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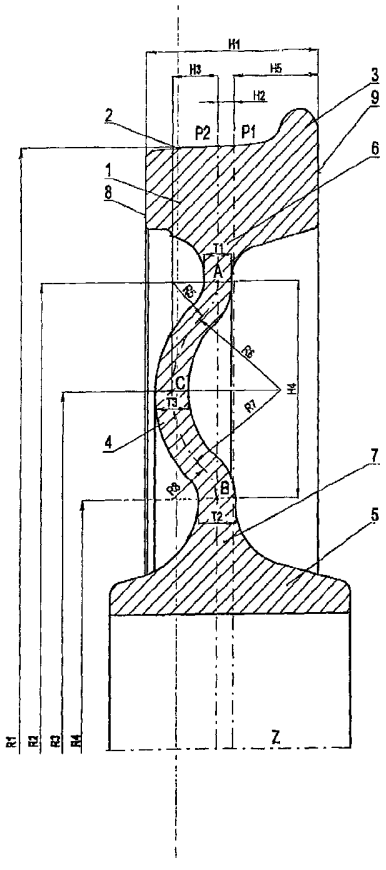
(54) Title: A DISC FOR RAILWAY WHEEL



(57) Abstract: A railway wheel having its central plane (P1) perpendicular to the wheel axis (Z) of rotation, which wheel comprises of a wheel rim (1) formed by a rolling surface (2) and a flange (3), a wheel plate (4) and a wheel hub (5). The transverse profile of said wheel plate (4) is situated around the theoretical central line with defined points (A, B, C), whereby, said first point (A) and said second point (B) are situated in one plane (P2), which plane (P2) is perpendicular to an axis of rotation (Z) of said wheel and is shifted off the central plain (P1) in the direction to the external edge (8) of said wheel rim (1) and where the distance (H3) between said plane (P2) and said central point (C) of said central line of said wheel plate (4) is maximally 0.5 of the width (H1) of said wheel rim (1). Individual parts of the central line of the wheel plate (4) are formed by circular arcs (R5, R6, R7, R8) or by parts of cubic curves or by combinations of circular arcs, straight sections and parts of cubic curves. Internal curvature radiuses (R6, R7) of the wheel plate (4) of both sections (AC, BC) of the central line are greater than the external curvature radiuses (R5, R8) of the wheel plate (4) in the given sections.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A DISC FOR RAILWAY WHEEL

Field of the Invention

The present invention relates to the design of a railway wheel, which railway wheel is permanently slightly deformed because of substantial thermal stress and subsequent cooling in combination with load by wheel forces when the wheel is braked by a brake block.

Background of the Invention

Railway wheels consist of three main parts, a wheel hub, a wheel rim and a wheel plate, which wheel plate provides transition between said wheel hub and said wheel rim. Wheels having a planar wheel plate are known in the art. However, the most frequently used ones are the lightweight wheels with various bent and shaped plates, wherein, the wheel plate shape has an influence on wheel resistance to mechanical and thermal loading.

The standard and still the most frequent design in the operation on railways is the wheel with a plate formed by a tangential profile, the so-called UIC-ORE wheel. This wheel can resist to high temperatures in the wheel rim. However, its disadvantage is high stress in the wheel rim after cooling and formation of plastic deformations because of low resilience. Said disadvantages substantially limit the use of higher axle pressures, which pressures are then insufficient particularly in case of railway freight wagons.

Another known and frequently used railway wheel is a wheel designed as a bell shape wheel according to the DE patent no.

3 117 572. In this design, the central line of said wheel, it is its axis, is formed by a regular curve defined by a cosine function. In practice, three identical curvature radiuses often approximate said curve. In case of this wheel, an advantage is a lower wheel weight and a lower residual stress in said rim when it is cooled down after breaking. However, to be used for higher axis pressures, such wheel design requires having a strengthened wheel plate, whereby, the advantage of lower weight is lost and moreover the level of residual stresses in the wheel rim is worse together with higher wheel rim deformations with regard to the wheel hub.

Summary of the Invention

The above mentioned disadvantages are substantially removed by a railway wheel having its central plane perpendicular to its wheel axis of rotation, which wheel comprises of a wheel rim formed by a rolling surface and a flange, a wheel plate and a wheel hub, wherein, the transverse profile of said wheel plate is situated along the theoretical central line, which central line runs between a first point situated in the transfer place where said wheel plate transfers into said wheel rim, a central point, which central point is situated at the opposite side of said central plane than said flange, in the place of maximal axial buckling of said wheel plate, and a second point situated at the place where said wheel plate transfers into said wheel hub, which railway wheel consists in that said first point and said second point of said central line of said wheel plate are situated in one plane, which plane is perpendicular to said wheel axis of rotation, it is shifted from said central plain in the direction to the external edge of said wheel rim and where the distance between said plane and said central point of said central line of said wheel plate is maximally 0.5 of the width

of said wheel rim, wherein, individual parts of said central line of said wheel plate are formed by cubic curves or are formed by circular arcs so that the section from said first point to said central point consists of a curvature having a first external radius of curve and of another curvature having a first internal radius of curve, whereby, in this section said first internal radius is greater than said first external radius and a section from said second point to said central point consisting of a curvature having a second external radius of curve and of a curvature of a second internal radius of curve, whereby, said second internal radius in this section is greater than said second external radius.

Said central plane of said wheel plate runs through said wheel rim in the place of the so-called contact circle, where theoretically the rolling surface of said wheel contacts the head centre of a rail. The curvature of said central line of said wheel plate with said first external radius is situated nearer to said wheel rim than the curvature with said first internal radius and the curvature with said second external radius is situated nearer to said wheel hub than said curvature with said second internal radius.

Considering the railway wagon bogie design and the guiding and the flank clearances in a pair of wheels of a bogie, the maximal axial buckling of said wheel plate is preferably selected so that the wheel plate surface does not exceed the external edge of said wheel rim. Preferably, the wheel is designed so that the distance between said first point of said wheel plate central line and said wheel axis or rotation is in the range from 0.7 to 0.85 of the railway wheel external diameter and the distance from said second point of said wheel plate central line to said

wheel axis of rotation is between 0.3 to 0.45 of said railway wheel external diameter.

To reach the most preferable results from the point of view of minimal deformations, it is also recommended to form said central line of said wheel plate by two pairs of dimensionally identical parts of cubic curves or circular arcs, i.e. so that both internal radiuses are of equal size and both external radiuses are also of equal size, whereby in each of said sections of said wheel plate central line the size of internal radiuses is 1.5 to 3.5 multiple of the size of external radiuses of said section.

Also, a preferable embodiment of said railway wheel is such that the wheel plate central line is formed by a combination of circular arcs or cubic curves and straight linear sections. Short linear sections can be situated in one or both places of mutual transitions between said internal and said external curvatures of circular arcs or cubic curves.

Also, a preferable embodiment of said railway wheel is such that the thickness of the wheel plate transverse profile along the central line is constant or it decreases evenly, or eventually according to a conic or cubic curve, beginning with the second point up to the first point.

Also, a preferable embodiment of said railway wheel is such that the thickness of wheel plate transverse profile along the wheel plate centre line decreases evenly or eventually according to a conic or cubic curve from said second point to said central point, from which point it is then constant up to said first point.

It is an advantage of this railway wheel that it exhibits very low tangential stress values in said wheel rim and first of all low values of permanent plastic deformations when keeping an optimal wheel weight. This allows using of such wheels not only for railway freight wagons but also for all railway vehicles with block brakes acting on rolling surface, including the driving vehicles and locomotives as it is possible to load with vertical wheel force up to 15 metric tons per one wheel, what is a substantially higher value than that of the now used wheels. The wheel can be made of steel of any quality used in the railway industry and manufactured according to the known technical standards by rolling and forging or eventually by casting. In breaking by a block brake the wheel is able to absorb repeatedly breaking cycles with break power 55 kW for 45 minutes without any negative consequences to the wheel rim deformation and to the increase in tensile tangential stresses in wheel rim at cooling the wheel rim after its heating caused by breaking. Therefore, no change in gauge or in the distance between a pair of wheels on a railway axle takes place, what increases safety during running through rail switches and crossings and limits the possibility of railway wagon derailing.

Brief Description of the Drawings

The invention in its various aspects will now be described with reference to a drawing thereof, in which Fig. 1 shows one half of a railway wheel in sectional view.

Detailed Description of the Invention

A railway wheel in Fig. 1 has an external radius R1 and comprises of a wheel rim 1 with a rolling surface 2 and a flange 3, of a wheel plate 4, of a wheel hub 5, of a first transfer 6

of said wheel plate 4 into said wheel rim 1 and of a second transfer 7 of said wheel plate 4 into said wheel hub 5. Said wheel rim 1 is limited by an external edge 8, an internal edge 9 and has width H1. On the central line of said transverse profile of said wheel plate 4 there is a first point A at radius R2, a central point C at radius R3, and a second point B at radius R4. The central line of said wheel plate 4 consists of section AC, which section AC is formed by a circular arc having a first external radius R5 and a circular arc having a first internal radius R6 and of section CB, which section CB is formed by a circular arc having a second internal radius R7 and a circular arc having a second external radius R8, whereby said internal radiuses R6 and R7 have the same size and are greater than identical external radiuses R5 and R8. A plane P2 is perpendicular to a wheel axis of rotation Z and is shifted off the central plane P1, which central plane P1 is situated with distance H5 to said internal edge 9 of said wheel rim 1, in the direction to said external edge 8 of said wheel rim 1 by a distance H2. Both said first point A and said second point B of said central line of said wheel plate 4 are situated in said plane P2. A distance H4 between said first point A and said second point B of said central line of said wheel plate 4 in plane P2 is given by the difference between said radiuses R2 and R4, whereby said radius R2 is 0.8 multiple of said external radius R1 and radius R4 is 0.4 multiple of said external radius R1. The distance H3 between said plane P2 and said central point C of said central line of said wheel plate 4 is designed so that the surface of said wheel plate 4 does not exceed said external edge 8 of said wheel rim 1. The wheel plate 4 has thickness T2 at the position of said second point B and the thickness evenly decreases via the central point C, where the thickness is T3 further to the first point A, where the thickness is T1.

Industrial Use

The railway wheel having low level of stress and deformations can be used for all models of rail vehicles with block brakes acting on the rolling surface, particularly for railway freight wagons, driving vehicles and locomotives. Considering the good radial compliance and sufficient fatigue strength in the critical place of the wheel, i.e. at the wheel plate transfer into the wheel hub, it is possible to use this wheel design also in rail vehicles where instead of the block brake separate break disks are used, what is the case of railway wagons for transport of persons.

Claims

1. A railway wheel having its central plane (P1) perpendicular to its wheel axis (Z) of rotation, which wheel comprises of a wheel rim (1) formed by a rolling surface (2) and a flange (3), a wheel plate (4) and a wheel hub (5), wherein, the transverse profile of said wheel plate (4) is situated along the theoretical central line, which central line runs between a first point (A) situated in the transfer place (6) where said wheel plate (4) transfers into said wheel rim (1), a central point (C), which central point (C) is situated at the opposite side of said central plane (P1) than said flange (3), in the place of maximal axial buckling of said wheel plate (4), and a second point (B) situated at the place (7) where said wheel plate (4) transfers into said wheel hub (5), characterized in that said first point (A) and said second point (B) of said central line of said wheel plate (4) are situated in one plane (P2), which plane (P2) is perpendicular to said wheel axis (Z) of rotation, it is shifted off said central plain (P1) in the direction to the external edge (8) of said wheel rim (1) and where the distance (H3) between said plane (P2) and said central point (C) of said central line of said wheel plate (4) is maximally 0.5 of the width (H1) of said wheel rim (1), wherein, individual parts of said central line of said wheel plate (4) are formed by cubic curves or are formed by circular arcs so that the section from said first point (A) to said central point (C) consists of a curvature having a first external radius (R5) of curve and of another curvature having a first internal radius (R6) of curve, whereby, in this section said first internal radius (R6) is greater than said first external radius (R5) and a section from said second point (B) to said central point (C) consisting of a curvature having a

second external radius (R8) of curve and of a curvature of a second internal radius (R7) of curve, whereby, said second internal radius (R7) in this section is greater than said external radius (R8).

2. A railway wheel according to claim 1, characterized in that said central plane of said wheel plate (4) is formed by a combination of circular arcs or cubic curvatures and linear sections situated between said internal curvature and said external curvature of said wheel plate (4).

3. A railway wheel according to claims 1 or 2, characterized in that along the central line of said wheel plate (4) the thickness of the transverse profile of said wheel plate (4) is constant or decreases proportionally or according to a conic or cubic curve beginning at the second point (B) and ending at the first point (A).

4. A railway wheel according to claims 1 or 2, characterized in that along the central line of said wheel plate (4) the thickness of the transverse profile of said wheel plate (4) decreases proportionally or according to a conic or cubic curve beginning at the second point (B) and ending at the central point (C) and is then constant from said central point (C) to said first point (A).

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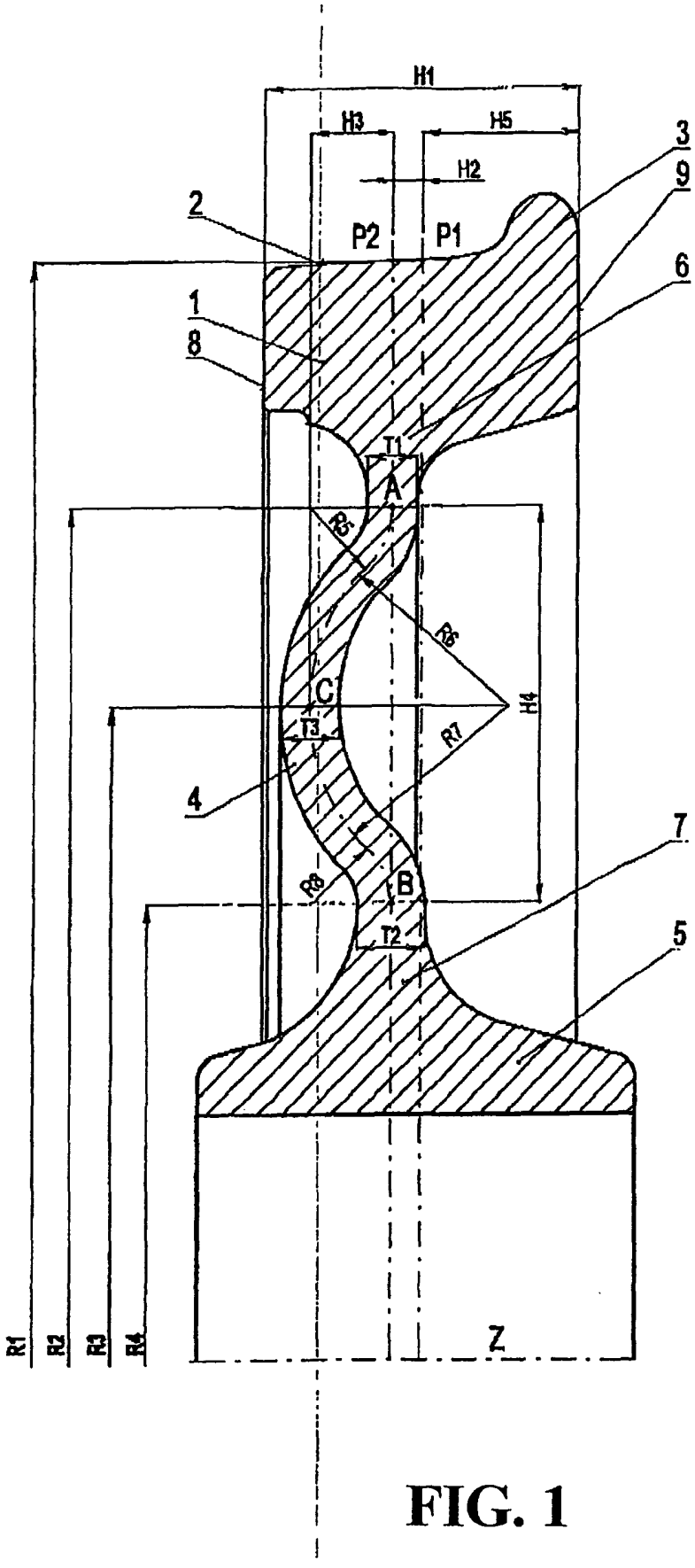

FIG. 1

INTERNATIONAL SEARCH REPORT

	nal Application No
	PCT/CZ 03/00006

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60B17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 31 17 572 A (ILSENBURG RADSATZFAB) 9 September 1982 (1982-09-09) cited in the application page 4, paragraph 3 -page 5, paragraph 1 figure 1	1
A	US 5 039 152 A (ESAULOV VASILY P ET AL) 13 August 1991 (1991-08-13) column 7, line 22 - line 35 abstract; figures 1,2	1
A	US 3 127 212 A (EKLUND, KNUT) 31 March 1964 (1964-03-31) column 1, line 53 - line 70	1
A	US 4 067 600 A (KNORR WALTER ET AL) 10 January 1978 (1978-01-10) figure 3	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
24 April 2003	06/05/2003

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Ir ɔnal Application No
PCT/CZ 03/00006

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
DE 3117572	A	09-09-1982	DD	159501 A3	16-03-1983
			CS	8103372 A1	18-06-1984
			DE	3117572 A1	09-09-1982
			FR	2485993 A1	08-01-1982
			PL	231995 A1	05-07-1982
			SE	441910 B	18-11-1985
			SE	8104171 A	04-01-1982
			SU	1139647 A1	15-02-1985
US 5039152	A	13-08-1991	WO	9009290 A1	23-08-1990
			BR	8907422 A	07-05-1991
			EP	0416103 A1	13-03-1991
			JP	3504112 T	12-09-1991
US 3127212	A	31-03-1964	SE	321945 B	23-03-1970
			FR	1320237 A	08-03-1963
			GB	963762 A	15-07-1964
			NO	120735 B	30-11-1970
US 4067600	A	10-01-1978	DE	2438550 A1	11-12-1975
			AT	343715 B	12-06-1978
			AT	545075 A	15-10-1977
			AU	8385775 A	17-02-1977
			BE	832257 A1	01-12-1975
			BR	7505063 A	03-08-1976
			CA	1011780 A1	07-06-1977
			CH	587130 A5	29-04-1977
			ES	438955 A1	16-02-1977
			FR	2281236 A1	05-03-1976
			GB	1485730 A	14-09-1977
			IT	1040499 B	20-12-1979
			JP	950028 C	27-04-1979
			JP	51035915 A	26-03-1976
			JP	53033166 B	12-09-1978
			NL	7509124 A	12-02-1976
			SE	7508960 A	11-02-1976