



(51) International Patent Classification:

B60B 11/06 (2006.01) B60B 11/02 (2006.01)

(21) International Application Number:

PCT/GB2019/051834

(22) International Filing Date:

28 June 2019 (28.06.2019)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1810725.0 29 June 2018 (29.06.2018) GB

(71) Applicant: **GKN WHEELS LIMITED** [GB/GB]; Ipsley House, Ipsley Church Lane, Redditch Worcestershire B98 0TL (GB).

(72) Inventors: **DALL, Ole**; GKN Wheels Nagbøl A/S, Nagbølvej 31, DK-6640 Lunderskov (DK). **WEISSBACH, Michael**; GKN Wheels Nagbøl A/S, Nagbølvej 31, DK-6640 Lunderskov (DK). **STOKER, Robert**; GKN

Wheels Limited, Ipsley House, Ipsley Church Lane, Redditch Worcestershire B98 0TL (GB).

(74) Agent: **FORRESTERS IP LLP**; Rutland House, 148 Edmund Street, Birmingham West Midlands B3 2JA (GB).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,

(54) Title: WHEEL APPARATUS

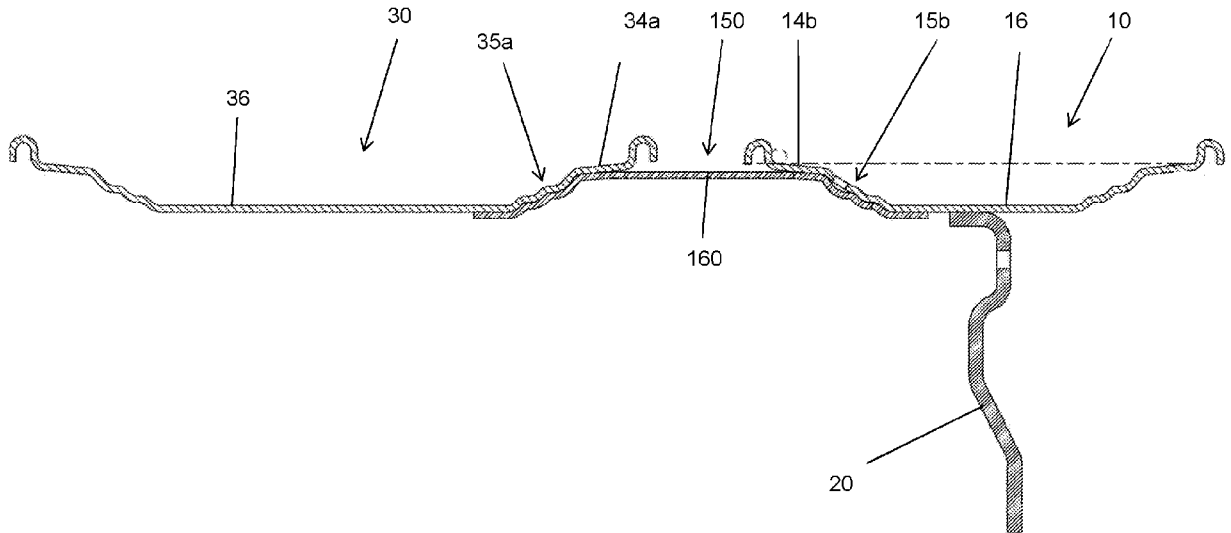


Figure 4

(57) Abstract: An attachment member (150) for attaching a pair of wheels together, the attachment member including a central portion (152), a first attachment portion (180) which includes at least one portion (130, 189) which is engageable with at least one of a side part (15) of a first wheel rim (10) and a central well (16) of the first wheel rim (10), and a second attachment portion (190) which includes at least one portion (140, 199) which is engageable with at least one of a side part (35) of a second wheel rim (30) and a central well (36) of the second wheel rim (30); and a dual wheel arrangement including such an attachment member (150), a first wheel rim (10) and a second wheel rim (30).



TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

Title: Wheel apparatus

5 Description of Invention

This invention relates to a wheel apparatus, in particular but not exclusively to an attachment member for attaching a pair of vehicle wheels.

10 Wheel constructions for vehicles, in particular agricultural vehicles and other off-road vehicles, typically include a substantially circular rim (an example of which is shown at 10 in in Figure 1). A typical rim 10 has a first axis A. A typical rim 10 also has axially inner and outer flanges 12a, 12b, each of which is positioned adjacent a respective bead seat 14a, 14b, which provides a seat
15 for a tyre bead of a tyre (not shown), which is fitted to a radially outer or “tyre side” 10a of the rim 10. Such wheel constructions typically also include a disc 20 which is connected to a radially inner side or “weather side” 10b of the rim 10. The disc 20 enables the wheel construction to be securable to a hub of a vehicle, for example by the use of bolts or other fixings. The rim 10 and the
20 disc 20 may be separable from one another, or may be permanently joined to one another, for example by welding.

The disc 20 is connected to the rim 10 in a central portion or “well” 16 of the rim 10. The well 16 is positioned between the inner and outer flanges 12a,
25 12b, and may be positioned substantially centrally between the inner and outer flanges 12a, 12b. This well 16 will hereinafter be referred to as the central well 16, despite the fact that the well 16 need not, in fact, be positioned exactly centrally between the inner and outer flanges 12a, 12b. The central well 16 has a reduced diameter compared with other parts of the rim 10, to enable a
30 tyre to be fitted on to the rim 10. Each bead seat 14a, 14b is positioned axially inwardly of the respective flange 12a, 12b. Each bead seat 14a, 14b typically includes a substantially straight surface against which a tyre bead may be

located. Upon inflation of a tyre to its in use pressure, a force is applied to each bead seat 14a, 14b and to each flange 12a, 12b. Each bead seat 14a, 14b has an axially outer end which is attached to the respective flange 12a, 12b by a flange connecting part 13a, 13b. Each flange connecting part 13a, 13b is a concave portion, and is known in the art as a bead seat radius.

Between each bead seat 14a, 14b and the central well 16 is positioned a side part 15a, 15b, which has a particular 'profile'. It is known for the profile of each side part 15a, 15b to include concave and convex portions which create 'sub-wells'. The profile of each side part 15a, 15b may include a straight portion in combination with the convex and concave portions.

It is desirable to provide additional wheels, particularly to off-road vehicles, and more particularly to agricultural vehicles, to provide additional traction and to spread the load of the vehicle across a larger footprint area, for example to reduce soil compaction in the case of agricultural vehicles.

A rim of each additional wheel is attached to the rim of a respective driven wheel (referred to herein as a first wheel or vehicle wheel), which is carried by an axle of the vehicle. The additional wheel rim has equivalent parts to the vehicle wheel rim 10.

It is known to provide an attachment arrangement including a spacer band which is fixed to both the first wheel and the corresponding additional wheel on the weather-side of the bead seat of each rim. The spacer band is attached to each of the rims using standard fixings, for example bolts. The attachment arrangement transmits torque from the corresponding axle to the additional wheel via the respective vehicle wheel, and tie rods which extend between the two wheel rims. The spacer band may also be used to centralise the pair of wheels to which it is attached. An exemplary spacer band 50 is shown in Figures 2 and 3. The spacer band 50 has a central portion 52, a first

attachment portion 60 and a second attachment portion 70. The first attachment portion 60 includes a bead seat engagement portion 62 which is attached to the weather side of the bead seat 14a of the vehicle wheel. The bead seat engagement portion 62 is substantially flat. As can be seen from
5 Figure 2B, when the spacer band 50 is attached to the wheel rim 10, there is only a small area of contact between the spacer band 50 and the bead seat 14a. The spacer band 50 also includes a flange tracking portion 64, which lies near to but is not in direct contact with the flange 12a of the rim 10. The second attachment portion 70 includes a first well 72 formed in the spacer
10 band 50, and a lip 74, which is attached to an underside of the first well 72, such that the first well 72 and the lip 74 define a receiving portion for receiving an adapter ring which may be attached to the rim of the additional wheel, for example to the flange and/or to the bead seat.

15 Methods of attachment of an additional wheel are disclosed, for example, in European patent application EP3162590 and European patent EP1529656.

Tyre slip (where the tyre slips relative to the bead seat of the wheel rim) in high traction situations can cause damage to the tyre. Friction between the tyre
20 and the rim may then be reduced, causing the tyre to slip further, which may result in the tyre deflating and/or further damage to the tyres. The applicant has developed a wheel rim which is particularly well suited to high traction situations, which aims to reduce tyre slip by increasing the stiffness of the bead seat by increasing the length of the flanges. An example of an improved
25 wheel rim is described in UK patent publication number GB2539032.

Existing spacer bands are unsuitable for use with such rims, for example because known spacer bands are difficult to locate on such rims, and therefore it may be difficult or impossible to attach additional wheels to vehicles with
30 such rims.

In accordance with embodiments of the invention, there is provided an attachment member for attaching a pair of wheels together, the attachment member including a central portion, a first attachment portion which includes at least one portion which is engageable with at least one of a side part of a first wheel rim and a central well of the first wheel rim, and a second attachment portion which includes at least one portion which is engageable with at least one of a side part of a second wheel rim and a central well of the second wheel rim.

At least one of the first attachment portion and the second attachment portion may include a profiled portion which is shaped to correspond with a profile of a side part of a corresponding one of the first wheel rim and the second wheel rim.

The first attachment portion may include a profiled portion which is shaped to correspond with a profile of a side part of the first wheel rim and the second attachment portion may include a profiled portion which is shaped to correspond with a profile of a side part of the second wheel rim.

One of the first attachment portion and the second attachment portion may include a profiled portion and the other of the first and the second attachment portion may include a substantially straight part.

One of the first and the second attachment portion includes a profiled portion and the other of the first and the second attachment portion may include a substantially curved part.

One of the first attachment portion and the second attachment portion may include a first straight part and a second straight part, and the other of the first attachment part and the second attachment part may include a curved part.

Both the first attachment portion and the second attachment portion may include a straight part.

Both the first attachment portion and the second attachment portion may include a curved portion.

The first attachment portion may include a substantially straight part which is engageable with the central well of the first wheel rim and the second
5 attachment portion may include a substantially straight part which is engageable with the central well of the second wheel rim.

The or each profiled portion may include at least one concave portion.

The or each profiled portion may include a plurality of concave portions.

The attachment member may include at least one inclined portion, the or each
10 inclined portion being adjacent and connected to the central portion.

According to embodiments of the invention, there is also provided a dual wheel arrangement including an attachment part according to an embodiment of the first aspect of the invention, a first wheel rim and a second wheel rim.

At least one of the first and the second wheel rim may include an extended
15 flange.

At least one of the first and second wheel rim includes a side part having a profile with a plurality of sub-wells.

The invention will now be described, by way of example only, with reference to
20 the accompanying drawings, of which:

FIGURE 1 is an illustrative perspective view of a prior art wheel rim;

FIGURE 2A is a cross-sectional view of a prior art spacer band;

FIGURE 2B is a cross-sectional view of a part of the prior spacer band of

25 Figure 2A, shown in engagement with a part of a wheel rim;

FIGURE 3 is an illustrative, cut away view of a pair of wheel rims attached to one another with an attachment member in accordance with the invention;

FIGURE 4 is a cross sectional view of a pair of wheel rims attached to one another with an attachment member in accordance with the invention;

FIGURE 5A is a cross-sectional view of an attachment member in accordance with the invention;

5 FIGURES 5B and 5C are cross-sectional views of another embodiment of an attachment member in accordance with the invention;

FIGURE 6 is a cross-sectional view of another embodiment of an attachment member in accordance with the invention;

10 FIGURE 7 is a cross-sectional view of another embodiment of an attachment member in accordance with the invention; and

FIGURE 8 is a cross-sectional view of another embodiment of an attachment member in accordance with the invention.

Referring to Figures 3 and 4, there is shown a first wheel rim 10, which bears
15 the same general features of the rim 10 described above. The rim 10 is the rim of a first wheel or vehicle wheel (i.e. a wheel carried by an axle of the vehicle and attached to a hub of the vehicle). A rim 30 of an additional wheel is attached to the rim 10. The additional wheel rim 30 has equivalent parts to the vehicle wheel 1: a rim 30, having a tyre side 30a and a weather side 30b;
20 flanges 32a, 32b; connecting parts 33a, 33b; bead seats 34a, 34b; side parts 35a, 35b; a central well 36.

The rims 10, 30 are attached to one another by an attachment arrangement which includes an attachment member 150. The attachment member 150 may
25 be a continuous, substantially circular band, and may be manufactured from steel, for example. The attachment member may be between approximately 4.5mm and approximately 10mm thick. The attachment member 150 may be a spacer band which holds the rims 10, 30 a predetermined distance apart. The attachment member may also enable the centralisation, in other words
30 alignment, of the rims 10, 30, such that they are substantially co-axial with one another.

The attachment member 150 includes a central portion 152. The central portion 152 is substantially flat. The width X of the central portion 160 may be dependent upon the type of the vehicle wheel rims 10, 30 to which the attachment member 150 is intended to be attached, and/or the type of tyre to be used. For example the width X may depend upon the profile of the tyre. At each end of the central portion 152, there may be an inclined portion 160, 170, each of which has a first end 161, 171 which is connected to the central portion 152, and a second end 162, 172 which is distal from the central portion 152. A band radius of each inclined portion 160, 170 is smaller at the respective second end 162, 172 than at the respective first end 161, 171 of each inclined portion. The width Y of each inclined portion 160, 170 may be dependent upon the type of the vehicle wheel rims 10, 30 to which the attachment member 150 is intended to be attached, and/or the type of tyres to be used, for example the width Y may depend upon the profile of the tyre.

The width X and/or the width Y may vary with the profile height of the tyre to be used. For example, a higher profile tyre may require an attachment member having a greater width X and or a greater width Y since part the tyre may extend outwardly beyond the edge of the rim 10, 30 when the tyre is in place.

Band diameters Z, Z' (as indicated on Figure 5A) are dependent upon the diameter of the wheel rims 10, 30 to which the attachment member 150 is intended to be attached.

An angle of inclination θ subtended between each inclined portion 160, 170 and the central portion 152 may be approximately 5° . The angle of inclination θ may match the inclination of a part of the bead seat 14, 34 of the rim 10, 30 to which the attachment member 150 is intended to be attached, in use.

The attachment member 150 also includes a first attachment portion 180 and a second attachment portion 190. The first attachment portion 180 and the second attachment portion 190 are intended to be attached to a part of the first rim 10, and the second rim 30, respectively. The first attachment portion 180
5 may be attachable to one of the side parts 15a, 15b of the first rim 10 and the second attachment portion 190 may be attachable to one of the side parts 35a, 35b of the second rim 30.

Each attachment portion 180, 190 has a first end 181, 191 and a second end
10 182, 192. The first end 181, 191 of each attachment portion 180, 190 is connected to the second end 162, 172 of a respective one of the first and second inclined portions 160, 170. Each attachment portion 180, 190 is connected to the respective inclined portion 160, 170 by a respective radiused portion 183, 193. In embodiments, the radiused portions 183, 193 are convex.
15 In embodiments the radius of curvature of each of the radiused portions 183, 193 may be 9mm. It will be appreciated that if no inclined portion or portions, 160, 170 are provided, then one or both of the attachment portions 180, 190 would be connected to the central portion 152 of the attachment member 150.

20 In embodiments, the attachment portions 180, 190 may be identical (i.e. they may mirror one another such that the attachment member 150 is symmetrical) or may be different from one another. In the example shown in Figures 5A-C, the attachment member 150 is symmetrical.

25 In embodiments, each attachment portion 180, 190 may include one or more profiled portions 130, 140. In embodiments, the or each profiled portion 130, 140 may include a first concave portion 184, 194 and a second concave portion 186, 196. In embodiments, the radius of curvature of each of the first and second concave portions 184, 194, 186, 196 may be the same. The
30 radius of curvature of each of the first and second concave portions 184, 186, 194, 196 may be 22mm. In embodiments, an angle Φ subtended between the

central portion 152 and a line struck between the first end 181, 191 of the respective attachment part and the midpoint of the first concave portion may be dependent upon the profile of the or each rim 10, 30. The angle Φ may be 53.6°.

5

A portion of the or each profiled portion 130, 140 may match a portion of the profile (i.e. the side part 15, 35) of the wheel rim 10, 30 to which the attachment member 150 is attached or is intended to be attached. It will be appreciated that one or both of the attachment portions 180, 190 may include a profiled portion 130, 140.

10

In embodiments, each of the first concave portions 184, 194 may have the same radius of curvature as one another, and each of the second concave portions 186, 196 may have the same radius of curvature, but the radius of curvature of the first concave portions 184, 194 may be different from the radius of curvature of the second concave portions 186, 196. In embodiments the radius of curvature of each of the first and second concave portions 184, 186, 194, 196 may differ from one another.

15

The first concave portion 184, 194 of each attachment part 180, 190 may be connected to the respective second concave portion 186, 196 by a second radiused portion 185, 195. In embodiments, each of the second radiused portions 185, 195 is convex. In embodiments, each of the second radiused portions 185, 195 may have a radius of curvature of between approximately 4mm and approximately 10mm, and the radius of curvature may be approximately 9mm. The radius of curvature may depend upon the ultimate thickness of the material from which the band is manufactured (rolled).

20

25

In embodiments (for example as shown in Figure 5B and 5C), one or both of the attachment parts 180, 190 may include a third concave portion 188, 198 which is connected to the respective second concave portion 186, 196 by a

30

respective third radiused portion 187, 197. One or both of the attachment parts 180, 190, may also include a straight portion 189, 199, which extends towards the second end 182, 192 of the respective attachment part 180, 190. The straight portion 189, 199 may be between approximately 20mm and
5 approximately 70mm, and is arranged to contact a part of the central well of a rim, when in use.

The example of the attachment member 150 shown in Figures 5A-C is intended for use with a pair of rims 10, 30, having the same profile as one another, i.e. having the same shape of the side parts 15a, 15b, 35a, 35b which
10 are to be connected together. The example shown in Figures 5A-C is suitable for connecting a pair of the applicant's wheel rims having a multiple sub-wells in their side parts 15a, 15b, 35a, 35b. Suitable rim profiles are described in detail in European patent publication numbers EP2193931 and EP3303002.

15

It will be understood that the configuration of the or each profiled portion 130, 140 of the attachment member 150 may include more or fewer concave portions and/or radiused portions, so as to produce a profiled portion or profiled portions which match the wheel rims which may be used with the
20 attachment member 150. All references to 'concave' and 'convex' in relation to an attachment member are with respect to an upper side of the attachment member, i.e. the side of the attachment member which, in use, contacts the weather side of the wheel rims 10, 30.

25 Referring to Figure 6, there is shown an embodiment of an attachment member 250. The attachment member 250 has a central portion 252. The central portion 252 may be substantially flat. At each end of the central portion 252 there may be an inclined portion 260, 270, each of which has a first end 261, 271 and a second end 262, 272. An angle of inclination θ' may be
30 subtended between the central portion 252 and each of the inclined portions 260, 270 may be approximately 5° . The angle of inclination θ' may be

dependent upon the inclination of a part of the bead set of the rims to which the attachment member 250 is intended to be fitted. The attachment member 250 may include a pair of attachment portions 280, 290, each having a first end 281, 291 and a second end 282, 292. Each attachment portion 280, 290
5 may include a profiled portion 230, 240. The or each profiled portion 230, 240 may include a first straight part 284, 294. One or both of the attachment portions 280, 290 may include a second straight part 286, 296. The or each second straight part may be between approximately 20mm and approximately 70mm, for example. The or each first straight part 284, 294 may be connected
10 to the respective inclined portion 260, 270 by a radiused portion 283, 293. In embodiments, the radiused portions 283, 293 are convex. The or each second straight part 286, 296 extends towards the respective second end 282, 292 of the respective attachment part 280, 290. The or each second straight part 286, 296 may be connected to the respective first straight part 284, 294
15 by a second radiused portion 285, 295. The or each of the second radiused portions 285, 295 may be concave. The or each second straight part 286, 296 may be between approximately 20mm and approximately 70mm, for example. The or each second straight part 286, 296 may be arranged to contact a part of the central well of a wheel rim, when in use.

20

The radiused portions, concave portions and convex portions of the attachment member 250 may have similar or identical radii of curvature to similar or corresponding features of the attachment member 150.

25 The attachment member 260 may be considered as a 'universal' attachment member which is compatible with rims having any profile. The second straight part 286, 296 is intended to contact and be attached to a part of the central well of the corresponding wheel rim 10, 30 to which the attachment member is intended to be attached, and the first straight part 284, 286 effectively
30 bypasses the side part (i.e. profiled part) of the rim 10, 30, such that the

attachment member 260 may be compatible with rims 10, 30 having any side part profile.

An embodiment of an attachment member 350 is shown in Figure 7.

5 Embodiments of the attachment member 350 may be very similar to the attachment member 250, in that the attachment member 350 may include a central portion 352, and first and second attachment parts 180, 190. Each of the first and second attachment parts 180, 190 may include a profiled portion 130, 140, including first straight parts 384, 394 and second straight parts 386, 10 396 for engagement with and/or attachment to a part of a central well of a rim. The attachment member 350 does not include angled portions between the central portion 352 and the attachment portions 370, 380.

An embodiment of an attachment member 450, is shown in Figure 8. The 15 attachment member 450 has a central portion 452. The central portion 452 may be substantially flat. At each end of the central portion 452 there may be an inclined portion 460, 470, each of which has a first end 461, 471 and a second end 462, 472. An angle of inclination θ'' which may be subtended between the central portion 452 and each of the inclined portions 460, 470 20 may be approximately 5° . The angle of inclination θ'' may be dependent upon the inclination of a part of the bead set of the rims to which the attachment member 450 is intended to be fitted. The attachment member 450 may include a pair of attachment portions 480, 490, each having a first end 481, 491 and a second end 482, 492. Each attachment portion 480, 490 may 25 include a profiled portion 430, 440. The or each profiled portion 430, 440 may include a curved part 484, 494. One or both of the attachment portions 480, 490 may include a straight part 486, 496. The or each straight part 486, 496 may be between approximately 20mm and approximately 70mm, for example. The or each curved part 484, 494 may be connected to the respective inclined 30 portion 460, 470 by a radiused portion 483, 493. In embodiments, the radiused portions 483, 493 are convex. The or each straight part 486, 496

extends towards the respective second end 482, 492 of the respective attachment part 480, 490. The or each straight part 486, 496 may meld with the curved part 484, 494, or may include a second radiused portion. The curved part 484, 494 effectively bypasses the side part (i.e. the profiled part) of the rim to which the attachment member 450 is intended to be attached, such that the attachment part 450 is compatible with a rim or rims having side parts with any profile. Embodiments of the attachment member 450 may be considered to be a 'universal' attachment member.

It will be understood that a hybrid attachment member may be provided, including a profiled portions having different configurations on each side, such that the attachment member is not symmetrical. It is possible to 'mix and match' profiled portions to suit different wheel and tyre types for different applications. For example a vehicle may have a certain type of wheel rims attached to the vehicle, but the wheels to be used as the additional wheels may have a different rim profile. Therefore, it may be beneficial to provide an attachment member having different profiled portions on each side, and/or to provide an attachment part having at least one side with a 'universal' profiled portion which is compatible with any rim which is suitable for the application.

20

In use, an attachment member 150, 250, 350, 450, or a hybrid attachment member is attached to the weather side of a vehicle wheel rim 10 and an additional wheel rim 30 to create a dual wheel arrangement. The attachment member 150, 250, 350, 450, or a hybrid attachment member may be used to centralise the wheel rims 10, 30 and also to enable torque to be transmitted from the first rim 10 to the additional rim 30. The attachment member 150, 250, 350, 450, or hybrid may be part of an attachment arrangement.

Known attachment members (spacer bands) contact the bead seat and/or the flange of each wheel rim of a dual wheel arrangement. Embodiments of the

invention enable the attachment member to contact the side part (i.e. the profiled part) of one or both rims and/or the central well of one or both wheels.

5 An advantage of the present invention is that the attachment member may be used in combination with high traction rims having an extended flange. Furthermore, efficacy of the attachment member to transmit torque from the vehicle wheel to the additional wheel is improved compared with known arrangements, since the contact surface area between the attachment member and the rim is increased. Twisting or torsion of the attachment
10 member in high-traction situations is lessened, improving the integrity and reliability of the attachment member. In addition, centralising the pair of wheels is facilitated, reducing the risk of damage to wheels and tyres, thus improving performance.

15 When used in this specification and claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or components.

20 The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse
25 forms thereof.

CLAIMS

1. An attachment member for attaching a pair of wheels together, the attachment member including a central portion, a first attachment
5 portion which includes at least one portion which is engageable with at least one of a side part of a first wheel rim and a central well of the first wheel rim, and a second attachment portion which includes at least one portion which is engageable with at least one of a side part of a second wheel rim and a central well of the second wheel rim.
- 10 2. An attachment member according to claim 1, wherein at least one of the first attachment portion and the second attachment portion includes a profiled portion which is shaped to correspond with a profile of a side part of a corresponding one of the first wheel rim and the second wheel rim.
- 15 3. An attachment member according to claim 1 wherein the first attachment portion includes a profiled portion which is shaped to correspond with a profile of a side part of the first wheel rim and the second attachment portion includes a profiled portion which is shaped to correspond with a profile of a side part of the second wheel rim.
- 20 4. An attachment member according to claim 2 wherein one of the first attachment portion and the second attachment portion includes a profiled portion and the other of the first and the second attachment portion includes a substantially straight part.
- 25 5. An attachment member according to claim 2 wherein one of the first and the second attachment portion includes a profiled portion and the other of the first and the second attachment portion includes a substantially curved part.

6. An attachment member according to claim 1 wherein one of the first attachment portion and the second attachment portion includes a first straight part and a second straight part, and the other of the first attachment part and the second attachment part includes a curved part.
- 5 7. An attachment member according to claim 1 wherein both the first attachment portion and the second attachment portion include a straight part.
8. An attachment member according to claim 1 wherein both the first attachment portion and the second attachment portion include a curved portion.
10
9. An attachment member according to any of claims 1 to 8 wherein the first attachment portion includes a substantially straight part which is engageable with the central well of the first wheel rim and the second attachment portion includes a substantially straight part which is engageable with the central well of the second wheel rim.
15
10. An attachment member according to claim 2 wherein the or each profiled portion includes at least one concave portion.
11. An attachment member according to claim 10 wherein the or each profiled portion includes a plurality of concave portions.
- 20 12. An attachment member according to any one of the preceding claims including at least one inclined portion, the or each inclined portion being adjacent and connected to the central portion.
13. A dual wheel arrangement including an attachment part according to any of claims 1 to 13, a first wheel rim and a second wheel rim.
- 25 14. A dual wheel rim arrangement according to claim 13 wherein at least one of the first and the second wheel rim includes an extended flange.

15. A dual wheel rim arrangement according to claim 13 or claim 14 wherein at least one of the first and second wheel rim includes a side part having a profile with a plurality of sub-wells.

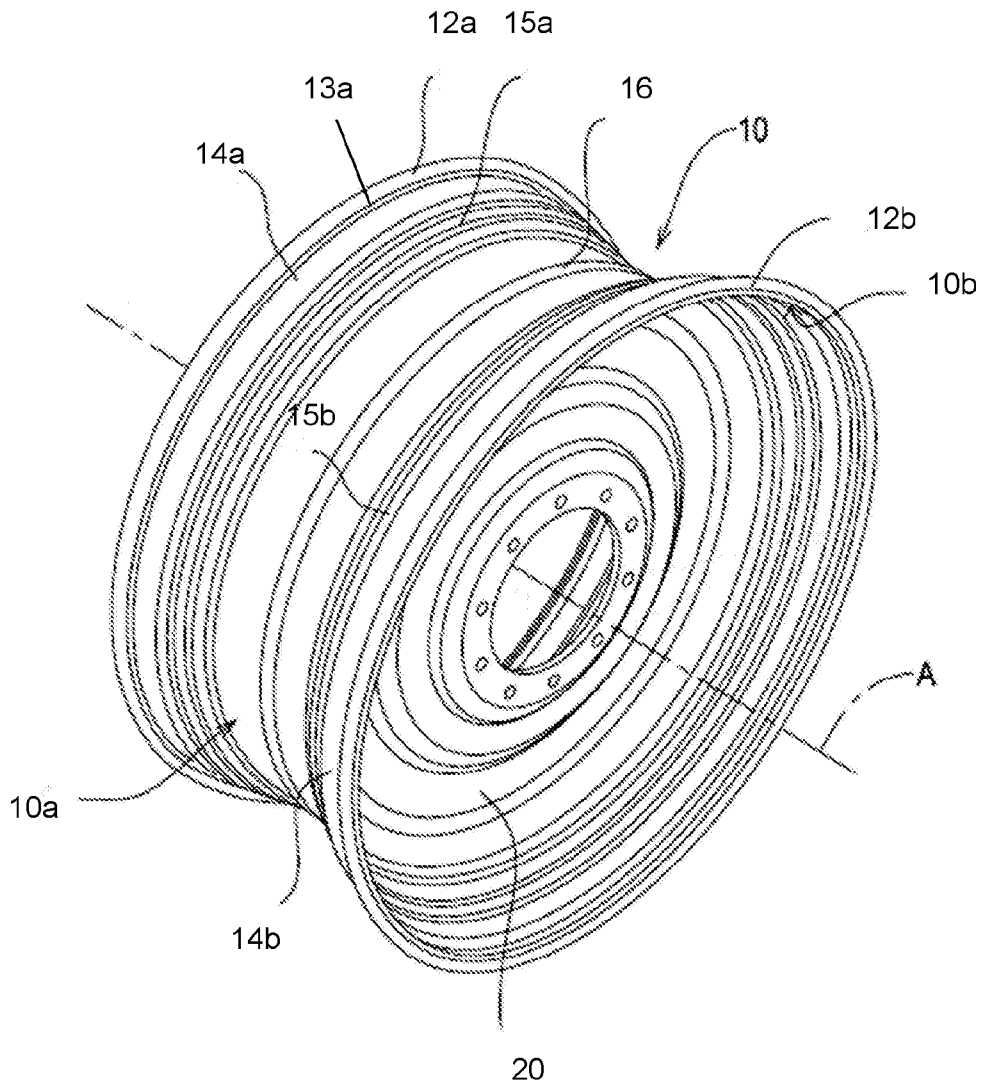


Figure 1
PRIOR ART

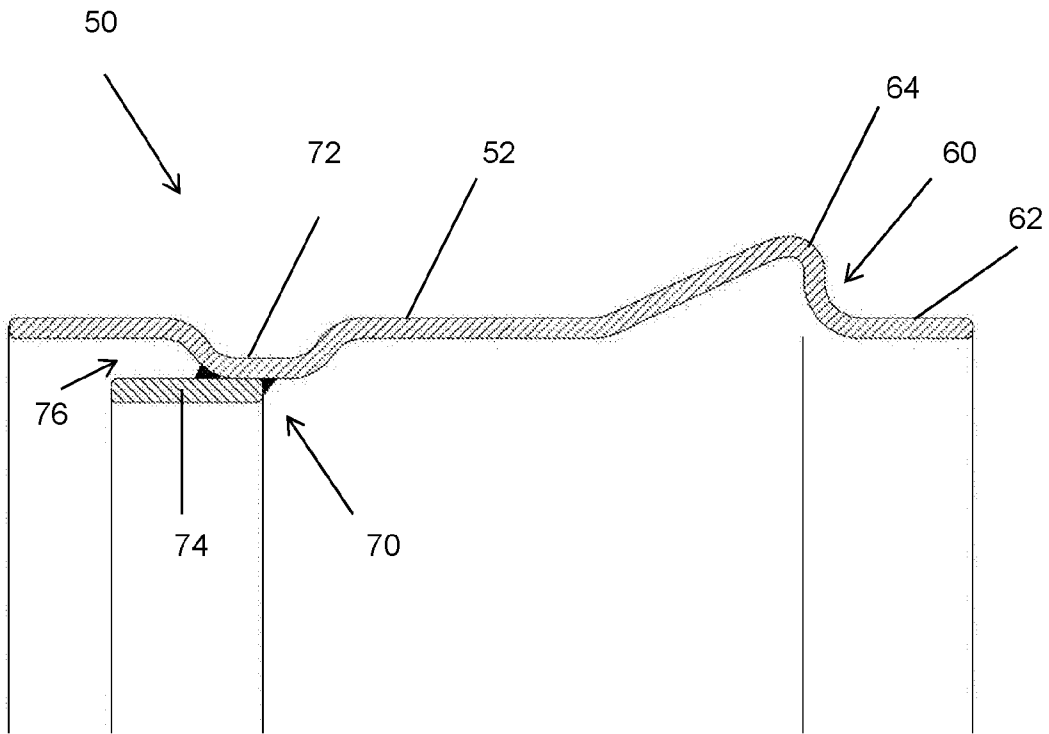


Figure 2A

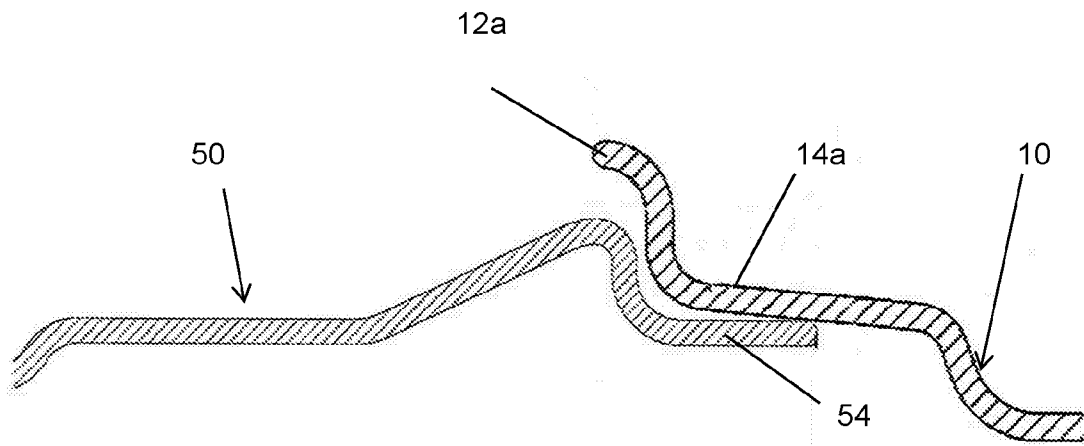


Figure 2B

PRIOR ART

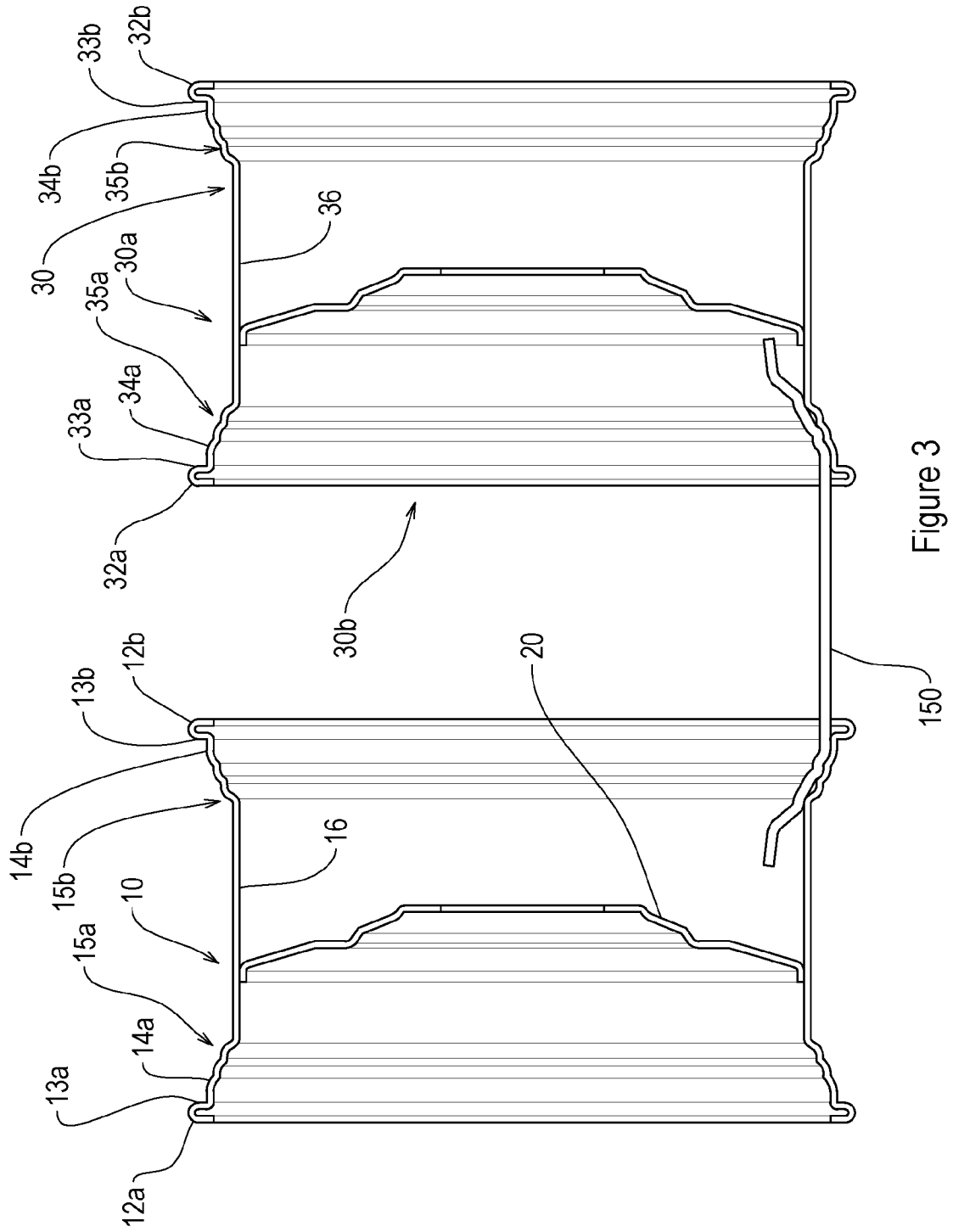


Figure 3

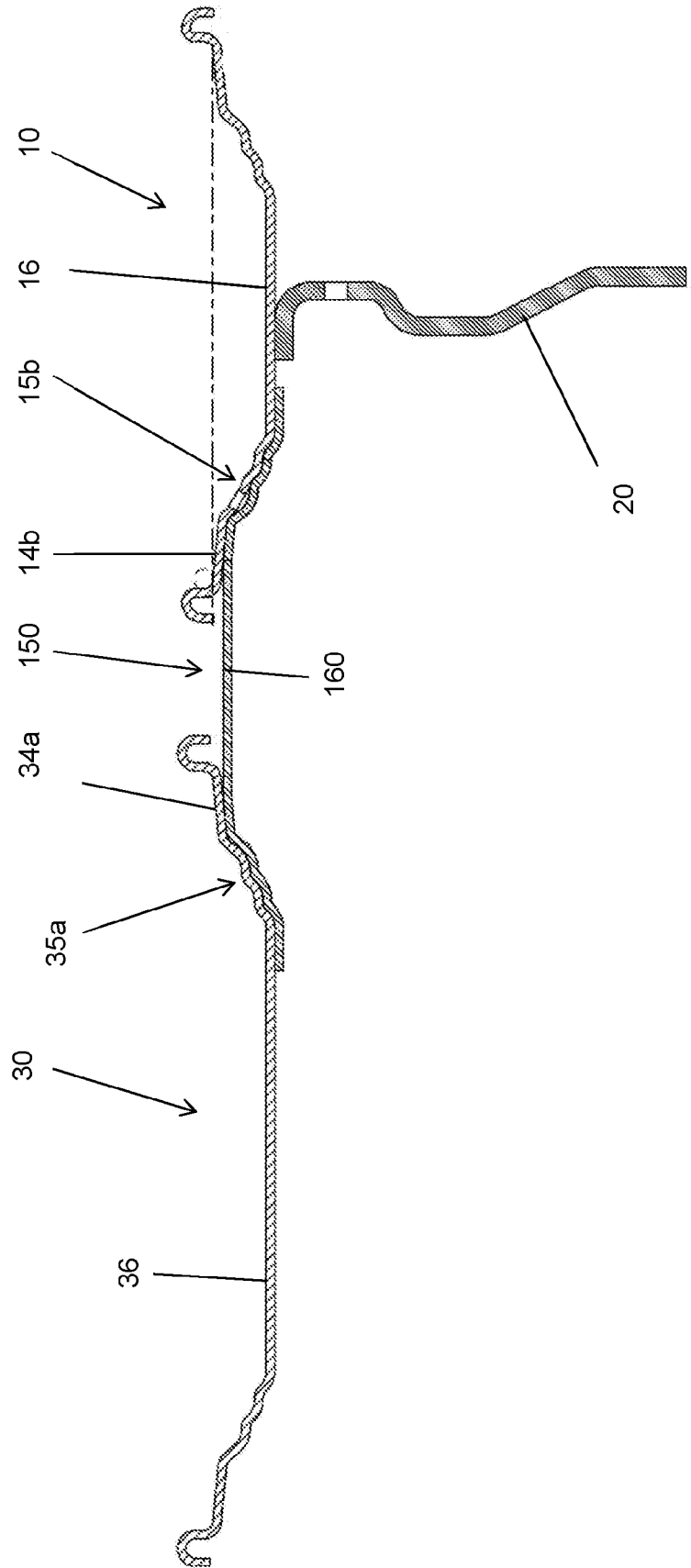


Figure 4

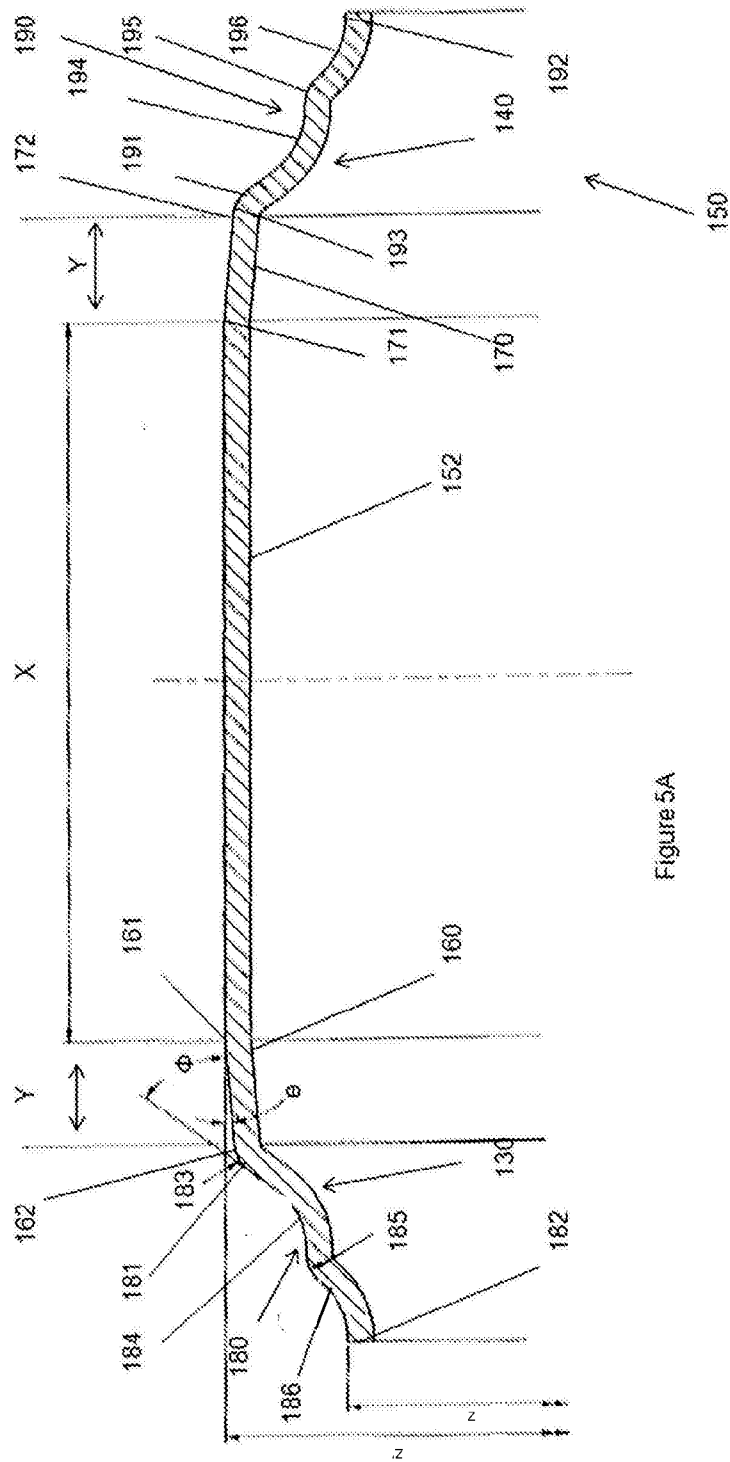
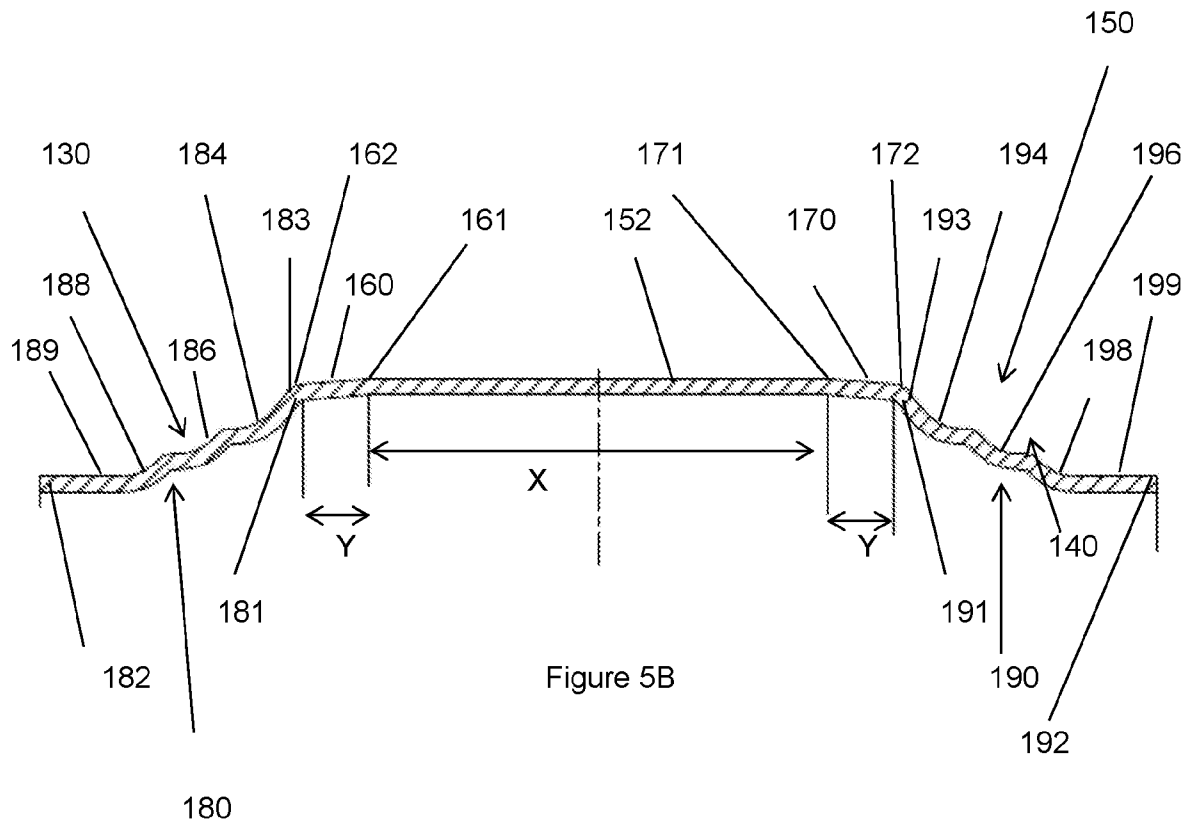


Figure 5A



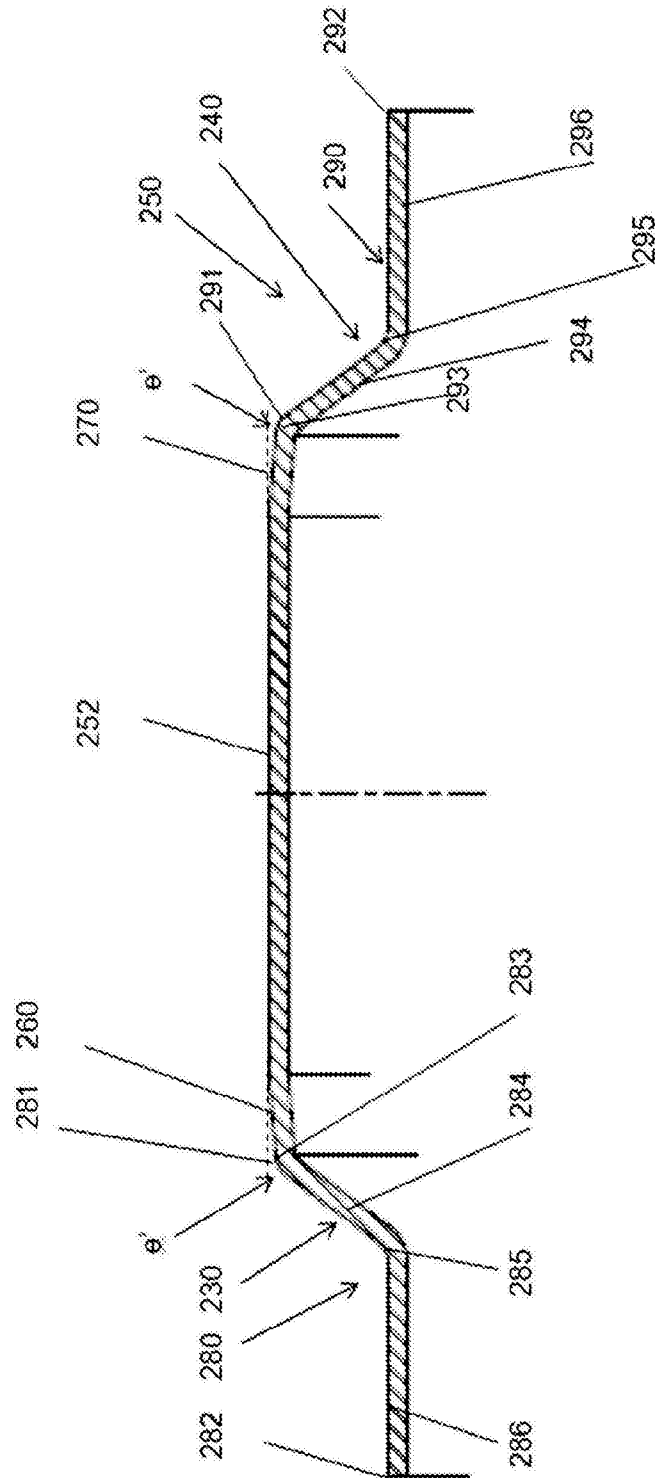


Figure 6

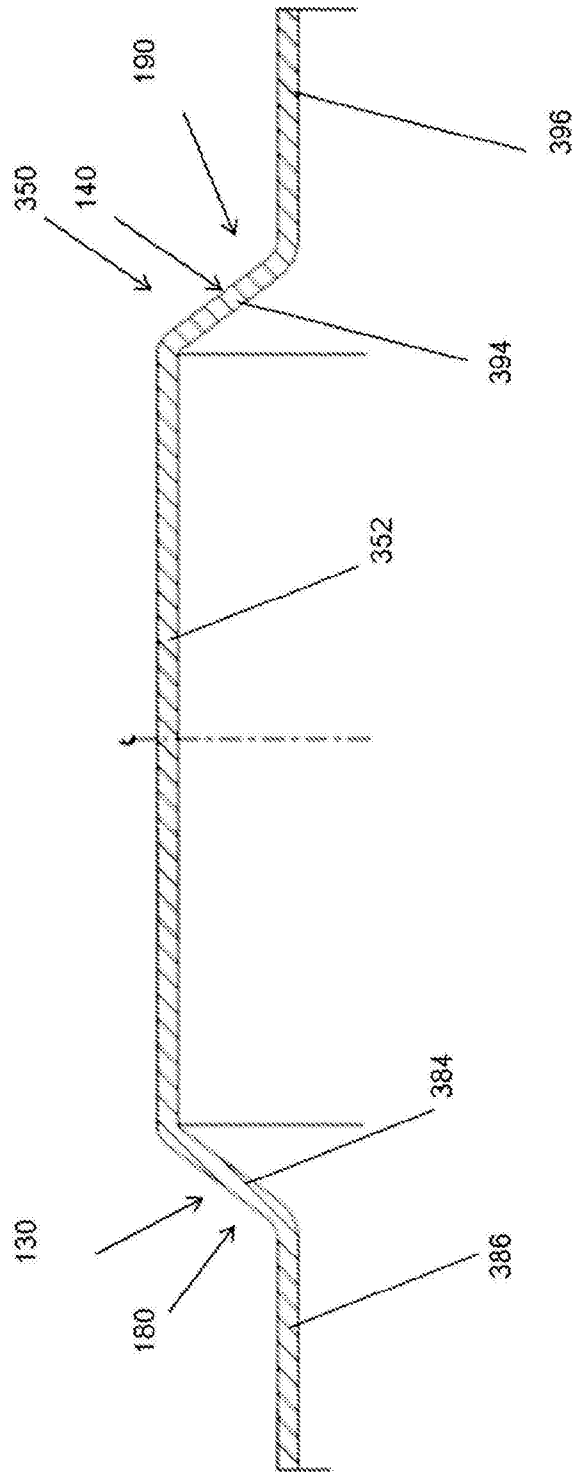


Figure 7

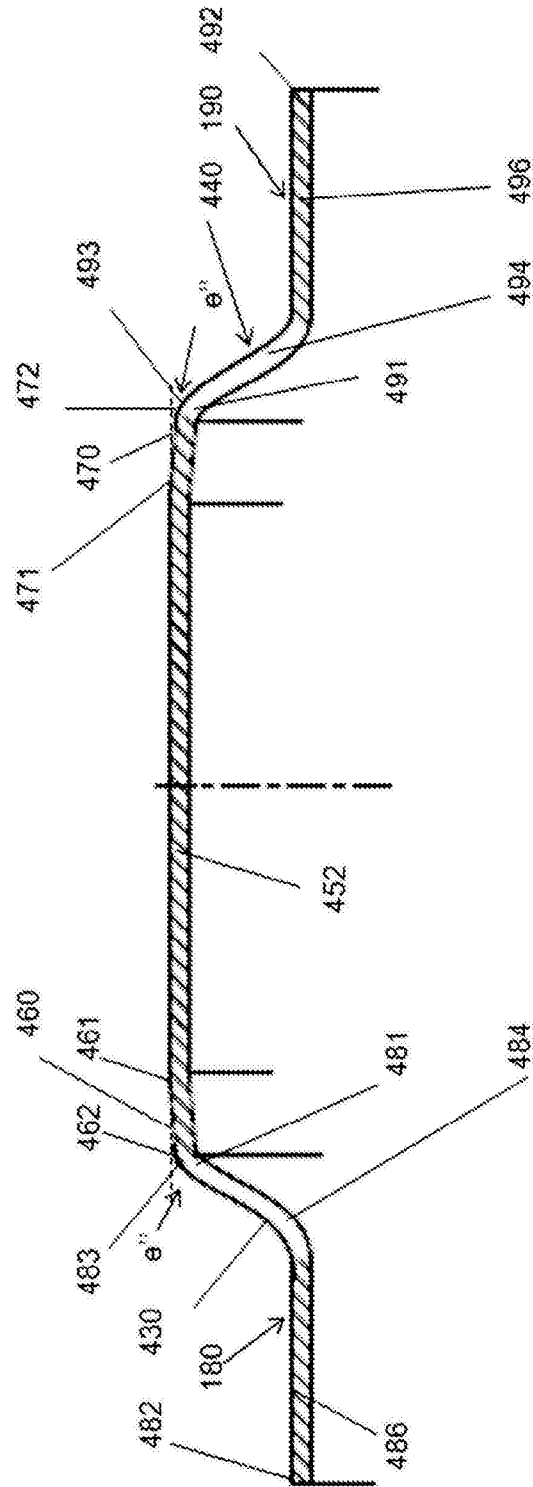


Figure 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2019/051834

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60B11/06 B60B11/02
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
B60B
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 084 188 A1 (MOL PIETER KRIJN) 27 July 1983 (1983-07-27) page 3, line 27 - page 6, line 12; figures 1-5	1-15
X	EP 3 162 590 A2 (KOCK UND SOHN RÄDER GMBH [DE]) 3 May 2017 (2017-05-03) cited in the application paragraphs [0024] - [0035]; figure 1	1-8, 10-15
X	DE 10 2008 021790 A1 (CLAAS SELBSTFAHR ERNTEMASCH [DE]) 5 November 2009 (2009-11-05) paragraph [0021]; figures 1, 4	1-11, 13-15
X	WO 2016/067079 A1 (TITAN ITALIA S P A [IT]) 6 May 2016 (2016-05-06) figures 2, 3	1-11, 13-15
	----- -/--	

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search 16 September 2019	Date of mailing of the international search report 10/10/2019
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Schreck, Mathias

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2019/051834

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2010/088912 A1 (TYRE TRADE DK APS [DK]; RATGEN FELIX PALUDAN [DK]) 12 August 2010 (2010-08-12) abstract; figure 1 -----	1-8, 10-15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2019/051834

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-15

Attachment member for attaching a pair of wheels, comprising a central part, a first attachment part and a second attachment part.

1.1. claims: 1-15(partially)

an attachment member as defined in claim 1, comprising: a first attachment portion engageable with a "side part" of the first rim and second attachment portion engageable with a "side part" of second rim;

1.2. claims: 1-15(partially)

an attachment member as defined in claim 1, comprising: a first attachment portion engageable with a "side part" of first rim and a second attachment portion engageable with a "central well" of second rim; and

1.3. claims: 1-15(partially)

an attachment member as defined in claim 1, comprising: a first attachment portion engageable with a "central well" of first rim and second attachment portion engageable with a "central well" of second rim.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/GB2019/051834

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0084188	A1	27-07-1983	DE 3268031 D1 30-01-1986
			DK 18683 A 20-07-1983
			EP 0084188 A1 27-07-1983
			NL 8200185 A 16-08-1983
			US 4501450 A 26-02-1985

EP 3162590	A2	03-05-2017	DE 102015118196 A1 27-04-2017
			EP 3162590 A2 03-05-2017

DE 102008021790	A1	05-11-2009	NONE

WO 2016067079	A1	06-05-2016	EP 3212435 A1 06-09-2017
			WO 2016067079 A1 06-05-2016

WO 2010088912	A1	12-08-2010	CA 2751423 A1 12-08-2010
			EP 2393672 A1 14-12-2011
			US 2011285195 A1 24-11-2011
			WO 2010088912 A1 12-08-2010
