



(51) International Patent Classification:

B25J 15/00 (2006.01) B25J 18/00 (2006.01)

(21) International Application Number:

PCT/EP2017/074754

(22) International Filing Date:

29 September 2017 (29.09.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1659733 10 October 2016 (10.10.2016) FR

(71) Applicant: **COMPAGNIE GENERALE DES ETABLISSEMENTS MICHELIN** [FR/FR]; 12, Cours Sablon, 63000 CLERMONT-FERRAND (FR).

(72) Inventors: **DETTORRE, Jean-Marie**; MANUFACTURE FRANCAISE DES PNEUMATIQUES MICHELIN, DGD/PI - F35 - LADOUX, 63040 CLERMONT-FERRAND Cedex 9 (FR). **DRAGO, Frédéric**; MANUFACTURE FRANCAISE DES PNEUMATIQUES MICHELIN, DGD/

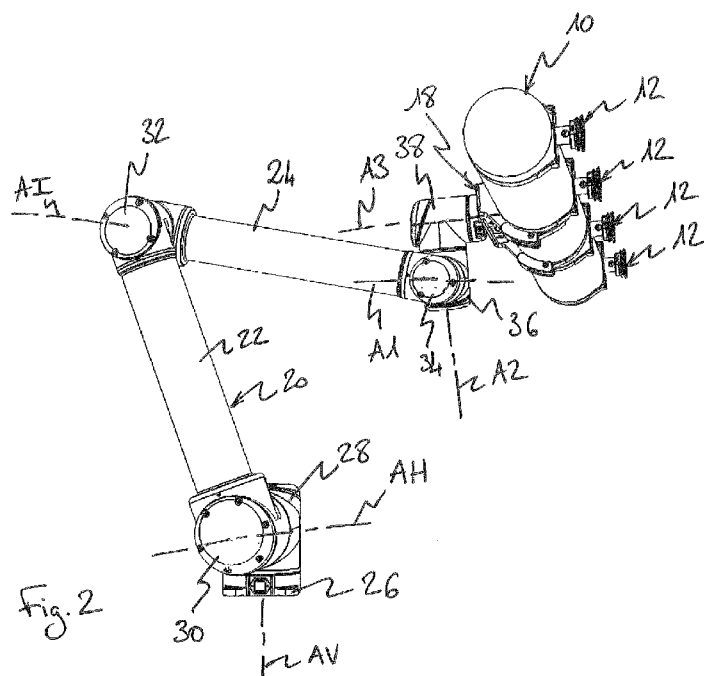
PI - F35 - LADOUX, 63040 CLERMONT-FERRAND Cedex 9 (FR).

(74) Agent: **DEQUIRE, Philippe**; MANUFACTURE FRANCAISE DES PNEUMATIQUES MICHELIN, 23, place des Carnes-Déchaux, DGD/PI - F35 - Ladoux, 63040 CLERMONT-FERRAND CEDEX 9 (FR).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,

(54) Title: INFLATABLE GRIPPING DEVICE



(57) Abstract: The invention relates to a gripping device (10) for gripping an object, the gripping device having at least one gripping element (12) for gripping the object, a connection base (18) connected to an automated handling device (20) such as a robotic arm, and at least one structural element (40) that bears each gripping element (12) and that is attached to the connection base (18) or to another structural element (40). According to the invention, each structural element (40) is a bladder (50) that is inflated with at least one gas.

UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

INFLATABLE GRIPPING DEVICE

[001] The invention relates to the field of robotics, and more specifically the field known as collaborative robotics.

5 **[002]** In the present invention, "robot" means a device for holding a load, which could be a tool, a product being manufactured, a product being used to manufacture another product, etc.

10 **[003]** Unlike a non-collaborative industrial robot that operates alone and is usually installed behind protective grilles, a collaborative robot is installed in the same work station as an operator and is used to perform different tasks close to the operator. Moreover, it is not usually necessary to place protective grilles between the operator and the collaborative robot.

15 **[004]** For example, a collaborative robot can be used to help an operator to handle loads repetitively, to perform tasks that are tiring and/or liable to contribute to the development of different musculoskeletal ailments.

[005] Certain gripping devices cannot be positioned close to operators without generating risks. For example, the gripping device described in application CA2870574 is not suitable for collaborative use. Indeed, the structure of this gripping device is an elongate metal section that could seriously injure an operator in the event of a collision.

20 **[006]** Furthermore, solutions have been developed to enable robots to work close to operators without grilles or any other protective element being interposed.

[007] For example, application EP1810795 describes a safety device that is designed to be arranged about the arm of a handling device and that includes means for detecting a collision with an operator.

25 **[008]** According to a first drawback, the safety device described in application EP1810795 does not entirely eliminate the risk of injury in the event of a collision since the rigid metal structure of the arm of the handling device is always present beneath the safety device.

30 **[009]** According to another drawback, although the safety device described in application EP1810795 partially protects an operator from a collision with the arm of the handling device, such device does not appear to be suitable for protecting an operator from a collision with a

gripping device such as the one described in application CA2870574, for example.

[010] Utility model DE202005002475 describes a safety device in the form of an envelope that is designed to be positioned on the structure of a robot, the envelope being made of a foam that is designed to absorb the energy of a collision with an operator and being fitted with tactile and capacitive sensors that are designed to detect the collision with an operator in order to quickly stop the movements of the robot. This safety device has the same drawbacks as the safety device described in application EP1810795.

[011] The present invention is intended to overcome at least one of the drawbacks of the devices described in the prior art documents.

[012] For this purpose, the invention relates to a gripping device for gripping an object, the gripping device having at least one gripping element for gripping the object, a connection base to an automated handling device such as a robotic arm, and at least one structural element that bears each gripping element and that is attached to the connection base or to another structural element.

[013] According to the invention, the gripping device is characterized in that each structural element is a bladder that is inflated with at least one gas.

[014] According to a first advantage, a bladder inflated with gas is a deformable pneumatic element. Consequently, the gripping device according to the invention has an advantageous structure that limits the injuries caused to a nearby operator in the event of a collision.

[015] However, when inflated to a suitable pressure, the bladder can provide sufficient rigidity to the structural element to enable the element to hold objects with satisfactory precision. By way of comparison, a structural element comprising a sufficiently inflated bladder can be as rigid as a structural element comprising a deformable member made of foam or a framework or a rigid core in the form of a metal section, for example.

[016] According to another advantage, the pneumatic structure of the gripping device is very lightweight because same is made of one or more inflated bladders. Notably, this pneumatic structure is lighter than a structure formed by one or more members made of foam stiffened by a framework or a rigid core. This low mass of the pneumatic structure makes it possible to use robotic arms with actuators that are less powerful and therefore less dangerous and expensive. However, most significantly, the low mass of the pneumatic structure affords to it a low inertia, which reduces the violence of the impact with an operator

and facilitates a rapid stopping of the movements of the gripping device when a collision is detected. In parallel, the low inertia of the pneumatic structure also makes it possible to comply with standards limiting the maximum permissible energy levels on different portions of the member in the event of contact with an operator.

5 **[017]** According to another inherent advantage of the pneumatic structure, the gripping device can adapt to the surface of the object being handled by deforming slightly, such as when the upper surface of the object to be conveyed is not perfectly flat. It should be noted that this ability to deform is a departure from the normal practice in the field of robotics, which is normally focused on ensuring that movements and positions are as precise as possible.

10 **[018]** Finally, the pneumatic structure of the gripping device according to the invention makes same perfectly suited to performing collaborative tasks close to one or more operators, without a protective grille.

15 **[019]** In a particularly advantageous application, the gripping device according to the invention is used to collaboratively automate the turning of a ply used in the assembly of a tyre blank close to an operator. Indeed, until now, plies were turned manually and this could be tiring or even traumatic for operators, more because of the repetitive nature of the task and the amplitude of the movement than the mass of the plies, which weigh just a few hundred grams. For the purpose of such automation, the gripping device is associated with a handling device such as a robotic arm and two tables (incoming and reception) for the plies
20 to form a turning device for a ply. Advantageously, the collaborative aspect of this turning device can be achieved thanks to the non-hazardousness of the structural element or elements of the gripping device according to the invention.

25 **[020]** Other characteristics and advantages of the invention are set out in the description below. This description is provided as a non-limiting example and refers to the attached drawings, in which:

- Figure 1 is a perspective view of a first variant of a gripping device according to the invention,
- Figure 2 is a perspective view of a first variant of a gripping device according to the invention, mounted on a robotic arm,
- 30 - Figure 3 is a perspective view of a second variant of a gripping device according to the invention,
- Figure 4 is a perspective view of a third variant of a gripping device according to the

invention,

- Figure 5 is a perspective view of a turning device for turning a ply according to the invention, and
- Figure 6A to 6D illustrate the turning of a ply using a ply turning device according to the invention.

[021] As shown in Figures 1 and 2, the invention relates to a gripping device 10 for gripping an object. As shown in Figures 5 and 6A to 6D, in a particularly advantageous application, this object can be a ply N that is made of a rubber compound and that is intended for the assembly of a tyre blank for a vehicle wheel.

[022] In order to convey an object or any other load from one position to another, the gripping device 10 has at least one gripping element 12 for gripping the object. This gripping element 12 may take various different forms, and for the conveyance of a ply N intended for the assembly of a tyre blank, the gripping element 12 is preferably a suction pad 14. A suction pad 14 has a deformable soft membrane 16 that is designed to be pressed against the object to be conveyed then placed under suction to adhere to the object to be conveyed.

[023] In order to convey an object or any other load from one position to another, the gripping device 10 has a connection base 18 connected to an automated handling device 20, for example a robotic arm such as the one illustrated in Figure 2. Such a handling device 20 is able to move the gripping device 10, and therefore the object or the load being conveyed, at least about and/or along a handling axis, and preferably about and/or along several handling axes.

[024] In the example shown in Figure 2, the handling device 20 has a lower arm 22, an upper arm 24 and a base 26. The lower arm 22 is articulated in relation to the base 26, the upper arm 24 is articulated in relation to the lower arm 22, and the gripping device 10 is articulated in relation to the upper arm 24.

[025] In greater detail, the lower arm 22 is articulated in rotation in relation to the base 26 about a vertical axis AV and about a horizontal axis AH, the upper arm 24 is articulated in rotation in relation to the lower arm 22 about an intermediate axis AI, and the gripping device 10 is articulated in rotation in relation to the upper arm 24 about three axes A1, A2, A3 that are perpendicular with one another. Preferably, an electric motor 28 drives the lower arm 22 in rotation in relation to the base 26 and about the vertical axis AV and another electric motor 30 drives the lower arm 22 in rotation in relation to the base 26 and about the horizontal axis

AH. Subsequently, another electric motor 32 drives the upper arm 24 in rotation in relation to the lower arm 22 about the intermediate axis A1. Finally, three other electric motors 34, 36, 38 drive the gripping device 10 in rotation in relation to the upper arm 24 about the three perpendicular axes A1, A2 and A3 respectively.

5 **[026]** In this layout, the handling device 20 provides a six-axis architecture referred to as being anthropomorphic. Naturally, depending on the intended use of the gripping device 10 and the arrangement of the work station, the handling device 20 may be based on a different architecture with more or fewer axes of mobility.

10 **[027]** In order to bear each gripping element 12, the gripping device 10 has at least one structural element 40. In the different variants of the gripping device 10, at least one structural element 40 is attached to the connection base 18.

[028] In a first variant shown in Figures 1 and 2, the gripping device 10 has a single structural element 40 attached to a connection base 18 in the form of an attachment plate 42.

15 **[029]** In a second variant shown in Figure 3, the gripping device 10 has two structural elements 40 attached to a connection base 18 in the form of an attachment frame 44. Preferably, the two structural elements 40 extend parallel to one another to enable the gripping device 10 to handle larger objects, in particular wider plies N.

20 **[030]** Finally, in a third variant shown in Figure 4, the gripping device 10 has a main structural element 40' attached to a connection base 18 in the form of an attachment plate 42, and a plurality of secondary structural elements 40'' attached to the main structural element 40'. Again in order to enable the gripping device 10 to handle larger objects, the secondary structural elements 40'' extend perpendicular to the main structural element 40'.

25 **[031]** In order to make the gripping device 10 as safe as possible, each structural element 40 is a bladder 50 that is inflated with at least one gas. A bladder 50 can be inflated with air or with a specific gas, such as a gas that is lighter than air.

[032] Advantageously in terms of the safety of the operator working close to the gripping device 10 and the robotic arm thereof, the rigidity of the bladder 50 is achieved exclusively by the pressure of the air or of the gas contained inside the bladder 50, i.e. without the use of a framework, a core and/or any rigid reinforcements.

30 **[033]** For example, the pressure of the air or of the gas inside a bladder 50 is around 0.2 to 0.4 bars. This low pressure is sufficient to convey objects or loads weighing up to 5 kg and prevents the bladder 50 from being too rigid and therefore dangerous in the event of a

collision with an operator.

[034] In order to contain the air or the gas in an airtight manner, the bladder is preferably made of polyvinyl chloride (PVC) with a mass per unit area of 850 g/m². This material also has the advantage of deforming, which enables same both to withstand any collisions with another object and to prevent injury being caused to an operator in the event of a collision.

[035] Again in order to maximize the safety of the operator working close to the gripping device 10, a bladder 50 has rounded ends 52, 54. In the invention, "rounded" means substantially hemispherical ends 52, 54.

[036] With the same objective and to facilitate production of a bladder 50, each bladder 50 is cylindrical.

[037] In order to handle objects extending lengthwise over several tens of centimetres, such as plies N used in the assembly of tyre blanks, each bladder 50 is elongate. Thus, a bladder 50 bears several gripping elements 12.

[038] In order to handle objects extending lengthwise and widthwise over several tens of centimetres, such as plies N used in the assembly of tyre blanks, each bladder 50 is elongate.

[039] The first variant of the gripping device 10 having a single elongate bladder 50 is perfectly suited where the object to be conveyed extends only lengthwise or where the object to be conveyed extends both lengthwise and widthwise but need only be gripped on one of the edges thereof (longitudinal or transverse).

[040] The second and third variants of the gripping device 10 including several parallel bladders 50 are more suitable where the object to be conveyed extends both lengthwise and widthwise and the object needs to be gripped both lengthwise and widthwise.

[041] In the different variants of the gripping device 10, flexible collars 56 are used to attach a bladder 50 to the connection base 18 or to attach two bladders 50 to one another. These flexible collars 56 are also used to attach the gripping elements 12 to a bladder 50. These flexible collars 56 may be made of metal, fabric or plastic.

[042] In order to simplify the installation and use of the gripping device 10 at an industrial site, the gripping device 10 carries a device 60 for creating a vacuum using a source of compressed air. Advantageously, the compressed air is supplied to the device 60 by the

compressed-air circuit 62 usually present at industrial sites. This device 60 is designed to be connected to each of the suction pads 14 to enable same to adhere to the object to be conveyed. Preferably, this device 60 is borne by the plate 42 or the frame 44 of the connection base 18. By way of example, in being supplied with air or gas at a pressure of 6 bar, the device 60 enables the creation of suction of 0.2 to 0.5 bar.

[043] In addition to the non-hazardousness of the structural elements 40, 40', 40'', the handling device 20 and/or the gripping device 10 may be fitted with means designed to detect, and potentially to anticipate, an impact or collision of an object or an operator with the handling device 20 and/or with the gripping device 10 to stop the movement of the handling device 20 and of the gripping device 10 as quickly as possible.

[044] First of all, the handling device 20 can be fitted with means for measuring the force supplied by the actuator or actuators of same, for example the torque supplied by the electric motors 28, 30, 32, 34, 36, 38, that are also able to detect a sudden variation in this force, corresponding to an impact or a collision.

[045] Subsequently, the handling device 20 and/or preferably the gripping device 10 can be fitted with means for detecting a collision with an object or an operator. These detection means are preferably capacitive proximity sensors designed to detect non-metal objects, and therefore an operator.

[046] Thus, at least one capacitive proximity sensor 90 is arranged on a structural element 40, 40', 40'' in the form of a bladder 50. However, preferably and as shown in Figure 1, a network of several capacitive proximity sensors 90 is installed on the structural element or elements 40, 40', 40'' of the gripping device 10.

[047] Advantageously, where the capacitive proximity sensors 90 are arranged on a structural element 40, 40', 40'' that is a bladder 50 inflated using air or gas, the operation of same, and in particular the detection range of same, is improved. Indeed, in this position, the sensors are sufficiently removed from any metal masses, electrical connection and electrical devices, such as a motor of the handling device 20 that is liable to disturb operation of same, and more specifically the electrical field emitted by same.

[048] As shown in Figures 5 and 6A to 6D, the invention also relates to a turning device 70 for turning a ply N that is made of a rubber compound and that is intended for the assembly of a tyre blank for a vehicle wheel. This turning device 70 is designed to work collaboratively in the vicinity of an operator O.

[049] In the invention, "ply" N means a thin, substantially rectangular object that is made of a raw rubber mix, i.e. not cross-linked, that can incorporate reinforcements that are arranged parallel to one another and that are oriented lengthwise or widthwise in the ply, or inclined at a given angle to the transverse and longitudinal directions of the ply. For example, a ply N is approximately 1 mm thick, several tens of centimetres wide, and longer than it is wide.

[050] Moreover, such a ply N essentially has a lower face FI and an upper face FS.

[051] In order to perform the turning, the turning device 70 has a first incoming table 72 for a ply N to be turned, a second reception table 74 for a ply N that has been turned, and a handling device 20 designed to automatically convey a ply N from the incoming table to the reception table using a gripping device 10.

[052] Advantageously, with the ply N lying on the lower face FI thereof on the incoming table 72, the reception table 74 is higher than the incoming table in order to form a step 76 to enable the turning device 70 to rapidly turn the ply N as same is being conveyed from the incoming table 72 to the reception table 74. Once conveyed, the turned ply N is resting on the upper face FS thereof on the reception table 74.

[053] More specifically, the step 76 forms a linear stop against which the ply N butts, to facilitate the turning thereof.

[054] The step 76 simplifies the design of the turning device 70 by obviating the need to use a second gripping device to grip the lower face FI of the ply N and to turn the ply N.

[055] Preferably, in order to turn the ply N, the height H76 of the step 76 is between one quarter and one half of the width LN of the ply N to be turned. In the case of plies intended for the assembly of motorcar tyre blanks, the height H76 of the step 76 is approximately 25 cm.

[056] Preferably, the turning device 70 incorporates the first variant of the gripping device 10 in which a single elongate bladder 50 bears several aligned gripping elements 12.

[057] In this first variant, the gripping device 10 enables one edge B of the ply N that is to be turned to be gripped. The edge B gripped is preferably a longitudinal edge BL since turning the ply N using the step 76 must be carried out by means of a movement of the ply N that is principally performed in a horizontal direction DH parallel to the transverse direction of the ply N.

[058] On account of the length of a ply N, the gripping device 10 of the turning device 70 preferably includes a plurality of gripping elements 12 for gripping a ply.

[059] Moreover, given that the objective is to grip the ply only by one of the edges B thereof, the gripping elements 12 of the turning device 70 are aligned.

5 [060] On account of the low mass of a ply and to limit the energy consumed when turning, each gripping element 12 of the turning device 70 makes it possible to grip the ply to be turned locally, i.e. over a surface area of several square centimetres.

[061] Preferably, each gripping element 12 of the turning device 70 is a suction pad 14, the suction pads 14 having the advantage of not piercing or damaging the surface condition
10 of the plies N being conveyed.

[062] Also preferably, the turning device 70 includes an inclined section 78 between the incoming table 72 and the reception table 74. This inclined section 78, that is for example inclined to 45°, ensures that the ply N is not damaged when being turned.

[063] As shown in Figures 6A to 6D, the handling device 20 at least makes it possible to
15 move the gripping device 10 in a vertical direction DV that is perpendicular to the working planes P72 and P74 of the incoming table 72 and the reception table 74 and in a horizontal direction DH parallel to the working planes P72 and P74 of the incoming table 72 and the reception table 74.

[064] Also preferably, the handling device 20 also makes it possible to pivot the gripping
20 device 10 about a horizontal axis AH that is parallel to the working planes P72 and P74 of the incoming table 72 and the reception table 74 and perpendicular to the vertical direction DV that is perpendicular to the working planes P72 and P74 of the incoming table 72 and the reception table 74.

[065] Figure 6A shows a first step of the turning in which the gripping device 10 grips a
25 longitudinal edge BL of the ply N with the gripping elements 12 of same, i.e. four aligned suction pads 14 that are spaced apart from one another and provided with a vacuum.

[066] In a second step of the turning shown in Figure 6B, the handling device 20 moves the gripping device 10 upwards in the vertical direction DV in order to lift the longitudinal edge BL of the ply N gripped by the gripping elements 12.

30 [067] The turning of the ply takes place more specifically during the third step shown in Figure 6C. For this purpose, the handling device 20 moves the gripping device 10 in the

horizontal direction DH and from the incoming table 72 towards the reception table 74. In parallel with this movement in the horizontal direction DH, the handling device 20 pivots the gripping device 10 by approximately 90° about the horizontal axis AH in order to prevent the ply N from folding about itself and in order to place the gripping device 10 in a suitable position to release the turned ply N onto the reception table 74.

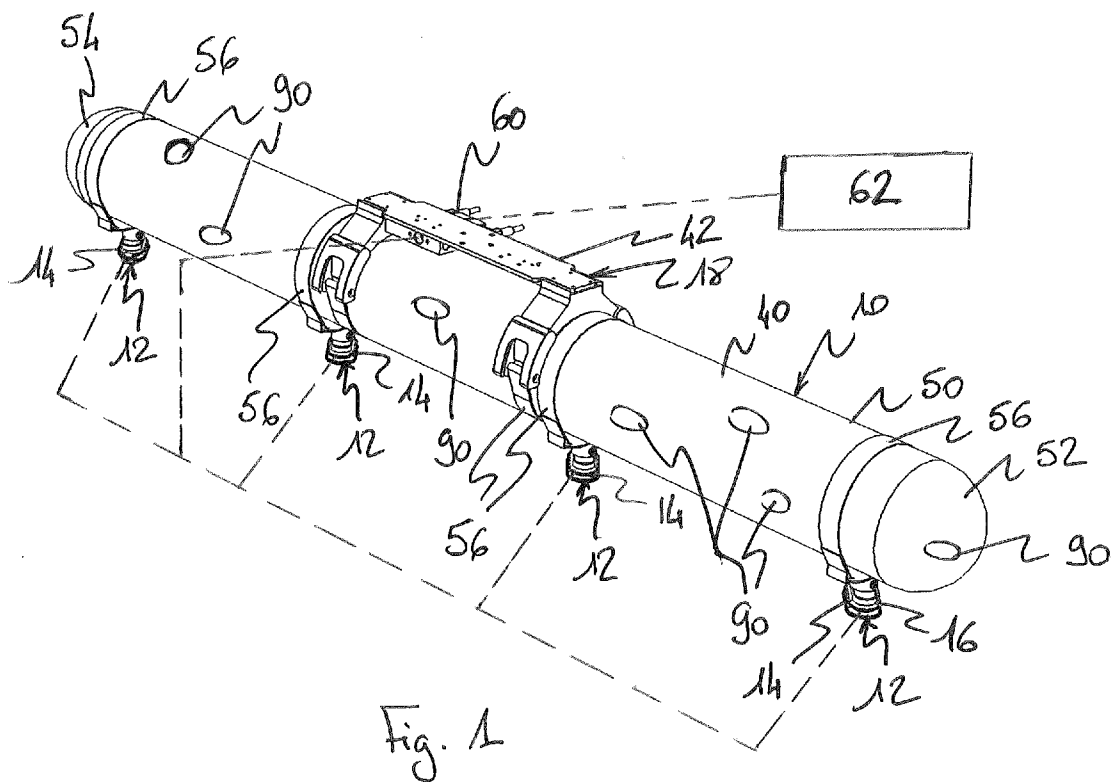
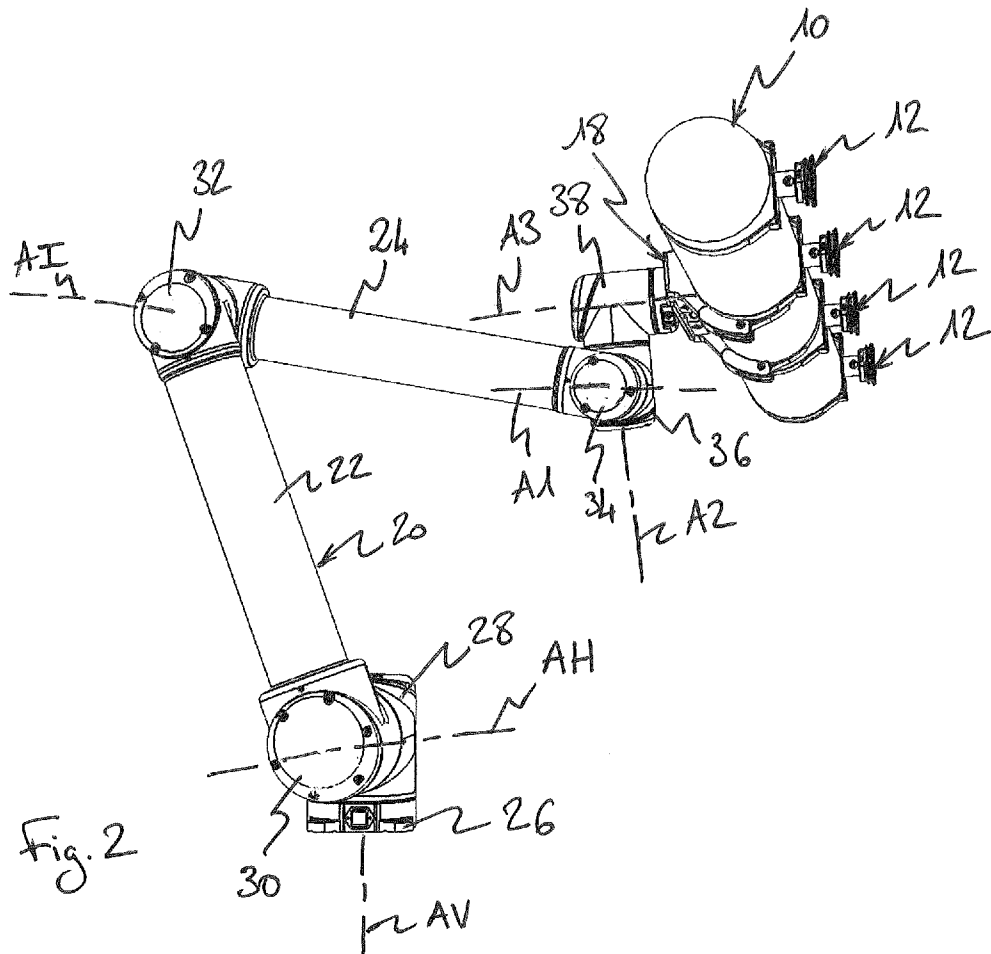
[068] In order to release the turned ply N, as shown in Figure 6D, the handling device 20 continues to move the gripping device 10 in the horizontal direction DH and from the incoming table 72 towards the reception table 74, as well as moving the gripping device 10 downwards in the vertical direction DV in order to move the gripping device 10 and the gripping elements 12 thereof as close as possible to the working plane P74 of the reception table.

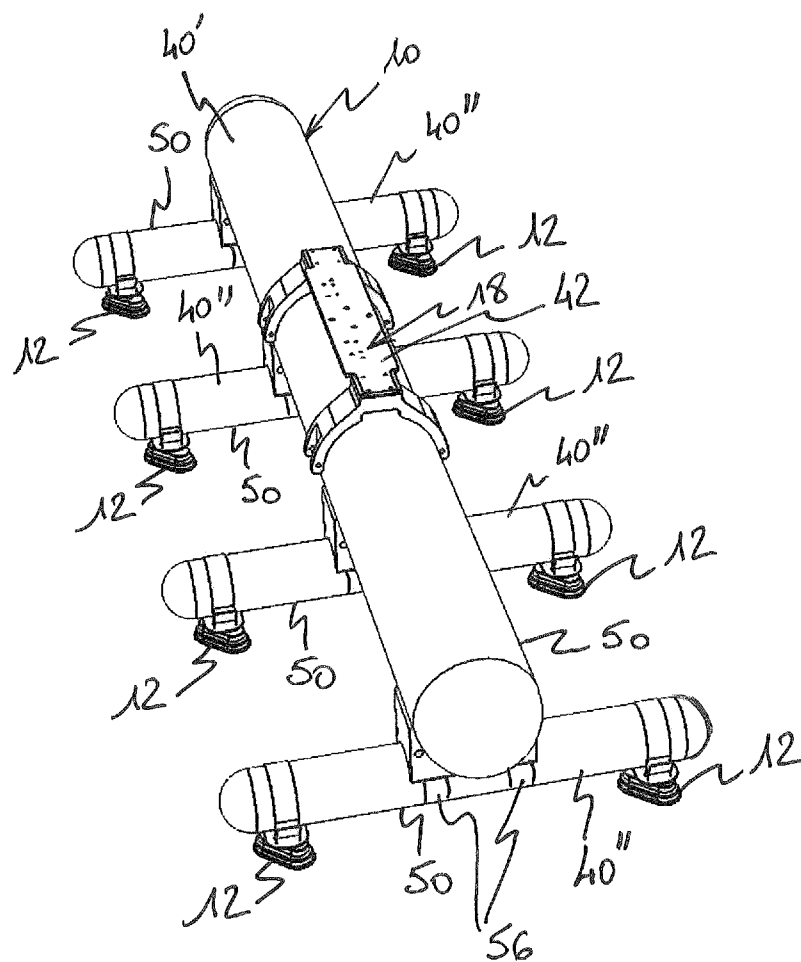
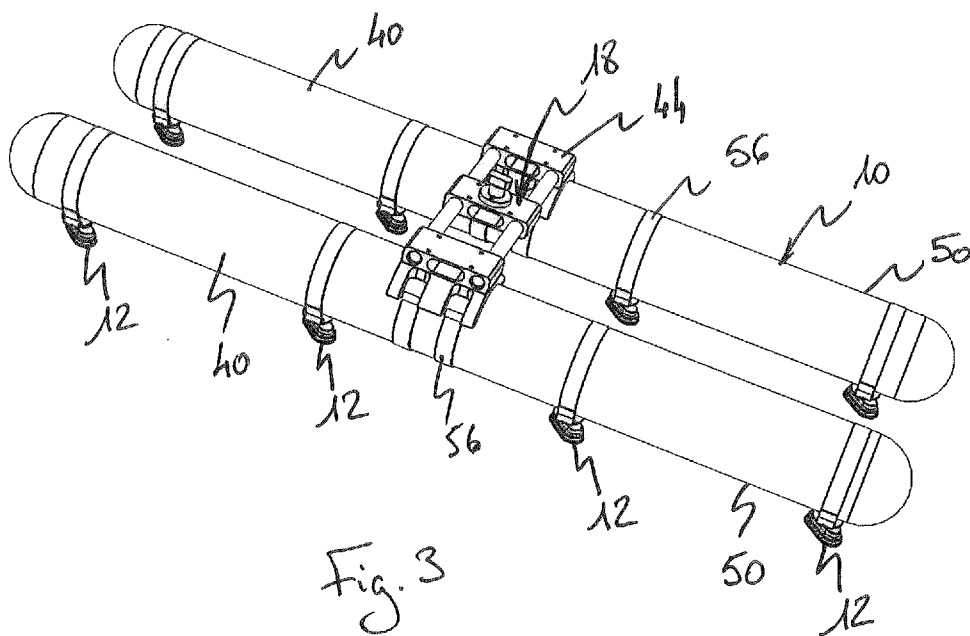
[069] Thanks to the turning device 70, the operator is no longer required to perform the repetitive movements related to manual turning. Thus, the operator has more time to visually check the lower face FI and the upper face FS of the plies N and to perform an additional step of joining and assembling the transverse rear edge BTR of a first ply N turned by the turning device 70 to the transverse front edge BTF of a second ply N turned by the turning device 70.

CLAIMS

- 5 1. A gripping device (10) for gripping an object, the gripping device having at least one gripping element (12) for gripping the object, a connection base (18) connected to an automated handling device (20) such as a robotic arm, and at least one structural element (40, 40") that bears each gripping element (12) and that is attached to the connection base (18) or to another structural element (40'), the gripping device being characterized in that each structural element (40, 40', 40") is a bladder (50) that is inflated with at least one
10 gas.
2. A gripping device (10) for gripping an object according to Claim 1, in which the pressure of the air or the gas inside a bladder (50) is around 0.2 to 0.4 bars.
3. A gripping device (10) for gripping an object according to one of the preceding claims, in which a bladder (50) has rounded ends (52, 54).
- 15 4. A gripping device (10) for gripping an object according to one of the preceding claims, in which each bladder (50) is elongate.
5. A gripping device (10) for gripping an object according to one of the preceding claims, in which each bladder (50) is cylindrical.
- 20 6. A gripping device (10) for gripping an object according to one of the preceding claims, in which at least one structural element (40, 40") bears several gripping elements (12) for gripping an object.
- 25 7. A gripping device (10) for gripping an object according to one of the preceding claims, in which at least one main structural element (40') connected to the connection base (18) bears at least one other secondary structural element (40") that bears at least one gripping element (12) for gripping an object.
8. A gripping device (10) for gripping an object according to one of the preceding claims, in which a gripping element (12) is a suction pad (14).
- 30 9. A gripping device (10) for gripping an object according to one of the preceding claims, in which at least one capacitive proximity sensor (90) is arranged on a structural element (40, 40', 40") in the form of a bladder (50).

10. A handling device (20) for handling an object, the handling device having at least one moveable arm (24) and being moved by an actuator (32), characterized in that a gripping device (10) according to one of the preceding claims is linked to the moveable arm (24) via the connection base (18) thereof.





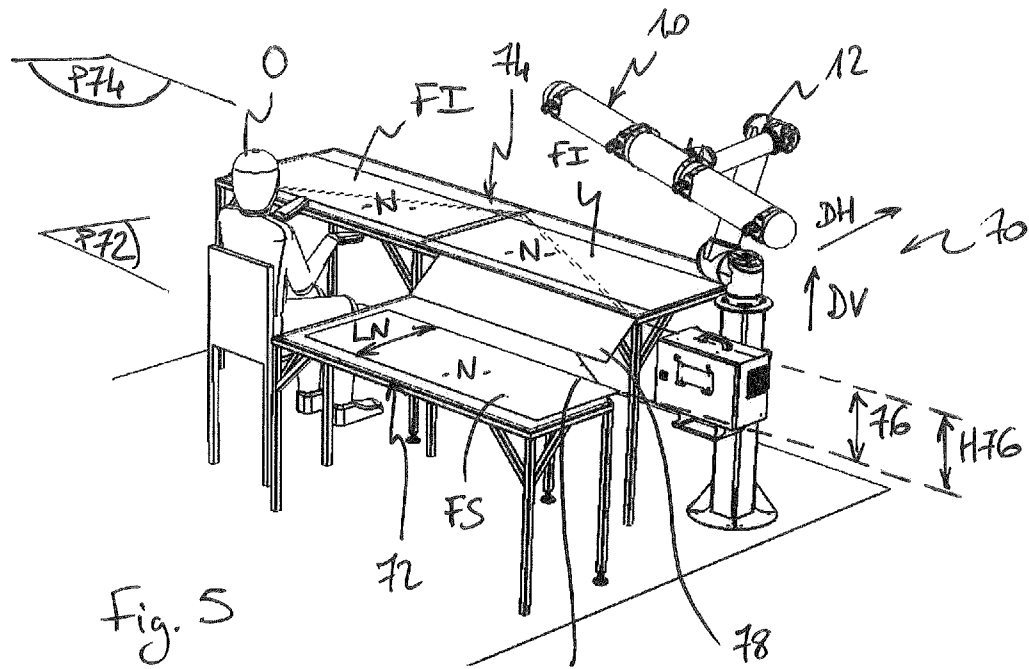


Fig. 5

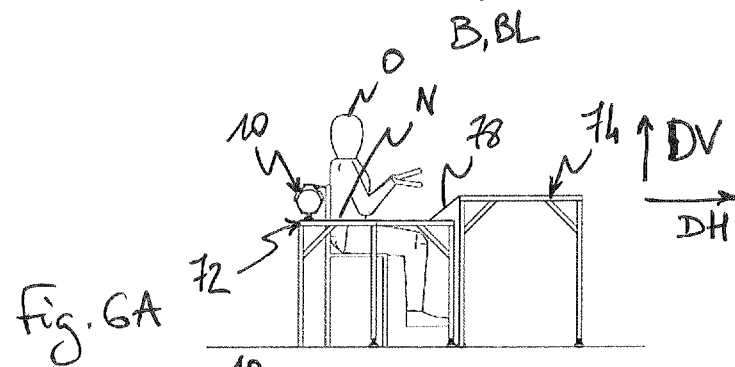


Fig. 6A

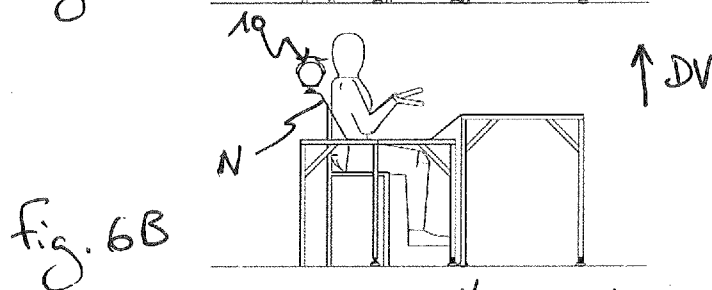


fig. 6B

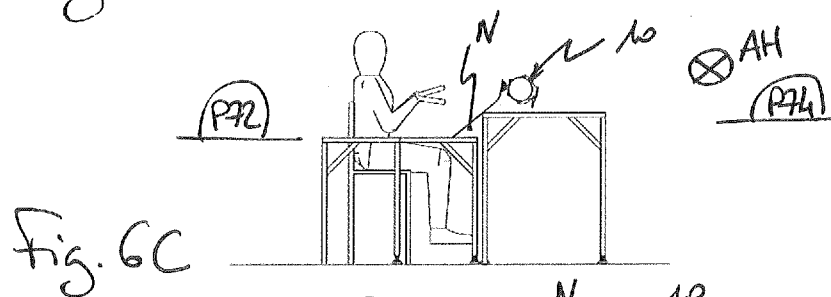


Fig. 6C

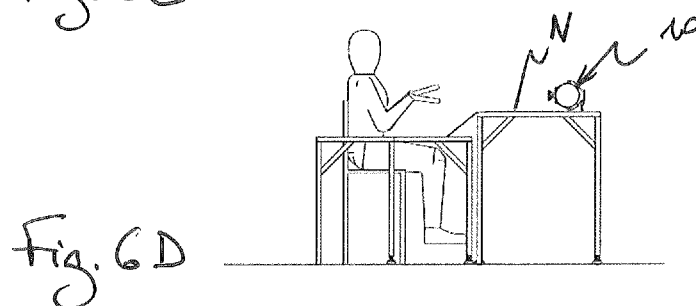


Fig. 6D

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/074754

A. CLASSIFICATION OF SUBJECT MATTER

INV. B25J15/00 B25J18/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B25J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 5 065 640 A (KOREN YORAM [US] ET AL) 19 November 1991 (1991-11-19) column 3, lines 33-40 column 3, line 67 - column 4, line 54 column 5, lines 59-64 figures 1-3 -----	1,2,4-8, 10 9
X A	EP 2 762 280 A1 (CVUT V PRAZE FAKULTA STROJNÍ [CZ]; COMPOTECH PLUS S R O [CZ]) 6 August 2014 (2014-08-06) paragraphs [0016], [0017], [0034], [0036], [0043] - [0045], [0048], [0049] figures 1,20,23,37-39,43,44 -----	1-4,6-8, 10 9



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 November 2017

Date of mailing of the international search report

06/12/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Grenier, Alain

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/074754

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5065640	A	19-11-1991	NONE

EP 2762280	A1	06-08-2014	CZ 304220 B6 08-01-2014
		EP 2762280 A1	06-08-2014
