Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2513332 C 2009/03/31

(11)(21) 2 513 332

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 1997/02/12

(41) Mise à la disp. pub./Open to Public Insp.: 1997/08/14

(45) Date de délivrance/Issue Date: 2009/03/31

(62) Demande originale/Original Application: 2 240 693

(30) Priorités/Priorities: 1996/02/12 (US08/598,566);
1997/01/21 (US08/786,515)

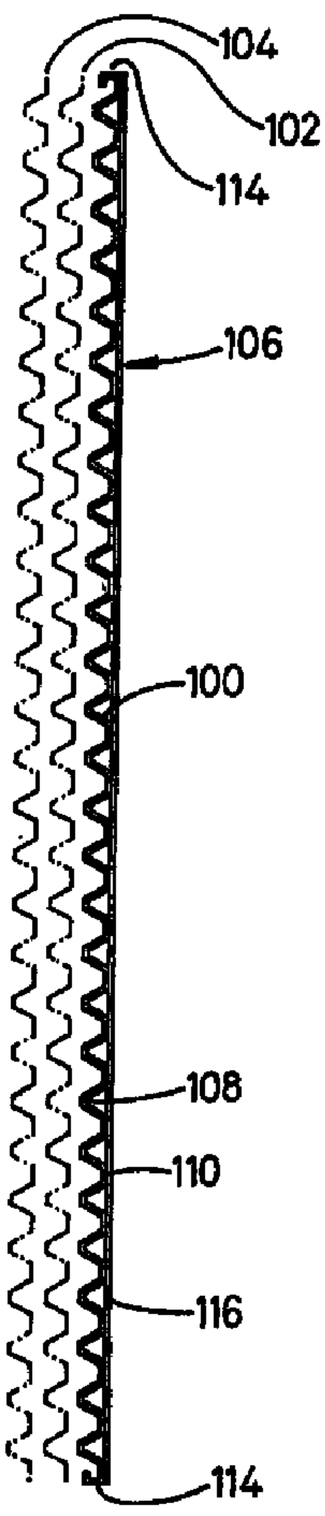
(51) Cl.Int./Int.Cl. *B07B 1/46* (2006.01)

(72) Inventeurs/Inventors:
ADAMS, THOMAS COLE, US;
SCHULTE, DAVID LEE JR., US;
WALKER, JEFFREY EARL, US;
MCCLUNG, GUY LAMONT III, US;
LEONE, VINCENT DOMINICK SR., US;
GRICHAR, CHARLES NEWTON, US;
SEYFFERT, KENNETH WAYNE, US

(73) Propriétaire/Owner:
VARCO I/P, INC., US

(74) Agent: MCFADDEN, FINCHAM

(54) Titre : TAMIS POUR SEPARATEUR VIBRANT
(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

CA 2513332 C 2009/03/31

(11)(21) 2 513 332

(13) C

(57) Abrégé(suite)/Abstract(continued):
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).

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).

SCREEN FOR VIBRATING SEPARATOR

This application is a divisional application of Canadian Patent Application Serial Number 2,240,693, filed on February 12, 1997.

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 collects 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 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 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 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 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 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 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, 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 in at least one wire of the lower of the two meshes 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 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 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:

(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.

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 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. 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 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 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 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.

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;

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;

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;

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;

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;

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

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;

Fig. 14 shows one alternative detail to the detail shown in Fig. 13b;

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

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;

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 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 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 manually 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 sufficiently 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 an opening 304 to the point the upper edge of the channel 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 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 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. 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 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 U-bolt lifts up on latching bar 808, causing the latching 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 (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 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 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 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 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 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 plug held in a cell by friction fit, any "snap fit" structure, welding or adhesive. A plug according 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 aspect in which a cell is not initially behind a torn 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.

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.

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.

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 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 (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 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 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 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 width (distance between two adjacent openings) of 3.17mm (0.125"), has a border of " 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 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. 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.

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 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.

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 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) 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.

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

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

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.

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

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.

CLAIMS:

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

2. The panel as claimed in claim 1, wherein bases of said two opposing ones of said triangular apertures are parallel to sides of said panel.

3. The panel as claimed in claim 1 or 2, including an edge member for facilitating mounting of said panel to a vibratory shaker.

4. The panel as claimed in claim 1, 2 or 3, wherein said panel is provided with at least one layer of mesh which is secured thereto.

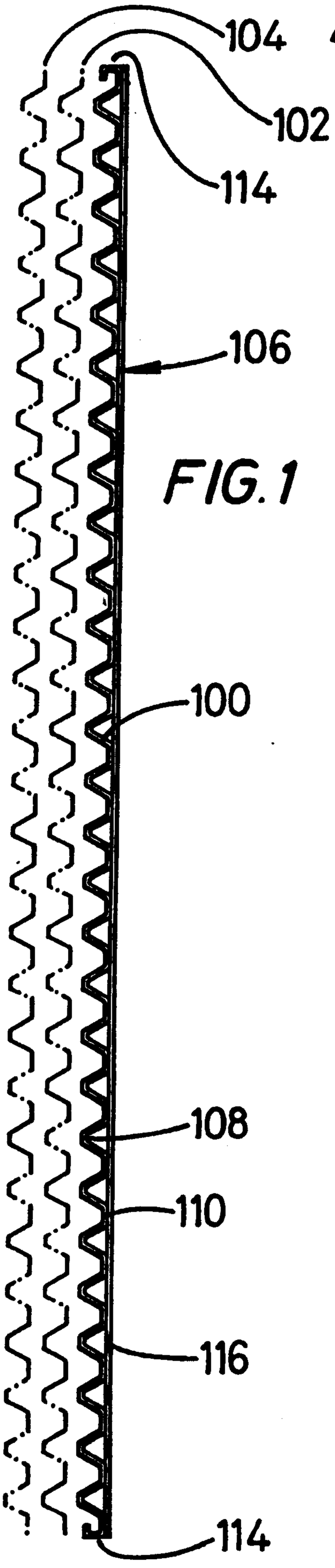

104
102
114
106
100
108
110
116
114

FIG. 1

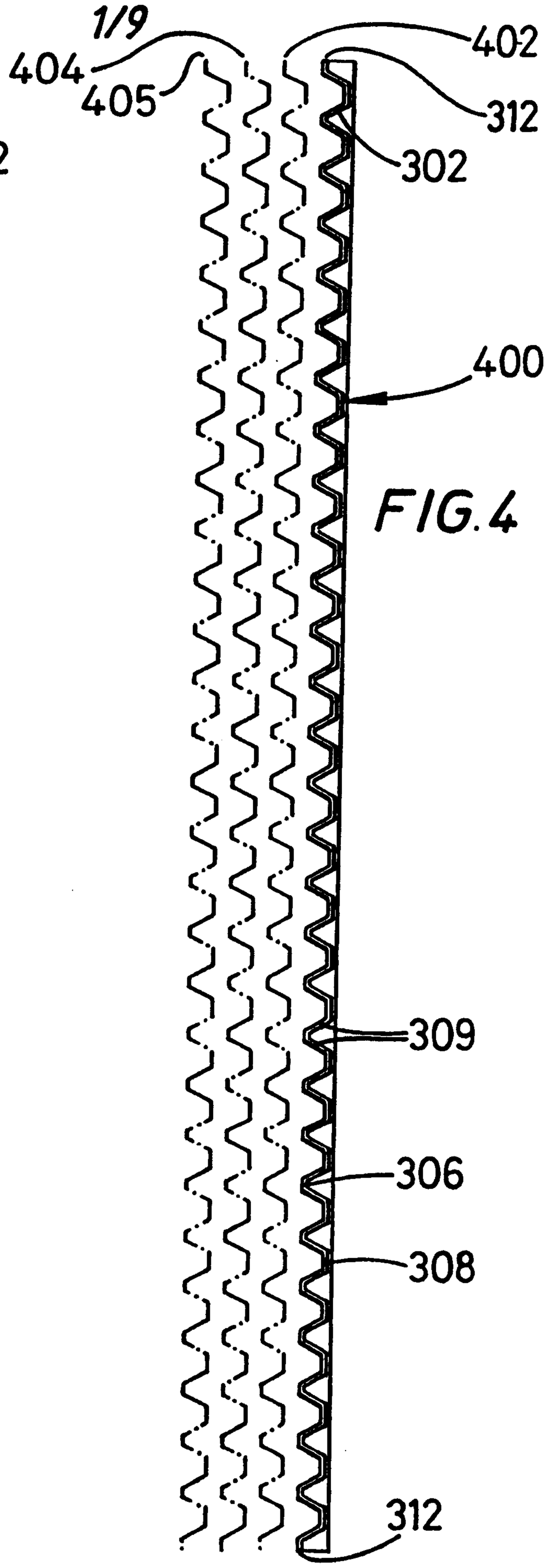

404
405
402
312
302
400
309
306
308
312

FIG. 4

FIG. 2

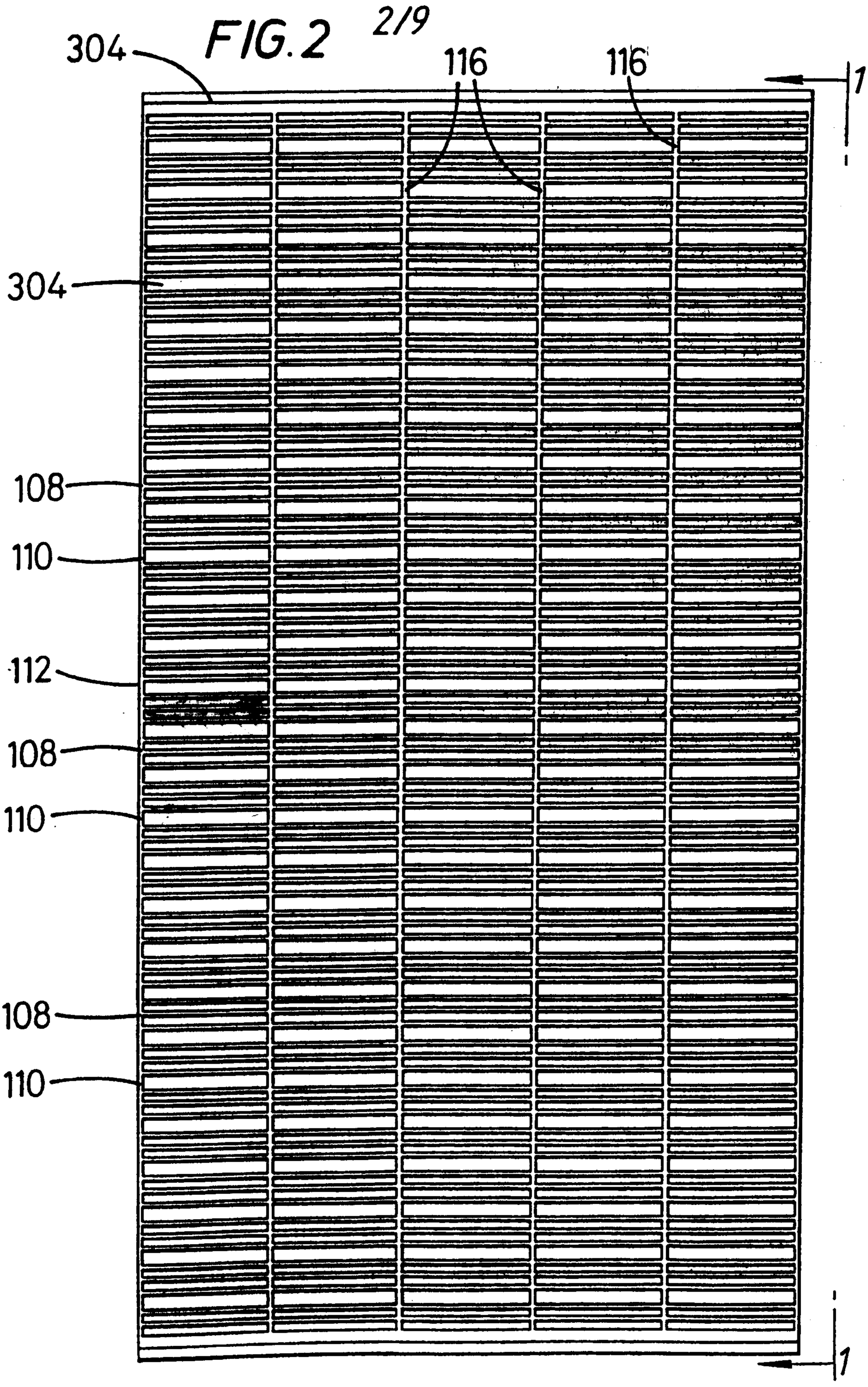
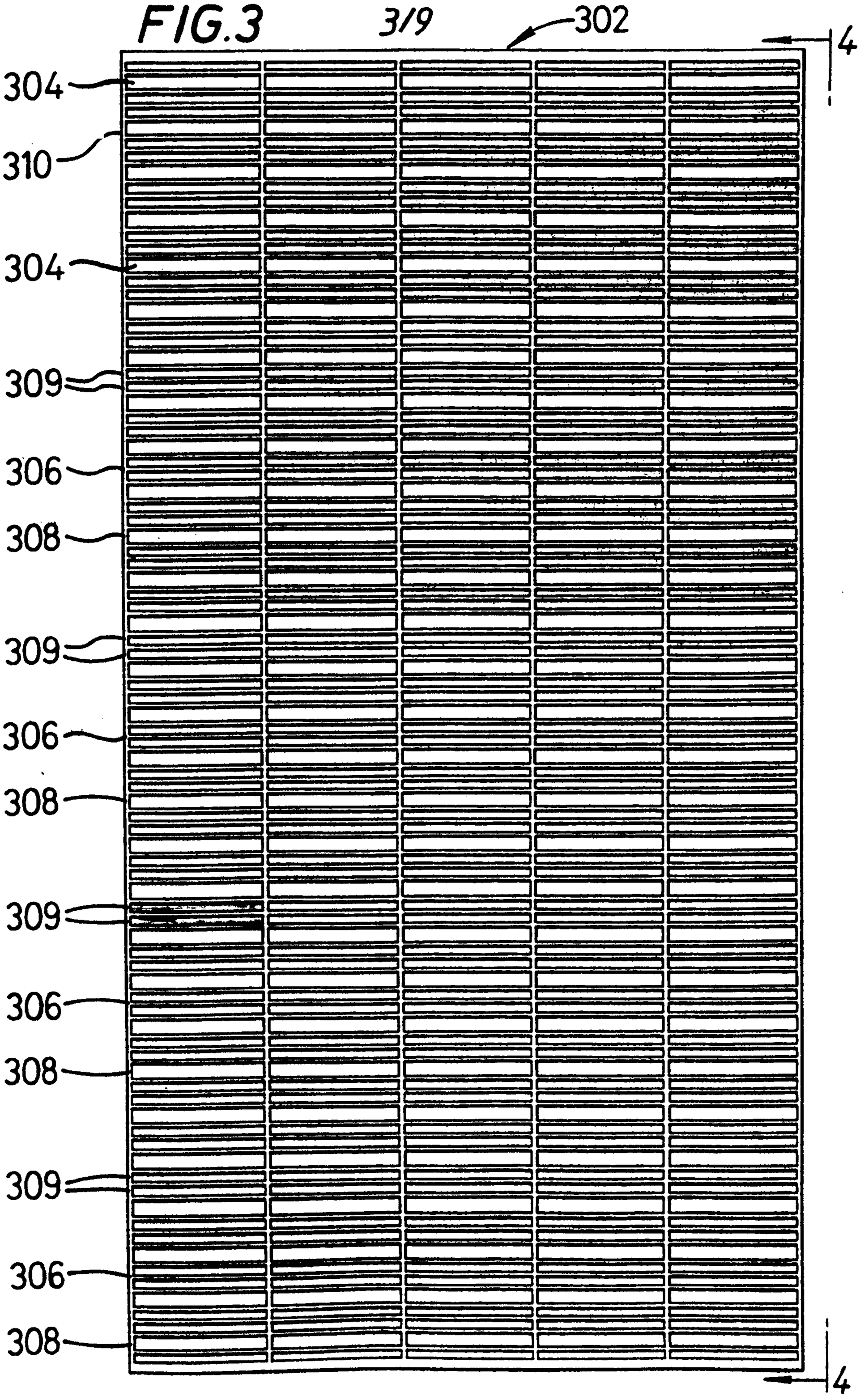


FIG.3


319
302
4
304
310
304
309
306
308
309
306
308
309
306
308
309
306
308
4

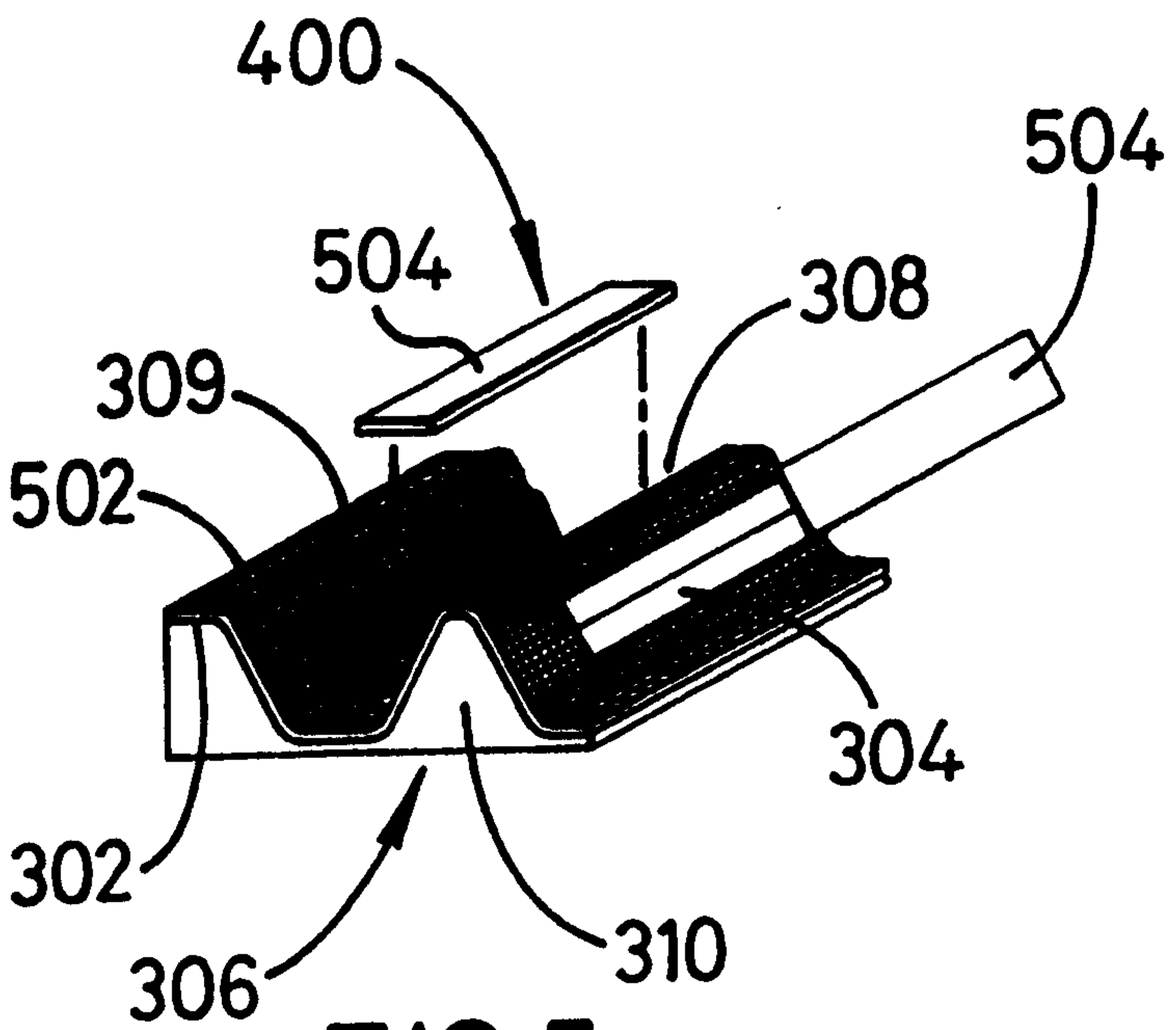


FIG.5

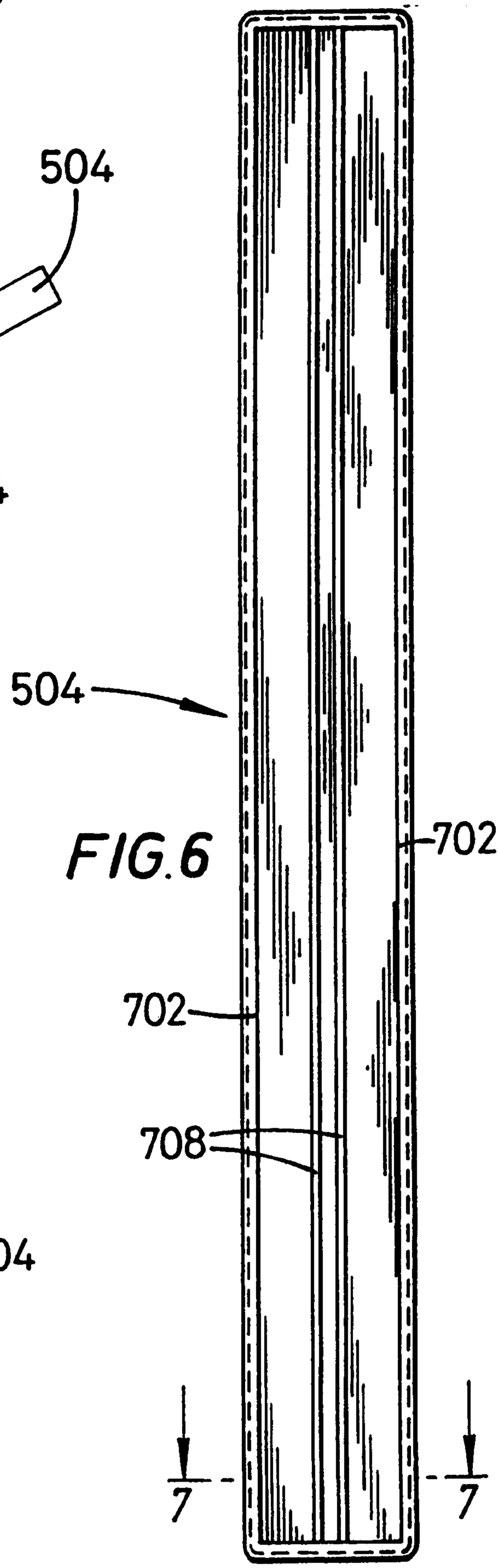


FIG.6

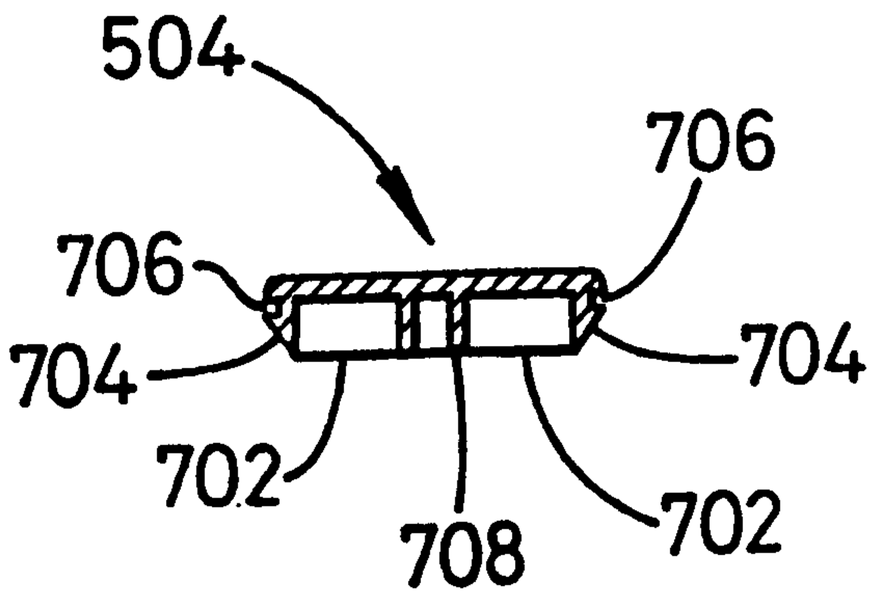


FIG.7

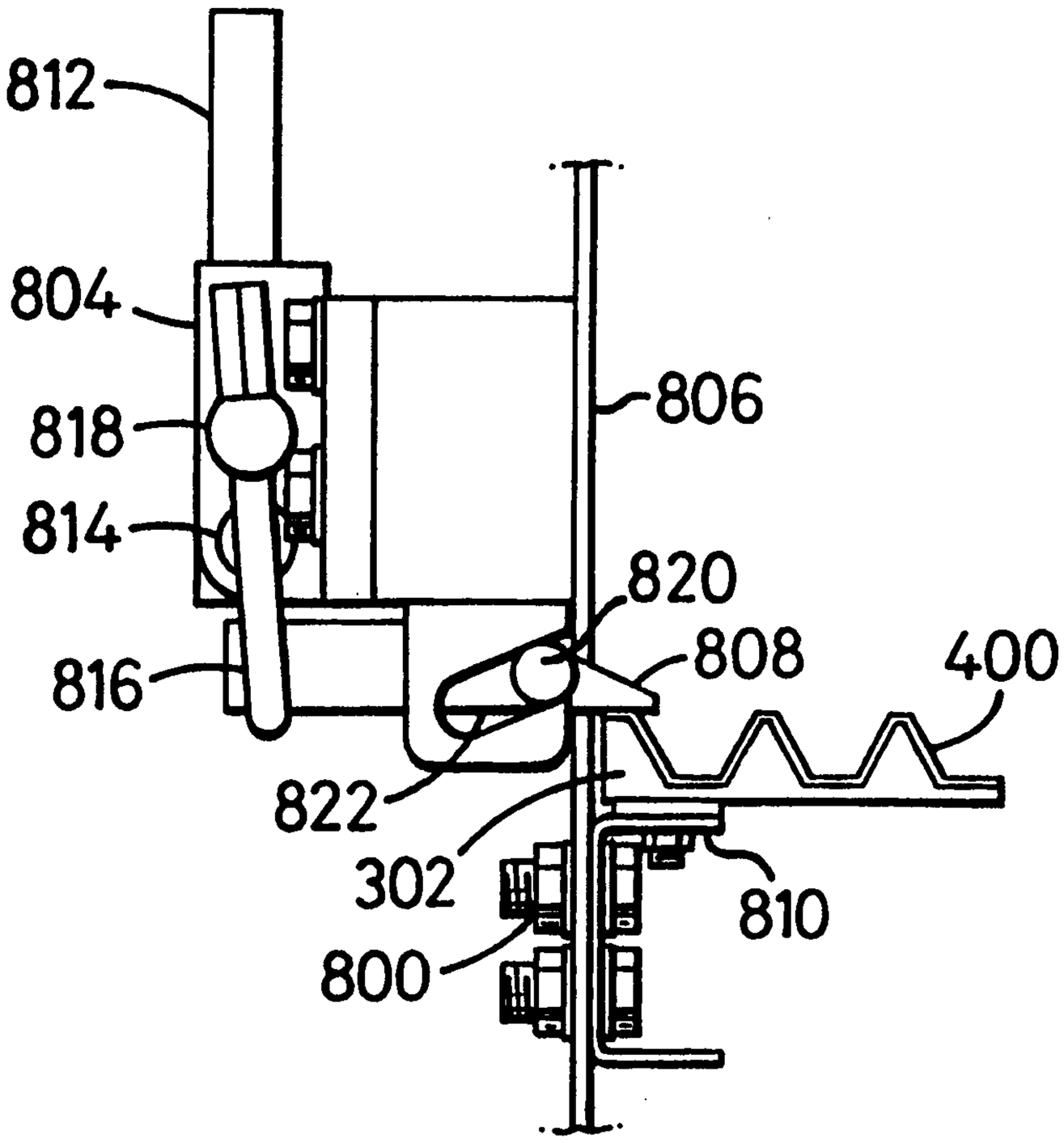


FIG.8

FIG.9

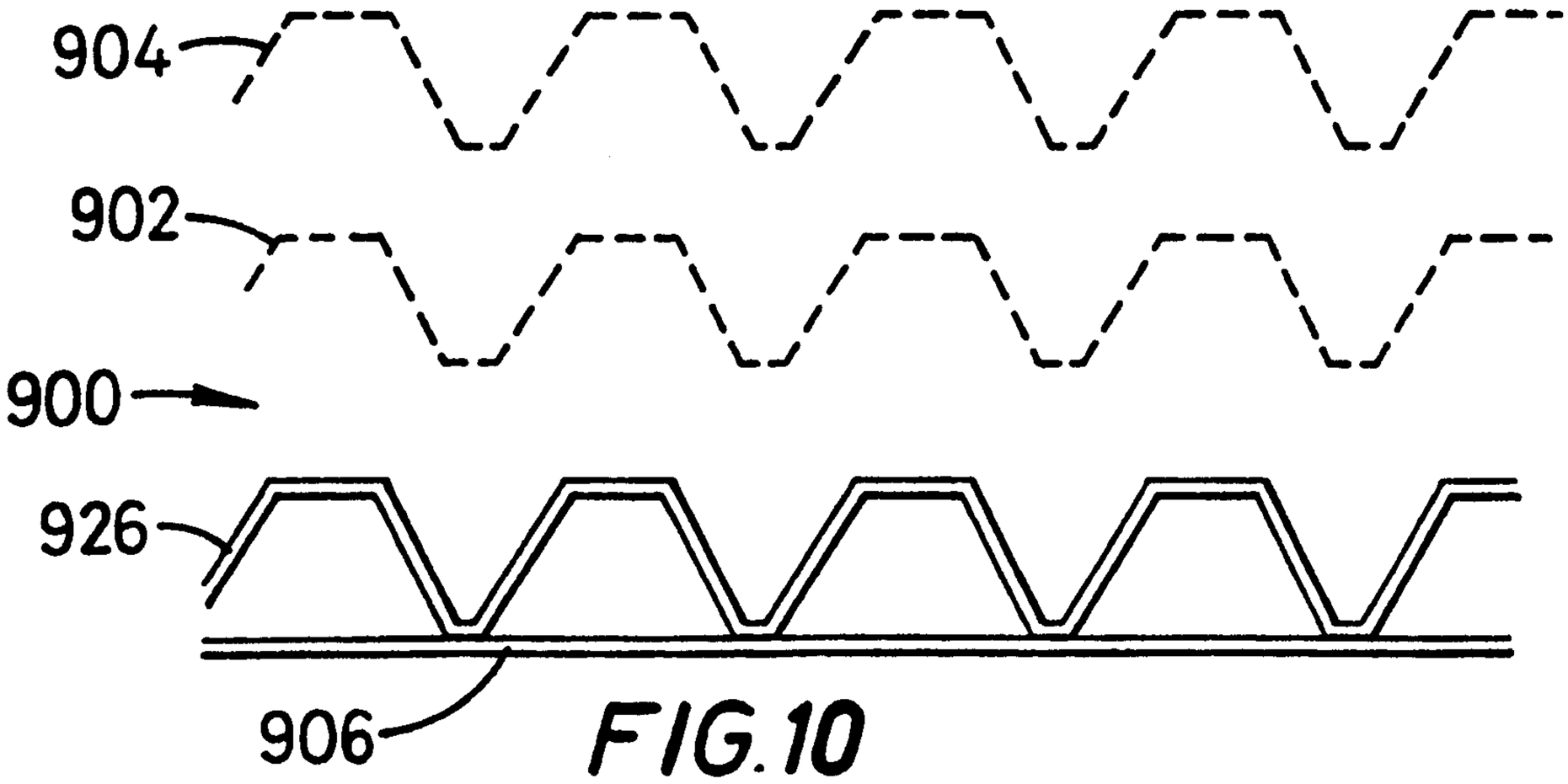


FIG. 10

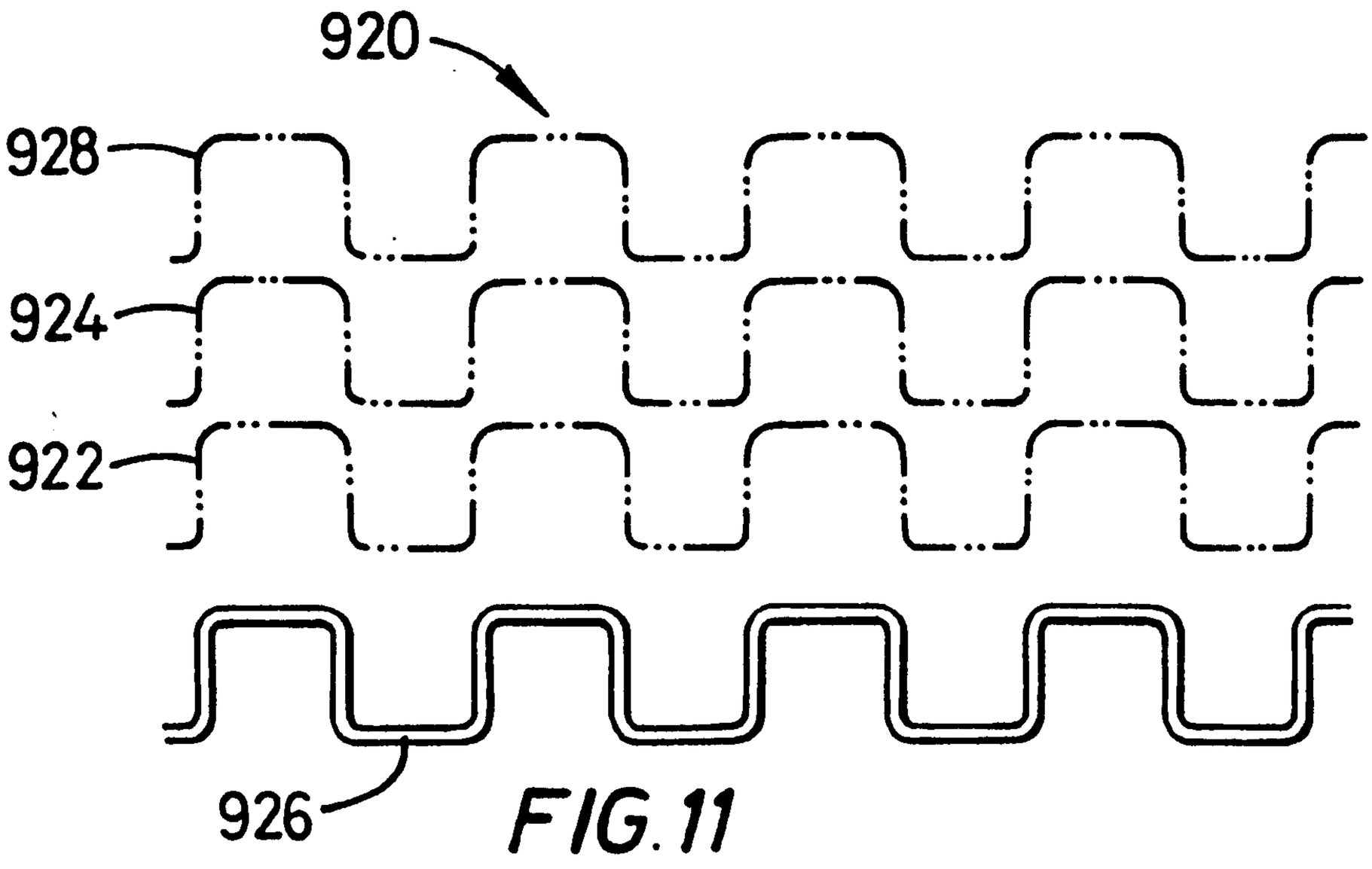


FIG. 11

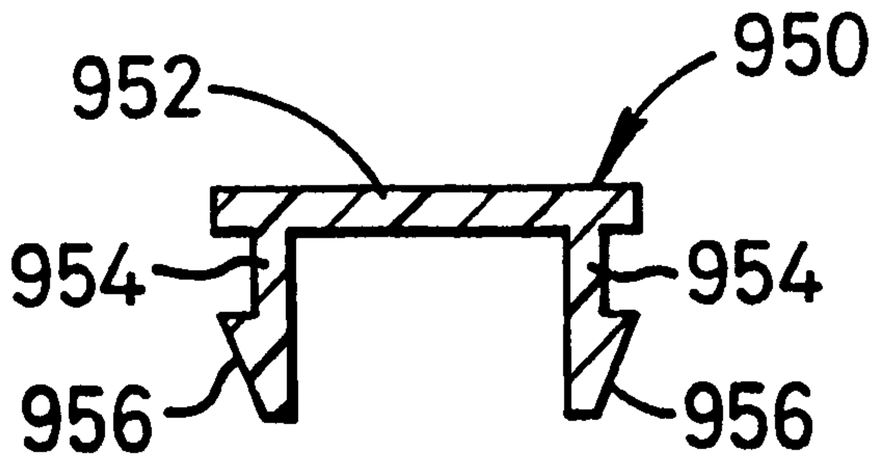
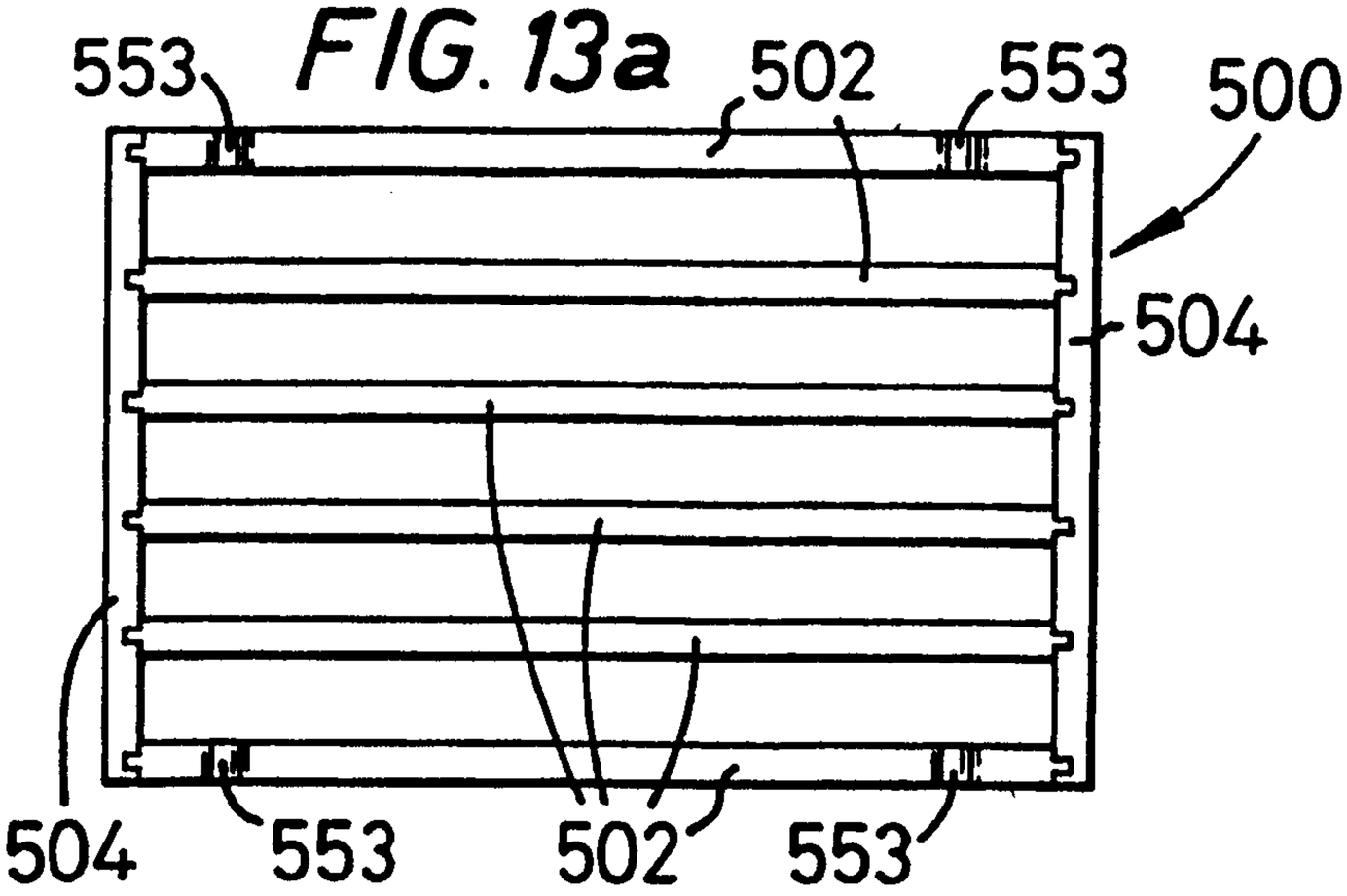


FIG. 12

FIG. 13a



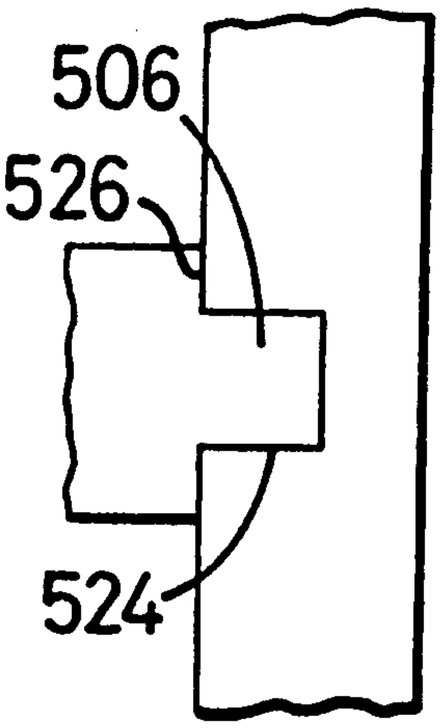
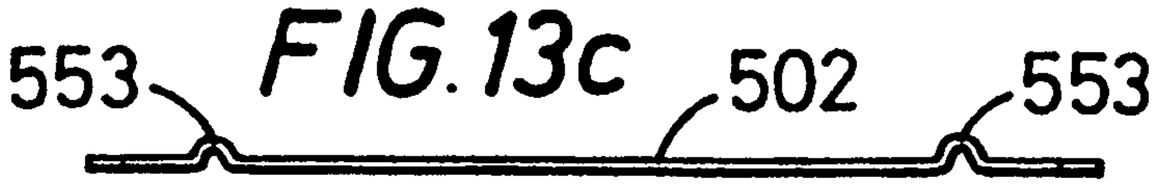


FIG. 13b

FIG. 13c



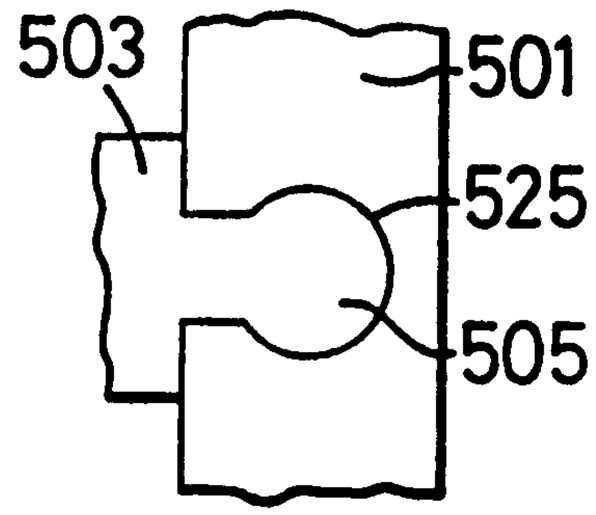


FIG. 14

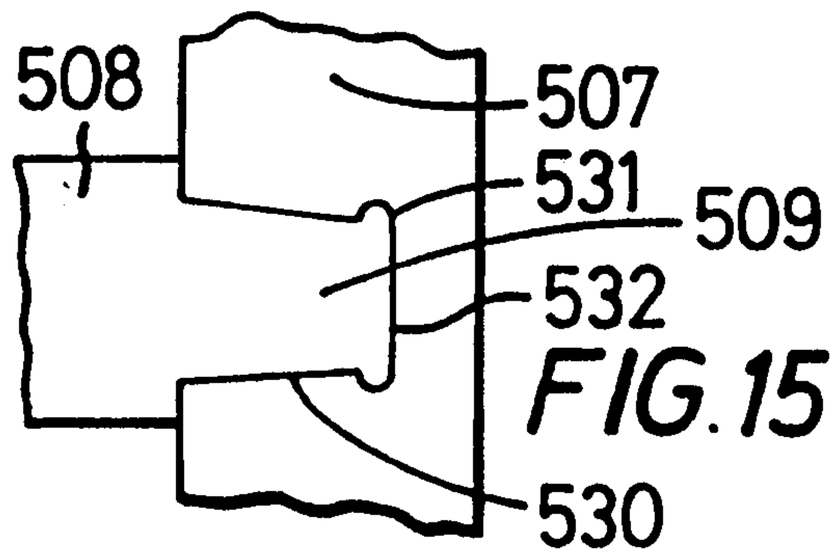


FIG. 15

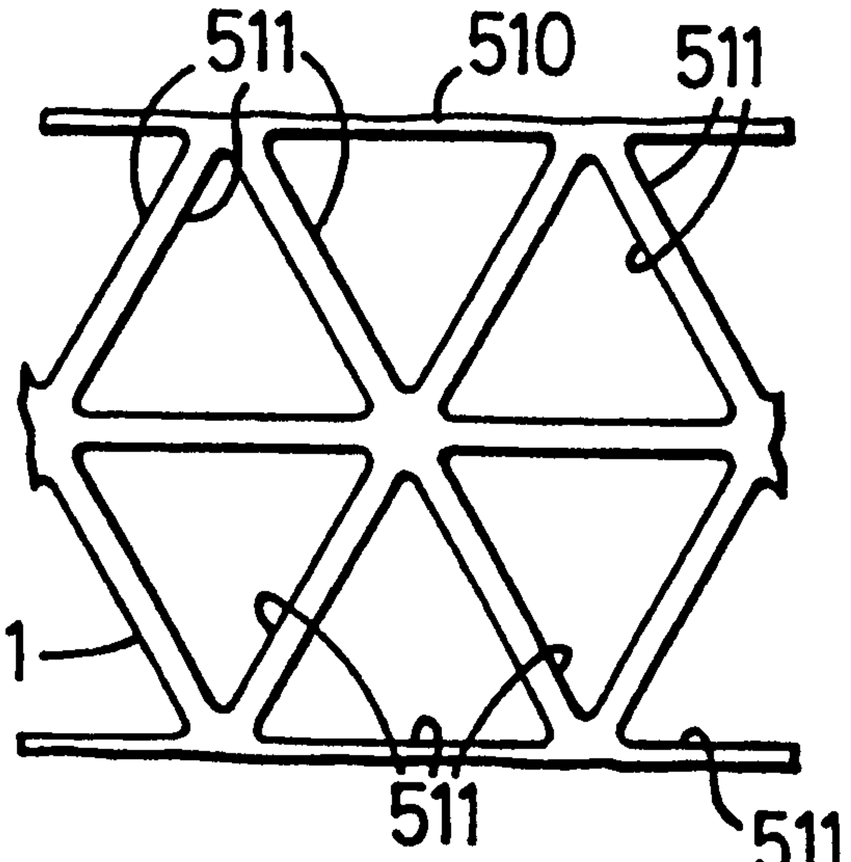


FIG. 16

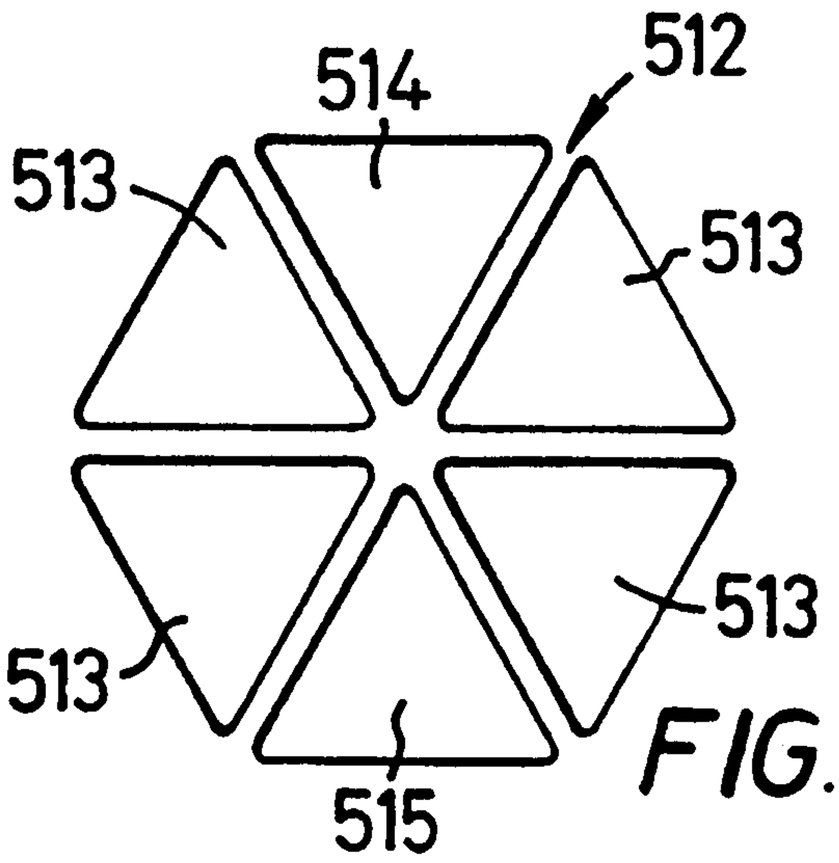


FIG. 17

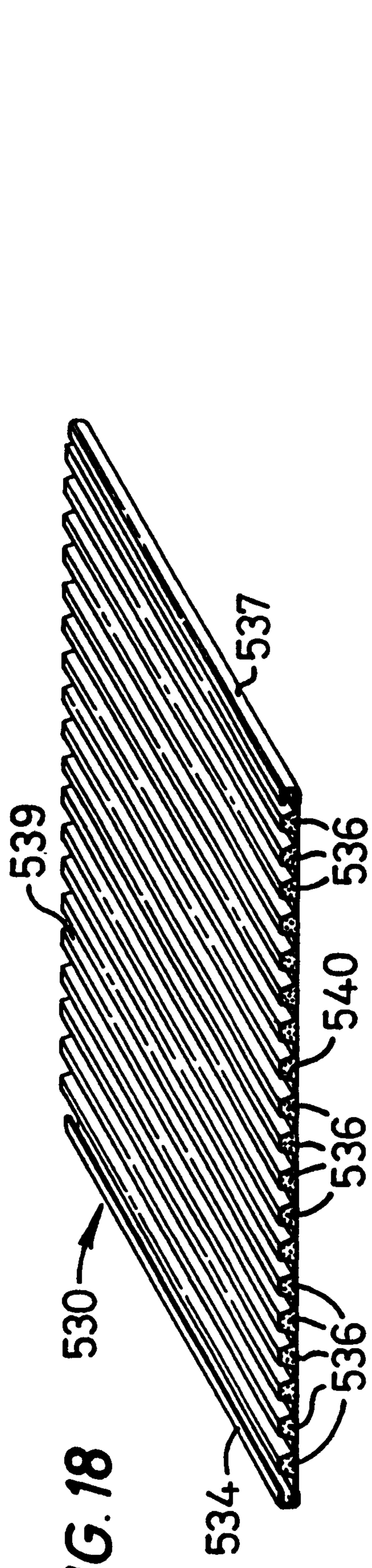

537
539
536
540
530
536
534

FIG. 18

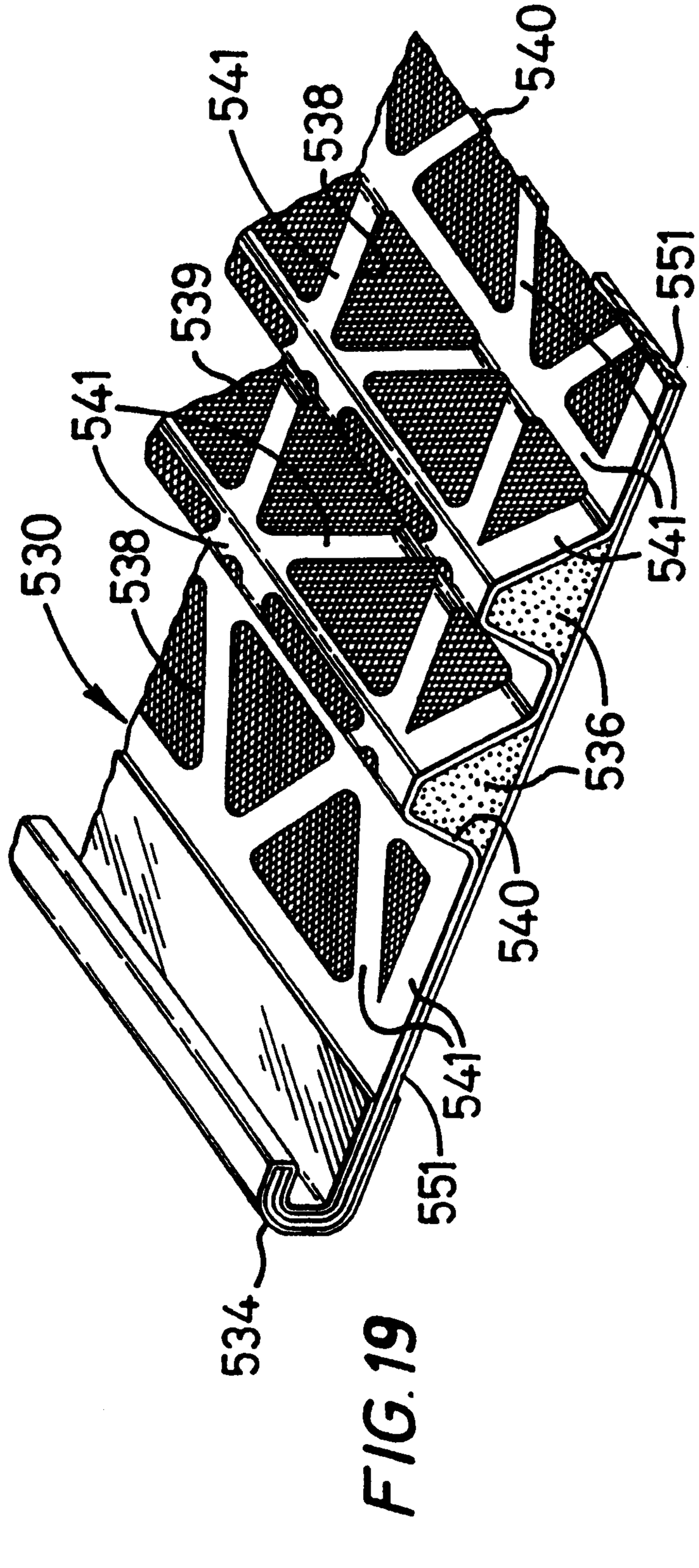

541
538
540
539
551
541
530
538
536
540
541
551
534

FIG. 19

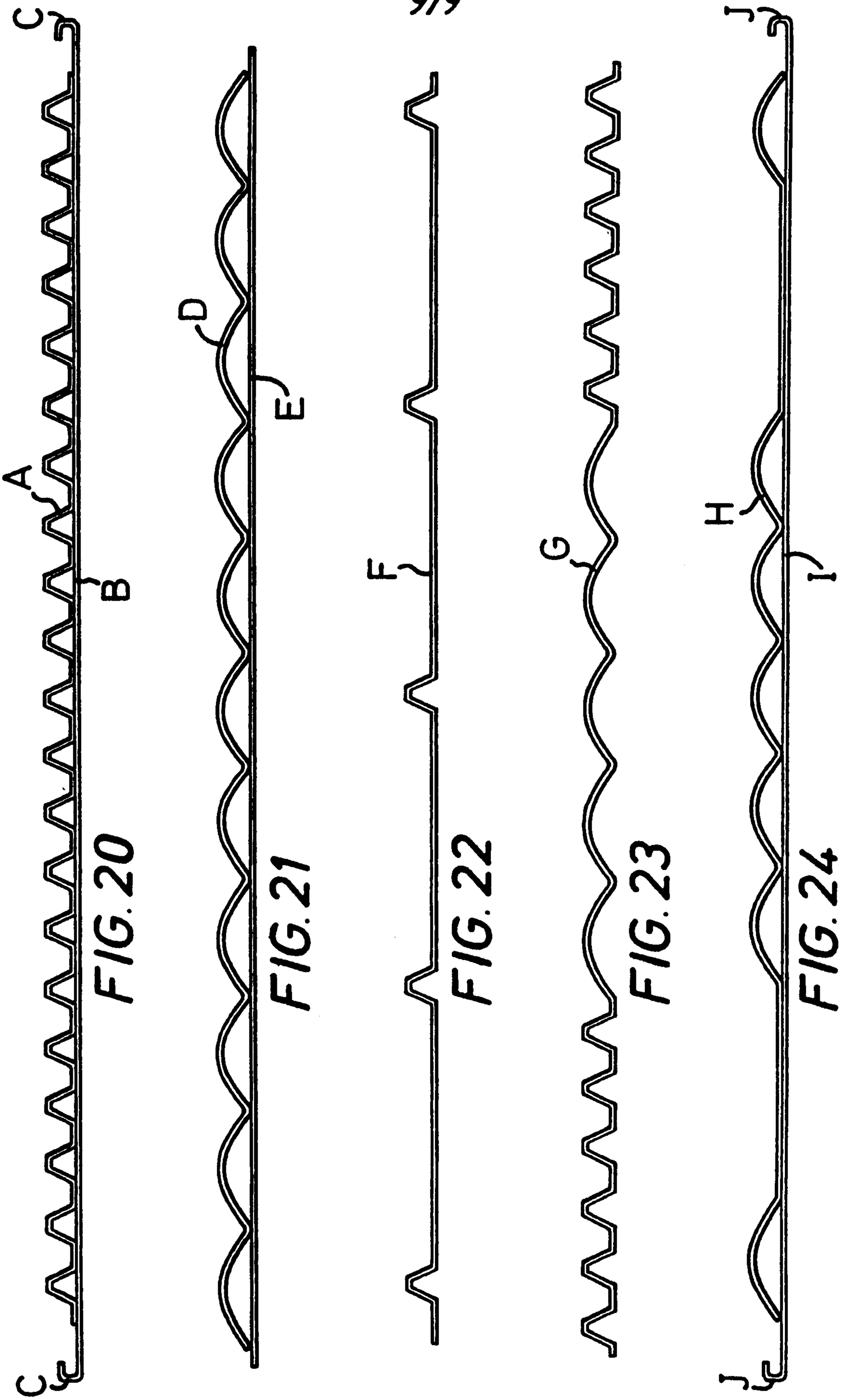


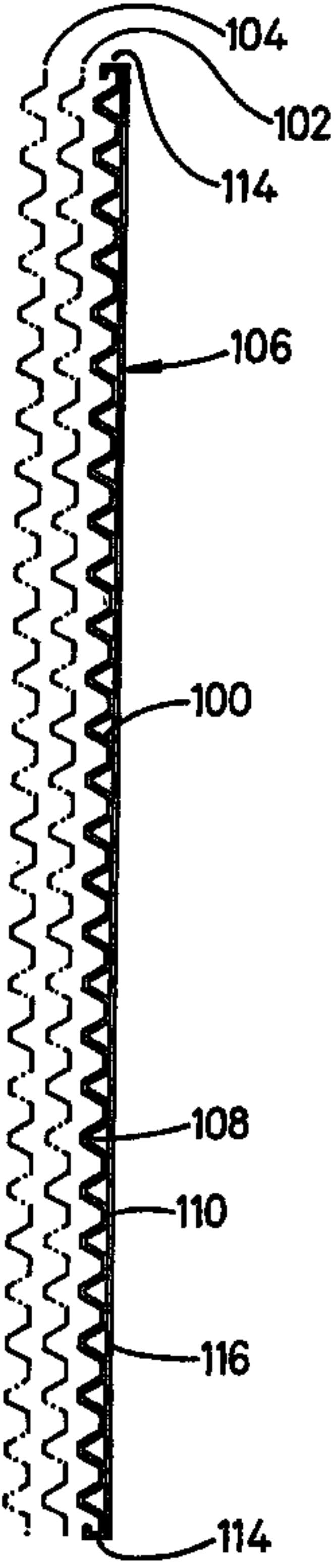
FIG. 20

FIG. 21

FIG. 22

FIG. 23

FIG. 24


104
102
114
106
100
108
110
116
114