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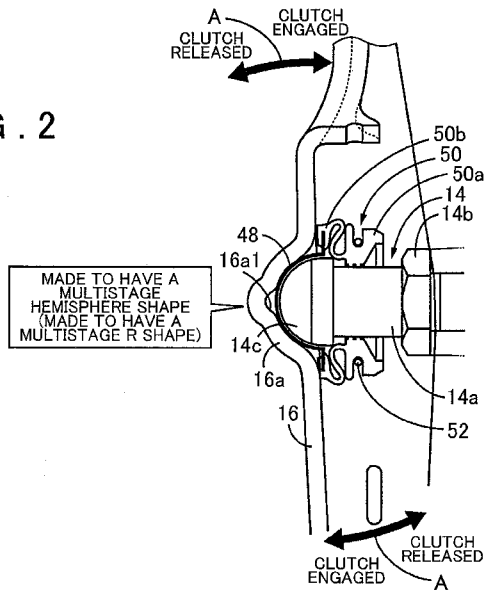
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(54) Title: CLUTCH DEVICE

FIG. 2



(57) Abstract: A recess is provided in an inner peripheral surface of a ball head housing portion that abuts against a ball head portion via a resin sheet. Accordingly, a portion of a surface on the ball head housing portion side, of the resin sheet that is pressed against by the ball head portion and the ball head housing portion deforms so as to. enter the recess. Therefore, when the clutch release fork rotates, a protruding portion that is in the recess becomes resistance that impedes sliding between the resin sheet and the ball head housing portion. Thus, relative sliding between the resin sheet and the ball head housing portion when the clutch release fork rotates is able to be inhibited.

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CLUTCH DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to a clutch device that establishes and interrupts a power transmission path of a vehicle. More particularly, the invention relates to the structure of a rotating portion of a clutch release fork.

2. Description of Related Art

[0002] A clutch device that is provided with a support on which a ball head is provided, and a clutch release fork on which a ball head housing portion that houses the ball head portion is provided, and in which a friction clutch is engaged and disengaged by the clutch release fork being rotated with the ball head portion as the fulcrum, is well known. For example, the clutch device described in Japanese Patent Application Publication No. 2009-30759 (JP 2009-30759 A) is just such a clutch device. JP 2009-30759 A describes a grease reservoir, an oil passage that extends from this grease reservoir to an abutting portion of the clutch release fork and the ball head, and a ball that abuts with the clutch release fork and is housed in a large diameter portion that extends to the grease reservoir. Moreover, JP 2009-30759 A describes technology in which the clutch release fork is able to rotate smoothly by having the grease reservoir, the oil passage, and the ball provided in a support, and supplying lubricating oil to the abutting portion.

SUMMARY OF THE INVENTION

[0003] A structure in which the grease reservoir, the oil passage, and the large diameter portion are provided in the support, and the ball is provided is difficult because it leads to an increase in the number of parts. Moreover, the component cost may increase. Instead of forming the grease reservoir and the like in the support, it is possible to provide a solid lubricant such as a resin sheet between the support and the clutch release fork. As

a result, it is thought that the clutch release fork would be able to rotate smoothly. When providing the resin sheet between the support and the clutch release fork, the resin sheet contacts the support, as well as contacts the clutch release fork. Therefore, when the clutch release fork rotates, it is desirable that sliding (i.e., relative sliding) occur between the resin sheet and one of the support or the clutch release fork, which is advantageous for the durability of the resin sheet. However, depending on the friction between the support and the resin sheet that contact each other, and the friction between the clutch release fork and the resin sheet that contact each other, sliding may occur between either when the clutch release fork rotates. If this happens, sliding, which is advantageous for the durability of the resin sheet, may not occur between the resin sheet and one of the support or the clutch release fork. This kind of problem is not yet well known. Nothing has yet been proposed to maximize sliding, which is advantageous for durability, between one of the support or the clutch release fork and a resin sheet when the resin sheet is provided between the support and the clutch release fork.

[0004] The invention provides a clutch device which, when a film lubricant is provided between a support and a clutch release fork, is able to inhibit relative sliding between the film lubricant and the clutch release fork when the clutch release fork rotates.

[0005] A first aspect of the invention relates to a clutch device that includes a support on which a ball head portion is provided; a ball head housing portion within which the ball head portion is housed; a film lubrication provided between the ball head portion and the ball head housing portion, an inner peripheral surface of the ball head housing portion abutting against the ball head portion via the film lubricant, the inner peripheral surface of the ball head housing portion having a recess; and a clutch release fork that is provided with the ball head housing portion, the clutch release fork being configured to rotate with the ball head portion as a fulcrum.

[0006] According to this aspect, a portion of the surface on the ball head housing portion side, of the film lubricant that is pressed against by the ball head portion and the ball head housing portion deforms so as to enter the recess on the inner peripheral surface of the ball head housing portion. Therefore, when the clutch release fork rotates with the

ball head portion as the fulcrum, the protruding portion that is in the recess becomes resistance that impedes sliding between the film lubricant and the ball head housing portion. Thus, when the clutch release fork rotates, relative sliding between the film lubricant and the clutch release fork (especially the ball head housing portion) is able to be inhibited. As a result, sliding occurs between the film lubricant and the ball head portion when the clutch release fork rotates.

[0007] In the aspect described above, a portion of the inner peripheral surface of the ball head housing portion other than the recess may have a hemisphere shape that matches a hemisphere shape of the ball head portion. According to above aspect, the recess is appropriately provided in the inner peripheral surface of the ball head housing portion that abuts against the ball head portion via the film lubricant.

[0008] In the aspect described above, the clutch device may also include a retaining member configured to retain the film lubricant, and the support may be fit into the retaining member such that sliding occurs between the film lubricant and the ball head portion. According to above aspect, the film lubricant is able to be held in the proper position by a simple structure. That is, relative sliding between the film lubricant and the ball head housing portion is inhibited by the recess. Therefore, machining or parts for fixing the retaining member to the clutch release fork so that the film lubricant will not be able to slide relative to the clutch release fork is not necessary. Also, the retaining member is able to seal between the film lubricant and the ball head portion, so foreign matter will not be able to get in between the film lubricant and the ball head portion, and grease or the like is kept between the film lubricant and the ball head portion. As a result, sliding is able to more appropriate occur between the film lubricant and the ball head portion when the clutch release fork rotates.

[0009] In the aspect described above, the film lubricant may be a plastic deformable resin sheet, and the film lubricant may have a hemisphere shape that matches a hemisphere shape of the ball head portion. According to above aspect, a portion of the surface of the film lubricant on the ball head housing portion side plastic deforms so as to enter the recess, so relative sliding between the film lubricant and the ball head housing

portion when the clutch release fork rotates is appropriately inhibited. Also, sliding between the film lubricant and the ball head portion is able to appropriately occur when the clutch release fork rotates. In the aspect described above, the hemisphere shape of the portion of the inner peripheral surface of the ball head housing portion other than the recess may be provided having multiple stages. In the aspect described above, the recess may have a hemisphere shape, and a radius of the recess may be smaller than a radius of the hemisphere shape of the ball head portion. Also with above aspect, an axial center of a hemisphere shape of the recess may be the same as an axial center of a hemisphere shape of the ball head portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] 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:

FIG. 1 is a sectional view schematically showing the structure of a clutch device to which the invention is applied;

FIG. 2 is a partial enlarged view of the clutch device in FIG. 1;

FIG. 3 is a view showing a frame format of a resin sheet when it deforms; and

FIG. 4 is a reference drawing illustrating one example of a clutch release fork to which the invention is not applied.

DETAILED DESCRIPTION OF EMBODIMENTS

[0011] Hereinafter, an example embodiment of the invention will be described in detail with reference to the accompanying drawings. The drawings described in the example embodiment below have been simplified or modified as appropriate, so the scale ratios and the shapes and the like of the portions are not always accurately depicted.

[0012] FIG. 1 is a partial sectional view schematically showing the structure of a clutch device 10 for a vehicle to which the invention is applied. In FIG. 1, the clutch device 10 is provided in a power transmission path between an engine (not shown) and a

transmission (also not shown) of the vehicle. The clutch device 10 includes a friction clutch 12, a support 14, a clutch release fork 16, a well-known release bearing 18, and a well-known release cylinder 20. FIG. 1 is not an overall view of the clutch device 10, but rather shows mainly half of the clutch device 10 on a side where the clutch release fork 16 and the like is arranged, with respect to an axial center C.

[0013] The friction clutch 12 is a dry-operating single disc clutch that connects and disconnects a power transmission path between the engine and the transmission. The friction clutch 12 functions as a friction coupling that transmits power by friction. The friction clutch 12 is provided in a cylindrical clutch housing 22 that is integrally connected to both the engine and a housing (not shown) of the transmission. The friction clutch 12 is provided between a disk-shaped flywheel 24 that is fixed to a crankshaft of the engine, and a clutch shaft 26 that is concentrically and relatively rotatably provided with respect to the flywheel 24, within the clutch housing 22. The clutch shaft 26 passes through a partition wall 28 between the transmission and the friction clutch 12. The clutch shaft 26 is also an input shaft for the transmission, which is rotatably supported by the partition wall 28.

[0014] The friction clutch 12 is provided inside of a clutch cover 30 that is fixed to an outer peripheral portion of the flywheel 24. The friction clutch 12 includes a disk-shaped clutch disc 32 that is spline-engaged with a tip end portion of the clutch shaft 26, an annular plate-shaped pressure plate 34 that is arranged on the opposite side of the clutch disc 32 from the flywheel 24, and an annular plate-shaped diaphragm spring 36 that is arranged on the opposite side of the pressure plate 34 from the clutch disc 32.

[0015] The clutch disc 32 includes an annular plate-shaped disc plate 38 that opposes both the flywheel 24 and the pressure plate 34. The clutch disc 32 includes annular plate-shaped friction elements (a facing and a lining) 40, 42 that are fixed one to each side surface of the disc plate 38. The pressure plate 34 is arranged so as to be able to be moved closer to and away from the clutch disc 32.

[0016] The diaphragm spring 36 is attached to the clutch cover 30 via a pair of annular pivot rings 44. The diaphragm spring 36 urges the pressure plate 34 toward the

clutch disc 32 at an outer peripheral edge portion of the diaphragm spring 36, with the pivot rings 44 as the fulcrum. The diaphragm spring 36 is such that when the center portion (an inner peripheral end portion) of the diaphragm spring 36 is pressed toward the clutch disc 32 side in a direction parallel to the axial center C, the outer peripheral edge portion of the diaphragm spring 36 bends backward away from the pressure plate 34, with the pivot rings 44 as the fulcrum. Then when the pressure on the center portion of the diaphragm spring 36 is released, the outer peripheral edge portion of the diaphragm spring 36 returns to the state in which it urges the pressure plate 34 toward the clutch disc 32.

[0017] With the friction clutch 12 structured in this way, when external force is not acting on the center portion of the diaphragm spring 36, the clutch disc 32 is squeezed between the pressure plate 34 and the flywheel 24. As a result, the friction clutch 12 is in a fully engaged state. Accordingly, the flywheel 24 and the clutch disc 32 are in a power transmitting state. On the other hand, when the center portion of the diaphragm spring 36 is operated toward the clutch disc 32 side in the axial center C direction, the pressure from the pressure plate 34 toward the clutch disc 32 side changes according to this operating force. When this pressure is completely removed, the friction clutch 12 is in a fully released state. Accordingly, power transmission between the flywheel 24 and the clutch disc 32 is interrupted.

[0018] The support 14 has a bolt portion 14b provided on one end of a circular cylindrical main body portion 14a. The support 14 has a hemisphere-shaped ball head portion 14c provided on the other end of the circular cylindrical main body portion 14a. The support 14 is attached to the partition wall 28 by being screwed into the partition wall 28. The support 14 structured in this way functions as a fulcrum when the clutch release fork 16 rotates.

[0019] One end of the clutch release fork 16 is connected to the release cylinder 20, and the other end of the clutch release fork 16 is connected to the release bearing 18 via a bearing collar 46. The clutch release fork 16 has a ball head housing portion 16a that houses the ball head portion 14c, formed near the center of the main body of the clutch release fork 16. The ball head housing portion 16a has a hemisphere shape that matches

the hemisphere shape of the ball head portion 14c. The clutch release fork 16 is rotated with the ball head portion 14c as the fulcrum, in response to operation of the release cylinder 20, as shown by arrow A in FIG. 2. FIG. 2 is a partial enlarged view of the clutch device 10 in which the area near the ball head housing portion 16a in FIG. 1 has been enlarged.

[0020] The release bearing 18 is attached by being press-fit into the bearing collar 46. The bearing collar 46 is provided so as to be non-rotatable around the axial center C and able to move in a direction parallel to the axial center C. When the clutch release fork 16 is rotated to the clutch released side shown by arrow A in FIG. 2, the release bearing 18 presses the center portion of the diaphragm spring 36 toward the clutch disc 32 side.

[0021] The clutch device 10 further includes a resin sheet 48 that is a film lubricant sandwiched between the ball head portion 14c and the ball head housing portion 16a. The resin sheet 48 is provided so that the clutch release fork 16 will rotate smoothly. The resin sheet 48 is a plastic deformable resin sheet. The resin sheet 48 is molded in a hemisphere shape matching the hemisphere shape of the ball head portion 14c. This resin sheet 48 may be made entirely of resin, for example. This resin sheet 48 may be made of metal mesh that is coated with a resin coating, for example.

[0022] The clutch device 10 also includes a retaining member 50 that retains the resin sheet 48. The retaining member 50 is a rubber bellows-type member, for example. The retaining member 50 has a retaining portion 50b that retains an outer peripheral portion of the resin sheet 48, formed on one end of a main body portion 50a. An inner peripheral surface of the main body portion 50a has a cylindrical shape that matches the shape of the main body portion 14a of the support 14, so as to closely contact the circular cylindrical main body portion 14a when the support 14 is fit into the retaining member 50 from the other end of the main body portion 50a. As a result, when the support 14 is fit into the retaining member 50, an internal space surrounded by the resin sheet 48, the retaining member 50, and the support 14 is cut off from (noncontiguous with) an external space not surrounded by the resin sheet 48, the retaining member 50, and the support 14.

In this way, the retaining member 50 has a seal function. In order to improve this seal function, a spring 52 such as an O-ring may be provided, for example. Also, the retaining member 50 is configured to allow sliding between the resin sheet 48 and the ball head portion 14c, with the support 14 inserted. The internal space is filled with grease, for example, to facilitate sliding between the resin sheet 48 and the ball head portion 14c. The grease is prevented from flowing out into the external space, and foreign matter is prevented from getting into the internal space from the external space, by the seal function of the retaining member 50 described above. Therefore, a decrease in the durability of the resin sheet 48 due to sliding between the resin sheet 48 and the ball head portion 14c is inhibited.

[0023] With the clutch device 10 structured in this way, when clutch hydraulic pressure is supplied to the release cylinder 20, thrust from the release cylinder 20 is transmitted to one end of the clutch release fork 16 because the release cylinder 20 is connected to one end of the clutch release fork 16. Then the clutch release fork 16 is rotated with the ball head portion 14c as the fulcrum from a clutch engaged position to a clutch released position, as shown by arrow A in FIG. 2, in response to this clutch hydraulic pressure. As a result, the center portion of the diaphragm spring 36 is pressed via the release bearing 18 so as to move toward the clutch disc 32 side, and the friction clutch 12 switches from an engaged state to a released state.

[0024] Here, with the clutch device 10 of this example embodiment, a recess 16a1 is formed in the inner peripheral surface of the ball head housing portion 16a that abuts against the ball head portion 14c via the resin sheet 48. In order to clarify the operation effect of applying the structure of this recess 16a1, problems when this structure is not applied will be described below. FIG. 4 is a reference drawing illustrating one example of a clutch release fork 16 to which the structure of the recess 16a1 is not applied. In FIG. 4, the clutch release fork 16 is rotated with the ball head portion 14c as the fulcrum, just as shown in FIG. 2. When this clutch release fork 16 is rotated, a decrease in the durability of the resin sheet 48 is inhibited by sliding between the resin sheet 48 and the ball head portion 14c, as described above. The seal function of the retaining member 50 aims to

facilitate sliding between the resin sheet 48 and the ball head portion 14c. However, oil or the like may get in between the resin sheet 48 and the ball head housing portion 16a. Consequently, the friction force between the resin sheet 48 and the ball head housing portion 16a may become less than the friction force between the resin sheet 48 and the ball head portion 14c, and sliding may end up occurring between the resin sheet 48 and the ball head housing portion 16a. Sliding between the resin sheet 48 and the ball head housing portion 16a is not the original aim. Moreover, foreign matter may also get in between the resin sheet 48 and the ball head housing portion 16a. If this happens, the durability of the resin sheet 48 may decrease. Therefore, a method to prevent sliding between the resin sheet 48 and the ball head housing portion 16a is necessary. One conceivable way to prevent relative sliding between the resin sheet 48 and the ball head housing portion 16a is to provide a pin (see the broken line B in FIG. 4) or the like on the retaining member 50, and fix the retaining member 50 to the clutch release fork 16 by inserting this pin into a hole formed in the clutch release fork 16. However, this would increase the number of parts and machining hours, which in turn may lead to an increase in cost.

[0025] Therefore, the clutch device 10 of this example embodiment has the recess 16a1 formed in the inner peripheral surface of the ball head housing portion 16a. More specifically, as shown in FIGS. 1 and 2, with the ball head housing portion 16a, the recess 16a1 is formed in the inner peripheral surface of the ball head housing portion 16a by a large diameter hemisphere overlapping with a small diameter hemisphere on the same axial center, such that a multistage (two stages in this example embodiment) hemisphere shape is formed.

[0026] FIG. 3 is a view showing a frame format of the resin sheet 48 when it deforms. In FIG. 3, when the clutch release fork 16 rotates, the ball head portion 14c operates as a fulcrum. Accordingly, pressing force is generated between the ball head portion 14c and the ball head housing portion 16a. As a result, the resin sheet 48 that is sandwiched between the ball head portion 14c and the ball head housing portion 16a maintains a hemisphere shape at the surface on the ball head portion 14c side. Meanwhile, at the surface on the ball head housing portion 16a side, the resin sheet 48 plastically

deforms and consequently assumes a shape that protrudes following the shape of the recess 16a1 formed in the ball head housing portion 16a. Accordingly, this protruding portion acts as a slide inhibitor, so the resin sheet 48 and the clutch release fork 16 operate as a single unit when the clutch release fork 16 rotates. In this way, by forming the recess 16a1, relative sliding between the resin sheet 48 and the clutch release fork 16 when the clutch release fork 16 rotates is inhibited without additional parts such as a pin or the like to fix the retaining member 50 to the clutch release fork 16.

[0027] As described above, according to this example embodiment, the recess 16a1 is formed in the inner peripheral surface of the ball head housing portion 16a that abuts against the ball head portion 14c via the resin sheet 48. Consequently, a portion of the surface on the ball head housing portion 16a side, of the resin sheet 48 that is pressed against by the ball head portion 14c and the ball head housing portion 16a deforms so as to enter the recess 16a1. Therefore, when the clutch release fork 16 rotates, the protruding portion that is in the recess 16a1 becomes resistance that impedes sliding between the resin sheet 48 and the ball head housing portion 16a. Thus, when the clutch release fork 16 rotates, relative sliding between the resin sheet 48 and the ball head housing portion 16a is able to be inhibited. As a result, sliding will occur between the resin sheet 48 and the ball head portion 14c when the clutch release fork 16 rotates.

[0028] Also, according to this example embodiment, the hemisphere shape of the ball head housing portion 16a that matches the hemisphere shape of the ball head portion 14c is provided having multiple stages (a portion of the inner peripheral surface of the ball head housing portion 16a other than the recess 16a1 has the hemisphere shape that matches the hemisphere shape of the ball head portion 14c, and a hemisphere of the portion of the inner peripheral surface of the ball head housing portion 16a other than the recess 16a1 is provided having multiple stages). Thus, the recess 16a1 is appropriately formed in the inner peripheral surface of the ball head housing portion 16a.

[0029] Also, according to this example embodiment, the support 14 is fit into the retaining member 50 in a manner such that sliding is possible between the resin sheet 48 and the ball head portion 14c. Therefore, the resin sheet 48 is able to be held in a proper

position by a simple structure. Accordingly, machining or parts for fixing the retaining member 50 to the clutch release fork 16 so that the resin sheet 48 will not be able to slide relative to the clutch release fork 16 is not necessary. Also, the retaining member 50 is able to seal between the resin sheet 48 and the ball head portion 14c, so foreign matter will not get in between the resin sheet 48 and the ball head portion 14c, and grease or the like is kept between the resin sheet 48 and the ball head portion 14c. As a result, sliding is able to more appropriate occur between the resin sheet 48 and the ball head portion 14c when the clutch release fork 16 rotates.

[0030] Also, according to this example embodiment, the resin sheet 48 is a plastic deformable sheet, and is molded in a hemisphere shape matching the hemisphere shape of the ball head portion 14c. Accordingly, a portion of the surface of the resin sheet 48 on the ball head housing portion 16a side plastically deforms so as to enter the recess 16a1. As a result, relative sliding between the resin sheet 48 and the ball head housing portion 16a when the clutch release fork 16 rotates is appropriately inhibited. Also, sliding between the resin sheet 48 and the ball head portion 14c appropriately occurs when the clutch release fork 16 rotates.

[0031] Heretofore, an example embodiment of the invention is described in detail with reference to the drawings. The invention may also be applied to other example embodiments.

[0032] For example, in the example embodiment described above, the recess 16a1 is formed in the inner peripheral surface of the ball head housing portion 16a by the top portion of the ball head housing portion 16a being formed in a multistage hemisphere shape. For example, a recess may also be formed in the inner peripheral surface without a protrusion being formed on an outer peripheral surface of the ball head housing portion 16a. Also, a recess may be formed in a portion offset from the top portion. Also, a plurality of recesses, not just one, may be formed. Also, small asperities may also be formed. All that is necessary is that a recess into which a portion of the surface of the resin sheet 48 on the ball head housing portion 16a side deforms and enters from pressing force between the ball head portion 14c and the ball head housing portion 16a be formed in the inner

peripheral surface of the ball head housing portion 16a.

[0033] Also, with the clutch device 10 of the example embodiment described above, the friction clutch 12 is a diaphragm spring type clutch, and the actuator that operates the clutch release fork 16 is the release cylinder 20 that is a hydraulic actuator. For example, the friction clutch may also be a coil spring type clutch, and the actuator may be another type of actuator such as an electric actuator. Also, the actuator may operate the clutch release fork 16 by an operation by a driver being transmitted via only a mechanical connection. The invention may be applied as long as the clutch device is one in which the clutch release fork 16 having the ball head housing portion 16a rotates with the ball head portion 14c formed on the support 14 as the fulcrum. The clutch device includes a dry-operating single disc friction clutch, and has a function in which it operates this friction clutch. Also, the clutch device may be a manual type clutch device that switches the operating state of the friction clutch in conjunction with a clutch pedal operated by a driver, for example. The clutch device may also be an automatic type clutch device that switches the operating state of the friction clutch according to a shift or a running state or the like, for example. The friction clutch forms part of a power transmission path from a driving force source to a driving wheel of a vehicle, and connects or interrupts the power transmission path between the driving force source and the transmission. Also, the driving force source may preferably be an internal combustion engine such as a gasoline engine or a diesel engine. Alternatively, an electric motor may be used either alone or in addition to an engine, as the driving force source. Also, the transmission is a well-known constant mesh parallel shaft transmission, and may be either a manual transmission or an automatic transmission.

[0034] The description above describes no more than an example embodiment. That is, the invention may be carried out in modes that have been modified or improved in any of a variety of ways based on the knowledge of one skilled in the art.

CLAIMS:

1. A clutch device comprising:

a support on which a ball head portion is provided;

a ball head housing portion within which the ball head portion is housed;

a film lubrication provided between the ball head portion and the ball head housing portion, an inner peripheral surface of the ball head housing portion abutting against the ball head portion via the film lubricant, the inner peripheral surface of the ball head housing portion having a recess; and

a clutch release fork that is provided with the ball head housing portion, the clutch release fork being configured to rotate with the ball head portion as a fulcrum.

2. The clutch device according to claim 1, wherein

a portion of the inner peripheral surface of the ball head housing portion other than the recess has a hemisphere shape that matches a hemisphere shape of the ball head portion.

3. The clutch device according to claim 1 or claim 2, further comprising:

a retaining member configured to retain the film lubricant, wherein

the support is fit into the retaining member such that sliding occurs between the film lubricant and the ball head portion.

4. The clutch device according to any one of claims 1 to 3, wherein

the film lubricant is a plastic deformable resin sheet; and

the film lubricant has a hemisphere shape that matches a hemisphere shape of the ball head portion.

5. The clutch device according to claim 2, wherein

the hemisphere shape of the portion of the inner peripheral surface of the ball head

housing portion other than the recess is provided having multiple stages.

6. The clutch device according to any one of claims 1 to 5, wherein

the recess has a hemisphere shape; and

a radius of the recess is smaller than a radius of the hemisphere shape of the ball head portion.

7. The clutch device according to any one of claims 1 to 6, wherein

an axial center of a hemisphere shape of the recess is the same as an axial center of a hemisphere shape of the ball head portion.

FIG. 1

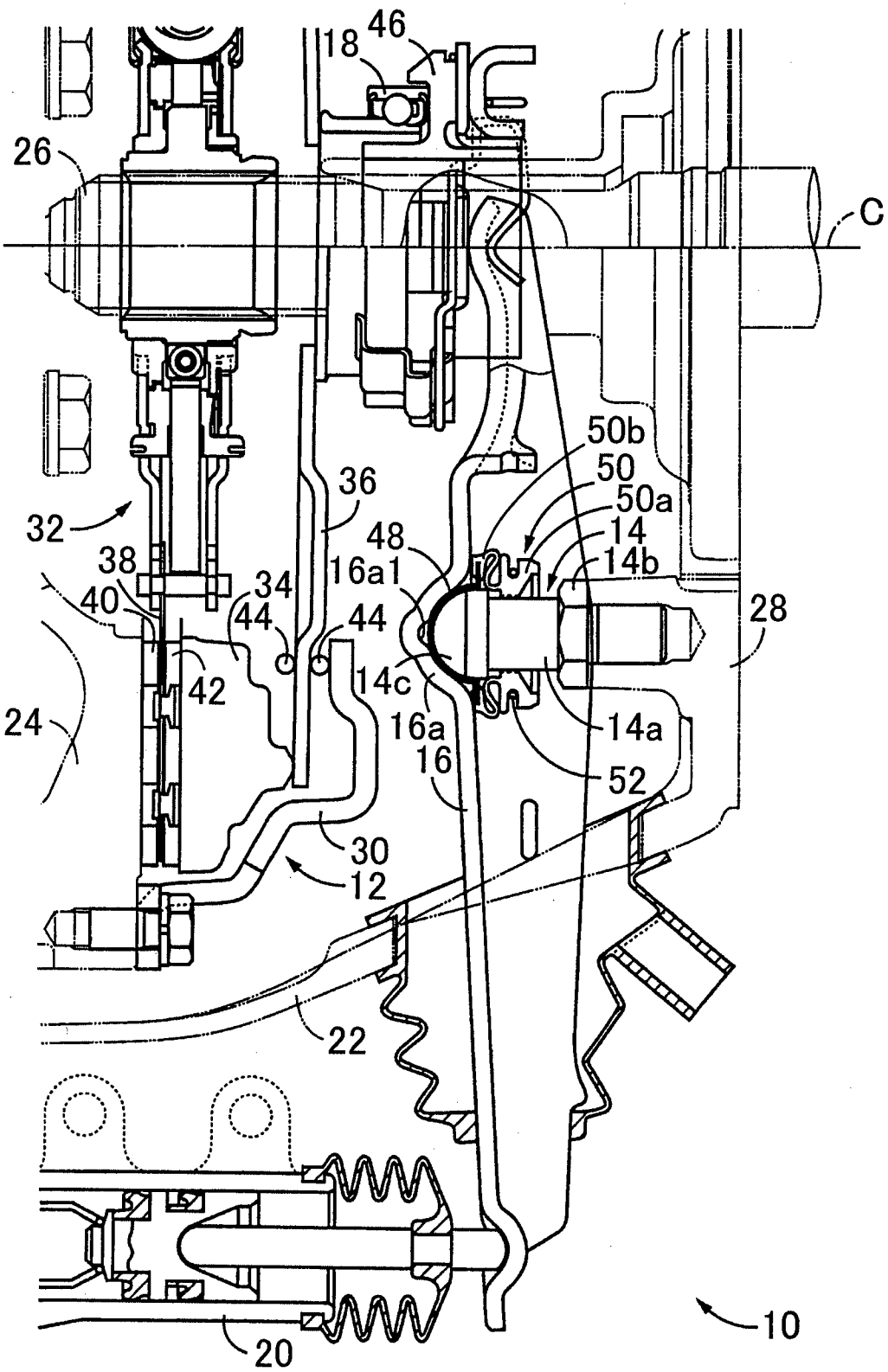

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FIG. 2

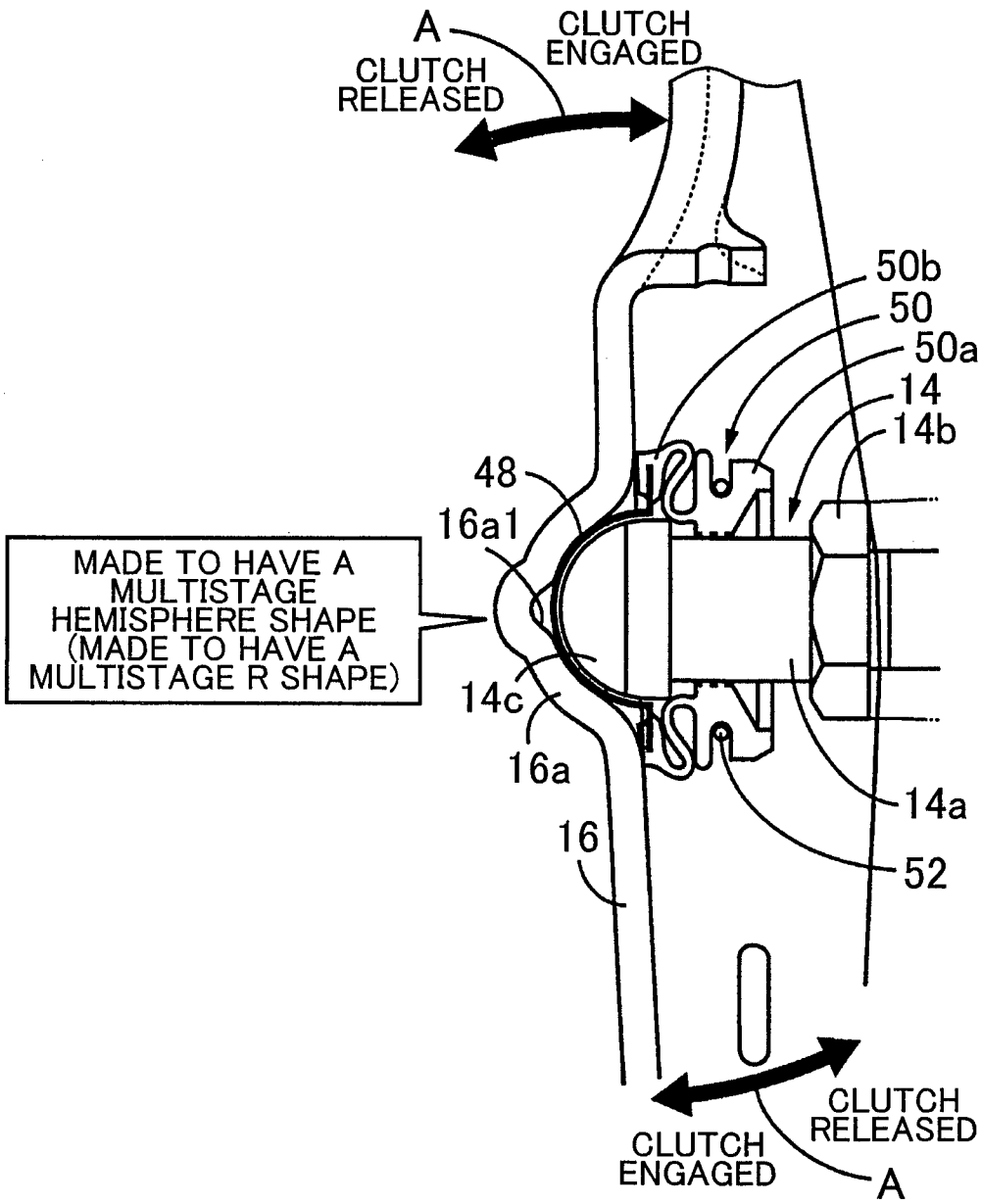

A
CLUTCH ENGAGED
CLUTCH RELEASED
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50a
14
14b
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MADE TO HAVE A MULTISTAGE HEMISPHERE SHAPE (MADE TO HAVE A MULTISTAGE R SHAPE)
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16a
16
14a
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CLUTCH RELEASED
CLUTCH ENGAGED
A

FIG. 3

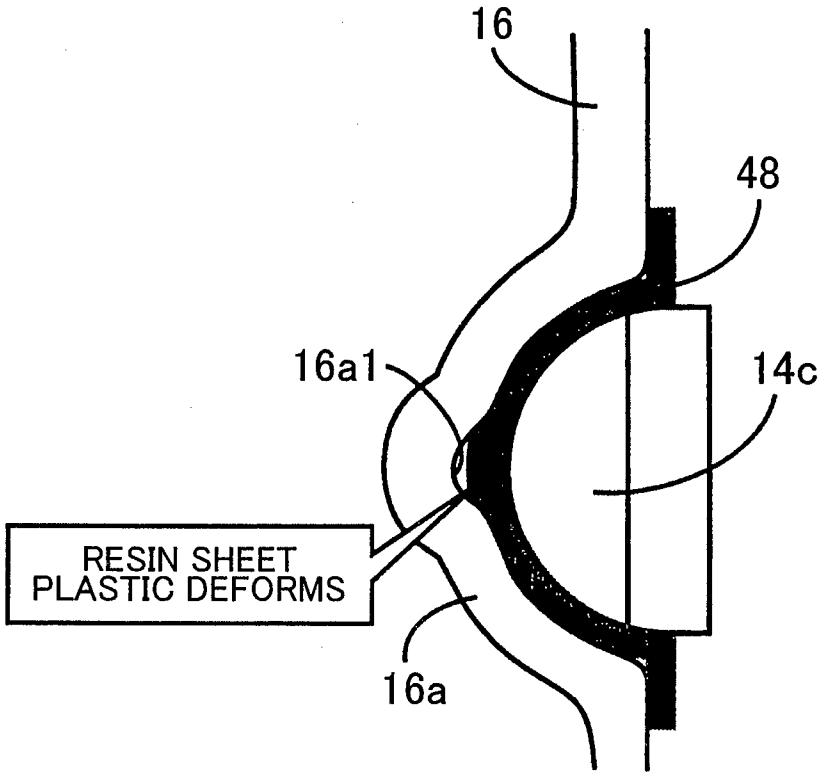


FIG. 4

