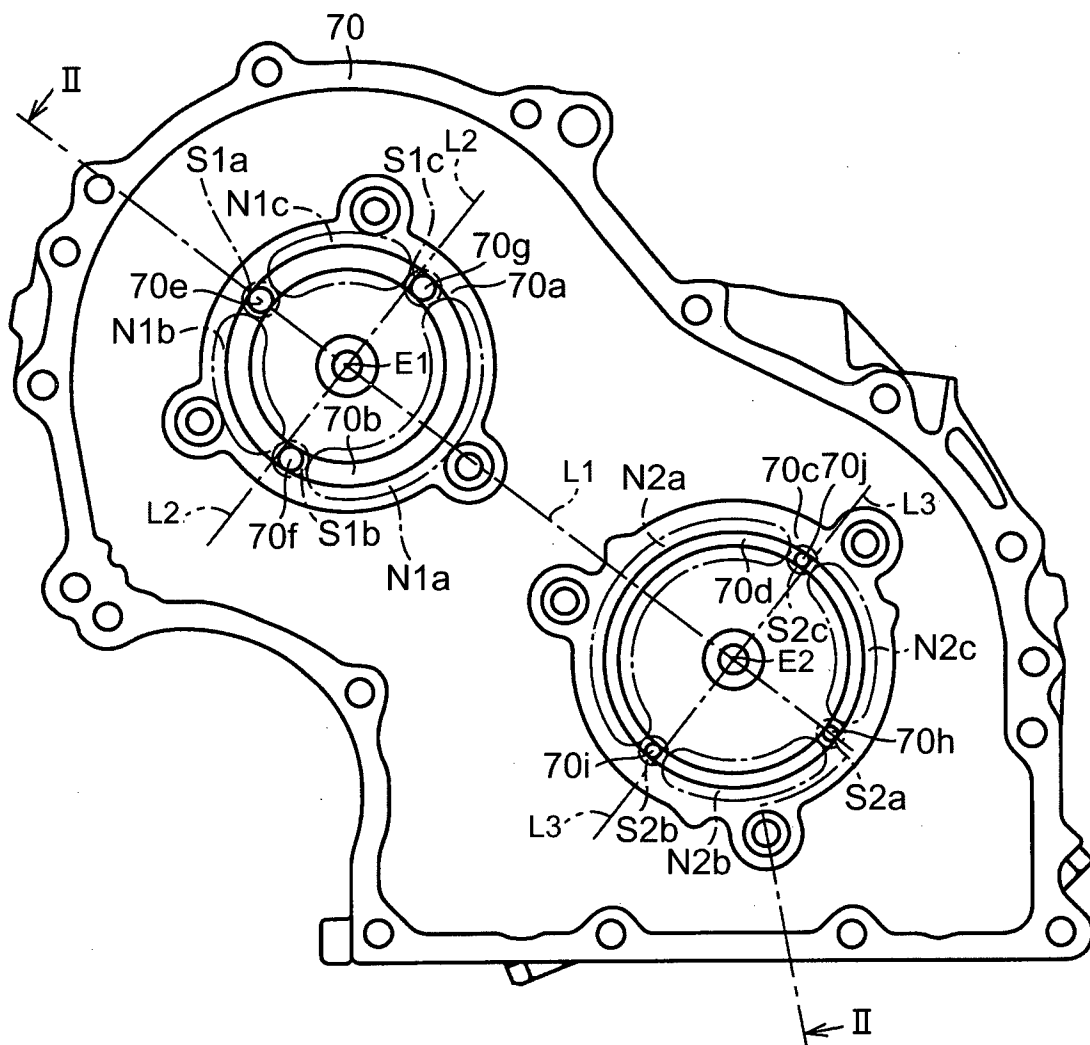


FIG. 4

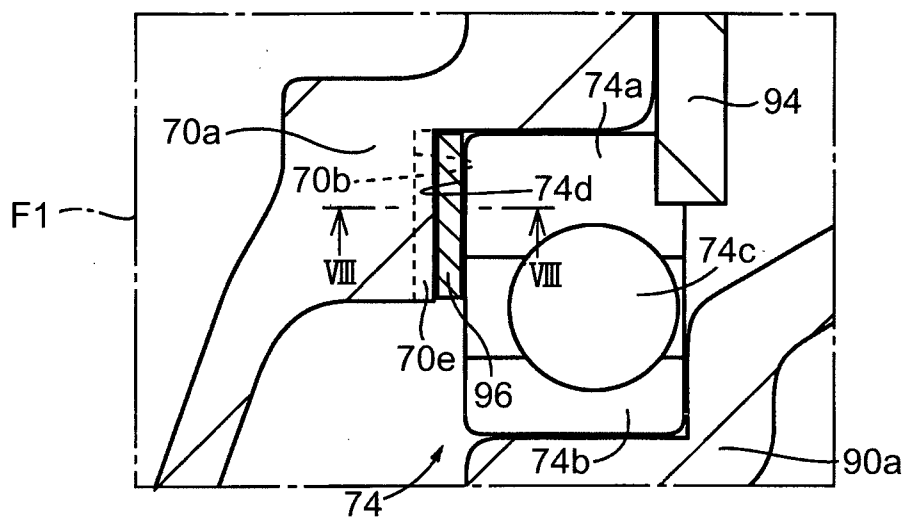


FIG. 5

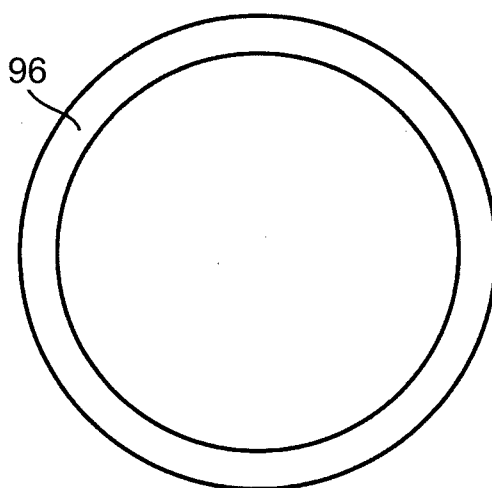


FIG. 6

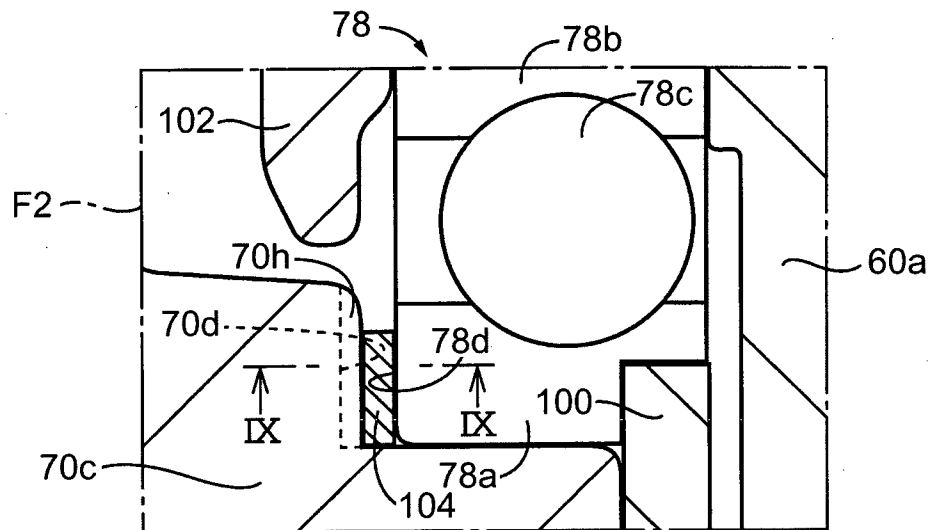


FIG. 7

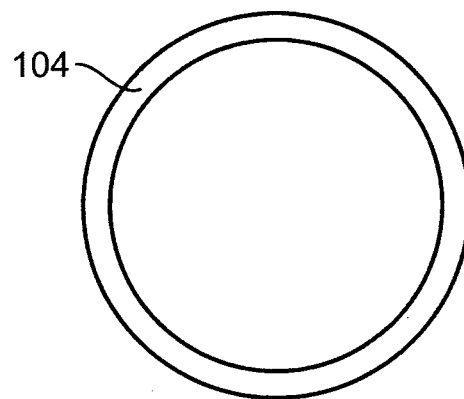


FIG. 8

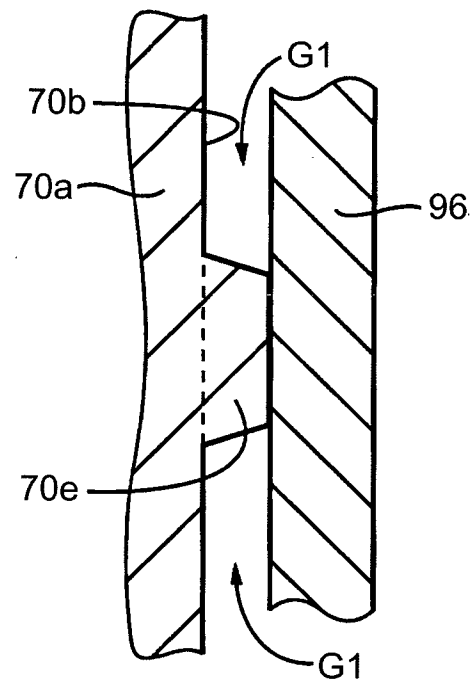


FIG. 9

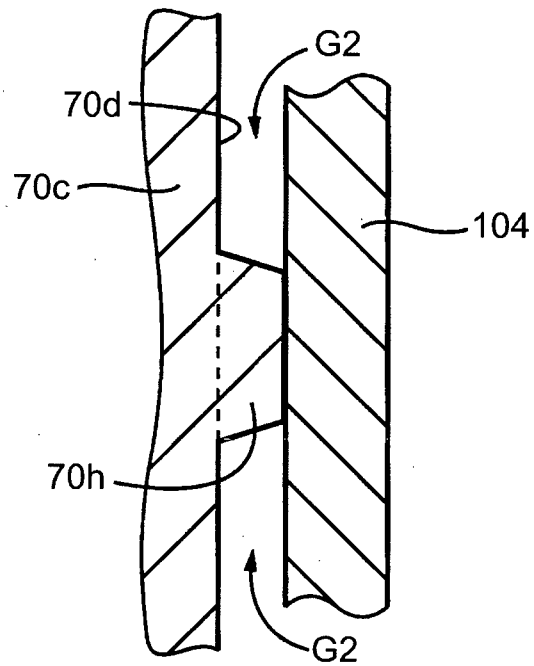


FIG. 10

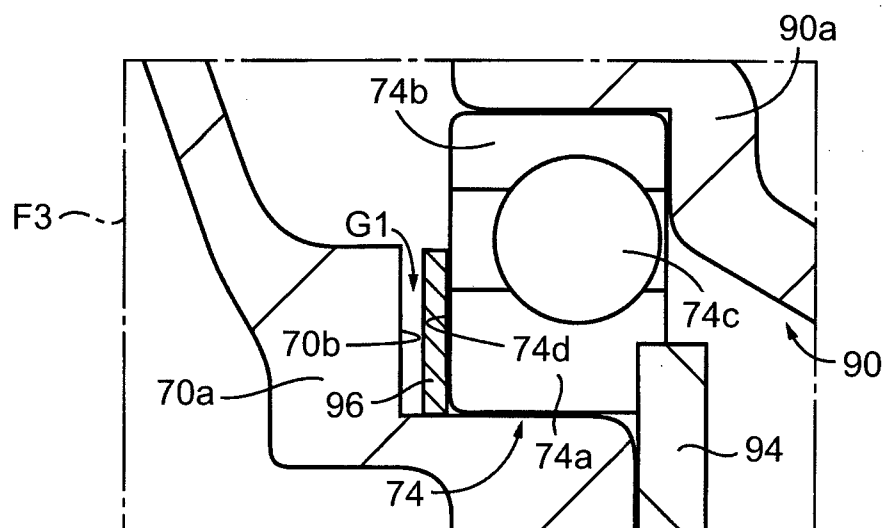


FIG. 11

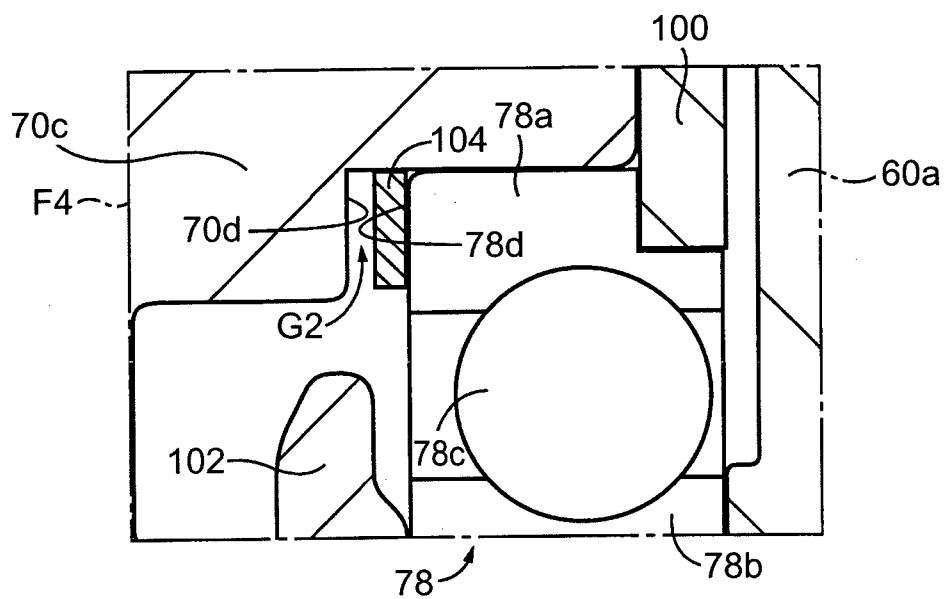


FIG. 12

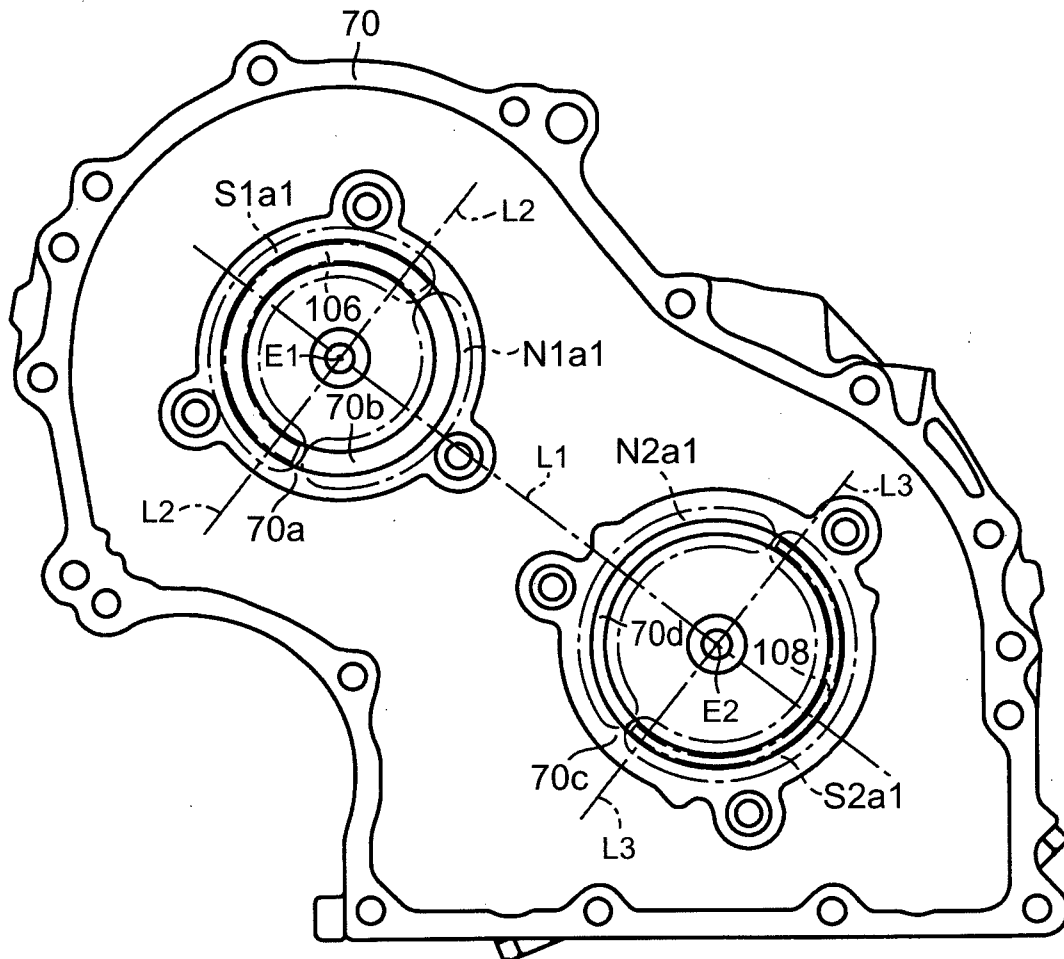


FIG. 13

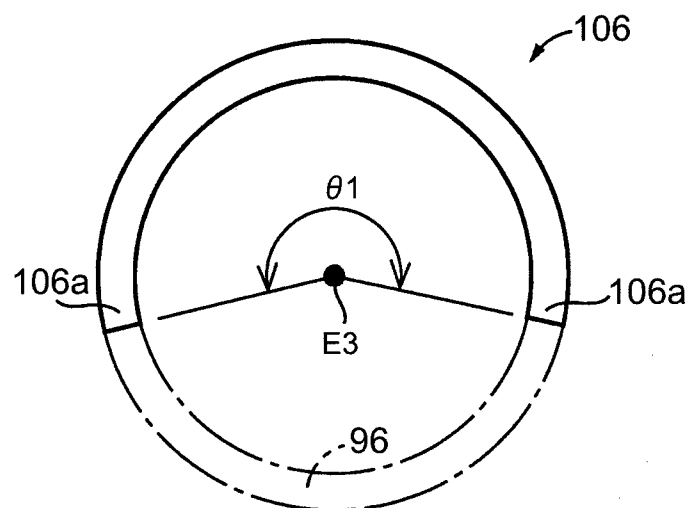


FIG. 14

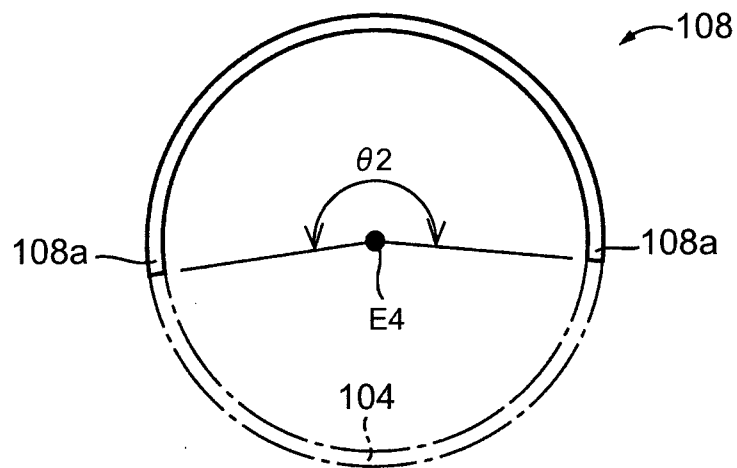


FIG. 15

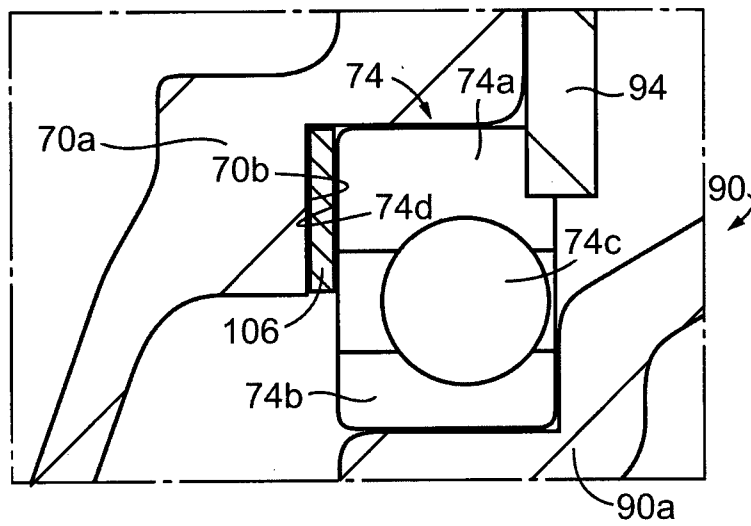


FIG. 16

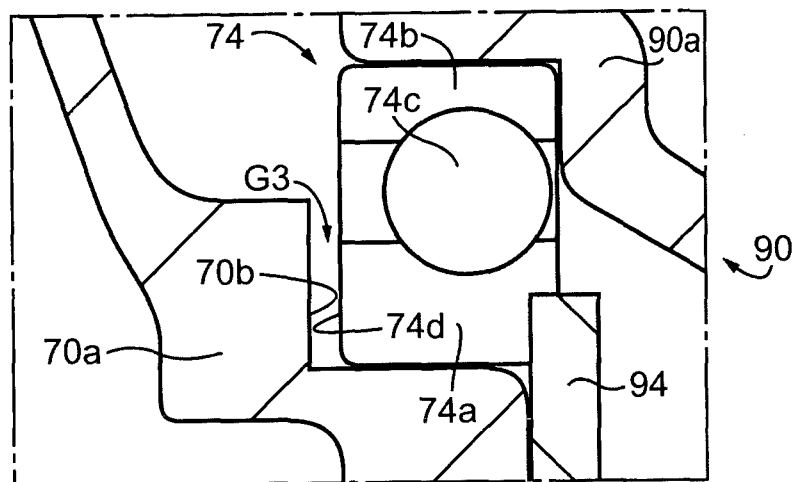


FIG. 17

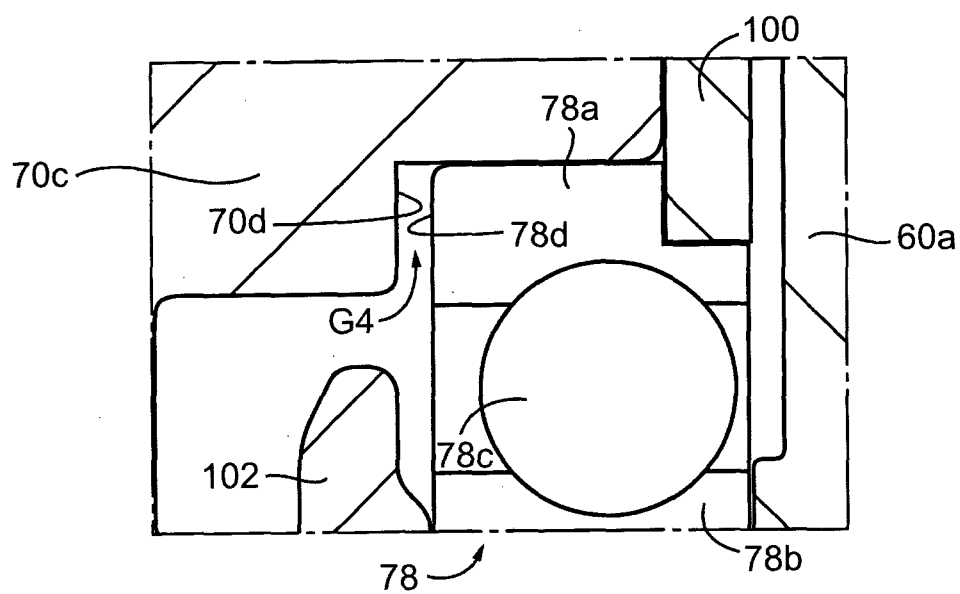


FIG. 18

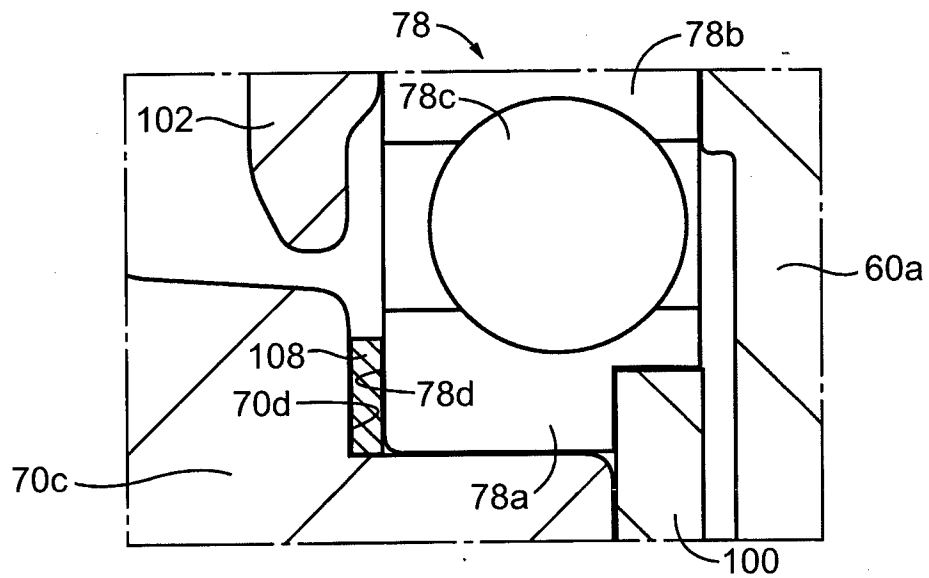


FIG. 19

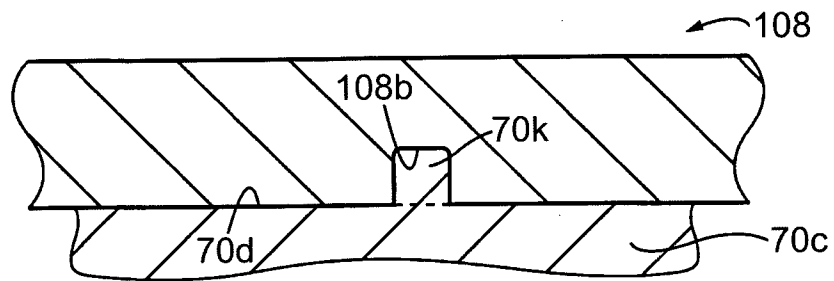


FIG. 20

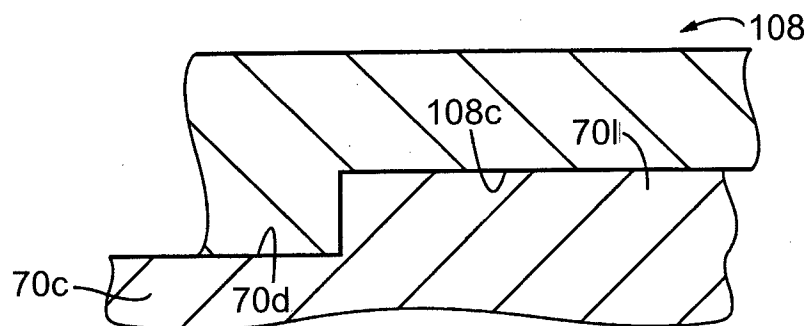


FIG. 21

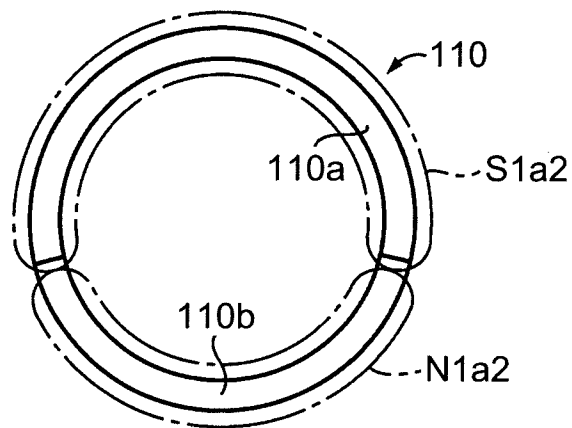
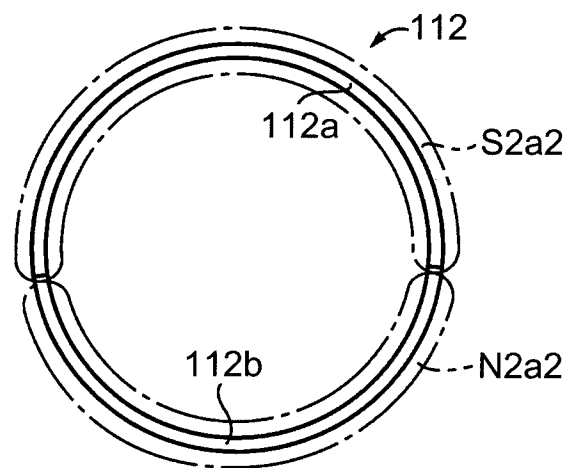


FIG. 22



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/000875

A. CLASSIFICATION OF SUBJECT MATTER INV. F16H9/18 F16C35/067 F16H55/56 ADD.		
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 F16C		
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) EP0-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	US 2010/099526 A1 (TSUKUDA KAZUMICHI [JP] ET AL) 22 April 2010 (2010-04-22)	1,2,5,6
Y	figures 2-4	3,7
Y	----- US 2004/033851 A1 (LUBBEN JEFFREY L [US]) 19 February 2004 (2004-02-19) figure 1	3,7
X	----- JP 2010 242951 A (TOYOTA MOTOR CORP) 28 October 2010 (2010-10-28) cited in the application figure 3	1
A	----- JP 2012 132495 A (NSK LTD) 12 July 2012 (2012-07-12) the whole document ----- -/--	1-8
☒ 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	
24 September 2015	05/10/2015	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Hassiotis, Vasilis	

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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