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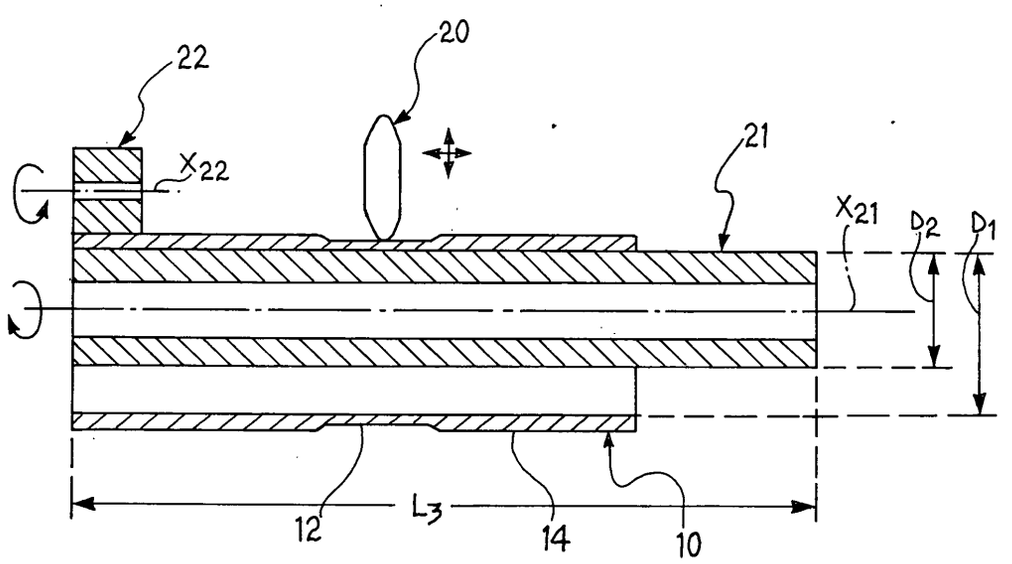
(54) A method for producing a wheel rim for a vehicle

(57) A tubular blank (10) of a constant thickness (s_1) is arranged on an inner counter roller (21) with an outer diameter (D_2) which is significantly smaller than the inner diameter (D_1) of the tubular blank (10). A motor-driven roller (22) is pressed radially against the outside of the blank (10). The outer roller (22) is controlled to rotate, thereby causing the tubular blank (10) and the inner counter roller (21) also to rotate. A forming roller (20), operable to move in a controlled manner through an axial plane, is brought into contact with the outside of the blank (10) in order to obtain a tubular blank with a final axial length (L_2) greater than the initial axial length (L_1) and at least one portion (12) which is thinner (s_2) and axially elongated.

FIG. 4



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Description

[0001] The present invention relates to a method for manufacturing a wheel rim for a motor vehicle, as defined in the preamble to Claim 1.

[0002] In the prior art, wheel rims for motor vehicles are produced from cylindrical blanks. Until recently, rims of constant thickness were produced by shaping cylindrical steel sheet blanks by multiple rolling operations which flared the edges thereof.

[0003] In the last few years, several methods have been put forward for manufacturing wheel rims not of uniform thickness, in order to reduce the weight of the rim and thus cut fuel consumption. In such known arrangements, a so-called spin-forming method is used to manufacture a rim in which certain areas, which are subjected to less stress, are thinner. See for example, US-A-4 962587.

[0004] International Patent Application WO-A-96/25257 describes a method for producing a wheel rim for a vehicle by flow-forming. As shown in Figure 1, a tubular semi-finished piece or blank 10 of a uniform thickness s_1, having a cylindrical wall 11 of a first, predetermined axial length L_1, is first calibrated, causing it to expand in a controlled manner until its internal diameter D_1 reaches a predetermined value which enables the blank to be force fitted, with some radial interference, onto the spindle of a flow-forming machine. The spindle is then rotated, causing the blank also to rotate as a result of friction at the interface of the spindle with the blank. One or more forming rollers, controlled for movement in an axial plane, act on the outer surface of the blank and are moved axially and radially so as to deform this latter. A semifinished blank 10' (see Figure 2) is thus obtained being of an axial length L_2 greater than the initial axial length L_1 and one or more thinner and axially elongated areas 12. The semifinished blank 10' is then flared at its axial edges 10a, 10b and finally put through a series of roll-forming operations which produce a rim 10'' with the required section, as shown in Figure 3 of the appended drawings.

[0005] Other examples of methods such as that described above are known from the patents WO-A-95/11768 and JP-A-2000288669.

[0006] Methods of the type described above involve a first disadvantage arising from the fact that they require a preliminary calibrating operation for stretching the inner diameter of the blank so that it can be force fitted onto the spindle, thereby preventing the blank from rotating relative to its rotating support during rotation of the spindle, thereby compromising the quality of the work.

[0007] Another disadvantage of the prior art is that these methods are not suited to the manufacture of small series of rims, since each diameter of rim requires a spindle of a corresponding diameter.

[0008] The object of the present invention is to provide an improved method able to overcome the disadvantages of the above discussed prior art. In particular, the invention provides a method which is more flexible, and which is able to produce rims of any diameter whatsoever with the same equipment. The invention also provides a method which is more economical as it eliminates the need for the costly calibrating or expansion step required in the prior art before the blank can be spin-formed.

[0009] These and other objects and advantages, which will be better understood later, are achieved according to the invention by providing a method as claimed in the appended Claims.

[0010] A preferred, though non-limitative embodiment of the method of the invention will now be described with reference to the appended drawings, in which:

Figure 1 is an axially sectioned partial view of a tubular blank which is initially of a uniform thickness;
Figure 2 is a schematic view, partly axially sectioned, of a semifinished blank obtained by spin-forming the blank of Figure 1;
Figure 3 is a partly axially sectioned view of a rim obtained from the semifinished blank of Figure 2; and
Figure 4 is an axially sectioned schematic view, on a reduced scale, which illustrates a step in the method of the invention.

[0011] With reference to Figure 1, a tubular blank or partly finished piece is indicated 10, being of a uniform thickness s_1, with a cylindrical wall of a predetermined axial length L_1.

[0012] In order to obtain a rim 10'' such as that shown in Figure 3 from the blank of Figure 1, a method is used which also involves steps which are known per se. This description will therefore only go into detail of the steps or characteristics which are of specific importance and interest in respect of implementing the present invention. The steps which are not described in detail here can be found in any description of the prior art, such as for example WO-A-96/25257, WO-A-95/11768, JP-A-2000288669, US-A-496587 which are incorporated herein by reference.

[0013] The tubular blank 10 is manufactured from a strip of steel sheet, of a width L_1 and a uniform thickness s_1, which is cut into a required length in dependence on the diameter of the rim to be produced; the cut portion of sheet is then bent, its ends are welded edge to edge and the weld area then undergoes further operations (scraping, upsetting, shearing off excess metal, smoothing the edges of the weld area) which are not described here since they are well known in the art.

[0014] With reference to Figure 4, the tubular blank 10 is loaded onto a spin-forming or fluoforming machine in which it is deformed by pressure from a forming roller 20.

[0015] According to the present invention, the tubular blank 10 is inserted onto an inner counter roller, sche-

matically indicated 21 and preferably of a length L_3 greater than the initial length L_1 of the tubular blank 10 and, even more preferably greater than the finished axial length L_2 of the semifinished blank at the conclusion of the spin-forming operation. The external diameter D_2 of the inner counter roller 21 is significantly shorter than the inner diameter D_1 of the tubular blank 10.

[0016] An outer motor-driven roller 22 is driven for rotation about an axis X_{22} parallel to the axis X_{21} of the inner counter roller 21. The outer roller 22 is urged into contact with the outer cylindrical surface of the tubular blank 10, thus clamping the latter against the inner roller and using friction to rotate the blank 10 and the inner roller 21. This latter can either be idle or alternatively, be driven for rotation in the opposite sense to that of the motor-driven roller 22.

[0017] In addition to rotating the blank 10, the motor-driven roller 22 holds it in a precise axial position, preventing it from moving in an uncontrolled manner along the inner counter roller 21 under the action of the forming roller 20.

[0018] In the manufacturing step illustrated in Figure 4, the outer roller 22 engages against an axial end of the tubular blank 10. It should be noted that the roller 22 can be longer axially than is shown in the example of Figure 4.

[0019] The movements of the roller 20 are controlled, in a manner which is known per se, in an axial plane (along an axial or radial direction). The manufacturing and operating characteristics of the forming roller 20 are not in themselves relevant to understanding the invention and are therefore not described in detail here. It is sufficient to explain that in order to make the blank 10 thinner, the forming roller is moved radially, towards and away from the axis X_{21} of the inner counter roller 21, while in order to determine the axial extent of the area to be made thinner, it is moved axially, parallel to the axis X_{21}. Naturally the aforesaid radial and axial movements of the forming roller 20 can be combined in various patterns in order to form variable-section portions 13 in the rotating blank, which join the portions 14 of a greater thickness S_1 and those 12 of the lesser thickness s_2, as illustrated in Figure 2.

[0020] The outer motor-driven roller 22 can also be moved axially in order to enable the forming roller 20 or an additional forming roller (not shown), equivalent to the forming roller 22, to deform the area of the blank which the motor-driven roller 22 was engaged against at the start of the operation. Alternatively, once a portion of the blank has been spin-formed, it can be removed from the inner counter roller and reinserted on it after being turned through 180°, so that the portion which was against the motor-driven roller 22 can be worked.

[0021] On completion of the spin-forming step, the semifinished tubular blank 10' has an axial extent L_2 greater than its initial length L_1.

[0022] Once the various portions of different thicknesses have been formed, in accordance with the requirements of the application, as illustrated by way of example in Figure 2, the blank 10' is removed from the spin-forming machine and undergoes other operations, typically the flaring of one or both axial ends of the blank and roll-forming so as to give the rim the required section.

[0023] It will be appreciated that the method of the invention provides a convenient way to eliminate the conventional preliminary calibration operation, which is required in the prior art in order to fit the blanks onto conventional spin-forming machines.

[0024] It will also be appreciated that, since the diameter D_2 of the inner counter roller is significantly smaller and independent of the inner diameter D_2 of the blank, the method of the present invention makes it possible to spin-form rims of any diameter and axial extent.

[0025] Finally, it should be pointed out that the operations of loading and unloading the blanks onto and from the spin-forming machine are simplified and involve a simple linear movement.

[0026] Naturally, the principle of the invention remaining unchanged, the manufacturing details and embodiments may vary widely from those described and illustrated here, without departing thereby from the scope of the invention, as defined in the following Claims.

Claims

1. A method for producing a wheel rim for a vehicle, including the steps of:

a) first forming a tubular blank (10) of a uniform thickness (s_1) and having a cylindrical wall (11) of a predetermined first axial length (L_1);
b) forming at least one portion (12) of a reduced thickness (s_2) in the said blank by rotating it about an axis of rotation and bringing at least one forming roller (20), movable in a controlled manner through an axial plane, into contact with the outside of the rotating blank, so as to obtain a semifinished blank of a second axial length (L_2) greater than the said first axial length (L_1) and at least one thinner and axially elongate portion (12);

characterised in that the said step b) includes the steps of:

b1) providing an inner counter roller (21) rotatable about its longitudinal axis (X_{21}) and having an outer diameter (D_2) which is significantly smaller than the diameter (D_1) of the tubular blank (10);
b2) arranging the tubular blank (10) on the inner counter roller (21);
b3) providing an outer roller (22) rotatable about its longitudinal axis (X_{22}) parallel to the

axis (X_{21}) of the inner rotatable cylinder (21);
b4) exerting a radial force to bring together the outer roller (22) and the inner roller (21), thereby radially clamping the tubular blank (10) between them;
b5) controlling the rotation of at least one of the said outer roller (22) and inner roller (21) so as to rotate the tubular blank (10) and the other of the said inner roller (21) and outer roller (22).

2. A method according to Claim 1, **characterised in that** the said step b5) includes the step of pressing the outer roller (22) and the inner roller (21) against each other for retaining axially the portion of the blank (10) interposed between the outer roller (22) and the inner roller (21).

3. A method according to Claim 1, **characterised in that** the axial length (L_3) of the inner roller (21) is greater than the first predetermined axial length (L_1) of the tubular blank (10).

4. A method according to Claim 3, **characterised in that** the axial length (L_3) of the inner roller (21) is greater than the said second axial length (L_2) of the tubular blank (10).

5. A method according to Claim 1, **characterised in that** the outer roller (22) is a motor-driven pressure roller which is controlled to rotate during the said step b5).

6. A method according to Claim 5, **characterised in that** the inner roller (21) is also motor-driven and is controlled to rotate during the said step b5) in the opposite sense to that of the outer roller (22).

7. A method according to Claim 1, **characterised in that** the inner roller (21) is idle and is caused to rotate, during the said step b5) by the said radial force which clamps the tubular blank (10) between the outer roller (22) and the inner roller (21).

8. A method according to Claim 1, **characterised in that**, during the said step b5), the outer roller (22) is engaged against a first axial end portion of the tubular blank.

9. A method according to Claim 8, **characterised in that** the said step b5) is followed by the steps of:

- removing the semifinished blank (10) from the inner roller (21);
- turning the blank (10) through 180° in an axial plane; and
- repositioning the blank (10) on the inner roller (21) and engaging the outer roller (22) against a second axial end portion of the tubular blank (10) opposite the said first axial end portion.

10. A method according to Claim 1, **characterised in that** the said step b5) includes the step of moving the outer roller (22) axially along the outer surface of the tubular blank (10) .

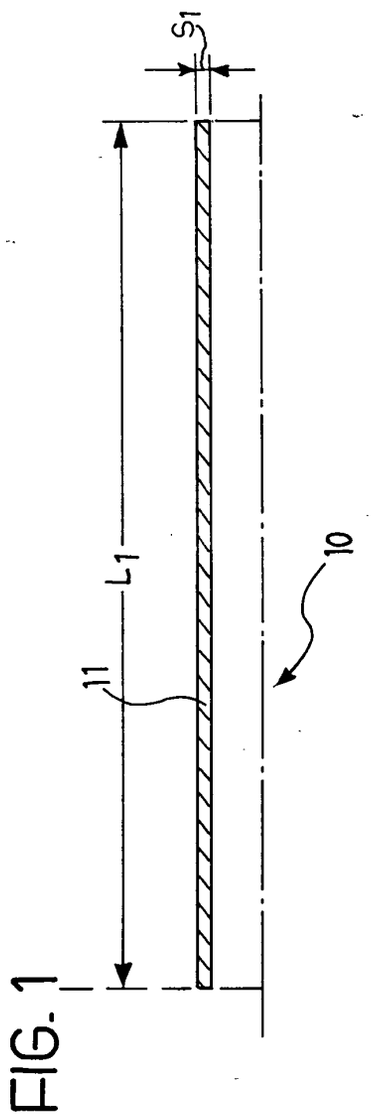


FIG. 1

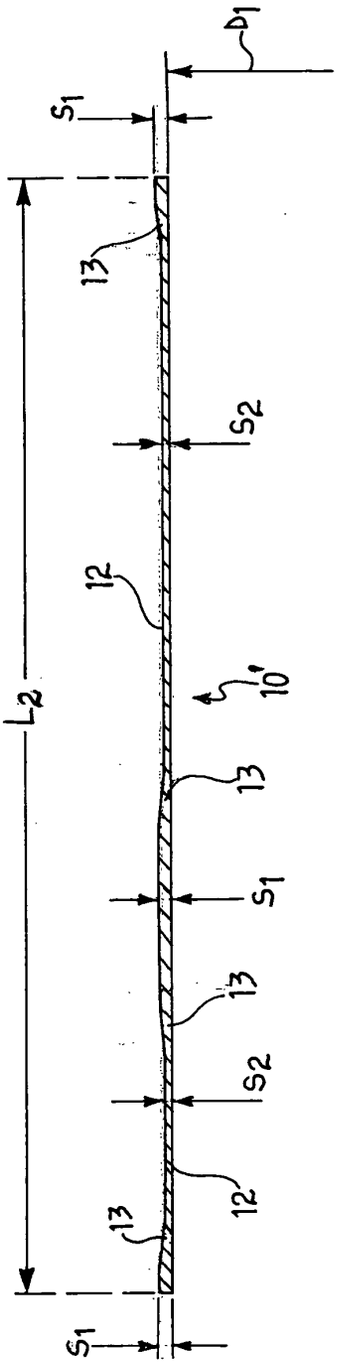


FIG. 2

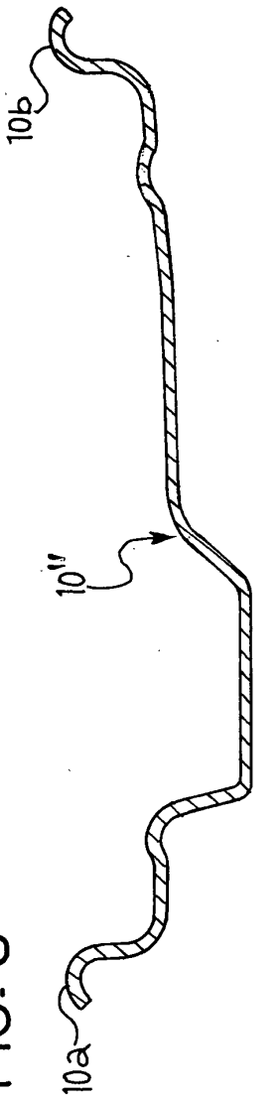
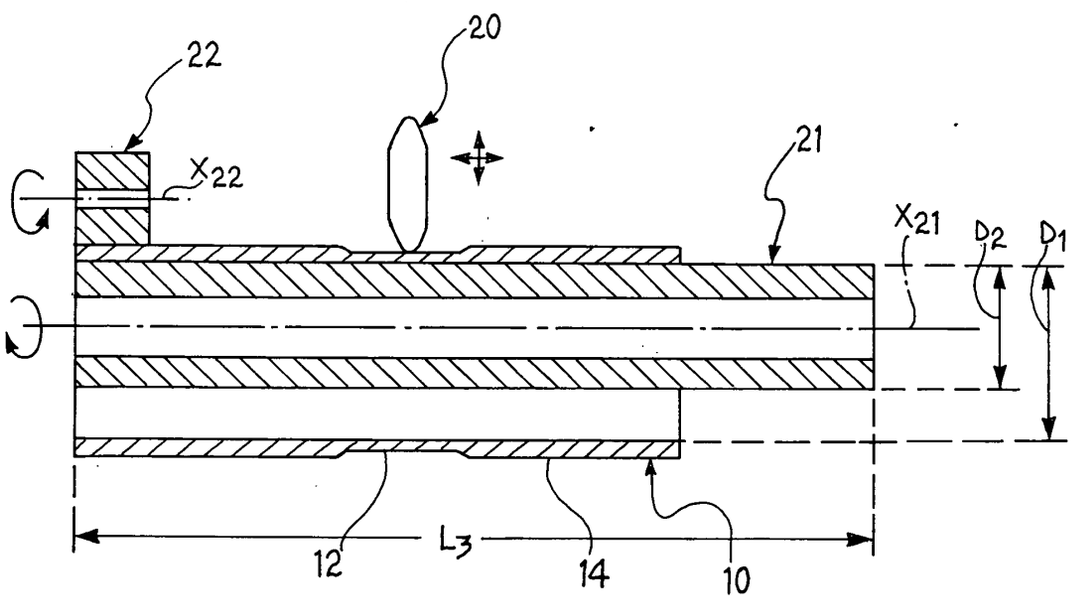


FIG. 3

FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 02 01 5064

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)
B21D
B21H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	27 September 2002	Meritano, L

CATEGORY OF CITED DOCUMENTS

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