



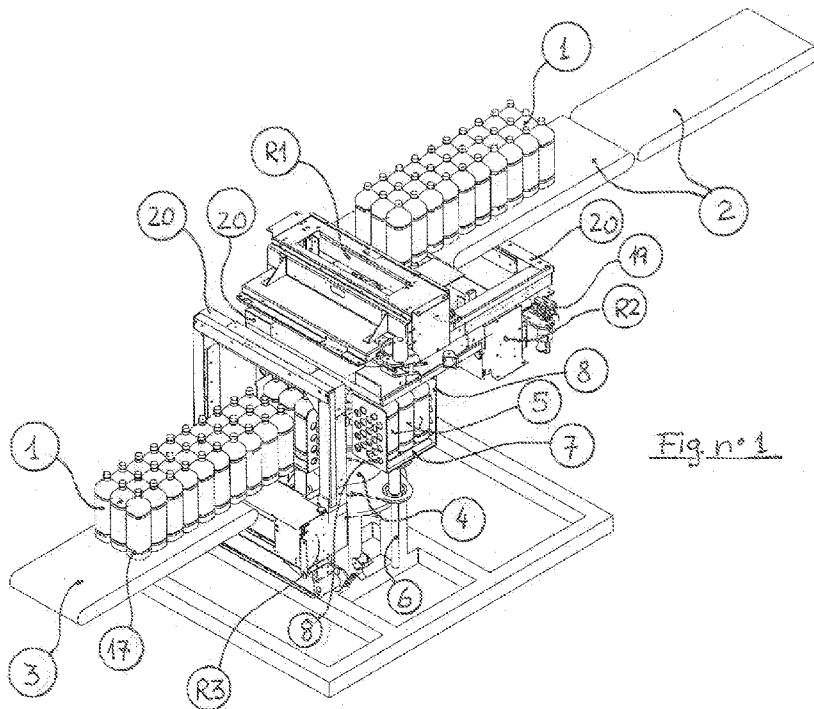
- (51) International Patent Classification:
B65B 13/02 (2006.01)
- (21) International Application Number:
PCT/IB2012/053939
- (22) International Filing Date:
1 August 2012 (01.08.2012)
- (25) Filing Language:
Italian
- (26) Publication Language:
English
- (30) Priority Data:
01299/11 4 August 2011 (04.08.2011) CH
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: PLANT FOR RAPID STRAPPING OF BOTTLES OR OTHER SIMILAR CONTAINERS



(57) Abstract: System for the strapping of packs of PET bottles or similar containers, on three operational levels of which two are horizontal and one is vertical, including two horizontal strapping machines and one vertical strapping machine.



PLANT FOR RAPID STRAPPING OF BOTTLES OR OTHER SIMILAR
CONTAINERS

5

INTRODUCTION

With current technology, PET bottles for beverages and, even more likely, also other equivalent containers are assembled into units or packs 5 of 4 or 6 elements, mainly using heat-shrink
10 polymer plastic sheets.

Instead, this invention regards another rapid packing method and therefore a new safe and economic system which uses tape bindings called straps 18, applied with special and specific devices using
15 traditional strapping machines. These machines have long been used for the general packaging of a variety of boxes, crates or containers but they have not yet been used industrially for the assembly of PET bottles or similar containers.

20 There have been only sporadic attempts at machines for this purpose which, however, give unconvincing results in terms of efficiency and scarce executive results.

The system which is the object of this invention
25 regards an operational unit able to execute a rapid, secure and simple packing, i.e. a pack 5, constituted of three straps: two placed on parallel surfaces which are perpendicular to the axes of the four or six bottles, which are preferable fitted into annular
30 grooves 17 in the sides of the bottles themselves. A third strap placed perpendicular with respect to the above two straps and passing through the centre of

gravity of the four or six bottles 1, i.e. placed on a surface between two rows of two bottles 1 in the case of a four bottle pack or between two rows of three bottles in the case of a six bottle 1 pack.

5 This packaging method has two basic advantages: the first is that of preventing, thanks to the two horizontal straps, i.e. those perpendicular to the longitudinal axes of the bottles 1, any rotation of the bottles with respect to each other around any

10 horizontal axis. The second is that of placing a restriction on a vertical surface which, in addition to tightening and therefore strengthening the two horizontal bindings, can be used as a grip or handle-holder for manual transportation of the pack.

15 The system which is the object of this invention has been conceived to simplify and reduce packing time to a minimum, thus guaranteeing reduced operating costs as well as constant, reliable operation.

20 DESCRIPTIVE TEXT

The system works on three distinct operating surfaces or levels:

A) Feeding the bottles 1 to be packed, transported by a feed conveyor belt 2.

25 All of the bottles 1, in rows of three, are in contact with each other on the belt 2. The belt 2 can advantageously be replaced by two belts: a long first belt which feeds a shorter following one, to better control the feed to the system.

30 B) Strapping for two horizontal, simultaneous strapping of six (or four) bottles 1 executed by two strapping machines R1 and R1, with two strapping levels B and C, one above the other and separated by

a space equal to the distance of the annular grooves 17 on the bottles 1 for the placement of the tape bindings 18 (straps).

5 The two operator devices 19 (machinery) of the strapping machines R1 and R2 are one on one side of the four or six bottles 1 to be packaged, and one on the other; i.e. opposite the groups to be packed.

10 C) Carousel 4 and output conveyor belt 3 as well as the vertical strapping machine R3. Again in this case, the belt 3 can be replaced by two successive belts.

The Carousel

The carousel 4 serves to transport, on the lower table C, by means of two discrete 90° rotations, the 15 incomplete packs 5, (i.e. with only the two horizontal straps executed on level B), in correspondence to the output conveyor belt 3 where the strapping machine R3 is located, working with its frame 20 on a vertical surface.

20 The partially strapped packs 5 of bottles 1 arrive in correspondence to the above mentioned conveyor belt 3 and are positioned under the vertical frame 20 of strapping machine R3 by one of the four pushing devices 12, integral with the carousel 4, so 25 that the centre of gravity of packs 5, i.e. their vertical surface of symmetry, corresponds to the vertical strapping surface R3.

The carousel 4 is constituted of two horizontal plates 25 (ps and pi) which are parallel, rigid and 30 integral with each other, both capable of rotating around an axis perpendicular to them, which rotates the whole using successive discrete 90° rotations,

always in the same direction. The axis is controlled by an electric motor with corresponding controls that are used to adjust all of the rotation parameters.

Four shafts 6, the head of each fitted with a small plate 7 perpendicular to the shafts (square for four bottles 1 or rectangular for six bottles 1), can slide with seal, but not rotate around their own axes, inside two holes 21 each fitted with anti-friction bushings 22 and both drilled in the two horizontal plates p1 and p2, the centres of which are aligned along the same vertical axis parallel to the axis of rotation of the carousel 4. The centres of the four axes are at the same distance from the centre of the axis of rotation, i.e. they lie on a circle and are staggered by 90°.

Four baskets 8 are attached in correspondence to the four holes in the upper horizontal plate p1 of the carousel 4, they are centred and integral with upper plate p1, while the bases of these baskets 8 are slightly larger than the bases of the small plates 7; their centres coincide with the axes of the shafts 6 of the small plates 7: their centres are practically aligned so that they coincide vertically with the centre of gravity of the packs 5, the movement of which is sensed. The baskets 8 have three vertical, adjacent walls integral with each other, which are also perpendicular to each other. The only side of the baskets 8, without a wall which is perpendicular to the straight line joining the centre of the carousel 4 and the centre of the axis of the shafts 6 is the exterior one, i.e. the one distal to the rotation axis of the carousel 4.

The four walls of the four baskets 8 closest to

the rotation axis of the carousel 4, in addition to the possibility of being made lighter by holes in their sheet metal, have one or two openings or holes to allow the passage of one or two shafts 9 which, by sliding horizontally, can push, by means of a flat rigid plate 15 perpendicular and integral with the aforementioned shafts 9, the packs 5 with only two horizontal straps under the vertical frame 20 of the vertical strapping machine R3, in front of the output conveyor belt when said packs 5 are aligned with the output conveyor belt 3 itself.

These shafts 9 with their flat plates 15 are housed in the centre part of the carousel 4 and rotate with it.

The loaded small plates 7 can slide vertically, guided by their shafts 6, inside the baskets 8.

During the vertical movement of the packs 5 between the three levels A, B and C, the shafts 6 of the small plates 7 can be driven both by electric motors linear with the corresponding controls and by pneumatic pistons.

Instead, to raise the small plates 7 with their shafts 6 from level A to level B, after the partially strapped packs 5 have been deposited in correspondence to output conveyor belt 3, the best solution is to lift the shafts 6 using a fixed cam 10 which lies in an arc of a circle of about 180° with a radius equal in length to the distance between the axis of the carousel 4 and the centre of the axes of the shafts 6. This arc of a circle begins from two discrete 90° feeds of the carousel 4, i.e. starting from 180° from the angle 0° which is found in

correspondence to the position of the centre of the shafts 6 when they support the pack 5 during the two simultaneous horizontal strapping operations.

The outline of the flat development of said fixed cam 10 can also be simply a straight line corresponding to the hypotenuse of a triangle with sides equal to the lifting height h and base equal to about $2\pi r$, the length of which will obviously be $\sqrt{(h^2 + r^2)}$, while its slope will correspond to the ratio h/r .

Other improved forms that allow a reduction in the cyclical inertia reactions due to the variation in the slope of the outline of the fixed cam 10 can be considered for the purpose of reducing the vibrations by designing the outline of a cam 10 which produces accelerations and subsequent decelerations distributed to minimise the peak intensities.

In order to reduce the friction of the shafts 6 along the fixed cam 10 a wheel will be applied 11 mounted on bearing 13 at the lower end of the shafts 6, with a horizontal rotation axis perpendicular to the surface defined by the centre of the wheel 11 and by the axis of carousel 4.

As already mentioned, the successive descent of the shafts 6 with their small plates 7 may be driven either by the motorised shafts 6 (electric or pneumatic) or more simply by gravity, controlled with calibrated friction brakes acting on the same shafts 6.

30 Carousel accessories

There are three accessories for the carousel 4 which are fundamental for correct operation and, especially, to drastically reduce the total packing

time using the three envisioned strapping machines R1, R2, and R2.

These accessories are:

1) An upper stop RS which, through the aid of a hopper, allows the settling of groups of four or six bottles 1 coming from the feed conveyor belt 2 directly on the four or six bottles 1 stopped on second level B where the first two simultaneous horizontal strapping operations take place.

This stop RS is constituted of two rigid narrow horizontal plates 24 in contact with the terminal edge of the conveyor belt 2; when these two plates come together on a horizontal surface flush with the surface of the feed conveyor belt 2 thanks to two synchronised linear motors, they allow four or six bottles 1 from the row of bottles 1 coming from the aforementioned feed conveyor belt 2 to level A to be pushed onto and then held there by a special vertical stop wall for the time necessary on the vertical of the group of the same number of bottles 1 below which undergo double horizontal strapping on level B.

Instead, when these two plates 24 of the stop RS separate, they allow the four or six bottles 1 that are at the vertical above the four or six bottles already partially packed to rest directly on the caps of the latter, thanks to a special containment hopper, to then simultaneously move down one level together with the aforementioned partially packed bottles 1 below while the carousel 4 is stopped.

This way, because the lower stop RI is open, the aforementioned group, already partially packed and resting on its small plate 7, will be placed on the bottom of a basket 8 below the carousel 4 while the

one to be partially packed will stop, being held by lower stop RI (described in the following paragraph) which, in the meantime, has closed precisely at the right level B where it will, in turn, be partially packed. At this point the two plates 24 of the upper
5 stop RS will be closed and will allow the next group of four or six bottles 1 to be correctly positioned at the vertical above the previous ones.

2) A lower stop RI, which holds at the second
10 level B the four or six bottles 1 coming from the first level A to be horizontally packed, while the carousel 4 rotates with the previously partially packed group to present it at the entrance to the output conveyor belt 3.

15 This stop RI is constituted essentially of two rigid horizontal bars 15, interlocked to two linear electric motors which move them horizontally on level B; these horizontal bars 15 have a series of horizontal pins (6 along their length, perpendicular
20 to the same, arranged like the teeth of a comb; the pins can be perfectly fitted in the grooves 26, open at the top and made in the small plates 7.

This way when the two parts of the stops RI separate or come together, they will open or close
25 the same stop RI.

With the stop RI open, the column of two stacked groups of bottles 1 can be lowered with the small plate 7 which supports them both. Once this column of two groups rests on a basket 8 of the carousel, the
30 stop RI will close, holding the top group at the second level B to be packed, while it waits for the following small plate 7 which, being raised with its shaft 6 along the fixed cam 10 will engage the pins

16 of the stop RI within its grooves 26.

3) A device 12 which expels the partially strapped packs from the carousel 4 and positions them under the frame 20 of the vertical strapping machine R3.

This device, integral with the carousel 4 is constituted of eight horizontal mobile shafts 9 on four surfaces, one per basket 8, driven either with electric motors or pneumatic shafts. These bars 9 have plates 14 at their ends, integral with and perpendicular to the bars; at rest they coincide with the vertical internal walls of the baskets 8. When the baskets 8 stop in correspondence to output conveyor belt 3 the partially strapped packs 5 can then be expelled from the baskets 8 by the aforementioned plates 14.

The expulsion will position the partially strapped packs 5 coming from the baskets 8 under the frame 20 of the vertical strapping machine R3 while at the same time the partially strapped packs 5, positioned under said frame 20 will push the preceding packs 5 which have just been vertically packed, onto the output conveyor belt 3.

25

DESCRIPTION OF THE CYCLE

Cycle at full capacity.

The situation is that illustrated in the axonometric projection drawing no. 4.

30 Situation at angle 0° of the carousel 4: (the angle 0° corresponds to the vertical axis along which the groups of bottles 1 descend).

At first level A, we find all of the bottles 1 arriving from conveyor belt 2. The first group at first level A still not packed, is at the vertical, in position 0°, resting directly on the group below, which is being packed on level B. Both of the two stops, upper RS and lower RI, are open.

1) The column of the two aforementioned stacked groups goes down one level, with carousel 4 stopped on small plate 7 in the direction of third level C.

2) Just before the arrival on the basket 8 below at the third level, the lower stop RI closes, stopping the upper group, still not strapped, at the exact level B of the double horizontal strapping.

3) The upper stop RS closes and the horizontal row on the conveyor belt 2 advances and places a new group on the closed plates 24 of upper stop RS. Simultaneously the two horizontal strapping machines R1 and R2 partially strap the group below stopped at second level B and the already partially strapped group at third level C in 0° angle position rotates 90° with the carousel 4 while the empty small plate 7 of the next basket 8 rises with its shaft 6 along the fixed cam 10 by a half level, i.e. from 270 to 360° where it engages the pins 16 of closed lower stop RI in its grooves 26.

4) Upper stop RS opens and the group of bottles 1 which is settled on top rests with the aid of a hopper 15 (not shown in the drawings) directly with its bottoms 6 on the caps of the one below undergoing double horizontal strapping: then, it closes again.

5) Lower stop RI opens and the column composed

of the level A group, still not strapped, and by the level B group just horizontally strapped, both being supported by the same small plate 7, goes down one level to angle 0° in the basket 8 below with carousel 4 stopped while the previously partially strapped group at angle 180° , i.e. positioned in front of the conveyor belt 3 is immediately expelled from its basket 8 and positioned under the frame 20 of the vertical strapping machine R3, and simultaneously pushes the previous one onto the output conveyor belt 3

6) During the two 90° rotations, i.e. from 0° to 180° , which bring the initial, partially strapped pack 5 in front of the conveyor belt 3, the baskets 8, now empty, will rise from level C to level B, thanks to the semicircular fixed cam 10 from 180° to almost 360° , their small plates 7, pushed by their shafts 6 which position themselves at level B in correspondence to angle 0° , engaging the pins 16 in their grooves 26.

The cycle ends.

LEGEND:

- 1) Bottles or similar containers
- 5 2) Feed conveyor belt
- 3) Output conveyor belt
- 4) Carousel
- 5) Packs
- 6) Vertical shafts of carousel 4
- 10 7) Small perpendicular plates of the vertical shafts (6) of the carousel 4
- 8) Baskets
- 9) Shafts of the pushing device 12
- 10) Fixed semi-circular cam
- 15 11) Wheels of shafts 6
- 12) Pushing devices (expellers)
- 13) Wheel bearings
- 14) Plates of pushing device 12
- 15) Horizontal bars of stop RI
- 20 16) Pins of the horizontal bars 15 of the stop RI
- 17) Annular grooves of the bottles 1
- 18) Straps

CLAIMS

1) Strapping packing system for PET bottles (1) or similar containers, mainly constituted of a feed conveyor belt (2) and by a mobile vertical stop RS situated on an upper level (A), two stacked strapping machines (R1) and (R2) with their frames (20) positioned horizontally and by a lower mobile vertical stop (RI) situated on an intermediate level (B), a rotating carousel (4) with discrete 90° feeds fitted with four baskets (8) housing the packs (5) which, in turn, is fitted with four vertical handling devices constituted of four vertical shafts (6) holding four small plates (7) to support the packs (5), of four expellers or push devices (12) and an output conveyor belt (3) that goes through the frame (20), of a vertically positioned strapping machine (R3), all situated on a lower level (C).

2) A system, according to claim no. 1, characterised by the fact that the three strapping operations by the three strapping machines (R1, R2 and R3) occur simultaneously.

3) A system, according to claim no. 1, characterised by the fact that the upper vertical stop (RS) is constituted by two horizontal motorised plates (24) that can come together to support a group of bottles (1) to be packed coming from conveyor belt (2) and to be separated from each other to allow the aforementioned group of bottles (1) to go down to the intermediate level (B) where they will be held by closed lower stop (RI) to be simultaneously strapped by the two strapping machines (R1 and R2).

4) System, according to claim no. 1,

characterised by the fact that the lower vertical stop (RI) is constituted of two horizontal bars (15) each fitted with a series of pins (16) perpendicular to the bars, i.e. arranged like combs that can be fitted into the special grooves (26) of the small plates (7) and motorised so they can open and close on a horizontal surface.

5) A system, according to claim no. 1, characterised by the fact that it is fitted with a carousel (4), which is constituted of two parallel, horizontal, joined plates (25) able to rotate around a centred motorised, monitored axis, in which the upper plate (25(ps)), in addition to supporting four baskets (8) integral with it and able to receive the packs (5), has four holes (21) each staggered by 90° in correspondence to the centre of the base of the baskets (8) and each positioned at the vertical of the four holes (21) of the lower plate (25(pi)) while said holes (21) fitted with bushings (22) hold four vertical handling devices.

6) A system, according to claim no. 5, characterised by the fact that each of the four vertical handling devices of the carousel (4) includes a shaft (6), supporting a small plate (7) on its upper end and perpendicular to the same; this shaft (6) can move vertically but cannot rotate around its own axis; moreover, said shaft (6) moves vertically thanks to linear electric motors or pneumatic pistons or also rises from the lower level (C) to intermediate level (B) if fitted with a wheel (11) mounted on a bearing (13) and thanks to a fixed semi-circular cam (10).

7) A system, according to claim no. 6,

characterised by the fact that the small plates (7), supported by the shafts (6), used to move the bottles to be strapped down from the upper level (A) to the intermediated level (B) and simultaneously lower the
5 packs (5) strapped by the two simultaneous strapping machines (R1 and R2) from intermediate level (B) to lower level (C), have on their upper surfaces special grooves (26) which engage the pins (16) or equivalent bars of the lower stop (RI).

10 8) A system, according to claim no. 5, characterised by the fact that four pushing devices (12) are inserted in the central part of the carousel (4) to expel the groups of strapped bottles (1) at level (C) from its four baskets (8) to position them
15 under the frame (20) of strapping machine (R3) and then, through the same group of bottles (1) just strapped by strapping machine (R3), push the previous group onto the output conveyor belt (3).

20 9) A system, according to claim no. 8, characterised by the fact that the four expellers or pushing devices (12) are essentially each constituted of two shafts (9) attached diagonally on the push plates (14) and placed on four different horizontal levels so they don't interfere mechanically with each
25 other while driven by linear electric motors, suitably monitored, inserted in push reaction blocks (27) integral with the carousel (4) itself.

30 10) A system, according to claims no. 8 and no. 9, characterised by the fact that the shafts (9) are driven pneumatically.

11) A system, according to claim no. 1 and following, characterised by the fact that it is fitted with a fixed cam (10) which constitutes a ramp

with an average slope equal to the ratio between its maximum height h , i.e. the distance between the Levels (C) and (B), and its base $R \times 3.14$ and where the local slope may also be variable, and more precisely,
5 said ramp develops over a cylindrical surface with a radius equal to the distance between the centre of the axis of the carousel (4) and the centre of the axes of the shafts (6) along a development of about 180° ; the wheels (11) rise on this ramp thanks to the
10 rotation of the carousel (4), allowing the aforementioned shafts (6) with their small plates (7) to rise from the lower level (C) to the intermediate level (B).

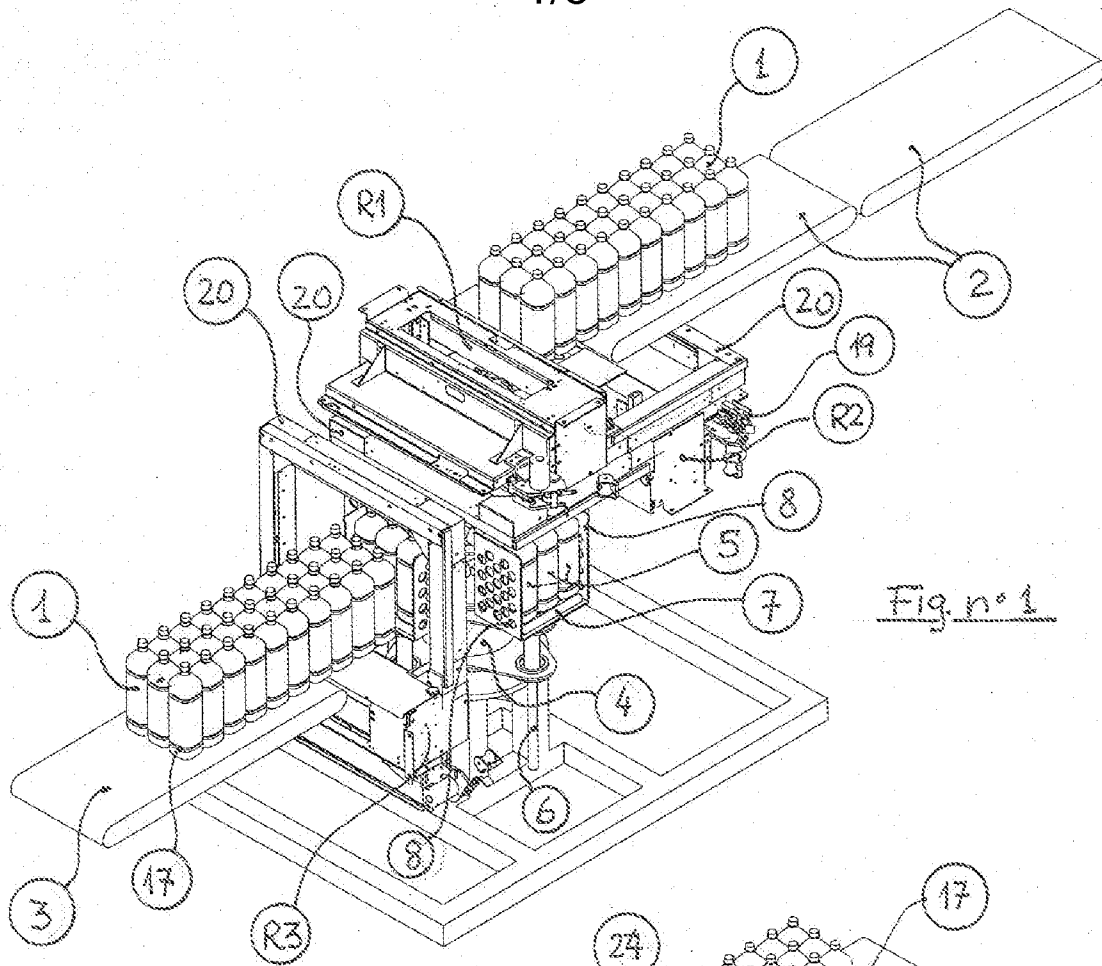


Fig. n°1

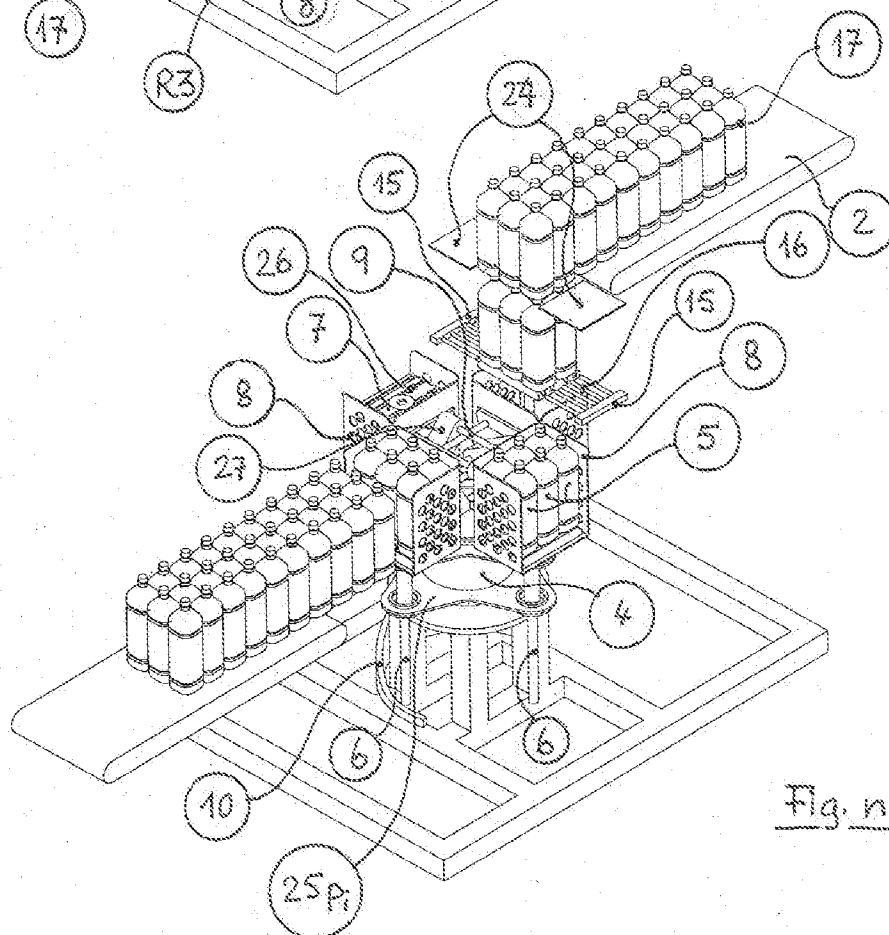


Fig. n°2

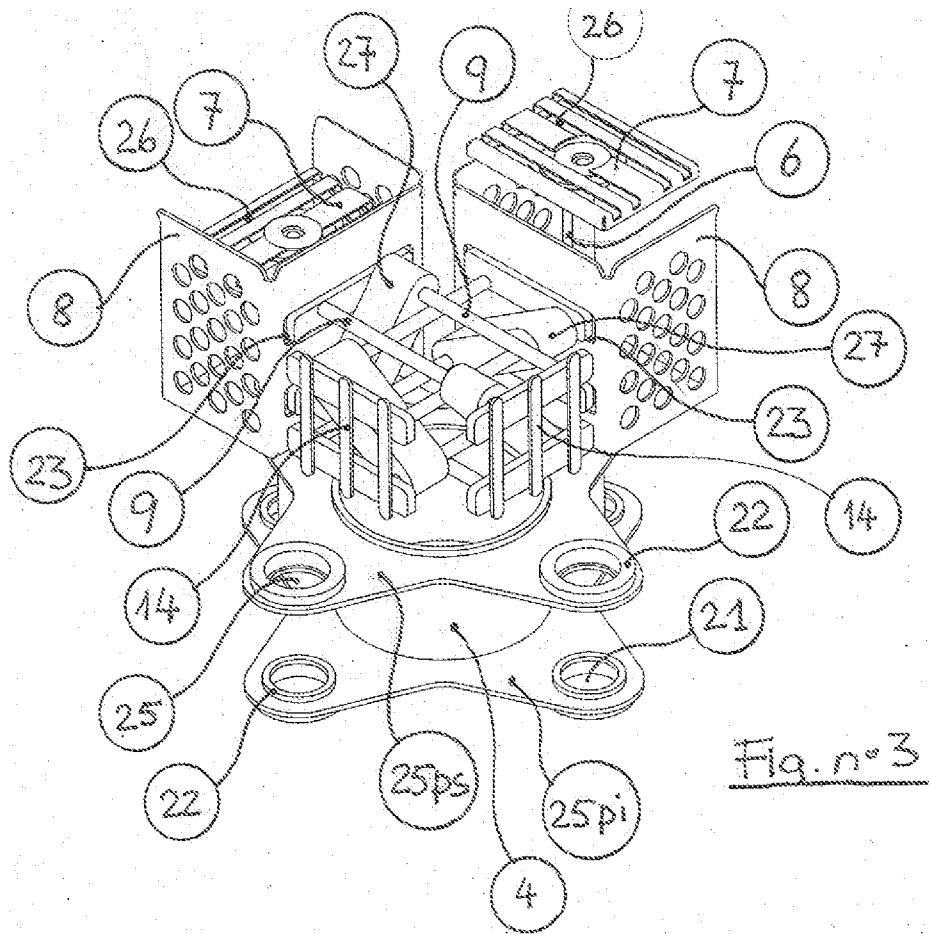


Fig. n° 3

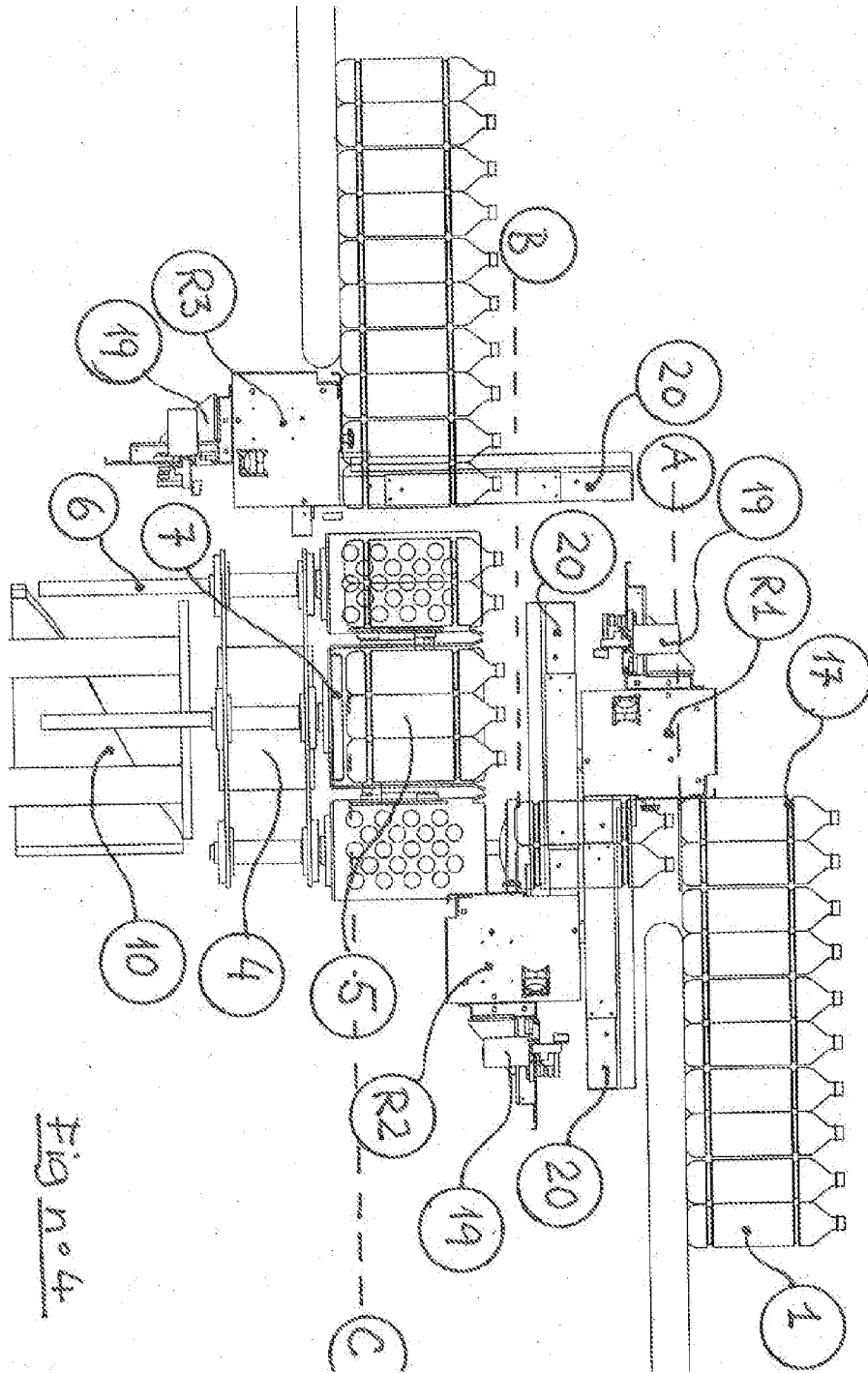


Fig no 4