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Sundine et al.

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(54) **SAMPLE PAINT ADAPTER**

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B01F 35/42 (2022.01)
B01F 35/43 (2022.01)
B01F 101/30 (2022.01)

(52) **U.S. Cl.**
CPC ***B01F 35/421*** (2022.01); ***B01F 35/43*** (2022.01); *B01F 2101/30* (2022.01)

(58) **Field of Classification Search**
CPC B01F 35/421; B01F 35/43; B01F 2101/30
See application file for complete search history.

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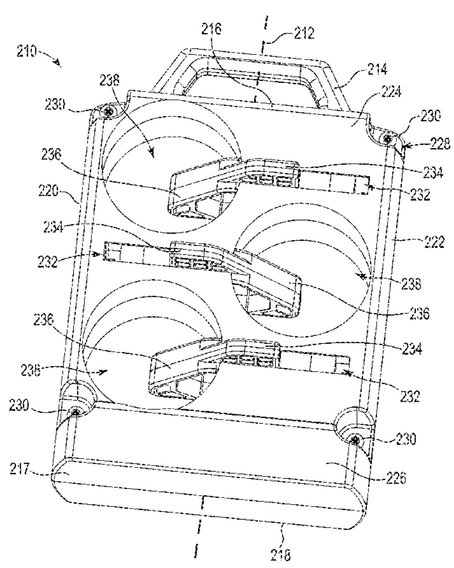
Primary Examiner — Marc C Howell

(57) **ABSTRACT**

A self-balancing adapter for use with a mixer, the adapter having a body configured to interface with the mixer as a unit, the body having a front and a back, left and right edges, a top and a bottom, and a vertical axis passing through the top and the bottom, where the front has at least a first recess configured to receive and hold a first vessel substantially within the body; and the adapter having at least one movable counterweight configured to be displaced when the first vessel is received in the first recess such that the movable weight at least partially offsets a weight of the first vessel within the body with respect to the vertical axis.

20 Claims, 18 Drawing Sheets



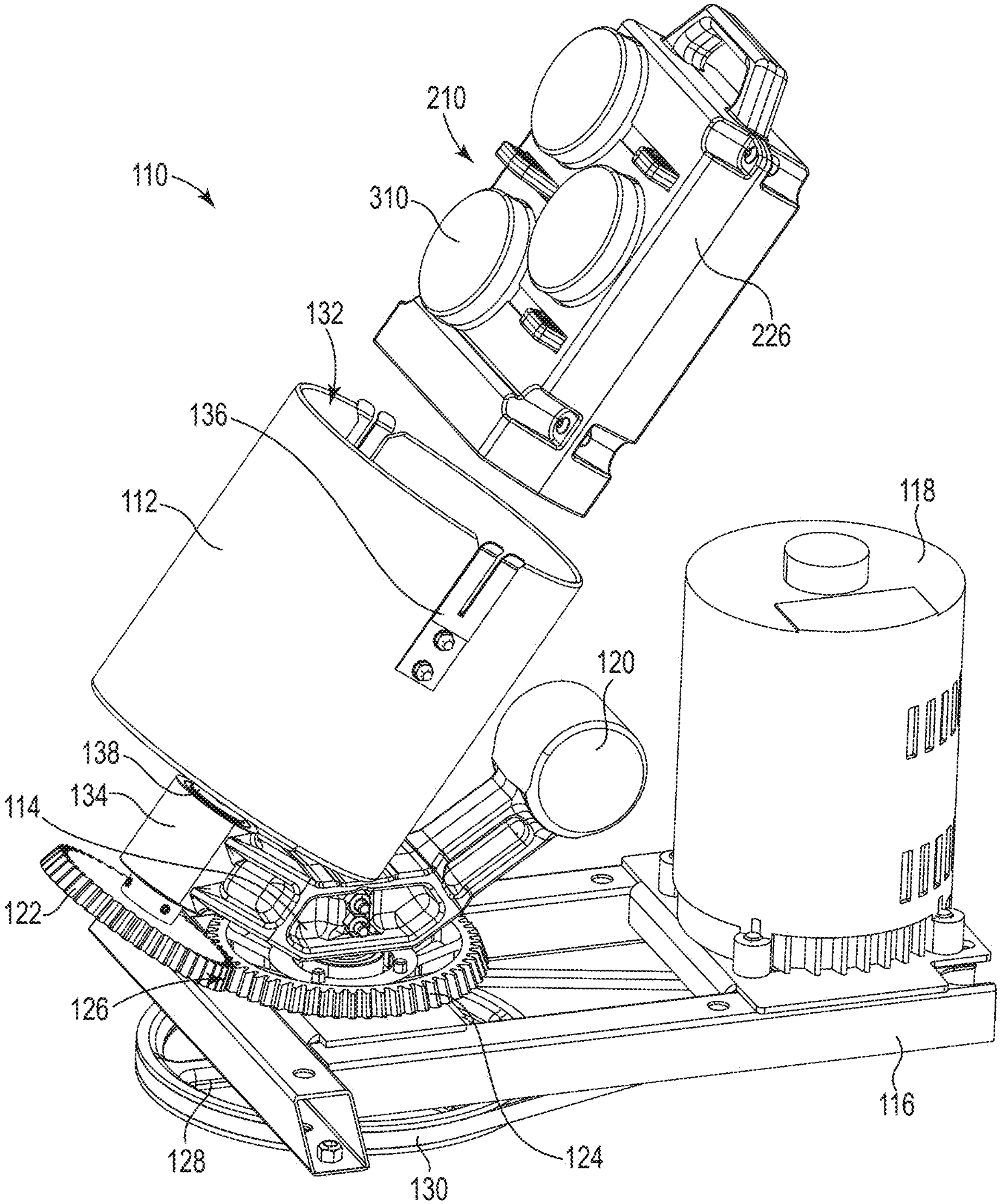

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Fig. 1

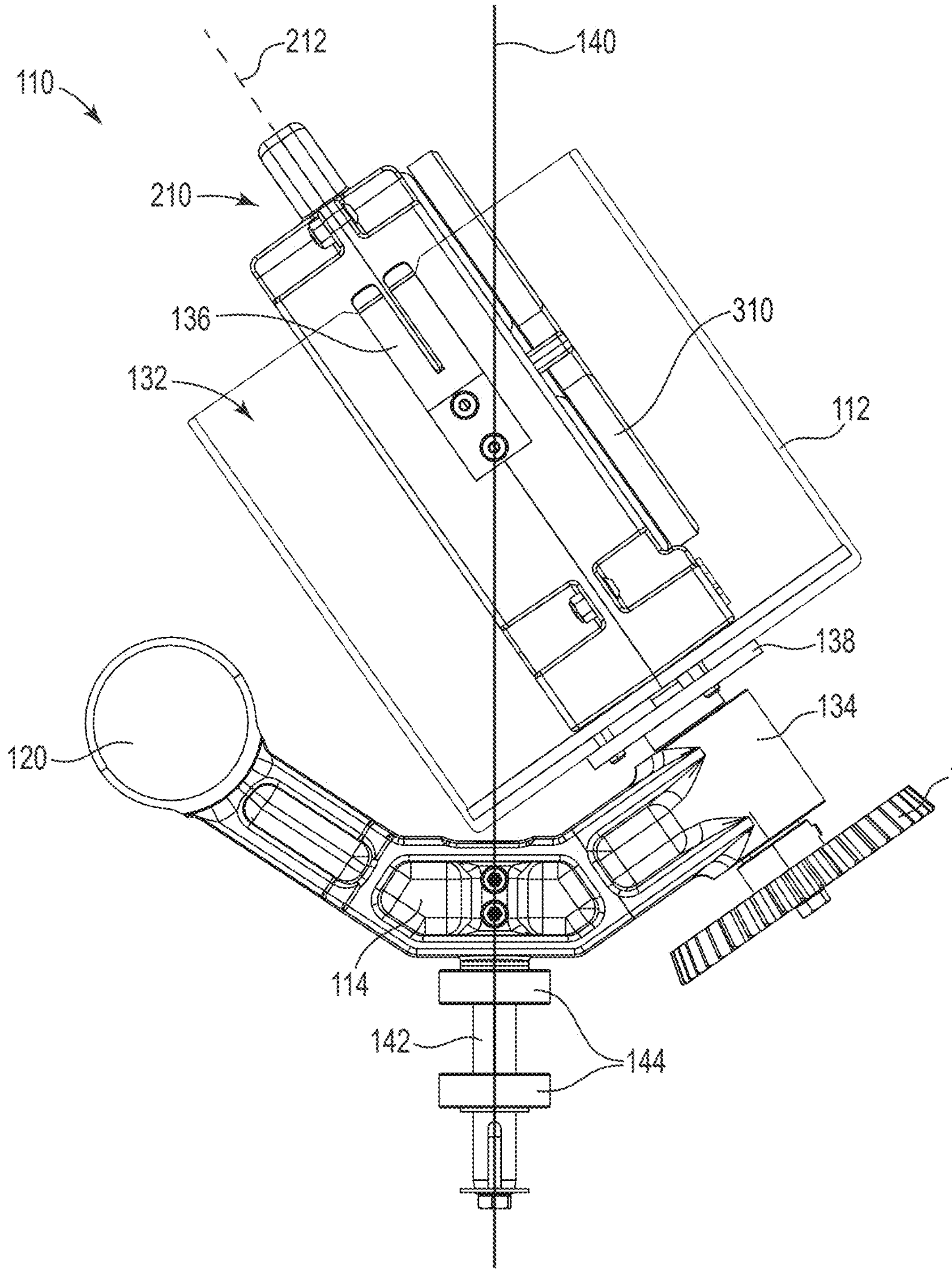

Fig. 2

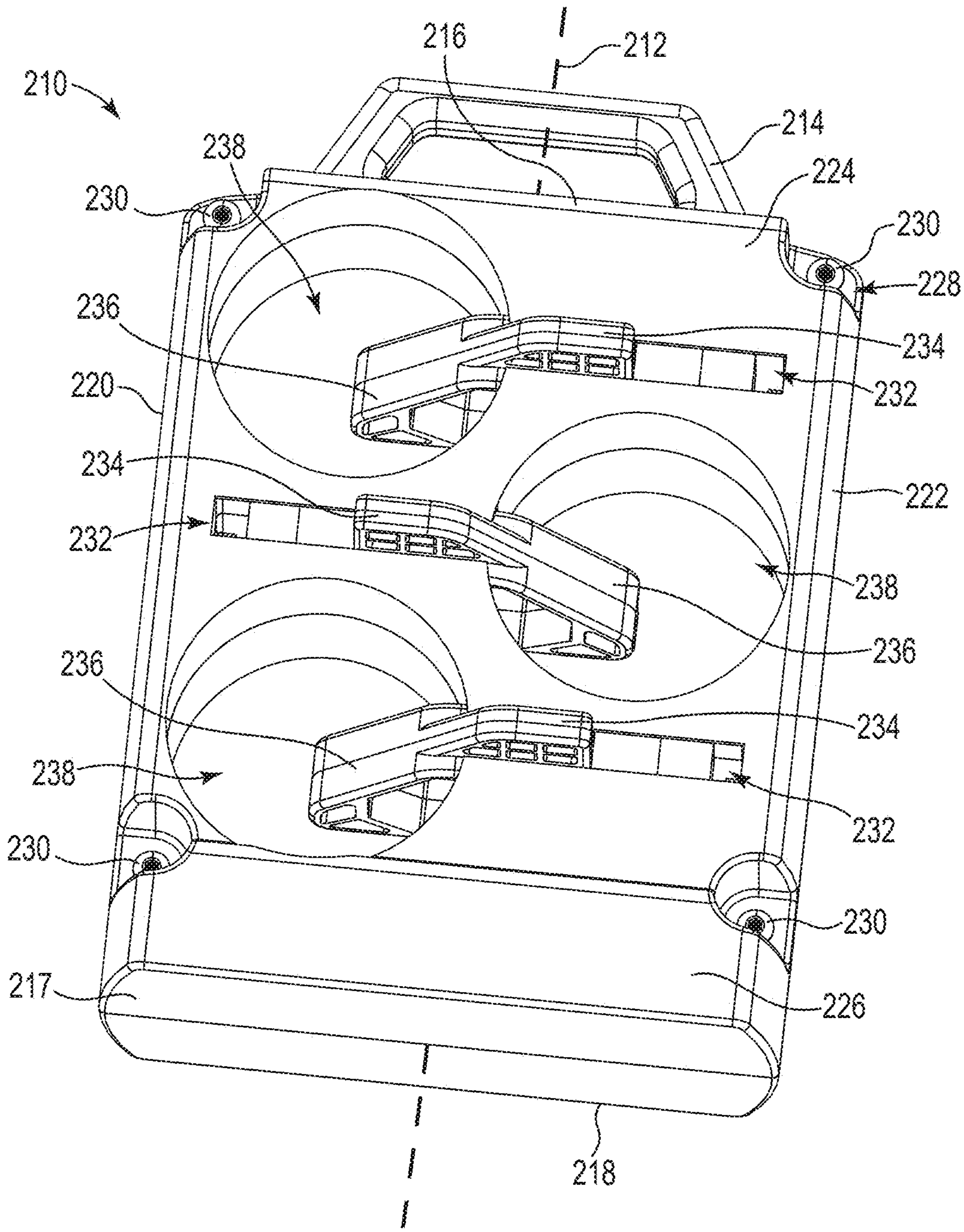
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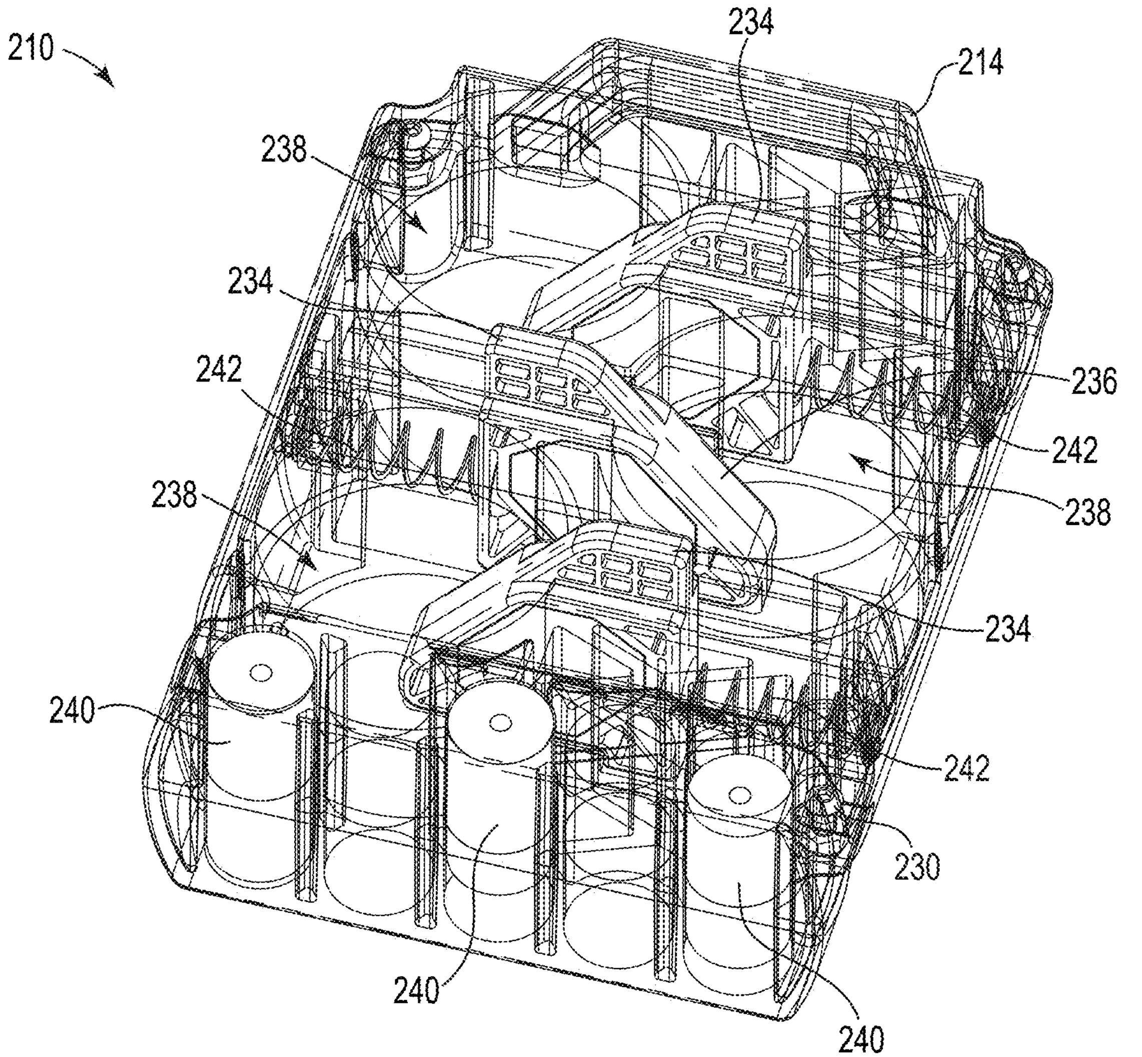
Fig. 3



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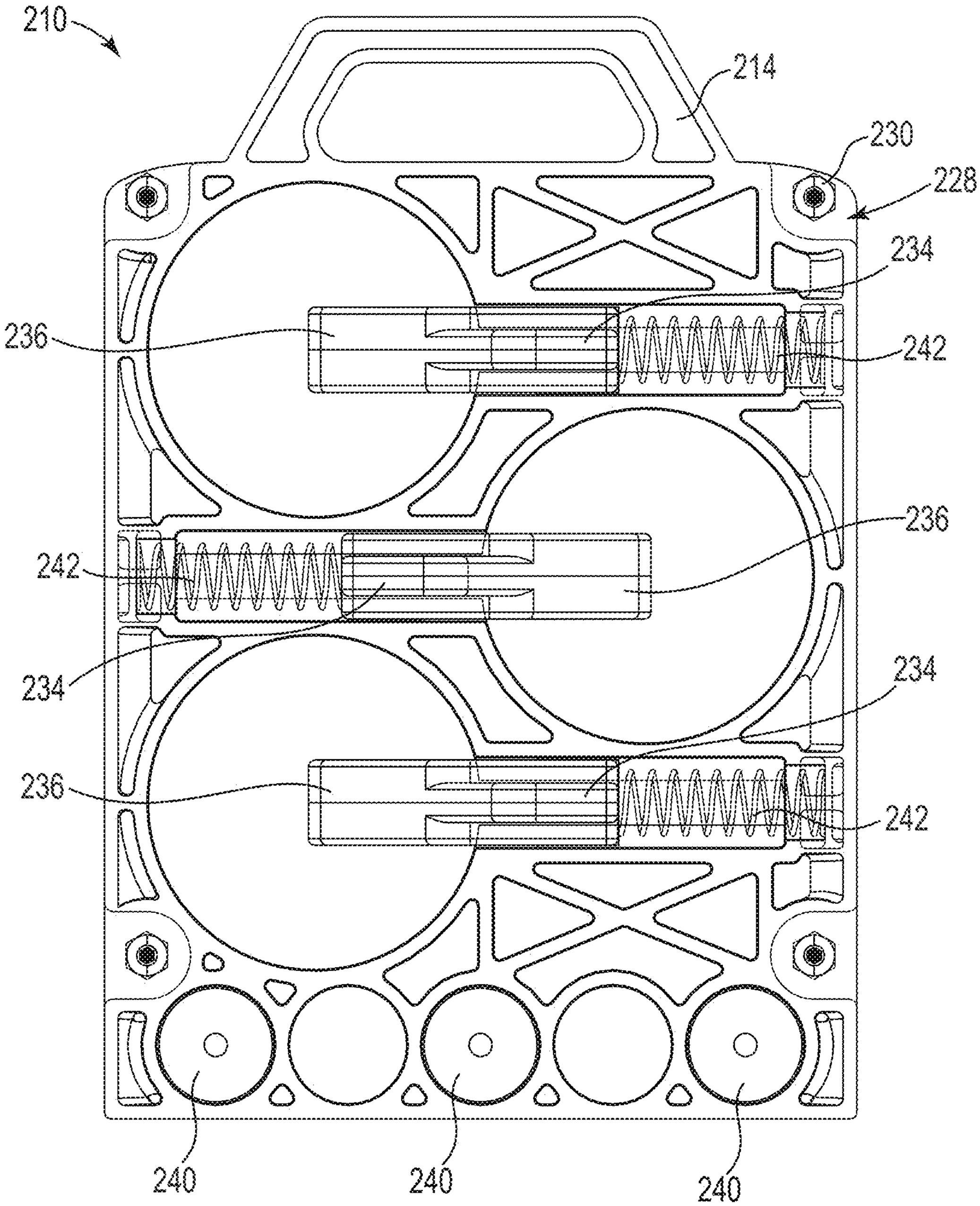

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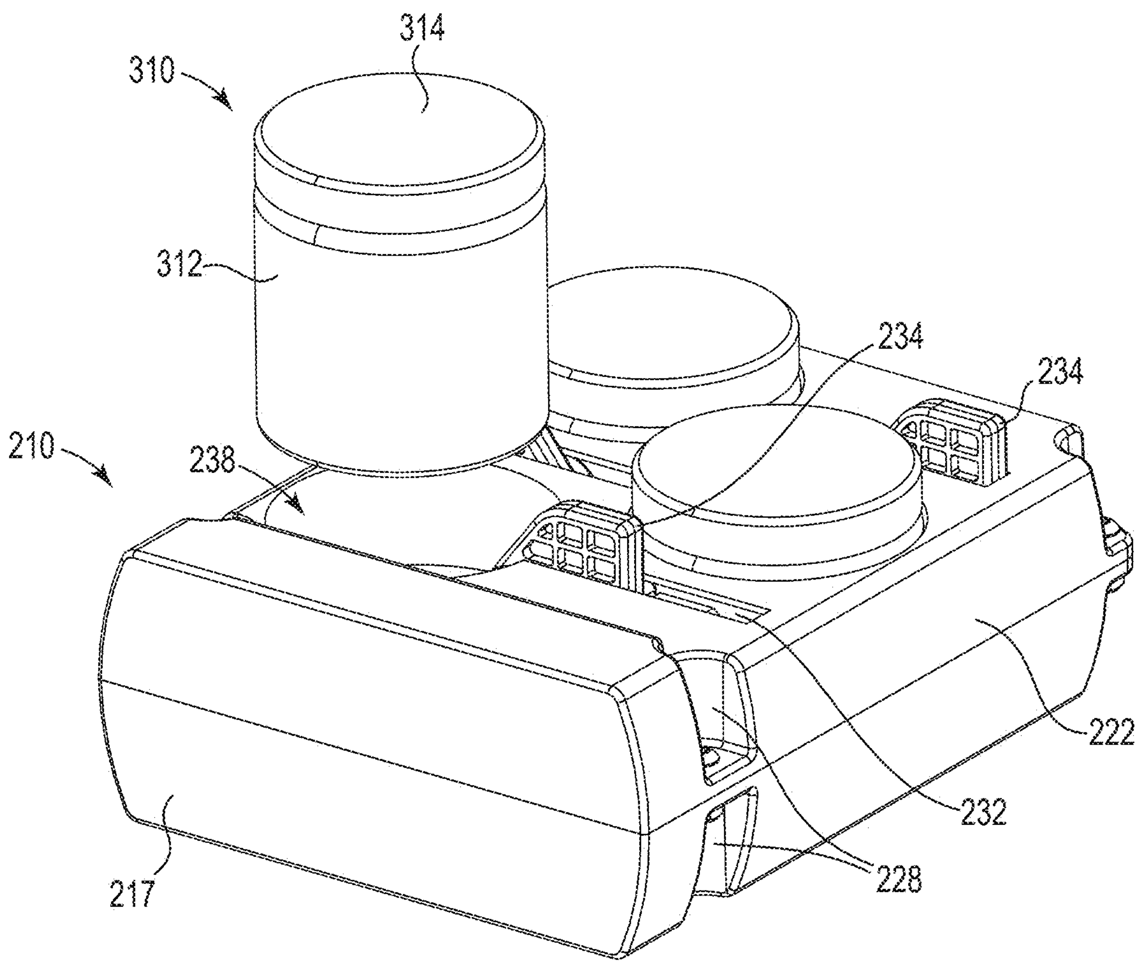

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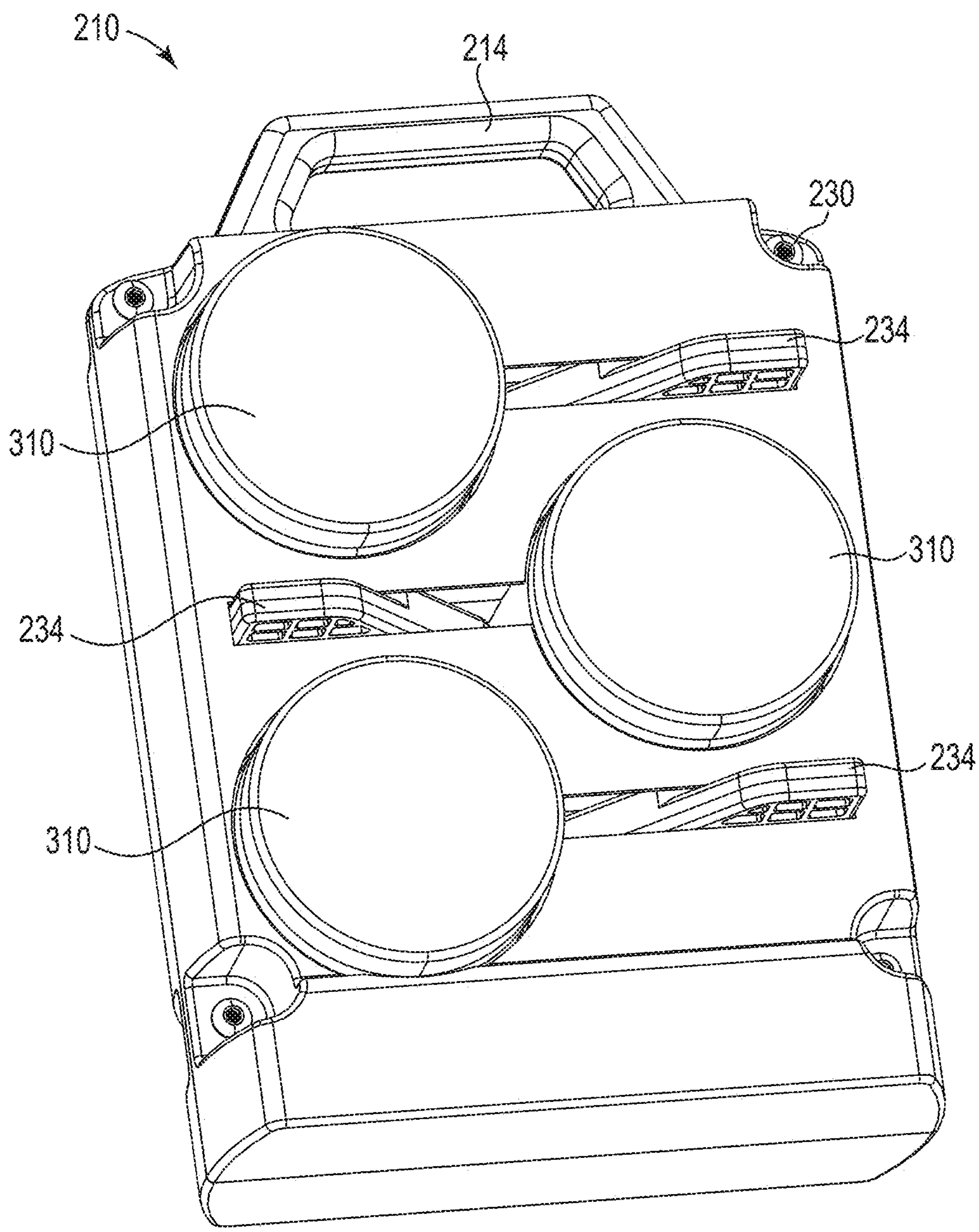

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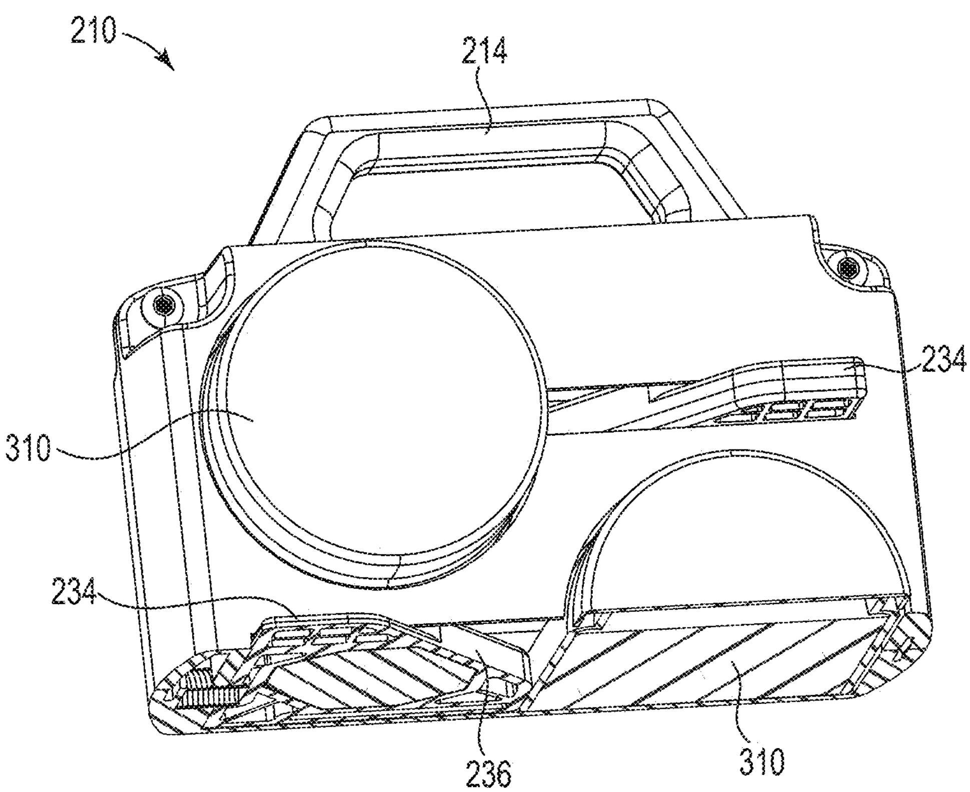

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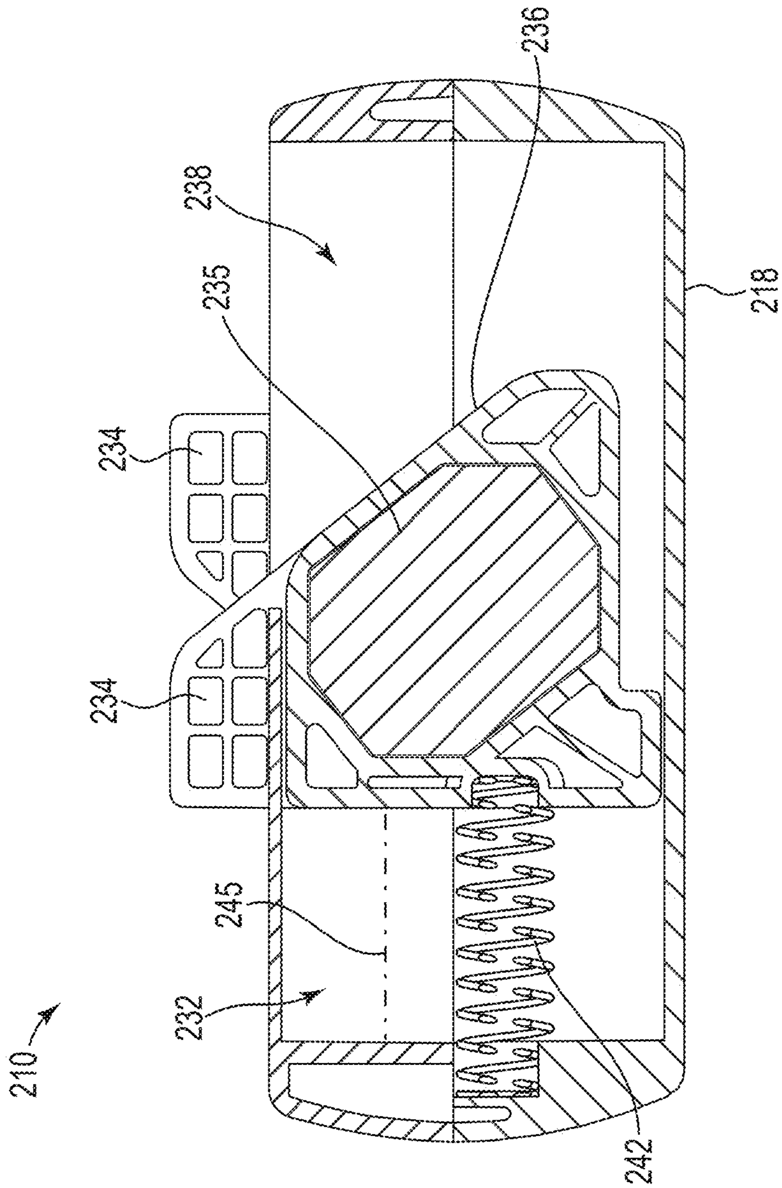

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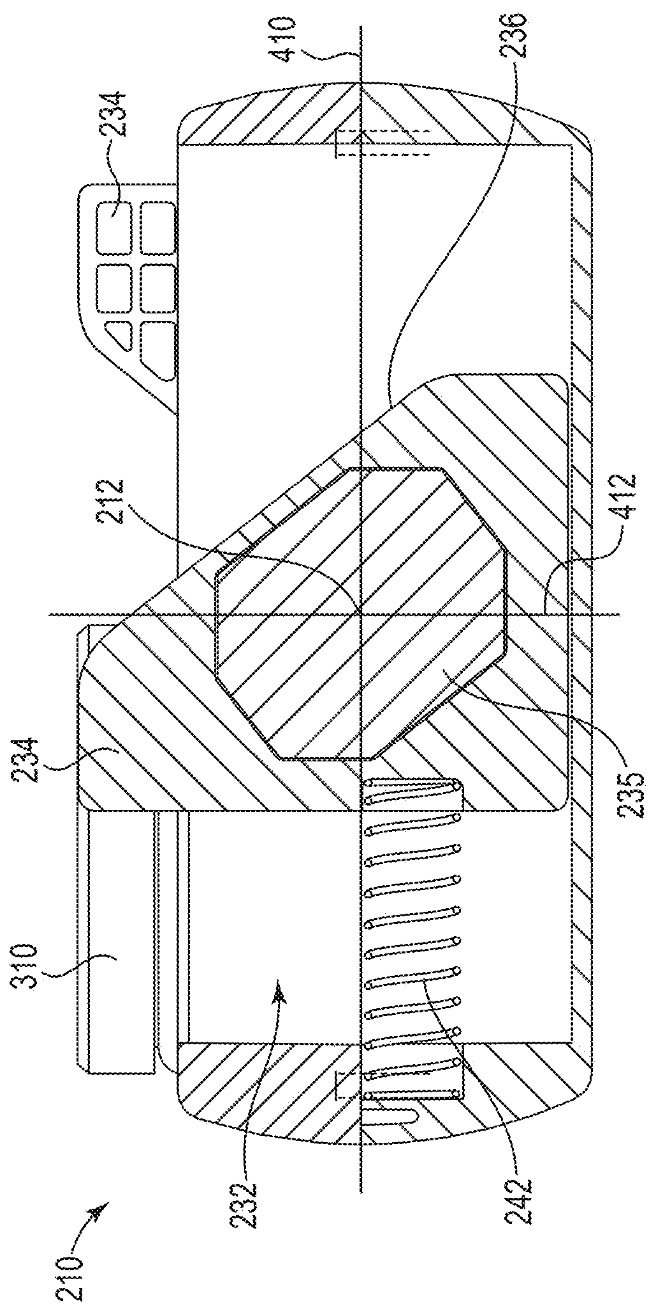

Fig. 10

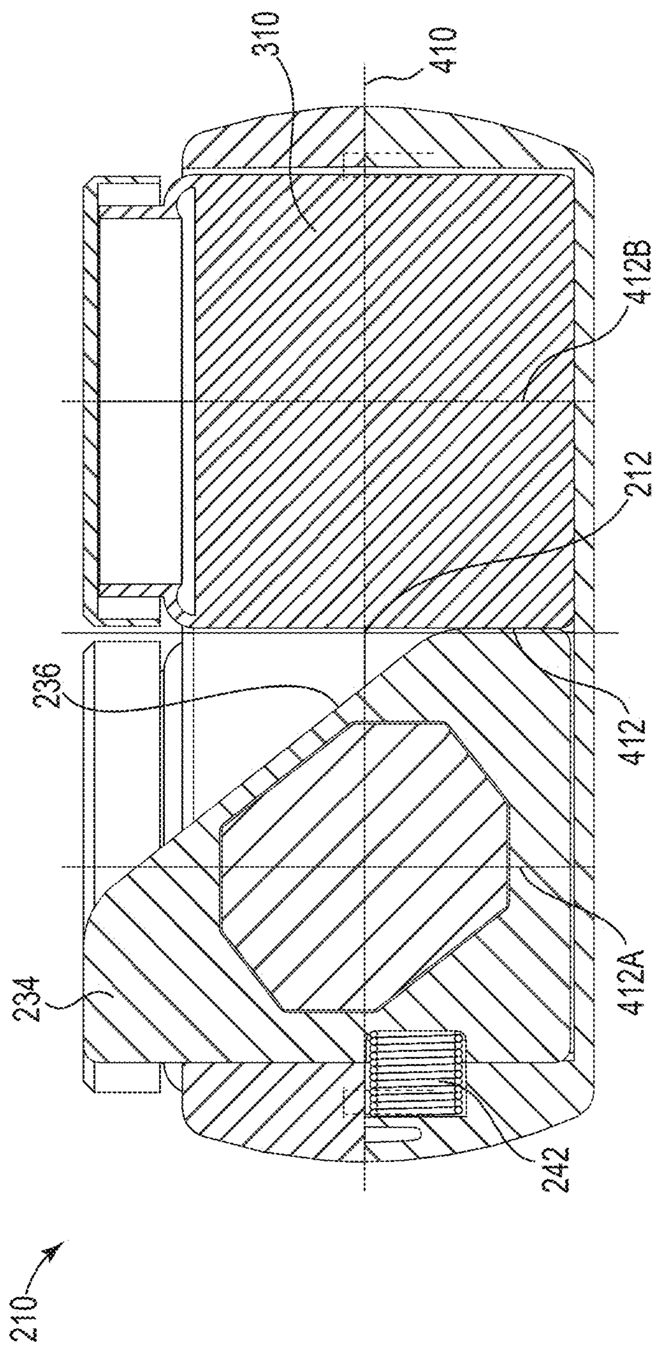

Fig. 11

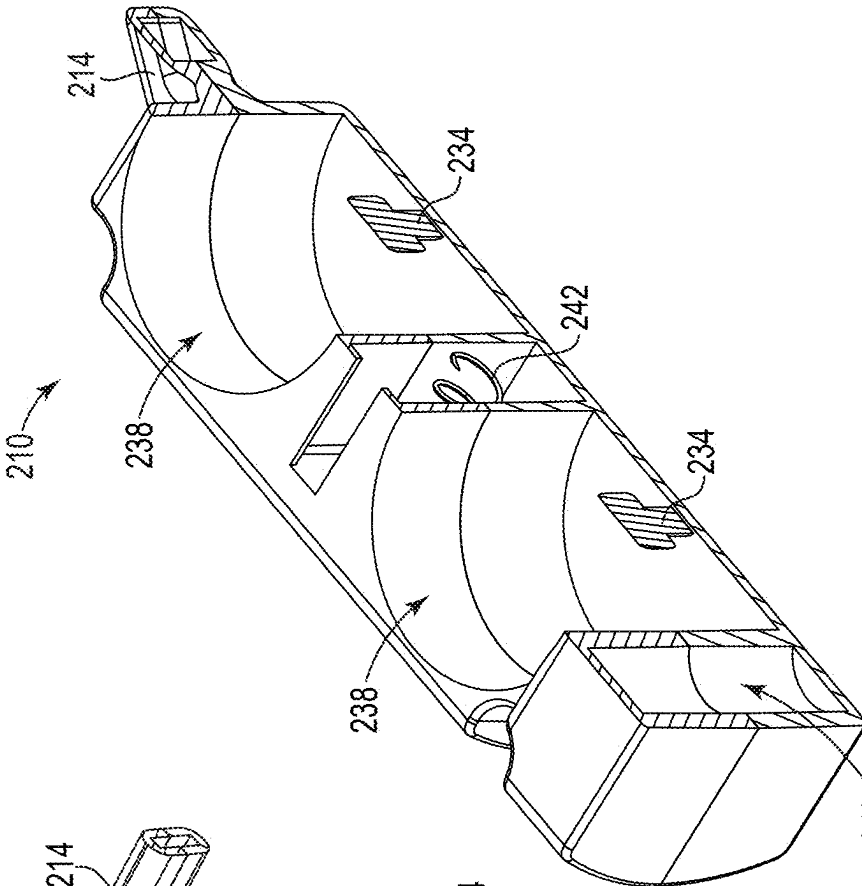
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Fig. 13

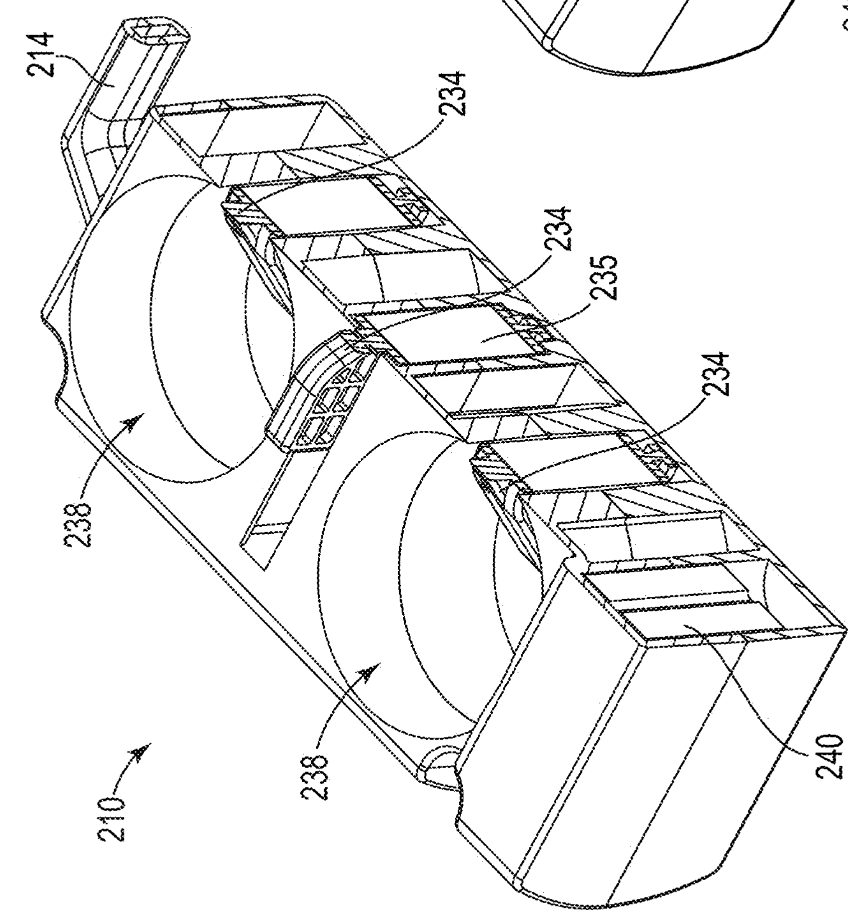
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Fig. 12

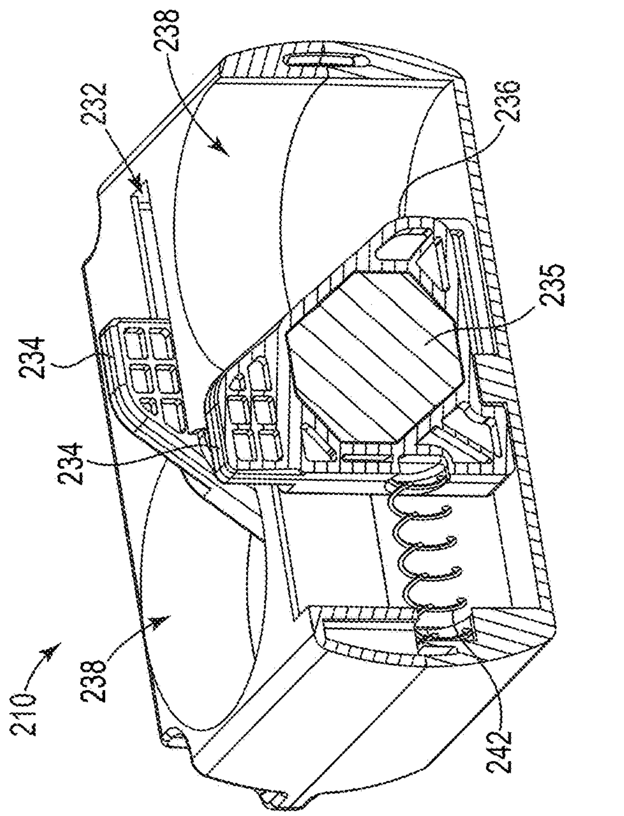
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Fig. 15

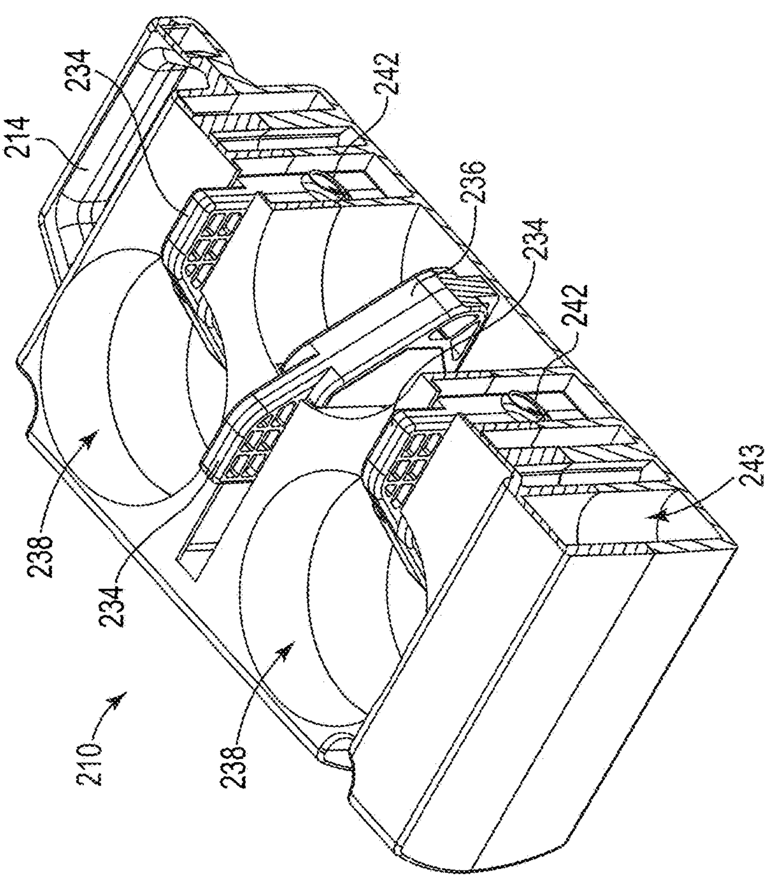
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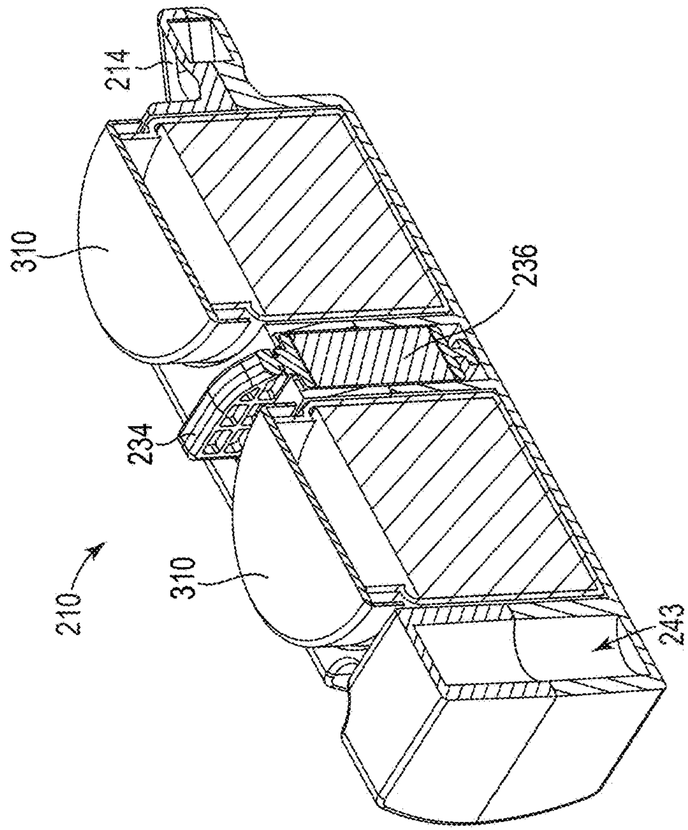
Fig. 14



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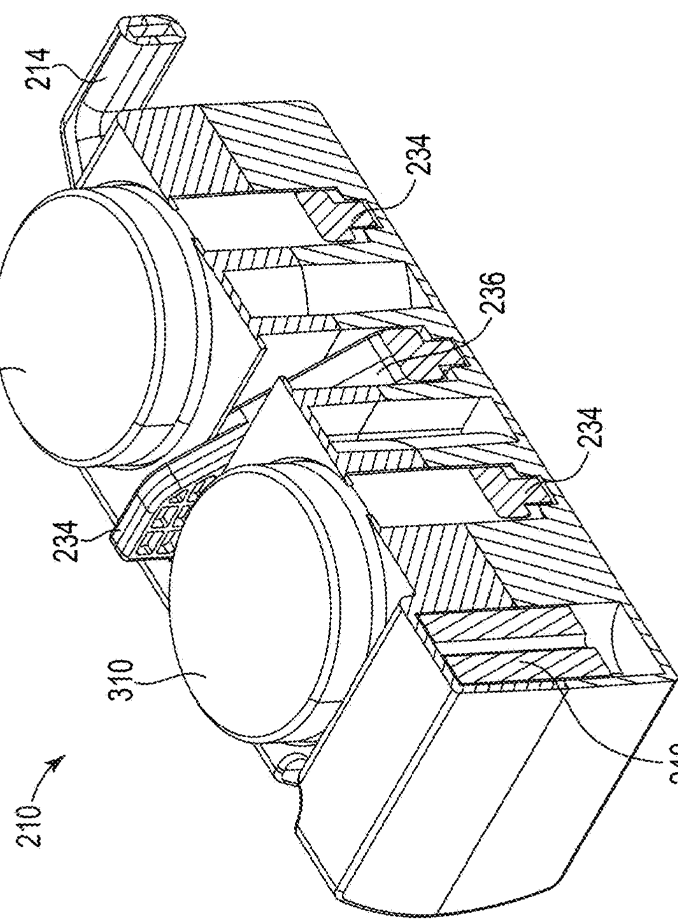

Fig. 16

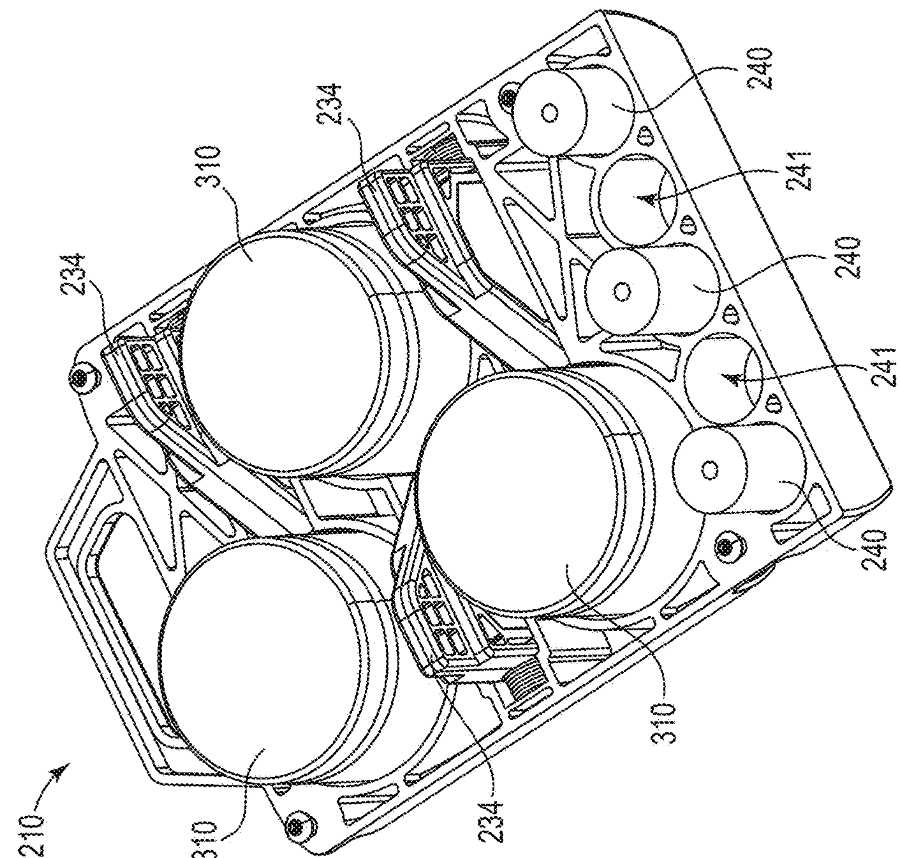

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Fig. 19

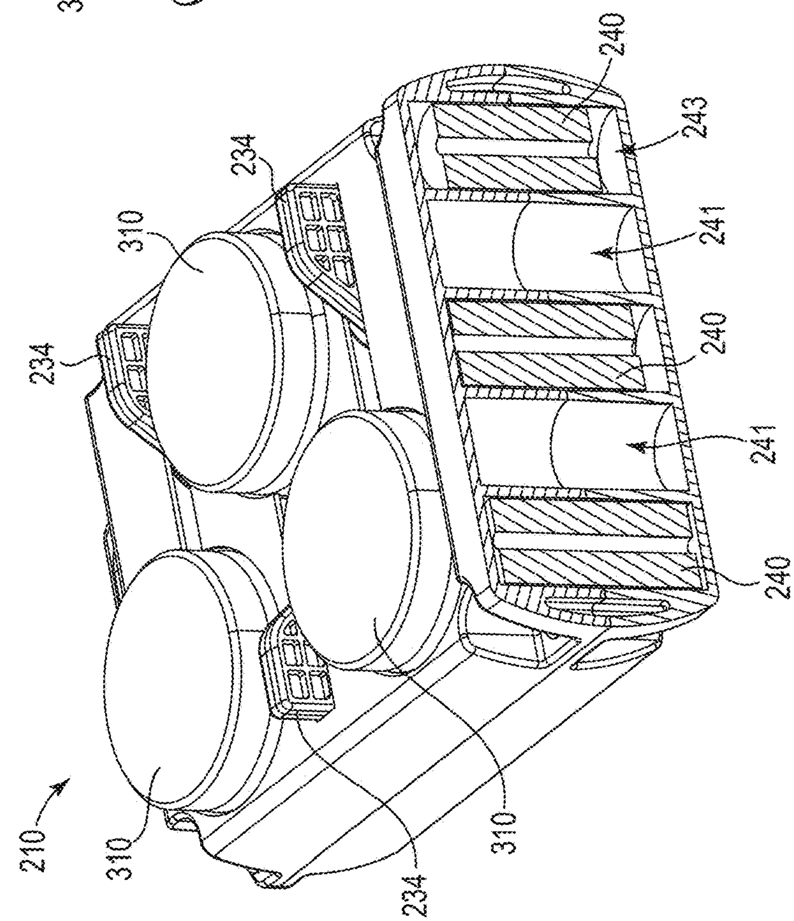

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Fig. 18

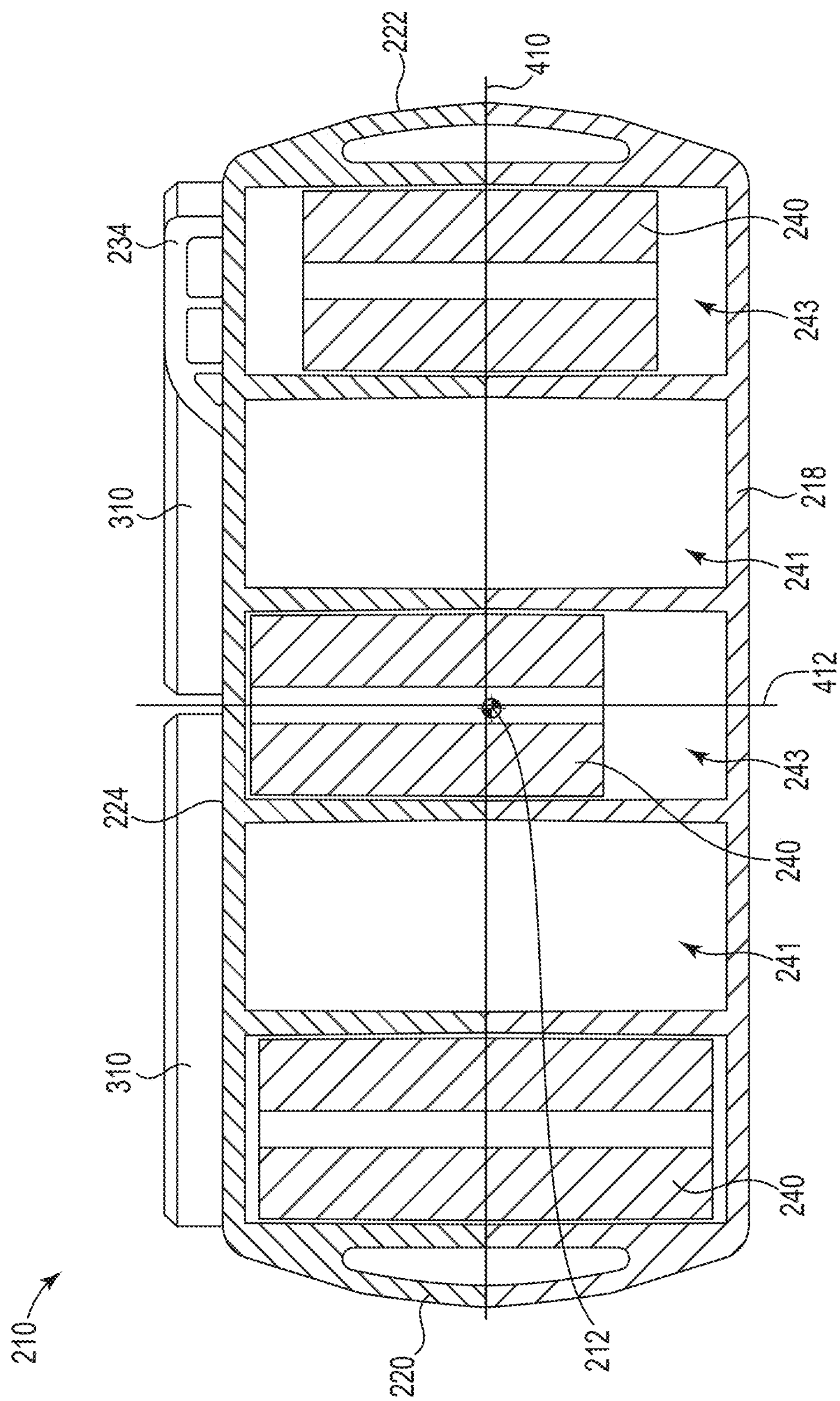
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Fig. 20

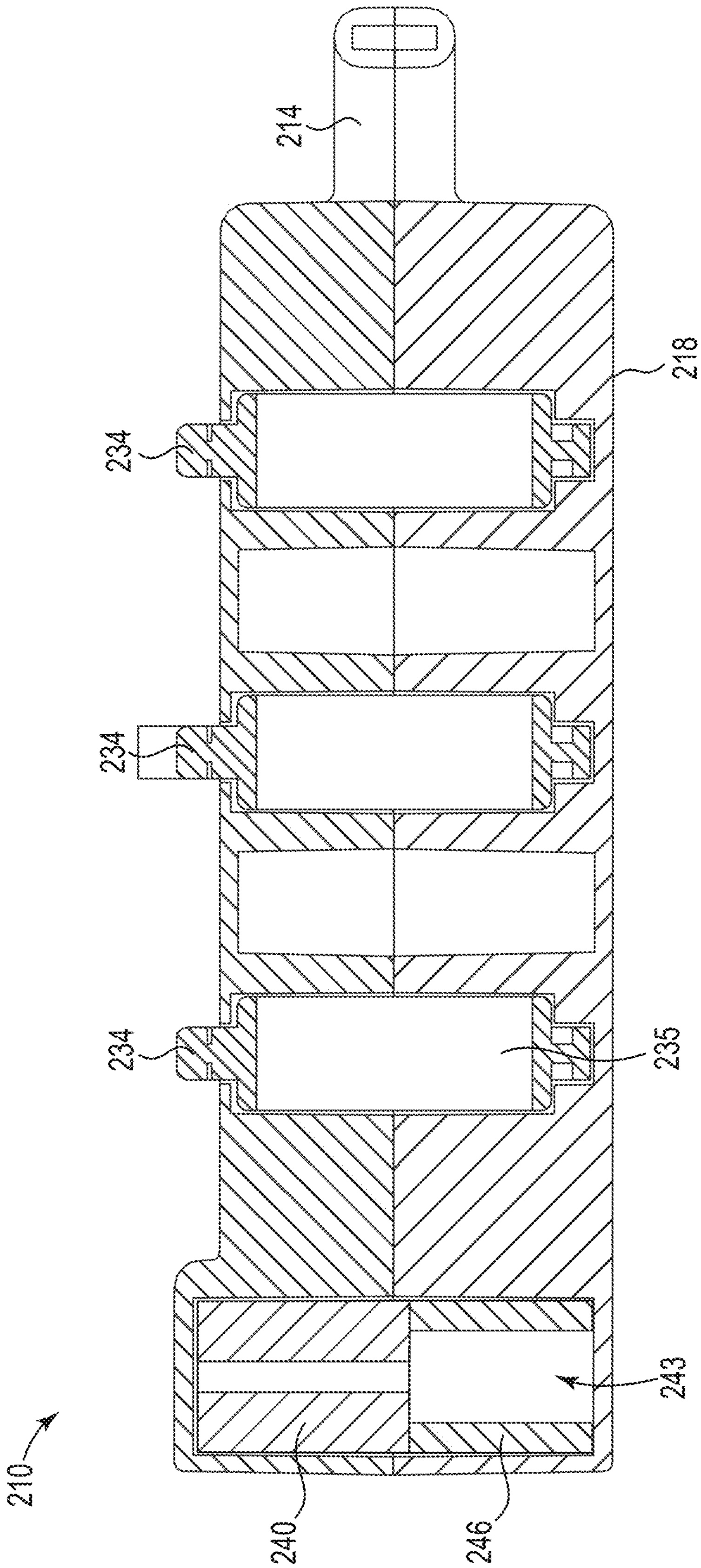

Fig. 21

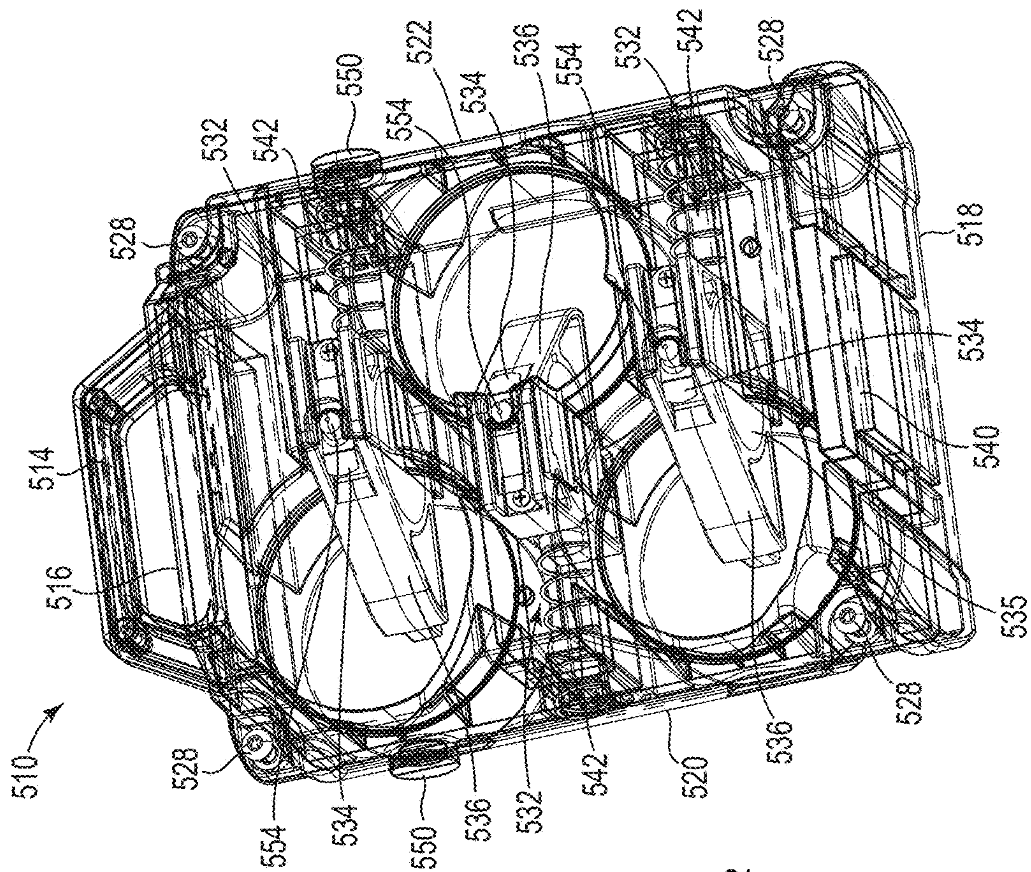
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Fig. 23

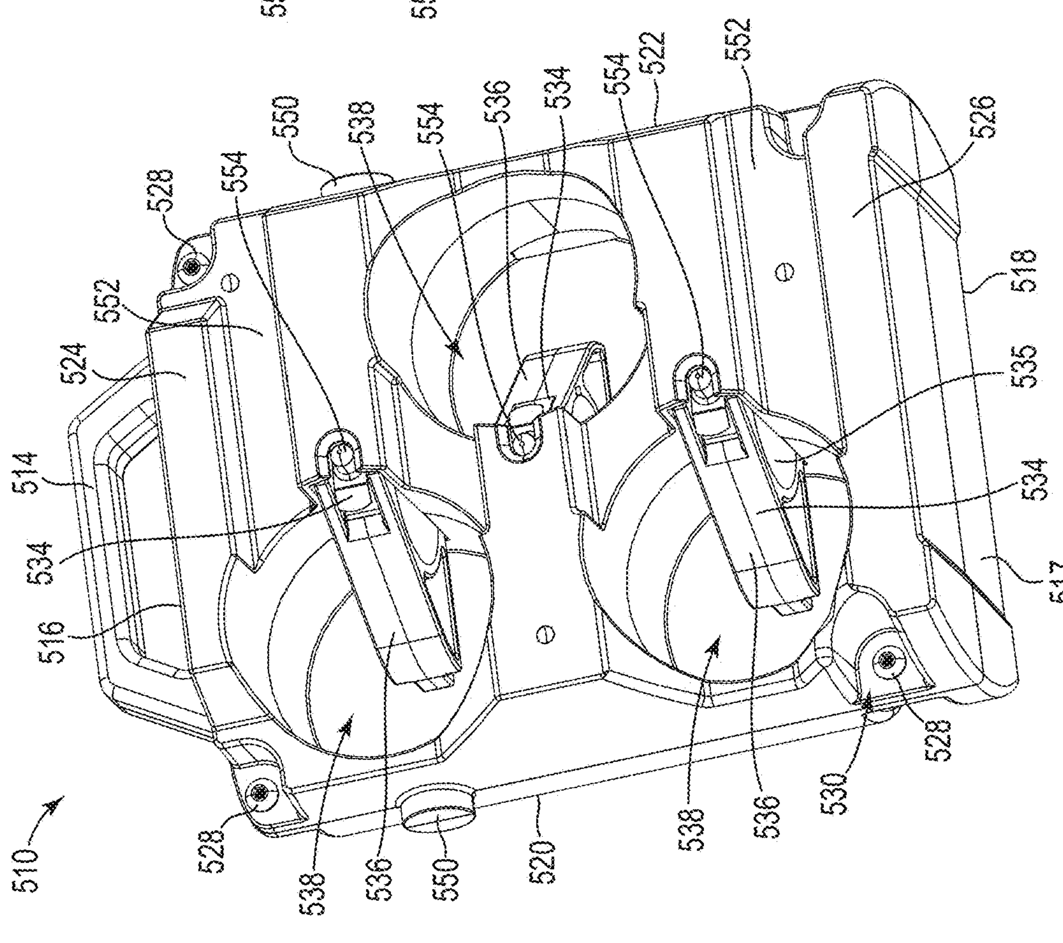
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Fig. 22

SAMPLE PAINT ADAPTER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application No. 63/218,597, filed Jul. 6, 2022, the entire contents of which are incorporated herein by reference in its entirety.

BACKGROUND

The present invention is directed to mixing, and more particularly to self-balancing adapters for allowing the use of different sized containers, such as sample containers, in a mixer typically configured to specifically use a primary or standard size container.

It is frequently desirable to mix flowable substances such as liquids contained in various containers. For example, constituent parts of paint are commonly mixed within a given container, and sometimes samples of paint are mixed in smaller containers as compared to standard size retail liquid paint cans.

At present, a mixing apparatus typically receives a set size of container to be mixed, such as a one-U.S. gallon paint can. However, drawbacks and limitations presently exist when attempting to mix a smaller, sample size paint can in the apparatus primarily designed to receive and mix paint within a larger can. Additionally, rotationally balancing of the smaller container is challenging especially if more than one container would be mixed during a single mixing cycle. Therefore, there exists a need to allow for adapting mixing apparatuses to mix one or more containers of a different size at once while keeping the apparatus balanced during mixing.

SUMMARY

The present invention addresses limitations in the art and relates to versatile adapters for use with various mixers. Examples of mixers include vortex mixers. Disclosed adapters allow for easy-to-use, self-balancing, and flexible mixing of any number or position of one, two, three, or more smaller containers (also referred to herein as vessels) at a time within a single adapter unit. Beneficially, multiple sample paint containers can be inserted and loaded into any position of a single adapter, and the adapter can then be inserted into a receiving portion of a mixer while maintaining rotational balance and smooth mixing operation regardless of how many or which locations are loaded or unloaded.

Loading the adapter is easily accomplished by inserting one or more smaller containers into recesses of the adapter. The smaller containers can be sample size paint containers or the like. One, two, three, or more sample size paint containers can be mixed at a time using the disclosed adapter.

As each smaller container is individually inserted into the adapter, a weighted balancing feature is correspondingly displaced such that a central plane of a center of gravity of the adapter is substantially maintained by a counterweight. The weighted balancing feature can incorporate a ramp feature to permit easy and consistent loading. In this way, a single container or multiple containers are each individually and independently balanced as they are inserted, resulting in an overall balanced adapter. The balanced adapter then permits smooth, consistent mixing of any number of loaded containers held by the adapter simultaneously.

According to a first aspect of the present disclosure, a self-balancing adapter for use with a mixer is disclosed. According to the first aspect, the adapter includes a body configured to interface with the mixer as a unit, the body having a front and a back, left and right edges, a top and a bottom, and a vertical adapter axis passing through the top and the bottom. Also according to the first aspect, the front has at least a first recess configured to receive and hold a first vessel substantially within the body. The adapter also includes at least one movable counterweight configured to be displaced when the first vessel is received in the first recess such that the movable weight at least partially offsets a weight of the first vessel within the body with respect to the vertical adapter axis.

According to a second aspect of the present disclosure, a mixer is disclosed. According to the second aspect, the mixer includes a receptacle supported by a carrier yoke, where the yoke is rotatably supported by a frame. The mixer also includes a motor supported by the frame, where the motor is configured to rotate at least the yoke supporting the receptacle. The mixer also includes a self-balancing adapter configured to be received within the receptacle. According to the second aspect, the adapter includes a body configured to interface with the mixer as a unit. According to the second aspect, the body includes a front and a back, left and right edges, a top and a bottom, and a vertical adapter axis passing through the top and the bottom. Also according to the second embodiment, the front has at least a first recess configured to receive and hold a first vessel substantially within the body. The adapter also includes at least one movable counterweight configured to be displaced when the first vessel is received in the first recess such that the movable weight at least partially offsets a weight of the first vessel within the body with respect to the vertical adapter axis.

According to a third aspect of the present disclosure, a method of adapting a mixer for use with different sized vessels is disclosed. According to the third aspect, the method includes providing a self-balancing adapter for use with a mixer. According to the third aspect, the adapter includes a body configured to interface with the mixer as a unit. The body includes a front and a back, left and right edges, a top and a bottom, and a vertical adapter axis passing through the top and the bottom. Also according to the third aspect, the front has at least a first recess configured to receive and hold a first vessel substantially within the body. The adapter also includes at least one movable counterweight configured to be displaced when the first vessel is received in the first recess such that the movable weight at least partially offsets a weight of the first vessel within the body with respect to the vertical adapter axis. The method also includes receiving a vessel within the adapter, and inserting the adapter into the mixer.

These and various other features and advantages will be apparent from a reading of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a mixing apparatus and an adapter for use with the mixing apparatus, according to various embodiments.

FIG. **2** is a profile view of various components of the mixing apparatus of FIG. **1**, showing the adapter inserted into the mixing apparatus and a vertical mixer axis, according to various embodiments.

FIG. **3** is a perspective view of the adapter as shown in FIGS. **1** and **2**, according to various embodiments.

FIG. **4** is a partially transparent perspective view of the adapter of FIG. **3**, according to various embodiments.

FIG. **5** is a partially transparent front plan view of the adapter of FIG. **3**, according to various embodiments.

FIG. **6** is a three-quarters perspective view of the adapter of FIG. **3**, showing the loading of multiple vessels into the adapter, according to various embodiments.

FIG. **7** is another perspective view of the adapter of FIG. **3**, showing multiple vessels fully loaded into the adapter, according to various embodiments.

FIG. **8** is a perspective transverse cross-section view of the adapter of FIG. **3**, showing multiple vessels fully loaded into the adapter, according to various embodiments.

FIG. **9** is a lower cross-sectional view of the adapter of FIG. **3** showing an unloaded adapter, according to various embodiments.

FIG. **10** is a lower cross-sectional view of the adapter of FIG. **3** showing a partially loaded adapter, according to various embodiments.

FIG. **11** is another lower cross-sectional view of the adapter of FIG. **3** showing a loaded adapter, according to various embodiments.

FIG. **12** is a longitudinal cross-sectional view of the adapter of FIG. **3**, with an unloaded adapter, according to various embodiments.

FIG. **13** is another longitudinal cross-sectional view of the adapter of FIG. **3**, with an unloaded adapter, according to various embodiments.

FIG. **14** is a yet another longitudinal cross-sectional view of the adapter of FIG. **3**, with an unloaded adapter, according to various embodiments.

FIG. **15** is even yet another longitudinal cross-sectional view of the adapter of FIG. **3**, with an unloaded adapter, according to various embodiments.

FIG. **16** is a longitudinal cross-sectional view of the adapter of FIG. **3**, with a loaded adapter, according to various embodiments.

FIG. **17** is another longitudinal cross-sectional view of the adapter of FIG. **3**, with a loaded adapter, according to various embodiments.

FIG. **18** is a transverse cross-sectional view of optional ballast weights within the adapter of FIG. **3**, according to various embodiments.

FIG. **19** is a perspective view of the adapter of FIG. **3**, with a front cover removed to show various components, according to various embodiments.

FIG. **20** is another transverse cross-sectional view of the adapter as shown in FIG. **18**, showing a center of gravity and planes, according to various embodiments.

FIG. **21** shows a weight-positioning spacer within the adapter as shown in FIG. **18**, according to various embodiments.

FIG. **22** shows a perspective view of an embodiment of an alternative adapter, according to various embodiments

FIG. **23** shows a partially transparent perspective view of the alternative adapter of FIG. **22**, according to various embodiments.

DETAILED DESCRIPTION

With reference now to the Figures, disclosed are embodiments of a self-balancing adapter for use with a mixing apparatus, such as the example mechanical, multi-axis vortex mixer **110** as shown in FIGS. **1** and **2**. An example adapter **210** for use with the mixer **110** can include a body **226** with an outer shell configured to interface with an interior **132** of a receptacle **112** of the mixer **110** as a unit as shown in FIGS. **1** and **2**. As shown in FIG. **1**, a mixer frame **116** generally supports a motor **118** and rotatable mixing components attached to a pulley **128**. A V-belt **130** then operatively connects a drive pulley (not shown) of the motor **118** to a driven pulley **128**, and the driven pulley **128** in turn is connected to rotate a carrier yoke **114**. Other mixer types and configurations are also contemplated.

As shown, the yoke **114** is fixedly connected to a shaft **142** that is rotatably supported by bearings **144**, which are preferably supported by the frame **116** as shown in FIGS. **1** and **2**. The yoke **114** includes a first end, a shaft end **134**; and a second end, a counterweight end **120** located opposite the first, shaft end **134**. The yoke **114** is connected to the mixer receptacle **112** that is itself caused to be rotated about a (vertical as shown) mixer axis **140** in a planetary fashion as a second gear **122** is caused to rotate about a first gear **124** that is preferably fixed and stationary and connected to frame **116**. The receptacle **112** optionally has one or more bail tabs **136** configured to receive a container bail in a vertical position. The shown mixer **110** with yoke **114**, shaft end **134**, and a counterweight end **120** located on an opposite side of the yoke **114** are sized and weighted such that the receptacle **112** and counterweight **120** of the mixer generally have a center of gravity (COG) (which can alternatively be referred to as a center of mass) centered at mixer axis **140** (see FIG. **2**). A flange **138** or other suitable interface can connect the receptacle **112** to the rotatable yoke **114**, as shown.

As described herein, the mixer **110** is typically configured to receive a conventional, one U.S. gallon container, such as a standard size paint can that contains contents to be mixed. The adapter **210** as described herein can be inserted as if a standard container into the mixer **110** such that the mixer **110** is adapted seamlessly and operates normally when the adapter **210** is received and held within the receptacle **112**. Therefore, in some embodiments, the adapter body **226** is shaped and sized in order to closely fit within the interior **132** of the receptacle **112**. The receptacle **112** can be configured to receive a container larger than a smaller vessel **310**. The vessel **310** is preferably a smaller, sample paint container for mixing within the mixer **110**.

With reference now to FIGS. **3** and **4**, adapter **210** is shown in greater detail. The adapter **210** is preferably an internally self-balancing adapter that includes one or more internal movable, self-balancing features that make the adapter **210** versatile and simple to use. The adapter **210**, as shown, has a body **226** that includes a front **224** and a back **218**, left **220** and right **222** edges, a top **216** and a bottom **217**. In various embodiments, the adapter **210** body **226** is formed as a clamshell with the front **224** and the back **218** comprising separate pieces fastened together as a single housing. The front **224** and the back **218** of the body **226** can be fastened together, e.g., using fasteners **228** in corner fastener recesses **230**. In some embodiments, the body **226** further comprises a handle **214** extending from the top **216** of the body **226**. The handle **214** is preferably graspable by a user such that the adapter **210** can be inserted and/or removed from the receptacle **112** before or after mixing. The front **224** of the adapter **210** preferably has at least a (e.g., first) recess **238** configured to receive and hold a first container, vessel, or can (e.g., vessel **310**, see FIG. **6**) substantially within the body **226** of the adapter **210**. For example, if a vessel **310** is intended to be loaded into the recess **238**, and the vessel has a generally cylindrical shape, the recess **238** can have a corresponding and slightly larger diameter bore and cylindrical shape configured to slidably receive and closely hold and support a loaded vessel **310**.

Other embodiments can provide for a generally rectangular recess **238** for a corresponding rectangular vessel **310** (not shown). Other shapes of the recess **238** and vessel **310** are also contemplated herein. As shown in FIG. **6**, the example vessel **310** can include a lower portion **312** and a cap **314** that is optionally threadably or otherwise sealingly engageable with the lower portion **312**.

As shown in FIG. **6**, when each vessel **310** is loaded into the adapter **310**, the vessel lower portion **312** can be substantially surrounded by the recess **238**, and the cap **314** can be exposed beyond the recess, e.g., to be engageable and graspable by a user's hand for loading and unloading of one or more vessels **310**. In some embodiments, the bottom **217** of the body **226** comprises an anti-skid feature (not shown) to reduce movement of the body within the mixer **110** during mixing.

With reference to FIGS. **9-11**, the adapter **210** also preferably includes at least one movable, internally and self-balancing, movable counterweight **234** configured to be displaceable when a vessel **310** is received in a respective recess **238** such that the movable counterweight **234** at least partially offsets a weight of the vessel **310** within the body **226** of the adapter **210** with respect to a vertical adapter axis **212**. The movable counterweights **234** in various embodiments can be weight holders for holding a weight insert **235**. The movable counterweights **234**, each including the weight insert **235** as shown in FIG. **15**, can each be configured to have a composition and weight that corresponds to and offsets the weight of the vessel **310** when the vessel **310** is loaded into the adapter **210** for mixing. If present, the weight insert **235** can be replaceable and/or swappable according to various configurations either by a user or a servicer. The weight insert **235** can optionally be composed of a material different than the movable counterweights **234** themselves, and in some embodiments can be formed of a denser material than the counterweights **234**. For example, the weight insert **235** can be made of various metals or the like, including steel, iron, lead, etc. The weight of each counterweight **234**, including the respective weight insert **235** if present, can be defined according to the size of the respective recess **238** as a proxy for a typical weight of such size and shape vessel **310**.

As shown in at least FIGS. **9-11**, and **14-16**, in some embodiments, the movable counterweight **234** comprises a sloped ramp feature **236** such that inserting the vessel **310** into the recess **238** causes contact between a lower part of the vessel **310** and the ramp feature **236**, causing a corresponding, balancing displacement of the movable counterweight **234**. The ramp feature **236** of each movable counterweight **234**, if present, can be angled, e.g., at 45 degrees relative to the front **224** of the body **226**. Other angles greater than and less than 45 degrees are also contemplated for the ramp feature **236**. The ramp feature **236** can be substantially linear in slope, curved, or any other suitable ramp shape. Optionally, at least a portion of the ramp feature **236** can have a surface with a low coefficient of friction.

The movable counterweight **234** optionally is configured to securely hold the vessel **310** in place by friction using a bias of the counterweight **234**, such as by a biased coil spring **242**. As shown in FIG. **6**, each movable counterweight **234** is slidable within the adapter **210** along a guide slot **232** on the front **224** of the body **226**. As shown in FIG. **9**, each guide slot **232** can define a maximum stroke **245** length that allows movement of the counterweight **234** such that the spring **242** can freely compress and decompress based upon the loading status or manual retraction of the counterweight **234**. The spring **242** can be of a size and specification (e.g., one or more spring constant, variable/progressive/linear spring rate, etc.) such that a bias is applied throughout the stroke **245** as desired for smooth and consistent operation and loading/unloading. It is understood that the adapter **210** receiving a vessel **310** may compress the spring **242** partially, and therefore move the counterweight **234** along a distance less than the maximum stroke **245** according to, e.g., a diameter of the received vessel **310**.

As shown in FIG. **3**, a vertical (spin) axis **212** of the adapter **210** can virtually pass through the top **216** and the bottom **217** of the adapter **210**. As containers **310** are inserted into the adapter **210** and counterweights **234** are moved in a corresponding and opposite fashion and direction. The adapter **210** preferably offsets vessel **310** weight relative to the adapter axis **212** thereby substantially keeps a COG at the adapter axis **212**. Each recess **238** and movable counterweight **234** combination individually balances each vessel **310** individually as each is loaded into the adapter **210**. Thus, each balanced vessel **310** and counterweight **234** combination is independent of any other vessel **310** counterweight **234** combinations. In some embodiments, the adapter **210** is formed as a clamshell with the front and the back sections comprising separate pieces fastened together when assembled.

In some embodiments, and with reference again to FIGS. **10** and **11**, each movable counterweight **234** is biased by a respective biasing coil spring **242**, and is able to be moved manually as the first vessel **310** is inserted into the recess **238**. Any other biasing structure can be used to bias the counterweight **234**. In some embodiments, and with reference in particular to FIGS. **4** and **5**, the moveable counterweight **234** is biased to a fully extended resting position using the spring **242**. As shown in FIG. **11**, when a vessel **310** is loaded into the adapter **210**, the spring **242** corresponding to the counterweight **234** is fully compressed. As shown in FIGS. **6** and **8**, body **226** can be configured to receive at least a second and/or third vessel **310**, such as for a total of three vessels **310**. In other embodiments not shown, more than three vessels **310** can be held and balanced by a variation on adapter **210** in various configurations and arrangements.

In some embodiments, the adapter **210** when unloaded and resting is rotationally balanced such that it has COG that is substantially centered on the adapter axis **212**. As discussed herein, when the adapter **210** is at least partially loaded, it preferably substantially maintains rotational balance about adapter axis **212**. In some embodiments, the mixer **110** is a vortex mixer that mixes the first vessel **310** using the adapter **210** according to both the adapter axis **212** and a second, non-aligned axis. In some embodiments, the adapter axis **212** is a vortex spin axis canted relative to mixer axis **140** as shown in FIG. **2**. In some preferable embodiments, the mixer axis **140** also represents an overall balanced COG of the mixer **110**, adapter **210**, and any loaded vessels **310**.

Sliding ramps **236** on movable counterweights **234** allow for self-balancing of the adapter **210** as a center plane **412** progressively moves away to become offset planes as each sample container or vessel **310** is loaded or inserted into the adapter **210**. In some embodiments, the displacement of each movable counterweight **234** provides a rotation offset such that a COG of the adapter **210** is substantially aligned with the adapter axis **212** when the first vessel **310** is received in the recess **238**. Pushing a vessel **310** down on the ramp feature **236** of the counterweight **234** causes the counterweight to slide over, e.g., into guide slot **232**. This sliding and moving of the counterweight **234** offsets the weight of the full vessel **310** being pushed in, keeping the overall COG of the adapter **210** centered. When a vessel **310** is removed, the corresponding spring **242** repositions the counterweight **234** so that it is re-centered on the adapter **210**. According to the present disclosure, the COG of the adapter **210** is therefore maintained substantially centrally to the adapter **210** during all stages of loading, unloading, mixing, and so forth.

As shown in FIGS. **10**, **11**, and **20**, transverse plane **410** is a plane that is generally coplanar with the front **224** and back **218** of the body **226** of the adapter **210**. As described herein, the transverse plane **410** is stable before, during, and after loading vessels **310** into adapter as described herein. One or more vertical planes **412** are preferably also collectively centered before, during, and after loading the vessels **310** into the adapter **210**. As shown in FIG. **11**, a vessel **310** and counterweight **234** combination when loaded have split vertical planes **412**A and **412**B corresponding to a center plane. Each of the split vertical planes **412**A/B as shown can correspond to a COG of the counterweight **234** or the vessel **310** when loaded, respectively. The average of the split vertical planes **412**A/B corresponding to various weighted bodies is preferably equivalent to the single vertical plane **412** as shown in FIG. **10**. Loading any number of vessels **310** into adapter therefore preferably causes the one or more vertical planes **412**A/B to sum to a central vertical plane **412** as shown in FIG. **20**.

The adapter axis **212** is preferably a vertical spin axis in a frame of reference of the adapter **210**, as shown in FIGS. **3** and **20**. The adapter axis **212** is defined as the intersection of two planes, a vertical plane **412** and a transverse plane **410** that each bisect the adapter **210**. Three weights **240**, as shown in FIG. **3**, are positioned to align the COG of the adapter **210** at the adapter axis **212** and to position the COG of the adapter **210** at or near the mixer axis **140** for mixing. A COG as used herein can include one or more COG components corresponding to one or more axes, such as aligned in any orientation in three-dimensional space.

A COG of adapter **210** assembly is shown in FIG. **20**, which rotates on adapter axis **212**. As shown in particular in FIGS. **4**, **12**, **18**, **19**, and **20**, in some embodiments, the one or more weights **240** are located proximate the bottom **217** of the body **226**. The weights **240** can be provided, sized, weighted, positioned, and configured such that a COG of the adapter **210** is positioned (e.g., lowered) along the mixer axis **140**. The weights **240** can optionally give inertial stability and/or a perceived feeling of substantiality to a user handling the adapter **210** as compared to example of the adapter **210** without weights **240**. The three weights **240** proximate the bottom of the adapter **210** also preferably serve to lower the COG of the adapter **210**, which brings the overall loaded, unloaded, or partially loaded adapter **210** COG closer to being aligned with the mixer axis **140** of FIG. **2**. Preferably, the COG of the adapter **210** is therefore aligned with both of axes **212** and **140** for mixing.

Keeping the two COG components close to center at the two respective axes **140** and **212** can reduce the vibration in the mixer **110** during mixing operation. It is to be understood that any weights **240** are optional and the adapter **210** as described herein is functional even without the provision of one or more weights **240**. As shown in FIGS. **18**-**20**, the weights **240** are receivable within pockets **243** within adapter **210**. Also shown are one or more optionally empty pockets **241**, which are shown without weights **240** inserted therein. The weights **240** can be of any suitable size and can be in any suitable location, including but not limited to pockets **243**, and/or **241**. In various embodiments, a weight **240** inside a pocket **243** can leave at least some open space. For example, and as shown in FIG. **21**, one or more weight spacers **246** (e.g., comprising plastic) can be positioned within pockets **243** for holding weights **240** in position. Optionally, each spacer **246**, if employed, can be sized and positioned such that the COG is optimally aligned with axes **140** and/or **212**. Various stepped features (not shown) can be added into the adapter **210** body pockets, so in some embodiments no spacers **246** are used to hold the weight(s) **240**, e.g., in optimal balancing position.

With reference now to FIGS. **22** and **23**, an alternative embodiment **510** of an adapter similar to adapter **210** described above is shown. Descriptions of certain parts of adapter **510** are omitted for brevity, although it is understood that any features described with reference to adapter **210** can be implemented with alternative adapter **510**, which is described in greater detail below.

With reference now to FIGS. **22** and **23**, the alternative adapter **510** is shown in detail. The adapter **510**, which can be similar to adapter **210**, is preferably a self-balancing adapter that includes internal movable, self-balancing features that make the adapter versatile and simple to use. The adapter **510**, as shown, has a body **526** that includes a front **524** and a back **518**, left **520** and right **522** edges, a top **516** and a bottom **517**. As shown in FIG. **22**, the body **526** preferably has one or more groves **552** on a surface thereof. Also as shown, the body **526** of adapter **510** optionally includes one or more transverse projections **550** therefrom (optionally configured to fit into a respective bail tab **136** as shown in FIG. **1**, such as to hold the adapter **510** in place relative to a receptable such as **112**, above.). In various embodiments, the adapter **510** is formed as a clamshell with the front **524** and the back **518** comprising separate pieces fastened together. The front **524** and the back **518** can be fastened together, e.g., using fasteners **528** in corner fastener recesses **530**. In some embodiments, the body **526** further comprises a handle **514** extending from the top **216** of the body **226**. The handle **514** is preferably graspable by a user such that the adapter **510** can be inserted and/or removed from a receptacle (e.g., receptable **112** of FIGS. **1** and **2**, above) before or after mixing. The front **524** of the adapter **510** preferably has at least a (e.g., first) recess **538** configured to receive and hold a first container, vessel, or can (e.g., vessel **310**, see FIG. **6**) substantially within the body **526** of the adapter **510**. For example, if a vessel **310** is intended to be loaded into the recess **538**, and the vessel has a generally cylindrical shape, the recess **538** can have a corresponding and slightly larger diameter bore and cylindrical shape configured to slidably receive and closely hold and support a loaded vessel **310**. Other embodiments can provide for a generally rectangular recess **538** for a corresponding rectangular vessel **310** (not shown). Other shapes of the recess **538** and vessel **310** are also contemplated herein.

Still with reference to FIGS. **22** and **23**, the adapter **510** also preferably includes at least one movable balancing counterweight **534**, shown with a protrusion **554** thereon, configured to be displaceable when a vessel **310** is received in a respective recess **538**, as in adapter **210**. Protrusions **554**, if present, can benefit balance of the adapter **510** during mixing and can be snap-action, friction-based, or other releasably holding parts configured to at least partially hold counterweights **534** (in conjunction with a complementary mechanical part of adapter body **526**) in place particularly when a recess **538** is not presently filled with a vessel **310**. The protrusions **554** therefore optionally hold the counterweight **534** in a stable position during mixing and/or spinning. Insertion of a vessel **310** preferably causes protrusions

554 to be displaced from a stable held position shown as a corresponding spring 542 is increasingly compressed.

As shown, the movable counterweight 534 comprises a sloped ramp feature 536 such that inserting the vessel 310 into the recess 538 causes contact between a lower part of the vessel 310 and the ramp feature 536, causing a corresponding, balancing displacement of the movable counterweight 534. The ramp feature 536 of each movable counterweight, if present, can be angled, e.g., at 45 degrees relative to the front 524 of the body 526. Other angles greater than and less than 45 degrees are also contemplated for the ramp feature 536. The ramp feature 536 can be substantially linear in slope, curved, or any other suitable ramp shape. Counterweights 534 have optionally round weight inserts 535 shown therein. Any other shape weight insert 535 is also contemplated here.

The movable counterweight 534 optionally is configured to securely hold the vessel 310 in place by friction using a bias of the counterweight 534, such as by the biased coil spring 542. As shown, each movable counterweight 534 is slidable within the adapter 510 along an internal guide slot 532 not visible from the front 524 of the body 526. As shown, adapter 510 has a generally planar weight 540, which preferably provides similar characteristics to weight(s) 240, described above. In various embodiments, the planar weight 540 can be utilized to optimize and/or reduce the adapter 510 size and shape according to various dimensions and requirements. Other variations on weights and placements thereof are also contemplated.

According to an example of the present disclosure, a method of mixing a sample paint vessel is disclosed. According to the example, a self-balancing adapter for use with a mixer is provided, the adapter comprising a body configured to interface with the mixer as a unit. According to the example, the body has a front and a back, left and right edges, a top and a bottom, and a vertical adapter axis passing through the top and the bottom. According to the example, the front has at least a first recess configured to receive and hold a first vessel substantially within the body; and at least one movable counterweight configured to be displaced when the first vessel is received in the first recess such that the movable weight at least partially offsets a weight of the first vessel within the body with respect to the vertical adapter axis. According to the example, the method also includes receiving a vessel within the adapter, inserting the adapter into a mixer, and optionally performing a mixing operation of the adapter.

The present invention has now been described with reference to several embodiments thereof. The entire disclosure of any patent or patent application identified herein is hereby incorporated by reference. The detailed description and examples have been given for clarity of understanding only. No unnecessary limitations are to be understood therefrom. It will be apparent to those skilled in the art that many changes can be made in the embodiments described without departing from the scope of the invention. Thus, the scope of the present invention should not be limited to the structures described herein, but only by the structures described by the language of the claims and the equivalents of those structures.

The invention claimed is:

1. A self-balancing adapter for use with a mixer, comprising:
 a body configured to interface with the mixer as a unit, the body having:
  a front and a back,
  left and right edges,
  a top and a bottom, and
  a vertical adapter axis passing through the top and the bottom;
 the front having at least a first recess configured to receive and hold a first vessel substantially within the body; and
 at least one movable counterweight configured to be displaced when the first vessel is received in the first recess such that the movable weight at least partially offsets a weight of the first vessel within the body with respect to the vertical adapter axis.

2. The adapter of claim 1, wherein the movable counterweight comprises a ramp feature such that inserting the first vessel into the first recess causes the displacement of the movable counterweight.

3. The adapter of claim 1, wherein the movable counterweight is moved manually as the first vessel is inserted into the first recess.

4. The adapter of claim 1, wherein the moveable counterweight is biased to a resting position.

5. The adapter of claim 4, wherein the movable counterweight is biased using a spring.

6. The adapter of claim 1, wherein the body is configured to receive at least a second vessel.

7. The adapter of claim 1, wherein the body further comprises a handle attached at the top of the body.

8. The adapter of claim 1, wherein the body is shaped and sized to fit in a space within the mixer configured to receive a vessel larger than the first vessel.

9. The adapter of claim 8, wherein the first vessel is a sample paint container and the mixer is configured to receive a one-U.S. gallon paint container.

10. The adapter of claim 1, wherein the bottom of the body comprises an anti-skid feature to reduce movement of the body within the mixer during mixing.

11. The adapter of claim 1, wherein the displacement of the movable counterweight provides a rotation offset such that a center of gravity of the adapter is substantially aligned with the vertical adapter axis when the first vessel is received in the first recess.

12. The adapter of claim 1, wherein the body further comprises at least a weight located proximate the bottom of the body such that a center of gravity of the adapter is lowered along the vertical adapter axis.

13. The adapter of claim 1, wherein the adapter when unloaded and resting is rotationally balanced such that it has a center of gravity that is substantially centered on the vertical adapter axis.

14. The adapter of claim 1, wherein the vertical axis is an adapter spin axis.

15. The adapter of claim 1, wherein the mixer is a vortex mixer.

16. The adapter of claim 15, wherein the vortex mixer mixes the first vessel according to the vertical adapter axis and a second, non-aligned mixer axis.

17. The adapter of claim 16, wherein the adapter has a center of gravity that is substantially centered on the vertical adapter axis and the second, non-aligned mixer axis.

18. The adapter of claim 1, wherein the adapter is formed as a clamshell with the front and the back comprising separate pieces fastened together when assembled.

19. A mixer, comprising:
 a receptacle supported by a carrier yoke, wherein the yoke is rotatably supported by a frame;
 a motor supported by the frame, wherein the motor is configured to rotate at least the yoke supporting the receptacle; and

a self-balancing adapter configured to be received within the receptacle, the adapter comprising:
a body configured to interface with the mixer as a unit, the body having:
a front and a back,
left and right edges,
a top and a bottom, and
a vertical adapter axis passing through the top and the bottom;
the front having at least a first recess configured to receive and hold a first vessel substantially within the body; and
at least one movable counterweight configured to be displaced when the first vessel is received in the first recess such that the movable weight at least partially offsets a weight of the first vessel within the body with respect to the vertical adapter axis.

20. A method of adapting a mixer for use with different sized vessels, comprising:
providing a self-balancing adapter for use with a mixer, the adapter comprising:
a body configured to interface with the mixer as a unit, the body having:
a front and a back,
left and right edges,
a top and a bottom, and
a vertical adapter axis passing through the top and the bottom;
the front having at least a first recess configured to receive and hold a first vessel substantially within the body; and
at least one movable counterweight configured to be displaced when the first vessel is received in the first recess such that the movable weight at least partially offsets a weight of the first vessel within the body with respect to the vertical adapter axis;
receiving a vessel within the adapter; and
inserting the adapter into the mixer.

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