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(54) DISPENSING CANISTERS FOR PACKAGING PHARMACEUTICALS VIA ROBOTIC TECHNOLOGY

AUSGABEKANISTER ZUM VERPACKEN VON PHARMAZEUTIKA ÜBER ROBOTERTECHNOLOGIE

BOÎTES DE DISTRIBUTION POUR L'EMBALLAGE DE PRODUITS PHARMACEUTIQUES PAR TECHNOLOGIE ROBOTIQUE

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Description

Background of the Invention

Field of the Invention

[0001] The present invetion is directed to robotic pick-and-place systems.

Description of the Related Art

[0002] Currently, various automated packaging systems exist for placing oral solid pharmaceuticals into packaging solutions which correlate individual dosing times with patient prescription dated. Examples include United States patent Nos. 8,831,773 and 7,185,476. These issued patents describe systems that are capable of placing one or more oral solid pharmaceutical products into package cavities that correspond to patient prescription data. While the existing solutions describe various systems that are capable of rapidly and efficiently placing oral solid pharmaceuticals into packages, there remains a need in the art for ensuring that the oral solid pharmaceuticals have been precisely placed into the packages according to the patient prescription data with absolute confidence and within a single system. Currently there are no systems available that provide automatic verification that oral solid pharmaceutical packaging has been filled precisely according to patient prescription data within a single system and blister carded packaging. Accordingly, there remains a need in the field for systems and methods that are capable of ensuring that oral solid pharmaceuticals have been placed strictly in accordance with predetermined patient prescription data within a single system and in blister carded packaging.

[0003] The conventional approach to solving this issue requires that a trained technician or pharmacist review the packaged pharmaceuticals in order to ensure that the oral solid pharmaceutical products have been properly placed within the packaging material. The conventional approach is prone to errors and significant delays associated with the manual review process. Applicants' innovation that is set forth below overcomes these deficiencies of existing systems and obviates the need for post packaging quality review. Applicants' unique use and arrangement of various sensors ensures that the oral solid pharmaceuticals have been packaged properly.

[0004] US 2011/278319 A1 relates to a dual-reservoir canister for dispensing pills having a hinged access door provided with an extension that can block a passage of medications from the backup reservoir to the dispensing reservoir while the access door is open.

Summary of the Present Invention

[0005] The present invention provides robotic pick-and-place systems in accordance with the appended claims.

Brief Description of the Drawings:

[0006]

Figure 1 illustrates a first exemplary embodiment of the overall robotic pick-and-place oral solid pharmaceutical packaging system of the present invention;
Figure 2 illustrates a first exemplary embodiment of a non-claimed med verification tray or transfer sensing unit;
Figure 3 illustrates a second non-claimed exemplary embodiment of the med verification tray or transfer sensing unit;
Figure 4 is a flow diagram illustration of the verification process;
Figure 5 illustrates the end of arm tooling for the robotic pick-and-place device;
Figure 6 illustrates a dispensing canister with its lid in the open position;
Figure 7 is a cut-away illustration of the dispensing canister illustrated in Figure 6;
Figure 8 illustrates robotic transfer of a disclosed dispensing canister;
Figure 9 illustrates the robotic pick-and-place end of arm tooling with the removable suction tip secured for pill transfer.

Detailed Description of the Presently Preferred Embodiments

[0007] Robotic pick-and-place automation is used to transfer oral solid pharmaceuticals from moveable trays or canisters that have been quality checked by a pharmacist to package locations in accordance with patient prescription data. Advantageously, a variety of sensors are used in order to verify that the oral solid pharmaceuticals have been properly placed in the desired oral solid pharmaceutical package locations precisely according to the patient prescription data. In accordance with a non-claimed embodiment, a pharmacist places oral solid pharmaceutical products within dispensing trays or canisters which are used to present the oral solid pharmaceutical products for picking and placing via the robotic pick-and-place machinery. Once the canister or tray is located adjacent the pick-and-place device, a further sensor or imaging unit associated with the pick-and-place device verifies that the oral solid pharmaceutical product presented by the tray or canister matches the size and shape and/or color of an expected oral solid pharmaceutical product that is to be placed within the packaging material in accordance with patient prescription data that is stored by a computer associated with the system.

[0008] If the expected data matches the actual oral solid pharmaceutical product sensed by the imaging unit associated with the pick-and-place device, the robotic pick-and-place continues to transfer one oral solid pharmaceutical product to a desired package location which has a dosing time corresponding to the patient prescrip-

tion data that is for the package that is currently being filled. Once the robotic pick-and-place end of arm tooling has transferred the oral solid pharmaceutical product to the desired package location, additional sensing units ensure that the transfer is completed into the desired package location in order to verify that the robotic pick-and-place unit has dropped the oral solid pharmaceutical product into a desired package location. If the imaging sensor of the robotic pick-and-place device determines that the oral solid pharmaceutical product presented at the tray or canister is not a match to the expected oral solid pharmaceutical product according to the current patient prescription data, then the system issues an alert to the system operator in order to prevent the erroneous transfer of oral solid pharmaceutical products into the packaging material and will not pick that oral solid pharmaceutical.

[0009] In accordance with a non-claimed embodiment, a med verification tray or transfer sensing unit is located between the end of arm tooling for the robotic pick-and-place mechanism and a oral solid pharmaceutical product package or temporary store having cavity locations corresponding to the cavities of a solid pharmaceutical package that is to be filled by the system. The med verification tray or transfer sensing unit preferably includes a plurality of sensors that operate to confirm transfer from the robotic pick-and-place end of arm tooling and the package cavity location corresponding to the prescription data that is currently being filled by the system. It is preferred that the system is able to ensure that a specific cavity location is being filled by confirming the drop of the oral solid pharmaceutical from the robotic pick-and-place end of arm tooling.

[0010] In accordance with a further non-claimed embodiment, one or more optical sensing units are used to ensure that the oral solid pharmaceutical product that is transferred by the robotic pick-and-place device actually drops into the specific package cavity location that is to be filled by the system. An optical sensor unit includes an emitter that emits a wide beam that at least substantially covers a region above the cavity location that is to be filled. One or more receiving units are located opposite the emitting unit and sense the emitted beam generated by the emitter. An interrupt signal is generated when the one or more receiving units sense that at least a portion of the beam has been interrupted. Because the emitter and receiving unit are preferably individually associated with each package cavity location, it is possible to confirm that an oral solid pharmaceutical that has been transferred by the robotic pick-and-place unit from the dispensing tray or canister specifically into a desired oral solid pharmaceutical package cavity location corresponding to the patient prescription data. This technique ensures strict compliance for packaging oral solid pharmaceutical products in accordance with stored patient prescription data. It is also preferred that the sensors of the med verification tray or transfer sensing unit preferably sense any additional breach of the beam immediately after the drop of the oral solid pharmaceutical product in order to ensure that the oral solid pharmaceutical product does not bounce from the desired oral solid pharmaceutical packaging location when the oral solid pharmaceutical product is dropped by the robotic pick-and-place device.

[0011] A further verification may also be performed by imaging the packaged pharmaceuticals and matching the oral solid pharmaceutical products located within each package cavity with the corresponding patient prescription data for the specific dosing time corresponding to the package cavity location. In accordance with the foregoing verifications, it is possible to ensure that the individual oral solid pharmaceutical package cavities have been filled with the appropriate doses corresponding to predetermined patient prescription data with absolute confidence. Conventional systems have not been able to provide this high level of confidence for the existing automated oral solid pharmaceutical packaging systems. The present invention overcomes these shortcomings and deficiencies of the existing systems thereby providing a much more economical and efficient packaging solution.

[0012] Figure 1 illustrates a first preferred exemplary embodiment of the present invention which is generally shown at 10 in the illustration. A robotic pick-and-place device 12 transfers oral solid pharmaceutical products from the dispensing containers (transfer trays or cassettes) 14, 15, 16 into individual oral solid pharmaceutical package locations in accordance with patient prescription data. The individual dispensing containers 14, 15, 16 are preferably transferred to the respective locations shown in the illustration by another transfer robot from a staging location at which a pharmacist or technician fills the individual dispensing containers from bulk storage. An initial verification is provided by a pharmacist or technician in order to ensure that the medications placed into the dispensing containers 14, 15, 16 match the medication designated for a specific transfer tray or cassette. Bar coding verification or other automatically verified visual coding is preferably used by the automated system in order to confirm that an individual dispensing container that is staged adjacent the robotic pick-and place device 12 for filling matches the designation provided by the pharmacist or technician at the time of filling.

[0013] An additional verification of the oral solid pharmaceutical is performed by an imaging unit (not shown) that is preferably associated with the end of arm tooling portion 18 of the robotic pick-and-place device 12. The imaging unit provides image data for comparison with a library of image data that is used to ensure the oral solid pharmaceutical actually picked up by the robotic pick-and place device 12 matches an expected oral solid pharmaceutical designated by a prescription to be filled based on a plurality of visual characteristics including one or more of shape, size, and/or color of the solid oral pharmaceutical. The imaging unit is also preferably used in order to ensure that the end of arm tooling is placed prop-

erly above a specific oral solid pharmaceutical so that the suction tip is able to grab and move an individual solid pharmaceutical. An automated processing unit compares the actual image data with expected image data to determine whether there is a match, if there is no match then an alert is issued to the system operator.

[0014] In accordance with a preferred exemplary embodiment, the end of arm tooling initially engages a suction tip that is secured to the dispensing container from which a solid oral pharmaceutical is to be transferred for packaging. The suction tip is a soft rubber end that is engaged and removed from the end of arm tooling of each cassette so that each dispensing container has its own dedicated suction tip thereby avoiding the potential for cross-contamination from different medications that are filled by the system. Once all medications have been transferred from a particular dispensing container for a particular package that is being filled by the system, the suction tip of the end of arm tooling is again secured to its corresponding dispensing container so that it is available for use the next time that a solid oral pharmaceutical is to be transferred from the dispensing container. The round suction tip is preferably temporarily secured at the dispensing container via a plastic semicircular structure so that the end of arm tooling can easily engage and disengage the suction tip of each dispensing container.

[0015] Figure 1 also illustrates the location of the med transfer verification unit 20 that is placed above a package or package template that is to be filled by the system. The med transfer verification unit 20 incorporates a plurality of sensors that verify the transfer into a specific package or package template cavity corresponding to a patient prescription that is filled by the system.

[0016] Figure 2 illustrates a first exemplary embodiment of the med transfer verification unit 20. The med transfer verification unit 20 preferably includes an array of cavities 22 that each individually provide a transfer path for a solid oral pharmaceutical that is packaged by the system of the present invention. The array of cavities 22 of the med transfer verification unit 20 preferably correspond with the individual cavities of an oral solid pharmaceutical product package that is located beneath the med transfer verification unit 20. Each cavity of the package or package template corresponds with a specific patient dosing time and the system automatically transfers each required oral solid pharmaceutical into its specified location strictly in accordance with predetermined patient prescription data using the robotic pick-and-place device.

[0017] Figure 2 also illustrates a plurality of electromagnetic emitter units 26 that are used to verify that medication transferred by the robotic pick-and-place device actually drops into a desired package cavity or template location. In accordance with this first embodiment, an electromagnetic energy receiving unit (not shown) is placed opposite each of the electromagnetic emitting units and a path is formed in the med transfer verification unit 20 through the oral solid pharmaceutical transfer path for each cavity in a given row or column of the med transfer verification unit 20 in order to confirm that an oral solid pharmaceutical has been deposited in a desired cavity according to the predetermined patient prescription data. In accordance with this first embodiment of the med transfer verification unit 20, it is possible to verify that an oral solid pharmaceutical has been deposited by the end of arm tooling but verification is only possible for rows or columns of the med transfer verification unit 20. Those skilled in the art will appreciate that additional emitters and receivers can be used in order to provide greater resolution for pill drop verification into each individual cavity. The med transfer verification unit 20 also acts as a barrier between cavities to prevent inadvertent transfer of the medication between the cavities.

[0018] Figure 3 illustrates an alternate embodiment of the med transfer verification unit 20 wherein each cavity 22 of the med transfer verification unit 20 includes its own pair of electromagnet emitter and receiver units for specifically confirming that a solid oral pharmaceutical has been dropped into a specific cavity of a package in accordance with patient prescription data. The electromagnetic emitter units are not shown in the illustration of Figure 3. Figure 3 illustrates the med transfer verification unit 20 and the individual electromagnetic receiving units 30 that are individually associated with each cavity of the med transfer verification unit 20. When an individual solid oral pharmaceutical is dropped by the robotic pick-and-place device through a specific cavity of the med transfer verification unit 20, the med transfer verification unit 20 is able to sense and verify the drop of the solid oral pharmaceutical based on a break in the beam that is received by each of the electromagnetic receiving units 30. This sensing of the drop at each individual cavity provides confirmation that the oral solid pharmaceutical that has been dropped by the robotic pick-and-place device into the package strictly in accordance with the predetermined patient prescription data. The individual electromagnetic emitters and receivers can also be used to ensure that pills have not bounced out from the cavities by verifying that only a single break in the beam is associated with each pill drop.

[0019] Additional image data from optical sensing units positioned above and/or below the package cavity may be used to further confirm that each individual cavity has been properly filled with the oral solid pharmaceuticals strictly in accordance with the predetermined patient prescription data.

[0020] Figure 4 is a flow diagram which illustrates the overall process for automatically verifying the placement of oral solid pharmaceutical products into specific cavities of a package strictly in accordance with patient prescription data stored in an electronic memory of a computer controller that is used for controlling the packaging machinery. In step 42 a pharmacist or technician verifies transfer of medication from bulk storage into the appropriate canister or dispenser for the specified medication. The medication canister is returned to a carousel where it can be automatically retrieved by a robot for transfer

to the robotic pick-and place device of the present invention. It is preferred that a bar code, QR code or rfid reader associated with the system reads a code on the canister before it is positioned at a specific location in a staging area so a robotic retriever can transfer the desired canister automatically to the robotic pick-and-place device.

[0021] In step 44, a bar code or other automated reader reads a code or data from the canister when it is transferred to the staging area of the robotic pick-and-place packaging system in order to ensure that the system transfers the desired medication. In step 46, image data from the pick-and-place unit verifies that the individual pill being transferred has physical characteristics matching those of the expected pill. In step 48, the system verifies drop of the pill into the specific package cavity corresponding to the patient prescription data. Finally, in step 50, the resultant package is labeled and sealed with the patient specific data after all required medications for all doses specified by patient prescription data have been filled by the system into the cavities of the product package.

[0022] In an alternate more manual version of the system, the med transfer verification tray includes one or more lights that illuminate at a region of the tray corresponding to a specific cavity of the package that is to be filled with an oral solid pharmaceutical. This assists in the manual transfer of oral solid pharmaceuticals into specific package cavities according to patient prescription data. The remaining operations associated with pill transfer can then be performed in accordance with manual transfer into a package cavity. The system cause one or more lights in a specific region to illuminate in order to guide the user to place a solid pharmaceutical in a desired package location corresponding to patient prescription data.

[0023] Figure 5 illustrates the details of the end of arm tooling for the robotic pick-and-place device which is shown generally at 60. High pressure and low pressure lines 62 and 64 operate to generate a vacuum at the suction tube 65. A pressure sensor 66 located proximate the suction tube 65 operates to ensure that a pill has been picked up by the system based on a predetermined pressure change at the pressure sensor 66. A valve 67 is a pneumatic solenoid switch that selectively applies the vacuum at the suction tube 65. The switch is preferably a 2 msec switch which causes the pressure change within 10 msec at the suction tube end within 10 msec. The solenoid switch or valve 67 consists of four standard ports and the port A and B are the supply of negative pressure and positive pressure. Port A is directly coupled to the vacuum ejector which supplies the negative pressure and port B is directly coupled to a positive pressure regulator which supplies low positive pressure. As a result, the P port is the port which supplies the vacuum pressure and the positive pressure to the suction tube. Ports A and B always have the vacuum and positive pressure active during picking and placing operations. This arrangement assures rapid pressure changes at the end of the suction tube 65. The positive pressure is required to simply and effectively remove the vacuum pressure at the end of suction tube 65.

[0024] For performing pill drop verification, it is preferred to use emitters such as model LV S 62 manufactured by Keyence as an optical emitter along with an optical sensor. Alternatively a Fairchild semiconductor infrared emitting diode can be used as the light source in conjunction with an optical sensor. Those skilled in the art will appreciate that virtually any emitter and sensor can be used to sense a break in the sensed emission beam associated with the transit of an oral solid pharmaceutical into a product package cavity. In an alternate arrangement, it is recognized that one or more imaging units could be used to sense the transit of oral solid pharmaceuticals into package cavities but this arrangement requires additional image data processing in order to identify transfer into a specific package cavity.

[0025] Figure 6 illustrates placement of a dispensing container at the staging area of the robotic pick-and-place system generally at 70. The container 72 includes a rotating lid portion 74 and the removable rubber tip 75 for the end of the suction tube of the robotic pick-and place device. The removable rubber or neoprene tip 75 is secured into a plastic locking member based on the resilient nature of the rubber or neoprene tip 75 and the shape of the locking member which is preferably semi-cylindrical in order to match the contour of the removable rubber or neoprene tip 75. After the dispensing container 72 is secured into the staging area of the robotic pick-and-place system, the suction tube of the robotic pick- and-place device is inserted into the removable rubber or neoprene tip 75. Each dispensing container preferably includes its own removable rubber or neoprene tip to ensure that there is no cross-contamination of medicines via the system. Each medication therefore has its own removable rubber or neoprene tip and cross-contamination is eliminated.

[0026] The dispensing container 72 includes a vision region 76 (also referred to herein as a pick-and-place staging area) at which medications are picked up by the robotic pick-and-place device. The rotating lid portion 74 includes a barrier portion 77 that separates medications from a storage region (also referred to herein as the reservoir portion) during transit of the dispensing container 72. A locking base portion 78 mechanically secures the dispensing container 72 based on interaction with a protruding portion of the dispensing container 72. Those skilled in the art will appreciate that a variety of known mechanical and electro-mechanical locking mechanisms may be used to secure the dispensing container 72 to the staging area.

[0027] Each location of the staging area of the system includes a linear motor 79 for adjusting a resting angle of the dispensing container 72 when secured to the staging area. In addition to adjusting the resting angle of the dispensing container 72, the linear motor 79 selectively causes vibration of the dispensing container 72 in order

to shake solid oral pharmaceuticals from a reservoir portion of the dispensing container 72 to the vision region 76 so that the robotic pick-and-place device can conveniently grab solid oral pharmaceuticals from the vision region for placement in packaging as described above. A digital imaging unit that is preferably secured to the end of arm tooling for the robotic pick-and-place device guides the suction tube and the removable rubber or neoprene tip 75 in order to properly secure a solid oral pharmaceutical located in the vision region 76 for transfer to a package.

[0028] The preferred angle of tilt provided by the linear motor 79 for the dispensing container 72 in order to easily transfer solid oral pharmaceuticals from a storage portion to the vision portion of the dispensing container 72 depends on a number of factors. The factors considered in selecting an appropriate tilt angle include the relative fill level for the storage portion of the dispensing container 72. Greater fill indicates less tilt and when the dispensing container 72 is almost empty, a greater tilt must be provided. Additional factors that should be considered in making this determination include the slope of the internal ramp connecting the storage region and the vision region 76 of the dispensing container 72 as well as the size and shape of the medications that are stored by the dispensing container 72. Generally, a tilt of approximately 10-20 degrees is preferable for transferring the oral solid pharmaceuticals to the vision region by vibration.

[0029] It is preferred that the system monitors the number of solid oral pharmaceuticals in the dispensing container 72 so that the angle of tilt can be dynamically altered in order to provide the most desirable transfer of solid pharmaceuticals into the vision region 76 of the dispensing container 72. This is accomplished by noting when the technician or pharmacist has filled the dispensing container 72 and the pill count is then decremented based on the number of oral solid pharmaceuticals that have been packaged by the robotic pick-and-place device from a particular container.

[0030] The amount of vibration provided by the linear motor 79 also depends on a number of factors including pill size, shape and weight. It is preferred that a database be maintained by the system so that an electronic controller may access an electronic memory having this stored information so that the controller can selectively operate the linear motor 79 at a desired tilt angle and at a desired vibration in order to conveniently transfer medications from the storage region to the vision region of the dispensing container 72. The vibration amplitude is typically a few tenths of a millimeter and the duration is typically a fraction of a second to several seconds at a frequency of a few kilohertz. A database should be maintained which stores the most desirable transfer characteristics for the linear motor 79 including tilt, and vibration parameters.

[0031] A mechanical cam 82 preferably engages a static arm of the staging area for the robotic pick-and-place device so that placement of the dispensing container 72 in the staging area causes opening of the rotating lid portion 74 and a barrier portion 77 when the dispensing container 72 is placed in the staging area of the robotic pick-and-place device. This arrangement is very efficient and eliminates the need to open the lid portion 74 with a separate motion of a robot.

[0032] Figure 7 is a cut-away view of an exemplary dispensing container 72. Gripping structures are used by the transfer robot to transfer the dispensing container 72 to the staging area of the robotic pick-and-place unit. This view clearly illustrates the vision region 76 and the storage region 86 with the sloped bottom between the vision region and the storage region 86. The sloped arrangement of the bottom for the storage region 86 enables convenient transfer of the oral solid pharmaceuticals from the storage region 86 to the vision region 76 based on tilt and vibration of the dispensing container 72 as noted above.

[0033] Figure 8 illustrates a disclosed dispensing container which is generally shown at 90.

[0034] Figure 8 also illustrates the end of arm tooling 91 for the robotic unit that transfers the dispensing containers from storage locations to the staging region of the robotic pick-and-place system. According to this non-claimed disclosure, the dispensing container includes a sliding lid 92 which the end of arm tooling for placement the dispensing container engages via arm 93 once the container has been placed in the staging area in order to slide open the sliding lid 92.

[0035] The barrier that is attached to the lid engages an end of the vision region shown at 94 in order to ensure that medications do not inadvertently fall into the vision region during transit. This ensures that the vision region maintains a single layer of solid oral pharmaceuticals which can be easily grabbed via the end of arm tooling for the robotic pick-and-place device.

[0036] Figure 9 illustrates the robotic pick-and-place end of arm tooling and the removable rubber or neoprene tip 75 secured to the suction tip for grabbing medications. The pressure sensor located at the end of arm tooling adjacent the suction tip is preferably monitored during pill transit in order to ensure that there is no inadvertent drop of the pill during transit before the pill is place in the container.

[0037] Those skilled in the art will appreciate that various substitutions and alterations can be made to the systems and methods described in the instant application while still falling within the scope of the appended claims.

Claims

1. A robotic pick-and-place system (10) comprising:

a dispensing container (14, 15, 16, 72) for robotic pick-and-place packaging of solid oral pharmaceuticals, the dispensing container (14, 15, 16, 72) comprising:

a solid pharmaceutical reservoir portion (86) having a volume that is sufficient to hold a plurality of solid pharmaceuticals;
a pick-and-place staging area (76) adjacent to the reservoir portion providing a flat surface for receiving the solid pharmaceuticals transferred from the reservoir portion, wherein the dispensing container (14, 15, 16, 72) is configured such that solid pharmaceuticals can be transferred from the reservoir portion (86) to the pick-and-place staging area (76) by tilting the dispensing container; and
a hinged lid (74) for covering the pick-and-place staging area, wherein the hinged lid comprises a barrier (77) which prevents transfer of solid pharmaceuticals from the reservoir portion to the pick-and-place staging area when the lid is in a closed position;

a staging area (70) of the system to which the dispensing container (14, 15, 16, 72) is securable;
a linear motor (79) configured to tilt and vibrate the dispensing container (14, 15, 16, 72) to transfer solid pharmaceuticals from the reservoir portion to the pick-and-place staging area when the dispensing container (14, 15, 16, 72) is secured to the staging area; and
a robotic pick-and-place device (12) configured to transfer solid pharmaceuticals from the pick-and-place staging area to a package cavity filling location when the dispensing container (14, 15, 16, 72) is secured to the staging area (70) of the system.

2. The robotic pick-and-place system of claim 1, wherein the dispensing container (14, 15, 16, 72) for robotic pick-and-place packaging of solid oral pharmaceuticals further comprises a suction tip holder portion that temporarily secures a suction tip for the robotic pick-and-place device (12) so that a suction tube of the robotic pick-and-place device can be covered by a suction tip (75) corresponding to its respective dispensing container (14, 15, 16, 72) when transferring solid pharmaceuticals from the dispensing container thereby prevent cross-contamination by using suction tips with different medications.

3. The robotic pick-and-place system according to any one of the preceding claims, wherein:
the hinged lid (74) comprises a mechanical cam (82) that is configured to engage a static arm of the staging area of the robotic pick-and-place system, wherein the engagement of the mechanical cam and the static arm opens the hinged lid.

4. The robotic pick-and-place system according to any one of the preceding claims, wherein:
a bottom surface of the reservoir portion (86) is sloped between the pick-and-place staging area (76) and the reservoir portion.

5. The robotic pick-and-place system according to any one of the preceding claims, wherein:
the barrier (77) is configured to permit access between the reservoir portion (86) and the pick-and-place staging area when the hinged lid (74) is in an open position.

6. The robotic pick-and-place system according to any one of the preceding claims, wherein the linear motor (79) is configured to vibrate the dispensing container (14, 15, 16, 72) by an amount based on a size of each solid pharmaceutical, a shape of each solid pharmaceutical, and a weight of each solid pharmaceutical.

7. The robotic pick-and-place system according to any one of the preceding claims, wherein the linear motor (79) is configured to dynamically alter an angle of tilt of the dispensing container (14, 15, 16, 72) based on the relative fill level of the solid pharmaceuticals present in the dispensing container.

Patentansprüche

1. Roboterbestückungssystem (10), Folgendes umfassend:

einen Abgabebehälter (14, 15, 16, 72) zum Verpacken fester oraler Arzneimittel durch Roboterbestückung, wobei der Abgabebehälter (14, 15, 16, 72) Folgendes umfasst:

einen Reservoirabschnitt für feste Arzneimittel (86), der ein Volumen aufweist, das ausreicht, um mehrere feste Arzneimittel zu halten;
einen Bestückungsbereitstellungsbereich (76) angrenzend an den Reservoirabschnitt, der eine flache Oberfläche zum Aufnehmen der festen Arzneimittel vorsieht, die von dem Reservoirabschnitt weitergegeben werden, wobei der Abgabebehälter (14, 15, 16, 72) derart konfiguriert ist, dass feste Arzneimittel von dem Reservoirabschnitt (86) zu dem Bestückungsbereitstellungsbereich (76) durch Kippen des Abgabebehälters weitergegeben werden können; und
einen Klappdeckel (74) zum Abdecken des Bestückungsbereitstellungsbereichs, wobei der Klappdeckel eine Barriere (77) umfasst, die eine Weitergabe fester Arzneimit-

tel von dem Reservoirabschnitt zu dem Bestückungsbereitstellungsbereich verhindert, wenn sich der Deckel in einer geschlossenen Position befindet;

einen Bereitstellungsbereich (70) des Systems, an dem der Abgabebehälter (14, 15, 16, 72) befestigbar ist;
einen Linearmotor (79), der konfiguriert ist, um den Abgabebehälter (14, 15, 16, 72) zu kippen und zu rütteln, um feste Arzneimittel von dem Reservoirabschnitt zu dem Bestückungsbereitstellungsbereich weiterzugeben, wenn der Abgabebehälter (14, 15, 16, 72) an dem Bereitstellungsbereich befestigt ist; und
eine Roboterbestückungsvorrichtung (12), die konfiguriert ist, um feste Arzneimittel von dem Bestückungsbereitstellungsbereich zu einer Verpackungshohlraumfüllstelle weiterzugeben, wenn der Abgabebehälter (14, 15, 16, 72) an dem Bereitstellungsbereich (70) des Systems befestigt ist.

2. Roboterbestückungssystem nach Anspruch 1, wobei der Abgabebehälter (14, 15, 16, 72) zum Verpacken fester oraler Arzneimittel durch Roboterbestückung ferner einen Saugspitzenhalterabschnitt umfasst, der vorübergehend eine Saugspitze für die Roboterbestückungsvorrichtung (12) befestigt, so dass ein Saugrohr der Roboterbestückungsvorrichtung durch eine Saugspitze (75), die ihrem jeweiligen Abgabebehälter (14, 15, 16, 72) entspricht, beim Weitergeben fester Arzneimittel von dem Abgabebehälter abgedeckt werden kann, wobei dadurch eine Kreuzkontamination durch Verwenden von Saugspitzen für verschiedene Medikamente verhindert wird.

3. Roboterbestückungssystem nach einem der vorhergehenden Ansprüche, wobei:
der Klappdeckel (74) einen mechanischen Nocken (82) umfasst, der konfiguriert ist, um einen statischen Arm des Bereitstellungsbereichs des Roboterbestückungssystems in Eingriff zu nehmen, wobei der Eingriff des mechanischen Nockens und des statischen Arms den Klappdeckel öffnet.

4. Roboterbestückungssystem nach einem der vorhergehenden Ansprüche, wobei:
eine Unterseite des Reservoirabschnitts (86) zwischen dem Bestückungsbereitstellungsbereich (76) und dem Reservoirabschnitt geneigt ist.

5. Roboterbestückungssystem nach einem der vorhergehenden Ansprüche, wobei:
die Barriere (77) konfiguriert ist, um einen Zugang zwischen dem Reservoirabschnitt (86) und dem Bestückungsbereitstellungsbereich zu ermöglichen, wenn sich der Klappdeckel (74) in einer offenen Position befindet.

6. Roboterbestückungssystem nach einem der vorhergehenden Ansprüche, wobei der Linearmotor (79) konfiguriert ist, um den Abgabebehälter (14, 15, 16, 72) um ein Ausmaß basierend auf einer Größe jedes festen Arzneimittels, einer Form jedes festen Arzneimittels und einem Gewicht jedes festen Arzneimittels zu rütteln.

7. Roboterbestückungssystem nach einem der vorhergehenden Ansprüche, wobei der Linearmotor (79) konfiguriert ist, um einen Kippwinkel des Abgabebehälters (14, 15, 16, 72) basierend auf dem relativen Füllstand der festen Arzneimittel dynamisch zu ändern, die in dem Abgabebehälter vorhanden sind.

Revendications

1. Système de transfert robotique (10) comprenant :

un récipient de distribution (14, 15, 16, 72) pour l'emballage par transfert robotique de produits pharmaceutiques oraux solides, le récipient de distribution (14, 15, 16, 72) comprenant :

une partie réservoir pharmaceutique solide (86) ayant un volume suffisant pour contenir une pluralité de produits pharmaceutiques solides ;
un préconditionnement de transfert (76) adjacent à la partie réservoir fournissant une surface plate pour recevoir les produits pharmaceutiques solides transférés depuis la partie réservoir, le récipient de distribution (14, 15, 16, 72) étant conçu de telle sorte que les produits pharmaceutiques solides puissent être transférés depuis la partie réservoir (86) vers le préconditionnement de transfert (76) en inclinant le récipient de distribution ; et
un couvercle à charnière (74) pour recouvrir le préconditionnement de transfert, le couvercle à charnière comprenant une barrière (77) qui empêche le transfert de produits pharmaceutiques solides depuis la partie réservoir vers le préconditionnement de transfert lorsque le couvercle est en position fermée ;

un préconditionnement (70) du système auquel le récipient de distribution (14, 15, 16, 72) peut être fixé ;
un moteur linéaire (79) configuré pour incliner et faire vibrer le récipient de distribution (14, 15, 16, 72) pour transférer les produits pharmaceu-

tiques solides depuis la partie réservoir vers le préconditionnement de transfert lorsque le récipient de distribution (14, 15, 16, 72) est fixé au préconditionnement ; et
un dispositif de transfert robotique (12) configuré pour transférer des produits pharmaceutiques solides depuis le préconditionnement de transfert vers un emplacement de remplissage de cavité d'emballage lorsque le récipient de distribution (14, 15, 16, 72) est fixé au préconditionnement (70) du système.

2. Système de transfert robotique selon la revendication 1, dans lequel le récipient de distribution (14, 15, 16, 72) pour l'emballage par transfert robotique de produits pharmaceutiques oraux solides comprend en outre une partie support d'embout d'aspiration qui fixe temporairement un embout d'aspiration pour le dispositif de transfert robotique (12) de sorte qu'un tube d'aspiration du dispositif de transfert robotique puisse être recouvert par un embout d'aspiration (75) correspondant à son récipient de distribution respectif (14, 15, 16, 72) lors du transfert de produits pharmaceutiques solides depuis le récipient de distribution, ce qui permet d'éviter la contamination croisée en utilisant des embouts d'aspiration avec différents médicaments.

3. Système de transfert robotique selon l'une quelconque des revendications précédentes, dans lequel :
le couvercle à charnière (74) comprend une came mécanique (82) qui est conçue pour entrer en prise avec un bras statique du préconditionnement du système de transfert robotique, la mise en prise de la came mécanique et du bras statique ouvrant le couvercle à charnière.

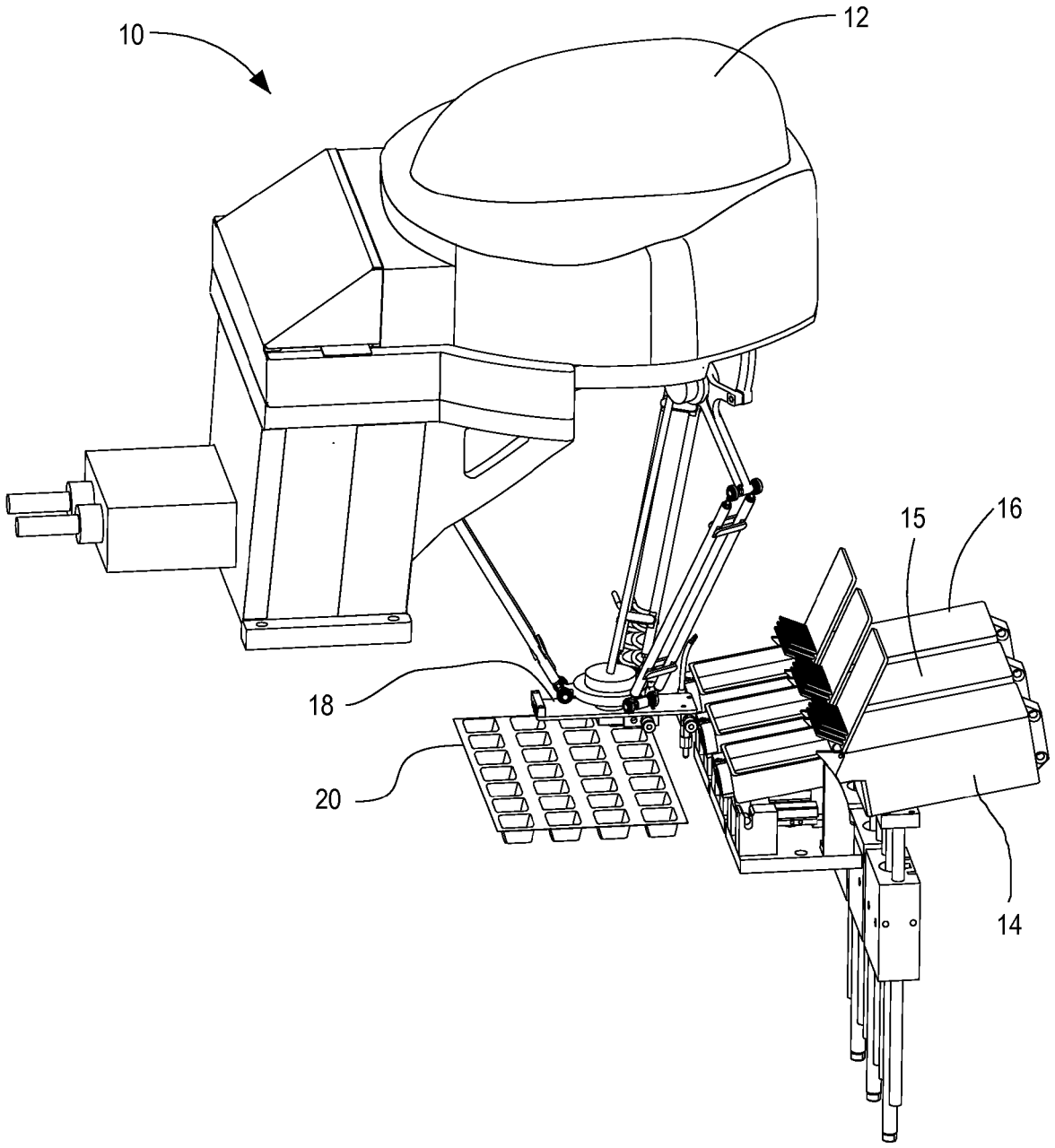
4. Système de transfert robotique selon l'une quelconque des revendications précédentes, dans lequel :
une surface inférieure de la partie réservoir (86) est inclinée entre le préconditionnement de transfert (76) et la partie réservoir.

5. Système de transfert robotique selon l'une quelconque des revendications précédentes, dans lequel :
la barrière (77) est conçue pour permettre l'accès entre la partie réservoir (86) et le préconditionnement de transfert lorsque le couvercle à charnière (74) est en position ouverte.

6. Système de transfert robotique selon l'une quelconque des revendications précédentes, dans lequel le moteur linéaire (79) est conçu pour faire vibrer le récipient de distribution (14, 15, 16, 72) selon une valeur basée sur une taille de chaque produit pharmaceutique solide, une forme de chaque produit pharmaceutique solide, et un poids de chaque produit pharmaceutique solide.

7. Système de transfert robotique selon l'une quelconque des revendications précédentes, dans lequel le moteur linéaire (79) est conçu pour modifier dynamiquement un angle d'inclinaison du récipient de distribution (14, 15, 16, 72) en fonction du niveau de remplissage relatif des produits pharmaceutiques solides présents dans le récipient de distribution.

Fig. 1



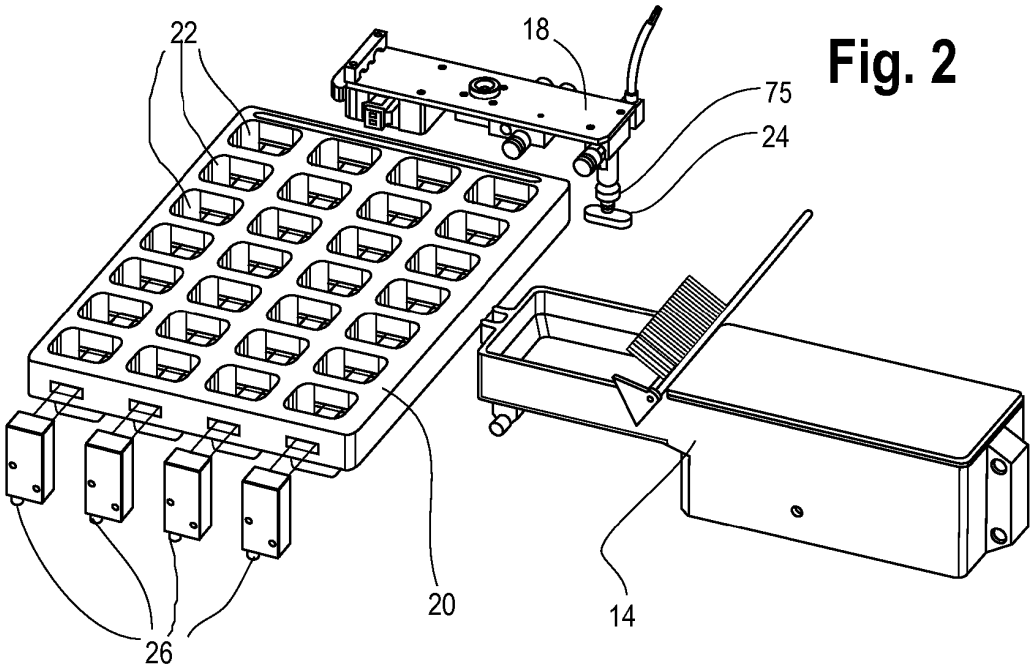


Fig. 2

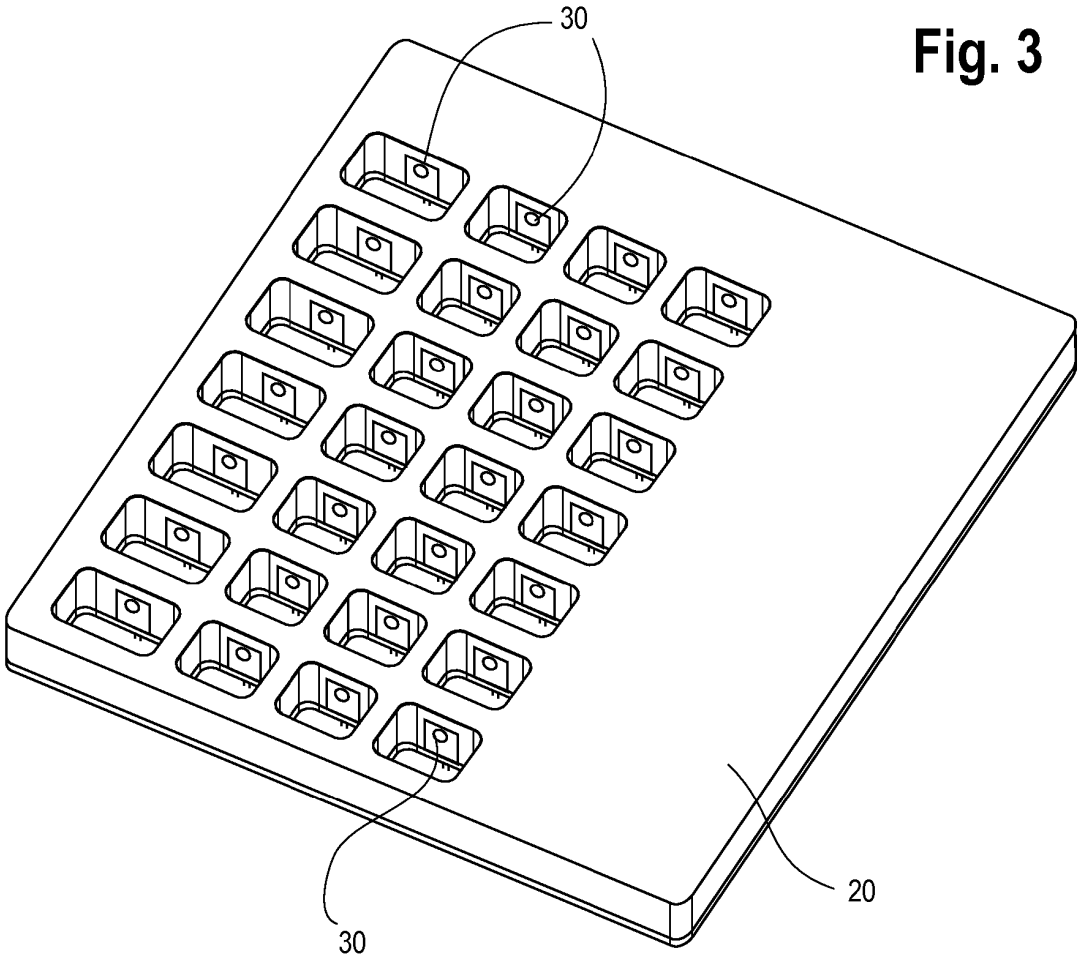


Fig. 3

Fig. 4

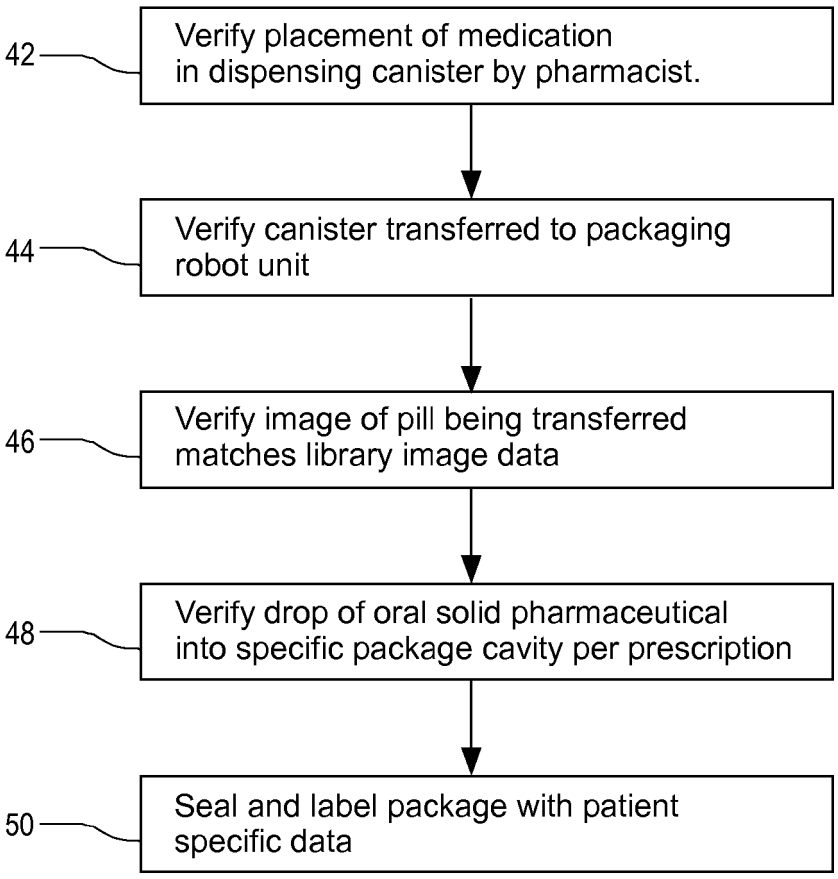

42
Verify placement of medication in dispensing canister by pharmacist.
44
Verify canister transferred to packaging robot unit
46
Verify image of pill being transferred matches library image data
48
Verify drop of oral solid pharmaceutical into specific package cavity per prescription
50
Seal and label package with patient specific data

Fig. 5

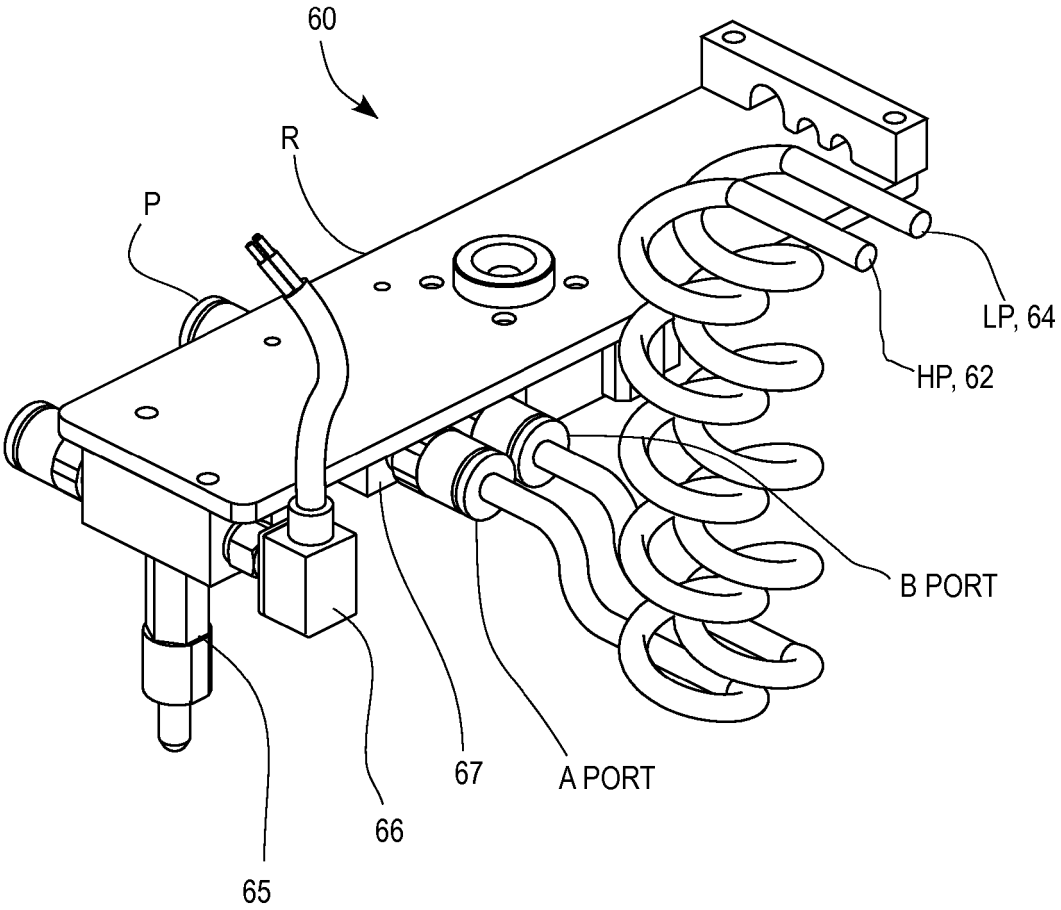


Fig. 6

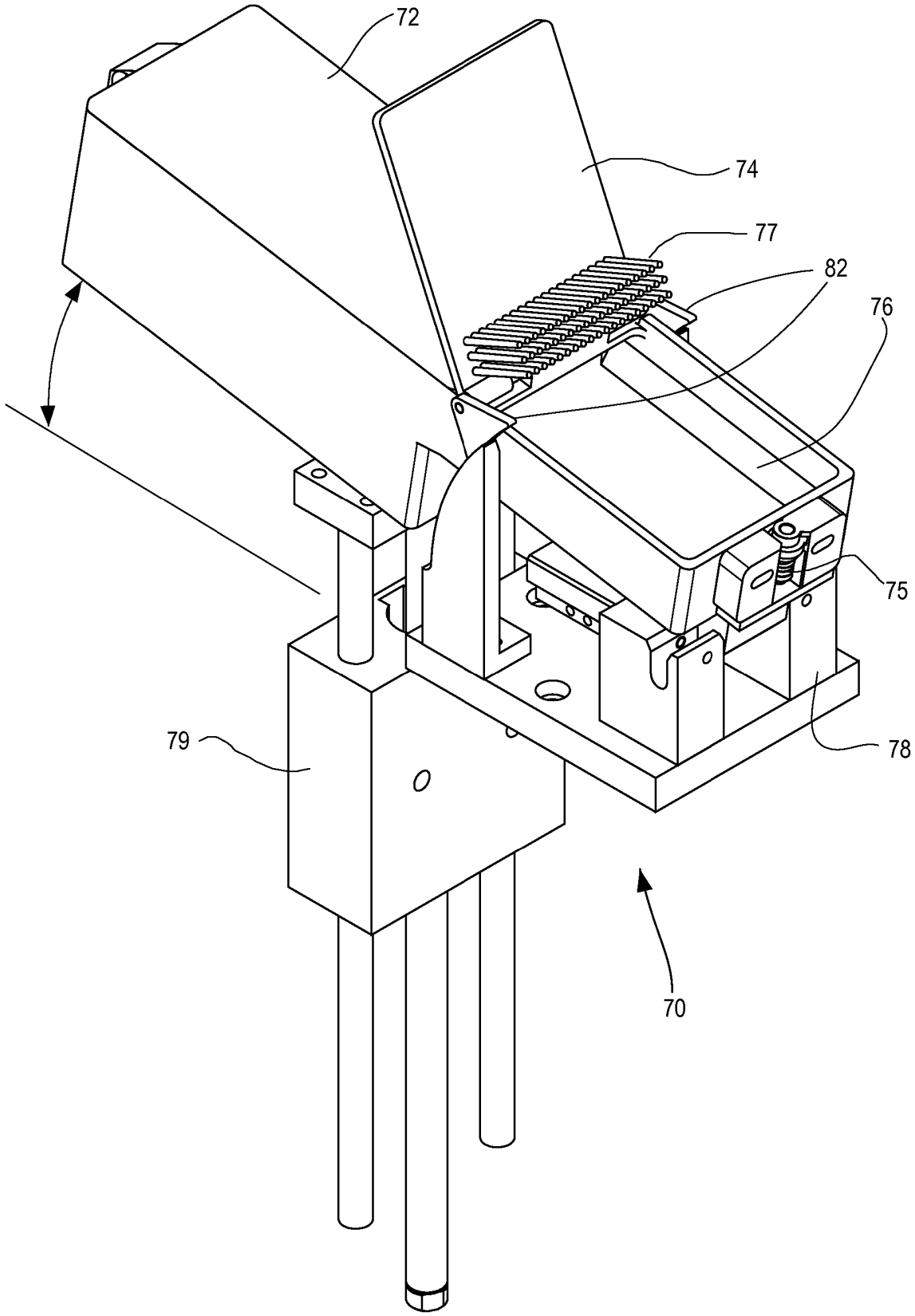


Fig. 7

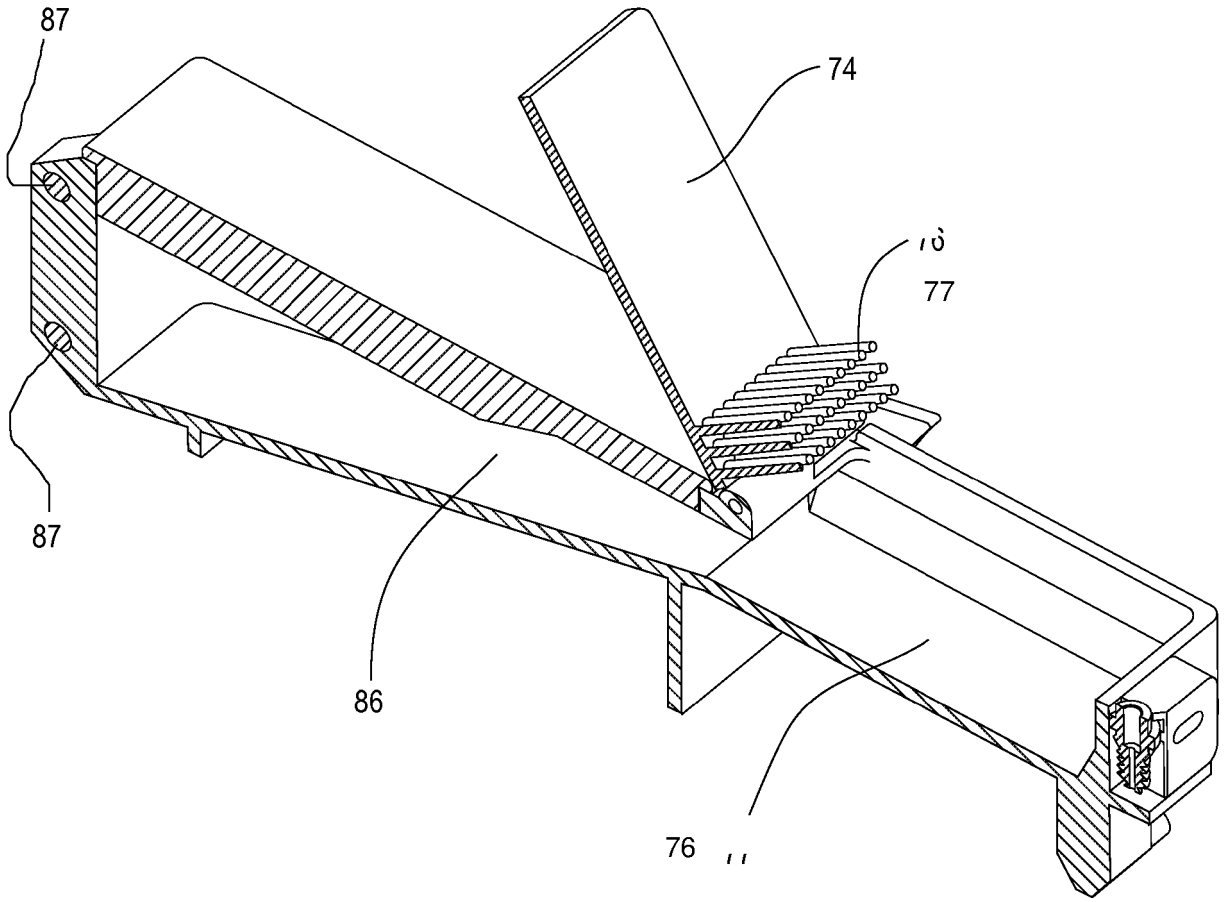


Fig. 8

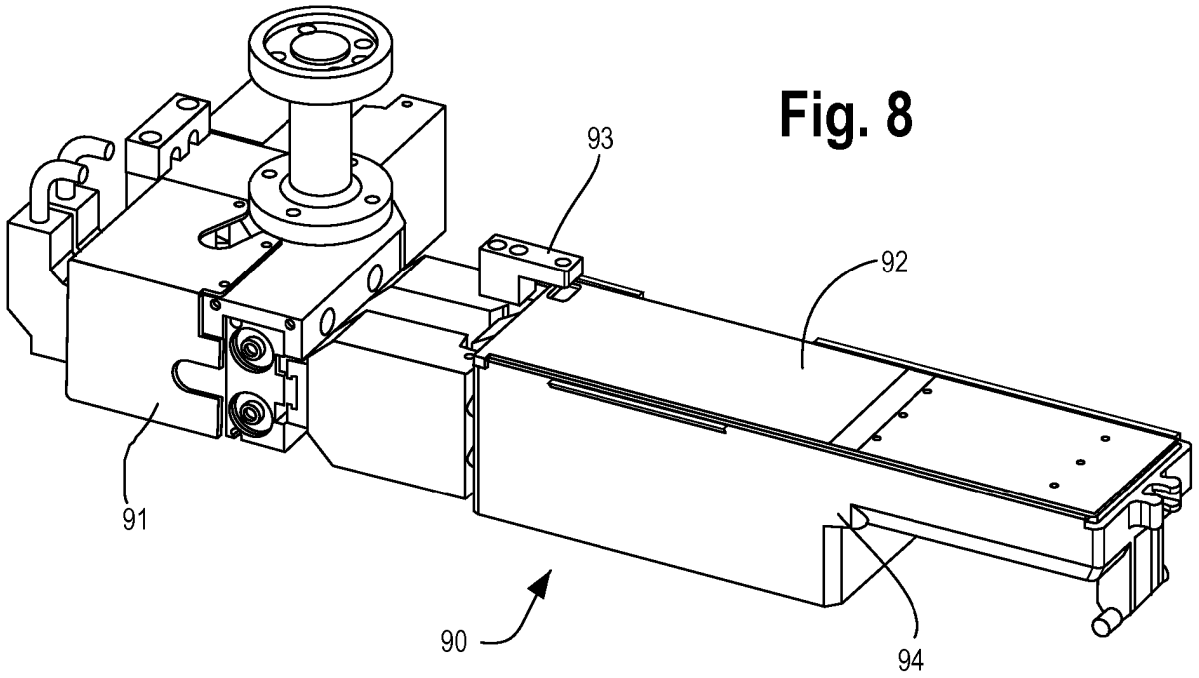
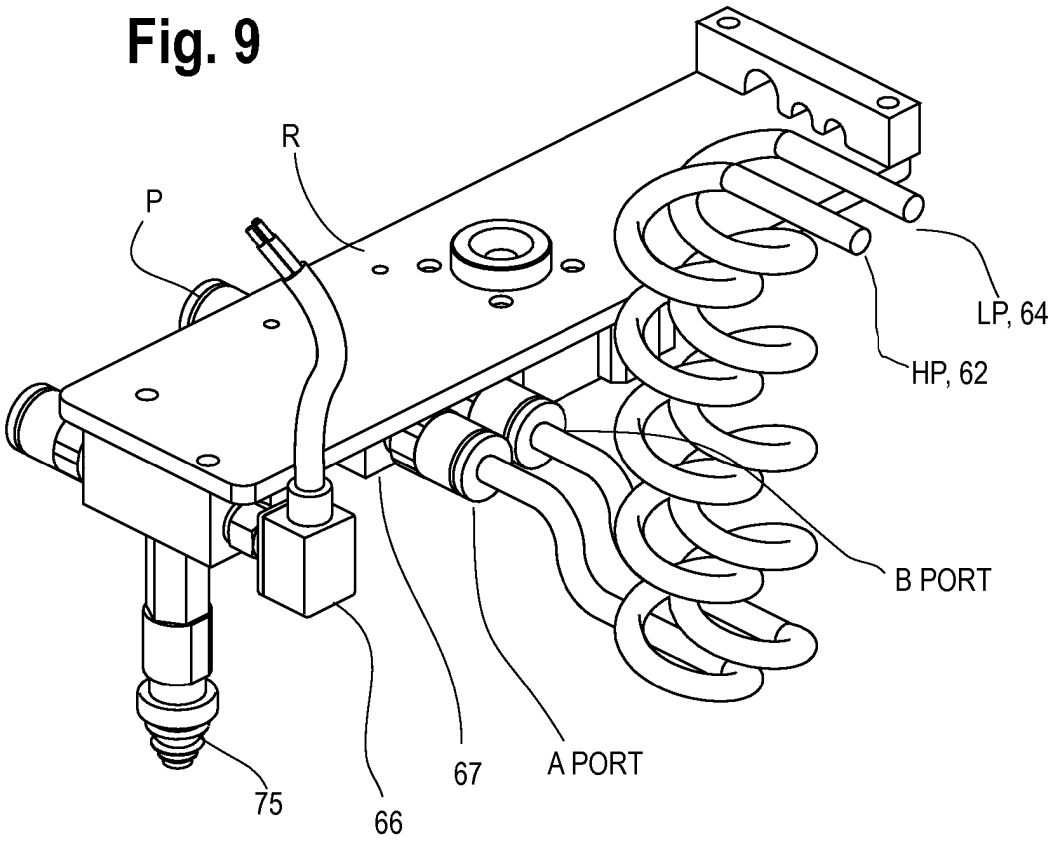


Fig. 9



REFERENCES CITED IN THE DESCRIPTION

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- US 7185476 B **[0002]**
- US 2011278319 A1 **[0004]**