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(54) **PERFORATED DRUM FOR THROUGH-AIR DRIERS**

(57) A perforated drum (1) for through-air dryers is disclosed, consisting of a hollow cylinder made of metal material or the like. Said drum (1) is made up by a series of radial plates (2) having the same length as the cylinder itself, said plates being joined together by perforated profiles (3), which are bent and circumferentially arranged perpendicular to said radial plates (2), thus forming H-shaped profiles with them.

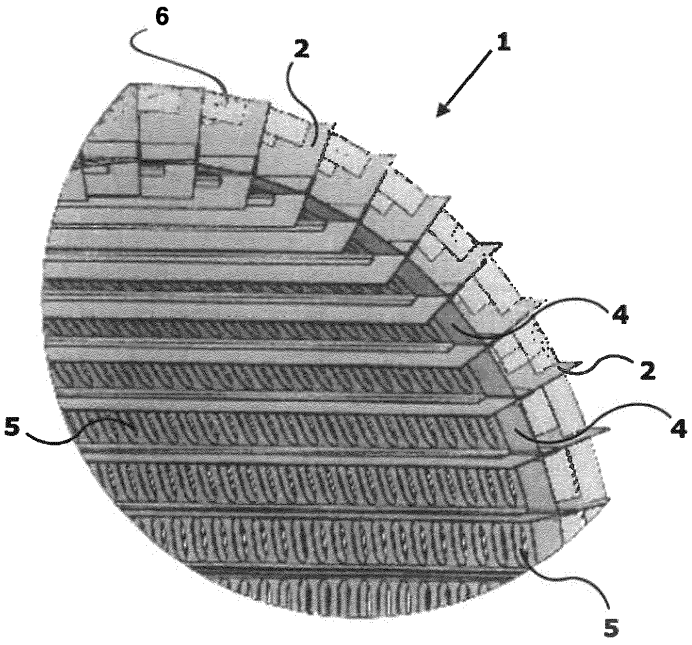

Fig. 3

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Description

[0001] This invention refers to a perforated drum for through-air dryers, to be mainly used in the textile industry.

[0002] The textile industry is among the oldest ones that humanity remembers. Handlooms are very ancient - already built by the Egyptians - while other techniques have gradually developed over time.

[0003] Usually, fabrics are made of a series of weft threads, within which warp threads are inserted (transversal to the weft threads and brought closer to each other, to form a more compact or less compact structure). In more recent times, so called "non-woven fabrics" have been created and manufactured. In these products, fibres are arranged randomly, instead of being orderly arranged as just mentioned, joining them together in other ways than plaiting, as it actually happens in weaving.

[0004] Non-woven fabrics can be made by many different ways. One of the most frequent one is to lay the scattered fibres on a transporting device; fibres are partly textile fibres and partly low-melting fibres or chemical resins, randomly mixed on the transporting device. The transporting device enters an oven wherein the temperature is raised, thus causing the low-melting fibres to melt, or the resins to dry. The non-woven fabric formation is completed by a passage through calenders which makes the non-woven fabric compact, which is then bonded or dried upon exiting the oven, and normally wrapped in rolls.

[0005] Generally, drying or bonding is accomplished through suitable drying drums which rotate inside appropriate ventilated, heated chambers. The drums are generally made in the form of cylindrical, hollow rollers, having perforated surfaces. The air suitably heated in the dryer is drawn to the inside of the drum, through the surface of the material to be dried; this is accomplished by means of fans placed inside the drying chamber. This type of drums is also used for other operations related to the textile industry, e.g., to dry fabrics after dyeing. The drying thus obtained is generally highly effective.

[0006] Drums for dryers generally consist of two rollers. A first fixed inner roller having a perforated surface, and a second also perforated roller, which rotates around the first one, usually having a grid for supporting a net onto which the material to be dried can be laid without being damaged. The rotating roller plays the role of supporting the fabric dried by the through-air, while the fixed roller is to uniform the air flow over the entire surface of the material to be dried.

[0007] The drum in its entirety has the function of supporting the fabric, transporting it, and forming the needed depression for drying. Obviously, the drum surface which contacts the fabric (the rotating roller outer surface) needs to be shaped in such a way as to avoid damaging the fabric while processing it.

[0008] The drum in its entirety should present an extremely high void to solid ratio, to minimise the areas where air cannot pass through, due to the presence of the metal material. This feature increases the drying speed and uniformity. Initially, drums were made as cylinders of metal sheet covered with circular holes of appropriate size, sometimes different from each other even on the same surface. This embodiment, however, achieved void to solid ratio of no more than 40%.

[0009] A subsequent embodiment provided that the surface had two perforated nets, one with coarser meshes and one with thinner meshes; the thin meshes one was normally arranged on that with coarse meshes, to avoid as much as possible any damage to the drying fabric surface caused by the engraving that the depression could make on the fabric. Instead, a kind of air channelling was concurrently achieved thanks to the coarse mesh, so that a certain passage of air was provided also in the blind areas in the perforated sheet, where the solid material was. In these devices, the net support structure was particularly important and it was implemented in various ways. Therefore, cylinder-shaped curved grids or U-shaped grids, supported on traditional perforated sheets as seen above, were available. These more recent embodiments achieve a void to solid ratio of 90% and sometimes even more.

[0010] As for the fixed roller also it is perforated, the holes being sized to uniform as much as possible the air flow passing through them and through the woven or non-woven fabric. Advantageously, the holes can be adjustable to adapt to any situation.

[0011] In any case, a drum like those described above, made up of a fixed roller and a rotating roller, is rather complex to be manufactured, being quite expensive and having a not negligible overall weight.

[0012] US2018/080 712 discloses a drum dryer, the side surface of which is made of U-shaped profiles, each being clearly provided with a bottom, each profile being welded to the next one and the bottom of said U-profile being apertured through holes. This solution has the drawback that, to increase the drum bending stiffness you need to lengthen the branches of the U, thus moving away its bottom through which air is drawn from the drum outer surface whereon the material to be dried lies, so that such distance becomes not optimal.

[0013] US 5 495 681 discloses a panel to be used in the drum of a clothes dryer, which comprises a perforated panel, of a size suitable to adapt to the shape of a peripheral portion of the drum; a PTFE coating on the panel, to prevent dust and the like from adhering to the clothes to be dried; a piano hinge, to mount the panel on the drum, along the panel edge. Owed to the hinge, the panel can move from a closed position, wherein the panel substantially adheres to the drum surface in its sector, to an open position, wherein the panel extends transversely to the drum inner surface.

[0014] NL 2 017 847 discloses a centrifuge, comprising a basket support, an engine, and a basket. The basket can be filled with a product and the engine-operated basket support drives into rotation the basket.

[0015] US 687 742 relates to a washing machine rotating drum, the periphery of which is made of woven thread, and which is provided with longitudinal ribs combined with grooved heads apt to engage with said woven thread to keep the structure closed.

[0016] US 2015/159 949 relates to a method for drying an article, which makes use of a radiofrequency applicator, having anode elements and cathode elements, and which provides for capacitively coupling the anode elements together, the cathode elements together, and an anode element to a cathode element, then powering electricity.

[0017] US2005/155 392 relates to a washing/drying machine drum, preferably with front loading, driven into rotation about its own axis by an engine, inside a tank comprising one or more plates which are separated from the drum, as to cover any manufacture defects and reduce the risks for the machine,

[0018] US2002/092 329 discloses a washing machine comprising a tank and a basket inside the tank, the basket being an open net and having a removable lid.

[0019] The problem underlying the invention is to provide a perforated drum structure for through-air dryers which overcomes the aforementioned drawbacks and which ensures a good drying, without damaging the surface of the object to be dried, and provides for a simpler construction, while maintaining the quality of drying. This purpose is achieved through a perforated drum for through-air dryers, consisting of a hollow cylinder of metal material or the like, characterised in that it is made up of a series of parallel radial plates, joined by a series of circumferentially arranged perforated plates (therefore preferably perpendicular to the plates) which are bent on their edges at the joint with the radial plates, so as to create a series of H-shaped profiles on the surface of the drum. The sub-claims disclose preferred features of the invention.

[0020] Further features and advantages of the invention will however become more apparent from the following detailed description of a preferred embodiment thereof, provided purely by way of non-limiting example and illustrated in the attached drawings, wherein:

Fig. 1 is a perspective view of a perforated drum for through-air dryers, according to a preferred embodiment of the present invention;
Fig. 2 is the detail within circle C in Fig. 1;
Fig. 3 is a front view of the detail of Fig. 2; and
Fig. 4 is a detail similar to Fig. 2, but according to a particularly preferred embodiment.

[0021] The drum 1, according to the present invention, is mounted in a through-air dryer (not shown in the drawings, since it per se belongs to the prior art), in such a way to be able to rotate. In the chamber where it is placed, means for making a vacuum (for example, one or more fans) are comprised, in a known way, apt to draw air which passes through a fabric dragged into rotation by the drum itself. The drum 1 is cylindrically shaped and usually made of metal material or the like. It could also be made of a non-metallic material which, however, should be sufficiently heat-resistant not to deform in use while drying, thus, when hot air passes through it, sufficiently hard to drag the woven or non-woven fabric being dried, and at the same time sufficiently elastic not to engrave the same woven or non-woven fabric as it contacts its surface. Preferably, stainless steel is used, but aluminium or others can be used as well; also, the thickness of the drum parts depends on the type of material.

[0022] Preferably, said drum has an extremely high permeability outer part (90% void, 10% solid, like in the prior art), to be used as the net support, and a low permeability inner part, to generate the needed depression for a perfect air distribution.

[0023] The drum 1 is made up of a series of radial plates 2, parallel to each other, joined by a series of circumferentially arranged perforated plates 3 (therefore, preferably perpendicular to the plates 2), having their edges bent at the joint with the plates 2.

[0024] According to a preferred embodiment, panels 4 are arranged adherent to the plates 3, and bent in the opposite direction, towards the inside of the drums, on their edges. Said panels 4 can be moved to adjust the opening of holes 5 in the plates 3. A series of H-shaped profiles are thus created on the drum surface. Preferably, said panels 4 are 300 mm long.

[0025] According to another preferred embodiment, on the plates 2 there are notches, facing out of the drum 1, for inserting and fixing circumferential rings 6. The rings 6 reinforce the drum 1 structure and form a grid which is the support onto which the laying net for the material to be dried rests.

[0026] With regard to the embodiment shown in Fig. 4, also the radial plates 2 are perforated, with holes 7 along their extension.

[0027] The drum 1 operation is per se similar to that of the drums of the prior art: it is driven into rotation by known means, and an interior vacuum is created, e.g., by means of one or more fans. An item to be dried, e.g., a woven or non-woven fabric, is made to adhere to the drum 1 surface and dragged into rotation by the same drum 1. As soon as the part to be dried covers the drum 1 surface, it is subjected to the action of the vacuum. Hot air from inside the dryer passes through the woven or non-woven fabric, thus removing water and moisture from it. The grid, covered by a laying net, and made up of the rings 6 and the plates 2, enables the adhesion on itself of the woven or non-woven fabric. The width of the meshes thus created and the number of voids ensure that the woven or non-woven fabric, supported by the external net, is uniformly dried, due to the extremely high ratio of void to solid in the support grid surface.

[0028] The H-shaped profile, created by the combination of the plates 2 and the perforated plates 3, allows a good channelling of the air flows, similarly to how it was in the prior art drums with the combination of a fixed and

a rotating roller, while offering a much simpler, less expensive, easier to use construction. The optional presence of the panels 4 allows to further adjust the air channelling while drying, to further improve its flow stability: thus, the material to be transversely dried can be subjected to a uniform drying air-flow throughout its entire surface.

[0029] The above-described construction surprisingly allows to get rid of the inner air distributing fixed roller, with the resulting advantages already listed several times. As such, the drum 1 according to the present invention allows to overcome all the drawbacks of the prior art, by way of an elegant and economical solution. Furthermore, the area below the support of the material is better accessible.

[0030] With respect to the embodiment illustrated in Fig. 4, upon a slightly higher cost than that of the other embodiments of the present invention, this solution presents the additional advantage of creating an even more uniform and homogeneous air flow, which is surprising compared to the expectations of a person skilled in the art, resulting in obvious advantages from the gas dynamic point of view. Furthermore, the drum according to this embodiment works less as a fan, as it wastes less energy than the other above-described embodiments, since the reduced resistance to rotation enabled by the presence of the holes 7, leading to considerable energy saving. Energy saving is also favoured by the drum weighing less with the same size. The smaller size also reduces the stresses related to the rotational movement and the consequent oscillation/vibration, thus considerably reducing the need for maintenance and replacement of parts. Finally, the drum lower mass caused by the presence of the holes 7, also allows to shorten the heating times.

[0031] Basically, upon a greater manufacturing expense, the embodiment according to Fig. 4 provides a noticeable energy and maintenance savings, so that the higher production costs are fully compensated by the energy consumption decrease for the operation of this drum.

[0032] Regardless of which embodiment of the present invention is implemented, the present invention allows to increase the drum bending stiffness by lengthening the branches of the H, while still maintaining constant, however, the distance of the drawing bottom (crosspiece of the H) from the drum outer surface whereon the material lies (which was impossible with the solutions of the prior art), in contrast to a U-profile according to the prior art, where you need to lengthen the branches of the U, thus moving away its bottom through which air is drawn from the drum outer surface whereon the material to be dried lies. It is understood, however, that the invention should not be considered as limited to the specific arrangement illustrated above, which is only an exemplary embodiment thereof, but that various variants are possible, all within the reach of a person skilled in the art, without thereby departing from the scope of protection of the invention itself, as defined by the following claims.

LIST OF REFERENCE CHARACTERS

[0033]

1	Drum
2	Radial plates
3	Circumferential perforated plates
4	Panels
5	Holes (of 3)
6	Rings
7	Holes (of 2)

Claims

1. A perforated drum (1) for through-air dryers, consisting of a hollow cylinder of metal material or the like, **characterised in that** it is made up of a series of parallel radial plates (2), joined by a series of circumferentially arranged perforated plates (3) (therefore perpendicular to the plates (2)), having their edges bent at the joint with the plates (2), so as to create a series of H-shaped profiles on the drum surface.

2. A perforated drum as claimed in claim 1), **characterised in that** said drum provides an outer part exhibiting extremely high permeability, apt to be used to support an external net for laying the material to be dried, and an inner part exhibiting low or adjustable permeability, apt to generate the needed depression for a perfect air distribution.

3. A drum (1) according to claims 1) or 2), **characterised in that** panels (4) are moreover arranged adherent to the plates (3), and bent in the opposite sense on their edges, towards the inside of the drum (1).

4. A drum (1) according to claim 3), **characterised in that** said panels (4) can be moved to adjust the opening of the holes (5) of the plates (3).

5. A drum according to any one of the preceding claims, **characterised in that** the radial plates (2) have notches, towards the outside of the drum (1), for inserting and fixing circumferential rings (6).

6. A perforated drum according to any one of the preceding claims, **characterised in that** also the radial plates (2) are perforated with holes (7) along their extension.

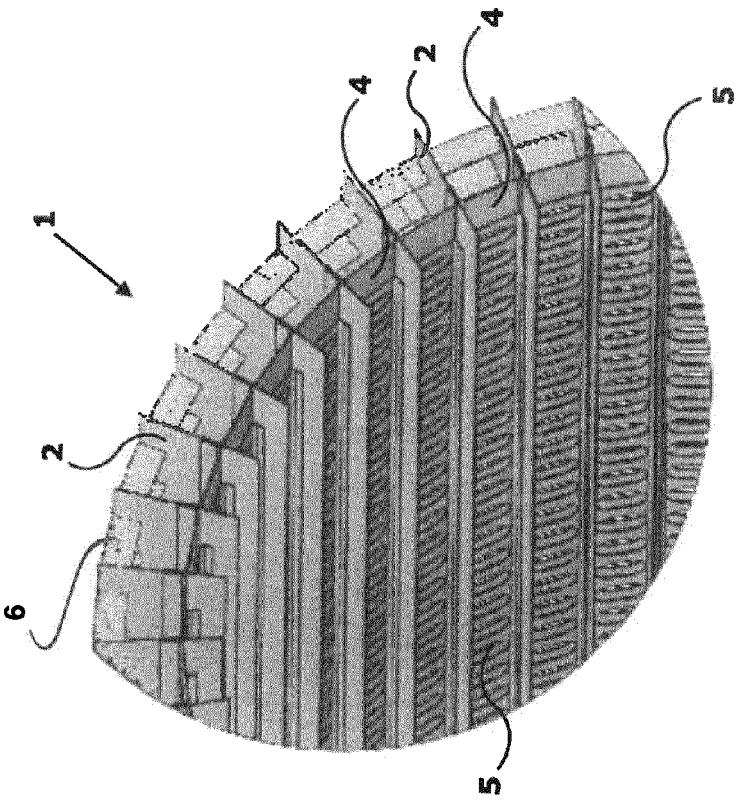

Fig. 3

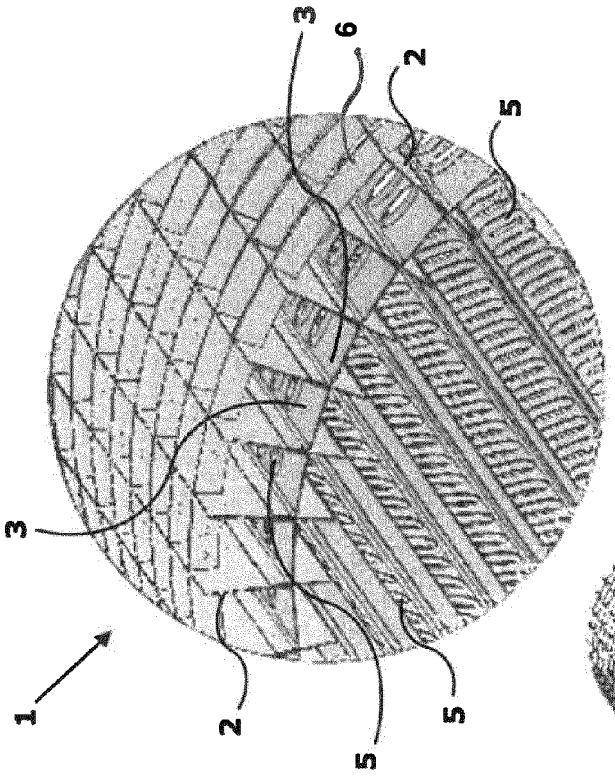

Fig. 2

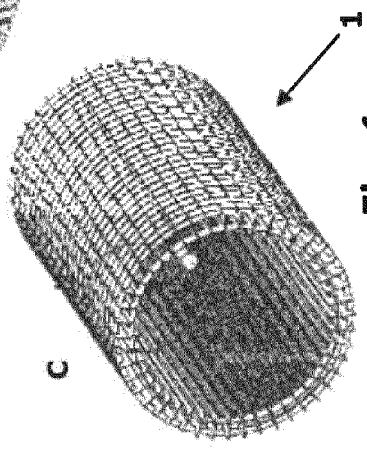

Fig. 1

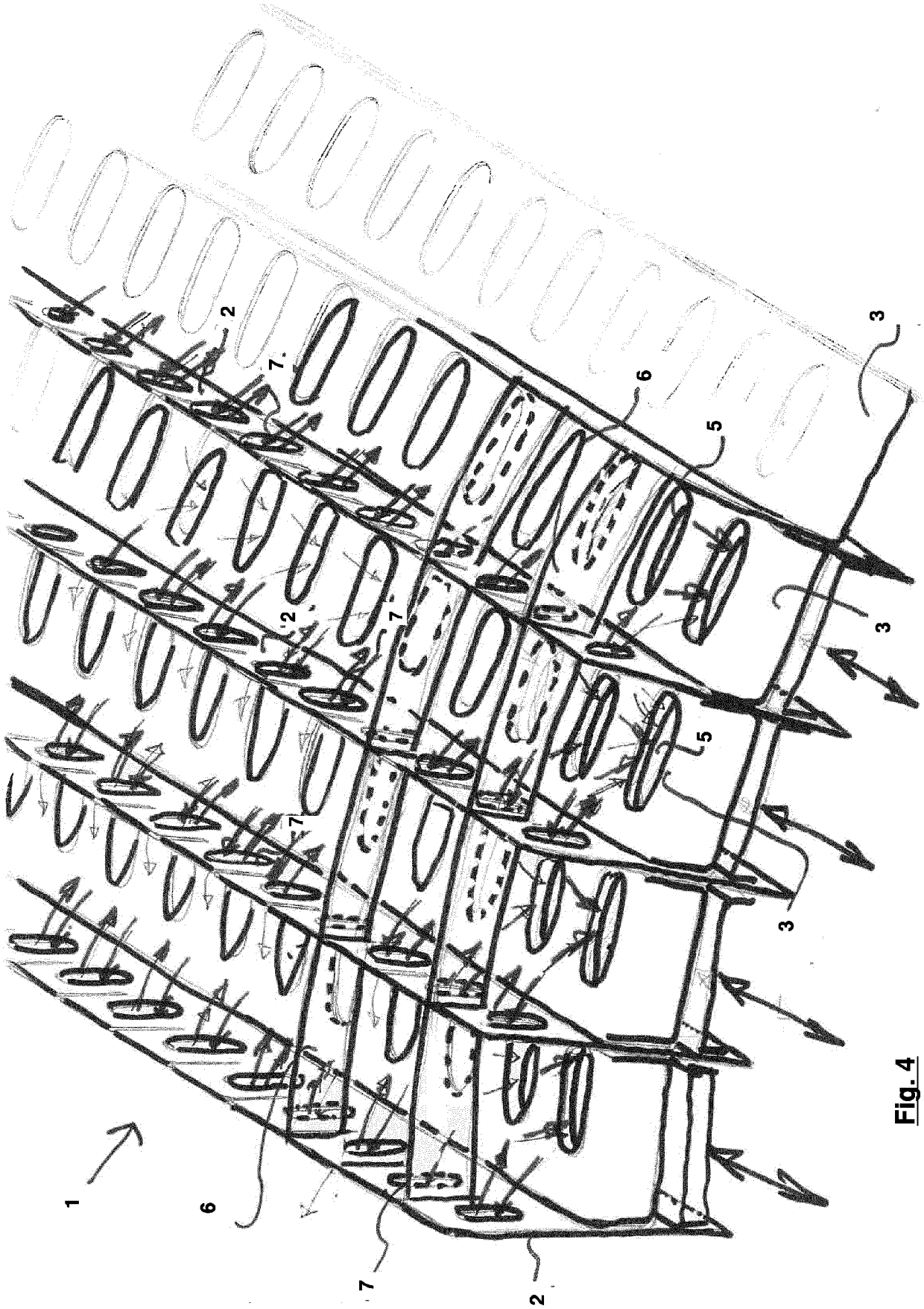

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 21 17 1436

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	IT 2018 0000 7443 A1 (SICAM SRL) 23 January 2020 (2020-01-23)	1-5	INV. F26B3/06 F26B13/16
Y	* the whole document *	6	

Y	US 2006/213079 A1 (RIBEIRO HELIO [US] ET AL) 28 September 2006 (2006-09-28)	6	
A	* the whole document *	1-5	

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	* the whole document *		

TECHNICAL FIELDS SEARCHED (IPC)

F26B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 October 2021	Villar Fernández, R

CATEGORY OF CITED DOCUMENTS

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08-10-2021

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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