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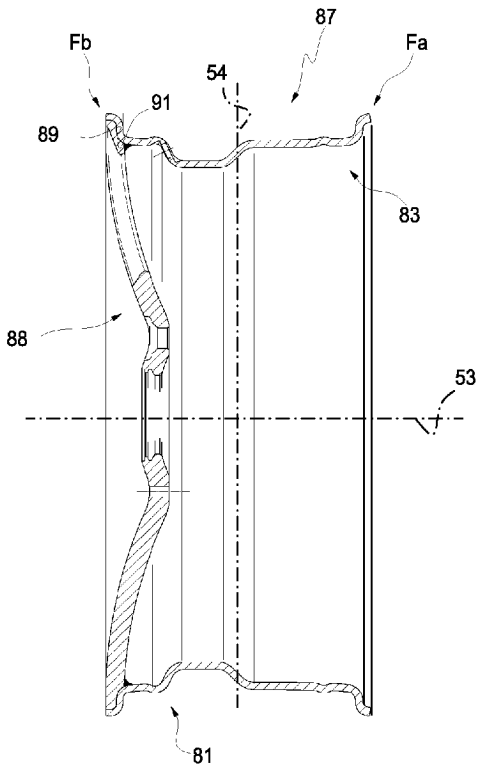

(57) Abstract: Method for producing a light alloy wheel (87) for motorcars or other vehicles, with rim (83) obtained, without welding, from a rolled discoid element (83), through a sequence of cold plastic deformations. The method providing the use of a laminate (62) of an Al-Mg alloy of the 5000 Series, in shape of annealed laminate, with elongation higher than 20%, before the yield stress. The rim (83) has a thickness decreasing from a first edge (Fa) to a second edge (Fb), final hardness of 80œ90 Hb and comprises an angled section (81) in the portion of reduced thickness adjacent to the second edge (Fb).

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"METHOD FOR PRODUCING A LIGHT ALLOY WHEEL AND WHEEL PRODUCED ACCORDING TO THIS METHOD"

Field of the invention

The invention relates to a method for producing a light alloy wheel and the wheel produced according to this method.

More specifically, the invention relates to a method for producing a light alloy wheel for motorcars or other vehicles, with rim or well obtained, without welding, from a rolled disk, through a sequence of cold plastic deformations and the wheel so produced, according to the introductory portions of the main claims.

Background of the invention

The wheels for motorcars or other vehicles and the respective components, as rim or well and fixing flanges, must satisfy severe technical and dimensional requirements, for a safe coupling with the tyres and to assure high resistance to dynamic stresses under overload conditions, impact and corrosion. These requirements are summarized in detailed national and international rules of homologation, to be complied for commerce and use. The homologation rules for the wheels are specifically directed to allow mounting and using of tyres responding to corresponding homologation rules and to ensure airtight to universally used tubeless tyres.

In Europe, the rules of homologation are defined by the European Tyre and Rim Technical Organisation (E.T.R.T.O).

In the field of motorcars and other vehicles as motorcycles and industrial vehicles, the light alloy wheels are appreciated in view of the limited weight which reduces the suspended masses, and for the intrinsic structure which leaves large liberty of design from an aesthetical point of view. In the industrial vehicles, the use of light alloy wheels is advantageous for increasing the paying load, which compensates, in short times, the higher initial costs.

Rim can be an integral element of the wheel itself or a component which, when mechanically joined to other components, forms a divisible wheel. In both cases, for the time being, the rims of light alloy wheels are obtained, in the majority of cases, by means of casting technology. Other methods, rather expensive, provide forging and hot stamping.

Casting technology, as gravity casting, and low-pressure casting present disadvantages including: relatively long times needed for the solidification, high discards of material to guarantee the soundness of the melted casting, and great waste of energy for melting the alloy.

Techniques of lamination for producing rims of light alloy wheels are also known in which the rims are obtained by open formation, following welding along the edges and calibration up to the final dimensions. This technique presents problems due to the fact that the welding of the rim is intrinsically subject to risks of micro-porosity which, in the use and especially in case of impacts, can jeopardize the airtight of the tyres. Moreover, the welding can cause softening of the structure and, therefore, weakening of the adjacent areas.

Patent publications: JP 55114433, JP 57205201, DE 32 15 029 and DE 35 28 362 disclose cold plastic treatments of flat laminates in aluminium alloys, with deep drawing and shearing for producing rims and other components of light alloy wheels. Nevertheless, these techniques, known for decades, have not produced to real industrial results, for practical problems met in complying all the above-mentioned technical requirements.

A method for producing rim or well for wheels in aluminium alloy with deep drawing treatments is known from Patent Application WO 2004/078377, in the name of the Applicant Tecnoforming S.p.A. However, the followed technique, very promising, has given rise to problems connected with the fact that the characteristics of the final product were not exactly predictable and with consequent discards for micro-breaks and structural weakening not overcome by the normal knowledge of deep drawing techniques unless of unacceptable costs.

In effects, the structural requirements of an alloy wheel, directed to endure the static and dynamic stresses of a motorcar or other vehicle, are in contrast with the needs of treatments by plastic deformations, especially for wide base rims.

The provision of high hardness light alloys naturally responds to the structural requirements of motorcar or other vehicle wheels. On the contrary, the hard alloys can cause serious problems both in the production of the rims, and in the assembling of the rims itself with the fixing flanges of the wheel.

On the other hand, the use of light alloys of low hardness has generally been excluded in treatments by plastic deformation relating to wheels with the believing that these alloys are non proper for structurally acceptable results.

Summary of the invention

Object of the present invention is a method for manufacturing wheels in light alloy for motorcars or other vehicles with rim or well, without welding, which ensures a reliable industrial production with relatively low costs and which overcomes the drawbacks of the known methods with a high quality of the final product.

Other object of the disclosure is to accomplish a light alloy wheel with rim without welding, starting from a suitable laminated product, possibly of commercial use, deeply exploiting the properties of ductility, deformability and welding thereof.

According to such objects, the proposed method for producing a light alloy wheel for motorcars or other vehicles provides for the manufacturing of the rim a sequence of cold plastic deformations, using a discoid laminate in an Al-Mg alloy of the 5000 Series, as annealed laminate, with allowed elongation higher than 20% and initial hardness of 50÷70 Hb.

According to another characteristic, the method is directed to produce a light alloy wheel with rim of a predetermined profile, obtained by a rolled disk, through a cold sequence of plastic deformations. The method comprises the steps: a) deep-drawing the rolled disk, forming a hollow cylindrical body with a bottom and an edge folded toward the outside provided to form a first edge of the rim and in which, for the deep drawing, the body has, adjacent to the bottom, a section of wall to reduced thickness; b) shearing the bottom of the hollow body and/or cutting the body so as to obtain a substantially tubular element with a first margin provided to form the first edge of the rim and a second margin, provided to define a second edge of the rim; c) shaping a section of wall adjacent to the second margin of the tubular element for obtaining an edged element with another edge, folded toward the outside, associated with the second edge of the rim; and d) rolling the edged element, forming a basic profile, provided to the definition of the profile for the tyre with the first edge and the second edge of the rim, and in which the basic profile shows an angled section in the section of the wall of reduced thickness, adjacent to the second edge.

According to a further characteristic, the method is directed to produce a light alloy wheel having a rim of predetermined profile, in which the rim is obtained, without

welding, by a rolled disk, through a sequence of cold plastic deformations comprising deep drawing and shearing. The method comprises the further steps of: a) shaping the lateral surface of the unfinished rim according to a basic profile for the rim having lower sections to the final profile; and b) calibrating the rim by stretching through widening of an expander with multiple sectors working on inside sections of the unfinished rim with the basic profile.

According to another characteristic, the light alloy wheel has a rim with a predetermined profile for the tyre, in which the rim is obtained by a rolled disk through a cold sequence of plastic deformations including deep drawing. Suitably, the rim has different thicknesses caused by the drawing and comprises an angled section in the section of wall of reduced thickness adjacent to one of the edges.

The light alloy wheel has a rim of a predetermined profile for the tyre obtained, without welding, through a sequence of cold plastic deformations from a rolled disk. The rim comprises, on a profile opposite to the support profile for the tyre, thickened portions indicative of calibration through a multiple sector expander.

According to a further characteristic, the light alloy wheel includes a rim and a fixing flange obtained through plastic deformations and in which the rim defines an edge rim and a bead seat, of support for a bead of the tyre, having a predetermined external profile. The fixing flange has, at the periphery, a flange edge with a profile complementary to the external profile of an edge rim, and the complementary profile of the flange is coupled with the external profile of the edge rim whilst a terminal portion of the complementary profile is welded to a portion of the external profile of the edge rim, opposite to the bead seat..

Brief description of the drawings

The characteristics of the invention will become clear from the following description given purely by way of non-limiting example, with reference to the appended drawings in which:

Figs. 1 and 2 represent, according to a known technique, a method for producing light alloy wheels, in detail for a rim or well without welding, and, respectively, the semi-finished result, in an initial step;

Figs. 3 and 4 show a step following the step of the method of fig. 1 and the semi-finished product;

Figs. 5 and 6 represent another step of the production method of fig. 1 and the respective semi-finished product;

Figs. 7 and 8 show a further step of the method of fig. 1 and the rim or well produced according to that method;

Fig 9 represents the shaping of a light alloy rim, with evidence of some basic elements considered by international rules (E.T.R.T.O.);

Fig 10 shows the section of a light alloy wheel for motorcars according to known (E.T.R.T.O) rules;

Figs. 11, 12 and 13 represent semi-finished products for a rim of light alloy wheel in different steps of the production method according to the invention;

Fig 14 is a section of a rim or well for a light alloy wheel according to the invention;

Fig 15 represents a front view of a portion of rim or well for a light alloy wheel according to the invention;

Fig 16 shows a partial section of a light alloy wheel according to the invention;

Figs. 17, 18, 19, 20 and 21 represent semi-finished products of a fixing disk or flange for light alloy wheel in different steps of the method according to the invention;

Fig 22 shows a front view of a light alloy wheel according to the invention;

Fig 23 is a section of the light alloy wheel of Fig. 22;

Fig 24 represents another fixing flange for the light alloy wheel of the invention;

Fig 25 shows a front view of another light alloy wheel according to the invention and using the flange of Fig. 24; and

Fig 26 is a section of the light alloy wheel of Fig. 25.

Detailed description of the preferred embodiments

Figures 1÷8 represent some steps of a method for producing light alloy wheel and, in detail, for a rim or well without welding and the obtained products, according to a known technique. This technique is the subject of Patent Application WO 2004/078377, in the name of the Applicant: Tecnoforming S.p.A, herein incorporated by reference.

In synthesis, the method of the Application WO 2004/078377 provides the use of a plate in an aluminium alloy, punch sheared as disk 31 (Fig. 1). The disk 31 is deep

drawn with a press 32 provided of punch 33, to obtain a hollow cylindrical body 34 (Fig. 2) with a bottom 36 and an externally folded edge 37. After the drawing, the excess portions of the body 34 are cut with using a press 38 (Fig. 3) provided of a shearing die 39. After shearing, the body 34 (Fig. 4) presents a basic edge 41 folded to the outside and, by the opposite part, a bottom edge 42 folded to the inside. Then, the edge 42 is straightened in a step not shown.

A press 43 (Fig. 5) with a punch 44 and a die 46 re-edges the lower portion 47 of the body 34 defining another edge 48 (Fig. 6) opposite the basic edge 41 and also folded to the outside. The body 34 is submitted to calibration and it is finally shaped with a specific machine and a shaping die 49 (Fig. 7), defining a rim 51 (Fig. 8) according to requested profile.

Figure 9 represents a rim or well 52 for light alloy wheels of motorcars or other vehicles, having diameter "D" and width "W". According to the rules E.T.R.T.O, the rim 52 presents as basic elements, edges or rim flanges Fa and Fb, tapered bead seats Sa and Sb for the beads of the tyres, humps Ha and HB, a well Wr, an axis 53 and a geometrical median surface 54 between the edges Fa and Fb. The well Wr is offset with respect to the median surface and is joined with one of the humps through a substantially cylindrical section Cp. The diameter "D" and the width "W" of the rim 52 are referred to a geometric intersection calculated in conventional way between the tapered bead seats Sa and Sb and respective inside surfaces of the edges Fa and Fb.

In dependence on the various typologies of wheel, the rules E.T.R.T.O point out the mutual relationships between the various basic elements: Specifically, the rim 52 of figure 9 is known as Wide Drop Center Rim with hump, of diameter "D" and width "W" and in which the tapered bead seats Sa and Sb are defined by a generating line with inclination of 5° with respect to the axis 53.

A light alloy wheel 55 for motorcars, of "Full Face" type according to rules E.T.R.T.O. is represented in figure 10: The wheel uses a rim 56 similar to the rim 52 of Fig. 9 and a flange 57 of fixing to the hub of the motorcar. The flange 57 include spokes 58 and a central portion 59 with holes 60 for bolts of fixing to the hub and a central hole 61 for a finishing disk. The wheel 55 is known, for instance, from US Patent 6,481,804 assigned to the ATP Ruote in Lega S.p.A. and is obtained, according to a known technique, through a single casting for the rim 56 and the fixing flange 57.

The method of the invention is efficiently used for producing wheels, exemplarily but not exclusively, of the previously described type with diameters of 14"÷25" and widths provided by the E.T.R.T.O. rules.

According to the invention, the method for the producing of the rim provides a sequence of cold plastic deformations, comprising deep drawing, shearing and/or cutting and rolling.

After complex experimentations it has been surprisingly found that the optimal material for producing the wheel is constituted by a flat laminated 62 (Fig. 11) , conveniently selected, in an alloy of Al-Mg of the Series AA 5754, as annealed laminated for strain hardening. In detail, the alloy has a 2,7÷3,3% Mg, hardness of 50÷70 HB, for instance conventionally equal to 60 HB, and such to guarantee a minimum elongation of 20% in the three directions before the yielding.

A given number of disks 63 are obtained, for instance by punch shearing, from the laminated 62, in rectangular sheets of industrial dimensions: the diameter of the disks 63 is associated to the dimensions and the typology of the rims to be manufactured.

The selected laminate presents characteristics which, with the solutions of the present invention, allow to effectively producing alloy wheels which fully satisfy the rules of homologation. The deep drawing and the other operations of plastic deformation improve in substantial way the structural characteristics. In detail, the hardness of the angled portions of the rim results particularly high, ensuring, in the final product, high resistance to the biggest binding stresses and impacts, with maintaining of these features constant in the time.

The step of deep drawing is executed on a disk 63 so as to obtain a hollow cylindrical body 64 (Fig. 12) with a bottom 66, a cylindrical portion 67 and a basic edge 68 folded toward the outside, provided to form a first edge of the rim. The press can be similar to the press 32 of Fig. 3 and the deep drawing is suitably effected leaving that the thickness of the cylindrical wall 67 reduces progressively of $-\Delta 1\%$ toward the bottom 66 with respect to a median surface 69, while the thickness of the basic edge 68 increases of $+\Delta 2\%$ with respect to the median surface 69. For instance, the overall differences in the thickness can be of about ±20%.

After the drawing, the bottom 66 and the exceeding portions of the basic edge 68 are sheared or cut so as to obtain a substantially tubular element forming a first margin provided to define a first edge of the rim. In not shown steps of the process, the edge

obtained from the bottom 66 is straightened and is cut to form a second margin. Further, the cutting for the second margin is suitably calculated so as to constitute, in the finished rim, the margin of the second edge.

The portion of the tubular element adjacent to the second margin is refolded toward the outside, forming another edge provided to define the second edge of the rim. The cut and edged body, represented with 71 (Fig. 13), will show a tubular structure with an externally folded (basic) edge 72, a cylindrical portion 73 and another edge 74 facing outwards from the part opposite the edge 72.

Thus, the corresponding thickness of the section adjacent to the edge 74 will be reduced with respect to the section adjacent to the edge 72. As non limitative example, for a 17" wheel produced from a laminate 62 of 6 mm, the resulting thickness of the edge 72 will be of about 8 mm, whilst the thickness of the edge 74 will be of about 5,5 mm.

Optionally, the drawing of the body 64 can be followed by the step of a fluoforming process in the cylindrical portion provided for defining the sections of the rim subject, in the use, to reduced stresses. This treatment is directed to reduce the thickness on the central portions of the body 71, to the end of lightening the rim itself. Naturally, the used material will be reduced and, for instance, in the 17" wheel the thickness of the cylindrical section "Cp" can be reduced up to about 3 mm.

The cut and edged body 71 is then shaped by means of a specific machine, for instance by rolling, forming a semi-finished rim 76 (Fig. 14), with intermediate profiles having external sections of few less with respect to the sections of the profile for the tyre of the finished rim.

According to a characteristic of the invention, the profile of the semi-finished rim 76 is formed by obtaining the intermediate profiles for the edge Fa, the bead seat Sa, and the hump Ha in a section 77, and the cylindrical section Cp in a section 78. The sections 77 and 78 of greater thickness correspond to the basic edge 72 and to the section adjacent to the cylindrical wall 73. The intermediate profiles for the edge Fb, the seat Sb, the hump Hb and a side of the well Wr adjacent to the hump Hb are obtained in a section 79 of smaller thickness of the cylindrical portion 73 adjacent to the other edge 74, while the remaining intermediate profiles of the well Wr are obtained in a section of medium thickness.

With this shaping, the sections of rim for wheels of motorcars or other vehicles, for instance according to the rules E.T.R.T.O, including the edge Fb, the tapered bead seat Sb and the hump Hb closest to the well Wr define a profiled or angled section 81 which extends for a limited axial distance. It intrinsically causes an increased rigidity of this section, which is substantially equal to the rigidity of the sections of greater thickness, including the elements Fa, Sa and Ha farthest from the well Wr.

The shaping of the basic elements: Fb, Sb, HB and of portions of the well Wr with formation of the angled section 81 in the section 79 of reduced thickness, compensates the smaller resistance caused by the thinning with respect to the sections 77 and 78. Therefore, under operational conditions and conditions of overload or impact, the edge Fb of the section 79 has a resistance of few less of the resistance of the edge Fa of the thickest sections 77 and 78.

According to the invention, the rim 76 is subsequently calibrated by stretching, obtaining a finished rim 83 (Figs. 15 and 23). To this end, a multi-sector expander is used to work on internal sections of the semi-finished rim 76 opposite the sections of the elements Sa and Sb, Ha and Hb and Wr. The expander is widened by hydraulic control, causing a stretching of the rim 76 up to reaching the external sections of the standard profile of the elements Sa and Sb, Ha and Hb and Wr, of acceptance for the tyre. The stretching leaves a plurality of thickened portions 84 on the profile opposite the standard profile in the finished rim 83. These portions have width of about 5÷10 mm and thickness of some tenth of mm, having no functional influence, but being indicative of the calibration by expansion. The final hardness of the rim 83 will be of 80÷90 HB for a thickness of 3÷8 mms in wheels of 14"÷25" and in which the smaller thickness is associated to the lightening of the less stressed central portions of the wheel.

According to another characteristic, the method for producing the wheel of the invention relates to a particular structure of the fixing disk or flange and its integration with the rim. A wheel, of "Full Face" type, is represented with 87 in the figures 22 and 23 and uses, for instance, the above described rim 83 and a flange or fixing disk 88.

The flange 88 has an edge with a surface 89 (Fig. 16) whose profile is complementary to the profiles of external surfaces 91 and 92 of the rim 83. The surface 91 is adjacent to the edge Fb, while the surface 92 is opposite the seat Sb of the rim. The surface 89 of the flange 88 has a cylindrical section, which is slightly forced in a corresponding

section of the surface 91. Moreover, the flange is welded to the rim 83, from the inside, in an area non-visible in the use, between a portion of the surface 89 and the surface 92.

With this structure, the external edge Fb of the wheel results hardly strengthened. In the specific case, the strengthening of the edge Fb determined by the coupling with the flange 88 and the welding will be clearly prevailing on the smaller resistance due to the reduced thickness of the edge Fb, and the wheel results of full reliability.

As far as the fixing disk or flange 88 it concerns, the production method provides plastic deformations by fluoforming process and shearing on a laminate of aluminium alloy, for instance of the thickness of 15 mm. A central holed disk 93 (Fig. 17) is obtained from the laminate, for instance by punch shearing, to be used for wheels of different diameters, for instance wheels of 16" and 17". The disk 93 is deep drawn (Fig. 18) and subsequently sheared, as intermediate disk 94 (Fig. 19), with fitting to the diameter of the rim to be coupled and shearing of openings of ventilation 96 and respective undercuts 97.

The disk 94 is further deep drawn with partial formation of seats 98 for bolts of fixing as blank disk 99 (Fig. 20). Finally, the disk 99 is machine worked on the peripheral edge so as to define the surface 89 (Fig. 21) complementary to the surfaces 91 and 92, and seats for nuts 101, assuming the shape of the final flange 88.

The assembling between the rim 83 (Fig. 22) and the flange 88 is performed by forcing the cylindrical portion of the surface 89 in the cylindrical portion of the surface 91, after suitable heating of the rim. Thereafter, a welding 102 (Figg. 16 and 23), for instance by means of a plasma torch, is executed between a terminal portion of the surface 89 and the surface 92. In the wheel 87 (Fig. 22) manufactured according to the above process, the welding 102 is not visible from the face visible in the use and the area of junction between disk 88 and rim 83 is recognizable a circular trace 103, corresponding to the coupling by forcing, which does not disturb the general drawing of the wheel as being similar to other structural or decorative lines of the disk itself.

The rim produced according to the method of the invention is also applicable, in optimal way, to wheels different from the "Full Face" wheels and to wheels, which use fixing flanges 106 (Fig. 24), having spokes with independent end, or shaped flanges, not shown in the drawings, having deep drawn connecting surfaces. The spoked flanges can be exemplarily produced by casting in view of the liberty of shapes

offered by these techniques. A light alloy wheel of this type has been represented with 107 in the figures 25 and 26.

The wheel 107 uses a rim 108 identical to the above-described rim 83, with a cylindrical portion "Cp" between the well Wr and the edge Fa and reduced thickness from the edge Fa to the edge Fb. However, the fixing flange is not welded to the thin portion of the rim 108.

Specifically, the flange 106 includes a series of spokes 109, in which each spoke presents an end 111 with a profile complementary to the profile of the section 78 regarding the cylindrical portion "Cp". The flange 106 is warm forced against the surface of the portion "Cp" opposite the support surface for the tyre and is made integral with the rim through a welding 112, non-visible from the face of the wheel, in a section included between the well Wr and the portion "Cp". In the flange with drawn connecting surface (not shown), the connecting surface will have complementary profile and will be welded from the inside to the profile of the section 78.

The wheel 107 can be finished with a plate of stainless steel 113 shaped so as to follows, in complementary way, the visible surface of the rim 83 adjacent to the edge Fa. The plate 113 is mechanically upsetted or chamfered to the wheel in the manner described in the cited US Patent 6,481,804 of ATP Ruote in Lega S.p.A.

A flange, also of continuous edge, can be fixed to the rim 108, by welding the edge in a section of the rim between the well and the thickest edge Fa.

Also the structures of the wheel 107 or of wheels with flange welded to the thick portions of the rim they are fully reliable, for the high thickness of the edge Fa and for the intrinsic resistence of the angled section adjacent to the edge Fb.

Naturally, the principle of the invention remaining the same, the embodiments and the details of realization can be widely varied with respect to what has been described and illustrated, by way of non limitative example, without by this departing from the scope of the present claimed invention.

In alternative to the alloys of the Series AA 5754, laminated in an Al-Mg alloy of the Series 5000 (5xxx) with greater quantities of Mg, of the 5 order% can be used. These alloys guarantee allowable elongations greater than 25%, excellently response to the various steps of treatment previously described and give rise to rims weldable to the

respective fixing flanges and fully responding to the prescribed rules of use for wheels of motorcars and other vehicles.

In the case of lightened rims, in alternative to the fluoforming process, machine working on the finished rim can be executed, to reduce the thickness of the less stressed portions, as the well "Wr" and the cylindrical portion "Cp."

Machine working of the rim can be also provided, in alternative to calibration by stretching, by rolling the tubular element up to an intermediate profile of few greater of the final profile and reaching this profile by removal of the excess portions.

The method of the invention can also be used effectively for wheels of industrial vehicles, by using laminated of greater thickness and fixing flanges of different structure welded to the cylindrical portion "Cp". This method can also be used effectively for wheels of motorcycles.

Finally, the flange having the edge with profile complementary to the edge of the rim can also be used in alloy wheels providing rims manufactured by rolling and welding.

What is claimed is

1. A method for producing a light alloy wheel (87) for motorcars or other vehicles, with rim (83) obtained, without welding, from a rolled discoid element (83), through a sequence of cold plastic deformations; the said method being characterized by the fact that the used laminate (62) is an Al-Mg alloy of the 5000 Series, in shape of annealed laminate, with allowable elongation higher than 20% and initial hardness of 50÷70 Hb.

2. Method for producing a rim (83) according to claim 1, characterized by the fact that the alloy of the rolled element (62) is of the AA 5754 Series.

3. Method for producing a rim (83) according to claim 1, characterized by the fact that the alloy of the laminate (62) has a quantity of Mg of 2,7÷5,0%, conventional hardness of 60 Hb. and final hardness of 80÷90 Hb.

4. Method for producing a rim (83) according to claim 1, characterized in that the sequence of deformations provides a deep drawing of the rolled element (63), with formation of a hollow cylindrical body (64) having a bottom (66), a lateral wall (67) and a basic edge (41), in which the basic edge is folded toward the outside for the formation of a first edge (Fa) of the rim and in which said wall has a thickness reducing toward the bottom, the said method further providing at least a shearing and/or a cutting operation for shaping a margin to form a second edge (Fb) of the rim.

5. Production method according to claim 4, for a rim (83) of the type with an axially asymmetric well (Wr), such that a side of the well is closest to one of the edges (Fb), the said method being characterized by the fact that the sequence of deformations provides a rolling operation directed to shape a support profile (Sb) for the tyre including said side in the reduced thickness, with definition of a respective angled structure (81).

6. Production method according to claim 4, for a rim (83) of the type with bead seats (Sa, Sb) with inclined profile and humps (Has, Hb) between well (Wr) and edges (Fa, Fb), characterized by the fact that the bead seat (Sb) and the hump (Hb) between well and second edge (Fb) of the rim are obtained in the wall (67) with reduced thickness.

7. Method for producing a light alloy wheel according to claim 1, characterized by the fact that it provides the assembling of the said rim (83) with a fixing disk or

flange (88) having a peripheral edge (89) with a profile complementary to a section of the said rim.

8. Production method according to claims 4 and 7, characterized by the fact that the peripheral edge (89) of said flange (88) is complementary to a surface (91) adjacent to the second edge (Fb) of the rim (83) and it is settled by contrast from the inside with a terminal portion of the said surface, adjacent to the second edge.

9. Method for producing a light alloy wheel according to claim 4, characterized by the fact that the wheel provides a spoked fixing flange (106) or a flange with a deep drawn connecting surface and in which the spokes or the connecting surface of the said flange are welded in a section of the rim (83) included between the well (Wr) and the first edge (Fa).

10. Method for producing a light alloy wheel according to claim 1, characterized by the fact that it is applied to wheels by 14" to 25", according to current rules (E.T.R.T.O.) for motor cars.

11. Method for producing a light alloy wheel according to claim 1, characterized by the fact that it is applied to wheels for motorcycles.

12. A light alloy wheel (87) for motorcars or other vehicles, with rim (83) of a predetermined profile for the tyre, obtained, without welding, from a rolled, substantially planar, discoid element (83) through a sequence of plastic deformations, the said wheel being characterized by the fact that the rim is accomplished in an Al-Mg alloy, in a laminate (62) of the 5000 Series, for a final thickness included between 3 mm and 8 mm and a hardness of 80÷90 Hb, in condition of use.

13. Light alloy wheel according to claim 12, characterized by the fact that the laminate (62) is of AA 5754 Series.

14. Wheel according to claim 12, characterized by the fact that the rim (83) has a thickness decreasing from a first edge (Fa) to a second edge (Fb) and comprises an angled section (81) adjacent to the second edge, said rim including a well (Wr) in an axially asymmetric position between the edges (Fa, Fb) and such to define a shortest section between the second edge and the well and which defines said angled section.

15. Wheel according to claim 12, characterized by the fact that the rim (83) has a thickness decreasing from a first edge (Fa) to a second edge (Fb) and comprises an angled section (81) adjacent to the second edge, said wheel comprising a fixing disk

or flange (88) having a peripheral edge (89) with a profile complementary to a section of the rim adjacent to the second edge and in which said profile is welded by contrast, from the inside, to the section of the rim adjacent to the second edge.

16 Light alloy wheel according to claim 12, characterized by the fact that it is provided for use in motorcycles.

17. Wheel (107) according to claim 12, characterized by the fact that the rim (83) has a well (Wr) in an axially asymmetric position between the edges (Fa, Fb) and such to define a longest section between the first edge (Fa) and the well, in which said rim has a thickness decreasing from the first edge (Fa) to the second edge (Fb) and comprises an angled section (81) adjacent to the second edge, said wheel including a fixing flange (106) with spokes (109), and in which said spokes are welded to the longest section of greater thickness of the rim between the first edge and said well (Wr).

18. Wheel according to claim 12, characterized by the fact that said rim (83) shows, on a profile opposite to the support profile for the tyre, a plurality of thickened portions (84) indicative of a process of calibration by expansion.

19. A method for producing a light alloy wheel (87) with rim (83) of a predetermined profile, obtained from a rolled disk (63), through a cold sequence of plastic deformations, the said method being characterized by the fact that comprises the steps:

a) deep-drawing the rolled disk (63), forming a hollow cylindrical body (64) with a bottom (66) and an edge (84) folded toward the outside provided to form a first edge (Fa) of the rim and in which, for the deep drawing, said body has, adjacent to the bottom, a section of wall (67) to reduced thickness;

b) shearing the bottom (66) of the said hollow body and/or cutting the hollow cylindrical body so as to obtain a substantially tubular element (71) with a first margin (72) provided to form the first edge (Fa) of the rim and a second margin (74), provided to define a second edge (Fb) of the rim;

c) shaping a section of wall (67) adjacent to the second margin of the tubular element for obtaining an edged element with another edge, folded toward the outside, associated with the second edge (Fb) of the rim; and

d) rolling the edged element, forming a basic profile (76), provided to the definition of the profile for the tyre with the first edge and the second edge of the rim, and in

which the basic profile shows an angled section (81) in a section of the wall (67) of reduced thickness, adjacent to the second edge (Fb).

20. Production method according to claim 19, characterized in that the used laminate (62) is an Al-Mg alloy with allowed elongation greater than 20%.

21. Method according to claim 19, characterized in that said second edge (Fb) is obtained from the wall (67) of reduced thickness and in which, with respect to an axially median section of the rim (83), the first edge (Fa) has a thickness increased of 10÷20%, while the second edge has a thickness reduced of 10÷20%.

22. Method according to claim 19, characterized by the fact that it further provides:

e) obtaining a fixing flange (88) of the wheel, having a peripheral section with a profile (89) complementary to a section of the rim (91) adjacent to the second edge (Fb); and

f) welding, by contrast from the inside, said complementary profile on the second edge of the rim.

23. Method for producing a light alloy wheel according to claim 19, characterized by the fact that the rolling is directed to form an intermediate profile (76) having sections smaller with respect to the sections of the final profile, said method comprising the further step:- calibrating the said rim (83), through a multiple sector expander sectors, by widening of internal sections of the rim to be calibrated.

24. Method according to claim 19 for a rim (83) having a well (Wr) in asymmetric position between the edges and a tapered bead seat (Sb) with inclination of 5° between well and a closest edge (Fb), characterized by the fact that said tapered bead seat is formed in the section of the wall (67) with reduced thickness.

25. A light alloy wheel (87) having a rim (83) with a predetermined profile for the tyre, in which said rim is obtained by a rolled disk (63) through a cold sequence of plastic deformations including deep drawing, said rim being characterized by the fact that it has different thicknesses caused by the deep drawing and it comprises an angled section (81) in correspondence of a section of wall (67) of reduced thickness adjacent to one (Fb) of the edges (Fa, Fb).

26. Wheel according to claim 25, in which the rim (83) is in an Al-Mg alloy of the 5000 Series, with 2,7÷5,0% of Mg and permissible elongation greater than 20%.

27. Light alloy wheel according to claim 25, characterized in that the edges (Fa, Fb) have different thickness and the reducing is included between 20% and 40% with respect to the thickness of the edge of greater thickness (Fa).

28. A method for producing a light alloy wheel (87) having a rim (83) of given profile, in which said rim is obtained, without welding, by a rolled disk (63), through a sequence of cold plastic deformations comprising deep drawing and shearing; the said method being characterized by the fact that it comprises the further steps:

g) shaping the lateral surface of the unfinished rim according to a basic profile (76) for the rim having lower sections to the final profile (83); and

h) calibrating the rim by stretching through widening of an expander with multiple sectors working on inside sections of the unfinished rim with the basic profile.

29. Production method according to claim 28, characterized in that the used laminate (62) is an Al-Mg alloy of the 5000 Series, with allowable elongation greater than 20%.

30. Method for producing a light alloy wheel according to claim 28, characterized by the fact that the rim (83) is stretched for a temporary profile of sections greater and pre-defined with respect to the sections of the final profile (83) and in which said final profile is obtained by elastic return after narrowing of the said expander.

31. A light alloy wheel (87) with rim (83) of a predetermined profile for the tyre obtained, without welding, through a sequence of cold plastic deformations from a rolled disk (63), the said rim being characterized by the fact that it comprises, on a profile opposite to the support profile for the tyre, thickened portions (84) indicative of calibration through a multiple sector expander.

32. Wheel according to claim 31, in which the rim (83) is in an Al-Mg alloy of the 5000 series, with 2,7÷5,0% of Mg and allowable elongation greater than 20%.

33. A method for producing a light alloy wheel (87) having a rim (83) and a fixing flange (88) obtained for plastic deformations, in which the rim defines a reference edge rim (Fb) and a bead seat (Sb), of support for a bead of the tyre, having predetermined external profiles, the said method being characterized by the fact that it comprises the steps:

a) shaping the fixing flange (88) so as to define, at the periphery, a flange edge with a profile (89) complementary to the external profile of the edge rim (Fb);

b) coupling the complementary profile of the flange edge with the external profile of the reference edge rim; andc) welding a terminal portion of the said complementary profile of the edge flange with a portion of the external profile of the rim, opposite to the bead seat (Sb).

34. Wheel according to claim 33, characterized by the fact that the rim (83) is made of an Al-Mg alloy of the 5000 Series, with 2,7÷5,0% of Mg and elongation greater than 20% before yield stress.

35. A light alloy wheel (87) with rim (83) and fixing flange (88) obtained through plastic deformations, in which the rim defines an edge rim (91) and a bead seat (Sb), of support for a bead of the tyre, having a predetermined external profile, the said wheel being characterized by the fact that the fixing flange has, at the periphery, a flange edge with a profile (89) complementary to the external profile of the edge rim (Fb), and in which the complementary profile of the flange is coupled with the external profile of the edge rim whilst a terminal portion of the said complementary profile is welded to a portion of the external profile of the edge rim, opposite to the bead seat.

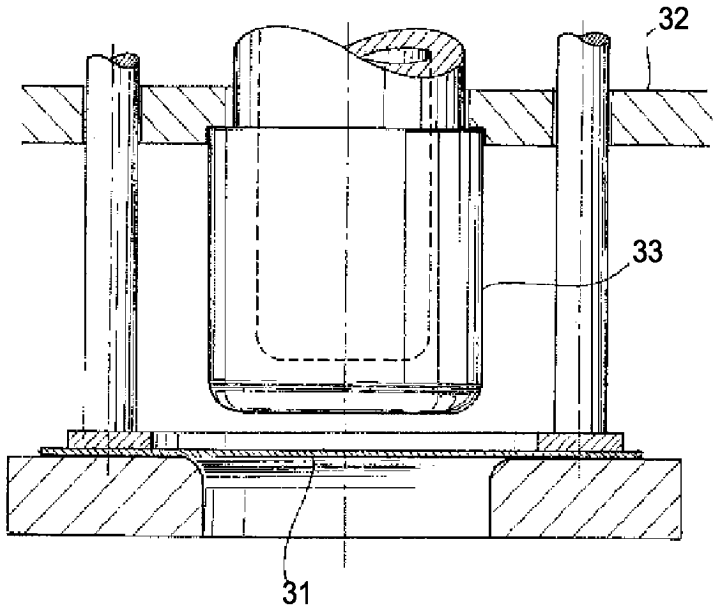


Fig. 1

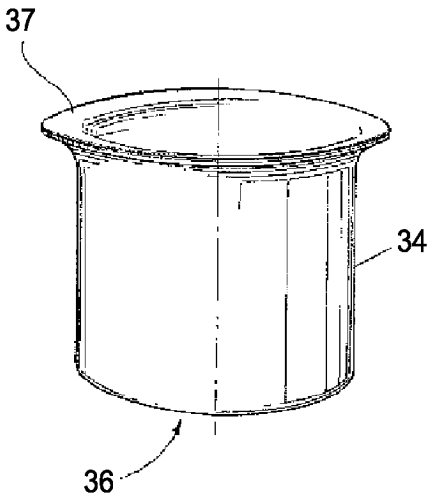


Fig. 2

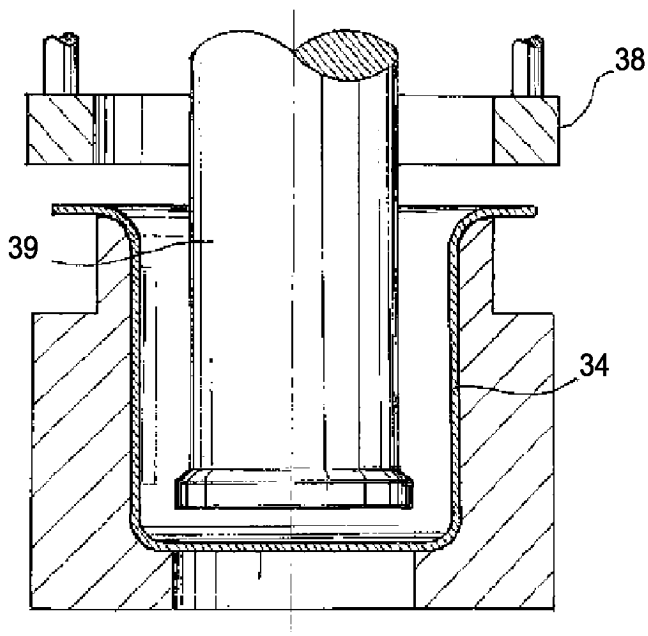


Fig. 3

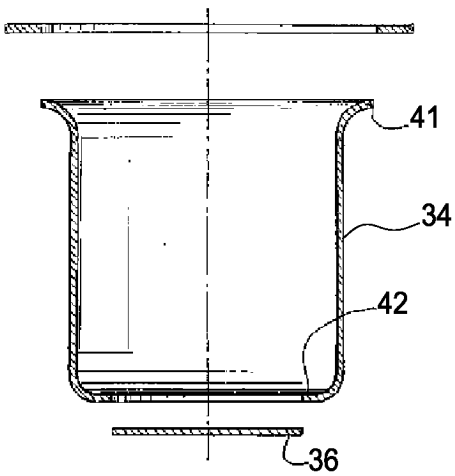


Fig. 4

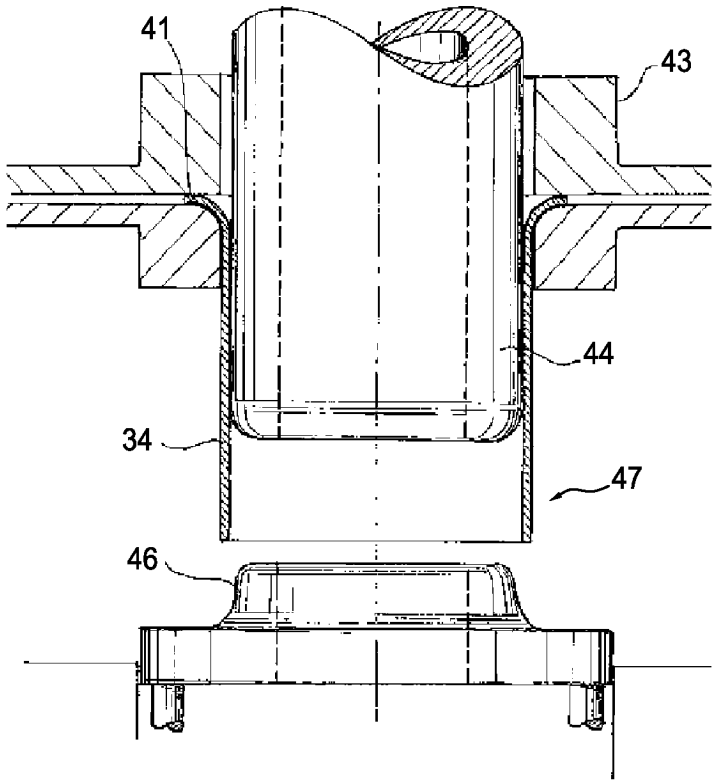


Fig. 5

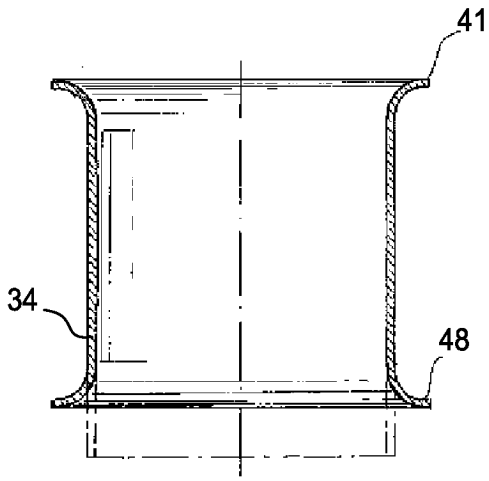


Fig. 6

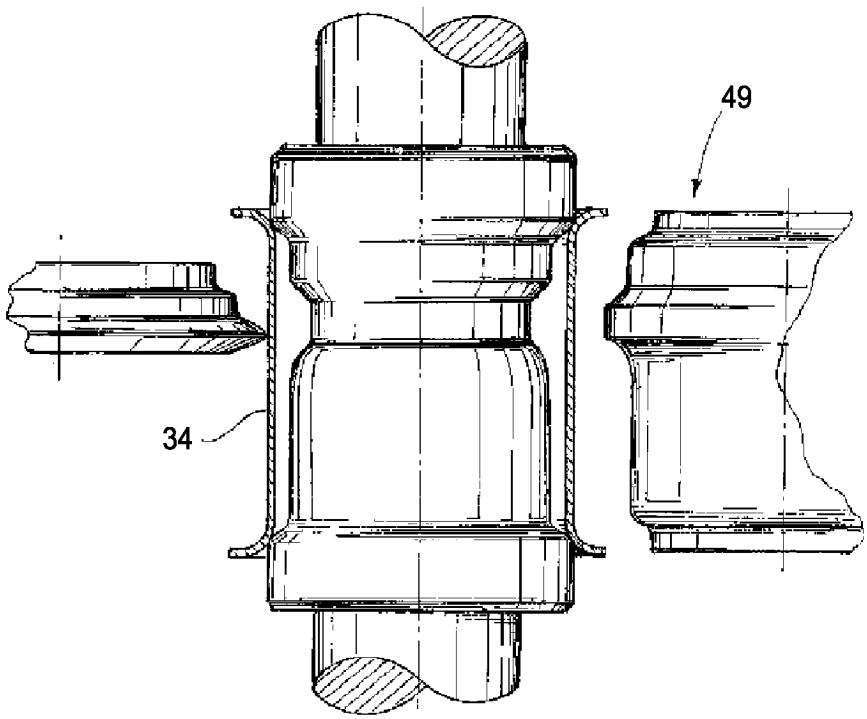


Fig. 7

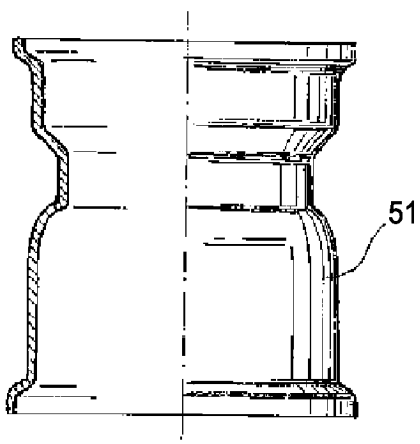


Fig. 8

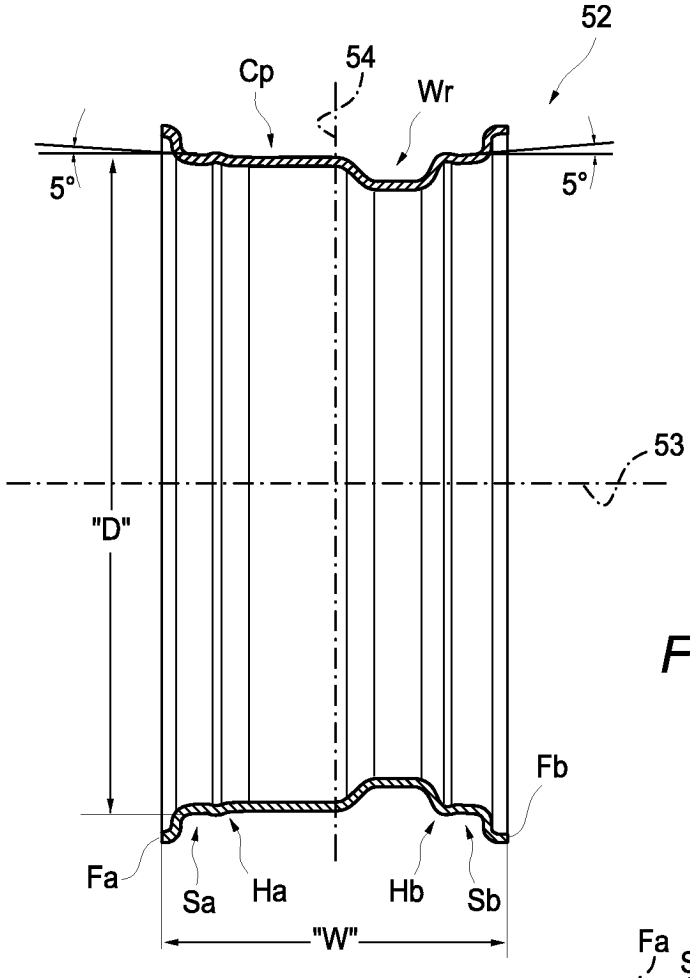
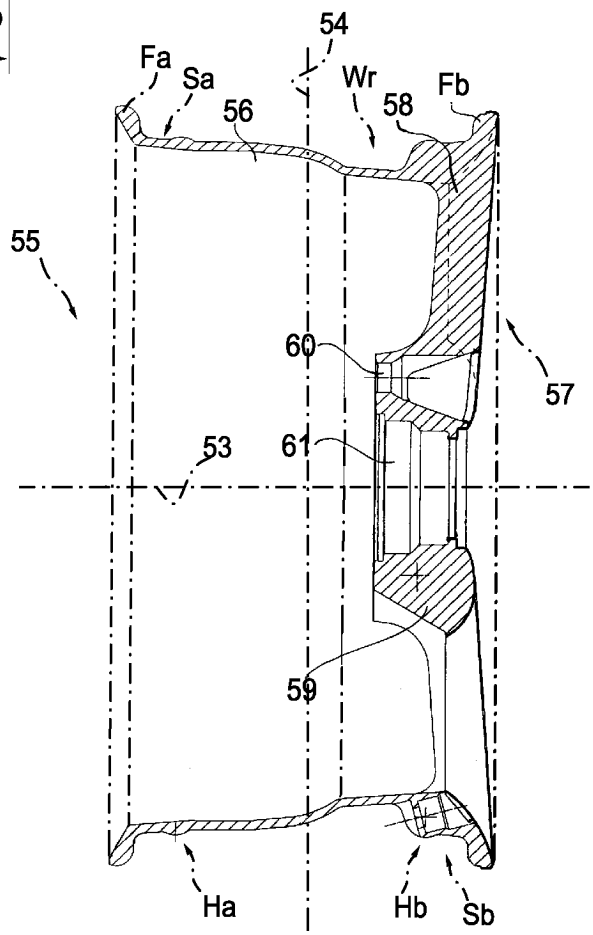

52
Cp
54
Wr
5°
5°
53
"D"
Fb
Fa
Sa
Ha
Hb
Sb
"W"

Fig. 9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Fa
Sa
Wr
Fb
56
58
55
60
57
53
61
59
Ha
Hb
Sb

Fig. 10

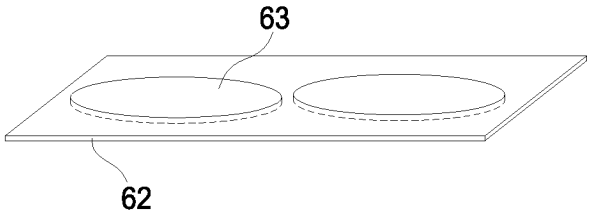

Fig. 11

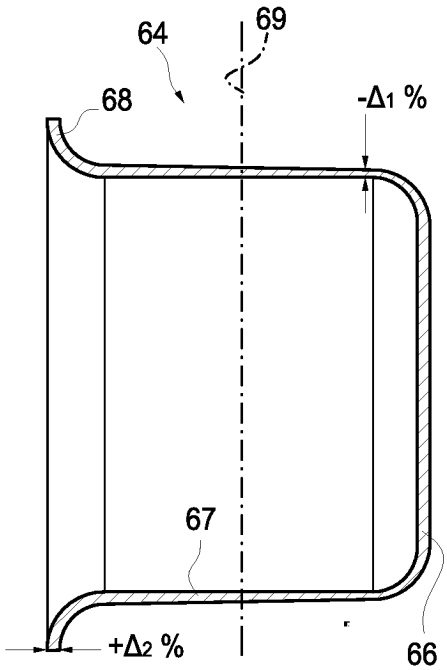

Fig. 12

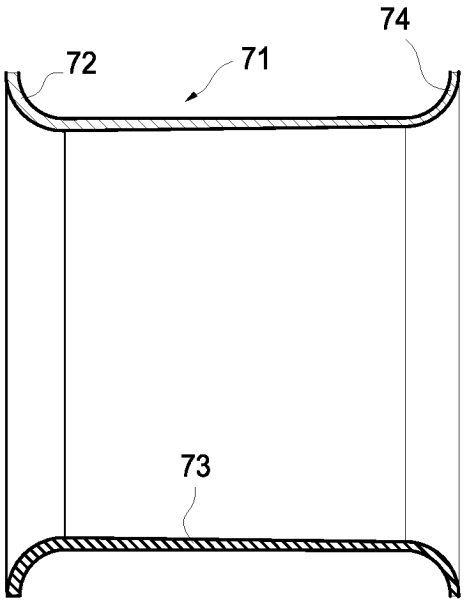

Fig. 13

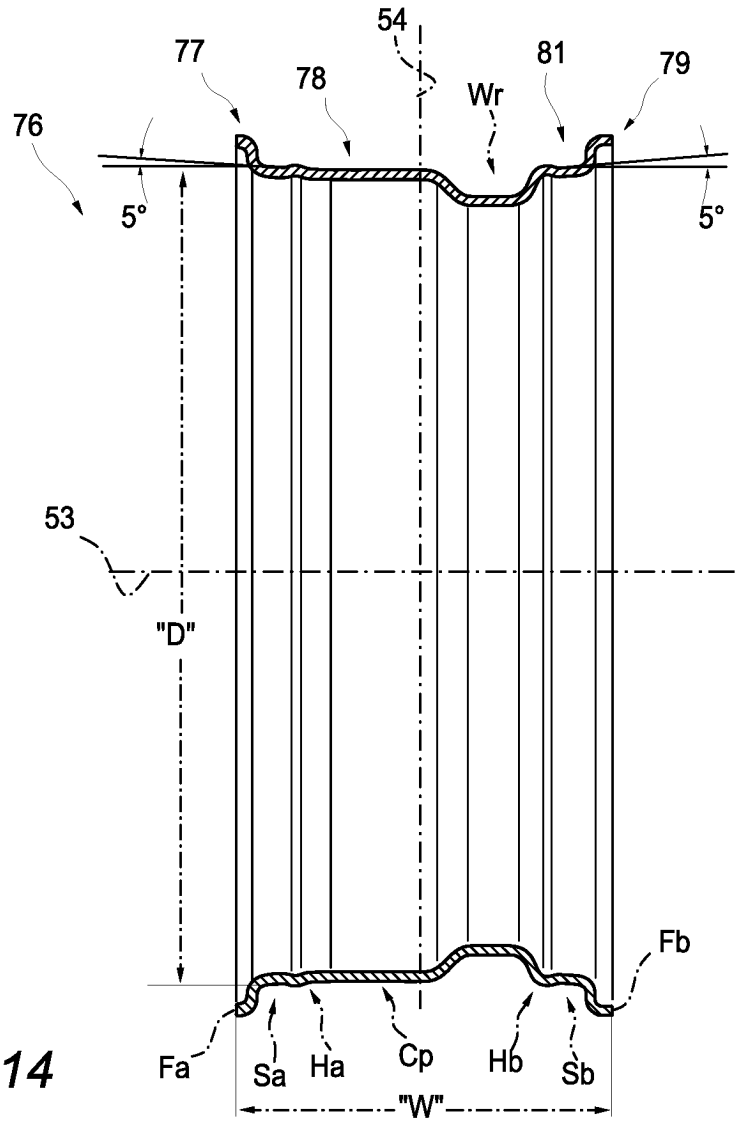

Fig. 14

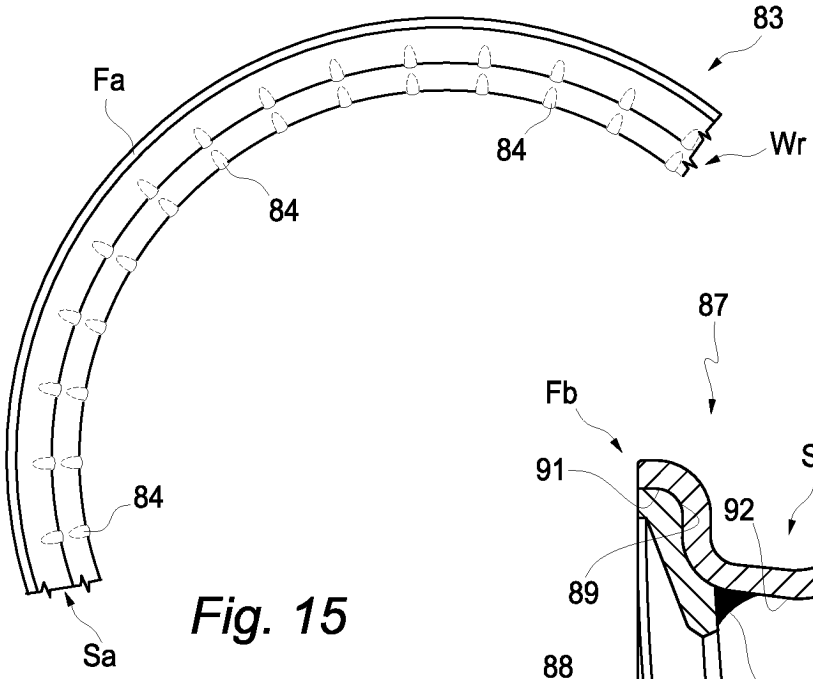

Fig. 15

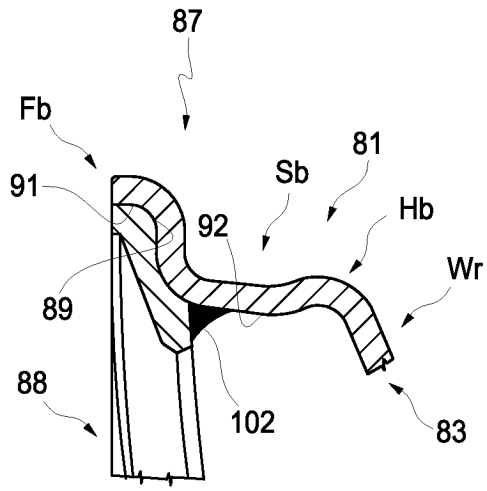

Fig. 16

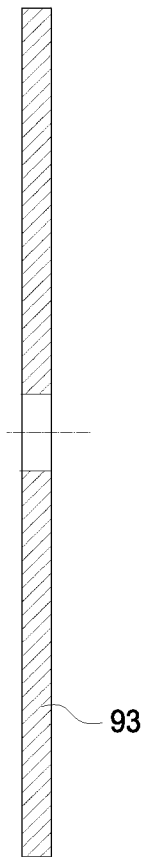

Fig. 17

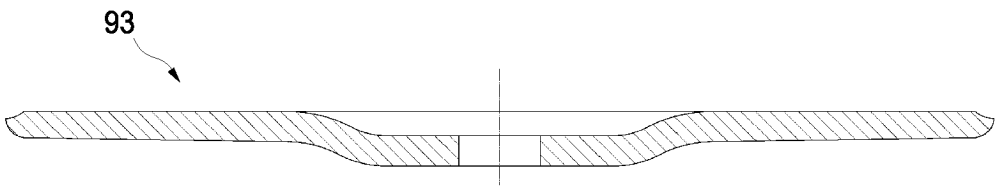

Fig. 18

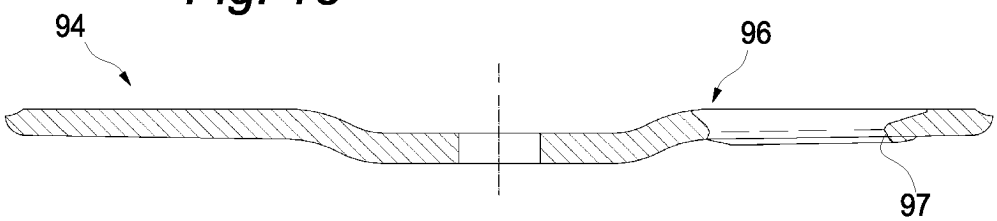

Fig. 19

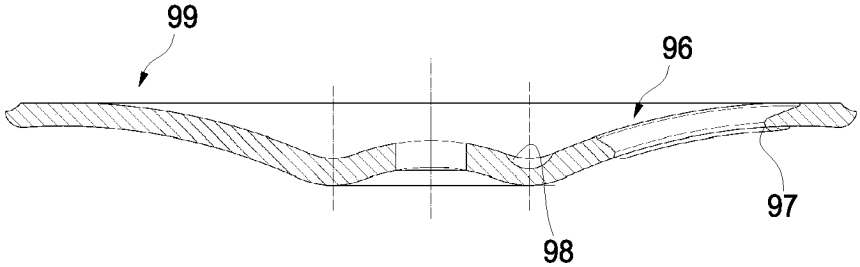

Fig. 20

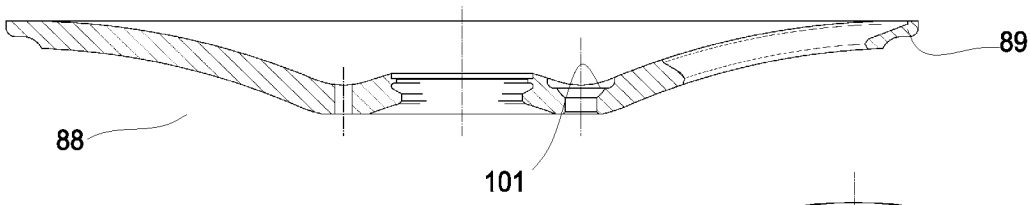

Fig. 21

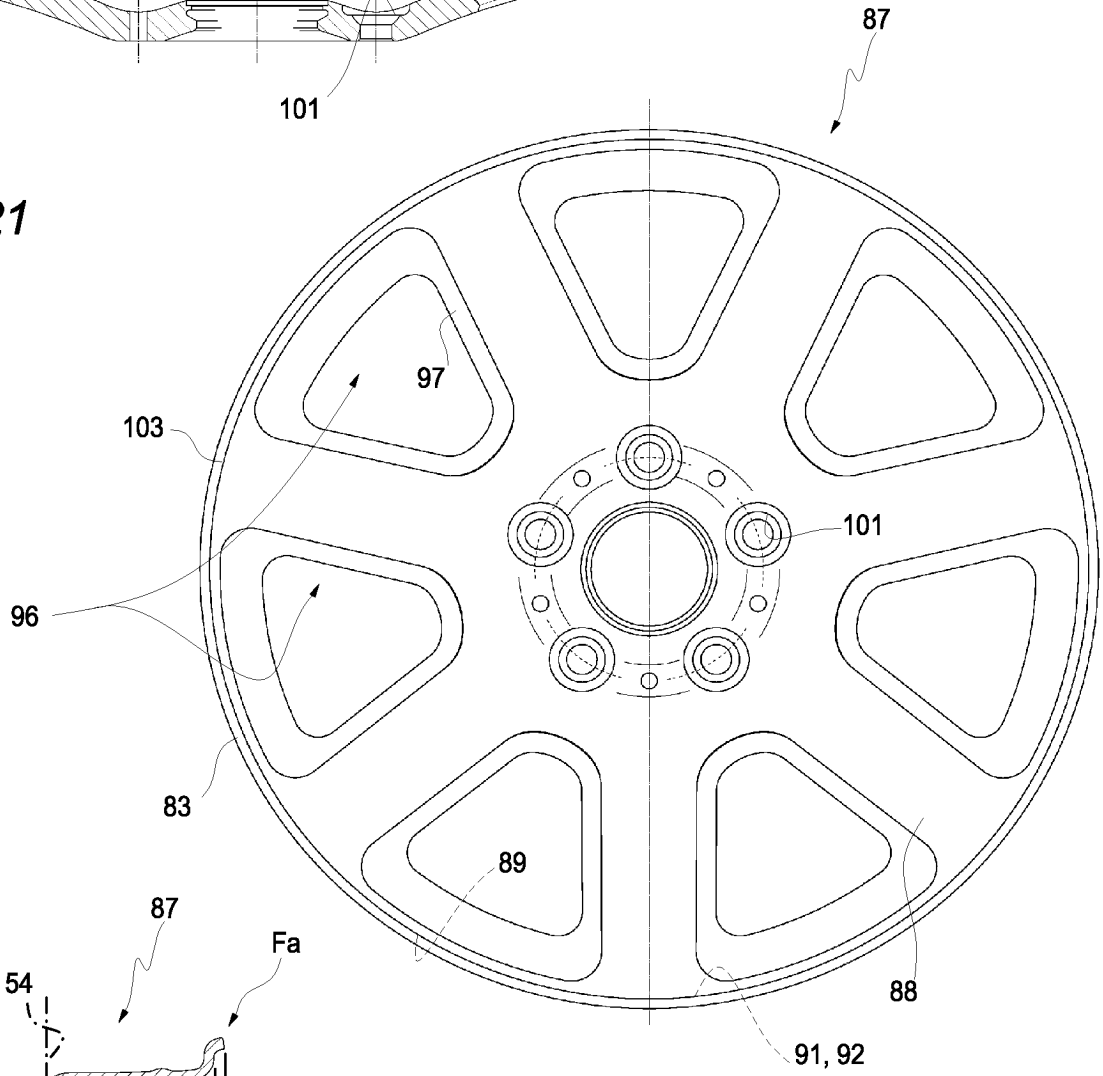

Fig. 22

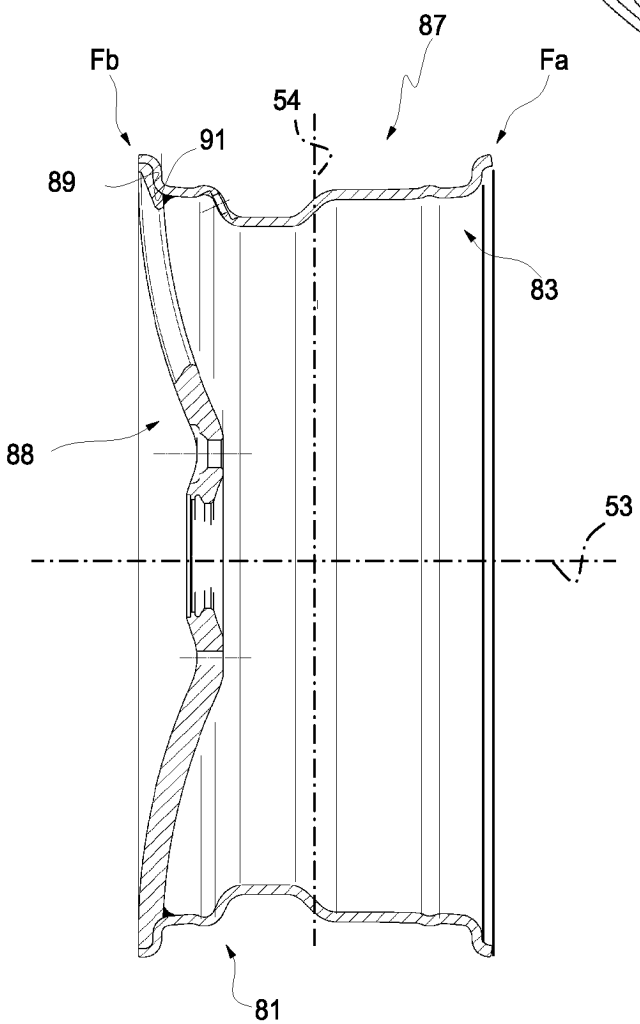

Fig. 23

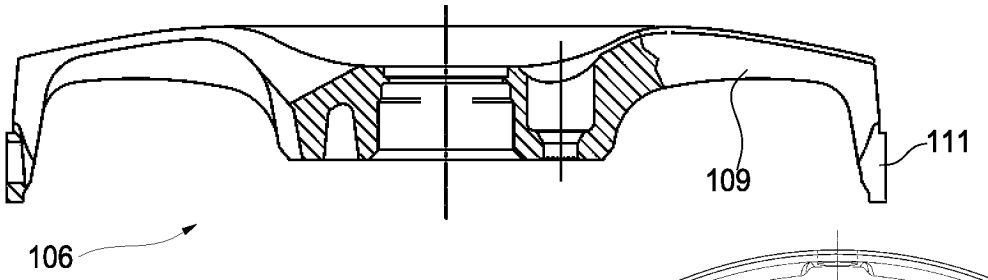

Fig. 24

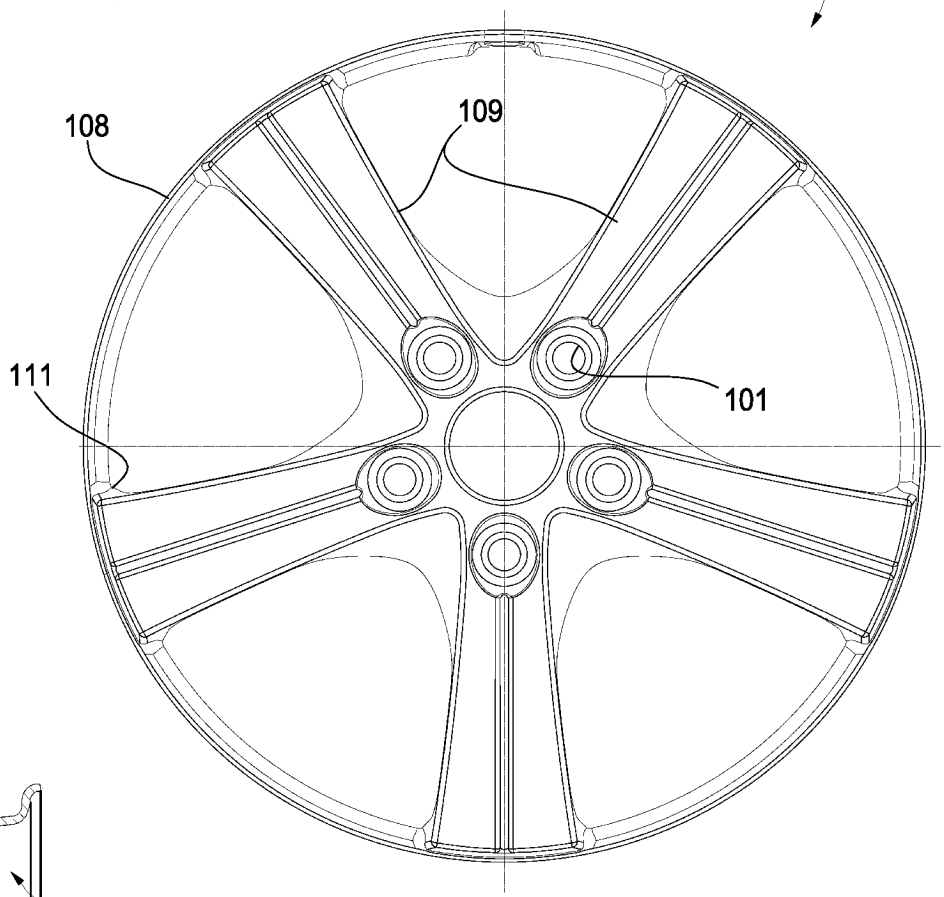

Fig. 25

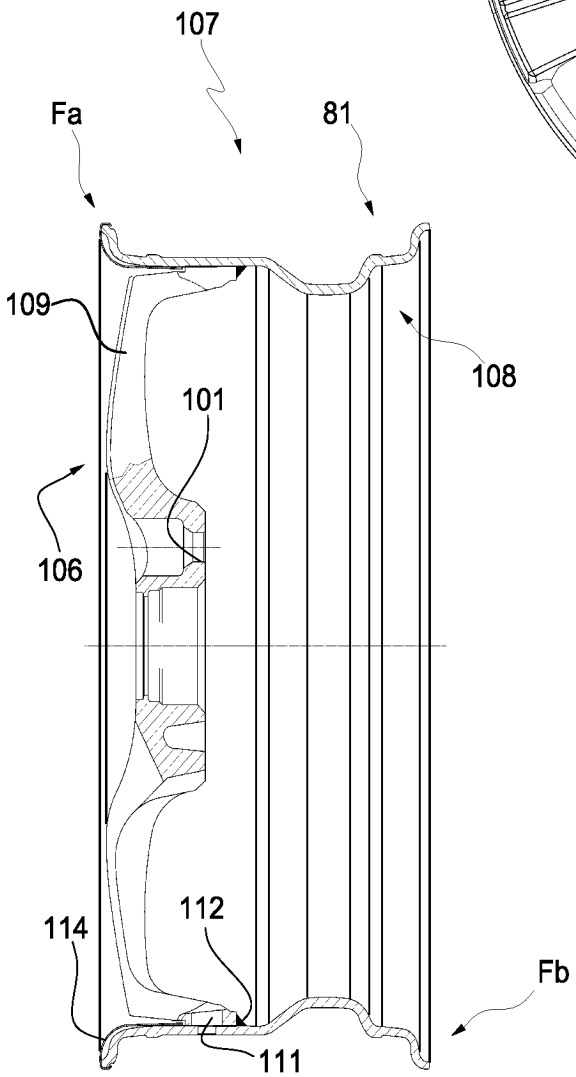

Fig. 26