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(54) PROTECTION COVER, METHOD OF INSTALLING THEREOF AND METHOD OF PERFORMING MAINTENANCE THEREWITH

(57) A protection cover for covering a transformer terminal of a transformer substation comprising a base configured to be fixed to the transformer terminal, a cap and a fastening mechanism, a method of installing thereof and a method of performing maintenance therewith. The base defines a receptacle to receive the transformer terminal. The cap is configured to cover the receptacle and enclose the transformer terminal. The fastening mechanism is configured to fasten the cap to the base.

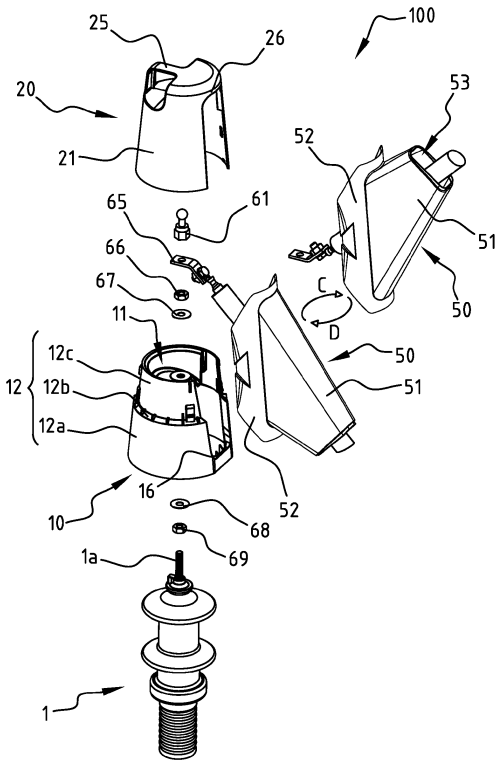

FIG. 2

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Description

[0001] The present application relates to protection covers for electrical conductors, in particular protection covers for transformer terminals of transformer substations, for instance protection covers for transformer bushings in medium-voltage transformer substations. The application also relates to a method of installing said covers and a method of performing maintenance with said covers.

[0002] The energy transition means that the way electricity flows through our society is changing. Even more than before, high- and medium voltage grids are needed to help connecting energy sources and customers. Medium-voltage transformer substations in these energy grids often provide the final voltage transformation by stepping down the voltage used in the distribution lines to the level used by the customer. By medium voltage is typically understood that the input voltage of the transformer is on the order of 5kV to 35kV, typically 10kV, 13kV, 20kV or 23kV. These high voltages are dangerous and can upon touch lead to severe accidents for living beings. Such transformers need yet to be serviced and maintained during their lifetime. To protect operators performing the servicing/maintenance, bare conductor parts need thus to be protected from accidental touch. Typically, such bare conductors like bushings of transformers in substations are covered by protection covers held in place by gravity. Such typical, prior art, held-by-gravity covers are removed by hitting them with a stick, leading to an uncontrolled ejection of the cover and a possible damage/loss of the cover.

[0003] EP2568479A1 discloses a prior art protective hood for protecting an electrical coupling between two conductors which substantially enclose a sharp angle and extend at this angle to the coupling and wherein at least one of the conductors extends at the enclosed angle beyond the coupling, comprising a mounting plate accommodating at least the conductor protruding beyond the coupling; and a skirt-like configuration covering at least the coupling and a part of the length of the conductors up to the coupling, wherein the mounting plate and the skirt-like configuration form an integrated unit which accommodates the conductor protruding beyond the coupling at a location on conductor along the length thereof opposite the enclosed angle relative to the coupling.

[0004] An object of the invention, next to other objects, is to provide an improved protection cover alleviating the problems of the prior art.

[0005] This object, next to other objects is met by the protection cover according to claim 1. Specifically, this is met by a protection cover for covering a transformer terminal of a transformer substation comprising a base configured to be fixed to the transformer terminal, a cap and a fastening mechanism. The base defines a receptacle to receive the transformer terminal. The cap is configured to cover the receptacle and enclose the transformer terminal. The fastening mechanism is configured to fasten the cap to the base. In this way, the transformer terminal may be protected against accidental removal since the cap can be fastened to the base in a secure manner.

[0006] According to a preferred embodiment, the cap is moveable with respect to the base from an exposed position to a covered position:

- wherein, in the exposed position, the receptacle and the transformer terminal are exposed to the outside of the cap and
- wherein, in the covered position, the fastening mechanism fastens the cap to the base and the transformer terminal is at least partially enclosed inside the receptacle and the cap.

In this way, the removal of the cover may be performed in a controlled manner since the effort to unfasten the cap may be predetermined by the fastening mechanism.

[0007] According to a preferred embodiment, the fastening mechanism comprises at least one snap-fit element. In this way, the connection between the base and the cap can be controlled by exerting a predetermined amount of force respective to the fastening force. A snap-fit element may be particularly efficient way of controlling the fastening/unfastening action of the cap from the base. In this way, a simple snap-fit mechanism may be realized to fasten the base and the cap to each other. Preferably, the fastening mechanism comprises at least one hook, preferably protruding internally in the cap and at least one matching recess, preferably provided in the base. Alternatively the fastening mechanism may comprise at least one hook protruding externally in the base and at least one matching recess provided in the cap.

[0008] According to a preferred embodiment, the cap comprises a handle for moving the cap, in particular for moving the cap to the exposed position. In this way a technician may easily remove the cap in toolless manner by grabbing the handle or using a tool as a lever inside the handle for further security.

[0009] According to a preferred embodiment, the base comprises an outer skirt around at least part of the transformer terminal. Preferably, the outer skirt is tubular sleeve, more preferably having a conical shape. In this way, the lower part of the electrical conductor may be protected from any accidental touch, as the skirt covers said lower part of the transformer terminal. In addition the conical shape may improve the stackability of base elements for transport.

[0010] According to a preferred embodiment, the outer skirt of the base comprises a shoulder for receiving the cap. In this way, the cap can be easily fastened to the base at the shoulder. The shoulder helps the user to put the cap back into position.

[0011] According to a preferred embodiment, the cover further comprises a guide for guiding the movement of the cap with respect to the base, preferably when moving

between the exposed and covered positions. In this way, security during the removal is improved and the repositioning after maintenance is facilitated.

[0012] According to a preferred embodiment, the guide comprises one or more ribs disposed on the base and/or on the cap. In this way, the cap is guided along the axis of the ribs during its movement. Preferably the ribs extend radially with respect to a longitudinal axis of the base, wherein when the base is mounted on the transformer terminal the longitudinal axis of the base corresponds with the longitudinal axis of the transformer terminal, to maintain a safe distance between the operator and the transformer terminal.

[0013] According to a preferred embodiment, the base comprises an inner waist surface for attaching the base to the transformer terminal, the inner waist surface defining the receptacle to receive the transformer terminal. In this way, the base may be attached to the transformer terminal to form a fixed part of the cover for the operator and a receptacle, i.e. a bottom part of a cavity for enclosing the transformer terminal. Preferably, the inner waist surface comprises an opening debouching in the receptacle. In this way, the protection cover may be easily mounted onto the transformer terminal by placing the opening over the terminal such that it extends into the receptacle. The cover may thus be vertically stacked on top of the terminal.

[0014] According to a preferred embodiment, the protection cover comprising a cable feed configured to guide a cable to the transformer terminal. In this way the protection cover may remain in place all the time since it accommodates the connection of the transformer terminal with an outside cable. The cable feed is either a separate element or monolithic with the base. It is here noted that this aspect of the cable feed being a separate element from the base may be applied independently from the aspect of fastening the cap and the base. Indeed, the provision of a separate cable feed element may increase the range of applications and reduce the costs over that range since the base and cap may remain the same and only the cable feed may be adapted to the application. According to this aspect, a protection cover for covering a transformer terminal of a transformer substation may be provided comprising a base configured to be fixed to the transformer terminal, wherein the base defines a receptacle to receive the transformer terminal, a cap configured to cover the receptacle and enclose the transformer terminal, and a cable feed configured to guide a cable to the transformer terminal, wherein the cable feed is a separate element.

[0015] According to a preferred embodiment, the cable feed comprises a tubular portion for receiving the cable and a connecting portion configured to be connected to the base and/or the cap. In this way, the cable feed may be a separate element leading to increased versatility of use. Different cable feeds may be envisaged for different types of connection between the transformer terminal and the cable, while the base and cap may remain identical. In particular, a plurality of cable feeds for connecting a cable with an associated plurality of angles with respect to the transformer terminal may be envisaged. Preferably, the connecting portion comprises a flange coupled to the tubular portion, wherein the flange is arranged to couple the cable feed to the cap and/or base. In addition the tubular shape may improve the stackability of cable feed elements for transport.

[0016] According to a preferred embodiment, the connecting portion is connectable in at least two positions with respect to the base. The connecting portion may thereto be symmetrical such that it is connectable according to two positions with respect to the base. In this way, the same cable feed may be used to achieve two sorts of connections between the transformer terminal and a cable depending on the connection position.

[0017] According to a preferred embodiment, the tubular portion is arranged with respect to the connecting portion such that an angle between the axis of the tubular portion with respect to the longitudinal axis of the base, i.e. when with respect to the longitudinal axis of the transformer terminal is selectable between two values. In this way, the same cable feed may be used to provide two directions of the cable to the transformer terminal.

[0018] According to a preferred embodiment, when the cable feed is connected to the base, the axis of the tubular portion is oriented with respect to the longitudinal axis of the transformer terminal preferably at an angle of between 30 to 150 degrees, preferably at an angle of 45 degrees or at an angle of 135 degrees. In this way, the orientation of the cable may be selected to meet the mounting circumstances, whether for example the cable is coming from above or below the transformer terminal. According to a preferred embodiment, the tubular portion may have a section, preferably an oval section, configured to accommodate allowing for an additional range of orientation of the cable within a range of +/- 10 degrees. In this way the cable feed may provide further flexibility in the orientation of the cable.

[0019] Generally, the longitudinal axis of the transformer terminal as mentioned herein is substantially colinear with the longitudinal axis or centerline of the base, which is preferably cylindrical or conical, at the skirt thereof, as mentioned above. The longitudinal axis of the tubular portion then preferably extends under an angle with respect to the longitudinal axis or centerline of the base when coupled to the base, as mentioned above.

[0020] According to a preferred embodiment, the base is configured to receive the cable feed, preferably the cable feed is configured to be inserted inside the base. In this way, the cable feed may be easily connected to the base. Preferably, the base comprises an open side edge to allow for the insertion of the cable feed into the base. The flange of the cable feed may for instance be received in a correspondingly shaped open side edge in the base. Additionally or alternatively, the base comprises an open top edge to allow for the insertion of the cable feed into the base.

[0021] According to a preferred embodiment, the cap comprises an open side edge to match the shape of the cable feed. In this way, when the cap is covering the base and the cable feed, a closed cavity can be obtained formed by the receptacle, the cap and the cable feed. Preferably, the open side edge is shaped to closely fit to the tubular portion of the cable feed, while the coupled flange is received within the base and/or the cap for connection thereto.

[0022] Preferably, in connected position, the cable feed is clamped or otherwise held between the cap and the base. The fastening mechanism for coupling the cap and the base then also fastens the cable feed.

[0023] Preferably, the cap is configured to overlap with at least part of the connecting portion of the cable feed. Similarly the base is configured to overlap at least part of the connecting portion of the cable feed. In this way, the cap and base may totally overlap the connecting portion of the cable feed, so that no seem portion may be left open in order to obtain a substantially close cavity. In this way, a given creepage between the transformer terminal and an operator may be ensured, to guaranty the operator's safety.

[0024] According to a preferred embodiment, a cable feed cover is further provided, preferably made of rubber, to seal a space between the cable and the cable feed. In this way, dust may be prevented from entering the cavity via a space between the cable and the cable feed.

[0025] According to a preferred embodiment, the transformer terminal comprises a threaded terminal. Preferably, the transformer terminal is a bushing. In this way, an easy connection both for electrical and mechanical purposes is available.

[0026] According to a preferred embodiment, the transformer terminal is a terminal of a medium-voltage transformer, preferably a terminal of a transformer for an input voltage in the range of 5kV to 35kV, more preferably a terminal of a 10 kV transformer.

[0027] According to a preferred embodiment, the base and the cap, optionally the cable feed, are made of an electrically insulating material, preferably of a thermoplastic or thermoset polymer material, more preferably of a polycarbonate material. In this way, the protection cover may protect operators from the danger of touching a high voltage terminal. Preferably, the base and the cap, optionally the cable feed, are configured to meet an Ingress Protection (IP) of at least IP1X.

[0028] According to a preferred embodiment, a transformer is provided, the transformer comprising at least one transformer terminal and a protection cover to cover the at least one transformer terminal according to any of the above preferred embodiments.

[0029] According to another aspect of the invention, a method for installing a cover according to any of the above preferred embodiments onto a transformer terminal of a transformer substation is provided. This method comprising in this order the steps of attaching the base to the transformer terminal, using preferably at least a nut, connecting a cable to the transformer terminal, fastening the cap to the base. In this way the base may be attached to the transformer terminal, serving as a support for the cap safely attached to it via the fastening mechanism. The transformer terminal may thus be protected against accidental removal since the cap can be fastened to the transformer terminal in a secure manner.

[0030] According to a preferred embodiment, connecting a cable to the transformer terminal further comprises guiding the cable to the transformer terminal through a cable feed, mechanically connecting the cable feed to the base, and electrically and mechanically connecting the cable to the transformer terminal. In this way, the installation method accommodates the connection to the cable such that the cover may remain during normal and maintenance operations.

[0031] According to a preferred embodiment, mechanically connecting the cable feed to the base comprises selecting an orientation of the cable feed with respect to the transformer terminal, and accordingly connecting the cable feed to the base. In this way, the installation accommodates more than one orientation of the cable to the transformer terminal, increasing the range of applications of the protection cover.

[0032] According to another aspect of the invention, a method for performing maintenance of a transformer terminal covered by an isolation protection cover according to any of the above preferred embodiments is provided. This method comprises unfastening the cap from the base to expose the transformer terminal and performing the required maintenance.

[0033] According to a preferred embodiment, the method further comprises, after completion of the maintenance, fastening the cap onto the base to cover the transformer terminal. In this way, once maintenance is finished, the transformer terminal may be covered for normal operation such as to protect operators evolving in the area around the transformer terminal during normal operation.

[0034] According to a preferred embodiment, unfastening the cap from the base comprises pulling the handle by hand or via a tool. In this way, an operator may remove the cap with ease.

[0035] According to a preferred embodiment, fastening the cap to the base comprises pushing the cap towards the base until fastened.

[0036] According to a preferred embodiment, performing the required maintenance comprises connecting an earthing cable to the transformer terminal. Preferably prior to connecting the earthing cable an operator may verify the absence of power at the transformer terminal. In this way, security of further maintenance operations may be insured.

[0037] It is noted that, although presented for a transformer terminal, the invention is not limited to covers for a transformer terminal of a transformer substation but is intended for covers for any high-voltage electrical conductor in the broad sense, in particulars covers for bush-

ings which are by definition used in high voltage application. Of importance is that the electrical conductor is at a potentially dangerous potential and should be covered to protect living beings against an accidental touch.

[0038] This and other aspects of the present invention will now be described in more detail, with reference to the appended drawings showing currently preferred embodiments of the invention, wherein:

- Figure 1 illustrates a schematic view of a transformer sub-station with a transformer terminal covered by a protection cover according to an embodiment.
- Figure 2 illustrates an exploded view of a protection cover according to an embodiment.
- Figures 3a and 3b illustrate perspective views of a protection cover according to the embodiment of Figure 2, where Figure 3a corresponds to one configuration of the cover according to Figure 2 and Figure 3b represents an alternative configuration of the cover according to Figure 2.
- Figures 4a and 4b illustrates see-through perspective views of Figures 2d and 2e
- Figures 5a-5c illustrate side views of the cover according to Figure 3b and Figure 2c an above view of a protection cover according to Figure 3b.
- Figures 6a and 6b illustrate cross-sections of the cover of Figure 3b taken along two perpendicular planes.
- Figure 7 shows an exploded perspective view from above of the first embodiment of Figure 2E.
- Figures 8a and 8b illustrate side views of a protection cover according to another embodiment.
- Figures 9a and 9b illustrates steps of a method for mounting a protection cover according to an embodiment onto a transformer terminal.
- Figures 10a and 10b illustrate alternative steps of a method for removing the protection cover according to an embodiment.
- Figure 11a illustrates a schematic side view of a protection according to another embodiment comprising a cable feed cover, Figure 11b illustrates a schematic cross section view of the cable feed of Figure 11a while Figure 11b illustrates a schematic 3D view of the cable feed cover of Figure 11a.

[0039] Figure 1 illustrates a schematic view of a transformer sub-station with a transformer terminal covered by a protection cover according to an embodiment. A transformer substation 200 may comprise a high-voltage side and a low-voltage side to transform for instance the high voltage of the high-voltage side to a low voltage on the low-voltage side. The transformer substation 200 may comprise a high-voltage side transformer terminal 1 connected to a high-voltage side cable 2, a low-voltage side transformer terminal 4 connected to a low-voltage side cable 5. The transformer terminals 1 and 4 may extend out of a transformer case 3 comprising a primary coil 6, a secondary 7 and a core 8. The high-voltage transformer terminal 1, respectively the low-voltage transformer terminal 4 may typically be a bushing with a threaded terminal 1a, respectively 4a. A bushing is a hollow electrical insulator that allows an electrical conductor to pass safely through a conducting barrier such as the case of a transformer or circuit breaker without making electrical contact with it. Bushings are typically made from porcelain. Bushings are typically terminated by a bare conductor part in the shape of a threaded terminal. Transformer substations comprise typically a medium-voltage transformer, which a high-voltage voltage in the range of 5kV to 35kV. However, the invention is not limited to this specific range of voltage and may be applied in a large range of applications in which a (bare) electrical conductor with a potentially dangerous potential needs to be covered to protect living beings against an accidental touch. In that sense, the teachings of the invention are not limited to a cover for a transformer terminal but encompass covers for any high-voltage electrical conductor in the broad sense. It is noted that also a single-phase transformer has been shown in Figure 1 for ease of representation, the principle behind the invention would of course apply as well to multiple-phase transformers.

[0040] Figure 2 illustrates an exploded view of a protection cover according to an embodiment. A protection 100 for covering a transformer terminal 1, for instance a transformer terminal of a transformer substation 200 as shown in Figure 1, comprises a base 10 configured to be fixed to the transformer terminal 1, a cap 20 and a fastening mechanism 30 configured to fasten the cap 20 to the base 10. The base 10 defines a receptacle 11 to receive the transformer terminal 1 and the cap 20 is configured to cover the receptacle 11 and enclose the transformer terminal 1. Further the protection cover 100 may comprise a cable feed 50 configured to guide a cable 2 to the transformer terminal 1. In Figure 2, the cable feed 50 is represented according to two possible configurations, in which the axes of the cable 2 are oriented along two different directions The cable feed 50 may be oriented according to either configuration by being rotated by 180 degrees with respect to the base as illustrated by the arrows C and D.

[0041] The fastening mechanism 30 may be located between the base 10 and the cap 20. The fastening mechanism 30 may comprise at least one snap-fit element 30. The one or more snap-fit elements may regularly be provided in between the base 10 and the cap 20. Alternatively other fastening options enabling a controllable fastening and release of the cap 20 from the base 10 can be envisaged by a person skilled in the art. The fastening mechanism 30 may comprise at least one hook 31 protruding internally in the cap 10 and a matching recess 32 provided in the base 10.

[0042] The cap 20 may be moveable with respect to the base 10 from an exposed position (see for instance figure 9a or 10a) to a covered position (see for instance figures 3a and b). In the covered position, the fastening mechanism 30 may fasten the cap 20 to the base 10 and

the transformer terminal 1 may be enclosed inside the receptacle 11 and the cap 20. In the exposed position, the receptacle 11 and the transformer terminal 1 may be exposed to the outside of the cap 20.

[0043] The cap 20 may comprise a handle 25 for moving the cap between the exposed and covered positions. The handle 25 may be hold by hand or via tool, where the tool may for instance be a stick to be slid in the handle 25. In this way, the cap 20 may be moved by an operator using the handle 25. The cap 20 may further comprise a tubular sleeve portion 21 and a closed top 22. The handle 25 may be attached to the closed top 22 to allow pulling/pushing the cap 20 away/towards the base 10. The tubular sleeve portion 21 may comprise an open side edge 26 and a bottom edge 23 away from the closed top 22. The open side edge 26 may match the shape of the cable feed 50.

[0044] The base 10 may comprise an outer skirt 12 around at least part of the transformer terminal. The outer skirt 12 may be a tubular sleeve, preferably having a conical shape. The outer skirt 12 may comprise a lower portion 12a, a shoulder 12b and an upper portion 12c. The shoulder 12b may be configured for receiving the cap 10. The shoulder 12b may extend substantially perpendicularly from the axis A of the transformer terminal 1. The shoulder 12b may be configured to receive the bottom edge 23 of the cap 20.

[0045] The cable feed 50 may be configured to guide the cable 2 to the transformer terminal 1. The cable feed 50 may comprise a tubular portion 51 for receiving the cable 2 and a connecting portion 52 in the form of a flange configured to be connected to the base 10 and/or the cap 20. The tubular portion 51 may be configured to house the cable 2 and may have an opening 53 debouching to the outside of the protection cover 100. The opening 53 may be provided to allow for the insertion of the cable 2. The size of the opening 53 may be dimensioned with respect to the diameter of the cable 2 to meet an Ingress Protection (IP) of at least IP1X. In this way a protection against solid objects over 50mm entering the cable feed is achieved, e.g. accidental touch by hands is prohibited. The connecting portion 52 is symmetrical such that it is connectable according to two positions with respect to the base 10 and/or cap 20. The connecting portion 52 may be configured to be received inside the base 10 and attached to the outer skirt 12 of the base 12. The connecting portion 52 may comprise snap fit elements interacting with the base 1, for example protrusions may be provided on the connecting portion 51 to engage recesses in the inner surface of the outer skirt 12. The connecting portion 52 may further be slidable inside the outer skirt 12 and be maintained by gravity inside the outer skirt 12. The tubular portion 51 may be arranged with respect to the connecting portion 51 such that the angle between the axis of the tubular portion 51 with respect to the axis A of the transformer terminal 1 is selectable between two values. The axis of the tubular portion 51 may be oriented with respect to the axis A of the transformer terminal 1 preferably at an angle of between 30 to 150 degrees. In the example of Figure 2, the axis of the tubular portion may have an angle of 45 degrees or an angle of 135 degrees with the axis of the transformer terminal 1. The opening 53 of the tubular portion 51 may have a section to accommodate an additional range of cable angle. For example the opening 53 may have a substantially oval section to accommodate an additional range of +/- 10 degrees or orientation of the cable 2 with respect to the longitudinal axis or centerline of the base 10.

[0046] The base 10 may further comprise a side edge 16 on the outer skirt 12 to allow for the insertion of the cable feed 50 into the base 10. Similarly, the cap 20 may comprise a side edge 26 on the tubular portion 21 matching the shape of the cable feed 50.

[0047] The cover 100 may serve as a protection cover meeting an ingress protection (IP) of at least IP1X. The cover 100 may have electrical insulation properties. The base 10, the cap 20 and the cable feed 50 may be made of an electrically insulating material, preferably of a thermoplastic or thermoset polymer material, more preferably of a polycarbonate material.

[0048] To assemble the base 10 to the transformer terminal 1, and more in particular to the threaded terminal 1a at the extremity of the transformer terminal 1, may be provided in this order from the lower part of the threaded terminal 1a, a nut 69 and a flange 68, an inner waist surface 13 (further shown in Figure 6a, 6b and 7) and a flange 67 and a nut 66. To assemble the cable 2 to the transformer terminal 1, and more in particular to the threaded terminal 1a at the extremity of the transformer terminal 1, may be provided in this order from the bolt 66, a connection strip 65 electrically connected to the cable 2, a lock ring 64, a spring ring 63, a nut 62. To provide an easy connection for earthing purposes, a ball head part 61 may further be screwed on top of the previously described assembly.

[0049] Figures 3a and 3b illustrate top-perspective views of a protection cover according to the embodiment of Figure 2, where Figure 3a corresponds to one configuration of the cover according to Figure 2 and Figure 3b represents an alternative configuration of the cover according to Figure 2. Figure 3a illustrates a protection cover according to Figure 2 when the cap 20 may be in its covered position and the cable feed 50 may be oriented to accommodate a cable 2 approaching the transformer terminal 1 from above with a 45-degree angle. Figure 3b illustrates a protection cover according to Figure 2 when the cap 20 may be in its covered position and the cable feed 50 may be oriented to accommodate a cable 2 approaching the transformer terminal 1 from below with a 45-degree angle. In the covered position, the tubular sleeve portion 21 may cover the upper portion 12c of the outer skirt 12 and the connecting portion 52 of the cable feed 50 such that the threaded terminal 1a is enclosed inside the base 10, the cap 20 and the cable feed 50. In this configuration, only the outer surface of the cap 20,

the outer surface of the tubular section 51 and the outer surface of the lower portion 12a of the base 10 are accessible to an operator. In this way, the bare conductor part of the transformer, i.e. the threaded terminal 1a of the transformer terminal 1 is entirely enclosed in a cavity formed by the receptacle 11 of the base 10, the cap 10 and the cable feed 50. The potentially electrically charged conductor part of the transformer terminal 1 may thus be entirely covered by the protection cover 100, such that the safety of operators evolving around the transformer is ensured.

[0050] Figures 4a and 4b illustrates see-through perspective views of Figures 3a and 3b. These figures show in particular how the cable 2 may be connected to the threaded terminal 1a. Similar references apply further to similar features.

[0051] Figures 5a and 5b illustrate side views of the cover according to Figure 3b and Figure 5c illustrate an top view of a protection cover according to Figure 3b. Similar references apply again to similar features. These figures show a cap 100 having a substantially conical shape with a flat top and side entry for the cable 2. Although the side entry of the cable 2 has been represented with a 45-degree angle, it is understood that any angle between 30 to 150 may be envisaged. A perpendicular side entry at 90 degrees is an obvious option. Yet small angles have the advantages that in the three-part assembly of a base 10, a cap 20 and a cable feed 50, two orientations for the cable feed 50 may be selected to accommodate connection to a cable 2 approaching from above or below the cap.

[0052] Figures 6a and 6b illustrate cross-sections of the cover of Figure 3b taken along two perpendicular planes. Figure 6a shows that the base 10 may further comprise an inner waist surface 13 for attaching the base 10 to the transformer terminal 1. The inner waist surface 13 may define the receptacle 11 configured to receive the transformer terminal 1. The inner waist surface 13 may extend substantially perpendicular to the axis A of the transformer terminal 1. The inner waist surface 13 may be connected to the outer skirt by an edge portion 15. The inner waist surface 13 may comprise an opening 14 (shown in Figure 7) debouching in the receptacle 11. When the protection cover 100 is mounted onto the transformer terminal 1, the threaded terminal 1a of the transformer terminal 1 may be arranged to extend through the opening 14 and debouch in the receptacle 11. When the protection cover 100 is mounted onto the transformer terminal 1, the axis B of the cable 2 may be at an angle α with the axis A of the transformer terminal 1.

Figure 6b shows that the inner waist surface 13 may have a profile with a substantially flat central portion around the opening 14, and elevated side portions connected to the edge 15 linking the outer skirt 12 to the inner waist surface 13.

[0053] Figure 7 shows an exploded perspective view from above and from the open side edge 16 of the outer skirt 12 of the base 10 and the cap 20. As previously shown in Figure 2, the base 10 may comprise a side edge 16 on the outer skirt 12 to allow for the insertion of the cable feed 50 into the base 10 and the cap 20 may comprise a side edge 26 on the tubular portion 21 matching the shape of the cable feed 50. Additionally, the base 10 may further comprise a side edge 17 on the inner waist surface 13 to allow for the insertion of the cable feed 50 into the base 10.

[0054] The base 10 may further comprise a guide 40 for guiding the movement of the cap 20 between the covered and the exposed position. The guide 40 may comprises one or more ribs protruding on the shoulder of the outer skirt 12 to guide the cap 20 with respect to the base 10. The ribs may be regularly spaced on the shoulder 12b of the outer skirt 12 and/or on the upper portion 12c. The presence of ribs both on the shoulder 12 b and the upper portion 12c at a predetermined distance from each other may particularly help guiding the movement of the cap 20 with respect to the base 10. Alternatively or additionally the guide 40 may comprise ribs protruding on the inner surface of the cap 20, for example ribs protruding on the inner surface of the tubular sleeve portion 21. The ribs of the guide 40 may be oriented to guide a movement along the axis A of the transformer terminal 1. The ribs 40 may extend radially with respect to a longitudinal axis A of the base 10.

[0055] Figures 8a and 8b illustrate side views of a protection cover according to another embodiment. According to this additional embodiment, the cable feed 50 may be merged with the base 10. The protection cover 100 of Figures 8a and 8a may then comprise a base 10 and a cover 20, where the base 10 further comprises a cable feed portion 50 monolithic with the outer skirt 12.

[0056] Figures 9a and 9b illustrates steps of a method for mounting a protection cover according to an embodiment onto a transformer terminal. A method for installing a protection cover according to any of the above embodiments onto a transformer terminal of a transformer substation may comprise in this order:

- Attaching the base 10 to the transformer terminal 1, using preferably at least a nut 66,
- connecting the cable 2 to the transformer terminal 1 as illustrated in Figure 9a,
- Fastening the cap 20 to the base 10, as illustrated in figure 9b.

The step of connecting the cable 2 to the transformer terminal 1 may further comprise guiding the cable 2 to the transformer terminal 1 through a cable feed 50, mechanically connecting the cable feed 50 to the base 10, and electrically and mechanically connecting the cable 2 to the transformer terminal 1 using for example the nut 62.

[0057] The step of mechanically connecting the cable feed 50 to the base 10 may comprise selecting an orientation of the cable feed 50 with respect to the transformer terminal 1, and accordingly connecting the cable feed 50

to the base 10, for example by sliding the connecting portion 51 of the cable feed 51 into the outer skirt 12 of the base 10.

[0058] Figures 10a and 10b illustrate some steps of a method for performing maintenance of a conductor covered by an isolation protection cover according to any of the above embodiment. Such a method may comprise in this order:

- Unfastening the cap 20 from the base 10 to expose the transformer terminal 1 (as illustrated in Figures 10a) and 10b), and
- Performing the required maintenance (not illustrated).

[0059] After completion of the maintenance, the method may further comprise fastening the cap 20 onto the base 10 to cover the transformer terminal 1.

[0060] The step of unfastening the cap 20 from the base 10 may comprise pulling the handle 25 by hand or via a tool.

[0061] The step of fastening the cap 20 to the base 10comprises pushing the cap back onto the base 10 until the fastening mechanism 30 is engaged.

[0062] The step of performing the required maintenance may comprise connecting an earthing cable to the transformer terminal. Yet other maintenance operations requiring access to the bare conductor of the transformer terminal 1, may be envisaged.

[0063] Figure 11a illustrates a schematic side view of a protection cover 100 according to another embodiment comprising a cable feed cover 70. Figure 11b illustrates a schematic cross section view of the cable feed cover 70 of Figure 11a while Figure 11c illustrates a 3D view of the cable feed cover 70 of Figure 11a. The cable feed cover 70 may be configured to seal an open space at the opening 53 between the cable feed 50 and cable 2. The cable feed cover 70 may be a tubular sleeve. The cable feed cover 70 may comprise a first portion 71 and a second portion 71. Although represented in Figure 11b at a distance of each other, the first portion is configured to fit tightly around the tubular portion 51 and the second portion 72 is configured to fit tightly around the cable 2. The second portion 72 may be tapered from the diameter of the cable feed opening 53 to the diameter d of the cable 2. The cable feed cover 70 may be made of a flexible material, and preferably may be made of a rubber material.

Embodiment 1

[0064] A protection cover (100) for covering a transformer terminal (1) of a transformer substation (200) comprising:

- a base (10) configured to be fixed to the transformer terminal (1), wherein the base (10) defines a receptacle (11) to receive the transformer terminal (1),
- a cap (20) configured to cover the receptacle (11) and enclose the transformer terminal (1),
- a fastening mechanism (30) configured to fasten the cap (20) to the base (10).

Embodiment 2

[0065] The cover of embodiment 1, wherein the cap (20) is moveable with respect to the base (10) from an exposed position to a covered position:

- wherein, in the exposed position, the receptacle (11) and the transformer terminal (1) are exposed to the outside of the cap (20) and
- wherein, in the covered position, the fastening mechanism (30) fastens the cap (20) to the base (10) and the transformer terminal (1) is at least partially enclosed inside the receptacle (11) and the cap (20).

Embodiment 3

[0066] The cover of any of the above embodiments, wherein the fastening mechanism (30) comprises at least one snap-fit element; and/or
wherein the fastening mechanism (30) comprises at least one hook protruding internally in the cap (10) and at least one matching recess provided in the base (10).

Embodiment 4

[0067] The cover of any of the above embodiments, wherein the cap (20) comprises a handle (25) for moving the cap (20).

Embodiment 5

[0068] The cover of any of the above embodiments, wherein the base (10) comprises an outer skirt (12) around at least part of the transformer terminal (1).

Embodiment 6

[0069] The cover of the previous embodiment, wherein the outer skirt (12) is a tubular sleeve, preferably having a conical shape; and/or
wherein the outer skirt (12) of the base (10) comprises a shoulder (12b) for receiving the cap (20).

Embodiment 7

[0070] The cover of any of the above embodiments, further comprising a guide (40) for guiding the movement of the cap (20) with respect to the base (10), wherein preferably the guide (40) comprises one or more ribs disposed on the base (10) and/or on the cap (20).

Embodiment 8

[0071] The cover of any of the above embodiments, wherein the base (10) comprises an inner waist surface (13) for attaching the base (10) to the transformer terminal (1), the inner waist surface defining the receptacle (11) to receive the transformer terminal (1), wherein preferably the inner waist surface (13) comprises an opening (14) debouching in the receptacle (11).

Embodiment 9

[0072] The cover of any of the above embodiments, further comprising a cable feed (50) configured to guide a cable (2) to the transformer terminal (1).

Embodiment 10

[0073] The cover of the previous embodiment, wherein the cable feed (50) comprises a tubular portion (51) for receiving the cable (2) and a connecting portion (52) configured to be connected to the base (10) and/or the cap (20).

Embodiment 11

[0074] The cover of the previous embodiment, wherein the connecting portion (52) is symmetrical such that it is connectable according to two positions with respect to the base (10); and/or

wherein the tubular portion (51) is arranged with respect to the connecting portion (52) such that an angle between the axis of the tubular portion (52) with respect to the axis (A) of the transformer terminal (1) is selectable between two values; and/or
wherein, when the cable feed (50) is connected to the base (10), the axis of the tubular portion (51) is oriented with respect to the direction (A) of the transformer terminal (1) preferably at an angle of between 30 to 150 degrees, preferably at an angle of 45 degrees or at an angle of 135 degrees.

Embodiment 12

[0075] The cover of any of the above embodiment10 or 11, further comprising a cable feed cover (70) to seal an open space between the cable feed (50) and the cable (2).

Embodiment 13

[0076] The cover of any of the above embodiments 9-12, wherein the base (10) is configured to receive the cable feed (50); and/or

wherein the base (10) comprises an open side edge (16) to allow for the insertion of the cable feed (50) into the base (10); and/or
wherein the base (10) comprises an open top edge (17) to allow for the insertion of the cable feed (50) into the base (10); and/or
wherein the cap (20) comprises an open side edge (26) to match the shape of the cable feed (50); and/or
wherein the cap (20) and/or the base (10) is configured to overlap with at least part of a portion of the cable feed (50).

Embodiment 14

[0077] The cover of any of the above embodiments, wherein the transformer terminal (1) comprises a threaded terminal (1a); and/or

wherein the transformer terminal (1) is a bushing; and /or
wherein the transformer terminal (1) is a terminal of a medium-voltage transformer, preferably a terminal of a transformer for an input voltage in the range of 5kV to 35kV, more preferably a terminal of a 10 kV transformer.

Embodiment 15

[0078] The cover of any of the above embodiments, wherein the base (10) and the cap (20), optionally the cable feed (50), are made of an electrically insulating material, preferably of a thermoplastic or thermoset polymer material, more preferably of a polycarbonate material; and/or
wherein the base (10) and the cap (20), optionally the cable feed (50), are configured to meet an Ingress Protection (IP) of at least IP1X.

Embodiment 16

[0079] A transformer (200) comprising at least one transformer terminal (1) and a protection cover (100) to cover the at least one transformer terminal (1) according to any of the above embodiments.

Embodiment 17

[0080] A method for installing a cover (100) according to any of the preceding embodimentonto a transformer terminal (1) of a transformer substation, comprising in this order:

- Attaching the base (10) to the transformer terminal (1), using preferably at least a nut,
- connecting a cable (2) to the transformer terminal (1),
- Fastening the cap (20) to the base (10).

Embodiment 18

[0081] The method of the previous embodiment,

wherein connecting a cable (2) to the transformer terminal (1) further comprises guiding the cable (2) to the transformer terminal (1) through a cable feed (50), mechanically connecting the cable feed (50) to the base (10), and electrically and mechanically connecting the cable (2) to the transformer terminal (1).

Embodiment 19

[0082] The method of the previous embodiment, wherein mechanically connecting the cable feed (50) to the base (10) comprises selecting an orientation of the cable feed (50) with respect to the transformer terminal (1), and accordingly connecting the cable feed (50) to the base (10).

Embodiment 20

[0083] A method for performing maintenance of a transformer terminal (1) covered by an isolation protection cover (100) according to any of the preceding apparatus embodiments, comprising:

- Unfastening the cap (20) from the base (10) to expose the transformer terminal (1),
- Performing the required maintenance.

Embodiment 21

[0084] The method of the previous embodiment, further comprising as, after completion of the maintenance, fastening the cap (20 onto the base (10) to cover the transformer terminal (1).

Embodiment 22

[0085] The method of any of the previous embodiments 20 or 21, wherein unfastening the cap (20) from the base (10) comprises pulling the handle (25) by hand or via a tool; and/or
wherein fastening the cap (20) to the base (10) comprises pushing the cap (20) towards the base (10) until fastened; and/or
wherein performing the required maintenance comprises connecting an earthing cable to the transformer terminal (1).

[0086] Whilst the principles of the invention have been set out above in connection with specific embodiments, it is understood that this description is merely made by way of example and not as a limitation of the scope of protection which is determined by the appended claims.

Claims

1. A protection cover (100) for covering a transformer terminal (1) of a transformer substation (200) comprising:

   - a base (10) configured to be fixed to the transformer terminal (1), wherein the base (10) defines a receptacle (11) to receive the transformer terminal (1),
   - a cap (20) configured to cover the receptacle (11) and enclose the transformer terminal (1),
   - a fastening mechanism (30) configured to fasten the cap (20) to the base (10),
   - wherein the base (10) comprises an inner waist surface (13) for attaching the base (10) to the transformer terminal (1), the inner waist surface defining the receptacle (11) to receive the transformer terminal (1),
   - further comprising a cable feed (50) configured to guide a cable (2) to the transformer terminal (1) inside the receptacle (11).

2. The cover of claim 1, wherein the cap (20) is moveable with respect to the base (10) from an exposed position to a covered position:

   - wherein, in the exposed position, the receptacle (11) and the transformer terminal (1) are exposed to the outside of the cap (20) and
   - wherein, in the covered position, the fastening mechanism (30) fastens the cap (20) to the base (10) and the transformer terminal (1) is at least partially enclosed inside the receptacle (11) and the cap (20).

3. The cover of any of the above claims, wherein the fastening mechanism (30) comprises at least one snap-fit element; and/or

   wherein the fastening mechanism (30) comprises at least one hook protruding internally in the cap (10) and at least one matching recess provided in the base (10); and/or
   further comprising a guide (40) for guiding the movement of the cap (20) with respect to the base (10), wherein preferably the guide (40) comprises one or more ribs disposed on the base (10) and/or on the cap (20).

4. The cover of any of the above claims, wherein the cap (20) comprises a handle (25) for moving the cap (20), and/or further comprising a cable feed cover (70) to seal an open space between the cable feed (50) and the cable (2).

5. The cover of any of the above claims, wherein the base (10) comprises an outer skirt (12) around at least part of the transformer terminal (1), wherein the outer skirt (12) is preferably a tubular sleeve, more preferably having a conical shape; and/or
wherein the outer skirt (12) of the base (10) comprises preferably a shoulder (12b) for receiving the cap (20).

6. The cover of any of the above claims, wherein the inner waist surface (13) comprises an opening (14) debouching in the receptacle (11), and/or
wherein the cable feed (50) comprises a tubular portion (51) for receiving the cable (2) and a connecting portion (52) configured to be connected to the base (10) and/or the cap (20).

7. The cover of the previous claim, wherein the connecting portion (52) is symmetrical such that it is connectable according to two positions with respect to the base (10); and/or wherein the tubular portion (51) is arranged with respect to the connecting portion (52) such that an angle between the axis of the tubular portion (52) with respect to the axis (A) of the transformer terminal (1) is selectable between two values; and/or
wherein, when the cable feed (50) is connected to the base (10), the axis of the tubular portion (51) is oriented with respect to the direction (A) of the transformer terminal (1) preferably at an angle of between 30 to 150 degrees, preferably at an angle of 45 degrees or at an angle of 135 degrees.

8. The cover of any of the above claims, wherein the base (10) is configured to receive the cable feed (50); and/or

wherein the base (10) comprises an open side edge (16) to allow for the insertion of the cable feed (50) into the base (10); and/or
wherein the base (10) comprises an open top edge (17) to allow for the insertion of the cable feed (50) into the base (10); and/or
wherein the cap (20) comprises an open side edge (26) to match the shape of the cable feed (50); and/or
wherein the cap (20) and/or the base (10) is configured to overlap with at least part of a portion of the cable feed (50).

9. The cover of any of the above claims, wherein the transformer terminal (1) comprises a threaded terminal (1a); and/or

wherein the transformer terminal (1) is a bushing; and /or
wherein the transformer terminal (1) is a terminal of a medium-voltage transformer, preferably a terminal of a transformer for an input voltage in the range of 5kV to 35kV, more preferably a terminal of a 10 kV transformer.

10. The cover of any of the above claims, wherein the base (10) and the cap (20), optionally the cable feed (50), are made of an electrically insulating material, preferably of a thermoplastic or thermoset polymer material, more preferably of a polycarbonate material; and/or
wherein the base (10) and the cap (20), optionally the cable feed (50), are configured to meet an Ingress Protection (IP) of at least IP1X.

11. A transformer (200) comprising at least one transformer terminal (1) and a protection cover (100) to cover the at least one transformer terminal (1) according to any of the above claims.

12. A method for installing a cover (100) according to any of the preceding claims onto a transformer terminal (1) of a transformer substation, comprising in this order:

- Attaching the base (10) to the transformer terminal (1), using preferably at least a nut,
- connecting a cable (2) to the transformer terminal (1), wherein connecting a cable (2) to the transformer terminal (1) further comprises guiding the cable (2) to the transformer terminal (1) through a cable feed (50), mechanically connecting the cable feed (50) to the base (10), and electrically and mechanically connecting the cable (2) to the transformer terminal (1),
- Fastening the cap (20) to the base (10).

13. The method of the previous claim, wherein mechanically connecting the cable feed (50) to the base (10) comprises selecting an orientation of the cable feed (50) with respect to the transformer terminal (1), and accordingly connecting the cable feed (50) to the base (10).

14. A method for performing maintenance of a transformer terminal (1) covered by an isolation protection cover (100) according to any of the preceding apparatus claims, comprising:

- Unfastening the cap (20) from the base (10) to expose the transformer terminal (1),
- Performing the required maintenance.

15. The method of the previous claim, further comprising, after completion of the maintenance, fastening the cap (20 onto the base (10) to cover the transformer terminal (1), and/or wherein unfastening the cap (20) from the base (10) comprises pulling the handle (25) by hand or via a tool; and/or

wherein fastening the cap (20) to the base (10) comprises pushing the cap (20) towards the base (10) until fastened; and/or
wherein performing the required maintenance comprises connecting an earthing cable to the transformer terminal (1).

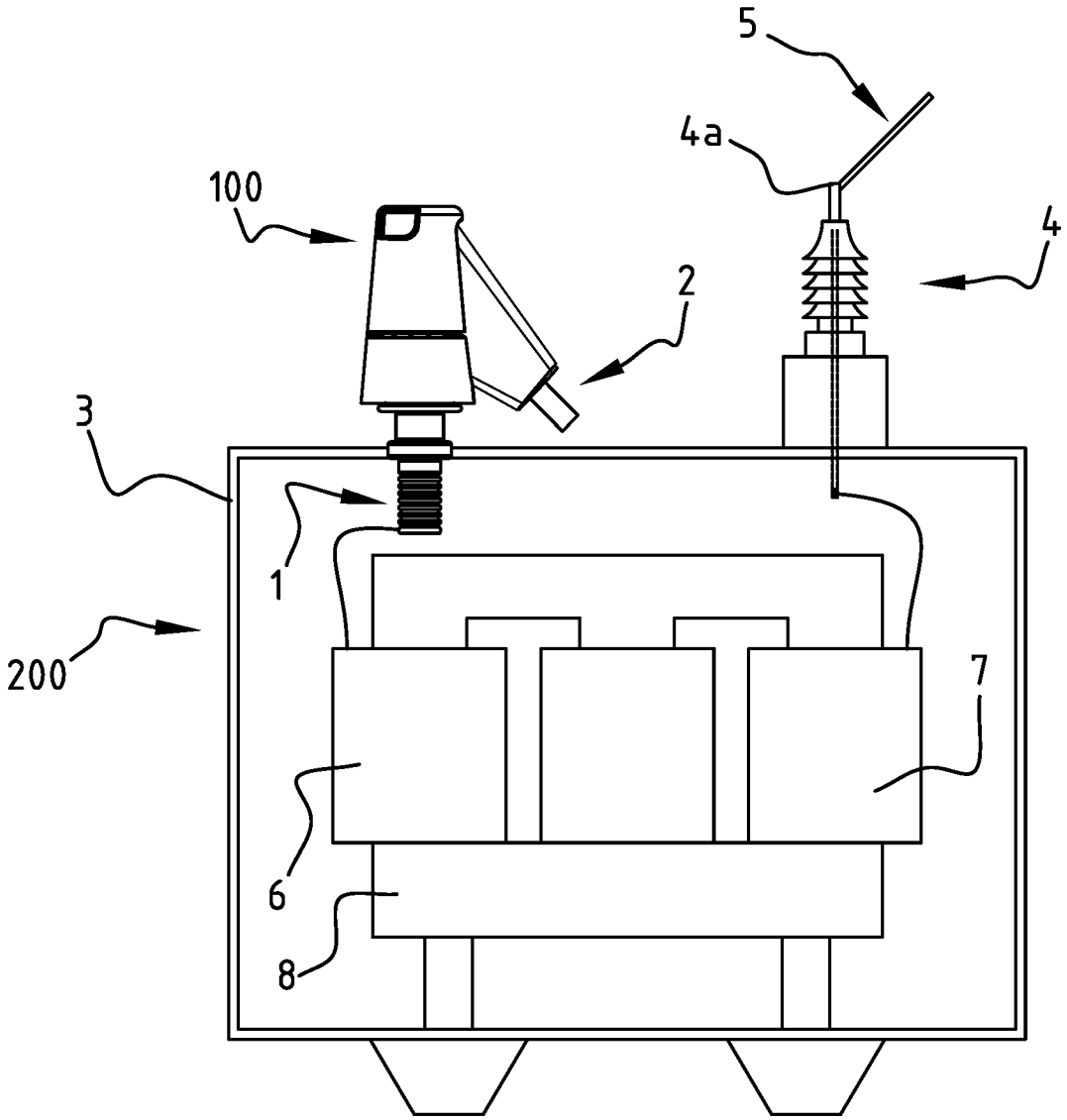
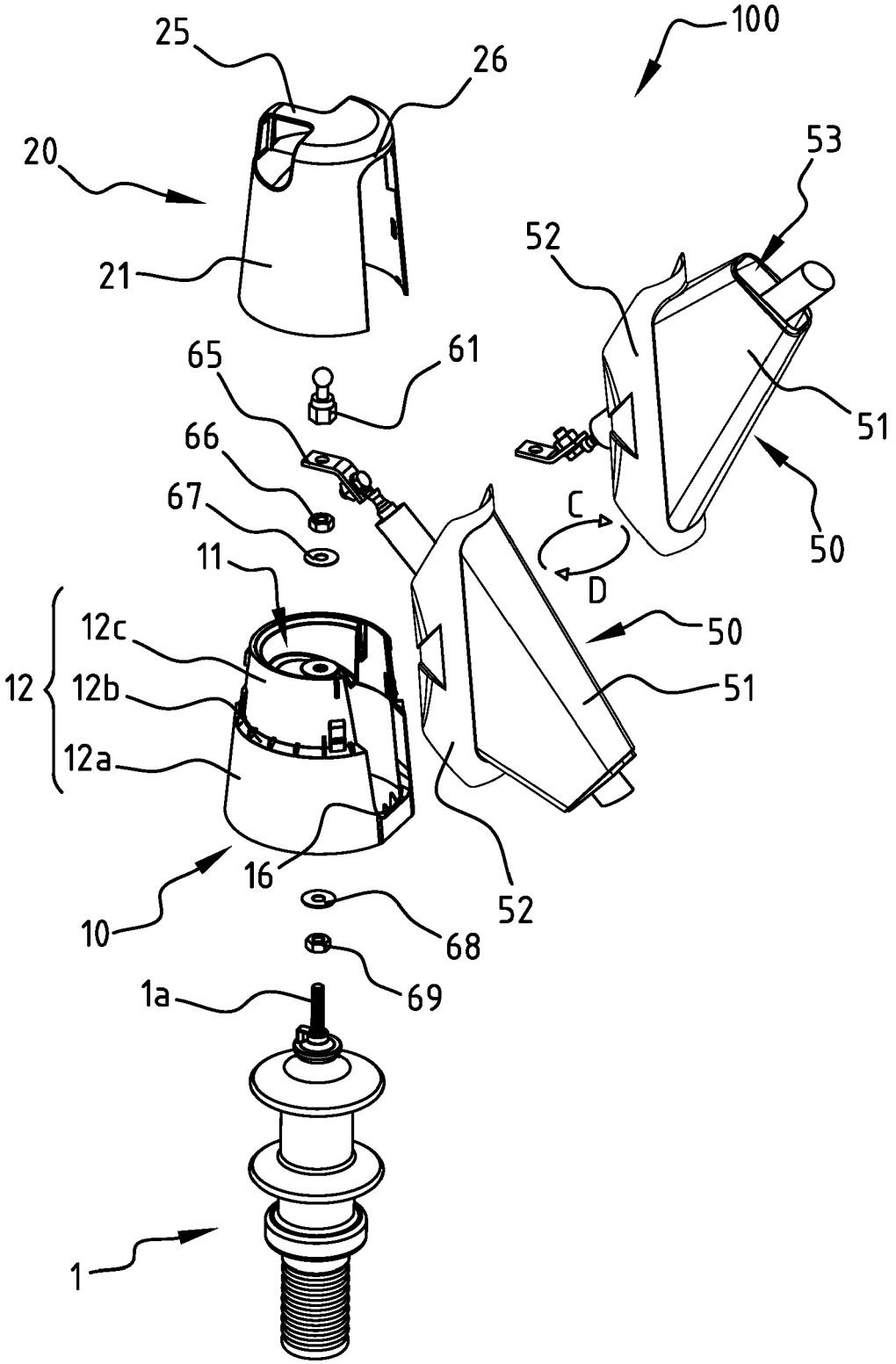


FIG. 1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16
52
10
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69
1a
1

FIG. 2

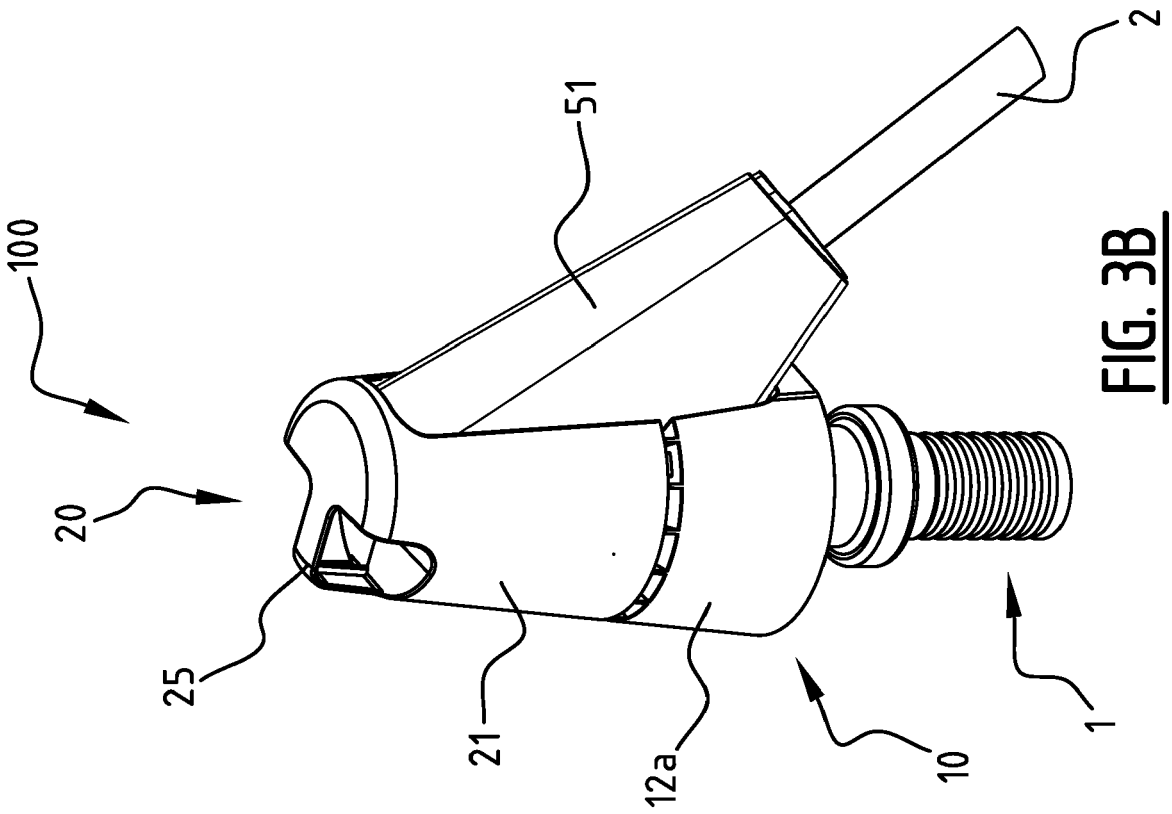

FIG. 3B

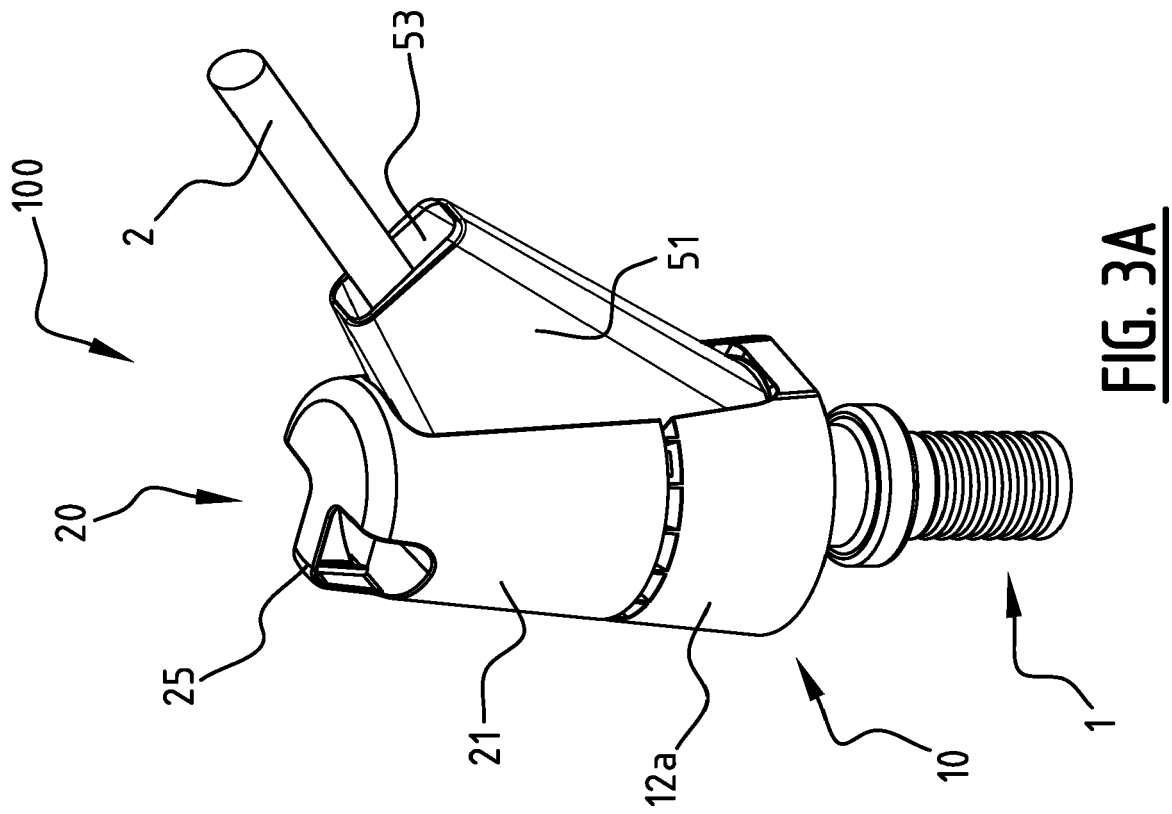

FIG. 3A

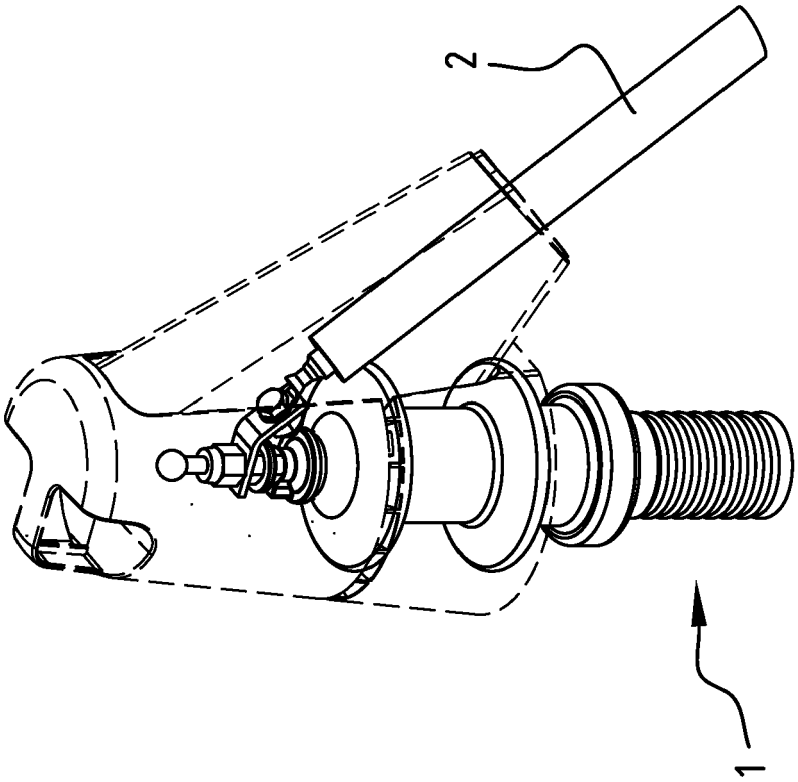

FIG. 4B

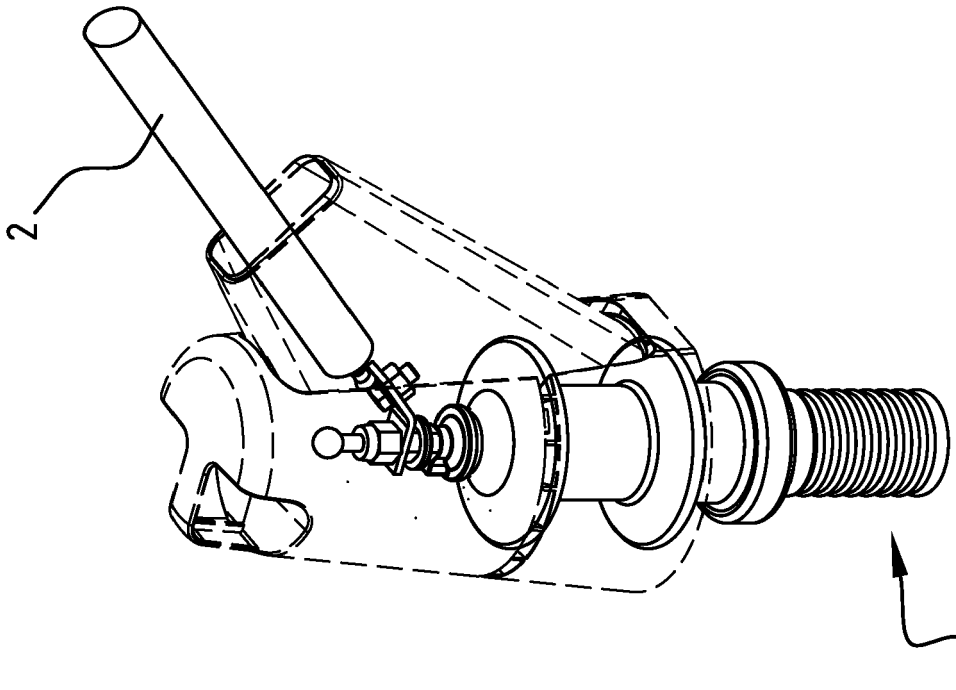

FIG. 4A

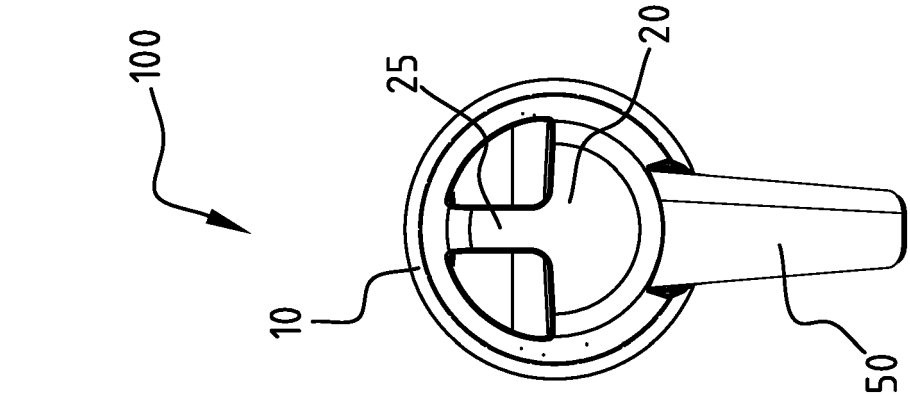

FIG. 5C

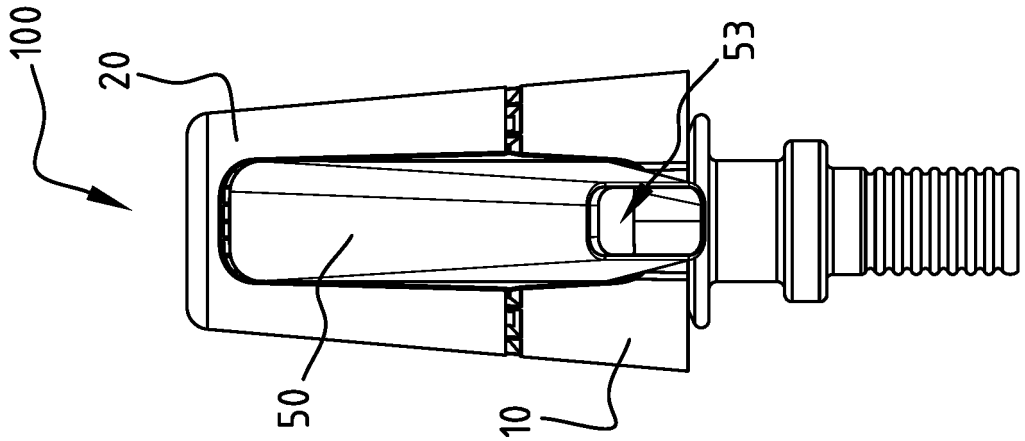

FIG. 5B

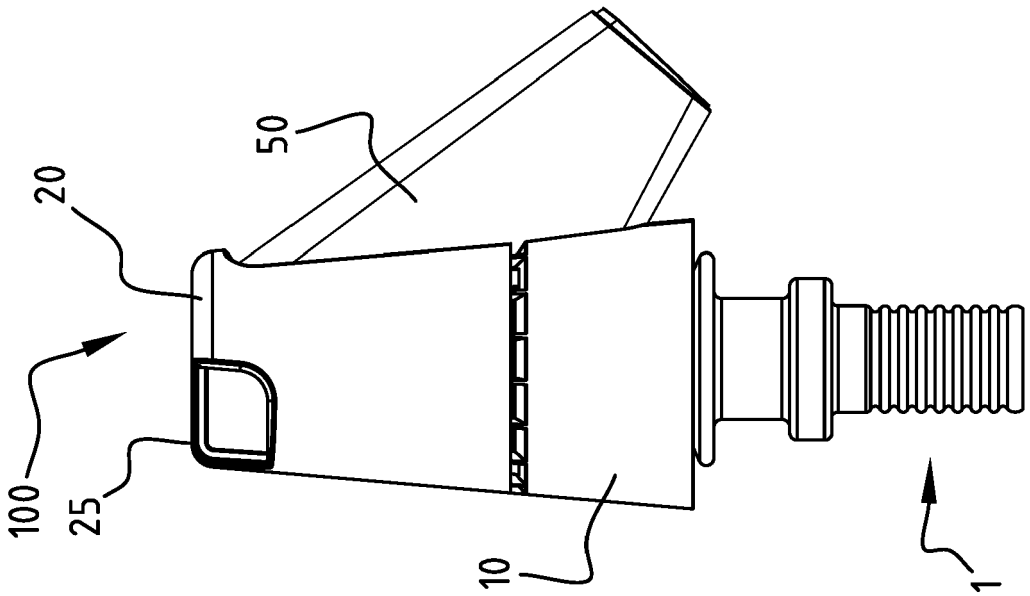

FIG. 5A

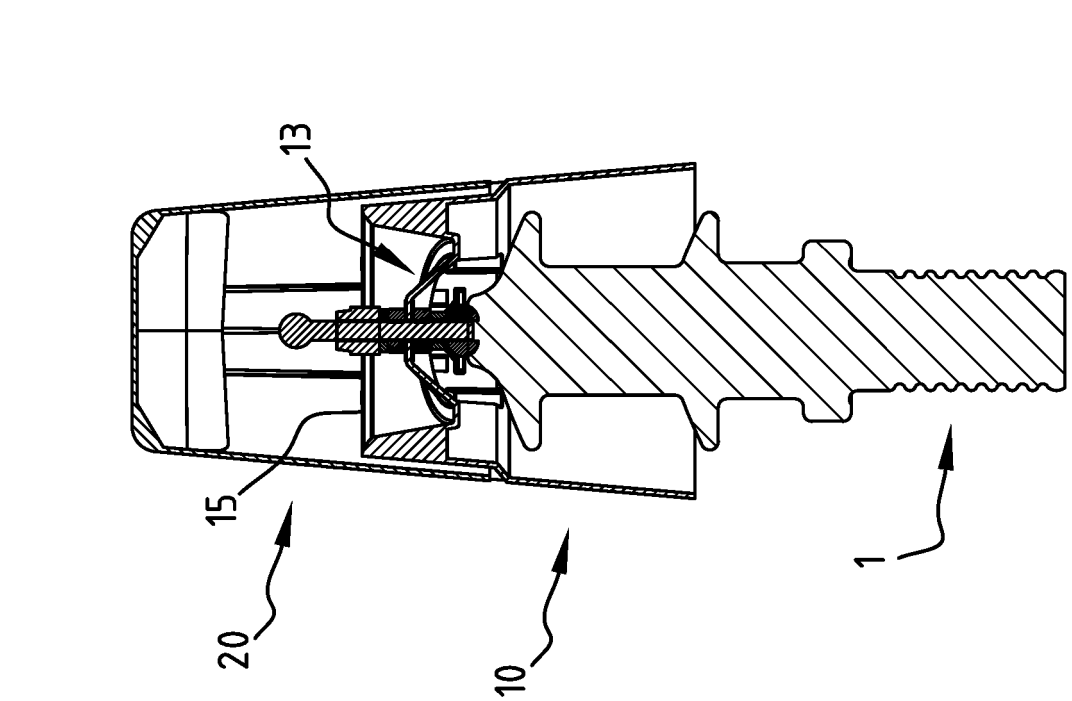

FIG. 6B

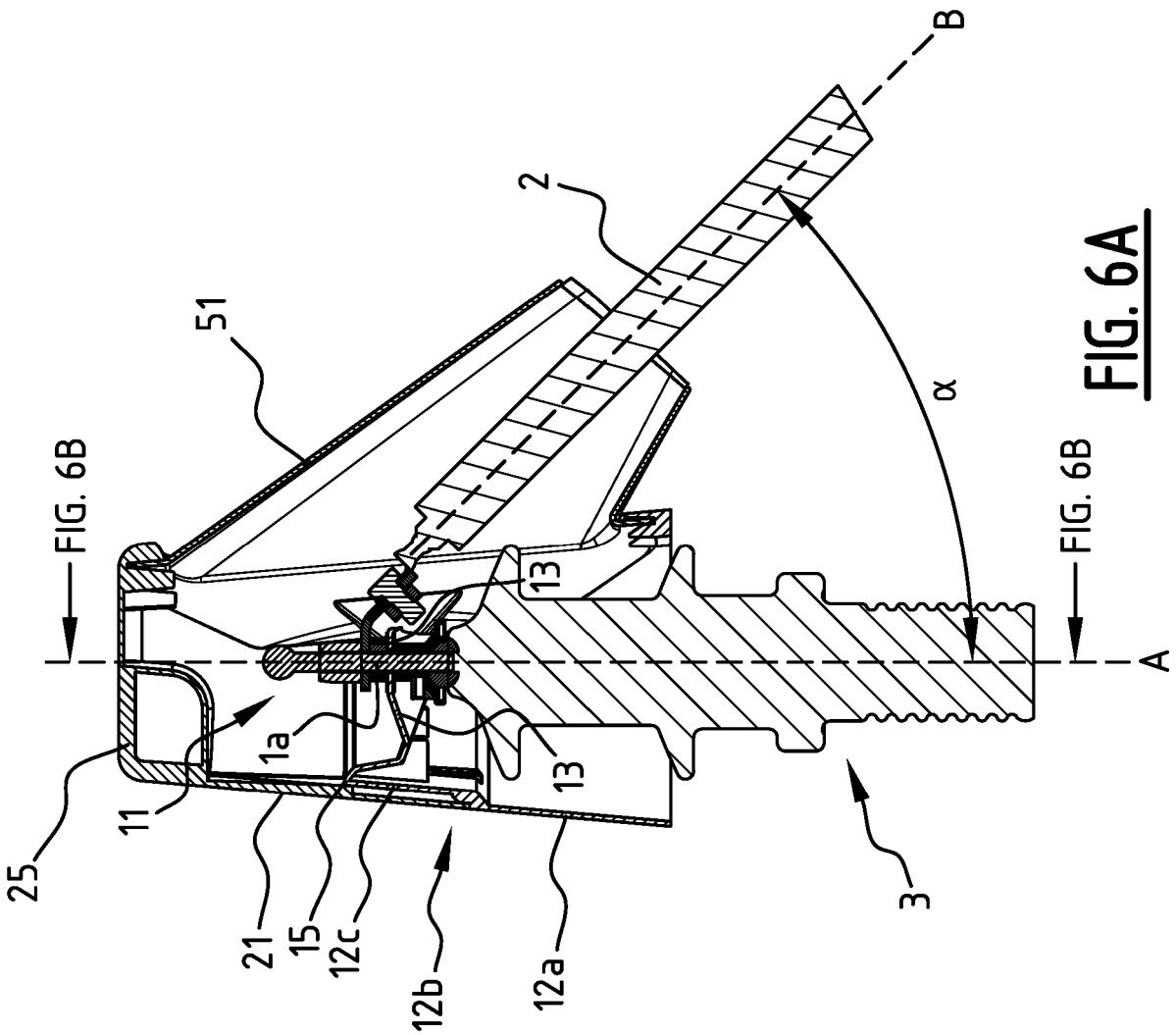

FIG. 6A

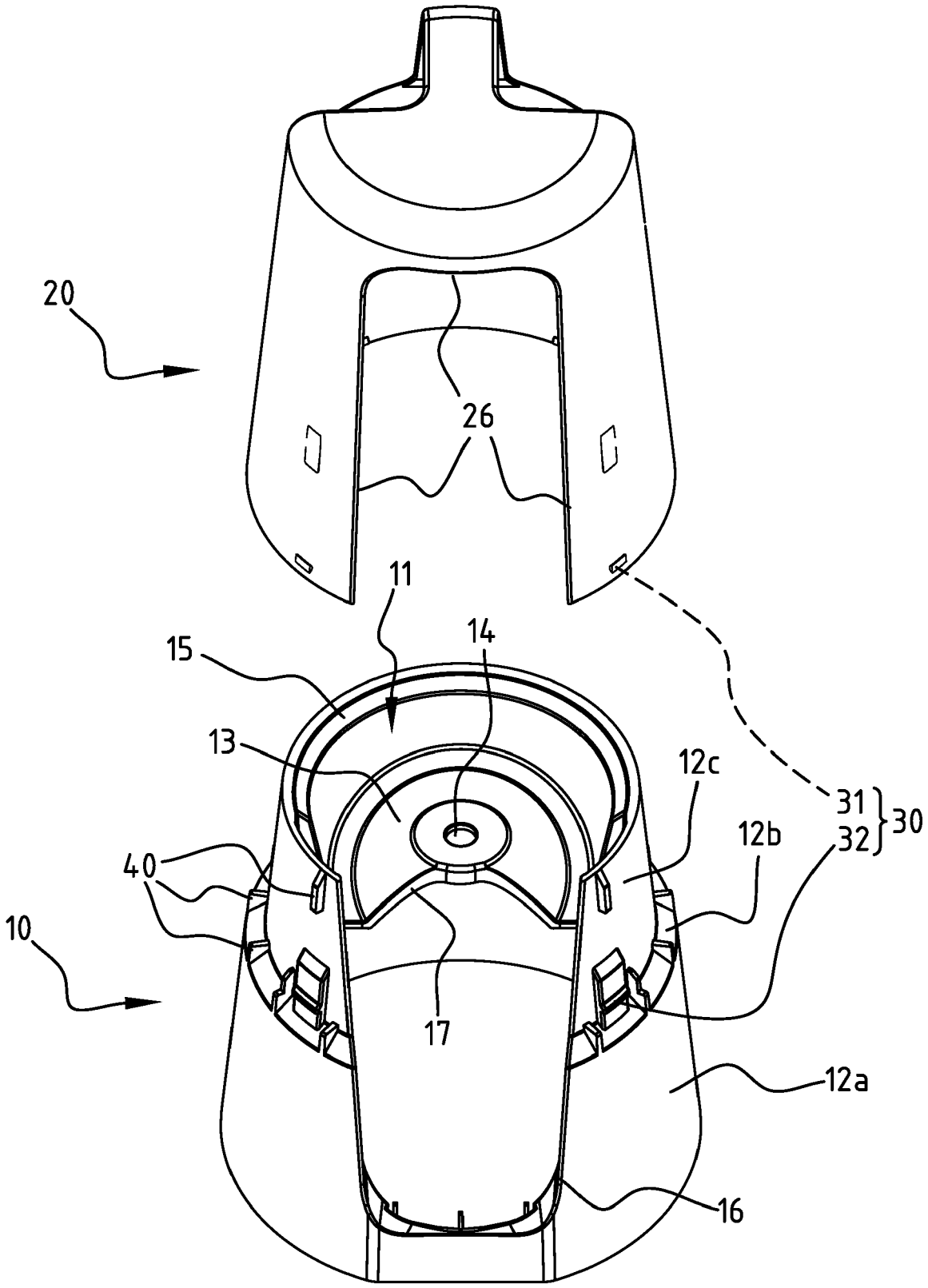

FIG. 7

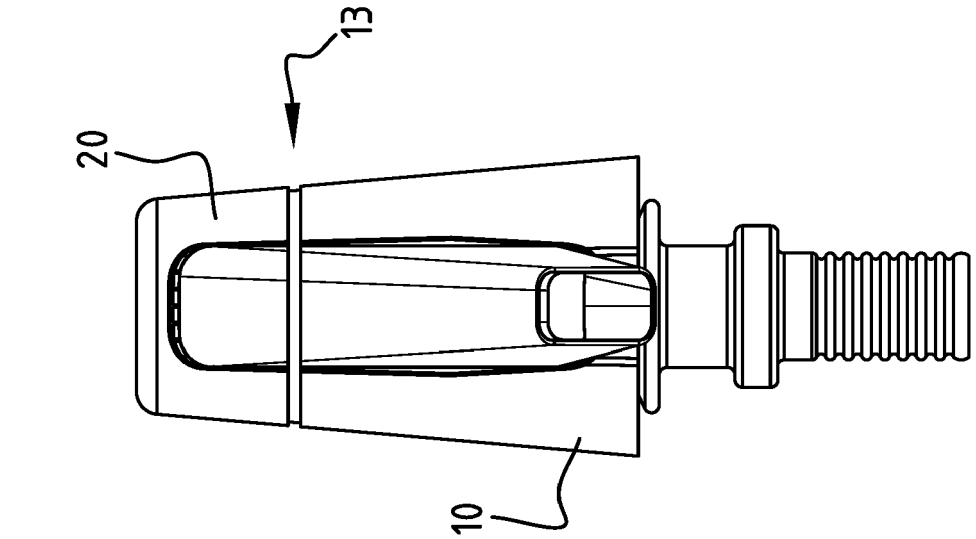

FIG. 8B

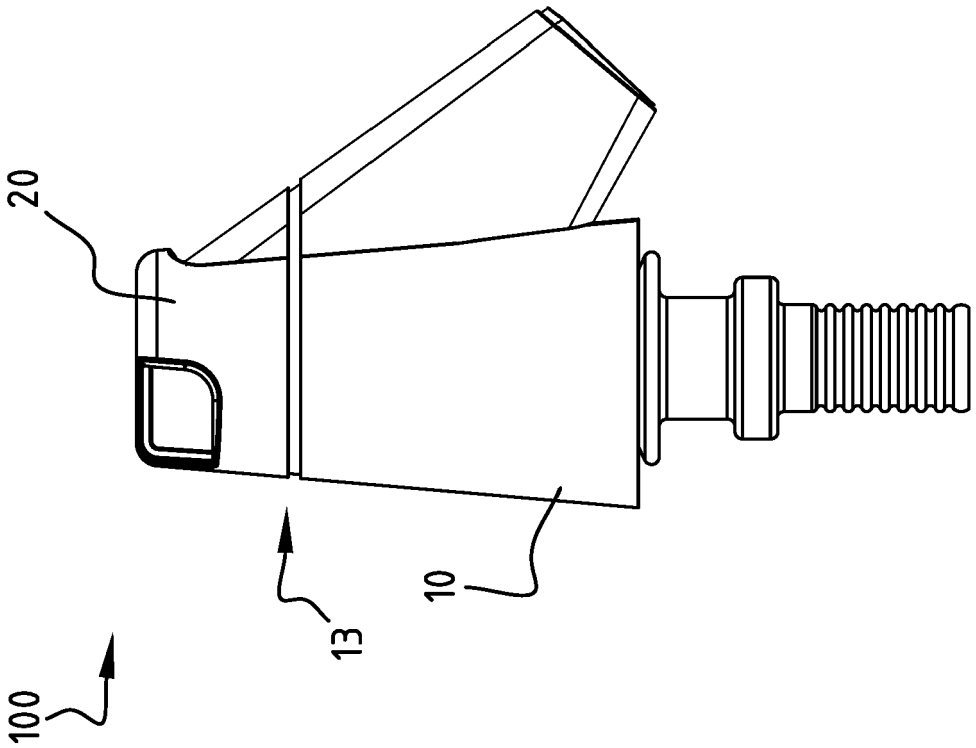

FIG. 8A

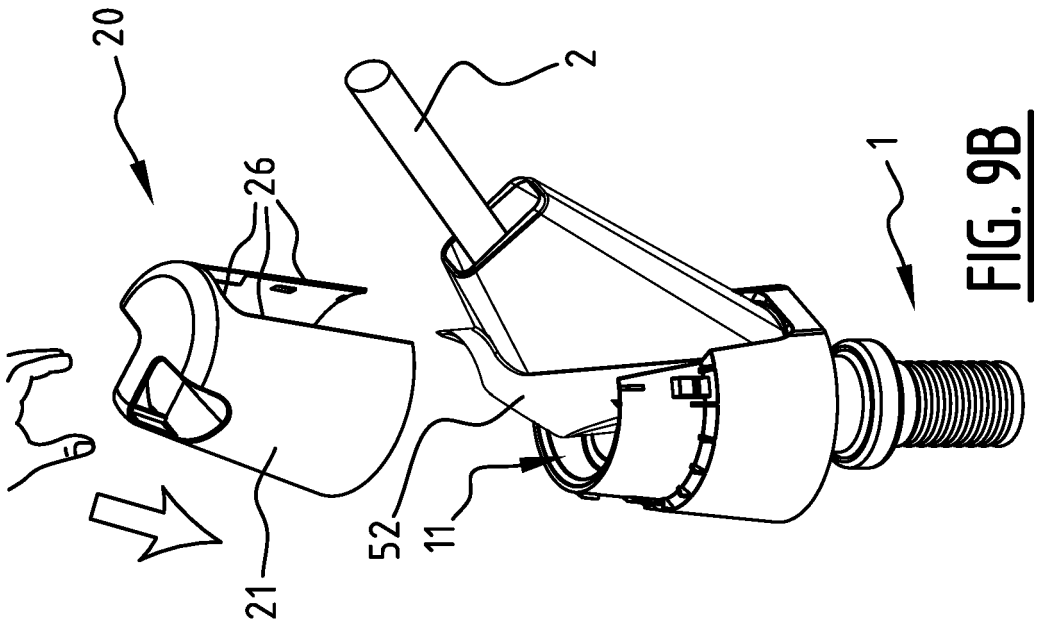

FIG. 9B

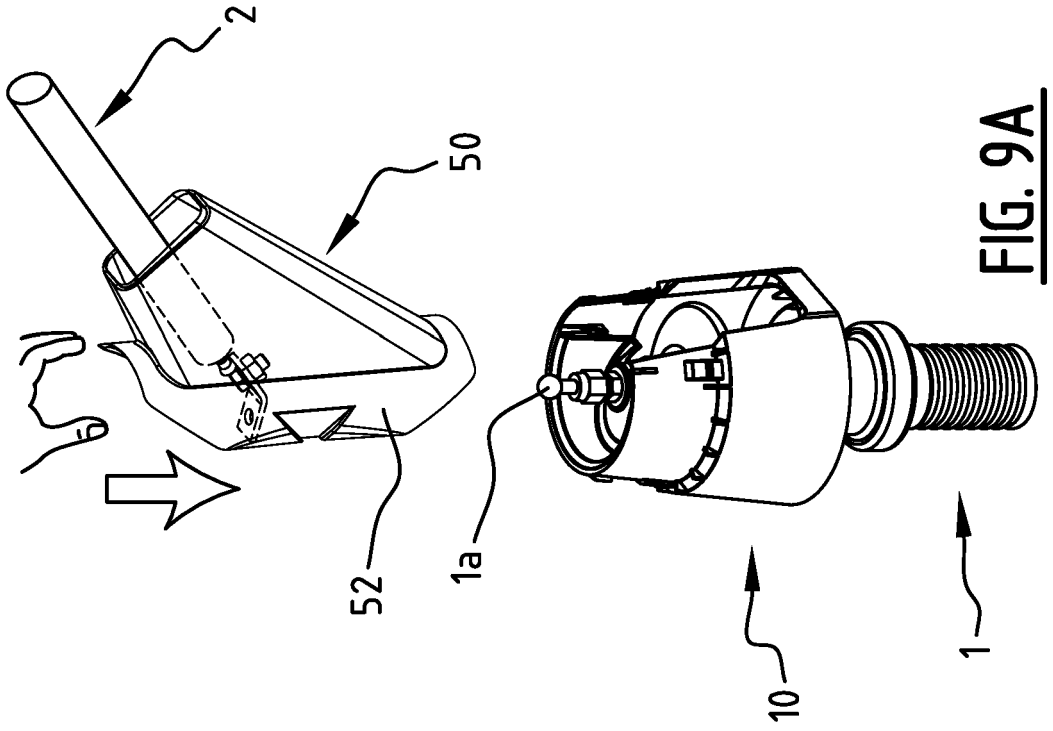

FIG. 9A

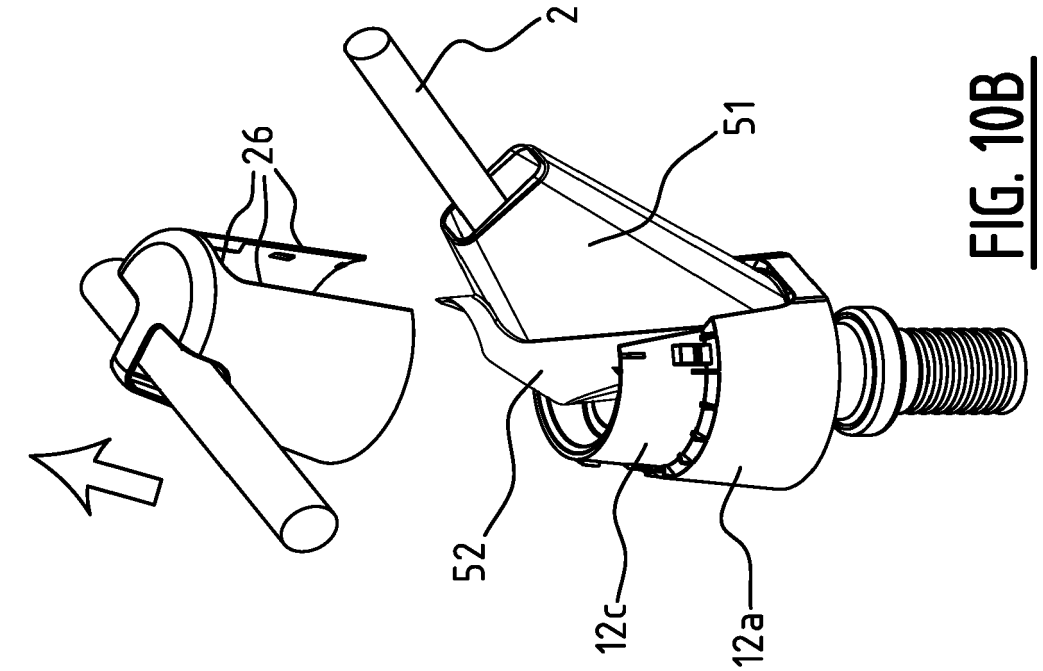

FIG. 10B

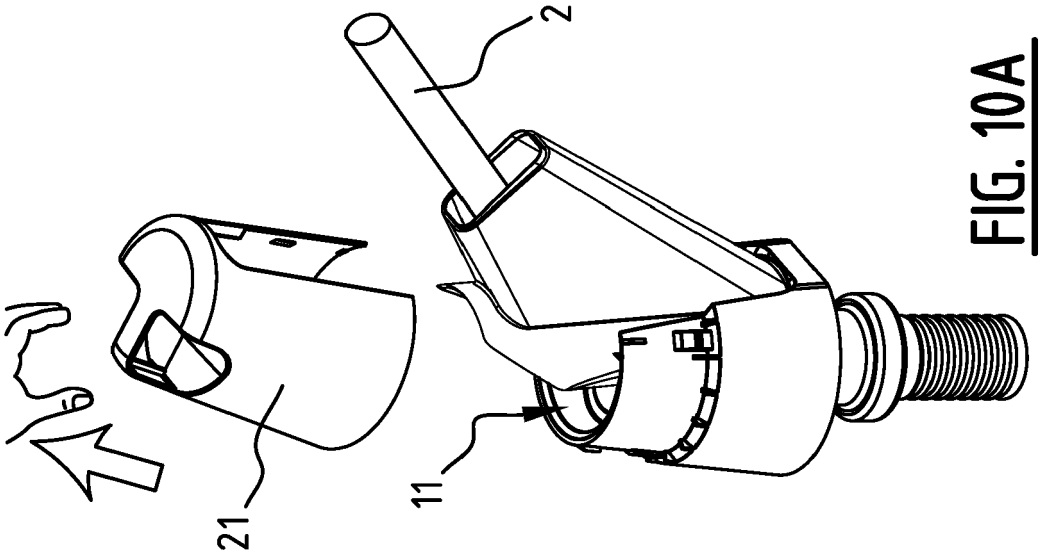

FIG. 10A

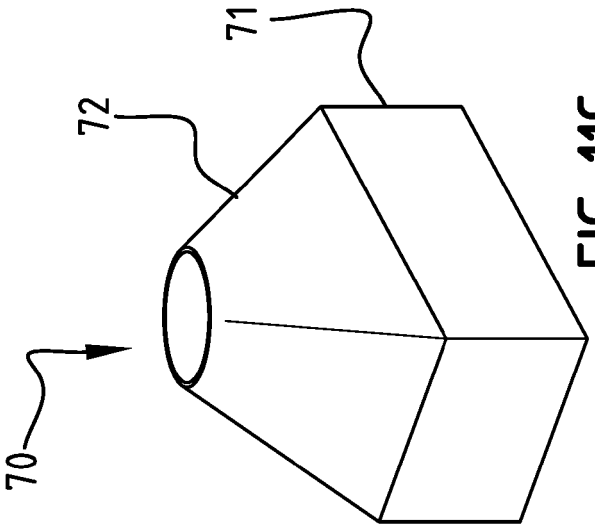

FIG. 11C

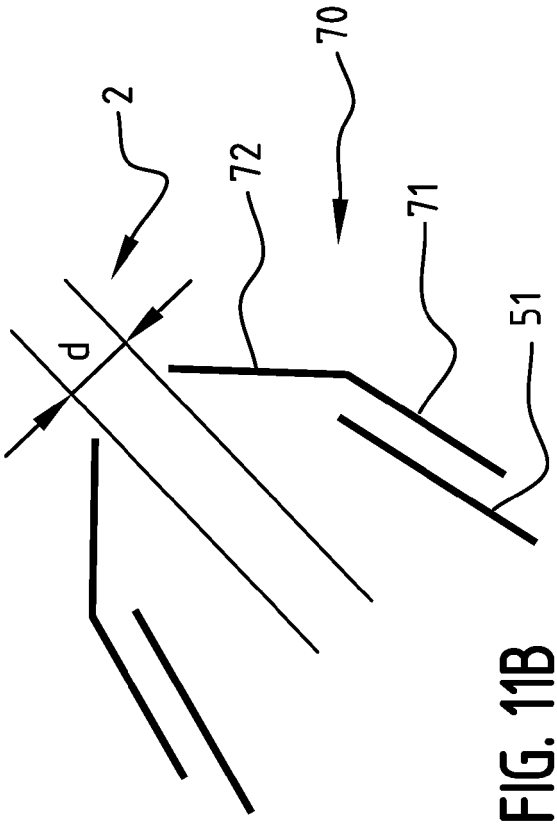

FIG. 11B

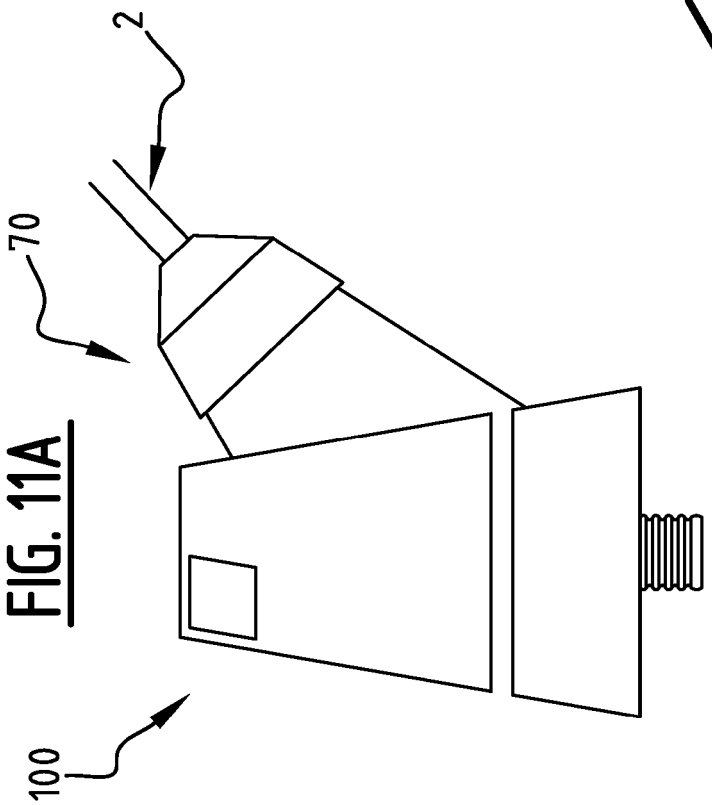

FIG. 11A

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EUROPEAN SEARCH REPORT

Application Number
EP 23 16 9169

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 568 479 A1 (ALFEN B V [NL]) 13 March 2013 (2013-03-13) * paragraphs [0003], [0014]; claims 1,3,4,11; figures 1-5 *	1-15	INV. H01F27/04 H01R13/52 H01B17/00
A	US 2008/128163 A1 (BRADFORD LAWRENCE E [US] ET AL) 5 June 2008 (2008-06-05) * paragraph [0036]; figure 2 *	1-15	
A	US 2004/184210 A1 (LYNCH MICHAEL D [US]) 23 September 2004 (2004-09-23) * figures 2,3 *	1-15	
A	US 6 995 313 B1 (BARNETT A DARREN [US] ET AL) 7 February 2006 (2006-02-07) * figures 1,2 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01R H02G H01F H01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 October 2023	Primus, Jean-Louis

CATEGORY OF CITED DOCUMENTS

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05-10-2023

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- EP 2568479 A1 **[0003]**