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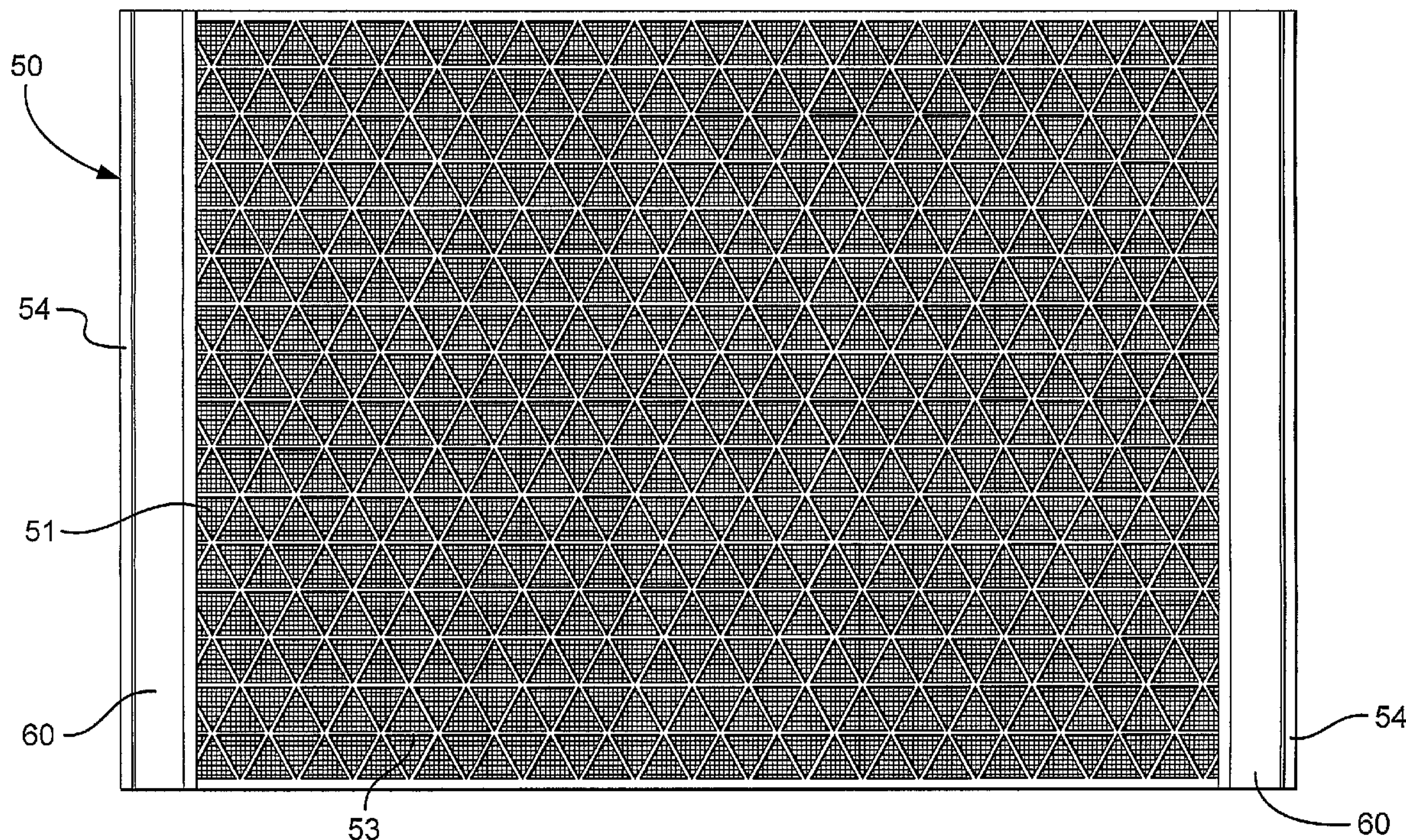
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A screen assembly (50) for a vibratory separator, the screen assembly having at least two layers (51) of screening material having a pair of opposing edges, the at least two layers of screening material having a top surface and a bottom surface and a side mount (60) arranged on each of said opposing edges, the screen assembly having a usable area of screening between the side mounts (60), characterised in that at least one of the side mounts comprises strips on the top and bottom surface of the layers of screening material characterised in that, said at least two layers of screening material has a portion at an angle to the strips beyond the edge of the usable area of screening material.

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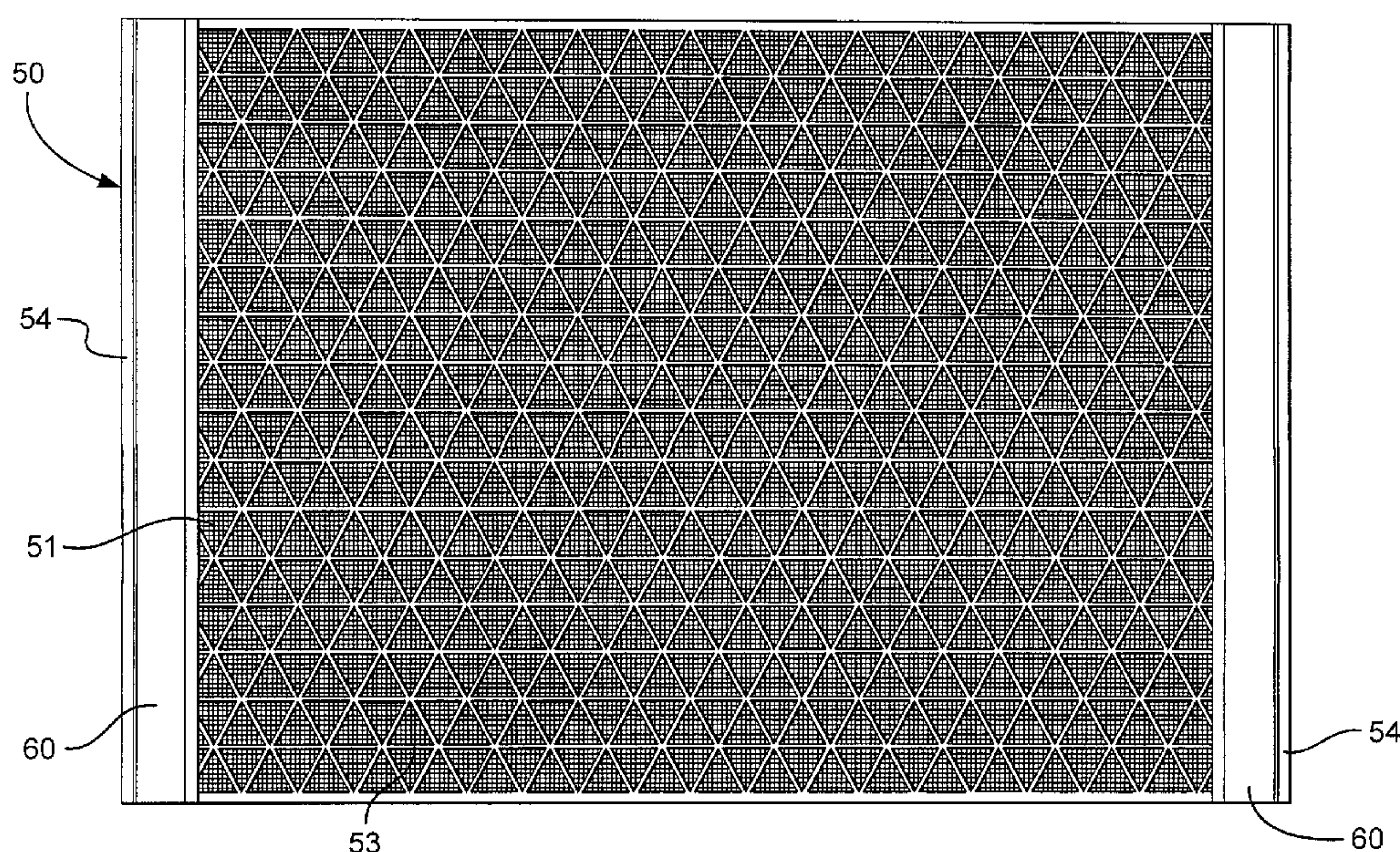
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(54) Title: SCREEN ASSEMBLY FOR A VIBRATORY SEPARATOR



(57) Abstract: A screen assembly (50) for a vibratory separator, the screen assembly having at least two layers (51) of screening material having a pair of opposing edges, the at least two layers of screening material having a top surface and a bottom surface and a side mount (60) arranged on each of said opposing edges, the screen assembly having a usable area of screening between the side mounts (60), characterised in that at least one of the side mounts comprises strips on the top and bottom surface of the layers of screening material characterised in that, said at least two layers of screening material has a portion at an angle to the strips beyond the edge of the usable area of screening material.

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SCREEN ASSEMBLY FOR A VIBRATORY SEPARATOR

The present invention relates to a screen assembly for a vibratory separator and particularly, but not exclusively, to a screen assembly for a shale shaker for screening solids from solids laden drilling mud.

In the drilling of a borehole in the construction of an oil or gas well, a drill bit is arranged on the end of a drill string and is rotated to bore the borehole. A drilling fluid known as "drilling mud" is pumped through the drill string to the drill bit to lubricate the drill bit. The drilling mud is also used to carry the cuttings produced by the drill bit and other solids to the surface through an annulus formed between the drill string and the borehole. The drilling mud contains expensive synthetic oil-based lubricants and it is normal therefore to recover and re-use the used drilling mud. This is achieved by processing the drilling fluid. The first part of the process is to separate the solids from the solids laden drilling mud. This is at least partly achieved with a vibratory separator, such as those shale shakers disclosed in US 5,265,730, WO 96/33792 and WO 98/16328.

Shale shakers generally comprise an open bottomed basket having one open discharge end and a solid walled feed end. A number of rectangular screens are arranged in the basket, which are held in C-channel rails located on the basket walls, such as those disclosed in GB-A-2,176,424. The basket is arranged on springs above a receptor for receiving recovered drilling mud. A skip or ditch is provided beneath the open discharge end of the basket. A motor is fixed to the basket, which has a drive rotor provided with an offset clump weight. In use, the motor rotates the rotor and the offset clump weight,

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which causes the basket and the screens fixed thereto to shake. Solids laden mud is introduced at the feed end of the basket on to the screens. The shaking motion induces the solids to move along the screens towards the open
5 discharge end. Drilling mud passes through the screens. The recovered drilling mud is received in the receptor for further processing and the solids pass over the discharge end of the basket into the ditch or skip.

The screens are generally of one of two types: hook-
10 strip; and pre-tensioned.

The hook-strip type of screen comprises several rectangular layers of mesh in a sandwich, usually comprising one or two layers of fine grade mesh and a supporting mesh having larger mesh holes and heavier
15 gauge wire. The layers of mesh are joined at each side edge by a strip which is in the form of an elongate hook. In use, the elongate hook is hooked on to a tensioning device arranged along each side of a shale shaker. The shale shaker further comprises a crowned set of
20 supporting members, which run along the length of the basket of the shaker, over which the layers of mesh are tensioned. An example of this type of screen is disclosed in GB-A-1,526,663. The supporting mesh may be provided with or replaced by a panel having apertures therein.

25 The pre-tensioned type of screen comprises several rectangular layers of mesh, usually comprising one or two layers of fine grade mesh and a supporting mesh having larger mesh holes and heavier gauge wire. The layers of mesh are pre-tensioned on a rigid support comprising a
30 rectangular angle iron frame and adhered thereto. The screen is then inserted into C-channel rails arranged in a basket of a shale shaker. An example of this type of

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screen is disclosed in GB-A-1,578,948.

A further example of a known rigid support is disclosed in PCT Publication No. WO 01/76719, which discloses, amongst other things, a flat panel like
5 portion having apertures therein and wing portions which are folded to form a support structure, which may be made from a single sheet of material. This rigid support has been assigned the Trade Mark "UNIBODY" by the applicants.

The layers of mesh in the screens wear out
10 frequently and therefore need to be easily replaceable. Shale shakers are generally in the order of 5ft (1.5m) wide and 15ft (4.6m) long. A screen of dimensions 4ft (1.2m) wide by 15ft (4.6m) long is difficult to handle, replace and transport. It is known to use two, three,
15 four or more screens in a single shale shaker. A standard size of screen currently used is of the order of 4ft (1.2m) by 3ft (0.9m).

GB-A-1,526,663 discloses a hook strip type screen assembly, comprising a layer of coarse screen cloth
20 supporting two layers of fine screen cloth. The layers of screen cloth are held together by return-bent channel members arranged on a pair of opposing sides of the layers of screen cloth. The layers of screen cloth are not connected together between the return-bent channel
25 members.

It is known to adhere layers of screening material with a resin, which when set, is stiff and brittle.

It is also known to attach overlying layers of screening material together in a sandwich with a flexible
30 material, such as hot melt glue.

The inventors have observed that the layers of screening material pull out of state of the art

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hookstrips, which results in incorrect tensioning of the layers of screening material in use. This may happen fairly quickly, or may present itself over a long period of time in use in a vibratory separator whilst being
5 vibrated. The present invention attempts to inhibit this problem.

The present invention attempts to tackle the problems associated with difficult to handling, replacing and transporting screen assemblies.

10 It has been observed by the inventors that during screening of solids laden drilling fluid, that solids collect at the side edges of the screen assemblies. The solids which collect at the side edges may interfere with the screen mounting apparatus. Further, when the screen
15 assembly is removed from the shale shaker, solids built up proximate the side edges may fall into the sump in which the screened fluid collects, thus contaminating the screened fluid. Accordingly, the inventors have devised a way of inhibiting the build up of solids proximate the
20 side edges.

According to the present invention, there is provided a screen assembly for a vibratory separator, the screen assembly having at least two layers of screening material having a pair of opposing edges, the at least
25 two layers of screening material having a top surface and a bottom surface and a side mount arranged on each of said opposing edges, the screen assembly having a usable area of screening between the side mounts, characterised in that at least one of the side mounts comprises a strip
30 on both the top and bottom surface of the layers of screening material characterised in that, said at least two layers of screening material has a portion at an

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angle to the strips beyond the edge of the usable area of screening material.

Preferably, the strip is folded about either side of the layers of screening material. The side mounts include
5 a piece of material folded or bent over on itself to grasp between parts thereof an edge portion of the screening material.

Advantageously, the portion of screening material is at substantially at a right angle to the strip, the
10 strip having a integral portions at substantially right angles to the plane of the strip, the integral portions about either side of said portion of screen screening material. Preferably, the integral portions comprise crimped portions to grip said portion of screening
15 material. Preferably, the strip comprises a sloped portion sloping upwardly from the general plane of the at least two layers of screening material in direction generally away from said at least two layers of screening material.

20 According to the present invention, there is provided a screen assembly for a vibratory separator, the screen assembly comprising at least two layers of screening material having a pair of opposing edges, a side mount arranged on each of the opposing edges,
25 characterised in that the at least one of the side mounts has a portion sloping upwardly from the plane of the at least two layers of screening material in direction generally away from the at least two layers of screening material. The portion may slope towards the nearest edge
30 or part of the perimeter of the screen material or have an upper inwardly directed edge. The at least two layers of screening material may be arranged in a sandwich. Side

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mount such as screening holding apparatus facilitates fixing of the screen assembly in a shale shaker. The vibratory separator may be a shale shaker for separating solids from used solids laden drilling mud. The screening material may be flat or undulating and in use, may be tensioned over crowned ribs in a tray or fixed in the deck of a shale shaker.

Preferably, the at least two layers of screening material are connected together between the side mounts, wherein the screen is flexible, such that the screen can be rolled or folded.

It should be noted that the screen assembly of the present invention does not have an integral non-foldable or rollable or bendable support. Thus, allowing the screen assembly to be easily handled, transported and replaced.

Preferably, the at least two layers of screening material are connected together with a hot melt glue. Other flexible connecting means, which allows the layers of screening material to flex to be rolled or folded may be used, such as sewing material, sewn into the layers of screening material. The glue pattern may be of a different pattern or larger scale from the pattern of wires forming the mesh. Advantageously, the at least two layers of screening material has a length and a width and the hot melt glue is in continuous lines of glue extending across the length and the width of the screening material. Preferably, the hot melt glue is applied to a layer of screening material in discrete amounts spaced-apart across the screening material. Advantageously, the hot melt glue is in at least one line across the screening material.

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Advantageously, the layers of screening material are layers of metal mesh. Preferably, one of the at least two layers of screening material is a fine screening material and the other is a coarse screening material for supporting the fine screening material. Advantageously, the screen assembly further comprises a third layer of screening material. Preferably, the third layer of screening material is a fine screening material.

Preferably, at least one of the side mounts comprises at least one opening for receiving a toothed member. The toothed member may be attached to a tensioning device in a shale shaker for applying tension between the two opposing side mounts. Advantageously, a plurality of openings are provided for one or a plurality of corresponding upstanding members. Advantageously, at least one of the side mounts comprises a handling apparatus. Preferably, the handling apparatus comprises a handle, which may be integral with the side mount. Preferably, at least one of the side mounts comprises a seal member, such that, in use in a shale shaker, the seal member seals between the side mount and the shale shaker to inhibit solids and particles from passing therebetween. The seal member may have a hollow portion. Advantageously, the seal comprises handling apparatus, which may be integral therewith. It is important to achieve a seal at the interface between screen assemblies and between the screen assembly and the vibratory separator to prevent or inhibit solids from passing between the screen assemblies and between the screen assemblies and the vibratory separator.

Preferably, the side mount has an end opening defined at least partly by the portion sloping upwardly

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from the plane of the at least two layers of screening material, the end opening sealed with sealing material. The sealing material may be a hot melt glue, resin etc. In other aspects these ends are sealed with plugs (for
5 example, of wood, metal, plastic, fiberglass, composite); two part acrylic filler; two-part epoxy filler; thermoplastic material; thermosetting material; moisture cure urethane or PUR.

Preferably, at least one of the side mounts comprise
10 two portions, one above and one below the at least two layers of screening material. The side mount may be welded to the at least two layers of screening material between the two portions. Advantageously, at least one of the side mounts comprises a single piece of material. A
15 single sheet of material may be folded around the edges of the at least two layers of screening material.

The present invention also provides a vibratory separator comprising a basket and means for vibrating the basket, characterised in that a screen assembly of
20 the present invention is arranged in the basket.

Preferably, the vibratory separator further comprises a series of crowned ribs over which the screen assembly is installed and at least one toothed member arranged in the basket for location in a hole in the side
25 mount of the screen assembly for tensioning the at least two layers of screening material. The screen assembly may be tensioned over the ribs. An upstanding member of a vibratory separator may be arranged on the crowned ribs of the vibratory separator be received in a
30 corresponding opening in the screen assembly.

Preferably, the series of crowned ribs is removable in the form of a tray from the vibratory separator.

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The present invention also provides a screen assembly for a vibratory separator, the screen assembly comprising at least two layers of screening material having a pair of opposing edges, a side mount arranged on each of the opposing edges, characterised in that the at least two layers of screening material are connected together between the side mounts, wherein at least one of the side mounts comprises a handle for facilitating removal or insertion of the screen assembly in a vibratory separator.

The present invention also provides a screen assembly for a vibratory separator, the screen assembly comprising at least two layers of screening material having a pair of opposing edges, a side mount arranged on each of the opposing edges, characterised in that the at least two layers of screening material are connected together between the side mounts, wherein at least one of the side mounts comprises a seal, such that in use the seal seals between the side mount and a vibratory separator. Preferably, the seal comprises a handle for facilitating removal or insertion of the screen assembly in a vibratory separator.

In certain aspects the screening material includes two or more layers glued together as disclosed in U.S. Patent 6,450,345 and U.S. Applications 09/517,212 filed March 2, 2000; 10/037,474 filed October 19, 2001; 09/454,722 filed 12/04/1999 and 10/087,025 filed October 19, 2001; all co-owned with the present invention and fully incorporated herein for all purposes. In certain aspects the glue used is hot melt glue.

The screen has one or more upper layers of screen,

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screen cloth, and/or mesh. The layer or layers may be mounted on frame apparatus which may include a solid side support on each of two spaced apart sides of the layer(s), or a full four sided screen frame, with or
5 without one or more interior crossmembers such as tubular rods or hollow tubular members extending between the sides. A strip support or strips of support material (for example, flat steel) may be used beneath screen layer(s).

10 With such a shale shaker, the pin(s), projections, and/or finger(s) of the deck, bed or tray can be formed integrally of the deck, bed or tray; or the pin(s) and/or finger(s) may be part of strips, bars, wear strips or elongated members that are releasably connectable to the
15 deck, bed or tray. In one particular aspect, such pin(s) and/or finger(s) are on separate wear strips that are releasably connected to a shaker tray and which, in position thereon, provide an upward force that forces a screen assembly thereabove upwardly, facilitating the
20 maintenance in position of the screen assembly. Wear strips that are made in an originally upwardly bowed configuration can provide such an upward force or an initially flat wear strip that is installed so that it bows slightly upwardly can provide such a force.

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

Figure 1A is a top plan view of a screen assembly in accordance with the present invention; Figure 1B is a bottom view of the screen assembly shown in Figure 1A; Figure 1C is an end view of the screen assembly shown in Figure 1A; Figure 1D is an enlarged view in cross section of a side mount structure of the screen assembly shown in Figure 1A, the cross-section taken close to one of the ends of the side mount structure;

Figure 2 is an end view of a screen assembly in accordance with the present invention;

Figure 3 is a top view of a screen material combination used in any screen assembly in accordance with the present invention;

Figure 4A is a top view of a screen assembly in accordance with the present invention; Figure 4B is a bottom view of the screen assembly shown in Figure 4A; Figure 4C is an end view of the screen assembly shown in Figure 4A; Figure 4D is a side view of the screen assembly shown in Figure 4A; Figure 4E is an enlarged view of a side mount structure of the screen assembly as shown in Figure 4C; Figure 4F is a top view of the screen assembly shown in Figure 4A in a rolled-up configuration.

Figures 5A to 5D are views of glue patterns applied to a screen material combination used in any screen assembly in accordance with the present invention;

Figure 6 is a top view of a screen assembly in accordance with the present invention;

Figure 7 is a top view of screen assemblies in

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accordance with the present invention, with parts partially cut away;

Figure 8 is a top view of a screen component of a screen assembly in accordance with the present invention;

5 Figure 9A is an end view of the screen component shown in Figure 8, when rolled up; Figure 9B is an end view of a rolled up screen component for example, like the screen component of Figure 8.

10 Figure 10A is a top view of a substrate for glue for a screen assembly in accordance with the present invention; Figure 10B is a top view that shows the substrate of Figure 10A with a glue pattern in accordance with the present invention deposited thereon; Figure 10C shows the glue pattern of Figure 10B removed from the
15 substrate of Figure 10A; Figure 10D is an end view that shows the glue pattern of Figure 10C in a roll;

Figure 11A is a side view of a screen assembly in accordance with the present invention; Figure 11B is a side view of a screen assembly in accordance with the
20 present invention; Figure 11C is a side view of a screen assembly in accordance with the present invention;

Figure 12 is a side view of a screen assembly in accordance with the present invention;

25 Figures 13 to 15 are perspective views of screen mount structures for a screen assembly in accordance with the present invention;

Figures 16 and 17 are perspective views of seals for screen assemblies in accordance with the present invention.

30 Figures 1A to 1D show a screen assembly 10 in accordance with the present invention, which has layers 12 of screening material and side mounts 14. In one

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particular aspect there are three layers 12 of stainless steel screening material with a lowermost layer with mesh of 20 x 20, a middle layer of 105 x 64 mesh, and a top layer of 170 x 105 mesh; and these layers are glued together with hot melt glue applied in the diamond pattern shown in Figures 1A and 1B. Of course it is within the scope of this invention for the layers 12 to be any known screening material with layers bonded, connected, fused, sintered, glued together, or sewn together in any known manner and the screening material may be made of any known material used for such screen assemblies.

In certain aspects, the layers 12 of screening material are glued together with cured hot melt glue producing glued-together screening material that is flexible and a screen assembly in accordance with the present invention with such material can be folded on itself or rolled up.

Figure 3 shows an alternative pattern P for glue applied to one or more of the layers 12.

Referring back to Figures 1A to 1D, each side mount 14 has a bottom part 21, a side part 22, a top part 23, a top lip 24, and a top lip 25. The layers 12 pass between and are secured between the bottom part 21 and the top lip 24. An end of the layers 12 is held between opposed parts 25a and 25b of the top lip 25. The top lip 24 may, optionally, be adhesively secured together and/or welded to the bottom part 21 with multiple spaced-apart welds 26 along the length of the side amounts 14. Similar adhesive material and/or welds may be, optionally, used along the top lip 25. In other aspects, the welds 26 are deleted or are supplemented with glued areas along the

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mounts 14. Alternatively, or in addition, inwardly projecting teeth or humps on the top lip 24 and/or bottom part 21 may be used to hold screening material. The bottom part 21 has a plurality of spaced-apart holes 29
5 for receiving corresponding upwardly-directed projections of a screen mounting structure, such as those disclosed in WO 03/061854. The screen mounting structure may be in the form of a tray, such as that disclosed in Figure 19 of WO 03/061854, which tray is removable from the shale
10 shaker, or be a mounting structure integral with the shale shaker or vibratory separator. Optionally ends 16 of the side mounts 14 are sealed with any suitable seal material or seal structure. As shown in Figure 1D, an amount of hot melt glue 27 has been applied over the end
15 opening 16 and allowed to set. Optionally, such material may encapsulate the edge of screening material layers 12. In certain aspects the side mounts are made of plastic, epoxy, acrylic, steel, stainless steel, fiberglass, composite, aluminum, aluminum alloy, zinc, zinc alloy,
20 brass or bronze. Optionally the top part 23 is deleted and a generally "L" shaped side mount is provided and it is within the scope of this invention to provide such a side mount with any seal or handling apparatus described herein.

25 A plurality of screws 31 secure a seal member 30 to the side part 22. In one aspect the seal member 30 is (as may be the case for any seal or seal member in accordance with the present invention) made of neoprene, but it may be made of nitrile rubber, rubber, plastic,
30 gasket material, polyurethane, or any suitable seal material. The seal member 30 has an upper portion 32 of generally circular cross-section (but, in accordance with

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the present invention, this cross-section may be any desired shape, including, but not limited to, square, oval, and rectangular). Optionally, the upper portion 32 is hollow and, for example, may have a space 33 of a generally circular (or of any desired shape) cross-section. An elongated part 34 of the seal member 30 extends down from the upper portion 32. The seal member 30 is, in one aspect, positioned so that when the screen assembly 10 is in place on a shale shaker or vibratory separator, the seal member 30 is trapped between the screen assembly 10 and the side wall of a basket or other screen holding structure. In another aspect the seal member 30 is positioned so that the upper portion 32 is above a top edge of the top lip 25. The seal member 30 may be adhesively secured to a side mount.

Figure 2 shows a screen assembly 40 in accordance with the present invention which has side mounts 44 (like the side mounts 14, Figure 1D); one or more layers 42 of screening material (like the layer or layers 12 of the screen assembly 10); and one, two, three or more layer(s) 46 of ridged or undulating screening material on and/or connected to the layer(s) 42. The screening material layer(s) 46 may be any known undulating or ridged screening material, including, but not limited to, that disclosed in U.S. Patents 6,450,345; 5,868,929; 5,720,881; 5,958,236; 5,876,552; 5,636,749; 5,417,858; 5,417,793; 5,417,859; and 5,944,993, all fully incorporated herein fully for all purposes. In the screen assembly 40 a portion of the layers 46 may pass with the layer(s) 42 between the bottom part and lower lip of the side mounts 44 and, if desired, into the top lip. Alternatively only the layer(s) 42 are secured

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within the side mounts 44.

Figures 4A to 4F show a screen assembly 50 in accordance with the present invention which has glued-together layers 51 of screening material whose side edges 52 are secured in side mounts 60. Glue in a pattern 53 extends across the surfaces of the layers 51 and has a different pattern than that of the layers 51.

Each side mount 60 has a seal 54 secured thereon with plastic rivets 55. The seal 54 is like the seal member 30 described above. The side mounts 60 are like the side mounts 14, described above, but edges 61 of the layers 51 do not extend up into an uppermost lip 62 of the side mounts 60. Instead, these edges 61 are folded as shown within the side mounts.

As shown in Figure 4F, unlike the prior art screens with perforated plates, the screen assembly 50 (and any other screen assembly in accordance with the present invention which has layers of screening material glued together with hot melt glue or similar glue) is flexible enough to fold it or to roll it up into a roll 63. Alternatively, the screen assembly 50 may be folded, for example, folded in half, thirds or fourths. It is within the scope of this invention to delete the side mounts 60 and substitute for them any known hookstrip or other tubular or screen mounting edge structure.

It is within the scope of the present invention to secure together the layers 51 (or any layers of any screen assembly in accordance with the present invention) with plastic, including, but not limited to, any known plastic, thermoplastic, polypropylene, or nylon used to secure screening material layers together. The use of such material that does not result in a screen flexible

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as are those made with hot melt glue or its equivalents will result in a screen assembly that cannot be rolled up like the screen assembly 50 as shown in Figure 4F.

5 The side mounts 60 and screen material layers therein may be welded, for example, with resistance welds, like the welds 26 described above. The side mounts 60 each have a series of spaced apart openings 64 into which project teeth, fingers, or projecting members of a shale shaker screen assembly mounting apparatus.

10 The ends of side mounts 60 may be filled, as are the side mounts 14 described above, with PUR or other suitable filler, foam, and/or sealing material, for example, to a thickness of between one-half to three-fourths inches thick. Alternatively the entire side mount is filled.

15 Figures 5A to 5D show possible glue patterns that may be applied by systems in accordance with the present invention (including, the systems disclosed in U.S. Applications WO 01/39862 (09/517,212 filed March 2, 2000); WO 03/033102 (10/037,474 filed October 19, 2001 and 10/087,025 filed October 19, 2001); WO 01/39861 (USSN 09/454,722 filed 12/04/1999). These patterns can be

20 achieved by appropriate control of rate of movement of the screen or mesh and/or by the rate and/or direction of travel of glue dispensing nozzle(s). In Figures 5A to

25 5D, angle measurements are in degrees (either " " or "deg"), length measurements are in inches ("inches" or "in" or a number, for example, Figure 17A "1.38" is 1.38 inches) and area measurements ("sq. in.") are in square inches.

30 Figure 6 shows a screen 90 produced with any of the systems disclosed in U.S. Applications 09/517,212 filed March 2, 2000; 10/037,474 filed October 19, 2001;

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09/454722, filed 12/04/1999 and 10/087,025 filed October 19, 2001). An optional frame 90a is used around the screen 190. Figure 7 shows a screen 92 with a glue layer 93 in accordance with the present invention produced with any of the systems disclosed in U.S. Applications 09/517,212 filed March 2, 2000; 10/037,474 filed October 19, 2001; 09/454,722 filed 12/04/1999 and 10/087,025 filed October 19, 2001). The screen 92 is like the screens disclosed in U.S. Patent 4,575,421 (incorporated fully herein for all purposes), but made with a system in accordance with the present invention and by a method in accordance with the present invention. The screen 92 has three layers of mesh or screening material 56, 57 and 58 and a lower perforated plate 54. Any of the layers of mesh may be deleted and the glue 93 may be applied on top of any of the layers. In one aspect the plate 54 is deleted. In one aspect the plate 54 is deleted and any other support is used. The screen 90 is like a screen disclosed in U.S. Patents Des. 366,040 (incorporated fully herein for all purposes) and U.S. 5,971,159 (incorporated fully herein for all purposes).

Figure 8 shows a glue/substrate combination 1450 with a paper substrate 1452 and a glue pattern 1454 deposited thereon (for example, by any apparatus and by any method disclosed herein, by hand, or by any suitable machine or apparatus; using any glue suitable for use in a screen assembly for a vibratory separator). Alternatively the pattern may be any desired pattern including any pattern disclosed herein, with or without edges and/or with or without one or more shear lines of glue.

Figure 9A illustrates a roll 1451 of the

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glue/substrate combination 1450 of Figure 8. As shown the roll is rolled with the substrate on the roll's exterior and the glue pattern disposed internally of the roll; but it is within the scope of this invention for the position of these components to be reversed (as is true of any roll of material in accordance with the present invention), for example, as shown in Figure 9B. Such a roll (and any roll of material described herein) may be unrolled for subsequent use. In certain aspects, as needed, such a roll of material may be heated to facilitate its unrolling.

Figure 10A illustrates a piece of release liner material 1462 (or wax paper or waxed cardboard) to which a glue pattern is to be applied. Figure 10B shows a resulting glue pattern 1464 applied to the release liner material 1462. Figure 10C shows the resulting layer of glue pattern 1464 after it has been separated from the substrate of release liner material 1462. The layer of glue pattern 1462 may be used flat as shown in Figure 10C; or as shown in Figure 10D it can be rolled into a roll 1461 for further future use.

Figure 11A shows a screen assembly 1470 in accordance with the present invention with a glue pattern 1474 in accordance with the present invention that has been separated from a substrate to which it was previously applied. The glue pattern 1474 has been applied onto a layer (or layers) of screening material 1473. In accordance with the present invention the glue pattern 1474 (any glue pattern in accordance with the present invention) may be pressed onto and/or into the screening material 1473 and/or heat may be applied to the combination of glue pattern and screen layer to fuse

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and/or connect the two together and/or to impregnate the screening material 1473 with some or all of the glue pattern 1474. The screening material 1473 may be any screen, screens, mesh, or meshes, or any combination thereof. The glue pattern and screen layer(s) may be pressed together in any suitable manner; for example, but not limited to, between dual opposed pressing rollers, by a flat plate (heated or not) placed on top of the combination; and/or between the flat plates of a press apparatus.

Figure 11B shows a screen assembly 1480 in accordance with the present invention which has a glue pattern layer 1484 (like the glue pattern 1474, Figure 11A or any of its alternative versions) between two screen layers 1483, 1485 (each like the screen layer 1473, Figure 11A or any of its alternative versions). Figure 11C illustrates a screen assembly 1490 with two glue pattern layers 1494, 1496 (each like the glue pattern layer 1474, Figure 11A, or any of its alternative embodiments). A screen layer 1493 (like the screen layer 1473, Figure 11A or any of its alternative embodiments) is disposed between the glue pattern layers 1494, 1496. The components of the screen assemblies of Figures 11B and 11C may be heat treated and/or pressure treated as are the components of the screen assembly 1470, Figure 11A, as described above.

Figure 12 shows a screen assembly in accordance with the present invention with a screening material layer 1499 on either side of which are glue pattern layers 1495 and 1497. Each glue pattern layer has not been separated from a substrate 1492, 1498 respectively on which the glue pattern layers have been previously deposited. The

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screening material layer 1499 may be any screening material disclosed herein. The substrates 1492, 1498 may be any substrates disclosed herein. In one particular embodiment the substrates are suitable cardboard release material (for example, waxed) which serves as a protective cover or package (with ends appropriately folded over and/or sealed) for the resulting screen assembly. Such cardboard may be sized and of such a nature to withstand any heat treatment and/or pressure treatment to the glue/screening material combination.

It is within the scope of this invention for any screen assembly described herein that includes a glue pattern layer to include a substrate on which the glue pattern layer is formed. The substrate is subsequently removed from the resulting screen assembly by peeling it away, by burning, by chemical degradation (chemical applied with or without pressure) or by liquid (for example, water) blasting. In any embodiment of a screen assembly herein that employs a glue/substrate combination in the screen assembly, the substrate side or the glue pattern side may be on the exterior on either top or bottom (or both) of the screen assembly. It is also within the scope of this invention for the substrate to include multiple layers of similar or different material. Also, any glued screen layer or layers may be rolled up into a roll in accordance with the present invention without a separator sheet or release liner; or with a separator sheet or release liner material under the layer or layers so that screen does not touch screen in a resulting roll of screening material. When curing glue is in such a roll, using such a separator or liner prevents undesired gluing together of screening material

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within the roll. A screen assembly with layers connected together by cured glue may be folded and/or rolled up for ease of handling and/or for ease of packaging and/or shipping.

5 "Screening material" for any screen or screen assembly disclosed herein may be any screening material(s) and/or layer(s) disclosed or referred to herein and it may, optionally, be corrugated following glue application. Such corrugation may be in the form of
10 any corrugated screen disclosed in the prior art for use on vibratory separators or shale shakers.

Figure 13 shows a screen side mount 100 in accordance with the present invention which has a main member 102 to which is connected a secondary member 104,
15 for example, by resistance welding and/or adhesives. As shown the members 102, 104 are spaced apart (prior to their connection together) to illustrate areas 106, 108 defined, respectively, by portions 101, 103 and 105, 107 of the member 102, 104. Screening material (not shown)
20 may pass through area 106 and, in one aspect, into area 108. An end opening 109 may be left open or it may be sealed off (for example, as described above for the side mount 14). A series of spaced-apart holes 102a (two shown) in the main member 102 are like the holes 29,
25 Figure 1B, and the openings 64, Figure 4B. There may be any desired number of holes 102a (one, two, three, etc.) and, in one aspect, such holes are spaced-apart along the entire length of the screen side mount 100.

Figure 14 shows a screen side mount 110 in
30 accordance with the present invention which is formed of a single piece of material 112, (for example, metal or plastic) which is formed, folded or bent as shown in

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Figure 14. A resulting upper edge 114 serves as a rigid handle for manipulating holding, lowering, and raising a screen assembly with such a screen side mount. The screen side mount 110 is similar to the side mount 60, Figure 4E. A series of holes 116 extend along the length of the screen side mount 110. Screening material may pass between a lip 111 and a lower portion 113 and, in one aspect, may extend up and between top portions 115, 117. The lip 111 and lower portion 113 may be welded together and/or adhered together with adhesive material, as may be the top portions 115, 117.

The edge 114 may serve the functions of: stiffening a screen assembly during use, handling, and shipment; protecting a mid-portion 119 during handling and shipment; and preventing curling of a screen assembly in accordance with the present invention that has flexible screening material. Since the edge 114 is relatively rigid (as opposed to a flexible floppy piece of wire, rope, or cable), it can be pulled on and also torque can be applied to it which is useful in removing a screen assembly from its operational position on a vibratory separator or shale shaker.

Figure 15 illustrates a rigid handle 122 on a screen side mount 120 in accordance with the present invention which has some of the advantages of the rigid edge 114 described above. The handle 122, in certain aspects, is metal and is welded to a metal screen side mount 120. Alternatively sufficiently rigid and strong plastic, composite, or fiberglass may be used. One, two, three or more such handles may be used with the screen side mount 120 (and with any side mount in accordance with the present invention). Optionally or alternatively, the

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side mount 120 has one, two, or any desired number of rigid projections 123 with a base 125 and an optional crossmember 127 connected to the side mount 120 as is the handle 122.

5 Figure 16 shows a seal member 130 in accordance with the present invention made of any of the materials described above for seal member 30. Formed integrally with or secured to the seal member 130 is a handle 137 useful for handling, moving, and manipulating a screen
10 assembly with a side mount with a seal member 130. The seal member 130 has an upper portion 132 (like the upper portion 32, Figure 1D) and an elongated portion 134 (like the elongated portion 34, Figure 1D). It is within the scope of this invention to have a seal member with one,
15 two, three or more handles like the handle 137. Optionally, the upper portion 132 is deleted (as may be the case for the upper portion 32, Figure 1D). The handle 137 has upright parts 137a and a crossmember 137b. The crossmember 137b may be deleted and one, two, three,
20 or any desired number of upright parts 137a, with or without holes for human fingers, may be used to facilitate handling of a screen assembly using a seal member 130. Optionally or alternatively, one or more (two, three, any desired number) "T" shaped upright parts
25 138, with or without holes for human fingers, may be used formed with or secured to the seal member 130 to facilitate handling and manipulation of a screen assembly with a seal member 130.

30 Figure 17 shows a seal member 140 used in a position on a screen side mount as are the seal members 30, 54, and 130. As may be the case with any seal member in accordance with the present invention, the seal member

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140 has cut out portions 141 which define openings so that a hand or finger may be inserted therethrough to facilitate handling and manipulation of a screen assembly with a seal member 140. It is within the scope of this invention to use one, two, three or any desired number of such openings of any desired shape for the seal member 140 (or with any seal or seal member in accordance with the present invention). An optional seal portion 142 extends from a main body 143 of the seal member 140. The seal portion 142 may be positioned as are the seal members 30, 54, and 130 on a screen assembly with the portion 142 either between a screen assembly and a basket wall or above the screen assembly.

The present invention, therefore, in some, but not necessarily in all embodiments, provides a vibratory separator including container apparatus, screen assembly apparatus removably secured in the container apparatus, the vibratory apparatus connected to the container apparatus for vibrating the container apparatus and the screen assembly apparatus, the screen assembly apparatus with screening material with opposed spaced-apart sides including a first side and a second side, a side mount on each of the opposed spaced-apart sides, each side of the opposed spaced-apart sides of screening material having an edge portion, each edge portion held within a side mount, seal structure on an exterior of each side mount for sealing a side mount/screen holding apparatus interface, wherein the screening material has a plurality of layers of screening material flexibly connected so that the screen assembly is foldable, wherein the side mount has a lower part with a plurality of spaced-apart holes for receiving a corresponding plurality of spaced-

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apart members which are part of screen mounting apparatus of the vibratory separator, the screening material including at least two layers of screening material including at least a first layer and a second layer, the
5 first layer made of metal and with a first metal mesh through which liquid in the fluid is passable and having a first metal mesh pattern with an amount of hot melt glue in a glue pattern on the first layer of screening material, the second layer adjacent and in contact with
10 the first layer glued together with the first layer by the hot melt glue, the second layer made of metal and with a second metal mesh through which liquid in the fluid is passable, wherein the glue pattern is different from the first metal mesh pattern, and handling apparatus
15 on the screen assembly apparatus (on the seal structure or on each side mount, or both) for facilitating handling of the screen assembly apparatus. Such a vibratory separator or shale shaker may have one or some, in any possible combination, of the following: the screen
20 assembly's screening material is suitable for treating drilling fluids with solids entrained therein; wherein the seal member includes the handling apparatus; and/or wherein at least one of the side mounts includes handling apparatus.

25 The present invention, therefore, in some, but in not necessarily all embodiments, provides a screen assembly for a vibratory separator, the screen assembly having screening material (for example, one, two, three or more layers of screen mesh) with opposed spaced-apart
30 sides including a first side and a second side, a side mount on each of the opposed spaced-apart sides, each of the first side and the second side of the opposed spaced-

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apart sides having a screening material edge portion, each screening material edge portion having part thereof extending into and held within a corresponding side mount. Such a screen assembly may have one or some, in
5 any possible combination, of the following: seal structure on an exterior of each side mount for sealing a side mount/screen holding apparatus interface; wherein the seal structure includes a hollow portion; wherein the seal structure is positioned for location between the
10 screen assembly and screen assembly mounting structure of the vibratory separator; wherein the screening material comprises a plurality of interconnected layers of screening material; wherein the layers of screening material are glued together with cured hot melt glue;
15 wherein the screening material has a first layer of screening material made of metal and with a first metal mesh through which liquid in the fluid is passable and having a first metal mesh pattern with an amount of hot melt glue in a glue pattern on the first layer of
20 screening material, a second layer of screening material adjacent and in contact with the first layer glued together with the first layer by the hot melt glue, the second layer of screening material made of metal and with a second metal mesh through which liquid in the fluid is
25 passable, and wherein the glue pattern is different from the first metal mesh pattern; wherein the screening material has a length and a width and the hot melt glue is in intermittent or continuous lines of glue extending across the length and the width of the screening
30 material; wherein the hot melt glue is in discrete amounts spaced-apart across the screening material; wherein the hot melt glue is in at least one line across

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the screening material; wherein the side mount has a lower part with a plurality of spaced-apart holes for receiving a corresponding plurality of spaced-apart members which are part of screen mounting apparatus of the vibratory separator; wherein the vibratory separator is a shale shaker and the screen assembly's screening material is suitable for treating drilling fluids; wherein an edge of the screening material passes between two opposed parts of the side mount, said two opposed parts secured together; wherein the two opposed parts of the side mount are welded together; wherein an edge of the screening material passes between two first opposed parts of each side mount and an end of the screening material is secured between two second opposed parts of each side mount; wherein each side mount has two spaced-apart openings, said openings sealed off with seal material; wherein the screening material is generally flat; wherein at least part of the screening material in cross-section is undulating; wherein the screening material has material flexible so that the screen assembly is foldable and/or can be rolled up; wherein the seal structure includes handling structure; wherein the handling structure is T shaped; wherein the handling structure is at least one handle; wherein the handling structure is at least one hole through the seal structure; wherein each side mount has an upper inwardly directed edge; wherein each side mount is made of a single piece of material; and/or at least one rigid handling apparatus formed of or connected to at least one of the side mounts.

The present invention, therefore, in some, but in not necessarily all embodiments, provides a screen

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assembly for a vibratory separator, the screen assembly having screening material with opposed spaced-apart sides including a first side and a second side, a side mount on each of the opposed spaced-apart sides, each side of the
5 opposed spaced-apart sides of screening material having an edge portion, each edge portion held within a side mount, seal structure on an exterior of each side mount for sealing a side mount/screen holding apparatus interface, wherein the screening material is a plurality
10 of layers of screening material flexibly connected so that the screen assembly is foldable and/or can be rolled up, and wherein the side mount has a lower part with a plurality of spaced-apart holes for receiving a corresponding plurality of spaced-apart members which are
15 part of screen mounting apparatus of the vibratory separator.

The present invention, therefore, in some, but in not necessarily all embodiments, provides a screen assembly for a vibratory separator, the screen assembly
20 having screening material with opposed spaced-apart sides including a first side and a second side, screen mounting apparatus on each of the opposed spaced-apart sides, each of the first side and the second side of the opposed spaced-apart sides having a screening material edge
25 portion, each screening material edge portion having part thereof extending into and held within a side mount, and the screening material comprising flexible material so that the screen assembly is foldable and/or can be rolled up. Such a screen assembly may have one or some, in any
30 possible combination, of the following: wherein the screening material is a first layer of screening material made of metal and with a first metal mesh through which

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liquid in the fluid is passable and having a first metal mesh pattern with an amount of hot melt glue in a glue pattern on the first layer of screening material, a second layer of screening material adjacent and in contact with the first layer glued together with the first layer by the hot melt glue, the second layer of screening material made of metal and having a second metal mesh through which liquid in the fluid is passable, and wherein the glue pattern is different from the first metal mesh pattern; wherein the screening material has a length and a width and the hot melt glue is in one or more continuous and/or intermittent lines of glue extending across the length and the width of the screening material; wherein the hot melt glue is in discrete amounts spaced-apart across the screening material; wherein the hot melt glue is in at least one line across the screening material; and/or wherein the screen mounting apparatus is hookstrip apparatus.

The present invention, therefore, in some, but in not necessarily all embodiments, provides a mount for a screen assembly for a vibratory separator, the mount for holding screening material of the screen assembly, the mount including a body with a bottom part, a side part extending up from and connected to the bottom part, a top part connected to the side part, a top lip formed by overlapping portions of the body, a bottom lip formed by overlapping portions of the top part and bottom part, a space defined between the top part, the side part, and the bottom part, which space is suitable for the passage therethrough of a portion of screening material, the overlapping portions of the bottom lip spaced-apart for the passage therethrough of a portion of the screening

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material, seal structure on an exterior of each side mount for sealing a side mount/screen holding apparatus interface, wherein the seal structure is positioned for location of at least a portion of the seal structure between the screen assembly and screen assembly mounting structure of the vibratory separator. Such a mount may have one or some, in any possible combination, of the following: the body having two sealed spaced-apart end openings; wherein the top lip includes a space therebetween suitable for holding a portion of the screening material; wherein the seal structure includes a hollow portion (for example, either along the entire length of the seal structure or only in part thereof or with intermittent spaced-apart hollow portions), and the hollow portion is positioned for location above the top part of the mount; wherein each side mount has an upper inwardly directed edge; wherein the side mount is made of a single piece of material; and/or at least one rigid handling apparatus formed of or connected to the side mount.

The present invention, therefore, in some, but in not necessarily all embodiments, provides a mount for a screen assembly for a vibratory separator, the mount for holding screening material of the screen assembly, the mount including a body with a bottom part, a side part extending up from and connected to the bottom part, a top part connected to the side part, a top lip formed by overlapping portions of the body, a bottom lip formed by overlapping portions of the top part and bottom part, a space defined between the top part, the side part, and the bottom part, said space suitable for the passage therethrough of a portion of screening material, the

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overlapping portions of the bottom lip spaced-apart for the passage therethrough of a portion of the screening material, seal structure on an exterior of each side mount for sealing a side mount/screen holding apparatus interface, and handle apparatus formed of the seal structure. Such a mount may have one or some, in any possible combination, of the following: wherein the handle apparatus is at least one cut out portion of the seal structure; wherein the handle apparatus is an upwardly projecting portion of the seal structure formed integrally of the seal structure; and/or the body having two sealed spaced-apart end openings.

The present invention, therefore, in some, but in not necessarily all embodiments, provides a mount for a screen assembly for a vibratory separator, the mount for holding screening material of the screen assembly, the mount having a body with a bottom part, a side part extending up from and connected to the bottom part, the side part made of side part material, a top part connected to the side part, a top lip formed by overlapping portions of the body, a bottom lip formed by overlapping portions of the top part and bottom part, a space defined between the top part, the side part, and the bottom part, the space suitable for the passage therethrough of a portion of screening material, the overlapping portions of the bottom lip spaced-apart for the passage therethrough of a portion of the screening material, and handle apparatus formed of the side part, the handle apparatus made of side part material or of material different therefrom, and formed integrally of the side part. Such a mount may have two sealed spaced-apart end openings.

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The present invention, therefore, in some, but in not necessarily all embodiments, provides a method for making a screen assembly for a vibratory separator, the method including connecting together a plurality of
5 layers of screening material, securing each of two opposed edge portions of the screening material within a side mount according to the present invention. Such a method may include use of a screen assembly with layers of screening material wherein the layers of screening
10 material are flexible and are glued together with hot melt glue.

The present invention, therefore, in some, but in not necessarily all embodiments, provides a seal for installation on a screen assembly for sealing a screen-
15 assembly/screen-holder interface in a vibratory separator, the seal having a body with a portion thereof connectible to the screen assembly, and handling apparatus on the body for facilitating handling of the screen assembly. Such a seal may have one or some of the
20 following, in any possible combination: wherein the handling apparatus is at least one handle formed of the body; wherein the handling apparatus is at least one cut out portion of the body; and/or wherein the handling apparatus is at least one projection projecting from the
25 body, for example, with cylindrical or T shape.

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CLAIMS

1. A screen assembly for a vibratory separator, the screen assembly having at least two layers of screening material having a pair of opposing edges, the at least
5 two layers of screening material having a top surface and a bottom surface and a side mount arranged on each of said opposing edges, the screen assembly having a usable area of screening between the side mounts, characterised in that at least one of the side mounts comprises strips
10 on the top and bottom surface of the layers of screening material characterised in that, said at least two layers of screening material has a portion at an angle to the strips beyond the edge of the usable area of screening material.
- 15 2. A screen assembly as claimed in Claim 1, wherein the strip is folded about the top and bottom surface of the layers of screening material.
3. A screen assembly as claimed in Claim 1 or 2, wherein the portion of screening material is at
20 substantially at a right angle to the strip, the strip having a integral portions at substantially right angles to the plane of the strip, the integral portions about either side of said portion of screen screening material.
4. A screen assembly as claimed in Claim 3, wherein the
25 integral portions comprise crimped portions to grip said portion of screening material.
5. A screen assembly as claimed in any preceding claim, wherein the strip comprises a sloped portion sloping upwardly from the general plane of the at least two
30 layers of screening material in direction generally away from said at least two layers of screening material.
6. A screen assembly for a vibratory separator, the

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screen assembly comprising at least two layers of screening material having a pair of opposing edges, a side mount arranged on each of said opposing edges, characterised in that said at least two layers of screening material are connected together between said side mounts, wherein said screen is flexible, such that the screen can be rolled or folded.

7. A screen assembly as claimed in Claim 15, wherein said side mount has an end opening defined at least partly by said portion sloping upwardly from the plane of the at least two layers of screening material, said end opening sealed with sealing material.

8. A screen assembly as claimed in any preceding claim, wherein the at least two layers of screening material are connected together with a hot melt glue.

9. A screen assembly as claimed in Claim 8, wherein the hot melt glue is in discrete amounts spaced-apart across the screening material.

10. A screen assembly as claimed in Claim 8 or 9, wherein the hot melt glue is in at least one line across the screening material.

11. A screen assembly as claimed in any preceding claim, wherein the at least two layers of screening material has a length and a width and the hot melt glue is in continuous lines of glue extending across the length and the width of the screening material.

12. A screen assembly as claimed in any preceding claim, wherein the layers of screening material are layers of metal mesh.

13. A screen assembly as claimed in any preceding claim, wherein one of the at least two layers of screening material is a fine screening material and the other is a

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coarse screening material for supporting the fine screening material.

14. A screen assembly as claimed in Claim 13, further comprising a third layer of screening material.

5 15. A screen assembly as claimed in Claim 14, wherein said third layer of screening material is a fine screening material.

16. A screen assembly as claimed in any preceding claim, wherein at least one of said side mounts comprises at
10 least one opening for receiving a tensioning tooth.

17. A screen assembly as claimed in any preceding claim, wherein at least one of said side mounts comprises a handling apparatus.

18. A screen assembly as claimed in Claim 17, wherein
15 said handling apparatus comprises a handle.

19. A screen assembly as claimed in any preceding claim, wherein at least one of the side mounts comprises a seal member, such that, in use in a shale shaker, the seal member seals between the side mount and the shale shaker
20 to inhibit solids and particles from passing therebetween.

20. A screen assembly as claimed in Claim 19, wherein said seal comprises handling apparatus.

21. A screen assembly as claimed in any preceding
25 claim, wherein at least one of the side mounts comprises a single piece of material.

22. A vibratory separator comprising a basket and means for vibrating said basket, characterised in that a screen assembly as claimed in any preceding claim is arranged in
30 the basket.

23. A vibratory separator further comprising a series of crowned ribs over which said screen assembly is installed

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and at least one upstanding member arranged on said crowned ribs.

24. A screen apparatus comprising a screen assembly as claimed in any of Claims 1 to 21 and a rigid support tray, insertable into a shale shaker over which said screening assembly is installed.

25. A screen apparatus as claimed in Claim 24, wherein said rigid support tray comprises an upstanding member.

26. A screen assembly for a vibratory separator, the screen assembly comprising at least two layers of screening material having a pair of opposing edges, a side mount arranged on each of said opposing edges, characterised in that said at least two layers of screening material are connected together between said side mounts, wherein at least one of said side mounts comprises a handle for facilitating removal or insertion of said screen assembly in a vibratory separator.

27. A screen assembly for a vibratory separator, the screen assembly comprising at least two layers of screening material having a pair of opposing edges, a side mount arranged on each of said opposing edges, characterised in that said at least two layers of screening material are connected together between said side mounts, wherein at least one of said side mounts comprises a seal, such that in use said seal seals between said side mount and a vibratory separator.

28. A screen assembly as claimed in Claim 27, wherein said seal comprises a handle for facilitating removal or insertion of said screen assembly in a vibratory separator.

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Fig.1A

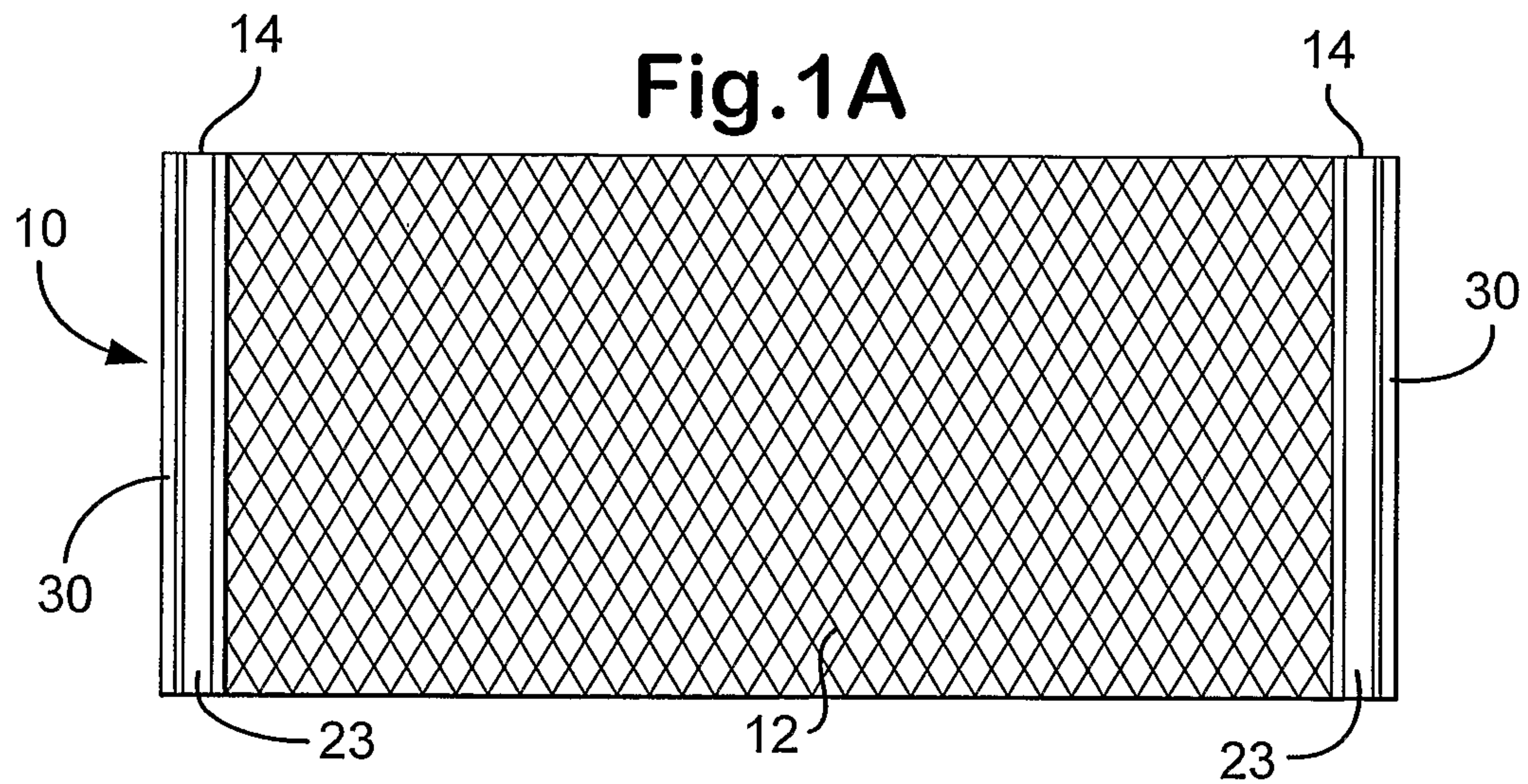


Fig.1 B

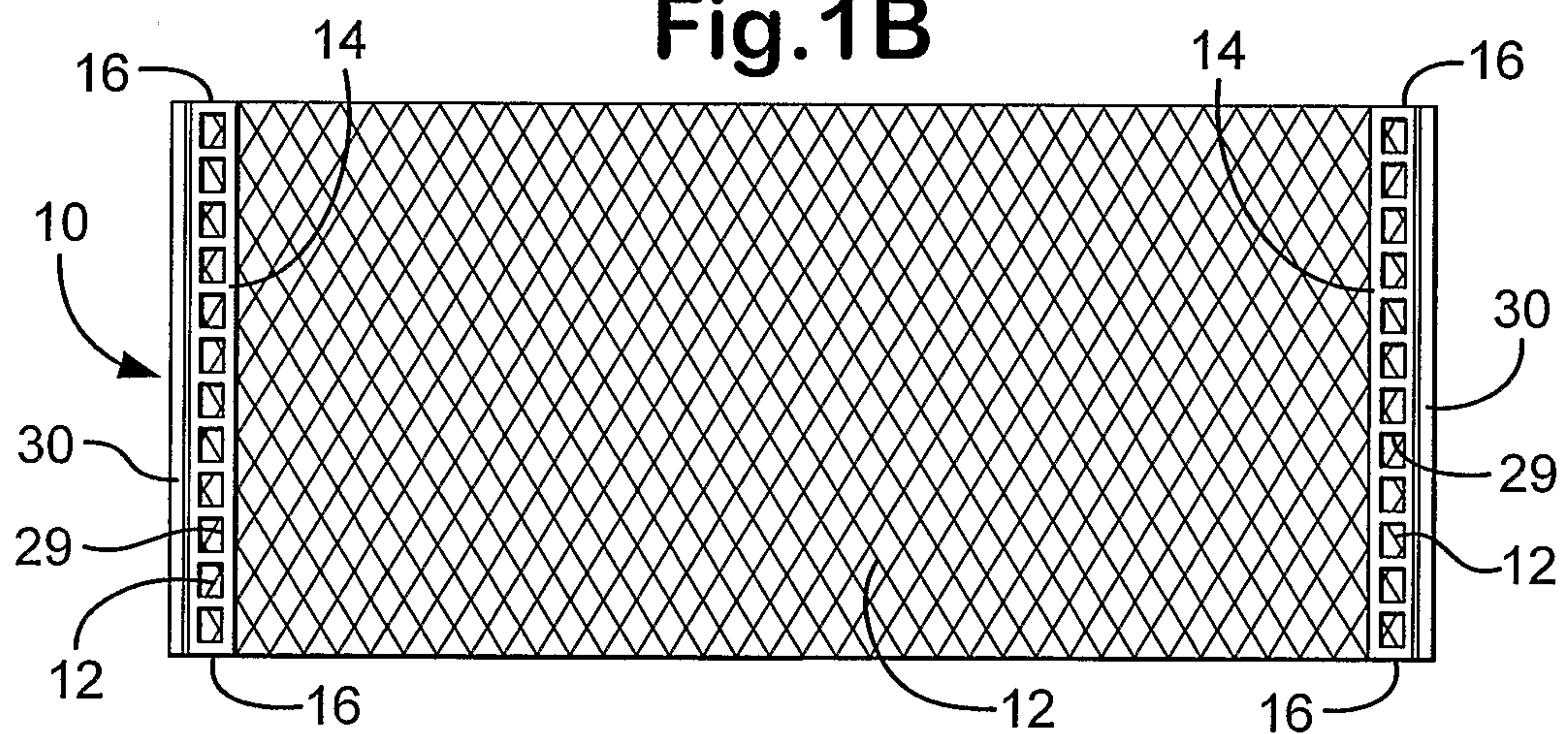


Fig.1C

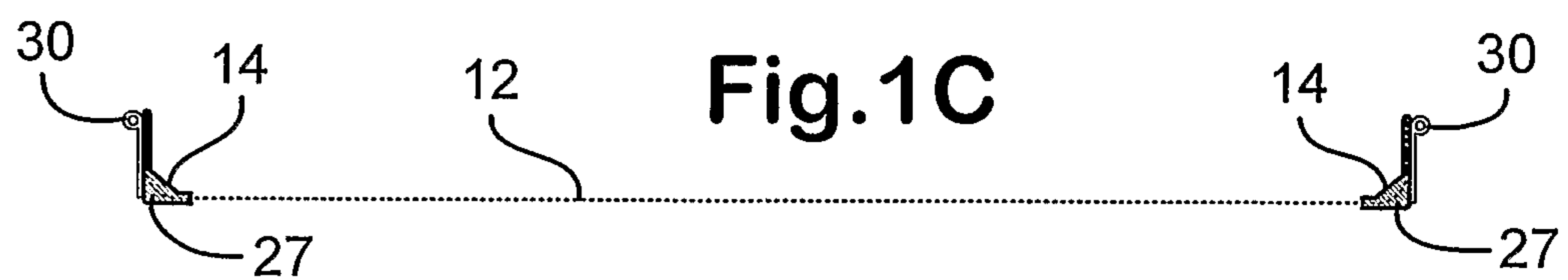


Fig.1 D

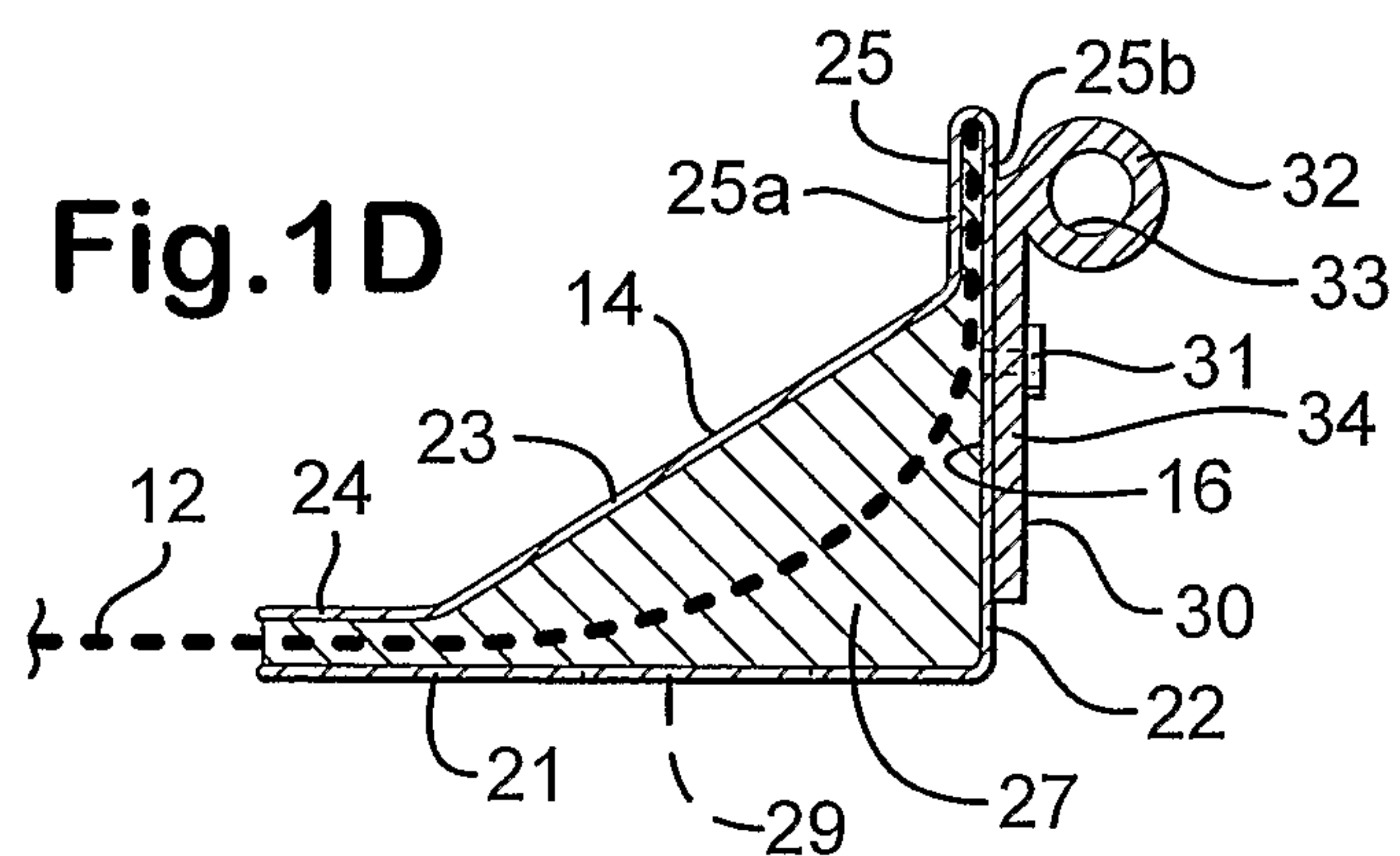


Fig.2



Fig.3

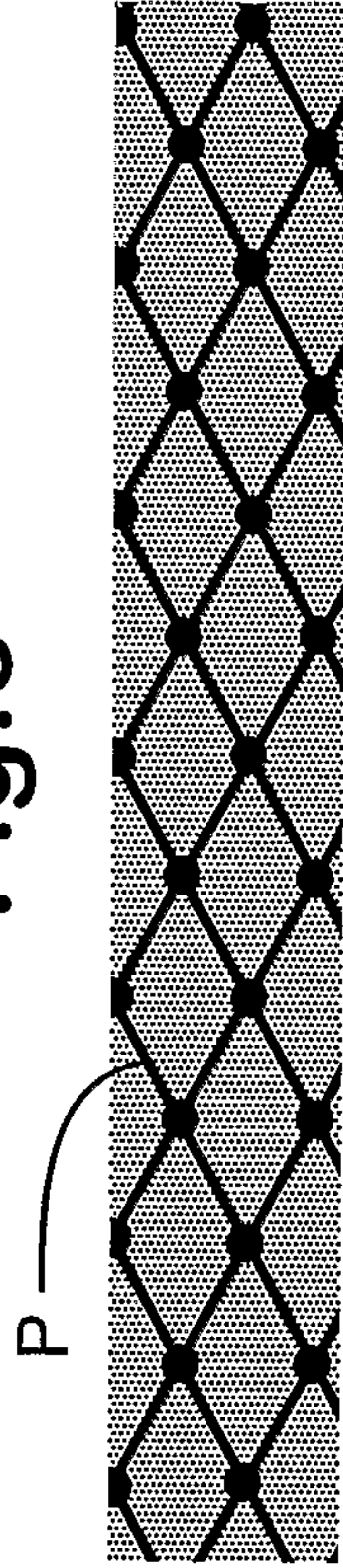


Fig.4C

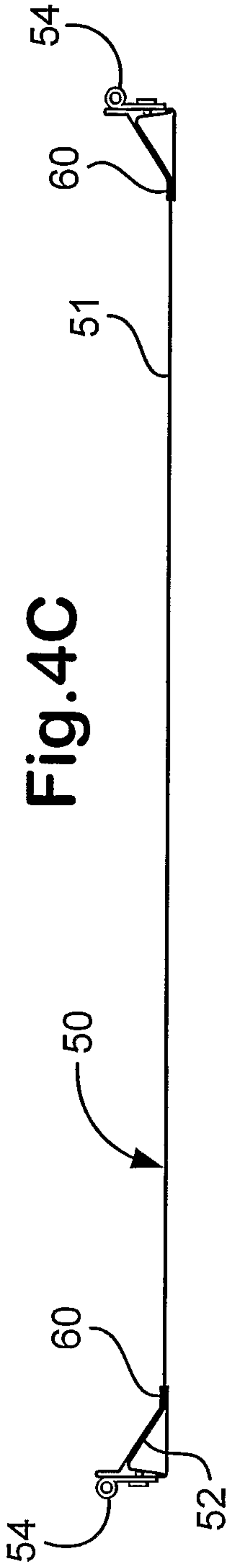


Fig.4D

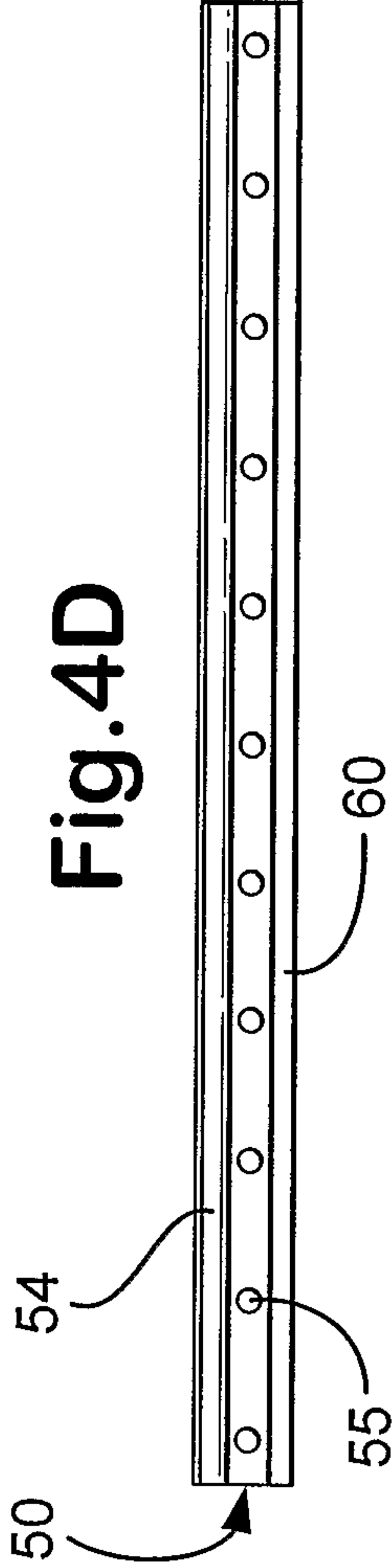


Fig.4E

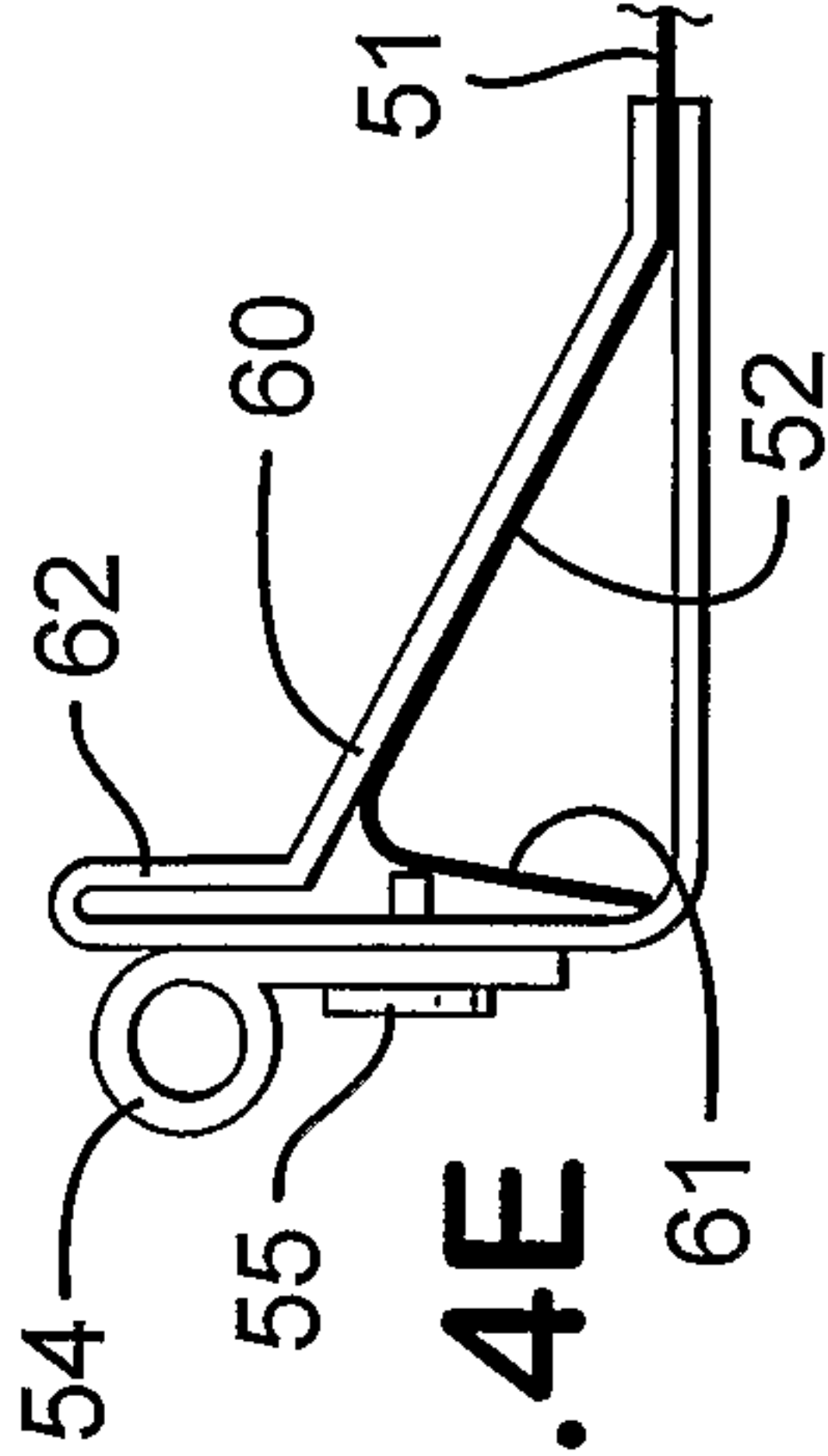
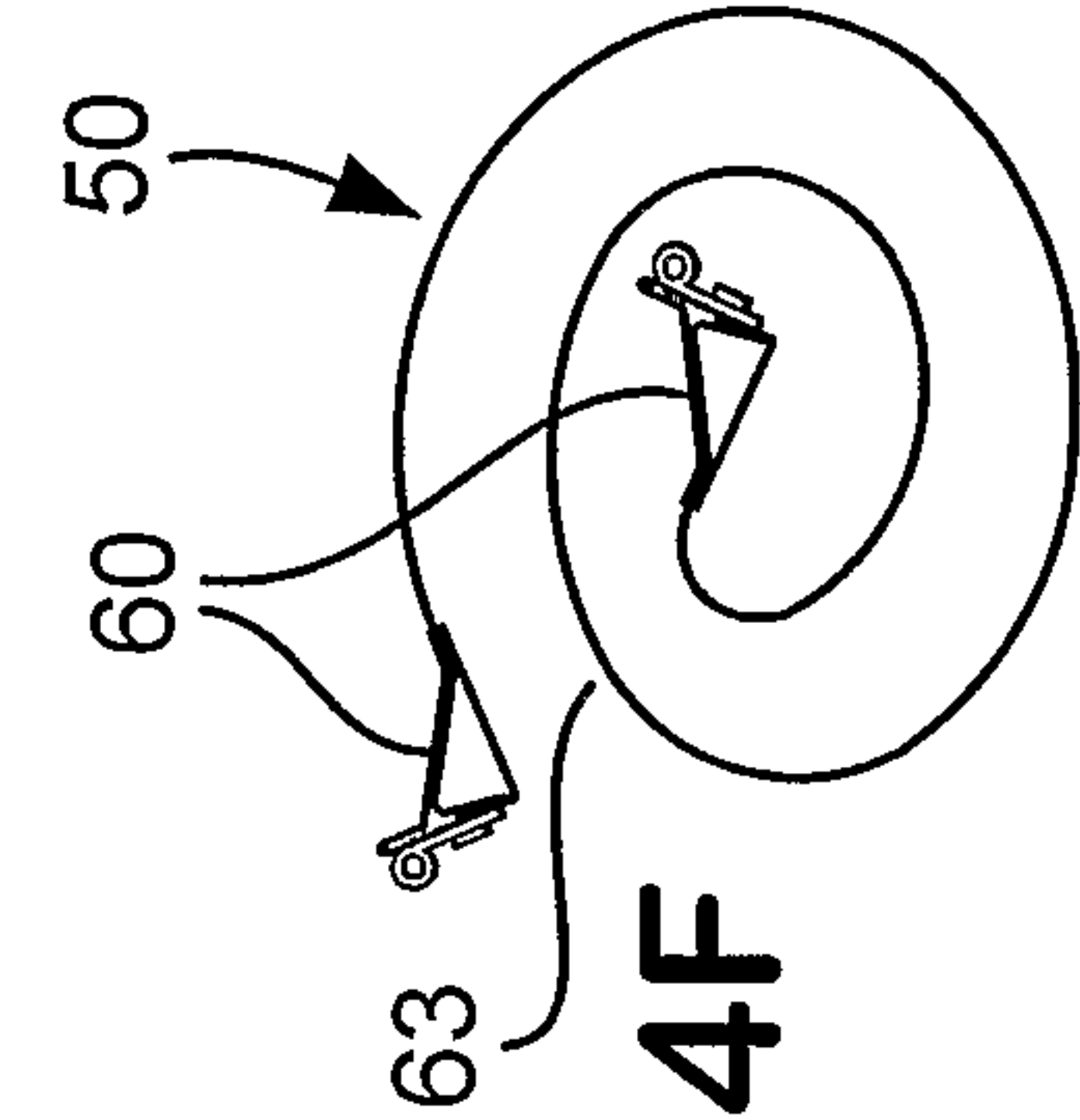


Fig.4F



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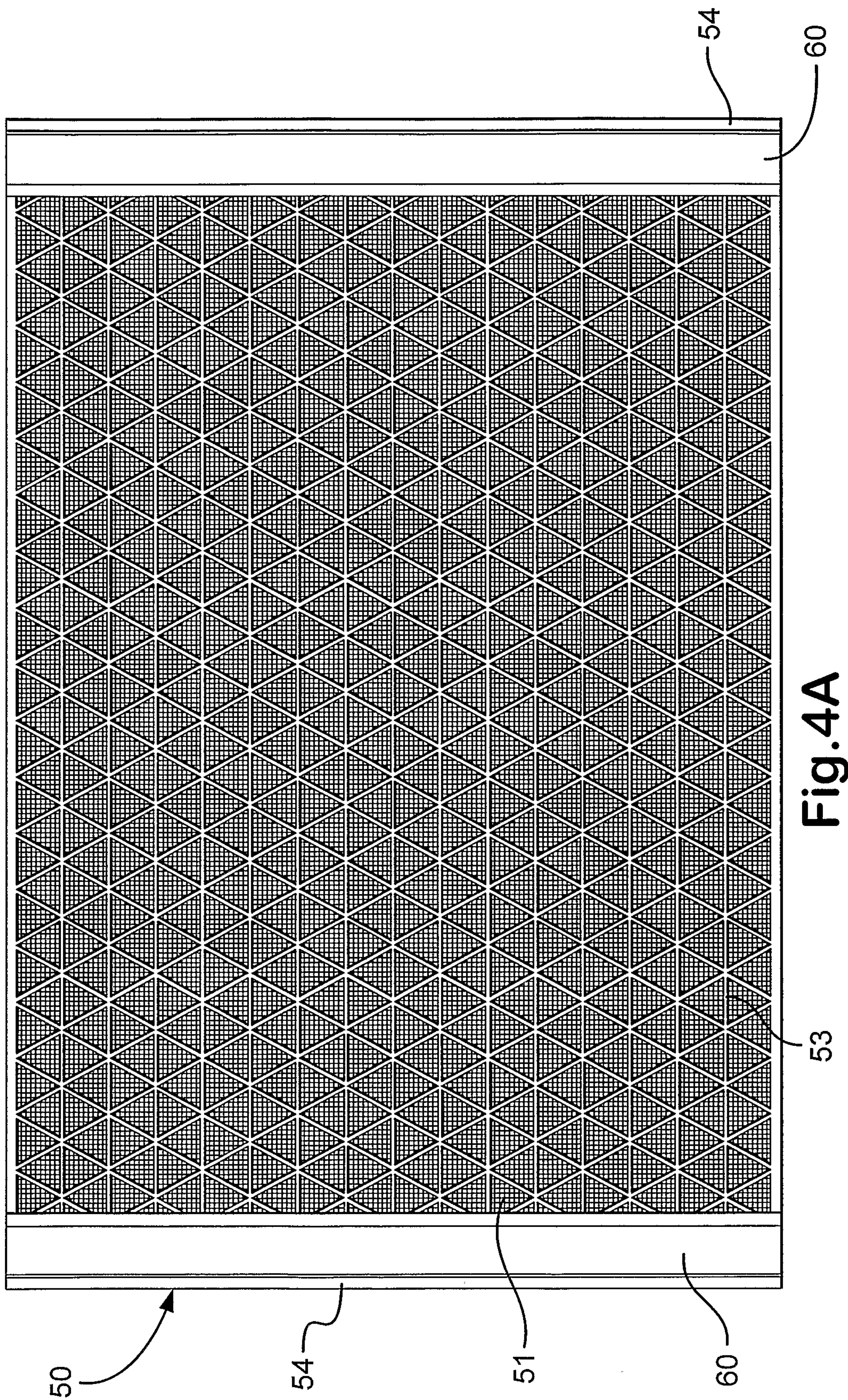


Fig. 4A

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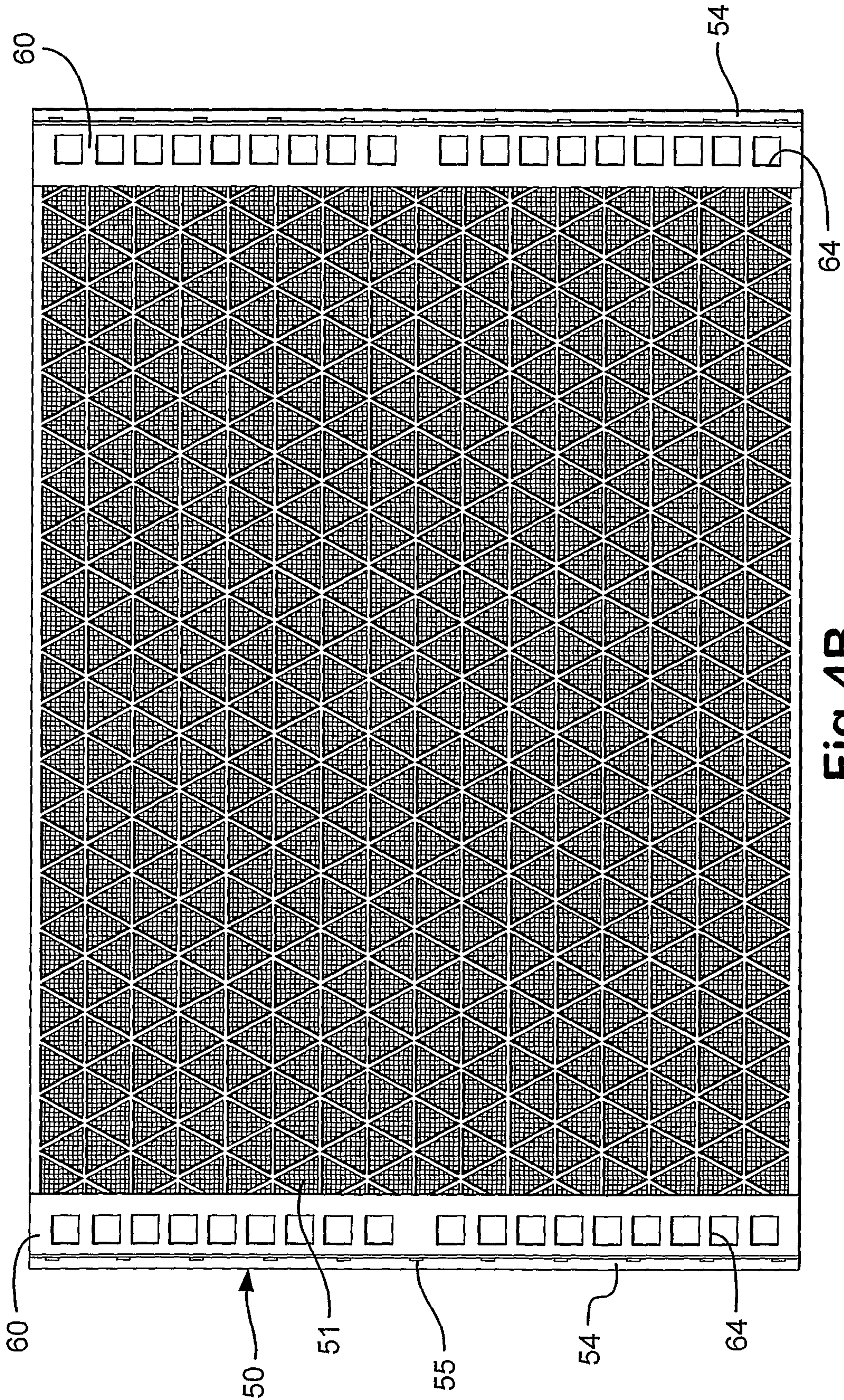
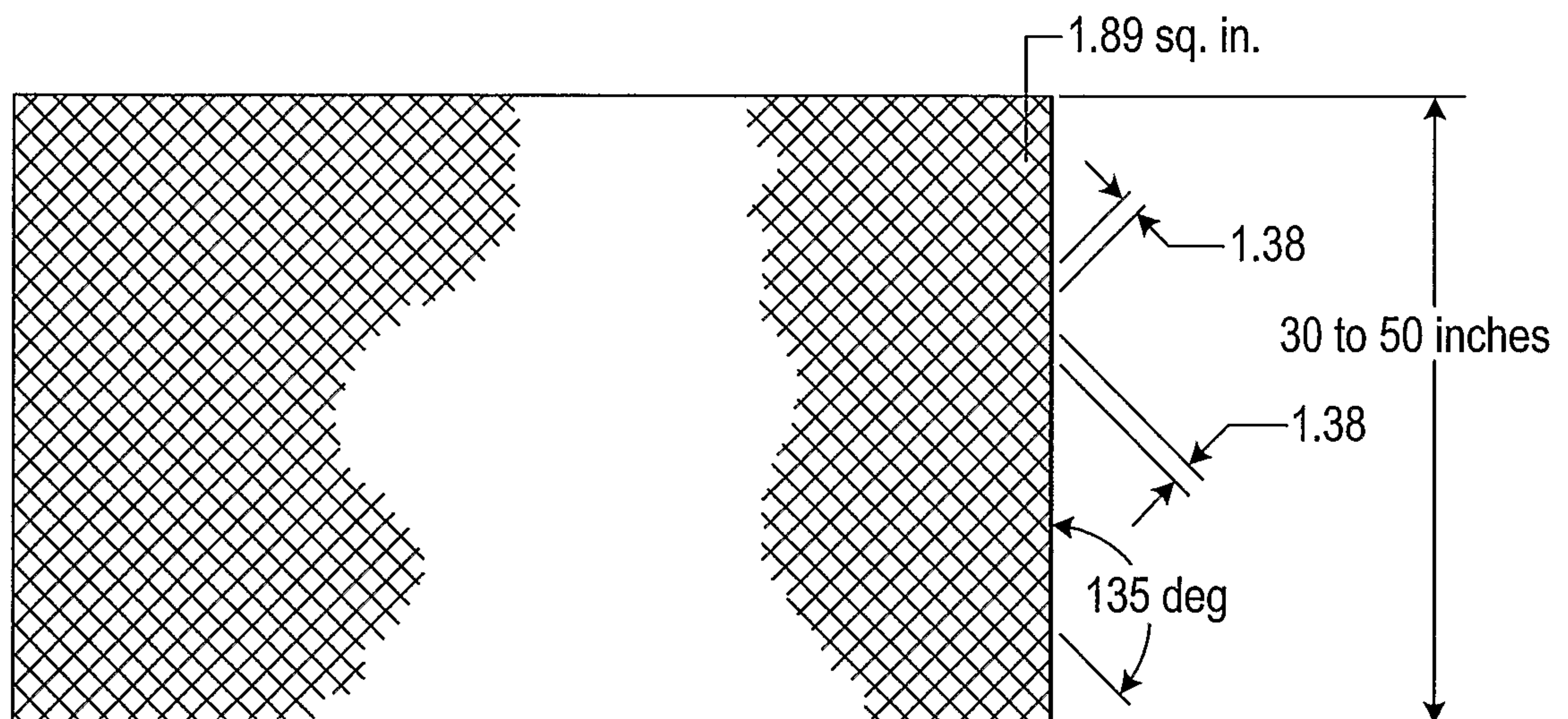
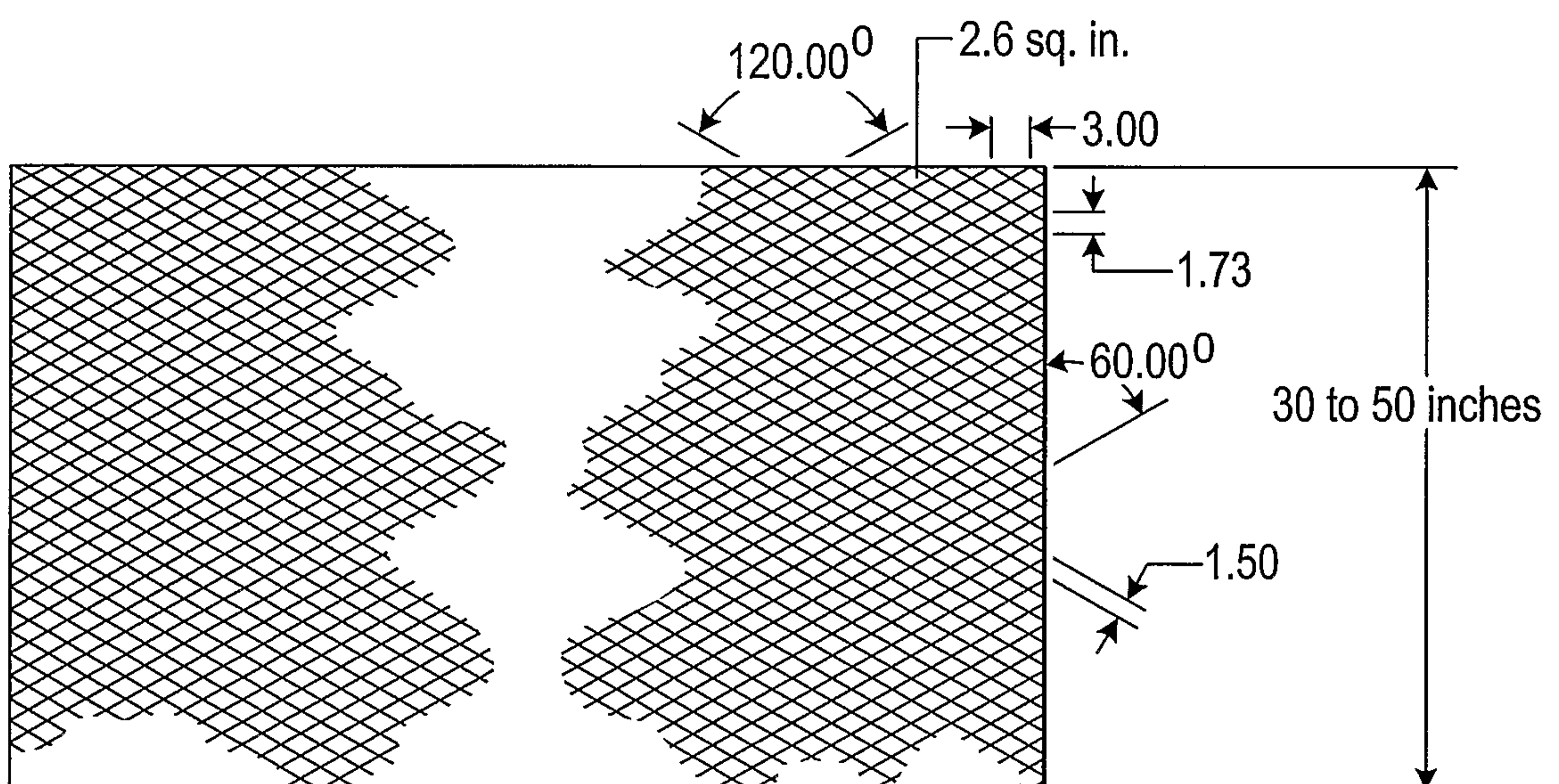
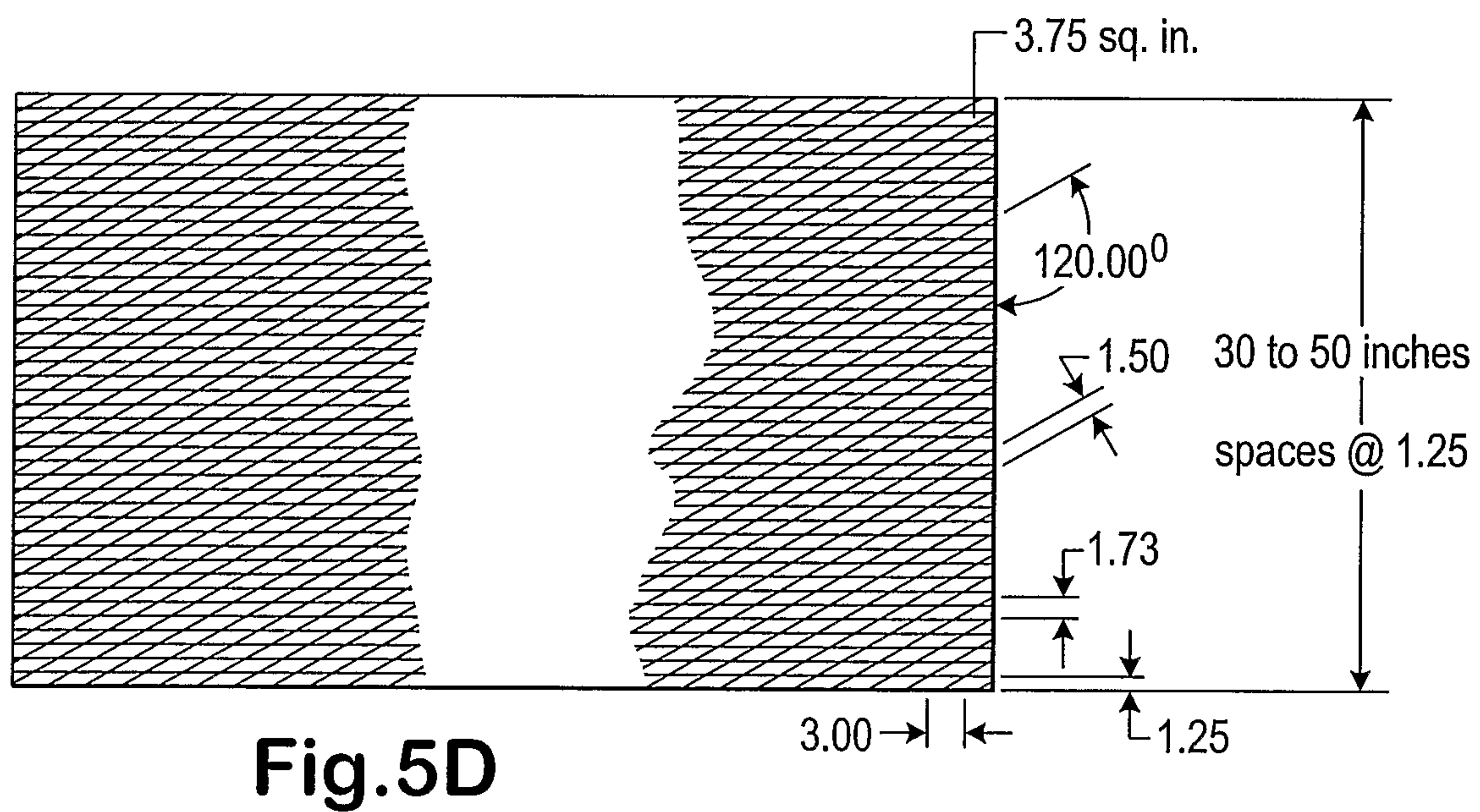
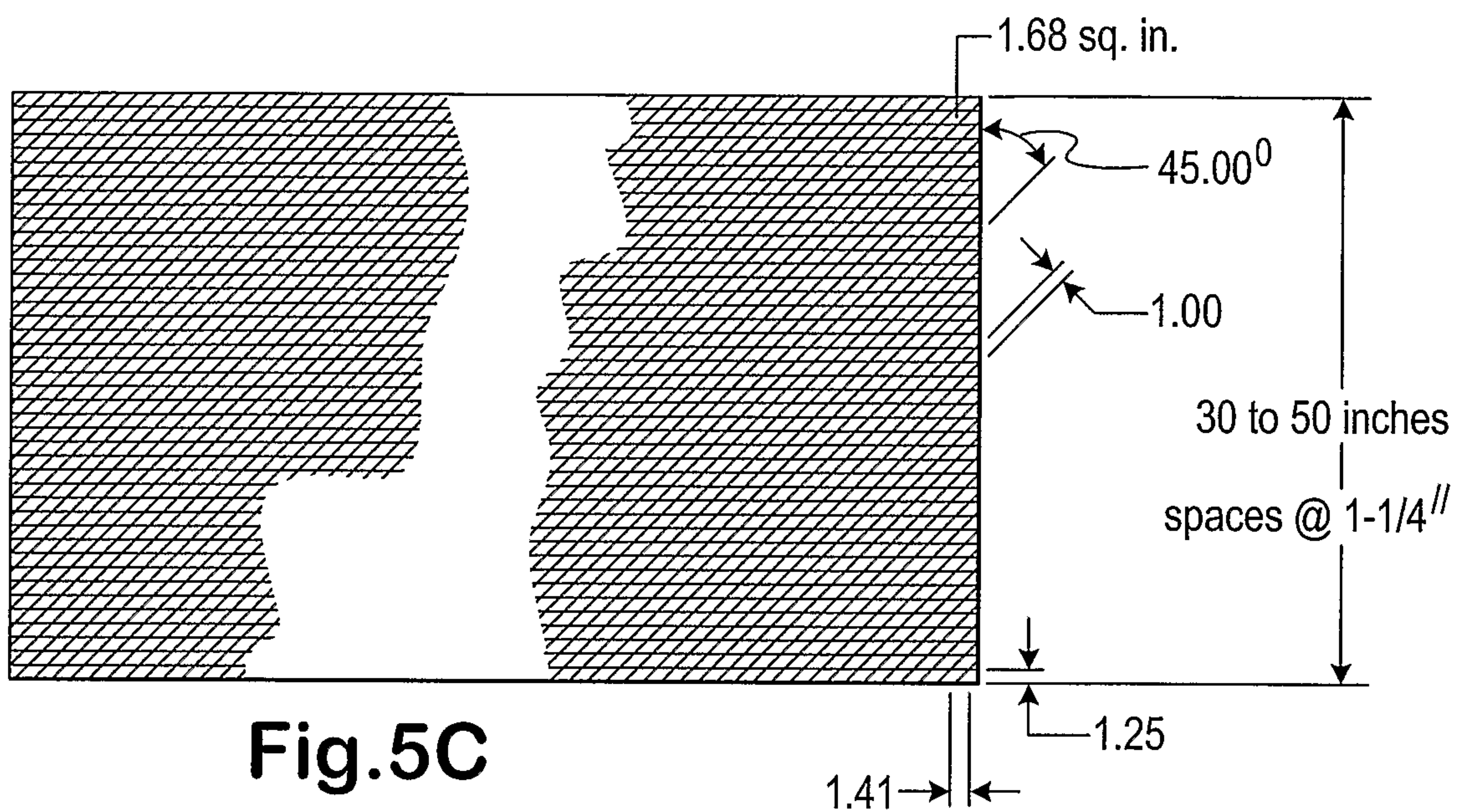


Fig. 4B

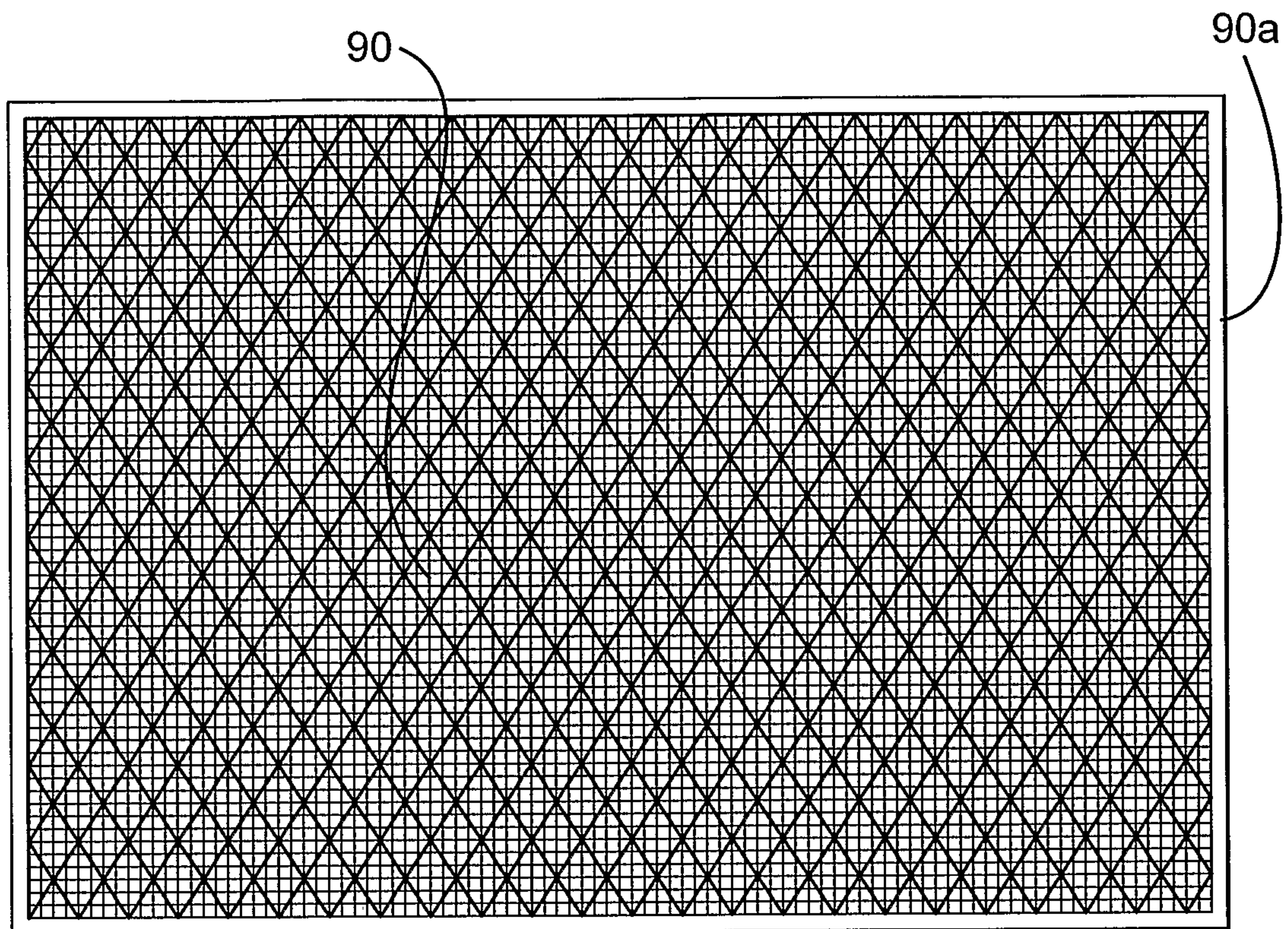
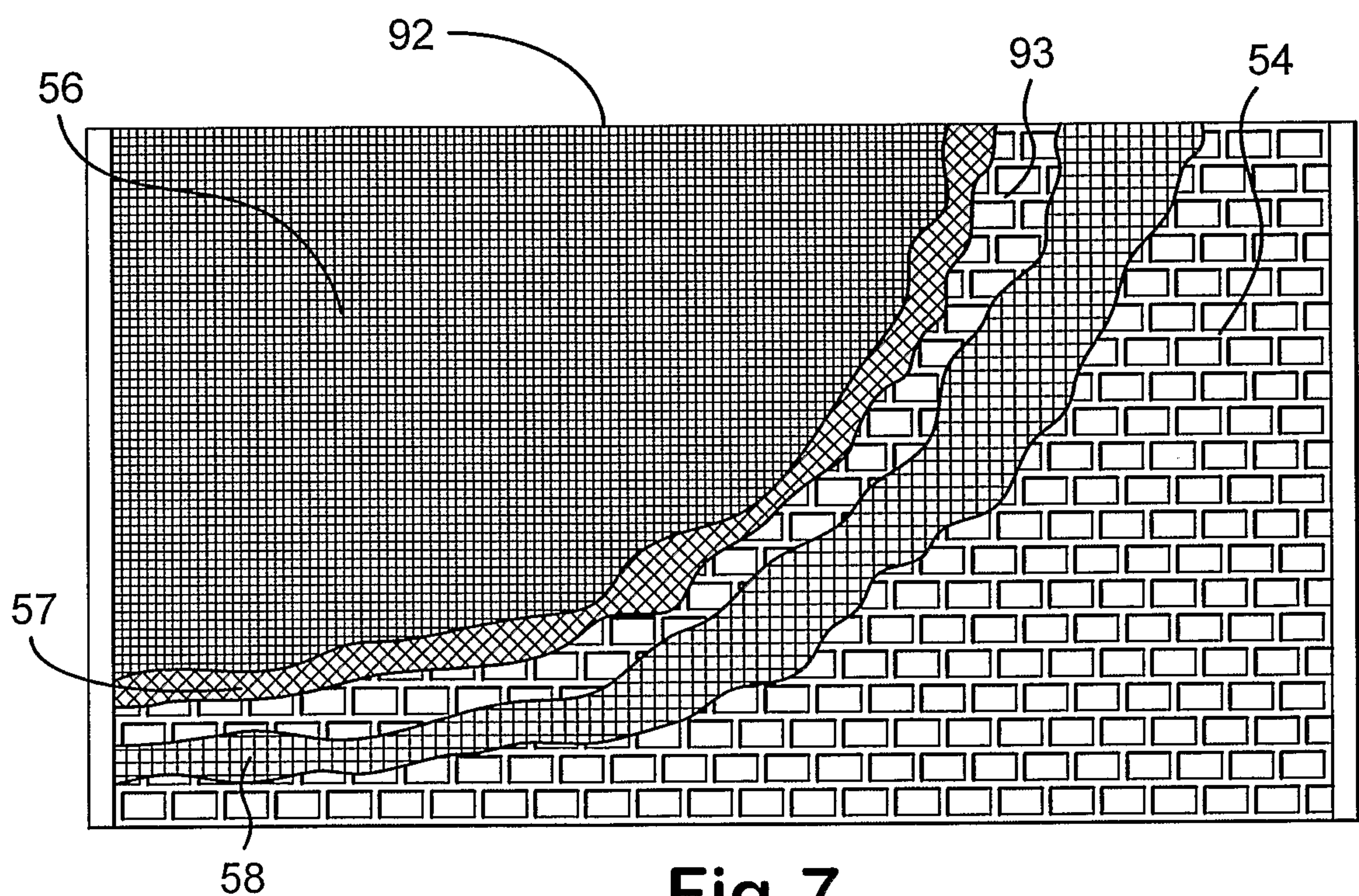
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**Fig.5A****Fig.5B**

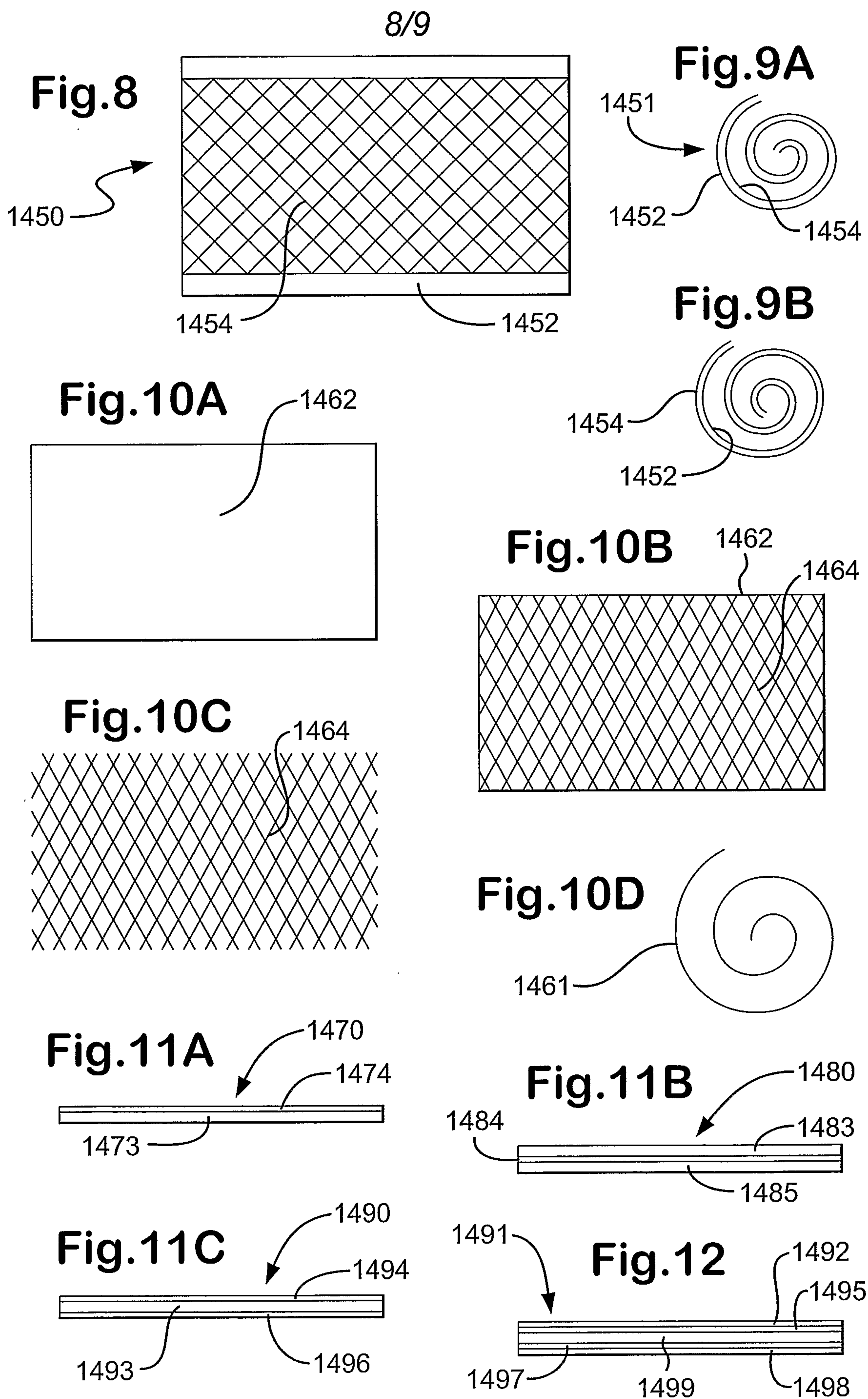
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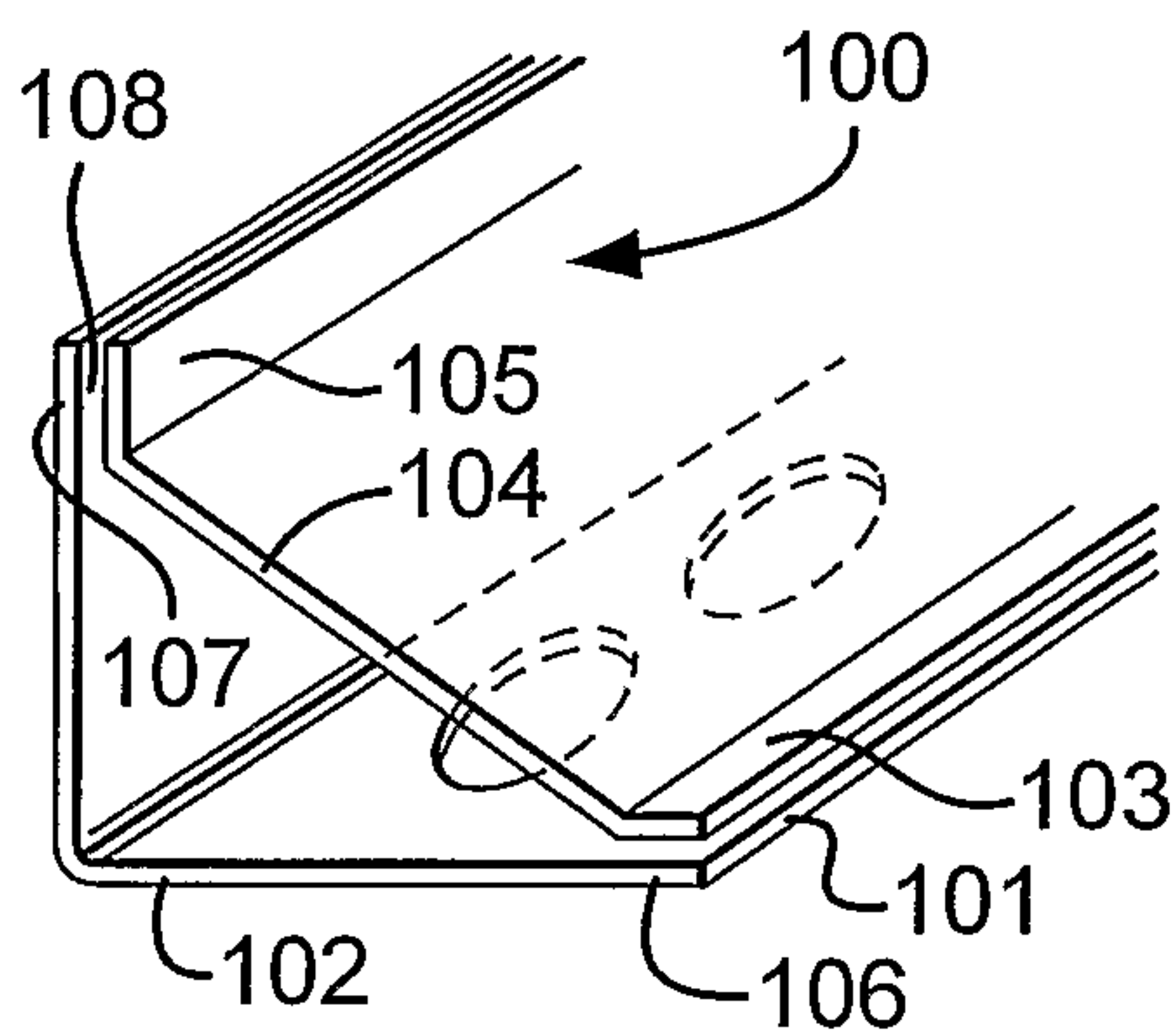
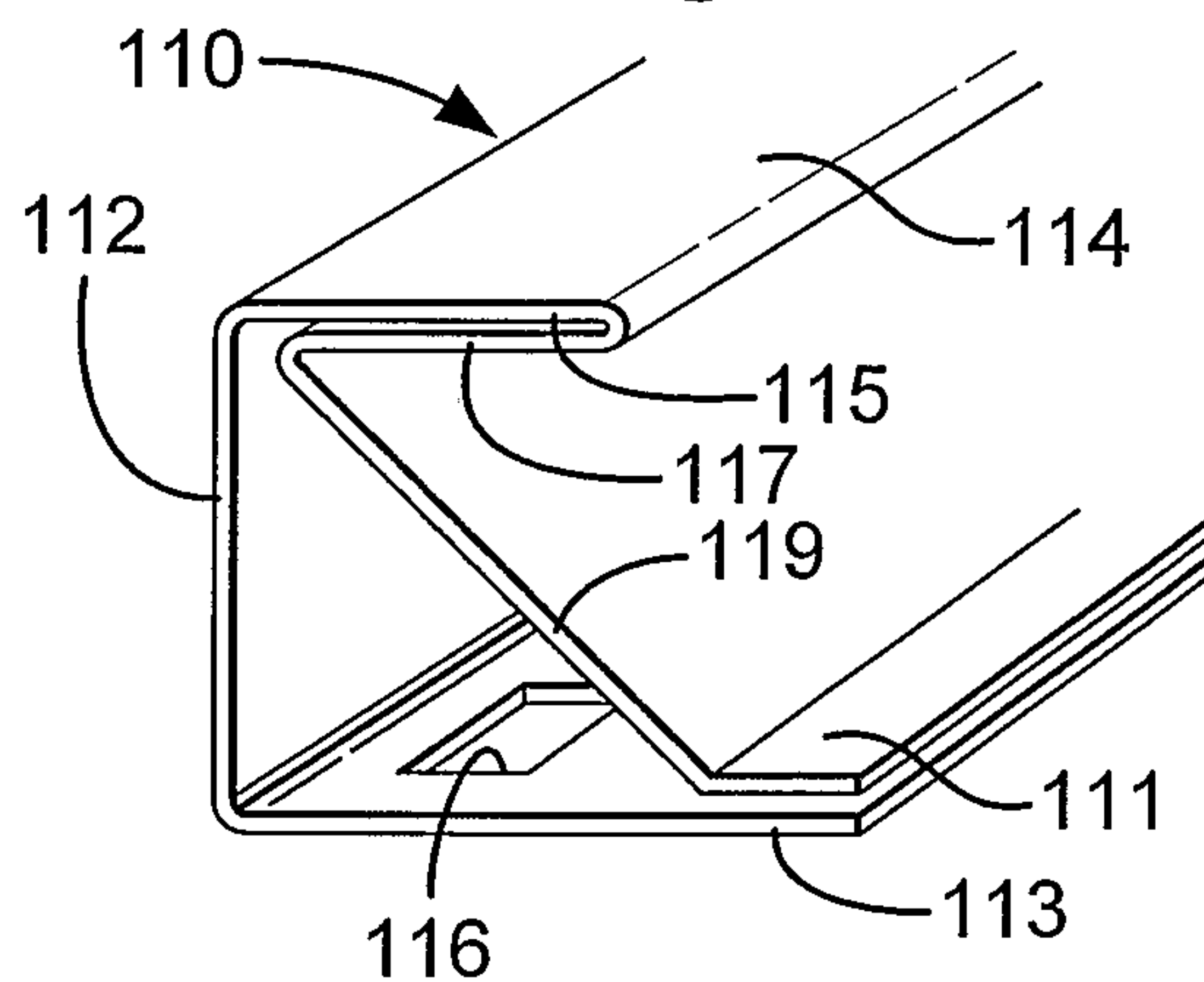
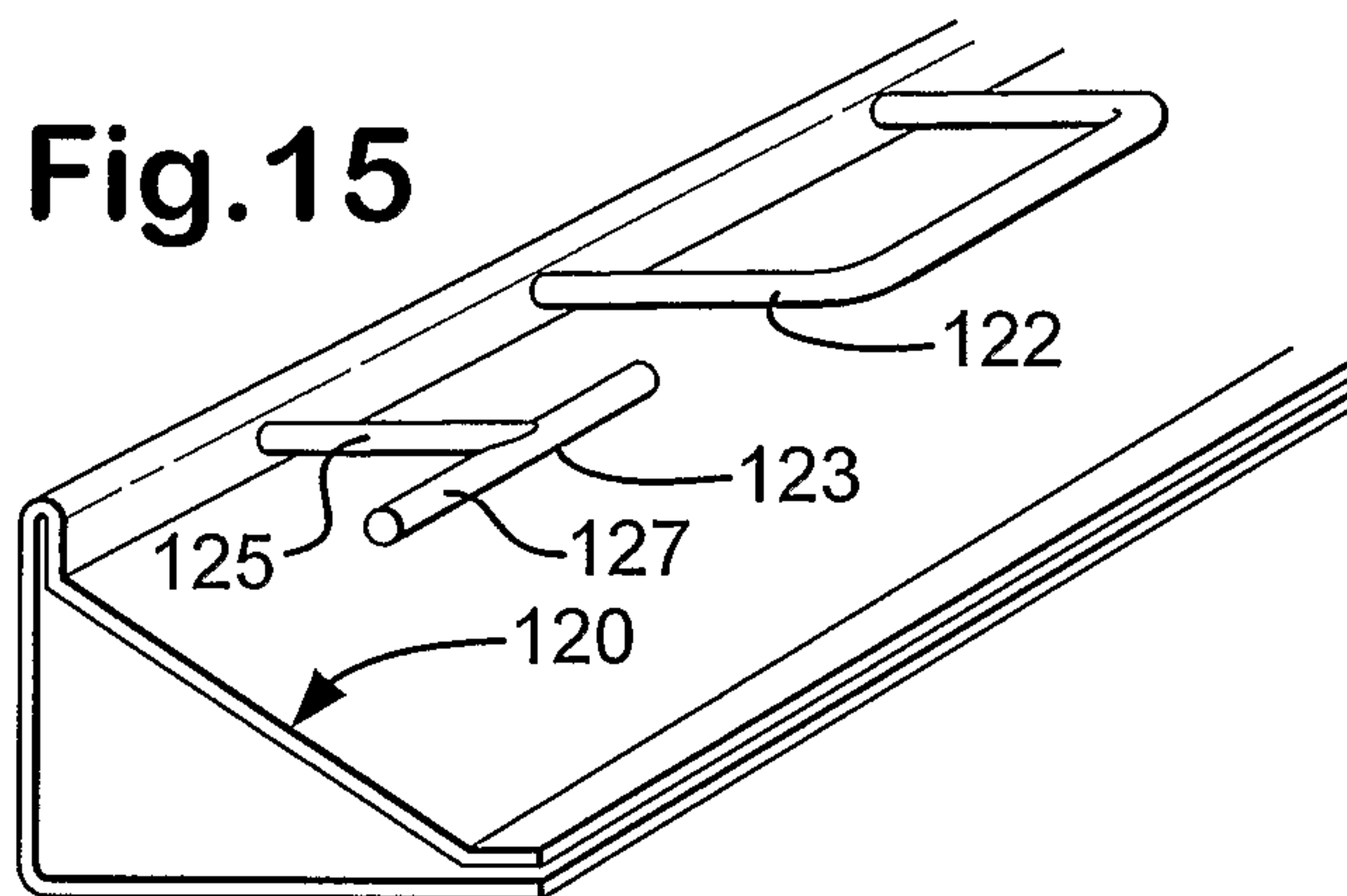
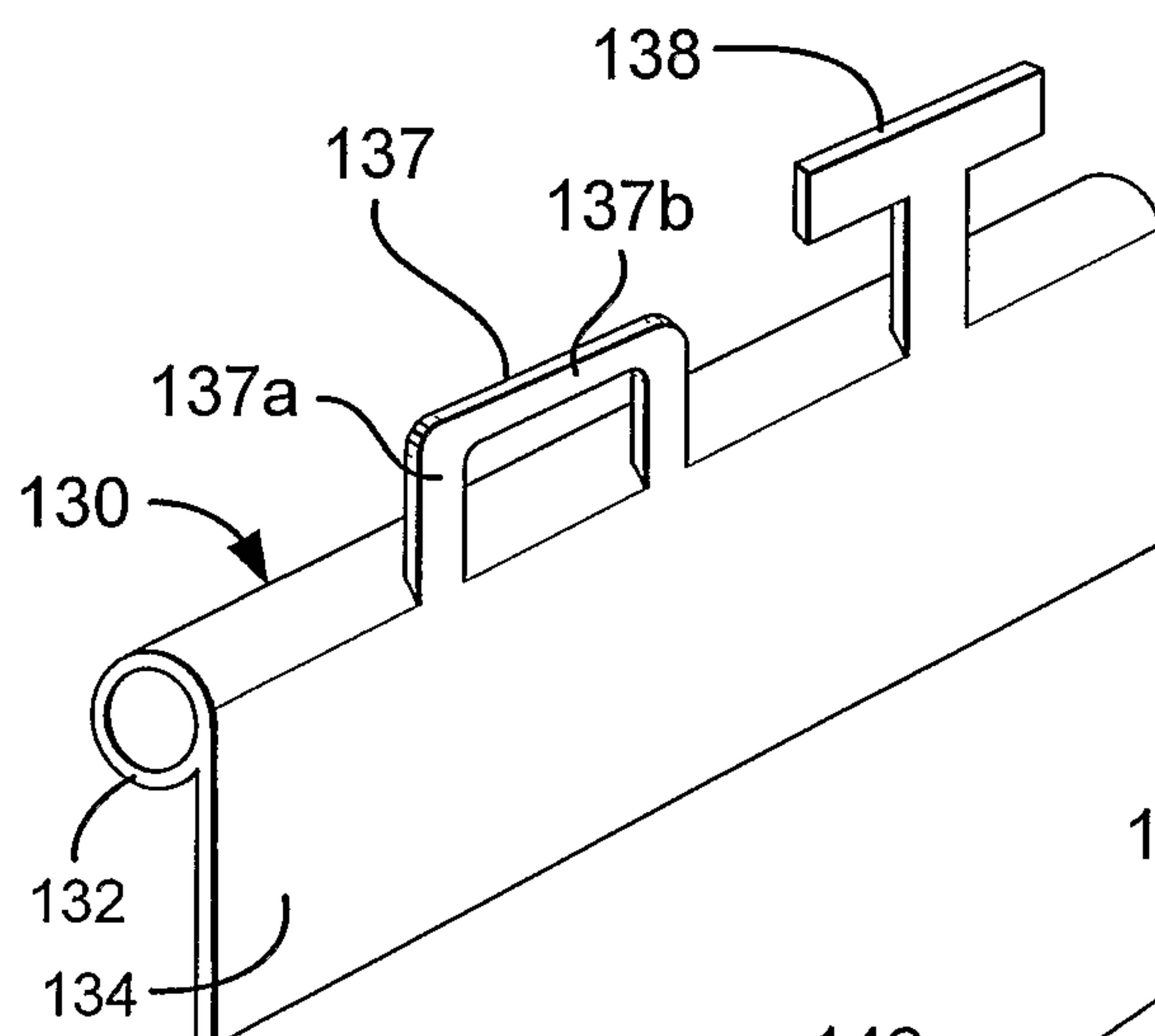
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**Fig. 6****Fig. 7**

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Fig.13**Fig.14****Fig.15****Fig.16****Fig.17**