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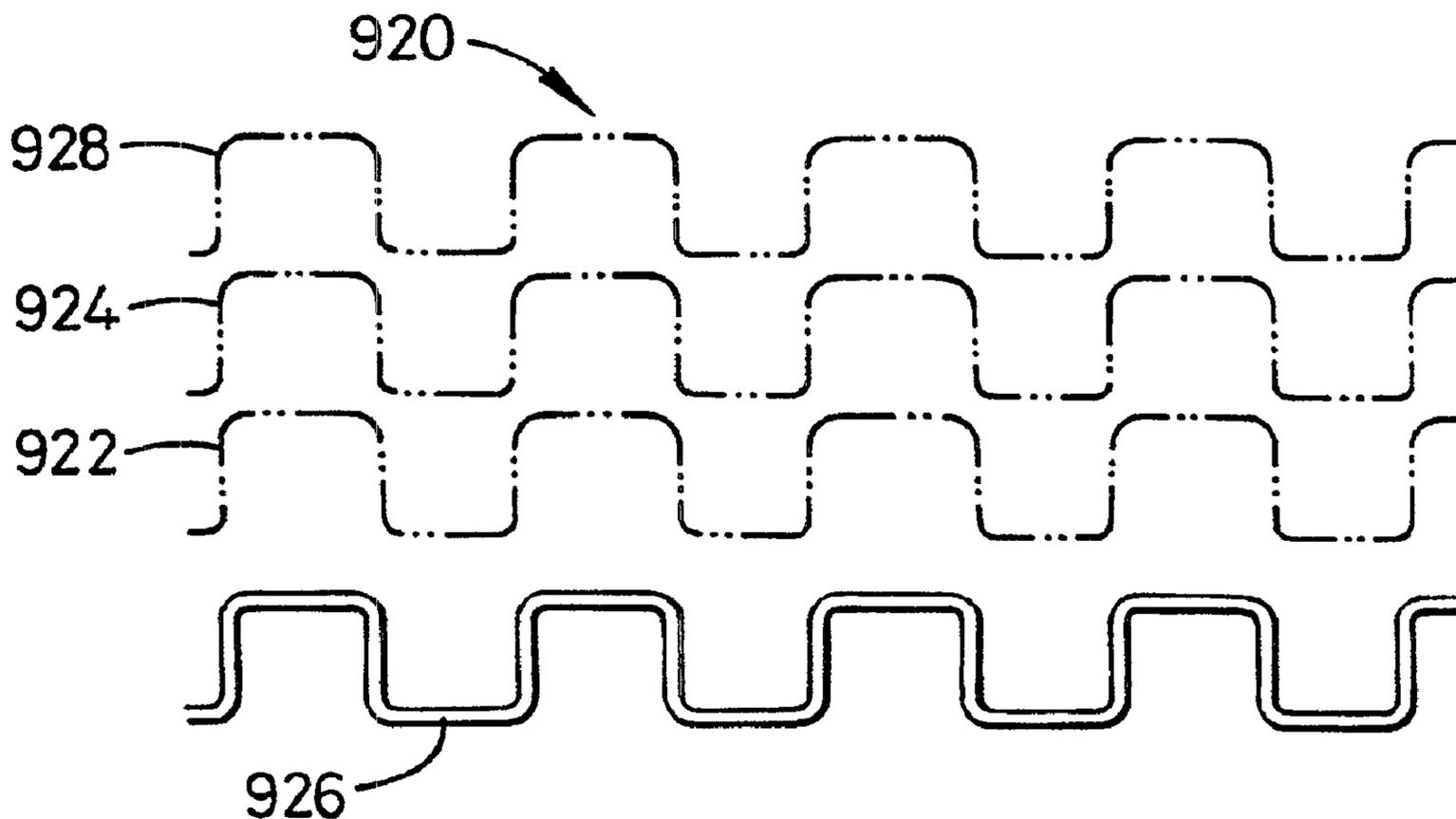
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 (54) Title: SCREEN FOR VIBRATING SEPARATOR



(57) Abrégé/Abstract:

A screen for use in a shale shaker, which screen (900; 920) comprises: (a) a support panel formed with a series of alternating substantially parallel ridges and channels, wherein at least the top of one of said ridges is substantially flat and is provided with at least one elongate opening which is wholly contained within said ridge; and (b) at least a first layer of mesh bonded to said support member, the arrangement being such that in use, if the mesh covering said elongate opening in said ridge is punctured said mesh overlying said elongate opening can be removed and the open cell formed thereby fitted with a plug. A frame for supporting a screen, which frame comprises a plurality of spaced-apart strips (502) secured to and between spaced-apart sides (504), characterised in that at least one of said strips (502) is provided with at least one projection (553) to be received in a corrugation in a corrugated screen. A panel for a screen, said panel comprising a plurality of groups of perforations, each group comprising six generally equal triangular apertures (513, 514, 515) arranged with their apices facing a central portion (550), wherein the apices of two (514, 515) opposing ones of said triangular apparatus are spaced apart further than the apices of opposed ones of the remaining triangular apparatus (513, 513; 513, 513).

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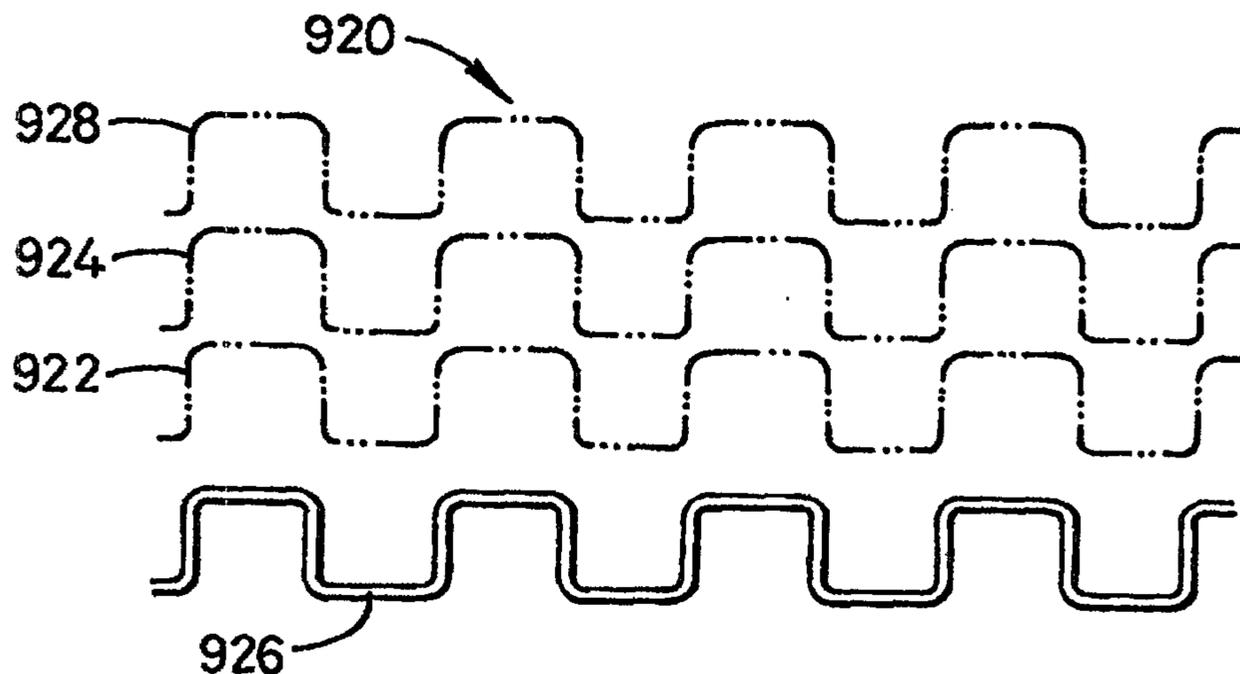
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(54) Title: SCREEN FOR VIBRATING SEPARATOR



(57) Abstract

A screen for use in a shale shaker, which screen (900; 920) comprises: (a) a support panel formed with a series of alternating substantially parallel ridges and channels, wherein at least the top of one of said ridges is substantially flat and is provided with at least one elongate opening which is wholly contained within said ridge; and (b) at least a first layer of mesh bonded to said support member, the opening can be removed and the open cell formed thereby fitted with a plug. A frame for supporting a screen, which frame comprises a plurality of spaced-apart strips (502) secured to and between spaced-apart sides (504), characterised in that at least one of said strips (502) is provided with at least one projection (553) to be received in a corrugation in a corrugated screen. A panel for a screen, said panel comprising a plurality of groups of perforations, each group comprising six generally equal triangular apertures (513, 514, 515) arranged with their apices facing a central portion (550), wherein the apices of two (514, 515) opposing ones of said triangular apparatus are spaced apart further than the apices of opposed ones of the remaining triangular apparatus (513, 513; 513, 513).

SCREEN FOR VIBRATING SEPARATOR

The invention relates to a screen for use in a shale shaker.

Vibrating screens have been employed for many years to separate particles in a wide array of industrial applications. One common application of vibrating screens is in drilling operations to separate particles suspended in drilling fluids. The screens are generally flat and are mounted generally horizontally on a vibrating mechanism or shaker that imparts either a rapidly reciprocating linear, elliptical or circular motion to the screen. Material from which particles are to be separated is poured onto a back end of the screen, usually from a pan mounted above the screen. The material generally flows toward the front end of the screen. Large particles unable to move through the screen remain on top of the screen and move toward the front of the screen where they are collected. The smaller particles and fluid flow through the screen and collect in a pan beneath the screen.

A vibrating screen may be formed from one or more layers of wire mesh. Wire mesh is generally described with reference to the diameter of the wires from which it is woven, the number wires per unit length (called a mesh count), and the shape or size of the openings between wires. Wire mesh comes in various grades. "Market" grade mesh generally has wires of relative large diameter. "Mill" grade has comparatively smaller diameter wires and "bolting cloth" has the smallest diameter wire. The type of mesh chosen depends on the application. Smaller diameter wires have less surface and thus less drag, resulting in greater flow rates. Smaller diameter wires also result, for a given opening size, in a larger percentage of open area over the total area of the screen, thus allowing greater flow rates and

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increased capacity. However, screens of bolting cloth
tear more easily than market or mill grade screens,
especially when used in harsh conditions such as
drilling and mining operations. The smaller diameter
5 wires tend to have less tensile strength and break more
easily, and the finer mesh also tends not to retain its
shape well.

Most meshes suffer from what is termed as "near
sized particle blinding". During vibration, wires
10 separate enough to allow particles of substantially the
same size or slightly larger than the openings to fall
between the wires and become lodged, thus "blinding" the
openings of the screen and reducing capacity of the
screen. If a particle becomes lodged when the wires are
15 at a maximum distance apart, it is almost impossible to
dislodge the particle. Sometimes, however, wires will
subsequently separate further to release the lodged
particle. Unfortunately, some wire mesh, especially
bolting cloth, is tensioned. Tensioning restricts
20 movement of the wires. Restricting movement assists in
holding the shape of the wire mesh, keeping the size of
the openings consistent to create a more consistent or
finer "cutting point" and reducing abrasion from wires
rubbing against each other. However, restricted
25 movement of the wires reduces the probability that, once
a near sized particle becomes stuck, the wires will
subsequently separate to allow the particle to pass.
Use of smaller diameter wires, with smaller profiles,
helps to reduce blinding. With a smaller diameter wire,
30 a particle is less likely to become lodged midway
through the opening.

Multiple layers of mesh may be used to alleviate
blinding. U.S. Patent No. 4,033,865 to Derrick, Jr.,
describes layering two meshes in a manner that results
35 in at least one wire of the lower of the two meshes

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bisecting each opening in the upper mesh. The openings in each mesh are at least twice as wide as the diameters of the wires and the lower mesh has openings the same size as or slightly larger than the openings in the upper mesh. The lower mesh, when held tightly against the upper mesh, prevents particles from migrating far enough into an opening in the upper mesh to be trapped. Some relative movement of the layers also helps to dislodge particles caught in the upper layer. The two-layer arrangement has the further benefit of a finer "cutting point," allowing smaller particles to be separated out. A third "backing" layer of relatively coarse, mill grade mesh is often used to carry most of the load on the screen and to increase the tensile strength of the screen.

Another problem faced in most applications is the inevitable tearing of the screen. The problem can be especially acute in heavy duty applications such as drilling and mining. A torn screen must be replaced or repaired. To facilitate repair, the screen layers are bonded to a flat rigid or semi-rigid support panel that has a pattern of large openings, forming on the screen a plurality of small cells of wire mesh. When a tear occurs in the screen, the mesh remaining within the cell in which the tear occurred is cut out and the cell is plugged. The capacity of the screen is diminished but its life is extended. Typically, several cells of a screen can be repaired before its capacity drops far enough to require replacement. Unfortunately, bonding the screen to the support panel further restricts relative movement of the layers and the wires in each mesh layer, thus compounding the problem of blinding.

Blinding and tearing of the screens are inevitable, and thus capacity of the screen continually drops through its useful life. Although capacity can be

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increased by increasing the total area the screens, the size of the screen is limited in most applications, such as on drilling rigs, especially those on offshore platforms. There has thus been generally a trade-off
5 between capacity, longevity, repairability and resistance to blinding of the screens.

According to one aspect of the present invention there is provided a screen for use in a shale shaker, which screen comprises:

- 10 (a) a support panel formed with a series of alternating substantially parallel ridges and channels, wherein at least the top of one of said ridges is substantially flat and is provided with at least one elongate opening which is wholly contained within said ridge: and
15 (b) at least a first layer of mesh bonded to said support member, the arrangement being such that, in use, if the mesh covering said elongate opening in said ridge is punctured said mesh overlying said elongate opening can be removed and the open cell formed thereby fitted
20 with a plug.

The ridges and channels increase the surface area of the screen without increasing the overall dimensions of the screen, thus improving flow capacity. Additionally, with the vibration, particles tend to drop
25 into the channels, leaving the tops of the ridges exposed to fluids for relatively unimpeded flow through the screen that further improves flow rates. Furthermore, the ridges and channels tend to assist in distributing separated particles across the screen.
30 Uneven distribution, due to for example rolling of the screen from side to side when used on offshore platforms, degrades the flow capacity of the screen.

According to another aspect of the invention there

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is provided a frame for supporting a screen, which frame comprises a plurality of spaced-apart strips secured to and between spaced-apart sides, characterised in that at least one of said strips is provided with at least one
5 projection to be received in a corrugation in a corrugated screen.

The present invention also provides a panel for a screen, said panel comprising a plurality of groups of perforations, each group comprising six generally equal
10 triangular apertures arranged with their apices facing a central portion, wherein the apices of two opposing ones of said triangular apparatus are spaced apart further than the apices of opposed ones of the remaining triangular apparatus.

15 Preferably, in the above one aspect, the bottom of the channels are generally 'v' shaped, the bottom of at least one of the channels is substantially flat and is provided with at least one elongate opening which is wholly contained within the channel, such that, in use,
20 the mesh is positioned to cover the elongate opening in the channel, the mesh is capable of being punctured and removed and the open cell formed thereby fitted with a plug.

Desirably, the channel of the one above aspect and
25 the ridge include sides, at least one of which is provided with at least one elongate opening which is wholly contained within the side such that, in use, the mesh is positioned to cover the elongate opening in the side, the mesh capable of being punctured and removed
30 and the open cell formed thereby fitted with a plug, the elongate opening only extends across the side or the top of the ridge or the elongate opening only extends across the side or the bottom of the channel.

Moreover, it is preferable the above one aspect
35 further comprises a second layer of mesh bonded to the

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support panel, and a third layer of mesh bonded to the support panel.

In the one other aspect of the present invention there is provided a screen assembly for a vibratory separator, the screen assembly comprising a corrugated support plate having a plurality of alternating raised portions and lower portions, the corrugated support plate having a plurality of spaced apart openings therethrough, a screen frame with a first pair of spaced apart first sides and a second pair of spaced apart second sides, the first sides spaced apart by the second sides and connected thereto, the frame having a plurality of spaced apart support strips extending beneath the corrugated support plate, each support strip independent of and not connected to the other support strips along its length, each support strip having two spaced apart ends each connected to a spaced apart side of the frame and to which the corrugated support plate is secured, wherein each support strip has at least one projecting portion for reception within a raised portion of the corrugated support plate, and screening material on the corrugated support plate.

It is desirable the plurality of spaced apart support strips are made of a material from the group consisting of metal, plastic, fiberglass, rubber or cermet, the spaced-apart openings of the corrugated support plate are triangular, the spaced-apart openings are positioned side-by-side in an array that extends across substantially all of the corrugated support plate, and the array comprises rows of triangular openings, each row including a repeating pattern of a first, second, and third triangular opening, the first and third triangular openings positioned with a main base down and a vertex pointing away from the base, the second triangular opening positioned between the first

- 5b -

and third triangular openings with a primary vertex pointing toward a line connecting the bases of the first and third main triangular openings and positioned between sides of the first and third triangular openings, the second triangular opening with a primary base disposed beyond a line between the vertices of the first and third triangular openings that point away from their main bases.

It is further desirable the first triangular openings of adjacent rows are positioned with their main bases in a side-to-side relationship, the third triangular openings of adjacent rows are positioned with their main bases in a side-to-side relationship, the second triangular openings of adjacent rows are positioned with their primary vertices pointing at each other, the corrugated support plate has two spaced-apart opposed sides, each of the sides having an upturned edge to facilitate anchoring the screen assembly to the vibratory separator, and further comprises the screening material comprising at least one wire mesh secured on the corrugated support plate.

Further desirable is the at least one wire mesh is a plurality of wire meshes. It is also further desirable the above further comprises the corrugated support plate made of metal, and bonding material bonding the at least one wire mesh to the corrugated support plate.

Preferably, the bonding material is an adhesive and adhesive envelops solid areas of the corrugated support plate between the spaced-apart openings of the corrugated support plate.

It is also further desirable the corrugated support plate is made of metal and the at least one wire mesh is bonded directly to the corrugated support plate with no plastic grid therebetween.

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Moreover, it is preferable the adhesive is cured and the at least one wire mesh is in tension on the corrugated support plate due to thermal expansion effected during curing of the adhesive, the above
5 further comprises a series of openings at opposed sides of the corrugated support plate beneath the raised portions, and a plug in each opening beneath a raised portion, the at least one projecting portion is at least two projecting portions, each of the at least two
10 projecting portions projecting into a raised portion of the corrugated support plate, and for each raised portion of the corrugated support plate there is a corresponding projecting portion of each support strip.

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For a better understanding of the present invention reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 is an exploded end view of a screen;

5 Figure 2 is a plan view of the screen of Figure 1 with parts removed for clarity;

Figure 3 is a plan view of an alternative embodiment of screen with parts removed for clarity;

10 Figure 4 is an exploded end view of the screen of Figure 3;

Figure 5 is a perspective view of an end portion of a screen similar to that shown in Figures 3 and 4 undergoing repair;

15 Figure 6 is a top plan view of a plug for repairing the screen of Figure 5;

Figure 7 is a cross-section of a plug of Figure 6, taken along section line 7-7;

20 Figure 8 is an end view of a portion of a screen similar to that shown in Figure 5 mounted to the basket of a shaker, showing a latching mechanism for securing the screen to the shaker;

Figure 9 is a side view of the screen illustrated in Figure 1;

25 Figures 10 and 11 are end views of screens in accordance with the present invention;

Figure 12 is an end view of an alternative plug; and

* * *

30 Fig 13a is a plan view of a frame in accordance with the present invention for supporting a screen;

Fig. 13b shows, to an enlarged scale, a detail of the frame shown in Fig. 13a;

Fig. 13c is an end view of the frame shown in Fig. 13a;

35 Fig. 14 shows one alternative detail to the detail

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shown in Fig. 13b;

Fig. 15 shows another alternative detail to the detail shown in Fig. 13b;

* * *

5 Fig. 16 is a plan view of a panel for a screen;

Fig. 17 is a plan view of a panel for a screen in accordance with the present invention;

Fig. 18 is a perspective view of a screen;

10 Fig. 19 shows, to an enlarged scale, a detail of the screen shown in Fig. 18;

Figs. 20 to 24 show end views of five different embodiments of corrugated panels mounted on supports.

Referring to Figures 1 and 9, there is shown a screen 100 which includes a first layer 102 of wire mesh and a second layer 104 of wire mesh. Preferably, the first layer 102 is made from a web of bolting cloth grade wire mesh. The second layer 104 is a backing mesh. The first and the second layers 102, 104 are supported on a panel 106. The panel 106 is formed to create a plurality of ridges 108 running the length of the screen 100, defining therebetween a plurality of channels 110. The channels 110, which can be clearly seen in Figure 2 (in which the first layer 102 and second layer 104 of wire mesh have been omitted for clarity), run the length of the screen 100 from the back end of the screen 100 to its front end 112. Attached to each side of the screen are hook straps 114. Each hook strap 114 is bonded to the frame 106 and the first layer 102 and second layer 104. Steel straps 116 support the first and second layers 102, 104.

The screen is secured to a shaker in a well known manner by hooking around the hook straps 114 and tightening rails disposed along the edges of the basket of a shaker (not shown). A series of stringers below the screen (not shown) cause the screen to bow as the rails

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pivot downwardly as they are tightened.

During operation, material containing solids to be separated is poured onto the back of the screen. Solids tend to collect in the channels and move towards the front end 112 of the screen 100 when the screen is vibrated. Fluid and particles smaller than the openings in the finest layer of mesh flow through the mesh along the sides of ridges 108 and the bottoms of channels 110.

Referring now to Figures 3 and 4, in an alternate embodiment of screen 400, a first layer 402 of wire mesh, a second layer 404 of wire mesh and a third layer 405 of wire mesh (the layers 402, 404, 405 are shown only in Figure 4 exploded away from panel 302) are bonded to panel 302.

The first and second layers (402, 404) are a bolting cloth grade wire mesh. The third layer 405 is a mill grade or market grade wire mesh supporting the first and second layers 402, 404. The panel 302 is formed from a sheet of metal by punching or cutting an array of elongated, rectangular openings 304 into the sheet of metal according to a predetermined pattern. The openings have uniform size and shape. The sheet is then bent with a press or rolled into a corrugated configuration substantially as shown in Figure 4. The corrugated configuration is comprised of alternating series of triangular shaped ridges 306 and flat bottom channels 308. Each triangular ridge 306 has two substantially flat side surfaces separated by a narrow peak 309.

Along each end of the panel is bonded a frame 310. Frame 310 is contoured to fit and provide support for the ridges 306. The screen is formed so that its side edges run along the peak of a ridge 306. Terminating the sides of the screen along a ridge helps to prevent material from falling between the screen and the inside

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wall of a shaker basket (not shown) over which the screen is placed.

Each opening 304 is located on a flat surface of either a side of a ridge or a bottom surface of a channel. The rectangular shape of the openings allows as much of the flat surface to be cut with openings as is possible while leaving enough solid area to remain to form a grid or lattice-like structure that will retain its shape and not break during normal use.

Once the panel is formed, the first layer 402, the second layer 404 and the third layer 405 of wire mesh are heated and then bonded to the panel. The heating expands the wire mesh. After the wire mesh is bonded to the panel, it cools and contracts, thus tensioning the wire mesh. Tensioning helps to maintain uniformity of the wire mesh and to keep the first 402 and second 404 layers of wire mesh together during operation, thus giving the screen a finer cutting point. Tensioning the wire mesh also assists in conveying particles to the end of the screen. A slack screen will not convey particles as well, especially when heavily loaded.

Referring now to Figure 5, a perspective view of a portion of a screen 400 shows a layer of wire mesh 502, which includes wire mesh webs 402, 404 and 405 (Fig. 4) bonded to panel 302. Should a tear develop in wire mesh layer 502, the wire mesh surrounding the tear is cut from around the opening 304 in which the tear occurs. A plug 504 is then inserted into the opening in the screen to seal the screen.

Referring now to Figures 6 and 7, plug 504 is made of an elastic rubber or similar elastomeric material. Its width and length are very slightly larger than one of the openings 304. It has a flat top section surrounded on all sides by a skirt-like side edge 702. The side edge is adapted for enabling the plug to be manual-

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ly inserted into one of the openings 304 and to seal
securely against the side of the opening. The side
edges have an outwardly tapering bottom section 704 and
a channel 706. The tapering bottom section is suffici-
5 ently flexible to deflect inwardly under force of the
edges of the opening when the plug is pushed into the
opening. Deflection of the bottom of the sides pulls
inwardly a lower edge of channel 706, thereby providing
sufficient clearance to push the plug further down into
10 an opening 304 to the point the upper edge of the chan-
nel engages the upper edge of the opening. The width of
channel 706 is slightly larger than the thickness of the
edge of an opening 304 (which includes the thickness of
the panel and two layers of wire mesh). Therefore, the
15 bottom tapering section 704 springs back, locking the
plug into place and sealing it against the edges of the
opening. Support ribs 708 provide lateral strength to
the plug so that it does not deflect downward when
loading during operation, in a manner that would pull
20 the top edge of the channel away from the edge of the
opening and allow the load to force the plug through the
bottom of the opening.

Referring to Figure 8, the screen 400 is secured to
a basket of a shaker (not shown) using cam latch 804.
25 Cam latch 804 is secured to side wall 806 of the basket
802. A latching end of latching bar 808 extends through
an opening in the wall to engage the top of screen and
to force the screen against bracket 810. Handle 812
pivots about pin 814. U-bolt 816 is connected through
30 rod 818. Rod 818 extends through handle 812. The other
end of the U-bolt (not seen) is connected in a similar
fashion to other end of the rod so that the U-bolt is
permitted to swing about rod 818 under the handle 812.
When handle 812 is pivoted upwardly, the saddle of the
35 U-bolt lifts up on latching bar 808, causing the latch-

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ing bar to pivot about pin 820 and press against the screen. Pulling down on handle 812 lowers the saddle of U-bolt 816, permitting the latching bar to pivot counter-clockwise and release the screen. To assist in quickly replacing the screen, slot 822 allows pin 820 to be moved back and thus allows the latching member 808 to be pulled behind the side of the basket.

Fig. 10 shows a screen 900 like the screen 100 (Figs. 1, 2) with a similar length and width (see Fig. 2), but with a somewhat different screen shape as viewed from the end (e.g. as in Fig. 1). The screen 900 has a first layer of wire mesh 902 and a second layer of wire mesh web 904 mounted on a perforate panel 926'. It is within the scope of this invention to use only one screening layer for any screen described herein or to use three or more layers. A frame 906 (like the frame of the screen 100) supports the mesh and/or screening layers. In one aspect the layers shown for the screen rest one on top of the other and in another aspect one or more or all of the layers are bonded together and in another aspect they are bonded to the frame across their entire surfaces or only around the periphery thereof. The frame 906 is configured and shaped to correspond to the corrugated or undulating shape of the layer(s) above it; alternatively the layer(s) may be made to correspond to the shape of the frame. Ridges 908 have relatively elongated flat tops as compared to the apices of the ridges of the screen 100 and flat valleys 912 of the frame 906 are relatively short as compared to the valleys of the screen 100. The elongate flat tops facilitate the insertion of an effective plug if the ridge is damaged. It is within the scope of this invention for the ridges and valleys to have any desired width or shape.

Fig. 11 shows a screen 920 like the screens 100

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(Figs. 1, 2) and 900 with a similar length and width (see Fig. 2), but with a somewhat different screen shape as viewed from the end. The screen 920 has a first layer of wire mesh 922, a second layer of wire mesh web 5 924 and a third layer of mesh or screening 928. A panel 926 (like the panel of the screen 900) supports the mesh and/or screening layers. In one aspect the layers shown for the screen rest one on top of the other and in another aspect one or more or all of the layers are 10 bonded together and in another aspect they are bonded to the frame across their entire surfaces or only around the periphery thereof. The screens 900 and 920 may be used with or without straps (e.g. as the straps 114 and 116, Fig. 9). Individual cells of the screens 900 and 15 920 may be shaped as the individual cells of the screens of Figs. 2 and 3 or they may be any desired shape, including but not limited to, oval, square, trapezoidal, or triangular (acute, obtuse, isosceles, congruent). The cells of the screens 900 and 920 are repairable as 20 are cells of the previously-described screens.

Fig. 12 shows a plug 950 for plugging off a cell of a screen according to the present invention. The plug 950 has a body member 952 and ears 956 which project from legs 954 depending on the body member 952. The 25 plug 950 is made from a resilient material so the legs 954 are bendable to permit the ears 956 to enter a cell to be repaired and then expand outwardly so the ears catch and hold on an edge of the cell.

It is within the scope of this invention to have a 30 plug held in a cell by friction fit, any "snap fit" structure, welding or adhesive. Accordingly, a plug may be any desired shape to fit in and mate with the shape of a cell. The plug may be solid or it may be solid with openings, holes or perforations therethrough. In one 35 aspect in which a cell is not initially behind a torn

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screen area a cell or cells is placed at the torn cone area on one side of the screen and a plug is inserted into the cell from the other side of the screen to repair a torn area.

5

* * *

Fig. 13a shows a screen frame 500 according to the present invention with a plurality of spaced-apart strips 502 (made of any suitable metal or metal-like material) secured to and between spaced-apart sides 504. Each end 506 of each strip 502 is received and held in a recess 524 in a side 504. The recess 524 corresponds in shape to the shape of the end 506 and a shoulder 526 of each strip 502 abuts a side 504. The end 506 may be inserted into the recess 524 from the side (to the left in Fig. 13b) or from above or below. The top and bottom strips 502 (as viewed in Fig. 13a) each has two humps or ridges 553 (see Fig. 13c) which are located, sized, and configured to be received in corresponding corrugations of a corrugated plate and/or corrugated screen assembly. It is within the scope of this invention for each strip to have one, two, or a plurality of multiple humps or ridges. In one aspect there is one hump or ridge for each corrugation of a superimposed plate and/or screen assembly.

25

Fig. 14 shows a strip interlocking structure which includes a bulb 505 at each end of a strip 503 (disposed in a frame as are the strips 502). The bulb 505 is in a recess 525 in a side 501 (like the sides 504). The bulb 505 is lifted out from the recess 525 for removal or inserted into it from below or above for installation.

30

Fig. 15 shows a strip interlocking structure which includes a tongue 509 at each end of a strip 508 (disposed in a frame as are the strips 502). The tongue 509 is in a recess 530 in a side 507 (like the sides 504). The tongue 509 is lifted out from the recess 530 for

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removal or inserted into it from below or above for installation. An enlarged end 531 resides removably in a recess 532 and prevents the strip 508 from inadvertently moving out from the recess 530 to the side
5 (to the left in Fig. 15).

Fig. 16 shows a pattern of triangular openings in a perforated panel 510 (made of metal or metal-like material). The openings 511 are positioned side-by-side in an array that extends across substantially all of a
10 panel. The panel may be corrugated or flat or a combination thereof with alternating flat and corrugated portions.

Fig. 17 shows the pattern of the triangular openings for the perforated plate 512. It will be noted
15 that openings 514 and 515 are spaced apart from each other slightly more than the middle openings of the plate 510 producing, in certain embodiments, stronger central portions 550. The panel may be corrugated or flat or a combination thereof with alternating flat and
20 corrugated portions.

In the pattern of openings as in Fig. 17, the pattern is shifted slightly as compared to that of the plate 510 to optimize use of a screening surface. For example, a screen using the pattern in Fig. 16 and a web
25 width (distance between two adjacent openings) of 3.17mm (0.125"), has a border on each edge. By shifting the triangle openings to the pattern of Fig. 17, a web width of 3.17mm (0.125") may be maintained while decreasing the border. This allows more openings in the screen of
30 Fig. 17 as compared to that of Fig. 16, thus increasing surface area and improving appearance.

In the pattern of Fig. 16, the openings are arranged in rows with bases and peaks alternating. The peak of one opening is level with the base of the next.

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In the pattern of Fig. 17 the openings 513 are moved closer together and the peaks of the openings 513 are not level with the base of the opening 514 or 515.

5 Figs. 18 and 19 show a screen 530 with a corrugated support panel 540 (preferably made of metal) having a plurality of triangular openings 538 (not shown in Fig. 18; see Fig. 19) thereacross the surface of and therethrough; optional upturned edges 534 and 537 for anchoring the screen 530 to a vibratory shaker; wire mesh or meshes 539 secured to the panel 540; and plugs 10 536 at both ends to plug ridge openings 532 at each end of the corrugations of the plate 540. The plate 540 rests on and is secured to a strip or strips 551 (alternately a frame of multiple strips criss-crossing the plate 540 or a series all in the same direction, or a perforated plate may be used). In one aspect the strip(s) 551 are omitted. The strips 551 may be made of any suitable material, including, but not limited to, metal, plastic, fiberglass, rubber, or cermet.

20 A screen according to the present invention may be made without a plastic grid located between a lower panel and screen(s) or mesh(es) above the plastic grid. When screening material is bonded to a corrugated perforated panel (e.g. as in Fig. 19), thermal expansion 25 puts the screening material in tension. Such a result is not produced when a plastic grid process is used. A metal corrugated perforated panel withstands tension induced thereon by screening material applied and/or bonded thereto. In one aspect the panel is first covered with adhesive (e.g. powdered epoxy) then the mesh(es) 30 and/or screen(s) are placed on the panel. Upon curing of the epoxy, adhesive 541 covers or envelops part of the mesh/screen at the solid areas of the panel.

35 Figs. 20-24 present a variety of configurations for corrugated perforated panels according to the present

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invention and/or for strips according to the present invention.

Fig. 20 shows a corrugated panel A on a support strip B having optional mounting hooks C.

5 Fig. 21 shows a corrugated panel D on a support strip E. Optionally, mounting hooks may be used with such an assembly.

10 Fig. 22 shows a support strip F. A corrugated perforated panel may have such a configuration and mounting hooks may be used with the strips or with the plate.

Fig. 23 shows a support strip G. A corrugated perforated panel may have such a configuration and mounting hooks may be used with the strips or with the plate.

15 Fig. 24 shows a corrugated panel H on a support strip I having optional mounting hooks J.

20 Any mesh, meshes, screen, screens, screening material(s) or any combination thereof or any such as described herein may be used with any of the items shown in Figs. 13-24.

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CLAIMS:

1. A screen for use in a shale shaker, which screen comprises:
 - 5 (a) a support panel formed with a series of alternating substantially parallel ridges and channels, wherein at least the top of one of said ridges is substantially flat and is provided with at least one elongate opening which is wholly contained within
10 said ridge; and
 - (b) at least a first layer of mesh bonded to said support panel, such that, in use, said mesh is positioned to cover said
15 elongate opening in said ridge, said mesh is capable of being punctured and removed and the open cell formed thereby fitted with a plug.
2. The screen as claimed in Claim 1, wherein the
20 bottom of said channels are generally 'v' shaped.
3. The screen as claimed in Claim 1, wherein the bottom of at least one of said channels is substantially flat and is provided with at least one elongate opening which is wholly contained
25 within said channel, such that, in use, said mesh is positioned to cover said elongate opening in said channel, said mesh is capable of being punctured and removed and the open cell formed thereby fitted with a plug.
- 30 4. The screen as claimed in Claim 1, 2 or 3, wherein said channel and said ridge include sides, at least one of which is provided with at least one elongate opening which is wholly contained within said side such that, in use, the mesh is
35 positioned to cover said elongate opening in said

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side, said mesh capable of being punctured and removed and the open cell formed thereby fitted with a plug.

5. The screen as claimed in Claim 4, wherein said
5 elongate opening only extends across said side or the top of said ridge.
6. The screen as claimed in Claim 4, wherein said elongate opening only extends across said side or said bottom of said channel.
- 10 7. The screen as claimed in any of Claims 1 to 6, further comprising a second layer of mesh bonded to said support panel.
8. The screen as claimed in Claim 7, further comprising a third layer of mesh bonded to said support panel.
- 15 9. A screen assembly for a vibratory separator, the screen assembly comprising a corrugated support plate having a plurality of alternating raised portions and lower portions, the corrugated support plate having a plurality of spaced apart openings
20 therethrough, a screen frame with a first pair of spaced apart first sides and a second pair of spaced apart second sides, the first sides spaced apart by the second sides and connected thereto, the frame having a plurality of spaced apart support strips
25 extending beneath the corrugated support plate, each support strip independent of and not connected to the other support strips along its length, each support strip having two spaced apart ends each connected to a spaced apart side of the frame and to
30 which the corrugated support plate is secured, wherein each support strip has at least one projecting portion for reception within a raised portion of the corrugated support

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plate, and screening material on the corrugated support plate.

- 5 10. The screen assembly of Claim 9, wherein the plurality of spaced apart support strips are made of a material from the group consisting of metal, plastic, fiberglass, rubber or cermet.
11. The screen assembly of Claim 9 or 10, wherein the spaced-apart openings of the corrugated support plate are triangular.
- 10 12. The screen assembly of claim 10 or 11, wherein the spaced-apart openings are positioned side-by-side in an array that extends across substantially all of the corrugated support plate.
- 15 13. The screen assembly of Claim 12, wherein the array comprises rows of triangular openings, each row including a repeating pattern of a first, second, and third triangular opening, the first and third triangular openings positioned with a main base down and a vertex pointing away from the base, the second triangular opening positioned between the first and third triangular openings with a primary vertex pointing toward a line connecting the bases of the first and third main triangular openings and positioned between sides of the first and third triangular openings, the second triangular opening with a primary base disposed beyond a line between the vertices of the first and third triangular openings that point away from their main bases.
- 20 25 30 35 14. The screen assembly of Claim 13, wherein the first triangular openings of adjacent rows are positioned with their main bases in a side-to-side relationship, the third triangular openings of adjacent rows are positioned with their main

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bases in a side-to-side relationship, the second triangular openings of adjacent rows are positioned with their primary vertices pointing at each other.

- 5 15. The screen assembly of any one of Claims 9 to 14, wherein the corrugated support plate has two spaced-apart opposed sides, each of said sides having an upturned edge to facilitate anchoring the screen assembly to the vibratory separator.
- 10 16. The screen assembly of any one of Claims 9 to 15, further comprising the screening material comprising at least one wire mesh secured on the corrugated support plate.
- 15 17. The screen assembly of Claim 16, wherein the at least one wire mesh is a plurality of wire meshes.
- 20 18. The screen assembly of Claim 16, further comprising the corrugated support plate made of metal, and bonding material bonding the at least one wire mesh to the corrugated support plate.
- 25 19. The screen assembly of Claim 18, wherein the bonding material is an adhesive and adhesive envelopes solid areas of the corrugated support plate between the spaced-apart openings of the corrugated support plate.
- 30 20. The screen assembly of Claim 16, wherein the corrugated support plate is made of metal and the at least one wire mesh is bonded directly to the corrugated support plate with no plastic grid therebetween.
- 35 21. The screen assembly of Claim 19, wherein the adhesive is cured and the at least one wire mesh is in tension on the corrugated support plate due to thermal expansion effected during curing of the adhesive.

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22. The screen assembly of any one of Claims 9 to 15,
further comprising a series of openings at
opposed sides of the corrugated support plate
beneath the raised portions, and a plug in each
5 opening beneath a raised portion.
23. The screen assembly of Claim 22, wherein the at
least one projecting portion is at least two
projecting portions, each of the at least two
projecting portions projecting into a raised
10 portion of the corrugated support plate.
24. The screen assembly of Claim 23, wherein for each
raised portion of the corrugated support plate
there is a corresponding projecting portion of
each support strip.

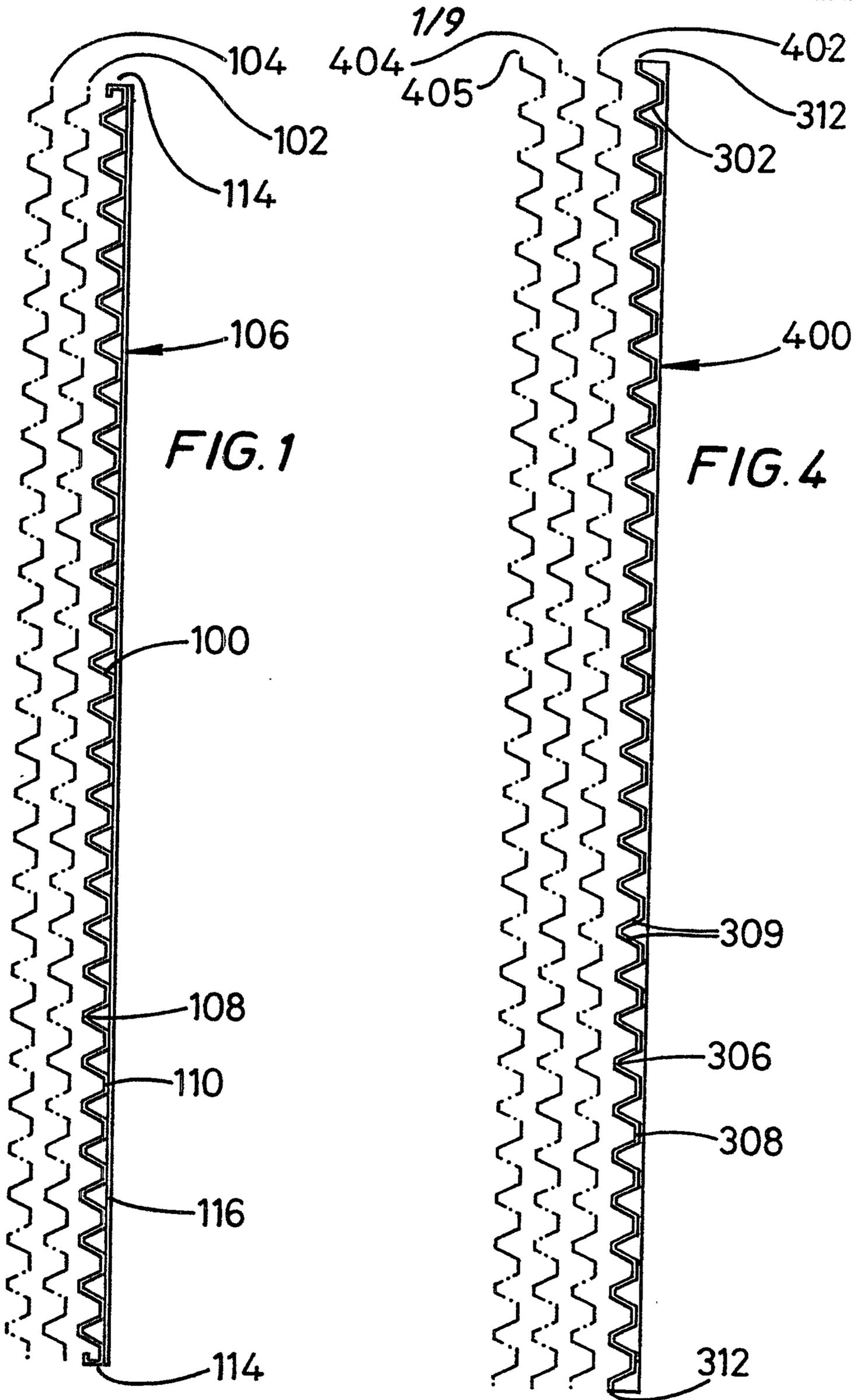
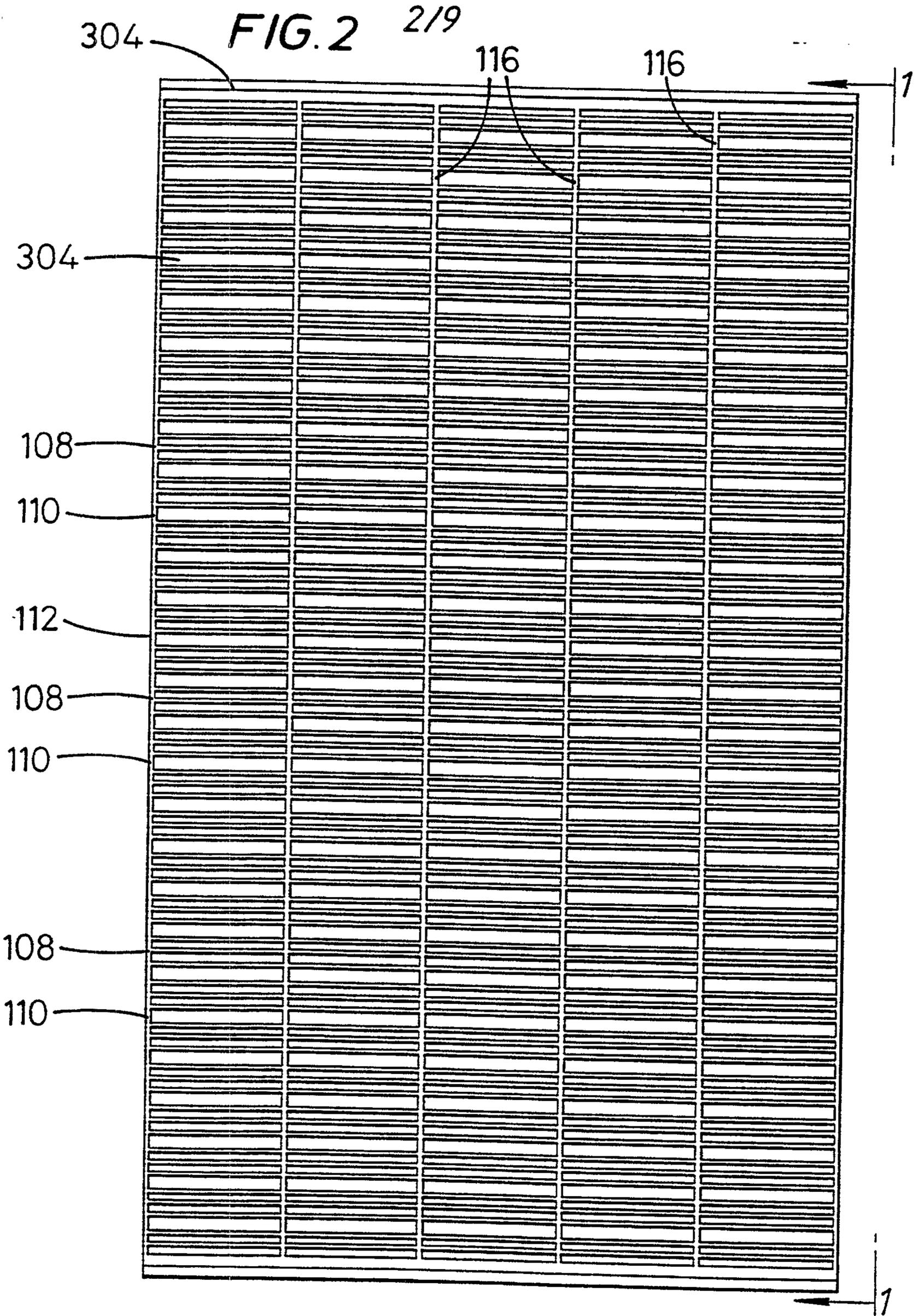
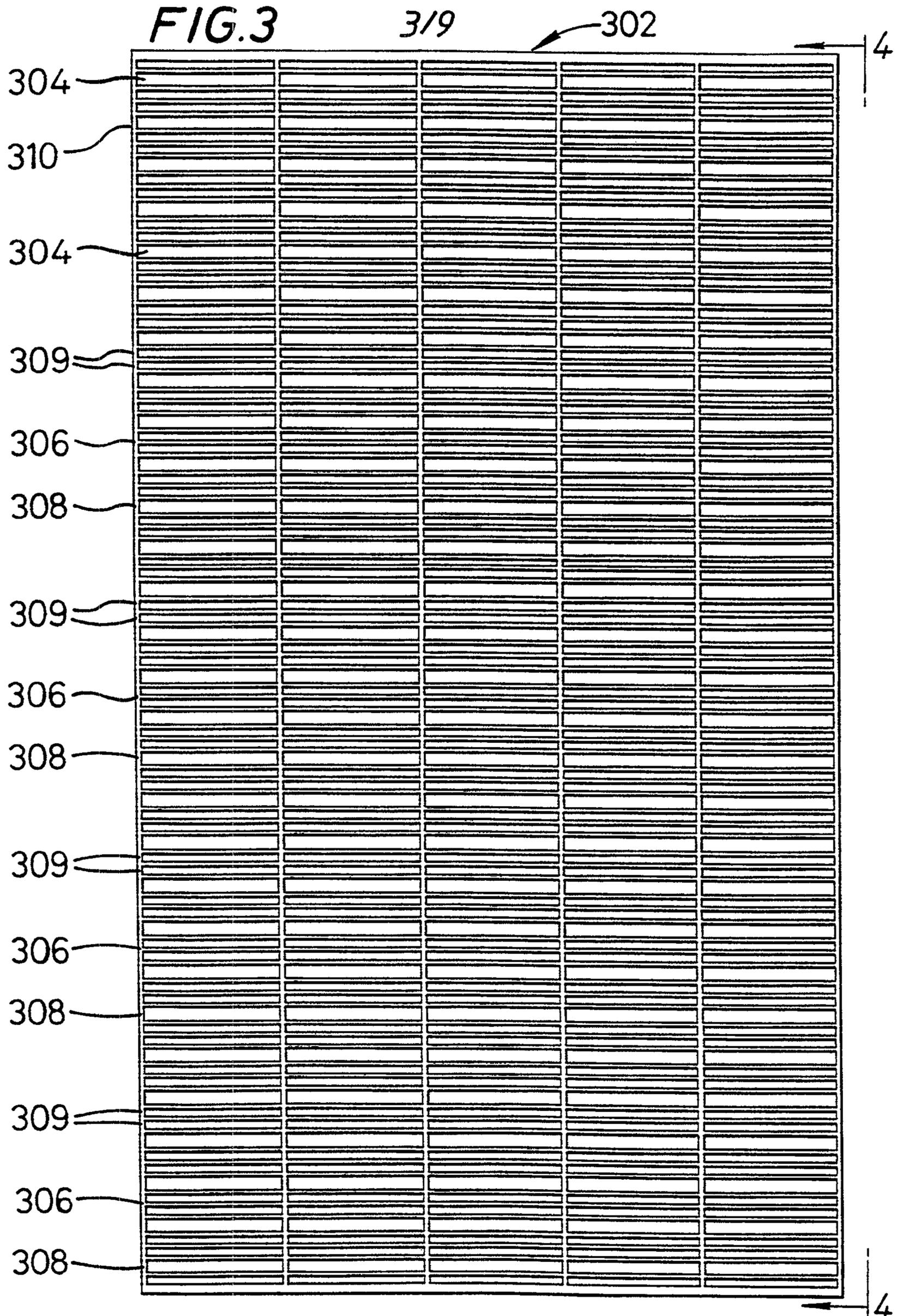


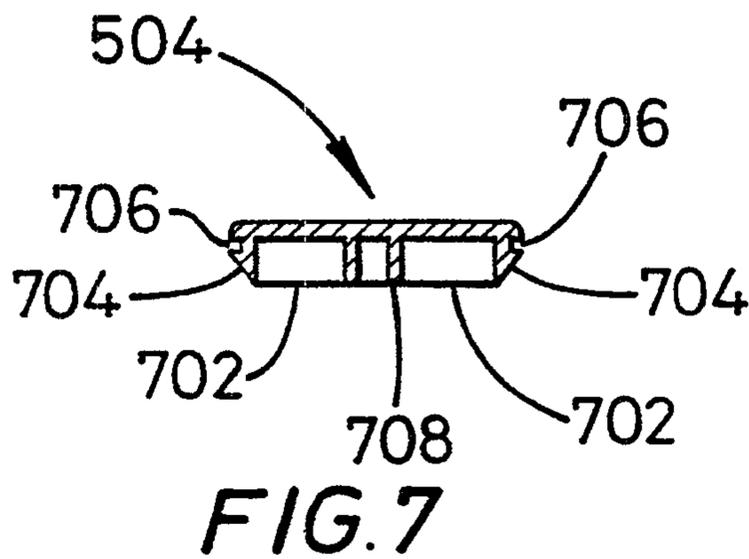
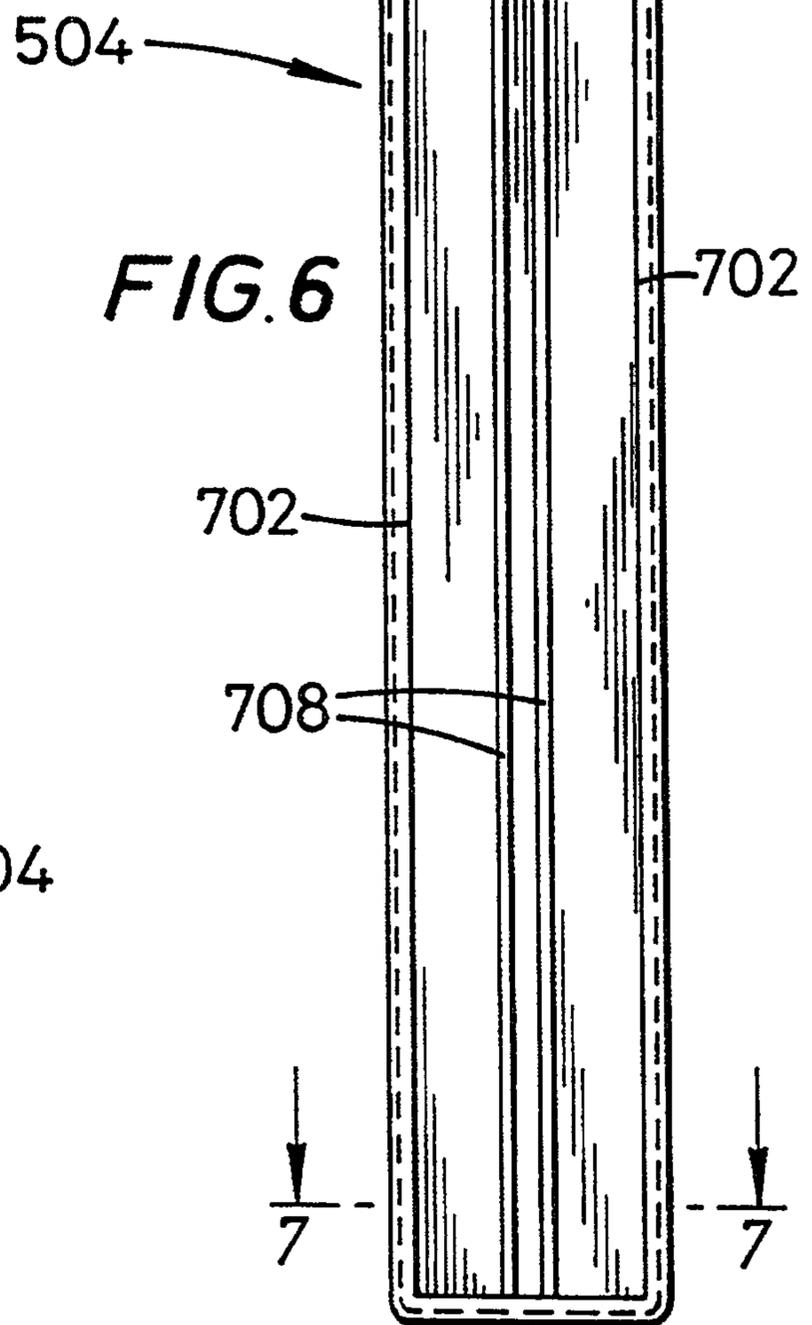
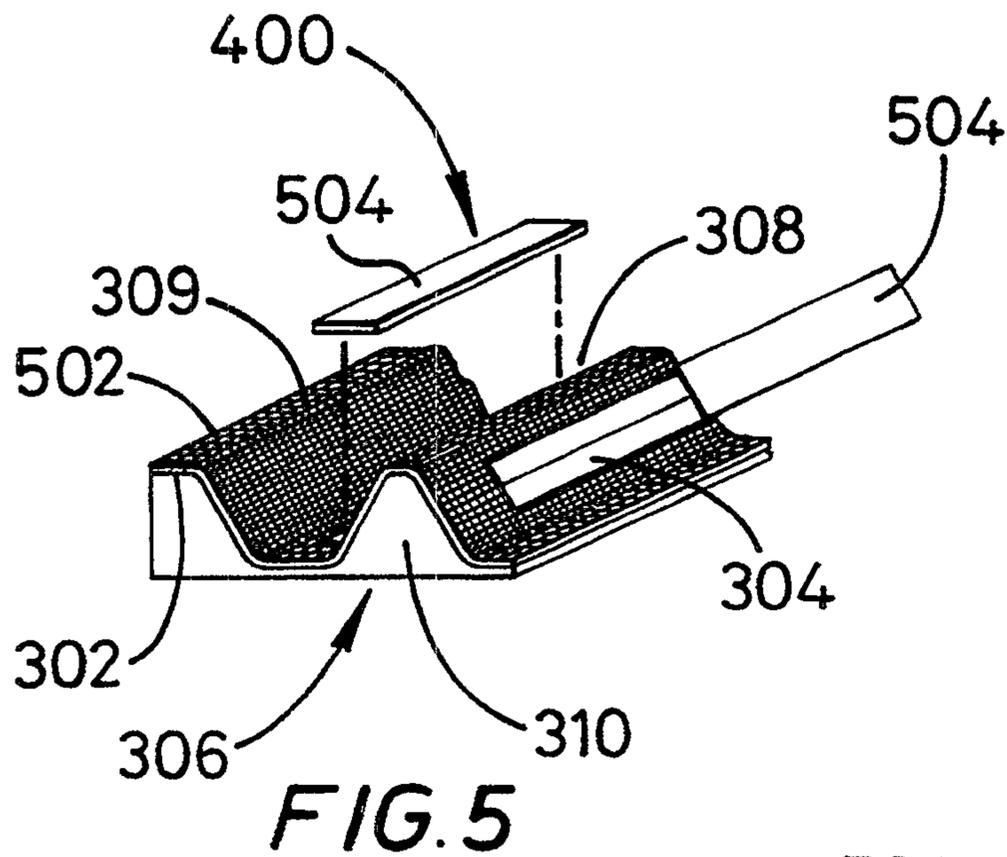
FIG. 1

FIG. 4





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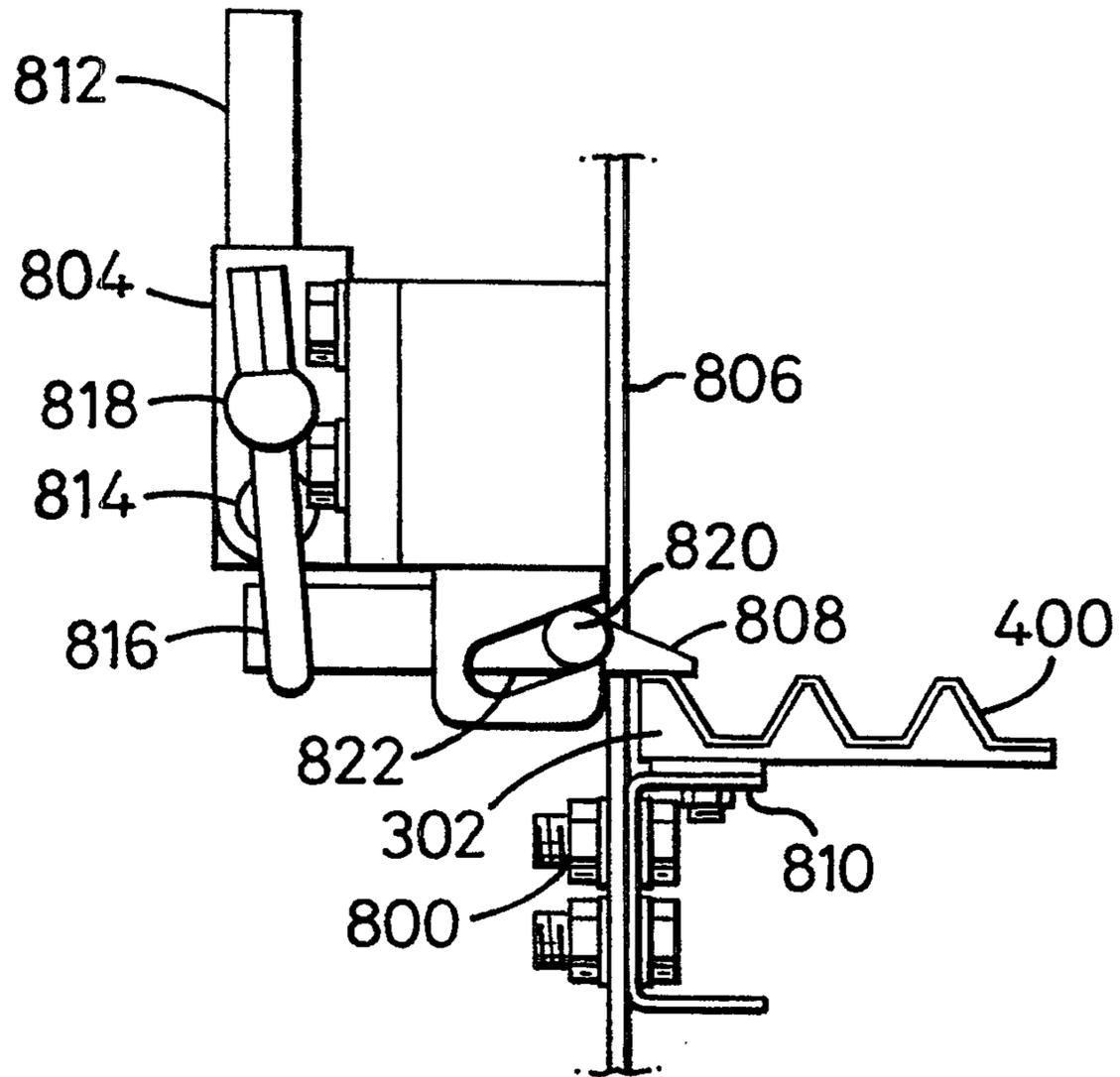


FIG. 8

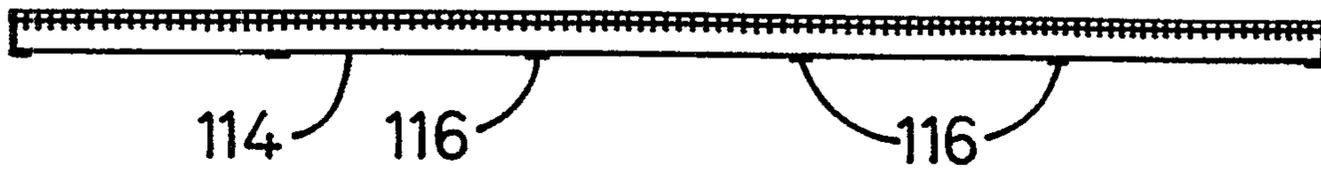


FIG. 9

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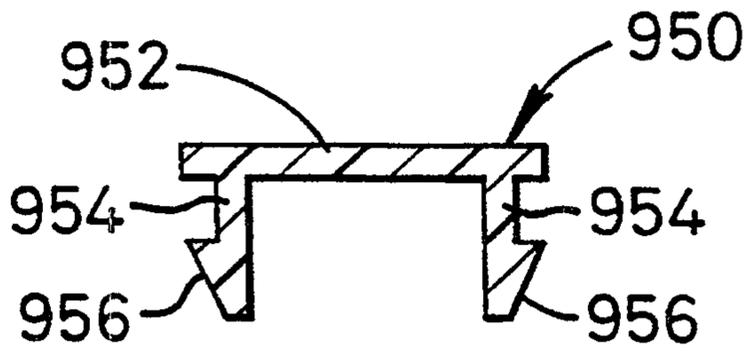
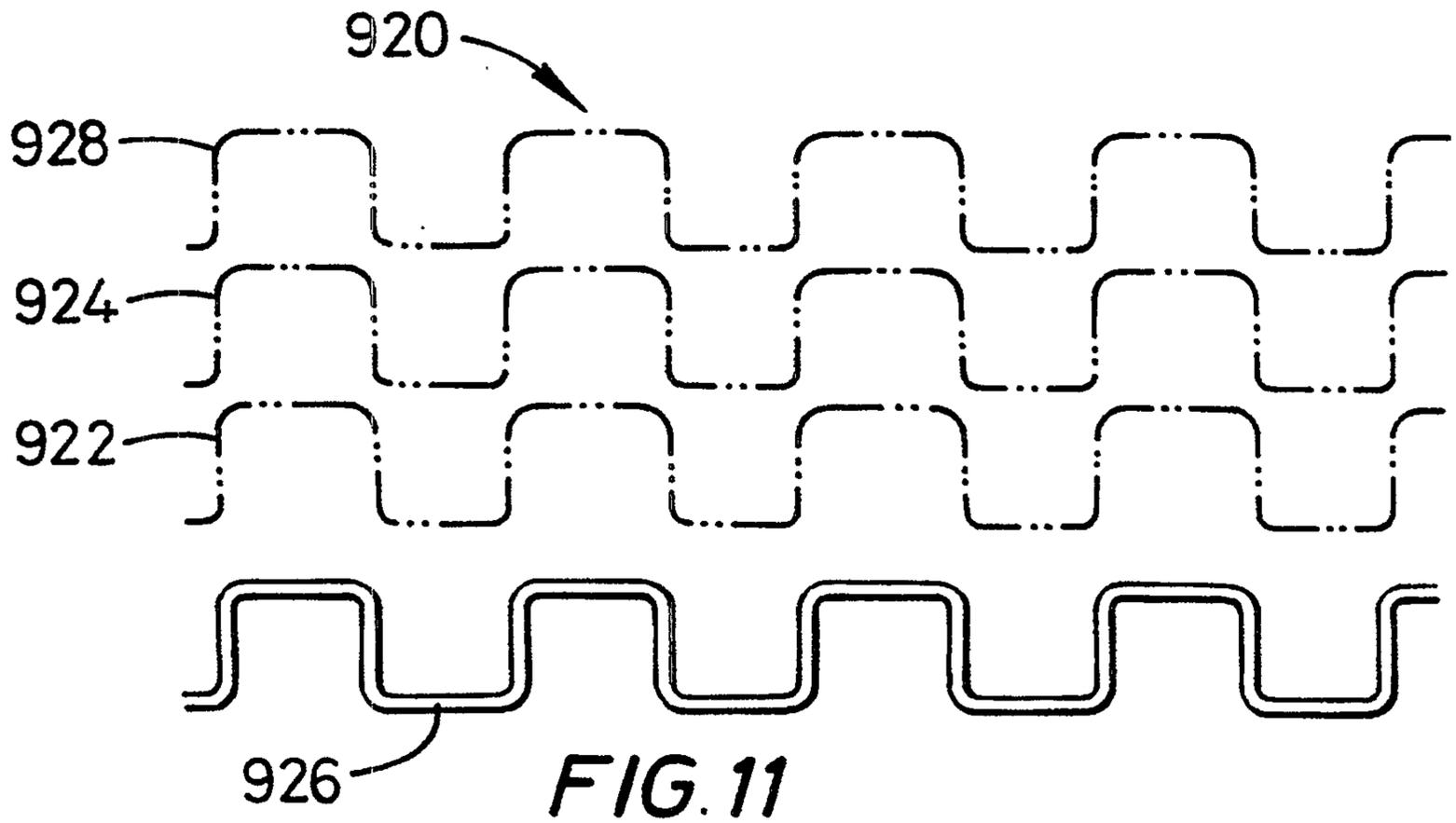
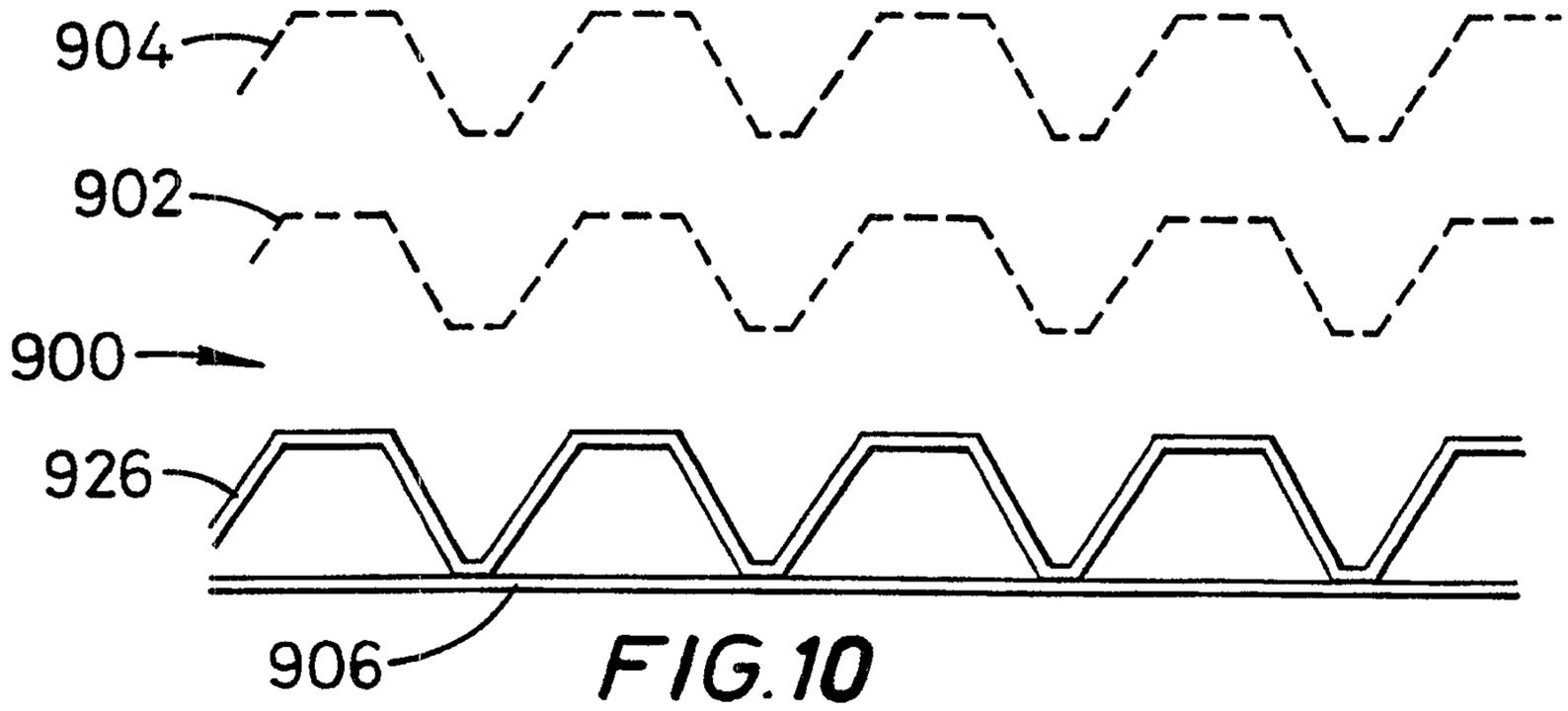
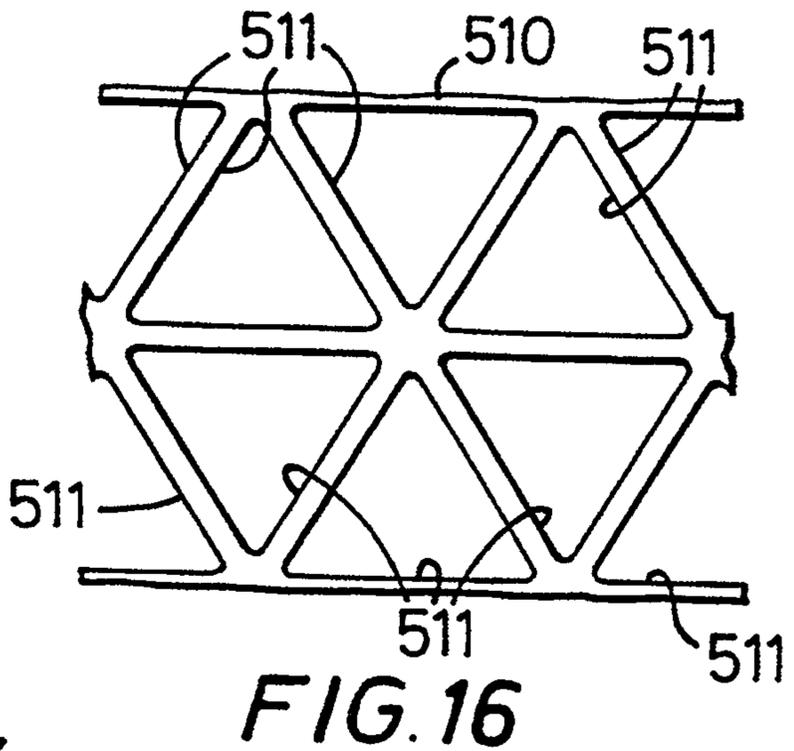
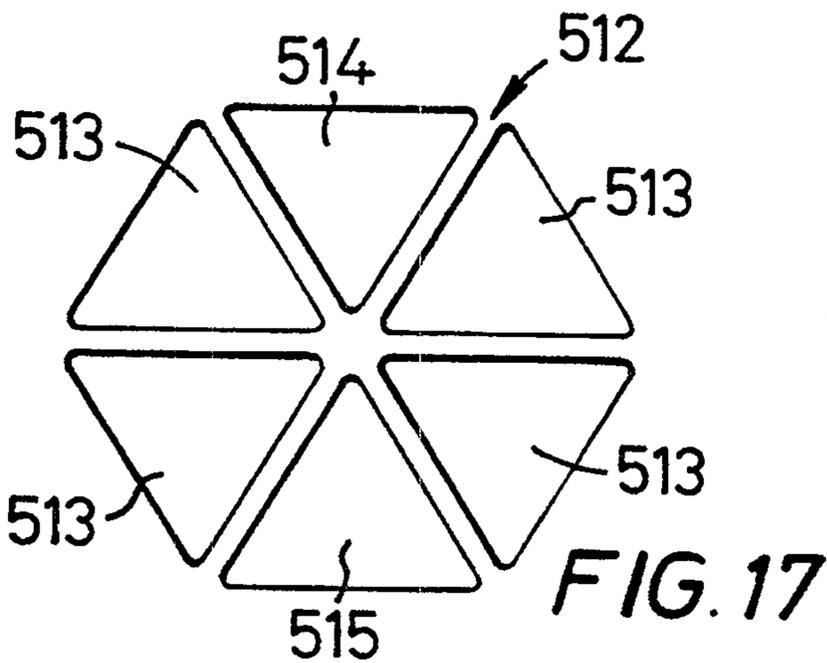
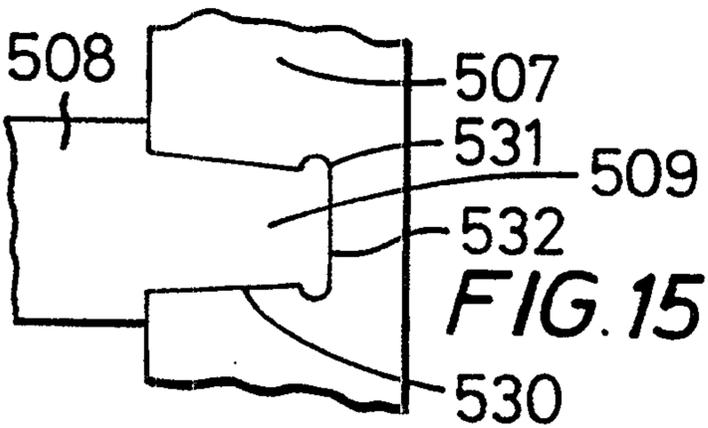
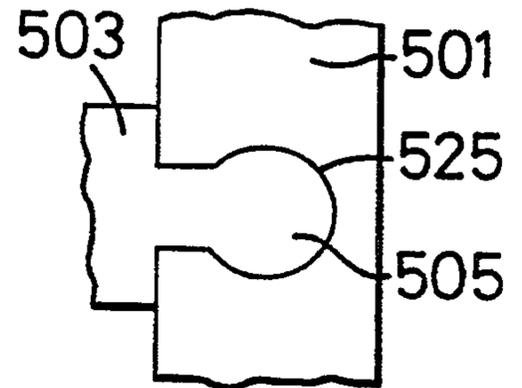
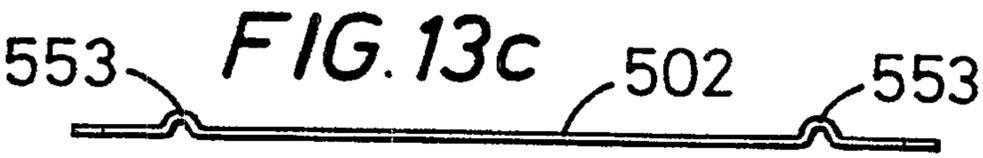
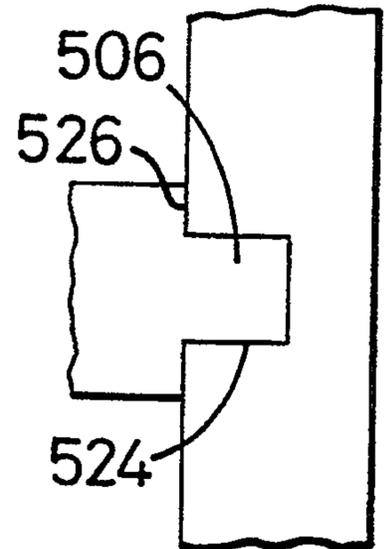
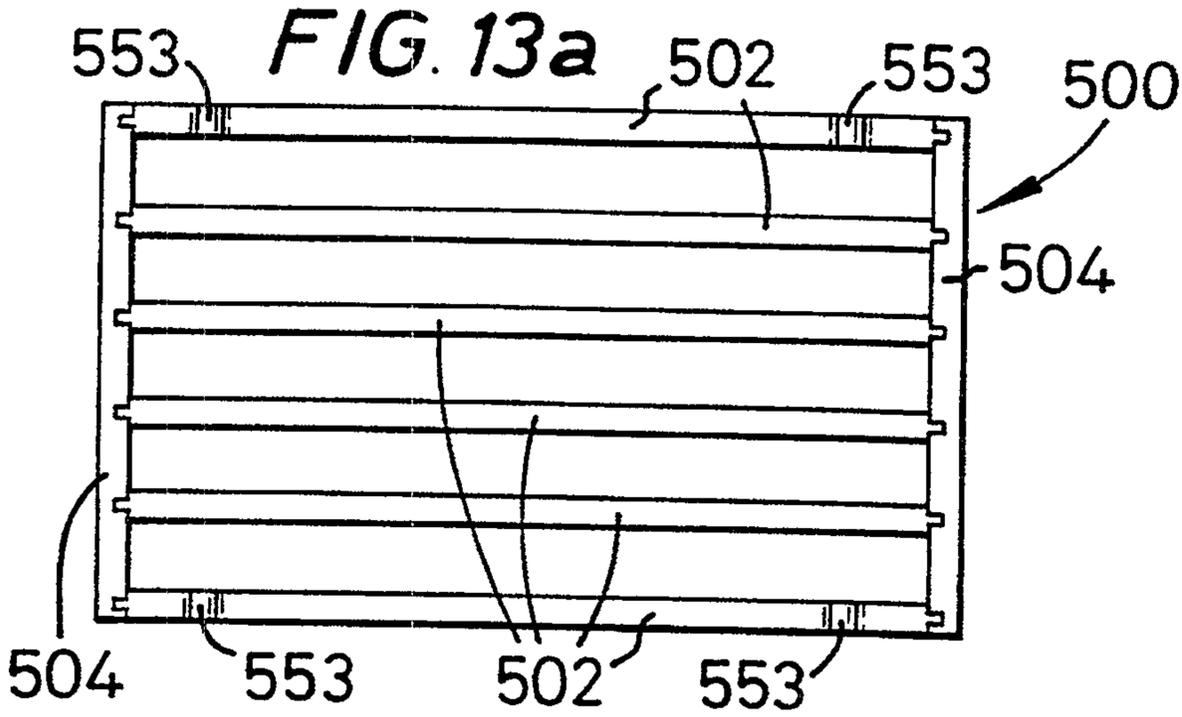
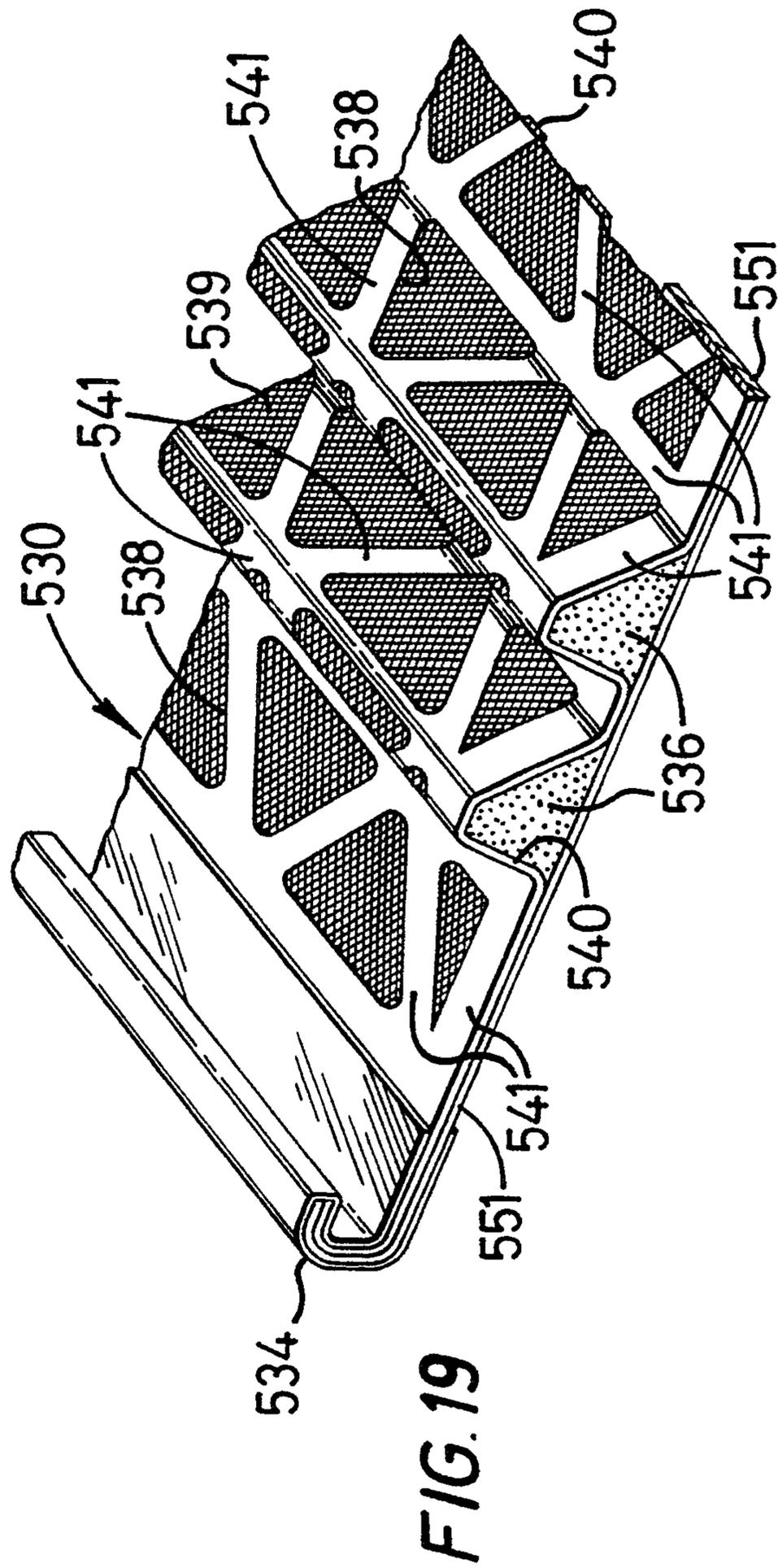
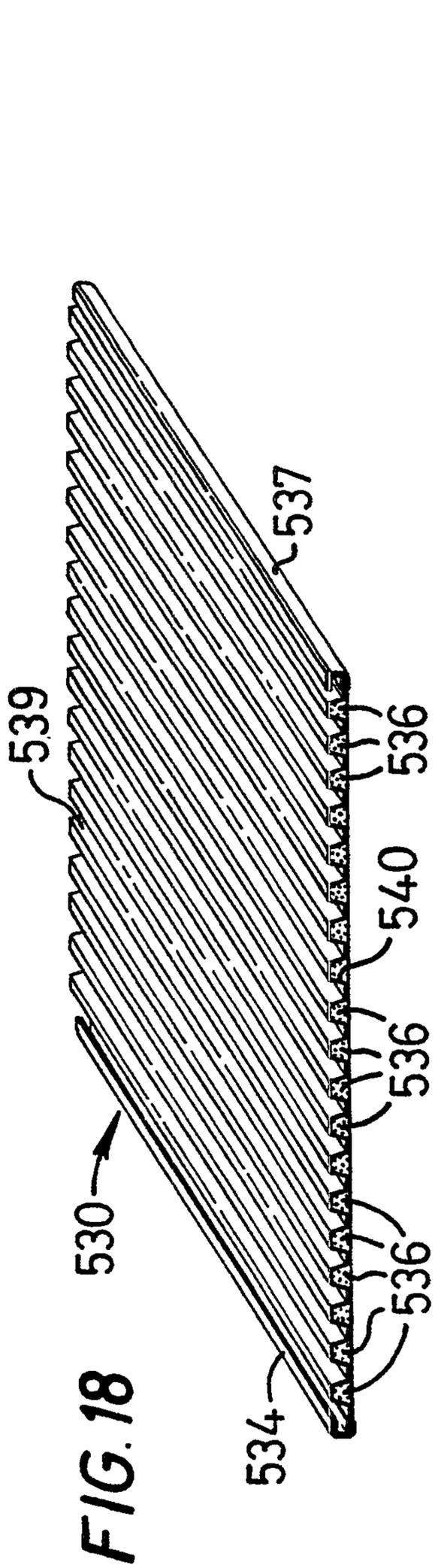


FIG. 12





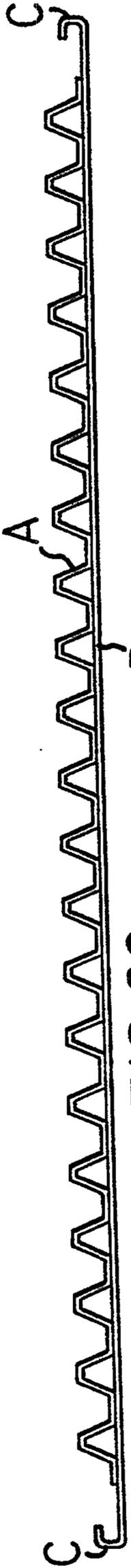


FIG. 20

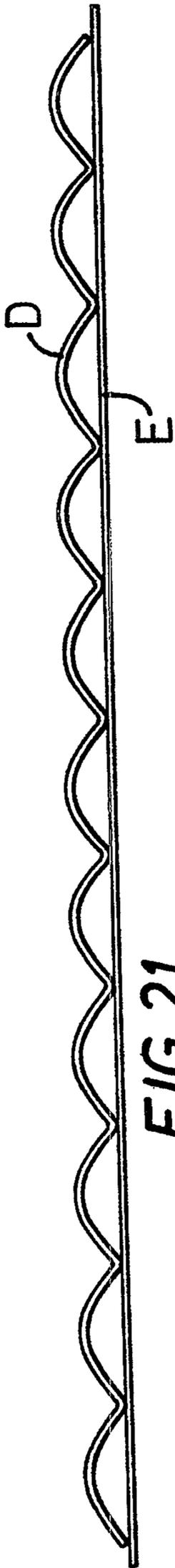


FIG. 21

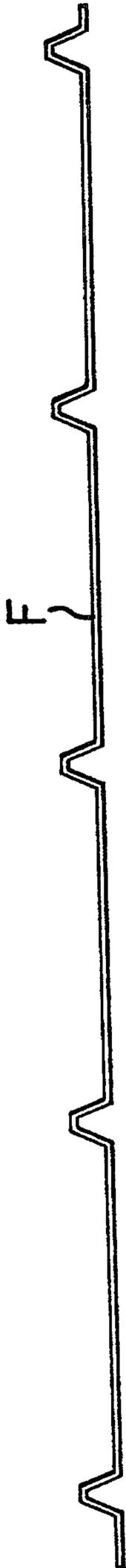


FIG. 22

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FIG. 23

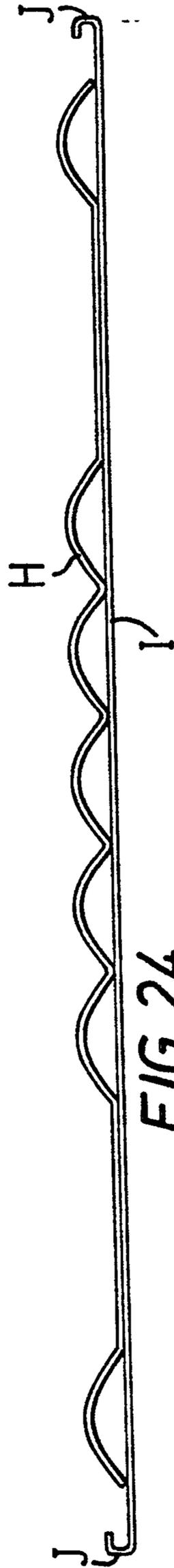


FIG. 24

