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(54) Title: A WHEEL HUB UNIT FOR A VEHICLE

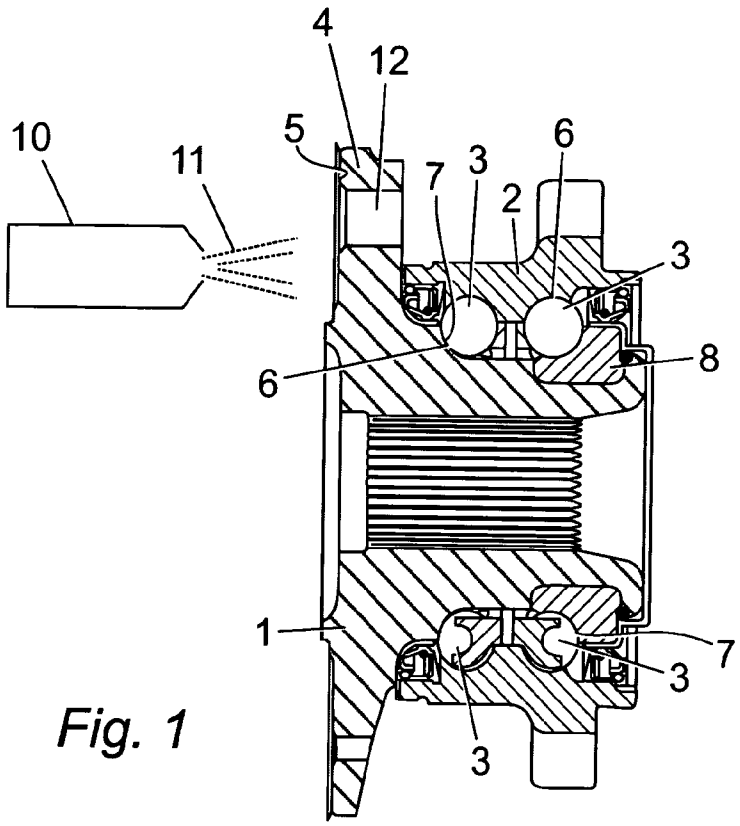


Fig. 1

(57) Abstract: The invention concerns a wheel hub bearing unit for a vehicle, said hub bearing unit comprising a rotating bearing ring member (1) and a non-rotating bearing ring member (2), where the rotating bearing ring (1) has at least a radially extending wheel mounting flange (4) with a reference flange surface (5); wherein a layer of an electrolytically sacrificial metal or metal alloy is provided by an electric arc spraying process on the flange surface (5).

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A wheel hub unit for a vehicle

FIELD OF THE INVENTION

The present invention relates to a wheel hub bearing unit for a vehicle, said hub bearing unit comprising a rotating bearing ring and a non-rotating bearing ring, where the rotating bearing ring has at least a radially extending wheel mounting flange with a reference flange surface.

BACKGROUND TO THE INVENTION

In a typical wheel end assembly, a brake rotor may be fitted to the mounting flange of the rotating bearing ring of the hub unit. The wheel rim is then mounted against the brake rotor and both are bolted to the wheel mounting flange. The hub-rotor interface is exposed to atmospheric corrosion from humid air and from salt water. The corrosion leads to the formation of rust on and between the contacting surfaces of the wheel mounting flange, brake rotor and wheel rim. The layer of corrosion that forms on the wheel mounting flange surface results in increased runout, which may exceed that specified for finished and assembled hub units of e.g. 10 to 15 micro meters. When vehicles are serviced and undergo replacement of a brake rotor, the fixation of a (new) brake rotor on a wheel mounting flange having corrosion on the contact surface for the brake rotor would lead to axial runout and brake shudder.

US 2006/0177169 A1 discloses a hub unit with a wheel mounting flange for mounting a wheel on the hub. The flange is provided with a rust-preventive layer on the surface receiving the wheel. This rust-preventive layer may be a fused ceramics material or a plastic material either moulded onto the surface by insert moulding or a separate part fixed to the surface by an adhesive.

EP 0 800 011 A2 discloses a corrosion-protective element for protecting junctions between metal components made of different metals against electrolytic corrosion when exposed to moisture by providing a shield of sheet metal which is electrically passivated or has an anti-corrosion coating on its opposite surfaces.

It is further known to provide electrolytic zinc plating on the hub flange surface to prevent corrosion. The electrolytic plating is usually a bath process where at least the component in which the flange is formed is submerged in molten zinc and subjected to high temperature (over 150°C) baking to eliminate hydrogen embrittlement.

CONFIRMATION COPY

SUMMARY OF THE INVENTION

The wheel hub bearing unit according to the invention preferably comprises a rotating ring member with at least one annular track which cooperates with at least one annular track on the non-rotating ring member and accommodates rolling elements in said annular tracks for rotatably mounting the ring members in relation to each other. Accordingly, the hub unit may be provided with either balls, rollers or a combination thereof as rolling elements for the bearing. Moreover, the hub unit may also be provided as a plain bearing.

In one embodiment, a first ring member is a rotating inner ring and a second ring member is a stationary outer ring of the hub bearing unit. However, as an alternative, the first ring member may be a rotating outer ring and the second ring member may be a stationary inner ring of the hub bearing unit. The rotating ring member of the hub bearing unit comprises at least a radially extending wheel mounting flange with a reference flange surface.

By the invention, corrosion protection of the surface of the wheel mounting flange of a hub bearing unit is realized in a cost-effective manner by providing a hub bearing unit, wherein a layer of an electrolytically sacrificial metal or metal alloy is provided by an electric arc spraying process on the flange surface.

According to the invention, corrosion protection of a hub bearing unit for a vehicle is provided which is advantageous due to low production costs and which is possible to provide in an in-line process for the production of the hub bearing unit. It is found advantageous to apply the sacrificial metal coating by an arc spray process since it is possible to automatically control this metal coating method. Moreover, starting and stopping the arc spray process may be accurately and reliably controlled. By the invention, an in-line processing time of within approx. 11 seconds and even within 2-6 seconds can be achieved for applying the arc spray coating to the flange surface.

Accordingly, the invention in its second aspect provides a method of providing corrosion protection on a flange surface of a hub bearing unit, where the hub unit comprises a rotating bearing ring member having at least a radially extending mounting flange with a reference flange surface, wherein a sacrificial metal or metal alloy is provided on the flange surface, by melting a distal end of one or more metal wires by providing an electric arc and subjecting said melted metal to a pressurised gas flow, whereby the melted metal is sprayed onto the flange surface.

Hereby, a simple in-line process for corrosion protection is achieved which besides allowing for low production costs, also offers an environmentally friendly solution using a sacrificial

principle to prevent corrosion of the wheel mounting flange of a hub bearing unit, as the application does not require the usage of additional hazardous and harmful materials or solvents in the production process.

By providing a protective layer that is electrolytically sacrificial, a corrosion protection of the mounting flange of the hub unit satisfying the industry standard ASTM B117 may be achieved. Moreover, the arc sprayed sacrificial metal layer may be provided with a run-out surface tolerance of less than 10-15 μm. Another advantage of the arc-sprayed metal layer is that it does not result in loosening of bolt torque when a brake rotor and wheel rim are fixed to the wheel mounting flange. The surface of the arc sprayed metal layer also offers a satisfactory resistance to bolt load and has anti-fretting and failure-safe properties, just as the arc sprayed metal coating has a satisfactory resistance to hot brake fluid, preservatives and cleaning fluids, and does not adversely affect the performance of the hub bearing unit in the vehicle's wheel end.

In a preferred embodiment, the rotating bearing ring member is made of a steel alloy. The sacrificial metal is preferably zinc or a zinc alloy, such as zinc-aluminium alloy, preferably an alloy comprising approx. 85% zinc and approx. 15% aluminium (ZnAl15). This zinc-aluminium alloy is inexpensive and provides effective protection. However, it should be understood that other suitable metals may be used for the electrolytically sacrificial layer. The sacrificial metal layer may be provided as a layer with a thickness of between 0.005 and 1 mm, preferably with a thickness of between 0.01 and 0.1 mm. This enables machining of the metal coated flange surface, which may be advantageous if a precise surface roughness or flatness is needed.

Preferably, additional sealant may be applied on top of the sacrificial metal layer. Hereby the corrosion resistance may be further increased.

Preferably, before the arc spraying process, the flange surface is prepared for the metal spray coating, by washing, alkaline cleaning, acid etching, grit blasting and/or sand blasting. Hereby, a clean and rough surface is obtained and sufficient bonding of the coating on the flange surface may be ensured.

Throughout this patent, the term sacrificial metal is meant to be understood as a metal which in the electrolytic sense is sacrificial compared with the metal used for the rotating ring member and in particular the wheel mounting flange.

DESCRIPTION OF THE FIGURES

In the following, the invention is described with reference to the accompanying drawings, in which:

figure 1 is a radial section through a hub bearing unit according to a first preferred embodiment of the invention,

figure 2 is a radial section through a hub bearing unit according to a second embodiment, and

figure 3 is a schematic drawing of an arc spray nozzle.

DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to figures 1 and 2, examples of hub bearing units with rotating inner ring are shown. Such hub bearing units are used in the automotive industry for supporting driven and non-driven wheels and brake rotors, which are secured to a wheel mounting flange 4. A hub bearing unit comprises an inner ring member 1, which is rotatably mounted in relation to an outer ring member 2. The inner and outer ring members 1, 2 are assembled in a bearing unit, as the inner ring member 1 is provided with at least one raceway, which is an annular track 7 supporting rolling elements 3, such as balls, which are also accommodated in at least one annular track 6 in the outer ring member 2. The rolling elements 3 accommodated in the track 7 of the inner ring member 1 are preferably held in place by a separate inner ring element 8 for facilitating assembly of the bearing unit. The outer ring member 2 is fixed to the frame of the vehicle and the inner ring member 1 is assembled on a shaft-like member 9 (see fig. 2), which may be a drive section in the case of a driven wheel or a centering section in the case of a non-driven wheel. The inner ring member 1 is provided with a flange 4 having an exterior surface 5 for receiving a brake rotor and a wheel rim (not shown). The mounting flange 4 is provided with a plurality of fixation means 12, such as threaded holes for receiving mounting bolts (not shown), but could alternatively be stud bolts (not shown) projecting out of the flange surface 5.

During use, in particular the axially outward surface 5 of the flange 4 is exposed to moisture. In order to protect the flange 4 against corrosion, a layer of electrolytically sacrificial metal, preferably zinc or a zinc alloy, is sprayed onto the flange surface 5 by an arc spraying process. The metal is preferably an alloy comprising approx. 85% zinc and approx. 15% aluminium (ZnAl15).

By the arc spraying process, a metal wire is supplied to an arc spraying gun 10 wherein a distal end of the wire is melted by an electric heating process and the melted metal is

subjected to a pressurised gas flow, which is directed into the melted wire tip; thereby generating a melted metal spray 11 which is directed onto the flange surface 5.

In the embodiment shown in figure 1, the flange surface 5 extends radially. As shown in figure 2, the flange surface 5 may also include an axial extension 5'. The arc spraying gun 10 may be moveable so that the spray 11 may be directed towards surfaces 5, 5' with different orientation.

Before the application of the sacrificial metal coating, the surface 5, 5' is cleaned so that a clean and rough surface is obtained and sufficient bonding of the coating on the flange surface may be ensured. The surface 5, 5' may be subjected to alkaline cleaning, acid etching, grit blasting and/or sand blasting.

With reference to figure 3, an arc spraying gun 10 for the arc spraying process preferably generates an arc 16 between two metal wires 17 to melt the metal wires. The wires 17 are fed through a set of wire guide electrodes 15 through an insulated housing member 13. An air supply is provided in this housing member 13 between the electrodes 15 and compressed air is supplied through a nozzle 14 used to atomize and propel the molten metal to the surface 5. The two wires 17 are continuously fed at a uniform speed. A DC power supply is used, with one wire serving as the cathode and the other as the anode. The metal layer provided on the surface 5, 5' by the metal spray 11 may be controlled by the air pressure, the nozzle shape, the DC power, the wire feed rate, the distance from the arc spraying gun 10 to the surface 5, 5' etc.

It is found particularly suitable in relation to corrosion protection of the wheel mounting flange on a hub bearing unit to apply the sacrificial metal coating by an arc spray process since this process enables automatic control of the metal coating process and, in particular, because it is possible to accurately control the starting and stopping of the arc spraying process. By the invention, an in-line processing time of within approx. 11 seconds and even within 2-6 seconds can be achieved for applying the arc spray coating to the flange surface.

Above, the invention is described with reference to some preferred embodiments. However, a hub unit according to the invention may be executed in many embodiments. For instance, the hub bearing unit may be of the type with rotating inner ring or with rotating outer ring. In this latter case, the outer ring member then comprises at least a radially extending mounting flange for attachment of a brake rotor and wheel rim. The corrosion protection as described in any of the above embodiments can also be applied on a hub bearing unit with rotating

outer ring. Likewise, the rolling elements may be balls or rollers or a combination thereof. Thus, variations of the embodiments of the invention described may be performed without departing from the scope of the invention defined in the claims.

Patent Claims:

1. A wheel hub bearing unit for a vehicle, said hub bearing unit comprising:
a rotating bearing ring member (1) and a non-rotating bearing ring member (2), where the rotating bearing ring (1) has at least a radially extending wheel mounting flange (4) with a reference flange surface (5);
characterised in that
a layer of an electrolytically sacrificial metal or metal alloy is provided by an electric arc spraying process on the flange surface (5).

2. A wheel hub bearing unit according to claim 1, wherein at least the rotating ring member (1) is made of a steel alloy.

3. A wheel hub bearing unit according to any of the preceding claims, wherein the rotating ring member (1) is provided with at least one annular track (7) cooperating with at least one annular track (6) on the non-rotating ring member (2) and accommodating rolling elements (3) in said annular tracks (6, 7) for rotatably mounting the ring members (1, 2) in relation to each other.

4. A wheel hub bearing unit according to any of the preceding claims, wherein the sacrificial metal is zinc or zinc alloy, such as zinc-aluminium alloy, preferably an alloy having approx. 85% zinc and approx. 15% aluminium (ZnAl15).

5. A wheel hub unit according to any of the preceding claims, wherein the sacrificial metal layer is provided in a layer with a thickness of between 0.005 and 1.0 mm, preferably between 0.01 and 0.1 mm.

6. A wheel hub unit according to any of the preceding claims, wherein additional sealant is applied on top of the sacrificial metal layer.

7. A method of providing corrosion protection on a flange surface of a hub bearing unit, where the hub bearing unit comprises a rotating bearing ring member (1) with at least a radially extending wheel mounting flange (4) with a reference flange surface (5), wherein a sacrificial metal or metal alloy is provided on the flange surface (5) by melting a distal end of one or more metal wires (17) by providing an electric arc (16) and subjecting said melted

metal to a pressurised gas flow, whereby the melted metal is sprayed onto the flange surface (5).

8. A method according to claim 7, whereby the pressurised gas is pressurised air or a protective gas.

9. A method according to claim 7 or 8, whereby before the arc spraying process, the flange surface (5) is prepared for the metal spray coating, by washing, alkaline cleaning, acid etching, grit blasting and/or sand blasting.

10. A method according to any of claims 7 to 9, whereby the metal coated flange surface may be machined.

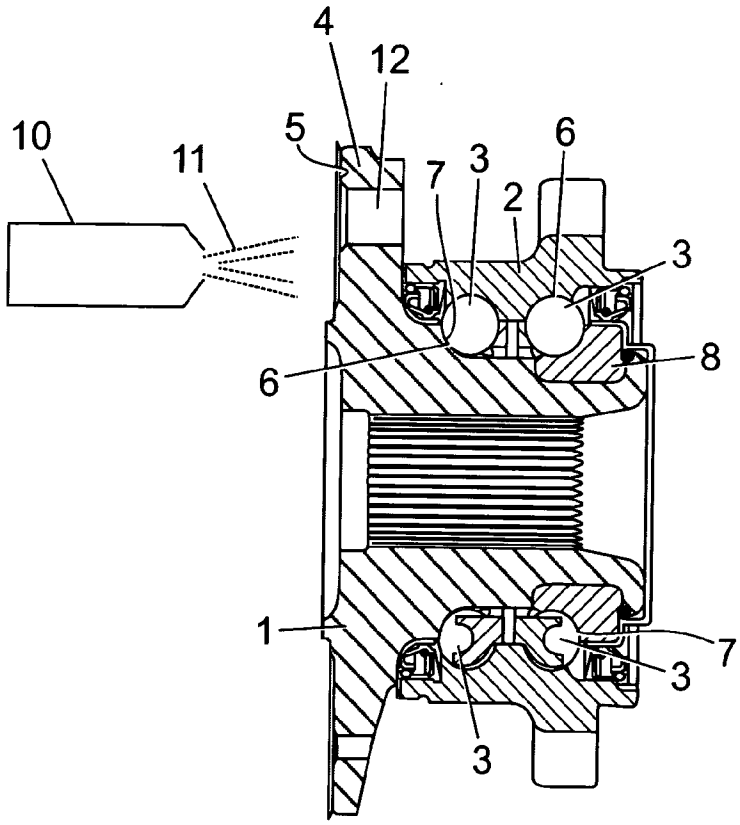


Fig. 1

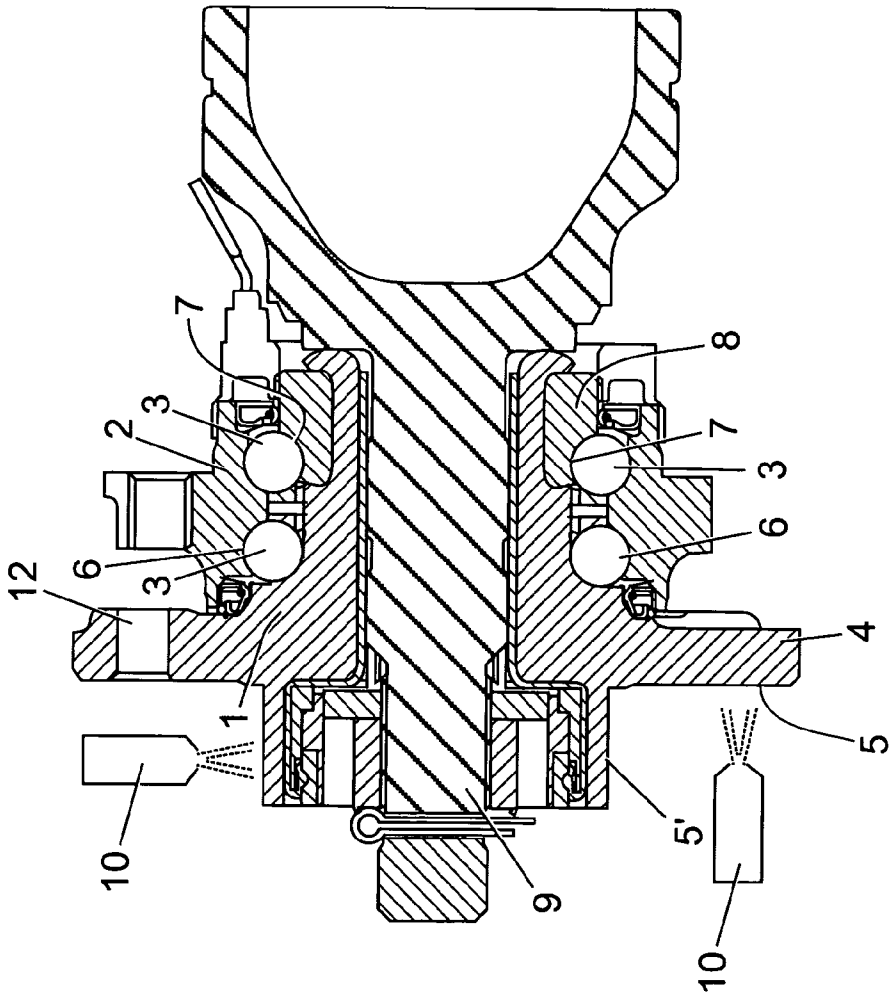


Fig. 2

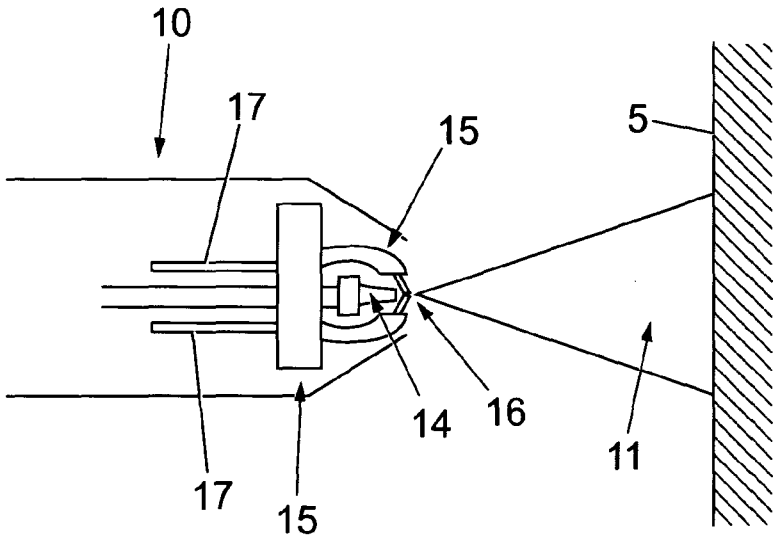


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2007/004821

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60B27/00 C23C4/06

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)
B60B C23C

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2006/177169 A1 (TAKAHASHI AKIRA [JP] ET AL) 10 August 2006 (2006-08-10) figure 1	1-10
Y	EP 1 219 726 A (COPELAND CORP [US]) 3 July 2002 (2002-07-03) paragraphs [0021], [0022], [0024]	1-10
A	US 5 753 313 A (TSAI TUNG-HUNG [TW]) 19 May 1998 (1998-05-19) the whole document	1-10
A	US 5 827 573 A (TSAI TUNG-HUNG [TW]) 27 October 1998 (1998-10-27) the whole document	1-10

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

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 November 2007	14/12/2007

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

Information on patent family members

International application No
PCT/EP2007/004821

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