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(54) **ELECTRICAL CONNECTOR**

(57) The invention is a new electrical connector (C), comprising at least one main body (1) suited to be mechanically coupled with a corresponding main body (1') of a corresponding electrical connector (C'), an electrical contact pin (3, 3') housed in said main body (1), a locking element (4) suited to lock the conductor of the cable in the

contact pin (3, 3'), suited to fit around said contact pin (3), and wherein the connection of said locking element (4) to said contact pin (3, 3') results in that said locking element (4) is completely or partially inserted into at least one generically linear opening or slot (3f) or notch of said contact pin (3, 3').

C ↘

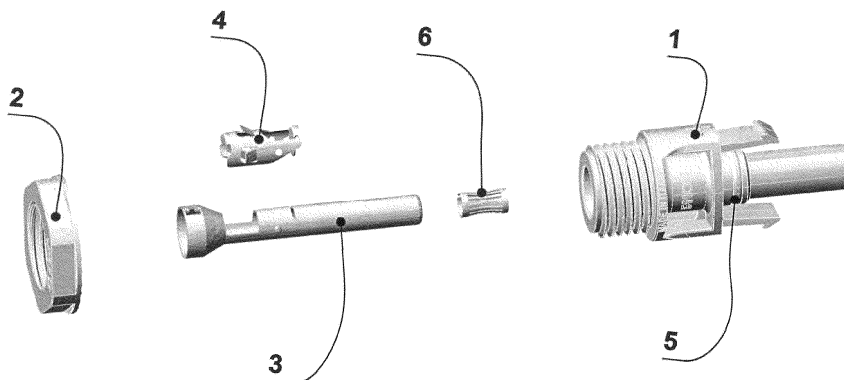


Fig. 1

EP 4 742 458 A1

Description

[0001] The present patent concerns electrical connectors and in particular it concerns single-pole electrical connectors for live systems with terminals protected against accidental contact.

[0002] More specifically, the present patent concerns a new type of electrical connector for potentially live systems with terminals protected against accidental contact, equipped with a tool-free locking mechanism for the conductor of the connection cable and suited to be installed on panels.

[0003] In some electrical applications or uses the connectors, even when not connected, must not have potentially live parts with which a person could accidentally come into contact.

[0004] Typically, said connectors are preferably used in photovoltaic systems, accumulators, etc., in which each photovoltaic panel is connected to other photovoltaic panels, accumulators, etc.

[0005] Both during installation and during the replacement of each individual photovoltaic panel, electrical voltage is present at the ends of its conductors. Even once photovoltaic panels have been installed, during use, several hundred volts and a few dozen amperes, which are very dangerous, are present at the ends of the conductors of each photovoltaic panel.

[0006] The connection of an electrical cable of a photovoltaic panel to the corresponding connector is a demanding operation, which requires a secure and stable connection notwithstanding the operating voltage, the temperatures to which the photovoltaic system may be subjected, the thermal and mechanical expansion to which the mechanical-electrical connection of the cable with the metallic parts of the connector and of each connector of the solar panel with the connector of the system may be subjected.

[0007] The connection of each cable to the corresponding connector, carried out with a screw clamp terminal and/or a crimp terminal, is complex and certainly not straightforward, requires the use of a specific tool, typically a screwdriver or pliers, as well as the separation of at least one part of the connector for fastening the cable, and the reassembly of the various parts of the connector.

[0008] In the case of connectors installed on a panel, each metal terminal must be separated from each insulating body of each connector, each insulating body must be fixed to the panel, each cable must be connected to its metal terminal, and finally each metal terminal connected to the cable must be reinserted into the respective insulating body of the corresponding connector.

[0009] This involves various difficulties, including the need to connect each metal terminal to each potentially live cable, to reinsert each metal terminal connected to the cable into its insulating body without reversing the male and female terminals in the corresponding bodies of the female and male terminals.

[0010] The subject of the present patent is a new connector for potentially live systems whose terminals are protected against accidental contact, having a tool-free locking mechanism for locking the conductor of the connection cable.

[0011] It is one object of the present invention to provide a new connector that can be fastened to the connection cable with no need to separate any part of the connector itself.

[0012] It is another object of the present invention to provide a new connector that can be fastened to the connection cable with no need to use specific tools.

[0013] It is another object of the present invention to provide a new connector that ensures the electrical and mechanical connection of the cable to the metal contact part or parts even after significant temperature fluctuations.

[0014] It is another object of the present invention to provide a new connector that can be connected to a corresponding electrical connector even after significant temperature fluctuations.

[0015] It is another object of the present invention to provide a new connector that ensures the watertightness of the metal parts affected by the electrical connection both for the cable fastening and for its connection to a corresponding electrical connector. It is another object of the present invention to provide a new connector that can be fixed to a panel.

[0016] These and other direct and complementary objects are achieved by the new connector for potentially live systems whose terminals are protected against accidental contact, having a tool-free locking mechanism for locking the conductor of the connection cable and suited to be installed on panels.

[0017] For clarity of explanation, the new connector is described below making reference to the drawings, which are attached hereto by way of non-limiting examples.

[0018] Figure 1 shows the separate parts of the new connector (C), whose main parts comprise:

- a main body (1, 1') suitable for mechanical coupling,
- a fixing nut (2),
- an electrical contact pin or bushing (3, 3'),
- a locking element (4) suited to lock the conductor of the electrical cable (O) to the contact pin or bushing (3, 3'), hereinafter referred to as the locking element (4).

[0019] The main body (1) is generically cylindrical in shape and hollow.

[0020] The main body (1, 1') houses said electrical contact pin (3, 3').

[0021] Said main body (1, 1') has a first end (1a, 1a') suited to be connected to an equivalent main body (1', 1) of another new connector (C', C), so that said first end (1a', 1a) of a new connector (C', C) is housed in the corresponding first end (1a, 1a') of the other new con-

nector (C, C').

[0022] Figure 2 shows two main bodies (1, 1') of two new connectors (C, C') before they are connected to each other. The configuration of said main bodies (1, 1') is commonly known as male and female.

[0023] Each main body (1, 1') is also provided with coupling and fastening elements (1c, 1c') suited to cooperate with complementary coupling and fastening elements (1c', 1c) of another new connector (1', 1).

[0024] On said first end (1a) of the main body (1') there is a sealing element (5), in this example consisting of an annular gasket (5) suited to prevent water or moisture or dust from getting into two connectors (C, C') joined together.

[0025] At the second end (1b) opposite said first end (1a) of each main body (1) there is a substantially cylindrical portion whose outer part is provided with a threaded protrusion suitable for coupling with said nut (2).

[0026] Said nut (2) and said second end (1b) of each main body (1) are designed to fix the new connector (C, C') to a panel (P), as shown in Figures 3a and 3b.

[0027] Said electrical contact pin (3) is housed inside said main body (1), and in particular inside at least said first end (1a) of said main body (1).

[0028] Said electrical contact pin (3), shown in Figure 4, is made of metal and is cylindrical in shape.

[0029] Said cylindrical shape of said electrical contact pin (3) has a first end area (3a) facing towards said first end (1a) of said main body (1) and suitable for electrical contact with a corresponding electrical contact pin (3') of a corresponding new connector (C').

[0030] The second end area (3b) of said contact pin (3), opposite said first end area (3a), comprises the following, proceeding from the free end towards the centre of the pin (3) itself:

- a conical portion (3c) with circular cross section, designed to facilitate and guide the insertion of the end of the conductor of the electrical cable (O),
- a portion with U-shaped cross section (3d), open on one side of said contact pin (3) and generically extending over half the circumference of said contact pin (3),
- a tubular portion with circular cross section (3e),
- a generically linear opening or slot (3f) or notch, orthogonal to the main axis of said contact pin (3), indicatively extending over at least half the circumference of the contact pin (3) and arranged on the same side as the opening of said U-shaped cross section (3d).

[0031] Said locking element (4) suited to lock the conductor of the electrical cable (O) to the contact pin (3) is applied to said second end area (3b).

[0032] Said second end area (3b) is suited to receive and accommodate the end of the conductor of the electrical cable (O) and to accommodate said locking element

(4).

[0033] Figures 4, 5a and 5b show said locking element (4).

[0034] The locking element (4) is generically tubular with C-shaped cross section, suited to fit around said contact pin (5).

[0035] At one end (4a) of said locking element (4) there is a first portion (4c), while at the opposite end (4b) of said locking element (4) there is a second portion (4d).

[0036] Said first portion (4c) of said locking element (4) is orthogonal to the main axis of the locking element itself and generically extends from the median part of said C-shaped cross section towards the open part of said C-shaped cross section, so as to form a partition in the C-shaped cross section of the locking element (4) itself. Said second portion (4d) is generically inclined from the median part of said C-shaped cross section towards the inside and towards the centre of the locking element (4) itself.

[0037] Both said first portion (4c) and said second portion (4d) are connected to the tubular shape of the locking element (4) in the position opposite the opening of the C-shaped cross section of the locking element (4) itself and are generically directed towards the opening of said C-shaped cross section.

[0038] Said locking element (4), made up as described above, is applied to said contact pin (3).

[0039] In said position, shown in Figure 6a and in a cross-sectional view in Figure 6b, the situation is the following:

- said first portion (4c) of the locking element (4) is inserted into the generically linear opening or slot (3f) or notch of said contact pin (3) and occupies the inner section of the second end area (3b) of the contact pin (3),
- said second portion (4d) of the locking element (4) is accommodated in the opening of the U-shaped portion (3d) of said contact pin (3) and facing towards the first end area (3a) of the contact pin (3) itself.

[0040] Both said contact pin (3) and said locking element (4) are provided with elements, projections (3r), openings (4r) or other parts due to which said locking element (4) does not travel along said contact pin (3).

[0041] Furthermore, said locking element (4) is provided with tabs (4t), appendages, projections or similar parts on its outer surface, inclined and diverging with respect to its outer surface and facing towards said second portion (4d) of the locking element (4) itself.

[0042] Said contact pin (3), together with said locking element (4), is housed in the main body (1) of the new connector (C), in such a way that:

- the first end area (3a) of said contact pin (3) is housed in said first end (1a) of said main body (1), and the second end area (3b) of said contact pin (3) is housed in said second end (1b) of said main body (1),

- said locking element (4) is constrained to said contact pin (3) due both to its shape enveloping the contact pin (3) itself and to the projections (3r) and openings (4r) present on said contact pin (3) and on said locking element (4),
- the sliding movement of the contact pin (3) and the locking element (4) towards the first end (1a) of said main body (1) is prevented by the internal shape of the main body itself,
- the sliding movement of the contact pin (3) and the locking element (4) towards the second end (1b) of said main body (1) is prevented by said tabs (4t), appendages, projections or similar parts present on the outer surface of said locking element (4).

[0043] The connection of an electrical cable (O) to the new connector (C) requires a few simple steps.

[0044] The fixing nut (2) is separated from the body (1) of the new connector (C), the second end (1b) of the main body (1) is inserted in the hole made in the panel (P), in which the new connector (C) must be installed, and the fixing nut (2) is screwed and tightened on the second end (1b) of the main body (1), securing said main body (1) to the panel (P), as shown in Figure 3b.

[0045] The electrical cable (O) is stripped of its outer insulating sheath, uncovering the inner electrical conductor, to an extent generally equal at least to the length of the locking element (4).

[0046] The end of the electrical cable (O) prepared as described is inserted through the fixing nut (2) and the second end (1b) of the main body (1) of the connector (C) into the inside of said main body (1).

[0047] During insertion, the electrical conductor is guided by the conical portion (3c) of the contact pin (3) towards the second portion (4d) of the locking element (4).

[0048] A sufficient thrusting action exerted on the electrical cable (O) causes said second portion (4d) of the locking element (4) to bend, allowing said electrical cable (O) to move inside the contact pin (3) and the locking element (4) until it reaches the first portion (4c) of the locking element (4).

[0049] A further thrusting action exerted on the electrical cable (O) that is introduced into the new connector (C) does not lead to a further insertion of the electrical cable (O) itself and does not lead to any movement of the locking element (4) or the contact pin (5) with respect to each other or within the main body (1).

[0050] In this position, the electrical cable (O) is electrically connected to the locking element (4) and the contact pin (3).

[0051] Furthermore, in this position, the new connector (C) is completely positioned and connected and is ready for use.

[0052] The extraction of the electrical cable (O) from the new connector (C) is prevented by the second portion (4d) of the locking element (4), which rests on the conductor of the electrical cable (O).

[0053] The extraction of the contact pin (3) and the locking element (4) from the main body (1) of the new connector (C) is not possible, since it is prevented by said tabs (4t), appendages, projections or similar parts present on the outer surface of the locking element (4) and prevented by said projections (3r) and openings (4r) present and co-operating between said contact pin (3) and said locking element (4).

[0054] In the new connector (C) shown in Figure 1 the contact pin (3) is of the female, tubular type and is suited to receive a male contact pin (3'). The outer diameter of the male contact pin (3'), shown in cross section in Figure 7, is smaller than or nearly equal to the inner diameter of the female contact pin (3). To compensate for any expansion and/or production tolerances, and to ensure contact between the two contact pins (3, 3'), inside the female contact pin (3) there is an elastic tubular element (6), visible in Figures 1, 6b, 7.

[0055] The new connector (C) made up as described above offers considerable advantages.

[0056] The new connector (C) can be fastened to the electrical cable (O) with no need to separate any part of the connector (C) itself.

[0057] The new connector (C) can be fastened to the electrical cable (O) with no need to use specific tools.

[0058] The new connector (C) ensures the electrical and mechanical connection of the cable (O) to the metal contact part or parts (3, 3', 4) even after significant temperature fluctuations.

[0059] The new connector (C) ensures the electrical and mechanical connection of the cable to a corresponding electrical connector (C') even after significant temperature fluctuations.

[0060] The new connector (C) ensures the watertightness of the metal parts (3, 3', 4) affected by the electrical connection both for its fastening to the electrical cable (O) and for its connection to a corresponding electrical connector (C').

[0061] The new connector (C) prevents each contact pin (3, 3', 4) from being incorrectly inserted in the non-matching main body (1).

[0062] These are the schematic outlines that are sufficient for the expert in the art to carry out the invention, consequently, on practical application variants may be obtained that do not affect the substance of the innovative concept introduced herewith. Therefore, with reference to the above description and the attached drawings, the following claims are made.

Claims

1. Electrical connector (C), **characterized in that** it comprises at least one main body (1) for mechanical coupling with a corresponding main body (1') of a corresponding electrical connector (C'), a fixing nut (2), an electrical contact pin (3, 3') housed in said main body (1), a locking element (4) for locking the

conductor of the cable (O) onto the contact pin (5), designed to be applied around said contact pin (5), *and wherein* the connection of said locking element (4) to said contact pin (3, 3') results in the complete or partial insertion of said locking element (4) into at least one generically linear opening or slot (3f) or notch of said contact pin (3, 3'), *and wherein* said main body (1) has, at its end (1b) opposite its end (1a) suitable for mechanical coupling with a corresponding electrical connector (C'), a substantially cylindrical portion (1b) whose outer part is provided with a threaded projection suitable for coupling with said nut (2).

2. Electrical connector (C) according to claim 1, **characterized in that** said locking element (4) is elastic.
3. Electrical connector (C) according to claim 1 or 2, **characterized in that** said contact pin (3), proceeding from the end (3b) where the cable (O) is inserted towards the centre of the pin (3) itself, has:

- a conical portion (3c) with circular cross section, designed to facilitate and guide the insertion of the end of the conductor of the cable (O),
- a portion with U-shaped cross section (3d), open on one side of said contact pin (3, 3') and generically extending over half the circumference of said contact pin (3, 3'),
- a tubular portion with circular cross section (3e),
- a generically linear opening or slot (3f) or notch, orthogonal to the main axis of said contact pin (3, 3'), indicatively extending over at least half the circumference of the contact pin (3, 3') and arranged on the same side as the opening of said U-shaped cross-section (3d);

and wherein said locking element (4)

- is generically tubular with C-shaped cross-section, suited to fit around said contact pin (3, 3');
- has, at one end (4a), a first portion (4c), orthogonal to the main axis of the locking element (4) itself, generically extending from the median part of said C-shaped cross-section towards the open part of said C-shaped cross-section;
- has, at the opposite end (4b), a second portion (4d), generically inclined from the median part of said C-shaped cross-section towards the inside and towards the centre of the locking element (4) itself;
- *and wherein* the connection of said locking element (4) to said contact pin (3, 3') results **in that** said first portion (4c) of the locking element (4) is inserted in the generically linear opening or slot (3f) or notch of said contact pin

(3, 3') and occupies the inner section of the contact pin (3, 3'), and **in that** said second portion (4d) of the locking element (4) is housed in the opening of the U-shaped portion (3d) of said contact pin (3, 3') and faces towards the first end area (3a) of the contact pin (3, 3') itself.

4. Electrical connector (C) according to the preceding claims, **characterized in that** both said contact pin (3) and said locking element (4) are provided with elements, projections (3r), openings (4r) or other parts suited to prevent any translation or displacement between said locking element (4) and said contact pin (3, 3').
5. Electrical connector (C) according to claim 1, **characterized in that** said locking element (4) is provided with tabs (4t), appendages, projections or similar parts on its outer surface, inclined and diverging with respect to its outer surface and facing towards said second portion (4d) of the locking element (4) itself.
6. Electrical connector (C) according to claim 1, **characterized in that** said nut (2) and said second end (1b) of said main body (1) are suited to make it possible to attach the new connector (C, C') to a panel (P).

C ↗

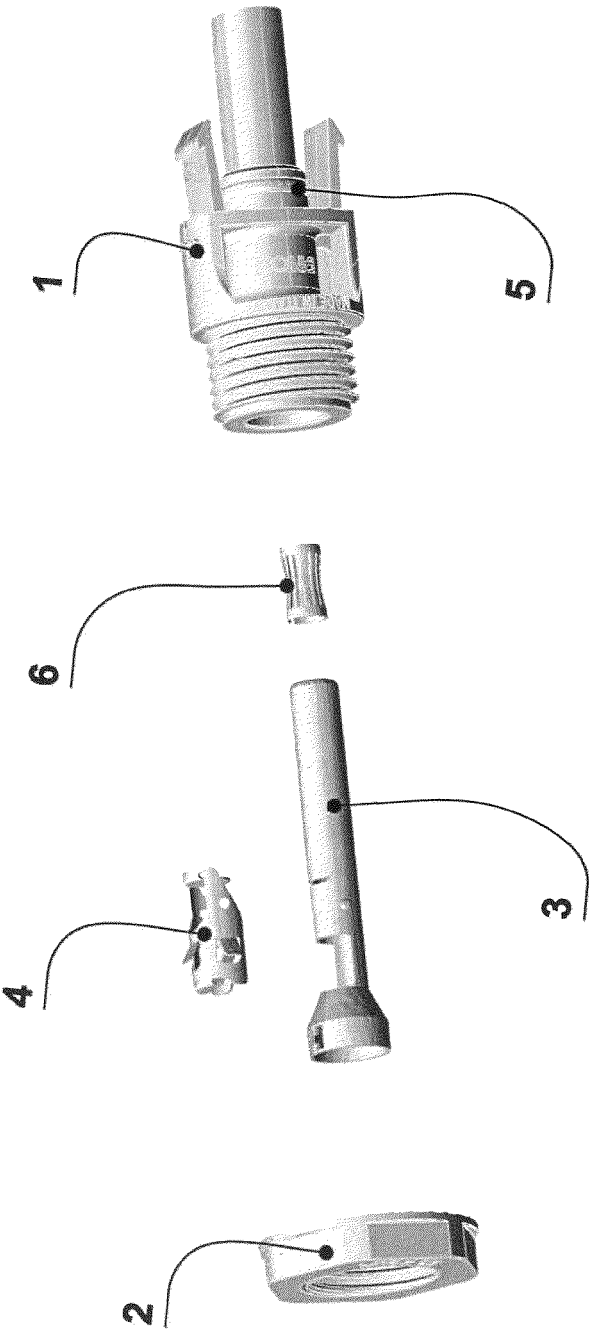


Fig. 1

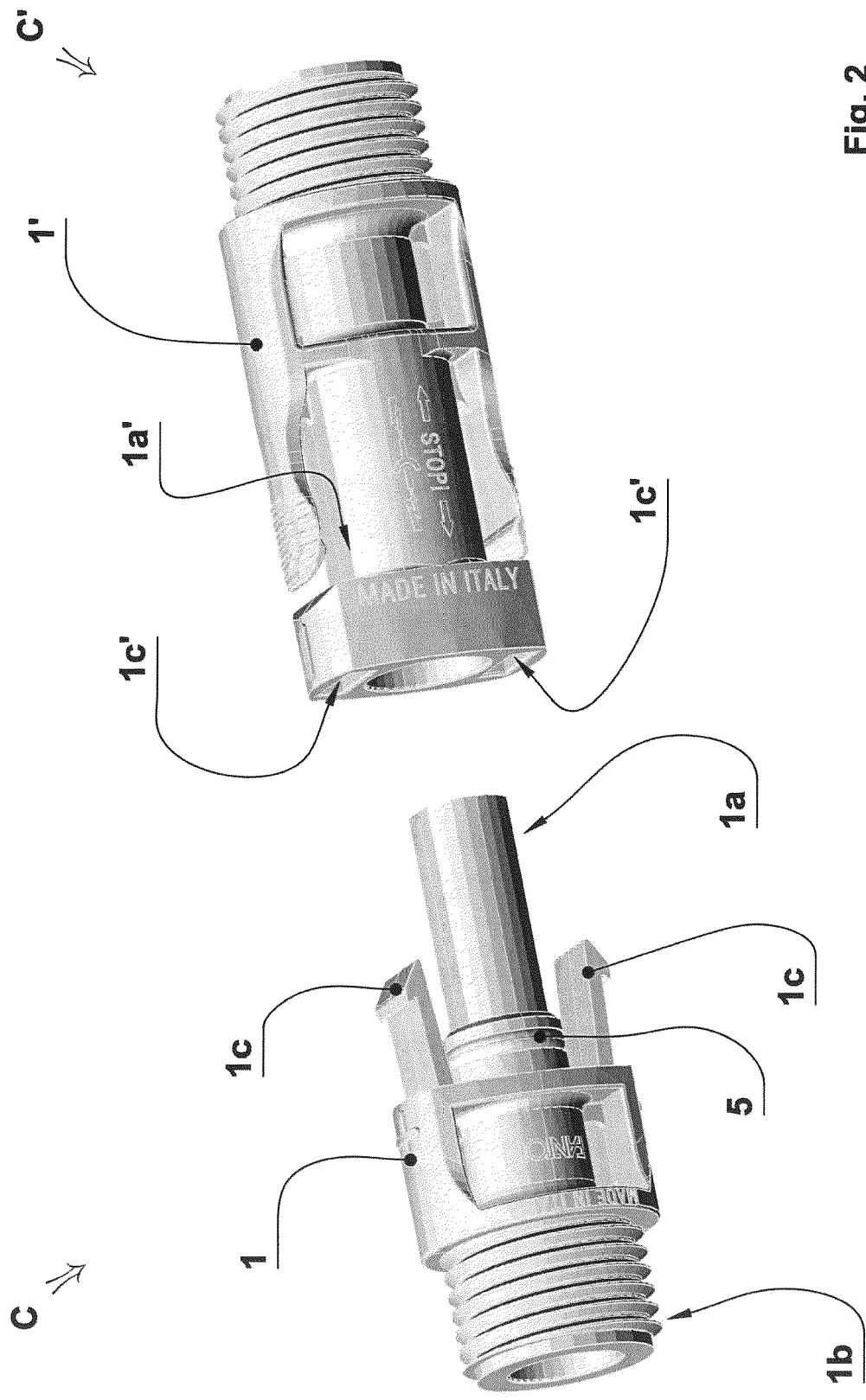


Fig. 2

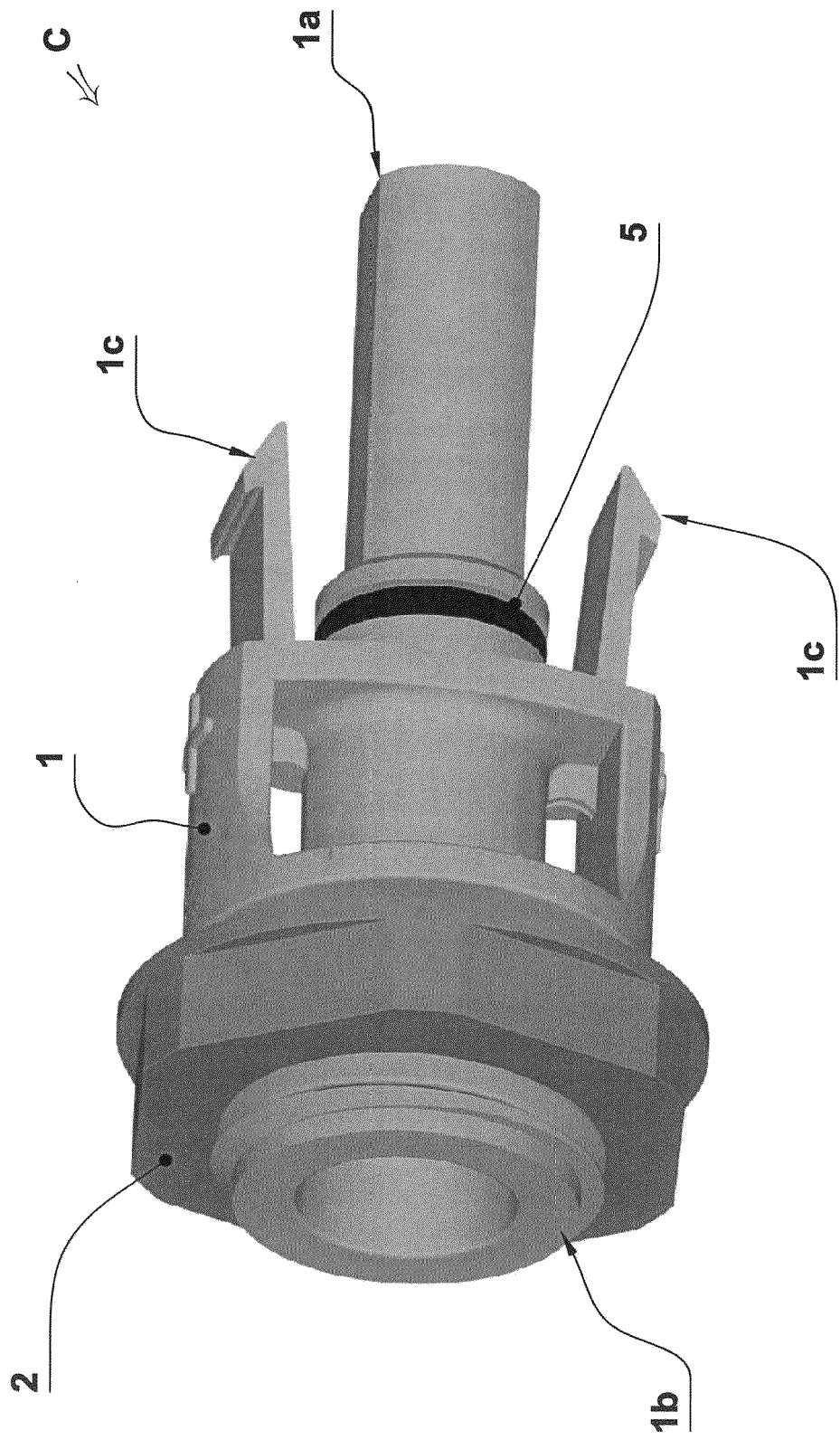


Fig. 3a

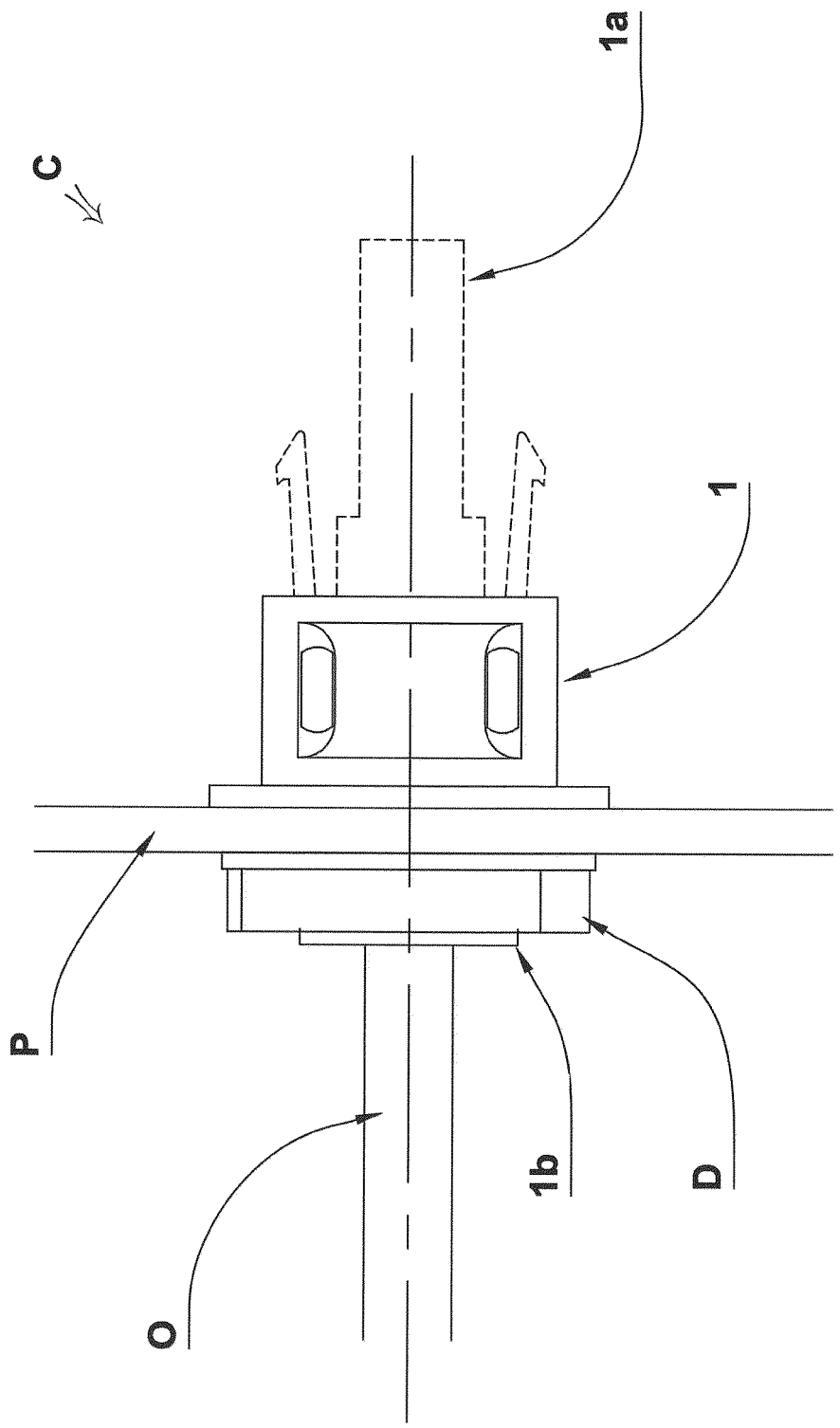


Fig. 3b

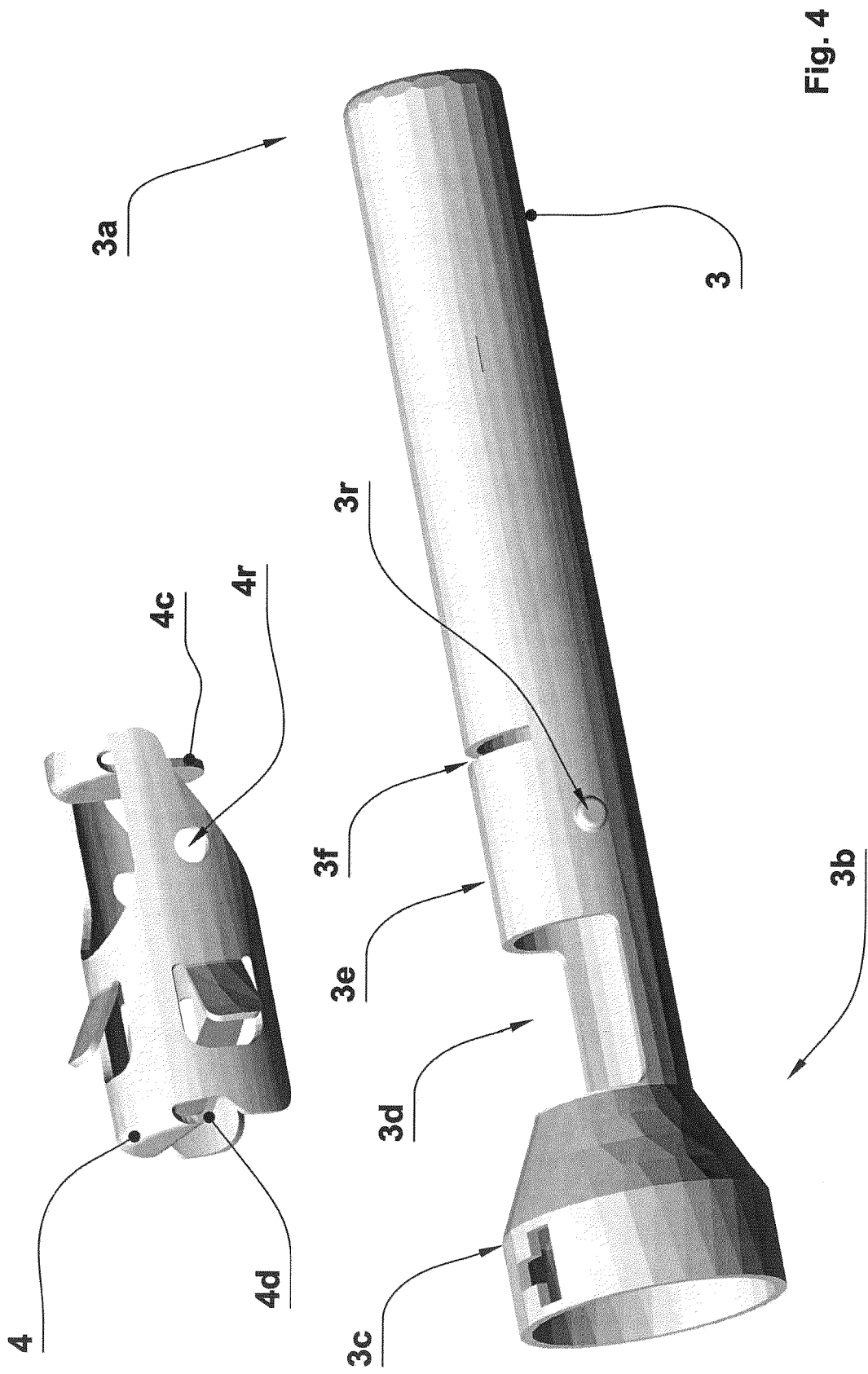


Fig. 4

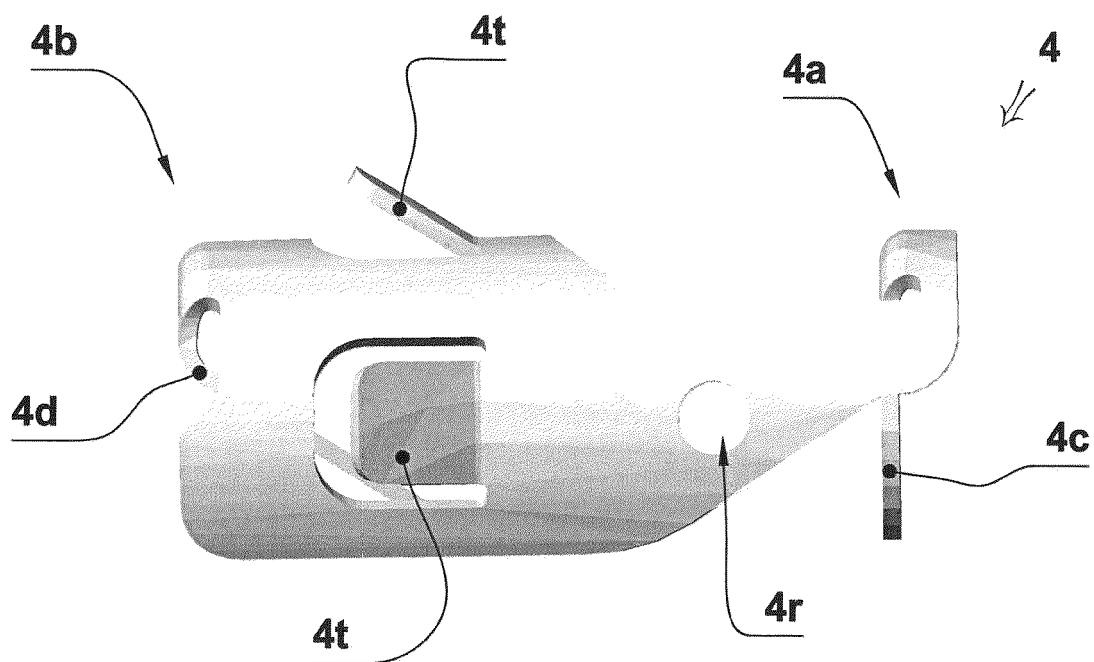


Fig. 5a

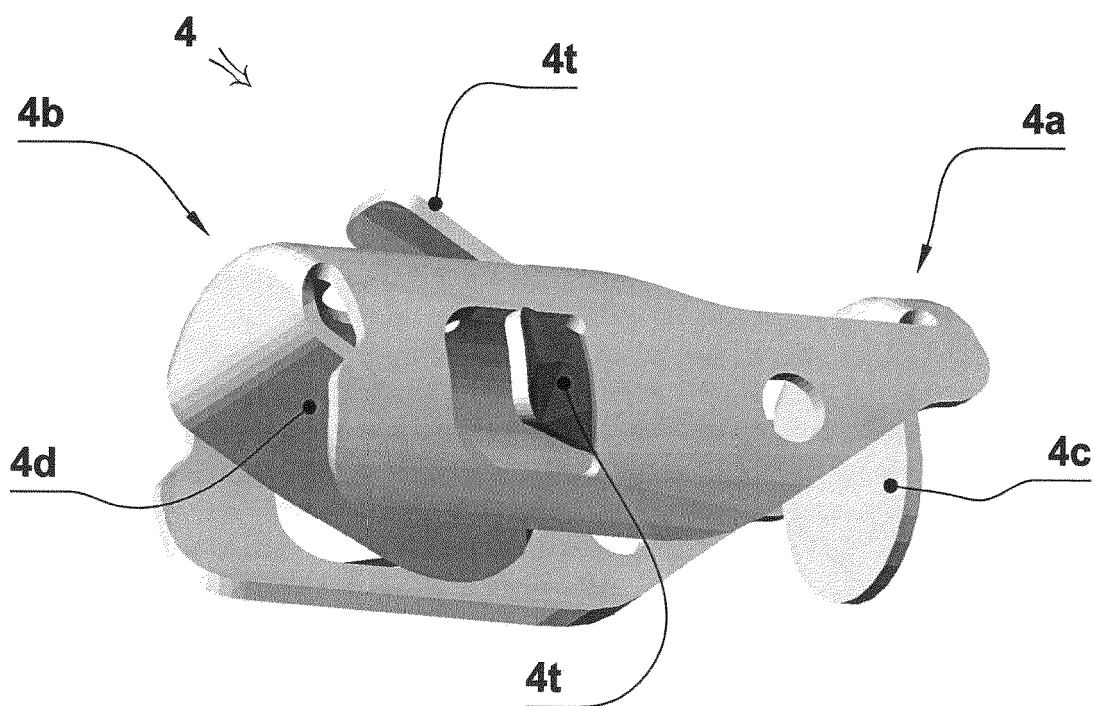


Fig. 5b

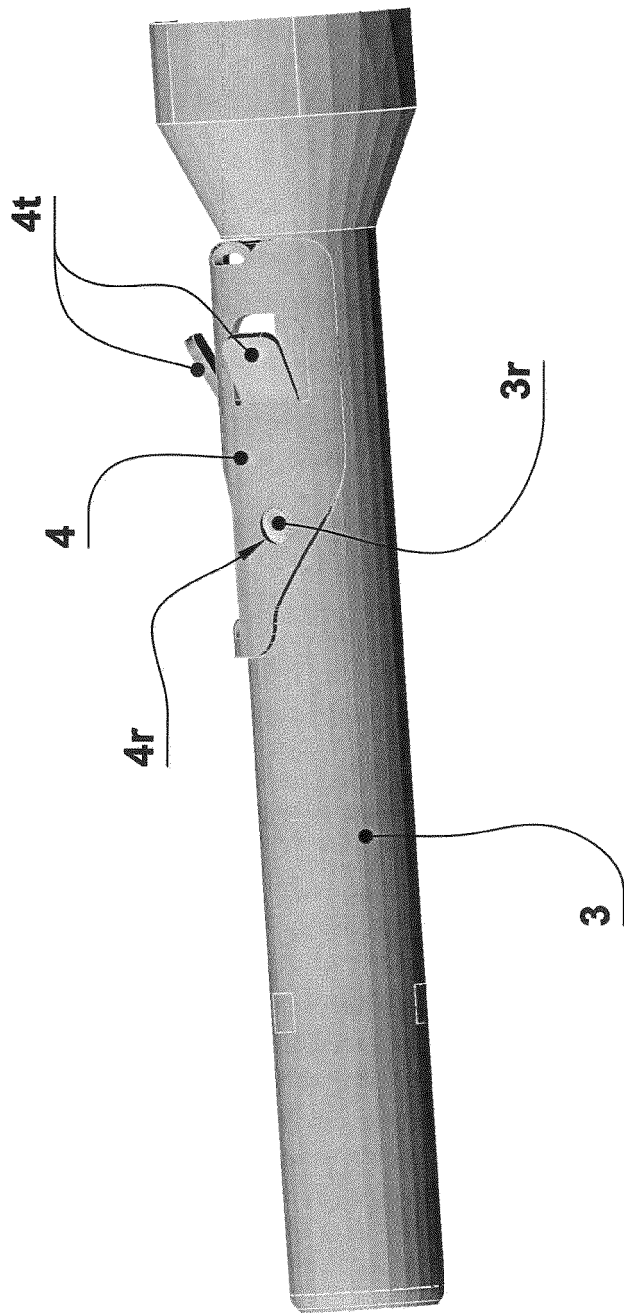


Fig. 6a

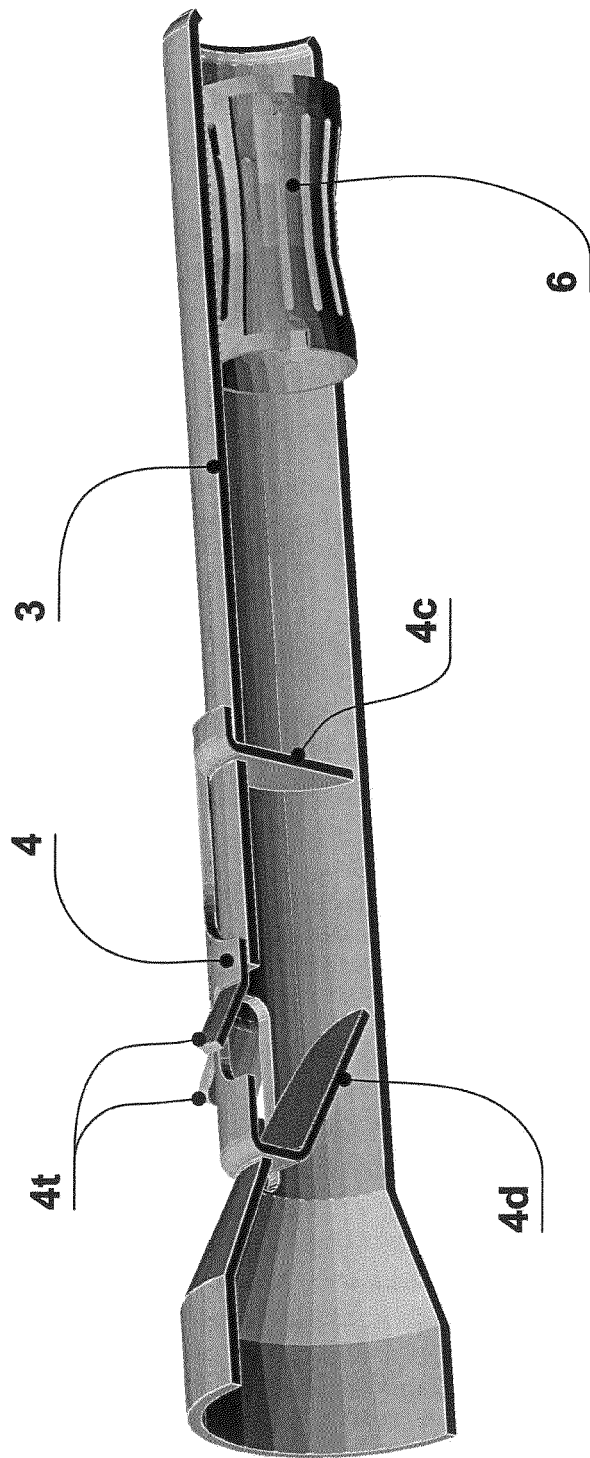


Fig. 6b

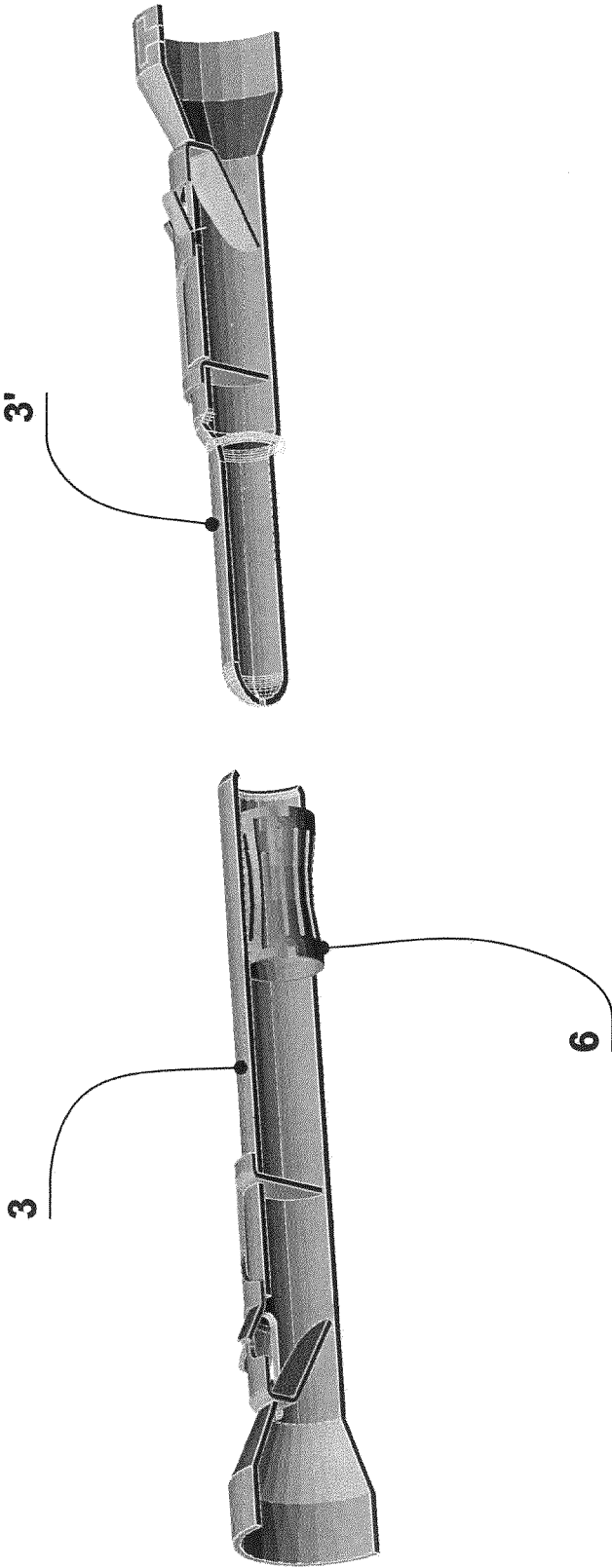


Fig. 7



EUROPEAN SEARCH REPORT

Application Number

EP 25 21 3870

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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		Date of completion of the search	Examiner
The Hague		4 March 2026	Mateo Segura, C
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			
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 25 21 3870

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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