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(54) **WIRE COILING DEVICE**

(57) A wire coiling device (10) comprising, a round cylindrical wire storage container (310) and a wire guiding device (100), the wire guiding device (100) comprising an universal joint (150) comprising a first joint part (160), a second joint part (170) and a pivot cross (180) that movable links the first joint part (160) and the second joint part (170), wherein the first joint part (160) is attached to a first end portion (142) of a straight tube (140), wherein the first joint part (160) comprises a first wire opening (161), the second joint part (170) comprises a second wire opening (171), the pivot cross (180) comprises a third wire opening (181) and the first end portion (142) of the straight tube (140) comprises a fourth wire opening (141), wherein the center of the first wire opening (161), the second wire opening (171), third wire opening (181) and the fourth wire opening (141) are centered along a vertical axis (Y), furthermore the guiding device (100) comprises a turning means that moves a second end portion (144) of the straight tube (140) circular around the vertical axis (Y).

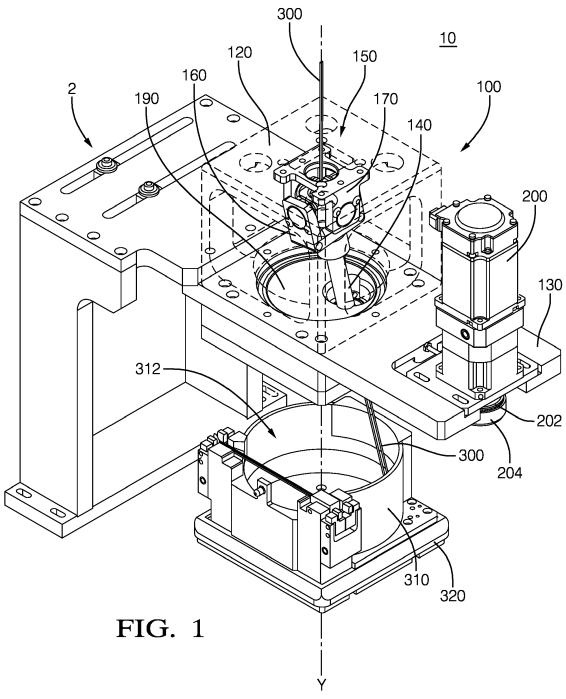

FIG. 1

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Description

TECHNICAL FIELD OF INVENTION

[0001] The invention relates to a wire coiling device, particularly a coiling device of a wire cutting machine or an automatic assembly machine for assembling connectors with long wires attached. The wire coiling device guides the provided wire in a circular movement into a wire container. Furthermore, the invention relates to a method for coiling an electrical wire employing the wire coiling device.

BACKGROUND OF INVENTION

[0002] In today's automatic assembly machines (transfer lines) for assembling connectors with long wires attached (e.g. SRS pigtails or antenna cables), the wires hanging down from the work piece carrier and running along the assembly process for the connector. Therefore the lines are realized as transfer lines with a floor conveyor moving the long wires, placed on the conveyor, parallel to the assembly process.

[0003] If the wires becoming up to 8m long, they laying down on the conveyor and it is rather difficult to unload them manual or automated after the assembly from the conveyor, as they interloop to each other. This becomes even worse, if a connector gets a pair of single wires connected (e.g. SRS pigtail with single wires). Another disadvantage is the layout of the transfer lines in regards to their flexibility. If there are many versions of the connector to be produced, the line becomes longer and longer, because additional process steps have to be queued up into the transfer line.

[0004] There is a need in the art to provide a solution for the above mentioned problems with long wires processed on transfer lines.

[0005] The objective technical problem to be solved could be seen in providing a device that improves the handling of long wires that are processed with cutting machines and especially transfer lines for wire harnesses.

[0006] A wire coiling device according claim1 and the method for coiling an electrical wire according claim 15 solve these and other objects, which become apparent upon reading the following description.

SUMMARY OF THE INVENTION

[0007] The present application relates to a wire coiling device comprising, a round cylindrical wire storage container and a wire guiding device. The wire guiding device comprising an universal joint comprising a first joint part, a second joint part and a pivot cross that movable links the first joint part and the second joint part. The first joint part is attached to a first end portion of a straight tube. The first joint part comprises a first wire opening, the second joint part comprises a second wire opening, the pivot cross comprises a third wire opening and the first end portion of the straight tube comprises a fourth wire opening. The center of the first wire opening, the second wire opening, third wire opening and the fourth wire opening are centered along a vertical axis. The guiding device comprises a turning means that moves a second end portion of the straight tube circular around the vertical axis.

[0008] The disclosed invention solves the problems of long electrical wires processed with transfer lines by coiling up the electrical wires into round cylindrical wire storage containers attached onto work piece carriers. In this case the electrical wires disappear into a round box, mounted to the work piece carrier and do not hang down from the work piece carrier. For this reason the line layout can be designed as optimal as possible in regards to flexibility and size, e.g. by designing indexing table solutions for different processes or version. A special fixation (universal joint) keeps the electrical wire path until the entry into the guiding tube in the center point of the rotation (along the vertical axis Y) so that torsion forces act on the electrical wire get reduced. The straight tube also does not apply torsion forces on the electrical wire when passing the straight tube. If necessary the straight tube can comprise a separating wall, arranged inside the straight tube, continuing along the length of the straight tube, defining two channels extending along length of the straight tube. This design allows to coil two electrical wires in parallel at the same time, into the round cylindrical wire storage container. When the electrical wire exits the straight tube, the electrical wire has still its preferred shape as had in the package as delivered to the cutting machine. That's why the electrical wire forms itself in its preferred position into the round cylindrical wire storage container.

[0009] The present application discloses also a method for coiling an electrical wire. The method comprises the steps:

a) Providing an electrical wire fed by a feeding device
b) Guiding the electrical wire through the wire guiding device, thereby guiding the electrical wire, through the first wire opening, the second wire opening, the third wire opening, the fourth wire opening, thereby turning the second end portion of the straight tube around the vertical axis, thereby fill the electrical wire in a loop shape inside the round cylindrical wire storage container.

[0010] The turning means can be for example a programmable robot device or other mechanical assemblies known by the skilled person.

[0011] Preferably, a first plate is parallel shifted to a second plate, wherein the universal joint is arranged in between the first plate and the second plate, wherein the first joint part is attached to the first plate. This design makes it possible to just add the two plates to an existing machine, for example by screwing. That reduces costs

for a housing that covers the movable parts. If the wire coiling device should be used standalone, the first plate at the second plate can be linked by arms or walls surrounding the movable parts.

[0012] Advantageously, the first plate comprises a fifth wire opening and wherein the second plate comprises a sixth opening, wherein the fifth wire opening and the sixth opening are centered along the vertical axis. Due to this design the wire can be guided along the vertical axis, along the center of rotation. The fifth opening can be shaped in any shape as long as the electrical wire can be guided through. The sixth opening is shaped circular or oval, dependent on the requested shape of the wire loops. The sixth opening could be even rectangular shaped, as long as the second end portion of the straight tube can be moved around the vertical axis.

[0013] Preferably, the sixth opening is sized to enable pivoting movement of the straight tube of at least 5° in relation to the vertical axis. To be able to form wire loops, the straight tube must be angled in a minimum angle to the vertical axis. A bigger angle results in wire loops with a bigger diameter.

[0014] Advantageously, a second end portion of the straight tube protrudes trough the sixth opening. The electrical wire leaving the straight tube is not in danger to collide with the second plate. The straight tube cannot be moved to a range outside the predefined fixed opening. That protects the straight tube from damage.

[0015] Preferably, the sixth opening is a circular opening and wherein the center point of the sixth opening is centered to the vertical axis. This design is the most straightforward part and promises best results.

[0016] Preferably the turning means comprises a round disc received and hold in the sixth opening, tunable around the vertical axis and wherein the round disc comprise a seventh opening, wherein the seventh opening is arranged distanced from the center point of the round disc, wherein the second end portion of the straight tube protrudes through the seventh opening. The design of the turning means is robust. The round disc can be for example made of metal as the second plate. The second end portion of the straight tube protrudes through the seventh opening but is thereby not engaged to the round disc. When the round disc turns the second end portion his moved in a circle around the vertical axis.

[0017] In a preferred embodiment, the turning means comprise a first bearing arranged in between the second plate and the round disc to tunable hold the round disc...

[0018] Preferably, the turning means comprises a second bearing arranged in the seventh opening surrounding the second end portion of the straight tube. The first bearing connects the second end portion movable to the round disc. The second end portion is guided more precise while turning around the vertical axis.

[0019] Advantageously, the turning means comprises gear teeth arranged along the circumference of the round disc and an electrical drive having a gear wheel, wherein the round disc and the gear wheel are coupled by a toothed belt. The design to transfer force by gear wheels and a toothed belt is well-established.

[0020] Preferably, the turning means comprises gear teeth arranged along the circumference of the round disc and an electrical drive having a gear wheel, wherein the round disc and the gear wheel are in engagement to turn the round disc. The design employing a gear comprising gear wheels is also an opportunity to transfer to force.

[0021] In a preferred embodiment, the pivot cross comprises a first cross axis and a second cross axis, wherein the first cross axis is fixed in relation to the vertical axis and wherein the second cross axis is variable in relation to the vertical axis.

[0022] Advantageously, the wire storage container comprises a container opening that is arranged opposite to the second end portion of the straight tube and wherein a centerline of the round cylindrical wire storage container is in line to the vertical axis. The centering of the wire storage container make sure that the wire loops are defined at the correct position.

[0023] Also disclosed is a wire cutting machine comprising a wire coiling device, wherein the wire coiling device is attached on a machine frame of the wire cutting machine. The wire cutting machine comprises a wire feeding device, which feeds an electrical wire to the wire coiling device. The round cylindrical wire storage container is independent movable in relation to the machine frame and the wire coiling device. This design makes it possible to move the round cylindrical wire storage container from the wire cutting machine to another station for example to crimp terminals on the wire end and then to a further station for example block loading the terminals into a housing. The round cylindrical wire storage container is for this mounted to a container carrier. The container carrier can be adapted to be moved on railways between the several stations. The container carrier can also be simply equipped with wheels to be movable in relation to the stations.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] In the following, the invention is described exemplarily with reference to the enclosed figures, in which

- Fig. 1 shows a perspective, view to a wire coiling device an a part of a machine frame;
- Fig. 2 shows a cut view of the perspective view of Fig. 1 showing the wire coiling device an a part of a machine frame;
- Fig. 3 shows a cut view of the perspective view of Fig. 1 showing the wire coiling device and a part of a machine frame from a side;
- Fig. 4 shows a perspective, view of the universal joint with attached straight tube;
- Fig. 5 shows a perspective, view of the guiding device;
- Fig. 6 shows a top view to the wire coiling device;

Fig. 7 shows a side view of the guiding device;

[0025] Figure 1 shows a perspective, view to a wire coiling device 10 and a part of a machine frame 2. The wire coiling device 10 comprising, a round cylindrical wire storage container 310 and a wire guiding device 100. The wire guiding device 100 comprising an universal joint 150 comprising a first joint part 160, a second joint part 170 and a pivot cross 180 that movable links the first joint part 160 and the second joint part 170 (shown in figure 4). The guiding device 100 comprises a turning means that moves a second end portion 144 of the straight tube 140 circular around the vertical axis Y. The wire coiling device 10 comprises a first plate 120 parallel shifted to a second plate 130, wherein the universal joint 150 is arranged in between the first plate 120 and the second plate 130, wherein the first joint part 160 is attached to the first plate 120. The wire coiling device 10 is attached on a machine frame 2 of the wire cutting machine. The wire cutting machine (not shown) comprises a wire feeding device that feeds an electrical wire 300 to the wire coiling device 10. The wire storage container 310 comprises a container opening 312 that is arranged opposite to the second end portion 144 of the straight tube 140. A centerline of the round cylindrical wire storage container 310 is in line to the vertical axis Y. The round cylindrical wire storage container 310 is independent movable in relation to the machine frame 2 and also to the wire coiling device 10.

[0026] Figure 2 shows a cut view of the perspective view of figure 1 showing the wire coiling device 10 and a part of a machine frame 2. The first plate 120 comprises a fifth wire opening 121 and the second plate 130 comprises a sixth opening 131. The fifth wire opening 121 and the sixth opening 131 are centered along the vertical axis Y. The sixth opening 131 is sized to enable pivoting movement of the straight tube 140 of at least 5° in relation to the vertical axis Y. A second end portion 144 of the straight tube 140 protrudes trough the sixth opening 131. The sixth opening 131 is a circular opening. The center point of the sixth opening 131 is centered to the vertical axis Y. The turning means comprises a round disc 190 received and hold in the sixth opening 131, tunable around the vertical axis Y. The round disc 190 comprise a seventh opening 191. The seventh opening 191 is arranged distanced from the center point of the round disc 190. The second end portion 144 of the straight tube 140 protrudes through the seventh opening 191. The turning means comprise a first bearing 194 arranged in between the second plate 130 and the round disc 190 to tunable hold the round disc 190. The turning means comprises a second bearing 134 arranged in the seventh opening 191 surrounding the second end portion 144 of the straight tube 140. The turning means comprises gear teeth 193 arranged along the circumference of the round disc 190 and an electrical drive 200 having a gear wheel 202, wherein the round disc 190 and the gear wheel 202 are coupled by a toothed belt 204.

[0027] Figure 3 shows a cut view of the perspective view of Fig. 1 showing the wire coiling device 10 and a part of a machine frame 2 from a side. This view shows in more detail how the mechanical parts are arranged in relation to the vertical axis Y.

[0028] Fig. 4 shows a perspective, view of the universal joint 150 with attached straight tube 140. The universal joint 150 comprising a first joint part 160, a second joint part 170 and a pivot cross 180 that movable links the first joint part 160 and the second joint part 170. The first joint part 160 is attached to a first end portion 142 of a straight tube 140. The first joint part 160 comprises a first wire opening 161, for the wire 300 inside the straight tube 140. The second joint part 170 comprises a second wire opening 171, the pivot cross 180 comprises a third wire opening 181 and the first end portion 142 of the straight tube 140 comprises a fourth wire opening 141. The center of the first wire opening 161, the second wire opening 171, third wire opening 181 and the fourth wire opening 141 are centered along a vertical axis Y. The pivot cross 180 comprises a first cross axis A and a second cross axis B. The first cross axis A is fixed in relation to the vertical axis Y. The second cross axis B is variable in relation to the vertical axis Y.

[0029] Figure 5 shows a perspective view of the guiding device 100. The first plate 120 is part of a frame having legs connectable to the second plate 130. The legs link the first plate 120 and the second plate 130 and keep the first plate 120 and the second plate 130 in the distance parallel to each other.

[0030] Figure 6 shows a top view to the wire coiling device 10. The fourth wire opening 141 at the first end portion 142 of the straight tube 140 is aligned to the vertical axis Y perpendicular to the axis A and the axis B.

[0031] Figure 7 shows a side view of the guiding device 10. The fourth wire opening 141 at the first end portion 142 of the straight tube 140 is aligned to the vertical axis Y even when the second end portion 144 is moved around the vertical axis Y.

Claims

1. A wire coiling device (10) comprising, a round cylindrical wire storage container (310) and a wire guiding device (100), the wire guiding device (100) comprising an universal joint (150) comprising a first joint part (160), a second joint part (170) and a pivot cross (180) that movable links the first joint part (160) and the second joint part (170), wherein the first joint part (160) is attached to a first end portion (142) of a straight tube (140), wherein the first joint part (160) comprises a first wire opening (161), the second joint part (170) comprises a second wire opening (171), the pivot cross (180) comprises a third wire opening (181) and the first end portion (142) of the straight tube (140) comprises a fourth wire opening (141), wherein the center of the first wire opening (161),

the second wire opening (171), third wire opening (181) and the fourth wire opening (141) are centered along a vertical axis (Y), furthermore the guiding device (100) comprises a turning means that moves a second end portion (144) of the straight tube (140) circular around the vertical axis (Y).

2. A wire coiling device (10) according to claim 1, comprising a first plate (120) parallel shifted to a second plate (130), wherein the universal joint (150) is arranged in between the first plate (120) and the second plate (130), wherein the first joint part (160) is attached to the first plate (120).

3. A wire coiling device (10) according to the preceding claim, wherein the first plate (120) comprises a fifth wire opening (121) and wherein the second plate (130) comprises a sixth opening (131), wherein the fifth wire opening (121) and the sixth opening (131) are centered along the vertical axis (Y).

4. A wire coiling device (10) according to any preceding claim, wherein the sixth opening (131) is sized to enable pivoting movement of the straight tube (140) of at least 5° in relation to the vertical axis (Y).

5. A wire coiling device (10) according to any preceding claim, wherein a second end portion (144) of the straight tube (140) protrudes trough the sixth opening (131).

6. A wire coiling device (10) according to any preceding claim, wherein the sixth opening (131) is a circular opening and wherein the center point of the sixth opening (131) is centered to the vertical axis (Y).

7. A wire coiling device (10) according to the preceding claim, wherein the turning means comprises a round disc (190) received and hold in the sixth opening (131), tunable around the vertical axis (Y) and wherein the round disc (190) comprise a seventh opening (191), wherein the seventh opening (191) is arranged distanced from the center point of the round disc (190), wherein the second end portion (144) of the straight tube (140) protrudes through the seventh opening (191).

8. A wire coiling device (10) according to the preceding claim, wherein the turning means comprise a first bearing (194) arranged in between the second plate (130) and the round disc (190) to tunable hold the round disc (190).

9. A wire coiling device (10) according to claim 8 or 9, wherein the turning means comprises a second bearing (134) arranged in the seventh opening (191) surrounding the second end portion (144) of the straight tube (140).

10. A wire coiling device (10) according to any of claims 8 to 10, wherein the turning means comprises gear teeth (193) arranged along the circumference of the round disc (190) and an electrical drive (200) having a gear wheel (202), wherein the round disc (190) and the gear wheel (202) are coupled by a toothed belt (204).

11. A wire coiling device (10) according to any of claims 8 to 10, wherein the turning means comprises gear teeth (193) arranged along the circumference of the round disc (190) and an electrical drive (200) having a gear wheel (202), wherein the round disc (190) and the gear wheel (202) are in engagement to turn the round disc (190).

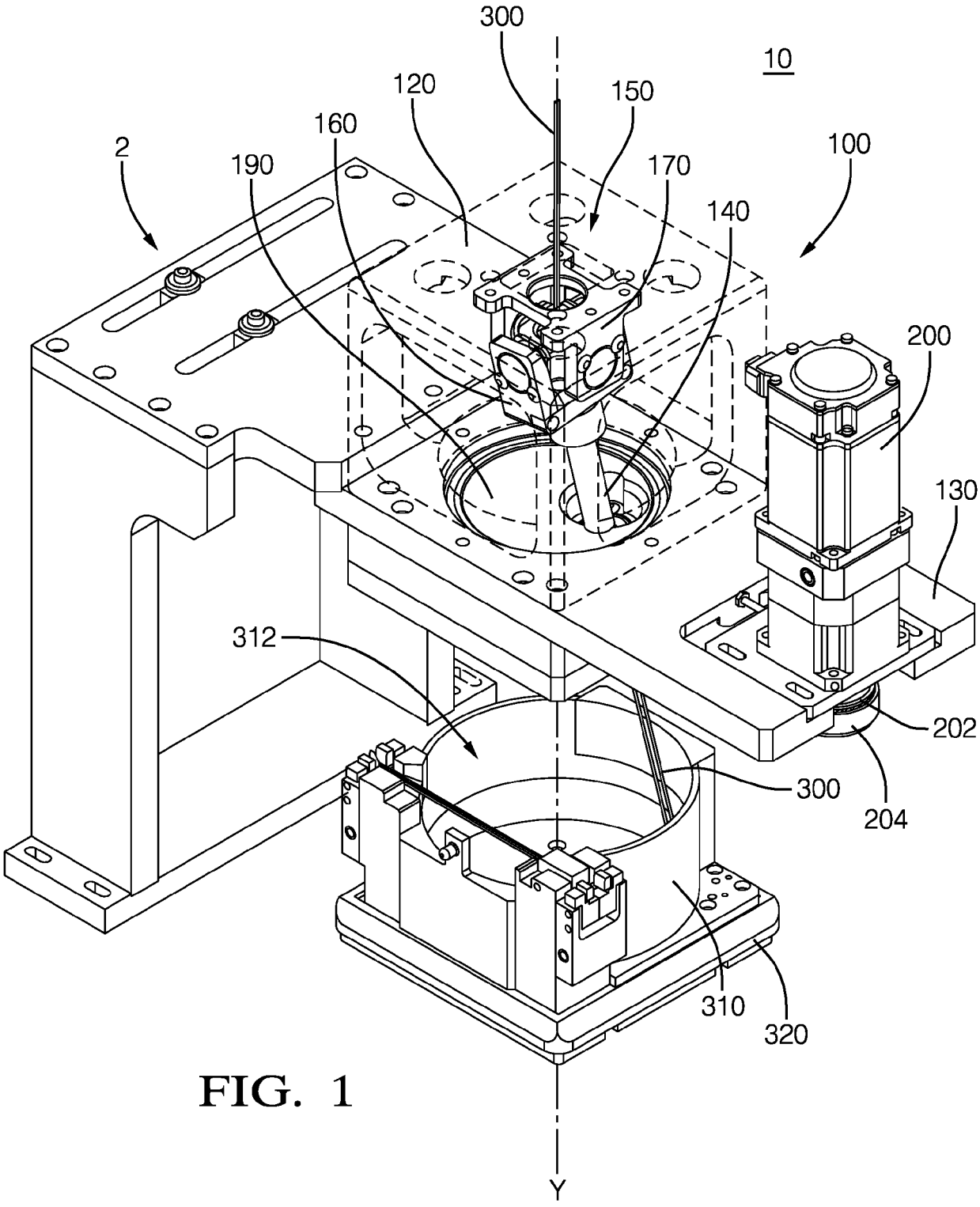
12. A wire coiling device (10) according to any preceding claim, wherein the pivot cross (180) comprises a first cross axis (A) and a second cross axis (B), wherein the first cross axis (A) is fixed in relation to the vertical axis (Y) and wherein the second cross axis (B) is variable in relation to the vertical axis (Y).

13. A wire coiling device (10) according to any of the preceding claims, wherein the wire storage container (310) comprises a container opening (312) that is arranged opposite to the second end portion (144) of the straight tube (140) and wherein a centerline of the round cylindrical wire storage container (310) is in line to the vertical axis (Y).

14. A wire cutting machine comprising a wire coiling device (10) according to any of the preceding claims, wherein the wire coiling device (10) is attached on a machine frame (2) of the wire cutting machine and wherein the wire cutting machine comprises a wire feeding device, that feeds an electrical wire (300) to the wire coiling device (10), wherein the round cylindrical wire storage container (310) is independent movable in relation to the machine frame (2) and the wire coiling device (10).

15. Method for coiling an electrical wire using a wire coiling device (10) according to any of claims 1 to 13 comprising the steps:

a) Providing an electrical wire (300) fed by a feeding device;
b) Guiding the electrical wire through the wire guiding device (100), thereby guiding the electrical wire, through the first wire opening (161), the second wire opening (171), the third wire opening (181), the fourth wire opening (141), thereby turning the second end portion (144) of the straight tube (140) around the vertical axis (Y), thereby fill the electrical wire (300) in a loop shape inside the round cylindrical wire storage container (310).


300
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120
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Y

FIG. 1

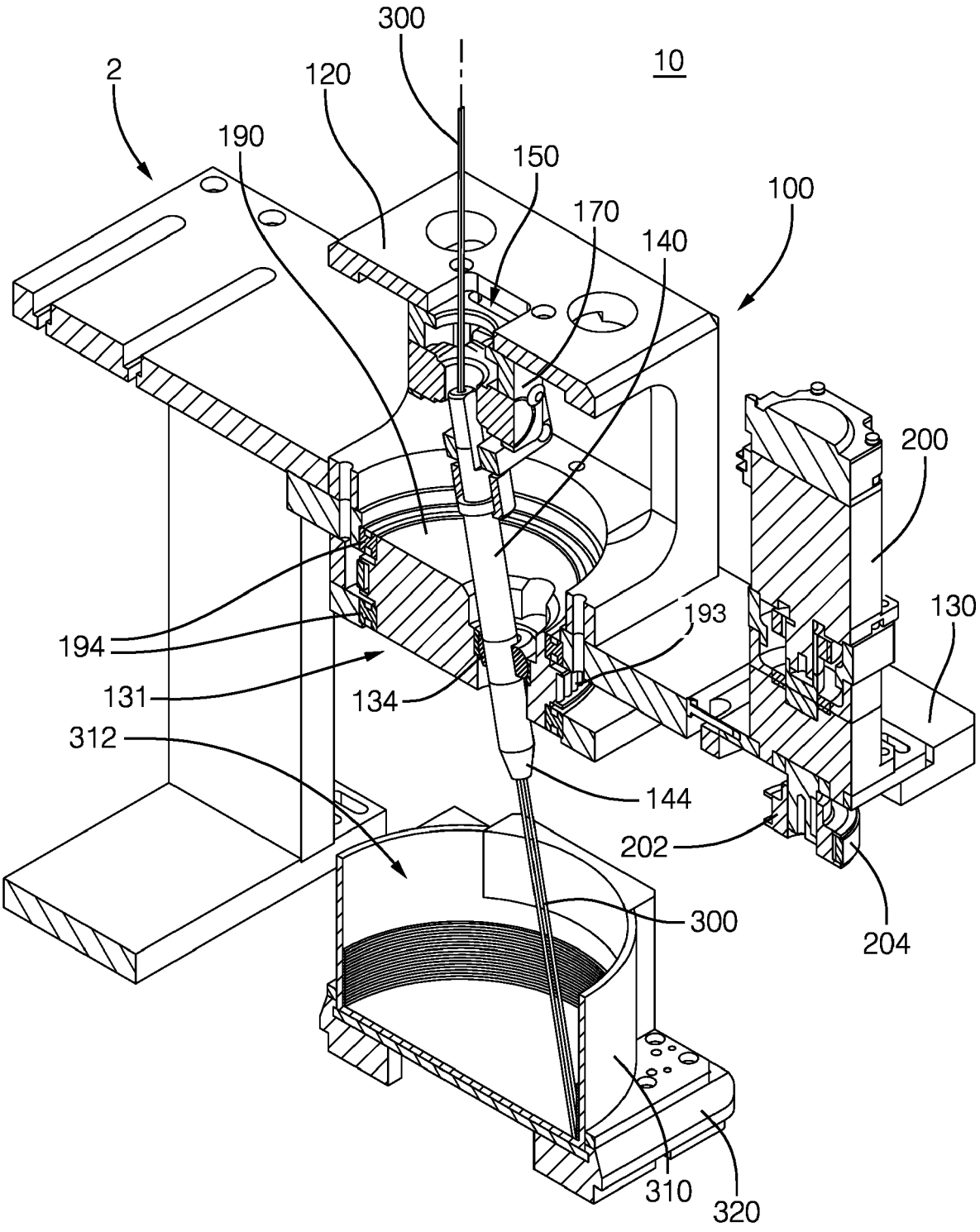
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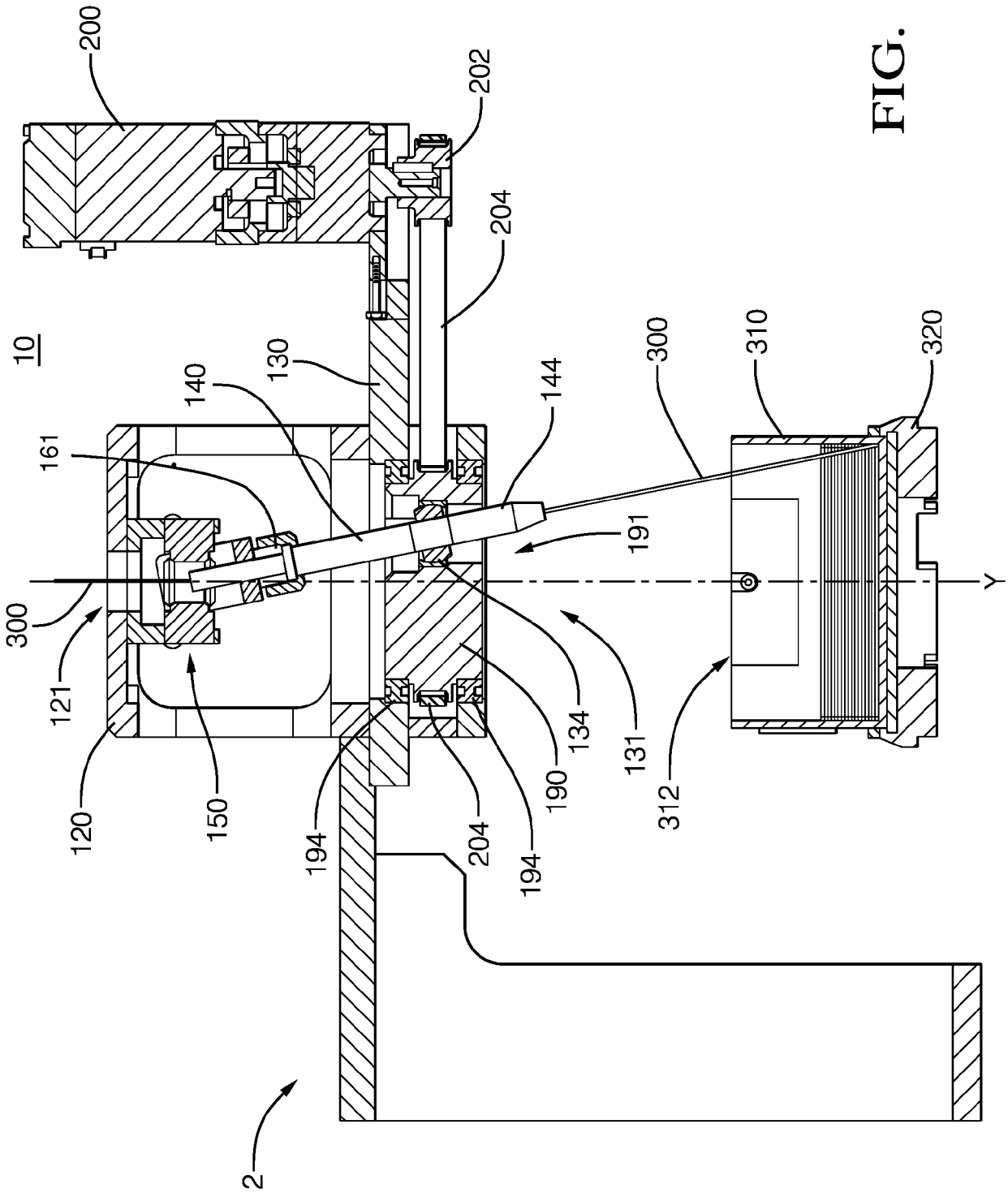
FIG. 2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2

FIG. 3

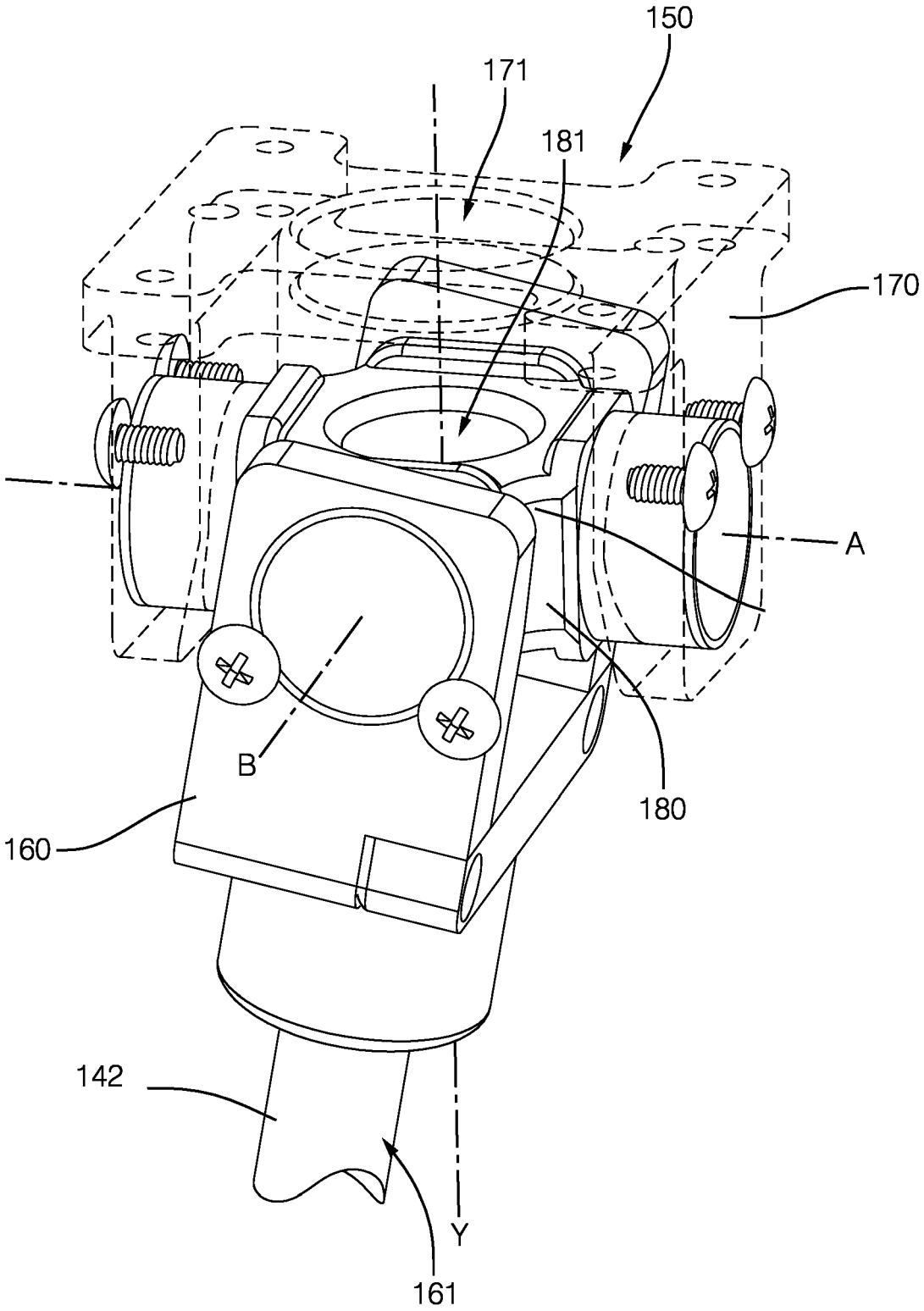

FIG. 4

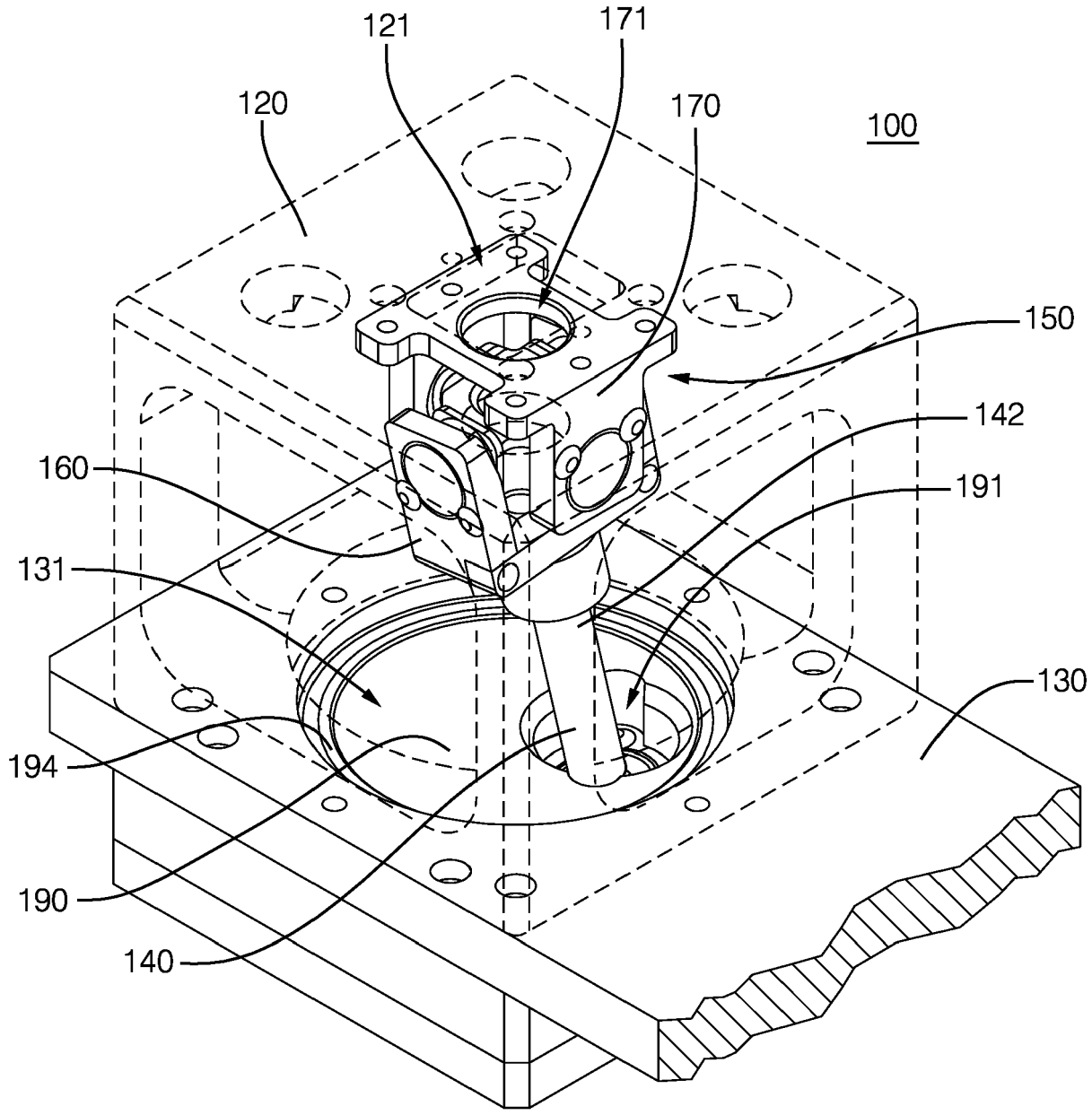

FIG. 5

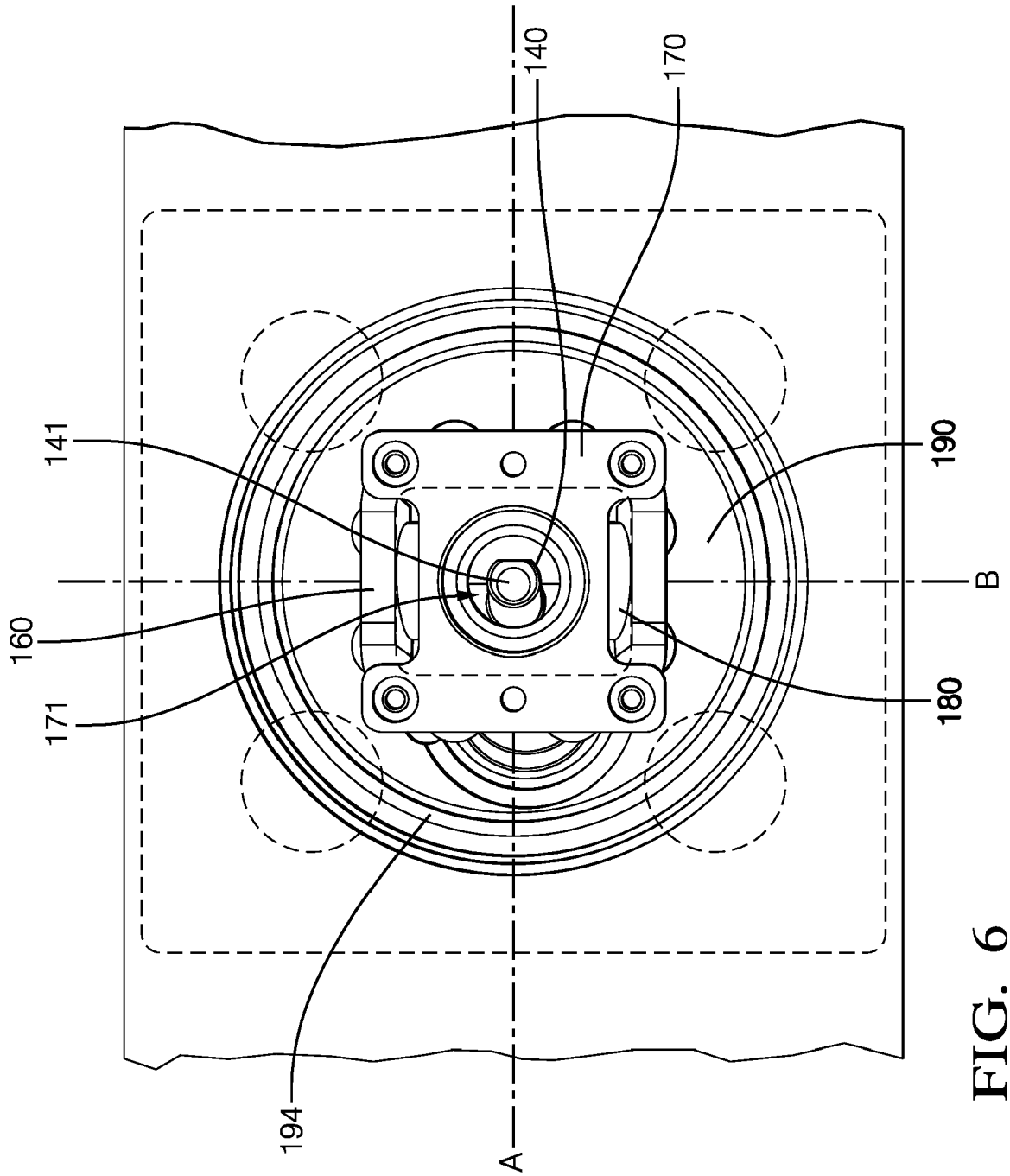

FIG. 6

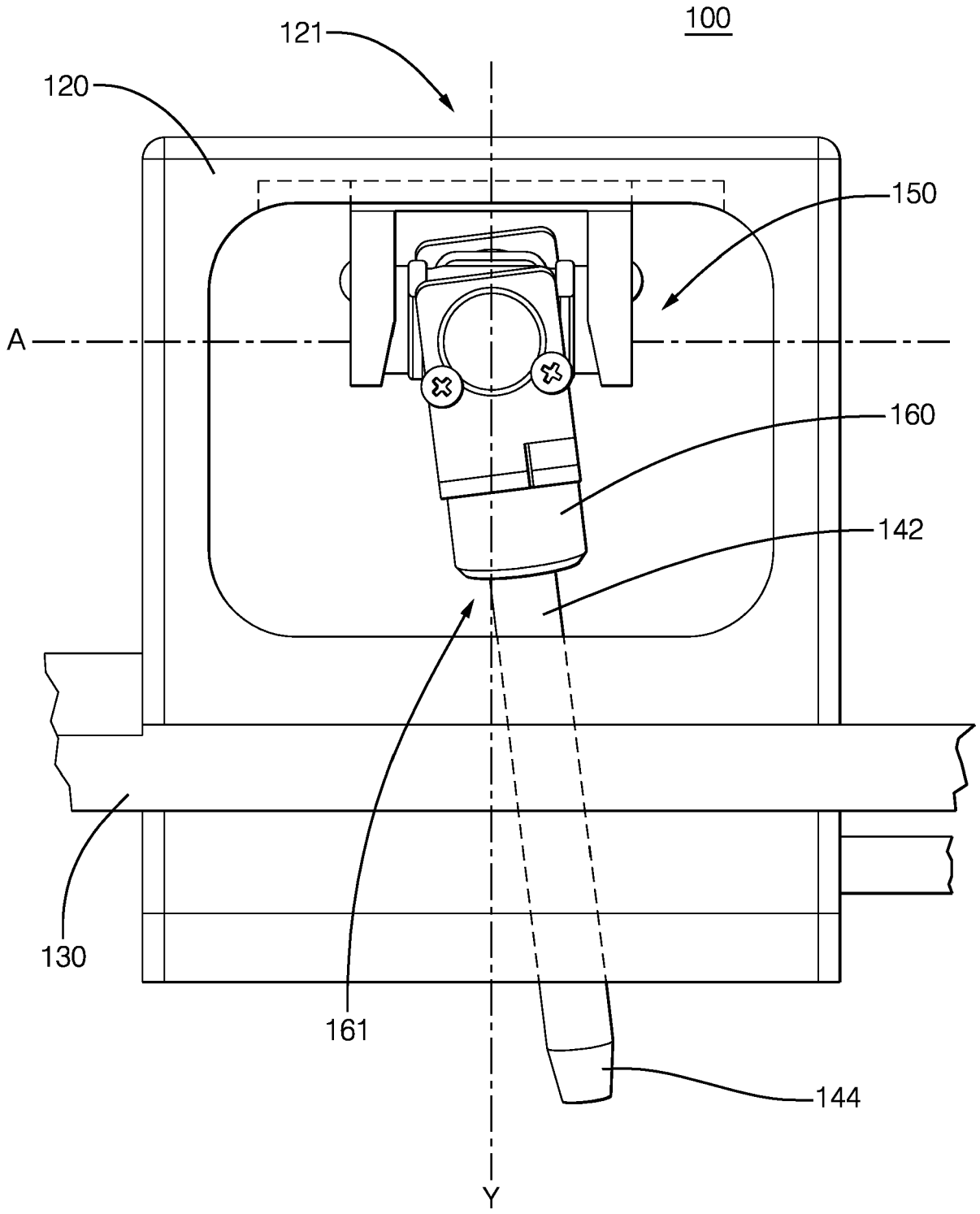

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 18 17 7882

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	US 3 599 891 A (STONE KENNETH RAY) 17 August 1971 (1971-08-17) * column 2, line 53 - column 4, line 52; figures 1-2 *	1-15	INV. B21C47/14 B65H54/80
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TECHNICAL FIELDS SEARCHED (IPC)

B21C
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 November 2018	Augé, Marc

CATEGORY OF CITED DOCUMENTS

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15-11-2018

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