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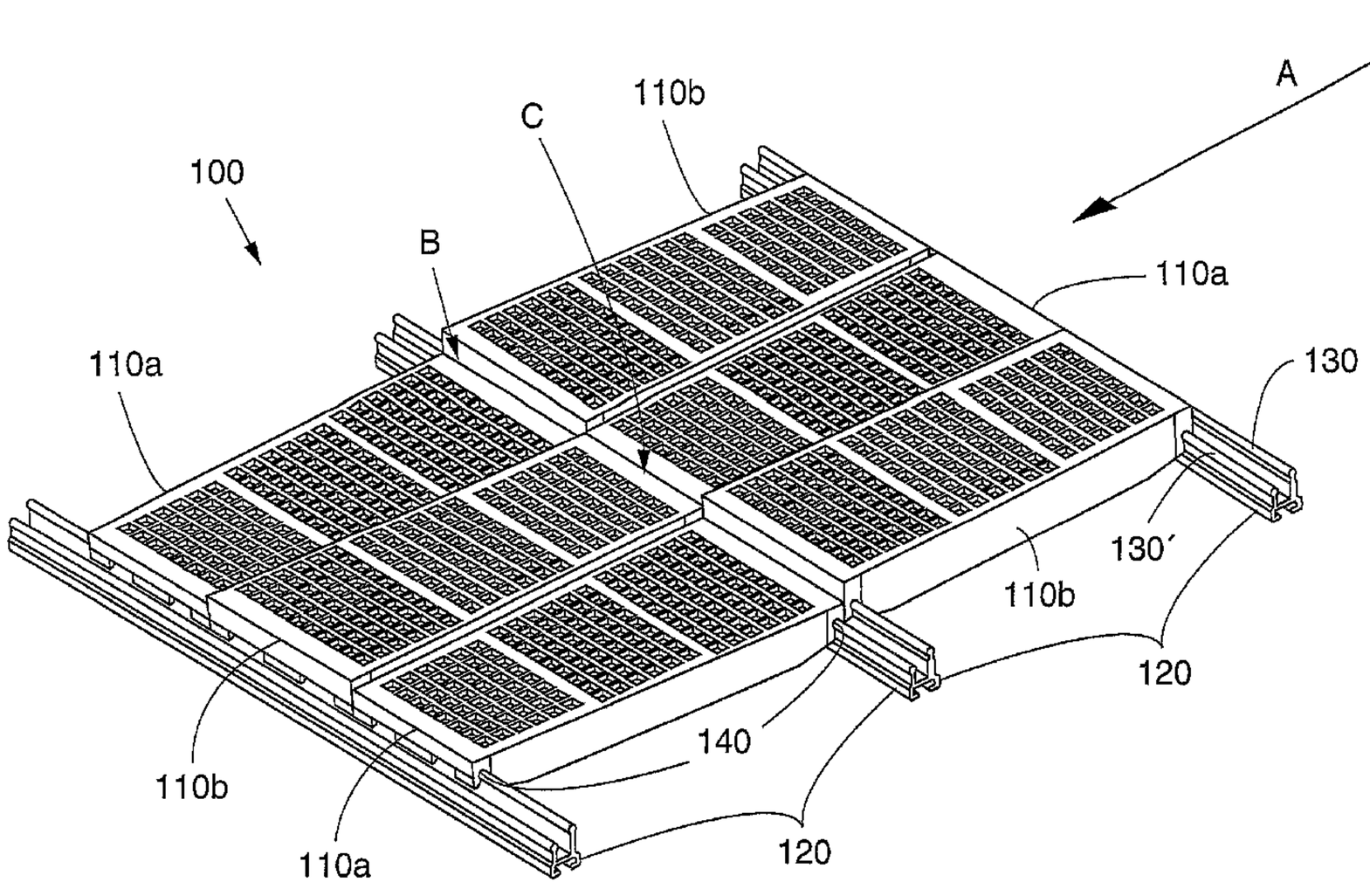

(57) Abrégé/Abstract:
A screening deck (100) for screening of material, such as crushed stone, gravel or the like, the screening deck (100) comprising screening elements (110a, 110b), and where at least one side of each screening element (110a, 110b) is not parallel with a longitudinal direction (A) of the screening deck (100), and that the screening deck (100) includes at least two different types of said screening elements (110a, 110b), and that different screening elements (110a, 110b) are arranged at different heights in the screening deck (100) for creating narrowing passages or winding paths for the material on the screening deck (100).

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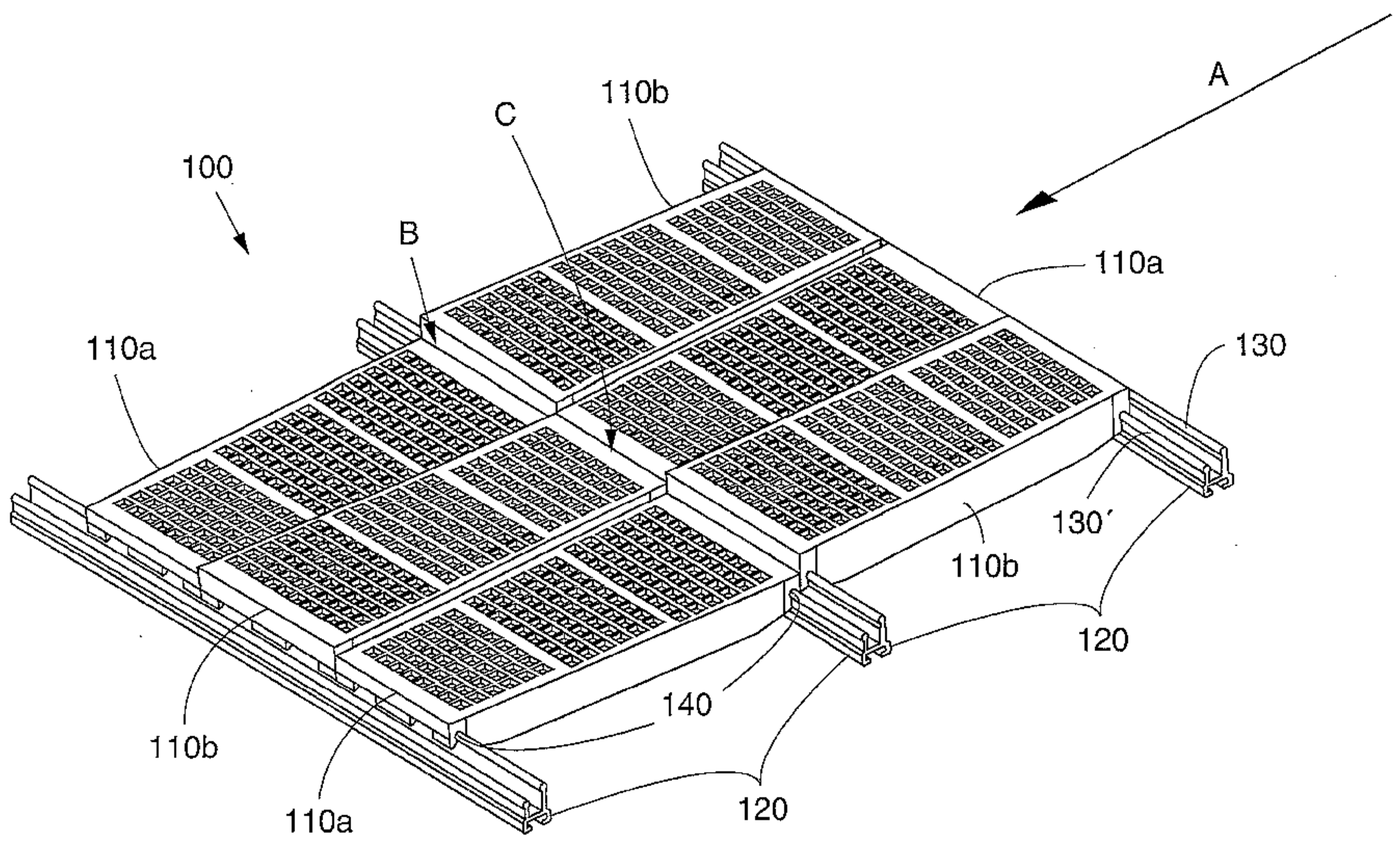
(54) Title: SCREENING DECK



(57) Abstract: A screening deck (100) for screening of material, such as crushed stone, gravel or the like, the screening deck (100) comprising screening elements (110a, 110b), and where at least one side of each screening element (110a, 110b) is not parallel with a longitudinal direction (A) of the screening deck (100), and that the screening deck (100) includes at least two different types of said screening elements (110a, 110b), and that different screening elements (110a, 110b) are arranged at different heights in the screening deck (100) for creating narrowing passages or winding paths for the material on the screening deck (100).

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SCREENING DECK

Background of the invention

The present invention relates to a screening deck for screening of material, such as crushed stone, gravel or the like. The screening deck comprising screening elements.

In mining and stone industries, it is in many cases important to fractionate crushed stone and gravel into fractions of stones with different sizes. Normally, a deviation from the size is permitted according to industry standards, e.g. 10 percent oversized particles and 15 percent undersized particles. It is, however, important that the fractions contain the right mixture, since mixtures that deviate from the standard blends are prized lower.

In most cases, fractionating is done by supplying an unfractionated stream of crushed stone or gravel to a vibrating screen provided with screening elements including screening holes for allowing stones smaller than the screening holes to pass through the holes. The vibration pattern and the inclination of the vibrating screen are arranged so that the crushed stones continuously flow in one direction on the screen, ultimately leaving it on one side or falling through the holes in the screening elements.

In this way it is possible to fractionate the crushed stone stream into stones smaller than the screening holes and stones larger than the screening holes. For most applications, such a fractionating is not sufficient, since the resulting crushed stone fractions reach from stone powder up to the screening hole size and from the screening hole size up to the largest stones entering the screen, respectively. One way of further fractionating the crushed stone into finer fractions is to run one fraction leaving the screen to a further screen, but a more common way of solving the problem is to use a screen with multiple screening decks on top of each other.

On a screen with multiple screening decks, the screening decks are provided with ever smaller screening holes the lower the deck is placed. Due to gravity, stones smaller than the screening holes in an upper deck will fall down to the neighboring lower deck. Stones smaller than the screening holes in that deck will fall through the screening holes, either to a further lower deck or to a surface below the lowermost screening deck. Hence, as the crushed stones leave the screen, the fraction between two decks will contain stones ranging in size from larger than the hole size of the lower screening deck to smaller than the hole size of the upper screening deck.

A problem with screening decks is the wear. As is well known by people skilled in the art, crushed stones are very abrasive, especially when they vibrate in order to flow slowly over a screen. In order to reduce the wear, virtually all surfaces contacting the crushed stone can be clad with or made of rubber or polyurethane.

The areas most exposed to wear are the edges of the screening holes. Hence, most screening decks are provided with exchangeable screening elements. This not only allows exchange due to worn elements, but also for exchange between screening elements of various screening hole sizes.

A system for exchangeable screening elements in a vibrating screen for screening of crushed rocks or gravel is described in SE-A-0 460 340. The screen according to this invention includes a multitude of screening elements. The elements are at one end provided with snap locks for interaction with elongated stanchions provided on transverse carriers reaching across the screen. The other ends of the screening elements that are not provided with snap locks are jammed in place by means of an extension of a neighboring screen element.

One major problem with all screening decks is that the material to be screened, i.e. stones or gravel, travel along a longitudinal path in the screening deck. The travel path of the material is also called the travelling direction. At the edges of the screening elements, there

are no screening holes. Hence, the longitudinal connection area between two adjacent screening elements is not provided with holes. This means that if the material starts to travel close to the edges of the screening element, where no holes are placed, the material will travel over the entire length of the screening deck without encountering a screening hole. This problem is worsened by the fact that the screening elements are rectangular or square having symmetrically located holes, thus creating longitudinal paths without holes. One way of decreasing this problem has been to provide wedge-shaped obstacles on the screening element or on the edges of the screening elements that cause the material to change direction or at least move it transversely to the travelling direction.

Further, it is important that the material to be screened does not move so quickly and undistorted over the screening element that the material that should fall down through the holes has the possibility to pass.

Summary of the invention

The above-mentioned and other problems are solved in that at least one side of each screening element is not parallel with a longitudinal direction of the screening deck, and that the screening deck includes at least two different types of said screening elements, and that different screening elements are arranged at different heights in the screening deck for creating narrowing passages or winding paths for the material on the screening deck.

Preferred embodiments are defined by the features of the dependent claims.

Brief description of the drawings

In the following, the invention will be explained with reference to the accompanying drawings, wherein

Fig. 1 is a schematic perspective assembly view of a screening deck according to a first embodiment of the present invention,

Fig. 2 is a perspective view of a screening element according to the present invention,

Fig. 3 is a perspective view showing the underside of a screening element according to the present invention,

Figs. 4a-4d are simple plan views of alternative embodiments of a screening element according to the present invention,

Fig. 5 is a schematic perspective assembly view of a screening deck with the screening elements arranged perpendicularly to the longitudinal direction of the screening deck,

Fig. 6 is a section view of a first embodiment of a carrier in a screening deck according to the present invention,

Fig. 7 is a section view of a second embodiment of a carrier in a screening deck according to the present invention, and

Fig. 8 is a perspective assembly view specifically illustrating an adapter for use of the screening element according to the present invention in a prior art screening deck assembly.

Description of preferred embodiments

Fig. 1 schematically shows a screening deck 100 for screening of crushed stones, gravel or the like comprising three screening elements 110a, three screening elements 110b and three transverse carriers 120. The screening elements 110a and 110b differ in height, but otherwise they have a substantially identical shape. In Fig. 1 screening element 110a is lower than screening element 110b. The screening elements 110a and 110b are normally alternately placed so that the neighboring screen element always will be of the other type. Each carrier 120 includes two elongated stanchions 130, 130', extending parallel to the carriers 120. A longitudinal direction of the screening deck is indicated with an arrow A in Fig. 1. The longitudinal direction of the screening deck is also the travelling direction for the material, i.e. stones or

gravel, in the vibrating screen. As shown especially well in Fig. 2, each screening element 110a is provided with snap locks 140 at its underside. The snap locks interact with the elongated stanchions 130, 130′ for fastening the screening element to the transverse carriers 120. Fig. 2 shows a perspective view to a larger scale of the screening element 110a including the snap locks 140. Through holes H have been provided in a screening membrane 115 for fractionating crushed stone and gravel into fractions of stones with different sizes. The screening element 110b is substantially similar to the screening element 110a, except for the difference in height.

In Fig. 3, an underside of a screening element 110a, 110b is shown. As can be seen, the screening element comprises a framework 111, including both longitudinal frame portions 112 and transversal frame portions 113. The screening membrane 115 is provided between the frame portions 111, 112 and 113.

Four embodiments 160, 170, 180 and 190 of the screening element according to the present invention are shown in Figs. 4a-4b. The screening element 160, which is shown in Fig. 4a, is similar to the screening element shown in Figs. 1-3. The screening element 160 has two sides 161, 162 that are not parallel with the longitudinal direction A of the screening deck or with the travelling direction of the material. The sides deviate with an angle α from the longitudinal direction A. The angle α should be between 1 and 45 degrees, preferably between 1 and 15 degrees. The angles have an effect on the travelling of material that will be discussed later. The screening element 170, shown in Fig. 4b, has one side 172 parallel with the longitudinal direction A, and has one side 171 that is not parallel with the longitudinal direction A. In Fig. 4c a screening element 180 that has two sides 181, 182 that are not parallel with the longitudinal direction A is shown. The two sides 181, 182 are, however, parallel with each other. The screening element 190, shown in Fig. 4d, is rotated 180 degrees compared to the screening element 160. It has two

sides 191, 192 that are not parallel with the longitudinal direction A of the screening deck or with the travelling direction of the material.

In Fig. 5 an alternative orientation of the screening elements 110a on the screening deck 100 is shown. The screening element 110b could also have been used. According to this embodiment, the carriers 120 are parallel with the longitudinal direction A of the screening deck 100. Only one type of screening elements 110a, 110b is used, i.e. all screening elements have the same height, creating a substantially flat screening deck 100. The screening elements 110a are alternately orientated so that a continuous screening deck 100 is created, and the screening elements 110a can be fastened to the carriers 120.

In Figs. 6 and 7, cross-sections of two embodiments of the carriers 120 are shown. According to the first embodiment, in Fig. 6, the stanchion 130 is lower than the stanchion 130', which together with the different heights of the screening elements 110a, 110b results in "steps" being formed on the screening deck 100, as indicated by the arrow B in Fig. 1. According to the second embodiment, shown in Fig. 7, the stanchions 130, 130' have the same height, which results in a flat screening deck 100, shown in Fig. 5, provided that the height of the screening elements 110a, 110b, from the snap lock 140 to the screening membrane 115, does not differ.

In Fig. 8, an adapter 200 is shown for fitting a screening element 110a according to the present invention to a prior art assembly according to SE-A-0 460 340. The adapter 200 comprises a lower surface 210 for interaction with a shelf 220 of a prior art carrier 230. The adapter further comprises a stanchion 240 for interaction with the snap locks 140 of the screening elements 110a according to the present invention. During operation, the adapter 200 is kept in its place by a force exerted by a screening element fastened on the stanchion 240, since the screening element is fastened to a stanchion 250 in its other end.

In practice, the carriers 120 are fastened by bolting, welding or other suitable fastening means to support beams (not shown) arranged in a vibrating screen. The screening elements 110a, 110b are fastened to the elongated stanchions 130, 130′ with the snap locks 140. The combination of screening elements 110a, 110b being fastened on the stanchions results in a screening deck 100. Even though the shown embodiments include the feature of fastening both ends of the screening elements 110a, fastening by only one end of the screening element is also possible. Likewise the invention has only been shown with the snap locking method for fastening the screening element as it provides flexible fastening means, but other means of fastening are also possible, e.g. bolting, screwing, jamming or clamping.

As implied in Figs. 1-3 and 5, but shown in Figs. 4a-4c, the screening elements 110a, 110b according to the present invention in most cases have a non-rectangular shape seen from above, i.e. the screening elements have one narrow end 110N and one wide end 110W. The screening element 180 in Fig. 4c differs from this by having two ends with the same width. As earlier stated, the screening elements 110a, 110b are alternately fastened on the carriers 120, i.e. one wide end 110W of one screening element 110a, 110b is neighbored by two narrow ends 110N of the neighboring screening elements 110a, 110b. By this arrangement, straight paths from one end of the screening deck 100 to the other end of the screening deck 100 are avoided, which minimizes the risk that stones or gravel travel all the way from one end of the screening deck 100 to the other end of the screening deck 100 without encountering a hole H.

As is well known to people skilled in the art of screening, the screening membrane is provided with holes H, which holes can have varying sizes and shapes to fractionate crushed stone and gravel into fractions of stones with different sizes. According to the invention, the holes H are also arranged with a transversal

displacement so that the stones or gravel cannot travel in the longitudinal direction of the screening deck without encountering a screening hole. As shown in e.g. Fig. 2, the holes H could be grouped in different groups H1-H3 as the width of the screenings element varies. In Fig. 2 the holes are parallelly arranged, having more holes parallelly arranged in the group of holes H1, close to the wide end 110W of the screening element 110a, and having fewer holes parallelly arranged in the group of holes H3, close to the narrow end 110N. Fig. 2 further shows that the holes of the different groups H1-H3 are displaced in relation to each other and in relation to the longitudinal direction A of the screening deck. Every row of holes H can be transversally displaced in relation to the most of the other rows (not shown), and not only transversally displaced in relation to other groups of rows of holes H as shown in Fig. 2.

As mentioned above the angle α can vary between 1 and 45 degrees. It is preferable to have a rather large angle α, since with increasing angle α the travelling speed of the stones and the gravel over the screening deck is reduced, and the likelihood for a stone or piece of gravel to fall into the screening holes is thereby increased. A larger angle α, however, causes a larger wear on the screen element that needs to be replaced more often. The preferred angle α is therefore between 1 and 15 degrees.

The size of the screening elements can vary, but is adapted to fit as many vibration screens as possible. To facilitate the assembly of the screening decks the different screening elements 110a, 110b with different heights can be colored differently, e.g. grey for the screening element 110a and blue for the screening element 110b.

The preferred material of the screening elements is polyurethane (PU) or rubber. In a preferred embodiment, the framework 111, 112, 113 is manufactured from relatively unresilient PU, whereas the screening membrane 115 of the screening element 110a, 110b is manufactured of a more

resilient PU. The preferred materials for the framework 111, 112, 113 have a hardness that preferably is in the range from about 90° Shore A to about 75° Shore D, and the preferred materials for the screening membrane have a hardness of about 30° Shore A to about 95° Shore A or, more preferred, from about 40° Shore A to about 80° Shore A.

Preferred materials are e.g. PU, metal, rubber, PVC, polyethylene, polyamide, polyester or the like for the framework 111, 112, 113 and urethane rubber, suitable natural rubber compounds or other rubber materials for the screening membrane. The invention is, however, not limited to screening elements without a separate framework, but also applies to screening elements with a frame like prior art screening elements.

The height of the stanchions 130, 130′ can, as mentioned, be varied. By having a larger height difference between the stanchions 130, 130′, the step height between each row of screening elements increases. The difference in stanchion height corresponds to the step height B, shown in Fig. 1, on the screening deck 100.

As an alternative to the embodiment in Fig. 1, every screening element can be rotated 180 degrees in the vertical plane having the narrow end of the screening element 110a up-streams and the wide end down-streams. The screening elements 110b will have the wide end up-streams and the narrow end down-streams. This provides a screening deck, where material from the screening element 110b will fall down to screening element 110a and create turbulence in the material. The screening element 110a will alter the direction of the material much less due to the widening shape. It is, however, possible that the material membrane is slightly thinned out since the screening element is widening along the travelling direction.

In the above it has been described that the non-flat structure of the screening deck, i.e. the steps and difference in level, is provided with screening elements of different height and with stanchions of different height, but it could of course be provided in other ways as well.

The invention should not be limited to the shown embodiment; several modifications within the scope of the appended claims are possible.

CLAIMS

1. A screening deck (100) for screening of material, such as crushed stone, gravel or the like, the screening deck (100) comprising screening elements (110, 110a, 110b) **characterized in** that at least one side of each screening element (110a, 110b) is not parallel with a longitudinal direction (A) of the screening deck (100), and that the screening deck (100) includes at least a first type (110a) and a second type (110b) of the screening elements, wherein the first type of screening elements (110a) has a different height than the second type of screening element (110b), and that the first type (110a) and the second type (110b) of the screening elements are arranged to create different heights in the screening deck (100) for creating narrowing passages or winding paths for the material on the screening deck (100).

2. A screening deck (100) according to claim 1, wherein the screening elements (110a, 110b) have two sides that are not parallel with a longitudinal direction (A) of the screening deck (100).

3. A screening deck (100) according to claim 1 or 2, wherein the different types of screening elements (110a, 110b) are arranged alternately, providing non-flat screening.

4. A screening deck (100) according to any preceding claim, wherein the screening deck (100) further comprises carriers (120), and where said screening elements (110a, 110b) are provided with fastenings means to fasten the screening elements (110a, 110b) to the carrier (120).

5. A screening deck (100) according to claim 4, wherein the carriers (120) are provided with elongated stanchions (130, 130') on which ends (110N, 110W) of screening elements (110a, 110b) are fastened, and where the screening elements (110 a, 110b) at both ends are provided

with snap locks (140) interacting with the stanchions (130, 130') provided on the carriers (120).

6. A screening deck (100) according to claim 5, wherein the elongated stanchions (130, 130') create together with height difference between different screening elements (110a, 110b) steps along the longitudinal direction of the screening deck (100) between rows of arranged screening elements (110a, 110b).

7. The screening deck (100) according to any preceding claim, wherein the screening elements (110a, 110b) are provided with a framework (111, 112, 113) supporting a screening membrane (115).

8. The screening deck (100) according to claim 7, wherein the framework (111, 112, 113) and the screening membrane (115) are manufactured from polyurethane (PU).

9. The screening deck (100) according to claim 8, wherein the framework (111, 112, 113) and the screening membrane (115) are manufactured of polyurethane (PU) having different hardness.

10. A screening deck (100) according to any preceding claim, wherein the carriers (120) can be mounted transversally or parallelly to the longitudinal direction of the screening deck (100).

11. A screening deck (100) provided with an adapter (200) for allowing mounting of a screening element (110a, 110b) according to any of the preceding claims on a screening deck assembly comprising carriers with one stanchion (250) and one shelf (220) for screening element support, and where the adapter (200) being provided with a stanchion (240) interacting with the snap locks (140) on one end of the screening element (110a, 110b).

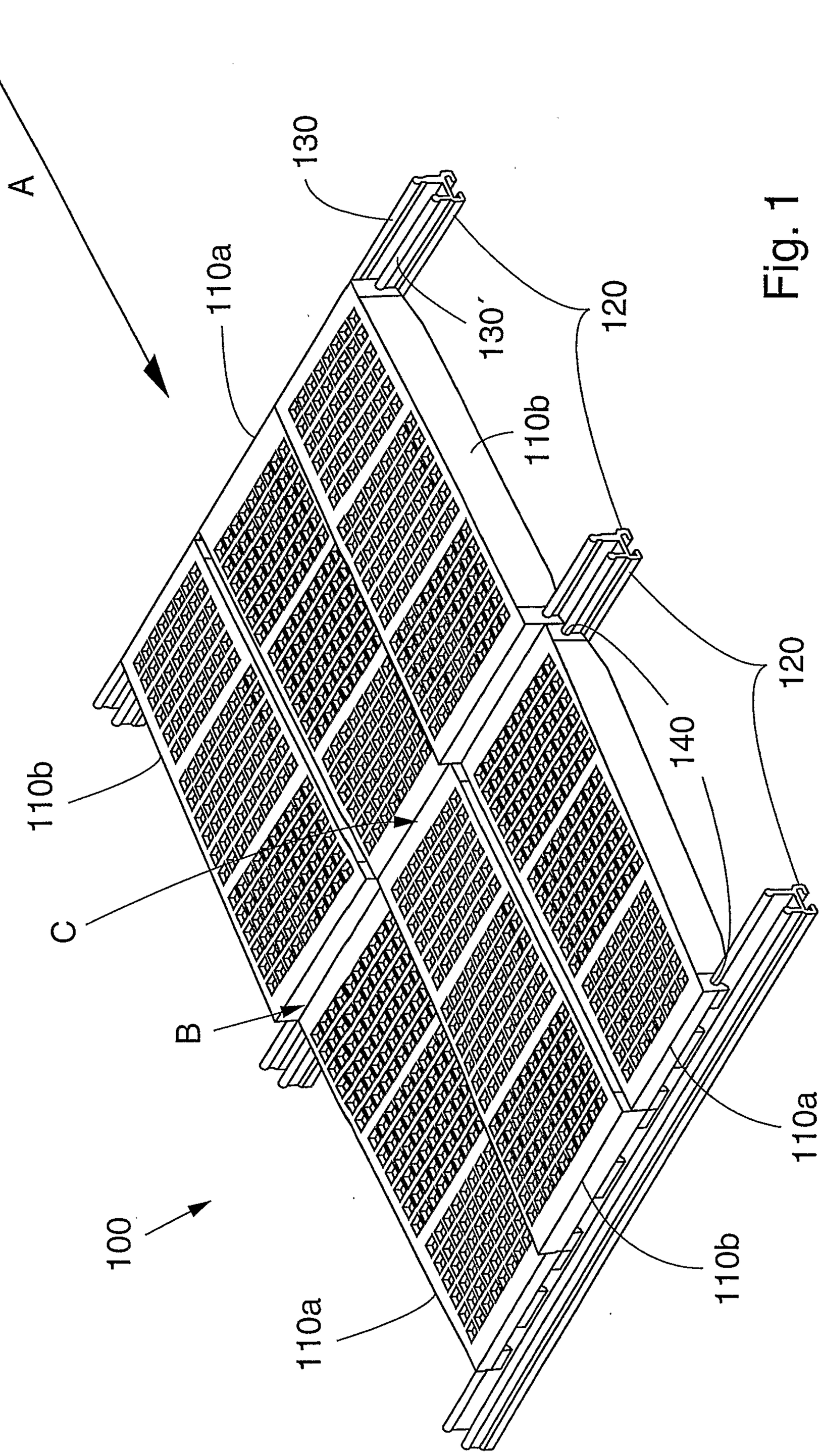


Fig. 1

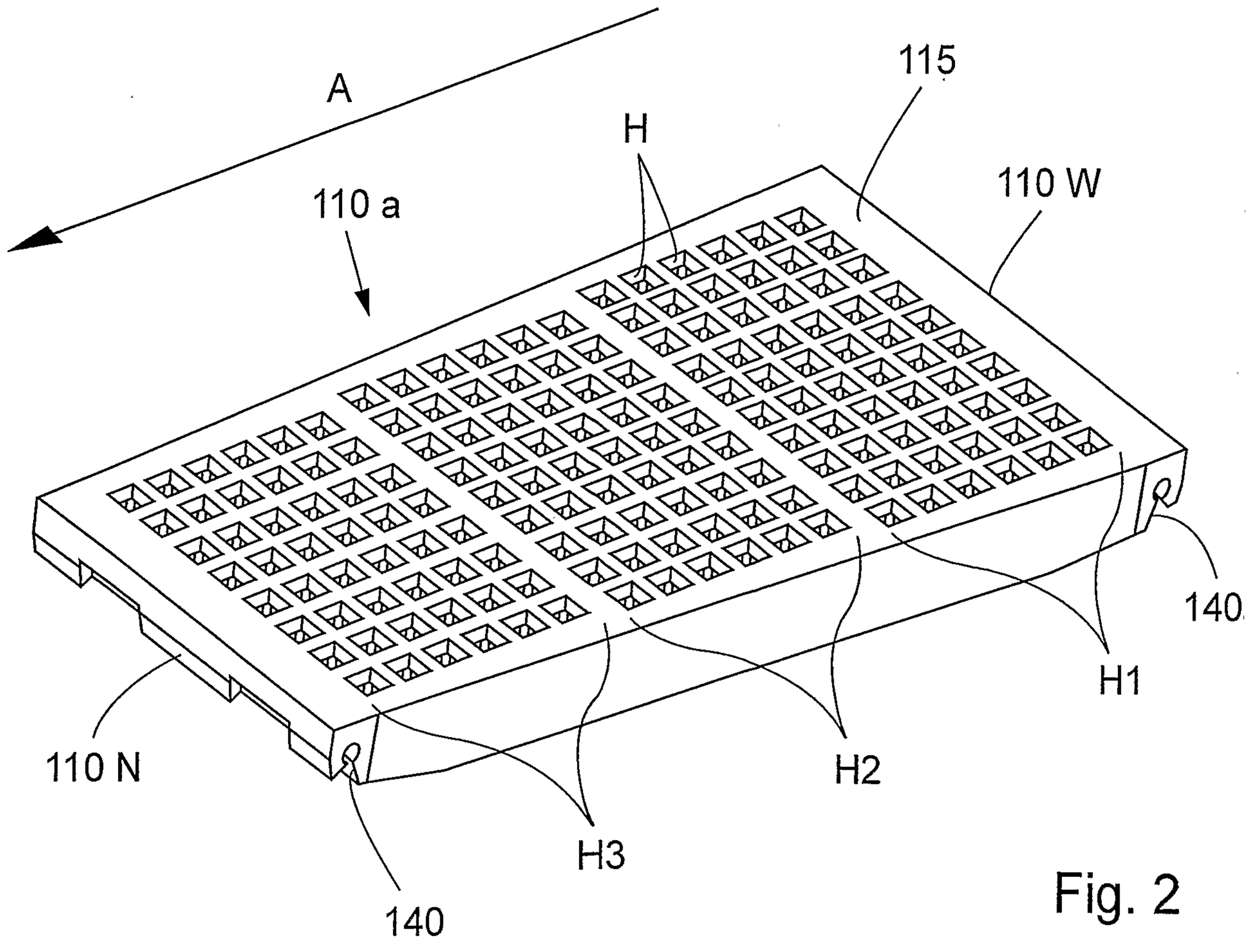


Fig. 2

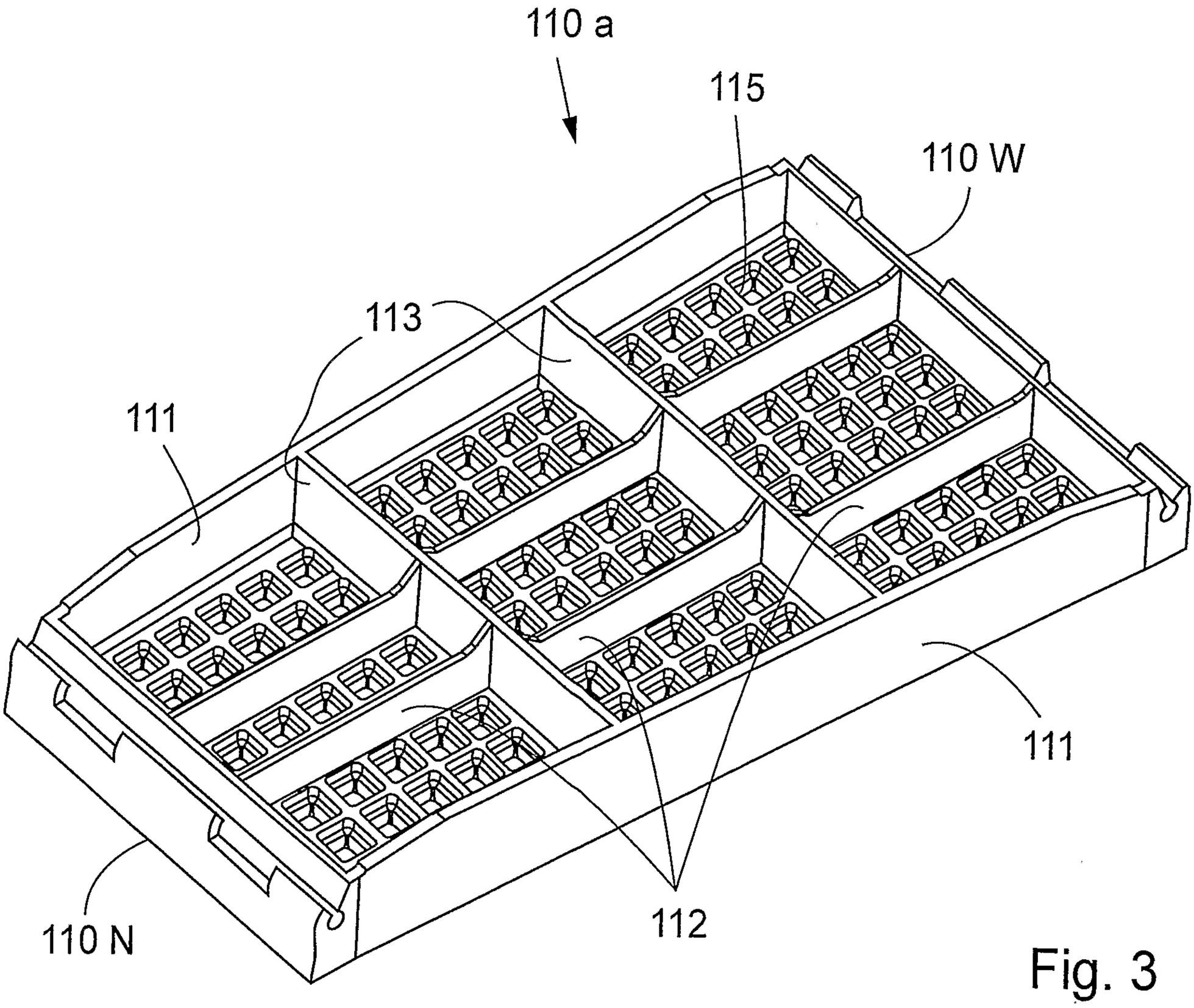


Fig. 3

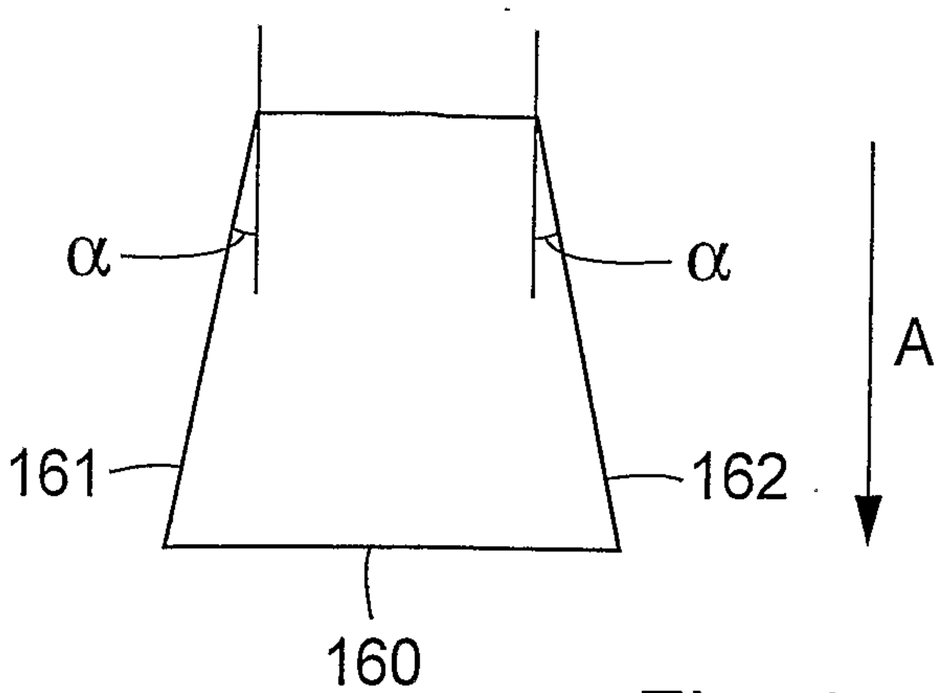


Fig. 4 a

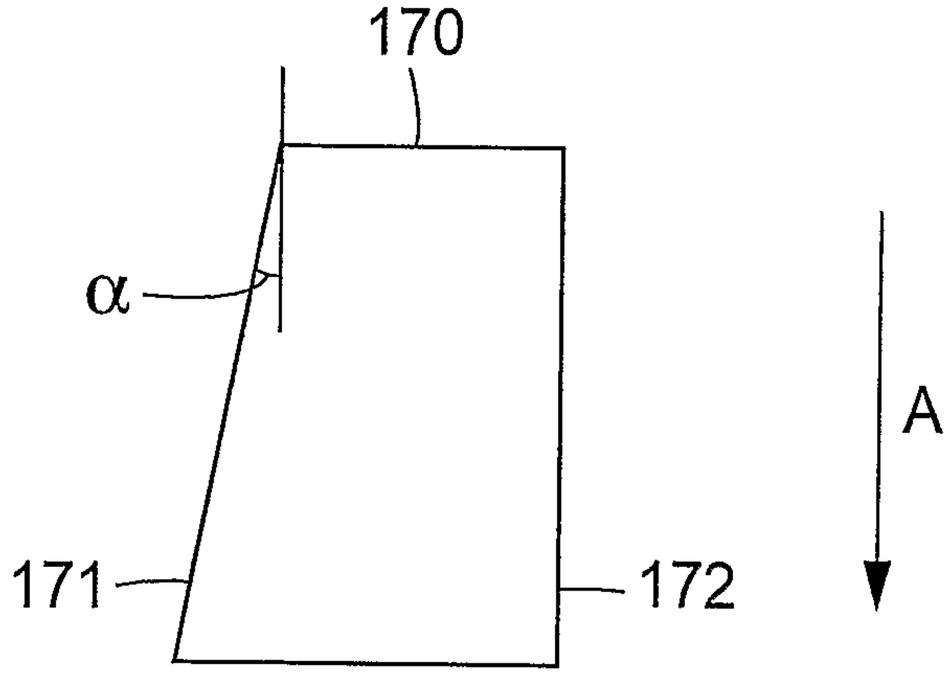


Fig. 4 b

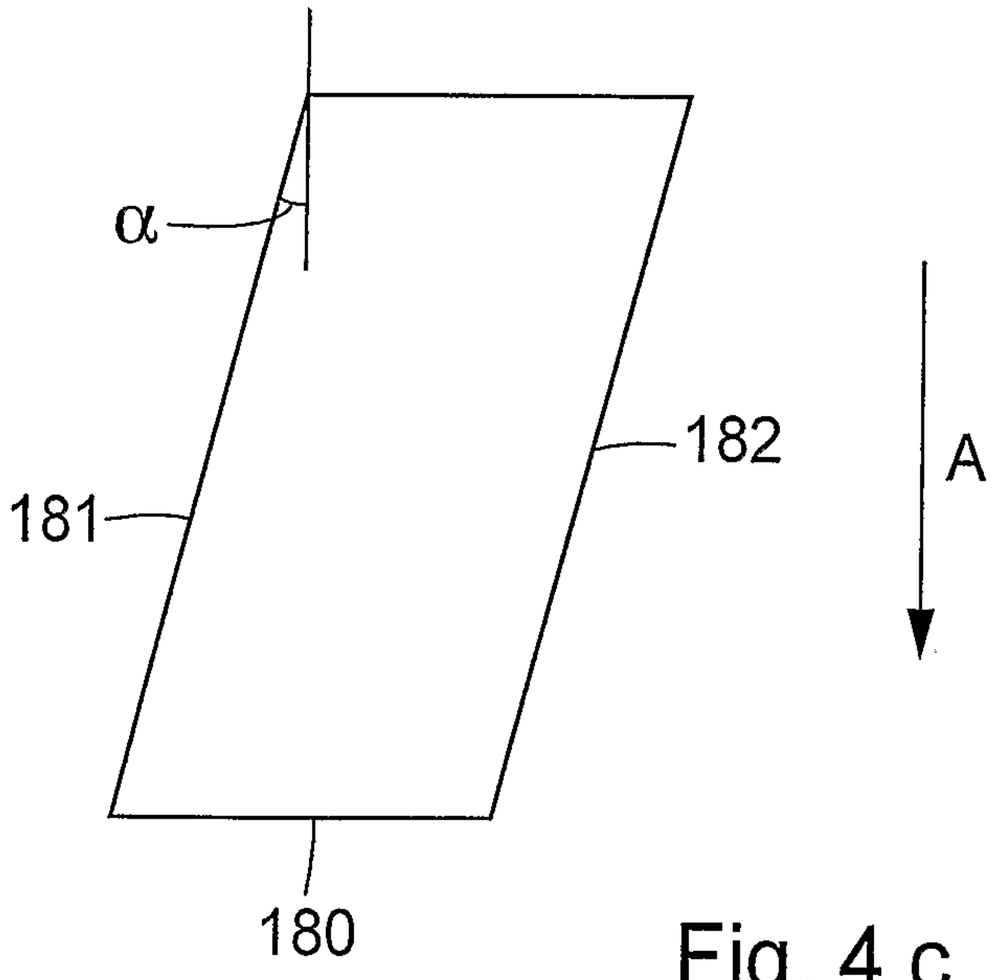


Fig. 4 c

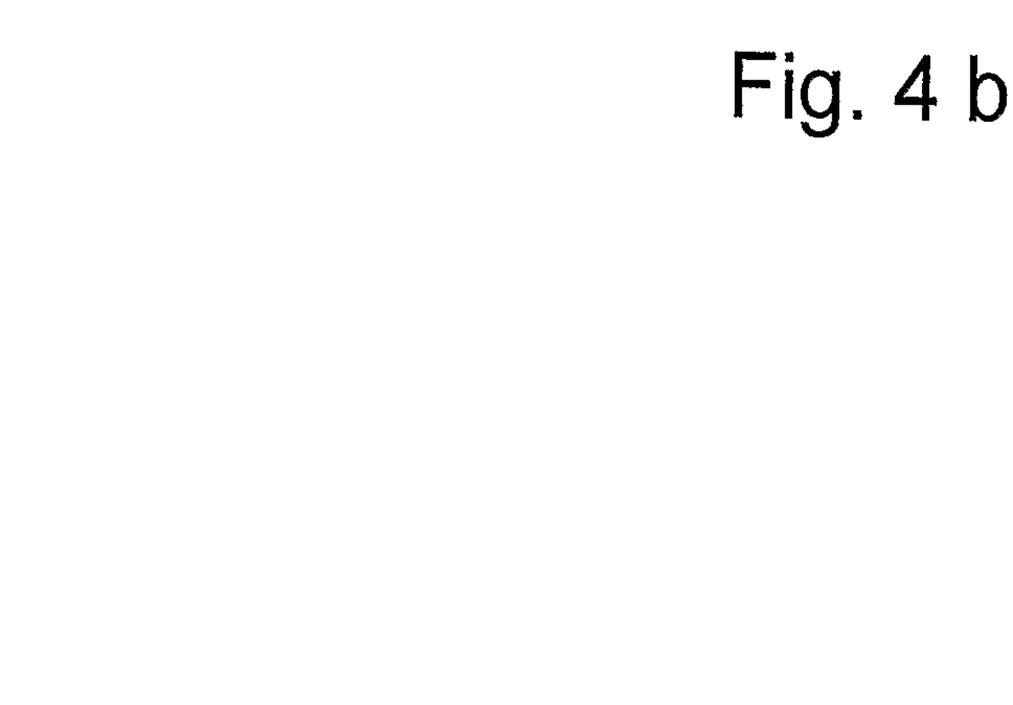


Fig. 4 d

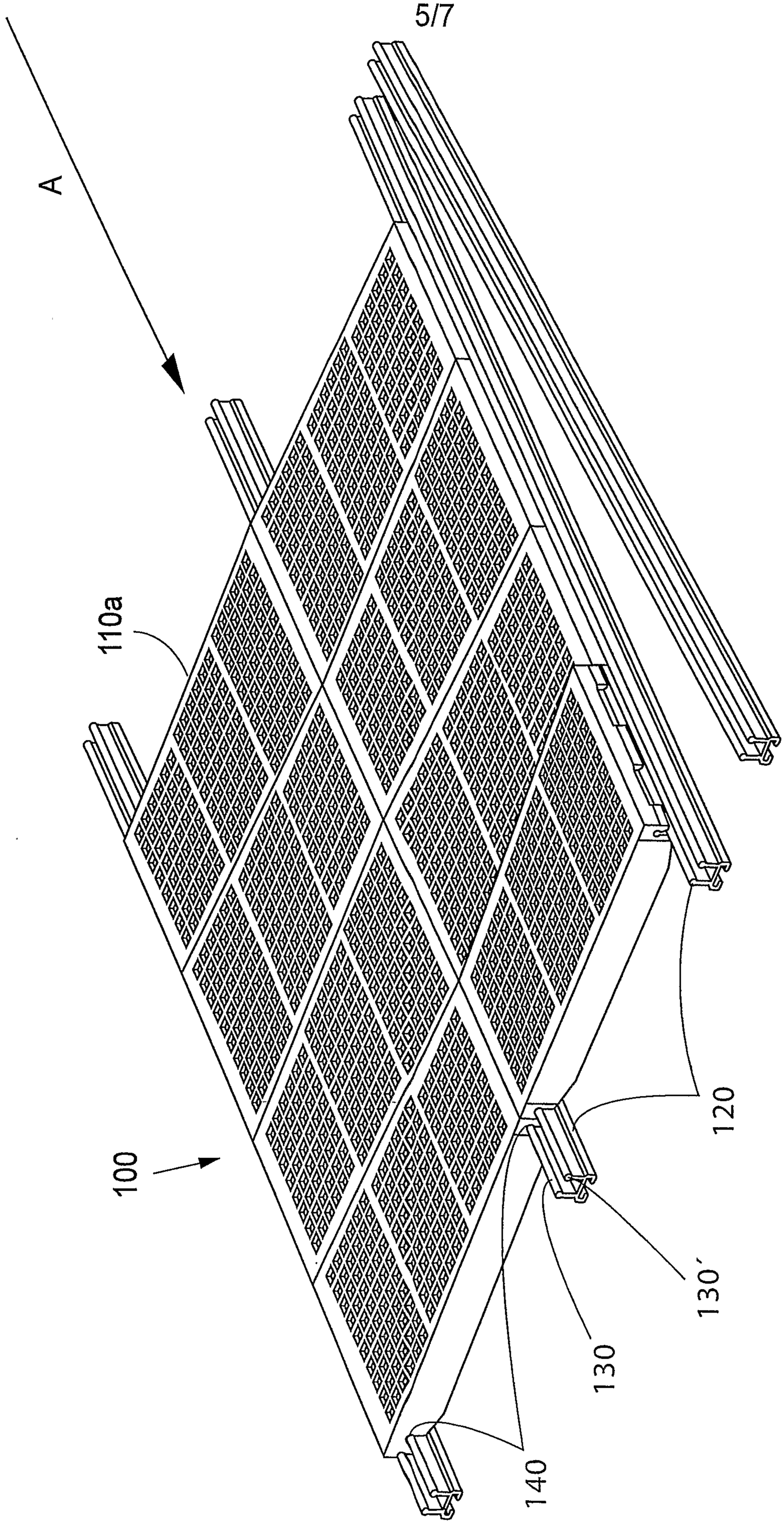


Fig. 5

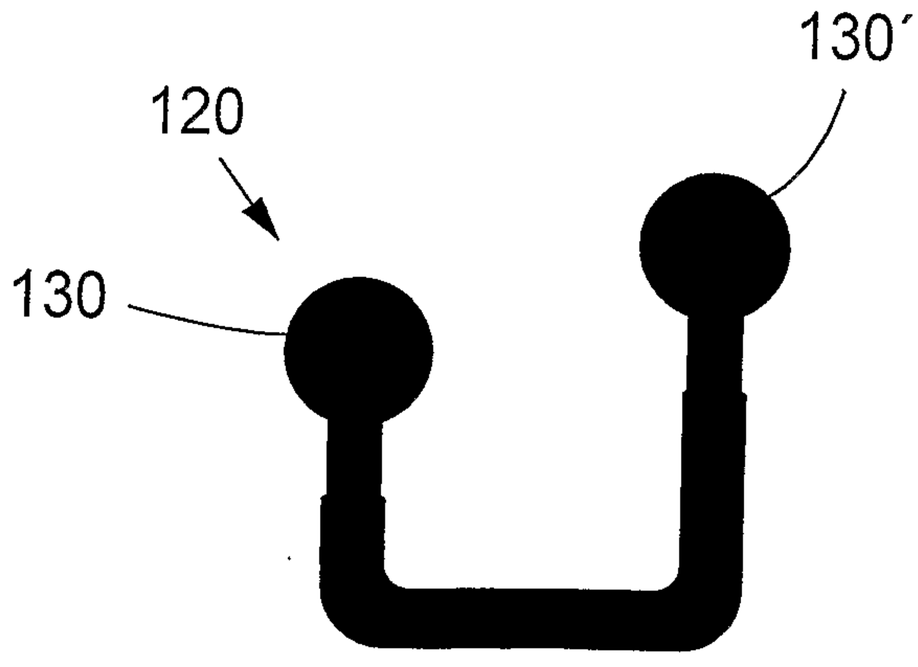


Fig. 6

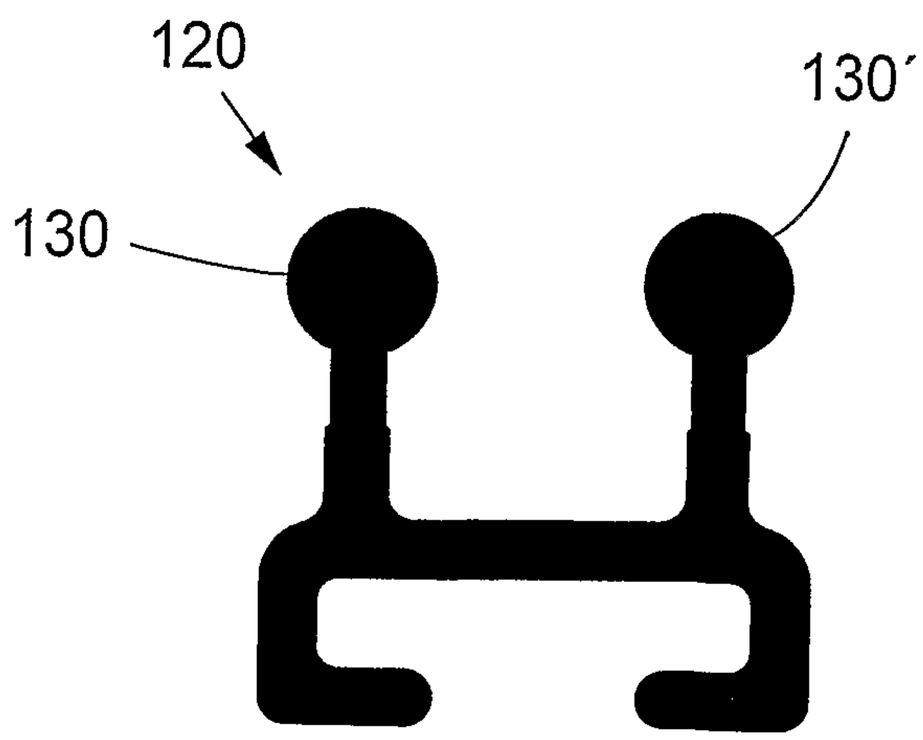


Fig. 7

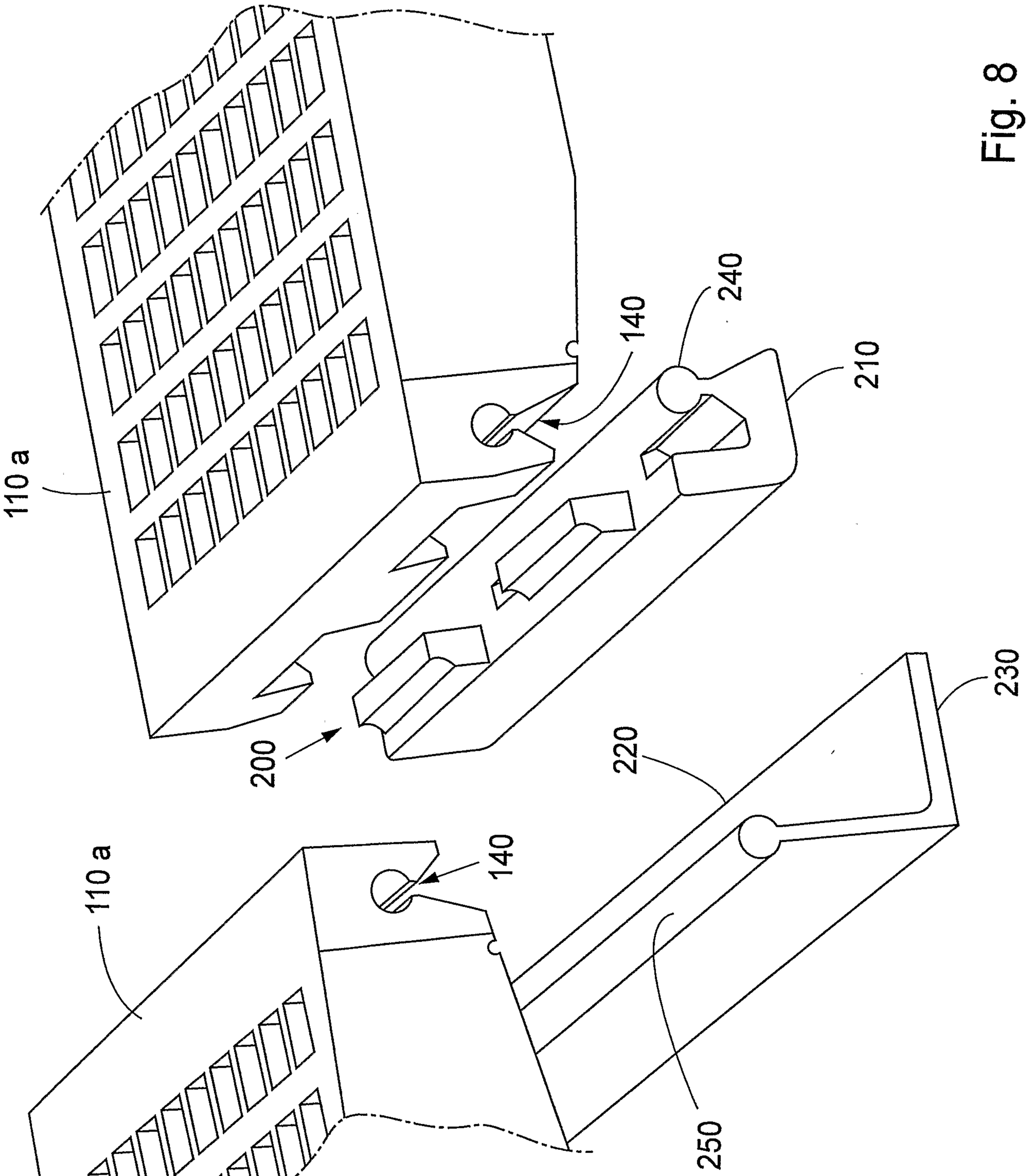
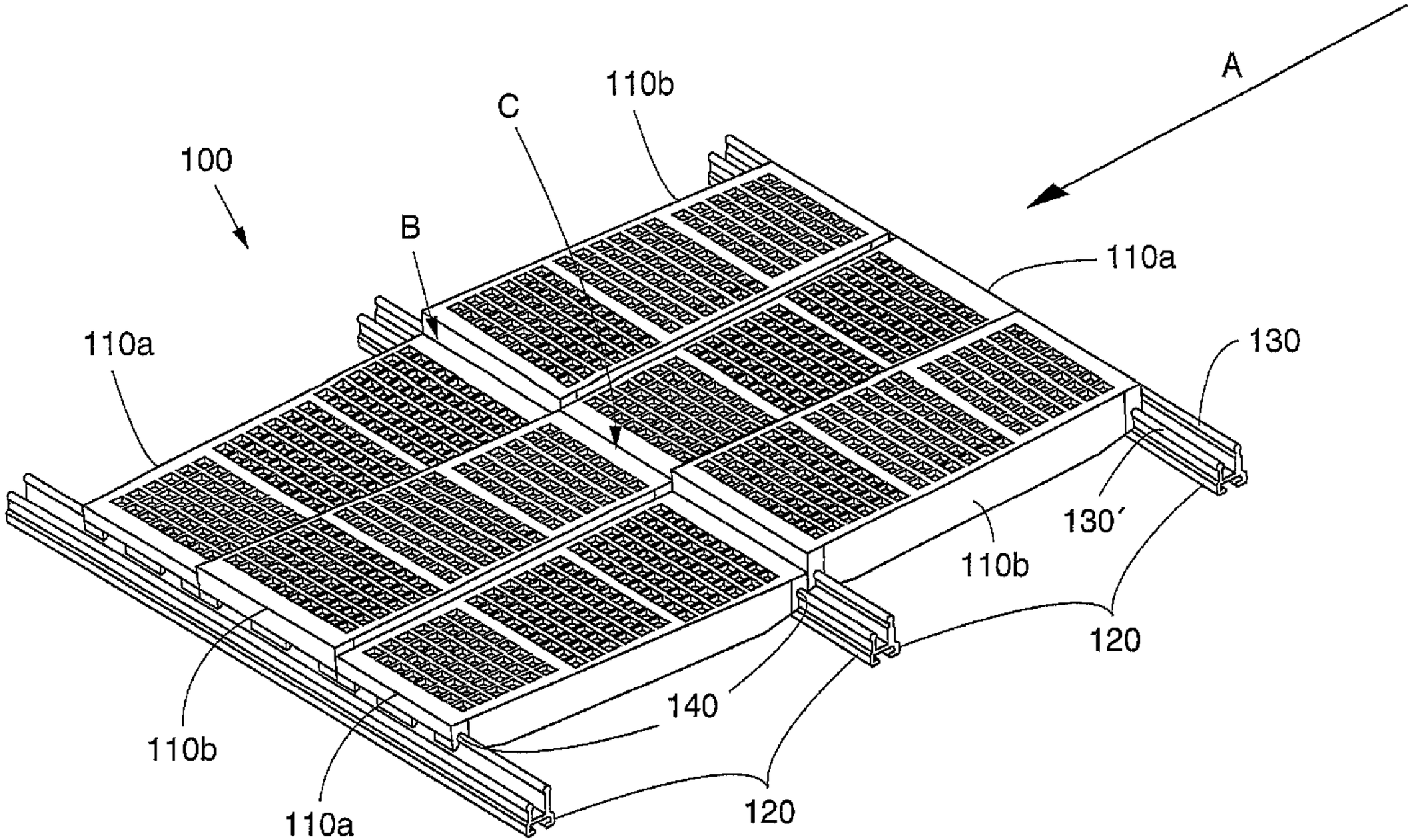


Fig. 8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