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(54) **Moisture management and transport cover**

(57) An occupant support **(20)** includes an intermediate layer **(26, 30, 120)** and a wicking layer **(52)** atop the intermediate layer. The wicking layer comprises a first region **(62)** having a lower moisture wick rate **(W1)** and a second region **(64)** having a higher wick rate **(W2).** A moisture management cover **(52)** for use with an occupant support article has discrete higher **(64)** and lower **(62)** wick rate regions. A related method for transporting moisture away from a target region of an occupant support comprises distributing the moisture over an area beyond area **A** and exposing the distributed moisture to a fluid stream capable of receiving the moisture.

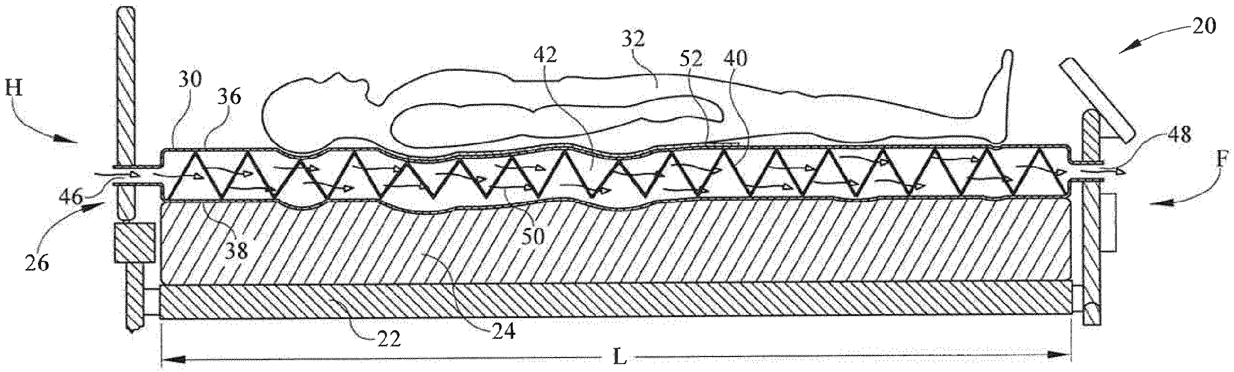


FIG. 1

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## Description

**[0001]** The subject matter described herein relates to a cover for enhanced in-plane moisture transport. One example application for the cover is on a hospital bed where it may be used in conjunction with a microclimate control topper or as a stand alone mattress cover to help transport moisture away from a region underneath an occupant of the bed thus achieving better control of moisture on the occupant's skin.

**[0002]** Long term occupants of beds, such as patients confined to a hospital bed, are at risk of skin breakdown. Such risks are exacerbated by excessive moisture on the occupant's skin. Frequently the source of the moisture is the occupant's own perspiration. One known way to control moisture in contact with the occupant's skin is to place a microclimate control (MCC) topper between the mattress and the occupant. A typical MCC topper comprises a vapor permeable top side and a bottom side. The sides define an interior cavity having an air inlet and an air outlet. The interior cavity serves as a flowpath for ambient or conditioned air. In operation, a blower propels a stream of air through the flowpath. Occupant perspiration, specifically the gaseous phase of the perspiration, enters the flowpath through the vapor permeable top side. The ambient or conditioned air flowing through the flowpath carries the moisture away. The flowpath thus serves as a moisture sink for moisture in contact with the occupant's skin.

**[0003]** Although MCC toppers are effective, their effectiveness is limited by the fact that the source moisture is mostly present in a confined area immediately underneath the occupant. Only those portions of the air stream directly under the moist area are effective at removing the moisture. As a result some of the moisture removal capacity of the topper is unused.

**[0004]** One embodiment of an occupant support includes an intermediate layer defining at least part of a fluid flowpath and having a vapor permeable occupant side. The occupant support also includes a wicking layer atop the intermediate layer. The wicking layer comprises a first region having a first moisture wick rate and a second region having a second moisture wick rate that exceeds the first moisture wick rate.

**[0005]** A moisture management cover described herein is cooperable with an occupant support article having an occupant support side so that the occupant support side and an opposing portion of the cover define a fluid flowpath. The cover has discrete higher and lower wick rate regions

**[0006]** The invention will now be further described by way of example with reference to the accompanying drawings, in which:

FIG. **1** is a simplified side elevation view of a hospital bed showing a bed frame, a mattress, an intermediate layer in the form of a microclimate control (MCC) topper, and a moisture transport cover, which is also referred to as a wicking layer, in the form of a substantially flat sheet removably secured to the topper by a zipper.

FIG. **2** is a plan view of the bed of FIG. **1** showing that the wicking layer has a higher wick rate central region and a lower wick rate perimetrical region.

FIG. **3** is a simplified perspective view of the bed of FIGS. **1-2.**

FIG. **4** is a perspective view of a wicking layer in the form of a fitted sheet.

FIG. **5** is a view showing the wicking layer nonremovably secured to a topper.

FIG. **6** is a view in which the wicking layer comprises a wicking material bonded to the topper by a vapor permeable adhesive.

FIG. **7** is a view in which the wicking layer is a vapor permeable coating applied to a topper.

FIG. **8** is a view in which the wicking layer is integrated into the topper.

FIG. **9** is a perspective view showing an embodiment in which an air mattress comprising multiple bladders plays the role of the intermediate layer.

FIGS. **10-11** are perspective views each showing moisture management covers in isolation, i.e. not in the context of a bed.

**[0007]** Referring to FIGS. **1-3,** an occupant support such as a hospital bed **20** extends longitudinally from a head end **H** to a foot end **F** and laterally from a right side **R** (seen in the plane of FIG. **1)** to a left side **L.** The bed includes a frame **22,** a mattress **24** supported on the frame, and an intermediate layer **26** in the form of a microclimate control topper **30** resting on the mattress. The topper is referred to as an intermediate layer **26** because of its position between frame **22** and occupant **32.**

**[0008]** The microclimate control topper **30** has a vapor permeable top or occupant side **36,** whose longitudinal and lateral dimensions are **D1, D2,** a bottom side **38,** and an air permeable spacer **40** between the sides. The occupant and bottom sides **36, 38** define a fluid flowpath **42** extending longitudinally substantially the length L of the topper. The topper has an inlet **46** and an outlet **48.** A blower, not shown, propels a stream of air **50** through the flowpath. In operation, the occupant's perspiration, after having transitioned to the gaseous phase, passes through the vapor permeable occupant side **36** and enters the air stream **50.** The air stream carries the moisture away through outlet **48.** In the embodiment of FIGS. **1-3** topper sides **36, 38** of the topper or intermediate layer define the flowpath from inlet **46** to outlet **48.** In another embodiment described below, the intermediate layer only partly defines the flowpath.

**[0009]** The occupant support also includes a moisture management cover or wicking layer **52,** atop the intermediate layer. At least part of the wicking layer is made of a material exhibiting a high in-plane moisture transport rate, referred to herein as a wick rate. Examples of materials having high wick rates include polypropylene, Meryl Skinlife®, SORBTEK™, and Poro-Tex expanded PTFE (ePTFE). The wicking layer of FIGS. **1-3** is in the form of a substantially flat sheet having longitudinal and lateral dimensions **D3, D4** approximately equal to the longitudinal and lateral dimensions **D1, D2** respectively of occupant side **36** of the topper. Although the wicking layer can form part of a stand-alone moisture management cover, the illustrated wicking layer is attached to the intermediate layer, i.e. to topper **30,** by a zipper **58,** a strip of VELCRO® or other connection that allows the wicking layer to be separated or removed from the topper without causing damage to or destruction of the wicking layer, the topper or the connection therebetween.

**[0010]** The illustrated wicking layer comprises a first region **62** having a first moisture wick rate **W1** and a second region **64** having a second moisture wick rate **W2** that exceeds the first moisture wick rate. In one embodiment the longitudinal borders of region **64** are laterally extending border **91** located approximately at the occupant's scapula and border **92** located at about mid-thigh. In another embodiment the borders are border **93** at about midway along the occupant's back and **94** at about the occupant's buttocks. First region **62** is a perimetrical region that laterally and longitudinally bounds second region **64.** The second region extends laterally beyond the approximate outline **66** of a supine occupant of the bed. The high wick rate of second region **64** spatially distributes the occupant's perspiration more readily than would be the case if the wick rate were lower. In particular the high wick rate of region **64** spreads the perspiration beyond the outline **66** of the occupant. More moisture is therefore exposed to air stream **50** resulting in better use of the moisture removal capacity of the topper and an attendant increase in moisture removal from the occupant's skin. Nevertheless, it is also contemplated that a high wick rate that does not extend laterally beyond the occupant could be beneficial.

**[0011]** The wicking layer illustrated in FIGS. **1-3** is in the form of a flat sheet whose dimensions **D3, D4** are only slightly larger than topper dimensions **D1,** D2 so that zipper **58** will not interfere with occupant comfort. The sheet could be made larger so that a considerably larger portion of it drapes over the edge of the topper, or smaller so that it does not completely cover occupant side **36** of the topper. Moreover, forms other than flat are not precluded. For example FIG. **4** shows the wicking layer in the form of a fitted sheet having elastic corners **70** and/or an elastic edge **72** so that the wicking layer fits snugly on topper **30.**

**[0012]** Wick rate **W2** may be spatially nonuniform, i.e. the wick rate need not be constant in any given direction. In addition the wick rate, even if constant in any given direction, need not be the same in one given direction as in another given direction. For example it is envisioned that wick rate **W2** could have a value $\mathbf{W2}_{LONG}$ in the longitudinal direction and a different, higher value $\mathbf{W2}_{LAT}$ in the lateral direction, with at least $\mathbf{W2}_{LAT}$ being greater than first wick rate **W1**. Because most occupants are taller than they are wide, the higher wick rate in the lateral direction can quickly transport moisture beyond the left and right edges **74, 76** of the occupant outline **66** where that moisture will be exposed to the drying effects of ambient air in addition to being acted on by the internal air stream **50.** The higher lateral wicking rate is therefore believed to be more efficacious than a higher longitudinal wicking rate.

**[0013]** In FIGS. **1-4** second region **64** is rectangular which, as used herein, includes the special case of a square, and the wicking layer is removably attached to the intermediate layer (topper 30). FIG. **6A** shows a nonrectangular second region **64,** specifically a substantially circular region. The illustrated nonrectangular region could also be shaped and dimensioned so that distance **D** from the edge of occupant outline **66** to the edge of second region **64** were approximately constant, or varied depending on typical perspiration rates at different portions of the occupant's body. FIGS. **5-8** show alternative architectures. In FIGS. **5A-5B** the alternative architecture is one in which wicking layer **52** is nonremovably attached to the topper, for example by a stitched seam **80.** In such an arrangement at least the stitching would be destroyed or damaged by the act of separating the wicking layer from the topper. In FIGS. **6A-6B** the alternative architecture is one in which the wicking layer **52** comprises higher and lower wick rate materials **84, 86** bonded to intermediate layer **30** by a vapor permeable adhesive **88.** Alternatively the bond could be effected by spot bonding with a non-vapor permeable adhesive. Higher wick rate region **64** corresponds to the higher wick rate material **84;** lower wick rate region **62** corresponds to the lower wick rate material **86.** In FIGS. **7A-7B,** the alternative architecture is one in which wicking layer **52** is a vapor permeable higher wick rate coating **100** and a vapor permeable lower wick rate coating **102** applied to the topper. Higher wick rate region **64** corresponds to the higher wick rate coating **100;** lower wick rate region **62** corresponds to the lower wick rate coating **102.** In FIGS. **8A-8B** the alternative architecture is one in which wicking layer **52** comprises higher and lower wick rate overlays **106, 108** integrated into the topper. Higher wick rate region **64** corresponds to the higher wick rate overlay **106;** lower wick rate region **62** corresponds to the lower wick rate overlay **108.** In one embodiment (not shown), the overlays **106, 108** form the top wall of the topper **52.**

**[0014]** In the variants of FIGS. **6-8,** the lower wick rate material **86** (FIG. **6),** lower wick rate coating **102** (FIG. **7)** and lower wick rate overlay **108** (FIG. **8)** could be dispensed with, in which case the portion of occupant side **36** of topper 30 outboard of region **64** could serve as the low wick rate region having a wick rate **W1.**

**[0015]** FIG. **9** shows an embodiment in which an air mattress **120** comprising multiple bladders **122** plays the role of intermediate layer **26.** Collectively, the bladders define a mattress occupant side **136** and a bottom side **138.** Air discharge apertures **126** penetrate through the occupant side of the mattress. A blower, not shown, supplies pressurized air to inflate the bladders. The moisture management cover or wicking layer **52** rests atop the air mattress. In this embodiment, intermediate layer **26,** as represented by air mattress **120,** only partly defines fluid flowpath **42** for airstream **50,** and is analogous to the bottom side **38** of the topper in the embodiments of FIGS. **1-3.** The wicking layer itself cooperates with the occupant side of the mattress to define flowpath **42** and is therefore analogous to the occupant side **36** of the topper in the embodiments of FIGS. **1-3.** Collectively, apertures **126** serve as an inlet analogous to inlet **26** of FIGS. **1-3.** Air discharges from the flowpath at the edges of the wicking layer. In operation the high wick rate wicking layer causes moisture to spread out over a relatively large area so that it can be more readily carried away by airstream **50.** If the wicking layer is connected to the intermediate layer by an airtight seam, other avenues for air discharge can be provided.

**[0016]** FIGS. **10-11** shows moisture management cover **52** in isolation, i.e. without the contextual framework of a hospital bed. The cover is nevertheless capable of being placed atop a companion article such as air mattress **120** of FIG. **9** or mattress **24** augmented by MCC topper **30** of FIGS. **1-3.** The moisture management cover has discrete higher and lower wick rate regions **64, 62** with wick rates of **W2** and **W1** respectively where **W2** is greater than **W1** (FIG. **11**). The moisture management cover can take the form of, for example, a flat sheet (as depicted in FIG. **10)** or a fitted sheet (as depicted in FIG. **11).** The illustrated cover of FIG. **10** includes an attachment element or elements, such as zipper **58** so that the moisture management cover can be removably joined to the occupant support article by way of a cooperating attachment element on the occupant support article. Alternatively the moisture management cover could be nonremovably secured to the occupant support article by, for example, continuous or spot stitching. In yet another alternative the cover is devoid of a closure element and is merely placed atop the occupant support article without being secured thereto. As already described previously the high and low wick rate regions of FIGS. **10-11** can be bonded onto a substrate, can be a coating applied to a substrate or can be integral with the cover. The wick rate can be spatially nonuniform.

**[0017]** Although the embodiments disclosed herein have a first region with a lower wick rate and a second region with a higher wick rate, more than two regions each having individual, customized wick rates can be used.

**[0018]** The terms "wicking" and its variants, as used herein to describe the moisture management cover, are intended to convey the notion of moisture transport in the plane of the cover and are not to be interpreted as limited to any particular physical mechanism of moisture transport.

**[0019]** The terms "moisture management cover" and "wicking layer" are used somewhat interchangeably herein but as will be appreciated, at least one embodiment is disclosed where a moisture management cover includes a wicking layer and where there is a wicking layer but not a stand alone moisture management cover.

**[0020]** Although this disclosure refers to specific embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made.

**[0021]** Embodiments of the invention can be described with reference to the following numbered clauses, with preferred features laid out in the dependent clauses:

1. An occupant support comprising:

   a intermediate layer defining at least part of a fluid flowpath and having a vapor permeable occupant side; and

   a wicking layer atop the intermediate layer, the wicking layer comprising a first region having a first moisture wick rate and a second region having a second moisture wick rate that exceeds the first moisture wick rate.

2. The occupant support of clause 1 wherein the first region is a perimetric region that bounds the second region.

3. The occupant support of clause 1 wherein the wicking layer is in the form of a fitted sheet.

4. The occupant support of clause 1 wherein the second wick rate comprises longitudinal and lateral wick rates at least the lateral one of which is greater than the first wick rate and the lateral wick rate exceeds the longitudinal wick rate.

5. The occupant support of clause 1 wherein the second region is nonrectangular.

6. The occupant support of clause 1 wherein the wicking layer is removably attached to the intermediate layer.

7. The occupant support of clause 1 wherein the wicking layer is nonremovably attached to the intermediate layer.

8. The occupant support of clause 1 wherein the wicking layer comprises a material bonded to the intermediate layer by a vapor permeable adhesive.

9. The occupant support of clause 1 wherein the wicking layer is a vapor permeable coating.

10. The occupant support of clause 1 wherein the wicking layer is integrated into the intermediate layer.

11. The occupant support of clause 1 wherein the wick rate of the second region is nonuniform.

12. The occupant support of clause 1 wherein the intermediate layer is a microclimate control topper.

13. A moisture management cover, the cover being cooperable with an occupant support article having an occupant support side so that the occupant support side and an opposing portion of the cover define a fluid flowpath, the cover having discrete higher and lower wick rate regions, the higher wick rate region having a higher moisture wick rate than that of the lower wick rate region.

14. The moisture management cover of clause 13 wherein the higher wick rate region is a perimetral region that bounds the lower wick rate region.

15. The moisture management cover of clause 13 wherein the cover is in the form of a fitted sheet.

16. The moisture management cover of clause 13 wherein the higher wick rate comprises longitudinal and lateral wick rates at least the lateral one of which is greater than the lower wick rate and the lateral wick rate exceeds the longitudinal wick rate.

17. The moisture management cover of clause 13 wherein the higher wick rate region is nonrectangular.

18. The moisture management cover of clause 13 wherein the wicking layer is removably attachable to a intermediate layer.

19. The moisture management cover of clause 13 wherein the higher wick rate region comprises a material bonded to the intermediate layer by a vapor permeable adhesive.

20. The moisture management cover of clause 13 wherein the wicking layer is a vapor permeable coating.

21. The moisture management cover of clause 13 wherein the wick rate of the higher wick rate region is nonuniform.

22. A method for transporting moisture away from a target region of an occupant support, the region having an area A, the method comprising:

distributing the moisture over an area beyond area A; and
exposing the larger area to a fluid stream capable of receiving the moisture

23. The method of clause 22 wherein the area beyond area A is laterally beyond area A.

## Claims

**1.** An occupant support comprising an intermediate layer (26, 30) defining at least part of a fluid flowpath (42) and having a vapor permeable occupant side (36), and a wicking layer (52) atop the intermediate layer, the wicking layer comprising a first region (62) having a first moisture wick rate and a second region (64) having a second moisture wick rate that exceeds the first moisture wick rate.

**2.** The occupant support of claim 1 wherein the wicking layer (52) is integrated into the intermediate layer (26, 30).

**3.** The occupant support of either claim 1 or claim 2 wherein the intermediate layer is a microclimate control topper.

**4.** A moisture management cover, the cover being cooperable with an occupant support article (120) having an occupant support side so that the occupant support side and an opposing portion of the cover define a fluid flowpath, the cover including a wicking layer (52) and having discrete first and second wick rate regions (62, 64), the second wick rate region (64) having a higher moisture wick rate than that of the first wick rate region (62).

**5.** The moisture management cover of claim 4 wherein the occupant support article comprises an air mattress (120) with one or more bladders (122) defining the occupant support side, the cover cooperating with the occupant support side to define the flowpath.

**6.** The moisture management cover of claim 4 wherein the cover has an occupant support side (36), and wherein the wicking layer (52) is atop at least a part of the occupant support side (36), the second wick rate region comprising said at least a part of the occupant support side (36) of the cover.

**7.** The occupant support of either claim 1 or claim 3 or the moisture management cover of any one of claims 4 to 6 wherein the wicking layer (52) is removably attached to the intermediate layer (26, 30).

**8.** The occupant support of either claim 1 or claim 3 or the moisture management cover of any one of claims

4 to 6 wherein the wicking layer (52) is nonremovably attached to the intermediate layer (26, 30).

**9.** The occupant support of either claim 1 or claim 3 or the moisture management cover of any one of claims 4 to 6 wherein the wicking layer comprises a material (84, 86) bonded to the intermediate layer (30) by a vapor permeable adhesive (88).

**10.** The occupant support of either claim 1 or claim 3 or the moisture management cover of any one of claims 4 to 6 wherein the wicking layer is a vapor permeable coating (100, 102).

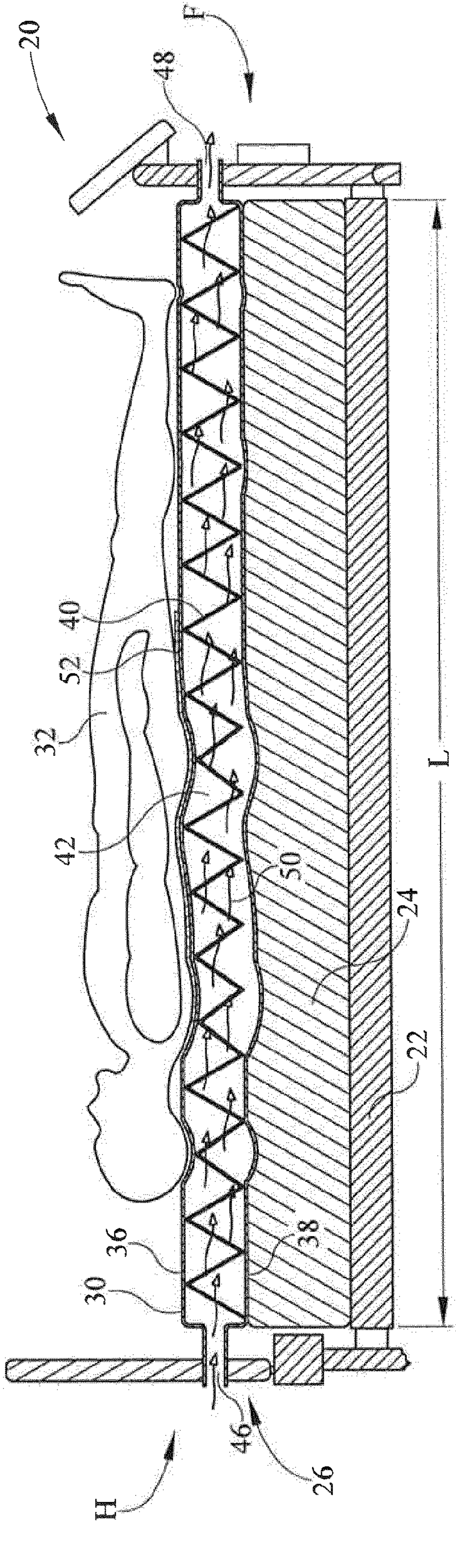
**11.** The occupant support of either claim 1 or claim 3 or the moisture management cover of any one of claims 4 to 6 wherein the wicking layer is in the form of a fitted sheet (52).

**12.** The occupant support of any one of claims 1 to 3 and 7 to 11 or the moisture management cover of any one of claims 4 to 11 wherein the first region (62) is a perimetric region that bounds the second region (64).

**13.** The occupant support of any one of claims 1 to 3 and 7 to 12 or the moisture management cover of any one of claims 4 to 12 wherein the second wick rate comprises longitudinal and lateral wick rates at least the lateral one of which is greater than the first wick rate and the lateral wick rate exceeds the longitudinal wick rate.

**14.** The occupant support of any one of claims 1 to 3 and 7 to 13 or the moisture management cover of any one of claims 4 to 13 wherein the second region (64) is nonrectangular.

**15.** The occupant support of any one of claims 1 to 3 and 7 to 14 or the moisture management cover of any one of claims 4 to 14 wherein the wick rate of the second region (64) is nonuniform.


20
F
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40
52
32
42
50
24
22
36
38
30
46
26
H
L

FIG. 1

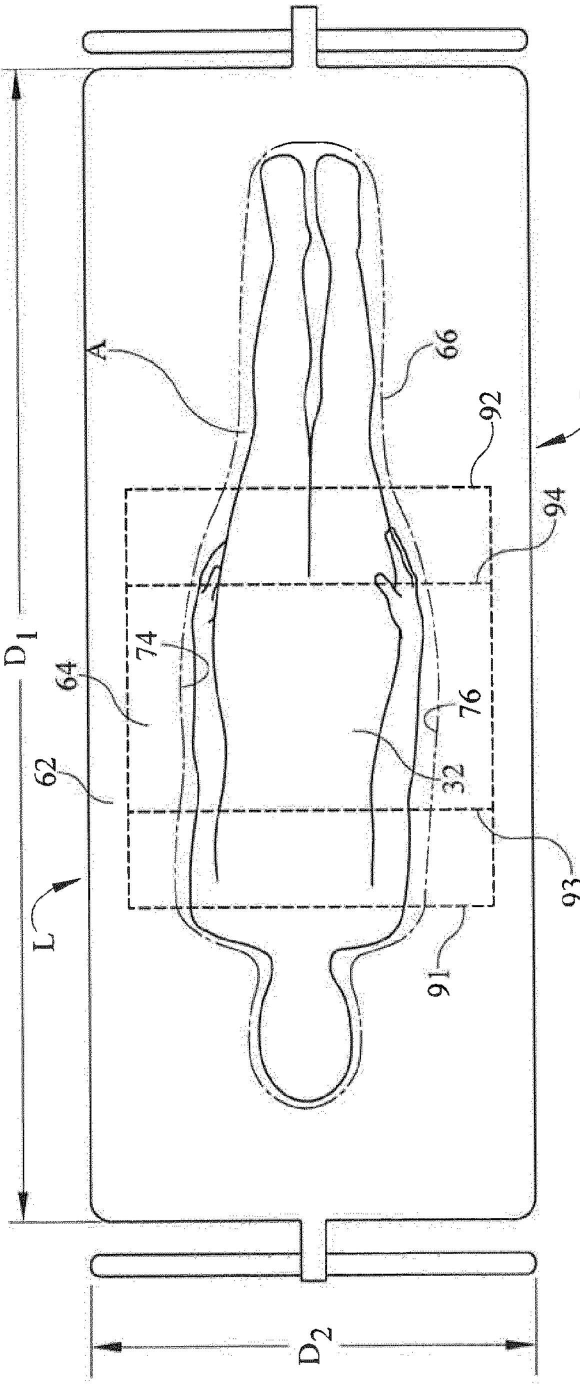

A
66
92
R
94
74
64
76
62
32
93
L
91
D1
D2

FIG. 2

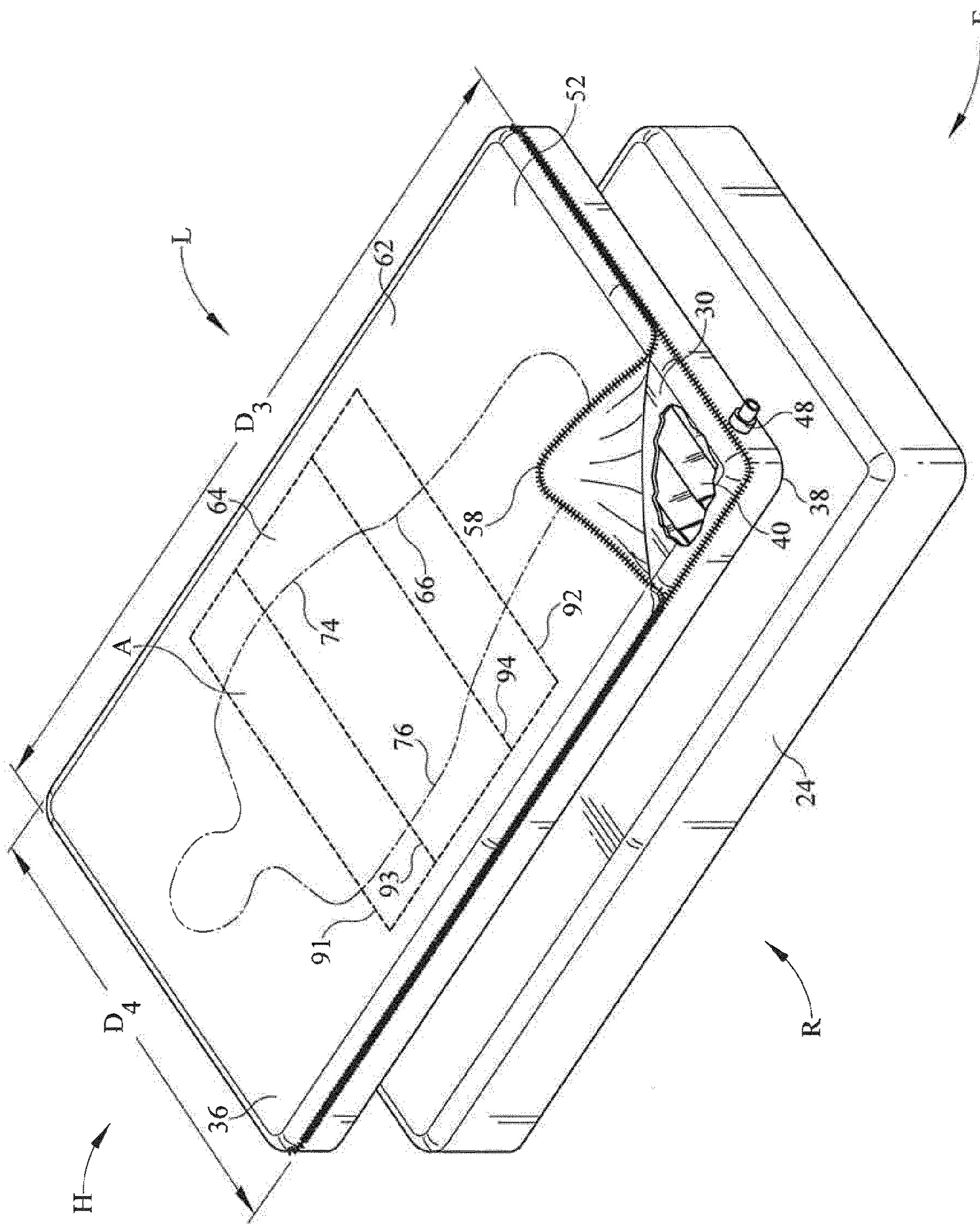
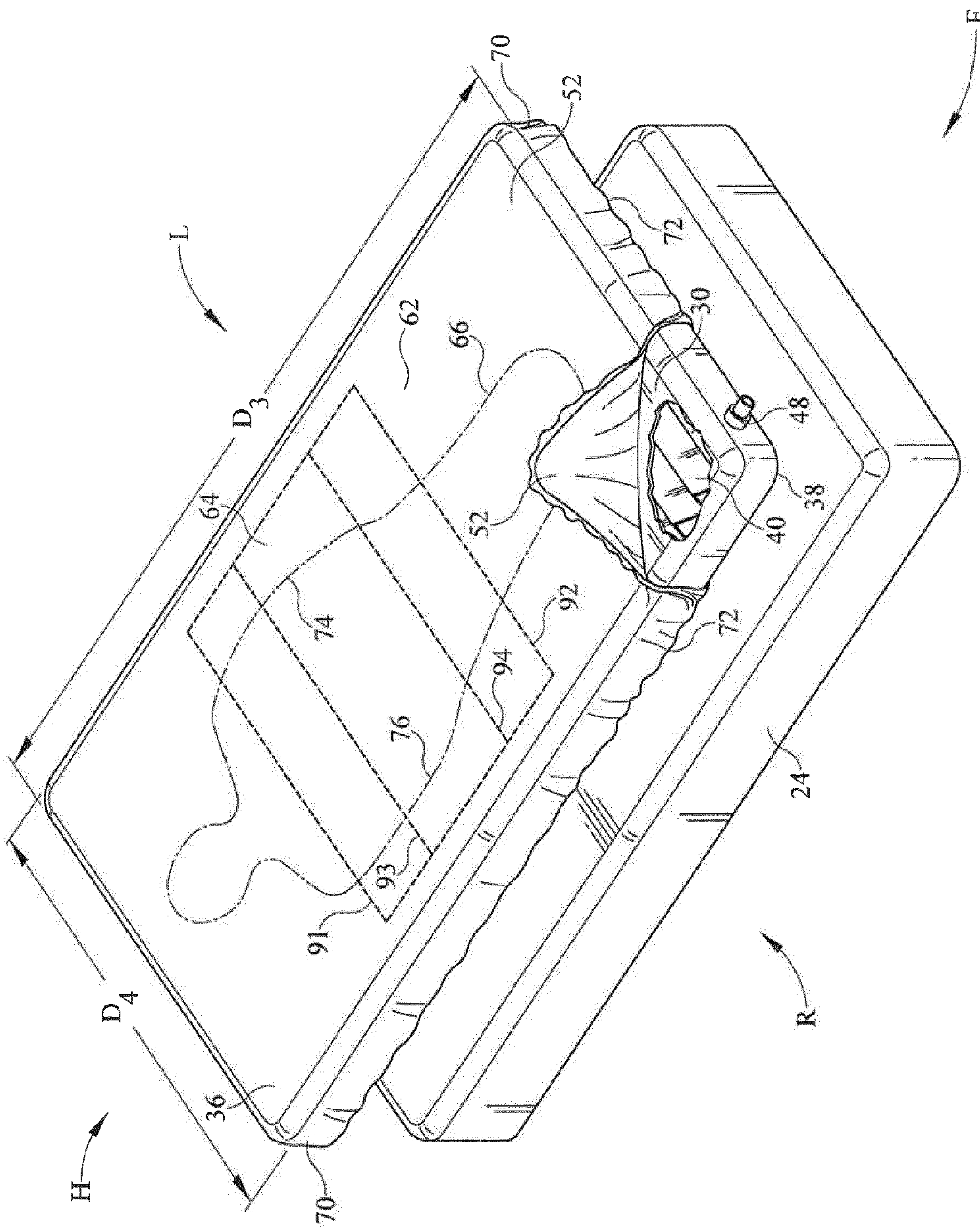



FIG. 3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L
R
H
$D_3$
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70
52
72
30
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38
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76
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93
91
36
70

FIG. 4

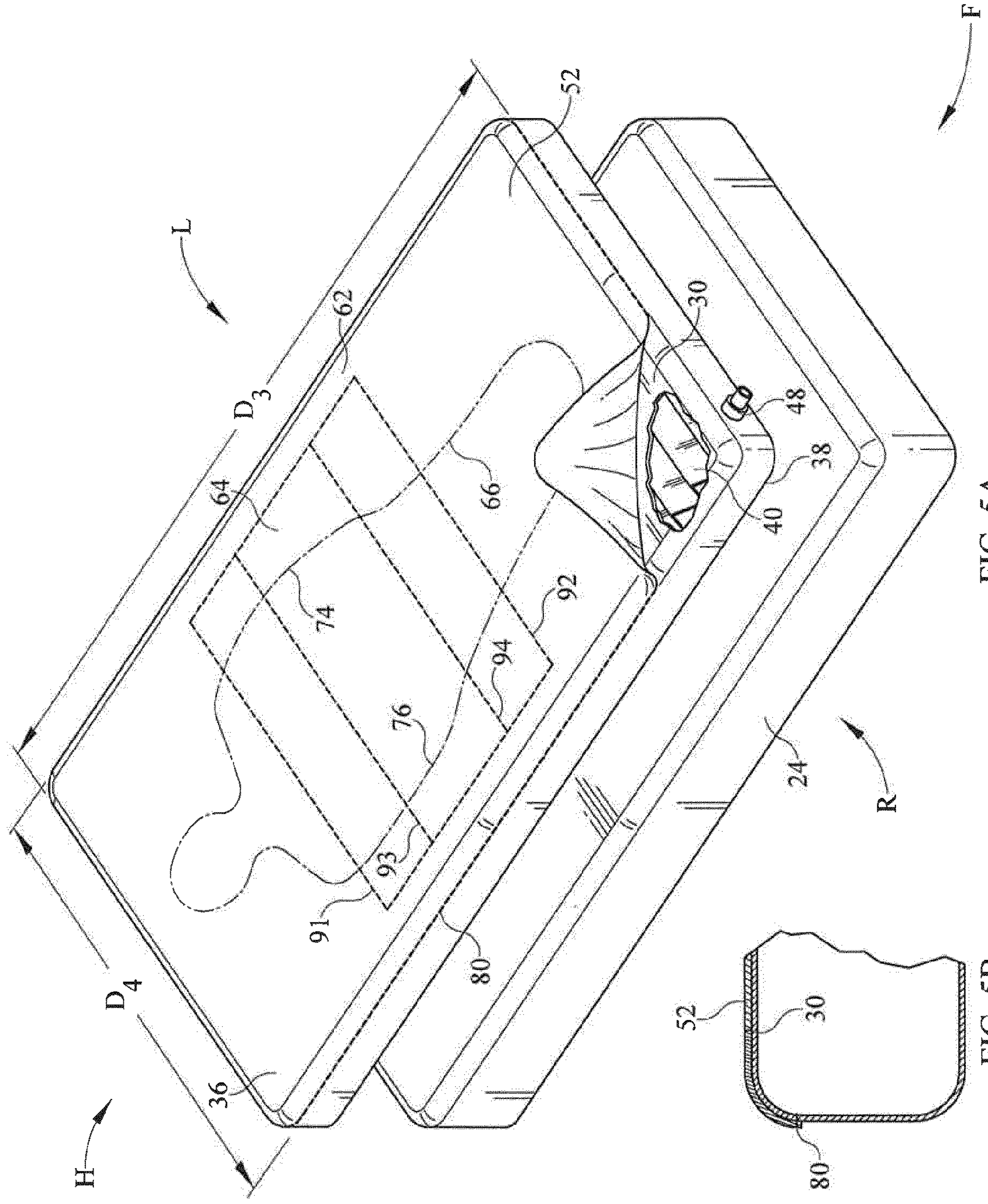



FIG. 5A

FIG. 5B

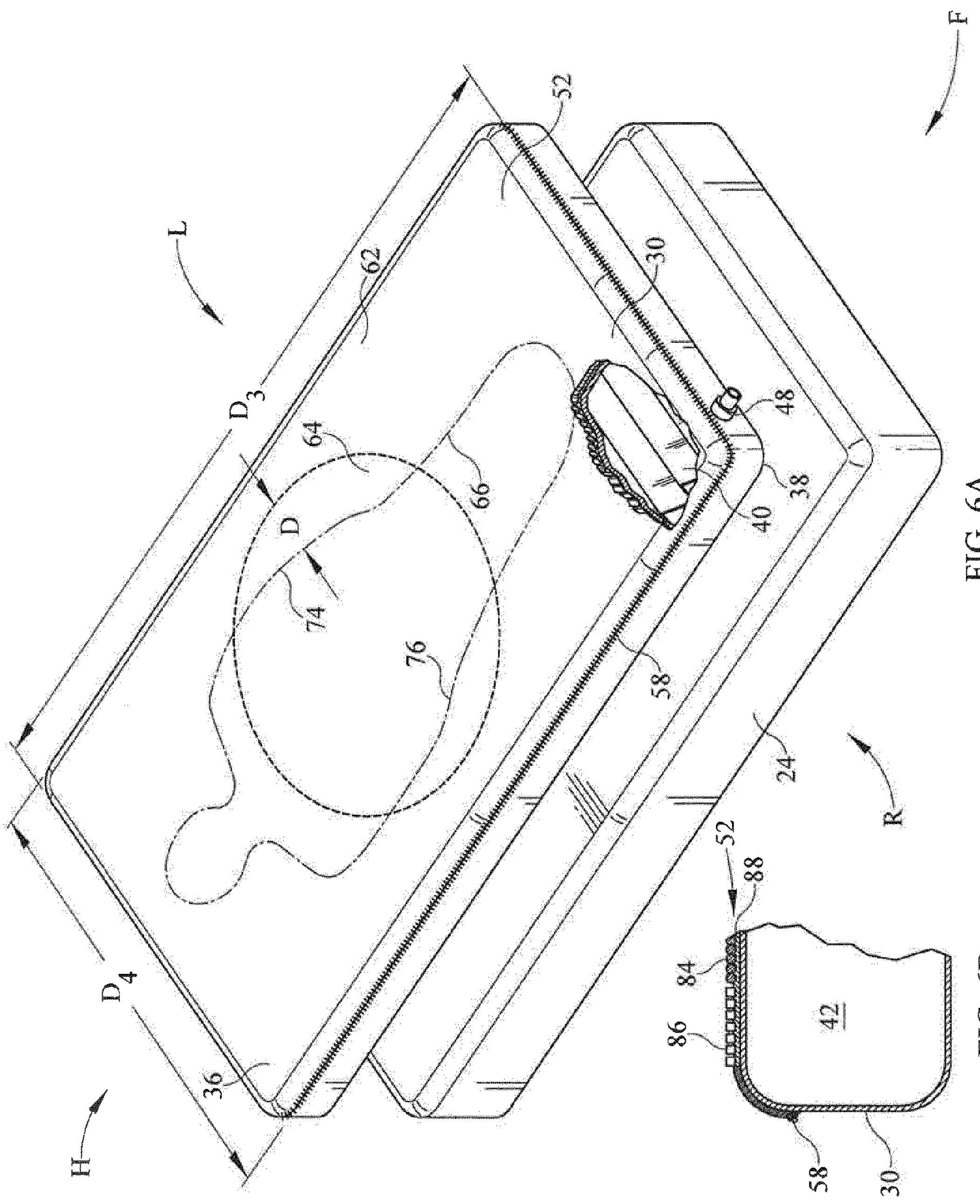
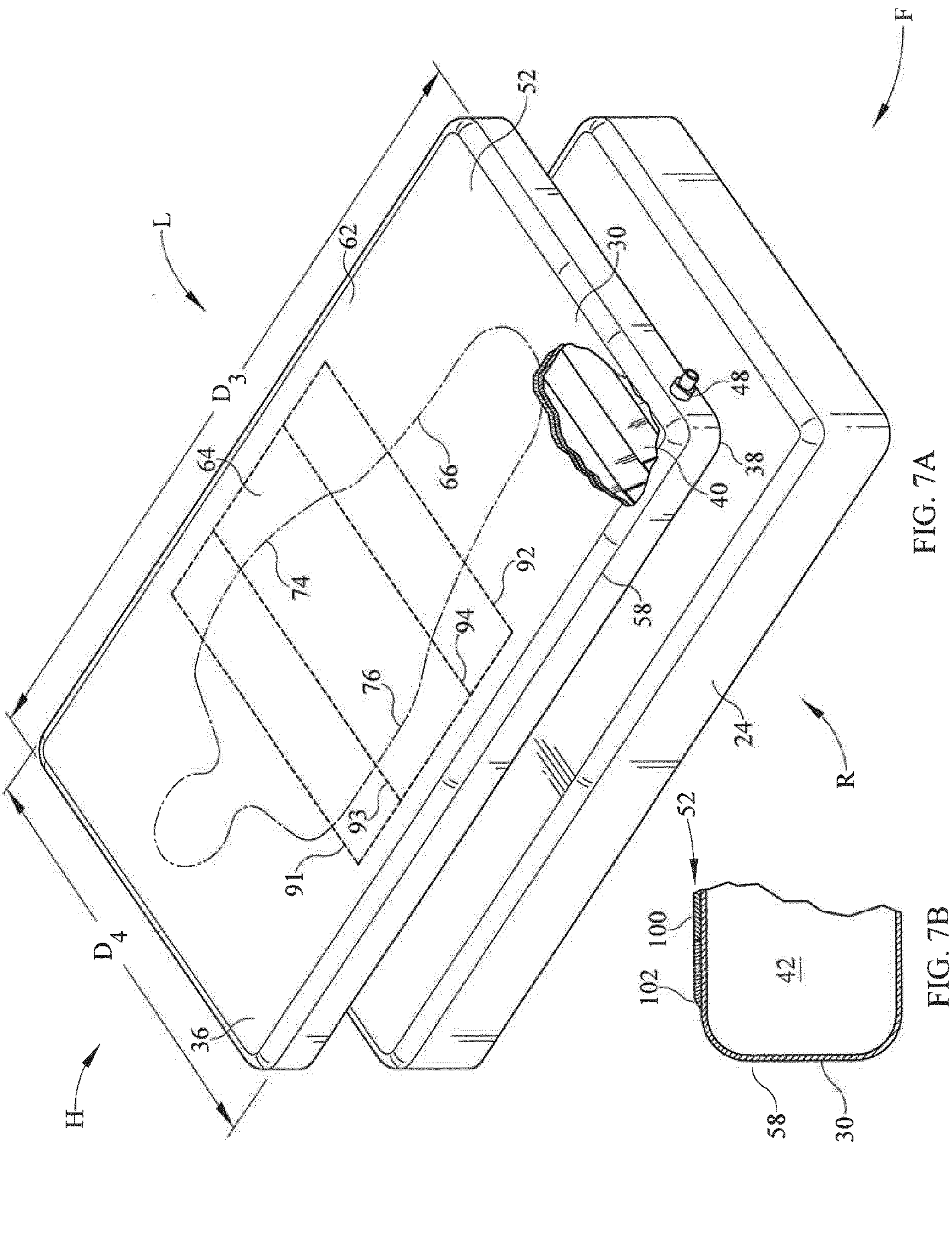



FIG. 6A

FIG. 6B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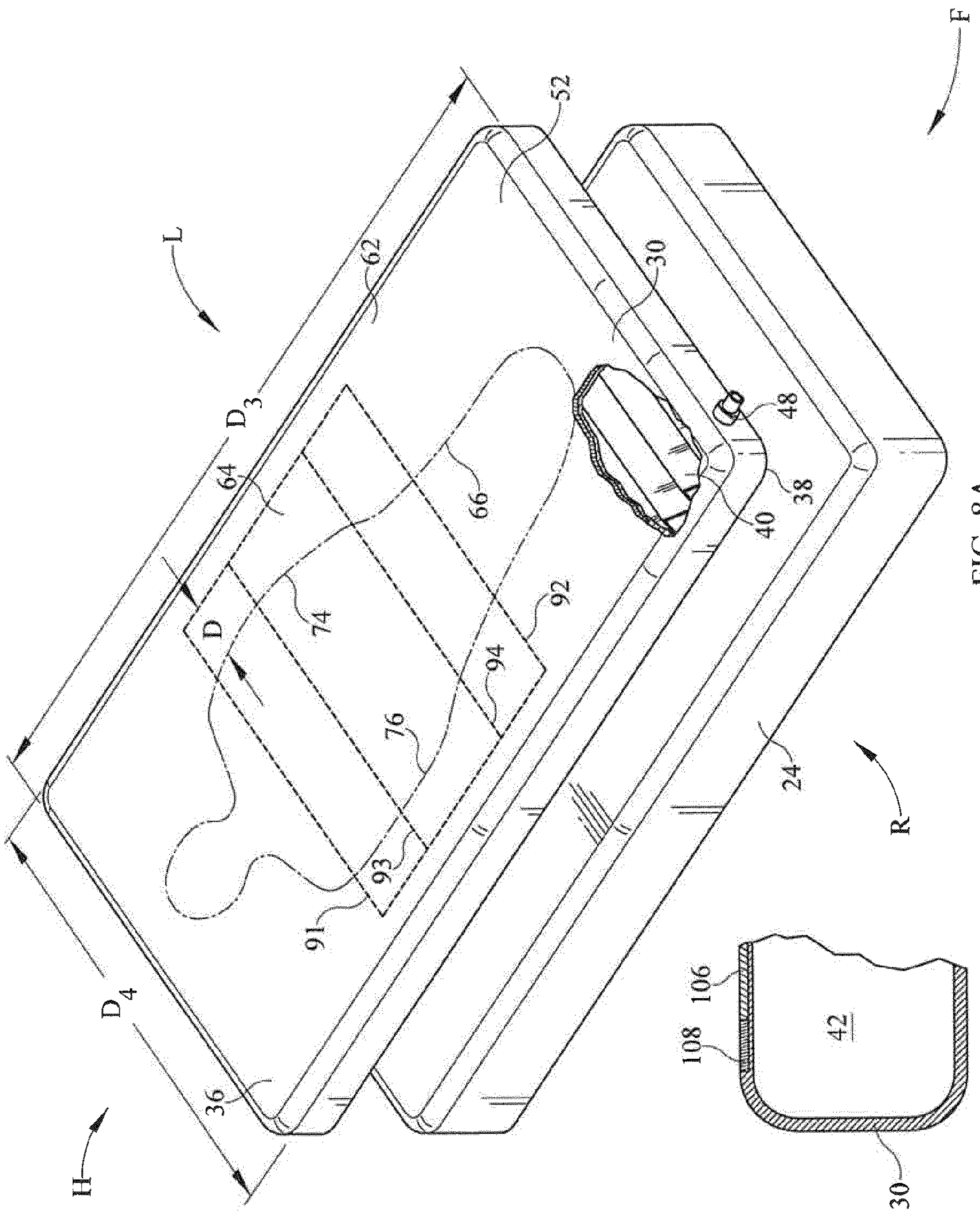
24
93
91
36
100
102
42
58
30

FIG. 7A

FIG. 7B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F
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R
D3
D4
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52
62
30
64
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40
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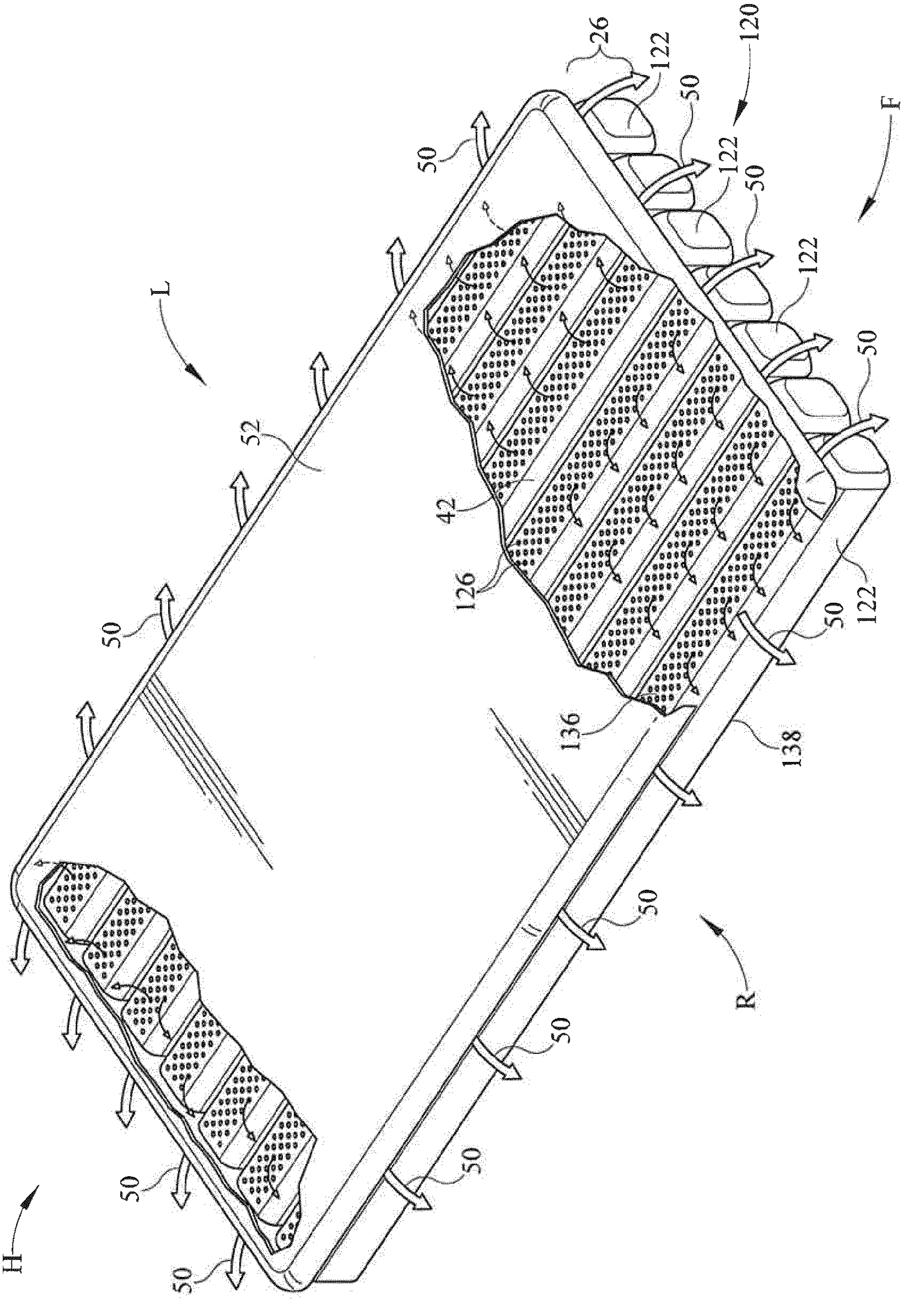
92
94
76
24
93
91
36

FIG. 8A

106
108
42
30

FIG. 8B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50
50
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50
F
L
52
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138
R
H

FIG. 9

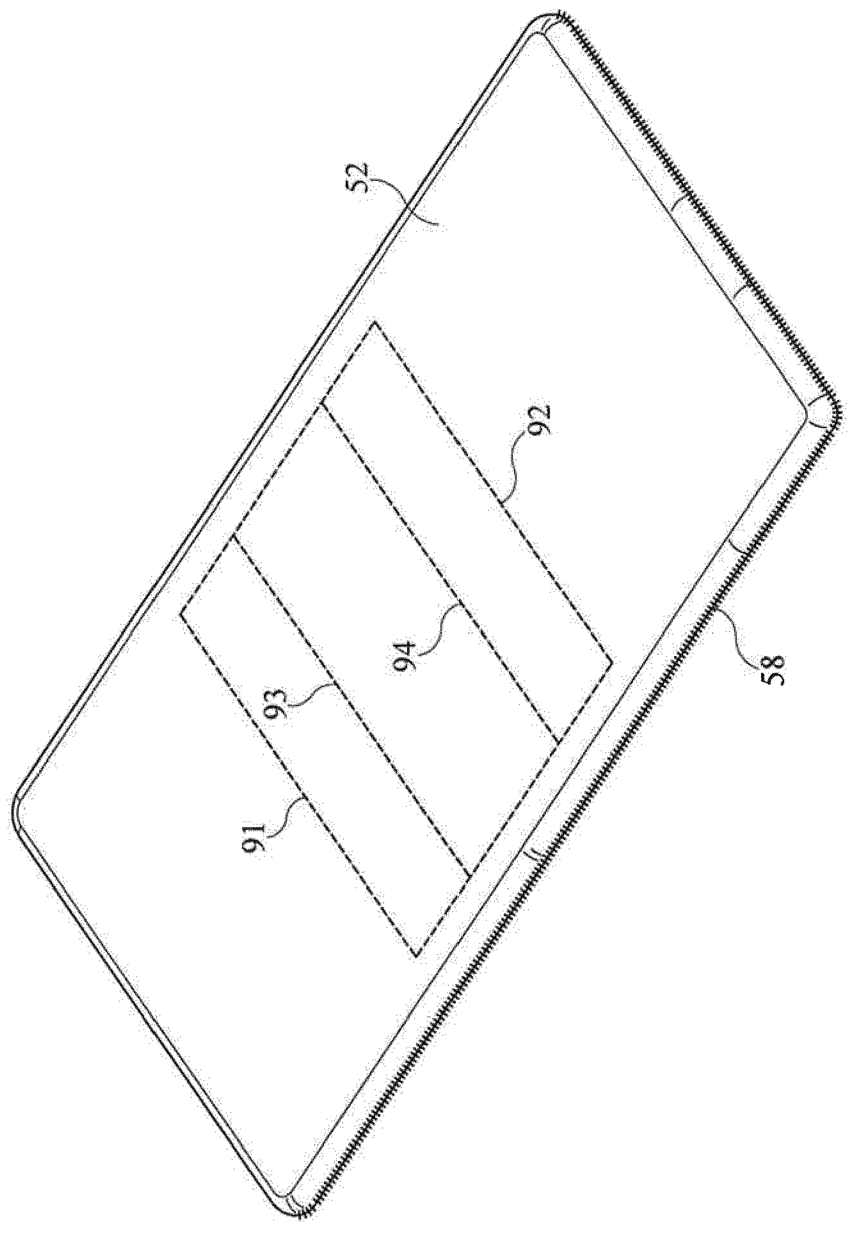


FIG. 10

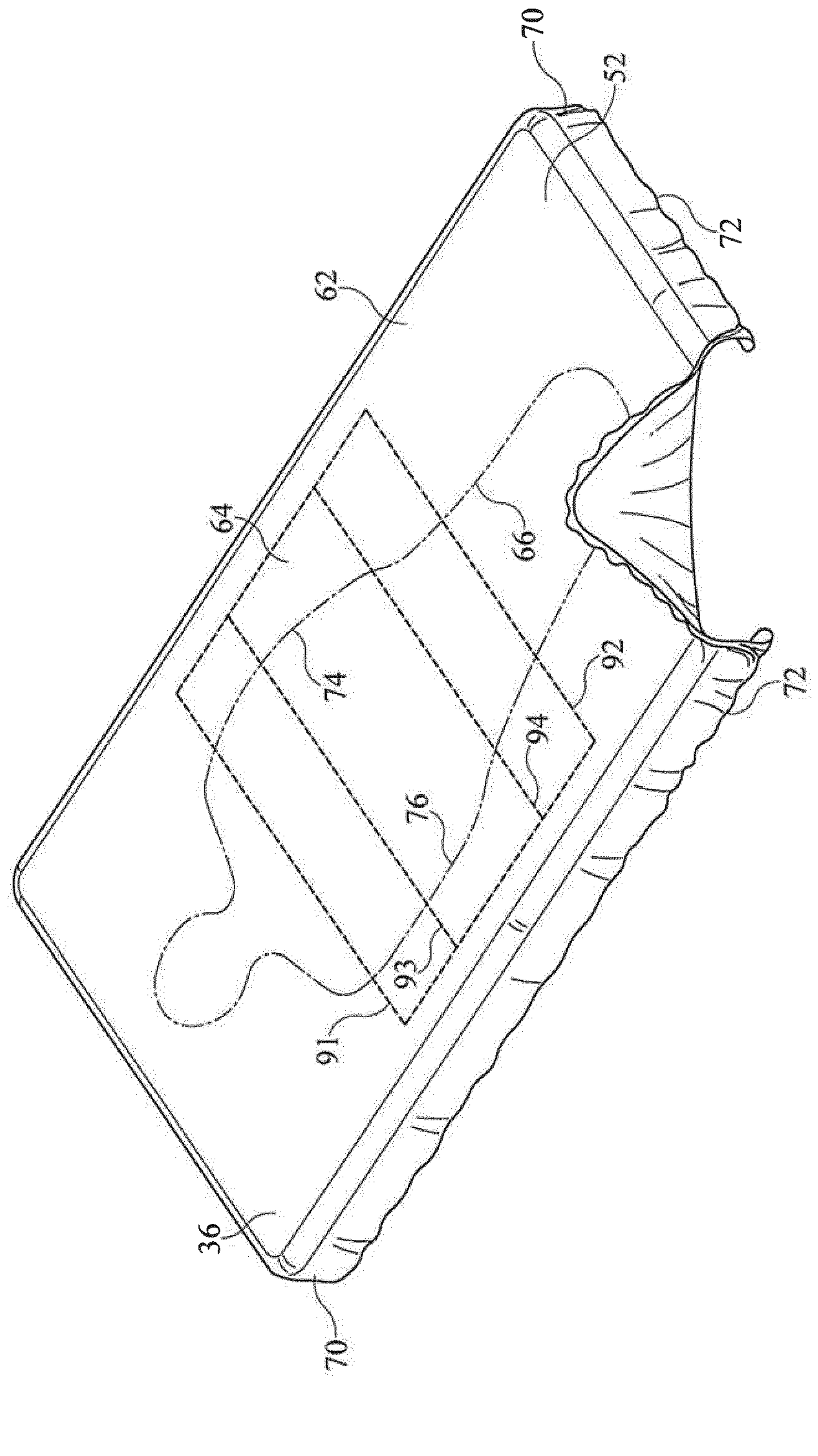


FIG. 11