



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.12.2020 Bulletin 2020/50

(51) Int Cl.:
B08B 9/08 (2006.01)
B08B 9/20 (2006.01)
B08B 9/44 (2006.01)

(21) Application number: **20178109.3**

(22) Date of filing: **03.06.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **03.06.2019 IT 201900007845**

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(54) **WASHING MACHINE FOR CONTAINERS, IN PARTICULAR FOR PRODUCTS OF THE PHARMCEUTICAL INDUSTRY**

(57) Washing machine (6) for containers (1), in particular in the pharmaceutical industry, comprising: an input conveyor (7) designed to move a plurality of containers (1) along a first segment (A) of a processing path; a screw transporter (8) which is designed to move the containers (1) along a second segment (B) of the processing path and is arranged immediately downstream of the input conveyor (7) so as to receive the containers (1) coming directly from the input conveyor (7); and a cleaning

unit (9) which is arranged along a third segment (E) of the processing path downstream of the screw transporter (8) and is designed to wash each container (1). The input conveyor (7) is movable so as to change the inclination of the first segment (A) of the processing path relative to the horizontal direction and adjustment means (39) are provided, which are designed to adjust the inclination of the first segment (A) of the processing path relative to the horizontal.

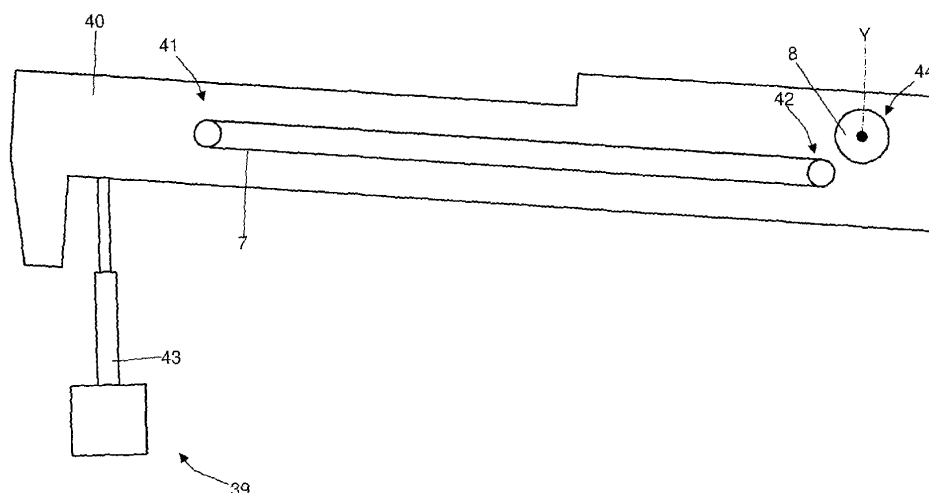


Fig. 4

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application no. 102019000007845 filed on 03/06/2019.

TECHNICAL FIELD

[0002] The present invention relates to a washing machine for containers, i.e. bottles, small bottles, flasks, vials, carpules etc. of various formats, in particular for products of the pharmaceutical industry.

[0003] The present invention finds advantageous application in the cleaning of bottles for products of the pharmaceutical industry, to which the following disclosure will make explicit reference without thereby losing its generality.

PRIOR ART

[0004] In the industry of bottle filling machines for products of the pharmaceutical industry it is known to have a washing machine for bottles upstream of the filling station of a bottle filling machine to clean each container before filling it with a given quantity of product of the pharmaceutical industry, in liquid or powder form.

[0005] A known washing machine for containers for products of the pharmaceutical industry comprises: a linear input conveyor for moving a plurality of bottles along a segment of a processing path; a screw transporter arranged immediately downstream of the linear feeding conveyor to receive the bottles coming from the linear input conveyor and to move the bottles along another segment of the processing path; a cleaning unit arranged downstream of the screw transporter and designed for cleaning the bottles while moving along a cleaning conveyor carried by the cleaning unit; a further screw transporter arranged downstream of the cleaning unit to receive the cleaned bottles leaving the cleaning unit and to move the bottles towards an output conveyor, through which the cleaned bottles will be directed towards a further station of the bottle filling machine, typically towards the weighing station or towards the filling station. A known washing machine comprises, furthermore, a feeding conveyor arranged immediately upstream of the cleaning unit to feed the bottles towards the cleaning unit and a pick-up conveyor arranged at the exit of the cleaning unit to receive the bottles leaving the cleaning unit.

[0006] The cleaning conveyor carries in a cantilevered manner a plurality of gripping devices (typically pliers or forks), which are designed to take the bottles, by grasping them at the neck, rotate them so that the dispensing opening of each bottle is oriented towards the bottom, move them rotated (i.e. "upside down" with the bottom facing up and with the neck ending in the dispensing opening oriented downwards) along a plurality of clean-

ing stations, and then rotate them again (i.e. bring them back with the bottom facing down and with the neck ending in the dispensing opening oriented upwards) before conveying them out of the cleaning unit.

[0007] A known cleaning unit comprises, furthermore, a plurality of vertically oriented dispensing ducts which are connected to a system for feeding an operating fluid (which can be, for example, demineralized water, purified water, recycled water, water added with silicone, dry air, ionized air) and ending with a dispensing nozzle from which the more or less pressurized operating fluid flows, when necessary. Through a cleaning unit thus made, each bottle is moved by the gripping devices with the dispensing opening oriented downwards, and is stopped above a dispensing duct arranged in a transport position or in a rest position (in which the dispensing duct is spaced from the bottle so as not to hinder the movement of the bottle along the cleaning conveyor). Once the bottle has been stopped over the dispensing duct, the dispensing duct is lifted from the transport or rest position to a raised position or working position, wherein the top (end) of the dispensing duct provided with the dispensing nozzle is arranged inside the bottle. At this point, the feeding system pumps an operating fluid under pressure (which can be, for example, demineralized water, purified water, recycled water, water added with silicone, dry air, ionized air) towards the dispensing duct so as to let out (spray) the operating fluid from the dispensing nozzle directly into the bottle for sufficient time to complete the cleaning step. At the end of the cleaning step, the dispensing duct is lowered to exit the bottle and place itself again in the transport or rest position, the freshly treated bottle is then moved towards the exit of the cleaning unit or towards another dispensing duct to start a new step of the cleaning cycle.

[0008] In particular, during a cleaning cycle each bottle, moving along the cleaning conveyor, is subjected to the action of several operating fluids, the various dispensing ducts are, in fact, typically arranged to dispense at least two different operating fluids, for example a cleaning liquid (typically water, possibly demineralized, and/or purified and/or recycled and/or water added with silicone) to wash the bottles, and dry air (typically heated) to dry the bottles. The feeding system suited to feed the dispensing ducts comprises, in fact, a plurality of feeding collectors, each dedicated to feed a particular operating fluid, and each connected to one or more dispensing ducts to introduce the operating fluid into the dispensing duct.

[0009] The washing machine described above has some drawbacks.

[0010] In the first place, a washing machine thus made allows only one cleaning cycle to be carried out, which is repeated and is always the same since the various dispensing ducts are each connected to a particular feeding collector. Therefore if, for any reason (e.g. when the customer and/or the material with which the bottles are made and/or the type of product to be inserted inside is changed) the cleaning cycle of the bottles needs to be

changed (i.e. the sequence with which the different operating fluids acting upon each bottle needs to be changed), it is necessary to use a different washing machine, in which the dispensing ducts that follow one another along the cleaning conveyor (and therefore along which each bottle is moved in succession) are connected to the feeding collectors of the feeding system in order to carry out the desired cleaning cycle.

[0011] Another problem encountered with the washing machine described above is linked to the fact that the gripping devices carried by the cleaning conveyor are designed to take the bottles by grasping them from a precise gripping section generally arranged near a dispensing opening of the bottle (typically at the neck of the bottle). In fact, considering that each bottle arrives at a corresponding gripping device moving on the input conveyor (i.e. resting in an upright position on the input conveyor) as the size of the bottle changes, the vertical height of the gripping section will also change, so it will be necessary to consequently change the vertical height of the gripping device to ensure the correct gripping of the bottle. Therefore, to date, as the format of the containers entering the washing machine changes, it is necessary to adjust the position of the gripping devices and/or replace the gripping devices and/or replace, or at least adjust, the connecting means with which the gripping devices are bound to the cleaning conveyor. Said operations are very laborious, require skilled workers and cannot be performed while the washing machine is mounted, therefore they require machine downtime (at least for the time necessary to complete the aforementioned replacement and/or adjustment operations) with obvious disadvantages in terms of costs and production time.

[0012] A further problem of known washing machines such as the one proposed is linked to the fact that in order for the washing machine to work at its best, i.e. at maximum efficiency, it is necessary that each pitch of the helical ridge of the screw transporter receives a bottle; however, as the format (i.e. shape and size) of the bottles varies, the amount of thrust with which the bottles arrive at the screw transporter varies, so that for given bottle formats a not optimal loading of the screw transporter could occur (i.e. some pitches of the helical ridge of the screw transporter could remain unused). To try to remedy this problem, some washing machines are designed to change the movement speed of the input conveyor arranged upstream of the screw transporter as the size of the bottles entering the washing machine changes. However, the increase in the forward speed of the input conveyor arranged upstream of the screw transporter also determines a considerable slipping of the bottles on the input conveyor. The slipping of the bottles on the input conveyor causes an increase in the wear of the feeding conveyor with a consequent reduction in the useful life of the feeding conveyor and also could cause an irregular movement of the bottles, which in the worst case would make the solution ineffective.

[0013] Patent application EP0734998A1 describes a

conveyor which moves the bottles in a bottle treatment machine; in particular, the conveyor has a transport surface adjustable in height according to the size of the bottles.

DESCRIPTION OF THE INVENTION

[0014] The object of the present invention is to provide a washing machine for products of the pharmaceutical industry, which washing machine is free from at least part of the above-mentioned drawbacks and is, at the same time, easy and inexpensive to manufacture.

[0015] According to the present invention, a washing machine for containers is provided, in particular for products of the pharmaceutical industry, according to what is claimed in the attached claims.

[0016] The claims describe embodiments of the present invention forming an integral part of the present description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The present invention will now be described with reference to the attached drawings, which illustrate some non-limiting examples of embodiments, wherein:

- Figure 1 is a schematic view of a bottle for products of the pharmaceutical industry;
- Figure 2 is a plan and schematic view of a bottle washing machine of the type illustrated in Figure 1;
- Figures 3 and 4 are side views, schematic and on an enlarged scale of a feeding conveyor and of a screw transporter of the washing machine of Figure 2 in a first and a second operating configuration, respectively;
- Figure 5 is a schematic perspective view with parts removed for clarity of a cleaning conveyor of the washing machine of Figure 2;
- Figure 6 is a plan view of the cleaning conveyor of Figure 5;
- Figure 7 is a schematic and enlarged view of a part of the cleaning conveyor of Figure 5;
- Figure 8 is a schematic and vertical section view of the cleaning conveyor of Figure 5;
- Figure 9 is an enlarged view of a part of the vertical section of Figure 8; and
- Figures 10 to 13 are schematic plan views of the cleaning conveyor of Figure 5 and of a corresponding feeding system for operating fluids in a non-operating configuration and in three different operating configurations, respectively.

PREFERRED EMBODIMENTS OF THE INVENTION

[0018] In Figure 1, number 1 denotes as a whole a bottle (small bottle, flask, vial, carpule, syringe or container of various formats) for example, a single-use one (i.e. disposable which is therefore used only once and is

then replaced) of a type known to contain a product 2 of the pharmaceutical industry (typically liquid or powder). The bottle 1 is closed by means of a cap 3, possibly covered with a plastic coating 4 which must be removed in order to remove the cap 3, and is provided with (at least) one label 5 which is glued to an external surface of the bottle 1.

[0019] In Figure 2, number 6 denotes as a whole a washing machine designed for cleaning (washing, blowing) each bottle 1 before said bottle 1 is filled with a given quantity of product 2 in a filling station of a filling machine for bottles 1. In particular, inside the washing machine 6 the bottles 1 are moved along a processing path by means of a succession of conveyors described in the following.

[0020] The washing machine 6 illustrated in Figure 2 comprises an input conveyor 7 which is designed to move a succession of bottles 1 along a linear segment A of the processing path towards a screw transporter 8, which is arranged upstream of a cleaning unit 9 and is designed to move the succession of bottles 1 along a further linear segment B of the processing path, substantially perpendicular to the segment A, towards the cleaning unit 9, passing through a star-like feeding conveyor 10 interposed between the screw transporter 8 and cleaning unit 9. The washing machine 6 comprises, furthermore, a screw transporter 11 designed to receive the clean bottles 1 which, from the cleaning unit 9, are conveyed outwards by means of a star-like pick-up conveyor 12 arranged immediately downstream of the cleaning unit 9 for guiding the bottles 1 from the cleaning unit 9 towards the screw transporter 11, which is designed to move the bottles 1 along a further linear segment C of the processing path which ends at an output conveyor 13, through which the bottles 1 moving along the linear segment D of the processing path, substantially perpendicular to the segment C, exiting the washing machine 6. The input conveyor 7 and the output conveyor 13 can either be linear or rotary and in the attached Figures are linear conveyors.

[0021] The cleaning unit 9 in turn comprises a cleaning conveyor 14 which moves the bottles 1 along a further circular segment E of the processing path, along which each bottle 1 is subjected to a cleaning cycle.

[0022] The cleaning conveyor 14 illustrated in Figures from 5 to 9 is a rotary conveyor which rotates around a vertical rotation axis Z and which carries in a cantilevered manner a plurality of gripping devices 15 (typically pliers or forks). In detail, the gripping devices 15 are mounted rotatably on a plurality of reticular beams 16 and can be moved forward by the cleaning conveyor 14 along the segment E of the processing path; in particular, in the embodiment illustrated in the attached Figures, each beam 16 supports an assembly of six gripping devices 15 side by side to one another; consequently, the rotation of each beam 16 determines the simultaneous rotation of all six gripping devices 15 carried by the beam 16. Each gripping device 15 is designed to pick-up a bottle

1 at the entering of the cleaning conveyor 14 by grasping it with a gripping section arranged near a dispensing opening of the bottles 1 (typically at the neck of the bottles 1), rotating the bottle 1 by 180° until it is placed with the dispensing opening arranged downwards, and to feed the bottle 1 rotated (i.e. "upside down" with the bottom facing upwards and with the neck ending in the dispensing opening oriented downwards) through successive cleaning stations and then rotating the bottle 1 again before leading it out of the cleaning unit 9. In other words, the bottles 1 enter the cleaning conveyor 14 oriented upwards (i.e. with the dispensing opening facing upwards), are overturned (i.e. arranged with the dispensing opening facing downwards) by means of a 180° rotation and are finally overturned again (i.e. arranged again with the dispensing opening facing upwards) before exiting the cleaning conveyor 14.

[0023] The cleaning unit 9 illustrated in Figures from 5 to 9 comprises, furthermore, a plurality of dispensing ducts 17 carried by a circular support 18 which is arranged in a fixed position (i.e. it does not rotate), is coaxial to the rotation axis Z of the cleaning conveyor 15 and is arranged below the cleaning conveyor 15. The circular support 18 carries in a cantilever manner a plurality of shelves 19 (which, in the illustrated embodiment, are integral one with the other as they are made in a single body) on which the dispensing ducts 17 are arranged, each of which is designed for dispensing an operating fluid (not illustrated) inside a bottle 1, when the bottle 1 is with the dispensing opening oriented downwards above the corresponding dispensing duct 17.

[0024] As illustrated in Figures from 10 to 13, the cleaning unit 9 comprises, furthermore, a plurality of feeding collectors 20a, 20b, 20c, in the present case three feeding collectors 20a, 20b, 20c, each designed for feeding a different operating fluid (which can be demineralized, purified, recycled water, water added with silicone, water added with sterilizing agents, dry air, or ionized air, depending on the operations that the operating fluid must carry out) and each connectable to at least one dispensing duct 17.

[0025] According to a preferred embodiment of the present invention, the dispensing ducts 17 are assembled in a plurality of dispensing assemblies 21 which are independent of and separate from one another and are arranged in succession one after the other along the processing path. Each dispensing assembly 21 is formed by four dispensing ducts 17 and is provided with a single distributing device 22 connectable to each of the feeding collectors 20a, 20b, 20c to receive an operating fluid and distribute the same to the dispensing ducts 17 of the dispensing assembly 21 (in the present case to the four dispensing ducts 17 of each dispensing assembly 21); in other words, each dispensing assembly 21 is potentially connectable to all the feeding collectors 20a, 20b, 20c and is effectively connected to a single feeding collector 20a or 20b or 20c at a time.

[0026] Furthermore, each feeding collector 20a, 20b,

20c has a plurality of outputs 23 which can be used by a distributing device 22 (i.e. connected to a distributing device 22), or unused (i.e. disconnected from all distributing devices 22 and therefore from all the dispensing assemblies 21) and typically closed by means of a respective screwed cap (not illustrated) and/or by means of a valve which is integrated with the feeding collector 20a or 20b or 20c and can be manually or electrically operated.

[0027] In particular, the connection between the outputs 23 of the feeding collectors 20a, 20b, 20c and the distributing devices 22 of the various dispensing assemblies 21 takes place by means of a plurality of flexible pipes 24, each arranged to connect a single output 23 of a feeding collector 20a or 20b or 20c to an input 25 of a distributing device 22 of a single dispensing assembly 21, independently of the remaining dispensing assemblies 21, so that by adding a new pipe 24, or by moving an existing pipe 24, it is possible to selectively connect the inputs 25 of the various distributing devices 22 to respective feeding collectors 20. In this way, by connecting at will the inputs 25 of the various distributing devices 22 with the outputs 23 of the various collectors 20a, 20b, 20c, it will be possible to modify at will the cleaning cycle to which each bottle 1 is subjected while moving along the cleaning conveyor 14 through the various dispensing assemblies 21 (i.e. through at least one dispensing duct 17 of each of the dispensing assemblies 21). An example of the extreme flexibility of the system is illustrated in Figures 11, 12 and 13, from comparison thereof it is evident that simply by changing the configuration (i.e. the number and/or the arrangement) of the pipes 24 it is possible to modify the number and arrangement of the dispensing assemblies 21, which feed a given operating fluid thus changing the cleaning cycle to which each bottle 1 is subjected. For example, supposing to dispense water to the feeding collector 20a and dry air to the feeding collector 20b, in the embodiment illustrated in Figure 11 six consecutive dispensing assemblies 21 are provided, which dispense water followed by four dispensing assemblies 21 (not all consecutive) that dispense dry air, while the embodiment illustrated in Figure 12 five consecutive dispensing assemblies 21 are provided, which dispense water followed by two consecutive dispensing assemblies 21 which dispense dry air. On the other hand, supposing to feed water added with sterilizing additives to the feeding collector 20a, pure water to the feeding collector 20b and dry air to the feeding collector 20c, in the embodiment illustrated in Figure 13 one single dispensing assembly 21 is provided, which dispense pure water, followed by three consecutive dispensing assemblies 21 which dispense water added with sterilizing additives, followed by two consecutive dispensing assemblies 21 which dispense pure water, and finally followed by five consecutive dispensing assemblies 21 which dispense dry air.

[0028] With particular reference to Figure 7, the dispensing ducts 17 of each dispensing assembly 21 are mounted on the corresponding distributing device 22, so

as to be oriented with the dispensing opening facing upwards (i.e. so as to dispense the operating fluid upwards) and comprise threaded pipes 26 that protrude from the distributing device 22 and on which the corresponding dispensing ducts 17 are screwed, provided with respective dispensing nozzles 27.

[0029] Furthermore, in order to allow the cleaning cycle to be carried out, the circular support 18 which carries the shelves 19 and therefore the various cleaning assemblies 21 is movable close to or away from the cleaning conveyor 14 in a vertical direction (parallel to the rotation axis Z of the cleaning conveyor 14) under the action of an actuating device (schematically illustrated in Figure 7) between an operating position, in which each dispensing duct 17 is partially arranged inside a corresponding bottle 1 carried with the dispensing opening facing downwards by a gripping device 15, and a transport position in which each dispensing duct 17 is completely on the outside relative to the bottles 1 carried by the cleaning conveyor 14 so as not to hinder the bottles 1 during their movement from one cleaning station to the next (i.e. from a dispensing assembly 21 which dispenses a given operating fluid to another dispensing assembly 21, which dispenses an operating fluid that can be different from the previous one).

[0030] In detail, during a cleaning cycle, each bottle 1 is moved by the cleaning conveyor 14 with the dispensing opening oriented downwards and is stopped, by the cleaning conveyor 14, at a cleaning station and above a dispensing duct 17 of a dispensing assembly 21 arranged in a lowered or rest position in which the dispensing duct 17 is spaced from the bottle 1 so as not to hinder the movement of the bottle 1. Once each bottle 1 is above a dispensing duct 17, the circular support 18, under the action of the actuating device, is lifted from the transport position or lowered position towards an operating or raised position in which the upper (terminal) part of each dispensing duct 17, provided with the dispensing nozzle 27, is inside the bottle 1. At this point, each feeding collector 20a, 20b, 20c dispenses, preferably by means of a dispensing pump (not illustrated), the operating fluid through the pipes 24 to each distributing device 22 connected to one of the outputs 23 of the feeding collector 20a, 20b, 20c, which distributing device 22 will distribute the operating fluid to the various dispensing ducts 17 of each dispensing assembly 21 to let the operating fluid out (spray) from the dispensing nozzles 27 directly into the respective bottles 1 for a time sufficient to complete the cleaning step. At the end of each cleaning step the dispensing assemblies 21 are lowered to make each dispensing duct 17 exit from the corresponding bottle 1 and are placed again in the transport or rest position. It should be noted that during the cleaning step both the bottles 1 and the dispensing ducts 17 are moving along the processing path: the bottles 1 are carried by the gripping devices 15 (which are in turn carried by the cleaning conveyor 14) while the dispensing ducts 17 are set into rotation by the shelves 19 which rotate coaxial to the rota-

tion axis Z of the cleaning conveyor 14.

[0031] In detail, during the cleaning step the dispensing ducts 17 are in the operating position inside the bottles 1 and rotate in the same direction with the cleaning conveyor 14. Once the cleaning step is over, the dispensing ducts 17 are brought to the rest position and rotate in a direction different from the rotation direction of the cleaning conveyor 14. Therefore, this alternating movement of the dispensing ducts 17 allows to perform the internal cleaning cycle without stopping the bottles 1.

[0032] According to an alternative embodiment, the bottles 1 could be moved forward step by step corresponding to the various cleaning stations; in this case, each bottle 1 which has just been treated is then moved towards a new cleaning station (i.e. towards another dispensing assembly 21 which dispenses a given operating fluid that may be different from the previous one) until the cleaning cycle is completed (i.e. until each bottle 1 has been moved in the area of a dispensing duct 17 of each active dispensing assembly 21).

[0033] Basically, for the purpose of cleaning the bottles 1, the latter and the dispensing ducts 17 are moved mutually in order for the dispensing nozzles 27 of the dispensing ducts 17 to be inside the respective bottles 1 during the various cleaning steps so that the operating fluid directly and optimally contacts the inner walls of the bottles 1.

[0034] According to a possible embodiment, the operating fluid is let out of the dispensing duct 17 during a single dispensing operation without interruption (i.e. during the single dispensing operation the flow of the operating fluid is never interrupted). According to a different embodiment, the operating fluid is let out of the dispensing duct 17 during two (or more) successive dispensing operations between which a pause is provided (i.e. a lack of dispensing of the operating fluid).

[0035] Preferably, the movement at step of the cleaning conveyor 14 during its rotation around the axis Z is such as to make sure that a number of bottles 1 equal to the number of dispensing ducts 17 which form each dispensing assembly 21 is moved at each feeding step (i.e. at each rotation step around the rotation axis Z) from a cleaning station to the next cleaning station, therefore from a position in the area of a dispensing assembly 21 to the next dispensing assembly 21.

[0036] In the embodiment illustrated in the attached Figures, the cleaning unit 9 comprises eleven dispensing assemblies 21, each comprising four dispensing ducts 17; whereby each bottle 1 during a cleaning cycle undergoes a maximum of eleven cleaning steps, which can be different from one another, since each of these dispensing assemblies 21 can be selectively and independently connected to any of the various feeding collectors 20a, 20b, 20c.

[0037] As illustrated in Figures 10 to 13, the cleaning unit 9 comprises three different feeding collectors 20a, 20b and 20c which are arranged inside the circular support 18; each feeding collector 20a, 20b or 20c has twelve

outputs 23 in order to be connectable to all eleven dispensing assemblies 21, i.e. a single feeding collector 20a, 20b or 20c could be connected to all eleven dispensing assemblies 21 (in fact there is a twelfth output 23 which is in excess since there are only eleven dispensing assemblies 21 and which is in reserve). Each feeding collector 20a, 20b or 20c is connected to a respective operating fluid feeding system 29a or 29b or 29c, which can for example provide a tank (not illustrated) that contains an operating fluid and which is connected, possibly by means of a pump, to the respective feeding collector 20a or 20b or 20c. The operating fluid can be, for example, demineralized water, purified water, recycled water, water added with silicone, dry air, or ionized air.

[0038] As previously mentioned, Figures from 11 to 13 show some of the different configurations that the cleaning unit 9 of the invention can assume, which corresponds to as many different cleaning cycles. In particular in Figures 11 and 12, the feeding collector 20a is connected to the distributing devices 22 of dispensing assemblies 21 arranged in the initial part of the segment E of the processing path and could, for example, feed a cleaning liquid (typically water), the feeding collector 20b, which is connected to distributing devices 22 of dispensing assemblies 21 arranged in the final part of the segment E of the processing path could feed dry (preferably heated) air so as to perform a drying step subsequent to the washing step; while the collector 20c is unused. Whereas, In Figure 13 some of the outputs 23 of the feeding collector 20c are also used: in detail, in Figure 13 the distributing devices 22 of a dispensing assembly 21 arranged in the initial part of the segment E of the processing path is connected to the feeding collector 20b, the distributing devices 22 of three consecutive dispensing assemblies 21 are connected to the feeding collector 20a and the distributing devices 22 of the remaining dispensing assemblies 21 arranged in the final part of the segment E of the processing path are connected in part to the feeding collector 20b and the remaining part to the feeding collector 20c, therefore this configuration could represent, for example, a cleaning cycle which envisages three distinct washing steps followed by a drying step, in the event that the collectors 20a and 20b are designed for feeding fluids cleaning agents, for example water and ionized air, and the collector 20c is designed for feeding dry air (preferably hot).

[0039] According to an embodiment not illustrated, the unused dispensing assemblies 21 could be provided with plugs (not illustrate) mounted on the threaded pipe 26 of the distributing device 22 of each of the dispensing ducts 17 of the dispensing assembly 21 so as to prevent unwanted leaks of the operating fluid in the event of connection errors and, at the same time, protect the dispensing ducts 17 and prevent the same from being damaged or blocked during their non-use, for example due to external agents such as dust, production waste, etc.

[0040] Alternatively, or in combination, valves, prefer-

ably electric ones, could be provided which can be operated to prevent the flow towards the unused dispensing assemblies 21, said valves could for example be arranged at the entering of each distributing device 22.

[0041] It is understood that as the number of feeding collectors 20a, 20b, 20c increases the number of different operating fluids that can be used and, therefore, increases the number of possible cleaning cycles that can be performed with the washing machine 6 simply by arranging in a different way the pipes 24 and thus modifying the connections between the distributing devices 22 and the outputs 23 of the various feeding collectors 20a, 20b, 20c.

[0042] It is also understood that each dispensing assembly 21 could be formed by any number of dispensing ducts 17, in particular as the number of dispensing ducts 17, which forms a single dispensing assembly 21, increases, the number of distributing devices to be connected to the various feeding collectors 20a, 20b, 20c and, consequently, the number of outputs 23 of each feeding collector 20a, 20b, 20c will decrease, thus simplifying the washing unit 9, but at the same time the number of different cleaning steps at which every single bottle 1 along a cleaning cycle can be subjected will decrease. On the contrary, as the number of dispensing ducts 17, which form each single dispensing assembly 21, decreases, the freedom with which the cleaning cycle can be varied will increase, i.e. the possible cleaning steps to which each individual bottle 1 moving along the cleaning conveyor 14 will increase.

[0043] The cleaning unit 9 can also comprise a collecting tank (not illustrated) which collects the water following cleaning and is arranged in a fixed position below the dispensing assembly 21.

[0044] In the event that one of the feeding collectors 20a, 20b and 20c is suited to feed ionized air, a suction source (situation not illustrated) can also be provided to suck the ionized air so that it does not disperse into the surrounding environment.

[0045] It is understood that the feeding conveyor 14 could support any other seat (not illustrated), in place of the gripping devices 15, designed for housing a container 1 and for moving the container 1 suitably oriented along the segment E of the processing path (i.e. along the succession of dispensing ducts 17).

[0046] According to a preferred embodiment of the present invention illustrated in Figures 8 and 9, the cleaning conveyor 14 is mounted on a frame 30 of the washing machine 6 so as to be movable along a vertical adjustment direction, which is preferably coaxial to the rotation axis Z of the cleaning conveyor 14.

[0047] In said regard, the washing machine 6 comprises adjustment means 31 designed to move the cleaning conveyor 14 along the adjustment direction to change a vertical height of the gripping devices 15 with respect to the feeding conveyor 10, which moves the bottles 1 towards the gripping devices 15. In particular, the adjustment means 31 are arranged to change a vertical portion of the cleaning conveyor 14 so that the vertical portion

of the gripping devices 15 coincides with a vertical portion of the gripping section of the bottles 1 entering the cleaning conveyor 14; as previously said, the gripping section of a bottle 1 is typically arranged near the opening of the bottle 1, preferably at the neck of the bottle 1. In this way it will be possible, by suitably operating the adjustment means 31, to lift or lower the cleaning conveyor 14 according to the size of the bottles 1 entering the washing machine 6 so as to make sure that each gripping device 15 grasps the gripping section of a corresponding bottle 1 while said bottle 1 moves along the feeding conveyor 10 arranged upstream of the cleaning conveyor 14.

[0048] According to what is illustrated in Figures 2 and 8, the bottles 1 enter the cleaning conveyor 14 carried by the feeding conveyor 10 interposed between the screw transporter 8 and the cleaning unit 9; in the embodiment illustrated in the attached Figures, the feeding conveyor 10 is a rotating star-like conveyor, while according to other embodiments not illustrated, the feeding conveyor 10 could be replaced by any other linear or rotating conveyor which moves the bottles 1 in an upright position towards the cleaning conveyor 14.

[0049] In Figures 8 and 9, the drum 28 of the cleaning conveyor 14 is mounted on a shaft 32 which is rotatable around the rotation axis Z and is also axially slidable along the rotation axis Z so as to allow the lowering or lifting of the cleaning conveyor 14 by suitably operating the adjustment means 31.

[0050] With particular reference to Figure 9, the adjustment means 31 comprise a vertical support rod 33 (in this case a screw) which supports the shaft 32 with the interposition of an oblique ball bearing 34 and is connected to an actuating device 35 designed to actuate the rod 33 in motion along the rotation axis Z.

[0051] According to the embodiment illustrated in Figures 8 and 9, the actuating device 35 comprises a nut 36 internally threaded and coupled to the rod 33 and an electric motor (schematically illustrated in Figure 8) designed to rotate the nut 36 so that the rotation of the nut 36 determines the screwing of the rod 33 and consequently a movement of the shaft 32, and therefore of the entire cleaning conveyor 14, along the rotation axis Z.

[0052] Further bearings 37 are also arranged between the shaft 32 and the frame 30 of the washing machine 6 above the oblique ball bearing 34 and are both shaped to allow rotation of the shaft 32 around the rotation axis Z, and to allow the movement of the shaft 32 along the rotation axis Z.

[0053] The adjustment means 31 are preferably connected to a control unit 38 (schematically illustrated in Figure 2) configured to determine the format of the bottles 1 entering the washing machine 6 and therefore to change the vertical height of the gripping devices 15 accordingly, so as to ensure that each gripping device 15 grips the gripping section of a corresponding bottle 1. For this purpose, the control unit 38 comprises at least one memory unit designed for storing a program associating each format of the containers 1 with a corresponding ver-

tical portion of the gripping devices 15. For this reason, once the data about the format of the containers 1 has been entered, the control unit 38, based on the programming contained in the memory unit, will activate the adjustment means 31 to ensure the correct gripping of the containers 1 by means of the gripping devices 15.

[0054] In particular, the format of the containers 1 can be entered manually by the operators before starting to use the washing machine 6 by using a user interface (not illustrated) which is connected to the control unit 38. As an alternative or in combination with the user interface, the washing machine 6 can comprise detection means (for example optical sensors) capable of scanning the containers 1 moving along the processing path and sending the corresponding data to the control unit 38, which, by comparing the data with those contained in the memory unit, will be able to identify the format of the containers 1 and consequently, again on the basis of the data contained in the programming, to operate the adjustment means 31.

It is understood that the actuating device 35 described above and shown in Figures 8 and 9 could be replaced with any other actuating device with the same function. For example, the rod 33 could be connected directly to a linear actuating device that can be operated to lift or lower the rod 33 and therefore to change the vertical height of the gripping devices 15.

[0055] According to a further preferred embodiment and with reference to Figures 3 and 4, the washing machine 6 comprises further adjustment means 39 designed to adjust the inclination of the input conveyor 7 relative to the horizontal direction, and therefore the pressure with which the bottles 1 arrive at the screw transporter 8, to ensure that each pitch of the helical ridge of the screw transporter 8 receives a bottle 1 coming from the input conveyor 7, in order to optimize the efficiency of the washing machine 6 in terms of speed and feed regularity of the bottles 1.

[0056] According to said embodiment illustrated in Figures 3 and 4, the input conveyor 7 is carried by a support frame 40 which is mounted rotatably around a horizontal rotation axis Y so that, when suitably operated by the adjustment means 39, can rotate around the axis Y consequently changing the inclination of the input conveyor 7 relative to the horizontal direction.

[0057] According to what is illustrated in Figures 3 and 4, the adjustment means 39 are arranged to act on the support frame 40 so as to change the vertical height of an input end 41 of the input conveyor 7 and keep the vertical height at an output end 42 of the input conveyor 7 constant, since at the output end 42 the input conveyor 7 is coupled to the screw transporter 8 so that said section cannot be moved in order not to lose contact with the screw transporter 8; in other words, the output end 42 of the input conveyor 7 represents the fixed point around which the support frame 40 and therefore the input conveyor 7 can rotate.

[0058] According to what is illustrated in Figures 3 and

4, the adjustment means 39 comprise a linear actuating device 43 (for example a pneumatic or hydraulic cylinder) which is connected to the end of the support frame 40 opposite the screw transporter 8 and is designed to lift or lower said end.

[0059] Preferably the rotation axis Y around which the support frame 40 rotates in order to change the inclination of the input conveyor 7 is parallel, and even more preferably coaxial, to the screw transporter 8.

[0060] The control unit 38 of the washing machine 6 is configured to determine a format of the containers 1 entering the washing machine 6 and therefore to change the inclination of the input conveyor 7 relative to the horizontal direction so as to ensure that each pitch of the helical ridge of the screw transporter 8 receives a container 1 coming from the input conveyor 7.

[0061] The control unit 38 comprises at least one memory unit designed for containing a program associating each format of the containers 1 with a corresponding inclination of the input conveyor 7 relative to the horizontal direction. Therefore, once the data about the format of the containers 1 has been entered, the control unit 38, based on the programming contained in the memory unit, will activate the adjustment means 39 to ensure that the containers 1 arrive at the screw transporter 8 with a pressure such as to ensure that each pitch of the helical ridge of the screw transporter 8 is occupied by a container 1.

[0062] In particular, the format of the containers 1 can be entered manually by the operators before starting to use the washing machine 6 by using a user interface (not illustrated) which is connected to the control unit 38. Alternatively or in combination with the user interface, the washing machine 6 can comprise detection means similar to those already described, which can coincide with those already described, and which are arranged to detect the format of the containers 1 moving along the processing path and sending the corresponding data to the control unit 38 which, by comparing the data with those contained in the memory unit, will be able to identify the format of the container 1 and consequently always on the basis of the format of the containers 1 will actuate the adjustment means 39.

[0063] It is understood that the actuating device 41 could be replaced with any other actuating device having the same function.

[0064] The embodiments described herein can be combined with one another without departing from the scope of the present invention.

[0065] The washing machine 6 described above has numerous advantages.

[0066] Firstly, due to the subdivision of the dispensing ducts 17 into separate and independent dispensing assemblies 21 each provided with its own distributing device 22 and each connectable to any of the feeding collectors 20a, 20b, 20c, the washing machine 6 allows to change the cleaning cycle performed by the washing machine 6 in a simple and quick manner by simply moving the pipes 24 to connect each distributing device 22 to an

output 23 of a feeding collector 20a, 20b, 20c and/or by adding new pipes 24 to connect previously disconnected distributing devices 22. Therefore, the washing machine 6 thus obtained is extremely flexible and is capable of performing various cleaning cycles, without having to make a special washing machine 6 for each possible cleaning cycle. Furthermore, a washing machine 6 thus made allows the possibility to change the cleaning cycle even during the useful life of the washing machine 6 itself, simply by changing the various connections between the outputs 23 of each feeding collector 20a, 20b, 20c and the distributing devices 22, by moving and/or adding pipes 24.

[0067] Furthermore, the washing machine 6 described above, due to the presence of the adjustment means 31 designed to change the vertical height of the cleaning conveyor 14 and therefore of the gripping devices 15 depending on the format of the containers 1, ensures that each container 1 is grasped by a corresponding gripping device 15 in a correct manner (i.e. at the gripping section). In other words, the washing machine 6 thus made can be adapted in a simple a quick manner to containers 1 of any format, by adjusting the vertical height of the cleaning conveyor 14 according to the vertical height of the gripping section of the containers 1 entering the washing machine 6.

[0068] Furthermore, the washing machine 6, due to the presence of the adjustment means 39 designed to adjust the inclination of the input conveyor 7, ensures that each pitch of the helical ridge of the screw transporter 8 receives a container 1 coming from the input conveyor 7, improving in this way the performance of the washing machine 6 in terms of feed speed, and therefore of the productivity of the washing machine 6.

[0069] Finally, the washing machine 6 described above is simple and inexpensive to implement, since compared to a similar known washing machine 6 it only requires the addition of adjustment means 31 and/or 39 and a different assembling of the dispensing ducts 17.

Claims

1. A washing machine (6) for containers (1), in particular of the pharmaceutical industry, comprising:

an input conveyor (7) designed to move a plurality of containers (1) along a first segment (A) of a processing path;
a screw transporter (8), which is designed to move the containers (1) along a second segment (B) of the processing path and is arranged immediately downstream of the input conveyor (7) so as to receive the containers (1) coming directly from the input conveyor (7); and
a cleaning unit (9), which is arranged along a third segment (E) of the processing path downstream of the screw transporter (8) and is de-

signed to wash each container (1);
the washing machine is **characterized in that:**

the input conveyor (7) is movable so as to change the inclination of the first segment (A) of the processing path relative to the horizontal direction; and
adjustment means (39) are provided, which are designed to adjust the inclination of the first segment (A) of the processing path relative to the horizontal direction.

2. The washing machine (6) according to claim 1, wherein the first segment (A) of the processing path defined by the input conveyor (7) is perpendicular to the second segment (B) of the processing path defined by the screw transporter (8).

3. The washing machine (6) according to claim 1 or 2, wherein:

the input conveyor (7) comprises an input end (41) and an output end (42);
the screw transporter (8) comprises an input end (44) directly coupled to the output end (42) of the input conveyor (7) and an output end;
the adjustment means (39) are suited to keep a vertical height of the output end (42) of the input conveyor (7) constant and to change a vertical height of the input end (41) of the input conveyor (7).

4. The washing machine (6) according to any one of the claims from 1 to 3, wherein the input conveyor (7) comprises a support frame (40), which carries the input conveyor (7) and is hinged so as to rotate around a rotation axis (Y).

5. The washing machine (6) according to claim 4, wherein the rotation axis (Y) is parallel to the screw transporter (8).

6. The washing machine (6) according to claim 4 or 5, wherein the rotation axis (Y) is parallel and coaxial to the screw transporter (8).

7. The washing machine (6) according to any one of the claims from 4 to 6, wherein the adjustment means (39) comprise a linear actuator (43), which is connected to an end of the support frame (40) opposite the screw transporter (8) and is designed to lift or lower said end of the support frame (40).

8. The washing machine (6) according to one of the claims from 1 to 7 and comprising a control unit (38) configured to determine a format of the containers (1) and to change the inclination of the first segment (A) of the processing path relative to the horizontal

direction depending on the format of the containers (1), so as to ensure that each pitch of the helical ridge of the screw transporter (8) receives one single container (1) coming from the input conveyor (7).

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9. The washing machine (6) according to claim 8, wherein the control unit (38) comprises a memory designed to contain a program associating each format of the containers (1) with a corresponding inclination of the first segment (A) of the processing path relative to the horizontal direction. 10
10. The washing machine (6) according to claim 8 or 9 and comprising a user interface, which is connected to the control unit (38) so as to manually select the format of the containers (1). 15
11. The washing machine (6) according to claim 8 or 9 and comprising detection means, which are designed to detect the format of the containers (1) entering the washing machine (6), are arranged along the processing path and are connected to the control unit (38). 20
12. A control method to control a washing machine (6) for containers (1), in particular of the pharmaceutical industry, comprising: 25

an input conveyor (7) to move a plurality of containers (1) along a first segment (A) of a processing path; 30

a screw transporter (8), which is designed to move the containers (1) along a second segment (B) of the processing path and is arranged immediately downstream of the input conveyor (7) so as to receive the containers (1) coming directly from the input conveyor (7); and 35

a cleaning unit (9), which is arranged along a third segment (E) of the processing path downstream of the screw transporter (8) and is designed to wash each container; 40

the method comprises the step of detecting the format of the containers (1);

the control method is **characterized in that** it comprises the further step of adjusting the inclination of the first segment (A) of the processing path relative to the horizontal direction depending on the format of the containers (1). 45

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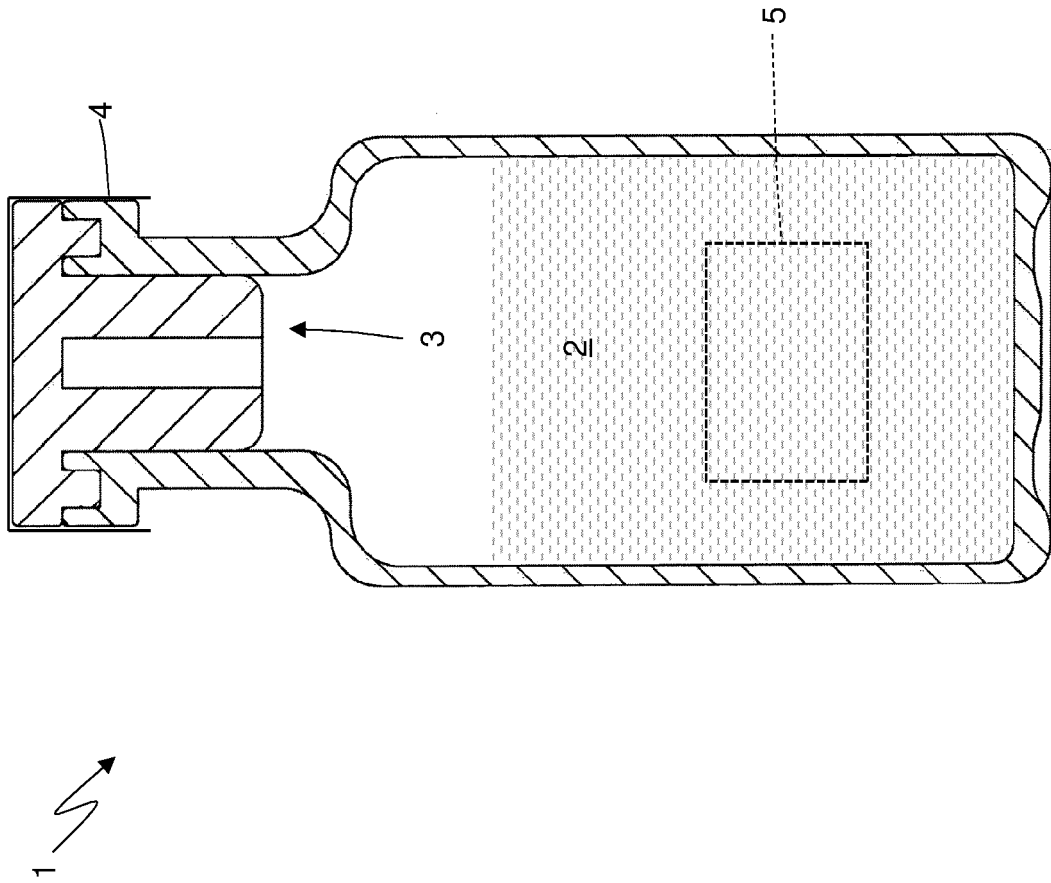
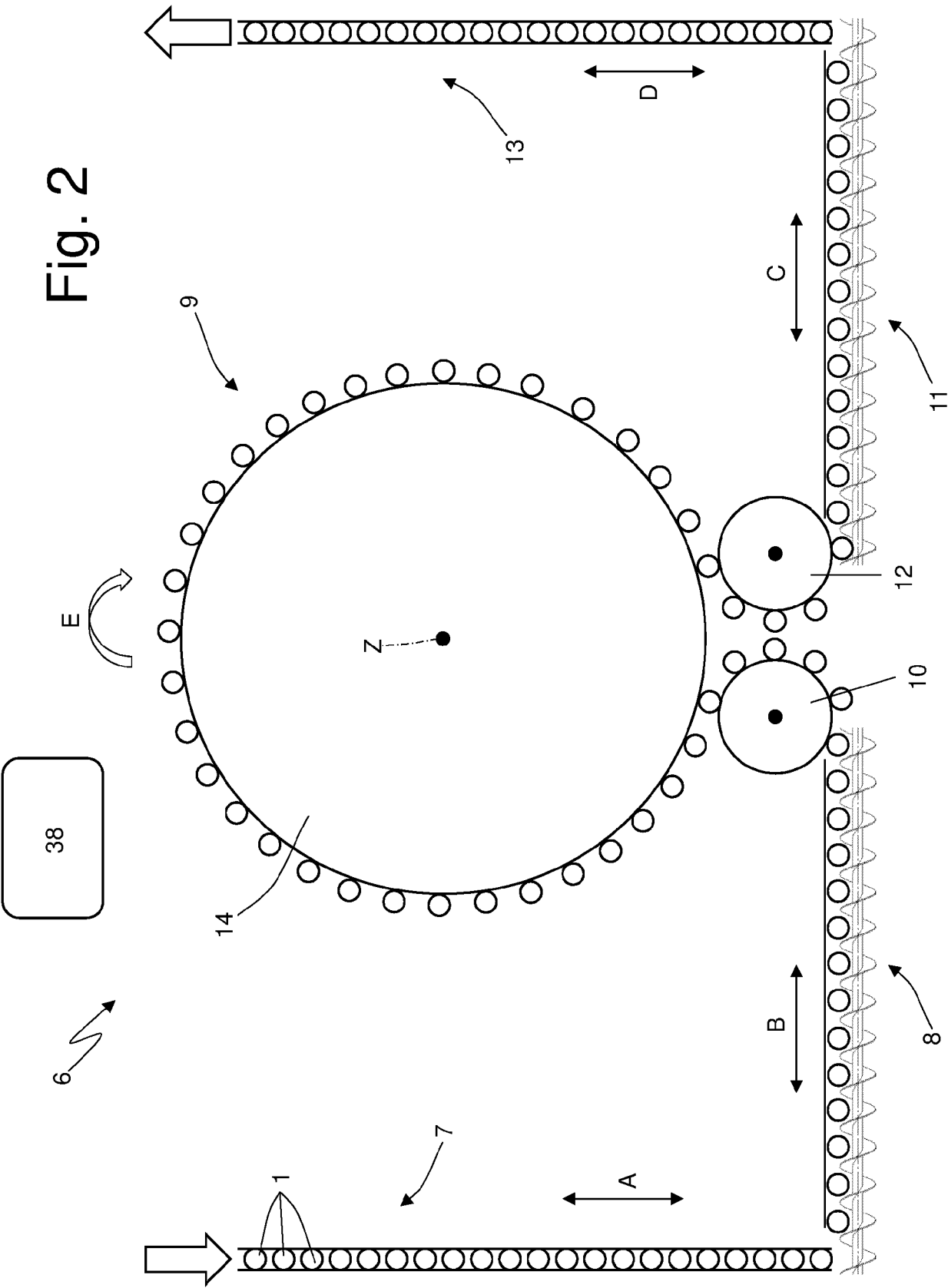


Fig. 1



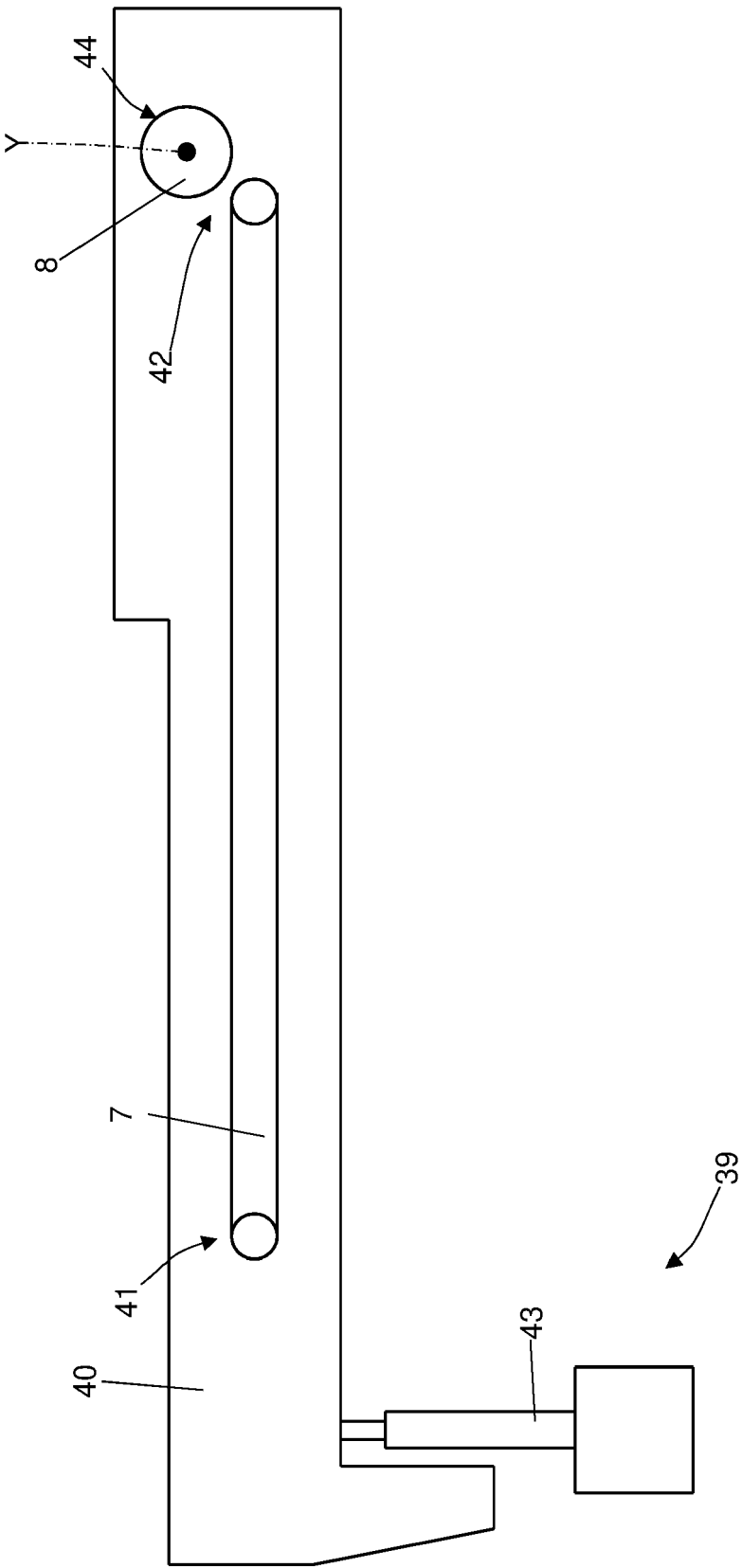


Fig. 3

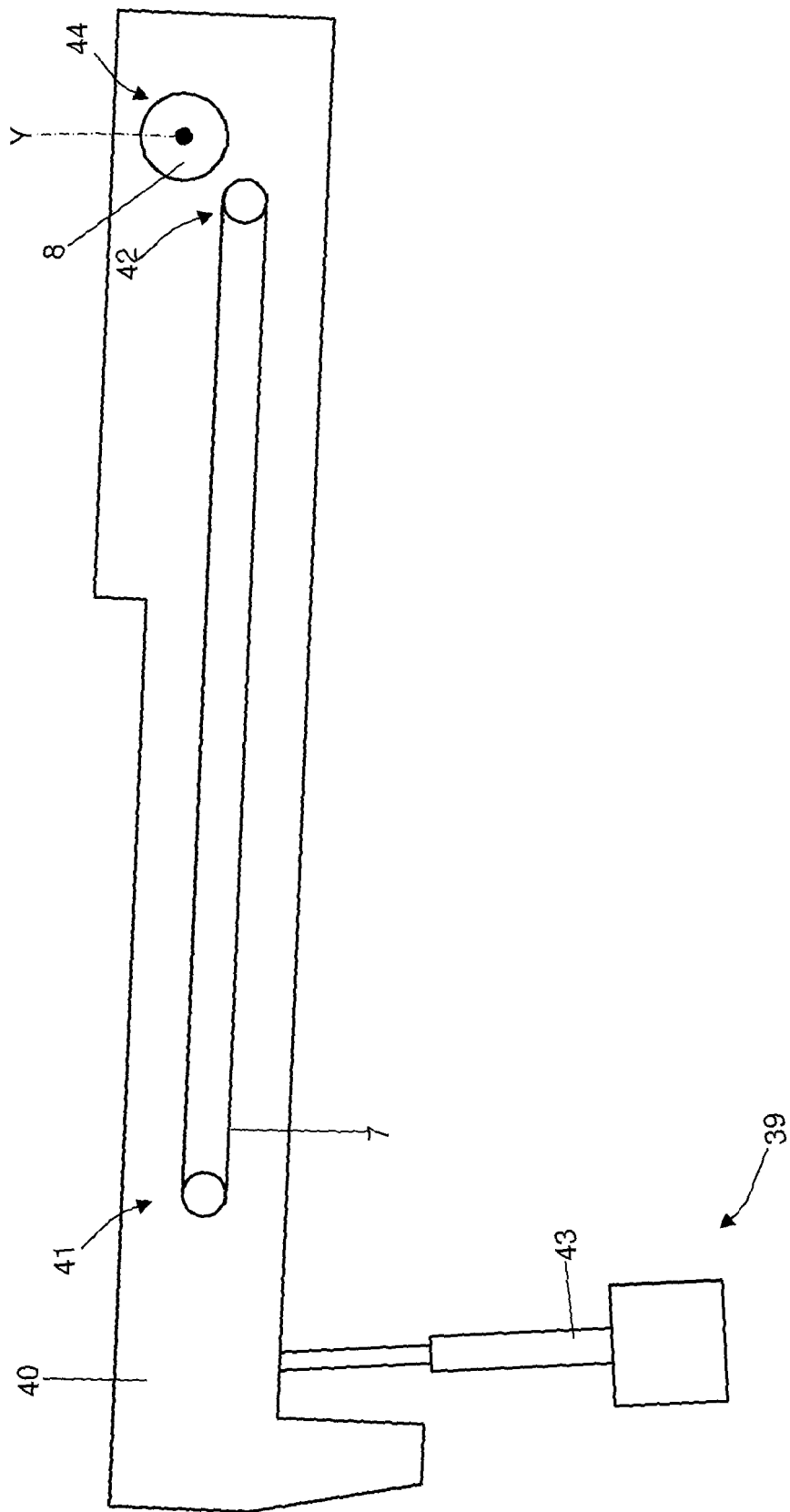


Fig. 4

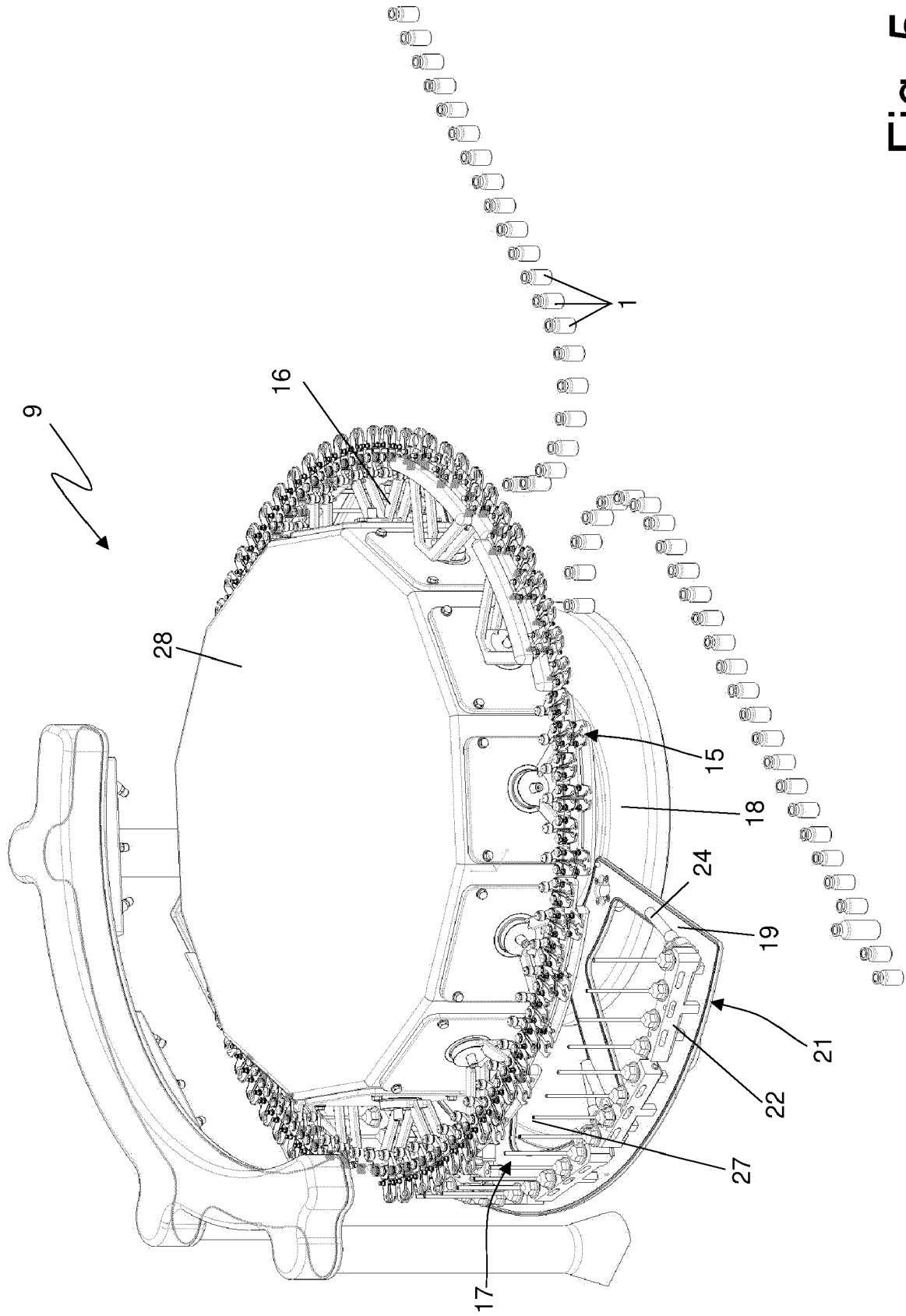


Fig. 5

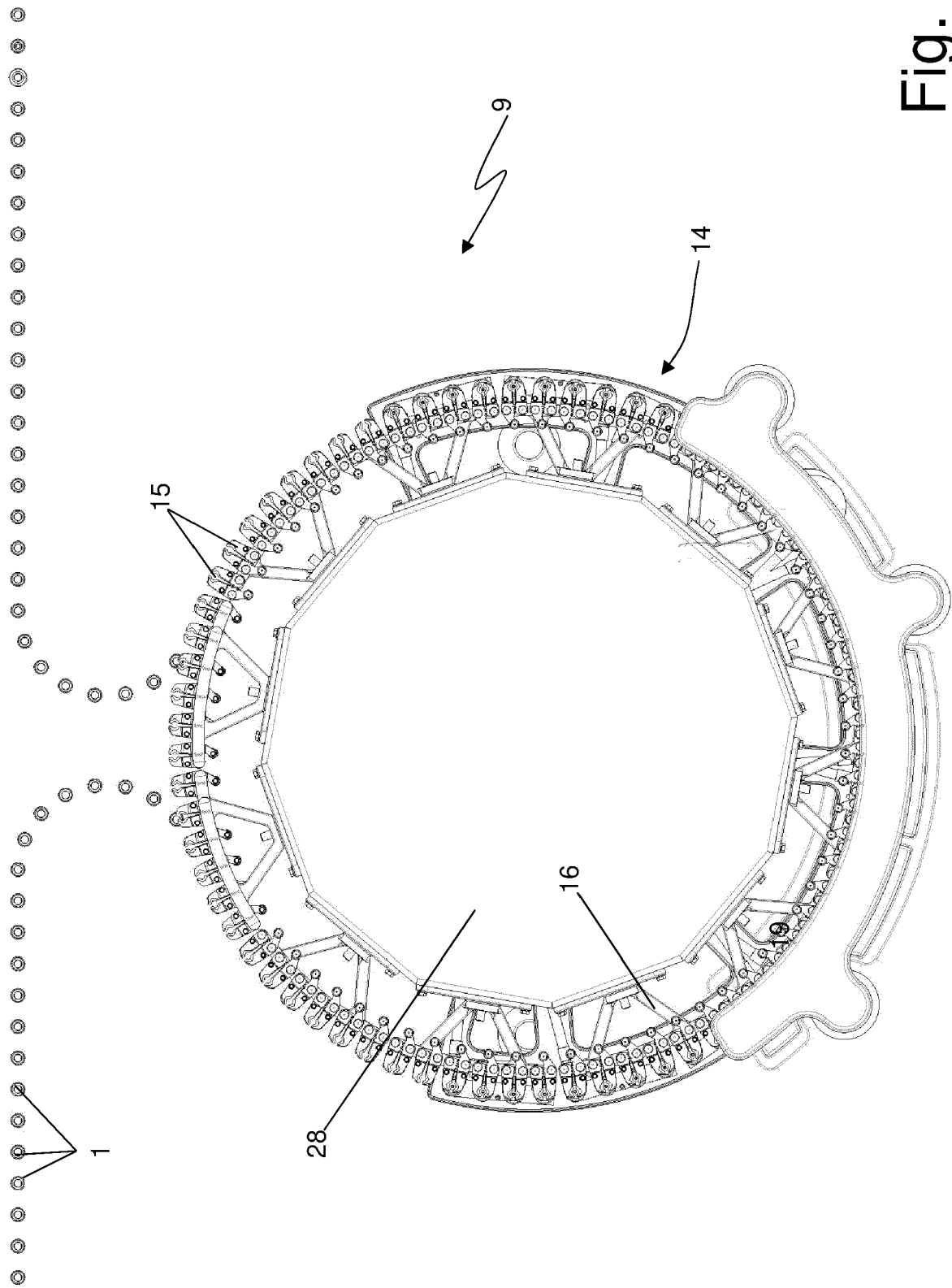


Fig. 6

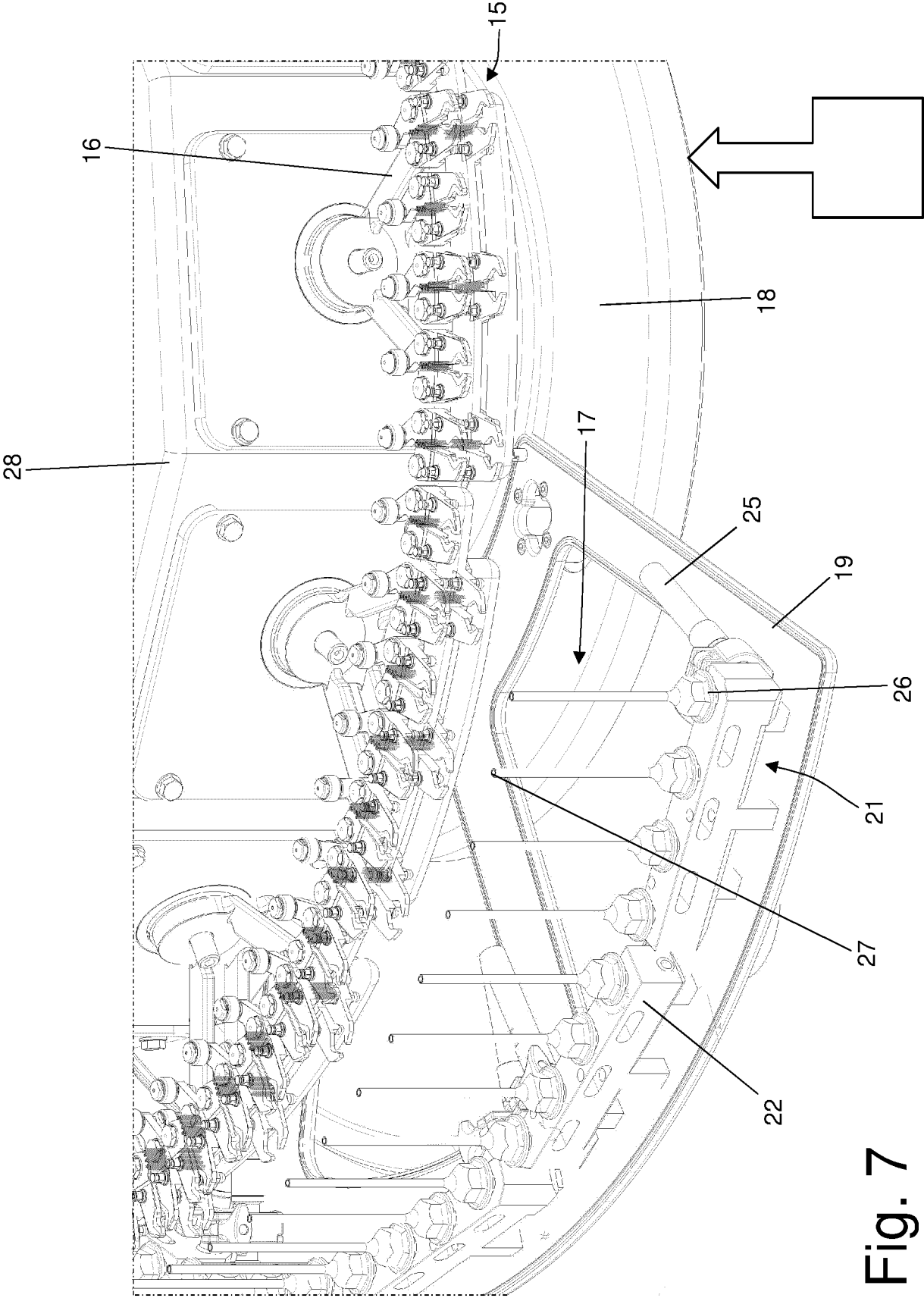


Fig. 7

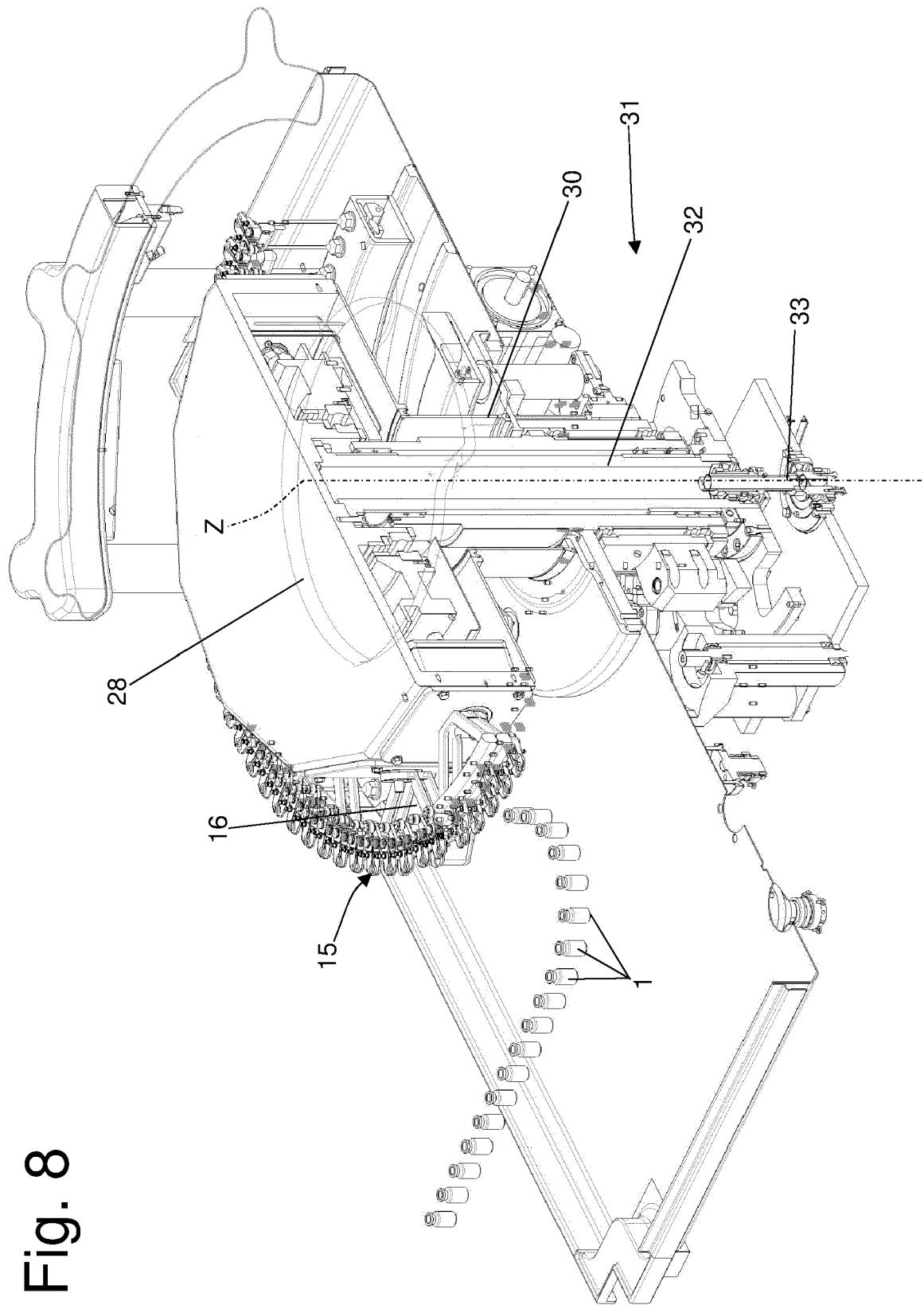


Fig. 8

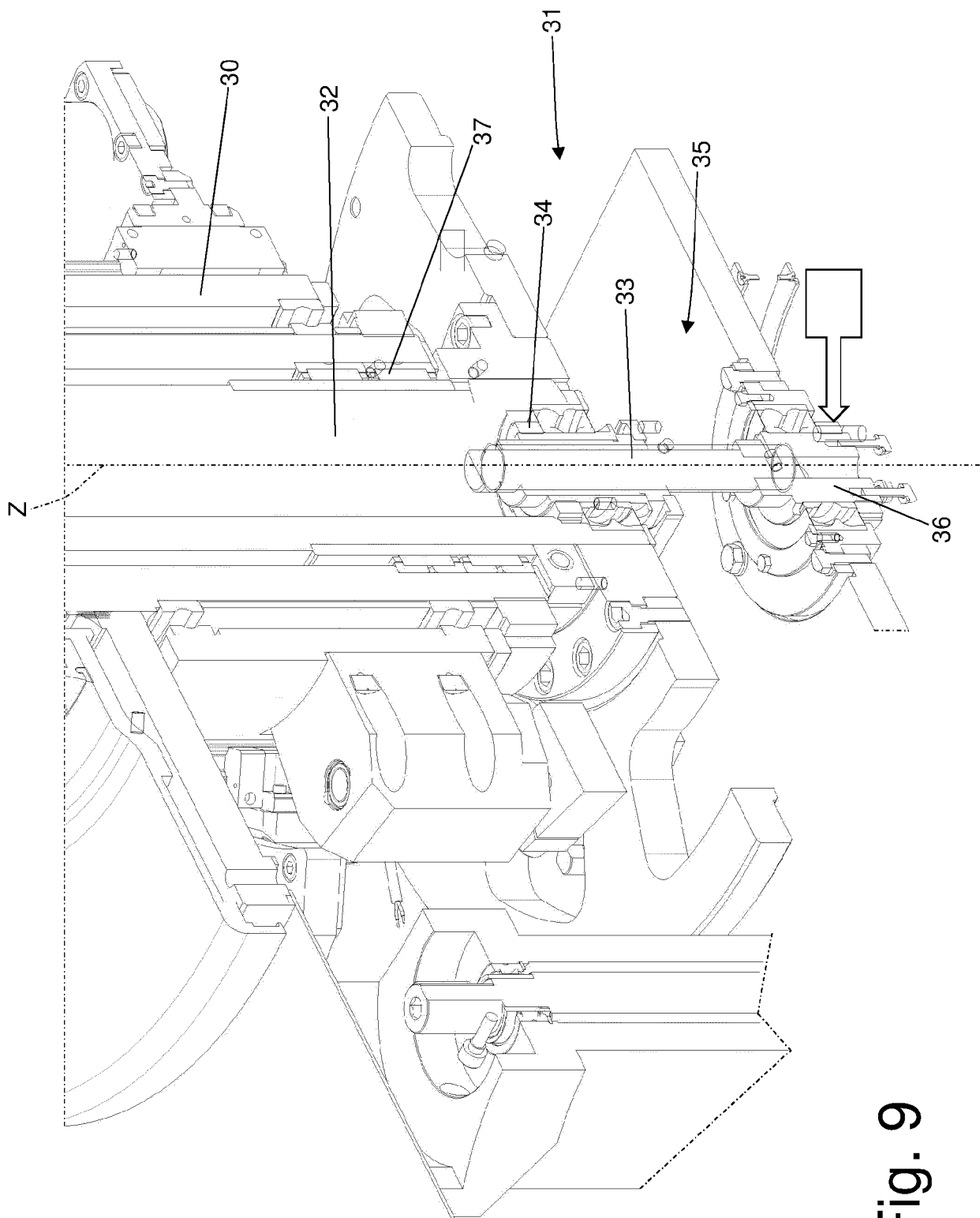


Fig. 9

Fig. 10

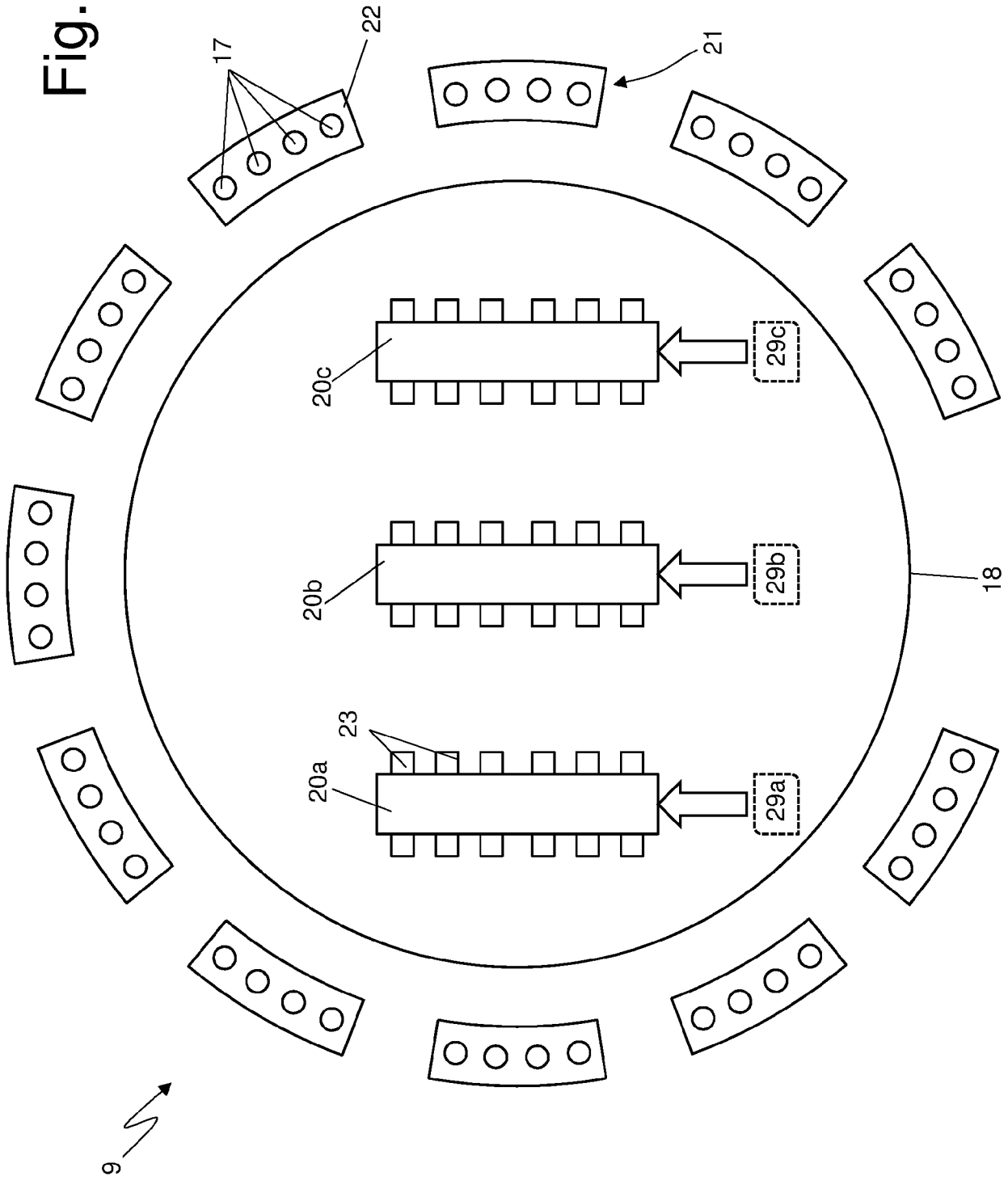


Fig. 11

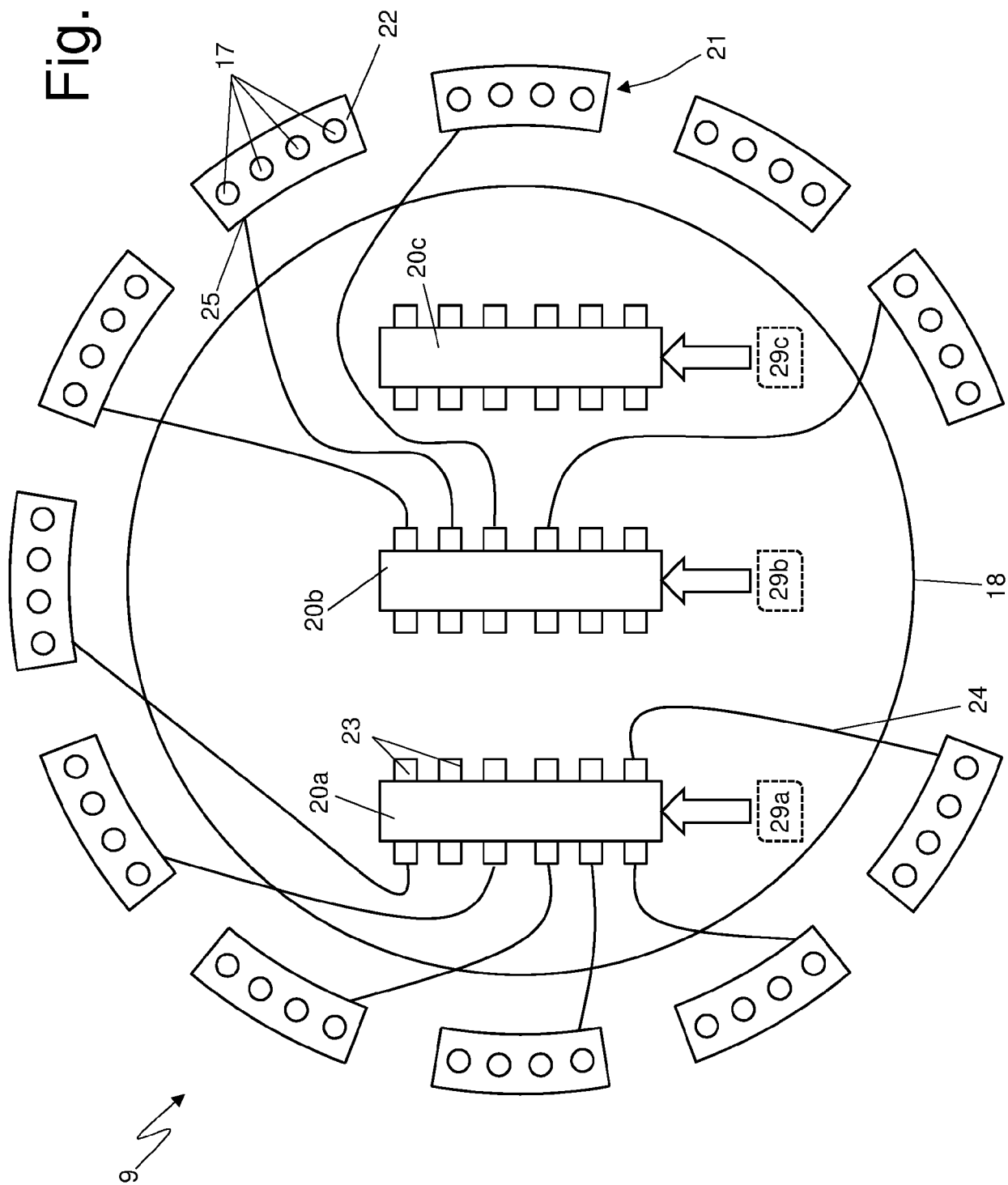


Fig. 12

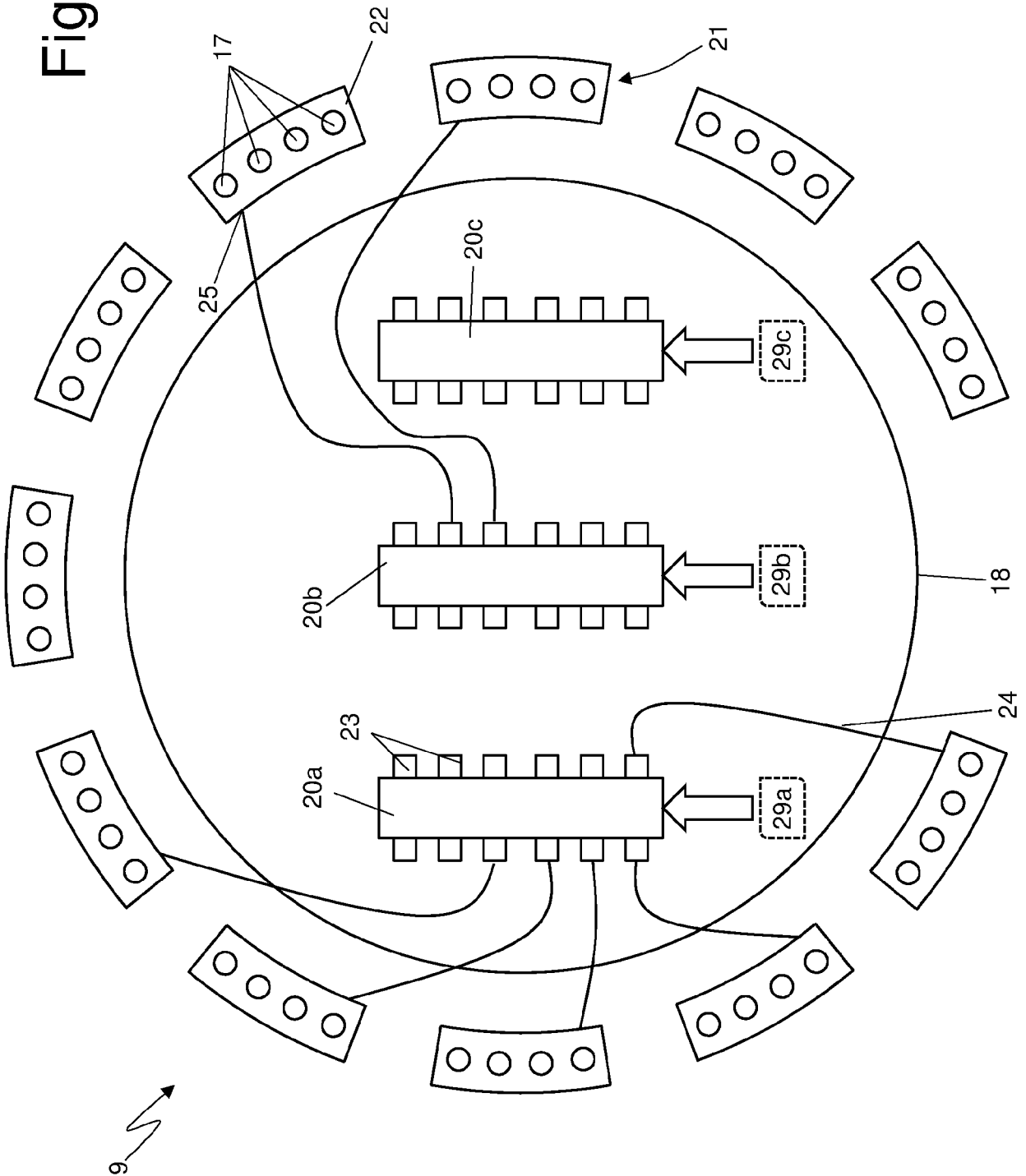
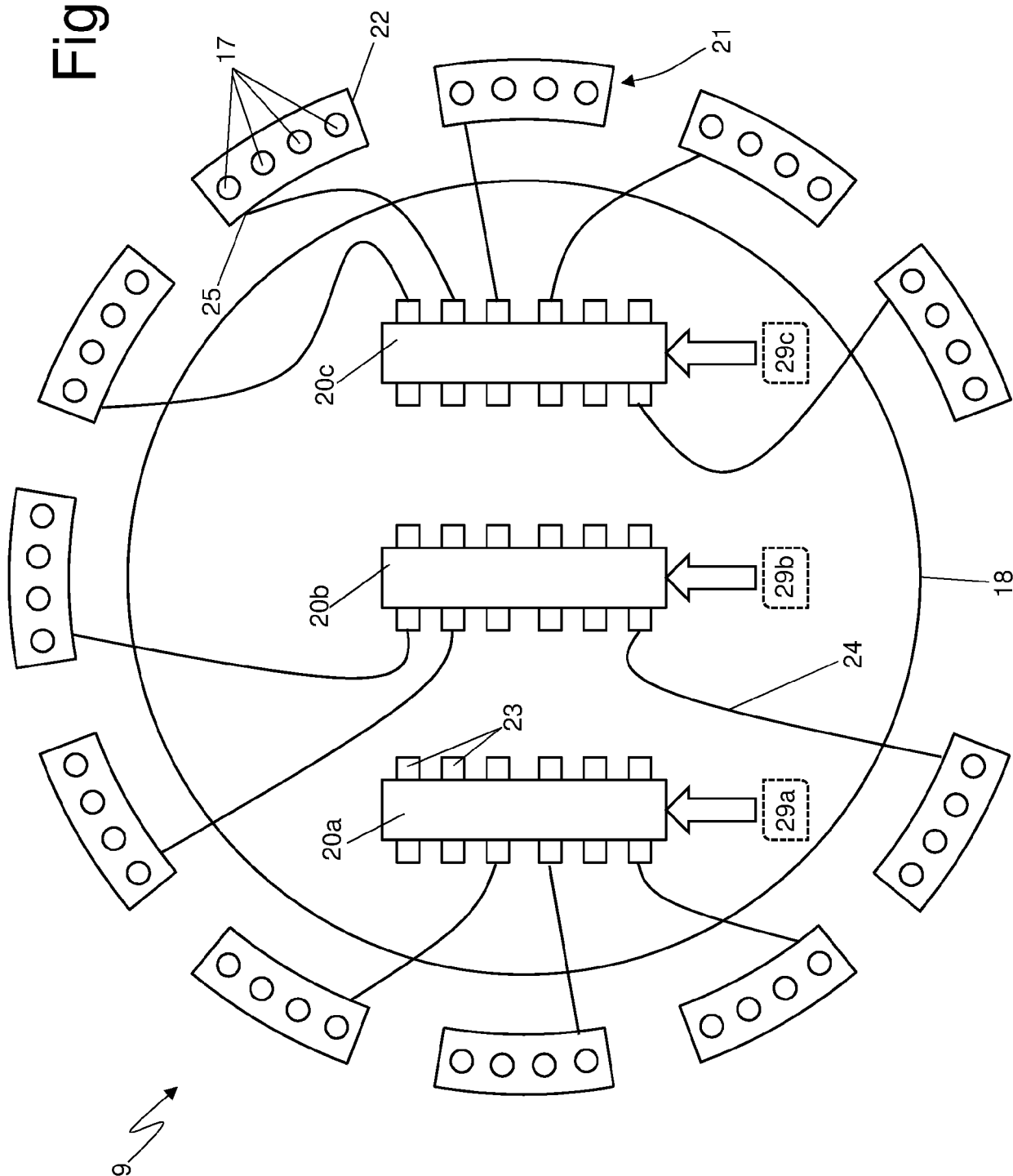


Fig. 13





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