between the inner safety wheel 3 and rim flanges of the wheel 1A.

Then, in FIGS. 1 and 3, the left side of the drawing is the inside in a vehicle width direction and the right side of the drawing is also the outside in the vehicle width direction.

[0028]

In addition, in the wheel 1A, a direction perpendicular to an axle P of the axle hub 4 is referred to as a diameter direction or a radial direction, a direction revolving around the axle P is referred to as a circumferential direction, and a direction parallel to the axle P is referred to as a width direction X.

[0029]

As shown in FIGS. 1 to 3, the wheel 1A is provided with a plurality of (in FIG. 2, twenty) wheel coupling bolts 7 (first bolts) and a plurality of (in FIG. 2, ten) hub bolts 8 (second bolts) joining an out-side half wheel 20 and the axle hub 4 together. The wheel coupling bolts 7 connect an in-side half wheel 10 and the out-side half wheel 20, that are pieces of the wheel 1A divided into two in a direction of the axle P, to each other, are fixed to the axle hub 4, and join a mating surface 10a of the in-side half wheel 10 and a mating surface 20a of the out-side half wheel 20 together. The wheel coupling bolts 7 and the hub bolts 8 are screwed into nuts 9A (first nuts) and hub nuts 9B (second nuts) from the out-side half wheel 20 side respectively.

[0030]

The axle hub 4 is provided with a hub flange 41 protruding in the radial direction at a given position in an axial direction, and a plurality of (in FIG. 2, ten) hub bolt holes 42 that penetrate the hub flange 41 in a thickness direction along an outer peripheral portion of the hub flange 41 and are arranged at equal intervals in the circumferential direction.

[0031]

The in-side half wheel 10 is provided with a rim section 11 which is fitted to a bead portion on one side in the width direction of the tire 2, and a disk section 12 which is fixed to the axle hub 4 on the vehicle side, and disposed inside in the width direction of a vehicle. The rim section 11 is annularly formed at a peripheral border of the disk section 12 and is provided with a rim flange arranged at an end portion in the axial direction of the rim section 11.

The disk section 12 has a circular opening portion 12a at the center, and on the outer periphery side thereof, is provided with a plurality of (in FIG. 2, twenty) outer periphery side bolt holes 13 arranged at equal intervals in the circumferential direction for the wheel coupling bolts 7. The size of the opening portion 12a is larger than the size of the outer diameter of the hub flange 41 of the axle hub 4.

[0032]

The out-side half wheel 20 is provided with a rim section 21 which is fitted to a bead portion on ~~one~~the other side in the width direction of the tire 2, and a disk section 22 which is fixed to the axle hub 4 on the vehicle side, and disposed ~~inside~~outside in the width direction of a vehicle. The rim section 21 is annularly formed at a peripheral border of the disk section 22 and is provided with a rim flange arranged at an end portion in the axial direction of the rim section 21.

[0033]

The disk section 22 has a circular opening portion 22a at the center, and on the outer periphery side thereof, is provided with a plurality of (in FIG. 2, twenty) outer periphery side bolt holes 23 arranged at equal intervals in the circumferential direction for the wheel coupling bolts 7. A plurality of (in FIG. 2, ten) inner periphery side bolt holes 24 for the hub bolts 8 are arranged at equal intervals in the circumferential direction

out-side half wheel 20 are coupled together, an O-ring is mounted in order to prevent leakage of air in the tire 2 through the mating surfaces. In this way, the wheel 1A can also be applied to a tubeless tire.

[0036]

Next, a method of assembling and disassembling the wheel 1A is described.

First, when the wheel 1A is detached from the tire 2, as shown in FIG. 1, the plurality of hub bolts 8 are detached by loosening the ~~second nuts~~hub nuts 9B from the outside of the out-side half wheel 20 (a first step). Then, the hub flange 41 of the axle hub 4 and the out-side half wheel 20 are disengaged from each other, and thus an aggregate of the wheel ~~1~~1A and the tire 2 can be detached from the axle hub 4. Then, a worker at this time can perform work without entering the inside of the vehicle, that is, the in-side half wheel 10 side. Then, air in the tire 2 is released through the valve 5, and the inner pressure of the tire 2 is reduced (a second step).

[0037]

Next, the wheel coupling bolts 7 are detached by loosening the ~~first~~ nuts 9A from the outside of the out-side half wheel 20 (a third step). Also at this time, the worker can perform work without entering the inside of the vehicle, that is, the in-side half wheel 10 side.

Then, the in-side half wheel 10 and the out-side half wheel 20 are separated from each other at the mating surfaces 10a and 20a and detached from the tire 2 (a fourth step).

In addition, in this embodiment, since the inner safety wheel 3 is incorporated in the tire 2, after the wheel 1A is detached from the tire 2, the inner safety wheel 3 is disassembled and detached from the tire 2.

[0038]

Further, when the wheel 1A is mounted on the tire 2, the assembly is performed according to the reverse procedure of the above-described disassembly procedure. That is, the in-side half wheel 10 and the out-side half wheel 20 are brought into contact with each other at the mating surfaces 10a and 20a at a given position of the ~~axle~~axle hub 4, the wheel coupling bolts 7 are inserted into the outer periphery side bolt holes 13 and 23 of the in-side half wheel 10 and the out-side half wheel 20 from the in-side half wheel 10 side, and the nuts 9A are tightened to the wheel coupling bolts 7 from the out-side half wheel 20 side. Then, air is supplied into the tire 2 through the valve 5.

Then, when given inner pressure has been obtained, supply of air is stopped, and the outer surface 41a of the hub flange 41 and the mating surface 20a of the out-side half wheel 20 are put together and the hub bolts 8 are inserted into the hub bolt holes 42 of the hub flange 41 and the inner periphery side bolt holes 24 of the out-side half wheel 20 from the in-side half wheel 10 side. The ~~second nuts~~hub nuts 9B are tightened to the hub bolts 8 from the out-side half wheel 20 side, and thus assembly to mount the wheel 1A on the tire 2 is completed.

[0039]

Next, a function of the wheel 1A divided into two is described based on the drawings.

As shown in FIG. 1, in the wheel 1A of this embodiment, in the out-side half wheel 20, the wheel coupling bolts 7 which are mounted on the in-side half wheel 10 and the hub bolts 8 which are mounted on the hub flange 41 of the axle hub 4 are separately mounted. In this way, the assembly and disassembly of the in-side half wheel 10 and the out-side half wheel 20 and the assembly and disassembly of the out-side half wheel 20 and the axle hub 4 can be prevented from being performed at the same time.

That is, when the tire 2 is replaced, the wheel with a tire can be detached from

configuration different from that in the first embodiment is described.

[0045]

(Second Embodiment)

As shown in FIGS. 4 and 5, a wheel 1B (a vehicle wheel) according to a second embodiment is provided with a first cover body 30 that covers the ~~first~~ nuts 9A which are screwed onto the wheel coupling bolts 7, and a second cover body 31 that covers the wheel coupling bolts 7 inserted into the outer periphery side bolt holes 13 and 23 of the in-side half wheel 10 and the out-side half wheel 20 from the in-side half wheel 10 side.

[0046]

The first cover body 30 is jointed by the ~~second nuts~~hub nuts 9B which are screwed onto the hub bolts 8. That is, the first cover body 30 is provided with a locking portion 30a having bolt holes into which a leading end of the hub bolts 8 are inserted, and has the shape of a flat plate which overhangs outward from the locking portion 30a and is bent so as to cover the outer periphery side of the ~~first~~ nuts 9A.

[0047]

Then, in the in-side half wheel 10, an air hole 32 communicating with the rim outer circumferential surface thereof is mounted. A whistle mechanism section 34 which is fixed by a third nut 33 and emits a warning sound due to air flowing through the air hole 32 toward the inner circumference side from the rim outer circumference side is mounted at an end portion on the rim inner circumference side of the air hole 32.

[0048]

The whistle mechanism section 34 is more specifically described using FIG. 6. The whistle mechanism section 34 is provided with a pushing screw 34A, a whistle main body 34B mounted at a protruding end of the pushing screw 34A and communicating with a through-hole 34a, and a ball valve 34C which opens and closes an air flow path of

the air hole 32 by the screwed amount of the pushing screw 34A. The pushing screw 34A is screwed into a female screw portion formed in the end portion on the rim inner circumference side of the air hole 32 and has the through-hole 34a communicating with the air hole 32.

The third nut 33 is integrally fixed to an outer circumference of the pushing screw 34A. By tightening the third nut 33, the pushing screw 34A is tightened into the female screw portion and presses the ball valve 34C at a leading end thereof, so the air hole 32 can be closed. On the other hand, by loosening the third nut 33, the leading end of the pushing screw 34A retracts to the rim inner circumference side and the ball valve 34C is opened, and thus air in the tire 2 is released through the through-hole 34a while emitting a warning sound at the whistle main body 34B.

[0049]

The second cover body 31 is jointed by the third nut 33 of the whistle mechanism section 34, is provided with a locking portion 31a having a bolt hole into which the pushing screw 34A is inserted, and has the shape of a flat plate which is bent from the locking portion 31a so as to cover the outer periphery side of ~~the first nuts 9A~~the wheel coupling bolts 7. That is, the second cover body 31 is mounted by disposing the locking portion 31a between the third nut 33 and the rim section 11.

[0050]

According to the wheel 1B related to the second embodiment of the present invention, since the ~~first~~ nuts 9A for the wheel coupling bolts 7 joining the in-side half wheel 10 and the out-side half wheel 20 together are covered by the first cover body 30, the ~~first~~ nuts 9A are not visible from the outside. Then, since the ~~first~~ nuts 9A cannot be loosened from the outside unless the first cover body 30 is removed, it can be prevented that the in-side half wheel 10 and the out-side half wheel 20 are separated from each

other by mistakenly removing the wheel coupling bolts 7 before the out-side half wheel 20 and the axle hub 4 are detached from each other.

[0051]

Then, the first cover body 30 can be detached from the out-side half wheel 20 by loosening and removing the ~~second nuts~~hub nuts 9B for the hub bolts 8. For this reason, when the wheel 1B is disassembled, a disassembly procedure to first detach the out-side half wheel 20 and the axle hub 4 from each other, then loosen the ~~first~~ nuts 9A, and separate the in-side half wheel 10 and the out-side half wheel 20, can be carried out.

[0052]

Since the wheel coupling bolts 7 joining the in-side half wheel 10 and the out-side half wheel 20 together are covered by the second cover body 31, the wheel coupling bolts 7 are not visible from the outside. Since the wheel coupling bolts 7 cannot be removed unless the second cover body 31 is removed, it can be prevented that the in-side half wheel 10 and the out-side half wheel 20 are separated from each other by mistakenly removing the wheel coupling bolts 7 before the out-side half wheel 20 and the axle hub 4 are detached from each other.

[0053]

Then, after the wheel is detached from the axle hub 4, the second cover body 31 can be detached from the in-side half wheel 10 by loosening and removing the third nut 33 of the whistle mechanism section 34. That is, when the in-side half wheel 10 and the out-side half wheel 20 are disassembled, an attempt to detach the second cover body without releasing air in the tire 2 through the air valve 5 is made. In this case, when the third nut 33 of the whistle mechanism section 34 is loosened, air in the tire 2 flows to the rim outer circumference side through the air hole 32, and therefore the whistle mechanism section 34 emits a warning sound. For this reason, after the inner pressure

in the inside of the tire 2 is reduced until the warning sound disappears, the second cover body 31 can be detached. Then, a disassembly procedure to loosen the ~~first~~ nuts 9A and separate the in-side half wheel 10 and the out-side half wheel 20 from each other can be carried out.

[0054]

(Third Embodiment)

Next, in a wheel 1C (a vehicle wheel) according to a third embodiment shown in FIG. 7, in place of the first cover body 30 (refer to FIG. 4) according to the second embodiment described above, a third cover body 35 that covers the ~~first~~ nuts 9A which are screwed onto the wheel coupling bolts 7 is mounted in a state of being jointed to an opening portion of the valve 5 mounted at the out-side half wheel 20 and communicating with the inside of the tire, by a fourth nut 36.

The third cover body 35 is provided with a locking portion 35a having a bolt hole into which the valve 5 is inserted, and has the shape of a flat plate in which is bent from the locking portion 35a so as to cover the outer circumference side of the ~~first~~ nuts 9A.

[0055]

In this case, since the ~~first~~ nuts 9A for the wheel coupling bolts 7 joining the in-side half wheel 10 and the out-side half wheel 20 together are covered by the third cover body 35, the ~~first~~ nuts 9A are not visible from the outside. Then, since the ~~first~~ nuts 9A cannot be loosened from the outside unless the third cover body 35 is removed, it can be prevented that the in-side half wheel 10 and the out-side half wheel 20 are separated from each other by mistakenly removing the wheel coupling bolts 7 before the out-side half wheel 20 and the axle hub 4 are detached from each other.

[0056]

Then, after the wheel 1C is detached from the axle hub 4, the third cover body 35 can be detached from the out-side half wheel 20 by loosening and removing the fourth nut 36 from the third cover body 35. That is, when the in-side half wheel 10 and the out-side half wheel 20 are disassembled, in a case where an attempt to detach the third cover body 35 without releasing air in the tire 2 is made, when the fourth nut 36 is loosened, air in the tire 2 flows to the outside of the out-side half wheel 20 through the valve 5, and after the inner pressure in the inside of the tire 2 is reduced, the third cover body 35 can be detached. Then, a disassembly procedure to loosen and remove the ~~first~~ nut 9A and separate the in-side half wheel 10 and the out-side half wheel 20 from each other can be carried out.

[0057]

While the embodiments of the vehicle wheel, the running wheel, the vehicle, and the method of assembling and disassembling the vehicle wheel according to the present invention have been described above, the present invention is not limited to the above-described embodiments and a change can be appropriately made without departing from the scope of the present invention.

For example, in the embodiments, an inner safety wheel is incorporated in the tire 2. However, it is also possible to apply the present invention to a tire in which an inner safety wheel is not mounted.

[0058]

Further, the number of wheel coupling bolts 7 and the number of hub bolts 8 can be changed appropriately depending on the conditions such as the size of the diameter of the wheel.

In addition, the shapes, the mounting positions, the mounting structures, or the like of the first cover body 30, the second cover body 31, and the third cover body 35 are

not limited to the above-described embodiments and can be changed.

In addition, it is possible to appropriately substitute the constituent elements in the above-described embodiments for well-known constituent elements without departing from the scope of the present invention, and the embodiments described above may also be combined appropriately.

Industrial Applicability

[0059]

According to the vehicle wheel, the running wheel, the vehicle, and the method of assembling and disassembling the vehicle wheel related to the present invention, there is no chance of the wheel flying toward the outer worker side, and improvements in work efficiency and workability and safety pertaining to assembly and disassembly can be attained.

Reference Signs List

[0060]

1A, 1B, 1C: wheel (vehicle wheel)

2: tire

3: inner safety wheel

4: axle hub

7: wheel coupling bolt (first bolt)

8: hub bolt (second bolt)

9A~~, 9B~~: nut (first nut)

9B: hub nut (second nut)

10: in-side half wheel

10a: mating surface

CLAIMS

1. A vehicle wheel divided in an axial direction of a tire into two pieces which are an in-side half wheel and an out-side half wheel that are connected to each other and fixed to an axle hub, the vehicle wheel comprising:

first bolts joining a mating surface of the in-side half wheel and a mating surface of the out-side half wheel together; and

second bolts joining the out-side half wheel and the axle hub together,

wherein the first bolts and the second bolts are respectively screwed into nuts from an out-side half wheel side.

2. The vehicle wheel according to claim 1, further comprising a first cover body covering first nuts that are screwed onto the first bolts.

3. The vehicle wheel according to claim 2, wherein the first cover body is jointed by second nuts that are screwed onto the second bolts.

4. The vehicle wheel according to any one of claims 1 to 3, further comprising

a fit joint type mating portion protruding from one of the mating surfaces of the in-side half wheel and the out-side half wheel toward the other of the mating surfaces of the in-side half wheel and the out-side half wheel, wherein the fit joint type mating portion extends over an entire circumference of the vehicle wheel.

5. The vehicle wheel according to any one of claims 1 to 4, further comprising

a second cover body covering the first bolts that are arranged at the in-side half

wheel side.

6. The vehicle wheel according to claim 5, wherein

the in-side half wheel is provided with an insertion hole communicating with a rim outer circumferential surface of the in-side half wheel,

a whistle mechanism section that is fixed by a third nut and emits a warning sound due to air flowing through the insertion hole toward an inner circumference side from a rim outer circumference side is mounted at an end portion on the rim inner circumference side of the insertion hole, and

the second cover body is jointed by the third nut of the whistle mechanism section.

7. The vehicle wheel according to any one of claims 1 to 6, further comprising

a third cover body covering first nuts that are screwed onto the first bolts, wherein

the out-side half wheel is provided with a valve communicating with the inside of the tire,

a fourth nut is fixed to an opening portion of the valve, and

the third cover body is jointed by the fourth nut.

8. A running wheel comprising a wheel in which a tire is mounted on the vehicle wheel according to any one of claims 1 to 7.

9. A vehicle comprising the running wheel according to claim 8.

10. A method of assembling and disassembling the vehicle wheel according to any one of claims 1 to 7 which is provided with a pneumatic tire, the method comprising:

a first step of detaching the second bolts by loosening nuts from an outside of the out-side half wheel;

a second step of reducing inner pressure by releasing air in the tire;

a third step of detaching the first bolts by loosening nuts from the outside of the out-side half wheel; and

a fourth step of separating the in-side half wheel and the out-side half wheel and detaching the in-side half wheel and the out-side half wheel from the tire,

wherein the disassembling the vehicle wheel is performed in order from the first step to the fourth step when the vehicle wheel is detached from the tire, and

the assembling the vehicle wheel is performed in reverse order of the disassembling when the vehicle wheel is mounted on the tire.

CLAIMS

1. A vehicle wheel divided in an axial direction of a tire into two pieces which are an in-side half wheel and an out-side half wheel that are connected to each other and fixed to an axle hub, the vehicle wheel comprising:

first bolts joining one mating surface of the in-side half wheel and the other mating surface of the out-side half wheel together; and

second bolts joining the out-side half wheel and the axle hub together,

wherein the first bolts and the second bolts are respectively screwed into nuts from an out-side half wheel side,

in the one mating surface, a convex portion is provided protruding from the one mating surface at the outer periphery side of the in-side half wheel in the radial direction extends over the entire circumference in the circumferential direction,

in the other mating surface, a concave portion is provided capable of engaging with the one mating surface at the outer periphery side of the in-side half wheel in the radial direction extends over the entire circumference in the circumferential direction,

a first cover body is provided that covers first nuts that are screwed onto the first bolts, and

the first cover body is joined by second nuts that are screwed onto the second bolts.

2. The vehicle wheel according to claim 1, further comprising

a second cover body covering the first bolts that are arranged at the in-side half wheel side.

3. The vehicle wheel according to claim 2, wherein

the in-side half wheel is provided with an air hole communicating with a rim outer circumferential surface of the in-side half wheel,

a whistle mechanism section that is fixed by a third nut and emits a warning sound due to air flowing through the air hole toward an inner circumference side from a rim outer circumference side is mounted at an end portion on the rim inner circumference side of the air hole, and

the second cover body is jointed by the third nut of the whistle mechanism section.

4. A vehicle wheel divided in an axial direction of a tire into two pieces which are an in-side half wheel and an out-side half wheel that are connected to each other and fixed to an axle hub, the vehicle wheel comprising:

first bolts joining one mating surface of the in-side half wheel and the other mating surface of the out-side half wheel together; and

second bolts joining the out-side half wheel and the axle hub together,

wherein the first bolts and the second bolts are respectively screwed into nuts from an out-side half wheel side,

in the one mating surface, a convex portion is provided protruding from the one mating surface at the outer periphery side of the in-side half wheel in the radial direction extends over the entire circumference in the circumferential direction,

in the other mating surface, a concave portion is provided capable of engaging with the one mating surface at the outer periphery side of the in-side half wheel in the radial direction extends over the entire circumference in the circumferential direction,

a third cover body is provided that covers first nuts that are screwed onto the first bolts,

the out-side half wheel is provided with a valve communicating with the inside of the tire,

a fourth nut is fixed to an opening portion of the valve, and

the third cover body is jointed by the fourth nut.

5. A running wheel comprising a wheel in which a tire is mounted on the vehicle wheel according to any one of claims 1 to 4.

6. A vehicle comprising the running wheel according to claim 5.

7. A method of assembling and disassembling the vehicle wheel according to any one of claims 1 to 4 which is provided with a pneumatic tire, the method comprising:

a first step of detaching the second bolts by loosening nuts from an outside of the out-side half wheel;

a second step of reducing inner pressure by releasing air in the tire;

a third step of detaching the first bolts by loosening nuts from the outside of the out-side half wheel; and

a fourth step of separating the in-side half wheel and the out-side half wheel and detaching the in-side half wheel and the out-side half wheel from the tire,

wherein the disassembling the vehicle wheel is performed in order from the first step to the fourth step when the vehicle wheel is detached from the tire, and

the assembling the vehicle wheel is performed in reverse order of the disassembling when the vehicle wheel is mounted on the tire.