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(54) **CAPPING AND CAP SORTING DEVICE AND METHOD**

(57) Capping and cap sorting device comprising a capping machine, a cap transporter, a transporter and a sorter, characterised in that it comprises a robotic manipulator 27 located in the sorter 5, with a separation system 6 and a transporter 4 with platforms 38 coupled with the sorter 5, wherein all the elements of the device are coupled with each other with releasable or permanent couplings, wherein the sorter 5 comprises a primary transporter 19 belt mounted on a separate base or sharing a common base with a cap transporter 10 and/or the separation system 6, preferably with an illuminator 28 located under the primary transporter 19 or inside it, preferably with a second upper illuminator 29 above the primary transporter 19, whereas the transporter 4 with platforms 38 further comprises cells 36 with releasably-installed platforms 38 with container sockets 43, wherein the distance between the sockets 43 is uniform and corresponding to the distance between jaws 33 with vacuum grabs 34 on a grab 32 of a hexaxial robotic manipulator 44, and corresponding to the distance between capping heads 30, and equal to the length of a "puck"-type carrier, wherein a bottle 8 is transported to the packing line, wherein the shape of the sockets 43 corresponds to the shape of a cap 12 inserted into the device, preferably a trigger, atomiser or pump type cap, preferably with a dip tube 40, wherein the shape corresponds to the shape profile of the cap 12 inserted into the device, the cap 12 lying on its side, horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser, pump, flip top, cylindrical, press on, snap on or asymmetric type cap 12, preferably with a dip tube 40, preferably horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator.

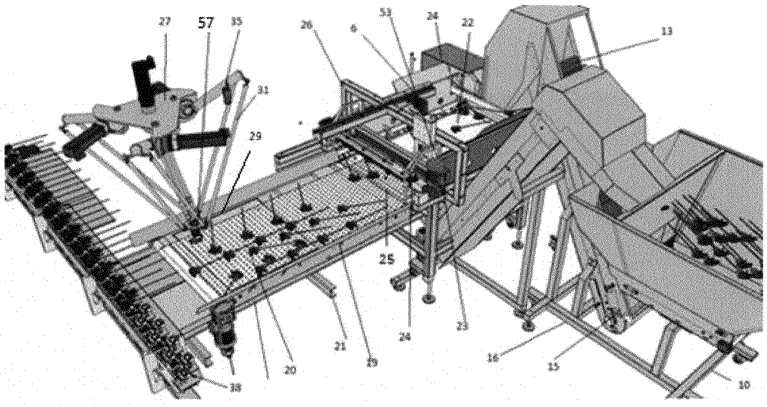

Fig. 4

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Description

[0001] The subject of the invention is a capping and cap sorting device, a sorting, transportation and capping method intended for the sorting and application of container caps of any shape, and a cap transportation platform, utilised particularly in the cosmetic, pharmaceutical and chemical industries.

[0002] A device for applying screw threaded caps to bottles is known from US3905177. A capping machine for applying screw threaded caps to threaded containers with threaded finishes is known from US2017233233. A device for filling water bottles with an automatic container capping system is known from US2010275556. Therefore, sorting devices and methods are known to the industry, and these solutions comprise a separate sorter or a separate sorter insert adjusted each time exclusively to a specific type of cap. Solutions known hitherto require changing the tooling that transports the caps from the sorter to the capping device or require adjusting the guides that ensure the correct position of the caps during transport and their smooth transfer. Traditional belt, chain or pneumatic conveyors, where the caps are also buffered and queued, are used for transportation. Buffering entails the necessity to form an appropriately long queue of caps in order to guarantee the appropriate number of caps for capping device operation under traditional mechanical sorter efficiency fluctuations. Queueing entails the necessity of contact and, consequently, the mutual interactions between caps placed in the queue. The element receiving the caps from the queue in the capping system is a carousel or a different mechanical system designed for taking the first cap in the queue and transferring it to the capping head. Typically, the capping head is an element that descends over the cap and collects it via gripping and clamping, or via the vacuum or frictional methods. In the carousel device, transfer occurs during the motion of the cap and the carousel head at the contact point of both element trajectories, determined by the guiding carousel diameters. In linear devices with single or multiple heads, the cap is transferred to the mobile or immobile head via a cam mechanism, or via pneumatic or electric drives with two or three degrees of freedom. In the case of capping devices for trigger, atomiser, pump, flip top, cylindrical, press on, snap on, asymmetric etc. type caps that include dip tubes, a separate, additional element is inserted into the capping machine that serves to straighten and guide the dip tube. This element comprises a dip tube guiding component and remains immobile, thereby determining the additional motion of the head (capping heads) in the cycle before applying the cap to the bottle, or constitutes an element with a separate drive operating in sync with the vertical motion of the capping head/heads.

[0003] The purpose of the invention is to develop such a device and method for cap sorting and transportation that would enable the utilisation of a single production line for multiple types of caps, with minimal interference in the production line during container shape and cap type change, without the necessity to replace or install an additional sorter or its insert. The solution makes it possible to simultaneously obtain higher outputs and maximum flexibility of devices in the line compared to devices traditionally utilised in the industry for operation with one or two caps and their different sizes. A transporter with platforms removes the negative effects related to queueing and buffering, since the caps do not remain in contact and do not interact with each other. The machine is capable of operation with any type of cap and container. The solution makes it possible to quickly introduce a new product type into the production line, whereas the only action necessary to begin operation with the new cap and bottle is the replacement of the 3D-printed tooling and the capping head formats. The above advantages can be achieved thanks to the presented device, which comprises a cap sorter and a capping machine, as well as the cap transportation methods. The solution ensures high tooling availability due to the small tooling sizes, which require less processing compared to tooling utilised in comparable traditional devices. There are no known capping systems utilising robotic manipulators designed to transfer caps to the capping heads and to simultaneously straighten the dip tubes in the trigger, pump or atomiser type caps, nor capping systems utilising robotic manipulators designed for operation in speed and/or position synchronisation modes during the vertical motion of the capping heads during the final moment of the cycle of dip tube insertion via a centring assembly mounted on the robot grab. Sorters and transporters with replaceable elements whose shapes are fitted to the inserted cap are not appropriate.

[0004] The nature of the invention is a device for capping and sorting, comprising a capping machine, a cap transporter and a sorter, characterised by comprising a capping machine with at least one servomechanism and a robotic manipulator, a transporter located under the capping machine, a sorter with a robotic manipulator located above said sorter, as well as a separation system and cap transportation system coupled with the sorter, wherein all the elements of the device are coupled with each other with releasable or permanent couplings. The cap transporter with a cap motion sensor comprises a dispenser with open top and bottom sides, under which a feeder belt conveyor and an incline conveyor are located, preferably with permanent couplings. The separation belt system comprises a casing, a belt conveyor mounted on a base, a motoreducer mounted on an arm or a base, an arm mounted above the belt conveyor that further comprises a separation system scraper and a sensor. The sorter comprises a primary transporter belt mounted on a separate base or on a common base with the cap transporter and/or separation system. Preferably, an illuminator is mounted under or inside the primary transporter. Preferably, a second illuminator is located above the primary transporter. The primary transporter belt is located under a delta or scara type manipulator. The illuminators are located within the manipulator workspace. The transporter comprises cells with platforms with sockets for containers. The distance between the con-

tainer sockets is uniform and corresponds to the distance between jaws with vacuum suction nozzles on a hexaxial manipulator grab located on the capping machine. Preferably, the platforms are mounted via magnets. The distance between container sockets and the distances between capping heads are equal to the length of a "puck"-type carrier in which a bottle is transported to the packing line. Preferably, the dispenser and belt conveyors are installed permanently on a common base. Preferably, the cap transporter comprises a motion sensor mounted on the dispenser or in the base. Preferably, a return loop for uncollected caps is located under the primary transporter, separator and separation system. Preferably, the uncollected cap return loop comprises a return transporter belt and a return belt conveyor with paddles, located at the end of the return transporter belt, wherein the return transporter belt with paddles is mounted on a separate base or on a common base with the cap transporter, preferably the return belt conveyor is mounted on a base, preferably together with the cap transporter. Preferably, the separation belt system is mounted on a separate base or on a common base with the cap transporter. Preferably, the scraper consists of a cylindrical brush or at least one rubber flap, preferably four. Preferably, the robotic manipulator in the cap sorter is of a delta or scara type and comprises a single grab. Preferably, the platform sockets are of a shape corresponding to the shape profile of the cap inserted into the device, the cap lying on its side, horizontally should it comprise a dip tube, with the dip tube oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser, pump, flip top, cylindrical, press on, snap on or asymmetric type cap, preferably with a dip tube.

[0005] The capping machine comprises a robotic manipulator controller, a centring device unit, a vertical drive unit with a mounted capping head unit located above the bottles transported along the line in "puck"-type carriers, and a robotic manipulator mounted sorter-side, preferably hexaxial, with a grab mounted on the effector, with jaws with vacuum suction nozzles.

[0006] Preferably, the platforms installed in the transporter are mounted releasably, preferably via positioning pins. The platforms comprise container sockets, wherein the distance between said sockets is uniform. Preferably, the vacuum grabs comprise jaws with vacuum suction nozzles mounted inside said jaws, wherein the jaws correspond to the cap shape, which corresponds to the shape profile of the cap inserted into the device, the cap lying on its side, horizontally should it comprise a dip tube, with the dip tube oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser, pump, flip top, cylindrical, press on, snap on or asymmetric type cap, preferably with a dip tube. The number of processed caps always depends on capping machine efficiency, and the device can be utilised with various types of caps. The device can comprise a pusher mechanism for the "puck"-type carriers transporting the bottles. When the pusher mechanism is not installed in the device, the capping process is accomplished on a puck transporter operating in a start-stop manner.

[0007] Platforms for caps characterised by their releasable mounting in the transporter also constitute the nature of the invention. The transporter comprises cells with platforms with cap sockets, wherein the distance between said sockets is uniform and corresponds to the distance between the jaws with vacuum suction nozzles on the hexaxial robotic manipulator grab, and corresponds to the distance between the capping heads, and is equal to the length of the "puck"-type carrier wherein the bottle is transported along the packing line. The platform sockets are of a shape corresponding to the shape profile of the cap inserted into the device, the cap lying on its side, horizontally should it comprise a dip tube, with the dip tube oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser, pump, flip top, cylindrical, press on, snap on or asymmetric type cap, preferably with a dip tube, preferably horizontally should it comprise a dip tube with the dip tube oriented perpendicularly to the direction of motion, towards the sorting manipulator. Preferably, the platforms comprise magnets and are mounted to the cells via positioning pins.

[0008] The method of cap sorting and capping, consisting in the movement of a cap elevator infeed transporter when a cap presence sensor is not active, also constitutes the nature of the invention. The energy sensor, with a beam with a mirror, transmits information in the form of a high signal to the PLC unit controlling the operation of the device, signalling cap placement or cap feeding conclusion by means of the elevator infeed transporter. After the device is started, the cap elevator infeed transporter moves forward, releasing the caps placed in the infeed compartment to the second outfeed compartment until the sensor is activated. The cap elevator incline transporter moves stepwise until the reception of the signal transmitted by the sensor. The reflective sensor in a high state signals that caps are present in its operating range. The PLC must stop the operation of the elevator vertical transporter. The cap elevator incline transporter always stops in the same position thanks to the driver sensor installed in the transporter casing. The driver sensor detects the vertical transporter paddle. After the paddle is detected, the PLC counts the time necessary to always stop the paddle in the same position - just before rolling through the vertical transporter idler roller, just before unloading to the next cap separation system. The paddle detector enables the quick start of the incline transporter and allows the control of the number of caps fed into the separation system. The caps are transported from the infeed compartment, where they are placed mechanically and manually, and from the supply of uncollected caps that were rerouted by the transporter return loop, which comprises a return conveyor, located above the primary transporter and transportation conveyor, and a return incline transporter. The caps from the cap elevator incline transporter are transferred to the separation conveyor, which transports the caps to the primary transporter. A scraper is located above the separation conveyor, consisting of

a cylindrical brush or at least one rubber flap, preferably four, and driven by a motoreducer, the speed of which is controlled by a frequency converter. The frequency converter is located in the sorting device control cabinet. The scraper makes it possible to obtain a single layer of caps leaving the separation system. The scraper height is controlled by means of a servomechanism. The caps on the separation conveyor transferred to the primary transporter are gathered by the scraper at a set speed. From the separation system and separation conveyor, the caps are transferred to the primary transporter, which moves at a faster speed compared to the separation system transporter, which makes it possible to increase the distances between caps. The primary transporter comprising an illuminator is mounted under the belt and comprises elements increasing cap stability, such as vulcanised cylindrical elements, preferably approximately 7 mm high and 12 mm in diameter. A second illuminator can be mounted above the primary transporter. The position of the primary transporter is set and controlled by the robotic manipulator controller, which takes the caps from the moving primary transporter by means of a vacuum grab, preferably 3D-printed. The video system camera, mounted above the primary transporter, controls the robot's workspace during every cycle when a cap is collected and delivered. This is done to control the possible displacements of other caps when one of them is being collected. This functionality is used when working with any type of cap, but primarily with caps that exhibit protruding geometric elements which may result in overlays with other caps, i.e. dip tubes or tubes of trigger, pump and atomiser type caps. Thanks to the utilisation of this function, a stable and precise operation of the sorter is possible with the aforementioned caps. Caps that fall from the primary transporter are directed to the elevator hopper via the transporter return loop. The vacuum grab takes a cap and transfers it to a cap transporter with at least one servomechanism. The transporter moves in a start-stop manner or continuously. The cap transporter comprises platforms, preferably 3D-printed, which further comprise sockets for single caps or for multiple caps, with shapes corresponding to the shape of the cap. The position of the caps is determined by their size, wherein the distance between the same sockets on subsequent platforms is equal to the distance between the capping heads in the capping machine. The vacuum grab places the caps in the platforms, mounted to the cap transporter cells via magnets, wherein the correct position of the platforms is maintained by the positioning pins. Trigger, pump and atomiser type caps with dip tubes are transported horizontally, with the dip tube oriented towards the robotic manipulator that collects them from the cap sorter primary transporter.

[0009] Caps placed in the transporter are transferred to the capping machine, comprising a vertical drive unit with a mounted capping head unit and centring device unit. The hexaxial robotic manipulator collects a cap from the cap transporter, driven by at least one servomechanism, and transfers it to the capping heads. The container transporter with pucks delivers bottles into the pusher system area. The bottles are pushed onto an intermediate plate where they undergo capping. In an alternate mode of operation, the pusher mechanism is not installed, whereas the capping process is performed on a puck transporter operating in a start-stop manner. The bottles are removed from the capping area by the next batch by means of the pusher system or by the puck transporter in the alternate mode of operation. The bottles leave the capping device on a traditional chain transporter. The hexaxial robot installed on the capping device frame, above the cap transporter, collects the caps from the platforms mounted on the transporter with a servomechanism. The number of simultaneously collected caps depends on the efficiency of the capping machine and is always equal to the number of capping heads. The collection is performed by means of vacuum suction nozzles installed inside the jaws, with shapes corresponding to the shape of the cap. The jaws make it possible to maintain the exact position of the caps as they are collected from the cap transporter and transferred to the capping heads. The shape of the jaws reflects the shape of the caps. During the first stage of cap delivery, the hexaxial robot moves the triggers from the cap transporter to an "awaiting delivery" position. The robot remains in this position until the capping heads return to the upper position after the conclusion of the previous capping cycle. The position is determined by bottle height, and preferably by dip tube length should it be present in the cap. The dip tube clasp in the cap grab remains open during this stage of delivery. During the second stage of delivery, the hexaxial robot delivers the caps to the open capping head gripper jaws by performing a horizontal motion towards the capping heads. After stopping, the positions of the capping head gripper axis and the threaded or locking cap element axis overlap. Closing of the capping head gripper jaws occurs in the next stage. After the caps are clenched in the correct position by the capping head gripper jaws, the vacuum holding the caps is deactivated. The hexaxial robot rotates around the dip tube clasp assembly axis in order to switch the gripper to a dip tube straightening position. After this position is attained, the clasp is switched by the servomotor to a closed position holding the dip tube. The clasp remains in the closed position throughout the entire dip tube straightening process. A sensor in the closed clasp commences dip tube straightening. The robot performs a vertical motion, ending just before the end of the dip tube, at a determined distance above the bottle neck. After this position is attained, the robot and capping heads move simultaneously, in speed or position synchronisation mode, towards the bottle neck. Afterwards, once the robot grab attains a height of approx. 2 mm above the bottle neck, the robot stops and releases the clasp, whereas the capping heads continue their vertical motion. Once the clasp is released, the robot moves the entire gripper to the collection position, which allows it to collect the next set of caps from the cap transporter. After capping is concluded, the capping heads return to the cap collection position where the cycle begins anew. The same method is utilised for subsequent caps. For caps that do not comprise dip tubes, the delivery cycle skips the operation to switch the gripper to a straightening position and the dip tube straightening process itself.

[0010] The subject of the invention has been demonstrated on a drawing, where fig. 1 presents the sorting and capping system, fig. 1a presents the sorting and capping system with the visible robotic manipulator, fig. 2 - the cap sorter with the cap transporter, fig. 3 - the dispenser and cap transporter incline belt conveyor, fig. 4 - the transporter with platforms, the sorter and the separation system, fig. 5 - the transporter with platforms, fig. 6 - the capping machine, fig. 7 - the hexaxial robot arm in the cap collection position, fig. 8 - the hexaxial robot arm in the cap collection position, fig. 9 - the capping machine in the "awaiting delivery" position, fig. 10 - the capping machine in the "cap delivery" position, fig. 11 - the capping heads during delivered cap clenching, fig. 12 - the machine rotating the hexaxial robot during the switch to dip tube straightening, fig. 13 - the hexaxial robot grab in the dip tube straightening position, fig. 14 - the hexaxial robot grab in the dip tube straightening position with an open clasp, fig. 15 - the hexaxial robot grab in the dip tube straightening position with a closed clasp, fig. 16 - robot arm and capping head unit, fig. 17 - the hexaxial robot grab in the dip tube straightening position commencing a synchronised motion with the capping head unit, fig. 18 - the hexaxial robot grab in the dip tube straightening position with the capping head unit, fig. 19 - the hexaxial robot grab with the capping head unit, fig. 20 - a side view of the hexaxial robot grab with the capping head unit, and fig. 21 - capping heads during the capping process conclusion.

[0011] Example I. The capping and cap sorting device 1 comprises a capping machine 2 and a transporter 4 with platforms 38 and a sorter 5, with a separation system 6 and the transporter 4 with platforms 38 coupled with said sorter 5, wherein all the elements of the device are coupled with each other with releasable or permanent couplings. It also comprises a feeder 7, which supplies liquid-filled bottles 8, and a bottle transporter 3, which transports capped bottles away from the capping machine. The cap transporter 10 comprises a dispenser 9 with open top and bottom sides and the shape of a prism. A feeder belt conveyor 11 is installed permanently under the dispenser 9, which feeds caps 12 to an incline conveyor 13. The dispenser 9 and belt conveyors 11 and 13 are installed permanently on a common base 14. The cap transporter 10 comprises a motion sensor 15, mounted on the dispenser 9, which is used to detect the driver 16 on the elevator incline transporter 13. The caps 12 are stored in the cap 12 dispenser 9 and transferred via the feeder belt conveyor 11 to the separation system 6 after the motion sensor 15 detects the caps 12 in the dispenser 9. The dispenser 9 is also refilled with caps 12 from an uncollected cap return loop 17. The uncollected cap return loop 17 comprises a return transporter belt 18 that receives the uncollected caps 12 falling from a primary transporter 19 and from a return belt conveyor 20 which is located at the end of the return transporter belt 18 and which receives the uncollected caps 12. The return belt conveyor 20 is mounted on a separate loop base 21.

[0012] The caps 12 are delivered via the feeder belt conveyor 11 to the separation system 6 onto a separation conveyor 22. The separation system 6 comprises a separation conveyor 22, which is a belt conveyor mounted on a separate base. The separation system 6 comprises a sensor 23 mounted on a casing 24, which transmits information to the controller regarding the presence of caps 12 just before the separation system 6 scraper 25. A scraper 25 is mounted on an arm 26 located above the separation conveyor 22. The scraper 25 consists of a cylindrical brush and is driven by a motoreducer 53, which is mounted on the arm 26 or the separation system base. The caps 12 are delivered by the separation conveyor 22 to the sorter 5 onto the primary transporter 19, wherein before they are moved into the sorter 5, the scraper 25 gathers the caps 12 and places them in a single layer. The sorter 5 comprises a primary transporter belt 19, mounted on a separate base. The position of the primary transporter 19 is controlled by a robotic manipulator 27 controller. An illuminator 28 is mounted in the primary transporter 19. An upper illuminator 29 is located above the primary transporter 19. The caps 12 are collected from the primary transporter 19 by the robotic manipulator 27, which transfers the caps 12 to the transporter 4 with platforms 38. Uncollected caps 12 are transferred to the uncollected cap return loop 17, directly to the return transporter belt 18.

[0013] The capping machine 2 comprises three capping heads 30. A hexaxial robotic manipulator 44 comprises arms 41 with single grabs 32 that further comprise three jaws 33 with vacuum suction nozzles 34 installed at the ends of said jaws.

[0014] A camera 35 in the sorter 5 controls the robot's workspace during every cycle when a cap 12 is collected and delivered, in order to control the possible displacements of other caps 12 when one of them is being collected, which is particularly advantageous when collecting caps 12 with geometric elements, i.e. dip tubes and tubes.

[0015] A grab 57 transfers the caps to the transporter 4 with platforms 38 which comprises a servomechanism 54 and which couples the sorter 5 to the capping machine 2. The transporter 4 with platforms 38 moves in a start-stop manner. The transporter 4 comprises cells 36, wherein platforms 38 are mounted via magnets 37, as well as positioning pins 39 that keep the platforms 38 in the correct positions. The platforms 38 are not installed permanently and can be replaced as appropriate. The platforms 38 comprise sockets 43. Caps 12 delivered by the robotic manipulator 27 are placed in the platforms 38. The shape of the sockets 43 is adapted to the shape of the caps 12. The shape corresponds to the shape profile of the cap 12 inserted into the device, the cap 12 lying on its side, horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser, pump, flip top, cylindrical, press on, snap on or asymmetric type cap, preferably with a dip tube 40. In this example, it is the shape of a trigger with a dip tube 40. The platforms 38 are positioned by means of positioning pins 39. Distance 42 between the container sockets 43 is uniform and corresponds to the distance between the jaws

33 with vacuum suction nozzles 34 on the hexaxial manipulator 44 grab 32. The platforms 38 are mounted via magnets 37. The distance 42 between container sockets 43 and the distances between capping heads 30 are equal to the length of a "puck"-type carrier 45 wherein the bottle 8 is transported to the packing line. The transporter 4 with platforms 38 moves towards the capping machine 2 with the caps 12 placed in the platforms 38. The caps 12 are collected from the transporter 4 and transferred to a capping head 30 unit, located above the bottles 8 in "puck"-type carriers 45 transported by the line.

[0016] The capping machine 2 comprises a vertical drive unit 46 with a mounted capping head 30 unit, a centring device 47 unit and a hexaxial manipulator 44. The hexaxial manipulator 44 collects the caps 12 from the servomechanism 54-driven transporter 4 with platforms 38 by means of the vacuum suction nozzles 34 installed inside the jaws 33. The jaws 33 are mounted at the end of the hexaxial manipulator 44 arm 41. The jaws 33 correspond to the shape of the cap 12 in the same way as the platform 38. The hexaxial manipulator 44 transfers the caps 12 to the capping heads 30, wherein the number of capping heads 30 is equal to the number of jaws 33 on the robot grab 32. The arm 41 transfers the caps 12 from the transporter 4 with platforms 38 to an "awaiting delivery" position. The arm 41 remains in this position until the capping heads 30 return to the upper position after the conclusion of the previous capping cycle. The position is determined and selected based on bottle 8 height and dip tube 40 length. The dip tube 40 clasp 48 in the cap 12 grab 32 remains open during this stage of delivery. Then the arm 41 delivers the caps 12 to the open capping head 30 gripper jaws 56 by performing a horizontal motion towards the capping heads 30. After stopping, the positions of the capping head 30 gripper 49 axis and the threaded or locking cap 12 element axis overlap. Closing of the capping head 30 gripper jaws 56 occurs in the next stage. Since the caps 12 comprise dip tubes 40, the arm 41 performs cap 12 dip tube 40 straightening. After the caps 12 are clenched in the correct position by the capping head 30 gripper jaws 56, the vacuum holding the caps 12 is deactivated. The hexaxial robot arms 44 rotate around the dip tube 40 clasp 48 assembly axis in order to switch the gripper 49 to a dip tube 40 straightening position. After this position is attained, the clasp 48 is switched by the servomotor 55 to a closed position holding the dip tube 40. The clasp 48 remains in the closed position throughout the entire dip tube 40 straightening process. A sensor 50 in the closed clasp 48 commences dip tube 48 straightening. The robot performs a vertical motion, ending just before the end of the dip tube 40, at a determined distance above the bottle 8 neck. After this position is attained, the robot and capping heads 30 move simultaneously, in speed or position synchronisation mode, towards the bottle 8 neck. Once the grab 32 attains a height of approx. 2 mm above the bottle 8 neck, the robot stops and releases the clasp 48, whereas the capping heads 30 continue their vertical motion. Once the clasp 48 is released, the robot moves the entire gripper 49 to the collection position, which allows it to collect the next set of caps 12 from the transporter 4 with platforms 38. After capping is concluded, the capping heads 30 return to the cap 12 collection position where the cycle begins anew. Bottles 8 are delivered to the pusher area by the transporter of bottles with pucks. The bottles 8 are pushed onto an intermediate plate 52 where they undergo capping. The bottles 8 are supplied to the device via a feeder 7, located above the transporter and before the capping machine. The bottles 8 are removed from the capping area by the next batch by means of the pusher system. The bottles 8 leave the capping device on a traditional chain transporter 3.

[0017] Example II differs from example I in that the capping and cap sorting device 1 comprises a capping machine 2 and a transporter 4 with platforms 38 and a sorter 5, with a separation system 6 and a cap transporter 10 coupled with the sorter 5, wherein all the elements of the device are coupled with each other permanently and mounted on a single base. Furthermore, the cap transporter 10 comprises a motion sensor 15 mounted on a base 14, whereas the scraper 25 consists of a set of four rubber flaps. Example III differs from example I in that the capping and cap sorting device 1 does not comprise an uncollected cap return loop 17.

[0018] Example IV differs from example I in that the shape of the sockets 43 matches the shape of the caps 12 in the form of a pump.

[0019] Example V differs from example I in that the shape of the sockets 43 matches the shape of the caps 12 in the form of an atomiser without a dip tube, which means that the delivery cycle skips the operation to switch the gripper to a straightening position and the dip tube straightening process itself, as described in example I.

[0020] Example VI differs from example I in that the shape of the sockets 43 matches the shape of the caps 12 in the form of a flip-top cap.

[0021] Example VII differs from example I in that the shape of the sockets 43 matches the shape of the caps 12 in the form of a snap-on cap.

[0022] Example VIII differs from example I in that the shape of the sockets 43 matches the shape of the caps 12 in the form of a push-pull cap.

[0023] Example IX differs from example I in that the shape of the sockets 43 matches a trigger type cap 12, the robotic manipulator 27 delivers the caps 12 onto the transporter 4 while the transporter 4 moves, whereas the hexaxial manipulator 44 in the capping machine 2 collects caps 12 from the transporter 4 while they move as well.

[0024] Example X differs from example I in that the sorting system comprises two robotic manipulators based on the same principle of operation; the hexaxial robot comprises a grab simultaneously collecting seven trigger type caps and transfers them to seven capping heads.

[0025] Example XI differs in that three types of caps are placed on a single platform: a threaded flip-top cap, a regular cylindrical screw cap and an asymmetric snap-on type cap, and that there is no necessity to replace the platforms when changing the format between these caps.

Captions:

1 -	Capping and cap sorting device	30 -	Head
2 -	Capping machine	31 -	Robotic manipulator arms
3 -	Bottle transporter	32 -	Grab
4 -	Transporter	33 -	Jaws
5 -	Sorter	34 -	Vacuum grabs
6 -	Separation system	35 -	Camera
7 -	Feeder	36 -	Cells
8 -	Bottle	37 -	Magnet
9 -	Dispenser	38 -	Platforms
10 -	Cap transporter	39 -	Positioning pins
11 -	Feeder belt conveyor	40 -	Dip tube
12 -	Caps	41 -	Hexaxial manipulator arm
13 -	Incline conveyor	42 -	Distance between sockets
14 -	Base	43 -	Sockets
15 -	Motion sensor	44 -	Hexaxial manipulator
16 -	Driver	45 -	Carriers
17 -	Uncollected cap return loop	46 -	Vertical drive unit
18 -	Return transporter belt	47 -	Centring devices
19 -	Primary transporter	48 -	Clasp
20 -	Return belt conveyor	49 -	Gripper
21 -	Loop base	50 -	Sensor
22 -	Separation conveyor	51 -	Bottle transporter
23 -	Sensor	52 -	Intermediate plate
24 -	Casing	53 -	Motoreducer
25 -	Scraper	54 -	Transporter servomechanism
26 -	Arm	55 -	Servomotor
27 -	Robotic manipulator	56 -	Gripper jaws
28 -	Illuminator	57 -	Grab
29 -	Upper illuminator		

Claims

1. Capping and cap sorting device comprising a capping machine, a cap transporter, a transporter and a sorter, **characterised in that** it comprises a robotic manipulator 27 located in the sorter 5, with a separation system 6 and a transporter 4 with platforms 38 coupled with the sorter 5, wherein all the elements of the device are coupled with each other with releasable or permanent couplings, wherein the sorter 5 comprises a primary transporter 19 belt mounted on a separate base or sharing a common base with a cap transporter 10 and/or the separation system 6, preferably with an illuminator 28 located under the primary transporter 19 or inside it, preferably with a second upper illuminator 29 above the primary transporter 19, whereas the transporter 4 with platforms 38 further comprises cells 36 with releasably-installed platforms 38 with container sockets 43, wherein the distance between the sockets 43 is uniform and corresponding to the distance between jaws 33 with vacuum suction nozzles 34 on a grab 32 of a hexaxial robotic manipulator 44, and corresponding to the distance between capping heads 30, and equal to the length of a "puck"-type carrier, wherein a bottle 8 is transported to the packing line, wherein the shape of the sockets 43 corresponds to the shape of a cap 12 inserted into the device, preferably a trigger, atomiser or pump type cap, preferably with a dip tube 40, wherein the shape corresponds to the shape profile of the cap 12 inserted into the device, the cap 12 lying on its side, horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser, pump, flip top, cylindrical, press on, snap on or asymmetric type cap 12, preferably with a dip tube 40, preferably horizontally

should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator.

2. According to claim no. 1, the device is **characterised in that** the capping machine 2 comprises a robotic manipulator controller, a centring device unit 47, a vertical drive unit 46 with a mounted capping head 30 unit located above bottles 8 transported along the line in "puck"-type carriers, and a robotic manipulator 27 mounted sorter-side 5, preferably hexaxial, with arms 41 further comprising grabs 32 mounted at the ends of said arms, with jaws 33 with vacuum suction nozzles 34.

3. According to claims no. 1 or 2, the device is **characterised in that** the cap transporter 10 with a cap 12 motion sensor 15 comprises a dispenser 9 with open top and bottom sides, under which a feeder belt conveyor 11 and an incline conveyor 13 are located, preferably with permanent couplings, preferably comprising the motion sensor 15 mounted on the dispenser 9 or on a base 14.

4. According to claims no. 1, 2 or 3, the device is **characterised in that** the belt separation system 6 comprises a casing 24, a separation belt conveyor 22 mounted on a base, a motoreducer 53 mounted on an arm 26 or on a base, and an arm 26 mounted above the separation belt conveyor 22, further comprising a separation system 6 scraper 25 installed on the arm 26 as well as a sensor 23, wherein the scraper 25 preferably consists of a cylindrical brush or at least one rubber flap, preferably four rubber flaps.

5. According to claims no. 2, 3 or 4, the device is **characterised in that** the dispenser 9 and belt conveyors 11 and 13 are installed permanently on a common base 14.

6. According to claims no. 1 to 5, the device is **characterised in that** an uncollected cap return loop 17 is located under the primary transporter 19, the sorter 5 and the separation system 6, preferably comprising a return transporter belt 18 as well as a return belt conveyor 20 located at the end of the return transporter belt 18, wherein the return belt conveyor 20 is installed on a separate base or on a common base with the cap transporter 10.

7. According to claims no. 1 to 6, the device is **characterised in that** the robotic manipulator 44 in the capping system is preferably hexaxial with a single grab 32 with jaws 33 with vacuum suction nozzles 34 installed inside the jaws 33, wherein the shape of the jaws 33 corresponds to the shape of the cap 12 inserted into the device, preferably a trigger, atomiser or pump type cap, preferably with a dip tube 40, wherein the number of jaws 33 on the capping system hexaxial manipulator 44 grab 32 corresponds to the number of capping heads 30, whereas the shape of the jaws 33 corresponds to the shape profile of the cap 12 inserted into the device, the cap 12 lying on its side, horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser or pump type cap 12, preferably with a dip tube 40, wherein the robotic manipulator 27 in the cap sorter 5 is preferably of a delta or scara type and is located directly above the illuminator 28, wherein the workspace of the robotic manipulator 27 is observed by a video system camera 35.

8. According to claims no. 1 to 7, the device is **characterised in that** the platforms 38 are mounted in the cells 36 by means of positioning pins 39 and comprise magnets 37.

9. The cap platforms are **characterised in that** the transporter 4 comprises cells 36 with platforms 38 with cap 12 sockets 43, wherein the distance between the sockets 43 is uniform and corresponding to the distance between the jaws 33 with vacuum suction nozzles 34 on the hexaxial robotic manipulator 44 grab 32, and corresponding to the distances between the capping heads 30, and equal to the length of the "puck"-type carrier, wherein the bottle 8 is transported to the packing line, wherein the shape of the sockets 43 corresponds to the shape of the cap 12 inserted into the device, preferably a trigger, atomiser, pump, flip top, cylindrical, press on, snap on or asymmetric type cap, preferably with a dip tube 40, wherein the shape corresponds to the shape profile of the cap 12 inserted into the device, the cap 12 lying on its side, horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser or pump type cap 12, preferably with a dip tube 40.

10. According to claim no. 9, the platforms are **characterised in that** the platforms are mounted to the cells 36 via positioning pins 39 and comprise magnets 37 and sockets 43, wherein the shape of the sockets 43 corresponds to the shape profile of the cap 12 inserted into the device, the cap 12 lying on its side, horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser or pump type cap 12, preferably with a dip tube 40.

11. The cap sorting and capping method is **characterised in that** the robotic manipulator 27 mounted above the sorter 5 grabs the caps 12 by means of arms 31 with mounted jaws 33 with vacuum suction nozzles 34 from the moving primary transporter 19 and transfers the caps 12 to the transporter 4 with platforms 38, placing the caps 12 in the platforms 38 with cap 12 sockets 43, wherein the shape of the sockets 43 corresponds to the shape of the cap 12 inserted into the device, preferably a trigger, atomiser, pump, flip top, cylindrical, press on, snap on or asymmetric type cap, preferably with a dip tube 40, wherein the shape of the cap 12 corresponds to the shape profile of the cap 12 inserted into the device, the cap 12 lying on its side, horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser or pump type cap 12, preferably with a dip tube 40, preferably horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator, wherein the transporter 4 moves in a start-stop manner or continuously, after which the caps 12 are preferably transferred by the hexaxial robotic manipulator 44 to the capping heads 30 in the capping machine 2, which cap the bottles 8 supplied by the feeder 7 by known methods.

12. According to claim no. 11, the method is **characterised in that** the device comprises a video system 35 that controls the robot 27 workspace during every cycle when a cap 12 is collected from the transporter 19 and delivered to the transporter 4 with platforms 38.

13. According to claims no. 11 and 12, the method is **characterised in that** the robotic manipulator 44 delivers the cap 12, preferably while also straightening the dip tube 40, by means of the grab 32 with jaws 33 with vacuum suction nozzles 34.

14. According to claims no. 11 to 13, the method is **characterised in that** the platforms 38 are coupled releasably in the cells 36, preferably via positioning pins 39.

15. According to claims no. 11 to 14, the method is **characterised in that** the vacuum grab 32 with jaws 33 with vacuum suction nozzles 34 installed inside the jaws 33 transfers the caps 12 to open capping head 30 gripper jaws 56 by performing a horizontal motion towards the capping heads 30 until the capping head 30 gripper 49 axis and the threaded or locking cap 12 element axis overlap, after which the capping head 30 gripper jaws 56 close, followed by a rotation around the axis of a dip tube 40 clasp 48 assembly until the dip tube 40 is straightened, after which the grab 32 performs a vertical motion and releases the clasp 48 after attaining a position above the neck of the container.

16. According to claims no. 11 to 14, the method is **characterised in that** the vacuum grab 32 comprises jaws 33 with vacuum suction nozzles 34 installed inside the jaws 33, wherein the jaws 33 correspond to the shape of the cap 12, wherein the shape corresponds to the shape profile of the cap 12 inserted into the device, the cap 12 lying on its side, horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator, preferably for a trigger, atomiser, pump, flip top, cylindrical, press on, snap on or asymmetric type cap 12, preferably with a dip tube 40, preferably horizontally should it comprise a dip tube 40, with the dip tube 40 oriented perpendicularly to the direction of motion, towards the sorting manipulator.

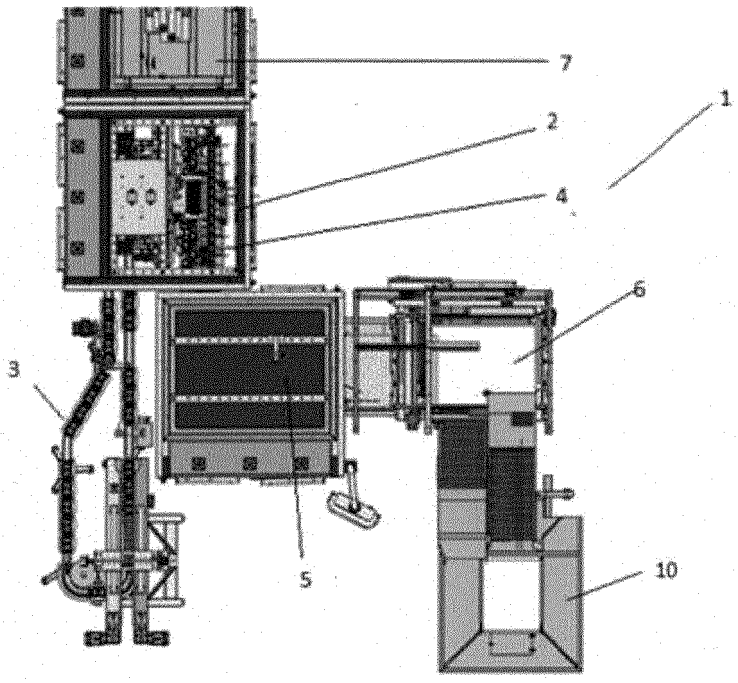

Fig. 1

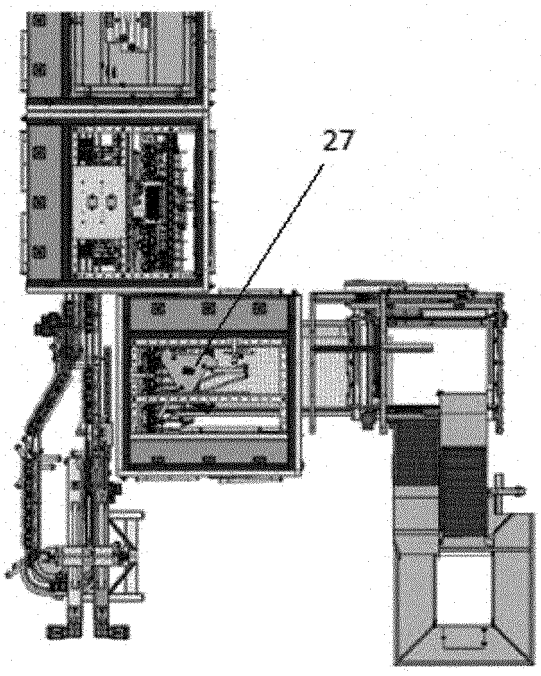

Fig. 1a

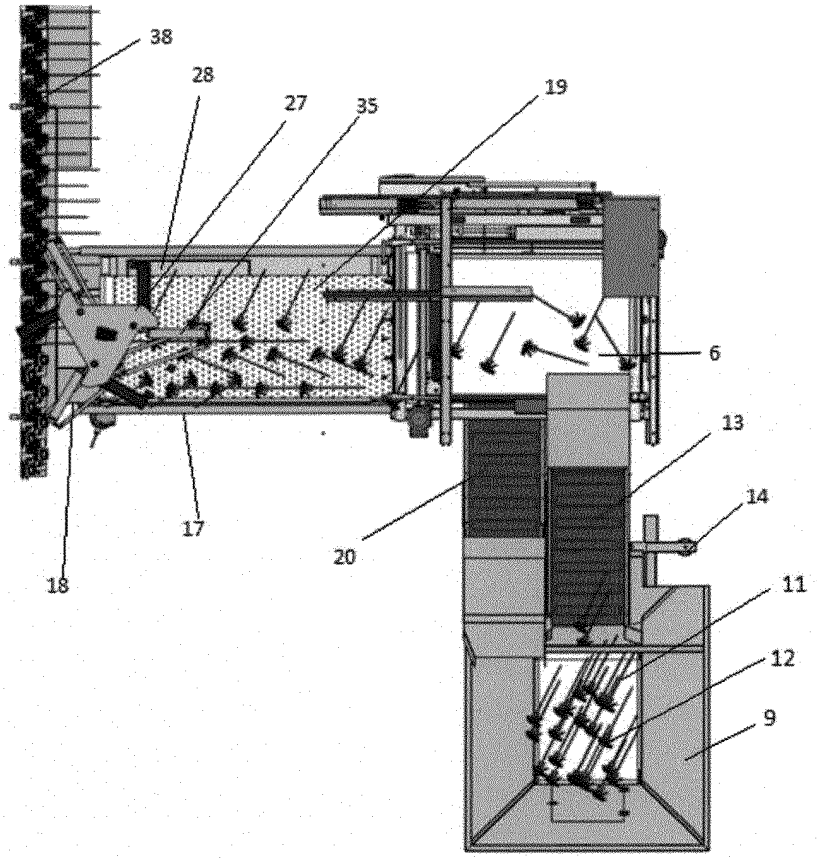

Fig. 2

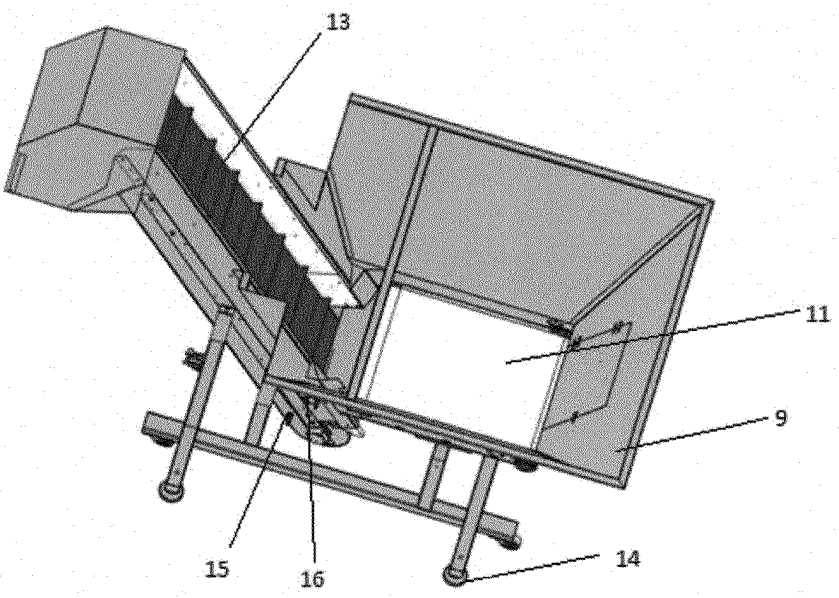

Fig. 3

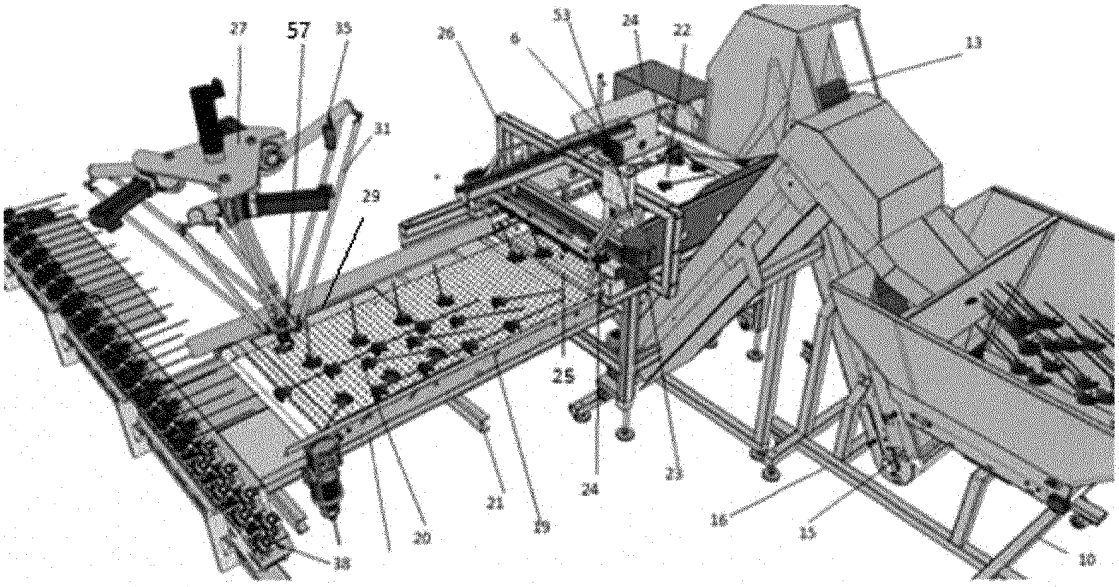
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Fig. 4

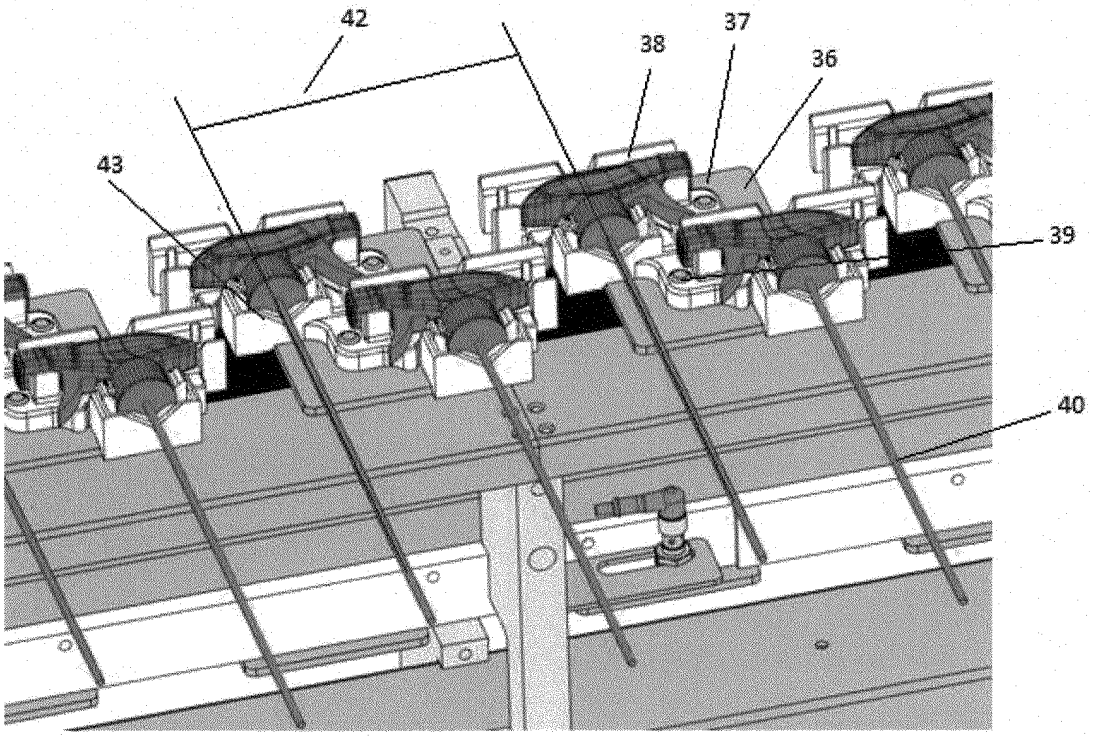
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Fig. 5

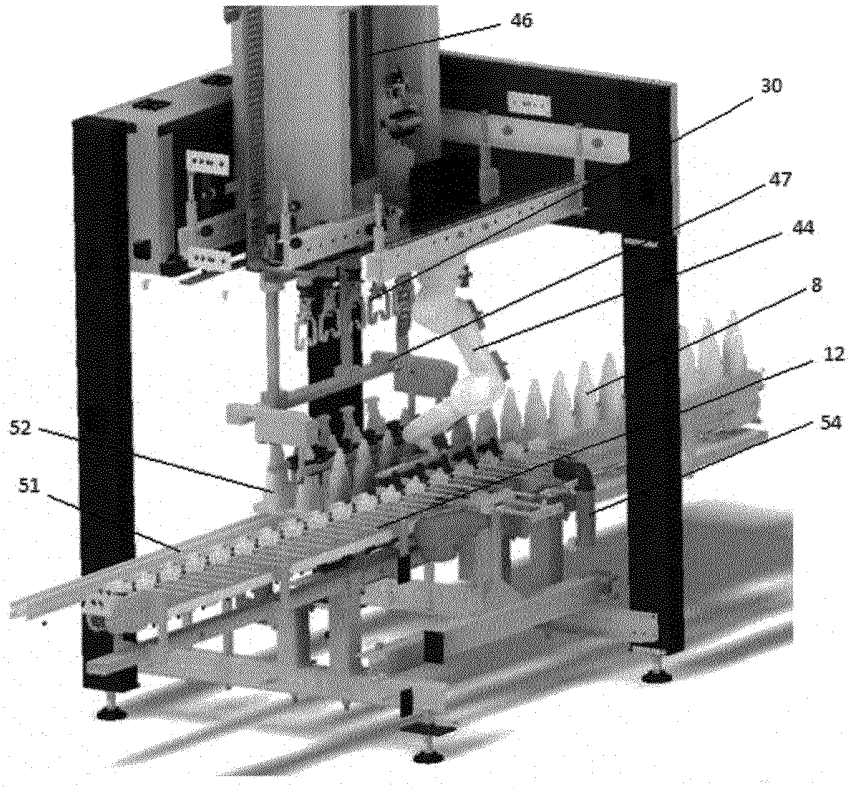

Fig. 6

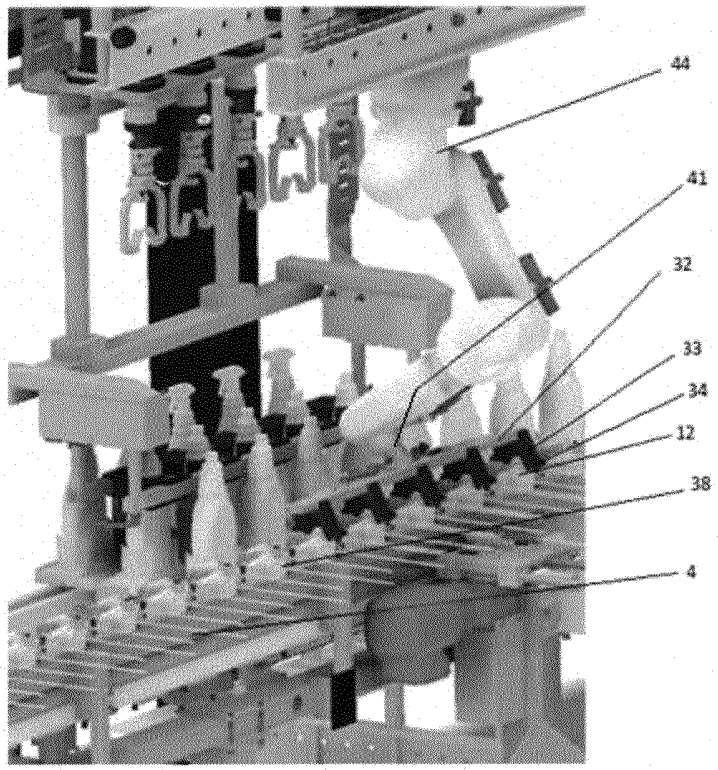

Fig. 7

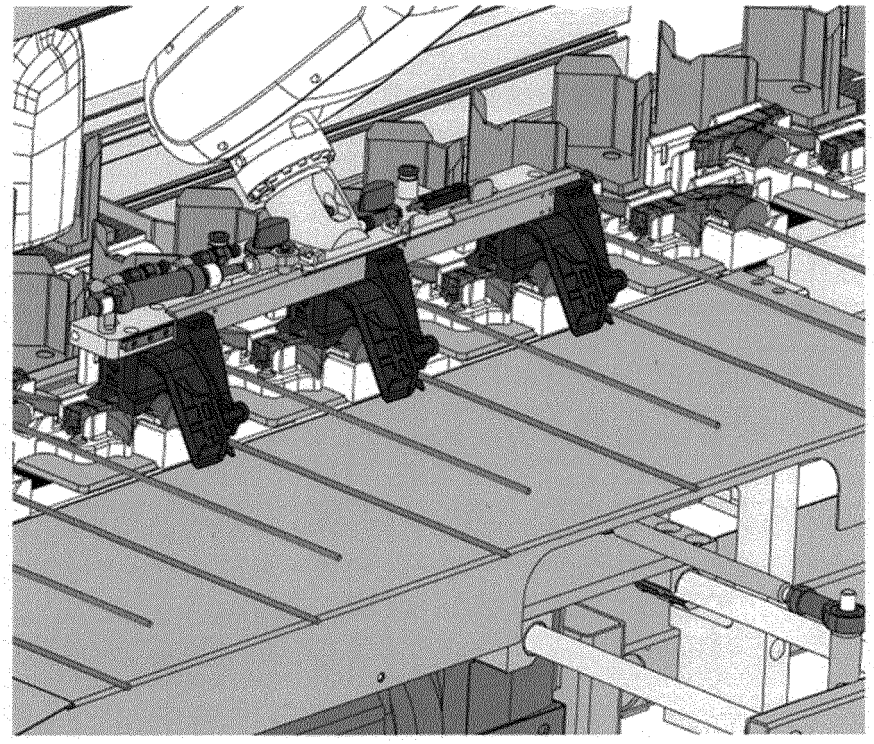

Fig. 8

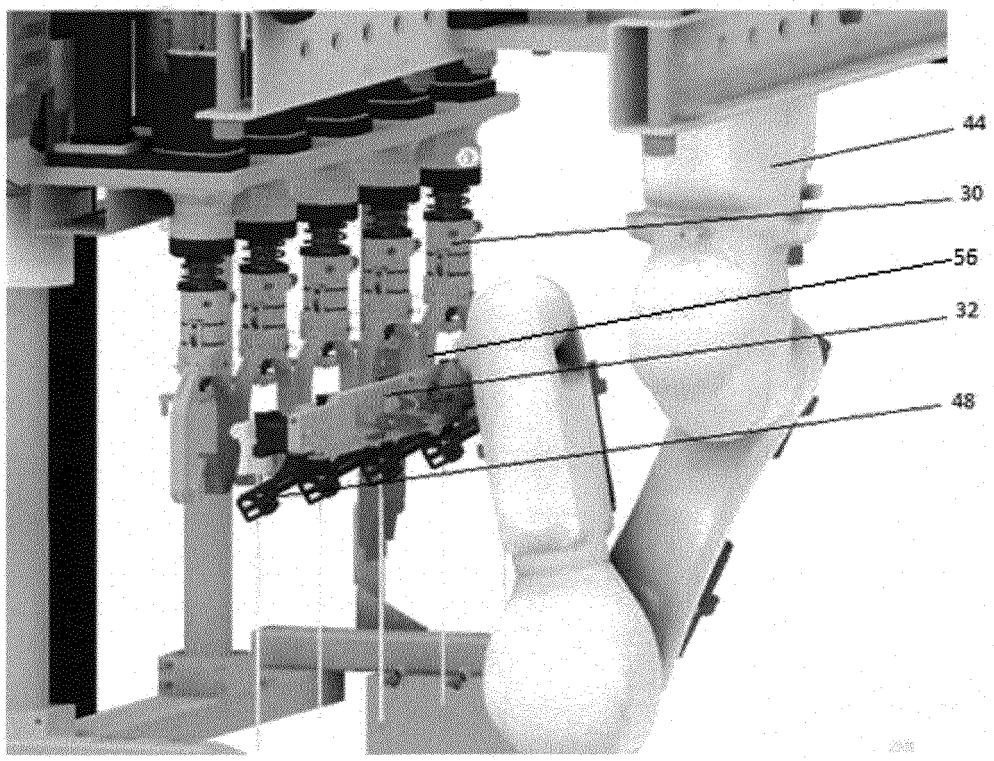

Fig. 9

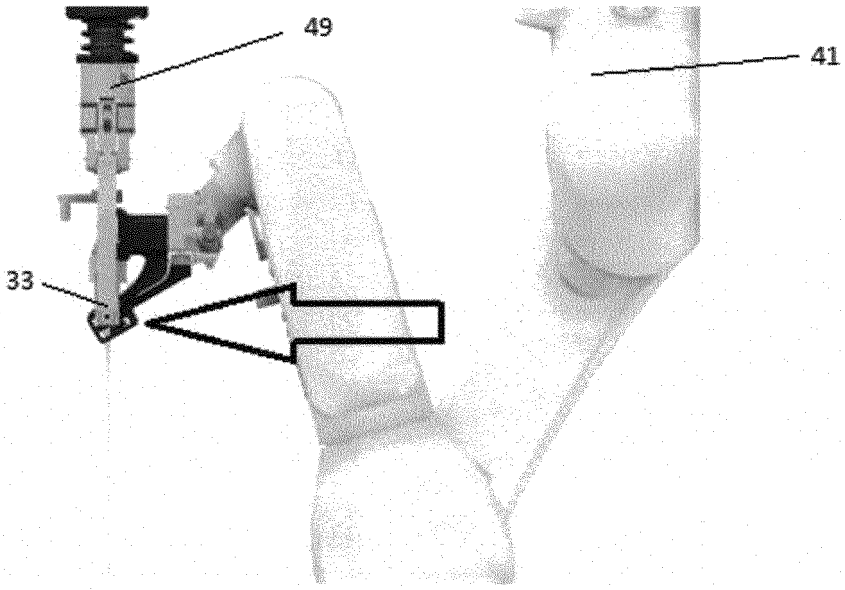

Fig. 10

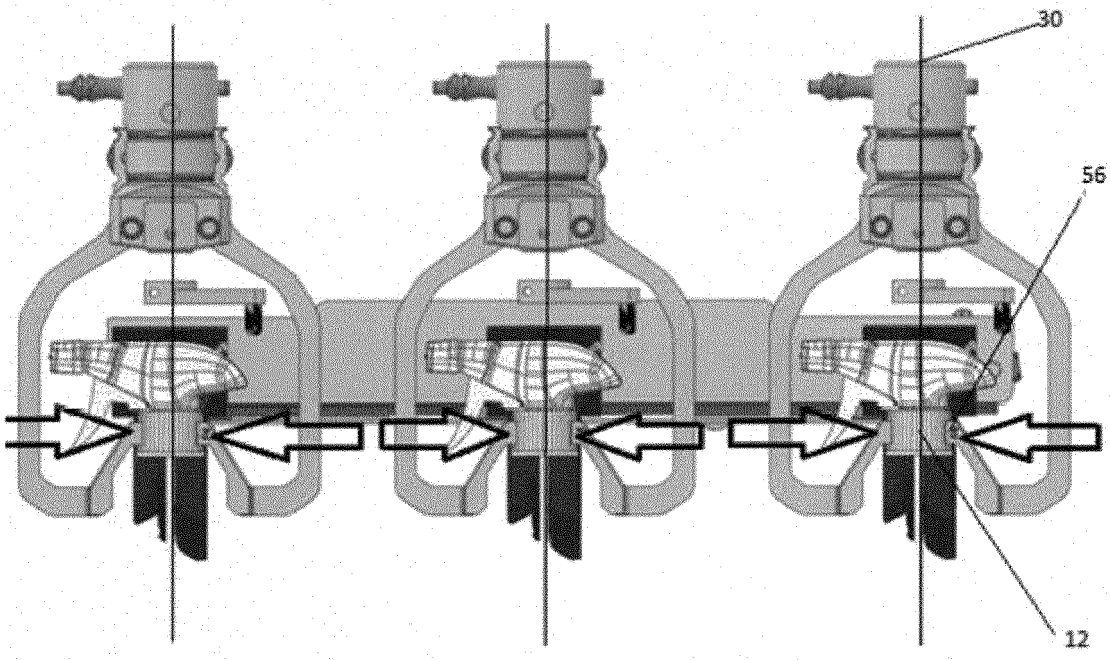

Fig. 11

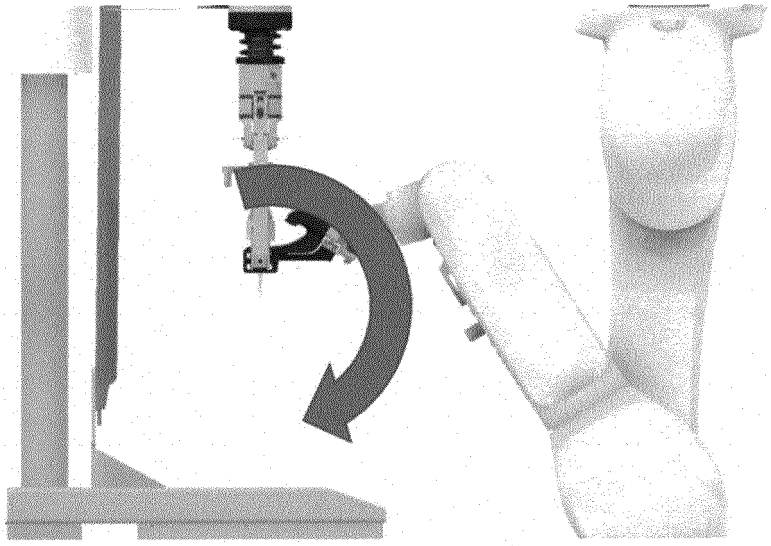

Fig. 12

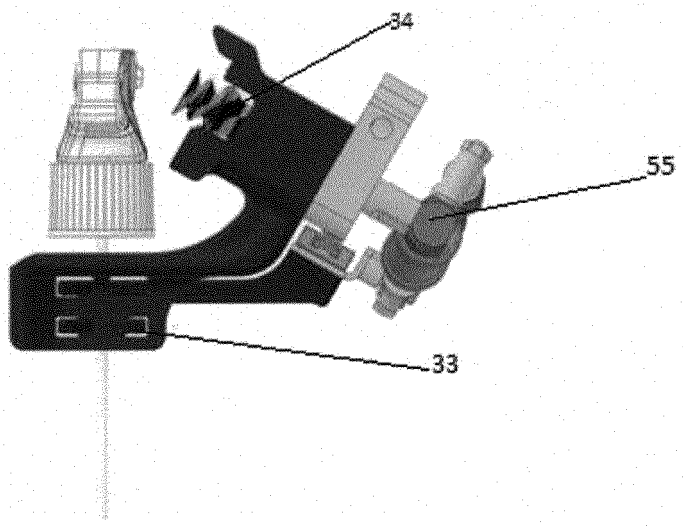

Fig. 13

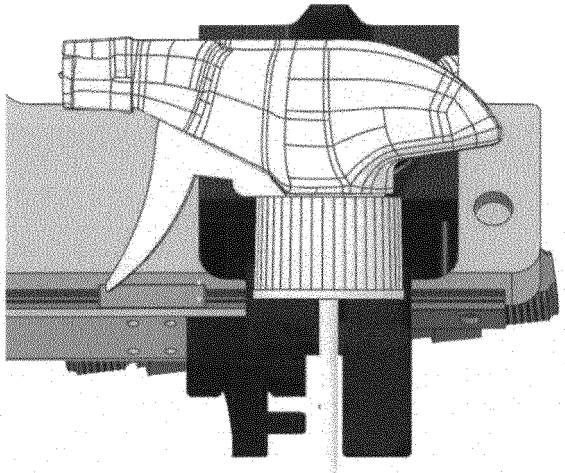

Fig. 14

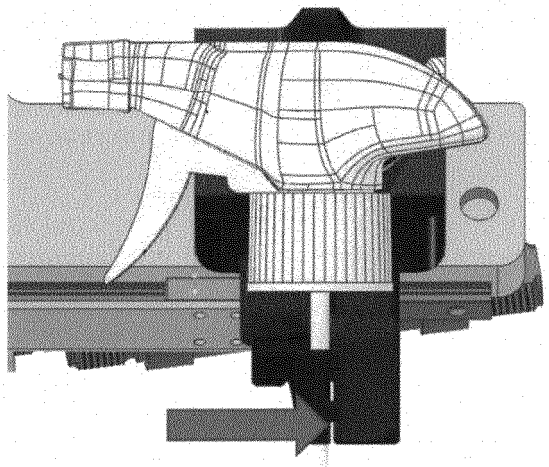

Fig. 15

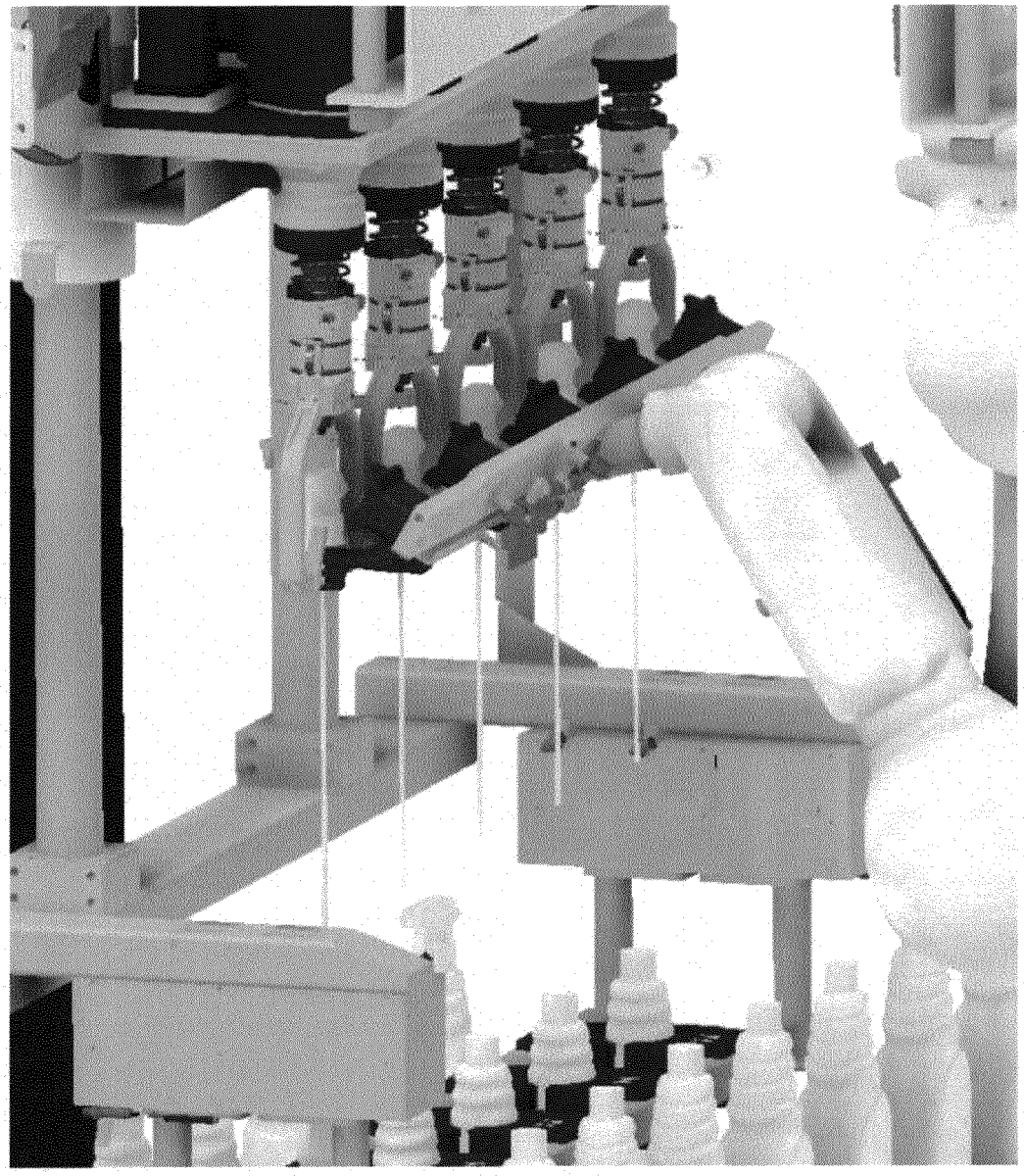

Fig. 16

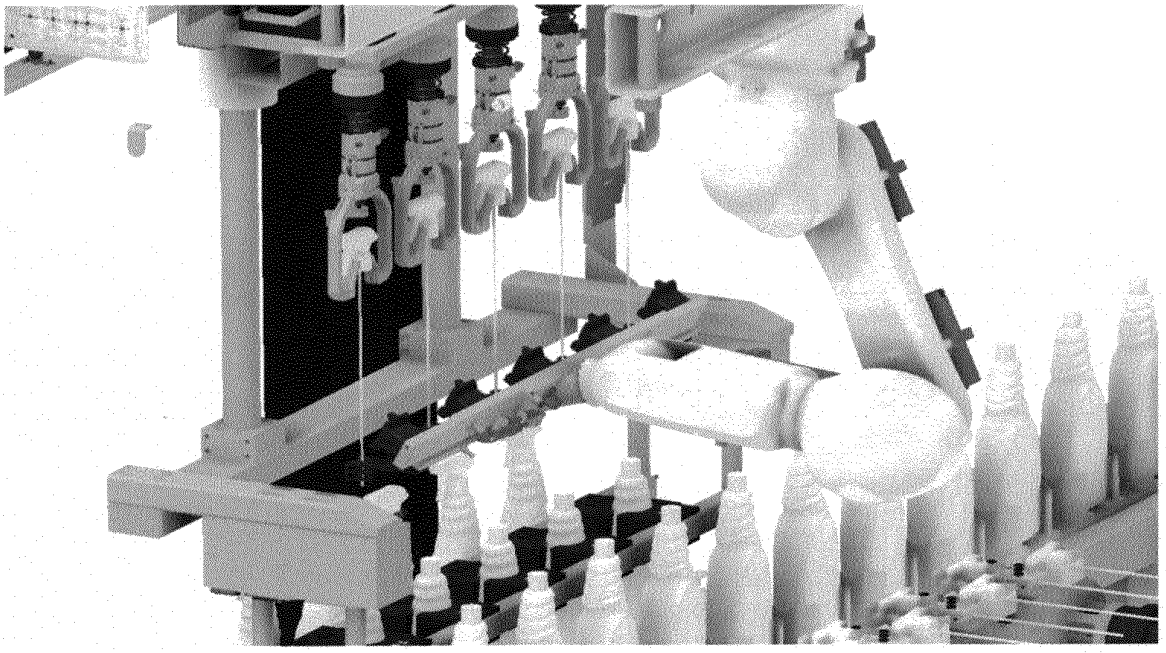

Fig. 17

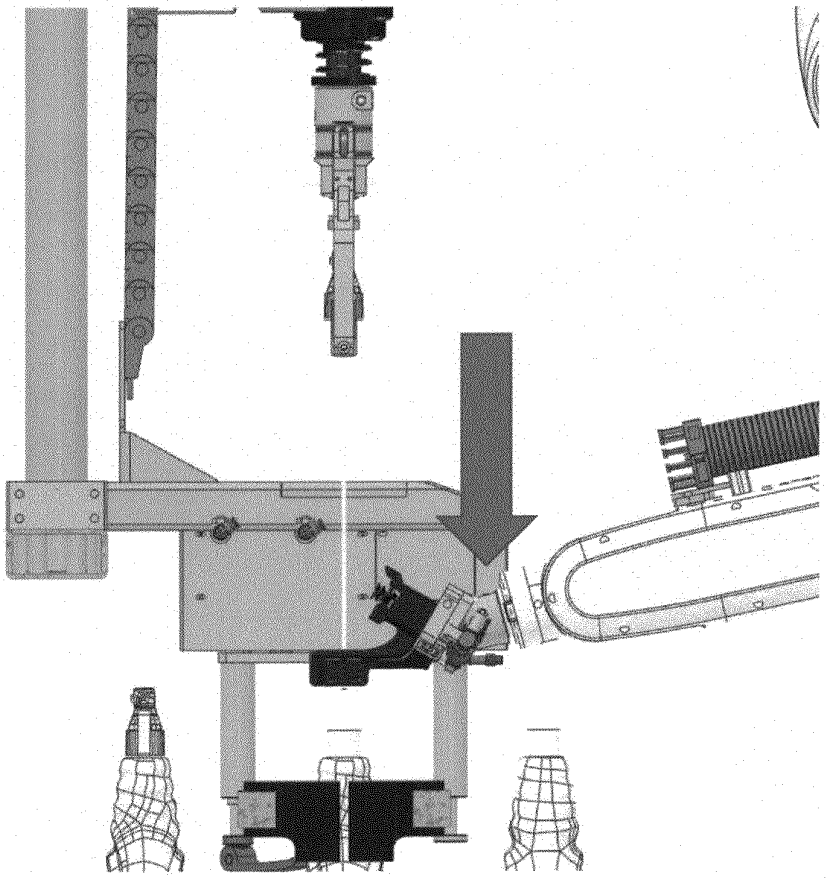

Fig. 18

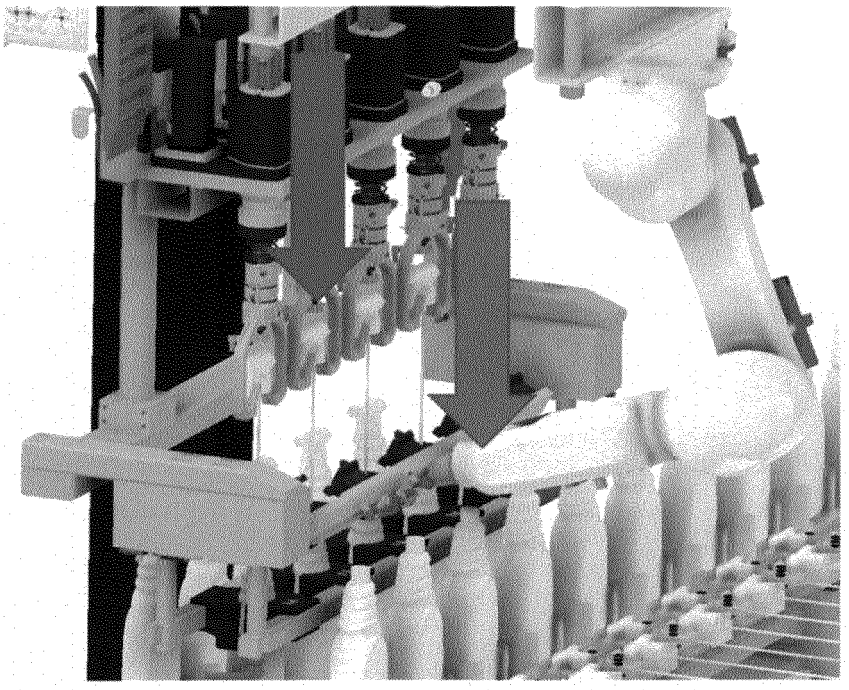

Fig. 19

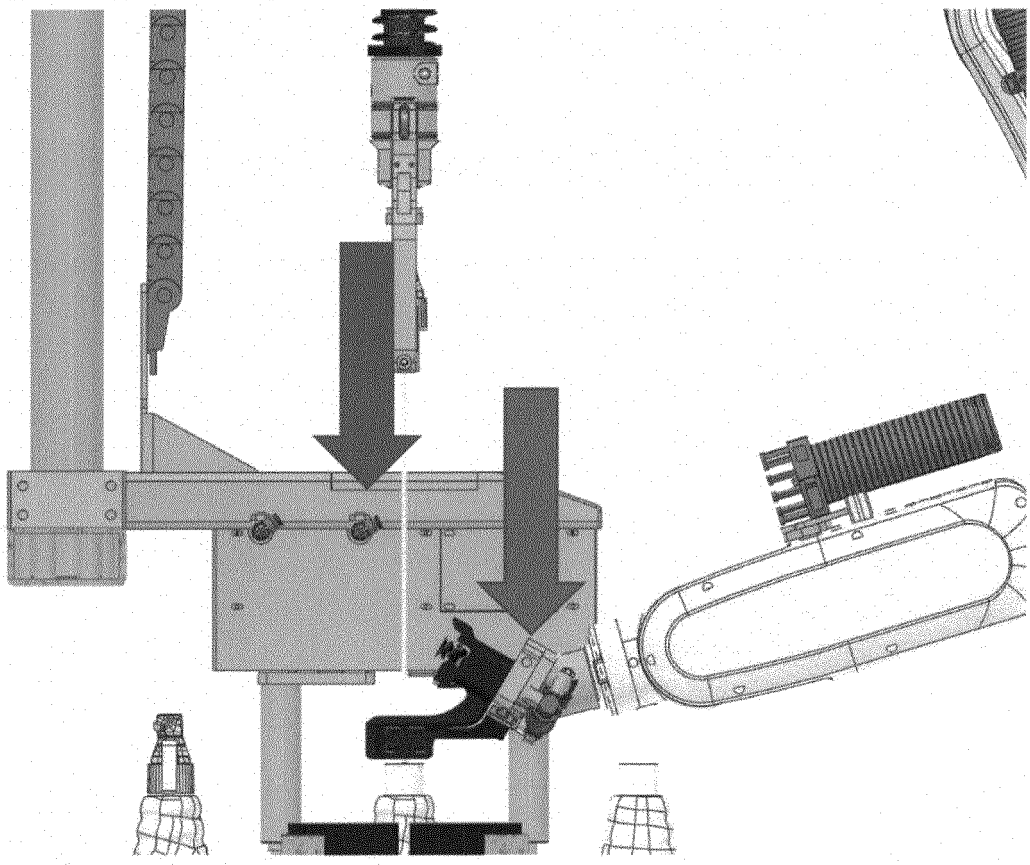

Fig. 20

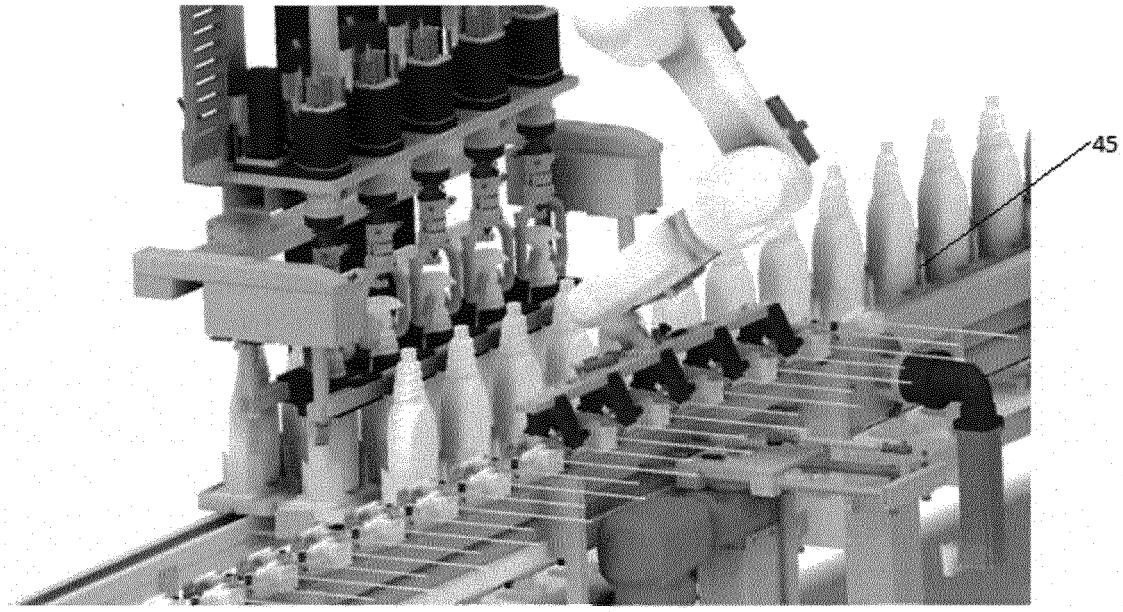

Fig. 21

Captions:

1 - Capping and cap sorting device
2 - Capping machine
3 - Bottle transporter
4 - Transporter
5 - Sorter
6 - Separation system
7 - Feeder
8 - Bottle
9 - Dispenser
10 - Cap transporter
11 - Feeder belt conveyor
12 - Caps
13 - Incline conveyor
14 - Base
15 - Motion sensor
16 - Driver
17 - Uncollected cap return loop
18 - Return transporter belt
19 - Primary transporter
20 - Return belt conveyor
21 - Loop base
22 - Separation conveyor
23 - Sensor
24 - Casing
25 - Scraper
26 - Arm
27 - Robotic manipulator
28 - Illuminator
29 - Upper illuminator
30 - Head
31 - Robotic manipulator arms
32 - Grab
33 - Jaws
34 - Vacuum grabs
35 - Camera
36 - Cells
37 - Magnet
38 - Platforms
39 - Positioning pins
40 - Dip tube
41 - Hexaxial manipulator arm
42 - Distance between sockets
43 - Sockets
44 - Hexaxial manipulator
45 - Carriers
46 - Vertical drive unit
47 - Centring devices
48 - Clasp
49 - Gripper
50 - Sensor
51 - Bottle transporter
52 - Intermediate plate
53 - Motoreducer
54 - Transporter servomechanism
55 - Servomotor
56 - Gripper jaws
57 - Grab

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PARTIAL EUROPEAN SEARCH REPORT

under Rule 62a and/or 63 of the European Patent Convention. This report shall be considered, for the purposes of subsequent proceedings, as the European search report

Application Number
EP 18 46 0057

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2011/125016 A1 (TIRELLI S R L [IT]; TIRELLI ROBERTO [IT]) 13 October 2011 (2011-10-13) * abstract; figures 1-21 * * page 4, line 22 - page 6, line 15 *	1-8, 11-16	INV. B67B3/064 B67B3/20
A	EP 1 431 181 A1 (MARCHESINI GROUP SPA [IT]) 23 June 2004 (2004-06-23) * abstract; figures 1-4 *	1-8, 11-16	
A	CN 103 832 953 A (YUHUAN CNC MACHINE TOOL CO LTD) 4 June 2014 (2014-06-04) * abstract; figures 1-7 *	1-8, 11-16	
A	WO 2018/109549 A1 (PHARMA INTEGRATION S R L [IT]) 21 June 2018 (2018-06-21) * abstract; figures 1-8 *	1-8, 11-16	

TECHNICAL FIELDS SEARCHED (IPC)

B67B
B65B

INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC so that only a partial search (R.62a, 63) has been carried out.

Claims searched completely :

Claims searched incompletely :

Claims not searched :

Reason for the limitation of the search:

see sheet C

Place of search	Date of completion of the search	Examiner
The Hague	10 July 2019	Pardo Torre, Ignacio

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

EPO FORM 1503 03.82 (P04E07)

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INCOMPLETE SEARCH
SHEET C

Application Number
EP 18 46 0057

Claim(s) completely searchable:
-

Claim(s) searched incompletely:
1-8, 11-16

Claim(s) not searched:
9, 10

Reason for the limitation of the search:

ART. 84 EPC - MAJOR LACK OF CLARITY
The claims of present application lack clarity within the meaning of Art. 84 EPC to such an extent that it is not patentable. The reasons are as follows.
Claim 1 includes four different "or-ed" options, 5 options after the term "preferably", and two conditional options after the term "should". This makes the wording of the claim so entangled that it is not clear the intended scope of protection, nor how the capping and cap sorting device of claim 1 is configured, or which technical features it actually includes. The same applies to claim 11.
Dependent claims 2 through 10, which also include a large series of entangled possibilities introduced by the terms "or", "preferably" and "should", are equally unclear if one reads them in combination with the previous claims they depends on. The same applies to claims 12 to 16.
Claim 1 is also not clear because it introduces three times the feature "transporter" (lines 1, 2 and 3), and the reader does not know whether these transporters refer to the same or different elements and, in the second case, how these elements are arranged and what their purpose is.
Claim 1 is also not clear because the feature "equal to the length of a "puck"-type carrier", said length being unknown because pucks do not have a standard size.
Claim 1 is also not clear because it intends to define the scope of the capping and sorting device by its use or by method features, such as "a bottle is transported to the packing line", "the cap lying on its side", "the dip tube 40 oriented perpendicularly to the direction of motion".
Claim 1 is also not clear because it intends to define the scope of the capping and sorting apparatus by reference to an external entity, such as "the shape of a cap".
Claim 11 is not clear because it refers to its physical technical elements with the definite article "the", whilst this claim is the first -i.e. independent- method claim.
Claim 11 is also not clear because its scope is undefined due to the expression "supplied by the feeder by known methods". It is not clear for the reader which those known methods would be, and/or which of those known methods would be applicable to the method of the claim, or restrict its scope.
The independent claims 1 and 11 lack essential features, in that they are not aligned with the teaching of the application, page 4, second paragraph, and page 5, second paragraph. Furthermore, independent claims 1 and 11 claim an unduly broad scope of protection, because they are not restricted to the type of caps of the application as described. Indeed, although the first paragraph of the application states that the apparatus and the method are intended for "caps of any shape", the only working

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INCOMPLETE SEARCH
SHEET C

Application Number
EP 18 46 0057

embodiment which has been presented is that of screw-caps comprising a dip tube.

ART. 83 EPC - INSUFFICIENT DISCLOSURE
Due to the unduly large scope of the independent claims, there is a part of the invention as defined in said independent claims which is not sufficiently disclosed for a skilled person to reproduce it. This is so, because the only working example the application includes is directed to a screw-cap with a dip tube, of the kind of those including a pump, but the claims are directed to any kind of cap, and even explicitly state that the pump-type cap is an optional feature.

R. 63 & 62(a) EPC - INCOMPLETE SEARCH
The objections under Art. 84 and 83 EPC made above are so severe, that a meaningful search is not possible, because the subject-matter of the claimed invention is not understandable and therefore not known.
On the other hand, claims 1 and 9 are directed to devices in the same category (apparatus), yet they do not fall under any of the exceptional situations listed under R. 43(2) EPC. The set of claim lacks therefore conciseness under Art. 84 EPC.
In his reply to the invitation to clarify the subject-matter to be searched, the applicant annexed amended claims wherein the optional features of the claims have been included. The applicant also requested the search for all three independent claims, but failed to provide an explanation as to why claim 9 would comply with R. 43(2) EPC. This authority is still of the opinion that claim 9 does not comply with R. 43(2) EPC because it does not fall under any of the three exceptions, particularly also not as a second solution to the same technical problem, when it is impossible to cover both solution by a single independent claim. In the present case, indeed, claim 1 and claim 9 are directed to different solution of different technical problems (a whole capping a sorting device vs. a supporting platform).
Consequently, the search has been restricted to claims 1 to 8 and 11 to 16, wherein the scope of these claims has been restricted so as to also include all the features originally claimed in a facultative manner, as indicated by the applicant.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 46 0057

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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10-07-2019

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		EP 3335844 A1	20-06-2018
		WO 2018109549 A1	21-06-2018

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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- US 3905177 A **[0002]**
- US 2017233233 A **[0002]**
- US 2010275556 A **[0002]**