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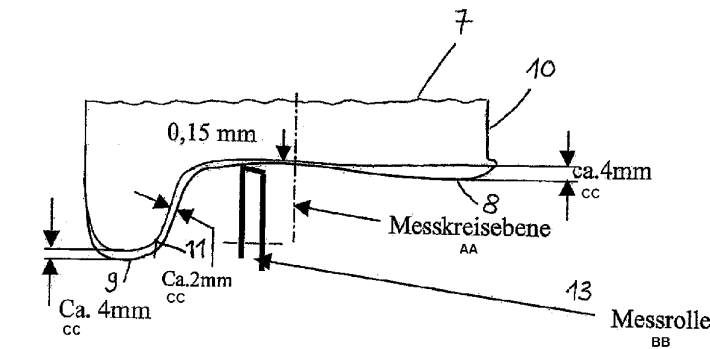
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(54) Title: METHOD FOR REPROFILING WHEELSETS ON UNDERFLOOR WHEEL LATHES

(54) Bezeichnung : VERFAHREN ZUM REPROFILIEREN VON RADSÄTZEN AUF UNTERFLURRADSATZDREHMASCHINEN



AA Measuring circle plane
BB Measuring roller
CC Approx. 4 mm

Fig. 2

(57) Abstract: The invention relates to a method for reprofiling wheelsets (1) rotatably supported on rail vehicles in axle bearing housings (6) on underfloor wheel lathes (12; 14), which comprise material-removing machining tools, a machine controller for the machining tools, drive rollers (15), axial guiding rollers (17), measuring rollers (13), and clamping elements (21; 22) for acting on the axle bearing housings (6). The method is characterized in that the wheelset (1) is lifted from the track with the aid of the drive rollers (15) and weighed, the axle bearing housings (6) are fixed between the drive rollers (15) and the clamping elements (21; 22), an axial guiding roller (17) is brought in contact with the inside (16) of each of the two wheels (3; 4) of the wheelset (1) and is fixed in the position thereof, an additional force (20) is applied to the drive rollers (15), the actual diameter (8) and the wear profile of each wheel (3; 4) are determined by means of a measuring roller (13), and the smaller actual diameter is determined based on the measurement results and is input into the machine controller for the machining tools with a specified machining allowance as a desired diameter (11).

(57) Zusammenfassung:

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— *Erfindererklärung (Regel 4.17 Ziffer iv)*

Erklärungen gemäß Regel 4.17:

— *hinsichtlich der Berechtigung des Anmelders, ein Patent zu beantragen und zu erhalten (Regel 4.17 Ziffer ii)*

Veröffentlicht:

— *mit internationalem Recherchenbericht (Artikel 21 Absatz 3)*

Die Erfindung betrifft ein Verfahren zum Reprofilieren von in Achslagergehäusen (6) an Schienenfahrzeugen drehbar gelagerten Radsätzen (1) auf Unterflurradsatzdrehmaschinen (12; 14) die spanabhebende Bearbeitungswerkzeuge, eine Maschinensteuerung für die Bearbeitungswerkzeuge, Antriebsrollen (15), Axialführungsrollen (17), Messrollen (13) sowie Spannorgane (21; 22) zum Angreifen an den Achslagergehäusen (6) aufweisen. Das Verfahren ist gekennzeichnet dadurch, dass man den Radsatz (1) mit Hilfe der Antriebsrollen (15) vom Gleis abhebt und dabei wiegt, die Achslagergehäuse (6) zwischen den Antriebsrollen (15) und den Spannorganen (21; 22) fixiert, auf der Innenseite (16) von jedem der beiden Räder (3; 4) des Radsatzes (1) eine Axialführungsrolle (17) zur Anlage bringt und in ihrer Stellung fixiert, die Antriebsrollen (15) mit einer zusätzlichen Kraft (20) beaufschlagt, mit einer Messrolle (13) den Ist-Durchmesser (8) und das Verschleißprofil von jedem Rad (3; 4) feststellt, anhand der Messergebnisse den kleineren Ist-Durchmesser bestimmt und mit einer vorgegebenen Bearbeitungszugabe als Soll-Durchmesser (11) in die Maschinensteuerung für die Bearbeitungswerkzeuge eingibt.

A method for reprofiling wheelsets on underfloor wheelset lathes

This invention relates to a method for reprofiling wheelsets rotatably mounted in axle bearing housings on rail vehicles on underfloor wheelset lathes equipped with machining tools, a machine control for the machining tools, drive rollers, axial guide rollers, measuring rollers as well as clamping devices to engage the axle bearing housings.

EP 0 201 619 B1 describes a method for correcting the profile of a railway wheel in a material-saving way using a machining process. This well-known method is used when areas of the profile deviate from a nominal profile due to material wear on the running surface and/or wheel flange, it is characterised by the fact that profile areas with lesser wear are detected, whereupon these are subjected to a forming process, displacing material from the profile areas which flows into deeper-lying areas and at least partially fills the most worn areas with material before the radial position of a corrected profile is determined, which is produced by the cutting process and is offset radially outwards with respect to the wear profile. Hence, the application of this method presupposes that the worn wheel flange is subjected to a forming operation such as rolling or forging, and that thereby material is removed from the tip of the round edge of the wheel flange so that the amount of material that is displaced to the flange peak, thereby increasing the thickness of the wheel flange, is shifted towards the running surface. From this reference to the state of the art, it is apparent to an expert that the reprofiling of railway wheelsets can be performed only on machines which do not belong into the category of underfloor lathes. It would, therefore, seem to be impossible that the method disclosed in EP 0 201 619 B1 could be applied to underfloor wheelset lathes.

DE 10 2006 054 437 A1 describes a method for reprofiling a railway wheel belonging to a railway wheelset by machining. This method is characterised by limiting reprofiling to the removal of instances of out-of-roundness in a first, central area to both sides of the tapping line of the railway wheel; in a second area extending from the outer edge of the profile to the central area, the nominal contour is restored, and in a third area extending from the middle section up to the wheel flange, reprofiling is limited to the removal of a layer close to the surface. Although this method is

somewhat more suitable to be applied to underfloor wheelset lathes, there is nevertheless no indication in this principle according to DE 10 2006 054 437 A1 as to how highly accurate reprofiling can be carried out on an underfloor wheelset lathe.

However, highly accurate reprofiling of a wheelset is the prerequisite before such a wheelset can be used on high-speed vehicles. It is characteristic of the wear pattern of a wheelset for use in high-speed ranges that in the initial stage material will be rolled out in the area of the taping line and shifted equally to the wheel flange side and to the outer side of the wheel tyre.

This insight gives rise to the purpose of the present invention; namely, to propose a method in which the mileage of the wheelsets can be significantly increased with a minimal removal of material. According to the method to be created, it should in particular be possible to reprofile the wheelsets of high-speed vehicles. As such, a wheel to be reprofiled is to be machined on an underfloor wheelset lathe in a single cut with a cutting depth of between 0.1 mm to 0.2 mm. In doing so, the maximum deviation from the nominal diameter should not exceed a value of 0.1 mm. The highly accurate reprofiling on an underfloor wheelset lathe should also increase cost-effectiveness, since the wheelset does not need to be removed from the vehicle in order to be reprofiled.

According to the invention, this function is achieved by:

- Lifting the wheelset off the rail using the drive rollers of the underfloor wheelset lathe and weighing it in the process
- Fixing the axle bearing housings between the drive rollers and the clamping devices
- Bringing an axial guide roller into contact on the inner side of each of the two wheels of the wheelset and fixing it in position
- Applying additional force to the drive rollers
- Determining the actual diameter and the wear profile of each wheel by using a measuring roller

- Determining the smaller actual diameter based on the measurement results and, having modified it by a specified machining allowance, entering it as the nominal diameter into the machine control for the machining tools.

In an advantageous embodiment of the method, it is intended that the drive rollers be subjected to an additional force between 20 kN and 50 kN, preferably 30 kN for each drive roller. Thus, a particularly rigid clamping of the wheelset on the underfloor wheelset lathe is achieved.

According to a further advantageous embodiment, there is provision for the machining allowance to be selected between 0.10 mm and 0.25 mm, preferably 0.15 mm. Such a feed is useful for eliminating surface damage of the reprofiled profile by fine cracks.

A restoration of the profile is preferably performed by only a single machining cut. In this case, the procedure is as follows:

The machining is carried out from the outer side of the wheel towards the taping line, that is, in the first third of the actual profile, with a cutting depth of between 2 mm and 6 mm, preferably 4 mm. In the area of the taping line, that is in the area of the running circle of the actual profile, the machining is carried out with a depth of between 0.10 mm and 0.25 mm, preferably 0.15 mm. Thereafter, in the area of wheel flange flank, the machining is carried out with a depth of between 0.0 mm and 4.0 mm, preferably 2.0 mm. Consequently, it is possible that no material is removed in the area of the wheel flange flank. Finally, at the round edge of the wheel flange, the machining is carried out with a depth of between 2.0 mm and 6.0 mm, preferably 4.0 mm.

With such different cutting depths, the passive cutting forces which influence the stiffness of the clamping and thus the accuracy of the nominal diameter of the restored profile also change. In this case, the "specific cutting force" is to be taken into consideration. The specific cutting force is that force that is required for machining a material with a machining cross section of 1 mm². This force depends on the machinability of the material, the thickness of the chip taken off, the cutting speed and the cutting edge geometry of the cutting tool. The specific cutting force increases

disproportionately with smaller chip thickness. This power increase has an impact on the accuracy of the profile to be produced. It is therefore important for the accurate machining of the wheel profile, the diameter and the concentricity, to ensure a rigid fixation; that is, clamping, of the wheel axle. It is also important to consider that the wheel axle remains mounted in axle bearing housings during machining on the underfloor wheelset lathe. The required bearing clearance must consequently be controlled in such a way that it does not enter into the machining result. This purpose is initially served by the fixation of the two wheels of the wheelset from the inner side by an axial guide roller which is brought into contact and then fixed on the inside of the wheel in its operative position. There is further provision for the axle bearing housings to be fixed by holding down with clamping lugs. However, the axle bearing housings can also be fixed with a support. Finally, there is also provision for the axle bearing housings be fixed by both holding down and fixing with a support.

By using this method, it becomes possible considerably to increase the mileage of wheelsets by removing a bare minimum of material. In this way, the wheelsets of high-speed vehicles in particular can be economically reprofiled.

The invention is described in detail below using a sample embodiment. A simplified depiction that is mostly schematic can be seen in the following figures:

Fig. 1 A perspective view of a removed wheelset on a reduced scale

Fig. 2 A cross section through the wear profile of a wheelset

Fig. 3 A variant of the axle bearing fixation by holding down, in a side view

Fig. 4 A variant of the axle bearing fixation with a support, in a side view

Fig. 5 A variant of the axle bearing fixation with a support and by holding down in a side view

The wheelset 1 shown in Figure 1 comprises an axle shaft 2 and the two wheel discs 3 and 4. In the installed state, the wheelset 1 with its axle journals 5 is rotatably mounted in axle bearing housings 6 on the rail vehicle (not shown).

Figure 2 shows a section of the wheel profile 7 through which the wheel discs 3 and 4 are each limited in their outer circumference. Here, line 8 indicates the wear profile

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that develops on the wheelset 1 after a certain mileage. This wear profile 8 is the actual profile, and it is obvious that material was rolled out from the taping line and was equally shifted to the side of the wheel flange 9 and to the outer side 10 of the wheel profile 7.

For reprofiling it is necessary to eliminate the actual profile 8 and restore a nominal profile 11 that meets the requirements of the reprofiling of the wheelset 1. In this case, the underfloor wheelset lathe is equipped with a measuring roller 13 to determine the actual profile 8, and this is also used to confirm the work result by checking the restored nominal profile 11. The results obtained from the measuring roller 13 are entered into the machine control (not shown), in which case the measurement results from the left wheel disc 4 and the right wheel disc 3 can be compared with each other and then the smaller of the actual diameters of the two wheel discs 3; 4 minus a machining allowance of, for example, 2×0.15 mm is entered as the target diameter. This allowance of 0.15 mm is necessary to rule out residual damage to the nominal profile 11, which can be formed by material displacement in the form of minute cracks. In Figure 2, each of the cutting depths is given with which, starting from the actual profile 8, the nominal profile 11 can be restored.

Figure 3 shows a version for fixing an axle bearing housing 6 by holding it down. In the underfloor wheelset lathe 12, the wheel disc 3 is supported from below by two drive rollers, of which only one drive roller 15 is shown. At the same time, the wheel disc 3 is fixed on its inner side 16 by an axial guide roller 17. The wheel load 18 indicated by an arrow is offset by a force 19, also indicated by an arrow, on the drive rollers 15, which is composed of a reaction force corresponding to the amount of the wheel load 18 and a further additional load 20 indicated by an arrow. The additional load 20 causes the clamping lug 21 which is used to hold down the axle bearing housing 6 on the underfloor wheelset lathe 12 to be deformed by bending upwards. At the same time, the additional load 20 acts on the clamping lug 21 and deforms it depending on its stiffness. During machining, the additional load 20 is increased by the specific cutting force which has already been explained above. Due to the finite stiffness of the total system consisting of the wheel disc 3, axle journal 5, axle bearing

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housing 6, clamping lug 21, underfloor wheelset lathe 12 and drive rollers 15, the additional load 20 affects the machining accuracy.

Figure 4 shows a version for fixing an axle bearing housing 6 by means of a support 22. Such a support 22 is used, for example, in vehicles with a sufficient wheel load 23 (indicated by an arrow) larger than about 120 kN. A load reduction 24 of about 20 kN, indicated by an arrow, yields a resultant force 25, also indicated by an arrow, which acts via the axle bearing housing 6 on the support 22 of the underfloor wheelset lathe 14 and deforms it in accordance to its stiffness. During machining, the resultant force 25 is reduced by the specific cutting force. Due to the finite stiffness of the system, this reduction affects the machining accuracy as well.

Figure 5 shows a version for fixing an axle bearing housing 6 by holding it down with a clamping lug 21 and a support 22. With this clamping variant, the negative effects of the passive cutting force, as described in connection with Figure 3 and Figure 4, cancel each other out. Accordingly, this clamping variant is optimal for economical reprofiling of railway wheelsets 1 with a single cut.

List of reference numbers

- 1 Wheelset
- 2 Axle shaft
- 3 Wheel disc
- 4 Wheel disc
- 5 Axle journal
- 6 Axle bearing housing
- 7 Wheel profile
- 8 Actual profile (wear profile)
- 9 Wheel flange
- 10 Outer side
- 11 Nominal profile (reprofiling profile)
- 12 Underfloor wheelset lathe
- 13 Measuring roller
- 14 Underfloor wheelset lathe
- 15 Drive roller
- 16 Inner side
- 17 Axial guide roller
- 18 Wheel load
- 19 Wheel load and additional load
- 20 Additional load
- 21 Clamping lug
- 22 Support
- 23 Wheel load
- 24 Wheel load - reduction
- 25 Resultant force

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The claims defining the invention are as follows:

1. A method for reprofiling wheelsets rotatably mounted in axle bearing housings on rail vehicles on underfloor wheelset lathes equipped with machining tools, a machine control for the machining tools, drive rollers, axial guide rollers, measuring rollers as well as clamping devices to engage the axle bearing housings, the method comprising the steps of lifting the wheelset off the rail by means of the drive rollers while weighing the wheelset in the process, fixing the axle bearing housings between the drive rollers and the clamping devices, bringing the axial guide roller into contact with the inner side of each of the two wheels of the wheelset and fixing the axial guide roller in position, applying an additional force to the drive rollers, determining the actual diameter and wear profile of each wheel by using a measuring roll and determining the smaller actual diameter based on the measurement results, which, after having been modified by a specified machining allowance, is entered as the nominal diameter into the machine control for the machining tools.
2. The method according to claim 1, in which the additional force to act on the drive rollers is selected between 20 kN and 50 kN. for each drive roller.
3. The method according to claim 2 in which the additional force to act on the drive rollers is 30 kN, for each drive roller.
4. The method according to any one of claims 1 to 3, in which the machining allowance is selected between 0.10 mm and 0.25 mm.
5. The method according to claim 4 in which the machining allowance is 0.15 mm.
6. The method according to any one of claims 1 to 5, in which the method is done starting from a tapping line of each wheel from the outer side of the wheel towards the tapping line in the first third of the actual profile with a cutting depth of between 2 mm and 6 mm.

7. The method according to claim 6 in which the cutting depth is 4 mm.
8. The method according to claim 6 or 7, in which the method is carried out in the area of the taping line, wherein the taping line is in the running circle of the actual profile, with a cutting depth of between 0.10 mm and 0.25 mm.
9. The method according to claim 8 in which the cutting depth is 0.15 mm.
10. The method according to claim 6 or 7, in which in the area of the wheel flange flank the method is carried out with a cutting depth of between 0.0 mm and 4.0 mm.
11. The method according to claim 10 in which the cutting depth is 2.0 mm.
12. The method according to claim 6 or 7, in which on the round edge of wheel flange, the method is carried out with a cutting depth of between 2.0 mm and 6.0 mm.
13. The method according to claim 12, in which the cutting depth is 4.0 mm.
14. The method according to claim 6 or 7, in which reprofiling is carried out with a single machining cut.
15. The method according to any one of claims 1 to 14, in which the axle bearing housings are fixed by holding down by means of clamping lugs.
16. The method according to any one of claims 1 to 14 in which the axle bearing housings are fixed with a support.
17. The method according to any one of claims 1 to 14, in which the axle bearing housings are fixed with a support and by holding down.

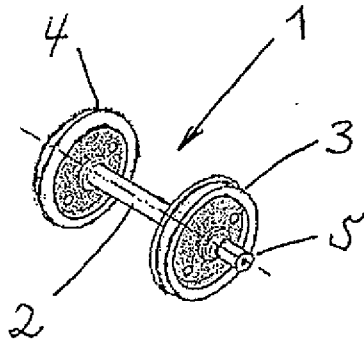


Fig. 1

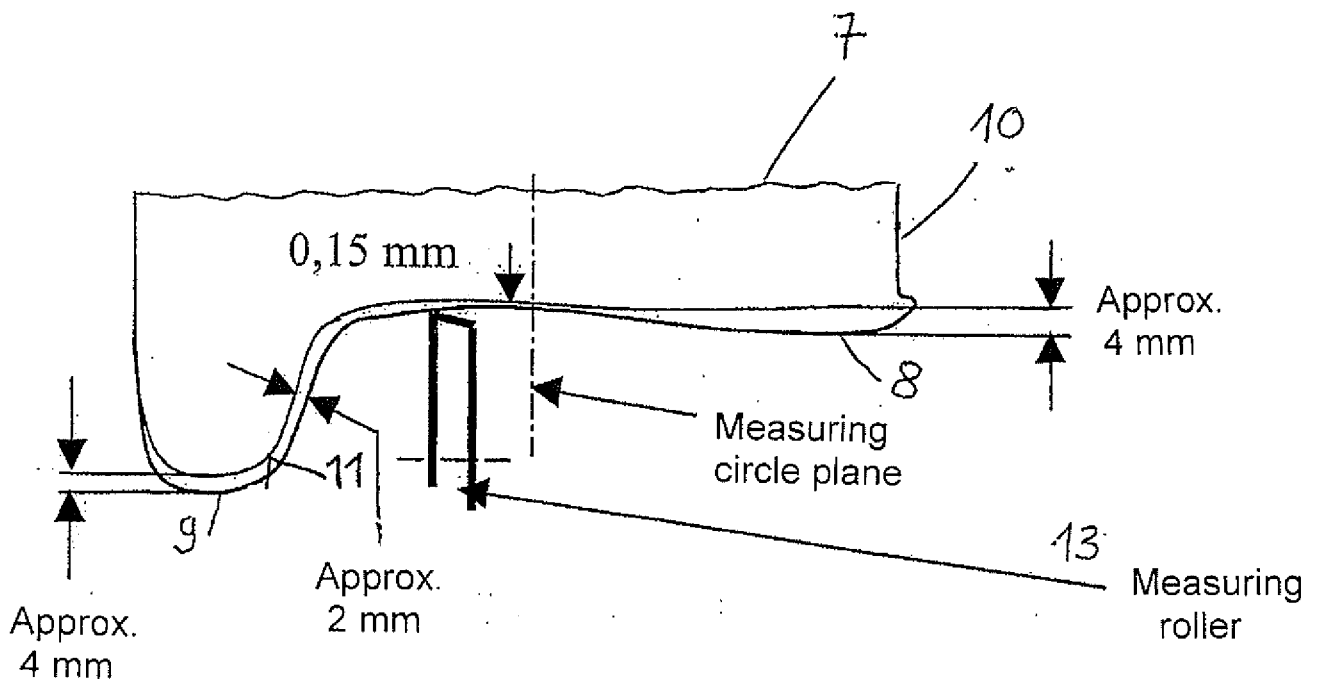


Fig. 2

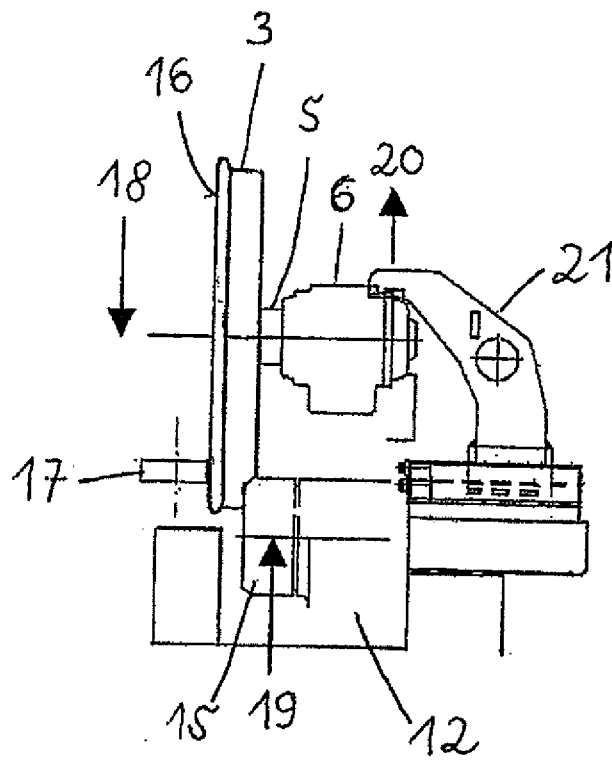


Fig. 3

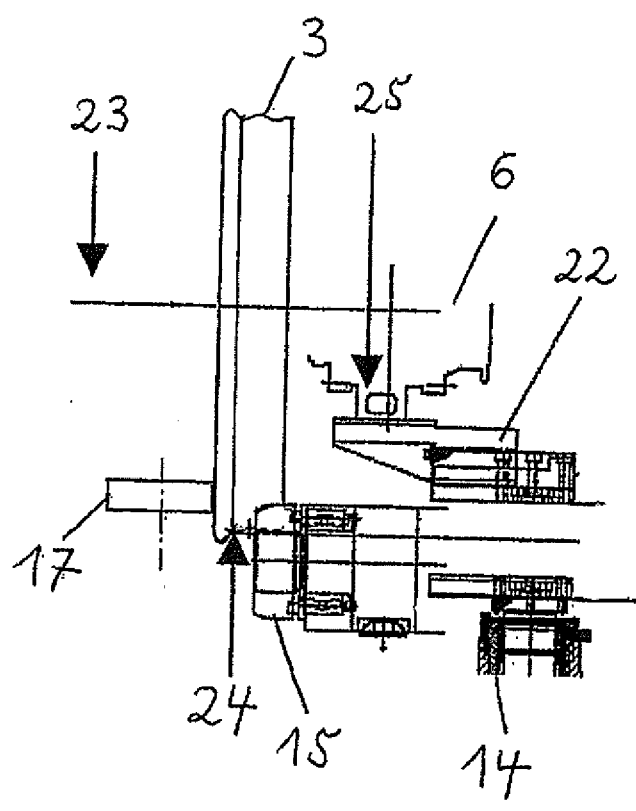


Fig. 4

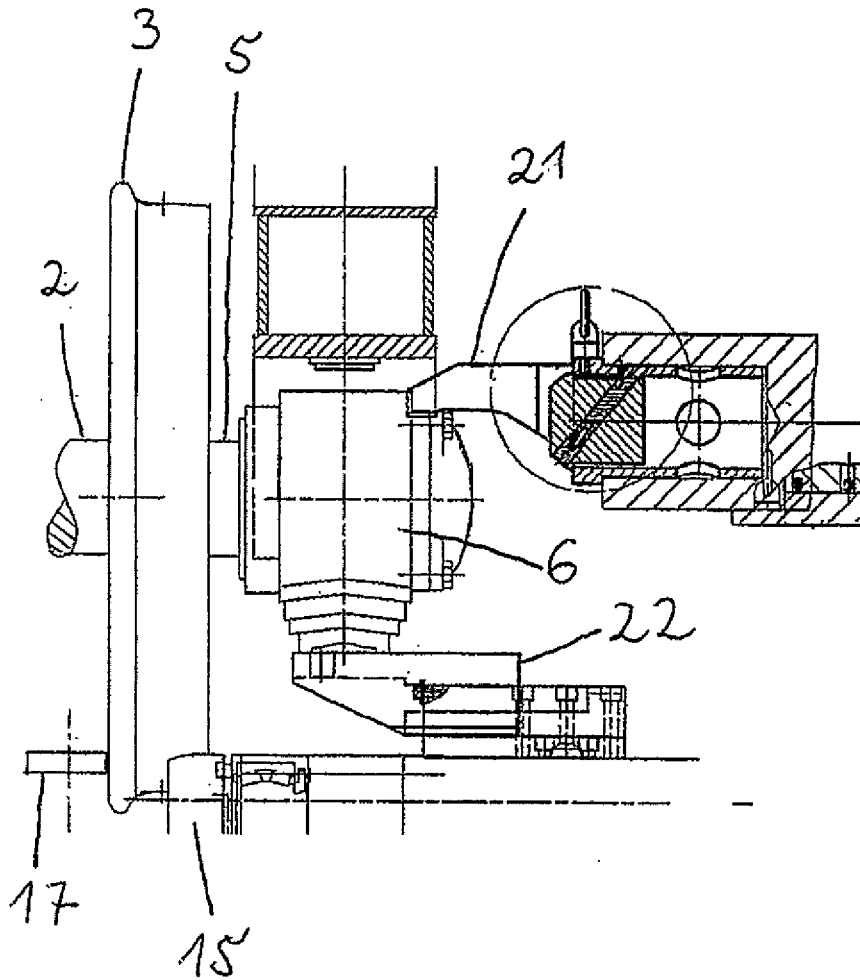


Fig. 5