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ACTUATOR FOR BRAKE DEVICE

Abstract

Disclosed is an actuator for a brake device. In accordance with an aspect of the disclosure an actuator for a brake device includes a motor; a first reduction gear unit connected to the motor; and a second reduction gear unit connected to the first reduction gear unit; wherein the first reduction gear unit is provided as a planetary gear assembly, and the second reduction gear unit is provided as a bevel gear assembly.

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Background/Summary

CROSS-REFERENCE OF RELATED APPLICATIONS [0001] This is a Continuation Application of U.S. application Ser. No. 17/776,061 filed May 11, 2022, which claims priority to a U.S. National Phase under 35 U.S.C. § 371 of International Patent Application No. PCT/KR2020/015241, filed on Nov. 3, 2020, which claims the benefit of Korean Patent application No. 10-2019-0144019, filed on Nov. 12, 2019, the entire disclosure of each are incorporated by reference herein.

TECHNICAL FIELD

[0002] The present disclosure relates to an actuator for a brake device, and more particularly, to an actuator for a brake device capable of realizing a parking function by operation of a motor.

BACKGROUND ART

[0003] Generally, a brake device is a device for stopping a vehicle from moving during braking or parking, and serves to prevent a wheel of the vehicle from rotating.

[0004] Recently, an Electric Parking Brake (EPB) system for electronically controlling driving of a parking brake has been widely used, and the EPB is mounted on a conventional disc brake to perform function of the parking brake. The disk brakes include a cable puller type, a motor-on-caliper (MOC) type, and a hydraulic parking brake type.

[0005] For example, documents disclosed in Korean Patent Publication No. 10-2011-0072877 (Jun. 29, 2011) and Korean Patent Publication No. 10-2018-0133976 (Dec. 18, 2018) relate to a structure of a MOC-type EPB actuator. These EPB actuator disclosed an actuator used in an electronic disc brake that decelerates power generated from a motor while increasing torque by using a plurality of gear devices and transmits the power to a caliper for a parking brake to perform a braking operation.

[0006] Actuators used in such electronic disc brakes generate large vibrations and noises, and inferior in terms of assembly and price competitiveness.

[0007] Furthermore, Actuators used in such electronic disc brakes take a disadvantage in that the structure between gears for transmitting a rotational force is complicated, and heat loss and durability performance due to friction decrease as the number of connecting parts of the gear increases.

DISCLOSURE

Technical Problem

[0008] An aspect of the disclosure is to provide an actuator for a brake device capable of packaging a planetary gear and a bevel gear connected to a motor to have a simple structure and miniaturization, thereby reducing weight and increasing efficiency.

Technical Solution

[0009] In accordance with an aspect of the present disclosure, an actuator for a brake device includes a motor; a first reduction gear unit connected to the motor; and a second reduction gear unit connected to the first reduction gear unit; wherein the first reduction gear unit is provided as a planetary gear assembly, and the second reduction gear unit is provided as a bevel gear assembly.

[0010] The actuator may further include a housing having a motor accommodating portion accommodating the motor and a gear accommodating portion accommodating the first reduction gear unit.

[0011] The actuator may further include a bracket that is coupled to an upper side of the gear accommodating portion and on which the second reduction gear unit is installed.

[0012] The first reduction gear unit may include a sun gear coupled to a rotation shaft of the motor; a plurality of planetary gears meshed with an outer side of the sun gear; a gear mounting portion provided with a ring gear on an inner circumference thereof to accommodate the plurality of planetary gears; and a carrier that rotatably supports the plurality of planetary gears and is installed to rotate coaxially with the sun gear and is provided with an output shaft for outputting rotational power.
[0013] The gear mounting portion may be provided integrally with the gear accommodating portion of the housing.
[0014] The gear mounting portion may be detachably coupled to the housing.
[0015] The gear accommodating portion may be provided with an extension panel to which the gear mounting portion is coupled, and a hook is provided at an outer lower end of the gear mounting portion to be detachably from the extension panel.
[0016] The extension panel may be provided with a plurality of locking ribs spaced apart from each other by a predetermined distance along a circumferential direction thereof, and coupling ribs engaged between the plurality of locking ribs may be formed to protrude from an lower side of the gear mounting portion.
[0017] The second reduction gear unit may include a first bevel gear provided on the output shaft of the carrier; and a second bevel gear meshed with the first bevel gear.
[0018] The second reduction gear unit may further include a power transmission shaft provided to pass through the second bevel gear and rotate together with the second bevel gear.
[0019] An output gear for outputting rotational power may be provided at one end of the power transmission shaft.
[0020] The actuator may further include a bearing provided on the power transmission shaft to rotatably support the power transmission shaft.
[0021] The bearing may be provided to be supported by a bracket provided to install the second reduction gear unit.
[0022] A damper member for supporting a lower end of the motor may be provided at a bottom of the motor accommodating portion.

Advantageous Effects

[0023] An embodiment of disclosure may provide an actuator for a brake device capable of packaging in a compact size by using a planetary gear and a bevel gear in the power transmission process of the motor, and reducing a weight thereof.
[0024] Furthermore, an embodiment of disclosure may provide an actuator for a brake device having a simple gear connection structure to increase an efficiency and capable of effectively implementing a low-noise operation.

Description

DESCRIPTION OF DRAWINGS

[0025] FIG. **1** is a perspective view illustrating an actuator for a brake device according to an embodiment of the disclosure.
[0026] FIG. **2** is an exploded perspective view illustrating an actuator for a brake device according to an embodiment of the disclosure.
[0027] FIG. **3** is an exploded perspective view illustrating a lower side of FIG. **2**.
[0028] FIG. **4** is an exploded perspective view illustrating a coupling state between a motor and a first reduction gear unit of an actuator for a brake device according to an embodiment of the disclosure.
[0029] FIG. **5** is an exploded perspective view illustrating a coupling state between a bracket and a second reduction gear unit of an actuator for a brake device according to an embodiment of the

disclosure.
[0030] FIG. **6** is a partially perspective view illustrating a coupling state of a first reduction gear unit and a second reduction gear unit of an actuator for a brake device according to an embodiment of the disclosure.
[0031] FIG. **7** is a view illustrating a housing of an actuator for a brake device according to another embodiment of the disclosure.
[0032] FIG. **8** is a view illustrating an actuator for a brake device according to another embodiment of the disclosure.
[0033] FIG. **9** is a view illustrating an actuator for a brake device according to another embodiment of the disclosure.

MODES OF THE INVENTION

[0034] Hereinafter, the embodiments of the disclosure will be described in detail with reference to accompanying drawings. It should be understood that the terms used in the specification and the appended claims should not be construed as limited to general and dictionary meanings, but interpreted based on the meanings and concepts corresponding to technical aspects of the disclosure on the basis of the principle that the inventor is allowed to define terms appropriately for the best explanation. Therefore, the description proposed herein is just a preferable example for the purpose of illustrations only, not intended to limit the scope of the disclosure, so it should be understood that other equivalents and modifications could be made thereto without departing from the spirit and scope of the disclosure.
[0035] FIG. **1** is a perspective view illustrating an actuator for a brake device according to an embodiment of the disclosure, FIG. **2** is an exploded perspective view illustrating an actuator for a brake device according to an embodiment of the disclosure, FIG. **3** is an exploded perspective view illustrating a lower side of FIG. **2**, FIG. **4** is an exploded perspective view illustrating a coupling state between a motor and a first reduction gear unit of an actuator for a brake device according to an embodiment of the disclosure, FIG. **5** is an exploded perspective view illustrating a coupling state between a bracket and a second reduction gear unit of an actuator for a brake device according to an embodiment of the disclosure, and FIG. **6** is a partially perspective view illustrating a coupling state of a first reduction gear unit and a second reduction gear unit of an actuator for a brake device according to an embodiment of the disclosure.
[0036] Referring to FIGS. **1** to **6**, an actuator **10** for a brake device according to an embodiment of the disclosure includes a motor **200**, a first reduction gear unit **300** connected to the motor **200**, a second reduction gear unit **400** connected to the first reduction gear unit **300**, and a housing **100** accommodating the motor **200** and the first reduction gear unit **300**. Furthermore, the actuator **10** for a brake device according to an embodiment of the disclosure further includes a bracket **500** coupled to the housing **100** and on which the second reduction gear unit **400** is installed.
[0037] The housing **100** includes a motor accommodating portion **120** accommodating the motor **200**, and a gear accommodating portion **130** accommodating the first reduction gear unit **300**. The gear accommodating portion **130** is located on an upper side of the motor accommodating portion **120**, and an upper part of the gear accommodating portion **130** is provided in an open form. The open upper part of the housing **100** may be closed by the bracket **500** to be described later.
[0038] The motor accommodating portion **120** has a depth capable of accommodating the motor **200**, and may have a cylindrical shape with an open upper part thereof. Accordingly, the motor **200** may be inserted and mounted through the open upper part of the motor accommodating portion **120**.
[0039] Meanwhile, a damper member **140** capable of absorbing vibration while supporting a lower end of the motor **200** may be installed on a bottom of the motor accommodating portion **120**, thereby reducing noise caused by vibration by the damper member **140**.
[0040] The gear accommodating portion **130** is provided integrally with the open upper part of the motor accommodating portion **120**. The first reduction gear unit **300** is accommodated in the gear

accommodating portion **130**, and an extension panel **123** coupled to the gear mounting portion **330** of the first reduction gear unit **300** to be described later may be formed on the gear accommodating portion **130**. The gear accommodating portion **130** may be provided in a vertically open form in order to output a rotational force reduced through the first reduction gear unit **300**. A structure in which the gear mounting portion **330** is coupled to the extension panel **123** will be described again below.

[0041] The bracket **500** is provided in the form of a box with an open lower side, and forms a space therein while being coupled to the housing **100**. The bracket **500** and the housing **100** may be made of a synthetic resin material, and after the motor **200**, the first reduction gear unit **300**, and the second reduction gear unit **400** are fixedly installed in the housing **100** and the bracket **500**, the housing **100** and the bracket **500** may be bonding by ultrasonic or laser welding. Accordingly, an inside of the housing **100** may be easily sealed.

[0042] On the other hand, a connector portion **110** for supplying power to the motor **200** is formed in the housing **100**, and when the motor **200** is installed in the housing **100**, a power terminal (not shown) of the motor **200** may be provided to be connected to a terminal of the connector portion **110**.

[0043] The first reduction gear unit **300** transmits the rotational force of the motor **200** by directly connecting the motor **200** and the second reduction gear unit **400**. The first reduction gear unit **300** may be provided as a planetary gear assembly.

[0044] More specifically, the first reduction gear unit **300** includes a sun gear **310** coupled to a rotation shaft **210** of the motor **200**, a plurality of planetary gears **320** meshed with an outer side of the sun gear **310**, the gear mounting portion **330** provided with a ring gear **332** on an inner circumferential to accommodate the plurality of planetary gears **320**, and a carrier **340** that rotatably supports the plurality of planetary gears **320** and installed to rotate coaxially with the sun gear **310**.

[0045] The plurality of planetary gears **320** are provided in three and arranged to surround the sun gear **310**. At this time, the three planetary gears **320** are provided in consideration of efficiency and economic feasibility, but four planetary gears may be optionally provided and used. The plurality of planetary gears **320** are rotatably coupled to a planetary gear shaft portion **342** formed on the carrier **340**.

[0046] The gear mounting portion **330** is provided with a shaft hole **331** penetrating vertically in a center thereof, and the ring gear **332** is provided along an inner side circumferential direction of the gear mounting portion **330**. The ring gear **332** may be manufactured integrally with the gear mounting portion **330**. Accordingly, when the gear mounting portion **330** is mounted on the gear accommodating portion **130**, the sun gear **310** is disposed in an inner space of the gear mounting portion **330** provided with the ring gear **332**.

[0047] The gear mounting portion **330** is provided in a hollow cylindrical shape with an open upper side and may be detachably coupled to the extension panel **123** formed in the gear accommodating portion **130**. A hook **335** may be provided at an outer lower end of the gear mounting portion **330** to be detachably from the extension panel **123**.

[0048] Furthermore, to stably couple the gear mounting portion **330** to the extension panel **123**, the extension panel **123** may be provided with a plurality of locking ribs **124** spaced apart from each other by a predetermined distance along an circumferential direction thereof, and coupling ribs **334** engaged between the plurality of locking ribs **124** may be formed to protrude from an lower outer circumferential surface of the gear mounting portion **330**.

[0049] When the gear mounting portion **330** is mounted on the extension panel **123**, the hook **335** is inserted into a hook groove **125** formed in the extension panel **123** to be bound, and as a result, the plurality of locking ribs **124** and the coupling ribs **334** are mutually constrained, so that rotation and separation of the gear mounting portion **330** are restricted.

[0050] On the other hand, although the gear mounting portion **330** has been illustrated and

described as being detachably provided on the extension panel **123**, it is not limited thereto. For example, the gear mounting portion **330** may be integrally formed with the housing **100**′ so that the ring gear **332**′ is provided in the gear accommodation portion **130**, which embodiment is illustrated in FIG. **7**. FIG. **7** shows another embodiment of the disclosure, the same reference numerals as in the drawings shown above refer to members having the same function. In other words, the actuator for the brake device shown in FIG. **7** differs from the described above embodiment only in that the ring gear **332**′ of the gear mounting portion is provided integrally with the housing **100**′, but the remaining of the configuration is the same, so a detailed description thereof will be omitted.

[0051] Referring back to FIGS. **1** to **6**, the carrier **340** may be formed in a disk shape, and the plurality of planetary gear shaft portions **342** spaced apart from each other in the circumferential direction are provided on the lower surface thereof, and an output shaft **341** is provided in a center of the upper surface thereof. At this time, the output shaft **341** may be formed integrally with the carrier **340** to rotate together.

[0052] The second reduction gear unit **400** may be provided to be supported by the bracket **500** so as to be connected to the first reduction gear unit **300**. The second reduction gear unit **400** may be provided as a bevel gear assembly.

[0053] More specifically, the second reduction gear unit **400** may include a first bevel gear **410** provided on the output shaft **341** of the carrier **340**, a second bevel gear **420** meshed with the first bevel gear **410**, and a power transmission shaft **430** installed through the second bevel gear **420**.

[0054] The first bevel gear **410** is provided in a conical shape and is coupled to rotate coaxially with the output shaft **341** of the carrier **340**. Accordingly, the first bevel gear **410** rotates in the same rotational direction as the carrier **340** and transmits the rotational force to the second bevel gear **420**.

[0055] The second bevel gear **420** rotates while meshing with the first bevel gear **410**, and rotates while changing the rotation direction to a direction perpendicular to the rotation shaft **210** of the motor **200**. The change of the rotation direction using the bevel gears **410** and **420** has a better contact ratio than that of the spur gear, so noise may be significantly reduced, and also the gear ratio may be adjusted to perform an efficient deceleration function.

[0056] The power transmission shaft **430** passes through the second bevel gear **420** so that the second bevel gear **420** maintains a meshing state with the first bevel gear **410** to rotate together with the second bevel gear **420**. The power transmission shaft **430** has a predetermined length, and an output gear **440** for outputting rotational power is provided at one end thereof. Accordingly, the one end at which the output gear **440** of the power transmission shaft **430** is formed may be disposed to be exposed to outside from the bracket **500**.

[0057] A bearing **450** is provided on the power transmission shaft **430** so that the power transmission shaft **430** rotates stably. The bearings **450** are provided as a pair and installed on the bracket **500**. One of the bearing **450** is provided at the other end of the power transmission shaft **430**, and the other of the bearing **450** may be provided between the second bevel gear **420** and the output gear **440** to rotatably support the power transmission shaft **430**.

[0058] On the other hand, the output gear **440** may be provided with gear teeth formed on one end of an outer surface of the power transmission shaft **430**. Accordingly, the output gear **440** outputs rotational power while rotating in the same rotational direction as the power transmission shaft **430**. For example, the output gear **440** may be provided to transmit the rotational power to an electric parking brake device.

[0059] The actuator **10** for the brake device as described above may be coupled to a caliper through a mounting portion **510** provided on an outer side of the bracket **500** in order to transmit power to a caliper for a parking brake (not shown). The mounting portion **510** is a portion coupled to the caliper for the parking brake, and may be formed on an outer side of the housing **100** as well as the bracket **500**. Furthermore, the shape or number of the mounting portions **510** may be varied according to a mounting position at which the actuator **10** for brake device is installed to transmit

power to the caliper. FIG. **8** shows the actuator **10** for the brake device having the mounting portion **510** whose position is changed for coupling with the caliper. FIG. **8** is a view illustrating another embodiment of the disclosure, and the same reference numerals as in the described above embodiment refer to members having the same function.

[0060] Referring to FIG. **8**, the mounting portion **510** may be formed on a distal end side of the bracket **500** in a direction in which the output gear **440** is positioned to be closely coupled to the caliper. In other words, the position at which the mounting portion **510** is formed is changed for coupling with the caliper, so that ease of installation may be secured.

[0061] On the other hand, in embodiments of the disclosure, the first reduction gear unit **300** receiving the rotational force from the motor **200** is provided as a planetary gear assembly, and the second reduction gear unit **400** connected to the first reduction gear unit **300** is provided as a bevel gear assembly, so that the structure has been illustrated and described as transmitting power in a so-called L-shape, but is not limited thereto. For example, the first reduction gear unit **300** is provided as a bevel gear assembly, and the second reduction gear unit **400** is provided as a planetary gear assembly, so that the power may be transmitted to the caliper. As shown in FIG. **9**, the power may be transmitted in a so-called C-shape structure by changing the position and structure in which the bevel gear assembly and the planetary gear assembly are assembled as described above. FIG. **9** is a view illustrating another embodiment of the disclosure, and the same reference numerals as in the described above embodiment refer to members having the same function.

[0062] Referring to FIG. **9**, the actuator **10** for the brake device according to the embodiment of the disclosure may be provided to transmit power in a C-shape structure by changing the assembly structure between the reduction gears of the described above embodiment. For example, although not shown, the bevel gear is assembled on the rotation shaft of the motor and the rotational force of the motor transmits the sun gear of the planetary gear assembly through the power transmission shaft and the plurality of other bevel gears, so that directionality of the output rotational power (meaning to a direction of the output shaft that is finally output) may be changed. In other words, the actuator **10** for the brake device according to an embodiment of the disclosure may change the assembling method of the planetary gear assembly and the bevel gear assembly in various forms to transmit power, and then adjust directionality of the rotational power finally output.

[0063] Hereinafter, the operation of the actuator for the brake device according to an embodiment of the disclosure will be described.

[0064] When a driver operates the parking brake after stopping the vehicle, the motor **200** is driven to rotate the rotating shaft **210** of the motor **200**. Accordingly, the sun gear **310** coupled to the rotation shaft **210** of the motor **200** rotates together and transmits the rotational force to the plurality of planetary gears **320** meshed with the sun gear **310**. The plurality of planetary gears **320** revolve and rotate along the circumference of the sun gear **310** and along the ring gear **332** provided along the circumference of the inner surface of the gear mounting portion **330**. As the carrier **340** rotates in the coaxial direction with the rotation shaft **310** of the motor **200** by the plurality of planetary gears **320** revolving, the output shaft **341** rotates together.

[0065] When the carrier **340** rotates, the first bevel gear **410** coupled to the output shaft **341** rotates together with the carrier **340** and transmits the rotational force to the second bevel gear **420**, and the power transmission shaft **430** installed through the second bevel gear **420** rotates together with the second bevel gear **420**. Accordingly, the output gear **440** provided at the one end of the power transmission shaft **430** rotates together with the power transmission shaft **430** to output the rotational power.

[0066] As described above, although a few embodiments of the disclosure have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the disclosure, the scope of which is defined in the claims and their equivalents.

Claims

1. An actuator for a brake device, comprising: a motor; a first reduction gear unit connected to the motor; and a second reduction gear unit;
2. The actuator of claim 1, further comprising a housing having a motor accommodating portion accommodating the motor and a gear accommodating portion accommodating the first reduction gear unit.
3. The actuator of claim 2, further comprising a bracket that is coupled to an upper side of the gear accommodating portion and on which the second reduction gear unit is installed.
4. The actuator of claim 2, wherein the first reduction gear unit comprises: a sun gear coupled to a rotation shaft of the motor; a plurality of planetary gears meshed with an outer side of the sun gear; a gear mounting portion provided with a ring gear on an inner circumference thereof to accommodate the plurality of planetary gears; and a carrier that rotatably supports the plurality of planetary gears and is installed to rotate coaxially with the sun gear and is provided with an output shaft for outputting rotational power.
5. The actuator of claim 4, wherein the gear accommodating portion is provided with an extension panel to which the gear mounting portion is coupled, and a hook is provided at an outer lower end of the gear mounting portion to be detachably from the extension panel.
6. The actuator of claim 5, wherein the extension panel is provided with a plurality of locking ribs spaced apart from each other by a predetermined distance along a circumferential direction thereof, and coupling ribs engaged between the plurality of locking ribs are formed to protrude from an lower side of the gear mounting portion.
7. The actuator of claim 4, wherein the second reduction gear unit comprises: a first bevel gear provided on the output shaft of the carrier; and a second bevel gear meshed with the first bevel gear.
8. The actuator of claim 7, wherein the second reduction gear unit further comprises a power transmission shaft provided to pass through the second bevel gear and rotate together with the second bevel gear.
9. The actuator of claim 8, wherein an output gear for outputting rotational power is provided at one end of the power transmission shaft.
10. The actuator of claim 9, the one end at which the output gear of the power transmission shaft is formed may be disposed to be exposed to outside from the bracket.