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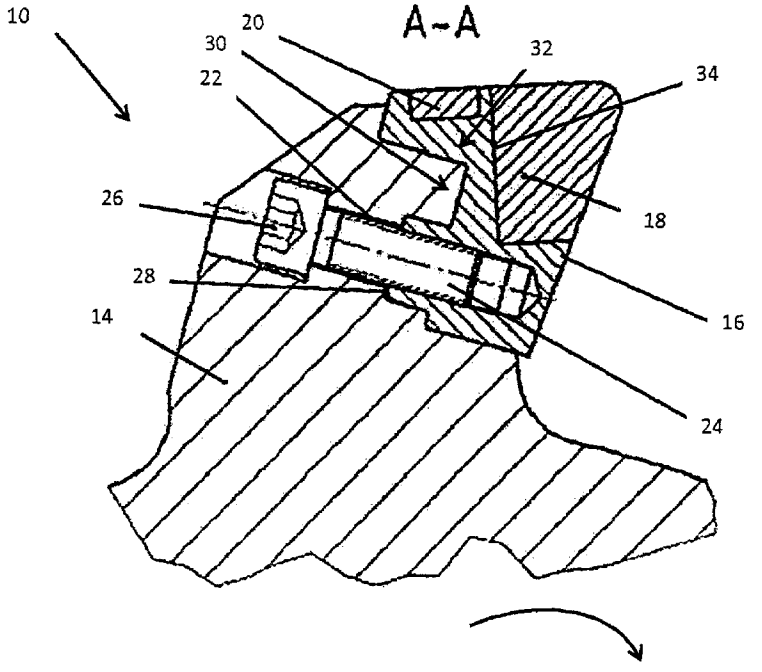

(57) Abrégé/Abstract:
The present invention relates to a crushing tool (10) of a crushing roller (12) of a roller crusher having a main body (14) and a fastening segment (16), which is attached to the front edge of the main body (14), and a wear protection segment (18) attached to the fastening segment (16), wherein the fastening segment (16) is detachably connected to the main body (14).

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Abstract

The present invention relates to a crushing tool (10) of a crushing roller (12) of a roller crusher having a main body (14) and a fastening segment (16), which is attached to the front edge of the main body (14), and a wear protection segment (18) attached to the fastening segment (16), wherein the fastening segment (16) is detachably connected to the main body (14).

-Fig. 3-

Crushing roller having a crushing tool

The invention relates to a crushing roller of a roller crusher as well as to a roller crusher with such a crushing tool. Furthermore the invention relates to a method for manufacturing such a crushing roller.

Materials such as limestone, oil shale, marl, clay, oil sand or similar mineral materials are normally broken up with the aid of crushers, in particular roller crushers. Known roller crushers have two crushing rollers, which rotate in opposite direction to each other, thereby forming a crushing gap between the crushing rollers. The crushing rollers comprise evenly spaced-apart crushing tools such as cleats, hammers, chisels or crushing teeth. The crushing tools of a roller crusher are subject to a high degree of wear and therefore require regular replacement. The DE4123967A1 has for example disclosed such a crushing tool.

To counteract wear of the crushing tools it is known to solder or weld a hard metal layer such as tungsten carbide onto the crushing tools, which are formed from relatively soft steel, for example. Usually such a wear-resistant layer has a thickness of max. 6 mm, wherein it is technically not possible to apply a thicker layer. As the wear-resistant layer applied to the crushing tool deteriorates, the relatively soft steel of the crushing tool is subject to wear resulting in the crushing tool wearing very quickly and frequently leading to damage and failure of the roller crusher. Furthermore, as the wear-resistant layer deteriorates, replacement of the crushing tool becomes necessary, which is very time-consuming and cost-intensive and results in long downtimes of the entire roller crusher.

It is therefore the object of the present invention to propose a crushing tool, which is characterized by low wear and which at the same time, in case of wear, causes a minimal downtime of the roller crusher.

According to the invention this problem is solved by a device with the characteristics as defined below. Advantageous further developments are also revealed in the following description.

Date Reçue/Date Received 2020-04-22

According to a first aspect a crushing tool of a crushing roller of a roller crusher comprises a main body and a fastening segment, which is attached to the front edge of the main body. Furthermore the crushing tool comprises a wear protection segment attached to the fastening segment. The fastening segment is detachably connected to the main body.

A roller crusher preferably comprises two crushing rollers rotating in opposite direction, which are arranged next to each other. A crushing gap is formed between the crushing rollers, in which material, such as limestone, marl, clay, ore-rich material, oil shale or oil sand is crushed. Each crushing roller comprises a plurality of crushing tools, which are attached to the surface of the crushing roller. Preferably the crushing roller comprises a plurality of crushing plates, which form the surface of the crushing roller. The main body is for example formed in one piece with the crushing roller, in particular the crushing plate of the crushing roller, or is substance-to-substance bonded, e.g. welded thereto. The main body preferably projects from the same in radial direction of the crushing roller. Preferably only the main body of the crushing tool is attached to the crushing roller or formed in one piece with the same. The crushing tool is, in particular, a crushing tooth, which is preferably attached to a secondary crusher or a tertiary crusher. The crushing tooth is for example a chisel-shaped, in particular tooth-shaped contour with a tip pointing in rotation direction of the crushing roller.

The front edge of the main body is understood to be the side surface of the main body pointing in rotation direction of the crushing roller. In particular, the wear protection segment is exclusively attached to the fastening segment and not fixedly connected to the main body. The wear protection segment forms in particular the front edge of the crushing tool. Wherein the front edge is understood to be the side surface pointing in rotation direction of the crushing roller, which is the first to come into contact with the material to be crushed. Preferably the wear protection segment is arranged exclusively on the front edge of the crushing tool, wherein there is no wear protection segment arranged at the rear edge.

A fastening segment, which is detachably connected to the main body, offers the advantage that it can be easily replaced as part of the crushing tool. As the crushing roller rotates, the front edge of the crushing tool is the first to come into contact with the material to be crushed and therefore is subject to the greatest wear. If only the front edge of the crushing tool is arranged to be replaceable, it is not necessary, in case of wear, to replace the entire crushing tool or even the crushing plate of the crushing roller. Thus it is possible, depending on the extent of wear on the crushing tool, to replace the worn region in a simple manner.

According to a first embodiment the main body comprises a connection region, which is connected to the fastening segment and wherein the connection region comprises a tooth profile. Preferably the connection region comprises a plurality of recesses and projections, which are alternately arranged next to each other. The connection region of the main body is the side surface pointing in rotation direction of the crushing roller, wherein the side surface is connected to the fastening segment. According to a further embodiment the fastening segment comprises a connection region, which is designed to complement the connection region of the main body and is connected thereto. The connection region of the fastening segment serves as the connection to the main body and also comprises a tooth profile, which is designed to complement the connection region of the main body. The main body and the fastening segment are positively connected with each other via their respective connection regions, wherein the connection regions essentially extend in radial direction of the crushing roller. This ensures reliable fastening of the fastening segment to the main body, so that even in case of impact stress due to the material to be crushed hitting the front edge of the crushing tool, the fastening segment is prevented from detaching itself from the main body.

According to a further embodiment the fastening segment comprises a bore for receiving a fastening means, such as e.g. a screw or a bolt. The fastening segment is preferably screwed to the main body, wherein the crushing tool in particular comprises a fastening screw, which passes through the bore in the main body and extends into the fastening segment. The bore extends in particular right through the main body, in particular from

the rear edge to the front edge. The fastening segment preferably comprises a bore for receiving the fastening screw.

According to a further embodiment the wear protection segment is substance-to-substance bonded to the fastening segment. Preferably the wear protection segment is welded, soldered or glued to the fastening segment. At its front edge the fastening segment preferably comprises a recess, into which the wear protection segment is fitted. The recess in the fastening segment, in which the wear protection segment is arranged, is preferably open towards the topside and towards the front side.

According to a further embodiment the wear protection segment is formed from ceramics and/or a hard metal, for example sintered carbide hard metals such as tungsten carbide, which comprise very high hardness, wear resistance and heat resistance and corrosion resistance. Hard metals comprise for example 90–94% tungsten carbide and 6–10% cobalt. The wear protection segment is for example formed from hard metal such as tungsten carbide, titanium carbide, boron carbide, niobium carbide, chrome carbide or ceramics or from a mixture of these materials.

According to a further embodiment a plurality of wear protection segments is attached to the fastening segment. The wear protection segments are for example arranged next to each other in a recess in the fastening segment and for example connected with each other. The plurality of wear protection segments preferably forms the tip of the crushing tool. The arrangement of a plurality of wear protection segments on a fastening segment offers the advantage of a simpler manufacture of individual wear protection segments. The wear protection elements comprise for example different sizes and/or material properties.

According to a further embodiment a wear protection segment is attached on the topside of the fastening segment, preferably on the outward-pointing surface in radial direction of the crushing roller. The topside of the fastening segment is also subject to heavy wear, wherein a wear protection segment from a wear-resistant material offers additional wear protection. In particular a plurality of wear protection segments is attached on the topside

of the fastening segment. The wear protection segment is preferably substance-to-substance bonded, positively connected and/or frictionally connected to the fastening segment. For example, the wear protection segment is designed in a plate-shaped or cubical manner and attached in a recess on the topside of the fastening segment. The wear protection segment finishes preferably flush with the surface of the fastening segment, so that a planar surface of the fastening segment is formed. In particular the wear protection segment is formed from a hard metal such as tungsten carbide, titanium carbide, boron carbide, niobium carbide, chrome carbide or from ceramics or from a mixture of these materials.

According to a further embodiment the fastening segment is formed from a more ductile material compared to the wear protection segment. The fastening segment is for example formed from steel and is in one piece. The fastening segment is for example formed from a relatively ductile steel with a hardness of 90-500 HB (Brinell), preferably 120-350 HB, in particular 150–200 HB, und preferably an elongation at break of approx. 18–26%. In particular the fastening segment 16 is cast.

The invention also comprises a crushing roller of a roller crusher, wherein the crushing roller comprises a plurality of crushing tools, as described above. According to a further embodiment the crushing roller comprises a plurality of crushing plates, which form the topside of the crushing roller and wherein the main body is formed in one piece with a crushing plate or is substance-to-substance bonded to the crushing plate.

Description of drawings

The invention will now be described in more detail by way of several exemplary embodiments with reference to the accompanying drawings, in which

Fig. 1 shows a schematic sectional view of a roller crusher with two crushing rollers according to an exemplary embodiment.

Fig. 2 shows a schematic top view of a crushing tool of a crushing roller.

Fig. 3 shows a schematic sectional view of the crushing tool as per fig. 2.

Fig. 1 shows a roller crusher 11 with two crushing rollers 12, which are arranged next to each other and wherein a crushing gap 36 is formed between the crushing rollers 12, in which the material is crushed. The crushing rollers 12 each comprise a plurality of crushing tools 10 on their surface, which are arranged on the circumference of the respective crushing roller 12 and spaced apart at equal distances from each other. The crushing tools 10 are arranged on the surface of the crushing roller and, for example, are formed at least partially in one piece with the crushing roller 12. The crushing rollers 12 each comprise a plurality of crushing plates 38, which form the surface of the crushing roller and which are arranged next to each other along the circumference. Each crushing roller 12 comprises for example four crushing plates 38, each of which has three rows of crushing tools 10 attached to it. When the roller crusher 11 is in operation, the crushing rollers 12 rotate in arrow direction, i.e. in opposite direction relative to each other. The material to be crushed is fed from above into the crushing gap 36 and is crushed in the crushing gap 36.

Figs. 2 and 3 show a crushing tool 10 on a crushing roller 12. The crushing tool 10 comprises a main body 14, which is preferably formed in one piece with the crushing roller 12, in particular with a crushing plate 38 of the crushing roller 12, or is attached to the same by welding, for example. The main body 14 protrudes from the crushing roller 12 in radial direction therefrom and is preferably tooth-shaped. A fastening segment 16 is attached to the front edge of the main body 14, wherein the front edge of the main body 14 is the side surface pointing in rotation direction of the crushing roller 12. The rotation direction is marked in fig. 1 by the arrow. The fastening segment 16 has a wear protection segment 18 attached to it. The wear protection segment 18 forms the tip of the crushing tool 10, which when the crushing roller 12 rotates in arrow direction, is the first to come into contact with the material to be crushed. In addition to the wear protection segment 18 there is for example a wear protection element 20 attached to the fastening segment 16. It is also feasible to realize the crushing tool 10 without the wear protection element 20. The wear protection element 20 is attached to the fastening

segment 16 on the outward-pointing surface of the crushing tool 10, which points in radial direction of the crushing roller.

The main body 14 is for example formed from a type of steel and comprises a bore 22. The bore 22 extends right through the main body 14, in particular from the rear edge, which points contrary to the rotation direction of the crushing roller 12 towards the front edge of the main body 14. The bore 22 comprises for example three different diameters and is used to receive a screw 24 for fastening the fastening segment 16 to the main body 14. The first diameter of the bore, which extends from the rear edge into the main body 14, corresponds to at least the diameter of the screw head 26 of the screw 24. The second diameter, which follows the first diameter, preferably comprises an internal thread, which cooperates with the external thread of the screw 24. The third diameter following the second diameter is wider than the outer diameter of the screw shaft and the second diameter and serves to receive a projection 28 on the fastening segment 16.

The screw 24 extends right through the main body 14 and into the fastening segment 16. The fastening segment 16 is for example attached to the main body 14 with two screws 24. It is also feasible to attach the fastening segment with only one screw or with more than two screws to the main body 14.

The main body 14 comprises a connection region 30, which is connected to the fastening segment 16. The connection region 30 forms the side surface of the main body 14 pointing in rotation direction of the crushing roller 12 and comprises a plurality of projections and recesses, in particular a tooth profile. The projections and recesses are alternately arranged next to each other, wherein the connection region 30 of the main body comprises for example two recesses and two projections. The tooth profile, in particular the recesses and projections of the connection region 30 of the main body 14 are formed to complement a connection region 32 of the fastening segment 16. The connection region 32 of the fastening segment 16 is the surface of the fastening segment 16 facing the main body 14 and is connected to the connection region 30 of the main body 14. The tooth profile of the connection regions 30, 32 serves as a positively connected fastening of the fastening segment 16 to the main body 14.

When the roller crusher 11 is in operation, the crushing roller 12 rotates in direction of the arrow shown in fig. 2, so that the material to be crushed hits the tip of the crushing tool 10, in particular the wear protection segment 18 attached to the fastening segment 16. Due to the rotational movement of the crushing tool 10 the crushing force acts, at least partially, radially outwards, preferably in direction of the clamping force of the screw 24. The tooth profile of the connection regions 30, 32 ensures that the fastening segment 16 is positively connected to the main body 14 and that a movement of the fastening segment 16 relative to the main body 14, in particular in radial direction outwards, is prevented.

The wear protection segment 18 is attached to the fastening segment 16, preferably substance-to-substance bonded thereto by means of welding, soldering or gluing. The fastening segment 16 comprises a recess 34, which is open towards the upper surface of the fastening segment 16, which points outwards in radial direction, and towards the front surface which points in rotation direction. This is the recess 34, in which the wear protection segment 18 is arranged, which forms the tip of the crushing tool 10. As revealed in fig. 1, the exemplary embodiment of figs. 1 and 2 shows that three wear protection segments 18 are arranged next to each other on each fastening segment 16 in axial direction of the crushing roller 12. It is also feasible that merely one wear protection segment 18 or that a plurality of wear protection segments 18 is arranged on each fastening segment 16. The wear protection segment 18 preferably comprises a tooth shape and finishes preferably flush with the surface and the side surface of the fastening segment 16. The fastening segment 16 is for example formed from relatively ductile steel. The steel used comprises for example a hardness of 90-500 HB (Brinell), preferably 120-350 HB, in particular 150–200 HB, and preferably an elongation at break of approx. 18 – 26%. In particular the fastening segment 16 is cast.

The wear protection segment 18 is formed from a hard metal, e.g. sintered carbide hard metals such as tungsten carbide, which comprise very high hardness, wear resistance, heat resistance and corrosion resistance. Hard metals may for example comprise 90–94% tungsten carbide and 6–10 % cobalt. For example the wear protection segment 18

may consist of hard metal, such as tungsten carbide, titanium carbide, boron carbide, niobium carbide, chrome carbide or ceramics or of a mixture of these materials. Equally the wear protection element 20, which is attached to the topside of the crushing tool 10 on the fastening segment 16, is made of a hard metal. The wear protection element 20 is for example shaped as a plate, wherein in fig. 1 three wear protection elements 20 are for example attached next to each other on a fastening segment 16. It is however also feasible to attach a different number of wear protection elements 18 to the fastening segment 16.

The wear protection segment 18 is exclusively attached to the fastening segment 16 and is not in any way directly connected to the main body 14. The wear protection element 20 also is attached exclusively to the fastening segment 16. This facilitates replacement of wear protection segment 18 and wear protection element 20 by detaching the fastening segment 16 from the main body 14 via the screw connection. The fastening segment 16 is relatively easy to produce and easy to remove from the main body 14, so that in case the tip of the crushing tool 10 is worn, there is no need to replace the crushing tool 10 as a whole, but merely the front region, which is subject to the greatest wear.

List of reference symbols

10	crushing tool
11	roller crusher
12	crushing roller
14	main body
16	fastening segment
18	wear protection segment
20	wear protection element
22	bore
24	fastening means / screw
26	screw head
28	projection
30	connection region
32	connection region
34	recess
36	crushing gap
38	crushing plate

Patent Claims

1. A crushing tool of a crushing roller of a roller crusher having a main body and a fastening segment, which is attached to a front edge of the main body, and a wear protection segment attached to the fastening segment,
characterized in that the fastening segment is detachably connected to the main body, wherein the main body comprises a connection region, which is connected to the fastening segment and wherein the connection region comprises a plurality of recesses and projections, which are arranged alternately next to each other.

2. The crushing tool according to claim 1, wherein the fastening segment comprises a bore for receiving a fastening means.

3. The crushing tool according to claim 1 or 2, wherein the fastening segment comprises a connection region, which is designed to complement the connection region of the main body and is connected thereto.

4. The crushing tool according to any one of claims 1 to 3, wherein the wear protection segment is substance-to-substance bonded to the fastening segment.

5. The crushing tool according to any one of claims 1 to 4, wherein the fastening segment comprises a recess in which the wear protection segment is arranged, and wherein the recess is open towards a topside and a front side of the fastening segment.

6. The crushing tool according to any one of claims 1 to 5, wherein the wear protection segment is formed from a hard metal and/or ceramics.

7. The crushing tool according to any one of claims 1 to 6, wherein a plurality of wear protection segments is attached to the fastening segment.

8. The crushing tool according to any one of claims 1 to 7, wherein a wear protection element is attached on a topside of the fastening segment.

Date Reçue/Date Received 2020-04-22

9. The crushing tool according to any one of claims 1 to 8, wherein the fastening segment is formed from a more ductile material compared to the wear protection segments.

10. A crushing roller of a roller crusher, wherein the crushing roller comprises a plurality of crushing tools as claimed in any one of claims 1 to 9.

11. The crushing roller according to claim 10, wherein the crushing roller comprises a plurality of crushing plates, which form the surface of the crushing roller and wherein the main body is formed in one piece with a crushing plate.

Date Reçue/Date Received 2020-04-22

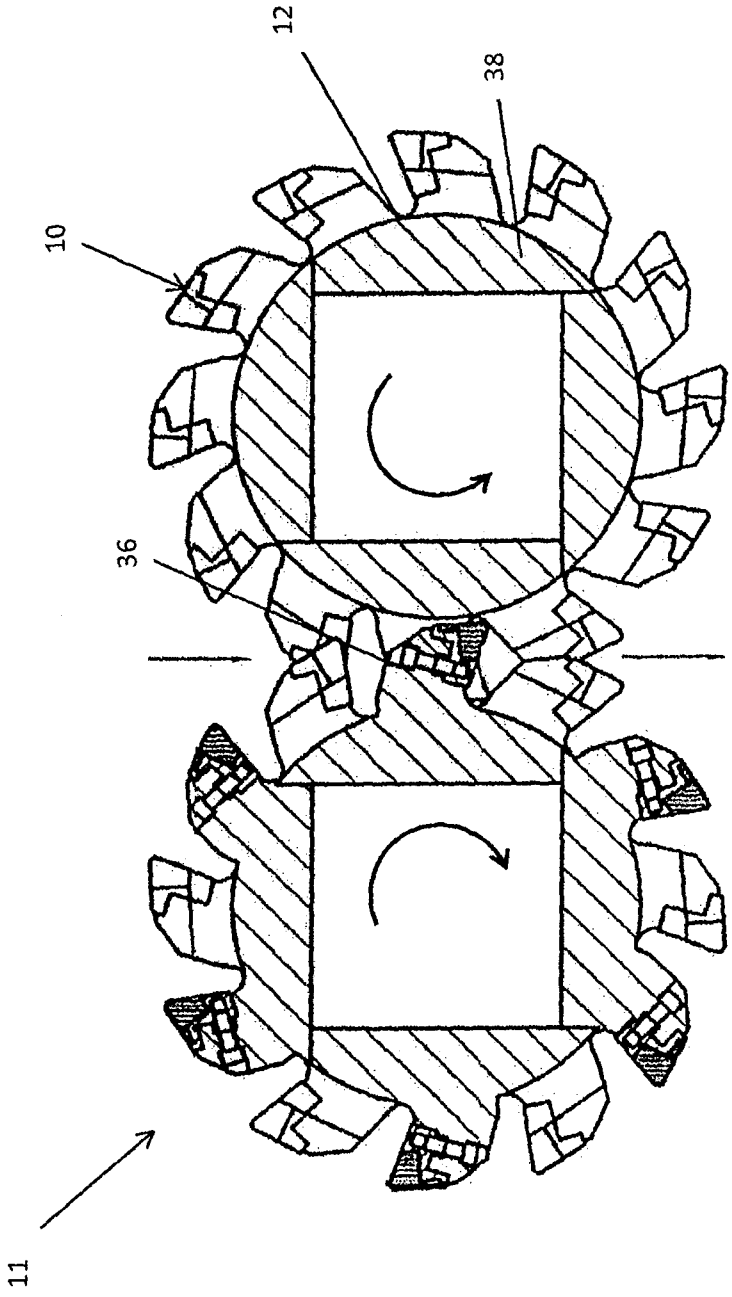

Fig. 1

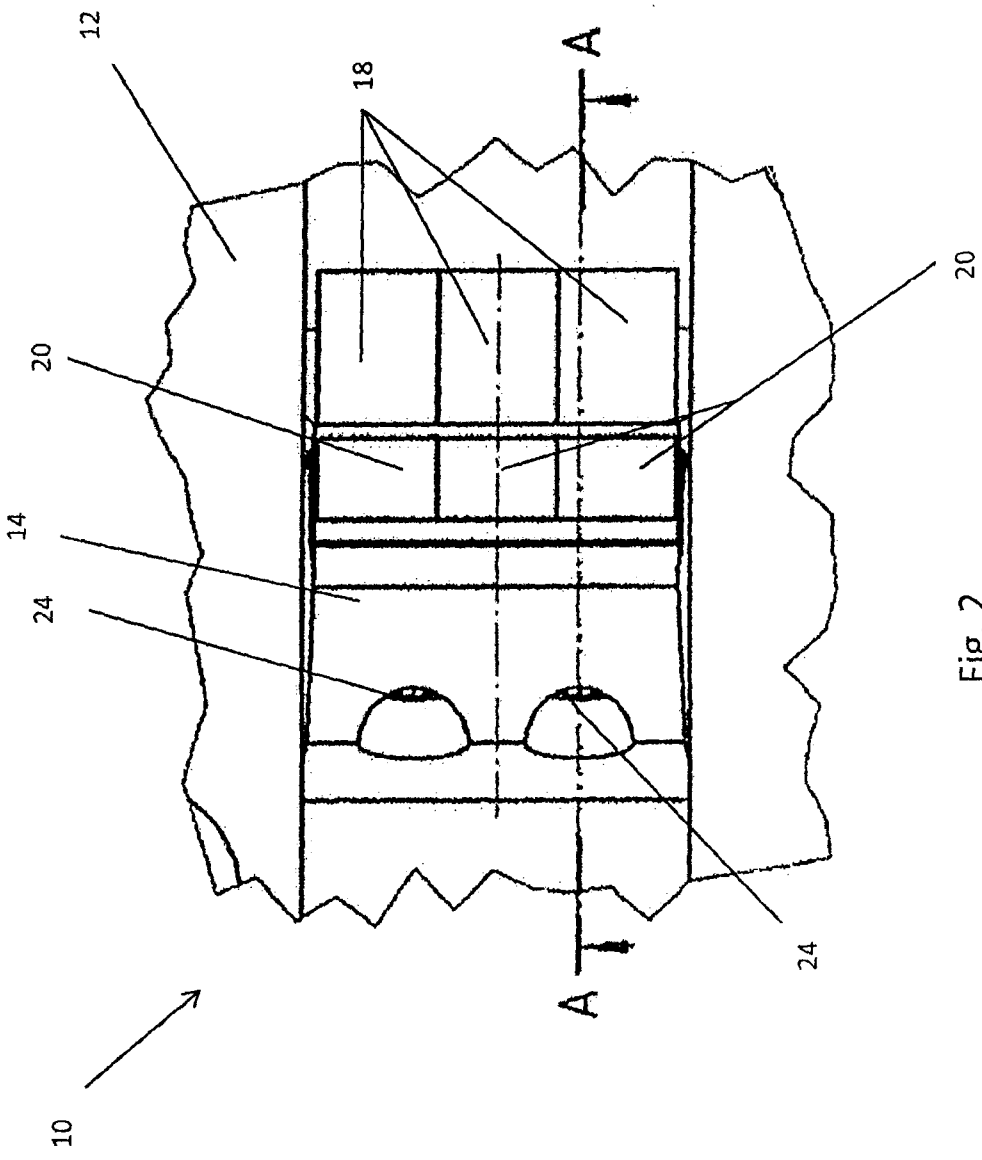

Fig. 2

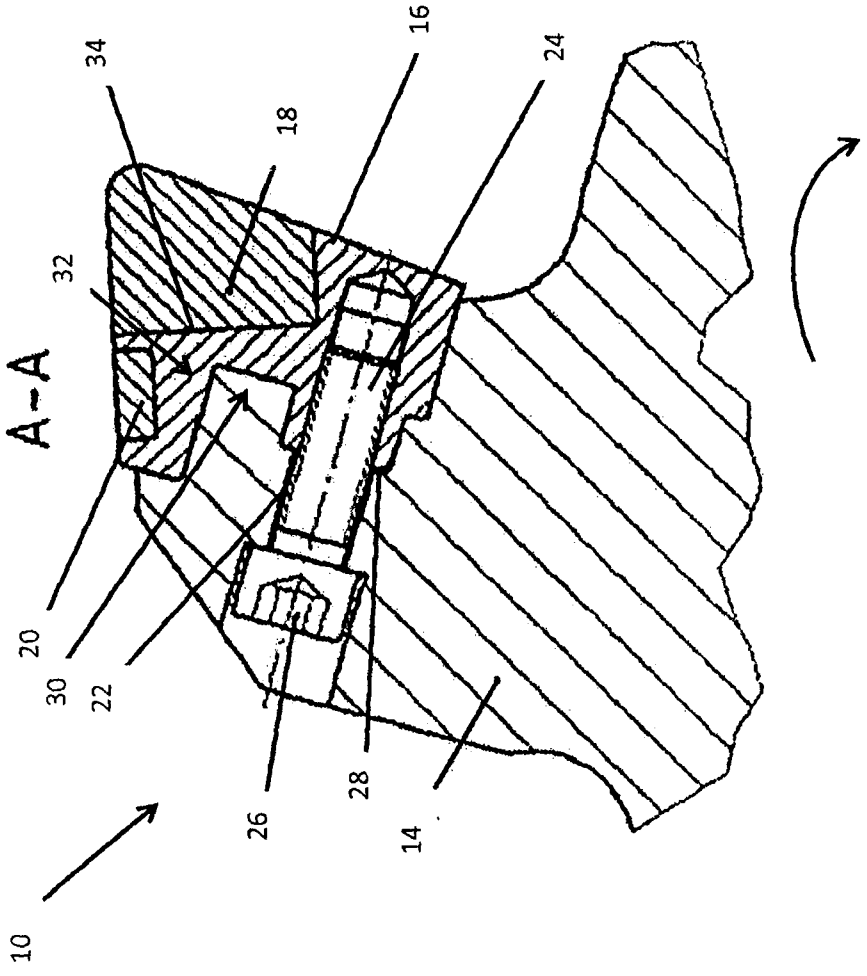

Fig. 3

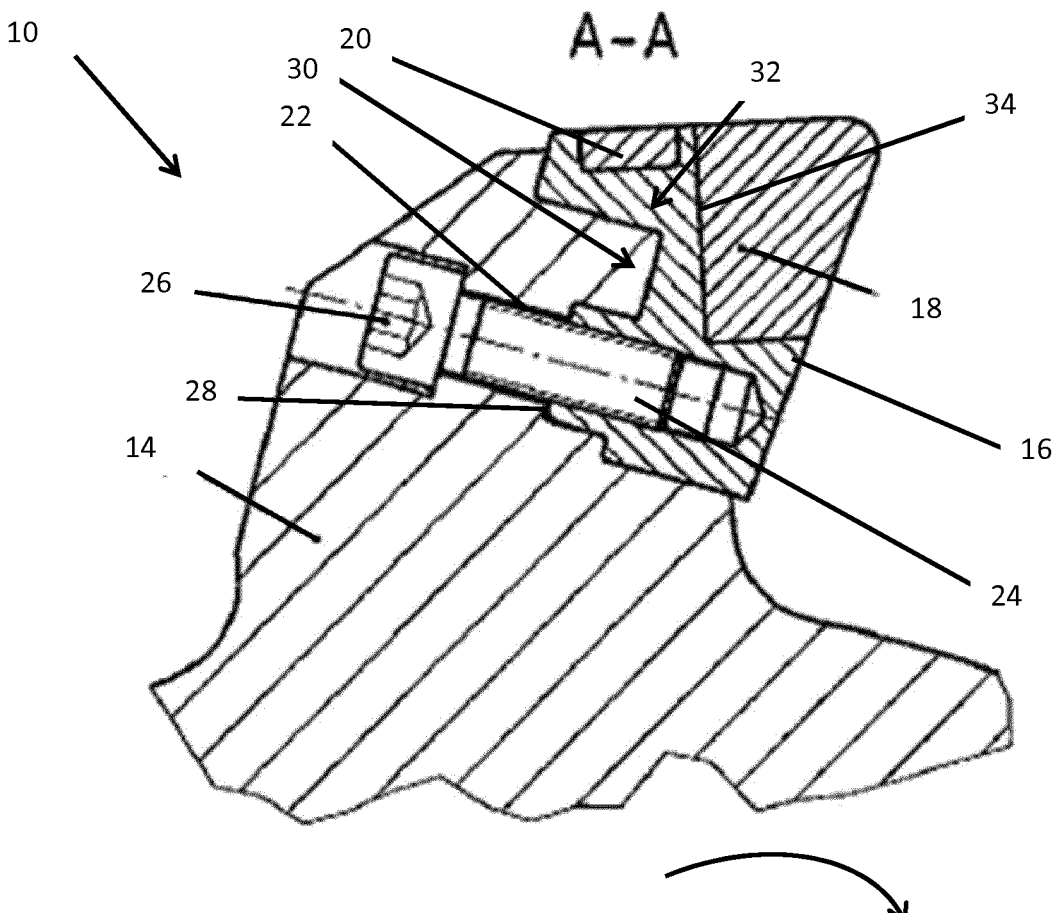

Fig. 3