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(54) **VEHICLE WHEEL STRUCTURE**

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(57) **ABSTRACT**

A vehicle wheel structure includes a wheel configured to support a tire and be assembled to a vehicle, and a wheel cover, the wheel cover serving as a wheel attachment member attached to the wheel. The wheel cover includes a body and an engaging portion provided at the body. The wheel has an engaged portion provided so as to extend to engage with the engaging portion. In a state where the engaging portion and the engaged portion are engaged with each other to attach the wheel cover to the wheel, in a region in which the engaging portion relatively moves with respect to the engaged portion, the engaged portion is provided so as to extend to relatively approach the engaging portion.

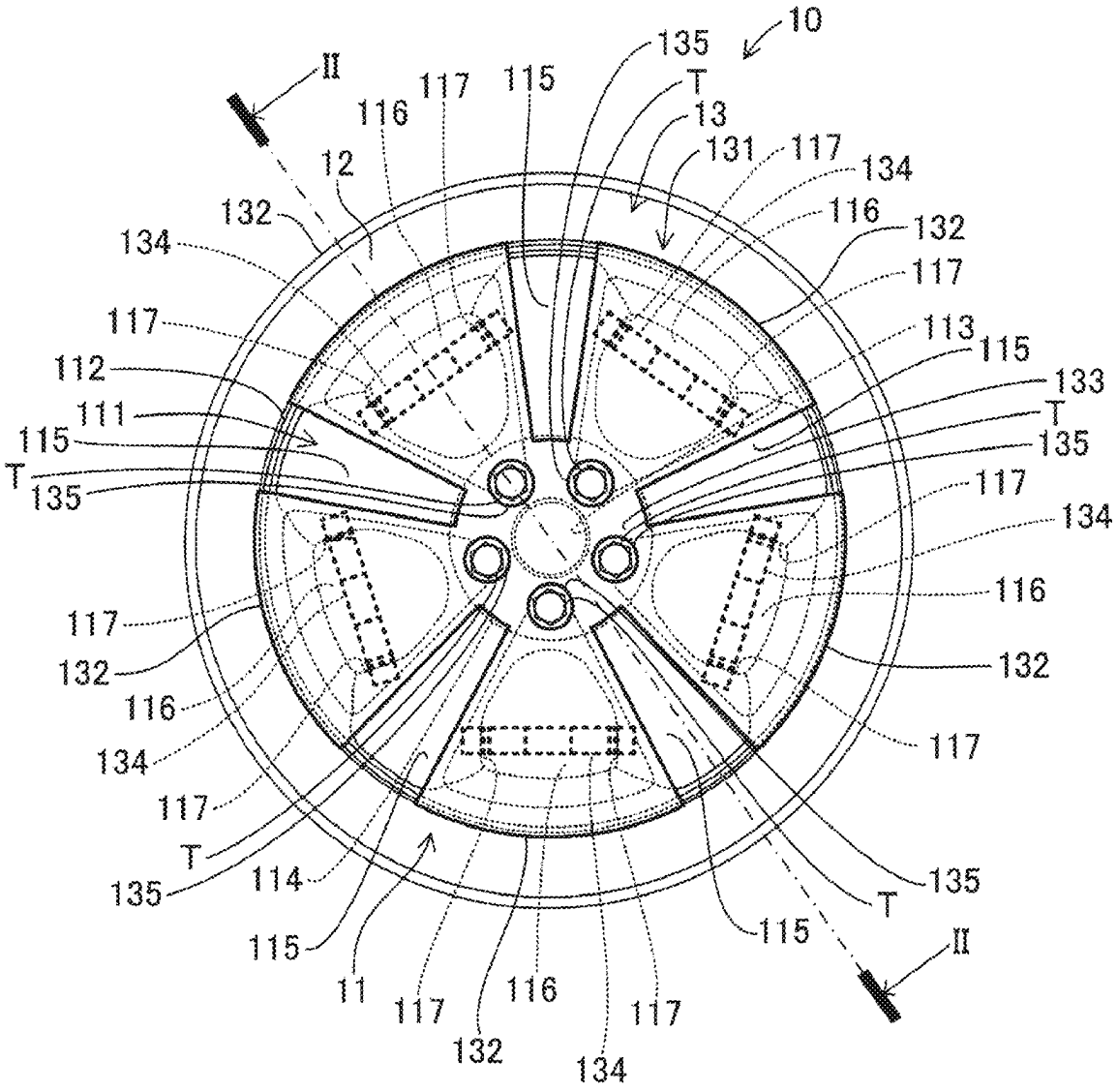


FIG. 1

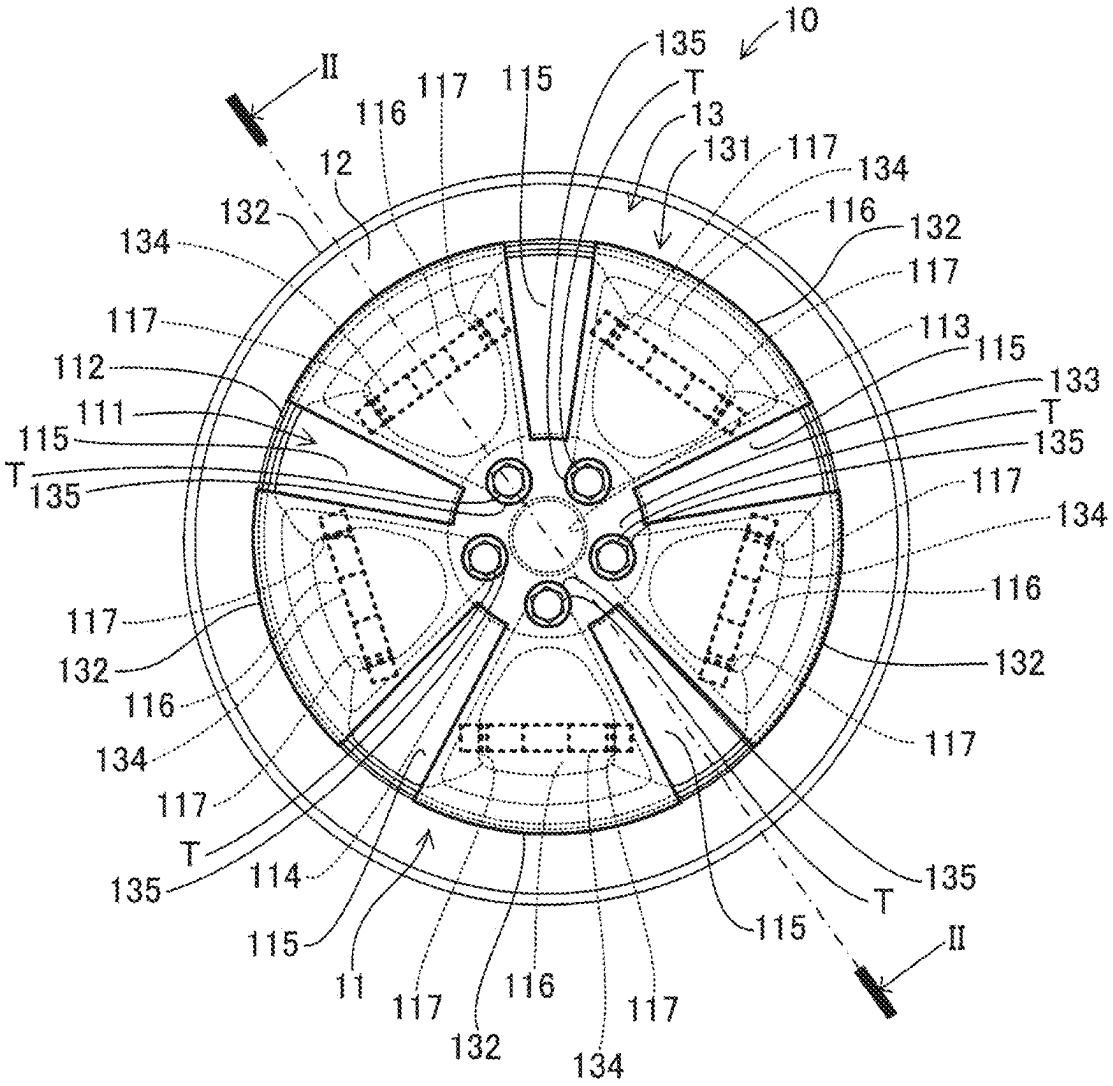


FIG. 2

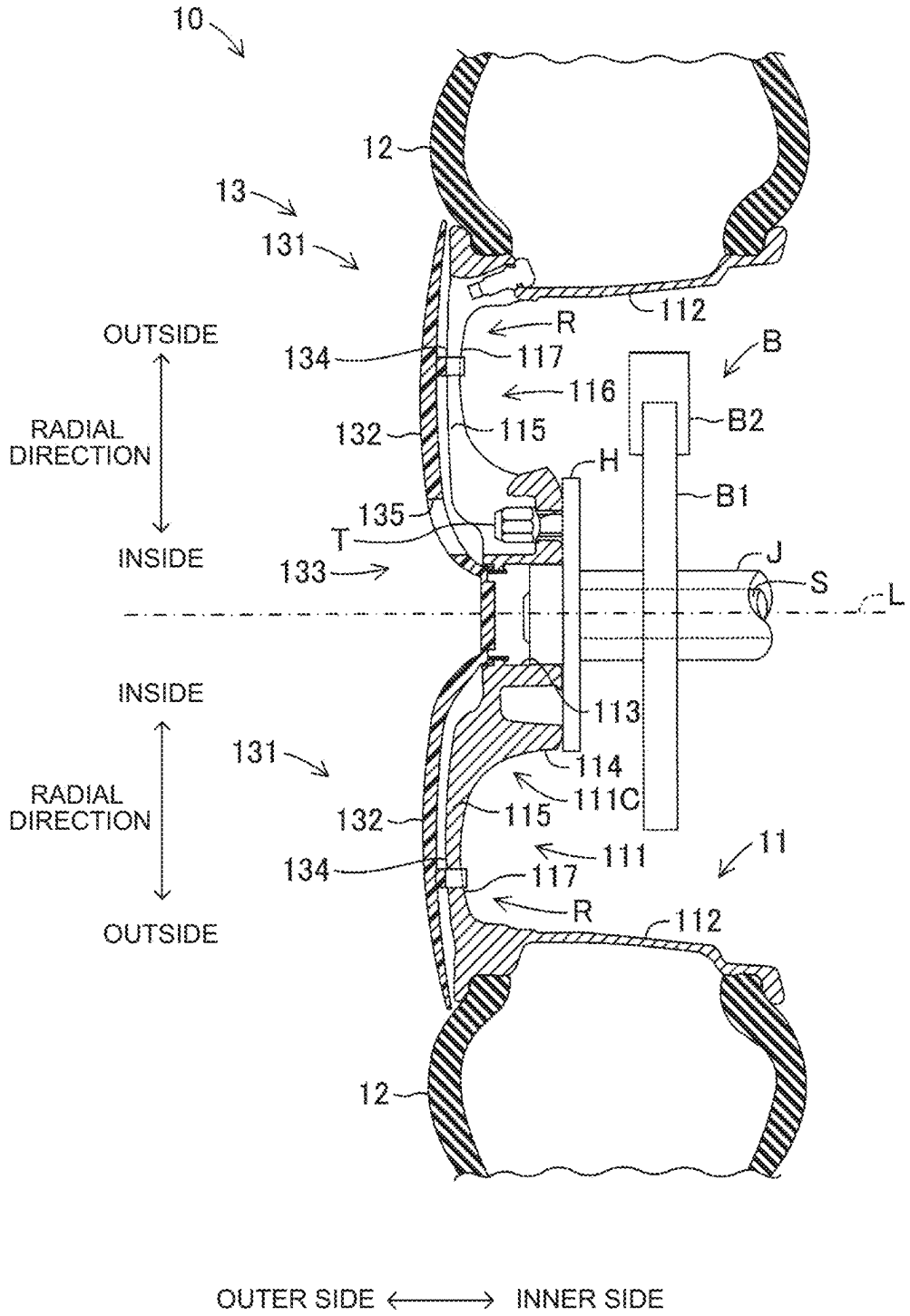

10
12
13
131
OUTSIDE
RADIAL DIRECTION
INSIDE
134
117
R
112
B
116
132
115
B2
H
B1
135
T
133
J
S
L
INSIDE
RADIAL DIRECTION
OUTSIDE
131
113
114
111C
132
115
134
117
111
11
R
112
12
OUTER SIDE ⟷ INNER SIDE

FIG. 3

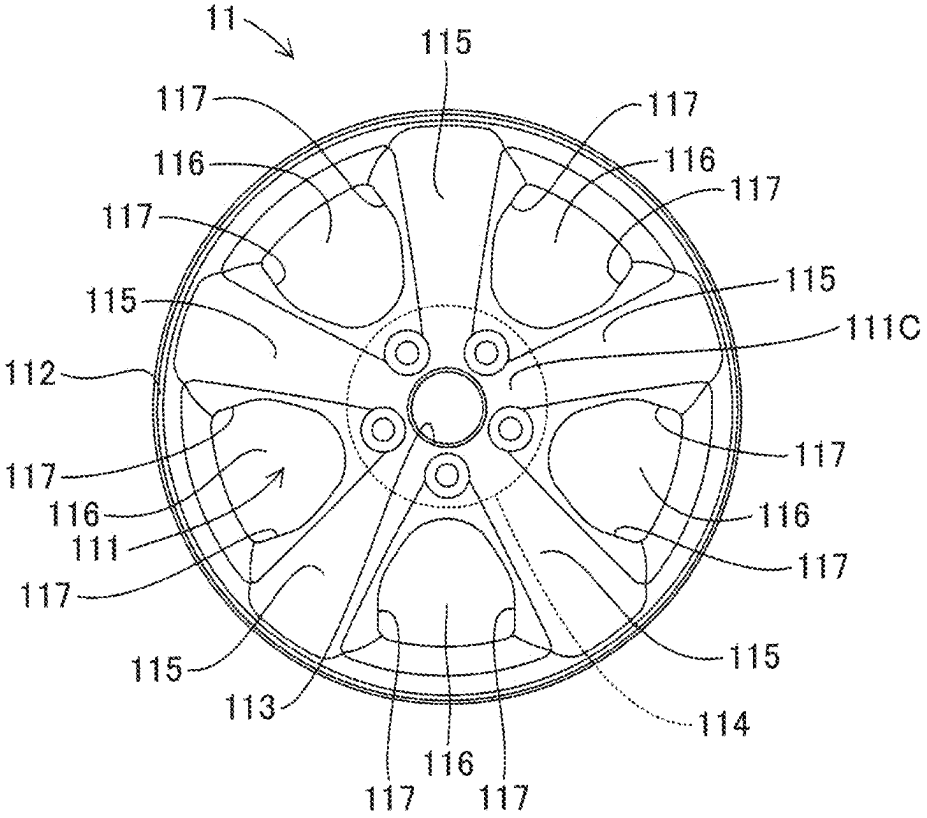

11
115
117
117
116
116
117
117
115
115
111C
112
117
117
116
116
111
117
117
115
115
113
114
116
117
117

FIG. 4

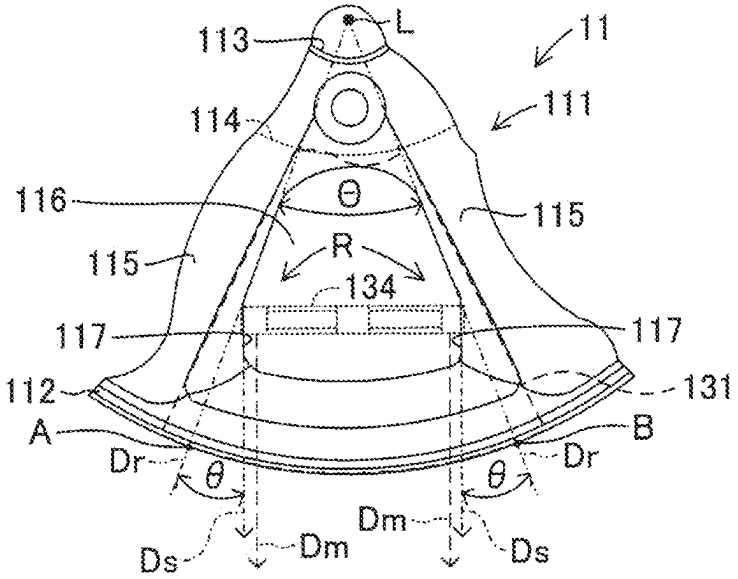

113
L
11
114
111
116
Θ
115
115
R
134
117
117
112
131
A
B
Dr
θ
θ
Dr
Dm
Ds
Dm
Ds

FIG. 5

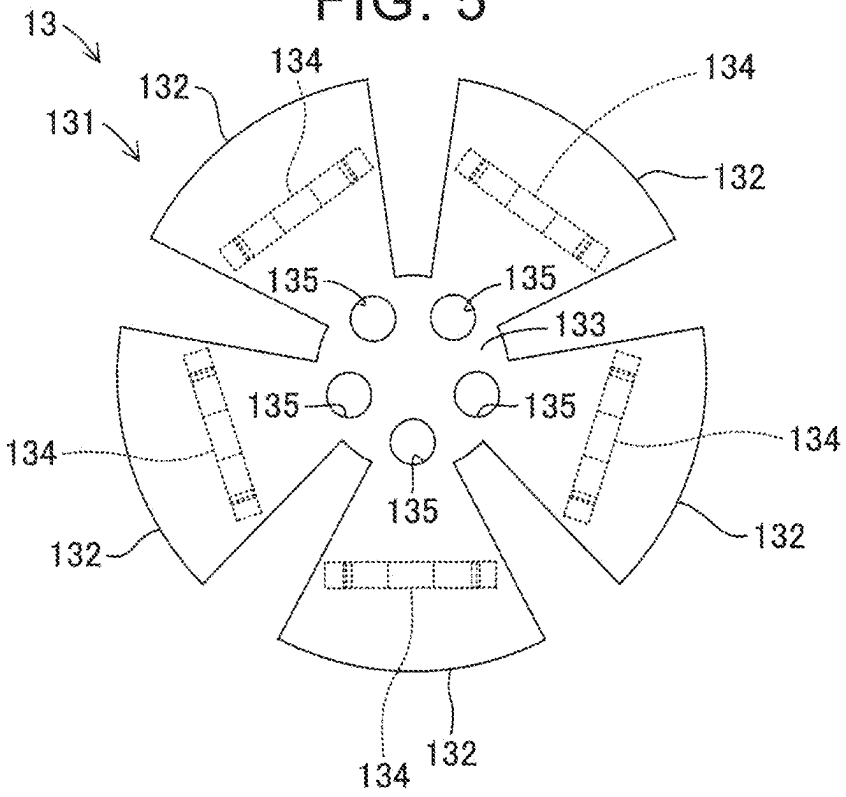

13
131
132
134
134
132
135
135
133
135
135
134
134
135
132
132
134
132

FIG. 6

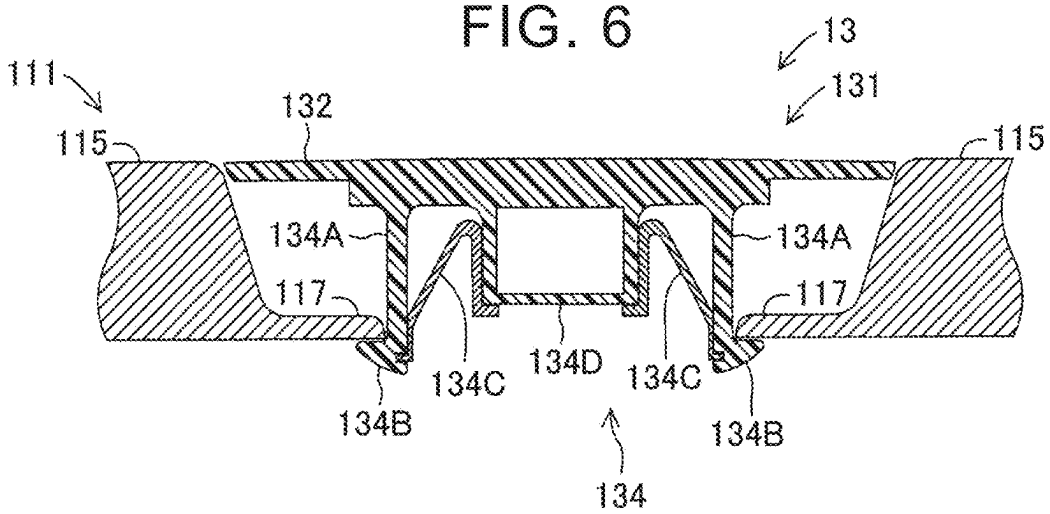

111
13
131
115
132
115
134A
134A
117
117
134C
134D
134C
134B
134B
134

FIG. 7

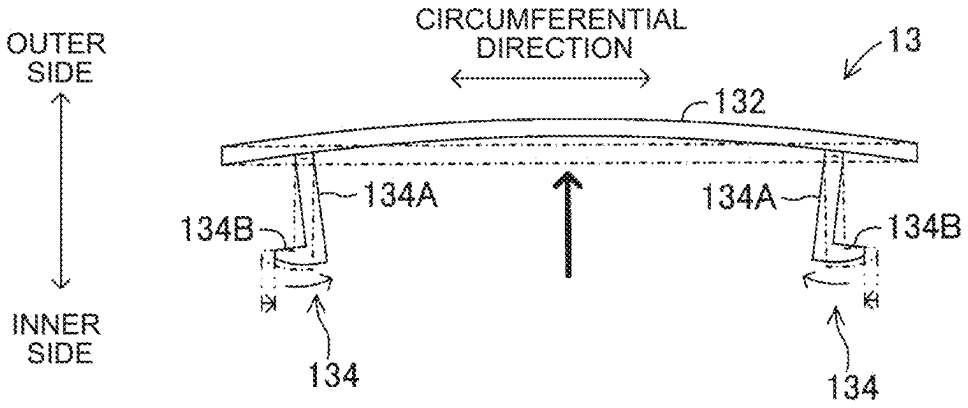

OUTER SIDE
INNER SIDE
CIRCUMFERENTIAL DIRECTION
13
132
134A
134A
134B
134B
134
134

FIG. 8

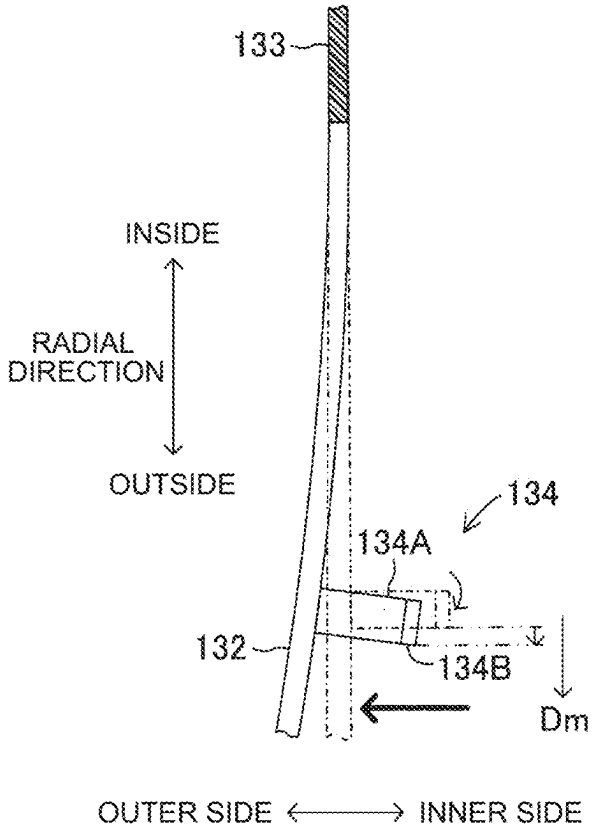

133
INSIDE
RADIAL DIRECTION
OUTSIDE
134
134A
132
134B
Dm
OUTER SIDE
INNER SIDE

FIG. 9

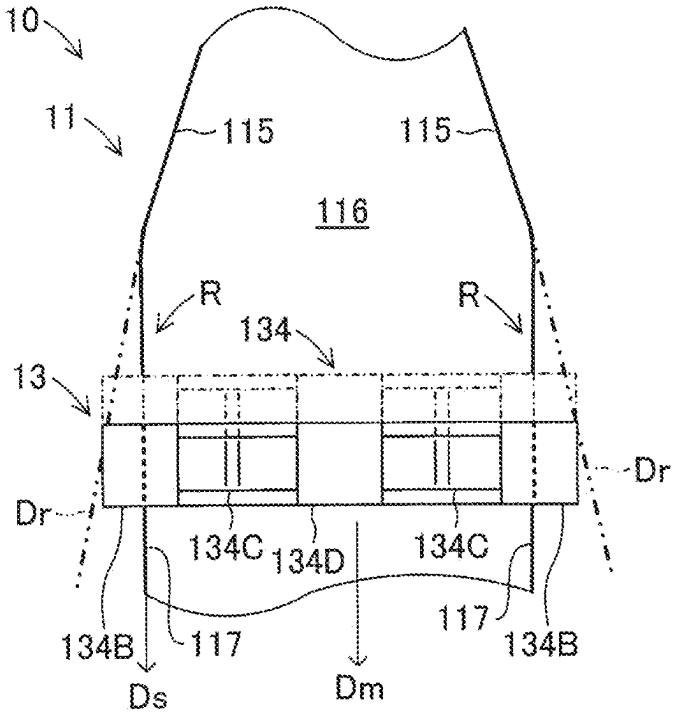
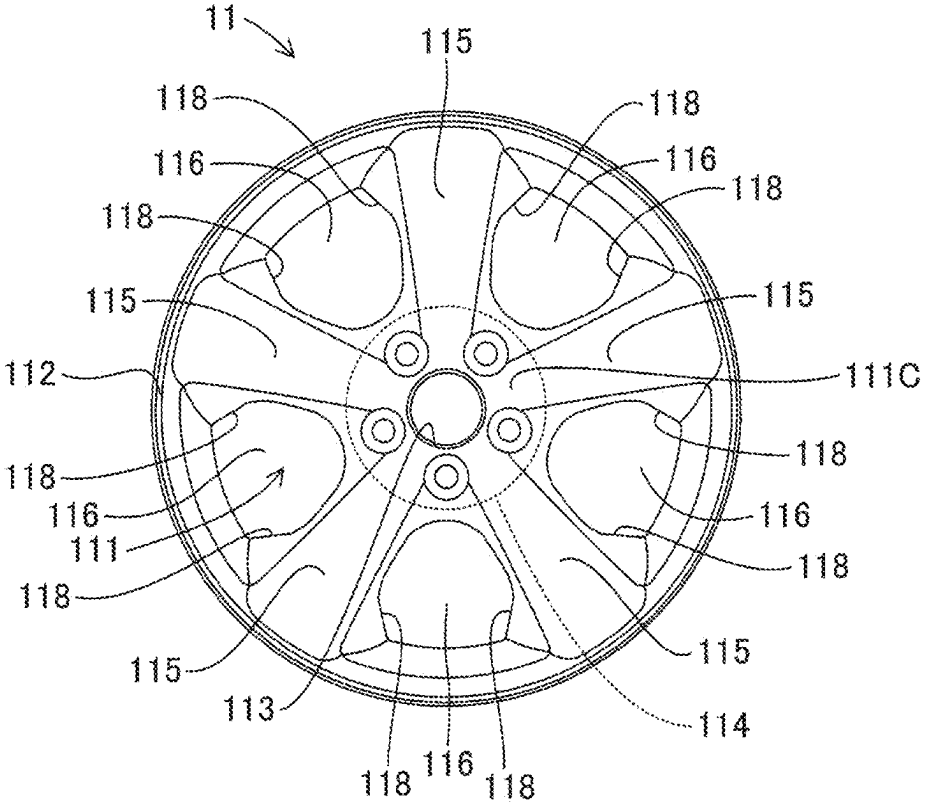

10
11
115
115
116
R
R
134
13
Dr
Dr
134C
134D
134C
134B
117
117
134B
Ds
Dm

FIG. 10


11
115
118
118
116
116
118
118
115
115
112
111C
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118
116
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115
115
113
114
118
116
118

FIG. 11

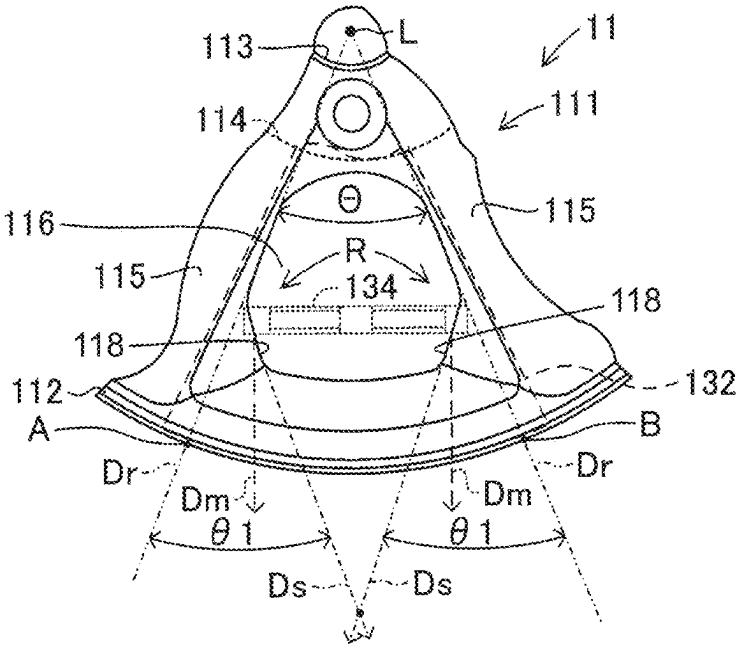

113
L
11
114
111
Θ
115
116
R
115
134
118
118
112
132
A
B
Dr
Dr
Dm
Dm
θ1
θ1
Ds
Ds

FIG. 12

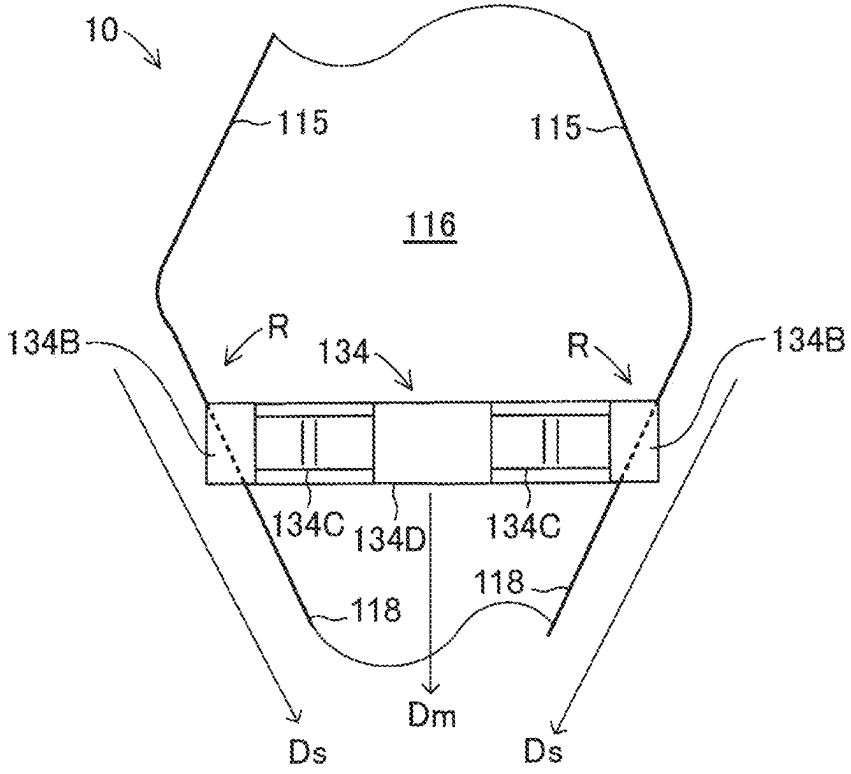
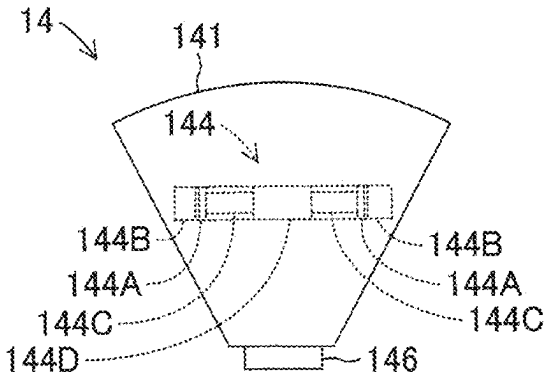

10
115
115
116
R
134
R
134B
134B
134C
134D
134C
118
118
Dm
Ds
Ds

FIG. 13



VEHICLE WHEEL STRUCTURE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Japanese Patent Application No. 2024-021661 filed on Feb. 16, 2024, incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

[0002] The disclosure relates to a vehicle wheel structure.

2. Description of Related Art

[0003] Generally, for example, a cap described in Japanese Unexamined Patent Application Publication No. 2016-193693 (JP 2016-193693 A) is known. The existing cap has three engaging portions, that is, an engaging portion that is engaged with a step of a wheel and two engaging portions that are respectively engaged with through-holes provided at two locations. The existing cap is positioned in a radial direction and in a circumferential direction with respect to the wheel in a manner such that the three engaging portions are engaged with the step and the through-holes of the wheel.

SUMMARY

[0004] In recent years, for the purpose of improving the design and aerodynamic characteristics of a wheel, a wheel attachment member, such as a wheel cover and an accessory piece including the above-described existing cap, can be attached to the wheel. In this case, the shape of the wheel attachment member can adopt not only a frame shape like the above-described existing cap but also a plate shape.

[0005] Incidentally, once a vehicle drives, external force that acts on a wheel attachment member in a direction to detach the wheel attachment member can occur due to wind pressure, vibration, and a collision of water, snow, or the like. In recent years, a wheel to be assembled to a vehicle tends to increase in diameter (increase in size), so large centrifugal force can occur in a wheel attachment member that rotates with the wheel.

[0006] For these reasons, in a case where an engagement structure in the existing cap is adopted, when material degradation occurs in the engaging portions or when external force or centrifugal force acts on a wheel attachment member, that is, the engaging portions, the engaging portion engaged with the step can particularly relatively move in a direction to separate from the step. Thus, engagement force decreases as a result of a reduction in engagement overlap width between the step and the engaging portion, with the result that there are concerns that detachment of the wheel attachment member can easily occur.

[0007] The disclosure provides a vehicle wheel structure capable of suppressing detachment of a wheel attachment member attached to a wheel.

[0008] An aspect of the disclosure provides a vehicle wheel structure. The vehicle wheel structure includes a wheel configured to support a tire and be assembled to a vehicle, and a wheel attachment member attached to the wheel. The wheel attachment member includes a body and an engaging portion provided at the body. The wheel has an engaged portion provided so as to extend to engage with the engaging portion. In a state where the engaging portion and the engaged portion are engaged with each other to attach the wheel attachment member to the wheel, in a region in which the engaging portion relatively moves with respect to the engaged portion, the engaged portion is provided so as to extend to relatively approach the engaging portion.

[0009] With the vehicle wheel structure according to the disclosure, even when the engaging portion relatively moves with respect to the engaged portion, the engaged portion can be present at a destination of movement of the engaging portion. Thus, even when external force or centrifugal force acts on the wheel attachment member and, therefore, the engaging portion relatively moves with respect to the engaged portion, an engaged state of the engaging portion with the engaged portion can be maintained. Therefore, it is possible to suppress detachment of the wheel attachment member from the wheel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Features, advantages, and technical and industrial significance of exemplary embodiments of the disclosure will be described below with reference to the accompanying drawings, in which like signs denote like elements, and wherein:

[0011] FIG. **1** is a view for illustrating a vehicle wheel structure;

[0012] FIG. **2** is a cross-sectional view taken along the line II-II in FIG. **1**;

[0013] FIG. **3** is a view for illustrating a wheel;

[0014] FIG. **4** is a view for illustrating engaged portions provided at the wheel so as to extend;

[0015] FIG. **5** is a view for illustrating a wheel attachment member;

[0016] FIG. **6** is a cross-sectional view for illustrating an engaging portion of the wheel attachment member;

[0017] FIG. **7** is a schematic diagram for illustrating relative movement of the engaging portion;

[0018] FIG. **8** is a schematic diagram for illustrating relative movement of the engaging portion;

[0019] FIG. **9** is a view for illustrating an engaged state of the engaging portion with the engaged portions;

[0020] FIG. **10** is a view for illustrating a wheel according to a first modification;

[0021] FIG. **11** is a view for illustrating engaged portions provided at the wheel so as to extend according to the first modification;

[0022] FIG. **12** is a view for illustrating an engaged state of the engaging portion with the engaged portions according to the first modification; and

[0023] FIG. **13** is a view for illustrating a wheel attachment member according to a second modification.

DETAILED DESCRIPTION OF EMBODIMENTS

[0024] Hereinafter, a vehicle wheel structure according to an embodiment of the disclosure will be described in details with reference to the attached drawings. The disclosure may be implemented in various forms with various modifications and improvements based on the knowledge of persons skilled in the art in addition to the following embodiment.

1. Embodiment

[0025] As shown in FIG. **1** and FIG. **2**, a vehicle wheel structure **10** according to the present embodiment includes a

wheel **11** that is a component of a tire-wheel assembly of a vehicle. The wheel **11** supports a tire **12** and is assembled to the vehicle. The vehicle wheel structure **10** according to the present embodiment includes a wheel cover **13** serving as a wheel attachment member attached to the wheel **11**. The vehicle wheel structure **10** described below is an example of a case where the vehicle wheel structure **10** is applied to a tire-wheel assembly that is a drive wheel. A case where the vehicle wheel structure **10** is applied to a tire-wheel assembly that is a drive wheel will be illustrated; however, the vehicle wheel structure **10** is, of course, applicable to a tire-wheel assembly that is a driven wheel.

[0026] When the wheel **11** is assembled to the vehicle, a side where a vehicle body of the vehicle is located with respect to the wheel **11** is the "inner side" and an opposite side where no vehicle body is located is the "outer side". In the following description, the side that is the "outer side" in the wheel **11** may also be referred to as "design surface". In the following description, a direction parallel to a rotation axis L passing through the center of the tire-wheel assembly including the wheel **11** is referred to as "axial direction", and a direction orthogonal to the rotation axis L is referred to as "radial direction".

[0027] The wheel **11** is made of an alloy of aluminum or the like or made of steel. The wheel **11** is configured to include a disc **111** having a disc shape and an annular rim **112** provided at an outer periphery of the disc **111** and holding the tire **12**. In the present embodiment, the wheel **11** is made of an alloy of aluminum or the like, and, as shown in FIG. **2**, a case where the wheel **11** is of a one-piece type in which the disc **111** and the rim **112** are integrally molded with each other is illustrated.

[0028] As shown in FIG. **2** and FIG. **3**, the disc **111** has a hub hole **113** formed so as to extend along the axial direction through a central part **111**C of the disc **111**. Here, the hub hole **113** has a projection on its inner periphery in a circumferential direction. When, for example, the wheel cover **13** is attached, the hub hole **113** can function as a hole for fixing the wheel cover **13** by engaging a hook member of the wheel cover **13** with the projection. The hub hole **113** can also function as a hole for mounting an ornament to be provided on the wheel **11** in a case where no wheel cover **13** is attached.

[0029] The disc **111** has a hub mounting portion **114** that is fixed to the hub H by fastening members T, that is, hub nuts, hub bolts, or the like, when the wheel **11** is assembled to the vehicle on the inner side. The hub mounting portion **114** is provided at a center side, that is, the central part **111**C, of the wheel **11**.

[0030] The disc **111** has spokes **115** that couple the hub mounting portion **114** to the rim **112**. The rim **112** supports the tire **12** at an outer peripheral side that is an outer side of the wheel **11** in the radial direction. In the present embodiment, a case where the disc **111**, that is, the wheel **11**, includes five spokes **115** radially extending from the hub mounting portion **114** toward the rim **112** in the radial direction is illustrated.

[0031] The disc **111** also has air holes **116** each formed between any adjacent spokes **115**. In the present embodiment, as shown in FIG. **3**, a case where the disc **111** has five air holes **116** each defined by the two spokes **115**, the hub mounting portion **114**, and the rim **112** is illustrated. Depending on the layout and shape of the spokes **115**, each of the air holes **116**, for example, may be defined by the two spokes **115** and the rim **112** or may be defined by the two spokes **115** and the hub mounting portion **114**.

[0032] As will be described later, each of the engaged portions **117** is provided so as to extend along a side face of a corresponding one of the spokes **115** in the circumferential direction to engage with a corresponding one of the engaging portions **134** provided at a body **131** of the wheel cover **13**. In this case, as shown in FIG. **4**, each of the engaged portions **117** is provided so as to extend such that an extension direction Ds of the engaged portion **117**, oriented outward in the radial direction, and a moving direction Dm of the engaging portion **134**, oriented outward in the radial direction, are parallel to each other in a region R in which the engaging portion **134** relatively moves with respect to the engaged portions **117**.

[0033] Specifically, the extension direction Ds in which the engaged portion **117** is provided so as to extend is set so as to have an angle θ ($\theta \geq \Theta/2$) with respect to the radial direction Dr indicated by the alternate long and two-short dashed line along the side face of the spoke **115**. Here, Θ is the angle of corner ALB formed by point A and point B in the radial direction Dr and the rotation axis L on an imaginary plane (not shown) orthogonal to the rotation axis L, and angle θ is set to $\Theta/2$ in the present embodiment. Thus, as will be described later, each of the engaged portions **117** according to the present embodiment is provided so as to extend such that the moving direction Dm of the engaging portion **134** and the extension direction Ds are parallel to each other in a situation in which the engaging portion **134** relatively moves with respect to the engaged portions **117**.

[0034] In the present embodiment, the engaged portions **117** are respectively provided at the side faces of the adjacent two spokes **115** so as to extend from the hub mounting portion **114** side toward the rim **112** side. In the present embodiment, the two engaged portions **117** are provided so as to extend in a manner such that the extension directions Ds of the two engaged portions **117** from the hub mounting portion **114** side toward the rim **112** side are parallel to each other. In other words, in the present embodiment, a case where the extension directions Ds of the engaged portions **117** are parallel to each other and the extension directions Ds are parallel to the moving direction Dm of the engaging portion **134** (described later) is illustrated.

[0035] Here, as shown in FIG. **2**, a disc brake B is provided on the inner side of the wheel **11**, more specifically, on the inner side of the hub H coupled to the hub mounting portion **114**. The disc brake B includes a brake rotor B**1** and a caliper B**2**. The brake rotor B**1** rotates integrally with the wheel **11**. The caliper B**2** presses a friction member against the brake rotor B**1**. In the present embodiment, a case where the disc brake B is provided is illustrated. Alternatively, a drum brake may be provided. When the tire-wheel assembly is a drive wheel, the hub H to which the hub mounting portion **114** is assembled is connected to a drive shaft S as shown in FIG. **2**. The drive shaft S is accommodated inside an axle J provided so as to extend through the hub H and the brake rotor B**1**. Then, when the tire-wheel assembly is a drive wheel, the distal end of the drive shaft S is inserted in the hub hole **113**.

[0036] As shown in FIG. **1** and FIG. **2**, the wheel cover **13** that is a component of the vehicle wheel structure **10** is formed so as to cover the entire or part of the design surface that is a surface corresponding to the outer side of the wheel

11, that is, to cover the air holes **116** of the wheel **11**. The wheel cover **13** is attached to the wheel **11**. As shown in FIG. **5**, the wheel cover **13** includes the body **131** as a main element. Here, the wheel cover **13** is molded from, for example, a resin material.

[0037] The body **131** according to the present embodiment has a plurality of body forming members **132** and a coupling portion **133**. The coupling portion **133** couples the body forming members **132** in the circumferential direction of the wheel **11** at the central part **111**C of the disc **111** in a state attached to the wheel **11**. Thus, the body forming members **132** are combined by the coupling portion **133**, and the disc-shaped body **131** is attached so as to cover the entire design surface in the disc **111** of the wheel **11**.

[0038] Here, in the present embodiment, a case where the body **131** has the plurality of fan-shaped body forming members **132** is illustrated. Specifically, the body **131** has five body forming members **132** in order to respectively cover or decorate the five air holes **116** provided in the disc **111** of the wheel **11**. The number of the body forming members **132** is not limited and may be one or more. The shape of each of the body forming members **132** is not limited to a fan-shape, and various shapes may be adopted.

[0039] In the present embodiment, a case where the coupling portion **133** couples the body forming members **132** at the central part **111**C of the wheel **11**, that is, the disc **111**, in a state attached to the wheel **11** is illustrated. However, for example, the coupling portion **133** is, of course, allowed to couple the body forming members **132** at a location other than the central part **111**C of the wheel **11**, that is, the disc **111**, according to the shape of the disc **111** of the wheel **11**, more specifically, a three-dimensional shape of the spokes **115**. In this case as well, the body forming members **132** are combined by the coupling portion **133**, and the disc-shaped body **131** can be attached to the disc **111** of the wheel **11**.

[0040] The body **131**, that is, each of the body forming members **132**, has the engaging portion **134** formed so as to engage with the engaged portions **117** respectively provided at the spokes **115** of the disc **111** (wheel **11**) so as to extend. Here, in the present embodiment, a case where the engaging portion **134** is provided to engage with the engaged portions **117** respectively provided at the two spokes **115** so as to extend is illustrated.

[0041] Although not specifically described, in a case where the wheel cover **13** is attached to the wheel **11**, not only the engaging portions **134** are engaged with the engaged portions **117** but also, for example, the projection provided on the inner periphery of the hub hole **113** can be engaged with the hook member provided in the coupling portion **133** (see FIG. **2**) or a peripheral groove provided in the rim **112** can be engaged with a fixing member. Thus, the wheel cover **13** can be attached to the wheel **11**.

[0042] As shown in FIG. **6**, the engaging portion **134** has two sets of a supporting portion **134**A and an engaging hook **134**B so as to engage with the two engaged portions **117** provided at the spokes **115** so as to extend. The supporting portions **134**A are provided upright on the inner side when the body forming member **132** is fixed to the disc **111** of the wheel **11** and support the engaging hooks **134**B. The engaging hooks **134**B are respectively provided at the distal end sides of the supporting portions **134**A. The engaging hooks **134**B are provided so as to protrude toward the corresponding spokes **115** when the body forming member **132** is fixed to the disc **111** of the wheel **11** and are engaged with the engaged portions **117** provided at the spokes **115** so as to extend.

[0043] Here, in the engaging portion **134**, the engaging hooks **134**B engage with the engaged portions **117** with a predetermined engagement overlap width such that the wheel cover **13** is not detached in a state where the wheel cover **13** is attached to the wheel **11**. In other words, in the engaging portion **134**, engagement of the engaging hooks **134**B with the engaged portions **117** is maintained in a manner such that the supporting portions **134**A support the engaging hooks **134**B so as to press the engaging hooks **134**B against the spokes **115**.

[0044] Incidentally, the engaging portion **134** is also formed from a resin material as in the case of the body **131**, that is, the body forming member **132**. For this reason, once a state where the supporting portions **134**A continue to press the engaging hooks **134**B engaged with the engaged portions **117** against the spokes **115**, that is, once a state where the engaging portion **134** is engaged with the engaged portions **117** continues, a state where reaction force in the circumferential direction of the wheel **11** acts on the supporting portions **134**A and the engaging hooks **134**B from the engaged portions **117** continues. Once a state where the supporting portions **134**A and the engaging hooks **134**B resist against reaction force continues, so-called degradation, such as thermal creep and stress relaxation in terms of material characteristics, can occur in the supporting portions **134**A and the engaging hooks **134**B.

[0045] For this reason, backup clips **134**C made of a thin sheet metal are assembled to the engaging portion **134** according to the present embodiment. The backup clips **134**C serve as an urging member that urges the supporting portions **134**A and the engaging hooks **134**B toward the spokes **115** so as to resist against reaction force that acts from the engaged portions **117**. In the present embodiment, as shown in FIG. **6**, each of the backup clips **134**C is assembled to between both the supporting portion **134**A and the engaging hook **134**B and a receiving portion **134**D and held. Thus, reaction force that acts on the supporting portions **134**A and the engaging hooks **134**B from the engaged portions **117** is absorbed in a manner such that the backup clips **134**C elastically deform between both the supporting portion **134**A and the engaging hook **134**B and the receiving portion **134**D.

[0046] The wheel cover **13** according to the present embodiment has work holes **135** that allow fastening members T (hub nuts or hub bolts) for assembling the wheel **11** to the hub H to pass for fastening work. As shown in FIG. **2** and FIG. **5**, the work holes **135** are provided in the coupling portion **133** and are through-holes formed in the axial direction.

[0047] The wheel cover **13** configured in this way is attached to the design surface that is the outer surface of the wheel **11** in a manner such that each engaging portion **134** provided on the body forming member **132** (body **131**) is engaged with the engaged portions **117** provided at the spokes **115** of the disc **111** (wheel **11**) so as to extend. Specifically, as shown in FIG. **1** and FIG. **2**, in a state where the wheel cover **13** according to the present embodiment is attached to the wheel **11**, each of the body forming members **132** can cover a corresponding one of the air holes **116** and cover up to the rim **112** of the wheel **11**.

[0048] Incidentally, in a case where the vehicle drives, air having entered to below a floor of the vehicle body (not shown) partially flows from the inner side of the tire-wheel assembly toward the outer side. For this reason, external force caused by flow of air acts from the inner side toward the outer side on the wheel cover **13** attached to the wheel **11** of the vehicle driving. When the vehicle drives in a rainfall situation or in a snowfall situation, water or snow (ice) flows from the inner side of the tire-wheel assembly toward the outer side due to air flowing from the inner side of the tire-wheel assembly to the outer side. For this reason, not only external force caused by flow of air but also external force due to a collision, such as water and snow (ice), acts from the inner side toward the outer side on the wheel cover **13** attached to the wheel **11** of the vehicle driving in a rainfall situation or in a snowfall situation.

[0049] Here, as schematically shown in FIG. **7**, a situation in which external force indicated by the thick arrow from the inner side toward the outer side acts on the body forming members **132** (body **131**) indicated by the alternate long and short dashed line is assumed. In this situation, since external force acts from the inner side toward the outer side, an outward-oriented convex warp deformation (elastic deformation) temporarily occurs in the body forming member **132** (body **131**) as indicated by the continuous line. For this reason, two sets of supporting portion **134**A and engaging hook **134**B that are components of the engaging portion **134** provided upright on the inner side, that is, the back side, of the body forming member **132** (body **131**) are displaced in a direction to approach each other in the circumferential direction as indicated by circular-arc arrows in FIG. **7**.

[0050] As schematically shown in FIG. **8**, a situation in which external force indicated by the thick arrow acts from the inner side toward the outer side at the outer side in the radial direction, that is, at the rim **112** side of the wheel **11**, on the body forming members **132** (body) indicated by the alternate long and short dashed line and coupled by the coupling portion **133** at the inner sides in the radial direction is assumed. As described above, the brake rotor B**1** of the disc brake B is disposed on the inner side of the wheel **11**. The vehicle body (not shown) is located on the inner side of the wheel **11**. Thus, air, water, or the like that flows in under the floor of the vehicle body and flows from the inner side of the tire-wheel assembly toward the outer side needs to pass under the brake rotor B**1** in a vertical direction, so a majority of the air, water, or the like flows at the rim **112** side of the wheel **11**.

[0051] Therefore, in this situation, since external force acts from the inner side toward the outer side at the outer side in the radial direction of the body forming members **132** (body) of which the inner sides in the radial direction are coupled by the coupling portion **133**, that is, the inner sides in the radial direction are fixed, a so-called cantilever state is established. Therefore, an outward-oriented warp deformation (elastic deformation) temporarily occurs in the body forming members **132** (body) as indicated by the continuous line. For this reason, two sets of supporting portion **134**A and engaging hook **134**B that are components of the engaging portion **134** provided upright on the inner side, that is, the back side, of each of the body forming members **132** (body) are displaced in a direction toward the outer sides in the radial direction, that is, the moving directions Dm, as indicated by circular-arc arrow in FIG. **8**.

[0052] Furthermore, in the vehicle driving, centrifugal force directed outward in the radial direction acts on the wheel cover **13** attached to the wheel **11**, particularly, the body forming members **132**, and vibration from a road surface is also input. Both the centrifugal force and the vibration can contribute to occurrence of a temporal warp deformation (clastic deformation) of the body forming members **132** (body). As a result, a displacement of the supporting portions **134**A and the engaging hooks **134**B as shown in FIG. **8** can be facilitated.

[0053] In this way, in the engaging portion **134** provided at the body forming member **132** (body), once a temporary warp deformation (elastic deformation) occurs in the body forming member **132** (body) by the action of external force or the like, the engaging hooks **134**B are displaced together with the supporting portions **134**A. A displacement of the engaging hook **134**B is relative movement with respect to the engaged portion **117** when the engaging hook **134**B is engaged with the engaged portion **117**. A range in which the engaging hook **134**B relatively moves with respect to the engaged portion **117** is a region R.

[0054] Incidentally, as described above, the extension directions Ds of the engaged portions **117** provided at the spokes **115** so as to extend are set so as to have an angle $\theta=\Theta/2$ with respect to the radial direction Dr. In the present embodiment, two engaged portions **117** are provided at the spokes **115** so as to extend such that the extension directions Ds are parallel to each other. Thus, as shown in FIG. **9**, in the region R, even when the engaging hook **134**B relatively moves with respect to the engaged portion **117** in the moving direction Dm, the engaging hook **134**B can maintain a state engaged with the engaged portion **117**. In other words, in this case, the engaged portion **117** is present also at a position to which the engaging hook **134**B is displaced, so an engaged state can be maintained with a sufficient engagement overlap width, with the result that it is possible to suppress detachment of the wheel cover **13** from the wheel **11**.

[0055] On the other hand, if the angle θ is smaller than $\Theta 2$, the extension direction Ds gets close to the radial direction Dr indicated by the alternate long and two-short dashed line in FIG. **9**. In this case, in the engaging portion **134** before relative movement, indicated by the thin alternate long and short dashed line, the engaging hook **134**B has an engagement overlap width with the engaged portion **117**. However, when the engaging portion **134** relatively moves as indicated by the continuous line, the engaged portion **117** is not present at a destination of movement or an engagement overlap width between the engaging hook **134**B and the engaged portion **117** reduces even when the engaged portion **117** is present, with the result that engagement force reduces, and there is a high possibility that engagement is released. In other words, when the angle Θ is smaller than $\Theta/2$, there is a high possibility that the wheel cover **13** is detached from the wheel **11**.

[0056] As can be understood from the above description, the vehicle wheel structure **10** according to the embodiment includes the wheel **11** configured to support the tire **12** and be assembled to the vehicle, and the wheel cover **13** serving as a wheel attachment member attached to the wheel **11**. The wheel cover **13** includes the body **131** and the engaging portions **134** provided at the body **131**. The wheel **11** has the engaged portions **117** provided so as to extend to engage with the engaging portions **134**. In a state where each of the

engaging portions **134** and the corresponding engaged portions **117** are engaged with each other to attach the wheel cover **13** to the wheel **11**, in the region R in which each of the engaging portions **134** relatively moves with respect to the corresponding engaged portions **117**, the engaged portions **117** are provided so as to extend to relatively approach the engaging portion **134**. In this case, the wheel cover **13** is molded from a resin material.

[0057] In this case, the engaged portions **117** are provided at the spokes **115**. The spokes **115** couple the hub mounting portion **114** to the rim **112**. The hub mounting portion **114** is assembled to the hub H of the vehicle at the central part **111**C of the disc **111**, that is, the center side of the wheel **11**. The rim **112** supports the tire **12** at the outer peripheral side of the wheel **11**. The engaging portion **134** is engaged with the engaged portions **117** respectively provided at the adjacent two spokes **115** in the circumferential direction of the wheel **11**. In this case, the engaged portions **117** respectively provided at the adjacent two spokes **115** are provided at the spokes **115** so as to extend parallel to each other from the hub mounting portion **114** side toward the rim **112** side.

[0058] In these cases, each of the engaging portions **134** has the supporting portions **134**A provided upright from the body **131** and the engaging hooks **134**B supported by the supporting portions **134**A and engaged with the engaged portions **117**. In this case, each of the engaging portions **134** has the backup clips **134**C. The backup clips **134**C serve as an urging member that urges the supporting portions **134**A and the engaging hooks **134**B against reaction force that acts in the circumferential direction of the wheel **11** from the engaged portions **117** in a state where the engaging hooks **134**B are engaged with the engaged portions **117**.

[0059] In this case, the body **131** is formed so as to cover the entire surface of the wheel **11**, corresponding to the outer side of the vehicle, in a state attached to the wheel **11**. In this case, the body **131** has the body forming members **132** and the coupling portion **133** that couples the body forming members **132** in the circumferential direction of the wheel **11** in a state attached to the wheel **11**. In this case, the coupling portion **133** couples the body forming members **132** at the central part **111**C of the disc **111** of the wheel **11** in a state attached to the wheel **11**.

[0060] With the vehicle wheel structure **10**, even when the engaging portion **134** relatively moves with respect to the corresponding engaged portions **117** in the region R, the engaged portions **117** can be present at a destination of movement of the engaging portion **134**. Thus, even when external force, vibration, centrifugal force, or the like acts on the wheel cover **13** and, therefore, the engaging portion **134** relatively moves with respect to the corresponding engaged portions **117**, an engaged state of the engaging portion **134** with the engaged portions **117** can be maintained. Therefore, it is possible to suppress detachment of the wheel cover **13** from the wheel **11**.

[0061] Since the engaged state of the engaging portion **134** with the engaged portions **117** can be maintained, occurrence of a warp deformation in the body **131** (body forming member **132**) can be suppressed. Thus, with the vehicle wheel structure **10**, for example, it is also possible to suppress occurrence of abnormal noise due to contact of the body **131** (body forming members **132**) with the wheel **11**.

2. First Modification

[0062] In the above-described embodiment, a case where the extension directions Ds of the engaged portions **117** respectively provided at the two spokes **115** so as to extend are parallel to each other has been illustrated. In this case, the moving directions Dm of the engaging portion **134** is also parallel to the extension directions Ds, and, even when the engaging portion **134** relatively moves in the region R, the engaged portions **117** are present at a destination of movement.

[0063] Incidentally, to further reliably maintain the engaged state with the engaging portion **134**, engaged portions **118** respectively provided at the adjacent two spokes **115** can be provided at the spokes **115** so as to extend to approach each other in the circumferential direction of the wheel **11** from the hub mounting portion **114** side toward the rim **112** side as shown in FIG. **10** and FIG. **11**. In other words, in the first modification, the engaged portions **118** may be provided so as to extend such that the extension directions Ds intersect with each other in the moving direction Dm of the engaging portion **134**.

[0064] Specifically, in the first modification, as shown in FIG. **11**, an angle θ**1** formed between the radial direction Dr and the extension direction Ds is set so as to be larger than Θ/2 and larger than the angle Θ described in the above-described embodiment. Thus, in the case of the first modification, as schematically shown in FIG. **12**, once the engaging portion **134** relatively moves with respect to the engaged portions **118** in the moving direction Dm toward the outer side in the radial direction, an engagement overlap width with the engaging hooks **134**B increases. Therefore, according to the first modification as well, similar advantageous effects to those of the above-described embodiment are obtained.

[0065] In the case of the first modification, it is possible to sufficiently ensure an engagement overlap width between the engaging hooks **134**B of the engaging portion **134** and the engaged portions **118**. Therefore, for example, the size of the engaging hook **134**B according to the first modification can be made smaller than the size of the engaging hook **134**B described in the above-described embodiment. Even when the size of each engaging hook **134**B is reduced to reduce the whole size of the engaging portion **134**, similar advantageous effects to those of the above-described embodiment are expected.

3. Second Modification

[0066] In the above-described embodiment and first modification, the wheel cover **13** serving as a wheel attachment member in which the plurality of (for example, five) body forming members **132** that are components of the body **131** is coupled by the coupling portion **133** has been illustrated. Instead of this, as shown in FIG. **13**, accessory parts **14** similar to the body forming members **132** according to the above-described embodiment may be attached to the wheel **11** as a wheel attachment member so as to close the air holes **116** of the wheel **11**.

[0067] Each of the accessory parts **14** has a body **141** and an engaging portion **144**. Here, the body **141** and the engaging portion **144** respectively have the same configurations as the body forming member **132** and the engaging

portion **134** described in the above-described embodiment. Therefore, the description of the body **141** and the engaging portion **144** is omitted.

[0068] The accessory part **14** has a fitting portion **146** that is fitted to the spoke **115** at the hub mounting portion **114** side of the spoke **115**. Thus, the accessory part **14** is attached (fixed) to the disc **111** of the wheel **11** in a manner such that, for example, the fitting portion **146** is fitted to the spoke **115** and subsequently the engaging portion **144** is engaged with the engaged portions **117** or the engaged portions **118**.

[0069] In this way, as in the case of the above-described embodiment and first modification, external force, vibration, centrifugal force, or the like also acts on the accessory part **14** shown in FIG. **13** as the vehicle drives. Therefore, in the accessory part **14** as well, the engaging portion **144** relatively moves with respect to the engaged portions **117** or the engaged portions **118**. Different from the case of the above-described embodiment and first modification, the accessory parts **14** are not coupled to one another. Therefore, in the case of the accessory parts **14**, a warp deformation (elastic deformation) of the body **141** as described in the above-described embodiment is less likely to occur.

[0070] However, since the individual accessory parts **14** are independently attached to the disc **111** of the wheel **11**, the accessory parts **14** are more easily displaced toward the outer side in the radial direction of the wheel **11** by the action of centrifugal force. In other words, in the accessory part **14**, the engaging portion **144** is relatively displaced with respect to the engaged portions **117** or the engaged portions **118** by the action of centrifugal force.

[0071] Incidentally, the engaged portions **117** or the engaged portions **118** are also provided in the wheel **11** to which the accessory parts **14** are attached as in the case of the above-described embodiment and first modification. Therefore, even when centrifugal force acts on the accessory part **14** and the engaging portion **144** is relatively displaced with respect to the engaged portions **117** or the engaged portions **118**, the engaged portions **117** or the engaged portions **118** can be present at a destination of movement of the engaging portion **144**, so similar advantageous effects to those of the above-described embodiment and first modification are also obtained from the second modification.

4. Other Modifications

[0072] In the above-described embodiment and modifications, the engaged portions **117** or the engaged portions **118** are respectively provided at the adjacent two spokes **115**, and the engaging portion **134** has two sets of supporting portion **134**A and engaging hook **134**B so as to engage with the engaged portions **117** or the engaged portions **118**. However, in a case where the engaged portion **117** or the engaged portion **118** is provided at one of the adjacent two spokes **115** and another fitting member is provided at the other one of the spokes **115**, the rim **112**, or/and the hub mounting portion **114**, the engaging portion **134** may have only a set of supporting portion **134**A and engaging hook **134**B. In this case as well, since the engaged portion **117** or the engaged portion **118** is present at a destination of movement to which the engaging portion **134** has relatively moved, it is possible to suppress detachment of the wheel cover **13** or the accessory parts **14** together with another fitting member.

[0073] In the above-described embodiment and modifications, a case where one engaging portion **134** is provided has been illustrated. However, the number of the engaging portions **134** is not limited to one, and a plurality of the engaging portions **134** may be provided as needed. In this case as well, as in the case of the above-described embodiment and modifications, it is possible to suppress detachment of the wheel cover **13** or the accessory parts **14**.

[0074] A first aspect of the disclosure provides a vehicle wheel structure. The vehicle wheel structure includes a wheel configured to support a tire and be assembled to a vehicle, and a wheel attachment member attached to the wheel. The wheel attachment member includes a body and an engaging portion provided at the body. The wheel has an engaged portion provided so as to extend to engage with the engaging portion. In a state where the engaging portion and the engaged portion are engaged with each other to attach the wheel attachment member to the wheel, in a region in which the engaging portion relatively moves with respect to the engaged portion, the engaged portion is provided so as to extend to relatively approach the engaging portion.

[0075] A vehicle wheel structure according to a second aspect of the disclosure is configured such that, in the vehicle wheel structure according to the first aspect, the engaged portion is provided at a spoke, the spoke coupling a hub mounting portion to a rim, the hub mounting portion being assembled to a hub of the vehicle at a center side of the wheel, the rim supporting a tire at an outer peripheral side of the wheel, and the engaging portion is engaged with engaged portions respectively provided at the adjacent two spokes in a circumferential direction of the wheel.

[0076] A vehicle wheel structure according to a third aspect of the disclosure is configured such that, in the vehicle wheel structure according to the second aspect, the engaged portions respectively provided at the adjacent two spokes are respectively provided at the spokes so as to extend parallel to each other from the hub mounting portion side toward the rim side.

[0077] A vehicle wheel structure according to a fourth aspect of the disclosure is configured such that, in the vehicle wheel structure according to the second aspect, the engaged portions respectively provided at the adjacent two spokes are respectively provided at the spokes so as to extend to approach each other in a circumferential direction of the wheel from the hub mounting portion side toward the rim side.

[0078] A vehicle wheel structure according to a fifth aspect of the disclosure is configured such that, in the vehicle wheel structure according to any one of the first aspect to the fourth aspect, the engaging portion has a supporting portion provided upright from the body and an engaging hook supported by the supporting portion and engaged with the engaged portion.

[0079] A vehicle wheel structure according to a sixth aspect of the disclosure is configured such that, in the vehicle wheel structure according to the fifth aspect, the engaging portion has an urging member that urges the supporting portion and the engaging hook against reaction force acting from the engaged portion in a circumferential direction of the wheel in a state where the engaging hook is engaged with the engaged portion.

[0080] A vehicle wheel structure according to a seventh aspect of the disclosure is configured such that, in the vehicle wheel structure according to any one of the first aspect to the sixth aspect, the wheel attachment member is molded from a resin material.

[0081] A vehicle wheel structure according to an eighth aspect of the disclosure is configured such that, in the vehicle wheel structure according to any one of the first aspect to the seventh aspect, the body is formed so as to cover an entire surface of the wheel, corresponding to an outer side of the vehicle, in a state attached to the wheel.

[0082] A vehicle wheel structure according to a ninth aspect of the disclosure is configured such that, in the vehicle wheel structure according to the eighth aspect, the body has a plurality of body forming members and a coupling portion coupling the body forming members in a circumferential direction of the disc that is a component of the wheel in a state attached to the wheel.

[0083] A vehicle wheel structure according to a tenth aspect of the disclosure is configured such that, in the vehicle wheel structure according to the ninth aspect, the coupling portion couples the plurality of body forming members at a central part of the disc in a state attached to the wheel.

What is claimed is:

1. A vehicle wheel structure comprising:

a wheel configured to support a tire and be assembled to a vehicle; and

a wheel attachment member configured to be attached to the wheel, wherein:

the wheel attachment member includes

a body, and

an engaging portion provided at the body;

the wheel has an engaged portion provided so as to extend to engage with the engaging portion; and

in a state where the engaging portion and the engaged portion are engaged with each other to attach the wheel attachment member to the wheel,

in a region in which the engaging portion relatively moves with respect to the engaged portion, the engaged portion is provided so as to extend to relatively approach the engaging portion.

2. The vehicle wheel structure according to claim **1**, wherein:

the engaged portion is provided at a spoke, the spoke coupling a hub mounting portion to a rim, the hub mounting portion being assembled to a hub of the vehicle at a center side of the wheel, the rim supporting the tire at an outer peripheral side of the wheel; and

the engaging portion is engaged with the engaged portions respectively provided at the adjacent two spokes in a circumferential direction of the wheel.

3. The vehicle wheel structure according to claim **2**, wherein the engaged portions respectively provided at the adjacent two spokes are provided at the spokes so as to extend parallel to each other from the hub mounting portion side toward the rim side.

4. The vehicle wheel structure according to claim **2**, wherein the engaged portions respectively provided at the adjacent two spokes are provided at the spokes so as to extend to approach each other in the circumferential direction of the wheel from the hub mounting portion side toward the rim side.

5. The vehicle wheel structure according to claim **1**, wherein the engaging portion has a supporting portion provided upright from the body, and an engaging hook that is supported by the supporting portion and engaged with the engaged portion.

6. The vehicle wheel structure according to claim **5**, wherein the engaging portion has an urging member that urges the supporting portion and the engaging hook against reaction force acting from the engaged portion in a circumferential direction of the wheel in a state where the engaging hook is engaged with the engaged portion.

7. The vehicle wheel structure according to claim **1**, wherein the wheel attachment member is molded from a resin material.

8. The vehicle wheel structure according to claim **1**, wherein the body is formed so as to cover an entire surface of the wheel, corresponding to an outer side of the vehicle, in a state attached to the wheel.

9. The vehicle wheel structure according to claim **8**, wherein the body has a plurality of body forming members, and a coupling portion that couples the body forming members in a circumferential direction of the wheel in a state attached to the wheel.

10. The vehicle wheel structure according to claim **9**, wherein the coupling portion couples the plurality of body forming members at a central part of the wheel in a state attached to the wheel.

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