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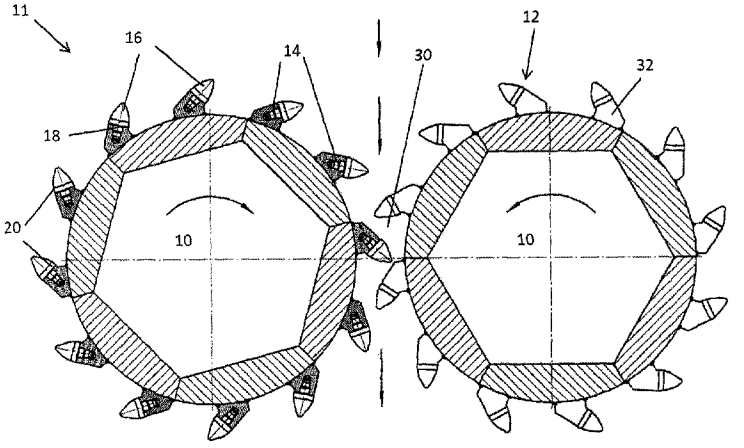
(54) **Titre : OUTIL DE BROYAGE POUR UN BROYEUR A CYLINDRES**
(54) **Title: CRUSHING TOOL FOR A ROLL CRUSHER**



(57) **Abrégé/Abstract:**
Disclosed is a crushing tool for mounting on a crushing roll of a roll crusher, having a securing segment connectable to the crushing roll and a wear segment connected to the securing segment, wherein the wear segment has been formed from a chromium steel.

Abstract

Disclosed is a crushing tool for mounting on a crushing roll of a roll crusher, having a securing segment connectable to the crushing roll and a wear segment connected to the securing segment, wherein the wear segment has been formed from a chromium steel.

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Crushing tool for a roll crusher

The invention relates to a crushing tool for mounting on a crushing roll of a roll crusher, and to a crushing roll having such a crushing tool.

Materials such as limestone, oil shale, marl, clay, oil sand or similar mineral materials are typically crushed using crushers, especially roll crushers. Known roll crushers have two crushing rolls that rotate counter to one another and form a crushing gap between the crushing rolls. The crushing rolls have crushing tools spaced apart uniformly from one another, such as impact bars, hammers or crushing teeth. The crushing tools of a roll crusher are subject to high wear and therefore have to be changed regularly. DE4123967A1, for example, discloses such a crushing tool.

In order to counter the wear on the crushing tools, it is known that a cemented carbide layer, for example tungsten carbide, can be soldered or welded onto the crushing tools formed, for example, from relatively soft steel. Typically, such an antiwear layer has a thickness of not more than 6 mm, the application of a thicker layer being technically impossible. In the event of wear of the antiwear layer applied to the crushing tool, the relatively soft steel of the crushing tool is subject to wear, such that the crushing tool is very quickly worn and there is frequently damage to and failure of the roll crusher.

Proceeding therefrom, it is an object to provide a crushing tool having low wear, with avoidance of frequent changing of the crushing tool.

Summary

Certain exemplary embodiments provide a crushing tool for mounting on a crushing roll of a roll crusher, having a securing segment connectable to the crushing roll and a wear segment connected

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to the securing segment, characterized in that the wear segment has been formed from a chromium steel having a chromium content of 20-40%.

A crushing tool for mounting on a crushing roll of a roll crusher comprises, in a first aspect, a securing segment connectable to the crushing roll, and a wear segment connected to the securing segment. The wear segment has been formed from a chromium steel having a chromium content of 20-40%. The percentages with regard to the chromium content describe percent by weight, especially the proportion by mass.

A roll crusher comprises preferably two counter-rotating crushing rolls arranged alongside one another. Between the crushing rolls is formed a grinding gap in which material, for example limestone, marl, clay, oil shale or oil sand, is comminuted. Each crushing roll has a multitude of crushing tools secured to the crushing roll.

The crushing tool is, for example, an impact bar, a crushing tooth, or an impact element, such as a hammer of a hammer crusher. The crushing tool is especially mounted on a crushing roll of a roll crusher, where the crushing roll has, for example, a multitude of recesses in its surface with a crushing tool mounted in each. The securing segment is at least partly mounted in and firmly bonded to the crushing roll. For example, the securing element of the crushing tool is cohesively and/or form-fittingly bonded to the crushing roll, especially adhesive-bonded, soldered, welded or screw-connected. The wear segment and the securing segment of the crushing tool are preferably separate components that are bonded together to form the crushing tool. The wear segment is preferably formed entirely from chromium steel, with the securing segment formed from a comparatively low-alloyed steel with a significantly lower hardness than the wear segment.

The wear segment preferably protrudes completely from the crushing roll and comes into contact with the material to be crushed in the operation of the roll crusher, such that the surface of the wear segment is exposed to high wear. The wear segment forms at least part of the surface of the

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crushing tool, and the wear segment especially forms the entire surface region of the crushing tool that protrudes from the crushing roll. More particularly, the wear segment is especially hemispherical and formed entirely from chromium steel. The crushing tool is, for example, in two-part form and consists exclusively of two segments, namely a wear segment and a securing segment. Each crushing tool preferably has exactly one wear segment formed from a chromium steel.

Forming of the wear region from a chromium steel offers reliable wear protection together with easy producibility of the wear region. In addition, it has been found that chromium steel is relatively insensitive to chemical stresses, for example bases or acids, and so it is especially suitable for use in oil sand processing, with use of chemical media for dissolving the oil out of the sand.

In a first embodiment, the securing segment has been formed from a more ductile steel compared to the wear segment. This offers the advantage of inexpensive production of the securing segment. The securing segment serves merely to secure the wear segment on the surface of a crushing roll. The securing segment preferably barely comes into contact, if at all, with the material to be comminuted, such that wear of the securing segment is very low.

The chromium steel of the wear segment, in a further embodiment, has a chromium content of 25-35%. Such a chromium content has been found to be particularly advantageous since the material of the wear segment with such a chromium content has particularly high wear resistance and at the same time as inexpensively producible and easily connectable to the securing region.

In a further embodiment, the wear segment has been cast from chromium steel. Preferably, the entire antiwear segment consists completely of the cast chromium steel. A cast antiwear segment is producible in a simple manner and in large numbers. Furthermore, such a crushing tool has a wear segment consisting completely of wear-resistant material, such that the wear resistance of the crushing tool is increased and the service life of the crushing tool in the roll crusher is extended.

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The wear segment, in a further embodiment, has a thickness of more than 50 mm, especially more than 150 mm, preferably more than 300 mm. Such a thickness of the wear segment achieves a particularly long service life of the wear segment.

In a further embodiment, the wear segment is in one-piece form. A one-piece wear segment is producible and mountable on the securing segment in a particularly simple manner. Preferably, the wear segment is in essentially hemispherical or frustoconical form or has the shape of a parabolic body, especially a parabolic cylinder.

The securing element, in a further embodiment, has been forged or manufactured by material-removing processing. Especially in the case of a from a steel which is ductile relative to the wear segment, forged or material-removing processing is advantageous since this can be effected in an inexpensive and simple manner.

The wear segment and the securing segment, in a further embodiment, are cohesively bonded to one another, especially adhesive-bonded, welded or soldered. Preferably, the solder comprises a copper solder, silver solder or brass solder, and the soldering is preferably effected in a sintering furnace. Soldering in a sintering furnace has the advantage that a multitude of crushing tools is producible simultaneously. Moreover, a sintering furnace has a uniform heat distribution, such that temperature-related damage to the crushing tools is avoided. Alternatively, the wear segment and the securing segment are inductively heated and then manually soldered to one another.

In a further embodiment, the wear segment and the securing segment are cohesively bonded to one another. More particularly, the wear segment and the securing segment are form-fittingly and cohesively bonded to one another. A form-fitting bond, especially in addition to the cohesive bond, offers the possibility of exact positioning of the wear segment on the securing segment.

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The securing segment, in a further embodiment, has a projection that interacts with a recess in the wear segment. Preferably, the securing segment has a receiving surface for receiving the wear segment that has been formed in such a way that it centers the wear segment relative to the securing segment. More particularly, the projection is in the form of a solid cylinder and arranged coaxially to the securing segment. The recess is especially formed so as to be complementary to the projection.

The securing segment, in a further embodiment, has a completely flat surface connected to the wear segment. The securing segment is preferably connected to the wear segment exclusively via the flat surface. The securing segment especially has a connecting region and a shaft region, where the connecting region has a receiving surface for receiving the wear segment and the receiving surface is flat.

The securing segment, in a further embodiment, has a recess that interacts with a projection of the wear segment. A recess in the securing segment offers the advantage of easy soldering of the securing segment with the wear segment, since the solder can preferably be positioned in the recess and escape of the solder during the joining process is reduced or completely avoided. For example, the securing segment has a multitude of recesses or projections that each interact with a complementary recess or a projection of the wear segment.

The invention further encompasses a roll crusher having two crushing rolls arranged so as to be counter-rotatable alongside one another and with a crushing gap formed between the crushing rolls, wherein a crushing tool as claimed in any of the preceding claims has been mounted on at least one of the crushing rolls. The crushing roll preferably has a multitude of recesses in the surface, with a crushing tool, especially solely the securing segment of the crushing tool, mounted in each recess. Preferably, the crushing roll has a multitude of mounts that are especially in a uniformly spaced-apart arrangement on the surface of the crushing roll. More particularly, the mounts have been welded or screwed onto the surface of the crushing roll. A crushing tool has

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been secured on each of the mounts, with the securing segment of the crushing tool preferably secured in a recess in the mount.

Description of the drawings

The invention is elucidated in detail hereinafter by multiple working examples with reference to the appended figures.

Fig. 1 shows a roll crusher with two crushing rolls having crushing tools according to a working example.

Fig. 2 shows a schematic diagram of a crushing tool for a roll crusher in a section view in a further working example.

Fig. 3 shows a schematic diagram of a crushing tool for a roll crusher in a section view in a further working example.

Fig. 4 shows a schematic diagram of a crushing tool for a roll crusher in a front view in a further working example.

Fig. 5 to 7 shows a schematic diagram of a crushing tool for a roll crusher in a section view in further working examples.

Fig. 1 shows a roll crusher 11 having two crushing rolls 10 that are arranged alongside one another with a crushing gap 30 formed between the crushing rolls 10, in which the material is comminuted. The crushing rolls 10 each have a multitude of crushing tools 12 on their surface, which are arranged around the circumference of the respective crushing roll 10 and are uniformly spaced

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apart from one another. A multitude of mounts 32 is secured, especially welded or screwed, onto the surface of the crushing rolls 10, with a crushing tool 12 secured to each mount 32. Each mount has a recess with a crushing tool 12 secured therein. The recesses in the mounts 32 are especially arranged in such a way that the crushing tools 12 are aligned at an angle of about 30-60°, preferably 45°, to the radial of the crushing roll 10. In operation of the roll crusher 11, the crushing rolls rotate counter to one another in the direction of the arrow. The material to be comminuted is introduced into the crusher gap 30 from the top and comminuted in the crusher gap 30.

Fig. 2 shows a crushing tool 12 for mounting on a crushing roll of a roll crusher. The crushing tool 12 has a securing segment 14 and a wear segment 16 that are joined to one another and form the crushing tool 12. The securing segment 14 can be secured on a crushing roll of a roll crusher and has a shaft region 18 and a connecting region 20. The shaft region 18 of the securing segment 14 forms one end of the crushing tool 12 and is secured, for example, in the surface of the crushing roll or on a mount mounted on the crushing roll. Preferably, the shaft region 18 is disposed entirely within the surface of the crushing roll or in a mount 32 mounted on the crushing roll according to fig. 1. The shaft region 18 has a multitude of diameters that serve to secure the shaft region 18, for example in a recess in the surface of the crushing roll. It is likewise conceivable that the shaft region 18 has a thread for securing in a recess or a mount 32 on the surface of the crushing roll. For example, the shaft region 18 may have a constant diameter and is be secured by means of a cohesive bond, such as welding, adhesive bonding or soldering, to the crushing roll or a mount 32.

The shaft region 18 is adjoined by the connecting region 20 which, in the working example of fig. 2, by way of example, has a greater diameter than the shaft region 18. The connecting region 20 preferably protrudes at least partly or completely from the surface or a mount of the crushing roll and serves essentially to connect the securing segment 14 to the wear segment 16. The surface of the connecting region 20 facing in the direction of the wear segment 16, in the working example of fig. 2, is essentially entirely flat and cohesively bonded to the wear segment 16, for example by screw connection, soldering or adhesive bonding.

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The securing segment 14 has been formed from a more ductile steel compared to the wear segment 16. For example, a steel having a hardness of 90-500 HB (Brinell), preferably 120-350 HB, especially 150-200 HB, and preferably an elongation at break of about 18-26%, is used. More particularly, the securing segment 14 has been forged or processed by material removal from a block, especially turned.

The wear segment 16 is essentially frustoconical or hemispherical or has the shape of a paraboloid. The surface of the wear segment 16 connected to the connecting region 20 of the securing segment 14 is essentially flat and has, for example, a circular cross section. By way of example, the wear segment of figs. 2 and 3 has a constriction. The wear segment 16 is in one-piece form and includes a chromium steel having a chromium content of 5%-70%, especially 10%-40%, preferably 15%-30%. The chromium steel preferably has a hardness of 38–68 HRC, especially 45-66 HRC, preferably 55-65 HRC (Rockwell).

The wear segment 16 and the securing segment 14 are joined to one another via a cohesive bond, for example soldering, welding or adhesive bonding. A solder applied between the wear segment 16 and the securing segment 14 is especially copper solder, silver solder or brass solder. The solder is preferably applied between the wear segment 16 and the securing segment 14 and fused in a sintering furnace to form a cohesive bond. The mutually bonded surfaces of the wear segment 16 and the securing segment 14 have preferably been sized and have, for example, a roughness of RZ = 1.6-10 and/or RA = 0.4-1, preferably RZ = 6.

Fig. 3 shows a crushing tool 12 corresponding essentially to the crushing tool 12 of fig. 2. By contrast with fig. 2, the connecting region 20 of the securing segment 14 of fig. 3 has a projection 22 arranged by way of example in the middle of the surface of the connecting region 20 facing the wear segment and preferably welded to or formed in one piece with the connecting region. The projection 22 is in cylindrical form and in a coaxial arrangement to the securing segment 14. Further shapes of the projection, for example conical or tooth-shaped, are likewise conceivable. Such a

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projection 22 together with such a recess 24 enables simple positioning of the wear segment 16 and the securing segment 14 relative to one another.

The wear segment 16 has a recess 24 that corresponds to the outside geometry of the projection 22 and interacts with the projection 22 to form a cohesive bond of the wear segment 16 and the securing segment 14. Between the wear segment 16 and the securing segment 14, in the working example of fig. 3, for example in addition to the form-fitting bond, a solder has been applied for cohesive bonding of the securing segment 14 to the wear segment 16. The connecting region 20 of the securing segment 14 may likewise have a multitude of projections 22, each of which interact with a recess 24 in the wear segment 16.

Fig. 4 and 5 show a further working example of a crushing tool 12 that essentially to the crushing tool 12 of figures 2 and 3, except that the wear segment has a tooth shape, especially the shape of a parabolic cylinder. The securing segment 14 corresponds essentially to that of figure 2, with cohesive bonding, especially soldering, of the securing segment 14 and the wear segment 16 to one another.

Fig. 6 shows a further working example of a crushing tool 12 that corresponds essentially to that of fig. 3, with the wear segment 16 in tooth form, especially in the form of a parabolic cylinder.

Fig. 7 shows a further working example of a crushing tool 12 corresponding essentially to that of fig. 5, except that the connecting region 20 of the securing segment 14 has a recess 26 and the wear segment 16 has a projection 28 that interacts with the recess 26 to form a cohesive bond of the securing segment 14 to the wear segment 16. The recess 26 has, for example, a circular cross section and is in concentric form relative to the securing segment 14. The securing segment 14 and the wear segment 16 are preferably cohesively bonded to one another by means of a solder bond. A recess 26 in the connecting region 20 offers the advantage that, on connection of the wear segment 16 and the securing segment 14, there is barely any escape, if any, of solder applied to

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the connecting surfaces between the wear segment 16 and the securing segment 14. In addition, positioning of the wear segment 16 and the securing segment 14 relative to one another is simplified.

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List of reference numerals

10	crushing roll
11	roll crusher
12	crushing tool
14	securing segment
16	wear segment
18	shaft region
20	connecting region
22	projection
24	recess
26	recess
28	projection
30	crushing gap
32	mount

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Claims

1. A crushing tool for mounting on a crushing roll of a roll crusher, having a securing segment connectable to the crushing roll and a wear segment connected to the securing segment, characterized in that the wear segment has been formed from a chromium steel having a chromium content of 20-40%.

2. The crushing tool as claimed in claim 1, wherein the securing segment has been formed from a more ductile steel compared to the wear segment.

3. The crushing tool as claimed in claim 1 or 2, wherein the chromium steel in the wear segment has a chromium content of 25%-35%.

4. The crushing tool as claimed in any one of claims 1 to 3, wherein the wear segment has been cast from chromium steel.

5. The crushing tool as claimed in any one of claims 1 to 4, wherein the wear segment has a thickness of more than 50 mm.

6. The crushing tool as claimed in any one of claims 1 to 4, wherein the wear segment has a thickness of more than 150 mm.

7. The crushing tool as claimed in any one of claims 1 to 4, wherein the wear segment has a thickness of more than 300 mm.

8. The crushing tool as claimed in any one of claims 1 to 7, wherein the wear segment is in one-piece form.

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9. The crushing tool as claimed in any one of claims 1 to 8, wherein the securing segment has been forged or produced by material-removing processing.

10. The crushing tool as claimed in any one of claims 1 to 9, wherein the wear segment and the securing segment are cohesively bonded to one another.

11. The crushing tool as claimed in any one of claims 1 to 9, wherein the wear segment and the securing segment are cohesively bonded to one another by being adhesive-bonded, welded or soldered together.

12. The crushing tool as claimed in any one of claims 1 to 11, wherein the wear segment and the securing segment are form-fittingly bonded to one another.

13. The crushing tool as claimed in any one of claims 1 to 12, wherein the securing segment has a projection that interacts with a recess in the wear segment.

14. The crushing tool as claimed in any one of claims 1 to 12, wherein the securing segment has a flat surface joined to the wear segment.

15. The crushing tool as claimed in any one of claims 1 to 12, wherein the securing segment has a cutout that interacts with a projection of the wear segment.

16. A roll crusher having two crushing rolls arranged so as to be counter-rotatable alongside one another and wherein a crushing gap is formed between the crushing rolls, wherein a crushing tool as claimed in any one of claims 1 to 15 has been mounted on at least one of the crushing rolls.

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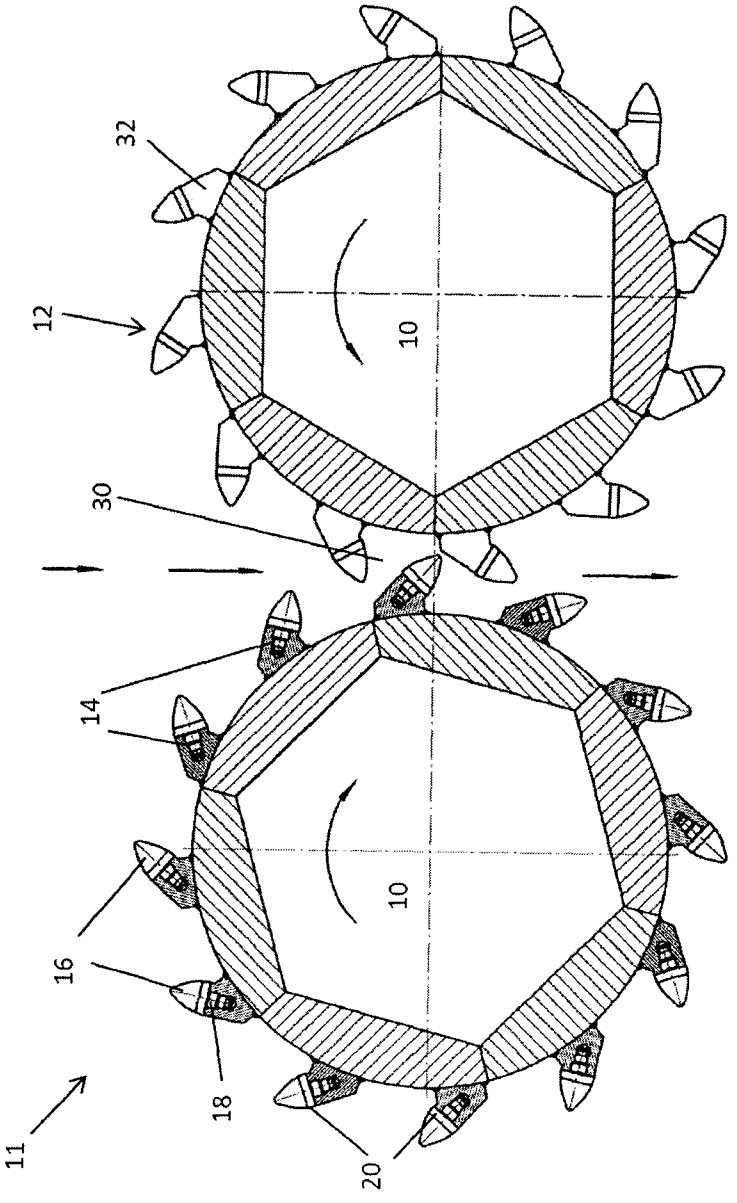


Fig. 1

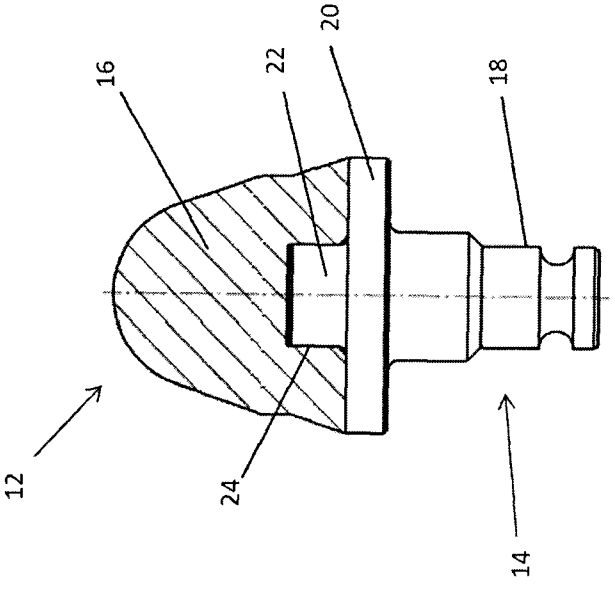


Fig. 3

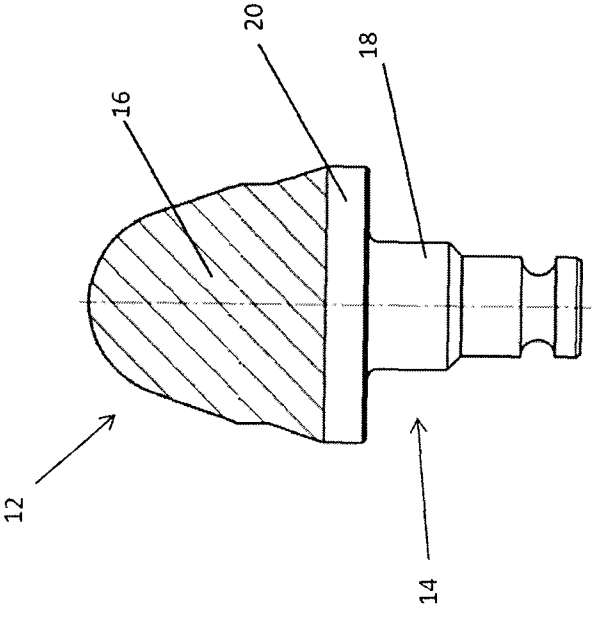


Fig. 2

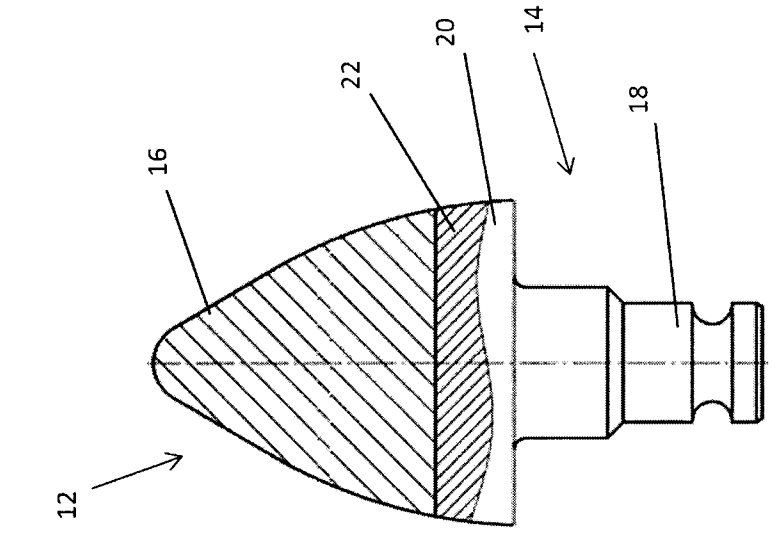


Fig. 5

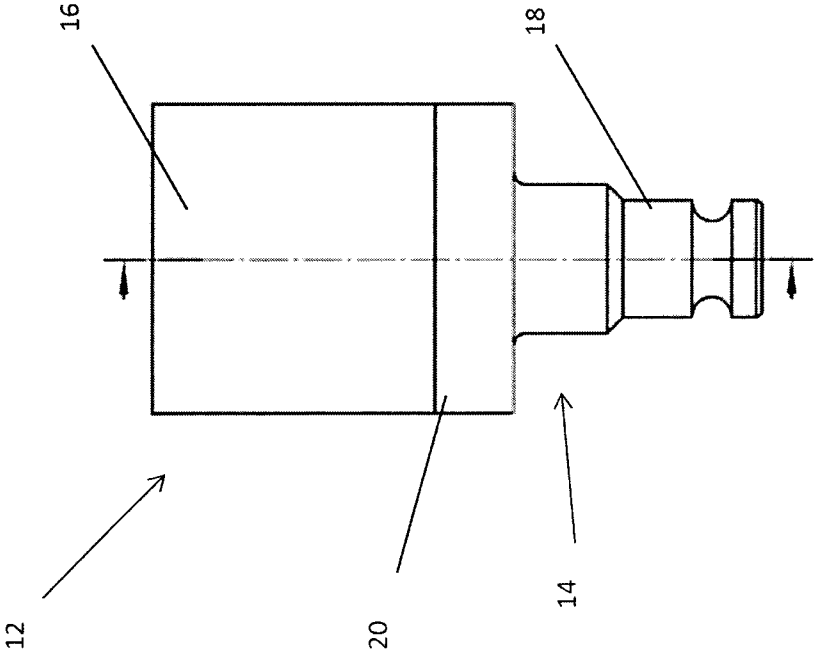


Fig. 4

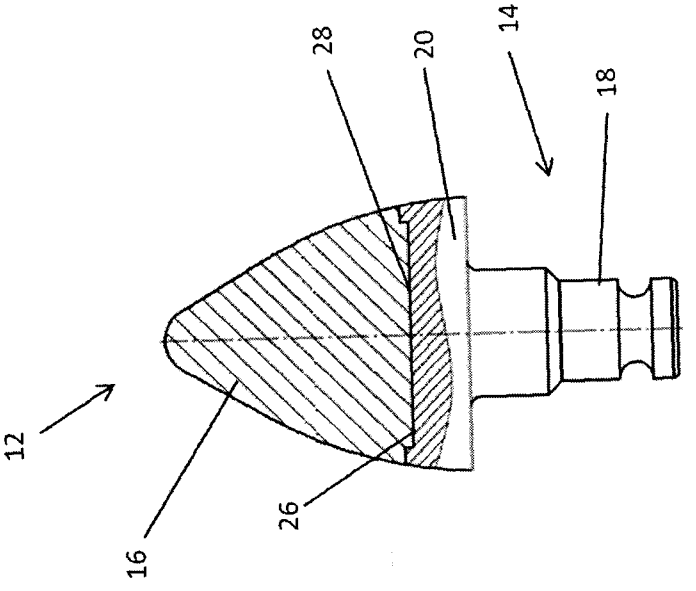


Fig. 7

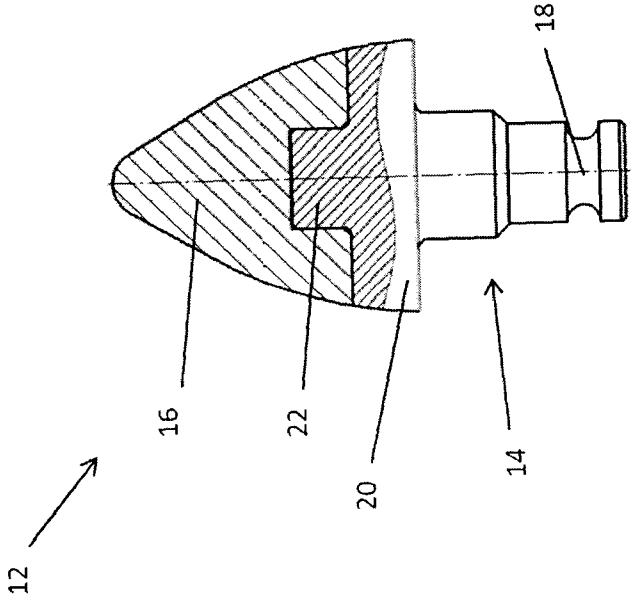
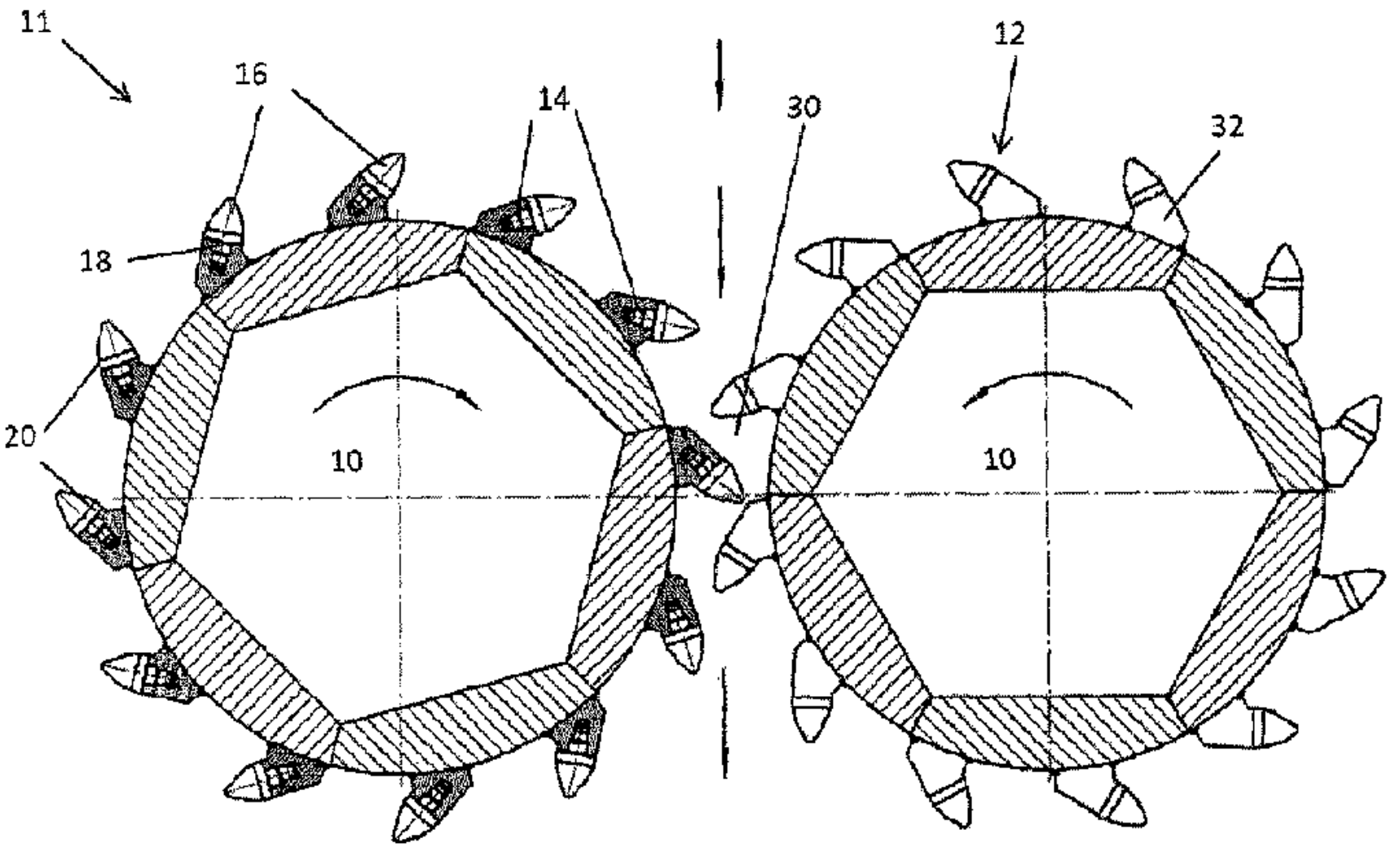


Fig. 6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