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(54) **CUTTING HEAD FOR A MACHINERY SUITABLE FOR CARRYING OUT MACHINING BY CHIP REMOVAL ON MATERIALS**

(57) A cutting head (1) for machinery suitable for carrying out machining by chip removal on materials comprises a main body in which one or more housing cavities (10) are obtained, each suitable for housing a respective cutter (11) and a clamping block (12). The cutter (11) is clamped between the clamping block (12) and a reference wall (4) of said housing cavity (10) and they have a geometry such as to provide a mechanical interference fit. Elastic means are provided in the housing, comprising an elastically deformable sheet element (21) with a can-

tilivered support portion located underneath the cutter (11) so that when said cutter (11) is in working position abutting on the reference wall (4) the elastically deformable sheet element (21) is bent downwards and thus exerts an action tending to push said cutter (11) radially outwards, in order to facilitate its extraction from the housing cavity (10). Further constructive expedient measures further facilitate and speed up the cutter (11) replacement operations.

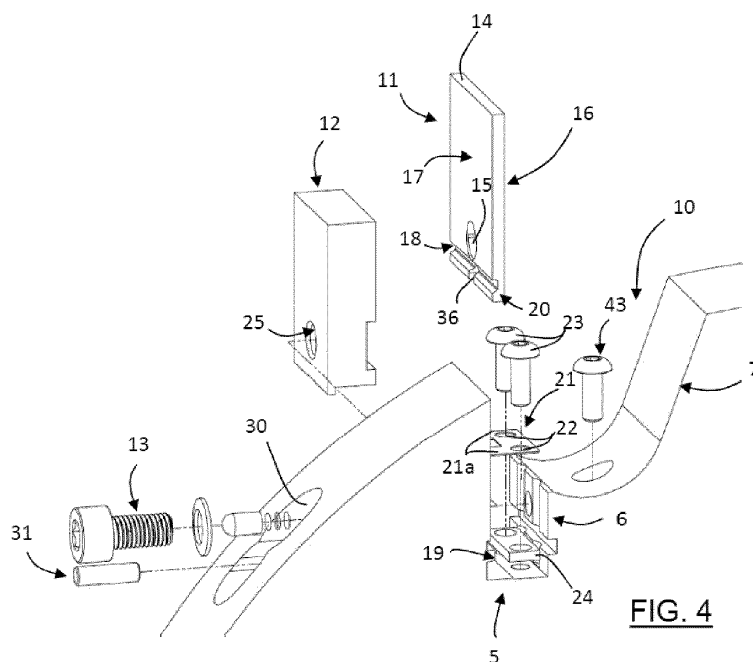


FIG. 4

Description

TECHNICAL SECTOR

[0001] The present invention relates to the technical field of milling machines.

[0002] In particular, the invention relates to a cutting head for machinery suitable for carrying out machining by chip removal on materials.

BACKGROUND ART

[0003] The milling operation is known to be carried out by means of machine tools in which the milling cutter is mounted on a rotating spindle, which is provided with a main cylindrical body rotatable around a rotation axis thereof at the periphery of which one or more housings, or recesses, for cutters are identified.

[0004] The housings in question generally extend on the surface parallel to the rotation axis mutually spaced apart and accommodate a cutter, or knife, a clamping element and engagement means intended to bring the clamping element towards a reference wall of the housing so that the knife is clamped between the aforesaid clamping element and reference wall of the housing. When the milling cutter is operating, i.e., rotating at high speed around the axis thereof, the cutters and the relative clamping elements tend to be pushed radially outwards due to the centrifugal force.

[0005] Furthermore, a known type of clamping includes, at the level of the reference wall, a groove suitable for abutting a projection obtained in the cutter, so as to provide a radial locking by mechanical interference of the knife.

[0006] It is also known that the aforesaid mechanical interference locking system includes an inclined plane at said groove and a corresponding inclined plane in the projection of the cutter which perform the function of guiding the correct positioning in the radial direction of the cutter itself following the clamping action against the reference wall.

[0007] In mechanical interference locking systems as outlined above, the possibility of including elastic elements to keep the cutter in the correct working position is known.

[0008] By way of example, the device known from EP1574307 is characterized by a locking system which uses elastic means located underneath the clamping element, which push on the clamping element and exert the clamping force which keeps the cutter clamped between the clamping element itself and the reference wall of the housing.

[0009] Document US2017291322A1 anticipates a cutting system also comprising elastic means and includes a cutter, a clamping element which with the aid of a tensioning screw locks the cutter against a wall of the housing within which the cutting system and elastic elements are inserted. The document claims that the inclination of

the inclined plane included in the mechanical interference system forms an angle between 92° and 112° with respect to the longitudinal axis of the cutter and that the elastic elements are suitable to press the inclined plane of the reference surface of the housing cavity against the corresponding inclined plane of the knife. The claimed system facilitates the operation of mounting the knife in the housing cavity and given the geometry of the housing cavity, the clamping block and the knife itself, the inclination angle of the inclined plane is of fundamental importance. In fact, the clamping block is pushed and rotated towards the bottom of the housing and in this movement the correct insertion of the knife is facilitated by the presence of elastic means which guide the insertion of the cutter itself. On the other hand, from what emerges, such an arrangement requires a specific geometry of the components and, in particular, is constrained to the maintenance of an angle between the inclined plane of the mechanical interference system and the longitudinal axis of the knife between 92° and 112°, preferably 95°, thus causing the need to perform complicated mechanical machining on the various elements of the locking system with an increase in the overall costs.

[0010] Ultimately, designs of this type and, in general, the solutions currently available propose the use of stop surfaces and elastic elements in order to facilitate the positioning of the cutting head components during assembly and to ensure the maintenance of the correct working position of the cutter, thus stabilizing it when the machine is in operation.

[0011] However, it should be noted that the removal and insertion of the cutter, to allow sharpening or replacement, are typically difficult and laborious, as well as constituting an obvious risk for the operator. The laborious nature of the operations described also translates into the long times required for removal and replacement and thus in the extension of machine downtime.

[0012] By virtue of the above, the need has emerged to seek solutions to make the disassembly and extraction of the cutting head components easy and immediate while keeping the costs of the individual elements of the locking system as low as possible.

SUMMARY OF THE INVENTION

[0013] In view of the foregoing, it is an object of the present invention to propose a device for locking the cutters in a milling cutter which allows a safe and quick extraction of the cutter.

[0014] It is a further object of the present invention to provide a device for locking the cutters in a milling cutter whose components are easy and economical to make.

[0015] These and other objects are achieved by means of a cutting head for machinery suitable for carrying out machining by chip removal on materials, which comprises a main body in which one or more housing cavities are obtained, each suitable for housing a respective cutter and a clamping block, with a clamping screw provided

to actuate the clamping block so that said cutter is clamped between said clamping block and a reference wall of the housing cavity in question. The cutting head in accordance with the present invention further includes elastic means intended to act between said housing cavity and said cutter, so as to push said cutter in a direction having at least one radial component facing outwards. Furthermore, the reference wall of said housing cavity and the cutter show a geometry such as to make a mechanical interference fit in which an inclined plane is provided at the reference wall itself and a corresponding inclined plane in the cutter which perform the function of guiding the correct positioning in the radial direction of the cutter itself following the clamping action against the reference wall. The device according to the invention is characterized in that the aforementioned elastic means comprise an elastic sheet element associated with the housing cavity with a cantilevered portion thereof located underneath a bottom surface of said cutter, so that when the cutter is in its working position abutting on said reference wall, the elastic sheet element is bent downwards by the bottom surface of said cutter, thus the elastic sheet element exerts an action tending to push said cutter radially outwards, in order to facilitate the extraction of the cutter from the housing cavity.

[0016] The replacement of the cutters with a device according to the present invention is quick and easy, due to the immediate and safe radial extraction of the cutter from the relative housing cavity.

[0017] Advantageously, the device according to the invention includes an anti-slip assembly associated with the clamping block, which allows to stabilize the clamping block itself in the steps of unscrewing the clamping and extraction screw of the cutter, thus ensuring a further increase in the safety and speed of the disassembly operations in question.

[0018] According to an advantageous aspect of the present invention, the elements forming the locking system are made of materials and according to geometries such as to allow a significant reduction of production and maintenance costs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] These and other aspects and advantages of the invention will be comprehensible from the following description of a preferred embodiment of the invention and some of its variants, provided by way of non-exhaustive example, with the aid of the accompanying drawings, in which:

- Figure 1 offers a perspective view, in a configuration of use, of a cutting head according to the invention;
- Figure 2 shows a sectional view of a portion of Fig. 1 depicting a cutting head housing and locking assembly;
- Figure 3 shows a perspective view of the assembly of Fig. 2;

- Figure 4 offers an exploded perspective view of the assembly of Fig. 2;
- 5 shows a sectional view analogous to that of Fig. 2;
- Figure 6 shows a front view of the locking assembly.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] With reference to the aforementioned figures, a cutting head for machinery suitable for carrying out machining by chip removal on materials of various kinds is generally indicated with reference number 1.

[0021] Typically, such cutting heads 1 comprise a main cylindrical body, suitable for being brought in rotation around the axis, Z, thereof at the periphery of which one or more (four, in this embodiment) housing cavities, 10, are obtained radially open, each intended to accommodate a relative cutter, 11.

[0022] With reference in particular to Figure 2, in the embodiment shown, the housing cavity 10 has a shape extending outwards and shows a deeper portion, 2, and an adjacent shallower portion, 3. Such a deeper portion 2 is delimited by a reference wall, 4, adapted to receive the cutter 11, a bottom wall, 5, and a third auxiliary wall, 6, opposite and substantially parallel to the reference wall 4. The shallower portion, 3, is delimited by the reference wall 4 and by a curved lightening wall, 7, which generates sufficient room for manoeuvring, as well as being suitable for allowing the chips to be unloaded.

[0023] As seen in Figures 3 to 6, each housing cavity 10 is arranged to accommodate a cutter 11 and a clamping block 12, the latter associated by means of a clamping screw, 13.

[0024] In detail, the cutter 11, as clearly visible in the exploded view of Fig. 3, has a substantially rectangular shape and is provided at the upper end with a cutting edge, 14, and near the lower end of an opening, 15, included for the passage of the aforementioned clamping screw 13. The cutter also shows a substantially flat side, 16, in contact with the clamping block 12, and a reference side, 17, opposite the substantially flat side 16 and intended to rest on the reference wall 4. According to a characteristic aspect of the present invention, such a reference side 17 of the cutter 11 has a recess, 18, which generates in the lower part a portion which is coplanar with the surface of the reference side 17 itself. A geometry of the cutter 11 of this type reduces its costs, as it minimizes the removal of material necessary to make the cutter.

[0025] In a configuration of use, the cutter 11 is clamped between said clamping block 12 and the reference wall 4 of the housing cavity 10. In fact, each housing cavity 10 has a side hole, 30, accessible from outside and leading into the reference wall 4 of the cavity itself, which hole is advantageously provided with a calibrated portion, 33, for the insertion of the clamping screw 13 and an enlarged portion, 34, for the passage of the screw head and also useful to allow the passage towards a

second calibrated hole, 35, leading into the deeper portion 2 and useful for housing a pin for axial centering, 31, of the cutter 11 thanks to the presence in the latter of an abutment opening, 36. The clamping screw 13, passing through the opening 15 included in the cutter 11 and engaging a threaded hole, 25, obtained in the clamping block 12 allows the pressure clamping of such a cutter 11 against the reference wall 4.

[0026] In the wall of the enlarged portion 34 of the side hole 30, housings are obtained suitable for accommodating magnetic elements, 32, suitable for retaining the clamping screw 13 in the aforesaid enlarged portion 34 when it is disengaged from the clamping block 12.

[0027] According to a characteristic aspect of the present invention, the reference wall 4 is provided with an inclined plane, 19, intended to abut the conjugate recess, 18, obtained in the reference side 17 of the cutter 11, so as to guide the correct positioning in the radial direction of the cutter 11 following the clamping action against the reference wall 4, thus obtaining the fit commonly known in the field as mechanical interference fit.

[0028] In this case, such an inclined plane 19 obtained on the reference wall 4 forms an angle with the longitudinal surface facing outwards of the cutter 11 between 115° and 135°, preferably 120°.

[0029] The locking system according to the present invention further includes elastic means intended to act between the housing cavity 10 and the cutter 11 so as to push the cutter 11 in a direction having at least one radial component facing outwards. According to a characteristic aspect of the present invention, the elastic means in question comprise an elastically deformable sheet element, 21, arranged at the bottom wall 5 of the housing cavity 10. Such an elastically deformable sheet element 21 is located underneath the cutter 11, according to an arrangement which allows a relative bending portion, 21a, to remain cantilevered underneath a bottom surface of the cutter 11. Thereby, when the cutter 11 is in the working position, the bending portion 21a is bent downwards underneath it, thereby exerting an action which tends to push the cutter 11 radially outwards. As a result, such an elastically deformable sheet element 21 in fact facilitates the extraction of the cutter 11 from the housing cavity 10 when the clamping screw 13 is removed.

[0030] The embodiment discussed envisages that the elastically deformable sheet element 21 is provided with at least one hole, 22, required for the passage of at least one fastening element, 23, suitable for fastening the sheet element itself on a support block, 24, included at the bottom wall 5 of the housing cavity 10. Thereby, the support block 24 allows to keep the elastically deformable sheet element 21 in an elevated position with respect to the bottom wall 5, allowing the elastic deformation of the bending portion 21a positioned below the cutter 11. The choice and geometry of the described elements, on the other hand, does not exclude the use of other solutions which regardless ensure the action of the elastically de-

formable sheet element 21 in the manner described above.

[0031] Advantageously, the elastically deformable sheet element 21 is made of harmonic steel and has a thickness of about 0.2 mm, this does not preclude the choice of another material with the appropriate elastic properties or other shape.

[0032] According to a preferred embodiment, the support block 24, the elastically deformable sheet element 21 and the fastening element 23, inserted inside a special second hole, 45, as seen in Fig. 2, are included underneath the clamping block 12. In any case, it is within the scope of the invention to envisage alternative arrangements of such elements.

[0033] In addition, the device according to the invention comprises an anti-slip assembly, 40, intended to stabilize the clamping block 12 in the steps of unscrewing and extracting the clamping screw 13.

[0034] In detail, the anti-slip assembly 40 is housed below the shallower portion 3 of the housing cavity 10 and comprises an anti-slip pin, 41, housed within a further relative hole, 46, a spring element, 42, and a stop element, 43, with such an anti-slip pin 41 and spring element 42 inserted within a hole, 44, coaxial to the calibrated portion 33 of the side hole 30. Specifically, such a spring element 42 is interposed between the stop element 43 and the anti-slip pin 41 and is intended to keep the anti-slip pin 41 in abutment on the clamping screw 13. Thereby, the anti-slip pin 41 is induced to insert in the threaded hole 25 of the clamping block 12 following the unscrewing of the clamping screw 13, so as to prevent the radial movement of the clamping block even in the absence of the clamping screw 13, consequently stabilizing it.

[0035] It should be noted, in this context, that the length of the anti-slip pin 41 and the extension of the spring element 42 are suitably calibrated so as to ensure that the anti-slip pin 41, engaging the clamping block 12 following the extraction of the clamping screw 13, does not intercept the cutter 11, thus allowing its free extraction.

[0036] As is evident, the arrangement of the anti-slip assembly 40 as described facilitates and significantly speeds up the operations of replacing the cutter 11. It is clear that the extraction of the cutter 11 does not require the disassembly and removal of the elements associated therewith, in fact speeding up maintenance operations.

[0037] It is clear that numerous variants of the device so far described by way of example can be implemented by a person skilled in the art, without departing from the principles of novelty inherent in the inventive idea.

[0038] In fact, the materials, geometries and dimensions of the components illustrated may be modified or replaced according to requirements. Such adaptations will therefore be considered equivalent to the exemplary embodiments.

Claims

1. Cutting head (1) for a machinery suitable for carrying out machining by chip removal on materials, said cutting head comprising holder body in which one or more housing cavities (10) are obtained, each suitable for housing a respective cutter (11) and a clamping block (12), a clamping screw (13) being provided to actuate said clamping block (12) so that said cutter (11) is clamped between said clamping block (12) and a reference wall (4) of said housing cavity (10), elastic means being provided to act between said housing cavity (10) and said cutter (11) so as to push said cutter in a direction having at least one radial component facing outwards, said reference wall (4) of said housing cavity (10) and said cutter (11) having a geometry such as to provide an interference fit in which an inclined face (19) is provided in correspondence with said reference wall (4) and a corresponding second inclined face (20) is provided in said cutter which perform the function of guiding the correct positioning in the radial direction of said cutter (11) following the clamping action against said reference wall (4), said cutting head (1) being **characterized in that** said elastic means comprise an elastically deformable sheet element (21) associated with said housing cavity (10) with a cantilevered portion thereof located underneath a bottom surface of said cutter (11) so that when said cutter (11) is in its working position abutting on said reference wall (4) said elastically deformable sheet element (21) is bent downwards by said bottom surface of said cutter (11), said elastically deformable sheet element (21) thus exerting an action tending to push said cutter (11) radially outwards, in order to facilitate the extraction of said cutter (11) from said housing cavity (10).
2. Cutting head according to claim 1, **characterized in that** said elastically deformable sheet element (21) is positioned on a support block (24) located in correspondence with the bottom wall (5) of said housing cavity (10) and is provided with at least one hole (22), intended to allow the insertion of at least one fastening element (23), able to fasten said elastically deformable sheet element (21) to said bottom wall (5) of said housing cavity (10).
3. Cutting head according to the preceding claim, **characterized in that** said support block (24), said elastically deformable sheet element (21) and said at least one fastening element (23) are arranged below said clamping block (12).
4. Cutting head according to claim 1, **characterized in that** said housing cavity (10) has a side hole (30) accessible from outside and leading into said reference wall (4), said side hole (30) being provided with a calibrated portion (33) for the passage of said tightening screw (13) and of an enlarged portion (34) suitable for housing magnetic elements (32) and a pin for axial centering (31) of said cutter (11).
5. Cutting head according to claim 1, wherein said clamping block (12) is provided with a threaded hole (25) for the passage of said clamping screw (13), **characterized in that** it comprises an anti-slip assembly (40) comprising an anti-slip pin (41) mounted on a spring element (42), said anti-slip pin (41) and said spring element (42) being inserted inside a relative hole (44) coaxial with said calibrated portion (33) of said side hole (30), said anti-slip pin (41) being intended to be inserted inside said threaded hole (25) of said clamping block (12), following the extraction of said tightening screw (13), so as to prevent the radial movement of said clamping block (12).
6. Cutting head according to the preceding claim, **characterized in that** said anti-slip assembly (40) is located below a shallower portion (3) of said housing cavity (10), in a position adjacent to the lower portion of said clamping block (12), on the side of said clamping block opposite to the side in contact with said cutter (11), and it comprises said spring element (42) and said anti-slip pin (41) and a stop element (43), substantially parallel to said clamping block, with said spring element (42) interposed between said stop element (43) and said anti-slip pin (41) and intended to keep said anti-slip pin (41) in abutment on said tightening screw (13), said anti-slip pin (41) being caused to pass, due to the extension of said spring element (42) consequent to the unscrewing and extraction of said tightening screw (13), from a first position in which it presses said clamping screw (13) to a second position in which it engages said threaded hole (25) of said clamping block (12), thus ensuring the stabilization of said clamping block (12) during removal of said tightening screw (13).
7. Cutting head according to the preceding claim, **characterized in that** the length of said anti-slip pin (41) and the extension of said spring element (42) are suitably calibrated in such a way that following unscrewing of said tightening screw (13), said anti-slip pin (41) does not engage said cutter (11).
8. Cutting head according to claim 1, **characterized in that** said cutter (11) has a cutting edge (14), a substantially flat side (16) in contact with said clamping block (12) and a reference side (17) providing a recess (18) in its lower portion intended to realize said interference fit by interaction with a respective projecting inclined plane (19) obtained on said reference wall (4).
9. Cutting head according to claim 1, **characterized in that** said inclined plane (19) forms an angle between

115° and 135° with the longitudinal surface facing the outside of said cutter (11).

10. Cutting head according to one of the preceding claims, **characterized in that** said magnetic elements (32) provided inside said enlarged portion (34) of said side hole (30) are intended to retain said clamping screw (13) in said enlarged portion (34) when said clamping screw (13) is disengaged from said clamping block (12).

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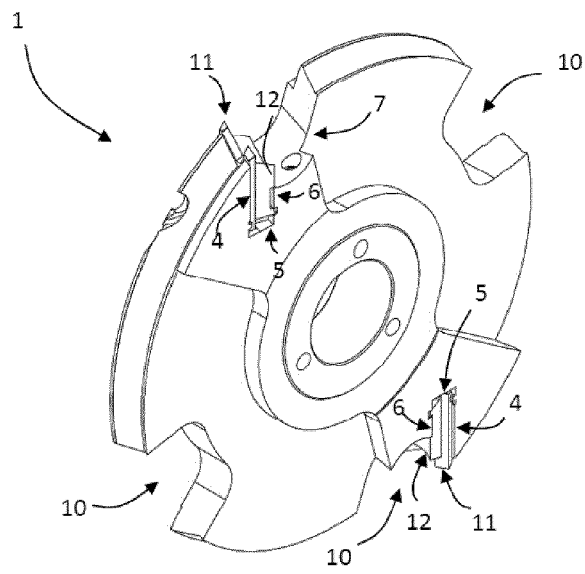


FIG. 1

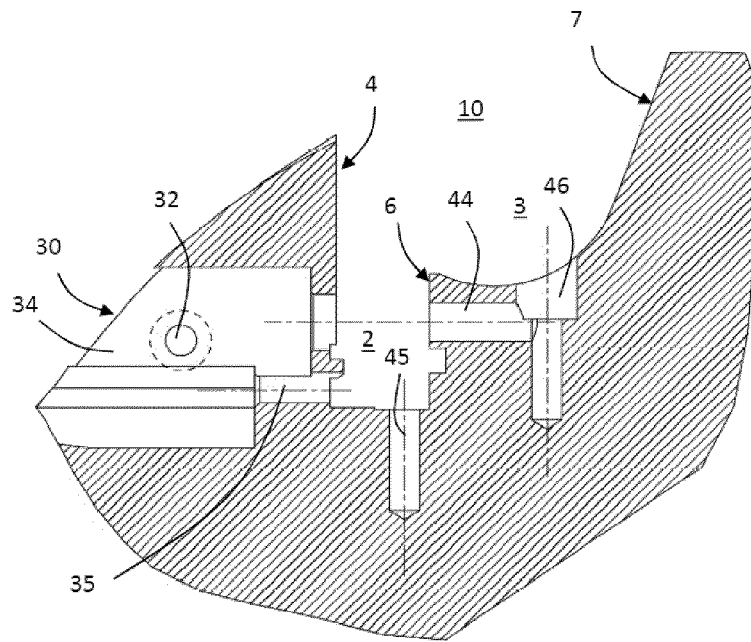
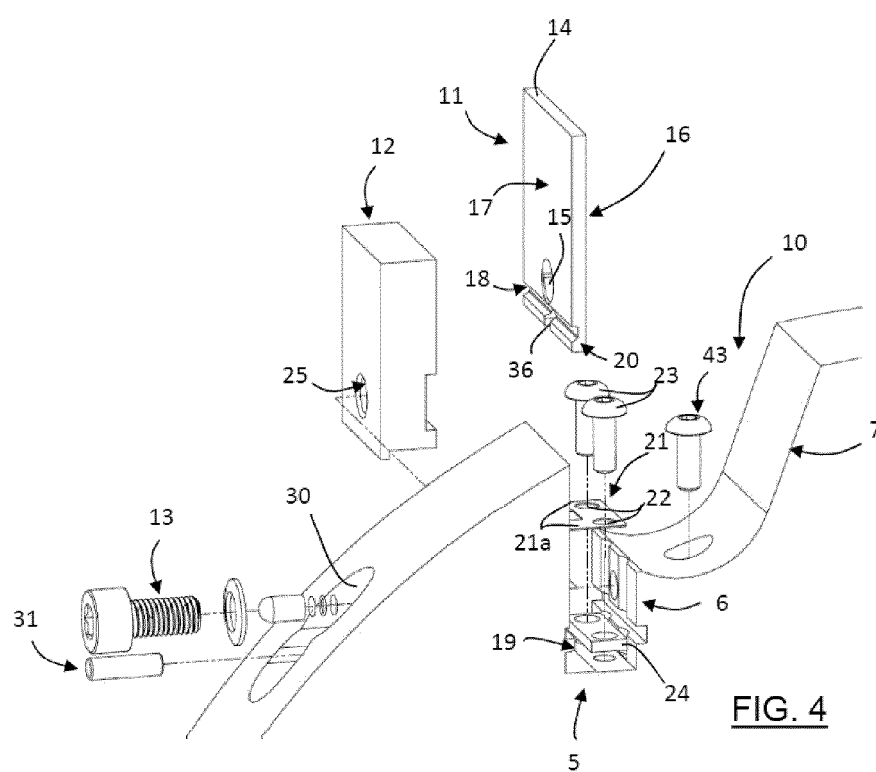
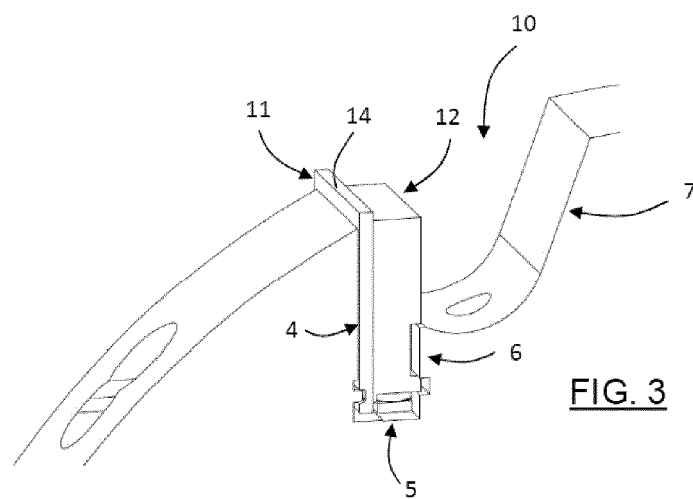


FIG. 2



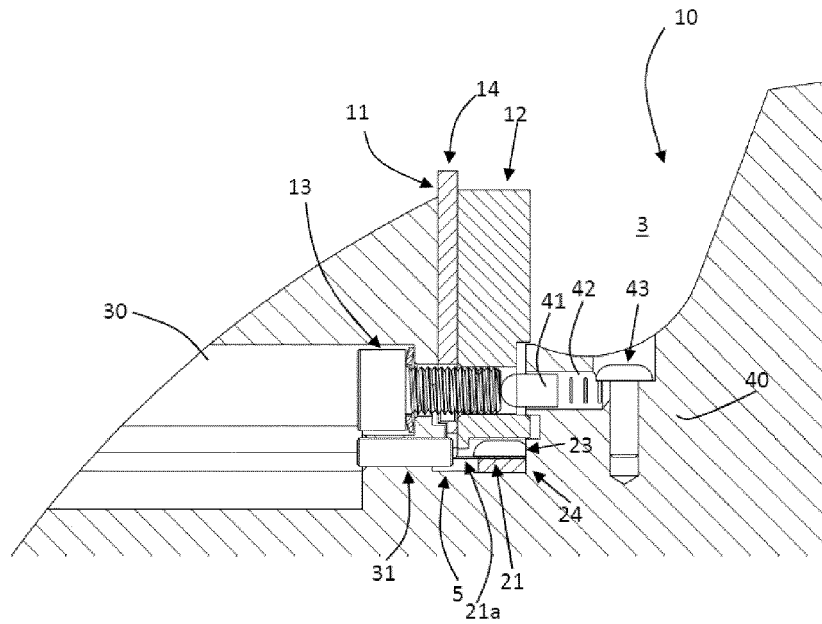


FIG. 5

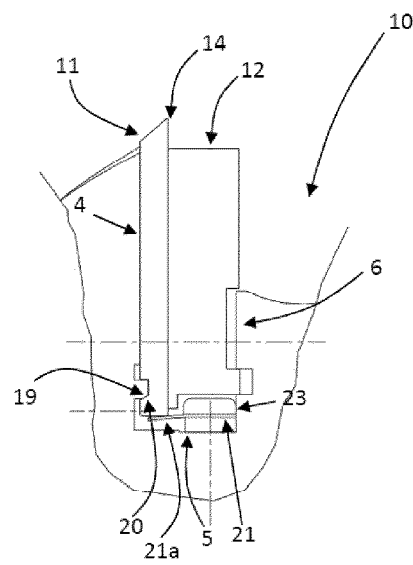


FIG. 6



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Application Number

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Y	* abstract *	2	B27G13/10
A	* paragraphs [0039], [0040], [0041] * * figures *	3	B27G13/12
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 September 2022	Examiner Hamel, Pascal
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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