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(54) **SOCKET LOCKING DEVICE**

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A socket locking device for locking a socket to an impact wrench comprises an arc-shaped bracket and a pin, wherein the arc-shaped bracket and the pin are integrally made of plastic, a first end of the pin is located in a centre of the arc-shaped bracket, and the pin is at least partially surrounded by a sleeve made of a material different from the plastic. The pin of the socket locking device of the present invention is surrounded by the different material, which can prevent the pin from breaking.

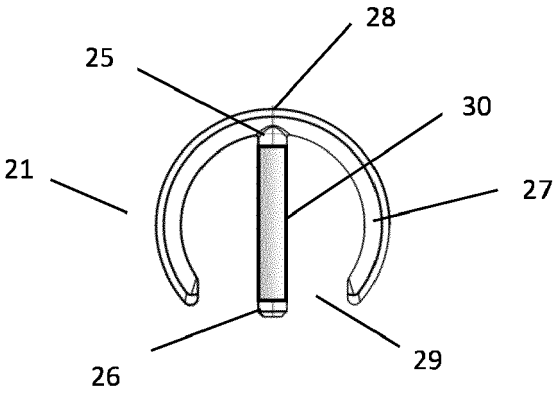

Fig.2

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Description

TECHNICAL FIELD

[0001] The present invention relates to an accessory for an impact tool, and in particular to a socket locking device for locking a socket to an output shaft of an impact wrench.

BACKGROUND ART

[0002] A socket of an impact wrench is connected to an output spindle by a rotating fit (most commonly with a square joint). As sockets of high-power impact wrenches may weigh up to 1.5 kg or more, they must be secured against coming off to avoid work interruption or even serious injury. The most common type of heavy-duty impact wrench is secured by means of a pin inserted in through-holes of a socket and a square joint. The pin is kept in place by an elastic o-ring surrounding the socket. However, such an anti-off device has the disadvantage that it is difficult to assemble / disassemble and the pin easily gets lost while assembly / disassembly.

[0003] There is a so-called "snap ring" made of silicone rubber with a strong metal shielding/reinforcing pin on the market, but this anti-off device of the snap ring type is not easy to mount and demount.

[0004] Hilti offers the so-called "E-Spring", which is a thermoplastic pin with an integrated circular-arc-shaped bracket that allows the pin to be firmly secured to the socket. The E-Spring is easy to mount and demount, but this purely plastic pin is not suitable for high-power impact wrenches, as it may deform or break after a short period of use.

SUMMARY OF THE INVENTION

[0005] An objective of the present invention is to provide a socket locking device for an impact wrench with the advantages of being sturdy and durable and at the same time easy to mount and dismount.

[0006] According to an embodiment of the present invention, a socket locking device for locking a socket to an impact wrench comprises an arc-shaped bracket and a pin, wherein the arc-shaped bracket and the pin are integrally made of plastic, a first end of the pin is located in a centre of the arc-shaped bracket, and the pin is at least partially surrounded by a sleeve made of a material different from the plastic. The pin of the socket locking device of the present invention is surrounded by the different material, which can prevent the pin from breaking.

[0007] The arc-shaped bracket and the pin are made of thermoplastic and the sleeve is made of a metal material. The metal sleeve surrounds the pin made of thermoplastic, which can improve the strength of the pin and prevent the pin from breaking during use.

[0008] The sleeve extends substantially along the entire length of the pin and substantially surrounds the pin. The metal sleeve substantially surrounds the pin, which can maximise the strength of the pin.

[0009] According to the other embodiment of the present invention, the sleeve surrounds the side of a second end of the pin, and preferably, the sleeve extends along the second end of the pin to at least 1/3 of its entire length. The metal sleeve partially surrounds the area of the pin that is most prone to breaking, which can increase the strength of the pin while saving manufacturing cost and simplifying the manufacturing process.

[0010] Alternatively, the sleeve surrounds the side of the first end of the pin, and preferably, the sleeve extends along the first end of the pin to at least 1/3 of its entire length. The area of the pin that is prone to breaking during use is often a portion close to the first end or the second end, so local reinforcement of the metal sleeve can provide an effect of preventing the pin from breaking.

[0011] According to another embodiment of the present invention, a socket locking device for locking a socket to an impact wrench comprises an arc-shaped bracket and a pin, wherein the arc-shaped bracket and the pin are integrally made of plastic, a first end of the pin is located in a centre of the arc-shaped bracket, and a second end of the pin is connected to a head made of a material different from the plastic. In this embodiment, the pin is reinforced by connecting to the head with a higher strength, so that the pin is prevented from breaking during use.

[0012] According to still another embodiment of the present invention, a socket locking device for locking a socket to an impact wrench comprises an arc-shaped bracket and a pin, wherein the arc-shaped bracket is made of thermoplastic, the pin is made of a metal material, and a first end of the pin is connected to a centre of the arc-shaped bracket. In this embodiment, the overall pin is made of a metal material with a higher strength and is then connected to the arc-shaped bracket, so that the pin is prevented from breaking.

[0013] According to yet another embodiment of the present invention, an impact wrench comprises: an impact mechanism for applying an impact in a direction of rotation around a work axis; an output spindle on the work axis, the output spindle being provided with a first hole; and a socket provided with a groove extending around the work axis and a second hole running through the groove and being perpendicular to the work axis, wherein the socket is attached to the output spindle by means of a socket locking device as described above, the first hole and the second hole are in line with each other, the pin is inserted into the first hole and the second hole, and the arc-shaped bracket is located in the groove. With the socket locking device of the present invention, the socket can be stably connected to the output spindle of the impact wrench without the risk of failure of the socket locking device due to breaking of the pin.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] A better understanding of the embodiments mentioned can be gained from the following detailed description with reference to the drawings. It is emphasized that various components are not necessarily drawn to scale. In fact, dimensions may be increased or decreased at will for the purpose of clear description. In the drawings, the same reference signs refer to the same elements.

Fig. 1 is a schematic diagram of an impact wrench connected to and fitted with a socket of the present invention;

Fig. 2 is a schematic diagram of a socket locking device according to an embodiment of the present invention;

Fig. 3 is another schematic diagram of the socket locking device shown in Fig. 2;

Fig. 4 is still another schematic diagram of a socket locking device according to an embodiment of the present invention;

Fig. 5 is a schematic exploded view of the socket locking device shown in Fig. 4;

Fig. 6 is a schematic diagram of a socket locking device according to another embodiment of the present invention;

Fig. 7 is a sectional view of a pin of the socket locking device according to the embodiment shown in Fig. 6;

Fig. 8 is a schematic diagram of a socket locking device according to still another embodiment of the present invention; and

Fig. 9 is a schematic exploded view of the socket locking device according to the embodiment shown in Fig. 8.

DETAILED DESCRIPTION OF EMBODIMENTS

[0015] A socket locking device for locking a socket to an impact wrench and an impact wrench of the present invention will be described below with reference to Figs 1 to 9. The following description is merely exemplary, and does not limit the disclosed content of the present application or the applications or uses of the present invention. In the description of the present invention, it should be understood that orientations or positional relationships indicated by terms such as "centre", "longitudinal", "transverse", "length", "width", "thickness", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside", "axial", "radial", and "circumferential" are based on orientations or positional relationships shown in the drawings, which are only for facilitating the description of the present invention and simplifying the description, rather than indicating or implying that devices or elements referred to must have a specific orientation or be constructed and operated in the specific orientation, and therefore cannot be construed as limiting the present invention.

[0016] Fig. 1 shows an example of an impact wrench 1. The impact wrench 1 comprises a housing 8. An electric motor 2, an impact mechanism 3 and an output spindle 4 are accommodated in the housing 8. The impact mechanism can be driven by the electric motor to apply an impact to the output spindle 4 located on a work axis 5 in a direction of rotation around the work axis 5. A handle 7 is connected to the housing 8, so that a user can hold and guide the impact wrench 1 by the handle 7 during operation. The handle 7 is provided with an on/off button 9. The electric motor 2 can be turned on or off by the button 9. A lower portion of the handle 7 may be connected to a battery 6 or an alternating-current power supply. The output spindle 4 protrudes from the housing 8 and has a front end forming an anvil 10 with a square cross-section. A socket 11 or similar tool may be mounted on the anvil 10.

[0017] The socket 11 comprises a hollow bushing 12 with a square cross-section. The bushing has dimensions substantially the same as those of the anvil 10. A groove 13 extending around the work axis 5 is provided on an outer periphery of the bushing 12. Opposite the bushing 12, the socket 11 further comprises an opening 14 for receiving a hexagonal bolt or hexagonal nut. The anvil 10 is provided with a first hole 22 substantially perpendicular to the work axis 5. The socket 11 also has a second hole 23 substantially perpendicular to the work axis 5. The second hole 23 extends at least into a cavity of the bushing 12. The first hole 22 and the second hole 23 are in line with each other. The socket 11 is secured to the output spindle 4 by means of a socket locking device 21. The socket locking device 21 comprises an arc-shaped bracket 27 and a pin 24. The pin 24 is inserted into the first hole 22 and the second hole 23 that are in line with each other, and the arc-shaped bracket 27 is located in the groove 13.

[0018] The arc-shaped bracket 27 is a circular arc having an opening. The circular arc has an inner diameter preferably corresponding approximately to an outer diameter of the socket 11 in the region of the groove 13. Moreover, when the socket locking device 21 is mounted to the impact wrench and the socket, the centre of a circle of the circular arc is required to be on the work axis 5 to ensure a tight fit between the arc-shaped bracket 27 and the socket 11. Preferably, the arc-shaped bracket 27 has a constant cross-section along its arc circumference. A centre angle around the centre of a circle of the arc-shaped bracket 27 ranges from 270 degrees to 300 degrees, and accordingly the arc-shaped bracket 27

has an opening 29 with an angle ranging from 40 degrees to 90 degrees. A centre point of the circular arc facing the opening 29 in a circumferential direction is a centre 28 of the arc-shaped bracket 27. The arc-shaped bracket 27 is made of plastic, in particular of thermoplastic. In this way, the arc-shaped bracket 27 has a certain degree of elasticity, so that when the arc-shaped bracket 27 is placed in or removed from the groove 13, the opening 29 thereof can be opened radially to allow for easy insertion and withdrawal of the socket locking device 21 from the socket 11.

[0019] The pin 24 is located in the arc-shaped bracket 27. A first end 25 of the pin 24 is joined to the centre 28 of the arc-shaped bracket 27, and a second end 26 of the pin 24 faces the opening 29. Preferably, the pin 24 is located on an axis of symmetry of the arc-shaped bracket 27, so that part of the arc of the arc-shaped bracket 27 on one side of the pin 24 is of the same size as part of the arc of the arc-shaped bracket 27 on the other side of the pin 24. Preferably, the pin 24 has a length less than an outer diameter of the arc-shaped bracket 27, so that the second end 26 of the pin 24 is located within the circle described by the arc-shaped bracket 27. More preferably, the second end 26 of the pin 24 does not extend beyond the opening 29.

[0020] The pin 24 passes through both the second hole 23 in the socket and the first hole 22 in the output spindle 4, limiting an axial movement of the socket 11 relative to the output spindle 4. The pin 24 is preferably a cylindrical rod with a constant cross-section and, preferably, the pin 24 has a diameter ranging from 4 mm to 6 mm. More preferably, a ratio of the area of the cross-section of the arc-shaped bracket 27 in its circumferential direction to the area of the cross-section of the cylindrical rod of the pin 24 ranges from 75% to 125%.

[0021] In this embodiment, the arc-shaped bracket 27 and the pin 24 are made of thermoplastic, where thermoplastic includes, but is not limited to, acrylonitrile-butadiene-styrene (ABS), polyamide (PA), polylactic acid (PLA), polyethylene (PE), and polypropylene (PP).

[0022] The arc-shaped bracket 27 and the pin 24 are manufactured in one piece or integrally. In a preferred manufacturing process, the pin 24 and the arc-shaped bracket 27 are subjected to injection moulding in a single process step. In this way, the pin 24 and the arc-shaped bracket 27 are connected together without a joint region. Bonding or welding creates a boundary layer, which may lead to weak points. One-piece moulding avoids the risk of the pin 24 coming off from the centre 28 of the arc-shaped bracket.

[0023] Referring to Figs. 2 to 5, in the socket locking device 21 of the present invention, the pin 24 is at least partially surrounded by a sleeve 30 made of a material different from plastic, so that the pin is prevented from breaking. The material of the sleeve 30 requires a higher strength and to be less prone to breaking than thermoplastic. Preferably, the sleeve is made of a metal material. Metals are significantly more rigid than thermoplastic, so a sleeve made of a metal material surrounding a pin made of thermoplastic can improve the strength of the pin to prevent the pin from breaking during use. There is a wide range of metal materials to choose from, such as steel for better rigidity or aluminium for better ductility, as well as a variety of alloys, all of which can be selected according to the weights and dimensions of impact wrenches and the matching sockets.

[0024] According to a preferred embodiment of the present invention, as shown in Figs. 2 and 3, the sleeve 30 extends substantially along the entire length of the pin 24 and completely surrounds the pin, thereby maximising the strength of the pin 24. The sleeve 30 may be first shaped into a sheet and then rolled into a tube in a circumferential direction of the pin 24 to surround the pin 24. The sleeve 30 may also be first shaped into a tube having a slit and then sleeved over the pin 24. The sleeve 30 securely surrounds the pin 24 by tightening the slit.

[0025] Referring to Figs. 4 and 5, according to another preferred embodiment of the present invention, the sleeve 30 only surrounds the side of the second end 26 of the pin 24. Preferably, the sleeve 30 extends along the second end 26 of the pin 24 to at least 1/3 of its entire length. More preferably, the length of the sleeve 30 is ½ of the length of the pin 24. The metal sleeve 30 partially surrounds the area of the pin 24 that is most prone to breaking, which can increase the strength of the pin while saving manufacturing costs and simplifying the manufacturing process.

[0026] Alternatively, the sleeve 30 surrounds the side of the first end 25 of the pin 24, and preferably, the sleeve 30 extends along the first end 25 of the pin to at least 1/3 of its entire length. The area of the pin 24 that is prone to breaking during use is often a portion close to the first end 25 or the second end 26, so local reinforcement of the metal sleeve 30 can provide an effect of preventing the pin from breaking. It is to be understood that the sleeve 30 may also be discontinuous. For example, all areas of the pin 24 that are prone to breaking are each surrounded by a section of sleeve 30. Alternatively, the sleeve 30 may not be a continuous sheet or tube; for example, it may be a metal mesh or ribs.

[0027] Figs. 6 and 7 show another embodiment of a socket locking device of the present invention. Unlike the embodiments shown in Figs. 2 to 5, the pin 24 is reinforced by connecting a head 40 with a higher strength to its second end 26. Preferably, the head 40 is made of a metal material and has the same diameter and shape as the pin 24. The head 40 may be connected to the second end 26 of the pin by any means, such as mechanical locking or bonding. Preferably, the head 40 is connected to the second end 26 of the pin by an insert moulding process. That is, the metal head is pre-embedded in an injection mould and then injected with plastic, such that the second end 26 of the pin 24 is over-moulded at one end of the metal head 40.

[0028] In the embodiment shown in Figs. 6 and 7, the length of the head 40 is substantially equal to the length of

the pin 24, the head 40 made of metal is located at a position under a greater force when the pin 24 and the head 40 are inserted into the first hole 22 and the second hole 23, thereby avoiding the risk of the original plastic-made pin breaking here. It is to be understood that in embodiments not shown in the drawings, the head 40 may be longer or shorter. For example, the length of the head 40 is twice or even longer than the length of the pin 24, and any length of the head 40 is acceptable as long as it is ensured that the head 40 made of a metal material is reliably connected to the second end of the pin. In addition, all other structural features of the socket locking device 21 are substantially the same as those of the socket locking device in the preceding embodiments and will not be repeated herein.

[0029] Figs. 8 and 9 illustrate a socket locking device 21 according to still another embodiment of the present invention. In this embodiment, the structures and dimensions, etc. of the arc-shaped bracket 27 and the pin 24 are not substantially different from those in the preceding embodiments. However, the arc-shaped bracket 27 in this embodiment is still made of thermoplastic but the pin 24 is made of a metal material and the first end 25 of the pin is connected to the centre 28 of the arc-shaped bracket 27. Unlike the preceding embodiments, in this embodiment, the overall pin 24 is made of a metal material with a higher strength and is then connected to the arc-shaped bracket 27, so that the pin is prevented from breaking.

[0030] Preferably, the pin 24 made of a metal material is secured to the centre 28 of the arc-shaped bracket 27 by mechanical continuous locking. As shown in Figs. 8 and 9, a hole is provided in the centre 28 of the arc-shaped bracket 27, and the first end 25 of the pin 24 made of metal is inserted into the hole and is secured by means of a circlip or a toothed lock washer 50.

[0031] The socket locking device 21 of the present invention enables the socket 11 to be firmly mounted to the output spindle 4 of the impact wrench 1. There is no risk of the socket 11 coming off from the impact wrench due to accidental breaking of the pin 24 during use.

[0032] As mentioned above, although exemplary embodiments of the present invention have been described in the specification with reference to the drawings, the present invention is not limited to each of the specific embodiments described above, and many other embodiments are possible, and the scope of the present invention should be limited by the claims and their equivalent meanings.

Claims

1. Socket locking device (21) for locking a socket (11) to an impact wrench (1), the socket locking device comprising an arc-shaped bracket (27) and a pin (24), wherein the arc-shaped bracket (27) and the pin (24) are integrally made of plastic, and a first end (25) of the pin (24) is located in a centre (28) of the arc-shaped bracket (27), **characterized in that** the pin (24) is at least partially surrounded by a sleeve (30) made of a material different from the plastic.

2. Socket locking device (21) according to Claim 1, **characterized in that** the arc-shaped bracket (27) and the pin (24) are made of thermoplastic and the sleeve (30) is made of a metal material.

3. Socket locking device (21) according to Claim 2, **characterized in that** the sleeve (30) extends substantially along the entire length of the pin (24) and substantially surrounds the pin (24).

4. Socket locking device (21) according to Claim 2, **characterized in that** the sleeve (30) surrounds the side of a second end (26) of the pin (24), and preferably, the sleeve (30) extends along the second end (26) of the pin (24) to at least 1/3 of its entire length.

5. Socket locking device (21) according to Claim 2, **characterized in that** the sleeve (30) surrounds the side of the first end (25) of the pin (24), and preferably, the sleeve (30) extends along the first end (25) of the pin (24) to at least 1/3 of its entire length.

6. Socket locking device (21) for locking a socket (11) to an impact wrench (1), the socket locking device comprising an arc-shaped bracket (27) and a pin (24), wherein the arc-shaped bracket (27) and the pin (24) are integrally made of plastic, and a first end (25) of the pin (24) is located in a centre (28) of the arc-shaped bracket (27), **characterized in that** a second end (26) of the pin (24) is connected to a head (40) made of a material different from the plastic.

7. Socket locking device (21) according to Claim 6, **characterized in that** the arc-shaped bracket (27) is made of thermoplastic and the head (40) is made of a metal material.

8. Socket locking device (21) according to Claim 7, **characterized in that** the head (40) has a length substantially equal to that of the pin (24).

9. Socket locking device (21) according to Claim 7, **characterized in that** the length of the head (40) is at least 2/3 of the length of the pin (24).

10. Socket locking device (21) for locking a socket (11) to an impact wrench (1), the socket locking device comprising an arc-shaped bracket (27) and a pin (24), wherein the arc-shaped bracket (27) is made of thermoplastic, **characterized in that** the pin (24) is made of a metal material and a first end (25) of the

pin (24) is connected to a centre (28) of the arc-shaped bracket (27).

11. Impact wrench (1), comprising: an impact mechanism (3) for applying an impact in a direction of rotation around a work axis (5); an output spindle (4) on the work axis (5), the output spindle (4) being provided with a first hole (22) substantially perpendicular to the work axis (5); and a socket (11) provided with a groove (13) extending around the work axis (5) and a second hole (23) running through the groove (13) and being perpendicular to the work axis (5), wherein the first hole (22) and the second hole (23) are in line with each other, **characterized in that** the socket (11) is attached to the output spindle (4) by means of a socket locking device (21) according to any one of the preceding claims, the pin (24) is inserted into the first hole (22) and the second hole (23), and the arc-shaped bracket (27) is located in the groove (13).

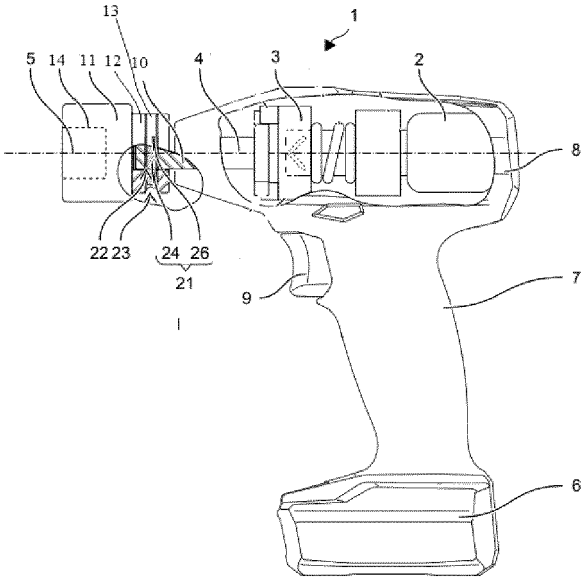

fig. 1

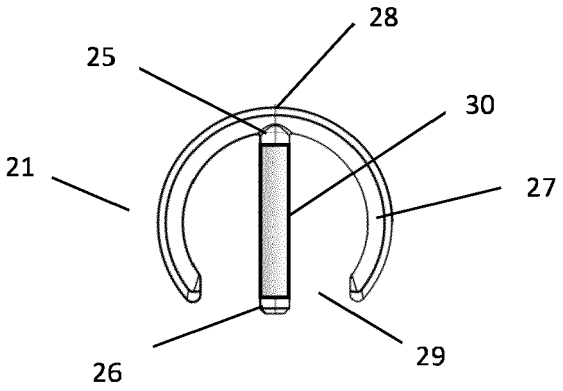

Fig.2

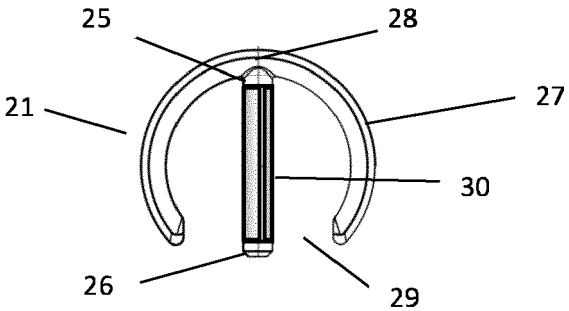

Fig.3

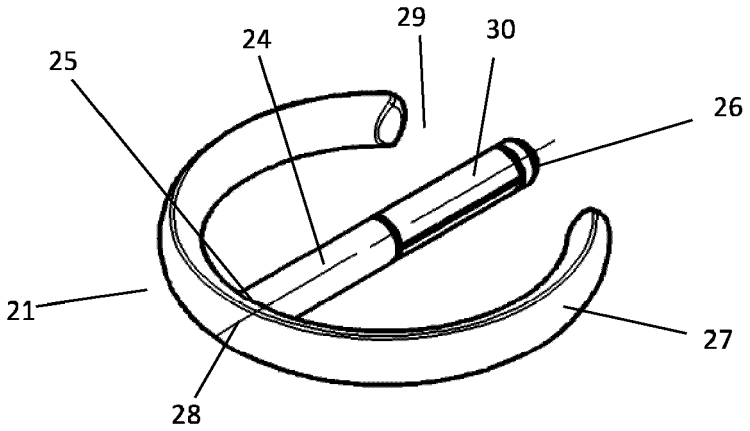

Fig.4

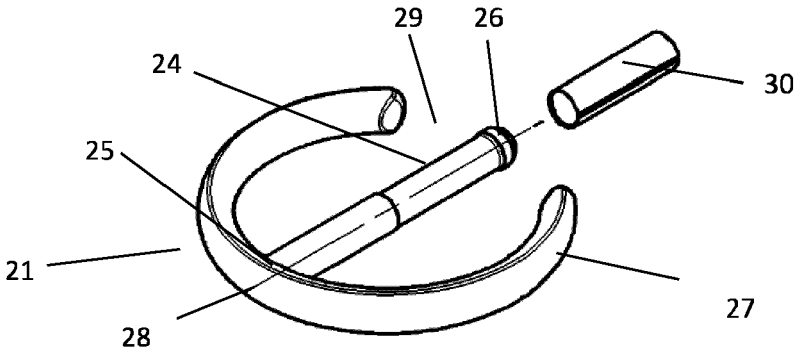

Fig. 5

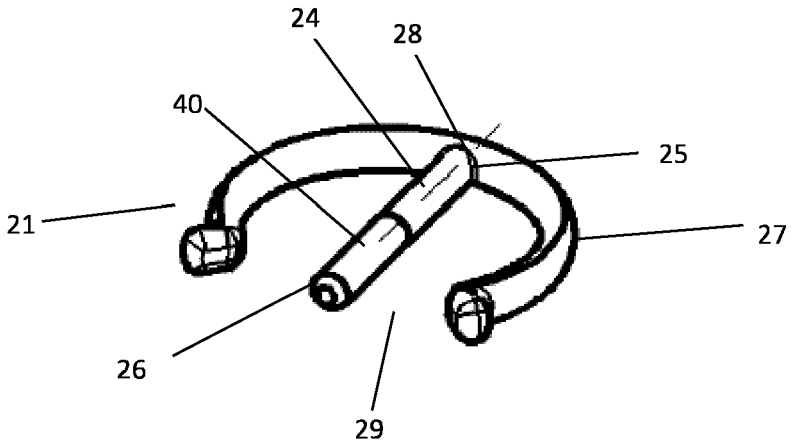

Fig. 6

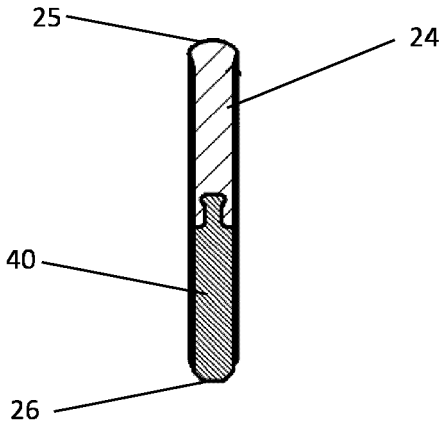

Fig.7

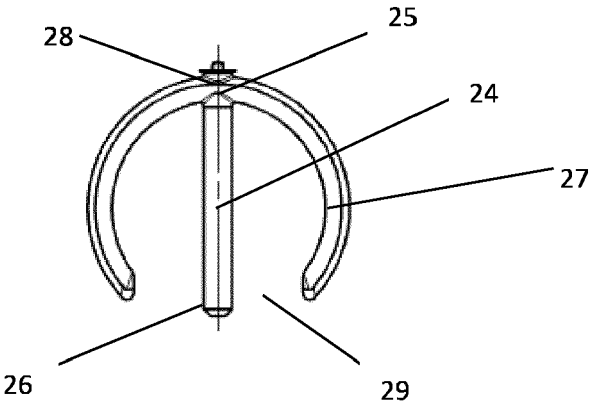

Fig. 8

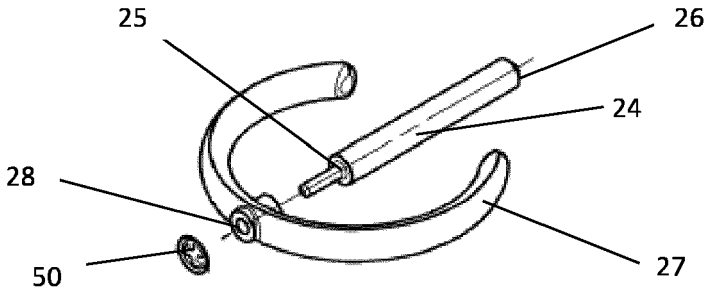

Fig.9

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EUROPEAN SEARCH REPORT

Application Number
EP 23 19 9278

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	EP 3 208 045 A1 (HILTI AG [LI]) 23 August 2017 (2017-08-23) * paragraph [0009] - paragraph [0019]; figures 1-4 *	1-5,10, 11 6-9	INV. B25B21/02 B25B23/00
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TECHNICAL FIELDS SEARCHED (IPC)

B25B
F16B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 March 2024	Pothmann, Johannes

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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01-03-2024

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