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(54) **METHOD AND DEVICE FOR SEPARATING ELECTRIC CONTACT PINS FROM A CONTINUOUS WIRE**

(57) A method and device for individually separating pin-shaped electric contacts (3) from a continuous wire (2), in a machine for manufacturing component parts for electric motors, wherein the pin is engaged in a rotating shaft (7) and a rotation of the post causes the notch connecting the pin to the rest of the wire to collapse by twisting, thus obtaining the individual separation of the pin by means of a twisting cut.

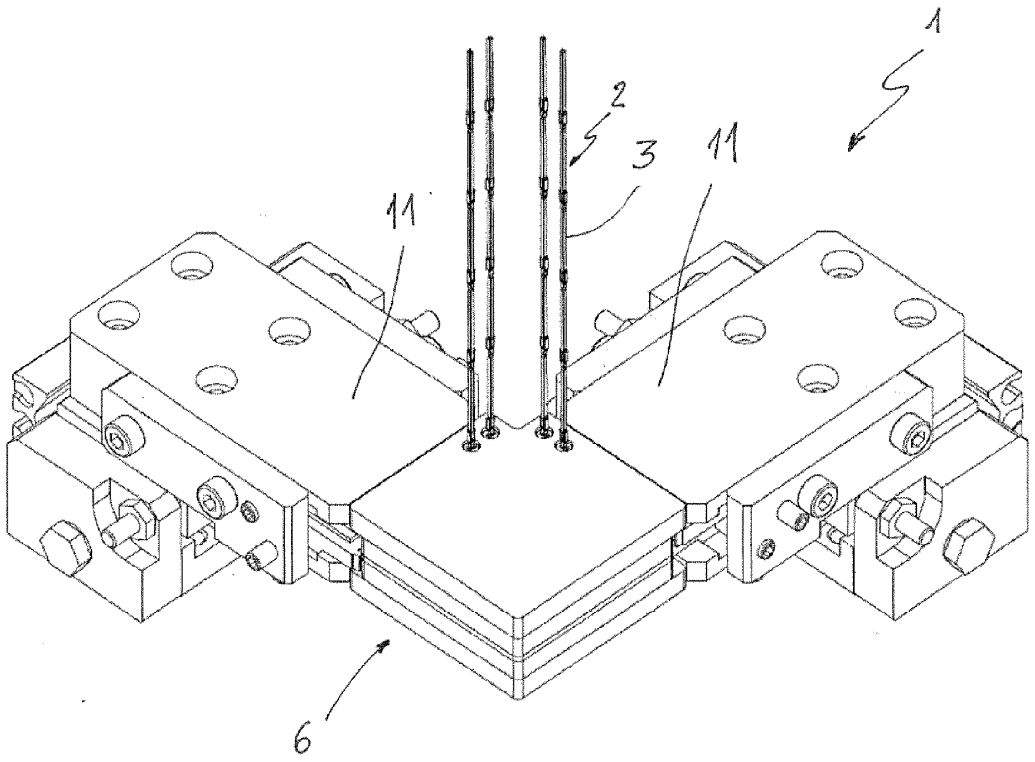

FIG. 1

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Description

Field of application

[0001] The invention relates to the technical field of machines for manufacturing electrical components. The invention relates more closely to machines and processes using electric contact terminals provided in the form of a continuous wire.

Prior art

[0002] Electric contact terminals shaped like pins are known, which are supplied in the form of a continuous wire wound into coils. The wire consists of pins interspaced by notches to facilitate separation. Said contacts are widely used in processes of SMT (surface-mount technology) type and THT (through-hole technology) type. Contact pins known under the Autosplice® brand are one example. An application of great industrial interest relates to the components for electric motors, especially for the automotive field where there is a growing demand due to the ever-increasing number of electric drives of modern vehicles (air conditioning, automatic mirror or seat adjustment, headlight adjustment, etc.).

[0003] The individual contact terminal (hereinafter referred to as a pin) is essentially pin-shaped, with a variable length according to customer request, typically of a few millimeters (e.g. 10-15 mm). The coil thus contains hundreds or thousands of individual pins. The cross-section of a pin can be of different shapes depending on the application. The cross-section dimension (diameter or equivalent) is typically less than a millimeter, for example the diameter is of about 0.5-0.6 mm in many applications.

[0004] The provision in the form of a wire coil is convenient to feed an industrial machine. However, the problem arises of how to separate the individual pins within the production process. In the prior art this is done by cutting the wire with a blade at the notches.

[0005] However, it has been noted that cutting can generate a microscopic burr that remains on the pin. The burr generally appears as a sharp edge protruding in the direction of the cutting blade. The formation of burrs could be limited by sharpening the blade frequently, but this remedy is not feasible because it would cause high production downtime costs. In use, a detachment of the burr from the cutting section may occur, for example due to vibrations. The detachment of the burr could create an undesired false contact. All new brushless electronic motors include an electronic board with the necessary components to read the position of the rotor relative to the stator, and thus position the rotor according to the input received. Reference can be made for example to the stator of an electric motor provided with the pins given here for the necessary contacts of the winding terminals. The material from the cutting burr could fall onto the underlying printed circuit and cause a false contact.

[0006] Such a risk can be considered small, but cannot be excluded, especially in components subject to high stresses and vibrations, as is the case in the automotive field and in the industry known as "appliances". This problem has been identified but a solution with acceptable industrial costs has not yet been found, therefore the presence of these cutting defects is tolerated. However, the problem remains unsolved, and even if the risk is remote, one should consider the economic and reputational damage of a recall campaign caused by such defect.

Summary of the invention

[0007] The invention aims at eliminating the above problem related to the cutting burrs on the pins and the consequent risk of a false contact due to the detachment of conductive material from the burrs themselves.

[0008] This object is achieved by a method according to the invention. The method includes separating the pins from the wire by twisting, rather than cutting, the weakened wire section at the notch. More in detail, the method includes:

bringing an end pin of the wire into engagement with a rotating element, the engagement being such as to create a rotation constraint between said pin and said element, so that a rotation of the element causes a rotation of the pin about the axis thereof;

rotating said rotating element to torsionally stress, until breaking, the wire portion at the notch between said end pin and the remaining part of the wire;

collecting the pin separated from the wire and transferring it to a next step of use, thus releasing the rotating element.

[0009] The applicant has found that by torsionally stressing, until breaking, the wire portion at the notch (a portion with reduced strength between two adjacent pins along the wire), a fracture surface of the wire is obtained, which is substantially free from the burrs typically formed by blade cutting. Microscope inspection shows a smoother and more regular fracture surface than that obtainable by conventional blade cutting. Therefore, the goal of reducing the risk that the material of the cutting burrs triggers a short circuit is achieved. Moreover, the method of the invention can be implemented in an industrial machine without affecting the process in terms of speed and production capacity. The method of the invention is as fast as conventional cutting, can be implemented automatically or semi-automatically, and is superior in quality.

Description of the invention

[0010] The method of the invention is performed in the context of a production process for manufacturing elec-

trical components. The wire is generally a drawn wire made of a suitable conductive material. Examples of preferred conductive material comprise copper or phosphor bronze. In applications of the invention, the pin has a shape adapted to form the desired torsional constraint engagement with the rotating element. The engagement can occur along all or part of the pin.

[0011] Preferably, the pin has a rectangular or square cross-section.

[0012] The end pin forming the end of the wire is brought into engagement with a rotating element, which twists the wire portion corresponding to the notch between said end pin and the next one until breaking. The end pin is thus separated from the wire and usable in the industrial process of interest.

[0013] Preferably, the pin separated from the wire falls by gravity being collected under the rotating element by means of a suitable collection and transfer device, such as a carriage or other movable member, for example. Once the pin separated from the wire has been ejected, the wire moves one length forward to bring the next pin into engagement with the rotating element, and the process can be repeated. The feed length of the wire corresponds to the length of a pin.

[0014] Said rotating element is preferably shaped like a shaft with an axial cavity adapted to accommodate the pin to be detached. Preferably, the shaft is vertically oriented. The cavity can be sized to accommodate part of the pin length or the whole pin. Preferably, the cavity is a passing through-cavity to allow the pin to fall by gravity after detachment.

[0015] The rotating element is moved by a suitable mechanical control. In a preferred embodiment, said control features a pinion and a rack. Particularly, in an embodiment, the rotating element is a shaft provided with a pinion which is integral with the body of the shaft itself and engaged with a rack being integral with a translating slide. The movement of the slide, through the engagement between rack and pinion, causes the rotation of the shaft and therefore the twisting until breaking of the wire in the notch area.

[0016] The rotational coupling between pin and rotating element can be given by a non-circular section of the pin and/or by a pin portion having a modified shape, e.g. a section with fins adapted to deform elastically upon assembly. Based on the shape of the pin, the cavity of the rotating element can be conveniently designed. The method of the invention can be performed in parallel on a plurality of wires thus obtaining the separation of a plurality of individual pins for each work cycle.

[0017] The method of the invention is performed continuously during a production process. The wire(s) is/are moved forward according to a feed length corresponding to the length of the pins. For each feed length, the head pin of the wire (or of each wire, if more than one) engages a respective rotating element, is separated by twisting, and ejected.

[0018] A machine for manufacturing components for electric motors according to the invention comprises a device for individually separating electric contact pins from a continuous feed wire, where said wire consists of pins joined together where, between one pin and the other, the wire has a low-strength notch, and where said separation device comprises:

a rotating element adapted to accommodate the end pin of the wire integrally with the rotation;

means arranged to rotate said rotating element to torsionally stress, until breaking, the reduced-strength portion which joins said end pin to the remaining part of the wire;

means for collecting the pin separated from the wire and transferring it to a next step of use, thus releasing the rotating element;

the machine being further provided with a control system configured to perform the aforesaid working steps cyclically in sequence.

[0019] The machine is preferably configured to operate with the method described above, in the various modes thereof as described.

[0020] In accordance with the above, the rotating element is preferably a vertically oriented shaft having a cavity for accommodating the end pin of the wire. More preferably, the shaft cavity is a through-cavity; the means for collecting the pin after it has detached from the wire comprise a carriage or other movable member positioned under the shaft. According to this preferred mode, once the pin has detached, it falls through the shaft cavity and is collected under the device.

[0021] Preferably, the shaft comprises a pinion and the separation device comprises a movable slide having a rack engaged with said pinion, where a movement of the slide imparts to the shaft the rotation required to detach the pin by twisting the wire.

[0022] In a preferred embodiment, the shaft is mounted inside a housing of a support pad. Said support pad can comprise a plurality of housings for a respective plurality of shafts. In an embodiment, for example, the shafts are distributed along a first side and a second side of the pad, and the device comprises a first and a second rack slide adjacent to said sides, where the first slide actuates the shafts arranged along the first side and the second slide actuates the shafts arranged along the second side.

[0023] A preferred application relates to the manufacturing of electric motor components. For example, the pins can form the contacts of an electric motor stator.

[0024] A non-limiting example of use for an electric motor stator is as follows. Once the pins have been individually separated from the wire, they are inserted into a plastic coil former forming the body of the stator. The coil former has one or more supports about which the windings are created. The pins provide the contacts for each

winding of the component: for example, a two-phase stator, with one winding per phase, will have four contact pins.

[0025] Without limitation, some preferred applications include: stators of small brushless motors, small electric coils, solenoids of pneumatic or hydraulic valves, or small electromagnets of linear servo-actuators.

[0026] The invention also relates to a machine for manufacturing electrical components according to the appended claims. A preferred but not exclusive application relates to the manufacturing of components for electric motors, more preferably for component parts in the automotive field.

[0027] Another aspect of the invention is a process for manufacturing electrical components, particularly for electric motors, comprising the method described above for separating contact pins from a continuous wire.

[0028] The features and advantages of the invention will become more apparent from the description of a preferred embodiment, shown in the drawings.

Description of the drawings

[0029]

Fig. 1 shows the main components of a device for separating pins from a continuous wire according to an embodiment of the invention.

Fig. 2 is a detail of Fig. 1.

Fig. 3 is another detail of Fig. 1.

Fig. 4 shows the device in Fig. 1 with some parts removed to see the internal components.

Fig. 5 is a detail of Fig. 4.

Fig. 6 is another detail of Fig. 4.

Figs. 7 and 8 show further constructional details of the device in the figures above.

Fig. 9 shows the operation of the device in Figs. 1-8.

Fig. 10 shows the device in Figs. 1-8 inserted to be coupled to a wire feeding system.

Fig. 11 shows the typical appearance of a cut made according to the prior art under a microscope.

[0030] Fig. 1 shows a device according to an embodiment of the invention with reference numeral 1. The device 1 individually separates electric contact pins supplied in the form of wires 2. The example shows a device operating on four wires 2.

[0031] The device 1 is advantageously used in a machine for manufacturing electrical components such as stators for electric motors or electric coils in general, especially of small size.

[0032] A wire 2 consists of a plurality of pins 3 connected to one another. In the example, the pin 3 is in the shape of a pin with a square section ending with a head 4. Two adjacent pins are separated by a notch 5 where the wire 2 has a reduced strength.

[0033] The wires 2 come from coils (not shown). The wires are drawn wires, for example.

[0034] The separation device 1 comprises a pad 6 housing a series of shafts 7 which rotate inside the pad 6. Each of the shafts 7 has a through-cavity 8 shaped to accommodate, partially or completely, one of the pins 3. In the example, the pad 6 houses four shafts; thereby, the device 1 is fed by four wires 2 as seen in the figure.

[0035] The cavity 8 is shaped so that a pin 3, once inserted, is rotationally integral with shaft 7, i.e., by rotating the shaft 7 about the axis thereof (axis A in Fig. 8), the pin 3 inserted into the shaft rotates together with the shaft itself. Either a part of the length of the end pin 3 of the wire or preferably the whole length thereof is accommodated inside cavity 8. Note that the notch 5 connecting the pin 3 to the rest of the wire remains free with respect to the shaft 7.

[0036] The separation of the end pin 3 from the rest of the wire occurs with a quick rotation of the shaft 7, which twists the wire until it breaks due to twisting. Breaking occurs at notch 5 where the wire 2 has a lower resistance to stress. In other words, a "twisting cut" of pin 3 from the rest of the wire is obtained.

[0037] In the example, the pad 6 houses four shafts 7 and therefore, at each working cycle, the device 1 is capable of ejecting four pins ready for use in the production process (such as assembly on a suitable support of an electrical component, for example).

[0038] The orientation of device 1 is vertical, i.e., the axis of the shafts 7 is a vertical axis as the direction of the wires 2 is vertical (Fig. 1).

[0039] In Fig. 4, a preferred mode to control the shafts 7 can be seen. The device 1 comprises two slides 11 on the sides of pad 6. Each of the slides 11 comprises a rack 10 and each of the shafts 7 has a pinion 9 which is integral with the body of the shaft and is engaged with the rack 10 of one of the slides 11. Note that, in Fig. 4, a cover 61 of the pad 6 is lifted, to allow the internal parts to be viewed.

[0040] A displacement of the slides 11 in the direction indicated by arrow 12, parallel to the sides of the pad 6, causes the rotation of the shafts 7 and the desired twisting effect up to breaking of wire 2 with the detachment of pin 3. The actuation of the slides 11 can be mechanical or pneumatic.

[0041] In the example, the adjacent shafts 7 along each side of the pad 6, being very close to one another, have the respective pinions 9 at staggered heights. Therefore, each slide 10 comprises an upper rack and a lower rack (in Fig. 4 and Fig. 6, only the upper racks can be seen).

[0042] In Fig. 5, the wire 2, the pins 3 forming it, the

notches 5 between one pin and the other are shown again.

[0043] Fig. 7 shows a preferred construction of the pad 6 consisting of a plurality of overlapping plates 61-65. The plates are conveniently shaped and comprise: bottom plate 65, intermediate plates 62 and 64, a cover 61, a central plate 63. Some details are shown in the figure: seats 66 for housing the pinions 9; alignment pegs 67; holes 68 for said pegs 67; holes 69 for the shafts 7.

[0044] A shaft 7 is shown in Fig. 8. In this figure, it can be seen that the shaft 7 has a circular section and the pinion 9 is keyed; the slot 8 is shaped with a rectangular section adapted to receive the head 4 of the contact pin 3 (Fig. 2) with a shape coupling that makes the pin 3 locked with respect to the axial rotation relative to shaft 7. The rotation is intended about the axis A of the shaft itself. As can be seen, the shape and size of the cavity 8 are conjugated to the shape and size of the head 4 of the contact pin. The head 4, entering into the cavity 8, establishes the rotation constraint which allows the shaft 7, when it rotates, to take the pin 3 therewith, thus twisting the notch 5 until it breaks.

[0045] Fig. 9 is similar to Fig. 1 and exemplifies the stages of a working cycle of device 1. The arrows in Fig. 9 show the displacement of the slides 11, the rotation of the shafts 7, the fall of the pins 13 by gravity. The pins 3 separated from the wire 2 are shown, which fall by gravity under the pad 6 where they are collected by a suitable translating feeder, for example a carriage.

[0046] Fig. 10 shows the device 1 coupled to a system 50 for feeding and guiding the wires 2. Note that the wires 2 are guided vertically between the elements 51 and 52 towards the underlying device 1. The wires 2 advance length by length, at each work cycle the pin 3 at the head of each wire is engaged in the respective shaft 7; the rotation imparted by the slides 11 detaches it from the wire, and once the pin 3 has been separated from the wire, it falls under the device 1 where it is collected. The wires 2 come from feeding coils (not shown).

[0047] Fig. 11 provides a better understanding of the problem addressed by the invention. The figure shows the cut surface 30 obtained with a traditional blade cutting in the direction indicated by arrow C. The figure shows the burr 31 as it typically appears under a microscope. Said burr 31 generally has a size of a few hundredths of a millimeter. The burr 31 is substantially eliminated by virtue of the invention.

Claims

1. A method for individually separating pin-shaped electric contacts (3) in a production process for manufacturing electrical components, wherein:

   the pins (3) are fed in the form of a continuous wire (2), said wire being formed by the pins joined together and interspaced by notches (5) of reduced strength,
   and wherein the method comprises the following steps:

   a) bringing an end pin (3) of the wire into engagement with a rotating element (7), the engagement being such that a rotation of the element causes a rotation of the pin about the axis thereof;
   b) rotating said rotating element to torsionally stress, until breaking, the wire portion at the notch (5) between said end pin and the remaining part of the wire;
   c) collecting the pin separated from the wire and transferring it to a next step of said process, thus freeing the rotating element, and bringing the next pin of the wire into engagement with the rotating element;
   d) repeating the sequence of steps a) to c) so as to feed the process with the pins separated from the wire.

2. A method according to claim 1, wherein the end pin is brought into engagement with a passing-through cavity of the rotating element, and after separation from the wire, the pin falls by gravity being collected under the rotating element.

3. A method according to claim 1 or 2, wherein said rotating element is shaped like a shaft with an axial cavity (8) adapted to receive the end pin of the wire.

4. A method according to claim 3, wherein the rotation of the shaft is imparted by an engagement between a pinion (9) integral with the shaft (7) and a rack (10) integral with a translating slide (11).

5. A method according to one of the preceding claims, wherein the method is performed in parallel on a plurality of wires obtaining a plurality of individually separated pins for each working cycle.

6. A method according to one of the preceding claims, wherein the method is automatically performed in a machine for manufacturing electrical components.

7. A machine for manufacturing electrical components, comprising a device (1) for individually separating electric contact pins (3) from a continuous wire (2), wherein said wire (2) consists of the pins (3) joined together and interspaced by notches (5) where the wire has a reduced strength, and wherein said separation device comprises:

   a rotating element (7) adapted to accommodate the end pin of the wire with a rotationally integral engagement,
   means arranged to rotate said rotating element

to torsionally stress, until breaking, the wire portion joining said end pin to the remaining part of the wire;
means for collecting the pin separated from the wire and transferring it to a next step of use, thus releasing the rotating element;
a control system configured to perform the aforesaid working steps automatically and cyclically.

8. A machine according to claim 7, wherein the rotating element is a vertically oriented shaft (7) having a cavity (8) for accommodating said end pin of the wire.

9. A machine according to claim 8, wherein the cavity (8) of the shaft is a passing-through cavity and the means for collecting the pin after detachment from the wire comprise a member positioned under the shaft.

10. A machine according to claim 8 or 9, wherein the shaft (7) comprises a pinion (9) and the separation device comprises a movable slide (11) having a rack (10) engaged with said pinion, wherein a displacement of the slide imparts to the shaft (7) the necessary rotation for the detachment of the pin (3) by twisting the wire (2).

11. A machine according to one of claims 8-10, wherein the shaft is mounted inside a housing of a support pad (6).

12. A machine according to claim 11, wherein said support pad (6) comprises a plurality of housings for a respective plurality of shafts.

13. A machine according to claim 12, wherein the support pad comprises housings for shafts distributed along a first side and a second side of the pad (6), and the device comprises a first and a second rack slide adjacent to said sides, wherein the first slide actuates the shafts arranged on the first side and the second slide actuates the shafts arranged on the second side.

14. A machine according to one of claims 7 to 13, for manufacturing components for electric motors, in particular for stators or rotors of electric motors.

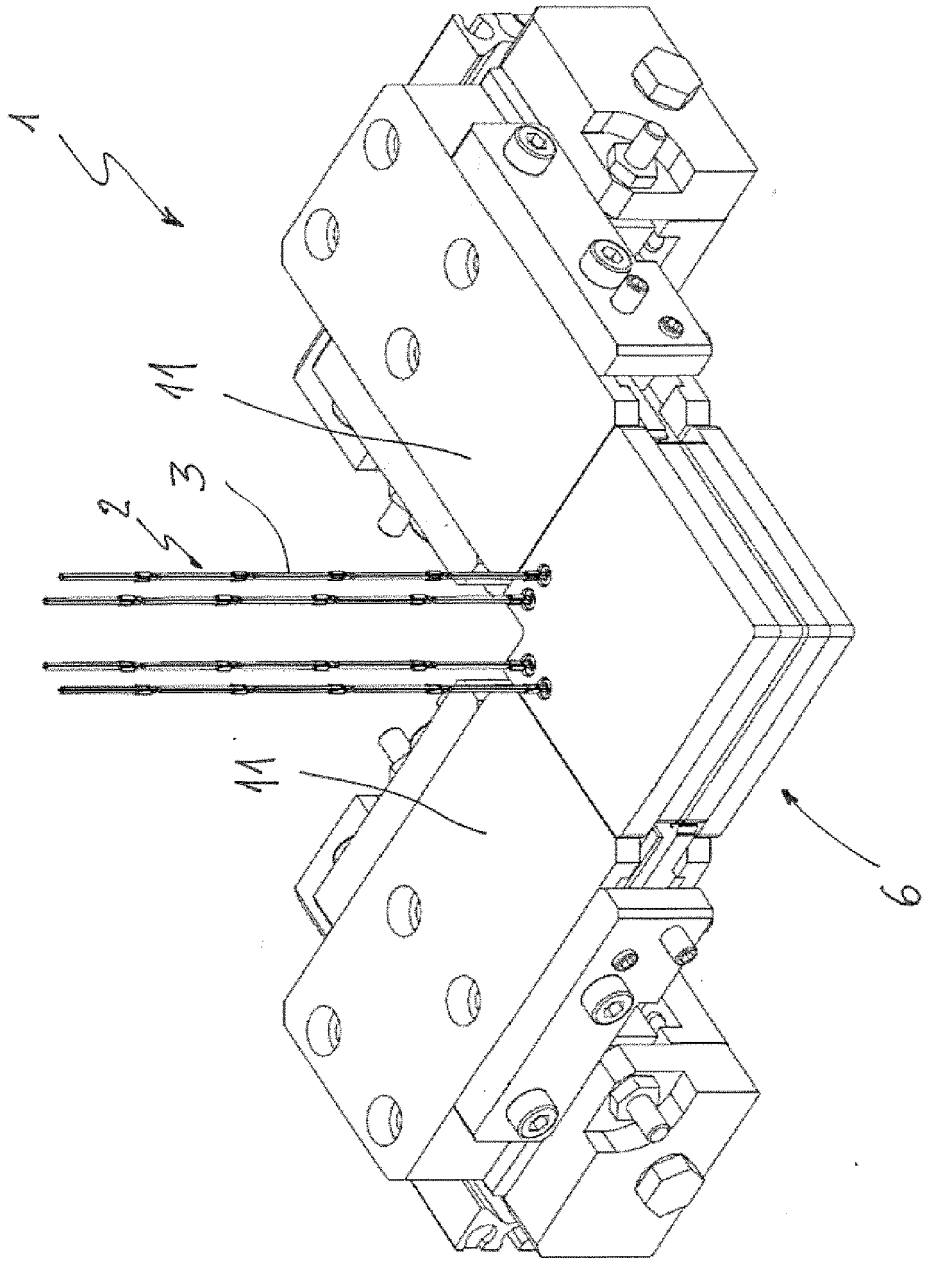

FIG. 1

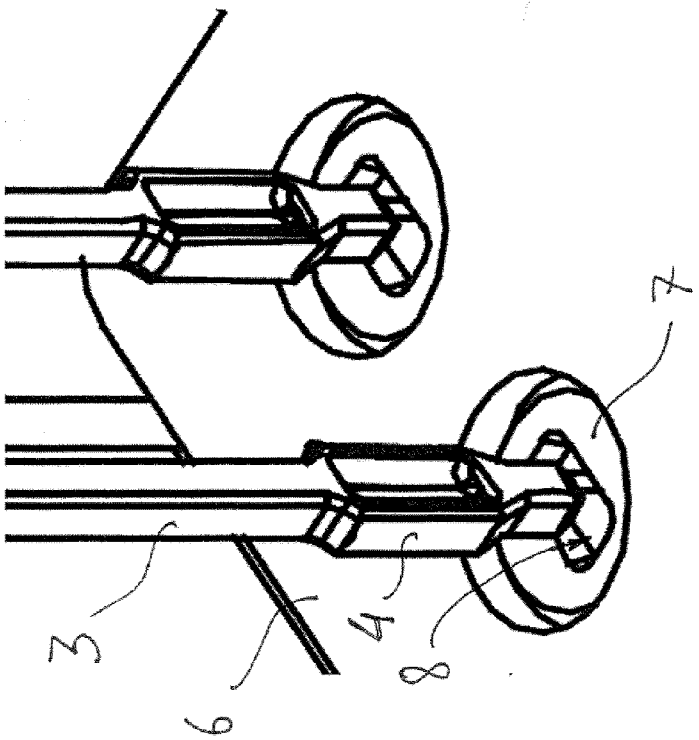

FIG. 3

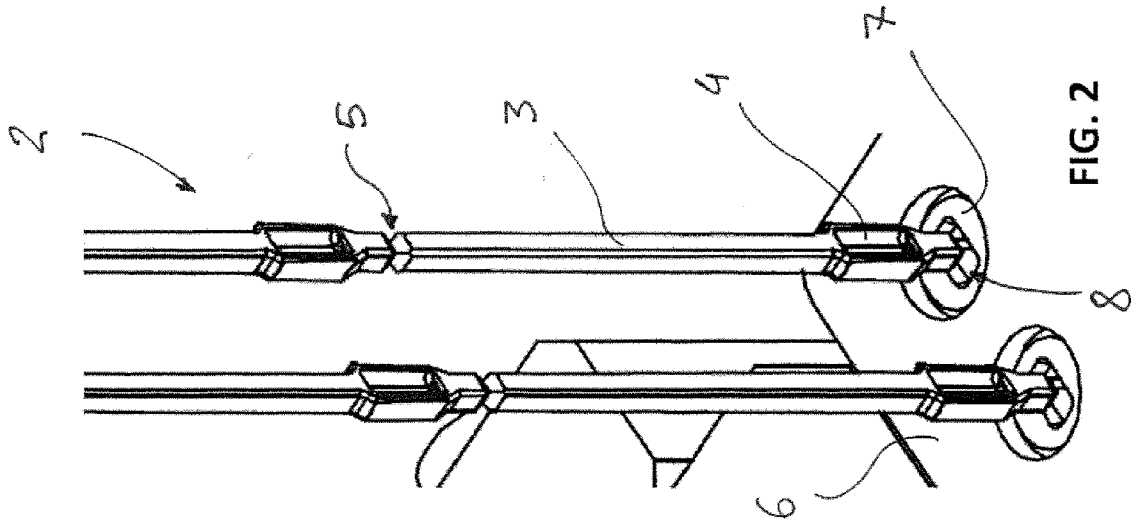

FIG. 2

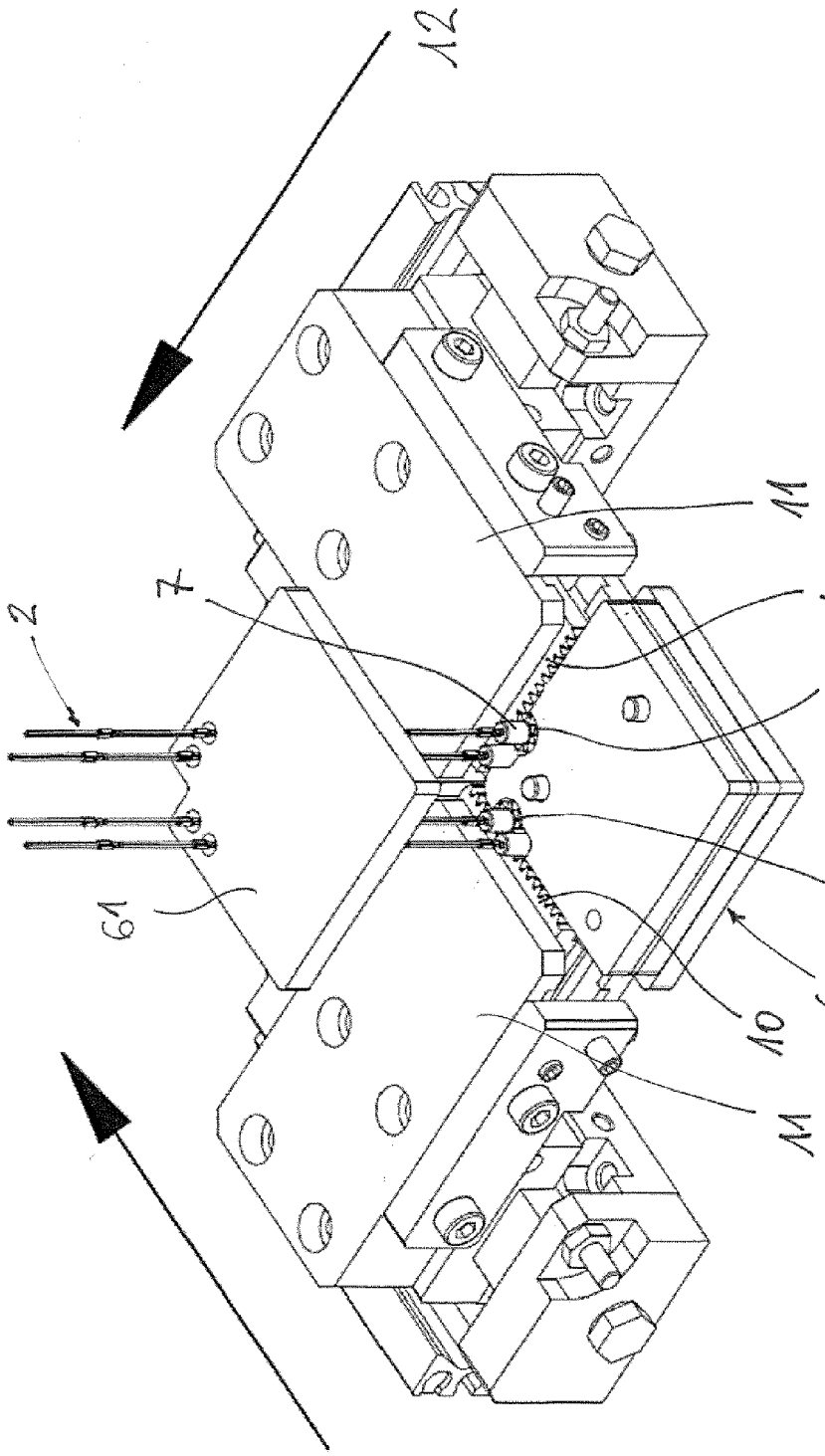

FIG. 4

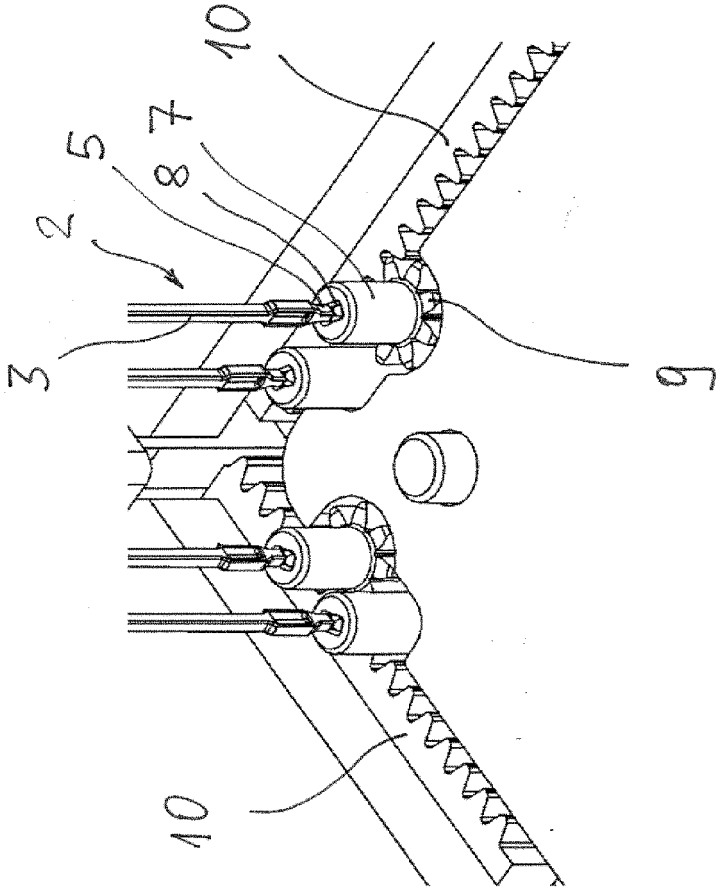

FIG. 6

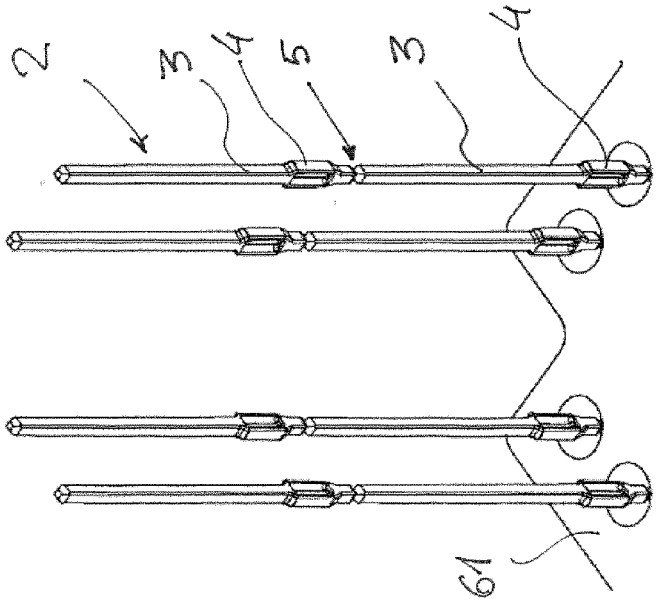

FIG. 5

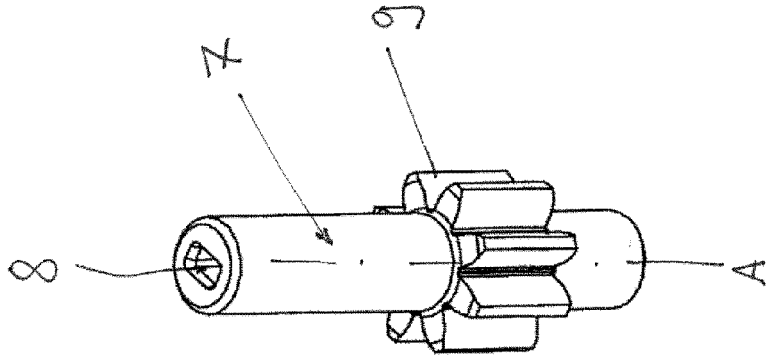

FIG. 8

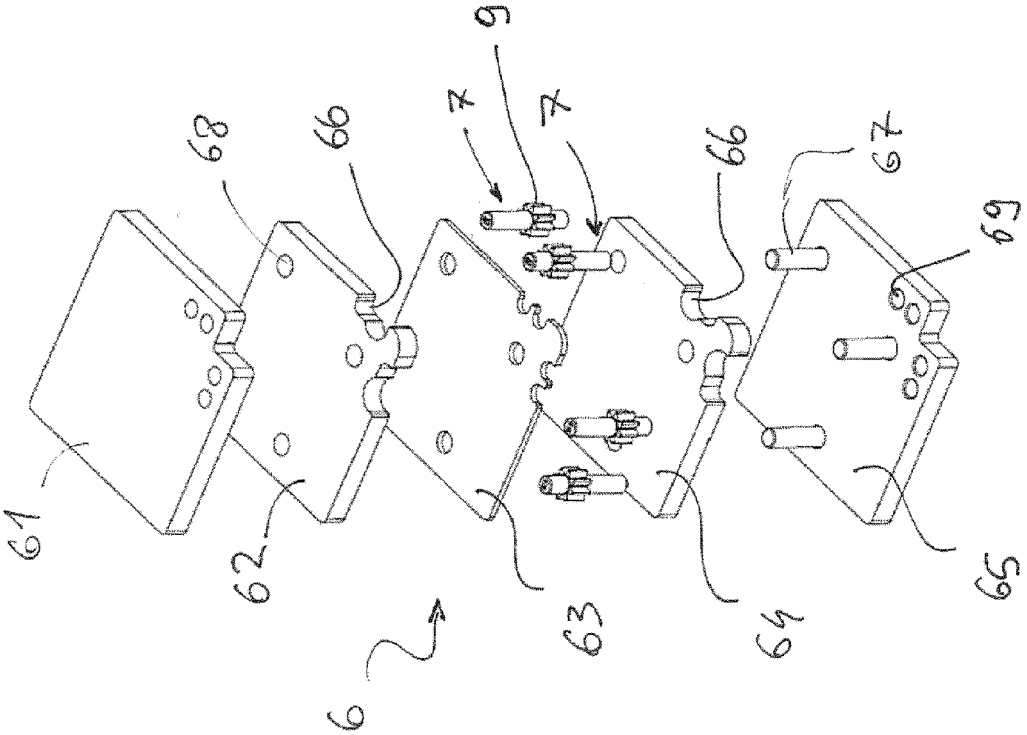

FIG. 7

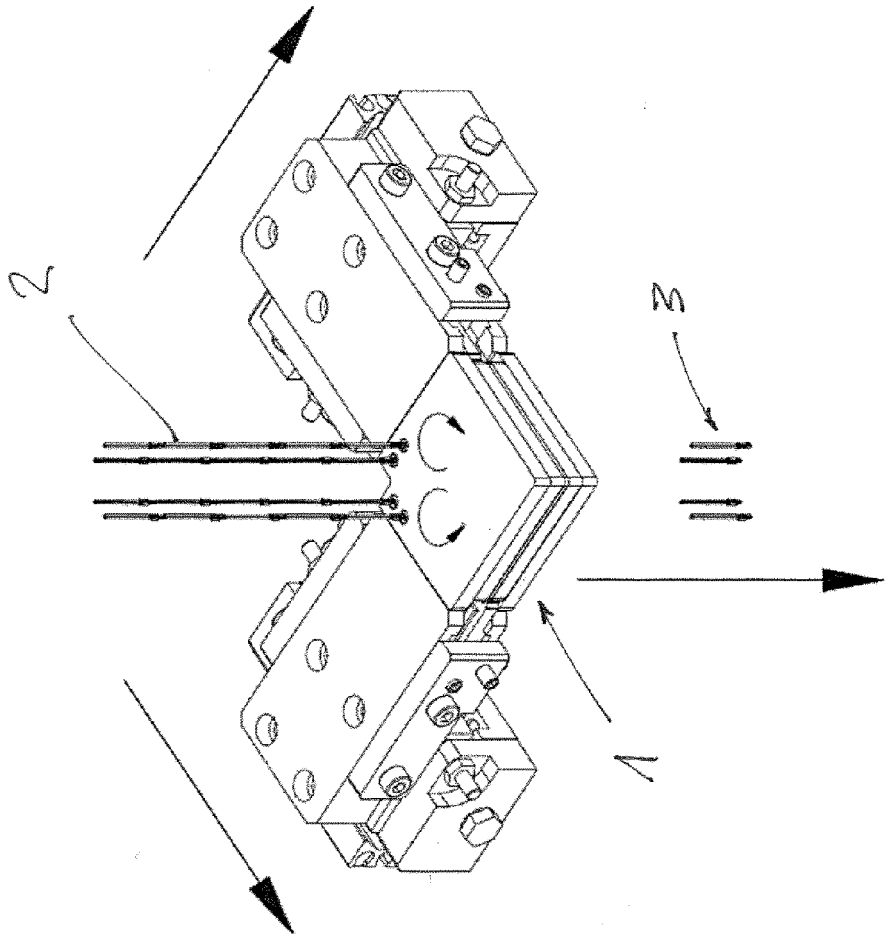

FIG. 9

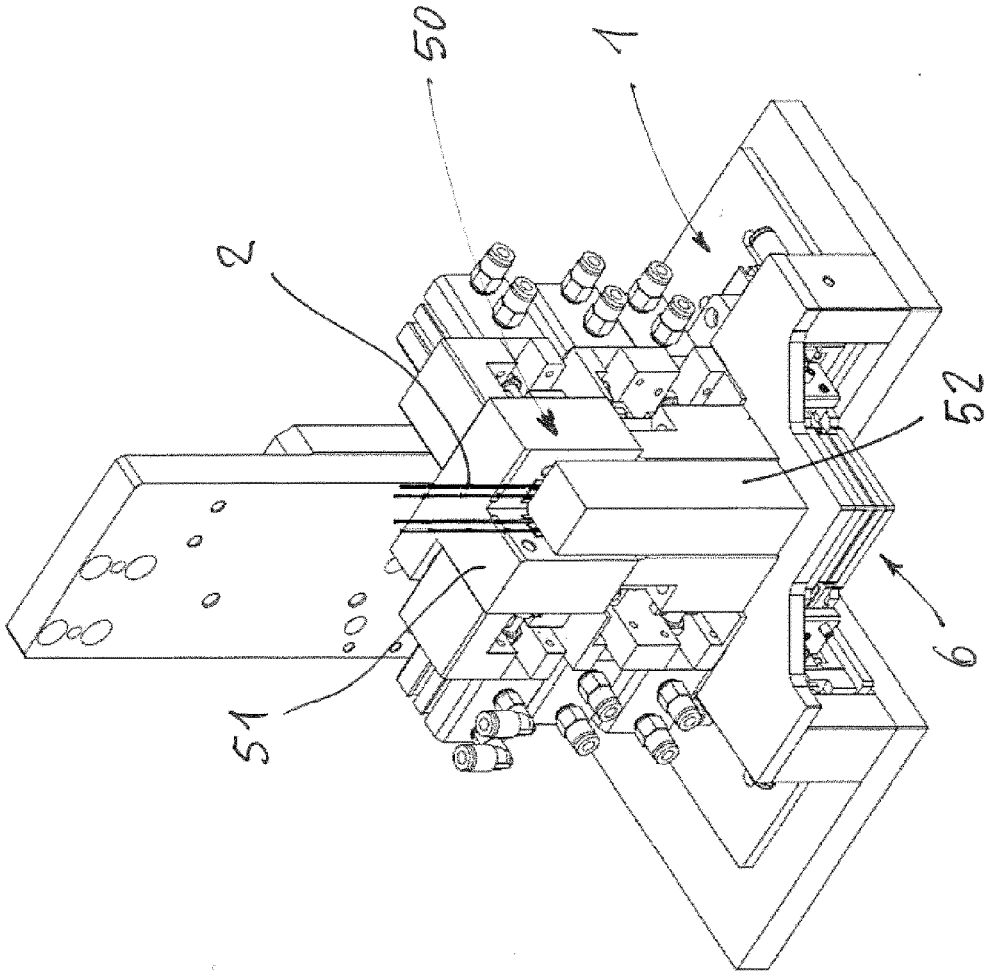

FIG. 10

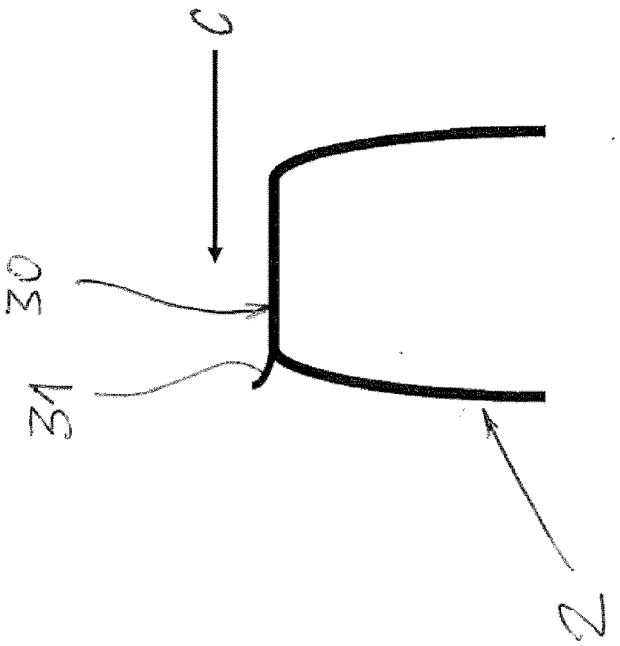

FIG. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 0009

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	CN 217 848 602 U (DONGGUAN HUATONG IND CO LTD) 18 November 2022 (2022-11-18)	1,3-5,7, 14	INV. H01R43/16
Y	* figures 1-3 * * paragraph [0002]; claim 1 *	10-13	B21F7/00 B21F11/00 B21G3/22
X	EP 2 928 278 A1 (J S T MFG CO LTD [JP]) 7 October 2015 (2015-10-07)	1-9,14	
Y	* figures 3a, 3b, 8a-8b * * paragraphs [0042] - [0046] *	10-13	

TECHNICAL FIELDS SEARCHED (IPC)

H01R
B21L
B21F
B21G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	5 October 2023	Hugueny, Bertrand

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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