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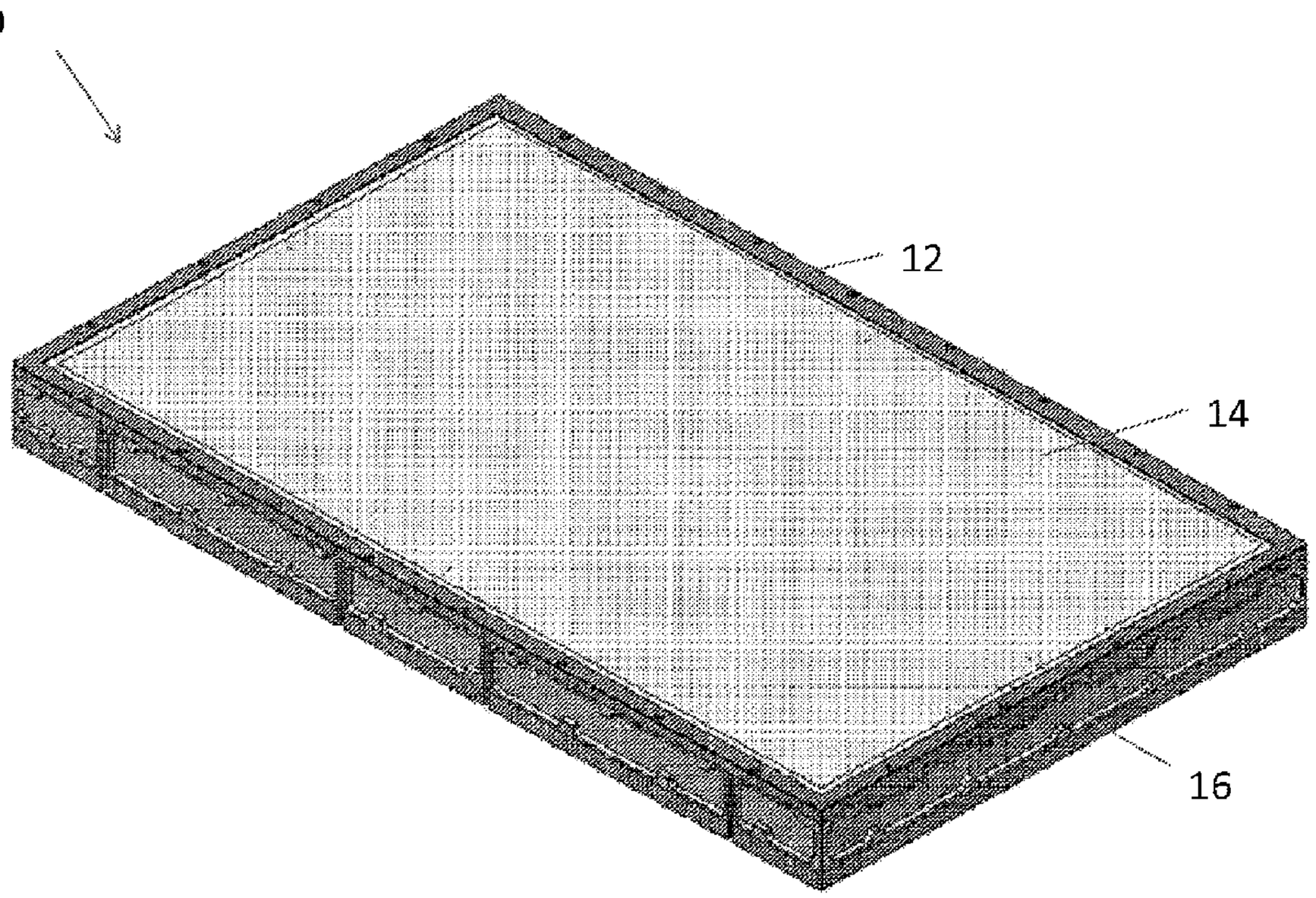

(57) Abrégé/Abstract:
A redundant touch panel (114) is placed above an electronic display (112) and the assembly is housed in a sealed gasket. The touch panel (1 14) has at least two adjoining, seamless touch sections, each in communication with an input/output device (116).

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(57) Abrégé(suite)/Abstract(continued):
The touch panel may be comprised of electronic circuits configured to minimize electromagnetic interference. Detectors are placed adjacent to the touch sections to detect signals therefrom. The electronic display (112) is comprised of multiple layers configured to provide visibility in bright ambient conditions.

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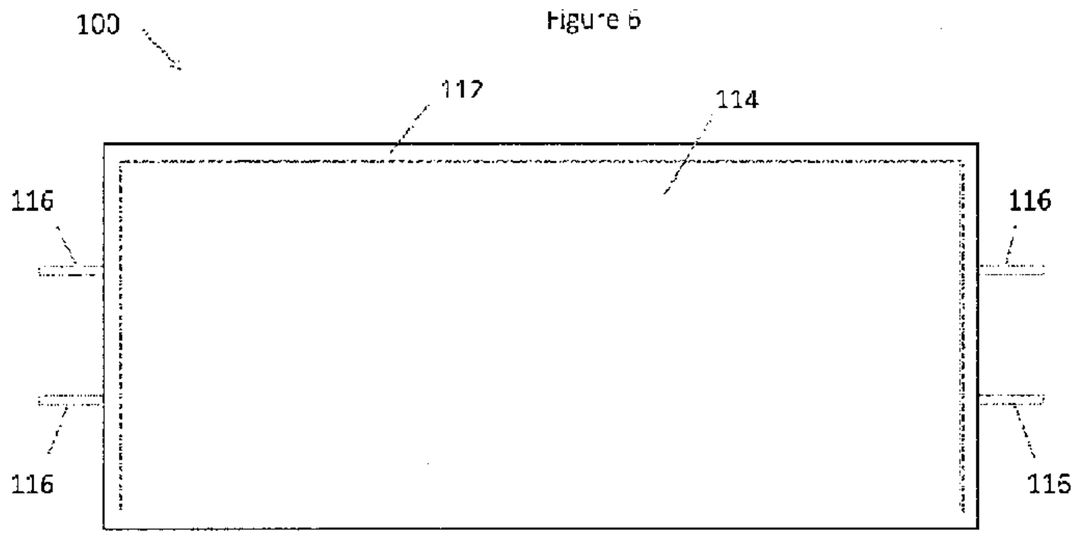
Figure 6



(57) Abstract: A redundant touch panel (114) is placed above an electronic display (112) and the assembly is housed in a sealed gasket. The touch panel (1 14) has at least two adjoining, seamless touch sections, each in communication with an input/output device (116). The touch panel may be comprised of electronic circuits configured to minimize electromagnetic interference. Detectors are placed adjacent to the touch sections to detect signals therefrom. The electronic display (112) is comprised of multiple layers configured to provide visibility in bright ambient conditions.

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REDUNDANT TOUCH PANEL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priority of U.S. Patent Application No. 14/876,382 filed on October 6, 2015 and U.S. Patent Application No. 14/876,393 filed on October 6, 2015, the disclosures of which are hereby incorporated by reference as if restated in their entirety.

TECHNICAL FIELD

[0002] Embodiments of the present invention generally relate to touch screen displays.

BACKGROUND AND SUMMARY OF THE INVENTION

[0003] Electronic touch panel displays are used in many commercial applications including ATMs, automobiles, informational displays, personal computers, cell phones, and the like. Such displays are advantageous as the content may be easily changed and the displays are interactive. For many applications having an electronic touch panel display is desirable, but requirements or needs for redundancy has prevented the use of such displays.

[0004] Examples of such applications include, but are not limited to, commercial aviation, space flight, and military applications, where redundancy measures are demanded to ensure continued performance of equipment in the event of a partial failure. In these and other applications there may also be visibility requirements to ensure performance under extreme environmental conditions. These may include ability to withstand high levels of solar loading and visibility in bright ambient conditions. Such stringent requirements are demanded because of the potential

consequences of failure. Therefore, it is desirable to provide an electronic touch panel display meeting visibility requirements and having redundancy measures.

[0005] Finally, in these and other applications, electromagnetic interference (EMI) and EMC becomes an issue as there are often multiple pieces of electronic equipment operating in close proximity. Each device may emit electromagnetic energy, which can cause EMI with the operation of the other unit resulting in interrupted performance. EMC is the ability for multiple devices to work in the same electromagnetic environment. Therefore, it is additionally desirable to provide the aforementioned electronic touch panel display also having EMC endurance capabilities that limit EMI.

[0006] Exemplary embodiments of the present invention may comprise an electronic display housed in a sealed gasket with a touch panel having redundant sensors and input/output devices. The gasket may prevent the display from being compromised by harsh environmental conditions. The display may additionally be comprised of multiple layers adapted to withstand high solar loading and remain visible in high ambient sunlight environments, such as by use of an active matrix liquid crystal display (AMLCD). This display may provide one large, contiguous video image or may provide multiple, independent video images.

[0007] The touch panel may comprise circuitry configured to limit EMI and improve EMC. The assembly may additionally comprise shielding between layers of the display and in channels associated with the display, which also limits EMI and improves EMC.

[0008] At least two seamless, adjoining grid sections and corresponding touch sensors capable of determining touch screen input are utilized, thus providing a seamless display and interaction experience when viewed and utilized. This also makes the touch panel redundant. For example, without limitation in the event of a

failure of one of the grids or the corresponding sensors, the display may automatically shift to display images only on the portion of the display covered by the remaining operable grid/sensor. Further, at least two input/output devices are utilized to ensure that each portion of the display and touch panel can be driven independently from either input/output device. These two measures provide redundancy and preserve the operability of the display under partial failure.

[0009] The display may be made such that it is adapted to comply with military specifications for use in military applications, such as aviation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In addition to the features mentioned above, other aspects of the present invention will be readily apparent from the following descriptions of the drawings and exemplary embodiments, wherein like reference numerals across the several views refer to identical or equivalent features, and wherein:

[0011] **Figure 1** is a perspective view of an exemplary embodiment of the present invention;

[0012] **Figure 2** is a top view of the device of **figure 1**;

[0013] **Figure 3** is a side view of the device of **figure 1**, additionally indicating Detail A;

[0014] **Figure 4** is a detailed side view of Detail A of **figure 3**;

[0015] **Figure 5** is a detailed side view of the device of **figure 1**, illustrated with a stylus contacting the touch panel;

[0016] **Figure 6** is a top view of another exemplary embodiment of the present invention;

[0017] **Figure 7** is a side view of the device of **figure 6**, also indicating Detail B;

[0018] **Figure 8** is a detailed side view of Detail B as indicated in **figure 7**;

[0019] Figure 9A is a front view of an exemplary touch panel in accordance with the present invention;

[0020] Figure 9B is a front view of another exemplary touch panel in accordance with the present invention;

[0021] Figure 10 is an exploded detailed side sectional view of an exemplary embodiment of a display panel in accordance with the present invention; and

[0022] Figure 11 is a plan view of an exemplary circuit in accordance with the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENT(S)

[0023] The invention is described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the exemplary embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the size and relative sizes of layers and regions may be exaggerated for clarity.

[0024] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/ or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0025] Embodiments of the invention are described herein with reference to illustrations that are schematic illustrations of idealized embodiments (and intermediate structures) of the invention. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, embodiments of the invention should not be construed as limited to the particular shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing.

[0026] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0027] **Figure 1** through **figure 5** illustrates an exemplary embodiment of the present invention. An electronic display and touch screen assembly **10** (hereinafter the "assembly") consists of a touch panel **14** located immediately above and extending in parallel with an electronic display **16.** In exemplary embodiments of the present invention the electronic display **16** is a normally black liquid crystal display (LCD), such as the AMLCD. Other displays types such as plasma, Light Emitting Diode (LED), Cathode Ray Tube (CRT), and the like are contemplated. In exemplary embodiments of the present invention, the assembly **10** and related components, including but not limited to the electronic display **16**, support 2560 x 1024 resolution.

[0028] As will be explained in greater detail in subsequent figures, the touch panel **14** may be a resistive touch panel or a projected capacitive touch panel. The touch panel

14 may be wet laminated to the electronic display **16** and a gasket **12** may be provided that frames the touch panel **14** and the electronic display **16**. Thereby protecting the assembly **10** and creating a seal therebetween. Other known methods of joining the touch panel **14** and the electronic display **16** are contemplated. The assembly **10** may include a heating device (not shown) that permits the touch panel **14** to operate in extreme conditions such as cold weather environments. The touch panel **14** may be in electronic communication with the electronic display **16** by flexible circuit, or the like. The touch panel **14** may be adapted to receive input from, for example, a human finger, including when gloved, or a stylus.

[0029] As best illustrated in **figure 2** though **figure 4**, the assembly **10** may further comprise a channel **18**. The channel **18** may extend from any side of the assembly **10** or from the back thereof. The channel **18** may be configured to permit a pair of independent input/output devices to travel therethrough. When both input/output devices are operable, each may provide input/output signals for a respective portion of the electronic display **16**. This provides a redundancy measure such that should one input/output device fail, the remaining operable input/output device may automatically provide input/output signals for the remaining portion of the electronic display **16** and thus maintain the operability of the assembly **10**. In other exemplary embodiments of the present invention, each input/output device is capable of providing input/output for the entire electronic display **16**.

[0030] As discussed, in some exemplary embodiments of the present invention, the touch panel **14** may be a resistive touch screen. In such embodiments, as best illustrated in **figure 5** the touch panel **14** may be comprised of two spaced apart surfaces where a top circuit layer **14A** is spaced apart from a bottom circuit layer **14B**. The two layers extend over the same surface and are substantially parallel. They may

be spaced apart by their placement within a housing, such as the gasket **12**. Alternatively, the top **14A** and bottom circuit layers **14B** may be spaced apart by individual spacer elements (not shown). The top circuit layer **14A** is sufficiently flexible such when contacted under sufficient force by a stylus **20**, the top circuit layer **14A** flexes to contact the bottom circuit layer **14B**. Such exemplary operation is illustrated at a contact point **22**. The top circuit layer **14A** may be sufficiently elastic, however, to return to its original position after the force of the stylus **20** is removed. The stylus **20** may be a human finger, including a gloved hand, or an artificial device.

[0031] **Figure 6** through **figure 8** illustrate another exemplary embodiment of an electronic display and touch screen assembly **100** (hereinafter the "assembly") in accordance with the present invention. The assembly **100** may be comprised of a touch panel **114** located immediately above and extending in parallel with an electronic display **112**.

[0032] Again, the touch panel **114** may be a resistive or a projected capacitive touch panel and may be configured to receive multiple inputs. The touch panel **114** may be comprised of a top circuit layer **118** and a bottom circuit layer **120**. The top and bottom circuit layers **118** and **120** may be spaced apart or immediately adjacent to one another. Additionally, the top and bottom circuit layers **118** and **120** may be located spaced apart from or immediately adjacent to the electronic display **112**. The touch panel **114** may be wet laminated to the electronic display **112** and a gasket may be provided that frames the two layers and creates a seal between the touch panel **114** and the electronic display **112**. Thereby protecting the assembly **100** from harsh environmental conditions and providing durability. Other known methods of joining the touch panel **114** and the electronic display **112** are contemplated. The assembly **100** may include a heating device (not shown) that permits the assembly **100** to

operate in extreme conditions such as cold weather environments. The touch panel **114** may be in electronic communication with the electronic display **112** by flexible circuit, or the like.

[0033] The assembly **100** may additionally comprise a series of channels **116**. The channels **116** may comprise shielding configured to reduce or eliminate EMI and promote EMC. In exemplary embodiment of the present invention, the assembly **100** comprises four channels **116**, a pair of which each extend from the left and right sides of the assembly, respectively. However, any number of channels **116** extending from any part of the assembly **100** is contemplated. The channel **116** may be adapted to house a pair of independent input/output devices (not shown), each extending though one of the channels **116**. When both input/output devices are operable, each may provide input/output signals for a respective portion of the assembly **100**. In exemplary embodiments of the present invention, each controls substantially half of the assembly **100**. In such an embodiment, if one input/output device fails, the remaining operable input/output device may provide input/output signals for the remaining half the assembly **100** and thus maintain operability. However, in other exemplary embodiments of the present invention, each input/output device is capable of providing input/output for the entire assembly **100.** This provides a redundancy measure. In such an embodiment, if one input/output device fails, the remaining operable input/output device may provide input/output signals for the assembly **100** and thus maintain operability.

[0034] In exemplary embodiments of the present invention, the assembly **100** and related components are configured to remain operable in atmospheric pressure conditions ranging from sea level to 55,000 feet altitude, including with a rate of change up to 120 feet per second. Similarly the assembly **100** and related

components are configured to withstand 95% humidity, temperature changes between 55 and 90 degrees Celsius (C) at a rate of 40 degrees C per minute with a maximum operating temperature of -45 degrees C to 71 degrees C and prolonged storage temperatures of -55 degrees C to over 90 degrees C. All coatings and materials in the assembly **100** may be configured to withstand, without degradation, commonly used solvents such as water, acetone, lacquer thinner, optical adhesive, and the like. Similarly, all coatings and materials in the assembly **100** may be configured to withstand, without degradation, commonly used cleaners such as ammonia, detergent, soap, and the like.

[0035] Figure 9A is a front view of an exemplary touch panel **200** in accordance with the present invention wherein the touch panel **200** is a resistive type touch panel. The touch panel **200** may comprise a grid **216** of vertically and horizontally extending electrodes. In exemplary embodiments of the present invention, the grid **216** may be comprised of two adjoining, seamless 8 x 10 sections formed by the vertically and horizontally extending electrodes, effectively providing an 8 x 20 grid and defining a first and a second grid section. Each of the first and second grid sections may be operated by an independent input/output device. In exemplary embodiments of the present invention, each of the first and the second grid sections corresponds to substantially half of the touch panel **200**. It is notable, however, that any size grid **216** having any number of vertically and horizontally extending electrodes and corresponding grid sections are contemplated. The grid **216** may be surrounded by a series of receivers **210**, **212**, **214**, **218**, **220**, and **222**. The pair of receivers **214** and **222** may extend along the right and left edges of the grid **216**, respectively. The pair receivers **210** and **212** may extend along the left and the right portions of the upper edge of the grid **216**, respectively. Finally, the pair of receivers **220** and **218** may

extend along the left and the right portions of the lower edge of the grid **216**, respectively.

[0036] In an exemplary embodiment of the present invention, the receivers **210**, **220**, and **222** may be placed to receive signals generated by touching the first grid section. Likewise, the receivers **212**, **214**, and **218** may be placed to receive signals generated by touching the second grid section. The grid **216** is sized to cover the entirety of the electronic display **16**. The vertically extending receivers **222** and **214** may be configured to receive input regarding the vertical (Y) position of the input. Similarly, the horizontally extending receivers **210**, **212**, **218**, and **220** may be configured to receive input regarding the horizontal (X) position of the input.

[0037] In exemplary embodiments of the present invention, each of the vertically extending receivers **222** and **214** may be capable of receiving input signals regarding the Y position of the input from both the first and second grid section. The horizontally extending receivers **210** and **220** may be capable of receiving input signals regarding the X position of the input from the first grid section. Similarly, the horizontally extending receivers **212** and **218** may be capable of receiving input signals regarding the X position of the input from the second grid section.

[0038] The grid **216** and the receivers **210**, **212**, **214**, **218**, **220**, and **222** may be configured to respond to a stylus, a human finger, or a gloved hand. The grid **216** and the receivers **210**, **212**, **214**, **218**, **220**, and **222** may be configured to respond to an activation pressure of under 0.8N and may allow for multiple touch inputs to be measured simultaneously.

[0039] The first and second grid sections and corresponding receivers provides a redundancy measure. When both the first and the second grid sections are operable, the entire touch panel **200** may be utilized. Should one of the first or the second grid

sections or the corresponding receivers be rendered inoperable, the remaining operable grid section may accept touch input for the portion of the grid **212** that it controls. For example, if the receiver **210**, **222**, and/or **220** should fail, the image that was being shown on the electronic display **112** may be shifted by a controller onto just the portion of the electronic display **112** corresponding to the remaining operable first or second grid sections such that the assembly **100** remains fully functional, albeit over a smaller area. In other exemplary embodiments, in such circumstances half of the assembly **100** may remain operable and the image may not be shifted.

[0040] It is notable that while the touch panel **200** may be described in terms of operating with a particular embodiment described herein, it is contemplated that the touch panel **200** may be utilized with any of the embodiments described herein.

[0041] As will be discussed in greater detail in subsequent figures, the touch panel **200** may be utilized in conjunction with a bottom glass layer **320** of an exemplary display panel **300** illustrated in **figure 10**, and each line of the touch panel **200** grid **216** may comprise an exemplary circuit **400**, such as the one illustrated in **figure 11**.

[0042] In one exemplary embodiment of the present invention, the touch panel active area may be 506.88 mm x 202.75 mm and the activation force needed may be in the range of 0.05N – 0.8N and may provide a minimum of two point multi-touch, and may have an operating life of over 1 million hits. In other embodiments of the present invention all of the above dimensions and values may change to the desire of the user or manufacturer.

[0043] Figure 9B is similar to **Figure 9A**, but presents an alternative exemplary embodiment of the present invention wherein the touch panel **200** is a projected capacitive touch panel. The touch panel **200** may comprise a first touch sensor **224** and a second touch sensor **224**. The first **224** and the second touch sensors **226** may

be located immediately adjacent to one another and provide a seamless touch screen surface that is indistinguishable in functionally to a user. The first **224** and the second touch sensors **226** may additionally be located immediately above the electronic display **112**. Each of the first and the second touch sensors **224** and **226** may be in communication with an independent input/output device. In this way, if one input/output device or one touch sensor fails, the remaining touch sensor will remain operable. In exemplary embodiments of the present invention, each of the first and the second touch sensors **224** and **226** may comprise multiple input/output devices, such that if one input/output device fails both touch sensors **224** and **226** will remain operable, thus providing redundancy.

[0044] The first touch sensor **224** may additionally comprise a first vertical sensor **234** and a first horizontal sensor **232**. The first touch sensor **224** may control a first portion of the touch panel **200**. Likewise, the second touch sensor **226** may additionally comprise a second vertical sensor **228** and a second horizontal sensor **230** and control a second portion of the touch panel **200**. In exemplary embodiments of the present invention, each of the touch sensors **224** and **226** corresponds to substantially half of the electronic display **112**. The vertical touch sensors **234** and **228** may be configured to sense the vertical (Y) location of a touch input, while the horizontal sensors **232** and **230** may be configured to sense the horizontal (X) location of a touch input. The touch panel **200** may be sized to cover the entirety of the electronic display **112** and substantially all of the assembly **100**.

[0045] In exemplary embodiments of the present invention, the first **224** and second touch sensors **226** may be configured to respond to a stylus or a human finger, including a gloved hand. The first **224** and second touch sensors **226** may be configured to respond to an activation pressure of less than 100g and may allow for

multiple touch inputs to be measured simultaneously. The touch panel **200** may be configured to receive at least ten points of touch simultaneously and respond to pinching and rotational gestures.

[0046] The use of the first **224** and the second touch sensors **226** provides a redundancy measure. When both the first **224** and the second touch sensors **226** are operable, the entire touch panel **200** may be utilized. Should one of the first **224** or the second touch sensors **226** be rendered inoperable, the remaining operable touch sensor **224** or **226** may accept touch input for the portion of the touch panel **200** that it controls. For example, if touch sensor **224** fails, the image that was being shown on the entire electronic display **112** may be shifted by a controller onto just the portion of the electronic display **112** controlled by the remaining operable touch sensor **226**. In this way, the assembly **10** remains fully functional, albeit over a smaller area. In other exemplary embodiments of the present invention, if one of the first **224** or the second touch sensors **226** be rendered inoperable the corresponding portion of the electronic display **112** may simply be turned off. In still other exemplary embodiments, the electronic display **112** may remain unchanged but touch input will only be accepted from the remaining operable touch sensor **224** or **226**.

[0047] As will be discussed in greater detail in subsequent figures, the touch panel **200** may be utilized in conjunction with a bottom glass layer **320** of an exemplary display panel **300** illustrated in **figure 9**, and each line of the touch panel **200** matrix may comprise an exemplary circuit **400** such as the one illustrated in **figure 10**.

[0048] In one exemplary embodiment of the present invention, the touch panel active area may be 506.88 mm x 202.75 mm and may have an operating life of over 1 million hits. Other embodiments of the present invention can vary in size, operating life, touch actuation force, etc., at the discretion of the user or manufacturer.

[0049] **Figure 10** is an exploded detailed side sectional view of the exemplary display panel **300** in accordance with the present invention, such for use with the electronic display **16**. A cover glass **310** may form the top layer of the display panel **300**. The cover glass **310** may comprise an anti-smudge, anti-reflective coating. A linear polarizer **312** followed by a quarter wave retarder **314** may be located below the cover glass **310** and above a top glass **316**. The quarter wave retarder **314** may be configured to withstand high temperatures. An optically clear adhesive (OCA) layer **318** may be placed between the top glass **316** and the bottom glass **320**.

[0050] The bottom glass **320** may be located below the top glass **316** but above an indium tin oxide (ITO) layer **322.** In exemplary embodiments of the present invention, the touch panel **200** will be located in the bottom glass **320** layer. The ITO layer **322** may be located immediately below and be affixed to the bottom glass **320**. The ITO layer **322** may act as an EMI shielding layer, thus promoting EMC. In exemplary embodiments of the present invention, the ITO layer **322** may extend beyond the bottom glass **320** by 3mm on all sides. Finally, a final quarter wave retarder **324** may form the bottom layer of the display **300**. The final quarter wave retarder **324** may have a smaller area than the previous layers, which may all have substantially the same surface area. Such a configuration permits the display panel **300** to be visible in high ambient light conditions and operable under high levels of solar loading. In exemplary embodiments of the present invention the display panel **300**, the assembly **100**, and other related components are configured to withstand prolonged exposure to solar radiation with a normal flux of 260 BTU/ft^2 at sea level atmospheric pressure and 55 degrees C.

[0051] Each of these layers may extend in parallel with the other layers. Each of these layers may also be spaced apart from one another and be of various thicknesses. In

exemplary embodiments of the present invention, the layers may be immediately adjacent to, secured to, or integrally formed with one another. In exemplary embodiments of the present invention, the cover glass **310** may be a 0.15mm micro sheet. In other embodiments, the cover glass **310** may be 0.5mm thick. The top glass **316** may also be 0.15mm thick, while the bottom glass may be 1.1mm thick. The ITO layer **322** may be 3mm thick. While these thicknesses are exemplary, they are not intended to be limiting, any functional thicknesses are contemplated. It is also notable that adhesive layers may be placed between any of the layers of the display panel **300**.

[0052] It is notable that while exemplary display panel **300** may be described in terms of operating with a particular embodiment described herein, it is contemplated that the display panel **300** may be utilized with any of the embodiments described herein.

[0053] **Figure 11** illustrates an exemplary circuit **400** in accordance with the present invention. The exemplary circuit **400** is configured to minimize EMI and maximize EMC. Each line of the sensors **214** and **212** may be comprised of the circuit **400**. It is contemplated that any number of the circuits **400** may be utilized in communication with one another.

[0054] The circuit **400** may be used with the assembly **10** or the assembly **100** in conjunction with the touch panels **14** and **114**, respectively. It is notable that while exemplary circuit **400** may be described in terms of operating with a particular embodiment described herein, it is contemplated that the circuit **400** may be utilized with any of the embodiments described herein.

[0055] The circuit **400** may comprise a pair of zener diodes **410** in parallel with and located on either side of a series of capacitors **412**. An inductor **416** may be placed in series between each capacitor **412**. In exemplary embodiments of the present

invention, three capacitors **412** are placed in parallel, and an inductor **416** is placed in series between each of said capacitors **412**. Other arrangements are contemplated.

[0056] Having shown and described a preferred embodiment of the invention, those skilled in the art will realize that many variations and modifications may be made to affect the described invention and still be within the scope of the claimed invention. Additionally, many of the elements indicated above may be altered or replaced by different elements which will provide the same result and fall within the spirit of the claimed invention. It is the intention, therefore, to limit the invention only as indicated by the scope of the claims.

CLAIMS

1. A redundant touch panel assembly comprising:

an electronic display for displaying images;

a projected capacitive touch panel comprising a pair of adjoining, seamless touch pads;

a first and second vertical sensor positioned adjacent to the side edges of said projected capacitive touch panel and configured to receive electrical signals generated therefrom;

a first and second horizontal sensor positioned along a horizontal edge of the projected capacitive touch panel such that each of said horizontal sensors is located substantially adjacent to one of said touch pads and is configured to detect electrical signals generated therefrom;

a first and second input/output device in communication with said electronic display and said first and second touch pads;

a gasket providing a substantially air tight seal between said electronic display and said projected capacitive touch panel; and

a controller in communication with the electronic display and the projected capacitive touch panel, wherein said controller is configured to shift the image displayed such that the displayed image corresponds entirely to one side of said touch pads;

wherein said projected capacitive touch panel is located above and in parallel with said electronic display and said first and second touch pads are located immediately adjacent to one another such that the touch panel presents a

seamless appearance that is indistinguishable in functionally across the touch panels;

wherein said vertical and horizontal sensors are located immediately adjacent to the perimeter of said first and second touch pads.

2. The assembly of claim 1 wherein:

the controller is further configured to automatically change the input/output device utilized if one of said input/output devices is rendered inoperable.

3. The assembly of claim 2 further comprising:

a housing for said electronic display and said touch panel; and

an input/output channel extending from within said housing though an edge thereof, wherein said first and second input/output devices extend through said input/output channel.

4. The assembly of claim 2 wherein:

the electronic display is comprised of a cover glass located above a linear polarizer located above a quarter wave retarder located above a top glass located above an optically clear adhesive located above a bottom glass located above an indium tin oxide layer located above a quarter wave retarder; and

the cover glass comprises an anti-reflective, anti-smudge coating.

5. The assembly of claim 2 wherein:

said pair of horizontal sensors are positioned along the same horizontal edge of the projected capacitive touch panel.

6. The assembly of claim 1 wherein:

the electronic display is a liquid crystal display.

7. The assembly of claim 1 wherein:

each of the touch panels comprise a series of electronic circuits; and

each of the electronic circuits comprise:

a first terminal;

a second terminal;

a third terminal comprising a common;

a number of zener diodes, each coupled between said first terminal and said third terminal;

a number of capacitors, each coupled between said first terminal and said third terminal, wherein each of said capacitors is coupled in parallel with each of said zener diodes;

a first inductor coupled in series between said first terminal and said second terminal;

a second inductor coupled in series between said first terminal and said second terminal, wherein said second inductor is coupled in series with said first inductor; and

a second capacitor coupled between said first terminal and said third

terminal, wherein said second capacitor is coupled in series with only said first and second inductors.

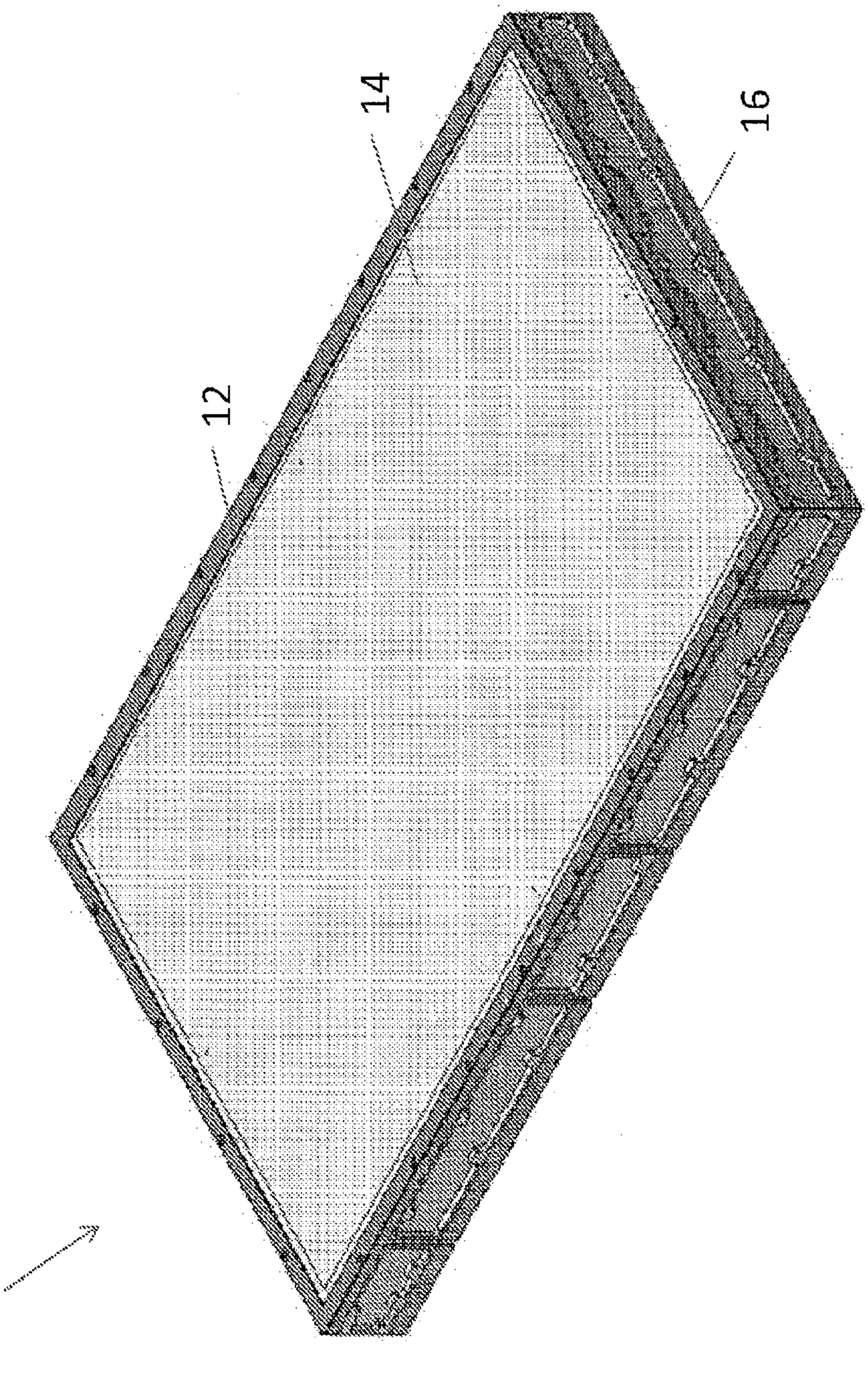


Figure 1

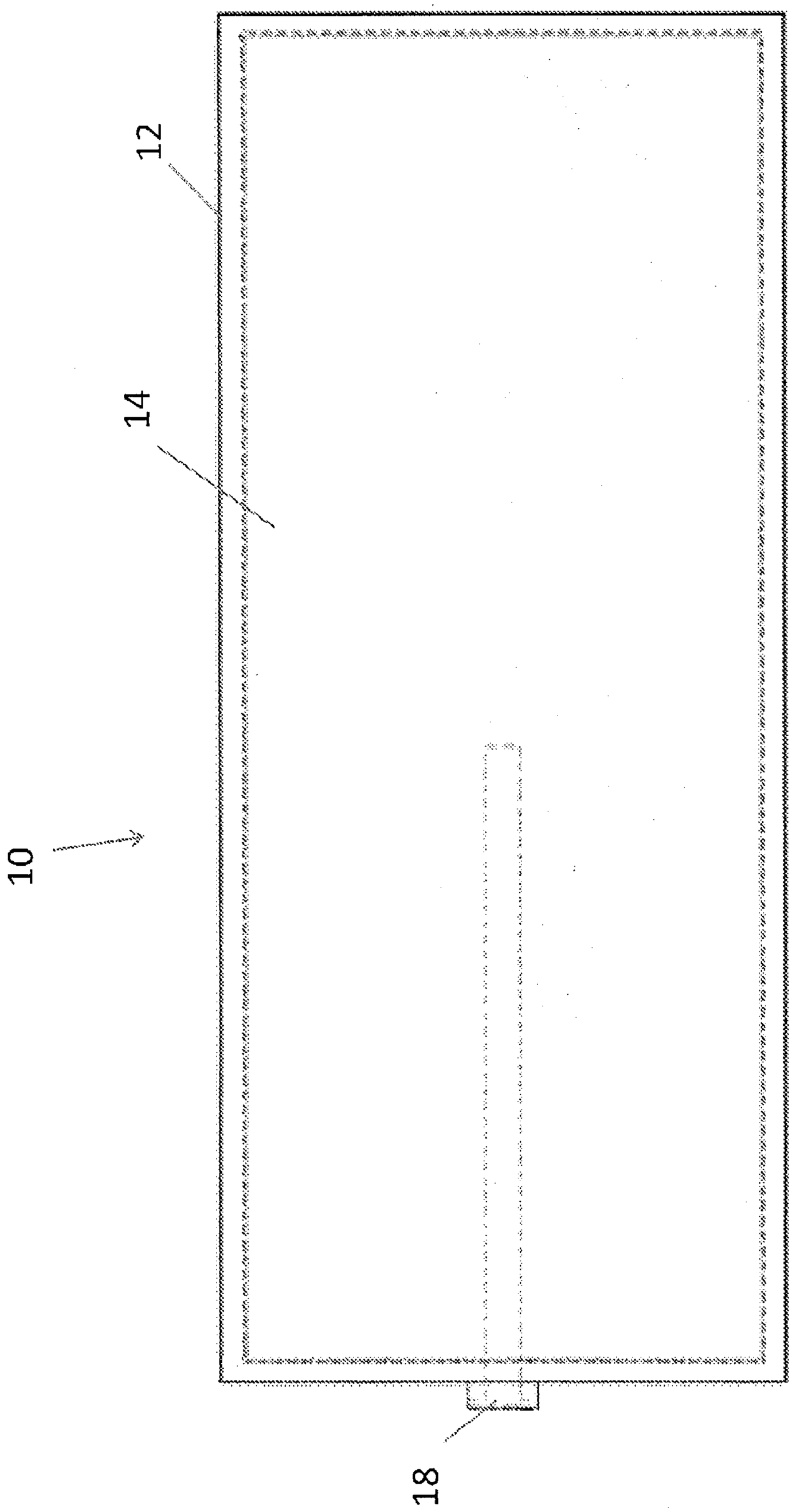


Figure 2

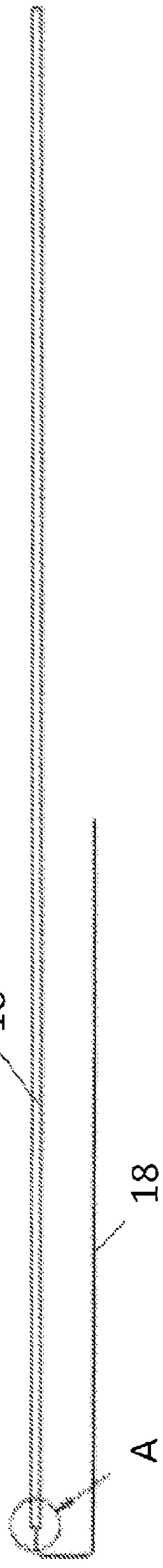


Figure 3

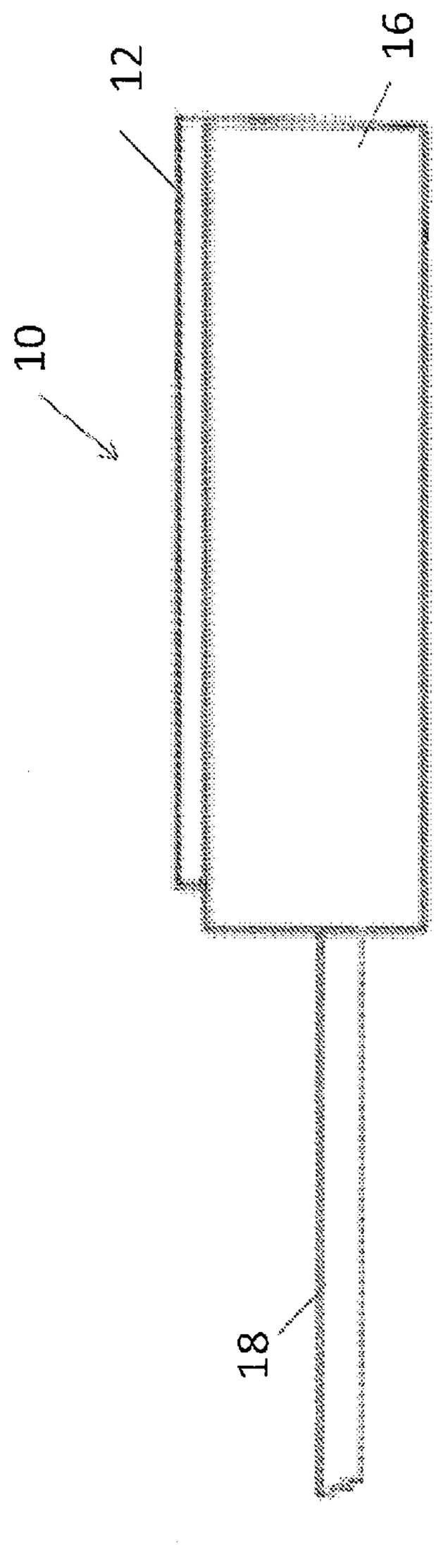


Figure 4

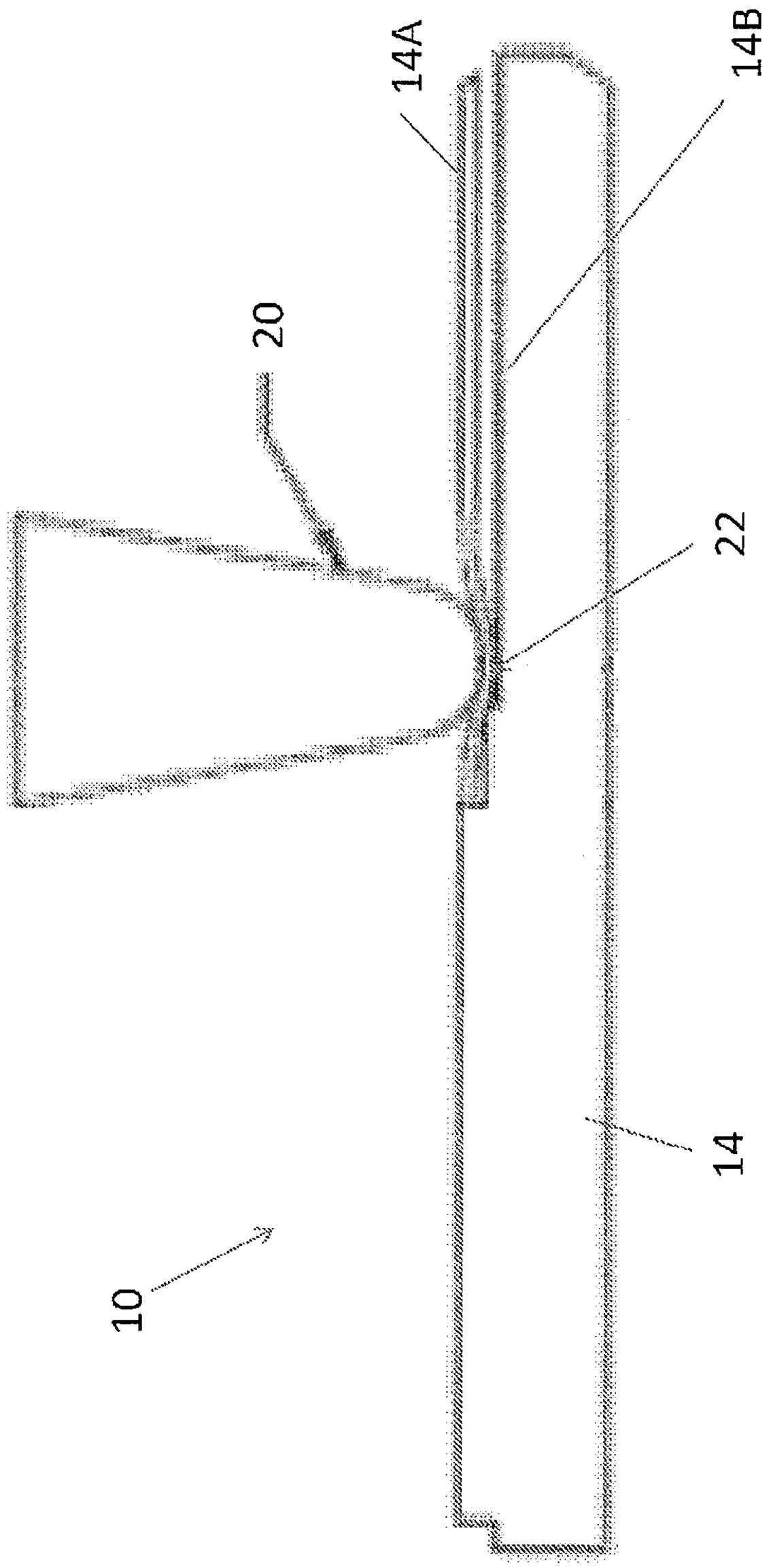
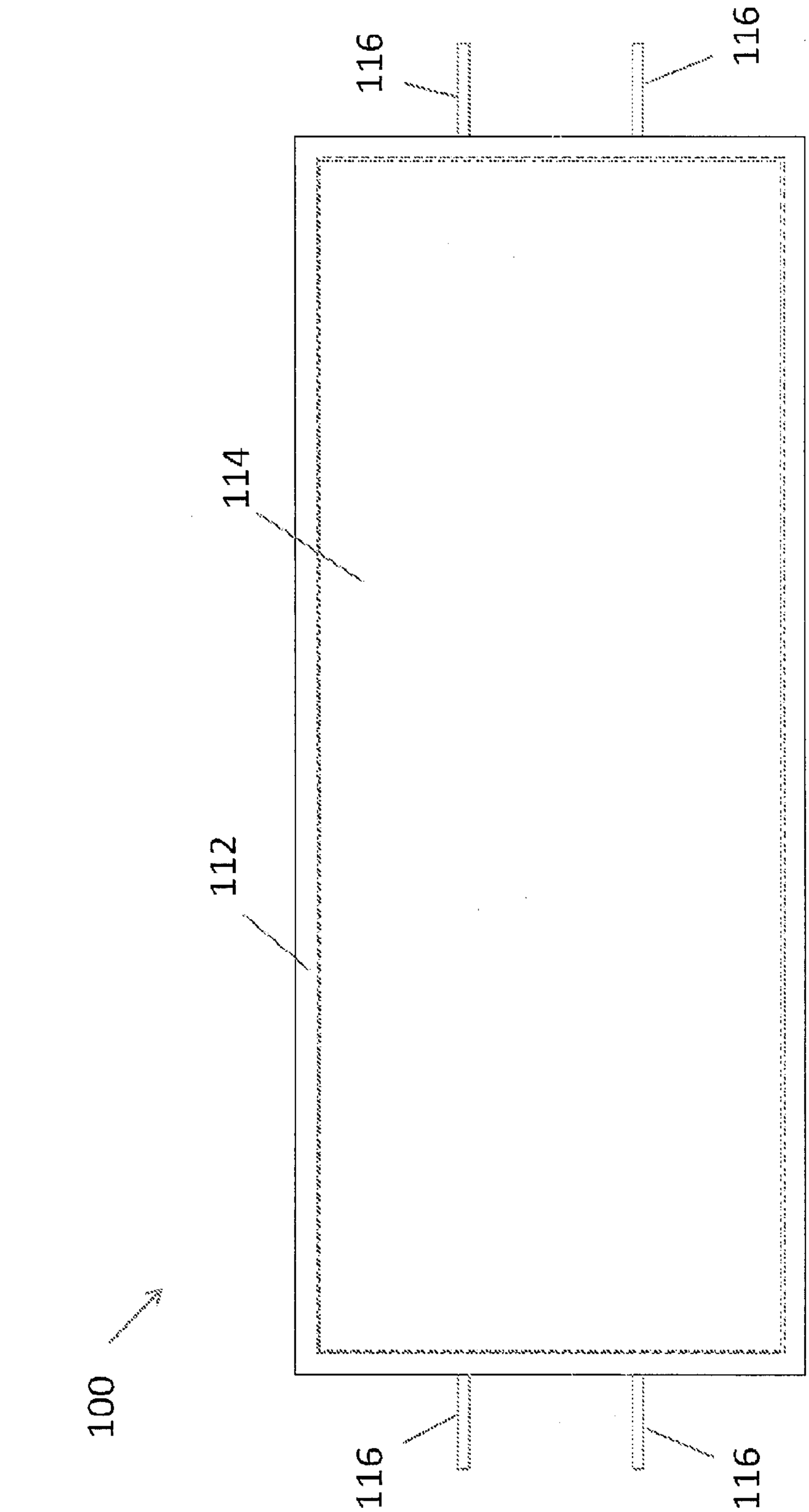


Figure 5



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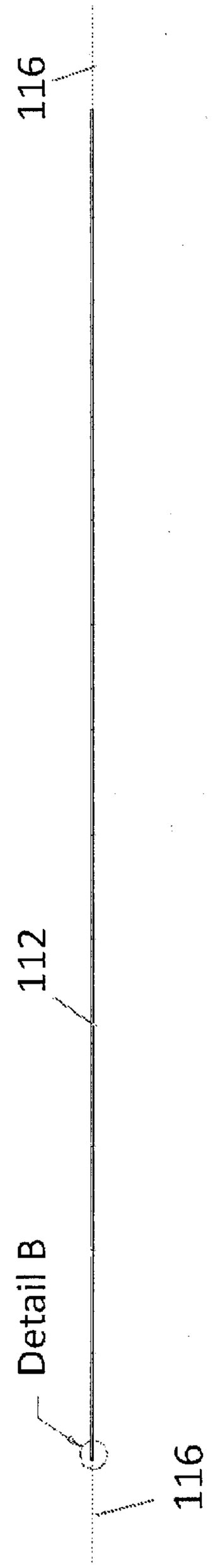

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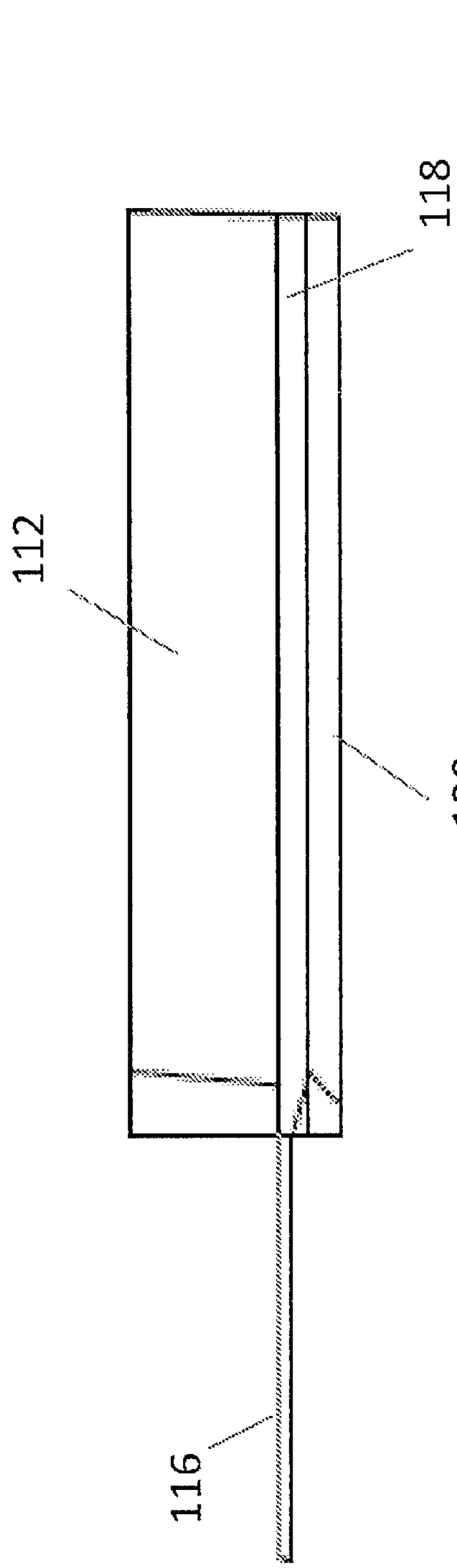

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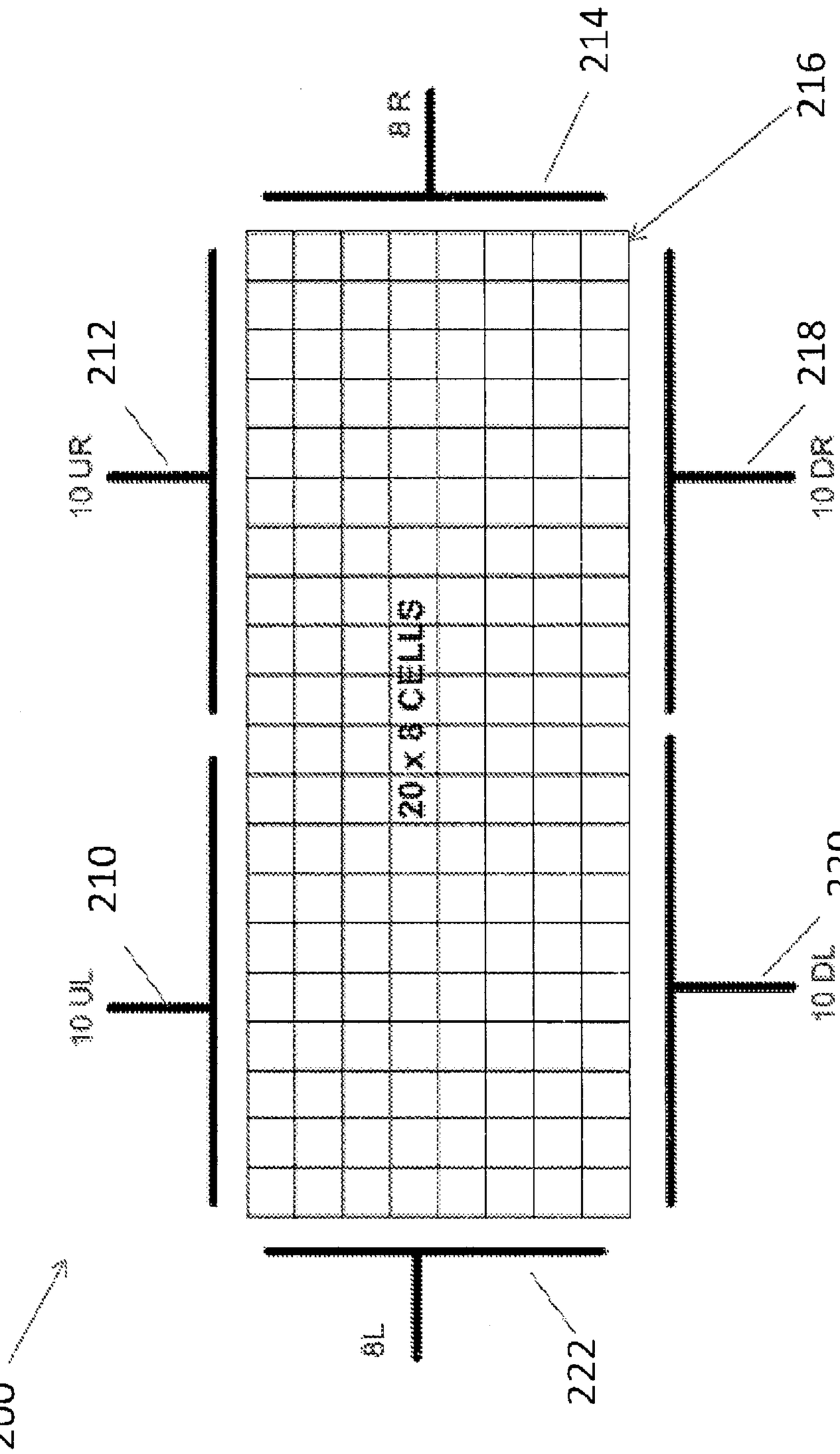
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200

Figure 9A

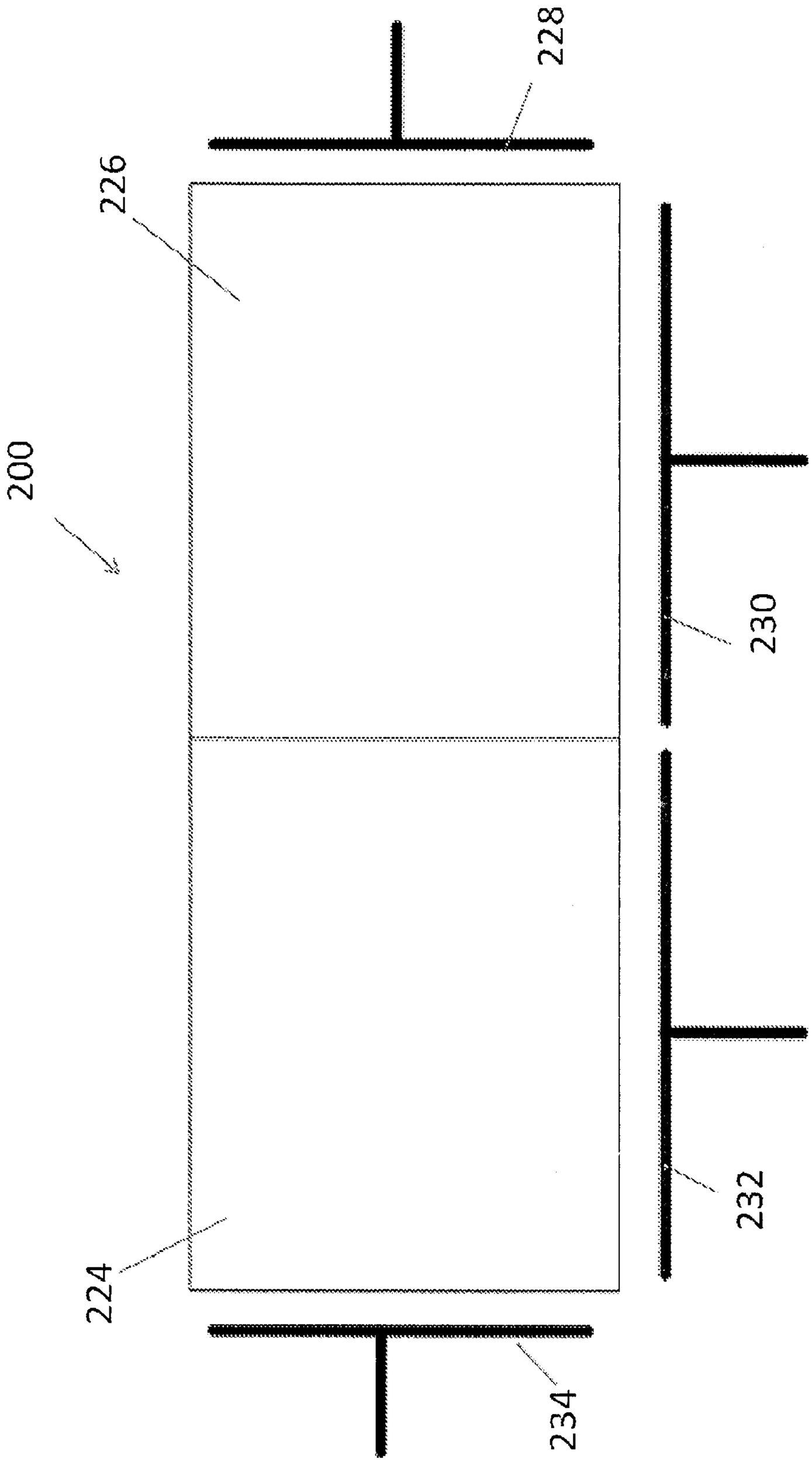


Figure 9B

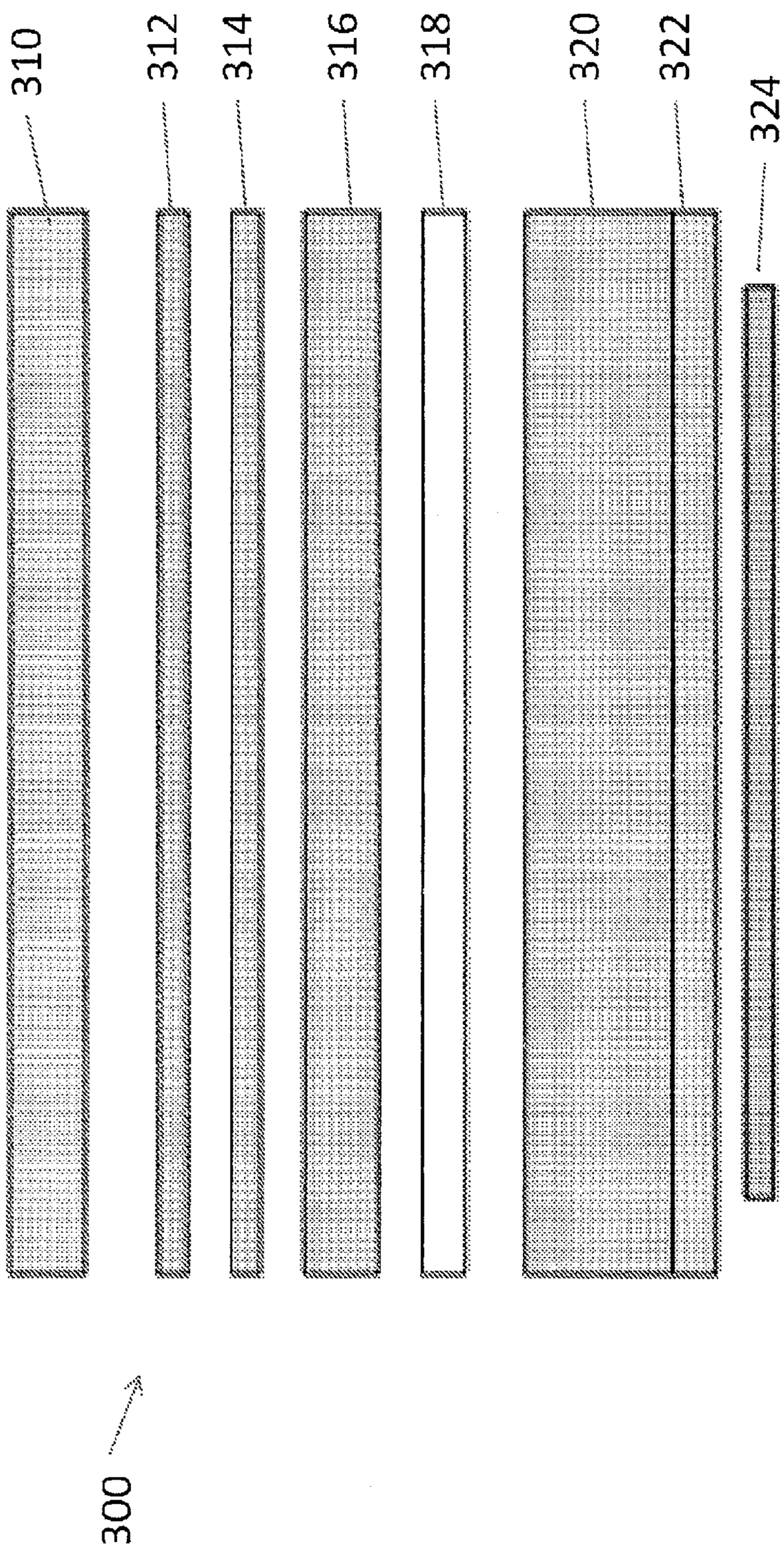


Figure 10

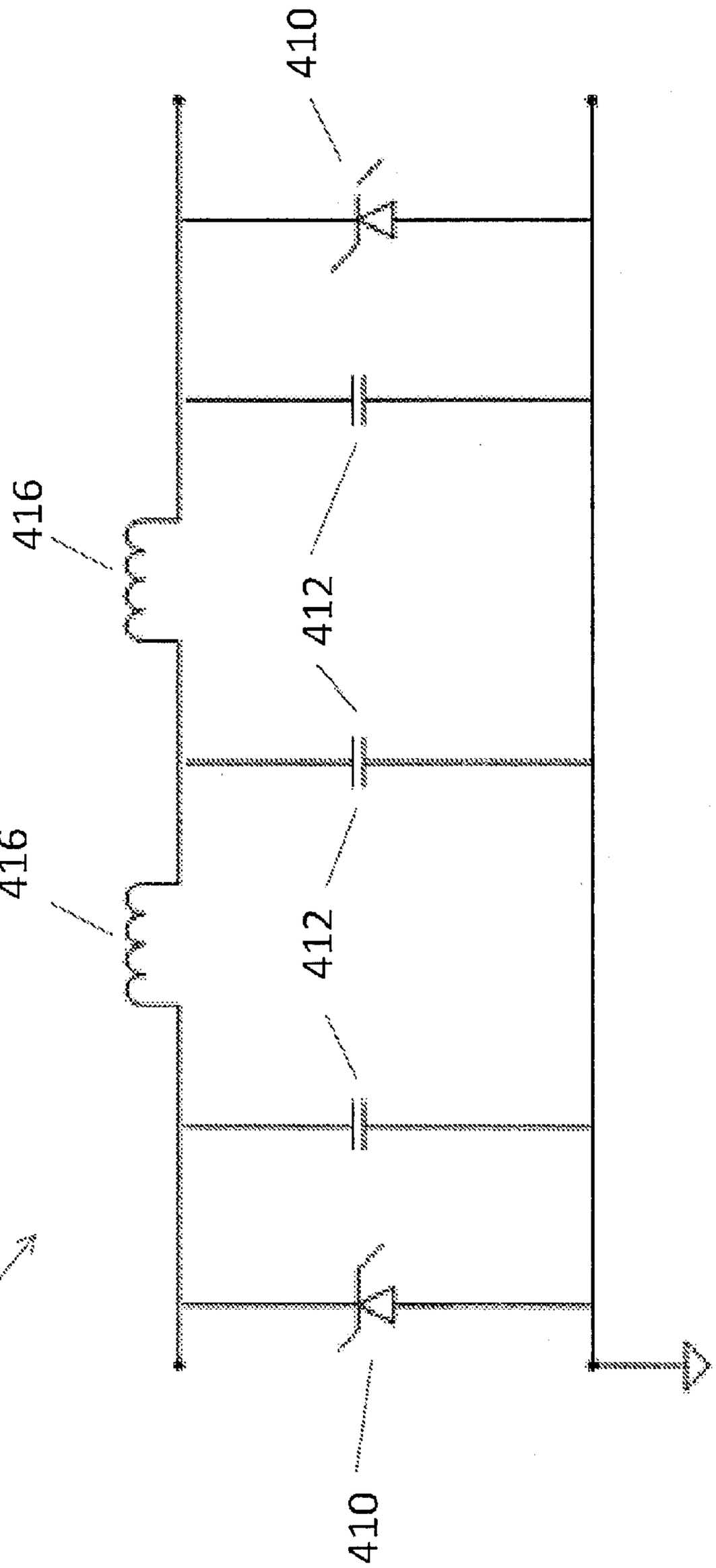
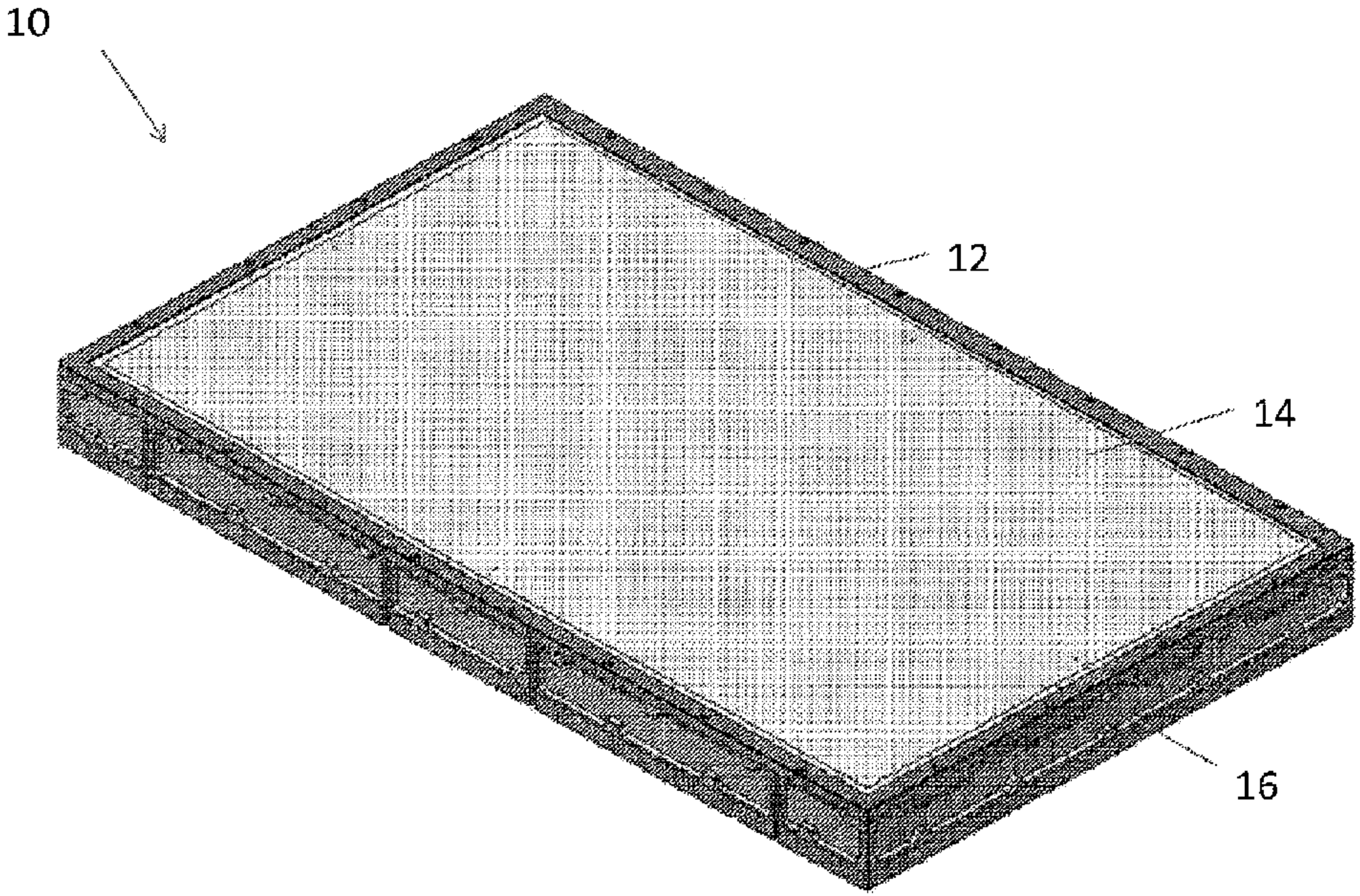


Figure 11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