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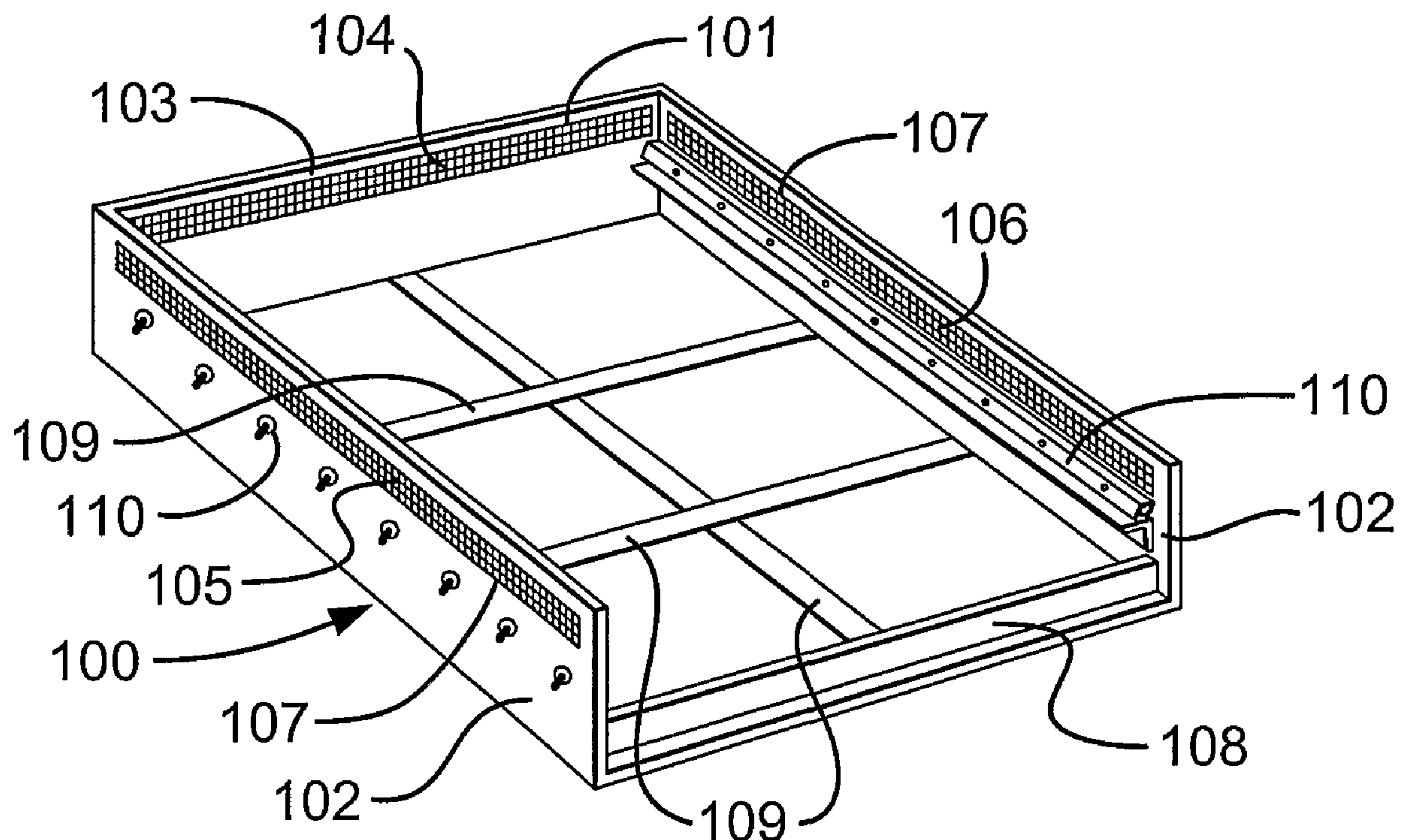
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(54) Title: A SHALE SHAKER



(57) Abrégé/Abstract:

A shale shaker for separating material, said shale shaker comprising a basket (100) for supporting a screen assembly and a collection receptacle, the basket comprising two side walls (102), an end wall (103) and an opening in the bottom of said basket (100), said basket (100) having means (109,110) to support screen assemblies for substantially covering said opening characterised in that said basket (100) further comprises separating means (104,105,106) in or on any of said walls (102,103) for separating material. Preferably, further comprising directing means for directing separated material therefrom into said collection receptacle. The invention also provides a method for separating material using the shale shaker of the invention, a basket of the shale shaker of the invention and screen assemblies used in the shale shaker of the invention.



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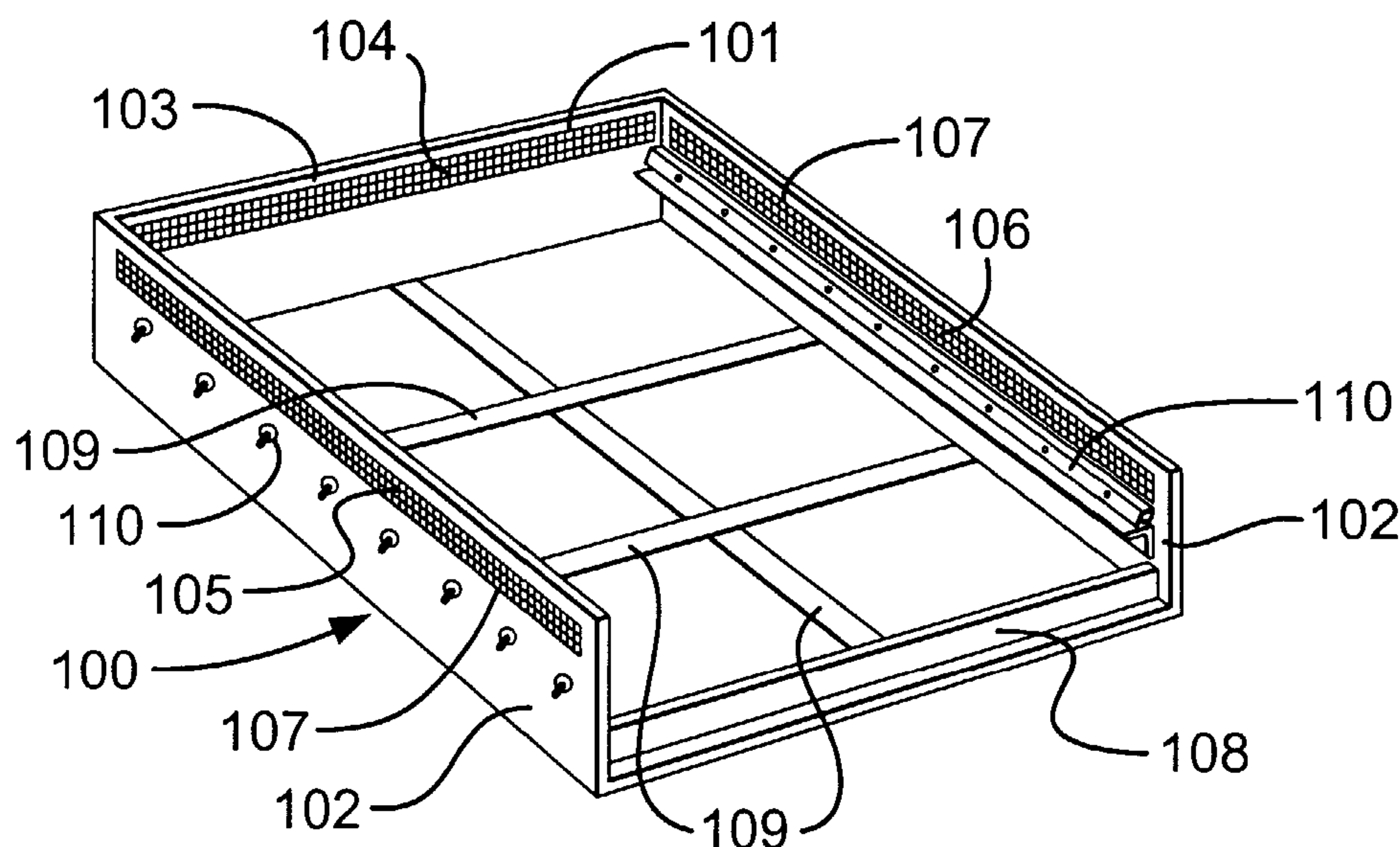
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(54) Title: A SHALE SHAKER



(57) Abstract: A shale shaker for separating material, said shale shaker comprising a basket (100) for supporting a screen assembly and a collection receptacle, the basket comprising two side walls (102), an end wall (103) and an opening in the bottom of said basket (100), said basket (100) having means (109,110) to support screen assemblies for substantially covering said opening characterised in that said basket (100) further comprises separating means (104,105,106) in or on any of said walls (102,103) for separating material. Preferably, further comprising directing means for directing separated material therefrom into said collection receptacle. The invention also provides a method for separating material using the shale shaker of the invention, a basket of the shale shaker of the invention and screen assemblies used in the shale shaker of the invention.

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A SHALE SHAKER

The present invention relates to a shale shaker, a basket therefor, screen assemblies therefor and a method for separating material using a shale shaker of the invention.

Vibratory separators are used in a wide variety of industries to separate materials such as liquids from solids or to grade particles. Typically such separators have a basket mounted in or over a receiving receptacle and vibrating apparatus for vibrating the basket. One or more screens is mounted in the basket. Material to be treated is introduced to the screen(s). Separated material (e.g. liquid and/or smaller solids) flows through the screen(s) into the lower receptacle and separated larger solids (with or without liquid) move down and off the screen(s).

The need for solids control in drilling fluid or "mud" used in hydrocarbon well drilling is well known in the prior art. Drilling mud, typically a mixture of clay and water and various additives, is pumped down through a hollow drill string (pipe, drill collar, bit, etc.) into a well being drilled and exits through holes in a drill bit. The mud picks up cuttings (rock) and other solids from the well and carries them upwardly away from the bit and out of the well in a space between the well walls and the drill string. At the top of the well, the solids-laden mud is discharged over a vibratory separator known as a shale shaker, a device which typically has one or a series of screens arranged in tiered or flat disposition with respect to each other. The prior art discloses a wide variety of vibrating screens, devices which use them, shale shakers, and screens for shale shakers. The screens catch and remove solids from the mud as the mud passes through them. If drilled solids are not removed from the mud used during the drilling operation,

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recirculation of the drilled solids can create weight, viscosity, and gel problems in the mud, as well as increasing wear on mud pumps and other mechanical equipment used for drilling.

5 Typically, the screens used with shale shakers are
emplaced in a generally horizontal fashion on a generally
horizontal bed or support within a basket in the shaker.
The screens themselves may be flat or nearly flat (i.e.
substantially two-dimensional); or, due to corrugated,
10 depressed, or raised surfaces, are three-dimensional. The
basket in which the screens are mounted may be inclined
towards a discharge end of the shake shaker. The shale
shaker imparts a rapidly reciprocating motion to the
basket and hence the screens. Material from which
15 particles are to be separated is poured onto a back end
of the vibrating screen. The material generally flows
toward the discharge end of the basket. Large particles
are unable to move through the screen, remain on top of
the screen, and move toward the discharge end of the
20 basket where they are collected. The smaller particles
and fluid flow through the screen and collect in a bed,
receptacle, or pan beneath the screen.

Shale shaker or screen capacity is typically
determined by the position of a "fluid-end point". The
25 fluid end-point is the point where the fluid pool stops
on the screen surface near the shaker's discharge end.
This is particularly noticeable when the basket is
inclined to the discharge end. As the fluid-end point
moves closer to the discharge end, discharged solids can
30 become too wet, risking whole mud losses over the screen.

It is advantageous to increase the screen area in a
predefined size shale shaker, in order to increase the
amount of material to be separated in a given time. It is
also advantageous to decrease the weight of material to
35 be separated in the vibratory separator as quickly as

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possible in order to conserve energy used by the vibratory mechanism and to increase total throughput for the basket is increased.

According to the present invention, there is provided
5 a shale shaker for separating material, the shale shaker comprising a basket for supporting a screen assembly and a collection receptacle, and a vibratory mechanism for vibrating the basket, the basket comprising two side walls, an end wall and an opening in the bottom of the basket, the
10 basket having means to support screen assemblies for substantially covering the opening characterised in that the basket further comprises separating means in or on any of the walls for separating material. Preferably, the shale shaker further comprises directing means for directing
15 separated material therefrom into the collection receptacle.

It is preferred the separating means is located on the end wall, is through at least one of the side walls, and comprises an aperture.

20 Desirably, the aperture is substantially covered by a screen assembly, the screen assembly comprises screening material, and the screen assembly comprises two-dimensional screening material. However, it is further desirable the screen assembly comprises three-dimensional screening
25 material and, the screen material preferably comprises wire mesh or cloth.

Preferably, the screen assembly comprises a perforated plate, the perforated plate comprises channels for directing separated material into the collection
30 receptacle. It is also preferable the screen assembly comprises a frame, the frame comprises directing means for directing separated material therefrom into the collection receptacle, wherein the walls comprise a plurality of apertures for a plurality of screen assemblies, the
35 plurality of apertures are arranged side-by-side, the screen assembly is held over the aperture by at least one of the following: welding; soldering; and brazing, and the screen assembly is removably replaceable from the aperture.

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It is further preferable the aperture is provided with channels, into which the screen assembly is removably replaceably slide, and the screen assembly is held in the aperture by at least one of the following: nuts and bolts; 5 clamps; glue; other adhesive; releasably cooperating fastener material such as VELCRO material; screws; inflatable structure; bladder; releasable tensioning bolts.

Desirably, the collection receptacle is beneath the basket, there is further comprising screen assemblies mounted 10 on the means to support the screen assemblies, there is further comprising a solid plate arranged in the bottom of the basket, the solid plate has holes therein, the separating means is arranged substantially at right angles to the bottom of the basket, and the separating means is arranged at the 15 end of the basket at which, in use, material to be separated is introduced.

The invention also provides a method for screening material, having small particles and fluid, using a shale shaker comprising a basket for supporting a screen assembly, 20 a collection receptacle, and a vibratory mechanism for vibrating the basket, the basket comprising two side walls, an end wall, an opening in the bottom of the basket, means to support screen assemblies for substantially covering the opening, separating means in or on any of the walls for 25 separating material and directing means for directing separated material therefrom into the collection receptacle, the method comprising the steps of introducing the material into the basket to be separated, whereupon small particles and fluid of the material flows through the separating means 30 and directing the separated material into the collection receptacle.

The invention also provides a screen assembly for a shale shaker comprising a rectangular frame having a first plane on which at least one layer of screen cloth is 35 arranged, characterised in that said rectangular frame comprises a hole or channel at an angle to the first plane. In use, the hole or channel is used to direct separated fluid and/or particles into a collection receptacle.

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In another embodiment of the present invention there is provided a screen mounting basket for a vibratory separator for separating components of material introduced into the basket, the vibratory separator including a collection
5 receptacle beneath the basket, the basket comprising two opposed spaced-apart side walls having first ends and second ends, the first ends spaced-apart by an end wall connected to each of the side walls, a basket bottom opening between the two spaced-apart side walls, basket bottom screening
10 apparatus at the basket bottom opening, at least one basket aperture not through the basket bottom, at least one aperture screen over the at least one basket aperture, and the at least one aperture screen and the bottom screening apparatus for separating a component material from the material
15 introduced into the basket, material flowing through the at least one aperture screen not flowing through the bottom screening apparatus, the separated component material flowing into the collection receptacle.

Preferably, the basket aperture is through the end wall,
20 the basket aperture is through one of the two spaced-apart side walls, the at least one aperture screen has a support with a plurality of openings therethrough suitable for the flow of fluid therethrough, the fluid from the material introduced into the basket, and the at least one aperture
25 screen having a plurality of fluid conducting channels therein at an angle to the plurality of openings so that fluid flowing into one of the plurality of openings may then flow into one of the plurality of fluid conducting channels and out from the support into the receptacle.

30 It is further preferable the support is a frame and the plurality of fluid conducting channels is a plurality of holes in part of the frame, the support is a perforated plate, the plurality of openings is a plurality of openings through the perforated plate, and the plurality of fluid
35 conducting channels is a plurality of holes through the perforated plate. It is also preferable the material introduced to the basket is drilling fluid with undesirable material therein and the separated component is drilling

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fluid.

In yet another embodiment of the present invention there is provided a screen apparatus for a vibratory separator, the vibratory separator having a basket, the vibratory separator
5 for separating components of material introduced into the basket, the vibratory separator including a collection receptacle beneath the basket, the screen apparatus comprising screening material, a support, the screening material on the support, the support having a plurality of
10 openings therethrough suitable for the flow of fluid therethrough, the fluid from the material introduced into the basket, the support having a plurality of fluid conducting channels therein at an angle to the plurality of openings so that fluid flowing into one of the plurality of openings may
15 then flow into one of the plurality of fluid conducting channels and out from the support into the receptacle.

In yet another embodiment of the present invention there is provided a vibratory separator system for separating components from a liquid-solid mixture fed to the vibratory
20 separator system, the vibratory separator system comprising a frame, a screen mounting basket on the frame, vibrating apparatus connected to the screen mounting basket for vibrating the screen mounting basket, the screen mounting basket comprising two opposed spaced-apart side walls having
25 first ends and second ends, the first ends spaced-apart by an end wall connected to each of the side walls, a basket bottom opening between the two spaced-apart side walls, basket bottom screening apparatus at the basket bottom opening, at least one basket aperture not through the basket bottom, at
30 least one aperture screen over the at least one basket aperture, and the at least one aperture screen and the bottom screening apparatus for separating a component material from the material introduced into the basket, material flowing through the at least one aperture screen not flowing through
35 the bottom screening apparatus, the separated component material flowing into the collection receptacle.

In yet another embodiment of the present invention there is provided a method for separating components of a material

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with a vibratory separator, the vibratory separator having a screen mounting basket into which the material is introduced, the vibratory separator including a collection receptacle beneath the basket, the basket comprising two opposed spaced-apart side walls having first ends and second ends, the first ends spaced-apart by an end wall connected to each of the side walls, a basket bottom opening between the two spaced-apart side walls, basket bottom screening apparatus at the basket bottom opening, at least one basket aperture not through the basket bottom opening, at least one aperture screen over the at least one basket aperture, and the at least one aperture screen and the bottom screening apparatus for separating a component material from the material introduced into the basket, the separated component material flowing into the collection receptacle, the method comprising introducing the material into the basket, separating a component of the material with the basket bottom screening apparatus and with the at least one aperture screen, component material separated by the at least one aperture screen not flowing through the basket bottom screening apparatus and the thus separated component material flowing into the receptacle.

In yet another embodiment of the present invention there is provided a method for separating components of a material with a vibratory separator, the vibratory separator having a screen mounting basket into which the material is introduced, the vibratory separator including a collection receptacle beneath the basket, the basket comprising two opposed spaced-apart side walls having first ends and second ends, the first ends spaced-apart by an end wall connected to each of the side walls, a basket bottom opening between the two spaced-apart side walls, at least one end opening through the end wall, at least one end screen over the at least one end opening, at least one basket screen over the basket bottom opening, and the at least one end screen and the at least one basket screen for separating a component from the material, the separated, component flowing into the collection receptacle, the method comprising introducing the material

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into the basket, separating a component of the material with the at least one basket screen and with the at least one end screen, component material flowing through the at least one end screen not flowing through the at least one basket screen
5 and the thus separated component material flowing into the receptacle.

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

Figure 1 is a perspective view of a prior art shale shaker;

Figure 2 is a schematic view of a prior art system for separating and treating mud in a well drilling operation;

Figure 3 is a schematic view of part of a prior art shale shaker;

Figure 4 is a side cross-sectional view of a prior art basket for a shale shaker as shown in Figure 1, in use;

Figure 5A is a side view of a basket for a shale shaker in accordance with the present invention; Figure 5B is a perspective view of a screen assembly of the basket of Figure 5A; Figure 5C is an end view of parts of the basket as shown in Figure 5A incorporating the screen assembly shown in Figure 5B; Figure 5D is a top view of part of the basket of Figure 5A; Figure 5E is a side view of a second embodiment of a basket and screen assembly for a shale shaker in accordance with the present invention;

Figure 6A is a perspective view of a plate for a screen assembly in accordance with the present invention; Figure 6B is a top view of a perforated plate in accordance to the present invention; Figure 6C is a cross-sectional view taken along line 6C-6C of Figure 6B; Figure 6D is a top view of a second embodiment of a perforate plate in accordance with the present invention;

Figures 7A to 7E are perspective views of respectively a third, fourth, fifth, sixth and seventh embodiment of a basket for a shale shaker in accordance to the present invention;

Figure 8 is a perspective view of a plate or sheet

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for a basket in accordance with the present invention.

Referring now to Figure 1, a prior art shale shaker 1 has a screen assembly 2 mounted in a vibratable screen mounting apparatus known as a "basket" 3. The screen
5 assembly 2 may be any known screen or any combination of screen cloth, coarse mesh, perforate plate with a rigid frame or hook strip. The basket 3 is mounted on four springs 4, two of which are shown and the other two are on the opposite side of the basket 3. The four springs 4 are
10 supported from a frame 6. The basket 3 is vibrated by a motor 5 and interconnected vibrating apparatus 8 which is mounted on the basket 3 for vibrating the basket and the screens. Elevator apparatus 7 provides for raising and
15 lowering of the basket 3 at one end. Typically the basket will be in an inclined, "climb the hill" position (see Figure 4) so that a pool 9 of liquid is maintained at a first end within the basket. In use, large particles will "climb the hill" towards a discharge end of the shale shaker.

20 Figure 2 discloses one example of a typical prior art shaker system, as shown in US-A-5,190,645. The system A comprises a shale shaker K having a screen assembly or assemblies S. The screen assemblies S (only one shown) are mounted in a typical shaker basket B and one or more
25 vibratory mechanisms V vibrates the basket B and the screen assemblies S, which are rigidly mounted therein. A collection receptacle CR is arranged beneath the basket B to collect separated mud, which will go on for further processing before being reused. The other components of
30 the system A are as described in US-A-5,190,645.

Figure 3 shows schematically a prior art system C with a Mud Box M, also known as a Back tank or Possum Belly, to distribute the flow to a screen assembly S (only one shown). The screen assembly S is mounted

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rigidly in a basket (not shown) which is vibrated to assist the throughput of mud and movement of separated solids. The basket (or deck) rests on Vibration Isolation Members, such as helical springs or rubber
5 mounts. The vibration isolation members rest on the support member, which is also used to divert flow as desired, and is called a Bed. There are many deck, basket configurations used depending on the design criteria. The deck, basket, may be flat, horizontal, or
10 mounted at a slope.

On sloped deck units for example, cascade or parallel flow units, the screens may be continuous with one screen covering the entire deck length, or have a divided deck which has more than one screen used to cover
15 the screening surface, or with individual screens mounted at different slopes. On multiple deck units, more than one screen layer may be employed. In a two or three deck unit, the mud passes through one screen before flowing through the second.

20 The motion of the shaker controls the efficiency of separation, rate of travel of cuttings on the screen, solids separation capacity and fluid capacity. The shape and axial direction of the vibration motion along the deck is controlled by the position of the vibrator
25 relative to the deck and the direction of rotation of the vibrator.

Shale shakers have capacity limits. Exceeding a capacity limit means excessive mud will be discharged over the ends along with the solids and hence, wasted.
30 Capacity limits are typically defined for non-blinded screens. Capacity limits of a shale shaker include:

1. The solids capacity limit is the maximum amount of solids that a device will remove; and
2. The liquid limit - the maximum GPM capacity for
35 various drilling muds.

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The solids capacity limit is encountered when drilling soft, gummy formations. Usually the liquid limit controls the minimum size screen that can be used for a given circulation rate. The thicker the mud, the lower the GPM capacity. Open area of the screens and usable area of the screening deck influence this limit. The solids capacity and/or liquid capacity varies with different shaker designs. In practice, the smallest screen size that can be employed without flooding a unit is used.

There is a need for an efficient vibratory separator system which is efficient and cost-effective with increased efficiency, and screen throughput.

Referring now to Figures 5A to 5D there is shown a basket 10 for supporting screen assemblies in a vibratory separator such as a shale shaker. The basket 10 has two spaced-apart side walls 12, 14 and an end wall 16 between them. Typical vibrator apparatus 20 is connectible to the basket 10. An end screen assembly 40 is mounted in channels 22, 24 on opposite sides of the end wall 16. Screen mounting apparatus 46 may be any such known apparatus.

In one aspect the channels 22, 24 are open at the top so the screen assembly 40 can be introduced into the space between the channels 22, 24. Optional removable blocks 26, 28 on the interior of the basket hold the screen assembly 40 in place in the channels; and optional crown bars 32 on the screen assembly's exterior provide support for the screen 40. In one aspect each crown bar 32 has a rubber part 34 that contacts the screen assembly 40. Screening material of the screen assembly 40 (as on any screen according to the present invention) may be any suitable known screening material, including, but not limited to one, two, three or more layers of known screening material and/or mesh, two-dimensional or three-

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dimensional, bonded, glued, connected or unconnected.

The screen assembly 40 may, optionally, have a curved lower portion 42 that corresponds to a curved-shape assumed by screens (not shown) mounted in the basket 10. Crown members (not shown) may be provided to support the screen in the basket 10 in the curved shape.

The screen assembly 40 is emplaced over an opening 18 in the end wall 16. Optionally a sealing gasket 19 or other seal material or seal member is used around the opening 18.

A basket 10 (and any basket according to the present invention) may be used with any suitable known shaker or separator. Figure 5E shows another embodiment 10a of a basket 10 with multiple vertical end screens 40', 40a, and 40b supported on lower part 22a of the channel 22 and positioned beneath upper part 22b of the channel 22. Alternatively, the screen assembly may have appropriate frames or other mounting members and/or structure so that they can be bolted in place. The screens 40a and 40b may be like the screen 40' with the screening material as described for the screen assembly 40 (and like numerals in Figures 5A and 5E are for like items). Each screen may have similar or different screening material. Two, three, four or more such screens may be used at a basket end and/or side(s) with screens positioned within or outside the basket.

Figure 6A shows part of a tubular frame 60 used as a screen support for screening material for a screen assembly according to the present invention for use in a vibratory separator or shale shaker. The frame 60 has a top member 61 and a bottom member 62. A plurality of cross members 63 (one shown) interconnect the top and bottom members. A screen or screen assembly (not shown) may be arranged vertically against top and bottom members 61 and 64. One, two, three, four, or more holes 64 (or a

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series of perforations through the bottom member 62) provide for fluid flow through the bottom member 62 (shown as hollow; solid bottom members with one or more holes or perforations may be used). In one aspect the top member also has such a hole or holes 64. Screening material may be adhered or otherwise attached to the front face of the frame and a back plate may be welded or otherwise attached to the rear face of the frame. In use, separated material flows through the screening material and falls or is diverted through holes 64 into a collecting receptacle, such as the one shown in Figure 2 with reference CR, beneath the basket of the shale shaker.

Figures 6B and 6C show a perforated plate 200 for supporting screening material (not shown) for a screen assembly for a vibratory separator, such as a shale shaker, particularly for an end wall or side wall of the basket. The perforated plate 200 has a plurality of spaced-apart openings 201 or holes extending through the plate from one surface to the other. A second series of spaced-apart openings 202 or holes extend from the topmost row of openings 201 (as viewed in Figure 6B) to a bottom side 203 of the plate 200. Openings 202 intersect openings 201 so that fluid flowing into an opening 201 can flow down (as viewed in Figure 6B) and out from the plate 200, e.g. into a collecting receptacle of a vibratory separator or shale shaker beneath a basket in which is mounted a screen assembly with such a plate.

It is within the scope of this invention for any known perforated plate or perforated member used as a support for a screen assembly which has a known series of spaced-apart perforations, holes, openings, etc. to have a second series of perforations, openings or holes (e.g. but not limited to like the holes 202) at any desired angle to the perforations, holes or openings, etc.

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through the plate (including, but not limited to at a right angle as shown in Figure 6B) to conduct fluid through the plate as is done by the plate 200.

Figure 6D shows a screen assembly 210 for a
5 vibratory separator, such as a shale shaker, according to the present invention, with a perforated plate 211 for supporting screening material 212 on the plate 211, particularly for an end screen or side basket screen according to the present invention as described herein.
10 The perforated plate 211 has a plurality of spaced-apart openings 213 or holes extending through the plate from one surface to the other. A series of spaced-apart grooves 214 or notches extend from one side of the plate 211 to the other and intersect the openings 213 so that
15 fluid flowing into an opening 213 can flow down and out from the plate 211, e.g. into a receptacle of a vibratory separator or shale shaker beneath a basket in which is mounted a screen assembly with such a plate. There may be multiple holes 213 under each hole 213 as viewed in
20 Figure 6D across the plate's surface. The screening material 212 may be any disclosed herein and/or any known in the art.

It is within the scope of this invention for any known perforated plate or perforated member used as a
25 support for a screen assembly which has a known series of spaced-apart perforations, holes, openings, etc. to have a second series of grooves or notches (e.g. but not limited to like the grooves 214) at any desired angle to the perforations, holes or openings, etc. through the
30 plate (including, but not limited to at a right angle as shown in Figure 6D) to conduct fluid down the plate as is done in the plate 211.

Figure 7A shows a basket 70 with side walls 72, end wall 73, and cross-braces 79 on which screen assemblies
35 for treating fluid introduced into the basket are to be

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mounted. End wall 73 has an end screen assembly 74 over an end opening 71 for treating fluid introduced to the basket 70. Side screen assemblies 75, 76 are mounted over side openings 77 in the side walls 72. An end brace
5 78 is interconnected between side walls 72 at an exit end of the basket 70 (opposite the other end at which fluid is introduced into the basket).

Figure 7B shows a basket 80 with side walls 82, end wall 83, in which screen assemblies for treating fluid
10 introduced into the basket are to be mounted. End wall 83 has an end screen assembly 84 over an end opening 81 for treating fluid introduced to the basket 80. Side screen assemblies 85, 86 are mounted over side openings 87 in the side walls 82. An end brace 88 is
15 interconnected between side walls 82 at an exit end of the basket 80 (opposite the other end at which fluid is introduced into the basket).

Figure 7C shows a basket 90 with side walls 92, end wall 93, and cross-braces 99 on which screen assemblies
20 for treating fluid introduced into the basket are to be mounted. End wall 93 has an end screen assembly 94 over an end opening 91 for treating fluid introduced to the basket 90. Side screen assemblies 95, 96 are mounted over side openings 97 in the side walls 92. An end brace
25 98 is interconnected between side walls 92 at an exit end of the basket 90 (opposite the other end at which fluid is introduced into the basket).

Figure 7D shows a basket 100 with side walls 102, end wall 103, and cross-braces 109. End wall 103 has an
30 end screen assembly 104 over an end opening 101 for treating fluid introduced to the basket 100. Side screen assemblies 105, 106 are mounted over side openings 107 in the side walls 102. An end brace 108 is interconnected between side walls 102 at an exit end of the basket 100
35 (opposite the other end at which fluid is introduced into

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the basket). Mounting apparatus 110 (any known in the art) is used to mount screen assemblies in the basket 100.

Figure 7E shows a basket 120 with side walls 122, end wall 123, and cross-braces 129. End wall 123 has end screen assemblies 124, 134 over end openings 121, 131 for treating fluid introduced to the basket 120. Side screen assemblies 125, 126 are mounted over side openings 127, 137 in the side walls 122. An end brace 128 is interconnected between side walls 122 at an exit end of the basket 120 (opposite the other end at which fluid is introduced into the basket). Mounting apparatus 130 (any known in the art) is used to mount screen assemblies in the basket 120.

Figure 7F shows a basket 140 with side walls 142, end wall 143, and screen assemblies 162, 163 mounted on the basket for treating fluid introduced into the basket. End wall 143 has an end screen assembly 174 over an end opening 141 for treating fluid introduced to the basket 140. Side screen assemblies 144, 145, 146, 147, 148, 149 are mounted over side openings 154, 155, 156, 157, 158, 159 in the side walls 142. An end brace 168 is interconnected between side walls 142 at an exit end 182 of the basket 140 (opposite the other end at which fluid is introduced into the basket). A solid sheet or plate 180 is mounted in the basket at the fluid introduction end 184 opposite the solids exit end 182. The solid sheet or plate 180 performs no fluid treatment function of separating components of a fluid introduced into the basket 140. The end screen 174 and side screen assemblies and/or side screen portions adjacent the solid sheet or plate 180 do perform a fluid component separation function. It is within the scope of this invention for the solid sheet or plate to be sized so that it underlies a pond or pool (e.g. as shown in Figure

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4, item 9). It is also within the scope of this invention for the solid sheet or plate to extend from the end wall 143 toward the exit end 182 six inches, one foot, eighteen inches, two feet, thirty inches, three
5 feet, forty two inches, four feet, or any desired amount. alternatively, the sheet or plate 180 may have a series of slits, slots, holes, openings and/or perforations therethrough so that the sheet or plate 180 does perform a fluid component separation function; and, in one such
10 embodiment, the slits, slots, holes, openings and/or perforations are of a size like that of a finest screen mesh on top of a screen used for the screen assemblies 162, 163. Any screen or screen assembly may be used in the basket 140. Any sheet or plate 180 may be used in
15 any known basket or any basket according to the present invention.

Figure 8 shows a plate 180 with a plurality of perforations 185 therethrough.

Vertically "stacked" screen assemblies in the walls
20 of the basket may all be mounted within the basket; outside the basket; or one or more of them may be mounted within the basket and one or more of them mounted outside the basket - with appropriate mounting members, gaskets, seals, seal members, and/or bolts and nuts so that fluid
25 flows through the screens and then exits from an outermost screen.

For an opening not covered by a screen, a blocking plate or member is releasably and sealingly installed over the opening(s) to close off the opening to flow.

30 The shale shaker of the invention is one of any type of vibratory separator which may incorporate the features of the claims.

CLAIMS:

1. A shale shaker for separating material, said shale shaker comprising a basket for supporting a screen assembly, a collection receptacle, and a vibratory mechanism for vibrating the basket, the basket comprising two side walls, an end wall and an opening in the bottom of said basket, said basket having means to support screen assemblies for substantially covering said opening characterised in that said basket further comprises separating means in or on any of said walls for separating material and directing means for directing separated material therefrom into said collection receptacle.
2. A vibratory shaker as claimed in claim 1, wherein said separating means is located on said end wall.
3. A shale shaker as claimed in claim 1 or 2, wherein said separating means is through at least one of said side walls.
4. A shale shaker as claimed in claim 1, 2 or 3, wherein said separating means comprises an aperture.
5. A shale shaker as claimed in claim 4, wherein said aperture is substantially covered by a screen assembly.
6. A shale shaker as claimed in claim 5, wherein said screen assembly comprises screening material.
7. A shale shaker as claimed in claim 6, wherein said screen assembly comprises two-dimensional screening material.
8. A shale shaker as claimed in claim 6, wherein said screen assembly comprises three-dimensional screening material.
9. A shale shaker as claimed in any of claims 6 to 8, wherein said screen material comprises wire mesh.
10. A shale shaker as claimed in any of claims 6 to 9, wherein said screening material comprises screening cloth.
11. A shale shaker as claimed in any one of claims 5 to 10, wherein said screen assembly comprises a perforated

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plate.

12. A shale shaker as claimed in claim 11, wherein said perforate plate comprises channels for directing separated material into said collection receptacle.

5 13. A shale shaker as claimed in claim 12, wherein said screen assembly comprises a frame.

14. A shale shaker as claimed in claim 13, wherein said frame comprises directing means for directing separated material therefrom into said collection receptacle.

10 15. A shale shaker as claimed in any one of claims 5 to 14, wherein said walls comprise a plurality of apertures for a plurality of screen assemblies.

16. A shale shaker as claimed in claim 15, wherein said plurality of apertures are arranged side-by-side.

15 17. A shale shaker as claimed in any one of claims 5 to 16, wherein said screen assembly is held over said aperture by at least one of the following: welding; soldering; and brazing.

20 18. A shale shaker as claimed in any one of claims 5 to 17, wherein said screen assembly is removably replaceable from said aperture.

19. A shale shaker as claimed in claim 18, wherein said aperture is provided with channels, into which said screen assembly is removably replaceably slide.

25 20. A shale shaker as claimed in claim 18 or 19, wherein said screen assembly is held in said aperture by at least one of the following: nuts and bolts; clamps; glue; other adhesive; releasably cooperating fastener material such as VELCRO material; screws; inflatable structure; bladder; releasable tensioning bolts.

30 21. A shale shaker as claimed in any one of claims 1 to 20, wherein said collection receptacle is beneath the basket.

35 22. A shale shaker as claimed in any one of claims 1 to 21, further comprising screen assemblies mounted on said means to support said screen assemblies.

23. A shale shaker as claimed in any one of claims 1 to

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22, further comprising a solid plate arranged in the bottom of said basket.

24. A shale shaker as claimed in claim 23, wherein said solid plate has holes therein.

5 25. A shale shaker as claimed in any one of claims 1 to 24, wherein the separating means is arranged substantially at right angles to the bottom of the basket.

26. A shale shaker as claimed in any one of claims 1 to 25, wherein said separating means is arranged at the end of the
10 basket at which, in use, material to be separated is introduced.

27. A method for screening material, having small particles and fluid, using a shale shaker, the shale shaker comprising a basket for supporting a screen assembly, a collection
15 receptacle, and a vibratory mechanism for vibrating the basket, the basket comprising two side walls, an end wall, an opening in the bottom of said basket, means to support screen assemblies for substantially covering said opening, separating means in or on any of said walls for separating material and
20 directing means for directing separated material therefrom into said collection receptacle, the method comprising the steps of introducing said material into said basket to be separated, whereupon small particles and fluid of the material flows through said separating means and directing said
25 separated material into said collection receptacle.

28. A screen mounting basket for a vibratory separator for separating components of material introduced into the basket, the vibratory separator including a collection receptacle beneath the basket, the basket comprising two opposed spaced-
30 apart side walls having first ends and second ends, the first ends spaced-apart by an end wall connected to each of the side walls, a basket bottom opening between the two spaced-apart side walls, basket bottom screening apparatus at the basket bottom opening, at least one basket aperture not through the
35 basket bottom, at least one aperture screen over the at least one basket aperture, and the at least one aperture screen and the bottom screening apparatus for separating a component material from the material introduced into the basket, material flowing through the at least one aperture screen not

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flowing through the bottom screening apparatus, the separated component material flowing into the collection receptacle.

29. The screen mounting basket of claim 28 wherein the basket aperture is through the end wall.

5 30. The screen mounting basket of claim 28 wherein the basket aperture is through one of the two spaced-apart side walls.

31. The screen mounting basket of claim 28 wherein the at least one aperture screen has a support with a plurality of openings therethrough suitable for the flow of fluid
10 therethrough, the fluid from the material introduced into the basket, and the at least one aperture screen having a plurality of fluid conducting channels therein at an angle to the plurality of openings so that fluid flowing into one of the plurality of openings may then flow into one of the
15 plurality of fluid conducting channels and out from the support into the receptacle.

32. The screen mounting basket of claim 31 wherein the support is a frame and the plurality of fluid conducting channels is a plurality of holes in part of the frame.

20 33. The screen mounting basket of claim 31 wherein the support is a perforated plate, the plurality of openings is a plurality of openings through the perforated plate, and the plurality of fluid conducting channels is a plurality of holes through the perforated plate.

25 34. The screen mounting basket of claim 28 wherein the material introduced to the basket is drilling fluid with undesirable material therein and the separated component is drilling fluid.

30 35. A screen apparatus for a vibratory separator, the vibratory separator having a basket, the vibratory separator for separating components of material introduced into the basket, the vibratory separator including a collection receptacle beneath the basket, the screen apparatus comprising screening material, a support, the screening material on the
35 support, the support having a plurality of openings therethrough suitable for the flow of fluid therethrough, the fluid from the material introduced into the basket, the support having a plurality of fluid conducting channels therein at an angle to the plurality of openings so that fluid

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flowing into one of the plurality of openings may then flow into one of the plurality of fluid conducting channels and out from the support into the receptacle.

5 36. A vibratory separator system for separating components from a liquid-solid mixture fed to the vibratory separator system, the vibratory separator system comprising a frame, a screen mounting basket on the frame, vibrating apparatus connected to the screen mounting basket for vibrating the screen mounting basket, the screen mounting basket comprising
10 two opposed spaced-apart side walls having first ends and second ends, the first ends spaced-apart by an end wall connected to each of the side walls, a basket bottom opening between the two spaced-apart side walls, basket bottom screening apparatus at the basket bottom opening, at least one
15 basket aperture not through the basket bottom, at least one aperture screen over the at least one basket aperture, and the at least one aperture screen and the bottom screening apparatus for separating a component material from the material introduced into the basket, material flowing through
20 the at least one aperture screen not flowing through the bottom screening apparatus, the separated component material flowing into the collection receptacle.

37. A method for separating components of a material with a vibratory separator, the vibratory separator having a screen
25 mounting basket into which the material is introduced, the vibratory separator including a collection receptacle beneath the basket, the basket comprising two opposed spaced-apart side walls having first ends and second ends, the first ends spaced-apart by an end wall connected to each of the side
30 walls, a basket bottom opening between the two spaced-apart side walls, basket bottom screening apparatus at the basket bottom opening, at least one basket aperture not through the basket bottom opening, at least one aperture screen over the at least one basket aperture, and the at least one aperture
35 screen and the bottom screening apparatus for separating a component material from the material introduced into the basket, the separated component material flowing into the collection receptacle, the method comprising introducing the material into the basket, separating a component of the

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material with the basket bottom screening apparatus and with the at least one aperture screen, component material separated by the at least one aperture screen not flowing through the basket bottom screening apparatus and the thus separated component material flowing into the receptacle.

38. A method for separating components of a material with a vibratory separator, the vibratory separator having a screen mounting basket into which the material is introduced, the vibratory separator including a collection receptacle beneath the basket, the basket comprising two opposed spaced-apart side walls having first ends and second ends, the first ends spaced-apart by an end wall connected to each of the side walls, a basket bottom opening between the two spaced-apart side walls, at least one end opening through the end wall, at least one end screen over the at least one end opening, at least one basket screen over the basket bottom opening, and the at least one end screen and the at least one basket screen for separating a component from the material, the separated, component flowing into the collection receptacle, the method comprising introducing the material into the basket, separating a component of the material with the at least one basket screen and with the at least one end screen, component material flowing through the at least one end screen not flowing through the at least one basket screen and the thus separated component material flowing into the receptacle.

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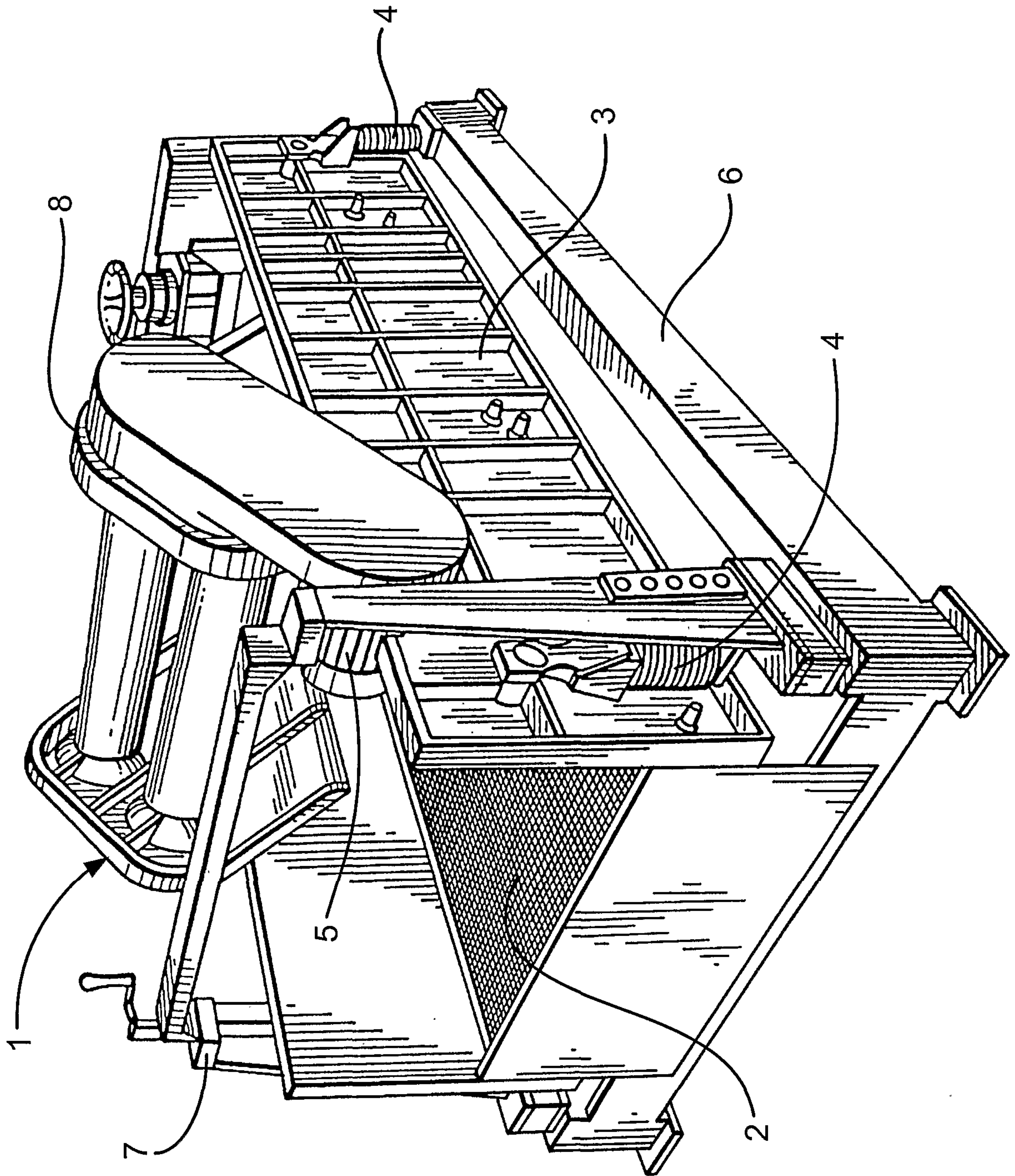
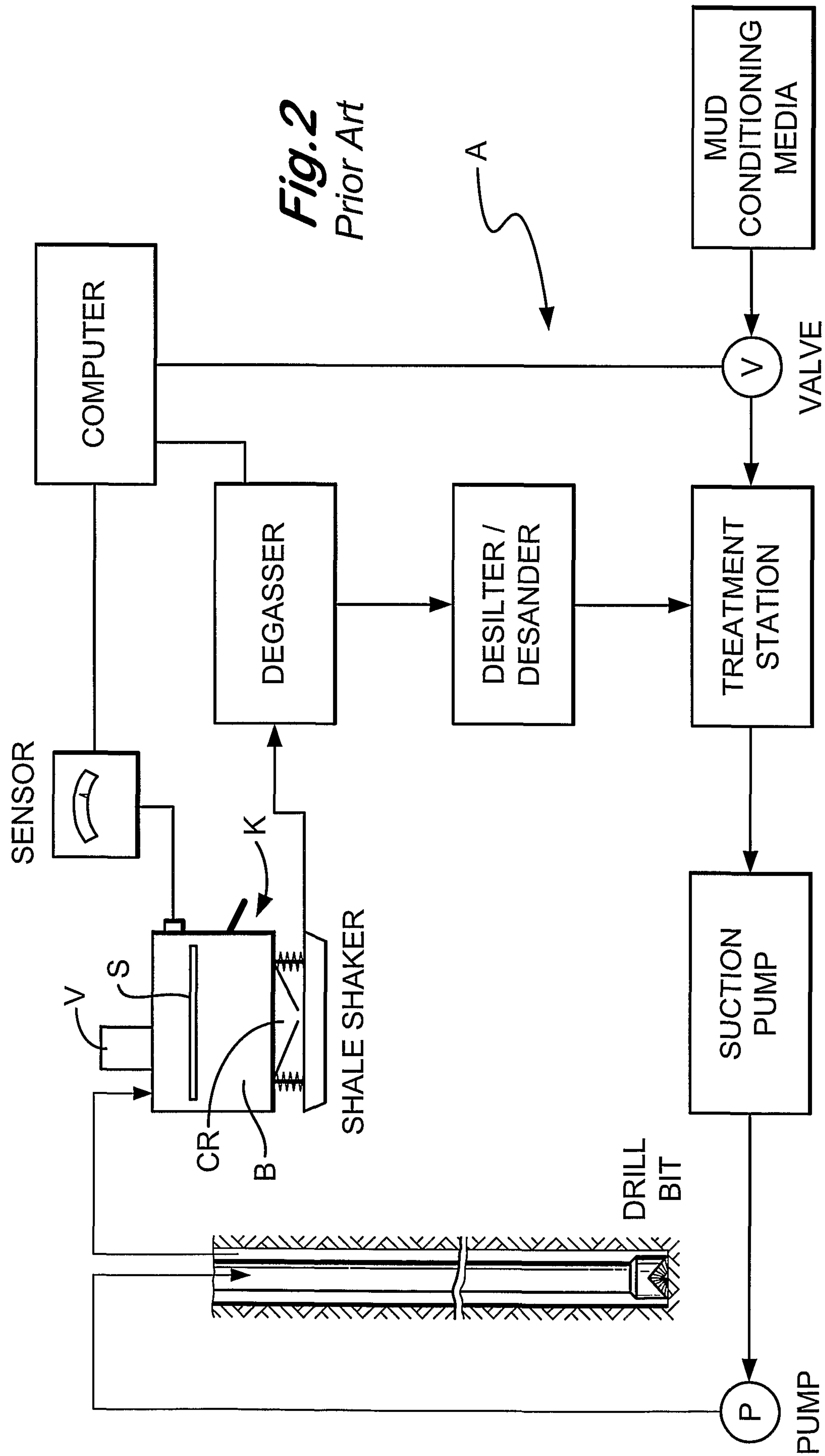


Fig. 1
Prior Art



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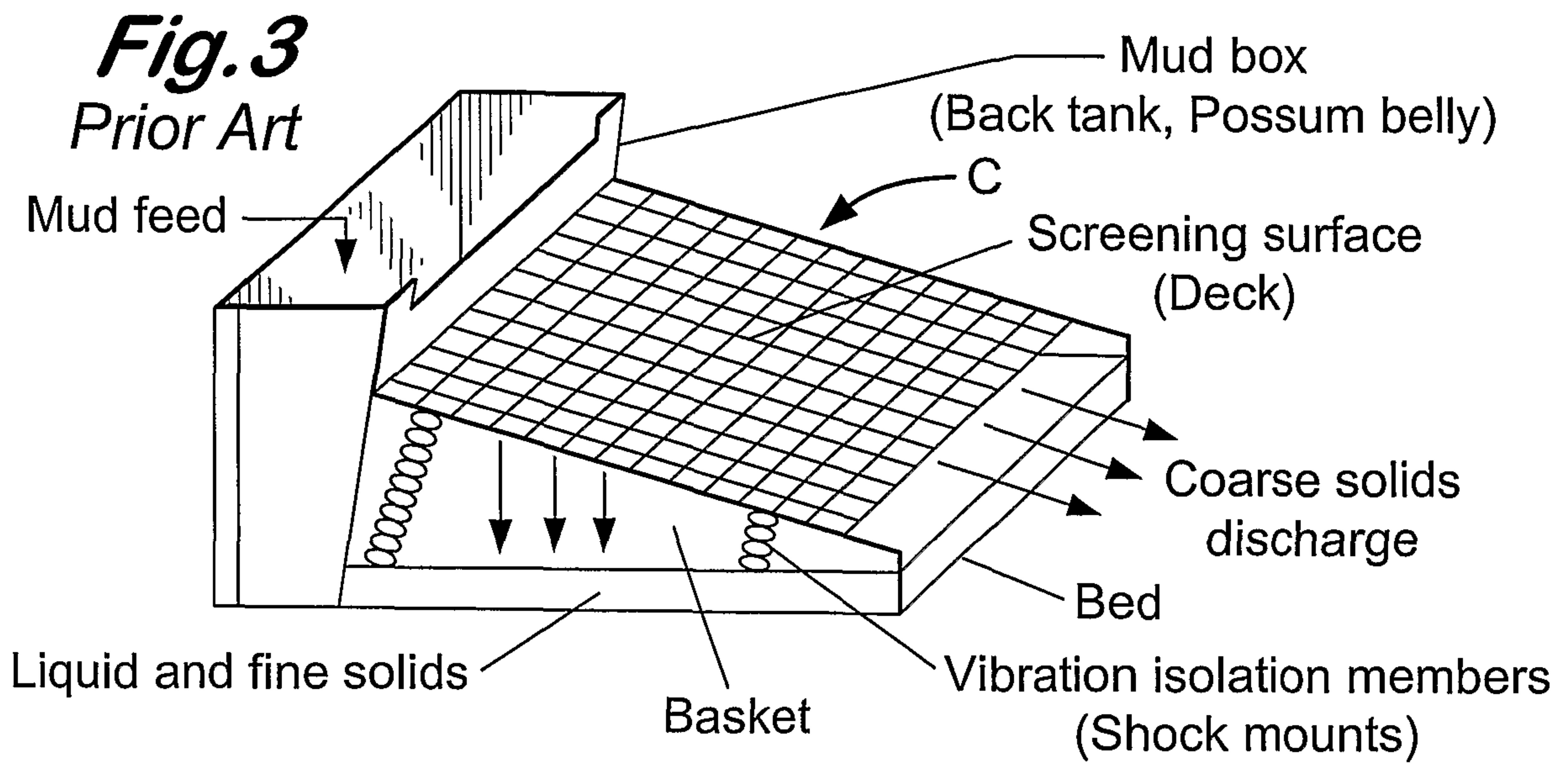


Fig.4
Prior Art

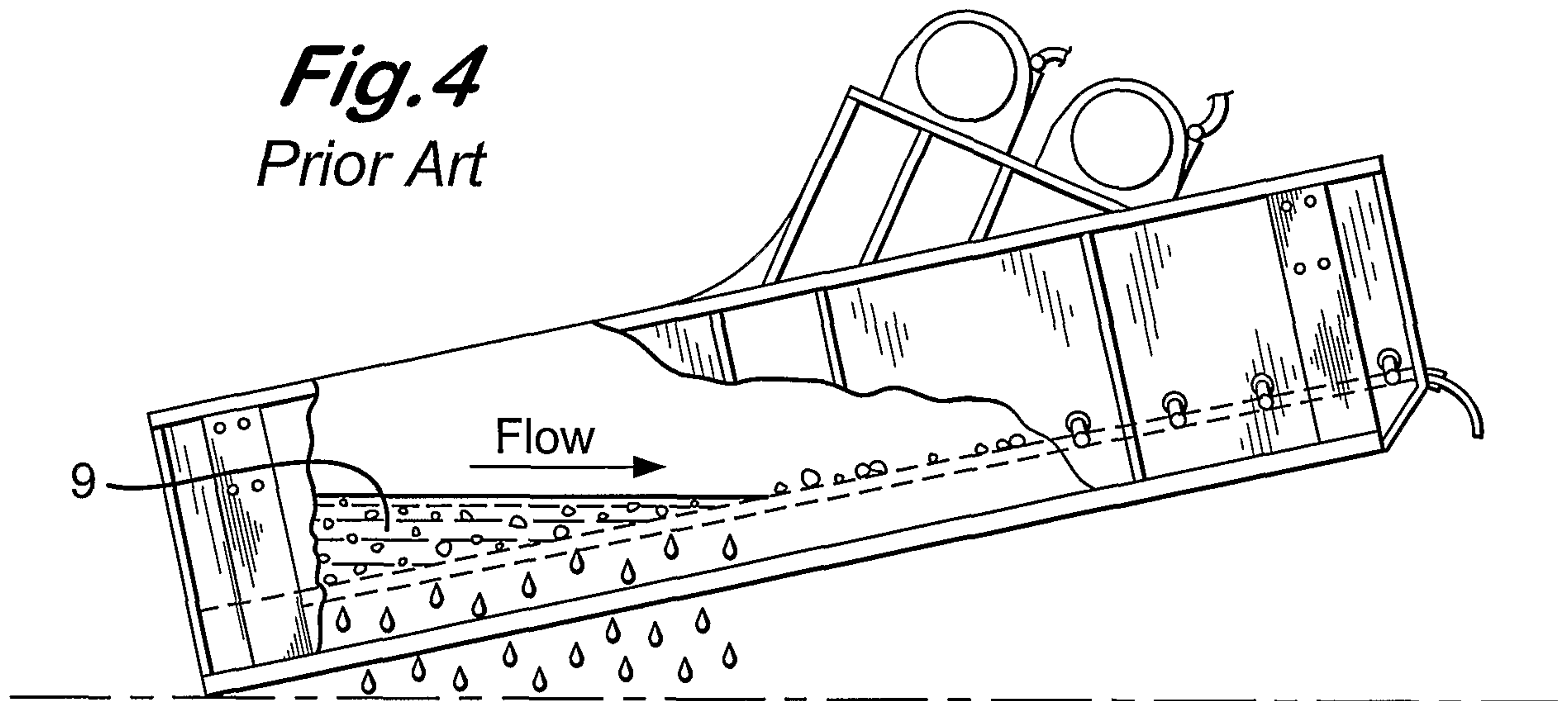
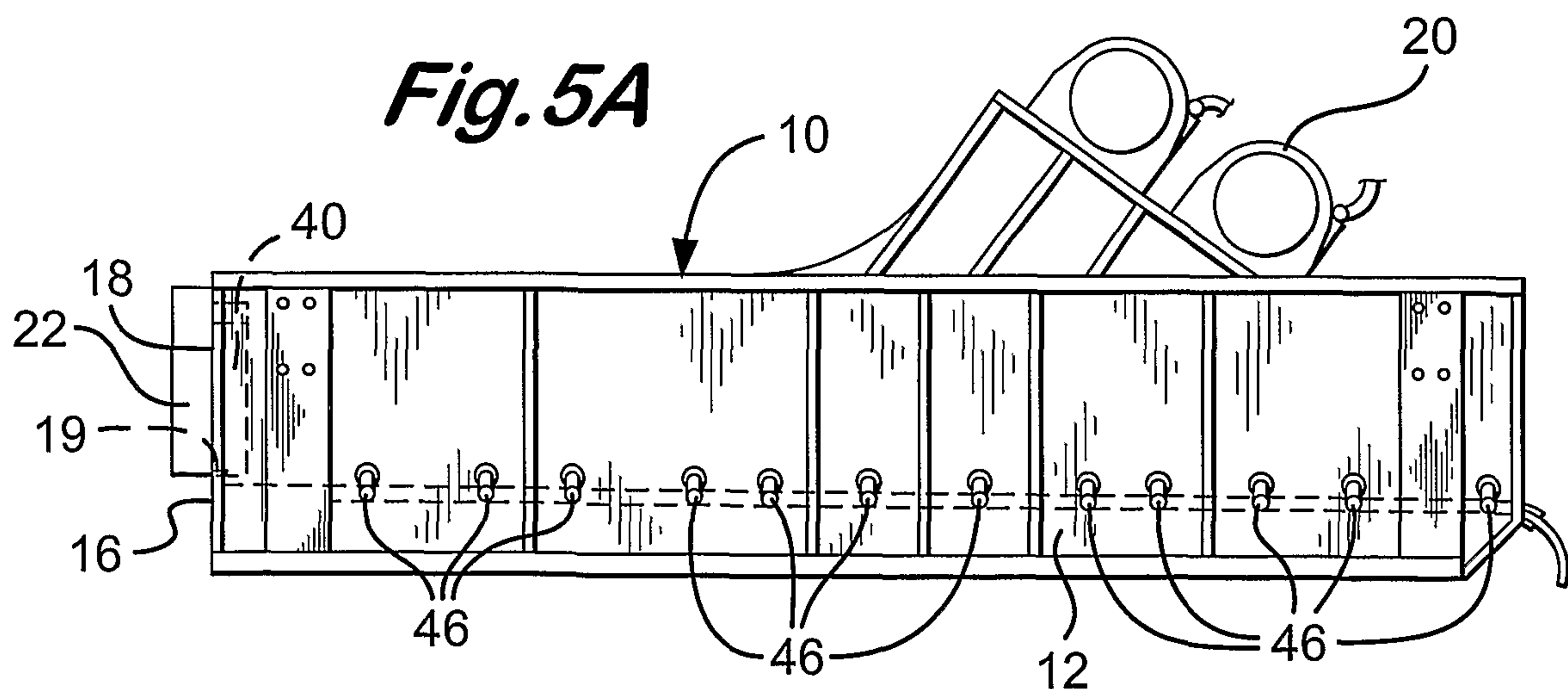
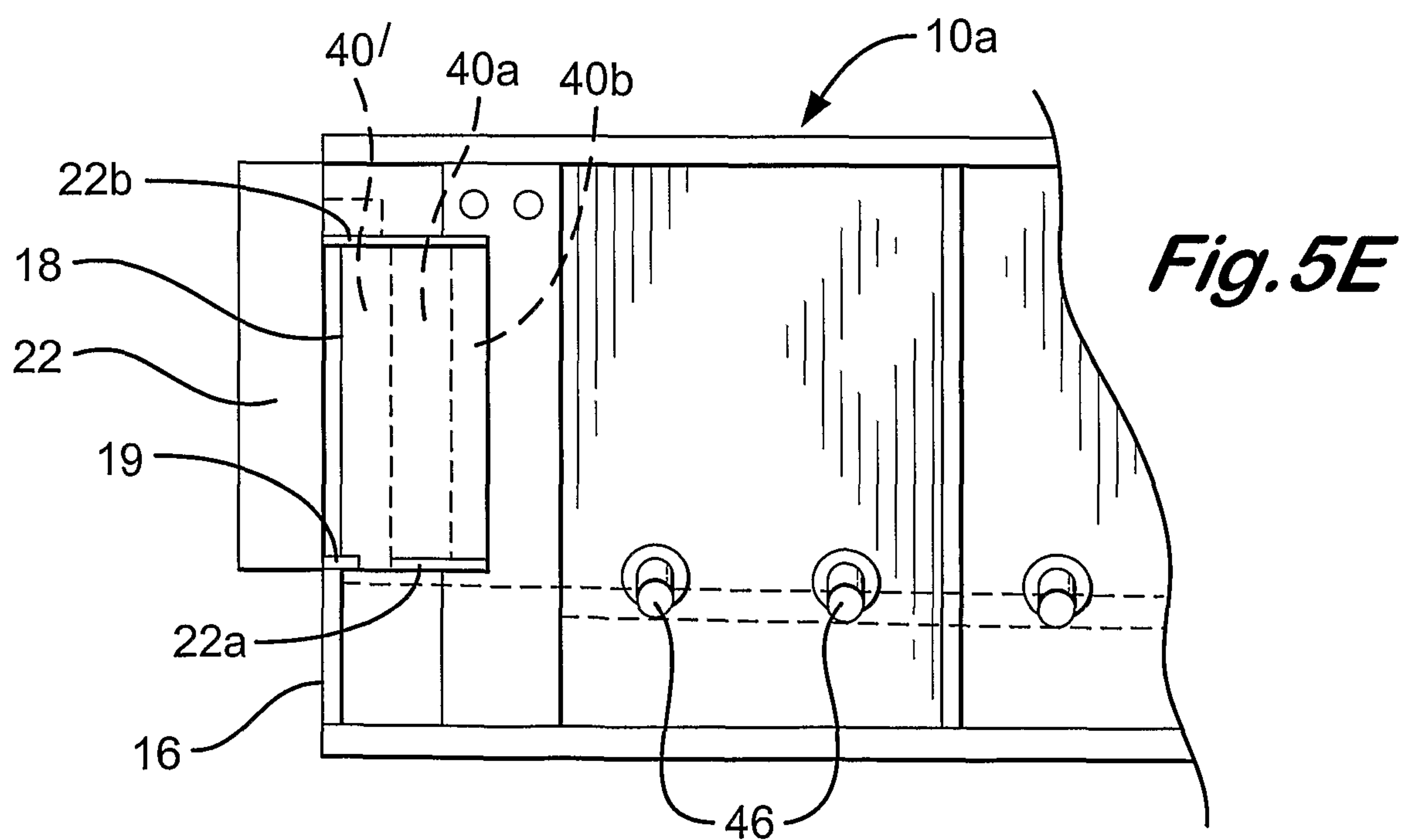
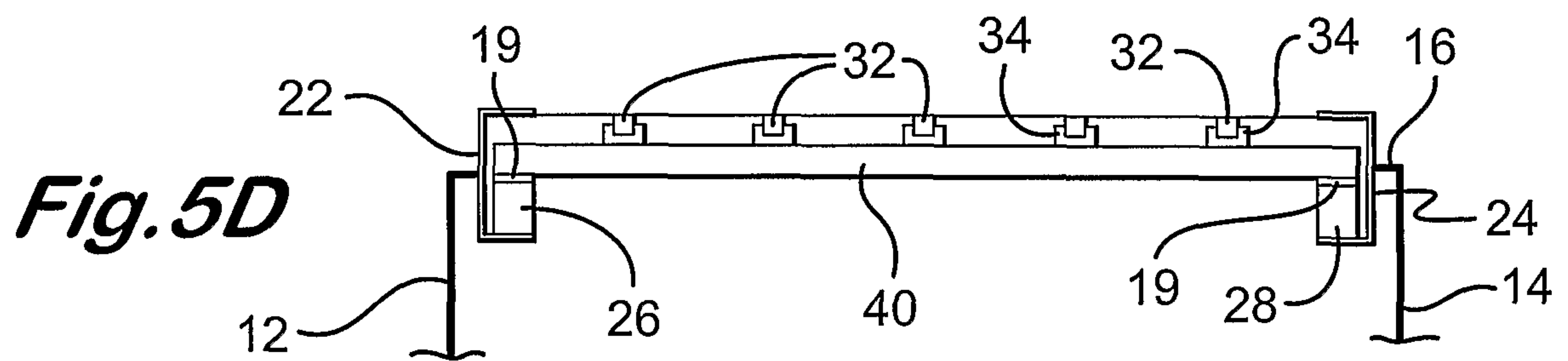
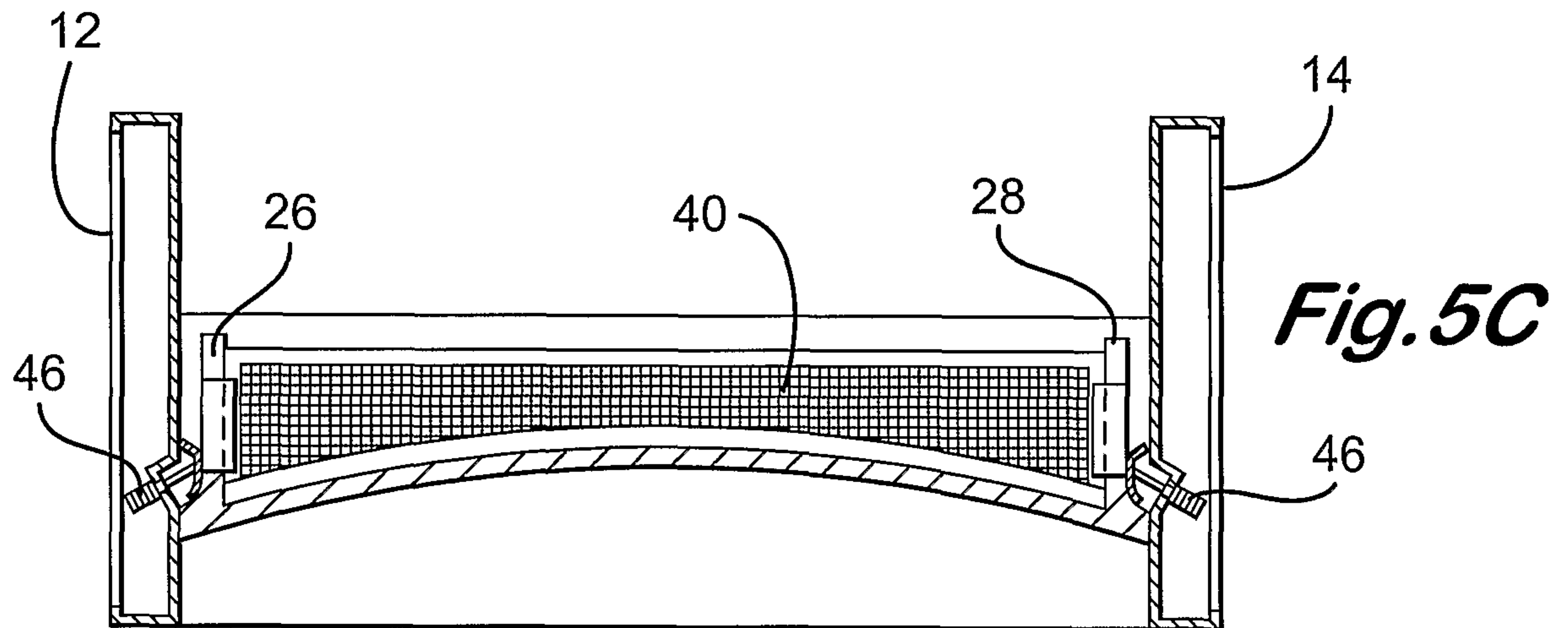
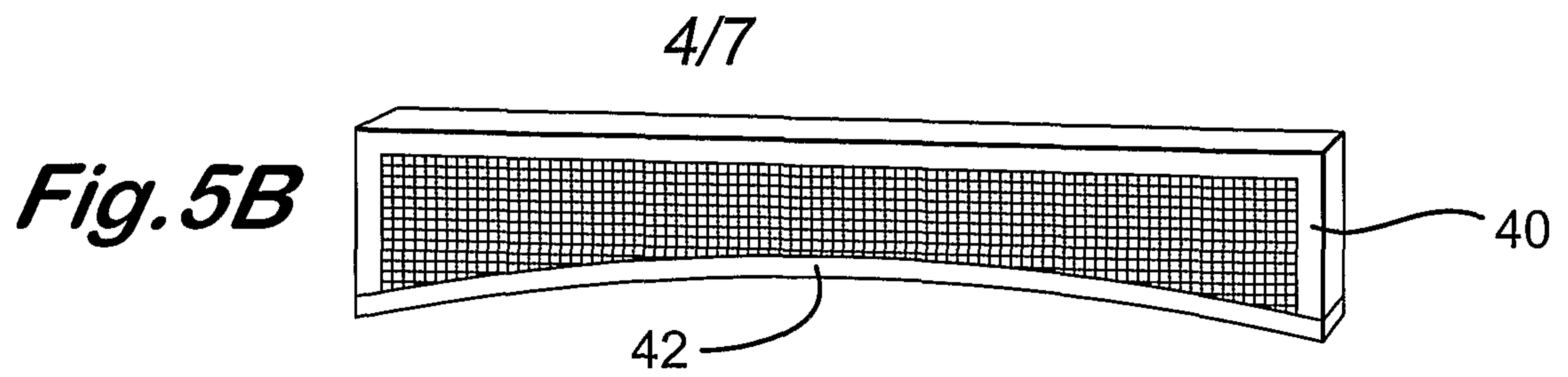
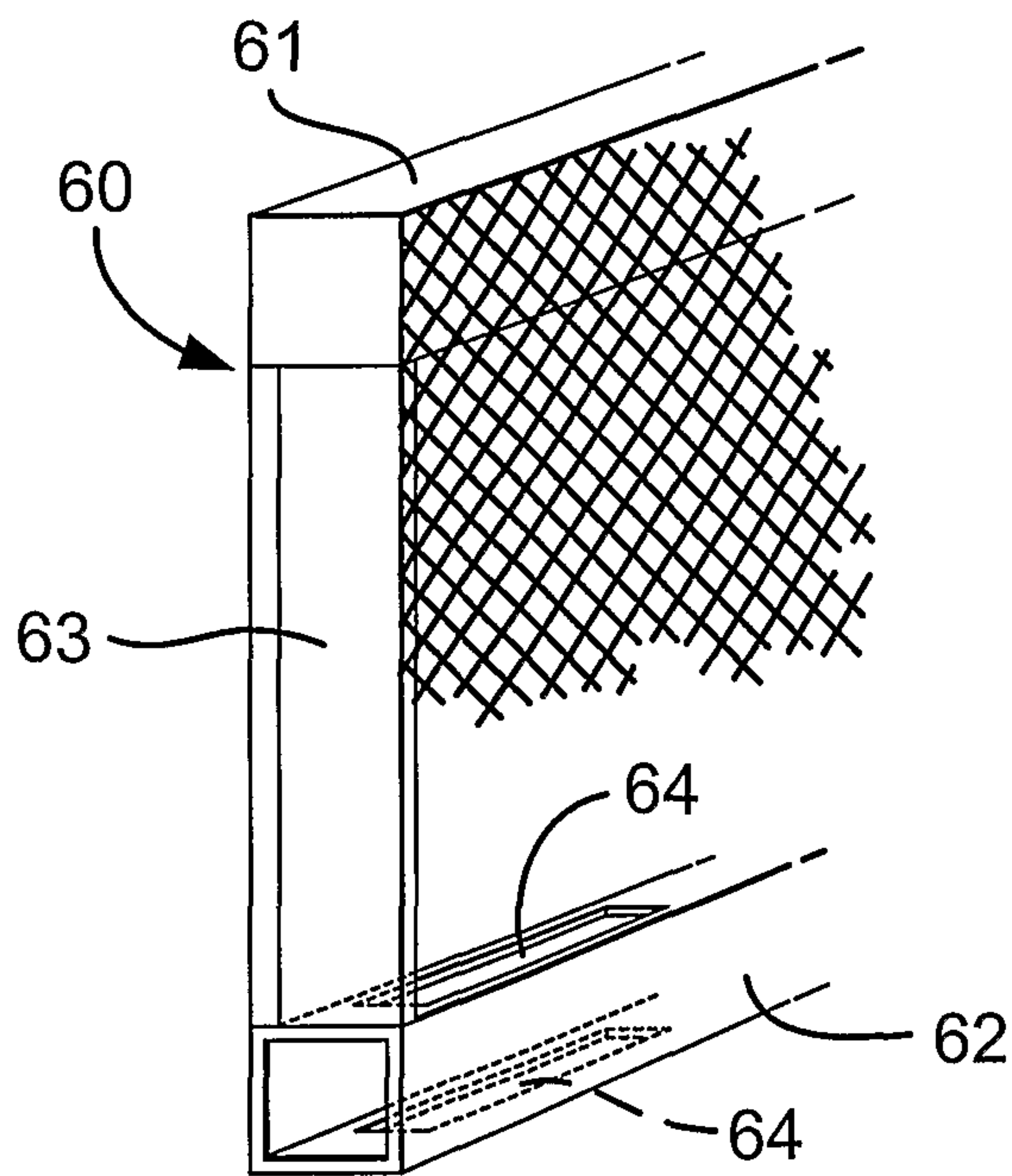
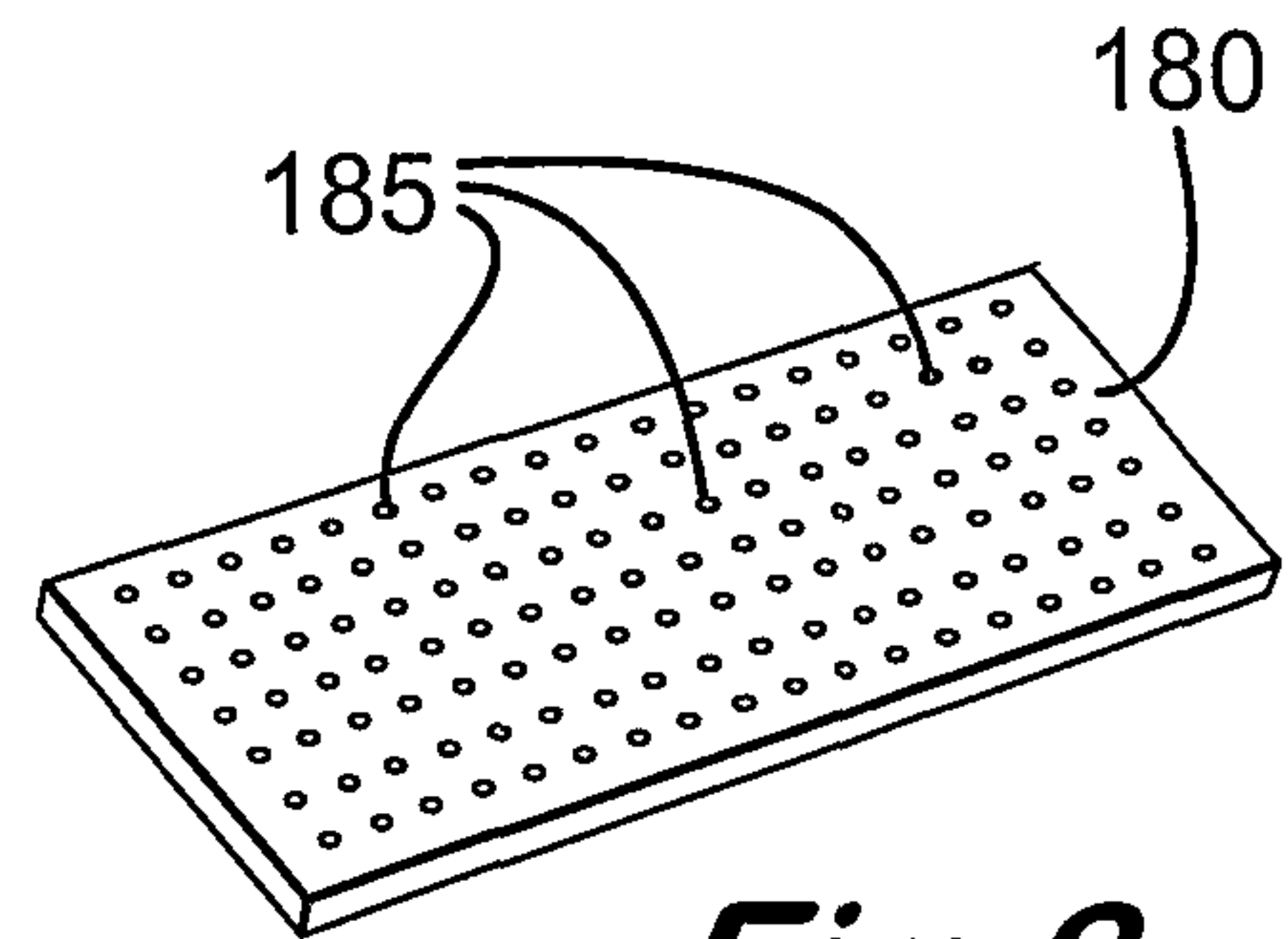
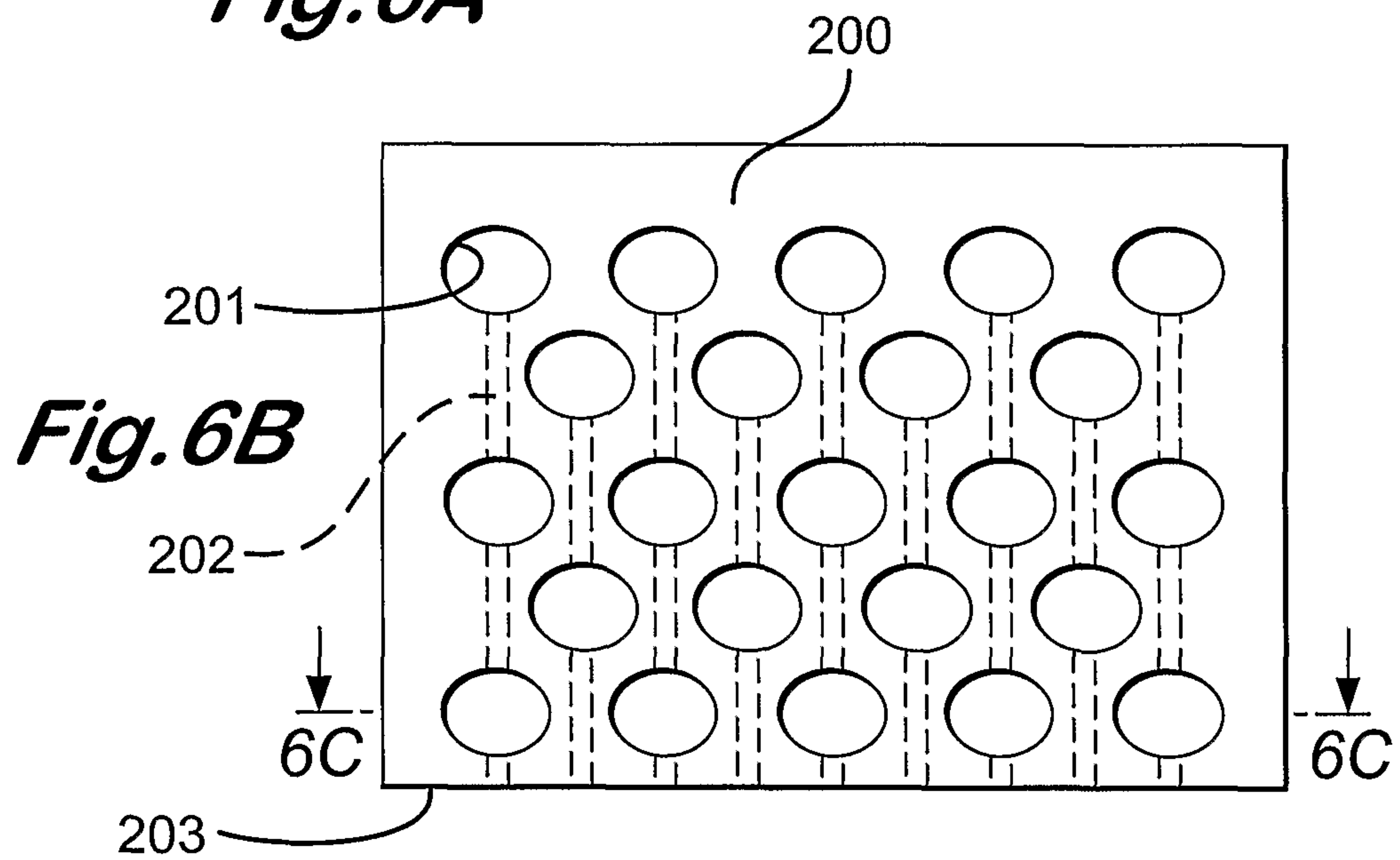
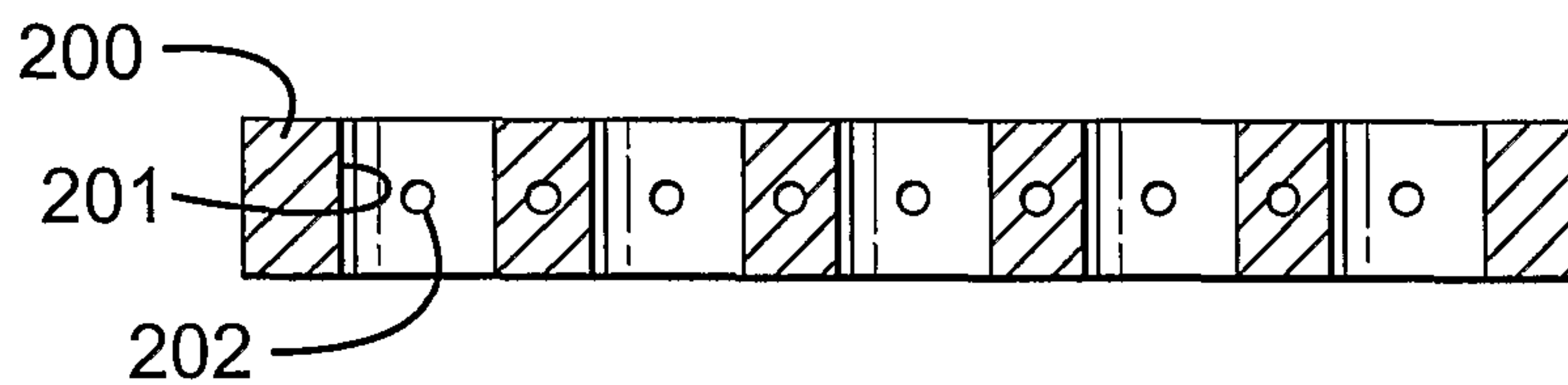
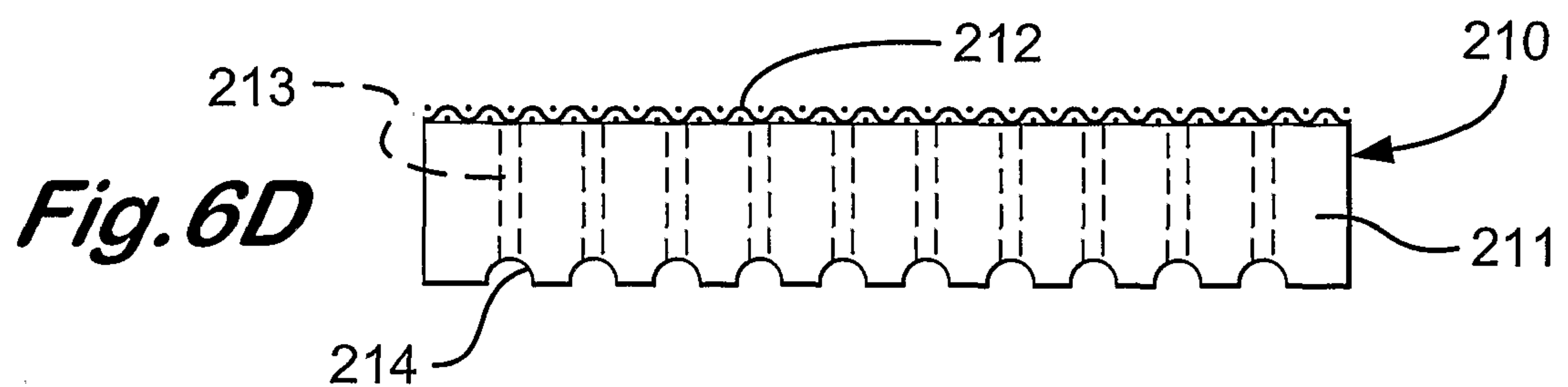


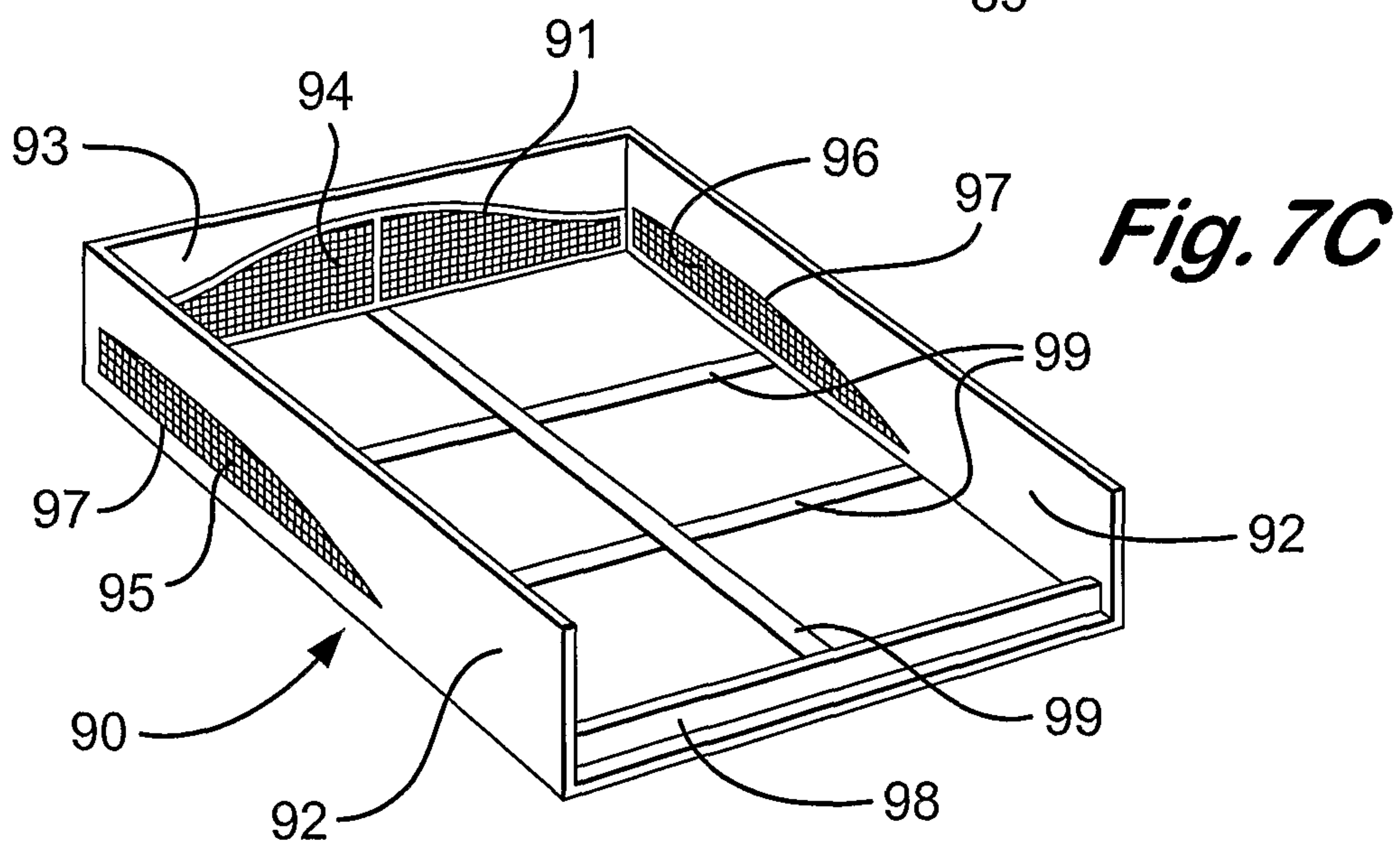
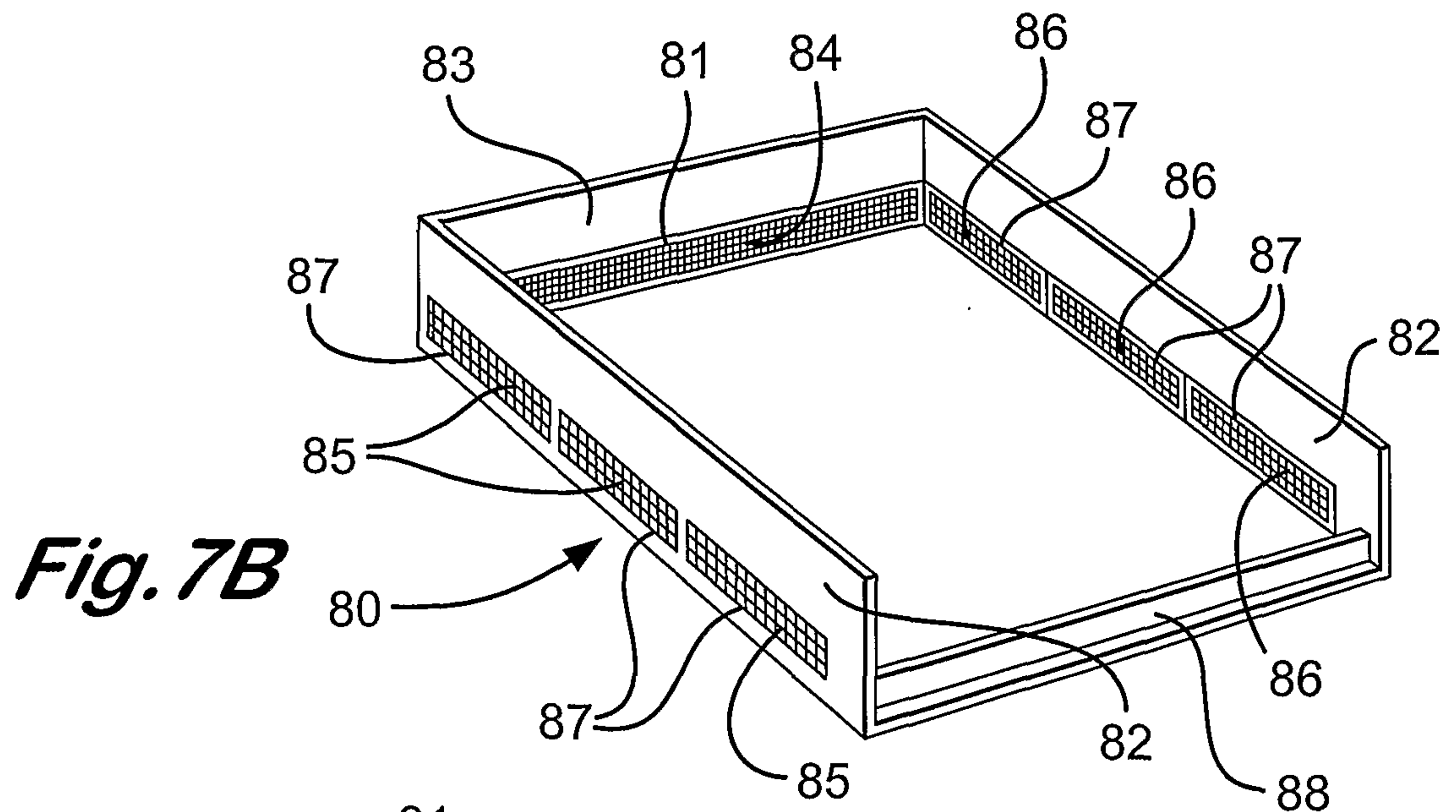
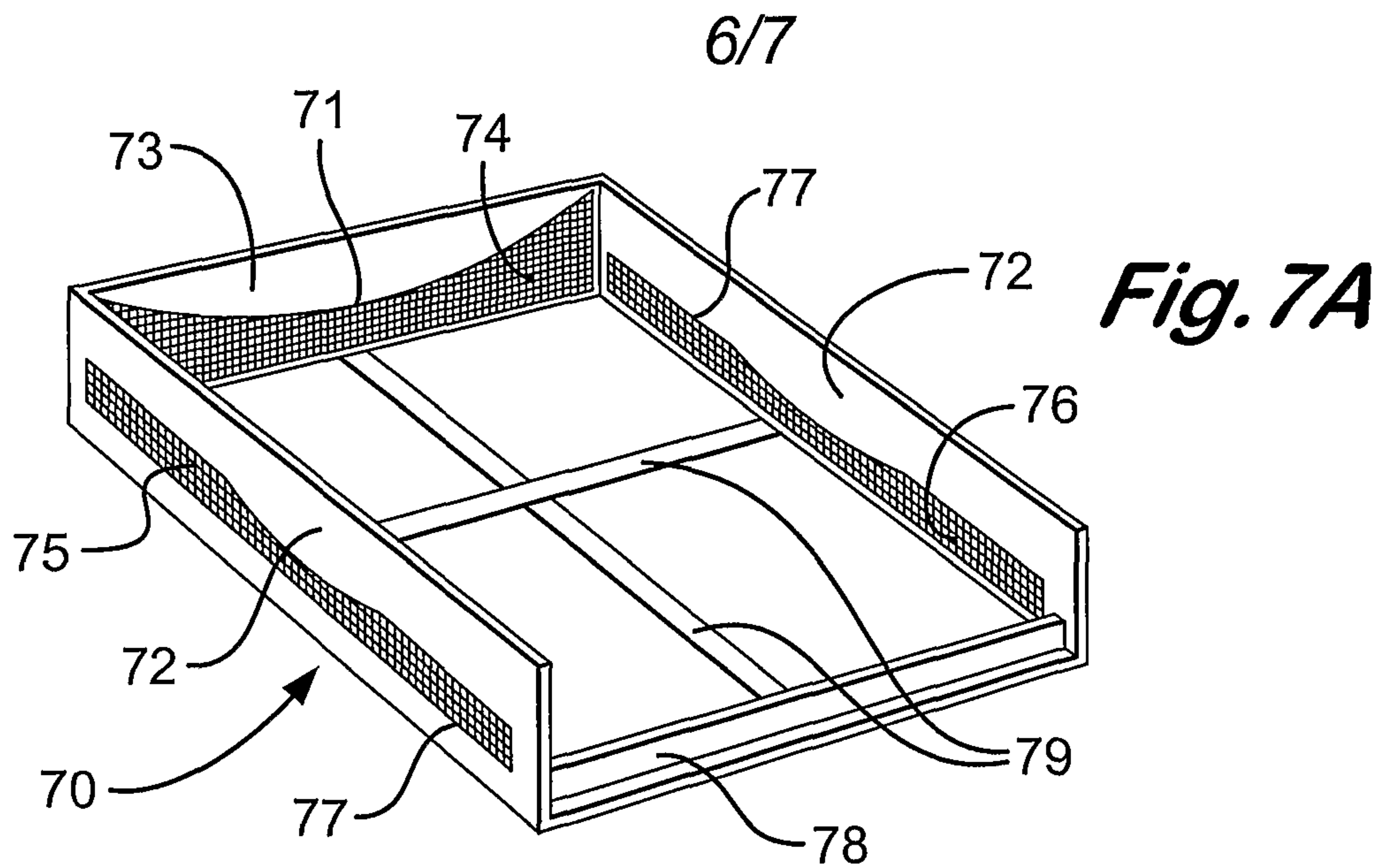
Fig.5A





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**Fig. 6A****Fig. 8****Fig. 6B****Fig. 6C****Fig. 6D**



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