(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 October 2009 (15.10.2009)

PCT

(10) International Publication Number
WO 2009/124335 A1

(51) International Patent Classification:
B01D 35/00 (2006.01) *B01D 29/00* (2006.01)

(21) International Application Number:
PCT/AU2009/000401

(22) International Filing Date:
2 April 2009 (02.04.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2008901762 11 April 2008 (11.04.2008) AU

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

— *with amended claims (Art. 19(1))*

WO 2009/124335 A1

(54) **Title**: AN IMPROVED FILTRATION BARRIER

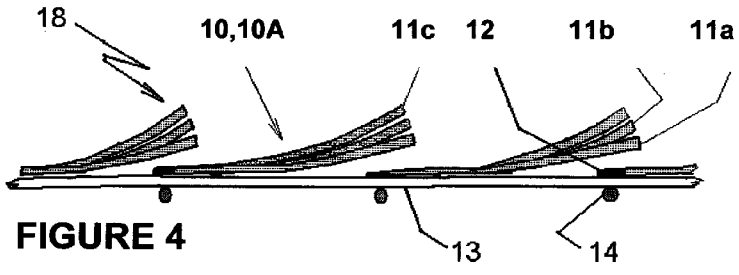

FIGURE 4

(57) **Abstract**: A filtration barrier comprises first elements that are fibres, strips, or bristles wherein apertures between elements provide passages for a fluid transporting granules to the filtration barrier, and wherein the elements (11) are supported against deflection by second elements (12) when the fluid is flowing in a forwards direction whereby granules are prevented from accompanying the fluid through said passages by the barrier, but whereby the second elements do not support the first elements against deflection when the fluid flows in a (back-wash) direction opposite the forwards direction, when the elements (11a, 11b, 11c) become deflected by the fluid to increase the size of the apertures. In various embodiments of the invention the elements are supported at one end or both ends, and elements are arranged to deflect differently to further increase the apertures between neighbouring elements as shown below.

AN IMPROVED FILTRATION BARRIER

FIELD OF THE INVENTION

The invention relates to filters wherein the elements forming the filtration apertures enlarge during reversals of the filtrate flow.

BACKGROUND TO THE INVENTION

Filtration barriers, particularly filter screens and meshes, require a periodic reversal of the fluid flow through the barrier (termed a back-wash) to clear the barrier of captured and entrapped solid particles. The back-washed filtration barrier is then ready for a further filtration.

OBJECTIVES OF THE INVENTION

To increase the effectiveness of the back-wash, by increasing the size of passages through the filter barrier during a back-wash.

PRIOR ART

Related prior art is disclosed in PCT patent, WO 98/23357; Inventor: Obst, Yuri

SUMMARY OF THE INVENTION

The invention provides in a first aspect

a filtration barrier comprising a plurality of apertures that permit passage of a fluid, but restrict the passage of particles of sizes greater than the aperture width, wherein the apertures are first spaces between neighbouring bristles or elements, and wherein

a plurality of bristles or elements are securely attached to a single support bar to form a comb, and

wherein each bristle or element has a free end with its other end attached to the single support bar with all said bristles or elements arranged parallel to each other, and wherein a plurality of said combs are arranged with second spaces between each pair of adjacent single support bars in a parallel array so that the free ends of the bristles or elements of each comb of the plurality of combs overlap the support bar of the next comb in the array, and wherein

the bristles or elements of each comb branch from the support bar and lie in a common plane in their relaxed state,

and wherein each support bar is supported upon a plurality of support joists arranged transversely to the support bars,

and each bristle or element is supported at its free end by the next comb, and each bristle or element is of a stiffness and length that permits each bristle or element to yield only slightly under pressure from fluid flowing forwardly between the bristles or elements towards the support joists,

and when fluid flows backwardly through the barrier each bristle or element is unsupported at its free end, whereby the bristles or elements yield under pressure from the backwardly flowing fluid and the free ends of bristles or elements are raised above the next comb, or combs, thereby enlarging the flow area through the filter barrier, and imparting a tangential direction to the fluid leaving each comb, and wherein

the cross-section of the bristles or elements may be round, or elliptical, or rectangular, or wedge-shaped.

The invention provides in a second aspect a filtration barrier as described in the first aspect comprising a first plurality of pairs of bristles or elements wherein each pair of the first plurality comprises a second bristle or element that is less stiff than a first bristle or element, whereby

each second bristle or element is lifted above each first bristle or element when fluid flows backwardly between bristles or elements.

The invention provides in a third aspect a filtration barrier as described in the first aspect comprising a second plurality of triplets of bristles or elements wherein each triplet of the second plurality comprises a third bristle or element that is less stiff than a second bristle or element, and a second bristle or element that is less stiff than the first bristle or element, whereby

each third bristle or element is raised further than each second bristle or element and each second bristle or element is raised further than each first bristle or element when the fluid flows backwardly between the bristles or elements.

The invention provides in a fourth aspect a filtration barrier as described in any prior aspect wherein variations of cross-section between individual bristles or elements determines stiffness.

The invention provides in a fifth aspect a filtration barrier as described in any of the prior aspects wherein the free end of each bristle or element extends in length beyond more than two said second spaces, and wherein fluid flowing forwardly between adjacent single support bars or strips passes sequentially through the first spaces of more than one comb.

The invention provides in a sixth aspect a filtration barrier as described in any of the prior aspects wherein

each comb in the plurality of said combs is numbered 1, 2, 3, 4, etc., in a third sequence of combs to denote the position of each comb in the plurality, and wherein each odd-numbered comb is a first comb and each even-numbered comb is a second comb,

and all the bristles or elements in each first comb branch from their single support bar or strip towards the right hand side, and all the bristles or elements in each second comb branch from their single support bar or strip towards the left hand side.

The invention provides in a seventh aspect a filtration barrier as described in any of the first, second, third, fourth, or fifth aspects wherein support joists are arranged in a parallel and equally-spaced apart array, and whereon
the combs are assembled and fastened at an angle between 45 and 135 degrees to the support joists in a fourth sequence of combs, wherein the bristles or elements of the next comb in the fourth sequence overlap the bristles or elements of one or more prior combs in the fourth sequence to form the filter barrier.

The invention provides in an eighth aspect a filtration barrier as described in the sixth aspect wherein the support joists are arranged in a parallel and equally-spaced apart array, and whereon the combs are assembled and fastened at an angle between 45 and 135 degrees to the support joists in a fifth sequence of combs, wherein the bristles or elements of the next comb in the fifth sequence overlap the bristles or elements and the support bar or strip of one or more prior combs in the fifth sequence to form the filter barrier.

The invention provides in a ninth aspect a filtration barrier whose components are defined in any of the first, second, third, fourth, or fifth aspects,
wherein said bristles or elements are primary elements within a first sheet of resilient material, and the single bars or strips are second elements within the first sheet, wherein the primary elements are arranged transversely to the second elements, and wherein the second elements are in the same plane as the primary elements in their relaxed state, and the primary elements are each anchored to the second elements at one end only leaving a non-attached end free to be lifted out of said plane, and wherein
said support joists are narrow third elements that are attached to the underside of the flat first sheet and are arranged at a common angle between 0 and 45 degrees to the second elements, and wherein the third elements are positioned to prevent each said non-attached end moving past the third elements, and wherein
the primary elements are grouped into pairs of primary elements in a sequence of pairs wherein the second primary element of each pair less stiff than the first primary element, whereby
each second primary element rises above each first primary element when fluid flows backwardly between the primary elements.

The invention provides in a tenth aspect a filtration barrier whose components are those of the ninth aspect wherein the primary elements are attached at each end to adjacent second elements, and wherein each primary element is of a flat and narrow zig-zag, or curved, or sinusoidal shape that increases its extensibility, and wherein
the support joists are narrow fifth elements that are attached to the underside of the flat first sheet and are arranged at a common angle between 45 and 135 degrees to the primary elements, and wherein the fifth elements are positioned below one or more places along the

length of each primary element to prevent each primary element moving past the fifth elements.

The invention provides in an eleventh aspect a filtration barrier whose components are those of either the ninth or tenth aspects wherein the primary elements are grouped into triplets of primary elements in a sixth sequence of triplets wherein the third primary element of each triplet is less stiff than the second primary element of each triplet, and the second primary element of each triplet within each sixth sequence is less stiff than the first primary element of each triplet, and whereby each third primary element is raised further than each second primary element, and each second primary element is raised further than each first primary element, when fluid flows backwardly between primary elements.

The invention provides in a twelfth aspect a filtration barrier as described in the eleventh aspect wherein the support joists are arranged in a parallel and equally-spaced apart array, and whereon the combs are assembled and fastened with the support bars or strips positioned at an angle between 0 and 45 degrees to the support joists in a fifth sequence of combs, wherein the bristles or elements of the next comb in the fifth sequence overlap the bristles or elements and the support bar or strip of one or more prior combs in the fifth sequence to form the filter barrier.

The invention provides in a thirteenth aspect a filtration barrier wherein the bristles or elements of the first aspect become primary elements within a first sheet of resilient material, and the single bars or strips of the first aspect become second elements within the first sheet, wherein the primary elements are arranged transversely to the second elements, and wherein the second elements share a common plane with the primary elements in their relaxed state, and the primary elements are each attached to a second element at one end only leaving a non-attached end free to be lifted out of the common plane, and wherein said support joists are narrow third elements attached to the underside of the flat first sheet and are arranged at a common angle between 0 and 45 degrees to the second elements, and wherein the third elements are positioned to prevent each said non-attached end moving past the third elements, and wherein the primary elements form pairs of primary elements in a sequence wherein the second primary element of each pair in the sequence is less stiff than the first primary element, whereby each second primary element is raised above each first primary element when the fluid flows backwardly between the primary elements.

The invention provides in a fourteenth aspect a filtration barrier as described in the thirteenth aspect wherein

the primary elements are attached at each end to adjacent second elements, and wherein each primary element is of a flat and narrow zig-zag, or curved, or sinusoidal shape that increases its extensibility, and wherein

the support joists are narrow fifth elements adjacent the underside of the flat first sheet and are arranged at a common angle between 45 and 135 degrees to the primary elements, and wherein the fifth elements are positioned at one or more places along the length of each primary element to prevent each primary element moving past the fifth elements.

The invention provides in a fifteenth aspect a filtration barrier as described in the thirteenth or fourteenth aspect wherein

the primary elements form triplets of primary elements in a sixth sequence of triplets wherein the third primary element of each triplet is less stiff than the second primary element of each triplet, and

the second primary element of each triplet is less stiff than the first primary element of each triplet, and whereby

each third primary element is raised further than each second primary element and each second primary element is raised further than each first primary element when the fluid flows backwardly between primary elements.

The invention provides in a sixteenth aspect a filtration barrier as described in the fifteenth aspect wherein

a single first comb of the sixth aspect and a single second comb of the sixth aspect are overlapped and assembled as a paired ribbon wherein the single first comb and the single second comb are appropriately spaced, and wherein the paired ribbon is wrapped around a tubular grid as a helix wherein each successive wrap of the paired ribbon appropriately overlaps a prior wrap to obtain the required spacing of first and second combs, whereby a tubular filter element is formed.

The invention provides in a seventeenth aspect a filtration barrier wherein the elements of the first aspect become warp elements within a filter mesh or screen, and the single bars or strips of the first aspect become weft elements within the filter mesh or screen, wherein the warp elements are arranged transversely to the weft elements, and wherein the spaces between the warp elements are the filtration apertures, and wherein

the weft elements and the warp elements lie in approximately the same plane in their relaxed state, and the warp elements are each secured to weft elements at each end, and wherein

the spaces between the weft elements are at least four times the spaces between the warp elements, and wherein

the support joists of the first aspect are stiff rod or wire elements that are adjacent to the underside of the filter mesh or screen and are arranged at a common angle between 0 and 45 degrees to the weft elements, and wherein

the stiff rod or wire elements are spaced and positioned at intervals shorter than the spaces between the warp elements, and wherein

stiff rod or wire elements are spaced and positioned to limit the deflection of warp elements when fluid flows forwardly past warp elements before passing between the stiff rod or wire elements, but wherein

the warp elements are raised away from the stiff rod or wire elements when fluid flows backwardly between the warp elements, and wherein

the warp elements are grouped into pairs of warp elements in a sequence of the pairs wherein the first warp element of each pair in the sequence is more extensible than the second warp element, whereby

each first warp element is raised above each second warp element when fluid flows backwardly between the warp elements.

The invention provides in an eighteenth aspect a filtration barrier as described in the seventeenth aspect wherein the warp elements are grouped into individual groups of warp elements in a sequence of individual groups wherein

the first warp element of each individual group is more extensible than the second warp element, and wherein

the second warp element of each individual group is more extensible than the next warp element,

and thereafter each next warp element of each individual group is more extensible than the sequentially next warp element,

until the last warp element of each group is the least extensible warp element of each individual group, whereby

when fluid flows backwardly between the warp elements each first warp element is raised above each second warp element of each individual group, and each second warp element is raised above each next warp element of each individual group, and thereafter each next warp element of each individual group is raised above its sequentially next warp element, until the last warp element of each individual group is the least raised warp element of each group.

The invention provides in a nineteenth aspect a filtration barrier as described in the eighteenth aspect or nineteenth aspect wherein individual warp elements comprise one or more filaments twisted together to form a rope or thread, and wherein

extensibility of individual warp elements decreases with an increase in the number of filaments in the individual warp element.

The invention provides in a twentieth aspect a filtration barrier as described in the seventeenth aspect or eighteenth aspect wherein individual warp elements comprise a single fibre or filament, and wherein the extensibility of individual warp elements decreases as the cross section size of the individual filament increases.

The invention provides in a twenty-first aspect a filtration barrier as described in the seventeenth aspect or the eighteenth aspect wherein each warp element is of a zig-zag shape, or sinusoidal shape, or curved shape.

The aspects described above can be employed to provide a continuously filtering filter wherein a filtration barrier and a set of nozzles are moved relatively to each other, and wherein flowing jets of washing fluid are directed backwardly onto the support joists side of the filtration barrier to progressively flush a part, or parts of the filter barrier, while simultaneously fluid to be filtered is being driven forwardly through the remaining parts of the filtration barrier by a higher fluid pressure on the bristles or elements side of the filter barrier, thereby providing washing fluid jets that locally and progressively lift the bristles or elements of a small part of the filtration barrier, thereby flushing ensnared particles from between or upon those bristles or elements, while filtration continues elsewhere, and wherein the discharge direction of washing fluid exiting the bristles or elements is preferably downwards.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a section of a filter comb.

Figure 2 shows the filter comb of Figure 1 with an additional stiffening strip supporting the bristles.

Figure 3 shows a side view in cross section of part of a filtration barrier comprising filter combs of Figure 1 or Figure 4A in the filtering position.

Figure 4 shows a side view in cross section part of the filtration barrier of Figure 3 with the bristles in the back-washing position.

Figure 4A shows a part of the filter comb of Figure 1 with the bristles arranged as a sequence of triplets where each triplet comprises three bristles of decreasing width.

Figure 5 shows the filter comb of Figure 1 with the bristles inclined to the right.

Figure 6 shows the filter comb of Figure 1 with the bristles inclined to the left.

Figure 7 shows the filter comb of Figure 1 with lengthened bristles.

Figure 8 shows a side view in cross section of a section of a filtration barrier comprising several overlaying filter combs of Figure 7 in the filtering position.

Figure 9 shows a plan view of a section of part of a filtration barrier comprising several filter combs of Figure 1 or Figure 4A or Figure 7 in the filtering position.

Figure 10 shows a plan view of a section of part of the filtration barrier comprising several filter combs of Figures 5 and 6 laid in alternate layers wherein the filter combs have lengthened bristles.

Figure 11 is a schematic end view in cross section of a continuously filtering filter where the filtration barrier is of tubular form.

Figure 12 shows a plan view of part of the filtration barrier comprising a screen with U-shaped slots with underlying support bars.

Figure 13 shows an enlarged view of a section of the filtration barrier of Figure 12.

Figure 14 shows a plan view of part of a filtration barrier comprising a screen and support bars wherein zig-zagged flat elements of two alternate widths are shown, and the elements are attached at one end only.

Figure 15 shows a plan view of part of the filtration barrier comprising a screen and support bars wherein zig-zagged flat elements of two alternate widths are shown, and the elements are attached at both ends.

Figure 16 shows a plan view of part of filter screen or mesh with curved and grouped warp elements arranged into groups wherein the warp elements increase in thickness and stiffness within each group.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Preferred embodiments of the invention will now be described, by way of examples only, with reference to the accompanying drawings in which:

Figure 1 shows a section of a filter comb 10 wherein a plurality of bristles or elements 11 are arranged parallel to each other and in a common plane, and wherein each bristle or element branches from a single strip or bar or backbone 12.

Figure 2 shows the filter comb of Figure 1 with an additional stiffening strip 15 to assist holding the bristles or elements 11 in their parallel arrangement.

Figure 3 is a side view in cross section of several filter combs 10, 10A of Figures 1 or 4A assembled into an array 18 wherein the single strip or bar of each filter comb is anchored onto transverse joists 13 with the free end of each bristle or element 11a, 11b and 11c of each triplet of elements is supported upon, and attached to, the bristles and the single strips 12 of the next filter comb 10. The joists 13 are supported by transverse bearers 14. The bristles 11a, 11b, and 11c are shown in their position when the filtration barrier 10 or 10A is filtering and fluid flows downwards.

Figure 4 is a side view in cross section the filter comb array18 of Figure 3 with bristles or elements 11a, 11b, 11c of each triplet of bristles or elements shown in their open position when the filtration barrier 10 is being back washed by an upwards flow of fluid through filtration barrier 10 and the free ends of bristles or elements are raised away from the bristles of the next filter comb by the (back-wash) flow of fluid from below. Figure 4

illustrates either the bristles 11 of Figure1 (shown by bristles 11a only), or the bristles 11a, 11b and 11c of Figure 4A arranged in triplets. Note that the most flexible bristle 11c in each triplet deflects furthest, the lesser flexible bristle 11b in each triplet deflects less far, and the least flexible bristle in each triplet 11a deflects least.

Figure 4A shows part of a single filter comb 10A, similar to that of Figure 1, with sequenced triplets of bristles 11a, 11b, 11c, with each bristle lengthened and branching from a single strip or backbone 12, wherein the bristle 11c in each triplet is narrower than the adjacent bristle 11b, and the bristle 11b in each triplet is narrower than the adjacent bristle 11a.

Figure 5 shows a filter comb 20, similar to that of Figure 1 with its bristles 11 inclined to the right, and branching from a single strip or bar or backbone 12.

Figure 6 shows a filter comb 20A, similar to that of Figure 1 with its bristles 11 inclined to the left, and branching from a single strip or bar or backbone 12.

Figure 7 shows a single filter comb 30, similar to that of Figure 1 with bristles 31 considerably lengthened and branching from a single strip or backbone 32.

Figure 8 is a side view in cross section of several filter combs 30 of Figure 7 assembled into a filter barrier 40 wherein the bristles of each filter comb is anchored onto joists 33 with the free end of each bristle supported upon the bristles of underlying filter combs. The joists 13 are themselves supported by bearers (not shown) like the bearers 14 of Figure 3. The bristles or elements are shown in their position when the filtration barrier 40 is filtering: in this example, fluid passes through nine layers of bristles. Items common to Figure 7 are shown by like numbers.

Figure 9 shows a plan view of a part of a filtration barrier 50 comprising a plurality of the 30 filter combs of Figure 7 or Figure 4A. It is a view as would be seen from above the array of Figure 8. The dimension Y shows the length of the bristles in one comb. Items common to Figure 7 are shown by like numbers.

Figure 10 shows a plan view of a part of the filtration barrier 60 comprising several filter combs of Figures 5 and 6 laid in overlapping alternate layers wherein the filter combs have lengthened bristles. The dimension Z shows the length of the bristles in one comb. Items common to Figures 5 and 6 are shown by like numbers.

Figure 11 is a schematic end view in cross section of a continuously filtering filter 70 wherein the filtration barrier is of tubular form. It shows a filtration barrier 71 wherein a rotating set of filter cleaning nozzles 74 deliver streams of back-washing fluid onto the inside of the filtration barrier 71, and the rotating set of filter cleaning nozzles are carried on a hollow arm 73, which is attached to a central driven hollow shaft 72, which moves the cleaning nozzles progressively and continuously around inside the filtration barrier to locally lift and flush the bristles of the filtration barrier while filtration continues in all other parts of the filter barrier. Filtration is continued by the filter 70 being immersed in a fluid containing

particles to be filtered with the pressure within the inside space 75 being at a lesser pressure than that outside of the filter barrier 70. The preferred orientation is with the axis vertical, allowing particles 76 flushed from the filtration barrier to fall away from the filter and collect at its base.

Figure 12 shows a section of a filtration barrier 80 that comprises a screen 82.

Figure 13 shows an enlargement of the designated "Section A" of the filtration barrier 80 shown in Figure12 wherein un-perforated regions of the screen 82 are shown shaded and the support joists 83 and support bearers 81(supporting the joists 83) are shown as dotted lines to indicate that they lie under the screen 82. The screen 82 is a perforated thin sheet (of metal or an appropriate plastic) with resilient properties perforated with a plurality of U-shaped slots 84. In this example each of the U-shaped perforations 84 have a cantilevered central strip 85 that is attached to (or continuous with) the thin sheet at one end: it is thereby free to deflect resiliently as a cantilever away from the plane of the thin sheet thereby increasing the flow area for fluid flowing through the slot. When fluid flows forwardly (through the screen before flowing through the support bars 81 and 83) the central strip 85 is supported by the support bars 83 and deflection of the central strip 85 is thereby restricted when fluid flows forwardly through the apertures towards the support bars 83. When fluid flows backwardly through the screen 80 each strip 85 is unsupported, and each strip can yield resiliently increasing the flow area through the U-slots to more easily release particles that have been entrapped within the U-slots. The resilience of each strip 85 causes it to return to the supported position shown in Figure 13 whenever the flow through the screen again forwardly again.

Although the slots 84 in this example are shown as generally rectangular in shape, they are not limited to this shape. Slots that are part- round, or part-square, or part-elliptical, or curved, with strips 85 that are zig-zag shaped with square or rounded corners can be readily devised, and the outer contour of the slots 84 surrounding each strip 85 can be shaped to provide a variety of different slot or hole shapes.

Figure 14 shows a section of a filtration barrier 100 that comprises a screen 102 wherein there are several strips 101A and 101B that are zig-zag in shape (to confer greater extensibility) with slots between each strip 101A and 101B, wherein the strips 101A are narrower (and thereby more flexible) than the strips 101B.

The strips 101A and 101B are attached to the sheet 102 at one end only. The support bars 103 support the free ends of strips 101A and 101B against deflection when fluid flows forwardly through the apertures towards the support bars 103. When deflection due to fluid flowing backwardly through the slots occurs the narrower strips 101A deflect more than strips 101B to provide increased flow areas through the slots.

Figure 15 shows a section of a filtration barrier 90 that is similar to that of Figure 14 wherein the strips 91A and 91B are attached to sheet 92 at both ends. The support bars 93 support the central region(s) of strips 91A and 91B against deflection when fluid flows forwardly through the slots towards the support bars 93. When deflection due to fluid flowing backwardly through the slots occurs the narrower strips 91B deflect more than strips 91A to provide increased flow areas through the slots.

Figure 16 shows a plan view of part of a filter screen or mesh 110 with curved and grouped warp elements 111a,111b,111c and 111d, which are arranged into groups, with each group comprising four warp elements, and where within each group warp elements 111a are thinner (and thereby more flexible) than warp elements 111b, and warp elements 111b are thinner (and thereby more flexible) than warp elements 111c, and warp elements 111c are thinner (and thereby more flexible) than warp elements 111d. Weft elements 112 secure the ends of all the warp elements at intervals, and support joists 113 underlay the warp elements at intervals between adjacent weft elements and support the warp elements when fluid being filtered flows downwards (or forwardly) past warp elements before flowing past the support joists 113. Support joists 113 are supported by bearers 114, which either lie under the joists 113 or are cross members of a grid containing both joists 113 and bearers 114. When fluid flows upwards (or backwardly) support joists 113 no longer support warp elements, whereby warp elements 111a deflect upwards more than warp elements 111b, and warp elements 111b deflect upwards more than warp elements 111c, and warp elements 111c deflect upwards more than warp elements 111d, thereby progressively increasing flow area through the filter screen or mesh 110.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and features of any embodiment may be adapted, or extended into other embodiments.

CLAIMS.

1. A filtration barrier comprising a plurality of apertures between elements that permit a fluid to flow through, but restrict the passage of particles of sizes greater than the aperture width, wherein the apertures are first spaces between neighbouring elements, and wherein a plurality of elements are securely attached to a single support bar to form a comb, and
wherein each element has a free end with its other end attached to the single support bar with all said elements arranged parallel to each other, and wherein
a plurality of said combs are arranged with second spaces between each pair of adjacent single support bars in a parallel array so that the free ends of the elements of each comb of the plurality of said combs overlap the support bar of the next comb in the array, and wherein the elements of each comb branch from the support bar and lie in a common plane in their relaxed state,
and wherein each support bar is supported by a support means, and each element is supported at its free end by the next comb, and each element is of a stiffness and length that permits each element to yield only slightly under pressure from fluid flowing forwardly between the elements,
and when fluid flows backwardly through the barrier each element is unsupported at its free end, whereby the elements yield under pressure from the backwardly flowing fluid and the free ends of elements are lifted away from the next comb, or combs, thereby enlarging the apertures through the filter barrier.

2. A filtration barrier as claimed in claim 1 wherein the support means is a plurality of support joists attached transversely adjacent the support bars.

3. A filtration barrier as claimed in claim1 or claim 2 wherein the cross-section of the elements may be round, or elliptical, or rectangular, or obround, or wedge-shaped.

4. A filtration barrier as claimed in claim 1 comprising a first plurality of pairs elements wherein each pair of the first plurality comprises a second element that is less stiff than a first element, whereby each second element is lifted above each first element when fluid flows backwardly between bristles or elements.

5. A filtration barrier as claimed in claim 1 comprising a second plurality of triplets of elements wherein each triplet of the second plurality comprises a third element that is less stiff than a second element, and a second element that is less stiff than the first element, whereby each third element is raised further than each second element and each second element is raised further than each first element when the fluid flows backwardly between the elements.

6. A filtration barrier as claimed in any prior claim wherein differences in cross-section between individual elements determines a different element stiffness.

7. A filtration barrier as claimed in any prior claim wherein differing material properties between individual elements determines a different stiffness for each element.

8. A filtration barrier as claimed in any prior claim wherein the free end of each element extends in length beyond more than two said second spaces, and wherein fluid flowing forwardly between adjacent single support bars or strips passes sequentially through the first spaces of more than one comb.

9. A filtration barrier as claimed in any prior claim wherein each comb in a plurality of said combs is numbered 1, 2, 3, 4, etc., in a third sequence to denote its position in the plurality of said combs, and wherein each odd-numbered comb is a first comb and each even-numbered comb is a second comb,
and wherein all the elements of each first comb branch from their single support bar towards the right hand side, and all the elements of each second comb branch from their single support bar towards the left hand side.

10. A filtration barrier as claimed in claim 9 wherein support joists are arranged in a parallel and equally-spaced apart array, and whereon
the combs are assembled and fastened at an angle between 45 and 135 degrees to the support joists in a fourth sequence of combs, wherein the elements of the next comb in the fourth sequence overlap the elements of one or more prior combs in the fourth sequence to form the filter barrier.

11. A filtration barrier as claimed in claim 10 wherein the support joists are arranged in a parallel and equally-spaced apart array, and whereon the combs are assembled and fastened with their support bars or strips positioned at an angle between 45 and 135 degrees to the support joists in a fifth sequence of combs, wherein the elements of the next comb in the fifth sequence overlap the elements and the support bar of one or more prior combs in the fifth sequence to form the filter barrier.

12. A filtration barrier wherein the elements of claim 1 become primary elements within a first sheet of resilient material, and the single bars or strips become secondary elements within the first sheet, wherein the primary elements are arranged transversely to the secondary elements, and wherein
the secondary elements share a common plane with the primary elements in their relaxed state, and the primary elements are each anchored to the secondary elements at one end only leaving a non-attached end free to be lifted out of the common plane, and wherein the support means are support elements adjacent the underside of the first sheet and are arranged transversely to the primary elements, and wherein the support elements are positioned to prevent each said non-attached end moving past support elements, and wherein the primary elements are grouped into pairs of primary elements comprising a first primary element and a second primary element in a sequence of pairs wherein the

second primary element of each pair is less stiff, than the first primary element, and whereby each second primary element is raised above each first primary element when fluid flows backwardly between the primary elements.

13. A filtration barrier as claimed in claim 12 wherein the primary elements are attached at each end to adjacent second elements, and wherein each primary element is of a flat and narrow zig-zag shape, or sinusoidal shape, or curved shape, and wherein the support means comprise fifth elements adjacent the underside of the first sheet and are arranged transversely to the primary elements, and wherein the fifth elements are positioned at one or more places along the length of each primary element to prevent each primary element moving past the fifth elements.

14. A filtration barrier as claimed in claim 12 or claim 13 wherein the primary elements are grouped into triplets of primary elements in a sixth sequence of triplets, each triplet comprising a first primary element, a second primary element, and a third primary element, wherein the third primary element of each triplet is less stiff, than the second primary element of each triplet, and the second primary element of each triplet is less stiff, than the first primary element of each triplet, whereby each third primary element is raised further than each second primary element, and each second primary element is raised further than each first primary element, when fluid flows backwardly between primary elements.

15. A filtration barrier as claimed in any prior claim wherein the support means is a stiff tubular grid and a long single comb is wrapped around the stiff tubular grid as a helix to form a tubular filter wherein each successive wrap of the long single comb overlaps a prior wrap to obtain a preferred spacing of the single combs in the helix, whereby the tubular filter is formed, and wherein fluid flowing forwardly flows from outside the tubular filter, and fluid flowing backwardly flows from inside the tubular filter.

16. A filtration barrier as claimed in claim 15 wherein a single first comb and a single second comb are overlapped and assembled together as a paired ribbon comprising the single first comb and the single second comb, and wherein the paired ribbon is wrapped around the tubular grid frame as a helix, and wherein each successive wrap of the paired ribbon overlaps a prior wrap in the helix to obtain the preferred spacing of first combs and second combs in the helix, whereby a tubular filter is formed.

17. A filtration barrier as claimed in claim 1 wherein the filter barrier is a filter screen and the elements become warp elements within a filter screen, and the single bars become weft elements within the filter screen, wherein the warp elements are arranged transversely to the weft elements, and wherein the spaces between the warp elements form the plurality of apertures, and wherein

the weft elements and the warp elements lie in approximately the same plane in their relaxed state, and the warp elements are each attached to weft elements at each warp-weft element intersection, and the weft elements are stiffer than the warp elements, and wherein the spacing between weft elements is more than three times the spacing between warp elements, and wherein

the support means comprise stiff elements adjacent the underside of the filter screen arranged transversely to the warp elements, and wherein

the stiff elements are spaced between the weft elements, and wherein the stiff elements are spaced and positioned to limit the deflection of warp elements when fluid flows forwardly between warp elements before passing the stiff elements, and whereby the warp elements are lifted away from the stiff elements when fluid flows backwardly between the warp elements.

18. A filtration barrier as claimed in claim 17 wherein the warp elements are grouped into pairs of warp elements in a sequence of element pairs wherein each first warp element of each element pair is more extensible than each second warp element, whereby each first warp element is raised above each second warp element when fluid flows backwardly between the warp elements.

19. A filtration barrier as claimed in claim 17 wherein the warp elements are grouped into individual groups of warp elements in a sequence of groups wherein each spaced group comprises more than two warp elements wherein each first warp element in each group is less resilient than each second warp element, and each second warp element in each spaced group is less resilient than each next adjacent warp element, and

thereafter, each next warp element of each spaced group is less resilient than each sequentially next warp element, until each last warp element of each spaced group is the least extensible warp element of each spaced group, whereby, when fluid flows backwardly between the warp elements,

each first warp element is raised above each second warp element of each individual group, and, each second warp element of each group is raised above each next warp element of each individual group, and

thereafter each next warp element of each individual group is raised above its sequentially next warp element, until the last warp element of each individual group is the least raised warp element of each group.

20. A filtration barrier as claimed in claim 17 or claim 18 or claim 19 wherein individual warp elements comprise one or more filaments twisted together to form a rope or thread, and wherein

the extensibility of individual warp elements decreases as the number of filaments in the individual warp element increases.

21. A filtration barrier as claimed in claim 27 or claim 18 or claim 19 wherein individual warp elements comprise a single fibre or filament, and wherein
the extensibility of individual warp elements decreases as the cross section size of the individual filament decreases.

22. A filtration barrier as claimed in claim 17 or claim 18 or claim 19 wherein each warp element is of a zig-zag shape, or sinusoidal shape, or curved shape between weft elements.

23. A filtration barrier as claimed in claim 1 wherein the elements are grouped into a primary sequence of groups wherein each group comprises a first element, a next element, and thereafter a sequentially next element, and wherein
each first element is less stiff than the next element, and the next element is less tiff than the sequentially next element, and thereafter
each next element is less stiff than each sequentially next element of each group, until each last element of each group is the stiffest element of each group, whereby, when fluid flows backwardly between the elements, the first element of each group of each primary sequence is lifted higher than each next element of each group, and the next element of each group is lifted higher than the sequentially next element of each group, and thereafter, the next element is lifted higher than the sequentially next element of each group, until the last element of each group is lifted least.

24. A filtration barrier as claimed in claim 1 wherein the elements are fibres.

25. A filtration barrier as claimed in claim 17 wherein the weft elements and the warp elements are joined by either a weaving means, or an adhesion means, or a fusion means.

26. A filtration barrier as claimed in claim 1 wherein the elements may be bristles, or strips or fibres.

AMENDED CLAIMS
received by the International Bureau on 17 September 2009 (17.09.2009)

1. A filtration barrier comprising a plurality of apertures between elements that permit a fluid to flow through, but restrict the passage of particles of sizes greater than an aperture width, wherein a plurality of said elements are securely attached to a single support bar to form a comb, and
wherein each element has a free end with its other end attached to the single support bar with all said elements arranged parallel to each other, and wherein
a plurality of said combs are arranged with second spaces between each pair of adjacent single support bars in a parallel array so that the free ends of the elements of each comb of the plurality of said combs overlap the support bar of the next comb in the array, and wherein the elements of each comb branch from the support bar and lie in a common plane in their relaxed state,
and wherein each element is supported at its free end by the next comb, and each element is of a stiffness and length that permits each element to yield only slightly under pressure from fluid flowing forwardly between the elements,
and when fluid flows backwardly through the barrier each element is unsupported at its free end, whereby the elements yield under pressure from the backwardly flowing fluid and the free ends of elements are lifted away from the next comb thereby enlarging the apertures through the filtration barrier.

2. A filtration barrier as claimed in claim 1 wherein the elements are arranged in groups wherein each group comprises two or more elements and wherein the elements within each group are designated a first element, a second element, a third element et cetera, according to the number and position of the elements within each group, and wherein each first element is more flexible than each second element, and each second element is more flexible than each third element, et cetera, whereby
when the fluid is flowing backwardly between and from below the elements the free ends of elements in each group are lifted away from the next comb so that the aperture below each second element is smaller than the aperture below each first element, and the aperture below each third element is smaller than the aperture below each second element , et cetera, so that the aperture below each next element of each group is smaller than the aperture below each prior element of each group, thereby providing groups wherein the first element of each group provides the largest aperture, and the aperture below each sequentially prior element is smaller until the last element within each group provides the smallest aperture when the fluid is flowing backwardly between the elements.

3. A filtration barrier as claimed in claim1 or claim 2 wherein the cross-section of the elements may be round, or elliptical, or rectangular, or obround, or wedge-shaped.
4. A filtration barrier as claimed in claim 2 wherein each group comprises only the first element and the second element.
5. A filtration barrier as claimed in claim 1 or claim 2 wherein additional stiffening strips attached laterally to the elements in each comb or each group assist the elements to sustain their spacing.
6. A filtration barrier as claimed in any prior claim wherein differences in cross-section between individual elements determines a different element stiffness.
7. A filtration barrier as claimed in any prior claim wherein differing material properties between individual elements determines a different stiffness.
8. A filtration barrier as claimed in any prior claim wherein the free end of each element extends in length beyond more than two said second spaces, and wherein fluid flowing forwardly between adjacent single support bars or strips passes sequentially through the apertures of more than one comb.
9. A filtration barrier as claimed in any prior claim wherein each comb in a plurality of said combs is numbered 1, 2, 3, 4, etc., in a third sequence to denote its position in the plurality of said combs, and wherein each odd-numbered comb is a first comb and each even-numbered comb is a second comb,
and wherein all the elements of each first comb branch from their single support bar towards the right hand side, and all the elements of each second comb branch from their single support bar towards the left hand side.
10. A filtration barrier as claimed in claim 9 wherein support joists are arranged in a parallel and equally-spaced apart array, and wherein the elements of the next comb in the third sequence overlap the elements of one or more prior combs in the third sequence to form the filtration barrier.
11. A filtration barrier wherein the elements of claim 1 become primary elements within a first sheet of resilient material, and the single support bars become secondary elements within the first sheet, wherein the primary elements are arranged transversely to the secondary elements, and wherein
the secondary elements share a common plane with the primary elements in their relaxed state, and each primary element is attached to one of the secondary elements at one end only leaving a non-attached end free to be raised away from the common plane, and wherein
support elements are provided adjacent the underside of the first sheet and are arranged transversely to the primary elements, and wherein the support elements are positioned to prevent each said non-attached end moving past the support elements.

12. A filtration barrier as claimed in claim 11 wherein the primary elements are grouped into pairs of primary elements comprising a first primary element and a second primary element in a sequence of pairs wherein the second primary element of each pair is less flexible than the first primary element, and whereby each first primary element is raised away from each second primary element when fluid flows backwardly between the primary elements.

13. A filtration barrier as claimed in claim 11 or claim 12 wherein the primary elements are attached at each end to adjacent second elements, and wherein each primary element is of a flat and narrow zig-zag shape, or sinusoidal shape, or curved shape, and wherein

fifth elements are provided adjacent the underside of the first sheet and are arranged transversely to the primary elements, and wherein the fifth elements are positioned at one or more places along the length of each primary element to prevent each primary element moving past the fifth elements.

14. A filtration barrier as claimed in claim 12 or claim 13 wherein the primary elements are grouped into triplets of primary elements in a sixth sequence of triplets, each triplet comprising a first primary element, a second primary element, and a third primary element, wherein the third primary element of each triplet is less flexible, than the second primary element of each triplet, and the second primary element of each triplet is less flexible, than the first primary element of each triplet, whereby each first primary element is raised away from each second primary element, and each second primary element is raised away from each third primary element, when fluid flows backwardly between primary elements.

15. A filtration barrier as claimed any of claims 1, or 2, or 3, or 4, or 5, or 6, or 7, or 8, or 9, or 10 wherein a long single said comb is wrapped as a helix around a stiff tubular grid to form a tubular filter wherein each successive wrap of the long single said comb overlaps a prior wrap to obtain a preferred spacing of the single combs in the helix, whereby the tubular filter is formed, and wherein fluid flowing forwardly flows from outside the tubular filter, and fluid flowing backwardly flows from inside the tubular filter.

16. A filtration barrier as claimed in claim 15 wherein a single first said comb and a single second said comb are overlapped and assembled together as a paired ribbon comprising

the single first said comb and the single second said comb, and wherein the paired ribbon is wrapped around the tubular grid frame as a helix, and wherein each successive wrap of the paired ribbon overlaps a prior wrap in the helix to obtain the

preferred spacing of first combs and second combs in the helix, whereby a tubular filter is formed.

17. A filtration barrier as claimed in claim 2 wherein the filtration barrier is supported upon stiff bars and wherein one or more stiff bars are spaced apart between each pair of support bars and positioned adjacent to and under the elements such that when fluid is flowing forwardly it passes firstly between the elements before passing the stiff bars, and wherein also
the free ends of all elements are attached to the support bar of the next comb in the array to form a mesh wherein the second spaces are more than four times the aperture width, and wherein each first element is the most flexible or most extendable element in each group, and each next element in each group yields and deflects less than its immediately prior element when fluid is flowing backwardly between the elements, thereby forming a series of apertures between the elements of each group and the adjacent stiff bars,
wherein the apertures between the first element of each group and the adjacent stiff bars are the largest, and the apertures between the second element of each group and the adjacent stiff bars are smaller, and the apertures between each next element of each group and the adjacent stiff bars are progressively smaller than the apertures between each prior element of each group and the adjacent stiff bars when fluid is flowing backwardly between the elements, and
when the fluid is flowing forwardly between the elements the deflection of all elements is limited by the stiff bars, and wherein said stiff bars may be part of a grid or mesh.

18. A filtration barrier as claimed in claim 17 wherein the elements become warp elements within a filter screen, and the support bars become weft elements within the filter screen, wherein the warp elements are arranged transversely to the weft elements, and wherein
the spaces between the warp elements form the aperture widths, and wherein
the weft elements and the warp elements lie in approximately the same plane in their relaxed state, and the warp elements are each attached to weft elements at each warp-weft element intersection, and wherein the weft elements are stiffer than the warp elements.

19. A filtration barrier as claimed in claim 18 wherein
individual warp elements comprise one or more filaments twisted together to form a rope or thread.

20. A filtration barrier as claimed in claim 17 or claim 18 wherein each warp element is of a zig-zag shape, or sinusoidal shape, or curved shape between weft elements.

21. A filtration barrier as claimed in claim 1 wherein the elements are bristles or strips or fibres.

22. A filtration barrier as claimed in claim 17 wherein the weft elements and the warp elements are joined by either a weaving means, or a crimping means, or an adhesion means, or a fusion means.

23. A filtration barrier as claimed in claim1 or claim 2 wherein the elements are not straight.

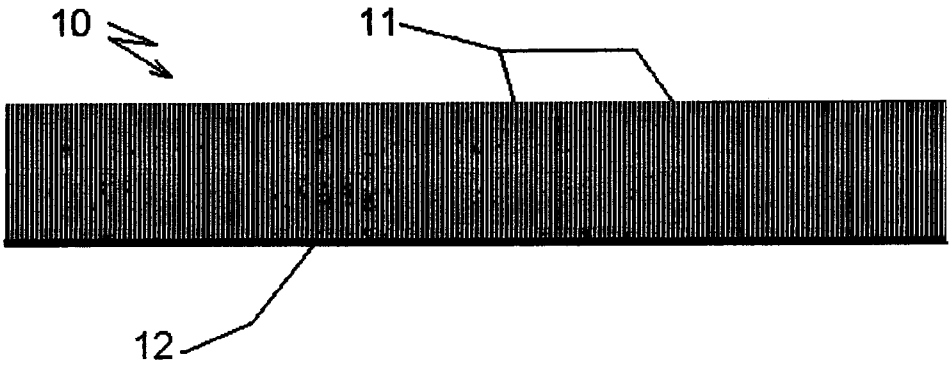

FIGURE 1

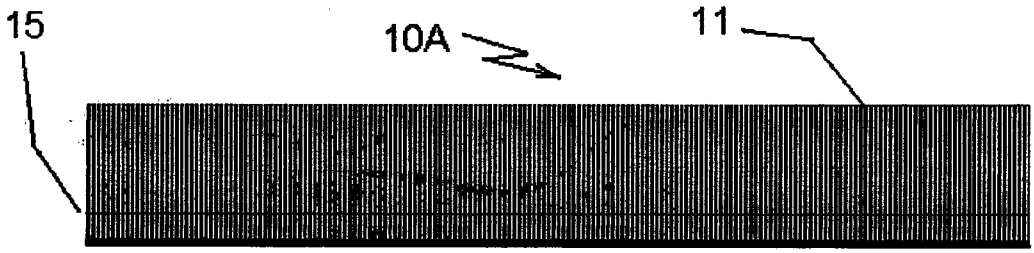

FIGURE 2

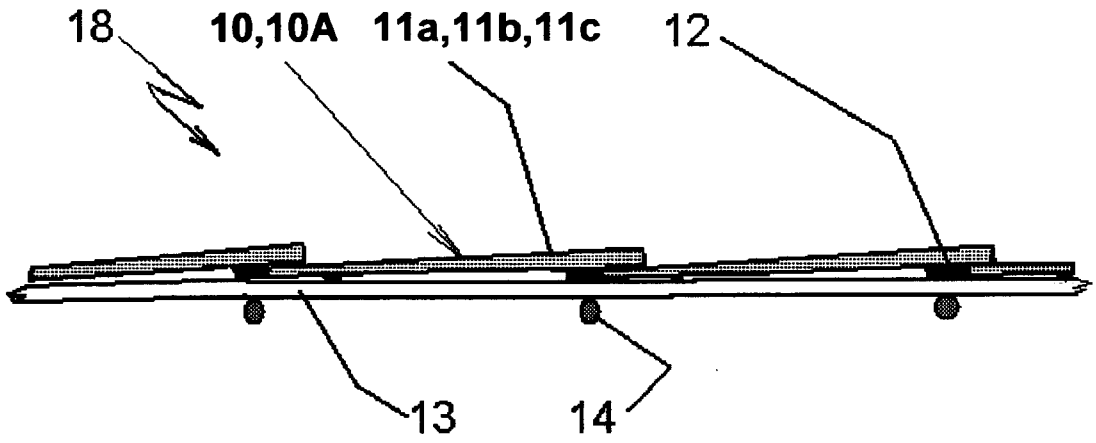

FIGURE 3

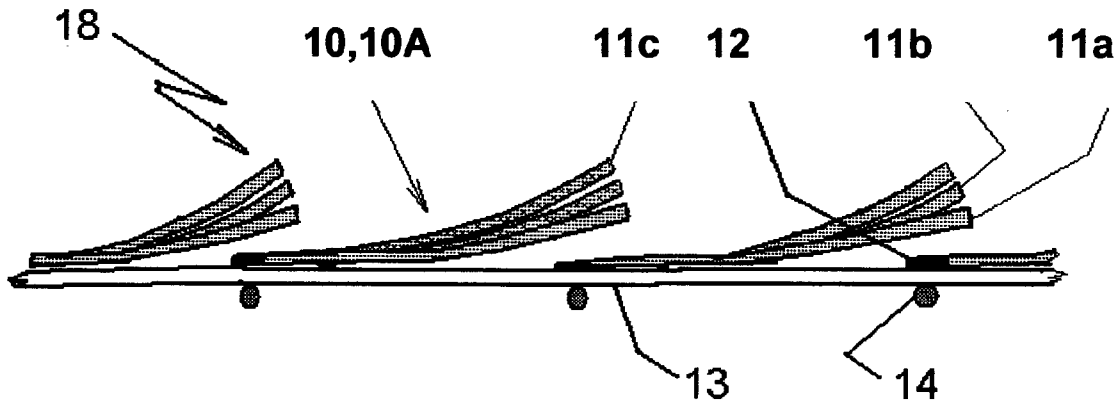

FIGURE 4

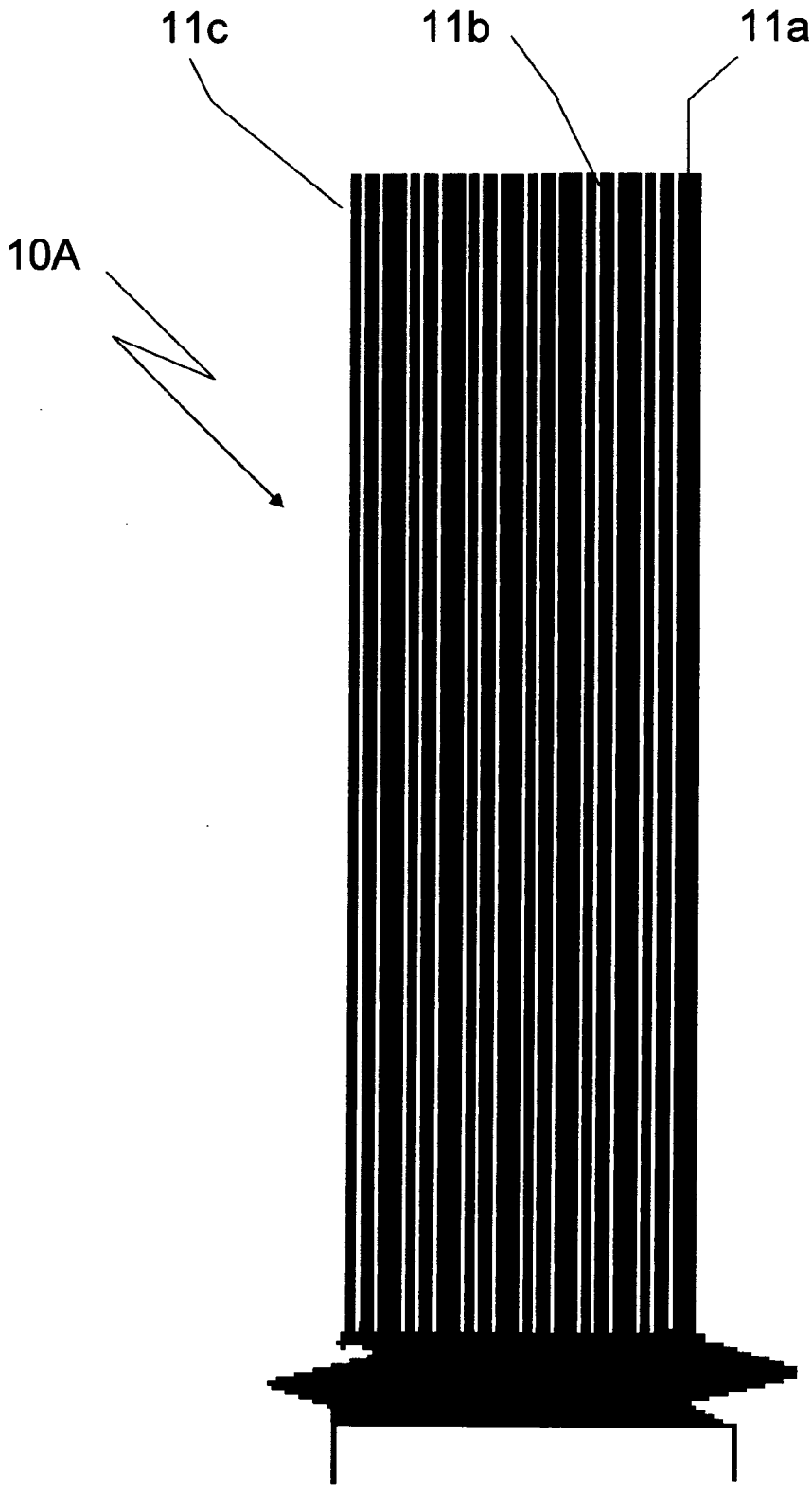

FIGURE 4A

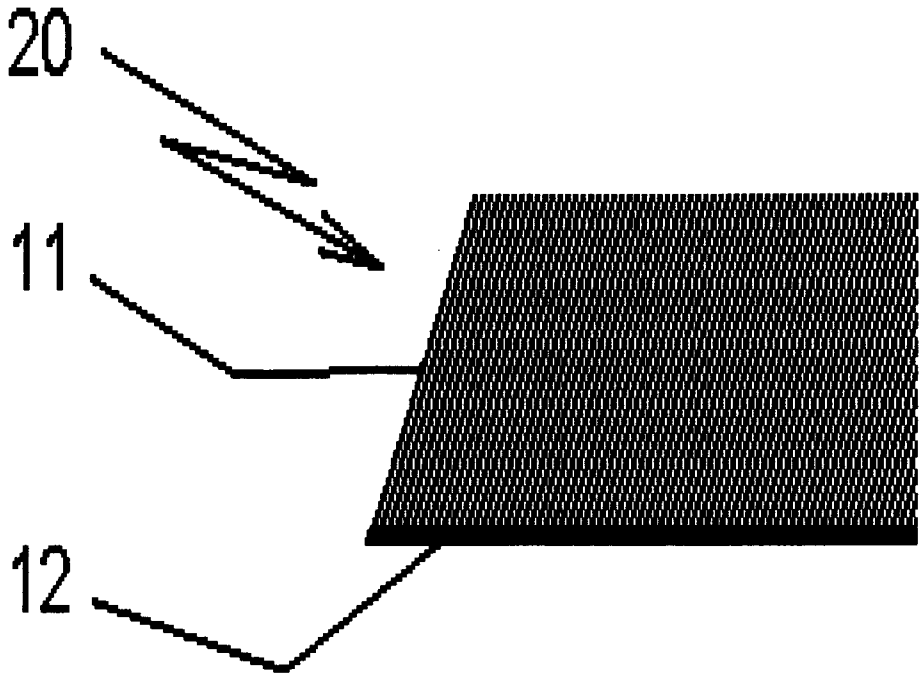

FIGURE 5

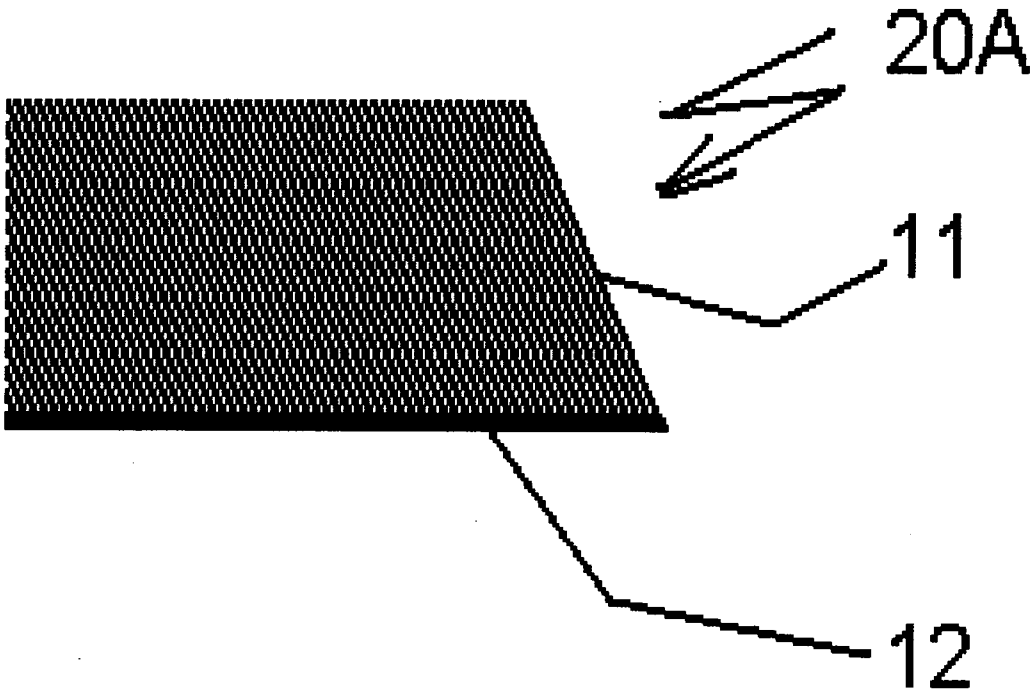

FIGURE 6

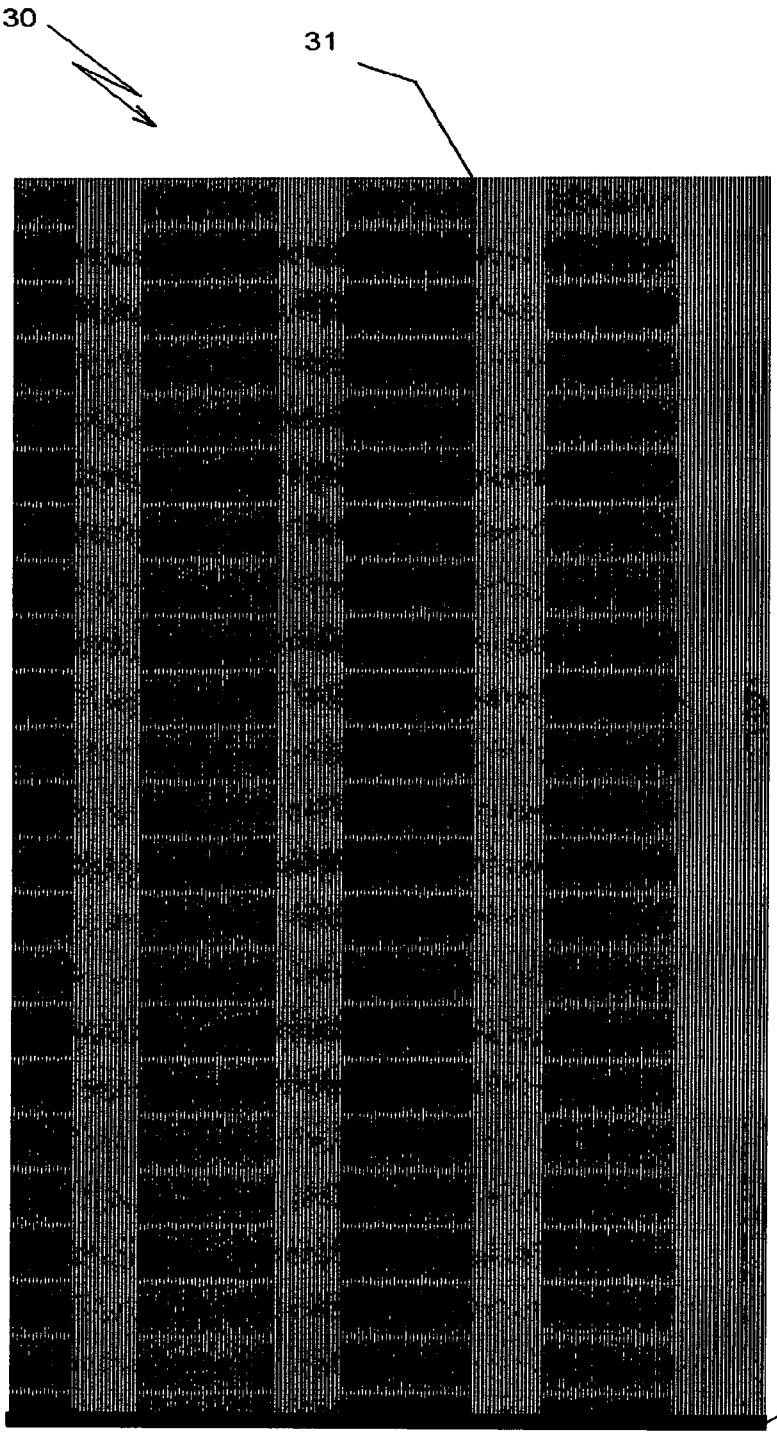

FIGURE 7

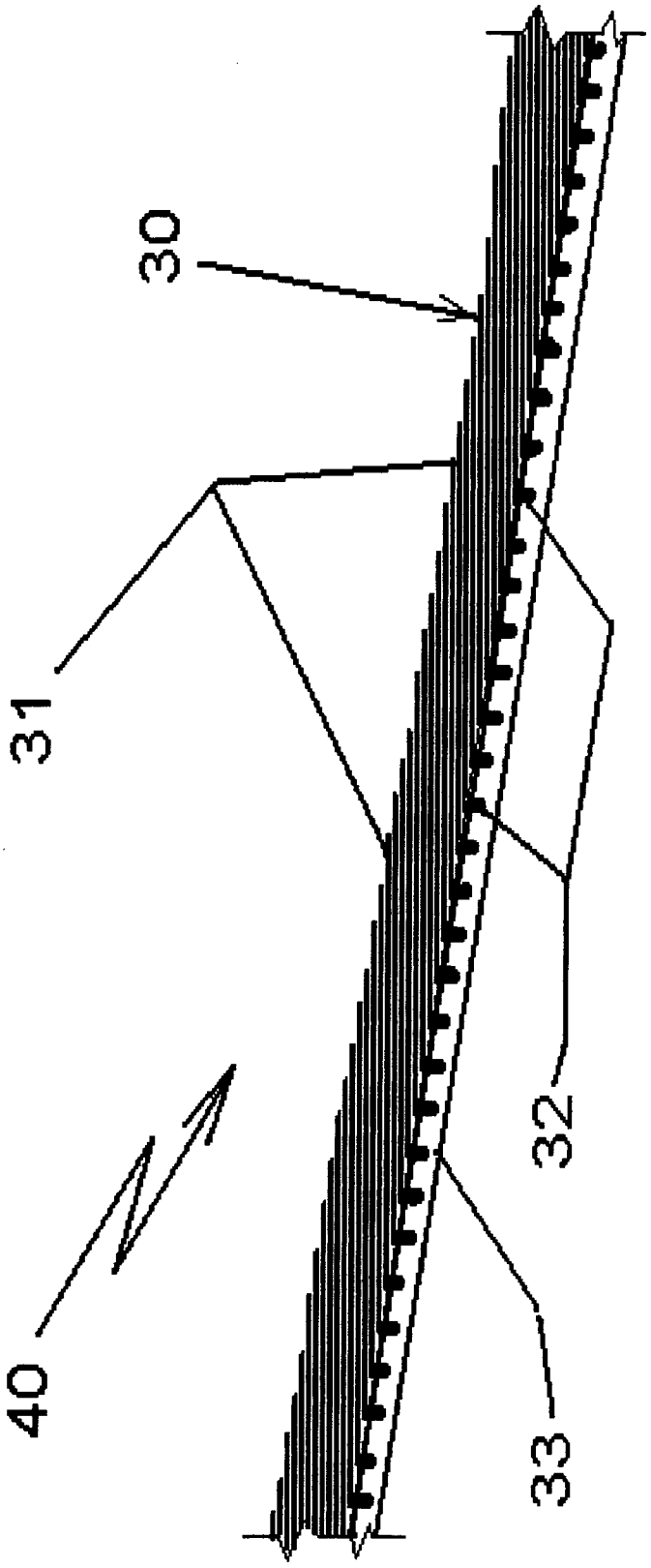

FIGURE 8

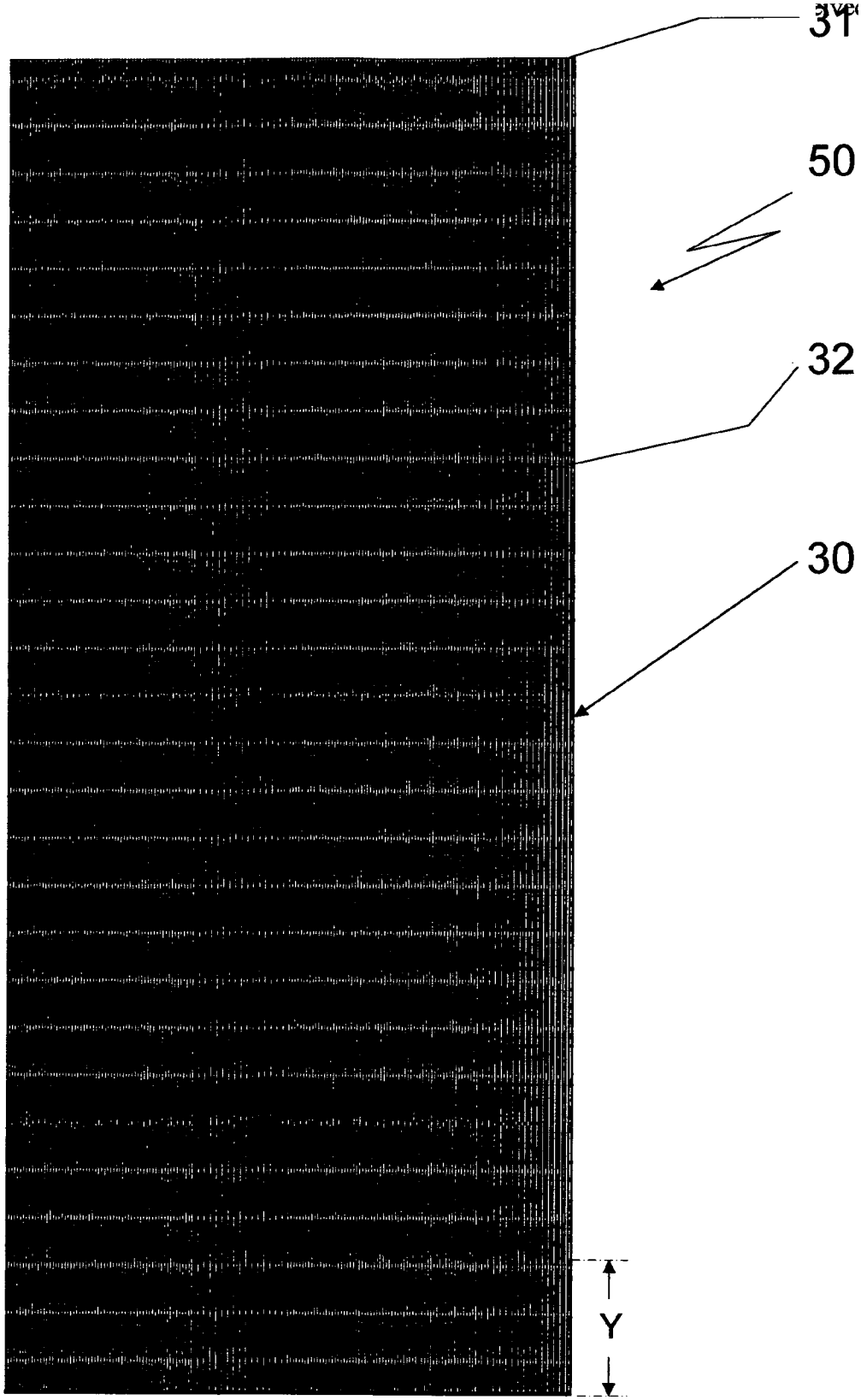

FIGURE 9

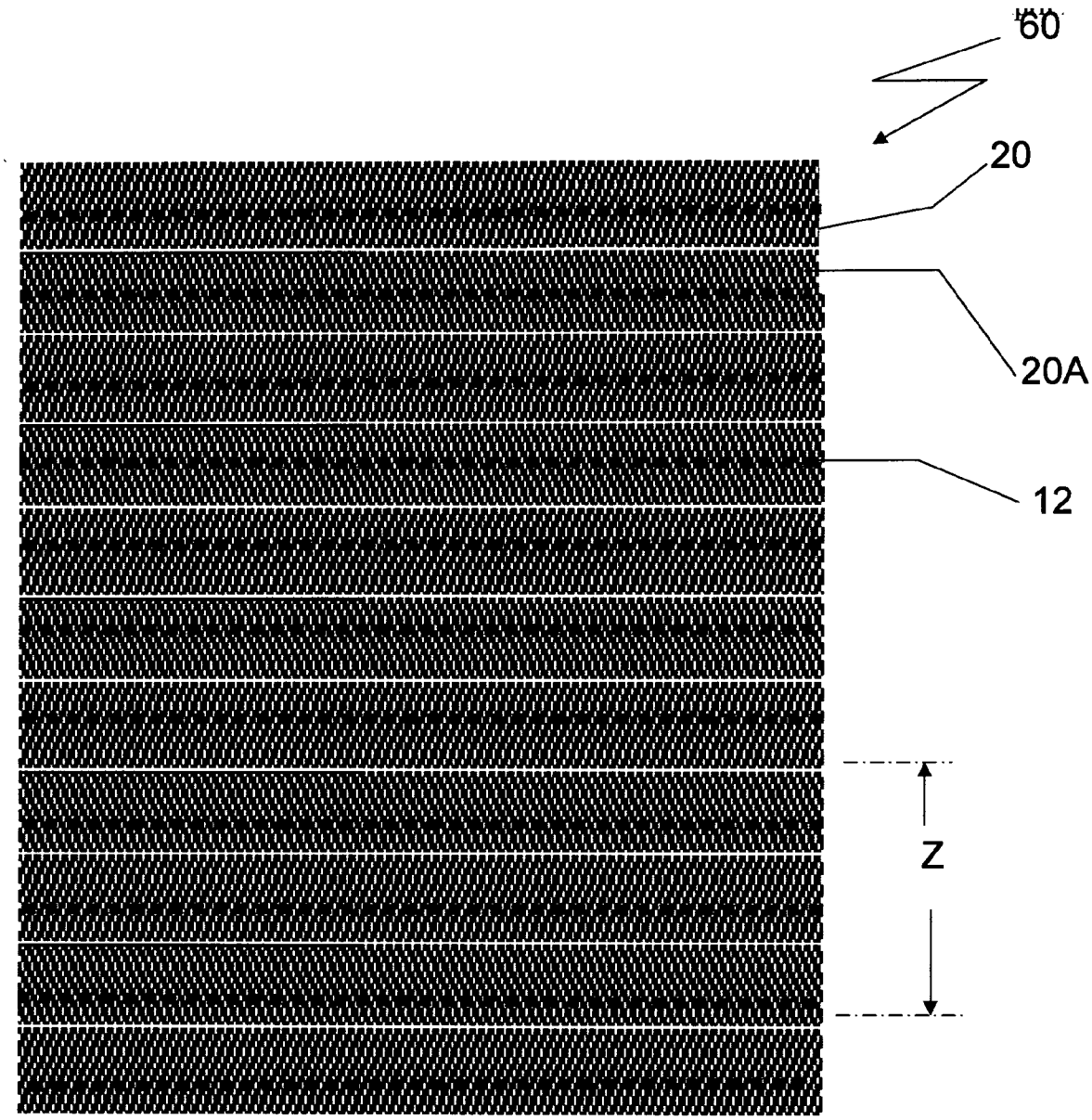

FIGURE 10

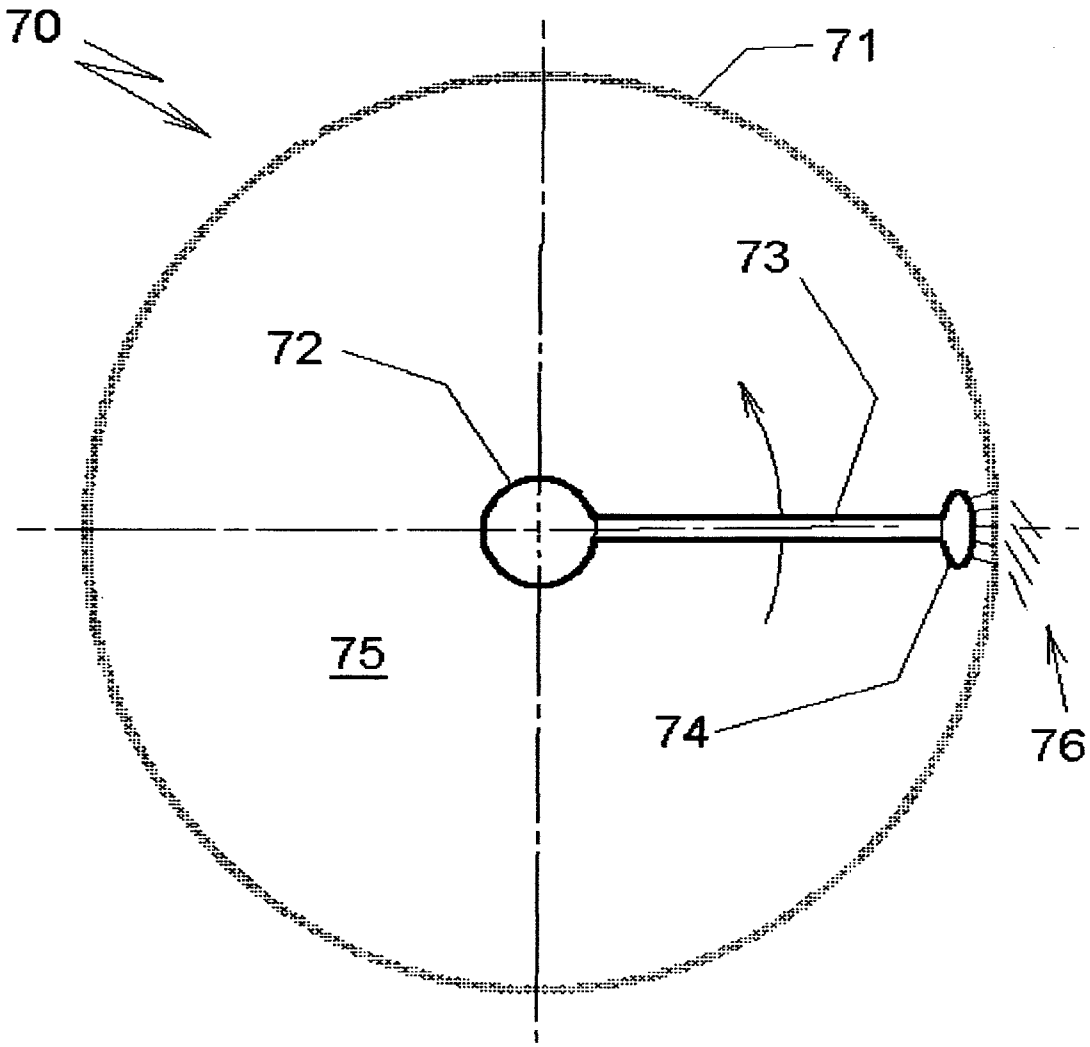

FIGURE 11

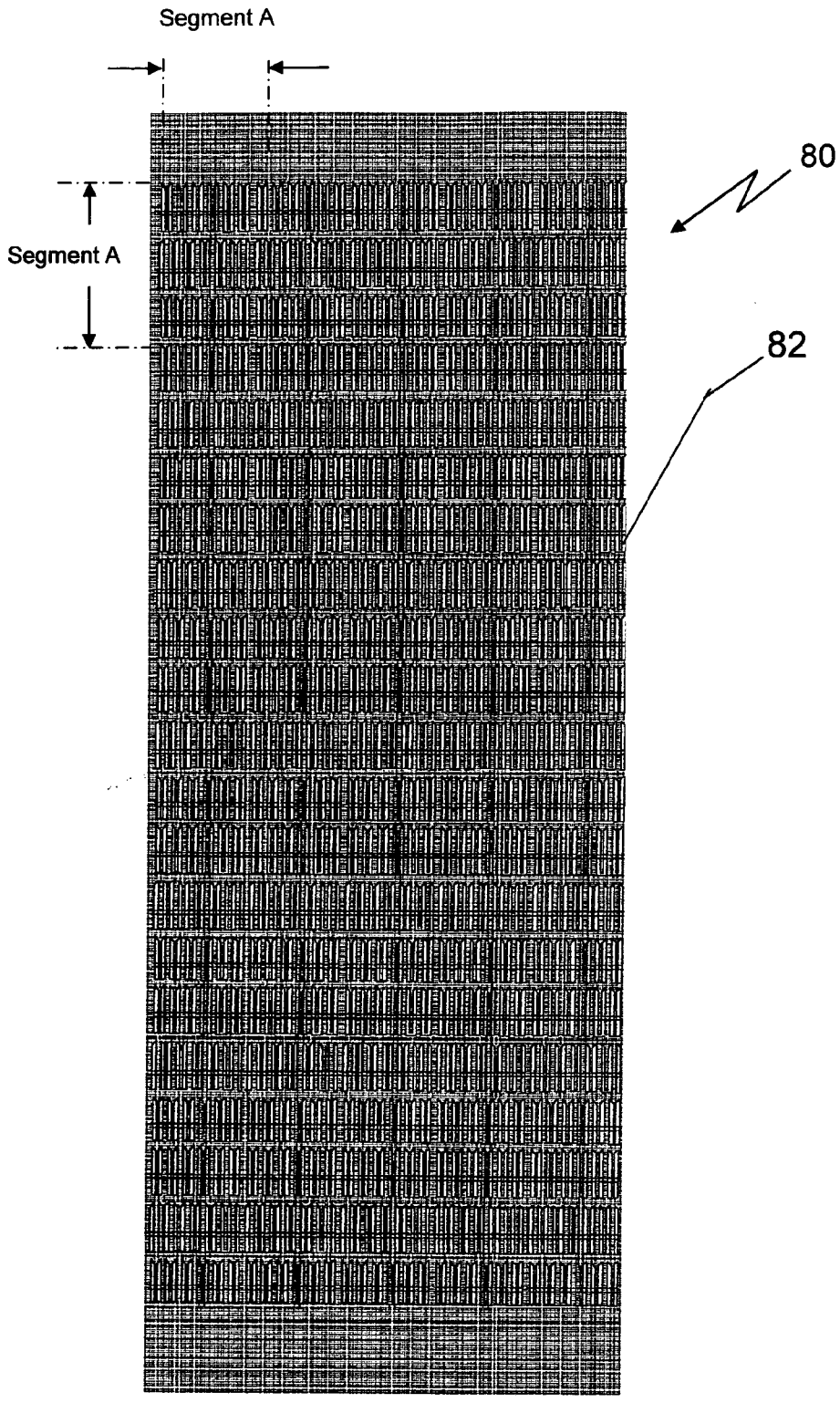

FIGURE 12

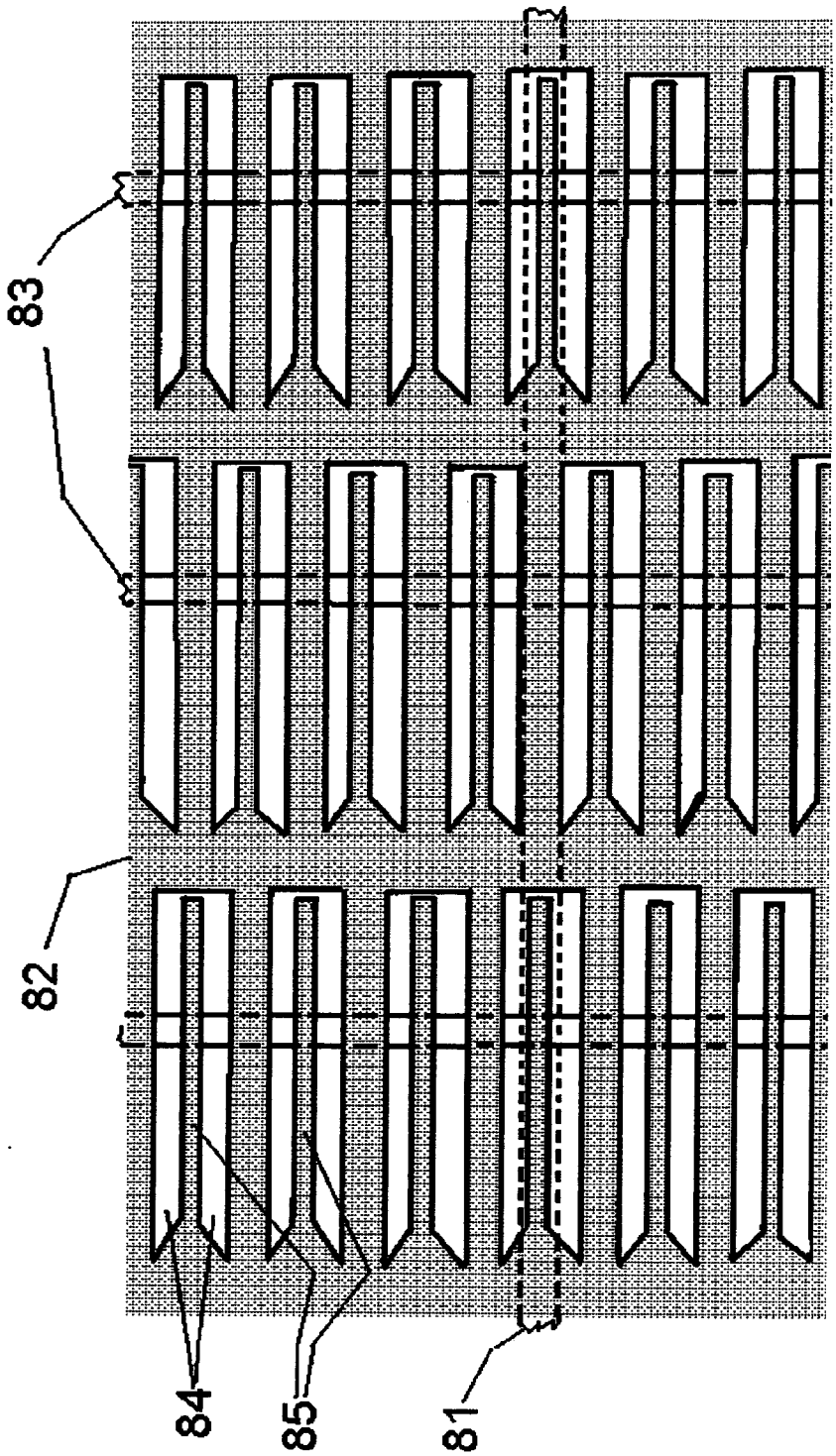

FIGURE 13

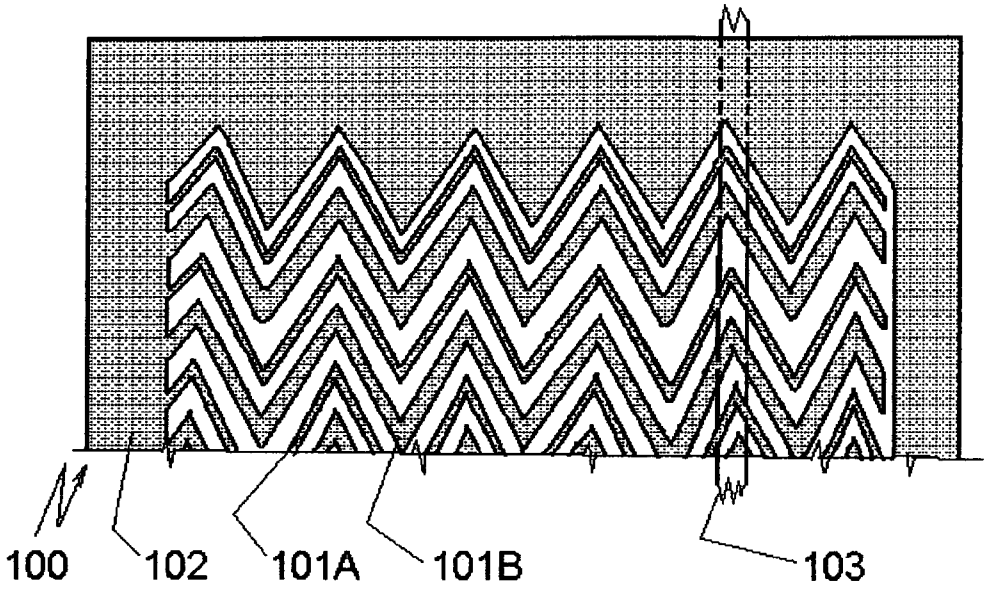

FIGURE 14

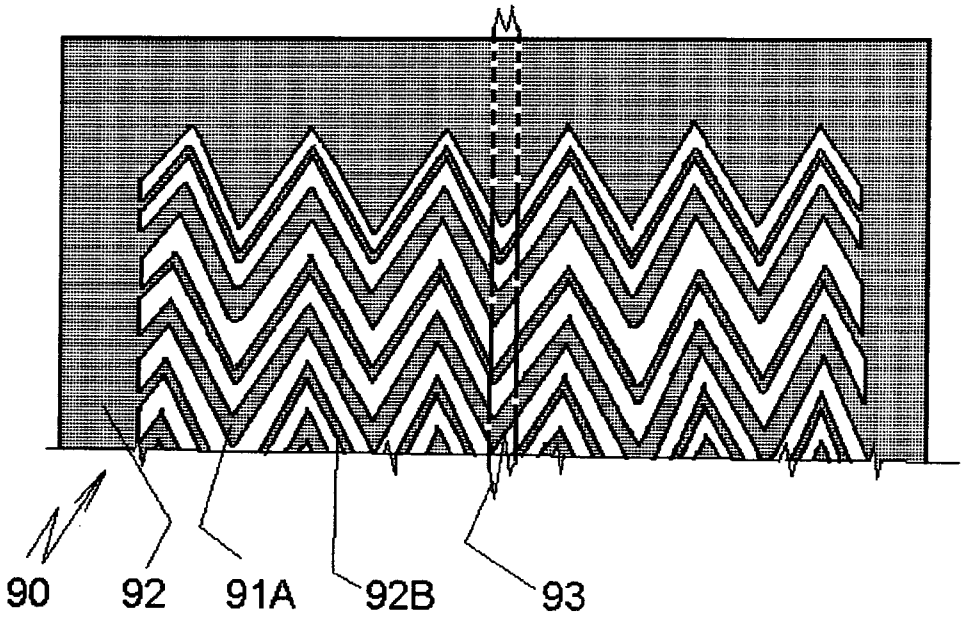

FIGURE 15

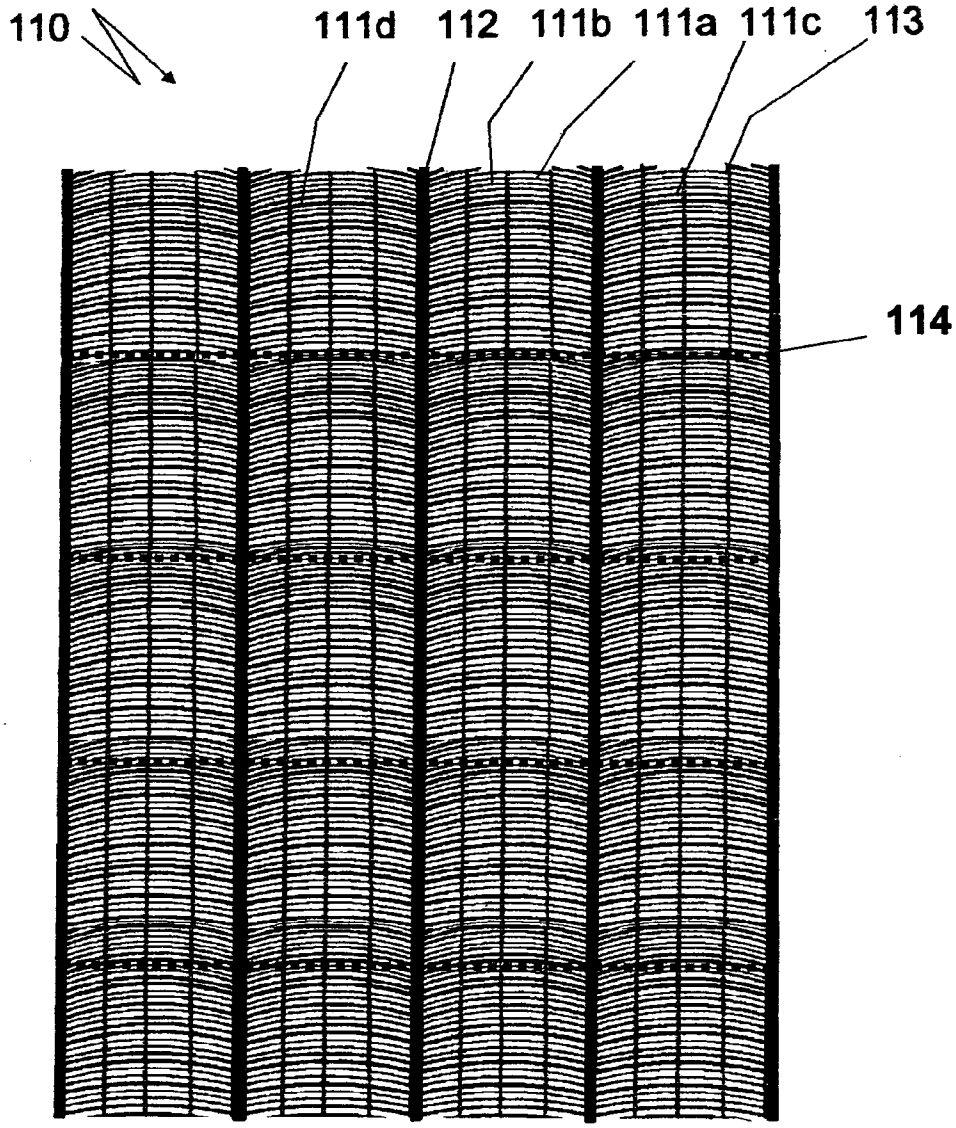

FIGURE 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2009/000401

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

B01D 35/00 (2006.01) ***B01D 29/00*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
REFER ELECTRONIC DATA BASE CONSULTED

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPODOC WPI EC/IC B01D 35/00, 29/00 & Keywords (support+, substrat+, attach+, secur+, fix+, anchor+, comb+, brush+, parrall+, overlap, backwash)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6103132 A (SEYFRIED et al) 15 August 2000 col 2, lines 6-34; col 3, lines 13-67; col 4, lines 1-10; fig. 1-3, 5	1-26
A	US 6241879 B1 (KATO et al) 5 June 2001 whole document	1-26
A	US 4750999 A (ROBERTS et al) 14 June 1988 whole document	1-26
A	US 4167482 A (MULLER) 11 September 1979 whole document	1-26

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 July 2009	18 JUL 2009
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **ASOKA DIAS-ABEYGUNAWARDENA** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : (02) 6283 2141

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2009/000401

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	6103132	CA	2258167	DE	19624483	EP	0958028
		KR	20000016811	WO	9748472		
US	6241879	EP	0848979	WO	9745188		
US	4750999	NONE					
US	4167482	CH	604835	CH	611174	CH	611529
		DE	2745526	DK	449377	FR	2366864
		GB	1574878	JP	53047069	JP	59048720U
		SE	7710010				

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX