



(11) **EP 4 159 340 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.04.2023 Bulletin 2023/14

(51) International Patent Classification (IPC):
B21D 51/44 (2006.01)

(21) Application number: **22198255.6**

(52) Cooperative Patent Classification (CPC):
B21D 51/44

(22) Date of filing: **28.09.2022**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Velomat S.r.l.**
40026 Imola (BO) (IT)

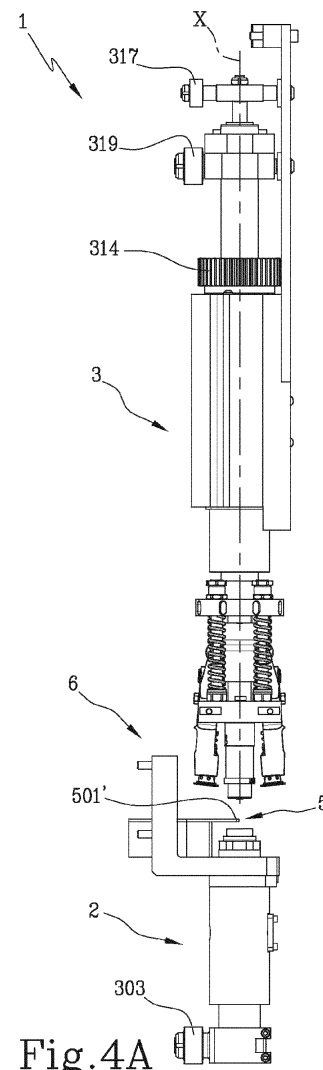
(72) Inventor: **DI DOMIZIO, Massiliano**
66026 ORTONA (CHIETI) (IT)

(74) Representative: **Conti, Marco**
Bugnion S.p.A.
Via di Corticella, 87
40128 Bologna (IT)

(30) Priority: **29.09.2021 IT 202100024902**

(54) **APPARATUS AND METHOD FOR BENDING A CAP**

(57) Described is an apparatus (1) for bending a cap equipped with a security seal and a closure casing defining a perimeter edge housing the security seal on a perimeter edge, comprising a support unit (2), including a seat (201) for receiving a closure casing, and a locking unit (3); the support unit (2) and the locking unit (3) are oriented along a longitudinal axis (X) and movable relative to each other along the longitudinal axis (X) between a spaced-apart position and a close-together position wherein the locking unit (3) engages the closure casing positioned in the seat (201) of the support unit. A deforming element (303) is positioned laterally to the longitudinal axis (X) and is movable, away from and towards the longitudinal axis (X), between an inactive position and an active position, wherein it presses outside the perimeter edge of the closure casing to deform it plastically towards the longitudinal axis (X); the deforming element (303) is also movable by rotating about the longitudinal axis (X).



EP 4 159 340 A1

Description

[0001] This invention relates to an apparatus and a method for bending a cap.

[0002] The apparatus for bending a cap makes it possible to bend and assemble caps of the "Talog" type, the cap of which includes a security seal and a closure casing defining a perimeter edge. In particular, in this type of cap, bending allows assembly between the closure casing and the security seal, which is therefore constrained along the perimeter edge of the closure casing.

[0003] Preferably, the security seal is made of plastic; whilst the closure casing is made of metal (for example, aluminium). In particular, the security seal is in turn preferably composed of two bands sealed to each other in such a way as to attest the correct closure of a container, for example of a bottle, on which the cap is installed. Once the bottle has been opened, the two bands of the security seal are completely or partly separated from each other and, in that case, one of either of the two bands or both the bands of the security seal are removed from the bottle together with the closure casing.

[0004] In general, an apparatus for bending caps of the above-mentioned type poses various requirements.

[0005] Of these, there is the need for the bending of the caps to be performed precisely and that the apparatus itself is sufficiently robust and reliable, so as to minimise repair work in the event of a fault of the apparatus. Moreover, there is the further need for bending to be performed quickly, in such a way as to be able to bend, in a predetermined period of time, as many caps as possible.

[0006] An example of an apparatus for bending caps of this type is described in patent documents IT10201900006222 and WO2020217186A1, or US4232500A and JP2011240188A.

[0007] In the type of devices described in these patent documents, there are two processing units; the lower unit supports the closure casing, whilst the upper unit has the dual function of locking the closure casing on the lower unit and, moving towards the perimeter edge of the closure casing, plastically deforming the closure casing. In particular, the deformation occurs by flattening by an annular element which moves along the longitudinal axis.

[0008] The prior art described comprises a significant drawback, linked to the possibility that the closure casing can have inclined edges, for example towards the outside relative to the longitudinal axis; this is the case if, for example, there are shape defects derived from a previous process for processing the closure casing, or if the closure casing has been incorrectly located on the support unit, and the closure casing is therefore inclined by a certain angle relative to the support unit. In these circumstances, the flattening by the deforming unit may result in a bending of the perimeter edge in the opposite direction to the desired direction and can therefore lead to the production of faulty caps; the device may therefore be imprecise and unreliable in bending the cap. For this reason, the prior art devices for processing the "Talog"

caps are disadvantageous since they are not very reliable and not very precise, and consequently they pose the risk of ruining the caps, especially in critical cases (shape or positioning defects).

[0009] The aim of this invention is to provide an apparatus and a method for bending a cap which overcome the above-mentioned drawback of the prior art.

[0010] Said aim is fully achieved by the apparatus and the method according to the invention as characterised in the appended claims.

[0011] This invention relates to an apparatus for bending a cap of the "Talog" type described above. The invention also provides a method for bending a cap of this type.

[0012] The apparatus comprises a support unit, which is designed to support the closure casing. For this purpose, the support unit may include a seat designed to receive, that is to say, house the closure casing or a part thereof. The support unit may be operatively oriented along a longitudinal axis.

[0013] The apparatus also comprises a locking unit which is designed to lock the closure casing positioned on the seat of the support unit. Preferably, the locking unit is operatively oriented along the longitudinal axis.

The support unit and the locking unit are movable relative to each other; preferably, the support unit and the locking unit are movable relative to each other along the longitudinal axis between a spaced-apart position and a close-together position. In the spaced-apart position, for example, the closure casing may be positioned on the support unit and the security seal may be positioned on the locking unit, or the security seal may be positioned directly on the closure casing; in the close-together position, for example, the locking unit may be partly inserted in the closure casing positioned in the seat of the support unit.

[0014] The apparatus may comprise a deforming element.

[0015] The deforming element may be positioned laterally relative to the longitudinal axis. The deforming element can move relative to the longitudinal axis. In particular, the deforming element can move along the longitudinal axis; in addition, or alternatively, the deforming element can move transversally, that is to say, radially, away from and towards the longitudinal axis. The deforming element can move between an inactive position and an active position. Preferably, in the passage between the inactive position and the active position, the deforming element moves transversely, that is to say, radially, relative to the longitudinal axis.

[0016] In the active, that is to say, end of stroke position (in the movement towards the longitudinal axis), for example, the deforming element can press outside the perimeter edge of the closure casing; in the active position, the deforming element can plastically deform the closure casing towards the longitudinal axis in such a way as to form a constraining seat housing the security seal. According to an example embodiment, the deforming element plastically deforms the perimeter edge by applying

a pressure in a transversal direction, that is to say, radially, relative to the longitudinal axis; according to another embodiment, the deforming element comprises a heated element and the deforming element can thermally deform in a direction transversal, that is to say, radially, relative to the longitudinal axis, by thermal contact between the heated element of the deforming element and the perimeter edge.

[0017] In the inactive position, the deforming element is in a position of non-interference with the closure casing.

[0018] Preferably, the plastic deformation of the closure casing towards the longitudinal axis occurs under pressure applied outside the perimeter edge of the closure casing and exerted in a direction transversal to the longitudinal axis, that is to say, radially.

[0019] The deforming element can move by rotating about the longitudinal axis. According to an example embodiment, during the rotating movement, the deforming element can press outside the perimeter edge along an arc of the perimeter edge or along the entire perimeter edge.

[0020] Thanks to the use of the deforming element which, by pressure or by thermal contact with the perimeter edge in a direction transversal to the longitudinal axis, deforms the perimeter edge of the closure casing in a transversal direction, that is to say, radially, relative to the longitudinal axis, it is also possible to bend in a precise fashion a closure casing which has the edges inclined, for example towards the outside relative to the longitudinal axis, if there are shape defects or the closure casing has been incorrectly placed on the support unit.

[0021] The apparatus for bending a cap may comprise a further deforming element; the deforming element and the further deforming element define a plurality of deforming elements.

[0022] The further deforming element may be positioned laterally relative to the longitudinal axis. The further deforming element may be angularly spaced relative to the deforming element. The deforming element can move relative to the longitudinal axis. In particular, the deforming element can move along the longitudinal axis; the deforming element can move transversally, that is to say, radially, away from and towards the longitudinal axis. Preferably, the further deforming element is movable between an inactive position of non-interference with the closure casing, and an active position, in which it presses outside the perimeter edge of the closure casing. Preferably, in the passage between the inactive position and the active position, the deforming element moves transversely, that is to say, radially, relative to the longitudinal axis. The further deforming element may be movable in a synchronous fashion relative to the deforming element. Similarly to the deforming element, the further deforming element can deform the perimeter edge by applying a pressure in a direction transversal, that is to say, radially, relative to the longitudinal axis. Or, similarly to the deforming element, the further deforming element can deform the perimeter edge by thermal contact between a

heated element of the further deforming element and the perimeter edge. Similarly to the deforming element, the further deforming element may be movable by rotating about the longitudinal axis, in such a way as to press externally along an arc of the perimeter edge or along the entire perimeter edge.

[0023] Preferably, each element of the plurality of deforming elements is angularly equispaced from each other, in such a way that the plurality of deforming elements is positioned symmetrically relative to the longitudinal axis. Preferably, each element of the plurality of deforming elements is movable by rotating about the longitudinal axis in the same direction as the other deforming elements.

[0024] The presence of a plurality of deforming elements angularly and equispaced from each other symmetrically relative to the longitudinal axis has the twofold advantage of increasing the precision and speed necessary for bending the closure casing, therefore responding to the need for production of the largest possible number of caps in a predetermined interval of time. Moreover, the rotating movement of the plurality of deforming elements in the same direction as each other has the advantage of being able to easily synchronize the rotating movements of each deforming element.

[0025] Hereinafter, for simplicity of description and unless otherwise specified, when it is indicated that the apparatus comprises a deforming element, it will be implicit that the apparatus can equally comprise at least one further deforming element.

[0026] The apparatus for bending a cap may form part of a machine for bending caps in a continuous cycle.

[0027] The machine may be configured to move the caps and/or the components of caps, that is to say, the closure casings and/or the security seals along straight or curvilinear paths; preferably, the machine comprises a carousel rotating about a central axis.

[0028] The machine may comprise a plurality of apparatuses mounted on the carousel. According to an example embodiment, the central axis of the rotary carousel is parallel to the longitudinal axis of the apparatuses for bending the caps. According to an example embodiment, the apparatuses mounted on the carousel are angularly spaced relative to the central axis of the carousel.

[0029] The machine may comprise an infeed station for the closure casings and/or the security seals. The machine may comprise an outfeed station for the bent caps. The infeed station and the outfeed station may be configured to move the caps and/or components of caps, that is to say, the closure casings and/or the security seals, along rectilinear or curvilinear paths.

[0030] The infeed station is configured for conveying, that is to say, directing the closure casings and/or the security seals on each apparatus of the carousel. According to an example embodiment, the infeed station may comprise seats configured to house the closure casings and/or the security seals.

[0031] The outfeed station is configured for conveying,

that is to say, directing towards the outfeed, the bent caps starting from each apparatus of the carousel. According to an example embodiment, the outfeed station comprises seats configured to house the bent caps.

[0032] According to an example embodiment, the infeed station and/or the outfeed station rotate about a central axis. Preferably, the central axis of the infeed station and/or of the outfeed station is parallel to the longitudinal axis of the apparatuses for bending the caps.

[0033] The deforming element may be associated with one between the support unit and the locking unit of the apparatus for bending the caps, or it may be independent of both the support and locking units, for example the deforming element may be associated with the carousel of the machine for bending caps in a continuous cycle.

[0034] Hereinafter, for simplicity of description and unless otherwise specified, when it is indicated that the deforming element is associated with the locking element, it will be implicit that the deforming element can be equivalently associated with the support unit or be independent of both the support and locking units, for example being associated with the carousel of the machine for bending caps in a continuous cycle.

[0035] Preferably, the locking unit to which the deforming element is associated is movable by translation along the longitudinal axis. According to an example embodiment, the machine for bending caps in a continuous cycle comprises an electric motor configured to move the locking unit to which the deforming element is associated, by translation along the longitudinal axis. According to an example embodiment, the apparatus may comprise a wheel and the translation movement along the longitudinal axis of the locking unit to which the deforming element is associated can be performed by sliding the wheel along a profiled surface of the carousel. The seat of the support unit may have a base and a lateral wall. The base of the seat of the support unit may be configured to house part of the security seal. The support unit may include a spring, connected to the base of the seat of the support unit for elastically moving the base along the longitudinal axis of the apparatus; the spring is designed to dampen the contact between the deforming element and the closure casing, in an active position of the deforming element, in such a way as not to ruin the closure casings during bending. According to a preferred example, the base of the seat of the support unit is at a fixed position relative to the longitudinal axis of the apparatus; the locking unit to which the deforming element is associated may comprise a plurality of springs for damping the contact between the deforming element and the closure casing, in an active position of the deforming element.

[0036] The seat of the support unit may be movable by translating along the longitudinal axis; according to a preferred example, the lateral wall of the support unit can move between a retracted position, of non-interference with the closure casing positioned on the seat of the support unit, and an extracted position, such that the lateral wall of the seat of the support unit surrounds, at least

partly, the closure casing. The extracted position of the lateral wall of the seat of the support unit allows the centring, relative to the longitudinal axis, of the closure casing positioned on the seat of the support unit. According to an example embodiment, the machine for bending caps in a continuous cycle comprises an electric motor configured for moving the lateral wall of the seat of the support unit, by translation along the longitudinal axis. According to an example embodiment, the apparatus may comprise a wheel and the translation movement along the longitudinal axis of the lateral wall of the seat of the locking unit can be performed by sliding the wheel along a profiled surface of the carousel. The movements of the apparatus, for example the translation movement along the longitudinal axis, the reciprocal movement of the deforming element in a direction transversal to the longitudinal axis and the rotary movement of the deforming element about the longitudinal axis may occur independently of each other, or they may occur in a synchronized fashion, that is to say, times, one with the other.

[0037] According to an example embodiment, the synchronization, that is to say, the timing of the movements of the apparatus may be performed using an electronic card programmed to synchronize the electric motors of the respective movements. According to an example embodiment, the synchronization, that is to say, the timing of the movements of the apparatus may be performed using a profiled surface to define a cam.

[0038] For example, the translation movement of the locking unit to which the deforming element is associated along the longitudinal axis may be constrained to the movement of the deforming element towards each other in a direction transversal to the longitudinal axis.

[0039] For example, the movement of the deforming element in a direction transversal to the longitudinal axis may be constrained to the rotary movement of the deforming element about the longitudinal axis.

[0040] For example, the translation movement of the locking unit to which the deforming element is associated along the longitudinal axis may be constrained to the rotary movement of the deforming element about the longitudinal axis.

[0041] In particular, the synchronization, that is to say, the timing of the movements may be such that, according to an example embodiment, the rotary movement of the deforming element starts when the movement towards of the deforming element has ended, that is to say, when the deforming element has reached the end of stroke. According to a further example embodiment, the rotary movement of the deforming element starts before or simultaneously with the movement towards of the deforming element, that is to say, before the deforming element reaches the end of stroke position; in that case, the trajectory described by the deforming element, relative to the locking element to which it is associated, is a spiral.

[0042] The embodiment wherein the rotary movement of the deforming element starts before or simultaneously with the movement towards the same deforming element,

that is to say, before the deforming element reaches the end of stroke position (in the movement towards the longitudinal axis), has the advantage, for example, that the pressure applied by the deforming element on the perimeter edge is exerted in a gradual fashion. In this invention, the label "T" denotes the time interval used by the deforming element to pass from a first contact position (that is to say, the position in which the deforming element touches the perimeter edge of the closure casing but has not yet reached the end of stroke position) to the active position, (that is to say, the end of stroke position in the movement towards the longitudinal axis). In this invention, the label "N" denotes the number of rotations about the longitudinal axis performed by the deforming element over time T, which are necessary to complete the bending along the entire perimeter edge. The number of rotations N is at least equal to 1. According to an example embodiment, the deforming element may perform a plurality of rotations about the longitudinal axis and the number of rotations N may therefore be a number greater than 1. If there is more than one deforming element, the number of deforming elements included in the apparatus is labelled "D" in this invention. The number of rotations about the longitudinal axis performed by the deforming element, which are necessary to complete the bending along the entire perimeter edge, is preferably N/D; that is to say, the number of rotations necessary may be reduced by a factor D equal to the number of deforming elements included in the apparatus.

[0043] According to an example embodiment, the apparatus may comprise a pinion. For example, the pinion may be rotated about the longitudinal axis of the apparatus for bending a cap from a component of the carousel of the machine, for example, from a ring gear of the carousel; the apparatus may comprise a connecting element which constrains the rotary movement of the pinion with the rotary movement of the deforming element about the longitudinal axis.

[0044] According to an example embodiment, the apparatus comprises a movement mechanism, the function of which is to move the deforming element. In particular, the movement mechanism moves the deforming element towards and away from, in a transversal direction, that is to say, radially, relative to the longitudinal axis. The movement of the deforming element towards and away from, in a transversal direction, that is to say, radially, relative to the longitudinal axis, may occur by means of an oscillation movement of the deforming element about an axis which may be transversal to the longitudinal axis.

[0045] For example, the movement mechanism may include an arm having a first and a second end. The arm may be articulated to the locking unit to which the deforming element is associated at a pivot point. The deforming element may be associated with the first end of the arm. The arm may oscillate about an axis of oscillation passing through the pivot point and the axis of oscillation may be transversal to the longitudinal axis. According to an example embodiment, the movement mechanism

which moves the deforming element towards and away, in a transversal direction, that is to say, radially, relative to the longitudinal axis may constrain the movement towards and away of the deforming element with the translation movement of the locking unit to which the deforming element is associated along the longitudinal axis.

[0046] In order to synchronize, that is to say, timing, the deforming movement towards and away from, in a transversal direction, that is to say, radially, relative to the longitudinal axis and the translation movement of the locking unit to which the deforming element is associated along the longitudinal axis, the movement mechanism may include a slider. The slider can slide along the longitudinal axis, relative to the locking unit.

[0047] The slider may interact with the second end of the arm to rotate it about the axis of oscillation.

[0048] According to an example embodiment, the constraint between the movement of the slider which slides along the longitudinal axis and the rotational movement about the axis of oscillation at the pivot point of the arm of the movement mechanism may occur including on the slider a profiled surface to define a cam. The deforming element may include a wheel, associated with the second end of the arm, and the wheel may be constrained to slide along the profiled surface of the slider.

[0049] The use of a cam for synchronizing the translation movement along the longitudinal axis of the locking unit to which the deforming element is associated and the movement towards and away in a transversal direction, that is to say, radially, relative to the longitudinal axis of the deforming element has the advantage of simplifying the construction of the apparatus for bending a cap and reducing the number of components of the apparatus, consequently, simplifying repair operations in the event of fault of the apparatus.

[0050] The locking unit to which the deforming element is associated may include a flange extending radially relative to the longitudinal axis. The flange may define a slot, wherein the slot constitutes a break in the flange. The arm of the movement mechanism may be articulated to the flange and be movably inserted in the slot.

[0051] According to an example embodiment, the deforming element may comprise a disc. The disc may be connected to the first end of the arm of the movement mechanism, in such a way as to rotate freely about an axis of the deforming element or in such a way as to be fixed relative to the axis of the deforming element. According to the example embodiment wherein the disc can rotate freely about the axis of the deforming element, for example, in the active position of the deforming element, the disc is rotated by friction with the perimeter edge of the closure casing. The idle rotation about the axis of the deforming element has the advantage of avoiding rubbing and, consequently, the wear of the deforming element. Moreover, the idle rotation has the further advantage of reducing the friction between the deforming element and the closure casing and therefore prevents the production of waste powder.

[0052] The apparatus may include a contact unit. Or the machine for bending caps in a continuous cycle may include a contact unit; for example, the contact unit may form part of the carousel of the machine for bending caps in a continuous cycle, or it may form part of the infeed station and/or the outfeed station of the machine for bending caps in a continuous cycle. According to an example, the contact unit is associated with the apparatus for bending a cap. For example, the contact unit may be associated with the support unit or it may be associated with the locking unit. Preferably, the contact unit is associated with the support unit when the deforming element is associated with the locking unit, or the contact unit is associated with the locking unit when the deforming element is associated with the support unit.

[0053] The contact unit may include one end. The end of the contact unit may be fixed, or it may be movable. For example, the end of the contact unit may be movable between a spaced-apart position and a close-together position with respect to the longitudinal axis of the apparatus. In the close-together position, the end of the contact unit may make contact with, or abut, the closure casing positioned on the support unit, in the spaced-apart position, the end of the contact unit is in a position of non-interference with the closure casing. The end of the contact unit may include a gripper configured to make contact with the closure casing on the support unit, for example after the closure casing has been conveyed on the support unit by the infeed station; in that case, the gripper acts as an abutment for the closure casing.

[0054] According to an example embodiment, the gripper may be configured to grip the closure casing. For example, the gripper of the contact unit can grip a closure casing positioned on a seat of the infeed station of the machine and place the closure casing on the seat of the support unit. For example, the gripper of the contact unit can grip a bent cap from the seat of the support unit and place the bent cap on a seat of the outfeed station of the machine.

[0055] According to an example, the contact unit may include a fixed end; the fixed end may have a contact seat configured to make contact with, that is to say, abut the closure casing on the support unit, for example after the closure casing has been conveyed to the support unit from the infeed station; in that case, the contact seat acts as an abutment for the closure casing.

[0056] In this invention, the label "n" denotes the number of apparatuses included in the machine for bending caps in a continuous cycle; in the example embodiment wherein the contact unit is associated with the apparatus for bending a cap and the apparatus forms part of a machine for bending caps in a continuous cycle, then the number of contact units present in the machine for bending caps in a continuous cycle is preferably equal to n. According to the example embodiment wherein the contact unit is associated with the machine for bending caps in a continuous cycle, for example, if the contact unit forms part of the carousel or of the infeed station

and/or of the outfeed station, then the number of contact units present in the machine is preferably between 1 and n.

[0057] Associated with the apparatus for bending a cap, or associated with the machine for bending caps in a continuous cycle, there may be a coupling element; for example, the coupling element may be associated with the carousel of the machine for bending caps in a continuous cycle. The coupling element is configured for coupling, at least partly, the support unit and the locking unit; for example, the coupling element may be configured for aligning the support unit and the locking unit. The coupling element includes an upper end and a lower end. Preferably, the coupling element can define an L shape.

According to the embodiment wherein the coupling element defines an L shape, the coupling element, for example, may be connected, in its lower part, to part of the support unit and in its upper part, to part of the machine for bending caps in a continuous cycle; according to this embodiment, in order to guarantee the correct alignment between the support unit and the locking unit, part of the carousel may be further connected to part of the locking unit.

[0058] The coupling element may comprise a slot, the slot constituting an interruption of the coupling element. According to an example embodiment, the contact unit may be inserted inside the slot of the coupling element.

[0059] The invention also provides a method for bending a cap of the type described above.

[0060] The method comprises a step of preparing a support unit. The method comprises a step of positioning the closure casing on a seat of the support unit, for example on a base of the seat of the support unit. The closure casing may be positioned on the seat of the support unit, for example, by a contact unit, which picks up the closure casing from an infeed station and places the closure casing on the seat of the support unit. Or, preferably, the positioning of the closure casing on the seat of the support unit may be performed by the infeed station; in that case, for example, the contact unit may act as a contact, that is to say, an abutment, for the closure casing on the seat of the support unit.

[0061] The method comprises a step of preparing a locking unit. For example, the method may comprise a step of placing the security seal on the locking unit, or placing the security seal directly on the perimeter edge of the closure casing. The positioning of the security seal may be performed, for example, by the contact unit, which picks up the security seal from an infeed station and places the security seal on the locking unit, or the contact unit places the security seal directly on the perimeter edge of the closure casing. Or, the positioning of the security seal may be performed by the infeed station; in that case, for example, the contact unit may act as a contact element, that is to say, as an abutment, for the security seal. The method comprises a step of relative movement between the support unit and the locking unit. The relative movement may occur along a longitudinal axis between

a spaced-apart position and a close-together position. In the spaced-apart position, for example, the closure casing is positioned on the seat of the support unit and the security seal is positioned on the locking unit. In the close-together position, for example, the locking unit is partly inserted in the closure casing in such a way as to stop, that is to say, lock, the closure casing during the bending of the cap.

[0062] The method comprises a step of preparing a deforming element. According to an example embodiment, the deforming element is positioned laterally relative to the longitudinal axis.

[0063] The method includes a step of moving the deforming element relative to the longitudinal axis. For example, the movement of the deforming element may occur along the longitudinal axis, or, preferably, the movement of the deforming element may occur transversely, that is to say, radially, towards the longitudinal axis, between an inactive position, of non-interference with the closure casing, to an active position, that is to say, an end of stroke position (in the movement towards the longitudinal axis), wherein the deforming element presses outside the perimeter edge of the closure casing to deform it plastically towards the longitudinal axis.

[0064] For example, the method may comprise a step wherein the movement of the deforming element towards the longitudinal axis occurs by a rotational movement about an axis, wherein the axis may be transversal to the longitudinal axis.

[0065] The method may comprise the step of moving the deforming element according to a rotary movement about the longitudinal axis. During the rotary motion, the deforming element can press externally along an arc of the perimeter edge or along the entire perimeter edge.

[0066] The method comprises the step of moving the deforming element away relative to the longitudinal axis. The movement of the deforming element may occur between the active position and the inactive position, of non-interference with the closure casing. The method comprises the step of moving away from each other along the longitudinal axis between the support unit and the locking unit.

[0067] The relative movement along the longitudinal axis between the support unit and the locking unit, the movement towards and away from the deforming element in a direction transversal to the longitudinal axis and the rotary movement of the deforming element about the longitudinal axis may be constrained to each other in such a way as to occur in a synchronized fashion, that is to say, timed, or may be independent of each other.

[0068] For example, the method may comprise the synchronization, that is to say, the timing, between the relative movement of the support unit and the locking unit and the movement towards the deforming element. In addition, or alternatively, the method may comprise the synchronization, that is to say, the timing between the movement towards the deforming element and the rotary movement of the deforming element. In addition, or al-

ternatively, the method may comprise the synchronization, that is to say, the timing between the relative movement of the support unit and the locking unit and the rotary movement of the deforming element.

[0069] According to an example embodiment, the method comprises a step of moving the deforming element, between the active position and the inactive position, according to a transversal movement, that is to say, radially relative to the longitudinal axis, the movement of which is constrained to the relative movement along the longitudinal axis between the support unit and the locking unit.

[0070] The method may comprise preparing a disc of the deforming element. The disc may be set up fixed relative to the axis of the deforming element, or it may be set up to rotate freely about the axis of the deforming element. For example, in the idle arrangement, the method may comprise the rotation of the disc about the deforming axis, and the pulling by friction with the perimeter edge of the closure casing, when the deforming element is in the active position.

[0071] The method may comprise a step of preparing a carousel. The carousel may form part of a machine for bending caps in a continuous cycle. The carousel may rotate about a central axis.

[0072] The method may include a step of preparing a plurality of apparatuses for bending a cap. Preferably, the apparatuses are positioned angularly spaced relative to the central axis of the carousel.

[0073] The method may comprise the preparation of components of caps, that is to say, closure casings and/or security seals, on seats of the infeed station. The method may include the positioning of the cap components, that is to say, closure casings and/or security seals, on the seat of the support unit of the apparatus included in the machine for bending caps in a continuous cycle. The method may comprise a step of removing the bent caps starting from the seat of the support unit of the apparatus included in the machine, on the seats of the outfeed station.

[0074] These and other features of the invention will become more apparent from the following detailed description of a preferred, non-limiting example embodiment of it, with reference to the accompanying drawings, in which:

- Figure 1A illustrates a diagram of a machine for bending caps in a continuous cycle;
- Figure 1B illustrates a carousel of a machine for bending caps in a continuous cycle, comprising an apparatus for bending a cap;
- Figure 2A illustrates part of an apparatus for bending a cap and part of a carousel according to an example embodiment comprising a plurality of contact units including a corresponding plurality of fixed contact seats;
- Figure 2B illustrates part of an apparatus for bending a cap according to an example embodiment com-

- prising a contact unit including a movable gripper;
- Figure 3A illustrates a cross section of part of an apparatus for bending a cap according to an example embodiment comprising a contact unit including a fixed contact seat;
- Figure 3B illustrates a cross section of part of an apparatus for bending a cap according to an example embodiment comprising a contact unit including a movable gripper;
- Figure 4A illustrates an apparatus for bending a cap, Figure 4B illustrates a cross section of an apparatus for bending a cap according to an example embodiment comprising a contact unit including a fixed contact seat;
- Figure 4C illustrates an apparatus for bending a cap, Figure 4D illustrates a cross section of an apparatus for bending a cap according to an example embodiment comprising a contact unit including a movable gripper;
- Figures 5, 5A, 5B, 5C illustrate, according to an operating example, the sequence of steps of using an apparatus for bending a cap.

[0075] The numeral 1 in the drawings denotes an apparatus for bending a cap. The caps being bent include a security seal and a closure casing along which the security seal can be housed.

[0076] The apparatus 1 is elongate along a longitudinal axis X.

[0077] The apparatus 1 forms part of a machine 7 for bending caps; the machine 7 comprises a carousel 701 rotating about a central axis X'. The carousel 701 includes a plurality of apparatuses 1 wherein the longitudinal axis X is parallel to the central axis X' of the carousel 701. The apparatuses 1 are positioned angularly equispaced relative to the central axis X'. The machine 7 comprises an infeed station 702 for the closure casings, rotating about an axis A, parallel to X'; the infeed station 702 comprises seats 703 configured to house the closure casings. The machine 7 comprises an outfeed station 704 for bent caps, rotating about an axis B, parallel to X'; the outfeed station 704 comprises seats 705 for housing the bent caps.

[0078] The apparatus 1 comprises a support unit 2 oriented along the longitudinal axis X. The support unit 2 includes a seat 201 configured to receive the closure casing. The seat 201 has a base 204 configured to house at least part of the closure casing. The seat 201 has side walls 205. The side walls 205 comprise a wheel 203 and the machine 7 comprises a profiled surface 202 for the lateral walls 205 for defining a cam and along the profiled surface 202 of which the wheel 203 of the side walls 205 are constrained to slide, in such a way as to move the side walls 205 along the longitudinal axis X. The side walls 205 preferably move between a retracted position to an extracted position; in the extracted position the side walls 205 surrounds, at least partly, the closure casing. In the retracted position, the side walls 205 do not inter-

ferre with the closure casing.

[0079] The apparatus 1 also comprises a locking unit 3, preferably oriented along the longitudinal axis X. The locking unit 3 is configured to be inserted at least partly in the closure casing on the support unit 2, to lock the closure casing on the support unit 2. The support unit 2 and the locking unit 3 are movable relative to each other along the longitudinal axis X, between a spaced-apart position and a close-together position. The locking unit comprises a hollow cylinder 301 and a central rod 302. The hollow cylinder 301 and the central rod 302 are movable by translation along the longitudinal axis X. The hollow cylinder 301 and the central rod 302 are configured to be inserted partly inside the closure casing, when the support unit 2 and the locking unit 3 are in a close-together position. The hollow cylinder 301 and the central rod 302 are slidable on each other along the longitudinal axis X; in particular, the hollow cylinder 301 is free to slide and the central rod 302 comprises a wheel 317 and the machine 7 comprises a profiled surface 316 for the central rod 302 for defining a cam and along the profiled surface 316 the wheel 317 of the central rod 302 is constrained to slide, in such a way as to move the central rod 302 along the longitudinal axis X.

[0080] In the passage between the close-together position and the spaced-apart position of the locking unit 3, the central rod 302 remains inserted partly in the closure casing located on the support unit 2, pressing on the bottom of the closure casing, whilst the hollow cylinder 301 escapes from the closure casing. In the spaced-apart position, the hollow cylinder 301 and the central rod 302 are both located outside the closure casing.

[0081] The apparatus 1 comprises a deforming element 303. According to the example illustrated in the drawing, the deforming element 303 is associated with the locking unit 3. The deforming element 303 is positioned laterally relative to the longitudinal axis X. The deforming element 303 can move away from and towards the longitudinal axis X, between an inactive position of non-interference with the closure casing, and an active, that is to say, end of stroke position (in the movement towards the longitudinal axis). In the active position, deforming element 303 presses outside the perimeter edge of the closure casing. The locking unit 3 includes a movement mechanism having an arm 304. The arm 304 includes a first end 304a and a second end 304b. The arm 304 is connected to the locking unit 3 by a pivot 305. The pivot 305 defines an axis of oscillation Y transversal to the longitudinal axis X; the arm 304 oscillates about the axis of oscillation Y at the pivot point 305 and the deforming element 303 is associated with the first end 304a of the arm 304.

[0082] A lower end of the hollow cylinder 301, that is to say, the end of the hollow cylinder 301 close to the support unit 2, is at a first position along the longitudinal axis X. The first end 304a of the arm 304 to which the deforming element 303 is associated is at a second position such that the first position of the lower end of the

hollow cylinder 301 is always at a smaller distance from the support unit 2 relative to the second position of the first end 304a.

[0083] The movement mechanism comprises a slider 306. The slider 306 is slidable longitudinally relative to the central rod 302. According to the example shown in the drawing, the slider 306 comprises a wheel 319 and the machine 7 comprises a profiled surface 318 for the slider 306 for defining a cam and along the profiled surface 318 of which the wheel 319 of the slider 306 is constrained to slide, in such a way as to move the slider 306 along the longitudinal axis X.

[0084] The slider 306 includes a profiled surface 307 for defining a cam and the movement mechanism includes a wheel 308 associated with the second end 304b of the arm 304 and constrained to slide on the profiled surface 307 of the slider 306; in particular, the slider 306 interacts with the second end 304b of the arm 304 for rotating the arm 304 about the axis of oscillation Y, transversal to the longitudinal axis X; in this way, the translation movement along the longitudinal axis X of the slider 306 is constrained to the movement towards or away of the deforming element 303.

[0085] The arm 304 includes two elastic elements, the axis of each of which is oriented transversally, that is to say, radially, relative to the longitudinal axis X. A first elastic element 321 of the two elastic elements is positioned at a first position along the arm 304 and a second elastic element 322 is positioned at a second position along the arm 304; the first height and the second position are such that the pivot 305 is positioned between the first position and the second position. In the active position of the deforming element 303, the first elastic element 321 is a spring under compression, the second elastic element 322 is a spring under traction. Vice versa, in an inactive position of the deforming element 303, the first elastic element 321 is a spring under traction, the second elastic element 322 is a spring under compression.

[0086] The slider 306 includes contact element 309 for the hollow cylinder 301. The contact element 309 acts as a contact, that is to say, an abutment for the hollow cylinder 301, constraining, at least partly, the sliding movement of the hollow cylinder 301 to the movement of the slider 306 translating along the longitudinal axis X. In this way, when the locking element 3 passes between the close-together position and the spaced-apart position, the hollow cylinder 301 is constrained to slide longitudinally together with the slider 306 thanks to the force of gravity applied longitudinally on the contact element 309 of the slider 306, whilst the central rod 302 remains at least partly inserted in the closure casing located on the support unit 2, pressing on the bottom of the closure casing.

[0087] The locking unit 3 includes a flange 310 projecting radially relative to the longitudinal axis X; the flange 310 defines a slot 311, which constitutes an interruption of the flange 310. The arm 304 is articulated to the flange 310 and is movably inserted in the slot 311.

[0088] The mechanism for moving the slider 306 comprises an elastic element 320; the elastic element 320 connects the slider 306 to the flange 310.

[0089] The elastic element 320 allows the flange 310 to move elastically along the longitudinal axis X.

[0090] The deforming element 303 includes a disc pivotally connected to the first end 304a of the arm 304. In the example shown in the drawing, the disc of the deforming element 303 is free to rotate in an idle fashion about an axis Z of the deforming element 303.

[0091] The deforming element 303 includes an elastic element 323, the axis of which is parallel to the axis Z of the deforming element 303. The elastic element 323 of the deforming element 303 dampens the contact between the disc of the deforming element 303 and the closure casing when the deforming element 303 is in the active position.

[0092] The locking unit 3 comprises a pinion 314 rotating about the longitudinal axis X. The locking unit 3 comprises a connecting element 315. The connecting element 315 connects the pinion 314 to the slider 306 for moving the deforming element 303 in rotation about the longitudinal axis X.

[0093] According to an example embodiment, each apparatus 1 comprises a contact unit 5, associated with the support unit 2. The contact unit 5 includes a gripper 501 movable towards and away from the longitudinal axis. The gripper 501 is configured to make contact, that is to say, to abut, the closure casing on the seat 201 of the support unit 2.

[0094] According to a preferred embodiment, the carousel 701 of the machine 7 comprises a plurality of contact units 5; according to this preferred embodiment, each contact unit 5 is fixed to the carousel 701 and comprises a fixed contact seat 501', configured to make contact with, that is to say, abut, the closure casing on the seat 201 of the support unit 2.

[0095] In the drawings, the numeral 501 denotes the gripper and the numeral 501' denotes the fixed contact seat.

[0096] The apparatus 1 comprises a coupling element 6. The coupling element 6 preferably defines an L shape and aligns the support unit 2 with the locking unit 3. In particular, the coupling element 6 comprises a lower end 601 and an upper end 602. The coupling element 6 is connected, at its lower end 601, to part of the support unit 2. The coupling element 6 is further connected, at its upper end 602, to part of the carousel 701 of the machine 7 for bending caps in a continuous cycle. In order to guarantee the correct alignment between the support unit 2 and the locking unit 3, part of the carousel 701 is further connected to part of the locking unit 3. The coupling element 6 includes a slot, that is to say, a cavity 603 and configured to house part of the contact unit 5.

[0097] The invention also provides a method for bending a cap. This method is preferably implemented in a machine 7 for bending caps in a continuous cycle comprising a plurality of apparatuses 1 according to one or

more features described above.

[0098] Preferably, the method for bending a cap comprises the following steps which can be performed in sequence. The steps are illustrated by way of example in Figure 5.

a. Preparing the support unit 2 and preparing the locking unit 3 in the spaced-apart position and placing the closure casing by the infeed station 702. Preparing the side walls 205 of the seat 201 in the retracted position, of non-interference with the closure casing.

b. Moving the side walls 205 towards the locking unit 3 along the longitudinal axis X, from the retracted position, to an extracted position, wherein the side walls 205 at least partly enclose the closure casing, by sliding the wheel 203 of the side walls 205 along the profiled surface 202 for the side walls 205.

c. Placing the security seal on the locking unit 3; moving the central rod 302 along the longitudinal axis X towards the support unit 2 by sliding the wheel 317 of the central rod 302 along the profiled surface 316 for the central rod 302. Moving the slider 306 along the longitudinal axis X towards the support unit 2 by sliding the wheel 319 of the slider 306 along the profiled surface 318 for the slider 306. Moving the hollow cylinder 301 along the longitudinal axis X towards the support unit 2.

d. Moving the central rod 302 along the longitudinal axis X towards the support unit 2 by sliding the wheel 317 of the central rod 302 along the profiled surface 316 for the central rod 302. Moving the slider 306 along the longitudinal axis X towards the support unit 2 by sliding the wheel 319 of the slider 306 along the profiled surface 318 for the slider 306. Moving the hollow cylinder 301 along the longitudinal axis X towards the support unit 2.

e. Moving the central rod 302 along the longitudinal axis X towards the support unit 2 in a close-together position, by sliding the wheel 317 of the central rod 302 along the profiled surface 316 for the rod 302, wherein the central rod 302 is partly inserted in the closure casing. Moving the slider 306 along the longitudinal axis X towards the support unit 2 by sliding the wheel 319 of the slider 306 along the profiled surface 318 for the slider 306. Moving the hollow cylinder 301 along the longitudinal axis X towards the support unit 2 wherein the hollow cylinder 301 is partly inserted in the closure casing.

f. Moving the slider 306 along the longitudinal axis X towards the support unit 2, by sliding the wheel 319 of the slider 306 along the profiled surface 318 for the slider 306 and moving the deforming element 303 towards each other, by sliding the wheel 308 of the arm 304 on the profiled surface 307 of the slider 306. The deforming element 303 moves towards, by means of an oscillation movement about the axis Y, passing through the pivot point 305, towards the lon-

gitudinal axis X, in an active position, wherein the deforming element 303 presses outside the perimeter edge of the closure casing for deforming it plastically towards the longitudinal axis X. Moving the deforming element 303 according to a rotary movement about the longitudinal axis X, by rotation of the pinion 314. Rotating the disc of the deforming element 303 about the deforming axis Z, and pulling by friction with the perimeter edge of the closure casing.

g. Moving the slider 306 away along the longitudinal axis X from the support unit 2; sliding of the wheel 308 of the arm 304 on the profiled surface 307 of the slider 306 and moving away, by rotation about the pivot 305, of the deforming element 303, in an inactive position, of non-interference with the closure casing.

h. Moving the side walls 205 away along the longitudinal axis X from the locking unit 3, from the extracted position, to the retracted position, of non-interference with the closure casing. Moving the slider 306 away along the longitudinal axis X from the support unit 2.

i. Moving the slider 306 away along the longitudinal axis X from the support unit 2 and away from the hollow cylinder 301, constrained to the contact element 309 of the slider 306. Moving the central rod 302 away along the longitudinal axis X from the support unit 2.

l. Moving the central rod 302 away along the longitudinal axis X from the support unit 2.

m. Picking up the bent cap by the outfeed station 704.

Claims

1. An apparatus (1) for bending a cap, the cap including a tamper-evident seal and a closure casing defining a perimeter edge, the tamper-evident seal being housed along the perimeter edge of the closure casing, the apparatus comprising:

- a support unit (2), oriented along a longitudinal axis (X) and including a seat (201) configured to receive the closure casing;
- a locking unit (3) oriented along the longitudinal axis (X),

wherein the support unit (2) and the locking unit (3) are movable reciprocally along the longitudinal axis (X) between a spaced-apart position and a close-together position where the locking unit (3) is partly inserted in the closure casing positioned in the seat of the support unit (2), **characterized in that** it further comprises a deforming element (303), positioned laterally of the longitudinal axis (X) and movable towards and away from the longitudinal axis (X) between an inactive position of non-interference with the closure casing, and an active position, where it

- presses the perimeter edge of the closure casing from the outside to deform it plastically towards the longitudinal axis (X) so as to make a constraining seat that houses the tamper-evident seal, the deforming element (303) being also movable by revolution about the longitudinal axis (X). 5
2. The apparatus (1) according to claim 1, wherein the deforming element (303) is associated with one between the support unit (2) and the locking unit (3). 10
 3. The apparatus (1) according to claim 2, wherein the one between the support unit (2) and the locking unit (3) is movable by translation along the longitudinal axis (X) and wherein the apparatus comprises a movement mechanism configured to mechanically constrain the translational movement of the one between the support unit (2) and the locking unit (3) and the movement of the deforming element (303) towards and away from the longitudinal axis (X). 15 20
 4. The apparatus (1) according to claim 3, wherein the movement mechanism includes:
 - an arm (304) having a first end (304a) and a second end (304b) and articulated to the one between the support unit (2) and the locking unit (3) at a pivot point (305) to oscillate about an axis of oscillation (Y) transverse to the longitudinal axis (X), where the deforming element (303) is associated with the first end (304a) of the arm (304); 25 30
 - a slider (306) that is slidable longitudinally relative to the one between the support unit (2) and the locking unit (3) and interacting with the second end (304b) of the arm (304) to rotate it about the axis of oscillation (Y), wherein the sliding of the slider (306) is kinematically correlated with the translational movement of the one between the support unit (2) and the locking unit (3). 35 40
 5. The apparatus (1) according to claim 4, wherein the slider (306) includes a profiled surface (307) to define a cam and wherein the movement mechanism includes a wheel (308) associated with the second end (304b) of the arm (304) and constrained to slide on the profiled surface (307) of the slider (306). 45
 6. The apparatus (1) according to claim 4 or 5, wherein the one between the support unit (2) and the locking unit (3) includes a flange (310) that extends radially relative to the longitudinal axis (X) and defining a slot (311), the slot (311) constituting a break in the flange (310), wherein the arm (304) is articulated to the flange (310) and is movably inserted in the slot (311). 50 55
 7. The apparatus (1) according to at least one of the preceding claims, comprising a movement mechanism to move the deforming element (303) towards and away from the longitudinal axis, the movement mechanism including an arm (304) having a first end (304a) and a second end (304b), wherein the deforming element (303) includes a disc that is pivotally connected to the first end (304a) of the arm to rotate idly about a deformation axis so that when the deforming element is at the active position, the disc is entrained in rotation by friction against the perimeter edge of the closure casing.
 8. The apparatus (1) according to at least one of the preceding claims, comprising an additional deforming element (303), positioned laterally of the longitudinal axis (X), angularly spaced from the deforming element (303) and movable synchronously with the deforming element (303) towards and away from the longitudinal axis (X) between an inactive position of non-interference with the closure casing, and an active position, where it presses the perimeter edge of the closure casing from the outside, the additional deforming element being movable by revolution about the longitudinal axis.
 9. The apparatus (1) according to claim 8, wherein the deforming element (303) and the additional deforming element (303) are spaced uniformly around the longitudinal axis (X) and are movable by revolution about the longitudinal axis (X) in the same rotation direction.
 10. A machine (7) for bending caps in continuous cycle, comprising:
 - a carousel (701) rotating about a central axis (X'); 35
 - a plurality of apparatuses (1) mounted on the carousel (701) angularly spaced about the central axis (X'), 40
 wherein each apparatus of the plurality of apparatuses (1) is according to any one of the preceding claims, and wherein the longitudinal axis (X) is parallel to the central axis (X').
 11. A method for bending a cap that includes a tamper-evident seal and a closure casing defining a perimeter edge, the tamper-evident seal being housed along the perimeter edge of the closure casing, the method comprising the following steps, for each cap:
 - positioning the closure casing in a seat (201) of a support unit (2), oriented along a longitudinal axis (X);
 - providing a locking unit (3) oriented along the longitudinal axis (X) and coupling the tamper-evident seal to the locking unit (3);
 - moving the support unit (2) and the locking unit

(3) relative to each other along the longitudinal axis (X) between a spaced-apart position and a close-together position where the locking unit (3) is partly inserted in the closure casing, **characterized in that** it further comprises the following steps:

- providing a deforming element (303), positioned laterally of the longitudinal axis (X);
- moving the deforming element (303) towards the longitudinal axis (X) from an inactive position of non-interference with the closure casing, to an active position, where the deforming element (303) presses the perimeter edge of the closure casing from the outside to deform it plastically towards the longitudinal axis (X);
- moving the deforming element (303) by revolution about the longitudinal axis (X);
- moving the deforming element (303) away from the longitudinal axis (X) to an inactive position of non-interference with the closure casing;
- moving the support unit (2) and the locking unit (3) away from each other along the longitudinal axis (X).

12. The method according to claim 11, wherein the movement of the deforming element (303) by revolution about the longitudinal axis (X) is constrained to the movement of the support unit (2) and the locking unit (3) relative to each other along the longitudinal axis (X).

13. The method according to claim 12, wherein the movement of the deforming element (303) towards the longitudinal axis (X) is accomplished through a rotational movement about an axis of oscillation (Y) transverse to the longitudinal axis (X).

14. The method according to any one of claims 11 to 13, wherein the movement mechanism for moving the deforming element (303) towards and away from the longitudinal axis includes an arm (304) having a first end (304a) and a second end (304b), and wherein the deforming element (303) includes a disc that is pivotally connected to the first end (304a) of the arm (304) to rotate idly about a deformation axis (Z), and wherein the method further comprises rotating the disc about the deformation axis (Z), entrained in rotation by friction against the perimeter edge of the closure casing, when the deforming element (303) is at the active position.

15. The method according to any one of claims 11 to 14, further comprising the following steps:

- providing a carousel (701) that rotates about a

central axis (X');

- providing a plurality of apparatuses (1), mounted on the carousel (701) angularly spaced about the central axis (X'), wherein each apparatus (1) includes a support unit (2), a locking unit (3) and a deforming element (303),

to bend a succession of caps in continuous cycle.

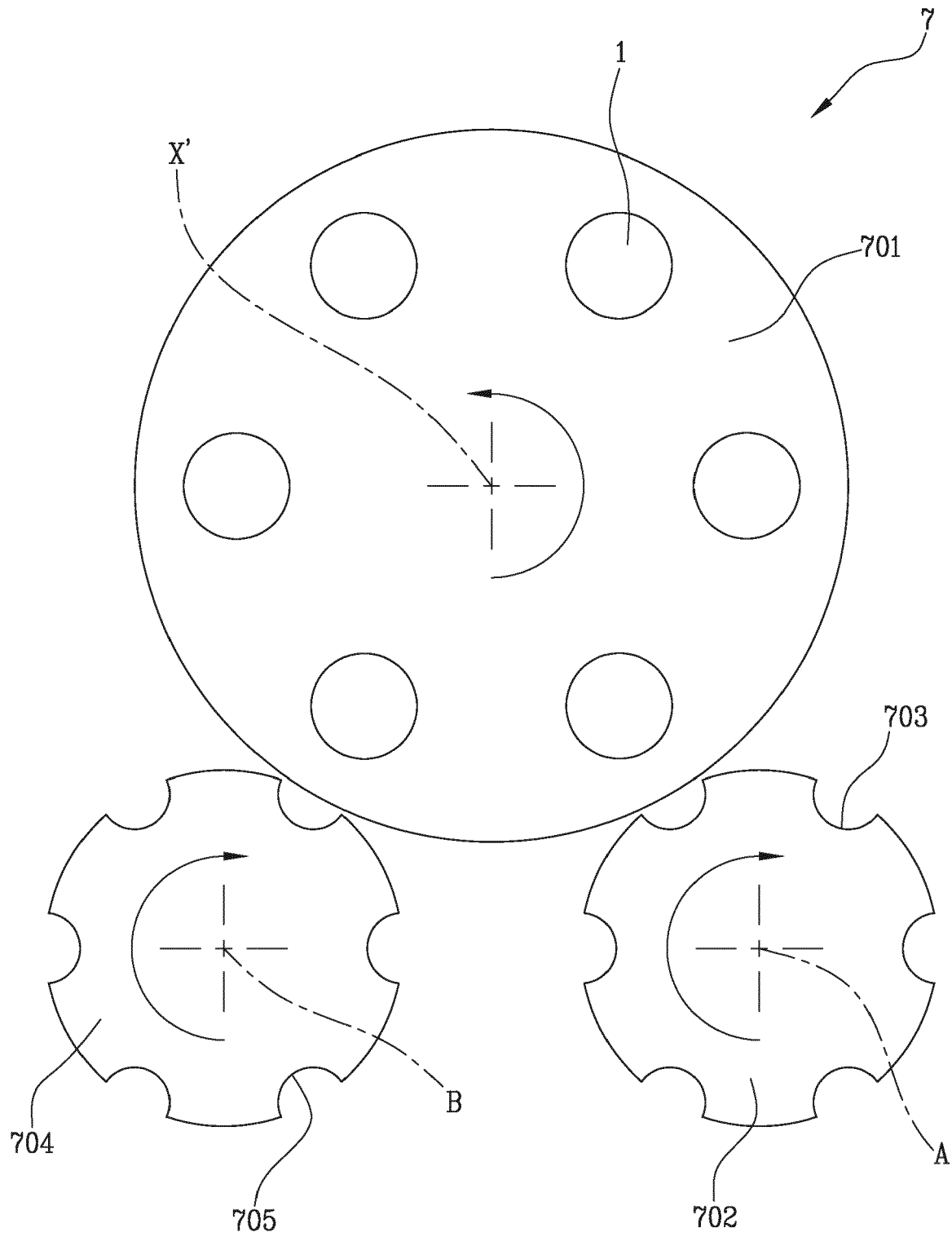


Fig.1A

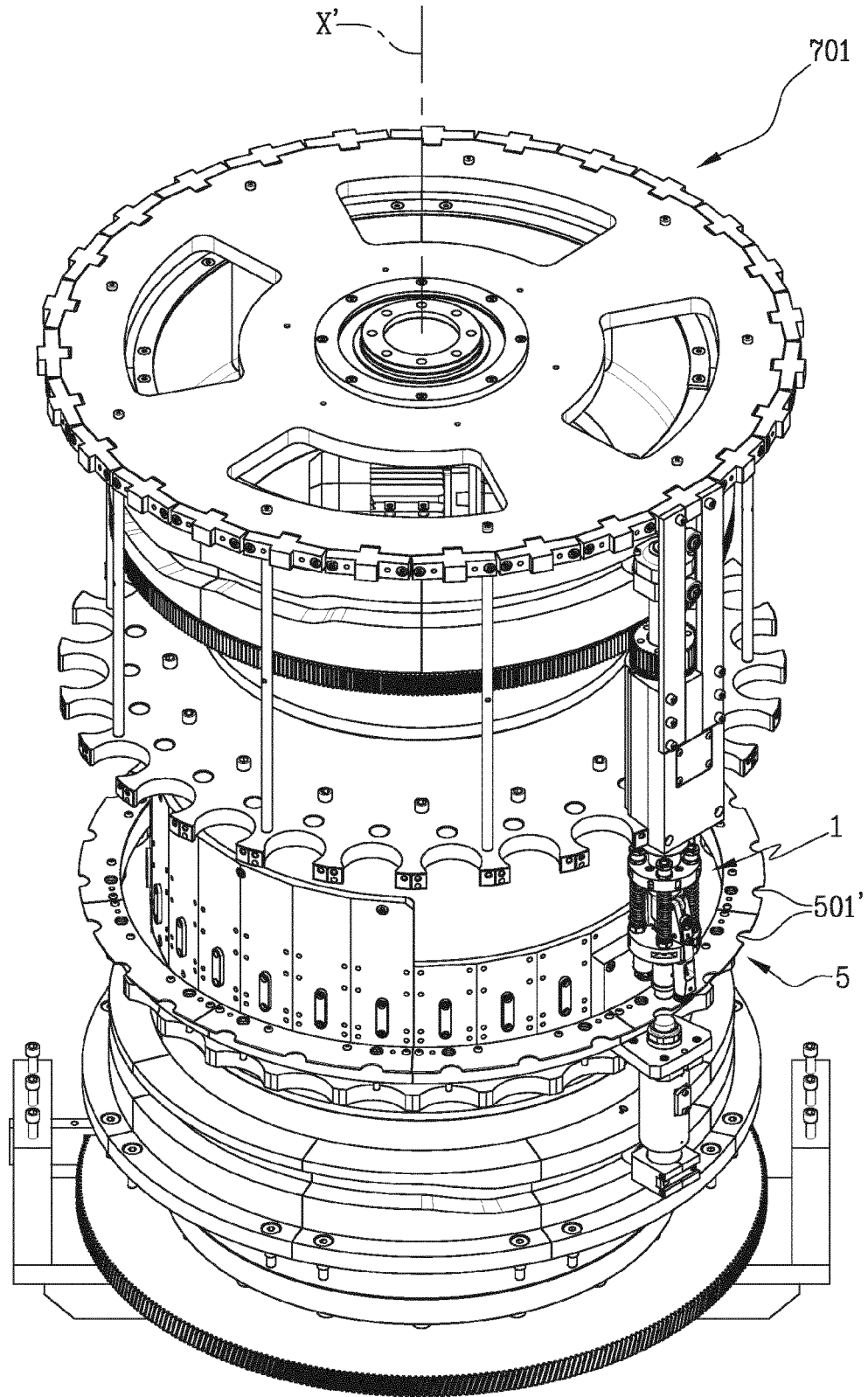


Fig.1B

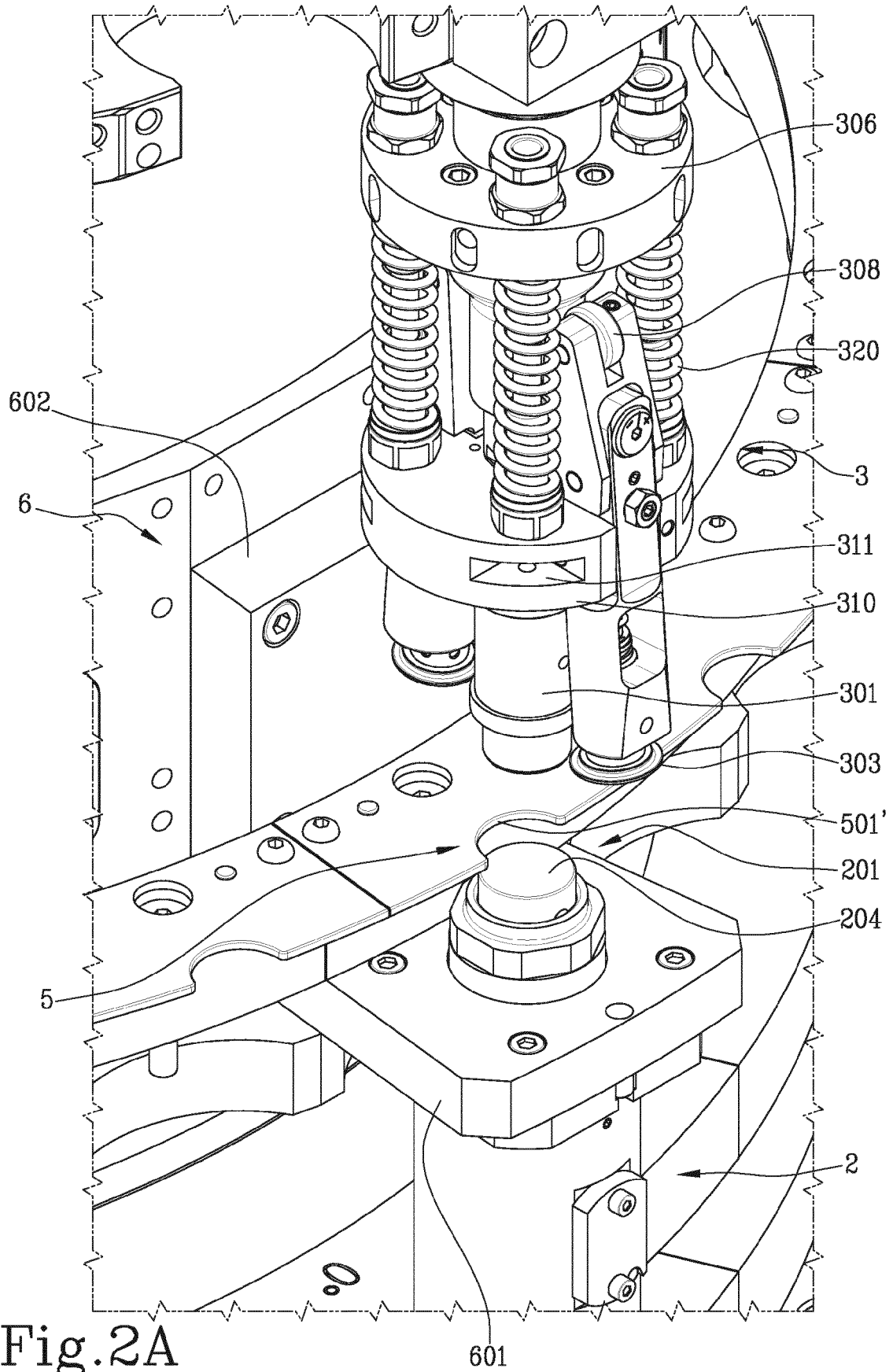


Fig. 2A

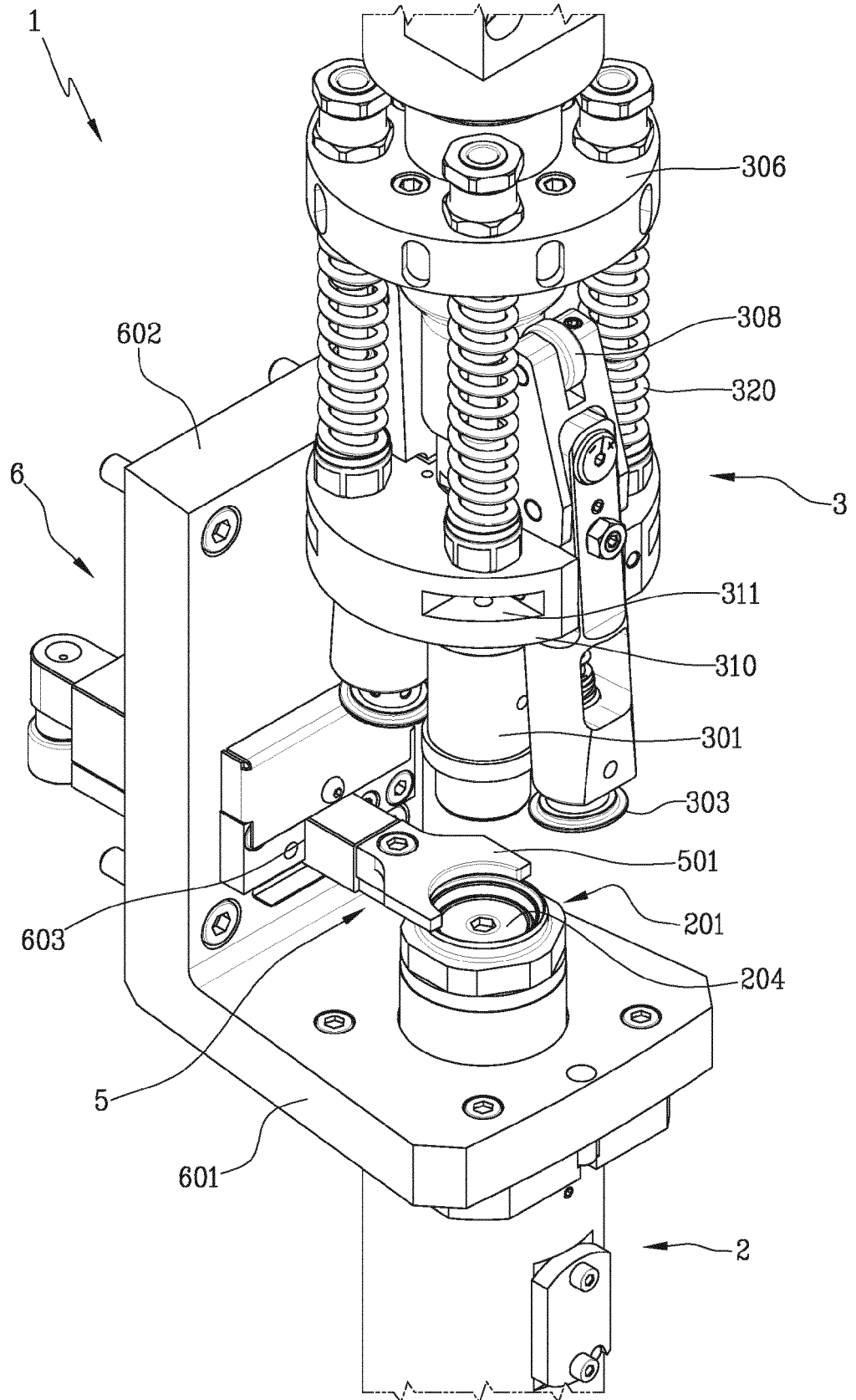


Fig.2B

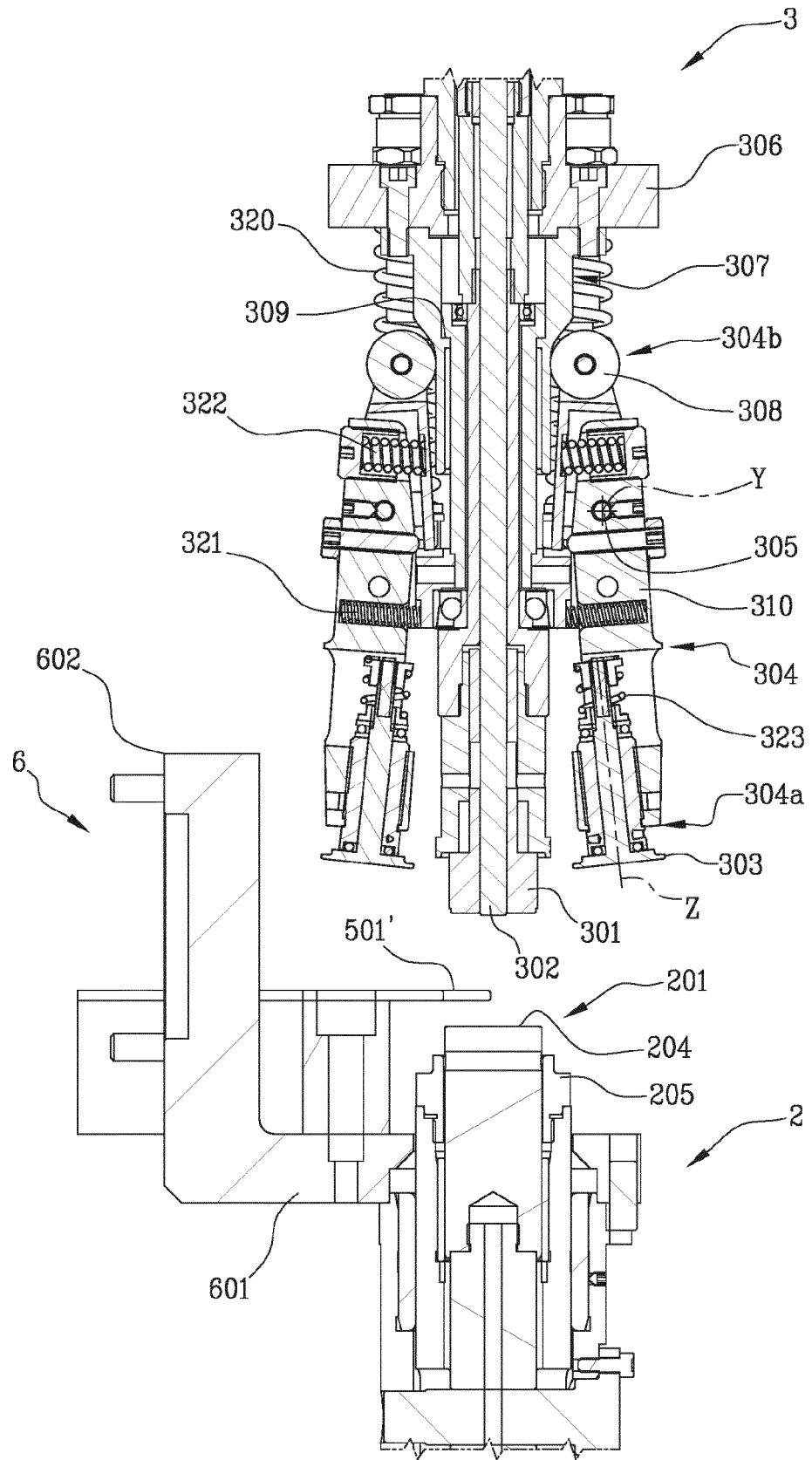


Fig.3A

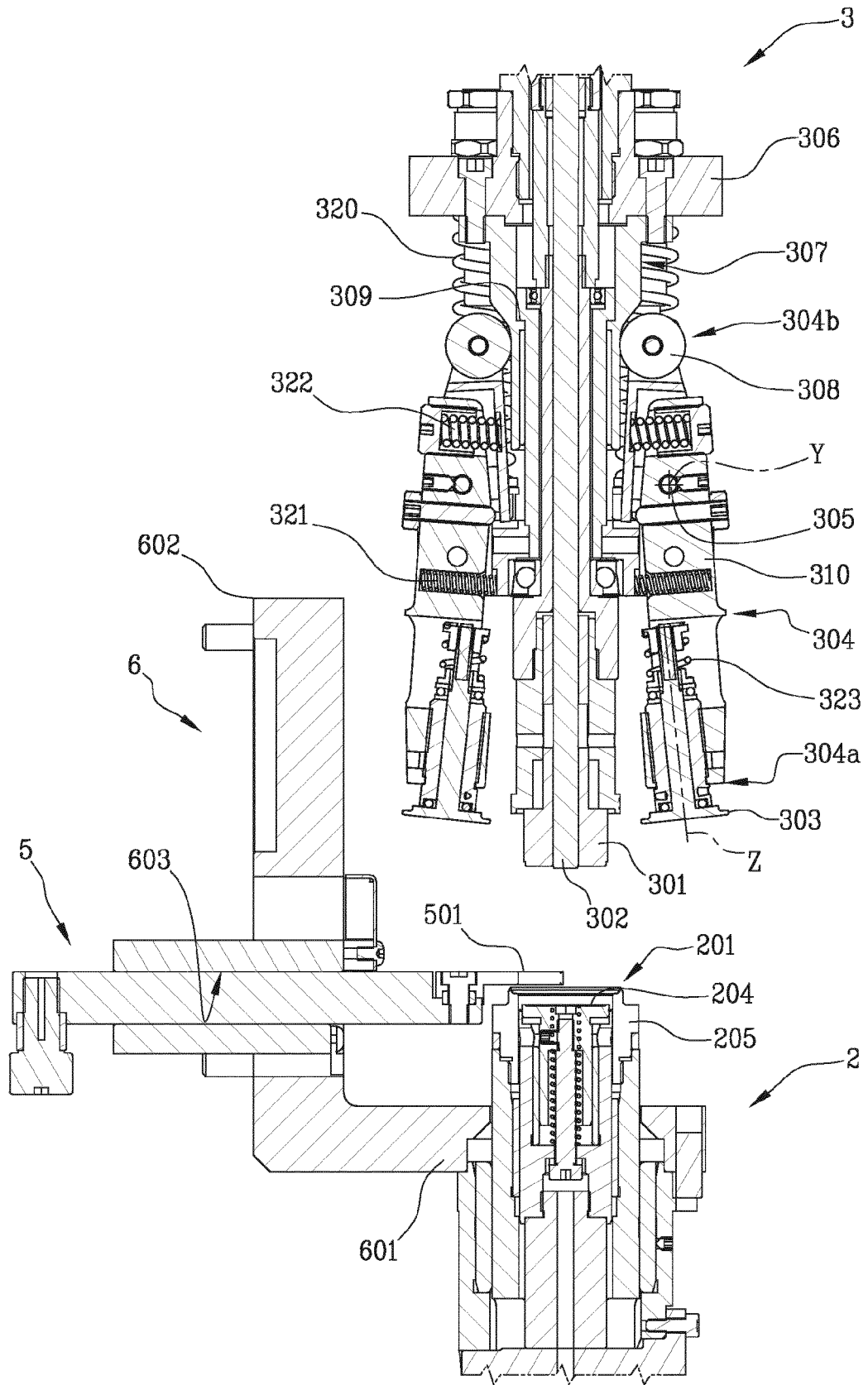
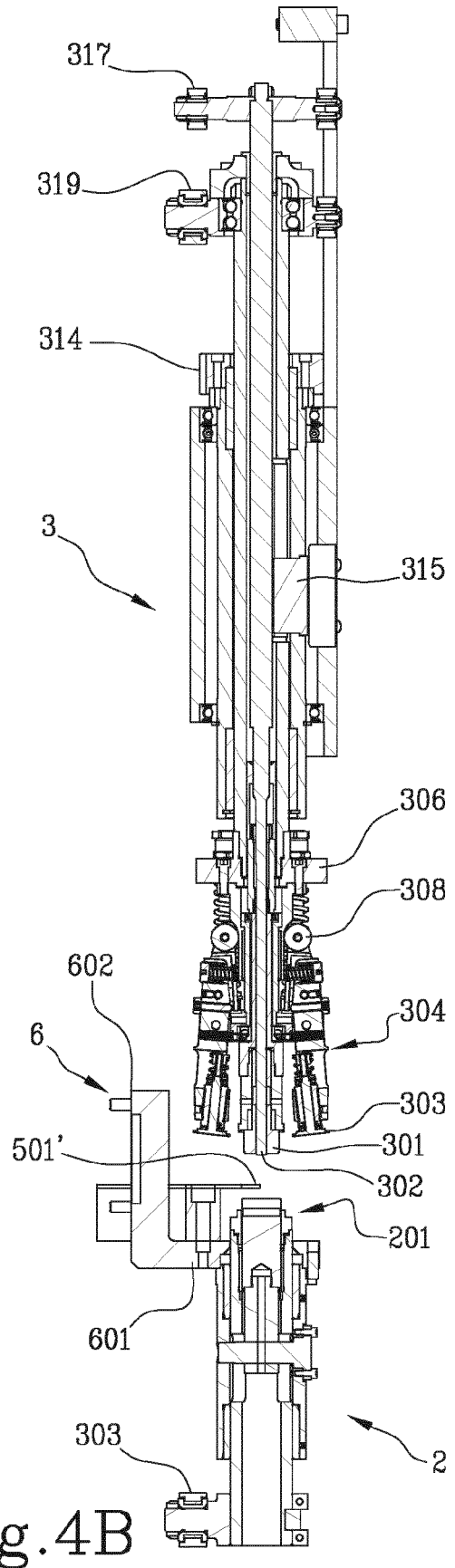
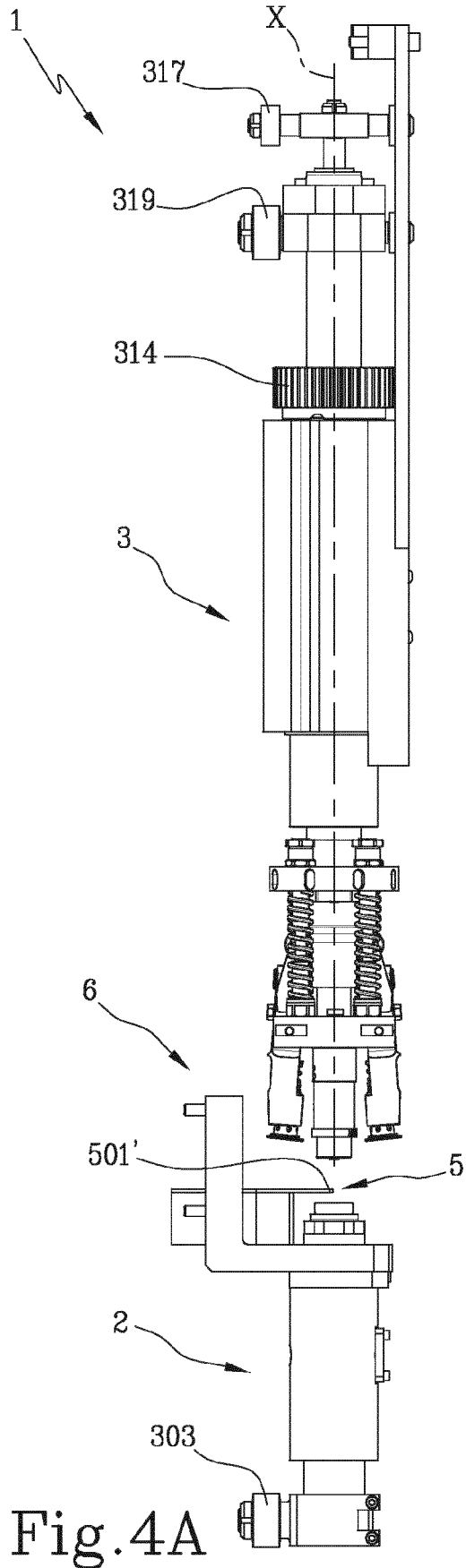
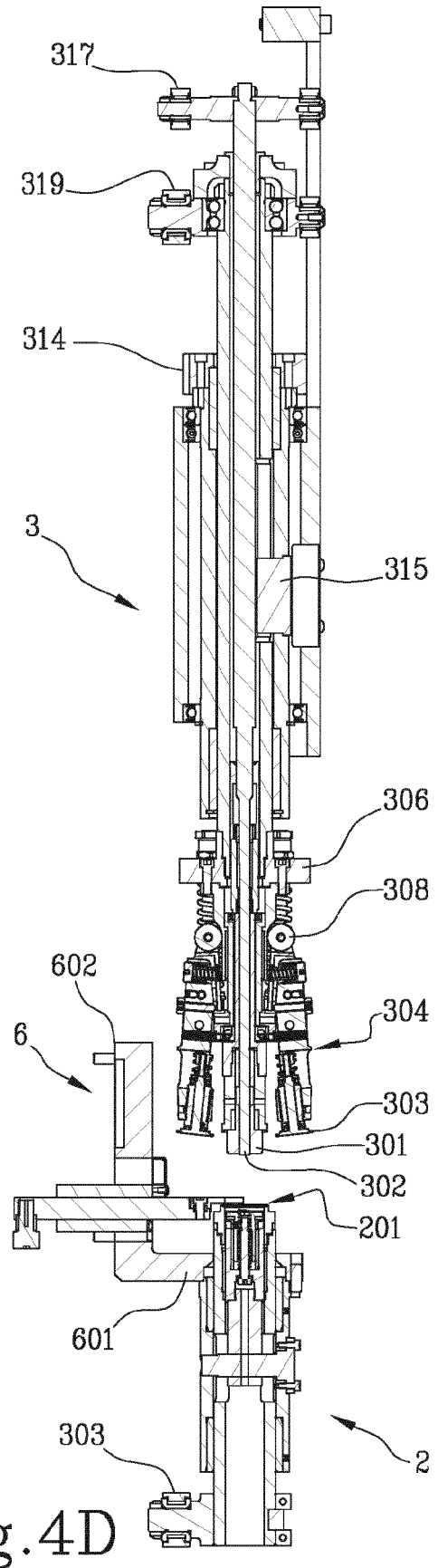
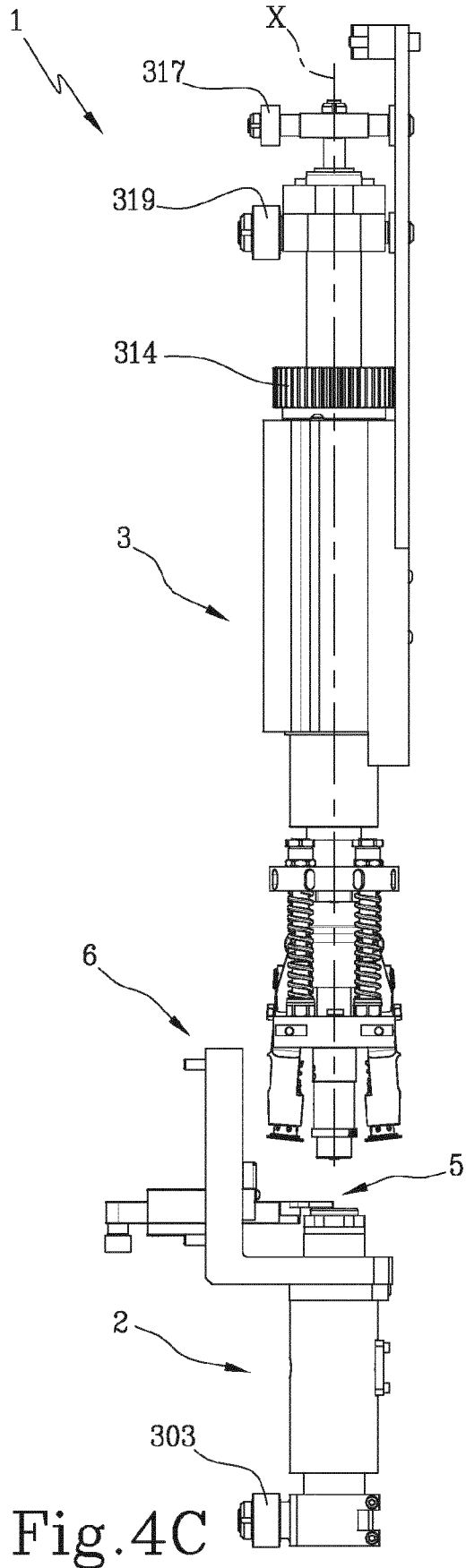


Fig.3B





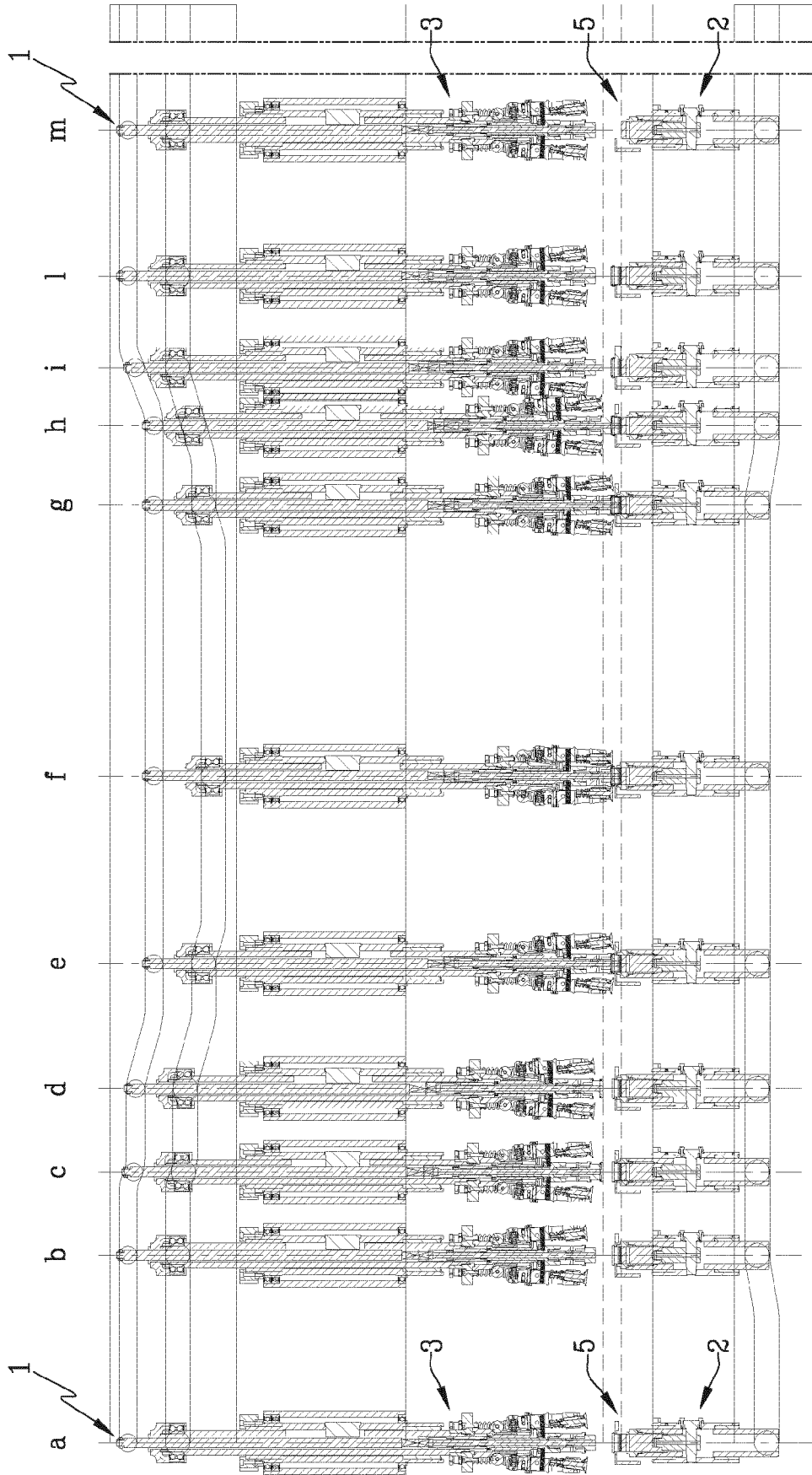


Fig.5

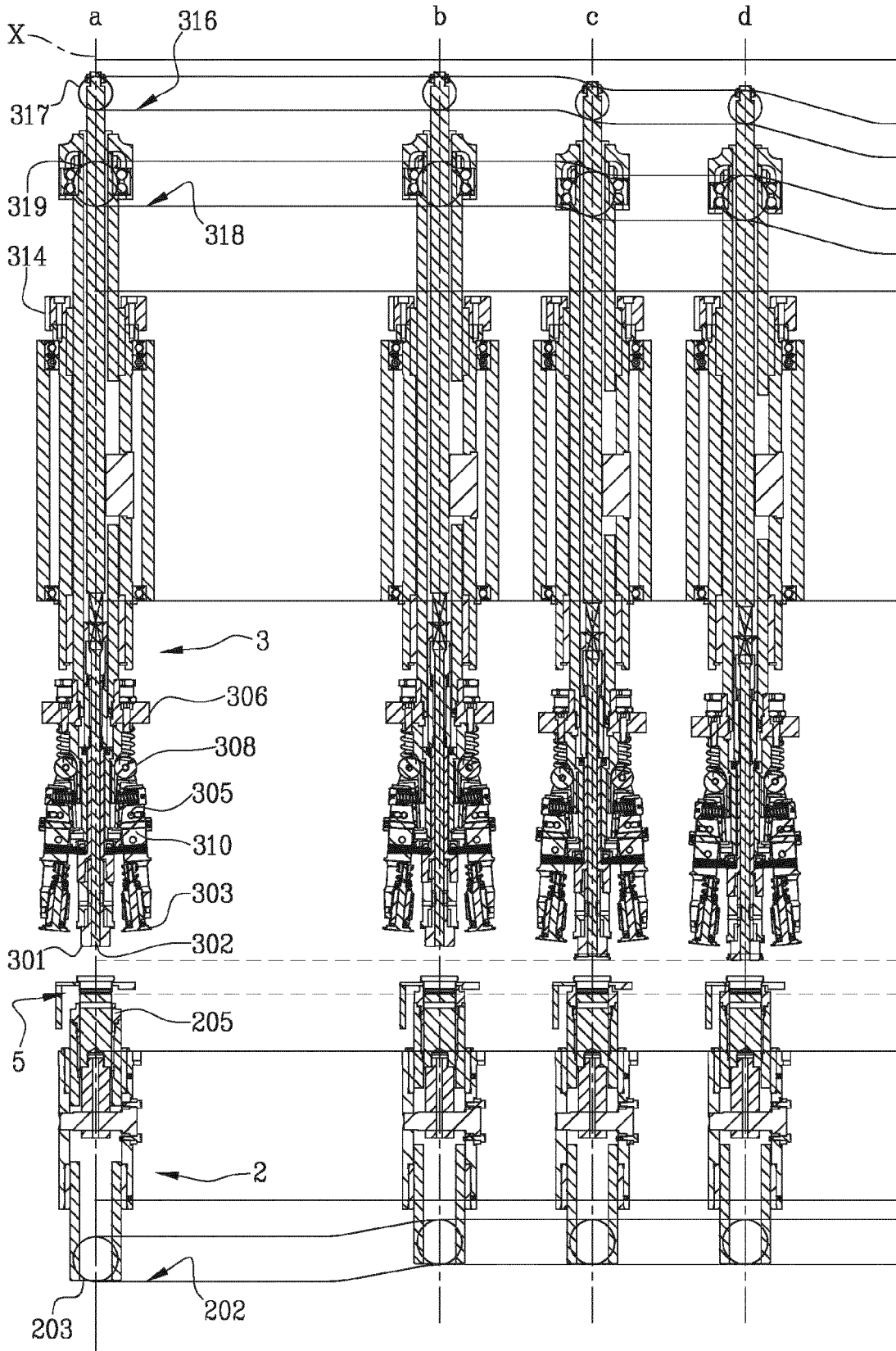


Fig.5A

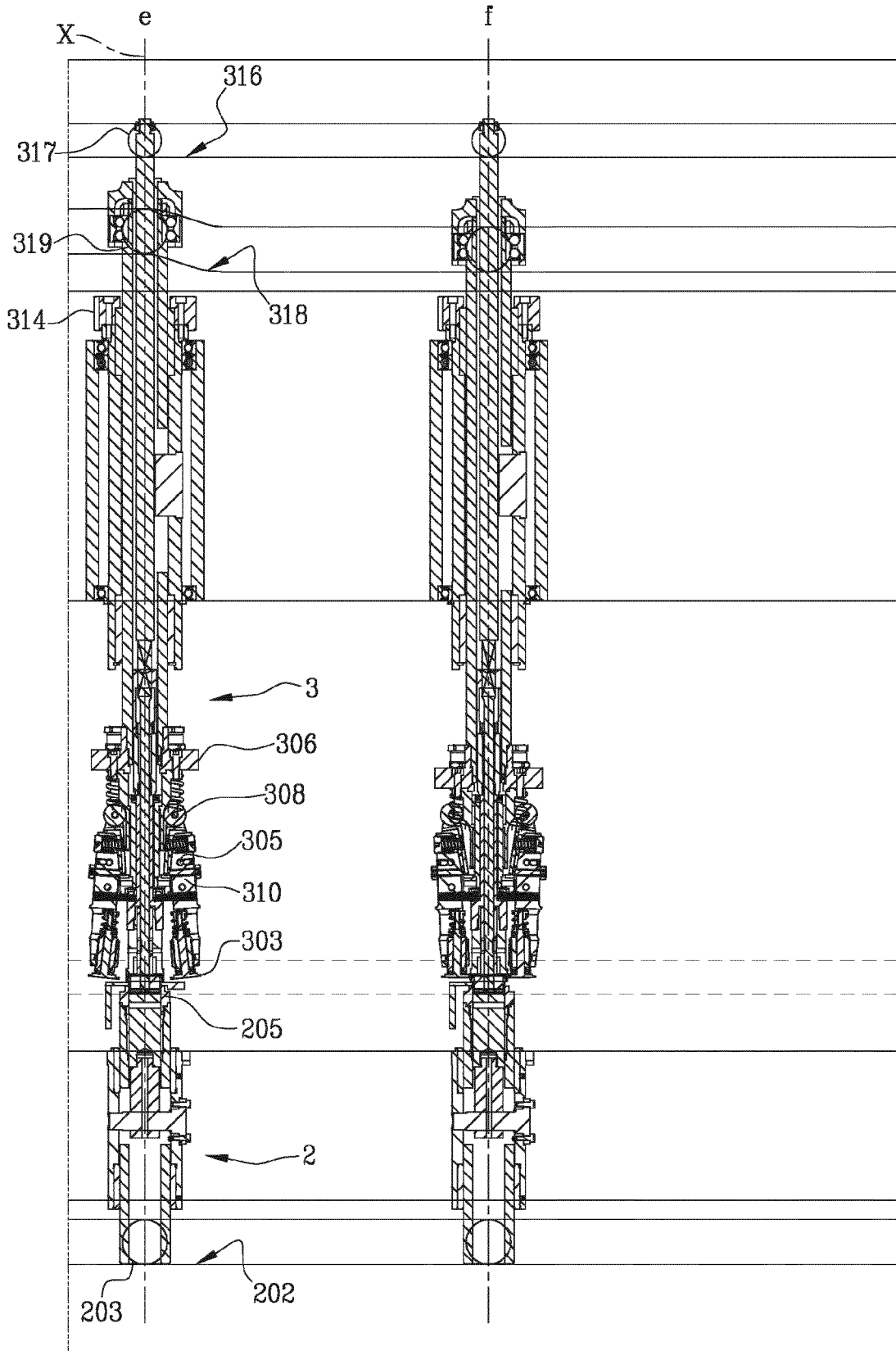


Fig.5B

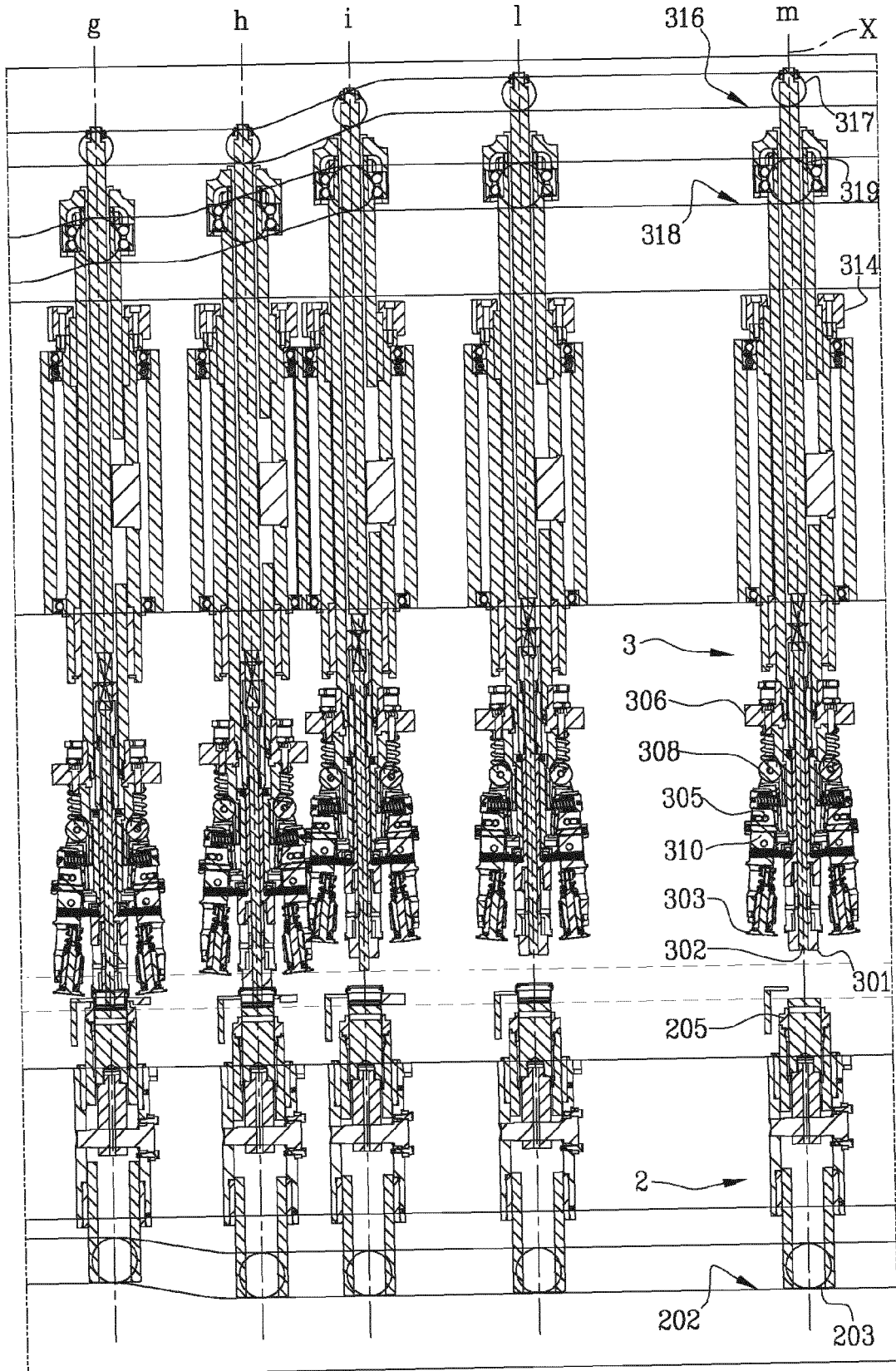


Fig.5C



EUROPEAN SEARCH REPORT

Application Number

EP 22 19 8255

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A, D	WO 2020/217186 A1 (TELEROBOT S P A [IT]) 29 October 2020 (2020-10-29) * figures 1, 4 *	1-15	INV. B21D51/44
A	US 4 232 500 A (HOLSTEIN JOHN H) 11 November 1980 (1980-11-11) * figures 1, 3 *	1-15	
A	JP 2001 240188 A (SHIBAZAKI SEISAKUSHO LTD) 4 September 2001 (2001-09-04) * figures 3-7 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			B21D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 February 2023	Examiner Vassoille, Philippe
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 & : member of the same patent family, corresponding document	

1
EPO FORM 1503 03:82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 22 19 8255

5 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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

06-02-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2020217186 A1	29-10-2020	CN 113710413 A	26-11-2021
		EP 3959032 A1	02-03-2022
		WO 2020217186 A1	29-10-2020

US 4232500 A	11-11-1980	NONE	

JP 2001240188 A	04-09-2001	NONE	

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- IT 102019000006222 [0006]
- WO 2020217186 A1 [0006]
- US 4232500 A [0006]
- JP 2011240188 A [0006]