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SINGLE PIECE SIDEWALL FOR A BATTERY HOUSING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This PCT International Patent Application claims the benefit of and priority to U.S. Provisional Patent Application Serial No. 63/521,179, filed June 15, 2023, titled “Single Piece Sidewall For A Battery Housing,” the entire disclosure of which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a battery housing for an automobile, and a related method of manufacturing same.

2. Related Art

[0003] This section provides background information related to the present disclosure which is not necessarily prior art.

[0004] Automobiles are the subject of a continuing effort to move away from internal combustion engines towards electrified vehicles, to reduce their dependency on fuel, improve emissions and increase fuel efficiency. Thus, this desire to increase fuel efficiency is both economically and environmentally motivated and has led to advanced internal components in automobiles as evidenced by developments in batteries, particularly in electrified automobiles. Unlike traditional automobiles that operate entirely with fossil fuels, electrified automobiles include a range of technologies that rely on electric energy. Even though electric energy is a more economical and environmentally friendly option over relying completely on fossil fuels, batteries are heavy, expensive, and relatively fragile compared to neighboring mechanical components. As such, the packaging of batteries, particularly within electrified automobiles, requires a number of

design considerations including weight distribution, temperature regulation, and serviceability. In terms of serviceability, there is a growing need, particularly with electrified automobiles, for the batteries to be stowed in such a manner to be charged and maintained without removal.

[0005] To meet the above minimum requirements, batteries have traditionally been packaged in protective battery housings. In some cases, these traditional battery housings have a lower tray/base plate and a peripheral sidewall to create an internal cavity for housing at least one battery cell/module. However, often this peripheral sidewall is built from multiple individual components that are joined together via welds, sealers, or the like. Put another way, certain battery housing architectures require that the vertical sidewall structure is constructed of several individually stamped or formed components, which are then collectively joined to form the peripheral sidewall during assembly of the battery housing. Two such examples of this prior art peripheral sidewall component are illustrated in Figures 1-2. For example, Figure 1 illustrates a first prior art arrangement for the peripheral sidewall comprised of eight different parts joined by eight sealed and spot welded joints, and Figure 2 illustrates a second prior art arrangement for the peripheral sidewall comprised of four different parts joined by four welded corner joints and one sealed and bolted joint.

[0006] However, having the peripheral sidewall of the battery housing built from several individual pieces poses a challenge for the leak tightness of the battery housing as each individual piece introduces potential leak paths into the design. In other words, step joints, skive joints and/or component gaps between each of the individual pieces of the peripheral sidewall are all potential spots where a leak could form. Accordingly, to stop the leaks in these joints/gaps, either a sealer must be applied on the joint, or the joint must be continuously welded. Yet, these sealing methods are not fully effective, and can still cause problems for leak sealing, without achieving leak

tightness. Furthermore, having the peripheral sidewall built from multiple components introduces challenging joint geometry into the design, especially where the overlapping sidewall components must be bonded to the lower tray/base plate. The multi-piece peripheral sidewall of the prior art designs leads to joint geometries which are very problematic for joint sealing the battery housing from water and environmental intrusion.

[0007] Accordingly, there remains a continuing need for improved battery housing designs, particularly with respect to the design of the peripheral sidewall.

SUMMARY OF THE INVENTION

[0008] The subject disclosure is directed to a battery housing including a peripheral sidewall constructed as a single piece. Put another way, the subject disclosure is directed to a peripheral sidewall for a battery housing which is manufactured or formed from a single, continuous piece of material. The incorporation of the single-piece peripheral sidewall into the battery housing provides a better solution for achieving leak tightness, namely by simplifying the design of the peripheral sidewall, which reduces the number of potential leak paths relative to the prior art designs. Put another way, by simplifying the peripheral sidewall structure from multiple pieces down to a single piece, the need for step or skive joints is eliminated, which reduces the number of potential and common leak paths. The single piece peripheral sidewall also reduces the amount of sealer or continuous welding needed to seal the battery housing, resulting in lower material costs and improved leak performance. The single piece design also reduces a part count for the overall battery housing, further potentially lowering costs and weight of the battery housing. The single piece design also provides potential for improvement or simplification of crash structure for the battery housing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] These and other advantages of the present disclosure will be more readily understood by reference to the following description in combination with the accompanying drawings wherein:

[0010] Figure 1 is a perspective view of a peripheral sidewall constructed in accordance with the prior art design principles;

[0011] Figure 2 is a perspective view of another exemplary peripheral sidewall component constructed in accordance with the prior art design principles;

[0012] Figure 3 is an exploded perspective view of a battery housing including a single-piece peripheral sidewall constructed in accordance with a first exemplary roll forming manufacturing process and extending from a bottom peripheral edge for connection to a base plate to an upper peripheral edge for connection to a top cover;

[0013] Figure 4 is an exploded perspective view of the battery housing illustrating the single-piece peripheral sidewall constructed in accordance with a second exemplary metal extrusion manufacturing process;

[0014] Figure 5 is a top view of the battery housing of Figure 3 with the top cover removed to more clearly illustrate the single-piece peripheral sidewall extending integrally and peripherally from a first end, through a plurality of corners and to a second end that is connected to the first end via a wall joint, and including an upper seal extending along a top flange;

[0015] Figure 6 is a top view of the battery housing of Figure 4 with the top cover removed to more clearly and similarly illustrate the single-piece peripheral sidewall extending integrally and peripherally from the first end, through the plurality of corners and to the second end that is connected to the first end via a wall joint, and also the upper seal extending along the top flange;

[0016] Figure 7 is an end view of the battery housing of Figure 3 to more clearly illustrate the upper peripheral edge of the peripheral sidewall connected to the top cover via an upper connection and the bottom peripheral edge of the peripheral sidewall connected to the base plate via a lower connection;

[0017] Figure 8 is a cross-sectional view of the first embodiment of the single-piece peripheral sidewall taken along 8-8 of Figure 1 to more clearly illustrate the top flange extending radially outward from the upper peripheral edge and the bottom flange extending radially outward from the bottom peripheral edge;

[0018] Figure 9 is an end cross-sectional view of the battery housing of Figure 4 to more clearly illustrate the peripheral sidewall formed as a metal extrusion in accordance with the second embodiment and an internal cavity collectively defined by the base plate, the peripheral sidewall, and the top cover for housing at least one battery module;

[0019] Figure 10 illustrates providing a single, continuous piece of material comprised of a stamped or rolled section of metal that extends from a first end to a second end in accordance with a first exemplary method of manufacturing the peripheral sidewall;

[0020] Figure 11 illustrates a subsequent step of the method of manufacturing the peripheral sidewall in which the single, continuous piece of stamped or rolled metal is passed through a roll forming apparatus to form the top flange in the upper peripheral edge and the bottom flange in the bottom peripheral edge;

[0021] Figures 12-13 illustrate a subsequent step of the method of manufacturing the peripheral sidewall in which the single, continuous piece of stamped or rolled metal is passed through a bending or folding apparatus to form the plurality of corners between the first and second ends;

[0022] Figure 14 illustrates a concluding step of the method of manufacturing the peripheral sidewall in which a wall joint is established between the first and second ends to complete formation of the single-piece peripheral sidewall;

[0023] Figure 15 illustrates providing a single, continuous piece of material comprised of a metal extrusion that extends from the first end to the second end and is initially formed to include the top flange and the bottom flange in accordance with a second exemplary method of manufacturing the peripheral sidewall;

[0024] Figures 16-17 illustrate a subsequent step of the second exemplary method of manufacturing the peripheral sidewall in which the single, continuous piece of metal extrusion is passed through a bending or folding apparatus to form the plurality of corners between the first and second ends; and

[0025] Figure 18 illustrates a concluding step of the method of manufacturing the peripheral sidewall in which a wall joint is established between the first and second ends to complete formation of the single-piece peripheral sidewall.

DETAILED DESCRIPTION OF THE ENABLING EMBODIMENTS

[0026] Example embodiments will now be described more fully with reference to the accompanying drawings. In general, the subject embodiments are directed to a battery housing for an automobile and a method of manufacturing same. However, the example embodiments are only provided so that this disclosure will be thorough, and will fully convey the scope to those who are skilled in the art. Numerous specific details are set forth such as examples of specific components, devices, and methods, to provide a thorough understanding of embodiments of the present disclosure. It will be apparent to those skilled in the art that specific details need not be employed, that example embodiments may be embodied in many different forms and that neither should be

construed to limit the scope of the disclosure. In some example embodiments, well-known processes, well-known device structures, and well-known technologies are not described in detail.

[0027] As best illustrated in Figures 3-4, 7 and 9, a battery housing **10** includes a base plate **12** that extends to an outer base perimeter **14**. While the base plate **12** is illustrated as being flat and generally planar, the base plate **12** could have other shapes, such as being domed or tub-shaped, without departing from the scope of the subject disclosure. The battery housing **10** further includes a peripheral sidewall **16** that is formed as a separate component from the base plate **12** and which extends peripherally adjacent the outer base perimeter **14**. The peripheral sidewall **16** extends vertically upward from a bottom peripheral edge **18** that, as best illustrated in Figures 7 and 9, is secured to the base plate **12** adjacent the outer base perimeter **14** via a lower connection **20**. For example, the lower connection **20** could be spot welding between the bottom peripheral edge **18** of the sidewall **16** and the base plate **12**. However, other means of the first connection **20** can be utilized, such as adhesive joining, mechanical fasteners (e.g., bolts) with or without sealer, or continuous seam welding, for securing the peripheral sidewall **16** to the base plate **12**.

[0028] The battery housing **10** further includes a top cover **22** that is disposed in spaced relationship with the base plate **12** and which extends to an outer top perimeter **24**. Similar to the base plate **12**, while the top cover **22** is illustrated as being flat and generally planar, the top cover **22** could also have other shapes without departing from the scope of the subject disclosure. The peripheral sidewall **16** extends upwardly from the bottom peripheral edge **18** to a top peripheral edge **26** that, as best illustrated in Figures 7 and 9, is secured to the top cover **22** adjacent the outer top perimeter **24** via an upper connection **28** to collectively define an internal cavity **30** by the base plate **12**, the peripheral sidewall **16** and the top cover **22** for housing at least one battery module **32**. (See Figures 3-4 and 9). Similar to the lower connection **20**, the upper connection **28** could be

established by spot welding between the top peripheral edge **26** of the peripheral sidewall **16** and the top cover **22**. However, other means of the second connection **28**, such as adhesive joining, mechanical fasteners (e.g., bolts) with or without sealer, or continuous seam welding, could be utilized without departing from the scope of the subject disclosure.

[0029] As best illustrated in Figures 3-4, the peripheral sidewall **16** is constructed or formed as a single piece, in contradistinction to the prior art sidewalls which, as shown in Figures 1-2, are constructed or formed from multiple pieces. Put another way, as best illustrated in Figures 3-6, the peripheral sidewall **16** for the battery housing **10** is formed from a single, unitary piece of material, preferably steel or aluminum. As described in more detail in the previous sections, use of a single-piece peripheral sidewall **14** reduces the presence of leak paths in the peripheral sidewall **14**, and thus provides an improved seal design over the prior art designs which require multiple pieces and thus multiple seals to form the sidewall component.

[0030] As best illustrated in Figures 3-6, the single-piece peripheral sidewall **14** extends integrally and peripherally adjacent the outer base and top perimeters **14**, **24** from a first end **34** and through a plurality of corners **36** formed in the sidewall **14** to a second end **38**. For example, the single-piece peripheral sidewall **14** can extend between the first and second ends **34**, **38** through four corners **36** to establish a generally rectangular box-like shape for the peripheral sidewall **14**, when viewed from a top perspective. (*See* Figures 5-6). However, the peripheral sidewall **14** could have more or less corners **36** and have different shapes without departing from the scope of the subject disclosure. As best illustrated in Figures 5-6, a wall joint **40** extends between the first and second ends **34**, **38** to establish an interconnection there between for completing formation of the single-piece peripheral sidewall **16**. In a preferred arrangement, the wall joint **40** is comprised of seam welding or adhesively sealing the first and second ends **34**, **38** of the peripheral sidewall **14**

to one another. However, other means of establishing the wall joint **40** could be utilized without departing from the scope of the subject disclosure.

[0031] As will be described in more detail below, and as best illustrated in Figures 3, 5, 7-8 and 10-14, in accordance with a first exemplary arrangement, the single-piece peripheral sidewall **16** is formed via a roll forming manufacturing process. Alternatively, as best illustrated in Figures 4, 6, 9 and 15-18 in accordance with a second exemplary arrangement, the single-piece peripheral sidewall **16** can be formed via a metal (e.g., aluminum) extrusion manufacturing process. In either manufacturing process, the single-piece peripheral sidewall **16** is preferably constructed to include a top flange **42** extending radially outwardly from the upper peripheral edge **26** and a bottom flange **44** extending radially outwardly from the lower peripheral edge **18**. The top flange **42** can be used for placement of the upper connection **28** to facilitate connection of the perimeter sidewall **16** to the top cover **16**. As best illustrated in Figures 5-7 and 9, an upper seal **46** can also be disposed along the top flange **42** for sealing the upper peripheral edge **26** of the perimeter sidewall **16** to the top cover **22**. Similarly, the bottom flange **44** can be used for placement of the lower connection **20** to facilitate connection of the perimeter sidewall **14** to the base plate **12**. A lower seal **48** can also be disposed along the bottom flange **44** for sealing the lower peripheral edge **18** of the peripheral sidewall **16** to the base plate **12**. Each of the upper and lower seals **46, 48** preferably extend around the entire perimeter of their respective upper and lower peripheral edges **18, 26** to establish a sealed relationship between the peripheral sidewall **16** and the top cover **22** and base plate **12** when these components are interconnected together for preventing the passing of contaminants from the environment and into the internal cavity **30** of the battery housing **10**.

[0032] As best illustrated in Figures 10-13 and 15-17, a method of manufacturing the single-piece peripheral sidewall **16** begins by providing a single, continuous piece of material **50'**,

50'' which extends between the first end **34** and the second end **36**. For example, in accordance with the first arrangement of the manufacturing process, the single, continuous piece of material **50'** can be a stamped or rolled section of metal, preferably steel or aluminum. Alternatively, in accordance with a second arrangement of the manufacturing process, the single, continuous piece of material **50''** can be a section of metal extrusion, again preferably steel or aluminum.

[0033] As best illustrated in Figures 11-12, in accordance with the first arrangement of the manufacturing process, the single, continuous piece of stamped or rolled metal **50'** can first be passed through a roll forming apparatus **52** having a pair of spaced apart rollers **54** to roll form the top flange **42** in the upper peripheral edge **26** and the bottom flange **44** in the bottom peripheral edge **18**. As best illustrated in Figures 15-17, in accordance with the second arrangement of the manufacturing process, the single, continuous piece of metal extrusion **50''** can be initially extruded to already include the top and bottom flanges **42, 44**.

[0034] As best illustrated in Figures 12-13 and 16-17, in both arrangements of the manufacturing process, the single piece of continuous material **50', 50''** is then passed through a bending or folding apparatus **56** to form the plurality of corners **36** in the single piece of continuous material **50', 50''** between the first and second ends **34, 38**. In a preferred arrangement, the bending or folding apparatus **56** forms four corners **36** to establish a generally rectangular box shape for the single piece of continuous material **50', 50''**. However, more or less corners and different shapes could be formed without departing from the scope of the subject disclosure.

[0035] As best illustrated in Figures 14 and 18, the method of manufacturing concludes by establishing a wall joint **40** between the first and second ends **34, 38** to complete formation of the single-piece peripheral sidewall **16**. The wall joint **40** is preferably established by seam welding or adhesively sealing the first and second ends **34, 38** to one another. However, other means of

establishing the wall joint **40** could be utilized without departing from the scope of the subject disclosure.

[0036] Although the method of manufacturing the single-piece peripheral sidewall **16** is preferably via a roll forming or metal extrusion process, the single-piece peripheral sidewall **16** can be constructed as a single unitary piece using other manufacturing processes, without departing from the scope of the subject disclosure. Obviously, many other modifications and variations of the present disclosure are possible in light of the above teachings and may be practiced otherwise than as specifically described.

CLAIMS

What is claimed is:

1. A battery housing comprising:
a base plate extending to an outer base perimeter;
a top cover disposed in spaced relationship with the base plate and extending to an outer top perimeter; and
a peripheral sidewall being comprised of a single-piece and extending from a bottom peripheral edge secured to said base plate adjacent said outer base perimeter to an upper peripheral edge secured to said top cover adjacent said outer top perimeter.
2. The battery housing as set forth in Claim 1, wherein said single-piece peripheral sidewall extends integrally and peripherally from a first end, through a plurality of corners and to a second end disposed adjacent said first end.
3. The battery housing as set forth in Claim 2, wherein said single-piece peripheral sidewall includes four corners to establish a generally rectangular box-like shape for the single-piece peripheral sidewall.
4. The battery housing as set forth in Claim 2, wherein said single-piece peripheral sidewall includes a wall joint extending between and interconnecting said first and second ends.
5. The battery housing as set forth in Claim 2, wherein said wall joint is comprised of a seam weld.

6. The battery housing as set forth in Claim 1, wherein said single-piece peripheral sidewall is manufactured via a roll forming process.

7. The battery housing as set forth in Claim 1, wherein said single-piece peripheral sidewall is manufactured via a metal extrusion process.

8. The battery housing as set forth in Claim 1, wherein said single-piece peripheral sidewall includes a top flange extending radially outwardly from said upper peripheral edge and a bottom flange extending radially outwardly from said lower peripheral edge.

9. The battery housing as set forth in Claim 8, further comprising an upper connection extending between said top cover and said top flange for establishing the secured relationship between said top cover and said peripheral sidewall, and a lower connection extending between said base plate and said bottom flange for establishing the secured relationship between said base plate and said peripheral sidewall.

10. The battery housing as set forth in Claim 9, further comprising an upper seal disposed along said top flange for sealing said upper peripheral edge of said peripheral sidewall to said top cover, and a lower seal disposed along said bottom flange for sealing said bottom peripheral edge of said peripheral sidewall to said base plate.

11. A peripheral sidewall for a battery housing, comprising:
a single piece of material extending integrally and peripherally from a first end, through a plurality of corners and to a second end disposed adjacent said first end.
12. The peripheral sidewall as set forth in Claim 11, wherein said single piece of material extends vertically upward from a bottom peripheral edge for being secured to a base plate of the battery housing to a top peripheral edge for being secured to a top cover of the battery housing.
13. The peripheral sidewall as set forth in Claim 12, further comprising a wall joint extending between and interconnecting said first and second ends.
14. The peripheral sidewall as set forth in Claim 13, wherein said single piece of material is formed to include four corners and establish a generally rectangular box-like shape for the peripheral sidewall.
15. The peripheral sidewall as set forth in Claim 13, wherein said single-piece of material includes a top flange extending radially outwardly from said upper peripheral edge and a bottom flange extending radially outwardly from said lower peripheral edge.

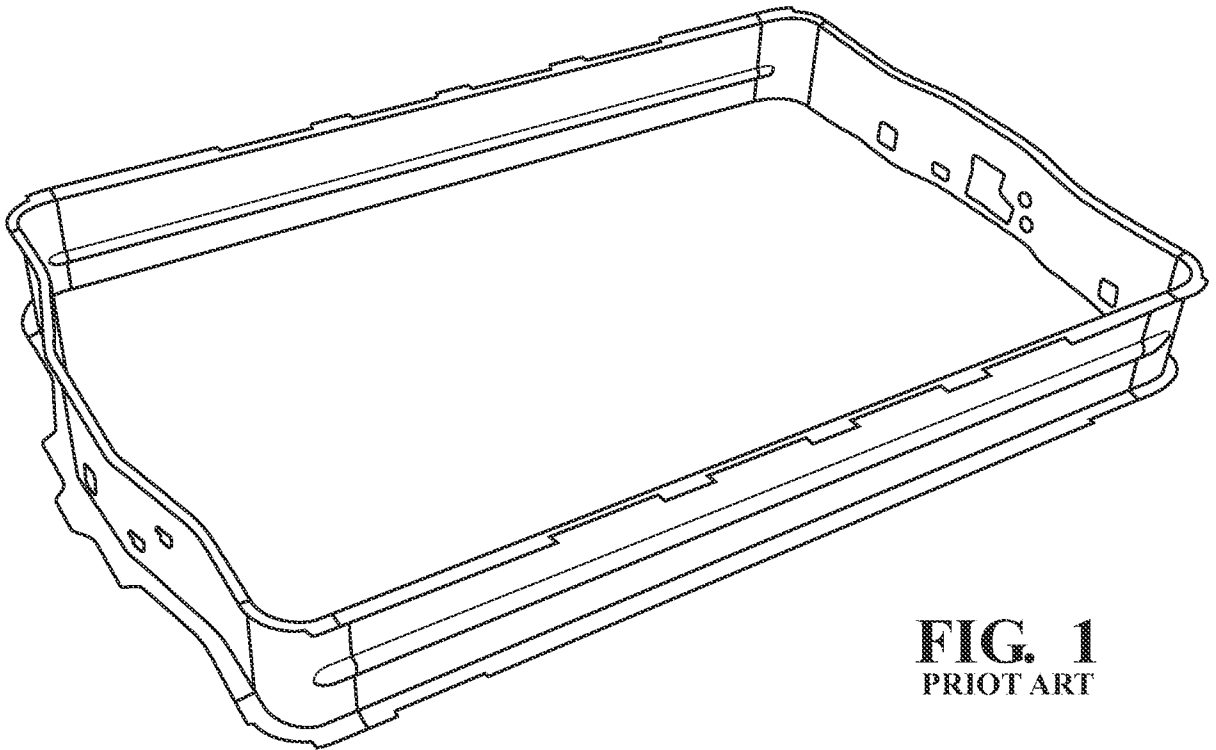


FIG. 1
PRIOT ART

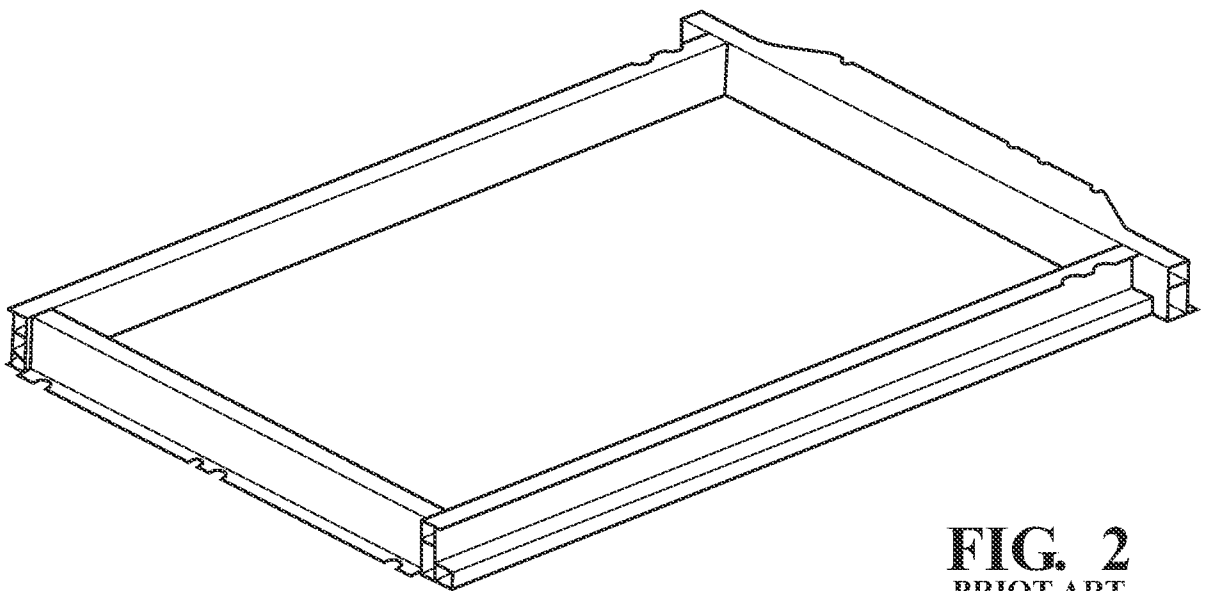


FIG. 2
PRIOT ART

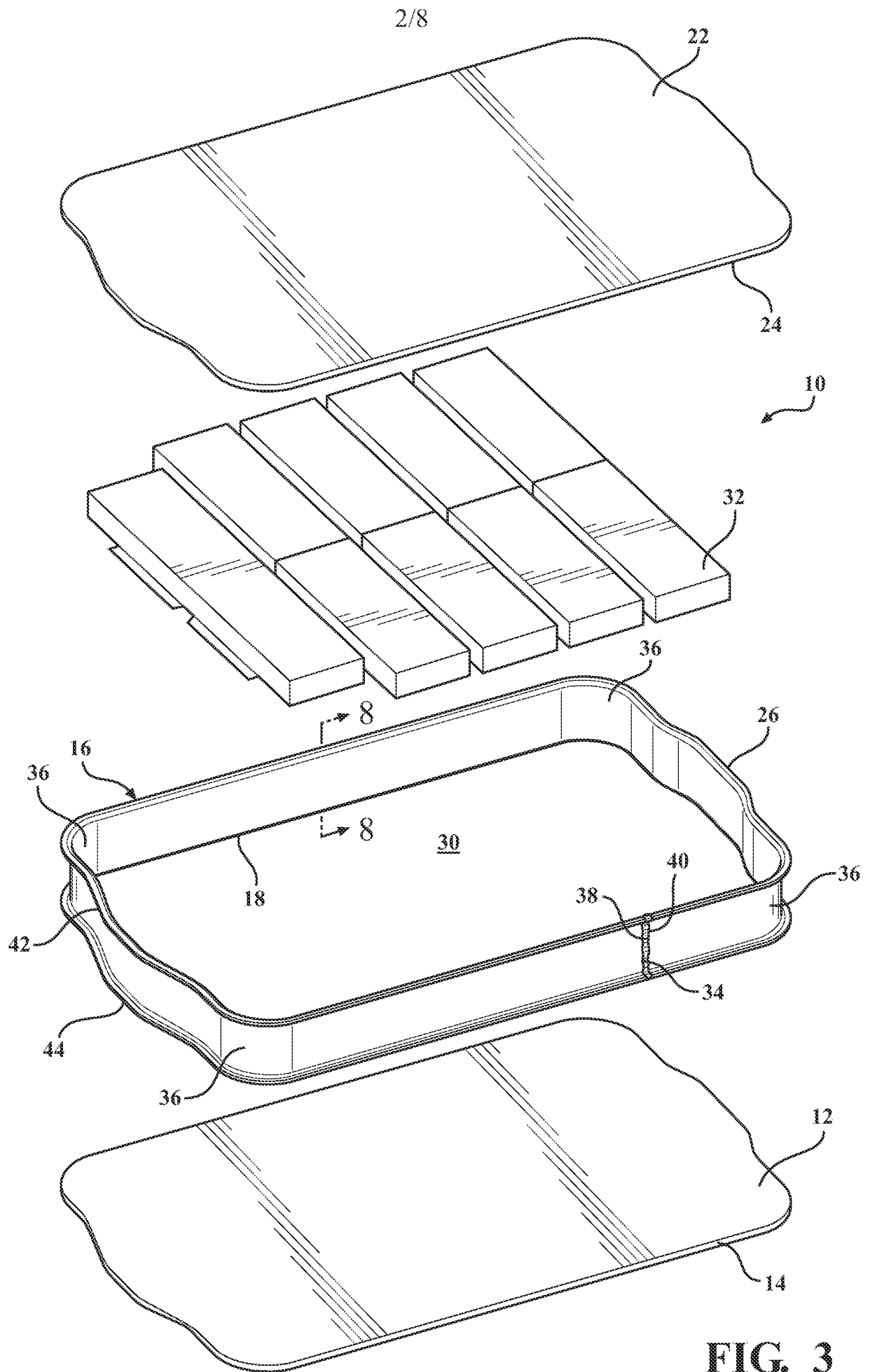


FIG. 3

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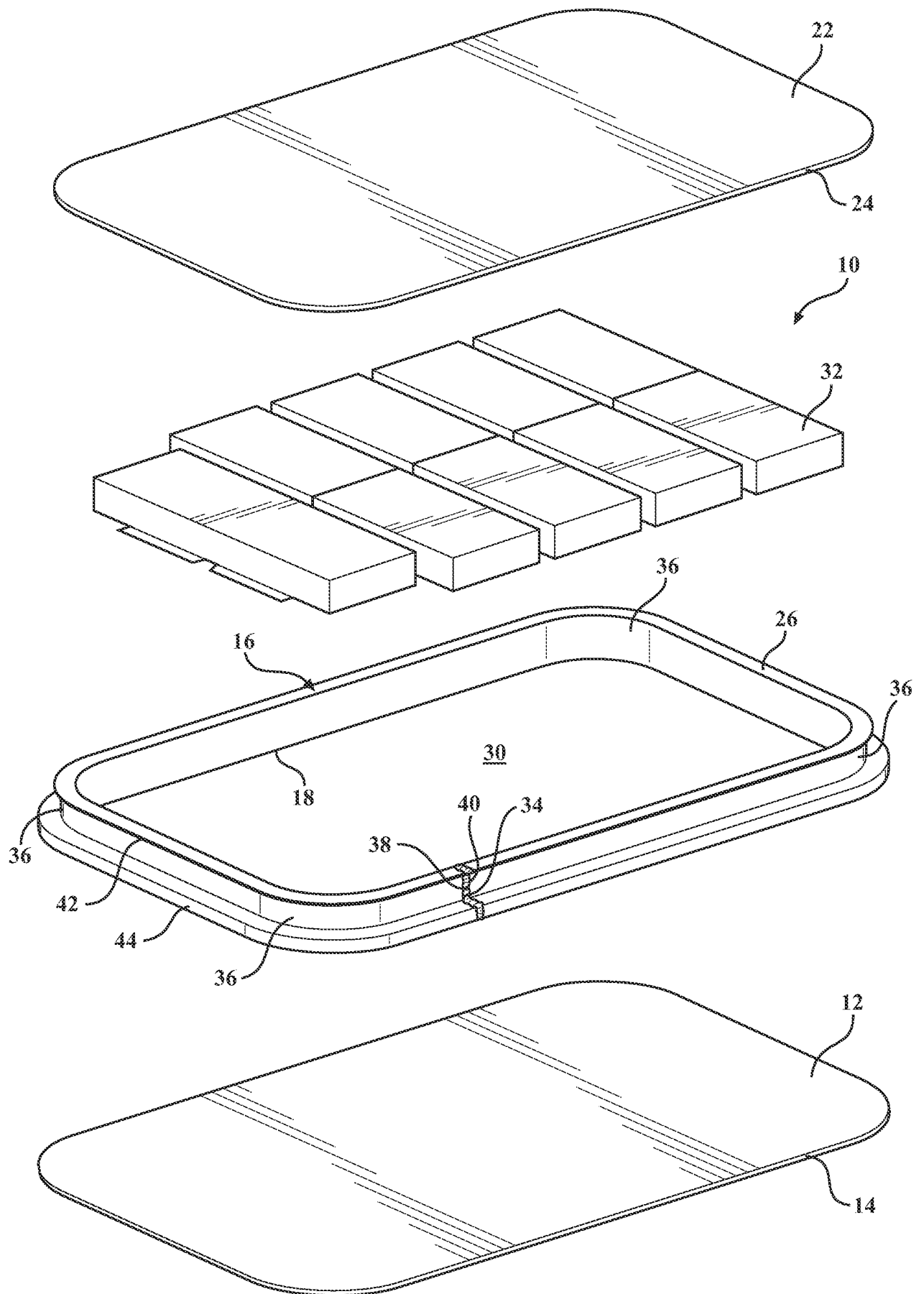


FIG. 4

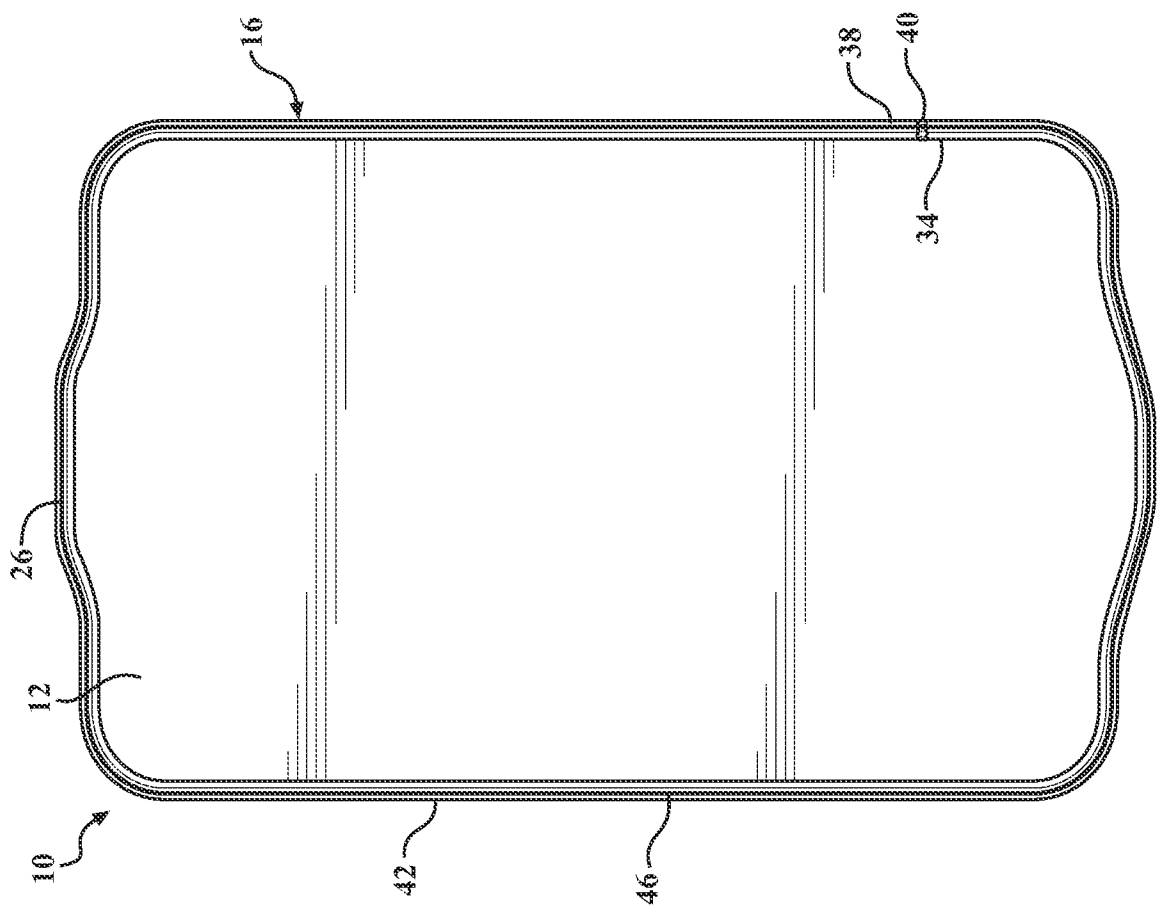


FIG. 5

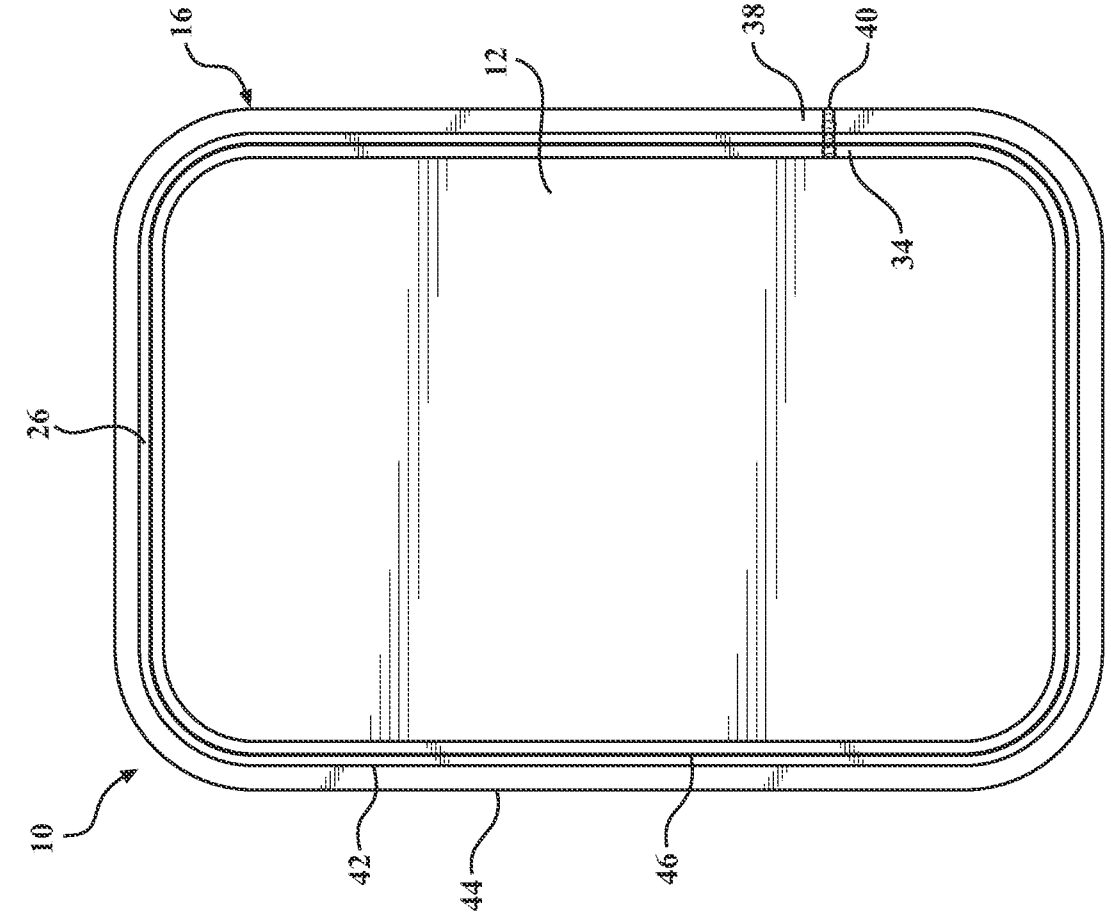
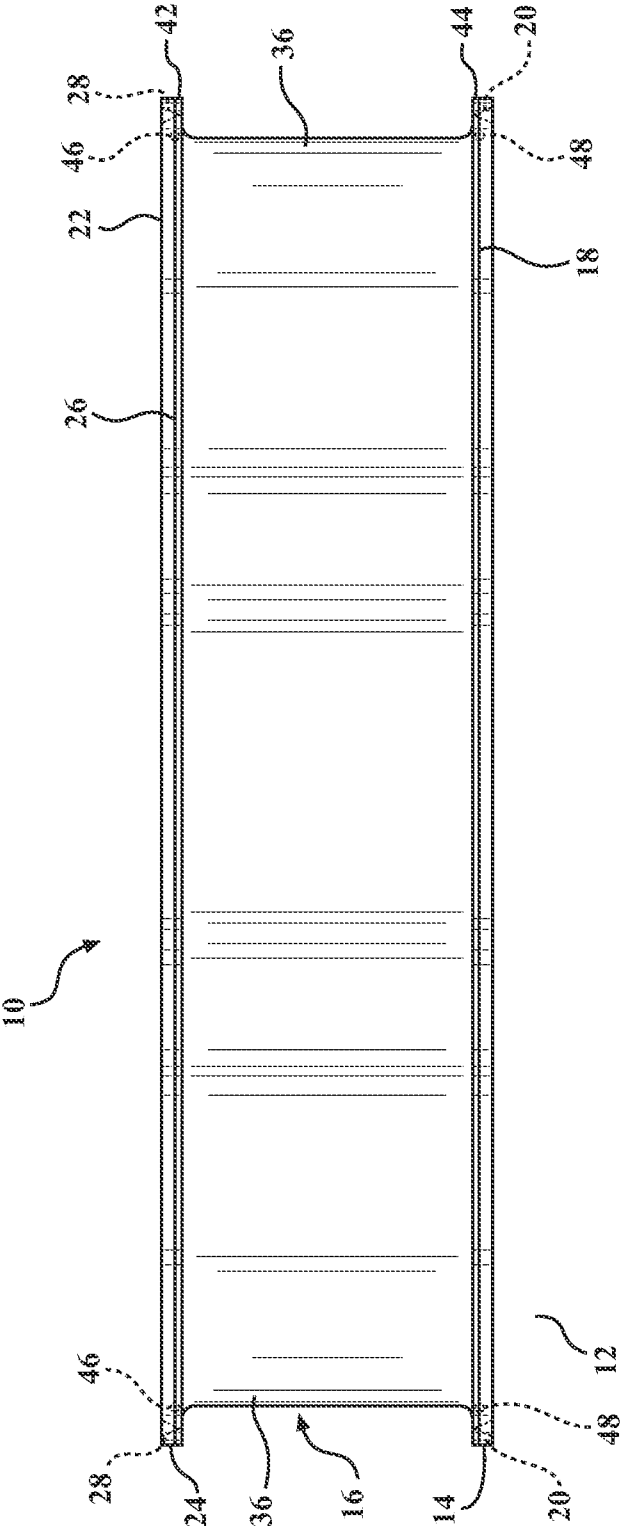
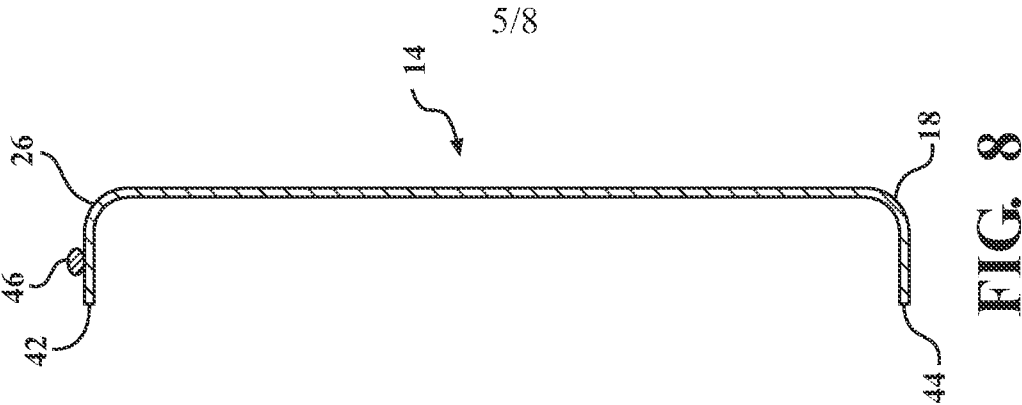


FIG. 6



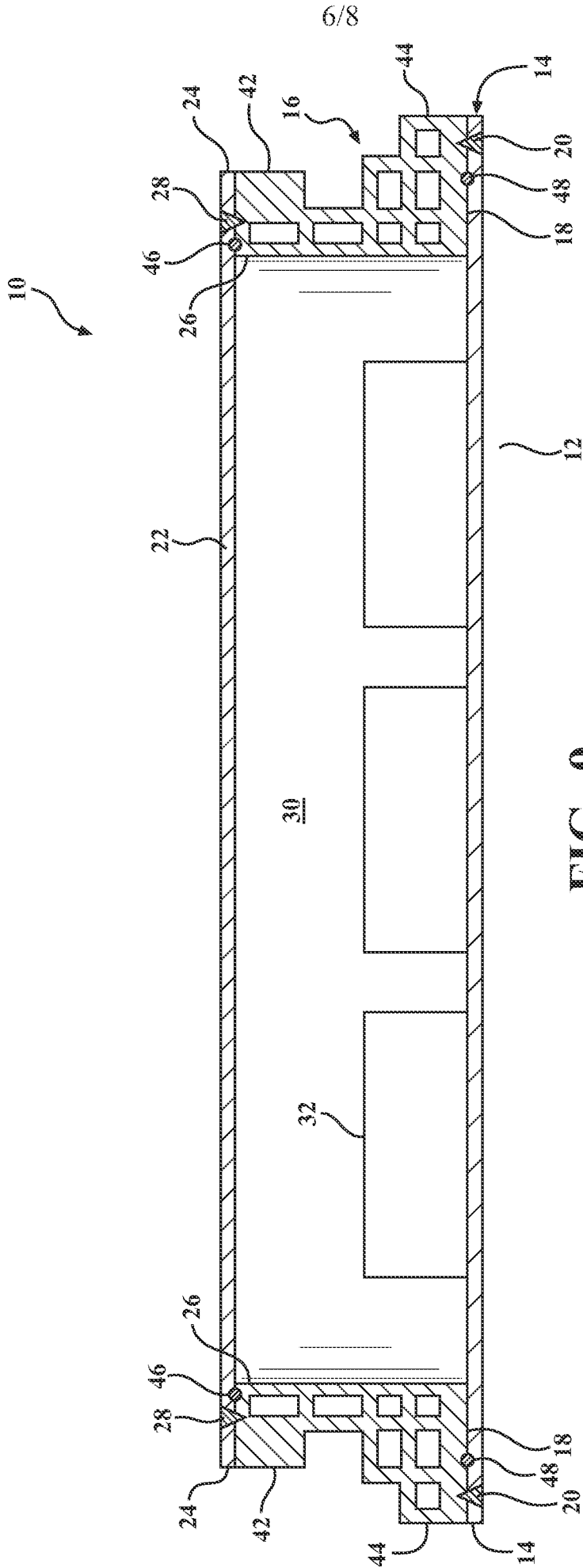


FIG. 9

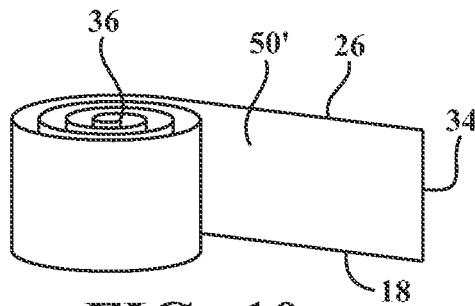


FIG. 10

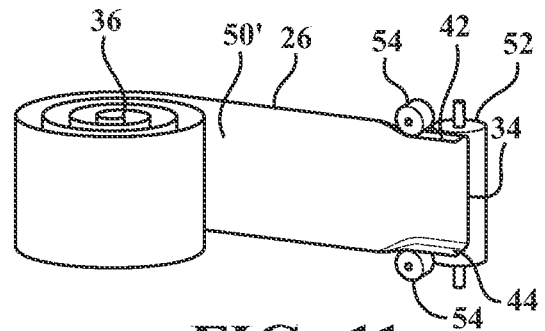


FIG. 11

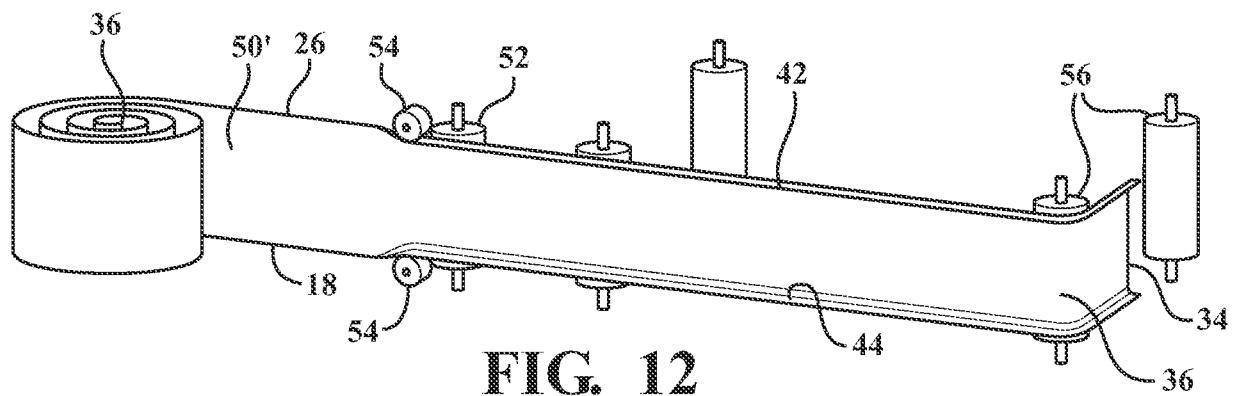


FIG. 12

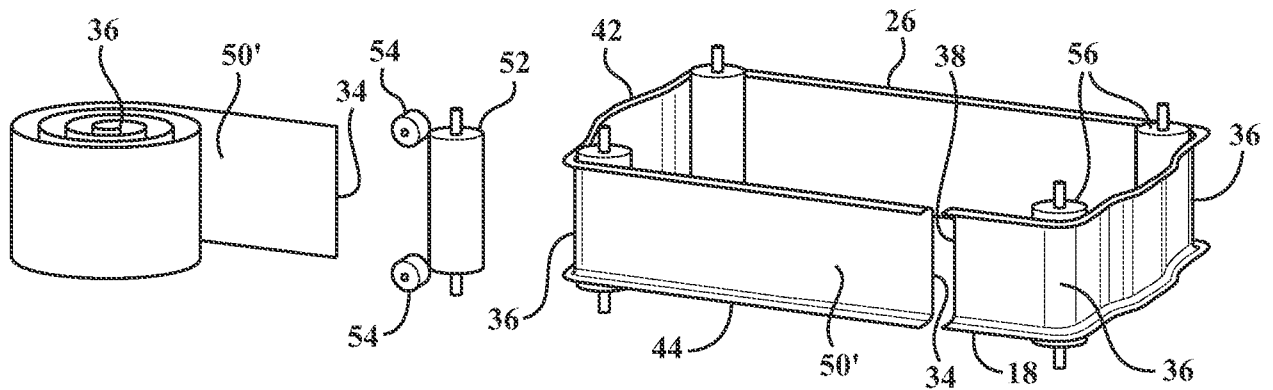


FIG. 13

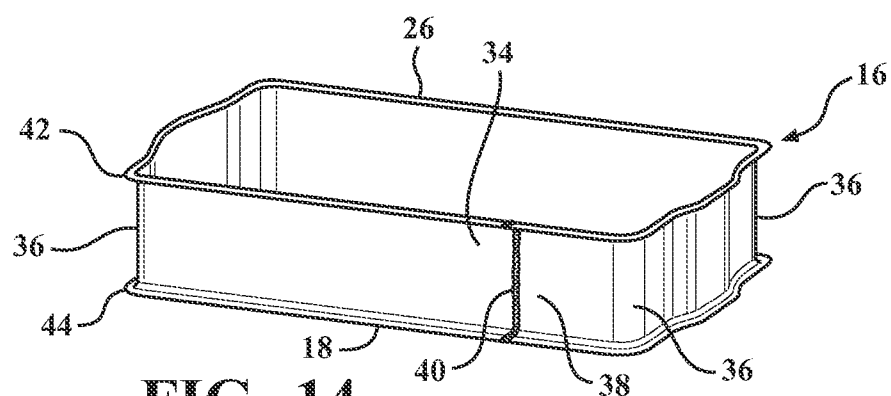


FIG. 14

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FIG. 15

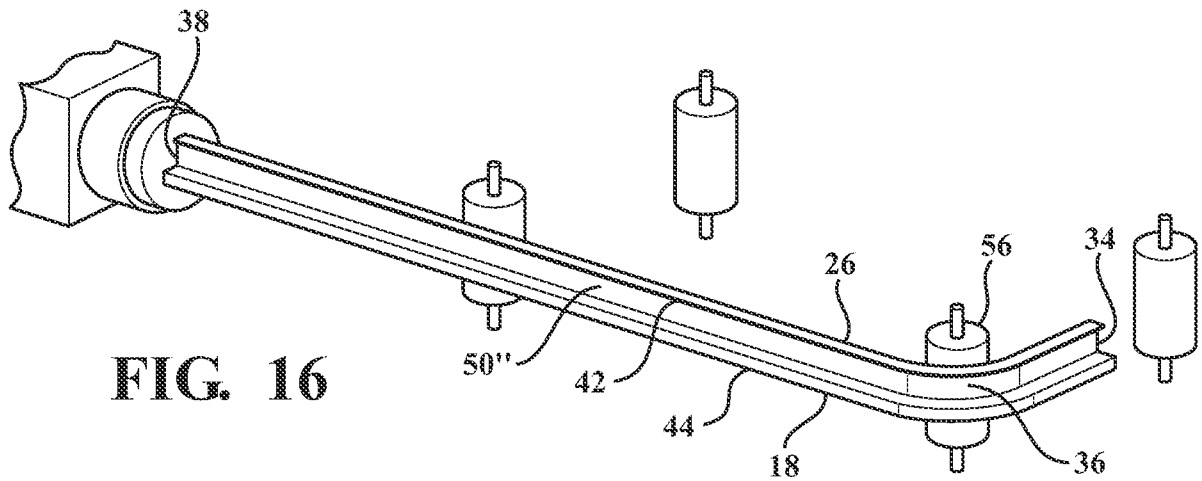
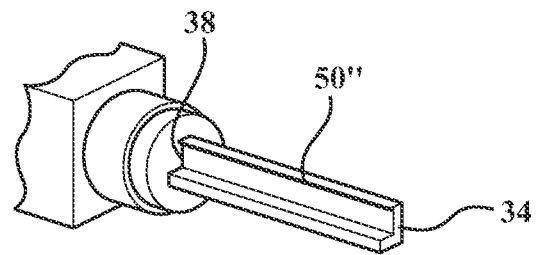


FIG. 16

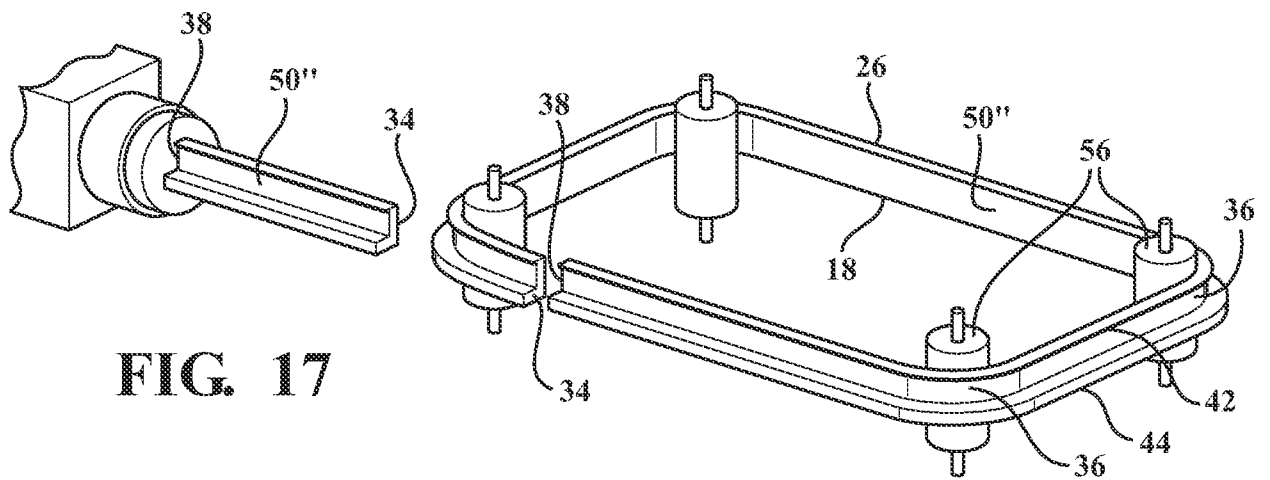


FIG. 17

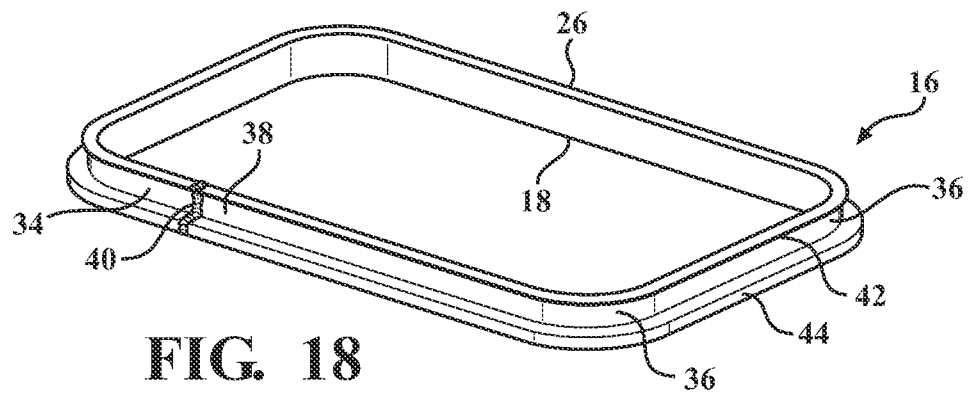


FIG. 18