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(54) **Device and system for sheet transportation**

(57) The present invention relates to a device (1) for conveying sheets (2), comprising a board (3) provided with bore holes (4); blowing means (5) connected to a first series of bore holes (4a); at least two conveyor belts (8) arranged such that they slide on said conveyor board; suction means (9) connected to a second series of bore holes (4b) of the board, arranged below the conveyor

belts. The conveyor belts are provided with holes (11) along their entire length which uncover intermittently and during the forward movement of the belt the bore holes of the second series of bore holes. The conveyor board comprises barriers (12) arranged adjacent to each side of each conveyor belt on the upper edges (12a) of which the sheet is supported during its travel over the board.

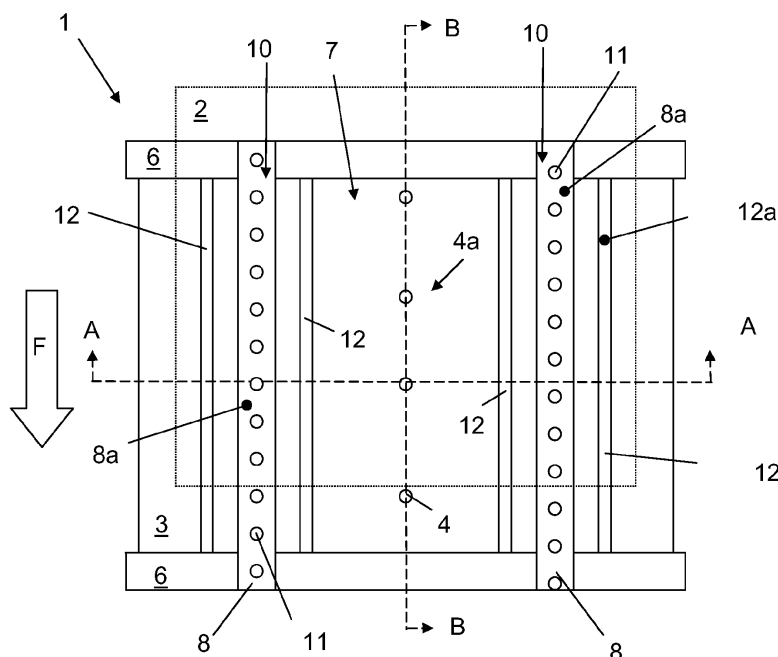


Fig. 1

Description

Technical Field of the Invention

[0001] The present invention describes a device and system for conveying sheets, such as sheets of paper or cardboard, of the type comprising a board provided with bore holes, conveyor belts and blowing and suction means.

Background of the Invention

[0002] Devices for conveying sheets, such as sheets of paper or cardboard from a stack of sheets where they are separated by means of a feeder to the point where said sheets are handled, are known.

[0003] Devices for conveying sheets provided with narrow conveyor belt-like belts for conveying sheets, provided with upper pressure wheels assuring the proper conveyance of the sheet without shifting with respect to the belts during conveyance are known. Nevertheless, said wheels complicate subsequent handling of the sheet for appropriately squaring it and arranging it in a known position suitable for being able to be handled correctly later, so the end conveyance sector cannot have wheels, the sheet being secured in said end sector only at its rear edge by end wheels. Therefore, said final pressure wheels must be adjusted every time according to the size of the sheet, so they have to be adjusted every time the size of sheet to be handled changes.

[0004] Alternatively, devices provided with a perforated conveyor belt-like wide band, which creates sufficient grip for conveying sheets by means of creating a lower vacuum chamber, are known. Nevertheless this grip makes it difficult to separate the sheet from the band in the end sector for handling, so the pressure exerted by the vacuum chamber on the sheet must be reduced, it being necessary to provide the end conveyance sector with end pressure wheels which must also be adjusted every time the size of sheet to be handled changes.

[0005] Devices like that described in patent document US5133543 are known, comprising a pair of conveyor belts which creates sufficient grip for conveying the sheets by means of creating a lower vacuum chamber, also having compensation holes preventing the generation of negative pressure between converging conveyor belts, in addition to being able to provide an air baffle to facilitate the lateral travel of the sheets for suitable lateral positioning.

[0006] Nevertheless, it is necessary to exert considerable air pressure to obtain an air baffle which allows being able to readily retain the sheet on the conveyor belts in the end conveyor sector for handling.

[0007] An objective of the present invention therefore is to disclose a conveyor device lacking pressure wheels which allows being able to readily retain the sheet on the conveyor belts in the end conveyor sector for handling.

Disclosure of the Invention

[0008] The device for conveying sheets of the present invention is of the type comprising a board provided with bore holes forming a first and a second series of bore holes; blowing means connected to the first series of bore holes of the board, determining at least one blowing area; at least two conveyor belts arranged such that they slide on said conveyor board in the forward movement direction of the sheets, said conveyor belts being essentially parallel to one another and the gap between conveyor belts comprising a blowing area; and suction means connected to the second series of bore holes of the board, arranged below the conveyor belts, determining suction areas.

[0009] The device is essentially **characterized in that** the conveyor belts are provided with holes along their entire length which uncover intermittently and during the forward movement of the belt the bore holes of the second series of bore holes, and in that the conveyor board comprises separation barriers between blowing areas and suction areas, arranged adjacent to each side of each conveyor belt on the upper edges of which the sheet is supported during its travel over the board, preventing the sheet from adhering to the surface of the board during its forward movement and allowing the creation of sufficient air baffle to allow being able to readily retain the sheet on the conveyor belts in the end conveyor sector for handling.

[0010] According to another feature of the invention, the separation barriers have a height similar to that of the conveyor belts, allowing the sheet to be supported on the separation barriers, in one variant of interest, the upper edge of the separation barriers being coplanar with the outer face of the conveyor belts, which allow that even though the sheet is made of a rigid material, it is always supported on the separation barriers.

[0011] According to another feature of the invention, the bore holes of the second series of bore holes arranged below the same conveyor belt are aligned, which facilitates being able to be covered and uncovered intermittently by the holes of the conveyor belt.

[0012] In one variant of the invention, the aligned bore holes arranged below the same conveyor belt are separated 10 cm, allowing a sheet of this length to always be arranged on a suction area.

[0013] In another variant of the invention, the distance between adjacent holes of the same conveyor belt is 8 cm, allowing the bore holes of the second series of bore holes arranged below the belt to be constantly covered and uncovered.

[0014] In another embodiment of interest, the bore holes of the second series of bore holes are of the same size as the holes of the conveyor belt, allowing a hole to completely uncover a bore hole when they align, therefore maximizing suction. The holes of the conveyor belt can naturally be larger than the bore holes of the second series of bore holes because the suction force is not af-

fected.

[0015] In one variant of the invention, the device comprises retractable retaining means in the board synchronized with the speed of the conveyor belt and, therefore, with the passage of sheets, for momentarily retaining each sheet, blocking its forward movement, without retaining the conveyor belts on which the sheet is traveling, and thus being able to square the sheet in the direction perpendicular to the forward movement direction of the sheet.

[0016] According to another feature, the board is inclined with respect to the horizontal, allowing the conveyance of sheets at a different height. In some variants of the invention, said inclination of the board is different at different points of said board, being able to determine a convex board, preventing the board from having steep ramps.

[0017] In another embodiment of interest, the device comprises four conveyor belts, allowing the conveyance of sheets of intermediate width.

[0018] In another embodiment, the device comprises six conveyor belts, allowing the conveyance of sheets of greater width.

[0019] The system of the present invention comprises a feeder suitable for obtaining sheets from a stack and at least one device according to the present invention suitable for conveying the sheets obtained from said feeder to squaring means.

Brief Description of the Drawings

[0020]

Figure 1 depicts a plan view of the device of the invention;

Figure 2 depicts a plan view of the board of the device of Figure 1;

Figure 3 depicts a cross-section view according to section plane AA of the device of Figure 1;

Figure 4 shows a longitudinal section view according to section plane BB of the device of Figure 1;

Figure 5 shows a plan view of another variant of the device;

Figure 6 shows a system comprising three devices; and

Figure 7 shows a system comprising a device.

Detailed Description of the Invention

[0021] Figures 1, 3 and 4 show different views of a device 1 for conveying sheets 2 according to the invention. As can be seen, the device comprises a board 3 made of a rigid material, such as a sheet metal or wood inlaid with stainless steel, on which the sheets 2 are conveyed by means of conveyor belts 8. In turn, it is possible to form the board 3 from different sectors of board, attached to one another, to cover the desired path. The sheets 2 can be semi-rigid, such as sheets of cardboard,

or flexible, such as sheets of paper or plastic. In a known manner and as will be shown below, the sheets 2 are obtained from a stack from where they are separated by means of a feeder of the type known in the state of the art, which feeder delivers them to the conveyor device 1 in a staggered manner, adjacent sheets being partially overlapped, or said sheets alternatively being delivered in series, i.e., one by one. It is stressed that when conveyance is staggered, the board 3 is completely covered by the sheets, there being no gaps between sheets, advantageously achieving better conveyance of said sheets by completely covering the surface of the board 3, as will be seen below.

[0022] Said sheets 2 must then be conveyed by means of the conveyor belts 8, which are driven in the same direction by rollers 6 to the point where said sheets 2 must be delivered.

[0023] As can be seen, the variant of the invention shown in Figure 1 comprises two conveyor belts 8 which are arranged such that they slide on the board 3 in the forward movement direction of the sheets 2, shown by the arrow F. Said conveyor belts 8 are essentially parallel to one another so that the direction of conveyance is rectilinear.

[0024] As shown in the board of Figure 2, bore holes 4 have been made in said board 3 to facilitate conveyance of the sheets 2 by means of the conveyor belts 8. A first and a second series of bore holes 4a, 4b can be seen in said bore holes 4, depending on the functionality of said bore holes 4, which will be described below. As can be seen in Figure 3, the first series of bore holes 4a is connected to typical blowing means 5 by means of blowing ducts 13 through which air is expelled through the bore holes 4 forming a blowing area 7 in which an air pocket is created between a board 3 and the sheets 2 which are conveyed and pass over the bore holes 4 of the first series of bore holes 4a, facilitating the sliding of the sheets 2. In the variant shown in Figures 1, 2 and 4, there is only one central blowing area 7, although there can be more blowing areas 7 as will be seen below. Although in this variant the size of the bore holes 4 of the first series of bore holes 4a and of the second series of bore holes 4b is the same, in other variants of the invention the sizes may be different to appropriately adjust blowing and suction in each sector of the device 1. Naturally, if necessary, the bore holes 4 of the first series of bore holes 4a may not be aligned, but rather be distributed throughout the entire blowing area 7 to form a homogenous air pocket.

[0025] The second series of bore holes 4b is connected to typical suction means 9, such as a suction pump or suction turbine, by means of respective suction ducts 14, determining a suction area 10 around said second series of bore holes 4b.

[0026] As can be seen in Figure 1, the conveyor belts 8 are provided with holes 11 along their entire length, the bore holes 4 forming part of the second series of bore holes 4b being visible in the detail of board 3 of Figure 2, advantageously covered below said conveyor belts 8.

[0027] Since the bore holes 4 of the respective second series of bore holes 4b which are arranged below the same conveyor belt 8 are aligned in the same direction as the conveyor belt 8, during the forward movement of the conveyor belt 8 during the conveying process for conveying one or several sheets 2, the holes 11 of said conveyor belt 8 cover and uncover intermittently each of the bore holes 4 of the second series of bore holes 4b, allowing the sheet 2 traveling over a sector of conveyor belt 8 to be adhered intermittently and exerting an increasing and decreasing force against the conveyor belt as the holes 11 are eventually aligned with the respective bore holes 4 of the second series of bore holes 4b during the forward movement of the conveyor belts 8. In the variant depicted in Figures 1 to 4, the separation between consecutive bore holes 4 of the second series of bore holes 4b is 10 cm, whereas the separation between consecutive holes 11 is 8 cm.

[0028] As can be seen in the variant depicted, the bore holes 4 of the second series of bore holes 4b are of the same size as the holes 11 of the conveyor belts 8. In said variant, the aligned bore holes 4 arranged below the same conveyor belt 8 are separated 10 cm from one another, whereas the distance between adjacent holes 11 of the same conveyor belt 8 is 8 cm, the diameter of both being the same, 2 cm. This difference of distances means that the bore holes 4 close to one another are not covered or uncovered at the same time, but rather with a certain lack of synchronism, favoring each sheet 2 always being arranged on top of a partially uncovered bore hole 4 of the second series of bore holes 4b.

[0029] During the travel of the conveyor belts 8 on the board 3, a certain allowance is created between the conveyor belts 8 and the surface of the board 3. This allowance advantageously allows that when the bore holes 4 of the second series of bore holes 4b are covered, the suction can be exerted on the sheet 2 through the edges of said conveyor belt 8. Naturally, the exerted suction and the allowance between the conveyor belts 8 and the surface of the board 3 must be calculated so as to allow sufficient suction of the sheet 2 without the conveyor belt 8 being affected by said suction, for example being diverted from its course or even becoming jammed.

[0030] As described above, the air expelled by the first group of bore holes 4a in the blowing area 7 creates an air pocket facilitating conveyance of the sheet 2, nevertheless, it is necessary that this air exiting with certain pressure is not quickly absorbed by the suction area 10 of the second group of bore holes 4b, because this would weaken the effect exerted by said air pocket on the sheet 2 and allow the sliding thereof, furthermore the suction force exerted by the suction area 10 would be less. Advantageously, the board 3 comprises separation barriers 12 between blowing areas 7 and suction areas 10, arranged adjacent to each side of each conveyor belt 8 on the upper edges 12a of which the sheet is supported during its travel over the board 3, preventing the sheet from adhering to the surface of the board during its forward

ward movement and advantageously allowing the creation of an air pocket with excess pressure between the barriers 12. Similarly, said barriers 12 favor the suction exerted by the second group of bore holes 4b being essentially normal to the surface of the board 3, i.e., towards the sheet 2.

[0031] These barriers 12 can be metal barriers made, for example, of stainless steel or of any other rigid material that allows the sliding of the sheets, such as plastic for example. As can be seen in Figure 3, the barriers 12 are adhered to the surface of the board 3, although it is possible for them to be press-formed in the actual board 3 or in a metal sheet that is adhered to the surface of the board 3. Advantageously, when the barriers 12 are made of an electric conducting material, said barriers 12 can be used to discharge the static electricity that can be generated in the sheets 2 due to friction, among others, and safely ground it.

[0032] It can be seen in Figure 3 that the separation barriers 12 essentially have the same height as the height by which the conveyor belt 8 protrudes from the board 3, the outer face 8a of the conveyor belts 8 being coplanar with the upper edge 12a of the barriers 12 and allowing a sheet 2 applied against the conveyor belts 8 to be correctly applied against the upper edge 12a of the barriers 12, as shown in Figure 3, separating the blowing areas 7 from the suction areas 10 of the device 1. Although the upper edge 12a of the barriers 12 is planar in the variant depicted, it could have different shapes that allow suitably separating the suction area 10 from the blowing areas 7, such as a rounded or pointed finish.

[0033] Naturally, since the sheet 2 is made of a somewhat flexible material, the separation barriers 12 could have a height similar to that of the conveyor belts 8, both the smaller and the larger ones, similar being understood in the context of the invention as that difference in height which allows, due to the effect of the weight of the sheet 2 itself and the suction exerted on the sheet 2, being able to apply it on the barriers 12 by bending it slightly and correctly separating each of the suction areas 10 from the adjacent blowing areas 7. Nevertheless, this difference in height must be small enough so as to prevent having to exert too much suction on the sheet 2 or the latter may be damaged as it is bent. For example, it has been found that a height of the conveyor belt 8 of 1 mm and a height of the barrier 12 of 0.7 mm allow correct conveyance of the sheets 2.

[0034] Since each sheet 2 is supported only on the upper edges 12a of the barriers 12 and partially adhered to the conveyor belts 8 in the suction areas 10, but separated from the surface of the board 3 by the air pocket of the blowing area 7, the sheet 2 can advantageously travel at the same speed and in the same forward movement direction of the conveyor belts 8, shown by the arrow F. Advantageously, since there is no friction between the sheet 2 and the surface of the board 3, the board 3 can have retractable retaining means 16, such as a pair of rods aligned perpendicular to the forward movement

direction protruding from the surface of the board 3, in a manner synchronized with the speed of the conveyor belt 8 and, therefore, with the passage of sheets 2, to momentarily retain the sheet 2 without retaining the conveyor belts 8 on which the sheet 2 travels, and the sheet 2 can therefore be squared in the direction perpendicular to the forward movement direction. To square the sheets 2 in the forward movement direction of the sheets 2, since there is no friction between the sheet 2 and the surface of the board 3 as described above, it is possible to shift the sheet 2 in the direction perpendicular to the forward movement direction of the conveyor belts 8 easily and without damaging the sheet 2, for example subjecting it to a pushing or clamping force by squaring means as will be shown below. To facilitate the conveyor belts 8 continuing to slide below the sheet 2 while it is retained and the travel of the sheet 2 in a direction perpendicular to the forward movement direction of the conveyor belts 8 is facilitated, the roughness of the conveyor belts 8 as well as the pressure exerted by the blowing areas 7 and the suction areas 10 must be suitably gauged. Additionally, to achieve this gauging, it is possible to incorporate regulation means, such as shut-off valves, in the blowing ducts 13 and in the suction ducts 14, allowing the opening or closing of those ducts or duct sectors, as appropriate. This arrangement is of particular interest to completely or partially close the suction ducts 14 associated with the end bore holes 4 of the second series of bore holes 4b in order to reduce the suction effect and prevent obstructing the squaring means.

[0035] Figure 5 shows a variant of the device 1 comprising four conveyor belts 8, suitable for conveying larger sheets 2. In this case, there are blowing areas 7 formed by bore holes 4 of the first series of bore holes 4a forming air pockets between the different conveyor belts 8. It can also be observed that arranged adjacent to each side of each conveyor belt 8 there are separation barriers 12 between blowing areas 7 and suction areas 10. Similarly, the number of conveyor belts can be increased to support larger sheets 2, there being able to be six, for example, or even a larger number thereof.

[0036] Figure 6 shows a system 100 formed by three devices 1: a first device 1 a, a second device 1 b and a third device 1 c, all aligned, the first device 1 a comprising a horizontal board 3 suitable for conveying a sheet 2 horizontally in the direction of the arrow F to the second device 1 b comprising a convex board 3 suitable for conveying the sheet 2 to a third device 1 c comprising an inclined board 3.

[0037] Naturally, the different devices 1 must be aligned so that the conveyor belts 8 of each device 1 can deliver the sheets 2 to the conveyor belts 8 of the next device 1, the sheets 2 suitably being able to travel in the forward movement direction shown by the arrow F. As can be seen in Figure 6, the flow of sheets 2 is obtained in a known manner from a stack 101 from which a feeder 102 of the type known in the state of the art sends them one by one to the first device 1 a, which conveys them

horizontally to the second device 1 b. The second device 1 b allows arranging the sheet 2 in an inclined position suitable for delivering it to the third device 1 c. The third device 1 c comprises an inclined board 3, where cavities 15 have been made to allow the retaining means 16 described above to suitably retain each sheet 2, allowing squaring means 103, which are synchronous with the retaining means 16, to square and suitably arrange the sheet 2 for subsequent processing in later steps. After squaring, the sheet 2 is removed by typical conveyor means 104 to be conveyed to the next processing phases.

[0038] Figure 7 shows a second system 200, an alternative variant of the preceding system, formed by a single device 1 the board 3 of which is formed by three attached board segments 3a, 3b, 3c, the first board segment 3a being horizontal, the second board segment 3b being convex and the third board segment 3c being inclined. In this variant it can be seen that the conveyor belt 8, which conveys sheets 2 in the direction of the arrow F, does not travel over the entire board 3, but rather returns through a recess 17 made in the board 3, allowing the sheets 2 to fall due to their own weight to retaining means 16 of the type described above, which means can be retracted through cavities 15 made in the board 3 for squaring the sheet 2 similarly to that described in the first system 100. It is observed in Figure 7 that the sheets 2 travel in the direction of the arrow F in a staggered fashion, the entire surface of the board 3 being advantageously covered and therefore there being no separation between sheets 2, preventing the air pocket formed in the blowing areas from being able to escape through the separation between sheets and favoring the suction force exerted in the suction areas directly striking the sheets 2.

Claims

1. A device (1) for conveying sheets (2) comprising:

- a board (3) provided with bore holes (4) forming a first and a second series of bore holes (4a, 4b);
- blowing means (5) connected to the first series of bore holes (4a) of the board, determining at least one blowing area (7);
- at least two conveyor belts (8) arranged such that they slide on said board in the forward movement direction of the sheets, said conveyor belts being essentially parallel to one another and the gap between conveyor belts comprising a blowing area;
- suction means (9) connected to the second series of bore holes (4b) of the board, arranged below the conveyor belts, determining suction areas (10) **characterized in that** the conveyor belts are provided with holes (11) along their entire length which uncover intermittently and during the forward movement of the conveyor belt

- the different bore holes of the second series of bore holes, and **in that** the conveyor board comprises separation barriers (12) between blowing areas and suction areas, arranged adjacent to each side of each conveyor belt on the upper edges (12a) of which the sheet is supported during its travel over the board. 5
2. The device (1) according to the preceding claim, **characterized in that** the height of the separation barriers (12) is similar to the height of the conveyor belts (8). 10
3. The device (1) according to the preceding claim, **characterized in that** the upper edge (12a) of the separation barriers (12) is coplanar with the outer face (8a) of the conveyor belts (8). 15
4. The device (1) according to any one of the preceding claims, **characterized in that** the bore holes (4) of the second series of bore holes (4b) arranged below the same conveyor belt (8) are aligned. 20
5. The device (1) according to the preceding claim, **characterized in that** the aligned bore holes (4) arranged below the same conveyor belt (8) are separated 10 cm. 25
6. The device (1) according to any one of the preceding claims, **characterized in that** the distance between adjacent holes (11) of the same conveyor belt is 8 cm. 30
7. The device (1) according to any one of the preceding claims, **characterized in that** the bore holes (4) of the second series of bore holes (4b) are of the same size as the holes (11) of the conveyor belts (8). 35
8. The device (1) according to any one of the preceding claims, **characterized in that** the board (3) is inclined with respect to the horizontal. 40
9. The device (1) according to the preceding claim, **characterized in that** the inclination of the board (3) is different at different points of said board. 45
10. The device (1) according to the preceding claim, **characterized in that** the board (3) is convex.
11. The device (1) according to any one of the preceding claims, **characterized in that** it comprises retractable retaining means (16). 50
12. The device (1) according to any one of the preceding claims, **characterized in that** it comprises four conveyor belts (8). 55
13. The device (1) according to any one of claims 1 to 11, **characterized in that** comprises six conveyor belts (8).
14. A system (100,200) for conveying sheets (2), **characterized in that** it comprises a feeder (102) suitable for obtaining sheets from a stack (101) and at least one device (1) according to any one of the preceding claims suitable for conveying the sheets obtained from said feeder to squaring means (103).

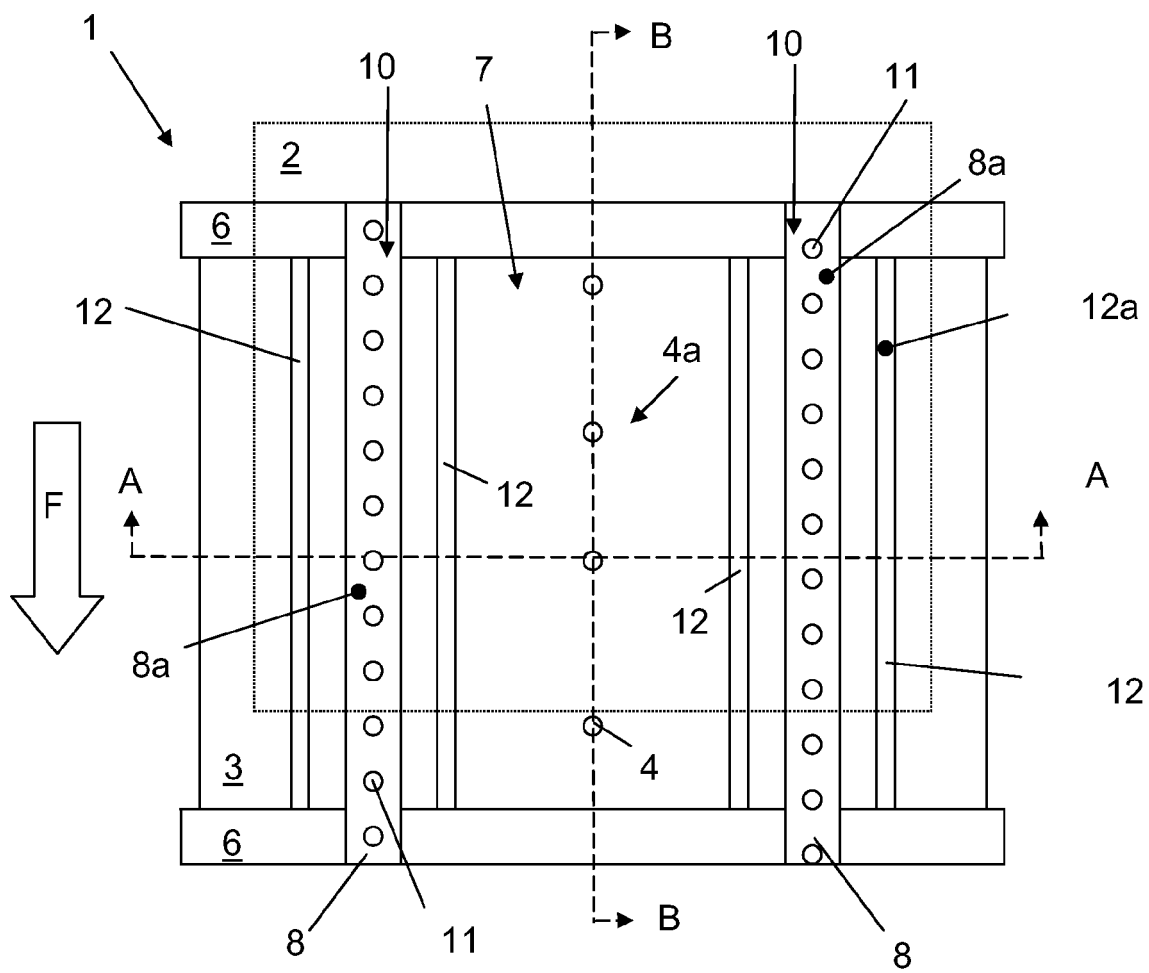


Fig. 1

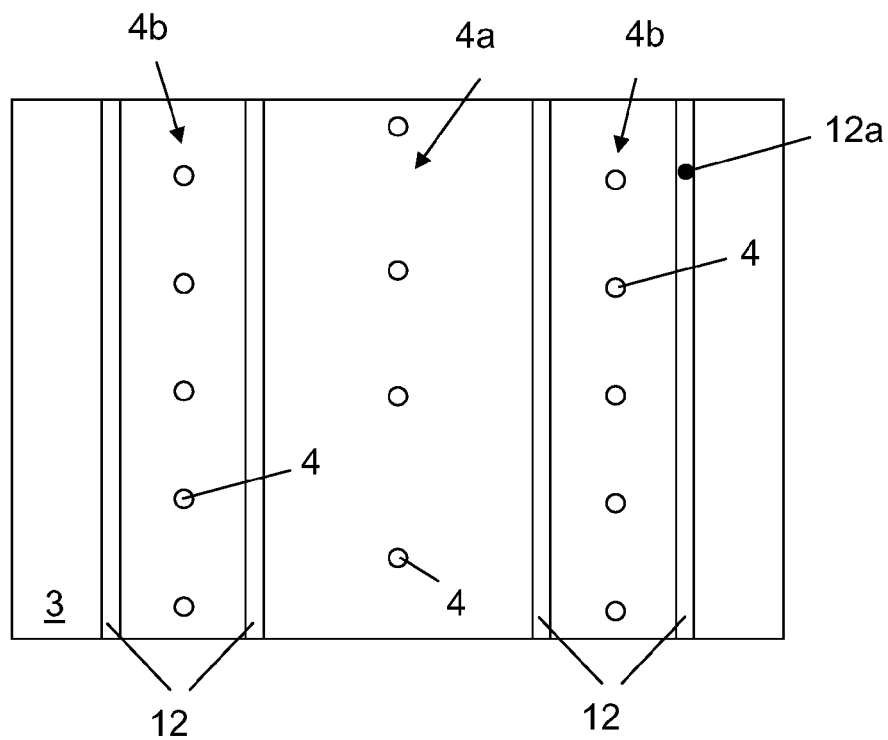


Fig. 2

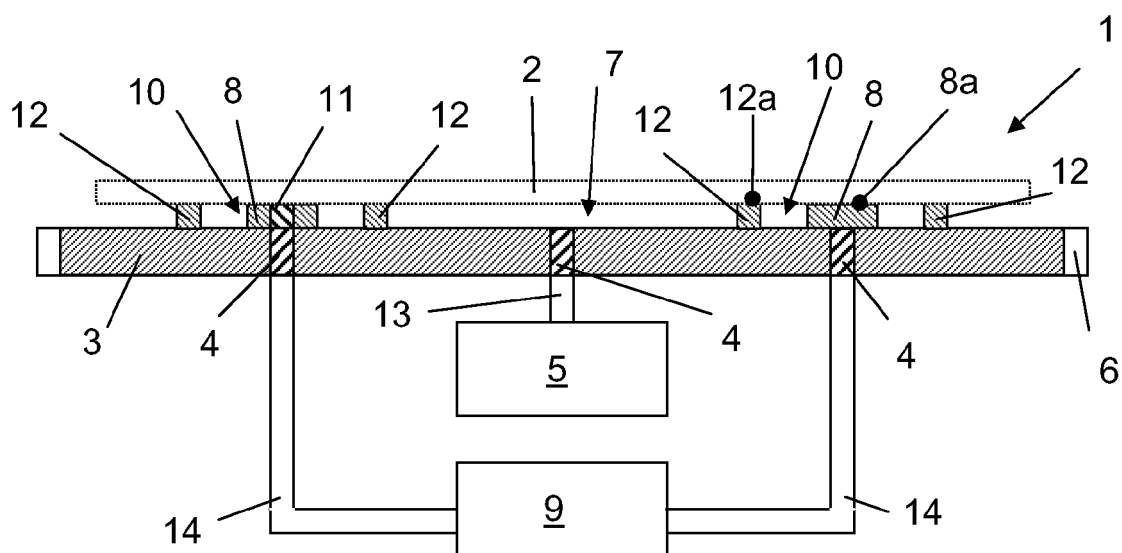


Fig. 3

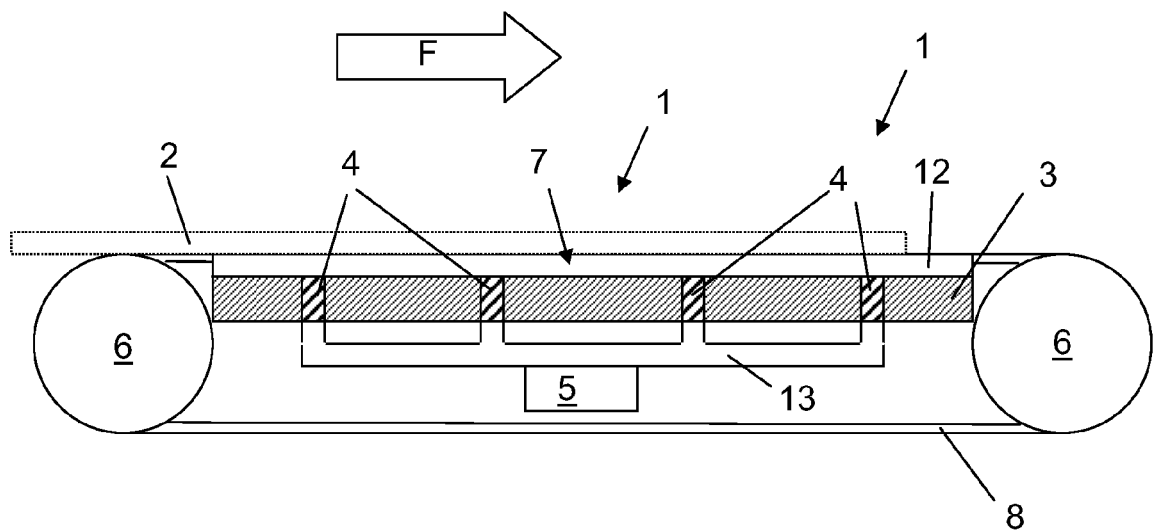


Fig. 4

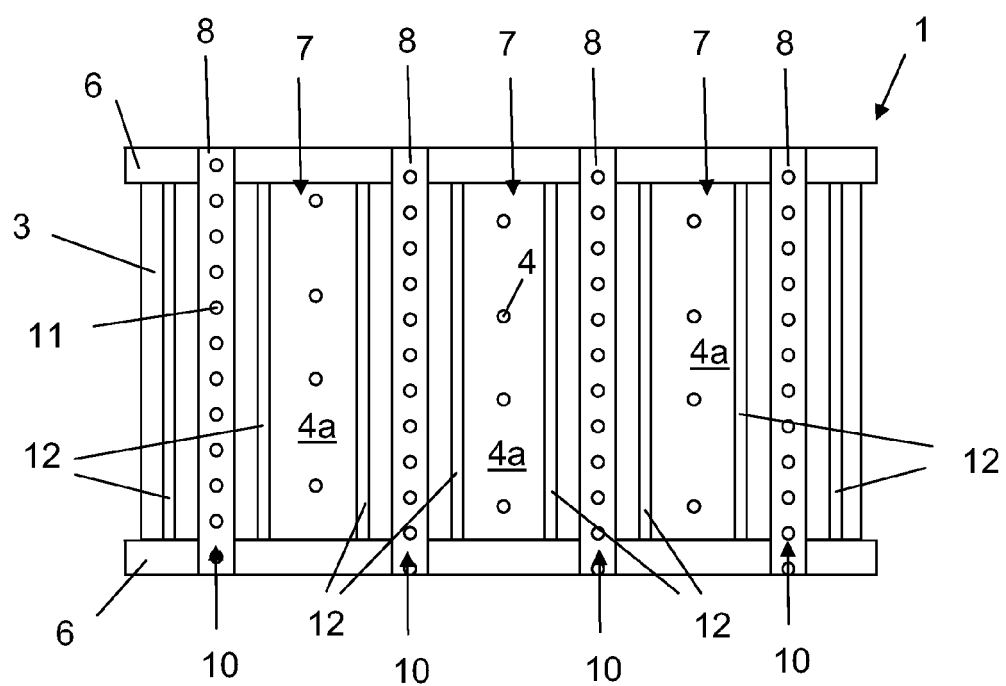
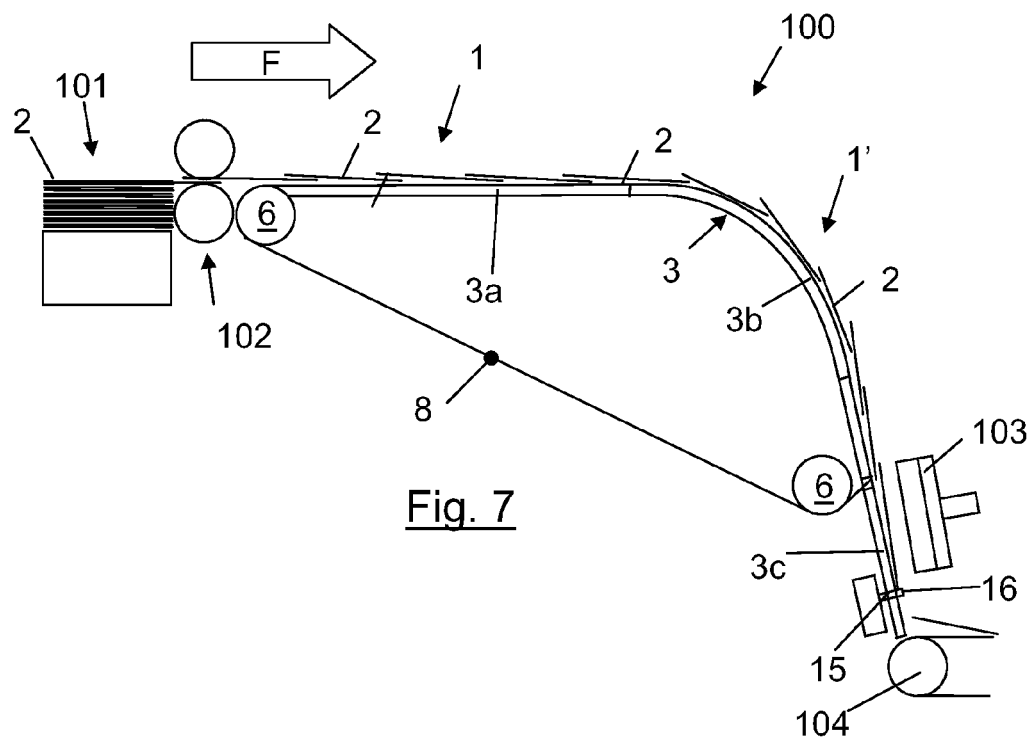
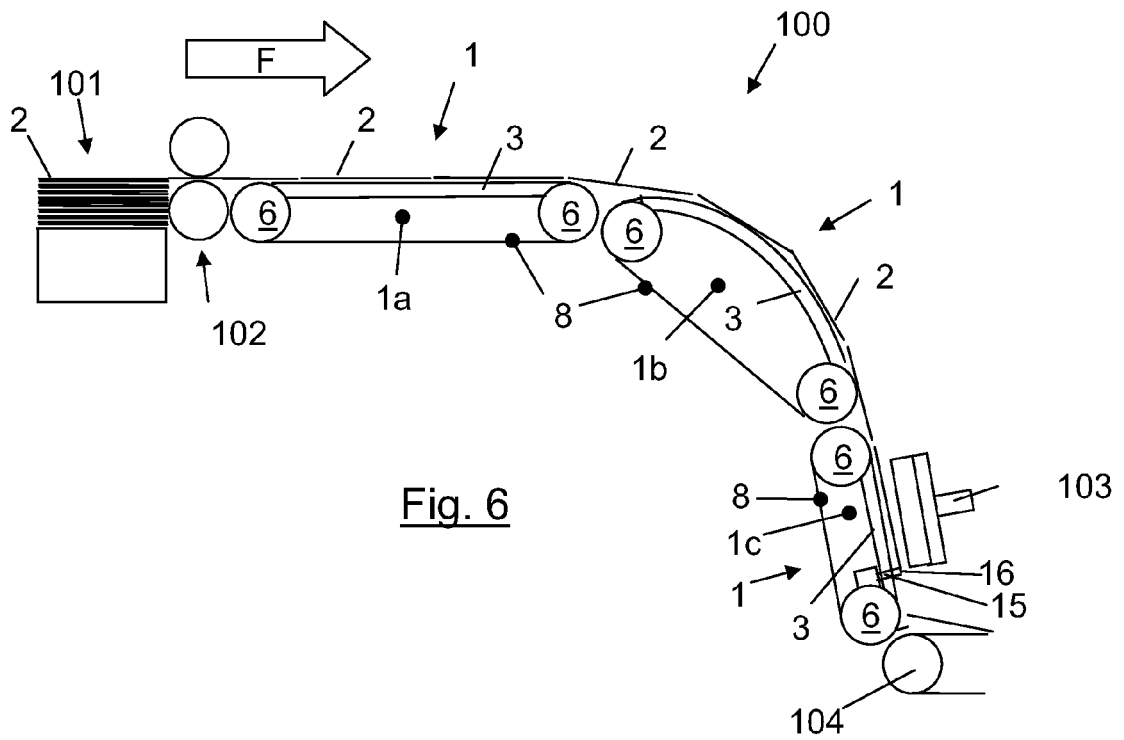


Fig. 5



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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