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(54) Stitched electrical terminal

(57) The present invention relates to an electrical terminal 1 with at least one terminal rotation protrusion 5 for causing a rotation of the electrical terminal 1 during insertion of said electrical terminal 1 through a material forming a connector housing 2. The invention further relates to a system for stitching a crimped electrical terminal 1 through a substrate material such as that forming a connector housing 2. The invention additionally relates to a method of stitching a crimped electrical terminal 1 into a substrate material that may form a connector housing 2.

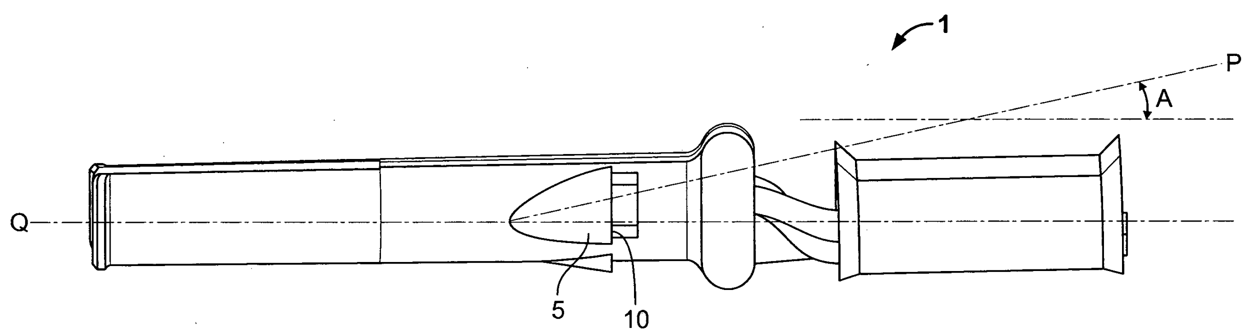

Fig. 1

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Description

[0001] The present invention relates to an electrical terminal that is stitched through a connector housing. In particular, the present invention relates to an electrical terminal with features causing a rotation of the electrical terminal when being stitched, and the system and method of stitching such an electrical terminal.

[0002] Electrical terminals are commonly stitched through connector housings or other components towards forming electric connectors or PCBs or the like. Applications where closely-packed electrical terminals are required often opt to have stitched terminals instead of terminals that have other kinds of positioning and holding features. Stitching is also a viable alternative to positioning electrical terminals within a leadframe. Often, the requirement of spacing individual electrical terminals closely together or other requirements of the application to be made to work within a limited amount of available space results in the electrical terminals in question being stitched through the material forming the connector housing. This leads to a saving of space and is advantageous over the requirement of forming individual cavities within a connector housing to receive electrical terminals. Stitching has been used not only for flat-tab like electrical terminals but also for pin-like terminals with square, rectangular or round cross sections. Stamped electrical terminals that are stitched into connector housings are also known.

[0003] The process of stitching an electrical terminal through a connector housing does have a disadvantage in that connector housings manufactured in this matter typically have lower pull-out forces required to cause failure of the connector housings. Pull-out forces may be experienced by electrical terminals at any time, and may originate in stitching process related sources, or may be exerted during use by forces pulling on wires that are crimped to the electrical terminal in question. Pull-out forces tend to pull the electrical terminal back through the connector housing into which it has been placed or stitched. Such pull-out forces are typically countered by providing abutment features on the electrical terminals, which increase the area over which the backward force may be distributed, when abutting the connector housing surface through which it was stitched. The problem stems from the fact that when electrical terminals pass through the plastic of the connector housing, they deform and usually damage at least a part of the material surrounding the stitched terminal. Electrical terminals often have a shoulder or nose constructed thereon to spread the force across a wider area of surrounding plastic if subjected to pull-out forces. Any damage caused to the surrounding plastic is generally even higher along the path taken by the shoulder or nose like protrusion formed on the electrical terminal when it is being stitched through the plastic forming the connector housing. This causes the disadvantage that although a given amount of pull-out force spread across the expanse of plastic that it abuts may otherwise not have caused failure, the weakening of the plastic as the electrical terminal and any protrusions formed on it pass through it causes failure at lower forces than expected. The usual method of calculating a failure point using factors such as the amount and kind of plastic, its area, its thickness, the area across which the electrical terminal actually distributes any pull-out force exerted thereon etc. are therefore rendered inexact, and the change in this is variable and not constant.

[0004] There is a need, therefore, for a stitched electrical terminal capable of avoiding failure and improving the resistance to failure for such an electrical terminal by increasing the required pull-out forces.

[0005] Stitching of an electrical terminal through a substrate material such as that forming a connector housing is inherently traumatic for the plastic or other kind of substrate material that the electrical terminal passes through while being stitched. The holding forces exerted by the plastic attempting to re-occupy the space occupied by an electrical terminal stitched through it may be significant, particularly depending upon the properties of the plastic or other substrate material used to form the connector housing. It is however common to use further features that ensure the safe positioning and retention of the electrical terminal within the connector housing. Commonly used features such as shoulders or noses or structures provided on the electrical terminal to increase the effective cross-sectional area of the terminal and correspondingly the volume of plastic that it abuts further exacerbate the trauma caused to the plastic or substrate material forming the connector housing that surrounds the electrical terminal.

[0006] The weakness of the plastic material abutted by the shoulder or nose or similar features as described above is worsened by the fact that the plastic material that such features abut is exactly the material that they have caused comparatively higher compression and correspondingly trauma in, when the electrical terminal is stitched through that plastic. This degraded mechanical integrity of the plastic abutted by the holding features causes a failure of this material at much lower forces than would otherwise be expected from a given type of plastic material, taking into account the volume of it that is appropriately located.

[0007] The disadvantages mentioned above are overcome by an electrical terminal according to this present invention. The electrical terminal described in the introductory part solves the problem according to the invention in that the electrical terminal is caused to rotate while being stitched through the plastic or other substrate material forming a connector housing. An electrical terminal with at least one terminal rotation protrusion may be provided according to this invention. The terminal rotation protrusion may cause a rotation of the electrical terminal during insertion of said electrical terminal through a substrate material forming the connector housing through which it is stitched. The rotation may be caused by an appropriately-formed terminal rotation protrusion pushing against the plastic it travels though, and in turn being pushed back by the plastic, resulting in the rotational movement. This may result in the electrical terminal undergoing a rotation as it travels though the plastic. Once the rotated electrical terminal emerges outside of the connector housing so that at least the terminal rotation protrusion is free of the plastic material, the electrical terminal may snap back into a relaxed state in which the rotation becomes undone. In such a state, depending upon the degree of rotation undergone by the electrical terminal while being stitched, the shoulder or nose or other abutment features that distribute the pull-out forces borne by the stitched electrical terminal may come to rest against areas of the surrounding plastic that are comparatively undamaged. Advantageously, the degree of rotation of the electrical terminal can be configured by appropriately selecting the shape of the terminal rotation protrusion, taking into consideration the nature and distance of the plastic that the electrical terminal passes through, while being stitched. The above may optimally be selected to result in the terminal rotation protrusion causing at least enough rotation so that when the rotation is undone, any holding shoulders or nose or any similar features come to rest against plastic material that they have not caused any trauma to, while the electrical terminal was being stitched.

[0008] The solution according to the present invention can be supplemented and further improved by the following embodiments, each of which is individually advantageous, and which can be combined with one another as desired. The features of the individual embodiments, the advantages of which will be specified in greater detail in what follows, can be combined with one another as desired or indeed can also be selectively omitted as required, for a given exemplary implementation of this present invention.

[0009] In an exemplary embodiment of this invention, at least one terminal rotation protrusion may be configured on an external surface of the electrical terminal. Two or more such terminal rotation protrusions may also be provided, with corresponding additive effects. The terminal rotation protrusions may be formed on the external surface of the electrical terminal, so that they are in direct contact with the material forming the connector housing when being stitched through it. Alternatively, in another exemplary embodiment, the terminal rotation protrusions may be formed on a separate sleeve-like structure that may be mounted onto the electrical terminal being stitched. In such a case, the sleeve may be configured to be removed from a forward direction, once the stitching process has been completed.

[0010] In an exemplary embodiment of this invention, the one or more terminal rotation protrusions may be configured along an axis that may be offset from a longitudinal axis of the electrical terminal. This offset may be selected depending upon the intended application, depending upon a variety of factors as described above, in order to cause a rotation of the electrical terminal when the latter is stitched through a given plastic material. Availability of more plastic material that the electrical terminal must pass through, i.e. a greater thickness of plastic that the electrical terminal is stitched through, may allow the offset to be of comparatively smaller angles from the longitudinal axis of the electrical terminal. Harder plastic material may also enable gentler offset angles, as the degree of rotation experienced by the electrical terminal may be higher in such cases. Correspondingly, if there is comparatively less thickness of plastic material available for the electrical terminal to be stitched through, or if the plastic material is comparatively softer and therefore susceptible for deformation easily and less capable of exerting sufficient force onto the electrical terminal to cause it to rotate, the angle of the terminal rotation protrusion may need to be made higher. The suitable angles would go from almost co-axial at the lower end up to higher angles where the terminal rotation protrusion itself causes too high a barrier of entry into the plastic material when being stitched into the connector housing. Advantageously, the angle formed by the axis of the one or more terminal rotation protrusions with respect to the longitudinal axis of the electrical terminal may be between 5° and 60°. The exact angle may vary in this range, depending upon the particulars of the application as described above and the nature and size of the connector housing itself.

[0011] In an exemplary embodiment of this invention, the terminal rotation protrusion may be configured to have a change in its height as measured from an external surface of the electrical terminal onto which it is formed or provided by means of a sleeve affixed onto an electrical terminal. Such a change may be gradual and along the full longitudinal length of the terminal rotation protrusion, or may be formed only in a part of the terminal rotation protrusion. For example, particular types of plastic material may require a greater deformative force initially but may succumb to even lower forces later in the insertion process. Other application may require the force being exerted by the terminal rotation protrusion changing at certain stages while going through the stitching process. The force being exerted by the terminal rotation protrusion onto the plastic corresponds with the force that is available to rotate the electrical terminal, by way of translation from an insertion force into a rotational force. This rotational force can therefore be administered and configured by suitably forming the terminal rotation protrusion.

[0012] In another exemplary embodiment, the rotation protrusion may change in height gradually from a first axial or front or insertion end of the electrical terminal to a second axial or rear end of the electrical terminal. The terminal rotation protrusion may be provided along the full longitudinal length of the electrical terminal, or may indeed be provided along only a part of the longitudinal length of the electrical terminal. In any case, the gradual change in the height of the terminal rotation protrusion may enable a comparatively constant or constantly changing force acting on the electrical terminal. This force acting on the electrical terminal would tend to rotate the electrical terminal as it passes through the plastic or other material that the connector housing may be formed of.

[0013] In another exemplary embodiment, the one or more rotation protrusions may be formed having a semi-circular cross section. The semi-circular cross sections may be increasing in diameter from a first axial or front or insertion end of the electrical terminal to a second axial or rear end of the electrical terminal. This would result in a kind of 'nose' being formed on the outside surface of the electrical terminal or sleeve affixed onto an electrical terminal. Such a design may be preferable as it may tend to cause least trauma such as scratching or cracking or other types of breakage in the plastic that it passes through. The avoidance of sharp edges in such a design would contribute to reduced trauma experienced by the plastic material it passes through.

[0014] In another exemplary embodiment, the nature of the plastic material or the available thickness thereof may require the one or more rotation protrusion to be formed as a flat or triangular surface. Such a flat or triangular surface forming a terminal rotation protrusion may increase in height along the longitudinal direction. Such an increasing height would form the terminal rotation protrusion as a slope along at least a part of an outer surface of the electrical terminal, from a first axial end that may be the front, insertion end of the electrical terminal to a second axial or rear end of the electrical terminal.

[0015] In an exemplary embodiment of this present invention, the one or more rotation protrusions may have a stop surface facing away from a first axial or front or insertion end of the electrical terminal and facing towards a second axial or rear end of the electrical terminal. Such a stop surface would help to spread the forces across a wider area of plastic, once the electrical terminal has been stitched through the plastic or other material forming the connector housing, and the stop surface comes to rest on the connector housing. A force tending to pull the terminal out would be countered by the combined effort of the holding forces exerted by the plastic material onto the electrical terminal as well as the mechanical abutment forces provided by the area of the connector housing abutted by the stop surface.

[0016] In an exemplary embodiment, a stop surface may be formed by an edge of the metal sheet forming the one or more terminal rotation protrusion, at its greatest height. This greatest height from the body of the electrical terminal would work to encompass a large area of the plastic or other material that the electrical terminal is stitched through, to provide the greatest degree of spreading of a force if a pull-out force is exerted on the electrical terminal or the cable to which it is crimped before being stitched through the connector housing. In an alternative exemplary embodiment, the stop surface may also be formed by a stepped surface formed on one or more of the terminal rotation protrusions along the axis of the at least one protrusion.

[0017] In another exemplary embodiment of the present invention, a system for stitching a crimped electrical terminal through a substrate material may be provided. The crimping of the electrical terminals would be done onto a wire, which may be insulated or not, depending upon the requirements of the application. The crimped electrical terminal may have one or more terminal rotation protrusions provided thereon, for causing a rotation of the electrical terminal during stitching of the electrical terminal through a substrate material forming, for example, a connector housing. It would be obvious that the substrate material may form any appropriate part, depending upon the requirements of the final use of the electrical terminal. However, the material forming the substrate that the electrical terminal is stitched through should enable the stitching process to be accomplished without causing mechanical breakage in the substrate material. Further, the properties of the substrate material should at least partially tend to bring the substrate material back to its initial position once it is pressed aside. Such a tendency of the substrate material may enable successful stitching of electrical terminals through the substrate material. For the stitching to be accomplished, the system may have a holder that may be capable of holding the electrical terminal during the stitching process. Due to rotational forces that may be generated during the stitching process as the electrical terminal is stitched through the substrate material, such a holder may be configured to allow the rotation of the electrical terminal as it passes through the substrate material that may form a connector housing. This may be accomplished by the provision of appropriate features on the holder itself that allow its rotation, along with the terminal that it holds. This may allow features such as terminal rotation protrusions provided on the electrical terminal to cause the rotational forces that in turn rotate the electrical terminal. Alternatively, the holder may be configured to be stationary during the stitching process, but may hold the wire that the electrical terminal is crimped onto at a far enough distance from the terminal. Appropriate selection of this distance may allow the holder to remain capable of holding the electrical terminal while the latter is being stitched, while allowing the electrical terminal to rotate by virtue of the flexibility of the insulation or wire or suitable parts of the electrical terminal itself.

[0018] In an exemplary embodiment, the holder may allow the rotation of the crimped electrical terminal by holding the crimped electrical terminal at a position suitable for allowing the flexibility of the crimped electrical terminal to enable the rotation of the electrical terminal. The flexibility may originate either in certain appropriately formed features of the electrical terminal itself, or may be enabled by the other components such as wire or insulation or any possible combination thereof. Alternatively, the holder may be provided with a rotation means that allows the holder to rigidly hold the crimped electrical terminal while the holder itself is rotated along with the crimped electrical terminal as the latter is being stitched through the substrate.

[0019] In another exemplary embodiment of the present invention, a method of stitching a crimped electrical terminal into a substrate material may be provided. Exemplarily, the method may include steps such as positioning the electrical terminal in a pre-assembly position near a substrate material into which it is intended to be stitched, followed by the step of inserting the electrical terminal through the substrate material forming, for example, a connector housing so that the electrical terminal goes from being in the pre-assembled position to ending up in the inserted position. While the stitching operation is ongoing, the method may include enabling the rotation of the electrical terminal when the electrical terminal is between the pre-assembled and the inserted position.

[0020] In an exemplary embodiment, the rotation of the electrical terminal may be achieved by a variety of well methods. As an example, the rotation may result from the springing back of the electrical terminal into a relaxed state. The excited state may have been reached by the rotation of the electrical terminal during insertion, where the rotation may itself have been caused by terminal rotation features having been present on the electrical terminal. The direction of movement into a relaxed state may be expected to be opposite to the direction of rotation that the electrical terminal may experience during the stitching process.

[0021] Alternatively, the rotation of the electrical terminal may be caused also by the application of a rotational force on the crimped electrical terminal, once it has been stitched through the substrate material. Such an application of an external rotational force may help to correct situations where insufficient rotation of the electrical terminal may have occurred, while it was stitched through the substrate material. This could also be useful where the amount of substrate material available for the electrical terminal to pass through does not enable the requisite degree of rotation required.

[0022] In what follows, the present invention will be specified in greater detail by way of example, within the context of embodiments, with reference to the attached set of drawings. The embodiments represent merely possible configurations, in which individual features, as described above, can be implemented independently of one another or can be omitted. In the interest of clarity, in the description of the embodiments, the same features and elements have been identified by the same reference signs.

[0023] The drawings show:

Fig. 1 shows a schematic perspective view of an embodiment of an electrical terminal according to the present invention;

Figs. 2a and 2b show a schematic perspective view of an embodiment of a connector housing receiving an electrical terminal according to the present invention in a pre-assembly position; and

Figs. 3a and 3b show a schematic perspective view of an embodiment of a connector housing receiving an electrical terminal according to the present invention in an inserted position.

[0024] Fig. 1 shows an electrical terminal 1 according to an embodiment of the present invention. The electrical terminal 1 has a terminal rotation protrusion 5 provided on its outer body surface. The axis of the terminal rotation protrusion 5 is offset from the longitudinal axis Q of the electrical terminal 1. The terminal rotation protrusion 5 has an axis of symmetry along a direction P, which forms and angle A with the direction Q as shown. Such an electrical terminal 1, when stitched through a substrate such as the plastic material forming a connector housing will experience rotational forces acting upon the electrical terminal 1. Such rotational forces would tend to rotate the electrical terminal 1 by a degree corresponding with the angle A and the amount of substrate that the electrical terminal 1 passes through. The terminal rotation protrusion 5 culminates in a shoulder 10 that is formed at the greatest height of the electrical terminal 1, at the rear end of the terminal rotation protrusion 5.

[0025] Figs. 2a shows a schematic perspective view of an embodiment of a connector housing 2 suitable for receiving a crimped electrical terminal 1 according to the present invention. In a pre-assembly position as shown in Fig. 2b, the crimped electrical terminal 1 is inserted into a cavity 20 formed in the connector housing 2. At some point during the insertion of the crimped electrical terminal 1 into the connector housing 2, the width of the combined features of the crimped electrical terminal 1 would equal the width of the available space in the connector housing 2 through which the crimped electrical terminal 1 must be stitched. As an example, such a situation may be considered to be reached at position 25, where the two above mentioned widths or cross-sections become equal. As the electrical terminal is continued to be inserted into the cavity 20 along the insertion direction T, the terminal rotation protrusion 5 abuts and interacts with the substrate material forming the connector housing. As the axis P of the terminal rotation protrusion 5 is offset from the axis Q of the crimped electrical terminal 1, a rotational force is exerted upon the electrical terminal as it passes through the connector housing 2. This rotation continues till the rear end or shoulder 10 of the terminal rotation protrusion 5 clears a forward surface 30 of the connector housing 2, causing the terminal to be rotated along the direction R. This results in the terminal rotation protrusion 5 and other features on the electrical terminal to rotate away from the positions they may have emerged in, had the stitching process only involved a straight forward movement.

[0026] Fig 3a shows a schematic perspective view of an embodiment of a connector housing 2, and Fig 3b shows this connector housing 2 receiving a crimped electrical terminal 1 according to the present invention, shown in an inserted position. Once the crimped electrical terminal 1 is inserted far enough into cavity 20 so that the shoulder 10 formed on the terminal rotation protrusion 5 is freed of the substrate material, the potential energy stored in the form of rotation of the crimped electrical terminal 1 is translated into a movement of the electrical terminal in a direction S, where S is opposite to the direction R. When shoulder 10 reaches the position corresponding with the forward surface 30 and is then pushed further in the direction T, the absence of further substrate material surrounding and abutting the terminal rotation protrusion 5 results in no further rotational force acting upon the components along the direction R. The potential energy stored in the form of the rotation of the crimped electrical terminal 1 is therefore freed to act, and results in the rotation of the electrical terminal along the direction S. This rotation along the direction S in turn results in the shoulder 10 ending up against a part of the substrate forming the forward surface 30 that it has not passed through, while being stitched into the connector housing.

Claims

1. An electrical terminal (1) with at least one terminal rotation protrusion (5) for causing a rotation of the electrical terminal (1) during insertion of said electrical terminal (1) through a material forming a connector housing (2).

2. The electrical terminal (1) according to claim 1 **characterized in that** said at least one terminal rotation protrusion (5) is configured on an external surface of the electrical terminal, said external surface being in direct contact with the material forming the connector housing (2).

3. The electrical terminal (1) according to claims 1 or 2 wherein the at least one terminal rotation protrusion (5) is configured along an axis offset from a longitudinal axis of the electrical terminal.

4. The electrical terminal (1) according to one of claim 3 wherein the angle formed by the axis of the at least one terminal rotation protrusion (5) with respect to the longitudinal axis of the electrical terminal (1) is between 5°and 60°.

5. An electrical terminal (1) according to claims 1 to 4 wherein the at least one terminal rotation protrusion (5) changes in height in at least a part of said at least one rotation protrusion.

6. The electrical terminal (1) of any of claims 1 to 5 wherein the rotation protrusion changes in height gradually from a first axial end of the electrical terminal (1) to a second axial end of the electrical terminal.

7. The electrical terminal (1) of any of claims 1 to 6 wherein said at least one rotation protrusion is formed having a semi-circular cross section, the semi-circular cross section increasing in diameter from a first axial end of the electrical terminal (1) to a second axial end of the electrical terminal.

8. The electrical terminal (1) of any of claims 1 to 6 wherein said at least one terminal rotation protrusion (5) is formed as a flat or triangular surface increasing in its height for forming a slope along at least a part of an outer surface of the electrical terminal (1) from a first axial end of the electrical terminal (1) to a second axial end of the electrical terminal.

9. The electrical terminal (1) of any of claims 1 to 8 wherein said terminal rotation means is formed on a separate sleeve affixed on to the electrical terminal.

10. The electrical terminal (1) of any of claims 1 to 9 wherein said at least one terminal rotation protrusion (5) has a stop surface (10) facing away from a first axial end of the electrical terminal (1) and facing towards a second axial end of the electrical terminal.

11. The electrical terminal (1) of claim 10 wherein said stop surface (10) is formed by an edge of the metal sheet forming said at least one terminal rotation protrusion (5) at its greatest height.

12. A system for stitching a crimped electrical terminal (1) through a substrate material (2), **characterized in that**

    a. the crimped electrical terminal (1) has at least one terminal rotation protrusion (5) for causing a rotation of the electrical terminal (1) during stitching of said electrical terminal (1) through the substrate material (2); and
    b. a holder configured to hold said electrical terminal (1) during the stitching process, said holder being further configured to allow the rotation of the electrical terminal (1) as it passes through the substrate material (2).

13. The system of claim 12 wherein the holder allows the rotation of the crimped electrical terminal (1) by at least one of: the holder holding the crimped electrical terminal (1) at a position suitable for allowing the flexibility of the crimped electrical terminal (1) to enable the rotation of the electrical terminal, or the holder is provided with a rotation means that allows the holder to rigidly hold the crimped electrical terminal (1) while the holder itself is rotated along with the crimped electrical terminal (1).

14. A method of stitching a crimped electrical terminal (1) into a substrate material (2), comprising the steps of

a. positioning the electrical terminal (1) in a pre-assembly position,
b. inserting the electrical terminal (1) through the substrate material (2) so that the electrical terminal (1) is moved from the pre-assembled position to the inserted position, and
c. enabling the rotation of the electrical terminal (1) between the pre-assembled and the inserted position.

15. The method of claim 14 wherein the rotation of said electrical terminal (1) is achieved by at least one of:

a. springing back of the electrical terminal (1) into a relaxed state, the excited state having been reached by the rotation (R) of the electrical terminal (1) during insertion, the direction of movement into a relaxed state (S) being opposite to that which the electrical terminal (1) experiences during the stitching process; or
b. applying a rotational force on the crimped electrical terminal (1).

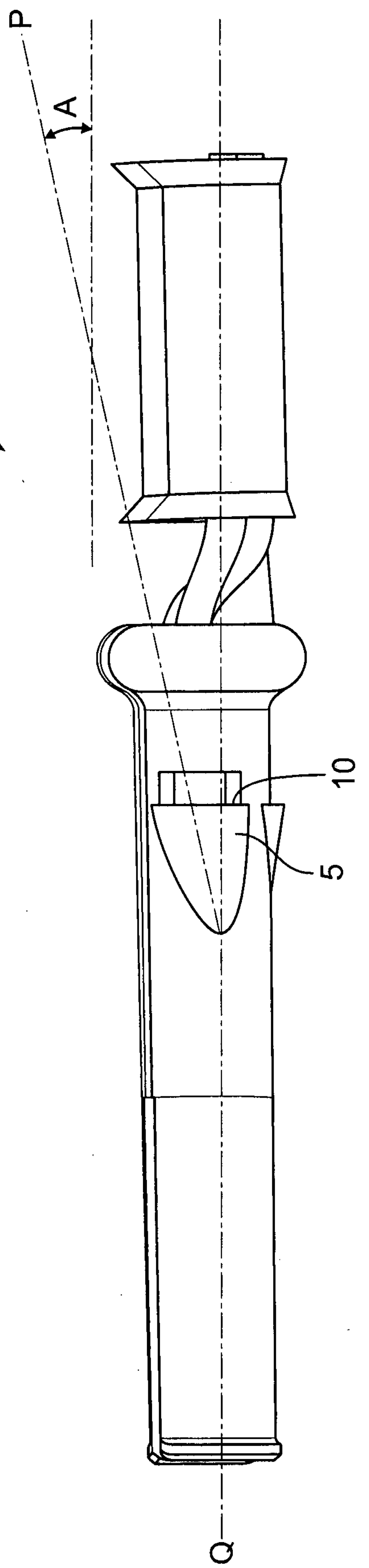

Fig. 1

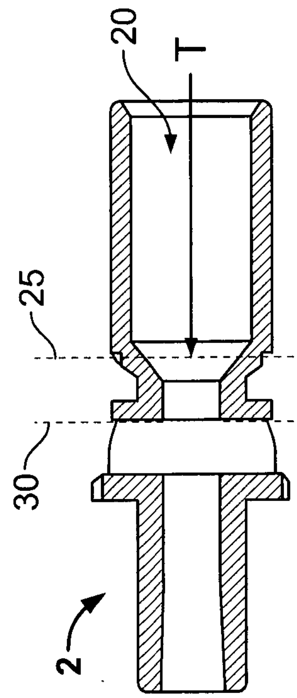

Fig. 2A

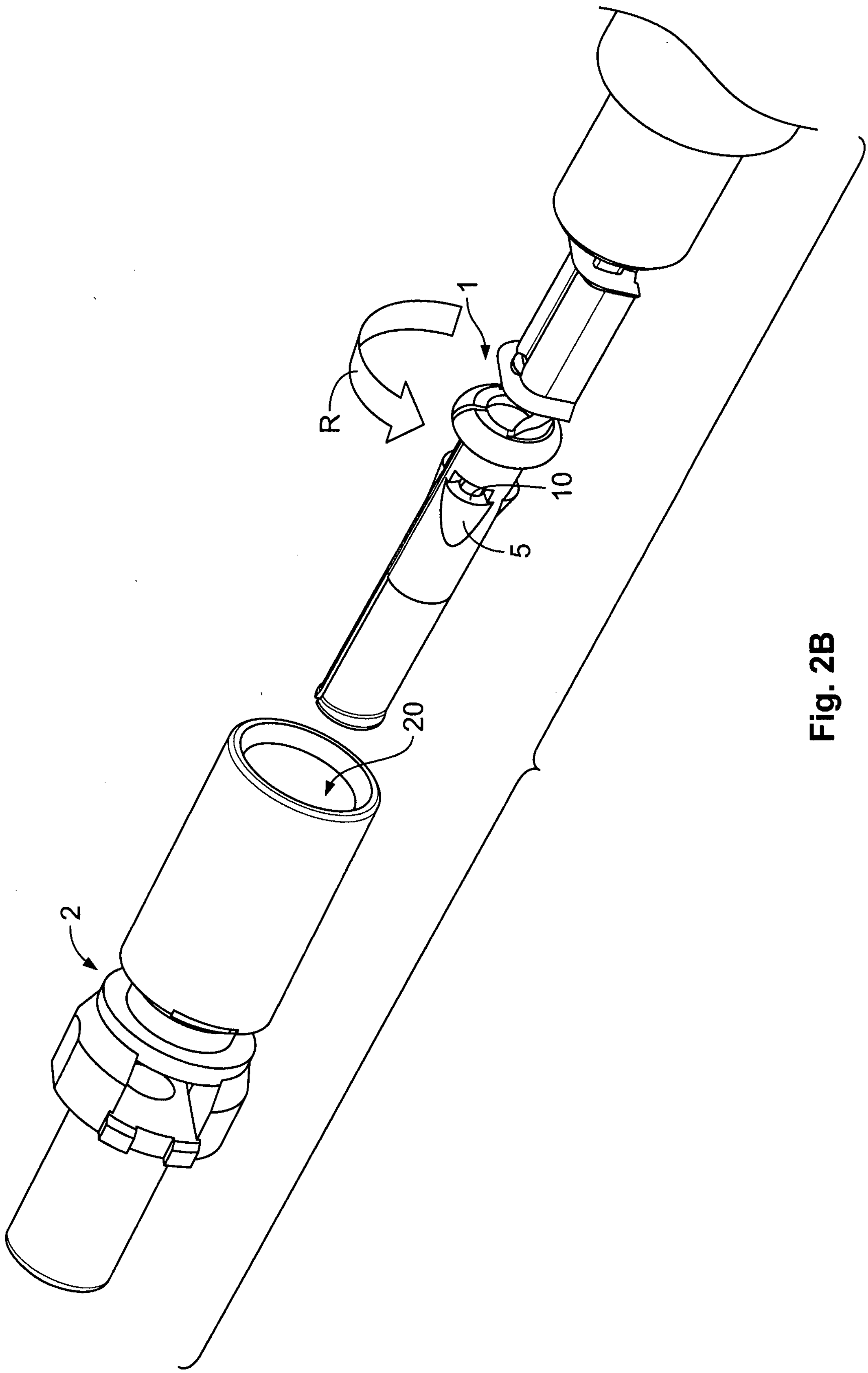

Fig. 2B

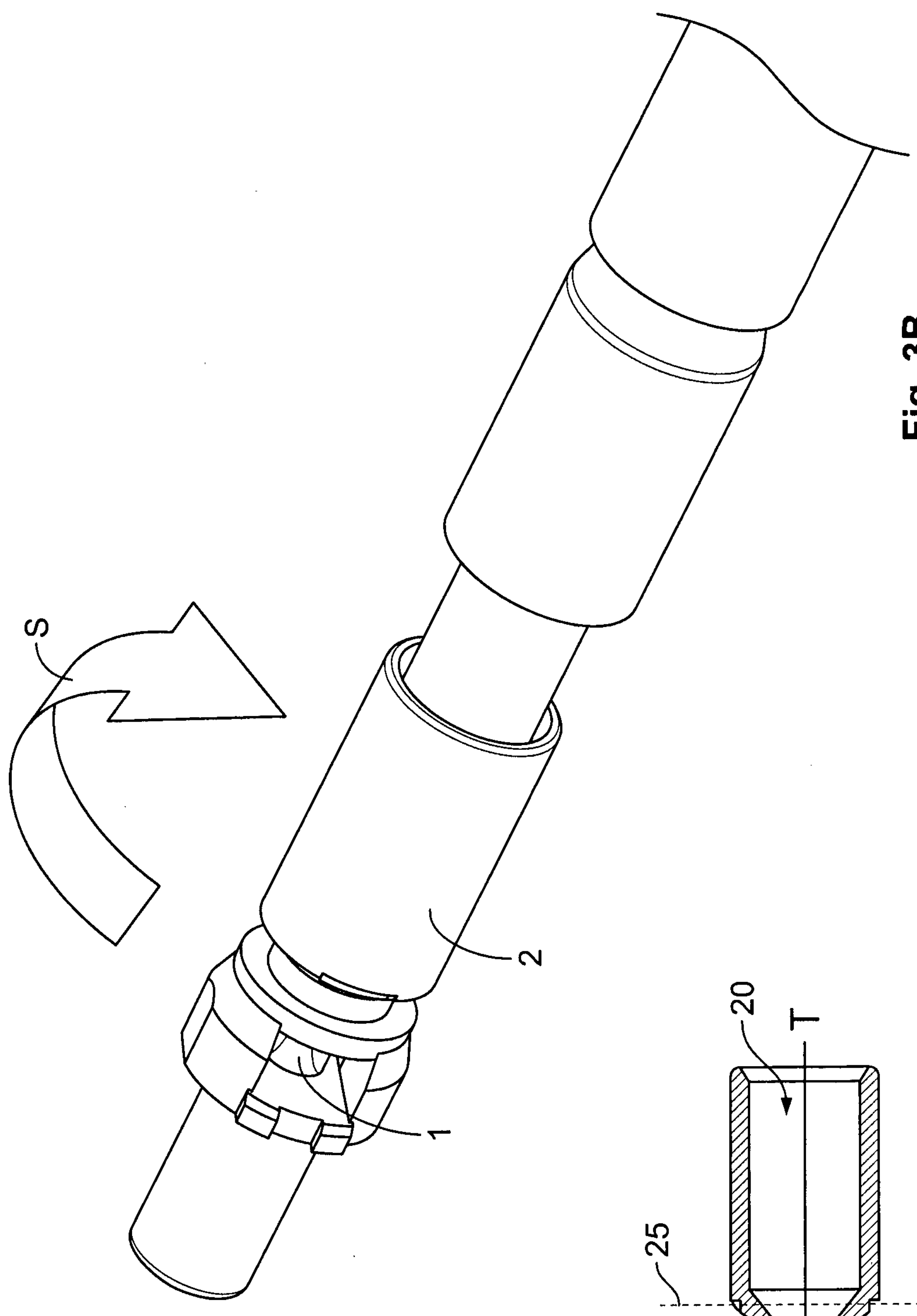

Fig. 3B

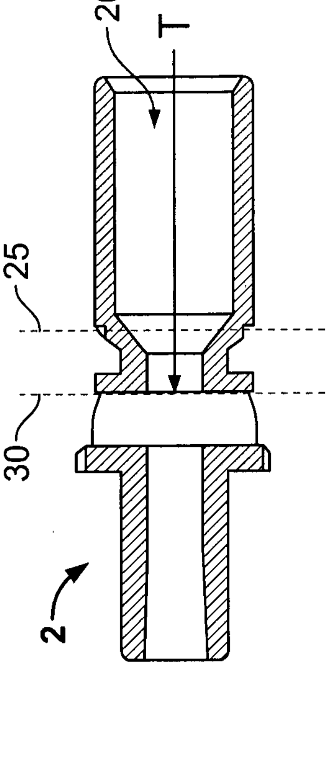

Fig. 3A

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 6443

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 4 867 714 A (OWEN LEONARD J [GB]) 19 September 1989 (1989-09-19) * column 4, line 15 - line 39 * -----	1-3,9-14 4-8	INV. H01R13/42 H01R43/20
X	EP 2 503 646 A1 (BOSCH GMBH ROBERT [DE]) 26 September 2012 (2012-09-26) * paragraph [0009] - paragraph [0013] * -----	1,2, 10-15	
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TECHNICAL FIELDS SEARCHED (IPC)

H01R

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	7 February 2014	López García, Raquel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 18 6443

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