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(54) **HEIGHT-ADJUSTABLE MASKING PALLET ASSEMBLY FOR ARC SPRAY APPLICATIONS**

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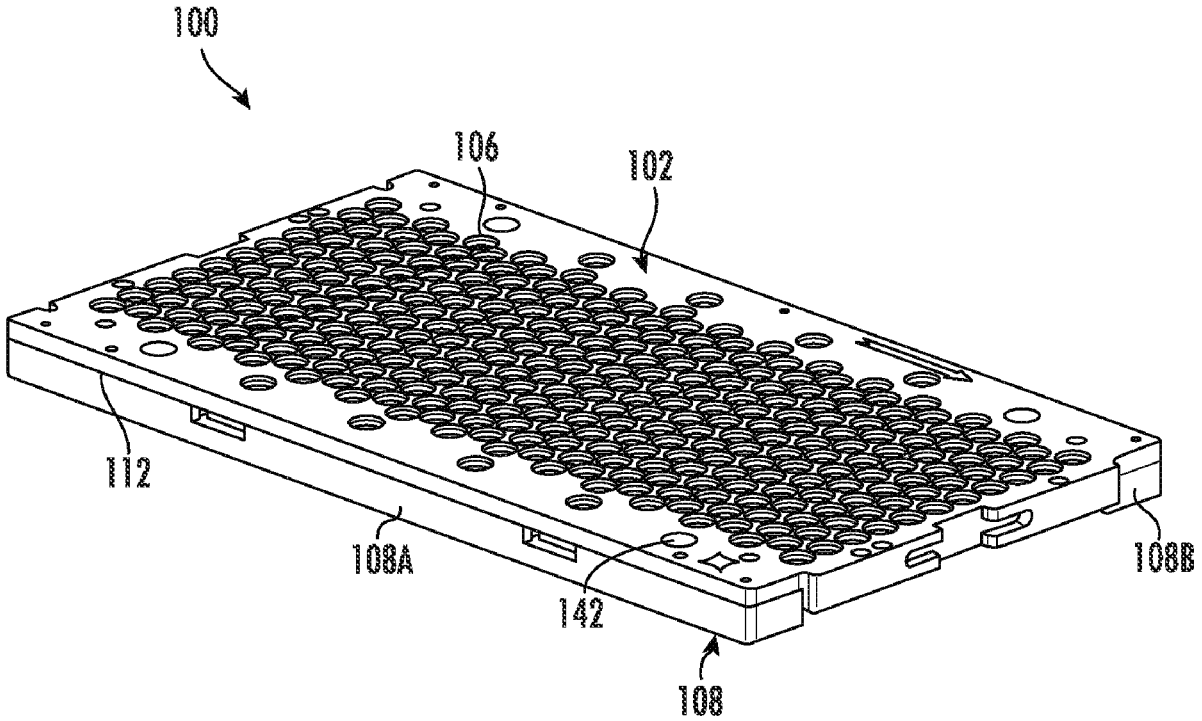
CPC ***B05B 12/29*** (2018.02); ***B05B 13/0292*** (2013.01)

(57) **ABSTRACT**

Disclosed are various pallet assemblies for arc spray applications. In some embodiments, an assembly may include a top frame comprising a plurality of recesses each operable to receive an electronic device, and a bottom frame coupled to the top frame, wherein the bottom frame comprises a plurality of support structures, and wherein each support structure of the plurality of support structures is aligned with a corresponding recess of the plurality of recesses. The assembly may further include a mechanical device coupled to the top frame and the bottom frame, wherein the mechanical device is operable to bias the top frame and the bottom frame relative to one another.



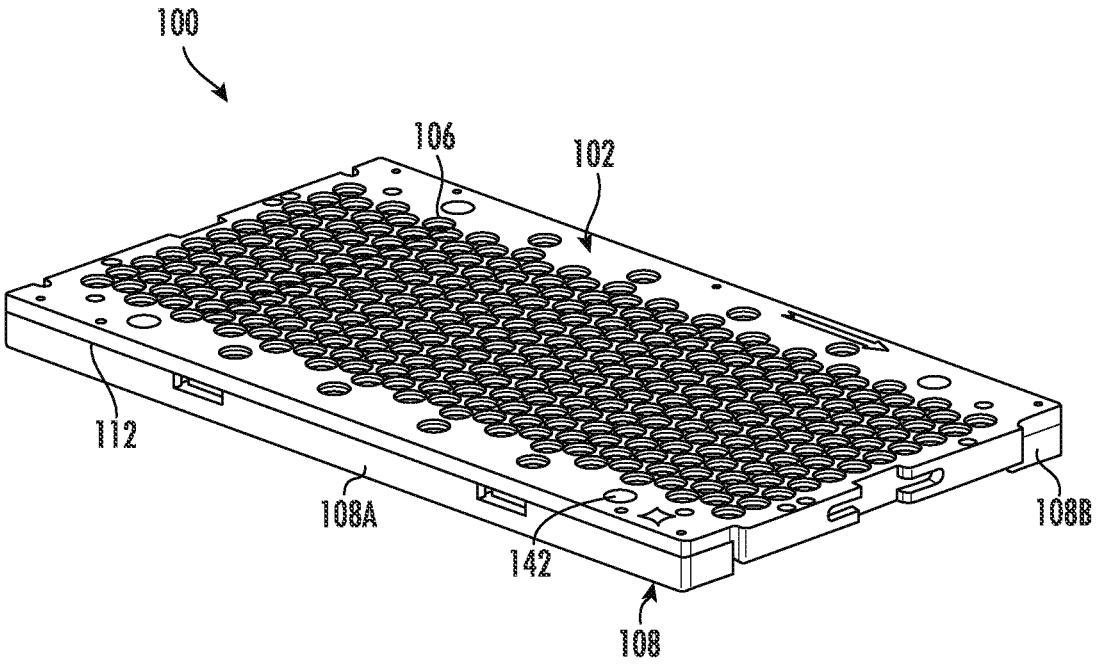


FIG. 1A

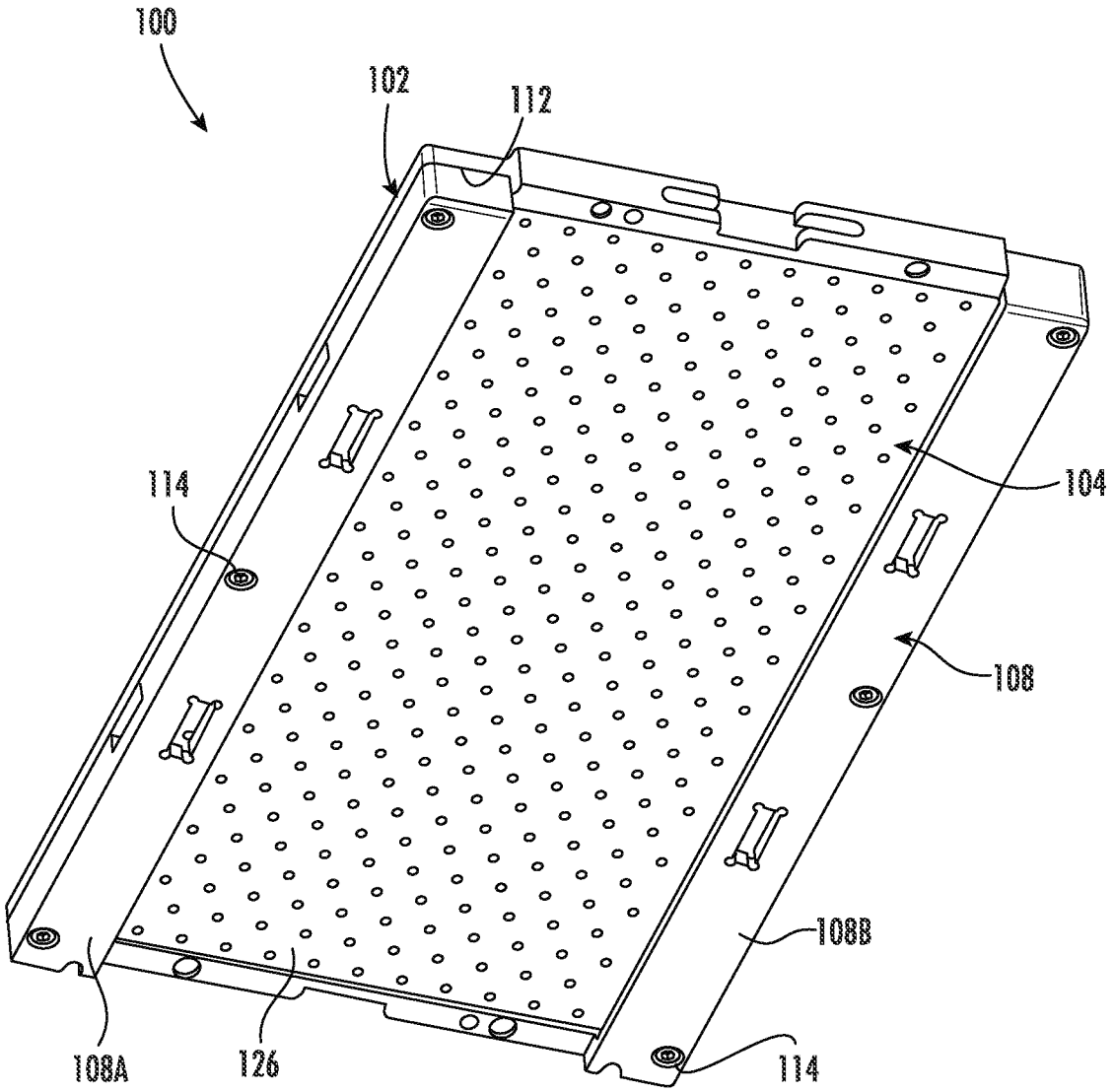


FIG. 1B

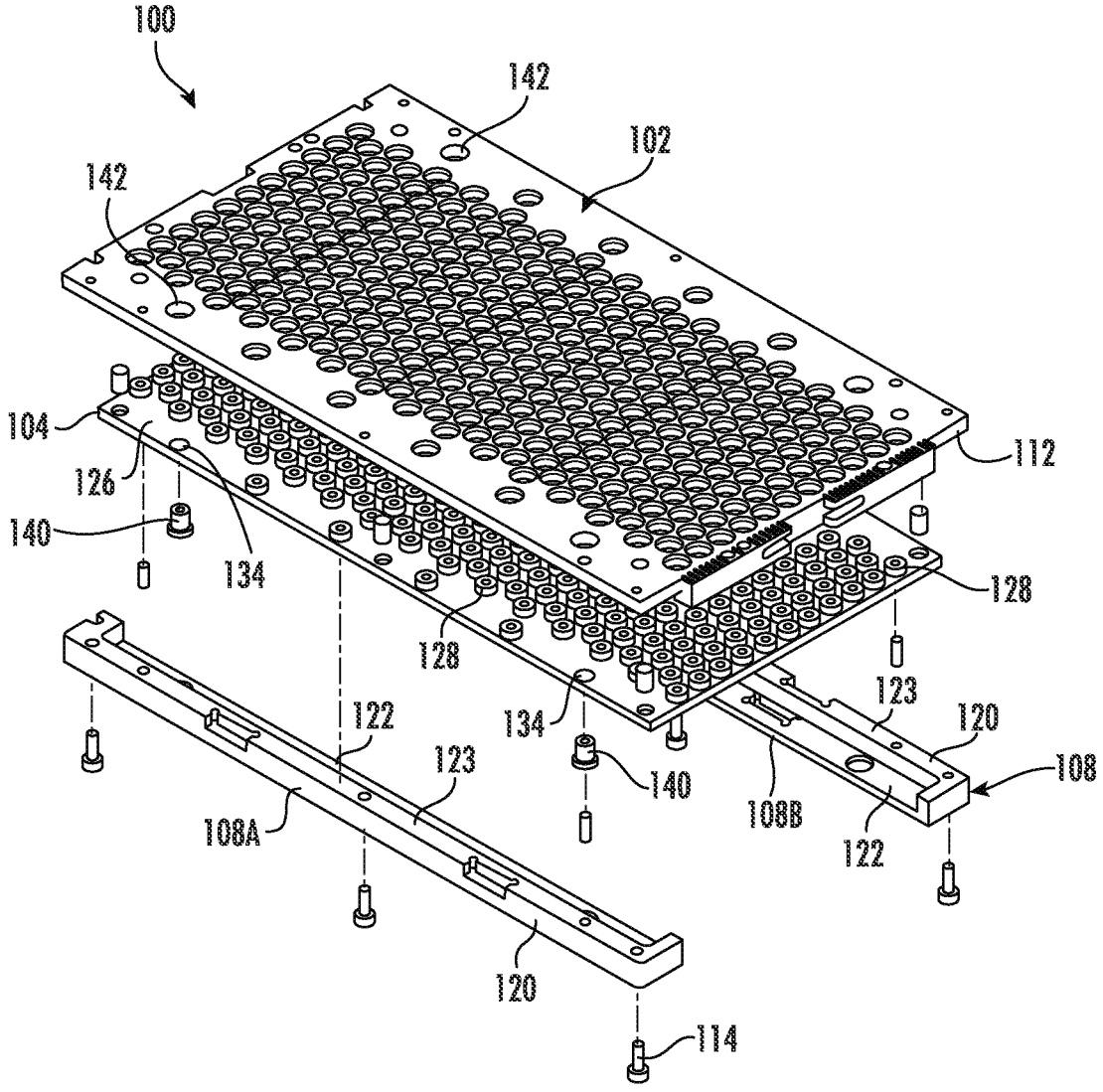
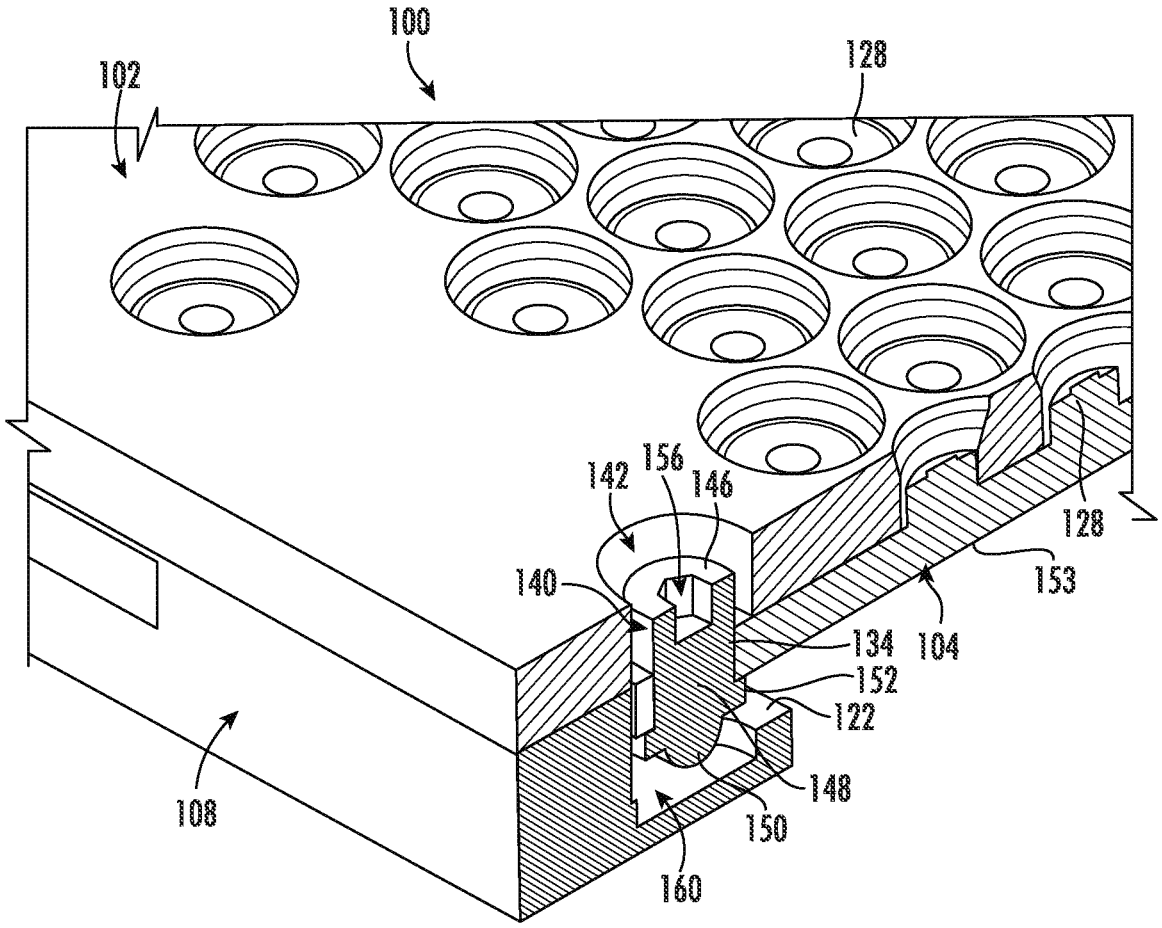

100
142
102
142
104
126
140
134
112
128
128
123
134
120
122
123
140
108
108A
108B
122
120
114

FIG. 1C


100
102
128
142
156
146
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140
153
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104
152
122
148
108
150
160

FIG. 2A

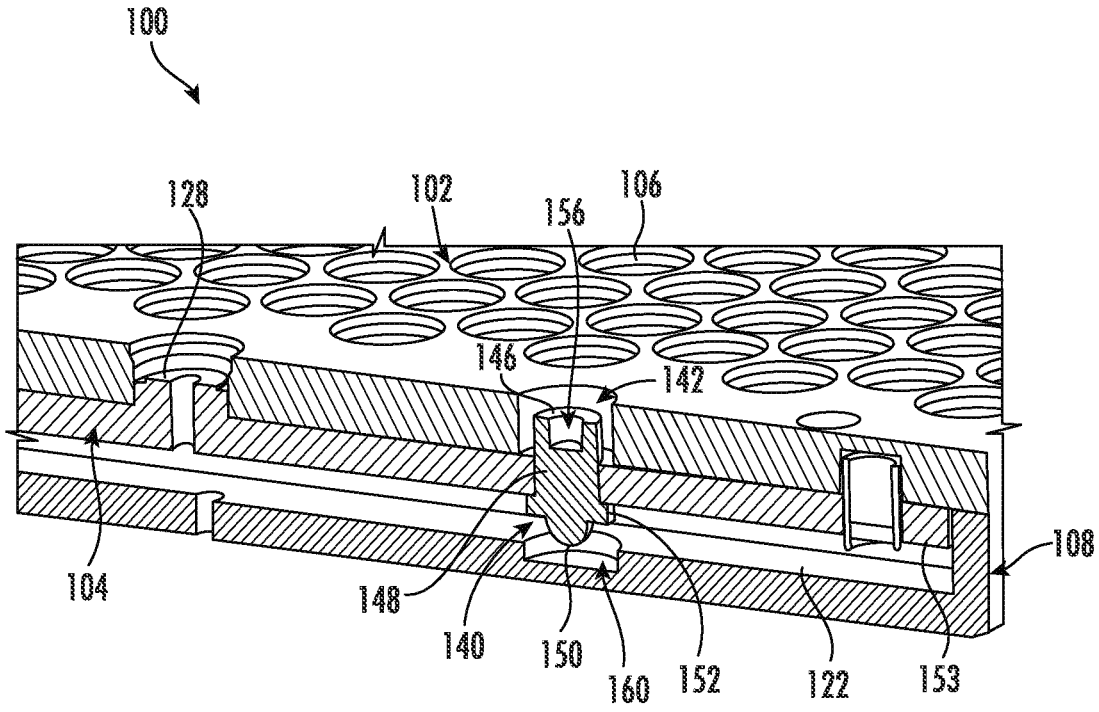

FIG. 2B

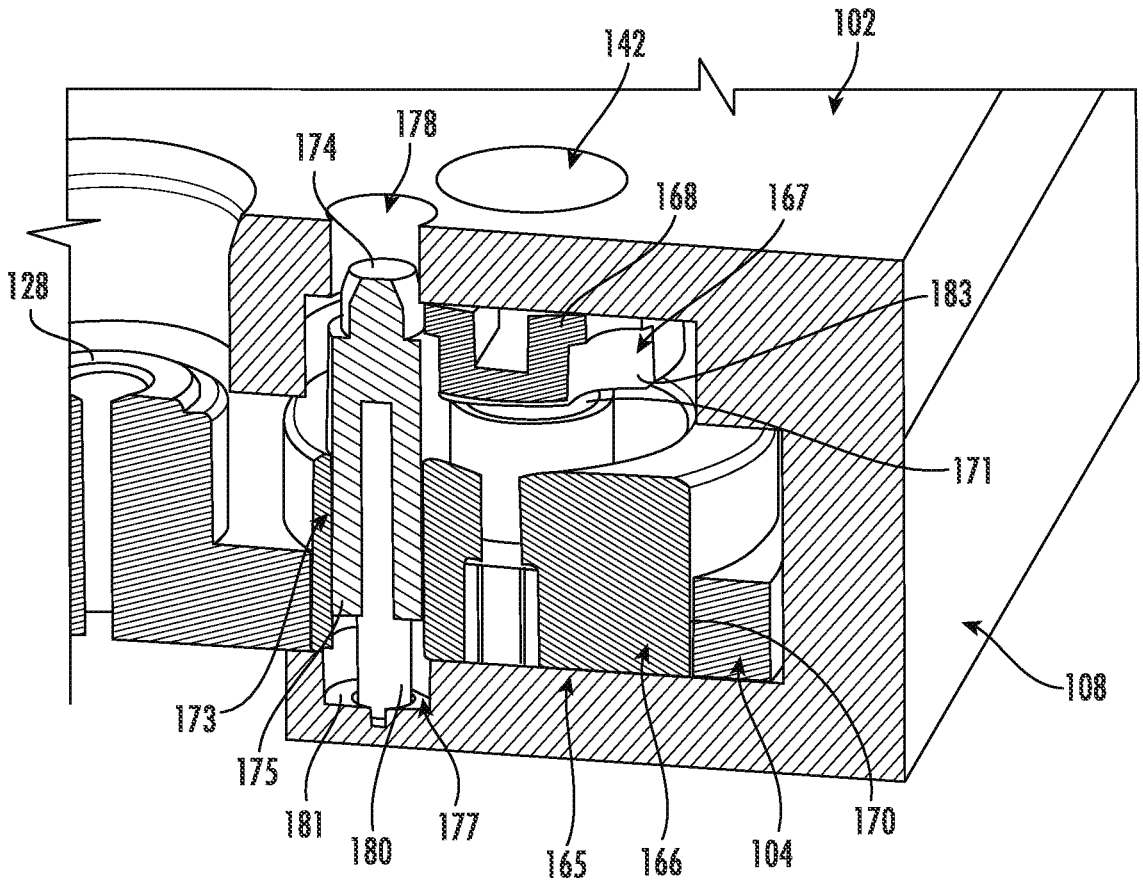
142
102
178
174
168
167
128
183
171
108
173
175
181
180
177
165
166
104
170

FIG. 3A

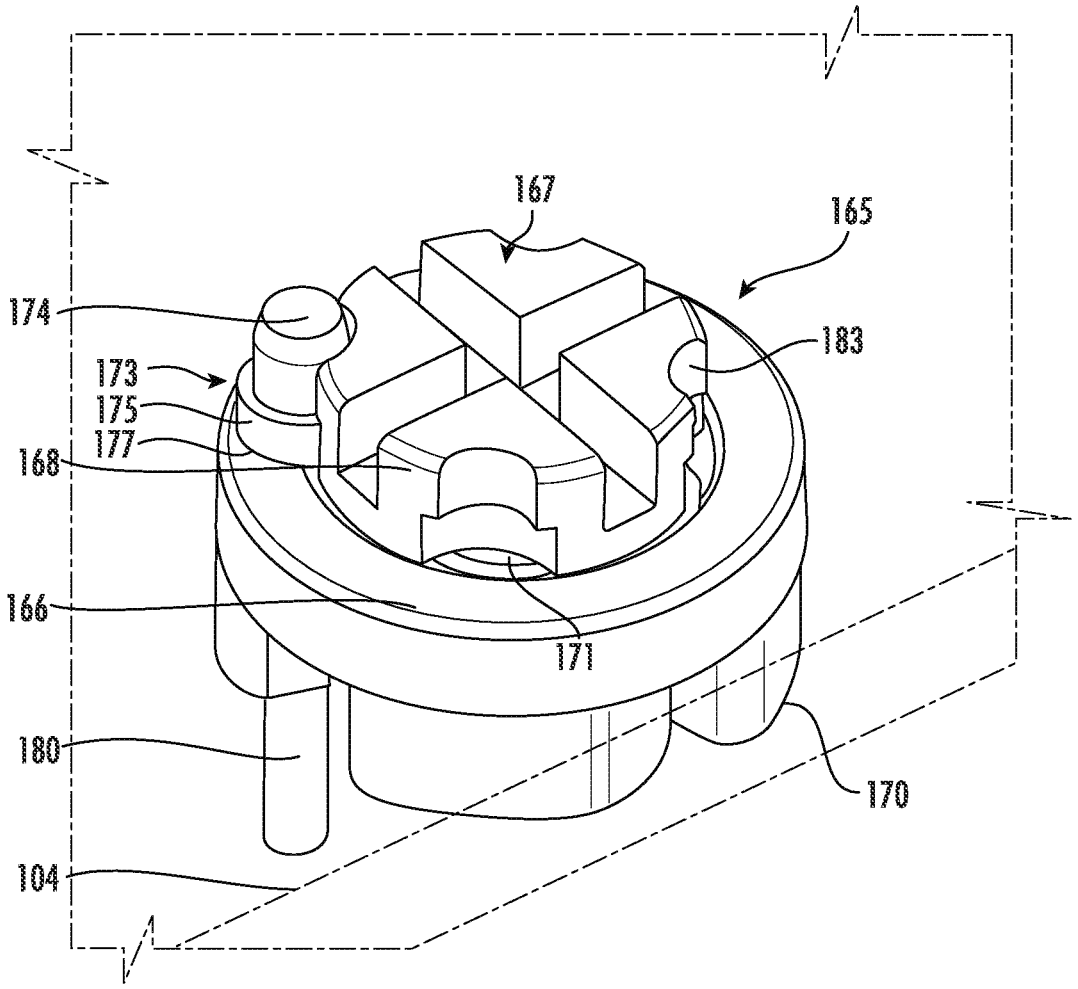

FIG. 3B

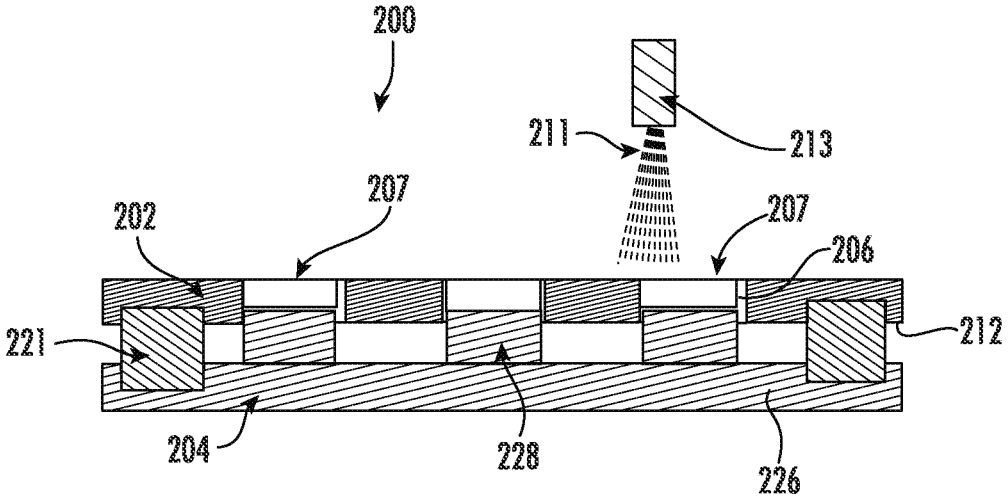
200
211
213
207
202
207
206
221
212
204
228
226

FIG. 4A

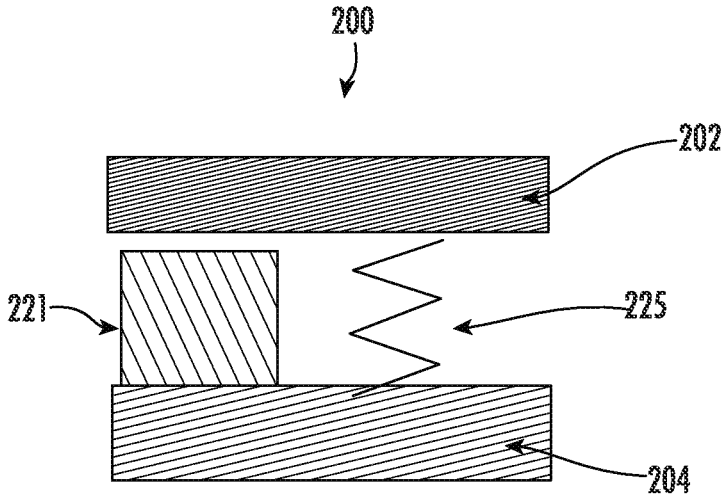
200
202
221
225
204

FIG. 4B

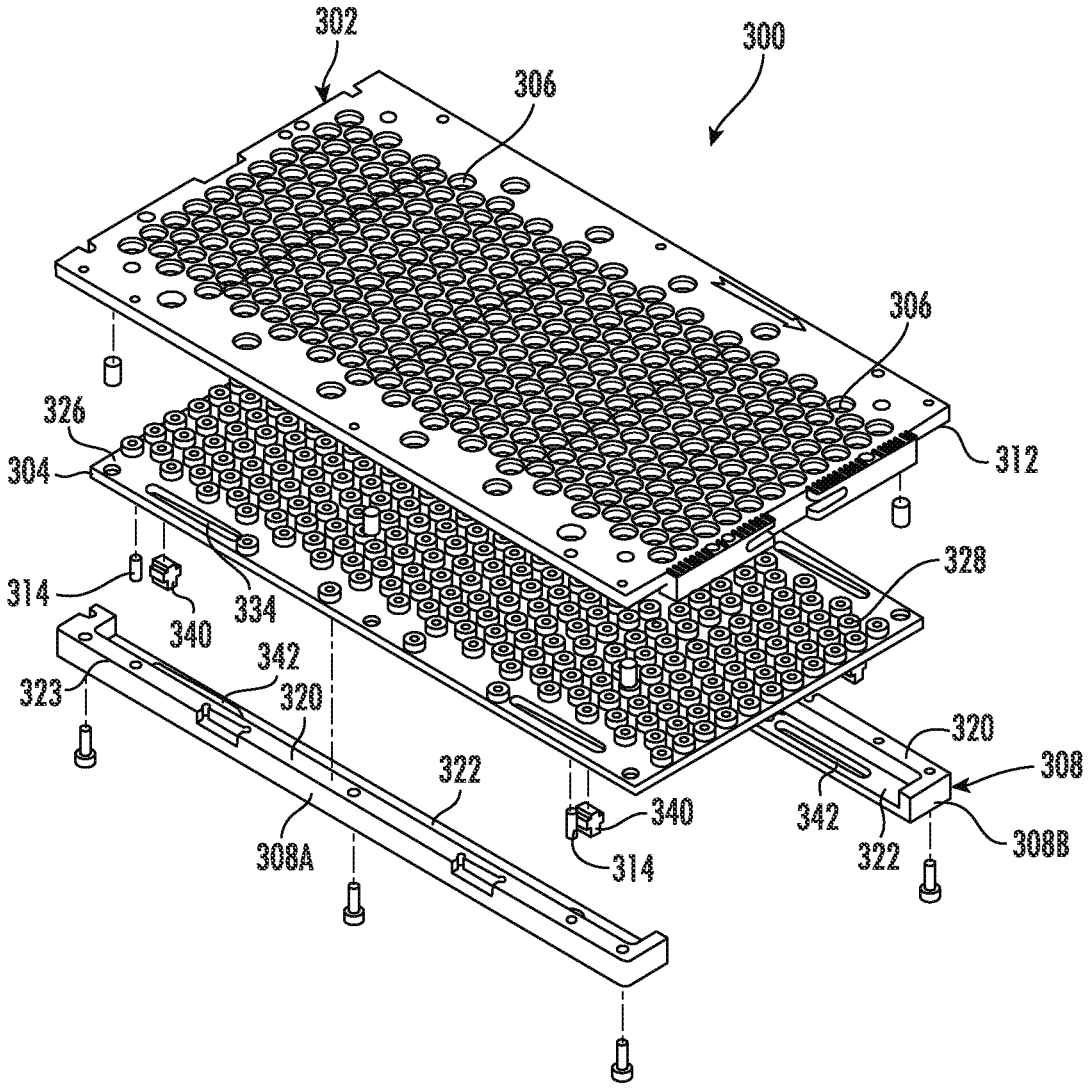
302
300
306
306
326
304
312
328
314
340
334
342
323
320
320
308
322
340
342
322
308B
308A
314

FIG. 5A

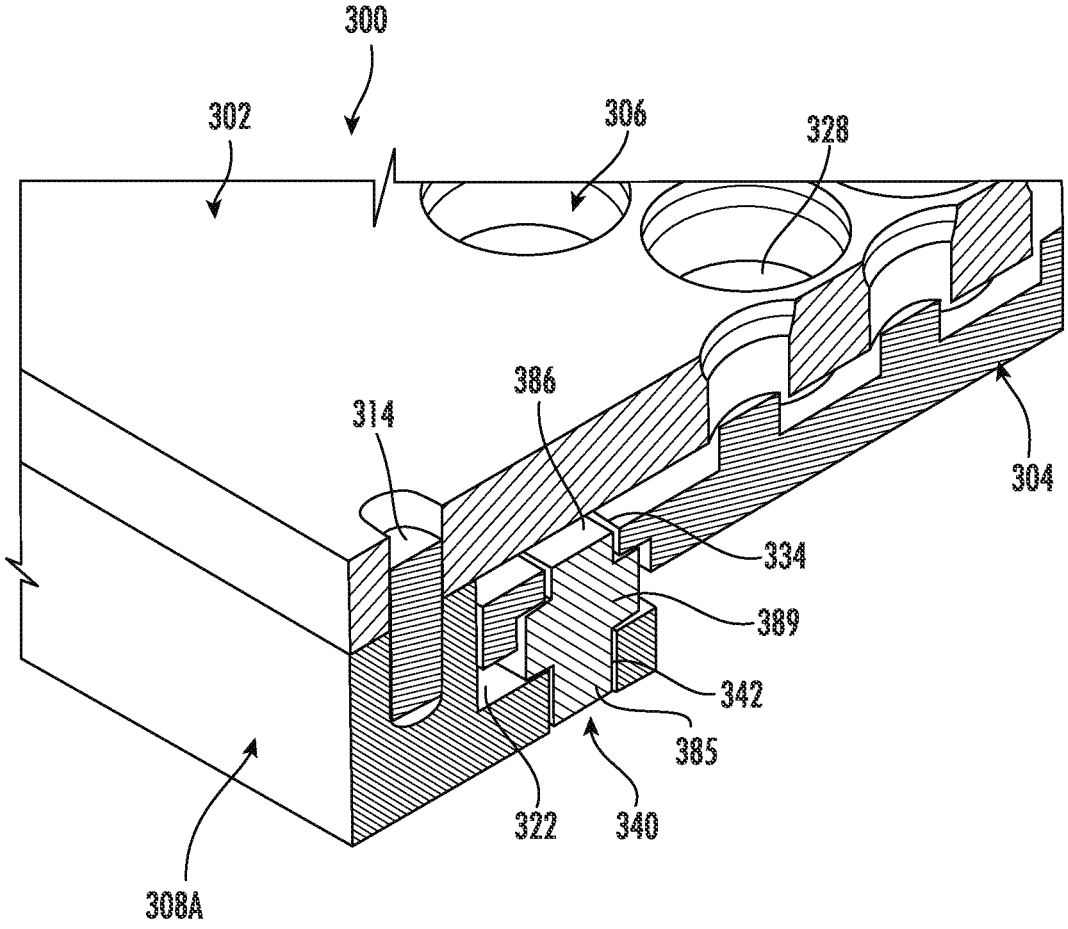

FIG. 5B

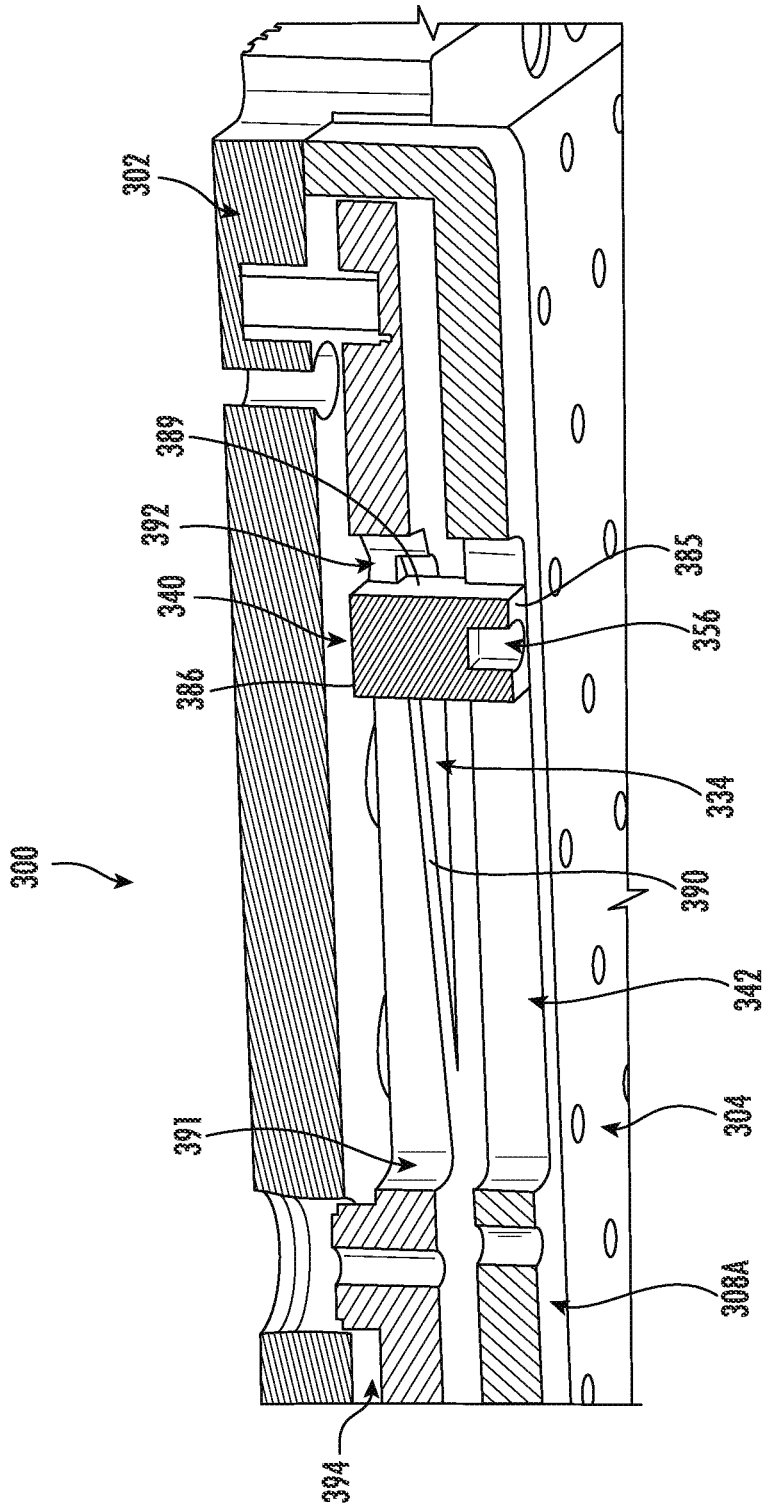

FIG. 5C

HEIGHT-ADJUSTABLE MASKING PALLET ASSEMBLY FOR ARC SPRAY APPLICATIONS

CROSS-REFERENCE TO CORRESPONDING APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 17/858,480, filed Jul. 6, 2022, which claims the benefit of priority to, Chinese Patent Application No. 202110777956.2, filed Jul. 9, 2021, entitled "HEIGHT-ADJUSTABLE MASKING PALLET ASSEMBLY FOR ARC SPRAY APPLICATIONS," which application is incorporated herein by reference in its entirety.

FIELD OF THE DISCLOSURE

[0002] The present disclosure is generally related to the field of circuit protection devices. More particularly, embodiments of the present disclosure relate to a height-adjustable masking pallet assembly for arc spray applications.

BACKGROUND OF THE DISCLOSURE

[0003] Typically, masking pallets for electronic devices, such as metal-oxide varistors (MOVs), are made of a solid metal, e.g., aluminum or steel. During an arc spray process, each MOV may be placed into a positioning hole of a carrier pallet. An ultra-high temperature and ultra-high velocity deposition of metal particles may then be applied to act as an electrode for each MOV. A second electrode may be sprayed onto the MOV at a different location, such as on the opposite side, with the electrode positions being based on the shape of the MOV core. However, to avoid flashover during surge testing, an outer edge area of the MOV surface (e.g., "free zone") should not be covered by the metal particles. In some approaches, each MOV is first covered with a paper mask to prevent contamination of the free zone.

[0004] During manufacturing, it is common to have ten or more different voltage ratings for a same diameter MOV, for example. A variety of chip disk thicknesses may also be desired, which requires different hole depths for the carrier pallet if the pallet height is fixed. Due to these variations, manufacturing MOVs using current carrier pallets is labor intensive and costly.

[0005] There is a need, therefore, for an improved masking pallet assembly for arc spray applications.

SUMMARY OF THE DISCLOSURE

[0006] The Summary is provided to introduce a selection of concepts in a simplified form, the concepts further described below in the Detailed Description. The Summary is not intended to identify key features or essential features of the claimed subject matter, nor is the Summary intended as an aid in determining the scope of the claimed subject matter.

[0007] In one approach, an assembly may include a top frame comprising a plurality of recesses each operable to receive an electronic device, and a bottom frame coupled to the top frame, wherein the bottom frame comprises a plurality of support structures, and wherein each support structure of the plurality of support structures is aligned with a corresponding recess of the plurality of recesses. The assembly may further include a mechanical device coupled to the top frame and the bottom frame, wherein the mechanical device is operable to bias the top frame and the bottom frame relative to one another.

[0008] In another approach, a pallet assembly may include a top frame comprising a plurality of recesses each operable to receive an electronic device, and a bottom frame coupled to the top frame, wherein the bottom frame comprises a plurality of support structures, and wherein each support structure of the plurality of support structures is aligned with a corresponding recess of the plurality of recesses. The pallet assembly may further include a mechanical device coupled to the top frame and to the bottom frame, wherein the mechanical device is operable to increase and decrease a distance between the top frame and the bottom frame.

[0009] In yet another approach, a pallet assembly may include a top frame comprising a plurality of recesses each operable to receive an electronic device, and a bottom frame coupled to the top frame, wherein the bottom frame comprises a plurality of support structures, and wherein each support structure of the plurality of support structures is aligned with a corresponding recess of the plurality of recesses. The pallet assembly may further include a mechanical device coupled to the top frame and to the bottom frame, wherein the mechanical device is operable to increase and decrease a distance between the top frame and the bottom frame.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The accompanying drawings illustrate exemplary approaches of the disclosed embodiments so far devised for the practical application of the principles thereof, and wherein:

[0011] FIG. **1**A depicts a top perspective view of an assembly according to embodiments of the present disclosure;

[0012] FIG. **1**B depicts a bottom perspective view of the assembly according to embodiments of the present disclosure;

[0013] FIG. **1**C depicts an exploded perspective view of the assembly according to embodiments of the present disclosure;

[0014] FIGS. **2**A-**2**B are cutaway views showing a mechanical device of the assembly according to embodiments of the present disclosure;

[0015] FIGS. **3**A-**3**B are cutaway views showing a mechanical device of an assembly according to embodiments of the present disclosure;

[0016] FIGS. **4**A-**4**B are side views showing a mechanical device of an assembly according to embodiments of the present disclosure;

[0017] FIG. **5**A is an exploded perspective view of an assembly according to embodiments of the present disclosure; and

[0018] FIGS. **5**B-**5**C are cutaway views showing a mechanical device of the assembly of FIG. **5**A according to embodiments of the present disclosure.

[0019] The drawings are not necessarily to scale. The drawings are merely representations, not intended to portray specific parameters of the disclosure. The drawings are intended to depict exemplary embodiments of the disclosure, and therefore are not to be considered as limiting in scope. In the drawings, like numbering represents like elements.

[0020] Furthermore, certain elements in some of the figures may be omitted, or illustrated not-to-scale, for illustrative clarity. The cross-sectional views may be in the form of "slices", or "near-sighted" cross-sectional views, omitting certain background lines otherwise visible in a "true" cross-sectional view, for illustrative clarity. Furthermore, for clarity, some reference numbers may be omitted in certain drawings.

DETAILED DESCRIPTION

[0021] Assemblies, devices, systems, and methods in accordance with the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, where embodiments are shown. The assemblies, devices, systems, and methods may be embodied in many different forms and are not to be construed as being limited to the embodiments set forth herein. Instead, these embodiments are provided so the disclosure will be thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art.

[0022] As will be described in greater detail herein, embodiments of the present disclosure provide a novel height-adjustable carrier pallet assembly, which can address the above identified problems of the prior art. Embodiments of the present disclosure allow the use of one pallet to meet different disk thicknesses for a same diameter MOV. Furthermore, the carrier pallet assembly of the present disclosure allows for a variety of different hole depths to generate MOVs with varying thickness. As a result, each MOV can be generally planar with a top surface of the carrier pallet assembly, and manufacturing accuracy can be increased.

[0023] Turning to FIGS. **1**A-**1**C, a pallet assembly (hereinafter "assembly") **100** will be described. As shown, the assembly **100** may include a top frame **102** coupled together with a bottom frame **104**. The top frame **102** may include a central interior area including a plurality of recesses **106** each operable to receive an electronic device, which may be one or more MOV disks. Although non-limiting, the top frame **102** and/or the bottom frame **104** may be made from a metal or other material with a high mechanical strength (e.g., metal alloy, steel, stainless steel, aluminum, aluminum alloy, etc.) to prevent deformation of the assembly **100**.

[0024] In some embodiments, the top frame **102** may be coupled to the bottom frame **104** by a side frame **108**. As shown, the side frame **108** may include a first frame member **108**A opposite a second frame member **108**B. The first and second frame members **108**A-**108**B may generally extend along opposite sides of the top and bottom frames **102**, **104**. The side frame **108** may be directly coupled to an underside **112** of the top frame **102**, for example, by one or more fasteners **114**. As best shown in FIG. **1**C, each of the first and second frame members **108**A, **108**B may include an outer wall **120** connected to an interior shelf **122**, wherein the top frame **102** may be positioned atop an upper surface **123** of the outer wall **120**, and wherein the bottom frame **104** may be positioned atop the interior shelf **122**.

[0025] The bottom frame **104** may include a base plate **126** and a plurality of support structures **128** extending from the base plate **126**, as best shown in FIG. **1**C. Each of the support structures **128** may be aligned beneath a corresponding recess **106** of the top frame **102**. It will be appreciated that a greater or fewer number of support structures **128** may be present along the base plate **126** in alternative embodiments. As shown, the base plate **126** may include one or more openings **134** operable to receive a mechanical device **140**, which may be a screw in some embodiments. Each of the mechanical devices **140** may further extend through corresponding screw openings **142** of the top frame **102**.

[0026] FIGS. **2**A-**2**B demonstrate the mechanical device **140** in greater detail. In some embodiments, the mechanical device **140** may be a screw including a first end **146** extending into the screw opening **142** of the top frame **102**, a central section **148** engaged with the bottom frame **104**, and a second end **150** engaged with an interior surface of the side frame **108**. In some embodiments, a flange **152** may separate the central section **148** from the second end **150**. Furthermore, the flange **152** may be in contact with an underside **153** of the bottom frame **104**. In some embodiments, the second end **150** may extend into and/or be in direct physical contact with a recess **160** provided in the interior shelf **122** of the side frame **108**.

[0027] During use, the screw opening **142** of the top frame **102** may provide access to the mechanical device **140** to enable adjustment thereof. In some embodiments, a tool (not shown) may be inserted into a tool opening **156** of the first end **146** of the mechanical device **140** to rotate the mechanical device **140**. The opening **134** of the bottom frame **104** may include internal threading (not shown) engaged with external threading (not shown) of the central section **148**. As the mechanical device **140** rotates, the mechanical device **140** causes the bottom frame **104** to move closer or farther from the first frame **102** to adjust a depth of one or more of the recesses **106** of the top frame **102**.

[0028] FIGS. **3**A-**3**B show another mechanical device **165** according to embodiments of the present disclosure. In some embodiments, the mechanical device **165** may be a screw assembly including an adjustment block **166** coupled to the bottom frame **104** and a screw **167** coupled with the adjustment block **166**. The adjustment block **166** may extend into a recess or opening **170** of the bottom frame **104**. The screw **167** may include a head **168** positioned within or beneath the screw opening **142** of the top frame **102** for engagement by a tool (not shown) to rotate the screw **167**. A body **171** of the screw **167** may extend within a central screw cavity of the adjustment block **166**. Although not shown, the body **171** may include exterior threading engaged with interior threading of the central screw cavity.

[0029] As further shown, the mechanical device **165** may include a stop pin **173** engaged with the head **168** of the screw **167** and the adjustment block **166**. More specifically, the stop pin **173** may include an engagement head **174** extending from a main body **175**, wherein the engagement head **174** is engageable with one or more indentations or notches **183** of the head **168** to prevent rotation of the screw **167** relative to the adjustment block **166**. As shown, the main body **175** of the stop pin **173** may extend through a pin opening **177** of the adjustment block **166**. The engagement head **174** may be accessible through a pin opening **178** of the top frame **102**, as shown in FIG. **3**A.

[0030] During use, the engagement head **174** may be depressed through the pin opening **178**, which causes the main body **175** to depress a spring **180** extending through a central spring cavity of the main body **175** of the stop pin **173**. In some embodiments, the spring **180** may be in direct contact with a spring opening surface **181** of the side frame **108**. Once the stop pin **173** has been disengaged, the screw **167** may be accessed through the screw opening **142** of the top frame **102** to enable rotation thereof. As the screw **167**

rotates, the screw **167** and the adjustment block **166** move relative to one another, which causes the bottom frame **104** and the top frame **102** to be biased relative to one another. Once a desired distance between the top frame **102** and the bottom frame **104** has been achieved, the stop pin **173** may once again be engaged to return the engagement head **174** against the notch **183** of the head **168** to prevent further rotation of the screw **167**.

[0031] FIGS. **4**A-**4**B demonstrate another assembly **200** according to embodiments of the present disclosure. As shown, the assembly **200** may include a top frame **202** coupled together with a bottom frame **204**. The top frame **202** may include a central interior area including a plurality of recesses **206** each operable to receive an electronic device **207**, which may be one or more MOV disks. Although non-limiting, the top frame **202** and/or the bottom frame **204** may be made from a metal or other material with a high mechanical strength (e.g., metal alloy, steel, stainless steel, aluminum, aluminum alloy etc.) to prevent deformation of the assembly **200**.

[0032] In some embodiments, the top frame **202** may be coupled to the bottom frame **204** by a side frame (not shown). As described above, the side frame may include a first frame member opposite a second frame member. The first and second frame members may generally extend along opposite sides of the top and bottom frames **202**, **204**. The side frame may be directly coupled to an underside **212** of the top frame **202**, for example, by one or more fasteners.

[0033] The bottom frame **204** may include a base plate **226** and a plurality of support structures **228** extending from the base plate **226**. Each of the support structures **228** may be aligned beneath a corresponding recess **206** of the top frame **202**. It will be appreciated that a greater or fewer number of support structures **228** may be present along the base plate **226** in alternative embodiments. During processing, each of the electronic devices **207** may be processed by an arc spray coating process in which metal particles **211** are delivered by a spray gun **213** to an upper surface of the electronic devices **207**.

[0034] The assembly **200** may further include a mechanical device, such as a wedge or spacing block **221**, which maintains a distance between the top frame **202** and the bottom frame **204**. As shown in FIG. **4**B, the assembly **200** may include a spring **225**, which is coupled to the top frame **202** and the bottom frame **204**. In some embodiments, the spring **225** may be held in tension to draw the top and bottom frames **202**, **204** together. When the spacing block **221** is in place, a relative position of the top and bottom frames **202**, **204** is maintained. It will be appreciated that differently sized spacing blocks **221** may be used across the assembly **200** to vary a height of the top frame **202**.

[0035] Turning to FIGS. **5**A-**5**C, a pallet assembly (hereinafter "assembly") **300** will be described. As shown, the assembly **300** may include a top frame **302** coupled together with a bottom frame **304**. The top frame **302** may include a central interior area including a plurality of recesses **306** each operable to receive an electronic device, which may be one or more MOV disks. Although non-limiting, the top frame **302** and/or the bottom frame **304** may be made from a metal or other material with a high mechanical strength (e.g., metal alloy, steel, stainless steel, aluminum, aluminum alloy etc.) to prevent deformation of the assembly **300**.

[0036] In some embodiments, the top frame **302** may be coupled to the bottom frame **304** by a side frame **308**. As shown, the side frame **308** may include a first frame member **308**A opposite a second frame member **308**B. The first and second frame members **308**A-**308**B may generally extend along opposite sides of the top and bottom frames **302**, **304**. The side frame **308** may be directly coupled to an underside **312** of the top frame **302**, for example, by one or more fasteners **314**. As best shown in FIG. **5**A, each of the side frame members **308**A, **308**B may include an outer wall **320** connected to an interior shelf **322**, wherein the top frame **302** may be positioned atop an upper surface **323** of the outer wall **320**, and wherein the bottom frame **304** may be positioned atop the interior shelf **322**.

[0037] The bottom frame **304** may include a base plate **326** and a plurality of support structures **328** extending from the base plate **326**. Each of the support structures **328** may be aligned beneath a corresponding recess **306** of the top frame **302**. It will be appreciated that a greater or fewer number of support structures **328** may be present along the base plate **326** in alternative embodiments. As shown, the base plate **326** may include one or more openings **334** operable to receive a mechanical device, which may be a slider **340** in some embodiments. The slider **340** may further extend through corresponding slider tracks **342** of the first and second frame members **308**A, **308**B.

[0038] FIGS. **5**B-**5**C demonstrate the slider **340** in greater detail. In some embodiments, the slider **340** may include a lower section **385** extending into the slider track **342** of the first frame member **308**A, an upper section **386** extending through the opening **334** of the bottom frame **304**, and a central section **389** in contact with the interior shelf **322** of the first frame member **308**A. Although non-limiting, the slider **340** may have a cross-shape profile. As best shown in FIG. **5**C, the opening **334** of the base plate **326** of the bottom frame **304** may include a sloped surface **390** along an underside thereof. That is, the sloped surface **390** may generally face the slider track **342**, and the central section **389** of the slider **340** may be engaged with the sloped surface **390**.

[0039] During use, the slider track **342** of the first frame member **308**A may provide access to the slider **340** to enable adjustment thereof by a tool (not shown), which may be inserted into a tool opening **356** of the lower section **385** of the slider **340**. As the slider **340** is biased between a first end **391** and a second end **392** of the opening **334**, the central section **389** of the slider **340** is forced against the sloped surface **390**, which raises or lowers the bottom frame **304** relative to the top frame **302**. Because the top frame **302** is fixed to the first frame member **308**A, the bottom frame **304** may be moved within a gap **394** between the top and bottom frames **302**, **304**.

[0040] As used herein, an element or step recited in the singular and proceeded with the word "a" or "an" is understood as not excluding plural elements or steps, unless such exclusion is explicitly recited. Furthermore, references to "one embodiment" of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments also incorporating the recited features.

[0041] The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Accordingly, the terms "including," "comprising," or "having" and variations thereof are open-ended expressions and can be used interchangeably herein.

[0042] The phrases "at least one", "one or more", and "and/or", as used herein, are open-ended expressions and are both conjunctive and disjunctive in operation. For example, expressions "at least one of A, B and C", "at least one of A, B, or C", "one or more of A, B, and C", "one or more of A, B, or C" and "A, B, and/or C" means A alone, B alone, C alone, A and B together, A and C together, B and C together, or A, B and C together.

[0043] All directional references (e.g., proximal, distal, upper, lower, upward, downward, left, right, lateral, longitudinal, front, back, top, bottom, above, below, vertical, horizontal, radial, axial, clockwise, and counterclockwise) are just used for identification purposes to aid the reader's understanding of the present disclosure. The directional references do not create limitations, particularly as to the position, orientation, or use of the disclosure. Connection references (e.g., attached, coupled, connected, and joined) are to be construed broadly and may include intermediate members between a collection of elements and relative movement between elements unless otherwise indicated. As such, connection references do not necessarily infer two elements are directly connected and in fixed relation to each other.

[0044] Furthermore, identification references (e.g., primary, secondary, first, second, third, fourth, etc.) are not intended to connote importance or priority, and are used to distinguish one feature from another. The drawings are for purposes of illustration, and the dimensions, positions, order and relative sizes reflected in the drawings attached hereto may vary.

[0045] Furthermore, the terms "substantial" or "approximately," as well as the terms "approximate" or "approximately," can be used interchangeably in some embodiments, and can be described using any relative measures acceptable by one of ordinary skill in the art. For example, these terms can serve as a comparison to a reference parameter, to indicate a deviation capable of providing the intended function. Although non-limiting, the deviation from the reference parameter can be, for example, in an amount of less than 1%, less than 3%, less than 5%, less than 10%, less than 15%, less than 20%, and so on.

[0046] While certain embodiments of the disclosure have been described herein, the disclosure is not limited thereto, as the disclosure is as broad in scope as the art will allow and the specification may be read likewise. Therefore, the above description is not to be construed as limiting. Instead, the above description is merely as exemplifications of particular embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

What is claimed is:

1. An assembly, comprising:

a top frame comprising a plurality of recesses each operable to receive an electronic device;

a bottom frame coupled to the top frame, wherein the bottom frame comprises a plurality of support structures, and wherein each support structure of the plurality of support structures is aligned with a corresponding recess of the plurality of recesses; and

a mechanical device coupled to the top frame and the bottom frame, wherein the mechanical device is operable to bias the top frame and the bottom frame relative to one another, and wherein the mechanical device is a slider engaged with a sloped surface of the bottom frame.

2. The assembly of claim **1**, further comprising a side frame coupled to the top frame and the bottom frame.

3. The assembly of claim **2**, wherein the side frame comprises a first frame member and a second frame member, and wherein the mechanical device is in direct physical contact with the first frame member or the second frame member.

4. The assembly of claim **2**, wherein the slider extends through a slider opening through the side frame.

5. The assembly of claim **1**, wherein the bottom frame comprises a base plate, and wherein each of the plurality of support structures extends from an upper surface of the base plate.

6. An assembly, comprising:

a top frame comprising a plurality of recesses each operable to receive an electronic device;

a bottom frame coupled to the top frame, wherein the bottom frame comprises a plurality of support structures, and wherein each support structure of the plurality of support structures is aligned with a corresponding recess of the plurality of recesses; and

a mechanical device coupled to the top frame and the bottom frame, wherein the mechanical device is operable to bias the top frame and the bottom frame relative to one another, and wherein the mechanical device is a slider engaged with a sloped surface of the bottom frame.

7. The assembly of claim **6**, further comprising a side frame coupled to the top frame and the bottom frame.

8. The assembly of claim **7**, wherein the side frame comprises a first frame member and a second frame member, and wherein the mechanical device is in direct physical contact with the first frame member or the second frame member.

9. The assembly of claim **7**, wherein the slider extends through a slider opening through the side frame.

10. The assembly of claim **6**, wherein the bottom frame comprises a base plate, and wherein each of the plurality of support structures extends from an upper surface of the base plate.

11. A pallet assembly, comprising:

a top frame comprising a plurality of recesses each operable to receive a metal-oxide varistor;

a bottom frame coupled to the top frame, wherein the bottom frame comprises a plurality of support structures, and wherein each support structure of the plurality of support structures is aligned with a corresponding recess of the plurality of recesses; and

a mechanical device coupled to the top frame and the bottom frame, wherein the mechanical device is operable to bias the top frame and the bottom frame relative to one another, and wherein the mechanical device is a slider engaged with a sloped surface of the bottom frame.

12. The assembly of claim **11**, further comprising a side frame coupled to the top frame and the bottom frame.

13. The assembly of claim **12**, wherein the side frame comprises a first frame member and a second frame member, and wherein the mechanical device is in direct physical contact with the first frame member or the second frame member.

14. The assembly of claim **12**, wherein the slider extends through a slider opening through the side frame.

15. The assembly of claim **12**, wherein the bottom frame comprises a base plate, and wherein each of the plurality of support structures extends from an upper surface of the base plate.

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