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SUSPENSION APPARATUS AND MANUFACTURING METHOD THEREOF

Abstract

A suspension apparatus and a method therefor are provided. The suspension apparatus includes a body connector including a main body connector provided with a body connection hole, and a carrier including a carrier hole which extends from the body connector and into which a wheel bearing is inserted, a caliper connector connected to a caliper, and a link connector connected to a link and configured to rotate with respect to the body connection hole.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from and the benefit under 35 USC § 119 of Korean Patent Application No. 10-2024-0022837, filed on Feb. 16, 2024 and Korean Patent Application No. 10-2024-0041791, filed on Mar. 27, 2024, in the Korean Intellectual Property Office, the entire disclosures of which are hereby incorporated by reference for all purposes.

BACKGROUND

1. Field

[0002] Exemplary embodiments of the present disclosure relate to a suspension apparatus and a manufacturing method thereof, and more particularly, to a suspension apparatus and a manufacturing method thereof, which may reduce unsprung mass, tolerance, and production cost.

2. Description of the Related Art

[0003] As eco-friendly vehicles are in demand, hybrid or electric vehicles with motors and batteries installed therein are increasingly being used.

[0004] Due to the essential placement of batteries in the hybrid or electric vehicles, the hybrid vehicles or electric vehicles are heavier than typical internal combustion engine vehicles by an amount equal to the weight of the batteries. The increased weight of the vehicles requires the increased rigidity of suspensions. The increased rigidity of the suspensions requires the increased weight of the suspensions, which in turn increases unsprung mass, resulting in a decrease in ride comport of the vehicles. Thus, there is a need for various technologies that may reduce the unsprung mass to improve ride comport of the vehicles.

[0005] In addition, there is a need for technologies that may maintain the rigidity of the suspensions while reducing the unsprung mass.

[0006] The related art of the present disclosure is disclosed in Korean Patent Application Publication No. 10-2015-0066110 (published on Jun. 16, 2015 and entitled “STRUCTURE OF TRAILING-ARM”).

SUMMARY

[0007] This Summary is provided to introduce a selection of concepts in simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0008] An objective of the present disclosure is to provide a suspension apparatus and a manufacturing method thereof, which may reduce unsprung mass.

[0009] In addition, an objective of the present disclosure is to provide a suspension apparatus and a manufacturing method thereof, which may minimize a tolerance.

[0010] In addition, an objective of the present disclosure is to provide a suspension apparatus and a manufacturing method thereof, which may increase rigidity.

[0011] In addition, an objective of the present disclosure is to provide a suspension apparatus and a manufacturing method thereof, which may maintain rigidity while reducing unsprung mass.

[0012] Furthermore, an objective of the present disclosure is to provide a suspension apparatus and a manufacturing method thereof, which may enhance the coupling strength between components.

[0013] In a general aspect of the disclosure, a suspension apparatus includes: a body connector including a main body connector provided with a body connection hole; and a carrier including: a

carrier hole which extends from the body connector and into which a wheel bearing is inserted; a caliper connector connected to a caliper; and a link connector connected to a link and configured to rotate with respect to the body connection hole.
[0014] The link connector may include: a first link connector provided on an upper side of the carrier; a second link connector provided on one side of a lower side of the carrier; and a third link connector provided on the other side of the lower side of the carrier.
[0015] The link may include: a first link rotatively connected to the first link connector; a second link rotatively connected to the second link connector; and a third link rotatively connected to the third link connector.
[0016] The body connection hole may be provided on a first side of the main body connector, wherein the body connection insertion portion provided on a second side of the main body connector may be inserted into and secured in the carrier connector of the carrier.
[0017] The body connection insertion portion may include a recessed body latching portion, wherein the carrier may include a first carrier connection member inserted into the body latching portion.
[0018] The suspension apparatus may further include: a body connection insertion hole through which a first side of the body connection insertion portion and a second side of the body connection insertion portion are in communication with each other, wherein the carrier connector includes a second carrier connection member configured to penetrate the body connection insertion hole.
[0019] The body connector may include a first material, and the carrier may include a second material different from the first material.
[0020] In another general aspect of the disclosure, a suspension apparatus includes: a body connector including a main body connector provided with a body connection insertion portion, and a coupling reinforcement portion arranged on the body connection insertion portion; and a carrier including a carrier connector to which the body connection insertion portion is inserted and which comes into contact with the coupling reinforcement portion, a carrier hole into which a wheel bearing is inserted, a caliper connector connected to a caliper, and a link connector connected to a link.
[0021] The coupling reinforcement portion may include a first coupling reinforcement portion, which is formed on a surface of the body connection insertion portion and configured to enhance the coupling strength between the body connection insertion portion and the carrier connector.
[0022] The first coupling reinforcement portion may include a coupling reinforcement hole configured to receive the body connection insertion portion, wherein the carrier connector may include: a first carrier connection member configured to come in contact with the coupling reinforcement hole; and a second carrier connection member configured to penetrate the coupling reinforcement hole.
[0023] The first coupling reinforcement portion may include a coupling reinforcement burr penetrating the body connection insertion portion and protruding in one direction with respect to the body connection insertion portion, wherein the carrier connector may include: a first carrier connection member configured to come in contact with the coupling reinforcement burr; and a third carrier connection member configured to penetrate the coupling reinforcement burr.
[0024] The first coupling reinforcement portion may include a coupling reinforcement form device configured to protrude in one direction and be inclined with respect to the body connection insertion portion, wherein the carrier connector may include: a first carrier connection member configured to come in contact with the coupling reinforcement form device; and a second carrier connection member seated on the coupling reinforcement form device.
[0025] The first coupling reinforcement portion may include a coupling reinforcement form device hole configured to protrude in one direction and be inclined with respect to the body connection insertion portion, and provided with a hole, wherein the carrier connector may include: a first carrier connection member configured to come in contact with the coupling reinforcement form

device hole; and a second carrier connection member configured to penetrate the coupling reinforcement form device hole.
[0026] The suspension apparatus may further include a second coupling reinforcement portion formed on an end of the body connection insertion portion to enhance the coupling strength between the body connection insertion portion and the carrier connector.
[0027] The second coupling reinforcement portion may include a coupling reinforcement flange extending from an end of the body connection insertion portion and configured to bend in one direction, wherein the carrier connector may include a first carrier connection member configured to surround the coupling reinforcement flange.
[0028] A manufacturing method of the suspension apparatus according to the present disclosure includes: an insertion step in which a body connector is arranged in a mold, wherein the body connector includes a main body connector provided with a body connection insertion portion and a coupling reinforcement portion arranged on the body connection insertion portion and includes a first material; and a casting step in which a carrier is manufactured by injecting a second material different from the first material into the mold, wherein the carrier includes: a carrier connector coming into contact with the body connection insertion portion; and a link connector connected to a link.
[0029] Prior to the insertion step, the manufacturing method may further include a step of forming the coupling reinforcement portion on the body connection insertion portion.
[0030] The step of forming the coupling reinforcement portion may include forming a first coupling reinforcement portion on a surface of the body connection insertion portion to enhance the coupling strength between the body connection insertion portion and the carrier connector.
[0031] The first coupling reinforcement portion may include a coupling reinforcement hole penetrating the body connection insertion portion.
[0032] The first coupling reinforcement portion may include a coupling reinforcement burr penetrating the body connection insertion portion and protruding in one direction with respect to the body connection insertion portion.
[0033] The first coupling reinforcement portion may include a coupling reinforcement form unit arranged to protrude in one direction and to be inclined with respect to the body connection insertion portion.
[0034] The first coupling reinforcement portion may include a coupling reinforcement form unit hole arranged to protrude in one direction and to be inclined with respect to the body connection insertion portion, and provided with a hole.
[0035] The step of forming the coupling reinforcement portion may include forming a second coupling reinforcement portion in an end of the body connection insertion portion to enhance the coupling strength between the body connection insertion portion and the carrier connector.
[0036] The second coupling reinforcement portion may include a coupling reinforcement flange extending from an end of the body connection insertion portion and bending in one direction.
[0037] The second coupling reinforcement portion may include a coupling reinforcement hem facing the body connection insertion portion by extending from an end of the body connection insertion portion and bending at the same.
[0038] The suspension apparatus and the manufacturing method thereof according to the present disclosure may reduce the weight of the suspension apparatus and improve ride comport of the vehicle.
[0039] In addition, the suspension apparatus and the manufacturing method thereof according to the present disclosure may minimize a tolerance occurring in the suspension apparatus.
[0040] In addition, the suspension apparatus and the manufacturing method thereof according to the present disclosure may increase the rigidity of the suspension apparatus.
[0041] In addition, the suspension apparatus and the manufacturing method thereof according to the present disclosure may lower the manufacturing cost.

[0042] In addition, the suspension apparatus and the manufacturing method thereof according to the present disclosure may maintain the rigidity of the suspension apparatus while reducing the weight thereof.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] FIG. **1** is a perspective view illustrating a suspension apparatus according to an embodiment of the present disclosure, when viewed from one side.

[0044] FIG. **2** is a perspective view illustrating the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.

[0045] FIG. **3** is a plan view illustrating a portion of the suspension apparatus according to an embodiment of the present disclosure.

[0046] FIG. **4** is a perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure, when viewed from one side.

[0047] FIG. **5** is a perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.

[0048] FIG. **6** is an enlarged perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure.

[0049] FIG. **7** is a perspective view illustrating a body connector of the suspension apparatus according to an embodiment of the present disclosure, when viewed from one side.

[0050] FIG. **8** is a perspective view illustrating the body connector of the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.

[0051] FIG. **9** is a flowchart illustrating a manufacturing method of the suspension apparatus according to an embodiment of the present disclosure.

[0052] FIG. **10** is a perspective view illustrating an insertion of the body connector of the suspension apparatus into a mold according to an embodiment of the present disclosure.

[0053] FIG. **11** is a perspective view illustrating a suspension apparatus according to an embodiment of the present disclosure, when viewed from one side.

[0054] FIG. **12** is a perspective view illustrating the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.

[0055] FIG. **13** is a plan view illustrating a portion of the suspension apparatus according to an embodiment of the present disclosure.

[0056] FIG. **14** is a perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure, when viewed from one side.

[0057] FIG. **15** is a perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.

[0058] FIG. **16** is an enlarged perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure.

[0059] FIG. **17** is a perspective view illustrating a body connector of the suspension apparatus according to an embodiment of the present disclosure, when viewed from one side.

[0060] FIG. **18** is a perspective view illustrating the body connector of the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.

[0061] FIG. **19** is a cross-sectional view illustrating a first coupling reinforcement portion of the suspension apparatus according to a first embodiment of the present disclosure.

[0062] FIG. **20** is a cross-sectional view illustrating a first coupling reinforcement portion of the suspension apparatus according to a second embodiment of the present disclosure.

[0063] FIG. **21** is a cross-sectional view illustrating a first coupling reinforcement portion of the suspension apparatus according to a third embodiment of the present disclosure.

[0064] FIG. **22** is a cross-sectional view illustrating a first coupling reinforcement portion of the suspension apparatus according to a fourth embodiment of the present disclosure.
[0065] FIG. **23** is a perspective view illustrating a body connector of the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.
[0066] FIG. **24** is a cross-sectional view illustrating an end of a second coupling reinforcement portion of the suspension apparatus according to the first embodiment of the present disclosure.
[0067] FIG. **25** is a cross-sectional view illustrating an end of a second coupling reinforcement portion of the suspension apparatus according to the second embodiment of the present disclosure.
[0068] FIG. **26** is a flowchart illustrating a manufacturing method of the suspension apparatus according to an embodiment of the present disclosure.
[0069] FIG. **27** is a perspective view illustrating an insertion of the body connector of the suspension apparatus into a mold according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0070] Exemplary embodiments of a suspension apparatus and a manufacturing method thereof will be described below with reference to the accompanying drawings. It should be considered that the thickness of each line or the size of each component in the drawings may be exaggeratedly illustrated for clarity and convenience of description. In addition, the terms as used herein are defined in consideration of functions of the present disclosure, and these terms may change depending on a user or operator's intention or practice. Therefore, definitions of these terms will have to be made based on the content herein.
[0071] FIG. **1** is a perspective view illustrating a suspension apparatus according to an embodiment of the present disclosure, when viewed from one side. FIG. **2** is a perspective view illustrating the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.
[0072] FIGS. **1** and **2** illustrate a suspension apparatus **1**. The suspension apparatus may include a body connector **10**, a carrier **20**, a disk **30**, a caliper **40**, a link **50**, and a bush **60**.
[0073] The body connector **10** may be arranged between a body (not illustrated) of a vehicle and the carrier **20** to connect the body (not illustrated) and the carrier **20**.
[0074] The body connector **10** may include a main body connector **110**. The main body connector **110** may be provided with a body connection hole **111**. According to an embodiment, the body connection hole **111** may be provided on one end of the main body connector **110**. The body connection hole **111** may enable one side (e.g., the +Y-axis direction) and the other side (e.g., the −Y-axis direction) of the main body connector **110** to communicate with each other. The bush **60** may be arranged in the body connection hole **111**. According to an embodiment, a body connection bush **61** may be arranged in the body connection hole **111**. The body connection bush **61** may be inserted into the body connection hole **111**. The main body connector **110** and the body may be connected through the body connection bush **61**. Since the body connection bush **61** is arranged in the body connection hole **111** to connect the body and the main body connector **110**, the main body connector **110** may rotate with respect to the body connection bush **61** arranged in the body connection hole **111**, and the carrier **20** connected to the main body connector **110** may also rotate with respect to the body connection bush **61**. Accordingly, the carrier **20** may move relative to the body.
[0075] The main body connector **110** may be inserted into the carrier **20** and secured to the carrier **20**. Since the main body connector **110** is inserted into and secured to the carrier **20**, the main body connector **110** and the carrier **20** may be integrally formed and movable. Since the main body connector **110** is inserted into the carrier **20** and formed integrally with the same, a coupling member (e.g., bolt, nut, etc.) connecting the body connector **10** and the carrier **20** may not be used.
[0076] Since the coupling member is not used, the unsprung mass of the suspension apparatus **1** may be reduced by the mass of the coupling member, and ride comport of the vehicle may be improved.

[0077] In addition, since the coupling member is not used, a tolerance between the body connector **10** and the carrier **20** may be reduced.
[0078] Furthermore, since a process for coupling the body connector **10** and the carrier **20** is not required, the manufacturing process may be simplified and the unit cost of the suspension apparatus **1** may decrease.
[0079] The carrier **20** may be connected to the disk **30**, the caliper **40**, and the link **50**.
[0080] The disk **30** may be arranged on one side of the carrier **20** (e.g., the +Y-axis direction). The disk **30** may include a disk cover **310** and a disk rotor **320**. The disk cover **310** may be arranged between the carrier **20** and the disk rotor **320**. The disk rotor **320** may rotate with respect to the carrier **20**, and the disk cover **310** may be secured to the carrier **20**.
[0081] The caliper **40** may be arranged to be connected to the carrier **20**. A portion of the caliper **40** may be secured to the carrier **20** and move to come into contact with the disk rotor **320** of the disk **30**. When the caliper **40** moves to come into contact with the disk rotor **320** rotating with respect to the carrier **20**, friction generated between the caliper **40** and the disk rotor **320** may reduce a rotational speed of the disk rotor **320** or stop the rotation of the disk rotor **320**.
[0082] The link **50** may be arranged to be connected to the carrier **20**. One end of the link **50** may be connected to the carrier **20**, and the other end thereof may be connected to the body. The link **50** may rotate with respect to the carrier **20** and the body. Since the link **50** rotates with respect to the carrier **20** and the body, the carrier **20** may move relative to the body. The link **50** may include a first link **51**, a second link **52**, and a third link **53**.
[0083] The first link **51** may be arranged on an upper side (e.g., the +Z-axis direction) of the carrier **20**. The second link **52** may be arranged on one portion (e.g., the +X-axis direction) of a lower side (e.g., the −Z-axis direction) of the carrier **20**. The third link **53** may be arranged on another portion (e.g., the −X axis direction) of the lower side (e.g., the −Z axis direction) of the carrier **20**.
[0084] The first link **51**, the second link **52**, and the third link **53** may be connected to the carrier **20** and rotate with respect to the carrier **20**. According to an embodiment, one end of the first link **51**, one end of the second link **52**, and one end of the third link **53** may be connected to the carrier **20** and rotate with respect to the carrier **20**, and the other end of the first link **51**, the other end of the second link **52**, and the other end of the third link **53** may be connected to the body and rotate with respect to the body. Since the first link **51**, the second link **52**, and the third link **53** rotate with respect to the carrier **20** and the body, the carrier **20** may move relative to the body.
[0085] The third link **53** may include an elastic support part **531**. The elastic support part **531** may be arranged between the one end and the other end of the third link **53**. An elastic element may be arranged on the elastic support part **531**, and the elastic element may be arranged to connect the third link **53** and a portion of the body. According to an embodiment, the elastic element may be provided as a spring. Since the elastic element connects the third link **53** and the portion of the body, the distance between the portion of the body and the third link **53** may change.
[0086] FIG. **3** is a plan view illustrating a portion of the suspension apparatus according to an embodiment of the present disclosure. FIG. **4** is a perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure, when viewed from one side. FIG. **5** is a perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side. FIG. **6** is an enlarged perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure. FIG. **7** is a perspective view illustrating a body connector of the suspension apparatus according to an embodiment of the present disclosure, when viewed from one side. FIG. **8** is a perspective view illustrating the body connector of the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.
[0087] The suspension apparatus **1**, the body connector **10**, the main body connector **110**, the body connection hole **111**, the carrier **20**, the bush **60**, the body connection bush **61**, and a third link connection bush **62** illustrated in FIGS. **3** to **8** are the same as the suspension apparatus **1**, the body

connector **10**, the main body connector **110**, the body connection hole **111**, the carrier **20**, the bush **60**, the body connection bush **61**, and the third link connection bush **62** illustrated in FIGS. **1** and **2**. Thus, the description of the same configuration may be omitted.

[0088] Referring to FIGS. **3** to **8**, a detailed structure of the body connector **10** and the carrier **20** may be seen.

[0089] The body connector **10** may include a main body connector **110**, a body connection insertion portion **120**, a body recess portion **130**, and a body bend portion **140**.

[0090] The main body connector **110** may include the body connection hole **111**. The body connection hole **111** may enable one side (e.g., the +Y-axis direction) and the other side (e.g., the −Y-axis direction) of the main body connector **110** to communicate with each other. According to an embodiment, the body connection hole **111** may be provided on one end of the main body connector **110**, and the body connection insertion portion **120** may be provided on the other end of the main body connector **110**.

[0091] The bush **60** may be arranged in the body connection hole **111**. According to an embodiment, the body connection bush **61** may be arranged in the body connection hole **111**. The body connection bush **61** may be inserted into the body connection hole **111**, and may be connected to the body. The body connection bush **61** may be provided as an elastic element. Since the body connection bush **61** is inserted into the body connection hole **111** and connected to the body, the main body connector **110** provided with the body connection hole **111** may rotate with respect to the body.

[0092] The body connection insertion portion **120** may be provided in the main body connector **110** to come into contact with the carrier **20**. The body connection insert **120** may be defined as a portion of the main body connector **110** coming into contact with the carrier **20**. According to an embodiment, the body connection insertion portion **120** may be inserted into the carrier **20** such that the body connector **10** and the carrier **20** may be integrally provided. Since the body connector **10** and the carrier **20** are integrally provided, the coupling member connecting the body connector **10** and the carrier **20** may not be used.

[0093] The body connection insertion portion **120** may be provided with a body latching portion **121** and a body connection insertion hole **122**.

[0094] The body latching portion **121** may be provided to have a step toward a center (e.g., the Z-axis direction) of the main body connector **110**.

[0095] According to an embodiment, the body latching portion **121** may be provided to be recessed. The body latching portion **121** may be provided to be recessed in the main body connector **110**, and the carrier **20** may be inserted into the body latching portion **121**.

[0096] According to an embodiment, the body latching portion **121** may be provided to protrude from the main body connector **110**. The body latching portion **121** may be provided to protrude from the main body connector **110**, and the body latching portion **121** may be inserted into the carrier **20**.

[0097] As the carrier **20** is inserted into the body latching portion **121** or the body latching portion **121** is inserted into the carrier **20**, the coupling strength between the body connector **10** and the carrier **20** may increase. In addition, there may be no clearance between the body connector **10** and the carrier **20**.

[0098] The body connection insertion hole **122** may enable one side (e.g., the +Y-axis direction) and the other side (e.g., the −Y-axis direction) of the main body connector **110** to communicate with each other. One or more body connection insertion holes **122** may be provided. Since the body connection insertion hole **122** is provided in the main body connector **110**, the carrier **20** may be arranged to penetrate the body connection insertion hole **122**. Since the carrier **20** is arranged to penetrate the body connection insertion hole **122**, the coupling strength between the body connector **10** and the carrier **20** may increase. In addition, there may be no clearance between the body connector **10** and the carrier **20**.

[0099] The body recess portion **130** may be provided in the main body connector **110**, and formed to be recessed toward one side (e.g., the −Y-axis direction). One or more body recess portions **130** may be provided in the main body connector **110**. The body recess portion **130** may be arranged in a central portion of the main body connector **110**. The location where the body recess portion **130** is arranged is not limited to the central portion of the main body connector **110**, but the body recess portion **130** may be arranged at various locations. Since the body recess portion **130** is provided in the main body connector **110**, the flexural rigidity of the body connector **10** may increase.
[0100] The body bend portion **140** may be provided in the main body connector **110** and bend toward one side (e.g., the −Y-axis direction). The body bend portion **140** may be provided in an outer portion of the main body connector **110**. Since the body bend portion **140** is provided in the main body connector **110**, the flexural rigidity of the body connector **10** may increase.
[0101] The carrier **20** may include a carrier hole **210**, a link connector **220**, a caliper connector **230**, a disk connector **240**, and a carrier connector **250**.
[0102] The carrier **20** may be provided with the carrier hole **210**. The carrier hole **210** may enable one side (e.g., the +Y-axis direction) and the other side (e.g., the −Y-axis direction) of the carrier **20** to communicate with each other. The disk **30** may be inserted into the carrier hole **210**. The disk **30** may be inserted into the carrier hole **210** and secured to the carrier **20**.
[0103] The carrier **20** may be provided with the link connector **220**. The link connector **220** may connect the carrier **20** and the link **50**. The link **50** may be provided to be connected to the carrier **20** through the link connector **220** and rotate with respect to the carrier **20**. The link connector **220** may include a first link connector **221**, a second link connector **222**, and a third link connector **223**.
[0104] The first link connector **221** may be provided in the carrier **20**. According to an embodiment, the first link connector **221** may be provided on an upper side (e.g., the +Z-axis direction) of the carrier **20**. The first link connector **221** may be provided with a hole into which the first link **51** may be inserted. The first link connector **221** may be connected to the first link **51**, and the first link **51** may rotate with respect to the carrier **20** by being connected to the first link connector **221**.
[0105] The second link connector **222** may be provided in the carrier **20**. According to an embodiment, the second link connector **222** may be provided on one side (e.g., the +X-axis direction) of a lower side (e.g., the −Z-axis direction) of the carrier **20**. The second link connector **222** may be provided with a hole into which the second link **52** may be inserted. The second link connector **222** may be connected to the second link **52**, and the second link **52** may rotate with respect to the carrier **20** by being connected to the second link connector **222**.
[0106] The third link connector **223** may be provided in the carrier **20**. According to an embodiment, the third link connector **223** may be provided on the other side (e.g., the −X-axis direction) of the lower side (e.g., the −Z-axis direction) of the carrier **20**. The third link connector **223** may be provided with a hole into which the third link **53** may be inserted. The third link connector **223** may be connected to the third link **53**, and the third link **53** may rotate with respect to the carrier **20** by being connected to the third link connector **223**.
[0107] The link connector **220** may be provided with the bush **60**. According to an embodiment, the third link connector **223** may be provided with the third link connection bush **62**. The third link connection bush **62** may be connected to the third link **53**. The third link **53** may rotate with respect to the carrier **20** by being connected to the third link connection bush **62**.
[0108] The caliper connector **230** may be provided in the carrier **20**. The caliper **40** may be connected to the caliper connector **230**. According to an embodiment, the caliper **40** may be secured to the caliper connector **230**, and the caliper **40**, while moving relative to the disk rotor **320** of the disk **30**, may come into contact with and rub against the disk rotor **320** or become spaced apart from the disk rotor **320**. Since the caliper **40** rubs against the disk **30**, rotation of the disk **30** may slow down or stop.
[0109] The disk connector **240** may be provided in the carrier **20**. The disk connector **240** may be

arranged adjacent to the body connection hole **111**. The disk connector **240** may be provided as a hole penetrating the carrier **20**. The disk connector **240** may be provided as one or more holes. The disk connector **240** may be connected to the disk **30**. According to an embodiment, a portion of the disk **30** may be secured to the carrier **20** by penetrating the disk connector **240**.

[0110] The carrier connector **250** may be provided in the carrier **20**. The carrier connector **250** may be connected to the body connector **10**. According to an embodiment, the body connector **10** may be inserted into the carrier connector **250**. A first carrier connection member **251** provided in the carrier connector **250** may be arranged in the body latching portion **121** of the body connector **10**. The first carrier connection member **251** may be inserted into the body latching portion **121**.

[0111] A second carrier connection member **252** provided in the carrier connector **250** may be arranged in the body connection insertion hole **122** of the body connector **10**. The second carrier connection member **252** may be inserted into the body connection insertion hole **122**. According to an embodiment, the second carrier connection member **252** may penetrate the body connection insertion hole **122**. Since the first carrier connection member **251** is arranged in the body latching portion **121** and the second carrier connection member **252** is arranged in the body connection insertion hole **122**, the coupling strength between the body connector **10** and the carrier **20** may increase. In addition, a clearance between the body connector **10** and the carrier **20** may decrease.

[0112] The body connector **10** may be made of a material including a first material. According to an embodiment, the first material may be provided as a material including at least one of iron, iron alloy, carbon fiber, and plastic, or a combination thereof.

[0113] The carrier **20** may be made of a material including a second material different from the first material. According to an embodiment, the second material may be provided as a material including at least one of aluminum, aluminum alloy, carbon fiber, and plastic, or a combination thereof.

[0114] With the body connector **10** provided, the carrier **20** integrally connected to the body connector **10** may be manufactured. Hereinafter, a manufacturing method of the suspension apparatus **1** provided with the body connector **10** and the carrier **20** will be described.

[0115] FIG. **9** is a flowchart illustrating a manufacturing method of the suspension apparatus according to an embodiment of the present disclosure. FIG. **10** is a perspective view illustrating an insertion of the body connector of the suspension apparatus into a mold according to an embodiment of the present disclosure.

[0116] The body connector **10**, the main body connector **110**, the body connection hole **111**, the body connection insertion portion **120**, the body latching portion **121**, the body connection insertion hole **122**, the body recess portion **130**, the body bend portion **140**, and the carrier **20** used in the description of FIGS. **9** and **10** are the same as the body connector **10**, the main body connector **110**, the body connection hole **111**, the body connection insertion portion **120**, the body latching portion **121**, the body connection insertion hole **122**, the body recess portion **130**, the body bend portion **140**, and the carrier **20** illustrated in FIGS. **1** to **8**. Thus, the description of the same configuration may be omitted.

[0117] Referring to FIGS. **9** and **10**, the manufacturing method of the suspension apparatus **1** may include an insertion step in which the body connector **10** is arranged in a mold M (S**910** in FIG. **9**). The body connector **10** may be made of a material including the first material. The body connection insertion portion **120** of the body connector **10** may be inserted into the mold M. Since the body connection insertion portion **120** is inserted into the mold M, the body connection insertion portion **120** may come into contact with a material including the second material in a casting step (S**920** in FIG. **9**), which will be described below.

[0118] The manufacturing method of the suspension apparatus **1** may include the casting step in which the material including the second material is disposed in the mold M to form the carrier **20** (S**920** in FIG. **9**). The material including the second material may be injected into the mold M through a mold hole MH of the mold M. The first material of the body connector **10** and the second

material of the carrier **20** may be different from each other. The mold M may be provided to correspond to a shape of the carrier **20**.

[0119] In the casting step (S**920**), the body connection insertion portion **120** provided in the body connector **10** may be connected to the carrier connector **250** of the carrier **20**. According to an embodiment, the body connection insertion portion **120** may be inserted into the carrier connector **250**. When the body connection insertion portion **120** is inserted into the carrier connector **250**, the coupling strength may be generated between the body connection insertion portion **120** and the carrier connector **250** such that the body connector **10** and the carrier **20** may be integrally formed. Since the body connector **10** and the carrier **20** may be integrally formed, the coupling member (e.g., bolt, nut, etc.) coupling the body connector **10** and the carrier **20** may not be used. Thus, the mass of the suspension apparatus **1** may be reduced, and a process for coupling the body connector **10** and the carrier **20** is not required, thereby lowering manufacturing cost of the suspension apparatus **1**.

[0120] The body connection insertion portion **120** may include the body latching portion **121** and the body connection insertion hole **122**.

[0121] The body latching portion **121** may be provided in a concave shape that is recessed toward a central portion of the main body connector **110**. In the casting step (S**920**), the material including the second material may be disposed in the body latching portion **121**, and accordingly, the first carrier connection member **251** of the carrier **20** may be arranged in the body latching portion **121**. As the first carrier connection member **251** is arranged in the body latching portion **121**, the coupling strength between the body connector **10** and the carrier **20** may increase, and a tolerance between the body connector **10** and the carrier **20** may be reduced.

[0122] The body connection insertion hole **122** may be provided as a hole through which one side and the other side of the main body connector **110** are in communication with each other. In the casting step (S**920**), the material including the second material may be disposed in the body connection insertion hole **122**, and accordingly, the second carrier connection member **252** of the carrier **20** may be arranged in body connection insertion hole **122**. According to an embodiment, the second carrier connection member **252** may penetrate the body connection insertion hole **122**. Since the second carrier connection member **252** penetrates the body connection insertion hole **122**, the coupling strength between the body connector **10** and the carrier **20** may increase, and a tolerance between the body connector **10** and the carrier **20** may be reduced.

[0123] The manufacturing method of the suspension apparatus **1** may include a bush arrangement step in which the bush **60** is arranged in the suspension apparatus **1** (S**930** in FIG. **9**). The bush **60** may include the body connection bush **61** and the third link connection bush **62**.

[0124] The bush arrangement step (S**930**) may include arranging the body connection bush **61** in the body connection hole **111**. According to an embodiment, the bush arrangement step (S**930**) may include inserting the body connection bush **61** into the body connection hole **111**.

[0125] The bush arrangement step (S**930**) may include arranging the third link connection bush **62** in the third link connector **223**. According to an embodiment, the bush arrangement step (S**930**) may include inserting the third link connection bush **62** into the third link connector **223**.

[0126] The suspension apparatus **1** manufactured by the manufacturing method of the suspension apparatus may be made lightweight, thereby improving ride comport. In addition, a tolerance occurring in the suspension apparatus **1** may be minimized, and rigidity may increase. Furthermore, the manufacturing cost of the suspension apparatus **1** may be lowered.

[0127] FIG. **11** is a perspective view illustrating a suspension apparatus according to an embodiment of the present disclosure, when viewed from one side. FIG. **12** is a perspective view illustrating the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.

[0128] FIGS. **11** and **12** illustrate a suspension apparatus **71**. The suspension apparatus **71** may include a body connector **710**, a carrier **720**, a disk **730**, a caliper **740**, a link **750**, and a bush **760**.

[0129] The body connector **710** may be arranged between a body (not illustrated) of a vehicle and the carrier **720** to connect the body (not illustrated) and the carrier **720**.
[0130] The body connector **710** may include a main body connector **7110**. The main body connector **7110** may be provided with a body connection hole **7111**. According to an embodiment, the body connection hole **7111** may be provided on one end of the main body connector **7110**. The body connection hole **7111** may enable one side (e.g., the +Y-axis direction) and the other side (e.g., the −Y-axis direction) of the main body connector **7110** to communicate with each other. The bush **760** may be arranged in the body connection hole **7111**. According to an embodiment, a body connection bush **761** may be arranged in the body connection hole **7111**. The body connection bush **761** may be inserted into the body connection hole **7111**. The main body connector **7110** and the body may be connected through the body connection bush **761**. Since the body connection bush **761** is arranged in the body connection hole **7111** to connect the body and the main body connector **7110**, the main body connector **7110** may rotate with respect to the body connection bush **761** arranged in the body connection hole **7111**, and the carrier **720** connected to the main body connector **7110** may also rotate with respect to the body connection bush **761**. Accordingly, the carrier **720** may move relative to the body.
[0131] The main body connector **7110** may be inserted into the carrier **720** and secured to the carrier **720**. Since the main body connector **7110** is inserted into and secured to the carrier **720**, the main body connector **7110** and the carrier **720** may be integrally formed and movable. Since the main body connector **7110** is inserted into the carrier **720** and formed integrally with the same, a coupling member (e.g., bolt, nut, etc.) connecting the body connector **710** and the carrier **720** may not be used.
[0132] Since the coupling member is not used, the unsprung mass of the suspension apparatus **71** may be reduced by the mass of the coupling member, and ride comport of the vehicle may be improved.
[0133] In addition, since the coupling member is not used, a tolerance between the body connector **710** and the carrier **720** may be reduced.
[0134] Furthermore, since a process for coupling the body connector **710** and the carrier **720** is not required, the manufacturing process may be simplified, and the unit cost of the suspension apparatus **71** may decrease.
[0135] The carrier **720** may be connected to the disk **730**, the caliper **740**, the link **750**.
[0136] The disk **730** may be arranged on one side of the carrier **720** (e.g., the +Y-axis direction). The disk **730** may include a disk cover **7310** and a disk rotor **7320**. The disk cover **7310** may be arranged between the carrier **720** and the disk rotor **7320**. The disk rotor **7320** may rotate with respect to the carrier **720**, and the disk cover **7310** may be secured to the carrier **720**.
[0137] The caliper **740** may be disposed to be connected to the carrier **720**. A portion of the caliper **740** may be secured to the carrier **720** and move to come into contact with the disk rotor **7320** of the disk **730**. When the caliper **740** moves to come into contact with the disk rotor **7320** rotating with respect to the carrier **720**, friction generated between the caliper **740** and the disk rotor **7320** may reduce a rotational speed of the disk rotor **7320** or stop the rotation of the disk rotor **7320**.
[0138] The link **750** may be arranged to be connected to the carrier **720**. One end of the link **750** may be connected to the carrier **720**, and the other end thereof may be connected to the body. The link **750** may rotate with respect to the carrier **720** and the body. Since the link **750** rotates with respect to the carrier **720** and the body, the carrier **720** may move relative to the body. The link **750** may include a first link **751**, a second link **752**, and a third link **753**.
[0139] The first link **751** may be disposed on an upper side (e.g., the +Z-axis direction) of the carrier **720**. The second link **752** may be arranged on one portion (e.g., the +X-axis direction) of a lower side (e.g., the −Z-axis direction) of the carrier **720**. The third link **753** may be arranged on another portion (e.g., the −X axis direction) of the lower side (e.g., the −Z axis direction) of the carrier **720**.

[0140] The first link **751**, the second link **752**, and the third link **753** may be connected to the carrier **720** and rotate with respect to the carrier **720**. According to an embodiment, one end of the first link **751**, one end of the second link **752**, and one end of the third link **753** may be connected to the carrier **720** and rotate with respect to the carrier **720**, and the other end of the first link **751**, the other end of the second link **752**, and the other end of the third link **753** may be connected to the body and rotate with respect to the body. Since the first link **751**, the second link **752**, and the third link **753** rotate with respect to the carrier **720** and the body, the carrier **720** may move relative to the body.

[0141] The third link **753** may include an elastic support part **7531**. The elastic support part **7531** may be arranged between the one end and the other end of the third link **753**. An elastic element may be arranged on the elastic support part **7531**, and the elastic element may be arranged to connect the third link **753** and a portion of the body. According to an embodiment, the elastic element may be provided as a spring. Since the elastic element connects the third link **753** and the portion of the body, the distance between the portion of the body and the third link **753** may change.

[0142] FIG. **13** is a plan view illustrating a portion of the suspension apparatus according to an embodiment of the present disclosure. FIG. **14** is a perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure, when viewed from one side. FIG. **15** is a perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side. FIG. **16** is an enlarged perspective view illustrating the portion of the suspension apparatus according to an embodiment of the present disclosure. FIG. **17** is a perspective view illustrating a body connector of the suspension apparatus according to an embodiment of the present disclosure, when viewed from one side. FIG. **18** is a perspective view illustrating the body connector of the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side.

[0143] The suspension apparatus **71**, the body connector **710**, the main body connector **7110**, the body connection hole **7111**, the carrier **720**, the bush **760**, the body connection bush **761**, and a third link connection bush **762** illustrated in FIGS. **13** to **18** are the same as the suspension apparatus **71**, the body connector **710**, the main body connector **7110**, the body connection hole **7111**, the carrier **720**, the bush **760**, the body connection bush **761**, and the third link connection bush **762** illustrated in FIGS. **11** and **12**. Thus, the description of the same configuration may be omitted.

[0144] Referring to FIGS. **13** to **18**, a detailed structure of the body connector **710** and the carrier **720** may be seen.

[0145] The body connector **710** may include a main body connector **7110**, a body connection insertion portion **7120**, a body recess portion **7130**, a body bend portion **7140**, and a coupling reinforcement portion **7150**.

[0146] The main body connector **7110** may include the body connection hole **7111**. The body connection hole **7111** may enable one side (e.g., the +Y-axis direction) and the other side (e.g., the −Y-axis direction) of the main body connector **7110** to communicate with each other. According to an embodiment, the body connection hole **7111** may be provided on one end of the main body connector **7110**, and the body connection insertion portion **7120** may be provided on the other end of the main body connector **7110**.

[0147] The bush **760** may be arranged in the body connection hole **7111**. According to an embodiment, the body connection bush **761** may be arranged in the body connection hole **7111**. The body connection bush **761** may be inserted into the body connection hole **7111** and may be connected to the body. The body connection bush **761** may be provided as an elastic element. Since the body connection bush **761** is inserted into the body connection hole **7111** and connected to the body, the main body connector **7110** provided with the body connection hole **7111** may rotate with respect to the body.

[0148] The body connection insertion portion **7120** may be provided in the main body connector **7110** to come into contact with the carrier **720**. The body connection insert **7120** may be defined as a portion of the main body connector **7110** coming into contact with the carrier **720**. According to an embodiment, the body connection insertion portion **7120** may be inserted into the carrier **720** such that the body connector **710** and the carrier **720** may be integrally provided. Since the body connector **710** and the carrier **720** are integrally provided, the coupling member connecting the body connector **710** and the carrier **720** may not be used.
[0149] The body recess portion **7130** may be provided in the main body connector **7110**, and formed to be recessed toward one side (e.g., the −Y-axis direction). One or more body recess portions **7130** may be provided in the main body connector **7110**. The body recess portion **7130** may be arranged in a central portion of the main body connector **7110**. The location where the body recess portion **7130** is arranged is not limited to the central portion of the main body connector **7110**, but the body recess portion **130** may be arranged at various locations. Since the body recess portion **7130** is provided in the main body connector **7110**, the flexural rigidity of the body connector **710** may increase.
[0150] The body bend portion **7140** may be provided in the main body connector **7110** and bend toward one side (e.g., the −Y-axis direction). The body bend portion **7140** may be provided on an outer portion of the main body connector **7110**. Since the body bend portion **7140** is provided in the main body connector **7110**, the flexural rigidity of the body connector **710** may increase.
[0151] The coupling reinforcement portion **7150** may be arranged in the main body connector **7110**. According to an embodiment, the coupling reinforcement portion **7150** may be arranged in the body connection insertion portion **7120**. Since the coupling reinforcement portion **7150** is arranged in the body connection insertion portion **7120**, the coupling reinforcement portion **7150** may come into contact with the carrier connector **7250** of the carrier **720**.
[0152] The coupling reinforcement portion **7150** may be provided, in the form of a hole or protrusion, in the body connection insertion portion **7120**, which may increase the contact area with the carrier connector **7250**. Alternatively, a portion of the carrier connector **7250** may be arranged to penetrate the coupling reinforcement portion **7150**, or may be arranged to surround the coupling reinforcement portion **7150**.
[0153] Thus, the coupling strength between the coupling reinforcement portion **7150** and the carrier connector **7250** may be improved, resistance to a shear force generated by an external force, on the coupling reinforcement portion **7150** and the carrier connector **7250** may increase, and the rigidity of the suspension apparatus **71** may increase.
[0154] The coupling reinforcement portion **7150** may include a first coupling reinforcement portion **7151** and a second coupling reinforcement portion **7152**. According to an embodiment, the first coupling reinforcement portion **7151** may be arranged to be formed on a surface of the body connection insertion portion **7120**, and the second coupling reinforcement portion **7152** may be arranged to be formed on an end of the body connection insertion portion **7120**. A description of the first coupling reinforcement portion **7151** will be described later with a description of FIGS. **19** to **22**. A description of the second coupling reinforcement portion **7152** will be described later with a description of FIGS. **23** to **25**.
[0155] The carrier **720** may include a carrier hole **7210**, a link connector **7220**, a caliper connector **7230**, a disk connector **7240**, and a carrier connector **7250**.
[0156] The carrier **720** may be provided with a carrier hole **7210**. The carrier hole **7210** may enable one side (e.g., the +Y-axis direction) and the other side (e.g., the −Y-axis direction) of the carrier **720** to communicate with each other. The disk **730** may be inserted into the carrier hole **7210**. The disk **730** may be inserted into the carrier hole **7210** and secured to the carrier **720**.
[0157] The carrier **720** may be provided with the link connector **7220**. The link connector **7220** may connect the carrier **720** and the link **750**. The link **750** may be provided to be connected to the carrier **720** through the link connector **7220** and rotate with respect to the carrier **720**. The link

connector **7220** may include a first link connector **7221**, a second link connector **7222**, and a third link connector **7223**.

[0158] The first link connector **7221** may be provided in the carrier **720**. According to an embodiment, the first link connector **7221** may be provided on an upper side (e.g., the +Z-axis direction) of the carrier **720**. The first link connector **7221** may be provided with a hole into which the first link **751** may be inserted. The first link connector **7221** may be connected to the first link **751**, and the first link **751** may rotate with respect to the carrier **720** by being connected to the first link connector **7221**.

[0159] The second link connector **7222** may be provided in the carrier **720**. According to an embodiment, the second link connector **7222** may be provided on one side (e.g., the +X-axis direction) of a lower side (e.g., the −Z-axis direction) of the carrier **720**. The second link connector **7222** may be provided with a hole into which the second link **752** may be inserted. The second link connector **7222** may be connected to the second link **752**, and the second link **752** may rotate with respect to the carrier **720** by being connected to the second link connector **7222**.

[0160] The third link connector **7223** may be provided in the carrier **720**. According to an embodiment, the third link connector **7223** may be provided on the other side (e.g., the −X-axis direction) of the lower side (e.g., the −Z-axis direction) of the carrier **720**. The third link connector **7223** may be provided with a hole into which the third link **753** may be inserted. The third link connector **7223** may be connected to the third link **753**, and the third link **753** may rotate with respect to the carrier **720** by being connected to the third link connector **7223**.

[0161] The link connector **7220** may be provided with the bush **760**. According to an embodiment, the third link connector **7223** may be provided with the third link connection bush **762**. The third link connection bush **762** may be connected to the third link **753**. The third link **753** may rotate with respect to the carrier **720** by being connected to the third link connection bush **762**.

[0162] The caliper connector **7230** may be provided in the carrier **720**. The caliper **740** may be connected to the caliper connector **7230**. According to an embodiment, the caliper **740** may be secured to the caliper connector **7230**, and the caliper **740**, while moving relative to the disk rotor **7320** of the disk **730**, may come into contact with and rub against the disk rotor **7320** or become spaced apart from the disk rotor **7320**. Since the caliper **740** rubs against the disk **730**, rotation of the disk **730** may slow down or stop.

[0163] The disk connector **7240** may be provided in the carrier **720**. The disk connector **7240** may be arranged adjacent to the body connection hole **7111**. The disk connector **7240** may be provided as a hole penetrating the carrier **720**. The disk connector **7240** may be provided as one or more holes. The disk connector **7240** may be connected to the disk **730**. According to an embodiment, a portion of the disk **730** may be secured to the carrier **720** by penetrating the disk connector **7240**.

[0164] The carrier connector **7250** may be provided in the carrier **720**. The carrier connector **7250** may be connected to the body connector **710**. According to an embodiment, the body connector **710** may be inserted into the carrier connector **7250**.

[0165] The body connector **710** may be made of a material including a first material. According to an embodiment, the first material may be provided as a material including at least one of iron, iron alloy, carbon fiber, and plastic, or a combination thereof.

[0166] The carrier **720** may be made of a material including a second material different from the first material. According to an embodiment, the second material may be provided as a material including at least one of aluminum, aluminum alloy, carbon fiber, and plastic, or a combination thereof.

[0167] With the body connector **710** provided, the carrier **720** integrally connected to the body connector **710** may be manufactured. Hereinafter, a manufacturing method of the suspension apparatus **71** provided with the body connector **710** and the carrier **720** will be described.

[0168] FIG. **19** is a cross-sectional view illustrating a first coupling reinforcement portion of the suspension apparatus according to a first embodiment of the present disclosure. FIG. **20** is a cross-

sectional view illustrating a first coupling reinforcement portion of the suspension apparatus according to a second embodiment of the present disclosure. FIG. **21** is a cross-sectional view illustrating a first coupling reinforcement portion of the suspension apparatus according to a third embodiment of the present disclosure. FIG. **22** is a cross-sectional view illustrating a first coupling reinforcement portion of the suspension apparatus according to a fourth embodiment of the present disclosure.

[0169] The body connection insertion portion **7120**, a first carrier connection member **7251**, and a second carrier connection member **7252** illustrated in FIGS. **19** to **22** are the same as the body connection insertion portion **7120**, the first carrier connection member **7251**, and the second carrier connection member **7252** illustrated in FIGS. **11** to **18**. Thus, the description of the same configuration may be omitted.

[0170] FIGS. **19** to **22** illustrate various embodiments of the first coupling reinforcement portion **7151**.

[0171] Referring to FIG. **19**, the first coupling reinforcement portion **7151** may be provided as a coupling reinforcement hole **7151-1**. According to an embodiment, the coupling reinforcement hole **7151-1** may be provided as a hole penetrating the body connection insertion portion **7120**. The coupling reinforcement hole **7151-1** is provided as a hole penetrating the body connection insertion portion **7120**. The carrier connector **7250** may be inserted into the coupling reinforcement hole **7151-1**. A plurality of the coupling reinforcement holes **7151-1** may be provided. The coupling reinforcement hole **7151-1** may vary in size, and the plurality of the coupling reinforcement holes **7151-1** may have different sizes.

[0172] The carrier connector **7250** may include the first carrier connection member **7251** and the second carrier connection member **7252**.

[0173] The first carrier connection member **7251** may be arranged to come into contact with a surface of the body connection insertion portion **7120**. According to an embodiment, the first carrier connection member **7251** may be arranged to come into contact with top and bottom surfaces of the body connection insertion portion **7120**.

[0174] The second carrier connection member **7252** may be inserted into the coupling reinforcement hole **7151-1** and arranged to connect the first carrier connection member **7251**. Since the second carrier connection member **7252** is inserted into the coupling reinforcement hole **7151-1**, the contact area of the body connection insertion portion **7120** and the carrier connector **7250** may increase, and the coupling strength between the body connection insertion portion **7120** and the carrier connector **7250** may be improved. Thus, resistance to a shear force generated by an external force, between the body connection insertion portion **7120** and the carrier connector **7250** may increase, the rigidity of the suspension apparatus **71** may increase, and durability of the suspension apparatus **71** may be improved.

[0175] Referring to FIG. **20**, the first coupling reinforcement portion **7151** may be provided as a coupling reinforcement burr **7151-2**. According to an embodiment, the coupling reinforcement burr **7151-2** may be provided as a hole penetrating the body connection insertion portion **7120** and may be provided to extend from a surface of the body connection insertion portion **7120** and protrude in one direction. The coupling reinforcement burr **7151-2** may be provided to and protrude from a surface of the body connection insertion portion **7120** in one direction or the other direction. A plurality of the coupling reinforcement burrs **7151-2** may be provided. According to an embodiment, the plurality of the coupling reinforcement burrs **7151-2** may protrude from the surface of the body connection insertion portion **7120** in different directions.

[0176] The angle formed between the surface of the body connection insertion portion **7120** and the direction in which the coupling reinforcement burr **7151-2** protrudes may be, but is not limited to, above 0 degrees to below 180 degrees. According to an embodiment, the angle formed between the surface of the body connection insertion portion **7120** and the direction in which the coupling reinforcement burr **7151-2** protrudes may be approximately 90 degrees.

[0177] The plurality of the coupling reinforcement burrs **7151-2** may be provided. The size of the coupling reinforcement burrs **7151-2** and the protruding length of the coupling reinforcement burrs **7151-2** may vary.
[0178] The second carrier connection member **7252** may be inserted into the coupling reinforcement hole **7151-1** and arranged to connect the first carrier connection member **7251**. Since the second carrier connection member **7252** is inserted into the coupling reinforcement burr **7151-2**, the contact area of the body connection insertion portion **7120** and the carrier connector **7250** may increase, and the coupling strength between the body connection insertion portion **7120** and the carrier connector **7250** may be improved. Thus, resistance to a shear force generated by an external force, between the body connection insertion portion **7120** and the carrier connector **7250** may increase, the rigidity of the suspension apparatus **71** may increase, and durability of the suspension apparatus **71** may be improved.
[0179] Referring to FIG. **21**, the first coupling reinforcement portion **7151** may be provided as a coupling reinforcement form unit **7151-3**. The coupling reinforcement form unit **7151-3** may be provided to extend from a surface of the body connection insertion portion **7120**. According to an embodiment, the coupling reinforcement form unit **7151-3** may be provided approximately in a square, trapezoidal, or embossed shape.
[0180] A plurality of the coupling reinforcement form units **7151-3** may be provided. The plurality of the coupling reinforcement form units **7151-3** may protrude in different directions.
[0181] The angle formed between the surface of the body connection insertion portion **7120** and the direction in which the coupling reinforcement form units **7151-3** protrudes may be, but is not limited to, above 0 degrees to below 180 degrees. According to an embodiment, the angle formed between the surface of the body connection insertion portion **7120** and the direction in which the coupling reinforcement form unit **7151-3** protrudes may be approximately 45 degrees.
[0182] A space formed to be recessed may be provided on the opposite side of the direction in which the coupling reinforcement form unit **7151-3** protrudes. A third carrier connection member **7252-1** may be arranged in the space, which is recessed with respect to the coupling reinforcement form unit **7151-3**. Since the coupling reinforcement form unit **7151-3** may be provided to extend from a surface of the body connection insertion portion **7120**, the contact area of the body connection insertion portion **7120** and the carrier connector **7250** may increase, and the coupling strength between the body connection insertion portion **7120** and the carrier connector **7250** may be improved.
[0183] Referring to FIG. **22**, the first coupling reinforcement portion **7151** may be provided as a coupling reinforcement form unit hole **7151-4**. The coupling reinforcement form unit hole **7151-4** may be provided to extend from a surface of the body connection insertion portion **7120**. According to an embodiment, the coupling reinforcement form unit hole **7151-4** may be provided approximately in a square, trapezoidal, or embossed shape.
[0184] The coupling reinforcement form unit hole **7151-4** may be provided in the form of a combination of the coupling reinforcement form unit **7151-3** and the coupling reinforcement hole **7151-1**.
[0185] A plurality of the coupling reinforcement form unit holes **7151-4** may be provided. The plurality of the coupling reinforcement form unit holes **7151-4** may protrude in different directions.
[0186] A space formed to be recessed may be provided on the opposite side of the direction in which the coupling reinforcement form unit hole **7151-4** protrudes. A third carrier connection member **7252-1** may be arranged in the space formed to be recessed of the coupling reinforcement form unit hole **7151-4**. The coupling reinforcement form unit hole **7151-4** is provided to extend from a surface of the body connection insertion portion **7120**, and the second carrier connection member **7252** is arranged to penetrate the coupling reinforcement form unit hole **7151-4**. Thus, the contact area of the body connection insertion portion **7120** and the carrier connector **7250** may increase, and the coupling strength between the body connection insertion portion **7120** and the

carrier connector **7250** may be improved.
[0187] FIG. **23** is a perspective view illustrating the body connector of the suspension apparatus according to an embodiment of the present disclosure, when viewed from the other side. FIG. **24** is a cross-sectional view illustrating an end of a second coupling reinforcement portion of the suspension apparatus according to the first embodiment of the present disclosure. FIG. **25** is a cross-sectional view illustrating an end of a second coupling reinforcement portion of the suspension apparatus according to the second embodiment of the present disclosure.
[0188] The body connector **710**, the main body connector **7110**, the body connection insertion portion **7120**, the first carrier connection member **7251**, and the second carrier connection member **7252** illustrated in FIGS. **23** to **25** are the same as the body connector **710**, the main body connector **7110**, the body connection insertion portion **7120**, the first carrier connection member **7251**, and the second carrier connection member **7252** illustrated in FIGS. **11** to **22**. Thus, the description of the same configuration may be omitted.
[0189] FIGS. **23** to **25** illustrate various embodiments of the second coupling reinforcement portion **7152**.
[0190] Referring to FIG. **23**, the second coupling reinforcement portion **7152** may be arranged on an end of the body connection insertion portion **7120**. According to an embodiment, the body connection hole **7111** may be arranged on one side of the body connection insertion portion **7120**, and the second coupling reinforcement portion **7152** may be arranged on the other side of the body connection insertion portion **7120**.
[0191] The second coupling reinforcement portion **7152** may extend from the body connection insertion portion **7120**. The angle formed between the direction in which the second coupling reinforcement portion **7152** extends and the surface of the body connection insertion portion **7120** may be approximately above 0 degrees to below 180 degrees. Since the second coupling reinforcement portion **7152** is arranged to extend from the body connection insertion portion **7120**, the contact area of the body connector **710** and the carrier **720** may increase, and the coupling strength therebetween may be improved. In addition, a shear force generated by an external force may increase, and the rigidity and durability of the suspension apparatus **71** may be improved.
[0192] Referring to FIG. **24**, the second coupling reinforcement portion **7152** may be provided as a coupling reinforcement flange **7152-1**. The coupling reinforcement flange **7152-1** may be provided to extend from an end of the body connection insertion portion **7120**. The coupling reinforcement flange **7152-1** may be provided to bend from the body connection insertion portion **7120**. According to an embodiment, the coupling reinforcement flange **7152-1** and the body connection insertion portion **7120** may form approximately an “L” shape in the alphabet. Since the coupling reinforcement flange **7152-1** and the body connection insertion portion **7120** form approximately an “L” shape in the alphabet, the first carrier connection member **7251** may be arranged to surround the coupling reinforcement flange **7152-1**. Thus, the contact area of the body connector **710** and the carrier **720** may increase, and the coupling strength therebetween may be improved. In addition, a shear force generated by an external force may increase, and the rigidity and durability of the suspension apparatus **71** may be improved.
[0193] Referring to FIG. **25**, the second coupling reinforcement portion **7152** may be provided as a coupling reinforcement hem **7152-2**. The coupling reinforcement hem **7152-2** may be provided to extend from an end of the body connection insertion portion **7120**. The coupling reinforcement hem **7152-2** may be provided to bend from the body connection insertion portion **7120**. According to an embodiment, the coupling reinforcement hem **7152-2** and the body connection insertion portion **7120** may form approximately a “C” shape in the alphabet. Since the coupling reinforcement hem **7152-2** and the body connection insertion portion **7120** form approximately a “C” shape in the alphabet, the first carrier connection member **7251** may be arranged to surround the coupling reinforcement hem **7152-2**. Thus, the contact area of the body connector **710** and the carrier **720** may increase, and the coupling strength therebetween may be improved. In addition, a

shear force generated by an external force may increase, and the rigidity and durability of the suspension apparatus **71** may be improved.

[0194] FIG. **26** is a flowchart illustrating a manufacturing method of the suspension apparatus according to an embodiment of the present disclosure. FIG. **27** is a perspective view illustrating an insertion of the body connection part of the suspension apparatus into a mold according to an embodiment of the present disclosure.

[0195] The body connector **710**, the main body connector **7110**, the body connection hole **7111**, the body connection insertion portion **7120**, the body recess portion **7130**, the body bend portion **7140**, the coupling reinforcement portion **7150**, and the carrier **720** used in the description of FIGS. **26** and **27** are the same as the body connector **710**, the main body connector **7110**, the body connection hole **7111**, the body connection insertion portion **7120**, the body recess portion **7130**, the body bend portion **7140**, the coupling reinforcement portion **7150**, and the carrier **720** illustrated in FIGS. **11** to **25**. Thus, the description of the same configuration may be omitted.

[0196] Referring to FIGS. **26** and **27**, the manufacturing method of the suspension apparatus **1** may include a step of forming a coupling reinforcement portion in which the coupling reinforcement portion **7150** is formed in the main body connector **7110** (S**2610** in FIG. **26**). According to an embodiment, the coupling reinforcement portion **7150** may be formed in the body connection insertion portion **7120**. The coupling reinforcement portion **7150** may be formed in the body connection insertion portion **7120** to enhance the coupling strength between the body connector **710** and the carrier **720**. Thus, resistance to a shear force generated by an external force, between the body connector **710** and the carrier **720** may increase. The coupling reinforcement portion **7150** may include the first coupling reinforcement portion **7151** and/or the second coupling reinforcement portion **7152**.

[0197] The step of forming a coupling reinforcement portion (S**2610**) may include forming the first coupling reinforcement portion **7151** on a surface of the body connection insertion portion **7120**. The first coupling reinforcement portion **7151** may be formed on the surface of the body connection insertion portion **7120** to increase the contact area of the body connector **710** and the carrier **720**. The first coupling reinforcement portion **7151** may be formed in various ways, such as drilling, milling, burring, extrusion, and the like.

[0198] The first coupling reinforcement portion **7151** may include the coupling reinforcement hole **7151-1**, the coupling reinforcement burr **7151-2**, the coupling reinforcement form unit **7151-3**, and/or the coupling reinforcement form unit hole **7151-4**.

[0199] The coupling reinforcement hole **7151-1** may be provided to penetrate the body connection insertion portion **7120**. A plurality of the coupling reinforcement holes **7151-1** may be provided. The shape, size, and number of the coupling reinforcement holes **7151-1** may vary.

[0200] The coupling reinforcement burr **7151-2** may be provided as a hole penetrating the body connection insertion portion **7120**, and may be provided to protrude in one direction with respect to the body connection insertion portion **7120**. The plurality of the coupling reinforcement burrs **7151-2** may be provided. The shape, size, number, and protruding direction of the coupling reinforcement burrs **7151-2** may vary.

[0201] The coupling reinforcement form unit **7151-3** may protrude from the body connection insertion portion **7120**. The direction in which the coupling reinforcement form unit **7151-3** protrudes may form a predetermined angle with a surface of the body connection insertion portion **7120**. Thus, the coupling reinforcement form unit **7151-3** may be provided to be inclined with respect to the body connection insertion portion **7120**. The plurality of the coupling reinforcement form units **7151-3** may be provided. The shape, size, and number of the coupling reinforcement form units **7151-3** may vary.

[0202] The coupling reinforcement form unit hole **7151-4** may be provided as a hole penetrating the body connection insertion portion **7120**, and may be provided to protrude in one direction with respect to the body connection insertion portion **7120**. The plurality of the coupling reinforcement

form unit holes **7151-4** may be provided. The shape, size, number, and protruding direction of the coupling reinforcement form unit holes **7151-4** may vary.

[0203] The step of forming a coupling reinforcement portion (S**2610**) may include forming the second coupling reinforcement portion **7152** on an end of the body connection insertion portion **7120**. The second coupling reinforcement portion **7152** may be formed on an end of the body connection insertion portion **7120** to increase the contact area of the body connector **710** and the carrier **720**. The second coupling reinforcement portion **7152** may be formed in various ways, such as extrusion, and the like.

[0204] The second coupling reinforcement portion **7152** may include the coupling reinforcement flange **7152-1** and/or the coupling reinforcement hem **7152-2**.

[0205] The coupling reinforcement flange **7152-1** may extend from the body connection insertion portion **7120** and bend in one direction. The angle formed between the coupling reinforcement flange **7152-1** and the body connection insertion portion **7120** may be approximately above 0 degrees to below 180 degrees. According to an embodiment, the angle formed between the coupling reinforcement flange **7152-1** and the body connection insertion portion **7120** may be approximately 90 degrees. The coupling reinforcement flange **7152-1** and the body connection insertion portion **7120** may form approximately an “L” shape. The length, protruding height, and placement location of the coupling reinforcement flange **7152-1** may vary.

[0206] The coupling reinforcement hem **7152-2** may extend from the body connection insertion portion **7120** and bend in one direction. The angle formed between the coupling reinforcement hem **7152-2** and the body connection insertion portion **7120** may be approximately above 0 degrees to below 180 degrees. According to an embodiment, The angle formed between the coupling reinforcement hem **7152-2** and the body connection insertion portion **7120** may be approximately 90 degrees. The coupling reinforcement hem **7152-2** may be bent at two points. Thus, the coupling reinforcement hem **7152-2** and the body connection insertion portion **7120** may form approximately a “C” shape. The length, protruding height, and placement location of the coupling reinforcement hem **7152-2** may vary.

[0207] The manufacturing method of the suspension apparatus **71** may include an insertion step in which the body connector **710** is arranged in a mold **7**M (S**2620** in FIG. **26**). The body connector **710** may be made of a material including a first material. The body connection insertion portion **7120** of the body connector **710** may be inserted into the mold **7**M. Since the body connection insertion portion **7120** is inserted into the mold **7**M, the body connection insertion portion **7120** may come into contact with the material including the second material in a casting step (S**2630** in FIG. **26**), which will be described below.

[0208] The manufacturing method of the suspension apparatus **71** may include the casting step in which the material including the second material is disposed in the mold **7**M to form the carrier **720** (S**2630** in FIG. **26**). The material including the second material may be injected into the mold **7**M through a mold hole **7**MH of the mold **7**M. The first material of the body connector **710** and the second material of the carrier **720** may be different from each other. The mold **7**M may be provided to correspond to a shape of the carrier **720**.

[0209] In the casting step (S**2630**), the body connection insertion portion **7120** provided in the body connector **710** may be connected to the carrier connector **7250** of the carrier **720**. According to an embodiment, the body connection insertion portion **7120** may be inserted into the carrier connector **7250**. When the body connection insertion portion **7120** is inserted into the carrier connector **7250**, the coupling strength may be generated between the body connection insertion portion **7120** and the carrier connector **7250**, resulting in the body connector **710** and the carrier **720** being integrally formed. Since the body connector **710** and the carrier **720** may be integrally formed, the coupling member (e.g., bolt, nut, etc.) coupling the body connector **710** and the carrier **720** may not be used. Thus, the mass of the suspension apparatus **71** may be reduced, and a process for coupling the body connector **710** and the carrier **720** is not required, resulting in lower

manufacturing cost of the suspension apparatus **71**.
[0210] The manufacturing method of the suspension apparatus **71** may include a bush arrangement step in which the bush **760** is arranged in the suspension apparatus **71** (S**2640** in FIG. **26**). The bush **760** may include the body connection bush **761** and the third link connection bush **762**.
[0211] The bush arrangement step (S**2640**) may include arranging the body connection bush **761** in the body connection hole **7111**. According to an embodiment, the bush arrangement step (S**2640**) may include inserting the body connection bush **761** into the body connection hole **7111**.
[0212] The bush arrangement step (S**2640**) may include arranging the third link connection bush **762** in the third link connector **7223**. According to an embodiment, the bush arrangement step (S**2640**) may include inserting the third link connection bush **762** into the third link connector **7223**.
[0213] The suspension apparatus **71** manufactured by the manufacturing method of the suspension apparatus may be made lightweight, thereby improving ride comport. In addition, a tolerance occurring in the suspension apparatus **71** may be minimized, and rigidity may increase. Furthermore, the manufacturing cost of the suspension apparatus **71** may be lowered.
[0214] Although the present disclosure has been described with reference to the embodiments illustrated in the drawings, the embodiments 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. In addition, the disclosure may also be used in other fields. Thus, the true technical scope of the present disclosure should be defined by the following claims.

Claims

1. A suspension apparatus comprising: a body connector including a main body connector provided with a body connection hole; and a carrier including: a carrier hole which extends from the body connector and into which a wheel bearing is inserted; a caliper connector connected to a caliper; and a link connector connected to a link and configured to rotate with respect to the body connection hole.
2. The suspension apparatus of claim 1, wherein the link connector comprises: a first link connector provided on an upper side of the carrier; a second link connector provided on one side of a lower side of the carrier; and a third link connector provided on the other side of the lower side of the carrier.
3. The suspension apparatus of claim 2, wherein the link comprises: a first link rotatively connected to the first link connector; a second link rotatively connected to the second link connector; and a third link rotatively connected to the third link connector.
4. The suspension apparatus of claim 1, wherein the body connection hole is provided on a first side of the main body connector, and wherein the body connection insertion portion provided on a second side of the main body connector is inserted into and secured in the carrier connector of the carrier.
5. The suspension apparatus of claim 4, wherein the body connection insertion portion comprises a recessed body latching portion, and wherein the carrier comprises a first carrier connection member inserted into the body latching portion.
6. The suspension apparatus of claim 4, further comprising: a body connection insertion hole through which a first side of the body connection insertion portion and a second side of the body connection insertion portion are in communication with each other, wherein the carrier connector comprises a second carrier connection member configured to penetrate the body connection insertion hole.
7. The suspension apparatus of claim 1, wherein the body connector comprises a first material, and wherein the carrier comprises a second material different from the first material.
8. A suspension apparatus comprising: a body connector including: a main body connector

provided with a body connection insertion portion; and a coupling reinforcement portion arranged on the body connection insertion portion; and a carrier including: a carrier connector to which the body connection insertion portion is inserted and which comes into contact with the coupling reinforcement portion; a carrier hole into which a wheel bearing is inserted; a caliper connector connected to a caliper; and a link connector connected to a link.

9. The suspension apparatus of claim 8, wherein the coupling reinforcement portion comprises a first coupling reinforcement portion, which is formed on a surface of the body connection insertion portion and configured to enhance the coupling strength between the body connection insertion portion and the carrier connector.

10. The suspension apparatus of claim 9, wherein the first coupling reinforcement portion comprises a coupling reinforcement hole configured to receive the body connection insertion portion, and wherein the carrier connector comprises: a first carrier connection member configured to come in contact with the coupling reinforcement hole; and a second carrier connection member configured to penetrate the coupling reinforcement hole.

11. The suspension apparatus of claim 9, wherein the first coupling reinforcement portion comprises a coupling reinforcement burr penetrating the body connection insertion portion and protruding in one direction with respect to the body connection insertion portion, and wherein the carrier connector comprises: a first carrier connection member configured to come in contact with the coupling reinforcement burr; and a second carrier connection member configured to penetrate the coupling reinforcement burr.

12. The suspension apparatus of claim 9, wherein the first coupling reinforcement portion comprises a coupling reinforcement form device configured to protrude in one direction and be inclined with respect to the body connection insertion portion, and wherein the carrier connector comprises: a first carrier connection member configured to come in contact with the coupling reinforcement form device; and a third carrier connection member seated on the coupling reinforcement form device.

13. The suspension apparatus of claim 9, wherein the first coupling reinforcement portion comprises a coupling reinforcement form device hole configured to protrude in one direction and be inclined with respect to the body connection insertion portion, and provided with a hole, and wherein the carrier connector comprises: a first carrier connection member configured to come in contact with the coupling reinforcement form device hole; and a second carrier connection member configured to penetrate the coupling reinforcement form device hole.

14. The suspension apparatus of claim 8, further comprising: a second coupling reinforcement portion formed on an end of the body connection insertion portion to enhance the coupling strength between the body connection insertion portion and the carrier connector.

15. The suspension apparatus of claim 14, wherein the second coupling reinforcement portion comprises a coupling reinforcement flange extending from an end of the body connection insertion portion and configured to bend in one direction, and wherein the carrier connector comprises a first carrier connection member configured to surround the coupling reinforcement flange.

16. A manufacturing method of a suspension apparatus, the method comprising: an insertion step in which a body connector is arranged in a mold, the body connector including a main body connector provided with a body connection insertion portion and a coupling reinforcement portion arranged on the body connection insertion portion, the body connector comprising a first material; and a casting step in which a carrier is manufactured by injecting a second material different from the first material into the mold, wherein the carrier includes: a carrier connector configured contact with the body connection insertion portion; and a link connector connected to a link.

17. The method of claim 16, further comprising: a step of forming the coupling reinforcement portion on the body connection insertion portion prior to the insertion step.

18. The method of claim 17, wherein the step of forming the coupling reinforcement portion includes forming a first coupling reinforcement portion on a surface of the body connection

insertion portion to enhance the coupling strength between the body connection insertion portion and the carrier connector.

19. The method of claim 17, wherein the step of forming the coupling reinforcement portion includes forming a second coupling reinforcement portion in an end of the body connection insertion portion to enhance the coupling strength between the body connection insertion portion and the carrier connector.