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(54) **Speed reduction type starter for engines**

Drehzahlreduktionsstarter für Motoren

Démarreur de type à réduction de vitesse pour moteurs

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(73) Proprietor: **DENSO CORPORATION**
Kariya-city,
Aichi-pref. 448-8661 (JP)

(72) Inventor: **Niimi, Masami**
Kariya-city,
Aichi-pref. 448-8661 (JP)

(74) Representative: **Kuhnen & Wacker**
Patent- und Rechtsanwaltsbüro
Prinz-Ludwig-Strasse 40A
85354 Freising (DE)

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Description

BACKGROUND OF THE INVENTION

Technical field of the invention

[0001] The present invention relates to a speed reduction type starter for engines having two planetary speed reducer systems.

DESCRIPTION OF THE RELATED ART

[0002] A starter for engines has been known, which is provided with a planetary speed reducer system that slows down the speed of a motor, and the reduction ratio of this speed reducer system is fixed to a single value (i.e., the reduction ratio cannot be changed) as disclosed in Japanese Patent Application Laid-Open Publication No. 61-28756, for example.

[0003] The single step reduction ratio is commonly decided from the required torque of the starter in the lowest usable temperature conditions (in general, -20 degrees centigrade or less) when the friction of an engine becomes the largest. For this reason, when starting the motor at a normal temperature at which the friction of the engine becomes smaller, the required torque of the motor is smaller as well. Since the operating point on the performance curve of the motor moves to the less load side and the output declines, the motor speed does not go up greatly

[0004] On the other hand, the time required for starting the engine depends on the starting speed of the starter, and the starting time can be shortened with the higher motor speed. If the starting speed of starter becomes high, the body vibration at the time of starting the engine decreases. Thus a driver's comfort will improve, and it can contribute to exhaust gas reduction as well. In order to raise the starting speed of the starter at normal temperatures, it is effective to lower the reduction ratio of the speed reducer system from that of the low temperature. That is, reduction ratio can be set to two different values and it can have different the reduction ratios for normal temperature and low temperature.

[0005] There are examples of the reduction ratio changing means between two values disclosed in Japanese Patent Application Laid-Open Publications No. 61-236951 and No. 61-282650.

[0006] However, the conventional speed reducer system disclosed in Publication No. 61-236951 becomes large in size because it has many parts and its structure is complicated, therefore it is difficult to apply to the conventional speed reducer system that requires miniaturization. Further, when the reduction ratio is low (reduction ratio=1; an input shaft and an output shaft are at the same speed), and high (reduction ratio=n; however, 10<n<1), the low reduction ratio=1 is not suitable for starting the motor at the normal temperature because the torque of the starter is insufficient.

[0007] On the other hand, for changing the reduction ratio of the planetary gears having two values of different reduction ratios, a method of putting brakes on an internal gear of the planetary gears in order to fix the internal gear by tightening a brake band around the perimeter of the internal gear is disclosed in the Publication No. 61-282650.

[0008] By the way, with the starter in which the two gear reduction systems are equipped, since it can be used in normal temperatures and low temperatures by changing the reduction ratio, the reduction ratio at low temperature can be set up more higher, as compared with the conventional starter having a fixed reduction ratio only.

[0009] Although the above set up may be realized by increasing the number of teeth of the internal gear, if the number of teeth of the internal gear is increased, the outer diameter of the internal gear will become large and thus the starter will become large as well.

[0010] For this reason, since increasing the number of the teeth without enlarging the outer diameter of the internal gear will produce a small internal gear module, an impact-absorbing mechanism will be needed for protecting the power transfer system of the starter from excessive shock.

[0011] However, for a starter having two different reduction ratios, it is difficult to obtain the space for arranging the impact-absorbing mechanism as compared with the conventional starter that has the fixed single step of the reduction ratio, therefore a new structure that can constitute the impact-absorbing mechanism compactly is required.

[0012] US 2004/093967 A1 discloses a starter for an internal combustion engine in which an ordinary planetary reduction mechanism is designed to provide a predetermined reduction ratio by fixing an internal gear, and the rotations of the internal gear is directly outputted without reduction when the internal gear is released from the fixed state to result in the same speed of rotation.

SUMMARY OF THE INVENTION

[0013] The present invention has been made in order to solve the issue described above, and has as its object to provide a starter such that the reduction ratio can be changed between two values and by using two planetary gear reduction systems having a low reduction ratio exceeding 1, the starter can secure the good engine starting characteristics of low temperatures, the starter can shorten the starting time in normal temperatures, and the starter that can constitute an impact-absorbing mechanism compactly for protecting a power transfer system of the starter from excessive shock.

[0014] In the speed reduction type starter for engines according to a first aspect, there is provided a speed reduction type starter for an engine equipped with a ring gear comprising a motor that has an armature shaft for generating torque, two planetary gear reduction systems

that have different reduction ratios and that are installed on the armature shaft of the motor, means for choosing either one of the reduction systems to change a reduction ratio that reduces the drive torque to be transmitted to from the motor to the engine, and an output shaft to which the drive torque of the motor is transmitted via the reduction system chosen by the reduction ratio changing means.

[0015] In addition, a pinion gear that engages with the ring gear of the engine arranged at a perimeter of the output shaft, an impact-absorbing mechanism that absorbs any excessive shock when the excessive shock is applied from the engine, and the starter that starts the engine by transmitting the drive torque of the motor amplified by the reduction systems to the ring gear from the pinion gear.

[0016] The reduction ratio changing means engages mechanically with one of two internal gears used in the two gear reduction systems and suppresses rotation of the one of internal gears, the gear reduction systems comprises a gear-switching means that permits rotation of the other internal gear, the gear-switching means arranged in a perimeter of the two internal gears coaxially and is arranged movable in the direction of an axis, and rotation of the gear-switching means is suppressed via the impact-absorbing mechanism, so that the reduction ratio is changed by changing the internal gear which rotation is suppressed by moving the gear-switching means in the direction of the axis.

[0017] According to the present invention, moving the engaging part arranged in the perimeter of the two internal gears coaxially in the direction of an axle so that the one of the internal gears mechanically engages to the engaging part can suppress the rotation of one of the internal gears and permits the rotation of the other internal gears.

[0018] Consequently, by changing the internal gear with which rotation is suppressed according to the operating condition (outside air temperature, for example) of the starter etc., two different reduction ratios, i.e., low reduction ratio and high reduction ratio can be properly used.

[0019] In addition, the internal gear where the rotation is suppressed and the internal gear where the rotation is permitted can easily be switched by moving the engaging part in the direction of the axle. Since the rotation of one internal gear is suppressed when the rotation of the other internal gear is permitted and the rotation of one internal gear is permitted when the other internal gear is suppressed, suppressing and permitting of the rotation of two internal gears can be performed with a simple composition and less parts.

[0020] Further, since the gear-switching means is suppressed in rotation via the impact-absorbing mechanism, the impact-absorbing mechanism decouples the impact when an excessive impact is applied to the internal gear connected with the gear-switching means, thus protecting the gear reduction systems from the excessive impact.

[0021] Moreover, because the impact force applied to the gear reduction system can be decreased, the module of the reduction gear used for two gear reduction systems can be reduced; especially can minimize the outside diameter of the module.

[0022] In the speed reduction type starter for engines according to a second aspect, the starter further comprises a toothed part formed in the perimeter of the 1st internal gear of the pair of internal gears arranged on the direction of the anti-motor side, another toothed part formed in the perimeter of the 2nd internal gear of the pair of internal gears arranged on the direction of the motor side, the 1st toothed part engageable with the toothed part formed in the 1st internal gear, and the 2nd toothed part engageable with the toothed part formed in the 2nd internal gear formed in the inner circumference of the engaging part

[0023] The rotation of the 1st internal gear is suppressed when the 1st toothed part engages with the toothed part of the 1st internal gear by moving the engaging part to the direction of motor side, and the rotation of the 2nd internal gear is suppressed when the 2nd toothed part engages with the toothed part of the 2nd internal gear by moving the engaging part to the direction of anti-motor side.

[0024] In the speed reduction type starter for engines according to a third aspect, the 1st toothed part and the 2nd toothed part are arranged as a unit in the direction of the axis continuously.

[0025] In the speed reduction type starter for engines according to a fourth aspect, end surfaces of the pair of internal gears facing each other in the direction of the axis are engaged rotatably in concavo-convex manner.

[0026] In the speed reduction type starter for engines according to a fifth aspect, resin material is used for at least one of the internal gears.

[0027] In the speed reduction type starter for engines according to a sixth aspect, the starter further comprises a magnetic coil that forms an electromagnet by energization and drives the engaging part to one direction by the magnetic force of the electromagnet, a return spring that pushes back the engaging part to another direction when the energization to the magnetic coil is stopped, the 1st internal gear arranged on the direction of the motor side, and the 2nd internal gear arranged on the direction of the anti-motor side, wherein the magnetic coil is arranged close to either the motor side of the 1st internal gear or the anti-motor side of the 2nd internal gear.

[0028] In the speed reduction type starter for engines according to a seventh aspect, a ferromagnetic substance attracted by the electromagnet constitutes the engaging part.

[0029] In the speed reduction type starter for engines according to a eighth aspect, a magnetic coil is arranged closely to the anti-motor side of the 2nd internal gear, and a yoke has a ring-like magnetic path part arranged in the direction of a diameter in between the 2nd internal

gear and the magnetic coil.

[0030] The gear-switching means has a cylindrical iron core part extended in the direction of the axis in the perimeter of the ring-like magnetic path part. The inner periphery of the cylindrical iron core part is engaged in a concavo-convex manner with the perimeter part of the ring-like magnetic path part so that the relative rotation of the both is suppressed and provided movable in the direction of the axis.

[0031] In the speed reduction type starter for engines according to a ninth aspect, the yoke has a cylindrical magnetic path part that extends from the inner circumference of the ring-like magnetic path part to the inner circumference side of the magnetic coil in the axial direction of the anti-motor side.

[0032] A frame member of which rotation is suppressed and provided unmovable in the direction of the axis is arranged in the axial direction of the anti-gear reduction system of the magnetic coil. A bearing section that supports the perimeter of the output axis rotatably via a bearing is provided integrally in an inner circumference of the frame member in the direction of the diameter.

[0033] The bearing section is extended cylindrically to the direction of the motor side and the bearing is disposed therein. The impact-absorbing mechanism is arranged in the space defined by the perimeter of the bearing section and the inner circumference of the cylindrical magnetic path part.

[0034] In the speed reduction type starter for engines according to a tenth aspect, the impact-absorbing mechanism comprises a rotating friction plate that is arranged rotatably to the frame member, and its own perimeter part is engaged in a concavo-convex manner with the inner periphery of the ring-like magnetic path part so that the rotation is suppressed, a fixed friction plate that is stacked with the rotating friction plate in the direction of the same axis and is suppressed in its rotation by the frame member, and a pressing means that presses the rotating friction plate and the fixed friction plate in between the frame member in the direction of their axis, wherein the impact-absorbing mechanism absorbs excessive shock by use of the rotating friction plate.

[0035] The friction force between the rotating friction plate and the internal gear resisting the excessive movement of the internal gear engages with the gear-switching means.

[0036] In the speed reduction type starter for engines according to an eleventh aspect, the impact-absorbing mechanism is constituted by using a plurality of the rotating friction plates and the fixed friction plates stacked alternating one-by-one.

[0037] In the speed reduction type starter for engines according to a twelfth aspect, the engaging part suppresses the rotation of the internal gear used for the speed reducer system with the low reduction ratio when the magnetic coil is not energized, and the engaging part suppresses the rotation of the internal gear used for the speed reducer system with the high reduction ratio when the magnetic coil is energized.

[0038] In the speed reduction type starter for engines according to a thirteenth aspect, the engaging part suppresses the rotation of the internal gear used for the frequently used speed reducer system when the magnetic coil is not energized, and the engaging part suppresses the rotation of the internal gear used for the not frequently used speed reducer system when the magnetic coil is energized.

[0039] In the speed reduction type starter for engines according to a fourteenth aspect, the magnetic coil is not energized when the outside air temperature is higher than 0 degree centigrade, and the magnetic coil is energized when the outside air temperature is 0 degree centigrade or less.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] In the accompanying drawings:

Fig. 1 shows a fragmentary sectional view of a starter of an embodiment according to the present invention;
Fig. 2 shows a sectional view of a speed reducer system and a reduction ratio switching means (coil is OFF);
Fig. 3 shows a sectional view of a speed reducer system and a reduction ratio switching means (coil is ON);
Fig. 4 shows a perspective diagram of a 1st internal gear;
Fig. 5 shows a perspective diagram of a 2nd internal gear;
Fig. 6 shows a perspective diagram of an engaging part;
Fig. 7 shows a perspective diagram of a coil unit; and
Fig. 8 shows the sectional view of an impact-absorbing mechanism;
Fig. 9 shows the perspective diagram of a rotating friction plate used for the impact-absorbing mechanism;
Fig. 10A shows the perspective diagram of a fixed friction plate used for the impact-absorbing mechanism viewed from the side in which the projection parts are not projected;
Fig. 10B shows the perspective diagram of a fixed friction plate used for the impact-absorbing mechanism viewed from the side in which the projection parts are projected; and
Fig. 11 shows a characteristic graph of a starter.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0041] With reference to the accompanying drawings, hereinafter will be described an embodiment of the present invention.

[0042] Fig. 1 shows a half cross-sectional view of a

starter 1. As shown in Fig. 1, the starter 1 of this embodiment generally comprises an electric motor 2, a speed reducer system (described later), a reduction ratio switching means (described later), a pinion gear 5, an electromagnetic switch 7, an impact-absorbing mechanism 8 (refer to Fig. 8) for protecting a power transfer system of the starter 1 from excessive shock, and a front housing 9. The electric motor 2 generates a rotational force. The speed reducer system has two levels of speed, which transmits the rotational speed of the electric motor 2 to an output shaft 3 after the rotational speed of the electric motor 2 is reduced. The reduction ratio switching means switches a reduction ratio of the speed reducer system.

[0043] The pinion gear 5 is arranged on the perimeter of the output shaft 3 together with a clutch 4 arranged as a unit. The electromagnetic switch 7 opens and closes a main point of contact (not shown) provided in an energization circuit of the electric motor 2, and moves the unit of the clutch 4 and the pinion gear 5 in the direction of an axle via a shift lever 6. The front housing 9 is fixed to the engine side.

[0044] In Fig. 1 to Fig. 3 of the present embodiment, the element explained below that is illustrated on the right-hand side is called the motor side, and illustrated on the left-hand side is called the anti-motor side.

[0045] The electric motor 2 is a commonly known commutator motor. The electric motor 2 has a commutator and brushes (not shown) for changing a current energized to an armature 2a according to a rotation phase. The armature 2a has an armature shaft 2b that outputs the torque.

[0046] The armature shaft 2b has a first end on the anti-motor side (left end in Fig. 1) that is inserted rotatably into an inner circumference of a space drilled in the motor side edge part of the output shaft 3 via a bearing 10. Another bearing (not shown), which is fixed to an end frame 11, rotatably supports the second end (right end in Fig. 1) of the armature shaft 2b.

[0047] The output shaft 3 is disposed in coaxial relation to the armature shaft 2b. The output shaft 3 has one end (right end in Fig. 1) supported rotatably by a bearing section 12a via bearing 13 provided integrally in an inner circumference of the frame member 12. A bearing 14, which is fixed to the front tip part of the front housing 9, rotatably supports the opposite end (left end in Fig. 1) of the output shaft 3. A frame member 12 is fit into the inner circumference of cylinder wall part 9a provided in the front housing 9, and is fixed so that the frame member 12 is supported unrotatably in the direction of a circumference and unmovable in the direction of the axis.

[0048] The clutch 4 is provided on the perimeter of the output shaft 3 via helical spline engagement that transmits a rotation of the output shaft 3 to the pinion gear 5 at the time of starting the engine. When the pinion gear 5 is rotated by the engine, that is, when the revolving speed of the pinion gear 5 exceeds the revolving speed of the output shaft 3, the clutch 4 acts as a one-way clutch that interrupts the power transfer between both the pinion gear 5 and the output shaft 3 so that the rotation of the pinion gear 5 is not transferred to the output shaft 3.

[0049] After the pinion gear 5 is engaged to a ring gear (not shown) of the engine, the pinion gear 5 transmits the torque via a clutch 4 to drive the ring gear.

[0050] The electromagnetic switch 7 has a switch coil (not shown) and a plunger 15. The switch coil is energized from a battery by closing a starting switch (not shown), and the plunger 15 that moves inside the inner circumference of the switch coil. When an electromagnet is formed by the energization to the switch coil, the plunger 15 will be attracted by the electromagnet and closes the main point of contact.

[0051] On the other hand, when the attracting force is removed by stopping the energization to the switch coil, the plunger 15 is pushed back to its original position by the force of the return spring (not shown) and opens the main point of contact.

[0052] The main point of contact is comprised of a pair of fixed contacts (not shown) connected to a motor circuit via two external terminals 16 and 17 that are disposed on the electromagnetic switch 7, and a movable contact (not shown) that connects and disconnects the pair of fixed contacts, which is disposed on the movable plunger 15. The main point of contact is in a closed state when the pair of fixed contacts is electrically connected via the movable contact, and the main point of contact is in a closed state when the pair of fixed contacts is electrically disconnected.

[0053] The shift lever 6 has a supporting part 6a, which is supported swingably by a lever holder 18. The shift lever 6 has a function of transmitting a motion of the plunger 15 to the clutch 4 by engaging one end of the shift lever 6 to a shifting rod 19 disposed on the plunger 15 of the electromagnetic switch 7, and by engaging another end of the shift lever 6 to the clutch 4.

[0054] The speed reducer system is explained hereafter.

[0055] As shown in Fig. 2, the speed reducer system is comprised of a 1st planetary speed reducer system (shortened to "1st speed reducer" hereafter) and a 2nd planetary speed reducer system (shortened to "2nd speed reducer" hereafter). The 1st speed reducer is constituted of having a 1st sun gear 20 formed on the armature shaft 2b in the center and the 2nd speed reducer is constituted of having a 2nd sun gear 21 formed on the armature shaft 2b in the center. Here, when describing a reduction ratio set for the 1st reduction ratio as a 1st reduction ratio and a reduction ratio set for the 2nd speed reducer as a 2nd reduction ratio, the 2nd reduction ratio is set larger than the 1st reduction ratio.

[0056] As for the 1st sun gear 20 and the 2nd sun gear 21, the 2nd sun gear 21 is formed on the tip side (left-hand side of Fig. 2) of the armature shaft 2b than the 1st sun gear 20. A teeth tip diameter of the 1st sun gear 20 is larger than that of the 2nd sun gear 21, and the 1st sun gear 20 is provided with more teeth than the 2nd sun

gear.

[0057] A plurality of 1st planetary gears 24 (three, for example) is engaged to the 1st sun gear 20. Planet pins 23 rotatably support the 1st planetary gears 24 via bearings 22. The 1st planetary gears 24 are engaged also to the inner circumference of a ist internal gear 25 that is located coaxially with the 1st sun gear 20.

[0058] Similarly, A plurality of 2nd planet gear 28 (three, for example) are engaged to the 2nd sun gear 21. Planet pins 27 rotatably support the 2nd planetary gears 28 via bearings 26. The 2nd planetary gears 28 are engaged also to the inner circumference of a 2nd internal gear 29 that is provided coaxially with the 2nd sun gear 21.

[0059] The planet pins 23 and 27 are fixed to a planet carrier 30 provided in the output shaft 3. The planet pins 23 and the planet pins 27 are arranged alternately in the direction of a circumference of the planet carrier 30. A spacer member 31 is inserted to the planet pins 23 in between the planet carrier 30 and the 1st planet gear 24. The spacer member 31 suppresses the 1st planet gear 24 from moving toward the direction of the anti-motor side (the planet carrier side).

[0060] As shown in Fig. 4, the 1st internal gear 25 is provided with an annular convex part 25a on the anti-motor side of the 1st internal gear 25. A large diameter part 25b with a larger outer diameter than the annular convex part 25a is provided on the motor side of the annular convex part 25a on the 1st internal gear 25. Further, pluralities of teeth part 25c are formed in all circumferences of the perimeter of the anti-motor side of the large diameter part 25b. As shown in Fig. 2, the large diameter part 25b is provided coaxially with the armature shaft 2b, and engages rotatably to the inner circumference of the joint member 33 that is pinched between a yoke 32 of the electric motor 2, and the cylinder wall part 9a of the front housing 9.

[0061] The 2nd internal gear 29 has an inner diameter larger than the 1st internal gear 25, and has a higher number of teeth. As shown in Fig. 5, the 2nd internal gear 29 is provided with an annular concave part 29a formed on the motor side of the 2nd internal gear 29 with the inner diameter larger than the diameter of teeth bottom of the 2nd internal gear 29. The annular concave part 29a and the annular convex part 25a provided in the 1st internal gear 25 are rotatably in meshing engagement (refer to Figs. 2, 4 and 5).

[0062] The 2nd internal gear 29 has two sizes of outer diameters. There provided are a small diameter part 29b on the motor side and a large diameter part 29c on the anti-motor side of the 2nd internal gear 29. Pluralities of teeth part 29d are formed on all circumferences of the motor side of the large diameter part 29c. The teeth part 29d formed on the large diameter part 29c has the same number of teeth as the teeth part 25c formed on the large diameter part 25b of the 1st internal gear 25, and the diameters of the teeth bottom and teeth tip of both the teeth part 25c and the teeth part 29d are the same.

[0063] Next, the reduction ratio switching means is explained hereafter.

[0064] As shown in Fig. 2, the reduction ratio switching means is equipped with a gear-switching member 34, and an electromagnetic drive means (described later) for moving the gear-switching member 34 in the direction of an axis.

[0065] The gear-switching member 34 is made of a ferromagnetic substance (for example, iron) magnetized by the electromagnet. The gear-switching member 34 has a ring shape arranged coaxially on the perimeter of two internal gears 25 and 29. The perimeter of the gear-switching member 34 fits into the inner circumference of the cylinder wall part 9a of the front housing 9 and its movement to the direction of the diameter is suppressed (centering), however it is allowed to slide along the axis.

[0066] As shown in Fig. 6, a rotation suppressing part 34a having a small inner diameter is formed on the motor side of the gear-switching member 34. A cylinder iron core part 34b having a large inner diameter is formed on the anti-motor side of the rotation suppressing part 34a. Pluralities of teeth parts 34c and 34d are formed in the inner circumference of the rotation suppressing part 34a, and the inner circumference of the cylinder iron core part 34b at all circumferences, respectively.

[0067] A motor side half of the teeth part 34c formed in the inner circumference of the rotation suppressing part 34a engages to the teeth part 25c formed in the 1st internal gear 25 when the gear-switching member 34 has moved to the motor side, as shown in Fig. 2. An anti-motor side half of the teeth part 34c engages to the teeth part 29d formed in the 2nd internal gear 29 when the gear-switching member 34 has moved to the anti-motor side, as shown in Fig. 3. That is, the teeth part 34c formed in the rotation suppressing part 34a is constituted by a 1st toothed part and a 2nd toothed part as a unit.

[0068] The length in the axis direction of the teeth part 34c formed in the rotation suppressing part 34a is set to a little shorter than the distance in the axial direction of the space obtained between the teeth part 25c formed in the 1st internal gear 25 and the 2nd internal gear 29. That is, the teeth part 34c formed in rotation suppressing part 34a never engages with the teeth part 25c formed in the 1st internal gear 25 and the teeth part 29d in the 2nd internal gear 29 at the same time.

[0069] In addition, in order to have teeth engage smoothly, it is effective to form suitable chamfering to the both edges of the circumference of the teeth part 34c formed in the rotation suppressing part 34a, teeth part 25c formed in the 1st internal gear 25, and the teeth part 29d formed in the 2nd internal gear 29, respectively.

[0070] The electromagnetic drive means comprises a magnetic coil 35, a yoke 36, and a return spring 37. The gear-switching member 34 engages mechanically with one of the 1st internal gear 25 and the 2nd internal gear 29. The magnetic coil 35 forms an electromagnet by energization and drives the gear-switching member 34 to the direction of anti-motor side by the attracting force of

the electromagnet.

[0071] The yoke 36 lets the magnetic flux generated by the magnetic coil 35 pass through. The return spring 37 pushes back the gear-switching member 34 to the direction of motor side when the energization to the magnetic coil 35 is stopped. The frame member 12 is constituted of ferromagnetic substances, such as iron, and forms a part of the magnetic path together with the yoke 36.

[0072] As shown in Fig. 2, the magnetic coil 35 is wound onto a bobbin 38 made of resin, and is arranged at the anti-motor side of the 2nd internal gear 29.

[0073] The magnetic coil 35 is fixed to the frame member 12 via a projected part 38a provided in the bobbin 38. An end of the magnetic coil 35 pulled out from the exterior of the starter 1 is connected to the energization control means (for example, ECU, not shown), and ON (energization) and OFF (stop energization) is switched by a signal from the energization control means.

[0074] The energization control means may detect the outside air temperature, for example, directly or indirectly, and switches the ON/OFF state of the magnetic coil 35 depending on the detected outside air temperature.

[0075] To be more specific, the energization control means switches the magnetic coil 35 OFF when the outside air temperature is above 0 degree centigrade, and switches the magnetic coil 35 ON when the outside air temperature is below 0 degree centigrade.

[0076] As shown in Fig. 2, the yoke 36 is comprised of a cylindrical magnetic path part 36a that forms a magnetic path in the inner circumference of the magnetic coil 35, and a ring-like magnetic path part 36b that forms the magnetic path in the motor side of the magnetic coil 35.

[0077] The anti-motor side edge part of the cylindrical magnetic path part 36a fits and is fixed rotatably into the perimeter of a part with middle stage 12b provided in the frame member 12. The yoke 36 is arranged so that its axis matches the axis of the armature shaft 2b.

[0078] Further, as shown in Fig.7, pluralities of engagement slots 36c are formed along the direction of an axis in the inner circumference of the ring-like magnetic path part 36b.

[0079] As shown in Fig. 7, a part 36d is formed along the entire outer circumference of the ring-like magnetic path part 36b. A toothed ring 34d formed in the inner circumference of the cylinder iron core part 34b of the gear-switching member 34 engages to the teeth part 36d so that the ring-like magnetic path part 36b suppresses the relative rotation of the gear-switching member 34 in the direction of a circumference.

[0080] However, movement of the gear-switching member 34 in the direction of its axis is permitted. Fig. 7 is the perspective diagram of the coil unit, which the magnetic coil 35 and the yoke 36 are attached to the frame member 12.

[0081] The return spring 37 is arranged between the outer diameter part of the frame member 12 and a level difference formed in the perimeter of the gear-switching member 34. The return spring 37 pushes the gear-switching member 34 to the motor side.

[0082] When the magnetic coil 35 is not energized, the gear-switching member 34 is pushed to the motor side by the force of the return spring 37, and the teeth part 34c formed in the rotation suppressing part 34a of the gear-switching member 34 engages with the teeth part 25c formed in the 1st internal gear 25.

[0083] At this time, the motor side end surface of the gear-switching member 34 contacts the joint member 33, and the gear-switching member 34 stands still, as shown in Fig. 2.

[0084] On the other hand, at the time the magnetic coil 35 is energized, the pushing force of the return spring 37 is resisted, and the gear-switching member 34 is attracted by the electromagnet.

[0085] Then the teeth part 34c formed in the rotation suppressing part 34a of the gear-switching member 34 engages with the teeth part 29d formed in the 2nd internal gear 29.

[0086] At this time, the anti-motor side end surface of the gear-switching member 34 contacts the frame member 12, and the gear-switching member 34 stands still, as shown in Fig. 3.

[0087] Next, the impact-absorbing mechanism 8 is explained hereafter.

[0088] As shown in Fig. 8, the impact-absorbing mechanism 8 is constituted with a plurality of (two, for example) rotating friction plates 39, a plurality of (two, for example) fixed friction plates 40, and a pressing means, or a plate spring 41 that presses the both plates 39 and 40 in between the frame member in the direction of an axis. The impact-absorbing mechanism 8 is arranged in the space defined by the perimeter of the bearing section 12a and the inner circumference of the cylindrical magnetic path part 36a of the yoke 36.

[0089] The bearing section 12a of the frame member 12 is formed extending cylindrically from an end of the inner circumference of the frame member in the direction of the diameter to the direction of the motor side, and provided in the position that overlaps the cylindrical magnetic path part 36a of the yoke 36 in the direction of the axis.

[0090] As shown in Fig. 9, the rotating friction plate 39 is formed in a ring shape having a round hole 39a that is provided in the central part of the direction of a diameter, and a plurality of convex part 39b is formed on the perimeter thereof.

[0091] As shown in Fig. 10, the fixed friction plate 40 is formed in a ring shape having a center hole 40a, and a plurality of projection parts 40b and a plurality of fitting slots 40c are provided in the inner circumference of the center hole 40a.

[0092] The projection parts 40b are projected to the one side of the direction of a thickness of the fixed friction plate 40, and their width in the direction of the circumference is formed in with two values; broad at the root side, and narrow at the tip side.

[0093] The projections from the surface of the fixed friction plate 40 of the broad part 40b1 having a broader width in the direction of the circumference, project to about the same height as the thickness of the rotating friction plate 39. The height of the projection the narrow part 40b2 having a narrower width in the direction of the circumference is approximately the same as the thickness of the fixed friction plate 40.

[0094] By the way, Fig. 10A is a perspective diagram which shows the fixed friction plate 40 viewed from the other side (the side in which the projection parts 40b are not projected) in the direction of the plate thickness, and Fig. 10B is a perspective diagram which shows the fixed friction plate 40 from the one side (the side in which the projection parts 40b are projected) of the direction in the plate thickness.

[0095] The inner diameter of the center hole 40a formed in the fixed friction plate 40 is formed almost the same in a size of the outer diameter of the bearing section 12a provided in the frame member 12 (however, the size is set so that the perimeter of the bearing section 12a can fit into the inner circumference of the center hole 40a).

[0096] The size of the inner diameter with the size equivalent to twice the thickness of projection part 40b added to the diameter of the center hole 40a is formed almost equal to the inner diameter of the round hole 39a (however, the size is set so that the plurality of projection parts 40b are able to fit into the inner circumference of the round hole 39a).

[0097] The fitting slots 40c are formed between the adjoining projection parts in the direction of the circumference, and are formed in the size that the narrow parts 40b2 of the projection parts 40b can fit exactly.

[0098] The above-mentioned rotating friction plates 39 and fixed friction plates 40 are stacked, alternating one-by-one, and attached to the perimeter of bearing section 12a provided in the frame member 12. The friction plates 39 and 40 are pushed against the end surface of the frame member 12 in response to the load of the plate spring 41.

[0099] However, both the frictions plates 39 and 40 are arranged from the frame member 12 side in the order of the rotating friction plate 39, the fixed friction plate 40, the rotating friction plate 39, and the fixed friction plate 40.

[0100] Moreover, the rotating friction plate 39 is rotatable to the frame member 12, and the relative rotation of both the rotating friction plate 39 and the frame member 12 is suppressed by concavo-convex fitting the convex part 39b provided in the perimeter to the engagement slots 36c formed in the inner circumference of the cylindrical magnetic path part 36a of the yoke 36.

[0101] On the other hand, the rotation of the 1st fixed friction plate 40 that has the rotating friction plate 39 between the frame members 12 is suppressed by fitting the narrow part 40b2 of the projection part 40b into engaging slot 12c (refer to Fig. 8) formed in the frame member 12. Further, the rotation of the 2nd fixed friction plate 40 is suppressed by fitting the narrow part 40b2 of the projection part 40b into fitting slot40c formed in the 1st fixed friction plate 40. The plate spring 41 is fixed and caulked to the end of the bearing section 12a in the state where the slide torque of the rotating friction plate 39 is set as the predetermined sliding torque.

[0102] Next, the operation of starter 1 is explained hereafter.

[0103] When the starting switch is closed, the switch coil of the electromagnetic switch 7 is energized and the plunger 15 is attracted therein. According to the movement of the plunger 15, the clutch 4 and the pinion gear 5 will be pushed out in the anti-motor direction (left of Fig. 1) on the output shaft 3 via the shift lever 6. By the movement of the plunger 15, the main point of contact closes, thus the electric motor 2 is energized from the battery, and the armature 2a starts rotating. The rotation of the armature 2a is slowed down by the 1st reduction ratio or the 2nd reduction ratio and transmitted to the output shaft 3. Further, the rotation of the armature 2a is transmitted from the output shaft 3 to the pinion gear 5 via the clutch 4. When the pinion gear 5 engages to the ring gear, the rotation is transmitted to the ring gear from the pinion gear 5, and it cranks the engine.

[0104] After the engine has started by cranking and the starting switch is opened, the energization to the switch coil will be stopped, and the attractive force of the electromagnet disappears. Consequently, the plunger 15 will be pushed back by the reactive force of the return spring 37 and the main point of contact opens and the energization to the electric motor 2 from a battery is stopped, thus rotation of the armature 2a slows down gradually and stops.

[0105] Furthermore, when the plunger 15 is pushed back, the clutch 4 is pushed back as well by the shift movement of the shift lever 6 i.e., in the opposite direction for starting the engine. Thus the pinion gear 5 is disengaged from the ring gear, and then returns back to the predetermined position (the position shown in Fig. 1) together with the clutch 4 on the output shaft 3 and stops.

[0106] Next, the operation of the speed reducer system is explained hereafter.

a) When the 1st reduction ratio is selected.

[0107] Since the magnetic coil 35 is in the OFF state, and the teeth part 34c formed in the rotation suppressing part 34a of the gear-switching member 34 and the teeth part 25c formed in the 1st internal gear 25 are engaged, the rotation of the 1st internal gear 25 is suppressed and rotation of the 2nd internal gear 29 is permitted (refer to Fig. 2).

[0108] Therefore, the rotation generated in the armature 2a is transmitted to the 1st planet gear 24 from the 1st sun gear 20, and while the 1st planet gear 24 rotates, it revolves the circumference of the 1st sun gear 20. On the other hand, since the rotation of the 2nd internal gear 29 is not suppressed (rotation is permitted), the 2nd plan-

et gear 28 only rotates according to the rotation of the 2nd sun gear 21, and does not revolve around the 1st sun gear 20.

[0109] Thereby, the revolution of the 1st planet gear 24 is transmitted to the output shaft 3 from the planet carrier 30. That is, the rotation of the armature 2a is slowed down by the 1st reduction ratio, and is transmitted to the output shaft 3.

b) When the 2nd reduction ratio is selected.

[0110] When the magnetic coil 35 is turned ON by the signal from the energization control means, the gear-switching member 34 will be attracted by the electromagnet, and will move to the anti-motor side resisting the elastic force of the return spring 37.

[0111] Consequently, the engagement of the teeth part 34c formed in the rotation suppressing part 34a and the teeth part 25c formed in the 1st internal gear 25 is canceled, and the engagement of the teeth part 34c formed in the rotation suppressing part 34a and the teeth part 29d formed in the 2nd internal gear 29 is performed.

[0112] At this time, when the teeth part 34c and the teeth part 29d are in the engageable position, in other words, when the teeth part 34c (convex part) formed in the rotation suppressing part 34a is located between the teeth part 29d and the adjoined teeth part 29d (concave part) formed in the 2nd internal gear 29, then the teeth part 34c formed in the rotation suppressing part 34a enters between the teeth part 29d and the adjoined teeth part 29d formed in the 2nd internal gear 29, and engagement of the both is completed. Thereby, the rotation of the 2nd internal gear 29 is suppressed and rotation of the 1st internal gear 25 is permitted (refer to Fig. 3).

[0113] On the other hand, when the gear-switching member 34 is attracted to the anti-motor side by the electromagnet, and when the end surface of the teeth part 34c formed in the rotation suppressing part 34a and the end surface of the teeth part 29d formed in the 2nd internal gear 29 contact in the direction of the axle, the 2nd internal gear 29 rotates slowly with the rotation of the armature 2a according to the 2nd gear ratio with the sun gear 21.

[0114] Consequently, the position of the teeth part 29d shifts in the direction of the circumference due to the attracting force of the electromagnet. The attracting force acts between the end surface of the teeth part 34c formed in the rotation suppressing part 34a and the end surface of the teeth part 29d formed in the 2nd internal gear 29. Thus both of the teeth parts 29d and 34c can engage when the teeth part 29d rotates to the position where the teeth part 34c can engage.

[0115] After the rotation of the 2nd internal gear 29 has been suppressed by the gear-switching member 34, if rotation occurs in the armature 2a by closing the starting switch, the rotation of the armature 2a is transmitted to the 2nd planet gear 28 from the 2nd sun gear 21, and the 2nd planet gear 28 rotates and revolves around the circumference of 2nd sun gear 21. On the other hand, since the rotation of the 1st internal gear 25 is not suppressed (rotation is permitted), the 1st planet gear 24 only rotates according to the rotation of the 1st sun gear 20, and does not revolve around the 1st sun gear 20.

[0116] Thereby, revolution of the 2nd planet gear 28 is transmitted to the output shaft 3 from the planet carrier 30. That is, the rotation of the armature 2a is slowed down by the 2nd reduction ratio, and is transmitted to the output shaft 3.

[0117] When the magnetic coil 35 is turned OFF by the signal from the energization control means after the engine has started, the attracting force of the electromagnet to the gear-switching member 34 disappears, and will move to the motor side by the elastic force of the return spring 37.

[0118] Consequently, the engagement of the teeth part 34c formed in the rotation suppressing part 34a and the teeth part 29d formed in the 2nd internal gear 29 is canceled, and the engagement of the teeth part 34c formed in the rotation suppressing part 34a and the teeth part 25c formed in the 1st internal gear 25 is performed.

[0119] At this time, when the teeth part 34c and the teeth part 25c are in the engageable position. In other words, when the teeth part 34c (convex part) formed in the rotation suppressing part 34a is located between the teeth part 25c and the adjacent teeth part 25c (concave part) formed in the 1st internal gear 25, then the teeth part 34c formed in the rotation suppressing part 34a enters between the teeth part 25c and the adjacent teeth part 25c formed in the 1st internal gear 25, and engagement of both is completed.

[0120] Thereby, the rotation of the 1st internal gear 25 is suppressed and rotation of the 2nd internal gear 29 is permitted (refer to Fig. 2).

[0121] On the other hand, when the gear-switching member 34 is pushed back to the motor side, and when the end surface of the teeth part 34c formed in the rotation suppressing part 34a and the end surface of the teeth part 25c formed in the 1st internal gear 25 contact in the direction of the axle, the state of the end surfaces of the teeth part 34c and the teeth part 25c being contacted is maintained while the force of the return spring 37 is applied.

[0122] When the armature 2a of the electric motor 2 rotates the next time the engine starts in the above state, the 1st internal gear 25 rotates slowly according to the gear ratio with the 1st sun gear 20, thus the position of the teeth part 25c formed in the 1st internal gear 25 shifts in the direction of the circumference, and both the teeth parts can be engaged when the teeth part 25c rotates to the position where it can engage the teeth part 34c formed in the rotation suppressing part 34a. By this, the rotation of the 1st internal gear 25 is suppressed, and the rotation of the 2nd internal gear 29 is permitted, thus starting the engine by the 1st reduction ratio becomes possible.

[0123] Next, the characteristics of the starter 1 are ex-

plained hereafter with reference to Fig. 11.

[0124] The torque and speed at the time of using the 1st speed reducer (the 1st reduction ratio) are shown in Fig. 11 by a solid line, and the torque and speed at the time of using the 2nd speed reducer (the 2nd reduction ratio) are shown in dashed line.

[0125] First, when the torque of the operating point at normal temperatures (in general, 5 to 35 degrees centigrade) is shown by Tw, the output at the time of using the 1st reduction ratio is set to P1, and the speed is set to N1, while he output at the time of using the 2nd reduction ratio is set to P2, and the speed is set to N2.

[0126] In the starter 1 of this embodiment, since the 1st reduction ratio is used in temperature conditions higher than 0 degree centigrade, an output is set to P1, the speed is set to N1, the output and the speed improve sharply and shortening of starting time can be aimed for, compared to the case where the 2nd reduction ratio is used.

[0127] On the other hand, when the torque of the operating point in low temperature of minus 20 degrees centigrade or less is shown by Tc, the output by conventional single reduction ratio is Pc, and the speed is Nc.

[0128] In the starter 1 of this embodiment, since the 2nd reduction ratio is used in temperature conditions of 0 degree centigrade or less, the output becomes Pc, the speed becomes Nc, and it becomes the same operating point as conventional single reduction ratio. Thereby, the same good low-temperature starting nature as the former can be obtained.

[0129] Next, the operation of the impact-absorbing mechanism 8 is explained hereafter.

[0130] If an excessive shock is applied to the starter side from the engine side by a certain cause, the shocking rotation load will be transmitted to the output axis 3 from the pinion gear 5, and will be further transmitted to the reduction gear from the output axis 3.

[0131] At this time, if the starter 1 is operated in the 1st reduction ratio, for example, the rotation load will be transmitted to the 1st internal gear 25 via the 1st planet gear 24, thus the 1st internal gear 25 is going to rotate in the counter direction of the output axis 3.

[0132] However, since the 1st internal gear 25 is engaging with the gear-switching member 34 mechanically, the rotation load is transmitted to the gear-switching member 34.

[0133] Moreover, the gear-switching member 34 is connected with the rotating friction plate 39 of the impact-absorbing mechanism 8 via the yoke 36.

[0134] Specifically, the engagement of the tooth parts 36d formed in the ring-like magnetic path part 36b of the yoke 36 and the tooth parts 34d of the cylindrical iron core part 34b of the gear-switching member 34 suppresses the relative rotation of the both.

[0135] Furthermore, the engagement between the convex part 39b provided in the rotating friction plate 39 and the engagement slots 36c formed in the cylindrical magnetic path part 36a of the yoke 36 suppresses the relative rotation of both.

[0136] Thereby, the shock generated by the shocking rotation load is eased by the rotation load transmitted to the gear-switching member 34 being transmitted to the rotating friction plate 39 via a yoke 36, so that the rotating friction plate 39 rotates between the end surface of the frame member 12 and the fixed friction plate 40 with predetermined frictional resistance.

[The effect of the embodiment]

[0137] The starter 1 of this embodiment is able to suppress reliably the rotation of the 1st internal gear 25 or the 2nd internal gear 29 by mechanical engagement (engagement of the teeth parts) to the gear-switching member 34.

[0138] By moving the gear-switching member 34 in the direction of the axis, the starter 1 is also being able to change the reduction ratio by switching the internal gears 25 and 29 that suppress the rotation. According to this composition, since suppressing and canceling the suppression of the rotation of the two internal gears 25 and 29 can be performed in one gear-switching member 34, the number of parts can be reduced and the structure can be simplified.

[0139] Further, the composition is to move the gear-switching member 34 in the direction of the axis for suppressing and canceling the suppression of the rotation of the two internal gears 25 and 29, and so it is not necessary to move the gear-switching member 34 radially, thus radial enlargement can be controlled.

[0140] When toothed parts are formed in the perimeter of the two internal gears 25 and 29 on the opposite side in the direction of the axle, respectively, for example, specifically, if toothed parts are formed in the perimeter of the 1st internal gear 25 on the direction of the motor side and in the perimeter of the 2nd internal gear 29 on the direction of the anti-motor side, respectively, it is necessary to detach and form the 1st toothed part and the 2nd toothed part in the direction of the axis on the gear-switching member 34.

[0141] That is, in order to form the 1st toothed part and the 2nd toothed part on both sides of the axis ranging over two internal gears 25 and 29, the length in the direction of the axis of the gear-switching member 34 becomes long.

[0142] On the other hand, in the present invention, since toothed parts are formed in the perimeter of the 1st internal gear 25 and the 2nd internal gear 29 that face each other in the direction of the axis, respectively, the 1st toothed part and the 2nd toothed part can be formed closely in the direction of the axis, and it is possible to shorten the length in the direction of the axis of the gear-switching member 34.

[0143] Two internal gears 25 and 29 are arranged adjoining in the direction of the axis, and since the end surfaces of both internal gears 25 and 29 facing each other in the direction of the axis are engaged rotatably in con-

cavo-convex manner, the axes of the both internal gears 25 and 29 can be matched.

[0144] Therefore, it is possible to control the inclination of the centers of the two internal gears 25 and 29, and to smoothly change the two internal gears 25 and 29 by the gear-switching member 34.

[0145] In addition, since one of the two internal gears 25 or 29 races because the engagement to the gear-switching member 34 is canceled, it is possible to use a low-mass resin material (polyamide resin, for example) for at least one of the internal gears, thus unbalancing influence that occurs to the racing internal gear can be reduced, thus there will be an effect that can control the vibration.

[0146] Although the magnetic coil 35 is used for the driving means of the gear-switching member 34 in this embodiment, the rotation of the internal gears 25 and 29 can be suppressed by a mechanical engagement of the gear-switching member 34 without depending on the power of attracting force of the magnetic coil 35, therefore the magnetic coil 35 can be miniaturized.

[0147] That is, the magnetic force generated by the magnetic coil 35 is needed only to attract the gear-switching member 34 in the direction of axis (the anti-motor direction), thus it is not necessary to suppress the rotation of the internal gears 25 and 29 by the attracting force of the magnetic coil 35, therefore the magnetic coil 35 can be miniaturized.

[0148] Moreover, the starter 1 being enlarged in the direction of the diameter is avoidable by arranging the miniaturized magnetic coil 35 adjoining to the 2nd internal gear 29 it in the direction of the axis.

[0149] The relative rotation of the gear-switching member 34 is suppressed in by engaging the toothed ring 34d formed in the inner circumference of the cylinder iron core part 34b to the teeth part 36c formed in the perimeter of the ring-like magnetic path part 36b of the yoke 36. In this case, it is not necessary to newly provide any parts other than the yoke 36 in order to suppress the rotation of the gear-switching member 34, thus the increase in parts number can be controlled.

[0150] Further, the facing areas of the inner side of the cylinder iron core part 34b and the perimeter side of the ring-like magnetic path part 36b becomes large by forming the teeth parts 34d and 36c in the inner circumference of the cylinder iron core part 34b and the inner circumference of the ring-like magnetic path part 36b that face each other in the direction of the diameter, respectively, thus the magnetic resistance decreases and the attracting force of the magnetic coil 35 can be improved.

[0151] Furthermore, since the ON/OFF state of the magnetic coil 35 is selected according to the outside temperature in this embodiment, when outside air temperature is higher than 0 degree centigrade, the magnetic coil 35 is turned OFF and a small reduction ratio of the 1st reduction ratio is selected, for example, it is possible to shorten the engine starting time by increased speed of the starter 1 instead of selecting the 2nd reduction ratio.

[0152] On the other hand, when the outside air temperature is 0 degree centigrade or less, it is possible to secure a good engine starting nature by selecting the a large reduction ratio of the 2nd reduction ratio even if the engine friction becomes large by the fall of outside air temperature.

[0153] Moreover, if the 1st reduction ratio is selected when the outside air temperature is higher than 0 degree centigrade, the frequency of using the 1st reduction ratio will increase rather than the 2nd reduction ratio in many areas on the earth, such as Japan, United States and Europe, for example.

[0154] For this reason, the electric energy needed to energize the magnetic coil 35 can be controlled to the minimum by turning OFF the magnetic coil 35 when selecting the frequently used 1st reduction ratio.

[0155] In the starter 1 of this embodiment, since the gear-switching member 34 is connected with the rotating friction plate 39 of the impact-absorbing mechanism 8 via the yoke 36, the power transfer system of the starter 1 can be protected when the excessive shock is applied to the internal gear (the 1st internal gear 25 or the 2nd internal gear 29) that engages with the gear-switching member 34 by the rotation of the rotating friction plate 39 that eases the shock.

[0156] Further, by equipping the impact-absorbing mechanism 8, it is possible to form the module of the reduction gear (the 1st internal gear 25 and the 2nd internal gear 29) used for two gear reduction systems smaller, and especially the outer diameter of the module can be miniaturized.

[0157] Furthermore, since the impact-absorbing mechanism 8 has a composition of having the rotating friction plate 39 and the fixed friction plate 40 stacked in the direction of their common axis, and is pressed in the direction of its axis with the plate spring 41, so that the parts are not disposed in the radial direction, so as not to increase the diameter of the starter 1, it is not necessary to secure a big loading space in the direction of the diameter, and the impact-absorbing mechanism 8 can be efficiently arranged in the space using the space defined by the cylindrical magnetic path part 36a of the yoke 36 and the bearing section 12a provided in the frame member 12.

[0158] Thereby, since the space for arranging the impact-absorbing mechanism 8 is securable reasonably even if the starter 1 has two speed reduction systems and a reduction ratio changing means, the size of the starter 1 can be controlled not to become large.

[0159] Moreover, the impact-absorbing mechanism 8 can improve an impact-absorbing capability by increasing the number of plates that are used for the rotating friction plate 39 and the fixed friction plate 40, respectively.

[0160] In this case, the big impact-absorbing mechanism 8 of impact-absorbing capability can be constituted compactly, without expanding the size of the direction of the axis sharply, since the impact-absorbing mechanism

8 is not enlarged in the direction of the diameter and both the frictions plates 39 and 40 are piled up in the direction of the plate thickness (the direction of the axis).

Claims

1. A speed reduction type starter (1) for an engine equipped with a ring gear comprising:

a motor (2) that has an armature shaft (2b) for generating torque,
two planetary gear reduction systems that have different reduction ratios and that are installed on the armature shaft (2b) of the motor (2);
reduction ratio changing means for choosing either one of the reduction systems to change a reduction ratio that reduces the drive torque to be transmitted to from the motor (2) to the engine;
an output shaft (3) to which the drive torque of the motor (2) is transmitted via the reduction system chosen by the reduction ratio changing means;
a pinion gear (5) that engages with the ring gear of the engine arranged at a perimeter of the output shaft (3);
an impact-absorbing mechanism (8) that absorbs any excessive shock when the excessive shock is applied from the engine; and
the starter (1) that starts the engine by transmitting the drive torque of the motor (2) amplified by the reduction systems to the ring gear from the pinion gear (5);
wherein the reduction ratio changing means engages mechanically with one of two internal gears (25, 29) used in the two gear reduction systems and suppresses rotation of the one of internal gears (25, 29),
the gear reduction systems comprises a gear-switching member (34) that permits rotation of the other internal gear, the gear-switching member (34) arranged in a perimeter of the two internal gears (25, 29) coaxially and is arranged movable in the direction of an axis, and rotation of the gear-switching member (34) is suppressed via the impact-absorbing mechanism (8), so that the reduction ratio is changed by changing the internal gear which rotation is suppressed by moving the gear-switching member (34) in the direction of the axis.

2. A speed reduction type starter (1) for engines of Claim 1, the starter (1) further comprises:

a toothed part (25c) formed in the perimeter of the 1st internal gear (25) of the pair of internal gears arranged on the direction of the anti-motor side;
another toothed part (29d) formed in the perimeter of the 2nd internal gear (29) of the pair of internal gears arranged on the direction of the motor side;
a 1st toothed part engageable with the toothed part (25c) formed in the 1st internal gear (25); and
a 2nd toothed part engageable with the toothed part (29d) formed in the 2nd internal gear (29) formed in the inner circumference of the engaging part; wherein the rotation of the 1st internal gear (25) is suppressed when the 1st toothed part engages with the toothed part (25c) of the 1st internal gear (25) by moving the engaging part to the direction of motor side, and the rotation of the 2nd internal gear (29) is suppressed when the 2nd toothed part engages with the toothed part (29d) of the 2nd internal gear (29) by moving the engaging part to the direction of anti-motor side.

3. A speed reduction type starter (1) for engines of Claim 2, the 1st toothed part and the 2nd toothed part are arranged as a unit (34c) in the direction of the axis continuously.

4. A speed reduction type starter (1) for engines of Claim 1, end surfaces of the pair of internal gears (25, 29) facing each other in the direction of the axis are engaged rotatably in concavo-convex manner.

5. A speed reduction type starter (1) for engines of Claim 1, resin material is used for at least one of the internal gears (25, 29).

6. A speed reduction type starter (1) for engines of Claim 1, the starter (1) further comprises:

an magnetic coil (35) that forms an electromagnet by energization and drives the engaging part to one direction by the magnetic force of the electromagnet;
a return spring (37) that pushes back the engaging part to another direction when the energization to the magnetic coil (35) is stopped;
the 1st internal gear (25) arranged on the direction of the motor side; and
the 2nd internal gear (29) arranged on the direction of the anti-motor side;
wherein the magnetic coil (35) is arranged nearly on either the motor side of the 1st internal gear (25) or the anti-motor side of the 2nd internal gear (29).

7. A speed reduction type starter (1) for engines of Claim 6, a ferromagnetic substance attracted by the electromagnet constitutes the engaging part.

8. A speed reduction type starter (1) for engines of Claim 6, the starter (1) further comprises:

a yoke (36) that lets magnetic flux generated by the magnetic coil (35) pass through, wherein the yoke (36) has a ring-like magnetic path part (36b) that is arranged between the magnetic coil (35) and one of the pair of the internal gears (25, 29); and
the engaging part having a cylinder iron core part (34b) that is extended in the direction of the axle on the perimeter of the ring-like magnetic path part (36b); wherein an inner circumference of the cylinder iron core part (34b) engages in concavo-convex manner to the ring-like magnetic path part (36b) so that the rotation in the direction of a circumference of the engaging part is suppressed, while a movement in the direction of axis is permitted.

9. A speed reduction type starter (1) for engines of Claim 8, the yoke (36) having a cylindrical magnetic path part (36a) that extends from the inner circumference of the ring-like magnetic path part (36b) to the inner circumference side of the magnetic coil (35) in the axial direction of the anti-motor side,
a frame member (12) for which rotation is suppressed and provided unmovable in the direction of the axis is arranged in the axial direction of an anti-gear reduction system of the magnetic coil (35),
a bearing section (12a) that supports the perimeter of the output axis rotatably via a bearing is provided integrally in an inner circumference of the frame member (12) in the direction of the diameter,
the bearing section (12a) is extended cylindrically to the direction of the motor side and a bearing (13) is disposed therein, and
the impact-absorbing mechanism (8) is arranged in the space defined by the perimeter of the bearing section (12a) and the inner circumference of the cylindrical magnetic path part (36a).

10. A speed reduction type starter (1) for engines of Claim 9, the impact-absorbing mechanism (8) comprises:

a rotating friction plate (39) that is arranged rotatably to the frame member (12), and its own perimeter part is engaged in a concavo-convex manner with the inner periphery of the ring-like magnetic path part (36b) so that the rotation is suppressed;
a fixed friction plate (40) that is stacked with the rotating friction plate (39) in the direction of an axis and suppressed its rotation by the frame member (12); and
a pressing means (41) that presses the rotating friction plate (39) and the fixed friction plate (40) in between the frame member (12) in the direction of its axis, wherein the impact-absorbing mechanism (8) absorbs an excessive shock by the sliding (rotating) of the rotating friction plate (39) that resists the friction power when the excessive shock exceeding a slide torque of the rotating friction plate (39) applied to the internal gear that engages with the gear-switching member (34).

11. A speed reduction type starter (I) for engines of Claim 10, the impact-absorbing mechanism (8) is constituted by using a plurality of the rotating friction plates (39) and the fixed friction plates (40) stacked alternating one-by-one.

12. A speed reduction type starter (1) for engines of Claim 6, the engaging part suppresses the rotation of the internal gear used for the speed reducer system with the low reduction ratio when the magnetic coil (35) is not energized, and the engaging part suppresses the rotation of the internal gear used for the speed reducer system with the high reduction ratio when the magnetic coil (35) is energized.

13. A speed reduction type starter (1) for engines of Claim 6, the engaging part suppresses the rotation of the internal gear used for the frequently used speed reducer system when the magnetic coil (35) is not energized,
and the engaging part suppresses the rotation of the internal gear used for the not frequently used speed reducer system when the magnetic coil (35) is energized.

14. A speed reduction type starter (1) for engines of Claim 12, the magnetic coil (35) is not energized when the outside air temperature is higher than 0 degree centigrade, and the magnetic coil (35) is energized when the outside air temperature is 0 degree centigrade or less.

15. A speed reduction type starter (1) for engines of Claim 13, the magnetic coil (35) is not energized when the outside air temperature is higher than 0 degree centigrade, and the magnetic coil (35) is energized when the outside air temperature is 0 degree centigrade or less.

Patentansprüche

1. Drehzahlreduktions-Starter (1) für einen mit einem Zahnkranz ausgestatteten Verbrennungsmotor, aufweisend:

einen Elektromotor (2), der eine Ankerwelle (2b) zum Erzeugen eines Drehmoments aufweist,

zwei Planetengetriebe-Reduktionssysteme, die unterschiedliche Untersetzungsverhältnisse aufweisen und auf der Ankerwelle (2b) des Elektromotors (2) installiert sind;
eine Untersetzungsverhältnis-Veränderungseinrichtung zum Wählen von einem der Reduktionssysteme zum Verändern eines Untersetzungsverhältnisses, das das an und von dem Elektromotor (2) an den Verbrennungsmotor zu übertragende Antriebsmoment reduziert;
eine Ausgangswelle (3), an die das Antriebsmoment des Elektromotors (2) über das Reduktionssystem, das durch die Untersetzungsverhältnis-Veränderungseinrichtung gewählt wurde, übertragen wird;
ein Antriebsritzel (5), das mit dem Zahnkranz des Verbrennungsmotors, der an einem Umfang der Ausgangswelle (3) angeordnet ist, Eingriff nimmt;
einen Stoßdämpfungsmechanismus (8), der alle zu großen Stoßkräfte dämpft, wenn die zu großen Stoßkräfte durch den Verbrennungsmotor aufgebracht werden; und
den Starter (1), der den Verbrennungsmotor durch Übertragen des durch die Reduktionssysteme verstärkten Antriebsmoments des Elektromotors (2) auf den Zahnkranz von dem Antriebsritzel (5) startet; wobei die Untersetzungsverhältnis-Veränderungseinrichtung mit einem von zwei Innenzahnräder (25, 29), die in den beiden Getriebeuntersetzungssystemen verwendet werden, mechanisch Eingriff nimmt und eine Rotation von einem der Innenzahnräder (25, 29) verhindert,
die Getriebeuntersetzungssysteme ein Gangschaltelement (34), das eine Rotation des anderen Innenzahnrads ermöglicht, aufweist, das Gangschaltelement (34), das in einem Umfang der beiden Innenzahnräder (25, 29) koaxial angeordnet ist und in der Richtung einer Achse beweglich angeordnet ist, und eine Rotation des Gangschaltelements (34) über den Stoßdämpfungsmechanismus (8) verhindert wird, so dass das Untersetzungsverhältnis durch Verändern des Innenzahnrads verändert wird, dessen Rotation durch Bewegen des Gangschaltelements (34) in der Richtung der Achse verhindert wird.

2. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 1, wobei der Starter (1) aufweist:

einen mit einer Verzahnung versehenen Teil (25c), der in dem Umfang des ersten Innenzahnrads (25) des Paars von Innenzahnräder ausgebildet ist, das in Richtung der dem Motor gegenüberliegende Seite angeordnet ist;
einen weiteren mit einer Verzahnung versehenen Teil (29d), der in dem Umfang des zweiten Innenzahnrads (29) des Paars von Innenzahnrädern ausgebildet ist, das in Richtung der Motorseite angeordnet sind;
einen ersten mit einer Verzahnung versehenen Teil, mit dem der mit einer Verzahnung versehene Teil (25c), der in dem ersten Innenzahnrad ausgebildet ist, Eingriff nehmen kann; und
einen zweiten mit einer Verzahnung versehenen Teil, der mit dem mit einer Verzahnung versehenen Teil (29d), der in dem zweiten Innenzahnrad (29) ausgebildet ist, das in dem Innenumfang des Eingriffsteils ausgebildet ist, Eingriff nehmen kann; wobei die Rotation des ersten Innenzahnrads (25) verhindert wird, wenn der erste mit einer Verzahnung versehene Teil mit dem mit einer Verzahnung versehenen Teil (25c) des ersten Innenzahnrads (25) durch Bewegen des Eingriffteils in Richtung der Motorseite Eingriff nimmt, und die Rotation des zweiten Innenzahnrads (29) verhindert wird, wenn der zweite mit einer Verzahnung versehene Teil mit dem mit einer Verzahnung versehenen Teil (29d) des zweiten Innenzahnrads (29) durch Bewegen des Eingriffteils in Richtung der dem Motor gegenüberliegende Seite Eingriff nimmt.

3. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 2, wobei der erste mit einer Verzahnung versehene Teil und der zweite mit einer Verzahnung versehene Teil als eine Einheit (34c) in Richtung der Achse kontinuierlich angeordnet sind.

4. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 1, wobei Endoberflächen des Paars von Innenzahnrädern (25, 29), die einander in Richtung der Achse gegenüberliegen, drehbar in konkav-konvexer Weise Eingriff nehmen.

5. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 1, wobei ein Harzmaterial für zumindest eines der Innenzahnräder (25, 29) verwendet wird.

6. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 1, wobei der Starter (1) aufweist:

eine Magnetspule (35), die durch Erregung einen Elektromagneten bildet und das Eingriffteil durch die Magnetkraft des Elektromagneten in eine Richtung antreibt;
eine Rückstellfeder (37), die das Eingriffteil in eine andere Richtung zurückschiebt, wenn die Erregung der Magnetspule (35) unterbrochen wird;
das erste Innenzahnrad (25), das in Richtung der Motorseite angeordnet ist; und

das zweite Innenzahnrad (29), das in Richtung der dem Motor gegenüberliegenden Seite angeordnet ist;
wobei die Magnetspule (35) in der Nähe entweder der Motorseite des ersten Innenzahnrads (25) oder der dem Motor gegenüberliegenden Seite des zweiten Innenzahnrads (29) angeordnet ist.

7. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 6, wobei eine ferromagnetische Substanz, die durch den Elektromagneten angezogen wird, das Eingriffteil bildet.

8. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 6, wobei der Starter (1) ferner aufweist:

ein Joch (36), das einen durch die Magnetspule (35) erzeugten Magnetfluss durchlässt, wobei das Joch (36) einen Teil (36b) eines ringförmigen magnetischen Wegs aufweist, der zwischen der Magnetspule (35) und einem von dem Paar der von Innenzahnräder (25, 29) angeordnet ist; und
das Eingriffteil, das einen Zylindereisenkernteil (34b) aufweist, der sich in Richtung der Achse auf dem Umfang des Teils (36b) des ringförmigen magnetischen Wegs erstreckt; wobei ein Innenumfang des Zylindereisenkernteils (34b) in konkav-konvexer Weise mit dem Teil (36b) des ringförmigen magnetischen Wegs Eingriff nimmt, so dass die Rotation in Richtung eines Umfangs des Eingriffteils verhindert wird, während eine Bewegung in Richtung der Achse ermöglicht wird.

9. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 8, wobei das Joch (36) einen Teil (36a) eines zylindrischen magnetischen Wegs aufweist, der sich von dem Innenumfang des Teils (36b) des ringförmigen magnetischen Wegs zu der Innenumfangsseite der Magnetspule (35) in der axialen Richtung der dem Motor gegenüberliegenden Seite erstreckt,
ein Rahmenelement (12), dessen Rotation verhindert wird und das unbeweglich in Richtung der Achse angeordnet ist, in der axialen Richtung eines Gegen-Untersetzungssystems der Magnetspule (35) angeordnet ist;
ein Lagerabschnitt (12a), der den Umfang der Ausgangsachse drehbar über ein Lager lagert, einstükkig in einem Innenumfang des Gehäuseelements (12) in Richtung des Durchmessers angeordnet ist, der Lagerabschnitt (12a) sich zylindrisch in Richtung der Motorseite erstreckt und ein Lager (13) darin angeordnet ist; und
der Stoßdämpfungsmechanismus (8) in dem Raum angeordnet ist, der durch den Umfang des Lagerabschnitts (12a) und den Innenumfang des Teils (36a) des zylindrischen magnetischen Wegs definiert ist.

10. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 9, wobei der Stoßdämpfungsmechanismus (8) aufweist:

eine rotierende Reibungsplatte (39), die drehbar an dem Rahmenelement (12) angebracht ist, und deren eigener Umfangsteil in konkav-konvexer Weise mit dem Innenumfang des Teils (36) des ringförmigen magnetischen Wegs Eingriff nimmt, so dass die Rotation verhindert wird;
eine feststehende Reibungsplatte (40), die mit der rotierenden Reibungsplatte (39) in Richtung einer Achse aneinandergestapelt ist und deren Rotation durch das Rahmenelement (12) verhindert wird; und
eine Druckeinrichtung (41), die die rotierende Reibungsplatte (39) und die feststehende Reibungsplatte (40) zwischen das Rahmenelement (12) in Richtung der Achse drückt, wobei der Stoßdämpfungsmechanismus (8) zu große Stoßkräfte durch das Gleiten (Rotieren) der rotierenden Reibungsplatte (39), die sich der Reibungsleistung widersetzt, dämpft, wenn die zu großen Stoßkräfte ein Gleitmoment der rotierenden Reibungsplatte (39), das auf das Innenzahnrad aufgebracht wird, das mit dem Gangschaltelement (34) Eingriff nimmt, übersteigen.

11. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 10, wobei der Stoßdämpfungsmechanismus (8) unter Verwendung von einer Mehrzahl der rotierenden Reibungsplatten (39) und der feststehenden Reibungsplatten (40), die jeweils abwechselnd aneinander gestapelt sind, gebildet wird.

12. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 6, wobei das Eingriffteil die Rotation des Innenzahnrads, das für das Drehzahlreduktionssystem mit dem niedrigen Untersetzungsverhältnis verwendet wird, verhindert, wenn die Magnetspule (35) nicht erregt ist, und das Eingriffteil die Rotation des Innenzahnrads, das für das Drehzahluntersetzungssystem mit dem hohen Untersetzungsverhältnis verwendet wird, verhindert, wenn die Magnetspule (35) erregt ist.

13. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 6, wobei das Eingriffteil die Rotation des Innenzahnrads, das für das häufig verwendete Drehzahlreduktionssystem verwendet ist, verhindert, wenn die Magnetspule (35) nicht erregt ist,
und das Eingriffteil die Rotation des Innenzahnrads,

das für das nicht häufig verwendete Drehzahlreduktionssystem verwendet wird, verhindert, wenn die Magnetspule (35) erregt ist.

14. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 12, wobei die Magnetspule (35) nicht erregt ist, wenn die Außenlufttemperatur mehr als 0 Grad Celsius beträgt, und die Magnetspule (35) erregt ist, wenn die Außenlufttemperatur 0 Grad Celsius oder weniger beträgt.

15. Drehzahlreduktions-Starter (1) für Verbrennungsmotoren nach Anspruch 13, wobei die Magnetspule (35) nicht erregt ist, wenn die Außenlufttemperatur mehr als 0 Grad Celsius beträgt, und die Magnetspule (35) erregt ist, wenn die Außenlufttemperatur 0 Grad Celsius oder weniger beträgt.

Revendications

1. Démarreur à réduction de vitesse (1) pour un moteur thermique équipé d'une couronne dentée, comprenant :

un moteur électrique (2) qui comporte un arbre d'induit (2b) pour générer un couple, deux systèmes de réduction à engrenage satellite qui possèdent des rapports de réduction différents et qui sont installés sur l'arbre d'induit (2b) du moteur électrique (2) ;
des moyens de changement de rapport de réduction pour choisir l'un ou l'autre des systèmes de réduction pour changer un rapport de réduction qui réduit le couple d'entraînement destiné à être transmis du moteur électrique (2) au moteur thermique ;
un arbre de sortie (3) auquel le couple d'entraînement du moteur électrique (2) est transmis par l'intermédiaire du système de réduction choisi par les moyens de changement de rapport de réduction ;
un engrenage à pignon (5) qui est en prise avec la couronne dentée du moteur thermique agencé à un périmètre de l'arbre de sortie (3) ;
un mécanisme d'absorption d'impact (8) qui absorbe tout choc excessif lorsque le choc excessif est appliqué à partir du moteur thermique ; et
le démarreur (1) qui démarre le moteur thermique en transmettant le couple d'entraînement du moteur électrique (2) amplifié par les systèmes de réduction à la couronne dentée à partir de l'engrenage à pignon (5) ;
dans lequel les moyens de changement de rapport de réduction entrent mécaniquement en prise avec un de deux engrenages internes (25, 29) utilisés dans les deux systèmes de réduction à engrenage et suppriment la rotation de l'un des engrenages internes (25, 29),
les systèmes de réduction à engrenage comprennent un élément de permutation d'engrenage (34) qui permet la rotation de l'autre engrenage interne, l'élément de permutation d'engrenage (34) étant agencé dans un périmètre des deux engrenages internes (25, 29) de façon coaxiale et est agencé de façon mobile dans la direction d'un axe, et la rotation de l'élément de permutation d'engrenage (34) est supprimée par l'intermédiaire du mécanisme d'absorption d'impact (8), pour que le rapport de réduction soit changé en changeant l'engrenage interne dont la rotation est supprimée en déplaçant l'élément de permutation d'engrenage (34) dans la direction de l'axe.

2. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 1, le démarreur (1) comprenant en outre :

une partie dentée (25c) formée dans le périmètre du premier engrenage interne (25) de la paire d'engrenages internes agencés dans la direction du côté opposé au moteur électrique ;
une autre partie dentée (29d) formée dans le périmètre du second engrenage interne (29) de la paire d'engrenages internes agencés dans la direction du côté moteur électrique ;
une première partie dentée pouvant s'engrener avec la partie dentée (25c) formée dans le premier engrenage interne (25) ; et
une seconde partie dentée pouvant s'engrener avec la partie dentée (29d) formée dans le second engrenage interne (29) formé dans la circonférence intérieure de la partie d'engrènement ; dans lequel la rotation du premier engrenage interne (25) est supprimée lorsque la première partie dentée est en prise avec la partie dentée (25c) du premier engrenage interne (25) en déplaçant la partie d'engrènement dans la direction du côté moteur électrique, et la rotation du second engrenage interne (29) est supprimée lorsque la seconde partie dentée est en prise avec la partie dentée (29d) du second engrenage interne (29) en déplaçant la partie d'engrènement dans la direction du côté opposé au moteur électrique.

3. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 2, dans lequel la première partie dentée et la seconde partie dentée sont agencées sous forme d'unité (34c) dans la direction de l'axe en continu.

4. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 1, dans lequel des surfaces d'extrémité de la paire d'engrenages inter-

nes (25, 29) se faisant face dans la direction de l'axe sont engrenées de façon rotative de manière concave-convexe.

5. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 1, dans lequel un matériau résine est utilisé pour au moins un des engrenages internes (25, 29).

6. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 1, le démarreur (1) comprenant en outre :

une bobine magnétique (35) qui forme un électroaimant par mise sous tension et entraîne la partie d'engrènement vers une direction par la force magnétique de l'électroaimant ;
un ressort de rappel (37) qui repousse la partie d'engrènement vers une autre direction lorsque la mise sous tension de la bobine magnétique (35) est arrêtée ;
le premier engrenage interne (25) agencé dans la direction du côté moteur électrique ; et
le second engrenage interne (29) agencé dans la direction du côté opposé au moteur électrique ;
dans lequel la bobine magnétique (35) est agencée presque sur le côté moteur électrique du premier engrenage interne (25) ou le côté opposé au moteur électrique du second engrenage interne (29).

7. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 6, dans lequel une substance ferromagnétique attirée par l'électroaimant constitue la partie d'engrènement.

8. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 6, le démarreur (1) comprenant en outre :

une culasse (36) qui laisse un flux magnétique généré par la bobine magnétique (35) passer à travers, dans lequel la culasse (36) comporte une partie trajet magnétique annulaire (36b) qui est agencée entre la bobine magnétique (35) et un de la paire dl'engrenages internes (25, 29) ; et
la partie d'engrènement possédant une partie noyau de fer cylindrique (34b) qui est étendue dans la direction de l'axe sur le périmètre de la partie trajet magnétique annulaire (36b) ;
dans lequel une circonférence intérieure de la partie noyau de fer cylindrique (34b) entre en prise de façon concave-convexe avec la partie trajet magnétique annulaire (36b) pour que la rotation dans la direction d'une circonférence de la partie d'engrènement soit supprimée, alors qu'un mouvement dans la direction de l'axe est permis.

9. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 8, la culasse (36) possédant une partie trajet magnétique cylindrique (36a) qui s'étend de la circonférence intérieure de la partie trajet magnétique annulaire (36b) au côté circonférence intérieure de la bobine magnétique (35) dans la direction axiale du côté opposé au moteur électrique,
un élément cadre (12) pour lequel une rotation est supprimée et prévu de façon immobile dans la direction de l'axe est agencé dans la direction axiale opposée au système de réduction à engrenage de la bobine magnétique (35),
une section à palier (12a) qui supporte le périmètre de l'axe de sortie de façon rotative par l'intermédiaire d'un palier est prévue d'un seul tenant dans une circonférence intérieure de l'élément cadre (12) dans la direction du diamètre,
la section à palier (12a) est étendue de façon cylindrique dans la direction du côté moteur électrique et un palier (13) est disposé dans celle-ci, et
le mécanisme d'absorption d'impact (8) est agencé dans l'espace défini par le périmètre de la section à palier (12a) et la circonférence intérieure de la partie trajet magnétique cylindrique (36a).

10. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 9, dans lequel le mécanisme d'absorption d'impact (8) comprend :

une plaque à frottement rotative (39) qui est agencée de façon rotative sur l'élément cadre (12), et sa propre partie périmétrique est en prise de manière concave-convexe avec la périphérie intérieure de la partie trajet magnétique annulaire (36b) pour que la rotation soit supprimée ;
une plaque à frottement fixe (40) qui est empilée avec la plaque à frottement rotative (39) dans la direction d'un axe et dont la rotation est supprimée par l'élément cadre (12) ; et
des moyens de compression (41) qui comprime la plaque à frottement rotative (39) et la plaque à frottement fixe (40) entre l'élément cadre (12) dans la direction de son axe, dans lequel le mécanisme d'absorption d'impact (8) absorbe un choc excessif par le coulissement (rotation) de la plaque à frottement rotative (39) qui résiste à la puissance de frottement lorsque le choc excessif dépasse un couple de coulissement de la plaque à frottement rotative (39) appliqué sur l'engrenage interne qui est en prise avec l'élément de permutation d'engrenage (34).

11. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 10, dans lequel le

mécanisme d'absorption d'impact (8) est constitué en utilisant une pluralité des plaques à frottement rotatives (39) et des plaques à frottement fixes (40) empilées en alternance une par une.

12. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 6, dans lequel la partie d'engrènement supprime la rotation de l'engrenage interne utilisé pour le système réducteur de vitesse avec le faible rapport de réduction lorsque la bobine magnétique (35) n'est pas mise sous tension, et la partie d'engrènement supprime la rotation de l'engrenage interne utilisé pour le système réducteur de vitesse avec le rapport de réduction élevé lorsque la bobine magnétique (35) est mise sous tension.

13. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 6, dans lequel la partie d'engrènement supprime la rotation de l'engrenage interne utilisé pour le système réducteur de vitesse fréquemment utilisé lorsque la bobine magnétique (35) n'est pas mise sous tension,
et la partie d'engrènement supprime la rotation de l'engrenage interne utilisé pour le système réducteur de vitesse non fréquemment utilisé lorsque la bobine magnétique (35) est mise sous tension.

14. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 12, dans lequel la bobine magnétique (35) n'est pas mise sous tension lorsque la température d'air extérieur est supérieure à 0 degré centigrade, et la bobine magnétique (35) est mise sous tension lorsque la température d'air extérieur est 0 degré centigrade ou moins.

15. Démarreur à réduction de vitesse (1) pour moteurs thermiques selon la revendication 13, dans lequel la bobine magnétique (35) n'est pas mise sous tension lorsque la température d'air extérieur est supérieure à 0 degré centigrade, et la bobine magnétique (35) est mise sous tension lorsque la température d'air extérieur est 0 degré centigrade ou moins.

FIG.1

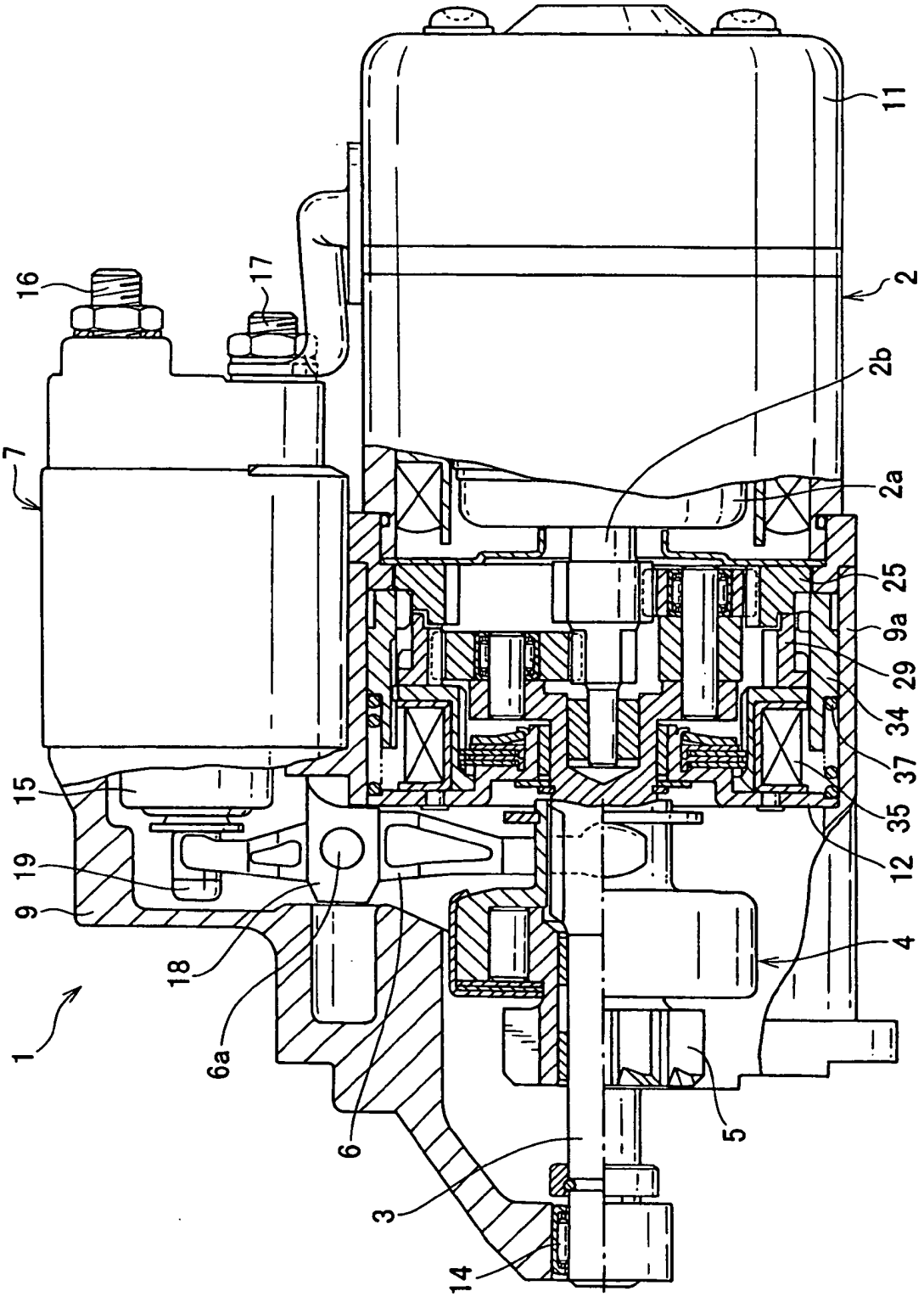


FIG.2

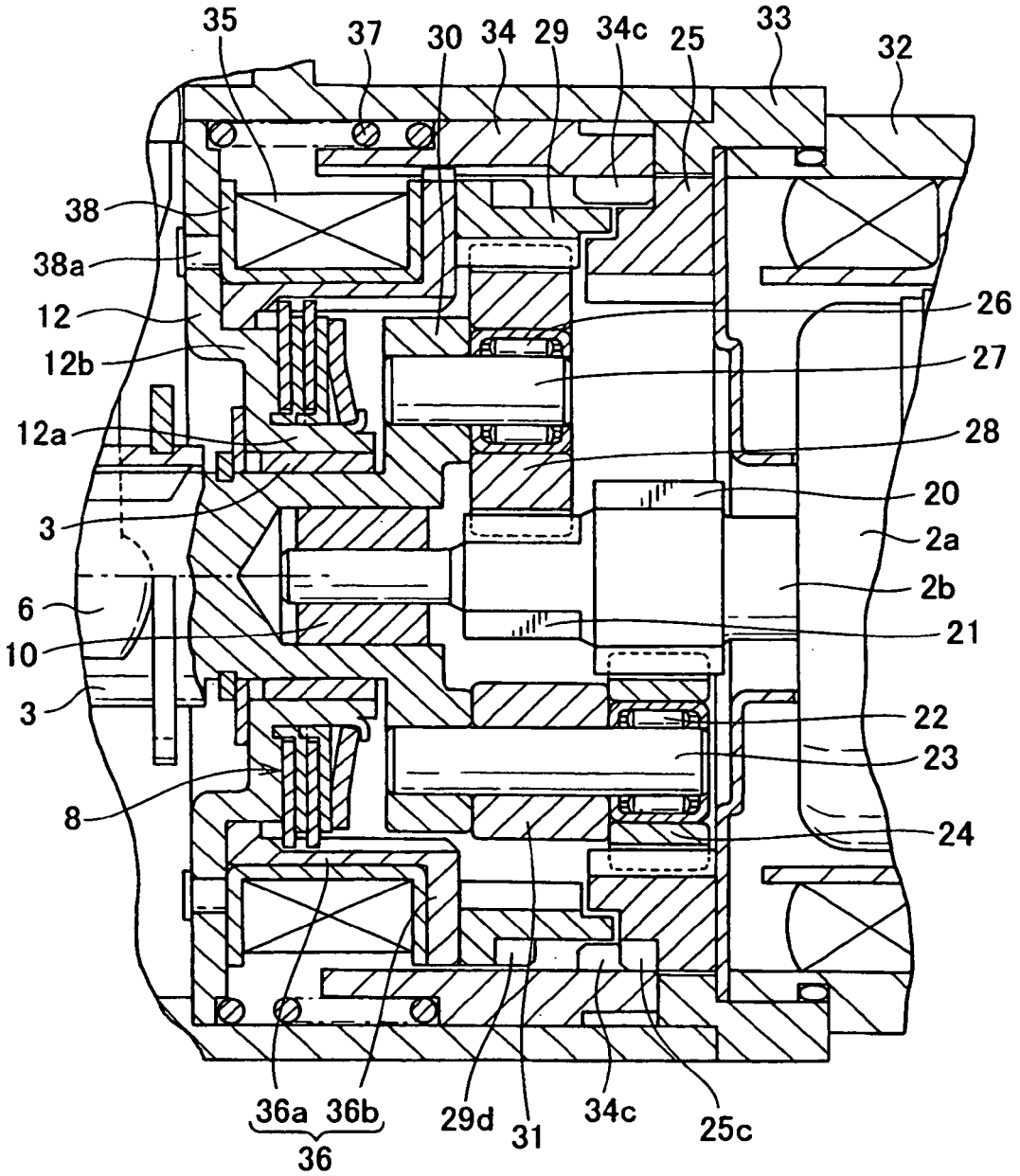
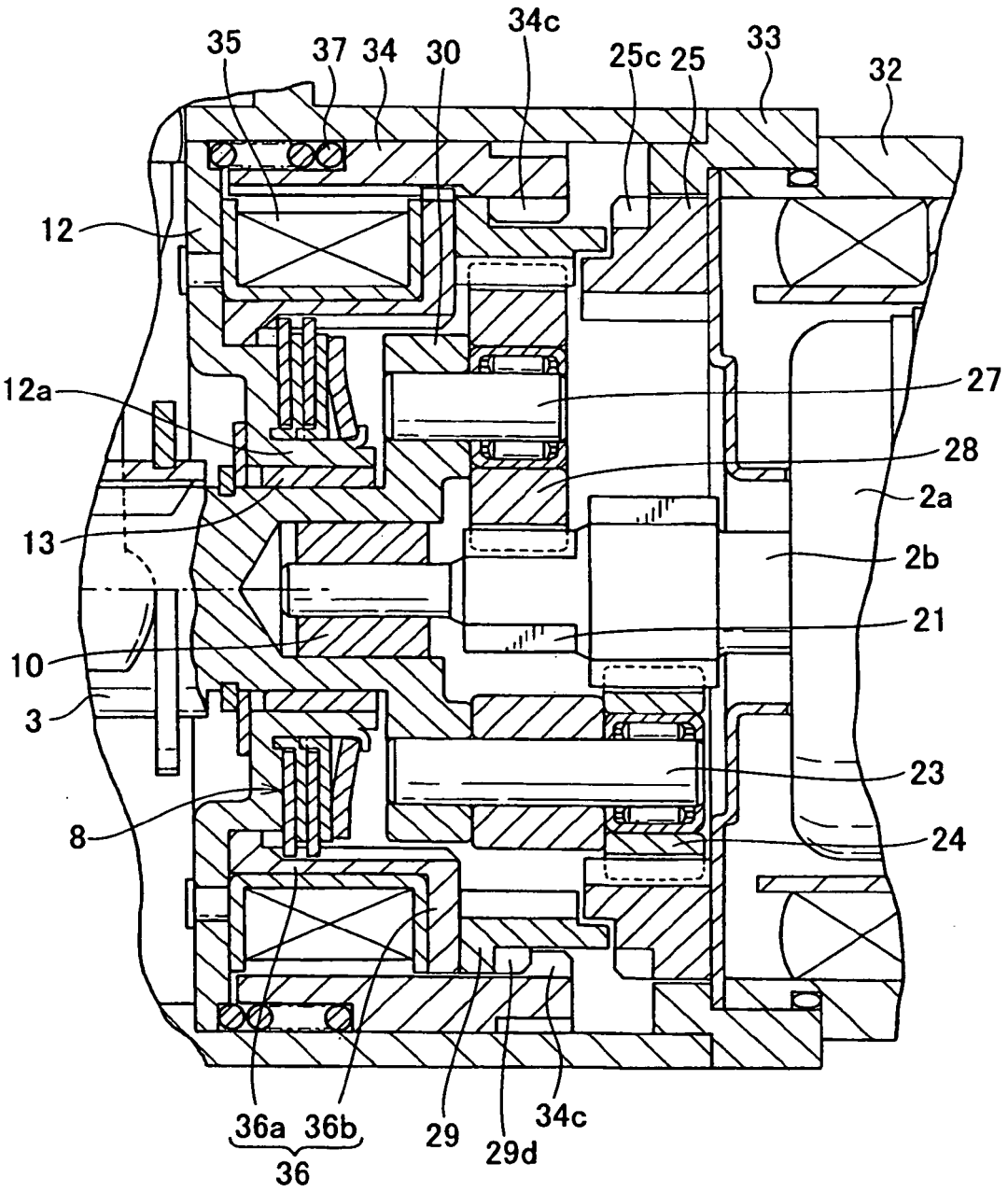

35
37
30
34
29
34c
25
33
32
38
38a
12
12b
12a
3
6
10
3
8
26
27
28
20
2a
2b
21
22
23
24
36a
36b
36
29d
31
34c
25c

FIG.3


35
37
34
30
34c
25c
25
33
32
12
12a
27
28
2a
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2b
21
10
3
23
8
24
36a
36b
36
29
29d
34c

FIG.4

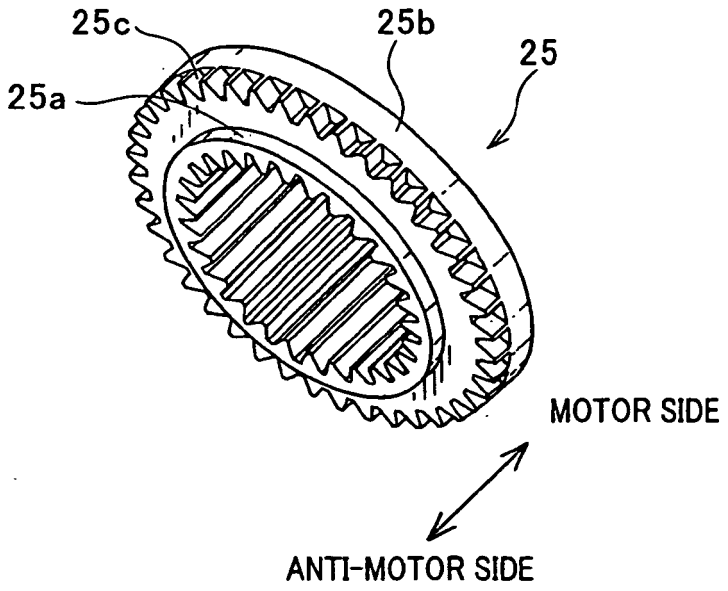

25c
25b
25
25a
MOTOR SIDE
ANTI-MOTOR SIDE

FIG.5

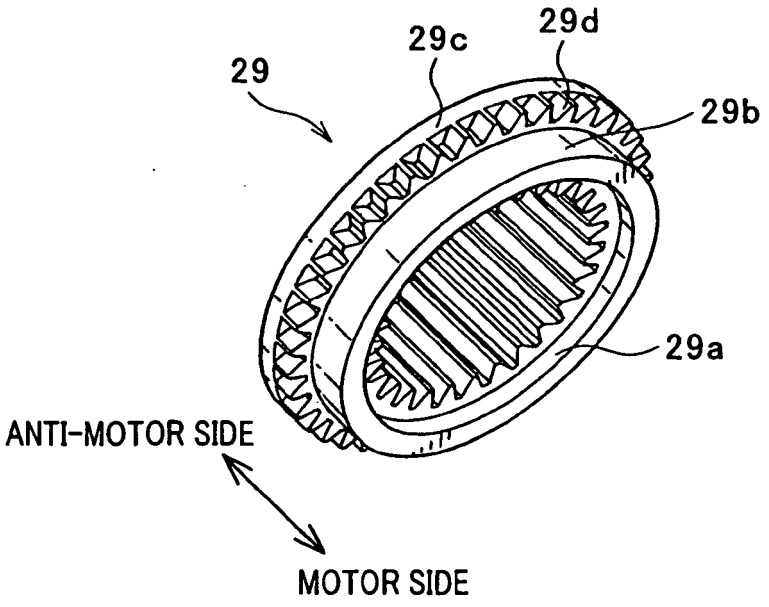

29d
29c
29
29b
29a
ANTI-MOTOR SIDE
MOTOR SIDE

FIG.6

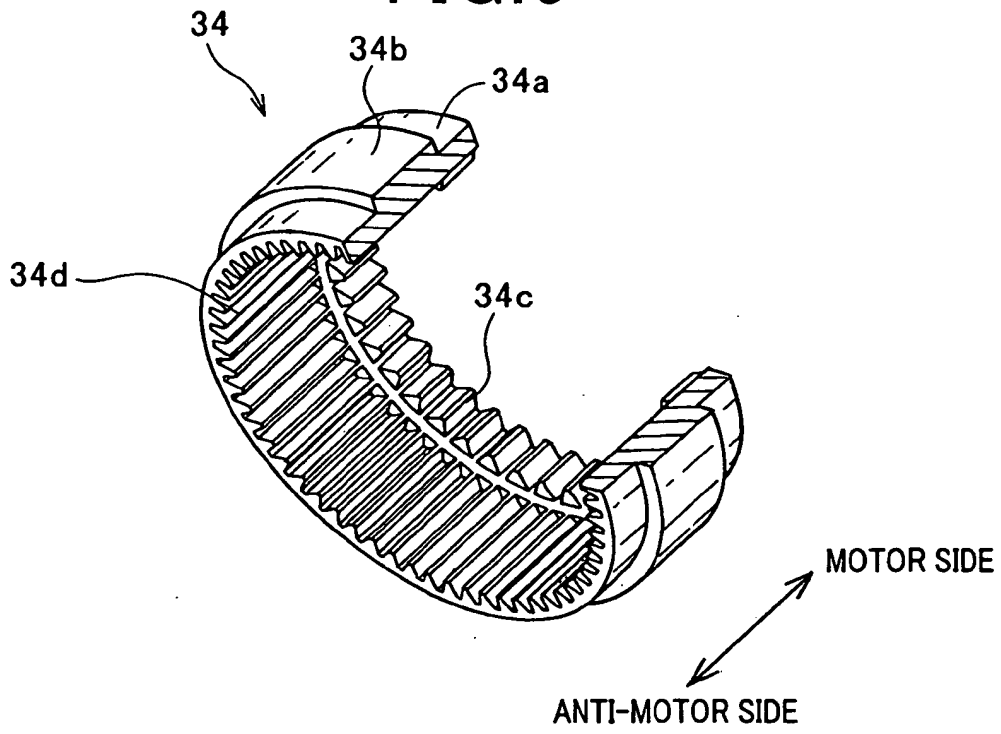

34
34b
34a
34d
34c
MOTOR SIDE
ANTI-MOTOR SIDE

FIG.7

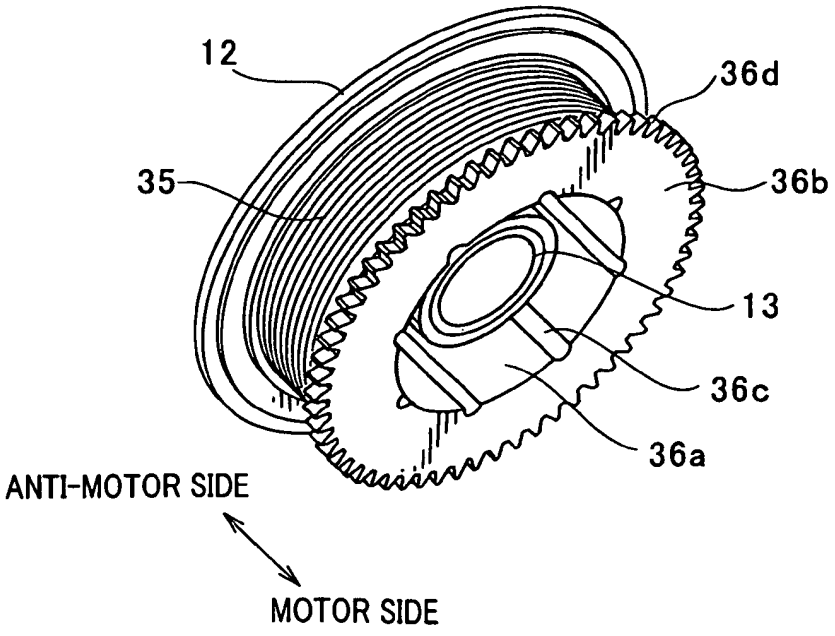

12
36d
35
36b
13
36c
36a
ANTI-MOTOR SIDE
MOTOR SIDE

FIG.8

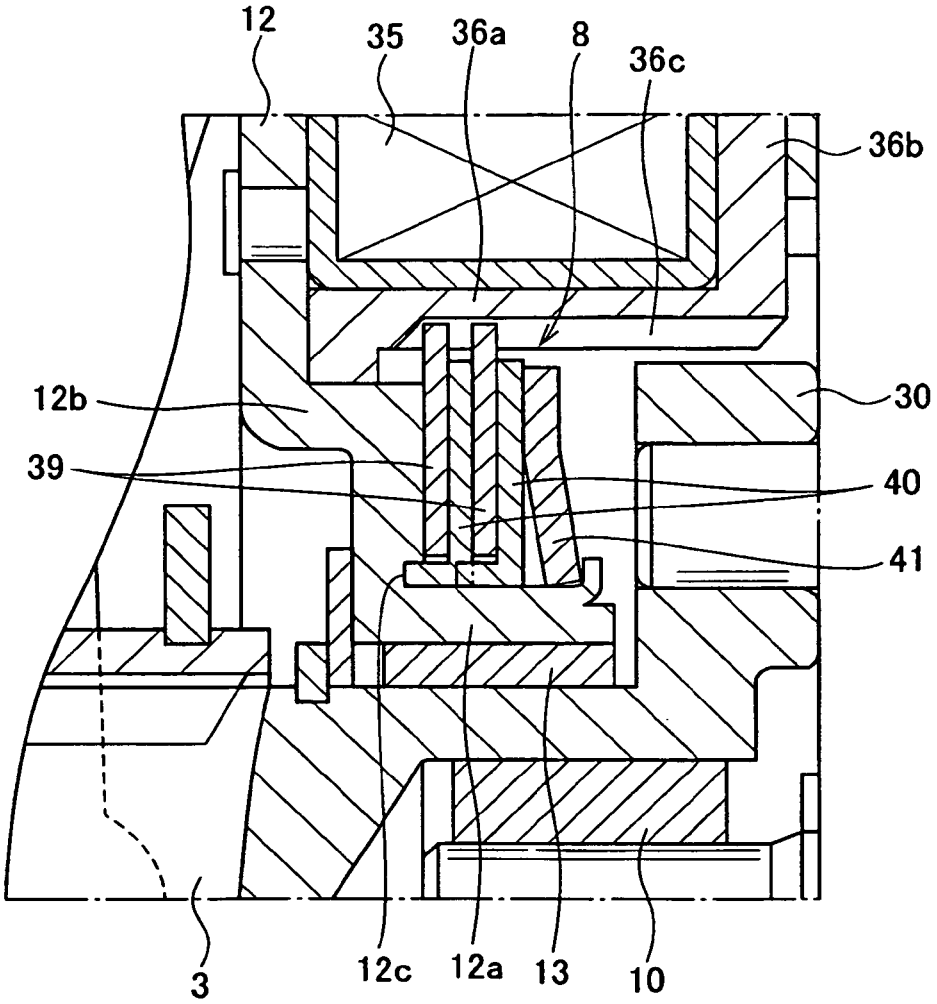


FIG.9

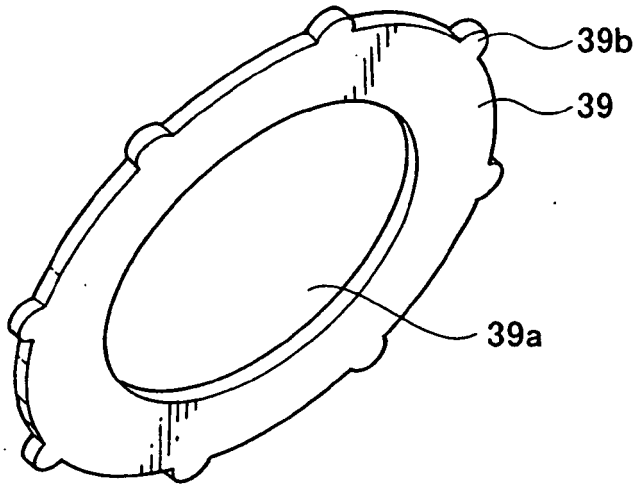


FIG.10A

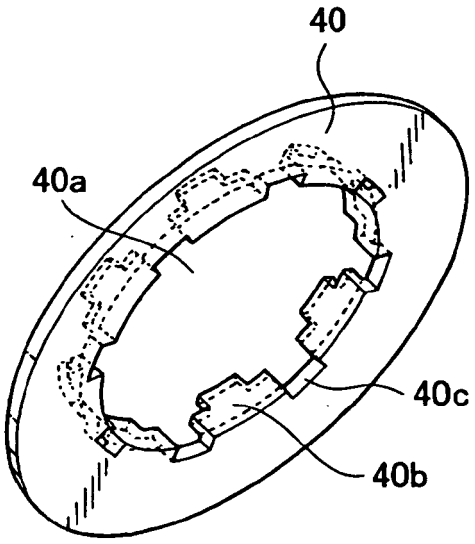


FIG.10B

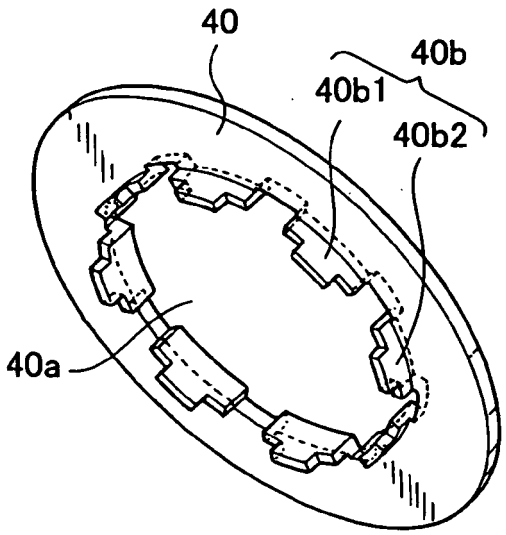
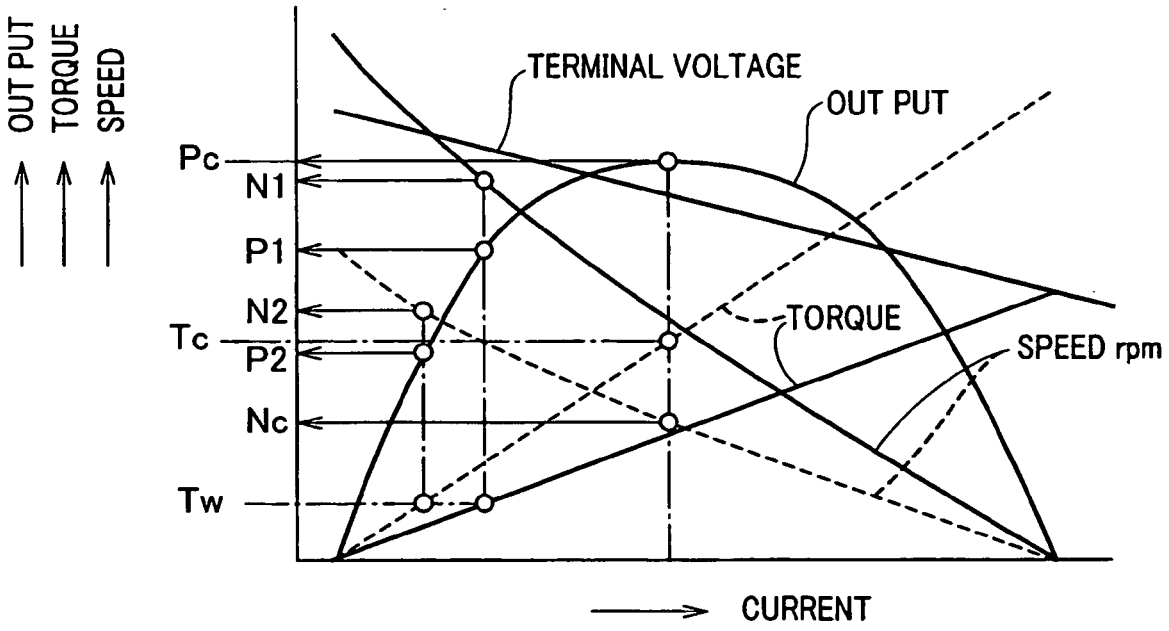


FIG.11


OUT PUT
TORQUE
SPEED
TERMINAL VOLTAGE
OUT PUT
Pc
N1
P1
N2
Tc
P2
Nc
Tw
TORQUE
SPEED rpm
CURRENT

REFERENCES CITED IN THE DESCRIPTION

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