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(54) **APPARATUS FOR FILLING AND CAPPING LIQUID CONTAINERS AND RELATED METHOD WITHOUT FORMAT CHANGE**

(57) The present invention refers to an apparatus (1) for transporting containers (2) (typically bottles) to a filling section (4) and finally to a container capping section (5).

The apparatus further comprises a first cochlea section (7a) extending into the filling section (4), and which is activated by first motorization elements (8), and a second cochlea section (7b) extending between the end of the filling section (4) and the capping section (5) and which is activated by second motorization elements (9) independent of the first motorization elements (8).

The two cochlea sections (7a, 7b) are operated in synchronism with each other, with the containers (8)

spaced at a machine pitch in the first cochlea section (7a), and then maintaining the machine pitch until the capping section (5).

Any direct contact between the containers is thus avoided, thus minimizing the phenomenon of liquid leaking from the bottle neck.

This also allows the equipment length to be reduced and simplifies its construction, with obvious advantages in terms of cost reduction.

Furthermore, it is not needed the necessary format change that is carried out in prior art apparatus every time the bottles dimensions and shapes change.

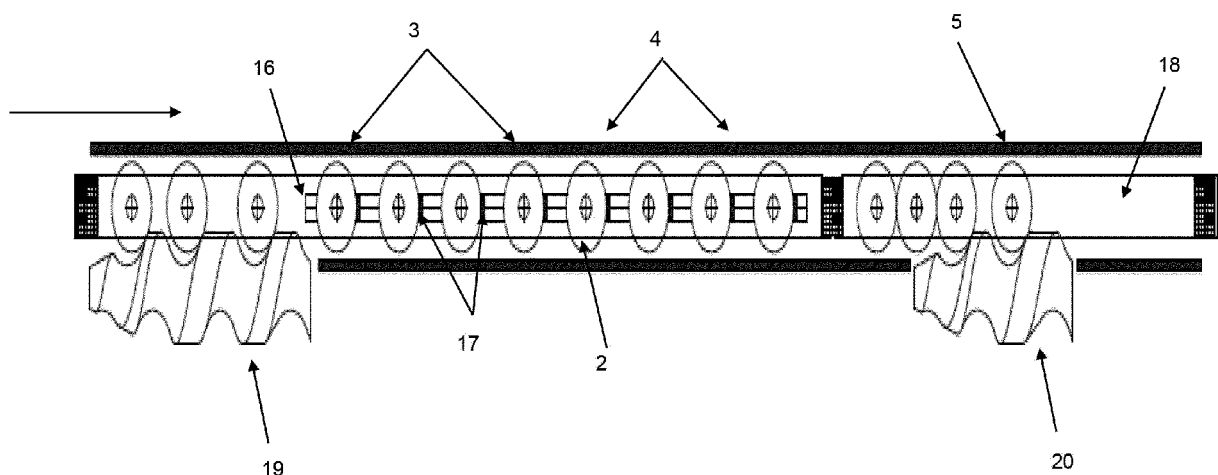


Fig. 1

Description

Field of the invention

[0001] The present invention refers to an apparatus for filling and capping containers for liquids and/or solids. In particular, the present invention refers to such an apparatus provided with a rinsing section (optional), a filling section and a capping section for the containers, and with at least one conveyor belt for moving the containers from one section to another, wherein the containers do not come into contact with each other and wherein a change of format is not required.

State of the art.

[0002] Current machines for rinsing, filling and capping bottles typically of large dimensions, from 4 to 20 litres, but also of lower or higher capacity, involve the bottle movement and their positioning in the various machine sections (rinsing, filling and capping) via systems using conveyor belts.

[0003] Alternatively, this movement in the known in the art machines can be achieved via a belt 16 provided with a plurality of profiled supports 17 (also called "facchini", see Fig. 1), i.e., elements applied to the belt and protruding from it, positioned at machine pitch which can act laterally or on the bottom of the bottles 2 spaced from each other on the belt 16. They have the purpose of moving the bottles 2 at machine pitch and positioning them in the respective working sections (rinsing section 3, filling section 4, capping section 5), after they have been prepared at machine pitch by a cochlea 19 positioned at the machine inlet (see Fig. 1).

[0004] In a further alternative, in the known in the art machines, this movement can be achieved by simply managing groups of bottles 2 in contact with each other, moved in a "package" assembly without being spaced apart (see Fig. 2). In this further movement alternative, the bottles 2 are equal in number to the number of clamps (not shown in the figures) present in the rinsing section and/or equal in number to the number of valves (not shown in the figures) present in the filling section, and sometimes even in a number equal to the number of capping heads of the capping device.

[0005] In these known in the art machine type, the capping device (also called "corker") is in line with the other two previous rinsing and filling sections; consequently, the bottles are moved on the same conveyor belt, or on two or more conveyor belts aligned with each other (see the two belts 16 and 18 in Fig. 1 and the two belts 22 and 23 in Fig. 2), without providing therefore lateral movements of the bottles, but only movements along the axis of the inlet conveyor belt.

[0006] Another variant of the known in the art machines allows the bottles to be moved on the same axis, and/or on the same conveyor belt, in the two rinsing and filling sections, and then to be laterally moved onto a second

conveyor belt, placed alongside the first conveyor belt and with independent motorization compared to the first conveyor belt. In this way, the bottles are moved using pneumatic pushers, mechanical chain systems or similar devices, and positioned in the capping section, which is parallel to the other two sections but not coaxial. Consequently, the bottles are moved by a different conveyor belt and capped with multiple capping heads, one for each bottle forming the group of bottles that are moved as a "package" assembly.

[0007] The disadvantage of the known in the art system which moves the bottles in a pack and transfers them into a capping section parallel to the other two consists in having to provide a container moving system and a capping head for each bottle, therefore, for example having from 2 to 5 capping heads for productions up to 1000-1100 bottle per hour, or with up to 10 or more capping heads, for higher bottle productions. The machine could also have a greater number (beyond the 10 indicated above) of filling and capping heads, but in the latter case the machine would become too long and difficult to manage, as well as expensive.

[0008] In the known in the art machines that have movement systems that cause collisions between the bottles, the phenomenon of water leaking from the neck of the bottle (also called "splash") often occurs. For example, if the bottles are moved step by step by profiled supports 17, or similar systems, in the rinsing section 3 (if present) and in the filling 4 section, they are recompressed in the capping section 5, where a cochlea 20 can be provided (see Fig. 1) to individually space the bottles and position them in the capping head/s. However, the impact of the bottles 2 against each other when they compact each other before the cochlea and/or against this cochlea 20 in Fig. 1 causes the deformations of the water filled bottles with consequent leakage of the same from the neck, especially in the case when the bottles are filled to a level close to the mouth level (also called "fill-point").

[0009] A variant of this machine type can include a star device at the capping device inlet, instead of a cochlea, to individually select the bottles and position them in axis with the capping head/s by rotating the star. However, even in this case, the bottles which compact each other when entering the star device and also during their rotation can collide one against the other, causing their deformations.

[0010] This phenomenon also occurs in machines that move bottles in "package" assemblies, i.e. with sequences of bottles equal to the number of filling valves; when the bottle package reaches the cochlea 20, or the star device, of the capping device in Fig. 1, to be spaced and positioned in axis with the capping head (or with the capping heads), an impact against the cochlea 20 or against the star device occurs (and also the bottle deformation) due to the bottle pushing one against the other, generated by the conveyor belt 18 which moves them.

[0011] In some known in the art machines, instead of the cochlea, a pneumatic bottle stopping device 21 of

Fig. 2 can be provided, for example one or more pads moved by pneumatic cylinders, or a similar and equivalent system, which allows to select one or more bottles at a time and position it/them in axis with the capping head/s.

[0012] Any known in the art system wherein a collision, or crushing, of one or more bottles against a fixed element 20 of Fig. 1 or 21 of Fig. 2 occur (or even when the bottles crush against each other) can cause the water leaking from the neck phenomenon, causing different levels in the bottles, and sometimes a volume lower than expected. Furthermore, this water leakage from the bottle neck can also create bottle labelling problems since, to ensure correct labelling, the external bottle surface must be dry.

[0013] The known in the art systems provided with profiled supports have also the drawback that they can deform in the case the filled bottles are strongly pushed; these known in the art systems involve format changes as the bottles change and are, however, decidedly complex and expensive.

[0014] An obvious limitation of the known in the art system involving the movement of bottles in a "package" consists in having to adjust the clamps or similar neck gripping elements of the rinsing section, the filling valves of the filling section and the plurality of capping heads in the capping section as the bottle sizes and shape vary, wherein said adjustments are almost always manual and need time. Furthermore, in these known in the art machines it is necessary to change the format of the feeding cochlea at the machine input and the format of the capping device, or of the star device or of the pneumatic bottle stopping devices, or similar systems, in the capping device, or to carry out their position adjustments. All of them are manual adjustments requiring time and also requiring some components replacement depending on the bottle size and shape.

[0015] Machines with at least one cochlea, a feeding line and a single assembly (or banks) of filling nozzles are known in the art.

[0016] Furthermore, the international patent application published with n. WO 2020/254111 A1 addresses the problem of increasing the bottle machine productivity. This problem is solved by means of a bottling machine comprising a feeding unit operating along a feeding line, at least one workstation crossed by said feeding line and at least one bottling unit. The feeding unit described therein includes at least one cochlea. The bottling unit includes at least two lateral banks of filling nozzles positioned, respectively, above at least two advancement channels for bottles to be processed organized in two rows parallel to each other and with said filling nozzles mutually spaced from each other in such a way as to be positioned at the vertical projection of said bottles to be processed.

[0017] Therefore, thanks to the characteristic of having the bottles to be filled arranged along two parallel feed lines, the machine described in WO 2020/254111 A1 allows to obtain an increased productivity.

[0018] However, the fact of having two distinct feeding lines creates a constructive and mechanical problem compared to having a single feeding line.

[0019] Furthermore, in the machine described in WO 2020/254111 it is necessary to change the cochlea every time the bottle dimensions and shapes change, thus creating an obvious significant disadvantage in terms of time and costs. Therefore, the Applicant of the present patent application has found the need to create an apparatus for the containers transport (typically bottles) from a rinsing section to a filling section and to a capping section able to solve the above described problems found in similar known in the art apparatus.

[0020] In particular, the Applicant of the present patent application has found the need to create such an apparatus preventing the contact between the bottles and avoiding the bottles to hit stationary parts, thus avoiding the phenomenon of water leaking from the bottle necks.

[0021] Furthermore, the Applicant of the present patent application has found the need to create such an apparatus which is inexpensive, with a structure less complex than those known in the art, and easily manageable during maintenance or replacement of some apparatus elements.

[0022] Finally, the Applicant of the present patent application has found the need to create such an apparatus wherein it is not necessary to carry out the format change every time the bottle dimensions and shapes change, which is instead necessary in the known in the art apparatus.

Summary of the invention

[0023] In a first aspect, the present invention refers to an apparatus (also indicated below by the term "machine") such as that one indicated in claim 1.

[0024] The present invention in fact arises from the general consideration according to which the above indicated technical problem can be effectively and reliably solved by means of an apparatus for the continuous filling and capping cycle of a plurality of containers, wherein said apparatus comprises at least one filling section for filling each of said containers with a liquid or solid, at least a capping section for capping each of said containers once filled, and at least a first conveyor belt section suitable for transporting a first still empty group of said plurality of containers in correspondence with at least one filling section and a second conveyor belt section suitable for transporting to said at least one capping section a second group of said plurality of containers filled in said at least one filling section, wherein said filling section is provided with at least one filling element, and wherein said capping section is provided with a capping device with at least one capping head.

[0025] The apparatus of the present invention further comprises a cochlea, which includes a first cochlea section extending in correspondence with said first conveyor belt section in said at least one filling section and a second

cochlea section extending in correspondence with said second conveyor belt section between the end of said filling section and said capping section, first motorization elements suitable for activating said first cochlea section and second motorization elements suitable for activating said second cochlea section, wherein said first elements of motorization are independent of said second motorization elements.

[0026] Said first and second cochlea sections are operated in synchronism with each other, maintaining the containers at a machine pitch, during the simultaneous phases wherein each empty container of said first group of containers is transported in correspondence with said at least one filling section and wherein each filled container of said second group of containers is transported from said filling section to said capping section.

[0027] Furthermore, said first cochlea section is able to remain stationary while waiting for the filling of said first group of empty containers in said filling section to be completed, and said second cochlea section is able to alternate a) rotating phases, during the which each of said filled containers is advanced in the capping section until it is positioned individually in correspondence with said capping head, and b) stopping phases, for the time necessary to align the single filled container in axis with said capping head and to cap the filled container itself.

[0028] In this way, the containers are moved by two cochlea sections along the entire path: the empty containers are driven from the first cochlea section up to the filling section and the containers filled with liquid or solid are driven from the second cochlea section up to the capping section. Furthermore, the containers are spaced at the machine pitch in the first cochlea section, and then maintain the machine pitch until the capping section.

[0029] The specific characteristic seen above whereby the second cochlea section of the apparatus of the present invention presents the alternation of rotating and stopping phases described above is new compared to WO 2020/25411 A1, which in fact only states in a generic way that each cochlea can be divided into two sections with independent speed (see page 7, lines 10-14), without giving any details on the specific actions, movements and timing relating to the two cochlea sections.

[0030] Nor in WO 2020/25411 A1 the feature of the present invention whereby the first cochlea section and the second cochlea section are operated in synchronism with each other is described, and whereby the containers are spaced at the machine pitch in the first cochlea section, and then keep the machine pitch until the capping section.

[0031] Thanks to these characteristics mentioned above, the apparatus of the present invention allows to avoid any direct contact between the containers, one against the other and also against initially stationary elements (such as, for example, any bottle stop elements in the capping device), eliminating the phenomenon of liquid leaking from the container neck, especially in the case of containers of low weight and therefore easily de-

formable.

[0032] This also allows to reduce the length of the apparatus as it does not need to have an intermediate section for accumulating containers before the capping device, which is necessary for example in the known in the art machines equipped with profiled supports, and simplifies its construction, with obvious advantages in terms of cost reduction.

[0033] Furthermore, the apparatus of the present invention also includes further particular features referring to said first and/or second motorization elements hereinbelow reported, thanks to which the relevant problem of avoiding the cochlea format size change every time the containers sizes and/or shapes change in a wide size range is also solved.

[0034] In fact, in the apparatus of the present invention said first and/or second motorization elements are suitable for anticipating (or delaying) the phase of said cochlea first section and/or second section by means of an adequate angular rotation of the involved cochlea section.

[0035] In this way, the propeller of that cochlea section is axially moved in the direction opposite to the containers travel direction (in case there is an anticipating phase) or in the containers travel direction (in case there is a delaying phase) to recover the diameter difference between the different container sizes.

[0036] In this way, the containers are always positioned at the machine pitch and in axis with the filling elements in the filling section and in axis with the at least one capping head in the capping section.

[0037] Consequently, thanks to the fact that said motorization elements are capable of anticipating or delaying the phase of said cochlea first and/or second section, the apparatus of the present invention is suitable to also transport with the same cochlea the containers having different diameters and also having shapes that are not only cylindrical but also containers having, for example, a square or rectangular shape, such as to include almost all the container formats usually used on the market.

[0038] Therefore, thanks to the cochlea rotation, by acting on the containers in the pushing direction or in the opposite slowing direction, a notable difference in diameter can be recovered.

[0039] For example, if the cochlea is sized for a certain bottle, for example 200 mm in diameter, the cochlea phase is such that the bottles axis coincides with the clamp/nozzle axis of the rinsing section (if a rinsing section is present), with the filling valves in the filling section and with the capping head/s in the capping section. However, if bottles having a reduced diameter, for example 160 mm, are to be processed without modifying the cochlea phase, the bottles, despite being in contact with the cochlea, would be out of phase by 20 mm (i.e., half the difference of the two diameters) with respect to the axes of the above indicated elements of the rinsing section (if provided), filling section and capping section. It would therefore not be possible to carry out the rinsing

(if foreseen), filling and capping phases of the machine and to complete the cycle, as the machine would not be able to function, since the bottles would not be aligned with the grippers/nozzles and with the valves of the filling section.

[0040] Conversely, thanks to the fact that said first and/or second motorization elements of the apparatus of the present invention are suitable for anticipating or delaying the phase of said first and/or second cochlea section by means of an adequate rotation of the cochlea section itself, the helix of the cochlea section is moved axially by 20 mm to recover the difference in diameter between the two different bottle formats. In this way, the axis of the smaller diameter bottles is also brought back to the centre, in line with the axes of the elements of the rinsing section (if provided), filling section and capping section.

[0041] Therefore, in the apparatus of the present invention it is not necessary to have to change the cochlea format every time the bottle dimensions and/or shapes change in a wide size range, which instead occurs using the bottling machine described in WO 2020/254111 A1, which however does not face the cochlea change problem, but only aims to obtain a production activity improvement thanks to the insertion of a double row of containers to be filled.

[0042] According to a preferred embodiment, said containers are bottles.

[0043] According to a preferred embodiment, said liquid is water, or another drinkable liquid or for industrial use, or a solid, such as for example pieces of fruit.

[0044] According to a preferred embodiment, said first and second conveyor belt section are aligned with each other.

[0045] In this way it is not necessary to create curves or loops along the bottle transportation from one section to another, nor to have to move the bottles with complex translation systems.

[0046] According to a preferred embodiment, said filling section is provided with a plurality of filling valves arranged in line along the travel direction of the first conveyor belt section.

[0047] In this way in the filling section it is possible to simultaneously fill a plurality of bottles arranged in line along the first conveyor belt section, each bottle being stopped step by step under a corresponding filling valve to be subjected to filling with the liquid that comes out from that filling valve.

[0048] In this way, the correct bottle filling with the required liquid quantity based on the individual bottle size is promoted.

[0049] According to a preferred embodiment, said capping section is equipped with a capping device with at least one capping head, the number of heads being a function of the hourly machine production.

[0050] According to a preferred embodiment, said capping device is provided with a single capping head.

[0051] In this way, a saving on the costs and on the

machine size is achieved compared to the version having a plurality of capping heads, also considering the fact that the capping phase of each individual bottle is a very rapid phase taking few seconds, which can be repeated several times in a short time for more bottles to be capped.

[0052] According to a preferred embodiment, the total cycle time of the capping phase of all the bottles of said second group of bottles is not greater than the cycle time of filling all the bottles of said first group of bottles.

[0053] In this way, as soon as all the bottles of the first group have been filled in the filling section, the bottles of the second group have already been capped in the capping section and sent to a labelling/packaging area, leaving empty the second cochlea section. Consequently, since the second cochlea section is empty, it is ready to receive other newly filled bottles, which can thus be sent towards the capping section to be capped in turn.

[0054] According to a preferred embodiment, the apparatus of the present invention further comprises at least one rinsing section for rinsing each of said containers placed before said at least one filling section along the travel direction of said first conveyor belt section. In this preferred embodiment wherein at least one rinsing section is also present, said first cochlea section extends both in said at least one rinsing section and in said at least one filling section, and said first cochlea section is operated in synchronism with said second cochlea section, with the containers kept at machine pitch, even during the transporting phase of each of said containers from said at least one rinsing section to said at least one filling section. Furthermore, in this preferred embodiment wherein at least one rinsing section is also present, said first conveyor belt section is placed in correspondence with said rinsing section and said filling section. In this way, the first conveyor belt section is designed to transfer the bottles from the beginning of the rinsing section to the end of the filling section.

[0055] According to a preferred embodiment, said rinsing section is equipped with tongs/nozzles designed to facilitate the bottle rinsing.

[0056] According to a preferred embodiment, said first and/or said second motorization elements are chosen from the group that includes reducers, brushless motors, stepper motors, asynchronous motors with current inverter, or other types of motorizations with different motion laws suitable for moving said first and second cochlea sections in synchronism in the phase for transporting the empty bottles to the filling section and the filled bottles from the filling section to the capping section.

[0057] According to a preferred embodiment, the external part (the one having the largest diameter) of said first and second cochlea section has the function of stopping the bottles at a machine pitch, in case the speed of the first and/or second conveyor belt section that moves the bottles was greater than the transporting speed of the involved cochlea section.

[0058] According to a preferred embodiment, the ap-

paratus of the present invention further comprises a plurality of guides placed on one or both sides of said first and/or second cochlea section, along the advancement axis of said first and/or second conveyor belt section, for the entire length of the two cochlea sections.

[0059] In this way, the sliding of said containers from one of said sections to the next one is facilitated.

[0060] Furthermore, the lateral guides allow the bottles to always be kept in axis with the first and/or second conveyor belt section, and therefore also in axis with the indicated above elements of the rinsing section (if a rinsing section is provided), of the filling section and of the capping section.

[0061] Therefore, thanks to the adjustable lateral guides and by exploiting said anticipating or delaying the cochlea phase, it is also possible to process non-cylindrical bottles without changing the format relating to their dimensions.

[0062] According to a preferred embodiment, said guides are arranged according to the bottle size and shape.

[0063] According to a preferred embodiment, said guides are suitable for being manually adjusted, through rapid intervention by the operator, without having to change any component.

[0064] According to a preferred embodiment, the apparatus of the present invention further comprises pneumatic or electric or similar systems suitable for adjusting said guides and completely automating the format change relating to the bottle shape and dimensions.

[0065] In a second aspect, the present invention relates to a method for filling and capping containers using the apparatus indicated above according to the first aspect of the present invention.

[0066] In particular, the present invention refers to a method for filling and capping containers using the apparatus indicated above, wherein the method includes the steps of:

a) operating the first cochlea section, extending along the first conveyor belt section in the rinsing section (if present) and in the filling section, so that a first group of empty containers coming from transport or supply means, upstream of the apparatus, reaches the rinsing section (if present), and a second group of rinsed containers reaches the filling section; at the same time activating the second cochlea section, extending along the second conveyor belt section between the end of the filling section and the capping section, and positioning in this section the filled containers coming from the filling section;

b) stopping the first cochlea section so that each empty container of the first group of containers is in correspondence with the axis of the clamps/nozzles of the rinsing section (if present) and each rinsed container coming from the rinsing section is in correspondence with the filling elements in the filling

section;

c) starting the rinsing phase (if present) and the container filling phase;

d) activate the second cochlea section, so that the filled containers are first individually transferred with an alternating movement to the capping device and, subsequently, once capped, they are transferred from the capping section onto special transport means to be, if necessary, transferred to packaging machines present in the bottling lines;

e) repeating the previous steps for the number of times necessary to fill and cap the required quantities of containers, wherein:

- the first and second cochlea sections are operated in synchronism with each other, keeping the containers at machine pitch, respectively, by first and second motorization elements, independent of each other,
- the second cochlea section is designed to alternate a) rotating phases, during which each of the filled containers is advanced in the capping section until it is individually positioned in correspondence with the capping head, and b) stopping phases, for the time necessary to align the single filled container in line with the capping head and to cap the filled container itself.

[0067] In this way, thanks to the above mentioned characteristic whereby the containers are moved by two cochlea sections for the entire journey, spaced at the machine pitch in the initial part of the first cochlea section, and then maintaining the machine pitch up to the capping section, wherein the above described method for filling and capping the containers using the apparatus of the present invention allows to avoid any direct contact between the containers, one against the other, eliminating the phenomenon of the liquid leaking from the container neck. This also allows to reduce the apparatus length.

[0068] Furthermore, the above described method for filling and capping the containers using the apparatus of the present invention also includes further particular characteristics relating to said first and/or said second motorization elements hereinbelow reported, thanks to which the problem referred to the non-need to change the cochlea size every time the container dimensions and/or shapes change in a wide size range is also solved.

[0069] In fact, in the method of the present invention:

- said first motorization elements and/or said second motorization elements are suitable for anticipating/delaying the phase of the first cochlea section and/or of the second cochlea section by rotating the interested cochlea section, so that the propeller of

that cochlea section is axially moved, in the opposite travel direction to that one of the containers, in the case of phase anticipating or, respectively, in the containers travel direction, in the case of phase delaying, so that the containers are always be positioned at the machine pitch and in axis with the filling elements in the filling section and in axis with the at least one capping head in the capping section.

[0070] Consequently, the method of the present invention also allows to transport containers having different diameters each other and also having shapes that are not only cylindrical but also, for example square or rectangular, such as to include almost all of the container formats usually used on the market.

[0071] Further characteristics and advantages of the present invention will be better highlighted by examining the following detailed description of various preferred, but not exclusive, embodiments, illustrated for indicative and non-limiting purposes, with the support of the attached drawings, wherein:

- figure 1 shows a first embodiment of a prior art apparatus for filling and capping bottles;
- figure 2 shows a second embodiment of a prior art apparatus for filling and capping bottles;
- figure 3 shows a side view of a first embodiment of an apparatus of the present invention;
- figure 4 shows a detail of figure 3, wherein the bottles shown have a cylindrical shape and wherein the contact area between the cochlea and each single bottle being pushed is shown;
- figure 5 shows a detail similar to figure 4, wherein the contact area between the cochlea and each individual bottle in slowing movement is shown;
- figure 6 shows a sectional detail of a bottle of figure 4, wherein the anticipating and delaying cochlea phase and the bottles lateral guides are schematically shown;
- figure 7 shows a bottle of smaller dimensions than the one shown in figure 6;
- figure 8 shows a sectional detail of the automatic control of the bottle lateral guides;
- figure 9 shows a detail similar to figure 4, wherein the bottles shown have a square rather than cylindrical shape.

Detailed description

[0072] With reference to figures 3 to 9, an embodiment

of an apparatus 1 of the present invention for the continuous filling and capping cycle of a plurality of containers 2, in particular of bottles to be filled with water, is shown.

[0073] As shown in figure 3 and in detail in figure 4, the apparatus 1 of the present invention includes a rinsing section 3 (optional), a filling section 4 and a capping section 5 of the bottles 2, arranged in this order along the travel direction of the first section 6a and of the second section 6b of the conveyor belt 6, aligned with each other, so that a first group of still empty bottles 2a is brought via the first section 6a of the conveyor belt 6 to the section filling section 4 and, at the same time, a second group of filled bottles 2b is carried via the second section 6b of the conveyor belt 6 from the filling section 4 to the capping section 5. In the optional case wherein the rinsing section 3 is also present (as shown in the figures), the first section 6a of the conveyor belt 6 also leads a third group of bottles 2c to the rinsing section 3, and then in turn allowing them to pass in subsequent phases first to the filling section 4 and then to the capping section 5.

[0074] The rinsing section 3 is provided with a plurality of grippers/nozzles 12 (four grippers/nozzles 12 are shown in figure 3, but the number of grippers/nozzles 12 could be greater or lesser depending on the production request), arranged in line along the travel direction of the first section 6a of the conveyor belt 6, and designed to facilitate the bottle rinsing.

[0075] The filling section 4 is provided with a plurality of filling valves 10 (four filling valves 10 are shown in figure 3, but the number of filling valves 10 could be greater or less depending on the hourly production request of the filling line), arranged in line along the travel direction of the first section 6a of the conveyor belt 6. The number of filling valves 10 in the filling section 4 is equal to the number of grippers/nozzles 12 in the rinsing section 3 so that, operationally, while a certain number of bottles 2c positioned in the rinsing section 3 are washed, at the same time the same number of another group of rinsed and empty bottles 2a is subjected to filling in the filling section 4. In another embodiment the number of filling valves 10 in the filling section 4 can be greater or less than the number of clamps/nozzles 12 in the rinsing section 3.

[0076] The capping section 5 consists of a capping device equipped with a capping head 11, particularly suitable for hourly productions of up to approximately 1000-1100 bottles 2 per hour. In alternative embodiments it is possible to envisage the use of two capping heads 11 for productions of up to 2000-2200 bottles 2 per hour, or even three or more capping heads 11 for higher productions.

[0077] The apparatus 1 also includes a cochlea 7, which includes a first cochlea section 7a, extending in correspondence with the first conveyor belt 6a, from the rinsing section 3 to the filling section 4 (or, in the absence of the rinsing section 3, directly from the inlet section of the machine to the filling section 4), and a second cochlea section 7b, extending in correspondence with the second

conveyor belt 6b, from the end of the filling section 4 to the capping section 5.

[0078] The apparatus 1 also includes first motorization elements 8 suitable for activating the first cochlea section 7a and second motorization elements 9 suitable for activating the second cochlea section 7b. The first motorization elements 8 are independent of the second motorization elements 9.

[0079] It is important that the first cochlea section 7a and the second cochlea section 7b are operated in synchronism with each other, maintaining the containers at a machine pitch, during the simultaneous phases wherein each bottle 2a of the first group of still empty bottles is transported in correspondence with the filling section 4 and wherein each bottle 2b of the second group of filled bottles is transported from the filling section 4 to the capping section 5, maintaining the machine pitch up to the capping section 5 itself.

[0080] It is also relevant that the first cochlea section 7a is able to remain stationary while waiting for the filling of the first group of empty bottles 2a in the filling section 4 to be completed.

[0081] The second cochlea section 7b is designed to alternate a) rotating phases, during which each filled bottle 2b is advanced in the capping section 5 until a bottle 2b arrives individually at the capping head 11, and b) stopping phases, to give the capping head 11 time to cap the filled bottle 2b.

[0082] The total cycle time of the capping phase of all the bottles 2b (previously filled in the filling section 4 and brought in succession to the single capping head 11 in the capping section 5) is preferably not greater than the cycle time necessary for filling all the empty bottles 2a of the new group of bottles brought to the series of filling valves 10 in the filling section 4.

[0083] In this way, while all the bottles 2a of the first group have been filled in the filling section 4, the bottles 2b of the second group have already been capped in the capping section 5 and sent to an area where other machines are positioned, typically for labelling and/or packaging. Consequently, the second cochlea section 7b is left empty and ready to receive the new filled bottles 2a of the first group.

[0084] Once the capping phase is completed, the second cochlea section 7b realigns and brings itself back in phase with the first cochlea section 7a, waiting for the filling cycle to be completed, upon its completion the two cochlea sections 7a and 7b move in synchronism again. In this phase, new empty bottles 2c enter the rinsing section (if present) to be rinsed, the already rinsed bottles 2a are transferred to the filling section 4 to be filled, and the filled bottles 2b are transferred to the second cochlea section 7b, always at the machine pitch, waiting for the capping phase to begin.

[0085] Once the transfer phase between the various sections of the machine is completed, the rinsing (if present) and filling cycles are repeated, with the first cochlea section 7a stopped, and the capping cycle is re-

peated too, with the second cochlea section 7b alternating rotating phases and stopping phases to allow the bottles 2b to be individually capped.

[0086] The first motorization elements 8 and/or the second motorization elements 9 are chosen from the group that includes gearboxes, brushless motors, stepper motors, asynchronous motors with current inverter, or other types of motorizations suitable for moving the first cochlea section 7a and the second cochlea section 7b with different motion laws.

[0087] All the bottles 2 shown in figure 4 have a cylindrical shape and all of them have the same diameter.

[0088] However, the apparatus 1 of the present invention is also suitable for processing bottles 2 having different diameters and also having shapes that are not only cylindrical but also, for example, square or rectangular, such as to include almost all of the bottle formats usually used on the market. For example, figure 9 shows the presence of square-shaped bottles 2d.

[0089] In fact, in order not to be affected by the difference in diameters and shapes of the bottles 2 used, in one embodiment the first motorization elements 8 and/or the second motorization elements 9 of the apparatus 1 of the present invention are suitable for anticipating the phase of the first cochlea section 7a and/or of the second cochlea section 7b by means of an adequate rotation of the involved cochlea section 7a, 7b, in such a way that the propeller of that cochlea section 7a, 7b is axially moved in the direction opposite to the travel direction to recover the difference in diameter between the two different formats of bottles 2 (see the arrangement of the contact area 25 between each cochlea section 7 and each single bottle 2 in slowing down movement in figure 5; this anticipating phase by rotating the cochlea 7 is also shown by the arrow 26 in an anti-clockwise direction in figures 6 and 7).

[0090] Similarly, in another embodiment the first motorization elements 8 and/or the second motorization elements 9 of the apparatus 1 of the present invention are suitable for delaying the phase of the first cochlea section 7a and/or of the second cochlea section 7b by means of an adequate rotation in the opposite direction compared to the case seen above, therefore with an axial movement of the two cochlea in the travel direction of the involved cochlea section 7a, 7b (see the arrangement of the contact area 24 between each cochlea section 7 and each single bottle 2 being pushed in figure 4; this timing delay by rotating the cochlea 7 is also shown by the clockwise arrow 27 in figures 6 and 7).

[0091] Thanks to this rotation of the cochlea 7, by acting on the bottles 2 in the pushing direction or in the slowing down opposite direction, a notable difference in diameter can be recovered, without changing the cochlea 7. In this way the bottles 2 are allowed to position themselves at a machine pitch and always be aligned with the filling valves 10 in the filling section 4, aligned with the capping head 11 in the capping section 5 and aligned with the clamps/nozzles 12 of the rinsing section 3 (if the

latter is present).

[0092] Furthermore, to laterally compensate for any difference in diameter of the bottles 2 shown in figures 6 and 7 (where the bottle 2' has a diameter d1 and the bottle 2" has a diameter d2, smaller than d1), the apparatus 1 of the present invention is provided with one or more guides 13 placed on one or both sides of the bottles 2' and 2", depending on their size and shape, for the entire cochlea 7 length. The two bottles 2' and 2" of different diameters are both moved on the same longitudinal axis 28, which preferably coincides with the axis of the first section 6a and/or the second section 6b of the conveyor belt 6. The internal diameter 14 of the cochlea 7, called "core", is located at a different distance from the two bottles 2' and 2" which, however, by means of the lateral guides 13, are kept on the same axis 28, which preferably coincides with that of the first section 6a and/or the second section 6b of the conveyor belt 6, and therefore also in axis with the elements (grippers/nozzles 12, filling valves 10, capping head 11) present respectively in the rinsing 3 section (if provided), filling 4 section and capping 5 sections.

[0093] Thanks to the lateral guides 13 and also taking advantage of the seen above phase adjustment (anticipating/delaying) of the cochlea 7, it is also possible to process non-cylindrical bottles 2 (such as, for example, the square-shaped bottles 2d shown in figure 9), without any format change related to the bottle dimensions.

[0094] The guides 13 are manually adjusted with quick intervention by the operator, without having to change any components; the adjustment of the guides 13 can also be automatic, via pneumatic or electric systems 15 or similar (schematized in figure 8), to completely automate the format change relating to the shape and dimensions of the bottles 2.

[0095] Of course, many modifications and variations of the preferred embodiments described will be apparent to those skilled in the art, while still remaining within the scope of the invention.

[0096] For example, in the previous description and in the figures of the present invention an embodiment is shown wherein a rinsing section 3 is always present. However, other embodiments of the present invention could be devoid of this rinsing section, although falling within the scope of protection of the invention itself.

[0097] An alternative embodiment (not shown in the figures) can provide a variant with cochlea 7 in three distinct sections, rinsing section 3, filling section 4 and capping section 5, to separate the three distinct phases of the machine and/or with three independent motors or can provide an accumulation of bottles 2 before the capping device, if necessary, while maintaining the same advantages described above of having one or more parts of the cochlea 7 which can be managed with different motion laws, which involve movement phases alternated with resting phases not necessarily in phase with each other.

[0098] Yet a further variant (not shown in the figures)

could consist of a machine which has the capping section 5 not in axis with the first two rinsing sections 3 and filling sections 4, wherein the movement of the filled bottles 2b occurs via pushing devices on a second section of conveyor belt parallel to the first section of conveyor belt or in any case with the capping section 5 separate from the rinsing section 3 and filling section 4.

[0099] Yet a further variant (not shown in the figures) could provide a further cochlea opposite the cochlea 7, at least in the filling and capping section, to move the bottles with two opposing cochleae, i.e., positioned on opposite sides of the bottles; this further cochlea will be made up of two or more sections, exactly as the cochlea 7.

[0100] Yet a further variant (not shown in the figures) could involve replacing the cochlea 7 with similar systems such as, for example, chains and/or belts with spacer elements fixed at machine pitch which perform the same function as the cochlea 7, or of the two parts of cochlea 7a and 7b, applying the same operating methods of the present invention to move the bottles.

[0101] Therefore, the present invention is not limited to the preferred embodiments described, illustrated for illustrative and non-limiting purposes only, but is defined by the following claims.

Claims

1. Apparatus (1) for the continuous filling and capping cycles of a plurality of containers (2), wherein said apparatus (1) comprises at least one filling section (4) for filling of each of said containers (2) with a liquid or solid, at least one capping section (5) for capping each of said containers (2) once they are filled, wherein said filling section (4) is provided with at least one filling element (10) and wherein said filling section capping (5) is equipped with a capping device with at least one capping head (11), **characterized in that** said apparatus (1) also comprises:

- at least a first conveyor belt section (6a) adapted to transport a first still empty group (2a) of said plurality of containers (2) in correspondence with said at least one filling section (4) and a second conveyor belt section (6b) adapted to transport to said at least one capping section (5) a second group (2b) of said plurality of containers (2) filled in said at least one filling section (4),
- a cochlea device (7), comprising a first cochlea section (7a) extending in correspondence with said first conveyor belt section (6a) in said at least one filling section (4) and a second cochlea section (7b) extending in correspondence with said second conveyor belt section (6b) between the end of said filling section (4) and said capping section (5),

- first motorization elements (8) suitable for activating said first cochlea section (7a) and second motorization elements (9) suitable for activating said second cochlea section (7b), wherein said first motorization elements (8) are independent from said second motorization elements (9),

and wherein:

- said first cochlea section (7a) and said second cochlea section (7b) are operated in synchronism with each other, maintaining the containers at a machine pitch, during the simultaneous phases wherein each still empty container (2a) of said first group of containers (2) is transported in correspondence with said at least one filling section (4) and wherein each filled container (2b) of said second group of containers (2) is transported from said filling section (4) to said filling section capping (5),

- said first cochlea section (7a) is adapted to remain stationary while waiting the filling of said first group of empty containers (2a) in said filling section (4) is completed, and

- said second cochlea section (7b) is adapted to alternate a) rotating phases, during which each of said filled containers (2b) is advanced to the capping section (5) until it is individually positioned in correspondence with said capping head (11), and b) stopping phases, for the time necessary to align the single filled container (2b) in axis with said capping head (11) and to cap the filled container (2b),

- wherein said first motorization elements (8) and/or said second motorization elements (9) are suitable for anticipating/delaying the first cochlea section (7a) phase and/or the second cochlea section (7b) phase by angular rotating the involved cochlea section (7a,7b), so that the propeller of that cochlea section (7a,7b) is axially moved in the opposite direction to that one of the containers (2), in the case of phase anticipating or, respectively, in the travel direction of the containers (2), in the case of delaying phase, to allow said containers (2) to remain at the machine pitch and in axis with said filling elements (10) in the filling section (4) and in axis with said at least one capping head (11) in the capping section (5) even if said containers (2) have different diameters and/or shapes from each other.

2. Apparatus (1) according to claim 1, wherein said first conveyor belt section (6a) and said second conveyor belt section (6b) are aligned with each other.
3. Apparatus (1) according to any of the previous claims wherein said filling section (4) is provided with a plu-

ality of filling valves (10) arranged in line along the travel direction of the first conveyor belt section (6a).

4. Apparatus (1) according to any of the previous claims which further comprises at least one rinsing section (3) for rinsing of each of said containers (2a) placed before said at least one filling section (4) along the travel direction of said first conveyor belt section (6a).
5. Apparatus (1) according to claim 4, wherein said first cochlea section (7a) extends both in said at least one rinsing section (3) and in said at least one filling section (4), and wherein said first cochlea section (7a) is operated in synchronism with said second cochlea section (7b), maintaining the containers at machine pitch, even during each of said containers (2a) moving from said rinsing section (3) to said filling section (4).
6. Apparatus (1) according to any of the previous claims, wherein said containers (2) are bottles and wherein said liquid is water, or other drinkable liquid or for industrial use, or wherein said solid is constituted for example by pieces of fruit.
7. Apparatus (1) according to any one of the previous claims, wherein said first motorization elements (8) and/or said second motorization elements (9) are selected from the group including gearboxes, Brushless motors, stepper motors, asynchronous motors with current inverter, or other types of motors suitable for moving said first cochlea section (7a) and said second cochlea section (7b) with different motion laws.
8. Apparatus (1) according to any of the previous claims 3-7, wherein said first motorization elements (8) and/or said second motorization elements (9) are suitable to allow the bottles (2) to be positioned at the machine pitch and to always be in axis with said filling valves (10) in the filling section (4) and in axis with said capping head (11) in the capping section (5).
9. Method for filling and capping a plurality of containers (2) using the apparatus (1) according to any of the preceding claims 1-8, wherein the method comprises the steps of:
 - a) operating the first cochlea section (7a), extending along the first conveyor belt section (6a) in the rinsing section (3) and in the filling section (4), so that a first group of empty containers (2c) coming from transport or supply means upstream of the apparatus (1), reaches the rinsing section (3) and a second group of rinsed containers (2a) reaches the filling section (4); at the same time activating the second cochlea section

(7b), extending along the second conveyor belt section (6b) between the end of the filling section (4) and the capping section (5), and positioning in this section the filled containers (2b) coming from the filling section (4); 5

b) stopping the first cochlea section (7a), so that each empty container (2a) of the first group of containers is in correspondence with the axis of the clamps/nozzles (12) of the rinsing section (3) and each rinsed container from the rinsing section (3) is located in correspondence with the filling elements (10) in the filling section (4), 10

c) starting the container rinsing phase and the container filling phase;

d) activating the second cochlea section (7b), so that the filled containers (2b) are first individually transferred with an alternating motion to the capping device (11) and, subsequently, once capped, they are transferred from the capping section (5) onto special transport means to be, if necessary, transferred to packaging machines present in the bottling lines; 20

e) repeating the previous steps for the number of times necessary to fill and cap the required quantities of containers (2), 25

wherein:

- the first and second cochlea sections (7a,7b) are operated in synchronism with each other, keeping the containers at machine pitch, respectively, by first and second motorization elements (8,9), independent of each other, 30
- the second cochlea section (7b) is designed to alternate a) rotating phases, during which each of the filled containers (2b) is advanced in the capping section (5) until it is individually positioned in correspondence with the capping head (11), and b) stopping phases, for the time necessary to align the single filled container (2b) in axis with the capping head (11) and to cap the filled container (2b), 35 40
- wherein said first motorization elements (8) and/or said second motorization elements (9) are suitable for anticipating/delaying the first cochlea section (7a) phase and/or of the second cochlea section (7b) phase by rotating the affected cochlea section (7a,7b), so that the propeller of that cochlea section (7a,7b) is axially moved, in the opposite direction to that one of the containers (2), in the case of anticipating phase, or, respectively, in the travel direction of the containers (2), in the case of delaying phase, to allow said containers (2) to remain at the machine pitch and in axis with said filling elements (10) in the filling section (4) 45 50 55

and in axis with said at least one capping head (11) in the capping section (5) even if said containers (2) have different diameters and/or shapes from each other.

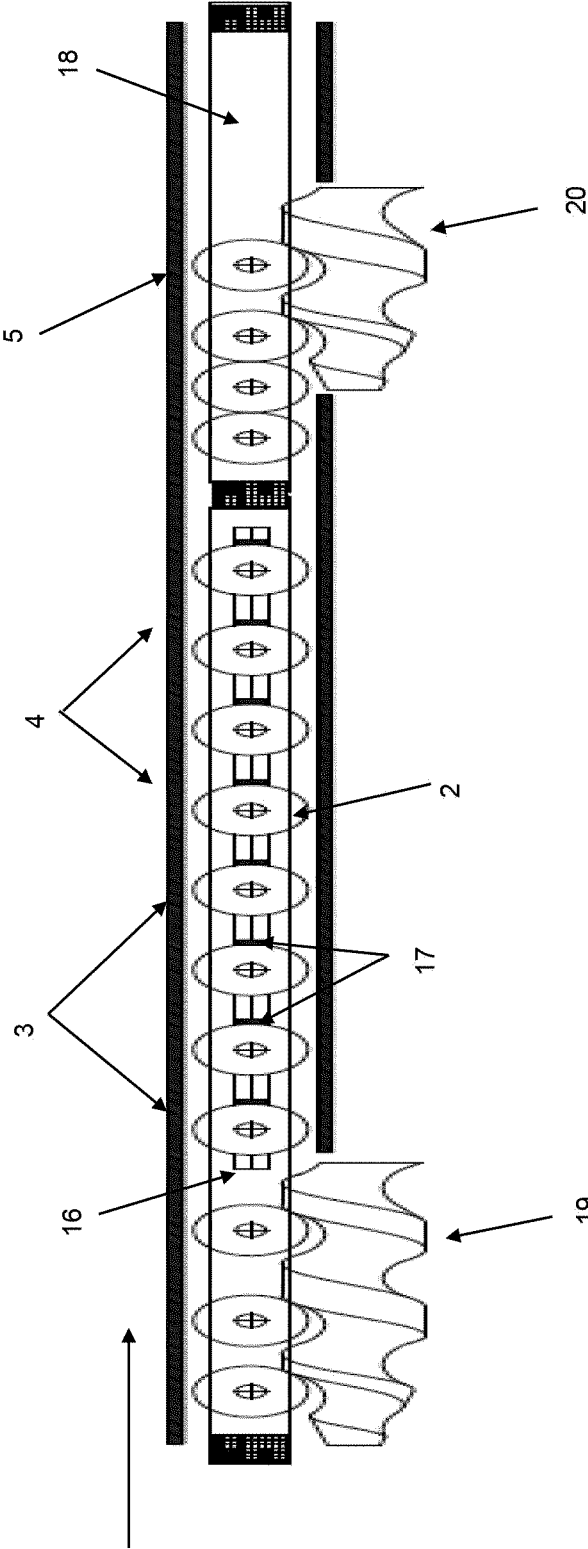


Fig. 1

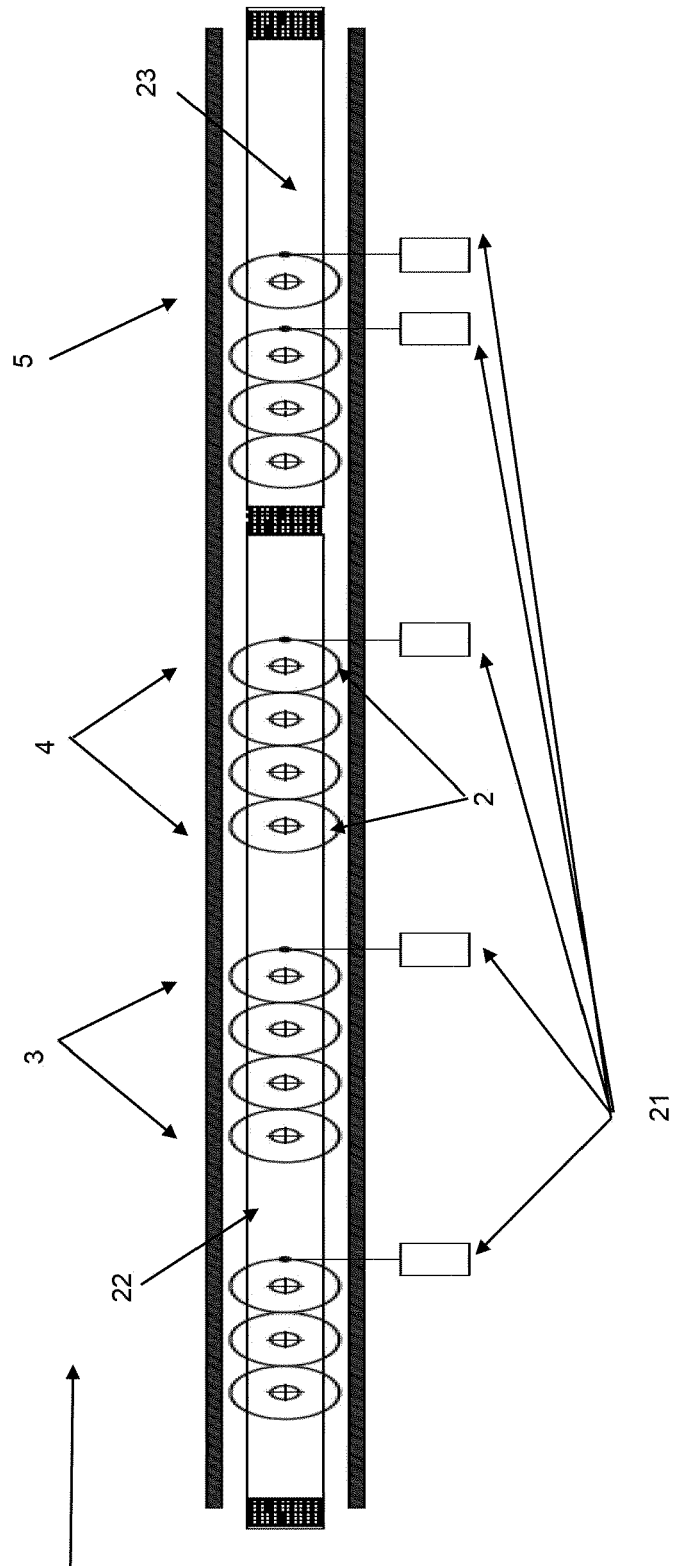


Fig. 2

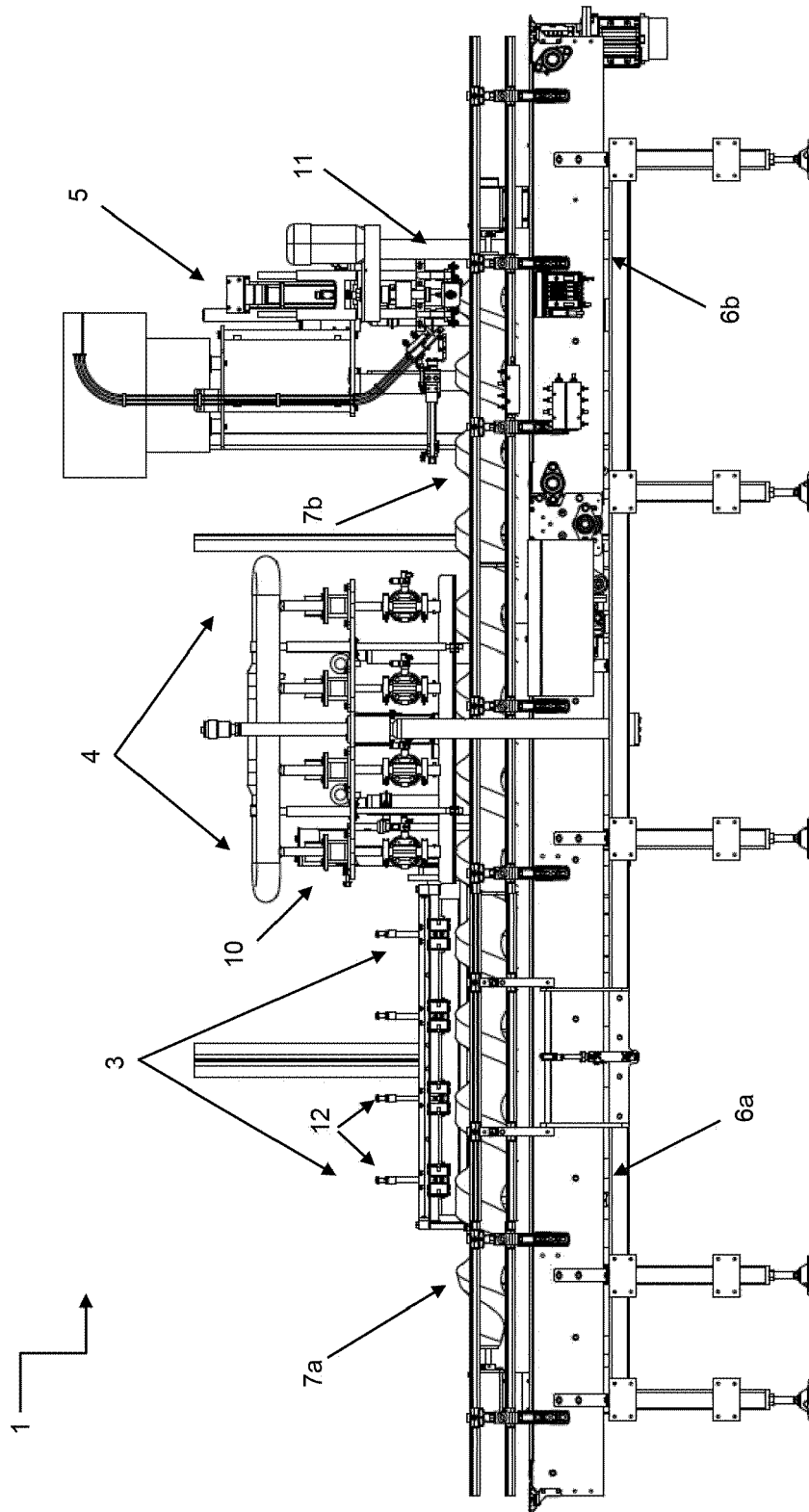


Fig. 3

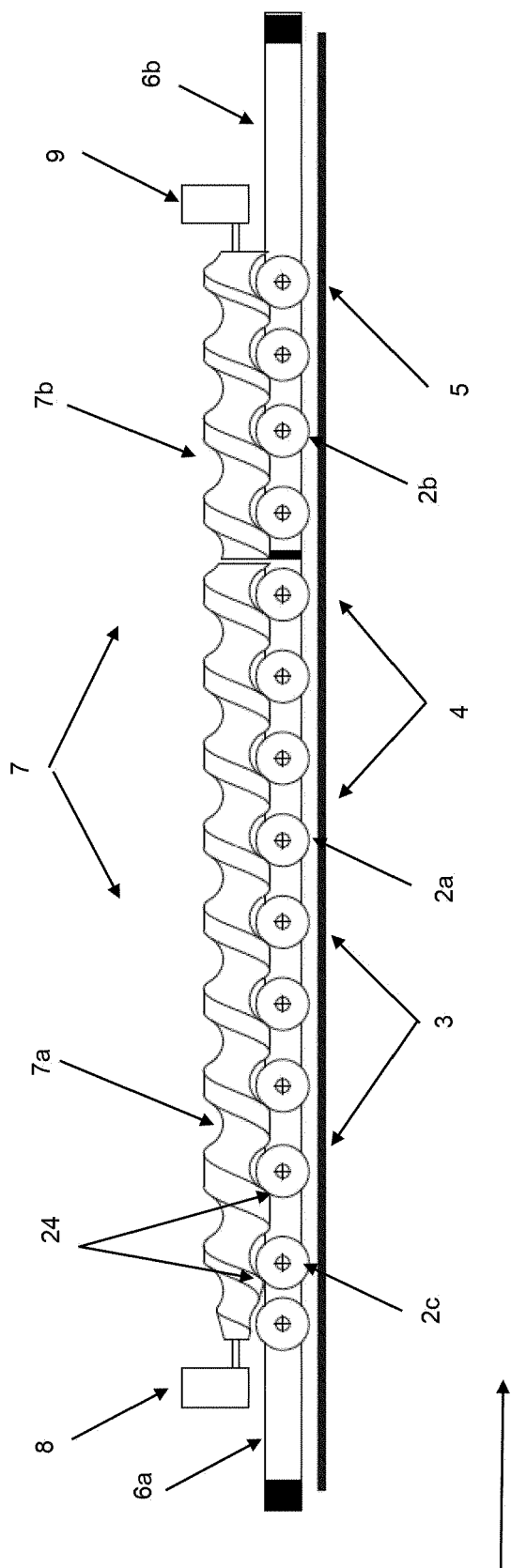


Fig. 4

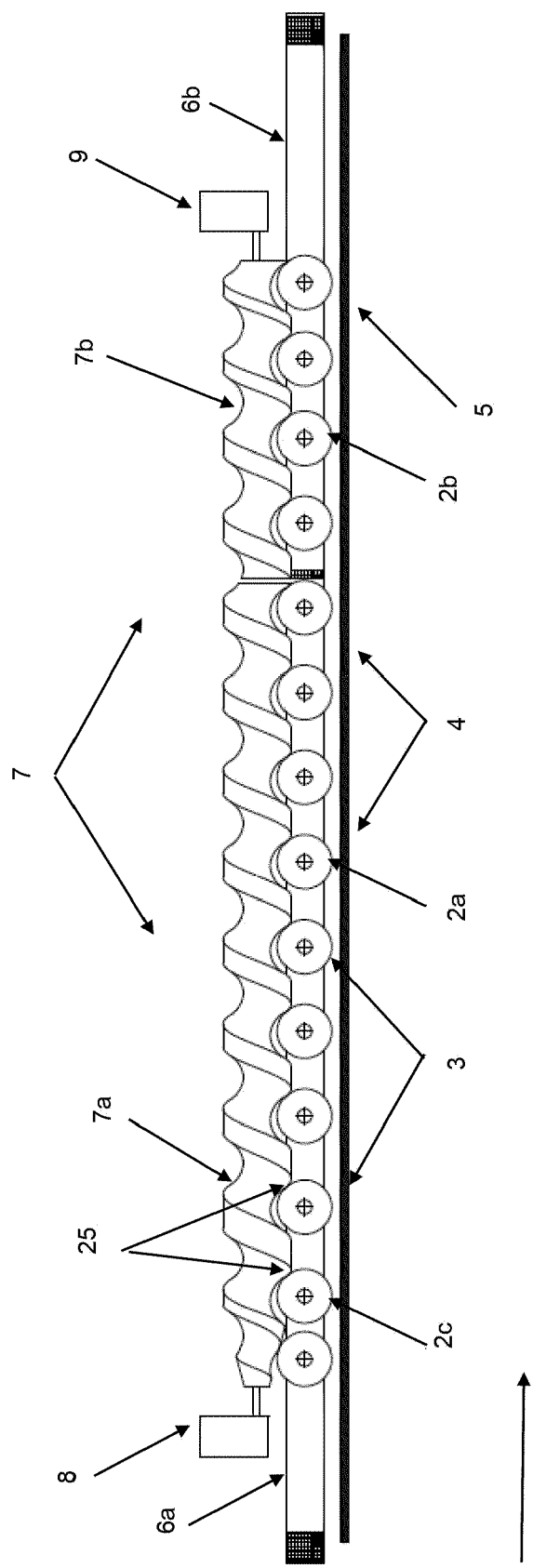


Fig. 5

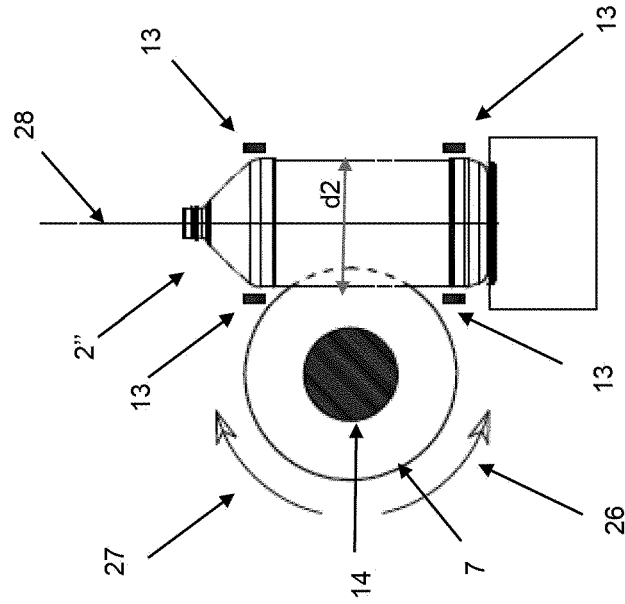


Fig. 7

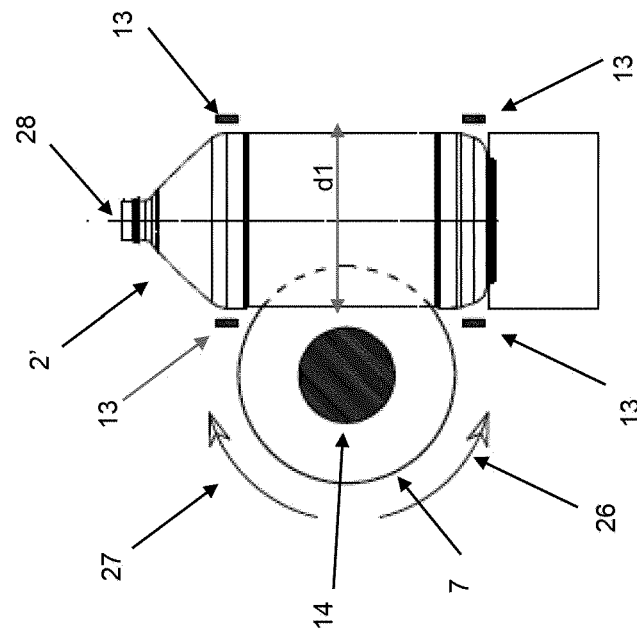


Fig. 6

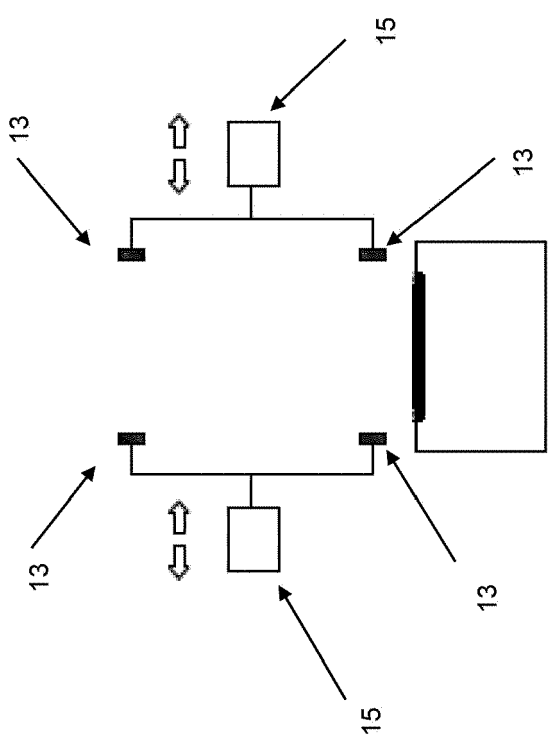


Fig. 8

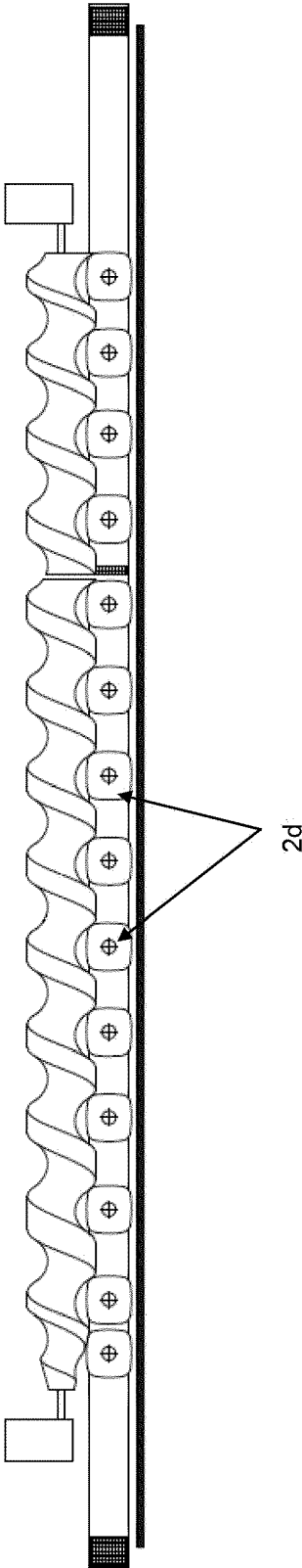


Fig. 9



EUROPEAN SEARCH REPORT

Application Number

EP 23 02 0415

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EPO FORM 1503 03.82 (P04C01)

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2020/254111 A1 (QUINTI S R L [IT]) 24 December 2020 (2020-12-24) * page 5, line 23 - page 7, line 21; figures 1-4 * -----	1-9	INV. B67C7/00
			TECHNICAL FIELDS SEARCHED (IPC)
			B67C B67B B65G
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 27 February 2024	Examiner Wartenhorst, Frank
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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27-02-2024

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