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(54) Hub assembly

(57) A hub assembly comprising a hub member (11) having a flange (12) for wheel attachment, a bearing (2) supporting the hub member for rotation, and a constant velocity ratio universal joint (3) of which the outer member (7) is held axially to the hub member by a central fastening bolt (4), wherein a torque transmitting connection between the joint member and hub member is provided by mutually interengaging straight cylindrical teeth (13, 14). The hub member may have external teeth (13) engagable with internal teeth (14) provided in a recess or annular groove in the joint member, or maybe connected by welding to an annular member provided with internal teeth or external teeth which engage, respectively, external teeth on the joint member or internal teeth therein.

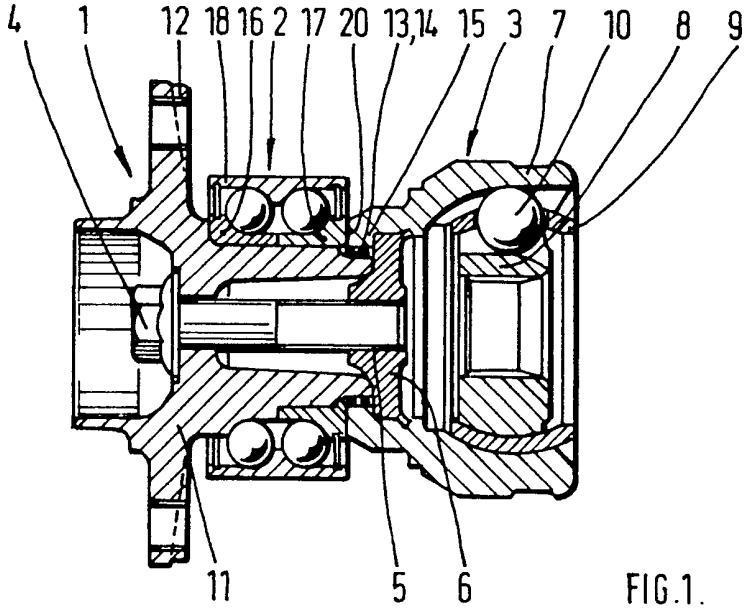

FIG.1.

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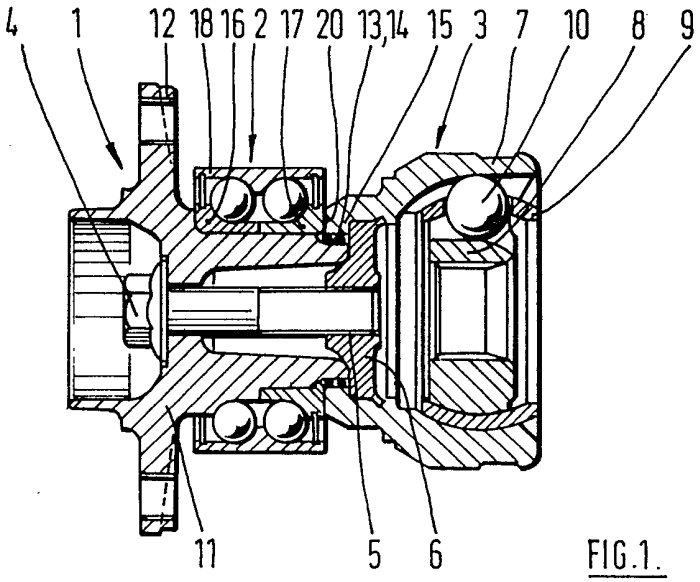

FIG.1.

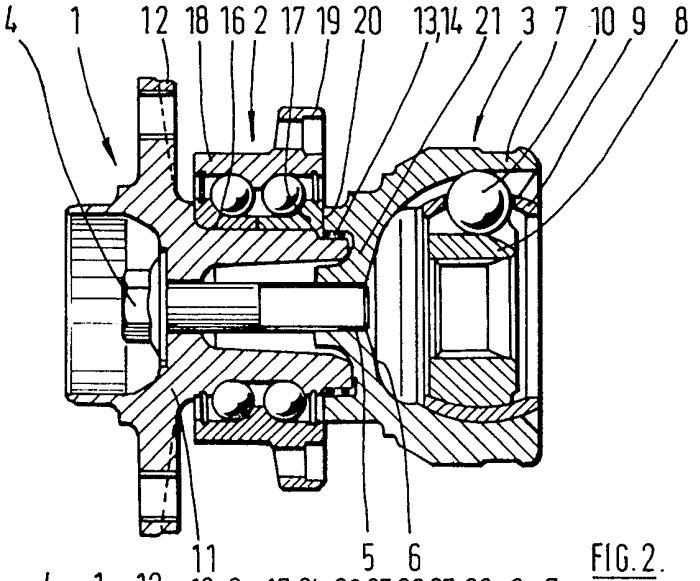

FIG.2.

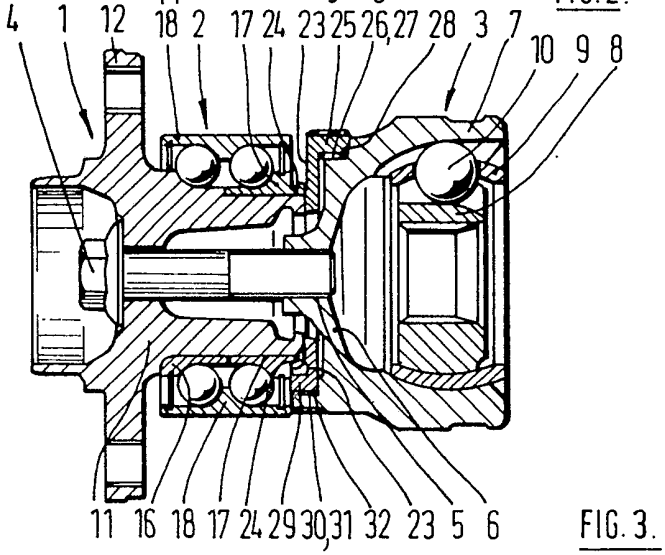

FIG.3.

SPECIFICATION

Hub assembly

This invention relates to a hub assembly for a wheel of a motor vehicle, the assembly comprising a hub member, a flange for wheel attachment which may be integral with the hub member, a wheel bearing supporting the hub member for rotation about an axis, and a constant velocity ratio universal joint of which a joint member (usually, and as hereafter described, the outer joint member) is held axially to the hub member by fastening means and has a torque transmitting connection with the hub member by mutually engaging teeth.

A hub assembly as above described is disclosed in DE-3219747, wherein the torque transmitting connection between the hub member and joint member is provided by interengaging teeth of conical form. This has a disadvantage in that the teeth are of a complicated shape, which makes production thereof difficult and expensive, and in the arrangement described it is not possible to use a wheel bearing whereof the inner race is provided by at least one separate inner bearing ring fitted on the hub member. Frequently it would be desirable to use such a wheel bearing, because the separate inner bearing ring enables the bearing to incorporate a greater number of rolling elements such as balls to increase the load carrying capacity of the bearing without increasing the diameter thereof. With the proposed design, the axial fixing, under tension if the bearing is to be preloaded, of the inner bearing rings would cause considerable difficulties.

Other assemblies are known wherein radially extending teeth are used instead of conical teeth. A backlash free torque transmission can be achieved, but the area of engagement of the teeth cannot be enlarged without increasing the diameter thereof. In this case, too, it is difficult to use bearings with separate inner bearing rings, and it can only be done if the axial length of the assembly is increased.

It is therefore the object of the present invention to provide a hub assembly in which the above disadvantages are overcome or reduced, and in particular which permits the use of small bearing diameters and especially a bearing with a separate inner bearing ring.

According to the present invention, we provide a hub assembly comprising a hub member, a flange for wheel attachment, a wheel bearing supporting the hub member for rotation about an axis, and a constant velocity ratio universal joint, a member of the joint being held axially to the hub member by fastening means and having torque transmitting connection with the hub member by mutually interengaging teeth, wherein the teeth are straight cylindrical teeth.

One advantage of a hub assembly according to the invention is that if there should be any loosening or loss of tension in the fastening means holding the joint member to the hub member, there is no diminution in the torque transmitting ability of the interengaging teeth. Further, the provision of simple straight cylindrical teeth is easier and more economical than the provision of conical or radial teeth.

In a first advantageous embodiment, the teeth may be provided directly on the hub member, on a diameter thereof which is within the free diameter required for assembly of the bearing, whether or not the bearing has a separate inner bearing ring. Such teeth comprise external teeth on the wheel hub, with the advantage of easy production and assembly thereof, and permitting maximum torque transmitting capacity for a relatively small hub and bearing diameter.

In a further embodiment, the teeth may be provided on a part, namely an annular member, unremovably attached to the hub member. Such an annular member must be attached to the hub member after the bearing has been assembled thereon. Such an annular member may be provided with internal or external teeth, which can be provided at a larger operative diameter than teeth directly provided on the hub member, thereby permitting axial shortening of the teeth while retaining the same torque transmitting capacity, without requiring an increase in the hub and bearing diameter.

Connection between such an annular member and the hub member may be provided by welding with a subsequent upsetting operation, e.g. a friction welding and upsetting operation, the resulting weld bead engaging a separate inner bearing ring of the wheel bearing to hold the inner bearing ring in position, possibly with the bearing preloaded.

The joint member having internal teeth may have such teeth provided in a radially recessed axially extending opening therein, or in an annular groove in the joint member axially facing the hub member. In the former case, the joint member may have central nut which engages in a recess in such opening, the nut having a spigot with a threaded bore for receiving a central fastening bolt to hold the joint member to the hub member. In the latter case, the joint member may itself have a spigot having a threaded bore for receiving a central fastening bolt. In both cases, the threaded bore for the central bolt is preferably substantially axially level with the teeth.

Especially if the bearing has a separate inner bearing ring, the joint member may be provided, radially outwardly of the teeth therein, with a supporting face engaging the inner bearing ring (or the hub member if there is not a separate inner bearing ring), the hub member being axially spaced from the rest of the joint member and the central nut therein if present, when the fastening means is tight-

ened.

To make most effective use of the available diameter when a bearing with a separate inner bearing ring is used, such inner bearing ring fitting on a seating on the hub member, the diameter of the addendum circle of the external teeth on the hub member corresponds to the diameter of such seating adjacent the teeth. In a design where the inner bearing race is integral with the hub member, the diameter of the addendum circle of the external teeth on the hub member may correspond to an inner dimension of an adjacent shoulder of the bearing inner race.

Internal teeth in the joint member may be produced by an extrusion process (e.g. by orbital forging) if they are in a closed recess in the joint member. Teeth may be produced by broaching if a broach is able to be moved axially through the teeth. Internal teeth in a separate annular member welded to the hub member may be produced by extrusion, whereas external teeth thereon may be produced by broaching. In both cases, because of the relatively large diameter at which such teeth are provided, and consequent light loading thereof, there may be no need for a subsequent mechanical or thermal treatment.

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

Figure 1 is an axial section through a hub assembly, the upper and lower halves of the drawing showing different embodiments thereof;

Figure 2 is an axial section showing two further embodiments of the invention;

Figure 3 is an axial section showing two yet further embodiments of the invention.

In the drawings, corresponding parts have been given the same reference numerals.

Referring firstly to Figure 1, the hub assembly there illustrated comprises three main parts, namely a hub 1, a bearing 2, and a constant velocity ratio universal joint 2.

The hub 1 comprises a hub member 11 with a flange 12 integral therewith, the flange having circumferentially spaced threaded apertures for receiving wheel fixing bolts.

The bearing 2 is a double row angular contact ball bearing, having two rows of balls which engage tracks in a single outer race 18. In the upper half of Figure 1, the inner race of the bearing comprises two separate inner bearing rings 16, 17, whilst in the lower half of Figure 1 the inner race of the bearing comprises one separate inner bearing ring 17 and one ball track formed on the hub member 11 itself.

The universal joint comprises an outer member 7, an inner member 8 having a splined bore to receive the end of a drive shaft, a cage 9, and a plurality of circumferentially spaced balls 10, received in windows in the cage 9 and engaging grooves in the outer and inner joint members for torque transmission therebetween, in known manner. The outer joint member 7 is held to the hub member by a central fastening bolt 4, whose head with a washer formation abuts the hub member 11 within the flange 12, and whose shank engages with a screw-threaded aperture 5 provided in a nut member 6 which is held in the universal joint member 7. The nut member 6 lies in a recess provided in an axially extending opening in the joint member 7, abutting a shoulder provided by a part 15 of the joint member 7, and serves to close off the joint member.

Torque is transmitted between the outer joint member 7 and the hub member 11 by external teeth 13 provided at the end of the hub member adjacent the universal joint, engaging internal teeth 14 provided in the annular shoulder portion 15 in the opening of the joint member. The teeth are straight cylindrical spur teeth. Radially outwardly of its teeth 14, the outer joint member has a supporting face 20 which engages the separate inner bearing ring, or the adjacent one of the two separate inner bearing rings 16, 17, so that when the bolt 4 is tightened the bearing is preloaded. The diameter of the addendum circle of the teeth 13 on the hub member is the same as, or possibly slightly smaller than, the diameter of the circumferential seating on the hub member on which the separate inner bearing ring 17 is received. The central nut 6, which preferably is captive in the outer joint member either by being pressed therein or welded thereto, has a central spigot in which the screw-threaded bore 5 is provided, so that the engagement of the bolt and nut is substantially axially level with the interengaging teeth. The axial length of the assembly is thus minimised. To ensure that the support surface 20 can engage the inner bearing ring 17, a clearance must exist, when the bolt 4 is fully tightened, between the end of the hub member 11 and the nut 6.

Referring now to Figure 2 of the drawings, this shows an assembly wherein the outer joint member has a base part 6 integral therewith, which part affords a spigot with a screw-threaded bore for receiving the fastening bolt 4. The hub member 11 has external teeth 13, and the joint member 14 internal teeth provided in an annular groove 21 which faces the hub member.

The upper and lower halves of Figure 2 show two variations in the bearing 2 by which the hub member is rotatably supported. The outer bearing race 18 has an integral flange 19 for attachment to a suspension component. In the upper half of the Figure, the bearing has two separate inner bearing rings 16, 17, and in the lower half of the figure inner tracks for engagement by the balls of the bearing are formed integrally on the hub member 11. In the upper half of the figure, a sup-

port surface 20 on the outer joint member engages the inner bearing ring 17 to preload the bearing, and the diameter of the addendum circle of the teeth 13 on the hub member is equal to that of the circumferential seating on which the bearing inner ring 17 is received. In the lower half of the figure, the diameter of such addendum circle is substantially equal to that of a shoulder adjacent the teeth.

Referring now to Figure 3, there is shown an embodiment wherein the teeth associated with the hub member 11 are not provided directly thereon, but on an annular member 23 which is unremovably connected to the hub member, e.g. by a friction welding and upsetting operation. The member 23 is connected to the hub member at a diameter within the diameter required for assembly of the bearing, i.e. within the diameter of a seating on the hub member for the inner ring 17 of the bearing. In the upper half of the figure, the bearing 2 has one separate inner bearing ring 17, which is engaged by the weld bead 24 formed by the welding and upsetting operation of securing the annular member 23, to position the inner bearing ring 17 and load the bearing. The annular member 23 has an annular cylindrical projection 25 which extends towards the joint outer member 7 and has internal teeth 26 which engage external teeth 27 provided on the joint outer member for torque transmission therebetween. The projection 25 may also have external teeth, for acting as a pulse emitter for cooperation with a suitable detector, e.g. to form part of an antiblocking braking system.

In the lower half of Figure 3, the annular member 23 is illustrated as being friction welded to the hub member 11, with the bead 24 formed thereby engaging the adjacent separate inner bearing ring 17. The bearing has a further separate inner bearing ring 16. The annular member 23 has an annular cylindrical projection 29 extending towards the bearing, and having external teeth 30 which engage internal teeth 31 provided in an annular cylindrical projection 32 of the outer joint member 7.

CLAIMS

1. A hub assembly comprising a hub member, a flange for wheel attachment, a wheel bearing supporting the hub member for rotation about an axis, and a constant velocity ratio universal joint, a member of the joint being held axially to the hub member by fastening means and having torque transmitting connection with the hub member by mutually interengaging teeth, wherein the teeth are straight cylindrical teeth.

2. An assembly according to Claim 1, wherein the joint member has internal teeth provided in a radially recessed axial opening therein, and the hub member has external spur teeth.

3. An assembly according to Claim 1, wherein the joint member has internal teeth provided in an annular groove in the joint member axially facing the hub member, and the hub member has external spur teeth.

4. An assembly according to Claim 1, wherein the teeth of the hub member are provided on an annular member unremovably attached to the hub member within the diameter of a seating of the inner race of the bearing.

5. An assembly according to Claim 4, wherein the annular member has a cylindrical projection extending towards the joint member, having internal teeth engaging external teeth on the joint member.

6. An assembly according to Claim 4, wherein the annular member has a cylindrical projection extending towards the bearing on the hub member, having external teeth engaging internal teeth in the joint member.

7. An assembly according to any one of Claims 4 to 6, wherein the annular member is connected to the hub member by friction welding followed by an upsetting operation, and the weld bead engages an inner bearing ring of the wheel bearing.

8. An assembly according to any one of Claims 1 to 7, wherein the joint member has an axially extending spigot provided within and substantially axially level with the teeth, the spigot having a threaded bore for receiving a central fastening bolt.

9. An assembly according to any one of Claims 1 to 7, wherein the joint member has a central nut engaging in a recess therein, said nut having a spigot with a threaded bore for receiving a central fastening bolt, the spigot being within and substantially axially level with the teeth.

10. An assembly according to any one of Claims 1 to 3, or Claim 8 or 9 as appendant thereto, wherein the joint member has radially outwardly of the teeth therein, a supporting face engaging an inner bearing ring of the wheel bearing, the hub member being axially spaced from the rest of the joint member and the central nut therein when the fastening means is tightened.

11. An assembly according to any one of Claims 1 to 3, or of Claims 8 to 10 as appendant thereto, wherein the wheel bearing has at least one inner bearing ring fitting on a seating on the hub member, and the addendum circle of the external teeth on the hub member is of substantially the same diameter as that of the seating adjacent the teeth.

12. An assembly according to any one of Claims 1 to 3, or of Claims 8 to 10 as appendant thereo, wherein the wheel bearing has an inner race integral with the hub member and the diameter of the addendum circle of the external teeth on the hub member corresponds to an inner dimension of an adjacent shoulder of the bearing inner race.

13. An assembly according to any one of Claims 4, 5, or 7 to 12 as appendant to Claim 4 wherein the annular member has a set of external teeth, as a pulse emitter for an anti-blocking system.

14. An assembly according to Claim 3 wherein the internal teeth in the joint member are produced by cold extrusion.

15. An assembly according to Claim 2 wherein the internal teeth in the joint member are produced by broaching.

16. An assembly substantially as hereinbefore described with reference to Figure 1, Figure 2, or Figure 3, of the accompanying drawings.

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