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(54) **DEVICE AND METHOD FOR THE TRANSPORT OF FLEXIBLE SHEETS**

(57) A device (1) for transporting flexible sheets (2), combining movable support means (3) on which a sheet can be placed and which are adapted to move the sheet in a direction of displacement; and suction means (5) for maintaining the sheet placed against the support means, in which the support means are configured so that a sheet placed against the support means takes on a bent shape in a transverse plane to the direction of displacement. The method for transporting flexible sheets (2) in a direction of displacement comprises bending the sheets in a transverse plane to the direction of displacement.

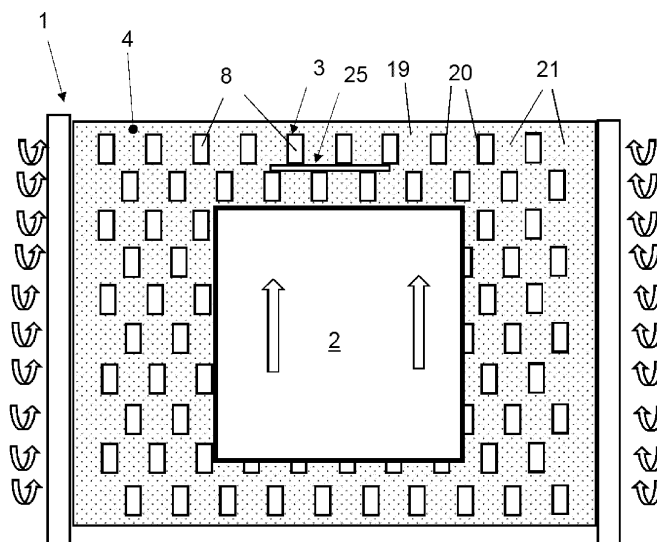
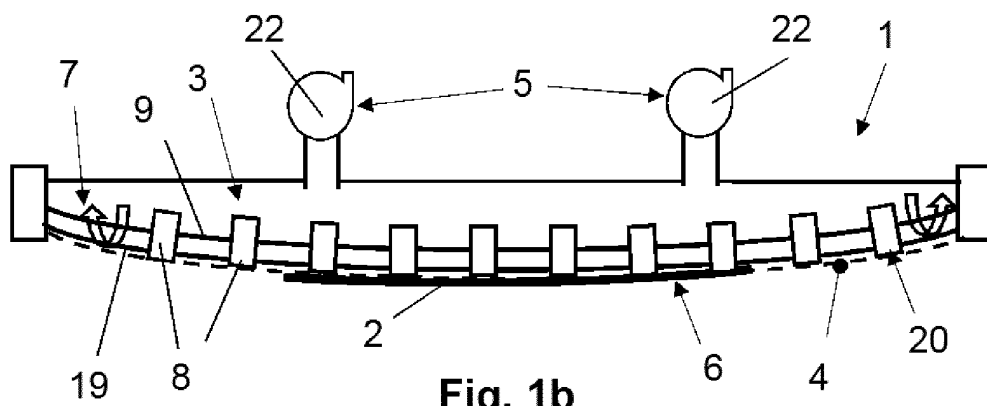


Fig. 1a



Description

Technical field of the invention

[0001] The device and method for transporting flexible sheets of the present invention belongs to those that enable transporting flexible sheets of the kind used in the graphic arts sector or the packaging industry between different handling stations.

Background of the invention

[0002] In the graphic arts sector or the packaging industry, it is common practice to transport flexible sheets, for example between a feeding station and a printing station or between a rotary sheeter and a stacking station. The rotary sheeter formats materials initially wound on a reel, and therefore flexible, in the longitudinal direction, such that after the sheets have been cut in a transverse direction, they must be transported for subsequent stacking or handling. These flexible sheets are made of materials such as paper, cardboard, plastic or similar, and particularly of single-sided corrugated cardboard, which consists of two sheets of paper one flat sheet or "liner" and one corrugated sheet or "fluting".

[0003] It is important that the transport takes place in a controlled manner so that the sheets are well positioned in the stacking station or other handling stations, such as a printing station, and that they do not curl up on each other during transport due to lack of rigidity in the longitudinal direction thereof, which at the same time is the transport direction, instead of remaining flat.

[0004] Devices like those described in patent document EP0363662 are known for transporting sheets. This document presents an assembly of driving rollers combined with an air extractor for transporting sufficiently rigid elements, such as double-sided or double/double corrugated cardboard sheets, in suspended manner.

[0005] Nevertheless, when the elements to be transported are not sufficiently rigid, such as when these elements are flexible sheets, the device described in this document does not allow these flexible sheets to be transported at high speeds, because the air currents generated while transporting each flexible sheet can separate the sheet from the device, initially bending the front edge thereof and finally separating the sheet from the device, causing the sheet to move out of the longitudinal direction of transport and to be arranged obstructing the passage of other sheets. This situation requires the intervention of an operator in order to remove the sheet that obstructs the passage, it being necessary to stop the transport device, thus entailing the corresponding loss of time.

[0006] One solution to this drawback would be to increase the force exerted on the air extractor in order to thus achieve that the sheets are more closely adhered to the driving rollers. However, since the sheets are flexible sheets, there would be a risk of damaging them dur-

ing transport due to the action of the rollers on the sheet, and furthermore, the sheets would slow down as they rub against the plate through which the rollers protrude.

[0007] It is therefore an objective of the present invention to disclose a device for transporting flexible sheets that allows flexible sheets to be transported at higher speed without damaging them.

Description of the invention

[0008] The device for transporting flexible sheets of the present invention belongs to the kind that combines movable support means on which a sheet can be placed and which are adapted to move the sheet in a direction of displacement, preferably straight and preferably horizontal; and suction means for maintaining the sheet placed against the support means.

[0009] In essence, the device is characterized in that the support means are configured so that a sheet placed against the support means takes on a bent shape in a transverse plane to the direction of displacement, which can be for example fluted or tile-shaped. Naturally, the bent shape can be either convex or concave, as well as being corrugated, having convex sections and concave sections, enabling advantageously that the sheet be able to move maintaining the bent shape thus increasing resistance to bending at the front part thereof and supporting greater accelerations and speeds, without separating from the device and without being damaged.

[0010] In a variant embodiment, the bent shape has a curve, the ratio of which between the chord and the sagitta is less than 100, i.e., 100 sagittas or less fit in the chord, such that the trajectory variation of the curve is high enough to allow the sheet to be sufficiently bent so that resistance to bending in the direction of transport is achieved.

[0011] In another variant embodiment, the bent shape has a curve, the ratio of which between the chord and the sagitta is greater than 10, i.e., 10 sagittas or more fit in the chord, such that the trajectory variation of the curve is low enough to allow the sheet to be sufficiently bent but without damaging it.

[0012] Preferably it is foreseen that the bent shape has a curve, the ratio of which between the chord and the sagitta is lesser than 100 and greater than 10, i.e., that between 10 and 100 sagittas fit in the chord, such that it provides the sheets with good resistance to bending in the longitudinal direction of transport without damaging them.

[0013] In a variant of interest, the bent shape has a curve, the sagitta of which is greater than 20 millimeters, said shape being suitable for transporting the flexible sheet of cardboard in bent or fluted shape.

[0014] In a variant of interest, the movable support means comprise drive shafts that are parallel to each other, perpendicular to the direction of displacement of the sheets and that follow a curved trajectory in the transverse plane to the direction of displacement of the sheets,

said shafts being provided with wheels. Said wheels determine a transport surface of the sheets through which the sheets can be transported when being pushed by the wheels. Each drive shaft can be independently actuated by a motor, thus being able to control the rotational speed of each shaft such that the sheets can be accelerated or slowed down, progressively increasing or decreasing the rotating speed of consecutive shafts, as appropriate. This speed control can be managed by a computer through which instructions are sent to the different motors that actuate the shafts, as well as other support means, such as a conveyor belt.

[0015] According to a variant embodiment, the curved trajectory that each drive shaft follows in the transverse plane thereof to the direction of displacement of the sheets is equal to the curve of the transport surface on that same transverse plane.

[0016] In a variant embodiment, the drive shafts comprise straight sections, the ends of which are connected to rotating transmission parts coupled to both sides of a same wheel, thus allowing the rotation of all the wheels of a shaft, thus allowing the rotation to be transmitted to all the wheels of a same shaft.

[0017] In a variant of interest, the wheels are provided with side inlets for coupling the rotating transmission parts, which allow the rotation of the section to be transmitted to the wheel and the wheel to transmit the rotation to the next section through the transmission part thereof.

[0018] In a variant of interest, the profile of the rotating transmission parts and of the inlets of the wheels is complementary, in a variant of interest the complementary profile being a gearwheel complementary profile.

[0019] It is also disclosed that in a variant embodiment, the wheels are made of a material that is more flexible than the rotating transmission parts, thus allowing the consecutive straight sections to vary the trajectory of the shaft when the rotating transmission parts are slightly deformed by the wheel inlets. In order to achieve this effect, it is foreseen that, in a variant of interest, the wheels be made of polyurethane or of any other flexible material.

[0020] In a variant embodiment, the device further comprises ejection means of defective sheets, arranged between the shafts, such that when said ejection means are actuated by an operator, it pushes a defective sheet to remove it from the device. It is highlighted that by being able to slightly separate the sheet from the device, it will disengage, enabling it to fall into a rejection container underneath the ejection means. These means of ejection means should preferably be retractable i.e., being able to be concealed inside the device and they can comprise a pneumatic piston which, when actuated, enables quickly pushing out the sheet from the device and removing the ejection means, thus removing only the defective sheet and preventing the rest of the sheets, which are not defective, from being ejected.

[0021] In another variant embodiment, the support means in the direction of displacement comprise a con-

veyor belt, which allows better control of the sheets, especially for braking and precise positioning.

[0022] It is also disclosed that the device can comprise an acceleration section in which the movable support means comprise drive shafts that are parallel to each other, perpendicular to the direction of displacement of the sheets and that follow a curved trajectory in the transverse plane to the direction of displacement of the sheets, said shafts being provided with wheels, and an end section in which the support means comprise a conveyor belt, thus allowing the sheets to be able to increase or decrease their speed in the acceleration section according to the actuation of the different drive shafts, maintaining the sheets attached to the device, and that, at the end section, the sheets can be better controlled, held more firmly and even released by deactivating the suction means in this end section, for example for stacking thereof.

[0023] Even when the previously described device comprises an acceleration section in which the movable support means comprise drive shafts that are parallel to each other, perpendicular to the direction of displacement of the sheets, said shafts being provided with wheels, and an end section in which the support means comprise a conveyor belt, sufficient transport of the sheets could be achieved even if these were not bent, i.e., if they were transported flat, although in this case they would not withstand speeds and accelerations as high as when they are bent. Naturally, the previously described devices could also be considered, in which the movable support means on which a sheet can be placed and which are adapted to move the sheet in a direction of displacement, would be configured so that a sheet placed against the support means would take on a flat shape in a transverse plane to the direction of displacement, although they would not withstand speeds and accelerations as high as when they are bent.

[0024] The device of the present invention therefore enables carrying out a method for transporting flexible sheets that comprises placing a flexible sheet against movable support means that are adapted to move the sheet in a direction of displacement, and maintain the sheet against the support means by means of suction means, such that the sheet takes on a bent shape in a transverse plane to the direction of displacement, i.e., the method for transporting flexible sheets comprises bending the sheets in a transverse plane to the direction of displacement, thus providing greater resistance to the sheets against bending at the front during transport and allowing them to be transported at higher speeds and accelerations.

Brief description of the drawings

[0025] As a complement to the description provided herein and for the purpose of helping to make the characteristics of the invention more readily understandable, this specification is accompanied by a set of drawings,

which by way of illustration and not limitation, represent the following.

Figure 1a shows a bottom view of a variant embodiment of the device of the present invention;
 Figure 1b shows a sectional view in a transverse plane of the device of Figure 1a;
 Figure 2 shows a diagram of the section in a transverse plane of the device;
 Figure 3 shows a sectional view in a transverse plane of another variant embodiment of the device of the present invention, and a detail of the sectional view;
 Figure 4 shows a sectional view of the wheels of the device of Figures 3a and 3b in correlative fitting position;
 Figure 5 shows a perspective view of the wheels of Figures 3a and 3b in correlative fitting position;
 Figure 6a shows a bottom view of another variant embodiment of the device of the present invention;
 Figure 6b shows a sectional view in a transverse plane of the device of Figure 6a; Figure 6c shows a side view of the device of Figure 6a;
 Figure 7 shows a system that incorporates the device of the present invention between a rotary sheeter and a stacking station;
 Figures 8a, 8b and 8c show the curvature of the sheets of the device of Figure 7 in different sections;
 Figure 9 shows another system that incorporates the device of the present invention between a stacking station and a printing station; and
 Figure 10 shows another system that incorporates the device of the present invention between a stacking station and a stack distribution station.

Detailed description of the drawings

[0026] Figures 1a and 1b show a bottom view and a sectional view of a first variant embodiment of the device 1 for transporting flexible sheets 2 of the present invention, which has movable support means 3 on which a sheet 2 can be placed and which are adapted to move the sheet in a direction of displacement, for transporting a sheet 2 or a sequence of sheets 2 between different stations. As shown, and as will be seen further on, the sheets will be transported preferably suspended or hung from the device 1, i.e., arranged between the device 1 and the floor, enabling an operator to better visualize the transport of the sheets from floor level.

[0027] As can be seen, the movable support means 3 are wheels 8 arranged on shafts 7 that enable pushing the sheets 2 during transport thereof. A plate 19 is arranged between the shafts 7 and the sheets 2, such that the wheels 8 traverse the plate 19 through windows 20 suitably performed on the plate 19, which allow the wheels 18 to protrude and push the sheets 2 in the direction of transport, as shown in Figure 1. It is foreseen that the same plate 19 has holes 21 through which air can be sucked in, such that suction means 5, which can

be made up of one or more air extractors 22, allow the sheets 2 to be placed against the support means 3, i.e., against the wheels 8. The plate 19 also has ejection means 25 of defective sheets 2, which when actuated, preferably by means of a pneumatic piston that would be actuated for example when an operator detects a defective sheet 2, protrude from the plate 18 causing the sheet 2 to be removed from the device 1.

[0028] As can be seen, the movable support means 3 comprise drive shafts 7 that are parallel to each other, perpendicular to the direction of displacement of the sheets 2 and that follow a curved trajectory in the transverse plane to the direction of displacement of the sheets 2, said shafts being provided with wheels 8 that determine the transport surface 4 of the sheets. It is foreseen that each shaft 7 is actuated by a different motor and can rotate at different speeds, such that it enables varying the transport speed of the sheets 2, accelerating or slowing down the sheets 2 so they can be displaced at greater or lesser speed and separated or joined together, without the increase in speed causing the sheets 2 to separate from the device 1 and block the passage of other sheets 2. Thus, it is also possible to sufficiently separate the sheets 2 between handling stations of the sheets 2, in which the sheets 2 have to be spaced apart for correct processing thereof.

[0029] As can be seen, the trajectory of each drive shaft 7 in the transverse plane thereof to the direction of displacement of the sheets 2 is equal to the curve 6 of the transport surface of that same transverse plane, such that all the wheels 8 of a same shaft 7, having the same radius, rotate at the same angular speed and will drive the sheet 2 at the same speed along the entire shaft 7, providing the sheet 2 with a curved 6 shape.

[0030] Advantageously, the movable support means 3 are configured so that the sheets 2 placed against the support means 3 take on a bent or fluted shape in a transverse plane to the direction of displacement, i.e., they take on a tile shape that provides the sheets 2 with greater resistance to bending at the front part thereof when being transported at high speeds between different stations, without damaging them. The sheets 2 will preferably maintain an essentially straight shape in a longitudinal direction to the direction of displacement, so that they do not offer resistance to transport thereof.

[0031] Therefore, it can be considered that the support means 3 determine a surface 4 for transport of the sheets 2 which in turn has a bent or fluted shape, the section of this transport surface 4 determining, in a transverse plane to the direction of displacement of the sheets 2, a curve 6, which can be either convex or concave, or even a combination between convex and concave portions that form a corrugation. Naturally, when a sheet 2 is arranged on the transport surface 4 through the effect of the suction means 5, it will take on the same shape as the surface 4.

[0032] It is foreseen that the support means 3 can be discreet, such as an assembly of wheels 8 shown in Figures 1a and 1b, the ends of which would determine the

transport surface 4 as continuous, such as a conveyor belt 12, which allows air to pass through it and which would determine the transport surface 4, such as a perforated belt or a net or mesh, for example a metallic mesh, as described below. As can also be seen in Figures 1a and 1b, the holes 21 in the plate 19 are distributed between the wheels 8 of the support means 3, thus achieving that the force exerted by the suction means 5 is distributed evenly along the shaft 7.

[0033] As can be seen in Figure 1b, in order to achieve that the sheets take on the bent shape, the support means 3 are arranged such that the transport surface 4 determines a curve 6, which will be the shape that the sheets 2 take on during transport thereof. In order to achieve that the sheets 2 have sufficient resistance to bending at the front during transport thereof, it is foreseen that the bent shape they take on has a curve 6, the ratio of which between the chord c and the sagitta s is less than 100, i.e., the distance of the chord c is 100 times or less the distance of the sagitta s, in other words, 100 sagittas or less fit in the cord. As can be seen, the support means 3 will have this same curved 6 shape and for example the shafts 7 will follow the same curve 6 as the plate 19.

[0034] Although it is foreseen that the sheets 2 are flexible, it is advisable that the sheets 2 do not take on an excessively bent shape since they could become damaged. In order to avoid damage, especially when the sheets 2 are made of cardboard, it is advisable that the bent shape has a curve 6, the ratio of which between the chord c and the sagitta s is greater than 10, i.e., the distance of the chord c is 10 times or more the distance of the sagitta s, in other words, 10 sagittas or more fit in the chord. Usually, it is foreseen that the bent shape has a curve 6, the sagitta s of which is greater than 20 millimeters, such that the device 1 is especially suitable for transporting standard sized flexible sheets 2.

[0035] Figure 3 shows a transverse section view of the device 1 according to the present invention together with a detail of the device 1 in which it can be seen how the support means 3 and the suction means 5 are combined. As can be seen, the drive shafts 7 are mounted passing through supports 23 of the plate 19 and comprise straight sections 9, the ends of which are connected to rotating transmission parts 10 coupled to both sides of a same wheel 8, said wheels being provided with side inlets 11 for coupling the rotating transmission parts 10, such that the shaft 7 is curved. This curvature of the shaft 7 is achieved by slightly deforming, through pressure, the rotating transmission parts 10 of the wheels 8, which are foreseen to be more flexible than the rotating transmission parts 10, such as polyurethane. The rotating transmission parts 10 of the wheels are foreseen to be made of a more rigid material, such as polyethylene, polyoxymethylene, and other plastics or even of a metallic material or also any other material that is more rigid than the material of the inlets 11 of the wheels 8. It is foreseen that the deformation exerted by the rotating transmission

parts 10 on the wheels 8 allows consecutive straight sections 9 to be rotated by approximately 0.5 degrees, such that the rotation of the straight section 9 is correctly transmitted to the wheels 8. It is also foreseen that the rotating transmission parts 10 can fit into the side inlets 11 of the wheels 8 such that the rotating transmission parts 10 can move axially inside each inlet 11, alternatively inward and outward of the wheel 8, during the shaft 7 rotation. Naturally, it is foreseen that the entire wheel 8 is not made of this flexible material, but that it may be sufficient that only the area of the inlets 11 be made of this flexible material.

[0036] It is foreseen that the suction means 5 incorporate an extractor 22 that exerts a suctioning effect through the holes 21 of the plate 19 that enables maintaining the sheet 2 against the support means 3. Naturally, it is also foreseen that the suction means 5 are made up of different extractors, such that suction can be controlled in different sections of the device 1, for example by allowing the sheet 2 to be released at the end of the transport thereof. It is foreseen that when the support means 3 are provided with wheels 8, and the plate 19 has windows 20 through which the wheels 8 pass, it is possible that the plate 19 not require holes 21 if the suction exerted by the suction means 5 through the windows 20 is sufficient.

[0037] As described above, the sheets 2 can be transported in a suspended manner, being the movable support means 3, such as wheels 8, which by rotating enable the sheets 2 to be displaced along a transport surface 4, which when taking on a curved or tile shape, advantageously allow the flexible sheets 2 to be transferred at higher speeds than if the sheets 2 were flat, preventing them from being separated from the device 1.

[0038] Figure 4 shows a detailed view of the section of the wheels 8 of the device 1 of Figure 3 in correlative fitting position with straight segments 9 of the shaft 7. As can be seen, the ends of the straight sections 9 are provided with a threaded pin 14, which will pass through an orifice 15 in each rotating transmission part 10 in which a nut 13 is secured, such that the straight section 9 is firmly joined to the rotating transmission part 10, thus achieving that by rotating the shaft 7, each straight section 9 rotates the rotating transmission parts 10 joined to the ends thereof. The rotating transmission parts 10 are adapted to fit and be coupled into the side inlets 11 arranged on both sides of the wheels 8, such that the straight section 9 that is actuated by a motor transmits the rotation to the remaining straight sections 9 through the respective wheels 8. As described previously, it is foreseen that the material around the side inlets 11 is flexible and allows successive straight sections 9 to be slightly inclined to one another when this material around the side inlets yields, but allowing the rotation to be transmitted correctly both to the wheel 8 and to the next straight section 9 of the shaft 7. Naturally, it is foreseen that the securing of the straight sections 9 to the rotating transmission parts 10 can be carried out in other alternative

ways, which ensure fastening of the straight sections 9 to the rotating transmission parts 10, such as a grooved shaft, a tapered shaft, or even a shaft integrated during the molding process of the rotary transmission part 10, among others.

[0039] As can best be seen in the perspective view shown in Figure 5, the profile of the rotating transmission parts 10 and of the inlets 11 of the wheels 8 is complementary, such that the rotation of the straight sections 9 can be transmitted to the wheel 8, which can transmit it to the next straight section 9 through the rotating transmission parts 10. A particularly advantageous form of the profile of the rotating transmission parts 10 and of the inlets 11 of the wheels 8 is a complementary gearwheel profile, as shown in Figure 5 and as was also shown in Figures 3 and 4, although it was not evident from the sectional views that were provided. Nevertheless, other complementary profiles that would allow the rotation to be correctly transmitted could be used, such as geometrical shapes or other irregular shapes that enable the fitting between the rotating transmission parts 10 and the inlets 11 of the wheels 8 and the rotating transmission of the shaft 7. It should also be noted that the profiles of the inlets 11 of the wheels 8 that are shown are the same and have a gearwheel on both sides, which makes it possible to use the same rotating transmission parts 10, one of the inlets 11 being rotated with respect to the other.

[0040] Figure 6a shows another variant embodiment of the device 1 in which the support means 3 comprise a conveyor belt 12, such as a conveyor belt that allows air to pass through, such that the suction means 5 allow the sheet to be placed against the conveyor belt 12 and transferred on the transport surface 4, which in this case coincides with the conveyor belt 12. Unlike the previous variants in which the support means 3 were made up by different shafts 7 that could rotate at a different speed, in the variant shown in Figure 6a, the conveyor belt 12 will move forward at a same speed, it being impossible to accelerate sheets to separate them from each other by means of a single device 1. One option to solve this drawback would be to arrange different devices 1 in series, such that the conveyor belt 12 of each device 1 has a higher or lower speed than the previous one, depending on whether the sheets 2 are to be accelerated or slowed down. Naturally, it is also foreseen that the conveyor belt 12 be made up of different longitudinal belts, for example 10 longitudinal belts measuring 40 mm each, provided with flexible, homokinetic couplings, among them, such that they follow the bent shape and they can all be dragged by means of a single motor.

[0041] Naturally, the sectional view of the variant of Figure 6a in which the support means 3 comprise a conveyor belt 12 will also have a curved section that allows the sheets 2 to be transported in tile shape, such that it allows greater speed to be achieved without damaging the sheets 2, as described above, the suction means 5 being adapted to exert a suction force that maintains the sheet 2 against the conveyor belt.

[0042] As shown in Figure 6c, the conveyor belt 12, which can be a belt or any other transport surface that allows air to pass through, such as a mesh or a grille, may be actuated by means of a single motor.

[0043] Naturally, it is foreseen that the support means 3 can have different sections, i.e., that in certain sections the support means 3 are made up of shafts 7 provided with wheels 8, such that the speed of each shaft 7 can be controlled independently in order to separate or join consecutive sheets 2, for example in an acceleration section T1 and other sections made up of a conveyor belt 12, such that although the speed of the conveyor belt 12 is the same, a single motor can be used to actuate the belt, for example, in a end section T2, as described below.

[0044] Figure 7 shows a system made up of a device 1 of the present invention for transporting sheets 2 between a rotary sheeter 16 and a stacking station 17. The rotary sheeter 16 is adapted to format materials initially wound on a reel and therefore flexible in the longitudinal direction, by cutting sheets 2 from the material previously wound on the reel in the transverse direction thereof.

[0045] The rotary sheeter 16 provides the flexible sheets 2 to the device 1 one by one, which although initially flat on the support means 3, as indicated in section A of Figure 8a, the support means 3 will progressively bend the flexible sheet 2, reaching a curvature as indicated in section B, shown in Figure 8b, until it takes on the curved tile shape indicated in section C and shown in Figure 8c. This bent shape will allow transport thereof at high speed as described above so that, before reaching the stacking station 17 where it should be presented flat, the sheet 2 returns from its curved transport position to the final flat position, adapted for storage thereof at the stacking station 17. The system shown in Figure 7 uses a rotary sheeter 16 and a stacking station 17 of the kind known in the state of the art that provide and require straight sheets 2 so it is necessary to make this transition between the flat and curved transport position of the sheets 2. However, if the rotary sheeter 16 would already provide curved sheets 2, similar to section C, the device 1 could take and transport the curved sheets 2 directly without needing to curve them progressively. The same would apply to the stacking station 17 if, for example, the sheets 2 were simply flat when separated from the device 1. Advantageously, when the sheets 2 take on the bent tile shape, not only do they prevent being separated from the device 1 during transport thereof, but they also prevent the sheets, obtained from initially wound material, from having a tendency to rewind.

[0046] As can be seen in Figure 7, the device 1 has an acceleration section T1 in which the support means 3 will be made up of shafts 7 provided with wheels 8, such that the speed of each shaft 7 can be controlled independently in order to separate or join consecutive sheets 2, and an end section T2 made up of a conveyor belt 12, such that although the speed of the conveyor belt 12 is the same, a single motor can be used to actuate the belt. Naturally, the support means 3 could also be integrally made up of

shafts 7 provided with wheels 8 or by one or more conveyor belts 12, as well as different combinations of sections. As shown, the sheets 2 are transported preferably suspended or hung from the device 1, i.e., arranged between the device 1 and the floor, enabling an operator not only to be able to better visualize the transport of the sheets from the floor, but also enabling the transport of sheets 2, such as single-sided corrugated cardboard with the open flute upwards, thus achieving the stacking thereof with the open flute upwards, which is preferably how they have to be provided to the end customer.

[0047] Figure 9 shows another system made up of a device 1 of the present invention for transporting sheets 2 between a stacking station 17, at which an assembly of flexible sheets 2 is stacked, and a printing station 18 at which the device 1 must transfer the sheets 2. As can be seen, the stacking station 17 will provide the flexible sheets 2 to the device 1 one by one, which although initially flat on the support means 3, as indicated in section A previously shown in Figure 8a, the support means 3 will progressively bend the flexible sheet 2, reaching a curvature as indicated in section B, shown previously in Figure 8b, until it takes on the curved tile shape indicated in section C and previously shown in Figure 8c, which will allow transport thereof at high speed as described above so that, before reaching the printing station 18 where it should be presented flat, the sheet returns from its curved transport position to the final flat position, adapted for insertion in the printing station. The system shown in Figure 7 uses a staking station 17 and a printing station 18 of the kind known in the state of the art that provide and require straight sheets 2, so it is necessary to make this transition between the flat and curved transport position. However, if the feeding station would already provide curved sheets 2, similar to section C, the device 1 could take and transport the curved sheets 2 directly without needing to curve them progressively. The same would apply to the printing station 18 if it would accept bent sheets 2. Thus, it is possible to transport sheets 2 by placing a flexible sheet 2 against the movable support means 3 adapted for moving the sheet 2 in a direction of displacement and holding the sheet 2 against the support means 3 by means of suction means 5, such that the flexible sheet takes on a bent shape in a transverse plane to the direction of displacement. Naturally, it is foreseen that the device 1 of the present invention can be used for transporting sheets 2 between many other types of stations, such as laminating stations, among others.

[0048] Figure 10 shows the device 1 of the present invention again, now between a stacking station 17 and a stack distribution station 24, allowing the sheets 2 to be transported from the stacking station 17 as described previously but now releasing the sheets 2 after passing an acceleration section T1 and upon reaching an end section T2, grouping the sheets two by two or even into larger groups in order to thus be able to redistribute the sheets 2, which were previously staked at the stacking

station 17, into different stacks at the stack distribution station 24, such that the size of each stack is smaller and the sheets can subsequently be moved more easily. This way, for example, as shown in Figure 10, the device 1 will wait for three sheets 2 to reach the end section T2 of the device 1 and then the suction means 5 of the end section T2 will be deactivated, and/or pushing means such as protrusions that protrude from the transport surface 4 to separate the sheets 2 of the transport surface 4 will be actuated, allowing the sheets 2 to be stacked up each in a stack of the stack distribution station 24. Naturally, the device will also allow transport between a rotary sheeter 16 and a stack distribution station 24, in a similar way.

[0049] Although in the previously described variants of the device 1 the flexible sheets 2 are transported in suspended manner, the support means 3 remaining above the sheets 2, it is also foreseen that in other variant embodiments, the flexible sheets 2 remain above the support means 3, for example when the device is mounted directly on the floor. Advantageously, when the flexible sheets 2 are transported in suspended manner, they can easily be monitored by an operator, such that defective sheets 2 can be detected visually. These defective sheets 2 could be removed from the device 1 by the operator's actuation of sheet ejection means 25, such as a pneumatic piston protruding from the support means 3, such that the defective sheet 2 can be released from the device 1 and fall into a rejection vessel underneath the pneumatic piston. Also, if it were not necessary for the speed or acceleration of the sheets 2 to be high, it would even be possible to envisage devices similar to those described above, in which the sheets 2 were transported flat, i.e., that the support means would determine a flat transport plane and would be configured so that a sheet placed against the support means would take on a flat shape with respect to a transverse plane to the direction of displacement.

Claims

1. A device (1) for transporting flexible sheets (2) combining:
 - movable support means (3) on which a sheet can be placed and which are adapted to move the sheet in a direction of displacement; and
 - suction means (5) for maintaining the sheet placed against the support means.

characterized in that the support means are configured so that a sheet placed against the support means takes on a bent shape in a transverse plane to the direction of displacement.

2. The device (1) according to the preceding claim, **characterized in that** the bent shape has a curve,

the ratio of which between the chord (c) and the sagitta (s) is less than 100.

3. The device (1) according to any one of the preceding claims, **characterized in that** the bent shape has a curve, the ratio of which between the chord (c) and the sagitta (s) is greater than 10. 5
4. The device (1) according to any one of the preceding claims, **characterized in that** the bent shape has a curve, the sagitta (s) of which is greater than 20 millimeters. 10
5. The device (1) according to any one of the preceding claims, **characterized in that** the movable support means (3) comprise drive shafts (7) that are parallel to each other, perpendicular to the direction of displacement of the sheets and that follow a curved trajectory in the transverse plane to the direction of displacement of the sheets, said shafts being provided with wheels (8). 15
20
6. The device (1) according to the preceding claim, **characterized in that** the curved trajectory that each drive shaft (7) follows in the transverse plane thereof to the direction of displacement of the sheets is equal to the curve (6) of the transport surface on that same transverse plane. 25
7. The device (1) according to any one of claims 5 to 6, **characterized in that** the drive shafts (7) comprise straight sections (9), the ends of which are connected to rotating transmission parts (10) coupled to both sides of the same wheel (8). 30
35
8. The device (1) according to the preceding claim, **characterized in that** the wheels (8) are provided with side inlets (11) for coupling the rotating transmission parts (10). 40
9. The device (1) according to any one of claims 7 to 8, **characterized in that** the profile of the rotating transmission parts (10) and of the inlets (11) of the wheels (8) is complementary. 45
10. The device (1) according to the preceding claim, **characterized in that** the profile of the rotating transmission parts (10) and of the inlets (11) of the wheels (8) is a gearwheel complementary profile. 50
11. The device (1) according to any one of claims 7 to 10, **characterized in that** the wheels (8) are made of a material that is more flexible than the rotating transmission parts (10). 55
12. The device (1) according to the preceding claim, **characterized in that** the wheels (8) are made of polyurethane.

13. The device (1) according to any one of claims 5 to 10, **characterized in that** it further comprises sheet (2) ejection means (25) arranged between the shafts (7).

14. The device (1) according the preceding claim, **characterized in that** the ejection means (25) comprise a pneumatic piston.

15. The device (1) according to any one of the preceding claims, **characterized in that** the support means (3) in the direction of displacement comprise a conveyor belt (12).

16. The device (1) according to any one of the preceding claims, **characterized in that** it comprises an acceleration section (T1) in which the movable support means (3) comprise drive shafts (7) that are parallel to each other, perpendicular to the direction of displacement of the sheets (2) and that follow a curved trajectory in the transverse plane to the direction of displacement of the sheets (2), said shafts being provided with wheels (8) and an end section (T2) in which the support means comprise a conveyor belt (12).

17. A method for transporting flexible sheets (2) in a direction of displacement, **characterized in that** it comprises bending the sheets in a transverse plane to the direction of displacement.

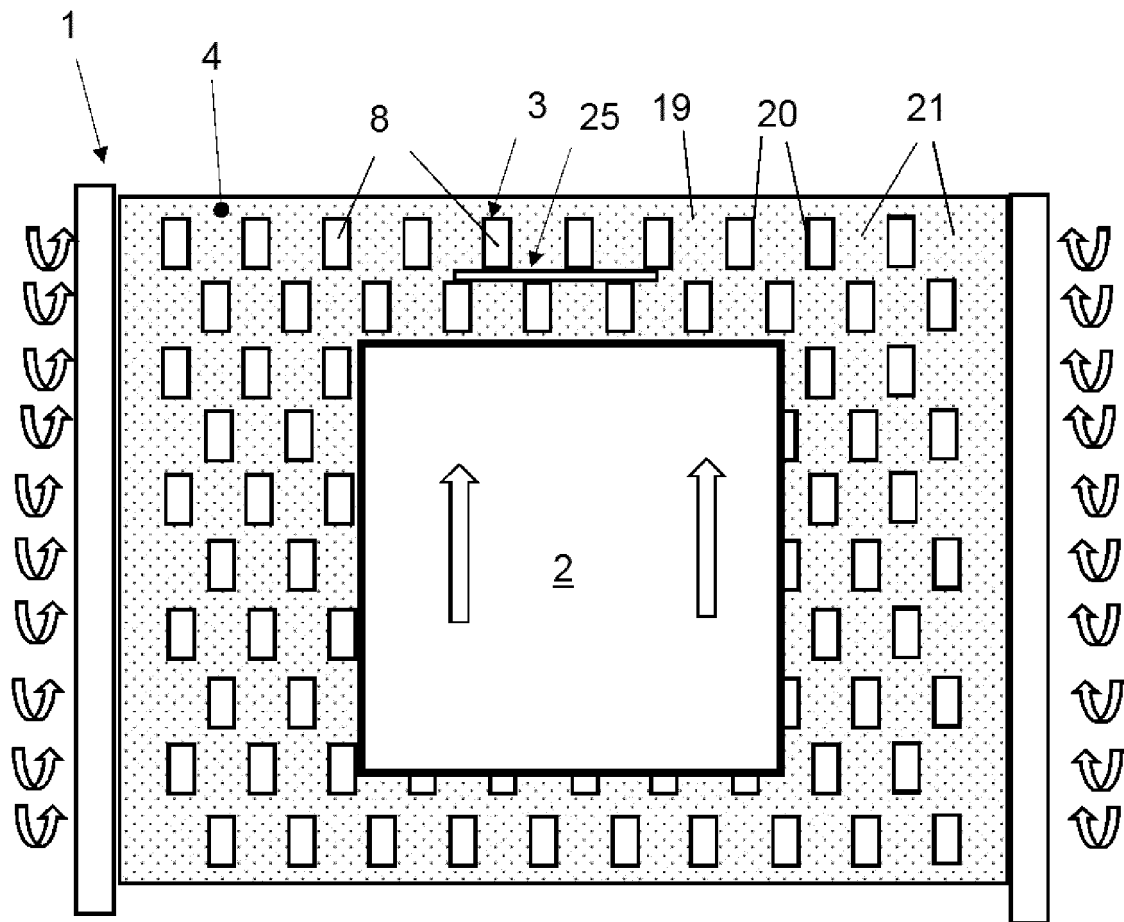


Fig. 1a

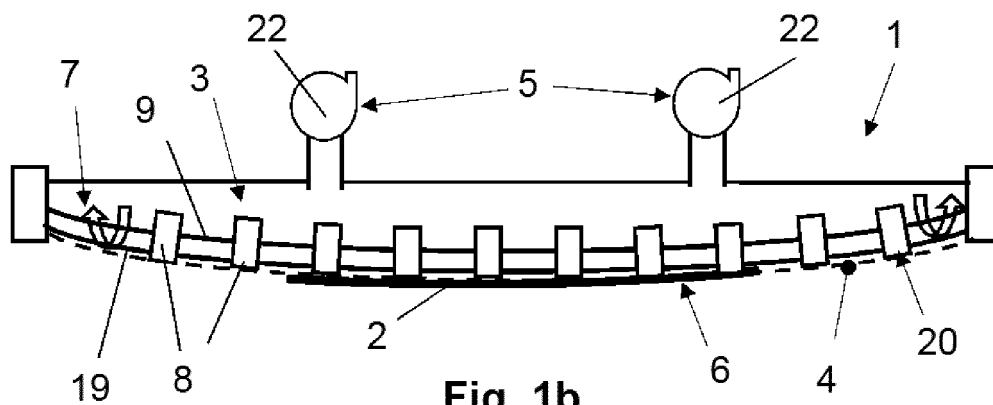


Fig. 1b

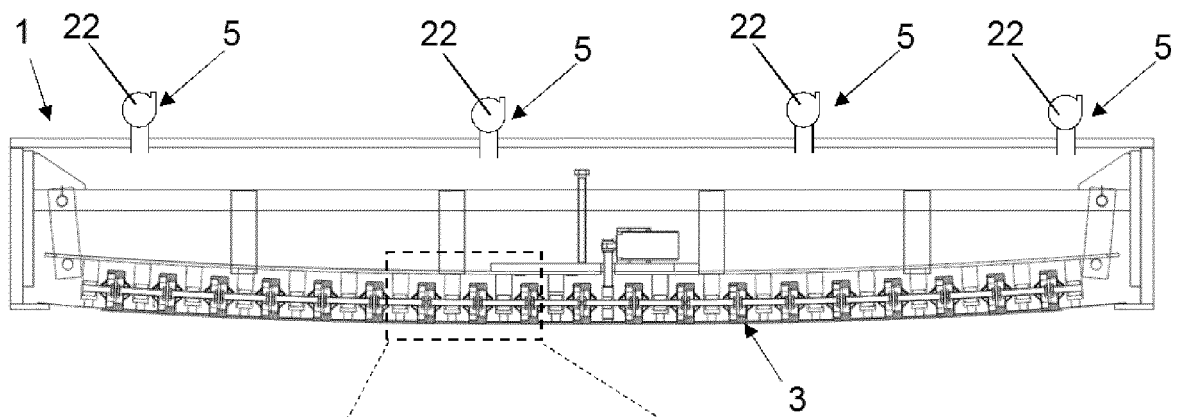
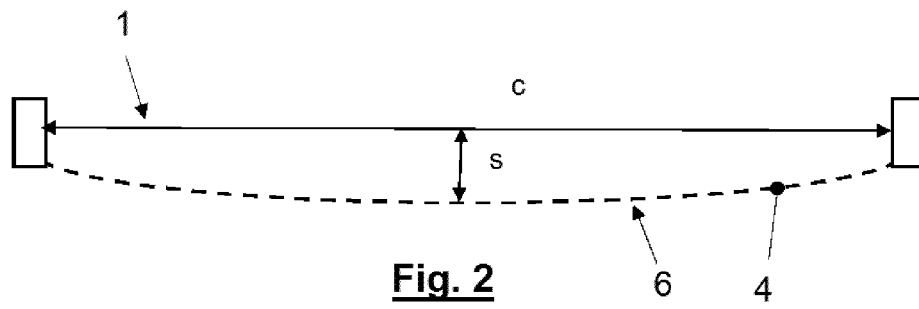
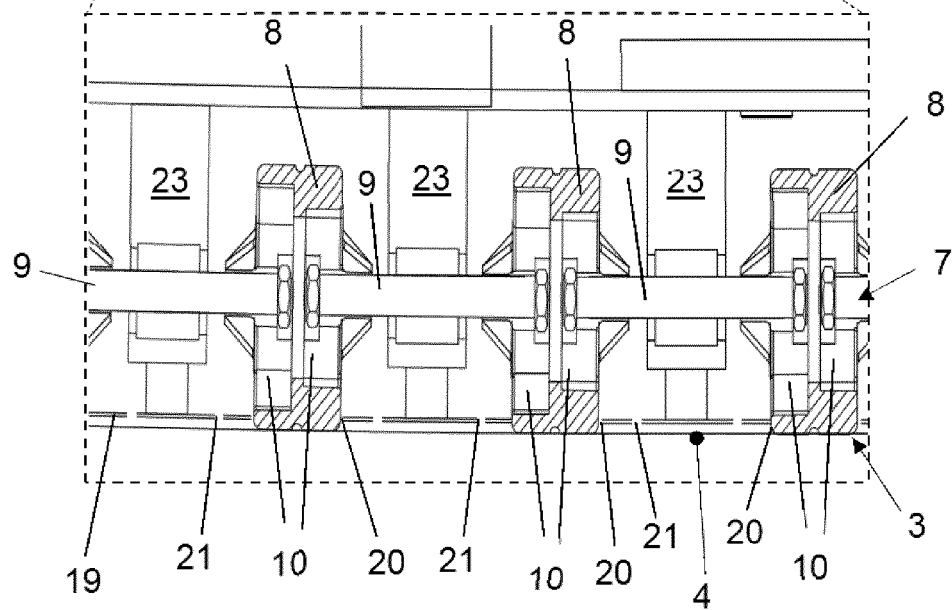


Fig.3



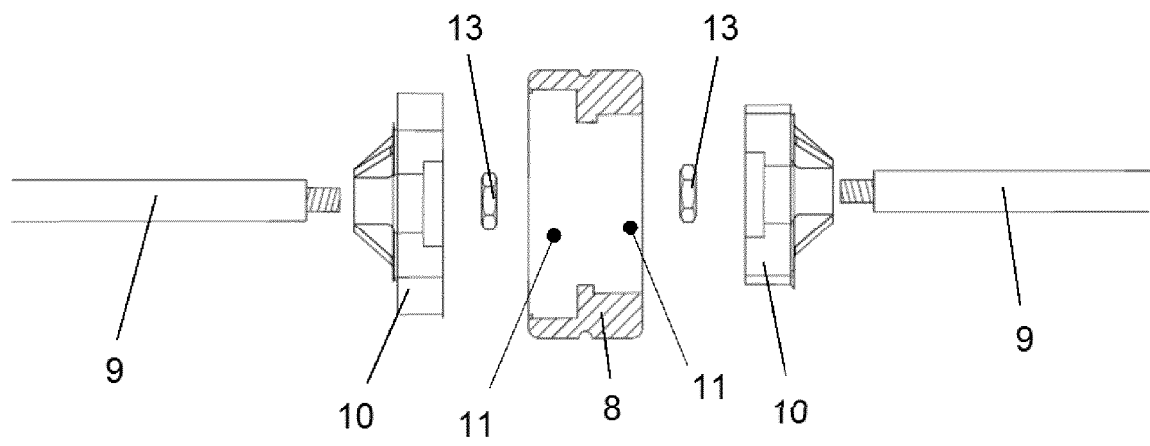


Fig.4

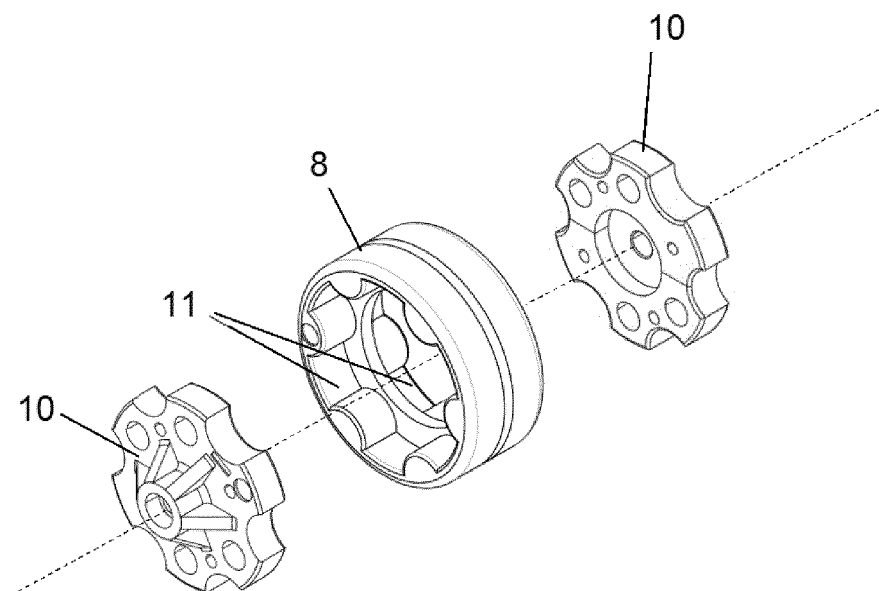


Fig.5

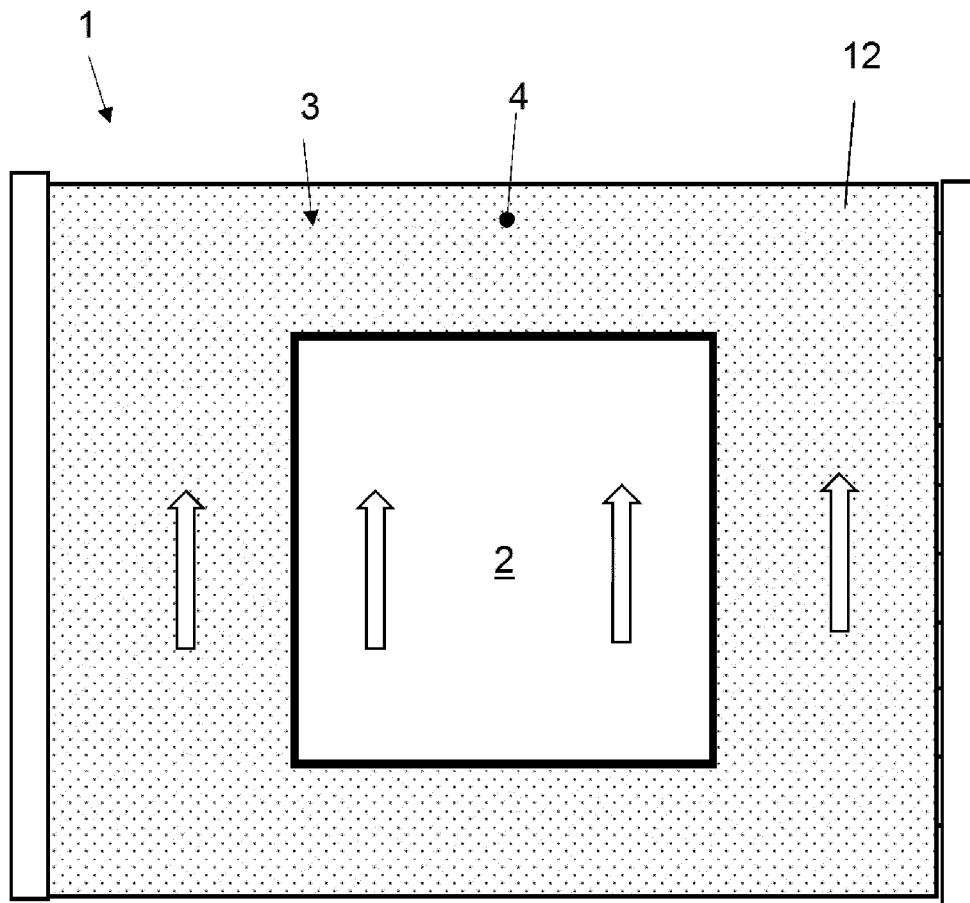


Fig. 6a

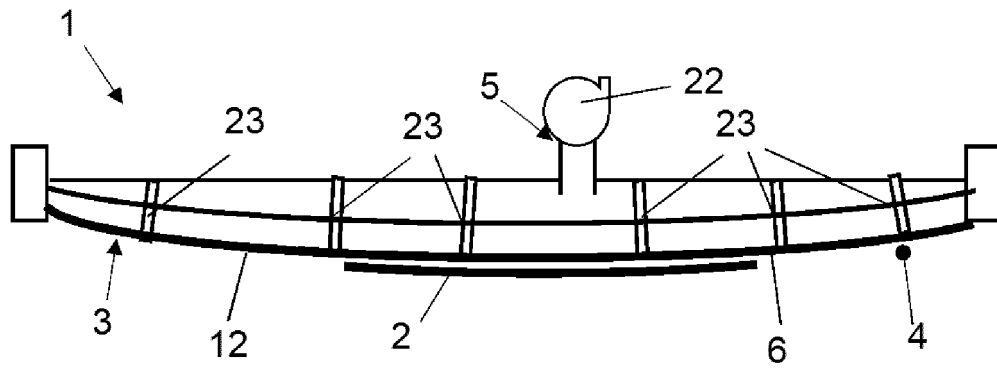


Fig. 6b

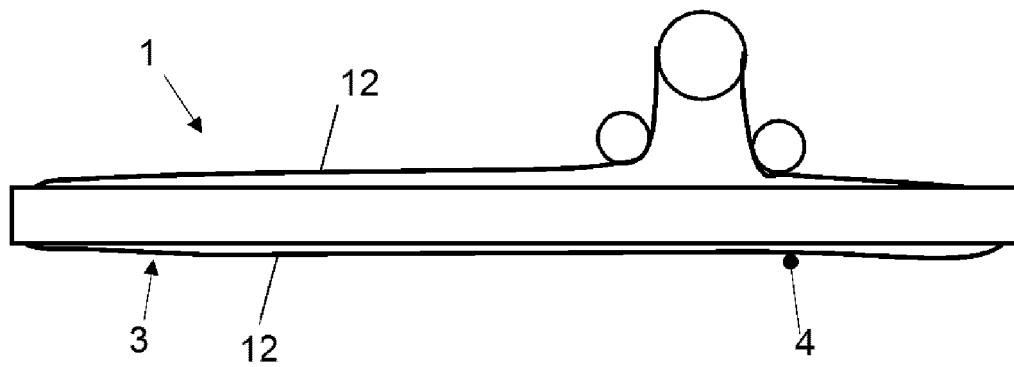
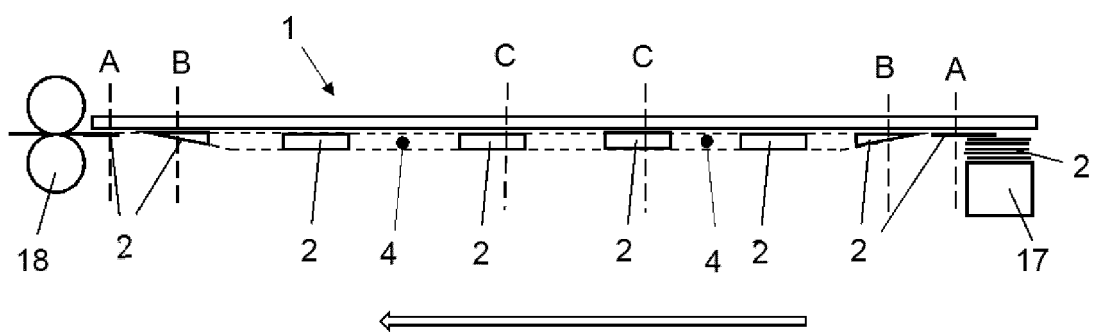
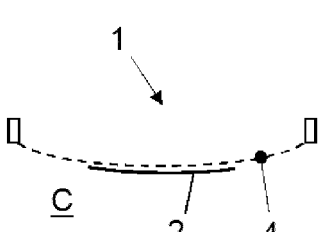
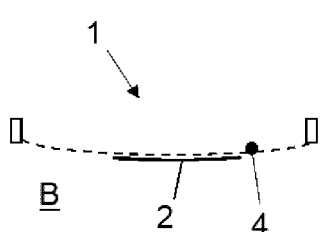
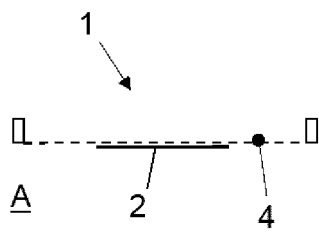
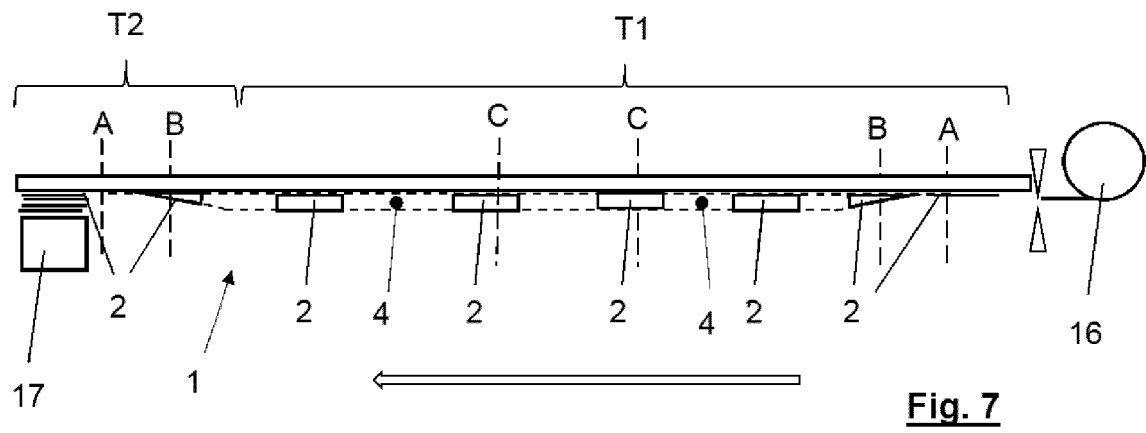


Fig. 6c



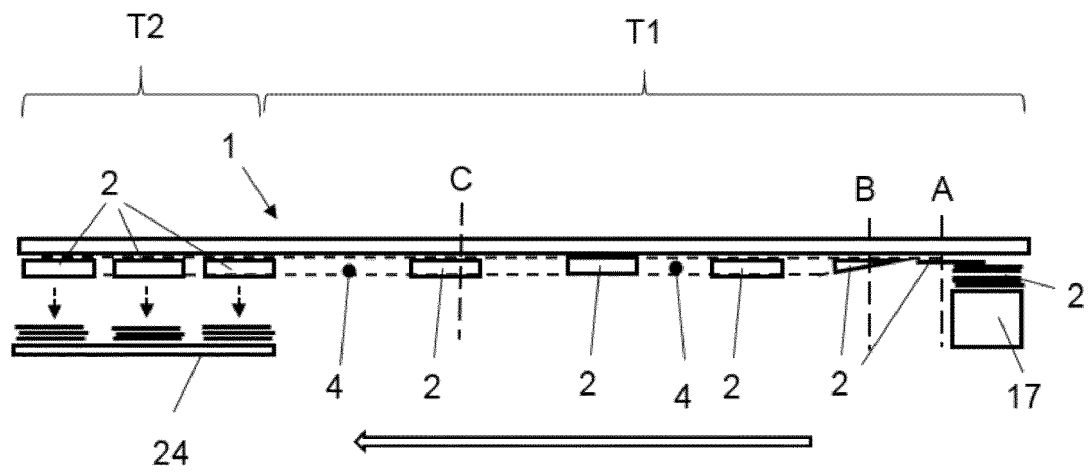


Fig. 10

INFORME DE BÚSQUEDA INTERNACIONAL

Solicitud internacional N°
PCT/ES2018/070170

5	A. CLASIFICACIÓN DEL OBJETO DE LA SOLICITUD B65H29/24 B65H29/62 B65H31/24 B65H29/70 B65H29/32 B65H5/22 De acuerdo con la Clasificación Internacional de Patentes (CIP) o según la clasificación nacional y CIP.																				
10	B. SECTORES COMPRENDIDOS POR LA BÚSQUEDA Documentación mínima buscada (sistema de clasificación seguido de los símbolos de clasificación) B65H Otra documentación consultada, además de la documentación mínima, en la medida en que tales documentos formen parte de los sectores comprendidos por la búsqueda																				
15	Bases de datos electrónicas consultadas durante la búsqueda internacional (nombre de la base de datos y, si es posible, términos de búsqueda utilizados) EP0-Internal, WPI Data																				
20	C. DOCUMENTOS CONSIDERADOS RELEVANTES																				
25	Categoría*	Documentos citados, con indicación, si procede, de las partes relevantes	Relevante para las reivindicaciones N°																		
30	X	JP 2008 266020 A (FUJIFILM CORP) 6 de Noviembre de 2008 (2008-11-06) todo el documento	1-4,15, 17																		
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50		----- -/-																			
55	☒ En la continuación del Recuadro C se relacionan otros documentos ☒ Los documentos de familias de patentes se indican en el Anexo <table border="1"> <tr> <td>* Categorías especiales de documentos citados:</td> <td>"T"</td> <td>documento ulterior publicado con posterioridad a la fecha de presentación internacional o de prioridad que no pertenece al estado de la técnica pertinente pero que se cita por permitir la comprensión del principio o teoría que constituye la base de la invención.</td> </tr> <tr> <td>"A" documento que define el estado general de la técnica no considerado como particularmente relevante.</td> <td>"X"</td> <td>documento particularmente relevante; la invención reivindicada no puede considerarse nueva o que implique una actividad inventiva por referencia al documento aisladamente considerado.</td> </tr> <tr> <td>"E" solicitud de patente o patente anterior pero publicada en la fecha de presentación internacional o en fecha posterior.</td> <td>"Y"</td> <td>documento particularmente relevante; la invención reivindicada no puede considerarse que implique una actividad inventiva cuando el documento se asocia a otro u otros documentos de la misma naturaleza, cuya combinación resulta evidente para un experto en la materia.</td> </tr> <tr> <td>"L" documento que puede plantear dudas sobre una reivindicación de prioridad o que se cita para determinar la fecha de publicación de otra cita o por una razón especial (como la indicada).</td> <td>"&"</td> <td>documento que forma parte de la misma familia de patentes.</td> </tr> <tr> <td>"O" documento que se refiere a una divulgación oral, a una utilización, a una exposición o a cualquier otro medio.</td> <td></td> <td></td> </tr> <tr> <td>"P" documento publicado antes de la fecha de presentación internacional pero con posterioridad a la fecha de prioridad reivindicada.</td> <td></td> <td></td> </tr> </table>			* Categorías especiales de documentos citados:	"T"	documento ulterior publicado con posterioridad a la fecha de presentación internacional o de prioridad que no pertenece al estado de la técnica pertinente pero que se cita por permitir la comprensión del principio o teoría que constituye la base de la invención.	"A" documento que define el estado general de la técnica no considerado como particularmente relevante.	"X"	documento particularmente relevante; la invención reivindicada no puede considerarse nueva o que implique una actividad inventiva por referencia al documento aisladamente considerado.	"E" solicitud de patente o patente anterior pero publicada en la fecha de presentación internacional o en fecha posterior.	"Y"	documento particularmente relevante; la invención reivindicada no puede considerarse que implique una actividad inventiva cuando el documento se asocia a otro u otros documentos de la misma naturaleza, cuya combinación resulta evidente para un experto en la materia.	"L" documento que puede plantear dudas sobre una reivindicación de prioridad o que se cita para determinar la fecha de publicación de otra cita o por una razón especial (como la indicada).	"&"	documento que forma parte de la misma familia de patentes.	"O" documento que se refiere a una divulgación oral, a una utilización, a una exposición o a cualquier otro medio.			"P" documento publicado antes de la fecha de presentación internacional pero con posterioridad a la fecha de prioridad reivindicada.		
* Categorías especiales de documentos citados:	"T"	documento ulterior publicado con posterioridad a la fecha de presentación internacional o de prioridad que no pertenece al estado de la técnica pertinente pero que se cita por permitir la comprensión del principio o teoría que constituye la base de la invención.																			
"A" documento que define el estado general de la técnica no considerado como particularmente relevante.	"X"	documento particularmente relevante; la invención reivindicada no puede considerarse nueva o que implique una actividad inventiva por referencia al documento aisladamente considerado.																			
"E" solicitud de patente o patente anterior pero publicada en la fecha de presentación internacional o en fecha posterior.	"Y"	documento particularmente relevante; la invención reivindicada no puede considerarse que implique una actividad inventiva cuando el documento se asocia a otro u otros documentos de la misma naturaleza, cuya combinación resulta evidente para un experto en la materia.																			
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"O" documento que se refiere a una divulgación oral, a una utilización, a una exposición o a cualquier otro medio.																					
"P" documento publicado antes de la fecha de presentación internacional pero con posterioridad a la fecha de prioridad reivindicada.																					
	Fecha en que se ha concluido efectivamente la búsqueda internacional. 06 de Julio de 2018		Fecha de expedición del informe de búsqueda internacional 20/07/2018																		
	Nombre y dirección postal de la Administración encargada de la búsqueda internacional European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Funcionario autorizado Ureta, Rolando																		
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Solicitud internacional N°

PCT/ES2018/070170

C (continuación).	DOCUMENTOS CONSIDERADOS RELEVANTES	
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Formulario PCT/ISA/210 (continuación de la segunda hoja) (Enero 2015)

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Información relativa a miembros de familias de patentes

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			US	5006042	A	09-04-1991

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