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(54) CRUSHING APPARATUS FOR A STONE-CRUSHING MACHINE

(57) Crushing apparatus for a stone-crushing machine, comprising a support base (5), at least one tooth (2), provided with a stem (3) inserted within the housing seat (6) of the support base (5), a work head (4); the stem (3) is provided with a retention portion (10), which is extended up to a second end (11), locking means (12) mechanically associated with the retention portion (10) of the stem (3) of the tooth (2) in order to maintain the tooth (2) constrained to the support base (5) comprising a first substantially annular groove (13) obtained on the retention portion (10) of the stem (3) of the tooth (2), a second substantially annular groove (16), facing towards the first annular groove (13) of the stem (3) of said tooth (2), obtained on the support base (5) in proximity to the second edge (20) of the second annular groove (16) opposite the first edge (17), a plurality of locking balls (14) inserted in the first and second annular grooves (13, 16), in order to constrain the stem (3) of the tooth (2) within the housing seat (6) of the support base (5).

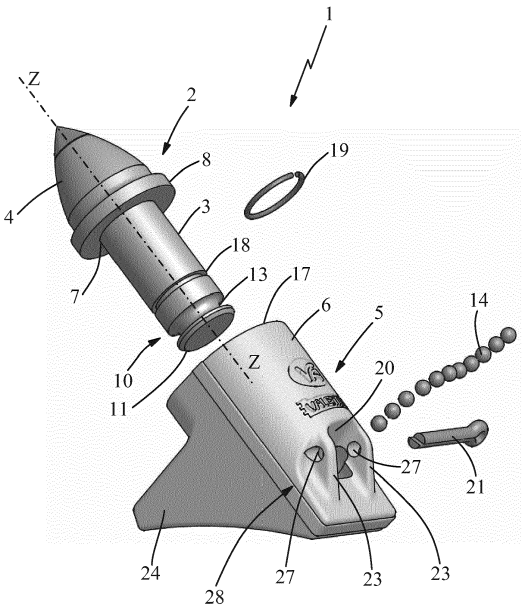

Fig. 4

EP 3 453 457 A1

Description

Field of application

[0001] The present invention regards a crushing apparatus for a stone-crushing machine, according to the preamble of the independent claim 1.

[0002] The present crushing apparatus is intended to be used in a stone-crushing machine, in particular fixed, together with a plurality of the same apparatuses, on a rotor roller of the latter, and it is conventionally used for crushing stone material present in the ground. For such purpose, each crushing apparatus is mounted on the external surface of the aforesaid rotor roller and supports at least one tooth, susceptible of penetrating into the ground in order to intercept the stone material present therein and reduce it into crushed stone or granules of limited size.

[0003] The stone-crushing machine has use in various fields, such as the farm sector for the reclamation of stony and rocky terrain, the forestry sector for the destruction of brush or stumps or for the creation and leveling of trails, fire stop trails or ski trails, as well as the road sector for the definition, leveling or maintenance of dirt roads, or for the reconstruction of road surfaces.

State of the art

[0004] In the abovementioned reference sectors of the present invention and in particular in the agriculture/farming sector, stone-crushing machines have for some time been known that are adapted to advance on a terrain and to crush rock, stones and stone material generally present in such terrain, for the purpose of rendering the latter uniform and suitable for being cultivated.

[0005] The stone-crushing machines currently available on the market are of self-moving type or, more frequently, are intended to be coupled to a drive machine, such as a tractor, in order to be driven by the latter over terrain that one wishes to treat.

[0006] Conventionally, the stone-crushing machines of towed type comprise a support structure, of substantially box-shaped form, which is open on the lower part and internally supports a rotor roller provided, on its peripheral external surface, with a plurality of crushing apparatuses each of which bearing one or more teeth mounted thereon.

[0007] An interference body susceptible of receiving in abutment the stone material transported by the teeth is also fixed to the support structure in a position facing the rotor roller, in order to define a crushing chamber with the latter.

[0008] The rotor roller is rotated around an axis orthogonal to the advancement direction of the machine by transmission means driven by the power take-off of the tractor.

[0009] Such stone-crushing machines are moved to be displaced by tractor actuation means between a lifted position, in which the rotor roller is raised from the ground, and an operating position, in which the rotor roller acts with its teeth on the ground, intercepting the stones present therein.

[0010] The teeth crush a part of the stone material directly on the ground and another part of the stone material in the crushing chamber, grinding it against the interference body and allowing it to then fall on the ground.

[0011] During the operation of the stone-crushing machines, the teeth of the rotor roller are subjected to very high stresses and, after an expected average lifetime, they are subjected to damage or breakage. For such reason, teeth are generally movably mounted in the crushing apparatuses, such that they can be substituted with other new teeth. Known from the patent FR 2824759 is an example of a crushing apparatus intended to be fixed to a rotor roller of a stone-crushing machine together with a plurality of equivalent apparatuses.

[0012] The rotor roller of such known machine is constituted by multiple parallel discs, fit on a rotation shaft; on each of these, a plurality of peripheral openings are made. The peripheral openings of each disc are aligned in a direction parallel to the rotation shaft with the openings of the other remaining discs, in order to form a plurality of longitudinal seats adapted to house an analogous plurality of crushing apparatuses. Each crushing apparatus comprises a support bar, which is intended to be housed in one of the seats of the rotor roller and to be fixed thereto by means of connection welds to the discs of the rotor roller. Each crushing apparatus also comprises two tilted teeth, inserted with one engagement portion thereof in a longitudinal cavity of the support bar and retained thereto by means of locking means so as to project from the longitudinal cavity with a work portion.

[0013] More in detail, the locking means comprise a wedge adapted to be inserted in the cavity of the bar in abutment against the engagement portion of the teeth, and two fixing screws, which traverse two first through holes made in the wedge and two second through holes, aligned with respect to the first and made on the bottom of the bar, in order to stop the wedge against the engagement portion of the teeth and consequently retain the teeth fixed to the support bar.

[0014] The just-described crushing apparatus of known type, nevertheless, has in practice proven that it does not lack drawbacks.

[0015] The main drawback lies in the fact that the maintenance operations are rather difficult also for this apparatus of known type, since the nuts that fasten the fixing screws of the wedge to the bar are hard to access and since, in order to intervene even on a single worn or damaged tooth, it is necessary to remove the wedge that retains the teeth.

[0016] For the purpose of remedying the drawbacks of the above-described crushing apparatuses, crushing apparatuses bearing a single tooth mounted thereon have more recently been implemented.

[0017] One example of a crushing apparatus of the lat-

ter known type is described in the patent US 7380576. Such apparatus is intended to be fixed to a rotor roller of a stone-crushing machine together with a plurality of equivalent apparatuses, each of which comprising a support body, intended to be fixed to the surface of a rotor roller of a stone-crushing machine, and a tooth removably couplable to the support body by means of locking means.

[0018] Each tooth is formed by a connection portion, intended to be fixed to the support body by means of the aforesaid locking means, and a work portion, which is provided with a metal tip made of particularly hard material.

[0019] More in detail, the work portion and the connection portion of the tooth are arranged at an angle of about 12° with respect to each other and are connected by a curved portion. In addition, the connection portion of the tooth is provided with a coupling seat susceptible of receiving a counter-shaped projecting portion of the support body.

[0020] The abovementioned locking means for fixing the tooth to the support body comprise two locking screws which are inserted in two corresponding through holes made on the support body starting from the projecting portion, and through two threaded holes made on the bottom of the coupling seat and aligned with the through holes of the support body.

[0021] The latter crushing apparatus briefly described above nevertheless also has several drawbacks. First of all, such crushing apparatus is structurally complex to make and consequently has high production costs.

[0022] In addition, the locking means employed in the aforesaid crushing apparatus rigidly connect the teeth together with the relative support bodies, attaining mechanical assemblies that are excessively rigid and unsuitable for optimally sustaining the violent blows and counter-blows that are transmitted between the teeth and the support bodies during the work operations of the stone-crushing machine.

[0023] For the purpose of speeding up the replacement of worn teeth, known from the patent US 4240669 is a crushing apparatus intended to be fixed to a rotor roller of a stone-crushing machine together with a plurality of equivalent apparatuses, each of which comprising a support body, intended to be fixed to the external surface of a rotor roller of a stone-crushing machine, and a tooth removably inserted in a bush couplable to the support body by means of locking means.

[0024] More in detail, the locking means comprise a screw adapted to be inserted in a through hole frontally made on the support body. Such screw pushes the bush against an opposite wall of the support body, fixing it and preventing the movements thereof.

[0025] The latter above-described crushing apparatus nevertheless also has several drawbacks. First of all, such crushing apparatus bases its mechanical strength on the thrust of a screw, which - being placed frontally with respect to the support body - is intended to sustain all the shear stresses that are formed during the normal use of the stone-crushing machine. The stresses thus sustained tend to bend and can even break the screw of the locking means, requiring a frequent replacement of the crushing apparatus.

[0026] In addition, the maintenance operations are also rather complex for this apparatus of known type, since the screw of the bar locking means is hard to access, as in order to unscrew it is necessary to insert a tool between two contiguous teeth, actually making the replacement rather difficult.

[0027] Also known from the document US 2009/200855 is a crushing apparatus that provides for interposing several elastic balls between the stem of the tooth and an internal surface of a seat of the support body. Such elastic balls engage the stem of the tooth and the seat via friction, in order to prevent the rotation of the tooth with respect to the support body. The tooth of the crushing apparatus described in the latter prior art document is nevertheless subjected to quick wear, since the tooth is intended to hit the ground always on the same point of its work head.

Presentation of the invention

[0028] In this situation, the problem underlying the present invention is therefore that of overcoming the drawbacks manifested by the crushing apparatuses of known type, by providing a crushing apparatus which is structurally simple and inexpensive to attain and entirely reliable in operation.

[0029] A further object of the present invention is to attain a crushing apparatus which is mechanically strong in order to endure for prolonged lifetime periods without requiring periodic maintenance interventions.

[0030] Another object of the present finding is to attain a crushing apparatus which allows a quick and easy removal and substitution of the damaged or worn teeth with other new ones.

Brief description of the drawings

[0031] The technical characteristics of the finding, according to the aforesaid objects, are clearly found in the contents of the below-reported claims and the advantages thereof will be more evident in the following detailed description, made with reference to the enclosed drawings, which represent a merely exemplifying and non-limiting embodiment of the invention, in which:

- figure 1 shows an exploded perspective view of a crushing apparatus, object of the present invention, in a first embodiment thereof;
- figure 2 shows a sectional side view of the crushing apparatus of fig. 1;
- figure 3 shows a sectional front view of the crushing apparatus of fig. 2 carried out along the transverse plane III-III;

- figure 4 shows an exploded perspective view of a crushing apparatus, object of the present invention, in a second embodiment thereof;
- figure 5 shows a sectional side view of the crushing apparatus of fig. 4;
- figure 6 shows a sectional front view of the crushing apparatus of fig. 5 carried out along the transverse plane VI-VI;
- figure 7 shows a sectional front view of a variant of the aforesaid second embodiment of the crushing apparatus, object of the present invention.

Detailed description of a preferred embodiment

[0032] With reference to the enclosed drawings, reference number 1 overall indicates a crushing apparatus, object of the present invention.

[0033] The crushing apparatus 1 is intended to be used on a stone-crushing machine (not illustrated), in particular fixed to a rotor roller of the latter together with a plurality of equivalent crushing apparatuses 1. The stone-crushing machine, provided with a plurality of crushing apparatuses 1 according to the present invention, was mainly provided for a use in the farming sector for the purpose of crushing the stone material present in any terrain type and making the latter uniform and suitable for being cultivated. The same stone-crushing machine can nevertheless be employed for other purposes, i.e. in sectors different from that of farming, such as the forestry or road sectors, as long as it is equally intended to reduce stones, rocks, stumps, branches or materials of different type into fragments of limited size, without departing from the protective scope of the present patent.

[0034] The crushing apparatus 1, in accordance with the present invention, can in particular be used in self-moving stone-crushing machines, or machines that are intended to be coupled to a drive machine, e.g. connected to a three-point attachment of a tractor, in order to be towed by the latter over terrain that one wishes to treat. The crushing apparatus 1 is in particular adapted to be employed in stone-crushing machines provided with a support structure, with substantially box-like shape and open on the lower part, within which a rotor roller is supported. The latter is provided, on its peripheral external surface, with a plurality of crushing apparatuses 1, each of which bearing one or more teeth 2 mounted thereon, in accordance with that illustrated in the enclosed figures, and it is susceptible of being rotated around an axis orthogonal to the machine advancement direction by transmission means controlled by the power take-off of the tractor. Preferably, the apparatus 1 is intended to be used in stone-crushing machines comprising an interference body, which is susceptible of receiving in abutment the stone material transported by the teeth and is fixed to the support structure in a position facing the rotor roller, in order to define a crushing chamber with the latter.

[0035] More in detail, a plurality of crushing apparatuses 1 is fixed on the peripheral external surface of the rotor roller, advantageously arranged in rows parallel to the axis of the roller and at regular distances along the circumference of the rotor roller 100 itself, i.e. distributed according to a geometric design set for carrying out an improved action on the ground.

[0036] With particular reference to the enclosed figures, in particular in accordance with figure 1, the crushing apparatus 1 comprises a support base 5 (normally termed "holder-pick base" in the technical jargon of the field), which is intended to be fixed on the rotor roller of the stone-crushing machine, e.g. by means of welding, and which is provided with a housing seat 6.

[0037] The crushing apparatus 1 is provided with at least one tooth 2, which is mainly extended along a longitudinal axis Z, and is provided with a stem 3 inserted within the housing seat 6 of the support base 5.

[0038] The tooth 2 comprises a work head 4 for crushing stone material, which is integral with the stem 3, is extended starting from a first end 7 of the stem 3 and is provided with a projecting shoulder 8, which is extended transverse to the main extension axis Z of the tooth 2, preferably with a bulk greater than at least one transverse size of said housing seat 6 and it is in abutment against a first edge 17 of the housing seat 6.

[0039] The stem 3 of the tooth 2 is provided with a retention portion 10, which is extended up to a second end 11 opposite the first end 7 of the stem itself.

[0040] In particular, the tooth 2 is composed of a highly resilient metal material, e.g. cemented carbide (Widia) and/or steel, or an alloy of multiple metallic materials.

[0041] In particular, the work head 4 and the retention portion 10 of the tooth 2 are extended starting from two opposite ends of the stem 3. The work head 4 comprises a tip intended to act against the ground on which the stone-crushing machine advances, in order to intercept and crush the stone material present therein. The retention portion 10 of the stem 3, made at its second end 11, is adapted to maintain the tooth 2 constrained to the support base 5.

[0042] More in detail, the connection stem 3 of the tooth 2 is inserted within the housing seat 6. In particular, such connection stem 3 has a substantially cylindrical shape, substantially corresponding to the shape of the housing seat 6.

[0043] In accordance with the first embodiment of the present invention, illustrated in the enclosed figures 1 - 3, the support base 5 is provided with a support base 24 intended to be fixed to the rotor roller of the stone-crushing machine and with a bush portion which defines the housing seat 6, in particular by means of a through hole 9.

[0044] In this situation, the stem 3 of the tooth 2 is placed to traverse the through hole 9 of the bush portion of the housing seat 6, with its retention portion 10 that projects from the second edge 20 of the housing seat 6, opposite the first edge 17.

[0045] In accordance with a second embodiment of the crushing apparatus 1, object of the present invention, illustrated in the enclosed figures 4 - 6, the support base

5 comprises a support base 24 (entirely analogous to the support base 24 of the aforesaid first embodiment) intended to be fixed to the rotor roller of the stone-crushing machine, e.g. by means of welding, and a sleeve portion that defines the housing seat 6 for the stem 3 of the tooth 2.

[0046] In accordance with the second embodiment illustrated in the enclosed figures 4 - 6, the sleeve portion of the support base also comprises an annular abutment wall 25 which is perimetrically defined by an annular shoulder 26 at the first edge 17 of the housing seat 6, in which the projecting shoulder 8 of the tooth 2 is inserted.

[0047] In this manner, the tooth 2 is firmly retained in position during the use of the stone-crushing machine, decreasing the risk of damaging the tooth 2 itself due to the mechanical forces that it sustains during the crushing of the stone material. Advantageously, the projecting shoulder 8 of the tooth 2 is adapted to define an abutment of the work head against the first edge 17 of the housing seat 6, in order to confer an abutment to the tooth 2 in its mechanical incision action of the ground during the crushing operations.

[0048] In accordance with the preferred embodiments illustrated in the enclosed figures, the work head 4 of the tooth 2 has a substantially conical form, in order to more easily penetrate into the ground and intercept the stone material present therein, also at a depth. In addition, the tip is preferably made of hardened metal material for effectively hitting and crushing the intercepted stone material in the ground to be worked.

[0049] The crushing apparatus 1, object of the present invention, also comprises locking means 12 mechanically associated with the retention portion 10 of the stem 3 of the tooth 2 in order to maintain the latter constrained to the support base 5.

[0050] According to the idea underlying the present invention, the locking means 12 comprise a first substantially annular groove 13 obtained on the retention portion 10 of the stem 3 of the tooth 2, a second substantially annular groove 16, facing towards the first annular groove 13 of the stem 3 of the tooth 2, obtained on the support base 5 outside the housing seat 6 and in proximity to the second edge 20 of the latter, opposite the first edge 17.

[0051] With the term "annular" used above for identifying the first and the second groove 13, 16, respectively made on the retention portion 10 of the stem 3 of the tooth 2 and on the support base 5, it must be intended generically; hereinbelow in the present description a groove of substantially curved shape, in particular at least for a section with annular sector form, must be intended.

[0052] The locking means 12 also comprise a plurality of locking balls 14 inserted in the first and the second annular groove 13, 16, in order to constrain the stem 3 of the tooth 2 within the housing seat 6 of the support base 5.

[0053] More in detail, the locking balls 14 of the locking means 12 are arranged substantially aligned along a ring-like path within the first and second annular grooves 13, 16 and simultaneously interfere with the support base 5 (in particular with the internal wall defining the hole 9 of the housing seat 6) and with the retention portion 10 of the stem 3 of the tooth 2 and hence mechanically constrain the tooth 2 to the support base 5.

[0054] In operation, the locking balls 14 of the locking means 12 allow a relative rotation of the tooth 2 around its main axis Z with respect to the support base 5, such that with the stone-crushing machine in use, the tooth 2 is free to rotate around such main axis Z. Indeed, during the normal use of the stone-crushing machine, each tooth 2 is subjected to a plurality of repeated impulsive stresses due to the blows that it sustains in the impact against the ground; such blows determine, due to the presence of the locking balls 14, a rotation of the tooth 2 around its main axis Z and consequently the same tooth 2 comes to be situated in different radial positions following each blow, which allow a uniform wear of the tooth 2 itself and simultaneously allow the tooth to absorb part of the impact by means of a rotation thereof.

[0055] Preferably, the housing seat 6 of the support base 5 is tilted with respect to the peripheral external surface of the rotor roller of the stone-crushing machine on which it is intended to be fixed.

[0056] The tilt of the housing seat 6 of the support base 5 also tilts the tooth 2 by the same angle, the stem of such tooth retained in the seat interior.

[0057] In particular, the tilt angle is selected in a manner such that the tooth 2 is introduced in the ground in a direction substantially orthogonal thereto and can effectively hit the stone material that it intercepts. In addition, such tilt of the tooth 2 with respect to the peripheral external surface of the rotor roller allows the tooth 2 to easily drive and lift the non-crushed stone material, until it is introduced in the crushing chamber of the stone-crushing machine.

[0058] In accordance with the first embodiment of the crushing apparatus, object of the present invention, illustrated in the enclosed figures 1 - 3, the housing seat 6 of the support base 5 is provided with a through hole 9 traversed by the stem 3 of the tooth 2.

[0059] In this situation, the retention portion 10 of the stem 3 of the tooth 2 exits outward from the housing seat 6.

[0060] In accordance with such first embodiment, the support base 5 comprises a metal ring 15 in which the second annular groove 16 is internally made for the locking balls 14, and such ring is placed around the retention portion 10 of the stem 3 of the tooth 2, in abutment against the second edge 20 of the housing seat 6, in order to lock the tooth 2 in position.

[0061] More in detail, the metal ring 15 is provided with a through window 22, which connects the second annular groove 16 with the exterior and therefore is susceptible of being traversed by the locking balls 14 during the mounting and dismounting of the crushing apparatus 1, for example for replacing a worn tooth 2.

[0062] In operation, after having positioned the tooth 2 within the hole 9 of the housing seat 6 with the second annular groove 16 aligned with and facing the first annular groove 13, the operator inserts the locking balls 14 inside the window 22.

[0063] In this manner, the locking balls 14 are aligned along the first and second annular grooves 13, 16 along a substantially curved path and in particular a path with annular sector, with particular reference to that illustrated in the enclosed figures 3 and 6. Otherwise, in accordance with the second embodiment of the crushing apparatus 1, object of the present invention, illustrated in the enclosed figures 4 - 6, the second substantially annular groove 16 is integrally obtained in the support base 5 at the retention portion 10 of the stem 3 of the tooth 2.

[0064] More in detail, in accordance with such second embodiment of the crushing apparatus 1, the sleeve portion of the support base 5 that defines the housing seat 6 for the tooth 2 is provided with a terminal portion 28 at the second edge 11 of the stem 3 of the tooth 2. Such terminal portion 28 is internally provided with the second annular groove 16 aligned with and facing the first annular groove 13 made on the retention portion 10 of the stem 3 of the tooth 2.

[0065] Advantageously, the terminal portion 28 of the support base 5 is provided with a window 22 placed to connect between the second annular groove 16 and the outside environment, and is susceptible of being traversed by the locking balls 14 during the mounting and/or dismounting of the crushing apparatus 1, for example for the substitution of the worn tooth 2, in a manner entirely analogous to that described above with reference to the first embodiment of the present invention.

[0066] More generally, the second annular groove 16 is advantageously interrupted by the window 22, in order to allow the entrance and/or exit of the locking balls 14 during the mounting and/or dismounting of the apparatus 1.

[0067] In particular, the window 22 interrupts the second annular groove 16 in the sense that it determines an opening of such second annular groove 16 for the entrance of the locking balls 14.

[0068] Advantageously, the stem 3 of the tooth 2 is provided, on its lateral surface, with a third substantially annular groove 18 in which an elastic element 19 is housed which is adapted to interact with friction against the internal surface of the housing seat 6, in order to limit the movements of the tooth 2 along the main axis Z.

[0069] In particular, in accordance with the preferred embodiments illustrated in the enclosed figures, the elastic element 19 is an elastic open washer housed in the third annular groove 18 of the stem 3 of the tooth 2.

[0070] In this manner, the elastic element 19 remains in position, being housed in the third annular groove 18 and it acts elastically in expansion against the internal wall that defines the hole 9 of the housing seat 6 of the support base 5.

[0071] Such elastic force imparted by the elastic element 19 brakes the tooth 2 with respect to the housing seat, decreasing the movements of the tooth 2 itself along the main axis Z during the use of the stone-crushing machine, consequently limiting the wear of the entire the crushing apparatus, which otherwise would be subjected to repeated stresses of overly high intensity.

[0072] The locking means 12 comprise a stop element 21 mechanically constrained to the support base 5 and at least partially placed to interfere with the locking balls 14 placed within the second annular groove 16, in order to stop the locking balls 14 in position. Preferably, the stop element 21 engages the second annular groove 16 at the aforesaid window 22.

[0073] In accordance with the first embodiment, the metal ring 15 is provided, on the external cylindrical surface, with a fourth annular groove 29 interrupted by the window 22 which communicates with the second annular groove 16.

[0074] In such fourth annular groove 29, the stop element is housed which, in accordance with the first embodiment illustrated in the enclosed figures 1 - 3, is an open metal ring provided with one end thereof bent and inserted inside the window 22, to obstruct the latter so as to prevent the exit of the locking balls 14 from the first and second annular grooves 13, 16.

[0075] In accordance with the second embodiment illustrated in the enclosed figures 4 - 6, the support base 5 is provided with two shoulders 23 arranged to the side of the window 22 and each provided with a through hole 27, which are aligned with each other. Advantageously, in accordance with such second embodiment, the stop element 21 is a pin or a split pin.

[0076] More in detail, the pin (or the split pin) is inserted within the through holes 27 of the shoulders 23 and is placed to obstruct the window 22, in order to prevent the exit of the locking balls 14.

[0077] Figure 7 illustrates an example of a variant of the aforesaid second embodiment illustrated in figures 4-6.

[0078] In particular, in such variant of figure 7, the stop element 21 of the locking means 12 comprises a bolt.

[0079] More in detail, the bolt of the stop element 21 comprises a screw inserted within the through holes 27 of the shoulders 23 and placed to obstruct the window 22. In addition, the bolt of the stop element 21 advantageously comprises a nut engaged via screwing the stem of the screw at an end thereof opposite the head of the screw itself, in order to lock the latter in position.

[0080] In operation, the operator, for the purpose of mounting or dismounting the crushing apparatus, object of the invention, must first remove the stop element 21 placed to obstruct the window 22 so to be able to remove the locking balls 14 from the first and second annular grooves 13, 16 which engage both the tooth 2 and the support base 5. Once the locking balls 14 are removed, the tooth 2 is released from the support base 5 and the technician can extract it in order to substitute it with a new one.

[0081] The finding thus conceived therefore attains the pre-established objects.

Claims

1. Crushing apparatus (1) for a stone-crushing machine, intended to be fixed to a rotor roller of a stone-crushing machine together with a plurality of equivalent crushing apparatuses (1), and such crushing apparatus comprises:

    - a support base (5) intended to be fixed on the rotor roller of said stone-crushing machine and provided with a housing seat (6);
    - at least one tooth (2), which is mainly extended along a longitudinal axis (Z), and is provided with:

        - a stem (3) inserted within said housing seat (6) of said support base (5);
        - a work head (4) for crushing stone material, which is integral with said stem (3), is extended starting from a first end (7) of said stem (3) and is provided with a projecting shoulder (8), which is extended transverse to the longitudinal axis (Z) of said tooth (2) in abutment against a first edge (17) of said housing seat (6);
        - said stem (3) being provided with a retention portion (10), which is extended up to a second end (11) opposite said first end (7);

    - locking means (12) mechanically associated with the retention portion (10) of the stem (3) of said tooth (2) in order to maintain said tooth (2) constrained to said support base (5);

    wherein said locking means (12) comprise:

    - a first substantially annular groove (13) obtained on the retention portion (10) of the stem (3) of said tooth (2);
    - a second substantially annular groove (16), facing towards the first annular groove (13) of the stem (3) of said tooth (2), obtained on said support base (5) in proximity to a second edge (20) of said housing seat (6), opposite the first edge (17);
    - a plurality of locking balls (14) inserted in said first and second annular grooves (13, 16), in order to constrain the stem (3) of said tooth (2) within the housing seat (6) of said support base (5);

    said crushing apparatus (1) being **characterized in that** said locking means (12) also comprise a stop element (21) mechanically constrained to said support base (5) and at least partially placed to interfere with said locking balls (14) within said second annular groove (16) in order to stop said locking balls (14) in position.

2. Crushing apparatus (1) according to claim 1, **characterized in that** said support base (5) comprises a metal ring (15) in which the second annular groove (16) is internally made for said locking balls (14), and such metal ring is arranged in abutment against the second edge (20) of said housing seat (6), in order to lock said tooth (2) in position.

3. Crushing apparatus (1) according to claim 1, **characterized in that** said second substantially annular groove (16) is integrally obtained in the support base (5) at said retention portion (10) of the stem (3) of said tooth (2).

4. Crushing apparatus (1) according to any one of the preceding claims, **characterized in that** said second annular groove (16) is interrupted by a window (22) engaged by said stop element (21).

5. Crushing apparatus (1) according to any one of the preceding claims, **characterized in that** the stem (3) of said tooth (2) is provided, on its lateral surface, with a third annular groove (18) in which an elastic element (19) is housed that is adapted to interact with friction against the internal surface of said housing seat (6) in order to limit the movements of said tooth (2).

6. Crushing apparatus (1) according to claim 5, **characterized in that** said elastic element (19) is an elastic open washer housed in said third annular groove (18) of the stem (3) of said tooth (2).

7. Crushing apparatus (1) according to any one of the preceding claims, **characterized in that** said stop element (21) is a pin or a split pin.

8. Crushing apparatus (1) according to claims 4 and 7, **characterized in that** said support base (5) is provided with two shoulders (23) arranged to the side of the window (22) and each provided with a through hole (27) traversed by the pin of said stop element (21) in order to stop said locking balls (14).

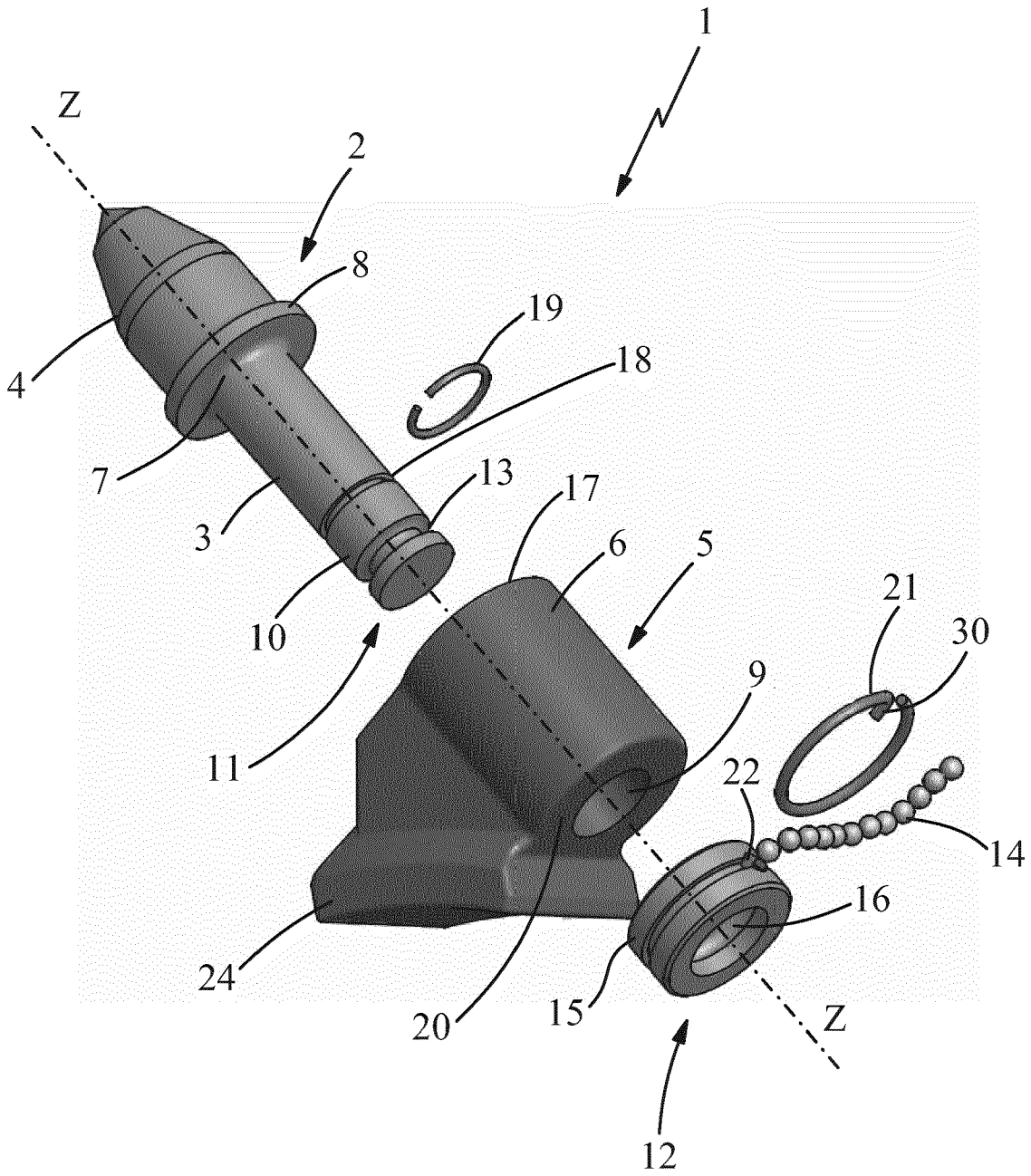

Fig. 1

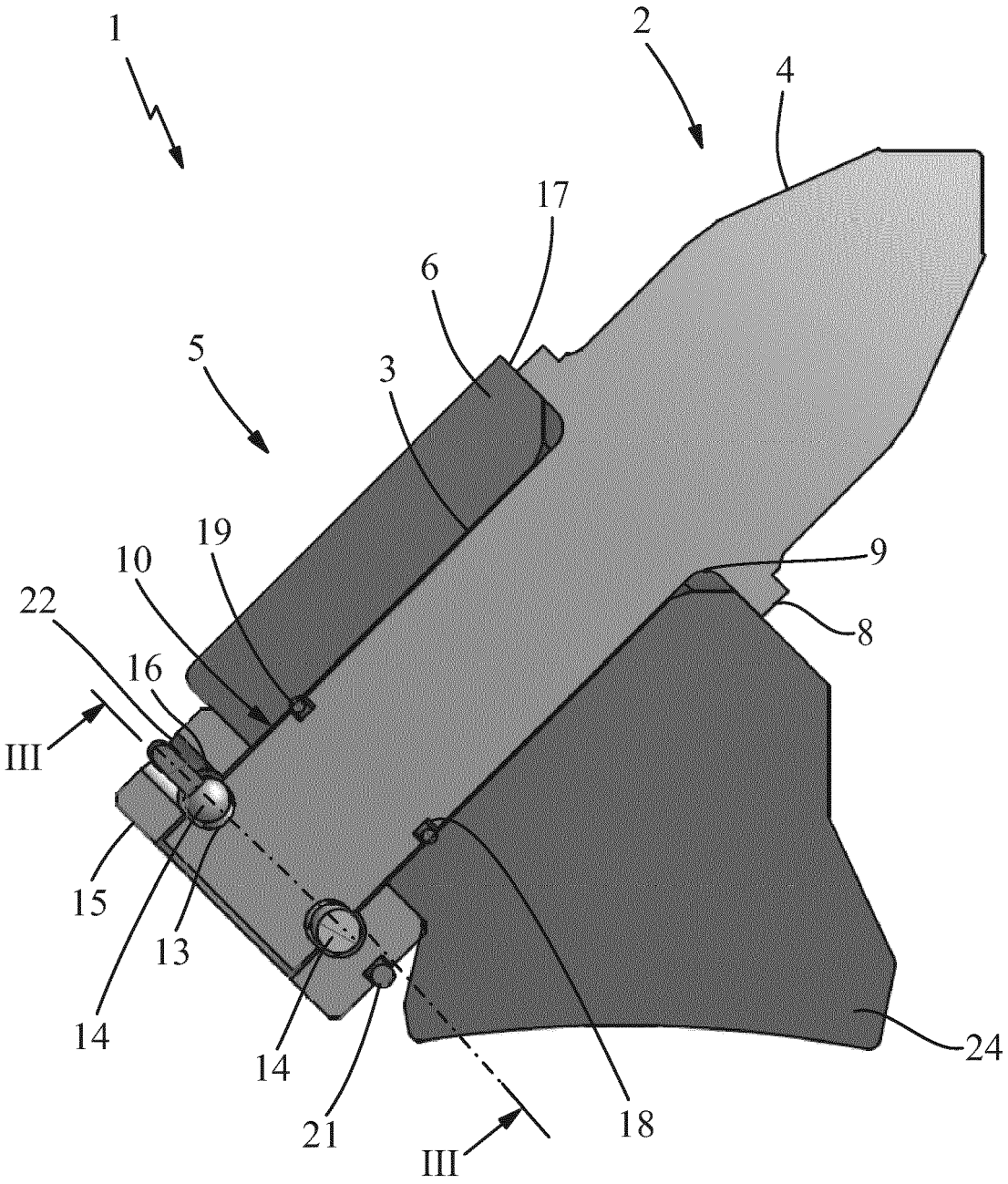

Fig. 2

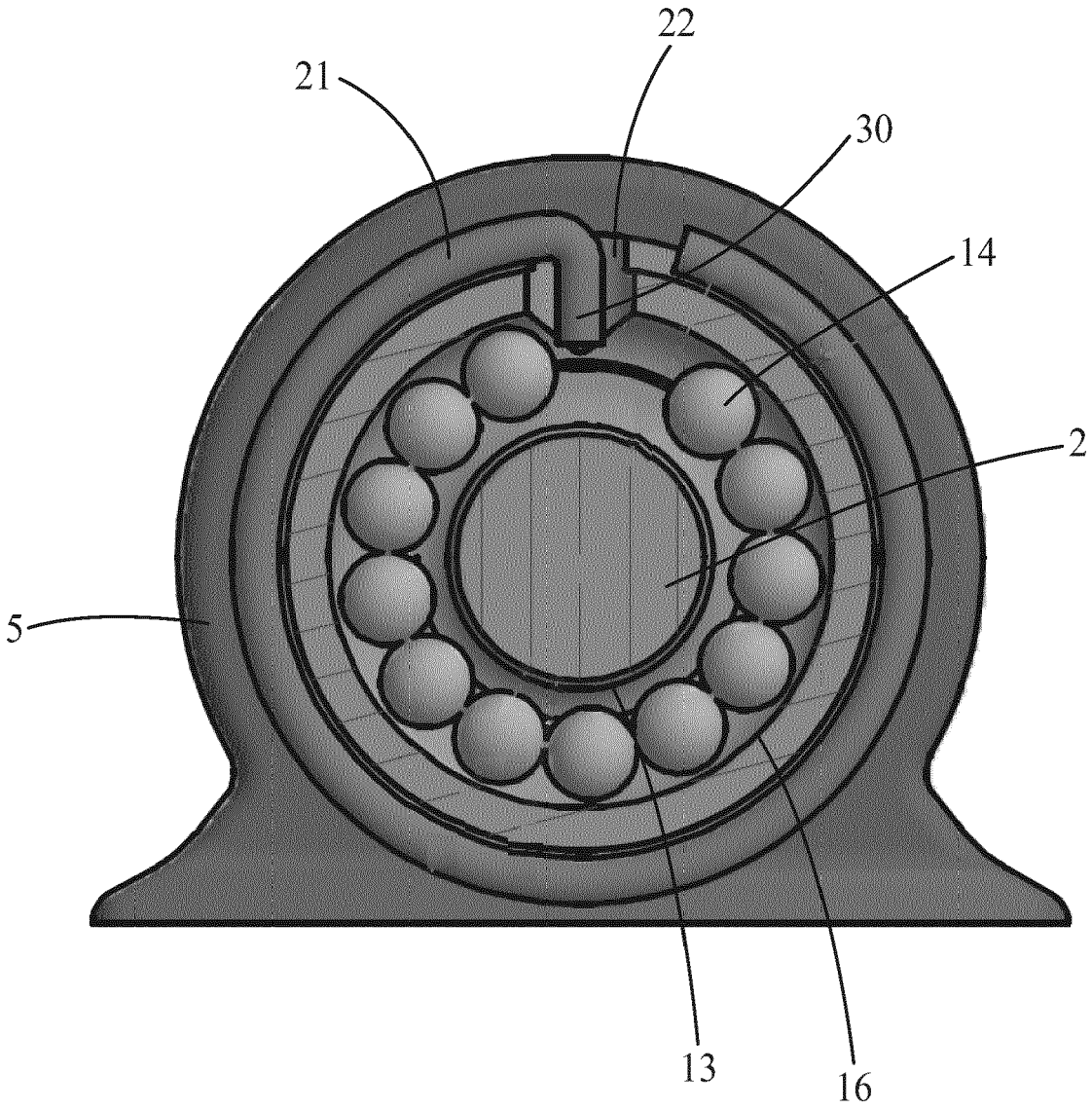

Fig. 3

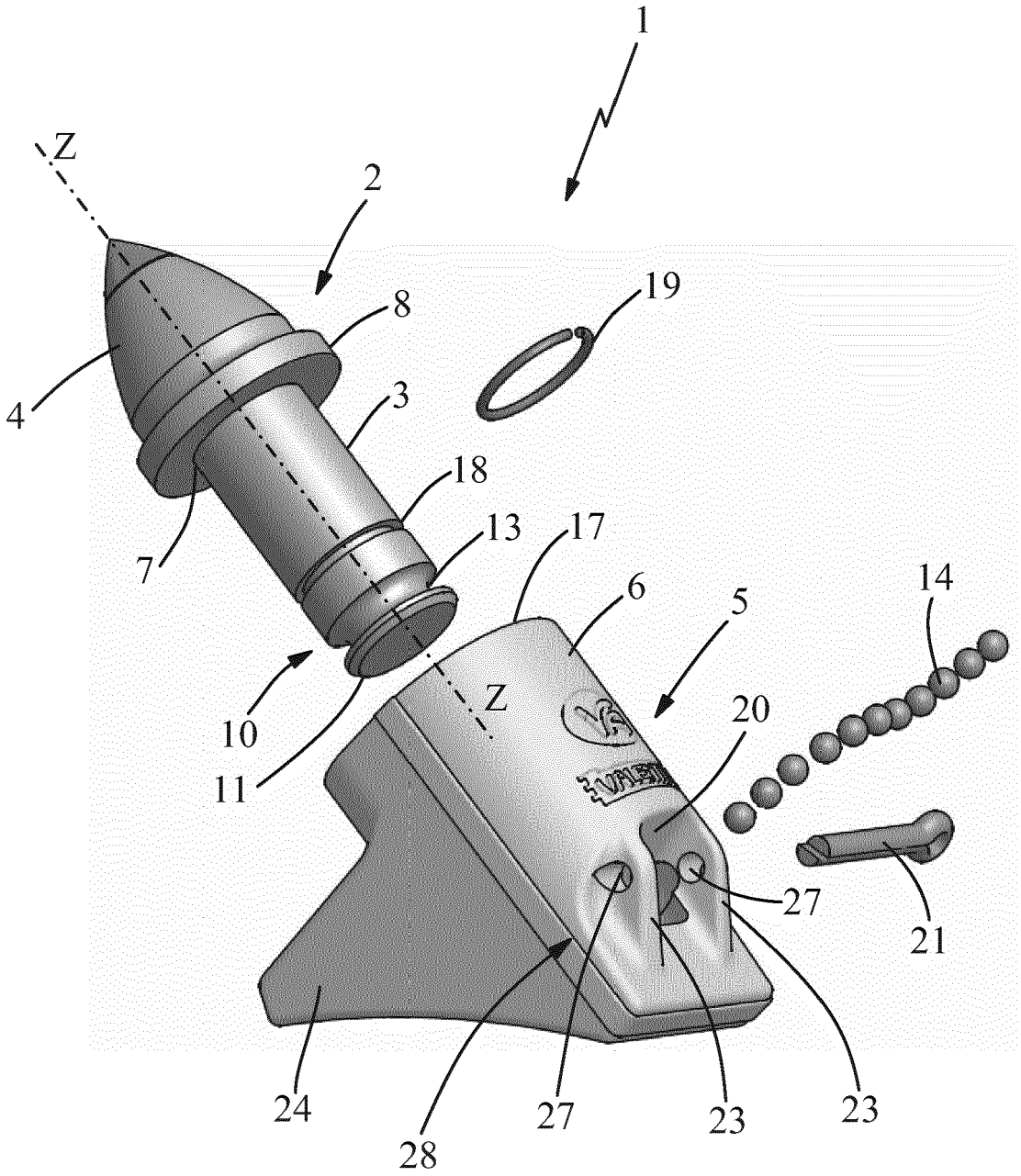

Fig. 4

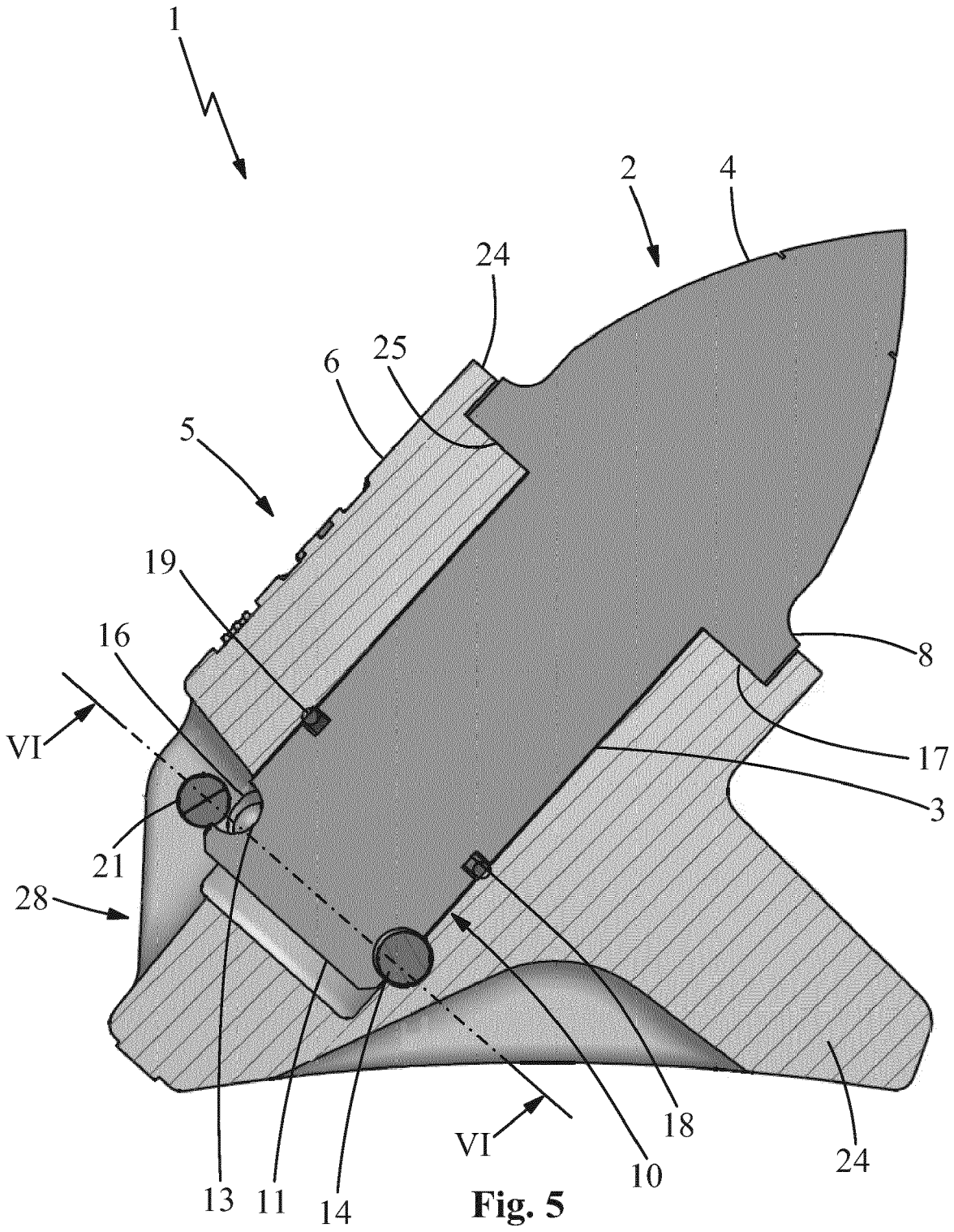

Fig. 5

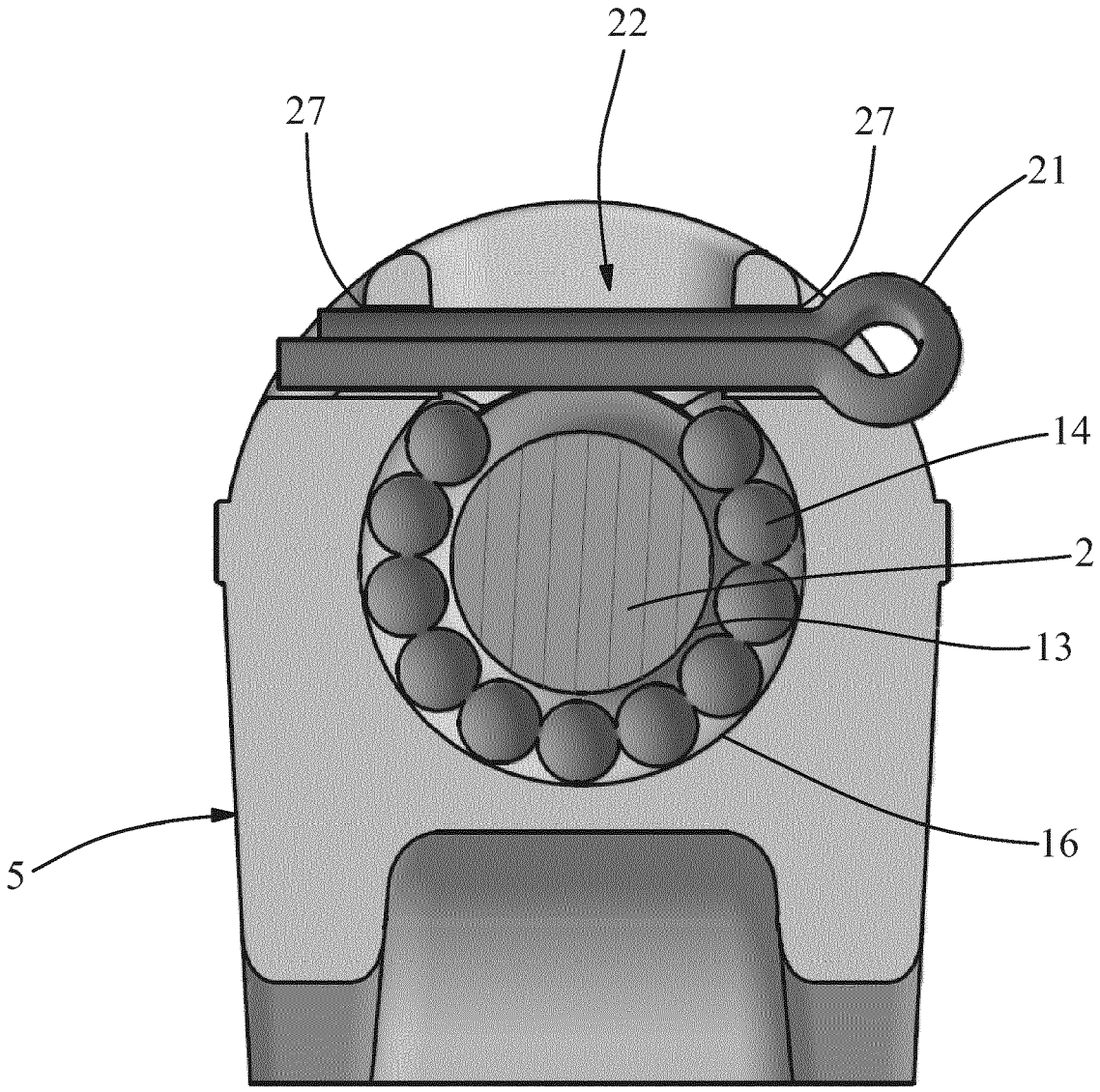

Fig. 6

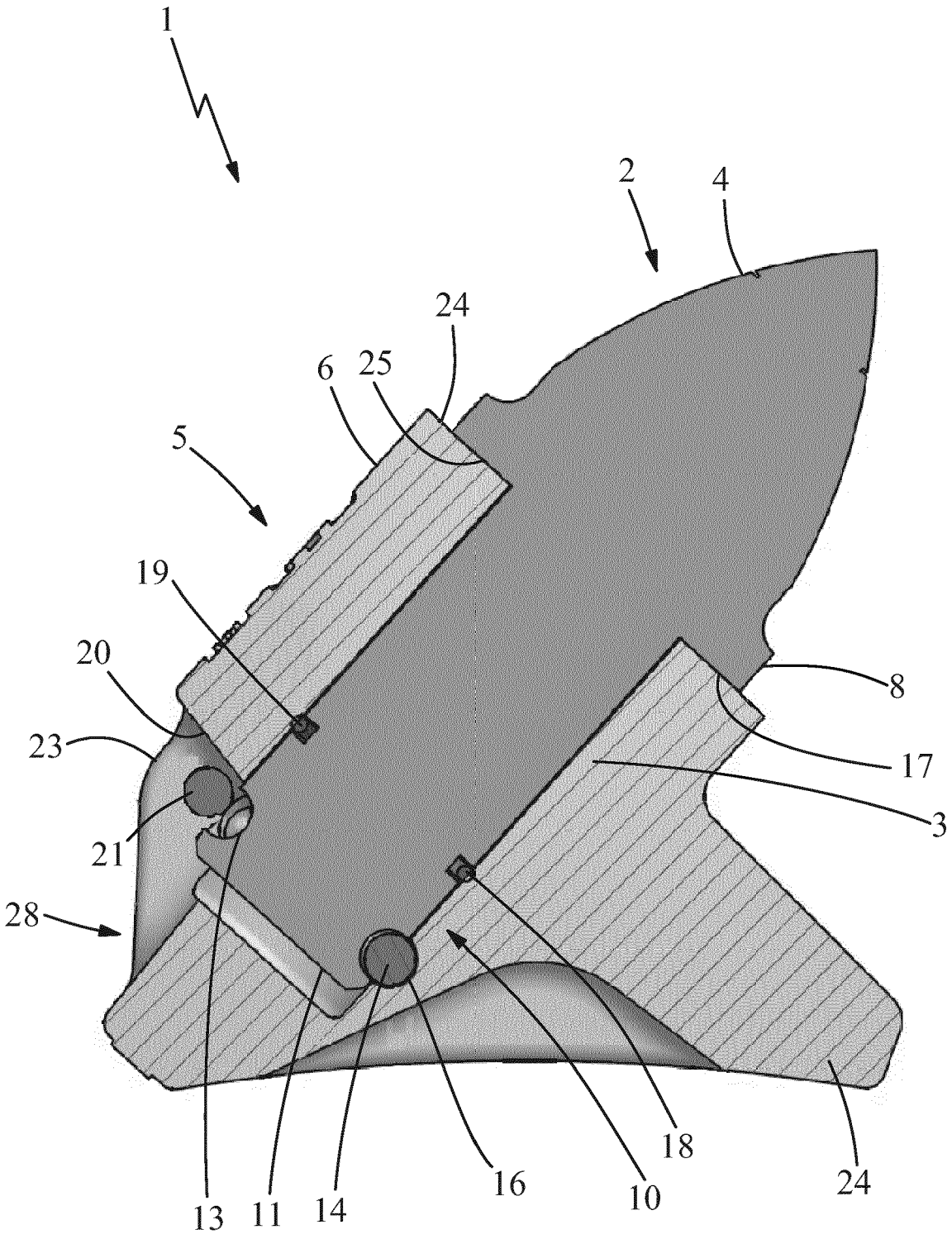

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 18 19 3303

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2009/200855 A1 (HALL DAVID R [US] ET AL) 13 August 2009 (2009-08-13) * figures *	1-8	INV. B02C4/30 E21C35/19 B02C21/02
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			B02C E21C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 November 2018	Kopacz, Ireneusz

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