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(54) **STERILIZATION MACHINE FOR STERILIZING CAPS AND METHOD OF CONFIGURING A STERILIZATION MACHINE**

(57) It is described a sterilization machine (1) for sterilizing caps (2), comprising at least: an isolation chamber (3) defining an inner space (4); one guide (6) arranged within the inner space (4) and defining an advancement path (P) for the caps (2), the machine (1) being configured so that the caps (2) are sterilized during advancement along said advancement path (P); wherein the guide (6) comprises a plurality of bars (25a, 25b, 25c) which defines a channel (26) for guiding the advancement of said caps (2) along the advancement path (P), said channel (26) having, transversally to said path (P), a first size (h) and a second size (w), which first size (h) and second size (w) are transversal to each other; wherein the sterilization machine (1) also comprises an adjustment system (30) configured for acting on at least two of said bars (25a, 25b, 25c) to adjust said height (h) and width (W) independently from each other.

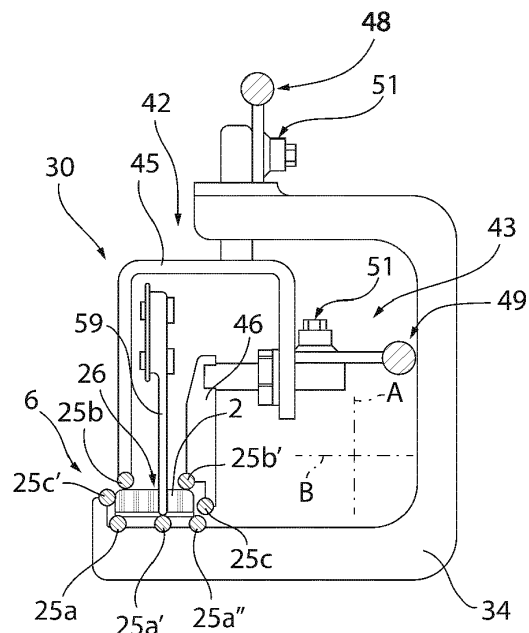


FIG. 4A

Description

TECHNICAL FIELD

[0001] The present invention relates to a sterilization machine for caps, in particular caps for receptacles being filled with a pourable product.

BACKGROUND ART

[0002] The sterilization of packaging material, in particular within the food packaging sector, is of fundamental interest for guaranteeing the needed shelf life of the packaged products and, accordingly, the safety of the consumers. This is even more important when food products are packaged under aseptic conditions.

[0003] It is known in the art to fill any type of pourable product, in particular any type of pourable food product such as carbonated liquids (e.g. sparkling water, soft drinks and beer), non-carbonated liquids (including still water, flavored water, juices, teas, sport drinks, wine, milk, etc) and beverages containing pulps, into receptacles, such as containers, vessels, jars and bottles made of base components, like glass, plastics, aluminum, steel, and composites.

[0004] In general, the receptacles prior to being filled with the pourable product are sterilized within a receptacle sterilization machine and are subsequently filled with the desired pourable product within a filling apparatus.

[0005] After the filling of the receptacles, typically the respective pouring openings of the receptacles are closed by the application and fastening of respective caps.

[0006] Prior to the application of the caps, the caps must be sterilized within a respective sterilization machine. After sterilization the sterile caps are fed to a capping apparatus, which also receives the filled receptacles.

[0007] A typical sterilization machine for caps comprises a conveying device having a guide track housed within an isolation chamber. The guide track defines an advancement path of the caps and the caps are arranged in succession to one another within and/or on the guide track and along the full advancement path.

[0008] In more detail, the advancement path extends from an inlet station to an outlet station and analogously the succession of caps extends from the inlet station to the outlet station.

[0009] A typical conveying device comprises a pushing element, which is configured to insert one cap at a time into the guide track, thereby bringing into contact the newly fed cap with the succession of caps already present within and/or on the guide track. This leads to the exertion of a pushing force onto the succession of caps, which leads to the advancement of the succession of caps.

[0010] One inconvenience of such known sterilization machines resides in that the caps are exposed to significant pushing forces and due to the relatively high tem-

peratures of the caps, the caps are susceptible to deformations.

[0011] Another inconvenience resides in that the guide track is suitable only for a limited number of different types and/or formats of caps. Therefore, often during a format change, technical operators must provide for lengthy modifications on the guide track.

[0012] There is also known a kind of sterilization machine, which comprises a plurality of guide tracks arranged within the isolation chamber, each of which is suitable for a number of respective types and/or formats of caps. In this way, the sterilization machine is adapted to handle a larger number of different types and/or formats of caps without the need of modifications of the guide tracks.

[0013] However, an inconvenience with such a kind of sterilization machine is seen in the space requirements due to the larger number of guide tracks.

[0014] Therefore, a need is felt in the sector to further improve the known sterilization machines, in order to improve at least one of the above-mentioned inconveniences.

DISCLOSURE OF INVENTION

[0015] It is therefore an object of the present invention to provide in a straightforward and low-cost manner an improved sterilization machine for caps.

[0016] According to the present invention, there is provided a sterilization machine for sterilizing caps according to the independent claim.

[0017] Further advantageous embodiments are specified in the respective dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a sterilization machine according to the present invention, with parts removed for clarity;

Figure 2 is a schematic top view of the sterilization machine of Figure 1, with parts removed for clarity; Figure 3 is a perspective view of a detail of the sterilization machine of Figure 1, with parts removed for clarity;

Figures 4A and 4B are schematic view of a cross section of a channel defined by the machine of Figure 1, in a first operative condition and in a second operative condition, respectively;

Figures 5A and 5B are another schematic view of a cross section of the channel of Figures 4A and 4B, in said first operative condition and in said second operative condition, respectively;

Figure 6 is a perspective view of another detail of the sterilization machine of Figure 1, with parts re-

moved for clarity;

Figure 7 is a perspective view of an even other detail of the sterilization machine of Figure 1, with parts removed for clarity;

Figure 8 is an enlarged perspective view of a further detail of the sterilization machine of Figure 1, with parts removed for clarity;

Figure 9 is an enlarged perspective view of a specific portion of the detail of Figure 8, with parts removed for clarity; and

Figure 10 is a perspective view of another portion of the sterilization machine of Figure 1, with parts removed for clarity.

BEST MODES FOR CARRYING OUT THE INVENTION

[0019] With particular reference to Figures 1 and 2, reference number 1 indicates as a whole a sterilization machine for sterilizing caps 2.

[0020] In particular, caps 2 are designed to be applied onto receptacles, such as bottles, jars, vessels, containers or the like, in particular being made of base components, like glass, paper or cardboard, plastics, aluminum, steel, and composites.

[0021] Preferentially, the receptacles may be designed to contain a pourable product, in particular a pourable food product, such as carbonated liquids (e.g. sparkling water, soft drinks and beer), non-carbonated liquids (including still water, flavored water, juices, teas, sport drinks, wine, milk, etc.), emulsions and beverages containing pulps.

[0022] Moreover, caps 2 may be of the type known as crown corks, screw caps, sports caps, stoppers or similar, and they may be produced from a variety of materials such as plastics and metal. It is further known that the caps 2 may vary in format (i.e. in size and/or dimensions).

[0023] In the specific example disclosed, a first type of caps 2 can be threaded caps (see Figure 4A), in particular plastic screw caps, to be screwed onto the receptacles. A second type of caps 2 can be sport caps (see Figure 4B).

[0024] However, it must be clear that the present invention may be also used to particular advantage for any other type of caps 2 such as crown corks, sports caps, stoppers and others.

[0025] Each type of caps 2 can be made also from materials different than plastic, such as metal or cork.

[0026] More specifically, the different types of caps may differ in shape, size, format, composition, etc.

[0027] Machine 1 comprises an isolation chamber 3. The chamber 3 defines an inner space 4. Chamber 3 and inner space 4 are indicated at least in Figures 1 and 2. At least in figures 1 and 2, the chamber 3 is showed without some components to show better some zones and other components which are placed in the inner space 4.

[0028] Machine 1 can comprise a conditioning device configured for controlling the physical and/or chemical

conditions of the inner space 4. In this way the machine 1 is configured so that the inner space 4 is an aseptic space and/or a sterile space. For example, the conditioning device can be configured for controlling the temperature and/or the pressure and/or the humidity and/or the sterility and/or the chemical composition in the inner space 4, and/or for controlling the flow of gas or gases which are present in the inner space 4.

[0029] Machine 1 comprises at least one guide 6. The guide 6 is arranged within the inner space 4. The guide 6 defines an advancement path P for the caps 2. The advancement path P extends through the inner space 4. The machine 1 is configured so that the caps 2 are sterilized during advancement along said advancement path P. The advancement path P is indicated in Figure 2. The guide 6 is indicated in Figures 2 and 3. Figures 4A, 4B, 5A and 5B are lying on a plane which is locally orthogonal to the advancement path. Figures 4A, 4B, 5A and 5B shows a cross section of the guide 6. Figure 2 is lying on plane which is parallel to the advancement path P.

[0030] The machine is configured so that the inner space 4 comprises an injection zone 19 and/or a contact or activation zone 20, and/or a venting zone 21.

[0031] For example, the conditioning device comprises sterilization means configured for injecting a sterilization agent in the injection zone 16 of the inner space 4. In particular, during the advancement of the caps along the injection zone 16, the caps are exposed to the sterilization agent.

[0032] The machine 1 is configured so that, during the advancement of the caps 2 along the contact or activation zone 20, the injected sterilization agent acts on the caps.

[0033] The machine 1 is configured so that, during the advancement of the caps 2 along the venting zone 21, the injected sterilization agent, after having acted on the caps, evaporates from the caps 2.

[0034] The guide 6 comprises a plurality of bars. With "bar" it is intended an elongated structural element. Therefore, also a beam or a rod can be considered to fall within the concept "bar".

[0035] The bars define a channel 26 for guiding the advancement of said caps 2 along the advancement path P. The channel 26 has, transversally to said path P, a first size h and a second size w. The first size h and second size w are transversal to each other. The first size h is along a first axis A. The first axis A can be for example operatively parallel top gravity. The second size w is along a second axis B. The second axis A is orthogonal with respect to the first axis A. The second axis B can be for example operatively orthogonal to the gravity. The first axis A and the second axis B are indicated in Figures 4A, 4B, 5A and 5B. The first size h and the second size w are indicated in Figures 5A and 5B. The channel 26 is indicated in Figure 3, 4A, 4B, 5A and 5B. The cap 2 showed in Figure 4A is a cap of a first type. The cap 2 showed in Figure 4B is a cap of a second type, which is different from the first type.

[0036] The machine 1 comprises an adjustment sys-

tem 30. The adjustment system is configured for acting on at least two bars of the plurality, to adjust said first size h and second size W independently from each other. The adjustment system 30 is configured for acting on said at least two bars so that the adjustment of the first size h can occur independently from the adjustment of the second size w and vice versa.

[0037] In this way the guide 6 can be adapted to the specific features or format of the specific caps type which is to be sterilized. The guide 6 can be modified in dependence on the said features or format of the type of caps to be sterilized.

[0038] Therefore, the changeover of the machine 1 from a first type of caps to a second type of caps is quicker.

[0039] The machine 1 can also adapt to a wider group of types of caps, as the adjustment of the first size is independent from the adjustment of the second size.

[0040] The adjustment system 30 is indicated in Figures 1, 2, 4A, 4B, 6, and 7.

[0041] Figure 5A is a detail of Figure 4A, without the cap 2. Figure 5B is a detail of Figure 4B, without the cap 2. Figures 4A-5A are referred to a first operative condition of the channel 26, corresponding to a first combination of values of first size h and second size w. Figures 4B-5B are referred to a second operative condition of the channel 26, corresponding to a second combination of values of first size h and second size w. Therefore, between situation of Figures 4A-5A and situation of Figures 4B-5B, a variation of first size h and a variation of second size w have occurred.

[0042] The plurality of bars comprises at least one lower bar, for supporting the advancing caps 2 and delimiting the channel 26 on a first side.

[0043] With reference Figures 3, 4A, 4B, 5A, 5B, the at least one lower bar can comprise for example a first lower bar 25a, a second lower bar 25a', and possibly also a third lower bar 25a''. The cross sections of said lower bars are showed in Figures 4A, 4B, 5A and 5A. The lower bars are visible in perspective in Figure 3.

[0044] Each lower bar delimits the channel 26 on said first side. Each lower bar supports the caps 2 during the advancement of the caps 2 along the advancement path P.

[0045] The plurality of bars comprises at least one upper bar delimiting said channel 26 at the opposite side with respect to said at least one lower bar. The first size h is defined by the distance between said at least one lower bar and said at least one upper bar. This distance defining the first size h is along a first axis A lying on a plane which is locally orthogonal to the advancement path P. The first size h can be a height of the channel 26.

[0046] With reference to Figures 3, 4A, 4B, 5A, 5B, the at least one upper bar can comprise for example a first upper bar 25b and a second upper bar 25b'.

[0047] The cross sections of the upper bars are showed in Figures 4A, 4B, 5A and 5A. The upper bars are visible in perspective in Figure 3.

[0048] Each upper bar delimits the channel 26 on the opposite side with respect to the at least one lower bar.

[0049] The plurality of bars comprises at least one lateral bar, delimiting laterally the channel 26 and contributing to define said second size w.

[0050] With reference to Figures 3, 4A, 4B, 5A, 5B, the at least one lateral bar can comprise for example a first lateral bar 25c and a second lateral bar 25c'. Figures 4A, 4B, 5A and 5A shows the cross sections of the lateral bars. The lateral bars are visible in perspective in Figure 3.

[0051] The second size w is defined by the distance between the first lateral bar 25c and the second lateral bar 25c'. This distance defining the second size w is along a second axis B lying on a plane which is locally orthogonal to the advancement path P. The second axis B is orthogonal or transversal with respect to the first axis A. The second size w can be a width of the channel 26.

[0052] The machine 1 can be configured so that one of the first axis A and the second axis B is operatively parallel to the gravity.

[0053] Each lateral bar delimits laterally the channel 26 and contributes to define the second size w.

[0054] The second lateral bar 25c' is fixed to the frame 34.

[0055] The adjustment system 30 comprises a first adjustment device 42. The first adjustment device 42 is coupled at least with one upper bar and one lateral bar, or at least with one lower bar and one lateral bar. In the example of the Figures, the first adjustment device 42 is coupled at least with one upper bar and one lateral bar.

[0056] The machine comprises a fixed frame 34. The machine 1 is configured so that the fixed frame 34 is operatively in a fixed position with respect to a floor supporting the machine 1. The fixed frame 34 can be placed in the inner space 4.

[0057] In the following, with "movement" it is intended a movement with respect to the fixed frame 34. In the following, with "vertical movement" it is intended a movement with respect to the fixed frame 34 and comprising at least one non-zero value of the component along the first size h. This component along the first size h can be considered a component along first axis A. This vertical movement can be a movement oriented predominantly along the first size h and/or along the first axis A.

[0058] In the following, with "horizontal movement" it is intended a movement with respect to the fixed frame 34 and comprising at least one non-zero value of the component along the second size w. This component along the second size W can be considered a component along second axis B. This horizontal movement can be a movement oriented predominantly along the second size w and/or along the second axis B.

[0059] If the first adjustment device 42 was coupled at least with one upper bar and one lateral bar, the at least one lower bar would be fixed to the frame 34. For example, with reference to Figures 3, 4A, 4B, 5A, 5B, the first lower bar 25a, the second lower bar 25a', and the third

lower bar 25a" are fixed to the frame 34.

[0060] If, in an alternative not shown embodiment, the first adjustment device 42 was coupled at least with one lower bar and one lateral bar, the at least one upper bar would be fixed to the frame 34. For example, differently from Figures 3, 4A, 4B, 5A, 5B, the first upper bar 25b, the second upper bar 25b', and the third upper bar 25b" would be fixed to the frame.

[0061] The adjustment system 30 comprises a second adjustment device 43. The second adjustment device 43 is coupled at least with one lateral bar.

[0062] With reference to Figures 3, 4, 4A, 5 and 5A, the first adjustment device 42 can be coupled at least with the first upper bar 25b and the first lateral bar 25c. With reference to Figures 3, 4, 4A, 5 and 5A, the second adjustment device 43 can be coupled at least with the first lateral bar 25c.

[0063] The first adjustment device 42 is configured for moving vertically all the bars that are coupled to the first adjustment device 42, so that a vertical movement of all the bars that are coupled to the first device 42 corresponds to the adjustment of the first size h. Therefore, the first adjustment device 42 causes the vertical movement of all the bars that coupled to the first device 42, and the vertical movement of all the bars that are coupled to the first device 42 causes the adjustment of the first size h. With reference to Figures, "all the bars that are coupled to the first device 42" means at least first upper bar 25b, and first lateral bar 25c.

[0064] The second adjustment device 43 is configured for moving horizontally all the bars that are coupled to the second device 43, so that an horizontal movement of all the bars that are coupled to the second device 43 corresponds to the adjustment of the second size w. Therefore, the second adjustment device 43 causes the horizontal movement of all the bars that are coupled to the second device 43, and the horizontal movement of all the bars that are coupled to the second device 43 causes the adjustment of the second size w. With reference to Figures, "all the bars that are coupled to the second device 43" means at least the first lateral bar 25c.

[0065] In this way the mechanical configuration of the adjustment system 30 is simplified. Therefore the structural complexity of the machine 1 and the costs for maintenance are reduced.

[0066] The machine comprises a plurality of pushers 59. The pushers 59 are engaged in a sliding manner in the channel 26. The machine 1 is configured so that each pusher 59 pushes at least one respective cap 2 along the channel 26, to cause the advancement of said at least one respective cap 2 along the advancement path P. One pusher is indicated in Figure 3, 4A, 4B, 5A, 5B and 7.

[0067] With reference in particular to Figures 3, 4A, 4B, 5A and 5B, each of the first device 42 and the second device 43 is coupled at least also with the second upper bar 25b'.

[0068] Therefore, "all the bars that are coupled to the first device 42" means at least first upper bar 25b, second

upper bar 25b', and first lateral bar 25c. Therefore, "all the bars that are coupled to the second device 43" means at least second upper bar 25b', and first lateral bar 25c.

[0069] The first adjustment device 42 comprises a respective structure 45. The structure 45 of the first adjustment device 45 is coupled with all the bars that are coupled to the first device 42. A vertical movement of the structure 45 of the first adjustment device 42 corresponds to the vertical movement of all the bars that are coupled to the first device 42. Therefore, the vertical movement of the structure 45 of the first device 42 causes the vertical movement of a first group of bars. This first group of bars comprises at least first lateral bar 25c, first upper bar 25b and possibly also second upper bar 25b'. In this way the vertical movement of the structure 45 of the first device 42 causes the adjustment of the first size h.

[0070] The first device 42 comprises a respective actuator 48. The actuator 48 of the first device 42 is coupled to the structure 45 of the first device 42 so that a movement of the actuator 48 corresponds to the vertical movement of the structure 45 of the first device 42. "Movement of the actuator 48" means a movement of the actuator 48 with respect to the frame 34.

[0071] The second adjustment device 43 comprises a respective structure 46. The structure 46 of the second adjustment device 46 is coupled to all the bars that are coupled to the second device 43. A horizontal movement of the structure 46 of the second device 43 corresponds to the horizontal movement of all the bars that are coupled to the second device 43. Therefore, the horizontal movement of the structure 46 of the second adjustment device 43 causes the horizontal movement of a second group of bars. The second group of bars comprises at least first lateral bar 25c and possibly also second upper bar 25b'. In this way the horizontal movement of the structure 46 of the second device 43 causes the adjustment of the second size w.

[0072] The second device 43 comprises a respective actuator 49. The actuator 49 of the second device 43 is coupled to the structure 46 of the second device 43 so that a movement of the actuator 49 of the second device 43 corresponds to the horizontal movement of the structure 46 of the second device 43. "Movement of the actuator 49" means a movement of the actuator 49 with respect to the frame 34.

[0073] The structure 46 of the second device 43 is coupled with the structure 45 of the first device 42, so that the structure 46 of the second device 43 is integral with the vertical movement of the structure 45 of the first device 42. This means that the structure 46 of the second device 43 follows the vertical movement of the structure 45 of the first device 42. In this way the structure 45 of the first device 42, in addition to being directly coupled with the first upper bar 25b, can be coupled, indirectly through the structure 46 of the second device 43, at least also with the first lateral bar 25c, and possibly also with the second upper bar 25b'. Therefore, the first adjustment device 42 can act also on the first lateral bar 25c and

possibly also on the second upper bar 25b'. Therefore, the first adjustment device 42 does not need to be positioned around the pusher 59 to move also the first lateral bar 25c, and possibly also the second upper bar 25b'. In this way the mechanical complexity of the adjustment devices 42 and 43 is simplified, the compactness of the first device 42 and second device 43 is improved, and therefore the costs of the machine 1 or for maintenance are furtherly reduced.

[0074] In particular, it can be for example that the machine 1 is configured so that the structure 45 of the first device 42 supports against the gravity the structure 46 of the second device 43. In this way, the gravity is also used for stabilizing the coupling between the structures of the adjustment devices and/or the assembly operations are simplified.

[0075] At least one of first device 42 and second device 43 comprises a linear motor 47. It can be that each of first device 42 and second device 43 comprises a respective linear motor 47. It can be that each of first device 42 and second device 43 comprises a respective linear motor 47.

[0076] For each device comprising a linear motor, the linear motor 47 is coupled with the respective actuator 48 or 49 to cause the movement of the respective actuator 48 or 49, and therefore the adjustment of the first size h or second size w.

[0077] A linear motor 47 for causing the adjustment of the first size h or the second size w allows a very fine tuning of the first size h and/or the second size w. In this way the precision of the machine 1 with respect to regulation of the guide 6 in dependence of the type of caps to be sterilized is improved.

[0078] For the first device 42 or the second device 43, the respective actuator 48 or 49 is coupled with the respective structure 45 or 46 by means of a respective cam coupling. It can be that, for each of the first device 42 and the second device 43, the respective actuator 48 or 49 is coupled with the respective structure 45 or 46 by means of a respective cam coupling.

[0079] The cam coupling comprises a cam 50 which is integral with or fixed to one of the respective actuator 48 or 49 and structure 45 or 46. The cam coupling comprises a cam follower 51 integral with or fixed to the other of said respective actuator 48 or 49 and structure 46 or 45. In Figure 7 are indicated a cam 50 which is integral with the actuator 48 of the first device, a cam follower 51 which is fixed to the structure 45 of the first device, and a cam follower 51 which is fixed to the structure of the second device. Fig. 8 shows a portion of the cam 50 and of the cam follower 51 of the first device 42. In Figs. 4A and 4B are indicated the cam follower 51 integral with the actuator 48 of the first device 42 and the cam follower 51 integral with the actuator 49 of the second device 43.

[0080] The cam follower 53 is eccentric so that a user can preliminary regulate, before the adjustment of channel 26, a preliminary position of the structure 45 or 46 of the respective adjustment device 42 or 43. This allows

to adapt quickly and precisely the preliminary starting condition of first device 42 or second device 43 to the specific machining tolerances.

[0081] Cam coupling also comprises a locking element to lock the cam follower 51 with respect to the component with which the cam follower 51 is integral or to which it is fixed. The cam coupling is configured so that a user, to regulate the preliminary position of the structure 45 or 46 before the adjustment, can unlock the cam follower 51 by rotating the locking element 52. The cam coupling is configured so that a user, after having regulated the preliminary position of the structure 45 or 46 before the adjustment, can lock the cam follower 51 by rotating the locking element 52. Fig. 7 also shows the axes C of locking element of two cam followers.

[0082] The guide 6 can comprise at least one straight sector 17 and/or at least one curved sector 18. The curved sector 18 is indicated in Figures 1, 2 and 10. In Figures 2 and 10 two straight sectors 17 are for example indicated. A curved sector 18 corresponds to a curved sector of the channel 26 and therefore of the advancement path P. A straight sector corresponds to a straight sector of the channel 26 and therefore of the advancement path P.

[0083] The machine 1 can comprise more than one adjustment system. The machine 1 can comprise for example a first adjustment system 30a and a second adjustment system 30b, which are showed in Figures 10. Each of first adjustment system 30a and second adjustment system 30b can have one or more of features of the adjustment system 30, or all the features of the adjustment system 30.

[0084] The machine 1 can be configured so that each adjustment system 30a or 30b is connected to a respective sector of the guide 6, to adjust independently from each other the first size and the second size of the respective sector of the channel 26, by acting on the respective sector of the guide 6.

[0085] The machine 1 can comprise a lever mechanism 35.

[0086] The lever mechanism 35 is mechanically interposed between the actuator 48 of the first adjustment device of the first adjustment system 30a, and the actuator 49 of the second adjustment device 49 of the second adjustment system 30b. The lever mechanism 35 is mechanically connected to the curved sector 18 of the guide 6, to adjust independently from each other the first size and the second size of the respective curved sector of the channel 26, by acting on the respective curved sector of the guide 6. This situation can be seen in Figure 10. The first device adjustment device of the first system 30a is used for adjusting the first size of the curved sector 18 of the channel 26, and the second adjustment device of the second system 30b can be used to adjust the second size of the curved sector 18 of the channel 26.

[0087] In this way it is simplified the mechanical configuration which is necessary for adjusting the first size and the second size of the channel along also a curved

sector of the guide 6.

[0088] Anyway, it can be possible to use one adjustment system to adjust also the first size and the second size of a curved sector of the channel 26, without the lever mechanism.

[0089] Chamber 3 separates inner space 4 from an outer space 5. Outer space 5 is in no aseptic and no sterile conditions.

[0090] Machine 1 comprises an advancement unit 7. The advancement unit comprises the plurality of pushers 59 and a moveable endless belt 58. The pushers 59 are connected and carried by the belt 58.

[0091] The pushers 59 are engaged in a sliding manner in the channel 26. The machine 1 is configured so that a movement of the belt 58 causes each pusher 59 to move along at least one active sector Q1 of the conveying path Q. In this way each pusher 59 can push at least one respective cap 2 along the channel 26, to cause the advancement of said at least one respective cap 2 along the advancement path P. The active sector Q1 is indicated in Figure 2.

[0092] Machine 1 sterilizes caps 2, in particular prior to being applied onto filled receptacles.

[0093] Additionally, advancement unit 7, for causing the movement of endless belt 58, may comprise a first pulley 60. The advancement unit 7, for causing the movement of the endless belt 58, may comprise a second pulley 61. One of the first pulley 60 and second pulley 61 can be a drive pulley, and the other a driving pulley. The endless belt 58 is coupled to drive pulley 60 and driven pulley 61.

[0094] In more detail, pushers 59 can be equally spaced along endless belt 58 with a constant pitch.

[0095] Chamber 3 defines a chamber inlet 8 allowing to feed caps 2 to be sterilized into inner space 4 and to guide 6. Chamber 3 defines a chamber outlet 9 allowing to discharge sterilized caps 2 from inner space 4 and from guide 6.

[0096] Guide 6 can be considered a sterilization guide 6, because the caps 2 are sterilized during advancement along channel 26 which is defined by guide 6.

[0097] Machine 1 can comprise an infeed guide 10 arranged at chamber inlet 8 and a discharge guide 12 arranged at outlet 9. The infeed guide 10 is for guiding the entry of the caps to be sterilized in the chamber inlet 8. Discharge guide 11 is for guiding the exit of the sterilized caps from the chamber outlet 9.

[0098] With particular reference to Figures 1 and 2, advancement path P extends from an inlet station 12 at which caps 2 are fed to sterilization guide 6. Inlet station 12 is placed at chamber inlet 8. Advancement path P extends from the inlet station 12 up to an outlet station 13 at which caps 2 are discharged from sterilization guide 6. Outlet station 13 is placed at chamber outlet 9.

[0099] The linear motor 47 of the first device 42 or the linear motor 47 of the second device 43 can comprise a passive portion 53 integrally connected to the respective actuator 48 or 49, and an active portion 54. The active

portion can be fixed to an outer surface of isolation chamber 3, which is the outer surface facing away from inner space 4. The active portion may be configured to generate an electromagnetic field for moving passive portion 53, so as to move the respective actuator 48.

[0100] In particular, by having passive portion 53 being arranged within inner space 4 and having the active portion 54 being arranged in outer space 5, less components must be placed in the inner space 4.

[0101] Machine 1 can be easily and quickly modified so as to sterilize a different types and/or format of caps 2.

[0102] A further advantage resides in having a robust set-up.

[0103] Clearly, changes may be made to sterilization machine 1 without, however, departing from the scope of protection as defined in the accompanying claims.

Claims

1. A sterilization machine (1) for sterilizing caps (2), comprising at least:

- an isolation chamber (3) defining an inner space (4); and
- one guide (6) arranged within the inner space (4) and defining an advancement path (P) for the caps (2), the machine (1) being configured so that the caps (2) are sterilized during advancement along said advancement path (P) ;

wherein the guide (6) comprises a plurality of bars (25a, 25b, 25c) which define a channel (26) for guiding the advancement of said caps (2) along the advancement path (P), said channel (26) having, transversally to said path (P), a first size (h) and a second size (w), which first size (h) and second size (w) are transversal to each other; wherein the sterilization machine (1) also comprises an adjustment system (30) configured for acting on at least two of said bars (25a, 25b, 25c) to adjust said first size (h) and second size (w) independently from each other.

2. Machine (1) according to claim 1, wherein said plurality of bars (25a, 25b, 25c) comprises:

- at least one lower bar (25a; 25a'; 25a'') for supporting the advancing caps (2) and delimiting said channel (26) on a first side;
- at least one upper bar (25b; 25b') delimiting said channel (26) at the opposite side with respect to said at least one lower bar (25a; 25a'; 25a''), said first size (h) being defined by the distance between said at least one lower bar (25a; 25a'; 25a'') and said at least upper bar (25b; 25b');;
- at least one lateral bar (25c; 25c'), delimiting

laterally said space (26), and contributing to define said second size (w);

wherein:

the adjustment system (30) comprises a first adjustment device (42) which is coupled at least with one upper bar and one lateral bar, or which is coupled at least with one lower bar and one lateral bar;

the adjustment system (30) comprises a second adjustment device (43) which is coupled at least with one lateral bar;

wherein the first adjustment device (42) is configured for moving vertically all bars that are coupled to the first adjustment device (42; 43), so that a vertical movement of all bars (25b; 25c) that are coupled to the first adjustment device (42; 43) corresponds to the adjustment of the first size (h);

wherein the second adjustment device (43) is configured for moving horizontally all bars (25b'; 25c) that are coupled to the second adjustment device (43), so that a horizontal movement of all bars (25b'; 25c) that are coupled to the second device (43) corresponds to the adjustment of the second size (w).

3. Machine (1) according to Claim 2, wherein:

- said at least one upper bar comprises a first upper bar (25b) and a second upper bar (25b'), said first adjustment device (42) being coupled at least with said first upper bar (25b), said second upper bar (25b') and said one lateral bar (25c), and said second adjustment device (43) being coupled at least with said second upper bar (25b') and said one lateral bar (25c); or
- said at least one lower bar comprises a first lower bar and a second lower bar, said first adjustment device (42) being coupled at least with said first lower bar, said second lower bar and said one lateral bar, and said second adjustment device (43) being coupled at least with said second lower bar and said one lateral bar.

4. Machine (1) according to Claim 2 or 3, wherein:

- for each adjustment device (42; 43), the adjustment device (42; 43) comprises a respective structure (45; 46), the structure (45; 46) being coupled with all bars that are coupled to the adjustment device (42; 43), so that a vertical movement of the structure (45) of the first device (42) corresponds to the vertical movement of all bars (25b; 25c) that are coupled to the first device (42), and a horizontal movement of the structure (46) of the second device (43) corresponds to

the horizontal movement of all bars (25b; 25c) that are coupled to the second device (43);

- each adjustment device (42; 43) comprises a respective actuator (48; 49), the actuator (48; 49) being coupled with the respective structure (45; 46), so that a movement of the actuator (48) of the first device (42) corresponds to the vertical movement of the structure (45) of the first device (42), and a movement of the actuator (49) of the second device (43) corresponds to the horizontal movement of the structure (46) of the second device (43).

5. Machine (1) according to Claim 4, wherein the structure (46) of the second device (43) is coupled with the structure (45) of the first device (43), so that the structure (46) of the second device (43) is integral with the vertical movement of the structure (45) of the first device (42).

6. Machine (1) according to Claim 4 or 5, wherein at least one adjustment device (42; 43) comprises a linear motor (47), the linear motor (47) being coupled with the respective actuator (48; 49) to cause the movement of the respective actuator (49; 49).

7. Machine according to any of Claims 4 to 6, wherein, for at least one (42; 43) of said adjustment devices (42, 43), the respective actuator (48; 49) is coupled with the respective structure (45; 46) by means of a cam coupling (50, 51).

8. Machine (1) according to Claim 7, wherein said cam coupling (50, 51) comprises:

- a cam (50) integral with or fixed to one of the respective actuator (48; 49) and structure (45; 46), and a cam follower (51) integral with or fixed to the other of said respective actuator (48; 49) and structure (46; 45);

the cam follower (51) being eccentric so that a user can preliminary regulate, before the adjustment, a preliminary position of the structure (45; 46) of the respective adjustment device (42; 43).

9. Machine (1) according to any of Claims from 4 to 8, wherein:

the machine (1) comprises a first adjustment system (30a) and a second adjustment system (30b);
each adjustment system (30a; 30b) is connected to a respective sector of the guide (6), to adjust, independently from each other and by acting on said respective sector of the guide (6), the first size (h) and the second size (w) of the respective sector of the channel (26);

the machine (1) comprises a lever mechanism (35);

the lever mechanism (35) is mechanically interposed between the actuator (48) of the first adjustment device of the first adjustment system (30a), and the actuator (49) of the second adjustment device of the second adjustment system (30b);

the lever mechanism (35) is mechanically connected to a curved sector of the guide (6), to adjust, by acting on the respective curved sector of the guide (6) and independently from each other, the first size (h) and the second size (w) of the respective curved sector of the channel (26).

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10. Machine according to any one of the preceding claims, further comprising an endless belt (58) and a plurality of pushers (59) connected to and carried by the endless belt (58), the machine (1) being configured so that a movement of the endless belt (58) causes a movement of the pushers (59) along an endless conveying path (Q);

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wherein the pushers (59) are engaged in a sliding manner in the channel (26), so that the movement of the belt (58) causes each pusher (59) to push at least one respective cap (2) along the channel (26), to cause the advancement of said at least one respective cap (2) along the advancement path (P) .

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11. Machine (1) according to any of the previous claims, configured so that the inner space (4) is an aseptic space and/or a sterile space.

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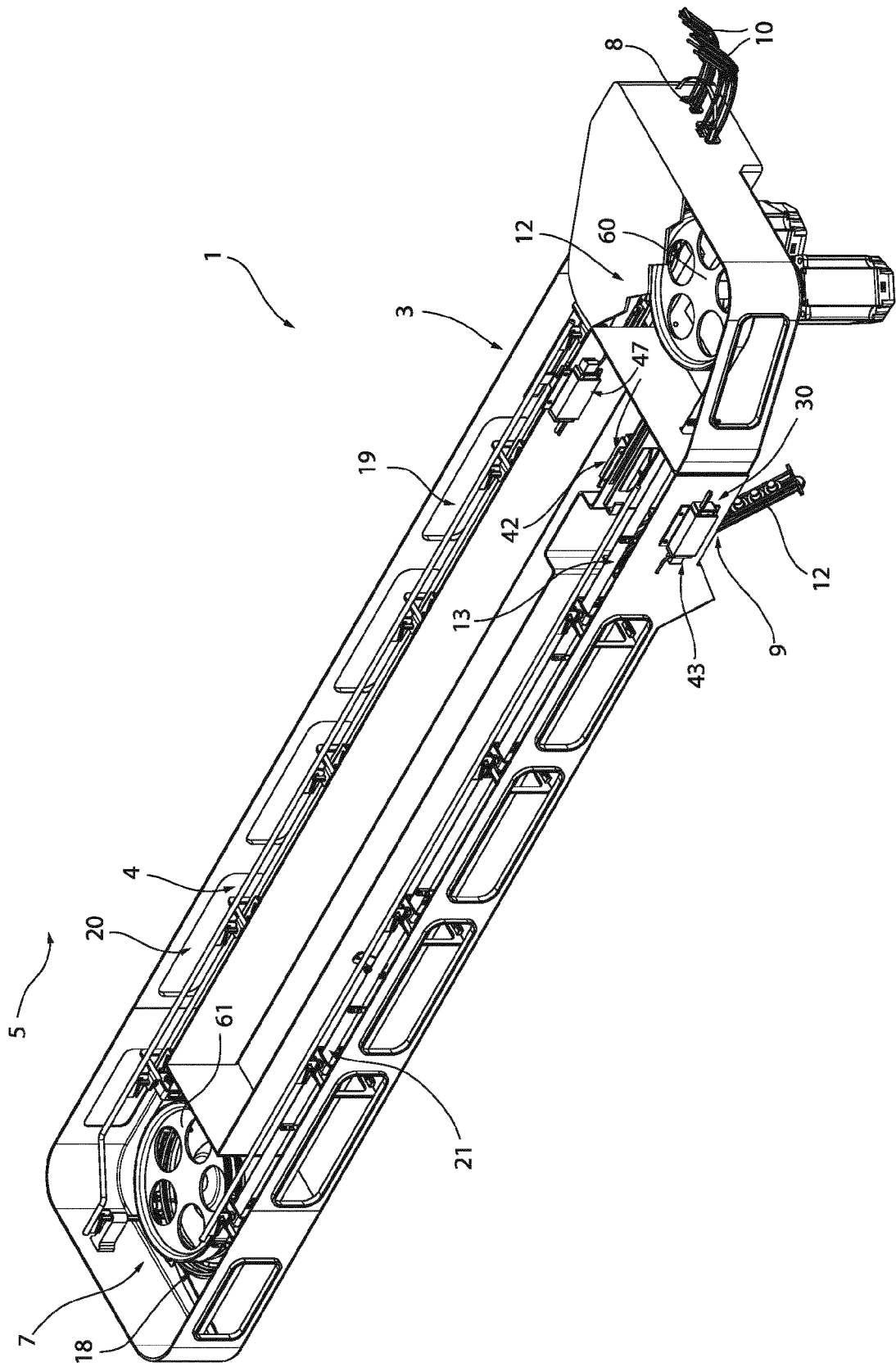


FIG. 1

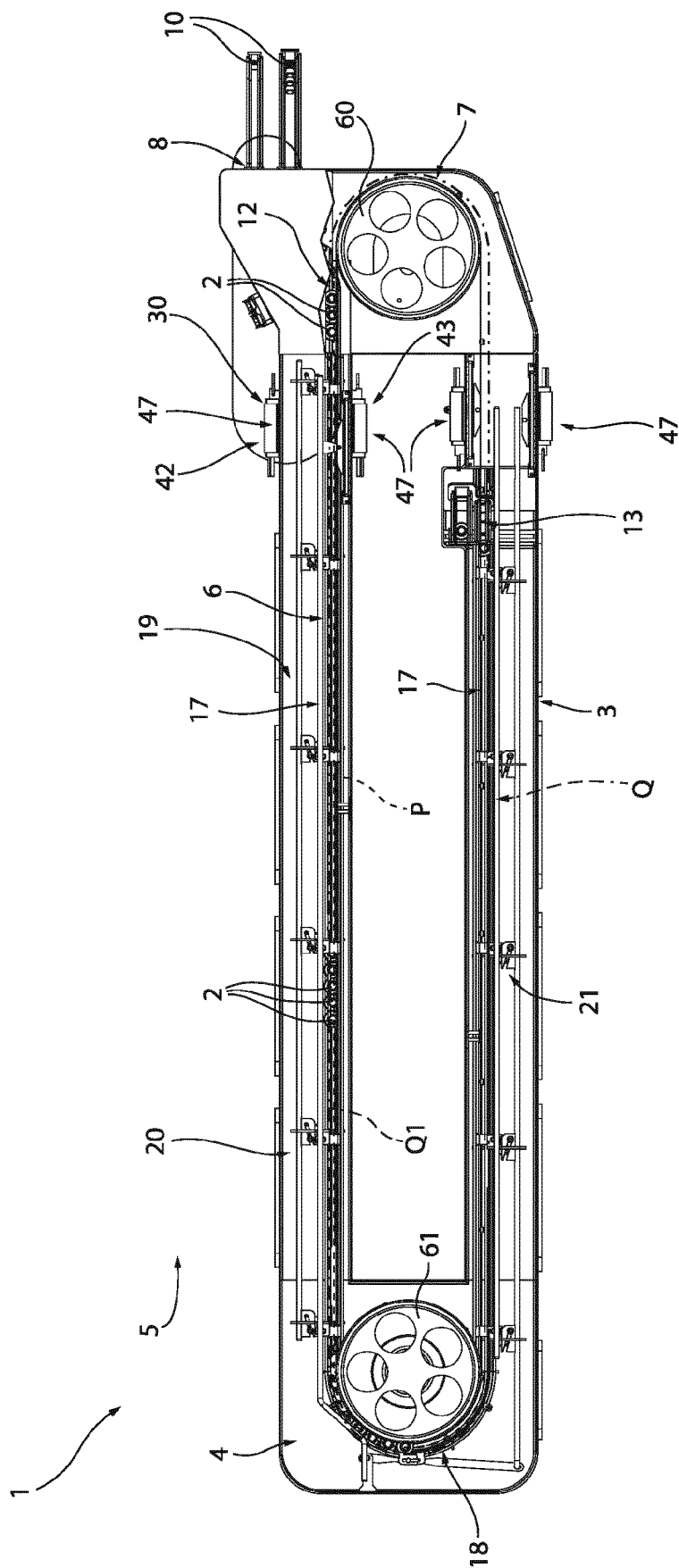


FIG. 2

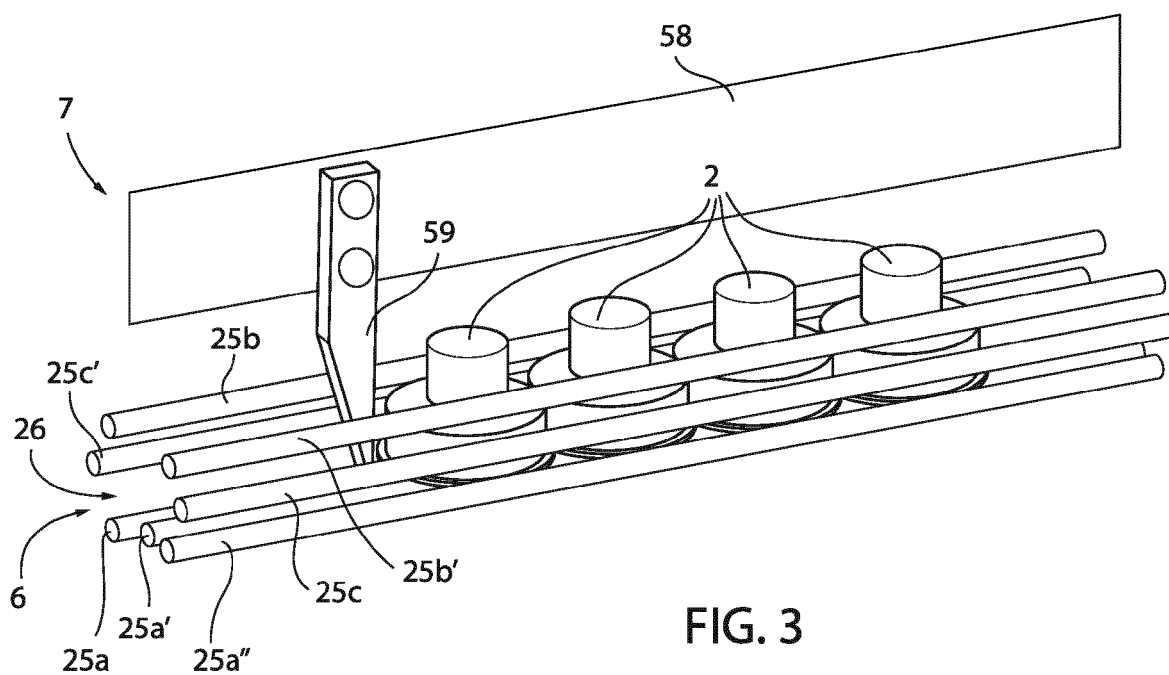


FIG. 3

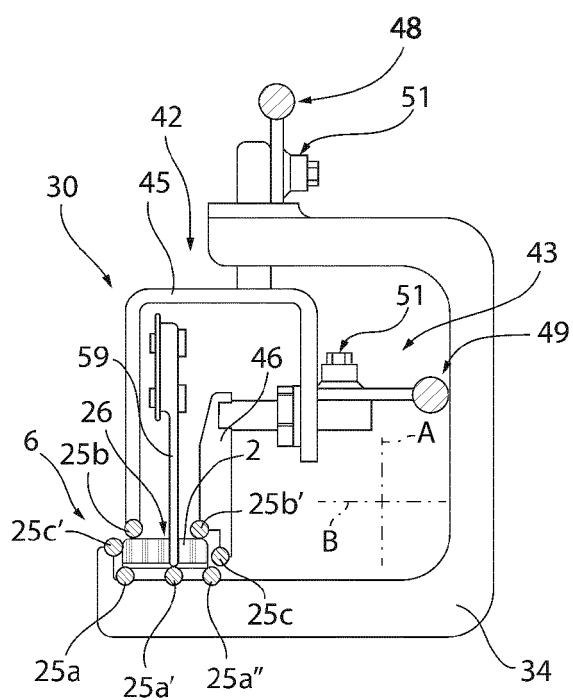


FIG. 4A

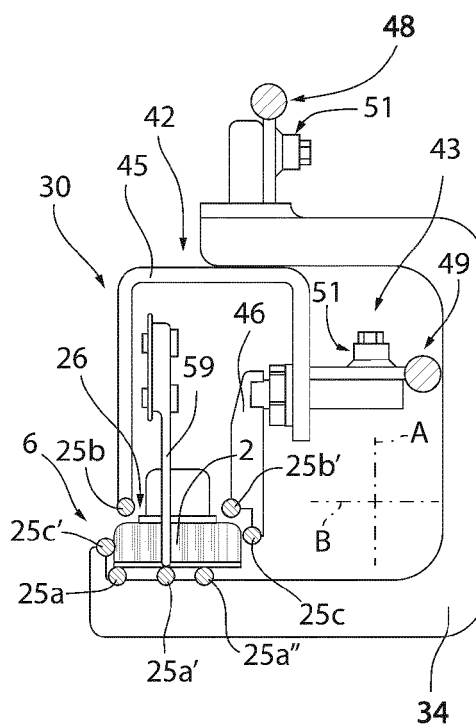


FIG. 4B

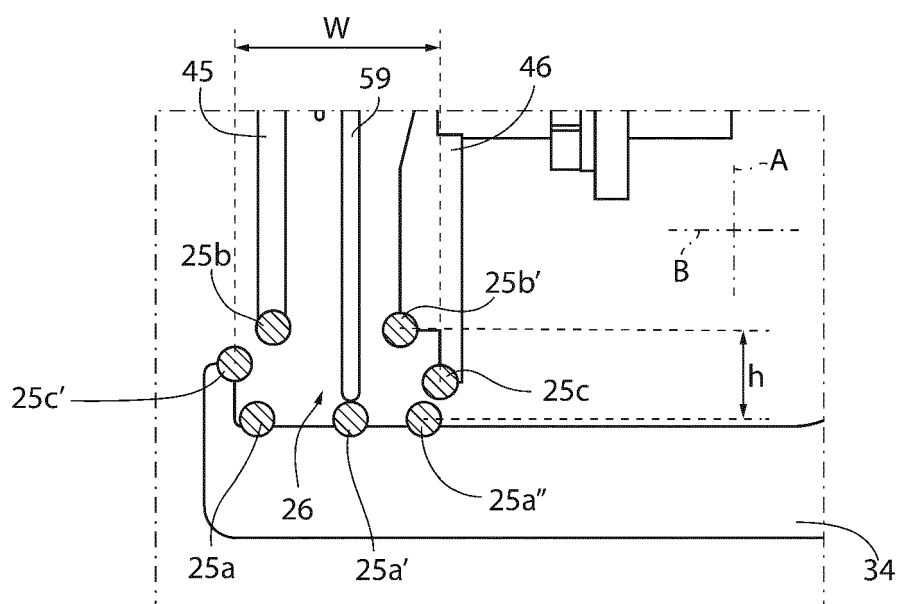


FIG. 5A

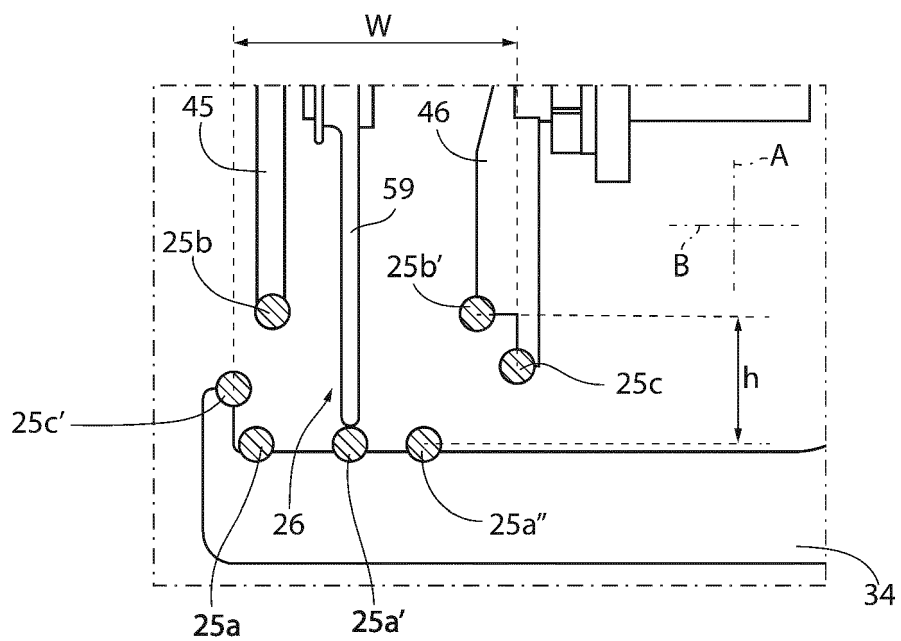
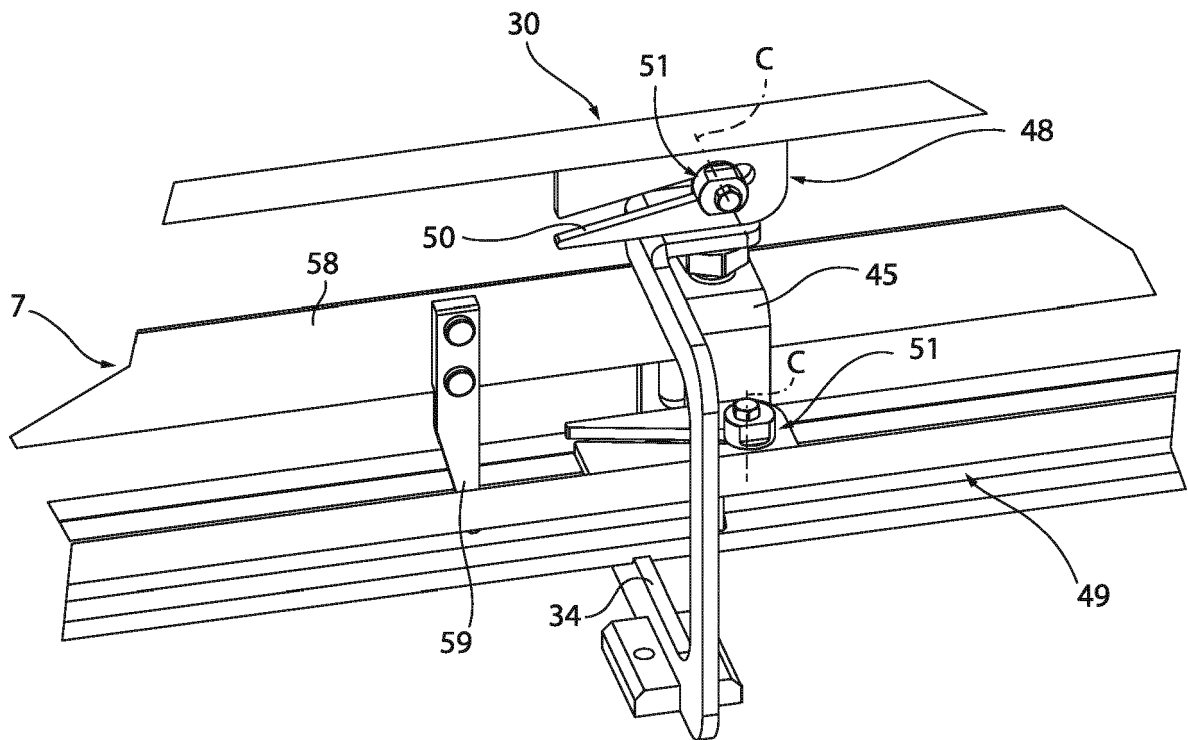
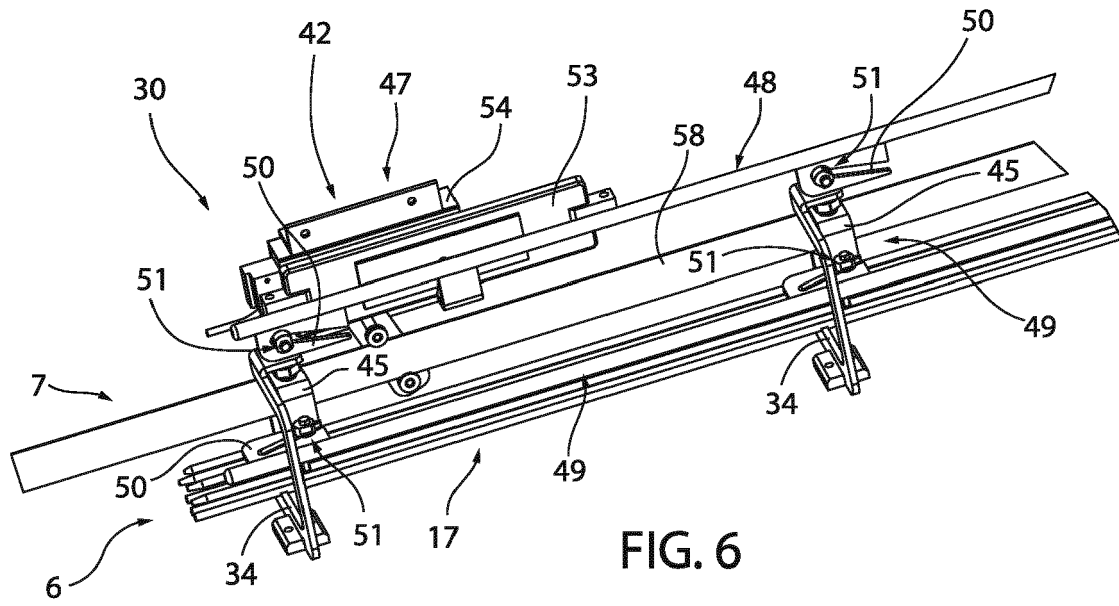


FIG. 5B



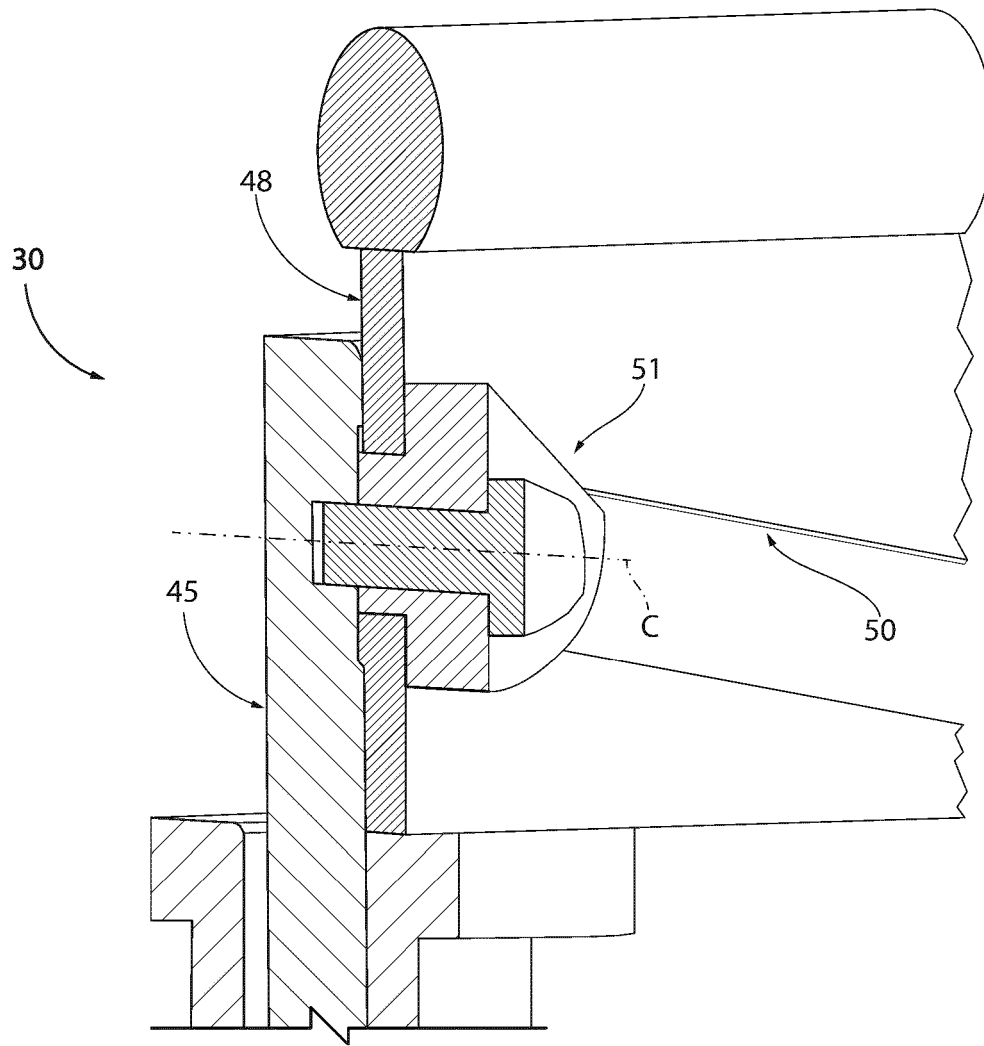


FIG. 8

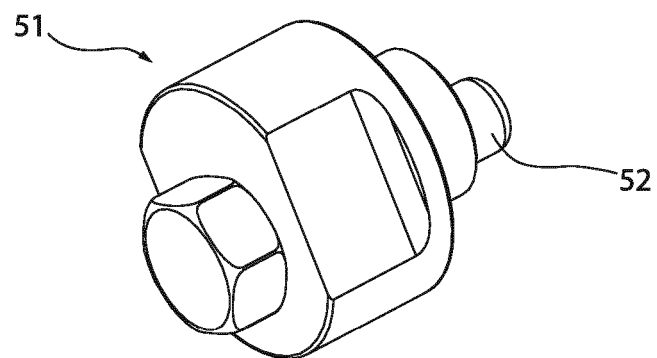


FIG. 9

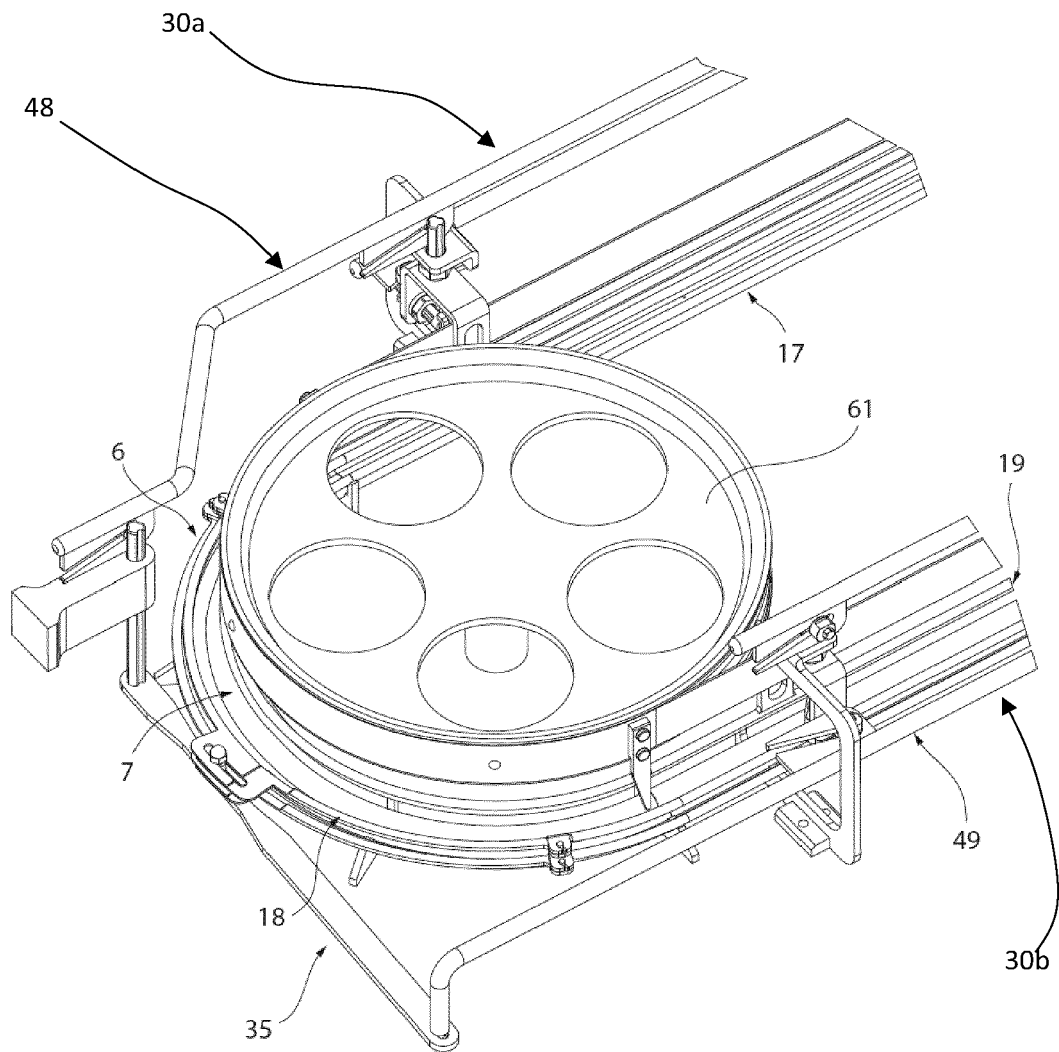


FIG. 10



EUROPEAN SEARCH REPORT

Application Number
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A	EP 3 192 531 A1 (SIDEL PARTICIPATIONS SAS [FR]) 19 July 2017 (2017-07-19) * paragraph [0030]; figures 1-7 *	1-11	
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			B65B A61L B67B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 11 November 2021	Examiner Dick, Birgit
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	

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