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(54) **SCREENING SYSTEM**

(57) A screening element (10) for screening material is disclosed. The screening element (10) comprises an upper surface (18) and a lower surface (19), wherein the screening element (10) comprises an apertured screening surface (13) and a rim section (15). The rim section (15) encompasses at least in part a perimeter of the apertured screening surface (13) and the rim section (15) comprises a deformation zone (17) along at least a part thereof.

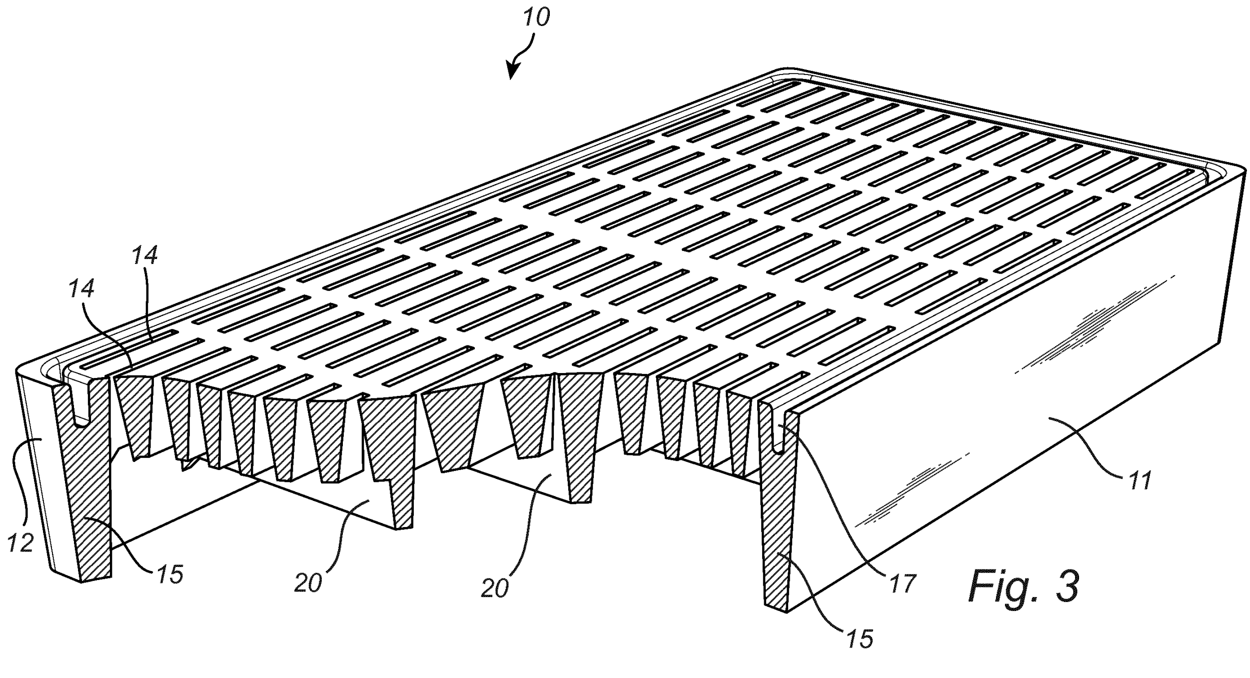

Fig. 3

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the screening of materials. More particularly, the present invention relates to a screening element and a screening media including the screening element for use in a screening assembly to for example sort, classify or dewater material.

BACKGROUND

[0002] In general, screening can be described as a method of separating materials having different dimensions into two or more products, and is widely used for example in the mining industry for the screening of ores and slurries. Material to be screened is passed over a vibratory screening arrangement, and the surface of a screening media arranged therein. The screening media presents apertures of a determined size, allowing for material having dimensions smaller than the determined size to pass through the media, whereas material having dimensions larger than the screening media apertures travel across the screening media surface for further processing.

[0003] Known screening media may consist of screen cloth or screening panels supported by a support structure which is mounted in the screening assembly. Another type of screening media consists of modules which are injection molded in one piece.

[0004] Yet another alternative is provided in which screening elements with an apertured surface are manufactured separately and inserted into a framework to form the screening media. In some cases, the screening elements are positioned in an open mold and a melted material, generally an ester or an ether based polyurethane, is poured into the mold and hardens around the screening elements to form the framework. This process involves high temperatures, which causes the material of the framework to shrink during subsequent cooling. This can be problematic, as shrinkage of the framework material can lead to deformation of the screening element and thus deformation of the apertures of the screening element surrounded by the framework such that aperture dimensions different from those desired are obtained. As a consequence, material of larger dimensions than desired may pass through the apertures. This is particularly true for the non-central apertures of the screening media or the screening element.

SUMMARY

[0005] An object of the invention is to overcome, or at least lessen the above mentioned problems. A particular object is to provide a screening element with improved screening properties.

[0006] According to the invention, these and other objects are achieved, in full or at least in part, by a screening element as herein disclosed. The screening element comprises an apertured screening surface and a rim section having a deformation zone. The rim section encompasses at least in part a perimeter of the apertured screening surface, and the deformation zone extends along at least a part of the rim section. According to the invention, the deformation zone in the rim section will compensate for shrinkage originating from the framework such that the apertures are left unaffected. This prevents the apertures from deforming during the manufacturing process of the screening media, which often occurs during cooling of the framework after moulding. The deformation zone ensures that the rim section can be deformed due to movements by the framework without affecting the apertured screening surface and in particular the apertures will maintain their size and shape such that predicted screening properties can be ensured. With prior art solutions using screening elements not having a deformation zone as defined in the present invention, it is common that the apertures become deformed. For example, it has been established that especially the two rows and columns of apertures arranged closest to the rim section of that prior art screening element are affected by shrinkage of the framework during cooling. It has been observed that those apertures become deformed such that the slot width at a central part of an aperture is widened and instead of having a rectangular shape, the opening of the aperture becomes slightly elliptical. This, of course, leads to the above-mentioned problem, namely that particles may pass the screening element that were not supposed to be able to pass.

[0007] In one embodiment, the deformation zone is provided in the form of a recess in an upper region of the rim section. The provision of a recess in the rim section is a simple and yet reliable way of creating a dedicated deformation zone in the rim section. The lack of material in that part will ensure that the rim section can compensate for movements due to for example shrinkage.

[0008] In one embodiment, the recess is open towards the upper surface of the screening element. A recess, i.e. the omission of material in certain predefined positions of the screening element is an effective way of creating a deformation zone.

[0009] In one embodiment, the deformation zone comprises material being softer than that of other parts of the rim section. By using softer, or material otherwise having preferable deformation properties, in the deformation zone, it is possible to obtain the desired properties.

[0010] In one embodiment, the upper surface of the rim section is flush with said apertured screening surface. A flat surface facilitates material flow over the screening element.

[0011] In one embodiment, the rim section encompasses the whole perimeter of the apertured screening surface.

[0012] In one embodiment, the deformation zone extends along the entire length of said rim section. By providing a deformation zone that extends along the entire length, movements affecting any part of the rim section can be compensated for.

[0013] In one embodiment, the screening element is made from a polymeric material.

[0014] In one embodiment, the screening element is made from thermoplastic polyurethane. Thermoplastic polyurethane (TPU) presents numerous favourable properties for this type of technology, such as wear properties; ease of manufacture; etc.

[0015] According to a second aspect of the invention, the above-mentioned and other objects are also achieved, in full or at least in part, by a screening media as herein disclosed. The screening media comprises a framework and one or more screening elements as described herein. The provision of a screening media having a screening element provided with a deformation zone in the rim section will compensate for shrinkage originating from the framework. This means that screening media can be manufactured that ensures that the apertures of the respective screening elements maintain the right size and shape also after manufacture of the screening media.

[0016] In one embodiment, the apertured screening surface of the screening element comprises elongated apertures oriented in a direction parallel to the material flow.

[0017] In one embodiment, the apertured screening surface of the screening element comprises elongated apertures oriented in a direction perpendicular to the material flow.

[0018] In one embodiment, the framework is made from a polymeric material.

[0019] In one embodiment, the polymeric material is a polyurethane.

[0020] According to a third aspect of the invention, the above-mentioned and other objects are also achieved, in full or at least in part, by a screening apparatus comprising one or more screening media as described herein.

[0021] According to a fourth aspect of the invention, the above-mentioned and other objects are also achieved, in full or at least in part, by a screening media as disclosed hereinafter. The screening media comprises a screening element and a framework and the screening element comprises an apertured screening surface. The framework comprises a deformation zone in a region adjacent to the screening element. Similar to the first aspect of the invention, the deformation zone in the framework adjacent to the screening element will compensate for shrinkage originating from the framework such that the apertures of the screening element are left unaffected. This prevents the apertures from deforming during the manufacturing process of the screening media, which often occurs during cooling of the framework after moulding. The deformation zone ensures that the apertured screening surface of the screening element will remain unaffected and in particular the apertures will maintain their size and shape such that predicted screening properties can be ensured. With prior art solutions using frameworks not having a deformation zone as defined in the present invention, it is common that the apertures become deformed. The deformation zone can be provided in the form of a recess in the part of the framework adjacent to the screening element or it can be provided by arranging a material in a region adjacent to the screening element which is softer than the material of other parts of the framework.

[0022] Other objectives, features and advantages of the present invention will appear from the following detailed disclosure, from the attached claims, as well as from the drawings. It is noted that the invention relates to all possible combinations of features.

[0023] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc.]" are to be interpreted openly as referring to at least one instance of said element, device, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

[0024] As used herein, the term "comprising" and variations of that term are not intended to exclude other additives, components, integers or steps.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The invention will be described in more detail with reference to the appended schematic drawings, which show an example of a presently preferred embodiment of the invention.

Fig. 1 is a schematic view of a screening element as known in the prior art;
Fig. 2A is a schematic perspective view of a screening element of an embodiment of the invention;
Fig. 2B is a schematic perspective view from below of a screening element of an embodiment of the invention;
Fig. 3 is a perspective cross-sectional view of the screening element disclosed in figure 2;
Fig. 4 is a schematic perspective view of a screening media of an embodiment of a second aspect of the invention; and
Fig. 5 is a schematic perspective view of a screening media of another aspect of the invention.

DETAILED DESCRIPTION

[0026] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments of the invention are shown. The present invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided for thoroughness and completeness, and to fully convey the scope of the invention to the skilled addressee. Like reference characters refer to like elements throughout.

[0027] Fig. 1 shows a schematic view of a prior art screening element 1. That screening element 1 typically has a rectangular shape with side walls of a certain height. The screening element comprises an upper surface 2 comprising apertures 3. The apertures 3 are evenly distributed over the upper surface 2 in columns and rows and are adapted to allow material of certain dimensions traveling across the surface 2 to pass therethrough.

[0028] Fig. 2A shows a screening element 10 of an embodiment of the first aspect of the invention. The screening element 10 is here illustrated as being generally rectangular. A person skilled in the art realizes, however, that further shapes are conceivable, such as for example square. Examples of typical dimensions of the screening element 10 can be 63x120 mm or 120x120 mm. The screening element 10 has two opposing first side walls 11, and two opposing second side walls 12. The screening element 10 further comprises an upper surface 18 and a lower surface 19. The upper surface 18 comprises an apertured screening surface 13 extending between the side walls 11 and 12 at upper ends thereof. The apertured screening surface 13 comprises apertures 14 having a size and shape adapted to allow material of certain dimensions to pass therethrough. The apertures 14 are here illustrated as being substantially elongated. In the example provided in Fig. 2A, the apertures 14 are elongated in a direction parallel to the first side walls 11 of the screening element 10. It is also conceivable to provide apertures 14 which are elongated in a direction parallel to the second side walls 12 of the screening element 10. A person skilled in the art would further realize that other shapes for the apertures 14 may be adapted, such as for example square. The apertures 14 are generally evenly distributed over the apertured screening surface 13 in columns and rows. It is of course also conceivable to provide apertures 14 which are distributed in a staggered pattern, or in a completely random distribution over the surface of the screening element 10. Typically, and as an example only, the width of the apertures can be around 0,1-2,0 mm. However, dimensions different from these are conceivable within the concept of the invention.

[0029] The screening element 10 further comprises a rim section 15. The rim section 15 encompasses at least in part a perimeter of the apertured screening surface 13. The rim section 15 extends between the side walls 11, 12 and the outermost positioned apertures 14, and comprises an upper rim surface 16. According to an embodiment of the screening element 10, the upper rim surface 16 is flush with the upper surface 18. In the exemplifying embodiment of Fig. 2A, the rim section 15 encompasses the whole perimeter of the apertured screening surface 13. The rim section further comprises a deformation zone 17. The deformation zone 17 extends along at least a part of the rim section 15. In the illustrated example of an embodiment of the screening element 10 shown in Fig. 2A, the deformation zone 17 extends along the entire length of the rim section 15. Of course, a deformation zone 17 which extends along only a part of the rim section 15, such as for example parallel to the first side walls 11, or to the second side walls 12 can also be provided.

[0030] The deformation zone 17 is, in the exemplifying embodiment illustrated in Fig. 2A, provided in the form of a recess in the upper surface 16 of the rim section15. The recess 17 is here illustrated as a continuous recess extending along the entire rim section. The recess 17 can, however, be of any for the purpose suitable dimension and shape, such as deep, narrow, wide or shallow. The recess 17 can also be provided as one or more discontinuous recesses distributed along the rim section 15. As an example only, the width of the recess 17 can typically be around 1-2 mm and its depth around 4-6 mm. However, other dimensions are also provided for within the inventive concept. As can be readily understood by the skilled person, the size and shape of the recess 17 need to accommodate to the size of the screening element 10, the thickness of the apertured surface and the size of the screening media 100. A larger screening media amounts to a larger framework 101 which in turn means greater shrinkage in absolute numbers.

[0031] Fig. 2B shows the screening element 10 of an embodiment of a first aspect of the invention from below. Aperture reinforcing ribs 20 extend between the first side walls 11. The aperture reinforcing ribs 20 thus extend in a direction parallel to the second side walls 12 between columns of apertures 14, thereby providing a mechanical support to the apertured screening surface 13. The depth of the apertures is inferior to the depth of the rim section 15. Typically, and as an example only, the depth of the apertures 14 is around 8 mm and that of the rim section 15 around 20 mm. The aperture reinforcing ribs 20 extend downwards from between the apertures in the direction parallel to the second side walls towards the lower surface of the rim section 15. The depth of the aperture reinforcing ribs 20 is inferior to that of the rim section 15, see also Fig. 3. In the exemplifying embodiment of Fig. 2B, the screening element 10 further comprises an intermediate support wall 21. The intermediate support wall 21 extends between the first side walls 11 and has the same depth as the rim section 15.

[0032] The screening element 10 is generally made of a polymeric material, such as thermoplastic polyurethane, or another material suitable for the purpose. The screening element 10 can typically be produced by injection molding. The skilled person realizes, however, that other manufacturing processes for the screening element 10, such as 3D printing, is conceivable within the concept of the disclosed invention.

[0033] A screening media 100 of an embodiment according to a second aspect of the invention is shown in Fig. 4. The screening media 100 comprises a framework 101. The framework can be made from any material suitable for the purpose, such as for example polymeric material. Typically, the framework 101 is made from esters or ether based polyurethanes.

[0034] The screening media 100 further comprises one or more screening elements 10. The screening elements 10 can be arranged in the screening media 100 such that the apertured screening surface 13 comprises elongated apertures 14 oriented in a direction parallel to the material flow. This would correspond to having the material flow in the y-direction indicated in Fig. 4. It is of course also possible that the apertured screening surface 13 of the screening element 10 comprises elongated apertures oriented in a direction perpendicular to the material flow, corresponding to having the material flow in the x-direction indicated in Fig. 4. With that said, it is obvious that material may flow in any direction over the apertured screening surface 13, and that the apertures 14 of the screening element 10 do not limit any possible material flow in the horizontal direction.

[0035] The framework 101 generally has a greater depth than the screening element 10. As an example only, the depth of the framework could be 40-60 mm.

[0036] The screening media 100 can be obtained by a molding process. In the process, screening elements 10 are positioned with the upper surface 18 facing downwards in an open mold. Weight blocks having the same exterior dimensions as the screening elements 10 are placed on the bottom surface 19 of the screening element 10. Thereafter, a molten material is poured into the mold, filling the spaces between the mold walls and the screening elements. At this stage, the weight blocks prevent molten material from entering between the bottom surface of the mold and the upper surface of the screening element 10 by forcing the upper surface 18 against the bottom of the mold. That would cause sealing the some or all apertures 14 of the screening element 10 completely or in part. The weight blocks also serve as mold walls for the part of the framework depth extending beyond that of the rim section 15 of the screening element 10.

[0037] An advantage of the screening element 10 of the present inventive concept is that the deformation zone 17, when comprising an open recess or similar, prevents molten material from the manufacturing process of the screening media to enter and seal the apertures 14 of the screening element 10. Should, despite the use of weight blocks, molten material leak in from the side walls 11, 12 at the upper surface 18 (i.e. between the bottom of the mold and the screening element 10), it would be collected in the recess 17, which thereby would hinder further propagation of the molten material towards the apertures 14.

[0038] According to another embodiment of the fourth aspect of the invention, the deformation zone 202 is located in the framework 201 of the screening media 200, see Fig. 5. The deformation zone 202 here comprises a recess in the framework 201, in a region adjacent to the screening element 20 and encompassing the same. The recess is, in the exemplifying embodiment of Fig. 5, of a depth which is smaller than the height of the rim section of the screening element 20. The recess is further open in the end arranged towards the screening element, such that a space is established between an upper part of the screening element 20 and the framework 201. Since the depth of the deformation zone 202 is less than the height of the rim section of the screening element 20, the screening element 20 will still be sufficiently bonded to the framework 201. An alternative to a recess is the provision of a material being softer or otherwise having preferable deformation properties, in a region adjacent to the screening element thereby creating a deformation zone.

[0039] According to a third aspect of the invention, there is provided a screening apparatus comprising one or more screening media.

[0040] The skilled person realizes that a number of modifications of the embodiments described herein are possible without departing from the scope of the invention, which is defined in the appended claims. For example, it must be emphasized that even though the screening element of the invention certainly can be made by injection molding, other manufacturing methods are very well conceivable. 3D-printing is such a method. 3D-printing provides possibilities that may be interesting. For example, it allows for the creation of deformation zones in the form of closed cavities within the rim section. This would allow for a screening element with a smooth upper surface of the rim section while maintaining the same, or at least comparable, deformability as a screening element having an open recess.

[0041] The skilled person also realizes that the deformation zone can be created by the combination of different materials at different positions in the screening element. For example, instead of having an open recess, a deformation zone can be created by the application of a material softer than that of other parts of the screening element. A deformation zone comprising a softer material could be arranged directly at the screening element, or in the framework in a region adjacent to the screening element. In general, a combination of different materials in the screening element to optimize properties thereof is conceivable within the scope of the invention.

Claims

1. Screening element (10) comprising an upper surface (18) and a lower surface (19), wherein said screening element (10) comprises an apertured screening surface (13) and a rim section (15), wherein said rim section (15) encompasses at least in part a perimeter of said apertured screening surface (13) and wherein said rim section (15) comprises a deformation zone (17) along at least a part thereof.

2. Screening element (10) according to claim 1, wherein said deformation zone (17) is provided in the form of a recess in an upper region of said rim section (15).

3. Screening element (10) according to claim 2, wherein said recess is open towards the upper surface (18) of the screening element (10).

4. Screening element (10) according to claim 1, wherein said deformation zone (17) comprises material being softer than that of other parts of the rim section (15).

5. Screening element (10) according to claim 2, wherein an upper surface (16) of the rim section (15) is flush with said apertured screening surface (13).

6. Screening element (10) according any of the preceding claims, wherein the rim section (15) encompasses the whole perimeter of the apertured screening surface (13).

7. Screening element (10) according to any of the preceding claims, wherein said deformation zone (17) extends along the entire length of said rim section (15).

8. Screening element (10) according to claim 1, wherein said screening element (10) is made from a polymeric material.

9. Screening element (10) according to claim 1, wherein said screening element (10) is made from thermoplastic polyurethane.

10. Screening media (100) comprising a framework (101) and one or more screening elements (10) according to any of the preceding claims.

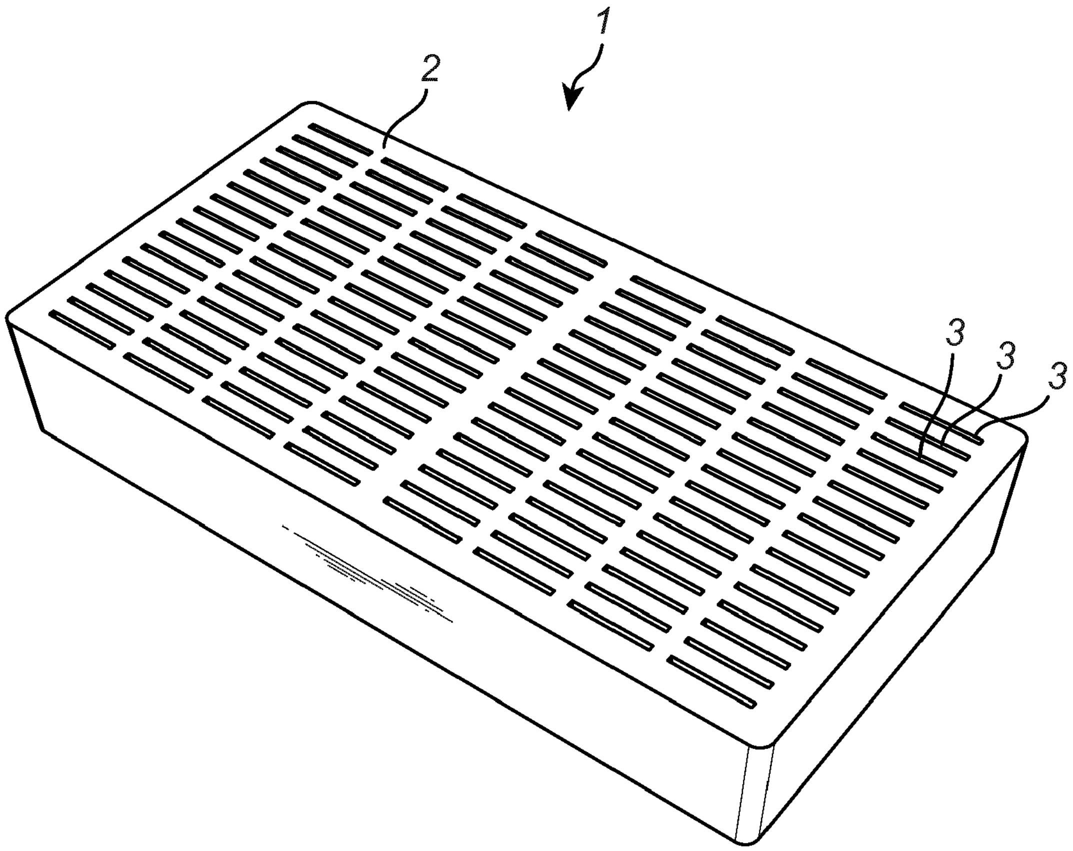
11. Screening media (100) according to claim 10, wherein the apertured screening surface (13) of the one or more screening element (10) comprises elongated apertures (14) oriented in a direction parallel to the material flow.

12. Screening media (100) according to claim 10, wherein the apertured screening surface (13) of the screening element (10) comprises elongated apertures (14) oriented in a direction perpendicular to the material flow.

13. Screening media (100) according to claim 10, wherein the framework (101) is made from a polymeric material, such as polyurethane.

14. Screening apparatus comprising one or more screening media (100) according to any of claims 10-13.

15. Screening media (200) comprising a framework (201) and a screening element (20) having an apertured screening surface, wherein said framework (201) comprises a deformation zone (202) in a region adjacent to said screening element (20).



(Prior art) Fig. 1

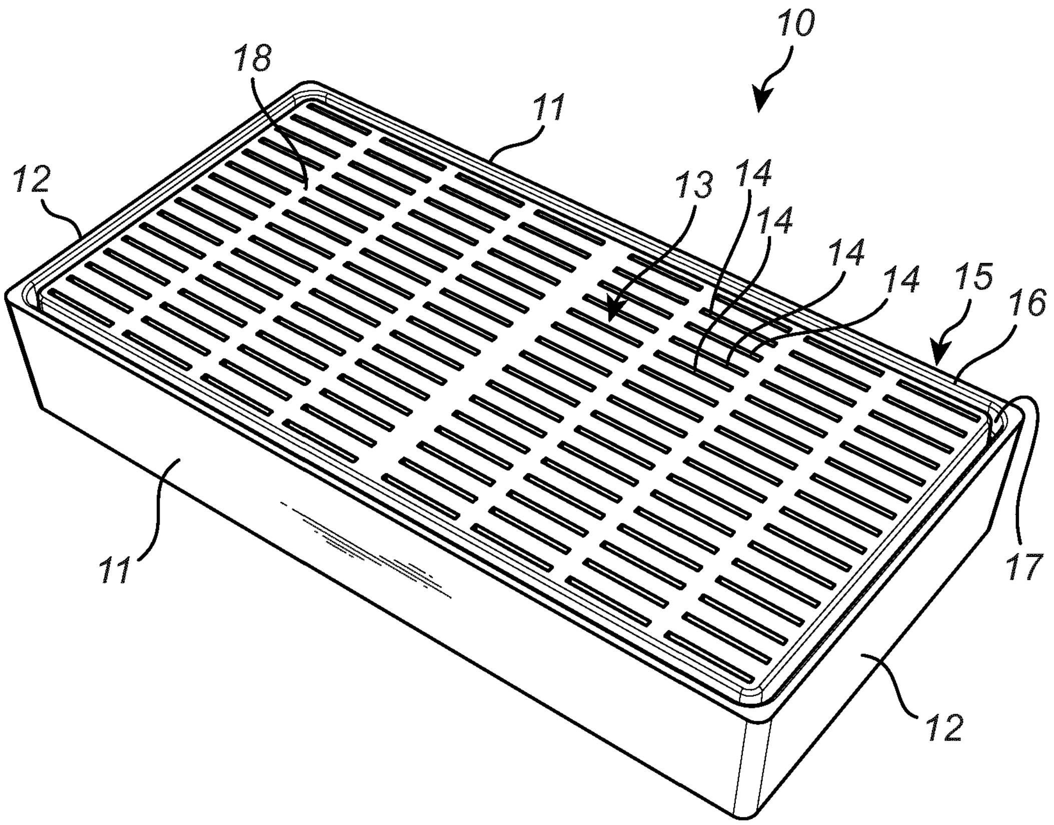


Fig. 2A

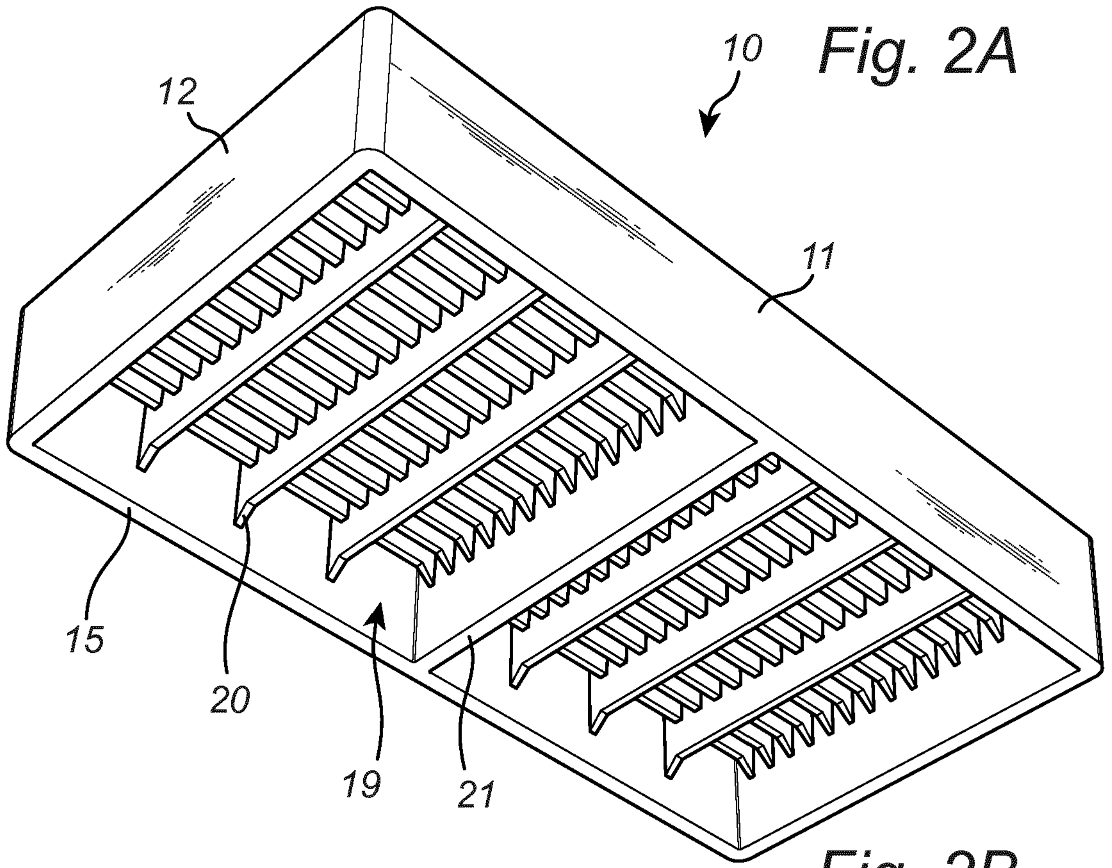


Fig. 2B

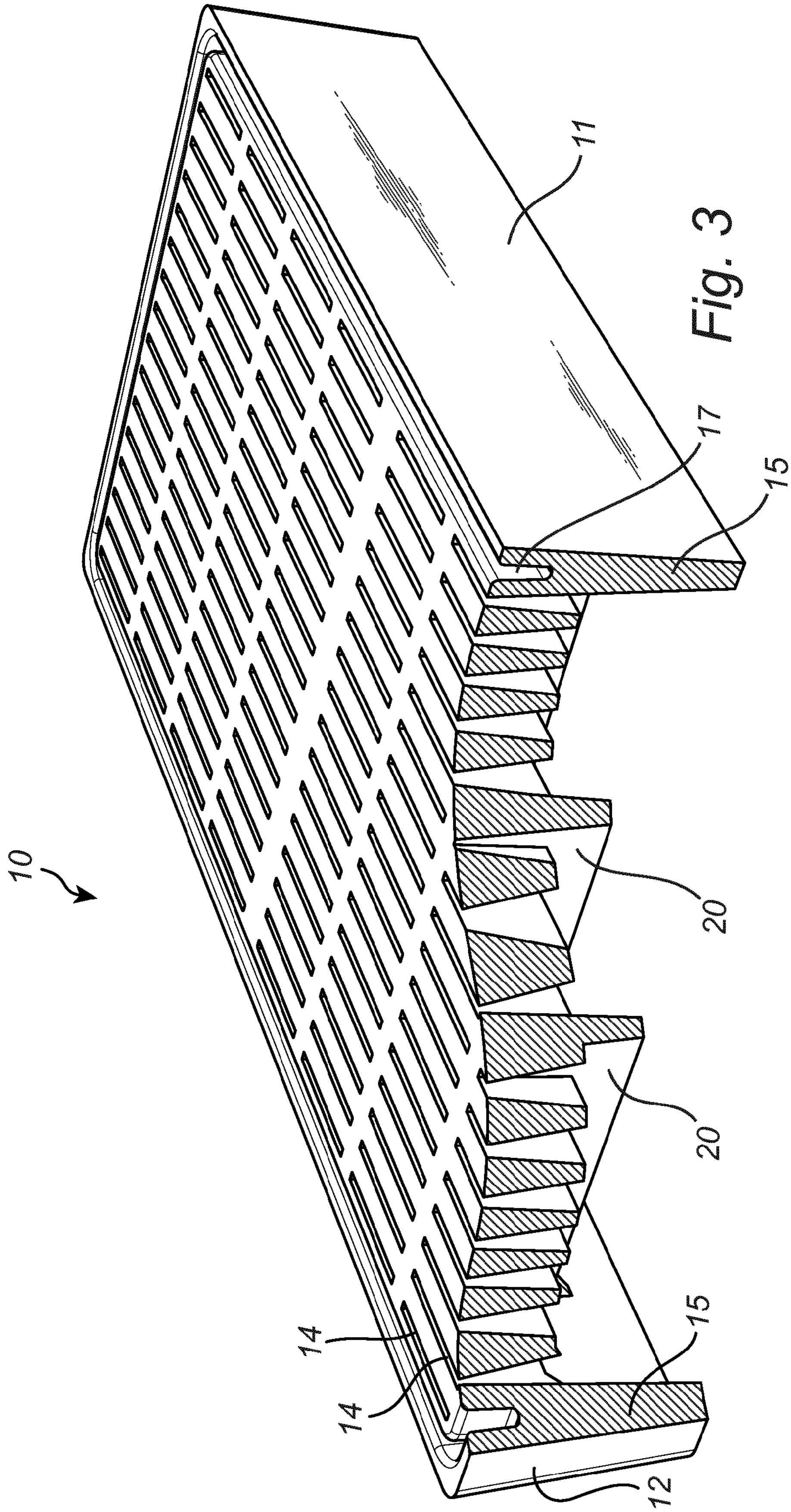


Fig. 3

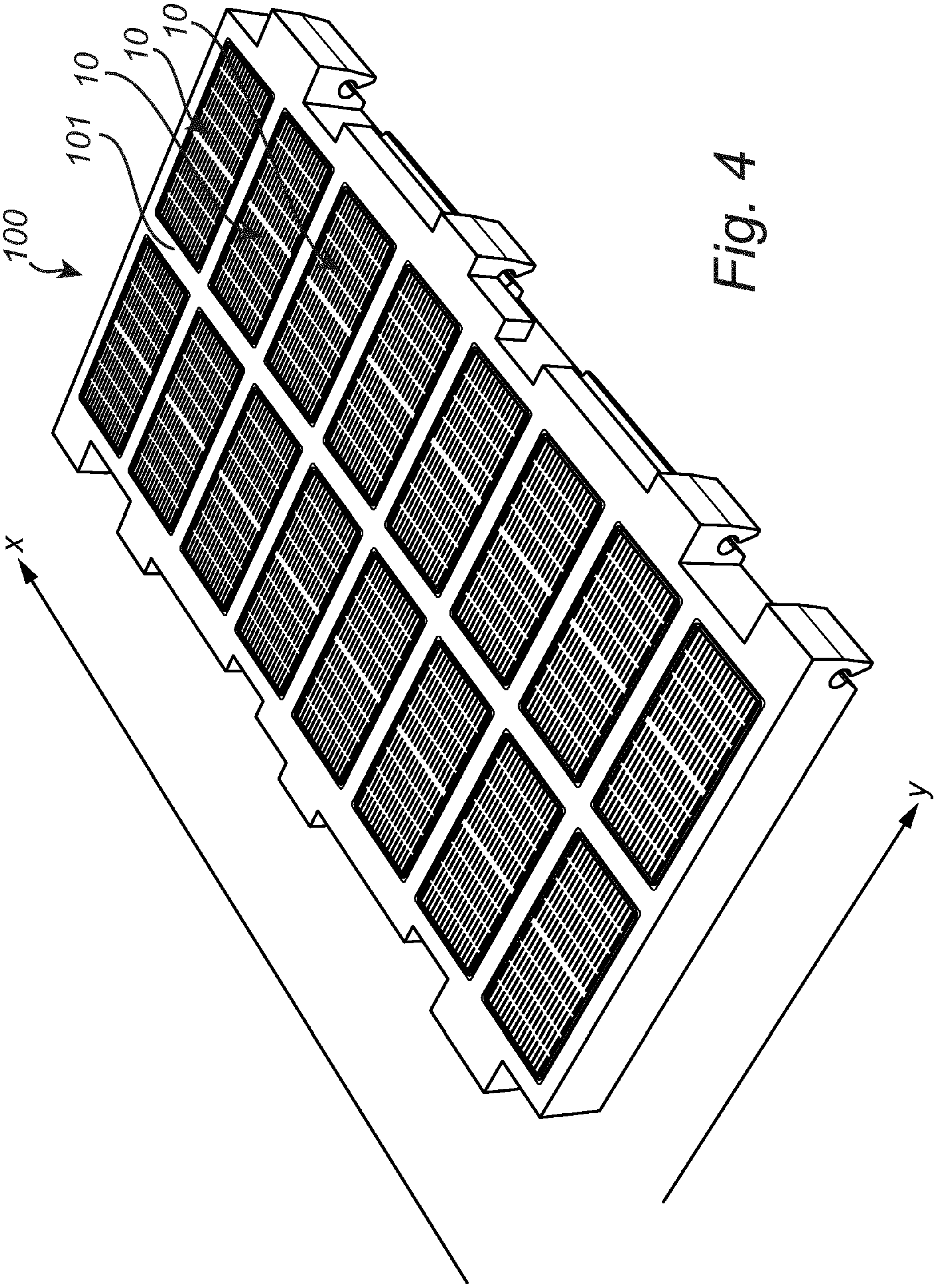


Fig. 4

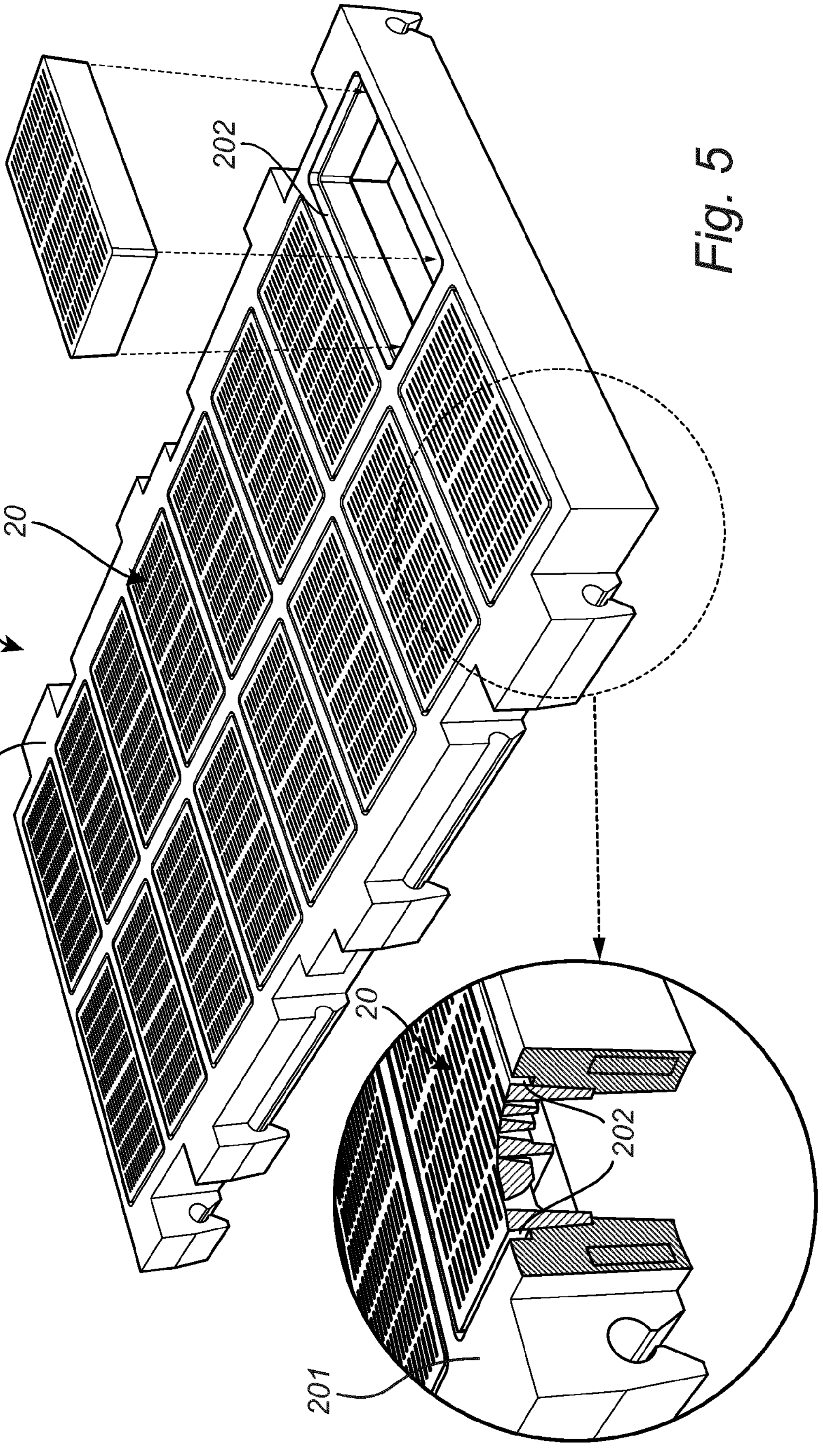


Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 17 19 4749

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B07B
B01D
B29C
B29K
B29L

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	28 March 2018	Kosicki, Tobias

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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