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(54) **Tubular blank and process for producing a tubular blank**

(57) The invention relates to a tubular blank formed from a substantially planar blank (6), welded along a seam (4). According to the invention, the tubular blank has a

flange (5) that extends in a direction away from said tubular blank, the flange (5) being integral part of the planar blank.

The invention also relates to a process for producing such a tubular blank.

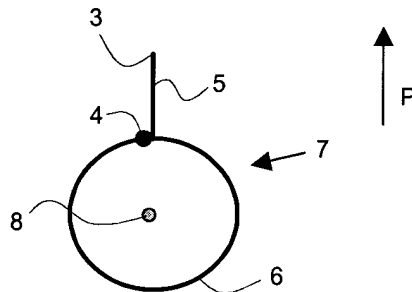


Fig. 2A

## Description

**[0001]** The invention relates to a tubular blank and a process for producing a tubular blank.

**[0002]** The invention further relates to an automotive structural component comprising such a tubular blank.

**[0003]** Tubular blanks are known and are regularly applied in various products, e.g. for structures in the automotive industry. Such tubular blanks can be produced from substantially planar sheets or blanks of metal, e.g. steel that is formed to arrive at the tubular blank. The tubular blanks may comprise tubes with a circular cross-section, but these tubular blanks may have other cross-sections as well, such triangular or square. The cross-section of the tubular blank may vary along its length, such as in a conical tube.

**[0004]** Tubular blanks are often used when the shape of the tube has to be changed, which is often done by using a method known as hydro-forming. In this method, the wall of a section of tube is pressed against a shaped part or die under the influence of, for example, water pressure inside the tube. The hydro-forming technique is generally known and therefore requires no further explanation here. In this way, it is possible to make numerous very complicated shapes, which are used in engineering, for example in the automotive industry.

**[0005]** Hydro-formed tubular blanks are typically attached to other parts to obtain a particular construction, such as the body of a car. Typically the tubular blanks are (spot) welded to such other parts.

**[0006]** It is an object of the invention to provide an improved tubular blank.

**[0007]** It is another object of the invention to provide a tubular blank that can be easier attached to other parts.

**[0008]** This is achieved by a tubular blank formed from a substantially planar blank, welded along a seam, wherein the tubular blank has a flange that extends in a direction away from said tubular blank, the flange being integral part of the planar blank.

**[0009]** The planar blank can be formed such that the flange is obtained, extending from the welded seam. The forming of the planar blank in this way results in a flange with a thickness of only once the thickness of the planar blank. The flange can be used to facilitate attachment of the tubular blank to other parts, such as construction parts of a car.

**[0010]** It should be mentioned that from US 5,070,717 a method for forming a tubular member with a flange is known, in which a tube is pressed between two dies such that part of the tube is compressed to form a flange having a thickness twice the thickness of the wall of the tube. The resulting flange is thus relatively thick. This known method cannot be used for forming a tubular blank with a flange from a planar sheet, and the resulting tubular blank cannot be used for hydro-forming because the double-walled flange would be forced open.

**[0011]** Preferably, the seam has been laser welded.

The laser-welded seam provides a strong connection at the seam, such that the tubular blank can be changed in shape afterwards.

**[0012]** According to preferred embodiments the length and/or the direction of the flange varies along the length of the tubular blank. Thus the flange can be present where it is needed.

**[0013]** The substantially planar blank can be a tailored blank when this is desired for the construction part to be formed.

**[0014]** According to a preferred embodiment the tubular blank with flange has been mechanically or hydraulically deformed, such as by bending or hydro-forming.

**[0015]** The invention further relates to an automotive structural blank comprising a tubular blank as described above. The tubular blank may e.g. form the A-pillar of a cabriolet, wherein the flange is applied to attach construction parts and/or sealing rubbers.

**[0016]** The invention also relates to a process for producing a tubular blank wherein said process comprises the steps of:

- providing a substantially planar blank having a first edge and a second edge;
- forming said planar blank into a formed blank by bringing said first edge in proximity with the blank at a distance of said second edge;
- forming a seam by joining said first edge and said blank such that a part of said formed blank extends in a direction away from said produced tubular blank to form a flange.

**[0017]** As a consequence of this process, the tubular blank comprises the extended part or flange prior to hydro-forming or other forming. Further a relatively thin flange is obtained. This is a relatively simple and cost-effective way to provide a tubular blank with a flange, since the flange is formed while the tubular blank is formed, and the flange does not have to be attached to the tube afterwards.

**[0018]** Specific embodiments of the invention are described in the detailed description of the invention.

**[0019]** The invention will be further illustrated with reference to the attached drawings, which schematically show preferred embodiments according to the invention. It will be understood that the invention is not in any way restricted to these specific and preferred embodiments.

**[0020]** In the drawings:

Fig. 1 shows a substantially planar blank of metal for producing a tubular blank;

Figs. 2A - 2C show examples of tubular blanks with an extended part according to an embodiment of the invention;

Fig. 3 shows a first modification of the tubular blank shown in Fig. 2A;

Fig. 4 shows a second modification of the tubular blank shown in Fig. 2A;

Fig. 5 shows a third modification of the tubular blank shown in Fig. 2A, and

Fig. 6 shows a fourth modification of a tubular blank with an extended part.

**[0021]** In Fig. 1 a substantially planar blank or sheet 1 of metal, e.g. steel, comprises a first edge 2 and a second edge 3 is shown. Although the blank 1 is drawn in two dimensions only, it should be appreciated that the blank 1 has a thickness suitable for the process of the invention. The thickness of the blank 1 may e.g. be in the range of 0,5 - 5,0 mm, e.g. 1,5 mm.

**[0022]** In the process according to an embodiment of the invention, the planar blank 1 is formed, indicated by the arrow A, such that the first edge 2 is brought in proximity to the blank at an imaginary line I at a distance D from the second edge 3. In this way the formed blank 7 is produced. It is noted that the second edge 3 should not necessarily run parallel to the line I, making the distance D variable for a single blank 1. The distance D can be chosen freely over the length of the edge 3. After bringing the first edge 2 in proximity with the formed blank 7, this first edge 2 and the blank are joined to form a seam 4 by laser welding. In this way a tubular blank 6 having an extended part or flange 5 has been formed from the planar blank 1, said flange 5 extending in a direction P away from the tubular blank 6 having a longitudinal axis 8.

**[0023]** Figs. 2A - 2C respectively illustrate possible cross-sections along line C - C of a circle-cylindrical tubular blank 6, a square tubular blank 6 and a triangular tubular blank 6, each having a flange 5 at a seam 4 in a direction P away from the tubular blank 6. It should be appreciated that the flange 5 may build an angle with (the surface of) the tubular blank 6, that is different from that shown in Figs. 2A - 2C.

**[0024]** Figs. 3, 4 and 5 show the tubular blank 6 of Fig. 2A in cross-section along the axis 8, with several variations for the flange 5. It should be appreciated that such variations can also be applied for other tubular blanks 6, such as those illustrated in Figs. 2B and 2C.

**[0025]** In Fig. 3 the length L of the flange 5 varies along the length of the tubular blank 6. In this way the flange 5 can be provided only on locations on the tubular blank 6 where other parts are to be attached. Accordingly the flange 5 is omitted at other locations on the blank 6 where it is not required.

**[0026]** In Fig. 4 the flange 5 is only present along a part of the length of the tubular blank. For such a tubular blank 6, the planar blank 1 of Fig. 1 may be pre-formed to obtain the flange 5 at a pre-determined location.

**[0027]** In Fig. 5 the direction P of the flange 5 varies along the length of the tubular blank, wherein the flange 5 spirals over the surface of the tubular blank 6. This embodiment may e.g. be obtained by forming the substantially planar blank 1 in a spiral wise fashion.

**[0028]** It should be appreciated that other modifications of the tubular blank 6 and/or the flange 5 are possible. The planar blank 1 may e.g. be formed to obtain a tubular blank 6 enclosing a volume with a varying diameter, such as a conical volume. The length L of the flange 5 may vary contrary to the diameter of the tubular blank 6. This is shown in Fig. 6.

**[0029]** The tubular blanks produced by the process described above are preferably modified by hydro-forming to arrive at a blank with a suitable shape that comprises a flange 5. Such tubular blanks may e.g. be used in the automotive industry, such as the A-pillar of a cabriolet. The flange 5 of the tubular blank can be used to attach further components to the blank, such as strengthening parts or sealing rubbers.

### Claims

1. A tubular blank formed from a substantially planar blank (6), welded along a seam (4), **characterised in that** the tubular blank (6) has a flange (5) that extends in a direction away from said tubular blank, the flange being integral part of the planar blank.
2. The tubular blank according to claim 1, wherein the seam (4) has been laser welded.
3. The tubular blank according to claim 1 or 2, wherein said flange (5) is arranged to vary in length (L) along the length of said tubular blank.
4. The tubular blank according to claim 1, 2 or 3, wherein the direction of the flange (5) varies along the length of said tubular blank.
5. The tubular blank according to any one of the preceding claims, wherein the substantially planar blank is a tailored blank.
6. The tubular blank according to one or more of the preceding claims, wherein said tubular blank (6) with flange (5) has been mechanical or hydraulic deformed, such as bended or hydro-formed.
7. An automotive structural part comprising the tubular blank according to any one of claims 1 - 6.
8. A process for producing a tubular blank (6), wherein said process comprises the steps of:
  - providing a substantially planar blank (1) having a first edge (2) and a second edge (3);
  - forming said planar blank into a formed blank (7) by bringing said first edge (2) in proximity with the blank at a distance (D) of said second edge;
  - forming a seam (4) by joining said first edge (2)

and the formed blank (7) such that a part of said formed blank (7) extends in a direction away from said produced tubular blank (6) to form a flange (5).

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9. The process of claim 8, wherein said seam (4) is executed by laser welding.

10. The process of claim 8 or 9, wherein said planar blank (1) is provided and/or formed such that said flange (5) varies in length (L) along the length of said tubular blank (6).

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11. The process of one or more of the preceding claims 9 - 10, wherein said planar blank (1) is provided and/or formed such that the direction of the flange varies along the length of said tubular blank (6).

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12. The process according to one or more of the claims 8 - 11, wherein said process further comprises the step of mechanical or hydraulic deforming said tubular blank (6), such as bending or hydro-forming said tubular blank.

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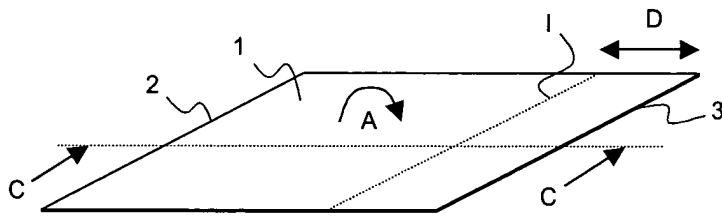


Fig. 1

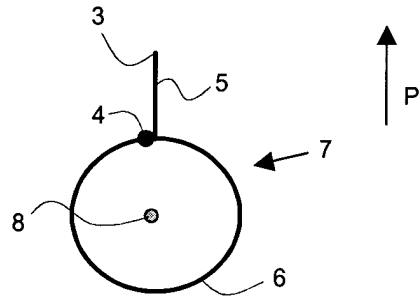


Fig. 2A

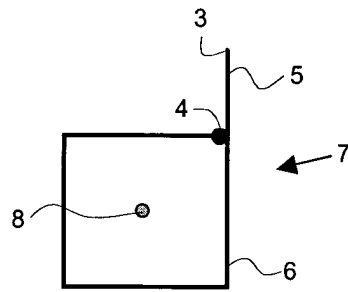


Fig. 2B

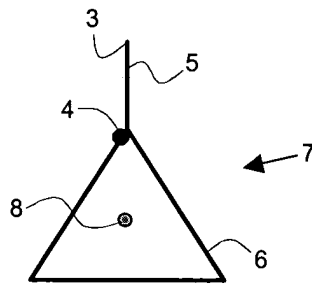


Fig. 2C

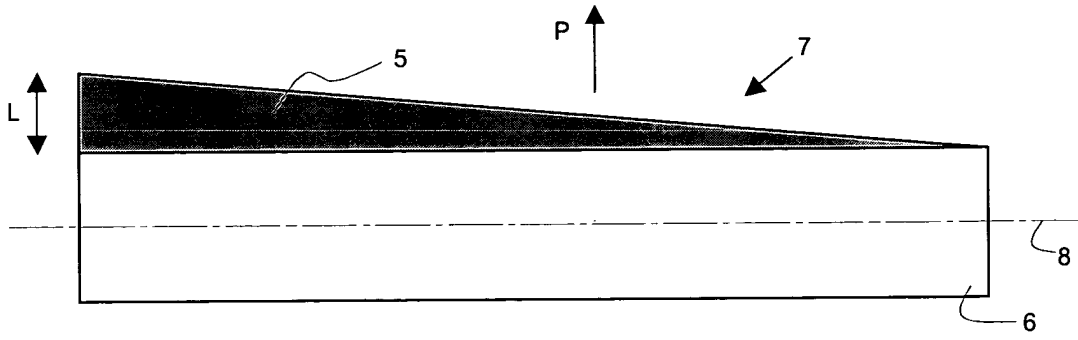


Fig. 3

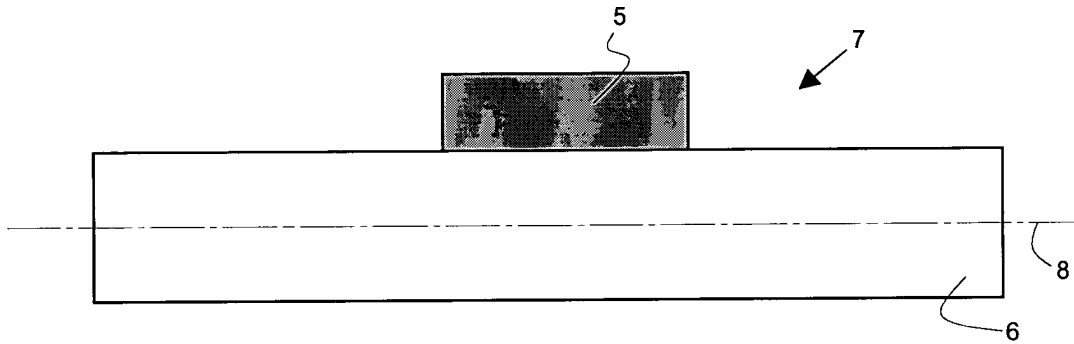


Fig. 4

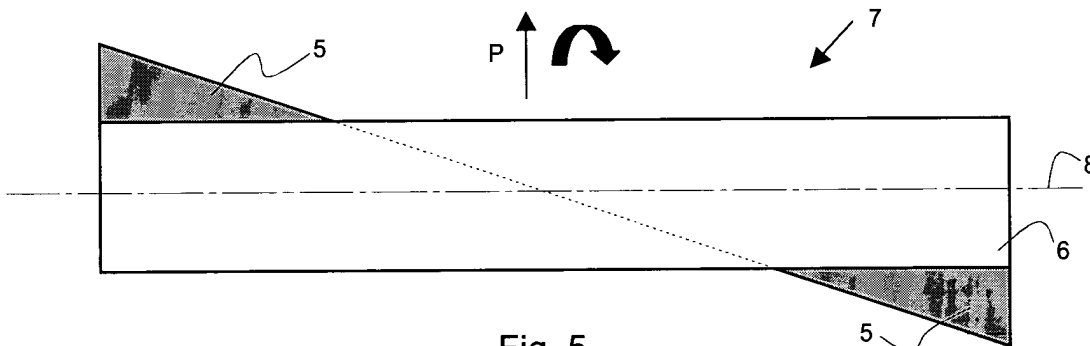


Fig. 5

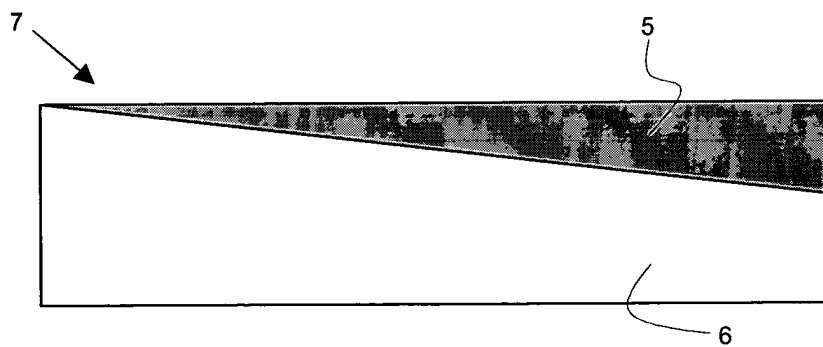


Fig. 6



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Application Number  
EP 04 07 6101

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Place of search Munich		Date of completion of the search 19 July 2004	Examiner Ritter, F
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