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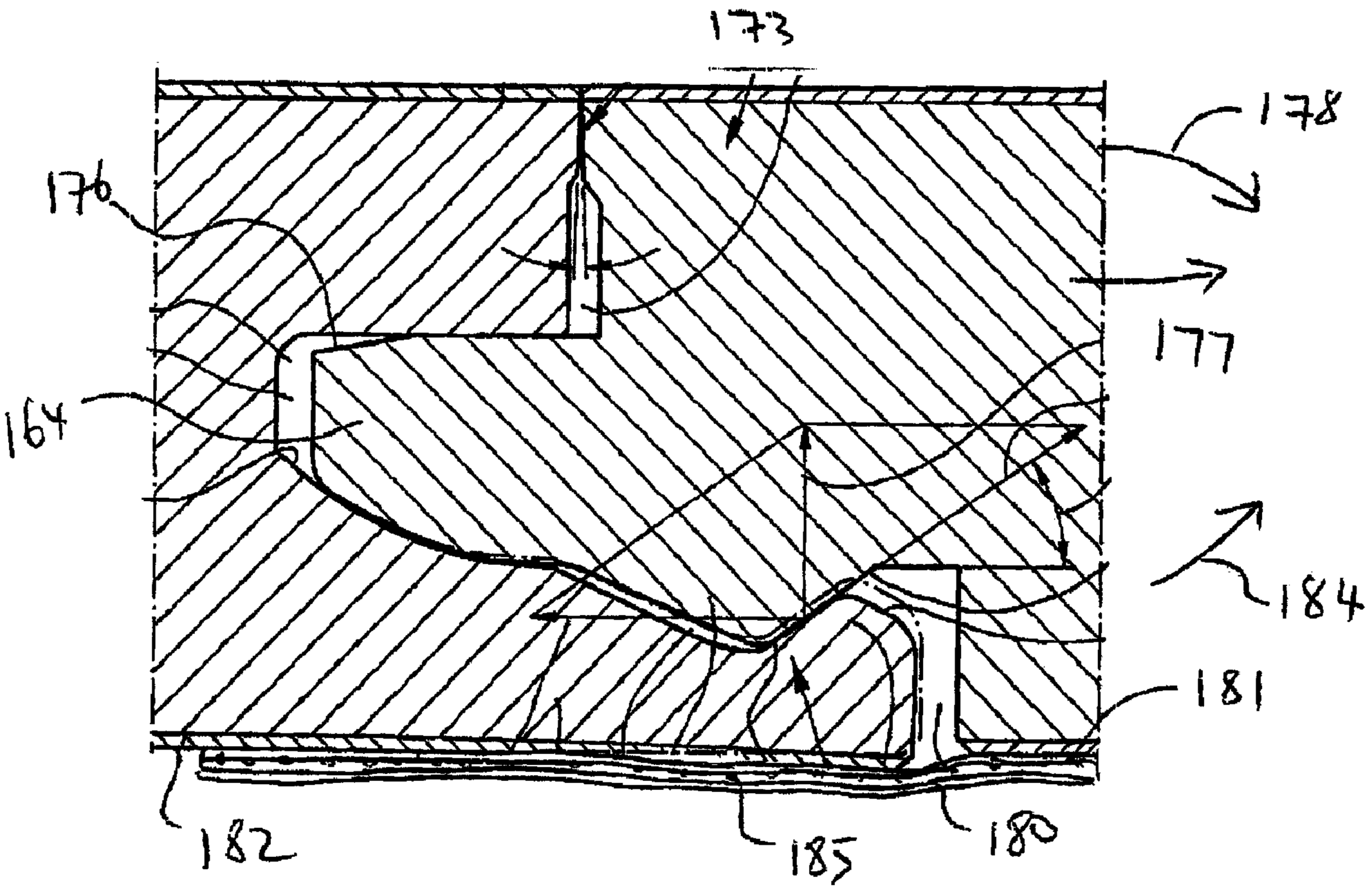

(57) Abrégé/Abstract:
A panelling system preferably for floors is defined by a series of panels each formed of a plurality of tongue and groove main floor plank strips arranged side edge to side edge and cut to a common length with a tongue along one cut edge and a groove along the other. At the edges are attached edge strips formed also from the flooring planks with tongue and groove and fastened together to form a common panel member for transportation and installation. The outwardly facing edge has a tongue or groove for mating

CA 2616254 A1 2008/04/08

(21) 2 616 254

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(57) Abrégé(suite)/Abstract(continued):
with a groove or tongue of a next adjacent panel. The strips are fastened by pins or corrugated plates from the rear or by a bonded sheet material on the rear. The strips may include tongue and groove joints of the snap fastening type where the connection of each strip to the next in the assembled panel can be simply by way of an adhesive tape over the rear surface of the joint.

ABSTRACT

A panelling system preferably for floors is defined by a series of panels each formed of a plurality of tongue and groove main floor plank strips arranged side edge to side edge and cut to a common length with a tongue along one cut edge and a groove along the other. At the edges are attached edge strips formed also from the flooring planks with tongue and groove and fastened together to form a common panel member for transportation and installation. The outwardly facing edge has a tongue or groove for mating with a groove or tongue of a next adjacent panel. The strips are fastened by pins or corrugated plates from the rear or by a bonded sheet material on the rear. The strips may include tongue and groove joints of the snap fastening type where the connection of each strip to the next in the assembled panel can be simply by way of an adhesive tape over the rear surface of the joint.

PANELLING SYSTEM

This invention relates to a panelling system defined by a plurality of inter-engaging panels. The system is primarily designed for flooring but can be used for other surfaces requiring to be paneled with an attractive layer of a covering material formed in individual panels. The system is primarily designed for use with panels formed of wood but other materials can be used either to form the entire panel or a part of the panel.

BACKGROUND OF THE INVENTION

Various techniques have been proposed for the manufacture of wood panel flooring. Conventionally wood panel flooring is formed as tongue and groove planks which are arranged edge to edge so that the tongue of one projects into a groove of the next. This construction is time consuming and relatively inaccurate so that gaps can be exposed leading to an unattractive appearance.

Floor panels in rectangular shape have been proposed which generally again connect one to the next using a tongue and groove arrangement so as to provide an improved laying system. Often such panels are formed from laminated or other non-wood materials and hence are not accepted as a high quality wood product.

In published US Patent Application 2006/0076394 published April 13th 2006 and in corresponding Canadian Application Serial No: 2,525,516 originally published March 4th 2005 of Kelly Gibson, one of the inventors herein, is disclosed a panelling system primarily for flooring which is formed from a plurality of wood floor panel members defined by a rectangular panel formed of wood and along two opposed side edges a decorative dividing strip extending along the length of the side edge and

having a top surface of the strip lying in a common plane with the upper surface of the panel with the other opposed side edges of the panel being exposed for butting directly against a next adjacent panel. The dividing strips project beyond an end of the side edge and are cut at 45 degrees to form a pointed portion having an apex at a position mid way through the thickness of the dividing strip such that four dividing strips, when the panels are laid on the floor, meet at the junction between four of the panels with the apexes in contact at a center of the rectangular area at the junction. This arrangement as disclosed was proposed for use with rectangular panels of solid wood or for deck strips and as such was not suitable for high quality interior flooring. The disclosure of this published application may be referenced for more detail of this construction.

SUMMARY OF THE INVENTION

It is one object of the invention to provide a panelling system.

According to the invention there is provided a panelling system comprising:

a plurality of panel members for locating on a supporting surface generally edge to edge in an array to at least partly cover the supporting surface;

each panel member having a front surface for defining an exposed surface of the panelling system, a rear surface for engaging the supporting surface and four side edges;

each panel member comprising a plurality of main strips arranged side edge to side edge with each main strip having a tongue along one side edge and a corresponding groove along an opposed side edge so that the main strips are connected side by side by interconnection of the tongues and the grooves;

the tongues and grooves being shaped such that:

the strips can be connected each to the next by simple sliding of the tongue into the groove with one strip pivoted about the joint in the direction such that an angle between the strips at the front surface of the panel is less than 180 degrees;

the strips can be connected each to the next with the strips co-planar by forcing of the tongue into the groove in a snap fastening action, with the snap fastening action resisting movement of the strips in a direction away from the joint when fastened;

the joint when fastened prevents pivoting movement of the strips to a position in which the angle between the strips at the front surface of the panel is greater than 180 degrees;

and a piece of a flexible sheet material adhesively attached across the joint on the rear surface of the panel.

Preferably the strips are connected each to the next, to form the panel, solely by the tongue and groove joint and the piece of material.

Preferably the piece of material comprises a tape expending longitudinally of the joint.

Preferably the tape includes fiber reinforcement.

In one arrangement the first ends of the main strips lie in a first common line and second ends of the main strips lie in a second common line; the main strips have a tongue along the first common line and a groove along the second common line; a first main strip at one side of the main strips has an exposed tongue along the first main strip for co-operating with a groove of a next adjacent panel and a second main strip at an opposed second side of the main strips has an exposed groove along the

second main strip for co-operating with a tongue of a next adjacent panel; each panel member having associated therewith a first dividing strip arranged to extend along the first common line and a second dividing strip arranged to extend along the second common line; each of the dividing strips has a front surface of the dividing strip to define with the front surfaces of the main strips the front surface of the panel; each of the dividing strips has a tongue along one side edge and a corresponding groove along an opposed side edge; the first dividing strip has the groove thereof engaged with the tongue along the first common line; the second dividing strip has the tongue thereof engaged with the groove along the second common line; the dividing strips being fastened to the ends of the main strips by the tongue and groove joint and the piece of material.

Preferably the panel members include dividing strips connected to the main strips where the dividing strips are arranged with a portion of each of the dividing strips of each panel member projecting beyond the main strips of the respective panel member such that, when four of the panel members are assembled into the system with one of the dividing strips between the main strips of each panel member and the next so as to form a rectangular area at a junction between corners of the main strips of the four of the panels, the rectangular area defined at the junction between said four of the panels is filled by said portions of the dividing strips which are shaped to cooperate to fill the rectangular area.

Preferably each end portion of the dividing strips is shaped to form diagonal end edges at an angle to the respective side edge such that the dividing strips meet at the junction between four of the panel members with the apexes in contact at a

center of the rectangular area.

Preferably one end edge of each end portion has a tongue and an opposed end edge of each end portion has a groove.

Preferably the dividing strips and the main strips are fastened together to form a common panel member for transportation and installation.

Preferably each of the main strips has the same width between side edges thereof and each dividing strip has substantially the same width as the main strips.

Preferably the end portions of the dividing strips have the end edges thereof in the front surface chamfered such that the dividing strips when butting have a chamfered groove at the front surface.

BRIEF DESCRIPTION OF THE DRAWINGS

One embodiment of the invention will now be described in conjunction with the accompanying drawings in which:

Figure 1 is a plan view of a panel of a flooring system according to the present invention.

Figure 2 is a plan view of four such panels assembled to form part of the flooring system.

Figure 3 is a cross sectional view through a junction between two boards of the panel of Figure 1 showing the pin connection therebetween.

Figures 4 and 5 show schematically a series of steps in a method for assembly of the panel of Figure 1.

Figure 6 is a more detailed view of the carousel for forming and attaching the dividing strips.

Figure 7 is a cross sectional view similar to that of Figure 3 through a junction between two boards of the panel of Figure 1 showing an alternative mode of connection therebetween.

Figure 8 is a plan view of a plurality of assembled panels of a further embodiment of flooring system according to the present invention where the individual panels are hexagonal and there is provide an edge strip on each of the six sides.

Figure 9 is a plan view of a panel of one square panel of a further embodiment of a flooring system according to the present invention.

Figure 10 is a plan view of a panel of one square panel of a yet further embodiment of a flooring system according to the present invention and there is provide an edge strip on each of the four sides.

Figure 11 is a plan view of a plurality of assembled panels of a further embodiment of flooring system according to the present invention where the individual panels are triangular and there is provide an edge strip on each of the three sides.

Figure 12 is a plan view of a plurality of assembled panels of a further embodiment of flooring system according to the present invention where the panels are rectangular and where some of the panels have the divider strips parallel to the main strips and some of the panels have the divider strips at right angles to the main strips.

Figure 13 is a plan view similar to that of Figure 12 wherein there is shown in addition that the pointed portions at the ends of the divider strips have the sides thereof formed with co-operating tongues and grooves.

Figure 14 is a cross-sectional view along the lines 14-14 of Figure 13 showing the connection between two boards and the manufacture of the boards from an

engineered two component construction.

Figure 15 is a bottom plan view of the small portion of the board of Figure 13 showing the fastening element.

Figures 16, 17 and 18 are respectively cross-sectional views through one joint in a panel, for example as shown in Figures 2 or 13.

In the drawings like characters of reference indicate corresponding parts in the different figures.

DETAILED DESCRIPTION

Reference is made to the above published application of Gibson which shows and describes the details of the panels with the dividing strips and the interconnection between the four corners of the panels.

The arrangement described herein comprises a floor system defined by a series of panel members, four of which are shown at 10 through 13. Each of the panel members has a top surface 16 defining a floor surface on which the user walks and providing an attractive appearance as described hereinafter. Each of the panel members includes a bottom surface 17 for sitting on a sub floor of a conventional nature.

Each of the panel members is formed from a plurality of side by side main strips 10A to 10G which are connected together side by side to form an initial panel portion which has four side edges so that for example the panel 10 has side edges 20 and 21 which form a first pair of opposed side edges and side edges 22 and 23 which form a second pair of opposed side edges.

The main strips are formed from tongue and groove boards which are

commonly available and are formed from many different wood varieties. Thus each board has a tongue 18 on one side and a groove 19 on the opposite side arranged to inter-fit to hold the boards side by side. Such boards are supplied in various lengths which can include random lengths and generally are supplied with tongue and groove ends so that the butting ands also inter-fit.

Each board conventionally has a chamfered edge 19A in the top surface 16 where the boards meet to form a micro-groove between the two butting chamfered edges.

In order to form these into a flooring system having an attractive appearance, each base panel formed by the side by side boards has attached two dividing strips which are attached to opposite side edges of the panel. Thus for example the panel 10 has two dividing strips 30 and 31 attached along the side edges 20 and 21. The dividing strips are formed from a board similar in appearance to the boards forming the panel but is arranged at right angles to the boards so as to provide an attractive appearance in the floor when completed and laid.

Each dividing strip has a depth equal to the thickness of the boards so that a bottom surface of the dividing strip is coincident with the plane of the bottom surface 17 and similarly a top surface of the dividing strip is coincident with the plane of the top surface 16. The dividing strips are preferably formed from the same boards as the main strips 10A to 10G so as to have the same dimensions and the same appearance.

The panel 12 has the dividing strips indicated at 30A and 31A so that the panel 13 is rotated through 180° relative to the pa nel 10. In this way the dividing strip 30A carried by the panel 13 engages the side edge 23 of the panel 10 which is free

from any dividing strips and is simply bare for butting the dividing strips 30A. Similarly the dividing strips 31A butts the next adjacent panel not numbered.

The panel 11 is also rotated through 180° relative to the panel 10 so that its bare edge 23A butts the dividing strip 31 and its dividing strip 30A butts the edge 23B of the panel 13. In this way it will be appreciated that the whole floor can be laid by rotating the panels back and forth through 180° and laying them each to the next with the side edges butting. In this way between each panel and the next adjacent panel is one dividing strip thus separating the panels by the thickness of the dividing strip while allowing the bare edge of the strip to butt against the outside surface of the dividing strip.

Each of the dividing strips extends along the full length of the respective side edge of the panel and also extends beyond the end of the side edge into a pointed portion 50. Thus as shown in Figure 2 the dividing strip 30A is fastened to the panel 12 and the dividing strip 31 is fastened to the panel 10. The dividing strip 30A extends to the end corner 51 of the side edge 22A of the panel 13. The dividing strips 30A then include the pointed portion 50 which is cut to form two side edges 52 and 53 converging to an apex 54. The ends 52 and 53 are cut at 45° r elative to the sides of the dividing strip so that they are 90° to each other forming a right angle triangle converging to the apex 54 which lies on a centre line 55 of the dividing strips 30A.

Symmetrically the dividing strip 30A includes an end portion 56 also converging to an apex which touches the apex 54 at the center of the rectangular area between the corners of the panels 10, 12 and the further two panels not numbered. In this way, in each of the square intersections between the edges of the panels, each

panel at the intersection carries one of the dividing strips with each of the dividing strips having the pointed extension portion symmetrical to the extension portion 50 and extension portion 56 projecting into the center of the square area with the apexes of these pointed portions touching at the center of the square area.

The panels are fastened to the sub floor 18 by screws 60 which are located in screw holes 61 located at the end of the respective dividing strip spaced from the apex 54. Each panel has four such screw holes 61 arranged adjacent the corners of the panel and spaced inwardly from the apexes of the dividing strips of the panel. Thus at each junction between floor panels, four screw holes 61 surround the junction and provide an attractive appearance, when those screw holes are plugged by visually distinct plugs in known manner. Thus the dividing strips coming to a junction where the junction is visually distinct together with the surrounding four holes of the screw pattern which are also visually distinct provides a visually distinct and attractive pattern across the whole extent of the floor when laid.

Each of the strips 10A through 10G is of an equal common width and is formed from conventional floor planking so each strip has a grove 19 on one side and a tongue 18 on the other side of a conventional nature.

As shown in Figure 1, some of the strips are continuous as indicated at 10A and 10C so as to extend from the side edge 20 to the side edge 21. Others of the strips are discontinuous and include a join 35 between two portions 36 and 37 of the strip. The joint 35 similarly includes a tongue and groove arrangement 38 where a tongue at the end of the strip portion 36 is joined into a groove at the end of the strip portion 37. This provides an integrated structure throughout the strip but allows lengths

of strip material to be used which are not necessarily continuous along the full length of the panel.

The divider strips are formed from a material of the same width and same construction as the strips forming the panel. Thus each divider strip itself has a groove 40 along one side and a tongue 41 along the opposite side. The divider strips are formed from a common source of the same material and generally therefore have the same width of the strips 10A through 10G and can be taken from the same supply. The divider strips are therefore not visually distinct from the main strips but are visibly distinguished by the right angle orientation.

In the alternative divider strips of a different width may be used and the divider strips may be of a different wood variety thus providing a visually distinct pattern. Yet further the strips may be stained or coloured to a different colour to provide a visually distinct arrangement as preferred by the user of the panels.

Most examples will have a divider strip that will be of the same width and the same variety so that the whole panel can be formed from a common supply of the wood strip materials.

Use of wood is not essential in this construction but is obviously preferred to provide a high quality finished wooden floor product as opposed to laminate materials or other materials which are considered to be of less quality.

The ends of the main strips 10 through 10g are cut to form a groove 43 at the edge 20 to receive the tongue 41 and symmetrically these strips are cut to form a tongue 44 at the edge 21 to corporate with the grove 40 of the divider strip 31.

A fastener arrangement for connecting each strip to the next adjacent strip

is shown in Figure 3. Thus a series of fastener pins 150 is provided and these fastener pins are engaged into the tongue and groove joint between each main strip and the next adjacent main strip and between at least some of the ends of the main strip and the respective divider strip.

Each pin 150 is of a type which has no head at a rear end 151 for the forward end 152 maybe pointed or may simply be straight to form a straight pin that can be simply driven into the wood at the joint using conventional driving tools. Such pins are previously known and the tools for driving them are commercially available.

With this arrangement, however, the pin 150 is driven through the bottom surface 17 and the pin is selected to have a length so that the rear end 151 is recessed from the surface 17 after the application is complete. Thus the rear end 151 is recessed below an adjacent portion of the surface 17 so if it is not proud of that surface then you've the possibility of snagging or catching or damaging any materials.

The leading end 152 is arranged by selecting a length of the pin so that the leading end 152 engages into the adjacent board to a position beyond the tongue 18.

The pin is driven at an angle to the surface 17 and therefore at an angle to the surface 16 so the pin passes through a plane P which joins the ends of the two strips indicated at 10A and 10B. Thus at the junction fastened by the pin 150, is one example of a series of such fastened joints throughout the structure of the panel. The strip 10A has a tongue 18 which is received within a groove 19 of the strip 10B. The pin 150 has its rear end 151 in the strip 10B in the area underneath the groove 19 and passes from that area into the tongue 18, extending through the tongue and into the

upper part of the strip 10A above the upper surface of the tongue 18. In this way the pin provides an effective fastening arrangement but the pin is wholly contained within the structure of the strips with neither the front end nor the trailing end exposed beyond the surfaces 16 and 17. The angle of the pin relative to the surface 17 is preferably of the order of 45 to 60 degrees and more preferably 54 degrees. The fact that the pin extends through the tongue 18 while the tongue is housed or contained in the groove inhibits or prevents any splitting of the tongue during the pinning action.

Thus each strip is fastened to the next adjacent strip by a series of such pins, the number of which can be selected depending upon structural strength required. In addition there is a connection between the ends of some of the strips 10A through 10G and the divider strip 31 which extends similarly through the tongue 44 at the grove 40. The number of such fastening pins can be selected again according to structural strength required so that only some of the ends of the strips are fastened or all of the ends or the strips are fastened as required.

Symmetrically further fasteners are inserted through the junction between the tongue 41 and the groove 43 between the divider strip 30 and the ends 20 of the main strips.

In this way the panel when completed is fixed in place and integrated by the fasteners so that the structure is prevented from twisting by side to side movement of the divider strips. It is preferred that the connection of the panel is effected without the use of glue so as to avoid the necessity for application of glue during the manufacturing process. However glue or other additional fastening methods may be used if required.

Turning now to the method of manufacture shown in Figures 4, 5 and 6, there are shown a serious of manufacturing stations through which the materials pass to complete assembly of the structure as describe above.

Thus the manufacturing process includes a first assembly station 60, a second convergence station 61, a fastening station 62, a cutting station 63, a tongue and groove station 64, a carousel 65, and a final assembly station 66.

In the assembly station 60, a number of channels 67 are formed each containing a respective one of the strips 10A through 10G. Thus each channel 67A through 67G contains a respective one of the strips which are fed forwardly in a continuous manner to the convergence station 61. The strips are introduced into the channel 67 so that they are in continuous manner including the connection lines or joints 35. Either automatically or manually at the assembly station, the strips are assembled so that the joint lines 35 are offset in a longitudinal direction from each channel relative to the next adjacent channel so that in this way no junction lines are arranged so that they are aligned or closely adjacent between side by side channels. This can be done in practice by providing the channels of sufficient length that a skilled operator can select the strips of different lengths and locate them so that the joint lines 35 are longitudinally offset. If the strips are of all identical length, this can be simply done by selecting the position of the ends of the strips in a staggered manner at the outset and the strips will remain in the staggered manner throughout the assembly provided the strips are carefully butted end to end and are all of a common length. In the alternative strips of different lengths can be selected and the operator arranged to select required lengths to ensure the required staggering of the butt joints.

Of course each strip in each channel has the groove and tongue arranged so that the strips can be brought together and interconnected in the proper tongue and grove arrangement side by side.

From the assembly station 60 the channels are arranged to feed the strips forwardly while at the same time converging those strips to bring them together using a series of converging rollers 68. The strips are thus brought to a position immediately side by side and brought to a position where the strips are compressed between a converging roller 69 on one side and a compressing roller 70 on the other side. In the arrangement shown, the converging roller 69 carries a tongue 69A which runs in the groove 19 on the right hand side of the assembled strips. In the convergence station there are series of such guide rollers 69 indicated that 69B and 69C and these are arranged at a specific fixed location to provided a datum line which accurately locates the position of the edge of the outside strip 10G and its grove 19.

On the opposite side of the datum line defined by the guide rollers 69, there is provided a cutting wheel 72 downstream of the compression roller 70. The cutting wheel 72 is located at a fixed determined distance from the guide rollers 69 to provide a cutting action on the edge of the strip 10A remote from the strip 10G.

The distance of the cutting wheel 72 from the datum line is accurately fixed and is slightly less than the minimum width of the converged strips 10A through 10G, bearing in mind that such strips when manufactured commonly have a significant manufacturing tolerance.

The cutting wheel 72 is arranged to cut a fresh tongue 18 and associated shoulders 18A and 18B above and below the tongue 18. Thus instead of relying on the

position of the tongue of the strip 10A, a fresh tongue and associated shoulders is cut so that the width of the converged strips is accurately equal to the distance between the cutting wheel and the guide rollers regardless of any variations or tolerance in the widths of the strips as supplied.

In this way the completed panel has a width between the sides 22 and 23 which is accurately cut and is exactly equal for each subsequent panel that is manufactured. In addition the amount of compression between the strips is accurately maintained so that the strips are held at this fixed spacing while substantially ensuring that any warping or bending of the strips is removed by sufficient transverse compression across the panel.

Downstream of the cutting wheel 72 is provided a guide roller 73 which is arranged opposite to a respective guide roller 69C. The guide roller 73 preferably contains a groove for receiving the tongue 18 recently cut by the cutting wheel 72. Thus the strips are maintained by these guide rollers and by further guide rollers 69D and 73A arranged downstream of the guide rollers 73 and 69C. These rollers are located at the fastening station 62 so that as the assembled panel formed by the individual strips is moved into the fastening station 62 it is maintained at the required fixed spacing and under the required compression.

At the fastening station 62 is provided a series of pin inserting tools indicated at 62A through to 62F. These fastening tools are arranged at positions bridging the junctions between the strips so as to be operable to insert the pins 150 at the required position and at the required angle.

The pin inserters 62A through 62F are controlled by a control unit 62G.

The control unit receives inputs from a series of detectors 75A through 75G which are arranged each in a respective one of the channels for detecting the forwarding action of the respective strips. Each detector 75 is arranged to detect the presence of a junction line 35. Thus the pin inserting devices 62A through 62F are controlled so that they are operated at a time to ensure that a pin is inserted at a position spaced from a junction line 35 on either side of the pin. The controlled unit is arranged to determine a predetermined distance on either side of a junction line 35 within which a fastener pin is not permitted to be inserted. The control unit is arranged to determine the positions of insertion of pins based upon the presence of the junction line 35 to ensure that sufficient pins are inserted in the junction between each strip and the next adjacent strip while ensuring that the pins are inserted at a position spaced from the junction lines.

Downstream from the fastening station is provided a clamping assembly generally indicated at 76. This includes a pair of clamping members 77 and 78 each on a respected side of the assembled fastened panel and which includes clamping engagements 79 which engage onto the sides 22 and 23 of the assembled panel formed by the strips 10A through 10G. Thus after the panel is released from the clamping rollers, is engaged by clamping members which are intended to hold that structure while it is moved at right angles to the forming line into the further stations 64 and 66. After the fastened panel formed by the panel is moved to up to a required location and engaged by the clamping members 77 and 78, this position is detected by a sensor 80 which therefore locates the edge 20 of the panel. At this position a cutting device 81 is operated which moves across the panel to provide a cutting action to define the side edge 21. The cutting device includes a conventional blade 82 carried on a

track 83 with the distance between the cutting blade and the sensor 80 being accurately determined to ensure an accurate spacing between the sides 20 and 21 of the panel when cut.

As shown in Figure 5, the panel so formed and fastened with the accurate spacing between the sides 20 and 21 and the accurate spacing between the tongue at the side 23 and the groove 19 at the side 22 is carried in the gripping members 77 and 78 on a suitable transport track (not shown), the formed panel defined by the main strips 10A through 10G is moved into the tongue and groove station 64.

At the tongue and groove station 64, the panel supported in the clamping members 78 and 79 is moved along the track past a set of guide rollers 85 and 86 which control the position of the edges 20 and 21 accurately in a predetermined spaced position. The guide rollers 85 and 86 include a second set 85A and 86A downstream thereof so that the panel is maintained accurately positioned and accurately square. A tongue cutter wheel 87 is provided on the side edge 21 and a groove cutter wheel 88 is provided on the side edge 20. These cutter wheels rotate relative to the panel as it is moved past the cutter wheels to effect a cutter action to form at the side edges 20 and 21 the respected tongue and groove previously described.

After the formation of the tongue and groove, the completed panel formed by the main strips is moved into the final assembly station 66 at the carousel 65.

The carousel 65 is shown in more detail in Figure 6 and comprises a series of stations arranged around the carousel which rotates around a central support 88. Thus the carousel defines a first station 65A at which tongue and groove strip from a supply 65B is cut to a required length by a cutting device 65C. At a second station

65D; the cut length of the strip is cut to define the pointed portion 50 at the front end. At a third station 65E, the cut strip is passed through a cutting station to effect cutting of the pointed section 50A at the rear end of the strip. The cutting stations are of course arranged so that the length of the dividing strip now formed from the supply of the board is accurately to the required length between the points of the pointed portions and the pointed portions have the accurate 90 degree angle. At the next station 65F the formed dividing strip is passed through a set of cutting members which form the chamfered edge 19A on the pointed portions 50 and 50A. At a further station 65G, the dividing strip is drilled to form the holes 61 at the base of the pointed portions 50 and 50A.

At a final station 65H, the completed dividing strip is moved into position onto the edge of the panel so that the groove in the dividing strip engages onto the tongue of the side edge on one side of the panel and on the other side the tongue of the dividing strip is engaged onto the groove at the side of the panel.

The carousel is of a conventional nature and uses conventional cutting, routing and drilling tools to effect the above cutting actions. The selection of the necessary tools is within the skill of a person skilled in this art so that description of the necessary tools is not required here. Carousels of this type are commonly available providing a series of stations. Of course the first carousel is arranged on one side and the second carousel is arranged on the second side of the panel moved along the track as carried by the clamping members 78 and 79.

At the final assembly station 66 including the two carousels 65 and 65X, there are provided additional pin driving members 62X, 62Y and 62Z for driving pins as previously described into the junction between the dividing strip and the ends of

selected ones of the main strips.

After the final assembly station 66, the completed panel assembled by the pins is moved to a stacking station (not shown) where it is released from the clamping members 78 and 79 for stacking onto a pile of finished such panels for transportation to a remote location for installation.

In Figure 7 is shown an alternative arrangement for fastening the strips of the panel member together and this comprises a sheet 90 of a fabric or similar flexible material which can be applied onto the whole of the rear surface of the panel member so as to cover all of the joints with the sheet being bonded to the rear surface 17 by a layer of an adhesive 91. While it is preferred that a common sheet covers all of the joints so that its dimension is substantially equal to the rear of the panel, it will be appreciated that separate strips can be applied along each joint or separate strips may cover some of the joints. Thus a single piece many be applied over the main strips when assembled and converged at the fastening station and separate pieces applied over the joints of the divider strips in the final assembly station. The fabric pieces can be unrolled from a supply of the required width and cut to length. The strips preferably carry the adhesive from the supply or the adhesive may be applied separately. The adhesive may be a hot melt which is activated by a heated plate or roller brought up onto the rear surface of the assembled panel which presses the fabric into engagement with the rear surface and activates the adhesive.

Turning now to Figures 8 through 11, there is shown an alternative arrangement where the finished panel is a polygon which therefore has a plurality of sides converging to an apex where each side is arranged to co-operate with a side of

next adjacent panel without any intervening divider strips of the type described above.

Thus in Figure 8 the panels 80 are hexagonal with a central panel section 81 which is hexagonal and with an edge strip 82 at each side edge of the center section. Thus when a panel butts with another panel there are two butting edge strips side by side as indicated at 82A and 82B, as opposed to the single divider strip of the above described arrangements. Each edge strip butts at its end with its next adjacent strip at a butt line 83 which is diagonal along a line 84 extending from a center of the panel 81 as indicated at 85. The butt line may include tongue and groove interconnection or may be merely a flat butt.

The center panel is formed from side by side tongue and groove main strips as previously described. In view of the hexagon shape, when arranged in a symmetrical manner, four of the edge strips extend in a direction at an angle of 120 degrees to the longitudinal direction of the main strips and two of the edge strips are parallel to the main strips. As an alternative, it will be appreciated that, in another symmetrical arrangement, the main strips may be arranged at right angles to those shown or may be at another angle intermediate the angle of the two symmetrical arrangements.

In Figure 9, the panel 90 is square with two edge strips 91 parallel to the main strips 93 and two edge strips 92 at right angles to the main strips 93. Again when a panel butts with another panel there are two butting edge strips side by side. Each edge strip may butt at its end with its next adjacent strip at a butt line which is diagonal, similar to the arrangement of Figure 8 and Figure 10, but in the example shown the edge strips 92 extend across the full width of the panel. The butt line may include

tongue and groove interconnection or may be merely a flat butt. In the arrangement shown, the ends of the edge strips 92 include tongue and groove connections.

In Figure 10, the panel 95 is also square with four edge strips 96 at an angle of 45 degrees to the main strips 97. Again when a panel butts with another panel there are two butting edge strips side by side. Each edge strip butts at its end with its next adjacent strip at a butt line which is diagonal, similar to the arrangement of Figure 8. The butt line may include tongue and groove interconnection or may be merely a flat butt.

In Figure 11, the panels 99 form an equilateral triangular shape with three edge strips 100 two of which 101 and 102 lie at an angle of 60 degrees to the main strips 100 and one of which 103 is at right angles to the strips. Again, when a panel butts with another panel there are two butting edge strips side by side. Each edge strip butts at its end with its next adjacent strip at a butt line which is diagonal passing through a center of the triangle, similar to the arrangement of Figure 8. The butt line may include tongue and groove interconnection or may be merely a flat butt.

In each case the edge strips present outwardly of the panel either a tongue or a groove for engaging a groove or a tongue of an edge strip of a next adjacent panel;

In each case the edge strips and the main strips are fastened together to form a common panel member for transportation and installation.

As shown, each of the main strips has the same width between the side edges with each edge strip having substantially the same width as the main strips.

The dividing strips and the main strips are fastened together by the pin

arrangement described above or by the adhesive sheet method described above.

Turning now to the embodiments shown in Figures 12, 13, 14 and 15 these use the constructions and principles described before so that only the important differences will be described herein after.

Firstly, the construction shown in Figure 14 uses a panelling material formed of a base layer 110 and a covering or face layer 111. This can be of the type known as "engineered flooring" where the base layer is commonly a plywood layer and the covering layer is a facing layer of a hard wood. Such materials are well known and widely used for high cost flooring where the facing layer forms the actual floor layer and the support or base layer 110 acts as a support to provide structural support both during laying and during operation of the floor. Plywood is a convenient base material since it is resistant to changes in dimension caused by moisture content, since it is flexible, since it is formed of a soft wood material and hence it can be attached to an underlying support surface 112 by a layer of adhesive 113. As the underlying base layer has the above features it can be considerably thinner than conventional flooring with the covering or face layer being merely sufficient to provide the attractive upper layer with no requirement form structural strength. The structural stability of the product allows the bonding by adhesive of the flooring directly to a concrete base using an adhesive without the change in dimension acting to crack the adhesive.

Such materials are commercially available for example from BOA-Franc of Quebec Canada and due to the above characteristics can be manufactured very accurately with dimensional accuracy in the range 0.001 inch.

Further details of such material are available to the person skilled in this

art from the actual products manufactured and sold by this company under the trademarks "Mirage" flooring.

The flooring is generally wider than conventional hard wood flooring having a width of the order of 3 to 5 inches and is thinner than conventional hard wood flooring having a total thickness of the order of 3/8 to 1/2 inches which is formed by plywood base of the order of 1/4 to 3/8 inches and a covering layer of the order of 1/16 to 5/32 inches.

The layer 111 is chamfered at the edges as indicated at 114 to form a groove 115 between side by side boards or strips of the material.

Secondly the boards are fastened each to the next from the rear using corrugated joining plate members 116 where each plate member bridges a butting line 117 between the strip members 118 and 119 so as to have a part of its length in one strip member 118 and a part of its length in a next adjacent strip member 119. Each plate member is engaged or punched into the strip members through the rear surface 120 thereof such that a height 121 of the plate member extends into the thickness of the strip members. Each joining plate member is shaped with a series of corrugations 122 spaced along its length with each corrugation extending through the height of the plate member from the bottom edge 123 at the rear surface 120 to the top edge 124.

This type of joining plate member is known and is conventionally formed from steel or other metal so as to have sufficient stiffness to undergo the insertion forces. However in this case the plate is formed of a plastics material of a type selected so that the material can be cut by a cutting blade when the strip members are cut. In this way when cutting a panel to size there is no risk that the plate will be broken or

ripped out to form flying debris of a dangerous nature. Also the person cutting can cut the panel to size without worrying about hitting a plate.

The height of the plate members is such that the plate members extend from the rear surface 120 into the base layer and do not reach the covering layer 111. Thus the plate is wholly within the plywood section and can be punched into the plywood without danger of splitting the wood due to the transverse strength available in plywood.

Such corrugated fasteners are available from many different manufacturers and are supplied in a row of fasteners connected together for supply to a fastening gun which drives the fastener into the material to be fastened by a bar which extends along a center line of the corrugations and forces the fastener forwardly into the material in a direction parallel to its height. The fasteners are typically formed of steel and are used in fastening wood furniture products at miter joints and the like. The fastener is corrugated on each side of a mid line part way along the length of the fastener. At the mid line the fastener is tapered slightly so that the corrugations move closer together as the fastener enters the material thus tending to draw the two parts together at the butt line.

However these have not been used in flooring and have not been manufactured from materials other than metal. Typically the joining plates when formed from a suitable plastics composite material, that is a polymer composite, will have a thickness of the body of the material of order of 0.015 to 0.025 inches and a corrugation height across the thickness of the fastener of the order of 0.1 to 0.2 inches. Typical fasteners will have a height of the order of 0.25 inches so that it extends only into the

plywood base and a length of the order of 1.0 inch. A strip of the fasteners is manufactured by injection moulding with connecting pieces between each fastener and the next which can be broken by the driving tool as each fastener is driven forwards. The leading edge can be chamfered for easier penetration but this is not essential. The corrugations are tapered together at the center so that there is a tendency to draw together the two strips as the fastener enters. A company Utility Composites Inc in Round Rock Texas manufacture nails in a suitable composite plastics material which can be used to manufacture the corrugated fasteners to be used in the present arrangements.

As the plywood can be manufactured to high accuracy and maintains that dimension despite changes in moisture, the panels can be manufactured without the necessity for re-cutting the tongue or groove along the edge after the required number of strips is assembled side by side. The corrugations engage into the fibers of the plywood to provide high strength in a direction tending to resist separation of the strips.

The joining plates are used to connect the main strips of the panels and the divider strips of the panels to the main strips. Sufficient numbers of plates can be used to ensure a structurally stable product.

The panels are formed from the material described to form a construction of the same general type as described in shown in Figure 1. One key difference being that the use of adhesive to fasten the panel to the sub-floor avoids the necessity for through holes for screws. These panels as shown in Figure 1 have the divider strips 30 and 31 at right angles to the main strips 10A to 10G. Such panels can be used in an array as previously described where the main strips of each panel are at right angles to

the main strips of the next adjacent panel.

Turning now to Figure 12, there is shown a flooring pattern formed from two separate types of panels where one of the types is as shown in Figure 1 where the divider strips are at right angles to the main strips and a second of the types is where the divider strips are parallel to the main strips. As shown in Figure 12 this forms a pattern where all the main strips are oriented in a common direction and the divider strips form a series of rows across the main strips. It will be appreciated that the combination of such panels can be used to create many different panelling effects.

As shown in Figure 12, there is therefore provided a panelling system defined by a plurality of first panel members 130 and a plurality of second panel members 131. As previously described, the first and second panel members are arranged for locating on a supporting surface 112 generally edge to edge in an array to at least partly cover the supporting surface. Each panel member has a front surface 133 for defining an exposed surface of the panelling system and a rear surface 123 for engaging the supporting surface. Each panel member is formed from a plurality of main strips 135 arranged side edge to side edge to form a rectangular panel body 136 having four sides including a first pair of parallel sides 137, 138 parallel to the main strips and a second pair of parallel sides 139, 140 at right angles to the main strips.

In the first panels 130, the dividing strips 143 and 144 are parallel to the main strips 135 and connected to the first sides 137, 138.

In the second panels 131, the dividing strips 141 and 142 are at right angles to the main strips 135 and connected to the second sides 139, 140.

The dividing strips and the main strips are fastened together using the

joining plates 116 to form a common panel member for transportation and installation.

In each of the first panel members 130, the main strips are parallel to the dividing strips and each dividing strip 143, 144 extends along a respective one of the first pair of parallel sides 137, 138 so as to define a first inner side edge 145 engaging the panel body 136 and a second exposed outer edge 146.

In each of the first panel members 130, the dividing strips 143, 144 include a first dividing strip 143 having a tongue along the outer edge 146 thereof and a second dividing strip 144 having a groove along the outer edge 146 thereof.

In each of the first panel members 130, a first one 140 of the second parallel sides has a tongue therealong and a second one 139 of the second parallel sides has a corresponding groove therealong.

In each of the second panel members 131, the main strips 135 are at right angles to the dividing strips 141, 142.

In each of the second panel members 131, each dividing strip 141, 142 extends along a respective one of the second pair of parallel sides 139, 140 so as to define a first inner side edge 147 engaging the panel body 136 and a second exposed outer edge 148.

In each of the second panel members 131, the dividing strips 141, 142 include a first dividing strip 141 having a tongue along the outer edge 148 thereof and a second dividing strip 142 having a groove along the outer edge 148 thereof.

In each of the second panel members 131, a first one 138 of the first parallel sides has a tongue therealong and a second one 137 of the first parallel sides has a corresponding groove therealong.

The first and second panel members 130 and 131 are arranged such that the outer edge 146 of the first dividing strip 143 of the first panel members 130 with the tongue therealong is arranged for co-operating engagement with the second one 137 of the first parallel sides 137, 138 of a respective one of the second panel members 131 with the groove therealong.

The first and second panel members 130 and 131 are arranged such that the outer edge 146 of the second dividing strip 144 of the first panel members 130 with the groove therealong is arranged for co-operating engagement with the first one 138 of the first parallel sides 137, 138 of a respective one of the second panel members 131 with the tongue therealong.

The first and second panel members 130 and 131 are arranged such that the outer edge 148 of the first dividing strip 141 of the second panel members 131 with the tongue therealong is arranged for co-operating engagement with the second one 139 of the second parallel sides 139, 140 of a respective one of the first panel members 130 with the groove therealong.

The first and second panel members 130 and 131 are arranged such that the outer edge 148 of the second dividing strip142 of the second panel members 131 with the groove therealong is arranged for co-operating engagement with the first one 140 of the second parallel sides 139, 140 of a respective one of the first panel members 130 with the tongue therealong.

In all the panels each of the main strips preferably has the same width between side edges thereof and each dividing strip has substantially the same width as the main strips.

In all of the panels, the dividing strips include the pointed portions 50 as previously described projecting beyond an edge of the panel body. Thus the dividing strips of the panel members are arranged with the portions 50 of the dividing strips of each panel member projecting beyond the main strips of the respective panel member such that, when four of the panel members are assembled into the system with the main strips of one panel member at right angles to the main strips of each next adjacent panel and with one of the dividing strips between the main strips of each panel member and the next so as to form a rectangular area at a junction between corners of the main strips of the four of the panels; the rectangular area defined at the junction between said four of the panels is filled by said portion of said at least one dividing strip.

While it is preferred that the main strips are fastened to one another by tongue and groove connection and also the dividing strips are fastened to the edge of the main panel body also by tongue and groove connection, any one or all of these connections may be formed by simple butt joints due to the strength and effectiveness of the plate type fasteners.

In addition, as the appearance of the panels is generally formed by the covering or facing layers and the chamfered grooves 115 therebetween, the main body portion can be formed using a back plate of the plywood which is square with the strips applied directly to the upper surface thereof. The dividing strips can then be fastened to the sides of the square main panel to simulate the flooring boards without actually forming such boards.

In Figure 13 is shown the same construction as in Figure 12 with the difference that the points 50 are modified to include on one side edge a groove 151 and

on the other side edge a tongue 152. Inspection of the drawing will show the pattern of the tongues and grooves which allow the sides of the points 50 to meet at the apexes 54 with the grooves and tongues intermeshing in the same plane approximately midway between the front and rear surfaces of the panels as the tongues and grooves along the side edges of the panels and dividing strips.

Turning now to Figures 16, 17 and 18, there is shown a further embodiment using panels formed in the manner known as laminated flooring. Such flooring is commonly formed from a base or core layer of MDF which is a fabricated wood product using wood or fiber particles bound in a resin material. The details of such materials are well known in the industry and hence will not be recounted here. On top and on the bottom of such a core layer is provided a covering material layer. In the laminated product this is commonly a plastics layer of vinyl or the like which provides a base for resting on a support surface and provides a top appearance layer which has the appearance required such as a wood grain appearance. The appearance layer is commonly a paper product on which the appearance is printed and is covered by the hard plastics layer to protect it from damage. Thus the MDF provides the structure and the plastics and appearance layers provide the wear coats.

Similar products are manufactures using cork veneers on top and bottom of an MDF core. These products simulate cork flooring and again use the MDF core layer as the structure of the product.

Such MDF material is strong and dimensionally stable so that it can provide suitable joints and can be held together as a floor structure without structural or dimensional changes due to moisture and humidity differences. Both of these types of

flooring therefore can be formed as "floating" floors where the complete floor covering acts as a single layer floating on the support surface or substrate without the necessity to attach the floating floor to the substrate by adhesive or other means. Thus installation is simplified and replacement is possible of pieces or the whole floor.

The floating floor system has become important in recent years based ion the development of joints which snap or lock into place. One example which is widely used is known as the "Uniclic" system and is shown in US Patent 6,006,486 (Moriau) issued December 28th 1999 and many other related patents. The disclosure of this document can be referred to for further details of this type of joint and is incorporated herein by reference.

Figures 16 and 17 are taken from this patent and Figure 18 includes also the assembled joint part of which is taken from the same patent.

The joint used in these figures can be used in any of the above described panelling systems. While the joint is best used in a laminated type product using MDF as the core layer, the same joint can also be used in other materials and in wholly wood products such as hard wood flooring.

It will be appreciated that where the term "tongue and groove" is used in this document to refer to such joints, the term can include conventional tongues and simple grooves where there is no interlocking effect and more complex tongue and groove joints where a snap lock effect is obtained tending to hold the boards connected edge to edge.

Thus in the above figures two of the boards indicated at 160 and 161 are connected together at a joint 162 using the tongue and groove arrangement from the

above patent or using a similar interlocking system.

In the above patent and as used herein, there is a tongue 164 on the board 161 and a groove 163 on the board 160 which are shaped in general such that:

a) the strips can be connected as shown in Figure 16 each to the next by simple sliding of the tongue 164 into the groove 163 with one strip or board 161 pivoted about the joint 162 in the direction as shown at 165 such that an angle A is formed between the strips with the strip 161 pivoted upwardly away from the support surface 166. This provides an angle between the strips at the front surface 168 of the panel which is less than 180 degrees. The strip 161 can then be bent downwardly to the coplanar position to snap the strips into the locked position by the rib 170 on the strip 161 slipping over the rib 173 into the groove 172 on the strip160.

b) The strips can be connected each to the next with the strips co-planar as shown in Figure 17 by forcing of the tongue 164 into the groove in a snap fastening action along the line 169. The snap fastening action is caused by the necessary distortion of the edge of the strip 160 at the rib 173 at the groove to allow the rib 170 to snap over into its groove 171. The movement along the coplanar line 169 is guided by the support surface on which both strips are placed and by the nose 175 of the tongue 164 sliding over the surface 176 of the groove.

c) As shown in Figure 18, the snap fastening action resists movement of the strips in a direction 177 away from the joint when fastened. Also the joint when fastened prevents pivoting movement of the strips in a direction 178 to a position in which the angle between the strips at the front surface of the panel is greater than 180 degrees. This is resisted by the top surface of the tongue 164 pressing against the

surface 176 of the groove.

However pivoting movement back to the position shown in Figure 16 is possible with only little force. Hence a piece or strip of a flexible sheet material 180 is attached by an adhesive layer across the joint on the rear surface 182 of the strips.

Thus the panels previously shown and described are manufactured to form the completed panel formed by the main strips and the dividing strips by assembling the strips edge to edge using the snap lock connections primarily by the pivoting technique shown in Figure 16. When the strips are assembled, the panel is held in place as a stable accurate structure using the adhesive tapes on the joints at the rear surface. The use of the adhesive tape merely on the rear surface is sufficient to hold the strips in place because the snap lock prevents movement in the direction 177 and prevents pivotal movement in the direction 178 so that the tape as only to hold the strips against movement in the direction 184.

When the panels including the dividing strips and the main strips are assembled and taped, the panels are stable and can be shipped in assembled condition to the place of installation. When being installed, the panels are located side by side and where possible the pivoting connection technique is used. However it will be appreciated that some joints are not linear so that the pivoting technique cannot be used. In these cases the coplanar snap technique of Figure 17 is used. When completed the floor is a floating floor arrangement with the connections holding the panels together without the need for adhesive or for connection to the sub-floor.

The piece of material 180 can comprise a tape expending longitudinally of the joint or can be pieces of tape across the joint or can be formed by a whole layer

covering the whole of the rear surface of the panel.

In order that the tape does not stretch and holds the panel stable, the tape includes fiber reinforcement 185 preferably of a bi-directional nature.

Since various modifications can be made in my invention as herein above described, and many apparently widely different embodiments of same made within the spirit and scope of the claims without department from such spirit and scope, it is intended that all matter contained in the accompanying specification shall be interpreted as illustrative only and not in a limiting sense.

CLAIMS:

1. A panelling system comprising:

a plurality of panel members for locating on a supporting surface generally edge to edge in an array to at least partly cover the supporting surface;

each panel member having a front surface for defining an exposed surface of the panelling system, a rear surface for engaging the supporting surface and four side edges;

each panel member comprising a plurality of main strips arranged side edge to side edge with each main strip having a tongue along one side edge and a corresponding groove along an opposed side edge so that the main strips are connected side by side by interconnection of the tongues and the grooves;

the tongues and grooves being shaped such that:

the strips can be connected each to the next by simple sliding of the tongue into the groove with one strip pivoted about the joint in the direction such that an angle between the strips at the front surface of the panel is less than 180 degrees;

the strips can be connected each to the next with the strips co-planar by forcing of the tongue into the groove in a snap fastening action, with the snap fastening action resisting movement of the strips in a direction away from the joint when fastened;

the joint when fastened prevents pivoting movement of the strips to a position in which the angle between the strips at the front surface of the panel is greater than 180 degrees;

and a piece of a flexible sheet material adhesively attached across the joint on the rear surface of the panel.

2. The panelling system according to claim 1 wherein the strips are connected each to the next, to form the panel, solely by the tongue and groove joint and the piece of material.

3. The panelling system according to claim 1 or 2 wherein the piece of material comprises a tape expending longitudinally of the joint.

4. The panelling system according to any one of claims 1 to 3 wherein the tape includes fiber reinforcement.

5. The panelling system according to any one of claims 1 to 4 wherein:

first ends of the main strips lie in a first common line and second ends of the main strips lie in a second common line;

the main strips have a tongue along the first common line and a groove along the second common line;

a first main strip at one side of the main strips has an exposed tongue along the first main strip for co-operating with a groove of a next adjacent panel and a second main strip at an opposed second side of the main strips has an exposed groove along the second main strip for co-operating with a tongue of a next adjacent panel;

each panel member having associated therewith a first dividing strip arranged to extend along the first common line and a second dividing strip arranged to extend along the second common line;

each of the dividing strips has a front surface of the dividing strip to define with the front surfaces of the main strips the front surface of the panel;

each of the dividing strips has a tongue along one side edge and a

corresponding groove along an opposed side edge;

the first dividing strip has the groove thereof engaged with the tongue along the first common line;

the second dividing strip has the tongue thereof engaged with the groove along the second common line;

the dividing strips being fastened to the ends of the main strips by the tongue and groove joint and the piece of material.

6. The panelling system according to any one of claims 1 to 4 wherein the panel members include dividing strips connected to the main strips where the dividing strips are arranged with a portion of each of the dividing strips of each panel member projecting beyond the main strips of the respective panel member such that, when four of the panel members are assembled into the system with one of the dividing strips between the main strips of each panel member and the next so as to form a rectangular area at a junction between corners of the main strips of the four of the panels, the rectangular area defined at the junction between said four of the panels is filled by said portions of the dividing strips which are shaped to cooperate to fill the rectangular area.

7. The panelling system according to claim 6 wherein each end portion of the dividing strips is shaped to form diagonal end edges at an angle to the respective side edge such that the dividing strips meet at the junction between four of the panel members with the apexes in contact at a center of the rectangular area.

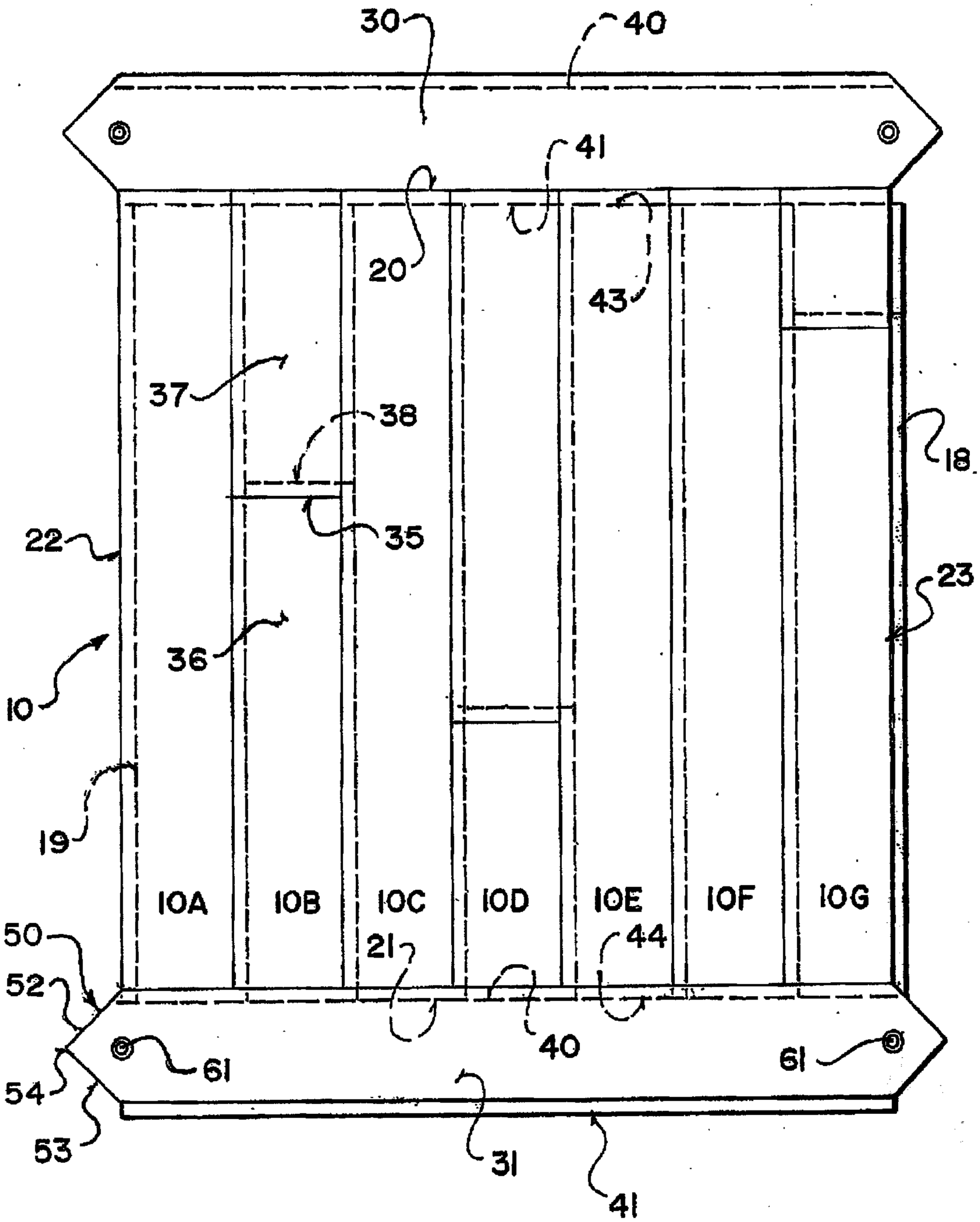
8. The panelling system according to claim 7 wherein one end edge of each end portion has a tongue and an opposed end edge of each end portion has a

groove.

9. The panelling system according to any one of Claims 5 to 8 wherein the dividing strips and the main strips are fastened together to form a common panel member for transportation and installation.

10. The panelling system according to any one of Claims 5 to 9 wherein each of the main strips has the same width between side edges thereof and each dividing strip has substantially the same width as the main strips.

11. The panelling system according to any one of Claims 5 to 10 wherein the end portions of the dividing strips have the end edges thereof in the front surface chamfered such that the dividing strips when butting have a chamfered groove at the front surface.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10A
10B
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FIG. 1

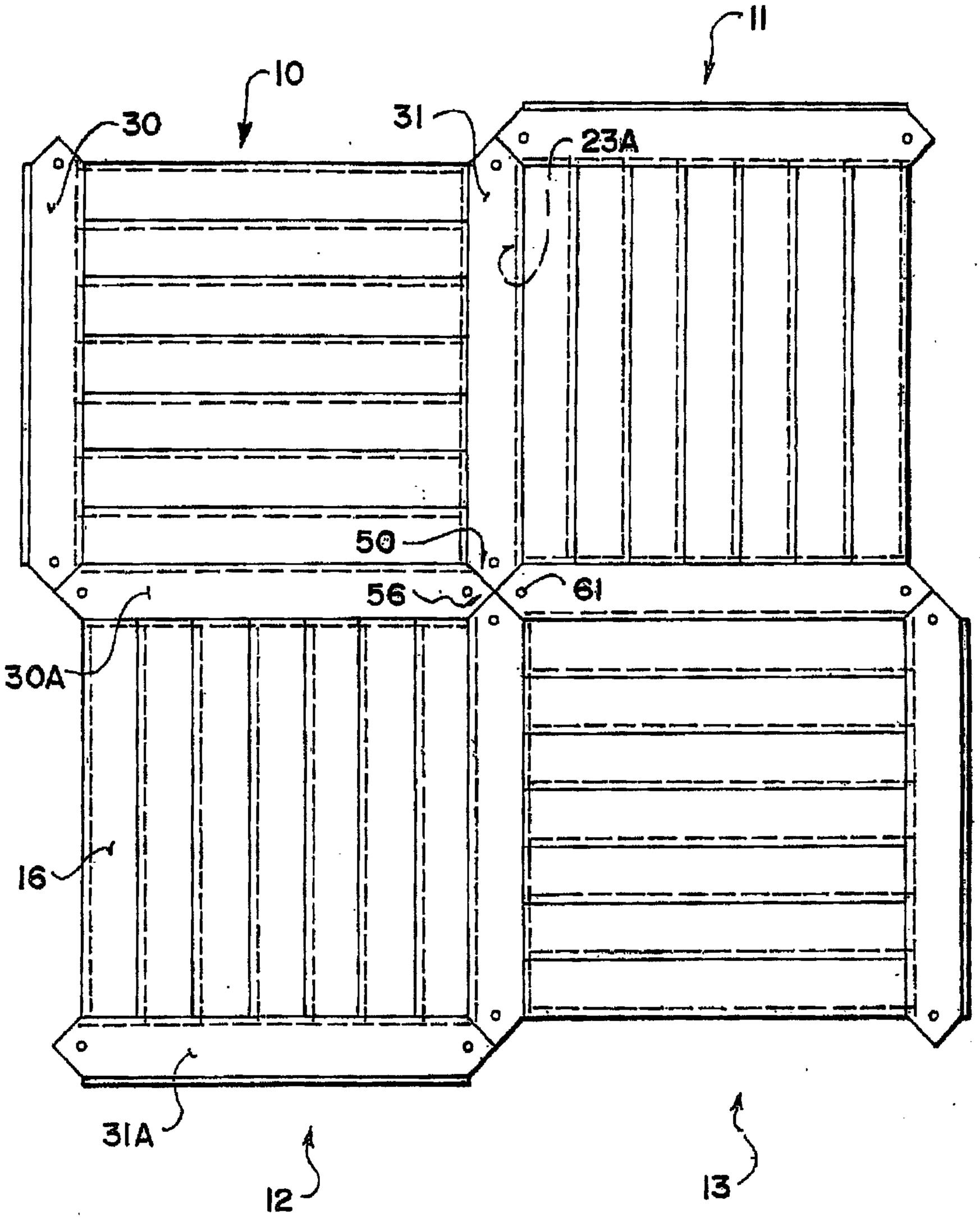
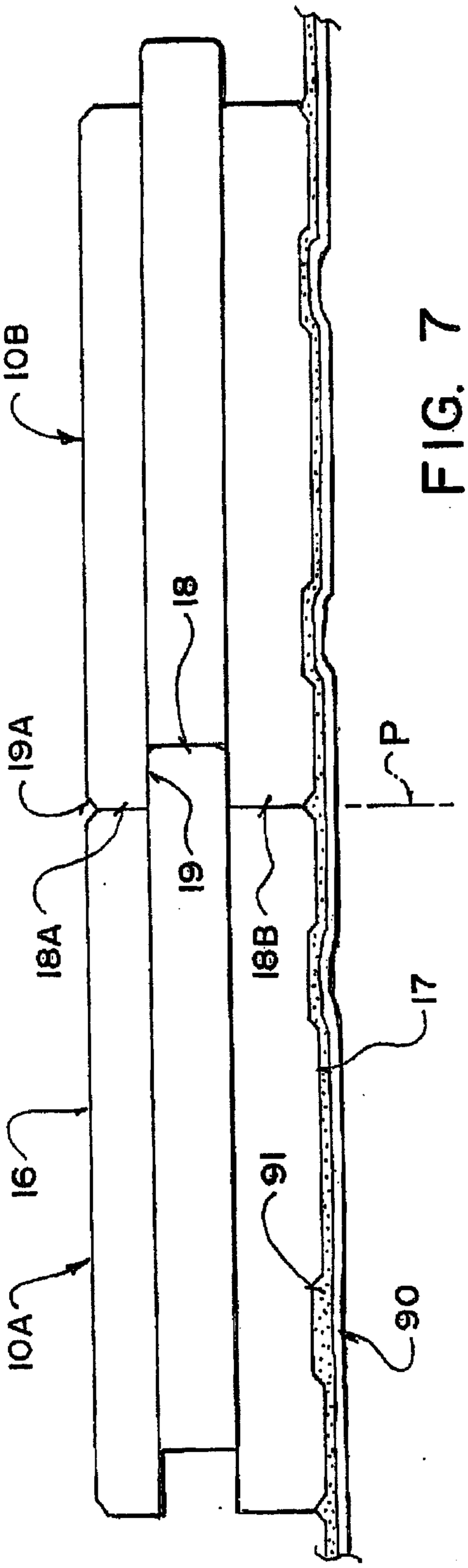


FIG. 2


10B
18
19A
19
18A
18B
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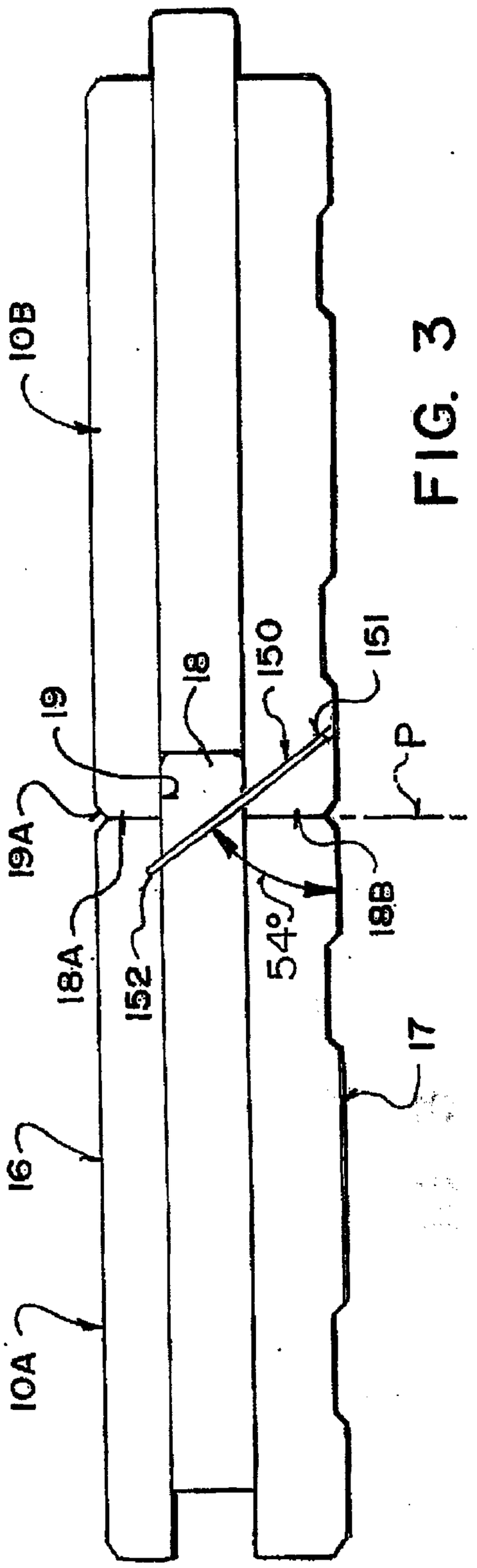
17
16
91
10A
90

FIG. 7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19A
18
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151
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18A
152
54°
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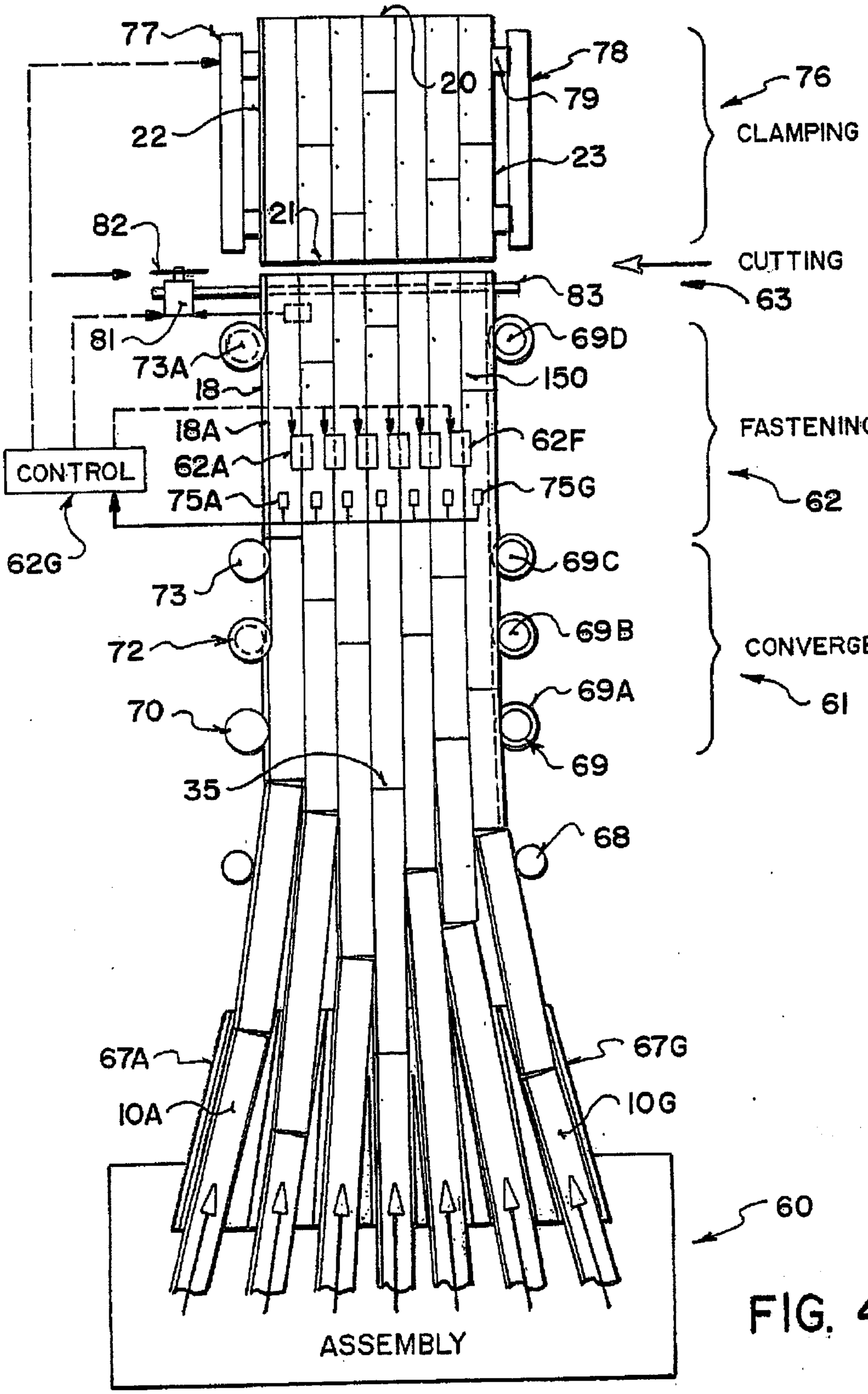
17
16
10A

FIG. 3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62F
FASTENING
62A
CONTROL
75G
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75A
62G
69C
73
69B
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10G
10A
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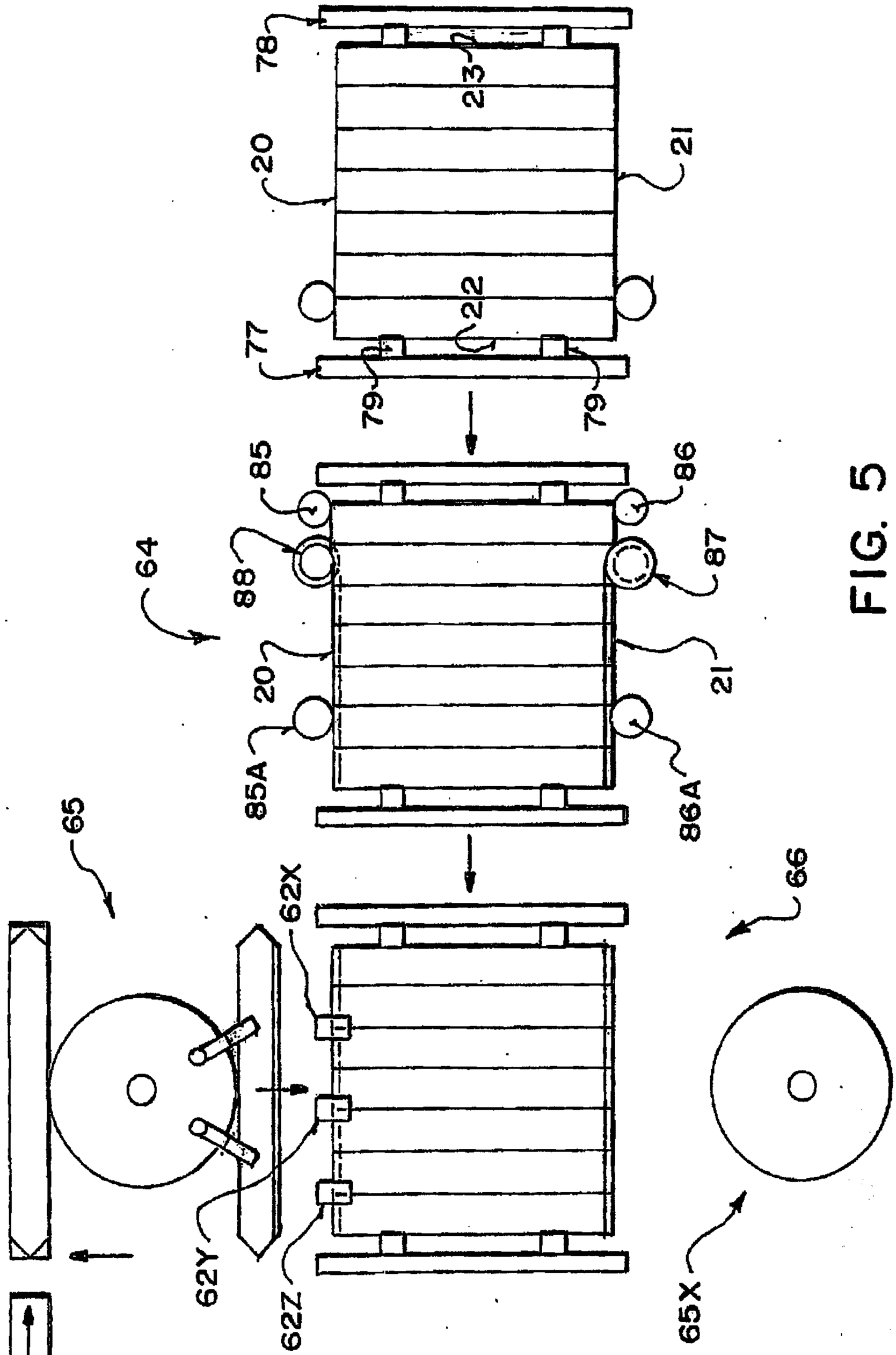
ASSEMBLY

FIG. 4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86A
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62X
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62Y
62Z
65X

FIG. 5

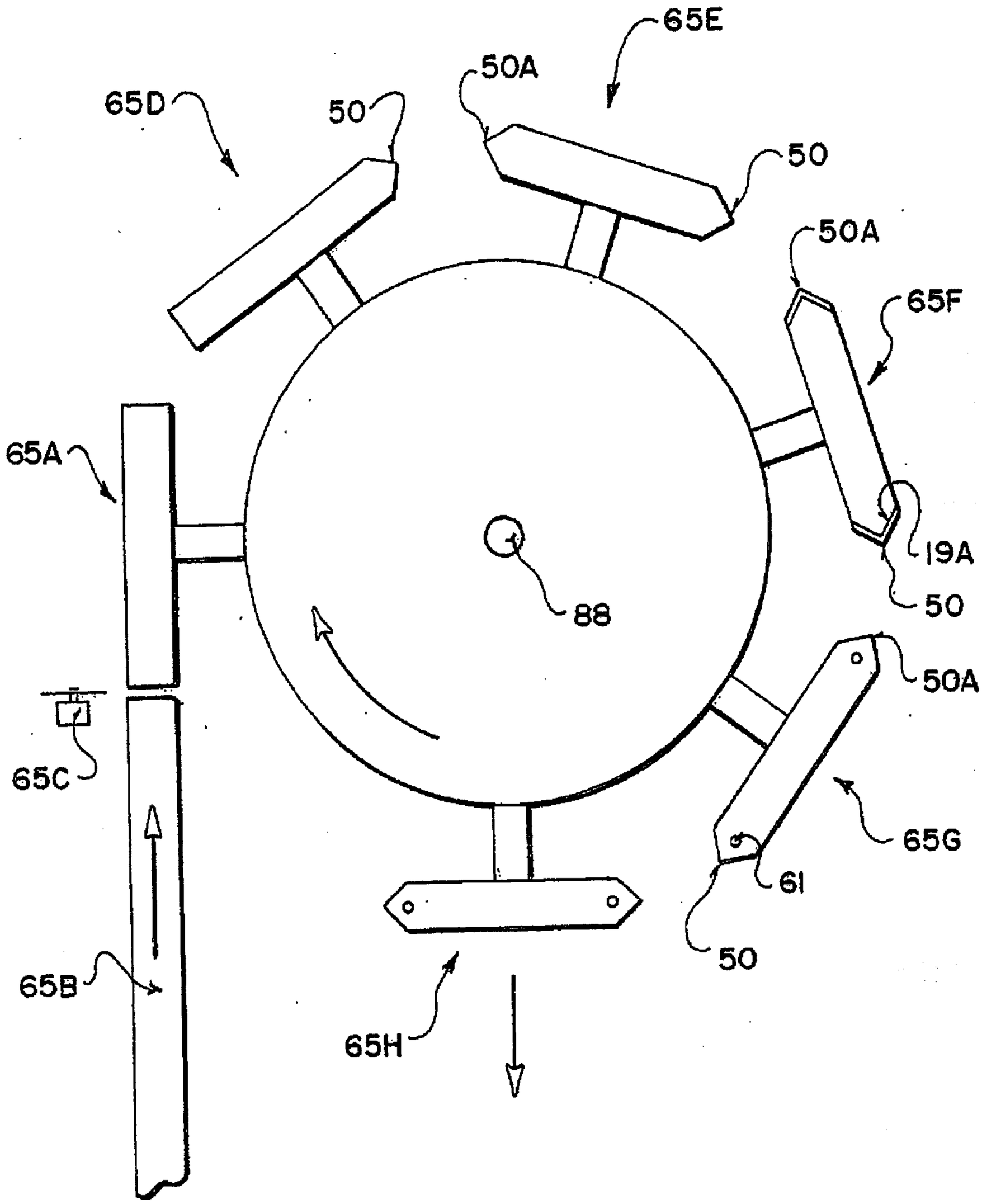

FIG. 6

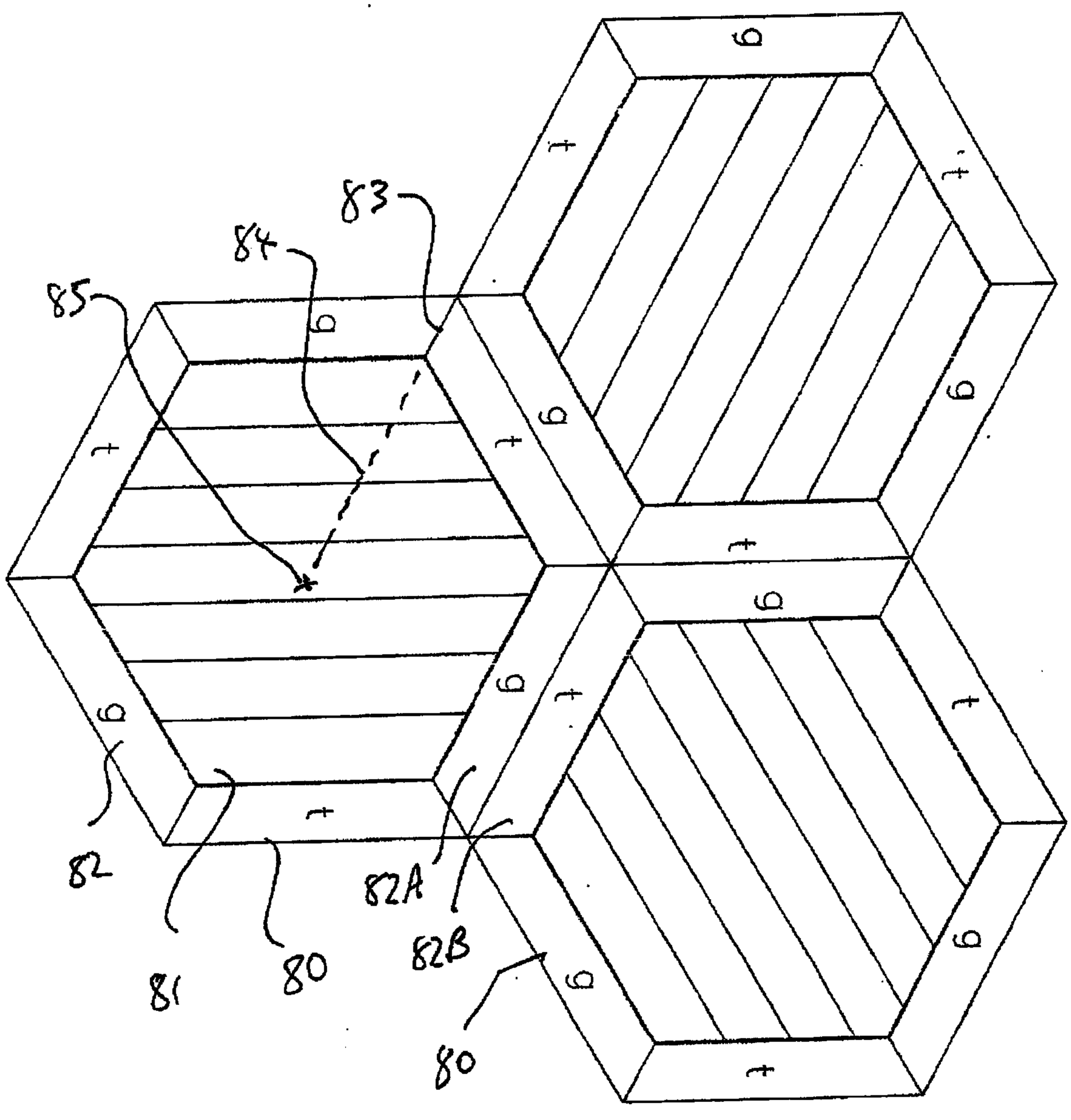

FIG. 8

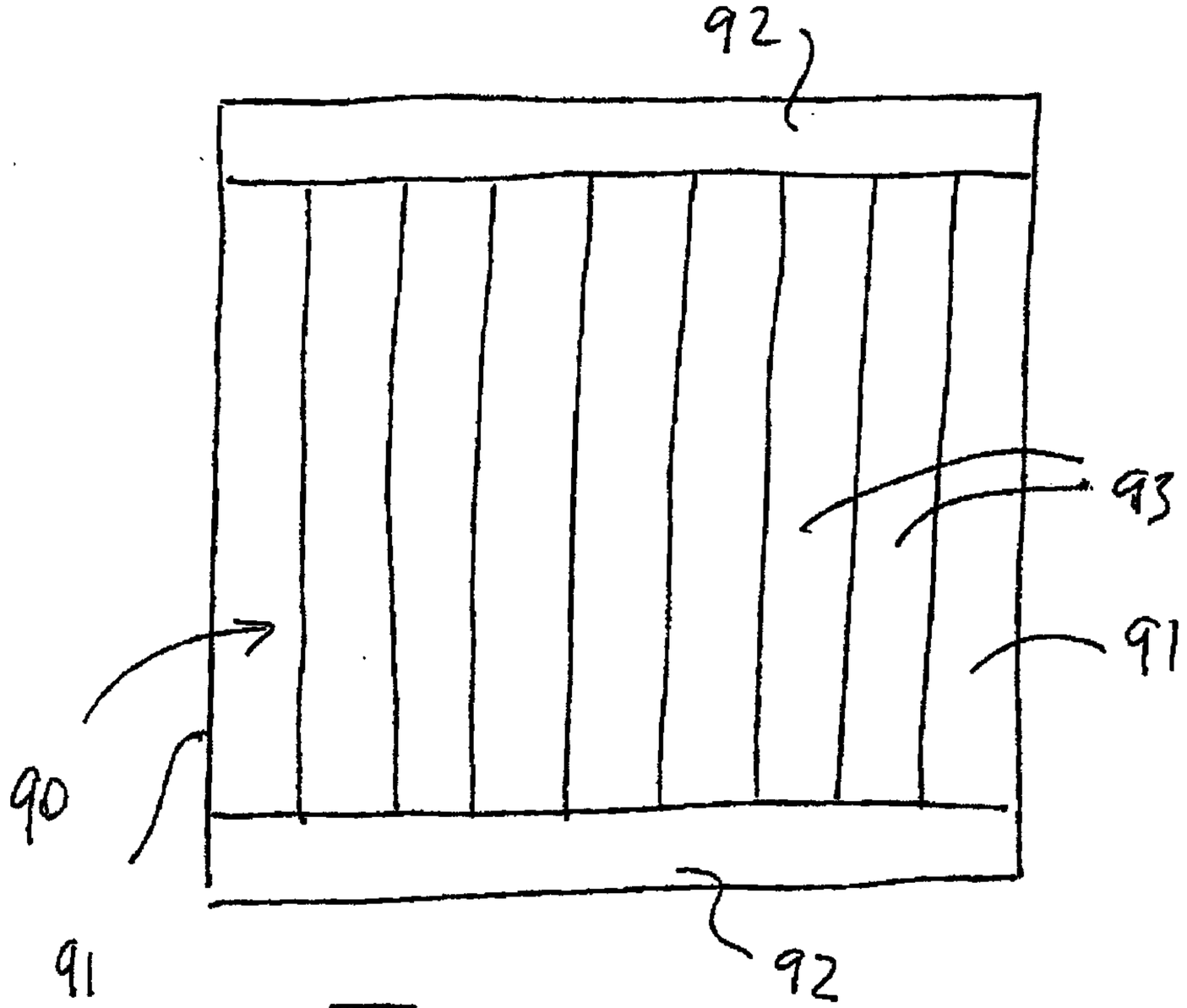

FIG. 9

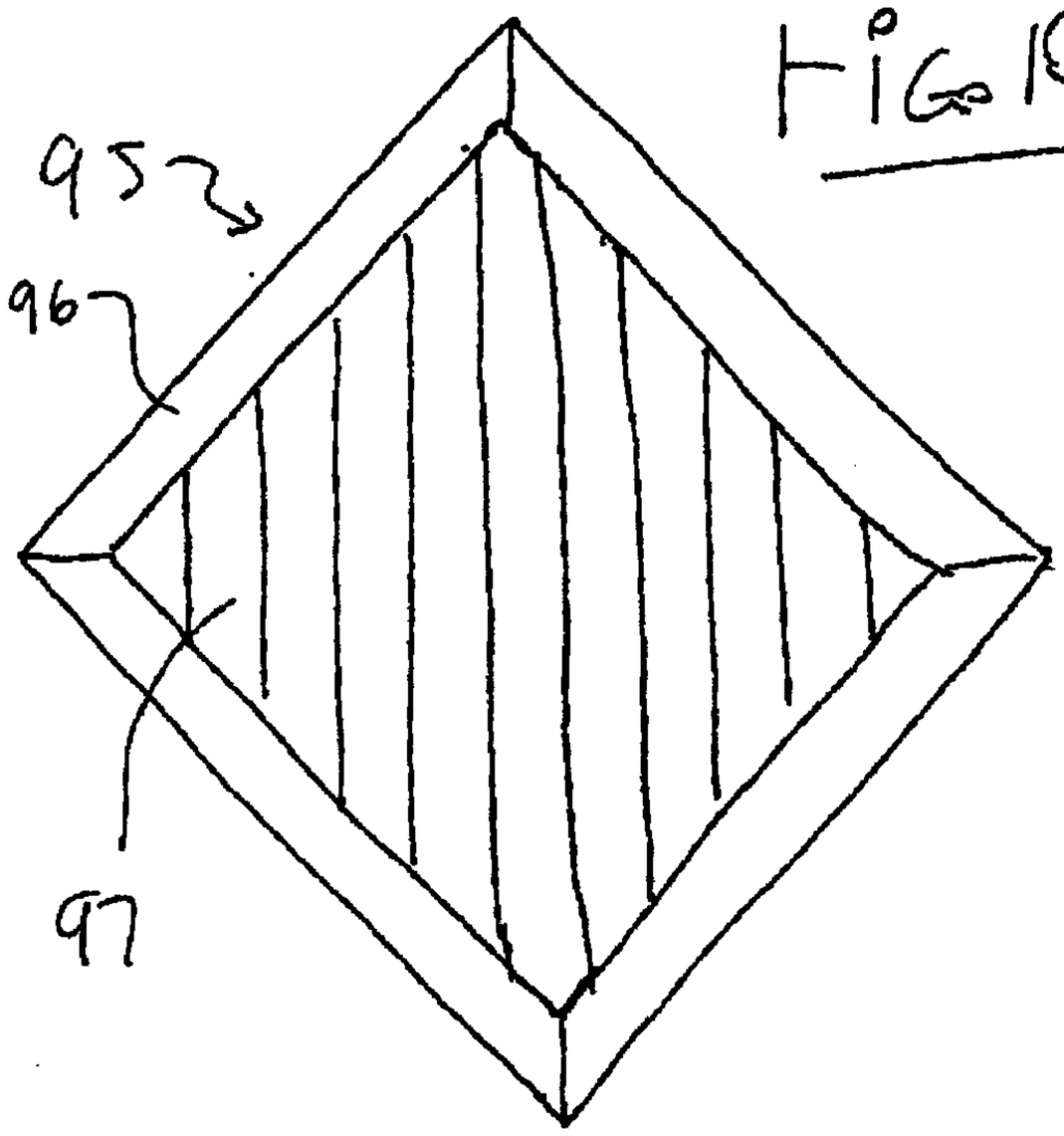

FIG. 10

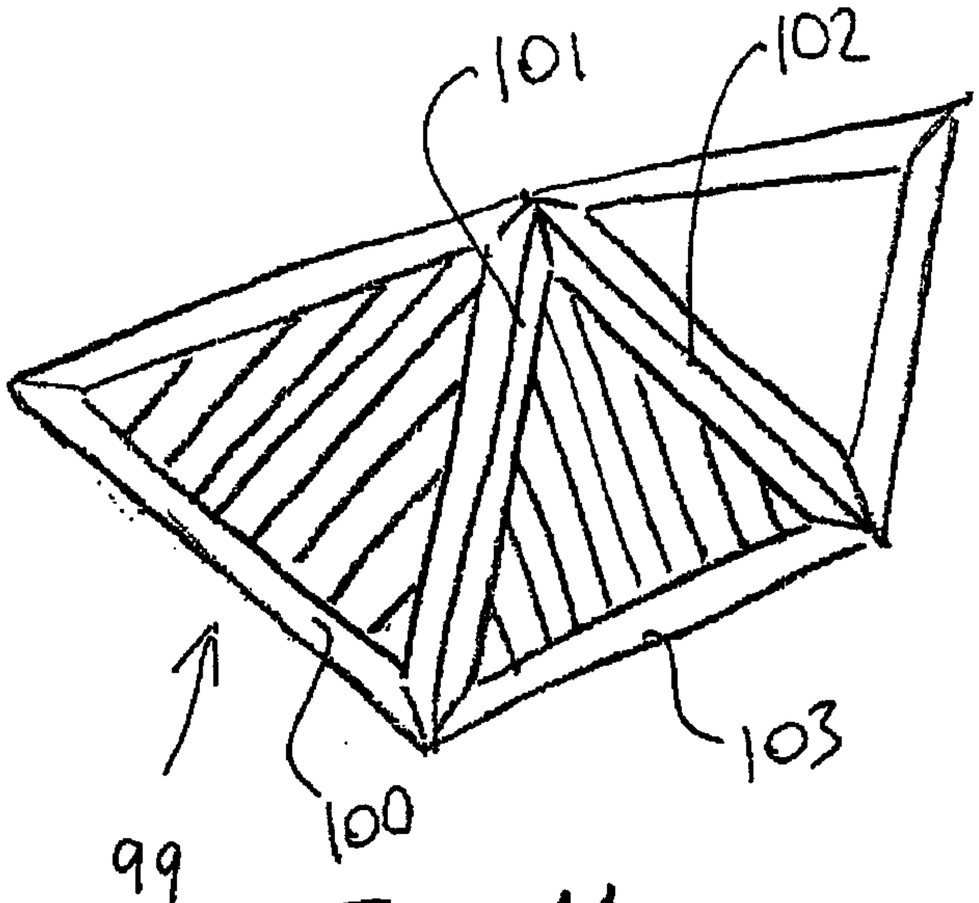

Fig. 11

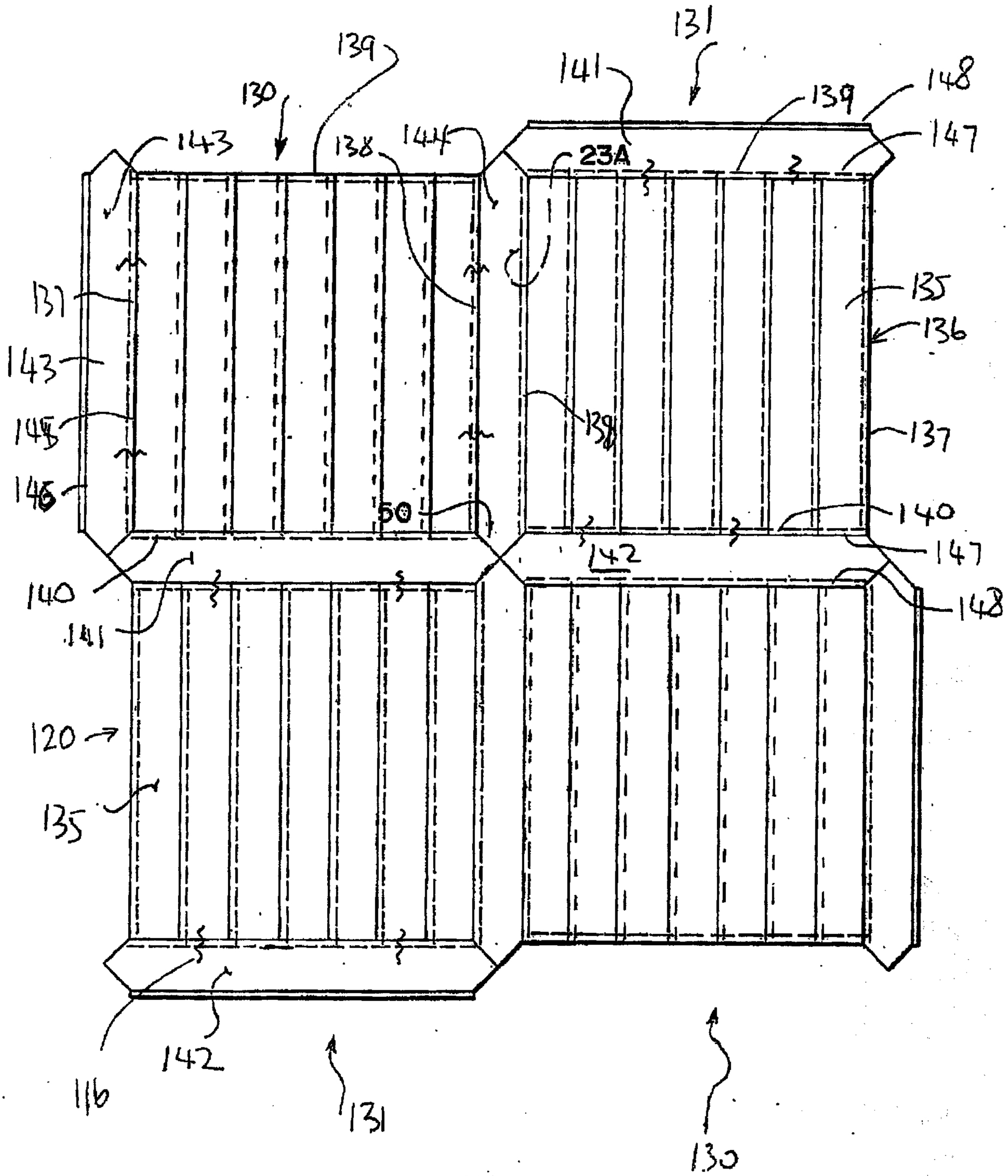
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FIG. 12

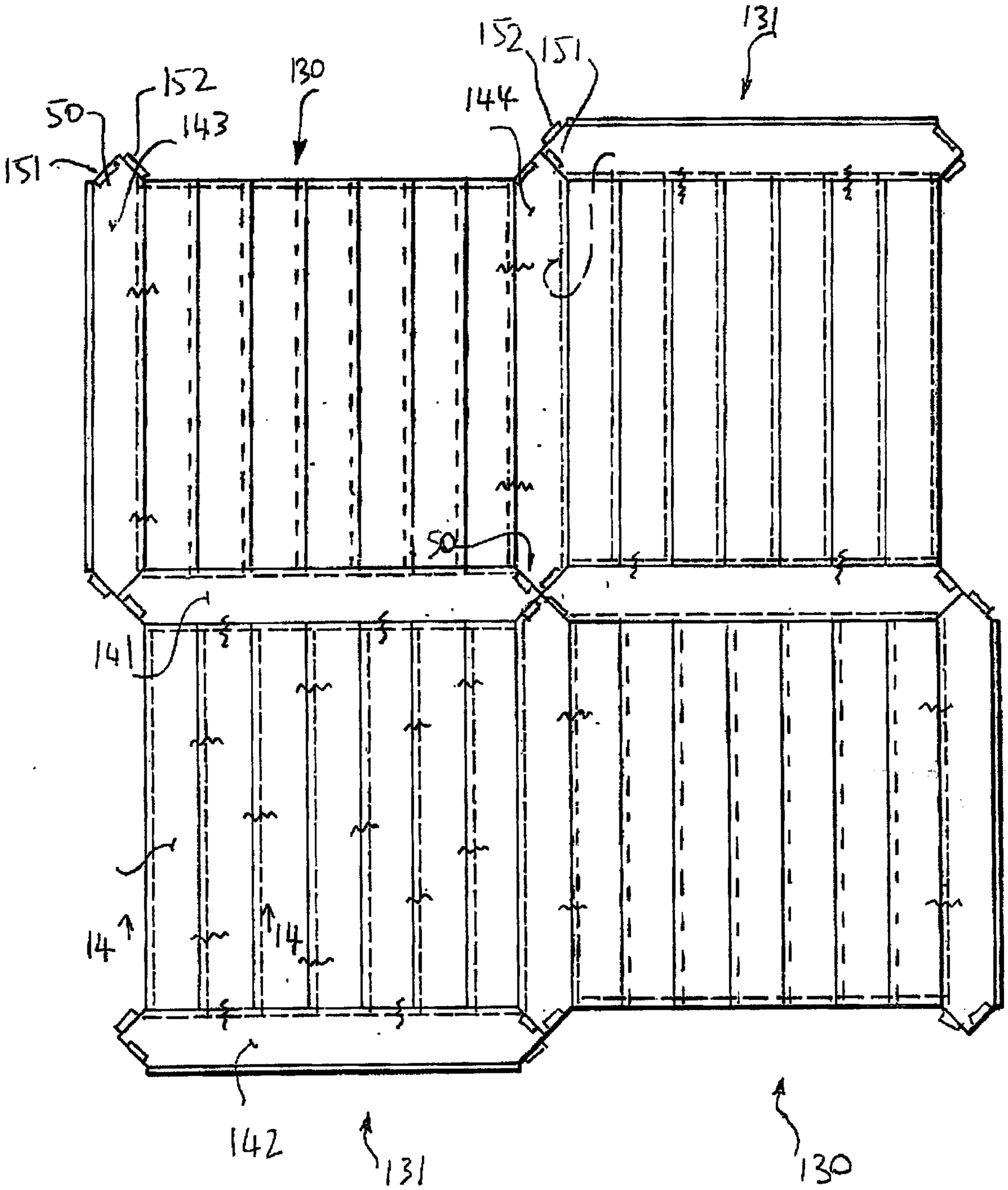

FIG. 13

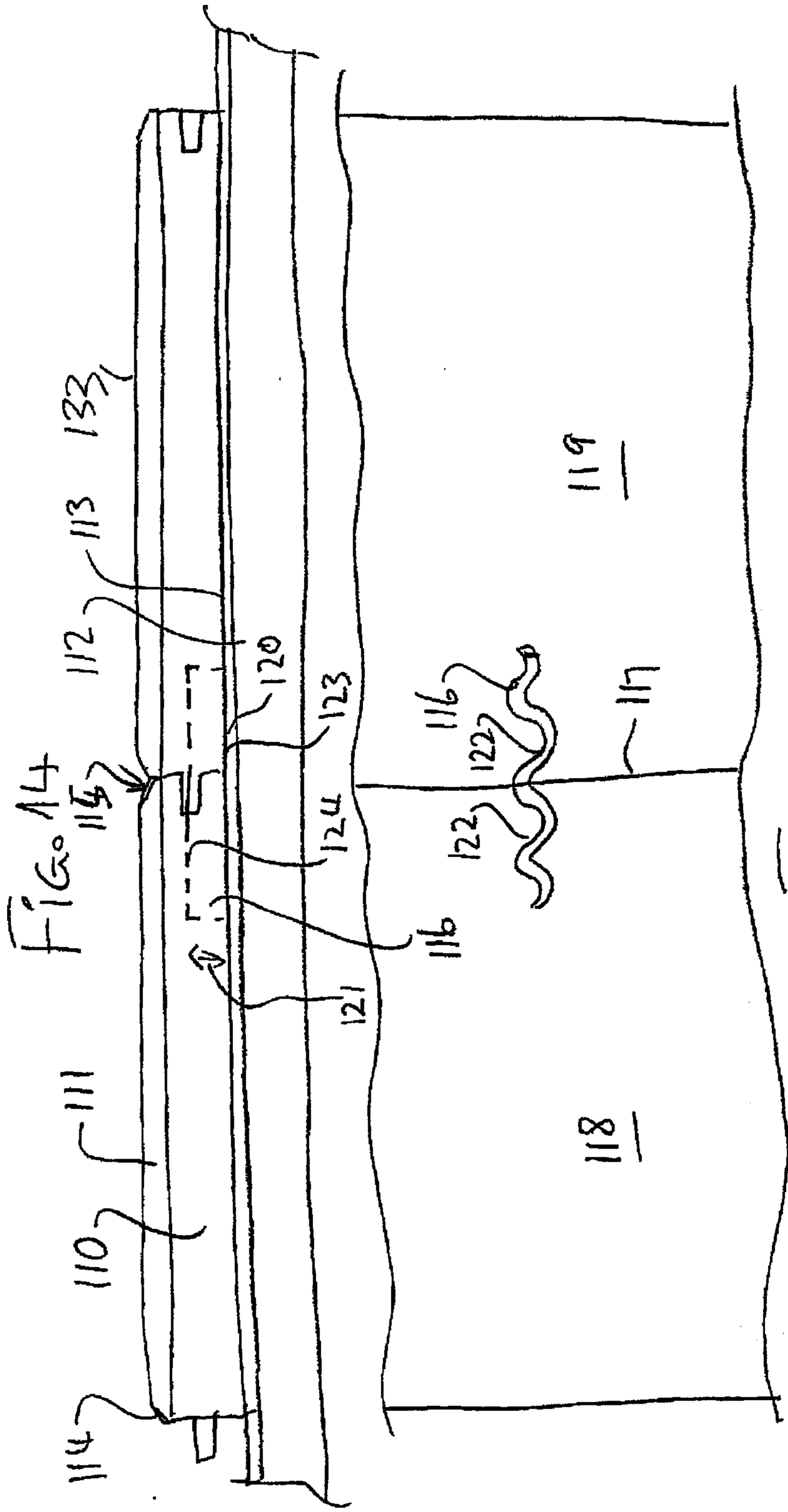

Fig. 14

Fig. 15

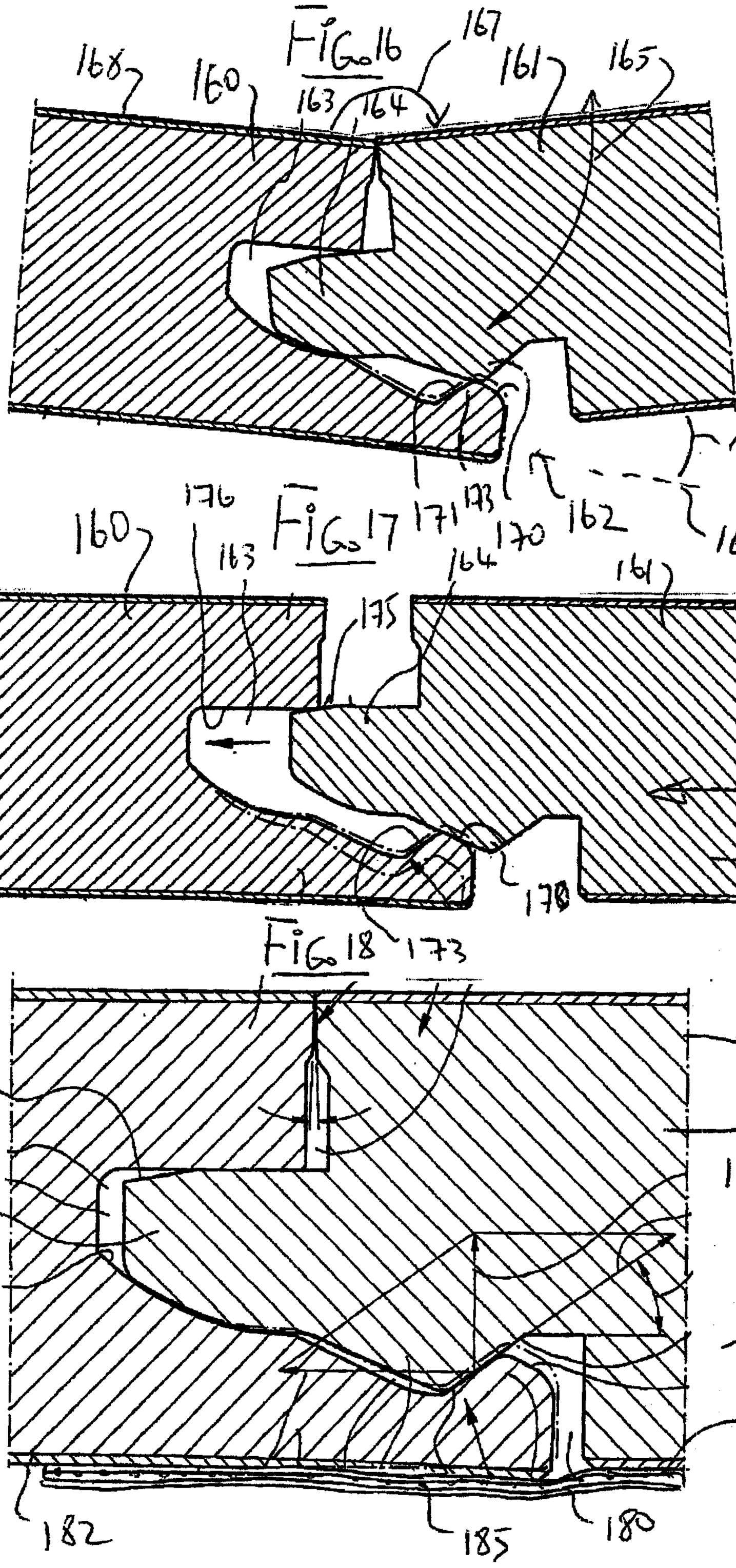
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FIG. 16
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FIG. 17
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FIG. 18
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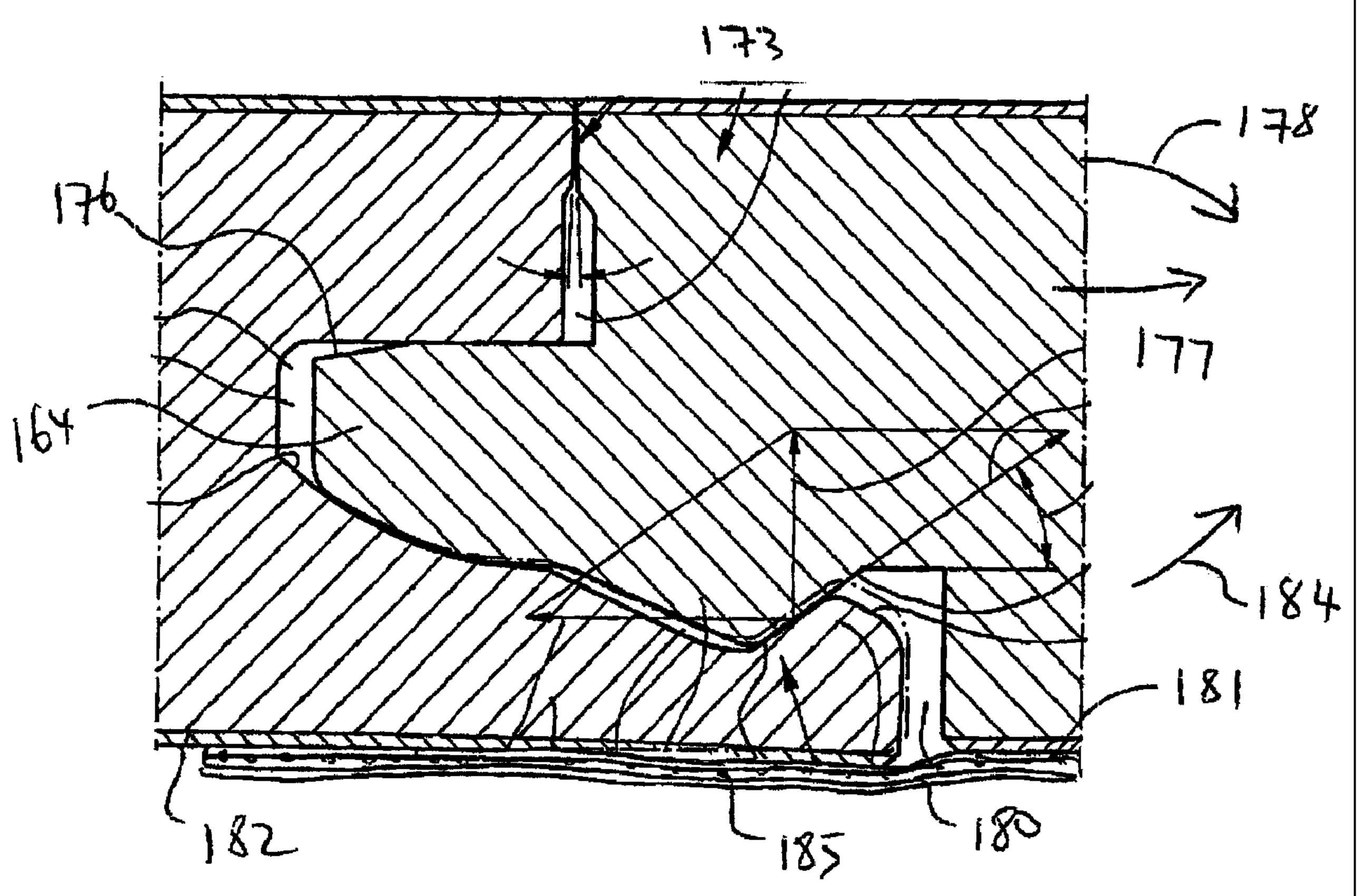
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