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(54) **A ROTATABLE TOOL FOR CLEANING PIPES INTERNALLY AND A TOOL ASSEMBLY**

(57) A rotatable tool (1) for holding an abrasive sheet so as to clean pipes internally, comprising a separate clamping (4) piece, such that an abrasive sheet may be attached to the tool (1) by clamping it in a slit (6) between the clamping (4) piece and the body (2) of the tool (1). An end cap (5) is attached to the body in a longitudinally adjustable manner, so as to at least partially house a longitudinal end of the clamp piece, such that a longitudinal movement of the end cap (5) towards the body (2) pushes the clamp piece (4) laterally towards the body (2), thereby securing the abrasive sheet in place. Correspondingly, the slit (6) can be then widened for removal of the abrasive sheet by moving the when the end cap (5) longitudinally away from the body (2). A corresponding tool assembly is also concerned.

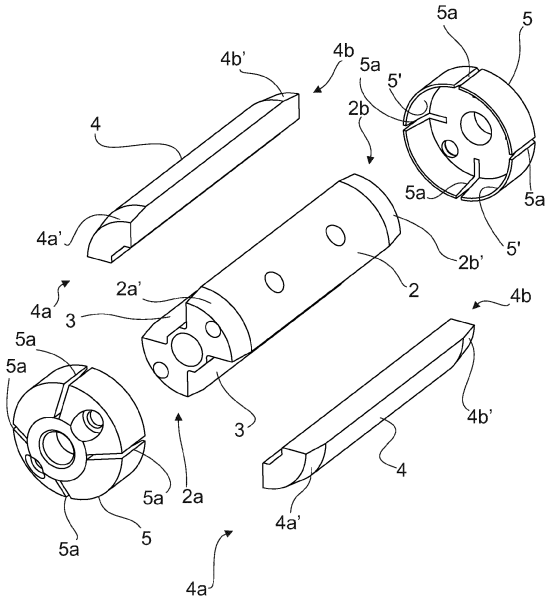

Fig. 1

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Description

FIELD OF THE DISCLOSURE

[0001] The present disclosure relates to a rotatable tool for cleaning pipes internally, and more particularly to such a tool suitable for holding an abrasive sheet thereon. The present disclosure further concerns a corresponding tool assembly.

BACKGROUND OF THE DISCLOSURE

[0002] Pipe lining has become an increasingly popular method of renewing old pipes and ducts, such as sewer pipes. Pipe lining is typically carried out by introducing a liner impregnated with a suitable resin into the existing pipeline. The liner is then inflated so as to conform to the internal shape of the existing pipeline and the resin is then subsequently cured, thereby forming a new, solid inner surface within the existing pipeline. In order for the liner to adhere properly to the existing pipeline, the inner surface thereof must be thoroughly cleared from deposits, oxidation and other debris.

[0003] To this end, several types of tools are used for cleaning the inner surface of the existing pipeline. For example, abrasive sheets attached to rotatable tools have been used, wherein such tools are drawn through the existing pipeline using a wire or a cable. Simultaneously, the tool is rotated using a separate rotation actuator coupled to the tool with the same wire or cable used for drawing the tool.

BRIEF DESCRIPTION OF THE DISCLOSURE

[0004] An object of the present disclosure is to provide a rotatable tool for cleaning pipes internally of the type holding abrasive sheets, while providing for enhanced replacement of the abrasive sheets. It is a further object of the present disclosure to provide a tool assembly having such a tool.

[0005] The object of the disclosure is achieved by rotatable tool and a tool assembly which are characterized by what is stated in the independent claims. The preferred embodiments of the disclosure are disclosed in the dependent claims.

[0006] The disclosure is based on the idea of providing a rotatable tool with a separate clamp piece, such that an abrasive sheet may be attached to the tool by clamping it between the clamp piece and the body of the tool. A slit, in which the abrasive sheet is inserted, is formed between the clamp piece and the tool body. Moreover, an end cap is attached to the body in a longitudinally adjustable manner, so as to at least partially house a longitudinal end of the clamp piece, such that a longitudinal movement of the end cap towards the body pushes the clamp piece laterally towards the body. Furthermore, this slit becomes narrower when the end cap is longitudinally moved towards the body, thereby securing the abrasive sheet in place. Correspondingly, the slit can be then widened for removal of the abrasive sheet by moving the when the end cap longitudinally away from the body.

[0007] This arrangement speed ups the process of replacing a worn abrasive sheet in several ways. For example, such an arrangement eliminates the need no need to detach the clamp piece to fit the abrasive sheet in place. This is because the clamp pieces can be moved away from the body while still being secured in place by the end cap. Furthermore, multiple clamp pieces can be pressed against the body simultaneously with the movement of the end cap, i.e., each clamp piece no longer needs to be clamped against the body separately. In effect, multiple abrasive sheets can be secured or detached by adjusting the end cap

[0008] According to a first aspect of the present disclosure, a rotatable tool is provided for cleaning pipes internally. Particularly, such a rotatable tool is intended for holding one or more abrasive sheets which, when the tool is rotated, act upon the internal wall of the pipe.

[0009] In the context of this disclosure, the term pipe is used to refer components of tubular pipelines, such as sewer pipes, ducts, and the like. Moreover, in the context of this disclosure, a longitudinal direction longitudinal is referred to as a direction in which the length of the tool extends in. The longitudinal direction is also parallel with the intended rotational axis of the rotatable tool. Most suitably, the rotational axis coincides with a central longtidunal axis of the tool. In the context of this disclosure, a lateral direction is defined as a direction transverse to the longitudinal direction. Furthermore, a radial direction of rotatable tool is defined with respect to the intended rotational axis of the tool.

[0010] The tool comprises a longitudinal body having at least a longitudinal groove extending between opposing longitudinal ends of the body. The tool further comprises a longitudinal clamp piece having, at least on a longitudinal end thereof, a tapered surface. Moreover, the tool comprises an end cap having an inner surface inclined with respect to the longitudinal direction.

[0011] The clamp piece is received within the groove of the body so as to extend between opposing longitudinal ends of the body, such that at least a longitudinal slit is formed between the clamp piece and the body, said slit being laterally outwardly open.

[0012] The end cap is attached to a longitudinal end of the body in a translationally adjustable manner along a longitudinal direction towards and away from the body, respectively. For example, the end cap could be attached to the body with one or more bolts extending through the end cap and threadedly engaging with corresponding threaded holes at the longitudinal end of the body.

[0013] Particularly, the end cap at least partially covers the tapered surface of the clamp piece. That is, the tapered surface of clamp piece is at least partially housed within the end cap. Moreover, the inclined inner surface of the end cap is configured to cooperate with the tapered surface of the clamp piece, such that a translational

movement of the end cap towards the body in the longitudinal direction urges the clamp piece laterally towards the body. That is, the inclined inner surface of the end cap slidingly engages with the tapered surface of the clamp piece, thereby resulting in the above-mentioned kinematics. Furthermore, the clamp piece, the end cap and the groove are configured such that a movement of the clamp piece laterally towards the body results in a decreased width of the longitudinal slit. In this manner, translational movement of the end cap towards the body enables an abrasive sheet to be secured within the slit by being clamped in between the clamp piece and the body.

[0014] As mentioned above, this arrangement eliminates the need to detach the clamp piece from the tool when replacing a worn abrasive sheet, thereby reducing down-time required by maintenance of the tools when cleaning pipes internally.

[0015] Preferably, but not necessarily, the body may comprise a longitudinal through hole, for attaching the tool with a transmission element, such as a wire or cable. The tool may then be fixed to the transmission element extending through the body, for example, by clamping the transmission element within the through-hole with suitable elements extending laterally through the body into the longitudinal through hole.

[0016] In an embodiment according to the first aspect of the present disclosure, a biasing member is provided between the clamp piece and the body. The biasing is configured to urge the clamp piece laterally outwardly from the body, such that the tapered surface of the clamp piece pushes against the inclined inner surface of the end cap, even when the end cap is moved longitudinally away from the body. This kind of an arrangement ensures that the width of slit between the clamp piece and the body increases simultaneously with the end cap being adjusted longitudinally away from the body, without the need to separately move the clamp piece. Furthermore, this facilitates the removal, and particularly the insertion of an abrasive sheet into the slit, as the clamp piece is urged open by the biasing member.

[0017] Such a biasing member may be provided, e.g., as one or more springs or other resilient components between the clamp piece and the body. Most suitably, such a biasing member is provided radially between the associated clamp piece and the body, such that insertion and removal of an abrasive sheet to and from the slit is not obstructed. Furthermore, if multiple clamp pieces are provided, one or more such biasing members are suitably provided between each clamp piece and the body in a similar manner as discussed above.

[0018] In a further embodiment according to the present disclosure, end caps are provided at both longitudinal lends of the tool, so as to cooperate with the clamp piece in a manner similar to what was discussed above.

[0019] Particularly, in such an arrangement both longitudinal ends of the clamp piece have tapered surfaces, and end caps are provided at both longitudinal ends of the body, such that both end caps are attachable to respective longitudinal ends of the body in a translationally adjustable manner along a longitudinal direction towards and away from the body, respectively. Furthermore, both end caps at least partially cover respective tapered surfaces of the clamp piece, in a similar manner as described above. The inclined inner surfaces of the end caps are configured to cooperate with the respective tapered surfaces of the clamp pieces, such that a translational movement of the end caps towards the body in the longitudinal direction urges the clamp piece laterally towards the body. The clamp piece, the end caps and the groove are configured such that a movement of the clamp piece laterally towards the body results in a decreased width of the longitudinal slit, so as to enable securing an abrasive sheet between the clamp piece and the body.

[0020] Providing end caps at both longtidunal ends of the clamp piece ensures that a uniform pressure can be applied along the slit on the abrasive sheet between the clamp piece and the body. This further improves the attachment of the abrasive sheet on the tool.

[0021] In a further embodiment according to the first aspect of the present disclosure, multiple grooves and respective clamp pieces are provided in a similar manner as discussed above, so as to enable multiple abrasive sheet to be attached to the tool.

[0022] Particularly, in such an arrangement, the body comprises two or more longitudinal grooves angularly spaced apart from each other, a respective longitudinal clamp piece being provided for each such longitudinal groove. The clamp pieces are received within respective grooves so as to extend between opposing longitudinal ends of the body, such that at least a longitudinal slit is formed between each of the clamp pieces and the body, said slit being laterally outwardly open.

[0023] The end cap at least partially covers the tapered surfaces of the clamp pieces. That is, the end cap at least partially houses the inclined surface of the multiple clamp pieces. The inclined inner surface of the end cap is configured to cooperate with the tapered surfaces of the clamp pieces, such that a translational movement of the end cap towards the body in the longitudinal direction urges the two or more clamp pieces laterally towards the body. Furthermore, the clamp pieces, the end cap and the grooves are configured such that movement of the clamp pieces laterally towards the body results in a decreased width of the respective longitudinal slits, so as to enable securing an abrasive sheet between each of the clamp pieces and the body.

[0024] In a further embodiment according to the first aspect of the present disclosure, a longitudinal slit is formed on both longitudinal sides of at least one clamp piece, such that an abrasive sheet can be clamped between said clamp piece and the body in both of said slits. In this kind of an arrangement, two separate abrasive sheets can be attached per each clamp piece.

[0025] In a further embodiment according to the first aspect of the present disclosure, for each slit between

the clamp piece and the body, the end cap is also equipped with a correspondingly positioned gap, such that a continuous slit is formed.

[0026] In a further embodiment according to the first aspect of the present, one or more abrasive sheets are provided, at least partially received and secured in respective one or more slits between a corresponding clamp piece and the body of the sheet holder.

[0027] It should be noted that the first aspect of the present disclosure encompasses any combination of two or more embodiments, or variants thereof, as discussed above. For example, the rotatable tool may be provided with end caps at both ends, multiple clamp pieces and longitudinal slits formed on both lateral sided of each clamp piece extending continuously through corresponding gaps on the end caps.

[0028] According to a second aspect of the present disclosure, a tool assembly is provided. Particularly, the tool assembly comprises a rotatable tool according to the first aspect of the present disclosure. Furthermore, the tool assembly comprises a rotation actuator, and a transmission element coupled between the rotatable abrasive tool and the rotation actuator for transmitting rotation movement therebetween.

[0029] For example, a wire or a cable may be used as the transmission element, such that the rotatable tool can also be drawn through a pipeline to be cleaned by said transmission element.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] In the following the disclosure will be described in greater detail by means of preferred embodiments with reference to the accompanying drawings, in which

Fig. 1 illustrates a rotatable tool according to an embodiment of the present disclosure in an exploded configuration, as seen as a perspective view;

Fig. 2a illustrates a rotatable tool according to an embodiment of the present disclosure in an assembled configuration, as seen as a plan view;

Fig. 2b illustrates a cut view of the section marked with dashed line in Fig. 2a;

Fig. 3a illustrates a rotatable tool according to an embodiment of the present disclosure in partially exploded configuration, as seen as a plan view, and

Fig. 3b illustrates a cut view of the section marked with dashed line in Fig. 3a;

DETAILED DESCRIPTION OF THE DISCLOSURE

[0031] Fig. 1 illustrates a rotatable tool 1 according to an embodiment of the present disclosure in an exploded configuration, as seen as a perspective view. Particularly, in this view, the end caps 5 have been longitudinally spaced apart from the body 2, whereas the clamp pieces 4 haven been laterally spaced apart from the grooves 3 of body 2.

[0032] The body is provided as a longitudinally extending piece having two external longitudinal grooves extending therethrough, on opposing lateral sides of the body. Furthermore, the body 2 is provided with a semi-cylindrical shape between the grooves 3.

[0033] At the opposing longitudinal ends 2a, 2b of the body 2, corresponding tapered surfaces 2a', 2b' are provided, helping the end caps 5 to be fitted over said longitudinal ends of the body. Particularly, these surfaces 2a', 2b' conform to a similar shape as corresponding inclined inner surfaces 5' of the end cap 5. A through-hole extends longitudinally through the body 2, enabling a transmission element (such as a cable or wire) to be inserted through, and attached to, the tool 1.

[0034] The clamp pieces 4 have a cross-sectional shape conforming to that of the grooves 3, such that the clamp pieces 4 can be inserted in the grooves 3. The clamp pieces 4 have tapered surfaces 4a', 4b' provided at their respective longtidunal ends 4a, 4b.

[0035] The end caps 5 are configured such that they can be inserted over the longtidunal ends 2a, 2b, 4a, 4b of the body 2 and the clamp pieces 4, such that the tapered surfaces 2a', 2b', 4a', 4b' are at least partially housed within the end caps 5, when the tool 1 is in a assembled configuration.

[0036] Fig. 1 also illustrates gaps 5a of the end cap 5 allowing an abrasive sheet to extend longitudinally through and past the end caps 5. Furthermore, the end caps 5 have central holes allowing a transmission element to pass therethrough. Additionally, the end caps 5 are provided with attachment openings laterally offset from the central hole, for inserting e.g., a bolt therethrough into, and engaging with, corresponding attachment holes provided on the longitudinal ends 2a, 2b of the body. This enables the end cap 5 to be longitudinally adjustably attached to the body 2.

[0037] Fig. 2a illustrates a rotatable tool 1 of Fig. 1 according to an embodiment of the present disclosure in an assembled configuration, as seen as a plan view from a side of a clamp piece 4. In this assembled configuration, the clamp pieces 4 are inserted into their respective grooves 3, and the end caps 5 are place on top of the longitudinal neds 2a, 2b, 4a, 5b of the clamp pieces 4 and the body 2. As can be seen, slits 6 are formed on both sides of the clamp piece 4, and the gaps 5a on the end caps 5 are aligned with the slits 6, allowing an abrasive sheet to extend longitudinally also though the end caps 5.

[0038] Fig. 2b illustrates a cut view of the section marked with a dashed line in Fig. 2a. Particularly, a biasing member 7 can be seen provided radially between the body 2 and the clamp piece 4. The biasing members 7 urge their respective clamp pieces 4 laterally away from the body 2 towards, and against the inside of the end

caps 5. Furthermore, Fig. 2b clearly shows the slits 6 formed between the clamp pieces 4 and the body 2, on both sides of the clamp piece 4.

[0039] When an abrasive sheet is attached to the tool, it is inserted into a slit 6, and the end caps 5 are adjusted towards the body, e.g. by tightening an associated attachment bolt(s). This causes the end caps to push the clamp pieces towards the body 2, thereby narrowing the slit formed between the clam pieces 4 and the body. The abrasive sheet inserted into the slit 6 is then clamped between the clamp piece 4 and the body.

[0040] Fig. 3a illustrates the rotatable tool 1 of Fig. 1 in a partially exploded configuration, as seen as a plan view. That is, Fig. 3a differs from the situation of Fig. 2a in that the end caps 5 are spaced apart from the body 2 for illustrative purposes.

[0041] Fig. 3b illustrates a cut view of the section marked with dashed line in Fig. 3a. This more clearly illustrate the way how the inclined inner surfaces 5' of the end cap 5 and the tapered surfaces 4a', 4b' of the clamp pieces 4 are correspondingly shaped to engage with each other. Particularly, when the end caps 5 are adjusted towards the body 2, the clamp pieces 4 assume corresponding positions to accommodate the now diminished inner diameter of the portion inclined inner surface 5' with which the tapered surfaces 4a', 4b', engage with.

[0042] Although the present disclosure has been described above with reference to the embodiment of the appended drawings, it should be noted that a rotatable tool according to the present disclosure may be implemented with another number of clamp pieces 4, end caps 5 or slits 6.

LIST OF REFERENCE NUMERALS

[0043]

1	sheet holder
2	longitudinal body
2a, 2b	opposing longitudinal ends
2a', 2b',	tapered surfaces
3	longitudinal groove
4	longitudinal clamp piece
4a	longitudinal end of clamp piece
4a'	tapered surface
4b	longitudinal end of clamp piece
4b'	tapered surface
5	end cap
5'	inner surface
5a	gap
6	longitudinal slit
7	biasing member

Claims

1. A rotatable tool (1) for cleaning pipes internally, comprising:

- a longitudinal body (2) having at least a longitudinal groove (3) extending between opposing longitudinal ends (2a, 2b) of the body (2);
- a longitudinal clamp piece (4) having, at least on a longitudinal end (4a) thereof, a tapered surface (4a') and
- an end cap (5) having an inner surface (5') inclined with respect to the longitudinal direction.

wherein the clamp piece (4) is received within the groove (3) so as to extend between opposing longitudinal ends (2a, 2b) of the body (2), such that at least a longitudinal slit (6) is formed between the clamp piece (4) and the body (2), said slit (6) being laterally outwardly open

wherein the end cap (5) is attached to a longitudinal end (2a, 2b) of the body (2) in a translationally adjustable manner along a longitudinal direction towards and away from the body (2), respectively,

wherein the end cap (5) at least partially covers the tapered surface (4a) of the clamp piece (4),

wherein the inclined inner surface (5') of the end cap (5) is configured to cooperate with the tapered surface (4a) of the clamp piece (4), such that a translational movement of the end cap (5) towards the body in the longitudinal direction urges the clamp piece (4) laterally towards the body (2), and

wherein the clamp piece (4), the end cap (5) and the groove (3) are configured such that a movement of the clamp piece (4) laterally towards the body (2) results in a decreased width of the longitudinal slit (6), so as to enable securing an abrasive sheet between the clamp piece (4) and the body (2).

2. The rotatable tool (1) according to Claim 1, **characterized in that** a biasing member (7) is provided between the clamp piece (4) and the body (2),

wherein the biasing member (7) urges the clamp piece (4) laterally outwardly from the body (2), such that the tapered surface (4a') of the clamp piece (4) pushes against the inclined inner surface (5') of the end cap (5).

3. The rotatable tool (1) according to Claim 1 or 2, **characterized in that** both longitudinal ends (4a, 4b) of the clamp piece (4) have tapered surfaces (4a', 4b'),

wherein end caps (5) are provided at both longitudinal ends (2a, 2b), of the body (2), such that both end caps (5) are attachable to respective longitudinal ends (2a, 2b) of the body (2) in a translationally adjustable manner along a longitudinal direction towards and away from the body (2), respectively,

wherein both end caps (5) at least partially cover respective tapered surfaces (4a', 4b') of the clamp piece (4),

wherein the inclined inner surfaces (5') of the end caps (5) are configured to cooperate with the respective tapered surfaces (4a', 4b') of the clamp pieces

(4), such that a translational movement of the end caps (5) towards the body (2) in the longitudinal direction urges the clamp piece (4) laterally towards the body (2), and
wherein the clamp piece (4), the end caps (5) and the groove (3) are configured such that a movement of the clamp piece (4) laterally towards the body (2) results in a decreased width of the longitudinal slit (6), so as to enable securing an abrasive sheet between the clamp piece (4) and the body (2).

4. The rotatable tool (1) according to any of the preceding Claims, **characterized in that** the body (2) comprises two or more longitudinal grooves (3) angularly spaced apart from each other, a respective longitudinal clamp piece (4) being provided for each such longitudinal groove (3),
wherein the clamp pieces (4) are received within respective grooves (3) so as to extend between opposing longitudinal ends (2a, 2b) of the body (2), such that at least a longitudinal slit (6) is formed between each of the clamp pieces (4) and the body (2), said slit (6) being laterally outwardly open,
wherein the end cap (5) at least partially covers the tapered surfaces (4a', 4b') of the clamp pieces (4),
wherein the inclined inner surface (5') of the end cap (5) is configured to cooperate with the tapered surfaces (4a', 4b') of the clamp pieces (4), such that a translational movement of the end cap (5) towards the body (2) in the longitudinal direction urges the clamp pieces (4) laterally towards the body (2), and
wherein the clamp pieces (4), the end cap (5) and the grooves (3) are configured such that movement of the clamp pieces (4) laterally towards the body (2) results in a decreased width of the respective longitudinal slit (6), so as to enable securing an abrasive sheet between each of the clamp pieces (4) and the body (2).

5. The rotatable tool (1) according to any of the preceding Claims, **characterized in that** a longitudinal slit (6) is formed on both longitudinal sides of at least one clamp piece (6), such that an abrasive sheet can be clamped between said clamp piece (4) and the body in both of said slits (6).

6. The rotatable tool (1) according to any of the preceding Claims, **characterized in that**, for each slit (6) between the clamp piece (4) and the body (2), the end cap (5) is also equipped with a correspondingly positioned gap (5a), such that a continuous slit is formed.

7. The rotatable tool (1) according to any of the preceding, **characterized by** comprising one or more abrasive sheets at least partially received and secured in respective one or more slits (6) between a corresponding clamp piece (4) and the body (2) of the sheet holder (1).

8. A tool assembly, **characterized by** comprising
the rotatable tool according to Claim 7;
a rotation actuator, and
a transmission element coupled between the rotatable abrasive tool (1) and the rotation actuator for transmitting rotation movement therebetween.

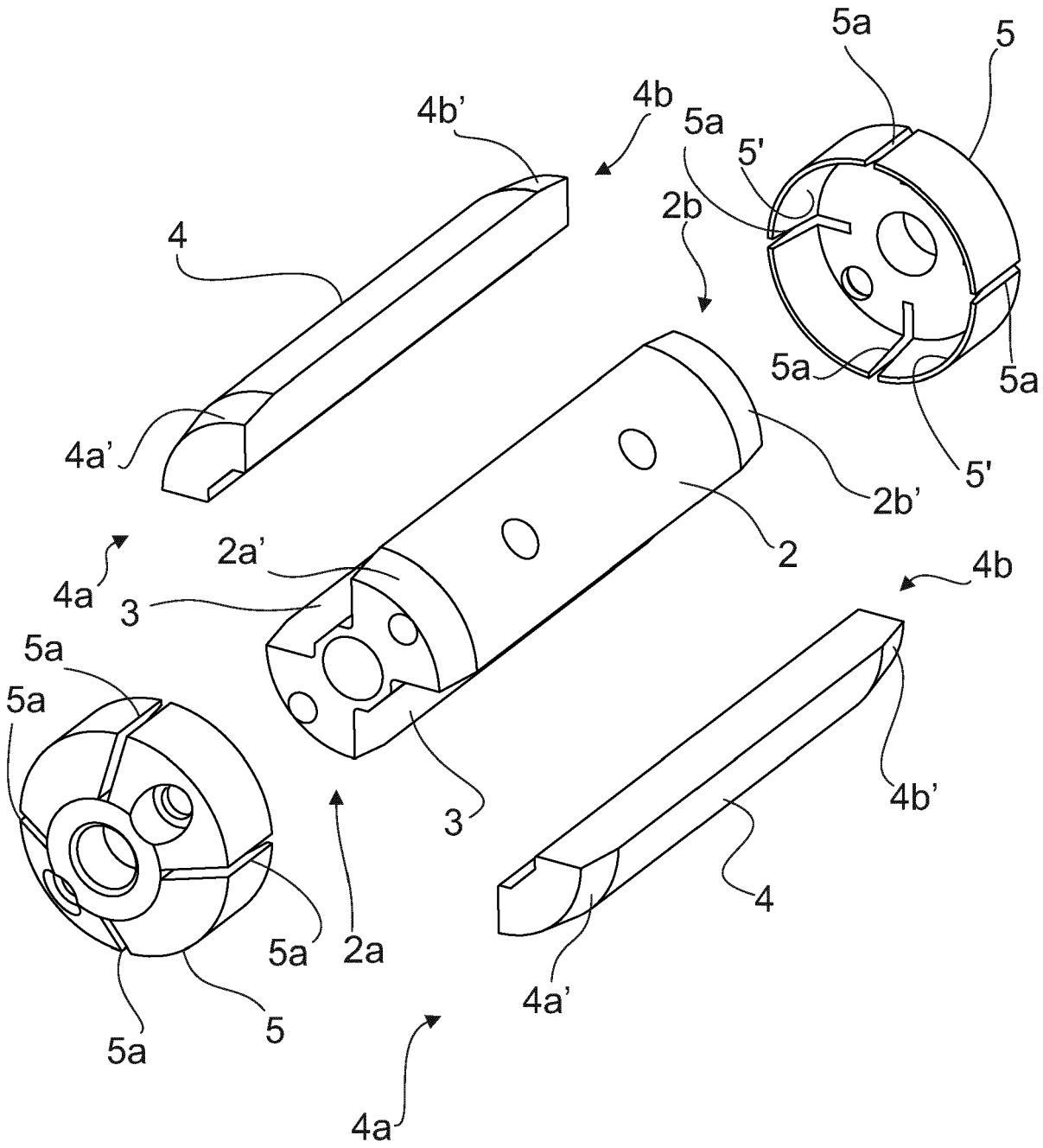

Fig. 1

1

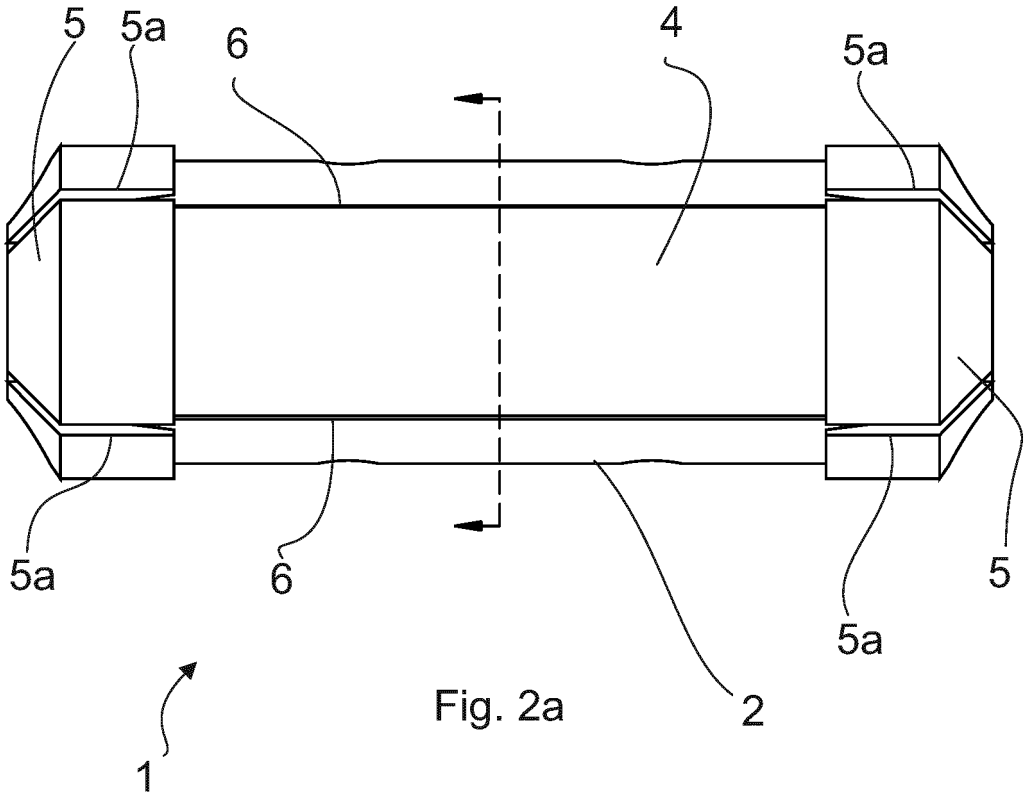

Fig. 2a

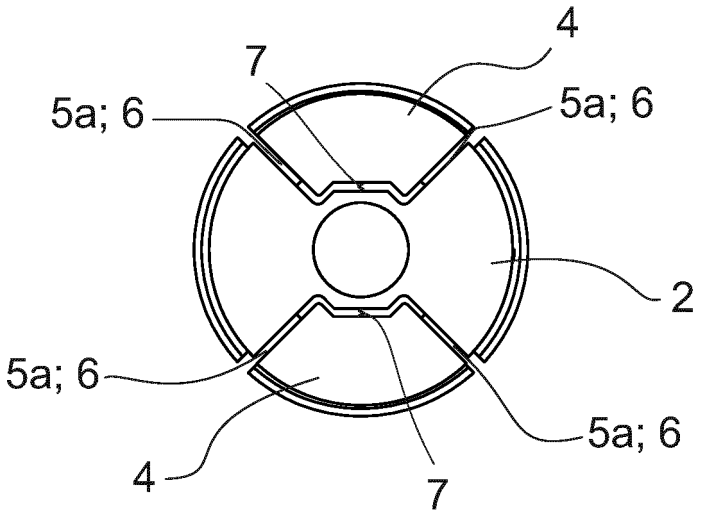

Fig. 2b

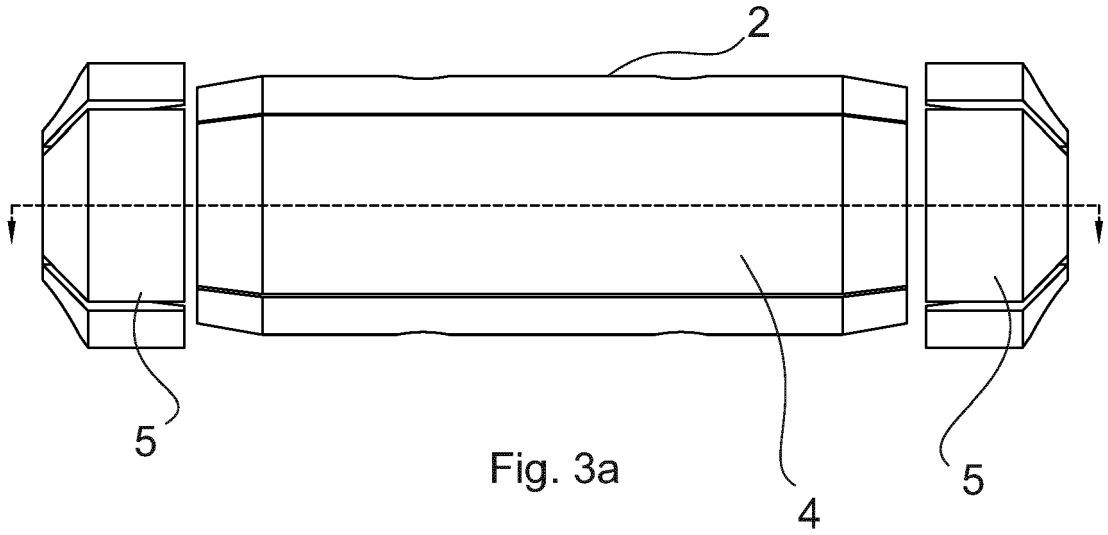

Fig. 3a

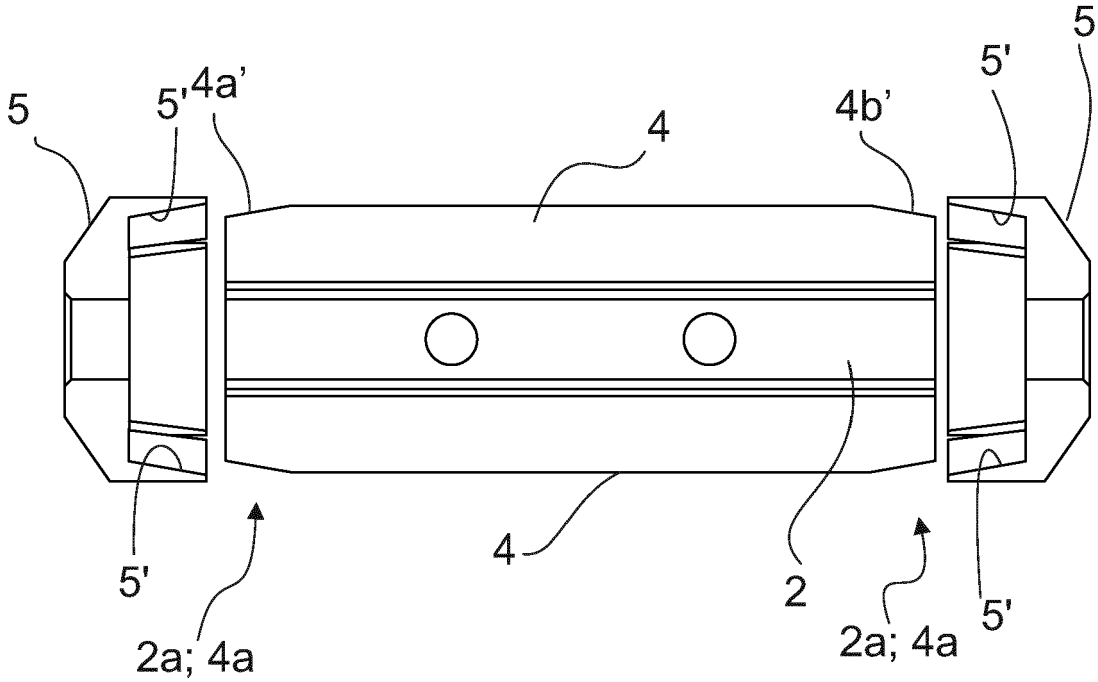

Fig. 3b

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EUROPEAN SEARCH REPORT

Application Number
EP 21 16 8083

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

B08B
B24B
B24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 September 2021	Plontz, Nicolas

CATEGORY OF CITED DOCUMENTS

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