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(72) Inventors:
• **Saletti, Lamberto**
53049 Torrita di Siena (Siena) (IT)
• **Broccolini, Giovanni**
52044 Cortona (Arezzo) (IT)

(74) Representative: **Bardini, Marco Luigi et al**
Corso dei Tintori, 25
50122 Firenze (IT)

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(71) Applicant: **Europrogetti S.r.l.**
53048 Sinalunga SI (IT)

(54) **Folding device and method for erecting boxes starting from T-shaped or double-T-shaped flat blanks**

(57) An apparatus for forming boxes starting from flat blanks (F) comprises an erecting station wherein the blanks (F), fed along a horizontal feeding direction (Y), are subjected to the action of a mandrel (101), movable vertically and adapted to push the blanks (F) against fixed folding means (104), arranged in proximity to the lower end of the run of the mandrel. The erecting station comprises a folding device with movable folding means (9) rotating on respective vertical planes, parallel to said

feeding direction (Y), adapted to interfere with respective lateral flaps (F1, F2, F3, F4) of a T-shaped or double-T-shaped blank (F) to cause folding along longitudinal folding lines thereof, i.e. parallel to said feeding direction (Y), the device further comprising, or being associated to, further fixed folding means (103) adapted to engage with the blanks to perform, in an initial step of downward movement of the mandrel (101), foldings along transverse lines, consequently allowing the rotating folding means (9) to engage with the lateral flaps (F1, F2, F3, F4).

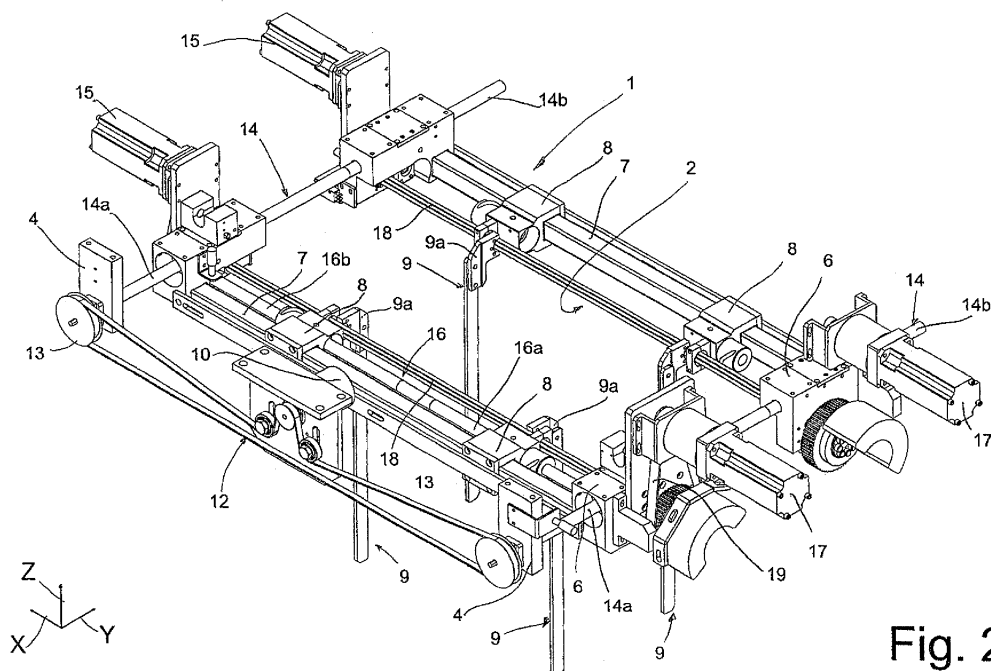


Fig. 2

Description

[0001] The present invention regards the field of the box erecting apparatuses.

[0002] A known box erecting apparatus is disclosed in Italian patent application n° B02004A0000338 filed on June 21, 2004, in the name of the same applicant of the present application, herein incorporated by reference. In brief, the apparatus comprises a storage station of flat blanks, or die-cuts, made of card material, from which the blanks are fed one by one, translating on a horizontal plane along a feeding direction, to an erecting station. In such station, the blank is subjected to the action of a so-called "mandrel" or "mould" vertically movable in a reciprocating manner and consisting in a block having a shape corresponding to the box to be erected.

[0003] The folding of the blank around the mandrel, along both transverse and longitudinal folding lines with respect to the above mentioned feeding direction, then occurs by engagement with underlying and fixed folding means, against which the blank abuts, pressed in a top-bottom direction by the same mandrel. The vertical corners of the box being erected are joined in correspondence with the folding means, by applying lengths of heat adhesive tapes. Then, the mandrel is lifted with the box arranged therearound, the slipping off of the box from the mandrel, and eventually the exit of the box from the erecting station in a horizontal direction, on the opposite side with respect to the feeding side.

[0004] In case of parallelepiped boxes, the blank is usually cross-shaped, or T-shaped or even double-T-shaped. The latter two mentioned formats are the preferred ones in case of deep boxes, i.e. boxes having one or two dimensions greatly prevailing with respect to a third dimension. With such formats, the above described erecting method may give rise to drawbacks, especially related with accuracy of the result. In particular, it is difficult to obtain an accurate folding of the lateral flaps of the T (or double T), i.e. the flaps intended to form (possibly being mutually overlapped in the case of the double T) the two opposite side walls of the box having a smaller surface area.

[0005] The object of the present invention is to provide, in a box erecting apparatus of the above referred kind, a new folding device and method capable of solving the above described problem, ensuring an entirely accurate folding in case of T-shaped or double-T-shaped blanks used for producing boxes of the deep type.

[0006] This object is achieved with a folding device and method for erecting boxes starting from T-shaped or double-T-shaped flat blanks, the essential characteristics of which are defined, respectively, by the attached claims 1 and 15.

[0007] The characteristics and advantages of the folding device and method for erecting boxes starting from T-shaped or double-T-shaped flat blanks according to the present invention will be apparent from the following description of an embodiment thereof, provided for ex-

emplifying and non-limiting purposes with reference to the attached drawings wherein:

- figure 1 represents a perspective view of a device according to the invention, in a stand-by configuration;
- figure 2 is a perspective view of the device of figure 1, in a working configuration; and
- figures 3a - 3h schematically represent respective successive steps of a box-erecting operation, using the device according to the invention.

[0008] With reference to said figures, the device according to the invention is used within a box erecting apparatus having overall characteristics corresponding to those of the prior art (for example of the apparatus disclosed in the Italian patent application mentioned in the introductory part), and thus neither illustrated nor described in detail. It is sufficient to point out that the device is arranged in the erecting station, over the area in which the flat blank F is positioned, awaiting to undergo the action of the mandrel. The latter, indicated at 101 and schematically represented only in figures 3a-3h, described in detail further ahead, works moving in a reciprocating manner along a vertical direction Z. The device has a generally quadrilateral framework 1 lying on a horizontal plane, i.e. orthogonal to the axis Z, which delimits a window 2 for the passage of the mandrel.

[0009] More in detail, the framework 1 comprises a pair of parallel and spaced fixed crosspieces 3 integral with respective plates 5 connected to the bearing structure of the apparatus. The crosspieces 3 and the plates 5 are omitted in figure 2 for the sake of illustrative clarity. The two crosspieces 3 are elongated in a direction indicated at Y, parallel to the direction along which the flat blank F is fed to the erecting station. Each crosspiece 3 slidably supports a pair of blocks 6, which in turn bear respective ends of two movable crosspieces 7, square sections elongated in a mutually parallel manner along a direction X orthogonal to the direction Y. The fixed and movable crosspieces 3, 7 thus define the sides of the framework structure 1, delineating the window 2.

[0010] The movable crosspieces 7 serve as guides for respective pairs of sliders 8, sliding therefore along the direction X. Each slider 8 pivotally supports the end of a folding blade 9, in such a manner that the latter rotates over the plane defined by the directions YZ. The rotation occurs between a lifted position, or stand-by position, in which the blade is extended horizontally, along the direction Y, in an arrangement substantially coplanar to the framework 1 and pointing outwards with its free end (figure 1), and a working position wherein it is rotated downwards, up to about 90°, or even beyond, with respect to the previous arrangement (figure 2). In the illustrated embodiment, the blades are made up of plate sections, with a square member 9a at the connection end, for spacing the rotation center from the longitudinal axis of the section, in such a manner that the lifted horizontal position

is allowed without mechanically interfering with other parts of the device.

[0011] The three movements of the device, i.e. the movement of the blocks 6 along the fixed crosspieces 3, the movement of the sliders 8 along the movable crosspieces 7, and the rotation of the folding blades 9 with respect to the sliders 8, are driven by respective independent drive means, controlled by the control system of the apparatus in a - *per se* - obvious manner. The first two above mentioned movements are mainly (but not exclusively, as clarified further on) adjustment movements, serving first of all to adjust the position of the folding blades depending on the size of the box under process, while the third movement is the actual working movement, i.e. serving for the folding operations, as better observed hereinafter.

[0012] In detail, the shifting movement of the blocks 6 along the axis Y is driven by a first motor 10, mounted on a support 11 integral with the apparatus bearing structure (not shown), which by means of a belt transmission system 12 drives two pulleys 13, rotating on the outside of respective brackets 4, and integrally coaxial with two first threaded bars 14 extended beneath respective fixed crosspieces 3. The pulleys 13 and the first threaded bars 14 are supported by the brackets 4, which in turn are integral with the apparatus bearing structure. The bars 14 each have threaded end portions 14a, 14b, with mutually opposite twist directions of the threads, with which the blocks 6 are engaged via suitable holes formed therein. In such manner, the rotation of the bars in one direction or the other corresponds to moving the four blocks 6, two by two, towards or away from each other along the fixed crosspieces 3.

[0013] The sliding of the sliders 8 along the movable crosspieces 7 is then driven by a couple of second motors 15 mounted in cantilever fashion on respective blocks 6 of a same fixed crosspiece 3 (the one on the left in the representation of figures 1 and 2), and projecting outwards. Each second motor 15 drives, by means of a transmission belt not shown, a second threaded bar 16 (not represented along one of the two sides, for the sake of clarity, in figure 2) extending between one block and the opposed block, and being arranged adjacent to the respective movable crosspiece. Analogously to the first threaded bars, the second bars 16 each have threaded end portions 16a, 16b with mutually opposite twist directions of the threads, on which the sliders 8 are engaged, in such a manner that the rotation of the bars corresponds to the motion of the four sliders 8, two by two, towards or away from each other along the movable crosspieces 7.

[0014] Finally, third motors 17 are associated with the other two blocks 6 (on the right in figures 1 and 2), in a substantially symmetrical manner with respect to the second motors 15. Each third motor drives, also in this case by means of a belt transmission 19, the rotation of a quadrangular section 18, rotatably supported, just like the relevant second threaded bar 16, between two opposite

blocks 6, and adjacent to such bar, displaced inwards. Each section 18 materializes the rotation axis of the two folding blades 9 arranged along the corresponding movable crosspiece. In fact, the section 18 rotates integrally with the two relevant square elements 9a, on which suitable seats are formed for the insertion of the section. On the contrary, mutual sliding between the section and the square elements is permitted.

[0015] With particular reference to figures 3a - 3h, the process of folding a flat blank F using the device according to the invention is as follows. In the example, the blank F is a double-T-shaped blank, with lateral flaps F1 and F2 (on one side), F3 and F4 (on the other side) projecting along longitudinal pre-formed folding lines (longitudinal with respect to the feeding direction), from a central band on which three foldably consecutive regions F5, F6 and F7 are identifiable. The central intermediate region F6 represents the one intended to provide a bottom of the box, from which there will be erected two main flat walls (regions F5 and F7), and two smaller side walls, obtained by overlapping the flaps F1 and F2 (on a side) and the flaps F3 e F4 (on the opposite side).

[0016] The flat blank F is fed to the erecting station, beneath the device according the invention, whose folding blades 9 are suitably adjusted in position depending on the shape of the box, and they are initially in a lifted position (figure 3a). In such figure the box-erecting mandrel 101 is shown, reciprocatingly movable along the direction Z, through the window 2 defined by the framework 1. A plate 102 for supporting the blank, in turn reciprocating along the direction Z, is conventionally provided with suction means for holding the blank itself, and has a profile congruent with the outline of the box bottom region F6, such region being positioned precisely in correspondence with the plate 102 aligned with the mandrel 101.

[0017] The mould 101 thus knocks down the blank, and at the same time the plate 102 undergoes a first, slight lowering (figure 3b). Such lowering, due to a couple of fixed abutment pieces 103 arranged adjacent to the plate 102 in such a manner to engage with the central regions F5 and F7, has the effect of causing the folding of this latter regions upwards, closing on the mandrel 101. At this point, as shown in figures 3c - 3f, the folding blades 9 drop in succession in such a manner to abut on the lateral flaps and bend them on the mandrel 101, in particular, on the side shown in the figures, firstly on flap F1 (the blade 9 on the left), then on flap F2 (the blade on the right). Side walls, with double layer, of the box are thus formed by overlapping the above mentioned flaps. In order to make steady the configuration of the box right from this step, a glue coating may be spread, during the blank feeding step, on the lower surface of the flaps F1 and F3 intended to remain on the inside.

[0018] Upon completion of this step, the mandrel 101, and the plate 102 therewith, is pushed further downwards (figure 3g), making the folding blades slip out of the box and bringing the same box to interfere with underlying

fixed folding means 104, arranged in proximity to the end of the run of the mandrel. The folding means 104, only schematized in the figure, may comprise pressure elements working on the side walls to improve the adhesion of the glue, and in any case they have the effect of compacting the box around the mandrel, conferring a stable and accurate form thereto, substantially according to equivalent methods already provided for by the prior art. In this step a further and definite consolidation of the box is also obtained by applying, on the corners, lengths of heat-adhesive tape, according to the known techniques.

[0019] To complete the erecting step (figure 3h), the plate 102 rises again up to the initial position, the mould 101 rises further, slipping off the box, and the latter is eventually removed - freeing the station preparing for the arrival of a new blank - by extraction means 105, also of the known type. In the meanwhile, also the folding blades 9 have been lifted, returning to the stand-by position.

[0020] In an entirely analogous manner, a T-shaped blank may be folded instead of a double-T-shaped blank, simply by actuating only one pair of folding blades instead of both, and thus without overlapping two flaps on respective side walls of the box.

[0021] From the above description, it will be understood that, due to the folding device and method according to the invention, it is made possible to perform an actually accurate erection of T-shaped or double-T-shaped blanks for obtaining deep boxes in an entirely reliable manner. The tuck-in action of the folding blades, whose position is adjustable in a highly precise manner, ensures maximum quality of the result, both in terms of the folding accuracy along the entire extension of the fold, and in ensuring a correct closure and extension of the lateral flaps over the complete development of the faces of the mandrel.

[0022] Furthermore, the blades 9 may be used as actual mechanical and automatic "fingers" to obtain further effects, for example withholding the box when slipping off the mandrel thereof during the final step of the erection, so as to prevent the mandrel itself from withholding the box, due to friction, in its upwards movement. The blades may even be used, after the slipping of the box off the mandrel and before the sideways extraction, to realize a certain shaping of the box, to compensate the natural, slight external bulging of the walls, inevitably present following the folding operations. Such functionalities shall be performed by suitably exploiting the movements of the blocks 6 and the sliders 8, thus such movements, as previously mentioned, also become working and not only adjustment movements. On the other hand, also during the folding operation previously described in detail, movements of the blades according to axes X and Y shall be used to assist and/or improve the performance of various steps, for example slightly pushing the blades against the mandrel in such a manner to stretch the lateral flaps on the mandrel itself in the most efficient manner.

[0023] The folding device and method for erecting boxes starting from T-shaped or double-T-shaped flat blanks

according to the present invention may be subjected to numerous variants and/or modifications without departing from the scope of protection of the invention itself as defined by the appended claims. In particular, the shape of the folding blades, and the respective adjustment/drive systems may undergo even substantial construction modifications, as long as it ensures an equivalent overall functionality. The term "blade" shall not be deemed restrictive, in that generally extended elements capable of ensuring the required folding function may be used.

[0024] In practice, the employed materials, as long as compatible with the specific use, as well as the dimensions, may vary depending on the requirements and according to what already present in the state of the art.

[0025] Where any of the characteristics and techniques described in any of the claims are followed by reference signs, these have been included for the purpose of providing examples simply to increase the clarity of the claims and, consequently, they have no limiting effect on the interpretation of each element they identify..

Claims

1. An apparatus for erecting boxes starting from flat blanks (F), said apparatus comprising an erecting station wherein the blanks (F), fed along a horizontal feeding direction (Y), undergo the action of a mandrel (101), movable vertically and adapted to push said blanks (F) against fixed folding means (104), arranged in proximity to the lower end of the run of the mandrel, **characterized in that** said erecting station comprises a folding device comprising movable folding means (9) rotating over respective vertical planes, parallel to said feeding direction (Y), adapted to engage with respective lateral flaps (F1, F2, F3, F4) of a T-shaped or double-T-shaped blank (F) to cause folding along longitudinal folding lines thereof, that is folding lines parallel to said feeding direction (Y), the device further comprising, or being associated with, further fixed folding means (103) adapted to engage with said blanks to carry out, in an initial step of downward movement of said mandrel (101), a folding of the blank along transverse lines, consequently allowing said rotating folding means (9) to engage with said lateral flaps (F1, F2, F3, F4).
2. The apparatus according to claim 1, wherein said rotating folding means comprise at least one pair of folding blades (9) rotating around a common horizontal rotation axis, between a lifted, horizontal or substantially horizontal position, and a working position rotated downwards, the two rotation planes of said blades (9) being mutually spaced in such a manner that the same blades are adapted to engage with said lateral flaps (F1, F2, F3, F4) of said blank, drive means for driving the rotation of said blades (9) being further provided.

3. The apparatus according to claim 2, wherein said rotating folding means comprise two pairs of said folding blades (9), arranged respectively on two horizontal rotation axis, mutually parallel and transverse with respect to said blank feeding direction (Y), each blade (9) being pivoted at a first end (9a), and being adapted to rotate towards said lifted position in such a manner to point the second end outwards and away with respect to the corresponding blade of the opposite pair.
4. The apparatus according to claim 2 or 3 wherein, in each pair, said blades (9) are pivotally supported by respective sliders (8) adapted to slide along a guide crosspiece (7) extending orthogonally to the rotation planes of the blades themselves, whereby said planes are movable towards or away from each other, the device further comprising means (17) for driving said sliders (8).
5. The apparatus according to claim 4, wherein said crosspiece (7) is adapted to translate along said blank feeding direction (Y), the device further comprising means (10, 12) for driving the translation of said crosspiece (7).
6. The apparatus according to claim 3, wherein said blades (9) are pivotally supported by respective sliders (8) adapted to slide along two guide crosspieces (7), one for each pair of blades (9), extending orthogonally to the rotation planes of the blades themselves, whereby said planes are movable towards or away from each other, the device further comprising means (17) for driving said sliders (8).
7. The apparatus according to claim 6, wherein said guide crosspieces (7) are adapted to translate towards and away from each other along said blank feeding direction (Y), the device further comprising means (10, 12) for driving the translation of said crosspieces (7).
8. The apparatus according to claim 7, wherein said crosspieces (7) are supported at the ends by blocks (6) sliding along a pair of fixed crosspieces (3) extended horizontally, parallel to said feeding direction (Y), said fixed crosspieces (3) and said movable crosspieces (7) generally defining a quadrilateral framework (1) which delimits a passage (2) for said mandrel (101).
9. The apparatus according to claim 8, wherein said means for driving the translation of said movable crosspieces (7), comprise first motor means (10) which drive the rotation of first threaded bars (14) extending along respective fixed crosspieces (3) and each having two threaded end portions (14a, 14b) with mutually opposite twist directions of the threads, on which the respective blocks (6) are engaged.
10. The apparatus according to claim 8 or 9, wherein said means for driving said sliders (8) comprise a couple of second motor means (15) mounted on respective blocks (6) of the same fixed crosspiece (3) and each driving a second threaded bar (16) extending between a block (6) and the opposite block (6), adjacent to the respective movable crosspiece (7), the second threaded bars (16) each having threaded end portions (16a, 16b) with mutually opposite twist directions of the threads, on which the sliders (8) are engaged.
11. The apparatus according to any of claims 8 to 10, wherein said means for driving the rotation of said folding blades (9) comprise a couple of third motor means (17) associated with respective blocks (6), each driving the rotation of a quadrangular section (18), rotatably supported between two opposite blocks (6), each section (18) materializing the rotation axis of the two folding blades (9) arranged along the same corresponding movable crosspiece (7), and being integral with said blades (9), as far as the rotation is concerned, whereas mutual sliding between the section and the blades is permitted.
12. The apparatus according to any of the previous claims, wherein the connection end of each of said blades (9) is shaped in a square (9a), in such a manner to displace the rotation center from the longitudinal axis of the blade.
13. The apparatus according to any of the previous claims, comprising or associated to means for spreading glue on at least one of said lateral flaps (F1, F2, F3, F4).
14. The apparatus according to claim 13, comprising or associated to pressure elements adapted press at least the side walls of the erected box obtained from mutual overlapping of said lateral flaps (F1, F2, F3, F4), during the movement of said mandrel (101).
15. A method for erecting a box starting from a T-shaped or double-T-shaped flat blank (F), fed along a horizontal feeding direction (Y) and comprising central regions (F5, F6, F7) foldably consecutive along transverse folding lines, and lateral flaps (F1, F2, F3, F4) projecting from said central regions along longitudinal bending lines, i.e. parallel to said feeding direction (Y), wherein said blank undergoes to the action of a mandrel (101) movable vertically to push the blank (F) against fixed folding means (104) arranged in proximity to the lower end of the run of the mandrel, **characterized in that** in a first initial step of the downward movement of said mandrel, the blank (F) is pushed to engage with further fixed fold-

ing means (103) to carry out a folding of the blank along said transverse lines, and subsequently said lateral flaps (F1, F2, F3, F4) undergo longitudinal foldings along said longitudinal folding lines, thanks to movable folding means (9) rotating over respective vertical planes, parallel to said feeding direction (Y). 5

16. The method according to claim 15, wherein said rotating folding means comprise at least one pair of folding blades (9) rotating around a common horizontal rotation axis, between a lifted, horizontal or substantially horizontal position, and a working position rotated downwards, the two rotation planes of said blades (9) being mutually spaced in such a manner that the same blades are adapted to engage with said lateral flaps (F1, F2, F3, F4) of said blank, said mandrel (101) continuing its movement downwards after the folding of said lateral flaps with said blades (9) in the working position. 10 15 20

17. The method according to claim 16, wherein said rotating folding means comprise two pairs of said folding blades (9), arranged respectively on two horizontal rotation axis, mutually parallel and transverse with respect to said blank feeding direction (Y), each blade (9) being pivoted at a first end (9a), and being adapted to rotate towards said lifted position in such a manner to point the second end outwards and away with respect to the corresponding blade of the opposite pair. 25 30

18. The method according to claim 17, wherein the blades (9) of a first pair and the blades (9) of a second, opposite pair are driven in succession to fold and overlap said lateral flaps. 35

19. The method according to any of claims from 16 to 18, wherein said blades are also translated along said feeding direction (Y) and/or in a horizontal direction (X) orthogonal to said feeding direction (X) to exert a pressure on said central regions or on said flaps after the folding. 40

20. The method according to any of claims from 16 to 19, wherein said blades (9) are used for withholding the erected box when slipping said mandrel (101) off in a final step of the erecting operations. 45

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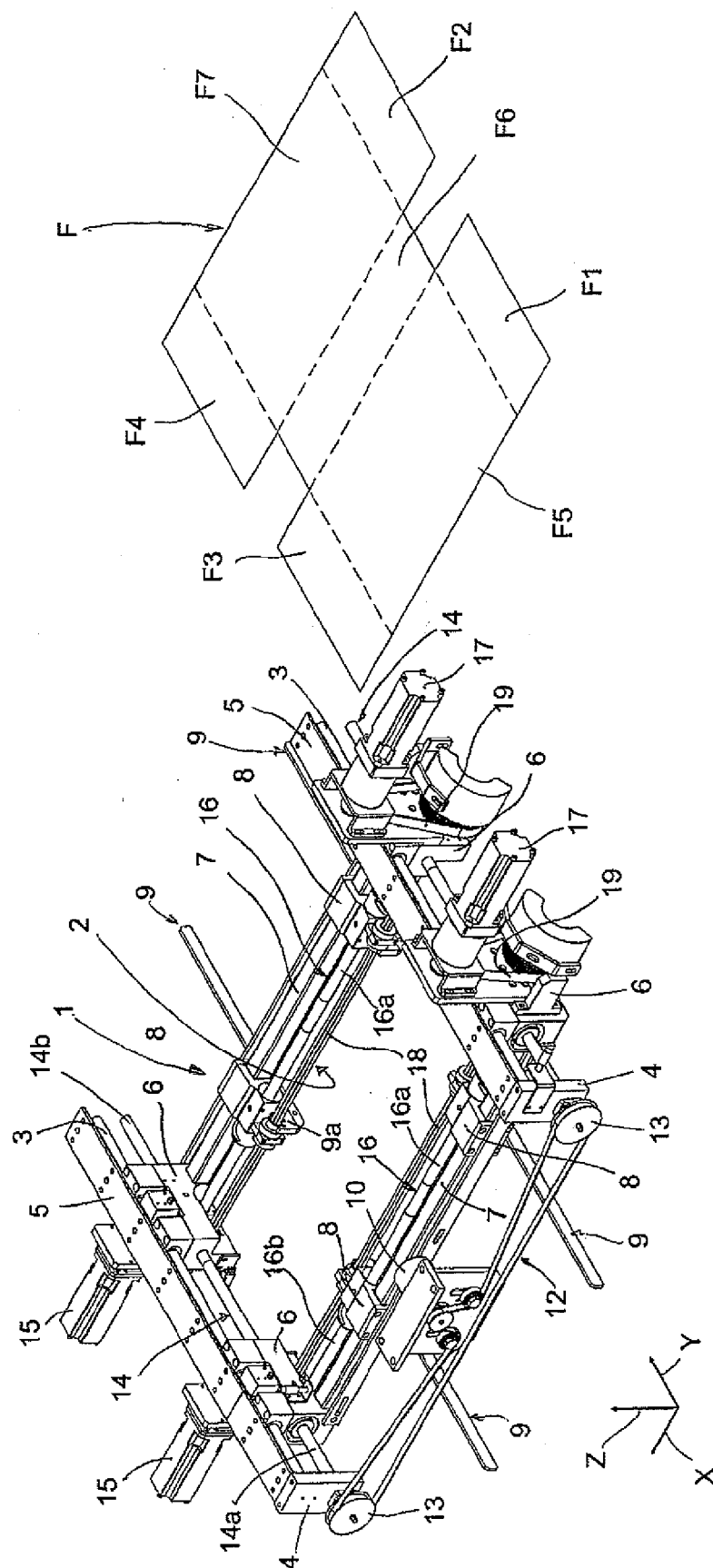


Fig. 1

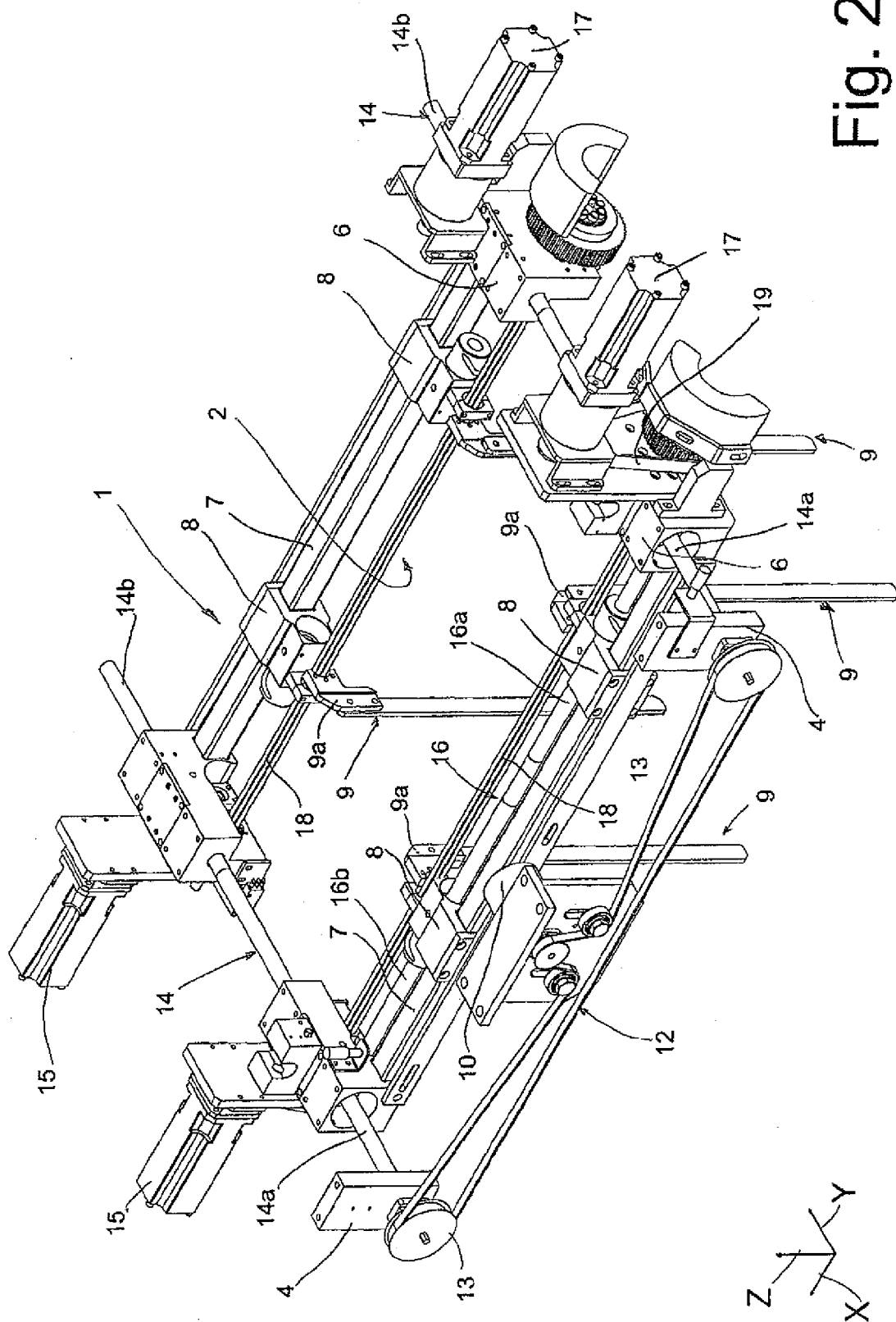


Fig. 2

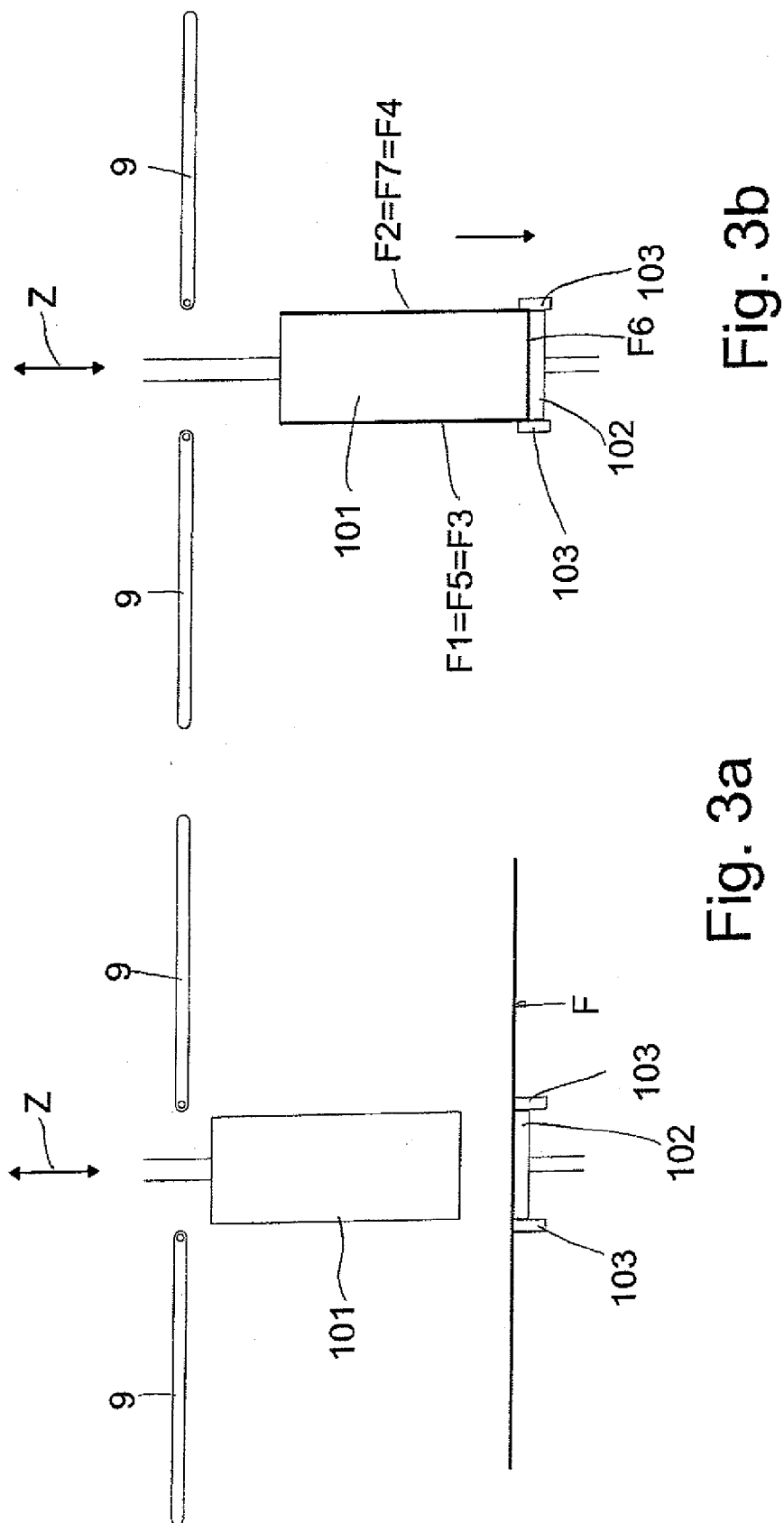
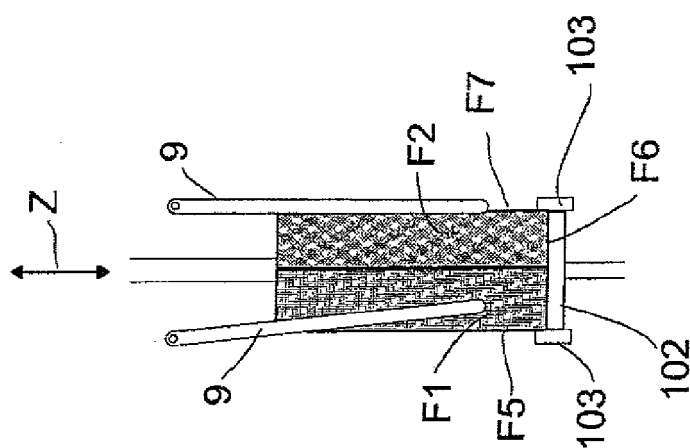
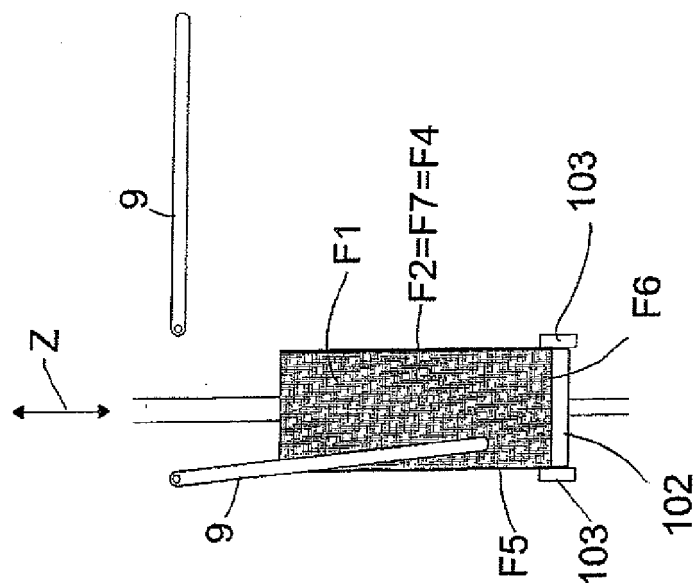
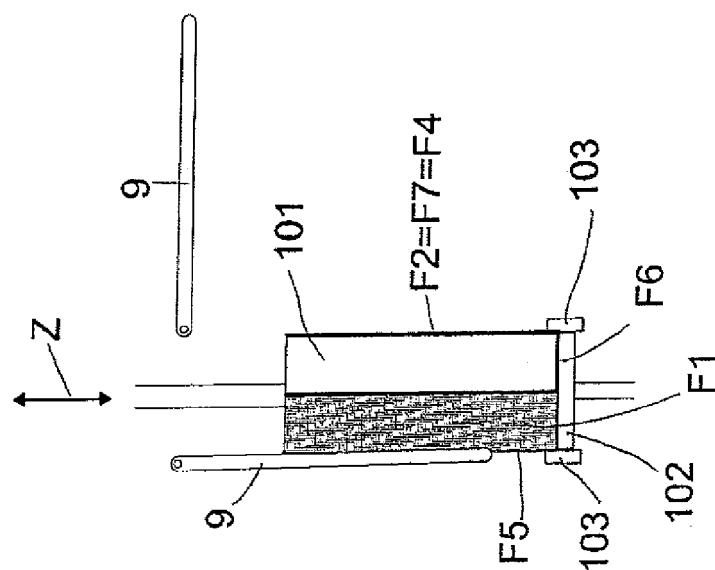


Fig. 3a

Fig. 3b



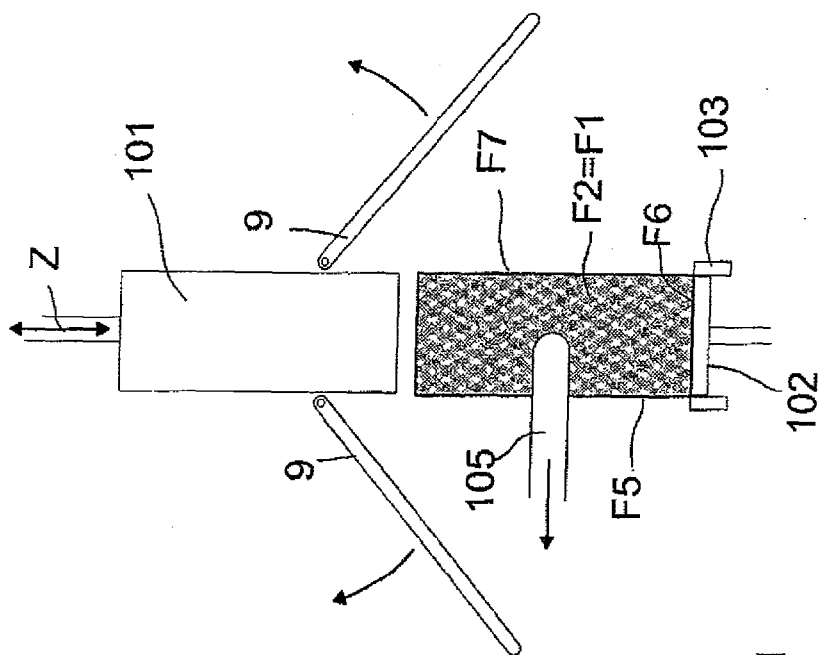


Fig. 3h

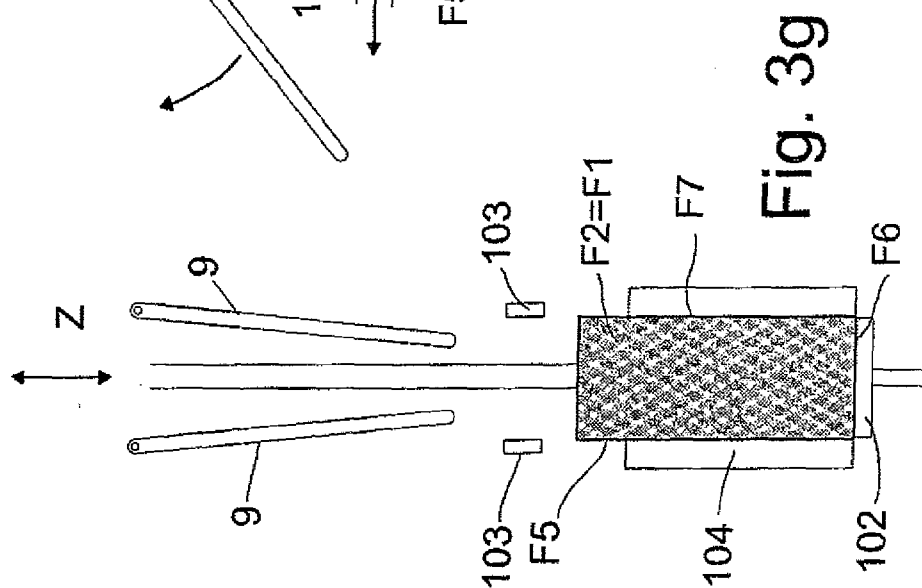


Fig. 3g

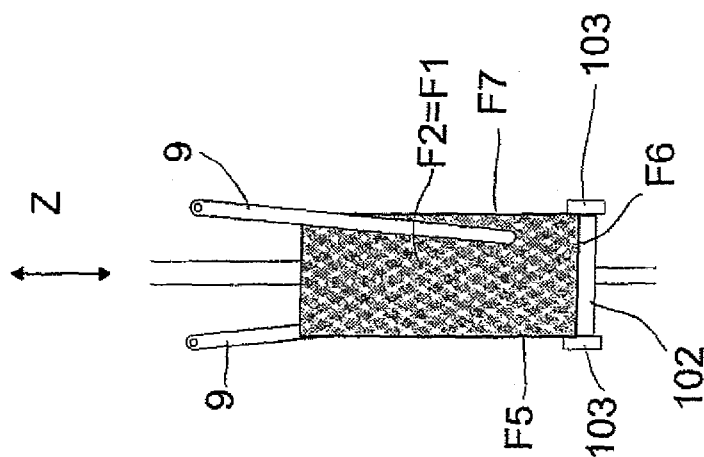


Fig. 3f

REFERENCES CITED IN THE DESCRIPTION

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