(12) UK Patent Application (19) GB (11) 2 295 365 (13) A

(43) Date of A Publication 29.05.1996

(21) Application No 9524017.2

(22) Date of Filing 23.11.1995

(30) Priority Data
(31) 4441631 (32) 23.11.1994 (33) DE

(71) Applicant(s)
Löhr & Bromkamp GmbH

(Incorporated in the Federal Republic of Germany)

Carl-Legien-Strabe 10, D-63073 Offenbach/Main, Federal Republic of Germany

(72) Inventor(s)
Werner Jacob
Manfred Niederhufner

(74) Agent and/or Address for Service
Forrester Ketley & Co
Chamberlain House, Paradise Place, BIRMINGHAM, B3 3HP, United Kingdom

(51) INT CL[6]
B60B 35/18 27/00

(52) UK CL (Edition O)
B7H HDH

(56) Documents Cited
GB 2088526 A GB 1241620 A

(58) Field of Search
UK CL (Edition O) B7H HDH , F2U
INT CL[6] B60B 27/00 35/18 , B60K 17/24 17/30

(54) Wheel bearing/constant-velocity universal joint assembly

(57) A wheel bearing unit (9) for rotatably supporting a drivable wheel on a wheel carrier (10) around a rotational axis (15). There is provided a double-row angular contact ball bearing comprising an outer bearing ring (20) for being attached to the wheel carrier (10) and having a central bearing plane (24). The inner tracks (16, 17) are worked into the outer face (19) of an outer joint member (11) carrying a flange (12). The outer ball running grooves (30) which are arranged opposite inner running grooves (35) of an inner joint member (34) and which, together with a cage (36), guide balls (37) for torque transmitting purposes are formed into the outer joint member (11). The inner joint member (34) is pivotable around the joint centre (42) relative to the outer joint member (11). The central bearing plane (24) is offset from the joint centre (42) by a distance sufficient to achieve the smallest possible rolling circle diameter. This leads to a lightweight unit which additionally ensures that during the transmission of torque, the joint does not adversely affect the bearing in the wheel carrier (10).

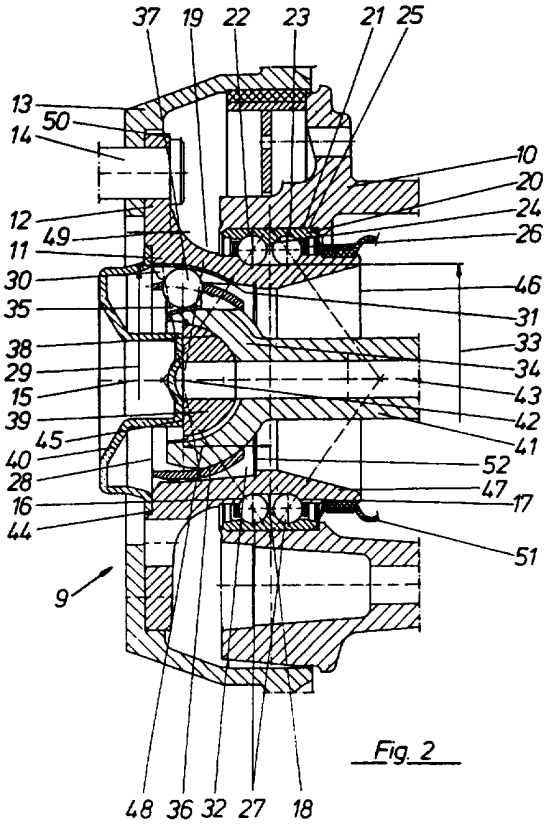

Fig. 2

GB 2 295 365 A

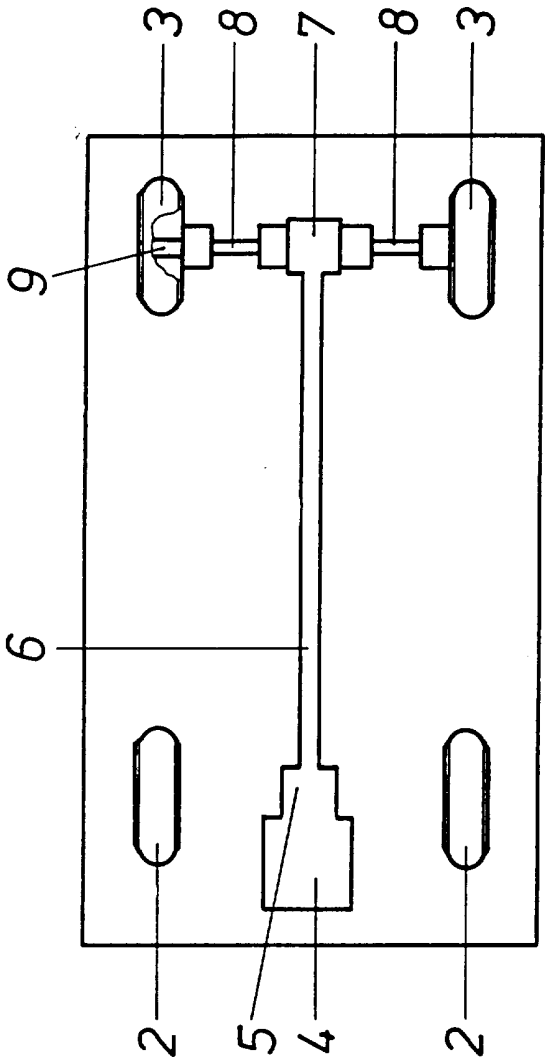

Fig. 1

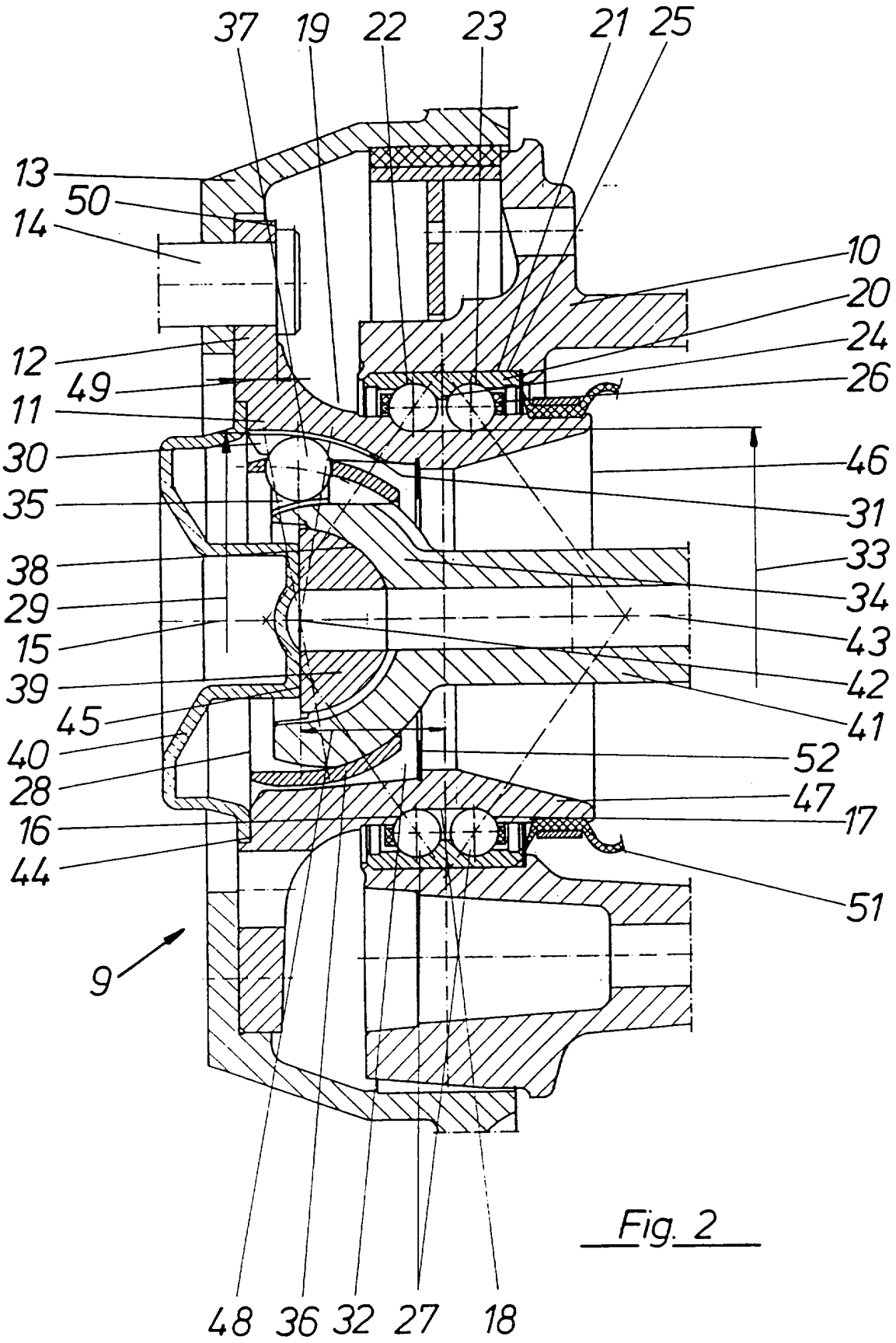
37
19
22
23
21
25
13
50
14
10
20
12
24
49
26
11
30
46
35
31
38
33
29
34
15
43
39
42
45
41
40
52
28
47
16
17
44
51
9
48
36
32
27
18

Fig. 2

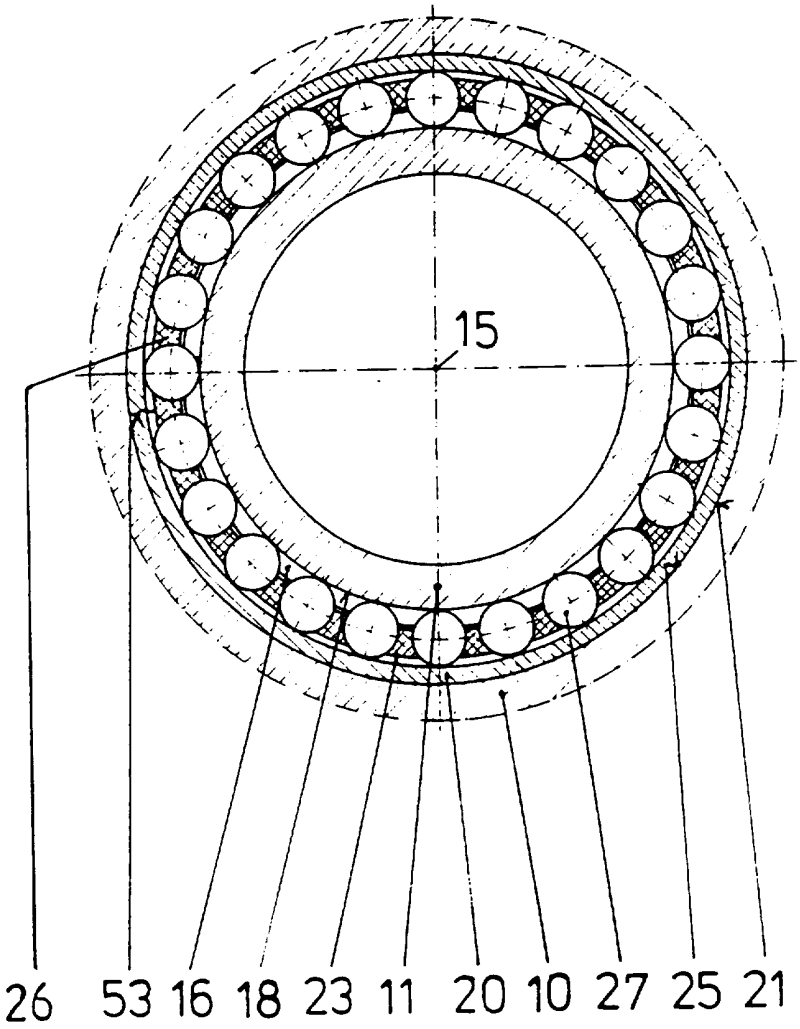

Fig. 3

Title: WHEEL BEARING/CONSTANT VELOCITY UNIVERSAL JOINT ASSEMBLY

Description of Invention

This invention relates to a wheel bearing/constant velocity ratio universal joint assembly for a motor vehicle, for supporting a drivable wheel of the vehicle relative to a wheel carrier, for rotation about an axis, the assembly comprising:

an outer bearing ring for attachment to the wheel carrier, the outer bearing ring comprising two parallel bearing tracks for rolling members of the bearing;

an outer hollow universal joint member and an inner joint member accommodated therein for universal pivoting about a joint centre, the outer and inner joint members comprising respective running grooves extending in meridian planes about said axis and facing each other in pairs with torque-transmitting balls received therebetween one in each facing pair of grooves and held in a cage;

the outer joint member having on its outer surface two parallel inner tracks for the rolling members of the bearing, said tracks being disposed opposite the outer tracks in the outer bearing ring between which the rolling members are received;

the outer joint member further being provided with a radially outwardly extending flange providing for attachment of a wheel and possibly a brake part, and the outer running grooves in the outer joint member being of undercut-free configuration considered from a first opening of the outer joint member adjacent the flange, and wherein:

a plane (herein called the central bearing plane) extending perpendicular to said axis and centrally between the tracks for the rolling members is offset in the direction along said axis from the joint centre.

Such an assembly will hereafter be referred to as an assembly of the kind specified.

A wheel bearing assembly of the kind specified is described in DE-3209690-C1, in which the inner tracks of the bearing by which the outer joint member is rotationally supported relative to the wheel carrier are arranged in an axial region of the outer surface of the outer joint member which axial region also has, internally, the outer running grooves of the joint member. This means that the rolling circle diameter of the rolling members which support the outer joint member relative to the wheel carrier is relatively large. This results in a high circumferential speed for the rolling members, and, because the outer bearing ring is in one piece, the number of such rolling members must be relatively small because of the requirement for them to be inserted into the tracks. The assembly requires a relatively large space in the radial direction, rendering it only suitable for use in those cases where wheels can be employed with a large diameter radial space therein. Furthermore, since the outer joint member is subject to elastic deformation under high torque loads, which would adversely affect the running of the bearing, a relatively great thickness of material in the outer joint member is required.

In DE-OS-1902942 there is described a vehicle wheel bearing assembly wherein the inner ring of a double row angular contact ball bearing is secured to a cylindrical neck portion of a hub member, with the outer ring of the ball bearing being received in the wheel carrier. The hub member comprises a flange-like projection with wheel bolts extending axially therefrom, and the outer joint member of a separate constant velocity universal joint is secured to the wheel bolts. In the axial direction, there then follows a brake disc at the well portion of a wheel rim. This assembly comprises a large number of individual parts and the outer joint member has a large diameter: in consequence the assembly is relatively heavy.

It is broadly the object of the present invention to provide a wheel bearing/constant velocity universal joint assembly which comprises a small number of components and is of low weight but which, at the same time, provides an acceptably small rolling circle diameter for the rolling members of the bearing

and prevents the bearing function from being affected by torque transmission in the universal joint.

In accordance with the invention, we provide an assembly of the kind specified wherein the joint centre is offset from the central bearing plane in the direction towards the flange; a connecting journal or shaft portion connected to the inner joint member extends from the outer joint member by way of an opening therein adjoining the inner bearing tracks thereon; and wherein the offset is dimensioned such that a first one of the two inner bearing tracks lies adjacent the innermost end of the outer running grooves in the outer joint member.

An advantage of the invention is that by offsetting the joint centre outwardly from the central bearing plane, i.e. when in a vehicle in the direction away from the differential towards the flange, it becomes possible to extend the length of intermediate drive shaft which connects the universal joint at the wheel to the differential. For identical maximum jounce and rebound positions of the wheel, a longer drive shaft enables the angle of articulation produced at both the inboard and outboard universal joints to be smaller. The offset of the joint centre from the central bearing plane is such that the inner tracks for the rolling members of the bearing (which may be a double row angular contact ball bearing or tapered seat roller bearing) lie axially adjacent the outer running grooves in the outer joint member so that the running characteristics of the rolling-contact bearing are not influenced by the joint or the torque being transmitted thereby. Further, the rolling circle diameter of the rolling members of the bearing assembly can be reduced. This results in a more lightweight unit. Furthermore, the constant velocity ratio joint can be assembled by introducing the inner joint member into the outer joint member from the outside, i.e. from the flange end of the latter.

A particularly advantageous application for the invention, as compared with conventional designs as described in DE-OS-1902942 is for rear wheel drive vehicles. Conventionally the drive shafts extending outwardly to the rear wheels

each incorporate a plunging constant velocity universal joint, whereas when using a wheel bearing assembly according to the present invention incorporating a fixed (i.e. non-plunging) constant velocity ratio universal joint, the joint at the innermost end of the drive shaft may also be a fixed joint and a separate means for accommodating plunge may be disposed adjacent the joint at the innermost end of the shaft. Such solutions are described in German patent application P4419373.4 and British application 9511002.9 for example. Generally, the diameter of constant velocity ratio fixed joints can be dimensioned more advantageously than that of constant velocity ratio joints which accommodate plunge in addition to providing for articulation.

By utilising the above-mentioned measures, it might be possible to provide sufficient space to accommodate a drum type of parking brake within a brake disc which is the service brake.

In a preferred embodiment, the outer joint member together with the flange comprises a solid part which preferably is made by a non-chip-producing forming operation (i.e. one not involving removal of material by machining) in which the outer running grooves in the joint member are also formed.

Alternatively, it is possible for the outer joint member, together with the flange, to be produced as a part which is formed from sheet metal. The flange provides adequate strength for the part of the joint member which contains the outer running grooves. Such reinforcement by the flange exists especially in those cases where the outer running grooves of the outer joint member extend as far as and into an outer joint member region which is within the thickness of the flange. The strength properties of a solid component may be improved further if, starting from the first inner track which lies closest to the flange, the external surface of the outer joint member extends towards the inner face of the flange in a curve extending away from the rotational axis.

The two inner tracks preferably form part of a recess in the external surface of the outer joint member, with the smallest diameter of such recess being equal to or smaller than the diameter of an imaginary circle which touches the

bases of the outer running grooves in the region of the first aperture in the outer joint member from which such outer running grooves start.

The rolling circle diameter of the rolling members of the double row angular contact ball bearing may be reduced if, in a transverse plane, the outer bearing ring comprises at least one join produced by a fracturing (blasting) operation. By thus separating the outer bearing ring, it is possible to introduce a larger number of rolling elements into the bearing thus achieving a higher load-bearing factor. In consequence, the overall bearing diameter can be reduced.

In order to ensure the necessary freedom of movement of a journal or shaft portion extending from the inner joint member of the constant velocity joint, relative to the outer joint member, during articulation, it is proposed that the cavity of the outer joint member should increase in size as it approaches its second opening, remote from the flange.

The inner joint member is preferably integral with a connecting journal or shaft portion. Such connection to a further shaft portion which extends to an inboard universal joint of the drive shaft assembly or to a plunging device, ensures a smaller diameter of the inner joint member so that this measure, too, overall leads to a wheel bearing unit whose diameter is reduced as compared to those generally hitherto known wherein there is a releasable connection between a shaft element and the inner joint member, e.g. by way of a bore in the inner joint member into which a shaft element is inserted. The necessity of providing such a connection with the inner joint member necessarily increases the diameter of the inner joint member.

The invention will now be described by way of example with reference to the accompanying drawings, of which:-

Figure 1 is a diagrammatic illustration of a motor vehicle drive arrangement;

Figure 2 is a longitudinal section through a wheel bearing/constant velocity ratio universal joint unit in accordance with the present invention;

Figure 3 is a cross-section through a wheel bearing portion of the unit shown in Figure 2.

Referring firstly to Figure 1 of the drawings, this shows diagrammatically a motor vehicle 1, such as a passenger car, which comprises front wheels 2 and rear wheels 3. An engine 4 is disposed generally between the front wheels 2, and there is a gearbox 5 and propeller shaft 6 leading to a rear axle differential unit 7. Drive shafts (half shafts) 8 extend outwardly from the differential 7 to the wheels 3. Each drive shaft comprises a first constant velocity ratio universal joint which is disposed adjacent the differential 7 and a second joint which is integrated into a wheel bearing unit 9 in the rear wheel. In each drive shaft, the two constant velocity joints are connected by an intermediate shaft. Both constant velocity joints may take the form of fixed joints which permit articulation only but no relative axial movement (plunge) between the parts they connect, in which case there is provided a separate plunging unit which is either associated with the intermediate shaft between the two joints or which is partially integrated into the constant velocity joint closest to the differential 7.

Referring now to Figures 2 and 3 of the drawings, which illustrate a unit such as that indicated at 9 in Figure 1 and in accordance with the present invention, a wheel carrier member is indicated at 10 and an outer joint member at 11. The outer joint member 11 has a flange 12 to which a drum 13 for a parking brake and a disc for a service brake are connected by means of wheel bolts one of which is shown at 14. The outer joint member 11 is rotatable relative to the wheel carrier 10 about a rotational axis 15, and is supported for such rotation by a double-row angular contact ball bearing assembly whose parallel inner tracks 16, 17 are formed in the outer surface (19) of the outer joint member. Such tracks lie in a recess 18 in the outer joint member, the diameter of such recess being indicated at 33.

An outer bearing ring 20 having an outer surface 21 received in a bore 25 in the wheel carrier member 10 lies coaxially around the part of the outer joint member which has the recess 18. The outer bearing ring 20 comprises two outer

running tracks 22, 23 extending circumferentially parallel to one another and facing the inner tracks 16, 17. Between the facing outer tracks 22, 23 and inner tracks 16, 17 there are disposed rolling members 27 in the form of balls, spaced circumferentially about the rotational axis 15 and engaging the tracks with angular contact relative to the axis 15.

The rolling members 27 are maintained in spaced relation from one another by a cage 26. A central bearing plane 24 lies centrally between the two track pairs 16, 22 and 17, 23, perpendicular to the rotational axis 15. The outer bearing ring 20 may be produced by a process in which, after it has been manufactured to its finished dimensions, it is separated by fracturing in one or more places to produce at least one join 53. Such an operation, which may be caused by suitable application of pressure to the bearing ring, is referred to as "blasting". After introduction of the rolling members, of which more may be introduced than if the outer bearing ring is not separated, the bearing ring is returned to its original configuration. A wheel bearing unit with a bearing ring blasted in a radial plane containing the rotational axis of the bearing is described in DE-3643484-A1, for example.

The outer joint member 11 is hollow and comprises an internal cavity 32 with a first aperture 28 adjacent the flange 12 and a second aperture 46 at its opposite end, remote from the flange. Outer running grooves 30 lying in meridian planes are formed in the cavity 32 of the outer joint member 11, starting from the first aperture 28 thereof. Adjacent the first aperture 28, the outer running grooves 30 are of their greatest opening width and the bases of the outer running grooves 30 are circumscribed by a circle whose diameter is indicated at 29. From the first aperture 28, the outer running grooves 30 extend towards the second aperture 46 in an undercut-free configuration, i.e. the bases of the grooves 30 approach the rotational axis 15, as far as the innermost ends identified by the reference number 31.

It can be seen that, considered in the direction of the axis 15, the inner end 31 of each of the outer running grooves 30 lies in front of the recess 18 in the

outer surface of the outer joint member, i.e. there is only a small amount of overlap. Since, however, the groove bases have approached the rotational axis 15, there exists an adequate thickness of material between the outer running grooves 30 and the first inner track 16 which lies closest to the flange 12.

In the region following the end 31 of the outer running grooves 30, the cavity 32 in the outer joint member initially reduces in diameter and then increases in diameter. The increasing diameter part 47 of the cavity 32 extends as far as the second aperture 46 of the outer joint member 11. The diameter 33 of the recess 18 is preferably equal to or smaller than the diameter 29 of the circle which circumscribes the bases of the outer running grooves 30 in the region of the first aperture 28.

The constant velocity ratio universal joint further comprises an inner joint member 34 and a cage 36 received in the cavity 32. The inner joint member 34 comprises inner running grooves 35 which lie in meridian planes and face the outer running grooves 30 of the outer joint member 11 in pairs. A plurality of balls 37 are disposed one in each facing pair of running grooves 30, 35. The balls are held in apertures in the cage 36 extending radially inwardly and outwardly from such apertures to engage the running grooves. The cage is held in contact with the inner joint member 34 by the balls 37. The inner joint member 34 comprises a control face 38 which is a hollow part-spherical face centred on the rotational axis 15 and a joint centre 42. A control element 39 in the form of a part-spherical section has a part-spherical outer face engaging the control face 38. Further, the control element 39 comprises a planar face by which it is guided on a corresponding supporting face 45 of a supporting element 40 which is centred and received in a recess 44 in the region of the first aperture 28 of the outer joint member. There is also a retaining plate 52 in the form of an annular disc which is supported in the outer joint member and serves to retain lubricating grease in the region between the outer joint member 11 and inner joint member 34, to lubricate the balls, cage, and control element thereof.

The inner joint member 34 has an integral connecting journal 41 and is pivotable about the joint centre 42 relative to the outer joint member. The longitudinal axis of the connecting journal 41 has been given the reference number 43. When the joint articulates, the axis 43 becomes inclined to the rotational axis 15 of the outer joint member.

The joint centre 42 is offset from the central bearing plane 24 by a distance 48 which is dimensioned in such a way that, on the one hand, it is possible for the necessary articulation to occur between the inner joint member and journal 41 and the outer joint member 11, and, on the other hand, it is possible to achieve as small a diameter 33 of the recess 18 as possible in order to obtain as compact and lightweight a unit as possible.

The outer running grooves 30 extend into the region of thickness 49 of the flange 12, so that radially outwardly of the bases of the outer running grooves 30 in such region there is available a considerable amount of material. The outer surface 19 of the outer joint member extends outwardly in the form of a curve from the recess 18 towards the face 50 of the flange 12 which is closest to the recess. To seal the unit between the outer joint member 11 and the connecting journal 41 there is provided a flexible sealing boot which may be of convoluted configuration, part of such a boot being shown in outline at 51.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. An assembly of the kind specified wherein the joint centre is offset from the central bearing plane in the direction towards the flange; a connecting journal or shaft portion connected to the inner joint member extends from the outer joint member by way of an opening therein adjoining the inner bearing tracks thereon; and wherein the offset is dimensioned such that a first one of the two inner bearing tracks lies adjacent the innermost end of the outer running grooves in the outer joint member.

2. An assembly according to Claim 1 wherein the outer joint member together with the flange comprises a solid part which is made by a non-chip-producing forming operation in which the outer running grooves in the joint member are also formed.

3. An assembly according to Claim 1 wherein the outer joint member together with the flange is a formed sheet metal part.

4. An assembly according to any one of the preceding claims wherein the outer running grooves of the outer joint member extend into a region thereof within the thickness of the flange.

5. An assembly according to any one of the preceding claims wherein, starting from the first inner track, the external surface of the outer joint member extends towards the inner face of the flange in a curve extending away from said rotational axis.

6. An assembly according to any one of the preceding claims wherein the two inner tracks form part of a recess in the external surface of the outer joint member.

7. An assembly according to Claim 6 wherein the smallest diameter of said recess is equal to or smaller than the diameter of an imaginary circle which touches the bases of the outer running grooves in the region of the first aperture in the outer joint member from which the outer running grooves start.

8. An assembly according to any one of the preceding claims wherein the outer bearing ring comprises at least one join produced by a fracturing operation.

9. An assembly according to any one of the preceding claims wherein the outer joint member includes an internal cavity which increases in size towards its second opening remote from the flange.

10. An assembly according to any one of the preceding claims wherein the inner joint member is integral with a connecting journal or shaft portion.

11. A wheel bearing/constant velocity universal joint assembly, substantially as hereinbefore described with reference to the accompanying drawings.

12. Any novel feature or novel combination of features described herein and/or in the accompanying drawings.

Amendments to the claims have been filed as follows

1. An assembly of the kind specified wherein the joint centre is offset from the central bearing plane in the direction towards the flange; a connecting journal or shaft portion connected to the inner joint member extends from the outer joint member by way of an opening therein adjoining the inner bearing tracks thereon; and wherein the offset is dimensioned such that a first one of the two inner bearing tracks lies adjacent the innermost end of the outer running grooves in the outer joint member.

2. An assembly according to Claim 1 wherein the outer joint member together with the flange comprises a solid part which is made by a non-chip-producing forming operation in which the outer running grooves in the joint member are also formed.

3. An assembly according to Claim 1 wherein the outer joint member together with the flange is a formed sheet metal part.

4. An assembly according to any one of the preceding claims wherein the outer running grooves of the outer joint member extend into a region thereof within the thickness of the flange.

5. An assembly according to any one of the preceding claims wherein, starting from the first inner track, the external surface of the outer joint member extends towards the inner face of the flange in a curve extending away from said rotational axis.

6. An assembly according to any one of the preceding claims wherein the two inner tracks form part of a recess in the external surface of the outer joint member.

7. An assembly according to Claim 6 wherein the smallest diameter of said recess is equal to or smaller than the diameter of an imaginary circle which touches the bases of the outer running grooves in the region of the first aperture in the outer joint member from which the outer running grooves start.

8. An assembly according to any one of the preceding claims wherein the outer bearing ring comprises at least one join produced by a fracturing operation.

9. An assembly according to any one of the preceding claims wherein the outer joint member includes an internal cavity which increases in size towards its second opening remote from the flange.

10. An assembly according to any one of the preceding claims wherein the inner joint member is integral with a connecting journal or shaft portion.

11. A wheel bearing/constant velocity universal joint assembly, substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977 17 **Examiner's report to the Comptroller under Section 17 (The Search report)**	Application number GB 9524017.2
Relevant Technical Fields (i) UK Cl (Ed.O) B7H (HDH), F2U (ii) Int Cl (Ed.6) B60B 27/00, 35/18; B60K 17/24, 17/30	Search Examiner T S SUTHERLAND Date of completion of Search 12 JANUARY 1996
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1-10

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	**P:**	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	**E:**	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	**&:**	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 2088526 A	(LÖHR & BROMKAMP)	
A	GB 1241620	(PORSCHE) Figure 1	

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).