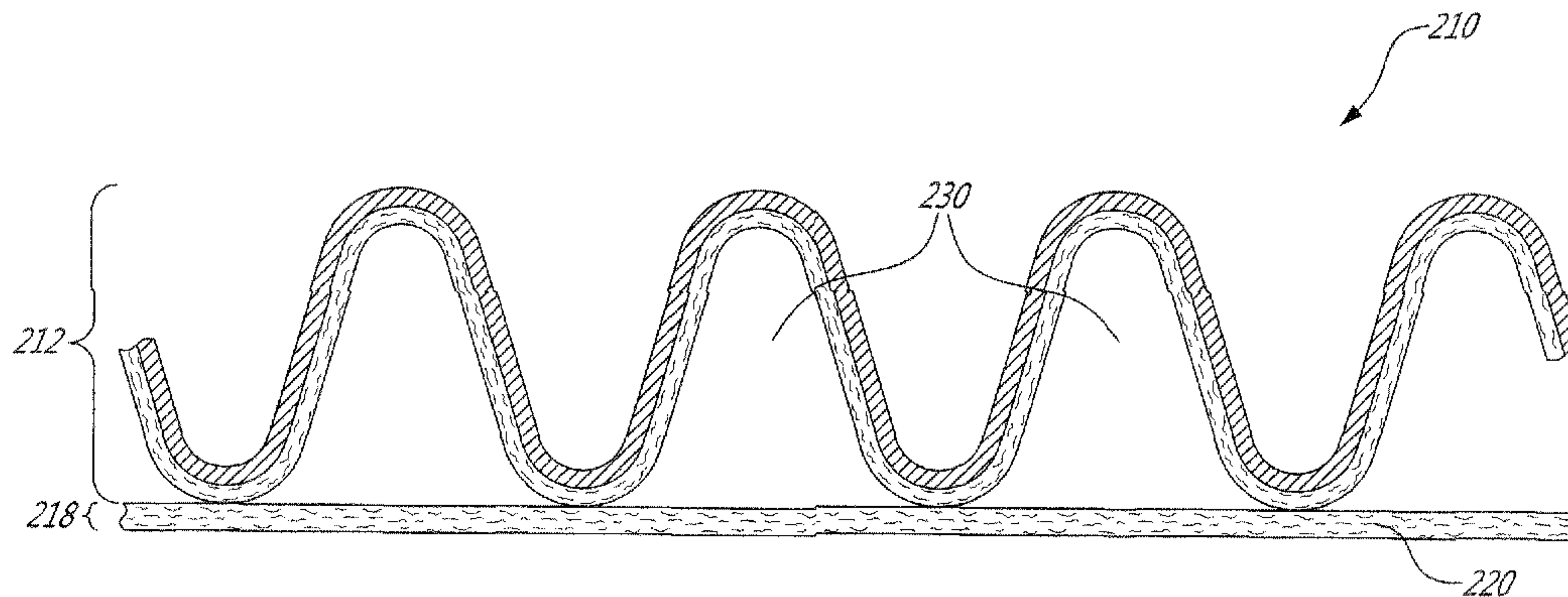




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(54) Title: PREFABRICATED PANELS AND METHOD OF MAKING A ROOF



(57) **Abrégé/Abstract:**

This specification discloses embodiments of prefabricated panels with insulating and/or roof covering characteristics, and a method of making a roof using prefabricated roofing panels.

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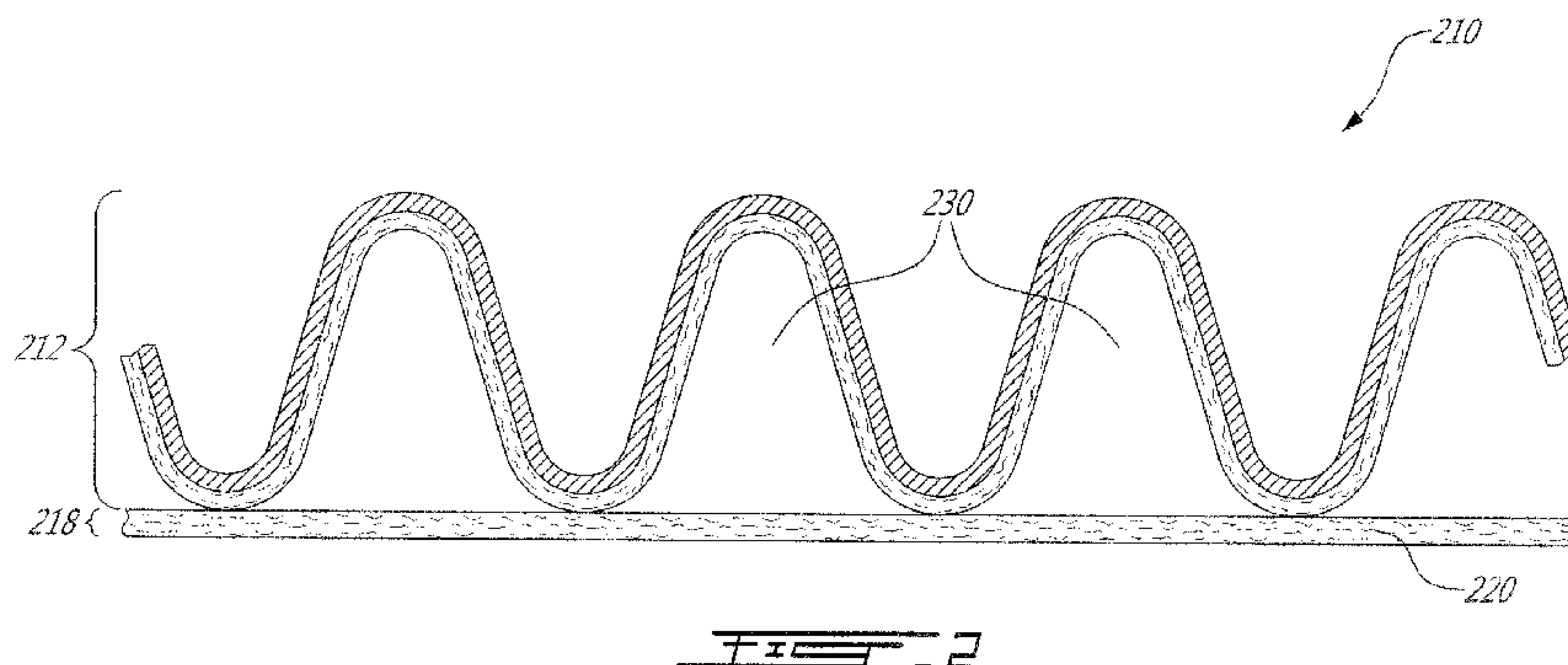
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(54) Title: PREFABRICATED PANELS AND METHOD OF MAKING A ROOF



(57) Abstract: This specification discloses embodiments of prefabricated panels with insulating and/or roof covering characteristics, and a method of making a roof using prefabricated roofing panels.

PREFABRICATED PANELS AND METHOD OF MAKING A ROOF

BACKGROUND

5 On one hand, corrugated metal roofing is widespread. It is provided in a number of forms, one of which consists of same-sized panel sections each made of a corrugated sheet of metal, typically of galvanized steel and sometimes painted, which are mounted adjacent one another and end to end to a roof structure typically consisting of a number of adjacent trusses.

10 These panels are typically manufactured with a length along the direction of the corrugations and a smaller width across the corrugations, and are installed with the corrugations oriented vertically to favour evacuation of snow and rain.

The metal sheet in such panels plays two roles : first it is weather-resistant in the sense that it is intended to resist to sun, rain/water, heat, cold, etc. for a relatively long time; and second
15 in that it provides structure. The structure is intended to allow receiving the weight of snow and the like, and to receive the weight of persons installing the roofing in certain conditions.

Because the corrugated metal sheet also needs to provide structure, it must be relatively thick, which requires a relatively large amount of metal, thus making the panels relatively costly.

20 Other shortcomings of corrugated metal roofing panels include the fact that they are installed to the structure of the roof by fasteners which are driven entirely through the thickness of the metal sheet to reach the trusses. This leaves holes in the metal sheet which are undesirable, and causes thermal bridges and/or air gaps. Also, such roofing have been known to receive stress from installers applying their weight between trusses and/or from thermal expansion,
25 which eventually broadens the holes caused by the fasteners, which has been known to lead to leaking.

On the other hand, prefabricated insulating panels have been known in the past. One known example consists of insulating panels having a thick core of insulating material such as expanded polystyrene and two facing sheets of particle board, OSB, or similar full wood

material panels used to provide structure to the insulating material. However, the use of two full wood material panels sandwiching the insulating material make the overall panel relatively heavy, which results in handling challenges during shipping and installation.

Such insulating panels are typically used for making insulated walls of dwellings. For instance, caution must be taken when handling panels having 8 feet in length to avoid breakage under their own weight, which has been known to occur when a panel is held flat from both ends. Probably because of their weight, handling limitations, and perhaps also due to manufacturing constraints, they are typically made available in limited lengths, which leads to a relatively high amount of joints representing areas of potential weakness which represent a concern in both design and installation.

Henceforth, there remained room for improvement.

SUMMARY

On the one hand, concerning the former corrugated roofing panels, it was found that the amount of metal, and thus the costs, can be reduced by providing at least portion of the structure function of the former corrugated metal sheet by a lower cost and/or more specialized material, such as a waved wood sheet for example, and have weather-resistant roofing function provided by another material mounted thereon. The waved wood sheet can thus receive an outer layer made of metal or another weather-resistant material which is also corrugated and adopts the shape thereof. Henceforth :

An aim is to provided a satisfactory corrugated roofing panel which is less costly and/or uses less metal than a corrugated roofing panel made solely of a metal sheet.

Accordingly, there is provided a prefabricated panel comprising : a covering having a waved wood structure and an outer layer made of a sheet of weather-resistant material mounted to and adopting the shape of the waved wood structure.

On the other hand, concerning former insulating panels, it was found that their weight could be reduced by replacing one or both of the former full boards with a panel having a waved wood sheet sandwiched between two flat sheets. Henceforth :

An aim is to provide a panel which is to provide a satisfactory prefabricated insulating panel which is both light and structural.

Accordingly, there is provided a prefabricated panel comprising : an insulating core sandwiched between a first structural layer and a second structural layer, wherein at least
5 one of the structural layers includes a waved wood layer sandwiched between two flat wood veneers.

If used as a roofing panel, the areas between the waved wood sheet and the two flat sheets can serve as humidity evacuation channels. Further, it can be prefabricated with a covering which can allow to provide a highly efficient to install integrated insulating roofing panel. The
10 construction can now be provided in length above 30' and still be reasonably easy to handle, which can allow installing along the entire width of a roof without vertical joints, in which latter case the prefabricated roofing panels can be provided with the integrated covering extending to one side so as to bridge the gap or horizontal joints between panels.

Finally, a new method of making a roof is also provided, the method comprising : obtaining
15 a roof width dimension, prefabricating roofing panels having a given panel width, and a panel length corresponding to the roof width dimension, and applying the roofing panels to cover a structure of the roof.

In this manner, a roof can be provided without vertical joints which represents the absence of such areas of potential weakness. Making operational panels having a length of 30 feet or
20 more, for instance, can be made possible when using facing panels for the insulation which have a waved wood layer sandwiched between flat veneers given the high structural/weight ratio of such constructions, where the use of facing panels of particle board or OSB would have led to unpractical fragility of similar length panels. Finally, the panels can be adhered to the roof structure instead of fastened, which can avoid thermal bridges and reduce areas of
25 potential water or warm air leakage.

DESCRIPTION OF THE FIGURES

In the figures,

Fig. 1 is a cross-sectional view of an example of a prefabricated panel, fragmented, configured to form a roofing panel;

Fig. 2 is a cross-sectional view of an other example of a prefabricated panel, fragmented, configured to form a roofing panel;

- 5 Fig. 3A is a cross-sectional view of an other example of a prefabricated panel, fragmented, configured to form a roofing panel with an integrated structural panel allowing ventilation;

Fig. 3B is an oblique view showing a portion of the prefabricated panel of Fig. 3A;

Fig. 4 is a schematic cross-sectional view of an other example of a prefabricated panel, fragmented, with integrated structure and insulation;

- 10 Fig. 5A is a schematic cross-sectional view of an other example of a prefabricated panel, fragmented, configured to form a roofing panel with integrated insulation, covering, ventilation and structure;

Fig. 5B is an oblique view of the prefabricated panel of Fig. 5A; and

- 15 Fig. 6 schematically illustrates a construction to which the prefabricated panel of Fig. 5A is applied;

Fig. 7 is a cross-sectional view of an other example of a prefabricated panel, fragmented, configured to form a wall panel;

Fig. 8 is a cross-sectional view of an other example of a prefabricated panel, fragmented, configured to form a wall panel with an internal spacing.

20 **DETAILED DESCRIPTION**

- Fig. 1 shows an example of an engineered prefabricated roofing panel 110. This prefabricated roofing panel 110 constitutes a relatively simple embodiment and is provided with an integrated weather resistant covering 112 as will be detailed below. Instead of being a simple corrugated metal sheet such as former panels, this prefabricated panel 110 is
25 engineered in the sense that it includes an assembly of components to achieve the intended functions in a more efficient or satisfactory manner.

The prefabricated roofing panel 110 in this example consists solely of a covering 112. The covering 112 can be seen to include two superposed waved layers including a structural layer 114 and an outer layer 116. The structural layer 114 focuses on structural characteristics. The structural layer 114 can be made of a waved wood structure for instance, i.e. to provide structural resistance to the outer layer, such as disclosed in PCT Publication WO 2010/060219 which teaches a waved wood structure formed of a stacked assembly having at least a first wood sheet adhered to a first face of a support sheet by an adhesive, the wood sheet having a given longitudinal wood grain orientation, the stacked assembly being waved in a direction transverse to the wood grain orientation, and optionally a second wood sheet similar to the first wood sheet adhered to a second face of the support sheet. It will be understood that other waved structures can also be used in alternate embodiments. It was found that a waved wood structure can provide highly interesting structural characteristics with a relatively low weight and cost.

Still referring to Fig. 1, the outer layer 116 can be seen to be smoothly covering the structural layer 114 and adopting the waved shape thereof. It can be highly advantageous to provide an outer layer 116 made of a weather resistant material integrated to the prefabricated roofing panel 110 because by doing so, the roofing can be complete once the prefabricated roofing panels 110 are installed, without requiring a labour intensive step of subsequent installation of a covering of shingles or the like. Further, by shaping an outer layer 116 specifically to adopt the waved shape of the structural layer 114, and stacking the outer layer 116 directly above it, the outer layer 116 can thoroughly benefit from the structural characteristics offered by the structural layer and can thus be made thinner than an alternate outer layer which would be made with the same material but which would be flat. This can be advantageous because weather resistant materials from which the outer layer 116 can be made will typically be more expensive and/or provide less structural resistance than the material used for the structural layer 114. Further, having an outer layer 116 which covers the entire surface of the structural layer 114 can provide for better adhesion between the two layers, where an adhesive is used. Preferably, the adhesive will cover at least most of the surface of the structural layer 114. In this specific example, the outer layer 116 can be a metal sheet of aluminium or steel (preferably galvanized), for instance or an appropriate plastic, for instance. In an alternate embodiment, the outer layer can be an appropriate varnish for instance. In alternate embodiments, the outer layer can include several

components or layers and be engineered, such as being made of a weather-resistant solar power sheet, for instance.

In this particular example shown in Fig. 1, the waved shape of the covering 112 is a regular sinusoidal-like shape. In alternate embodiments, the exact shape can vary, although a
5 minimum radius of curvature should be respected when using a waved wood structure to allow achieving satisfactory mechanical resistance characteristics without splitting. A more triangular shape could be used with other materials. Still alternately, the waved shape can be provided as a regular pattern or irregular arrangement having some waves larger than others, for instance, to provide visual design characteristics. It will be noted here that waved
10 wood structures can be produced in very long lengths across the waves.

Turning to Fig. 2, shows an alternate embodiment of a prefabricated panel 210 having a covering 212 applied to a support layer 218. This can be useful in constructions where the inner layer of the panel is intended to be visible subsequent to installation, such as in a gazebo, covered patio, balcony or the like. In this case, the support layer 218 is highly
15 simple and consists of a simple wood veneer sheet 220, which provides a neat visual appearance. Other materials and more complex constructions can alternately be used. Further, the use of a waved structure adhered on a flat support layer 214 provides humidity evacuation channels 230 along which humidity can be evacuated.

Turning now to Fig. 3A, a prefabricated roofing panel 310 having a construction slightly more
20 elaborate than the one shown in Fig. 2 is provided. It has a comparable covering 312, but a support layer 318 provided with greater structural support. More particularly, the structural layer 318 in this case can be comprised of a stacked arrangement having a waved wood structure 322 sandwiched between two facing sheets 320, 324. The facing sheets 320, 324 can be wood veneers for instance, and the construction of the waved wood structure 322
25 can be similar to the construction of the waved wood structure 314 in the covering 312, for instance. The so constructed support layer 318 can thus provide ventilation channels 332, 334 in the free areas between the two facing sheets 320, 324. Such ventilation channels 332, 334 will be particularly useful where insulation is to be used immediately under the support layer 318. It will be noted that the waved shapes of the covering 312 and waved
30 wood structure 322 of the support layer 318 match in the sense that they have the same period P, and are assembled so that the depressions 340 of the former are aligned with

summits 342 of the latter, for transmittal through the structure of compressive forces which could be applied from above.

Fig. 3B shows an oblique view of a prefabricated roofing panel 310 having a construction shown in Fig. 3A. As disclosed above, such prefabricated roofing panels can be provided for assembly with the length of the panel aligned horizontally when on the roof. This prefabricated roofing panel 310 can be seen to have a covering having a projecting portion 344 which projects transversally (along the width) from the support layer 318 along a given distance ϕ . This particular construction can advantageously protect horizontal joints between such panels which are aligned horizontally on a roof by the fact that the support layers 318 of two such panels can be positioned in abutment against one another with the projecting portion 344 of the higher panel covering the joint and overlapping a corresponding edge of the other, lower panel.

Turning now to Fig. 4, a still further embodiment of a prefabricated panel 410 is shown. This prefabricated panel 410 is a prefabricated insulating panel, which has a layer of insulating material sandwiched between two structural layers 318, 352. Contrary to former insulating panels wherein the insulating material was sandwiched between full wood material boards, this prefabricated panel can use engineered structural layers having better structural characteristics and/or lower weight, preferably both. The structural layers 318, 352 can each include a waved wood layer sandwiched between two wood veneers, for example. The layer of insulating material 350 can be a panel of solid foam material such as expanded or extruded polystyrene, a fibrous material, or any alternate suitable material for instance. Further, both structural layers 318, 352 thus provide a significant amount of structure at a relatively low weight.

As shown in Fig. 5A, features of the panel 410 shown in Fig. 4 and the panel 110 shown in Fig. 1 can be combined to make a prefabricated roofing panel 510 with an integrated covering 512, structural panels 518 and 552, and insulation 550. The result can provide satisfactory structural resistance and satisfactory low weight which allows making prefabricated panels in lengths of 30 feet and more, while rendering such sheets relatively convenient to handle (satisfactory ruggedness, light weight, and resistance to breakage under its own weight when held at given angles). Providing prefabricated panels in such lengths can thus make possible construction methods in which the roofing panels can be

made to cover the entire width of the roof, and therefore provide roofing without, or at least with a lot less, vertical joints between panels. Further, by manufacturing such a panel which has both i) insulation and ii) an integrated covering, one can build a roof which resists cold climates very efficiently, by adding the insulation in a single step, and thereafter avoiding a subsequent step of installing a covering such as shingles or the like, which can provide even further advantages.

The covering 512 can be produced in a machine having a given width (the waves being oriented transversally, along the width), and in a length which can be of 30 feet or more, for instance, and in which the waved shape of the structural layer 514 and the outer layer 516 can be produced and set. The outer layer 516 can be adhered to the structural layer 514. The wood veneer 520 of the support layer 518 can also be produced in lengths of 30 feet or more, and therefore the entire prefabricated roofing panel can be produced in lengths of 30 feet or more, which can be highly advantageous as detailed below.

Turning now to Fig. 5B, such a panel 510 is shown to have a given width w and a length l . The covering 512, if used, can project from the remainder of the panel over an overlapping distance o . The length l can be adapted to cover the entire width W of a roofing 600 such as shown in Fig. 6, thus leaving no vertical joints but only horizontal joints 605, and the horizontal joints 605 can be highly effectively protected and covered by the presence of the overlapping portion 544 of the covering 512. It will be understood here that when referring to a panel 510, the length l refers to the direction across the corrugations or waves, whereas the width w , which can be significantly shorter than the length l such as shown, refers to a direction coinciding with the direction of the corrugations or waves.

The method can thus include obtaining a predetermined width W of a roofing 600, making prefabricated roofing panels 510 having a length l corresponding to this predetermined width W of the roofing 600, and assembling the panels 510 adjacent one another in the roofing with the length l thereof oriented horizontally.

Fig. 7, shows still another embodiment of a prefabricated panel 710. In this embodiment 710 the panel is an insulating panel having an insulating layer 750 covered by a structural layer 718 on one face and a simple wood veneer 770 on the other face. In still alternate embodiments, the veneer 770 on the other face can be omitted.

Fig. 8 shows still another embodiment of a prefabricated panel 810 particularly adapted for making insulated walls. It has two insulating layers 850, 882, both sandwiched between corresponding structural layers 818, 852, 884. In this embodiment, the structural layer 852 between the two insulating layers 850, 882 can be used to pass wires or the like, for instance.

As can be seen, the examples described above and illustrated are intended to be exemplary only. The scope is indicated by the appended claims.

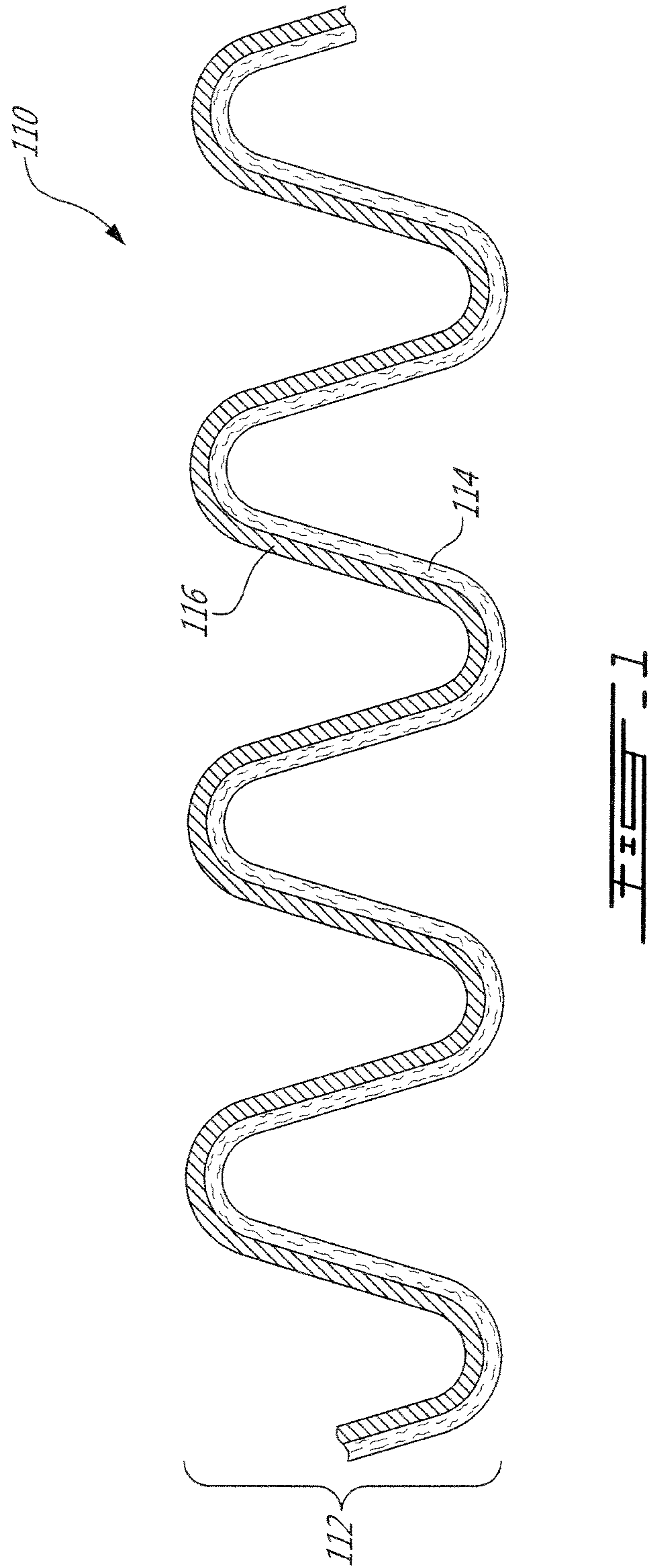
WHAT IS CLAIMED IS:

1. A prefabricated panel comprising : a covering having

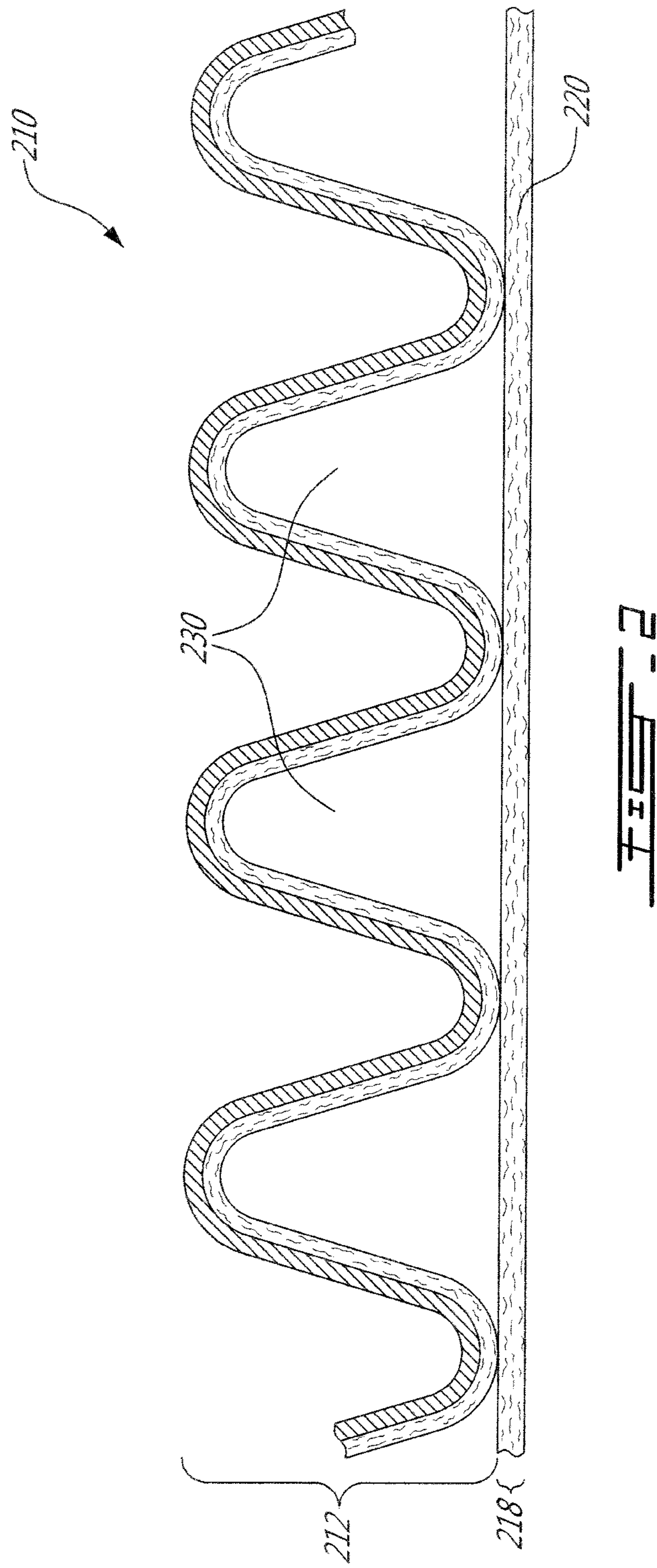
a waved wood layer having a stacked assembly having at least a first wood sheet adhered to a first face of a support sheet by an adhesive, the wood sheet having a given longitudinal wood grain orientation, the stacked assembly being waved in a direction transverse to the wood grain orientation; and

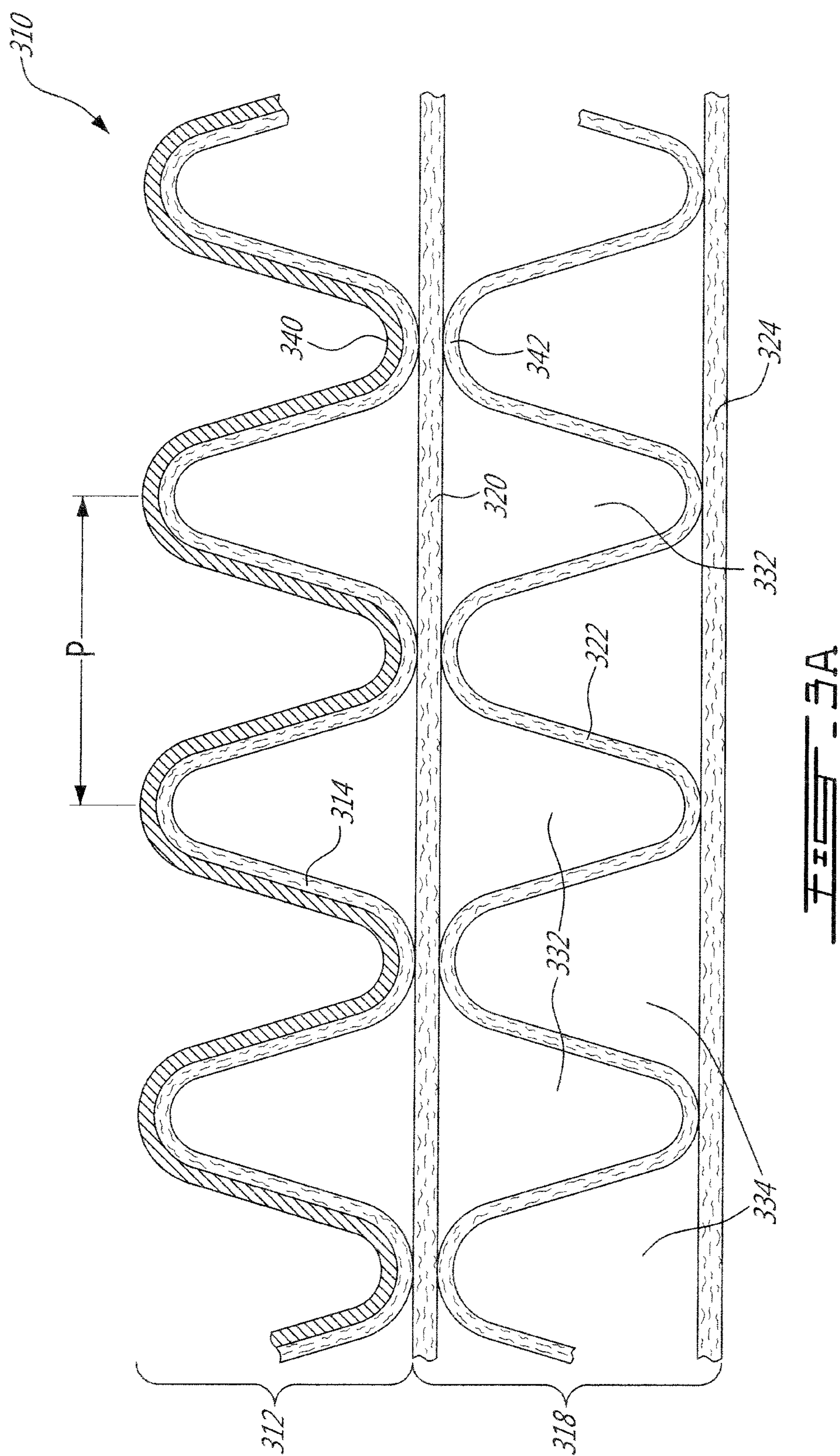
an outer layer of weather-resistant roofing material mounted to and adopting the shape of the waved wood layer.
2. The prefabricated panel of claim 1 wherein the weather-resistant material is a corrugated metal layer.
3. The prefabricated panel of claim 1 wherein the outer layer is adhered to the waved wood layer on at least most of a surface of the waved wood layer.
4. The prefabricated panel of claim 1 further comprising a support layer having at least one flat wood veneer, the waved wood layer being adhered to the flat wood veneer opposite the outer layer.
5. The prefabricated panel of claim 4 wherein the support layer has a second waved wood layer sandwiched between two flat wood veneers.
6. The prefabricated panel of claim 4 further comprising a layer of insulating material sandwiched between the support layer and a structural layer.
7. The prefabricated panel of claim 4 wherein the covering projects laterally along the width from the support layer by a given overlapping distance.
8. The prefabricated panel of claim 6 having a given width coinciding with a direction of corrugations of the waved wood and a length of at least 30 feet across the corrugations.
9. The prefabricated panel of claim 1 wherein all the layers are adhered to one another.

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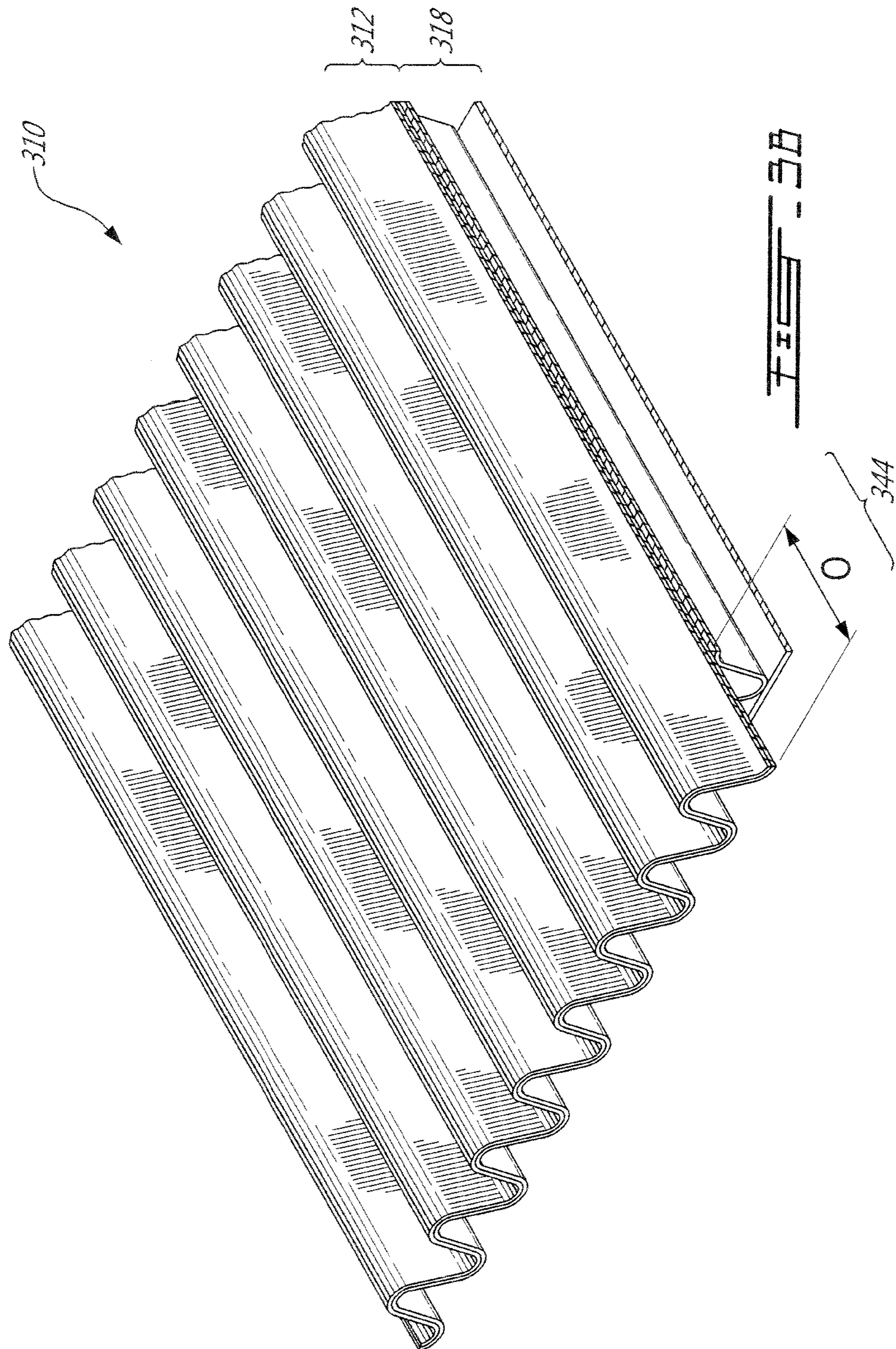


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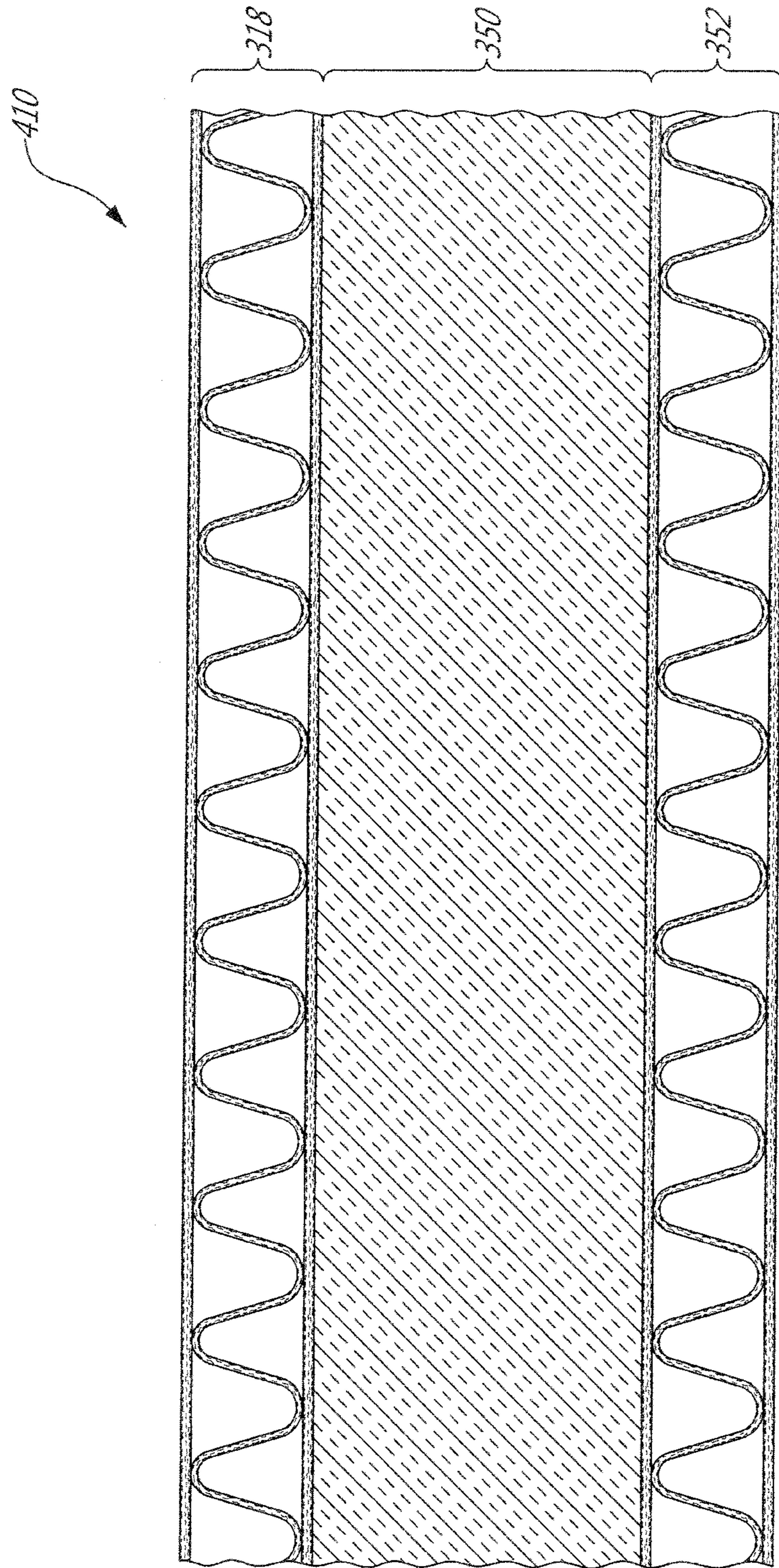




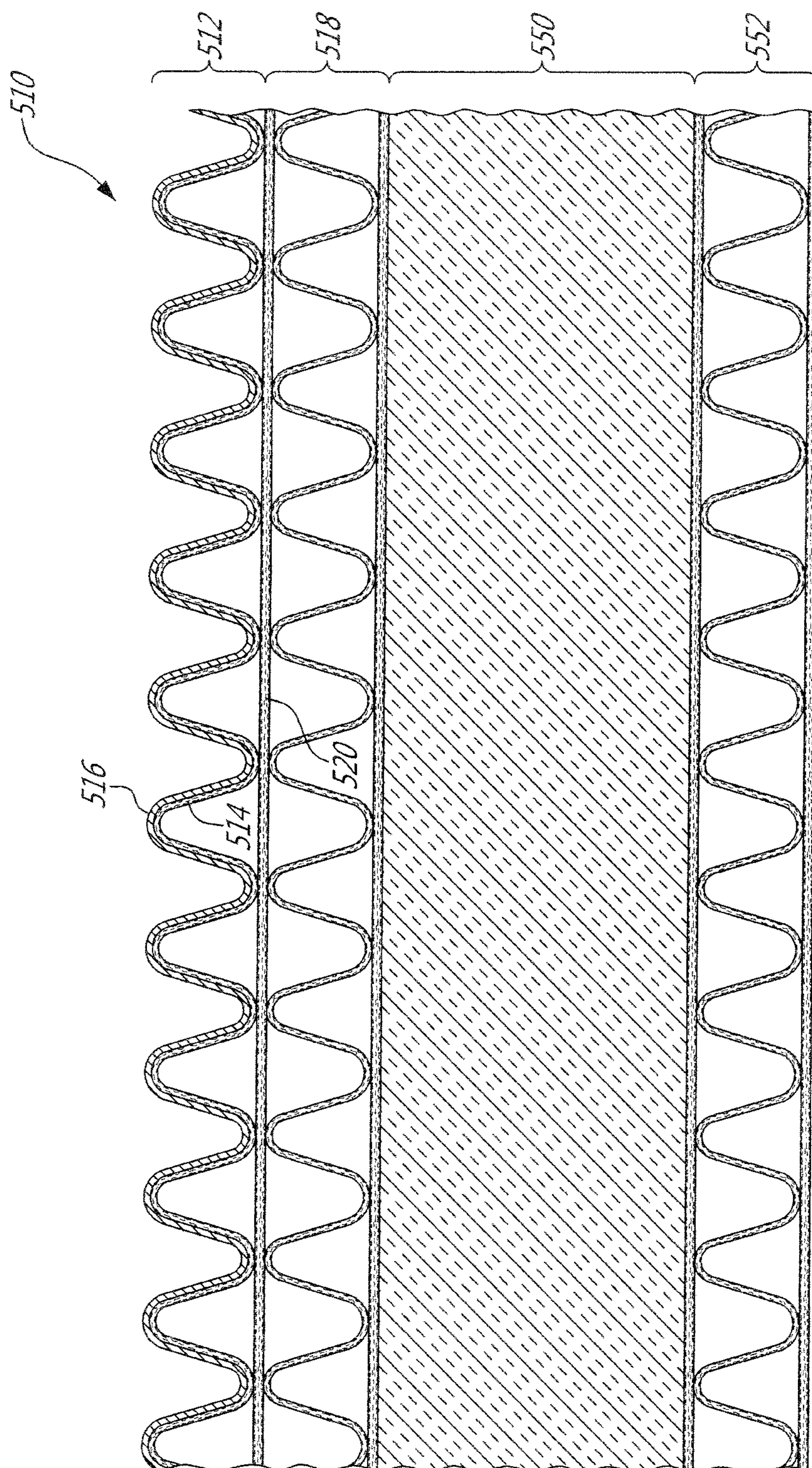
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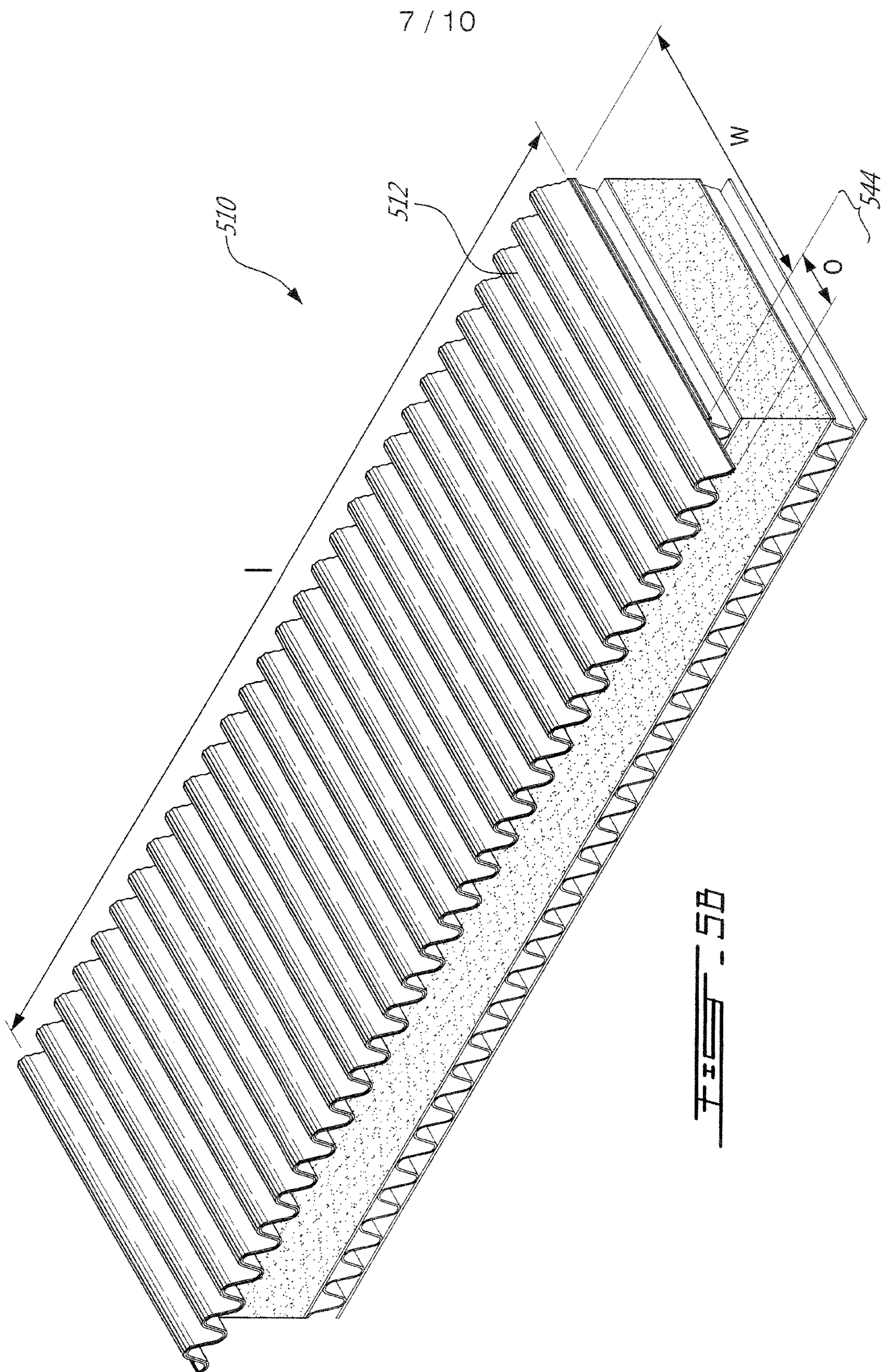


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FIG. 4

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FIG. 5A



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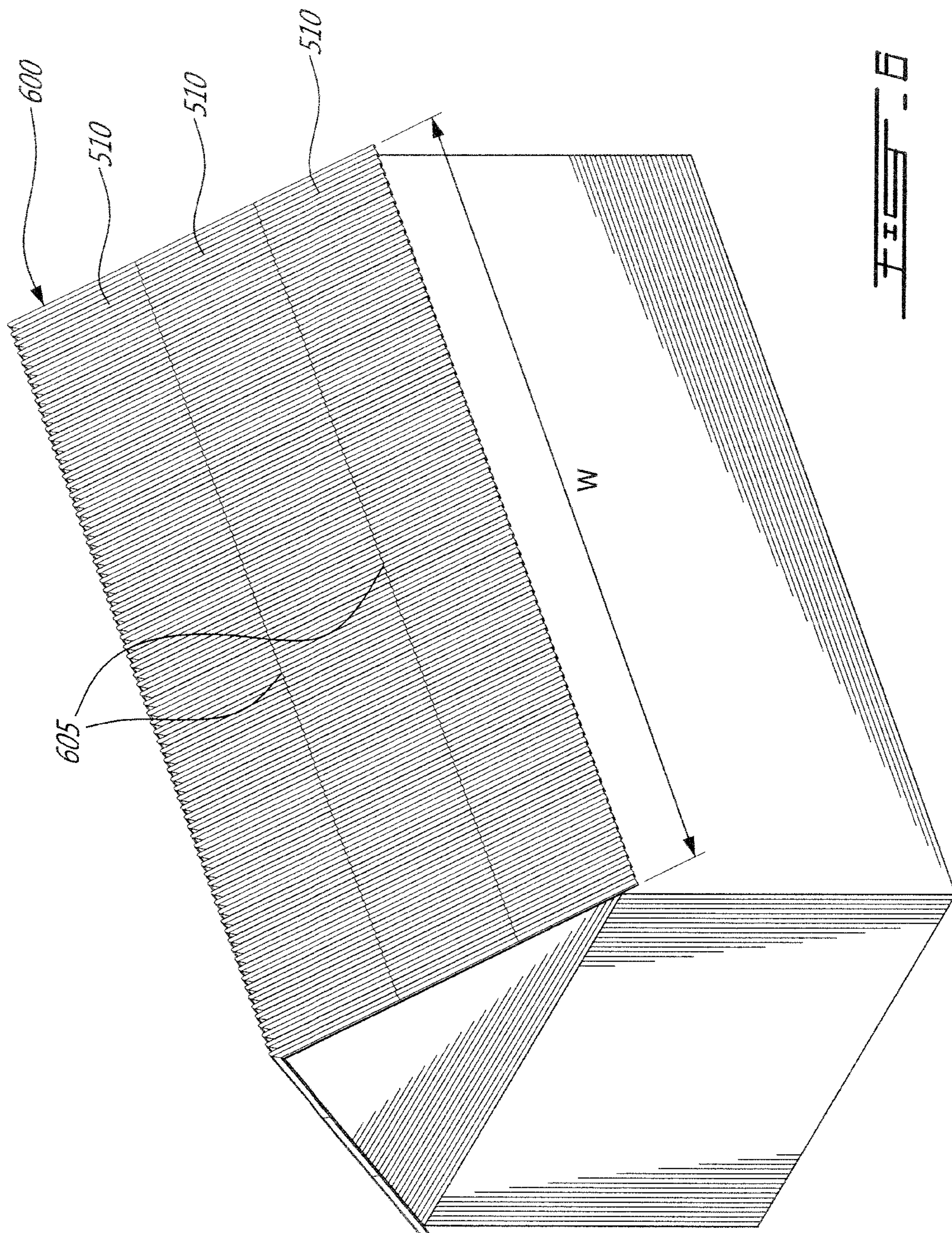


Fig. 8

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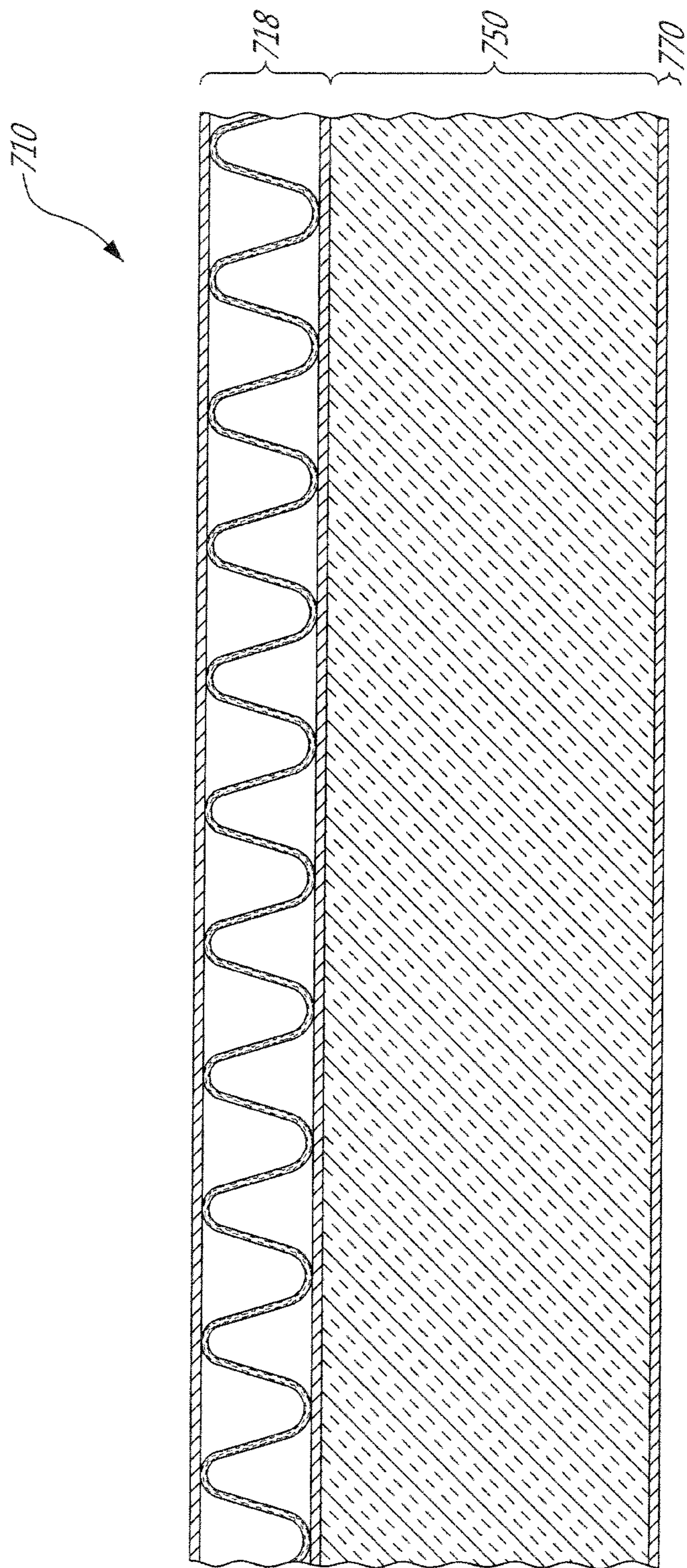


FIG. 7

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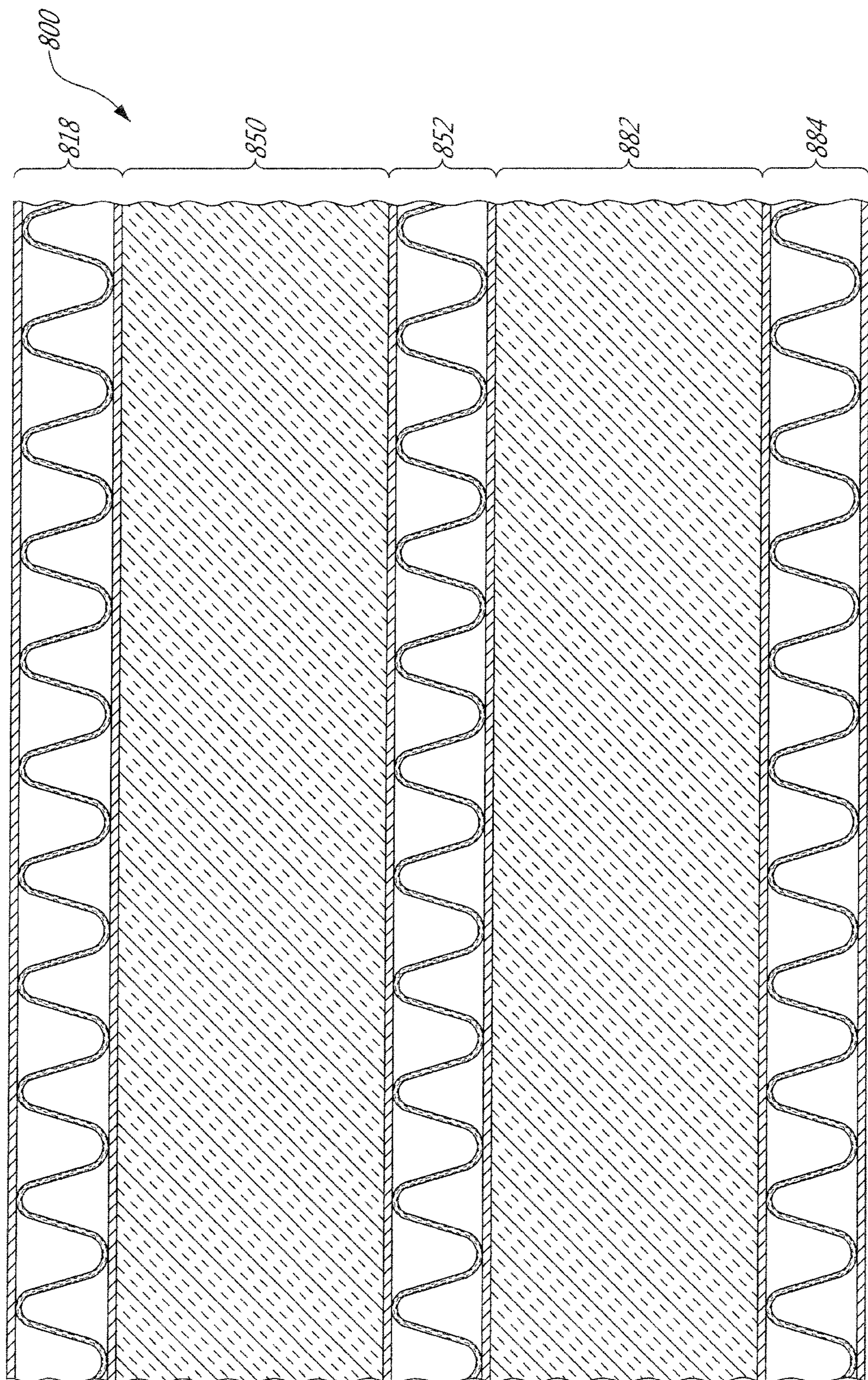


FIG. 10

