(19) Octrooicentrum Nederland

(11) **2021340**

(12) B1 **OCTROOI**

(21) Aanvraagnummer: **2021340**

(22) Aanvraag ingediend: **18 juli 2018**

(51) Int. Cl.:
B21C 37/08 (2018.01) **B23K 31/02** (2018.01) **B23K 26/262** (2019.01) **B23K 33/00** (2019.01)

(30) Voorrang:

(41) Aanvraag ingeschreven:
29 januari 2020

(43) Aanvraag gepubliceerd:
-

(47) Octrooi verleend:
29 januari 2020

(45) Octrooischrift uitgegeven:
30 januari 2020

(73) Octrooihouder(s):
VDL Weweler B.V. te APELDOORN

(72) Uitvinder(s):
Hans Bramer te EERBEEK

(74) Gemachtigde:
ir. J.C. Volmer c.s. te Rijswijk

(54) **Method for forming a tubular axle body**

(57) A tubular axle body having a substantially circular cross section for an air sprung wheel axle suspension is formed from a substantially flat steel plate having longitudinal edge portions, which is formed into a tubular shape and welded together at the longitudinal edge portions. A longitudinal strip of the plate is bent, at one or both of the longitudinal edge portions, to be slanting with respect to the remainder of the plate. The plate is formed into a tubular shape wherein either a longitudinal edge at the other one of the longitudinal edge portions is positioned against the slanting longitudinal strip, or, when a slanting strip is formed at both longitudinal edge portions, the slanting longitudinal strips are abutted. The slanting longitudinal strip and the longitudinal edge or the two slanting longitudinal strips are welded together by fillet welding.

NL B1 2021340

P33623NL00/CHO

Title: Method for forming a tubular axle body

The invention relates to a method for forming a tubular axle body for an air sprung wheel axle suspension, the tubular axle body having a substantially round cross section, wherein a substantially flat steel plate having longitudinal edge portions is formed into a tubular shape and welded together at the longitudinal edge portions.

Heavy vehicles such as trucks, trailers and semi-trailers generally have an air sprung wheel axle suspension. The wheel axle usually comprises a tubular axle body, which may have a circular or rectangular cross section. The axle body is suspended from the vehicle chassis by a flexible or rigid trailing arm which at the front end is pivotably connected to a bearing bracket. An air spring is operable between the axle body and the chassis.

Axle bodies having a substantially circular cross section have favourable properties compared to square or rectangular tubular axle bodies when it comes to resisting torsional loads which occur during normal operation of an air sprung wheel axle suspension.

The round axle tube for a heavy vehicle such as a truck, trailer or semi-trailer may have an outer diameter of 127 - 200mm and a wall thickness of 8 - 16mm. It is known to produce a round and seamless axle tube by cold drawing. However, this is a relatively expensive production method.

In DE 4300158 an air sprung wheel axle suspension is shown in Fig. 5. The axle body in this suspension has a square cross section. A method is disclosed for forming a tubular axle body having a square cross section. A steel plate is rolled to provide it with spaced apart thickenings for the angled regions of the square axle tube. The plate is bent to form it into a tubular body with a generally circular cross section. The longitudinal edges of the plate are butt welded together. After the round tube is formed and welded, the tubular body is deformed by a rolling process into a tubular body with a square cross section, wherein the position of the thickenings corresponds to the angle areas of the square.

Although it is not clearly shown in DE 4300158 it is in general necessary to pre-process the plate to provide bevelled longitudinal edges on the blank in order to be able to provide a good butt weld.

It is an object of the present invention to provide a simpler method to manufacture a tubular axle body with a round or circular cross section.

This object is achieved by a method according to claim 1.

According to this method the plate is bent near one of the longitudinal edges such that a longitudinal strip adjacent said longitudinal edges is set under an angle of less than 90° with respect to the remainder of the flat plate, e.g. by means of an angle bending machine. Thereby the longitudinal strip is made slanting. When the plate is formed into a tubular shape the other one of the longitudinal edges is positioned against the slanting longitudinal strip. By this a small overlap is created, which forms a sort of groove in which the fillet weld can be made.

The method according to the invention provides a cost effective method to manufacture an axle body with a round or circular cross section, because manufacturing it from a blank, which is a flat steel plate is considerably cheaper than cold drawing a tube.

Because the longitudinal edge is abutting the surface of the slanting longitudinal strip, a (in cross section) triangular groove with a depth corresponding to the thickness of the formed tubular wall is created. The fillet weld which fills the groove results in that the circular shape with a thickness corresponding to the difference between the outer radius R and the inner radius r of the tubular axle body is continuous in that it is massive over the entire circumference, in other words it does not have recesses or voids. This is desirable for the axle body because it has to resist torsional loads, e.g. due to roll movements of the vehicle, or braking of the wheels mounted to the axle body. Moreover, it is desired to have the mentioned massive circular shape when for example stub axles have to be attached to the axle body by means of friction welding. During friction welding the stub axle is rotated relative to the axle body around the central axis and then the end faces of the stub axle and the axle tube are brought into engagement with each other whereby they are welded together due to the friction heat generated between them.

Preferably, the plate is cut before the plate is formed into a tubular shape, to reduce the width of the longitudinal strip. Thus according to this method the slanting longitudinal strip is bent under an angle with respect to the remainder of the plate and next the width of said longitudinal strip is reduced. This provides the advantage that a larger width area next to the longitudinal edge of the plate can be gripped for bending, while the width of the strip to form the overlap may be much smaller.

In a preferred embodiment the tubular shape is formed such that the longitudinal strip extends inwardly into the tubular body and the fillet weld is formed at the outer side of the tubular body. This method has the advantage that a sort of V-groove results at the outside of the tube and the tube can thus be fillet welded from the outside. The fillet weld constitutes a part of the resulting tubular body that absorbs the torsional loads.

In another possible embodiment the tubular shape is formed such that the longitudinal strip extends outwardly from the tubular body and the fillet weld is formed at the inner side of the tubular body. This method provides an axle body in which the fillet weld on the inner side of the tubular body constitutes a part of the resulting tubular body that absorbs the torsional loads. Furthermore the resulting axle body has a longitudinal protrusion at the outer side. The protrusion may be used a locking member to interlock the axle body with an axle seat formed on a trailing arm or on a separate axle pad. By this interlocking a rotation of the round axle body due to torsional loads occurring during operation of the vehicle is prevented.

In a further embodiment the outwardly extending slanting longitudinal strip is finished so as to provide a fitted protrusion for narrowly fitting into a recess formed in a counterpart having an axle seat, such as an axle pad or a trailing arm. In this way the protrusion is made into a fitted interlocking member which snugly fits in the interlocking recess in the axle pad or trailing arm. The protrusion may be formed such that it has a triangular or trapezoidal cross sectional shape, but also other suitable shapes are conceivable.

The invention also relates to a tubular axle body for an air sprung wheel axle suspension, the tubular axle body having a substantially round cross section, which is formed by a bent plate having longitudinal edge portions welded together, wherein one of the longitudinal edge portions comprises a slanting longitudinal strip which extends under an angle with respect to the tangential direction of the tubular body, and wherein the other longitudinal edge portion has a longitudinal edge which faces substantially in the tangential direction, wherein the slanting longitudinal strip is arranged against the longitudinal edge of the other longitudinal edge portion and wherein a fillet weld is present in the space between the surface of said slanting longitudinal strip and said longitudinal edge.

In the axle body according to the invention the surface of the slanting longitudinal strip and the end face of the other longitudinal edge define a substantially triangular groove in which the fillet weld is made. Thus the tubular axle body has a tubular wall having a thickness R-r, wherein R is the outer radius and r the inner radius of the tubular axle body, which is massive,

that is without recesses or voids. This is advantageous for absorbing torsional loads and for friction welding as is mentioned in the above as well.

In a possible embodiment the slanting longitudinal strip extends inwardly and the fillet weld is located on the outer side of the tubular axle body. A fillet weld on the outside is easier to provide than from the inside. The fillet weld constitutes a part of the resulting tubular body that absorbs the torsional loads.

In another possible embodiment the slanting longitudinal strip extends outwardly and the fillet weld is located on the inner side of the tubular axle body. The fillet weld constitutes a part of the resulting tubular body that absorbs the torsional loads. In this case, advantageously an end portion of the slanting longitudinal strip may project from the circumference of the tubular axle body so as to form an interlocking protrusion to be received in a recess formed in a counterpart having an axle seat, such as an axle pad or a trailing arm. The protrusion may be formed such that it has a triangular or trapezoidal cross sectional shape, but also other suitable shapes are conceivable.

Another aspect of the invention relates to a method according to claim 10.

In this method not only one longitudinal strip of the plate is bent to be slanting, but on both longitudinal edge portions such longitudinal slanting strips are formed. The plate is formed into a tubular shape whereby the slanting longitudinal strips are abutted. The abutted slanting longitudinal strips are welded together by a fillet weld.

By the method according to this aspect a sort of (in cross section triangular) groove results between the slanting longitudinal strips which are abutted, which is filled by the fillet weld. The angle between the slanting longitudinal strips and the main body of the plate may even be 90° or a little smaller, whereby the groove is mainly formed between the roots of the abutting slanting longitudinal strips.

In one embodiment the tubular shape is formed such that the slanting longitudinal strips both extend outwardly from the tubular body and the fillet weld is formed at the inner side of the tubular body.

In another embodiment the tubular shape is formed such that the slanting longitudinal strips both extend inwardly from the tubular body and the fillet weld is formed at the outer side of the tubular body.

In a third embodiment one of the longitudinal strips extends inwardly and the other one of the longitudinal strips extends outwardly.

According to this aspect of the invention a tubular axle body for an air sprung wheel axle suspension is provided, wherein the tubular axle body has a substantially round cross section, which is formed by a bent plate having longitudinal edge portions welded together, wherein both of the longitudinal edge portions comprise a slanting longitudinal strip which extends under an angle with respect to the tangential direction of the tubular body, wherein the slanting longitudinal strips are arranged against each other and wherein a fillet weld is present connecting the slanting longitudinal strips.

In a possible embodiment both the slanting longitudinal strips extend inwardly and the fillet weld is located on the outer side of the tubular axle body.

In another possible embodiment both the slanting longitudinal strip extend outwardly and the fillet weld is located on the inner side of the tubular axle body.

In yet another possible embodiment one of the slanting longitudinal strips extends inwardly and the other one of the slanting longitudinal strips extends outwardly, and wherein said fillet weld is located on the inner side and/or the outer side of the tubular axle body.

The invention also relates to an air sprung wheel axle suspension comprising:
- a bearing bracket which is fixed to a vehicle chassis,
- a trailing arm which has a front end, which is pivotably connected to the bearing bracket,
- a tubular axle body as described in the above, which is attached to the trailing arm, and
- an air spring, which is operational between the axle body and the vehicle chassis.

The invention will be further elucidated in the following detailed description with reference to the drawing, in which:

Fig. 1 shows a cross sectional view of an embodiment of an axle body according to the invention,

Fig. 2 illustrates a step of the manufacturing method of an axle body according to the invention,

Fig. 3a shows a cross sectional view of another embodiment of an axle body according to the invention,

Fig. 3b shows a cross sectional view of a variation of the embodiment shown in Fig. 3a,

Fig. 3c shows a cross sectional view of another variation of the embodiment shown in Fig. 3a,

Fig. 4 shows a view in perspective of yet another embodiment of an axle body according to the invention,

Fig. 5 shows a cross sectional view of the axle body of Fig. 4,

Fig. 6a shows a side elevational view of a wheel axle suspension wherein the axle body of Fig. 4 is clamped in an axle seat of an axle pad,

Fig. 6b shows a side elevational view of a wheel axle suspension wherein the axle body of Fig. 4 clamped in an axle seat of a trailing arm,

Fig. 7 illustrates a step of the manufacturing method of an axle body according to the invention, and

Fig. 8 shows a cross sectional view of a welded joint of yet another embodiment of an axle body according to the invention.

Fig. 1 shows a cross section of tubular axle body 100 for an air sprung wheel axle suspension. The tubular axle body 100 has a substantially circular cross section. The tubular body 100 is formed from a flat metal plate 101 having a thickness of 6 – 16mm. The plate 101 is preferably a steel plate. The flat plate 101 is bent to form a longitudinal strip 102 of the plate, at a longitudinal edge portion 101B, to be slanting with respect to the remainder of the plate 101 as is shown in Fig. 2. The angle between the slanting strip 102, 102' and the remainder of the plate 101 is preferably smaller than 90°, but this may depend on the thickness of the plate. The slanting longitudinal strip 102 may be cut as is indicated by "C" in Fig. 2 to remove the portion 102' whereby the width of the slanting strip 102 is reduced.

The plate 101 is formed into a tubular shape, e.g. by a rolling process, wherein a longitudinal edge 103 at the other longitudinal edge portion 101A is positioned against the slanting longitudinal strip 102. The tubular shape is formed such that the slanting longitudinal strip 102

extends inwardly, under an angle with respect to the tangential direction of the tubular body 100, into the tubular body 100. The slanting longitudinal strip 102 and the longitudinal edge 103 form an overlap.

To attach the end portions 101A and 101B of the tubular body 100 together, a fillet weld 104 is made between the slanting longitudinal strip 102 and the longitudinal edge 103, in the groove-like space between the surface of the slanting longitudinal strip 102 and the longitudinal edge 103. The groove-like space has a substantially triangular cross section as can be seen in Fig. 1. Since the slanting strip 102 extends inwardly, the groove-like space is defined facing the outside of the tubular body 100 and the fillet weld 104 can made from the outside of the tubular body 100, which is convenient.

If the metal plate has a sufficiently large thickness, an angle of 90° between the longitudinal strip 102 and the remainder of the plate 101 may be possible, because a sufficiently deep groove would result between the longitudinal edge 103 and the root or bend portion 105 of the longitudinal strip 102 to provide a good fillet weld 104. However, in most embodiments the angle will be less than 90°.

In Fig. 3a a cross section at the welding connection of another tubular axle body 200 according to the invention is shown.

The tubular axle body 200 of this embodiment can be formed from a flat metal plate 201 as is shown in Fig. 2. The flat metal plate 201 may have a thickness of 8 – 16mm. The flat plate 201 is bent to form a longitudinal strip 202 of the plate, at a longitudinal edge portion 201B, to be slanting with respect to the remainder of the plate 201 as is shown in Fig. 2. The angle between the slanting strip 202, 202' and the remainder of the plate 201 is smaller than 90°. The slanting longitudinal strip 202 may be cut as is indicated by "C" in Fig. 2 to remove the portion 202' whereby the width of the slanting strip 202 is reduced.

The tubular form is made such that the slanting longitudinal strip 202 extends outwardly as is visible in Fig. 3a. Thereby the groove-like space in which a fillet weld 204 has to be formed faces the inwardly. The fillet weld 204 has thus to be made from the inside of the tubular body 200.

Welding from the inside of the tube is more complex and requires more complex equipment than welding from the outside, but this embodiment provides the advantage that the slanting longitudinal strip 202 forms a longitudinal protrusion on the outer circumference of the axle

body 200. Such a longitudinal protrusion can advantageously be used to form an interlocking protrusion to be received in a recess formed in a counterpart having an axle seat, such as an axle pad or a trailing arm as is illustrated in Fig.6a and Fig. 6b.

Fig. 6a shows a side elevational view of an air sprung wheel axle suspension. The wheel axle suspension comprises a carrying bracket 15 fixedly attached to a chassis 14 and a trailing arm 16, which has a front end portion, usually formed as an eyelet, which is pivotally connected to the carrying bracket 15. The trailing arm 16 has a rear end portion which is formed as a an air spring supporting arm 17. The trailing arm 16 as shown is a so called flexible trailing arm which is (hot) formed in one piece of spring steel by rolling and/or forging, and which has a typical spring portion 19 with a (parabolic) thickness taper. An air spring 18 is mounted to the air spring supporting arm 17 and supports at an upper side the chassis 14. Between the axle body 200 and the trailing arm an intermediate part called an axle pad 10 is arranged. The axle pad 10 has a substantially semi-circular axle seat 11 for the axle body 200. The axle body 200 is clamped in the axle seat 11 by means of tensioning means 13, in this example commonly known U-shaped bolts.

Fig. 6b shows a similar wheel axle suspension, but without an axle pad. The corresponding parts are indicated with the same reference numerals as in Fig. 6a and for their description is referred to the above.

Fig. 6b shows a trailing arm 20 having an axle attachment portion 22 wherein an axle seat 21 is formed integrally on the trailing arm 20. The trailing arm 20 in this example is a so called flexible trailing arm which is formed in one piece of spring steel by rolling or forging, and which has a typical spring portion 19 with a (parabolic) thickness taper. It is noted that also other trailing arms can be used such as rigid trailing arms, which may be welded or cast.

Both the axle seats 11 and 21 have a recess 12 and 22, respectively, formed in them to accommodate the interlocking protrusion 202. When the axle body 200 is clamped in the axle seat 11, 21 using tensioning means 13, such as clamping bolts or U-bolts, the protrusion 202 and the recess 12, 22 provide a locking structure that prevents the axle body 200 to rotate with respect to the axle seat 11, 21 due to torsional loads on the axle body 200 during operation of the vehicle. These torsional loads may be the result of, inter alia, roll movements of the vehicle or braking moments.

Since the slanting strip 202 is only short, only a triangular cross sectional shape extends from the circumference of the tubular axle body 200 as can be seen in Fig. 3a. The interlocking

protrusion 202A thus has a triangular cross sectional shape. For this embodiment no special finishing operation may be necessary. However, also other cross sectional shapes are possible. One example is shown in Fig. 3b, wherein the outwardly extending slanting strip 202' is initially longer than in Fig. 3a. The protruding portion of the slanting strip 202' may be finished, e.g. by means of a grinding process, to form another shape. In Fig. 3b the initial protruding portion of the slanting strip 202' is finished to provide a trapezoidal cross sectional shape to the interlocking protrusion 202B. In Fig. 3c is illustrated that the initial protruding portion of the slanting strip 202' is finished to form an interlocking protrusion 202C having rounded edges.

Fig. 4 and 5 show a tubular axle body 300. This tubular axle body 300 is formed by bending a longitudinal strip of an initially flat metal plate adjacent either longitudinal edge portion to be slanting with respect to the remainder of the plate. In this embodiment the angle between the longitudinal strips and the remainder of the flat plate the tube is formed of may be up to 90°.

The plate is formed into a tubular shape wherein the slanting longitudinal strips are brought into abutment and a groove-like channel is formed on the inside of the tube. A fillet weld 304 is provided in the groove-like channel formed by the opposing slanting strips 302. In embodiments wherein the slanting strips are extending radially or almost radially as is shown in Fig. 5 (thus initially under 90° or almost 90° with respect to the main body of the flat plate), the welding groove is mainly formed by the bend portion or root 303 of the slanting strips 302. In general it may be desirable to create a groove having a depth which corresponds to the thickness (R-r) of the tubular wall or exceeds the thickness of the tubular wall. Thereby the torsional loads on the axle body can be well absorbed. Furthermore it makes the axle body suitable for friction welding for attaching an axle stub to the end face of the axle body. The abutting slanting strips 302 form an interlocking protrusion which can be received in a recess 12 in an axle seat as is shown in Fig. 5.

The longitudinally extending interlocking protrusion 302A may be grinded away near the ends of the axle body as is shown in Fig. 4 so as to allow the connection of the axle body with stub axles. The interlocking protrusion 302A may be finished to provide it with a fitting form corresponding to the form of the recess 12.

In an alternative embodiment (not shown), the tubular shape is formed such that the slanting longitudinal strips both extend outwardly from the tubular body and the fillet weld is formed at the inner side of the tubular body.

Another option, which is illustrated in Fig. 7 is to bend one longitudinal slanting strip 402' such that it extends from one surface of the flat plate 401 and to bend the other longitudinal slanting strip 402'' such that it extends from the other plate surface. The tubular body 400 is formed after which one of the longitudinal slanting strips 402', 402'' extends inwardly and the other one of the longitudinal slanting strips extends outwardly as is shown in Fig. 8. The abutting slanting strips overlap and are connected by a fillet weld 404', 404'', which may be in particular a lap weld, which may be on an outer side (404') and/or on an inner side (404'') of the tubular body 400.

When the axle body is arranged under the trailing arm 16, 20, either with or without an intermediate axle pad (cf. Fig. 5, Figs 6a and 6b), the longitudinally extending interlocking portion 202, 302A is preferably extending upwardly and to the rear of the vehicle under an angle α of about 60° with respect to the height direction of the vehicle as is illustrated in Fig. 5, Fig. 6a and Fig. 6b. In case the axle body is arranged above the trailing arm (not shown), the interlocking portion is preferably extending downwardly and to the rear of the vehicle under an angle α of about 120° with respect to the height direction of the vehicle. Such an arrangement allows that the axle body can be clamped in the axle seat with common U-bolts, or other bolted strap connections, and at the same time the interlocking portion is not to excessively subjected to the effect of bending of the axle body due to loads on the vehicle. Thereby the risk of failure of the axle body at the interlocking portion is reduced.

CONCLUSIES

1. Werkwijze voor het vormen van een buisvormig aslichaam (100; 200) voor een luchtgeveerde wielasophanging, waarbij het buisvormige aslichaam (100; 200) een in hoofdzaak cirkelvormige dwarsdoorsnede heeft, waarbij een in hoofdzaak vlakke stalen plaat (101; 201) met langsrandgedeeltes (101A, 101B; 201A, 201B) wordt gevormd tot een buisvorm en aan elkaar gelast aan de langsrandgedeeltes (101A, 101B; 201A, 201B), **gekenmerkt door**:

- het buigen van een langsstrook (102 '; 202') van de plaat, bij één (101B; 201B) van de langsrandgedeeltes, om schuin te staan ten opzichte van de rest van de plaat (101; 201);
- het vormen van de plaat (101; 201) tot een buisvorm waarbij een langsrand (103; 203) aan de andere (101A; 201A) van de langsrandgedeeltes gepositioneerd is tegen de schuine langsstrook (102; 202);
- het hoeklassen van de schuine langsstrook (102; 202) en de langsrand (103; 203) aan elkaar.

2. Werkwijze volgens conclusie 1, waarbij de plaat wordt gesneden voordat de plaat tot een buisvorm wordt gevormd, om de breedte van de schuine langsstrook te verminderen.

3. Werkwijze volgens conclusie 1, waarbij de buisvorm zodanig wordt gevormd dat de schuine langsstrook (102) zich naar binnen in het buisvormige lichaam (100) uitstrekt en de hoeklas (104) aan de buitenzijde van het buisvormige lichaam wordt gevormd (100).

4. Werkwijze volgens conclusie 1, waarbij de buisvorm zodanig wordt gevormd dat de schuine langsstrook (202) zich naar buiten uitstrekt vanaf het buisvormige lichaam (200) en de hoeklas (204) wordt gevormd aan de binnenzijde van het buisvormige lichaam (200).

5. Werkwijze volgens conclusie 4, waarbij de zich naar buiten uitstrekkende schuine langsstrook (202 '; 202 '') zodanig wordt afgewerkt dat een passend uitsteeksel wordt verschaft voor het nauw passend passen in een uitsparing (12; 22) die is gevormd in een tegenstuk met een aszitting (11, 21), zoals een aspad (10) of een draagarm (20).

6. Buisvormig aslichaam (100; 200) voor een luchtgeveerde wielasophanging, waarbij het buisvormige aslichaam (100; 200) een in hoofdzaak cirkelvormige dwarsdoorsnede heeft, gevormd door een gebogen plaat met aan elkaar gelaste langsrandgedeeltes (101A, 101B; 201A, 201B), waarbij één van de langsrandgedeeltes (101B; 201B) een schuine langsstrook (102; 202) omvat die zich onder een hoek ten opzichte van de tangentiële richting van het buisvormige lichaam (100; 200) uitstrekt, en waarbij het andere langsrandgedeelte (101A;

201A) een langsrand (103; 203) heeft die in hoofdzaak in de tangentiële richting is gekeerd, waarbij de schuine langsstrook (102; 202) is aangebracht tegen de langsrand (103; 203) van het andere langsrandgedeelte en waarbij een hoeklas (104; 204) aanwezig is in de ruimte tussen het oppervlak van de schuine langsstrook (102; 202) en de langsrand (103; 203).

7. Buisvormig aslichaam volgens conclusie 6, waarbij de schuine langsstrook (102) zich naar binnen toe uitstrekt en de hoeklas (104) zich aan de buitenzijde van het buisvormige aslichaam (100) bevindt.

8. Buisvormig aslichaam volgens conclusie 6, waarbij de schuine langsstrook (202; 202'; 202") zich naar buiten toe uitstrekt en de hoeklas (204) zich aan de binnenzijde van het buisvormige aslichaam (200) bevindt.

9. Buisvormig aslichaam volgens conclusie 8, waarbij een eindgedeelte van de schuine langsstrook (202; 202'; 202 ") vanaf de omtrek van het buisvormige aslichaam uitsteekt om een vormsluitend uitsteeksel (202A; 202B; 202C) te vormen om te worden opgenomen in een uitsparing (12; 22) dat is gevormd in een tegenstuk met een aszitting (11; 21), zoals een aspad (10) of een draagarm (20).

10. Werkwijze voor het vormen van een buisvormig aslichaam (300; 400) voor een luchtgeveerde wielasophanging, waarbij het buisvormige aslichaam (300; 400) een in hoofdzaak cirkelvormige dwarsdoorsnede heeft, waarbij een in hoofdzaak vlakke stalen plaat (401) met langsrandgedeeltes wordt gevormd tot een buisvorm en aan elkaar gelast wordt bij de langsrandgedeeltes, **gekenmerkt door**:

- het buigen van een langsstrook (302; 402', 402") van de plaat bij elk van de langsrandgedeeltes, schuin te staan ten opzichte van de rest van de plaat;
- het vormen van de plaat tot een buisvorm, waarbij de schuine langsstroken (302; 402 ', 402 ") tegen elkaar aanliggen;
- het hoeklassen van de schuine langsstroken (302; 402 ', 402 ") aan elkaar.

11. Werkwijze volgens conclusie 10, waarbij de buisvorm zodanig is gevormd dat de schuine langsstroken (302) zich beide naar buiten uitstrekken vanaf het buisvormige lichaam (300) en de hoeklas (304) is gevormd aan de binnenzijde van het buisvormige lichaam (300).

12. Werkwijze volgens conclusie 10, waarbij de buisvorm zodanig is gevormd dat de schuine langsstroken zich beide naar binnen uitstrekken vanaf het buisvormige lichaam en de hoeklas is gevormd aan de buitenzijde van het buisvormige lichaam.

13. Werkwijze volgens conclusie 10, waarbij een (402") van de langsstroken (402', 402") zich naar binnen uitstrekt en de andere (402') van de langsstroken (402 ', 402 ") zich naar buiten uitstrekt.

14. Buisvormig aslichaam (300; 400) voor een luchtgeveerde wielasophanging, waarbij het buisvormige aslichaam (300; 400) een in hoofdzaak cirkelvormige dwarsdoorsnede heeft, die wordt gevormd door een gebogen plaat met aan elkaar gelaste langsrandgedeeltes, waarbij beide van de langsrandgedeeltes een schuine langsstrook (302; 402', 402") omvatten die zich onder een hoek ten opzichte van de tangentiële richting van het buisvormige lichaam (300; 400) uitstrekt, waarbij de schuine langsstroken (302; 402', 402") tegen elkaar aan zijn aangebracht en waarbij een hoeklas (304; 404', 404") aanwezig is die de schuine langsstroken (302; 402 ', 402 ") verbindt.

15. Buisvormig aslichaam volgens conclusie 14, waarbij beide schuine langsstroken zich naar binnen uitstrekken en de hoeklas aan de buitenzijde van het buisvormige aslichaam is gelegen.

16. Buisvormig aslichaam volgens conclusie 14, waarbij beide schuine langsstroken (302) zich naar buiten uitstrekken en de hoeklas (304) zich aan de binnenzijde van het buisvormige aslichaam (300) bevindt.

17. Buisvormig aslichaam volgens conclusie 14, waarbij een (402") van de schuine langsstroken (402', 402") zich naar binnen uitstrekt en de andere (402') van de schuine langsstroken (402', 402") zich naar buiten uitstrekt, en waarbij de hoeklas (404', 404") zich aan de binnenzijde en/of de buitenzijde van het buisvormige aslichaam (400) bevindt.

18. Wielasophanging, omvattende:
- een lagerbok (15) die is bevestigd aan een voertuigchassis (14),
- een draagarm (16, 20) die een voorste einde heeft, dat draaibaar is verbonden met de lagerbok (15),
- een buisvormig aslichaam (100; 200; 300; 400) volgens één van de conclusies 6 - 9 of 14 - 17, dat is bevestigd aan de draagarm (16, 20), en
- een luchtveer (18), die werkzaam is tussen het aslichaam (100; 200; 300; 400) en het voertuigchassis (14).

Fig. 1

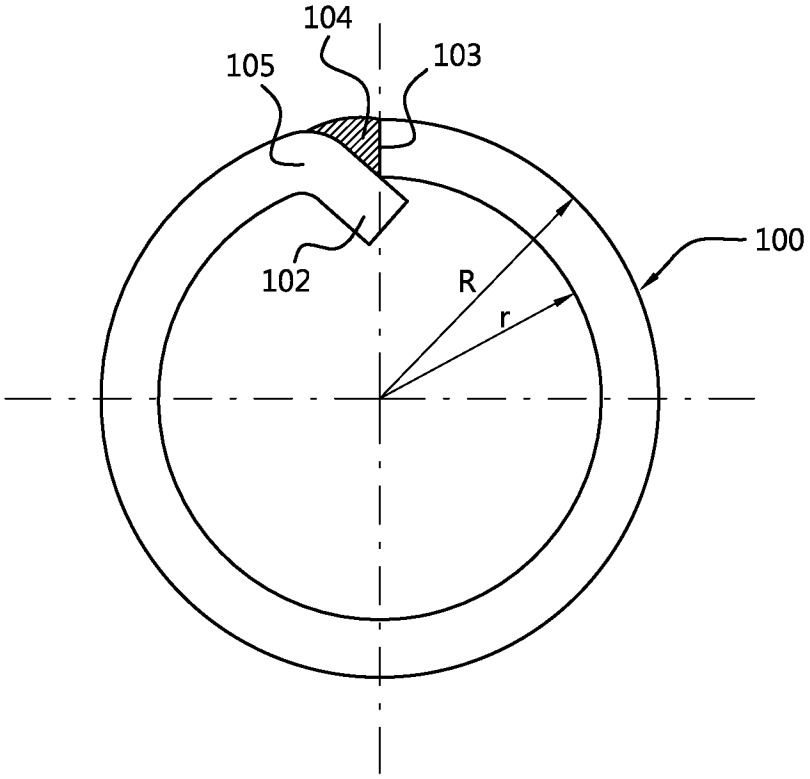

104
105
103
100
102
R
r

Fig. 2

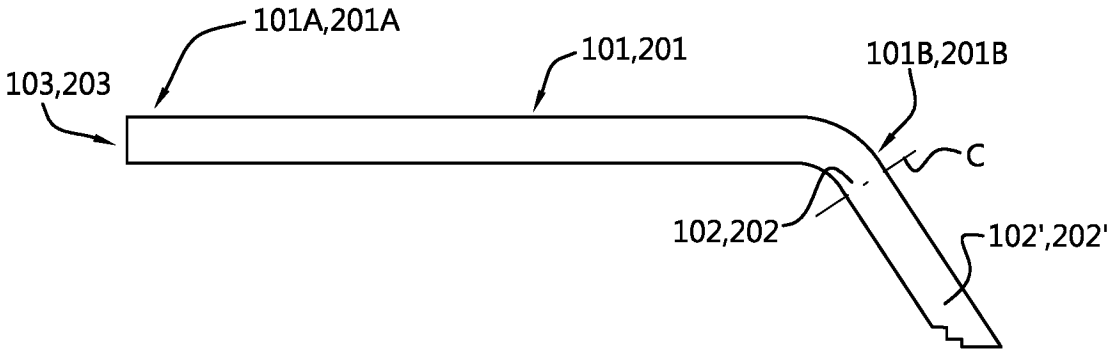

101A,201A
101,201
101B,201B
103,203
C
102,202
102',202'

Fig. 3A

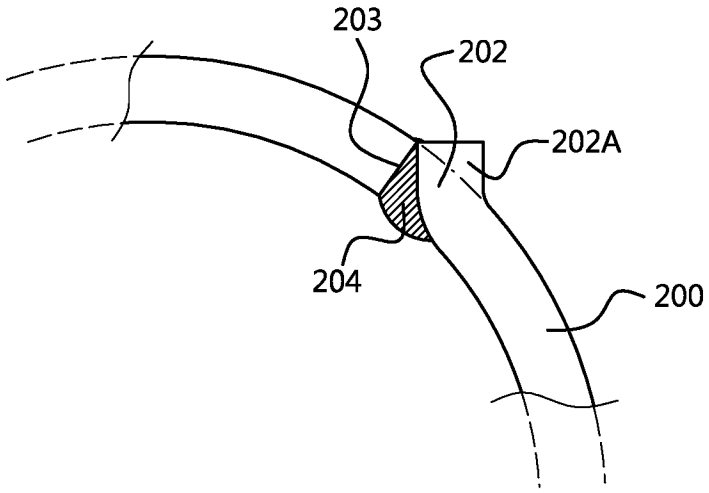


Fig. 3B

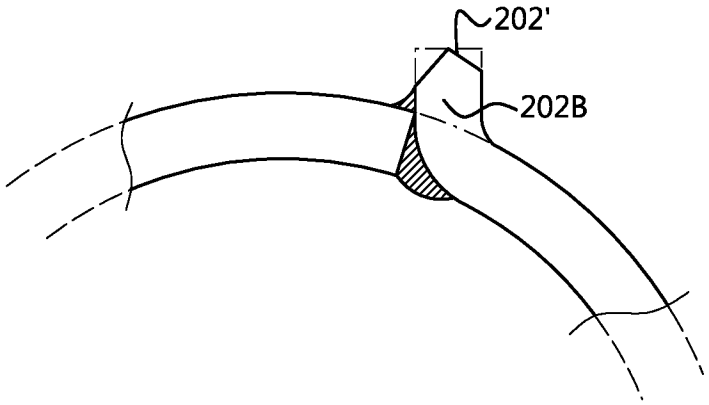


Fig. 3C

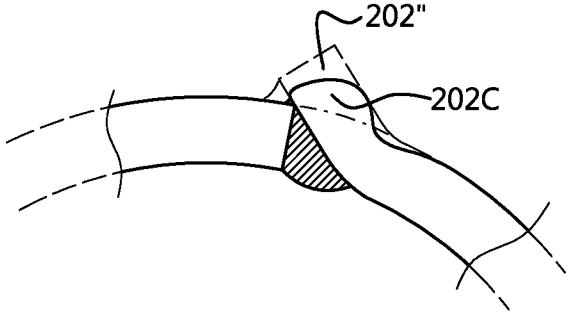


Fig. 4

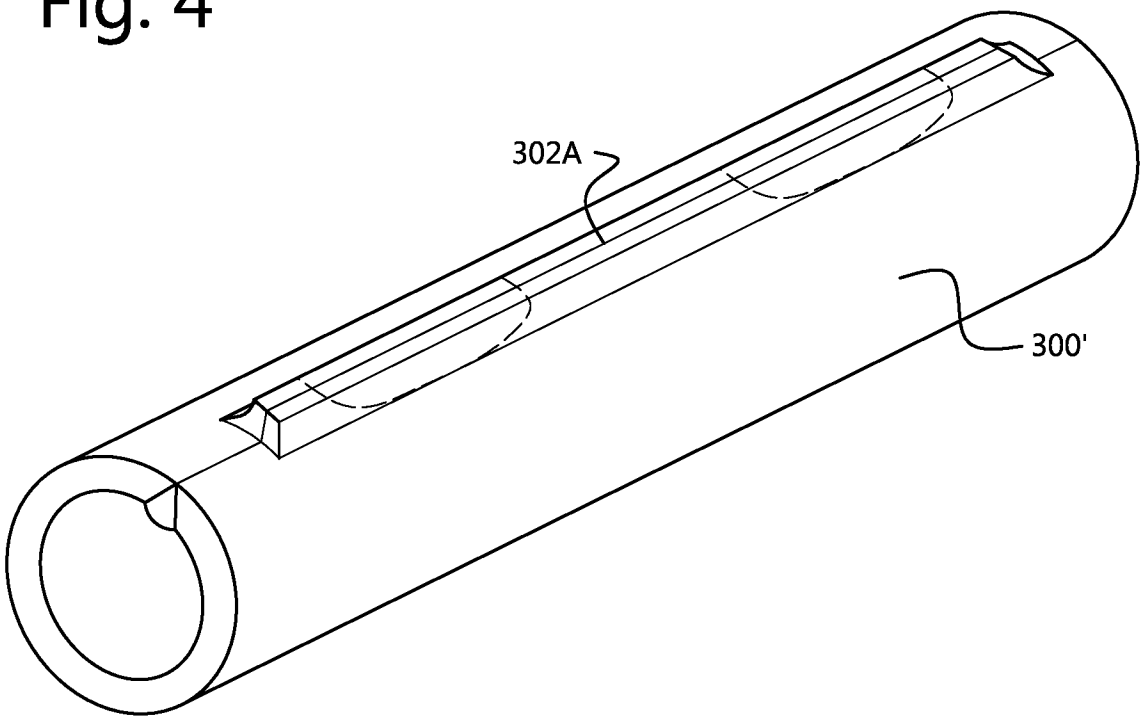


Fig. 5

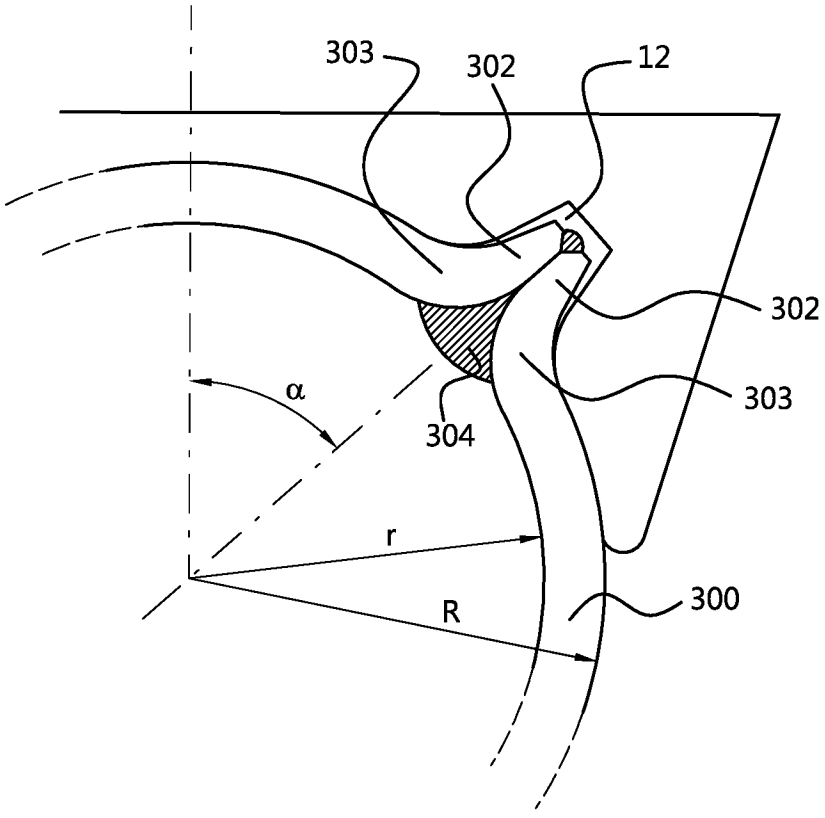


Fig. 6A

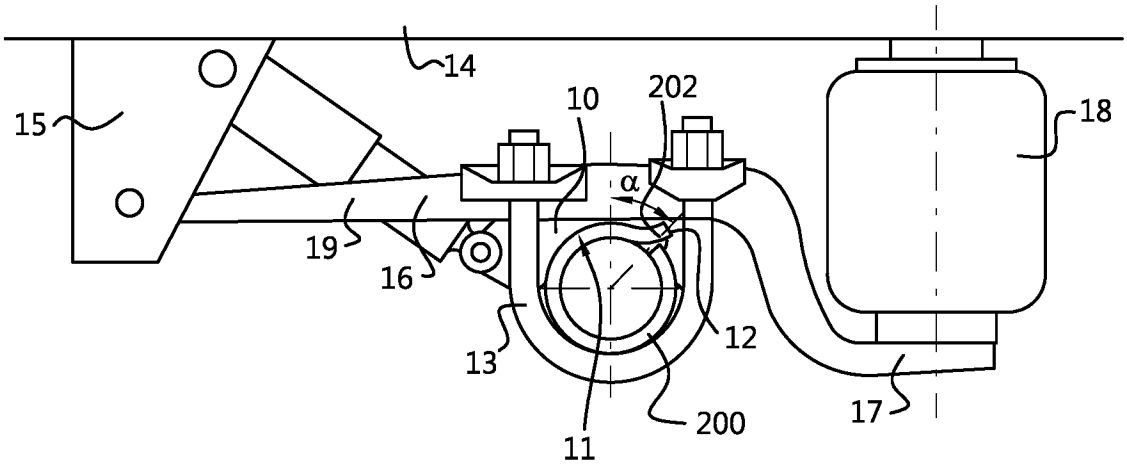

14
15
10
202
18
α
19
16
12
13
200
17
11

Fig. 6B

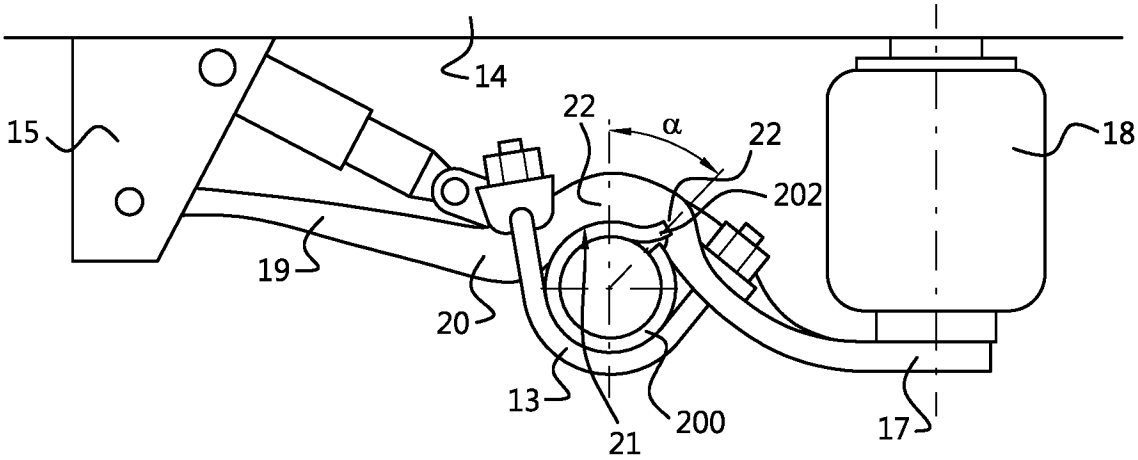

14
15
22
α
22
18
202
19
20
13
200
17
21

Fig. 7

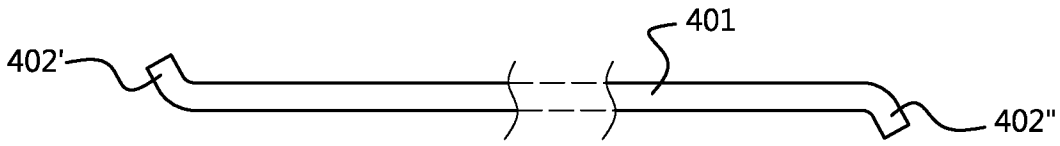
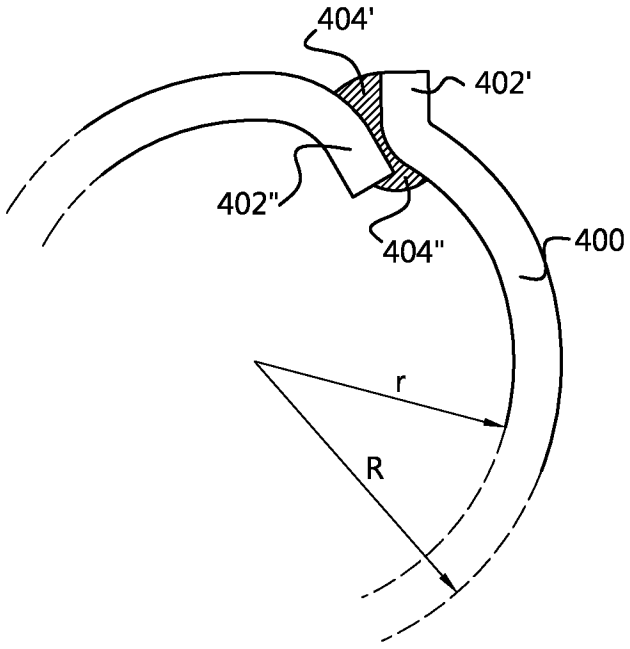


Fig. 8



ABSTRACT

A tubular axle body having a substantially circular cross section for an air sprung wheel axle suspension is formed from a substantially flat steel plate having longitudinal edge portions, which is formed into a tubular shape and welded together at the longitudinal edge portions. A longitudinal strip of the plate is bent, at one or both of the longitudinal edge portions, to be slanting with respect to the remainder of the plate. The plate is formed into a tubular shape wherein either a longitudinal edge at the other one of the longitudinal edge portions is positioned against the slanting longitudinal strip, or, when a slanting strip is formed at both longitudinal edge portions, the slanting longitudinal strips are abutted. The slanting longitudinal strip and the longitudinal edge or the two slanting longitudinal strips are welded together by fillet welding.

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	P33623NL00/CHO
Nederlands aanvraag nr. 2021340	Indieningsdatum 18-07-2018
	Ingeroepen voorrangsdatum
Aanvrager (Naam) VDL Weweler B.V.	
Datum van het verzoek voor een onderzoek van internationaal type 27-10-2018	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. SN72276
I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)	
Volgens de internationale classificatie (IPC) B23K31/02;B23K33/00;B21C37/08;B23K26/262	
II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK	
Onderzochte minimumdocumentatie	
Classificatiesysteem	Classificatiesymbolen
IPC	B23K;B21L;B21C
Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen	
III. ☐ GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES (opmerkingen op aanvullingsblad)	
IV. ☐ GEBREK AAN EENHEID VAN UITVINDING (opmerkingen op aanvullingsblad)	

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2021340

A. CLASSIFICATIE VAN HET ONDERWERP
INV. B23K31/02 B23K33/00 B21C37/08 B23K26/262
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimum documentatie (classificatie gevolgd door classificatiesymbolen)
B23K B21L B21C

Onderzochte andere documentatie dan de minimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	WO 2018/056886 A1 (KINNARPS AB [SE]) 29 maart 2018 (2018-03-29)	1,3,6,7, 10,12, 14,15
A	* alinea [0041] * * alinea [0046] - alinea [0047] * * figuren 5a-5b,8a-8b,9a-9b *	2,4,5,8, 9,11,13, 16-18

A,D	DE 43 00 158 A1 (BERGISCHE ACHSEN KOTZ SOEHNE [DE]) 14 juli 1994 (1994-07-14) in de aanvraag genoemd * het gehele document *	1-18

☐ Verdere documenten worden vermeld in het vervolg van vak C.

☒ Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
3 april 2019	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	De Backer, Tom

Formulier PCT/ISA/201 (tweede blad) (januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2021340

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
WO 2018056886 A1	29-03-2018	SE 1651263 A1	27-03-2018
		WO 2018056886 A1	29-03-2018
DE 4300158 A1	14-07-1994	GEEN	

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN72276	18.07.2018		NL2021340

International Patent Classification (IPC)
INV. B23K31/02 B23K33/00 B21C37/08 B23K26/262

Applicant
VDL Weweler B.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the application
- ☐ Box No. VIII Certain observations on the application

	Examiner
	De Backer, Tom

WRITTEN OPINION

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	2, 4, 5, 8, 9, 11, 13, 16-18
	No:	Claims	1, 3, 6, 7, 10, 12, 14, 15
Inventive step	Yes:	Claims	2, 4, 5, 8, 9, 11, 13, 16-18
	No:	Claims	1, 3, 6, 7, 10, 12, 14, 15
Industrial applicability	Yes:	Claims	1-18
	No:	Claims	

2. Citations and explanations

see separate sheet

WRITTEN OPINION

Box No. VII Certain defects in the application

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1 WO 2018/056886 A1 (KINNARPS AB [SE]) 29 maart 2018 (2018-03-29)

D2 DE 43 00 158 A1 (BERGISCHE ACHSEN KOTZ SOEHNE [DE]) 14 juli 1994 (1994-07-14)in de aanvraag genoemd

1 The present application does not meet the criteria of patentability, because the subject-matter of claims 1, 6, 10 and 14 is not new.

D1, Figures 5a-5b and 8a-8b, discloses a method with all the features as defined in claims 1 and 10 and a tubular body with all the features as defined in claims 6 and 14.

2 Dependent claims 3, 7, 12 and 15 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of novelty , see D1.

3 The combination of the features of the remaining dependent claims is neither known from, nor rendered obvious by, the available prior art.

Re Item VII

Certain defects in the application

The relevant background art disclosed in D1 is not mentioned in the description, nor is this document identified therein.