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(54) WASHING MACHINE AND METHOD FOR LOADING A WASHING MACHINE

(57) Washing machine (1) for washing containers (2) comprising: a washing tunnel (3); an endless conveyor (4); and a feeding system (5); the conveyor (4) comprises a set of receiving pockets (6a); the feeding system (5) comprises: a receiver (8) for loading the received containers (2) into the pockets (6a) and having a plurality of seats (10); and a robotic arm (11) for grasping containers (2) from one or more crates (12) and for releasing such containers into receiver seats (10); the robotic arm (11) comprises an end effector (13) having a set of grippers (14) movable towards and away from one another between: a first position, in which the grippers (14) are at a first distance (D1) from one another, so that the grasped containers (2) are arranged in a crate layout; and a second position, in which the grippers (14) are at a second distance (D2) from one another.

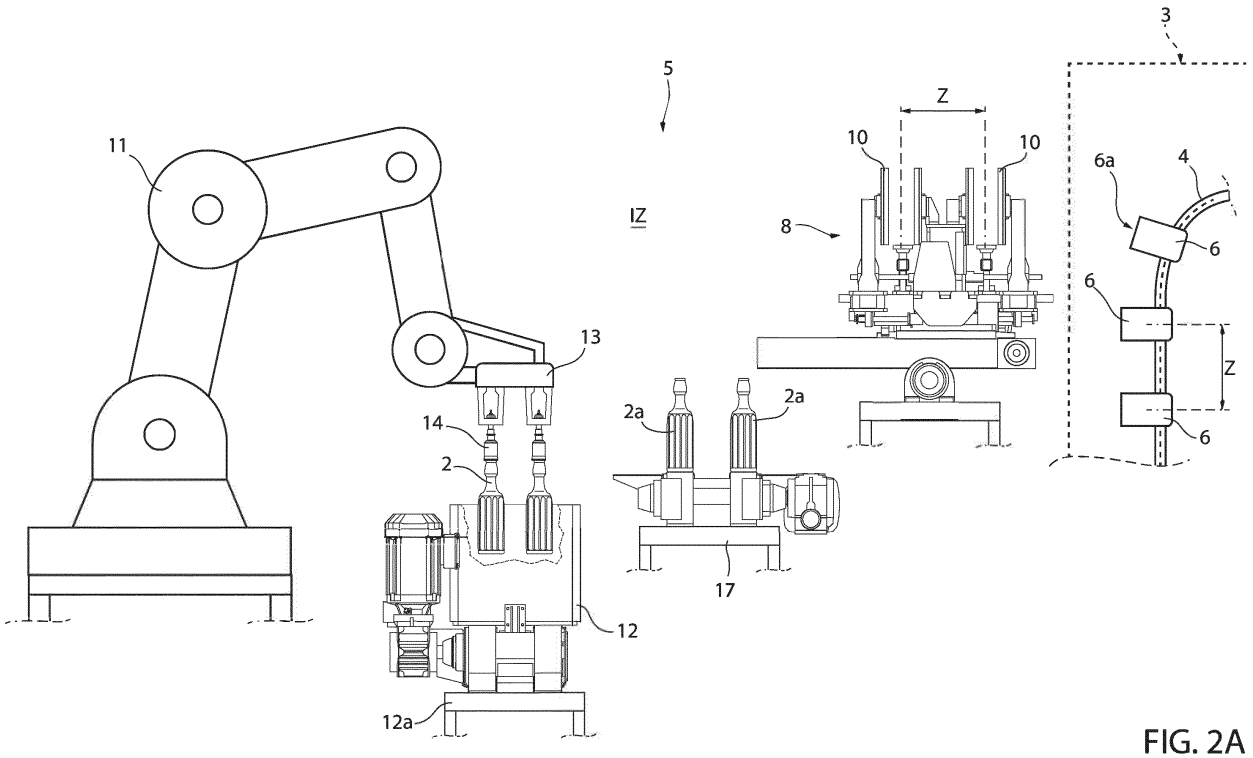

FIG. 2A

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Description

TECHNICAL FIELD

[0001] The present invention relates to a washing machine for washing (and cleaning) empty containers adapted to be filled with a pourable product, preferably a pourable food product.

[0002] The present invention also relates to a method for loading such a washing machine with empty containers.

BACKGROUND ART

[0003] Washing machines are known which are configured for washing and cleaning containers (usually used containers which have been emptied from the pourable product they are adapted to contain) upstream of a filling machine and a labelling machine, in which the containers are respectively filled with the pourable product and labelled with respective labels.

[0004] An example of washing machine is known, e.g. from EP-A-2727660 in the name of the same Applicant.

[0005] A typical washing machine of the above type essentially comprises:

- a washing tunnel;
- a looped chain conveyor advancing the containers along a closed washing path which extends inside the washing tunnel from an inlet station to an outlet station;
- a feeding system for feeding containers to be treated to the chain conveyor; and
- a plurality of consecutive treatment zones arranged between the inlet station and the outlet station, crossed by the washing path, and through which the chain conveyor advances the containers.

[0006] In detail, the chain conveyor comprises a plurality of beams, which are fed at the inlet station by the feeding system with respective rows of containers.

[0007] In greater detail, each beam comprises a plurality of aligned pockets organized in respective longitudinal rows, each pocket being configured to receive one container to be treated at a time, to convey such container from the inlet station to the outlet station through the washing tunnel and along the washing path, and to deliver the respective washed container at the outlet station.

[0008] More precisely, each beam is discharged of the respective washed containers at the outlet station and then is returned along a return path to the inlet station, where it receives new empty containers to be washed.

[0009] EP-A-3184181 describes a type of feeding system for feeding the containers onto the chain conveyor.

[0010] More precisely, such feeding system defines a loading apparatus for loading the beams of the washing machine with empty containers to be treated.

[0011] In particular, the containers are provided bundled in crates upstream of the washing tunnel.

[0012] More in particular, the containers 2 are organized in each crate with a certain matrix layout, defined by the structure of the crate itself (e.g. 3x3, 3x4, etc.).

[0013] Said crates are moved by a feed conveyor on which they stand.

[0014] The feeding system of EP-A-3184181 comprises a robotic arm which grasps the containers and extracts them from the crates.

[0015] Such robotic arm then releases the containers into a receiver, in the form of a basket having a series of aligned seats, spaced along a direction parallel to the longitudinal row of each beam so as to match the pitch of the pockets on each beam.

[0016] In other words, the pockets layout is reproduced by the receiver seats.

[0017] The receiver loaded with containers at the appropriate pitch is then pivoted for facing the chain conveyor and for feeding the containers into the pockets of one or more beams.

[0018] Although functionally valid, the Applicant has observed that the known washing machines, and especially their feeding systems, and methods for loading such washing machines are still prone to further improvements. In particular, there is a current need to improve the infeed of new replenishment containers during the loading of the washing machine with empty used containers, and to improve the flexibility and adaptability of the feeding system to different crate layouts, without unduly increasing the complexity of the feeding system.

DISCLOSURE OF INVENTION

[0019] It is therefore an object of the present invention to provide a washing machine and a method for loading a washing machine with containers which are designed to meet at least one of the above-mentioned needs in a straightforward and low-cost manner.

[0020] This object is achieved by a washing machine and a method for loading a washing machine as claimed in the appended independent claims and, preferably, in any of the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic side view, with parts removed for clarity, of a washing machine according to the invention;

Figures 2a-2c are larger-scale, schematic side views, with parts removed for clarity, of a feeding system of the washing machine of Figure 1, during different operative conditions;

Figure 3a is a perspective view, with parts removed

for clarity, of an end effector of a robotic arm of the feeding system of Figures 2a-2c;
Figures 3b-3c are schematic front views, with parts removed for clarity, of the end effector of Figure 3a, during different operative conditions;
Figures 3d-3e are schematic side views, with parts removed for clarity, of the end effector of Figures 3a-3b, during further different operative conditions;
Figure 4a is a perspective view, with parts removed for clarity, of a receiver of the feeding system of Figures 2a-2c;
Figures 4b-4c are schematic front views, with parts removed for clarity, of the receiver of Figure 4a, during different operative conditions;
Figures 5a-5b are schematic side view, with parts removed for clarity, of the receiver of Figure 4a, during different operative conditions; and
Figure 6 is a schematic top view of part of the washing machine of Figure 1 at an infeed zone thereof.

BEST MODE FOR CARRYING OUT THE INVENTION

[0022] With reference to Figure 1, number 1 indicates as a whole a washing machine for washing empty containers 2 adapted to be filled with a pourable product, preferably a pourable food product such as beer, wine, water, juice, soft drinks, milk or the like.

[0023] In particular, containers 2 are defined by respective empty bottles (for example, returnable glass bottles) intended to be filled with the pourable product.

[0024] Alternatively, containers 2 may be defined by returnable PET bottles.

[0025] Washing machine 1 comprises:

- a washing tunnel 3 housing a plurality of successive treatment zones P1, C1, C2, H1 for treating empty containers 2;
- a conveyor device 4 extending into washing tunnel 3 for conveying containers 2 along a conveying direction CD sequentially through the treatment zones; and
- a feeding system 5 for feeding containers 2 to be treated to conveyor device 4 at an infeed zone IZ upstream of washing tunnel 3.

[0026] Conveyor device 4 is defined by an endless conveyor, preferably a chain conveyor, for advancing containers 2 along a closed-loop washing path P inside washing tunnel 3, so as to convey containers 2 from one end of the tunnel 3 to the other end thereof along said conveying direction CD.

[0027] In detail, chain conveyor 4 is of the type described in WO-A-2020119958 and comprises:

- a pair of chains (not shown) elongated parallel to washing path P and parallel to one another; and
- a plurality of consecutive conveying beams 6, which extend between the chains in a transversal and, more in detail, orthogonal manner to the chains and washing path P.

[0028] Specifically, each beam 6 comprises a row of pockets 6a aligned orthogonally to washing path P and configured to receive corresponding containers 2.

[0029] In other words, chain conveyor 4 comprises a set of pockets 6a arranged as a plurality of consecutive tunnel rows TR, each pocket 6a being configured to receive one container 2 at a time and each tunnel row TR extending longitudinally along a transverse direction TD perpendicular to said conveying direction CD and parallel to washing path P.

[0030] Conveying direction CD is defined by a straight general direction of advancement of containers 2 within washing machine 1 (including feeding system 5).

[0031] In particular, the pockets 6a of each tunnel row TR are spaced with a tunnel pitch W between one another.

[0032] According to the above, the tunnel pitch W is defined along transverse direction TD.

[0033] Moreover, tunnel rows TR are arranged at a fixed tunnel distance Z between one another, orthogonally to transverse direction TD (parallel to washing path P).

[0034] Figure 6 schematically shows the above configuration.

[0035] In such a manner, containers 2 carried by a corresponding beam 6 are aligned orthogonally to path P and housed inside the respective pockets 6a, individually.

[0036] Washing machine 1 further comprises an outfeed conveyor 7, which receives rows of cleaned and washed containers 2 from chain conveyor 4 at an outlet station O of washing tunnel 3.

[0037] Hence, chain conveyor 4 is configured to convey the containers 2, by means of beams 6 and their pockets 6a, from infeed zone IZ to outlet station O.

[0038] In light of the above, washing path P comprises:

- a washing branch Q, which extends from infeed zone IZ to outlet station O and along which containers 2 are advanced by chain conveyor 4; and
- a return branch R, which extends from outlet station O to infeed zone IZ and defines a return zone through which beams 6 return towards infeed zone IZ after having discharged containers 2, i.e. with their respective pockets 6a emptied.

[0039] According to the aforementioned advancing direction of containers 2 along path P, washing machine 1 comprises in sequence along washing branch Q a plurality of known treatment stations or zones, namely:

- a prewash zone P1;
- a first cleaning zone C1;
- preferably, a second cleaning zone C2; and
- a final rinsing zone H1.

[0040] In the present disclosure, for the sake of clarity, terms like "upstream of" and "downstream of" are to be intended throughout the whole description and claims with reference to the advancing direction of containers 2 along path P and along conveying direction CD.

[0041] The operation of washing machine 1 at the pre-wash zone P1, first cleaning zone C1, second cleaning zone C2 and final rinsing zone H1 is well-known, for example from WO-A-2020119958, and therefore will not be described in detail herein.

[0042] Briefly, containers 2 are advanced through a series of tanks filled with cleaning agents at different respective temperatures (according to a manner known and not described herein) so as to define respective cleaning baths. For example, a cleaning agent may comprise basic aqueous solutions that include, in particular, sodium hydroxide.

[0043] Reference will be made in the following to feeding system 5 and infeed zone IZ.

[0044] In detail, feeding system 5 comprises:

- a receiver 8 which is located at infeed zone IZ, has a plurality of seats 10 for receiving, each, one container 2 at a time, and is configured for loading the received containers 2 into pockets 6a, respectively; and
- a robotic arm 11 configured for grasping containers 2 to be treated from one or more crates 12 and for releasing such containers 2 into seats 10, respectively.

[0045] In detail, seats 10 are arranged (aligned) in at least one receiver row RR extending along transverse direction TD.

[0046] According to the preferred embodiment shown, seats 10 are arranged in two receiver rows RR, each extending along transverse direction TD.

[0047] In the embodiment shown, receiver 8 is defined by a tipping basket with seats 10 and which is tiltable between a resting position (Figures 2b and 5a), for receiving containers 2 from robotic arm 11, and a tilted loading position (shown in Figure 2b with dashed lines and in Figure 5b), for loading containers 2 into pockets 6a.

[0048] Preferably, feeding system 5 comprises a feed conveyor 12a for advancing or providing crates 12.

[0049] Feeding system 5 further comprises a replenishing conveyor 17 for providing new replenishment containers 2a. Conveniently, replenishing conveyor 17 is operatively interposed between robotic arm 11 and receiver 8, with respect to conveying direction CD (as shown in Figure 2c).

[0050] In each crate 12, containers 2 are organized according to a specific predetermined matrix scheme, e.g. 3 by 4 or 4 by 4, and so on.

[0051] In order to withdraw containers 2 from one or more crates 12 at a time, robotic arm 11 comprises an end effector or robot hand 13 which has a set of grippers 14 arranged (aligned) in at least one gripper row GR.

[0052] According to an aspect of the present invention, grippers 14 are movable towards and away from one another between:

- a first position (Figure 3b), for grasping at least one row of containers 2 from the one or more crates 12 and in which grippers 14 are at a first distance D1 from one another, along a first gripper direction G1 parallel to gripper row GR, so that the grasped containers 2 are arranged in a crate layout at a non-zero distance with respect to one another thereby defining a first interaxis X between them; and
- a second position (Figure 3c), for releasing containers 2 to receiver 8 and in which grippers 14 are at a second distance D2 from one another, along first gripper direction G1, so that the grasped containers 2 are arranged in a packed layout and contact one another thereby defining a second interaxis Y between them.

[0053] According to the invention, second interaxis Y is smaller than first interaxis X.

[0054] In greater detail, second interaxis Y is the smallest interaxis possible between two adjacent grasped containers 2, since in the aforementioned packed layout the containers 2 of the same row contact one another.

[0055] According to a further aspect of the invention, the seats 10 of the at least one receiver row RR are movable, along transverse direction TD, between:

- a receiving position (Figure 4b), in which such seats 10 are arranged in a compact configuration at a minimum distance between one another corresponding to second interaxis Y for receiving containers 2 from end effector 13; and
- a releasing position (Figure 4c), in which seats 10 are arranged in an extended configuration at a maximum distance between one another corresponding to tunnel pitch W for releasing the received containers 2 into pockets 6a.

[0056] More precisely:

- each gripper 14 has a longitudinal axis A and said first distance D1 and second distance D2 are defined by distances between the longitudinal axes A of two adjacent grippers 14 along first gripper direction G1;
- each seat 10 has a central axis C and the minimum or maximum distance is a distance between the central axes C of two adjacent seats 10 along transverse direction TD.

[0057] Preferably, each container 2 has a central axis B and second interaxis Y is equal to the radial extension of each container 2 with respect to said central axis B. For example, each container 2 is defined by a substantially cylindrical glass bottle; hence, when containers 2 grasped by end effector 13 are in the packed layout, i.e.

when grippers 14 are moved in the second positions thereby bringing containers 2 in contact with one another, second interaxis Y corresponds to the diameter of each container 2.

[0058] More in detail, containers 2 in the packed layout contact one another at respective outer lateral surfaces thereof.

[0059] Thanks to the above-described configuration of feeding system 5 according to the invention, replenishing conveyor 17 can be very simple, without the need for any complicated means (e.g. an infeed cochlea) for sorting containers 2a or for adjusting the pitch of the replenishment containers 2a conveyed thereon. In particular, due to the fact that end effector 13 is configured so that grippers 14 are controlled in the second position after grasping containers 2 from the one or more crates 12, grippers 14 are already positioned for eventually grasping replenishing containers 2a (if needed), which can then be advanced in a simple row, one after the other and in contact with one another (i.e. with minimum interaxis, namely with second interaxis Y) by replenishment conveyor 17, which is the simplest configuration possible. Hence, the architecture of replenishment conveyor 17 and of feeding system 5, and ultimately of washing machine 1, is largely simplified.

[0060] Moreover, the movement of the grippers 14 from the first position to the second position allows for a better control and maneuverability of end effector 13, which conveys containers 2 in a "compact" configuration, with respect to the case in which grippers 14 are immediately spaced at tunnel pitch W by end effector, which would cause a decentered and unbalanced end effector 13 and also determine larger dimensions and less available space for two or more robotic arms 11 operating in parallel at infeed zone IZ.

[0061] In addition, end effector 13 does not have to be adapted each time to tunnel pitch W, which would require high precision and starting from a different configuration each time that the crate configuration varies. Packing containers 2 at the second interaxis Y requires less precision, since the movement can automatically stop when containers 2 contact one another.

[0062] Furthermore, complexity of receiver 8 is largely reduced, since seats 10 always receive containers 2 with the same interaxis (i.e. second interaxis Y), so that seats 10 do not have to be adapted each time to a different interaxis which would vary depending on the configuration of crates 12.

[0063] Expediently, robot arm 11 comprises an actuator 15a coupled to end effector 13 and configured to control the movement of grippers 14 between the first position and the second position.

[0064] In one embodiment, actuator 15a is pneumatic.

[0065] Alternatively, actuator 15a is hydrodynamic or electric.

[0066] In this way, an automatic control of the movement of grippers 14 can be easily obtained.

[0067] Conveniently, receiver 8 comprises a pantograph system 16 and seats 10 are mechanically and kinematically coupled to one another by means of pantograph system 16.

[0068] Accordingly, receiver 8 comprises an actuator device 15c configured to control pantograph system 16 for driving a synchronous movement of seats 10 between the receiving position and the releasing position.

[0069] In this way, the movement of seats 10 can be obtained in a simple and effective way, minimizing position errors and increasing the overall reliability of receiver 8, since no complex systems (such as linear motors) are needed.

[0070] However, in one alternative embodiment not shown seats 1 may be controlled by means of linear motors, independently from one another.

[0071] According to the preferred embodiment shown, grippers 14 are arranged into two gripper rows GR parallel to one another.

[0072] According to a further aspect of the invention, gripper rows GR are movable towards and away from one another, along a second gripper direction G2 perpendicular to first gripper direction G1, between:

- a first configuration (Figure 3d), for grasping at least two rows of containers 2 from the one or more crates 12 and in which gripper rows GR are at a first distance S1 from one another, along second gripper direction G2, corresponding to the distance between the container rows in the one or more crates 12; and
- a second configuration (Figure 3e), for releasing the at least two rows of containers 2 to receiver 8 and in which gripper rows GR are at a second distance S2 from one another, along second gripper direction G2, corresponding to tunnel distance Z.

[0073] Correspondingly, seats 10 are arranged in at least two said receiver rows RR spaced from one another at a distance, along conveying direction CD, corresponding to tunnel distance Z.

[0074] In particular, receiver rows RR are fixed at such distance.

[0075] In the embodiment shown, second distance S2, i.e. tunnel distance Z, is greater than first distance S1.

[0076] In this way, maneuverability of end effector 13 is further improved.

[0077] Preferably, end effector 13 comprises at least one actuator 15b, preferably two actuators 15b to control the movement of gripper rows GR between the first and second configurations.

[0078] In light of the above, end effector 13 is configured for:

- grasping containers 2 from the one or more crates 12 with grippers 14 in the first position and gripper rows GR in the first configuration; and for
- releasing containers 2 to receiver 8 with grippers 14 in the second position and gripper rows GR in the second configuration.

[0079] More precisely, in use, end effector 13 grasps at least one row (and preferably two rows) of containers 2 with grippers 14 in the first position and containers 2 spaced with first interaxis X, and with the two gripper rows GR in the first configuration, i.e. at first distance S1 from one another. Then, prior to releasing such containers 2, actuator 15 controls grippers 14 in the second position so that containers 2 are spaced with second interaxis Y, contacting one another. Also, gripper rows GR are controlled in the second configuration, i.e. at second distance S2 from one another which corresponds to tunnel distance Z. Prior to receiving containers 2, seats 10 are controlled in their receiving position. At this point, end effector 3 releases containers 2 into respective seats 10, which are spaced from one another by the minimum distance corresponding to second interaxis Y. In this condition, receiver rows RR are already spaced from one another by tunnel distance Z. Precisely, the distance between receiver rows RR is fixed and equal to tunnel distance Z. Furthermore, seats 10 are controlled in their releasing position at which they are spaced of tunnel pitch W.

[0080] At this point, receiver 8 is tilted from the rest position to the loading position for releasing containers 2 into pockets 6a.

[0081] To this end, receiver 8 preferably includes a plurality of expelling members 18, in the form of movable rods each coaxial with one respective seat 10 and axially movable to push one respective container 2 at a time to extract it from the relative seat 10.

[0082] Furthermore, receiver 8 is preferably slidable, while tilted in the loading position, on a linear guide for temporarily following the advancing movement of beams 6 (and pockets 6a) along path P. More precisely, receiver 8 comprises an actuator for controlling such movement of receiver 8. When the speed of receiver rows RR (and seats 10) matches the advancing speed of beams 6, expelling members 18 push the respective containers 2 into pockets 6a. In practice, containers 2 are released to pockets 6a when seats 10 are in a so-called "tracking" configuration with these latter. In other words, receiver 8 and conveyor 4 are in a so-called "master and slave" relationship, wherein the receiver 8 defines the slave and conveyor 4 define the master.

[0083] Thanks to the above configuration, complexity of receiver 8 is largely reduced, while reliability of the same is improved. In fact, receiver 8 is merely configured to bring the distance between received containers 2 from second interaxis Y to tunnel pitch W, while end effector 13 performs the distancing of the grasped row of containers 2 to match said tunnel distance Z.

[0084] In light of the above, thanks to the feeding system 5 according to the present invention, the infeed of new replenishment containers 2a during the loading of the washing machine 1 is largely improved, as well as the flexibility and adaptability of the washing machine 1 to different crate layouts, without unduly increasing the complexity of the feeding system 5.

[0085] Due to the foregoing, replenishing conveyor 17 is advantageously configured for providing new replenishment containers 2a spaced from one another with said second interaxis Y and end effector 13 is configured to grasp (selectively when needed) new replenishment containers 2a from replenishing conveyor 17 with grippers 14 in the second position (i.e. with grippers at second distance D2).

[0086] As visible in Figure 5a, each seat 10 comprises a pair of gripping pads 19 radially facing one another, with respect to axis C, and arrangeable between an opening position for receiving or releasing the respective container 2 and a closing position (shown in dashed lines in the figure) for gripping container 2.

[0087] Advantageously, at least one adjustable gripping pad 19' of said pair of gripping pads 19 is radially adjustable, when in said closing position, independently from the adjustable gripping pads 19' of the other seats 10 of the same receiver row RR, so as to regulate a gripping pressure thereof (independently from the other pair of gripping pads 19).

[0088] In this way, adaptability of receiver 8 to different containers 2 is improved. Furthermore, gripping pads 19 are better suited for adapting to possible tolerance errors in the radial dimension of containers 2: in detail, containers 2 of the same receiver row RR can have slightly different radial dimension, i.e. diameter. The possibility of finely adjusting the gripping pressure of each seat 10 separately allows to minimize the risk of breaking some containers 2 when gripping them, or of the undesired sliding of some containers 2 when receiver 8 is tilted in the loading position.

[0089] In one embodiment, feeding system 5 further comprises a first change station (not shown) at which a support frame (not shown) is located. The support frame supports one or more end effectors 13, each having a set of grippers 14 which are adapted to grasp containers 2 of a different format. That is, each end effector 13 supported in support frame is associated to one kind of format of containers 2 to be washed. Correspondingly, robotic arm 11 is configured to release end effector 13 of one format at first change station and to grip there another end effector 13 of a different format.

[0090] Conveniently, feeding system 5 comprises a second change station (not shown) at which another support frame (not shown) is located. Such support frame supports one or more receivers 8, each having a set of seats 10 which are adapted to receive containers 2 of a different format. That is, each receiver 8 supported in support frame is associated to one kind of format of containers 2 to be washed. Correspondingly, robotic arm 11 is configured to release receiver 8 of one format at second change station and to grip there another receiver 8 of a different format.

[0091] Hence, robotic arm 11 is also configured to perform a format change of end effector 13 and of receiver 8.

[0092] It is clear how feeding system 5 according to the invention allows to implement a method for loading

a washing machine with empty containers adapted to be filled with a pourable product, the method comprising the steps of:

a) advancing the empty containers in a washing tunnel, through consecutive treatment zones and along a conveying direction;
b) feeding a plurality of empty containers in respective pockets arranged within the washing tunnel as a plurality of consecutive tunnel rows, each tunnel row extending longitudinally along a transverse direction perpendicular to said conveying direction, the pockets of each tunnel row being spaced with a tunnel pitch between one another;
wherein the step b) of feeding comprises the steps of:

c) grasping the containers to be treated from one or more crates by means of a robotic arm comprising an end effector having a set of grippers arranged in at least one gripper row;
d) releasing the grasped containers to a receiver having a plurality of seats for receiving, each, one container at a time, the seats being arranged in at least one receiver row extending along said transverse direction; and
e) loading the received containers into said pockets by means of the receiver;
wherein the step c) of grasping includes controlling said grippers in a first position, in which the grippers are at a first distance from one another, along a first gripper direction parallel to said gripper row, so that the grasped containers are arranged in a crate layout at a non-zero distance with respect to one another thereby defining a first interaxis between them;
and wherein the step d) of releasing includes controlling said grippers in a second position, in which the grippers are at a second distance from one another, along said first gripper direction, so that the grasped containers are arranged in a packed layout and contact one another thereby defining a second interaxis between them.

[0093] Preferably, the method further comprises the step of:
f) controlling the seats of the at least one receiver row along said transverse direction, between a receiving position, in which the seats are arranged in a compact configuration at a minimum distance between one another corresponding to said second interaxis for receiving the containers from said end effector, and a releasing position, in which the seats are arranged in an extended configuration at a maximum distance between one another corresponding to said tunnel pitch for releasing the received containers to said pockets.

[0094] Preferably, the step c) of grasping is carried out by means of a robotic arm comprising an end effector having a set of grippers arranged in at least two gripper rows movable towards and away from one another along a second gripper direction perpendicular to said first gripper direction.

[0095] Accordingly, the method preferably comprises the further steps of:

g) controlling the gripper rows in a first configuration, for grasping at least two rows of containers from the one or more crates and in which the gripper rows are at a first distance from one another, along the second gripper direction, corresponding to the distance between the container rows in the one or more crates; and
h) controlling the gripper rows in a second configuration, for releasing the at least two rows of containers to the receiver and in which the gripper rows are at a second distance from one another, along the second gripper direction, corresponding to said tunnel distance.

[0096] Preferably, the method further comprises the steps of i) advancing new replenishment containers spaced from one another with said second interaxis;

1) grasping the replenishment containers by means of said end effector;
and wherein the step 1) of grasping the replenishment containers is carried out with said grippers controlled in the second position.

[0097] The advantages of washing machine 1 and the relative method according to the present invention will be clear from the foregoing description.

[0098] In particular, thanks to the feeding system 5 according to the present invention, the infeed of new replenishment containers 2a during the loading of the washing machine 1 is largely improved, as well as the flexibility and adaptability of the washing machine 1 to different crate layouts, without unduly increasing the complexity of the feeding system 5.

[0099] Clearly, changes may be made to washing machine 1 as described herein without, however, departing from the scope of protection as defined in the accompanying claims.

[0100] In particular, seats 10 of receiver 8 could be arranged in a number of receiver rows RR different from one or two. Correspondingly, grippers 14 in end effector 13 could be arranged in a number of gripper rows GR different from one or two. Preferably, the number of receiver rows RR and the number of gripper rows GR coincide.

[0101] Moreover, feeding system 5 could comprise two or more robotic arms 11 operating in parallel and, correspondingly, two or more receivers 8 operating in parallel and each configured to receive a respective plurality of containers 2 to be washed from one respective robotic arm 11.

Claims

1. Washing machine (1) for washing empty containers (2) adapted to be filled with a pourable product, the washing machine (1) comprising:

- a washing tunnel (3) housing a plurality of successive treatment zones (P1, C1, C2, H1) for treating the containers (2);
- an endless conveyor (4) extending into the washing tunnel (3) for conveying the containers (2) along a conveying direction (CD) sequentially through the treatment zones; and
- a feeding system (5) for feeding containers (2) to be treated to the conveyor (4) at an infeed zone (IZ) upstream of the washing tunnel (3);

the conveyor (4) comprising a set of receiving pockets (6a) arranged as a plurality of consecutive tunnel rows (TR), each pocket (6a) being configured to receive one container at a time, each tunnel row (TR) extending longitudinally along a transverse direction (TD) perpendicular to said conveying direction (CD);
the feeding system (5) comprising:

- a receiver (8) located at the infeed zone (IZ) and having a plurality of seats (10) for receiving, each, one container at a time, the seats (10) being arranged in at least one receiver row (RR) extending along said transverse direction (TD), the receiver (8) being configured for loading the received containers (2) into said pockets (6a); and
- a robotic arm (11) configured for grasping containers (2) to be treated from one or more crates (12) and for releasing such containers into the seats (10), respectively;

wherein the robotic arm (11) comprises an end effector (13) having a set of grippers (14) arranged in at least one gripper row (GR) and movable towards and away from one another between:

- a first position, for grasping at least one row of containers (2) from the one or more crates (12) and in which the grippers (14) are at a first distance (D1) from one another, along a first gripper direction (G1) parallel to said gripper row (GR), so that the grasped containers (2) are arranged in a crate layout at a non-zero distance with respect to one another thereby defining a first interaxis (X) between them; and
- a second position, for releasing the containers (2) to the receiver (8) and in which the grippers (14) are at a second distance (D2) from one another, along said first gripper direction (G1), so that the grasped containers (2) are arranged in a packed layout and contact one another thereby defining a second interaxis (Y) between them.

2. Washing machine as claimed in claim 1, wherein the pockets (6a) of each tunnel row (TR) are spaced with a tunnel pitch (W) between one another;
and wherein the seats (10) of the at least one receiver row (RR) are movable, along said transverse direction (TD), between a receiving position, in which the seats (10) are arranged in a compact configuration at a minimum distance between one another corresponding to said second interaxis (Y) for receiving the containers (2) from said end effector (13), and a releasing position, in which the seats (10) are arranged in an extended configuration at a maximum distance between one another corresponding to said tunnel pitch (W) for releasing the received containers (2) into said pockets (6a).

3. Washing machine as claimed in claim 2, wherein the receiver (8) comprises a pantograph system (16), said seats (10) being mechanically and kinematically coupled to one another by means of said pantograph system (16),
and wherein the receiver (8) comprises an actuator device configured to control the pantograph system (16) for driving a synchronous movement of the seats (10) between said receiving position and said releasing position.

4. Washing machine as claimed in claim 2 or 3, wherein each gripper (14) has a longitudinal axis (A) and said first distance (D1) and second distance (D2) are defined by distances between the longitudinal axes (A) of two adjacent grippers (14) along said first gripper direction (G1),

and/or wherein each container (2) has a central axis (B), and wherein said second interaxis (Y) is defined by distance between the central axis (B) of two adjacent containers and is equal to the radial extension of each container (2) with respect to said central axis (B),
and/or wherein each said seat (10) has a central axis (C) and said minimum or maximum distance is a distance between the central axes (C) of two adjacent seats (10) along said transverse direction (TD).

5. Washing machine as claimed in any one of the fore-

going claims, wherein the robot arm (11) comprises an actuator coupled to the end effector (13) and configured to control the movement of the grippers (14) between the first position and the second position; and wherein the actuator is pneumatic, hydrodynamic or electric.

6. Washing machine as claimed in any one of the foregoing claims, wherein said tunnel rows (TR) are arranged at a fixed tunnel distance (Z) between one another, orthogonally to said transverse direction (TD);
and wherein the grippers (14) of the set of grippers (14) of said end effector (13) are arranged in at least two said gripper rows (GR), such gripper rows (GR) being movable towards and away from one another, along a second gripper direction (G2) perpendicular to said first gripper direction (G1), between:

- a first configuration, for grasping at least two rows of containers (2) from the one or more crates (12) and in which the gripper rows (GR) are at a first distance (S1) from one another, along the second gripper direction (G2), corresponding to the distance between the container rows in the one or more crates (1); and
- a second configuration, for releasing the at least two rows of containers (2) to the receiver (8) and in which the gripper rows (GR) are at a second distance (S2) from one another, along the second gripper direction (G2), corresponding to said tunnel distance (Z) .

7. Washing machine as claimed in claim 6, wherein the seats (10) of the receiver (8) are arranged in at least two said receiver rows (RR) spaced from one another at a distance, along said conveying direction (CD), corresponding to said fixed tunnel distance (Z).

8. Washing machine as claimed in claim 6 or 7, wherein the end effector (13) is configured for grasping the containers (2) from the one or more crates (12) with the grippers (14) in the first position and the gripper rows (GR) in the first configuration, and wherein the end effector (13) is configured for releasing the containers (2) to the receiver (8) with the grippers (14) in the second position and the gripper rows (GR) in the second configuration.

9. Washing machine as claimed in any one of the foregoing claims, wherein the feeding system (5) comprises a replenishing conveyor (17) for providing new replenishment containers (2a) spaced from one another with said second interaxis (Y);
and wherein the end effector (13) is configured to selectively grasp said new replenishment containers (2a) with the grippers (14) in the second position.

10. Washing machine as claimed in claim 9, wherein said replenishing conveyor (17) is operatively interposed between the robotic arm (11) and the receiver (8), with respect to said conveying direction (CD).

11. Washing machine as claimed in any one of the foregoing claims, wherein each seat (10) of the receiver (8) has a central axis (C) and comprises a pair of gripping pads (19) radially facing one another and arrangeable between an opening position for receiving or releasing the respective container (2) and a closing position for retaining the container (2),
wherein, for each seat (10), at least one adjustable gripping pad (19') of said pair of gripping pads (19) is radially adjustable, when arranged in said closing position, independently from the adjustable gripping pads (19') of the other seats (10) of the same receiver row (RR), so as to regulate a gripping pressure thereof.

12. Method for loading a washing machine (1) with empty containers (2) adapted to be filled with a pourable product, the method comprising the steps of:

a) advancing the empty containers (2) in a washing tunnel (3), through consecutive treatment zones (P1, C1, C2, H1) and along a conveying direction (CD);
b) feeding a plurality of empty containers (2) in respective pockets (6a) arranged within the washing tunnel (3) as a plurality of consecutive tunnel rows (TR), each tunnel row (TR) extending longitudinally along a transverse direction (TD) perpendicular to said conveying direction (CD), the pockets (6a) of each tunnel row (TR) being spaced with a tunnel pitch (W) between one another;
wherein the step b) of feeding comprises the steps of:

c) grasping the containers (2) to be treated from one or more crates (12) by means of a robotic arm (11) comprising an end effector (13) having a set of grippers (14) arranged in at least one gripper row (GR);
d) releasing the grasped containers (2) to a receiver (8) having a plurality of seats (10) for receiving, each, one container at a time, the seats (10) being arranged in at least one receiver row (RR) extending along said transverse direction (TD); and
e) loading the received containers (2) into said pockets (6a) by means of the receiver (8);

wherein the step c) of grasping includes controlling said grippers (14) in a first position, in which the grippers (14) are at a first distance (D1) from

one another, along a first gripper direction (G1) parallel to said gripper row (GR), so that the grasped containers are arranged in a crate layout at a non-zero distance with respect to one another thereby defining a first interaxis (X) between them;
and wherein the step d) of releasing includes controlling said grippers (14) in a second position, in which the grippers (14) are at a second distance (D2) from one another, along said first gripper direction (G1), so that the grasped containers are arranged in a packed layout and contact one another thereby defining a second interaxis (Y) between them.

13. Method as claimed in claim 12, and further comprising the step of:
f) controlling the seats (10) of the at least one receiver row (RR) along said transverse direction (TD), between a receiving position, in which the seats (10) are arranged in a compact configuration at a minimum distance between one another corresponding to said second interaxis (Y) for receiving the containers (2) from said end effector (13), and a releasing position, in which the seats (10) are arranged in an extended configuration at a maximum distance between one another corresponding to said tunnel pitch (W) for releasing the received containers (2a) into said pockets (6a).

14. Method as claimed in claim 12 or 13, wherein said tunnel rows (TR) are arranged at a fixed tunnel distance (Z) between one another, orthogonally to said transverse direction (TD);

wherein the step c) of grasping is carried out by means of a robotic arm (11) comprising an end effector (13) having a set of grippers (14) arranged in at least two gripper rows (GR) movable towards and away from one another along a second gripper direction (G2) perpendicular to said first gripper direction (G1);
and wherein the method further comprises the steps of:

g) controlling the gripper rows (GR) in a first configuration, for grasping at least two rows of containers from the one or more crates (12) and in which the gripper rows (GR) are at a first distance (S1) from one another, along the second gripper direction (G2), corresponding to the distance between the container rows in the one or more crates (12); and
h) controlling the gripper rows (GR) in a second configuration, for releasing the at least two rows of containers to the receiver (8) and in which the gripper rows (GR) are at a second distance (S2) from one another, along the second gripper direction (G2), corresponding to said tunnel distance (Z).

15. Method as claimed in any one of the claims 12 to 14, and further comprising the step of

i) advancing new replenishment containers (2a) spaced from one another with said second interaxis (Y);
1) grasping the replenishment containers (2a) by means of said end effector (13);
and wherein the step 1) of grasping the replenishment containers is carried out with said grippers (14) controlled in the second position.

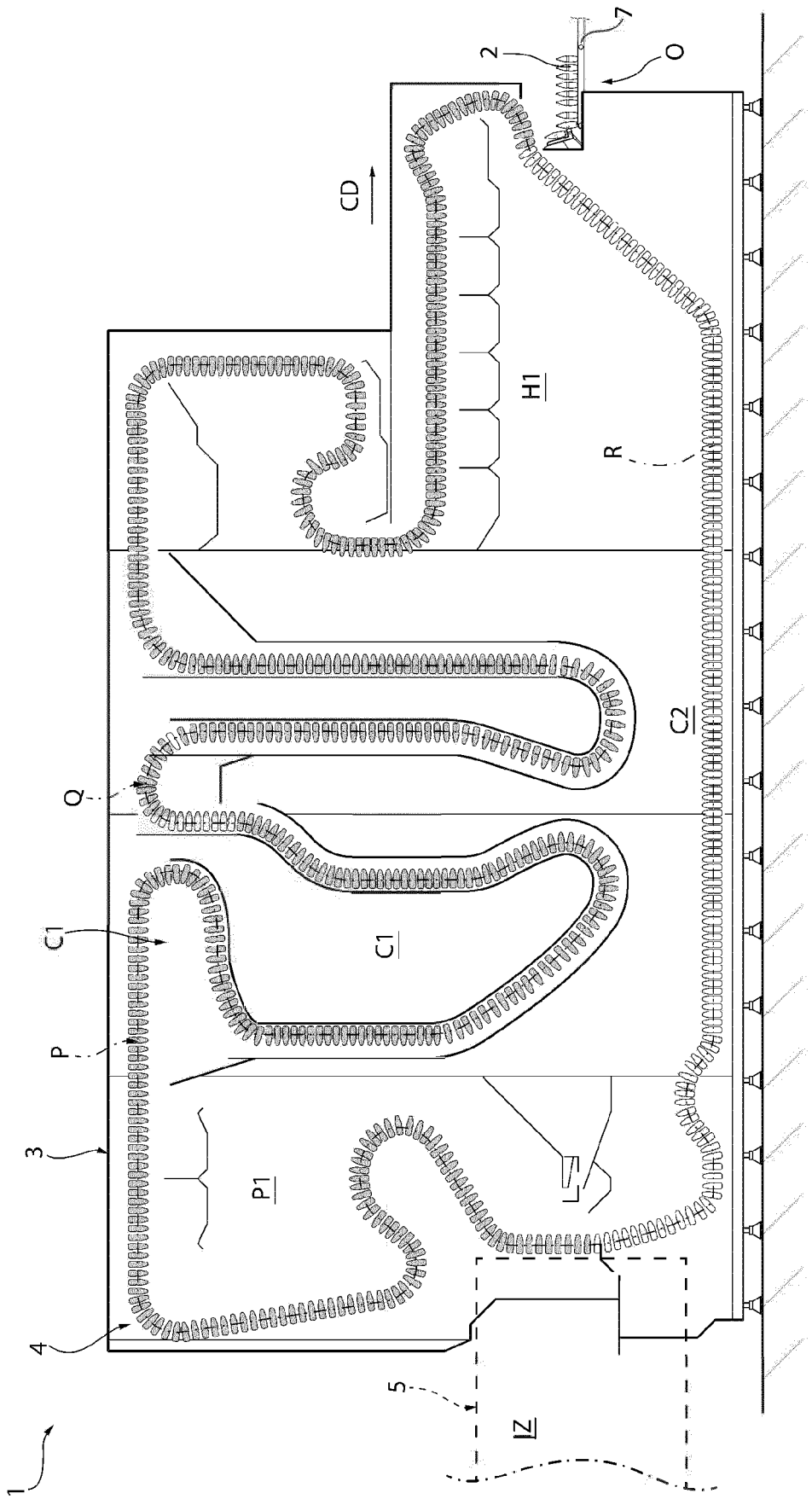


FIG. 1

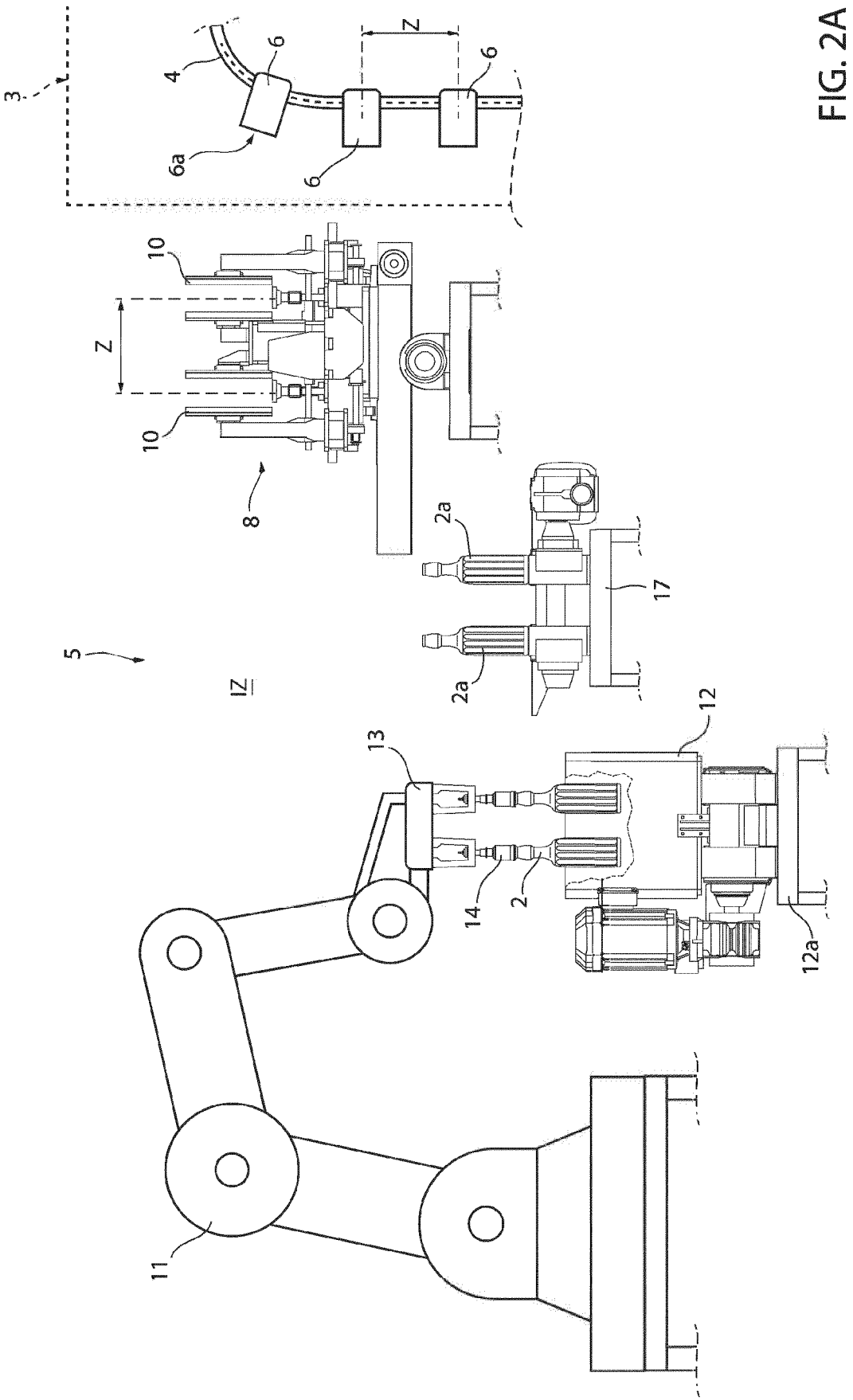


FIG. 2A

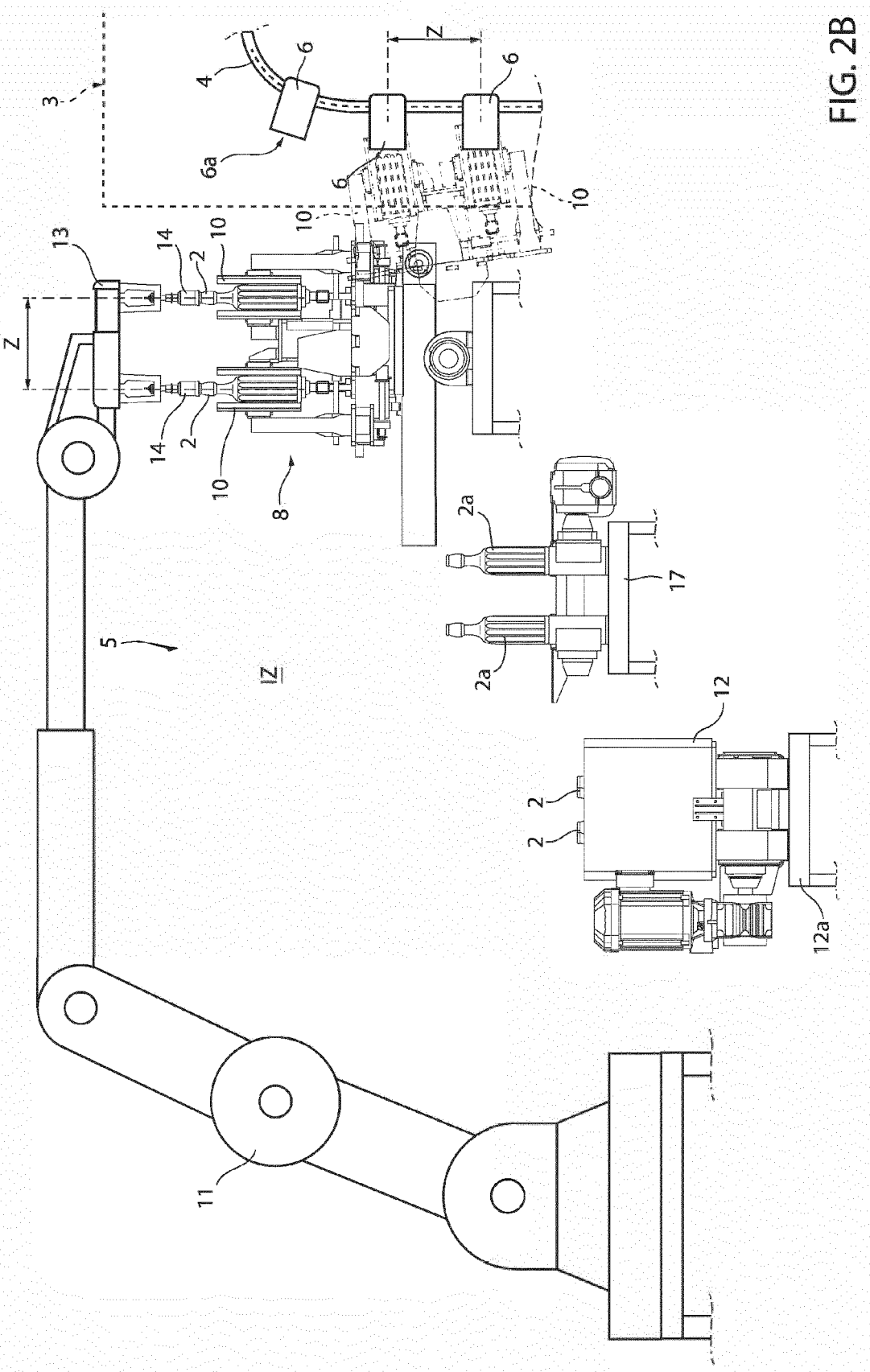


FIG. 2B

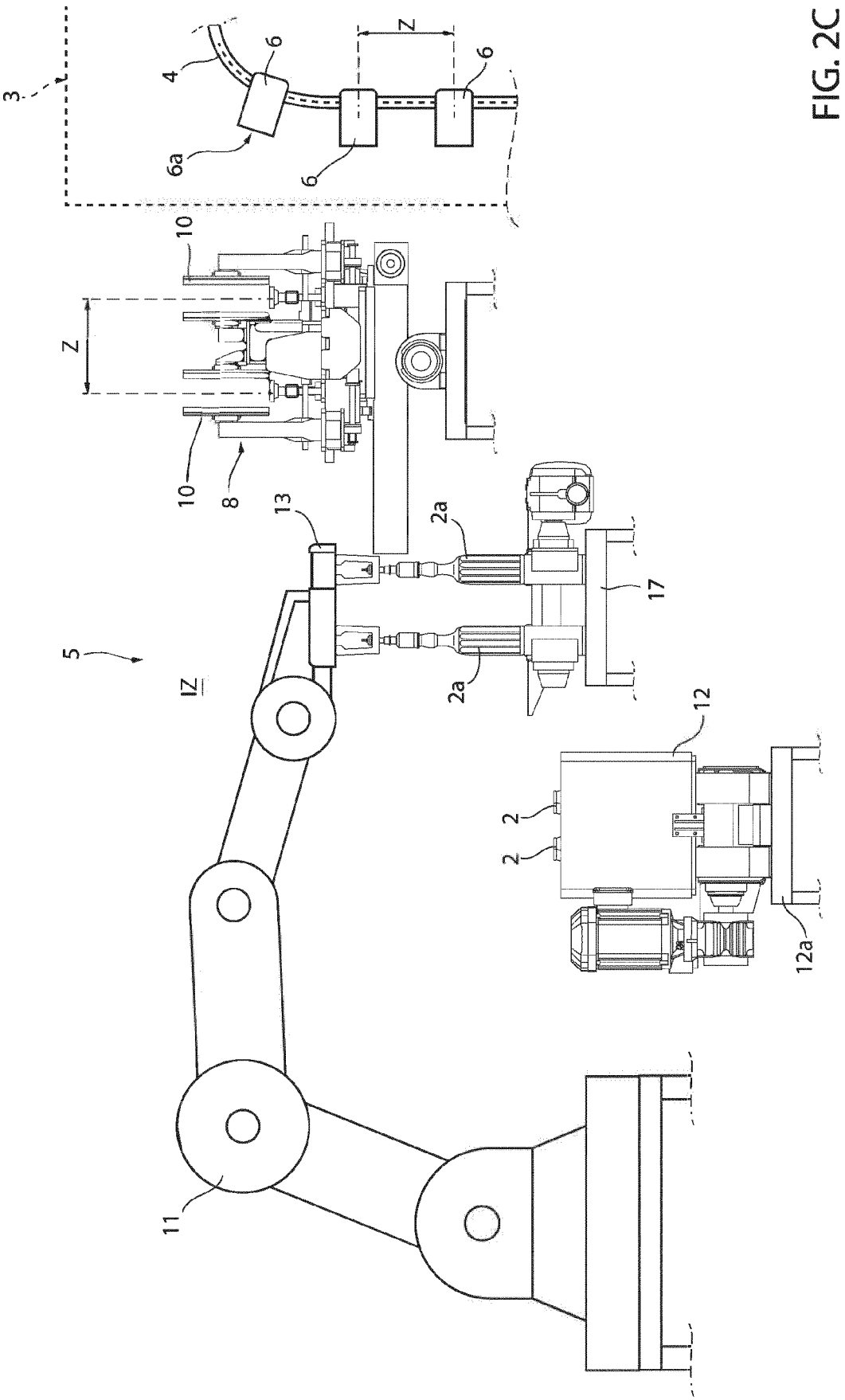


FIG. 2C

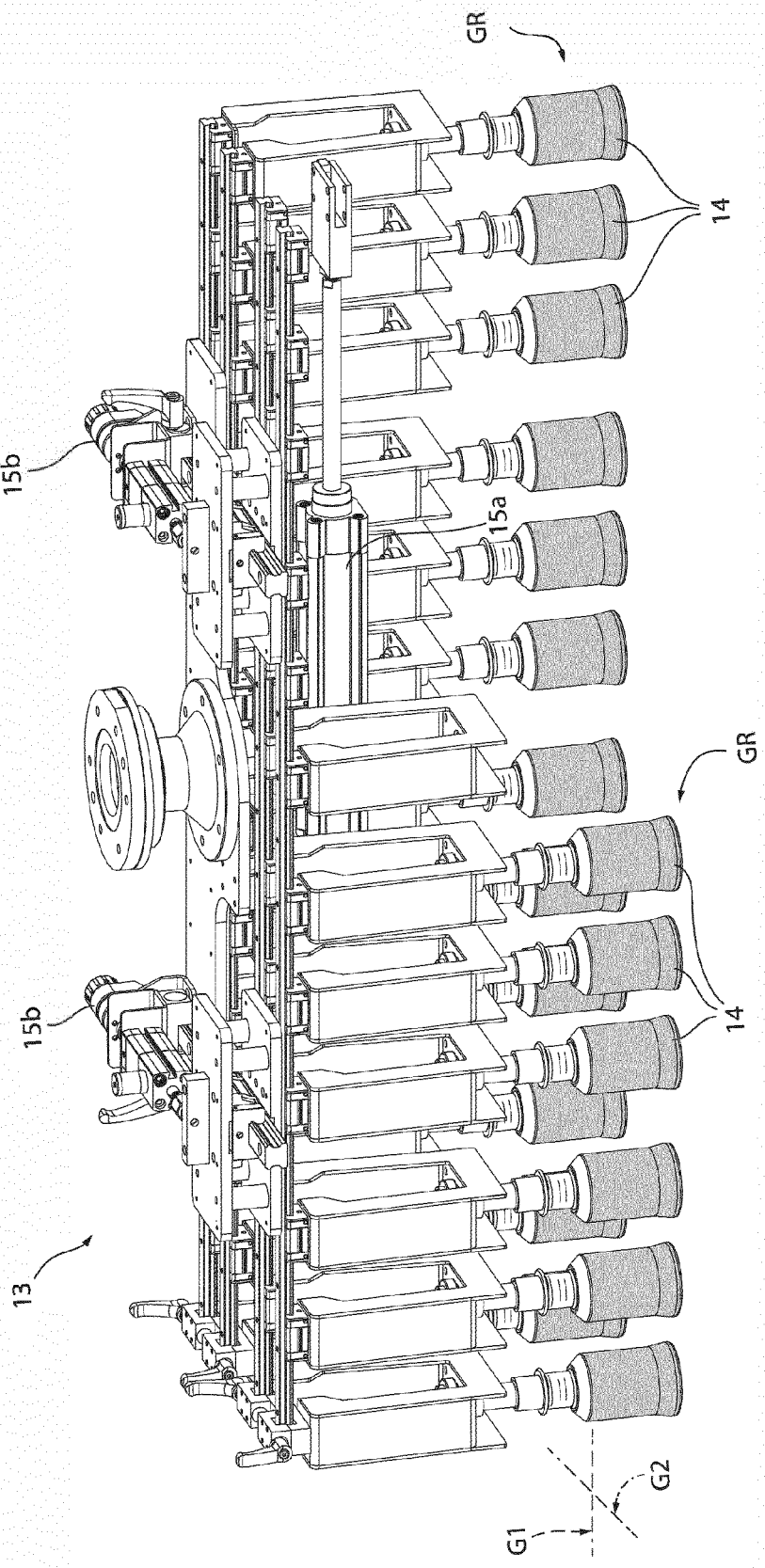


FIG. 3A

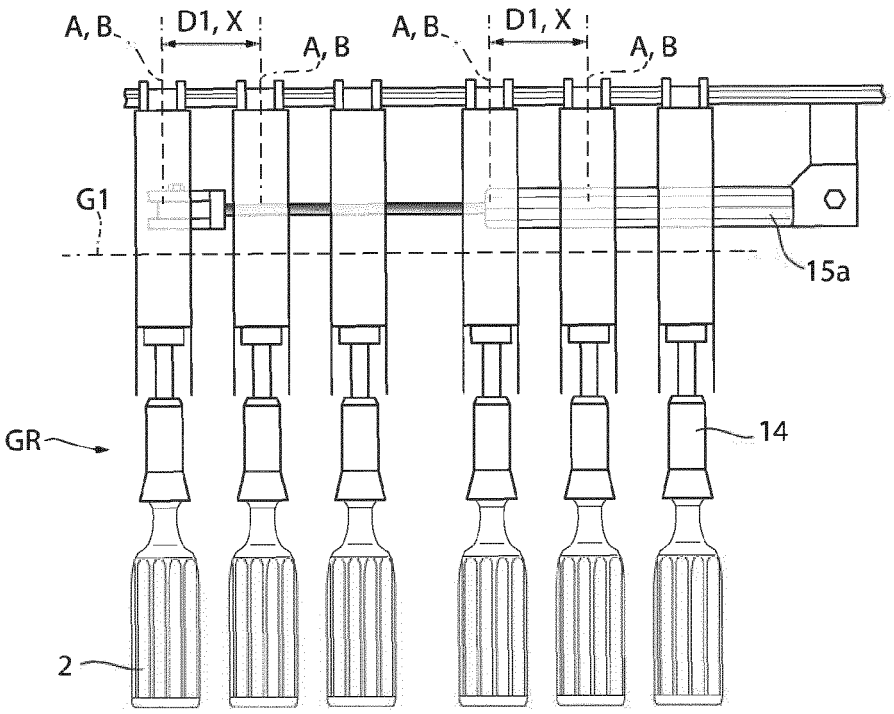


FIG. 3B

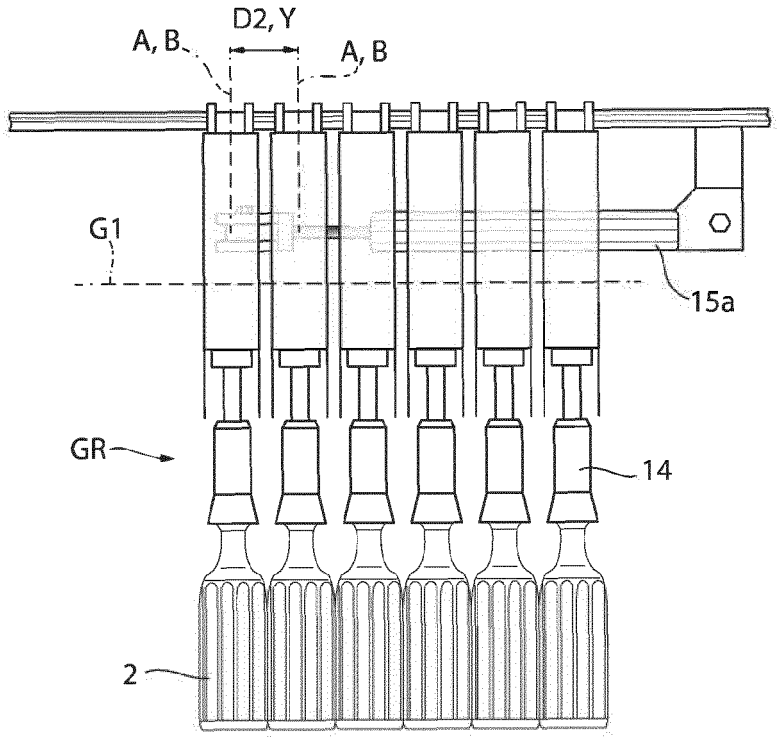


FIG. 3C

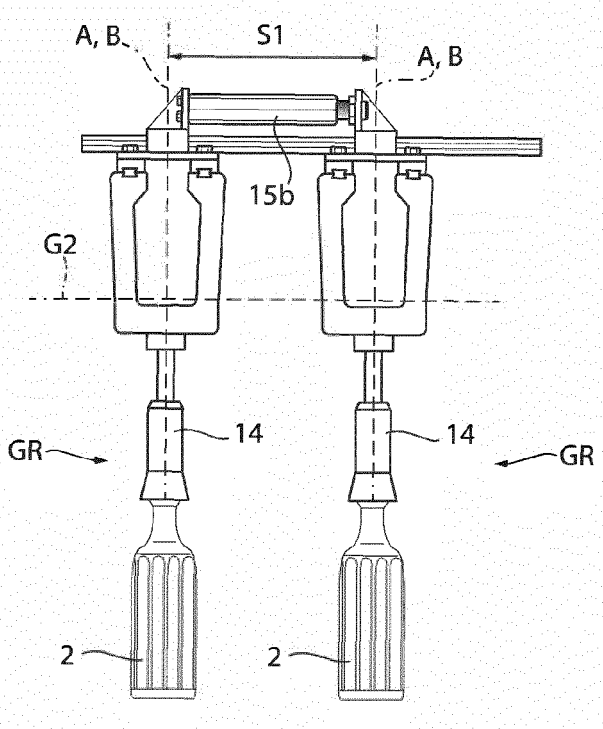


FIG. 3D

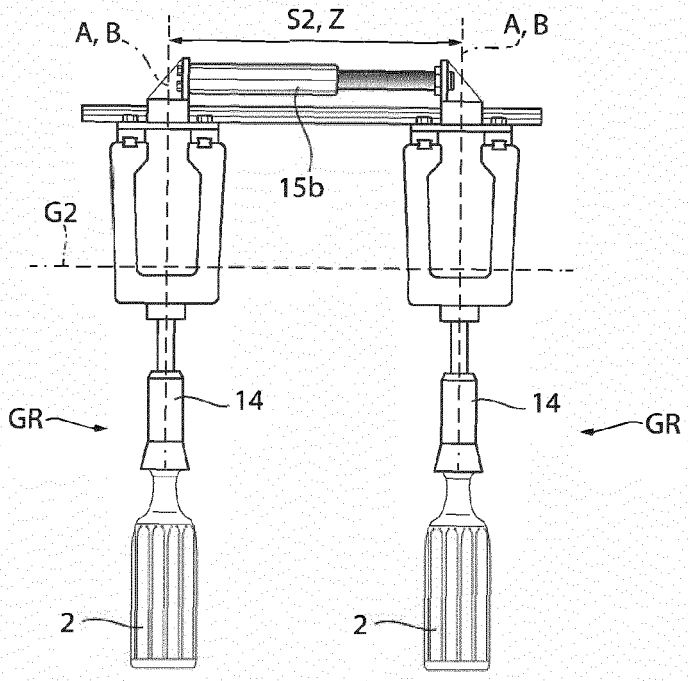
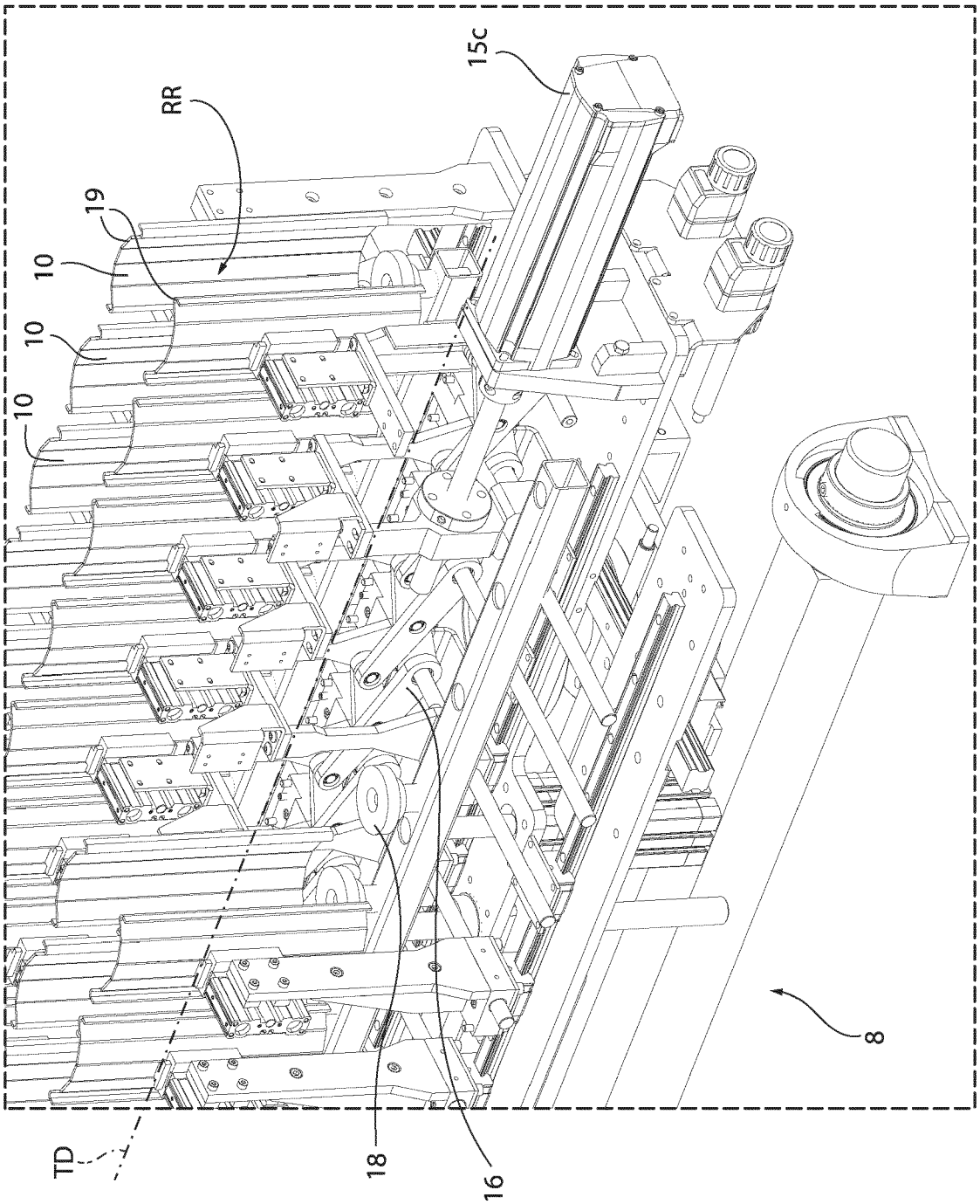


FIG. 3E

FIG. 4A



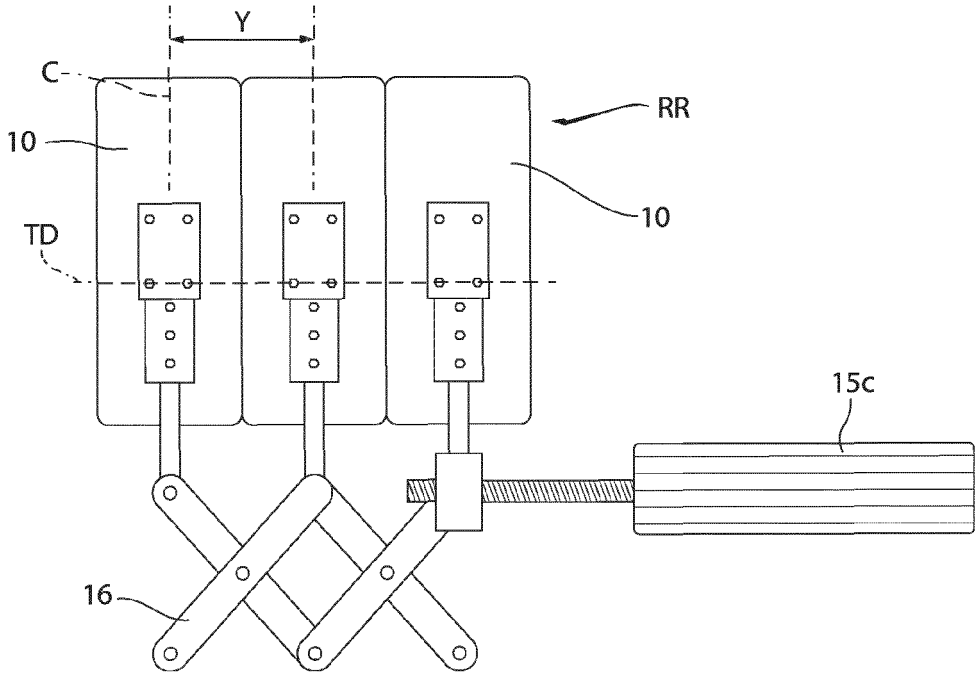


FIG. 4B

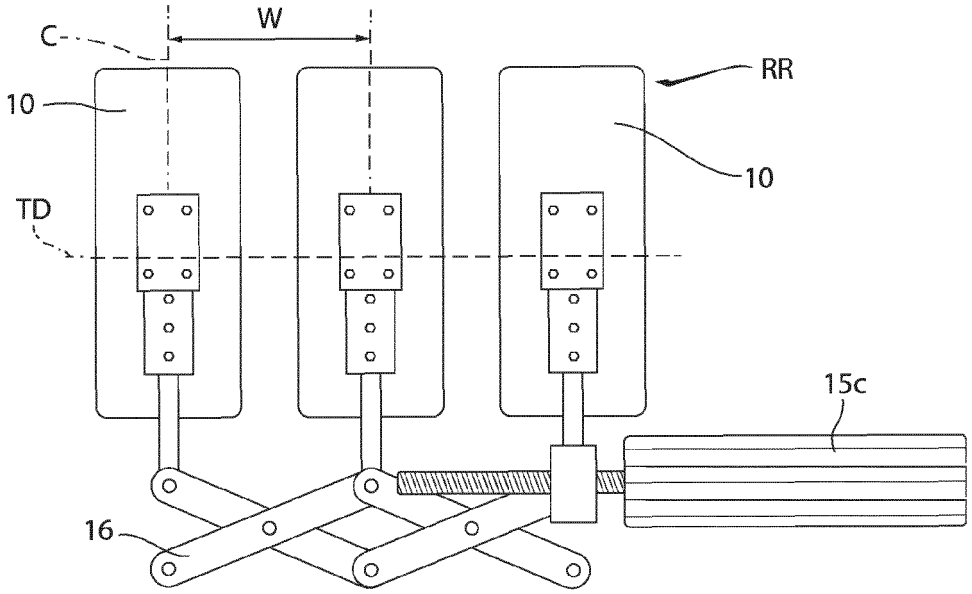


FIG. 4C

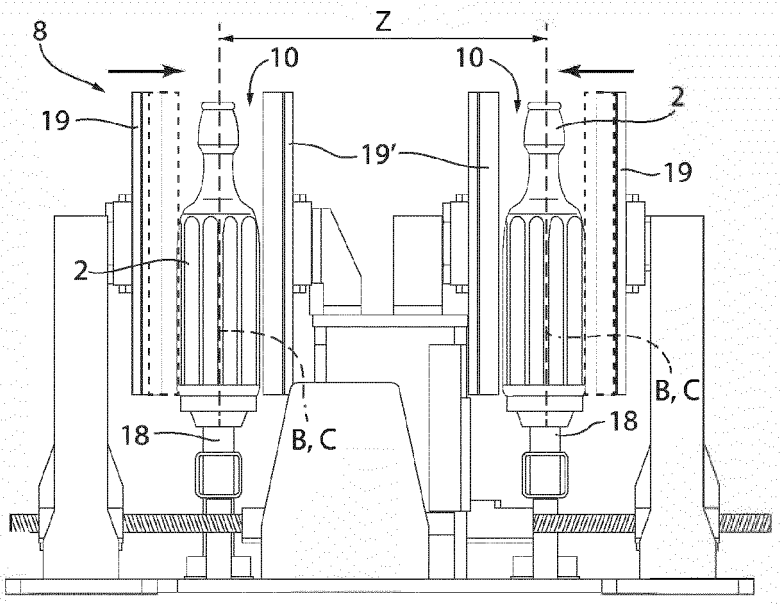


FIG. 5A

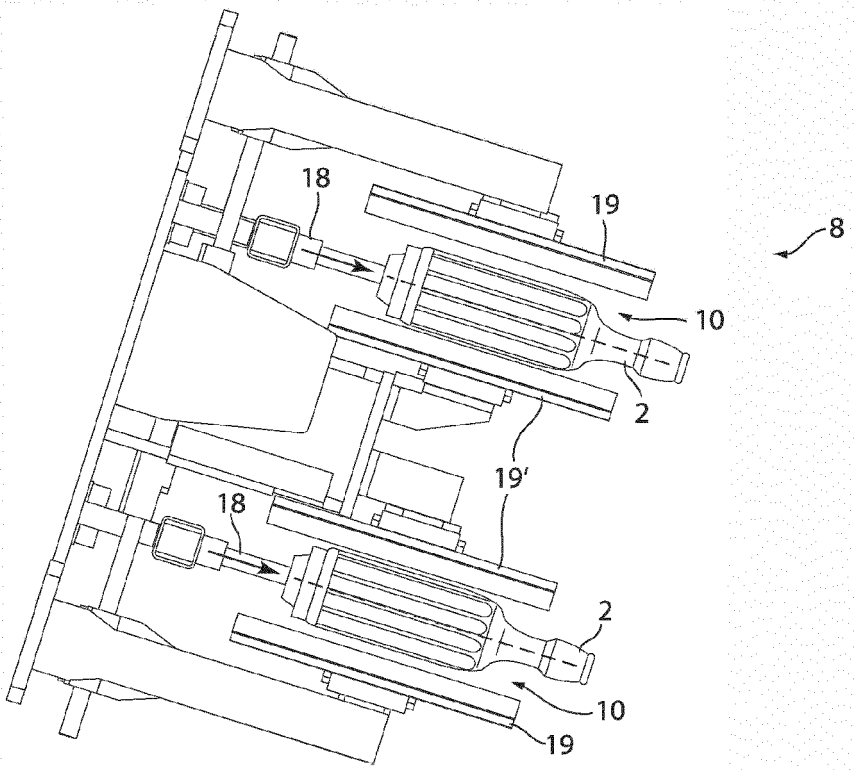


FIG. 5B

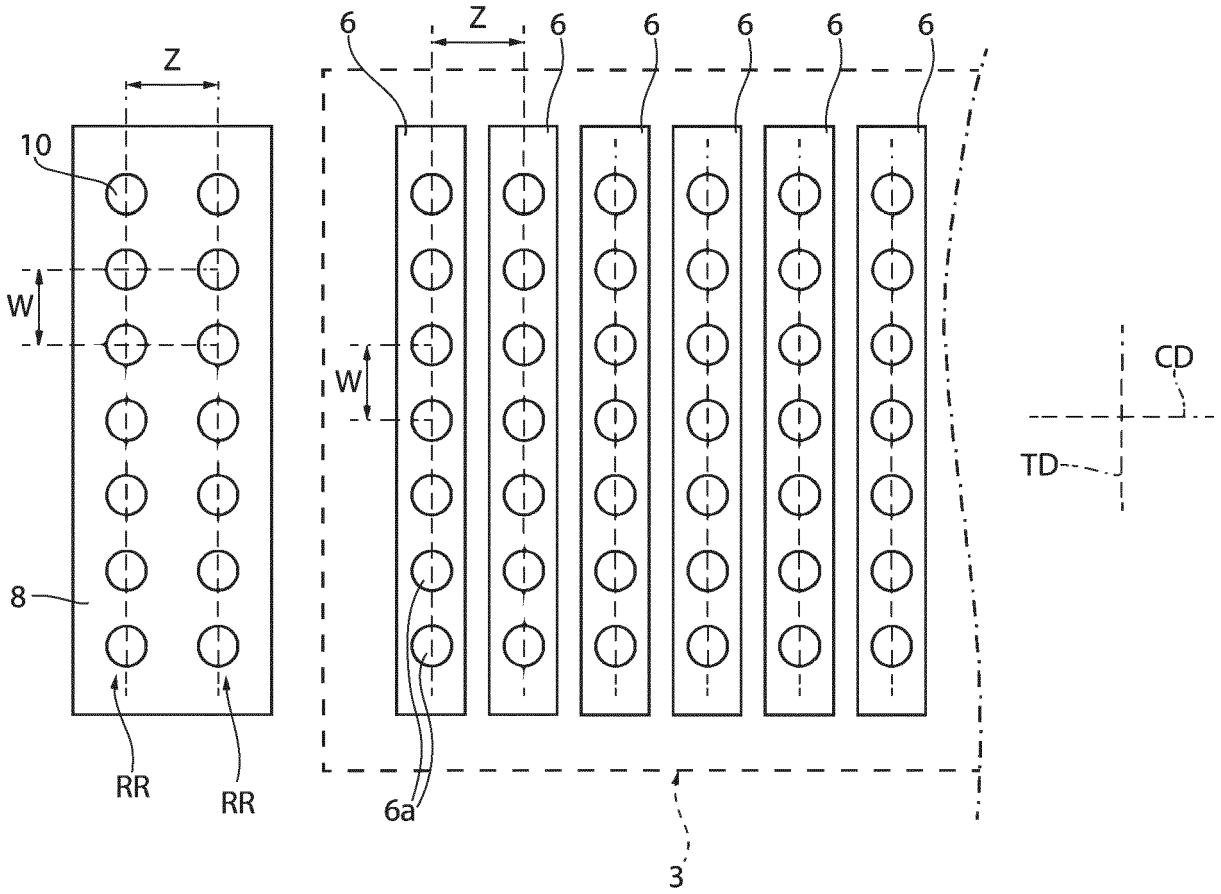


FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 3491

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	EP 3 184 181 A1 (GEBO PACKAGING SOLUTIONS ITALY SRL [IT]) 28 June 2017 (2017-06-28) * abstract * * paragraph [0001] - paragraph [0003] * * paragraph [0007] - paragraph [0013] * * paragraph [0015] - paragraph [0022] * * paragraph [0028] - paragraph [0037] * * paragraph [0041] * * paragraph [0045] - paragraph [0067] * * paragraph [0082] - paragraph [0083] * * claims * * figures *	1-15	INV. B08B9/44 B65G65/00 B08B9/42
A	US 2021/323777 A1 (MAGRI GIACOMO [IT] ET AL) 21 October 2021 (2021-10-21) * abstract * * paragraph [0001] * * paragraph [0005] * * paragraph [0013] - paragraph [0026] * * paragraph [0048] - paragraph [0052] * * paragraph [0060] - paragraph [0061] * * paragraph [0064] - paragraph [0069] * * paragraph [0072] * * paragraph [0077] - paragraph [0083] * * paragraph [0104] - paragraph [0108] * * paragraph [0113] - paragraph [0124] * * claims * * figures *	1-15	TECHNICAL FIELDS SEARCHED (IPC) B08B B65G B25J
A	CN 113 911 722 A (HUBEI CHUDA INTELLIGENT EQUIPMENT CO LTD) 11 January 2022 (2022-01-11) * figures *	1-5,8,12	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 January 2023	van der Zee, Willem

CATEGORY OF CITED DOCUMENTS

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26-01-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3184181 A1	28-06-2017	EP 3184181 A1	28-06-2017
		WO 2017109215 A1	29-06-2017
US 2021323777 A1	21-10-2021	EP 3896015 A1	20-10-2021
		IT 202000008080 A1	16-10-2021
		US 2021323777 A1	21-10-2021
CN 113911722 A	11-01-2022	NONE	

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2727660 A **[0004]**
- EP 3184181 A **[0009] [0014]**
- WO 2020119958 A **[0027] [0041]**