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(54) SYRINGE UNLOADING SYSTEM

(57) A syringe unloading system for a pharmaceutical compounding device for intravenous chemotherapy comprising a syringe unloading module (1) for receiving syringe adaptors (5, 6, 7, 8) having a syringe configured to hold a syringe adaptor available to collect (5) with an angle (α) greater than zero between a plane parallel to a syringe adaptor base and a plane parallel to a base of said syringe unloading module.

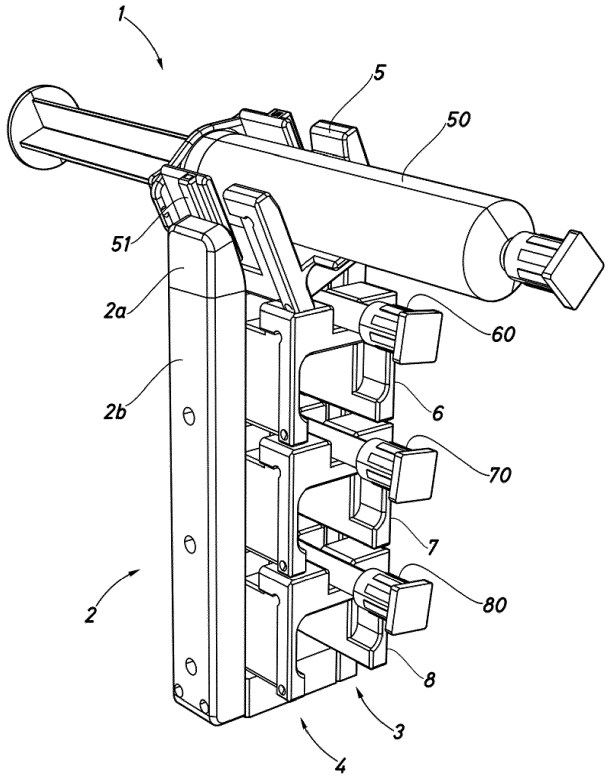

Fig.2

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Description

[0001] The present invention relates to machines for the automatic preparation of intravenous medication.

[0002] In particular, the present invention relates to a syringe unloading system for a pharmaceutical compounding device for intravenous chemotherapy for receiving syringe adaptors coming from a robotic system which can accommodate syringe adaptors containing syringes of different sizes without the need for any procedure for adjusting the equipment, and allows an operator to unload them manually, and a pharmaceutical compounding device for intravenous chemotherapy which comprises such a system.

[0003] The present invention is particularly advantageous when used in automated systems suitable for processing medications such as pharmacy compounding devices. Some of the known robotic devices for processing medications place the prepared medications in collecting points that are either not of easy access for an operator or that do not provide a secure placement of the prepared medications.

[0004] The patent document EP2913042B1 discloses a machine for the automatic preparation of intravenous medication wherein a syringe placement table is located on a back surface of the front door section or a front surface of the back door section, so that the syringe placement table comes outside of the co-infusion processing room and the opening is closed by the back door section when the syringe take-out door is open.

[0005] This syringe placement table has the disadvantage of placing said syringes in a structural component that will be manually rotated by an operator. Therefore, if the process of opening the door is performed in a too energetic manner the syringe might move or tumble within the table hitting other medical preparations or structural elements, with the potential risk of being fractured.

[0006] The patent document EP2624802B1 discloses a machine for the automatic preparation of intravenous medication comprising a prepared products area where at least one container is loaded and unloaded manually. A user carrying out the operation of loading and unloading has to access a main chamber by opening a window of the machine. The disadvantage of this approach is that the loading and unloading area is not specifically designed for the easy access of the operator but rather for an efficient preparation of the medication by a robotic arm.

[0007] Further, in said machines syringes are manually loaded/unloaded by a user into/from a syringe carrousel located within the loading and unloading area when the window of said machine is open. Said syringe carrousel has capacity to store 8 syringes. Nevertheless, in certain situations the full capacity cannot be achieved since collisions between syringe plungers might occur. This reduces the productivity when compounding preparations using syringes as final containers.

[0008] In order to overcome the above problems presented by machines according to the prior art, the present invention discloses a syringe unloading system for a machine for the automatic preparation of intravenous medication comprising an equipment to accommodate and hold extra syringe adaptors, and secure them at an angle to ease the access and unloading process to human operators. Thus, the syringe adaptor which is ready to collect is held at a position and angle such that there is no obstruction between an operator and said syringe adaptor. Further, the syringe unloading system of the present invention has a reduced area footprint, allowing it to be positioned within said machines (i.e. pharmacy compounding devices) at a close distance with respect to a window thereof, without interfering with the three-dimensional path of the arms of the robotic system and allowing easy operator access in a more ergonomic way. Besides, the present syringe system is not mounted on a movable structure but fixed to the frame and or cabinet of the automated system, reducing unnecessary motions of the syringes.

[0009] Therefore, the present invention discloses a syringe unloading system for a pharmaceutical compounding device for intravenous chemotherapy comprising a compounding area with a robotic compounding device, a sash window for closing the compounding area during operation of the robotic compounding device, and a window sensor system for detecting the open or closed status of the sash window. Said pharmaceutical compounding device can also comprise a pre-processing and/or post-processing area arranged in said pharmaceutical compounding device or in a separated station including a user interface screen and at least one of the group comprising a weighing device, a code scanner, a label printer or a combination thereof; and a control unit with a security circuit for preventing opening of the sash window when the robotic compounding device is performing a compounding operation and the sash window is closed, wherein the compounding area comprises an syringe unloading module for receiving syringe adaptors having a syringe and configured to hold a syringe adaptor available to collect with an angle between a plane parallel to a syringe adaptor base and a plane parallel to a base of said syringe unloading module greater than zero, to allow an operator to unload them manually.

[0010] The syringe unloading module disclosed in the present invention is configured to hold a syringe adaptor available to collect with a relative angle between a plane parallel to a syringe adaptor base and a plane parallel to a base of said syringe unloading module greater than zero. This is enabled by an asymmetric arrangement of the elements comprising the syringe unloading system in the transverse direction of the syringe adaptor.

[0011] The syringe unloading module preferably comprises two parallel structures wherein said structures have a bottom part and a top part, located at a horizontal distance from each other by means of a base that connects them, said structures comprising guides along a longitudinal direction suitable for accommodating a plu-

rality of syringe adaptors between them. Preferably, said structures are vertically arranged.

[0012] More preferably, a chamfer or fillet is formed in the inner side of the top part of one of the two structures to facilitate the leaning of the syringe adaptor. Yet more preferably, the chamber or fillet is formed in the inner side of the top part of the structure opposite to an operator accessible side.

[0013] Even more preferably, the syringe unloading module is installed within a machine for the automatic preparation of intravenous medication in such a way that the vertical structure where the chamfer or fillet is formed is located away from the sash window of said machine.

[0014] Advantageously, the distance between the guides widens at the top part of the vertical structures.

[0015] More preferably, the widening of the distance between the guides is formed by the progressive thinning of an inner face of one or both of the two vertical structures.

[0016] Preferably, the widening of the distance ranges from 5% to 25% of said distance. Even more preferably the widening of the distance ranges from 10% to 15% of said distance.

[0017] Preferably, the angle between a plane parallel to a syringe adaptor base and a plane parallel to a base of said syringe unloading module as a result of these structural and geometric features is between 1 and 45 degrees. More preferably, the angle is between 10 and 30 degrees.

[0018] Further, the syringe unloading module can comprise holding means to keep the uppermost syringe adaptor at the top part of said vertical structures. Preferably, the holding means comprise resilient elements. Even more preferably, the resilient element comprises a set of positioning spring ball plungers that are mounted on the two vertical structures, but other suitable means such as elastic straps can be used. Besides, said holding means can comprise a retainer to prevent the ejection of the uppermost syringe adaptor due to the upward force applied by the resilient element.

[0019] The syringe unloading module of the present invention is configured to accommodate a plurality of syringe adaptors. Preferably, it is configured to accommodate from one to ten syringe adaptors. Yet more preferably, it is configured to accommodate from one to four syringe adaptors.

[0020] The syringe unloading module according to the present invention is configured to be installed in a pharmacy compounding device.

[0021] The present invention also comprises a pharmaceutical compounding device for intravenous chemotherapy comprising: a compounding area with a robotic compounding device, a sash window for closing the compounding area during operation of the robotic compounding device, and a window sensor system for detecting the open or closed status of the sash window; the pharmaceutical compounding device comprising a syringe unloading module for receiving syringe adaptors from a robotised syringe actuator, the module being located in the compounding area such that an angle other than a right angle between a plane parallel to the sash window and a plane parallel to a base of the syringe adaptor is formed, so as to ease the access and unloading process of the syringe adaptor to a human operator

[0022] Preferably, said pharmacy compounding device can also comprise a pre-processing and/or post-processing area arranged in said pharmaceutical compounding device or in a separated station including a user interface screen and at least one of the group comprising a weighing device, a code scanner, a label printer or a combination thereof; and a control unit with a security circuit for preventing opening of the sash window when the robotic compounding device is performing a compounding operation and the sash window is closed. The present invention also discloses such a pharmacy compounding device.

[0023] For a better understanding, drawings of an embodiment of the equipment to which this invention relates are appended by way of an explanatory but no limiting example.

[0024] Figure 1 shows a perspective view of an inside part of a robotic system equipped with an empty syringe unloading system of the present invention.

[0025] Figure 2 shows a perspective view of the syringe unloading system standing free accommodating four syringe adaptors.

[0026] Figure 3 shows a front view of the syringe unloading system standing free accommodating four syringe adaptors.

[0027] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art pertinent to devices described. As used herein, the following terms and phrases have the meanings ascribed to them unless specified otherwise.

[0028] The term "compounding area" refers to the space inside the pharmacy compounding device that remains isolated from the environment during the automatic compounding process. The term "sash window" refers to the element that closes the compounding area from the environment. In a preferred embodiment, this element allows to see through and opens and closes said area by following a vertical motion, therefore the specific name, but any other means to physically separate the compounding area from the environment could be used, i.e. a rotary door, a rotary window. The "pre-processing and/or post-processing area" refers to an external area of/to the machine suitable for an operator to weight products, read labels of said products and/or print labels for said products. When referring to "syringe adaptors" these can either be loaded with a syringe or be empty since this feature does not affect the present invention in any way.

[0029] Figure 1 illustrates an exemplary embodiment of the device of the present invention 1 which is located within a robotic system for processing medications. In

this figure the device 1 has been shown empty to reduce clutter and to appreciate internal features.

[0030] Two vertical structures 2, 3 are connected to a base element 4 by fastening means (i.e. bolts, screws, plugs, rivets, pins) but other suitable ways of fixing can be used such as adhesion and or welding. The two vertical structures 2, 3 are equipped with respective vertical guides 20, 30 to match the lateral profile of the syringe adaptors 5, 6, 7, 8 (see figure 2). Further, the two vertical structures are provided with holes vertically aligned (21, 31, 22, 32, 23, 33) suitable for accommodating positioning spring ball plungers to secure each of the syringe adaptors in place.

[0031] In the embodiment shown in the figures, the horizontal distance h (see figure 3) between the inner wall of the guides 20, 30 increases in the top part of the vertical structures 2a, 3a in comparison with the corresponding distance at the bottom part of the vertical structures 2b, 3b, leading to a distance that exceeds the width of the syringe adaptor 5, 6, 7, 8 (see figure 3). This is particularly advantageous for allowing the leaning of the uppermost syringe adaptor 5, as will be explained below. Here, increasing the distance is achieved by a thinning of the wall thickness of said vertical structures. Further down, said distance is progressively reduced to match the width of the syringe adaptor and therefore accurately secure it in place.

[0032] Figure 2 illustrates an embodiment of the device that is suitable for accommodating from one to four syringe adaptors 5, 6, 7, 8 containing syringes 50, 60, 70, 80 of different sizes. The lateral profiles of the adaptors comprise protrusions 51 that match guides 20, 30 in the vertical structures. Thus, once the robotic arms places the syringe adaptor between said vertical structures, the adaptor can slide down while being securely placed. Once the syringe adaptor is fully inserted between the vertical structures this can only move vertically. However, the syringe adaptor (held by a resilient element) that is in the uppermost position remains partially outside of the vertical structures 2, 3 in a location where it is free to lean away from an operator accessible area.

[0033] Figure 3 shows a front view of the embodiment in figure 2 with four syringe adaptors 5, 6, 7, 8 in place. The uppermost syringe adaptor 5 leans towards one of the vertical structures 2. This is facilitated by the existence of a fillet or chamfer in one of the vertical structures 2. Preferably, the vertical structure with the fillet or chamfer is the one further from the operator. This naturally makes the syringe adaptor to lean away from the operator, placing it in a more ergonomic orientation to grasp it.

[0034] When more than one adaptor is to be stored inside the device of the present invention, the robotic arm pushes the adaptor to be placed against the adaptor that was previously on top. Thus, the adaptors inside the device are pushed and slide down along the guides until the uppermost adaptor is inserted and secured in place, partially leaning away from the operator.

[0035] The syringe unloading system is provided with holding means to hold the adaptors contained within in the uppermost part thereof. The holding means comprise a resilient element. In the present embodiment, the resilient element is a spring plunger but other means such as elastic straps could be also used for this purpose.

[0036] The holding means also comprises a retainer element adapted to prevent the syringe adaptors to be ejected over the top part of the vertical structures 2a, 3a due to the upward force applied by the resilient element.

[0037] In the present embodiment, the syringe unloading module is mounted fixed within the compounding area of a pharmacy compounding device next to the sash window thereof, for easy access of an operator.

[0038] Although the invention has been set out and described with reference to embodiments thereof, it should be understood that these do not limit the invention, and that it is possible to alter many structural or other details that may prove obvious to persons skilled in the art after interpreting the subject matter disclosed in the present description, claims and drawings. In particular, in principle and unless otherwise explicitly stated, all the features of each of the different embodiments and alternatives shown and/or suggested can be combined. Therefore, the scope of the present invention includes any variant or equivalent that could be considered covered by the broadest scope of the following claims.

Claims

1. A syringe unloading system for a pharmaceutical compounding device for intravenous chemotherapy comprising:
   a syringe unloading module (1) for receiving syringe adaptors (5, 6, 7, 8) having a syringe **characterized in that** it is configured to hold a syringe adaptor (5) available to collect with an angle (α) greater than zero between a plane parallel to a syringe adaptor base and a plane parallel to a base of said syringe unloading module.

2. The syringe unloading system according to claim 1 **characterized in that** the angle (α) between a plane parallel to the syringe adaptor base available to collect and a plane parallel to a base element (4) of said syringe unloading module is between 5 and 45 degrees.

3. The syringe unloading system according to claim 2, **characterized in that** it comprises two parallel structures (2, 3) wherein said structures have a bottom part (2b, 3b) and a top part (2a, 3a), located at a distance (h) from each other by means of a base element (4), said structures comprising guides (20) for accommodating one or more syringe adaptor (5, 6, 7, 8) between them.

4. The syringe unloading system according to claim 3,

characterized in that the distance (h) between the guides (20) widens at the top part of the structures (2a, 3a).

5. The syringe unloading system according to claim 4, **characterized in that** the widening of the distance (h) between the guides (20) is formed by a progressive thinning of an inner face of one or both of the two structures (2, 3).

6. The syringe unloading system according to any one of claims 3 to 5, **characterized in that** a chamfer or fillet is formed in an inner side of the top part of one of the two structures (2a, 3a) to facilitate the leaning of the syringe adaptor.

7. The syringe unloading system according to claim 6, **characterized in that** said chamfer or fillet is formed in an inner side of the top part of the structure (2a) opposite to an operator accessible side.

8. The syringe unloading system according to any one of the preceding claims, **characterized in that** it comprises holding means to keep the uppermost syringe adaptor (5) at the top part of said structures (2a).

9. The syringe unloading system according to claim 8, **characterized in that** the holding means comprise resilient elements.

10. The syringe unloading system according to claim 9, **characterized in that** the resilient element comprises positioning spring ball plungers.

11. The syringe unloading system according to claim 9, **characterized in that** the resilient element is an elastic strap.

12. The syringe unloading system according to any one of the preceding claims, **characterized in that** it is configured to accommodate a plurality of syringe adaptors.

13. The syringe unloading system according to the previous claim, **characterized in that** it is configured to accommodate one to four syringe adaptors.

14. A pharmaceutical compounding device for intravenous chemotherapy comprising:

a compounding area with a robotic compounding device, a sash window for closing the compounding area during operation of the robotic compounding device, and a window sensor system for detecting the open or closed status of the sash window;
characterized in that it comprises a syringe unloading module (1) according to any one of the preceding claims, the module (1) being located in the compounding area such that an angle other than a right angle between a plane parallel to the sash window and a plane parallel to a base of the syringe adaptor is formed, so as to ease the access and unloading process of the syringe adaptor to a human operator.

15. The pharmaceutical compounding device according to claim 14 further comprising:

a pre-processing and/or post-processing area arranged in said pharmaceutical compounding device or in a separated station including a user interface screen and at least one of the group comprising a weighing device, a code scanner, a label printer or a combination thereof;
a control unit with a security circuit for preventing opening of the sash window when the robotic compounding device is performing a compounding operation and the sash window is closed.

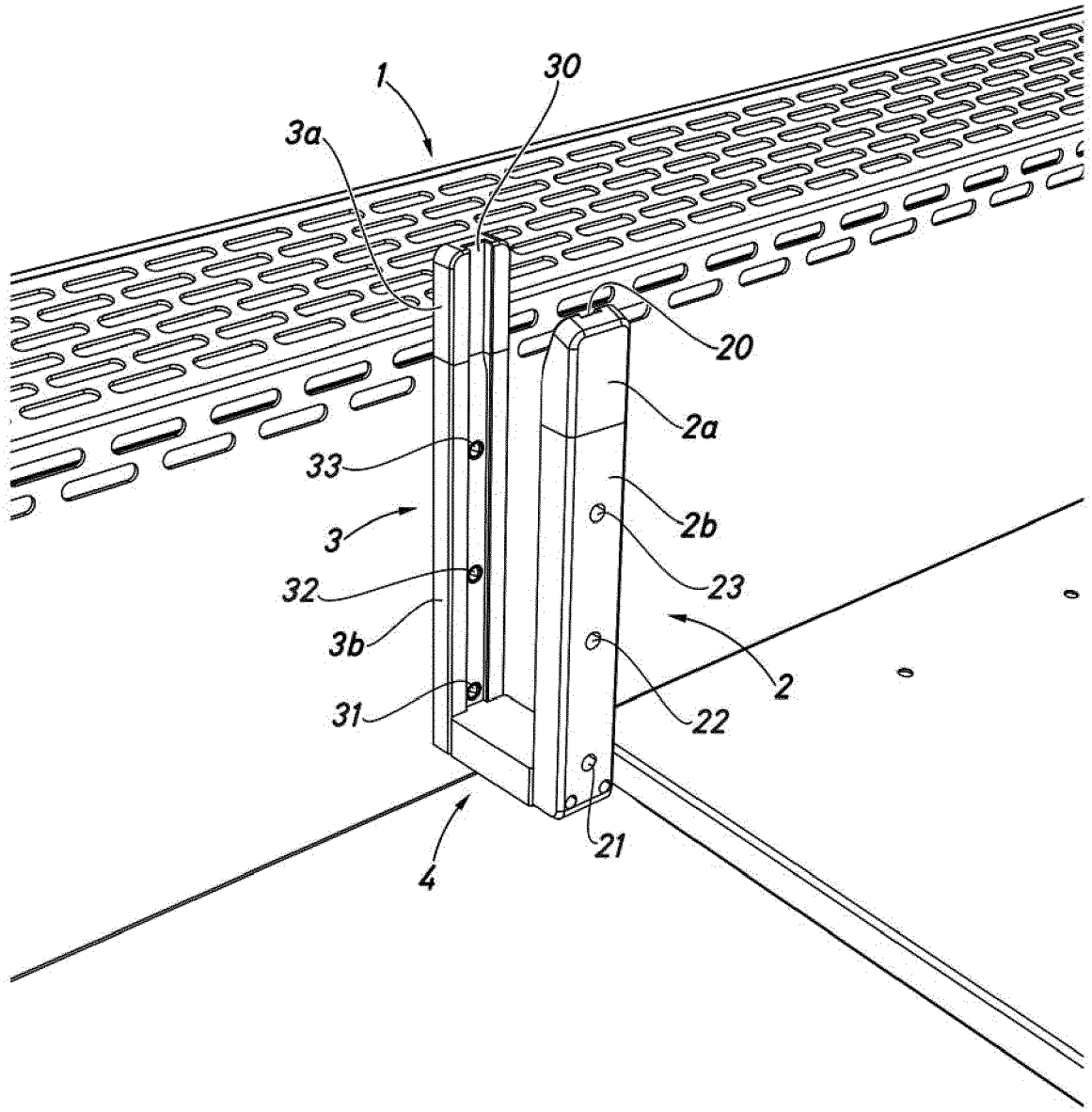

Fig.1

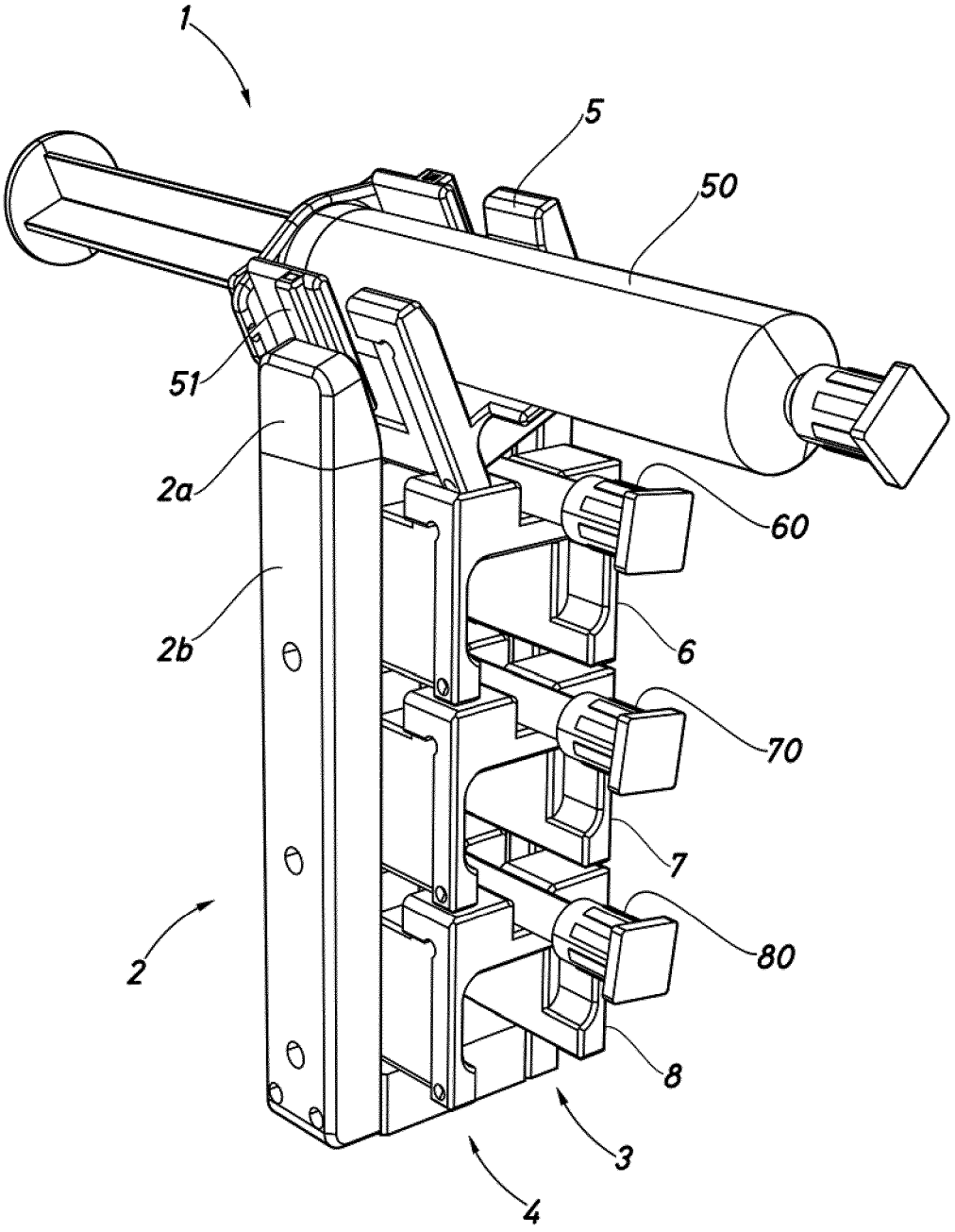

Fig.2

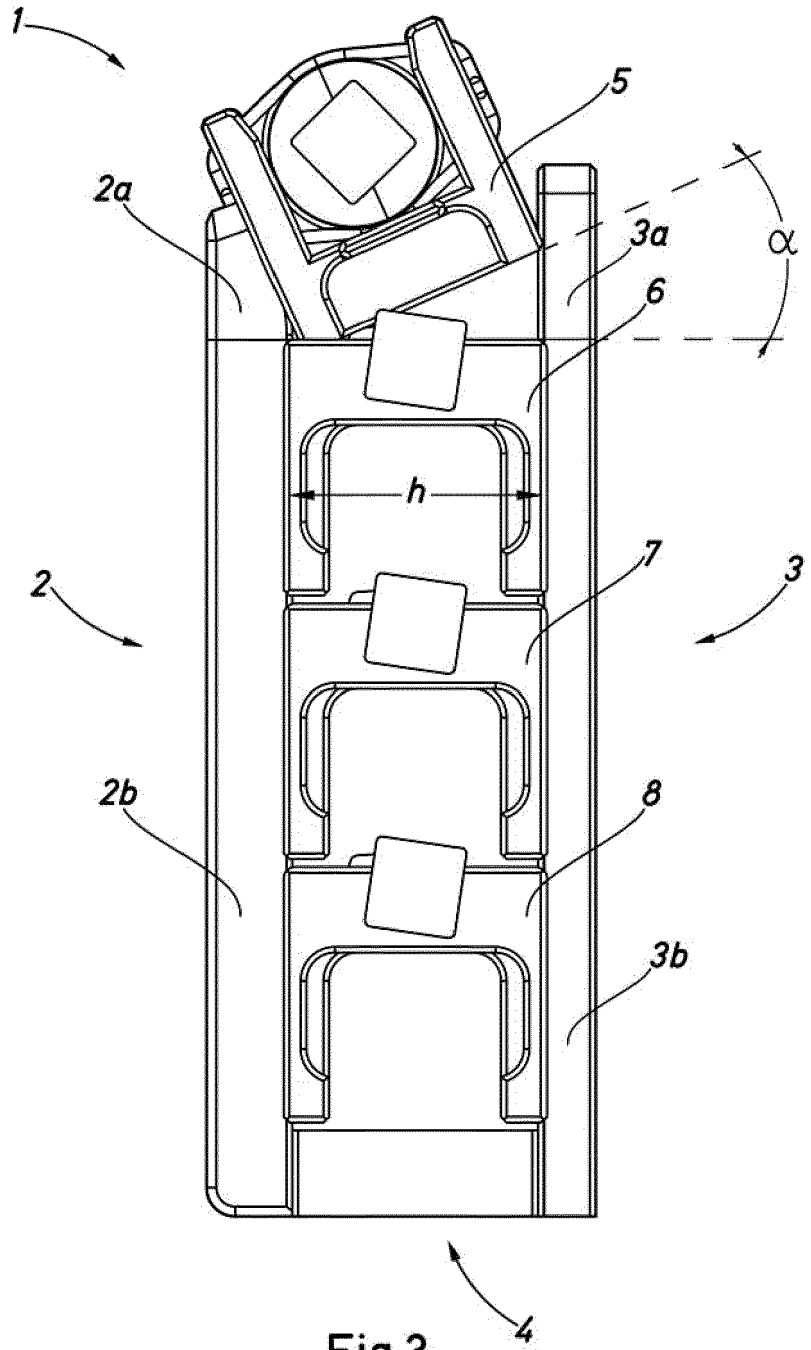

Fig.3

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EUROPEAN SEARCH REPORT

Application Number
EP 20 38 2833

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TECHNICAL FIELDS SEARCHED (IPC)

A61J
B25J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 February 2021	Birlanga Pérez, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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REFERENCES CITED IN THE DESCRIPTION

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