A connecting element 10, connecting a vehicle propeller shaft to a differential gear, the connecting element 10 comprising at least one first flange 14 which is formed in one piece and configured to be connected to a corresponding second flange of one in a rotationally fixed manner. The first flange 14 of the connecting element comprises a plurality of protrusions 18 configured to be inserted into corresponding receptacles of the second flange thereby connecting the first flange 14 to the second flange in a rotationally fixed manner. The first flange 14 may comprise a plurality of openings 20 to receive threaded fasteners to bolt the flanges together. The connecting element may have internal gearing/splines 12 to connect the connecting element 10 to another component in a rotationally fixed manner.
Connecting Element as well as Driving Assembly for a Drive Train of a Motor Vehicle

The invention relates to a connecting element according to the preamble of patent claim 1 as well as a driving assembly according to the preamble of patent claim 5.

Such connecting elements and driving assemblies for drive trains of motor vehicles are well-known from the general prior art. The driving assembly comprises a propeller shaft being a first component of the drive train. For example, the propeller shaft is configured to be driven by a motor of the drive train so that the motor vehicle can be driven by means of the motor and the propeller shaft. For example, the motor is an internal combustion engine or an electric motor. The driving assembly further comprises a differential gear being a second component of the drive train. The differential gear is drivable by the propeller shaft so that the motor vehicle can be driven by the propeller shaft and the differential gear. The differential gear is also referred to as a differential being used to allow an outer drive wheel to rotate faster than an inner drive wheel of the vehicle during a turn.

Furthermore, the driving assembly comprises a connecting element for connecting the propeller shaft to the differential gear in a rotationally fixed manner. The connecting element comprises at least one first flange which is formed in one piece. Moreover, the first flange is connected to a corresponding second flange of one of the components in a rotationally fixed manner. For example, the connecting element is connected to the differential gear, in particular a drive pinion of the differential gear, in a rotationally fixed manner, wherein the second flange is a part of the propeller shaft so that the first flange is connected to the second flange of the propeller shaft in a rotationally fixed manner. Thus, the differential gear can be driven by the propeller shaft via the connecting element which is connected to both the propeller shaft and the differential gear in a rotationally fixed manner.
Conventionally, the first flange of the connecting element comprises a plurality of through openings which receive threaded fasteners in the form of, for example, bolts. Thus, the first flange is connected to the second flange by means of the threaded fasteners in a rotationally fixed manner. For example, the through openings of the first flange are drilled which results in a time-consuming and expensive manufacturing of the connecting element.

It is therefore an object of the present invention to further develop a connecting element as well as a driving assembly of the aforementioned kinds in such a way that the connecting element can be manufactured in a particularly time- and cost-effective way.

This object is solved by a connecting element having the features of patent claim 1 as well as a driving assembly having the features of patent claim 5. Advantageous embodiments with expedient developments of the invention are indicated in the other patent claims.

In order to further develop a connecting element of the kind indicated in the preamble of patent claim 1 in such a way that the connecting element can be manufactured in a particularly time- and cost-effective way, according to the present invention the first flange of the connecting element comprises a plurality of protrusions such as, for example, lugs which are configured to be inserted into corresponding receptacles of the second flange thereby connecting the first flange to the second flange in a rotationally fixed manner. In other words, the first flange of the connecting element comprises at least two protrusions which can be arranged in corresponding receptacles of the second flange at least partially so that the connecting element, in particular its first flange, is connected to the second flange in a rotationally fixed manner by means of the protrusions and the corresponding receptacles. For example, in comparison with conventional connecting elements at least two through openings configured to receive threaded fasteners such as bolts can be substituted by the protrusions which can be manufactured in a particularly cost- and time-effective way since the first flange having the protrusions is formed in one piece. Thereby, drilling operations for manufacturing through openings can be avoided or the number of drilling operations can be kept particularly low.

Moreover, the number of threaded fasteners for connecting the first flange to the second flange can be reduced thereby reducing the number of parts of the drive train. Moreover, the drive train can be assembled in a particularly time-effective way due to the reduction of the number of threaded fasteners.
For example, the first flange is a forged part. Since the protrusions are parts of the first flange and the first flange is formed in one piece the protrusions can be manufactured by forging without drilling operations. Moreover, by substituting at least two through openings and, thus, at least two bolts by the protrusions the protrusions can carry the same torques as the bolts. This means torques can be carried in the same way and the strength of the connecting element remains the same.

The invention also relates to a driving assembly of the kind indicated in the preamble of patent claim 5. According to the present invention the first flange of the connecting element comprises a plurality of protrusions received in corresponding receptacles of the second flange thereby connecting the first flange to the second flange in a rotationally fixed manner so that a particularly easy and time- and cost-effective manufacturing of the connecting element can be realized. Advantages and advantageous embodiments of the connecting element according to the present invention are to be regarded as advantages and advantageous embodiments of the driving assembly according to the present invention and vice versa.

Further advantages, features, and details of the invention derive from the following description of a preferred embodiment as well as from the drawing. The features and feature combinations previously mentioned in the description as well as the features and feature combinations mentioned in the following description of the figure and/or shown in the figure alone can be employed not only in the respective indicated combination but also in any other combination or taken alone without leaving the scope of the invention.

The drawing shows in the only Fig. a schematic perspective view of a connecting element for connecting a propeller shaft to a differential gear of a drive train of a motor vehicle, the connecting element comprising at least one first flange having a plurality of protrusions by means of which the first flange can be connected to a second flange in a rotationally fixed manner.

The only Fig. shows a connecting element 10 for a driving assembly of a drive train of a motor vehicle. The driving assembly comprises a propeller shaft which is a first component of the drive train. In a completely assembled state of the motor vehicle the propeller shaft is connected to a motor of the motor vehicle at least indirectly, the motor being configured to drive the motor vehicle via the propeller shaft. Moreover, the driving assembly and, thus, the drive train comprises a differential gear configured to distribute torques provided by the propeller shaft to respective drive wheels of the vehicle. The
differential gear is a second component of the drive train, the differential gear allowing, during a turn, the outer drive wheel to rotate faster than the inner drive wheel. For example, the differential gear comprises a drive pinion meshing with a helical gear of the differential gear so that the helical gear can be drive by the drive pinion. The connecting element 10 is configured to connect the propeller shaft to the differential gear, in particular the drive pinion, in a rotationally fixed manner so that the differential gear can be driven by the propeller shaft.

As can be seen from the Fig. the connecting element 10 comprises a gearing in the form of an internal gearing 12 by means of which the connecting element 10 being formed in one piece is connected to, for example, the drive pinion and, thus, the differential gear in a rotationally fixed manner. Moreover, the connecting element 10 comprises a first flange 14 having flange arms 16 which are arranged at a distance from each other in the circumferential direction of the connecting element 10. The flange 14 and, thus, the flange arms 16 are formed in one piece. For example, the connecting element 10 being formed in one piece is a forged part so that the flange 14 is a forged part as well. This means the connecting element 10 can be manufactured by forging in one piece.

The first flange 14 is configured to be connected to a corresponding second flange of the propeller shaft in a rotationally fixed manner so that, in the completely assembled state of the drive train, the connecting element 10 is connected to both the drive pinion and the propeller shaft in a rotationally fixed manner. This means the propeller shaft comprises the second flange configured to be connected to the first flange 14 in a rotationally fixed manner.

In order to realize a particularly time- and cost effective manufacturing of the connecting element 10 the first flange 14 comprises two protrusions 18 which are, for example, lugs, the protrusions 18 being configured to be inserted into corresponding receptacles of the second flange thereby connecting the first flange 14 to the second flange in a rotationally fixed manner. In other words, in the completely assembled state of the drive train, the protrusions 18 are arranged in the corresponding receptacles of the second flange of the propeller shaft at least partially so that the first flange 14 and the second flange are connected with each other by positive-locking. Moreover, the connecting element 10 comprises two through openings 20 configured to receive threaded fasteners for bolting the flanges together. In other words, in the completely assembled state of the drive train, threaded fasteners in the form of bolts connected to the second flange are arranged at
least partially in the corresponding through openings 20 of the connecting element 10, wherein the first flange 14 is screwed to the second flange by means of said bolts.

As can be seen in the Fig. the number of through openings as well as bolts can be kept particularly low by using the connecting element 10 so that the total number of parts of the drive train can be kept particularly low. The idea behind the connecting element 10 is to use the protrusions 18 instead of bolts to transmit torques provided by the propeller shaft. Since the protrusions 18 are used instead of through openings and bolts, the number of drilling operations for manufacturing the connecting element 10 can be kept particularly low. Furthermore, by using the two through openings 20, two corresponding bolts, and the two protrusions 18 the same amount of torque can be transmitted as if a connecting element having four through openings for corresponding bolts was used.

However, since the connecting element 10 only has two through openings 20 and two protrusions 18 the connecting element 10 can be manufactured in a much more cost- and time-effective way than a connecting element having four through openings. Furthermore, since the connecting element 10 is a forged part a particularly high stability, strength and stiffness of the connecting element 10 can be realized so that a particularly high amount of torque can be transmitted from the propeller shaft via the connecting element 10 to the differential gear.
List of reference signs

10  connecting element
12  internal gearing
14  flange
16  flange arm
18  protrusion
20  through opening
Claims

1. A connecting element (10) for connecting a propeller shaft being a first component of a drive train of a motor vehicle to a differential gear being a second component of the drive train, the connecting element (10) comprising at least one first flange (14) which is formed in one piece and configured to be connected to a corresponding second flange of one of the components in a rotationally fixed manner, characterized in that the first flange (14) of the connecting element comprises a plurality of protrusions (18) configured to be inserted into corresponding receptacles of the second flange thereby connecting the first flange (14) to the second flange in a rotationally fixed manner.

2. The connecting element (10) according to claim 1, characterized in that the first flange (14) comprises a plurality of through openings (20) configured to receive threaded fasteners for bolting the flanges together.

3. The connecting element (10) according to claim 1 or 2, characterized in that the connecting element (10) is formed in one piece.

4. The connecting element (10) according to any one of the preceding claims, characterized in that the connecting element (10) comprises a gearing, in particular an internal gearing (12), configured to connect the connecting element (10) to the other component in a rotationally fixed manner.
5. A driving assembly for a drive train of a motor vehicle, the driving assembly comprising:
   - a propeller shaft being a first component of the drive train;
   - a differential gear being a second component of the drive train; and
   - a connecting element (10) for connecting the propeller shaft to the differential gear, the connecting element (10) comprising at least one first flange (14) which is formed in one piece and connected to a corresponding second flange of one of the components in a rotationally fixed manner;
   characterized in that the first flange (14) of the connecting element (10) comprises a plurality of protrusions (18) received in corresponding receptacles of the second flange thereby connecting the first flange (14) to the second flange in a rotationally fixed manner.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

<table>
<thead>
<tr>
<th>Category</th>
<th>Relevant to claims</th>
<th>Identity of document and passage or figure of particular relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>1-5</td>
<td>GB 2095792 A (BAYERISCHES LEICHTMETALLWERK GRAF BLUCHER VON WAHLSTATT GMBH) especially see flanges 2 &amp; 6, protrusion 7, receptacle 8 and bolts 4</td>
</tr>
<tr>
<td>X</td>
<td>1-5</td>
<td>GB 1599254 A (GELENKWELLENBAU GMBH) especially see flanges 2 &amp; 3, teeth 10 forming protrusions 13 and receptacles 14, and bolts 11</td>
</tr>
<tr>
<td>X</td>
<td>1-3 &amp; 5</td>
<td>GB 2027846 A (GLAENZER SPICER SA) especially see figures 1-3 noting flanges 4 &amp; 5, bolts 12 and protrusions 6 and corresponding receptacles 6</td>
</tr>
<tr>
<td>X</td>
<td>1-3 &amp; 5</td>
<td>GB 1439707 A (GLEASON WORKS) especially see flanges 12 &amp; 14, protrusions 28, receptacles 18 and bolts 16</td>
</tr>
<tr>
<td>X</td>
<td>1-3</td>
<td>JP S5219544 U (NONE) especially see the figures noting flanges 11a &amp; 11b, protrusions 13b, receptacles 13a and bolts 17</td>
</tr>
<tr>
<td>X</td>
<td>1, 2 &amp; 4</td>
<td>WO 2014/014564 A1 (BALDOR ELECTRIC CO) especially see pins 36 and fasteners 26</td>
</tr>
<tr>
<td>X</td>
<td>1 &amp; 3</td>
<td>US 3813898 A (HATCH) especially see the figures noting pin 14</td>
</tr>
<tr>
<td>X</td>
<td>1 &amp; 4</td>
<td>US 2006/019756 A1 (LATTIN) especially see drive pins 60</td>
</tr>
<tr>
<td>X</td>
<td>1 &amp; 3</td>
<td>CN 203285870 U (ZHANG, C.) especially see the abstract WPI AN 2014-B22309 and figures noting flanges 1 &amp; 2, protrusions 3 &amp; receptacles 4</td>
</tr>
</tbody>
</table>

Categories:

- X Document indicating lack of novelty or inventive step
- Y Document indicating lack of inventive step if combined with one or more other documents of same category
- & Member of the same patent family
- A Document indicating technological background and/or state of the art.
- P Document published on or after the declared priority date but before the filing date of this invention.
- E Patent document published on or after, but with priority date
Field of Search:
Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

Worldwide search of patent documents classified in the following areas of the IPC
F16D

The following online and other databases have been used in the preparation of this search report
EPODOC, WPI

<table>
<thead>
<tr>
<th>Subclass</th>
<th>Subgroup</th>
<th>Valid From</th>
</tr>
</thead>
<tbody>
<tr>
<td>F16D</td>
<td>0001/076</td>
<td>01/01/2006</td>
</tr>
<tr>
<td>F16D</td>
<td>0001/033</td>
<td>01/01/2006</td>
</tr>
</tbody>
</table>