



US012392789B2

(12) **United States Patent**
Harrison et al.

(10) **Patent No.:** **US 12,392,789 B2**

(45) **Date of Patent:** **Aug. 19, 2025**

(54) **ASSAY REACTION CONTROLLER**
MAGAZINE

2200/143 (2013.01); B01L 2300/0848
(2013.01); B01L 2300/0858 (2013.01); G01N
2035/00039 (2013.01); G01N 2035/00089
(2013.01); G01N 2035/00138 (2013.01); G01N
2035/00277 (2013.01); G02B 21/34 (2013.01)

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(58) **Field of Classification Search**

None

See application file for complete search history.

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(56)

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(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 1250 days.

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(21) Appl. No.: **17/121,668**

(22) Filed: **Dec. 14, 2020**

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(65) **Prior Publication Data**

US 2021/0239720 A1 Aug. 5, 2021

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(Continued)

Related U.S. Application Data

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(63) Continuation of application No. 15/681,255, filed on
Aug. 18, 2017, now Pat. No. 10,866,253, which is a
(Continued)

International Search Report and Written Opinion mailed May 30,
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Feb. 24, 2016, 12 pages.

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(51) **Int. Cl.**

G01N 35/00 (2006.01)

B01L 9/00 (2006.01)

G01N 1/31 (2006.01)

G01N 33/487 (2006.01)

G02B 21/34 (2006.01)

(57)

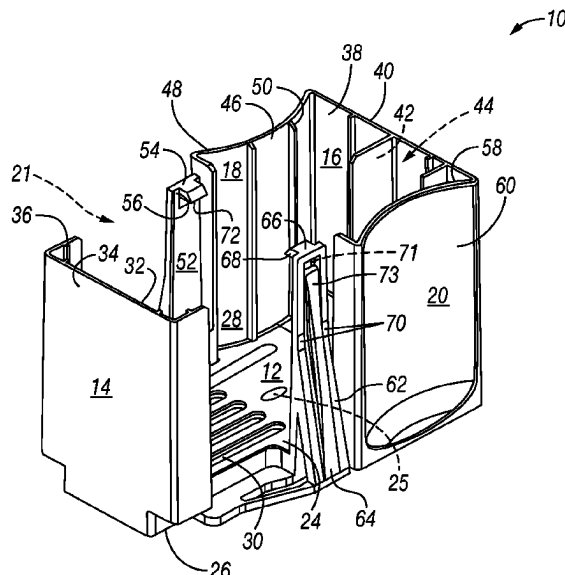
ABSTRACT

Devices and methods for providing and dispensing oppos-
ables onto slides are provided in which magazines loaded
with opposables include retention arms to reduce movement
of the opposables during shipment and processing and to
reduce or eliminate contamination.

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

CPC **G01N 35/00029** (2013.01); **B01L 9/52**
(2013.01); **G01N 1/312** (2013.01); **G01N**
33/48757 (2013.01); **B01L 2200/025**
(2013.01); **B01L 2200/141** (2013.01); **B01L**

13 Claims, 7 Drawing Sheets



Related U.S. Application Data

continuation of application No. PCT/EP2016/
053850, filed on Feb. 24, 2016.

- (60) Provisional application No. 62/126,283, filed on Feb.
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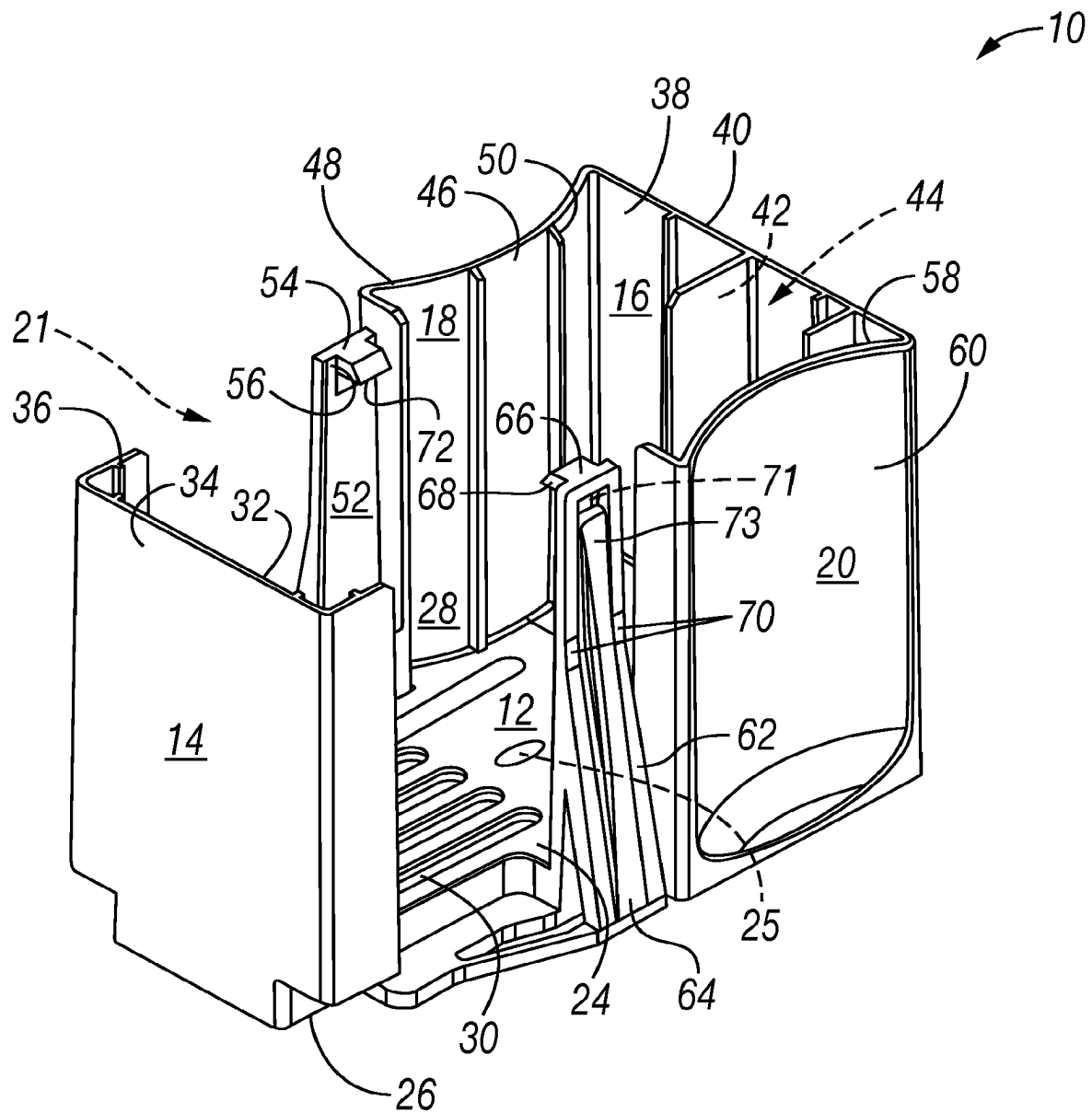
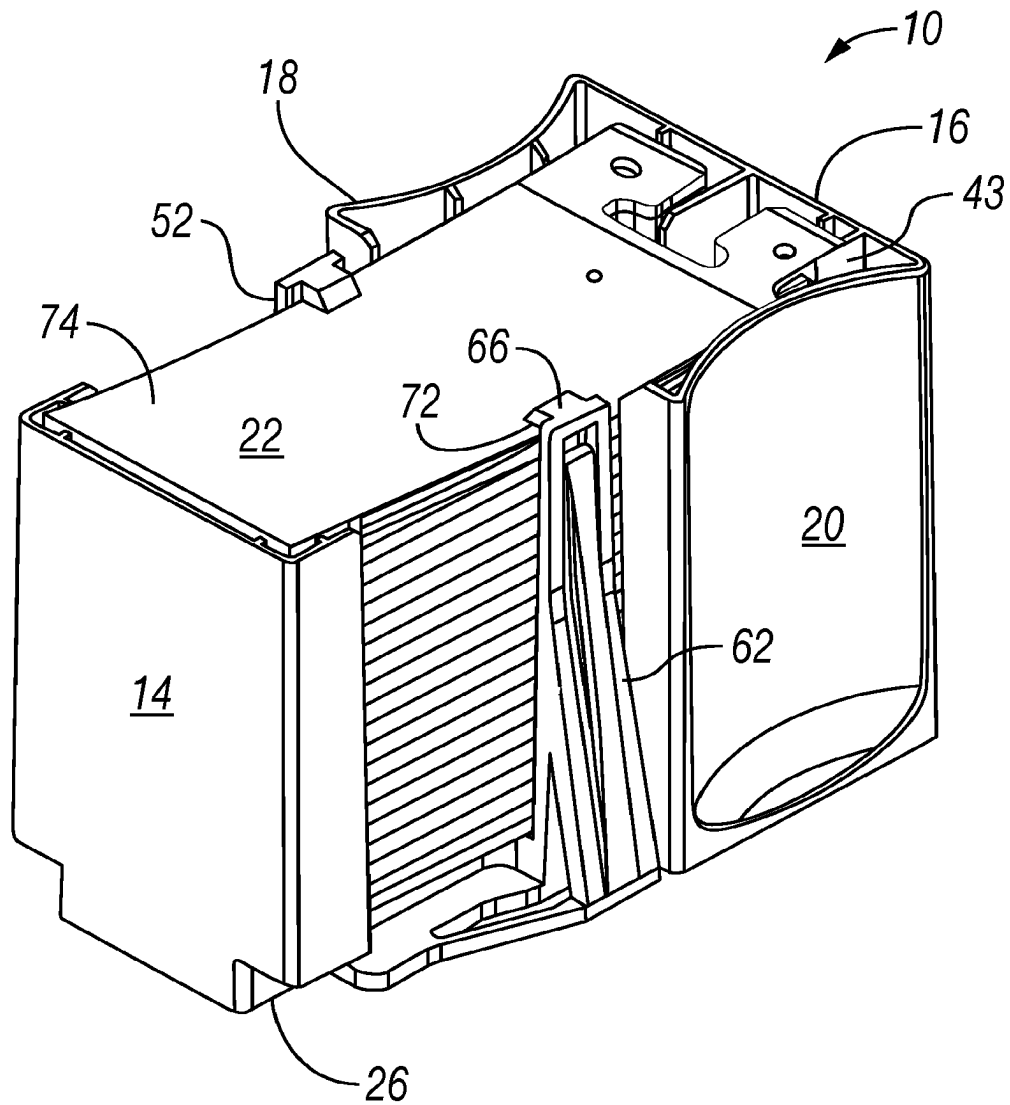


FIG. 1

**FIG. 2**

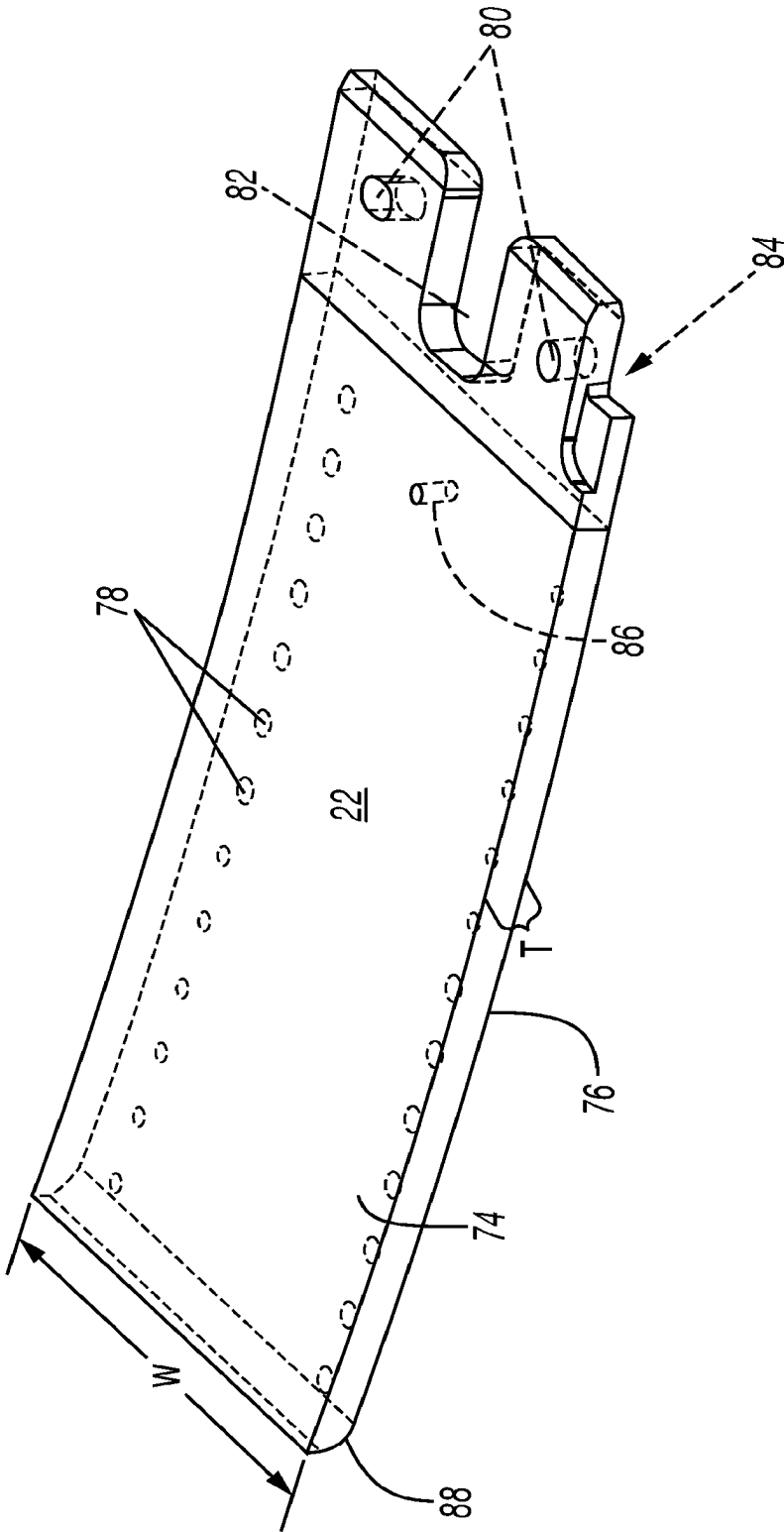


FIG. 3

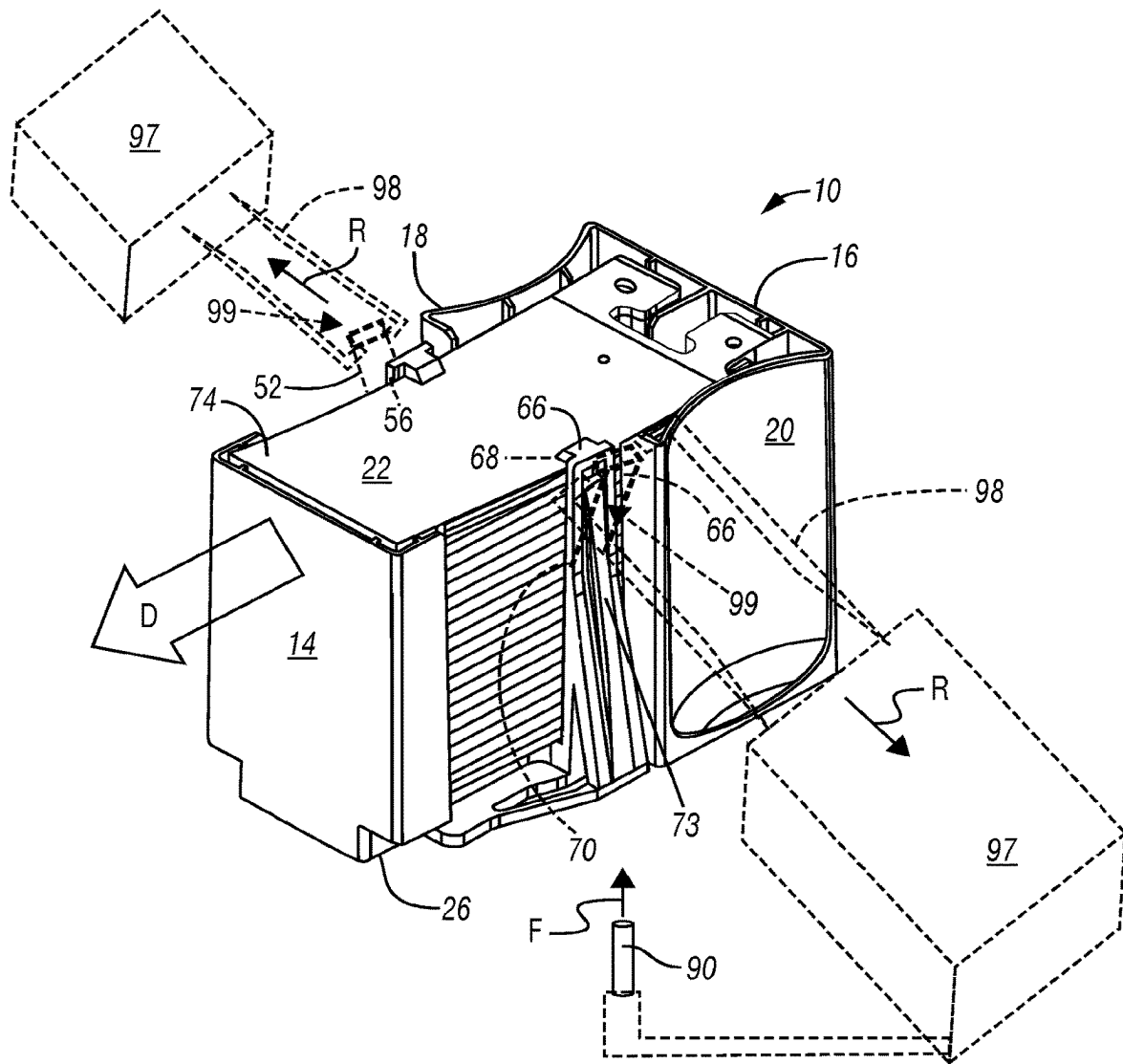
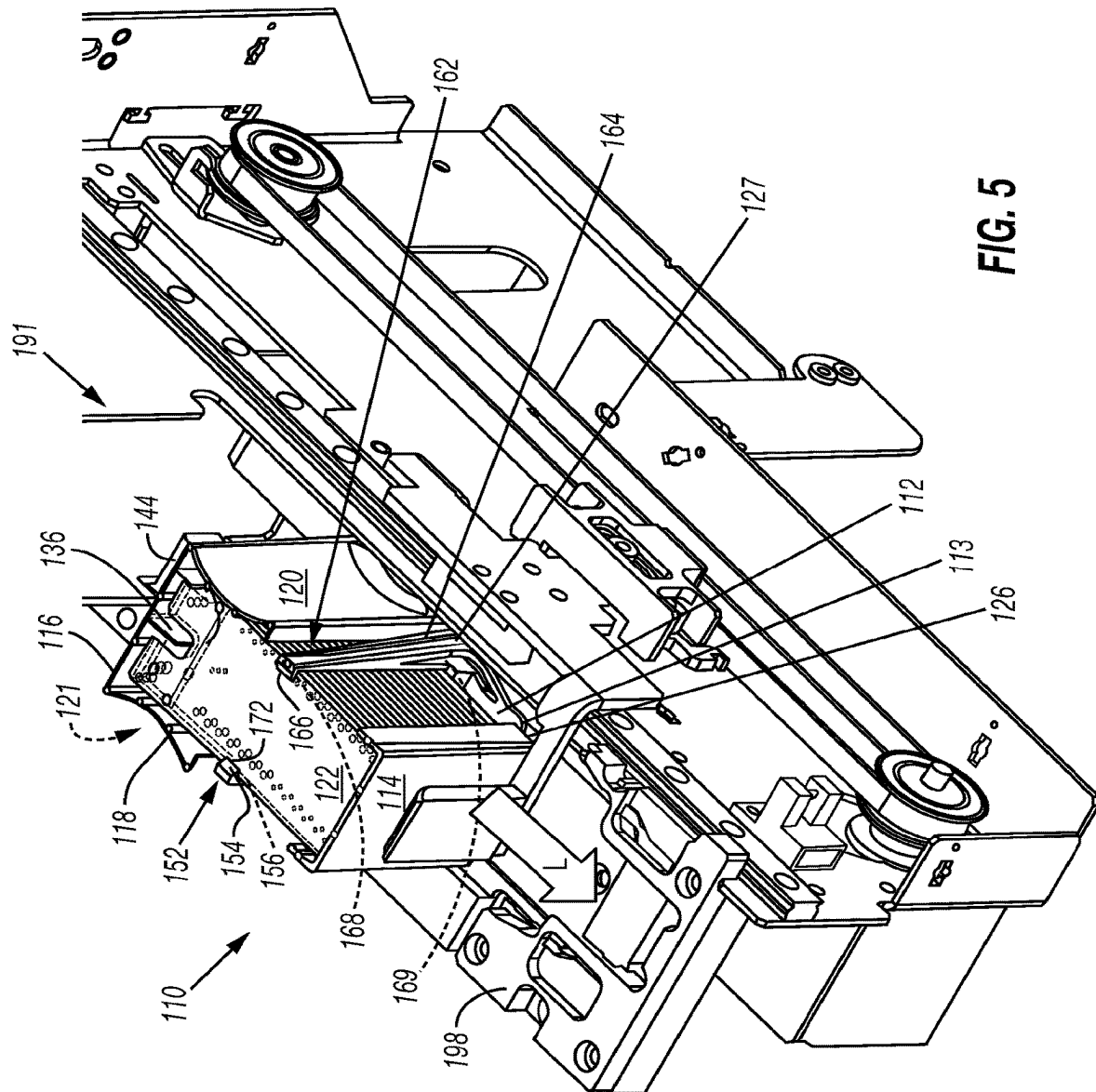


FIG. 4



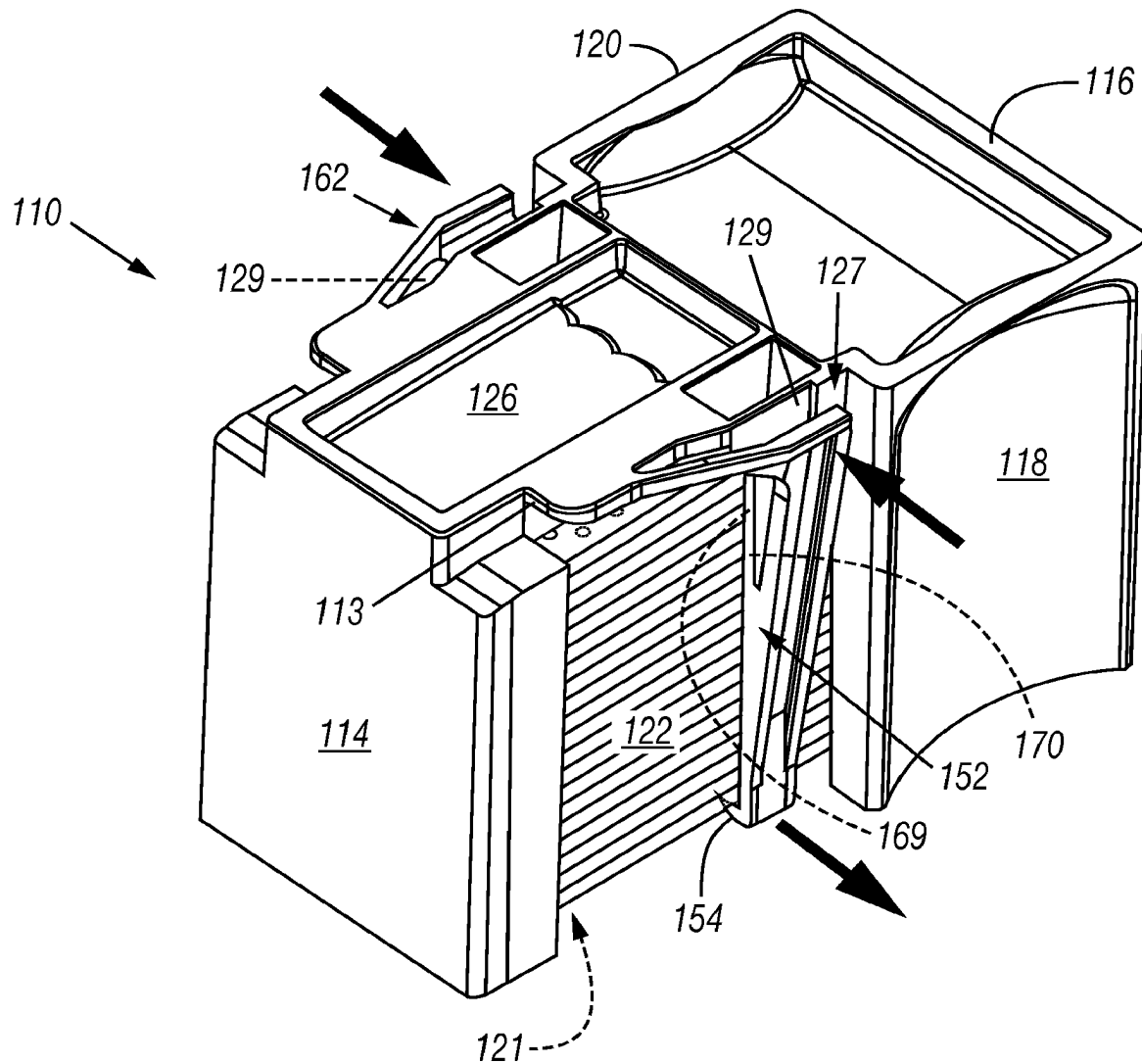


FIG. 6

FIG. 7A

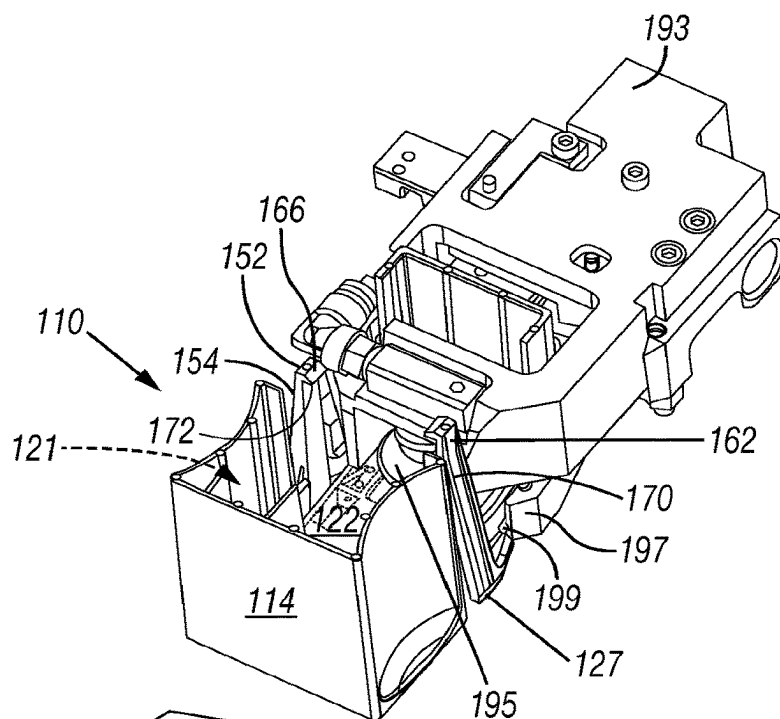


FIG. 7B

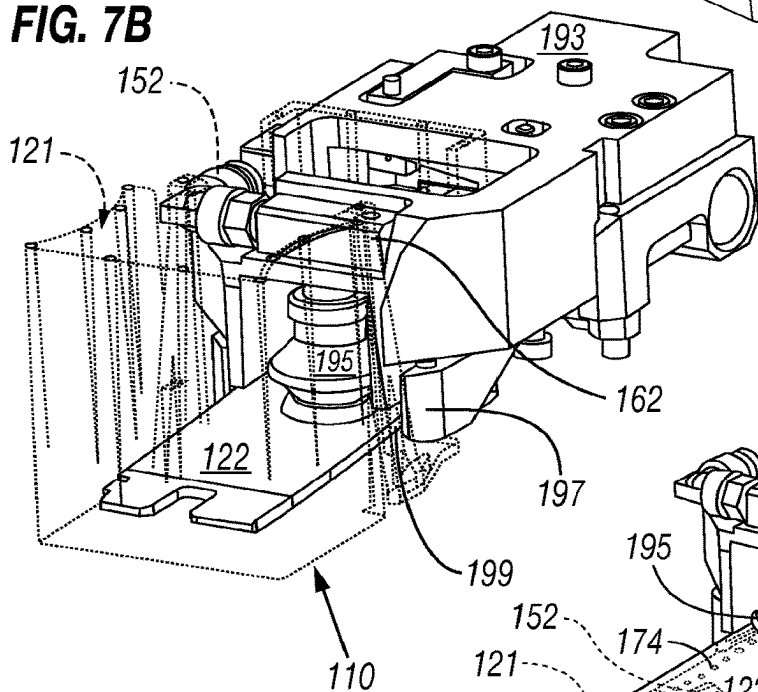
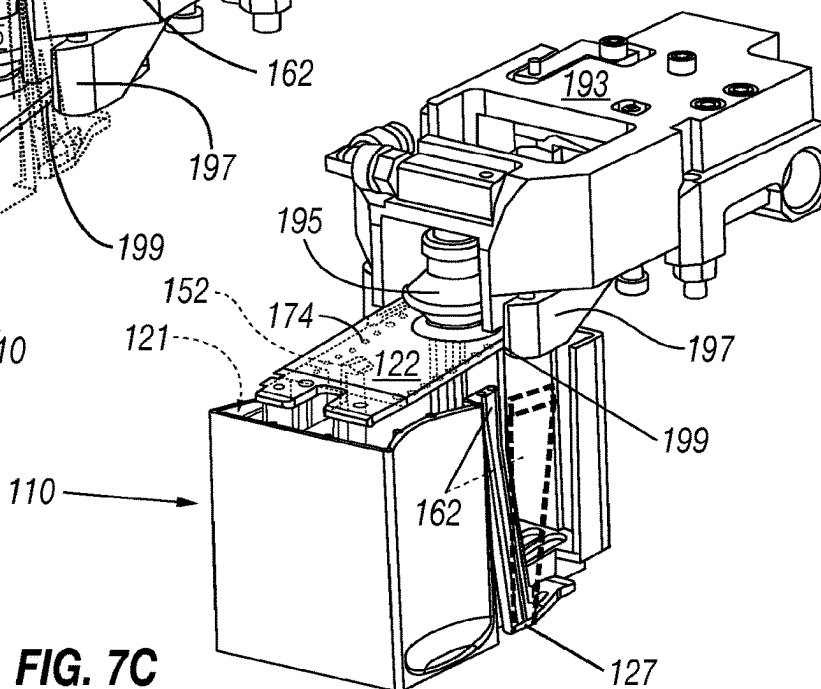


FIG. 7C



ASSAY REACTION CONTROLLER MAGAZINE

RELATED APPLICATION DATA

This application is a continuation of U.S. patent application Ser. No. 15/681,255 filed Aug. 18, 2017 (now U.S. Pat. No. 10,866,253), which is a continuation of International Patent Application No. PCT/EP2016/053850, filed Feb. 24, 2016, which claims priority to and the benefit of U.S. Provisional Patent Application No. 62/126,283, filed Feb. 27, 2015, the entire disclosures of which are hereby incorporated by reference herein for all purposes.

BACKGROUND

Covers for slides (coverslips) are known in the industry for protecting stained samples on microscope slides. When used on automated coverslipping devices the coverslips are often provided in a prepackaged group from a manufacturer and typically are handled manually by a technician. During shipment the coverslips are susceptible to shifting, misalignment and deformation. Later, when automatically applied to a slide more than one coverslip may be picked up as a result of shifting, static electricity and the like. This can lead to the formation on bubbles or other irregularities which can make microscopic examination of the sample difficult.

Additionally, analytical assay devices having opposing internal surfaces for performing capillary immunohistochemical (IHC), in situ Hybridization (ISH) and staining are also known and packaged similarly as coverslips. When used in automated systems the precise positioning of the assay devices in a retaining device or magazine is important for proper pick up and distribution.

Published applications US20130052331 A1 and US20130203100 A1 disclose a rectangular analytical reaction or assay devices that also have curved or arcuate surfaces. These devices are used to create a capillary gap and spread fluids through this gap across the surface of a microscope slide which contains a biological sample thereon. WO2014/102160 A1 discloses an automated system using such a device and the robotic systems employed for placement of the reaction devices. As mentioned above it is important that the retaining magazines for these reaction devices present each reaction device therein to the robotic pick up device in an aligned and individual manner.

What is described and claimed herein is a system for protecting stacked devices, such as coverslips, capillary reaction devices, microscope slide, etc., hereafter opposables, from shifting and deformation during shipping and processing. Furthermore, such a system is needed to enable the automated dispensing of individual opposables onto slide processing stations and for controlling on-slide fluid distribution to achieve superior staining results without contamination. The system should be economical to manufacture, and it should be simple, effective, and reliable to use.

BRIEF SUMMARY OF THE DISCLOSURE

The present disclosure relates in general to systems, devices, and processes for delivering slides, coverslips, flat reactions devices, curved, rectangular shape reaction devices, etc.—all also known herein as an opposable, or opposables—to specimen processing stations for use with specimen-bearing slides. Opposables can be single use, e.g., disposable, or multi-use devices.

The opposables can be used by automated specimen processing stations to manipulate and direct a series of liquids to specimens. The liquids may be manipulated over or across slide surfaces in conjunction with capillary action while the specimen processing stations control the movement of the opposables and the processing temperatures for histology staining, immunohistochemical staining, in situ hybridization staining, or other specimen processing protocols.

In some embodiments, the opposables are surfaces or opposable elements capable of manipulating one or more substances on a slide. Manipulating a substance in the form of a fluid can include spreading the fluid, displacing a thin film of fluid, or otherwise altering a bolus of fluid, a band of fluid, or a thin film onto the specimen-bearing slides.

By way of example, in one embodiment according to the present disclosure, an opposable magazine is provided with retention arms to maintain optimal alignment of a stack of opposables for transference to slide processing stations while simultaneously reducing or eliminating contamination. The magazine may be designed to be loaded only one way into a magazine fascia or opposable bay. The opposable bay pushes the magazine to a departure stage for distribution via a slide transfer head to individual slide processing stations. Once at the departure module, in one aspect of the disclosure, the retention arms of the magazine are retracted to permit an overhead robot or slide transfer assembly to access a top surface of each opposable.

In another aspect of the disclosure, a magazine for dispensing opposables onto slides may include a magazine floor; a dispensing end wall depending from the magazine floor; an alignment end wall depending from the magazine floor, the alignment end wall spaced apart from the dispensing end wall; a first side wall disposed substantially perpendicular to the alignment end wall and to the dispensing end wall; a second side wall disposed substantially perpendicular to the alignment end wall and to the dispensing end wall, the dispensing end wall, the alignment end wall, the first side wall, and the second side wall forming a bay therebetween for holding an opposable; and at least one retention arm depending from the magazine floor, the retention arm having a proximal end in connection with the magazine floor, the retention arm further comprising a joint and being bendable proximate the joint to release the opposable from the bay. The retention arm may include a guidepost, the joint being bendable away from the guidepost.

The magazine floor may include an aperture for access to an opposable by an ejection device. In this aspect, the ejection device may push the opposable in a direction of the distal end of the retention arm. Further, the magazine floor may include a gripping surface configured to minimize lateral movement of an opposable in the bay. The magazine floor may also include a trough configured to prevent a vacuum seal from developing between an opposable and the magazine floor.

Also according to the aspect of the disclosure, a rib or joist may depend from the dispensing end wall, the alignment end wall, the first side wall, and/or the second side wall in a direction of the bay. The distal end of the retention arm may overhang or extend across a portion of the top most opposable. Further, the distal end of the retention arm may be substantially coterminous with the first and second side walls.

The alignment end wall may include a keying feature complementary in shape to the opposable to facilitate loading of the bay.

3

The magazine floor may further include a feed aperture configured to receive an ejector therethrough to urge the opposable in a direction away from the magazine floor. The magazine in this aspect may also include a load monitoring tag for identifying a presence of the opposable.

In another aspect of the disclosure, a method for dispensing an opposable from a cartridge may include providing a magazine for holding a plurality of opposables, the magazine having a retention arm, the retention arm, when in a first resting state, being configured to restrict movement of the plurality of opposables in the magazine; positioning a pick-up device proximate a topmost opposable in the magazine, wherein the pick-up device is configured to take up the topmost opposable when engaged therewith; retracting the retraction arm to a second retracted state; activating the pick-up device to engage and retain the topmost opposable; raising the pick-up device with the topmost opposable engaged therewith; and removing the topmost opposable from the magazine.

In this exemplary method, a first portion of the retention arm may bend or rotate away from the plurality of opposables while a second portion maintains contact with the plurality of opposables.

The magazine may include at least two retention arms disposed apart from each other and positioned around or in close proximity to the plurality of opposables.

The topmost opposable in this aspect may be removed from a departure end of the magazine.

The method may also include positioning a control arm to engage a shoulder of the retention arm, engaging the shoulder with the control arm, and retracting the retraction arm to the second retracted state.

In this aspect, the retention arm may be configured such that upon release of the control arm, the retention arm returns to the first resting state, or the control arm may be reversed to return the retention arm to the first resting state.

The method may further include positioning a compression structure to engage a magazine portion proximate the retention arm, a compression gap being formed therebetween, engaging the magazine portion, and reducing the compression gap to retract the retraction arm to the second retracted state.

The method may further include transporting the topmost opposable to a microscope slide.

The method may further include sending an alert as the plurality of opposables in the magazine is expended.

Additional aspects of the present subject matter are set forth in, or will be apparent to, those of ordinary skill in the art from the detailed description herein. Also, it should be further appreciated that modifications and variations to the specifically illustrated, referred and discussed features and elements hereof may be practiced in various embodiments and uses of the disclosure without departing from the spirit and scope of the subject matter. Variations may include, but are not limited to, substitution of equivalent means, features, or steps for those illustrated, referenced, or discussed, and the functional, operational, or positional reversal of various parts, features, steps, or the like. Those of ordinary skill in the art will better appreciate the features and aspects of such variations upon review of the remainder of the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

A full and enabling disclosure of the present subject matter, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures, in which:

4

FIG. 1 is a top perspective or isometric view of an opposable magazine according to an aspect of the disclosure;

FIG. 2 is an isometric view of the opposable magazine as in FIG. 1, particularly showing the magazine loaded with a plurality of opposables;

FIG. 3 is an isometric view of an opposable as used in the opposable magazine of FIG. 1;

FIG. 4 shows retraction arms (in phantom) manipulating magazine arms according to one aspect of the disclosure;

FIG. 5 is an isometric view of an opposable magazine in an intended use environment according to another aspect of the disclosure;

FIG. 6 is a bottom isometric view of the opposable magazine as in FIG. 5 loaded with opposables, particularly showing a release feature of the magazine; and

FIGS. 7A-C include isometric and partial phantom views of the opposable magazine and an embodiment of a pick-up device.

DETAILED DESCRIPTION OF THE DISCLOSURE

Detailed reference will now be made to the drawings in which examples embodying the present subject matter are shown. The detailed description uses numerical and letter designations to refer to features of the drawings.

The drawings and detailed description provide a full and written description of the present subject matter, and of the manner and process of making and using various exemplary embodiments, so as to enable one skilled in the pertinent art to make and use them, as well as the best mode of carrying out the exemplary embodiments. However, the examples set forth in the drawings and in the detailed description are provided by way of explanation only and are not meant as limitations of the disclosure. The present subject matter thus includes any modifications and variations of the following examples as come within the scope of the appended claims and their equivalents.

In general, automated systems and methods for selecting opposables or slides from a magazine and for mounting or delivering an opposable on a specimen-bearing microscope slide are provided to minimize damage such as deformation of the opposable and to eliminate or reduce contamination.

More particularly, during a specimen-handling process, slides, slide coverslips, and assay reaction controllers (opposables) or disposable opposables can be provided in a prepackaged stack from a manufacturer or can then be loaded into a magazine. The opposable magazine may hold approximately twenty opposables, although varying quantities are possible. To properly handle the opposables and to reduce the risk of contamination, the magazine is provided with retention arms to contain the opposables. As detailed herein, the retention arms may be manipulated to allow opposable transference to specimen-bearing slides.

Referring now to the figures, FIG. 1 broadly shows an opposable magazine, cartridge or carrier designated in general by the numeral 10. The magazine 10 may include a magazine bottom, floor, or face 12, a departure side or wall 14, an alignment wall or side 16, a first side wall or face 18, and a second side wall or face 20. Together, these form a bay or holding area 21 to receive a load as will be explained herein.

The magazine floor 12 as shown in FIG. 1 includes an inner, interior, or first surface 24 and an outer, exterior or external surface 26. The inner surface 24 may be a gripping surface including a non-slick material, troughs, ridges, or

5

indentations 30 to help maintain a load position, stabilize the load, prevent a vacuum seal from forming between an opposable and the inner surface 24, and prevent lateral or longitudinal shifting movements when the magazine 10 is loaded or moved. A load monitoring tag for identifying a load quantity such as a radio frequency identification (RFID) tag or transmitter 28 also may be embedded in or attached to the interior surface 24 to transmit an alert when the magazine 10 is empty. Alternatively or additionally, the RFID tag 28 may be located in or on one or more of the walls 14, 16, 18, and 20 to send an alert when the magazine 10 is nearing empty. Completing the magazine bottom 12 can be an aperture 25 formed through the interior surface 24 and the outer surface 26 of the magazine floor 12. The aperture or opening 25 is provided through the outer surface 26 extending into the magazine 10 to permit ejection or sequential feeding of a cartridge load, as explained in more detail with respect to FIG. 4 below.

With reference to the departure side 14 of the magazine 10 shown in FIG. 1, an interior side 32 having ridges or ribs 36 and an opposing exterior side or wall 34 are provided. The ribs 36 assist in stabilizing a load in the cartridge 10. In this example, the departure side 14 may bend or turn in a direction of the alignment wall 16, and a pair of stabilizing pylons or retention arms 52 and 62 is provided between the walls 14, 16. More particularly, in this example the first retention arm 52 is located between walls 14, 18 and the second retention arm 62 is located between walls 14, 20. As shown, the first retention arm 52 has a distal end 54, also referred to as a finger or grip herein, which extends from a pair of shoulders or recesses 56.

Like the first retention arm 52, the retention arm 62 has a distal end, finger or grip 66 extending from one or more shoulders or recesses 68. The retention arm 62 most clearly shows a proximal end or stand assembly 64, also referred to herein as a bulwark or base, which includes one or more flexible points, leaf springs, or joints 70. As will be explained in detail with reference to an exemplary operation regarding FIG. 4 below, the joint 70 will bend or rotate away from the bay 21 to allow the grip 66, particularly its contact surface 72 that overhangs the opposables 22 in a resting state, to release an opposable 22 from the bay 21. This is also accomplished by forming a channel or notch 71 in the arms 52, 62 in which respective reeds or guiderails 73 are seated to permit the upper portion of the arms 52, 62 to bend away from the bay 21 while an inner surface of the arms 52, 62 maintains contact with the load in the bay 21. In some embodiments, the joint 70 will have a nominal spring constant to urge the retention arm 62 to its original resting state or position.

As briefly introduced above, FIG. 1 clearly shows the alignment wall 16. The alignment wall 16 has an interior wall or face 38 and an exterior wall or side 40. The face 38 may include a plurality of ribs or ridges 42 that may vary in size and may form an insertion guide or slot 44. As shown, the insertion guide 44 is sized and spaced to accommodate a shaped load such as opposables 22 as shown in FIG. 2 below.

Additionally, FIG. 1 shows that the first side wall 18 includes an interior wall or side 46 having ribs or ridges 50 and an exterior wall or side 48. The ribs 50, like previously introduced ribs 36 and 42, act as point bearing surfaces to assist with controlling or limiting movement of a load while simultaneously minimizing surface contact with the load. Also shown in this example, the exterior wall 48, as well as complementary exterior wall 60, may be concave shaped for gripping and handling as well as serving to increase struc-

6

tural integrity and to further serve as an orientation key such that the magazine 10 cannot be improperly loaded in the bay 21 nor by improperly inserting the magazine 10 into a specimen processing station.

Similar to wall 18, the opposing or second side wall 20 shown in FIG. 1 includes an interior side 58 and the exterior side 60 briefly noted above. Ridges or ribs similar to ribs 50 of side wall 18 are provided on the interior side 58 but are not shown in this view. Together, the floor 12 and the walls 14, 16, 18 and 20 form the bay or cavity 21 for holding a load such as opposables as discussed below.

Turning now to FIG. 2, the magazine 10 introduced in FIG. 1 is shown loaded with a plurality of disposable opposables or opposables 22 and resting on outer, exterior or external surface 26. Here, the opposables 22 are oriented and loaded between the walls 14, 16, 18 and 20. As shown, an asymmetrical rib feature 43 will interfere with an incorrectly oriented opposable 22 to prevent improper loading of the magazine 10. FIG. 2 particularly shows that the retention arms 52, 62 holding the opposables 22 in position to prevent shifting during shipment, loading and processing. For instance, the contact surface 72 of the grip 66 is mated against a top surface 74 of the uppermost opposable 22 to prevent upward movement of the opposable 22 from magazine 10.

FIG. 3 most clearly shows an exemplary disposable opposable or opposable 22 introduced above. Here, the opposable 22 includes the top or upper surface 74 and a lower or staining surface or specimen processing region 76. A plurality of gapping features or elements 78 are formed along longitudinal edges of the opposable 22 specimen processing region 76 in this example. The gapping elements 78 can help process a specimen with a desired or minimal amount of fluid. The gapping elements 78 may also be spaced apart from one another to reduce, limit, or substantially prevent wicking between adjacent elements. More specifically, the pattern, number, dimensions, and configurations of the gapping elements 78 can be selected based on the desired interaction between a specimen and a liquid. (See, for example, U.S. Pat. No. 8,911,815(B2) and WO 2014/102160(A1).) If the opposable 22 includes a field of gapping elements 78, the gapping elements 78 can be distributed evenly or unevenly across the opposable 22 to form different patterns that may include, without limitation, one or more rows, arrays, geometric shapes, or the like.

In the example shown in FIG. 3 the rows of gapping elements 78 extend longitudinally along a length of the opposable 22. The row of gapping elements 78 can include about five gapping elements to about sixty gapping elements with an average distance between adjacent gapping elements in a range of about 0.05 inch (1.27 mm) to about 0.6 inch (15.24 mm). In some embodiments, the row of gapping elements 78 has a zigzag configuration, a serpentine configuration, or other configuration or pattern. Moreover, the gapping elements 78 can be evenly or unevenly spaced from one another. For instance, the distance between adjacent gapping elements 78 can be greater or less than the heights of the gapping elements 78. Other spacing arrangements are also possible, if needed or desired. In some embodiments, the thickness T is about 0.08 inch (2 mm), and a width W can be in a range of about 0.6 inch (15.24 mm) to about 1.5 inch (38 mm). In some embodiments, the width W is about 1.2 inches (30 mm). Still other widths are possible.

With reference now to FIGS. 1, 2 and 3, the alignment features 80, a slot or insertion shoe 82, and a keying feature 84 are formed, sized and shaped to properly align and orient the opposable 22 in the magazine 10. More specifically, the

insertion shoe **82** can receive a feature of the magazine **10** such as the interior rib **42** which in part forms the guide **44**. The alignment features **80** (e.g., holes, protrusions, etc.) are also used to align the opposable **22**. As introduced above, the guide **44** ensures proper alignment and orientation of the opposable **22**. The keying feature **84** in particular mates with the rib **43** to ensure correct loading of the magazine **10**.

Continuing with specific reference to FIG. 3, a waste port **86** may also be provided through the surface **74** of the opposable **22**. Thus, when the staining surface **76** interfaces with or engages a liquid on a slide, the liquid may be removed via the port **86** as shown in this example. Also by way of example, although the opposable **22** shown in FIG. 3 is generally rectangular shaped, the opposable **22** may be generally circular shaped, square shaped, or other suitable shape. In some embodiments, the opposable **22** may be circular with diameters of 18 mm, 22 mm, or 25 mm. Square opposables **22** may have sides with lengths of about 18 mm, 22 mm, or 25 mm. Rectangular opposables **22** may have sides with lengths from about 11 mm×22 mm to about 48 mm×60 mm. The dimensions, shapes, and properties of the opposables **22** may be selected based on, for example, the size of the intended microscope slides. The opposables **22** may be made, in whole or in part, of transparent plastic, glass, or other transparent or semi-transparent materials. Depending on the materials used and intended use, the opposables **22** may be disposed of after one use or a finite number of uses, hence the name “disposable opposables”.

In a further aspect of the disclosure as shown in FIG. 3, the opposables **22** may have a substantially planar top and bottom surface and a substantially rectangular configuration, with a length and a thickness slightly less than a specimen slide. Here, the bottom surface **76** of the opposable **22** may define or express a curvature terminating in a gradually angled or curving end **88** positioned to captivate a band of liquid such that when the opposable **22** is over-rolled, a band of liquid can contact and cling to the tapered region **88**. Specifically, the tapered area **76** is a liquid captivation feature. The tapered region **76** provides a large surface area to which the liquid can cling. The illustrated tapered region **76** also may have a radius of curvature equal to or less than about 0.08 inch to cooperate with a standard microscope slide to captivate a band of liquid on the surface of the slide and help prevent “wicking” of the fluid therefrom. Other radii of curvature can be used, if needed or desired. In some embodiments, the curvature of the rounded edge **88** is uniform across the width **W** of the opposable **22**. In other embodiments, the curvature of the rounded edge **88** varies across the width **W** of the opposable **22**.

FIG. 4 shows an exemplary operation in which the opposable magazine **10** is employed in an intended environment. As shown, programmable logic controlled (PLC) machinery or a retraction robot assembly **97** may include in an exemplary embodiment one or more retraction or control arms **98**. The control arms **98** are configured to engage the respective shoulder areas **56**, **68** of the retention arms **52**, **62**. As shown for instance (in phantom for clarity) at arm **62**, when the retraction arms **98** are pulled back or retracted by the robot **97** (indicated by arrow **R**), the arm **62**, which is initially in a first state or resting condition, will bend at or rotate about a joint **70** to retract finger **66** away from the surface **74** of the topmost opposable **22** as indicated by a second state or condition **99** shown phantom for clarity. The foregoing process also occurs with the retention arms **52**. During this process, guidepost **73** remains seated against or in contact with an edge of the opposable load. Thus, the topmost opposable **22** may be picked up from the departure

end of wall **14** indicated by arrow **D**. The retention arms **52**, **62** may have a nominal spring constant such that when the retraction arm(s) **98** reverses direction **R**, the finger **66** is urged to return to its first resting state and reengage or overhang the next surface **74** of the next opposable **22** to prevent load slippage until the subsequent opposable **22** is required. Alternatively, the arms **98** may actively push or reposition the retention arms **52**, **62** proximate the surface **74** of the subsequent opposable **22**.

FIG. 4 further shows an ejector device, pin or push assembly **90** located under the magazine **10**. The assembly **90** may be controlled by the retraction robot assembly **97**. In one embodiment, the assembly **90** will be positioned and activated approximately simultaneously during retraction of the retention arms **52**, **62** by the retraction arm(s) **98**. Here, the push assembly **90** projects through the aperture **25** formed through the outer surface **26** and the interior surface **24** of the magazine floor **12** (see FIG. 1). Thus, the push assembly **90** will individually or sequentially push or feed the plurality of opposables **22** in a direction of the fingers **54**, **66** as indicated by feed arrow **F**.

With reference now to FIG. 5 in accordance with another aspect of the disclosure, an opposable magazine, cartridge, or carrier is designated in general by the numeral **110** and positioned on a processing station or opposable selection device **191**. The magazine **110** broadly includes a magazine bottom, floor, or face **112**, an extraction or departure side or wall **114**, an alignment wall or side **116**, a first side wall or face **118**, and a second side wall or face **120**. Together, these form a bay or holding area **121** to receive a load of assay reaction controllers (opposable) or disposable opposables **122**.

The magazine floor **112** shown in FIG. 5 includes an inner, interior, or first surface and an outer, exterior or external surface **126**. The inner surface may include a gripping surface including a non-slick material, troughs, ridges, or indentations to help maintain a load position, stabilize the load, prevent a vacuum seal from forming between an opposable and the floor **112**, and to prevent lateral or longitudinal shifting movements when the magazine **110** is loaded. A load monitoring tag for identifying a load quantity such as a radio frequency identification (RFID) tag or transmitter also may be embedded in or attached to the interior surface of the floor **112** to transmit an alert when the magazine **110** is empty. Alternatively or additionally, the RFID tag may be located in or on one or more of the walls **114**, **116**, **118**, and **120** to send an alert when the magazine **110** is nearing empty. The RFID may monitor load weight and/or a counting read/write system may track each consumable extraction to determine the remaining load.

As FIG. 5 further shows, a plurality of ridges or ribs **136** may be provided along interior areas of the walls **114**, **116**, **118**, and **120**. The ribs **136** assist in stabilizing a load in the cartridge **110**. The ribs **136** may vary in width (depth) and height and may form an insertion guide or slot **144** to dictate correct orientation and proper loading of a shaped load such as opposables **122**. As shown, the insertion guide **144** is sized and spaced to accommodate complementary shaped opposables **122**.

Also shown in the example of FIG. 5, the departure side **114** may be formed with a bend or turn in a direction of the alignment wall **116** to help secure the opposables **122** in the bay **121**. Moreover, a pair of stabilizing pylons or retention arms **152** and **162** may be provided between the walls **114**, **116** to secure the opposables **122**. Here, the first retention arm **152** is located between walls **114**, **118**. The second

retention arm **162** is located between walls **114**, **120** also to stabilize and secure the opposables **122** in the bay **121**.

With reference to FIGS. **5** and **6**, the first retention arm **152** has a finger, grip or distal end **154**, which extends from a pair of shoulders or recesses **156**. Likewise, the second retention arm **162** has a distal end, finger or grip **166** that extends from one or more shoulders or recesses **168**. As shown, in a first or resting state, the surface **172** of the grip **166** overhangs, or is in resting contact with, the topmost opposable **122**. This example also shows that the retention arm **162** includes a proximal end, bulwark, base or stand assembly **164**, which includes one or more compression features, gaps or apertures **169** that form flexible points or joints **170**.

As best shown from the perspective of the arm **162** in FIG. **5**, on either side of the magazine **110** is a compression structure **127** that depends at an angle from the floor **126** and includes a lateral gap or opening **129** (see FIG. **6**) in connection with the compression aperture **169** in the base **164**. The lateral opening **129** and the compression aperture **169** form a leaf spring arrangement as described in further detail below with respect to FIG. **6**. Also shown, a stop or shoulder **113** may be formed at or near the floor **126** to secure the magazine **110** in position during unloading.

The compression structure **127** of the magazine **110** is most clearly shown from a bottom perspective in FIG. **6**. The sliding engagement **L** of the magazine **110** with a complementary angled compression structure **198** noted above with respect to FIG. **5** causes the shoulder **113** to hold the magazine **110** in position on the selection device **191** while the lateral gap **129** and the compression gap **169** close in a direction of the bay **121**, as indicated by the inwardly directed arrows shown in FIG. **6**. This in turn causes the joint **170** to bend and to push the arms **152**, **162** away from the bay **121** as indicated by the outward arrow.

Turning now to FIGS. **7A-7C**, by way of exemplary operation, a portion of a pick-up device **193** is positioned above the magazine **110**. As the magazine **110** is moved in a loading direction **L** (see FIG. **5**) toward a slide processing station (not shown), the compression structure **198** (see FIG. **5**) engages the compression structure **127** of the magazine **110**. The sliding engagement causes the lateral gap **129** and the compression gap **169** noted in FIG. **6** to close in a direction of the bay **121**. This in turn causes the joint **170** to rotate and to push the arms **152**, **162** away from the bay **121** to allow the grip **166**, particularly its opposable holding surface **172**, to release an opposable **122** from the bay **121**.

FIGS. **7B** & **7C** further show that as the arms **152**, **162** are retracted away from the bay **121** in a second or tensioned state (in phantom), a pick-up device **195**, such as a suction cup or lifter head, is extended or lowered to a surface of the topmost opposable **122** in the bay **121**. Alternatively, or additionally, the opposable **122** may be spring-loaded and pushed upward to meet the pick-up device **195**. Once suction is applied and the device **195** is in suction contact with and has control of the topmost opposable **122** via the surface **174**, the topmost opposable **122** is removed from the magazine **110**. Each subsequent opposable **122** may be removed by the same or another pick-up device **195** until the magazine **110** is empty and a subsequent magazine is loaded via the magazine fascia of a slide processing station. Alternatively, the direction **L** of the magazine **110** may be reversed and/or the compression structure **198** (compare FIG. **5**) may be disengaged between each opposable **122** to return the arms **152**, **162** to their resting state between opposable **122** extractions.

Also shown in FIGS. **7A-C**, the suction head **195** is placed into suction contact with one of the opposables **122** in the bay **121**. A lifter arm **197** having a finger, shelf, or underlying protrusion **199** also may be pressed into contact with or be closed about a portion of a perimeter of the opposable **122** to assist the suction head **195** in securing the opposable **122** to lift it from the bay **121**, as indicated by the double-headed arrow.

While the present subject matter has been described in detail with respect to specific embodiments thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing may readily produce alterations to, variations of, and equivalents to such embodiments. Accordingly, the scope of the present disclosure is by way of example rather than by way of limitation, and the subject disclosure does not preclude inclusion of such modifications, variations and/or additions to the present subject matter as would be readily apparent to one of ordinary skill in the art.

The invention claimed is:

1. A method for dispensing an opposable from a cartridge, comprising:

providing a magazine for holding a stack of opposables, the magazine having a retention arm and a guidepost proximate the retention arm and positioned along a lateral side of the stack of opposables, wherein a topmost opposable of the stack of opposables includes a first edge, a second edge, and a generally linear portion that extends across a width of the topmost opposable between the first and second edges, wherein the retention arm has an overhanging portion with a contact surface that contacts the linear portion, and wherein the retention arm, when in a first resting state, is configured to restrict movement of the stack of opposables in the magazine;

positioning a pick-up device proximate the topmost opposable in the magazine;

retracting the retention arm to a second retracted state to deflect the contact surface away from the linear portion of the stack of opposables while the guidepost is biased toward the stack of opposables to restrict movement of each of the stack of opposables;

activating the pick-up device to engage and retain the topmost opposable;

raising the pick-up device with the topmost opposable engaged therewith; and

after raising the pick-up device and the topmost opposable away from the stack of opposables, returning the retention arm to the first resting state, and raising the stack of opposables to contact the contact surface.

2. The method of claim 1, wherein a first portion of the retention arm bends away from the stack of opposables and the guidepost maintains contact with the stack of opposables.

3. The method of claim 1, wherein the magazine includes at least two retention arms disposed apart from each other and about the stack of opposables.

4. The method of claim 1, wherein the topmost opposable is removed from proximate a departure end of the magazine.

5. The method of claim 1, further comprising positioning a control arm to engage a shoulder of the retention arm, engaging the shoulder with the control arm, and retracting the retention arm to the second retracted state.

6. The method of claim 5, wherein the retention arm is configured such that upon release of the control arm, the retention arm returns to the first resting state.

11

7. The method of claim 5, further comprising reversing the control arm to return the retention arm to the first resting state.

8. The method of claim 1, further comprising positioning a compression structure to engage a magazine portion proximate the retention arm, a compression gap being formed therebetween, engaging the magazine portion, and reducing the compression gap to retract the retention arm to the second retracted state.

9. The method of claim 1, further comprising sending an alert as the stack of opposables in the magazine is expended.

10. The method of claim 1, wherein the stack of opposables is a stack of coverslips.

11. A method comprising:

positioning a pick-up device proximate a topmost opposable of a stack of opposables in a magazine, wherein the magazine has a retention arm and a guidepost proximate the retention arm and positioned along a lateral side of the stack of opposables, wherein the topmost opposable includes two or more edge portions with a generally flat portion extending across a middle of the topmost opposable and between at least two of

12

the two or more edge portions, wherein the retention arm has an overhanging portion with a contact surface contacting the generally flat portion of the topmost opposable, and wherein the retention arm, when in a first resting state, is configured to restrict movement of the stack of opposables in the magazine;

retracting the retention arm to a second retracted state while the guidepost restricts movement of the stack of opposables;

operating the pick-up device to engage and retain the topmost opposable; and

moving the pick-up device carrying the topmost opposable so as to move the topmost opposable away from the magazine.

12. The method of claim 11, wherein a first portion of the retention arm bends away from the stack of opposables and the guidepost maintains contact with the stack of opposables.

13. The method of claim 11, wherein the stack of opposables includes coverslips configured to cover specimen-bearing microscope slides.

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