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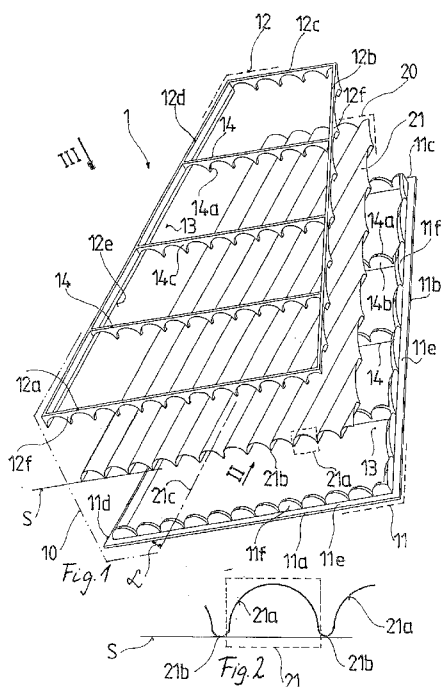
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) Title: FILTER PANEL FOR THE TREATMENT OF LIQUIDS, ESPECIALLY FOR DISC WASTEWATER FILTER EQUIPMENT



(57) Abstract: The invention relates to a filter panel for the treatment of liquids, especially for disc wastewater filtering equipment which has a supporting frame (10) surrounding the permeable surface (13), as well as at least one filter insert (20) that fills in at least a part of the permeable surface (13) fixed to the supporting frame (10), where at least a part of the filter insert (20) is formed as a spatial shape consisting of shell elements (21) protruding from the plane (S), the supporting frame (10) has at least three sides (1 1a, 1 1b, 1 1c, 1 2a, 1 2b, 1 2c) connected to each other, and the supporting frame (10) has one or more supporting ribs (14) running through the permeable surface (13), where the supporting ribs (14) have a rest surface (14a) and at least some of the shell elements (21) of the filter insert (20) are in contact with at least a part of the rest surfaces (14a) of the supporting ribs (14). The characteristic feature of the invention is that at least some of the shell elements (21) are formed by a set of curved space element pieces (21a) arranged next to each other, and at least some of the neighbouring curved space element pieces (21a) are connected to each other with a curved linking member (21b).

Filter panel for the treatment of liquids, especially for disc wastewater filter equipment

The subject of the invention relates to a filter panel for the treatment of liquids, especially disc wastewater filter equipment, which has a supporting frame surrounding the permeable surface, as well as at least one filter insert that fills in at least a part of the permeable surface fixed to the supporting frame, where at least a part of the filter insert is formed as a spatial shape consisting of shell elements protruding from the plane, the supporting frame has at least three sides connected to each other, and the supporting frame has one or more supporting ribs running through the permeable surface, where the supporting ribs have a rest surface and at least some of the shell elements of the filter insert are in contact with at least a part of the rest surfaces of the supporting ribs.

With the increase of the population and the expanding of industrial production an increasingly larger amount of communal and industrial wastewater is created. With the increasing significance of environmental protection and in the interest of reducing environmental loads the generated wastewaters – for a long time – are treated in wastewater treatment plants in the interest of them either being released into the natural waters or being used once again, e.g. for industrial or agricultural purposes, at the end of the treatment process. Traditionally wastewater treatment plants were built from facilities that require a large amount of area and that are less easy to integrate into the landscape, which characteristically were located far from residential areas, at the boundaries of settlements. Such wastewater treatment equipment is presented in, among others, publication document number WO 2012/163308, from publication document number WO 2012/139917, which present groups of equipment relating to the treatment of industrial wastewaters.

However, with the growth and expansion of settlements it has become unavoidable that wastewater treatment plants are wedged between residential areas. With the increase in population the amount of wastewater received and treated by wastewater treatment plants

has grown, and the existing plants are not always able to appropriately handle this growth. In such cases it is necessary to increase the capacity of the wastewater treatment plant. Publication document number WO 2012/158012 and patent specification registration number HU E009445 present modularly constructed wastewater treatment facilities that may be expanded in the case of an increase in the load, what is more, in a given case the effectiveness, performance of certain treatment steps may also be varied.

However, the disadvantage of these solutions is that area is needed for the expansion but due to the territorial characteristics of a given plant it is not always possible to appropriately treat the increased amount of wastewater.

In order to overcome the problem solutions have been elaborated in the case of which they endeavour to filter out the increasing load of suspended solids from the treated liquid on a small processing area. Such a solution is equipment with filter discs, the essence of which is that the liquid to be treated is passed onto rotating filter discs and the suspended solids is separated while the rotating discs are moving. Such equipment may be seen in, among others, patent specifications numbers KR 100927042 and KR 100812791.

However, the disadvantage of the filter inserts used in disc filtration equipment is that the filter surfaces are prone to become clogged, which significantly reduces the efficiency of suspended solids separation, so reducing the speed of the process.

A further disadvantage is that the filter inserts used contain planar filter surface elements, which also presents an obstacle to filtration efficiency and filtration performance.

Our objective with the solution according to the invention was to overcome the deficiencies of the known filter panels and to elaborate a version which, with a given flow cross-section, provides the greatest possible filtration surface and in which the filter panel back-washing characteristics are more favourable than those of the known constructions, furthermore, in which, with the same volume flow, smaller or even fewer devices fitted with the filter panel according to the invention are required in order to achieve the desired effluent water limit value.

The basis of the idea behind the invention was formed by the recognition that if the filter surface is formed in a different way, i.e. not using the usual planar part-elements but from space-curved surface pieces, e.g. cylindrical pieces and if the connection between the individual space-curved surface pieces is also solved using curved sections, then, on the one hand, we can achieve a significant filter surface increase of as much as 40% as compared to planar surfaced filters, and, on the other hand, as a result of the filter surface consisting of novel curved elements during back-washing the liquid can be appropriately controlled and the larger particles remaining during filtration are unable to become stuck to any single part of the filter surface either, which significantly reduces the possibility of clogging, and so the task becomes solvable.

In accordance with the set aim the filter panel according to the invention for the treatment of liquids, especially for disc wastewater filtering equipment – which has a supporting frame surrounding the permeable surface, as well as at least one filter insert that fills in at least a part of the permeable surface fixed to the supporting frame, where at least a part of the filter insert is formed as a spatial shape consisting of shell elements protruding from the plane, the supporting frame has at least three sides connected to each other, and the supporting frame has one or more supporting ribs running through the permeable surface, where the supporting ribs have a rest surface and at least some of the shell elements of the filter insert are in contact with at least a part of the rest surfaces of the supporting ribs – is set up in such a way that at least some of the shell elements are formed by a set of curved space element pieces arranged next to each other, and at least some of the neighbouring curved space element pieces are connected to each other with a curved linking member.

A further feature of the filter panel according to the invention may be that the curved space element pieces are cylinder pieces.

In the case of an advantageous version of the filter panel, the supporting frame has a first carrying member and a second carrying member, and the filter insert is clamped

between the first carrying member and the second carrying member. Also, the supporting frame has four sides.

In the case of another embodiment of the invention both the first carrying member and the second carrying member are fitted with supporting ribs, on the rest surface of the supporting ribs of the first carrying member facing the second carrying member there is a negative pattern formed conforming to and following the cross-sectional line of the curved space element pieces and linking members of the filter insert, while on the rest surface of the supporting ribs of the second carrying member facing the first carrying member there is a positive pattern formed conforming to and following the cross-sectional line of the curved space element pieces and linking members of the filter insert.

In the case of another, different embodiment of the filter panel on the inner surface of the sides of the first carrying member belonging to the supporting frame facing the second carrying member there is a negative pattern formed conforming to and following the cross-sectional line of the curved space element pieces and linking members of the filter insert, while on the inner surface of the sides of the second carrying member belonging to the supporting frame facing the first carrying member there is a positive pattern formed conforming to and following the cross-sectional line of the curved space element pieces and linking members of the filter insert.

Again, in the case of a different version of the invention the curved space element pieces and the curved linking members are formed from a single material. In a given case the longitudinal axes of the curved space element pieces forming the shell elements are parallel to one another, and the longitudinal axes are at an angle to any side of the supporting frame that differs from the perpendicular.

The most important advantage of the filter panel according to the invention is that as a consequence of the novel shape of the filter body in the case of the same flow cross-section a significantly more effective filter surface can be created than in the case of the filter panels of traditional disc filter equipment, and so with a smaller device the same capacity

of traditional solutions can be achieved, or in the same equipment volume a greater filtration capacity can be established.

A further advantage is that due to the curved filter surface profile pieces, which differ from traditional set-ups, significantly more effective back-washing can be achieved, due to which there is significantly less chance of the filter panel becoming clogged or of its effectiveness deteriorating. A further advantage deriving from this is that the lifetime of the filter panel according to the invention is greater, and its maintenance demand is lower than that of the usual filter panels.

An advantage that is also due to the novel curved surface formation is that the larger particles, grains separated during the filtering process are unable to become adhered to the linking members between the curved space element pieces, and so these do not cause clogging either, which further improves the reliable operation of the filter panel and its extended duration high degree of filtration efficiency. As, therefore, there is no "corner" where the coarse particles of the filtered medium can get stuck, and so obstruct back-washing, the periodical cleaning of the filter panel, i.e. back-washing, can be performed with much greater efficiency.

Another advantage due to the unusual form is that the curved space element pieces assist the "carrying off" of the concentrate sticking to the filter surface, as they guide the concentrate and force it into the appropriate direction, towards the collection channel.

Another advantage related to the filter panel according to the invention is that equipment fitted with it is able to process the same volume of treatable liquid can be processed with less equipment than devices that use traditional filter panels. Therefore, by using the new filter panel the phase separation capacity of existing wastewater treatment plants can be increased with minimal transformation work without having to increase the area used. An additional advantage deriving from this is the small investment cost and the reduction of the specific operation and maintenance costs as well.

In the following we present the filter panel according to the invention in connection with construction examples, on the basis of drawings. On the drawings

Figure 1 shows a view picture of a possible construction of the filter panel according to the invention, with the filter panel disassembled,

Figure 2 shows a detail of the view of the filter panel according to figure 1 from direction II,

Figure 3 shows a view of the filter panel according to figure 1 from direction III,

Figure 4 shows a view from the front of the filter panel according to the invention in clamped state.

In figure 1 a version of the filter panel 1 according to the invention that can be fitted into a disc filter unit can be seen in the state before assembly. The supporting frame 10 and the filter insert 20 forming the filter panel 1 can be observed. The supporting frame 10 consists of the first carrying member 11 and the second carrying member 12. Here, the first carrying member 11 is bordered by side 11a, side 11b, side 11c and side 11d, while the second carrying member 12 is bordered by side 12a, side 12b, side 12c and side 12d. Side 11a – side 12a, side 11b – side 12b, side 11c – side 12c and side 11d – side 12d systematically comply with each other in size and with respect to the neighbouring sides, therefore, the assembled first carrying member 11 and the second carrying member 12 are suitable for firmly retaining the filter insert 20 closed between them. Here we must note that the first carrying member 11 and, naturally, the second carrying member 12 may also have three sides, or even more than four sides. The number of sides that the supporting frame 10 has may be determined by the task and the shape of the surface bordered by the receiving structural elements.

It may also be observed on figure 1 that side 11a, side 11b, side 11c and side 11d of the first carrying member 11 border the permeable surface 13. In the same way the permeable surface 13 is bordered by side 12a, side 12b, side 12c and side 12d as well. In the end, the filter insert 20 covers the permeable surface 13. Also, in the interest of the part of the filter

insert 20 positioned in the permeable surface 13 being suitably firm and rigid, the first carrying member 11 and the second carrying member 12 also have supporting ribs 14.

In the case of the first carrying member 11 – in this embodiment – there are three supporting ribs 14 positioned between side 11b and side 11d. Also the rest surface 14a of the supporting ribs 14 facing towards the filter insert 20 is formed in such a way so that it completely conforms with the shape and size of the shell elements 21 forming the filter insert 20. As the shell elements 21 of the filter insert 20 consist of curved space element pieces 21a, which are concave looking from the first carrying member, therefore the rest surfaces 14a of the supporting ribs 14 have a negative pattern 14b – here with a regular wave shape – conforming with the shape of the curved space element pieces 21a forming the shell elements 21 of the filter insert 20. Opposed to this the rest surfaces 14a of the supporting ribs 14 running between and linking side 12b and side 12d of the second carrying member 12 have a positive pattern, as the curved space element pieces 21a forming the shell elements 21 of the filter insert 20 are convex when looking from the direction of the second carrying member 12. It is obvious that the first carrying member 11 and the second carrying member 12 are formed so that when the first carrying member 11 and the second carrying member 12 are in a position fitted together so that there is precisely the amount of space between the negative pattern 14b and the positive pattern 14c of the supporting ribs 14 that equals the thickness of the shell elements 21 of the filter insert 20.

In the interest of the edge located along the boundary of the first carrying member 11 and the second carrying member 12 of the filter insert 20 being suitably clamped, the internal surface 11e of the first carrying member 11 has a negative pattern, while the internal surface 12e of the second carrying member 12 has a positive pattern 12f. As is well illustrated by figure 1 the part of the negative pattern 11f on the internal surface 11e of the side 11a and its section on the internal surface 11e of side 11b are not the same, instead their structure depends on precisely what cross-sectional shape the curved space element pieces 21a of the shell elements 21 of the filter insert have. Obviously the situation is the

same in the case of side 11c and side 11d of the first carrying member 11, as well as in the case of the sections given positive patterns 12f on side 12a, side 12b, side 12c and, in a given case, side 12d protruding from the internal surface 12e of the second carrying member 12.

Actually, the shell elements 21 forming the filter insert 20 consist of curved space element pieces 21a protruding in a wave shape from plane "S", which in this embodiment of the filter panel 1 are cylinder pieces arranged next to each other. Also the curved space element pieces 21a are linked to each other with the help of the curved linking members 21b. Also observable on figure 1 is that the longitudinal axes 21c of the curved space element pieces 21a parallel to each other are at a non-perpendicular angle " α " to the side 11a of the first carrying member 11. However, we must note here that it is expressly advantageous if the longitudinal axes 21c of the curved space element pieces 21a are not only at a non-perpendicular angle " α " to side 11a of the first carrying member 11 but also to the others, side 11b, side 11c and side 11d as well.

Moving over now to figure 2, an enlarged cross-sectional picture of the shell element 21 and environment of the filter insert 20 can be seen. It can be observed how the two neighbouring curved space element pieces 21a protrude from the plane "S", and how a curved linking member 21b is positioned between each two curved space element pieces 21a. Naturally it is practical if the curved space element pieces 21a and the curved linking members 21b forming the shell elements 21 forming the filter insert 20 are constructed from a single filter material. In the case of such a filter insert 20 form not only does the actual filter surface of the filter insert 20 covering the permeable surface 13 increase significantly, but the danger of the filter surface becoming clogged is also reduced to a minimum, and also the cleaning of the filter surface, its back-washing can be realised more effectively.

Figure 3 shows an assembled filter panel 1. It can be seen how the first carrying member 11 of the supporting frame 10 – and the second carrying member 12 located underneath it, and so not indicated in figure 3 – encloses the shell elements 21 of the filter insert 20, and

how the supporting ribs 14 make the supporting frame 10 rigid, at the same time as supporting the shell elements 21. Furthermore it can also be observed that the longitudinal axes 21c of the shell elements 21 really are at a non-perpendicular angle “ α ” to the sides of the first carrying member 11.

Also, it can be seen on figure 4 how the filter panels 1 are positioned in a containing structure 30, which may be a part of the filter equipment. However, as the filter panel 1 with filter insert 20 construction according to the invention may also be suitable for solving numerous, various different filtration tasks, here we do not present the connected equipment, as this does not form the subject of the invention. The essence is that the filter panel 1 with an edge form suiting the task and the containing structure 30 fitted with suitable linking pieces may be fitted and fixed into any containing structure 30.

When using the filter panel 1 the liquid passing onto the filter insert 20 of the filter panel 1 flows over the curved space element pieces 21a of the shell element 21, and depending on the size of the opening of the filter insert 20 of the filter panel, the filter insert 20 retains the particles that are larger than the size of the opening. The particles stuck on the input side of the filter panel 1 – in the case of a suitable curved linking member 21b size selected to comply with the size of the opening of the filter insert 20 – are unable to remain, get stuck between two neighbouring curved space element pieces 21a, therefore these sections of the filter insert 20 do not get clogged either.

When the liquid filtered by the filter panel 1 arrives at the outlet side of the filter panel 1, due to the curved space element pieces 21a forming the shell elements 21 of the filter insert 20, it essentially continues to flow in a controlled way in the direction of the outlet of the equipment or in the direction of the structural part realising the next technology step.

When the cleaning of the filter panel 1 has to be realised the jet of liquid performing the washing of the filter insert 20 – also as a result of the control ability deriving from the shape of the curved space element pieces 21a forming the shell elements 21 of the filter

insert 20 – passing along the appropriate “channel” is able to wash out the pores of the filter insert 20 of the filter panel 1 in a shorter time and with greater effectiveness.

The filter panel according to the invention may be applied to good effect in all places where a reliable filter device that is less prone to faults and clogging is required for the performance of high-capacity and effective phase separation.

List of references

1 filter panel

10 supporting frame

11 first carrying member

11a side

11b side

11c side

11d side

11e internal surface

11f negative pattern

12 second carrying member

12a side

12b side

12c side

12d side

12e internal surface

12f positive pattern

13 permeable surface

14 supporting rib

14a rest surface

14b negative pattern

14c positive pattern

20 filter insert

21 shell element

21a curved space element piece

21b curved linking member

21c longitudinal axis

30 containing structure

“S” plane

“ α ” angle

CLAIMS

1. Filter panel for the treatment of liquids, especially for disc wastewater filtering equipment which has a supporting frame (10) surrounding the permeable surface (13), as well as at least one filter insert (20) that fills in at least a part of the permeable surface (13) fixed to the supporting frame (10), where at least a part of the filter insert (20) is formed as a spatial shape consisting of shell elements (21) protruding from the plane (S), the supporting frame (10) has at least three sides (11a, 11b, 11c, 12a, 12b, 12c) connected to each other, and the supporting frame (10) has one or more supporting ribs (14) running through the permeable surface (13), where the supporting ribs (14) have a rest surface (14a) and at least some of the shell elements (21) of the filter insert (20) are in contact with at least a part of the rest surfaces (14a) of the supporting ribs (14), **characterised by** that at least some of the shell elements (21) are formed by a set of curved space element pieces (21a) arranged next to each other, and at least some of the neighbouring curved space element pieces (21a) are connected to each other with a curved linking member (21b).

2. The filter panel according to claim 1, **characterised by** that the curved space element pieces (21a) are cylinder pieces.

3. The filter panel according to claim 1 or 2, **characterised by** that the supporting frame (10) has a first carrying member (11) and a second carrying member (12), and the filter insert (20) is clamped between the first carrying member (11) and the second carrying member (12).

4. The filter panel according to any of claims 1–3, **characterised by** that the supporting frame (10) has four sides (11a, 11b, 11c, 11d, 12a, 12b, 12c, 12d).

5. The filter panel according to claim 3 or 4, **characterised by** that both the first carrying member (11) and the second carrying member (12) are fitted with supporting ribs (14), on the rest surface (14a) of the supporting ribs (14) of the first carrying member (11) facing the second carrying member (12) there is a negative pattern (14b) formed

conforming to and following the cross-sectional line of the curved space element pieces (21a) and linking members (21b) of the filter insert (20), while on the rest surface (14a) of the supporting ribs (14) of the second carrying member (12) facing the first carrying member (11) there is a positive pattern (14c) formed conforming to and following the cross-sectional line of the curved space element pieces (21a) and linking members (21b) of the filter insert (20).

6. The filter panel according to any of claims 2–5, **characterised by** that on the inner surface (11e) of the sides (11a, 11b, 11c, 11d) of the first carrying member (11) belonging to the supporting frame (10) facing the second carrying member (12) there is a negative pattern (11f) formed conforming to and following the cross-sectional line of the curved space element pieces (21a) and linking members (21b) of the filter insert (20), while on the inner surface (12e) of the sides (12a, 12b, 12c, 12d) of the second carrying member (12) belonging to the supporting frame (10) facing the first carrying member (11) there is a positive pattern (12f) formed conforming to and following the cross-sectional line of the curved space element pieces (21a) and linking members (21b) of the filter insert (20).

7. The filter panel according to any of claims 1–6, **characterised by** that the curved space element pieces (21a) and the curved linking members (21b) are formed from a single material.

8. The filter panel according to any of claims 1–7, **characterised by** that the longitudinal axes (21c) of the curved space element pieces (21a) forming the shell elements (21) are parallel to one another, and the longitudinal axes (21c) are at an angle (α) to any side (11a, 11b, 11c, 11d, 12a, 12b, 12c, 12d) of the supporting frame (10) that differs from the perpendicular.

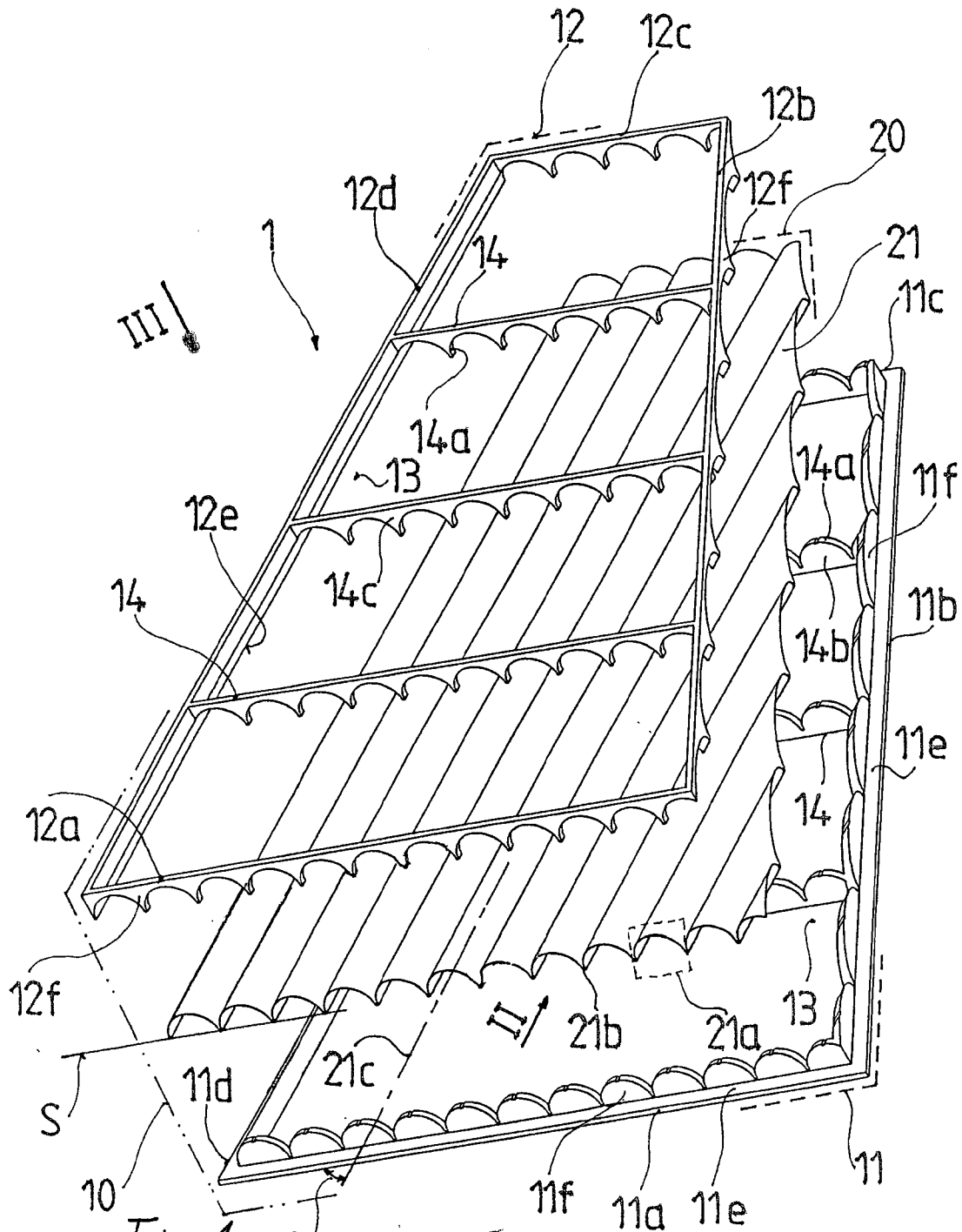


Fig. 1

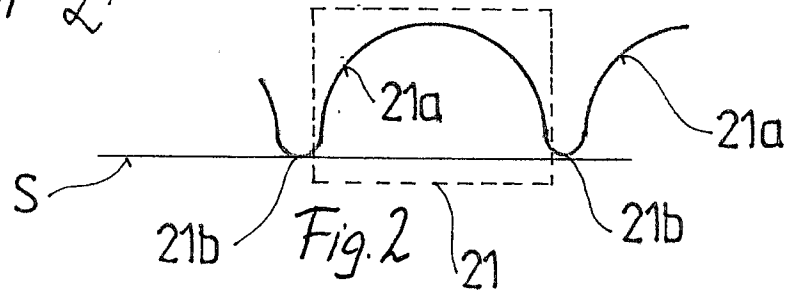
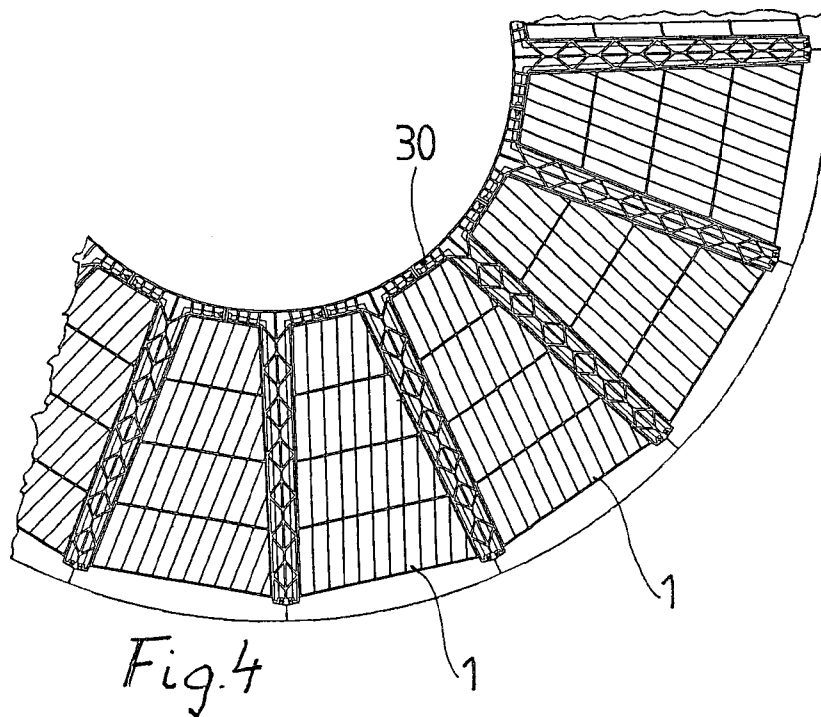
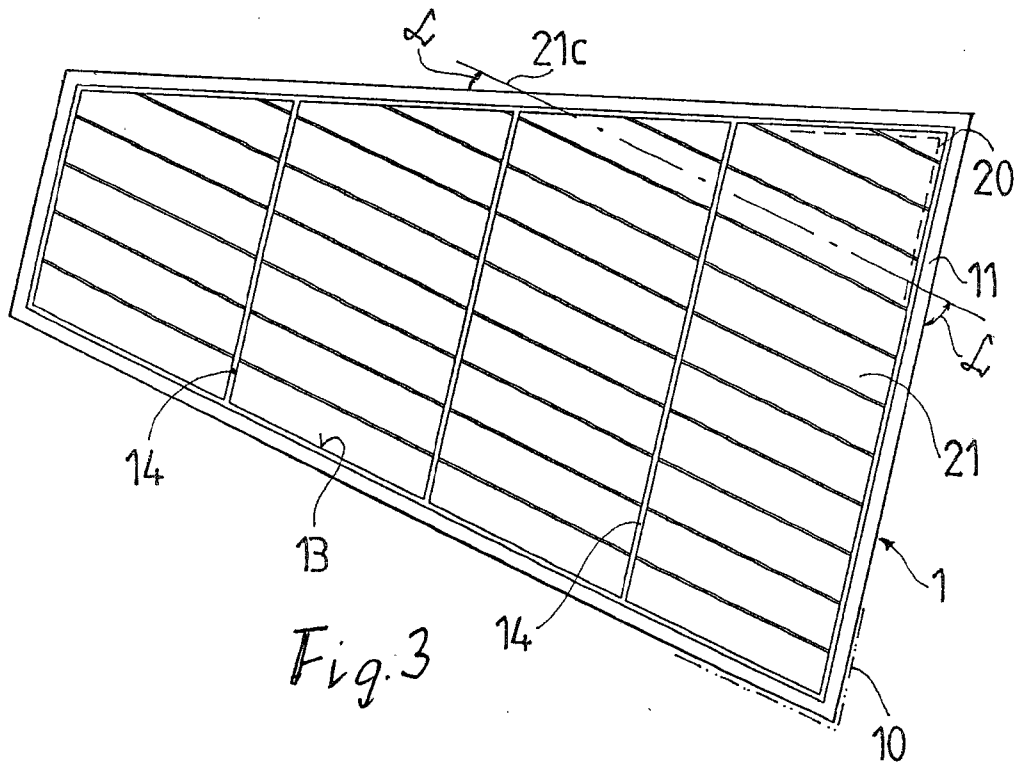


Fig. 2



INTERNATIONAL SEARCH REPORT

International application No
PCT/HU2013/000125

A. CLASSIFICATION OF SUBJECT MATTER
INV. B01D33/23
ADD.
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)
B01D

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	abstract; figures 1,6,9 paragraphs [0015], [0022]	2,8
Y	EP 0 938 359 A1 (KVAERNER PULPING AS [NO] VOITH PAPER PATENT GMBH [DE]) 1 September 1999 (1999-09-01)	2,8
X	paragraphs [0023], [0029]; figures 2-12	
X	US 2012/012519 A1 (ALTWIES EUGENE W [US]) 19 January 2012 (2012-01-19)	1,4,7
X	paragraphs [0004], [0007]; figures 1,3-6	
X	DE 43 10 129 C1 (ERNO RAUMFAHRTTECHNIK GMBH [DE]) 22 September 1994 (1994-09-22)	1-4,7,8
	abstract; figures 1-5	
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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
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Date of the actual completion of the international search

2 April 2014

Date of mailing of the international search report

22/04/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Sembritzki, Thorsten

INTERNATIONAL SEARCH REPORT

International application No
PCT/HU2013/000125

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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