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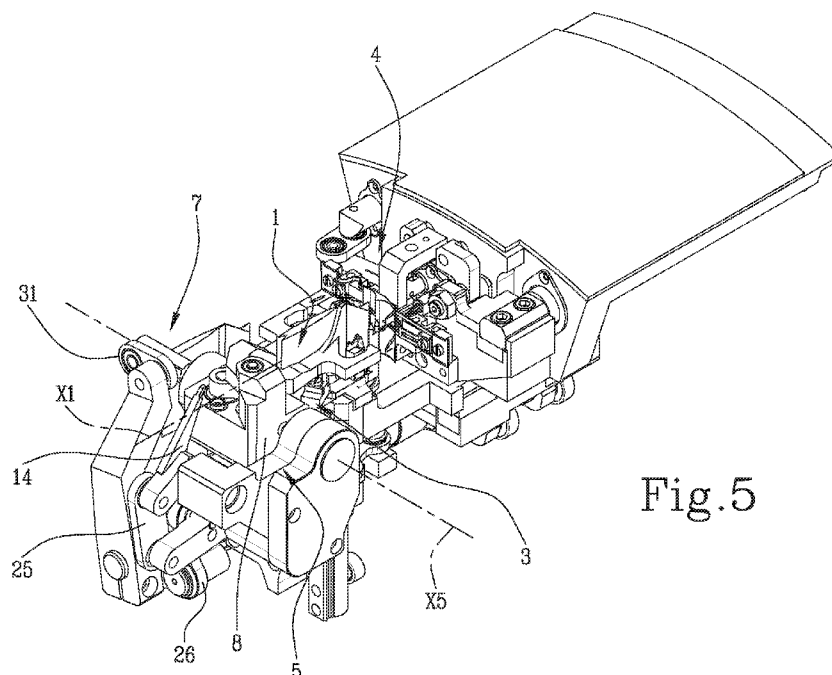


Fig.5

(57) Abstract: Described is a machine for forming filter bags (1) for infusion products starting from pieces (1) of filter material each containing at least one dose of infusion product and having, the pieces (1), a corresponding longitudinal axis (X1) of extension, comprising a carousel (2) rotating about a main axis (X2) of rotation and equipped with a plurality of gripping elements (3) movable in rotation about the main axis (X2) of rotation along a closed circular trajectory; each gripping element (3) is configured to receive and retain a piece (1) of filter material along an operating path (P); at least one operating station (4) configured to perform at least one operation on the piece (1) of filter material retained by a corresponding gripping element (3) along the operating path (P) inside the closed circular trajectory; each gripping element (3) is equipped with articulation means (5) configured for obtaining a further rotation about a secondary axis (X5) of rotation, transversal to the main axis (X2) of rotation, to rotate and position the corresponding piece (1)



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DESCRIPTION

MACHINE FOR FORMING FILTER BAGS FOR INFUSION PRODUCTS

Technical field

- 5 This invention relates to a machine for forming filter bags for infusion products, such as tea, coffee, camomile (in powder, granular or leaf form).

Background art

10 The term filter bags is used to indicate at least two types of filter bag: the single-chamber filter bags, comprising, in a minimum configuration, a piece of filter material forming a chamber containing a dose of infusion product; and the double-chamber filter bags, again comprising a single piece of filter paper, but forming two separate chambers. Each chamber contains a dose of infusion product. The two chambers are folded towards
15 each other forming a single upper end (in the shape of an upturned "V") and a bottom end in the shape of a "W".

The single-chamber and double-chamber filter bags can also be equipped with a tag and a tie string connecting the tag to the filter bag.

20 Lastly, an overwrap envelope may be added to the above mentioned filter bags for wrapping and closing the single filter bag, in a hermetic or non-hermetic manner.

A type of machine, used for making filter bags of the type called two-lobed, is known from patent documents EP762973, EP762974 and EP765274 (all in the name of the same Applicant).

25 The machine extends along a forming and feeding line on which are positioned:

- a station for feeding a web of filter paper along a feed surface;
- a station for feeding doses of product on the web of filter paper at predetermined distances;
- 30 - a tabularisation station for folding the strip on itself, wrapping the doses

of product and, subsequently, longitudinally joining the strip;

- a station for folding individual pieces of filter paper with double chamber;
- a carousel, equipped with radially protruding grippers, positioned beneath the folding station and configured to receive individual pieces of folded filter paper; the carousel, moved stepwise about a horizontal axis, rotates each piece of filter paper to the operating stations, arranged one after another and stationary relative to a frame of the machine, to associate to the piece of filter paper a string, suitably wrapped around the piece of filter paper, and a tag in turn connected to the string.

10 A further machine of this type is described in patent document EP 1 384 665 which also describes a carousel rotating in a stepwise fashion about an axis. The carousel has a plurality of grippers positioned along the carousel to receive and retain a corresponding piece of folded filter paper. The machine comprises at least one operating station configured for implementing an operation on each piece of filter paper held by a gripper during its circular path actuated by the carousel.

In some machine solutions, depending on the type of filter bag to be formed, there may be (alternatively):

- a station for folding the open ends of the two chambers of the piece along the path of the carousel with their retaining by the knotting of the string on the same piece; or
- a further station for transversal closing of the ends of the piece before or at the same time as the separation from the remaining film.

The machine may also comprise a station for applying a sheet of overwrapping material for each filter bag positioned along the path of the carousel, or at a further carousel.

The machine structured as described above operates intermittently, that is to say, stepwise for all the stations present along the feed line.

The stepwise operation places a limit on the productivity of the machine.

30

Disclosure of the invention

The aim of this invention is to provide a machine for forming filter bags for infusion products with a productivity greater than the productivity of the prior art machines, maintaining a high quality of the filter bag.

More specifically, the aim of this invention to provide a machine for forming
5 filter bags for infusion products with reduced dimensions and high flexibility.

These aims are fully achieved by a machine for forming filter bags for infusion products according to claim 1.

10 **Brief description of the drawings**

The invention will be described with reference to the accompanying drawings, provided by way of example only and without limiting the scope of the invention, in which:

- Figure 1 is a schematic front view, with some parts cut away to better
15 illustrate others, of a machine for forming filter bags containing infusion products according to this invention;
- Figure 2 illustrates a partly exploded perspective view of the machine for forming filter bags containing infusion products, according to this invention, comprising a carousel and a plurality of stations;
- 20 - Figures 3 to 6 are perspective views, each illustrating one of a plurality of operational stations arranged on the carousel shown in Figure 2 in corresponding different operating configurations for forming the filter bag;
- Figure 3a is an enlarged detail of Figure 3;
- Figure 7 illustrates an enlarged view of a part of the operating station and
25 gripper elements referred to Figure 4 and with some parts cut away to better illustrate others;
- Figure 8 illustrates an enlarged view of a part of the operating station and gripper elements referred to Figure 5 and with some parts cut away to better illustrate others;
- 30 - Figure 9 is a perspective view from below of a single operating station of the carousel of Figure 2;

- Figure 10 illustrates a schematic front view, with some parts cut away to better illustrate others, of a part of the carousel of Figures 1 and 2 and a tensioning drum for feeding a continuous string to the carouse.

5 **Detailed description of preferred embodiments of the invention**

A machine according to the invention, labelled 100 in its entirety, is used for making filter bags 1 containing infusion products, such as tea, coffee, camomile dosed in powder, granular or leaf form.

10 The expression “filter bags” is used to indicate at least two types of filter bag.

A first type, known as single-chamber, comprises a piece of filter material forming a single chamber containing a dose of infusion product.

A second type of filter bag, known as double-chamber, comprises a single piece 1a of filter material, which forms two separate chambers 1b, 1c.

15 Each chamber 1b, 1c contains a dose of infusion product. The two chambers 1b, 1c are folded towards each other forming a single upper end (in the shape of an upturned “V”) and a bottom end in the shape of a “W”.

20 These two types of filter bag may be equipped with a gripping tag 1t and a tie string 1g connecting the tag 1t to the filter bag 1 formed (see Figures 3 to 6).

An outer overwrapping envelope may also be added to wrap around and enclose each single filter bag 1 formed.

25 The machine structure which will be described and protected in this specification has technical solutions which can be used both for machines with step-mode or discontinuous operation and for machines operating continuously, without therefore limiting this solution to one or other type of machine.

30 For a greater simplification of the description, this solution will describe a machine with continuous operation, but without thereby limiting the scope of protection of this invention.

The machine 100, according to the invention, starts from the concept of

being able to obtain various types of filter bag, including those mentioned above (from the simpler single-chamber filter bag to the more complex double-chamber bag with tie string and tag in overwrap envelope) adding, when necessary, operating stations designed to perform the requested operation on the piece of filter material or on the filter bag.

This specification describes a machine which is capable of applying the string 1g between the tag 1t and the piece of filter material 1, with, in this case, a continuous operation of the machine.

As already mentioned, irrespective of the type of filter bag to be formed, the part of the piece 1 of filter material containing at least a dose of infusion product.

Each piece 1 has a corresponding longitudinal axis X1 of extension (that is, the axis of longest extension of the piece).

The machine 100 comprises a carousel 2 rotating about a main axis X2 of rotation and equipped with a plurality of movable gripping elements 3 rotating about the main axis X2 of rotation along a closed circular trajectory.

Each gripping element 3 is configured to receive and retain a piece 1 of filter material along an operating path P (in this case circular).

The machine 100 comprises at least one operating station 4 configured to perform an operation on the piece 1 of filter material retained by a corresponding gripping element 3 along the operating path P inside the closed circular trajectory.

As illustrated (Figures 3 to 8), each gripping element 3 is provided with articulation means 5 configured for obtaining a further rotation about at least a secondary axis X5 of rotation, transversal to the main axis X2 of rotation, to rotate and position the corresponding piece 1 of filter material with its longitudinal axis X1 of extension parallel to the main axis X2 of rotation at least at the operating station 4.

In other words, the gripping elements are designed to receive the piece of filter material (from other carousels or devices for formation / transit of the

piece) along radial trajectories relative to the axis of rotation of the carousel and then rotate the piece in such a way as to bring the piece parallel to the axis of rotation and in the direction of the operating station for the formation operations.

- 5 This structure of the gripping elements may be used, as mentioned above, both on carousels moved in a stepwise or discontinuous fashion and with carousels moved continuously.

As illustrated, the machine 100 is structured in such a way that it comprises the movement carousel 2 rotating continuously about the main
10 axis X2 of rotation.

The machine 100 also comprises the plurality of first gripping elements 3 positioned along, and movable continuously with, the movement carousel 2.

The machine 100 also comprises a plurality of first operating stations 4
15 positioned along, and movable continuously with, the movement carousel 2.

Each operating station 4 is linked to a corresponding gripping element 3 and is configured to perform at least one operation on the piece 1 of filter material along at least one stretch of the operating path P in the closed
20 circular trajectory of the movement carousel 2.

In short, the machine 100 comprises a multiplicity of operating units, all operating a same operation on the piece of filtering material, all independent of each other and driven continuously about an axis of rotation.

25 Moreover, at the infeed area of the movement carousel 2 (for example a further carousel or a conveying device 21 of the pieces of filter material, as shown in Figure 1), at which the piece 1a is released to a corresponding gripping element 3, the operating station 4 and the corresponding first gripping element 3 are offset horizontally, that is, positioned on different
30 vertical planes, in such a way as to allow the piece 1 to be picked up without interference from the corresponding gripping element 3.

Subsequently, the rotation of the gripping element 3 allows the piece 1 of filter material to be positioned in the operating station 4 (or the part of the piece 1 in question), so that the first operating station 4 can perform one or more operations on the piece 1.

5 Upon completion of the operations, the gripping element 3 rotates and moves away the piece 1 of filter material from the operating station 4, in such a way that, at an outfeed area of the movement carousel 2, the piece 1a is free to be transferred to a subsequent processing step/station, for example a second movement carousel, or suitably stored if the formation
10 is completed.

This configuration allows an intermediate operation or the completion of the filter bag to be obtained on a large number of pieces of filter material per unit of time and in a reduced space (angular section).

It should be noted that the carousel 2 forms a circumferential surface
15 parallel to the main axis X2 of rotation and on which are positioned the plurality of operating stations 4 and the corresponding plurality of gripping elements 3.

In light of this, each operating station 4 is positioned fixed on a first part of a circumferential surface 2a formed by the movement carousel 2.

20 Each gripping element 3 is positioned along a second part of the circumferential surface 2a of the carousel 2 in such a way that it faces the corresponding operating station 4.

In the case illustrated, the operating station 4 is away from the outer edge formed by the circumferential surface 2a of the carousel 2, whilst the
25 gripping elements 3 are moved towards the outer edge formed by the circumferential surface 2a of the carousel 2.

In the case illustrated, by way of a non-limiting example, each operating station 4 is a station for applying the string 1g and a tag 1t on an end 1a of the piece 1 of filter material.

30 In this specific case, the piece 1 is picked up by the gripping elements 3 (again with continuous movement) from the wheel or conveying device 21

in such a way as to block a zone close to the head end 1a of the piece 1 where, in this specific case, there is the tag 1t. In this case, therefore, each gripping element 3 is configured for picking up and retaining the piece 1 and tag 1t, keeping the end part 1a of the piece 1 free for the operation for applying the string 1g on the piece 1 and on the tag 1t with relative joining of the tag to the piece 1 by the operating station 4.

In Figure 1 (by way of non-limiting example), the conveying device 21 (comprising a carousel rotating continuously about an axis parallel to the main axis X2 of rotation) prepares and moves each piece 1 of filter material combined with a tag 1t located at the head end of the piece 1.

The individual tags 1t are fed from a rotary magazine 21m located in the proximity of the conveying device 21.

It should be noted that the conveying device 21 rotates in an anti-clockwise direction, whilst the carousel 2 rotates in a clockwise direction.

Below the carousel 2 is positioned a magazine 2m (reel) for feeding the string 1g towards a tangential zone of the carousel 2 in such a way that each operating station 4 intercepts and picks up, during its passage, a portion of string 1g to be applied to the piece 1 of filter material.

In this specification the operating station 4 is not described in detail, but only illustrated.

As illustrated in Figures 3 to 9, each gripping element 3 comprises a gripper 6 for gripping, retaining and releasing the piece 1 of filter material. Each gripping element 3 also comprises the articulation means 5 connected to the gripper 6 to obtain a further rotation about the secondary axis X5 of rotation, transversal to the main axis X2 of rotation.

The gripping element 3 also comprises a movement device 7 connected to the gripper 6 for moving the gripper 6 between a first non-operating open position for receiving or release (Figure 3) and a near operating position for retaining the piece 1 of filter material (figure 4).

It should be noted that each gripping element 3 comprises a tower 8 for supporting the gripper 6.

Preferably, the movement device 7 is connected to the gripper 6 along the above-mentioned secondary axis X5 of rotation, transversal to the main axis X2 of rotation.

5 The combined structure of the secondary rotation and opening and closing units of the gripper along the same axis X5 makes it possible to considerably reduce the dimensions of each gripping element.

Preferably, each gripper 6 comprises at least two plates 6a, 6b facing each other for gripping the piece 1 of filter material and a corresponding arm 9a, 9b for supporting each gripping plate 6a, 6b.

10 In light of this, each arm 9a, 9b is articulated on the supporting tower (8) and connected to the movement device 7 in such a way as to rotate the two plates 6a, 6b between the open, non-operating position (for receiving or release), with the plates 6a, 6b spaced apart, and the near operating position, with the plates 6a, 6b moved towards each other, for gripping the
15 piece 1 of filter material.

Preferably, each articulation means 5 comprises (see Figure 8) a gear wheel 10 keyed rotatably, by a first shaft 11 positioned coaxially to the secondary axis X5 of rotation, to the supporting tower 8.

Moreover, each articulation means 5 comprises a first motion transmission
20 unit 12 connected by a kinematic mechanism between the gear wheel 10 and a first cam means 13 for controlling the rotation of the tower 8 and positioning the gripping element 3 and the corresponding piece 1 of filter material with its longitudinal axis X1 of extension from the position transversal to the main axis X2 of rotation to the position parallel to the
25 main axis X2 of rotation at least at the operating station 4, and vice versa, along at least one stretch of the operating path P in the closed circular trajectory of the movement carousel 2.

In other words, the first cam means 13 are configured to rotate (by means of the first drive 12) the tower 8 towards the operating station 4 for a time /
30 arc of rotation of the carousel 2 sufficient to complete the operation on the piece 1 of filter material and, subsequently, return the tower 8 to the initial

position to allow the release of the piece 1 of filter material processed.

On the tower 8 are operatively positioned means 140 for temporarily retaining a tie string 1g for preparing a stretch of the tie string 1g inside the space formed by the plates 6a and 6b of the gripper 6 in the first open,
5 non-operating position and awaiting the piece 1 of filter material.

These retaining means 140 comprise a movable reference element 14 and a flexible plate 141.

The movable reference element 14 is connected to the above-mentioned drive unit 12; the flexible plate 141 is associated with the tower 8 and
10 extends transversally relative to the main axis X2 of rotation.

The reference element 14 (see in particular Figures 3, 3a and 4) is configured for positioning parallel to the main axis X2 of rotation and below the gripping element 3, in such a way as to retain a stretch of the string 1g on the bottom of the piece 1 of filter material in conjunction with the flexible
15 plate 141 at the positioning of the piece 1 of filter material between the plates 6a and 6b of the gripper 6.

This reference element 14 comprises a rod having a contact head 14a with a projection of the flexible plate 141 to be able to ensure stable retaining of the stretch of string 1g in the lower zone of the space formed of the plates
20 6a and 6b of the gripper 6 and close to the tower 8.

The positioning / feeding of the string 1g is performed in a predetermined zone of the carousel 2 and at the passage of each gripper 6 in that zone.

More specifically, during the continuous rotation of the carousel 2, the string 1g (continuous) is fed to the carousel 2 in such a way as to position
25 itself (taut and in a tangential position to the carousel 2) close to two plates 6a and 6b of the gripper 6 in passage (string 1g fed from the magazine 2m).

It should be noted (Figure 10) that the continuous string 1g is guided by a tensioning drum 142 positioned next to the carousel 2.

30 The tensioning drum 142 is equipped, along its circumference, with a plurality of arc-shaped sectors 143 for guiding the continuous string 1g in

order to keep the string taut 1g.

The tensioning drum 142 is also equipped with at least one insertion element 144 configured to intercept the continuous string 1g and insert the string 1g in the space between the two open plates 6a and 6b with
5 subsequent positioning of the string 1g between the reference element 14 and the plate 141 (thanks to the flexibility of the plate).

Preferably, on the tensioning drum 142 there are two or more insertion elements 144, each positioned between two consecutive curved guide sectors 143.

10 It should be noted that each insertion element 144 comprises an arm 144a connected to cam means 148, positioned on the tensioning drum 142, for allowing a rectilinear movement in both directions, that is, radial relative to the tensioning drum 142, between a non-operating position, wherein the arm 144a is retracted, and a forward operating position, wherein the arm
15 144a is advanced beyond the overall dimensions of the tensioning drum 142 and intercepts the portion of continuous string 1g taut between the two plates 6a and 6b.

The arm 144a has its head end 144b configured in the form of a fork in such a way as to pull the continuous string 1g towards the retaining area
20 formed by the reference element 14 and the flexible plate 141.

The head 144b of the arm 144a pushes the continuous string 1g in such a way as to bend the plate 141 and allow the entrance of the continuous string 1g between the plate 14 and the reference element 141 and remain there (see Figure 10).

25 It should also be noted that each plate 6a and 6b of each gripper 6 is equipped with a tooth 145 protruding outside the plate 6a or 6b relative to the zone for housing the piece 1 of filter material.

Each tooth 145 has a pin 146 for centring and sliding of the continuous string 1g protected by a wall 147 in such a way as to define a channel for
30 constraining the string 1g.

The string 1g being unwound is progressively intercepted by the pins 146

of the arms 6b and 6a (relative to the direction of rotation of the carousel 2 which in this case, only by way of example, is in a clockwise direction), and may be performed safely during the insertion of the stretch of string 1g inside the zone for housing by the arm 144a.

- 5 The string 1g therefore remains positioned in a “V”-shaped extension, inside the housing space defined by the two open plates 6a and 6b and constrained in three clearly defined points in such a way as to prevent movements of the portion of the string 1g until the closing of the gripper 6 on the piece 1 which determines the stabilisation of the piece 1 and the
10 portion of string 1g.

It should be noted that the rod 14 has a raising / lowering movement, by a relative articulation to the drive unit 12, for correctly following the rotation of the piece 1 of filter material towards and away from the operating station
4.

- 15 The lifting of the rod 14 during the rotation of the tower 8 allows the releasing of the string 1g, which may thus come into contact with the bottom of the piece 1 of material before the knotting operations in the corresponding operating station 4.

As illustrated in Figures 8 and 9, the drive unit 12 comprises a lever 22
20 equipped, at a first end, with a toothed arc 23 meshed in the gear wheel 10.

The drive unit 12 also comprises a transmission shaft 24 positioned parallel to the secondary axis X5 of rotation. The transmission shaft 24 is keyed, at a relative end, to the second end of the lever 22.

- 25 The drive unit 12 comprises a four-bar linkage 25 positioned on a vertical plane transversal to the secondary axis X5 of rotation and on which is rotatably articulated, on its upper part, the reference element 14. The four-bar linkage 25 is connected at the free end of the transmission shaft 24.

The four-bar linkage 25 is connected to the first cam means 13 using a
30 connecting rod 26 configured to obtain an angular drive of the lifting and lowering motion of the four-bar linkage 25.

The movement is in effect controlled by the first cam means 13 extending along an axis X13 parallel to the main axis X2 of rotation.

The connecting rod 26 is articulated, below, at the end of a first flange 27 connected to a proximal end of a first cylinder 28 rotatably mobile about the axis X13.

The first cylinder 28 is connected, at its distal end, with a pair of first cam follower rollers 29 positioned along a first circular cam track 30 positioned inside the carousel 2.

As illustrated in Figures 7 and 9, each movement device 7 comprises, inside the supporting tower 8:

- a main gear wheel 15 keyed to an arm, 9a, of the gripping element 3;
- a satellite gear wheel 16 keyed to the other arm 9b of the gripping element 3;
- a second shaft 17 positioned coaxially to the secondary axis X5 of rotation; the second shaft 17 is equipped, on a relative cylindrical portion, with a plurality of circular compartments formed from a corresponding series of annular slits 18 equidistant along the second shaft 17 and on which it is meshed on the main gear wheel 15 with the possibility of rotation about the secondary axis X5 of rotation;
- a second motion transmission unit 19 connected between the second shaft 17 and a second cam means 20 for controlling the translation, in both directions, of the second shaft 17 along the secondary axis X5 of rotation in such a way as to allow the rotation of the two plates 6a and 6b between the open, non-operating position, with the plates 6a and 6b spaced apart, and a near operating position, with the plates 6a and 6b moved towards each other, for gripping the piece 1 of filter material.

In other words, the second cam means 20 allow a translation of the second shaft 17 in both directions so as to act as a rack to obtain the rotation of the main gear wheel 15 (in one direction or the other) and consequently, the inverse rotation of the satellite gear wheel 16 so as to obtain the movement of the plates 6a and 6b.

The circular structure of the meshing incisions 18 allow the gripper 6 to rotate about the secondary axis X5 of articulation without thereby limiting the kinematic coupling between the main gear wheel 15 and the second shaft 17.

- 5 The second cam means 20 which allow the transfer of the second shaft 17 comprise a connecting rod 31 positioned parallel to the second shaft 17 and articulated at a free end of the second shaft 17.

The connecting rod 31 is articulated, in turn, to a second flange 32 connected to a proximal end of a second cylinder 33 (coaxial with and
10 inside the first cylinder 28) and rotatably movable about the axis X13 parallel to the main axis X2 of rotation.

The second cylinder 33 is connected, at its distal end, with a pair of second cam follower rollers 34 positioned along a second circular cam track 35 positioned inside the carousel 2.

- 15 This invention provides a method for making filter bags for infusion products starting from pieces 1a of filter material each containing at least one dose of infusion product.

Each piece 1 of filter material has a corresponding longitudinal axis X1 of extension.

- 20 The method comprises at least the following steps:

- feeding pieces 1 of filter material being formed to a movement carousel 2 having a plurality of elements 3 for gripping the pieces 1 of filter material; the carousel 2 rotating (continuously) about the main axis X2 of rotation (Figure 3);

- 25 - rotating the pieces 1 of filter material about the main axis X2 of rotation, positioned, with the relative longitudinal axis X1, transversal to the main axis X2 of rotation, and retained by corresponding gripping elements 3;

- rotating further the pieces 1 of filter material about corresponding secondary axes X5 rotation, transversal to the main axis X2 of rotation

- 30 (Figure 4); and

- placing the pieces 1 of filter material with the corresponding longitudinal

axis X5 of extension parallel to the main axis X2 of rotation at an operating station 4 configured to perform at least one operation on the piece 1 of filter material being formed, retained by a corresponding gripping element 3 (Figure 5).

5 There is then a step of further rotation, the opposite direction to the previous rotation, about the secondary axis X5 rotation to return the piece 1 of filter material with its longitudinal axis X1 transversal to the main axis X2 of rotation, again held from the corresponding gripping element 3 (Figure 6).

10 Then there is a further step of releasing the piece 1 of material from the corresponding gripping element 3.

The preset aims are fully achieved with the machine structure just described.

15 In effect, a machine according to the invention is extremely flexible and with a high productivity and with reduced dimensions.

The solution of foldable gripper elements can be used in different types of machines, both with continuous movement and with discontinuous or step-like movement.

20 Each unit may operate on the piece of filter material along an extremely short arcuate stretch of the carousel and, thanks to the particular gripping elements, may receive and release the piece quickly and with the possibility of starting the operations immediately, reducing the down times and the dimensions of the machine.

25 Thanks to the gripping element / operating station combination, the positioning of the piece of filter material in the station is rapid, precise and allows a high quality in a reduced unit of time.

CLAIMS

1. A machine for making filter bags for infusion products starting from pieces (1) of filter material each containing at least one dose of infusion product and having, the pieces (1), a corresponding longitudinal axis (X1) of extension, the machine (100) comprising at least:
- a carousel (2) rotating about a main axis (X2) of rotation and equipped with a plurality of movable gripping elements (3) rotating about the main axis (X2) of rotation along a closed circular trajectory; each gripping element (3) being configured to receive and retain the piece (1) of filter material along an operating path (P);
 - at least one operating station (4) configured to perform at least one operation on the piece (1) of filter material retained by a corresponding gripping element (3) along the operating path (P) inside the closed circular trajectory;
- characterised in that each gripping element (3) is provided with articulation means (5) configured for obtaining a further rotation about at least a secondary axis (X5) of rotation, transversal to the main axis (X2) of rotation, to rotate and position the corresponding piece (1) of filter material with its longitudinal axis (X1) of extension parallel to the main axis (X2) of rotation at least at the at least one operating station (4).
2. The machine according to claim 1, comprising:
- the movement carousel (2) rotating continuously about the main axis (X2) of rotation;
 - the plurality of first gripping elements (3) positioned along, and movable continuously with, the movement carousel (2);
 - a plurality of first operating stations (4) positioned along, and movable continuously with, the movement carousel (2), each operating station (4) being linked to a corresponding gripping element (3) and being configured to perform at least one operation on the piece (1) of filter material along at

least one stretch of the operating path (P) in the closed circular trajectory of the movement carousel (2).

3. The machine according to any one of the preceding claims, wherein
5 each operating station (4) is positioned fixed on a first part of a circumferential surface (2a) formed by the movement carousel (2), parallel to the main axis (X2) of rotation; each gripping element (3) being positioned along a second part of the circumferential surface (2a) of the carousel (2) in such a way that it faces the corresponding operating station
10 (4).

4. The machine according to any one of the preceding claims, wherein each operating station (4) is a station for applying a tie string (1g) and a tag (1t) on one end (1a) of the piece (1) of filter material.
15

5. The machine according to any one of the preceding claims, wherein each gripping element (3) comprises:
- a gripper (6) for gripping, retaining and releasing the piece (1) of filter material;
20 - the articulation means (5) connected to the gripper (6) to obtain a further rotation about at least the secondary axis (X5) of rotation, transversal to the main axis (X2) of rotation;
- a movement device (7) connected to the gripper (6) for moving the gripper (6) between a first non-operating open position for receiving or
25 release and a near operating position for retaining the piece (1) of filter material.

6. The machine according to claim 5, wherein each gripping element (3) comprises a tower (8) for supporting the gripper (6).
30

7. The machine according to claim 5 and 6, wherein the movement

device (7) is connected to the gripper (6) along the secondary axis (X5) of rotation, transversal to the main axis (X2) of rotation.

8. The machine according to any one of claims 5 to 7, wherein each
5 gripper (6) comprises at least two plates (6a, 6b) facing each other for gripping the piece (1) of filter material and a corresponding arm (9a, 9b) for supporting each gripping plate (6a, 6b); each arm (9a, 9b) being articulated on the supporting tower (8) and connected to the movement device (7) in such a way as to rotate the two plates (6a, 6b) between the
10 open, non-operating position, with the plates (6a, 6b) spaced apart, and the near operating position, with the plates (6a, 6b) moved towards each other, for gripping the piece (1) of filter material.

9. The machine according to any one of claims 5 to 8, wherein each
15 articulation element (5) comprises:
- a gear wheel (10) keyed rotatably, by a first shaft (11) positioned coaxially to the secondary axis (X5) of rotation, to the supporting tower (8);
- a first motion transmission unit (12) connected by a kinematic mechanism between the gear wheel (10) and a first cam means (13) for
20 controlling the rotation of the tower (8) and positioning the gripping element (3) and the corresponding piece (1) of filter material with its longitudinal axis (X1) of extension from a position transversal to the main axis (X2) of rotation to a position parallel to the main axis (X2) of rotation at least at the at least one operating station (4), and vice versa, along at
25 least one stretch of the operating path (P) in the closed circular trajectory of the movement carousel (2).

10. The machine according to any one of claims 5 to 9, wherein on
each tower (8) are operatively positioned means (140) for temporarily
30 retaining a tie string (1g) for preparing a stretch of the tie string (1g) inside the space formed by the plates (6a, 6b) of the gripper (6) in the first open,

non-operating position.

11. The machine according to any one of claims 5 to 10, wherein each movement device (7) comprises, inside the supporting tower (8):

- 5 - a main gear wheel (15) keyed to an arm (9a or 9b) of the gripping element (3);
- a satellite gear wheel (16) keyed to the other arm (9b or 9a) of the gripping element (3);
- a second shaft (17) positioned coaxially to the secondary axis (X5) of rotation; the second shaft (17) being equipped, on a relative cylindrical portion, with a plurality of circular compartments formed from a corresponding series of annular slits (18) equidistant along the second shaft (17) and on which it is meshed on the main gear wheel (15) with the possibility of rotation about the secondary axis (X5) of rotation;
- 15 - a second motion transmission unit (19) connected between the second shaft (17) and a second cam means (20) for controlling the translation, in both directions, of the second shaft (17) along the secondary axis (X5) of rotation in such a way as to allow the rotation of the two plates (6a, 6b) between the open, non-operating position, with the plates (6a, 6b) spaced
- 20 apart, and a near operating position, with the plates (6a, 6b) moved towards each other, for gripping the piece (1) of filter material.

12. A method for making filter bags for infusion products starting from pieces (1) of filter material each containing at least one dose of infusion product and having, the pieces (1), a corresponding longitudinal axis (X1)

- 25 of extension, comprising the following steps:
 - feeding pieces (1) of filter material being formed to a movement carousel (2) having a plurality of elements (3) for gripping the pieces (1) of filter material; the carousel (2) rotating about a main axis (X2) of rotation;
 - rotating the pieces (1) of filter material about the main axis (X2) of rotation, positioned, with the relative longitudinal axis (X1), transversal to
 - 30 the main axis (X2) of rotation, and retained by corresponding gripping

means (3);

- rotating further the pieces (1) of filter material about corresponding secondary axes (X5) rotation, transversal to the main axis (X2) of rotation; and

- 5 - placing the pieces (1) of filter material with the corresponding longitudinal axis (X5) of extension parallel to the main axis (X2) of rotation at least at an operating station (4) configured to perform at least one operation on at least one of the pieces (1) of filter material being formed, retained by a corresponding gripping element (3).

10

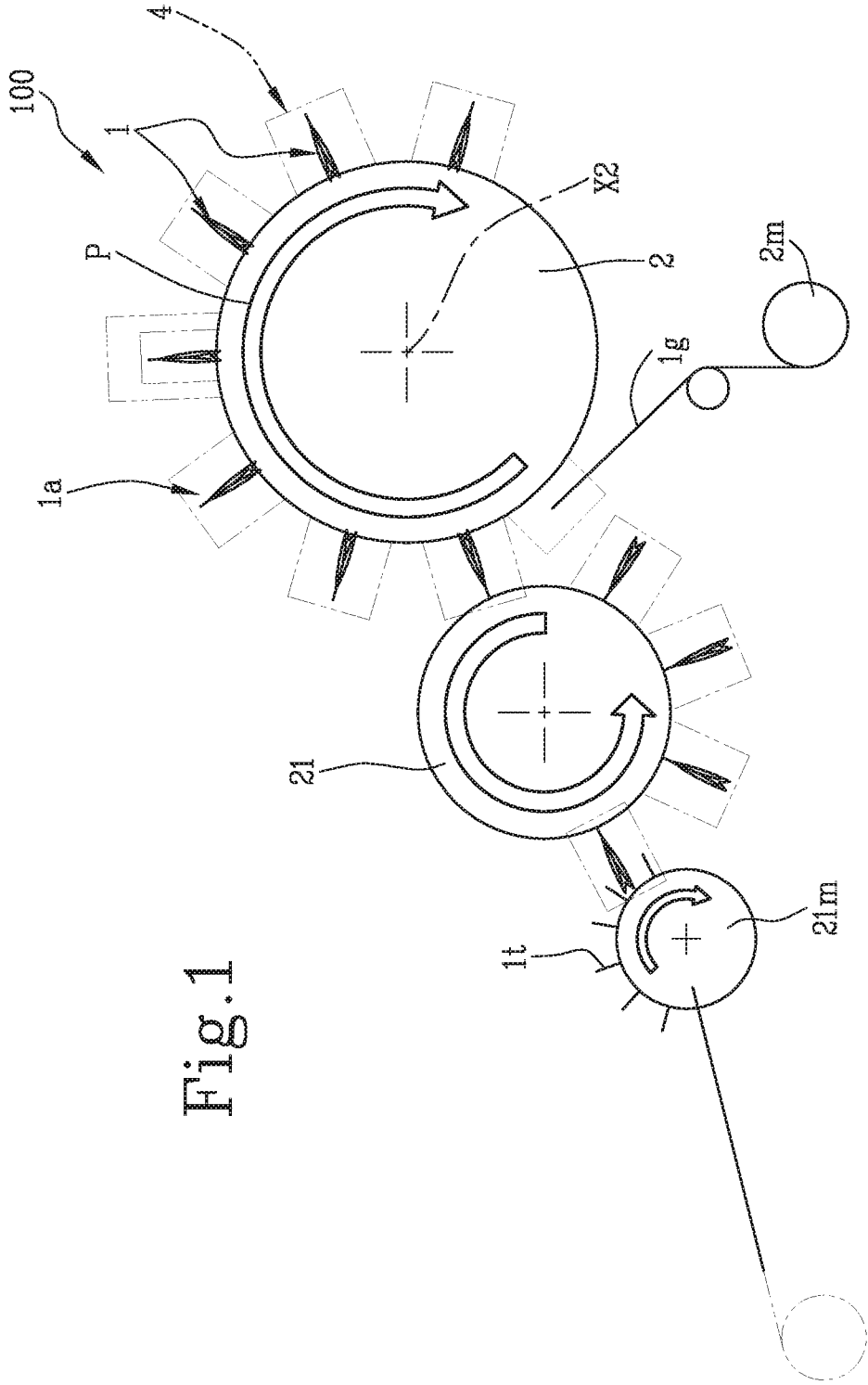


Fig.1

Fig. 2

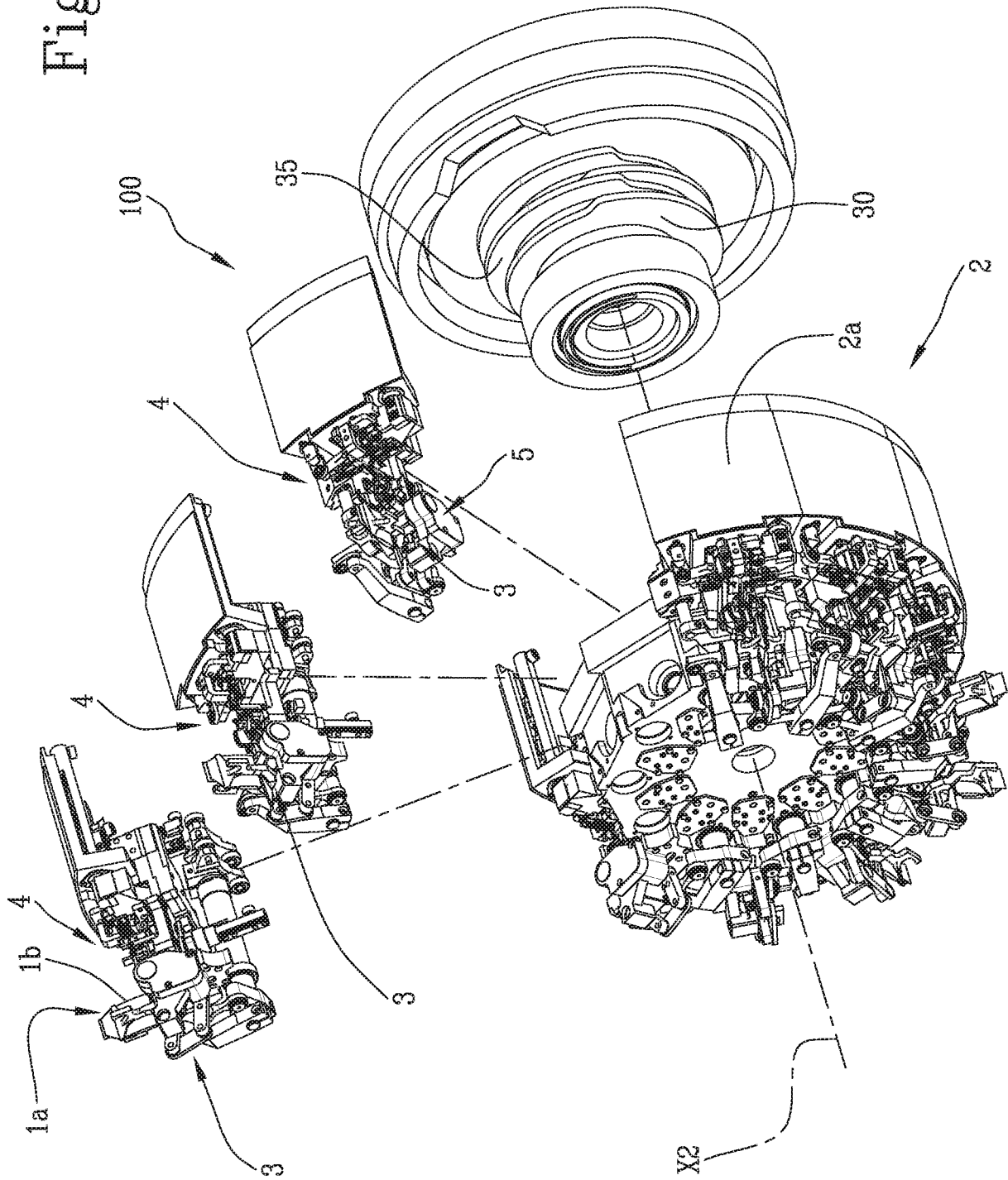


Fig. 3

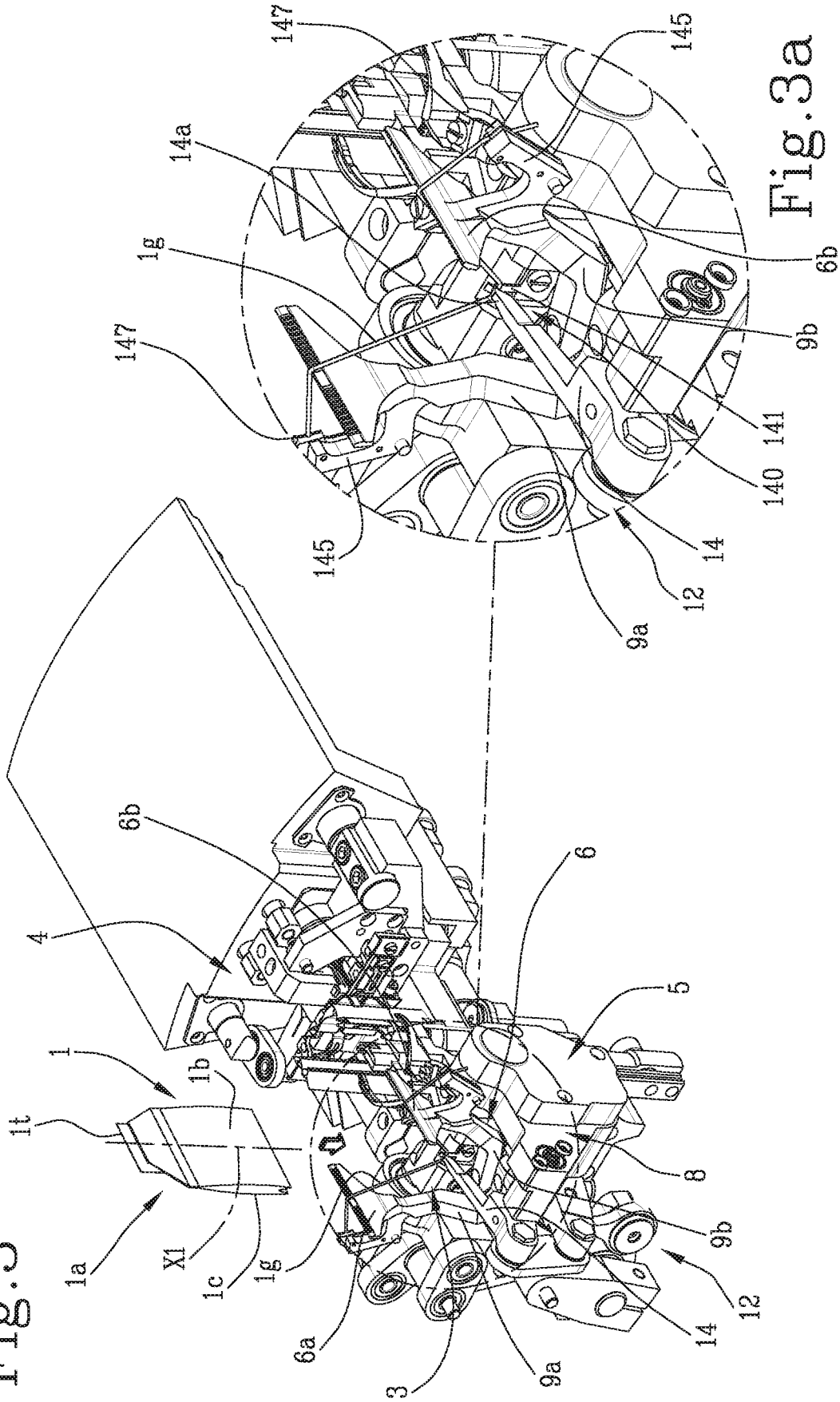


Fig. 3a

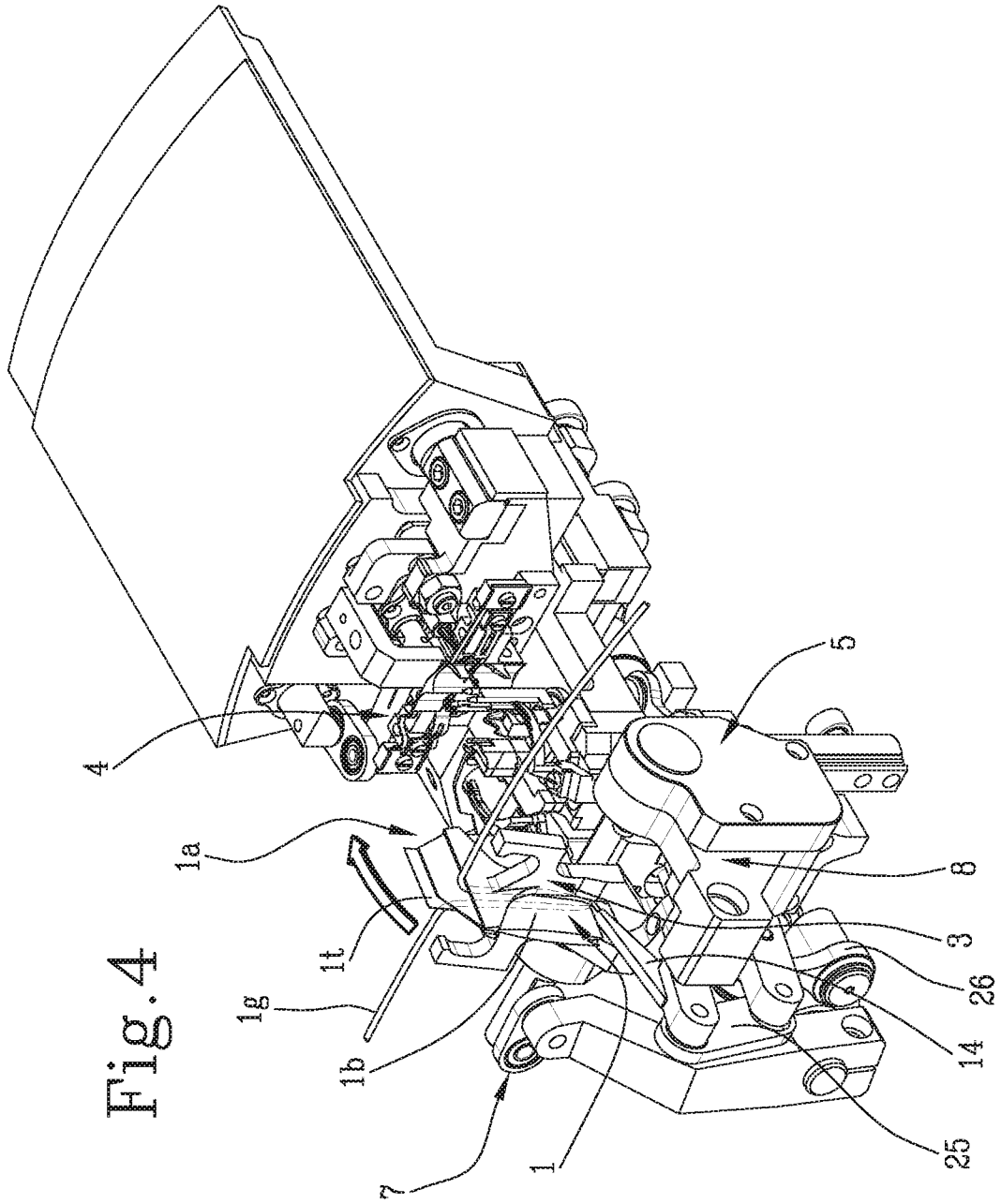


Fig. 4

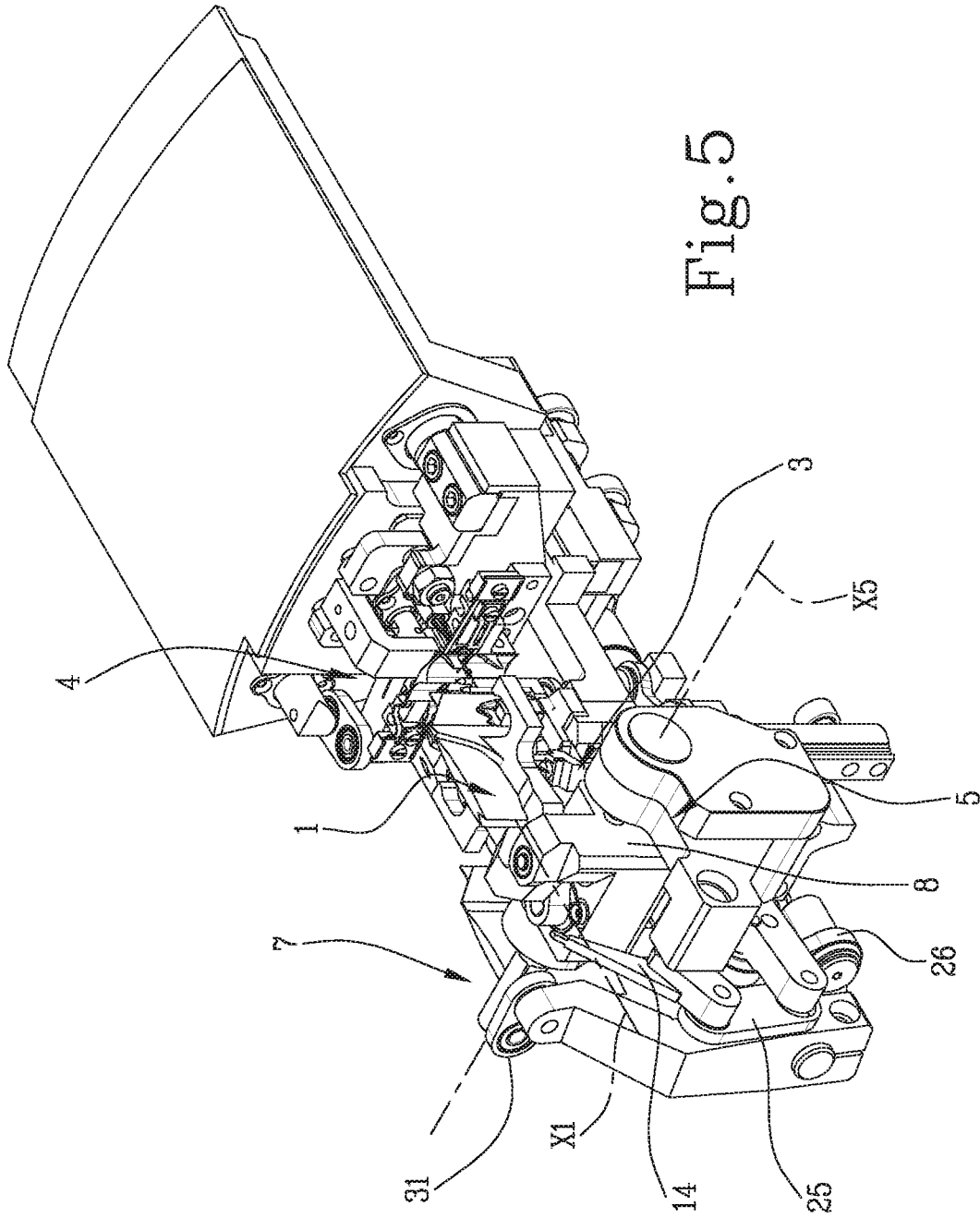


Fig. 5

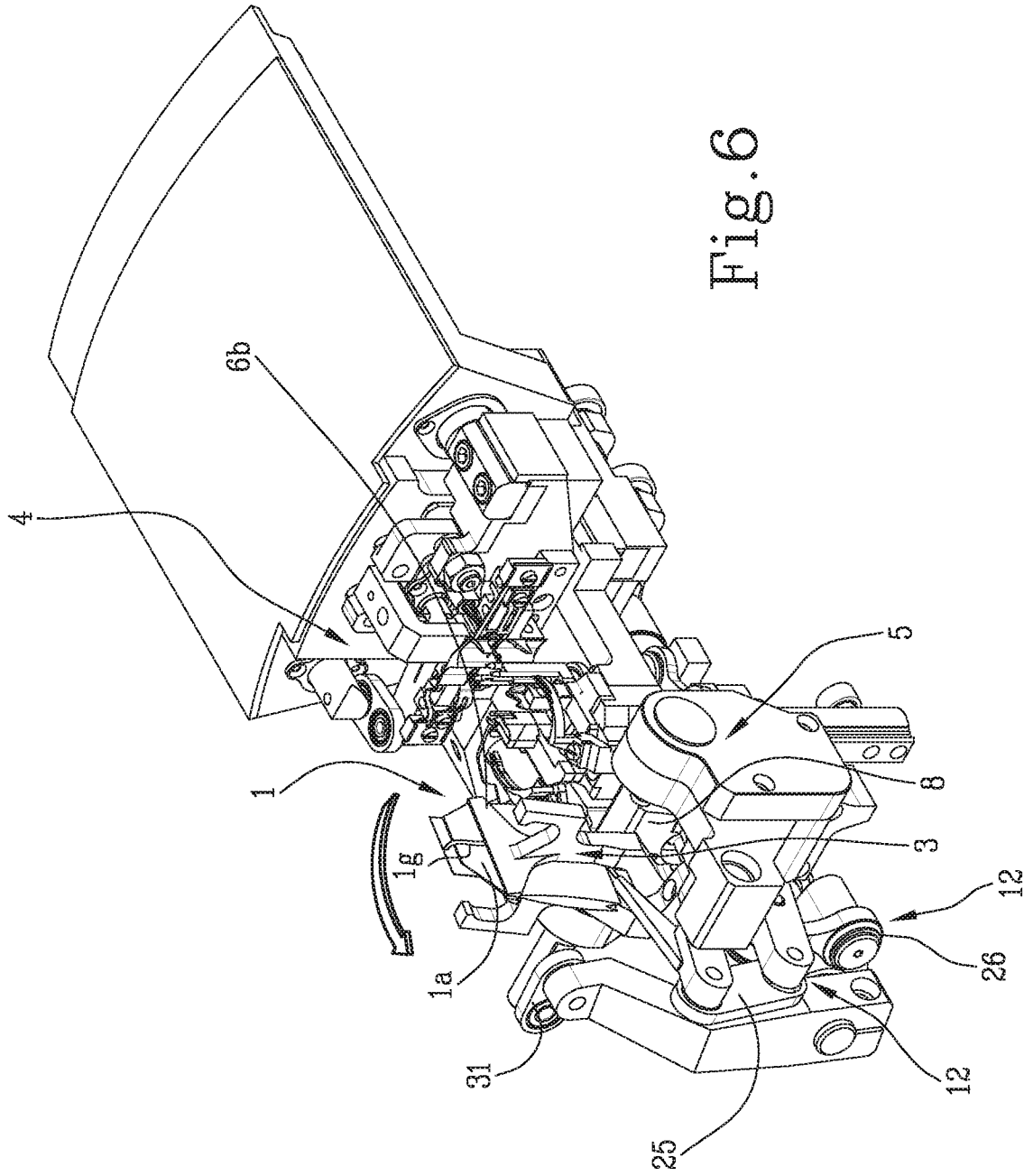


Fig.6

Fig. 7

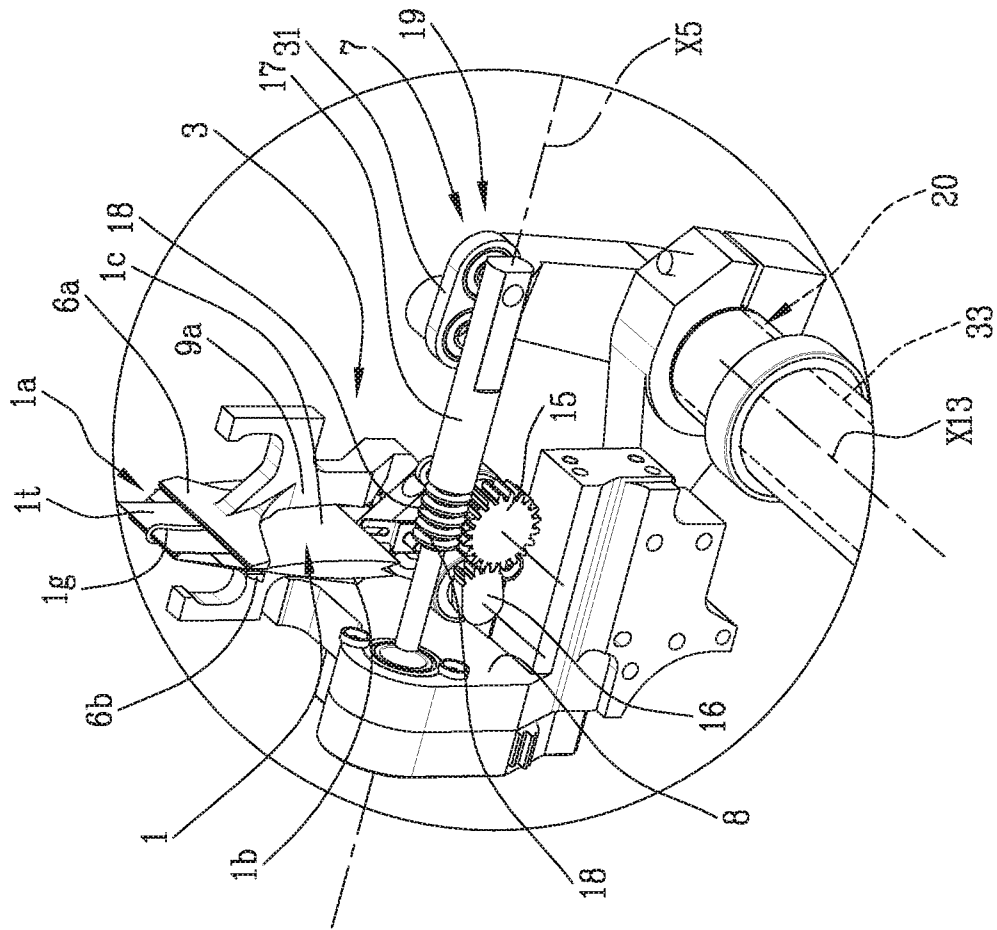
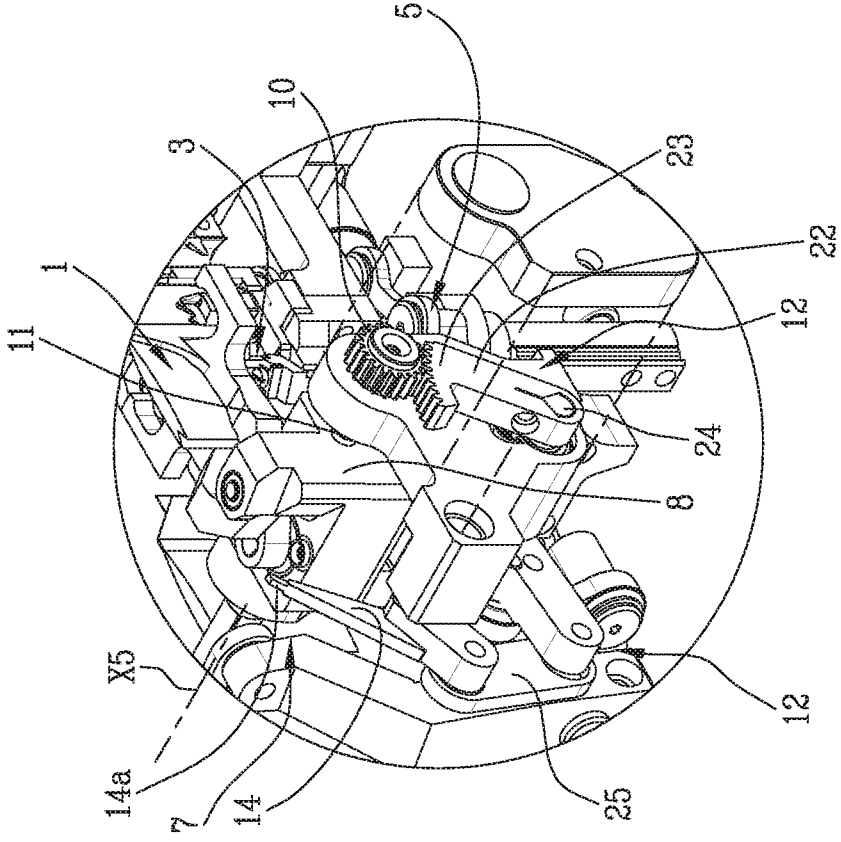


Fig. 8



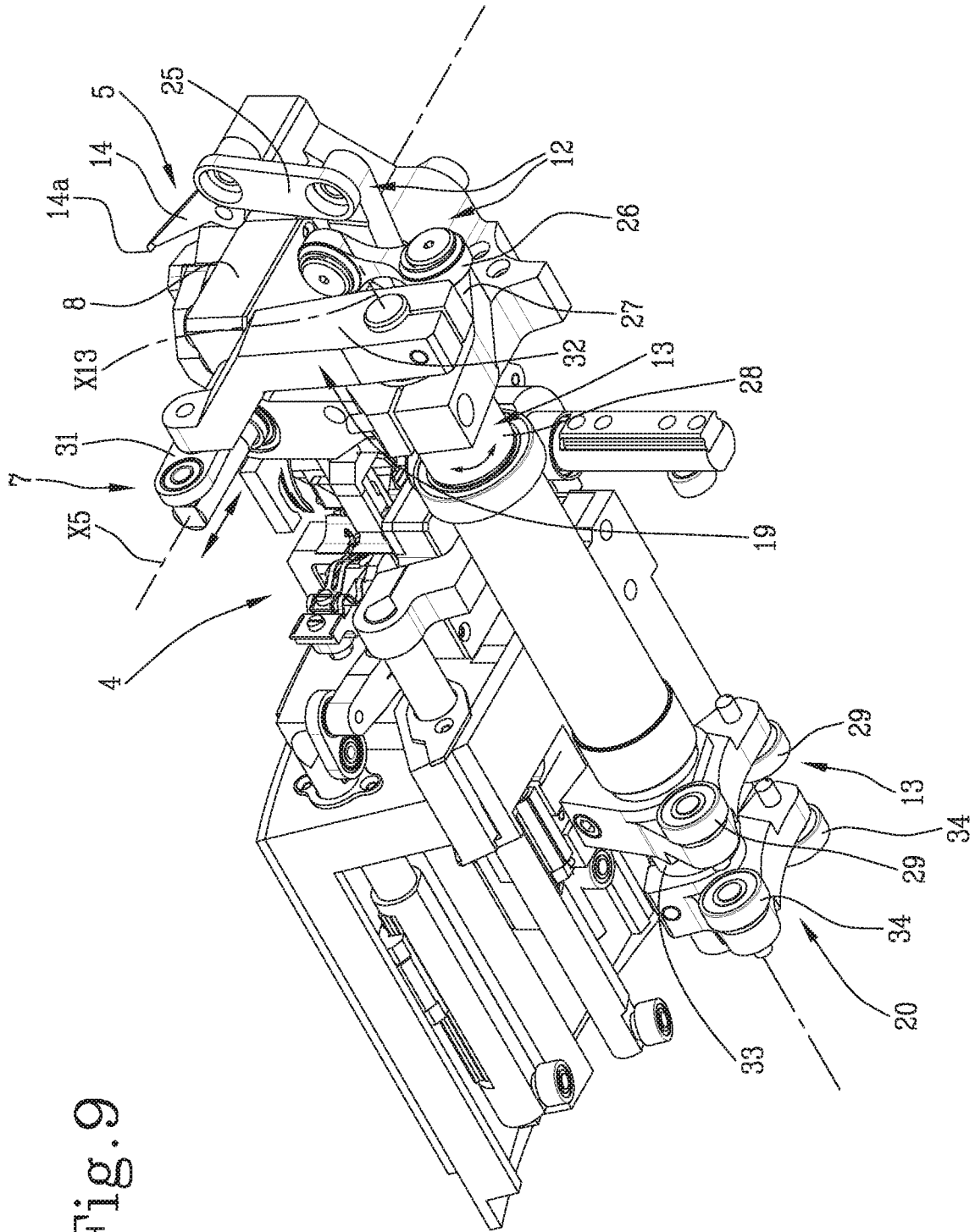
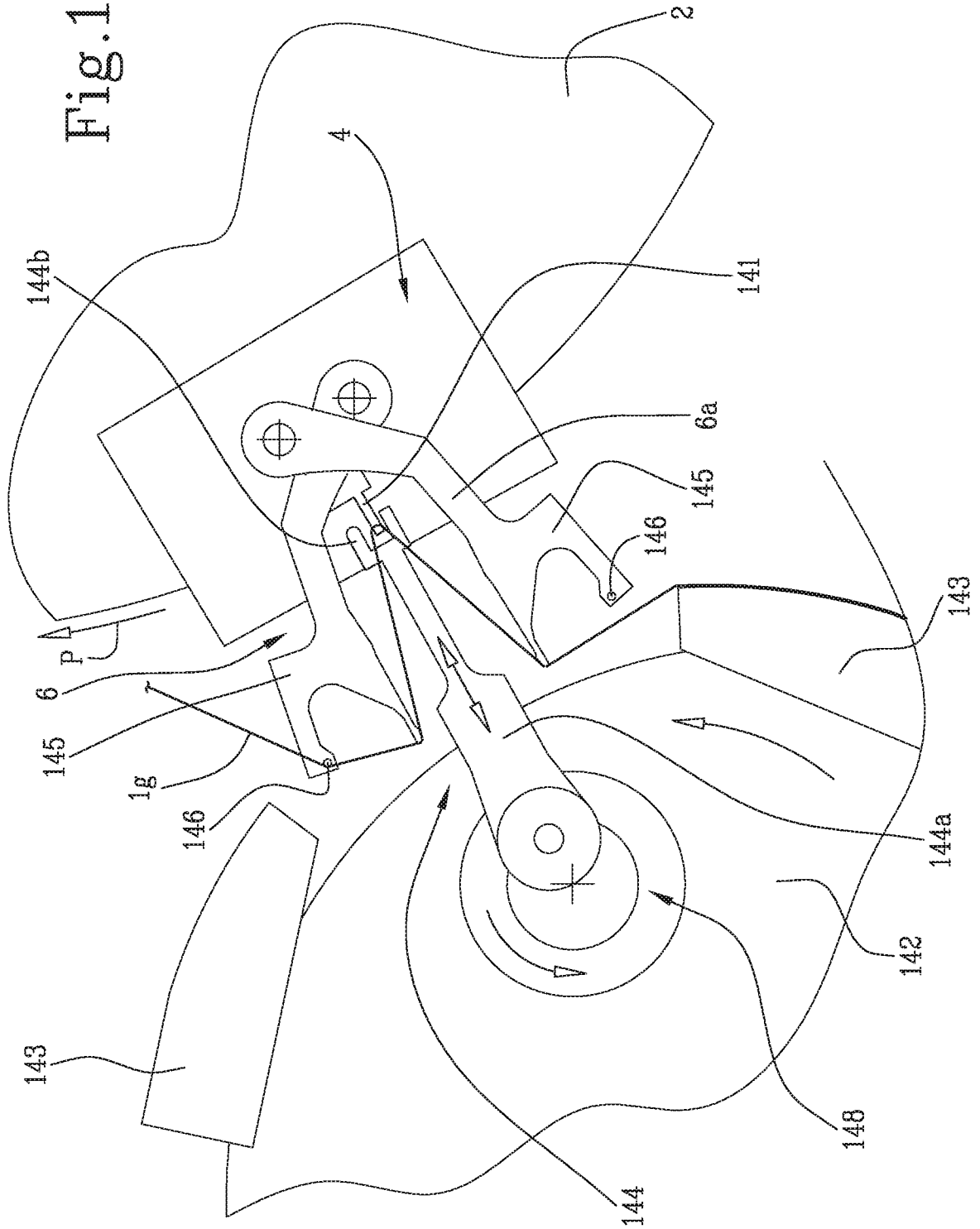


Fig. 9

Fig.10



INTERNATIONAL SEARCH REPORT

International application No PCT/IB2018/051436

A. CLASSIFICATION OF SUBJECT MATTER INV. B65B29/04 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B65B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 384 665 A1 (TECNOMECCANICA SRL [IT]) 28 January 2004 (2004-01-28) paragraph [0043] - paragraph [0061]; figures 14,19,20 -----	1-12
A	EP 0 765 274 B1 (IMA SPA [IT]) 8 March 2000 (2000-03-08) cited in the application paragraph [0016] - paragraph [0021]; figures 1-13 -----	1-12
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents :		
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
Date of the actual completion of the international search	Date of mailing of the international search report	
17 April 2018	04/05/2018	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Ngo Si Xuyen, G	

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Information on patent family members

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