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(54) **TRAILING ARM ATTACHMENT PORTION STRUCTURE**

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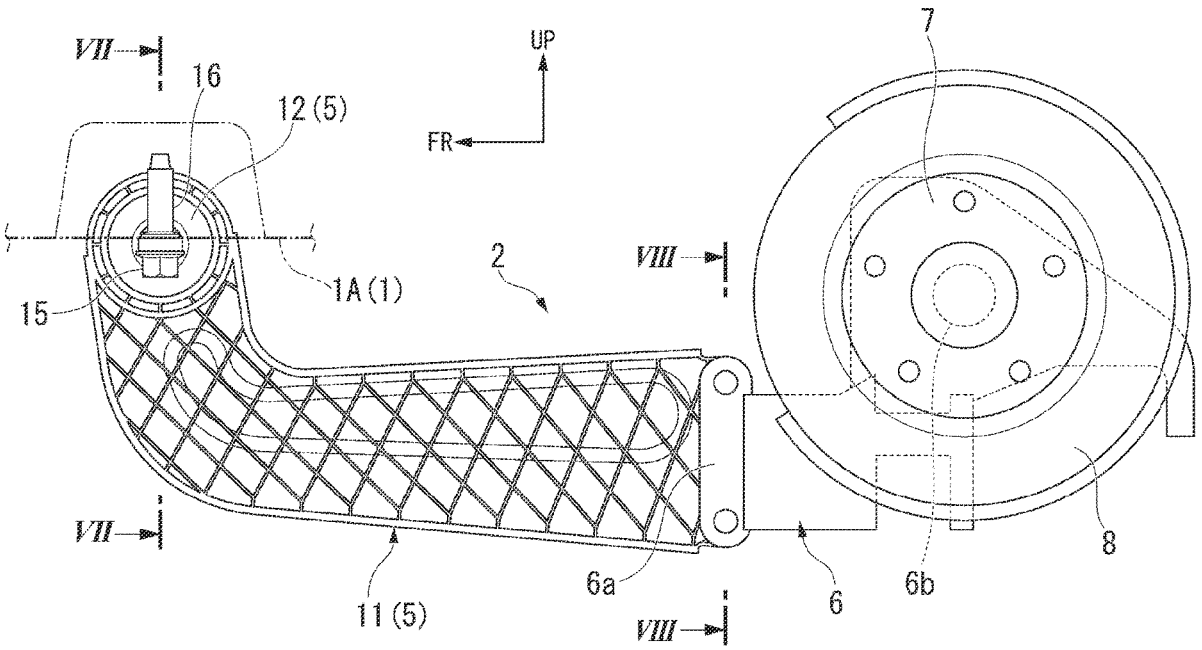
(57) **ABSTRACT**

A collar includes a tubular portion and a flange portion extending radially outward from an end portion of the tubular portion, first and second corner portions formed by the tubular portion and the flange portion are provided with first and second curved surface portions formed as concave curved surfaces, an end portion of the trailing arm is provided with a collar through-hole into which the collar is inserted, and an edge portion of the collar through-hole is provided with a through-hole side curved surface portion formed as a convex curved surface coming into contact with the first and second curved surface portions.



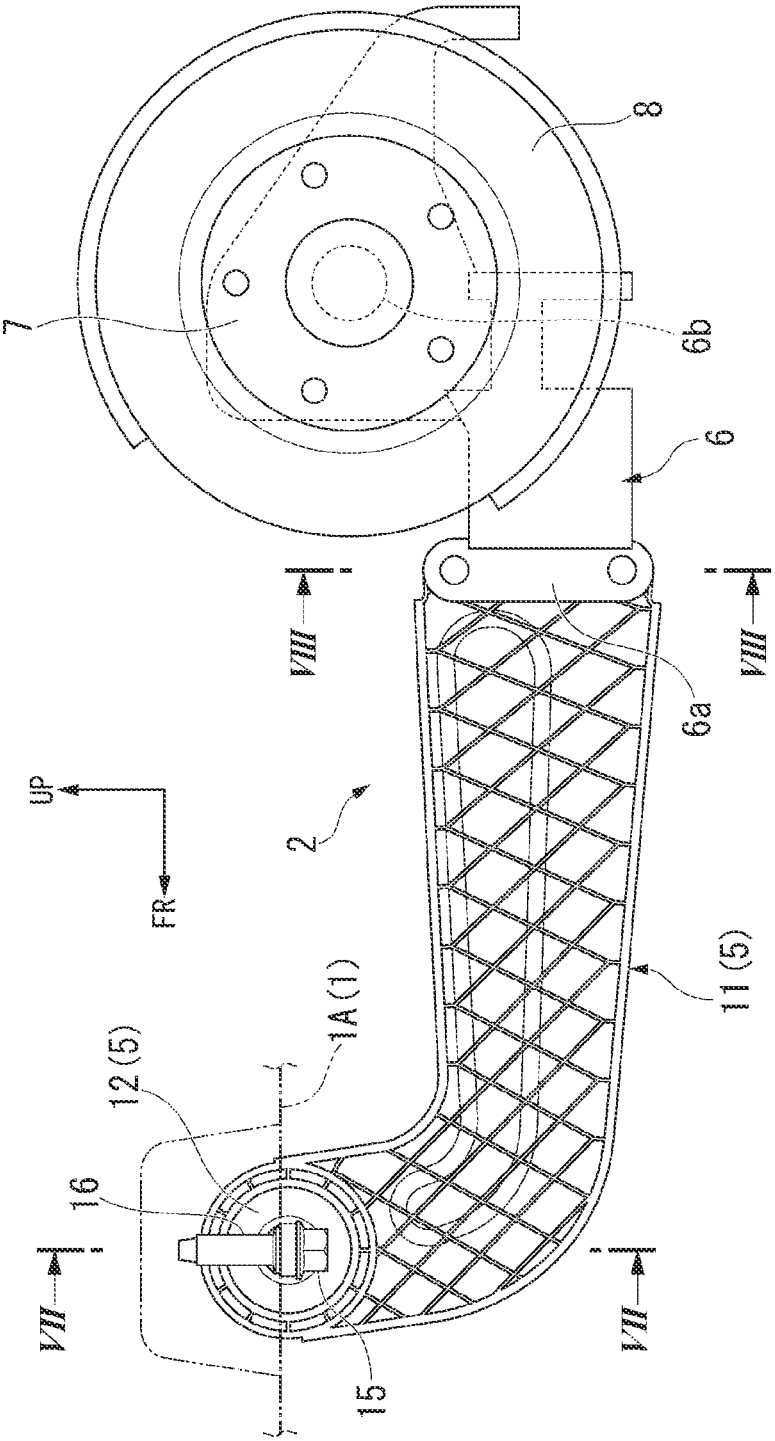


FIG. 1

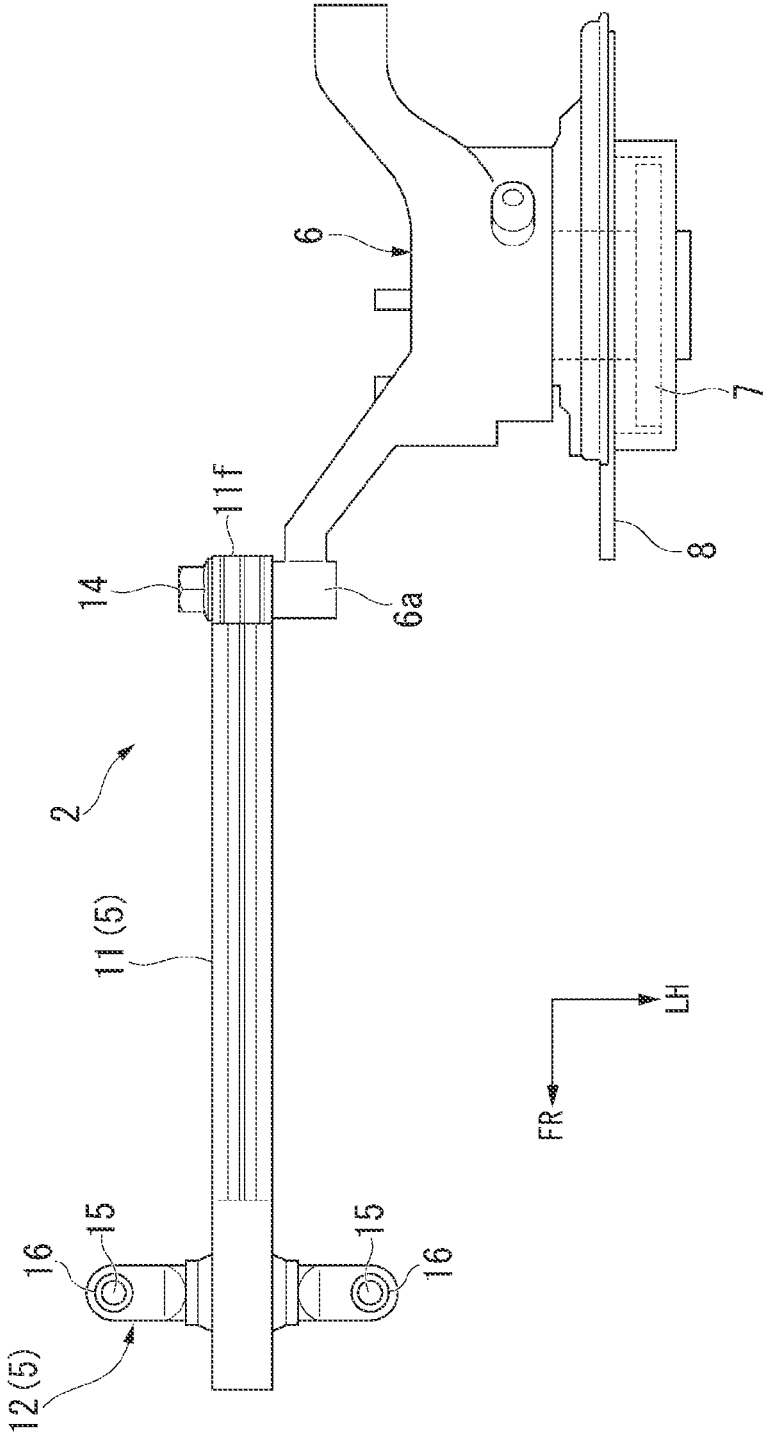
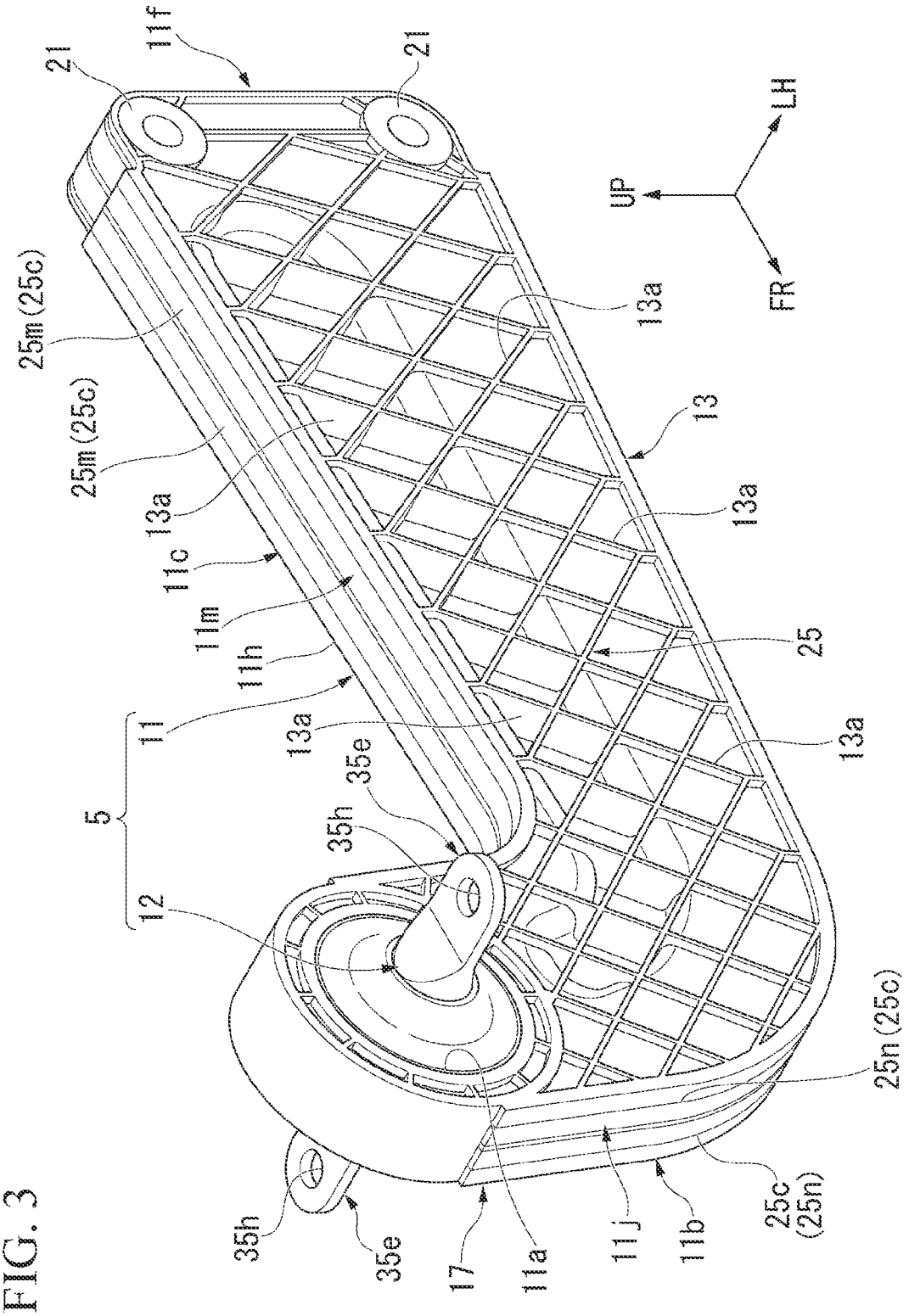


FIG. 2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LH
UP
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13a
13
25m (25c)
13a
13a
11c
11m
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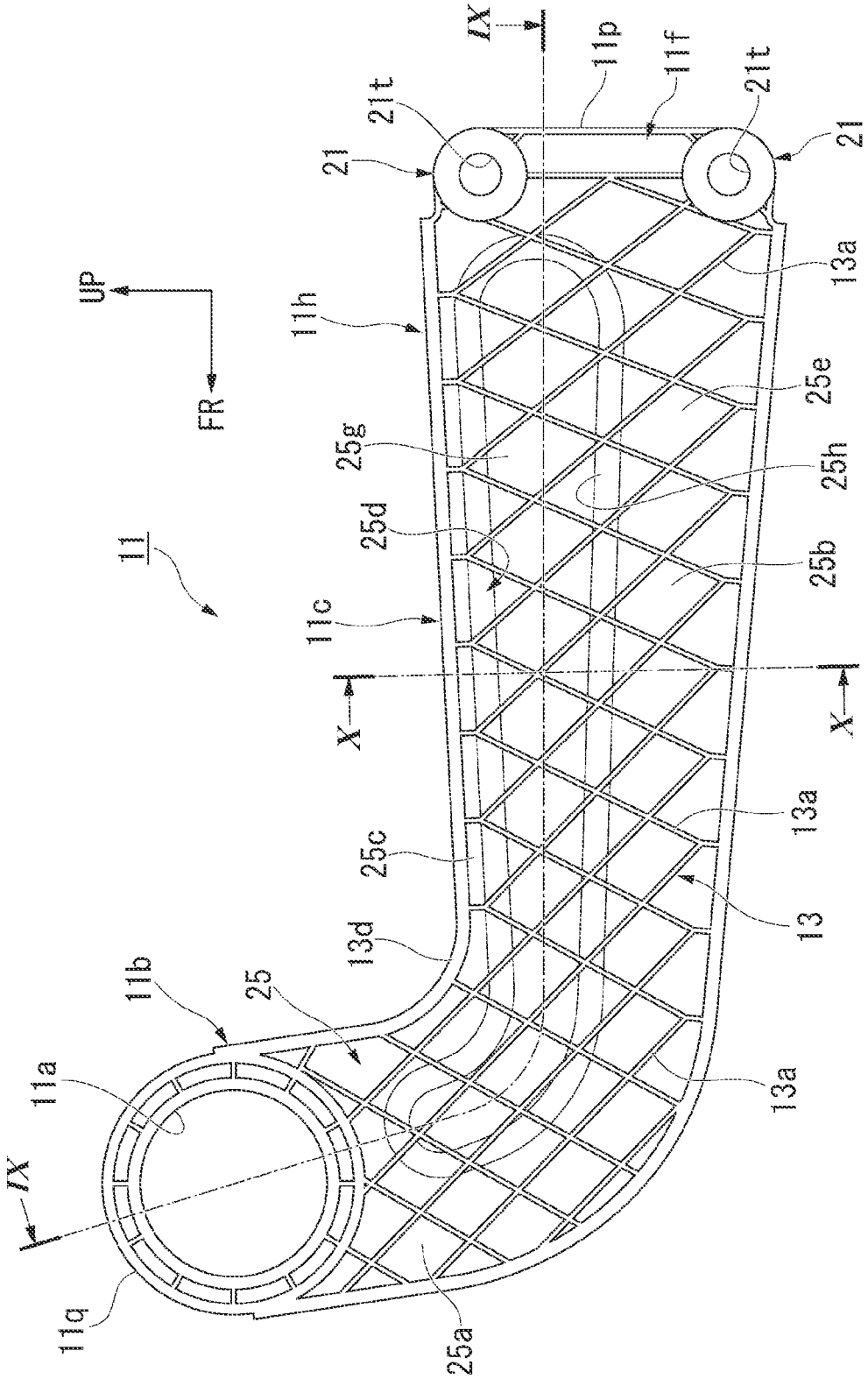
25
11
13a
13a
5
35e
35h
12
25n (25c)
35h
35e
17
11a
11j
11b
25c (25n)

FIG. 3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25b
11
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X
X
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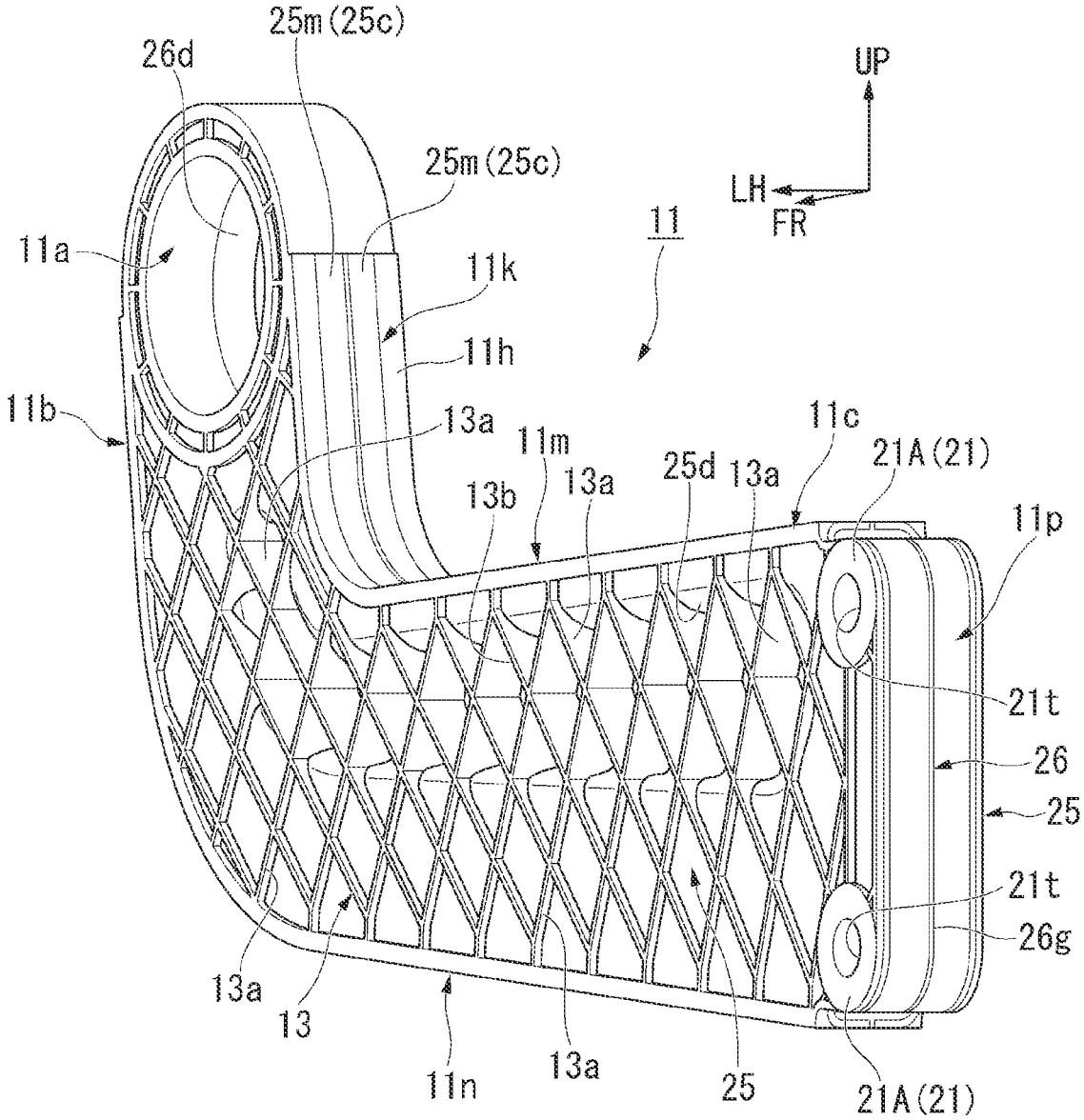
25c
13
13d
11b
25
11a
13a
IX
11q
25a

FIG. 4

FIG. 5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13a
11c
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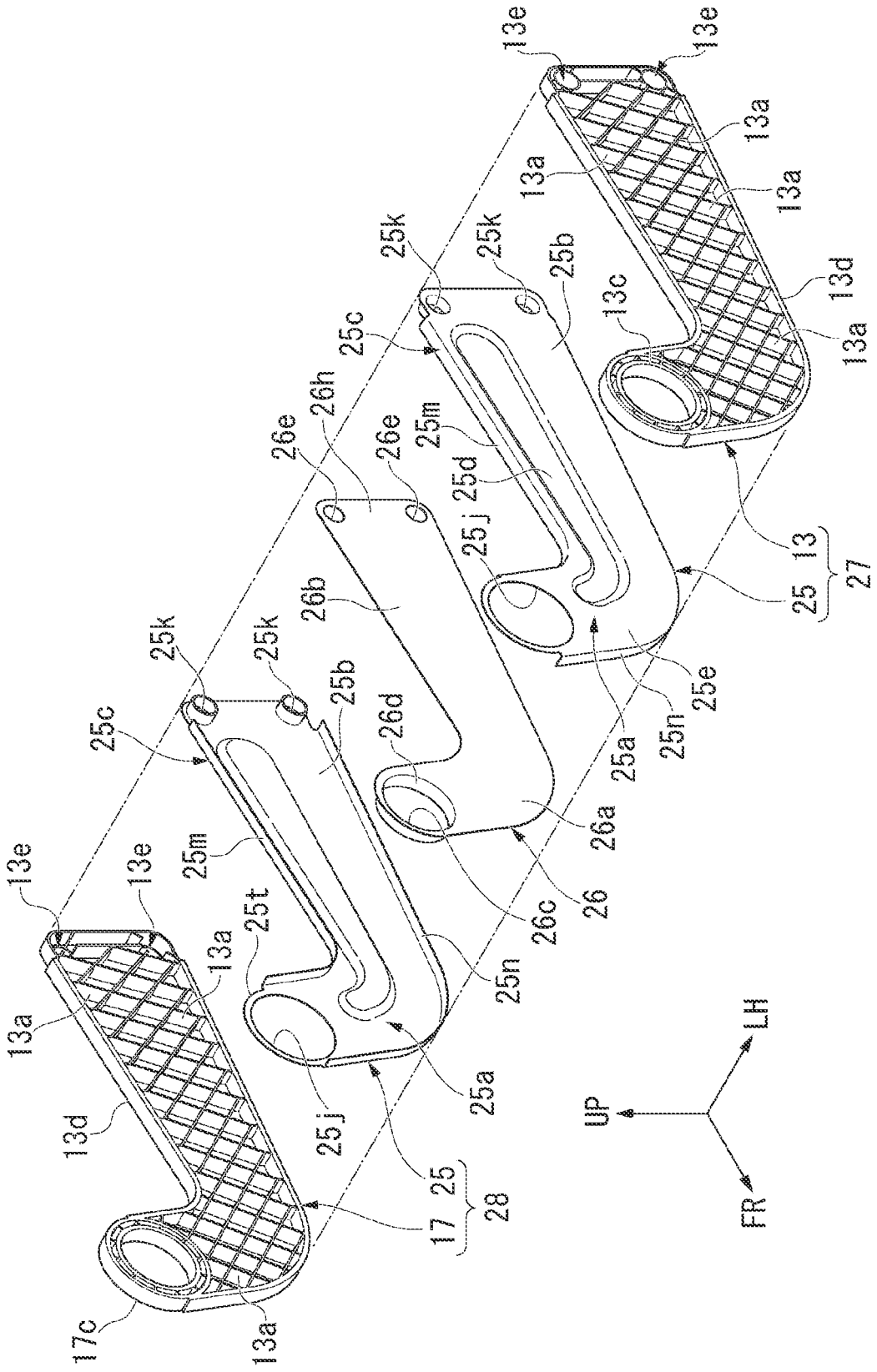
11p
21t
26
25
21t
26g
13a
13
11n
13a
25
21A(21)

FIG. 6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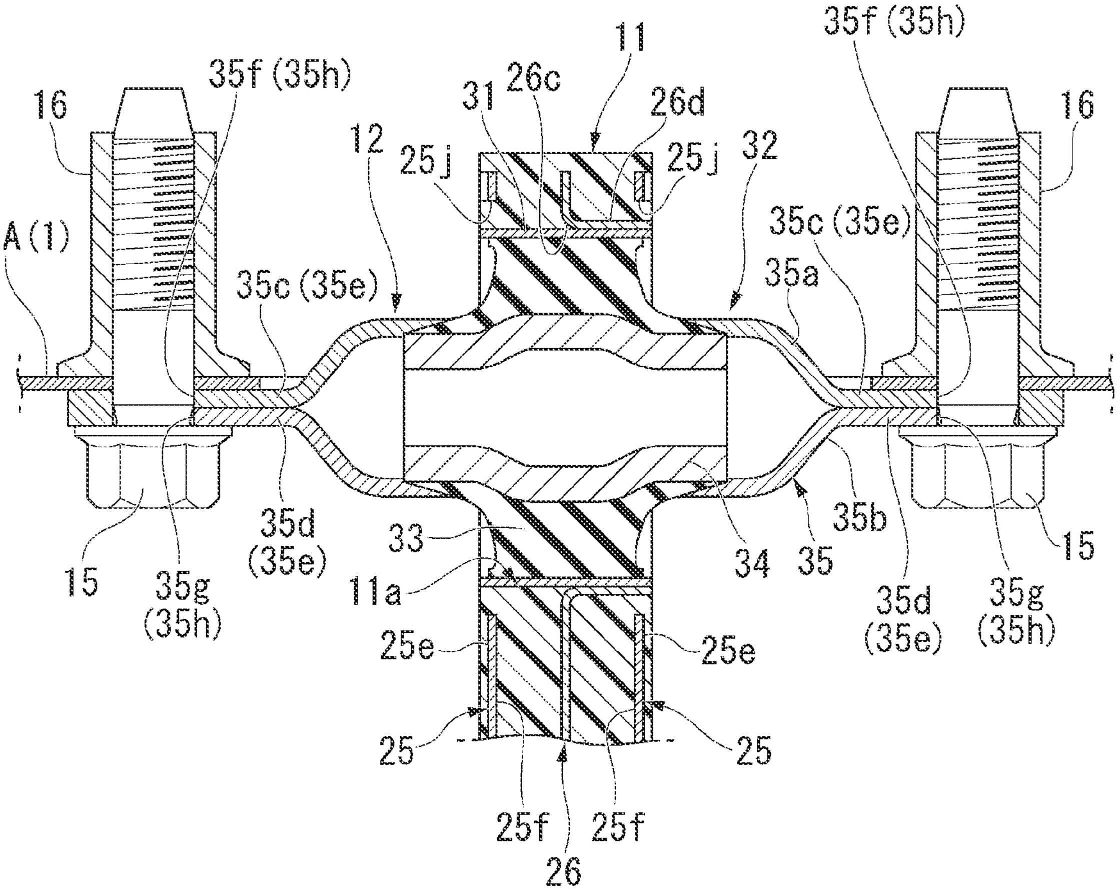
17c
17
28
UP
LH
FR

FIG. 7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35f (35h)
16
31
26c
26d
16
12
25j
25j
32
1A (1)
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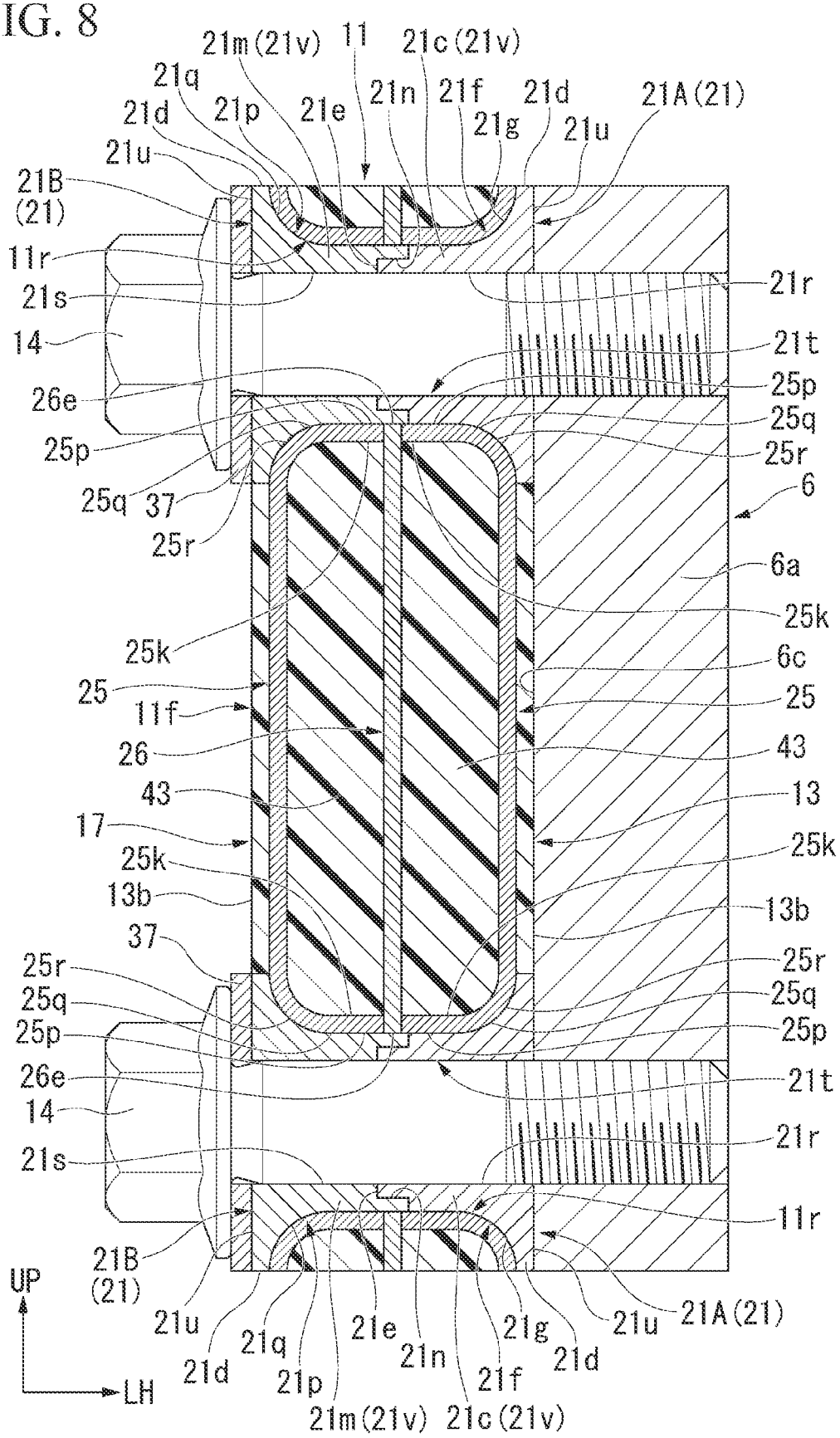
35c (35e)
35a
35d
(35e)
33
34
35
35b
15
35g
(35h)
11a
35d
(35e)
35g
(35h)
15
25e
25e
25
25
25f
25f
26

FIG. 8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21B
(21)
11r
21r
21s
21t
14
25p
26e
25q
25p
25r
25q
37
6
25r
6a
25k
25k
6c
25
25
11f
26
43
43
13
17
25k
25k
13b
13b
37
25r
25r
25q
25q
25p
25p
26e
21t
14
21r
21s
11r
21B
(21)
21A(21)
21u
21u
21q
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21n
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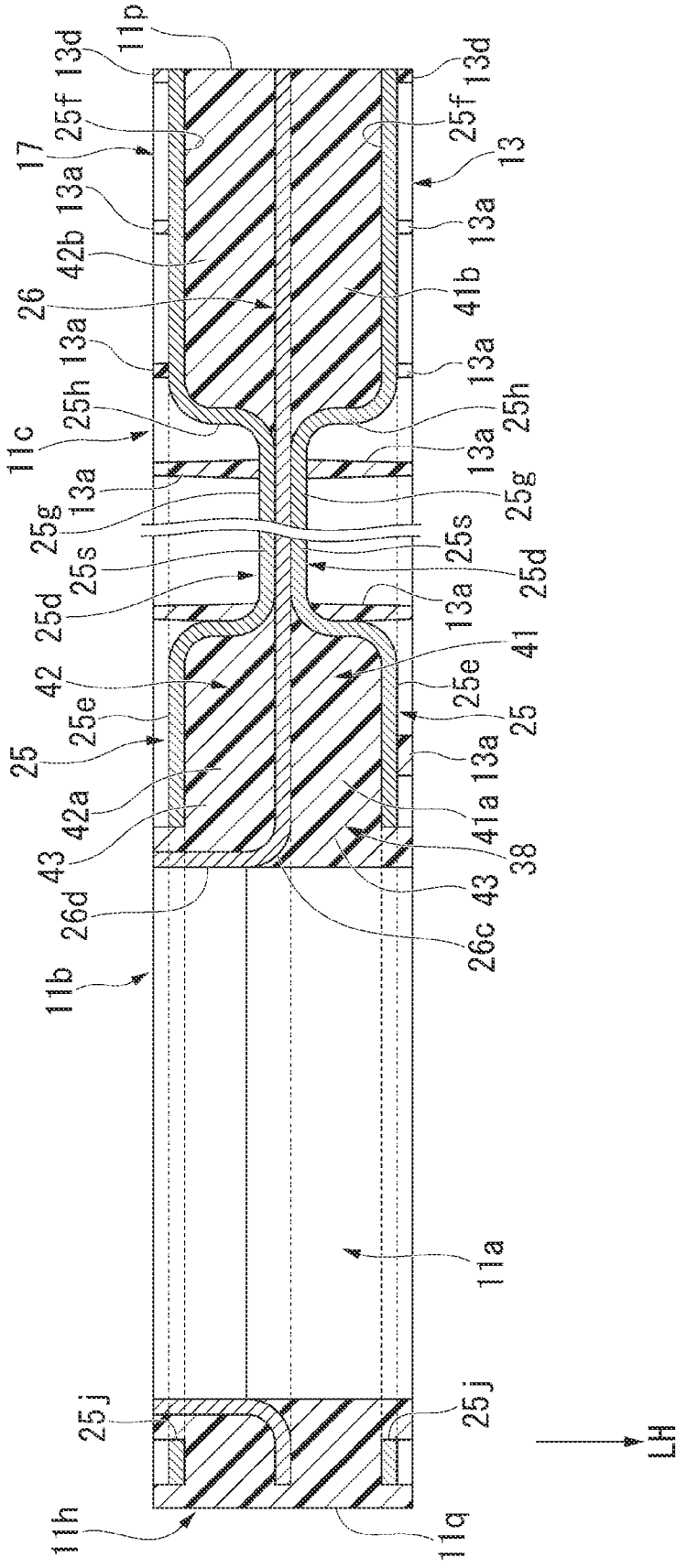
21d
21d
21p
21f
21m(21v)
21c(21v)
UP
LH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25d
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41
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42a
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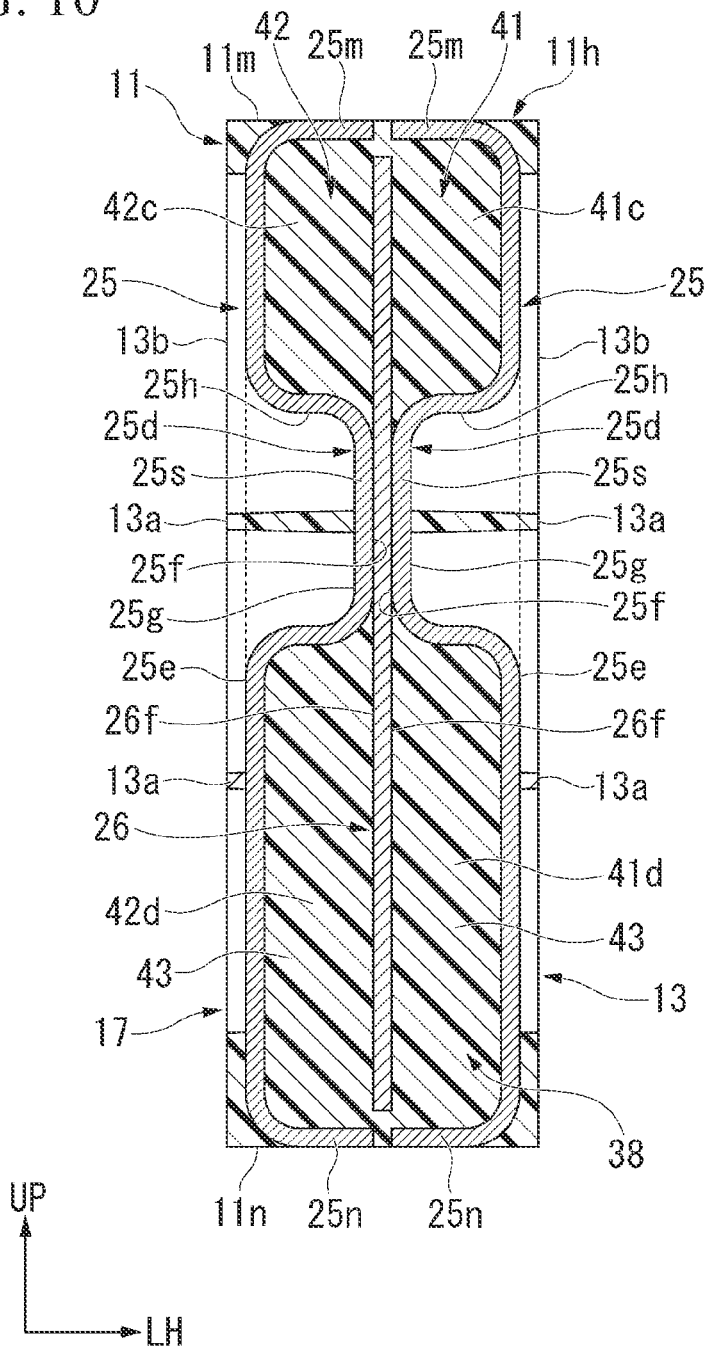
26d
26c
38
41a
11b
11a
25j
11h
11q
LH

FIG. 9

FIG. 10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13a
13a
25f
25g
25g
25f
25e
25e
26f
26f
13a
13a
26
41d
42d
43
43
13
17
38
11n
25n
25n
UP
LH

TRAILING ARM ATTACHMENT PORTION STRUCTURE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] Priority is claimed on Japanese Patent Application No. 2021-047591, filed Mar. 22, 2021, the content of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to a trailing arm attachment portion structure.

Description of Related Art

[0003] Conventionally, an attachment structure for attaching a plurality of members through a collar using a bolt is known (for example, see Japanese Patent No. 6030480).

[0004] The member includes a collar insertion hole into which a collar is inserted and the collar includes a tubular portion which is inserted into the collar insertion hole of the member and a flange portion which is formed at an end portion of the tubular portion.

SUMMARY OF THE INVENTION

[0005] In the above-described structure, since an edge portion of the collar insertion hole of the member is formed in an angular shape with a substantially right-angled cross-section and a corner portion formed by the tubular portion and the flange portion in the collar is formed in a concave shape along the edge portion of the collar insertion hole, there is concern that stress may concentrate on the edge portion of the collar insertion hole and the corner portion of the collar due to, for example, a moment acting between the member and the collar when an external force is applied to two fastening members.

[0006] An aspect of the present invention is to provide a trailing arm attachment portion structure for attaching the other member to a trailing arm provided in a vehicle body through a collar using a bolt and suppressing stress concentration in an edge portion of a through-hole provided in the trailing arm and a corner portion of the collar inserted into the through-hole.

[0007] (1) A trailing arm attachment portion structure according to an aspect of the present invention is a trailing arm attachment portion structure provided in a vehicle body and having a collar provided at an end portion of the trailing arm attachment portion structure so that a bolt passes therethrough in order to fasten other member and the collar, wherein the collar includes a tubular portion and a flange portion extending radially outward from an end portion of the tubular portion, wherein a corner portion formed by the tubular portion and the flange portion is provided with a collar side curved surface portion which is formed as a concave curved surface, wherein an end portion of the trailing arm is provided with a through-hole into which the collar is inserted, and wherein an edge portion of the through-hole is provided with a through-hole side curved surface portion which is formed as a convex curved surface coming into contact with the collar side curved surface portion.

[0008] With such a configuration of the above mentioned aspect (1), since each contact portion of the edge portion of the through-hole of the trailing arm and the corner portion of the collar is formed in a curved surface shape, it is possible to increase the contact area between the corner portion of the collar and the edge portion of the through-hole. Therefore, it is possible to suppress the stress concentration in the edge portion of the through-hole and the corner portion of the collar when an external force is applied between the through-hole and the collar.

[0009] (2) In the configuration of the above mentioned aspect (1), the collar may be consisted by two components each of which includes the tubular portion and the flange portion and end portions of the tubular portions of the two components may be mating-connected to each other.

[0010] With such a configuration of the above mentioned aspect (2), since two components are mating-connected to each other, it is possible to respectively insert two components into the through-hole from both ends of the through-hole and to improve the assembling property of the collar to the end portion of the trailing arm. Further, it is possible to improve the connection accuracy between two components.

[0011] (3) In the configuration of the above mentioned aspect (1) or (2), a part of the trailing arm including the edge portion of the through-hole may be made of a resin material.

[0012] With such a configuration of the above mentioned aspect (3), it is possible to reduce the weight of the trailing arm. Further, since the stress concentration of the collar side curved surface portion and the through-hole side curved surface portion is suppressed, it is possible to ensure the strength.

[0013] (4) In the configuration of any one the above mentioned aspects (1) to (3), the collar may be provided at a rear end portion of the trailing arm, and the other member may be a knuckle supporting a vehicle wheel.

[0014] With such a configuration of the above mentioned aspect (4), since the collar is disposed at the rear end portion of the trailing arm largely moved while the vehicle is running, the stress concentration of the collar side curved surface portion and the through-hole side curved surface portion is suppressed. Therefore, it is possible to ensure the strength of the trailing arm.

[0015] (5) In the configuration of any one of the above mentioned aspects (2) to (4), the trailing arm may include a resinous outer portion which is consisted by at least two members having a hollow portion and a metallic inner portion which is joined to the outer portion at inside of the hollow portion, and the through-hole may be formed through the outer portion and the inner portion.

[0016] With such a configuration of the above mentioned aspect (5), since the collar is inserted into the through-hole when joining the outer portion and the inner portion, it is possible to suppress the displacement of the outer portion and the inner portion in the direction orthogonal to the through-hole. Further, when the other member is fastened to the trailing arm, it is possible to sandwich the outer portion and the inner portion by the collar composed of two components and to firmly maintain the joint state between the outer portion and the inner portion.

[0017] According to an aspect of the present invention, since the contact portions of the edge portion of the through-hole of the trailing arm and the corner portion of the collar are formed in concave and convex curved surface shapes, it is possible to increase the contact area between the corner

portion of the collar and the edge portion of the through-hole. Accordingly, it is possible to suppress the stress concentration in the edge portion of the through-hole and the corner portion of the collar when an external force is applied between the through-hole and the collar.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. **1** is a left side view illustrating a rear suspension of an embodiment of the present invention.

[0019] FIG. **2** is a plan view of the rear suspension.

[0020] FIG. **3** is a perspective view of a trailing arm provided in the rear suspension.

[0021] FIG. **4** is a left side view of an arm body of the trailing arm.

[0022] FIG. **5** is a perspective view of the arm body.

[0023] FIG. **6** is a perspective view illustrating a configuration of the arm body.

[0024] FIG. **7** is a cross-sectional view taken along the line VII-VII of FIG. **1**.

[0025] FIG. **8** is a cross-sectional view taken along the line VIII-VIII of FIG. **1**.

[0026] FIG. **9** is a cross-sectional view taken along the line IX-IX of FIG. **4**.

[0027] FIG. **10** is a cross-sectional view taken along the line X-X of FIG. **4**.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Hereinafter, an embodiment of the present invention will be described with reference to the drawings. Unless otherwise specified, the directions such as front, rear, left, and right in the following description are the same as the directions in the vehicle equipped with a trailing arm **5** described below. Further, an arrow FR indicating the front side of the vehicle, an arrow LH indicating the left side of the vehicle, and an arrow UP indicating the upper side of the vehicle are shown in the appropriate place of the figure used in the following description.

[0029] <Trailing Arm Type Suspension>

[0030] FIG. **1** is a left side view illustrating a rear suspension **2**. FIG. **2** is a plan view of the rear suspension **2**.

[0031] As shown in FIGS. **1** and **2**, a vehicle body **1** of the vehicle includes a pair of left and right rear frames **1**A at the rear portion and the rear suspension (so-called trailing arm type suspension) **2** is attached to the left and right rear frames **1**A.

[0032] A trailing arm **5** which is attached to the lower portion of the rear frame **1**A, a knuckle (other component) **6** which is fixed to the rear end portion of the trailing arm **5**, and a hub **7** which is rotatably supported by the knuckle **6** is provided on each of the left and right sides of the rear suspension **2**. A vehicle wheel (rear wheel (not shown)) is attached to the left and right hubs **7**.

[0033] The rear suspension **2** includes various arms which connect the vehicle body **1** and the knuckle **6** and extend in the vehicle width direction, a vibration damping mechanism, an elastic member (for example, a spring), a stabilizer, and the like in addition to the above-described members and suspends the left and right rear wheels with respect to the vehicle body **1**.

[0034] The trailing arm **5** includes an arm body **11** which is formed in a plate shape and a rubber bush **12** which is fixed to the front end portion of the arm body **11**. The trailing arm **5** extends backward from the vehicle body **1** and connects the vehicle body **1** and the knuckle **6**.

[0035] The arm body **11** is disposed so that the longitudinal direction of the cross-section of the rear portion is directed in the up and down direction. The arm body **11** includes a knuckle connection portion **11***f* which is provided at the rear end portion of the arm body **11** and fastens and connects a trailing arm connection portion **6***a* provided at the front end portion of the knuckle **6** by a plurality of bolts **14**.

[0036] Both end portions of the rubber bush **12** in the vehicle width direction are respectively fastened to the rear frame **1**A by a bolt **15** and a nut **16**.

[0037] The knuckle **6** includes the trailing arm connection portion **6***a* which is integrally provided with the front end portion of the knuckle and an axle **6***b* which is integrally provided with the rear portion thereof. The hub **7** is rotatably supported by the axle **6***b*. A vehicle wheel (rear wheel) (not shown) and a brake disc **8** constituting a disc brake are attached to the hub **7** of the axle **6***b*. Additionally, the axle **6***b* may be supported by the knuckle **6** to be rotatable and the hub **7** may be supported by the axle **6***b* not to be rotatable.

[0038] <Trailing Arm>

[0039] FIG. **3** is a perspective view of the trailing arm **5**.

[0040] As shown in FIG. **3**, the arm body **11** is integrally provided with a vertical extension portion **11***b*, which extends in the up and down direction and of which an upper portion is provided with a bush mounting hole **11***a* for mounting a rubber bush **12** and a rear extension portion **11***c* which extends backward from the lower portion of the vertical extension portion **11***b*.

[0041] One side portion (left side portion) of the arm body **11** is provided with a pair of left and right resinous rib portions **13** and **17** which are composed of a plurality of ribs **13***a* such that the plurality of ribs **13***a* are arranged in a lattice shape. These rib portions **13** and **17** increase the rigidity of the arm body **11**. Since the plurality of ribs **13***a* are arranged in a lattice shape, it is possible to further increase the rigidity of the arm body **11**. The knuckle connection portion **11***f* to be connected to the knuckle **6** (see FIG. **2**) is provided at the rear end portion of the arm body **11**. The knuckle connection portion **11***f* is provided with a pair of upper and lower metallic collars **21** each allowing a bolt **14** (see FIG. **2**) to pass therethrough.

[0042] The rubber bush **12** includes a pair of left and right pivot brackets **35***e* which protrudes toward both sides in the vehicle width direction from the vertical extension portion **11***b* of the arm body **11**. The pivot bracket **35***e* has a bolt insertion hole **35***h* formed at a flat portion of each end portion and is fastened to the rear frame **1**A (see FIG. **1**) by the bolt **15** (see FIG. **2**) passing through the bolt insertion hole **35***h* and the nut **16** (see FIG. **2**).

[0043] <Arm Body>

[0044] FIG. **4** is a left side view of the arm body **11**.

[0045] As shown in FIG. **4**, the arm body **11** is formed such that a pair of left and right resinous plate members (outer portions) **25** is disposed on the inside of the rib portions **13** and **17** (the rib portion **17** is shown in FIG. **3**) in the vehicle width direction. The plate member **25** is integrally provided with a vertical extension plate portion **25***a* which is formed at the front portion to extend in the up and down direction and a rear extension plate portion **25***b* which extends backward from the lower portion of the vertical extension plate portion **25***a*. The plate member **25** has a plate concave portion (concave portion) **25***d* which has

an L shape in the side view and is formed on the inside of a peripheral edge portion **25***c* so as to extend from the vertical extension plate portion **25***a* to the rear extension plate portion **25***b*.

[0046] The plate concave portion **25***d* is recessed to a uniform depth from an outer surface (a surface on the side opposite to the hollow portion) **25***e* of the plate member **25** (that is, a surface on the outside of the vehicle width direction) toward an inner surface **25***f* (that is, a surface on the inside of the vehicle width direction (see FIG. **9**)) of the plate member **25**. The plate concave portion **25***d* includes a bottom surface **25***g* and an annular side surface **25***h* which rises from the peripheral edge portion of the bottom surface **25***g*.

[0047] Each rib **13***a* of the rib portion **13** is formed to be in close contact with an outer surface **25***e* of the plate member **25** and the bottom surface **25***g* and the side surface **25***h* of the plate concave portion **25***d*.

[0048] FIG. **5** is a perspective view of the arm body **11**.

[0049] As shown in FIGS. **4** and **5**, an end surface **13***b* on the outside of the vehicle width direction of each rib **13***a* of the rib portion **13** is located on the same plane. Therefore, in each rib **13***a*, the height from the portion in contact with the plate member **25** to the end surface **13***b* is higher in the portion with the plate concave portion **25***d* of the plate member **25** than the portion without the plate concave portion **25***d*. In this way, when the plate concave portion **25***d* is provided in the plate member **25** and the height of each rib **13***a* of the rib portion **13** formed on the outside of the vehicle width direction of the plate member **25** becomes higher in the plate concave portion **25***d*, the rigidity of the arm body **11** can be increased.

[0050] As shown in FIGS. **3** and **5**, in a lower portion of each of a front surface **11***j* and a rear surface **11***k* of the vertical extension portion **11***b* and an upper surface **11***m*, a lower surface **11***n*, and a rear surface **11***p* of the rear extension portion **11***c*, the peripheral edge portion **25***c* of the plate member **25** is exposed to the outside. Further, in the rear surface **11***p* of the arm body **11**, a rear edge portion **26***g* of an inner plate (inner portion) **26** to be described later is exposed to the outside.

[0051] FIG. **6** is a perspective view illustrating a configuration of the arm body **11**.

[0052] As shown in FIG. **6**, a metallic inner plate **26** is disposed at the center portion of the arm body **11** (see FIG. **3**) in the vehicle width direction and outer members **27** and **28** are respectively disposed on both sides of the inner plate **26** in the vehicle width direction.

[0053] The outer member **27** includes the plate member **25** that is crimped to the inner plate **26** from one side (left side) of the vehicle width direction and the rib portion **13** which is injection-molded on the outer surface **25***e* of the plate member **25**. The outer member **28** includes the plate member **25** that is crimped to the inner plate **26** from the other side (right side) of the vehicle width direction and the rib portion **17** which is injection-molded on the outer surface **25***e* (see FIG. **7**) of the plate member **25**.

[0054] The inner plate **26** and the left and right plate members **25** are joined (specifically, heat-crimped) in a pair of molding dies and the rib portions **13** and **17** are injection-molded on each plate member **25** in the same pair of molding dies.

[0055] The inner plate **26** is made of a pressed plate material and is integrally provided with a vertical extension plate portion **26***a* which is formed at the front portion of the inner plate **26** so as to extend in the up and down direction and a rear extension plate portion **26***b* which extends backward from the lower portion of the vertical extension plate portion **26***a*.

[0056] The vertical extension plate portion **26***a* includes a vehicle body side inner through-hole **26***c*. The edge portion of the vehicle body side inner through-hole **26***c* is subjected to burring work. Accordingly, a cylindrical rising portion **26***d* is formed to protrude toward one side (right side) of the vehicle width direction. The rising portion **26***d* constitutes a part of the bush mounting hole **11***a* (see FIG. **5**) of the arm body **11** (see FIG. **5**). The rubber bush **12** (see FIG. **3**) is fitted to the rising portion **26***d* similarly to other portions of the bush mounting hole **11***a*. The rising portion **26***d* forms a seat surface for fixing the rubber bush **12** to the arm body **11**.

[0057] A knuckle side inner connection portion **26***h* which is connected to the knuckle **6** (see FIG. **2**) is provided at the rear end portion of the rear extension plate portion **26***b* of the inner plate **26**. The knuckle side inner connection portion **26***h* includes a pair of upper and lower knuckle side inner through-holes **26***e*. The collars **21** (see FIG. **5**) are respectively inserted through the pair of knuckle side inner through-holes **26***e*.

[0058] The plate member **25** is made of a fiber reinforced resin containing, for example, carbon fiber as the reinforcing fiber, and the strength is increased. In addition to carbon fiber, the reinforcing fiber may be a fiber reinforced resin containing glass fiber, boron fiber, polyamide fiber, Kevlar (registered trademark) fiber, Izanas (registered trademark), and Zylon (registered trademark).

[0059] The plate member **25** is formed in advance with another molding die before the arm body **11** is molded with the molding die. The upper portion of the vertical extension plate portion **25***a* is integrally provided with a vehicle body side outer connection portion **25***t* which is formed in an annular shape and is connected to the knuckle **6** (see FIG. **2**). The vehicle body side outer connection portion **25***t* includes a vehicle body side outer through-hole **25***j*.

[0060] The inner diameter of the vehicle body side outer through-hole **25***j* is formed to be larger than that of the vehicle body side inner through-hole **26***c* of the inner plate **26** in order to form the bush mounting hole **11***a*.

[0061] The rear end portion of the rear extension plate portion **25***b* is integrally provided with a pair of upper and lower outer tubular portions (knuckle side outer connection portions) **25***k*. The pair of outer tubular portions **25***k* is formed to protrude toward the inner plate **26** and the collar **21** is inserted into each of them to be crimped.

[0062] The plate member **25** includes an upper flange portion **25***m* and a lower flange portion **25***n* which are bent toward the inner plate **26** over the edge portion of the vertical extension plate portion **25***a* and the edge portion of the rear extension plate portion **25***b*. The upper flange portion **25***m* and the lower flange portion **25***n* constitute a part of the peripheral edge portion **25***c* of the plate member **25**. In this way, when the upper flange portion **25***m* and the lower flange portion **25***n* are provided, the rigidity of the pair of plate members **25** can be increased.

[0063] The rib portion **13** includes a one-side edge portion **13***c* which is an edge portion of the bush mounting hole **11***a* on one side (left side) of the vehicle width direction, a peripheral edge portion **13***d* which excludes the edge portion **13***c* of the bush mounting hole **11***a*, and a plurality of ribs

13*a* which are formed on the inside of the one-side edge portion **13***c* and the peripheral edge portion **13***d*.

[0064] The rib portion **17** includes the other-side edge portion **17***c* which is the edge portion of the bush mounting hole **11***a* on the other side (right side) of the vehicle width direction, the peripheral edge portion **13***d*, and the plurality of ribs **13***a* which are formed on the inside of the other-side edge portion **17***c* and the peripheral edge portion **13***d*. The rib portion **17** is different from the rib portion **13** only in the other-side edge portion **17***c* due to the arrangement of the rising portion (vehicle body side inner connection portion) **26***d* of the inner plate **26**.

[0065] The rib portions **13** and **17** include a collar arrangement portion **13***e* which is formed at the rear end portion so that a part of the pair of collars **21** (see FIG. **5**) is disposed.

[0066] <Vehicle Body Side Attachment Structure of Trailing Arm>

[0067] FIG. **7** is a cross-sectional view taken along the line VII-VII of FIG. **1**.

[0068] As shown in FIG. **7**, the rubber bush **12** includes an outer tube **31**, an inner tube **32** which is disposed in the outer tube **31**, and a rubber **33** which is disposed between the outer tube **31** and the inner tube **32**. The outer tube **31** is press-fitted into the bush mounting hole **11***a* of the arm body **11**. The inner tube **32** includes an internal side inner tube **34** to which the rubber **33** is attached and an external side outer tube **35** which is attached to both end portions of the internal side inner tube **34**.

[0069] The external side outer tube **35** is a member in which an upper half body **35***a* and a lower half body **35***b* are combined. The upper half body **35***a* has an upper bracket **35***c* formed at both end portions of the upper half body **35***a* and the lower half body **35***b* has a lower bracket **35***d* formed at both end portions of the upper half body **35***a*.

[0070] The upper bracket **35***c* and the lower bracket **35***d* constitute the pivot bracket **35***e*.

[0071] The upper bracket **35***c* includes an upper through-hole **35***f* which penetrates vertically and the lower bracket **35***d* includes a lower through-hole **35***g* which penetrates vertically. The upper through-hole **35***f* and the lower through-hole **35***g* form the bolt insertion hole **35***h* of the pivot bracket **35***e*.

[0072] The left and right pivot brackets **35***e* are respectively fastened to the left and right rear frames **1**A of the vehicle body **1** by the bolt **15** passing through the bolt insertion hole **35***h* and the nut **16**.

[0073] <Knuckle Side Attachment Structure of Trailing Arm>

[0074] FIG. **8** is a cross-sectional view taken along the line VIII-VIII of FIG. **1**.

[0075] As shown in FIG. **8**, each outer tubular portion **25***k* of the left and right plate members **25** includes a collar insertion hole **25***p* through which each collar **21** is inserted in order to attach the arm body **11** to the knuckle **6** (see FIG. **2**).

[0076] Each collar insertion hole **25***p* of the left and right plate members **25** and the knuckle side inner through-hole **26***e* of the inner plate **26** form a collar through-hole **11***r* into which the collar **21** is inserted and crimped. As described above, the collar through-hole **11***r* is formed over the left and right plate members **25** and the inner plate **26** and is provided in the knuckle connection portion **11***f*.

[0077] The collar **21** includes a first collar (component) **21**A which is disposed in the arm body **11** on one side (left side) of the vehicle width direction and a second collar (component) **21**B which is disposed in the arm body **11** on the other side (right side) of the vehicle width direction. The first collar **21**A is inserted and crimped into the collar insertion hole **25***p* of the plate member **25** on one side (left side) of the vehicle width direction. The second collar **21**B is inserted and crimped into the collar insertion hole **25***p* of the plate member **25** on the other side (right side) of the vehicle width direction and one side (left side) of the vehicle width direction.

[0078] Additionally, the first collar **21**A may be inserted and crimped into the collar insertion hole **25***p* of the plate member **25** on one side (left side) of the vehicle width direction and the other side (right side) of the vehicle width direction. Further, the second collar **21**B may be inserted and crimped only into the collar insertion hole **25***p* of the plate member **25** on the other side (right side) of the vehicle width direction.

[0079] The first collar **21**A is integrally provided with a first tubular portion **21***c* and a flange portion **21***d* extending radially outward from one end portion of the first tubular portion **21***c*. The other end portion of the first tubular portion **21***c* is integrally provided with a convex portion **21***e*.

[0080] A first corner portion (corner portion) **21***f* formed by the first tubular portion **21***c* and the flange portion **21***d* is provided with a first curved surface portion (collar side curved surface portion) **21***g* formed on a concave curved surface. The first curved surface portion **21***g* is formed in an annular shape along the outer peripheral surfaces of the first tubular portion **21***c* and the flange portion **21***d* and the cross-section of the first curved surface portion **21***g* is formed in a concave arc shape.

[0081] The second collar **21**B is integrally provided with a second tubular portion **21***m* and a flange portion **21***d* extending radially outward from one end portion of the second tubular portion **21***m*. The other end portion of the second tubular portion **21***m* is provided with a concave portion **21***n*. The first tubular portion **21***c* of the first collar **21**A and the second tubular portion **21***m* of the second collar **21**B constitute a tubular portion **21***v* of the collar **21**. Since the tubular portion **21***v* is inserted into the collar through-hole **11***r*, the deviation between the inner plate **26** and the left and right plate members **25** (specifically, the deviation in the extension direction of the inner plate **26**) is suppressed when the left and right plate members **25** are joined to the inner plate **26**.

[0082] A second corner portion (corner portion) **21***p* formed by the second tubular portion **21***m* and the flange portion **21***d* is provided with a second curved surface portion (collar side curved surface portion) **21***q* formed on a concave curved surface. The second curved surface portion **21***q* is formed in an annular shape along the outer peripheral surfaces of the second tubular portion **21***m* and the flange portion **21***d* and the cross-section of the second curved surface portion **21***q* is formed in a concave arc shape. The second curved surface portion **21***q* is formed in the same shape as the first curved surface portion **21***g*.

[0083] An end surface **21***u* of the flange portion **21***d* of the first collar **21**A is disposed to be flush with an end surface **13***b* of the rib portion **13**. A side surface **6***c* of the trailing arm connection portion **6***a* of the knuckle **6** comes into contact with the end surface **21***u*.

[0084] The end surface **21***u* of the flange portion **21***d* of the second collar **21**B is flush with the end surface **13***b* of the rib

portion **17**. A washer **37** through which the bolt **14** passes comes into contact with the end surface **21***u*.

[0085] The first tubular portion **21***c* and the second tubular portion **21***m* have the same outer diameter and inner diameter. The outer diameter of the flange portion **21***d* is larger than those of the first tubular portion **21***c* and the second tubular portion **21***m*.

[0086] The convex portion **21***e* of the first collar **21**A and the concave portion **21***n* of the second collar **21**B has mating-connection. Due to the mating-connection, the first tubular portion **21***c* and the second tubular portion **21***m* can be coaxially arranged with high accuracy.

[0087] The first tubular portion **21***c* of the first collar **21**A includes a first bolt insertion hole **21***r* through which the bolt **14** passes. The second tubular portion **21***m* of the second collar **21**B includes a second bolt insertion hole **21***s* through which the bolt **14** passes. The first bolt insertion hole **21***r* and the second bolt insertion hole **21***s* constitute a bolt insertion hole **21***t*.

[0088] The second collar **21**B is inserted and crimped into the knuckle side inner through-hole **26***e* of the inner plate **26**. The tip end of each outer tubular portion **25***k* of the left and right plate members **25** is crimped to the edge portion of the knuckle side inner through-hole **26***e* of the inner plate **26**. Additionally, the first collar **21**A may be inserted and crimped into the knuckle side inner through-hole **26***e* or both the first collar **21**A and the second collar **21**B may be inserted and crimped thereinto.

[0089] A convex through-hole side curved surface portion **25***r* is formed on the edge portion **25***q* of the collar insertion hole **25***p* of the plate member **25**. The through-hole side curved surface portion **25***r* is formed in an annular shape along the inner peripheral surface of the collar insertion hole **25***p* and the cross-section of the through-hole side curved surface portion **25***r* is formed in a convex arc shape.

[0090] The first curved surface portion **21***g* and the second curved surface portion **21***q* which are formed as concave curved surfaces in the collar **21** and each through-hole side curved surface portion **25***r* formed as a convex curved surface in the plate member **25** have the same curvature and each portion is evenly in contact with each other. Thus, the contact area between the first curved surface portion **21***g* and the second curved surface portion **21***q* with respect to each through-hole side curved surface portion **25***r* can be increased. Accordingly, it is possible to reduce stress concentration by improving the adhesion at the contact portion between the first corner portion **21***f* and the second corner portion **21***p* of the collar **21** and the edge portion **25***q* of the collar insertion hole **25***p* of the plate member **25**.

[0091] In FIGS. **6** to **8**, the inner plate **26** includes the rising portion **26***d* which is connected to the vehicle body **1** through the rubber bush **12** and the knuckle side inner connection portion **26***h* which is connected to the knuckle **6** through the collar **21** and the bolt **14**. The metallic inner plate **26** connects the vehicle body **1** and the knuckle **6**.

[0092] The plate member **25** includes the vehicle body side outer connection portion **25***t* which is connected to the vehicle body **1** via a resin material **43** and the rubber bush **12** and the outer tubular portion **25***k* which is connected to the knuckle **6** via the collar **21** and the bolt **14**. Further, the plate member **25** is disposed between the vehicle body side outer connection portion **25***t* and the outer tubular portion **25***k*. The plate member **25** includes the plate concave portion **25***d* which increases the rigidity between the vehicle body side outer connection portion **25***t* and the outer tubular portion **25***k* in the plate member **25**.

[0093] <Arm Body Cross-Section Structure>

[0094] FIG. **9** is a cross-sectional view taken along the line IX-IX of FIG. **4**.

[0095] As shown in FIG. **9**, a hollow portion **38** is formed on the inside of the pair of left and right plate members **25** and the inner plate **26** is disposed and joined to the hollow portion **38**. The hollow portion **38** is divided into left and right by the inner plate **26**. That is, a space **41** is formed in the inner plate **26** on one side (left side) of the vehicle width direction and a space **42** is formed in the inner plate **26** on the other side (right side) of the vehicle width direction. The spaces **41** and **42** are respectively filled with the resin material **43**.

[0096] The space **41** includes a first space portion **41***a* which is located at the vertical extension portion **11***b* and a second space portion **41***b* which is located at the rear extension portion **11***c*. The first space portion **41***a* and the second space portion **41***b* communicate with each other above and below the plate concave portion **25***d* (also see FIG. **4**) of the left plate member **25**.

[0097] The space **42** includes a first space portion **42***a* which is located at the vertical extension portion **11***b* and a second space portion **42***b* which is located at the rear extension portion **11***c*. The first space portion **42***a* and the second space portion **42***b* communicate with each other above and below the plate concave portion **25***d* of the right plate member **25**.

[0098] The resin material **43** is formed such that a molten resin injected into molding dies when injection-molding the left and right rib portions **13** and **17** flows into the spaces **41** and **42** and is filled and solidified in the spaces **41** and **42**. In this way, since the spaces **41** and **42** are filled with the resin material **43**, it is possible to improve the strength and rigidity of the arm body **11**.

[0099] Since the spaces **41** and **42** are open to the outside in a convex arc surface **11***q* forming the upper end of the vertical extension portion **11***b* and the rear surface **11***p* of the rear extension portion **11***c* among an outer peripheral surface **11***h* of the arm body **11**, the resin material **43** is exposed to the outside. Further, since the space **41** is open to the outside also in the inner peripheral surface of the bush mounting hole **11***a*, the resin material **43** is exposed to the outside. On the other hand, since the space **42** is blocked by the rising portion **26***d* of the inner plate **26** also in the inner peripheral surface of the bush mounting hole **11***a*, the resin material **43** is not exposed to the outside.

[0100] FIG. **10** is a cross-sectional view taken along the line X-X of FIG. **4**.

[0101] As shown in FIG. **10**, each plate concave portion **25***d* includes a bottom wall **25***s* forming the bottom surface **25***g*. The pair of bottom walls **25***s* forming the plate concave portions **25***d* of the left and right plate members **25** is crimped to the inner plate **26** while sandwiching the inner plate **26** from both sides. In other words, the inner surface **25***f* which is a surface on the side of the inner plate **26** in the left and right plate members **25** is crimped to surfaces **26***f* on both sides of the inner plate **26**.

[0102] The plate member **25** is positioned to both sides of the inner plate **26** in the plate thickness direction of the arm body **11** in such a manner that the bottom wall **25***s* is brought

into contact with the inner plate **26**. Since the bottom wall **25***s* is joined to the inner plate **26** by surface, it is possible to increase the joint strength.

[0103] A third space portion **41***c* and a fourth space **41***d* constituting the space **41** are arranged in the periphery of the plate concave portion **25***d* on one side (left side). A third space portion **42***c* and a fourth space **42***d* constituting the space **42** are arranged in the periphery of the plate concave portion **25***d* on the other side (right side).

[0104] The rib portion **13** is formed on the outer surface **25***e* on the side opposite to the arrangement side of the third space portion **41***c* and the fourth space **41***d* with respect to the plate member **25** on one side (left side). The rib portion **17** is formed on the outer surface **25***e* on the side opposite to the arrangement side of the third space portion **42***c* and the fourth space **42***d* with respect to the plate member **25** on the other side (right side).

[0105] Each rib **13***a* of the rib portions **13** and **17** is formed along the shape of the outer surface **25***e* of the plate member **25**. That is, each rib **13***a* extends from the end surface **13***b* to the outer surface **25***e* on the outside of the vehicle width direction in the third space portion **41***c*, the fourth space **41***d*, the third space portion **42***c*, and the fourth space **42***d* and extends from the end surface **13***b* to the bottom surface **25***g* or the side surface **25***h* in the plate concave portion **25***d*. In the plate concave portion **25***d*, the height of each rib **13***a* becomes higher than that of a portion other than the plate concave portion **25***d*.

[0106] In the upper surface **11***m* and the lower surface **11***n* of the rear extension portion **11***c* among the outer peripheral surface **11***h* of the arm body **11**, the spaces **41** and **42** are covered with the upper flange portion **25***m* and the lower flange portion **25***n* of each of the left and right plate members **25**. Therefore, the upper flange portion **25***m* and the lower flange portion **25***n* of each of the left and right plate members **25** are exposed to the outside, but the resin material **43** is not easily exposed to the outside. Accordingly, it is possible to suppress the bending of the resin material **43** in the spaces **41** and **42** when a bending moment in the up and down direction is applied to the rear extension portion **11***c* of the arm body **11**.

[0107] As described above, in the above-described embodiment, the trailing arm **5** which is provided in the vehicle body **1** includes the collar **21** provided at the end portion of the trailing arm **5** so that the bolt **14** passes therethrough in order to fasten the knuckle **6** and the collar **21**. The collar **21** includes the tubular portion **21***v* and the flange portion **21***d* extending radially outward from the end portion of the tubular portion **21***v*. Further, the first curved surface portion **21***g* and the second curved surface portion **21***q* which are formed as concave curved surfaces are provided in the first corner portion **21***f* and the second corner portion **21***p* of the tubular portion **21***v* and the flange portion **21***d*. The end portion of the trailing arm **5** includes the collar through-hole **11***r* into which the collar **21** is inserted. The edge portion **25***q* of the collar through-hole **11***r* includes the through-hole side curved surface portion **25***r* which is formed as a convex curved surface coming into contact with the first curved surface portion **21***g* and the second curved surface portion **21***q*.

[0108] In this way, since each contact portion of the edge portion **25***q* of the collar through-hole **11***r* of the trailing arm **5** and the first and second corner portions **21***f* and **21***p* of the collar **21** are formed as curved surface shapes, the contact area between the edge portion **25***q* of the collar through-hole **11***r* and each of the first corner portion **21***f* and the second corner portion **21***p* of the collar **21** can be increased. Accordingly, it is possible to suppress the stress concentration in the edge portion **25***q* of the collar through-hole **11***r* and the first and second corner portions **21***f* and **21***p* of the collar **21** when an external force is applied between the collar through-hole **11***r* and the collar **21**.

[0109] The collar **21** is consisted by the first collar **21**A and the second collar **21**B each including the tubular portion **21***v* and the flange portion **21***d*. The end portions of the tubular portions **21***v* of the first collar **21**A and the second collar **21**B are mating-connected to each other. Therefore, since the first collar **21**A and the second collar **21**B are mating-connected to each other, it is possible to respectively insert the first collar **21**A and the second collar **21**B from both ends of the collar through-hole **11***r* into the collar through-hole **11***r*. Further, it is possible to improve the assembling property of the collar **21** to the end portion of the trailing arm **5**. Further, it is possible to improve the connection accuracy between the first collar **21**A and the second collar **21**B.

[0110] The plate member **25** corresponding to a part of the trailing arm **5** including the edge portion **25***q* of the collar through-hole **11***r* is made of a resin material. Therefore, it is possible to reduce the weight of the trailing arm **5**. Further, since the stress concentration of the first curved surface portion **21***g*, the second curved surface portion **21***q*, and the through-hole side curved surface portion **25***r* is suppressed, it is possible to ensure the strength.

[0111] The collar **21** is provided at the rear end portion of the trailing arm **5** and the other member is the knuckle **6** supporting the vehicle wheel. Thus, since the stress concentration of the first curved surface portion **21***g*, the second curved surface portion **21***q*, and the through-hole side curved surface portion **25***r* is suppressed by disposing the collar **21** at the rear end portion of the trailing arm **5** largely moved while the vehicle is running, it is possible to ensure the strength.

[0112] The trailing arm **5** includes the resinous plate member **25** having the hollow portion **38** and composed of at least two members and the metallic inner plate **26** joined to the plate member **25** at inside of the hollow portion **38**. The collar through-hole **11***r* is formed through the plate member **25** and the inner plate **26**. Therefore, it is possible to suppress the displacement of the plate member **25** and the inner plate **26** in the direction orthogonal to the collar through-hole **11***r* by inserting the collar **21** to the collar through-hole **11***r* when joining the plate member **25** and the inner plate **26**. Further, when the knuckle **6** is fastened to the trailing arm **5**, it is possible to sandwich the plate member **25** and the inner plate **26** by the collar **21** composed of the first collar **21**A and the second collar **21**B. Thus, it is possible to firmly maintain the joint state between the plate member **25** and the inner plate **26**.

[0113] Additionally, the present invention is not limited to the above-described embodiment. For example, in this embodiment, the collar **21** composed of two members is formed such that both members have the tubular portion and the flange portion. However, one of two members may include the tubular portion and the flange portion and the other of them may include only the flange portion. In this case, one flange portion may be provided with a concave

collar side curved surface portion and a connection portion mating-connected to one member.

[0114] The trailing arm of the above-described embodiment is applicable to three-wheeled and four-wheeled vehicles. Then, the configuration in the above-described embodiment is an example of the present invention, and various changes can be made without departing from the scope of the present invention, such as replacing the constituent elements of the embodiment with well-known constituent elements.

[0115] While preferred embodiments of the invention have been described and illustrated above, it should be understood that these are exemplary of the invention and are not to be considered as limiting. Additions, omissions, substitutions, and other modifications can be made without departing from the scope of the present invention. Accordingly, the invention is not to be considered as being limited by the foregoing description, and is only limited by the scope of the appended claims.

What is claimed is:

1. A trailing arm attachment portion structure provided in a vehicle body and having a collar provided at an end portion of the trailing arm attachment portion structure so that a bolt passes therethrough in order to fasten other member and the collar,

wherein the collar includes a tubular portion and a flange portion extending radially outward from an end portion of the tubular portion,

wherein a corner portion formed by the tubular portion and the flange portion is provided with a collar side curved surface portion which is formed as a concave curved surface,

wherein an end portion of the trailing arm is provided with a through-hole into which the collar is inserted, and

wherein an edge portion of the through-hole is provided with a through-hole side curved surface portion which is formed as a convex curved surface coming into contact with the collar side curved surface portion.

2. The trailing arm attachment portion structure according to claim **1**,

wherein the collar is consisted by two components each of which includes the tubular portion and the flange portion, and

end portions of the tubular portions of the two components are mating-connected to each other.

3. The trailing arm attachment portion structure according to claim **1**,

wherein a part of the trailing arm including the edge portion of the through-hole is made of a resin material.

4. The trailing arm attachment portion structure according to claim **1**,

wherein the collar is provided at a rear end portion of the trailing arm, and

wherein the other member is a knuckle supporting a vehicle wheel.

5. The trailing arm attachment portion structure according to claim **2**,

wherein the trailing arm includes a resinous outer portion which is consisted by at least two members having a hollow portion and a metallic inner portion which is joined to the outer portion at inside of the hollow portion, and

wherein the through-hole is formed through the outer portion and the inner portion.

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