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(54) **SUCTION TRANSPORT BELT ASSEMBLY FOR A FIXATION UNIT OF A SHEET PRINTER**

(57) A compact and efficient suction transport belt system for a printer is provided. The printer (1) comprises a fixation station (20) for fixing ink to print media (S3), which fixation station (20) comprises a transport belt system (30), which comprises:
- an endless belt (29) supported on a plurality of rollers (26, 27, 31-34), which belt (29) is provided with openings through which a negative pressure can be applied to print media (S3) on the belt (29) via a suction chamber assembly (25) facing the belt (29), wherein at least one of the rollers (26, 27, 31-34) is a heated roller (26, 27), which comprises a heater (28) for heating the belt (29),
characterized in that at least another one of the rollers (26, 27, 31-34) is positioned inside a volume defined by the other rollers (26, 27, 31-34), so that the belt (29) comprises a negative turn, which directs the belt (29) over the at least one heated roller over a contact angle (CA) greater than 100°.

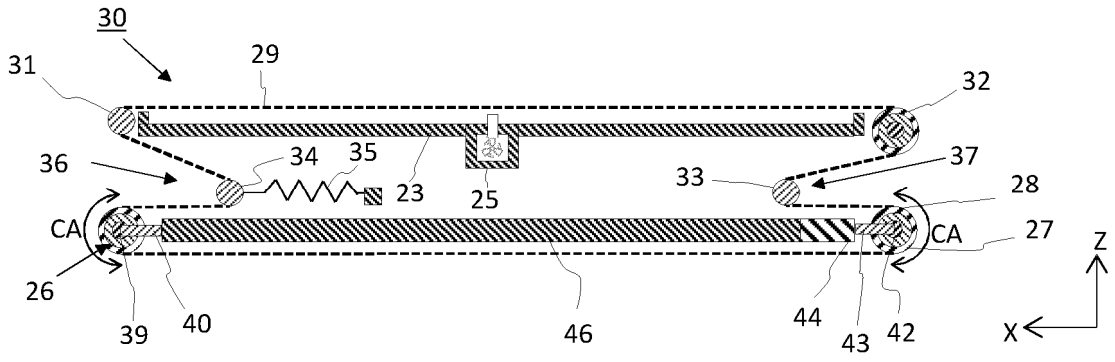


Fig. 2

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Description

BACKGROUND OF THE INVENTION

1. Field of the invention

[0001] The present invention relates to a printer, a fixation station for a printer, and to a transport belt system for a fixation station.

2. Description of Background Art

[0002] A sheet printer comprises a print station where ink is applied to sheets, for example by means of inkjet printheads. For productive printers, a fixation station is provided to rapidly fix the wet ink to the sheets. In the fixation station the ink may be dried, cured, solidified, etc., as it moves through the fixation station on a conveyor, such as a suction transport belt system. Generally, the sheet in the fixation station therefore has a temperature above room temperature to assist in the fixing of the ink. To control the temperature of the sheets, the belt can be heated to transfer heat to the sheets. It is known that the belt can be heated by means of a heated roller in direct contact with the belt. The heated roller is provided with a heater specifically for heating said roller. Such a printer is known from e.g. JP2019028275 A2.

SUMMARY OF THE INVENTION

[0003] It is an object of the invention to provide an improved transport belt system for a fixation station of a printer, specifically one which improves performance, energy consumption, and/or construction of the system.

[0004] In accordance with the present invention, a printer according to claim 1, a fixation station according to claim 12, and a transport belt system according to claim 13 are provided.

[0005] The printer comprises a fixation station for fixing ink to print media, which fixation station comprises a transport belt system, which comprises:

- an endless belt supported on a plurality of rollers, which belt is provided with openings through which a negative pressure can be applied to print media on the belt via a suction chamber assembly facing the belt.

[0006] The printer is characterized in that at least two of the rollers are heated rollers, which each comprises a heater for heating the belt. At least another one of the rollers is positioned inside a volume defined by the other rollers, so that the belt comprises two negative turns, which each locally direct the belt over the at least one heated roller over a contact angle greater than 100°.

[0007] The printer comprises two heated rollers, wherein each heated roller is provided with a respective negative roller to form a respective negative turn to allow for a contact angle greater than 100° between each heated roller and the belt. The two heated rollers with their respective negative turns are preferably positioned facing one another in the transport direction. In this manner a roughly mirror symmetric configuration may be achieved. The rollers are positioned with respect to one another, so that the belt curves around at least one heated roller over an angle greater than 90°. Combined the two heated rollers allow for contact between the belt and the heated roller over an angle greater than e.g. 200° to 360°. This results in a relatively large contact area between the heated roller and the belt, improving the heat transfer between the two. This results in an energy efficient system, which can be operated at relatively lower temperatures. Lower temperatures decrease the energy loss to the environment of the printer and reduce the thermal strain on the belt. The construction is further compact as the negative turn increases the contact area, but does increase the outer dimensions of the system (as compared to without such a negative turn). Thereby the object of the present invention has been achieved.

[0008] More specific optional features of the invention are indicated in the dependent claims.

[0009] In an embodiment, the contact angle is greater than 150°, preferably at least 170°, very preferably at least 180°. Preferably, the contact angle is sufficiently large, so that the belt substantially changes direction around the heated roller. On one side of the roller the belt extends in the transport direction and on the opposite side the belt extends against the transport direction. The belt is thereby in contact with roughly half the circumference of the heated roller, resulting in efficient heat transfer.

[0010] In an embodiment, the heated rollers are mounted on opposite ends of a rigid torsion body, which extends parallel to the suction chamber assembly. The torsion body extends in the transport direction, so that the negative turns are aimed towards one another. The torsion body comprises a stiff frame, which reduces or minimizes reorientation of the heated rollers with respect to one another due to torsion exerted on the torsion body from the tension in the belt. This ensures constant reliable positioning of the heated rollers and the belt, allowing for accurate control.

[0011] In an embodiment, the torsion body is formed of at least one tube body. The tube body's longitudinal axis extends preferably parallel to the transport direction. The tube body may be formed of a round tube, rectangular tube, square tube, or any other suitable tube material and/or shape. Preferably, the tube body is formed of metal, such as steel, but it will be appreciated that other rigid materials, such as composites may be applied as well.

[0012] In an embodiment, the at least one tube body has a closed shape cross-section when viewed parallel to a transport direction of the belt. Any cross-section of the tube body for the majority of its length, when viewed along its longitudinal axis, will have an endless shape. This

ensures a high rigidity against torsion forces. Suitable cross-sectional shapes may be a disc, circle, rectangular plane, rectangle, square plane, square, etc.

[0013] In an embodiment, at least one of the rollers is provided with a tensioner for tensioning the belt. The tensioner supplies constant tension to the belt, ensuring it runs reliably and controllably over the rollers. The tensioner preferably comprises a force actuator or spring element, such as a linear force motor, coil spring, pneumatic or hydraulic cylinder, etc.

[0014] In an embodiment, the at least one heated roller is provided with an actuator for adjusting an orientation of said roller for adjusting a position of the belt with respect to the rollers. The heating roller is simultaneously a belt steering roller. Rotating the heated roller around an axis perpendicular to its belt rotation axis, a steering force can be externed on the belt to adjust its lateral position on the rollers.

[0015] In an embodiment, the heater is positioned inside the heated roller. The heater is preferably an internal to optimize heat transfer between the heater and the heated roller.

[0016] In an embodiment, the belt is supported on six rollers, wherein negative rollers are positioned between respectively the heated rollers on a bottom side and top rollers on a top side during use in a height direction and between respectively the heated rollers and the top rollers in a transport direction. During use the top rollers are above the negative rollers, so that the print medium support plane over the suction chamber assembly is above the negative rollers. The heated rollers are then below the negative rollers. When viewed in the lateral direction, the negative rollers are in between the top rollers, though at a lower position. In a similar view, the negative rollers are in between the heated rollers, but at a higher position. The top rollers and heated rollers form the outer rollers, which define a volume in which volume the negative rollers are positioned. This results in a space-efficient construction.

[0017] The present invention further relates to a fixation station for a printer according to any of the above described embodiment. The fixation station is arranged to fix wet ink on print media. Thereto, the print station preferably comprises an emitter for transferring heat between the print media and the emitter. The emitter transfer heat in the form of e.g. heated or cooled air, radiation, etc. Preferably, the emitter comprises one or more hot air blowers. The present invention further relates to a transport belt system for a fixation station as previously described. The present invention further relates to transport belt system for a fixation station according to any of the above described embodiments.

[0018] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the present invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the present invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The present invention will become more fully understood from the detailed description given herein below and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Fig. 1 is a schematic side of a sheet printer comprising a fixation station with a sheet transporter;
Fig. 2 is a schematic side view of a transport belt system of the sheet transporter; and
Fig. 3 is a schematic perspective view of a torsion body of the transport belt system in Fig. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] The present invention will now be described with reference to the accompanying drawings, wherein the same reference numerals have been used to identify the same or similar elements throughout the several views.

Sheet printer

[0021] Fig. 1 illustrates a sheet printer 1. An input module 2 holds a sheet stack S1, from which sheets S3 are subsequently fed onto a transport path 3 of the printer 1. The transport path 3 extends from the input module 2 past a print station 4, followed by a fixation station 20, towards an output module 19, where the sheets S3 are re-stacked into a sheets stack S2. Optionally, the transport path 3 may comprise a return path for double sided printing of the sheets S3. The transport path 3 is formed of multiple transport devices, such as (suction) transport belts, rollers, pinches, etc. The transport path may further comprise sheet guides 4 for supporting and/or directing the sheet S3.

[0022] The print station 5 comprises a printing assembly 6 comprising at least one printhead 7. The one or more printheads 7 are arranged to print an image on the sheet S3 as it passes. Preferably, the one or more printheads 7 are part of a page wide printhead array, which allows the sheet S3 to be printed on without stopping its transport. Alternatively, the printheads may move reciprocally in a lateral direction Y, as in a scanning printer. To transport the sheet S3, the print station 5 further comprises an endless print transport belt 8. The print transport belt 8 is supported on a plurality of print support rollers 9, such that on said belt 8 a planar sheet support surface facing the printing assembly 6 is formed. This plane is preferably parallel to the transport direction X and the lateral direction Y, which directions X, Y during use are preferably

arranged in the horizontal plane. On an opposite side of the print transport belt 8 with respect to the printing assembly 6, a print suction chamber assembly 10 is arranged. The print suction chamber assembly 10 comprises at least one suction chamber in fluid connection with a print suction source 12, such as a pump or fan. By activating the print suction source 12 a negative pressure is created to suck the sheet S3 flat against the print transport belt 8. The print transport belt 8 is air permeable, as it comprises openings in the form of through-holes, channels, and/or is formed of an intrinsically air permeable material. Thus, the print station 5 comprises a print suction holder 11 to suck the sheet S3 against the print transport belt 8, so that the sheet S3 is transported by the belt 8.

[0023] After forming the image on the sheet S3 in the print station 5, the sheet S3 is transferred to the fixation station 20, where the jetted ink is fixed onto the sheet S3. Thereto, the fixation station 20 comprises a fixation unit 21 arranged to initiate and/or accelerate the transition of the ink into a solid layer. The fixation unit 21 comprises one or more emitters 22 to transfer energy between the fixation unit 21 and the ink on the sheet S3. Preferably heat is supplied to (or removed from) the sheet S3 by conduction, convection, and/or radiation. In the example in Fig. 1, the emitter 22 is arranged to emit heated air (or another suitable gas) onto the sheet S3, for example by means of an array of nozzles extending the lateral direction Y. The emitter 22 is preferably sufficiently wide in the lateral direction Y to emit a flow of heated air on the substantially full width of the fixation transport belt 29. Similar to the print station 5, the fixation station 20 comprises a fixation suction holder 24 formed of a fixation suction chamber assembly 23 and a fixation suction source 25. The air permeable fixation transport belt 29 is supported on a plurality of fixation support rollers. At least one of these rollers 26, 27, is a heated roller 26, 27. The heated roller 26, 27 is provided with a roller heater 28, for example a resistance heater or radiation heater. The roller heater 28 preferably directly heats the heated roller 27, which due to its contact with the respective belt 29, heats said belt 29. The belt 29 may be heated to heat the sheet S3 to enhance the ink drying process, to maintain a constant temperature inside the fixation unit 20, and/or to reduce energy transfer between the emitter 22 and the respective belt 8.

[0024] After fixing the image to the sheet S3, the sheet S3 is passed to the output module 19, which comprises a stacker for stacking the sheet S3 into a sheet stack S2. Alternatively, the sheet may be flipped and returned to the print station 5 for printing on its unprinted side. It will be appreciated that all components are controlled by means of a controller 38.

Belt system for fixation station

[0025] Fig. 2 illustrates in detail the suction transport belt system for the fixation station 20. The belt 29 is supported on six rollers. Three of these rollers are heated rollers 26, 27, 32 each comprising a respective roller heater 28. One heated roller is positioned as the top, upstream roller 32, where the sheet S3 moves onto the belt 29. The other heated rollers 26, 27 are positioned at the bottom side of the belt system 30. A torsion body 46 is provided to space the heated rollers 26, 27 apart from one another in the transport direction X. The heated rollers 26, 27 are in direct contact with the belt 29, and heat the belt 29 via conduction. Adjacent the bottom heated rollers 26, 27 negative rollers 33, 34 are provided, such that the belt 29 comprises an inward turn 36, 37 or curve at each heated roller 26, 27. The negative rollers 33, 34 are positioned within the volume defined by the other four rollers 31, 32, 26, 27. The negative rollers 33, 34 define an inward turn 36, 37, which increases the contact angle CA between each bottom heated roller 26, 27 and the belt 29. In Fig. 2, the contact angle CA is around 180°. A greater contact angle CA allows for more contact time between the belt 29 and the heated rollers 26, 27 thereby increasing the heat transfer between the two. This increases the efficiency of the energy transfer and allows the heated rollers 26, 27 to operate at lower temperatures. It will be appreciated that the effect of the greater contact angle CA applies also to the top heated roller 32, so the energy transfer can be enhanced at all three heated rollers 26, 27, 32. From the negative rollers 26, 27 the belt 29 extends to the respective top rollers 31, 32, which define the plane of the print medium support surface facing the emitter 22. The top rollers 31, 32 are at the respective ends of the suction chamber assembly 23. At least one of the rollers 26, 27 31-34 is provided with a tensioner, such as a spring, to keep tension in the belt 29. In Fig. 2, this tensioner roller is one of the negative rollers 33, 34, but it will be appreciated that any other roller, an additional roller, and/or multiple rollers may be provided with a tensioner. Different tensioning means may also be applied elsewhere along the belt 29, such as a pretensioned pressing plate.

[0026] The bottom heated rollers 26, 27 are connected to one another via a tension body 46, though it will be appreciated that any other roller may be mounted onto the tension body 46 as well. The torsion body 46 is constructed to be rigid to minimize deformation due to torsion in the torsion body 46. This maintains the heated rollers 26, 27 in well-defined positions with respect to one another. The construction of the torsion body 46 will be explained below in detail with respect to Fig. 3. In Fig. 2, the heated rollers 26, 27 are mounted at respective ends of the torsion body 46 in the transport direction X by respective mounting supports 40, 43. The mounting supports 40, 43 are provided with a rotational bearing 39, 42, which allows the heated rollers 26, 27 to rotate with respect to the torsion body 46. The right heated roller 27 is further provided with an actuator 44 to adjust the orientation of the heated roller 27 with respect to the torsion body 46. By adjusting the angle of the heated roller 27, the position of the belt 29 with respect to the

rollers 26, 27, 31-34 can be controlled. The actuator 44 makes the heated roller 27 suitable as a belt steering roller. By combining the functions of belt steering and heating into a single roller, a compact construction is achieved.

Torsion body

[0027] An example of a torsion body 46 is illustrated in Fig. 3. The torsion body 46 is designed to minimize it twisting around an axis parallel to the transport direction X. Thereby, the torsion body is formed of at least one tube body 47, 48. The tube body 47, 48 can be any shape, but has an endless or closed shape or loop when viewed in the transport direction X. The closed loop cross-section of the torsion 46 ensures it is sufficiently rigid to withstand torsional forces coming from the belt 29. The torsion body 46 may comprise additional support bodies 48, for example positioned within an outer tube body 47, to increase its stiffness. The outer tube body 47 preferably has a substantially rectangular cross-section to fit in the space defined by the belt 29. The support bodies 48 may also be tube bodies and preferably also have a closed loop cross-section as well. These are drawn in Fig. 3 to be circular, but it will be appreciated that other shapes, such as rectangular, may be applied as well. It will further be appreciated that the support bodies 48 may also be formed of profiles, such L, H, or T-profiles.

[0028] Although specific embodiments of the invention are illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations exist. It should be appreciated that the exemplary embodiment or exemplary embodiments are examples only and are not intended to limit the scope, applicability, or configuration in any way. Rather, the foregoing summary and detailed description will provide those skilled in the art with a convenient road map for implementing at least one exemplary embodiment, it being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope as set forth in the appended claims and their legal equivalents. Generally, this application is intended to cover any adaptations or variations of the specific embodiments discussed herein.

[0029] It will also be appreciated that in this document the terms "comprise", "comprising", "include", "including", "contain", "containing", "have", "having", and any variations thereof, are intended to be understood in an inclusive (i.e. non-exclusive) sense, such that the process, method, device, apparatus or system described herein is not limited to those features or parts or elements or steps recited but may include other elements, features, parts or steps not expressly listed or inherent to such process, method, article, or apparatus. Furthermore, the terms "a" and "an" used herein are intended to be understood as meaning one or more unless explicitly stated otherwise. Moreover, the terms "first", "second", "third", etc. are used merely as labels, and are not intended to impose numerical requirements on or to establish a certain ranking of importance of their objects.

[0030] The present invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the present invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

References

[0031]

1	Printer
2	Input module
3	Transport path
4	Sheet guide
5	Print station
6	Printing assembly
7	Printhead
8	Print transport belt
9	Print support rollers
10	Print suction chamber assembly
11	Print suction holder
12	Print suction source
19	Output module
20	Fixation station
21	Fixation unit
22	Emitter
23	Fixation suction chamber assembly
24	Fixation suction holder
25	Fixation suction source
26	First heated bottom roller
27	Second heated bottom roller
28	Roller heater
29	Fixation transport belt
30	Suction transport belt system Belt cooler
31	First top roller
32	Second top roller (heated)
33	First negative roller
34	Second negative roller
35	Belt tensioner
36	First negative turn
37	Second negative turn
39	First rotational bearing
41	First roller support
42	Second rotational bearing
43	Second roller support
44	Belt steering actuator
46	Torsion body Fourth slit array
47	Outer torsion body
48	Inner torsion body
CA	Contact angle
S1	Input sheet stack
S2	Output sheet stack
S3	First sheet

X Transport direction
Y Lateral direction
Z Height direction

Claims

1. A printer (1) comprising a fixation station (20) for fixing ink to print media (S3), which fixation station (20) comprises a transport belt system (30), which comprises:

- an endless belt (29) supported on a plurality of rollers (26, 27, 31-34), which belt (29) is provided with openings through which a negative pressure can be applied to print media (S3) on the belt (29) via a suction chamber assembly (25) facing the belt (29), **characterized in that** at least two of the rollers (26, 27, 31-34) are heated rollers (26, 27), which each comprises a heater (28) for heating the belt (29), wherein for each heated roller (26, 27) at least another one of the rollers (26, 27, 31-34) is positioned inside a volume defined by the other rollers (26, 27, 31-34), so that the belt (29) comprises two negative turns, which each locally direct the belt (29) over the at least one heated roller over a contact angle (CA) greater than 100°.

2. The printer (1) according to claim 1, wherein the negative turns are positioned facing one another.

3. The printer (1) according to claim 1 or 2, wherein one heated roller (26, 27) with its respective negative turn is arranged substantially mirror symmetric with respect to the other heated roller (26, 27) with its respective negative turn.

4. The printer (1) according to claim 1, wherein the contact angle is greater than 150°, preferably at least 170°, very preferably at least 180°.

5. The printer (1) according to any of the previous claims, wherein the heated rollers (26, 27) are mounted on opposite ends of a rigid torsion body (46), which extends parallel to the suction chamber assembly (23).

6. The printer (1) according to claim 5, wherein the torsion body (46) is formed of at least one tube body (47, 48)

7. The printer (1) according to claim 6, wherein the at least one tube body (47, 48) has a closed shape cross-section when viewed parallel to a transport direction (X) of the belt (29).

8. The printer (1) according to any of the previous claims, wherein at least one of the rollers (26, 27, 31-14) is provided with a tensioner (35) for tensioning the belt (29).

9. The printer (1) according to any of the previous claims, wherein the at least one heated roller (26, 27) is provided with an actuator (44) for adjusting an orientation of said roller (26, 27) for adjusting a position of the belt (29) with respect to the rollers (26, 27, 31-34).

10. The printer (1) according to any of the previous claims, wherein the heater (28) is positioned inside the heated roller (26, 27).

11. The printer (1) according to any of the previous claims, wherein the belt (29) is supported on six rollers (26, 27, 31-14), wherein negative rollers (33, 24) are positioned between respectively the heated rollers (26, 27) on a bottom side and top rollers on a top side during use in heigh direction (Z) and between respectively the heated rollers (26, 27) and the top rollers (31, 32) in a transport direction (X).

12. A fixation station (20) for a printer (1) according to any of the previous claims, which fixation station (20) comprises a transport belt system, which comprises:

- an endless belt (29) supported on a plurality of rollers (26, 27, 31-34), which belt (29) is provided with openings through which a negative pressure can be applied to print media (S3) on the belt (29) via a suction chamber assembly (25) facing the belt (29), wherein at least one of the rollers (26, 27, 31-34) is a heated roller (26, 27), which comprises a heater (28) for heating the belt (29),

characterized in that at least another one of the rollers (26, 27, 31-34) is positioned inside a volume defined by the other rollers (26, 27, 31-34), so that the belt (29) comprises a negative turn, which directs the belt (29) over the at least one heated roller over a contact angle greater than 100°.

13. A transport belt system for a fixation station according to claim 12, which comprises:

- an endless belt (29) supported on a plurality of rollers (26, 27, 31-34), which belt (29) is provided with openings through which a negative pressure can be applied to print media (S3) on the belt (29) via a suction chamber assembly (25) facing the belt (29), wherein at least one of the rollers (26, 27, 31-34) is a heated roller (26, 27), which comprises a heater (28) for heating the belt (29),

characterized in that at least another one of the rollers (26, 27, 31-34) is positioned inside a volume defined by the other rollers (26, 27, 31-34), so that the belt (29) comprises a negative turn, which directs the belt (29) over the at least one heated roller over a contact angle greater than 100°.

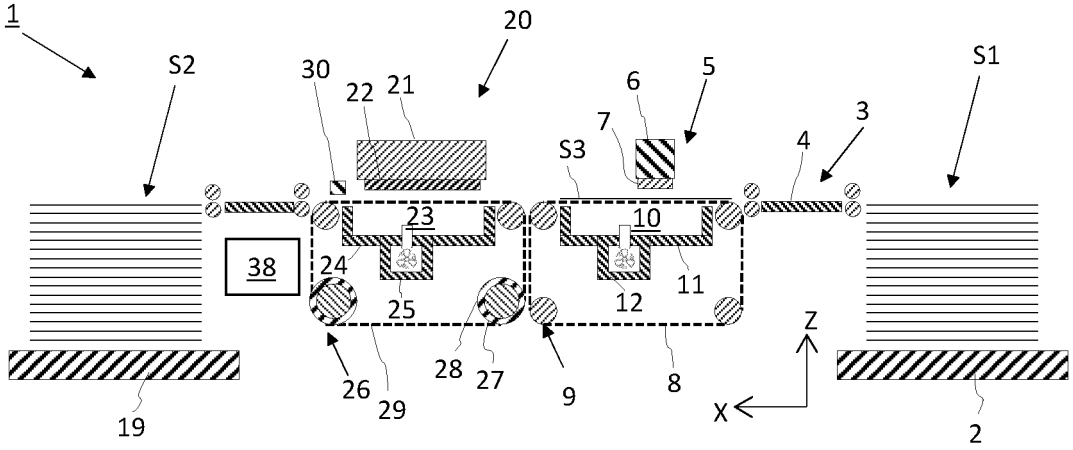


Fig. 1

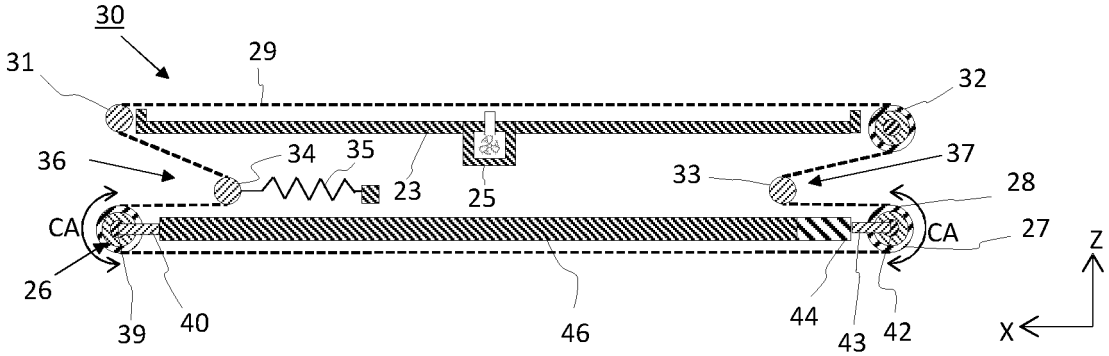


Fig. 2

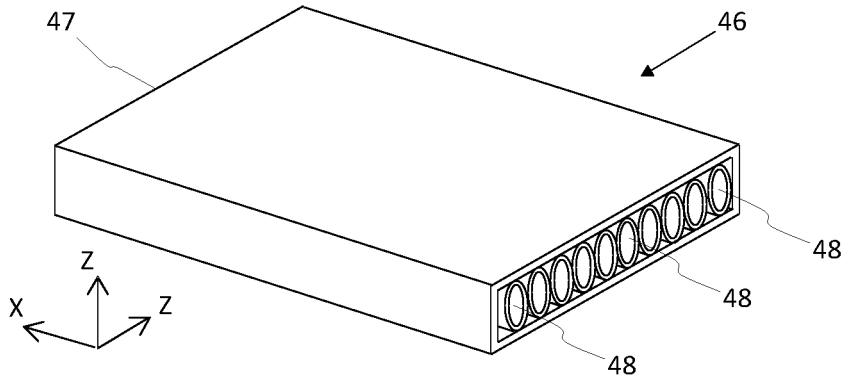


Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 25 16 8020

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	US 2024/408898 A1 (KAWAKITA JUN [JP] ET AL) 12 December 2024 (2024-12-12) * paragraphs [0042], [0043]; figure 2 *	1-13	INV. B41J11/00
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E	US 2025/282162 A1 (DOSHIDA TAKAAKI [JP]) 11 September 2025 (2025-09-11) * figure 3 *	12,13	
A	US 2019/202215 A1 (ASADA KOHKI [JP] ET AL) 4 July 2019 (2019-07-04) * figures 2, 10 *	1-13	
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TECHNICAL FIELDS SEARCHED (IPC)

B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 September 2025	Loi, Alberto

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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