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Assad et al.

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(54) **SOLID DOSAGE MEDICAMENT DISPENSER AND METHODS OF USE**

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(73) Assignee: **VISIP, LLC**, Tampa, FL (US)

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(51) **Int. Cl.**

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A45C 11/00	(2006.01)
A61J 1/03	(2023.01)
B65D 83/04	(2006.01)
B65G 47/91	(2006.01)

(52) **U.S. Cl.**

CPC ***A61J 7/0084*** (2013.01); ***A45C 11/00*** (2013.01); ***A61J 1/03*** (2013.01); ***B65D 83/0409*** (2013.01); ***B65G 47/912*** (2013.01); ***B65G 47/917*** (2013.01); *A45C 2011/007* (2013.01); *A61J 2205/10* (2013.01); *A61J 2205/60* (2013.01)

(58) **Field of Classification Search**

CPC A61J 7/0084; A61J 2205/007; A61J 2205/60; A45C 11/00; B65D 83/0409; B65G 47/912; B65G 47/917

USPC 221/1

See application file for complete search history.

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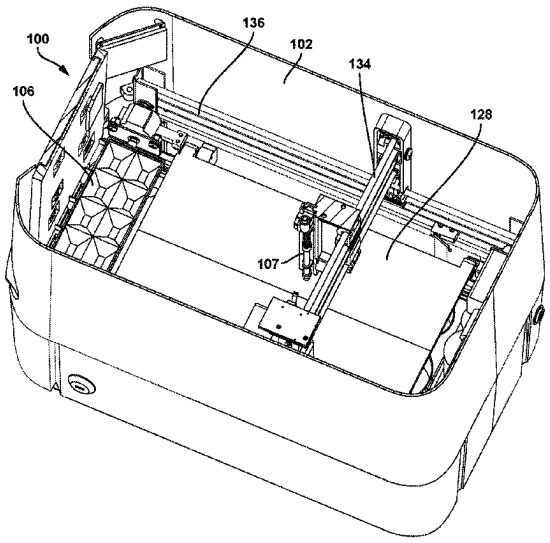
(57) **ABSTRACT**

The present disclosure provides a solid dosage medicament dispensing system including a user interface configured to receive one or more inputs from a user, and a control system configured to perform one or more functions of the solid dosage medicament dispensing system based on the one or more inputs received from the user.

11 Claims, 16 Drawing Sheets



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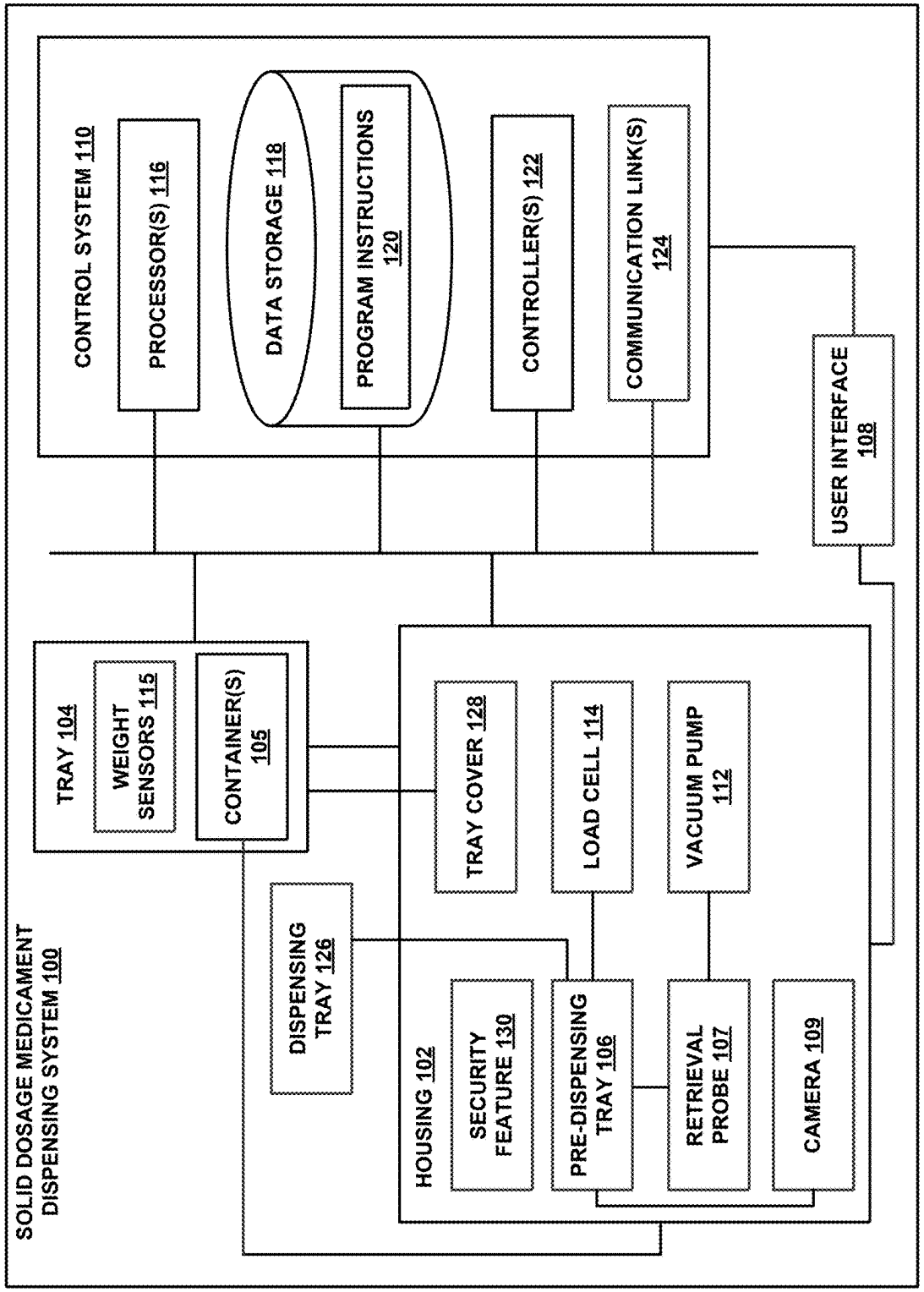
SOLID DOSAGE MEDICAMENT DISPENSING SYSTEM 100
CONTROL SYSTEM 110
PROCESSOR(S) 116
DATA STORAGE 118
PROGRAM INSTRUCTIONS 120
CONTROLLER(S) 122
COMMUNICATION LINK(S) 124
USER INTERFACE 108
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VACUUM PUMP 112
DISPENSING TRAY 126
HOUSING 102
SECURITY FEATURE 130
PRE-DISPENSING TRAY 106
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Fig. 1

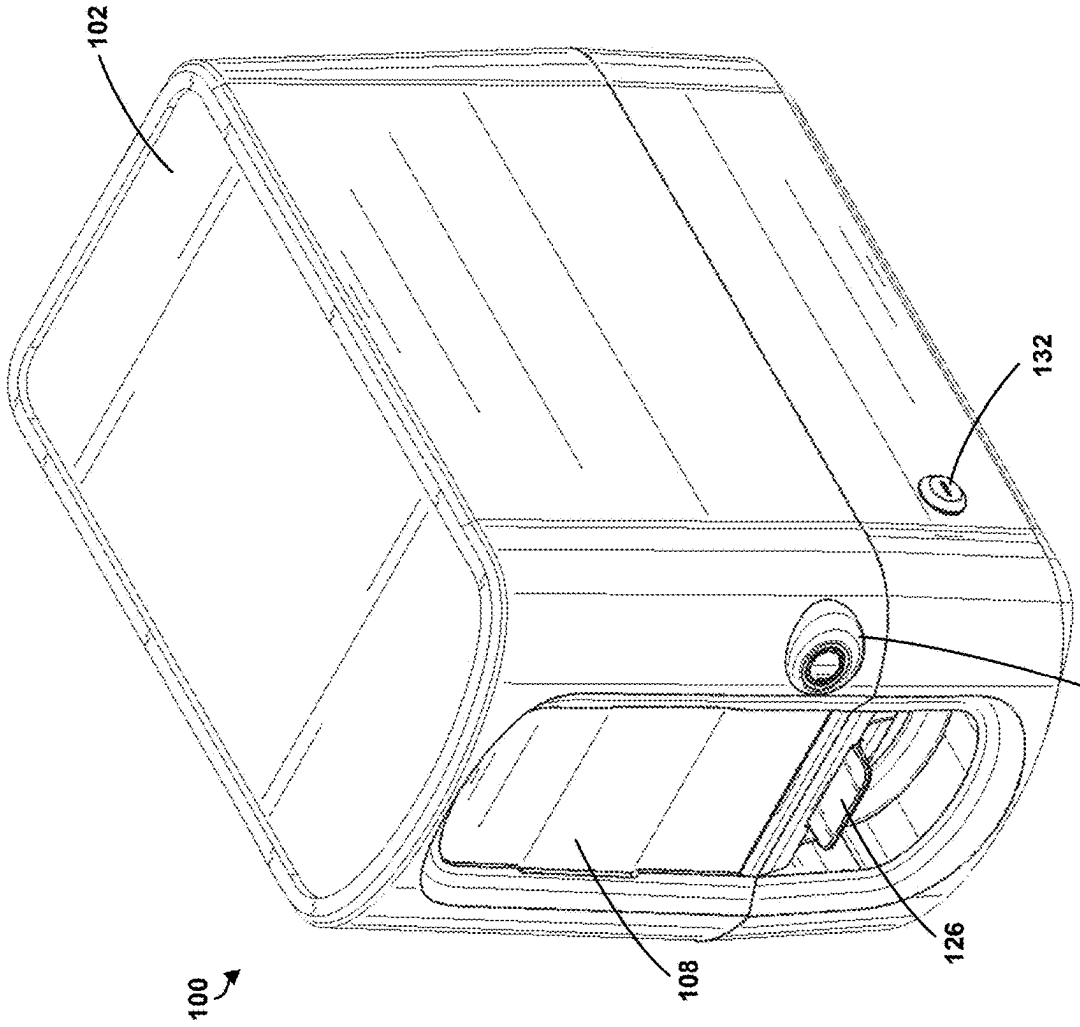


Fig. 2

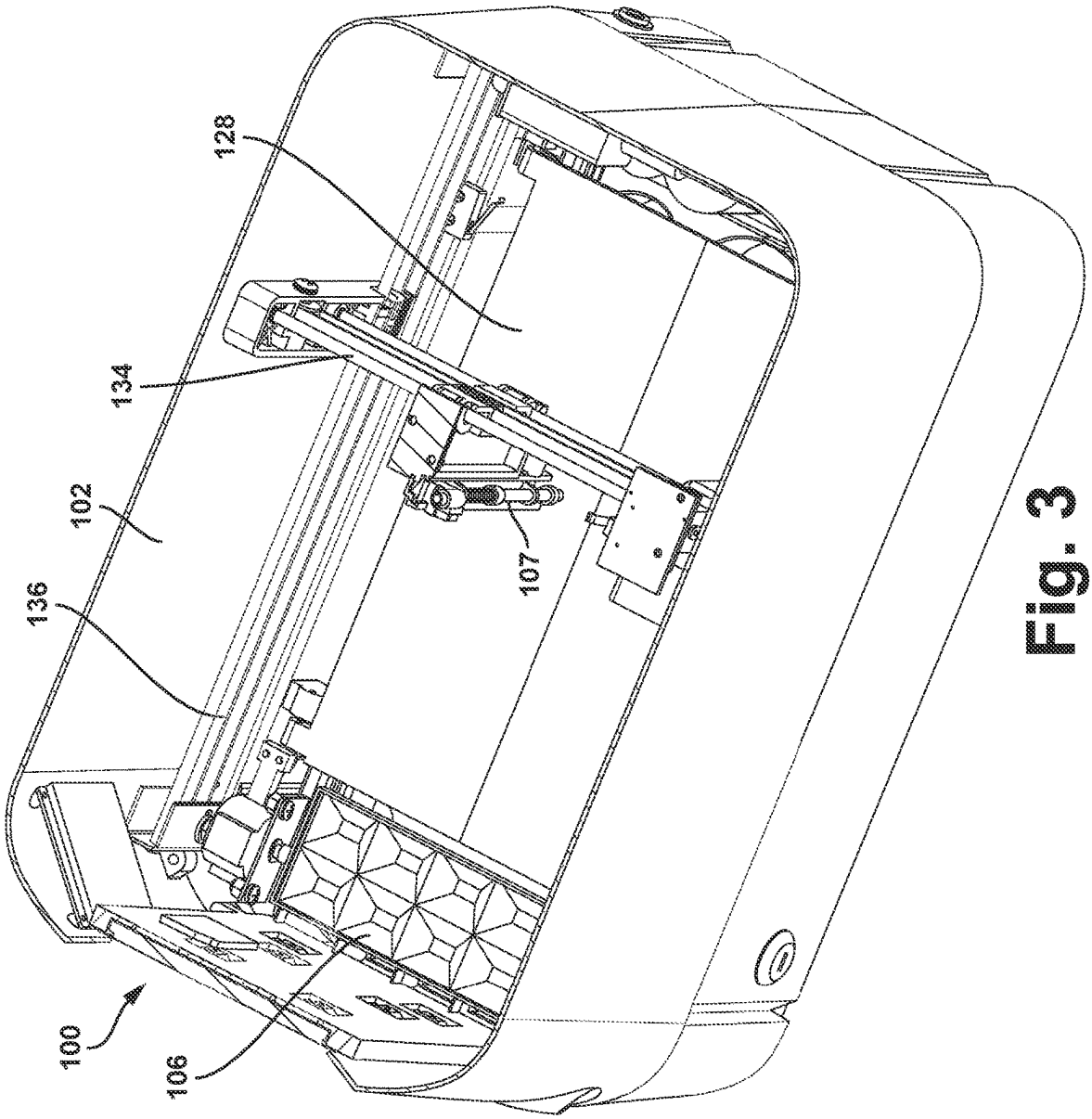


Fig. 3

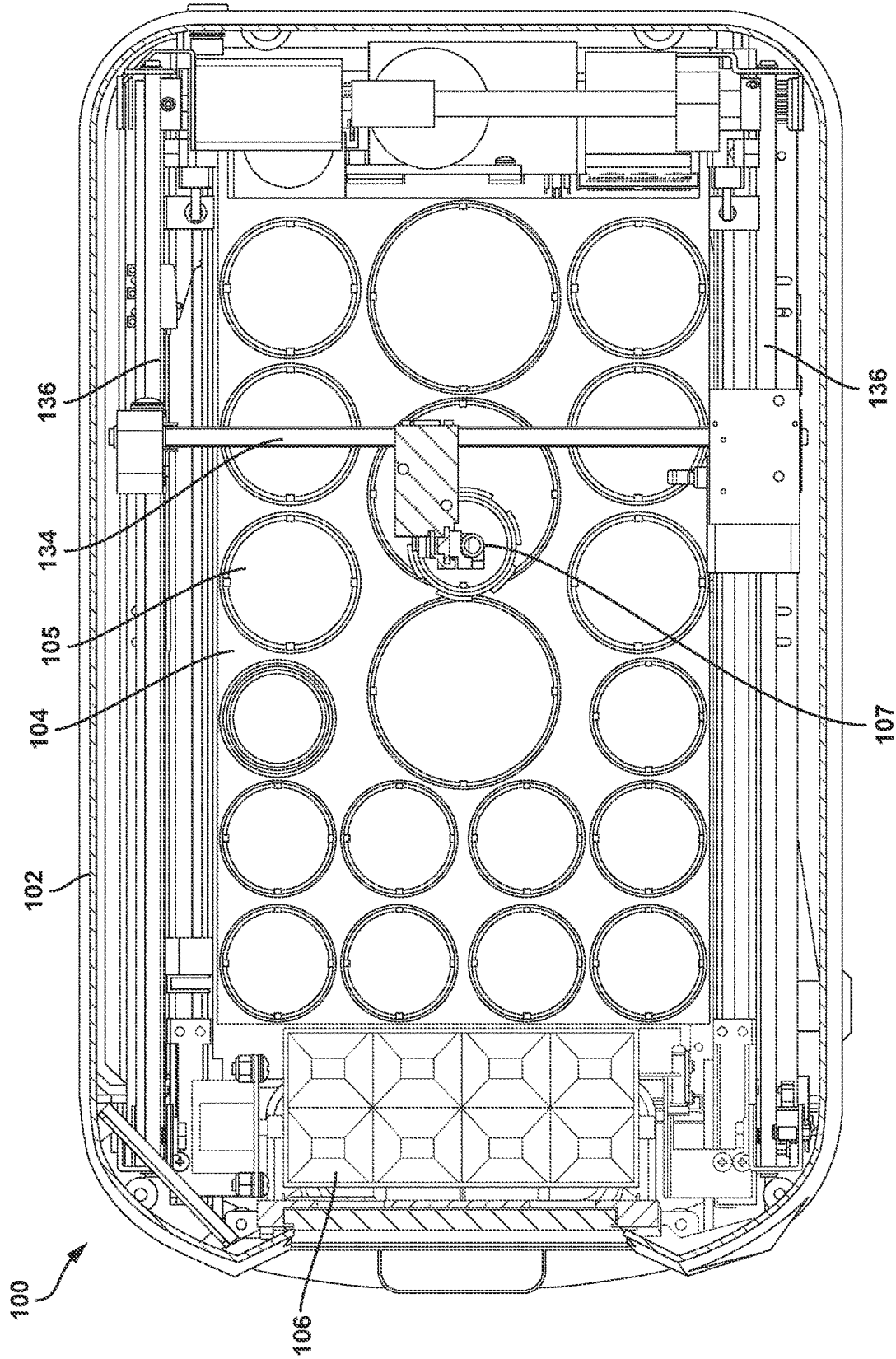


Fig. 4

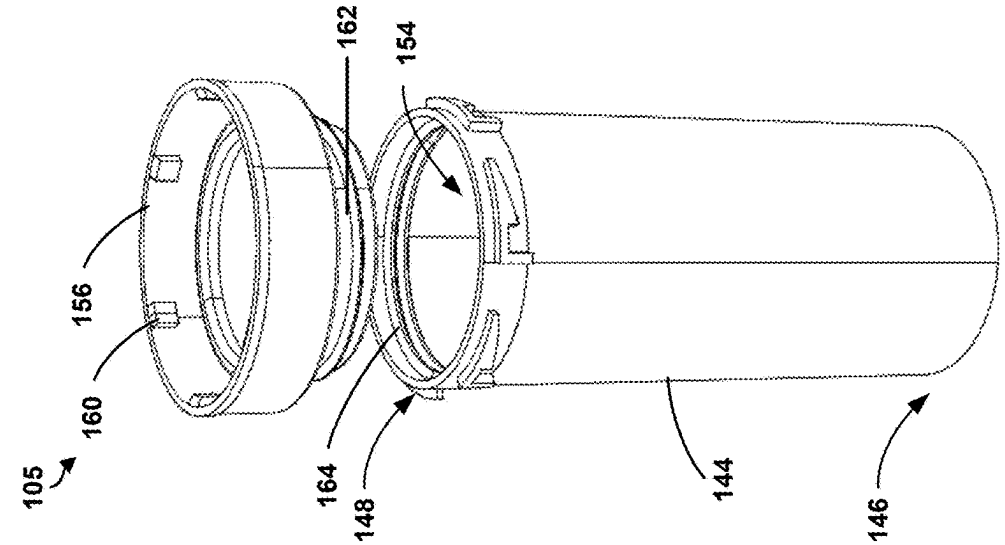


Fig. 5C

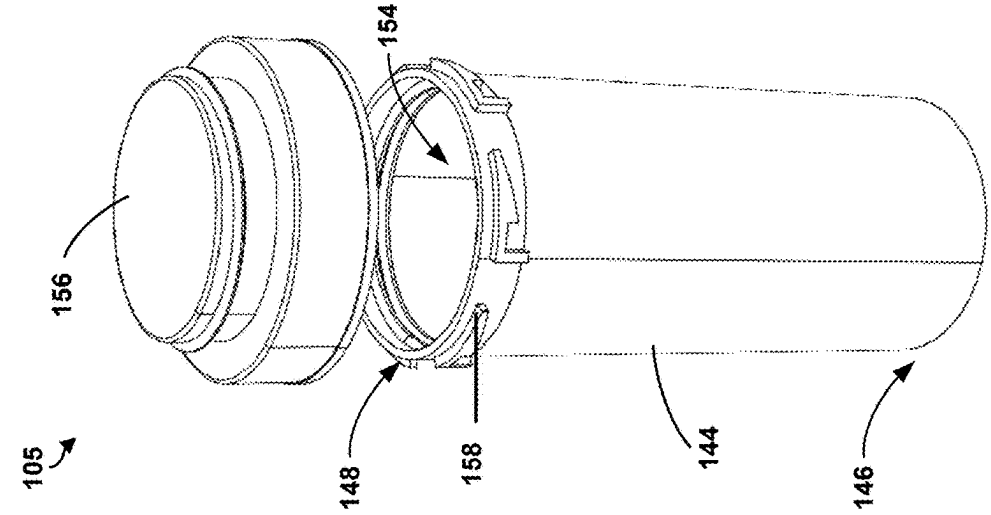


Fig. 5B

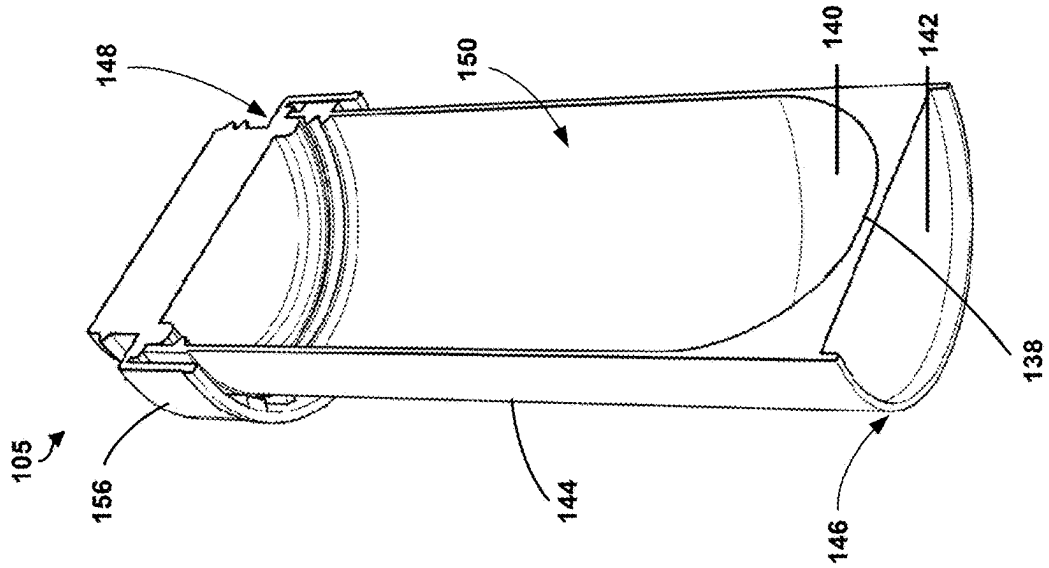


Fig. 5A

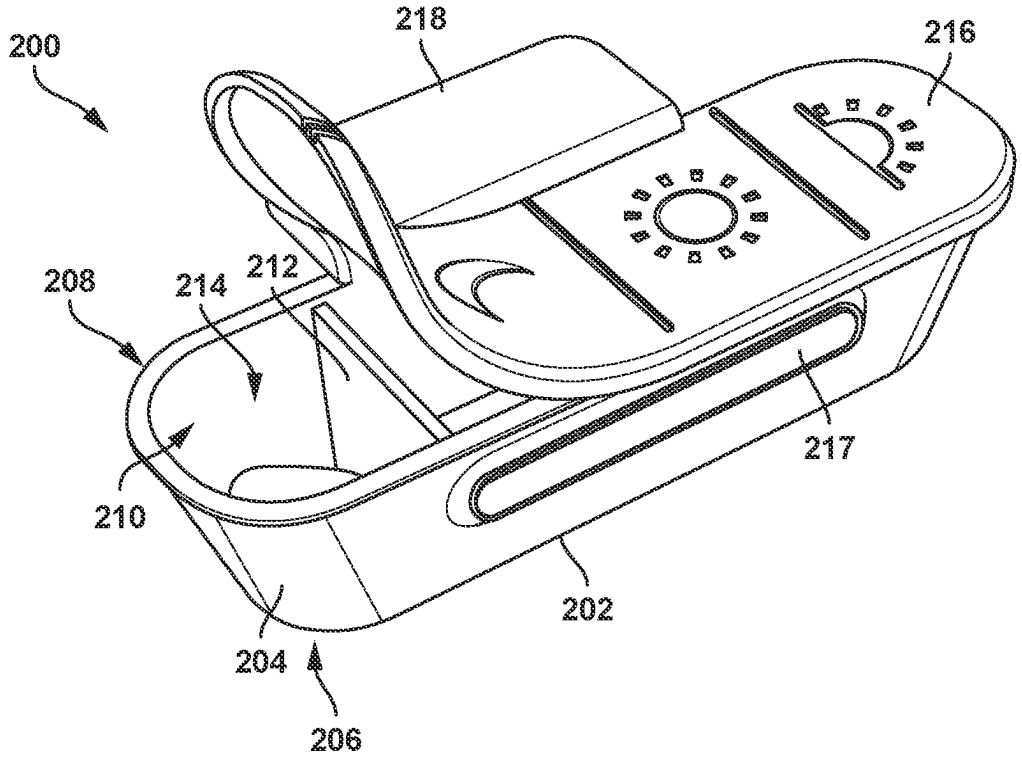

200
218
216
208
214
212
217
210
202
204
206

Fig. 6A

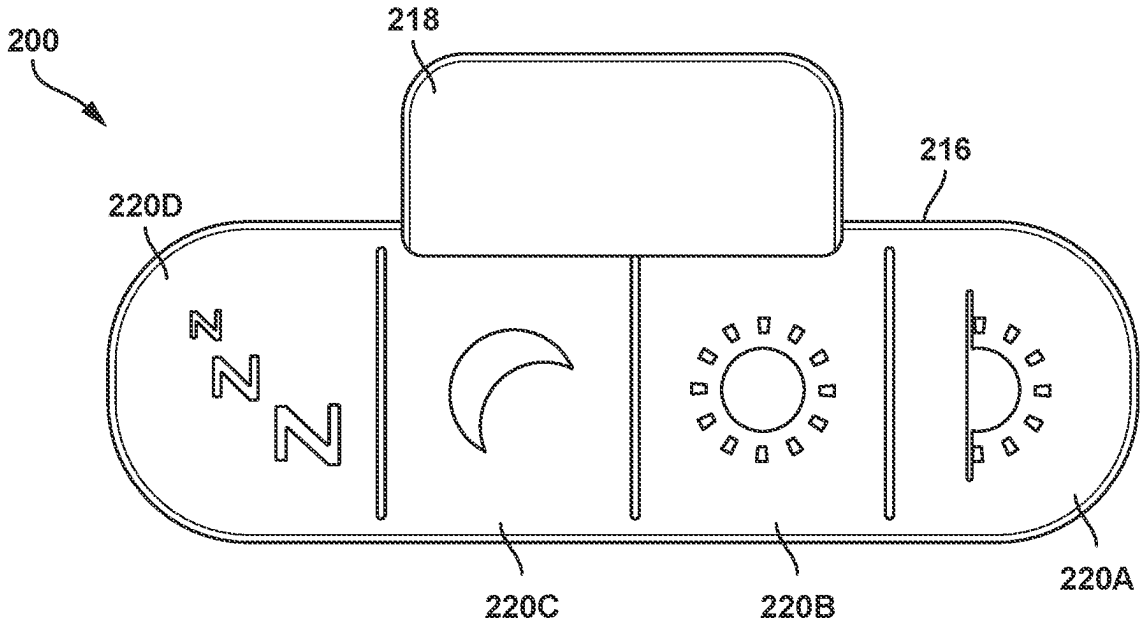

200
218
216
220D
220C
220B
220A

Fig. 6B

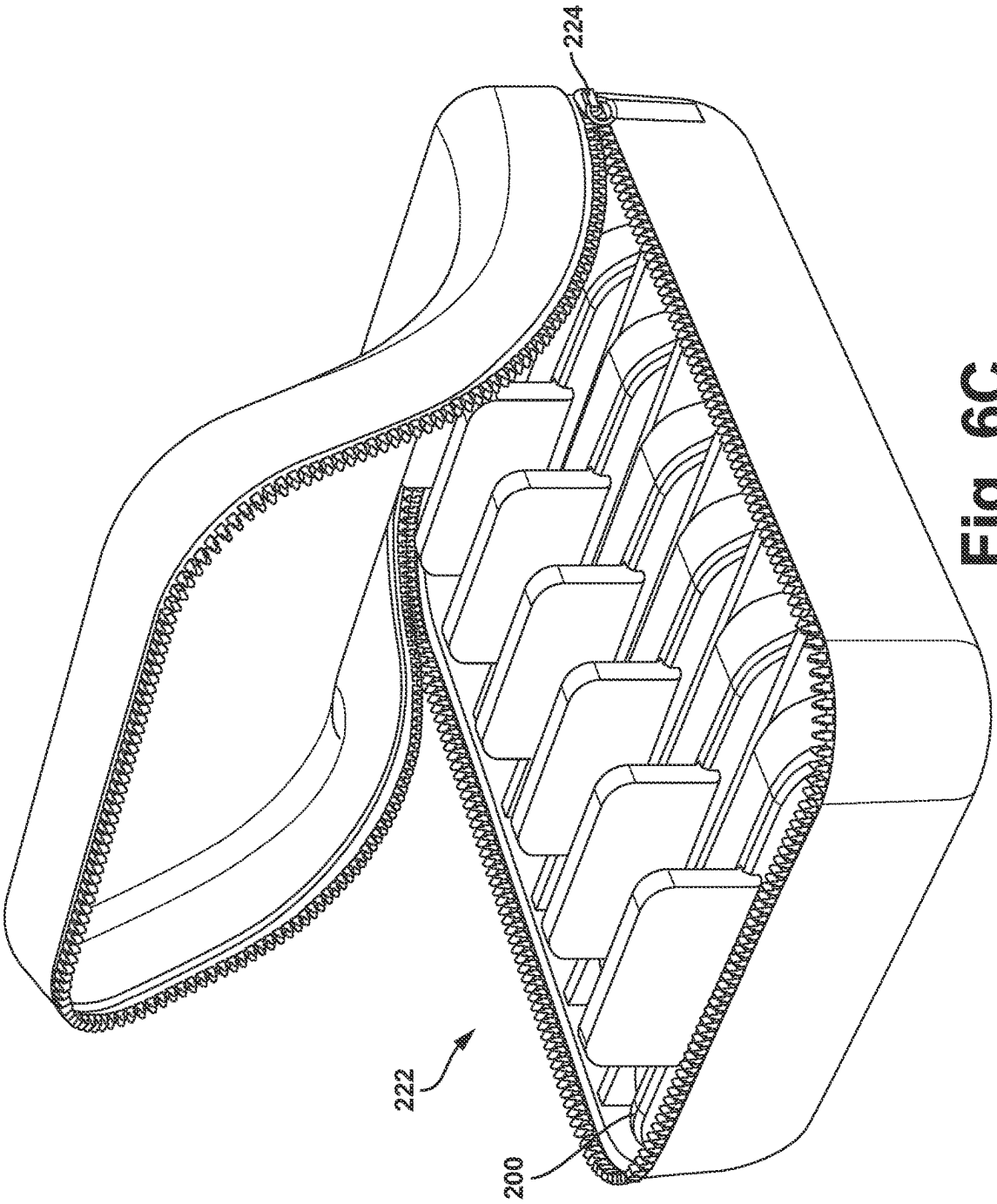


Fig. 6C

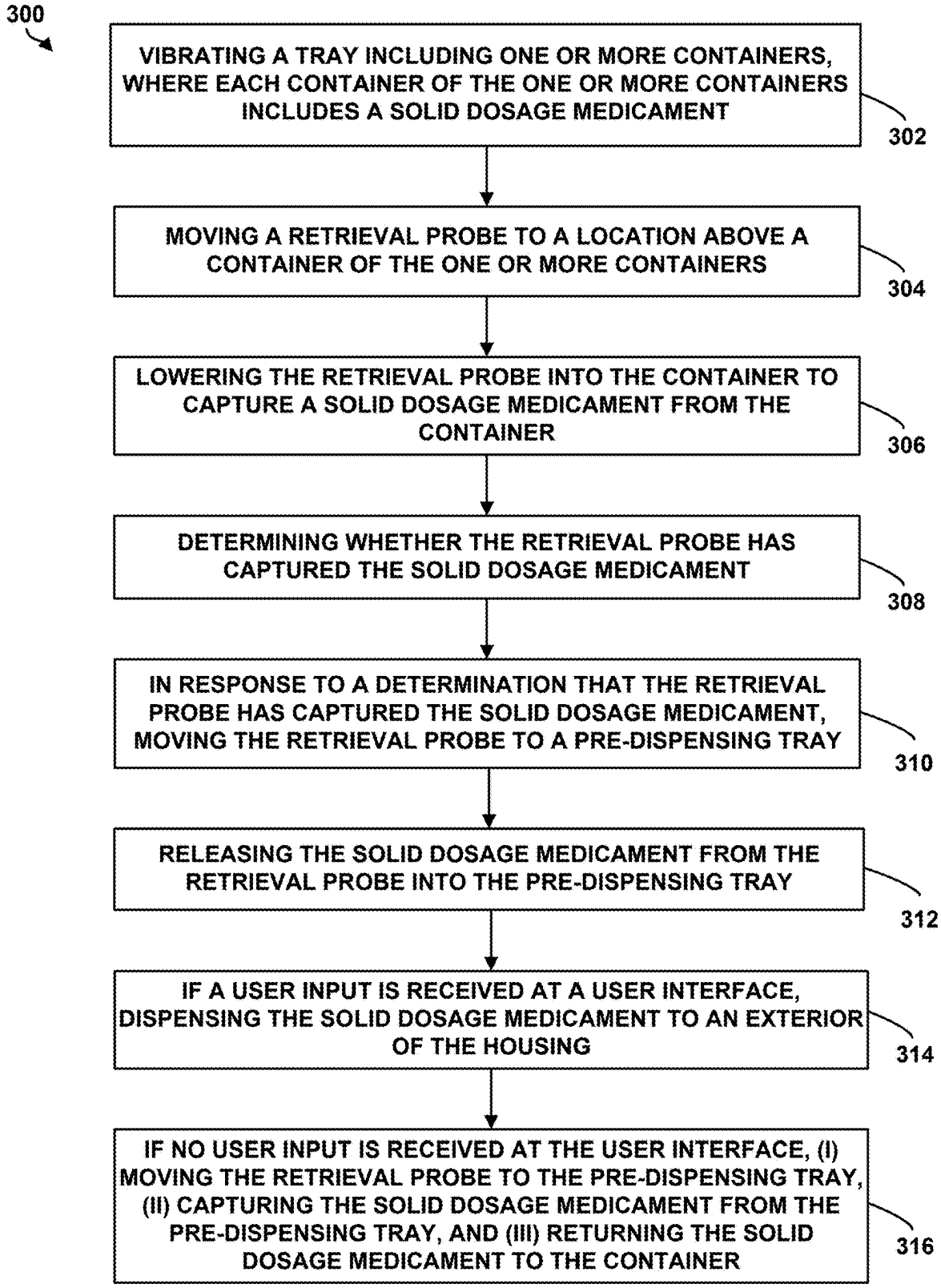

300
VIBRATING A TRAY INCLUDING ONE OR MORE CONTAINERS, WHERE EACH CONTAINER OF THE ONE OR MORE CONTAINERS INCLUDES A SOLID DOSAGE MEDICAMENT
302
MOVING A RETRIEVAL PROBE TO A LOCATION ABOVE A CONTAINER OF THE ONE OR MORE CONTAINERS
304
LOWERING THE RETRIEVAL PROBE INTO THE CONTAINER TO CAPTURE A SOLID DOSAGE MEDICAMENT FROM THE CONTAINER
306
DETERMINING WHETHER THE RETRIEVAL PROBE HAS CAPTURED THE SOLID DOSAGE MEDICAMENT
308
IN RESPONSE TO A DETERMINATION THAT THE RETRIEVAL PROBE HAS CAPTURED THE SOLID DOSAGE MEDICAMENT, MOVING THE RETRIEVAL PROBE TO A PRE-DISPENSING TRAY
310
RELEASING THE SOLID DOSAGE MEDICAMENT FROM THE RETRIEVAL PROBE INTO THE PRE-DISPENSING TRAY
312
IF A USER INPUT IS RECEIVED AT A USER INTERFACE, DISPENSING THE SOLID DOSAGE MEDICAMENT TO AN EXTERIOR OF THE HOUSING
314
IF NO USER INPUT IS RECEIVED AT THE USER INTERFACE, (I) MOVING THE RETRIEVAL PROBE TO THE PRE-DISPENSING TRAY, (II) CAPTURING THE SOLID DOSAGE MEDICAMENT FROM THE PRE-DISPENSING TRAY, AND (III) RETURNING THE SOLID DOSAGE MEDICAMENT TO THE CONTAINER
316

Fig. 7

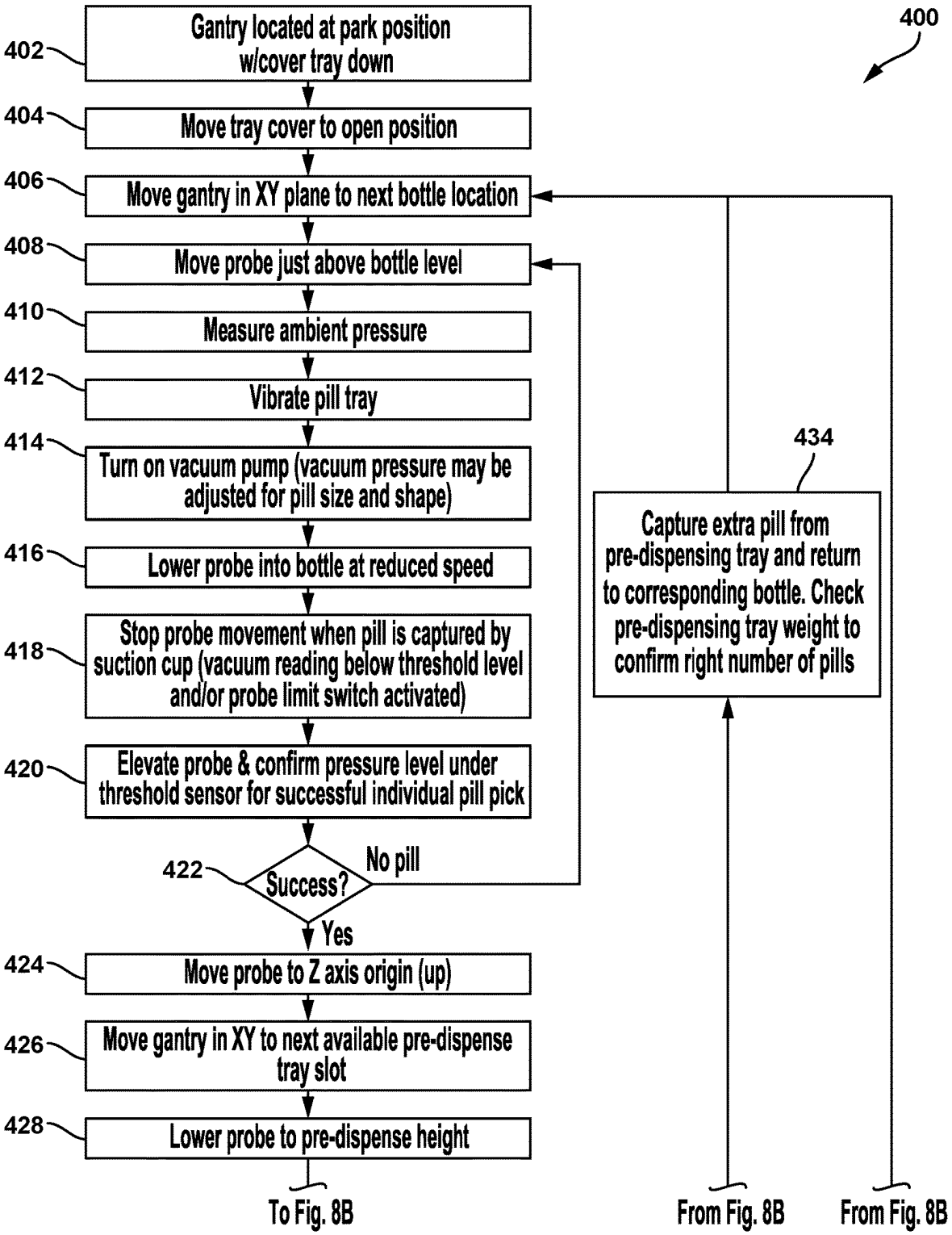

400
402
Gantry located at park position w/cover tray down
404
Move tray cover to open position
406
Move gantry in XY plane to next bottle location
408
Move probe just above bottle level
410
Measure ambient pressure
412
Vibrate pill tray
414
Turn on vacuum pump (vacuum pressure may be adjusted for pill size and shape)
416
Lower probe into bottle at reduced speed
418
Stop probe movement when pill is captured by suction cup (vacuum reading below threshold level and/or probe limit switch activated)
420
Elevate probe & confirm pressure level under threshold sensor for successful individual pill pick
422
Success?
No pill
Yes
424
Move probe to Z axis origin (up)
426
Move gantry in XY to next available pre-dispense tray slot
428
Lower probe to pre-dispense height
To Fig. 8B
434
Capture extra pill from pre-dispensing tray and return to corresponding bottle. Check pre-dispensing tray weight to confirm right number of pills
From Fig. 8B
From Fig. 8B

Fig. 8A

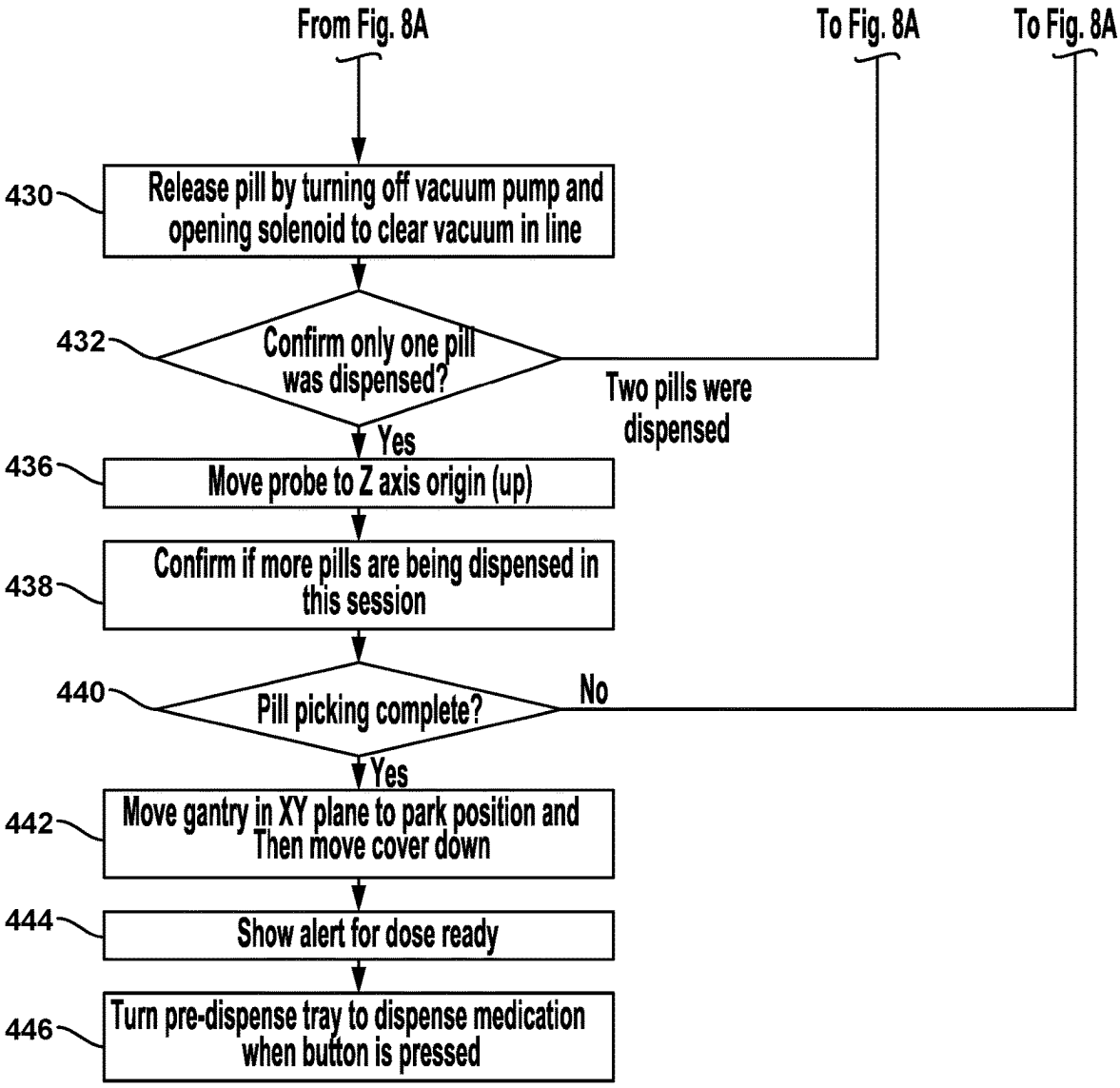

From Fig. 8A
To Fig. 8A
To Fig. 8A
430
Release pill by turning off vacuum pump and opening solenoid to clear vacuum in line
432
Confirm only one pill was dispensed?
Two pills were dispensed
Yes
436
Move probe to Z axis origin (up)
438
Confirm if more pills are being dispensed in this session
440
Pill picking complete?
No
Yes
442
Move gantry in XY plane to park position and Then move cover down
444
Show alert for dose ready
446
Turn pre-dispense tray to dispense medication when button is pressed

Fig. 8B

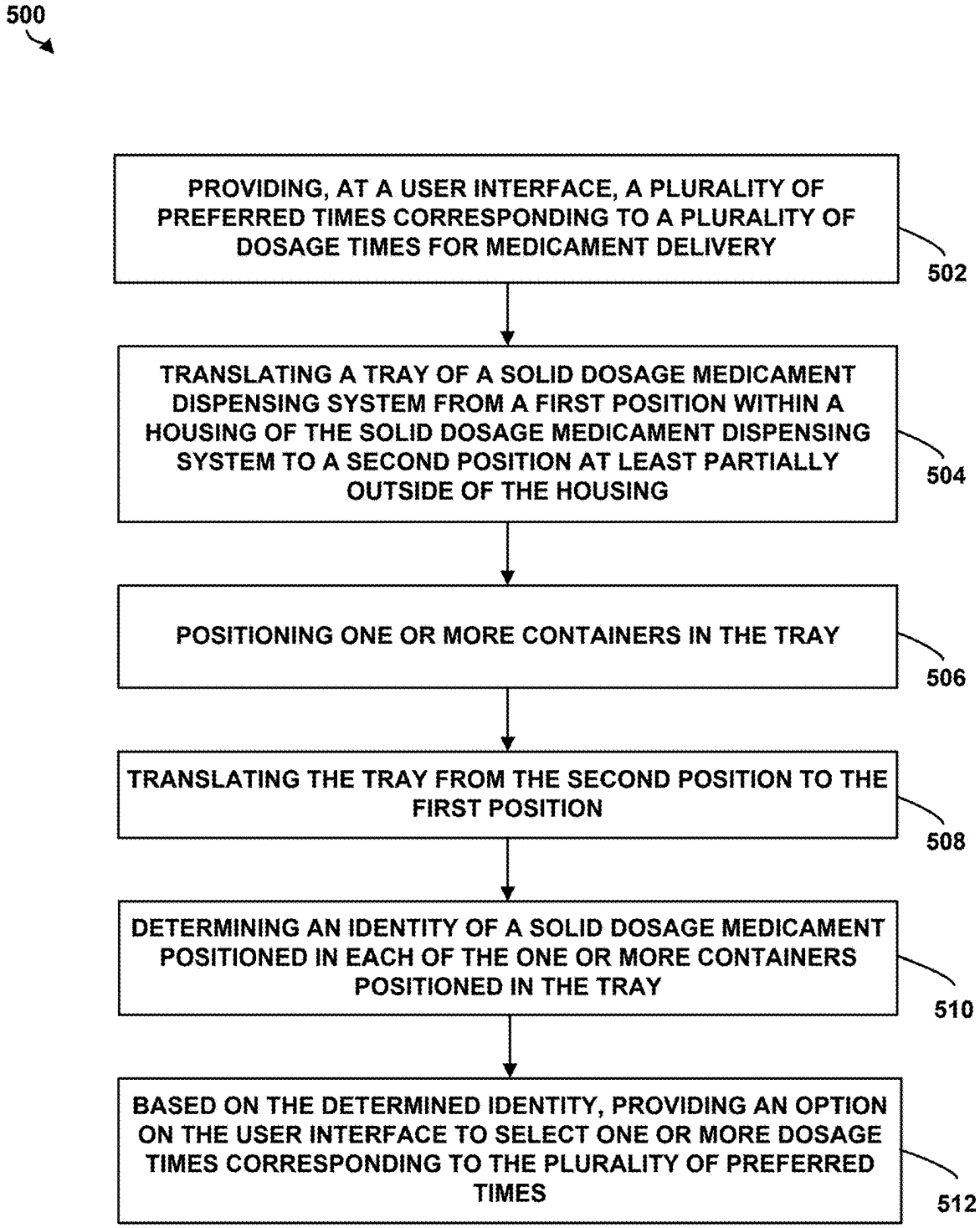

500
PROVIDING, AT A USER INTERFACE, A PLURALITY OF PREFERRED TIMES CORRESPONDING TO A PLURALITY OF DOSAGE TIMES FOR MEDICAMENT DELIVERY
502
TRANSLATING A TRAY OF A SOLID DOSAGE MEDICAMENT DISPENSING SYSTEM FROM A FIRST POSITION WITHIN A HOUSING OF THE SOLID DOSAGE MEDICAMENT DISPENSING SYSTEM TO A SECOND POSITION AT LEAST PARTIALLY OUTSIDE OF THE HOUSING
504
POSITIONING ONE OR MORE CONTAINERS IN THE TRAY
506
TRANSLATING THE TRAY FROM THE SECOND POSITION TO THE FIRST POSITION
508
DETERMINING AN IDENTITY OF A SOLID DOSAGE MEDICAMENT POSITIONED IN EACH OF THE ONE OR MORE CONTAINERS POSITIONED IN THE TRAY
510
BASED ON THE DETERMINED IDENTITY, PROVIDING AN OPTION ON THE USER INTERFACE TO SELECT ONE OR MORE DOSAGE TIMES CORRESPONDING TO THE PLURALITY OF PREFERRED TIMES
512

Fig. 9

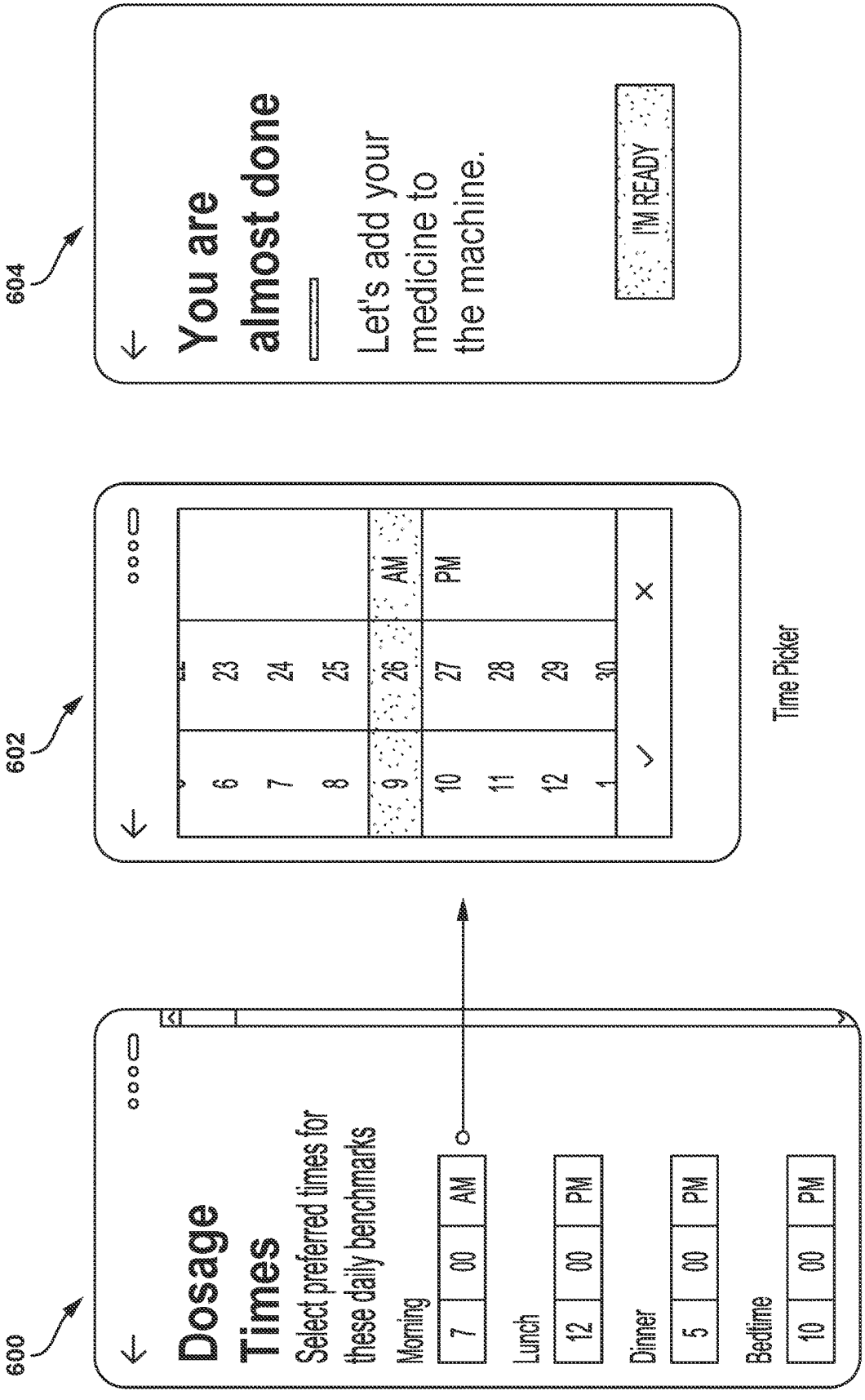


Fig. 10A

Fig. 10B

Fig. 10C

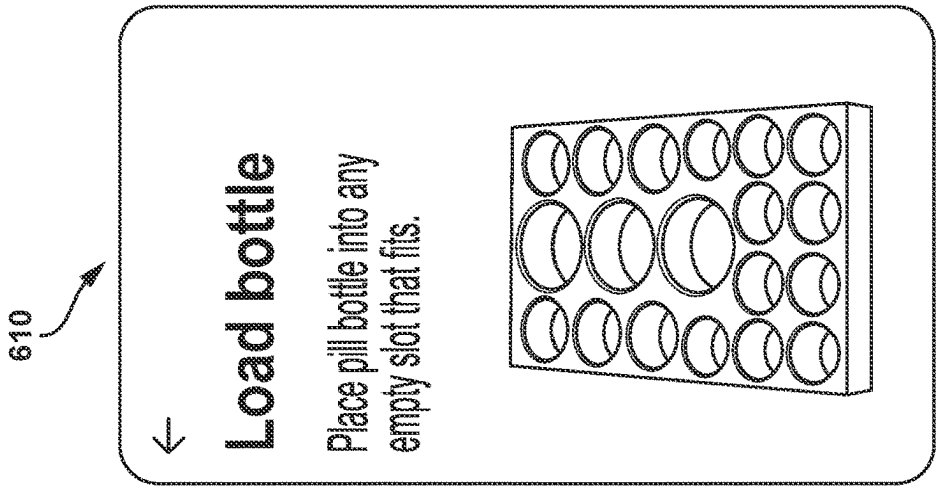


Fig. 10F

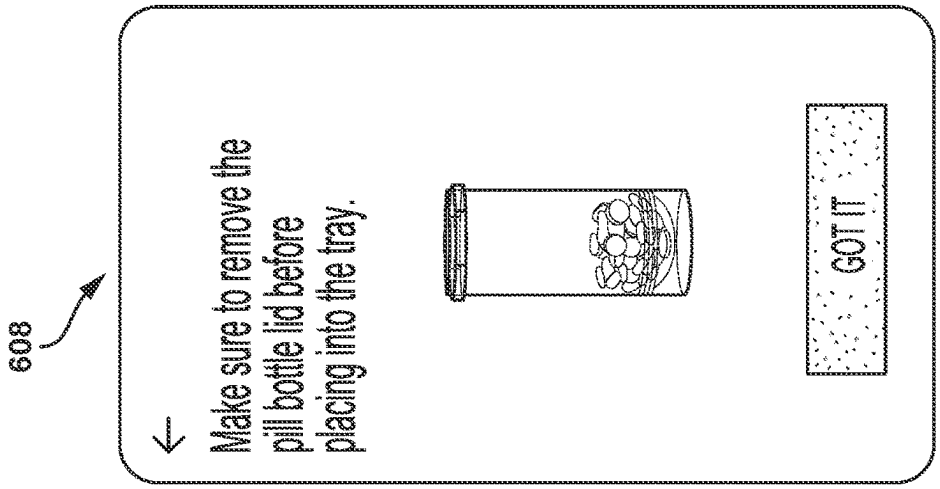
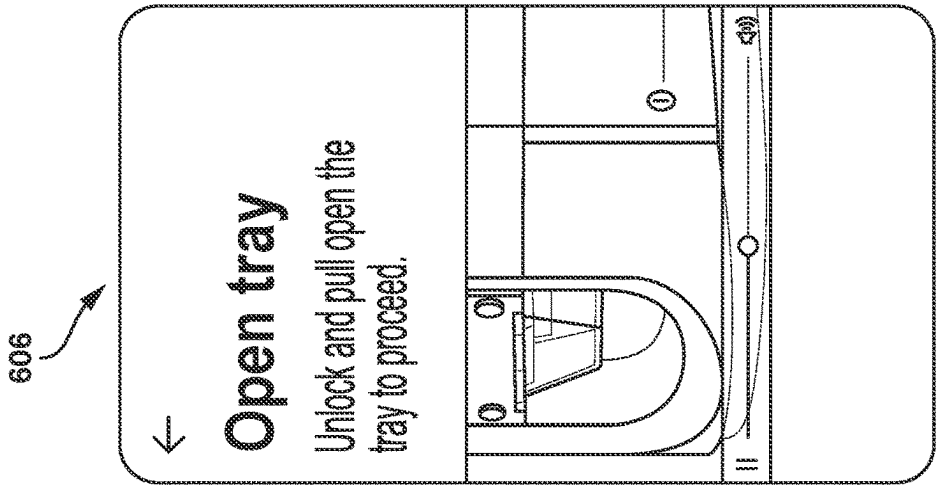


Fig. 10E



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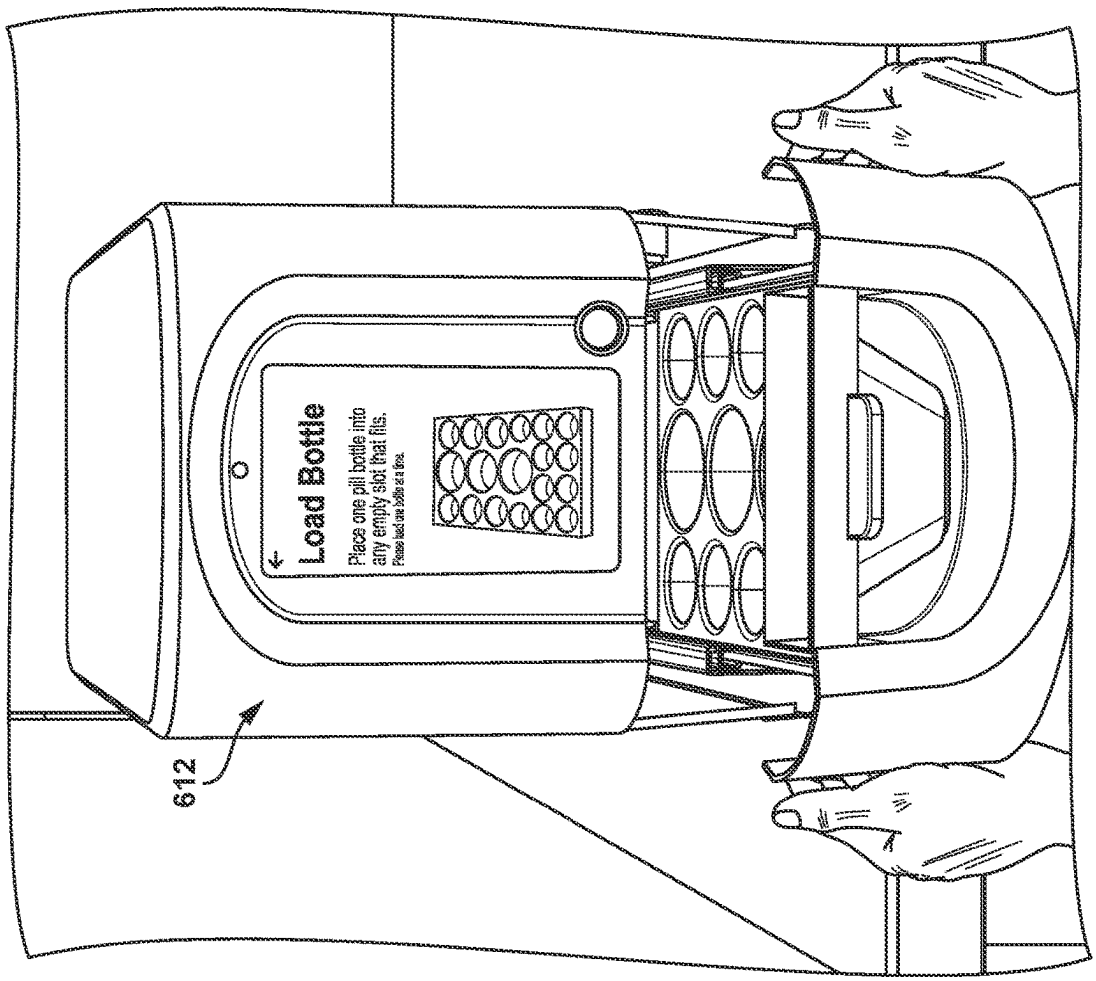
Load Bottle
Place one pill bottle into any empty slot that fits.
612

Fig. 10G

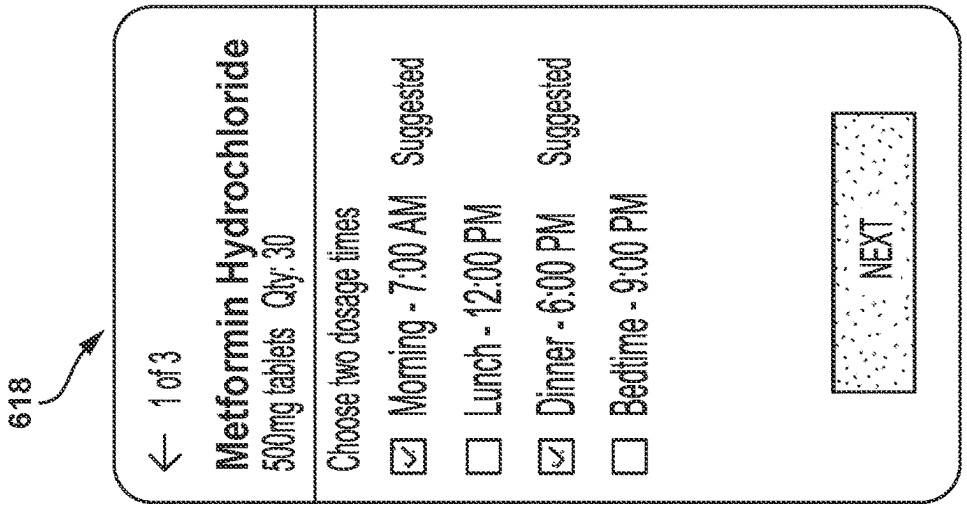

Fig. 10J

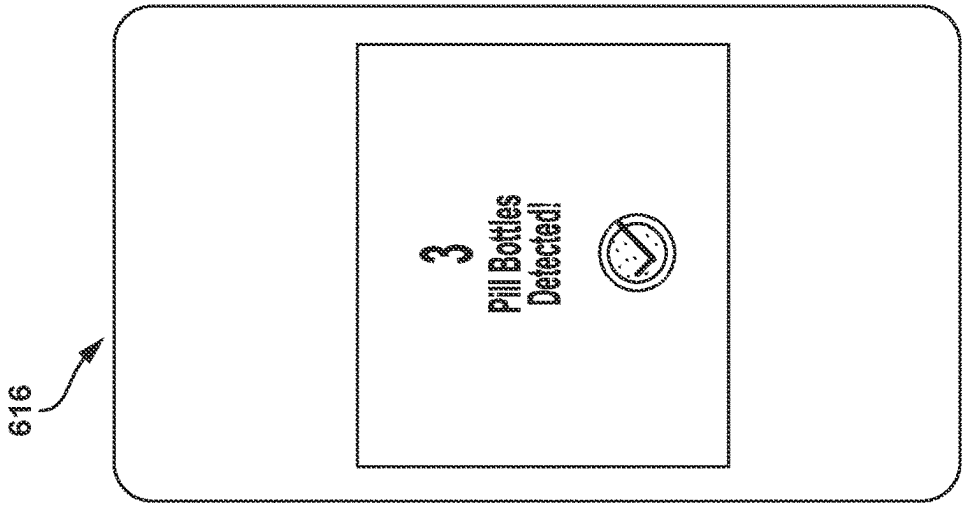

Fig. 10I

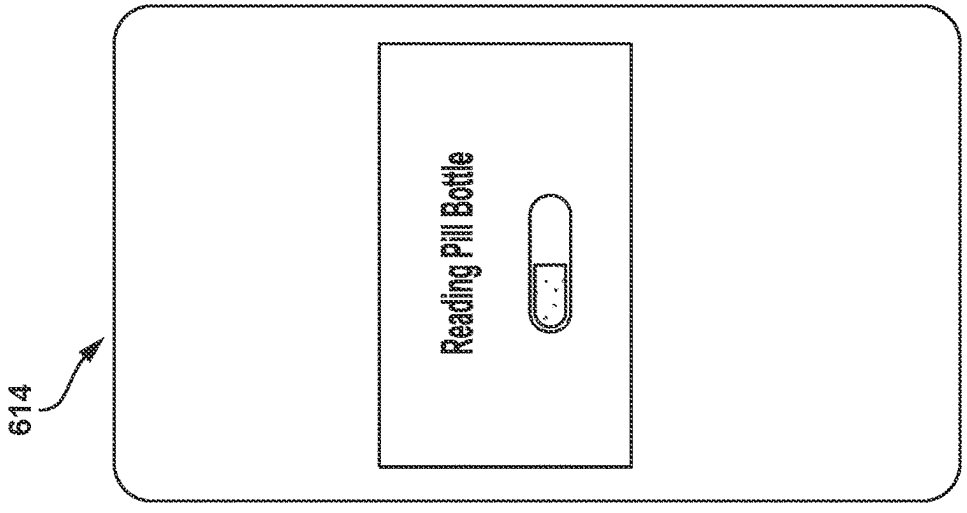

Fig. 10H

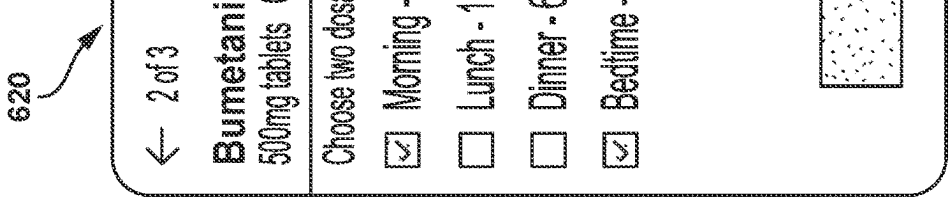

Fig. 10K

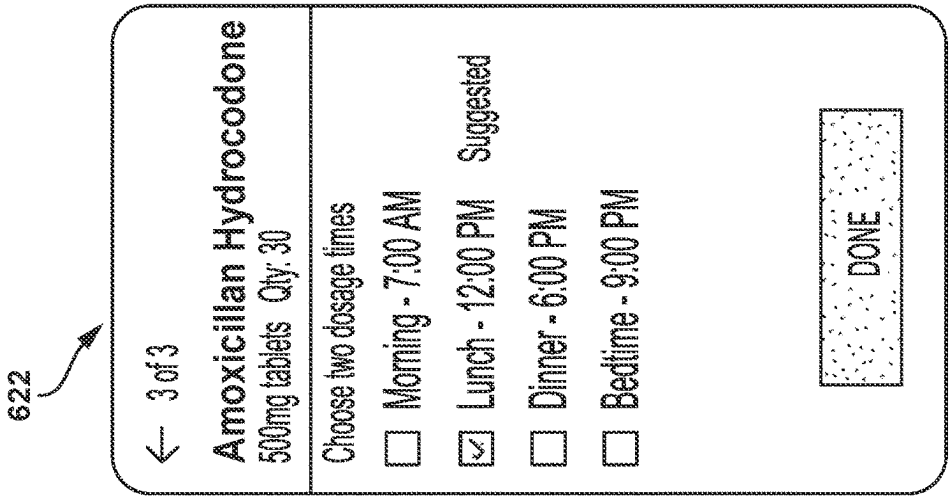

Fig. 10L

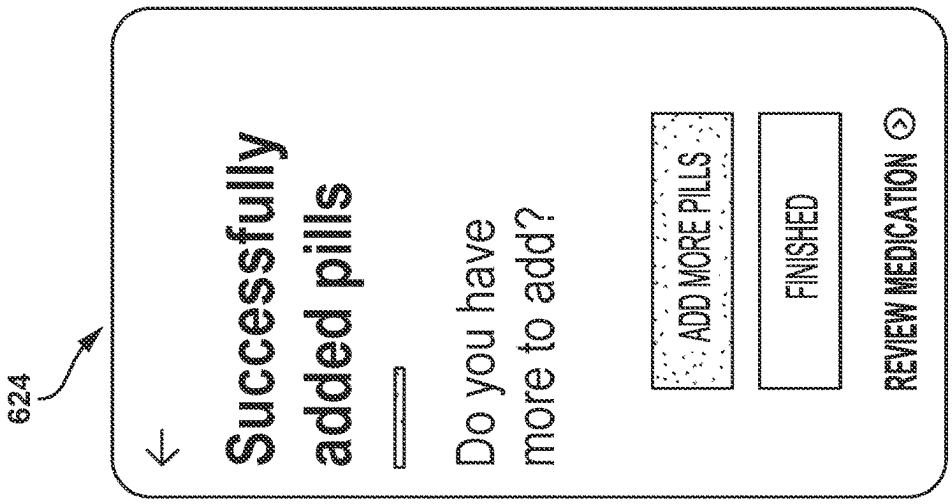

Fig. 10M

SOLID DOSAGE MEDICAMENT DISPENSER AND METHODS OF USE

RELATED APPLICATIONS

This application is a non-provisional of and claims priority to U.S. Provisional Application No. 62/964,257 entitled "Solid Dosage Medicament Dispenser and Methods of Use," filed on Jan. 22, 2020, which is hereby incorporated by reference in its entirety.

FIELD

The present invention relates generally to devices, systems, and methods for automated or on-demand dispensing of solid dosage medications.

BACKGROUND

Unless otherwise indicated herein, the materials described in this section are not prior art to the claims in this application and are not admitted to be prior art by inclusion in this section.

Solid dosage medications such as pills, capsules, tablets, and the like are traditionally provided in the form of a disposable plastic container having the medication name, dosage, and provider printed on the label. The current healthcare climate in which patients with chronic illnesses are required to retrieve daily doses often consisting of multiple different medications from such disposable plastic containers does not promote proper patient education, accountability, and adherence. In particular, patients that require a plurality of prescription and over-the-counter (OTC) medications frequently exhibit poor compliance in properly following the drug regimen required for each particular medication. For example, it is typical for medications to be taken in incorrect or varying dosages, on incorrect or varying days, and at incorrect or varying times. Such poor medication regimen adherence metrics can be exaggerated in geriatric patients, a group which is statistically more likely to be prescribed multiple chronic medications. While there exists a variety of products and techniques for reminding patients of their medication regimens, these known systems have had limited success as a result of cost, reliability, and/or complexity. Accordingly, an improved solid dosage medication dispenser and methods of use is needed.

SUMMARY

In one example, the present disclosure provides a solid dosage medicament dispensing system comprising (a) a housing, (b) a tray coupled to the housing, wherein the tray is configured to receive one or more containers, and wherein the tray is configured to translate from a first position within the housing to a second position in which the tray is positioned to receive the one or more containers, (c) a pre-dispending tray, (d) a retrieval probe moveable between the one or more containers and the pre-dispensing tray, (e) a user interface configured to receive one or more inputs from a user, and (f) a control system configured to perform one or more functions of the solid dosage medicament dispensing system based on the one or more inputs received from the user.

In another example, the present disclosure provides a container comprising (a) a base having an interior surface and an exterior surface, wherein the interior surface of the base has a radius of curvature greater than zero, (b) a sidewall having a first end coupled to the base and a second end opposite the first end, wherein an interior surface of the sidewall and the interior surface of the base define a chamber therebetween, and wherein the second end of the sidewall defines an opening, and (c) a removable cap removably coupled to the second end of the sidewall to thereby cover the opening.

In another example, the present disclosure provides a container comprising (a) a base having an interior surface and an exterior surface, (b) a sidewall having a first end coupled to the base and a second end opposite the first end, wherein the second end of the sidewall defines an opening, (c) a plurality of dividers each coupled to the interior surface of the base and an interior surface of the sidewall, wherein the interior surface of the sidewall, the interior surface of the base, and the plurality of dividers define a plurality of chambers therebetween, and (d) a removable cover removably coupled to the second end of the sidewall to thereby cover the opening, wherein the removable cover includes a visual indication of a time of day positioned over each of the plurality of chambers when the removable cover is positioned over the opening.

In another example, the present disclosure provides a method comprising (a) vibrating a tray including one or more containers, wherein each container of the one or more containers includes a solid dosage medicament, (b) moving a retrieval probe to a location above a container of the one or more containers, (c) lowering the retrieval probe into the container to capture a solid dosage medicament from the container, (d) determining whether the retrieval probe has captured the solid dosage medicament, (e) in response to a determination that the retrieval probe has captured the solid dosage medicament, moving the retrieval probe to a pre-dispensing tray, (f) releasing the solid dosage medicament from the retrieval probe into the pre-dispensing tray, (g) if a user input is received at a user interface, dispensing the solid dosage medicament to an exterior of the housing, and (h) if no user input is received at the user interface, (i) moving the retrieval probe to the pre-dispensing tray, (ii) capturing the solid dosage medicament from the pre-dispensing tray, and (iii) returning the solid dosage medicament to the container.

In yet another example, the present disclosure provides a method comprising (a) providing, at a user interface, a plurality of preferred times corresponding to a plurality of dosage times for medicament delivery, (b) translating a tray of a solid dosage medicament dispensing system from a first position within a housing of the solid dosage medicament dispensing system to a second position at least partially outside of the housing, (c) positioning one or more containers in the tray, (d) translating the tray from the second position to the first position, (e) determining an identity of a solid dosage medicament positioned in each of the one or more containers positioned in the tray, and (f) based on the determined identity, providing an option on the user interface to select one or more dosage times corresponding to the plurality of preferred times.

These as well as other aspects, advantages, and alternatives, will become apparent to those of ordinary skill in the art by reading the following detailed description, with reference where appropriate to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified block diagram of an example solid dosage medicament dispensing system, according to an example embodiment.

FIG. **2** is a perspective view of the solid dosage medicament dispensing system, according to an example embodiment.

FIG. **3** is a perspective cross-sectional view of the solid dosage medicament dispensing system of FIG. **2**, according to an example embodiment.

FIG. **4** is a top cross-sectional view of the solid dosage medicament dispensing system of FIG. **2**, according to an example embodiment.

FIG. **5**A is a cross-sectional view of a container, according to an example embodiment.

FIG. **5**B is a perspective view of the container of FIG. **5**A, according to an example embodiment.

FIG. **5**C is a perspective view of the container of FIG. **5**A, according to an example embodiment.

FIG. **6**A is a perspective view of a travel tray, according to an example embodiment.

FIG. **6**B is a top view of the travel tray of FIG. **6**A, according to an example embodiment.

FIG. **6**C is a perspective view of a travel tray carrying case, according to an example embodiment.

FIG. **7** is a flowchart of an example method, according to an example embodiment.

FIGS. **8**A-**8**B is a flowchart of another example method, according to an example embodiment.

FIG. **9** is a flowchart of another example method, according to an example embodiment.

FIGS. **10**A-**10**M illustrate example user interface prompts, according to example embodiments.

DETAILED DESCRIPTION

Example methods and systems are described herein. It should be understood that the words "example," "exemplary," and "illustrative" are used herein to mean "serving as an example, instance, or illustration." Any example or feature described herein as being an "example," being "exemplary," or being "illustrative" is not necessarily to be construed as preferred or advantageous over other examples or features. The examples described herein are not meant to be limiting. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the figures, can be arranged, substituted, combined, separated, and designed in a wide variety of different configurations, all of which are explicitly contemplated herein.

Furthermore, the particular arrangements shown in the Figures should not be viewed as limiting. It should be understood that other examples may include more or less of each element shown in a given Figure. Further, some of the illustrated elements may be combined or omitted. Yet further, an example may include elements that are not illustrated in the Figures.

In the following description, numerous specific details are set forth to provide a thorough understanding of the disclosed concepts, which may be practiced without some or all of these particulars. In other instances, details of known devices and/or processes have been omitted to avoid unnecessarily obscuring the disclosure. While some concepts will be described in conjunction with specific examples, it will be understood that these examples are not intended to be limiting.

Unless otherwise indicated, the terms "first," "second," etc. are used herein merely as labels, and are not intended to impose ordinal, positional, or hierarchical requirements on the items to which these terms refer. Moreover, reference to, e.g., a "second" item does not require or preclude the existence of, e.g., a "first" or lower-numbered item, and/or, e.g., a "third" or higher-numbered item.

As used herein, a system, apparatus, structure, article, element, component, or hardware "configured to" perform a specified function is indeed capable of performing the specified function without any alteration, rather than merely having potential to perform the specified function after further modification. In other words, the system, apparatus, structure, article, element, component, or hardware "configured to" perform a specified function is specifically selected, created, implemented, utilized, programmed, and/or designed for the purpose of performing the specified function. As used herein, "configured to" denotes existing characteristics of a system, apparatus, structure, article, element, component, or hardware which enable the system, apparatus, structure, article, element, component, or hardware to perform the specified function without further modification. For purposes of this disclosure, a system, apparatus, structure, article, element, component, or hardware described as being "configured to" perform a particular function may additionally or alternatively be described as being "adapted to" and/or as being "operative to" perform that function.

The limitations of the following claims are not written in means-plus-function format and are not intended to be interpreted based on 35 U.S.C. § 112 (f), unless and until such claim limitations expressly use the phrase "means for" followed by a statement of function void of further structure.

By the term "about," "approximately," or "substantially" with reference to amounts or measurement values described herein, it is meant that the recited characteristic, parameter, or value need not be achieved exactly, but that deviations or variations, including for example, tolerances, measurement error, measurement accuracy limitations and other factors known to those of skill in the art, may occur in amounts that do not preclude the effect the characteristic was intended to provide. For example, in one embodiment, the term "about" can refer to ±10% of a given value.

As used herein, the term "medicament" or "solid dosage medicament" is used herein to refer to a solid medication in the form of a pill, for example, a tablet or a capsule. Any other example of manufactured solid dosage medicament that contains a predetermined or intended amount (e.g., a dose) of a medicinal compound (e.g., a "pharmaceutical" or a "drug") is also considered to be a "medicament," according to the present disclosure. The term "solid," as used herein in the context of a solid medication, refers at least to an exterior surface of the dosage form. Therefore, contemplated medicaments can include liquids, gels, elixirs, solutions, emulsions, and the like that are contained within a solid object such as a hard package (consumable or otherwise) without limitation. It should also be understood that singular referents, e.g., "a pill" or "a medicament" contemplates a plurality of pills and a plurality of medicaments, respectively.

Illustrative, non-exhaustive examples, which may or may not be claimed, of the subject matter according the present disclosure are provided below.

With reference to the Figures, FIG. **1** provides a block diagram of an example solid dosage medicament dispensing system **100**. The solid dosage medicament dispensing system **100** is shown for illustrative purposes, and may include more or fewer components. The various components of solid dosage medicament dispensing system **100** may be connected in any manner, including wired and/or wireless connections. Further, in some examples, components of the solid dosage medicament dispensing system **100** may be distributed among multiple physical entities rather than a

single physical entity. Other example arrangements of the solid dosage medicament dispensing system **100** are contemplated herein as well.

As shown in FIG. **1**, the solid dosage medicament dispensing system **100** includes a housing **102**. The solid dosage medicament dispensing system **100** further includes a tray **104** coupled to the housing **102**. In one example, the tray **104** is slidably coupled to the housing **102**. Other arrangements are possible as well. The tray is configured to receive one or more containers **105**. In one example, each of the one or more containers **105** includes a solid dosage medicament. Further, the tray **104** is configured to translate from a first position within the housing **102** to a second position in which the tray **104** is positioned to receive the one or more containers **105**. In one example, the tray **104** is positioned entirely within the housing **102** in the first position, and the tray **104** is positioned at least partially outside of the housing **102** in the second position. The tray **104** may be configured to extend out of a front of the housing **102** in the second position, or the tray **104** may be configured to extend out of a side of the housing **102** in the second position. Other arrangements are possible as well.

As shown in FIG. **1**, the solid dosage medicament dispensing system **100** further includes a pre-dispensing tray **106**. In one example, the pre-dispensing tray **106** may be positioned entirely inside of the housing **102**. The solid dosage medicament dispensing system **100** may further include a load cell **114** positioned under the pre-dispensing tray **106**. Such a load cell **114** is configured to weigh the contents of the pre-dispensing tray **106** to determine whether or not an appropriate amount of medicament is positioned therein. In another example, the solid dosage medicament dispensing system **100** includes a camera **109** positioned inside the housing **102** and facing the pre-dispensing tray **106** to take picture of the contents of the pre-dispensing tray **106** to determine whether or not an appropriate amount of medicament is positioned therein. Other ways to verify that an appropriate amount of medicament is positioned in the pre-dispensing tray **106** are possible, as discussed in additional detail below.

The solid dosage medicament dispensing system **100** further includes a retrieval probe **107** moveable between the one or more containers **105** and the pre-dispensing tray **106**. In one example, the retrieval probe **107** may be positioned entirely inside of the housing **102**. In one example, the solid dosage medicament dispensing system **100** further includes a vacuum pump **112** in communication with the retrieval probe **107** and configured to create a negative pressure within the retrieval probe **107**. Such an arrangement enables the retrieval probe **107** to pick up or capture and move a single solid dosage medicament, as discussed in additional detail below. Other arrangements of the retrieval probe **107** for transporting a solid dosage medicament are possible as well.

The solid dosage medicament dispensing system **100** may further include a dispensing tray **126** removably coupled to the housing **102**. The dispensing tray **126** is configured to receive a solid dosage medicament from the pre-dispensing tray **106**. In another embodiment, the dispensing tray **126** can be configured to receive a solid dosage medicament directly from the retrieval probe **107**. The dispensing tray **126** may be removably coupled to an exterior of the housing **102**, while the pre-dispensing tray **106** is positioned within the housing **102**. The dispensing tray **126** may include a tab extending in a direction away from the housing **102**. Such a tab provides a surface for a user to grasp and remove the dispensing tray **126** from the housing **102**. In one example, the dispensing tray **126** is removably coupled to the housing **102** via one or more magnets. Other temporary coupling mechanisms or combinations of mechanisms are possible as well.

Further, the solid dosage medicament dispensing system **100** may include a tray cover **128** removably positioned over the tray **104** to cover the one or more containers **105** positioned in the tray **104**. As such, the one or more containers **105** may be positioned in the tray **104** without a cap or other closure, and the tray cover **128** is used to cover the one or more containers **105** positioned in the tray **104**. This arrangement may help prevent solid dosage medicaments positioned in the one or more containers **105** from spilling in the event that the solid dosage medicament dispensing system **100** tips over or is otherwise disturbed from the intended upright position. This arrangement may also help preserve the integrity of solid dosage medicaments positioned in the one or more containers **105** positioned in the tray **104**. In one example, the tray cover **128** comprises a plurality (e.g., a pair) of doors that open so that the retrieval probe **107** can access the contents of the one or more containers **105**. In another example, the tray cover **128** comprises a spring-loaded retractable cover. In one embodiment, the tray **104** can be configured to form a seal with the one or more containers **105** positioned in the tray **104**. Other arrangements for the tray cover **128** are possible as well.

The solid dosage medicament dispensing system **100** further includes a user interface **108** configured to receive one or more inputs from a user. The user interface **108** may comprise a finger-operable touchscreen and/or may include one or more buttons and/or sensors for receiving the one or more inputs from the user. In one example, the user interface **108** (e.g., touchscreen) can articulate so as to change the angle of the user interface with respect to the user. Such a touchscreen may be used by a user to input commands to the solid dosage medicament dispensing system **100**. To this end, the touchscreen may be configured to sense at least one of a position and a movement of a user's finger via capacitive sensing, resistance sensing, or a surface acoustic wave process, among other possibilities. The touchscreen may be capable of sensing finger movement in a direction parallel or planar to the touchscreen surface, in a direction normal to the touchscreen surface, or both, and may also be capable of sensing a level of pressure applied to the touchscreen surface. The touchscreen may be formed of one or more translucent or transparent insulating layers and one or more translucent or transparent conducting layers. The touchscreen may take other forms as well. Further, in some examples, the touchscreen may be configured as a display for providing output from various components of the solid dosage medicament dispensing system **100**.

The user interface **108** may further include or be associated with one or more microphones and/or one or more speakers. The microphone(s) may be configured to receive audio (e.g., a voice command or other audio input) from a user of the solid dosage medicament dispensing system **100**. Similarly, the speaker(s) may be configured to output audio to the user of the solid dosage medicament dispensing system **100**. In one particular example, the user interface **108** may be set up for wireless communications with a medical professional (either via a video conference or audio conference) to answer questions regarding the solid dosage medicament in the solid dosage medicament dispensing system **100**.

The solid dosage medicament dispensing system **100** may further include a security feature **130**, which may require an input from the user or a remote user (e.g., a caregiver, a

family member of the user, a doctor, or a pharmacist) prior to enabling the user interface **108** to receive one or more inputs from the user. As non-limiting examples, the security feature **130** may comprise a fingerprint scanner, a retina scanner, a camera, and/or a pin pad. The security feature **130** may be separate from the user interface **108**, or may be an integral component of the user interface **108**.

Further still, the solid dosage medicament dispensing system **100** includes a control system **110** configured to perform one or more functions of the solid dosage medicament dispensing system **100** based on the one or more inputs received from the user. As shown in FIG. **1**, the control system **110** may include processor(s) **116**, data storage **118**, controller(s) **122**, and communication link(s) **124**. Processor(s) **116** may operate as one or more general-purpose hardware processors or special purpose hardware processors (e.g., digital signal processors, application specific integrated circuits, etc.). The processor(s) **116** may be configured to execute computer-readable program instructions **120** stored in the data storage **118**. The processor(s) **116** may also directly or indirectly interact with other components of the solid dosage medicament dispensing system **100**, such as the retrieval probe **107**, vacuum pump **112**, tray cover **128**, load cell **114**, user interface **108**, security feature **130**, and/or communication link(s) **124**.

The data storage **118** may be one or more types of hardware memory. For example, the data storage **118** may include or take the form of one or more computer-readable storage media that can be read or accessed by processor(s) **116**. The one or more computer-readable storage media can include volatile and/or non-volatile storage components, such as optical, magnetic, organic, or another type of memory or storage, which can be integrated in whole or in part with processor(s) **116**. In some implementations, the data storage **118** can be a single physical device. In other implementations, the data storage **118** can be implemented using two or more physical devices, which may communicate with one another via wired or wireless communication. As noted previously, the data storage **118** may include the computer-readable program instructions **120**, as well as additional data. The additional data may be any type of data, such as configuration data, sensor data, and/or diagnostic data, among other possibilities.

The controller(s) **122** may include one or more electrical circuits, units of digital logic, computer chips, and/or microprocessors that are configured to (perhaps among other tasks) interface between any combination of the retrieval probe **107**, vacuum pump **112**, tray cover **128**, load cell **114**, user interface **108**, security feature **130**, communication link(s) **124**, and/or a user of the solid dosage medicament dispensing system **100**. In some implementations, the controller(s) **122** may be a purpose-built embedded device for performing specific operations with one or more subsystems of the solid dosage medicament dispensing system **100**.

The control system **110** may monitor and physically change the operating conditions of the solid dosage medicament dispensing system **100**. In doing so, the control system **110** may serve as a link between portions of the solid dosage medicament dispensing system **100**, such as between the user interface **108** and the retrieval probe **107**, between the retrieval probe and the one or more containers **105**, between the solid dosage medicament dispensing system **100** and another computing device, and/or or between the solid dosage medicament dispensing system **100** and a user, as non-limiting examples. The example interfaces and communications noted above may be implemented via a wired or wireless connection, or both. The control system **110** may perform other operations for the solid dosage medicament dispensing system **100** as well.

In some implementations, the control system **110** of solid dosage medicament dispensing system **100** may also include communication link(s) **124** configured to send and/or receive information. The communication link(s) **124** may transmit data indicating the state of the various components of the solid dosage medicament dispensing system **100**. For example, information read by the retrieval probe **107** or load cell **114** may be transmitted via the communication link(s) **124** to a separate device. Other diagnostic information indicating the integrity or health of the various components of the solid dosage medicament dispensing system **100** may be transmitted via the communication link(s) **124** to an external communication device. Further, data such as missed dosages or other patient compliance statistics with respect to the scheduled medicament delivery of a solid dosage medicament using the solid dosage medicament dispensing system **100** may be transmitted via the communication link(s) **124** to a separate device.

In some implementations, the solid dosage medicament dispensing system **100** may receive information at the communication link(s) **124** that is then processed by the processor(s) **116**. The received information may indicate data that is accessible by the processor(s) **116** during execution of the computer-readable program instructions **120**. Further, the received information may change aspects of the controller(s) **122** that may affect the behavior of one or more components of the solid dosage medicament dispensing system **100**.

In some cases, the communication link(s) **124** may include a wired connection. The solid dosage medicament dispensing system **100** may include one or more ports to interface the communication link(s) **124** to an external device. The communication link(s) **124** may include, in addition to or as an alternative to the wired connection, a wireless connection. Some example wireless connections may utilize a cellular connection, such as CDMA, EVDO, GSM/GPRS, or 4G telecommunication, such as WiMAX or LTE. Alternatively or in addition, the wireless connection may utilize a Wi-Fi connection to transmit data to a wireless local area network (WLAN). In some implementations, the wireless connection may also communicate over an infrared link, Bluetooth, or a near-field communication (NFC) device.

Operations of the control system **110** may be carried out by the processor(s) **116**. Alternatively, these operations may be carried out by the controller(s) **122**, or a combination of the processor(s) **116** and the controller(s) **122**. In some implementations, the control system **110** may partially or wholly reside on a device other than the solid dosage medicament dispensing system **100**, and therefore may, at least in part, control the solid dosage medicament dispensing system **100** remotely. The communication link(s) **124** may be used, at least in part, to carry out the remote communication. In other implementations, the control system wholly resides in the solid dosage medicament dispensing system **100**.

During operation, the control system **110** may communicate with other systems of the solid dosage medicament dispensing system **100** via wired or wireless connections, and may further be configured to communicate with one or more users of the solid dosage medicament dispensing system **100**. As one possible illustration, the control system **110** may receive an input (e.g., from a user) indicating an instruction to perform a particular set of one or more tasks. The input to control system **110** may be received via the user

interface **108**. Based on this input, the control system **110** may perform operations to cause the solid dosage medicament dispensing system **100** to perform one or more tasks.

In particular, the control system **110** may be configured to (i) determine an identity of a solid dosage medicament positioned in a container **105** of the one or more containers positioned in the tray **104**, and (ii) provide an option on the user interface **108** to select a dosage time based on the determined identity. In one particular example, an exterior surface of each of the one or more containers **105** includes a unique identifier configured to provide an identity of a solid dosage medicament positioned in the container **105**. The unique identifier may comprise a barcode, a Quick Response (QR) code, a radio frequency identification (RFID), a near-field communication (NFC), or a mechanical pin or other configuration, as non-limiting examples. The solid dosage medicament dispensing system **100**, in turn, includes a reader configured to read the unique identifier of the one or more containers **105**. In one example, the reader comprises a camera (not shown) on an exterior of the housing **102** of the solid dosage medicament dispensing system **100**. In such an example, the reader identifies the solid dosage medicament prior to the container **105** being positioned in the tray **104**. In another example, the reader is positioned in the tray **104** such that the reader identifies the solid dosage medicament when the container **105** is positioned in the tray **104**. In yet another example, the reader may comprise a camera on a smartphone of the user. In any case, the reader may be in communication with the control system **110**, and the control system **110** can process the data received from the reader to thereby determine the identity of the solid dosage medicament positioned in the one or more container **105**. In yet another example, the user inputs medication information directly into the user interface **108**.

In another example, the control system **110** may be configured to (i) vibrate the tray **104** (e.g., via a vibration motor positioned in the housing **102**), (ii) move the retrieval probe **107** to a location above a container **105** of the one or more containers positioned in the tray **104**, (iii) lower the retrieval probe **107** into the container **105** to capture a solid dosage medicament from the container **105** (e.g., via a suction from the vacuum pump **112**), and (iv) determine whether the retrieval probe **107** has captured the solid dosage medicament. The step of determining whether the retrieval probe **107** has captured the solid dosage medicament may comprise (i) comparing a detected vacuum reading of the retrieval probe to a threshold level, (ii) if the detected vacuum reading is less than the threshold level, determining that the retrieval probe **107** has captured the solid dosage medicament, and (iii) if the detected vacuum reading is not less than the threshold level, determining that the retrieval probe **107** has not captured the solid dosage medicament. In another example, a change in pressure may be measured to determine whether or not the retrieval probe **107** has captured the solid dosage medicament from the container **105**. In another example, the tray **104** may include weight sensors **115** to verify the weight taken out of the container **105** matches the weight determined by the load cell **114** in the pre-dispensing tray **106**. Other example methods for determining whether the retrieval probe **107** has captured the solid dosage medicament are possible as well.

The control system **110** may be further configured, in response to a determination that the retrieval probe **107** has not captured the solid dosage medicament, to adjust a lateral position of the retrieval probe **107**. Additionally or alternatively, the control system **110** may further cause the tray **104** to vibrate in response to a determination that the retrieval probe **107** has not captured the solid dosage medicament. In one example, adjusting the lateral position of the retrieval probe **107** comprises initially lowering the retrieval probe **107** into a first position in the container **105** and moving the retrieval probe **107** in a spiral direction from the first position until a determination is made that the retrieval probe **107** has captured the solid dosage medicament. In one such example, the first position is in the middle of the container **105**. In another example, the adjusting the lateral position of the retrieval probe **107** comprises initially lowering the retrieval probe **107** into a first position in the container **105** and moving the retrieval probe **107** in a random path from the first position until a determination is made that the retrieval probe **107** has captured the solid dosage medicament.

In another example, the control system **110** is further configured to (i) move the retrieval probe **107** to the pre-dispensing tray **106** in response to a determination that the retrieval probe **107** has captured the solid dosage medicament from a container **105**, and (ii) release the solid dosage medicament from the retrieval probe **107** into the pre-dispensing tray **106**. In one such example, the control system **110** is further configured to, (i) if a user input is received at the user interface **108**, dispense the solid dosage medicament to an exterior of the housing **102**, and (ii) if no user input is received at the user interface **108** within a threshold time period, (a) move the retrieval probe **107** to the pre-dispensing tray **106**, (b) capture the solid dosage medicament from the pre-dispensing tray **106**, and (c) return the solid dosage medicament to the container **105**. Such an arrangement ensures that the solid dosage medicament is positioned within the housing **102** (and therefore inaccessible) until a user provides a user input to dispense the solid dosage medicament.

FIG. **2** illustrates a perspective view of the solid dosage medicament dispensing system **100**. In particular, FIG. **2** illustrates the housing **102**, the user interface **108**, the dispensing tray **126**, and the security feature **130**. FIG. **2** further illustrates a lock **132** which may be included to maintain the tray **104** in the first position within the housing **102**. When the lock **132** is unlocked (e.g., via a corresponding key), the tray **104** can then transition from the first position to a second position outside of the housing **102** so that the tray **104** can receive one or more containers **105**.

FIG. **3** illustrates a perspective cross-sectional view of the solid dosage medicament dispensing system **100**. In particular, FIG. **3** illustrates the housing, the pre-dispensing tray **106**, the retrieval probe **107**, and the tray cover **128**. As shown in FIG. **3**, the tray cover **128** is in a closed position covering the one or more containers **105** positioned in the tray **104**. As shown in FIG. **3**, the solid dosage medicament dispensing system **100** may further include a gantry **134** coupled to the retrieval probe **107**. The gantry **134** may be positioned on a track **136** that runs along at least a portion of each side of the housing **102**. In use, the gantry **134** can move forward and backward along the track **136**, and the retrieval probe **107** can move side to side along the gantry **134**. Thus, the gantry **134** and track **136** together provide the x-y axis movement of the retrieval probe **107**. The retrieval probe **107** may be further configured to move up and down, giving the retrieval probe **107** its z-axis movement.

FIG. **4** illustrates a top cross-sectional view of the solid dosage medicament dispensing system **100**. In particular, FIG. **4** illustrates a view with the tray cover **128** in a retracted position, such that the one or more containers **105** (here shown in varying sizes) in the tray **104** are accessible by the retrieval probe **107**.

FIG. **5**A illustrates a cross-sectional view of a container **105**, according to an example embodiment. As discussed above, the container **105** may be configured to be positioned within the tray **104** of the solid dosage medicament dispensing system **100**. As shown in FIG. **5**, the container **105** comprises a base **138** having an interior surface **140** and an exterior surface **142**. The interior surface **140** of the base **138** has a radius of curvature greater than zero. This curved interior surface **140** of the base **138** of the container **105** may help to position the solid dosage medicament to the center of the interior surface **140** of the base **138**, thereby making pill retrieval by the retrieval probe **107** easier. In use, the tray **104** may be vibrated, which along with the curved interior surface **140** of the base **138**, will further help position the solid dosage medicament to the center of the interior surface **140** of the base **138**. The exterior surface **142** of the base may be substantially flat, as shown in FIG. **5**A. Such an arrangement may ease the positioning of a unique identifier thereon. Such a unique identifier may be configured to provide an identity of a solid dosage medicament positioned in the container **105**. As discussed above, the unique identifier may comprise a barcode, a QR code, an RFID, an NFC, or a mechanical pin, as non-limiting examples. In another embodiment (not shown), the exterior surface may have a mechanical configuration (e.g., pattern and/or shape) that serves as a unique identifier. The solid dosage medicament dispensing system **100**, in turn, includes a reader configured to read the unique identifier of the one or more containers **105**. The reader may be in communication with the control system **110**, and the control system **110** can process the data received from the reader to thereby determine the identity of the solid dosage medicament positioned in a container **105**.

The container **105** further includes a sidewall **144** having a first end **146** coupled to the base **138** and a second end **148** opposite the first end **146**. An interior surface **150** of the sidewall **144** and the interior surface **140** of the base **138** define a chamber **152** therebetween. The second end **148** of the sidewall **144** defines an opening **154**. The container **105** further includes a removable cap **156** removably coupled to the second end **148** of the sidewall **144** to thereby cover the opening **154**.

FIG. **5**B illustrates a perspective view of the container **105** of FIG. **5**A, according to an example embodiment. As shown in FIG. **5**B, the removable cap **156** has been removed from the container **105** to expose the opening **154**. The second end **148** of the sidewall **144** may include a plurality of tamper-proof features **158** that lock with corresponding tamper-proof features **160** of the removable cap **156** (as shown in FIG. **5**C).

FIG. **5**C illustrates another perspective view of the container **105** of FIG. **5**A, according to an example embodiment. As shown in FIG. **5**C, the removable cap **156** can be flipped 180 degrees and reattached to the container **105** for easy access screwing and unscrewing. In particular, the top of the removable cap **156** includes a thread **162** that is configured to interact with a corresponding thread **164** of the second end **148** of the sidewall **144**.

FIG. **6**A illustrates a perspective view of a travel tray **200**, according to an example embodiment. The travel tray **200** includes a base **202** having an interior surface and an exterior surface. The travel tray **200** further includes a sidewall **204** having a first end **206** coupled to the base **202** and a second end **208** opposite the first end **206**. The second end **208** of the sidewall **204** defines an opening **210**. The travel tray **200** further includes one or more dividers **212** each coupled to the interior surface of the base **202** and an interior surface of the sidewall **204**. The interior surface of the sidewall **204**, the interior surface of the base **202**, and the plurality of dividers **212** define a plurality of chambers **214** therebetween. The travel tray **200** further includes a removable cover **216** removably coupled to the second end **208** of the sidewall **204** to thereby cover the opening **210**. The removable cover **216** includes a visual indication of a time of day positioned over each of the plurality of chambers **214** when the removable cover **216** is positioned over the opening **210**. The sidewall **204** may further include a metal strip **217** or other coupling device that is used to removably couple the travel tray **200** to the housing **102** of the solid dosage medicament dispensing system **100**.

In one example, the removable cover further includes a tab **218** with a visual indication of a day of the week. In one particular example, as shown in FIGS. **6**A-**6**B the one or more dividers **212** comprises three dividers to thereby define four chambers **214**. Further, as illustrated in the top view of FIG. **6**B, in one example, the visual indication of a time of day on the removable cover **216** comprises a morning visual indication **220**A, a mid-day visual indication **220**B, an evening visual indication **220**C, and a bedtime visual indication **220**D.

In use, the travel tray **200** may be removably coupled to the housing **102** of the solid dosage medicament dispensing system **100** as discussed above. The user may provide an input into the user interface **108** indicating a length of time the user will be away from home, and the user interface **108** may provide prompts to removably couple one or more travel trays **200** corresponding to the one or more days the user will be away from home. The solid dosage medicament dispensing system **100** may be configured to cause the pre-dispensing tray **106** to move aside, and the retrieval probe **107** may be configured to directly place the solid dosage medicament into the chambers **214** of the travel tray **200**. The retrieval probe **107** is configured to position the solid dosage medicament into a particular chamber of the plurality of chambers **214** based on the identity of the solid dosage medicament and the time of day the user selected to take the solid dosage medicament.

FIG. **6**C illustrates a travel tray carrying case **222**, according to an example embodiment. As shown in FIG. **6**C, the travel tray carrying case **222** includes a plurality of slots to receive a plurality of travel trays **200**, and a zipper **224** configured to close the travel tray carrying case **222**. Other closure mechanisms are contemplated as well.

FIG. **7** is a block diagram of an example of a method **300**. Method **300** shown in FIG. **7** presents an embodiment of a method that could be used with any of the systems or devices described above in relation to FIGS. **1**-**6**C, as an example. Method **300** includes one or more operations, functions, and/or actions as illustrated by one or more of blocks **302**-**316**. Although the blocks are illustrated in a sequential order, these blocks may also be performed in parallel, and/or in a different order than those described herein. Also, the various blocks may be combined into fewer blocks, divided into additional blocks, and/or removed based upon the desired implementation.

In addition, for the method **300** and other processes and methods disclosed herein, the block diagram shows functionality and operation of one possible implementation of present embodiments. In this regard, the method **300** can be caused to be performed by program code, which includes one or more instructions executable by a processor or computing device for implementing specific logical functions or steps in the process. The program code may be stored on any type of computer readable medium, for example, such as a storage device including a disk or hard

drive. The computer readable medium may include a non-transitory computer readable medium, for example, such as one or more computer-readable media that store data for short periods of time like register memory, processor cache, and Random Access Memory (RAM). The computer readable medium may also include non-transitory media, such as secondary or persistent long term storage, like read only memory (ROM), optical or magnetic disks, and compact-disc read only memory (CD-ROM), for example. The computer readable medium may also be any other volatile or non-volatile storage systems. The computer readable medium may be considered a computer readable storage medium, for example, or a tangible storage device.

In addition, for the method **300** and other processes and methods disclosed herein, each block in FIG. **7** may represent circuitry that is wired or otherwise functionally connected to perform the specific logical functions in the process.

Initially, at block **302**, the method **300** includes vibrating a tray including one or more containers, where each container of the one or more containers includes a solid dosage medicament. At block **304**, the method **300** includes moving a retrieval probe to a location above a container of the one or more containers. At block **306**, the method **300** includes lowering the retrieval probe into the container to capture a solid dosage medicament from the container. At block **308**, the method **300** includes determining whether the retrieval probe has captured the solid dosage medicament. At block **310**, the method **300** includes, in response to a determination that the retrieval probe has captured the solid dosage medicament, moving the retrieval probe to a pre-dispensing tray. At block **312**, the method **300** includes releasing the solid dosage medicament from the retrieval probe into the pre-dispensing tray. At block **314**, the method **300** includes, if a user input is received at a user interface, dispensing the solid dosage medicament to an exterior of the housing. At block **316**, the method **300** includes, if no user input is received at the user interface, (i) moving the retrieval probe to the pre-dispensing tray, (ii) capturing the solid dosage medicament from the pre-dispensing tray, and (iii) returning the solid dosage medicament to the container. In another example, instead of returning the solid dosage medicament to the container, the method **300** may include transporting the solid dosage medicament to a different container or other pill disposal area.

In one example, the step in the method **300** of determining whether the retrieval probe has captured the solid dosage medicament comprises (a) comparing a detected vacuum reading of the retrieval probe to a threshold level, (b) if the detected vacuum reading is less than the threshold level, determining that the retrieval probe has captured the solid dosage medicament, and (c) if the detected vacuum reading is not less than the threshold level, determining that the retrieval probe has not captured the solid dosage medicament.

In another example, the method **300** further includes (a) after releasing the solid dosage medicament from the retrieval probe into the pre-dispensing tray, determining a weight of the contents of the pre-dispensing tray, and (b) if the determined weight exceeds a threshold, (i) moving the retrieval probe to the pre-dispensing tray, (ii) capturing an extra solid dosage medicament from the pre-dispensing tray, and (iii) returning the extra solid dosage medicament to the container.

FIGS. **8**A-**8**B is a block diagram of an example of a method **400**. Method **400** shown in FIGS. **8**A-**8**B presents an embodiment of a method that could be used with any of the systems or devices described above in relation to FIGS. **1**-**6**C, as an example. Method **400** includes one or more operations, functions, and/or actions as illustrated by one or more of blocks **402**-**446**, which when performed in concert can be considered a dispensing session. Although the blocks are illustrated in a sequential order, these blocks may also be performed in parallel, and/or in a different order than those described herein. Also, the various blocks may be combined into fewer blocks, divided into additional blocks, and/or removed based upon the desired implementation.

Initially, at block **402**, the method **400** includes positioning the gantry at a park position with the tray cover down. At block **404**, the method **400** includes moving the tray cover to an open position. At block **406**, the method **400** includes moving the gantry in an xy-plane to the next bottle location. At block **408**, the method **400** includes moving the probe just above the bottle level (e.g., the top of the bottle). At block **410**, the method **400** includes measuring the ambient pressure in the probe with a pressure sensor to establish a threshold pressure level. At block **412**, the method **400** includes vibrating the pill tray (e.g., via a vibration motor). At block **414**, the method **400** includes turning on a vacuum pump to create a vacuum pressure within the retrieval probe. The vacuum pressure may be adjusted for pill size and shape. At block **416**, the method **400** includes lowering the probe into the bottle at a reduced speed. At block **418**, the method **400** includes stopping probe movement when the pill is captured by suction cup at the end of the probe. This may be determined based on a vacuum reading dropping below the threshold pressure level and/or via an activation of a probe limit switch. At block **420**, the method **400** includes elevating the probe and confirming the pressure level is under the threshold pressure level for the sensor for a successful individual pill pick. At block **422**, the method **400** includes, (a) if a determination is made that no pill was picked up successfully, returning to block **408**, and (b) if a determination is made that a pill was picked up successfully, moving to block **424**.

At block **424**, the method **400** includes moving the probe to a z-axis origin (e.g., in an upward direction). At block **426**, the method **400** includes moving the gantry in the xy-plane to the next available pre-dispensing tray slot. At block **428**, the method **400** includes lowering the probe to a pre-dispensing height. At block **430**, the method **400** includes releasing the pill by turning off the vacuum pump and opening a solenoid to clear the vacuum line. At block **432**, the method **400** includes (a) if a determination is made that more than one pill was dispensed, moving to step **434** which includes (i) capturing the extra pill from the pre-dispensing tray and returning the extra pill to the corresponding bottle, and (ii) checking the pre-dispensing tray weight to confirm that the pre-dispensing tray includes the correct number of pills, and (b) if a determination is made that only one pill was dispensed, moving to block **436**.

At block **436**, the method **400** includes moving the probe to the z-axis origin (e.g., in an upward direction). At block **438**, the method **400** includes confirming if more pills are being dispensed in this dispensing session. At block **440**, the method **400** includes (a) if a determination is made that the pill picking is not complete, returning to block **406**, and (b) if a determination is made that the pill picking is complete, moving to block **442**. At block **442**, the method **400** includes moving the gantry in the xy-plane to a park position and then moving the tray cover down. At block **444**, the method **400** includes showing an alert for dose ready. At block **446**, the method **400** includes turning the pre-dispensing tray to dispense medication when a button is pressed or other user

input is detected. For example, the user input may comprise a fingerprint scan on the button, or a code that is entered on the user interface, or using a mobile application use code and/or face-identification, or a separate fingerprint scanner to verify and authenticate user for medication to be dispensed, or the user input can based on an external camera to unlock the system with face-identification or other user specific characteristic. Other user inputs prior to dispensing the solid dosage medicament are possible as well.

FIG. **9** is a block diagram of an example of a method **500**. Method **500** shown in FIG. **9** presents an embodiment of a method that could be used with any of the systems or devices described above in relation to FIGS. **1-6**C, as an example. Method **500** includes one or more operations, functions, and/or actions as illustrated by one or more of blocks **502-512**. Although the blocks are illustrated in a sequential order, these blocks may also be performed in parallel, and/or in a different order than those described herein. Also, the various blocks may be combined into fewer blocks, divided into additional blocks, and/or removed based upon the desired implementation.

Initially, at block **502**, the method **500** includes providing, at a user interface, a plurality of preferred times corresponding to a plurality of dosage times for medicament delivery. At block **504**, the method **500** includes translating a tray of a solid dosage medicament dispensing system from a first position within a housing of the solid dosage medicament dispensing system to a second position at least partially outside of the housing. At block **506**, the method **500** includes positioning one or more containers in the tray. At block **508**, the method **500** includes translating the tray from the second position to the first position. At block **510**, the method **500** includes determining an identity of a solid dosage medicament positioned in each of the one or more containers positioned in the tray. At block **512**, the method **500** includes, based on the determined identity, providing an option on the user interface to select one or more dosage times corresponding to the plurality of preferred times.

In one example, the method **500** further includes, (a) based on the selected one or more dosage times, providing the solid dosage medicament to a pre-dispensing tray of the solid dosage medicament dispensing system, (b) if a user input is received at the user interface, dispensing the solid dosage medicament to an exterior of the housing, and (c) if no user input is received at the user interface within a threshold time period, returning the solid dosage medicament to the container.

FIGS. **10**A-**10**M illustrate various user interfaces of the solid dosage medicament dispensing system described above. In particular, FIGS. **10**A-**10**M show user interfaces illustrating of one or more of the methods described above. FIG. **10**A illustrates a user interface **600** in which a user can selected preferred times for daily benchmarks corresponding to times for the user to receive their medication. FIG. **10**B illustrates a user interface **602** in which the user has selected the preferred time for a morning dosage. FIG. **10**C illustrates a user interface **604** in which the user can add medication in pill bottles to the solid dosage medicament dispensing system. FIG. **10**D illustrates a user interface **606** that instructs the user to unlock and pull open the tray. FIG. **10**E illustrates a user interface **608** that instructs the user to move the pill bottle lid. FIG. **10**F illustrates a user interface **610** that instructs the user to place the pill bottle into any empty slot in the tray. FIG. **10**G is a graphical representation **612** of the solid dosage medicament dispensing system in a functional context of illustrating the user interface **610** of FIG. **10**F.

FIG. **10**H illustrates a user interface **614** indicating that the solid dosage medicament dispensing system is reading the pill bottle that was just inserted into the tray. FIG. **10**I illustrates a user interface **616** indicating that three pill bottles were detected by the solid dosage medicament dispensing system. FIG. **10**J illustrates a user interface **618** displaying a first medicament detected in one of the three pill bottles, including an indication to select two dosage times from previously selected preferred dosage times. FIG. **10**K illustrates a user interface **620** displaying a second medicament detected in one of the three pill bottles, including an indication to select two dosage times from previously selected preferred dosage times. FIG. **10**L illustrates a user interface **622** displaying a third medicament detected in one of the three pill bottles, including an indication to select two dosage times from the previously selected preferred dosage times. FIG. **10**M illustrates a user interface **624** providing a visual indication that the medicament has been successfully added to the solid dosage medicament dispensing system.

The methods described herein can be utilized effectively with any of the examples or variations of the devices and systems described above, as well as with other examples and variations not described explicitly in this document. The features of any of the systems, devices, or components thereof described in any of the examples herein can be used in any other suitable example of a device or device component.

It should be understood that arrangements described herein are for purposes of example only. As such, those skilled in the art will appreciate that other arrangements and other elements (e.g. machines, interfaces, functions, orders, and groupings of functions, etc.) can be used instead, and some elements may be omitted altogether according to the desired results. Further, many of the elements that are described are functional entities that may be implemented as discrete or distributed components or in conjunction with other components, in any suitable combination and location, or other structural elements described as independent structures may be combined.

While various aspects and examples have been disclosed herein, other aspects and examples will be apparent to those skilled in the art. The various aspects and examples disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope being indicated by the following claims, along with the full scope of equivalents to which such claims are entitled. It is also to be understood that the terminology used herein is for the purpose of describing particular examples only, and is not intended to be limiting.

What is claimed is:

1. A solid dosage medicament dispensing system, comprising:

a housing;

a tray and a tray cover coupled to the housing, wherein the tray cover is removably positioned within the housing over the tray which is configured to receive one or more containers, the tray cover comprising two panels arranged to pivot to opposite sides of the housing in an open position, and wherein the tray is configured to translate between a first position that is fixed relative to the housing and to a second position in which the tray is positioned at least partially outside of the housing to receive the one or more containers;

a track enclosed in the housing;

a gantry carrying a retrieval probe positioned on the track, wherein movement of the gantry relative to the track positions the retrieval probe along an x-y plane, and

wherein the retrieval probe is moveable between the one or more containers when the tray is in the first position and fixed relative to the housing;

a pre-dispending tray, wherein the pre-dispensing tray is a rectangular tray comprising a plurality of compartments coupled within the housing adjacent to the tray in the first position;

a dispensing tray removably coupled to the housing below the pre-dispensing tray, wherein the dispensing tray is configured to receive a solid dosage medicament from the pre-dispensing tray when the dispensing tray is positioned within the housing;

a load cell positioned under the pre-dispensing tray, wherein the load cell is configured to weigh the contents of the pre-dispensing tray;

a user interface configured to receive one or more inputs from a user; and

a control system configured to perform one or more functions of the solid dosage medicament dispensing system based on the one or more inputs received from the user.

2. The solid dosage medicament dispensing system of claim **1**, wherein each container of the one or more containers includes a solid dosage medicament.

3. The solid dosage medicament dispensing system of claim **1**, further comprising:

a vacuum pump in communication with the retrieval probe and configured to create a negative pressure within the retrieval probe.

4. The dosage medicament dispensing system of claim **1**, wherein the control system is configured to:

determine an identity of a solid dosage medicament positioned in a container of the one or more containers positioned in the tray; and

provide an option on the user interface to select a dosage time based on the determined identity.

5. The dosage medicament dispensing system of claim **3**, wherein the control system is configured to:

vibrate the tray;

position, by the gantry, the retrieval probe at a location above a container of the one or more containers positioned in the tray;

lower the retrieval probe into the container to capture a solid dosage medicament from the container; and

determine, based on the negative pressure, whether the retrieval probe has captured the solid dosage medicament.

6. The dosage medicament dispensing system of claim **5**, wherein the control system is configured to:

in response to a determination that the retrieval probe has not captured the solid dosage medicament, direct the gantry to adjust a lateral position of the retrieval probe.

7. The dosage medicament dispensing system of claim **6**, wherein adjusting the lateral position of the retrieval probe via the gantry comprises initially lowering the retrieval probe into a first position in the container and moving the retrieval probe via the gantry along a spiral path relative to the first position until a determination, based on the negative pressure, is made that the retrieval probe has captured the solid dosage medicament.

8. The dosage medicament dispensing system of claim **7**, wherein the first position is in the middle of the container.

9. The dosage medicament dispensing system of claim **5**, wherein the control system is further configured to:

move the retrieval probe to the pre-dispensing tray in response to a determination that the retrieval probe has captured the solid dosage medicament; and

release the solid dosage medicament from the retrieval probe into the pre-dispensing tray.

10. The dosage medicament dispensing system of claim **9**, wherein the control system is further configured to:

if a user input is received at the user interface, dispense the solid dosage medicament to an exterior of the housing; and

if no user input is received at the user interface within a threshold time period, (i) move the retrieval probe to the pre-dispensing tray, (ii) capture the solid dosage medicament from the pre-dispensing tray, and (iii) return the solid dosage medicament to the container.

11. The dosage medicament dispensing system of claim **5**, wherein determining whether the retrieval probe has captured the solid dosage medicament comprises:

comparing a detected vacuum reading of the retrieval probe to a threshold level;

if the detected vacuum reading is less than the threshold level, determining that the retrieval probe has captured the solid dosage medicament; and

if the detected vacuum reading is not less than the threshold level, determining that the retrieval probe has not captured the solid dosage medicament.

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