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Inventor(s)	Yoon; Bo Ram et al.

Brake apparatus for vehicle

Abstract

A brake apparatus for a vehicle may include: a stator unit fixed to an inside of a wheel of the vehicle, a rotor unit disposed to face the stator unit and rotated by electromagnetic interaction with the stator unit, a disc unit connected to the rotor unit and rotated together with the rotor unit, a pair of caliper units disposed on both sides of the disc unit and configured to generate a braking force by contacting with the disc unit as hydraulic pressure is applied, and a transfer unit connected to the pair of caliper units, and configured to transfer hydraulic pressure applied to one of the pair of caliper units to a remaining one of the pair of caliper units.

Inventors: **Yoon; Bo Ram (Yongin-si, KR), Kim; Yong Hee (Yongin-si, KR), Choi; Ik Soon (Yongin-si, KR)**

Applicant: **HYUNDAI MOBIS Co., Ltd.** (Seoul, KR)

Family ID: **1000008751259**

Assignee: **Hyundai Mobis Co., Ltd. (Seoul, KR)**

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Primary Examiner: Schwartz; Christopher P

Attorney, Agent or Firm: Morgan, Lewis & Bockius LLP

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

(1) This application claims priority from and the benefit of Korean Patent Application No. 10-2021-0103112, filed on Aug. 5, 2021 and Korean Patent Application No. 10-2021-0103113, filed on Aug. 5, 2021, which are hereby incorporated by reference for all purposes as if set forth herein.

BACKGROUND

Field

(2) Exemplary embodiments of the present disclosure relate to a brake apparatus for a vehicle, and more particularly, to a brake apparatus for a vehicle, which is applied to an in-wheel motor.

Discussion of the Background

(3) In general, a brake apparatus for a vehicle is an apparatus that pushes a piston through hydraulic pressure generated from a master cylinder or rotational force of a motor to allow a pad and a disc to come into close contact with each other, and brakes a vehicle by using a friction force between the pad and the disc. In the case of a fixed caliper configured as a single caliper body, multiple pistons may be configured on the inside and outside with a disc interposed therebetween, so that higher braking force may be secured compared to the layout. Such a fixed caliper is applied to mid-to-large-sized SUVs, high-performance sedans, and sports cars.

(4) On the other hand, an e-corner module vehicle, which is the next-generation platform, is equipped with an in-wheel driving device that is mounted inside each wheel of the vehicle so that each wheel may be controlled independently, and since such an in-wheel itself is configured as a single driving motor, a space for mounting a brake apparatus is very limited. Therefore, when the existing fixed caliper brake is applied to an in-wheel, it may interference with adjacent components, and there is a problem in that it is difficult to secure braking safety equivalent to that of a general brake system.

(5) The background art of the present disclosure is disclosed in Korean Patent Application Laid-Open No. 10-2010-0098846 (published on Sep. 10, 2010 and entitled “Disc Brake having Parking Function”).

SUMMARY

(6) Various embodiments are directed to providing a brake apparatus for a vehicle, capable of easily transferring a brake fluid to calipers separated from each other.

(7) In order to solve the above problems, a brake apparatus for a vehicle in accordance with the present disclosure may include: a stator unit fixed to an inside of a wheel of the vehicle; a rotor unit disposed to face the stator unit and rotated by electromagnetic interaction with the stator unit; a disc unit connected to the rotor unit and rotated together with the rotor unit; a pair of caliper units disposed on both sides of the disc unit and configured to generate a braking force by contacting with the disc unit as hydraulic pressure is applied; and a transfer unit connected to the pair of caliper units, and configured to transfer hydraulic pressure applied to one of the pair of caliper units to a remaining one of the pair of caliper units.

(8) Furthermore, each of the pair of caliper units may include: a caliper body part disposed to face one surface of the disc unit and including a cylinder configured to generate hydraulic pressure by a brake fluid flowing into the cylinder; a pad plate part disposed between the caliper body part and the disc unit; and a piston part slidably installed in the cylinder, and configured to move forward and backward by hydraulic pressure generated by the cylinder and to press the pad plate part

toward the disc unit or release pressure on the pad plate part.
(9) Furthermore, the transfer unit may include: a transfer member disposed between the pair of caliper body parts and having both sides connected with an inside of the pair of caliper body parts, respectively; a fixing part detachably coupled to the caliper body part and configured to prevent the transfer member from moving relative to the caliper body part; and a sealing part installed between the transfer member and the caliper body part, and configured to prevent the brake fluid from leaking to an outside of the caliper body part.
(10) Furthermore, the transfer member may be inserted into an insertion portion penetrating through the caliper body part.
(11) Furthermore, a flow part extending along a longitudinal direction of the transfer member may be defined in the transfer member.
(12) Furthermore, the fixing part may protrude from an outer circumferential surface of the transfer member and may be screwed to an inner circumferential surface of the insertion portion.
(13) Furthermore, the sealing part may be elastically deformable and may be in contact with an outer circumferential surface of the transfer member and an inner circumferential surface of the insertion portion.
(14) Furthermore, the transfer unit may further include a stopper part extending from the transfer member and limiting a length of a portion of the transfer member that is inserted into the insertion portion.
(15) Furthermore, the stopper part may be disposed at one end of the transfer member, and may be in contact with an outer surface of any one of the pair of caliper body parts as the transfer member is inserted into the insertion portion by a predetermined distance or more.
(16) Furthermore, the stopper part may have a diameter larger than that of the transfer member.
(17) Furthermore, a brake apparatus for a vehicle in accordance with the present disclosure may include: a stator unit fixed to an inside of a wheel of the vehicle; a rotor unit disposed to face the stator unit and rotated by electromagnetic interaction with the stator unit; a disc unit connected to the rotor unit and rotated together with the rotor unit; a pair of caliper units disposed on both sides of the disc unit and configured to generate a braking force by contacting with the disc unit as hydraulic pressure is applied; and a support unit extending from each of the pair of caliper units and supporting each of the pair of caliper units with respect to the stator unit.
(18) Furthermore, the pair of caliper units may be separated from each other and are individually supported on the stator unit by the support unit.
(19) Furthermore, each of the pair of caliper units may include: a caliper body part disposed to face one surface of the disc unit and including a cylinder that generates hydraulic pressure by a brake fluid flowing into the cylinder; a pad plate part disposed between the caliper body part and the disc unit; and a piston part slidably installed in the cylinder, and configured to move forward and backward by hydraulic pressure generated by the cylinder and to press the pad plate part toward the disc unit or release pressure on the pad plate part.
(20) Furthermore, the support unit may include: a first support part extending from one of the pair of caliper units and detachably coupled to a first fastening part extending from the stator unit; and a second support part extending from a remaining one of the pair of caliper units and detachably coupled to a second fastening part extending from the stator unit.
(21) Furthermore, the first support part and the second support part may be disposed on a same axis.
(22) Furthermore, the first support part and the second support part may be disposed on different axes.
(23) Furthermore, wherein the first support part and the second support part may be provided in plural and disposed to be spaced apart from each other on both sides of the caliper units, respectively.
(24) A brake apparatus for a vehicle in accordance with the present disclosure can stably apply

hydraulic pressure by using a transfer unit without separately installing hydraulic pressure generation means in a pair of caliper units separated from each other, and can synchronize an operation of the pair of caliper units.
(25) Furthermore, a brake apparatus for a vehicle in accordance with the present disclosure can transfer a braking fluid only by a transfer member occupying a relatively small volume compared to an existing back, thereby preventing interference with adjacent components.
(26) Furthermore, a brake apparatus for a vehicle in accordance with the present disclosure can prevent arbitrary movement of the transfer member in the longitudinal direction and a change in a communication state with a cylinder by using a fixing part, thereby securing stable operation performance of the caliper unit.
(27) Furthermore, a brake apparatus for a vehicle in accordance with the present disclosure can prevent a brake fluid from leaking into a gap formed between the transfer member and an insertion portion by using a sealing part, and reduce concentricity tolerance between the transfer member and the insertion portion by an elastic restoring force of the sealing part.
(28) Furthermore, a brake apparatus for a vehicle in accordance with the present disclosure can allow the transfer member and the cylinder to communicate at a fixed position by using a stopper part without visually checking, and prevent damage due to collision between components.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a perspective view schematically illustrating the configuration of a brake apparatus for a vehicle in accordance with an embodiment of the present disclosure.
(2) FIG. **2** is a front view schematically illustrating the configuration of the brake apparatus for a vehicle in accordance with an embodiment of the present disclosure.
(3) FIG. **3** is an exploded perspective view schematically illustrating the configuration of the brake apparatus for a vehicle in accordance with an embodiment of the present disclosure.
(4) FIG. **4** is a perspective view schematically illustrating the configuration of a caliper unit, a support unit, and a transfer unit in accordance with an embodiment of the present disclosure.
(5) FIG. **5** is a cross-sectional view schematically illustrating the configuration of the caliper unit, the support unit, and the transfer unit in accordance with an embodiment of the present disclosure.
(6) FIG. **6** is an enlarged view schematically illustrating the configuration of the support unit in accordance with an embodiment of the present disclosure.
(7) FIG. **7** is a perspective view schematically illustrating the configuration of the transfer unit in accordance with an embodiment of the present disclosure.
(8) FIG. **8** is an operation view schematically illustrating an operating state of the transfer unit in accordance with an embodiment of the present disclosure.
(9) FIGS. **9**A to **9**F are a view schematically illustrating a process of assembling the brake apparatus for a vehicle in accordance with an embodiment of the present disclosure.
(10) FIG. **10** is a front view schematically illustrating the configuration of a brake apparatus for a vehicle in accordance with another embodiment of the present disclosure.
(11) FIG. **11** is a perspective view schematically illustrating the configuration of the brake apparatus for a vehicle in accordance with another embodiment of the present disclosure.
DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS
(12) Hereinafter, embodiments of a brake apparatus for a vehicle in accordance with the present disclosure will be described with reference to the accompanying drawings.
(13) In this process, the thicknesses of lines or the sizes of elements illustrated in the drawings may be exaggerated for the purpose of clarity and convenience of explanation. Furthermore, terms to be described later are terms defined in consideration of functions thereof in the present disclosure and

may be changed according to the intention of a user or an operator, or practice. Accordingly, such terms should be defined based on the disclosure over the present specification.

(14) Furthermore, in the present specification, when a certain part is referred to as being 'connected (or coupled) to' another part, it may indicate that the former part is directly connected (or coupled) to the latter part or indirectly connected (or coupled) to the latter part with another part interposed therebetween. In the present specification, when a certain part "includes (or comprises)" a certain component, it means that the element does not exclude another component but may further "include (or comprise)" another component, unless referred to the contrary.

(15) Furthermore, substantially the same reference numerals may refer to substantially the same components throughout the present specification. Even though substantially the same reference numerals or similar reference numerals are not mentioned or described in a specific drawing, the reference numerals may be described based on other drawings. Furthermore, even though there is a portion which is not indicated by reference numerals in a specific drawing, the portion may be described based on other drawings. Furthermore, the number, shapes, and sizes of detailed components included in the drawings of the present application and relative differences in the sizes are set for convenience of understanding, and do not limit embodiments and may be implemented in various forms.

(16) FIG. **1** is a perspective view schematically illustrating the configuration of a brake apparatus for a vehicle in accordance with an embodiment of the present disclosure, FIG. **2** is a front view schematically illustrating the configuration of the brake apparatus for a vehicle in accordance with an embodiment of the present disclosure, and FIG. **3** is an exploded perspective view schematically illustrating the configuration of the brake apparatus for a vehicle in accordance with an embodiment of the present disclosure.

(17) Referring to FIG. **1** to FIG. **3**, the brake apparatus for a vehicle in accordance with an embodiment of the present disclosure includes a stator unit **100**, a rotor unit **200**, a disc unit **300**, a caliper unit **400**, a support unit **500**, and a transfer unit **600**.

(18) The stator unit **100** is fixed to the inside of a wheel **10** of a vehicle, and receives power from the outside to form a magnetic field that rotates a rotor unit **200** to be described below. The stator unit **100** in accordance with an embodiment of the present disclosure is formed to have a cylindrical shape with one side open and is disposed inside the wheel **10**. The stator unit **100** is coupled to a knuckle **30** installed below the vehicle via an in-wheel bracket **20**. Accordingly, the stator unit **100** may be fixed inside the wheel **10** in a non-rotation state. The stator unit **100** receives three-phase power from a battery of the vehicle through a terminal. The stator unit **100** includes a plurality of coils to form an electromagnetic force from the supplied power.

(19) The stator unit **100** includes a first fastening part **110** and a second fastening part **120** coupled to a support unit **500** to be described below. The first fastening part **110** and the second fastening part **120** in accordance with an embodiment of the present disclosure extend from an inner circumferential surface of the stator unit **100** toward the radially inner side of the stator unit **100**. The first fastening part **110** and the second fastening part **120** are respectively disposed to face a first support part **510** and a second support part **520** to be described below. Through holes, which extend in a direction parallel to an axial direction of the disc unit **300**, may be formed at the ends of the first fastening part **110** and the second fastening part **120** so that the first fastening part **110** and the second fastening part **120** may be coupled to the first support part **510** and the second support part **520** by fastening means such as bolts and pins, respectively.

(20) The first fastening part **110** and the second fastening part **120** are disposed to be spaced apart from each other by a predetermined distance along an axial direction of the stator unit **100**. Hereinafter, a case where the first fastening part **110** is disposed on an outside (right side of FIG. **1**) in a vehicle width direction and the second fastening part **120** is disposed on an inside (left side of FIG. **1**) in the vehicle width direction will be described as an example. The distance at which the first fastening part **110** and the second fastening part **120** are spaced apart may be variously

changed in design according to the thickness of the disc unit **300**, the size of the caliper unit **400**, and the like, which will be described below.

(21) Each of the first fastening part **110** and the second fastening part **120** may be provided in plural. In such a case, the plurality of first fastening parts **110** and the plurality of second fastening parts **120** are disposed to be spaced apart from each other by a predetermined distance along a circumferential direction of the stator unit **100**. FIG. **1** and FIG. **2** illustrate an example in which each of the first fastening part **110** and the second fastening part **120** is provided as a pair; however, the number of first fastening parts **110** and the number of second fastening parts **120** are not limited thereto and may be variously changed in design according to the number of first support parts **510** and the number of second support parts **520**.

(22) The rotor unit **200** is disposed inside the wheel **10** to face the stator unit **100**. The rotor unit **200** is rotated about a central axis by electromagnetic interaction with the stator unit **100**. The rotor unit **200** in accordance with an embodiment of the present disclosure is formed to have a cylindrical shape with one side open and is disposed between the wheel **10** and the stator unit **100**. Accordingly, an inner circumferential surface and an outer circumferential surface of the rotor unit **200** are disposed to face an outer circumferential surface of the stator unit **100** and an inner circumferential surface of the wheel **10**, respectively. The central axis of the rotor unit **200** is positioned on the same line as that of the wheel **10**. The rotor unit **200** is rotatably supported inside the wheel **10** via a wheel bearing **40** connected to the knuckle **30**. The rotor unit **200** includes a magnetic material such as a permanent magnet or a metal, and is rotated about the central axis by an electromagnetic force formed by the stator unit **100**. The rotor unit **200** rotates the wheel **10** and the disc unit **300** when rotating about the central axis as both sides thereof are connected to the wheel **10** and the disc unit **300** by bolting or the like, respectively.

(23) The disc unit **300** is connected to the rotor unit **200** and is provided to be rotatable together with the rotor unit **200**. The disc unit **300** in accordance with an embodiment of the present invention is formed to have a disc shape and is installed inside the stator unit **100**. The central axis of the disc unit **300** is positioned on the same line as that of the rotor unit **200**. The disc unit **300** is disposed between the rotor unit **200** and the wheel bearing **40**, and both sides thereof are connected to the rotor unit **200** and the wheel bearing **40** through bolting or the like, respectively. Accordingly, the disc unit **300** is rotated about the central axis together with the rotor unit **200** when the rotor unit **200** rotates. The diameter of the disc unit **300** may be variously changed in design according to the diameter of the wheel **10**, the diameter of the stator unit **100**, and the like.

(24) The caliper unit **400** is disposed to face the disc unit **300**, and generates a braking force by coming into contact with the disc unit **300** as hydraulic pressure generated by a pedal operation of a driver is applied. The caliper unit **400** may be provided as a pair. The pair of caliper units **400** are formed to be separated from each other and are symmetrically disposed on both sides of the disk unit **300**. That is, the pair of caliper units **400** are formed to have a structure in which a back part or a bridge part is deleted from an existing brake caliper. Accordingly, the caliper units **400** may prevent interference with adjacent components in an in-wheel structure in which the layout of the inside of the wheel is relatively small compared to an internal combustion engine or an environmental vehicle, and may reduce overall weight. Furthermore, since the caliper units **400** may reduce the size of a core for forming an internal structure during casting as the structure of the back part is deleted, manufacturing cost may be reduced, and it is easy to secure heat capacity through diameter expansion of the disk unit **300**. The pair of caliper units **400** are individually supported on the stator unit **100** by the support unit **500** to be described below. Accordingly, the pair of caliper units **400** may be individually designed in a shape suitable for layout conditions, and assembly properties may be improved.

(25) FIG. **4** is a perspective view schematically illustrating the configuration of the caliper unit **400**, the support unit **500**, and the transfer unit **600** in accordance with an embodiment of the present disclosure, and FIG. **5** is a cross-sectional view schematically illustrating the configuration of the

caliper unit **400**, the support unit **500**, and the transfer unit **600** in accordance with an embodiment of the present disclosure.

(26) Referring to FIG. **4** and FIG. **5**, each caliper unit **400** in accordance with an embodiment of the present disclosure includes a caliper body part **410**, a pad plate part **420**, and a piston part **430**.

(27) The caliper body part **410** forms a schematic external appearance of the caliper unit **400** and supports the pad plate part **420** and the piston part **430** to be described below. The caliper body part **410** is disposed so that its inner surface is spaced apart from one surface of the disc unit **300** by a predetermined distance while facing the one surface. The caliper body parts **410** provided in the pair of caliper units **400** are spaced apart from each other in the vehicle width direction with the disk unit **300** interposed therebetween. The specific shape of the caliper body part **410** is not limited to the shape illustrated in FIG. **4**, and various design changes are possible within the technical idea of a shape capable of supporting the pad plate part **420** and the piston part **430** to be described below.

(28) The caliper body part **410** is provided therein with a cylinder **411**. The cylinder **411** is concavely recessed inside the caliper body part **410** to form an empty space inside the caliper body part **410**. The cylinder **411** is formed so that the side facing the disc unit **300** is opened. The cylinder **411** supports the piston part **430** to be described below to be slidably movable. A brake fluid such as oil flows into the cylinder **411** to form hydraulic pressure, and the cylinder **411** slidably moves the piston part **430** by the formed hydraulic pressure.

(29) A port **412** is formed in the caliper body part **410** disposed on the inside (the left side of FIG. **4**) in the vehicle width direction among the pair of caliper body parts **410**. The port **412** in accordance with an embodiment of the present disclosure may be formed to have a shape of a hole formed through the caliper body part **410**. Both sides of the port **412** are connected with the inside of the cylinder **411** and the outside of the caliper body part **410**, respectively. The port **412** guides the flow of the brake fluid flowing into the cylinder **411** or discharged from the inside of the cylinder **411**. Accordingly, the port **412** may transfer hydraulic pressure generated from a master cylinder of the vehicle by the pedal operation of the driver to the cylinder **411**.

(30) The caliper body part **410** is formed with an insertion portion **413** for supporting the transfer unit **600** to be described below. The insertion portion **413** in accordance with an embodiment of the present disclosure may be formed to have a shape of a hole penetrating an upper end of the caliper body part **410** in a direction parallel to the axial direction of the disc unit **300**. The insertion portion **413** is formed to have a diameter corresponding to that of a transfer member **610** provided in the transfer unit **600**. The insertion portion **413** is connected with the cylinder **411** so that the brake fluid inside the cylinder **411** may be transferred to the transfer member **610**. The insertion portion **413** is provided as a pair and individually formed in the pair of caliper body parts **410**. The pair of insertion portions **413** are disposed to face each other on the same axis.

(31) The pad plate part **420** is disposed between the caliper body part **410** and the disc unit **300**. The pad plate part **420** is slidably coupled to the caliper body part **410**. The pad plate portion **420** slides in the direction parallel to the axial direction of the disc unit **300** by a pressing force applied from the piston part **430** to be described below, and an inner surface of the pad plate part **420** is in contact with or separated from the disc unit **300**. A friction pad made of a material having a high friction coefficient, such as rubber, may be attached to the inner surface of the pad plate part **420** facing the disc unit **300**. Accordingly, the pad plate part **420** may apply a braking force to the vehicle by a friction force generated when the pad plate part **420** comes into contact with the disc unit **300**. The specific shape of the pad plate part **420** is not limited to the shape illustrated in FIG. **4**, and various design changes are possible within the technical idea of a brake pad that comes into contact with the disc unit **300** and applies a braking force to the vehicle.

(32) The piston part **430** is slidably installed in the cylinder **411**. The piston part **430** moves forward and backward in the direction parallel to the axial direction of the disc unit **300** by the hydraulic pressure formed inside the cylinder **411**. The piston part **430** presses the pad plate part

420 toward the disc unit **300** according to the movement direction or releases the pressure on the pad plate part **420**. The piston unit **430** may be provided in plural and arranged in parallel along the width direction of the caliper body part **410**. In such a case, the cylinder **411** may be formed in a number corresponding to the number of piston parts **430**.

(33) The support unit **500** extends from the caliper unit **400**, is coupled to the first fastening part **110** and the second fastening part **120**, and supports the caliper unit **400** with respect to the stator unit **100**. Accordingly, the support unit **500** may stably fix the position of the caliper unit **400** without a structure of a torque member coupled to the existing knuckle **30**, so that the size of the caliper unit **400** may be reduced to fit in-wheel layout conditions.

(34) FIG. **6** is an enlarged view schematically illustrating the configuration of the support unit **500** in accordance with an embodiment of the present disclosure.

(35) Referring to FIG. **4** and FIG. **6**, the support unit **500** in accordance with an embodiment of the present disclosure includes the first support part **510** and the second support part **520**.

(36) The first support part **510** and the second support part **520** extend from the pair of caliper units **400**, respectively. Hereinafter, a case where the first support part **510** extends from the caliper unit **400** disposed on the outside (right side of FIG. **4**) in the vehicle width direction among the pair of caliper units **400** and the second support part **520** extends from the caliper unit **400** disposed on the inside (the left side of FIG. **4**) in the vehicle width direction among the pair of caliper units **400** will be described as an example.

(37) The first support part **510** and the second support part **520** in accordance with an embodiment of the present disclosure may be formed to protrude upward from the upper end of the caliper body part **410**. The first support part **510** and the second support part **520** have through holes extending in the direction parallel to the axial direction of the disk part **300**, respectively. The first support part **510** and the second support part **520** are formed with through holes extending in the direction parallel to the axial direction of the disc unit **300**, respectively. The first support part **510** and the second support part **520** are disposed to face the first fastening part **110** and the second fastening part **120** extending from the stator unit **100**, respectively. The first support part **510** and the second support part **520** are detachably coupled to the first fastening part **110** and the second fastening part **120** by fastening means such as bolts and pins inserted through the through holes, respectively, and individually support the pair of caliper units **400**.

(38) The first support part **510** and the second support part **520** may be provided in plural and disposed on both sides of the pair of caliper units **400**, respectively. For example, as illustrated in FIG. **4**, the first support part **510** and the second support part **520** may be formed in a pair, and may be disposed to be spaced apart from each other by a predetermined distance on both sides of the caliper units **400** in the width direction. Accordingly, the first support part **510** and the second support part **520** may support the pair of caliper units **400** by a plurality of axes, respectively, thereby preventing the self-rotation of the caliper body part **410**.

(39) The first support part **510** and the second support part **520** may be disposed on different axes. That is, as illustrated in FIG. **4**, the first support part **510** and the second support part **520** may be disposed such that the positions of the through holes are shifted from each other. Correspondingly to this, the first fastening part **110** and the second fastening part **120** are also disposed on different axes. Accordingly, an operator may fix the caliper part **400**, which is disposed on the outside in the vehicle width direction and relatively first assembled among the pair of caliper units **400**, to the stator unit **100** prior to the caliper part **400** disposed on the inside in the vehicle width direction, so that stable assembly is possible.

(40) The transfer unit **600** is connected to the pair of caliper units **400**, and transfers hydraulic pressure, which is applied to one of the pair of caliper units **400**, to the other one of the pair of caliper units **400**. That is, the transfer unit **600** is provided to provide a path through which the brake fluids may be mutually flown through the pair of caliper units **400**. Accordingly, the transfer unit **600** may stably apply hydraulic pressure to the pair of caliper units **400** without separately

installing hydraulic pressure generation means in the pair of caliper units **400** separated from each other, and synchronize the operation of the pair of caliper units **400**.

(41) FIG. **7** is a perspective view schematically illustrating the configuration of the transfer unit **600** in accordance with an embodiment of the present disclosure, and FIG. **8** is an operation view schematically illustrating an operating state of the transfer unit **600** in accordance with an embodiment of the present disclosure.

(42) Referring to FIG. **7** and FIG. **8**, the transfer unit **600** in accordance with an embodiment of the present disclosure includes a transfer member **610**, a fixing part **620**, a sealing part **630**, and a stopper part **640**.

(43) The transfer member **610** is disposed between the pair of caliper body parts **410** to guide the flow of the brake fluid. The transfer member **610** in accordance with an embodiment of the present disclosure may be formed to have a shape of a rod having a substantially circular cross-section. The transfer member **610** is inserted into the insertion portion **413** formed through the caliper body part **410**. The transfer member **610** is supported in a state in which both ends thereof are inserted into the pair of insertion portions **413**, respectively. As the transfer member **610** occupies a relatively small volume compared to the existing back, interference with adjacent components may be prevented.

(44) The transfer member **610** is formed therein with a flow part **611** having a shape of a fluid path extending along the longitudinal direction of the transfer member **610**. The flow part **611** is connected with the outside of the transfer member **610** through both ends thereof by passing through the transfer member **610** in an axial direction or a radial direction, respectively. When the transfer member **610** is completely inserted into the pair of insertion portions **413**, both ends of the flow part **611** are connected with the inside of the pair of cylinders **411**, respectively. The flow part **611** receives the brake fluid from one of the cylinders **411** through one end thereof and transfers the braking fluid to the other one of the cylinders **411** through the other end thereof.

(45) The fixing part **620** is detachably coupled to the caliper body part **410** to prevent the transfer member **610** from moving relative to the caliper body part **410**. Accordingly, the fixing part **620** may prevent the transfer member **610** from being arbitrarily moved in the longitudinal direction and the communication state with the cylinders **411** from being changed. The fixing part **620** in accordance with an embodiment of the present disclosure may be formed to have a thread shape protruding from the outer circumferential surface of one end (the right end of FIG. **7**) of the transfer member **610**. The fixing part **620** is screwed to the inner circumferential surface of the insertion portion **413** formed in the caliper body part **410** disposed on the outside (the right side of FIG. **7**) in the vehicle width direction, and prevents relative movement of the transfer member **610** with respect to the caliper body part **410**.

(46) The sealing part **630** is installed between the transfer member **610** and the caliper body part **410**, and prevents the brake fluid from leaking to the outside of the caliper body part **410**. The sealing part **630** in accordance with an embodiment of the present disclosure is formed to have a circular ring shape and is installed between the outer circumferential surface of the transfer member **610** and the inner circumferential surface of the insertion portion **413**. The sealing part **630** is provided to be elastically deformable so that the inner circumferential surface and the outer circumferential surface thereof are in close contact with the outer circumferential surface of the transfer member **610** and the inner circumferential surface of the insertion portion **413**, respectively. Accordingly, the sealing part **630** may effectively prevent the brake fluid from leaking into a gap formed between the transfer member **610** and the insertion portion **413**. Furthermore, the sealing part **630** may reduce concentricity tolerance between the transfer member **610** and the insertion portion **413** by its own elastic restoring force. A plurality of sealing units **630** may be provided to be spaced apart from each other by a predetermined distance along the longitudinal direction of the transfer member **610**. FIG. **4** and FIG. **7** illustrate an example in which the sealing part **630** is installed on the side of the insertion portion **413** formed in the caliper body part **410**

disposed on the inside (left side of FIG. **7**) in the vehicle width direction; however, the location of the sealing part **630** is not limited thereto and the sealing part **630** may also be installed on the side of the insertion portion **413** formed in the caliper body part **410** disposed on the outside (right side of FIG. **7**) in the vehicle width direction.

(47) The stopper part **640** extends from the transfer member **610** and limits the length at which the transfer member **610** is inserted into the insertion portion **413**. More specifically, the stopper part **640** is disposed at one end of the transfer member **610**, and comes into contact with the outer surface of any one of the pair of caliper body parts **410** as the transfer member **610** is inserted into the insertion portion **413** by a predetermined distance or more. Accordingly, the stopper part **640** may allow the transfer member **610** and the cylinder **411** to communicate at a fixed position without visually checking during the assembly process of the transfer unit **600**, and may prevent damage due to collision between components. The stopper part **640** in accordance with an embodiment of the present disclosure is formed in the form of a bolt head having a larger diameter than that of the transfer member **610** and is disposed on the other end (left end of FIG. **7**) of the transfer member **610**. As the transfer member **610** is inserted into the insertion portion **413** by a predetermined distance or more, the inner surface of the stopper part **640** comes into contact with the outer surface of the caliper body part **410** disposed on the inside (left side of FIG. **7**) in the vehicle width direction, so that the transfer member **610** is fixed at a fixed position.

(48) Hereinafter, a process of assembling the brake apparatus **1** for a vehicle in accordance with an embodiment of the present disclosure will be described in detail.

(49) FIG. **9** is a view schematically illustrating a process of assembling the brake apparatus **1** for a vehicle in accordance with an embodiment of the present disclosure.

(50) Referring to FIG. **9** (*a*), the stator unit **100** and the rotor unit **200** are installed inside the wheel **10** of the vehicle.

(51) Referring to FIG. **9** (*b*), the caliper unit **400** disposed on the outside in the vehicle width direction is fixed to the stator unit **100** by coupling the first fastening part **110** and the first support part **510** through fastening means such as bolts.

(52) Referring to FIG. **9** (*c*), the disc unit **300** and the wheel bearing **40** are assembled to the rotor unit **200** by bolting or the like. Accordingly, the disc unit **300** and the wheel bearing **40** may be integrally coupled with the rotor unit **200** and rotated about the central axis together with the rotor unit **200**.

(53) Referring to FIG. **9** (*d*), the caliper unit **400** disposed on the inside in the vehicle width direction is fixed to the stator unit **100** by coupling the second fastening part **120** and the second support part **520** through fastening means such as bolts.

(54) Referring to FIG. **9** (*e*), the transfer unit **600** is connected to the pair of caliper units **400**.

(55) More specifically, first, one end of the transfer member **610** is sequentially inserted into the insertion portion **413** formed in the caliper unit **400** disposed on the inside in the vehicle width direction and the insertion portion **413** formed in the caliper unit **400** disposed on the outside in the vehicle width direction.

(56) When the one end of the transfer member **610** is inserted into the insertion portion **413** formed in the caliper unit **400** disposed on the outside in the vehicle width direction, an operator rotates the transfer member **610** about the central axis to screw the fixing part **620** to the inner circumferential surface of the insertion portion **413**.

(57) As the transfer member **610** is inserted into the insertion portion **413** by a predetermined distance or more, the inner surface of the stopper part **640** comes into contact with the outer surface of the caliper body part **410** disposed on the inside in the vehicle width direction, so that the transfer member **610** is fixed at a fixed position.

(58) Hereinafter, the configuration of a brake apparatus **1′** for a vehicle in accordance with another embodiment of the present disclosure will be described in detail. In this process, for convenience of description, description overlapping with the brake apparatus **1** for a vehicle in accordance with an

embodiment of the present disclosure will be omitted.
(59) FIG. **10** is a front view schematically illustrating the configuration of the brake apparatus **1**′ for a vehicle in accordance with another embodiment of the present disclosure, and FIG. **11** is a perspective view schematically illustrating the configuration of the brake apparatus **1**′ for a vehicle in accordance with another embodiment of the present disclosure.
(60) Referring to FIG. **10** and FIG. **11**, the first support part **510** and the second support part **520** in accordance with another embodiment of the present disclosure are disposed on the same axis. That is, the first support part **510** and the second support part **520** are disposed so that the central axis of a through hole is positioned on the same straight line. Correspondingly to this, the first fastening part **110** and the second fastening part **120** are also arranged on the same axis. Accordingly, the first support part **510** and the second support part **520** may be simultaneously coupled to the first fastening part **110** and the second fastening part **120** by single fastening means, so that more efficient and quick assembly is possible.
(61) Although the present disclosure has been described with reference to the embodiments illustrated in the drawings, the embodiments of the disclosure are for illustrative purposes only, and those skilled in the art will appreciate that various modifications and other equivalent embodiments are possible from the embodiments. Thus, the true technical scope of the present disclosure should be defined by the following claims.

Claims

1. A brake apparatus for a vehicle, comprising: a stator unit fixed to an inside of a wheel of the vehicle; a rotor unit disposed to face the stator unit and rotated by electromagnetic interaction with the stator unit; a disc unit connected to the rotor unit and rotated together with the rotor unit; a pair of caliper units disposed on both sides of the disc unit and configured to generate a braking force by contacting with the disc unit as hydraulic pressure is applied, a first caliper unit of the pair of caliper units including a first caliper body part including a first cylinder and a second caliper unit of the pair of caliper units including a second caliper body part including a second cylinder; a transfer unit configured to be inserted into a first insertion portion of the first caliper unit and a second insertion portion of the second caliper unit; and a port configured to transfer hydraulic pressure by flow of a brake fluid and connected to the first cylinder in the first caliper body part, wherein the first cylinder is connected to the first insertion portion such that the brake fluid is transferred from the port to the transfer unit via the first cylinder and the first insertion portion and flows through the transfer unit to the second insertion portion connected to the second cylinder.
2. The brake apparatus according to claim 1, wherein the first caliper unit includes: a first pad plate part disposed between the first caliper body and the disc unit; and a first piston slidably installed in the first cylinder, and configured to move forward and backward by hydraulic pressure generated by the first cylinder and to press the first pad plate part toward the disc unit or release pressure on the first pad plate part; and the second caliper unit includes: a second pad plate part disposed between the second caliper body and the disc unit; and a second piston slidably installed in the second cylinder, and configured to move forward and backward by hydraulic pressure generated by the second cylinder and to press the second pad plate part toward the disc unit or release pressure on the first pad plate part.
3. The brake apparatus according to claim 2, wherein the transfer unit comprises: a transfer member disposed between the pair of caliper body parts and having both sides connected with an inside of the pair of caliper body parts, respectively; a fixing part detachably coupled to the caliper body part and configured to prevent the transfer member from moving relative to the caliper body part; and a sealing part installed between the transfer member and the caliper body part, and configured to prevent the brake fluid from leaking to an outside of the caliper body part.
4. The brake apparatus according to claim 3, wherein the first insertion portion penetrates through

the first caliper body part and the second insertion portion penetrates through the second caliper body part.

5. The brake apparatus according to claim 4, wherein a flow part extending along a longitudinal direction of the transfer member is defined in the transfer member.

6. The brake apparatus according to claim 4, wherein the fixing part protrudes from an outer circumferential surface of the transfer member and is screwed to an inner circumferential surface of the insertion portion.

7. The brake apparatus according to claim 4, wherein the sealing part is elastically deformable and is in contact with an outer circumferential surface of the transfer member and an inner circumferential surface of the insertion portion.

8. The brake apparatus according to claim 4, further comprising: a stopper part extending from the transfer member and configured to limit a length of a portion of the transfer member that is inserted into the insertion portion.

9. The brake apparatus according to claim 8, wherein the stopper part is disposed at one end of the transfer member, and is in contact with an outer surface of any one of the pair of caliper body parts as the transfer member is inserted into the insertion portion by a predetermined distance or more.

10. The brake apparatus according to claim 8, wherein the stopper part has a diameter larger than a diameter of the transfer member.

11. A brake apparatus for a vehicle, comprising: a stator unit fixed to an inside of a wheel of the vehicle; a rotor unit disposed to face the stator unit and rotated by electromagnetic interaction with the stator unit; a disc unit connected to the rotor unit and rotated together with the rotor unit; a pair of caliper units disposed on both sides of the disc unit and configured to generate a braking force by contacting with the disc unit as hydraulic pressure is applied; and a support unit extending from each of the pair of caliper units and supporting the each of the pair of caliper units with respect to the stator unit, the support unit comprises: a first support part extending from one of the pair of caliper units and detachably coupled to a first fastening part extending from the stator unit; and a second support part extending from a remaining one of the pair of caliper units and detachably coupled to a second fastening part extending from the stator unit.

12. The brake apparatus according to claim 11, wherein the pair of caliper units are separated from each other and are individually supported on the stator unit by the support unit.

13. The brake apparatus according to claim 12, wherein each of the pair of caliper units comprises: a caliper body part disposed to face one surface of the disc unit and including a cylinder configured to generate hydraulic pressure by a brake fluid flowing into the cylinder; a pad plate part disposed between the caliper body part and the disc unit; and a piston part slidably installed in the cylinder, and configured to move forward and backward by hydraulic pressure generated by the cylinder and to press the pad plate part toward the disc unit or release pressure on the pad plate part.

14. The brake apparatus according to claim 11, wherein the first support part and the second support part are disposed on a same axis.

15. The brake apparatus according to claim 11, wherein the first support part and the second support part are disposed on different axes.

16. The brake apparatus according to claim 11, wherein the first support part and the second support part are provided in plural and disposed to be spaced apart from each other on both sides of the pair of caliper units, respectively.