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(54) **TUBE RACK TOOL AND METHOD FOR REMOVING TUBES FROM A RACK**

ROHRGESTELLWERKZEUG UND VERFAHREN ZUM ENTFERNEN VON RÖHRCHEN AUS EINEM GESTELL

OUTIL DE PORTOIR DE TUBES ET PROCÉDÉ POUR RETIRER DES TUBES D'UN PORTOIR DE TUBES

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Description

BACKGROUND

1. Technical Field

[0001] Embodiments of the present disclosure relate generally to tube rack tools for dislodging a plurality of tubes from a rack of tubes, and more specifically for synchronously dislodging a plurality of tubes from a rack of tubes, and methods for using the same.

2. Background and Relevant Art

[0002] A microtiter plate is a flat plate with multiple "wells" used as small test tubes or used to receive tubes therein. The microtiter plate has become a standard tool in analytical research and clinical diagnostic testing laboratories. A microtiter plate typically has 6, 24, 96, 384, 1536, 6144, or 24576 sample wells arranged in a 2:3 rectangular matrix. Some microtiter plates have even been manufactured with 3456 or even 9600 wells, although 96 wells, provided in an 8 x 12 arrangement is the most common.

[0003] Depending on the size, each well typically holds somewhere between a few nanoliters to several hundred milliliters of liquid or an equivalent amount of a solid sample, such as a dry powder. Accordingly, some plates have wells with closed bottoms. In certain embodiments, plates may be provided as racks to support glass or plastic tube or tube strip inserts. In such embodiments, the wells can alternatively have open bottoms. Illustrative wells can be circular (including cylindrical or conical) or square in cross-section. Pipettes (e.g., multi-channel pipettes) have been developed to pipette measured liquids into an entire row of wells at a time. PCR devices and other instruments for a wide variety of laboratory applications have been developed to receive microtiter plates of standard sizes and to process samples contained in the wells therein. A number of companies have even developed robots specifically configured to handle microtiter plates.

[0004] Microtiter plates often are provided with wells formed in the plate. The most common manufacturing process is injection molding, used typically for polystyrene, polypropylene and cyclo-olefin. However, microplates may be made from a variety of polymers, as is appropriate to withstand a wide temperature range and provide chemical resistance.

[0005] More recently, plates have become available that include a rack and a plurality of strips or individual tubes, a common configuration being twelve strips of eight tubes (or eight strips of twelve tubes). Such an arrangement may make it easier to use a portion of a plate or to prepare smaller groups of reactions within a single plate. Often, the spacing of the tubes results in standard spacing of wells of a 96-well microtiter plate, and the rack and tubes, once assembled, are compatible with the myriad tools and instrumentation that have been developed for use with microtiter plates.

[0006] One example of a rack and tubes is the Loborack-96 (Micronic North America, McMurray, PA). The Loborack-96 can hold, for example, 96 individual tubes (for example, 0.50ml or 0.75ml tubes), eight strips of twelve tubes, or twelve strips of eight tubes, in a 96-well configuration. Each tube may be individually capped, or each strip may be capped with a strip of eight or twelve caps, respectively. While the tubes are disposable and are intended as single-use items, the rack is reusable. However, it can be difficult to remove the tubes from the rack manually, and tubes often open as they are removed, potentially contaminating the tube contents or spilling hazardous or contaminating materials. While Micronic sells a tool for removing one tube at a time, a tool that removes rows of tubes or all tubes quickly and easily is desired.

[0007] CN 204 074 121 U describes a test tube box comprising a box body, a test tube rack and a cavity between the test tube rack and the bottom of the box body, with a plurality of lifting mechanisms arranged in rows in the cavity. US 2002/170867 A1 describes a test tube rack with an inserting structure comprising a transversely superposed tray bodies. US 2003/143120 A1 describes the base of a modular parallel chemistry reactor that includes a frame which defines an opening into which one of a plurality of interchangeable reaction vessel carrying inserts can be removably received.

BRIEF SUMMARY

[0008] The invention provides a tube removal system and method of using such a system, as defined in the claims

[0009] Additional features and advantages of the embodiments of the present disclosure will be set forth in the description which follows or may be learned by the practice of such embodiments. The features and advantages of such embodiments may be realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims. These and other features will become more fully apparent from the following description and appended claims, or may be learned by the practice of such embodiments as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a perspective view of a base for an illustrative tube rack tool.

Fig. 2 is a perspective view of a top piece for use with the base of Fig. 1.

Fig. 3 is an exploded perspective view of a rack of tubes inserted between the base of Fig. 1 and the top piece of Fig. 2.

Fig. 4 is a cross-sectional view of a rack of tubes inserted between the base of Fig. 1 and the top piece of Fig. 2.

Fig. 5 is similar to Fig. 4, except that pressure has been exerted on the top piece and some of the tubes are being removed from the rack.

Fig. 6 is similar to Fig. 1, except showing a base for a different illustrative tube rack tool.

Fig. 7 is similar to Fig. 2, except showing a top piece for an alternate illustrative tube rack tool.

Fig. 8 is similar to Fig. 5 except showing a base and top piece for an alternate illustrative tube rack tool.

Fig. 9 is a top view of the base and top piece of Fig. 8.

Fig. 10 shows a row of tubes with caps, and a top piece positioned to apply pressure to the caps.

Fig. 11 is similar to Fig. 10, except that the caps are in process of being seated by pressure from the top piece.

Fig. 12 is a cross-sectional view of a row of tubes with caps, and an inverted base positioned to apply pressure to the caps.

Fig. 13 is similar to Fig. 12, except that the caps are in process of being seated by pressure from the inverted base.

DETAILED DESCRIPTION

[0011] Before describing example implementations in detail, it is to be understood that this disclosure is not limited to parameters of the particularly exemplified systems, methods, apparatus, products, processes, compositions, and/or kits, which may, of course, vary. It is also to be understood that the terminology used herein is only for the purpose of describing particular implementations of the present disclosure, and is not necessarily intended to limit the scope of the disclosure and/or invention in any manner. Thus, while the present disclosure will be described in detail with reference to specific configurations, the descriptions are illustrative only and are not to be construed as limiting the scope of the claimed invention. For instance, certain implementations may include fewer or additional components than those illustrated in the accompanying drawings and/or described in the written description.

[0012] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the present disclosure pertains. While a number of methods and materials similar or equivalent to those described herein can be used in the practice of the present disclosure, only certain exemplary materials and methods are described herein.

[0013] Various aspects of the present disclosure, including devices, systems, methods, etc., may be illustrated with reference to one or more exemplary implementations. As used herein, the term "exemplary" means "serving as an example, instance, or illustration," and should not necessarily be construed as preferred or advantageous over other implementations disclosed herein. In addition, reference to an "implementation" of the present disclosure or invention includes a specific reference to one or more embodiments thereof, and vice versa, and is intended to provide illustrative examples without limiting the scope of the invention, which is indicated by the appended claims rather than by the following description.

[0014] It will be noted that, as used in this specification and the appended claims, the singular forms "a," "an" and "the" include plural referents unless the content clearly dictates otherwise. Thus, for example, reference to a "tile" includes one, two, or more tiles. Similarly, reference to a plurality of referents should be interpreted as comprising a single referent and/or a plurality of referents unless the content and/or context clearly dictate otherwise. Thus, reference to "tiles" does not necessarily require a plurality of such tiles. Instead, it will be appreciated that independent of conjugation; one or more tiles are contemplated herein.

[0015] As used throughout this application the words "can" and "may" are used in a permissive sense (i.e., meaning having the potential to), rather than the mandatory sense (i.e., meaning must). Additionally, the terms "including," "having," "involving," "containing," "characterized by," variants thereof (e.g., "includes," "has," and "involves," "contains," etc.), and similar terms as used herein, including the claims, shall be inclusive and/or open-ended, shall have the same meaning as the word "comprising" and variants thereof (e.g., "comprise" and "comprises"), and do not exclude additional, un-recited elements or method steps, illustratively.

[0016] As used herein, directional and/or arbitrary terms, such as "top," "bottom," "left," "right," "up," "down," "upper," "lower," "inner," "outer," "internal," "external," "interior," "exterior," "proximal," "distal" and the like can be used solely to indicate relative directions and/or orientations and may not be otherwise intended to limit the scope of the disclosure, including the specification, drawings, and/or claims.

[0017] Various aspects of the present disclosure can be illustrated by describing components that are bound, coupled, attached, connected, and/or joined together. As used herein, the terms "bound," "coupled", "attached", "connected," and/or "joined" are used to indicate either a direct association between two components or, where appropriate, an indirect association with one another through intervening or intermediate components. In contrast, when a component is referred to as being "directly bound," "directly coupled", "directly attached", "directly connected," and/or "directly joined" to another component, no intervening elements are present or contemplated.

[0018] The headings used herein are for organizational purposes only and are not meant to be used to limit the scope of the description or the claims. To facilitate understanding, like reference numerals have been used, where possible, to designate like elements common to

the figures. Furthermore, where possible, like numbering of elements have been used in various figures. Furthermore, alternative configurations of a particular element may each include separate letters appended to the element number.

[0019] Fig. 1 shows a base 10 of an illustrative tube rack tool 8 (see Fig. 3) according to an embodiment of the present disclosure. The base has a support surface 12, and four walls 15, 16, 17, 18, which surround a rack-receiving area 11 for receiving a rack of tubes. In the illustrative embodiment, support surface 12 is curved along an axis extending in the direction from wall 18 to wall 17. In some embodiments, support surface 12 can (also or alternatively) be curved along an axis extending in the direction from wall 16 to wall 15. As discussed further below, however, support surface 12 need not have a curved configuration in certain embodiments. Also in the illustrative embodiment, two spacings 13, 14 are provided between support surface 12 and walls 17, 18, respectively. Spacings 13, 14 comprise openings through base 10, although optionally openings 13, 14 may be provided with bottoms to result in recesses. Opposing recesses 20 are also disposed between support surface 12 and walls 15, 16, respectively. It is understood that walls 15, 16, 17, and 18, as well as spacings 13, 14, and recesses 20 are provided to aid in placement and retention of a rack (of tubes) within rack-receiving area 11, and that any or all of these walls, spacings, and/or recesses are optional and may be omitted. Similarly, the walls need not entirely surround the rack-receiving area 11 in some embodiments.

[0020] Fig. 2 shows a top piece 50 that may be used with base 10 (e.g., to form the tube rack tool 8 of Fig. 3). Top piece 50 has a top 52, and two legs 60, 61 extending downward from top 50. Legs 60, 61 are spaced to receive a rack of tubes therebetween. In alternative examples, top piece 50 can have a single leg or more than two legs extending downward therefrom. For example, a single leg can extend (entirely or partially) about top piece 50 and/or extend downward therefrom. Alternatively, three or four legs can be disposed at corners of top piece 50.

[0021] In the illustrative example depicted, leg 60 is provided with leg extensions 63, 64, and leg 61 is provided with leg extension 65 (and a second leg extension not shown in Fig. 2). As best seen with leg extension 63, the leg extensions project inward from each leg (e.g., toward the opposing leg). The leg extensions may be provided to aid in containing and/or properly positioning the rack of tubes between legs 60, 61, and/or restrain the rack of tubes from slipping sideways out of top piece 50. As discussed in further detail below, the leg extensions may also aid in properly positioning the rack of tubes about support surface 12 of base 10 (Fig. 1). Optionally, instead of or in addition to the leg extensions, top piece 50 may be provided with side walls extending between legs 60 and 61 to contain the rack of tubes.

[0022] Fig. 3 shows an exploded view of a tube removal tool assembly 40 comprising a rack of tubes 78 including rack 80 and ninety-six tubes 82 being inserted between base 10 and top piece 50. It is understood that while illustrative rack 80 includes space for ninety-six tubes, any other number or arrangement of a rack and tubes may be used. Moreover, while illustrative rack of tubes 78 is full, the illustrative embodiments may be used with a partially full rack of tubes. As discussed above, walls 15, 16, 17, 18 of base 10 are sized to receive rack of tubes 78 therein, thereby supporting rack of tubes 78 on support surface 12. As top piece 50 is placed over rack of tubes 78, legs 60, 61 of top piece 50 extend down at least partially around tubes 82, fit inside walls 15, 16, 17, 18, and assist with maintaining the orientation of rack 80 and tubes 82 relative to base 10 and/or support surface 12 thereof.

[0023] In this illustrative example, rack 80 is provided with twelve rows 85 of eight tubes 82, although it is understood that other configurations are within the scope of this disclosure. Each tube 82 has an open top portion 88 and a closed opposing bottom portion 90 (see Fig. 4) inserted into its respective well 84 in rack 80. Wells 84 comprise openings in a surface portion 81 of rack 80, and each tube 82 or a bottom portion 90 thereof (*see* Fig. 4) extends below surface portion 81. As best seen in the cross-sectional view of Fig. 4, a skirt 89 functions as a stand for rack 80, extending below any bottom 90 of tubes 82. Thus, when rack 80 is placed on a lab bench or other flat surface, tubes 82 are spaced apart from that surface, to prevent tubes 82 from inadvertently dislodging from rack 80.

[0024] It is understood that while only two walls of skirt 89 are visible in Fig. 3, rack 80 may have a skirt 89 having two, three, or four walls, or may have feet or other bottom projections to function to keep tubes 82 elevated. Tubes 82, may be of any configuration, illustratively with flat bottoms, rounded bottoms, or conical bottoms. Tubes 82 may snap into rack 80, or may be held in place by pressure. While not shown in Figs. 3-5, tubes 82 may be provided with caps, illustratively which may be screw caps, press fit caps, strip caps, or film adhered to or heat-sealed to tubes 82. For instance, in at least one embodiment, as shown in Figs. 10-11, tubes 82 can have sealing cap(s) 83 disposed thereon and/or attached thereto (e.g., sealing the upper open portions 88 thereof). Other configurations are also contemplated within the scope of this disclosure.

[0025] Fig. 4 shows a cross-sectional view of a tube removal tool assembly 40, including rack of tubes 78 inserted into base 10, and top piece 50 fitted on top of rack of tubes 78, with legs 60, 61 engaging rack 80 at upper surface portion 81. Because of the curvature of support surface 12, only a portion of the rows 85 of tubes 82 are in contact with support surface 12. In this illustrative embodiment, ends 86, 87 of rack 80 are cantilevered over openings 13, 14. Shown in Figs. 1 and 3, a recess 20 between support surface 12 and wall 15 allows skirt 89 of rack 80 to extend below support surface 12. A similar recess (not shown) may be provided between support

surface 12 and wall 16. Accordingly, in at least one embodiment, support surface 12 of base 10 engages a plurality of tubes 82 (or bottom portion(s) thereof) but does not engage and/or contact at least a portion of skirt 89 of rack 80.

[0026] Downward pressure (e.g., from above) on top piece 50 causes one or more rows 85 of tubes 82 (or bottom portion(s) thereof) to engage support surface 12 of base 10, which in turn causes one or more (rows 85 of) tubes 82 to begin to dislodge from rack 80, as shown in Fig. 5. Accordingly, a plurality of tubes 82 (e.g., at least one row 85) can be simultaneously, concurrently, and/or synchronously dislodge from the rack. In an illustrative embodiment, a back-and-forth rocking motion about or along the curvature of support surface 12, as indicated by arrows X-X, causes additional rows 85 of tubes 82 to engage support surface 12 of base 10, which in turn causes the additional rows 85 of tubes 82 to dislodge from rack 80. As pressure is placed more directly over leg 60, pressure is placed more directly over cantilevered end 86, which may deflect toward opening 13 (e.g., without engaging support surface 12 of base 10), thereby releasing the row 85 closest to end 86. As top piece 50 is rocked in the other direction and pressure is placed more directly over leg 61, pressure is placed more directly over cantilevered end 87, which may deflect toward opening 14 (e.g., without engaging support surface 12 of base 10), thereby releasing the row 85 closest to end 87. Continued back-and-forth motion causes all tubes 82 to loosen from rack 80, ultimately dislodging all tubes 82 from rack 80. Accordingly, a plurality of tubes 82 and/or rows 85 of tubes 82 can be simultaneously, concurrently, synchronously, and/or immediately sequentially (e.g., instantaneously) dislodged from the rack 80. The rack 80 and tubes 82 may then be removed from base 10 and top piece 50.

[0027] In the embodiment illustrated in Figs. 1 and 3-5, support surface 12 is curved. While the illustrative curvature is an arc of a circle having a radius of approximately 50.8 cm (20 inches), it is understood that this is illustrative only, and that other curvatures would be operational, illustratively having a radius of 15 inches to 25 inches, 25.4 (10 inches) to 76.2 (30 inches), or 17.8 (7 inches) to 101.6 (40 inches). While circular curvatures are used in certain embodiments herein, it is understood that other shapes are within the scope of this disclosure, including parabolic, and curved in two dimensions. In one illustrative embodiment, support surface 12 may be planar, provided that support surface 12 is smaller than skirt 89. It is understood that flatter support surfaces can dislodge more tubes at once but may require more pressure, while more curved support surfaces may dislodge fewer tubes at once, but may also require less pressure. Furthermore, curvature in one direction can dislodge tubes by rows, while curvature in both directions may allow dislodging of a single tube or a small group of tubes.

[0028] Returning to Fig. 2, in this illustrative example, a top portion 52 of top piece 50 is provided with an opening 53. As best shown in Figs. 10-11, top portion 52 is also provided with curved edge 55, shaped for pressing on tube caps 83 (e.g., to seal opening 88 with cap 83), and configured for capping a row 85 of tubes 82 with a (downward) force and/or a rocking motion, as indicated by arrows Y-Y in Fig. 11. It is also noted that curved edge 55 can be shaped and/or configured for seating (a row 85 of) tubes 82 into rack 80 (not shown) with a (pressing) force or the rocking motion indicated by arrows Y-Y in Fig. 11. Opening 53 optionally may be provided with grips 54 for comfortably holding top piece 50 during this capping operation.

[0029] Alternatively, base 10 may be inverted and support surface 12 positioned over (row 85 of) tubes 82 as depicted in Figure 12. A similar rocking motion, indicated by arrows Y-Y in Fig. 13, and/or (downward) force can be applied for pressing on tube caps 83 (e.g., to seal opening 88 with cap 83). It is also noted that inverted base 10 and/or support surface 12 thereof may be used for seating part or all of the tubes 82 of a rack of tubes 78 into rack 80 (see Fig. 3), or for capping one or more tubes 82 or part or all of one or more rows 85 of tubes 82 in a rack of tubes 78 by placing pressure on base 10 (e.g., using rocking motion Y-Y).

[0030] Figs. 6-7 show a base 110 and top piece 150 of an alternative example of a tube removal tool 140, wherein like reference numerals indicate similar components or components having similar functions. The base 110 has a support surface 112, and two walls 115, 116, which define a space for receiving a rack of tubes. Unlike the base 10 of Fig. 1, in this illustrative embodiment, support surface 112 is much narrower and is configured to contact a single row of tubes 85. It is understood that support surface 112 may be provided with any shape to contact any number of tubes or rows of tubes. For instance, support surface 112 can be curved along an axis extending in the direction from wall 116 to wall 115.

[0031] Fig. 7 shows a top piece 150 that may be used with base 110, to form a tube rack tool 140, as shown in Fig. 8. Top piece 150 has a top portion 152, and four legs 158, 159, 160, 161 extending downward from top 150. Legs 158, 159, 160, 161 are spaced to receive a rack of tubes 78 therebetween. It is understood that four legs is illustrative only, and that any or all of the legs may be omitted. An embodiment having leg extensions, as in Fig. 2, is also contemplated. It is understood that top piece 150 is not limited to use with base 110, and that the various top pieces described herein may be used with any compatible base, as desired for a specific application. Furthermore, various top pieces described herein may be used without a base. For instance, in at least one embodiment, a rack of tubes can be received by or within a portion of a top piece (e.g., between legs thereof) and a plurality of tubes dislodged from the rack by pressing on the (bottom of) the tubes (e.g., with a hand or other device, apparatus, or element).

[0032] In this illustrative example, only two walls 115, 116 are provided on base 110. The omission of the side

walls allows rack 80 and top piece 150 to be moved linearly along base 110. A number of guides 128 are also provided. Lining up rack 80 or top piece 150 with one of the guides 128 will position a specific row of tubes 85 over support surface member 112. As illustratively shown in Figs. 8-9, lining up top piece 150 even with the second guide 128 positions the fifth row of tubes 85 from that end of top piece 150 over support surface member 112. As best seen in Fig. 8, the row of tubes 85 that is positioned over support surface member 112 is dislodged upon pressure on rack 80 by top piece 150 in the direction of support surface member 112. As with other embodiments, it is understood that top piece 150 is optional, and pressure may be applied by hand or by other means directly to rack 80 to apply pressure to rack 80 to dislodge any tubes 82 that are positioned over support surface member 112.

[0033] It is understood that guides 128 may be provided with markings to indicate which row of tubes 85 would be removed when top piece 150 or rack 80 is aligned with each guide. Furthermore, in at least one embodiment, support surface member 112 can be moveable within base 110. For instance, support surface 112 can be disposed on or connected to a movement mechanism configured to permit support surface 112 to be positioned and/or secured at a plurality of positions within base 110. The movement mechanism can comprise a plurality of slots configured to receive a (detachable) support surface member 112, a rail or slide member configured to permit movement of support surface member 112 thereon, or any other means for moving support surface member 112 and/or changing the position thereof with base 110.

[0034] The present disclosure may be embodied in other specific forms without departing from its essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description.

Claims

1. A tube removal system, comprising:

(a) a rack of tubes (78) comprising:

(i) a rack (80) having a plurality of wells (84) and an upper surface (81) portion disposed about the plurality of wells (84), the plurality of wells (84) comprising openings in the upper surface (81) portion; and a skirt (80) disposed about the plurality of wells (84), the skirt (80) extending from the upper surface (81) portion; and
(ii) a plurality of tubes (82) disposed in the well; (84);

(b) a tube rack tool (40) configured to receive the rack of tubes (78), the tube rack tool (40) comprising:

(i) a base (10) having a surface (12) configured to engage a bottom surface of the plurality of tubes (82) when the rack of tubes (78) is received by the base, the base having a receiving area sized for receiving the rack of tubes (78), the base (10) having a surface (12) for engaging the plurality of tubes (82) disposed in the wells (84) of the rack when the rack of tubes (78) is disposed in the receiving area; and
(ii) a top piece (50) configured to engage the upper surface (81) portion of the rack (80) without engaging a top surface of the plurality of tubes (82) when the plurality of tubes (82) are disposed in the wells (84), and is configured for retaining the rack of tubes (78) in engagement with the surface of the base (12), wherein the top piece (50) has one or more legs (60, 61) configured to engage the upper surface (81) portion of the rack (80), such that pressure applied to the top piece (50) toward the surface of the base (12) dislodges the plurality of tubes (82) from the rack (80), the top piece (50) configured for retaining the rack of tubes (78) in engagement with the surface of the base (12) while providing pressure on the rack (80).

2. The tube removal system of claim 1, the skirt (89) extending from the upper surface (81) portion, wherein the surface of the base (12) is smaller than an area defined by the skirt (89) and is configured to receive the rack of tubes (78) without engaging the skirt (89).

3. The tube removal system of any one of claims 1 or 2, wherein the rack (80) comprises at least 96-wells.

4. The tube removal system of claim 3, wherein the tube rack tool (40) is sized to receive the 96-well rack.

5. The tube removal system of any one of claims 1-4, wherein the surface (12) of the base is curved.

6. The tube removal system of any one of claims 1-5, wherein the plurality of wells are disposed in rows, the surface of the base (20) being sized to engage all of the tubes (82) disposed in at least one row.

7. The tube removal system of any one of claims 1-6, wherein the tubes (82) are aligned with a guide and/or markings (128) on the base.

8. A method of removing a plurality of tubes from the tube removal system of claim 1, the method comprising:

(a) placing the rack of tubes (78) into a base (10), the base having a surface (12) for engaging the plurality of the tubes (82) in the rack of tubes; and
(b) providing pressure on the rack (80) toward the surface of the base (10) to dislodge the plurality of tubes from the rack (80), wherein:
(c) the providing pressure step includes placing a top piece (50) over the rack of tubes (78) and

applying pressure to the top piece (50) to provide pressure on the rack (80), engaging the surface of the base (10) to the plurality of tubes (82), and thereby dislodging the plurality of tubes (82).

9. The method of claim 8, wherein the surface of the base (12) is curved and the providing pressure step includes rocking the top piece (50), thereby dislodging substantially all of the set of tubes (82).

10. The method of any one of claims 8 or 9, wherein the plurality of tubes (82) is a row of tubes (85), the surface of the base (12) is shaped to remove the row of tubes (85), and the applying pressure step dislodges the row of tubes (85).

Patentansprüche

1. Röhrchenentfernsystem, umfassend:

(a) ein Röhrchengestell (78), umfassend:

(i) ein Gestell (80) mit einer Vielzahl von Vertiefungen (84) und einem oberen Oberflächenabschnitt (81), der um die Vielzahl von Vertiefungen (84) herum angeordnet ist, wobei die Vielzahl von Vertiefungen (84) Öffnungen in dem oberen Oberflächenabschnitt (81) umfasst; und einem Sockel (80), der um die Vielzahl von Vertiefungen (84) angeordnet ist, wobei sich der Sockel (80) von dem oberen Oberflächenabschnitt (81) erstreckt; und
(ii) eine Vielzahl von Röhrchen (82), die in den Vertiefungen (84) angeordnet sind;

(b) ein Röhrchengestellwerkzeug (40), das so konfiguriert ist, dass es das Röhrchengestell (78) aufnimmt, wobei das Röhrchengestellwerkzeug (40) umfasst:

(i) eine Basis (10) mit einer Oberfläche (12), die so konfiguriert ist, dass sie mit einer Bodenfläche der Vielzahl von Röhrchen (82) in Eingriff kommt, wenn das Röhrchengestell (78) von der Basis aufgenommen wird, wobei die Basis eine Aufnahmefläche hat, die so bemessen ist, dass sie das Röhrchengestell (78) aufnehmen kann, wobei die Basis (10) eine Oberfläche (12) zum in-Eingriff-kommen mit der Vielzahl von Röhrchen (82), die in den Vertiefungen (84) des Gestells angeordnet sind, aufweist, wenn das Röhrchengestell (78) in der Aufnahmefläche angeordnet ist; und
(ii) ein Oberteil (50), das so konfiguriert ist, dass es mit dem oberen Oberflächenabschnitt (81) des Gestells (80) in Eingriff kommt, ohne mit einer oberen Oberfläche der Vielzahl von Röhrchen (82) in Eingriff zu kommen, wenn die Vielzahl von Röhrchen (82) in den Vertiefungen (84) angeordnet ist, und das so konfiguriert ist, dass es das Röhrchengestell (78) in Eingriff mit der Oberfläche der Basis (12) hält, wobei das Oberteil (50) ein oder mehrere Beine (60, 61) aufweist, die so konfiguriert sind, dass sie mit dem oberen Oberflächenabschnitt (81) des Gestells (80) in Eingriff kommen, so dass

Druck, der auf das Oberteil (50) in Richtung der Oberfläche der Basis (12) ausgeübt wird, die Vielzahl von Röhrchen (82) von dem Gestell (80) entfernt,
wobei das Oberteil (50) so konfiguriert ist, dass es das Röhrchengestell (78) in Eingriff mit der Oberfläche der Basis (12) hält, während es Druck auf das Gestell (80) betreibt.

2. Röhrchenentfernsystem nach Anspruch 1,
wobei sich der Sockel (89) von dem oberen Oberflächenabschnitt (81) erstreckt, wobei die Oberfläche der Basis (12) kleiner ist als eine Gegend, die durch den Sockel (89) definiert ist, und so konfiguriert ist, dass sie das Röhrchengestell (78) aufnimmt, ohne mit dem Sockel (89) in Eingriff zu kommen.

3. Röhrchenentfernsystem nach einem der Ansprüche 1 oder 2, wobei das Gestell (80) mindestens 96 Vertiefungen umfasst.

4. Röhrchenentfernsystem nach Anspruch 3, wobei das Röhrchengestellwerkzeug (40) so bemessen ist, dass es das 96-Well-Gestell aufnehmen kann.

5. Röhrchenentfernsystem nach einem der Ansprüche 1 bis 4, wobei die Oberfläche (12) der Basis gekrümmt ist.

6. Röhrchenentfernsystem nach einem der Ansprüche

1 bis 5, wobei die Vielzahl von Vertiefungen in Reihen angeordnet ist und die Oberfläche der Basis (20) so bemessen ist, dass sie mit allen Röhrchen (82) in Eingriff kommt, die in mindestens einer Reihe angeordnet sind.

7. Röhrchenentfernsystem nach einem der Ansprüche 1-6, wobei die Röhrchen (82) mit einer Führung und/oder Markierungen (128) auf der Basis ausgerichtet sind.

8. Verfahren zum Entfernen einer Vielzahl von Röhrchen aus dem Röhrchenentfernsystem nach Anspruch 1, wobei das Verfahren umfasst:

(a) Platzieren des Röhrchengestells (78) in einer Basis (10), wobei die Basis eine Oberfläche (12) zum In-Eingriff-kommen mit der Vielzahl von Röhrchen (82) in dem Röhrchengestell aufweist; und
(b) Vorsehen von Druck auf das Gestell (80) in Richtung der Oberfläche der Basis (10), um die Vielzahl von Röhrchen aus dem Gestell (80) zu lösen, wobei:
(c) der Schritt des Druckausübens das Platzieren eines Oberteils (50) auf das Röhrchengestell (78) umfasst und Ausüben von Druck auf das Oberteil (50), um Druck auf das Gestell (80) vorzusehen, wobei die Oberfläche der Basis (10) mit der Vielzahl von Röhrchen (82) in Eingriff kommt und dadurch die Vielzahl von Röhrchen (82) entfernt wird.

9. Verfahren nach Anspruch 8, wobei die Oberfläche der Basis (12) gekrümmt ist und der Schritt des Vorsehens von Druck das Kippen des Oberteils (50) umfasst, wodurch im Wesentlichen der gesamte Satz von Röhrchen (82) gelöst wird.

10. Verfahren nach einem der Ansprüche 8 oder 9, wobei die Vielzahl von Röhrchen (82) eine Reihe von Röhrchen (85) ist, die Oberfläche der Basis (12) so geformt ist, dass sie die Reihe von Röhrchen (85) entfernt, und der Schritt des Ausübens von Druck die Reihe von Röhrchen (85) löst.

Revendications

1. Système de retrait de tubes, comprenant:

(a) un support de tubes (78) comprenant:

(i) un support (80) ayant une pluralité de puits (84) et une partie de surface supérieure (81) disposée autour de la pluralité de puits (84), la pluralité de puits (84) comprenant des ouvertures dans la partie de surface supérieure (81); et une jupe (80) disposée autour de la pluralité de puits (84), la jupe (80) s'étendant depuis la partie de surface supérieure (81); et
(ii) une pluralité de tubes (82) disposés dans les puits (84);

(b) un outil de support de tubes (40) configuré pour recevoir le support de tubes (78), l'outil de support de tubes (40) comprenant:

(i) une base (10) ayant une surface (12) configurée pour venir en contact avec une surface inférieure de la pluralité de tubes (82) lorsque le support de tubes (78) est reçu par la base, la base ayant une zone de réception dimensionnée pour recevoir le support de tubes (78), la base (10) ayant une surface (12) pour venir en contact avec la pluralité de tubes (82) disposés dans les puits (84) du support lorsque le support de tubes (78) est disposé dans la zone de réception; et
(ii) une pièce supérieure (50) configurée pour venir en contact avec la partie de surface supérieure (81) du support (80) sans venir en contact avec une surface supérieure de la pluralité de tubes (82) lorsque la pluralité de tubes (82) est disposée dans les puits (84), et est configurée pour retenir le support de tubes (78) en contact avec la surface de la base (12), dans lequel la pièce supérieure (50) a une ou plusieurs pattes (60, 61) configurées pour venir en contact avec la partie de surface supérieure (81) du support (80), de telle sorte qu'une pression appliquée à la pièce supérieure (50) vers la surface de la base (12) déloge la pluralité de tubes (82) du support (80), la pièce supérieure (50) étant configurée pour retenir le support de tubes (78) en contact avec la surface de la base (12) tout en exerçant une pression sur le support (80).

2. Système de retrait de tubes selon la revendication 1, la jupe (89) s'étendant depuis la partie de surface supérieure (81), dans lequel la surface de la base (12) est plus petite qu'une zone définie par la jupe (89) et est configurée pour recevoir le support de tubes (78) sans entrer en contact avec la jupe (89).

3. Système de retrait de tubes selon l'une quelconque des revendications 1 ou 2, dans lequel le support (80) comprend au moins 96 puits.

4. Système de retrait de tubes selon la revendication 3, dans lequel l'outil de support de tubes (40) est dimensionné pour recevoir le support à 96 puits.

5. Système de retrait de tubes selon l'une quelconque des revendications 1 à 4, dans lequel la surface (12) de la base est incurvée.

6. Système de retrait de tubes selon l'une quelconque des revendications 1 à 5, dans lequel la pluralité de puits sont disposés en rangées, la surface de la base (20) étant dimensionnée pour venir en contact avec tous les tubes (82) disposés dans au moins une rangée.

7. Système de retrait de tubes selon l'une quelconque des revendications 1 à 6, dans lequel les tubes (82) sont alignés avec un guide et/ou des marquages (128) sur la base.

8. Procédé de retrait d'une pluralité de tubes du système de retrait de tubes selon la revendication 1, le procédé comprenant:

(a) la mise en place du support de tubes (78) dans une base (10), la base ayant une surface (12) pour venir en contact avec la pluralité de tubes (82) dans le support de tubes; et
(b) l'application d'une pression sur le support (80) vers la surface de la base (10) pour déloger la pluralité de tubes du support (80), dans lequel:
(c) l'étape d'application de pression inclut la mise en place d'une pièce supérieure (50) sur le support de tubes (78) et l'application d'une pression sur la pièce supérieure (50) pour exercer une pression sur le support (80), mettre en contact la surface de la base (10) avec la pluralité de tubes (82), et déloger ainsi la pluralité de tubes (82).

9. Procédé selon la revendication 8, dans lequel la surface de la base (12) est incurvée et l'étape d'application de pression inclut le basculement de la pièce supérieure (50), délogeant ainsi sensiblement la totalité de l'ensemble de tubes (82).

10. Procédé selon l'une quelconque des revendications 8 ou 9, dans lequel la pluralité de tubes (82) est une rangée de tubes (85), la surface de la base (12) est mise en forme pour retirer la rangée de tubes (85), et l'étape d'application de pression déloge la rangée de tubes (85).

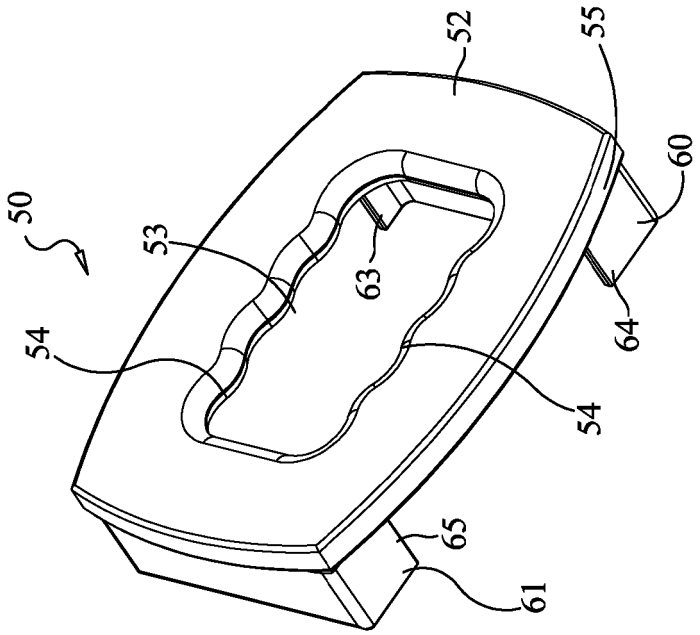

FIG. 2

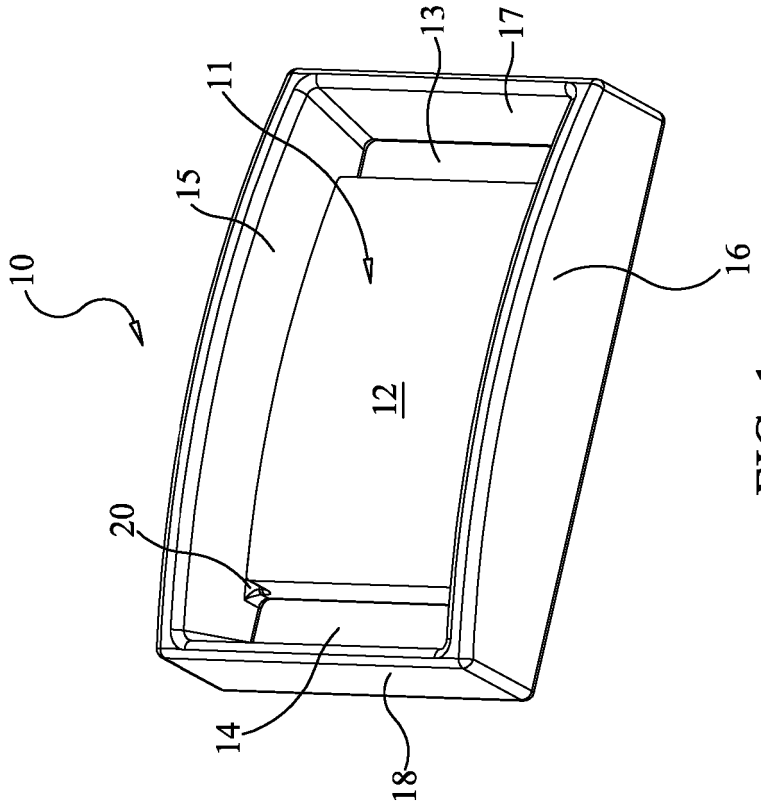

FIG. 1

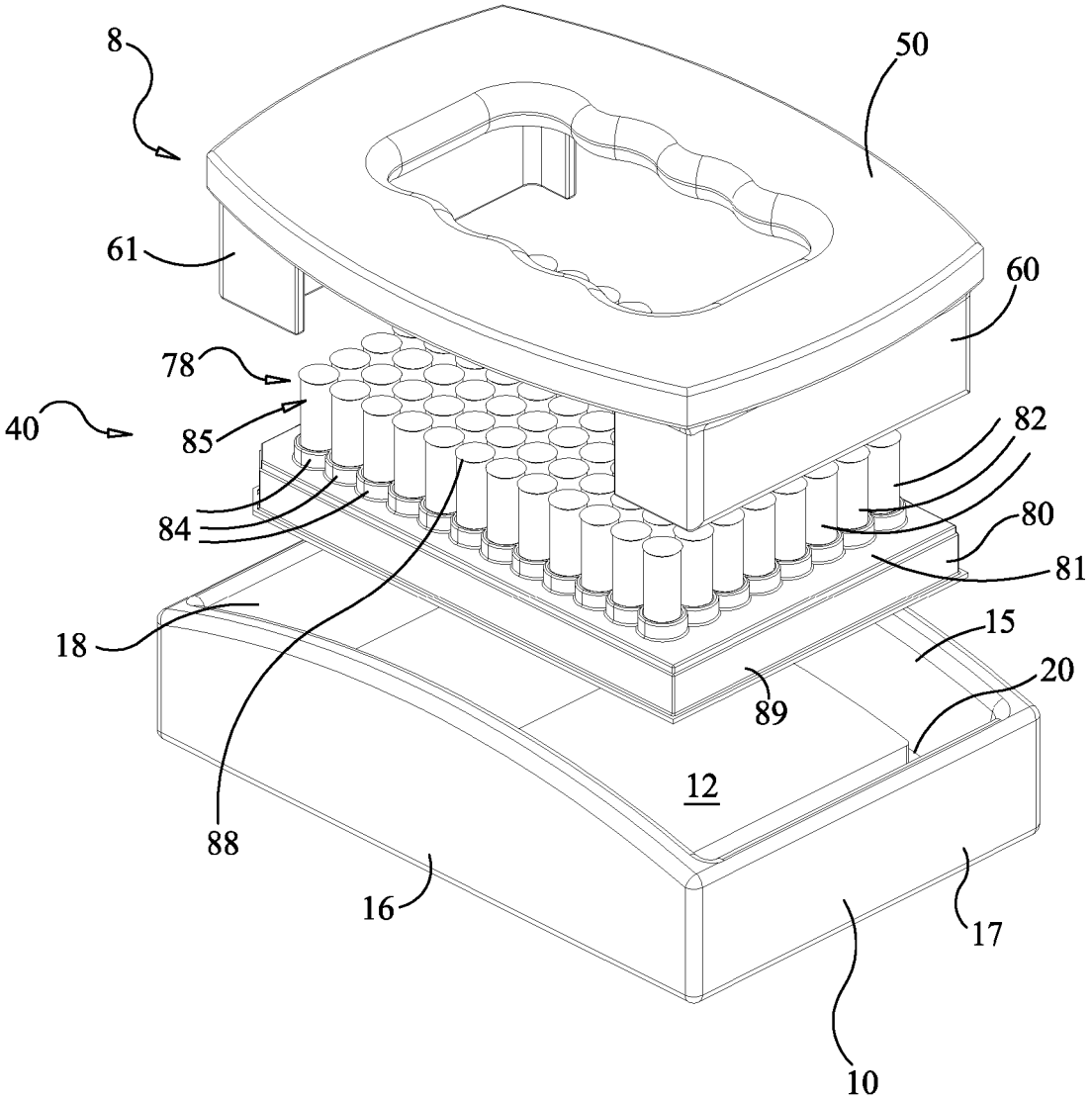

FIG. 3

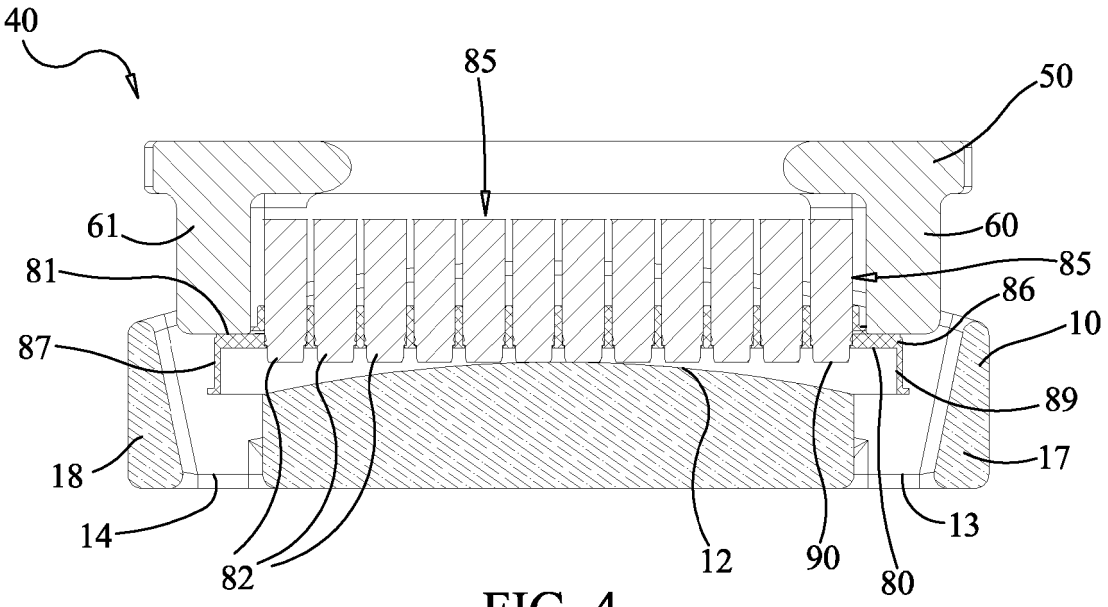
40
85
50
61
60
81
85
86
87
10
89
18
17
14
13
82
12
90
80

FIG. 4

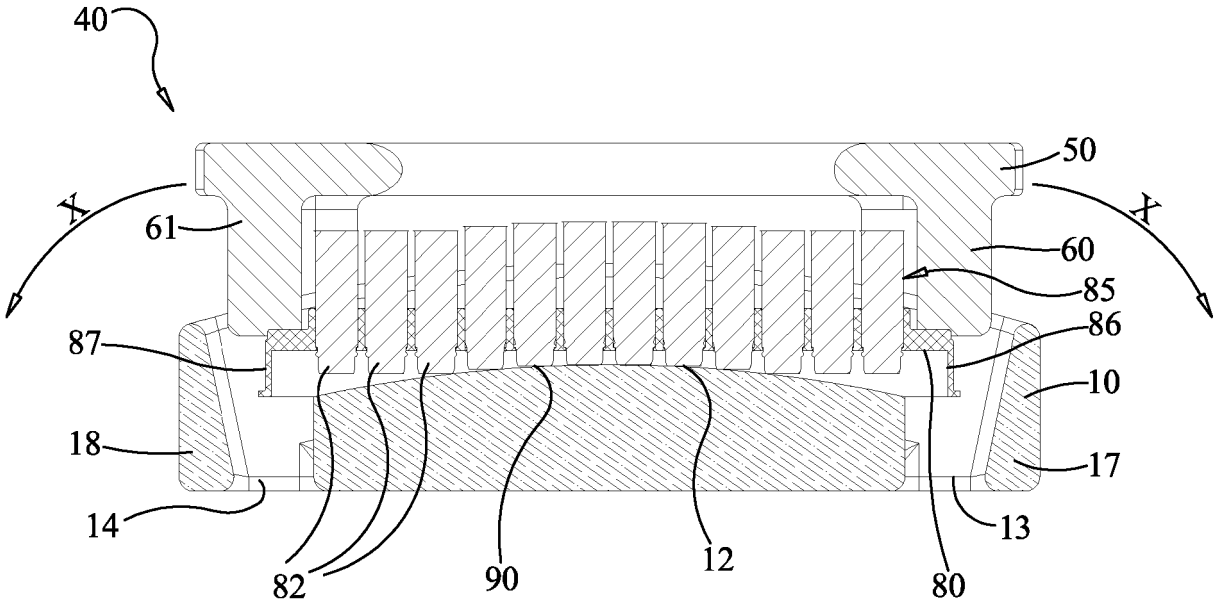
40
50
X
X
61
60
85
87
86
10
18
17
14
13
82
90
12
80

FIG. 5

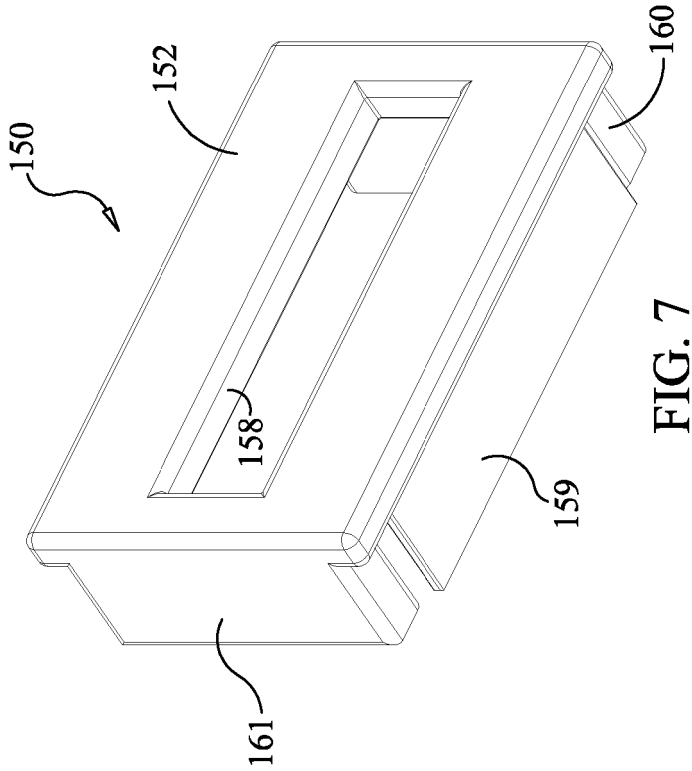

FIG. 7

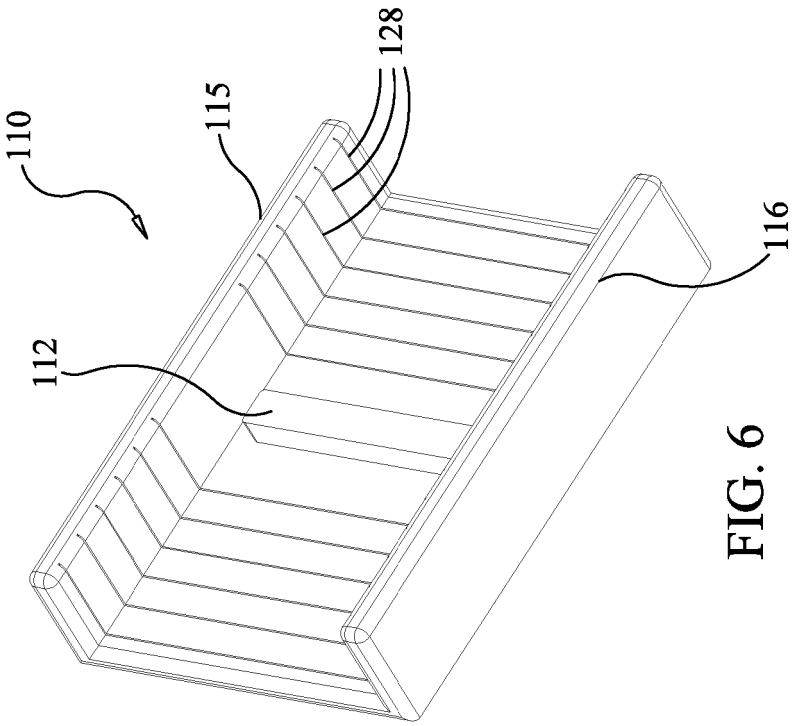

FIG. 6

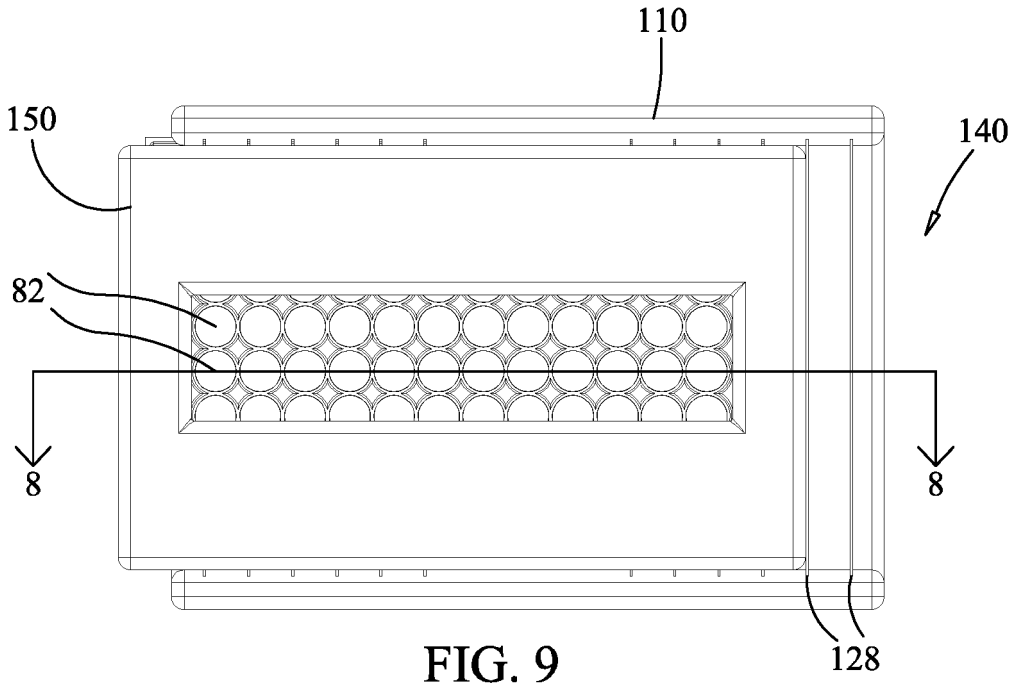

FIG. 9

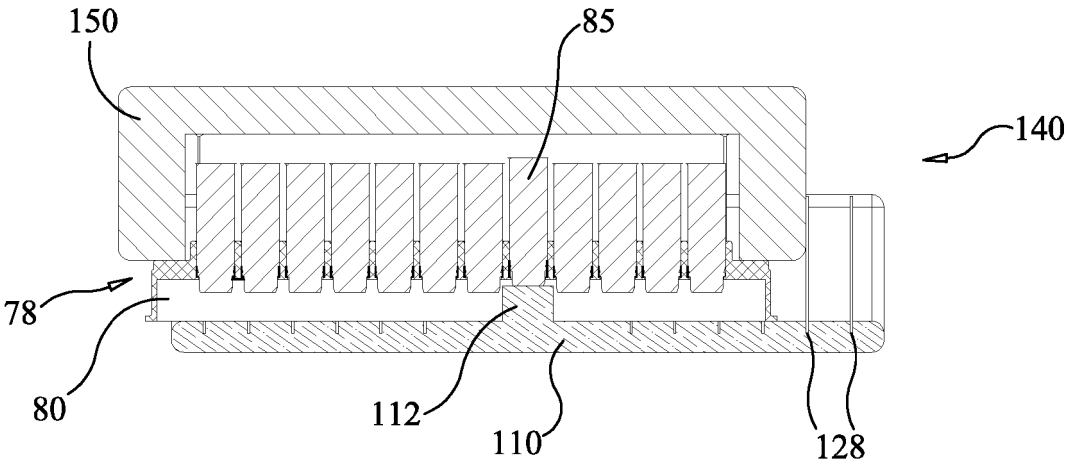

FIG. 8

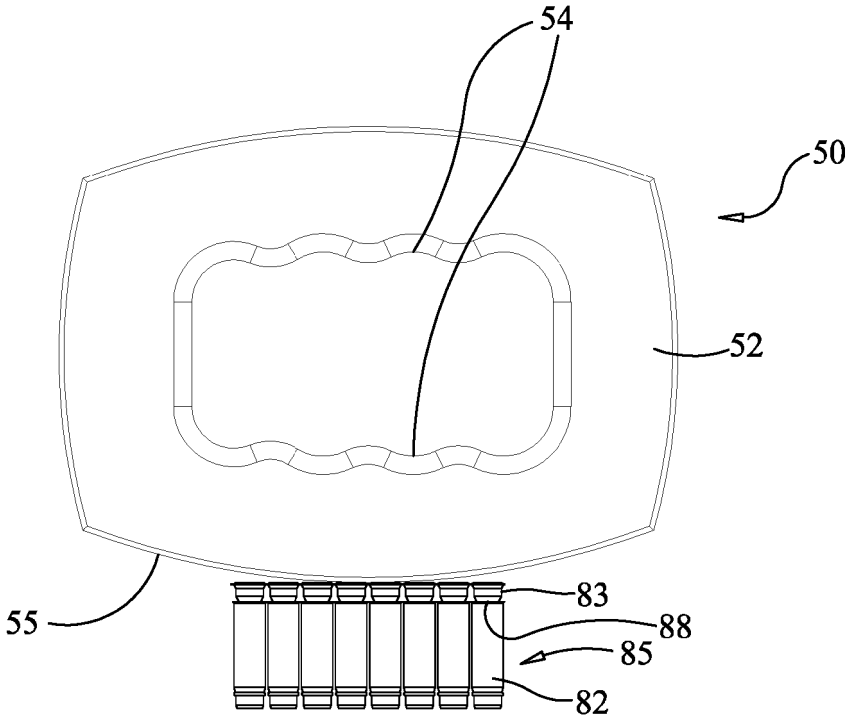

FIG. 10

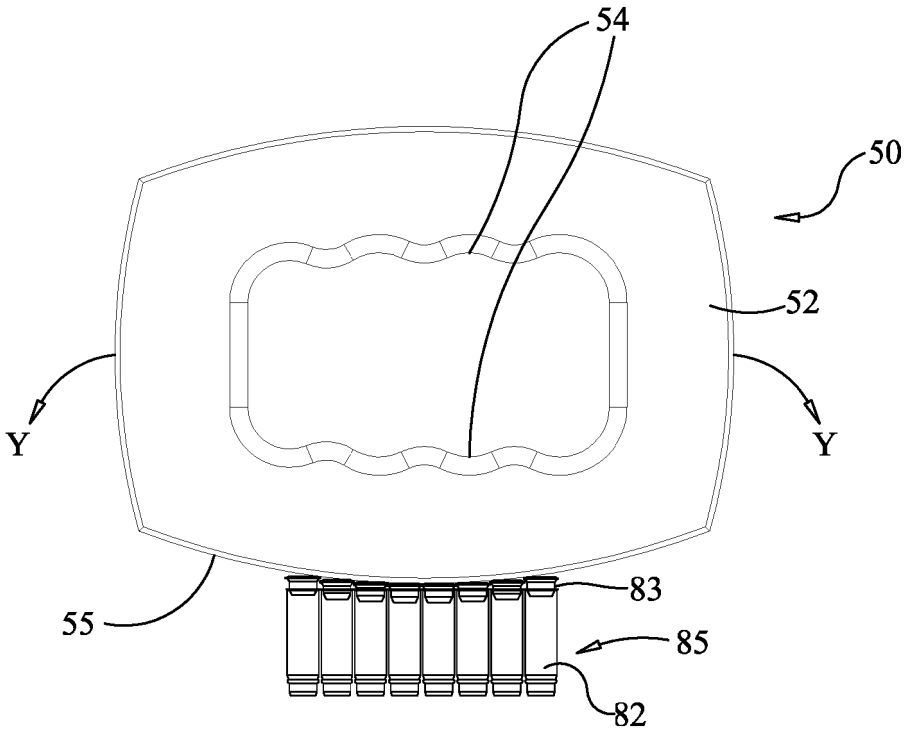

FIG. 11

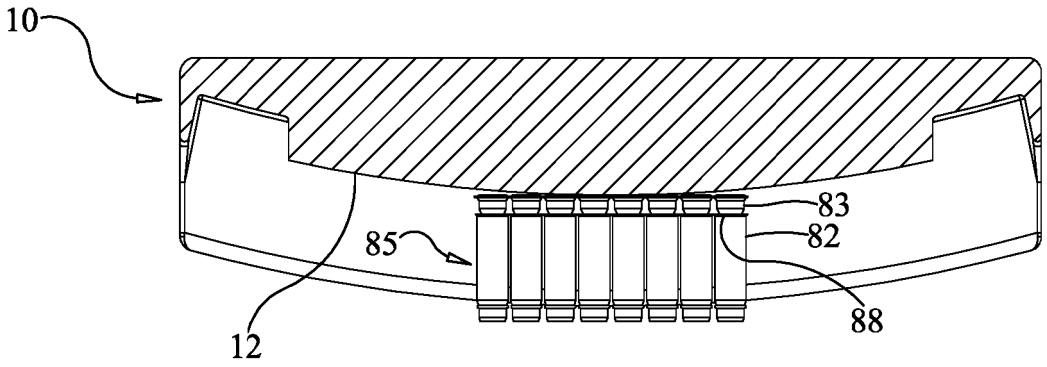

FIG. 12

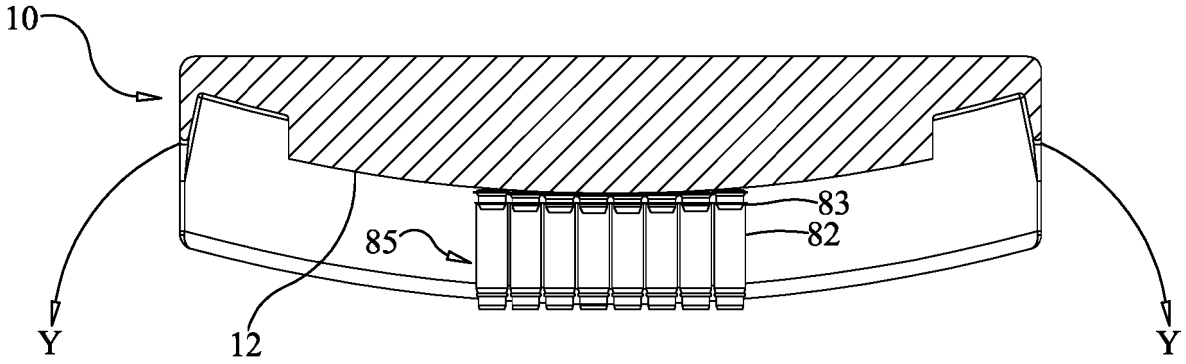

FIG. 13

REFERENCES CITED IN THE DESCRIPTION

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