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(54) **GEAR FITTING AND DISENGAGING DEVICE, AND ENGINE STARTER**

(57) When engaging a driving gear (14) with a driven gear (16) for the purpose of starting an engine (30), a pressing force is applied to the driving gear (14) towards one side in the axial direction from a cam plate (32) which is prevented from rotating, thereby moving the driving gear (14) towards the one side in the axial direction. After the engine (30) starts, a drive source (10) is stopped while

the driven gear (16) rotates. However, at that time, the driving gear (14) and a guide gear (18) are not engaged with the driven gear (16), and therefore stop rotating. As a consequence, mechanical losses such as dragging losses caused by sliding do not occur between the driving gear (14) and the cam plate (32) and between the driving gear (14) and the guide gear (18).

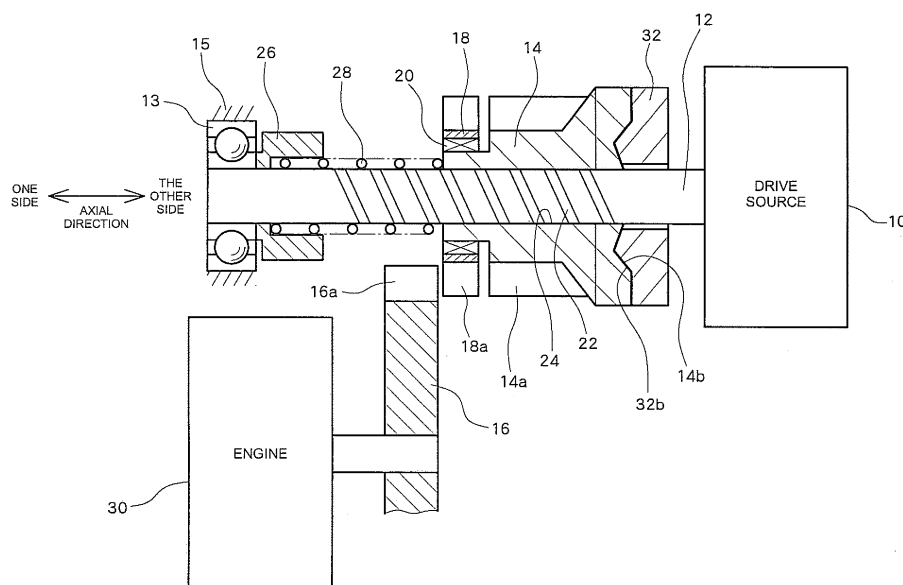


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to a gear fitting and disengaging device that performs fitting and disengaging operations for a gear, and to an engine starter including such a gear fitting and disengaging device.

BACKGROUND ART

[0002] Patent Document 1 indicated below discloses technology related to an engine starter including a gear fitting and disengaging device that performs fitting and disengaging operations for a gear. The engine starter disclosed in Patent Document 1 includes a solenoid device having a function of pushing out a pinion gear toward the side of a ring gear of an engine by using an attraction force of a first coil, and an electromagnetic switch that opens/closes a main contact provided in a motor energization circuit by means of an attraction force of a second coil. The solenoid device and the electromagnetic switch are axially arranged in series and integrally formed, and a magnetic plate forming a part of a magnetic circuit is disposed between the first coil and the second coil as a common member for the solenoid device and the electromagnetic switch. When starting the engine, the first coil is first energized to push out the pinion gear toward the side of the ring gear of the engine. After the pinion gear comes into contact with the ring gear, the second coil is energized to rotate the output shaft of the motor. When the pinion gear engages with the ring gear due to the rotation of the output shaft of the motor, the rotating force is transmitted from the pinion gear to the ring gear to thereby crank the engine.

[0003] Further, an engine starter disclosed in Patent Document 2 indicated below, when starting the engine, transmits rotation of a starter motor to the engine via a one-way clutch, thereby cranking the engine. After the engine is started, the rotation of the starter motor is stopped, and at this time, the starter motor is prevented from being rotation-driven by the engine by means of idle running of the one-way clutch.

[0004] Also, as technology related to a gear fitting and disengaging device that performs fitting and disengaging operations for a gear, a synchronous self-shifting clutch (SSS clutch) is disclosed in Patent Document 3 indicated below. In the SSS clutch of Patent Document 3, a switching sleeve rotates at the same rotation speed as a steam turbine until a synchronous rotation speed is reached, at which it is held firmly on a switching part of a generator shaft by means of a claw. If the rotation speed is oversynchronous, a thread results in the switching sleeve being moved axially in the direction of the steam turbine. After only a short time, the teeth of the switching sleeve and the teeth of the generator shaft engage, and the drive torque is transmitted via these teeth.

PIOR ART DOCUMENTS

PATENT DOCUMENT

[0005]

Patent Document 1: JP 2010-38103 A
 Patent Document 2: JP 2007-297966 A
 Patent Document 3: JP 2010-506113 A

DISCLOSURE OF THE INVENTION

TECHNICAL PROBLEMS

[0006] The engine starter disclosed in Patent Document 1 is of a tandem solenoid type and requires, in addition to the electromagnetic switch that energizes the motor to rotate the pinion gear, the solenoid device for pushing out the pinion gear to the ring gear side of the engine, which leads to an increase in the size of the device and also to an increase in cost. In addition, as it is necessary to control the fitting and disengaging operation of the pinion gear and the rotation operation of the pinion gear independently of each other, control is complicated.

[0007] In the engine starter disclosed in Patent Document 2, which is of a constant mesh type, after the engine is started, the starter motor is prevented from being rotation-driven by the engine by means of idle running of the one-way clutch. Accordingly, after the engine is started (i.e., after the starter motor is stopped), dragging losses of the one-way clutch occur continuously, which affects the fuel consumption of the engine.

[0008] Further, in the SSS clutch disclosed in Patent Document 3, when the drive side (the steam turbine) is stopped in a state in which the generator shaft is rotating, the sleeves of the generator shaft and the sleeves of the switch sleeve continuously slide on each other. Accordingly, when the drive side is stopped in a state in which the generator shaft is rotating, dragging losses and noises caused by sliding of the sleeves of the generator shaft and the sleeves of the switch sleeve occur continuously.

[0009] The present invention is aimed at enabling both the fitting and disengaging operation and the rotation operation of a gear by driving a drive source and also at reducing losses when the drive source is stopped.

SOLUTION TO PROBLEMS

[0010] A gear fitting and disengaging device and an engine starter according to the present invention adopt the following means in order to achieve the above advantages.

[0011] A gear fitting and disengaging device according to the present invention includes a rotation shaft which rotates in a predetermined direction by receiving power transmitted from a drive source, a driving gear which engages with the rotation shaft in a state in which the driving gear is movable in an axial direction of the rotation shaft,

a driven gear which engages with the driving gear when the driving gear is at a predetermined engagement position in the axial direction, a restraint device for restraining a movement of the driving gear from the predetermined engagement position toward one side in the axial direction, and a moving force generating mechanism which, when the driving gear is at a disengagement position toward the other side in the axial direction with respect to the predetermined engagement position and the rotation shaft rotates in the predetermined direction, causes application, to the driving gear from a fixed member which is prevented from rotating, of a force for moving the driving gear toward the one side in the axial direction.

[0012] In accordance with one aspect of the present invention, it is preferable that the driving gear moves toward the one side in the axial direction in accordance with relative rotation of the rotation shaft with respect to the driving gear in the predetermined direction, and the moving force generating mechanism is a mechanism that, when the driving gear is at the disengagement position and the rotation shaft rotates in the predetermined direction, causes a resistance force to be applied from the fixed member to the driving gear such that the rotation of the driving gear in the predetermined direction is restrained or a rotation speed of the driving gear is lower than a rotation speed of the rotation shaft.

[0013] In accordance with one aspect of the present invention, it is preferable that the moving force generating mechanism is a mechanism that, when the driving gear is at the disengagement position, restrains or restricts rotation of the driving gear with respect to the fixed member while allowing a movement of the driving gear with respect to the fixed member in the axial direction.

[0014] In accordance with one aspect of the present invention, it is preferable that the moving force generating mechanism is a mechanism that, when the driving gear is at the disengagement position, causes a friction force to be applied from the fixed member to the driving gear.

[0015] In accordance with one aspect of the present invention, it is preferable that the moving force generating mechanism is a mechanism that, when a reaction force having a predetermined value or greater against the resistance force is applied from the driving gear to the fixed member, allows a phase difference of the driving gear with respect to the fixed member.

[0016] In accordance with one aspect of the present invention, it is preferable that the moving force generating mechanism is a mechanism that, when the driving gear is at the disengagement position, causes a pressing force toward the one side in the axial direction to be applied from the fixed member to the driving gear in accordance with generation of a phase difference between the fixed member and the driving gear.

[0017] In accordance with one aspect of the present invention, it is preferable that the driving gear moves toward the one side in the axial direction in accordance with relative rotation of the rotation shaft with respect to the driving gear in the predetermined direction.

[0018] In accordance with one aspect of the present invention, it is preferable that the relative rotation of the driving gear with respect to the rotation shaft is restrained or restricted, whereas the relative movement of the driving gear with respect to the rotation shaft in the axial direction is allowed, and the driving gear and the driven gear are helical gears having teeth that are inclined toward the back in the rotation direction thereof from the one side toward the other side in the axial direction.

[0019] In accordance with one aspect of the present invention, it is preferable that the moving force generating mechanism is a mechanism that, when a reaction force having a predetermined value or greater against the pressing force is applied from the driving gear to the fixed member, allows a displacement of the fixed member toward the other side in the axial direction.

[0020] In accordance with one aspect of the present invention, it is preferable that the gear fitting and disengaging device further includes an intermediate member which engages with the rotation shaft in a state in which the intermediate member is movable in the axial direction of the rotation shaft, the driving gear engages with the rotation shaft via the intermediate member in a state in which the driving gear is movable in the axial direction of the rotation shaft, and the moving force generating mechanism is a mechanism which causes a force for moving the driving gear toward the one side in the axial direction to be applied to the driving gear from the fixed member via the intermediate member, and a relative displacement of the driving gear with respect to the intermediate member toward the other side in the axial direction is allowed when a force having a predetermined value or greater toward the other side in the axial direction is applied to the driving gear.

[0021] In accordance with one aspect of the present invention, it is preferable that the gear fitting and disengaging device further includes a guide gear which engages with the driven gear when the driving gear is at a position in the axial direction between the predetermined engagement position and the disengagement position, and a one-direction rotation allowing mechanism which supports the guide gear on the driving gear such that relative rotation of the guide gear with respect to the driving gear in the predetermined direction is allowed and relative rotation of the guide gear with respect to the driving gear in a direction opposite the predetermined direction is restrained in a state in which a phase of the teeth of the driving gear and a phase of the teeth of the guide gear match, and the moving force generation mechanism is a mechanism which causes a force for moving the driving gear toward the one side in the axial direction to act on the driving gear from the fixed member until the guide gear engages with the driven gear.

[0022] In accordance with one aspect of the present invention, it is preferable that a tooth surface of the guide gear on the back side in the rotation direction is formed into a guide side tapered surface which is inclined toward the back in the rotation direction with respect to the axial

direction from the one side toward the other side in the axial direction, and a tooth surface of the driven gear on the forward side in the rotation direction is formed into a driven side tapered surface which is parallel to the guide side tapered surface.

[0023] In accordance with one aspect of the present invention, it is preferable that the gear fitting and disengaging device further includes an urging device for applying an urging force toward the other side in the axial direction to the driving gear. The urging device is preferably a compression spring which is disposed toward the one side in the axial direction with respect to the driving gear, or a tension spring which is disposed toward the other side in the axial direction with respect to the driving gear.

[0024] In accordance with one aspect of the present invention, it is preferable that the gear fitting and disengaging device further includes a buffer member for reducing a force which is applied to the driving gear when the movement of the driving gear toward the one direction in the axial direction is restrained by the restraint device.

[0025] Further, an engine starter according to the present invention includes a drive source which generates power, and the gear fitting and disengaging device according to the present invention, for performing start of the engine coupled with a driven gear.

ADVANTAGEOUS EFFECTS OF INVENTION

[0026] According to the present invention, when engaging the driving gear with the driven gear by driving the drive source, a force for moving the driving gear toward one side in the axial direction is applied to the driving gear from the fixed member which is prevented from rotating, so that a movement of the driving gear toward the driven gear side can be started. Further, when the drive source is stopped in a state in which the driven gear is rotating, as the driving gear and the driven gear do not engage with each other and the rotation of the driving gear is stopped, mechanical losses such as dragging losses caused by sliding do not occur between the driving gear and the fixed member. Accordingly, losses that occur when stopping the drive source in a state in which the driven gear is rotating can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

[FIG. 1] View schematically illustrating the structure of an engine starter including a gear fitting and disengaging device according to Embodiment 1 of the present invention.

[FIG. 2] View for explaining the operation of the engine starter according to Embodiment 1 of the present invention.

[FIG. 3] View for explaining the operation of the engine starter according to Embodiment 1 of the

present invention.

[FIG. 4] View for explaining the operation of the engine starter according to Embodiment 1 of the present invention.

[FIG. 5] View schematically illustrating the structure of the gear fitting and disengaging device according to Embodiment 1 of the present invention.

[FIG. 6] View for explaining the operation of the engine starter according to Embodiment 1 of the present invention.

[FIG. 7] View for explaining the operation of the engine starter according to Embodiment 1 of the present invention.

[FIG. 8] View for explaining the operation of the engine starter according to Embodiment 1 of the present invention.

[FIG. 9] View schematically illustrating the structure of an engine starter including a gear fitting and disengaging device according to Embodiment 2 of the present invention.

[FIG. 10] View for explaining the operation of the engine starter according to Embodiment 2 of the present invention.

[FIG. 11] View schematically illustrating the structure of an engine starter including a gear fitting and disengaging device according to Embodiment 3 of the present invention.

[FIG. 12] View for explaining the operation of the engine starter according to Embodiment 3 of the present invention.

[FIG. 13] View schematically illustrating the structure of an engine starter including a gear fitting and disengaging device according to Embodiment 4 of the present invention.

[FIG. 14] View for explaining the operation of the engine starter according to Embodiment 4 of the present invention.

[FIG. 15] View for explaining the operation of the engine starter according to Embodiment 4 of the present invention.

[FIG. 16] View for explaining the operation of the engine starter according to Embodiment 4 of the present invention.

[FIG. 17] View schematically illustrating the structure of an engine starter including a gear fitting and disengaging device according to Embodiment 5 of the present invention.

[FIG. 18] View schematically illustrating the structure of an engine starter including a gear fitting and disengaging device according to Embodiment 6 of the present invention.

[FIG. 19] View for explaining the operation of the engine starter according to Embodiment 6 of the present invention.

[FIG. 20] View schematically illustrating the structure of an engine starter including a gear fitting and disengaging device according to Embodiment 7 of the present invention.

[FIG. 21] View schematically illustrating the structure of an engine starter including a gear fitting and disengaging device according to Embodiment 8 of the present invention.

[FIG. 22] View schematically illustrating the structure of an engine starter including a gear fitting and disengaging device according to Embodiment 9 of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0028] Preferred embodiments of the present invention will be described with reference to the drawings.

Embodiment 1

[0029] FIG. 1 is a view schematically illustrating the structure of an engine starter including a gear fitting and disengaging device according to Embodiment 1 of the present invention. A drive source 10 can be formed by an electric motor (motor), for example, and is capable of generating power at an output shaft thereof. A rotation shaft 12 is mechanically coupled to the output shaft of the drive source 10 and is rotatably supported by a housing 15 via a bearing 13. The rotation shaft 12 is prevented from moving in the axial direction (i.e., the right-left direction in FIG. 1). The rotation shaft 12 rotates in a predetermined one direction (which will be hereinafter referred to as a predetermined direction) by receiving power from the drive source 10 transmitted thereto. A thread (external thread) 22 is formed on an outer circumferential surface of the rotation shaft 12.

[0030] A driving gear 14 is a spur gear and can be formed from an external gear having teeth 14a formed on the outer circumferential portion thereof. The driving gear 14 includes, in the center thereof, a through hole for allowing the rotation shaft 12 to pass through, formed therein, and a thread (internal thread) 24 is formed on the internal circumferential surface of the through hole. The rotation shaft 12 passes through the through-hole of the driving gear 14, so that the driving gear 14 is supported by the rotation shaft 12 by thread engagement of the external thread 22 formed on the rotation shaft 12 with the internal thread 24 formed on the driving gear 14. FIG. 1 illustrates an example in which the threads 22 and 24 are right-hand screws.

[0031] A guide gear 18 is a spur gear and can be formed from an external gear having teeth 18a formed on the outer circumferential portion thereof. The driving gear 14 and the guide gear 18 have the same pitch circle radius and the same number of teeth. The guide gear 18 is disposed toward the one side in the axial direction with respect to the driving gear 14, and, in this state, is supported by the driving gear 14 via a ratchet mechanism 20. When the guide gear 18 attempts to rotate relatively with respect to the driving gear 14 in the predetermined direction (i.e. the counterclockwise direction when the rotation shaft 12 is viewed from the drive source 10 side

(in the example of FIG. 1, from the right side of the figure)), the ratchet mechanism 20, which is provided as a one-direction rotation enabling mechanism, is placed in a released (free) state to thereby allow the relative rotation of the guide gear 18. On the other hand, when the guide gear 18 attempts to rotate relatively with respect to the driving gear 14 in a direction opposite the predetermined direction (i.e. the clockwise direction when the rotation shaft 12 is viewed from the drive source 10 side (in the example of FIG. 1, from the right side of the figure)), the ratchet mechanism 20 is placed in an engaged (lock) state to thereby restrain the relative rotation of the guide gear 18. At this time, the relative rotation of the guide gear 18 with respect to the driving gear 14 in the direction opposite the predetermined direction is restrained in a state in which the phase of the teeth 14a of the driving gear 14 and the phase the teeth 18a of the guide gear 18 match each other. Here, the structure of the ratchet mechanism 20 itself is known and therefore will not be described in detail.

[0032] In a case in which the rotation shaft 12 rotates relatively with respect to the driving gear 14 in the predetermined direction, such as when the rotation shaft 12 rotates in the predetermined direction (i.e., the counterclockwise direction when the rotation shaft 12 is viewed from the drive source 10 side (in the example of FIG. 1, from the right side of the figure)) in a state in which the rotation of the driving gear 14 is stopped, when the rotation speed of the driving gear 14 in the predetermined direction is lower than the rotation speed of the rotation shaft 12 in the predetermined direction, and the like, the relative rotation movement of the rotation shaft 12 with respect to the driving gear 14 is converted into a linear movement of the driving gear 14 along the axial direction of the rotation shaft 12 due to the thread engagement between the rotation shaft 12 and the driving gear 14, so that the driving gear 14, along with the guide gear 18, moves toward the one direction in the axial direction of the rotation shaft 12 (toward the left side in FIG. 1; i.e., the side away from the drive source 10). On the other hand, in a case in which the rotation shaft 12 rotates relatively with respect to the driving gear 14 in a direction opposite the predetermined direction (i.e., the clockwise direction when the rotation shaft 12 is viewed from the drive source 10 side (in the example of FIG. 1, from the right side of the figure)), such as when the driving gear 14 rotates in the predetermined direction in a state in which the rotation of the rotation shaft 12 is stopped, when the rotation speed of the driving gear 14 in the predetermined direction is higher than the rotation speed of the rotation shaft 12 in the predetermined direction, and the like, the driving gear 14, along with the guide gear 18, moves toward the other direction in the axial direction of the rotation shaft 12 (toward the right side in FIG. 1; i.e., the side approaching the drive source 10). As described above, the driving gear 14 engages with the rotation shaft 12 such that the driving gear 14 can move in the axial direction of the rotation shaft 12. Here,

the structure for allowing the driving gear 14 to move in the axial direction with respect to the rotation shaft 12 is not limited to the thread engagement between the rotation shaft 12 and the driving gear 14. For example, the driving gear 14 may be supported by the rotation shaft 12 by helical spline engagement or via a ball screw mechanism.

[0033] A driven gear 16 is a spur gear and can be formed from an external gear having teeth 16a formed on the outer circumferential portion thereof. The driven gear 16 is mechanically coupled with an output shaft of an engine 30. As illustrated in FIG. 2, when the driving gear 14 is at a predetermined engagement position in the axial direction, the teeth 14a of the driving gear 14 and the teeth 16a of the driven gear 16 engage with each other and the teeth 18a of the guide gear 18 and the teeth 16a of the driven gear 16 do not engage with each other. On the other hand, as illustrated in FIG. 1, when the driving gear 14 is at a disengagement position which is located toward the other side in the axial direction with respect to the predetermined engagement position, the teeth 14a of the driving gear 14 and the teeth 16a of the driven gear 16 do not engage with each other, and the teeth 18a of the guide gear 18 and the teeth 16a of the driven gear 16 do not engage with each other, either. Further, when the driving gear 14 is at a position in the axial direction between the predetermined engagement position and the disengagement position, as illustrated in FIG. 3, for example, the teeth 18a of the guide gear 18 and the teeth 16a of the driven gear 16 engage with each other and the teeth 14a of the driving gear 14 and the teeth 16a of the driven gear 16 do not engage with each other, or as illustrated in FIG. 4, for example, both the teeth 14a of the driving gear 14 and the teeth 18a of the guide gear 18 engage with the teeth 16a of the driven gear 16.

[0034] As illustrated in FIG. 5, each of the teeth 18a of the guide gear 18 has, on a tooth surface on the back side in the rotation direction (on the back side in the predetermined direction), a guide side tapered surface 18b which is inclined toward the back side in the rotation direction (toward the back side in the predetermined direction) from the one side to the other side in the axial direction. Further, each of the teeth 16a of the driven gear 16 has, on a tooth surface on the forward side in the rotation direction (on the forward side in the predetermined direction), a driven side tapered surface 16b which is inclined toward the back side in the rotation direction (toward the back side in the predetermined direction) from the one side to the other side in the axial direction. The guide side tapered surface 18b of the guide gear 18 and the driven side tapered surface 16b of the driven gear 16 are parallel to each other.

[0035] A stopper 26 serving as a restraint device is attached at a position on the rotation shaft 12 toward the one side in the axial direction with respect to the predetermined engagement position. When the driving gear 14 moves to the predetermined engagement position

(i.e., a position at which the driving gear 14 engages with the driven gear 16), one end portion in the axial direction of the driving gear 14 (or the guide gear 18) comes into contact with the stopper 26, so that the driving gear 14 is restrained from moving toward the one side in the axial direction beyond the predetermined engagement position. An urging spring 28 serving as an urging device is provided between the stopper 26 and the driving gear 14 (guide gear 18) in the axial direction. The urging spring 28 applies an urging force toward the other side in the axial direction to the driving gear 14 and the guide gear 18. In the example illustrated in FIG. 1, the urging spring 28 is a compression spring which is disposed toward the one side in the axial direction with respect to the driving gear 14 and the guide gear 18 and is compressed to thereby apply the urging force toward the other side in the axial direction to the driving gear 14 and the guide gear 18.

[0036] A cam plate 32 is disposed toward the other side in the axial direction with respect to the driving gear 14 (in the disengagement position), and is prevented from rotating by being mechanically coupled with the housing 15. The cam plate 32 includes a cam surface 32b formed on a surface thereof opposite the driving gear 14 (i.e., an end surface on the one side in the axial direction), whereas the driving gear 14 includes a cam surface 14b formed on a surface thereof opposite the cam plate 32 (i.e. an end surface on the other side in the axial direction). When the driving gear 14 is at the disengagement position in the axial direction (i.e., the state illustrated in FIG. 1), the cam surface 14b of the driving gear 14 is in contact with the cam surface 32b of the cam plate 32. When, in a state in which the driving gear 14 is at the disengagement position in the axial direction, the driving gear 14 relatively rotates with respect to the cam plate 32 so that a phase difference is generated between the cam plate 32 and the driving gear 14, the cam surface 32b of the cam plate 32 presses the cam surface 14b of the driving gear 14 toward the one side in the axial direction. Consequently, a pressing force toward the one side in the axial direction is applied from the cam plate 32 to the driving gear 14, so that the relative rotation of the driving gear 14 with respect to the cam plate 32 is suppressed. Here, as the structures of the cam surfaces 14b and 32b that cause application of the pressing force from the cam plate 32 to the driving gear 14 in accordance with generation of the phase difference between the cam plate 32 and the driving gear 14 can be implemented by applying a torque cam mechanism, such a structure will not be described in detail.

[0037] Next will be described the operation of an engine starter according to the present embodiment, and particularly the operation of the engine starter when starting the engine by using power of the drive source 10 (motor).

[0038] First, the operation for starting the engine 30 in a state in which the rotation of the engine 30 (the driven gear 16) is stopped will be described. Before starting the

engine 30, the rotation of the drive source 10 (the rotation shaft 12) is stopped and the rotations of the driving gear 14 and the guide gear 18 are also stopped. Further, as illustrated in FIG. 1, the driving gear 14 is at the disengagement position in the axial direction, neither the driving gear 14 nor the guide gear 18 engage with the driven gear 16, and the cam surface 14b of the driving gear 14 is in contact with the cam surface 32b of the cam plate 32. When starting the engine 30 in this state, first, the drive source 10 is caused to generate power to rotate the rotation shaft 12 in the predetermined direction (i.e., the counterclockwise direction when the rotation shaft 12 is viewed from the drive source 10 side (from the right side in the figure) in the example illustrated in FIG. 1). While the driving gear 14 attempts to rotate in the predetermined direction with the rotation shaft 12, as, due to the generation of a phase difference between the cam plate 32 and the driving gear 14, the pressing force toward the one side in the axial direction is applied to the driving gear 14 from the cam plate 32 which is prevented from rotating, the relative rotation of the driving gear 14 with respect to the cam plate 32 in the predetermined direction is restrained. Consequently, the rotation shaft 12 relatively rotates with respect to the driving gear 14 in the predetermined direction, and the driving gear 14, along with the guide gear 18, moves toward the one side in the axial direction (toward the driven gear 16 side).

[0039] In order to start the engine 30 by using the power of the drive source 10, it is necessary to move the driving gear 14 toward the one side in the axial direction (toward the driven gear 16 side) from the disengagement position to make the driving gear 14 engage with the driven gear 16. However, in a no-load state, the driving gear 14 rotates with the rotation shaft 12 and does not move in the axial direction. In order to allow the driving gear 14 to start moving in the axial direction while the rotation shaft 12 is rotating, it is necessary to cause a rotation difference to occur between the rotation shaft 12 and the driving gear 14. In order to cause such a rotation difference to occur, it is necessary to cause a resistance force for restraining or reducing the rotation of the driving gear 14 to act on the driving gear 14 to thereby load the driving gear 14. In the present embodiment, when the driving gear 14 is at the disengagement position and the rotation shaft 12 rotates in the predetermined direction, by applying, as the resistance force, the pressing force toward the one side in the axial direction from the cam plate 32 which is prevented from rotating to the driving gear 14 to thereby load the driving gear 14, it is possible to restrain or reduce the rotation of the driving gear 14 in the predetermined direction. Consequently, the force for moving the driving gear 14 toward the one side in the axial direction can be applied from the cam plate 32 to the driving gear 14, so that the movement of the driving gear 14 toward the one side in the axial direction (toward the driven gear 16 side) can be started.

[0040] When the driving gear 14 moves toward the one side in the axial direction from the disengagement posi-

tion, the guide gear 18 first engages with the driven gear 16 as illustrated in FIG. 3. The cam plate 32, from when the driving gear 14 is at the disengagement position until the guide gear 18 engages with the driven gear 16, continues to apply the pressing force toward the one side in the axial direction to the driving gear 14 as the resistance force (i.e., the force for moving toward the one side in the axial direction) by continuing to push the cam surface 14b of the driving gear 14 toward the one side in the axial direction by the cam surface 32b. At this time, the range in which the cam plate 32 pushes the driving gear 14 (i.e., the moving distance of the driving gear 14) can be adjusted by the design of profiles of the cam surfaces 14b and 32b. Further, when the guide gear 18 engages with the driven gear 16, due to the release of the ratchet mechanism 20, the phase of the teeth 18a of the guide gear 18 varies until the guide gear 18 reaches the position at which the teeth 18a of the guide gear 18 can be fitted between the teeth 16a of the driven gear 16, as illustrated in FIG. 6.

[0041] After the guide gear 18 and the driven gear 16 engage with each other, the ratchet mechanism 20 is placed in an engaged state in a state in which the phase of the teeth 14a of the driving gear 14 and the phase of the teeth 18a of the guide gear 18 match each other, and the rotation elements on the driven gear 16 side including the rotation elements of the engine 30 become a load to the driving gear 14. Therefore, after the guide gear 18 and the driven gear 16 engage with each other, as the rotation shaft 12 continues to rotate relatively with respect to the driving gear 14 in the predetermined direction and the rotation movement of the rotation shaft 12 continues to be converted into the linear movement of the driving gear 14, the driving gear 14, along with the guide gear 18, continues to move toward the one side in the axial direction, although no pressing force is applied to the driving gear 14 from the cam plate 32. At this time, the urging force of the urging spring 28 is set such that the driving gear 14 can move toward the one side in the axial direction. When the driving gear 14 and the guide gear 18 further move toward the one side in the axial direction, both the guide gear 18 and the driving gear 14 engage with the driven gear 16, as illustrated in FIG. 4.

[0042] When the driving gear 14 continues to further move toward the one side in the axial direction with the guide gear 18, of the driving gear 14 and the guide gear 18, the guide gear 18 does not engage with the driven gear 16 and only the driving gear 14 engages with the driven gear 16. Then, as illustrated in FIG. 2, when the driving gear 14 moves to the predetermined engagement position, one end portion of the driving gear 14 (or the guide gear 18) in the axial direction comes into contact with the stopper 26 to thereby restrain and stop the movement of the driving gear 14 and the guide gear 18 toward the one side in the axial direction. Consequently, the rotation movement of the rotation shaft 12 is no longer converted into the linear movement of the driving gear 14, and the driving gear 14 rotates in the predetermined di-

rection with the rotation shaft 12. Accordingly, the power of the drive source 10 is transmitted to the output shaft of the engine 30 via the driving gear 14 and the driven gear 16, so that the engine 30 is cranked. As a result, it is possible to start the engine 30 by using the power of the drive source 10. Further, as the stopper 26 rotates with the rotation shaft 12, even when the driving gear 14 rotates in contact with the stopper 26, losses caused by friction between the driving gear 14 and the stopper 26 do not occur.

[0043] After the start of the engine 30, in a state in which the engine 30 (the driven gear 16) is rotating, generation of the power by the drive source 10 is stopped. As the rotation speed of the rotation shaft 12 in the predetermined direction becomes lower than that of the driving gear 14, the rotation shaft 12 relatively rotates with respect to the driving gear 14 in the direction opposite the predetermined direction (i.e., the clockwise direction when the rotation shaft 12 is viewed from the drive source 10 side (from the right side in the figure) in the example of FIG. 1). Accordingly, as illustrated in FIG. 7, the driving gear 14 moves to the other side in the axial direction with the guide gear 18. At this time, the driving gear 14 moves from the predetermined engagement position (the state illustrated in FIG. 2) to the disengagement position (the state illustrated in FIG. 1) while rotating in the predetermined direction with respect to the rotation shaft 12. Further, the restoring force for returning the driving gear 14 to the disengagement position can also be applied by the urging force of the urging spring 28 toward the other side in the axial direction. As illustrated in FIG. 1, in a state in which the driving gear 14 has moved to the disengagement position, the rotation of the drive source 10 (the rotation shaft 12) is stopped, and the rotations of the driving gear 14 and the guide gear 18 are stopped, neither the driving gear 14 nor the guide gear 18 engages with the driven gear 16, and the cam surface 14b of the driving gear 14 is in contact with the cam surface 32b of the cam plate 32. Accordingly, after the start of the engine 30, while the engine 30 (the driven gear 16) is rotating, mechanical losses such as dragging losses caused by sliding between the driving gear 14 and the cam plate 32 and between the driving gear 14 and the guide gear 18 do not occur, nor does noise.

[0044] Further, there are cases in which a vehicle having the engine 30 for vehicle driving and an idling stop mechanism stops driving by the engine 30 during creeping. This leads to cases in which although the engine 30 does not generate power, the engine 30 is started in a state in which the engine output shaft; i.e., the driven gear 16, is rotating. The operation for starting the engine 30 in a state in which the engine 30 (the driven gear 16) is rotating is basically the same as the operation for starting the engine 30 in a state in which the rotation of the engine 30 (the driven gear 16) is stopped. However, in a case in which the guide gear 18 and the driven gear 16 engage with each other, when the teeth 18a of the guide gear 18 collide with the teeth 16a of the driven gear

16, due to the release of the ratchet mechanism 20, the teeth 18a of the guide gear 18 are fitted between the teeth 16a of the driven gear 16 while the guide side tapered surface 18b on the back side in the rotation direction of the guide gear 18 (the back side in the predetermined direction) is sliding on the driven side tapered surface 16b on the forward side in the rotation direction of the driven gear 16 (the forward side in the engine rotation direction), as illustrated in FIG. 8. Then, when the rotation speed of the driving gear 14 in the predetermined direction is increased to the rotation speed of the guide gear 18 in the predetermined direction after the guide gear 18 and the driven gear 16 engage with each other, the ratchet mechanism 20 is placed in an engaged state in a state in which the phase of the teeth 14a of the driving gear 14 and the phase of the teeth 18a of the guide gear 18 match each other.

[0045] According to the present embodiment described above, as it is possible to allow the driving gear 14 to move in the axial direction due to the rotation difference between the driving gear 14 and the rotation shaft 12, both the fitting and disengaging operation and the rotation operation of the driving gear 14 can be performed by means of rotation driving of the drive source 10. Further, according to the present embodiment, when engaging the driving gear 14 with the driven gear 16 so as to start the engine 30, the pressing force toward the one side in the axial direction (toward the driven gear 16 side) is applied to the driving gear 14 from the cam plate 32 which is prevented from rotating, so that the movement of the driving gear 14 toward the one side in the axial direction can be started. After the engine 30 is started, the rotation of the drive source 10 (the rotation shaft 12) is stopped in a state in which the engine 30 (the driven gear 16) is rotating. At this time, because neither the driving gear 14 nor the guide gear 18 engages with the driven gear 16 and the rotations of the driving gear 14 and the guide gear 18 are stopped, mechanical losses such as dragging losses caused by sliding between the driving gear 14 and the cam plate 32 and between the driving gear 14 and the guide gear 18 do not occur, nor does noise. It is therefore possible to reduce the mechanical losses and noise when the drive source 10 is stopped in a state in which the driven gear 16 is rotating (after the engine 30 is started).

[0046] Further, according to the present embodiment, when starting the engine 30, even when the driven gear 16 is rotating, it is possible to first rotate the guide gear 18 to engage with the driven gear 16 due to release of the ratchet mechanism 20 and then make the driving gear 14 engage with the driven gear 16. Accordingly, even when the driven gear 16 is rotating, the driving gear 14 can be easily engaged with the driven gear 16. Also, as the guide side tapered surface 18b is formed on the tooth surface of the guide gear 18 on the back side in the rotation direction and the driven side tapered surface 16b is formed on the tooth surface of the driven gear 16 on the forward side in the rotation direction, when engaging

the guide gear 18 with the driven gear 16 while the driven gear 16 is rotating, the teeth 18a of the guide gear 18 are fitted between the teeth 16a of the driven gear 16 while the guide side tapered surface 18b of the guide gear 18 is sliding on the driven side tapered surface 16b of the driven gear 16. Accordingly, even when the driven gear 16 is rotating, it is possible to easily make the guide gear 18 engage with the driven gear 16.

Embodiment 2

[0047] FIG. 9 is a view illustrating an engine starter including a gear fitting and disengaging device according to Embodiment 2 of the present invention. In the description of Embodiment 2 below, the same elements as those of Embodiment 1 or corresponding elements will be denoted by the same reference numerals and the elements of Embodiment 1 which have not been described in detail will not be similarly described in detail in Embodiment 2.

[0048] In the present embodiment, a spline 34 having teeth and grooves extending in (or substantially along) the axial direction formed thereon is provided on the outer circumferential portion of the driving gear 14 (at a position toward the other side in the axial direction with respect to the teeth 14a), and a spline 35 having teeth and grooves extending in (or substantially along) the axial direction formed thereon is provided on the inner circumferential portion of the housing 15 which is prevented from rotating. When the driving gear 14 is at the disengagement position, the teeth of the spline 34 fit in the grooves of the spline 35 (the teeth of the spline 35 fit in the grooves of the spline 34), so that the rotation of the driving gear 14 with respect to the housing 15 is restrained. However, as the teeth of the spline 34 are movable in the axial direction along the grooves of the spline 35 (as the teeth of the spline 35 are movable in the axial direction along the grooves of the spline 34), the movement of the driving gear 14 with respect to the housing 15 in the axial direction is allowed. As described above, when the driving gear 14 is at the disengagement position, due to the engagement of the splines 34 and 35, the movement of the driving gear 14 with respect to the housing 15 in the axial direction is allowed and simultaneously the rotation of the driving gear 14 with respect to the housing 15 is restrained. Here, due to the key engagement of the driving gear 14 and the housing 15 in place of the spline engagement described above, it is similarly possible to restrain the rotation of the driving gear 14 with respect to the housing 15 while allowing the movement of the driving gear 14 with respect to the housing 15 in the axial direction when the driving gear 14 is at the disengagement position. Further, the splines 34 and 35 may be helical splines. In this case, it is similarly possible to restrict the rotation of the driving gear 14 with respect to the housing 15 such that the rotation speed of the driving gear 14 in the predetermined direction is lower than the rotation speed of the rotation shaft 12 in the predetermined direction, while allowing the movement of

the driving gear 14 with respect to the housing 15 in the axial direction.

[0049] In the present embodiment, as in Embodiment 1, before the engine 30 is started, the rotation of the drive source 10 (the rotation shaft 12) is stopped, the rotations of the driving gear 14 and the guide gear 18 are also stopped, and the driving gear 14 is at the disengagement position. When the engine 30 is started in this state, the drive source 10 is caused to generate power to rotate the rotation shaft 12 in the predetermined direction (i.e., in the example illustrated in FIG. 9, in the counterclockwise direction when the rotation shaft 12 is viewed from the drive source 10 side (from the right side in the figure)). As the rotation of the driving gear 14 with respect to the housing 15 is restrained or restricted due to the engagement of the splines 34 and 35, the rotation shaft 12 relatively rotates with respect to the driving gear 14 in the predetermined direction, and the driving gear 14, along with the guide gear 18, moves toward the one side in the axial direction (i.e., toward the driven gear 16 side). Thus, in the present embodiment, when the driving gear 14 is at the disengagement position and the rotation shaft 12 rotates in the predetermined direction, the rotation restraint force due to the engagement of the splines 34 and 35 is applied, as the resistance force, to the driving gear 14 from the housing 15 which is prevented from rotating to thereby load the driving gear 14, so that the rotation of the driving gear 14 in the predetermined direction can be restrained or restricted. It is therefore possible to apply the force for moving the driving gear 14 toward the one side in the axial direction to the driving gear 14 from the housing 15, to thereby start the moving of the driving gear 14 toward the one side in the axial direction (toward the driven gear 16 side).

[0050] When the driving gear 14 moves toward the one side in the axial direction from the disengagement position, the guide gear 18 engages with the driven gear 16 as illustrated in FIG. 10. At this time, from when the driving gear 14 is at the disengagement position until the guide gear 18 engages with the driven gear 16, the rotation restraint force due to the engagement of the splines 34 and 35 continues to be applied, as the resistance force (i.e., the force for allowing the movement toward the one side in the axial direction), to the driving gear 14, while allowing the movement of the driving gear 14 with respect to the housing 15 in the axial direction. After the guide gear 18 engages with the driven gear 16, the engagement of the splines 34 and 35 is released (i.e., the rotation restraint force is no longer applied to the driving gear 14) to thereby allow the rotation of the driving gear 14, and the rotation elements on the driven gear 16 side including the rotation elements of the engine 30 become a load to the driving gear 14. The subsequent operations are similar to those in Embodiment 1. As illustrated in FIG. 9, in the state in which the driving gear 14 returns to the disengagement position after the engine 30 is started, the rotation of the drive source 10 (the rotation shaft 12) is stopped, the rotations of the driving gear 14 and the guide

gear 18 are also stopped, neither the driving gear 14 nor the guide gear 18 engage with the driven gear 16, and the spline 34 of the driving gear 14 engages with the spline 35 of the housing 15.

[0051] In the present embodiment described above, as in Embodiment 1, both the fitting and disengaging operation and the rotation operation of the driving gear 14 can be achieved by rotation driving of the drive source 10. Further, when starting the engine 30, even when the driven gear 16 is rotating, the guide gear 18 can be easily engaged with the driven gear 16 and the driving gear 14 can be easily engaged with the driven gear 16. Also, after the engine 30 is started, the rotation of the drive source 10 (the rotation shaft 12) is stopped in a state in which the engine 30 (the driven gear 16) is rotating. At this time, as neither the driving gear 14 nor the guide gear 18 engages with the driven gear 16 and therefore the rotations of the driving gear 14 and the guide gear 18 are stopped, mechanical losses such as dragging losses caused by sliding and noises do not occur between the driving gear 14 and the housing 15, between the driving gear 14 and the guide gear 18, and so on. Accordingly, it is possible to reduce the mechanical losses and noises that occur when the drive source 10 is stopped in a state in which the driven gear 16 is rotating (after the engine 30 is started).

Embodiment 3

[0052] FIG. 11 is a view illustrating an engine starter including a gear fitting and disengaging device according to Embodiment 3 of the present invention. In the description of Embodiment 3 below, the same elements as those of Embodiments 1 and 2 or corresponding elements will be denoted by the same reference numerals and the elements of Embodiments 1 and 2 which have not been described in detail will not be similarly described in detail in Embodiment 3.

[0053] In the present embodiment, the guide gear 18 and the ratchet mechanism 20 are omitted. Further, a friction surface 14c is formed on the outer circumferential portion of the driving gear 14 (at a position towards the other side with respect to the teeth 14a in the axial direction), and a friction material 36 is attached to the housing 15 via a pressing spring 38. When the driving gear 14 is at the disengagement position, the friction material 36 presses the friction surface 14c of the driving gear 14 toward the inner side in the radial direction by an urging force of the pressing spring 38, so that a friction force is applied to the friction surface 14c of the driving gear 14 from the friction material 36 which is prevented from rotating. Here, it is also possible to apply a friction force from the friction material 36 to the friction surface 14c of the driving gear 14 by means of a hydraulic force or an electromagnetic force in place of the urging force of the pressing spring 38, and the magnitude of the friction force applied to the friction surface 14c of the driving gear 14 from the friction material 36 can be adjusted by the urging

force of the pressing spring 38 (or the hydraulic force or electromagnetic force).

[0054] In the present embodiment, as in Embodiments 1 and 2, before the engine 30 is started, the rotations of the drive source 10 (the rotation shaft 12) and the driving gear 14 are stopped, and the driving gear 14 is at the disengaged position. When the engine 30 is started in this state, the drive source 10 is caused to generate power to rotate the rotation shaft 12 in the predetermined direction (i.e., in the example illustrated in FIG. 11, in the counterclockwise direction when the rotation shaft 12 is viewed from the drive source 10 side (from the right side in the figure)). While the driving gear 14 attempts to rotate in the predetermined direction with the rotation shaft 12, as the friction force is applied to the friction surface 14c of the driving gear 14 from the friction material 36 which is prevented from rotating, the rotation shaft 12 rotates relatively with respect to the driving gear 14 in the predetermined direction, and the driving gear 14 moves towards the one side (toward the driven gear 16 side) in the axial direction. At this time, it is possible to adjust the magnitude of the friction force to be applied to the friction surface 14c of the driving gear 14 from the friction material 36 so as to restrain the rotation of the driving gear 14, or it is possible to adjust the magnitude of the friction force to be applied to the friction surface 14c of the driving gear 14 from the friction material 36 such that the driving gear 14 rotates in the predetermined direction at a rotation speed which is lower than the rotation speed of the rotation shaft 12. Thus, according to the present embodiment, when the driving gear 14 is at the disengagement position and the rotation shaft 12 rotates in the predetermined direction, by applying the friction force to the driving gear 14, as the resistance force, from the friction material 36 which is prevented from rotating to load the driving gear 14, it is possible to restrain or reduce the rotation of the driving gear 14 in the predetermined direction. In this manner, it is possible to apply the force for moving the driving gear 14 toward the one side in the axial direction to the driving gear 14 from the friction material 36, so that the movement of the driving gear 14 toward the one side in the axial direction (toward the driven gear 16 side) can be started.

[0055] When the driving gear 14 moves toward the one side in the axial direction from the disengagement position, the driving gear 14 engages with the driven gear 16 as illustrated in FIG. 12. At this time, from when the driving gear 14 is at the disengagement position until the driving gear 14 engages with the driven gear 16, the friction force continues to be applied, as the resistance force (i.e., the force for allowing the movement toward the one side in the axial direction), from the friction material 36 to the driving gear 14. After the driving gear 14 engages with the driven gear 16, the friction material 36 is no longer in contact with the friction surface 14c of the driving gear 14 (i.e., the friction force from the friction material 36 is no longer applied to the driving gear 14) to thereby allow the rotation of the driving gear 14, and the rotation ele-

ments on the driven gear 16 side including the rotation elements of the engine 30 become a load to the driving gear 14. The subsequent operations are similar to those in Embodiment 1. As illustrated in FIG. 11, in the state in which the driving gear 14 returns to the disengagement position after the engine 30 is started, the rotation of the drive source 10 (the rotation shaft 12) is stopped, the rotation of the driving gear 14 is also stopped, the driving gear 14 does not engage with the driven gear 16, and the friction surface 14c of the driving gear 14 is in contact with the friction material 36.

[0056] In the present embodiment described above, as in Embodiments 1 and 2, both the fitting and disengaging operation and the rotation operation of the driving gear 14 can be achieved by rotation driving of the drive source 10. Further, when starting the engine 30, by adjusting the magnitude of the friction force to be applied from the friction material 36 to the driving gear 14 such that the driving gear 14 rotates in the predetermined direction at a rotation speed which is lower than the rotation speed of the rotation shaft 12, even when the driven gear 16 is rotating, the driving gear 14 can be easily engaged with the driven gear 16. Also, after the engine 30 is started, the rotation of the drive source 10 (the rotation shaft 12) is stopped in a state in which the engine 30 (the driven gear 16) is rotating. At this time, as the driving gear 14 does not engage with the driven gear 16 and the rotation of the driving gear 14 is stopped, mechanical losses such as dragging losses caused by sliding and noises do not occur between the driving gear 14 and the friction material 36, and so on. Accordingly, it is possible to reduce the mechanical losses and noises that would occur when the drive source 10 is stopped in a state in which the driven gear 16 is rotating (after the engine 30 is started).

Embodiment 4

[0057] FIGs. 13 and 14 are views illustrating an engine starter including a gear fitting and disengaging device according to Embodiment 4 of the present invention. In the description of Embodiment 4 below, the same elements as those of Embodiments 1 to 3 or corresponding elements will be denoted by the same reference numerals and the elements of Embodiments 1 to 3 which have not been described in detail will not be similarly described in detail in Embodiment 4.

[0058] In the present embodiment, when compared to Embodiment 1, a spline 54 having teeth and grooves extending in (or substantially along) the axial direction formed thereon is provided on the outer circumferential portion of the rotation shaft 12, and a spline 55 having teeth and grooves extending in (or substantially along) the axial direction formed thereon is provided on the inner circumferential portion of the through hole of the driving gear 14. The teeth of the spline 54 fit in the grooves of the spline 55 (the teeth of the spline 55 fit in the grooves of the spline 54), so that the relative rotation of the driving gear 14 with respect to the rotation shaft 12 is restrained

(or restricted) and simultaneously the relative movement of the driving gear 14 with respect to the rotation shaft 12 in the axial direction is allowed. Thus, the driving gear 14 engages with the rotation shaft 12 in a state in which the driving gear 14 can move in the axial direction of the rotation shaft 12.

[0059] The driving gear 14 is a helical gear having teeth 14a which are inclined toward the back side in the rotation direction (toward the back side in the predetermined direction) with respect to the axial direction from the one side to the other side thereof. Similarly, the guide gear 18 is also a helical gear having teeth 18a which are inclined toward the back side in the rotation direction (toward the back side in the predetermined direction) with respect to the axial direction from the one side to the other side thereof. Further, the driven gear 16 is also a helical gear having teeth 16 which are inclined toward the back side in the rotation direction (toward the back side in the engine rotation direction) with respect to the axial direction from the one side to the other side thereof. The driving gear 14, the guide gear 18, and the driven gear 16 have the same helix angle. In the example illustrated in FIGs. 13 and 14, the teeth 14a of the driving gear 14 and the teeth 18a of the guide gear 18 are left-hand, and the teeth 16a of the driven gear 16 are right-hand. When the ratchet mechanism 20 is in an engaged (locked) state, the relative rotation of the guide gear 18 with respect to the driving gear 14 in the direction opposite the predetermined direction is restrained in a state in which the teeth 14a of the driving gear 14 and the teeth 18a of the guide gear 18 can simultaneously engage with the teeth 16a of the driven gear 16.

[0060] In the present embodiment, as in Embodiments 1 to 3, before the engine 30 is started, the rotation of the drive source 10 (the rotation shaft 12) is stopped, the rotations of the driving gear 14 and the guide gear 18 are also stopped, and the driving gear 14 is at the disengaged position. When starting the engine 30 in this state, the drive source 10 is caused to generate power to rotate the rotation shaft 12 in the predetermined direction (i.e., in the example illustrated in FIG. 13, in the counterclockwise direction when the rotation shaft 12 is viewed from the drive source 10 side (from the right side in the figure)). When the driving gear 14, along with the rotation shaft 12, relatively rotates with respect to the cam plate 32 in the predetermined direction and a phase difference is caused between the cam plate 32 and the driving gear 14, a pressing force toward the one side in the axial direction is applied from the cam plate 32 to the driving gear 14. Thus, it is possible to apply the force for moving the driving gear 14 toward the one side in the axial direction to the driving gear 14 from the cam plate 32, so that the driving gear 14 and the guide gear 18 can move toward the one side in the axial direction. The cam plate 32 continues to apply to the driving gear 14 the pressing force (the force for moving toward the one side in the axial direction), from when the driving gear 14 is at the disengagement position until the guide gear 18 engages

with the driven gear 16.

[0061] After the guide gear 18 and the driven gear 16 engage with each other, the ratchet mechanism 20 is placed in an engaged state. Further, as illustrated in FIG. 15, the reaction force F1 applied to the teeth 18a of the guide gear 18 from the teeth 16a of the driven gear 16 includes a component F2 toward the one side in the axial direction. Accordingly, after the guide gear 18 and the driven gear 16 engage with each other, although the pressing force is not applied to the driving gear 14 from the cam plate 32, the driving gear 14 and the guide gear 18 continue to move toward the one side in the axial direction due to the component F2 toward the one side in the axial direction which is applied to the teeth 18a of the guide gear 18. At this time, the urging force of the urging spring 28 is set such that the driving gear 14 and the guide gear 18 can move toward the one side in the axial direction. When the driving gear 14 and the guide gear 18 further move toward the one side in the axial direction, both the guide gear 18 and the driving gear 14 engage with the driven gear 16. After the driving gear 14 and the driven gear 16 engage with each other, the reaction force applied from the teeth 16a of the driven gear 16 to the teeth 14a of the driving gear 14 also includes a component toward the one side in the axial direction. This component toward the one side in the axial direction also acts as the force for moving the driving gear 14 and the guide gear 18 toward the one side in the axial direction.

[0062] When the driving gear 14 and the guide gear 18 continue to further move toward the one side in the axial direction, of the driving gear 14 and the guide gear 18, the guide gear 18 does not engage with the driven gear 16 and only the driving gear 14 engages with the driven gear 16. Then, when the driving gear 14 moves to the predetermined engagement position, one end portion of the driving gear 14 (or the guide gear 18) in the axial direction comes into contact with the stopper 26 to thereby restrain and stop the movement of the driving gear 14 and the guide gear 18 toward the one side in the axial direction. With the above operation, the power of the drive source 10 is transmitted to the output shaft of the engine 30 via the driving gear 14 and the driven gear 16, so that the engine 30 is cranked.

[0063] After the engine 30 is started, in a state in which the engine 30 (the driven gear 16) is rotating, generation of the power by the drive source 10 is stopped. In this state, as illustrated in FIG. 16, a force F3 applied to the teeth 14a of the driving gear 14 from the teeth 16a of the driven gear 16 includes a component F4 toward the other side in the axial direction. With this component F4 toward the other side in the axial direction, the driving gear 14, along with the guide gear 18, moves toward the other side in the axial direction to the disengagement position. Further, a restoring force for returning the driving gear 14 to the disengagement position can also be applied by the urging force of the urging spring 28 toward the other side in the axial direction. Also, when the driving gear 14

and the guide gear 18 move toward the other side in the axial direction and the guide gear 18 and the driven gear 16 engage with each other, the force applied from the teeth 16a of the driven gear 16 also includes a component toward the other side in the axial direction. This component toward the other side in the axial direction also acts as the force for moving the driving gear 14 and the guide gear 18 toward the other side in the axial direction. As illustrated in FIG. 13, in a state in which the driving gear 14 has moved to the disengagement position, the rotation of the drive source 10 (the rotation shaft 12) is stopped, the rotations of the driving gear 14 and the guide gear 18 are stopped, neither the driving gear 14 nor the guide gear 18 engages with the driven gear 16, and the cam surface 14b of the driving gear 14 is in contact with the cam surface 32b of the cam plate 32.

[0064] According to the present embodiment described above, as in Embodiments 1 to 4, when the drive source 10 is stopped in a state in which the driven gear 16 is rotating (after the engine 30 is started), as the mechanical losses such as dragging losses caused by sliding and noises do not occur between the driving gear 14 and the cam plate 32 and between the driving gear 14 and the guide gear 18, it is possible to reduce the mechanical losses and noises. Further, according to the present embodiment, the components in the axial direction included in the reaction force caused by the engagement of the helical gears are used to move the driving gear 14 and the guide gear 18 in the axial direction.

Embodiment 5

[0065] FIG. 17 is a view illustrating an engine starter including a gear fitting and disengaging device according to Embodiment 5 of the present invention. In the description of Embodiment 5 below, the same elements as those of Embodiments 1 to 4 or corresponding elements will be denoted by the same reference numerals and the elements of Embodiments 1 to 4 which have not been described in detail will not be similarly described in detail in Embodiment 5.

[0066] In the present embodiment, when compared to Embodiment 1, a buffer spring (compression spring) 48 serving as a buffer member is provided between a back surface of the cam plate 32 (i.e., the end surface toward the other side in the axial direction; that is, a surface of the cam plate 32 opposite the cam surface 32b) and the housing 15, and the cam plate 32 is supported by the housing 15 via the buffer spring 48. The buffer spring 48 has an elasticity concerning the axial direction thereof, and the rotational displacement (phase difference) of the cam plate 32 with respect to the housing 15 is restrained. When a force of a predetermined value or greater toward the other side in the axial direction acts on the cam plate 32, the buffer spring 48 is compressed in the axial direction, so that the displacement of the cam plate 32 with respect to the housing 15 toward the other side in the axial direction is allowed. However, the coefficient of

elasticity of the buffer spring 48 in the axial direction (i.e., a predetermined value of the force for displacing the cam plate 32) is set to a sufficiently great value such that the displacement of the cam plate 32 toward the other side in the axial direction (i.e., compression of the buffer spring 48) can be suppressed, when moving the driving gear 14 and the guide gear 18 toward the one side in the axial direction by applying the pressing force toward the one side in the axial direction to the driving gear 14 from the cam plate 32 in accordance with generation of the phase difference between the cam plate 32 and the driving gear 14.

[0067] In a case in which an attempted is made to apply the pressing force toward the one side in the axial direction from the cam plate 32 to the driving gear 14 to thereby cause the driving gear 14 and the guide gear 18 to move toward the one side in the axial direction and thereby mesh with the driven gear 16, when the end surface of the guide 18 (the teeth 18a) toward the one side in the axial direction collides with the end surface of the driven gear 16 (the teeth 16a) toward the other side in the axial direction, a great reaction force toward the other side in the axial direction is applied to the driving gear 14, which reaction force acts from the driving gear 14 to the cam plate 32. In this state, if the cam plate 32 pushes the driving gear 14 toward the one side in the axial direction, the driving gear 14 is locked and prevented from moving in the axial direction and from rotating. According to the present embodiment, on the other hand, when the reaction force of the predetermined value or greater against the pressing force is applied from the driving gear 14 to the cam plate 32, the buffer spring 48 is compressed to thereby allow the displacement of the cam plate 32 toward the other side in the axial direction, so that the reaction force can be lessened. Accordingly, even if the end surfaces of the guide gear 18 and the driven gear 16 collide with each other to generate a great reaction force, the reaction force acting on the driving gear 14 and the cam plate 32 can be reduced to thereby prevent the driving gear 14 from being locked. Here, in a case in which the guide gear 18 and the ratchet mechanism 20 are omitted, it is similarly possible to reduce the reaction force acting on the driving gear 14 and the cam plate 32 when the end surfaces of the driving gear 14 and the driven gear 16 collide with each other when engaging the driving gear 14 and the driven gear 16 with each other, to thereby prevent the driving gear 14 from being locked. Further, while, in the above description, an example in which the structure of the present embodiment is applied to Embodiment 1 has been described, it is also possible to apply the structure of the present embodiment to Embodiment 4.

Embodiment 6

[0068] FIG. 18 is a view illustrating an engine starter including a gear fitting and disengaging device according to Embodiment 6 of the present invention. In the descrip-

tion of Embodiment 6 below, the same elements as those of Embodiments 1 to 5 or corresponding elements will be denoted by the same reference numerals and the elements of Embodiments 1 to 5 which have not been described in detail will not be similarly described in detail in Embodiment 6.

[0069] In the present embodiment, when compared to Embodiment 2, the tooth surface 34a of the spline 34 provided on the outer circumferential portion of the driving gear 14 (at a position toward the other side in the axial direction with respect to the tooth 14a) is a tapered surface which is inclined toward the back side in the rotation direction (the back side in the predetermined direction) from the inner side toward the outer side with respect to the radial direction of the driving gear 14. Further, the spline 35 is supported by the housing 15 via a buffer spring (compression spring) 58 serving as a buffer member. The tooth surface 35a of the spline 35 is also a tapered surface which is inclined toward the back side in the rotation direction (the back side in the predetermined direction) from the inner side toward the outer side with respect to the radial direction of the driving gear 14. The tooth surface 34a of the spline 34 and the tooth surface 35a of the spline 35 are parallel to each other and the tooth surface 34a and the tooth surface 35a come into contact with each other. The buffer spring 58 has an elasticity concerning the radial direction of the driving gear 14, and the rotational displacement (a phase difference) of the spline 35 with respect to the housing 15 is restrained. When the rotation force of the predetermined value or greater toward the forward side in the rotation direction is applied from the driving gear 14 (spline 34) to the spline 35 (housing 15) due to the contact of the tooth surfaces 34a and 35a, as illustrated in FIG. 19, because the force F5 applied by the tooth surface 34a to push the tooth surface 35a includes a component F6 toward the outer side in the radial direction, the buffer spring 58 is compressed in the radial direction of the driving gear 14, so that the rotational displacement (phase difference) of the driving gear 14 (spline 34) with respect to the spline 35 (housing 15) toward the forward side in the rotation direction is allowed. However, the coefficient of elasticity of the buffer spring 58 concerning the radial direction of the driving gear 14 (the predetermined value of the rotation force for rotation-displacing the driving gear 14) is set to a sufficiently great value such that rotational displacement of the driving gear 14 (the compression of the buffer spring 58) toward the forward side in the rotation direction (the forward side in the predetermined direction) can be suppressed, when allowing the driving gear 14 and the guide gear 18 to move toward the one side in the axial direction by applying a rotation restraint force due to the engagement of the splines 34 and 35 from the housing 15 to the driving gear 14 in accordance with the rotation of the rotation shaft 12 in the predetermined direction.

[0070] According to the present embodiment described above, when the reaction force of the predeter-

mined value or greater against the rotation restraint force (the resisting force) is applied from the driving gear 14 to the spline 35, the buffer spring 48 is compressed to thereby allow the rotational displacement (phase difference) of the driving gear 14 with respect to the spline 35, so that the reaction force can be lessened. Accordingly, even if the end surfaces of the guide gear 18 and the driven gear 16 collide with each other to generate a great reaction force by allowing the driving gear 14 and the guide gear 18 to move toward the one side in the axial direction and make the driving gear 14 and the guide gear 18 engage with the driven gear 16, the reaction force acting on the driving gear 14 and the spline 35 can be reduced to thereby prevent the driving gear 14 from being locked. Here, in a case in which the guide gear 18 and the ratchet mechanism 20 are omitted, it is similarly possible to reduce the reaction force acting on the driving gear 14 and the spline 35 even if the end surfaces of the driving gear 14 and the driven gear 16 collide with each other when engaging the driving gear 14 and the driven gear 16 with each other, to thereby prevent the driving gear 14 from being locked.

Embodiment 7

[0071] FIG. 20 is a view schematically illustrating an engine starter including a gear fitting and disengaging device according to Embodiment 7 of the present invention. In the description of Embodiment 7 below, the same elements as those of Embodiments 1 to 6 or corresponding elements will be denoted by the same reference numerals and the elements of Embodiments 1 to 6 which have not been described in detail will not be similarly described in detail in Embodiment 7.

[0072] In the present embodiment, when compared to Embodiment 1, a through hole which allows the rotation shaft 12 to pass through is formed in the center portion of an intermediate member 19, and a thread (internal thread) 24 is formed on the inner circumferential surface of the through hole. The rotation shaft 12 is passed through the through hole of the intermediate member 19, and with the thread engagement between the external thread 22 formed on the rotation shaft 12 and the internal thread 24 formed on the intermediate member 19, the intermediate member 19 engages with the rotation shaft 12 in a state in which the intermediate member 19 is movable in the axial direction of the rotation shaft 12. FIG. 20 illustrates an example in which the threads 22 and 24 are right-hand threads. However, the structure for allowing the intermediate member 19 to move in the axial direction with respect to the rotation shaft 12 is not limited to the thread engagement between the rotation shaft 12 and the intermediate member 19. For example, the intermediate member 19 may be supported by the rotation shaft 12 by helical spline engagement between the rotation shaft 12 and the intermediate member 19, or the intermediate member 19 may be supported by the rotation shaft 12 via a ball thread mechanism.

[0073] A spline 44 having teeth and grooves extending in (or substantially along) the axial direction formed thereon is provided on the outer circumferential portion of the intermediate member 19, and a spline 45 having teeth and grooves extending in (or substantially along) the axial direction formed thereon is provided on the inner circumferential portion of the through hole of the driving gear 14. The teeth of the spline 44 fit in the grooves of the spline 45 (the teeth of the spline 45 fit in the grooves of the spline 44), so that the relative displacement of the driving gear 14 in the axial direction with respect to the intermediate member 19 is allowed and the relative rotation of the driving gear 14 with respect to the intermediate member 19 is restrained. The driving gear 14 engages with the rotation shaft 12 via the intermediate member 19 in a state in which the driving gear 14 is movable along the axial direction of the rotation shaft 12. Here, due to the key engagement of the driving gear 14 and the intermediate member 19 in place of the spline engagement described above, it is similarly possible to restrain the relative rotation of the driving gear 14 with respect to the intermediate member 19 while allowing the relative displacement of the driving gear 14 with respect to the intermediate member 19 in the axial direction. Further, the splines 44 and 45 may be helical splines.

[0074] A buffer spring (compression spring) 68 serving as a buffer member is provided in a gap formed in the axial direction between the driving gear 14 and the intermediate member 19 toward the other side in the axial direction with respect to the driving gear 14. The buffer spring 68 has an elasticity concerning the axial direction, and concerning the axial direction, the driving gear 14 is supported by the intermediate member 19 via the buffer spring 68. A stopper 46 is provided on the intermediate member 19 toward the one side in the axial direction with respect to the driving gear 14, and with the driving gear 14 in contact with the stopper 46, the relative displacement of the driving gear 14 with respect to the intermediate member 19 toward the one side in the axial direction is restrained. The urging spring 28 applies an urging force toward the other side in the axial direction to the driving gear 14 and the guide gear 18 via the intermediate member 19. When a force of the predetermined value or greater toward the other side in the axial direction is applied to the driving gear 14, the buffer spring 68 is compressed in the axial direction, thereby allowing the relative displacement of the driving gear 14 and the guide gear 18 with respect to the intermediate member 19 toward the other side in the axial direction.

[0075] A surface (an end surface toward the other side in the axial direction) of the intermediate member 19 opposite the cam plate 32 (cam surface 32b) is formed into a cam surface 19b. When the driving gear 14 is at the disengagement position in the axial direction, the cam surface 19b of the intermediate member 19 is in contact with the cam surface 32b of the cam plate 32. In a case in which the driving gear 14 is at the disengagement position in the axial direction, when, in accordance with the

rotation of the rotation shaft 12 in the predetermined direction, the intermediate member 19 and the driving gear 14 relatively rotate with respect to the cam plate 32 to generate a phase difference between the cam plate 32, and the intermediate member 19 and the driving gear 14, the cam surface 32b of the cam plate 32 pushes the cam surface 19b of the intermediate member 19 toward the one side in the axial direction. Consequently, the pressing force toward the one side in the axial direction is applied from the cam plate 32 to the driving gear 14 via the intermediate member 19, so that the relative rotation of the intermediate member 19 and the driving gear 14 with respect to the cam plate 32 in the predetermined direction is restrained. As such, it is possible to apply the force for moving the driving gear 14 toward the one side in the axial direction from the cam plate 32 to the driving gear 14 via the intermediate member 19, so that the intermediate member 19, the driving gear 14, and the guide gear 18 move toward the one side in the axial direction. At this time, the coefficient of elasticity of the buffer spring 68 in the axial direction (the predetermined value of the force for allowing the relative displacement of the driving gear 14 with respect to the intermediate member 19) is set to a sufficiently large value such that the relative displacement of the driving gear 14 and the guide gear 18 with respect to the intermediate member 19 toward the other side in the axial direction (the compression of the buffer spring 68) can be suppressed.

[0076] In the present embodiment described above, when the reaction force of the predetermined value or greater against the pressing force is applied to the driving gear 14, the buffer spring 68 is compressed to allow the relative displacement of the driving gear 14 with respect to the intermediate member 19 toward the other side in the axial direction, thereby reducing the reaction force. Accordingly, even if the end surfaces of the guide gear 18 and the driven gear 16 collide with each other to generate a great reaction force when moving the driving gear 14 and the guide gear 18 toward the one side in the axial direction to make the driving gear 14 and the guide gear 18 engage with the driven gear 16, it is possible to reduce the reaction force acting on the driving gear 14 so that the driving gear 14 can be prevented from being locked. Here, in a case in which the guide gear 18 and the ratchet mechanism 20 are omitted, it is similarly possible to reduce the reaction force acting on the driving gear 14 even when the end surfaces of the driving gear 14 and the driven gear 16 collide with each other when engaging the driving gear 14 and the driven gear 16 with each other, to thereby prevent the driving gear 14 from being locked.

[0077] While in the above description, an example in which the structure of the present embodiment is applied to Embodiment 1 has been described, it is also possible to apply the structure of the present embodiment to Embodiments 2 to 4. When the structure of the present embodiment is applied to Embodiment 2, the spline 34 is provided on the intermediate member 19, and when the

driving gear 14 is at the disengagement position, due to the engagement of the splines 34 and 35, the rotation of the intermediate member 19 with respect to the housing 15 is restrained or restricted, while the movement of the intermediate member 19 with respect to the housing 15 in the axial direction is allowed. Further, when the structure of the present embodiment is applied to Embodiment 3, when the driving gear 14 is at the disengagement position, the friction force is applied from the friction material 36 to the friction surface of the intermediate member 19.

Embodiment 8

[0078] FIG. 21 is a view schematically illustrating an engine starter including a gear fitting and disengaging device according to Embodiment 8 of the present invention. In the description of Embodiment 8 below, the same elements as those of Embodiments 1 to 7 or corresponding elements will be denoted by the same reference numerals and the elements of Embodiments 1 to 7 which have not been described in detail will not be similarly described in detail in Embodiment 8.

[0079] In the present embodiment, when compared to Embodiment 3, the urging spring 28 is disposed toward the other side in the axial direction with respect to the driving gear 14 and is a tension spring which is pulled to apply the urging force toward the other side in the axial direction to the driving gear 14. With this example structure, in which the urging spring (tension spring) 28 is provided toward the other side in the axial direction with respect to the driving gear 14, it is possible to reduce the distance between the driving gear 14 (the disengagement position) and the bearing 13 in the axial direction, so that the size of the device can be reduced. While in the above description, the example in which the structure of the present embodiment is applied to Embodiment 3 has been described, it is also possible to apply the structure of the present embodiment to Embodiments 1, 2, and 4 to 7.

Embodiment 9

[0080] FIG. 22 is a view schematically illustrating an engine starter including a gear fitting and disengaging device according to Embodiment 9 of the present invention. In the description of Embodiment 9 below, the same elements as those of Embodiments 1 to 8 or corresponding elements will be denoted by the same reference numerals and the elements of Embodiments 1 to 8 which have not been described in detail will not be similarly described in detail in Embodiment 9.

[0081] In the present embodiment, when compared to Embodiment 3, a buffer member 29 for reducing the force in the axial direction is provided on the end surface of the stopper 26 toward the other side in the axial direction. The buffer member 29 in this example can be formed from, for example, rubber, a compression spring, and so on. When the buffer member 29 is formed by a compres-

sion spring, the coefficient of elasticity of the buffer member (compression spring) 29 in the axial direction is set to be greater than the coefficient of elasticity of the urging spring 28 in the axial direction, and the stroke of the buffer member (compression spring) 29 in the axial direction is set to be shorter than the stroke of the urging spring 28 in the axial direction.

[0082] When the driving gear 14 engages with the driven gear 16 and the movement of the driving gear 14 toward the one side in the axial direction is restrained by the stopper 26 at the predetermined engagement position, as the driving gear 14 collides with the stopper 26, it is likely that the driving gear 14 returns towards the other side in the axial direction and collision noise is generated. According to the present embodiment, however, when the movement of the driving gear 14 toward the one side in the axial direction is restrained by the stopper 26 at the predetermined engagement position, the collision of the driving gear 14 with the stopper 26 is mitigated by the buffer member 29, so that the reaction force toward the other side in the axial direction acting on the driving gear 14 can be reduced by the buffer member 29. It is therefore possible to suppress return of the driving gear 14 toward the other side in the axial direction and generation of the collision noise. Here, the buffer member 29 may be provided on the end surface of the stopper 26 toward the one side in the axial direction (i.e., between the stopper 26 and the bearing 13), and in this case, it is also possible to reduce the reaction force toward the other side in the axial direction acting on the driving gear 14 by the buffer member 29 when the movement of the driving gear 14 toward the one side in the axial direction is restrained by the stopper 26 at the predetermined engagement position. Further, while in the above description, the example in which the structure of the present embodiment is applied to Embodiment 3 has been described, it is also possible to apply the structure of the present embodiment to Embodiments 1, 2, and 4 to 8.

[0083] In each of Embodiments described above, it is possible to omit the urging spring 28. However, provision of the urging spring 28 enables the driving gear 14 to return to the disengagement position more reliably when the drive source 10 is stopped in a state in which the driven gear 16 is rotating (after the engine 30 is started).

[0084] Further, the subject to which the gear fitting and disengaging devices according to the present embodiments are applied is not limited to an engine starter, and the gear fitting and disengaging devices according to the present embodiments can be also applied to mechanisms which require the gear fitting and disengaging operation during rotation, such as a synchromesh for a manual transmission.

[0085] While the embodiments for carrying out the present invention have been described, the present invention is not limited to such embodiments, and can be naturally carried out in various modes within the scope of the present invention.

REFERENCE SYMBOLS LIST

[0086] 10 drive source, 12 rotation shaft, 13 bearing, 14 driving gear, 14a, 16a, 18a tooth, 14b, 19b, 32b cam surface, 14c friction surface, 15 housing, 16 driven gear, 16b driven side tapered surface, 18 guide gear, 18b guide side tapered surface, 19 intermediate member, 20 ratchet mechanism, 22, 24 thread, 26, 46 stopper, 28 urging spring, 29 buffer member, 30 engine, 32 cam plate, 34, 35, 44, 45, 54, 55 spline, 36 friction material, 38 pressing spring, 48, 58, 69 buffer spring.

Claims

1. A gear fitting and disengaging device comprising:
 - a rotation shaft which rotates in a predetermined direction by receiving power transmitted from a drive source;
 - a driving gear which engages with the rotation shaft in a state in which the driving gear is movable in an axial direction of the rotation shaft;
 - a driven gear which engages with the driving gear when the driving gear is at a predetermined engagement position in the axial direction;
 - a restraint device for restraining a movement of the driving gear from the predetermined engagement position toward one side in the axial direction; and
 - a moving force generating mechanism which, when the driving gear is at a disengagement position toward the other side in the axial direction with respect to the predetermined engagement position and the rotation shaft rotates in the predetermined direction, causes a force for moving the driving gear toward the one side in the axial direction to be applied to the driving gear from a fixed member which is prevented from rotating.
2. The gear fitting and disengaging device according to Claim 1, wherein
 - the driving gear moves toward the one side in the axial direction in accordance with relative rotation of the rotation shaft with respect to the driving gear in the predetermined direction, and
 - the moving force generating mechanism is a mechanism that, when the driving gear is at the disengagement position and the rotation shaft rotates in the predetermined direction, causes a resistance force to be applied from the fixed member to the driving gear such that the rotation of the driving gear in the predetermined direction is restrained or a rotation speed of the driving gear is lower than a rotation speed of the rotation shaft.
3. The gear fitting and disengaging device according to Claim 2, wherein

the moving force generating mechanism is a mechanism that, when the driving gear is at the disengagement position, restrains or restricts rotation of the driving gear with respect to the fixed member while allowing a movement of the driving gear with respect to the fixed member in the axial direction.

4. The gear fitting and disengaging device according to Claim 2, wherein
the moving force generating mechanism is a mechanism that, when the driving gear is at the disengagement position, causes a friction force to be applied from the fixed member to the driving gear. 10
5. The gear fitting and disengaging device according to Claim 2, wherein
the moving force generating mechanism is a mechanism that, when a reaction force having a predetermined value or greater against the resistance force is applied from the driving gear to the fixed member, allows a phase difference of the driving gear with respect to the fixed member. 15 20
6. The gear fitting and disengaging device according to Claim 1, wherein
the moving force generating mechanism is a mechanism that, when the driving gear is at the disengagement position, causes a pressing force toward the one side in the axial direction to be applied from the fixed member to the driving gear in accordance with generation of a phase difference between the fixed member and the driving gear. 25 30
7. The gear fitting and disengaging device according to Claim 6, wherein
the driving gear moves toward the one side in the axial direction in accordance with relative rotation of the rotation shaft with respect to the driving gear in the predetermined direction. 35 40
8. The gear fitting and disengaging device according to Claim 6, wherein
the relative rotation of the driving gear with respect to the rotation shaft is restrained or restricted, whereas the relative movement of the driving gear with respect to the rotation shaft in the axial direction is allowed; and
the driving gear and the driven gear are helical gears having teeth that are inclined toward the back in the rotation direction thereof from the one side toward the other side in the axial direction. 45 50
9. The gear fitting and disengaging device according to Claim 6, wherein
the moving force generating mechanism is a mechanism that, when a reaction force having a predetermined value or greater against the pressing force is applied from the driving gear to the fixed member, 55

allows a displacement of the fixed member toward the other side in the axial direction.

10. The gear fitting and disengaging device according to any one of Claims 1 to 9, further comprising:

an intermediate member which engages with the rotation shaft in a state in which the intermediate member is movable in the axial direction of the rotation shaft,
wherein
the driving gear engages with the rotation shaft via the intermediate member in a state in which the driving gear is movable in the axial direction of the rotation shaft, and
the moving force generating mechanism is a mechanism which causes a force for moving the driving gear toward the one side in the axial direction to be applied to the driving gear from the fixed member via the intermediate member, and a relative displacement of the driving gear with respect to the intermediate member toward the other side in the axial direction is allowed when a force having a predetermined value or greater toward the other side in the axial direction is applied to the driving gear.

11. The gear fitting and disengaging device according to any one of Claims 1 to 9, further comprising:

a guide gear which engages with the driven gear when the driving gear is at a position in the axial direction between the predetermined engagement position and the disengagement position; and
a one-direction rotation allowing mechanism which supports the guide gear on the driving gear such that relative rotation of the guide gear with respect to the driving gear in the predetermined direction is allowed and relative rotation of the guide gear with respect to the driving gear in a direction opposite the predetermined direction is restrained in a state where a phase of the teeth of the driving gear and a phase of the teeth of the guide gear are matched,
wherein
the moving force generation mechanism is a mechanism which causes a force for moving the driving gear toward the one side in the axial direction to act on the driving gear from the fixed member until the guide gear engages with the driven gear.

12. The gear fitting and disengaging device according to Claim 11, wherein
a tooth surface of the guide gear on the back side in the rotation direction is formed into a guide side tapered surface which is inclined toward the back in

the rotation direction with respect to the axial direction from the one side toward the other side in the axial direction, and
 a tooth surface of the driven gear on the forward side in the rotation direction is formed into a driven side tapered surface which is parallel to the guide side tapered surface. 5

13. The gear fitting and disengaging device according to any one of Claims 1 to 9, further comprising: 10

an urging device for applying an urging force toward the other side in the axial direction to the driving gear. 15

14. The gear fitting and disengaging device according to Claim 13, wherein
 the urging device is a compression spring which is disposed toward the one side in the axial direction with respect to the driving gear. 20

15. The gear fitting and disengaging device according to Claim 13, wherein
 the urging device is a tension spring which is disposed toward the other side in the axial direction with respect to the driving gear. 25

16. The gear fitting and disengaging device according to any one of Claims 1 to 9, further comprising: 30
 a buffer member for reducing a force which is applied to the driving gear when the movement of the driving gear toward the one direction in the axial direction is restrained by the restraint device. 35

17. An engine starter, comprising:
 a drive source which generates power; and
 the gear fitting and disengaging device according to any one of Claims 1 to 9, 40
 the engine starter performing start of the engine coupled with a driven gear. 45

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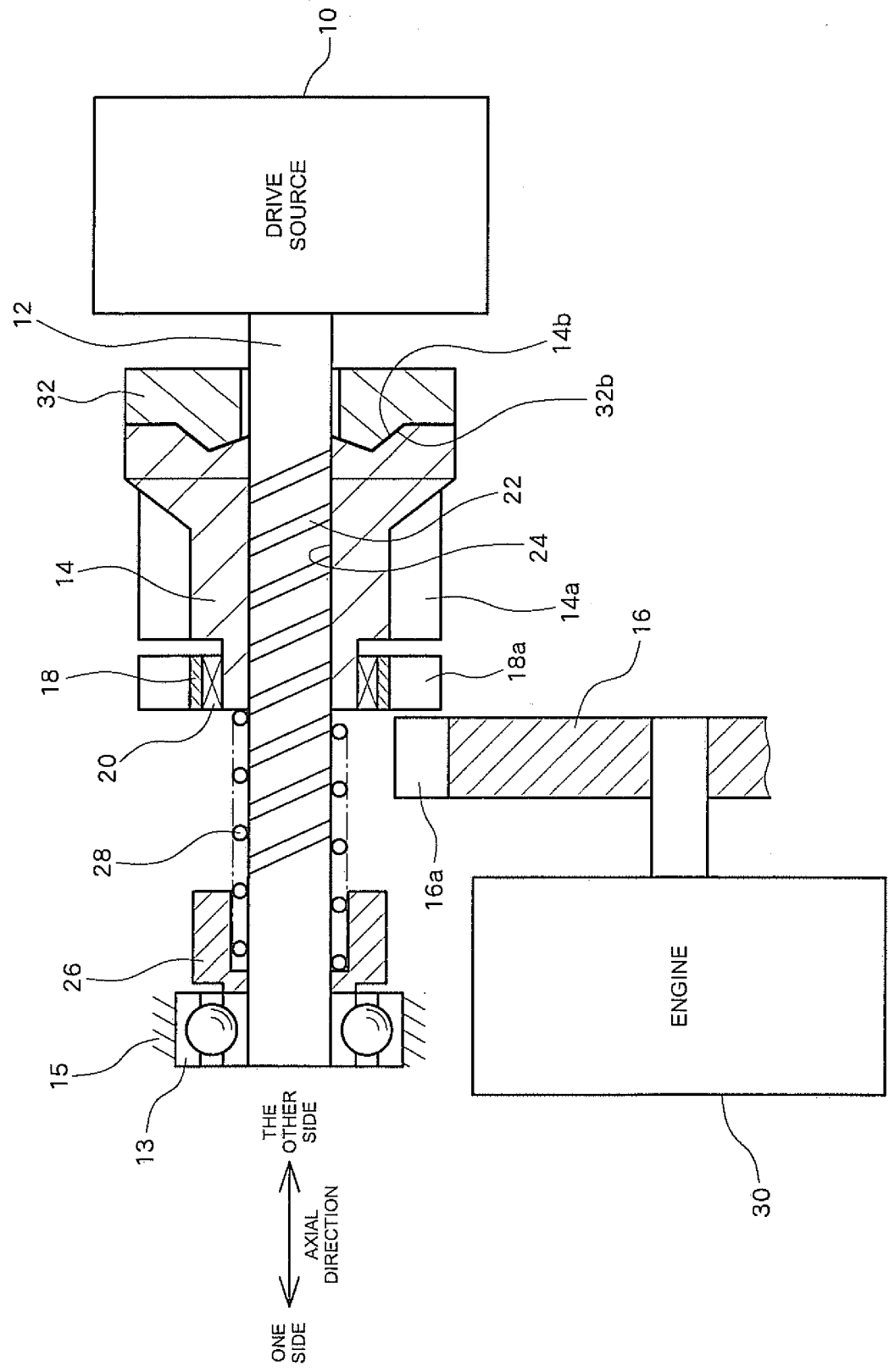


FIG. 1

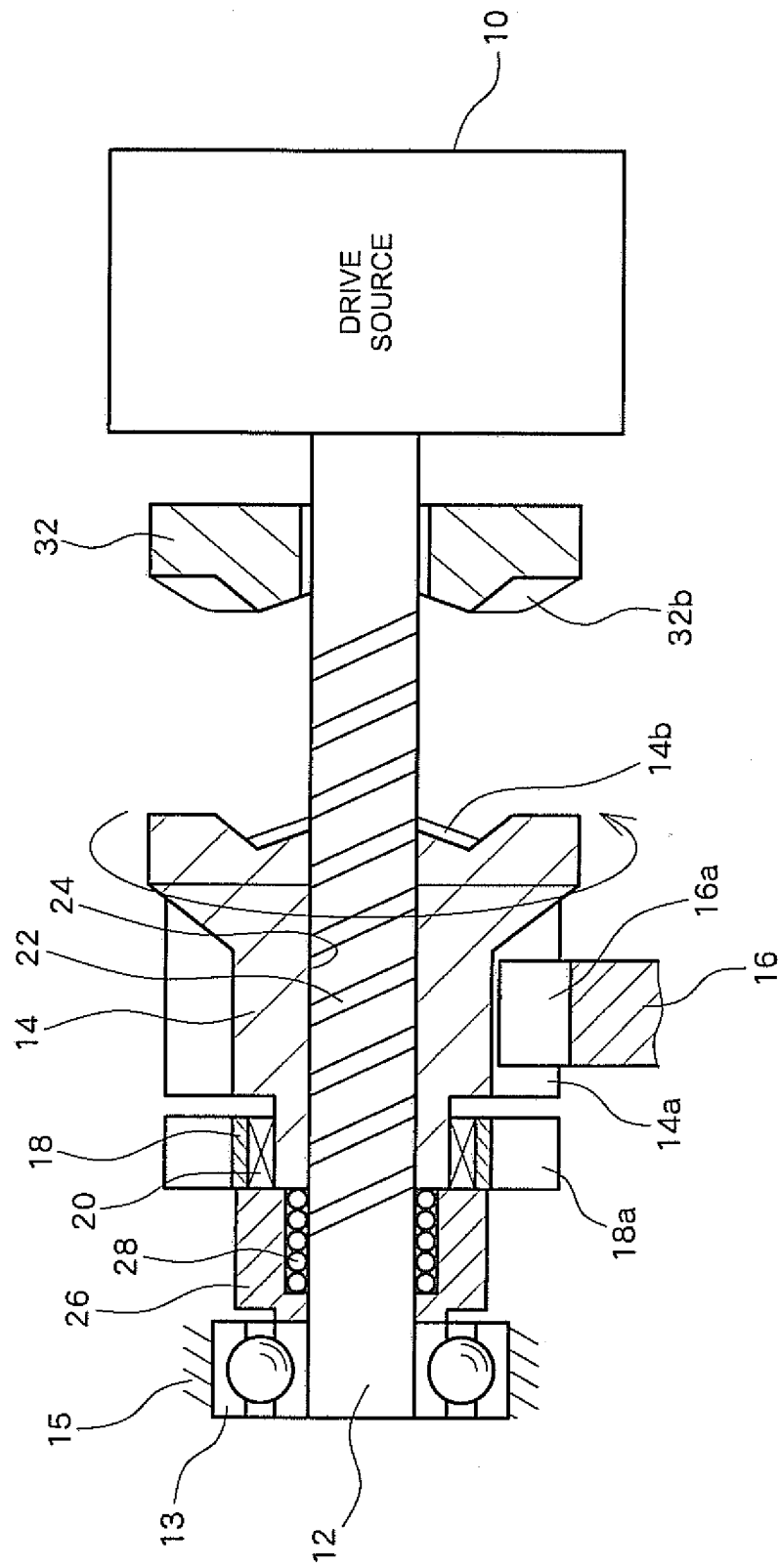
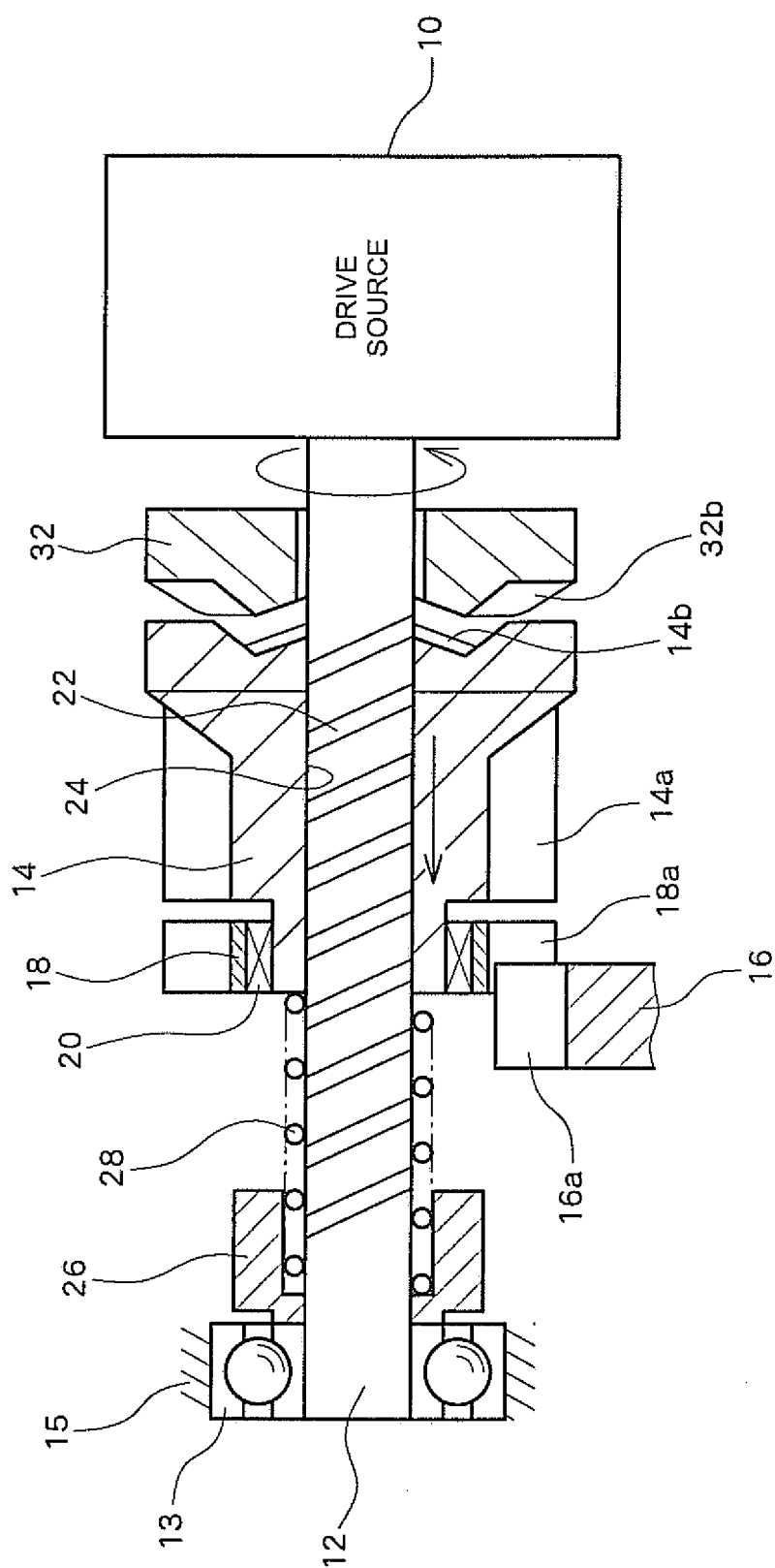


FIG. 2



3
G
F

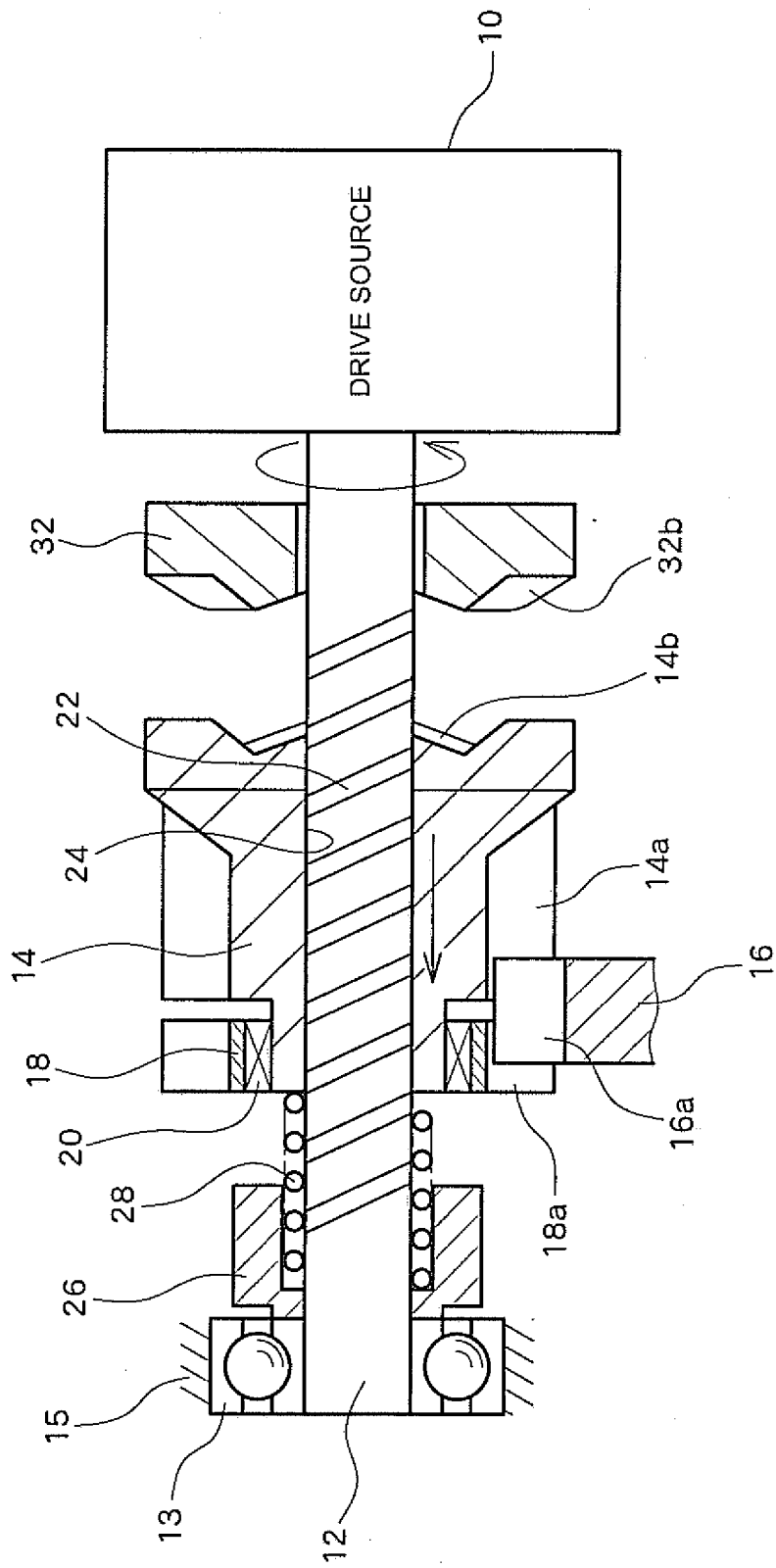


FIG. 4

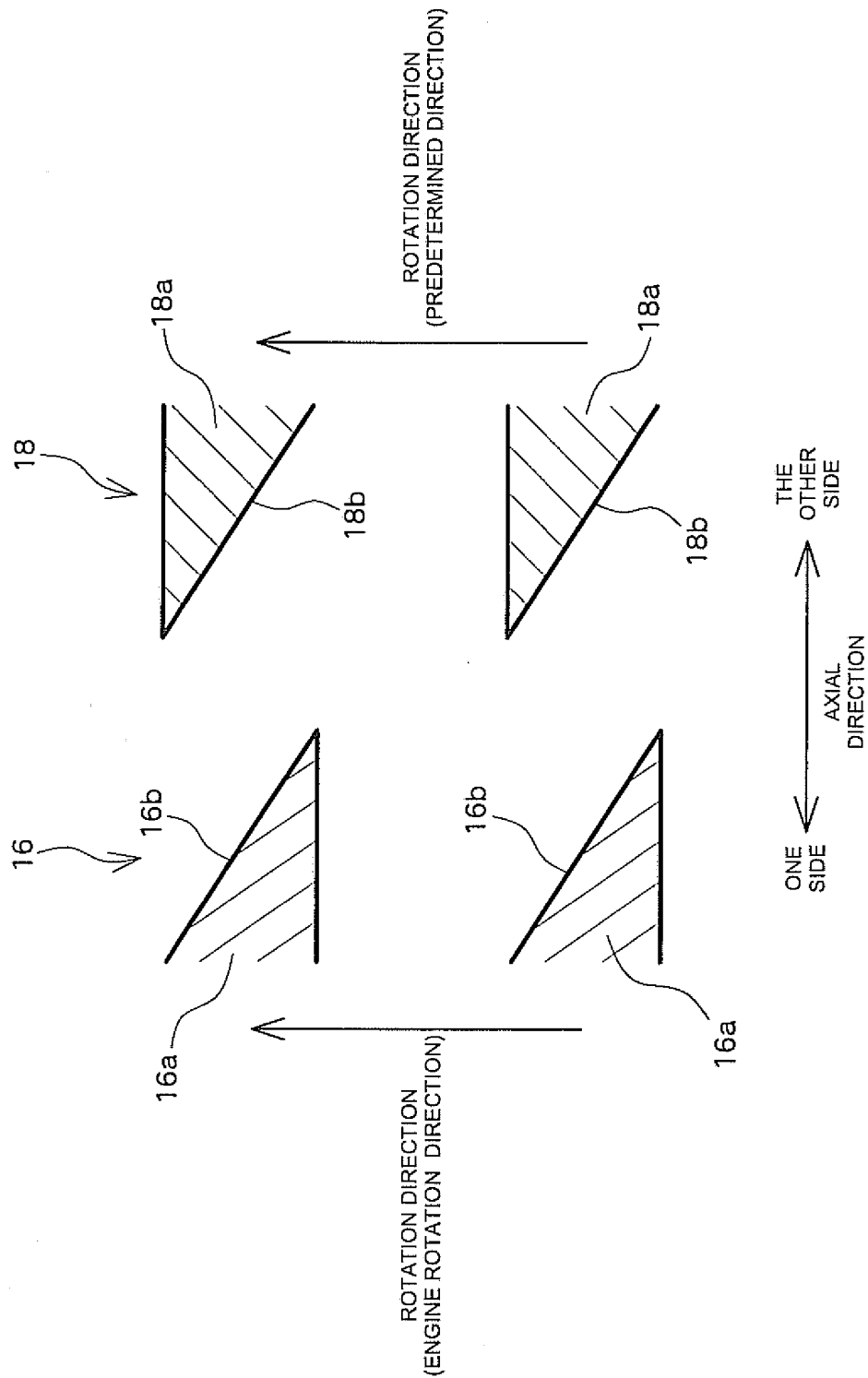


FIG. 5

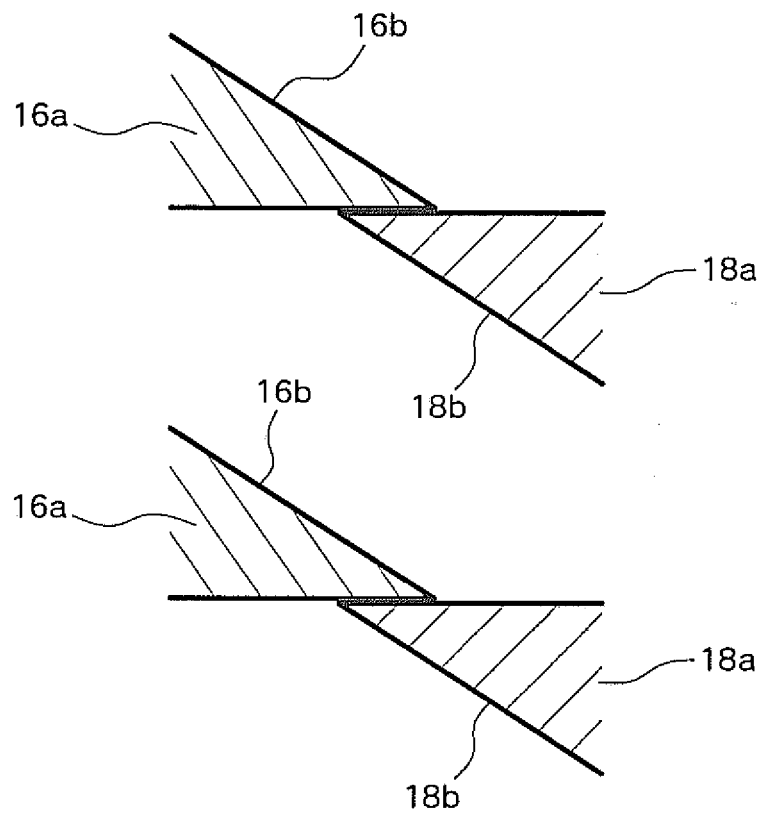


FIG. 6

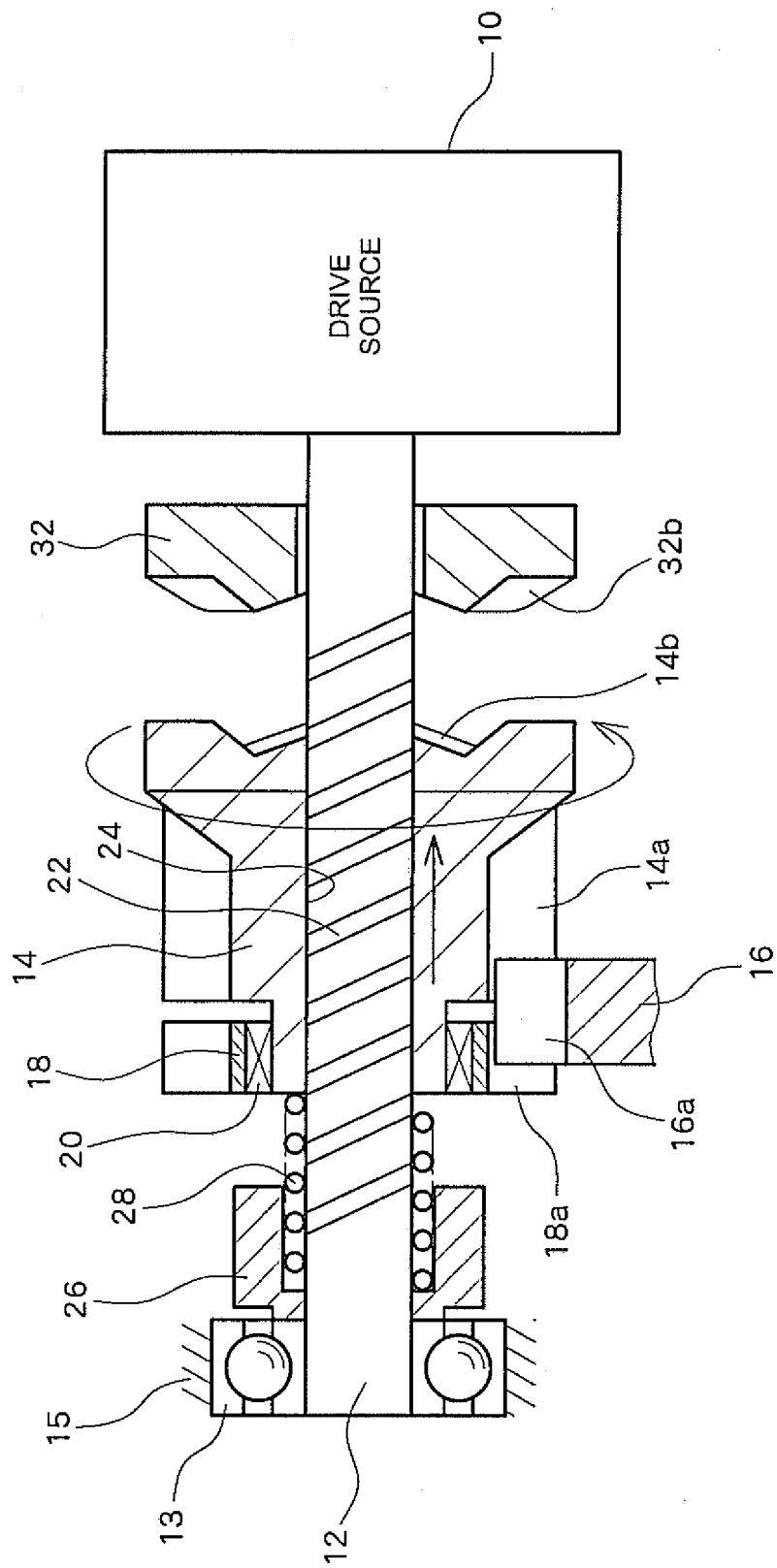


FIG. 7

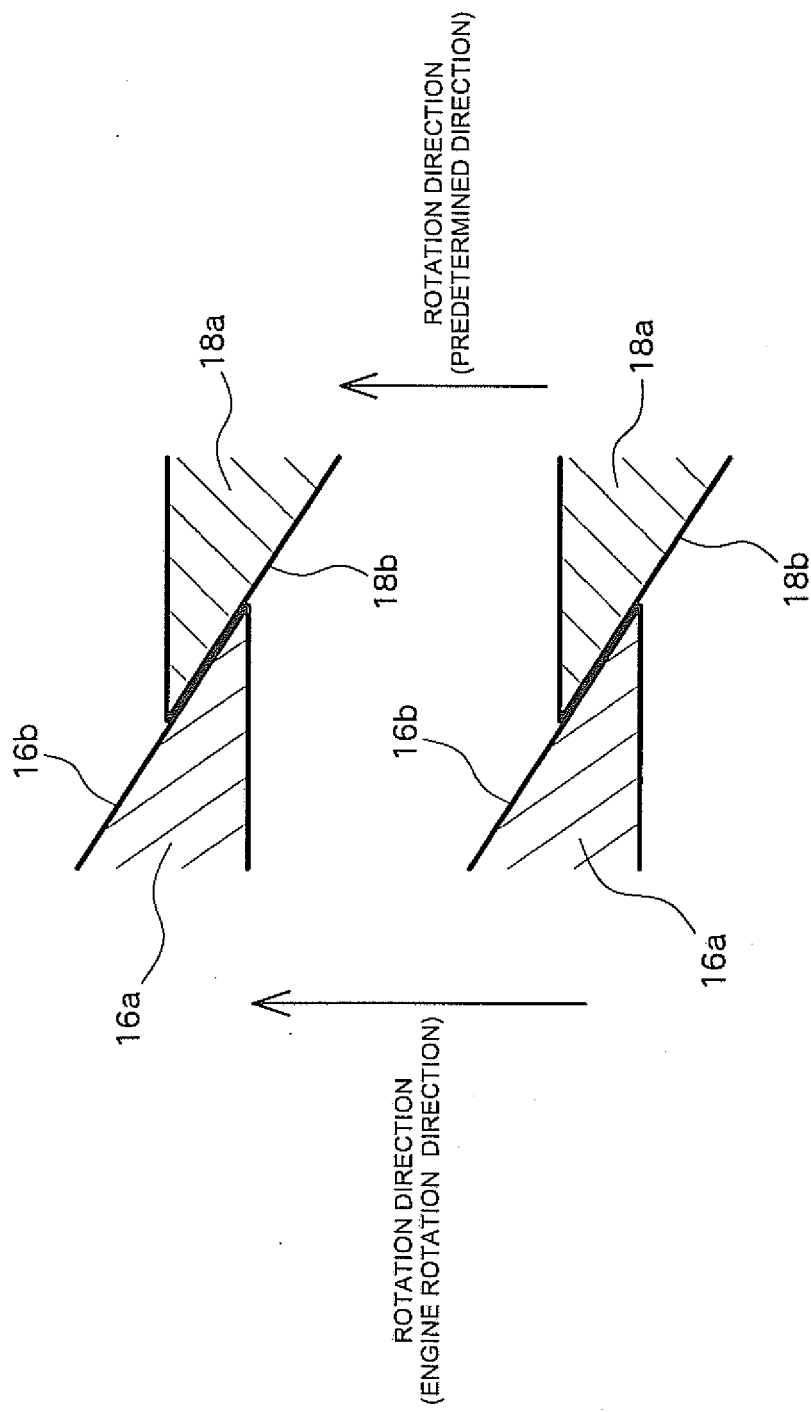


FIG. 8

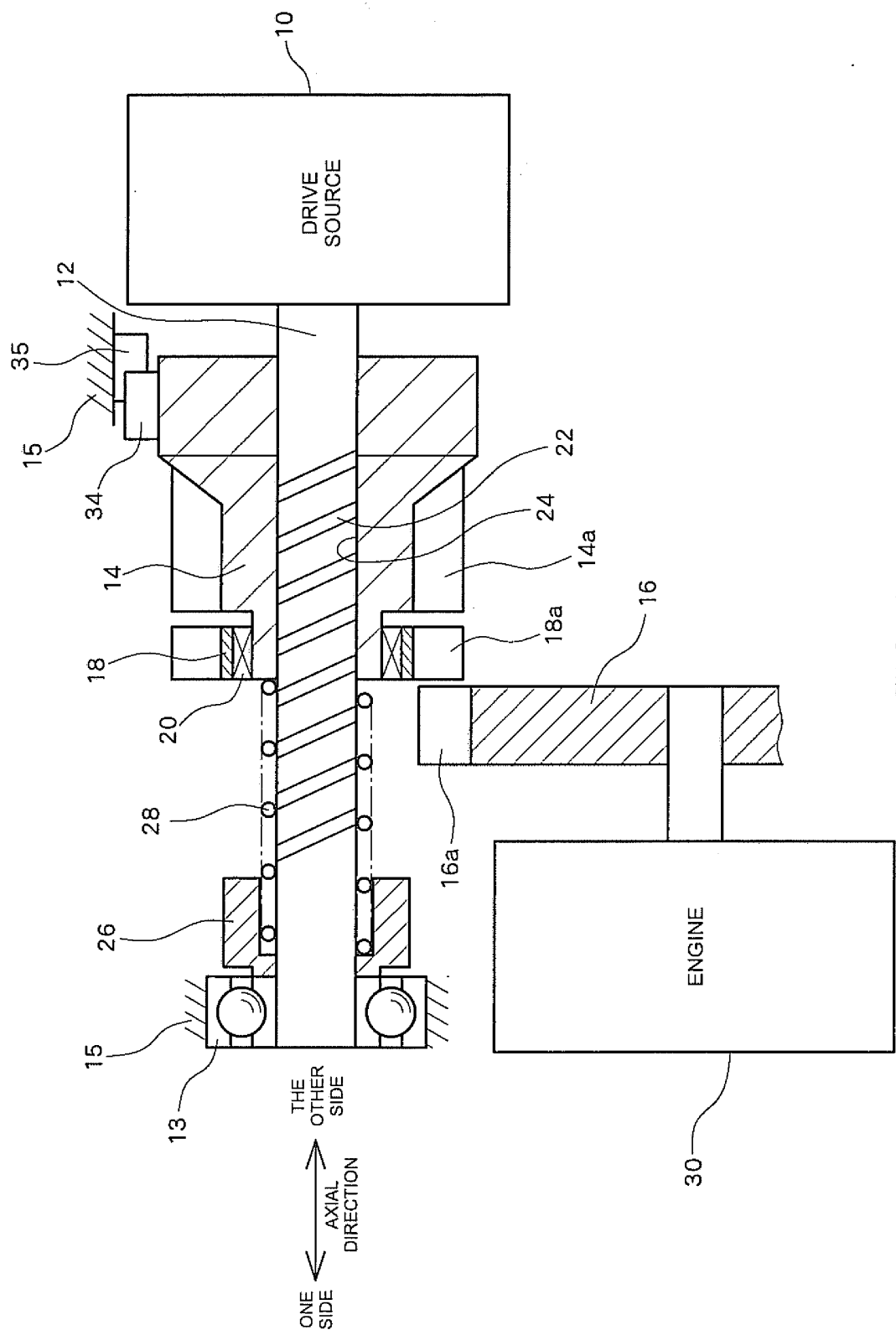


FIG. 9

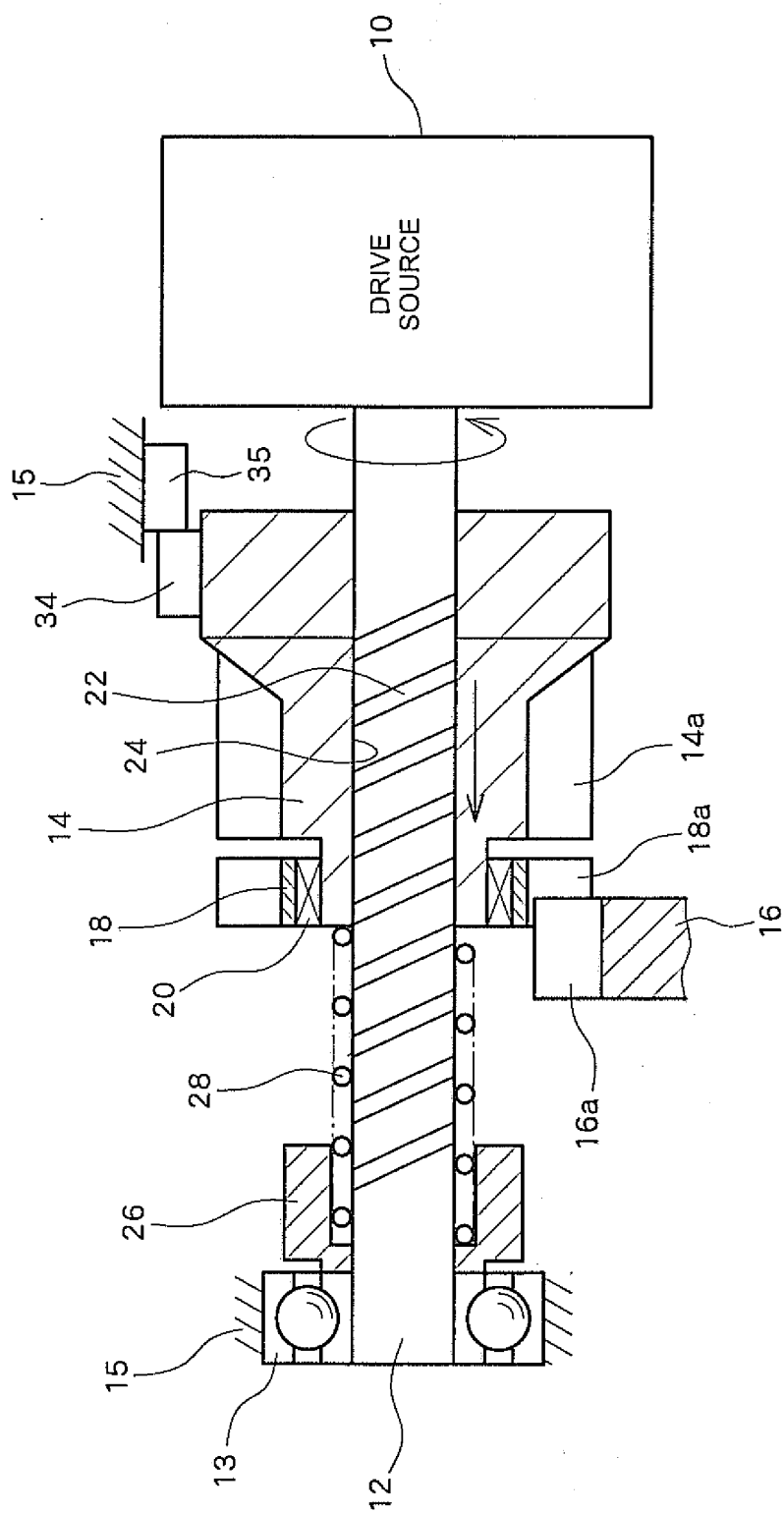


FIG. 10

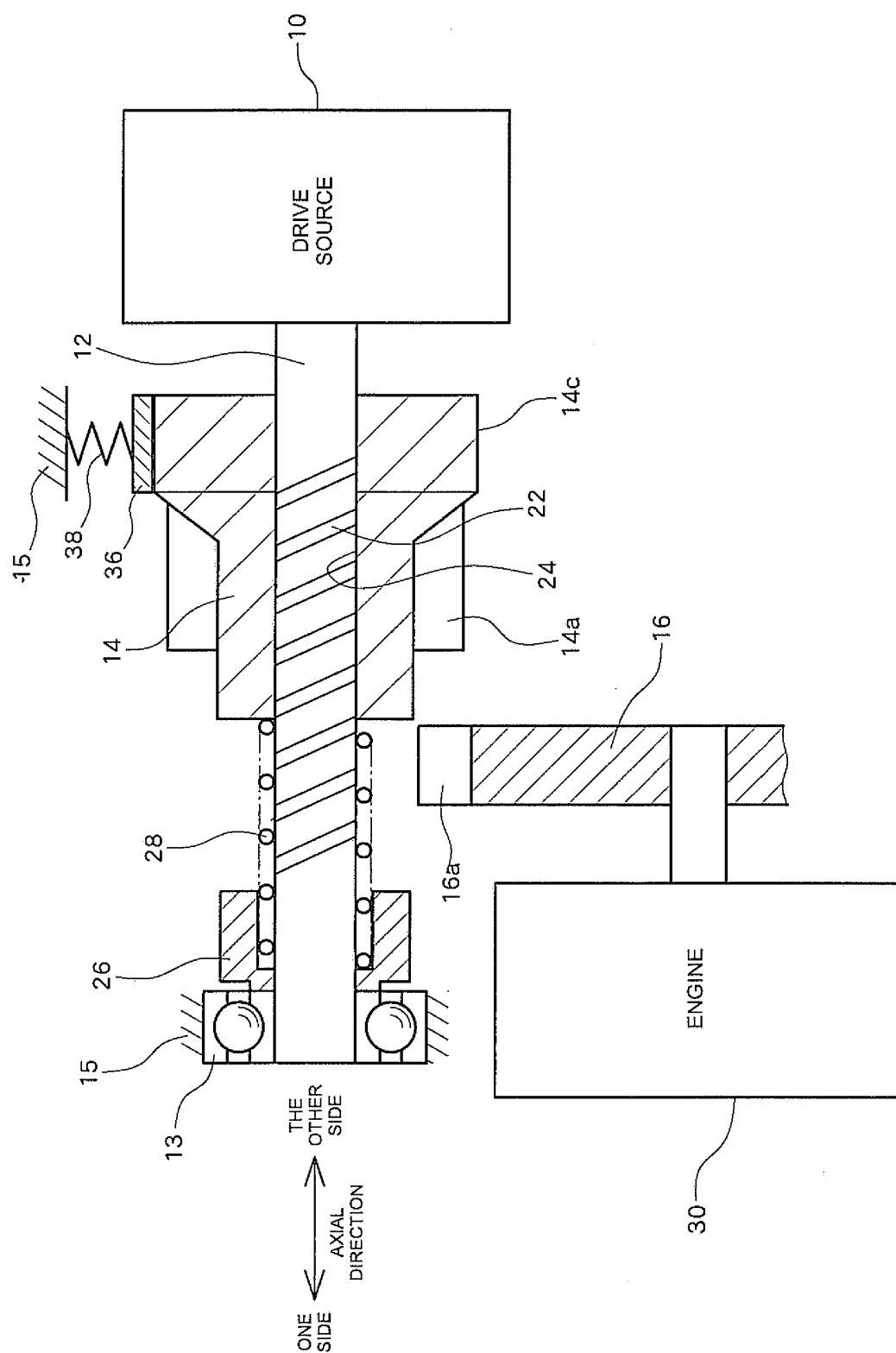


FIG. 11

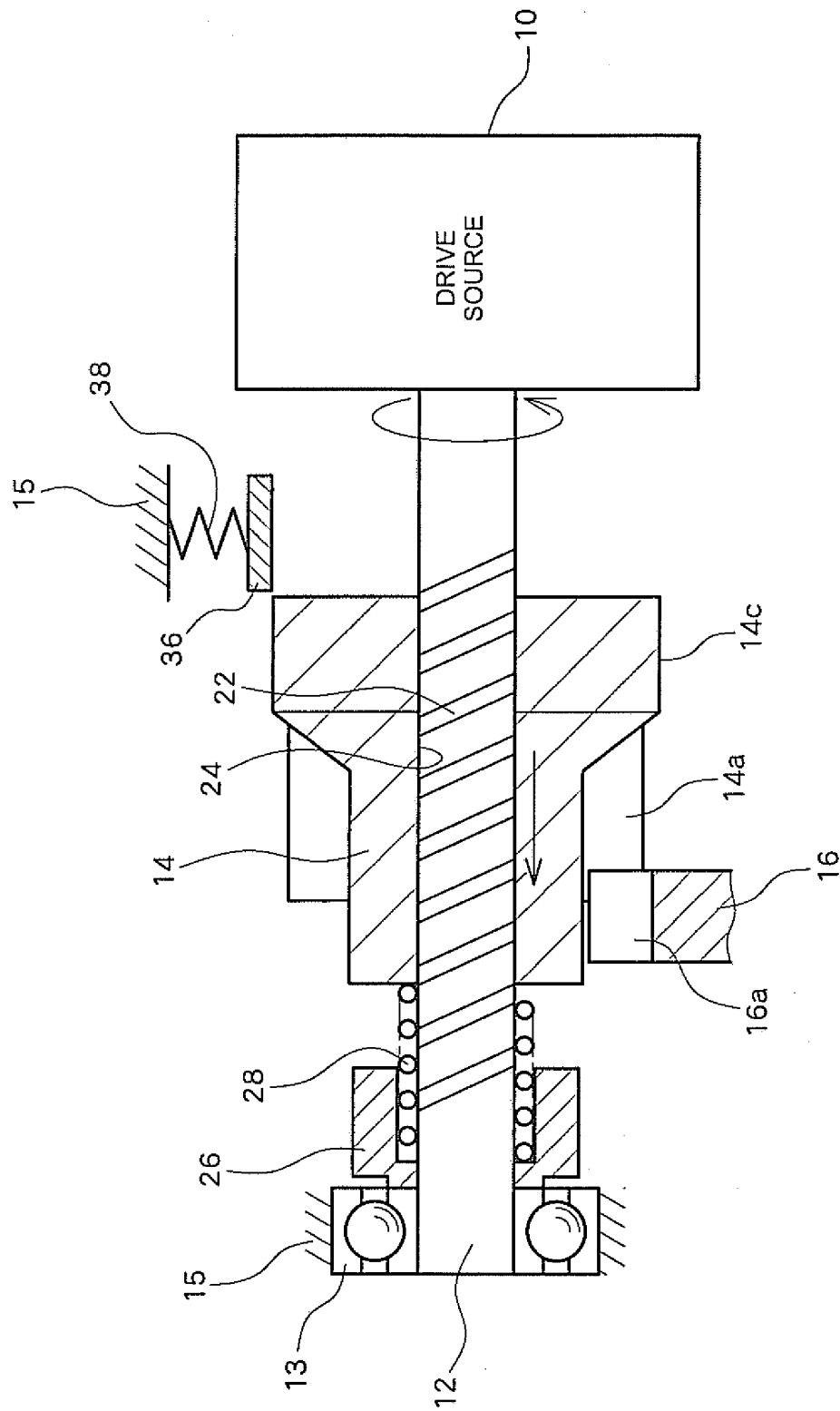


FIG. 12

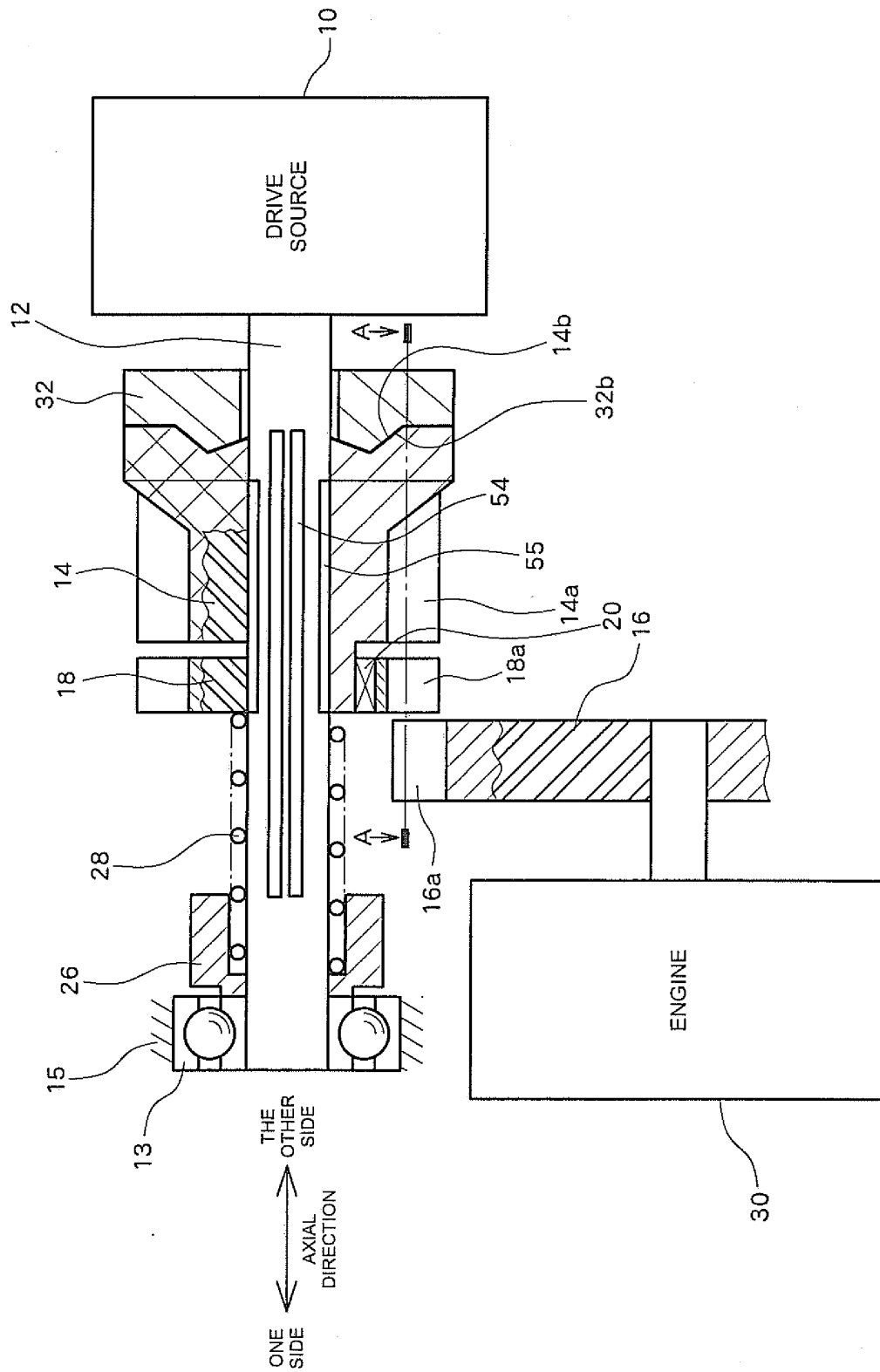


FIG. 13

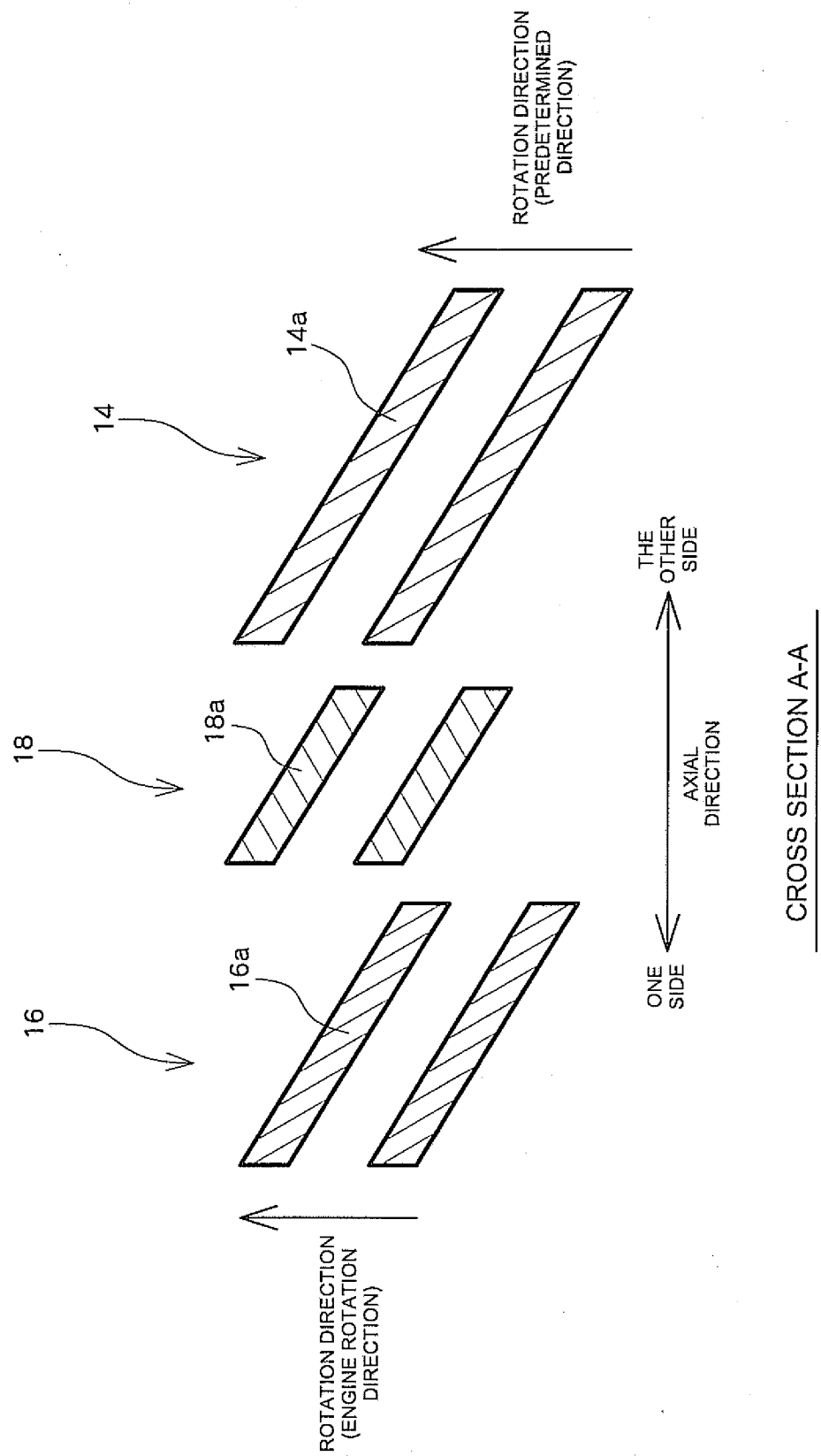


FIG. 14

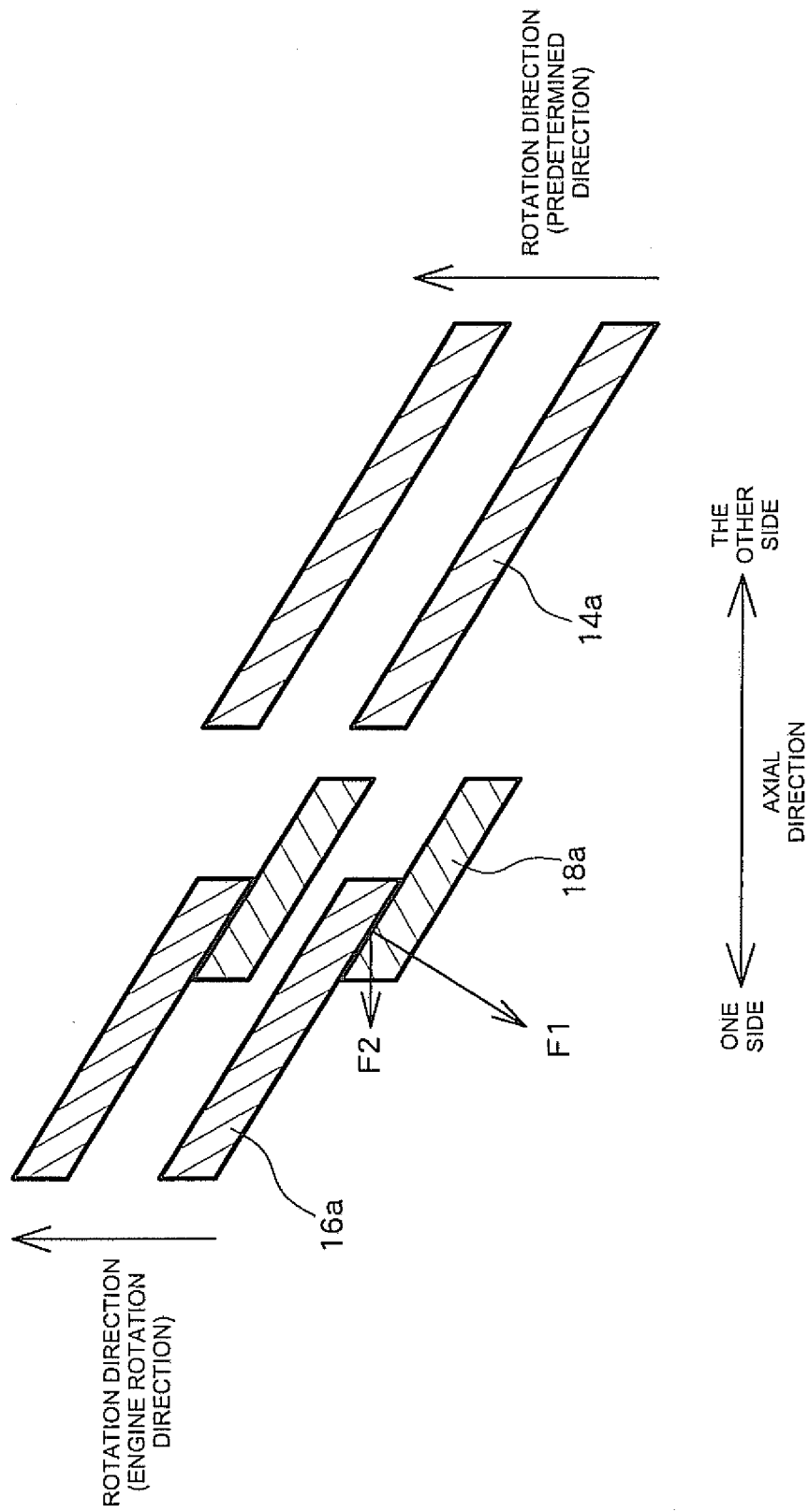


FIG. 15

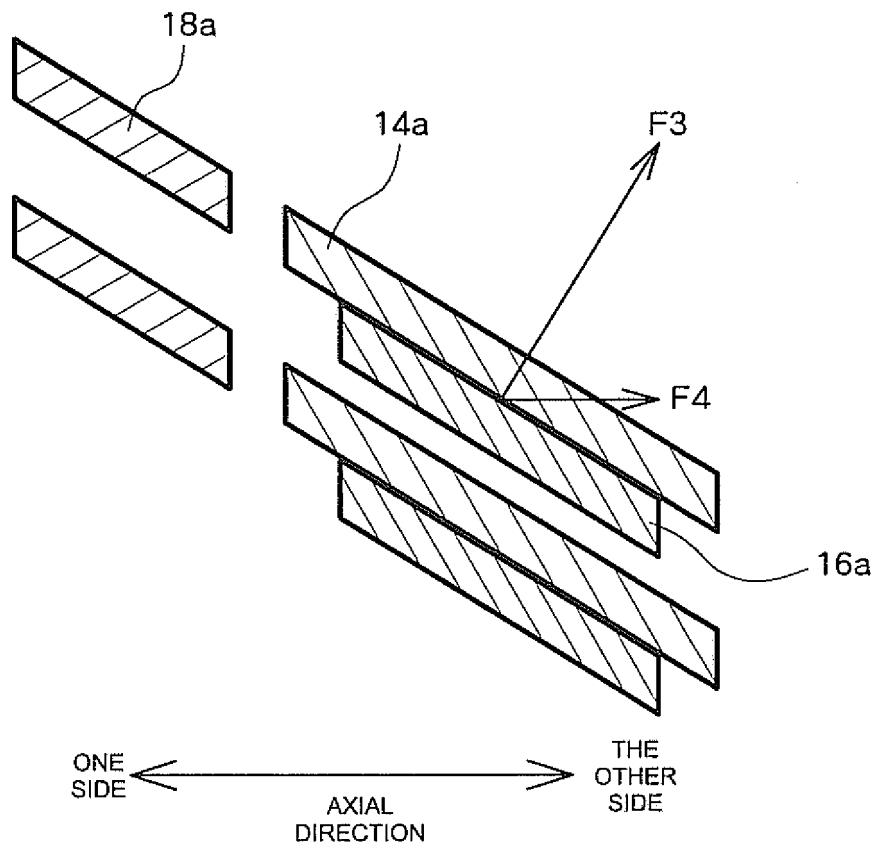


FIG. 16

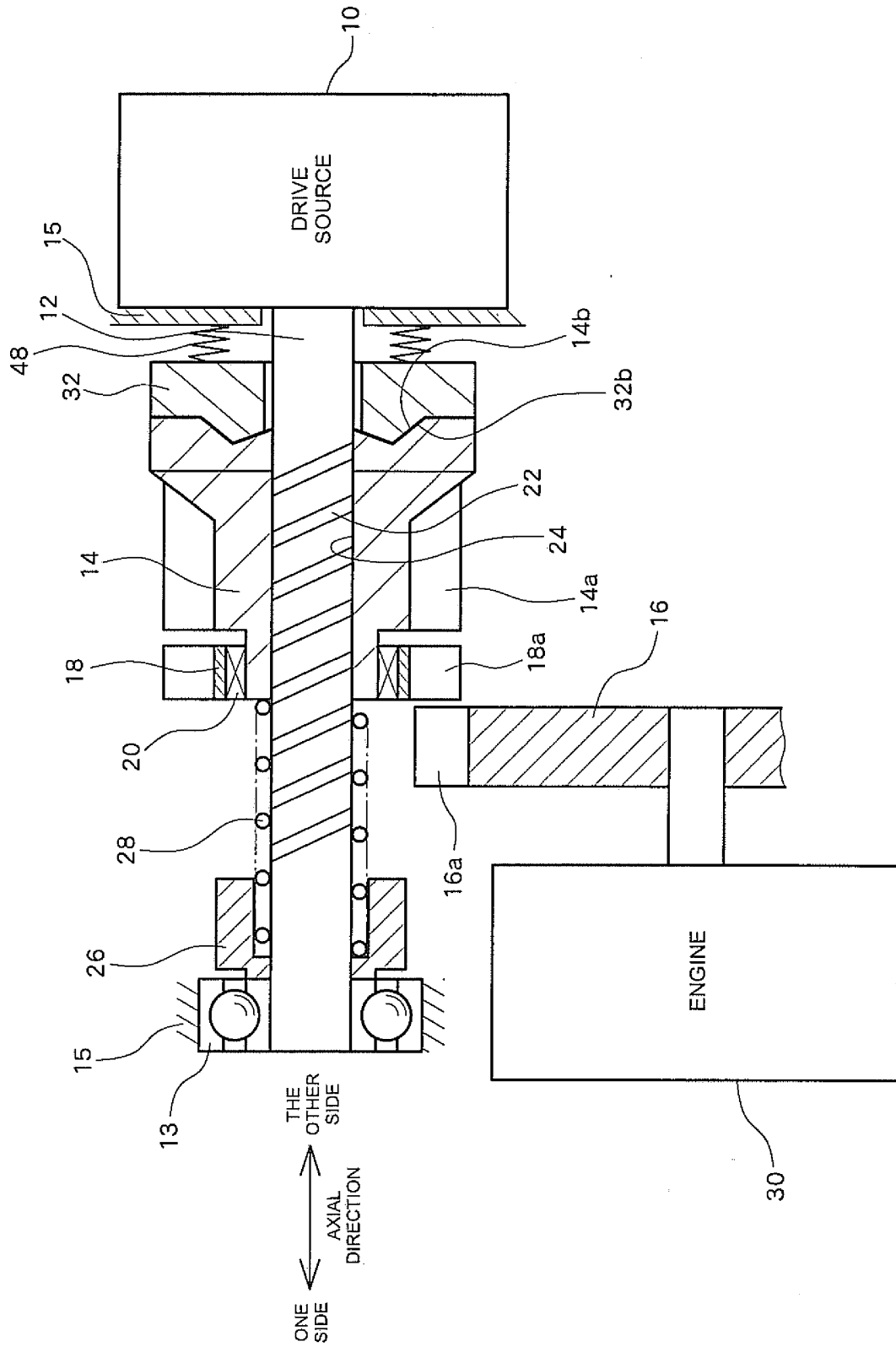


FIG. 17

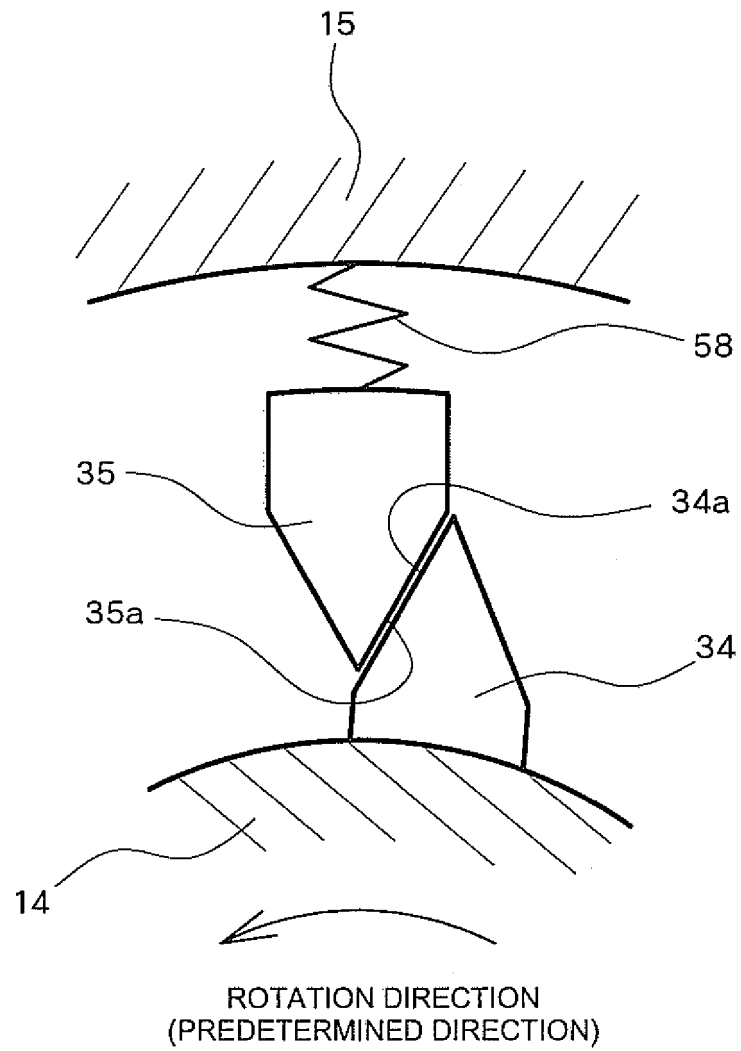


FIG. 18

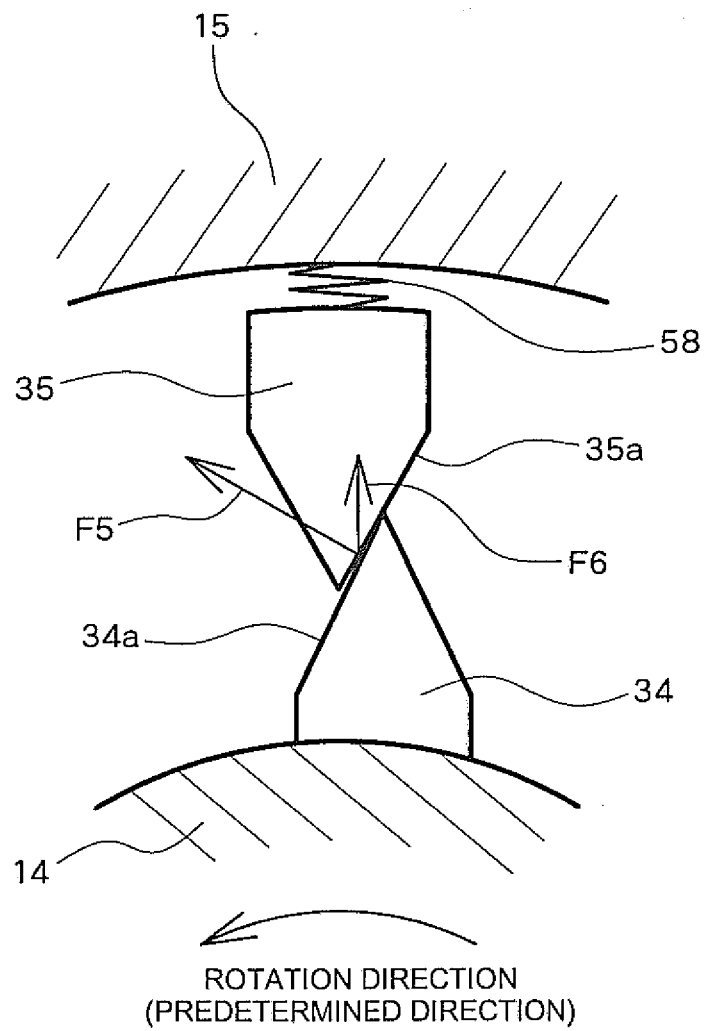


FIG. 19

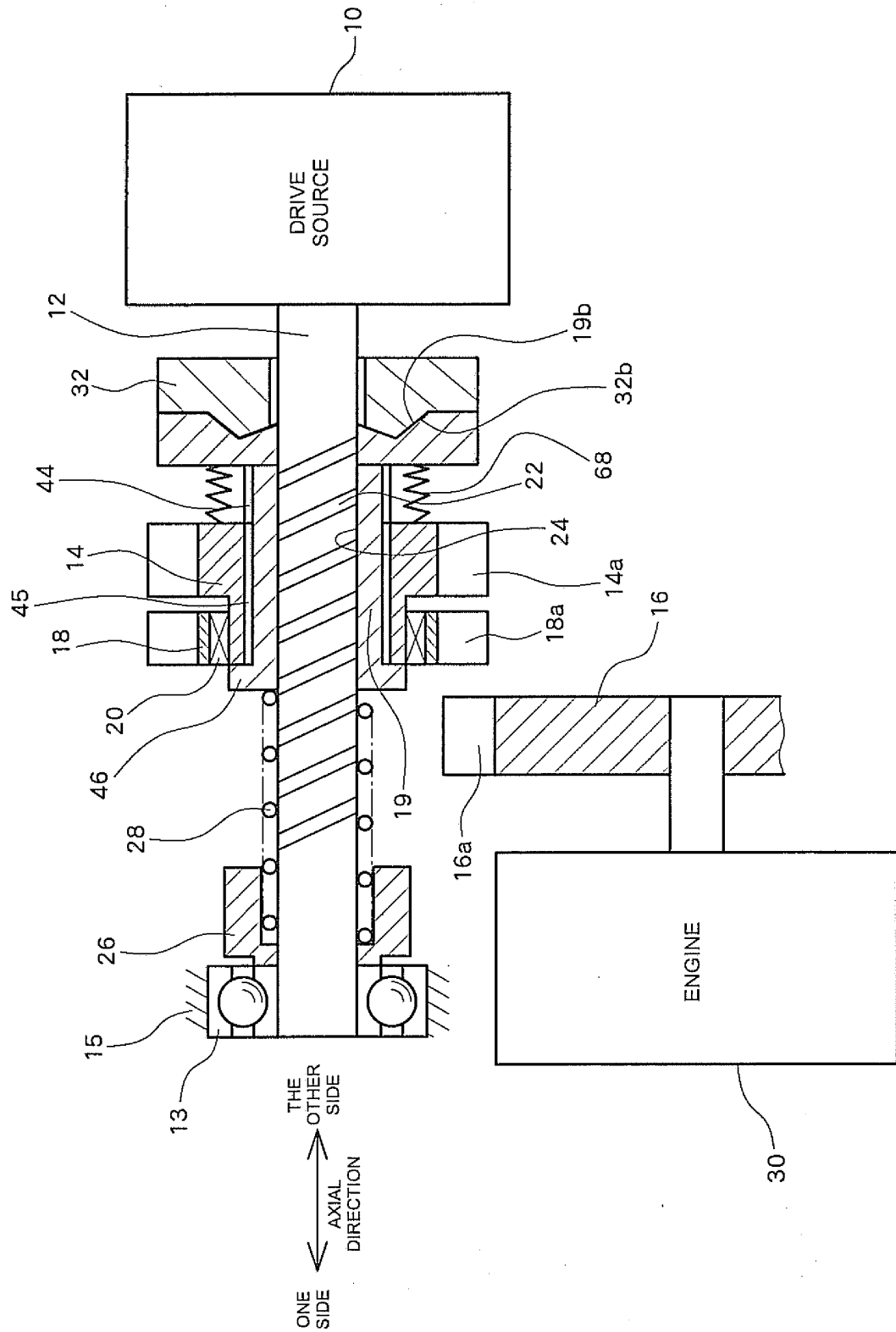


FIG. 20

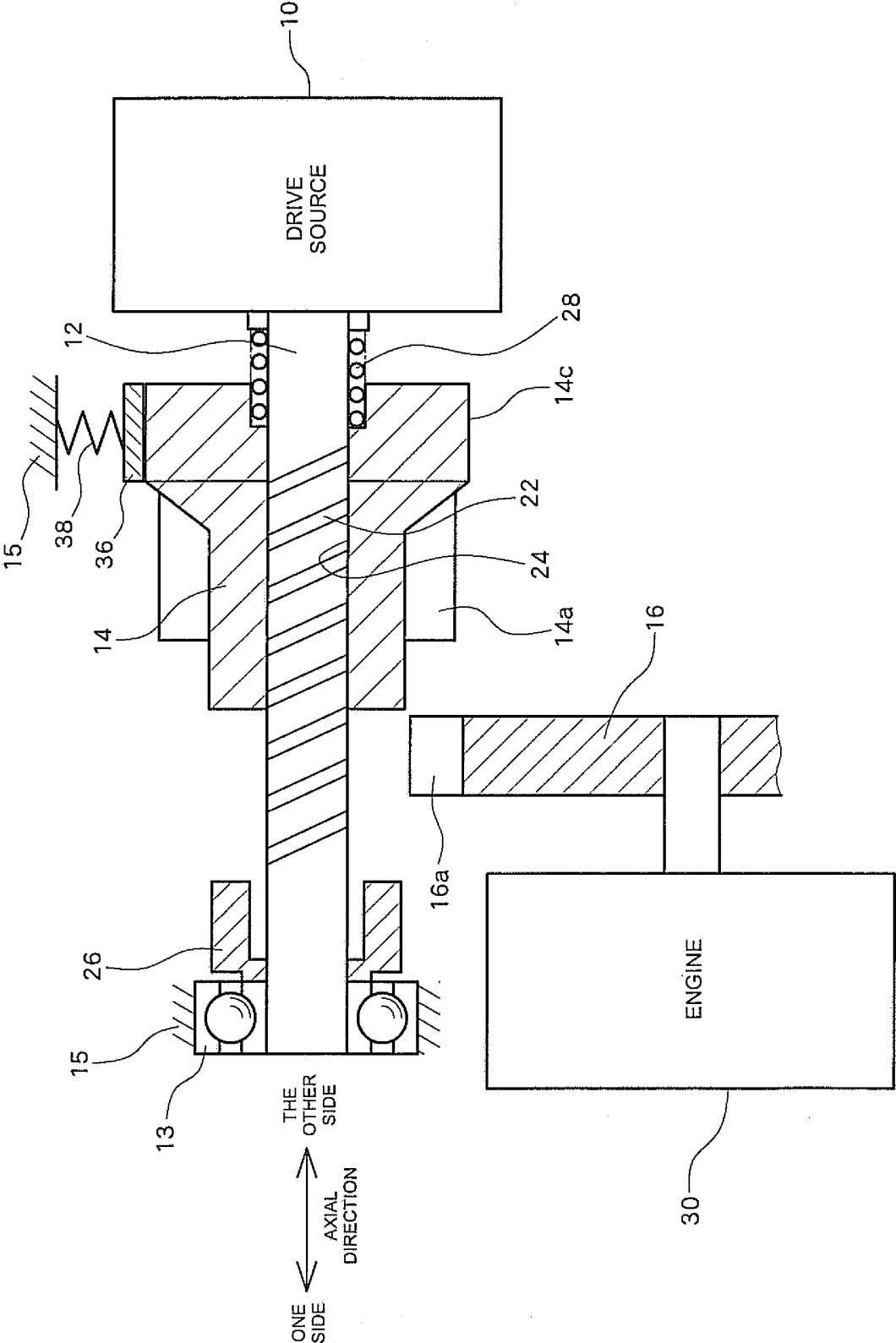


FIG. 21

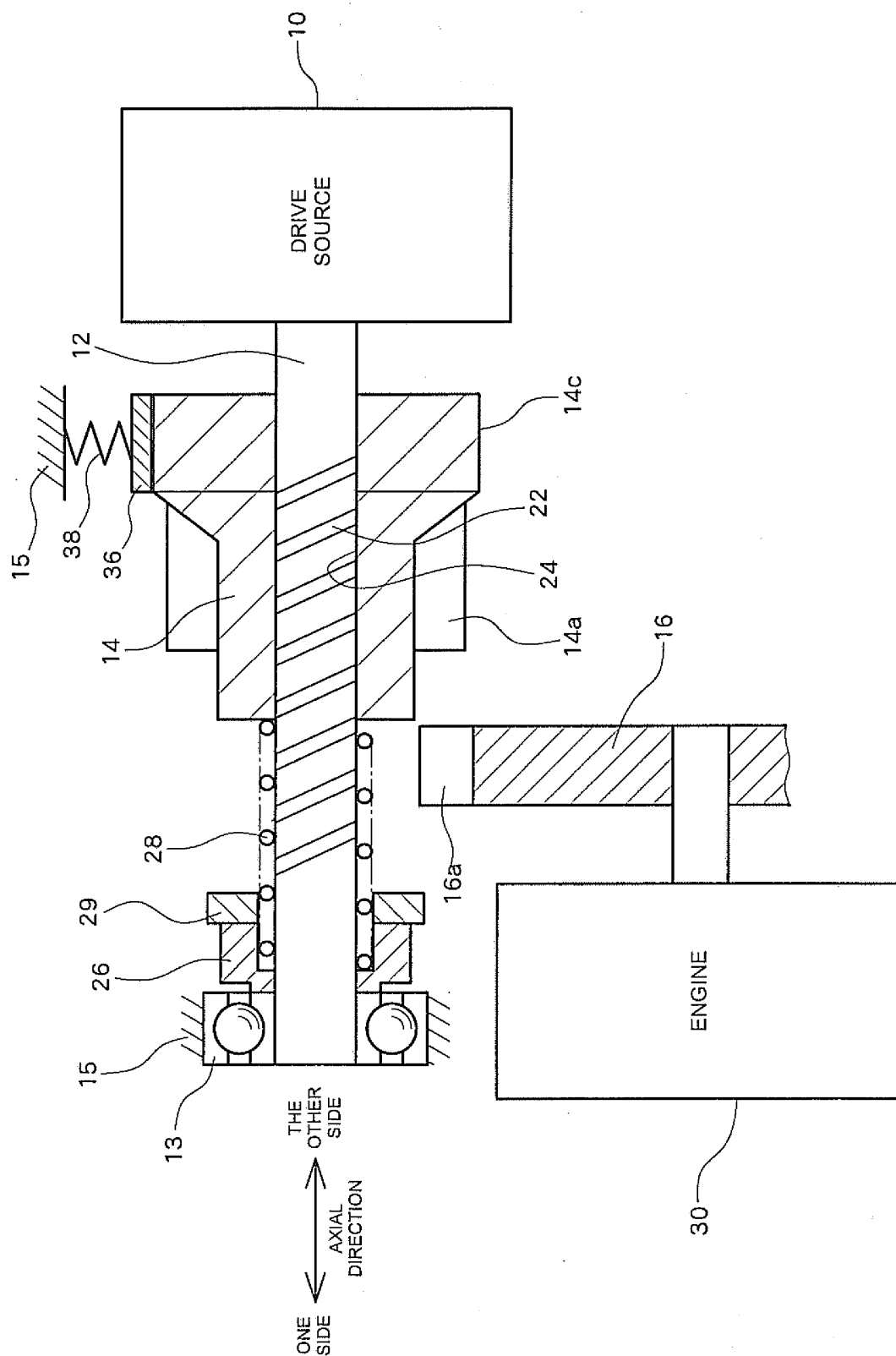


FIG. 22

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/074052

A. CLASSIFICATION OF SUBJECT MATTER <i>F16H25/24</i> (2006.01) i, <i>F02N15/02</i> (2006.01) i, <i>F16H1/06</i> (2006.01) i, <i>F16H31/00</i> (2006.01) i, <i>F16H55/08</i> (2006.01) i, <i>F16H55/17</i> (2006.01) i According to International Patent Classification (IPC) or to both national classification and IPC														
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) <i>F16H25/24</i> , <i>F02N15/02</i> , <i>F16H1/06</i> , <i>F16H31/00</i> , <i>F16H55/08</i> , <i>F16H55/17</i> Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012 Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)														
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>JP 63-41583 Y2 (Isuzu Motors Ltd.), 01 November 1988 (01.11.1988), entire text (Family: none)</td> <td>1-17</td> </tr> <tr> <td>A</td> <td>JP 2002-285942 A (Honda Motor Co., Ltd.), 03 October 2002 (03.10.2002), entire text (Family: none)</td> <td>1-17</td> </tr> <tr> <td>A</td> <td>JP 6-16975 Y2 (Nippondenso Co., Ltd.), 02 May 1994 (02.05.1994), entire text (Family: none)</td> <td>1-17</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	A	JP 63-41583 Y2 (Isuzu Motors Ltd.), 01 November 1988 (01.11.1988), entire text (Family: none)	1-17	A	JP 2002-285942 A (Honda Motor Co., Ltd.), 03 October 2002 (03.10.2002), entire text (Family: none)	1-17	A	JP 6-16975 Y2 (Nippondenso Co., Ltd.), 02 May 1994 (02.05.1994), entire text (Family: none)	1-17
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Date of the actual completion of the international search 10 January, 2012 (10.01.12)		Date of mailing of the international search report 24 January, 2012 (24.01.12)												
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer												
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REFERENCES CITED IN THE DESCRIPTION

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