



(11)

EP 4 506 270 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.02.2025 Bulletin 2025/07

(51) International Patent Classification (IPC):
B65B 65/02 ^(2006.01) **B65B 9/02** ^(2006.01)

(21) Application number: **24184214.5**

(52) Cooperative Patent Classification (CPC):
B65B 9/2049; B65B 65/02; B65B 9/207;
B65B 51/306

(22) Date of filing: **25.06.2024**

(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 ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

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(30) Priority: **09.08.2023 IT 202300017055**

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(54) **FORMING UNIT FOR FORMING SEALED PACKS CONTAINING A POURABLE PRODUCT AND METHOD FOR FORMING SEALED PACKS CONTAINING A POURABLE PRODUCT**

(57) There is described a forming unit (6) for forming sealed packs (2) from a tube (3) of packaging material and comprising: a central axis (X) along which the tube (3) is fed; a pair of forming members (8) configured to cyclically engage successive longitudinal portions of the tube (3) for the forming thereof; a conveyor device for cyclically advancing the forming members (8) along a first direction (A) parallel to the central axis (X); a cam system (11) for cyclically driving a movement of the forming members (8) towards and away from the central axis (X) and along a second direction (B) transversal to the first direction (A); the cam system (11) comprises: a pair of cam assemblies (12) arranged at opposite lateral sides of the central axis (X) and each including a fixed cam profile (13) and a movable cam profile (14); the movable cam profile (14) is movably coupled to the fixed cam profile (13) and is movable towards and away from the central axis (X) between a retracted position and an extracted position with respect to the central axis (X); each cam assembly (12) comprises a guiding device (19) configured to constrain the movable cam profile (14) to move parallel to the second direction (B) between the retracted position and the extracted position.

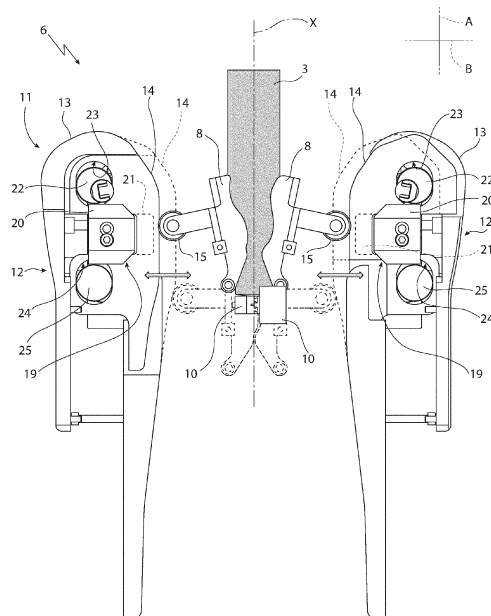


FIG. 3

Description

TECHNICAL FIELD

[0001] The present invention relates to a forming unit for forming sealed packs containing a pourable product, preferably a pourable food product, from a tube formed from a web of packaging material.

[0002] In particular, the present invention refers, without loss of generality, to a forming unit which is part of a packaging apparatus configured to produce sealed and folded packages containing a pourable product.

[0003] The present invention also relates to a method for forming sealed packs containing a pourable product, preferably a pourable food product, from a tube formed from a web of packaging material.

BACKGROUND ART

[0004] As it is generally known, many pourable food products, such as fruit juice, UHT (ultra-high temperature-treated) milk, wine, tomato sauce, etc., are sold in packages made of sterilized packaging material.

[0005] A typical example is the parallelepiped-shaped package for pourable food products known as Tetra Brik Aseptic (registered trademark), which is made by folding and sealing a laminated web of packaging material. The packaging material has a multilayer structure comprising a base layer, e.g. made of paper, covered on both sides with layers of heat-seal plastic material, e.g. polyethylene.

[0006] In the case of aseptic packages for long-storage products, such as UHT milk, the packaging material also comprises a layer of oxygen-barrier material, e.g. an aluminum foil, which is superimposed on a layer of heat-seal plastic material, and is in turn covered with another layer of heat-seal plastic material forming the inner face of the package eventually contacting the food product.

[0007] Packages of this sort are normally produced on fully automatic packaging apparatuses, which form and fill the packages starting from a multilayer web of packaging material.

[0008] In particular, in such packaging apparatuses a continuous tube is formed from the web of packaging material which is initially wound in a reel and fed through a plurality of unwinding rollers. The web of packaging material is typically sterilized in the packaging apparatus, e.g. by applying a chemical sterilizing agent, such as hydrogen peroxide solution, which, once sterilization is completed, is removed from the surfaces of the packaging material, e.g. evaporated by heating. The web so sterilized is then maintained in a closed, sterile environment, and, advanced by the aforementioned unwinding rollers, is folded to form the tube by means of a known web folding unit and then sealed longitudinally.

[0009] In order to perform the package forming operations, the tube is continuously fed along a first direction,

normally a straight vertical direction, is filled with the sterilized food product from above and is formed, sealed and subsequently cut along equally spaced transversal cross-sections extending along a second direction, normally a direction orthogonal to the first direction.

[0010] So-called pillow packs are obtained thereby, which have a longitudinal sealing band, a top transversal sealing band and a bottom transversal sealing band.

[0011] A packaging apparatus of such type is known from WO-A-2022017745. Such packaging apparatus comprises a plurality of jaw units and a conveyor device (normally a chain conveyor) for advancing the jaw units. Each jaw unit comprises:

- a pair of forming members configured to engage the tube from opposite sides thereof and to form the tube while advancing along respective operative sections of a conveying path; and
- a pair of sealing members configured to engage the tube from opposite sides thereof for transversally sealing the tube at the above-mentioned equally spaced transversal cross-sections and while advancing along respective operative portions of the conveying path.

[0012] In greater detail, each jaw unit includes two jaw members, each jaw members including a forming member and a sealing member.

[0013] The conveyor device is configured to advance each jaw member along a respective closed-loop path, which includes one operative section, along which the respective forming member and sealing member interact with the tube, and one return section.

[0014] For each jaw member, the sealing member is arranged operatively downstream of the forming member, with respect to the first direction.

[0015] A typical pair of forming members comprises two internally shaped half-shells, arranged at opposite lateral sides of the tube facing one another and configured to cyclically engage the tube from opposite lateral sides thereof, so as to surround successive portions of the tube to sequentially impart or transfer the predetermined external shape to these portions.

[0016] A typical pair of sealing members comprises a seal element and a counterseal element (typically in the form of clamps), arranged at opposite lateral sides of the tube facing one another and which are configured to cyclically engage the tube in a clamping manner from opposite lateral sides thereof, so as to repeatedly seal the tube at the aforementioned cross-sections (according to a manner known).

[0017] Typically, each jaw unit also comprises a cutting element, carried by one of the sealing element and countersealing element, for repeatedly interacting with the tube to cut the tube along the previously created sealing band.

[0018] In this way, the obtained pillow packs are separated from one another at the respective transversal

sealing bands.

[0019] In order to interact with the tube, the forming members and the sealing members are cyclically moved along a third direction orthogonal to the first direction and the second direction, i.e. towards and away from the tube.

[0020] Typically, the packaging apparatus further comprises a cam system for controlling the movement of the forming members towards and away from the tube.

[0021] The cam system includes cam profiles, which are opportunely shaped for allowing the engagement and disengagement of the tube at the appropriate positions, and a plurality of cam followers or rollers, whereby at least one roller is integrally carried by each forming member.

[0022] Due to the downward advancement of the forming members and the sealing members along the first direction, by means of the chain conveyor, and due to the interaction of the forming members and especially of the sealing members with the tube, the tube is drawn downwards and fed along the first direction.

[0023] Once the cutting operation is completed, each jaw member is advanced along the respective return section and then back to its respective operative section to be ready to interact again with the corresponding jaw member of the same jaw unit and with another subsequent portion of the tube (i.e. to form and seal another pillow pack).

[0024] The so-obtained pillow packs are then directed to a folding unit of the packaging apparatus for the final folding thereof, thereby obtaining fully-folded finished packages containing pourable product.

[0025] In WO-A-2022017745 each jaw unit is controllable in at least:

- an operative configuration in which the forming members and the sealing members are controlled in respective active states, whereby the forming members and the sealing members cyclically engage and interact with the tube for the forming and sealing thereof; and
- a partial operative configuration in which the sealing members are controlled in the respective active states and the forming members are controlled in respective inactive states, whereby the forming members remain spaced from the tube while the respective jaw unit is advanced by the conveyor device.

[0026] In other words, in the partial operative configuration, any significant contact between the forming member and the tube is avoided, even though the respective jaw member is advanced by the conveyor device. In this way, it is possible to reduce the risk of damaging the tube and/or the packs when operating at elevated production speeds and/or with the filling level of the tube (i.e. the measure of the volume of the pourable product present within the tube) below or above a determined filling level.

[0027] The switching from the operative configuration

to the partial operative configuration according to WO-A-2022017745 is briefly explained hereinafter.

[0028] The aforementioned cam system for controlling the movement of the forming members includes a pair of fixed cam profiles and a respective pair of movable cam profiles, wherein each movable cam profile is movably mounted to the respective fixed cam profile.

[0029] The cam system further includes an adjusting assembly for adjusting a position of each movable cam profile relatively to the respective fixed cam profile.

[0030] In detail, each movable cam profile is adjustable between a first limit position and a second limit position, with respect to the relative fixed cam profile. In the first limit position, the movable cam profiles are in a position approached to one another, whereas in the second limit position the movable cam profiles are in a position withdrawn from one another.

[0031] When the rollers of the forming members interact with the movable cam profiles in their second limit positions, the forming members are spaced apart from the tube notwithstanding the advancement of the respective jaw along the first direction and the movement of the forming members along the third direction. In other words, the forming members do not reach the tube.

[0032] Therefore, by moving the movable cam profiles from their first limit position to their second limit position, the switching between the operative configuration and the partial operative configuration of the jaw units is determined, respectively and according to a manner described in WO-A-2022017745.

[0033] During their movement between the first limit position and the second limit position, the movable cam profiles follow an arc-shaped trajectory, thereby rotating-translating.

[0034] In light of the above, the rollers carried by the forming members are configured to cyclically interact, due to the advancement of the respective jaw members along their respective closed-loop paths, partly with the fixed cam profile and partly with the movable cam profile.

[0035] Hence, a transition area between each fixed cam profile and the respective movable cam profile can be identified, through which transition area each roller is configured to cyclically pass.

[0036] Even though the forming units of the aforementioned type achieve excellent operative results and although being structurally and functionally valid, the known forming units are still open to further improvement, in particular with regard to the transition of the rollers between the fixed cam profiles and the movable cam profiles.

DISCLOSURE OF INVENTION

[0037] It is therefore an object of the present invention to provide a forming unit for forming sealed packs containing a pourable product, which is designed to meet the above-mentioned need in a straightforward and low-cost manner.

[0038] This object is achieved by a forming unit as claimed in claim 1.

[0039] It is a further object of the present invention to provide a method for forming sealed packs containing a pourable product, which is designed to meet the above-mentioned need in a straightforward and low-cost manner.

[0040] This object is achieved by a method as claimed in claim 14.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] Non-limiting embodiments of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view, with parts removed for clarity, of a packaging apparatus including a forming unit according to the present invention; Figure 2 is a larger-scale side view, with parts removed for clarity, of the forming unit according to the present invention and illustrating several successive operative conditions;

Figure 3 is a side view, with parts removed for clarity, of the forming unit of Figure 2 during a determined operative condition;

Figure 4 is a front perspective view, with parts removed for clarity, of the forming unit according to the invention;

Figure 5 is a larger-scale rear perspective view, with parts removed for clarity, of a forming unit according to a further preferred embodiment of the present invention;

Figure 6a and 6b are a larger-scale, rear perspective views of part of the forming unit of Figure 5 during two distinct operative conditions.

BEST MODE FOR CARRYING OUT THE INVENTION

[0042] With reference to Figure 1, number 1 indicates as a whole a non-limiting example of a packaging apparatus for producing a plurality of packages 2a containing a pourable product, preferably a pourable food product such as pasteurized or UHT milk, water, fruit juice, wine, peas, beans, etc.

[0043] In detail, packaging apparatus 1 is configured to form, seal and fold packages 2a starting from a tube 3 of packaging material.

[0044] Preferably, the packaging material has a multi-layer structure (not shown), and comprises a layer of fibrous material, e.g. paper, covered on both sides with respective layers of heat-seal plastic material, e.g. polyethylene.

[0045] In the case of aseptic packages 2a for long-storage products, such as UHT milk, the packaging material also comprises a layer of gas-and-light barrier material, e.g. aluminum foil or ethylene vinyl alcohol (EVOH) film, which is superimposed on a layer of heat-

seal plastic material, and is in turn covered with another layer of heat-seal plastic material, the latter forming the inner face of package 2a eventually contacting the pourable product.

5 **[0046]** Preferably, the packaging material is initially provided in form of a web 4.

[0047] As schematically shown in Figure 1, the packaging apparatus 1 comprises:

- 10 - tube folding devices 5 for progressively folding the web 4 into tube 3, in a manner known and not described in detail, and for providing tube 3 with a longitudinal seal by means of a sealing element 40;
- a filling device for filling tube 3 with the pourable product;
- 15 - a forming unit 6 for forming tube 3 by imparting a predetermined external shape, corresponding to a precursor of the shape of package 2a, to successive longitudinal portions of tube 3, and for sealing tube 3 at equally spaced cross-sections.

[0048] As visible in particular in Figure 2, forming unit 6 has a central axis X along which tube 3 is fed, in use.

25 **[0049]** Central axis X is parallel to a first direction A, which preferably is a straight vertical direction.

[0050] Hence, in use, tube 3 is fed along first direction A, downwards, and while being filled from above is formed and sealed by forming unit 6.

30 **[0051]** In this way, a plurality of pillow packs 2 are obtained.

[0052] Packaging apparatus 1 further comprises a folding unit (known per se and not shown) for folding the pillow packs 2, thereby obtaining packages 2a, according to a manner known and not described in detail.

35 **[0053]** Hence, packaging apparatus 1 is configured to form and seal a plurality of pillow packs 2 containing the pourable product starting from web 4 and tube 3 and then to fold the pillow packs 2 for obtaining the aforementioned formed, sealed and folded packages 2a containing the pourable product.

40 **[0054]** Forming unit 6 comprises at least one pair of forming members 8, known for example from WO-A-2022017745, which are arranged on opposite lateral sides of axis X (and therefore, in use, of tube 3) and which are configured to cyclically engage successive longitudinal portions of tube 3 for the forming thereof.

[0055] According to the non-limiting embodiment shown, each forming member 8 includes an internally shaped half-shell configured to cyclically interact in contact with tube 3 for imprinting its shape thereon.

50 **[0056]** In detail, and according to a manner described below, forming members 8 are movable towards and away from one another and from tube 3 along a second direction B transversal to first direction A, and in particular orthogonal to first direction A, for cyclically surrounding and engaging tube 3 and forming tube 3 at the successive portions.

[0057] Expediently, forming unit 6 also includes at least

one pair of sealing members 10 (e.g. a sealing element and a countersealing element) arranged at opposite lateral sides of axis X and which are configured to cyclically engage tube 3 at the equally spaced cross-sections in a clamping manner, so as to define transversal sealing bands on tube 3.

[0058] More specifically, each portion of tube 3 is longitudinally delimited by a pair of successive sealing bands.

[0059] In one embodiment, forming unit 6 comprises a plurality of forming and sealing jaw units (known from WO-A-2022017745), each forming and sealing jaw unit comprising a pair of forming members 8 and a pair of sealing members 10; and

- a conveyor device (not shown, preferably a chain conveyor) for advancing the forming and sealing jaw units.

[0060] In greater detail, each forming and sealing jaw unit includes two jaw members associated with one another, each jaw member including one forming member 8 and one sealing member 10.

[0061] The conveyor device is configured to advance each jaw member along a respective closed-loop path, which includes one operative section, along which the respective forming member 8 and sealing member 10 interact with tube 3, and one return section, according to the same configuration known from WO-A-2022017745.

[0062] For each jaw member, sealing member 10 is arranged operatively downstream of forming member 8, with respect to the advancement direction of the jaw member along the respective closed-loop path.

[0063] In light of the above, forming members 8 and sealing members 10 are cyclically carried by the conveyor device along the respective operative sections and along first direction A to cyclically and repeatedly engage the successive portions of tube 3, and then along the respective return sections.

[0064] Tube 3 is drawn (downwards) along first direction A in a known manner, due to the advancement of forming members 8 and sealing members 10 along first direction A carried by the respective forming and sealing jaw unit, and due to the interaction of forming members 8 and of sealing members 10 with tube 3.

[0065] Expediently, each forming and sealing jaw unit also comprises a cutting member (not shown), carried by one of the sealing members 10, for repeatedly interacting with tube 3 to cut tube 3 along the previously created sealing band, once the respective tube portion is formed.

[0066] In this way, the obtained pillow packs 2 are separated from one another at the respective transversal sealing bands.

[0067] In order to interact with tube 3, forming members 8 and sealing members 10 are movable along second direction B, i.e. towards and away from tube 3, towards and away from axis X and towards and away from one another, while being advanced along the respective operative sections by the conveyor device.

[0068] Forming unit 6 comprises a cam system 11 for controlling the movement of forming members 8 along second direction B.

[0069] In detail, cam system 11 is configured to cyclically drive a movement of forming members 8 along second direction B towards and away from axis X, towards and away from one another and, in use, towards and away from tube 3.

[0070] As visible in Figures 2, 3, 4 and 5, cam system 11 comprises:

- a pair of cam assemblies 12 arranged at opposite lateral sides of axis X (and in use of tube 3) and including, each, a fixed cam profile 13 and a movable cam profile 14; and
- a plurality of rollers 15, at least one roller 15 being carried by each forming member 8, configured to cyclically cooperate in contact with the movable cam profiles 14 for determining the movement of the respective forming members 8 along second direction B.

[0071] In other words, each forming member 8 integrally carries at least one roller 15 (or cam follower) which is configured to cooperate in rolling contact with the respective cam assembly 12, i.e. with the respective fixed cam profile 13 and movable cam profile 14, so as to determine the movement of such forming member 8 along second direction B, while such forming member 8 is conveyed along first direction A by the conveyor device.

[0072] It is specified that the movement of forming members 8 along second direction B driven by the interaction of rollers 15 with movable cam profiles 14 may be a composite movement including a translational component and an angular or rotational component.

[0073] On each cam assembly 12, the rollers 15 are configured to be advanced, by means of the respective forming and sealing jaw units and thus by means of the conveyor device, along a respective path S, which follows the contour of fixed cam profile 13 and movable cam profile 14 of such cam assembly 12, and which at least partially corresponds to or follows the respective aforementioned closed-loop path, as visible in Figure 2.

[0074] In particular, Figure 2 only shows part of the two paths S. In fact, paths S are preferably endless and extend along a closed-loop trajectory, following the respective closed-loop paths of the jaw members.

[0075] Each path S comprises an operative portion S1, extending along the respective movable cam profile 14. In use, when rollers 15 travel along operative portions S1, the respective forming members 8 are moved towards and away from tube 3 for engaging tube 3, as shown schematically in Figure 2.

[0076] Again, the movement of forming members 8 towards and away from tube 3 (along second direction B) may be a composite movement including a translational component and an angular or rotational compo-

nent.

[0077] Accordingly, movable cam profiles 14 are opportunely shaped for allowing the movement of forming members 8 towards and away from tube 3, i.e. the engagement and disengagement of tube 3 at the appropriate positions, according to a manner known and not described in detail.

[0078] As schematically shown in Figures 3, 6a and 6b, for each cam assembly 12 movable cam profile 14 is movably coupled to fixed cam profile 13 and is movable towards and away from axis X (and in use from tube 3) between a retracted position (represented in continuous lines in Figure 3 and shown in Figure 6b) and an extracted position (represented in dashed lines in Figure 3 and shown in Figure 6a) with respect to the axis X.

[0079] In particular, movable cam profile 14 is also movable, and may be arranged, in a virtually infinite number of intermediate positions between the retracted position and the extracted position.

[0080] To this end, forming unit 6 comprises an adjusting assembly 16 for adjusting the position of movable cam profiles 14 between the retracted position and the extracted position (and in any one of the aforementioned intermediate positions).

[0081] In detail, adjusting assembly 16 is configured to drive the movement of movable cam profiles 14 between the retracted position and the extracted position (and in any one of the aforementioned intermediate positions).

[0082] As visible in Figures 4 and 5, adjusting assembly 16 comprises:

- at least one, preferably one, actuator 17, such as an electric motor or a pneumatic or fluid-dynamic actuator;
- a transmission system 18 for kinematically coupling actuator 17 with each movable cam profile 14.

[0083] The transmission system 18 may comprise a main shaft 18a, coupled to actuator 17 for receiving torque and motion therefrom, and two control bars 18b each coupled to one movable cam profile 14. According to a modality better described in the following, actuator 17 is configured to drive a rotation of control bars 18b for moving movable cam profiles 14 between the retracted position and the extracted position.

[0084] In detail, each movable cam profile 14 is movable between a first limit position approached to axis X (and in use to tube 3) and corresponding to the extracted position, and a second limit position withdrawn from axis X (and in use from tube 3) and corresponding to the retracted position.

[0085] The first limit position corresponds to a position in which forming members 8 are the closest to axis X (and tube 3). The second limit position corresponds to a position in which forming members 8 are the farthest from axis X (and tube 3).

[0086] The intermediate positions are comprised between such first limit position and such second limit

position.

[0087] In particular, and as described in WO-A-2022017745, movable cam profiles 14 are selectively controllable in:

- their first limit positions for defining an operative configuration of forming unit 6, in which forming members 8 are controlled in respective active states, whereby forming members 8 cyclically engage and interact with tube 3 for the forming thereof;
- their second limit positions for defining a partial operative configuration of forming unit 6, in which forming members 8 are controlled in respective inactive states, whereby forming members 8 remain spaced and disengaged from tube 3 while advanced along first direction A; and
- their respective intermediate positions for defining further operative configurations of forming unit 6, which are comprised between the first limit positions and the second limit positions, in which forming members 8 are controlled in their respective active states and cyclically engage and interact with tube 3 but from different respective distances along second direction B, each distance being associated with a respective intermediate position.

[0088] More specifically, forming unit 6 is configured so that when movable cam profiles 14 are controlled in their second limit positions, forming members 8 do not reach tube 3 during their movement along second direction B driven by cam assemblies 12, and while advancing along first direction A driven by the conveyor device.

[0089] That is, when movable cam profiles 14 are controlled in their second limit positions, i.e. when forming unit 6 is in its partial operative configuration, the travel of rollers 15 along the respective operative portions S1 determines a movement of forming members 8 along second direction B towards tube 3. However, in this configuration, forming members 8 do not reach and contact tube 3, thereby remaining spaced from tube 3.

[0090] In other words, in the partial operative configuration, any significant contact between forming members 8 and tube 3 is avoided, even though the respective forming and sealing jaw unit is advanced by the conveyor device. In this way, it is possible to reduce the risk of damaging tube 3 and/or packs 2 when operating at elevated production speeds and/or with the filling level of tube 3 (i.e. the measure of the volume of the pourable product present within tube 3) below or above a determined filling level.

[0091] Conveniently, forming unit 6 may comprise a control unit configured to automatically control the movement of movable cam profiles 14 depending on the operative conditions of packaging apparatus 1.

[0092] In light of the above, in order to switch forming unit 6 between one of the operative configuration and the partial operative configuration, movable cam profiles 14 are controlled between their first limit positions (i.e. their

extracted positions) and their second limit positions (i.e. their retracted positions. Similarly, movable cam profiles 14 may be arranged in any of the intermediate positions, i.e. in any of the position interposed between the first limit position and the second limit position, so as to control the interaction of forming members 8 with tube 3.

[0093] According to an aspect of the present invention, each cam assembly 12 comprises a guiding device 19 configured to constrain movable cam profile 14 to move parallel to second direction B between the retracted position and the extracted position (i.e. in its movement towards and away from axis X or, in use, tube 3).

[0094] It is stated that the wording "constrain" indicates herein for the purpose of the invention that a movement of movable cam profile 14 in any direction other than the second direction B is substantially prevented by guiding device 19.

[0095] In detail, each guiding device 19 is configured to guide the respective movable cam profile 14 so that the movement of such movable cam profile 14 between the extracted position and the retracted position is a pure translation along second direction B.

[0096] In other words, each guiding device 19 is configured to produce a pure translational movement of the respective movable cam profile 14 exclusively along second direction B.

[0097] As visible in Figures 2, 3, 4 and 5, cam assemblies 12 are arranged facing one another, and in particular movable cam profiles 14 are arranged facing one another.

[0098] Hence, with the purpose of moving between the aforesaid operative configurations and the partial operative configuration, movable cam profiles 14 are simultaneously movable towards and away from one another between their retracted positions and extracted positions (and their respective intermediate positions).

[0099] During this movement, guiding devices 19 are configured to force the simultaneous movement of movable cam profiles 14 towards and away from one another to occur exclusively along second direction B.

[0100] In this regard, for each cam assembly 12, guiding device 19 comprises a guide element 20 integral to one of the fixed cam profile 13 and the movable cam profile 14, in the example shown integral to the fixed cam profile 13, and a slide element 21 integral to the other one of the fixed cam profile 13 and the movable cam profile 14, in the example shown integral to the movable cam profile 14. Slide element 21 is slidably coupled to guide element 20 and is configured to slide along guide element 20 during the movement of movable cam profile 14 between its retracted position and its extracted position.

[0101] Advantageously, guide element 20 extends parallel to second direction B, thereby determining a translational movement of slide element 21 exclusively along second direction B and constraining slide element 21 to move exclusively along second direction B.

[0102] In light of the above, guiding devices 19 are part of adjusting assembly 16, since they contribute to the

movement of movable cam profiles 14.

[0103] Thanks to the presence of guiding device 19, the Applicant has observed that, for each cam assembly 12, the cyclical transition of the rollers 15 between fixed cam profile 13 and movable cam profile 14 is improved.

[0104] In this regard, a transition area T is defined between fixed cam profile 13 and movable cam profile 14 (Figures 4, 5 and 6a, 6b).

[0105] In detail, each roller 15, carried in motion by the conveyor device, is configured to cyclically interact, due to the cyclical advancement of the respective jaw members, partly with fixed cam profile 13 and partly with movable cam profile 14.

[0106] In greater detail, each cam assembly 12 comprises a transition area T for rollers 15 defined partly by fixed cam profile 13 and partly by movable cam profile 14 and onto which transition area T each roller 15 is configured to cyclically pass for transitioning from fixed cam profile 13 to movable cam profile 14.

[0107] Thanks to the configuration of forming unit 6 according to the invention, and in particular due to the presence of guiding devices 19, the Applicant has observed that the transition of each roller 15 from fixed cam profile 13 to movable cam profile 14, especially when movable cam profiles 14 are in the extracted position (second limit position), is particularly smooth. Hence, wear in the aforesaid transition area T is limited, thereby leading to an increased lifespan of the involved components.

[0108] As visible in the Figures, transmission system 18 comprises, for each cam assembly 12, a main eccentric 22 coupled to actuator 17 and an elongated slot 23 obtained in movable cam profile 14.

[0109] Advantageously, main eccentric 22 engages elongated slot 23 in a sliding manner and is configured to slide within and along elongated slot 23 for transmitting the motion from actuator 17 to the respective movable cam profile 14.

[0110] In particular, each elongated slot 23 extends along first direction A, so that main eccentric 22 is freely movable within elongated slot 23 along first direction A.

[0111] More in particular, main eccentric 22 has a size smaller than the total extension of slot 23 along first direction A. That is, main eccentric 22 is completely contained in slot 23.

[0112] Even more in particular, main eccentric 22 does not completely fill slot 23, but instead is free to slidably move therein, along first direction A.

[0113] This configuration allows for maintaining substantially the same structural configuration of forming unit 6 and adjusting assembly 16 as the one described in WO-A-2022017745, only adapting it for the pure translational movement of movable cam profiles 14 along second direction B according to the present invention.

[0114] In this way, the forming unit 6 according to the present invention can be easily implemented and obtained with little effort and minimum architectural and design modifications.

[0115] Expediently, transmission system 18 further comprises, for each cam assembly 12, a further elongated slot 24 obtained in movable cam profile 14, an auxiliary eccentric 25 engaging further elongated slot 24 and configured to slide along further elongated slot 24, and a lever mechanism 26 integrally coupling main eccentric 22 with auxiliary eccentric 25 and configured to transmit the motion from main eccentric 22 to auxiliary eccentric 25.

[0116] Elongated slot 24 substantially corresponds, in shape and function, to elongated slot 23, and auxiliary eccentric 25 substantially corresponds, in shape and function, to main eccentric 22.

[0117] Conveniently, main eccentric 22 and auxiliary eccentric 25 are configured to simultaneously push the respective movable cam profile 14 during their sliding within elongated slot 23 and further elongated slot 24, respectively, thereby driving movable cam profile 14 between its retracted position and its extracted position.

[0118] Thanks to this configuration, a stable, repeatable and reliable movement of each movable cam profile 14 along second direction B can be easily obtained.

[0119] Preferably, but not necessarily, lever mechanism 26 is a sort of four-bar linkage, wherein the two hinge constraints are defined by main eccentric 22 and auxiliary eccentric 25, and wherein such hinge constraints are free to move along first direction A within the respective elongated slots 23, 24.

[0120] According to one preferred advantageous embodiment depicted in Figure 5, and as visible in particular in Figures 6a and 6b, for each cam assembly 12 the aforementioned transition area T between fixed cam profile 13 and movable cam profile 14 is arranged parallel to second direction B.

[0121] In this way, despite the movement of movable cam profile 14 between the retracted position and the extracted position (and in any one of the respective intermediate positions), the terminal section of fixed cam profile 13 and the initial section of movable cam profile 14, which together define transition area T, remain parallel to one another (and to second direction B), and preferably coplanar with one another.

[0122] This results in an even more improved transition of rollers 15 between fixed cam profiles 13 and movable cam profiles 14, whatever being the positioning of movable cam profiles 14.

[0123] In one embodiment, since first direction A is preferably vertical and second direction B is preferably orthogonal to first direction A, transition area T is horizontal, with respect to the direction of gravity.

[0124] The Applicant observed that this is the optimal configuration in terms of forces and loads.

[0125] From the foregoing, it is clear how forming unit 6 according to the present invention allows to implement a method for forming a plurality of packs 2 containing a pourable product from a tube 3 of packaging material, the method comprising the steps of:

- a) feeding the tube 3 along a first direction A;
- b) cyclically conveying at least one pair of forming members 8 arranged at opposite lateral sides of the tube 3 along the first direction A;
- c) cyclically engaging successive portions of the tube 3 by means of the forming members 8 for the forming thereof;
- d) cyclically driving a movement of the forming members 8 towards and away from the tube 3 and along a second direction B transversal, preferably orthogonal, to the first direction A;

wherein the step c) of engaging is carried out by means of the step d) of driving;

wherein the step c) of driving is carried out by means of a cam system 11 including a pair of cam assemblies 12 arranged at opposite lateral sides of the tube, each cam assembly including a fixed cam profile 13 and a movable cam profile 14;

wherein the method further comprises the steps of:

e) moving each movable cam profile 14 with respect to the relative fixed cam profile 13 between an extracted position and a retracted position, with respect to the tube;

f) constraining the movable cam profile 14 to move parallel to the second direction B between the extracted position and the retracted position.

[0126] The advantages of forming unit 6 and of the related method according to the present invention will be clear from the foregoing description.

[0127] In particular, thanks to the presence of guiding device 19, the Applicant has observed that, for each cam assembly 12, the cyclical transition of the rollers 15 between fixed cam profile 13 and movable cam profile 14 is improved. In fact, the transition of each roller 15 from fixed cam profile 13 to movable cam profile 14, especially when movable cam profiles 14 are in the extracted position (second limit position) and in any one of the respective intermediate positions), is particularly smooth. Hence, wear in the aforesaid transition area T is limited, thereby leading to an increased lifespan of the involved components.

[0128] This peculiar technical effect is further enhanced if transition area T is parallel to second direction B.

[0129] In addition, the presence of elongated slot 23 and of main eccentric 22 slidable therein allows for maintaining substantially the same structural configuration of forming unit 6 and adjusting assembly 16 as the one described in WO-A-2022017745, only adapting it for the pure translational movement of movable cam profiles 14 according to the present invention.

[0130] In this way, the forming unit 6 according to the present invention can be easily implemented and ob-

tained with little effort and minimum architectural and design modifications.

[0131] Clearly, changes may be made to forming unit 6 as described herein without, however, departing from the scope of protection as defined in the accompanying claims.

Claims

1. Forming unit (6) for forming sealed packs (2) containing a pourable product from a tube (3) of packaging material, the forming unit comprising:

- a central axis (X) along which the tube (3) is fed, in use;
- at least one pair of forming members (8) arranged at opposite lateral sides of the central axis (X) and configured to cyclically engage successive longitudinal portions of the tube (3) for forming the tube (3);
- a conveyor device for cyclically advancing the forming members (8) along a first direction (A) parallel to the central axis (X);
- a cam system (11) for cyclically driving a movement of the forming members (8) towards and away from the central axis (X) and from one another and along a second direction (B) transversal to the first direction (A);

the cam system (11) comprising:

- a pair of cam assemblies (12) arranged at opposite lateral sides of the central axis (X) and each including a fixed cam profile (13) and a movable cam profile (14); and
 - a plurality of rollers (15), at least one roller (15) being carried by each forming member (8), configured to cyclically cooperate in contact with the movable cam profiles (14) for determining the movement of the respective forming members (8) along the second direction (B);
- wherein, for each cam assembly (12), the movable cam profile (14) is movably coupled to the fixed cam profile (13) and is movable towards and away from the central axis (X) between a retracted position and an extracted position with respect to the central axis (X);
- and wherein each cam assembly (12) comprises a guiding device (19) configured to constrain the movable cam profile (14) to move parallel to the second direction (B) between the retracted position and the extracted position.

2. Forming unit as claimed in claim 1, wherein the guiding device (19) is configured to guide the movable cam profile (14) so that the movement of the movable cam profile (14) between the extracted

position and the retracted position is a pure translation along the second direction (B).

3. Forming unit as claimed in 1 or 2, wherein the cam assemblies (12) are arranged facing one another on opposite sides of the central axis (X),

the movable cam profiles (14) being simultaneously movable towards and away from one another between their retracted positions and extracted positions, and wherein the guiding devices (19) are configured to force the simultaneous movement of the movable cam profiles (14) towards and away from one another to occur exclusively along the second direction (B).

4. Forming unit as claimed in any one of the foregoing claims, wherein each guiding device (19) comprises a guide element (20) integral to one of the fixed cam profile (13) and the movable cam profile (14) and a slide element (21) integral to the other one of the fixed cam profile (13) and the movable cam profile (14), and wherein the guide element (20) extends parallel to the second direction (B) thereby determining a translational movement of the slide element (21) exclusively along the second direction (B).

5. Forming unit as claimed in any one of the foregoing claims, and further comprising an adjusting assembly (16) for driving the movement of the movable cam profiles (14) between the retracted position and the extracted position, the adjusting assembly (16) including:

- the guiding devices (19);
- at least one actuator (17);
- a transmission system (18) for kinematically coupling the actuator (17) with each movable cam profile (14).

6. Forming unit as claimed in claim 5, wherein the transmission system (18) comprises, for each cam assembly (12), a main eccentric (22) coupled to the actuator (17) and an elongated slot (23) obtained in the movable cam profile (14), wherein the main eccentric (22) engages the elongated slot (23) in a sliding manner and is configured to slide along the elongated slot (23) for transmitting the motion from the actuator (17) to the movable cam profile (14).

7. Forming unit as claimed in claim 6, wherein the elongated slot (23) extends along the first direction (A), and wherein the main eccentric (22) is freely movable within the elongated slot (23) along the first direction (A).

8. Forming unit as claimed in claim 6 or 7, wherein the transmission system (18) further comprises, for each cam assembly (12), a further elongated slot (24) obtained in the movable cam profile (14), an auxiliary eccentric (25) engaging the further elongated slot and configured to slide along the further elongated slot (24), and a lever mechanism (26) integrally coupling the main eccentric (22) with the auxiliary eccentric (25) and configured to transmit the motion from the main eccentric (22) to the auxiliary eccentric (25); wherein the main eccentric (22) and the auxiliary eccentric (25) are configured to simultaneously push the movable cam profile (14) during their sliding within the elongated slot (22) and the further elongated slot (25), respectively, thereby driving the movable cam profile (14) between its retracted position and its extracted position.
9. Forming unit as claimed in any one of the foregoing claims, wherein each movable cam profile (14) is movable between a first limit position approached to the central axis (X) and corresponding to the extracted position, and a second limit position withdrawn from the central axis (X) and corresponding to the retracted position; and wherein the movable cam profiles (14) are selectively controllable in:
- their first limit positions for defining an operative configuration of the forming unit (6), in which the forming members (8) are controlled in respective active states, whereby the forming members (8) cyclically engage and interact with the tube (3) for the forming thereof; and
 - their second limit positions for defining a partial operative configuration of the forming unit (6), in which the forming members (8) are controlled in respective inactive states, whereby the forming members (8) remain spaced from the tube (3) while advanced along the first direction (A).
10. Forming unit as claimed in any one of the foregoing claims, wherein the second direction (B) is orthogonal to the first direction (A).
11. Forming unit as claimed in any one of the foregoing claims, wherein each cam assembly (12) comprises a transition area (T) for the rollers (15) defined partly by the fixed cam profile (13) and partly by the movable cam profile (14) and onto which transition area (T) each roller (15) is configured to cyclically pass for transiting from the fixed cam profile (13) to the movable cam profile (14); and wherein the transition area (T) is arranged parallel to the second direction (B).
12. Forming unit as claimed in claim 11, wherein the transition area (T) is horizontal with respect to the direction of gravity.
13. Packaging apparatus (1) for producing sealed packages (2a) containing a pourable product from a tube (3) of packaging material, the packaging apparatus comprising:
- a forming unit (6) as claimed in any one of the foregoing claims for forming successive portions of the tube (3) while the tube is fed along the first direction (A);
 - at least one pair of sealing members (10) arranged at opposite sides of the central axis (X) and configured to cyclically engage the tube (3) at successive cross-sections thereof for sealing the tube along transversal sealing bands.
14. Method for forming a plurality of packs (2) containing a pourable product from a tube (3) of packaging material, the method comprising the steps of:
- a) feeding the tube (3) along a first direction (A);
 - b) cyclically conveying at least one pair of forming members (8) arranged at opposite lateral sides of the tube (3) along the first direction (A);
 - c) cyclically engaging successive portions of the tube (3) by means of the forming members (8) for the forming thereof;
 - d) cyclically driving a movement of the forming members (8) towards and away from the tube (3) and along a second direction (B) transversal to the first direction (A);
- wherein the step c) of engaging is carried out by means of the step d) of driving; wherein the step c) of driving is carried out by means of a cam system (11) including a pair of cam assemblies (12) arranged at opposite lateral sides of the tube (3), each cam assembly (12) including a fixed cam profile (13) and a movable cam profile (14); wherein the method further comprises the steps of:
- e) moving each movable cam profile (14) with respect to the relative fixed cam profile (13) between an extracted position and a retracted position, with respect to the tube;
 - f) constraining the movable cam profile (14) to move parallel to the second direction (B) between the extracted position and the retracted position.
15. Method as claimed in claim 14, wherein the step f) of constraining comprises guiding the movable cam profile (14) during its movement between the extracted position and the retracted position so that

such movement is a pure translation along the second direction (B).

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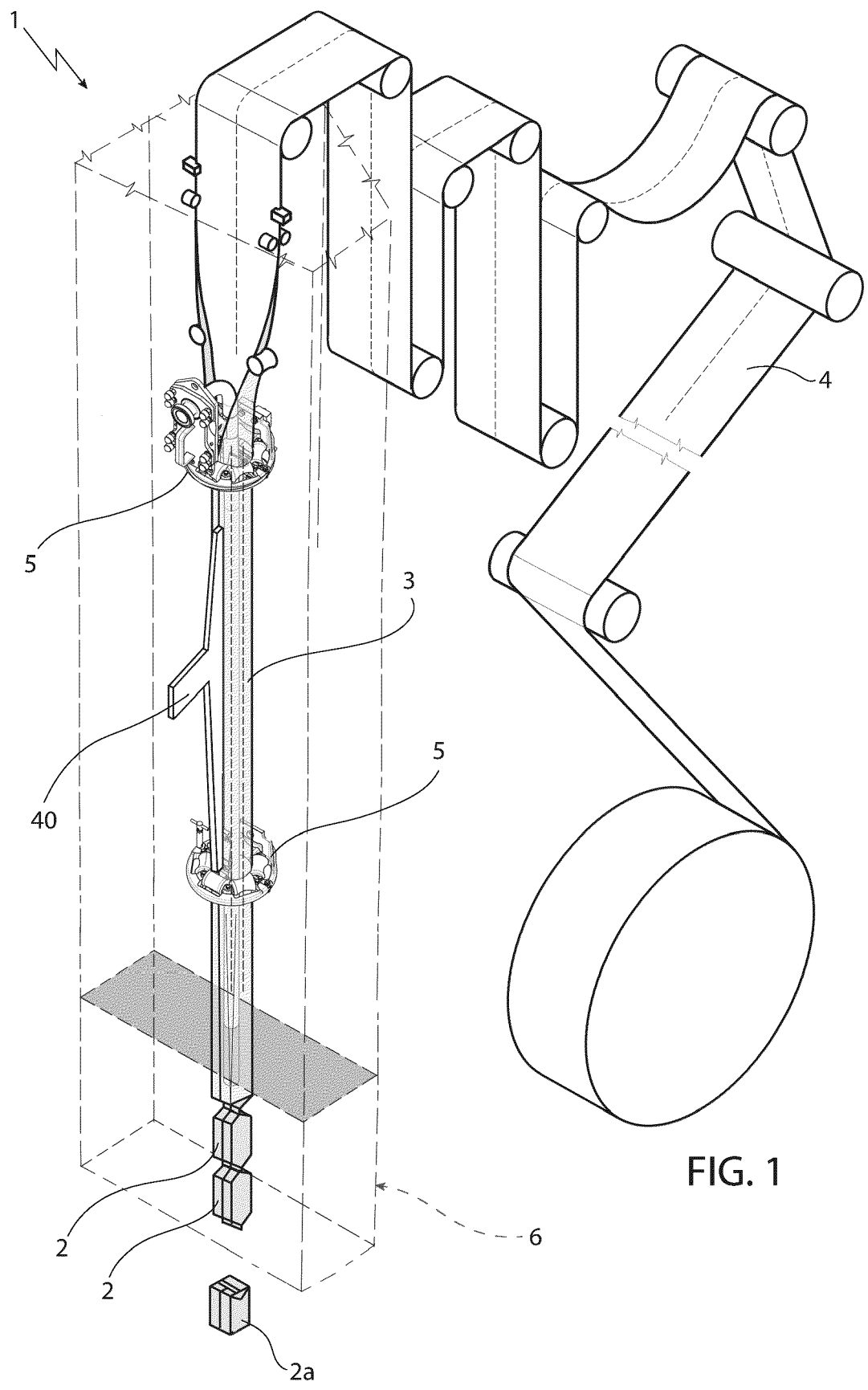


FIG. 1

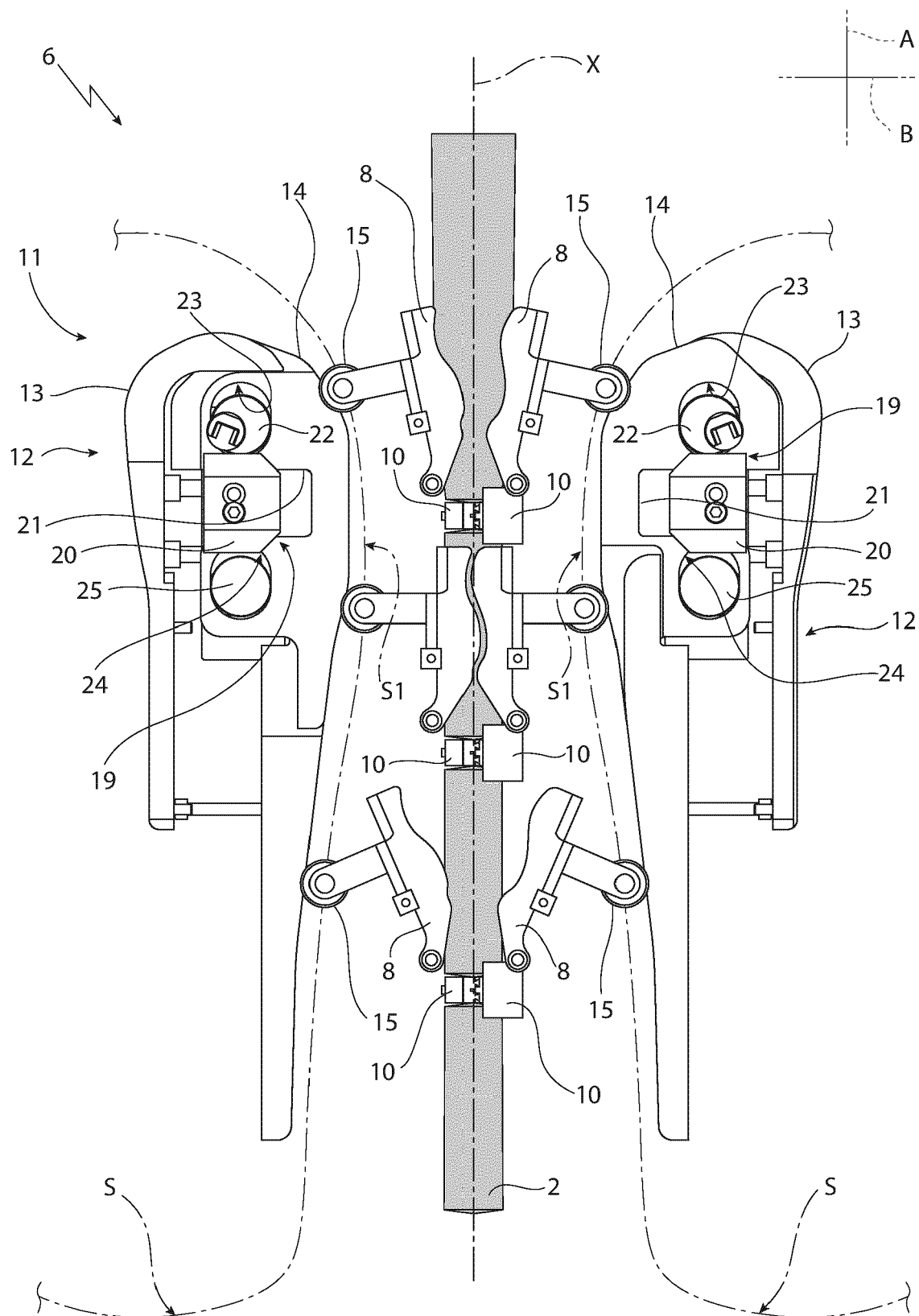


FIG. 2

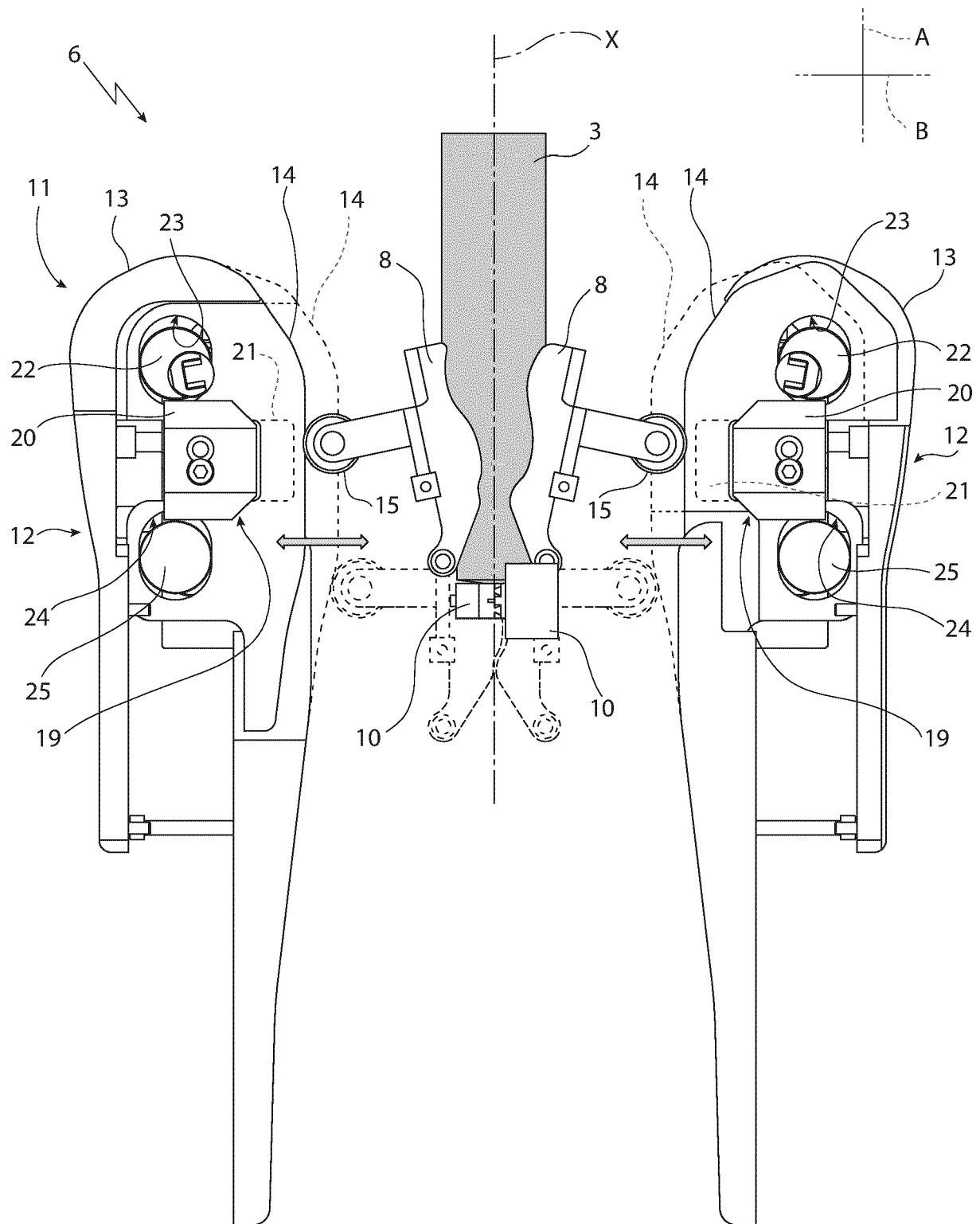
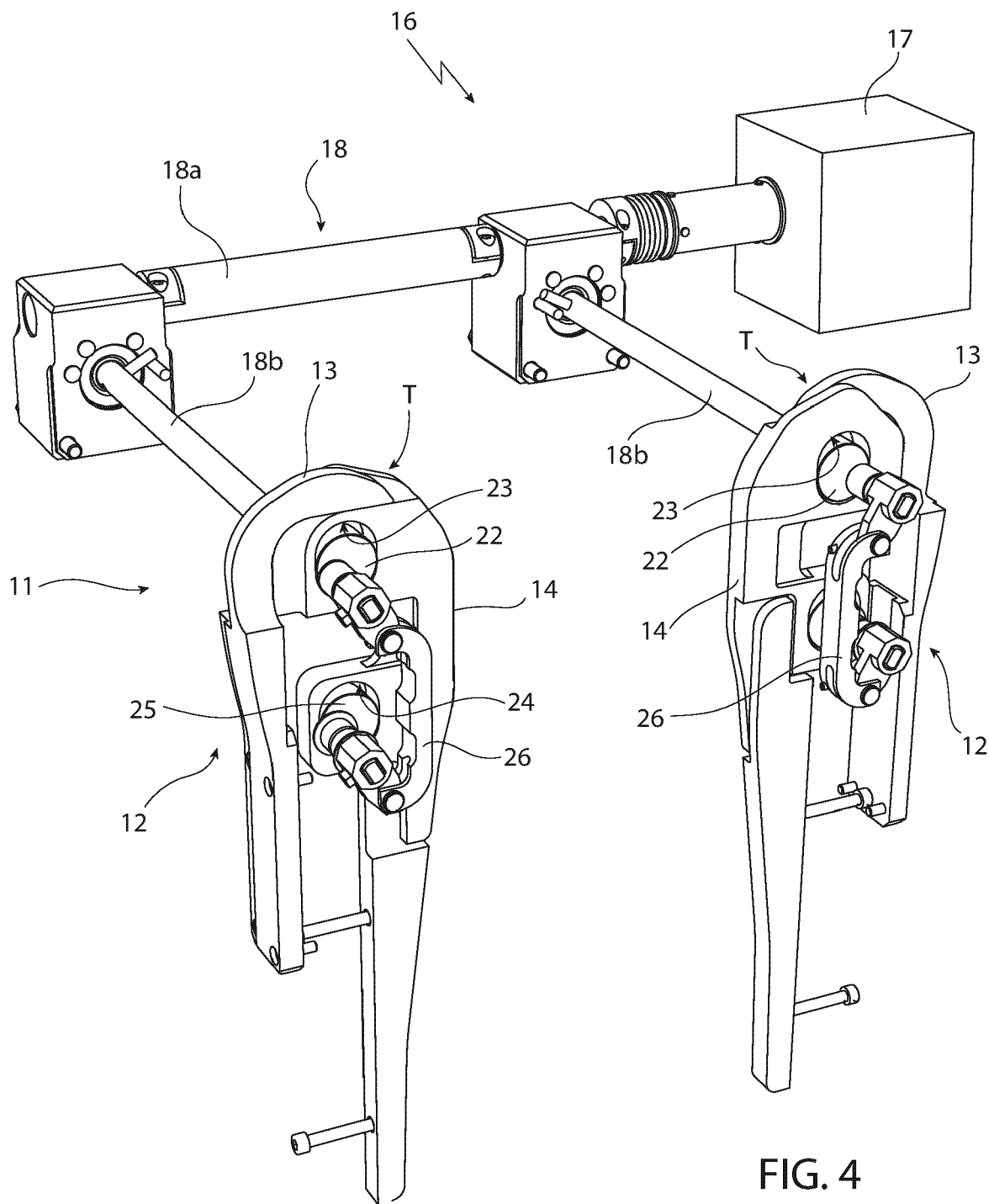


FIG. 3



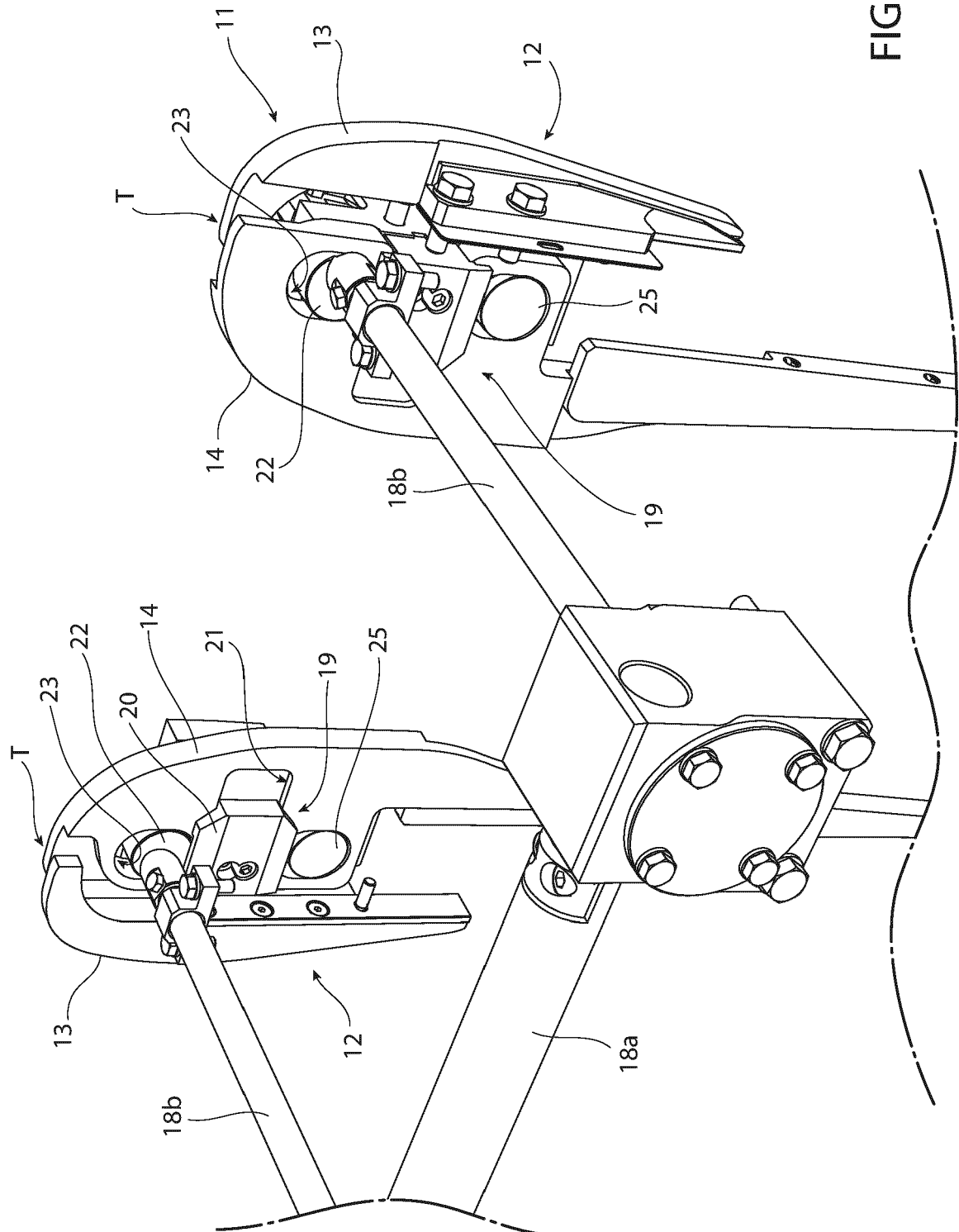


FIG. 5

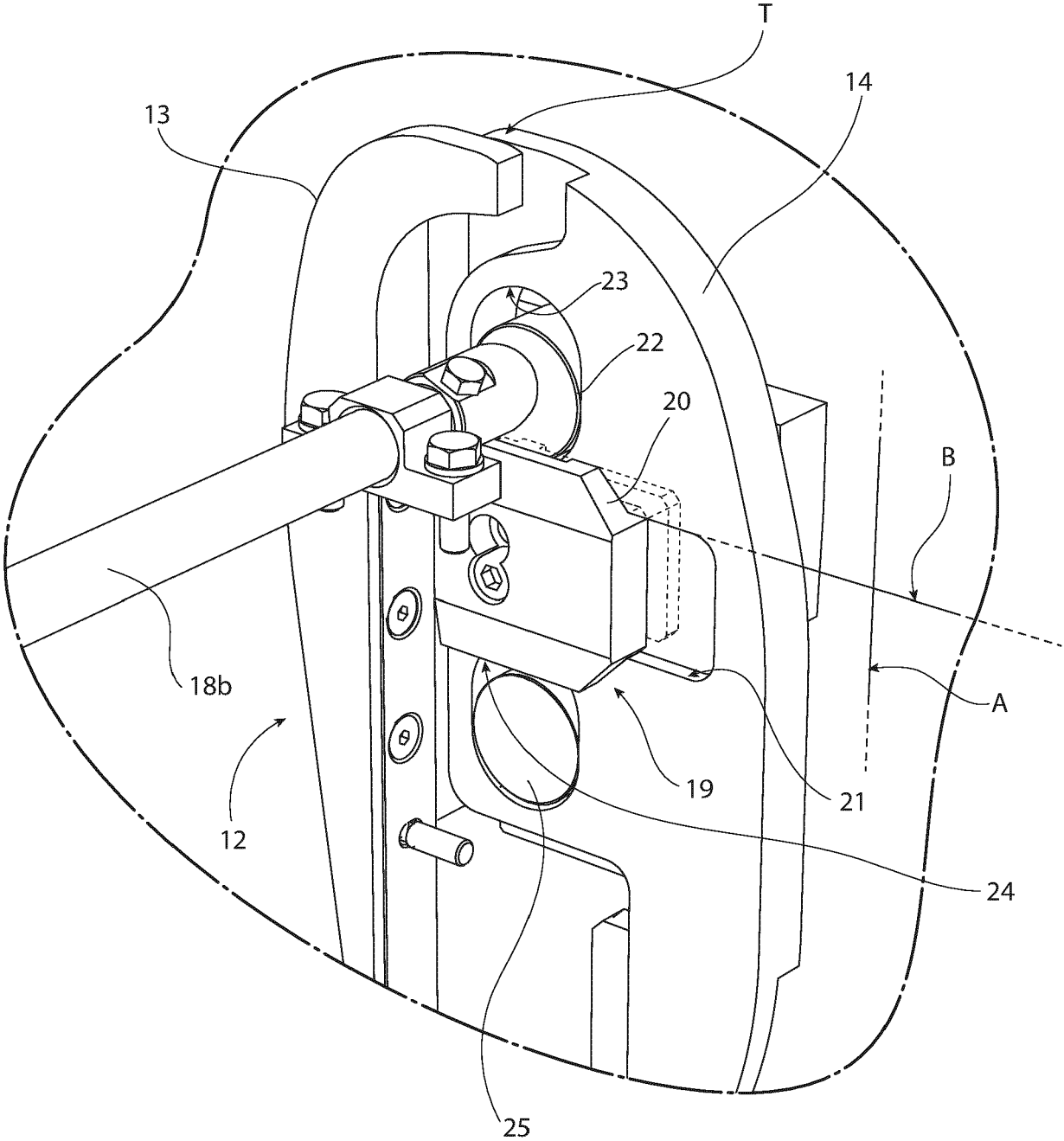


FIG. 6A

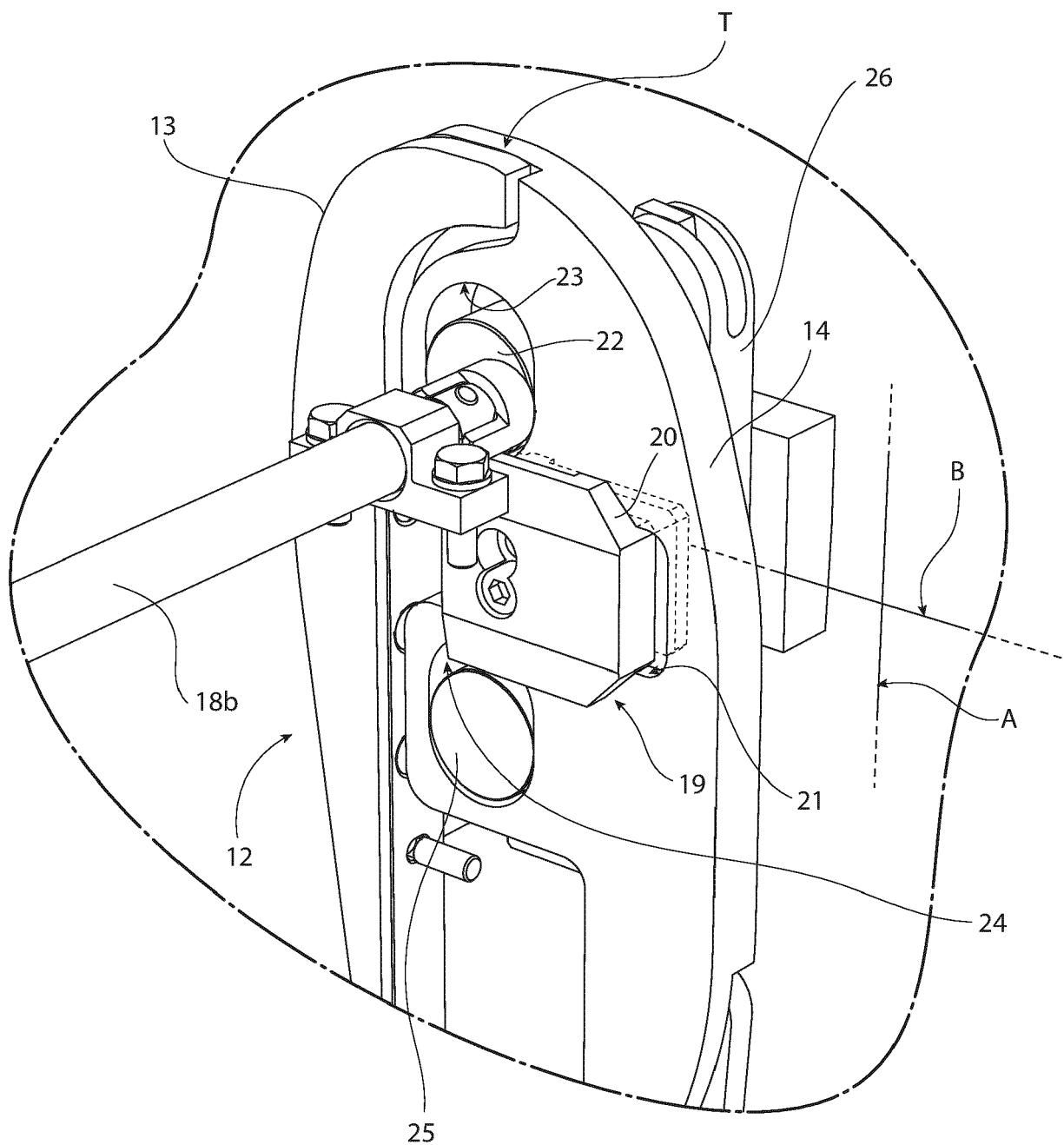


FIG. 6B



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The present search report has been drawn up for all claims			
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Munich		11 October 2024	Kelliher, Cormac
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