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(54) PRINTING PLATFORM FOR INKJET PRINTING EQUIPMENT

(57) The present invention relates to the field of printers, and particularly relates to a printing platform. The printing platform is located between a paper feeding platform and a paper outlet platform, a plurality of convex planes and concave planes is arranged on one side, in contact with a printing medium, of the printing platform, the convex planes and the concave planes are provided alternately along the X direction of the printing platform, and stretch across the Y direction of the printing platform; and the paper delivery ends of the concave planes are provided in an opened manner. The printing platform disclosed by the present invention well solves the problem of bulging of the ink-jet printing medium, which troubles the industry for a long time, especially large-ink-quantity wide format printing equipment. By the ground-breaking non-planar concave-convex design of the platform, the printing platform is skillfully based on ballooning and deformation of the medium absorption on site. While for the problem that the printing effect is affected because the platform is uneven, which is worried by the industry originally, because the ink droplets fly downwards vertically, in a certain stroke, tiny height difference may be neglected. Actual test also proves that the printing effect is better than that of the original design.

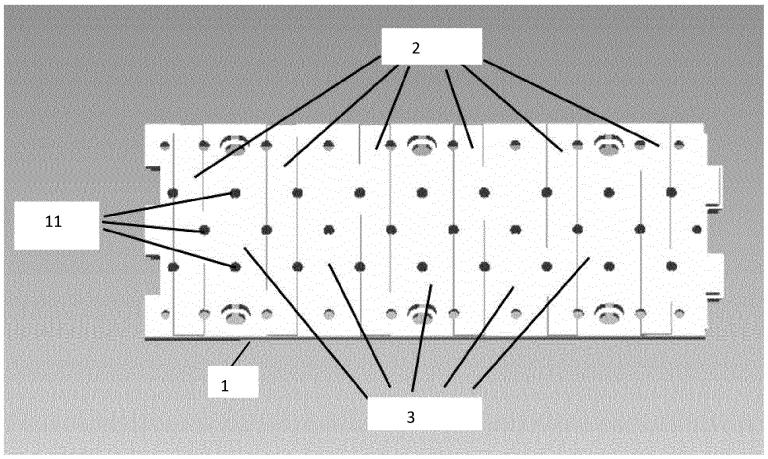

Figure 7

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Description

Technical Field

[0001] The present invention relates to the technical field of printers, and more particularly relates to a medium supporting jet printing printing platform for ink-jet printing equipment.

Background Art

[0002] As main equipment for digital printing, printers are used more and more widely. As mainstream of printing equipment, ink-jet printing can realize jet printing on various different media, for example various kinds of paper, polymer film media and films, various kinds of cloth and the like, and is playing a more and more important role. Because color ink jet has relatively high requirement on color rendition, for general printing media, a coating or a treating agent is formed on the surface of a base material to control diffusion of ink droplets and absorb ink. For paper with medium substrate being plant fiber or other water absorbing media, after ink jet, the base material swells and deforms by absorbing ink, and local ballooning is caused on a printing platform, which affects the printing precision effect in less severe cases and scratches a printing head in more severe cases, and causes damage of expensive sprayers or scrapping of batch printed products. This problem has increasingly affected the normal operation of printers, especially in the field of large scale production application, for example printing of decorative pictures in digital textile printing industry, requirement on operation stability is especially high. Because the precision of an effective range between the printing head and the platform has an obvious influence on the printing effect, conventional machine designs try to guarantee the smoothness of the printing platforms and reduce the distance between the sprayer and the printing platform and guarantee the movement parallelism between the printing platform and a jet printing ink trolley to the greatest extent. Therefore, the printing platforms are all smooth, especially in large scale large format printing equipment. However, in order to effectively control the problem of swelling and deformation of the medium on the platform after absorbing jet printing liquid, for conventional printing platform design, some air suction structures need to be provided while ensuring the flatness, so as to enable the medium to cling to the platform, typically comprising the following three manners:

1. Air suction holes of certain density are distributed in the platform, and low pressure adsorption is generated by a fan below the platform, as shown in Figure 1 and Figure 2.
2. Some air suction holes are distributed in the platform, and are combined with groove design for enlarging the air suction area. Two kinds of groove design may be adopted according to the material selected for the platform:

   (1) For an injection mould platform or a cast mould metal platform, some grooves in slant or criss-cross intersection may be flexibly adopted generally, so as to enlarge the air suction area and increase the air suction uniformity, as shown in Figure 3.
   (2) For extruded section platforms, such as platforms processed by adopting aluminium alloy extruded material, some transverse grooves may be distributed along the length direction of extrusion.

3. A few of companies may also adopt a manner that some air suction holes are distributed in the platform, and the area around the air suction holes is enlarged by digging to form some shallow air suction ponds so as to enlarge the air suction area. But such structures generally focus on the design of promotion of the air suction effect, and therefore, the outer circles of the ponds are flush with the printing platform, so as to guarantee that the height of the paper is not affected basically, as shown in Figure 4.

[0003] Defects of the prior art: The base material swells after the water absorbing medium absorbs ink, due to the combined action of the rolling-up tension of a feed roller in the pushing-out and paper take-up directions on the medium, the medium generates irregular vertical arching and bulging in the paper feeding direction (Y direction), which affects the printing picture quality. When the local bulging height is too great, the printing head may be scratched and picture scrapping may be caused. Wrinkling and ballooning conditions in actual operation are as shown in Figure 5 and Figure 6, and the wrinkling position and height both have uncertainty.

Summary of the Invention

[0004] In order to solve disadvantages of the prior art, the present invention provides a printing platform structure which is capable of uniformly absorbing medium ballooning and remarkably eliminating upward arching of the medium, so as to thoroughly avoid scratching of a printing head caused by bulging of the medium and improve the picture quality and the printing effect.

[0005] The present invention provides a printing platform, the printing platform is located between a paper feeding platform and a paper outlet platform, a plurality of convex planes and concave planes is formed on one side, in contact with a printing medium, of the printing platform, the convex planes and the concave planes are provided alternately along the X direction of the printing platform, and stretch across the Y direction of the printing platform; and the paper delivery ends of the concave planes are provided in an opened manner (preset of a

structure approaching to the height of the convex planes is not available).

[0006] Preferably, air suction holes are formed in the printing platform located on the concave planes.

[0007] Preferably, a plurality of air suction holes is formed in the printing platform located on the convex planes.

[0008] Preferably, the height difference H between the convex plane and the concave plane is greater than or equal to $\Delta E/(2N)$, ΔE is the length increased after the medium absorbs ink, and N is the number of the convex plane on the printing platform.

[0009] More preferably, the height difference H between the convex plane and the concave plane is greater than or equal to 0.1 mm and smaller than or equal to 0.8 mm; and the horizontal width of the concave plane is greater than 0.4 mm.

[0010] Preferably, the concave plane located at the paper feeding end is closed, and the width of the concave plane is gradually increased along the paper delivery direction of the printing platform.

[0011] Preferably, a section of a convex plane a with relatively small length is further provided on the printing platform, the convex plane a starts from the paper feeding end, and the convex plane a and the convex planes of the printing platform are provided alternately.

[0012] Preferably, a plurality of grooves or other auxiliary air suction structure is formed in the convex plane and the concave plane of the printing platform.

[0013] Preferably, the height of the highest part of the paper outlet platform is smaller than the height of the convex plane of the printing platform or smaller than the height of the concave plane.

[0014] Preferably, guide sections B and C are additionally arranged between the paper feeding platform and the printing platform, a guide section E is additionally arranged between the paper outlet platform and the printing platform, and the height of the highest point of the sections B, C and E is smaller than the height of the concave plane of the printing platform.

[0015] Preferably, the printing platforms may be mutually spliced.

[0016] The definition of the printing platform (or a jet printing platform, a main printing platform) disclosed by the present invention refers to a platform of partial width corresponding to the width (Y direction) of the printing head, that is, a platform position corresponding to real-time ink jet of the printing head when the printer works. In the industry, it is also called as a main printing platform. In the printer structure, generally, an auxiliary paper feeding platform is provided at the front end (close to the feeding roller part) of the printing platform; and an auxiliary paper outlet platform is provided at the rear end (close to the rolling-up part) of the printing platform.

[0017] All the convex planes run through the width (Y direction) of the whole platform in the longitudinal direction, and all the concave planes also run through the width (Y direction) of the whole platform in the longitudinal direction.

[0018] Horizontal (X direction) ribs or other structures equaling to the convex planes in height should not be provided in the concave planes, which affects the overall concave absorbing effect and longitudinal movement effect of the medium. Considering strengthening of the air suction effect, the provided rib structure needs to be lower than the convex planes. Since multi-pass superposition is generally adopted for ink jet, the ink quantity is gradually increased while approaching the rear end (the paper delivery end), and therefore, bulges should not be formed on the paper delivery end of the concave planes, while because the ink quantity at the front end (close to the paper feeding end) is relatively small, the structures such as ribs may be arranged moderately, and may be flush with the convex planes maximally. The paper delivery end of the concave planes is throughout, no bulging structure exists, and in combination with the overall sinking design of the auxiliary paper outlet platform at the rear end (being lower than the convex planes, or being not higher than the concave planes), the key point of the present invention is presented. This is the basic difference of the present invention from other manufacturers in the processing principle and design of printing medium ballooning.

[0019] All the concave planes must have enough width, so as to be favorable for the downward sinking of the medium under the assistance of air suction, and absorb the swelling amount of the medium. Generally, the horizontal width of each section of the concave plane should be greater than 5 mm. And the specific horizontal width needs to be reasonably computed and estimated and tested according to the rigidity of the medium and air suction force as well as the pulling force.

[0020] Height difference between the convex planes and the concave planes is relatively small. For printing heads with low ink droplet flying speed and small ink droplets, the height difference is generally between 0.1 mm and 0.8 mm. For printing heads with high ink droplet flying speed and large ink droplets, the height difference may be greater moderately, and is generally not greater than 4 mm maximally.

[0021] An overall relatively great swelling absorbing amount is achieved by uniformly distributing enough quantity of convex and concave planes on the whole platform. The height difference between the convex planes and the concave planes is reduced as mush as possible under the condition that the overall absorbing amount reaches enough use requirement, so as to ensure that the printing effect is not affected.

[0022] Arrangement of air suction holes or other air suction structure is emphasized in the area of the concave planes. A certain quantity of air suction holes are also distributed in the convex planes, or the air suction holes may not be distributed in the convex planes.

[0023] The platform is more suitable for manufacture of plastic moulds or segmented production of metal cast moulds. A machining manner may also be adopted, but

the manufacture cost is relatively high. The convex planes may also be manufactured by adopting other auxiliary means such as a stickup method.

[0024] The height of the highest part of the paper outlet platform at the rear end should be smaller than the height of the convex planes, and at least approach to the height of the concave planes.

[0025] A section of vacant part may also exist at the position of the paper outlet platform at the rear end, which is favorable for the free dispersion of the arching part of the medium.

[0026] Structure analysis and design implementation manners:

1. In a normal state, the medium will swell after absorbing ink. For a section of medium with normal length being L, length increase after water absorption is ΔE, as shown in Figure 8. The amplitude of ΔE depends on multiple factors such as the characteristics of the medium base material and the coating, the printing ink quantity, the printing speed and the duration time. But the amplitude of ΔE may be obtained by testing according to actual working conditions generally.
2. Several working platforms on the market may have the phenomenon of irregular local arching under the combined action of several factors including medium frictional force, paper rolling-up tension, air suction force and picture ink amount distribution, as shown in Figure 8, Figure 5 and Figure 6. The characteristics are that the arching heights are different and are unpredictable, and local special bulges may be produced.

[0027] The structure design of a new printing platform is as shown in Figure 9. The convex parts and concave parts of the platform are horizontally and uniformly distributed on the platform according to the widths of A and B. The height of the convex parts is H. The amplitudes of A and B need to be comprehensively determined according to factors such as the medium thickness rigidity, the medium coating water absorption characteristic, the air suction strength and the paper rolling-up tension. In actual conditions, the amplitudes of A and B may be obtained by testing the working conditions. Generally, A may be relatively small. While B needs to have enough amplitude to overcome the rigidity of the medium, and enable the medium to be concave smoothly under the combined action of the suction force and the rolling-up tension. The amplitude of H may be computed according to the number N of convex parts and total ΔE in the overall width of the platform:

$$H \geqq \Delta E/(2N)$$

[0028] Under the condition of meeting the absorbing condition of ΔE, H should be reduced as much as possible, so as to ensure that the printing effect is not affected. The effect of the design scheme is as shown in Figure 10, ΔE is digested and absorbed by a plurality of uniformly distributed convex and concave amounts. In actual test, after proper H amplitude is obtained, even in a most severe sensitive color, for example, a neutral grey and gradient color transition picture, the platform does not have visible influence on the printing effect. Therefore, the present patent has high feasibility. Figure 11 is the actual measurement of printing after implementation of the platform principle, and it may be seen that it is not in the bulging uncontrollable state like in Figure 5 and Figure 6 any more. The medium in Figure 11 may already be completely clung to the surface of the printing platform, and does not have especially abnormal bulging parts. In such a state, the printing quality may be improved greatly, and the fault problem of scratching of the printing head is solved, so that the equipment may work steadily for a long time under complicated working conditions.

[0029] The principle of the present invention is based on the absorption of ballooning and deformation of the medium on site, and therefore, the concave planes at the paper delivery end in the Y direction are designed with openings, which is the key point of distinctiveness. That is, other bulging structures do not exist at the outlet end of the concave planes, and meanwhile in combination with the further sinking design of the paper outlet platform, the swelling amount of the medium sinks sufficiently to get close to the concave planes, so as to be accommodated and absorbed.

[0030] According to the present invention, on the basis of theory and test, re-construction breaking through conventionality is performed on the platform, the problem of medium ballooning is controlled, and the overall printing precision is not affected, so that the long-term steady operation of the jet printing equipment in various ink amounts and water absorbing media is guaranteed. Product design and production of the printing platform disclosed by the present invention have already be performed, the printing platform is already used for customers of the industry in batches, and a remarkable effect is obtained.

[0031] Why cannot conventional platform structures solve the problem of ballooning? That is because the previous thought of the industry is that the medium is flattened by external force or adsorbed by strong air suction. However, uniform conduction of the tension is obstructed by the possibility of non-uniform distribution of modulus in the printing area and the rigidity of the medium, and the effect cannot be solved. Similarly, strong adsorption is incompatible with medium transfer, and meanwhile the rigidity of the medium and the uncertain area characteristic of ink jet doom that the adsorption effect is poor. Furthermore, fundamentally, if a complete platform does not have a longitudinal structure capable of accommodating and absorbing extra dimension, the problem of increased ΔE dimension of medium balloon-

ing cannot be fundamentally solved, and finally ΔE can only wrinkle upwards at several unmeasurable heights, resulting in scratching of the printing head and damage of the picture, as shown in Figure 8, Figure 5 and Figure 6.

[0032] Beneficial effects of the present invention: The present invention well solves the problem of bulging of an ink jet printing medium, which troubles the industry for a long time, especially large-ink-quantity wide format printing equipment. By the ground-breaking non-planar convex-concave design of the platform, the present invention is skillfully based on absorption of ballooning and deformation of the medium on site. While for the problem that the printing effect is affected because the platform is uneven, which is worried by the industry originally, because the ink droplets fly downwards vertically, in a certain stroke, tiny height difference may be neglected. Actual test also proves that the printing effect is better than that of the original design. Just because of such tiny height difference H, this problem is perfectly solved by digestion of great ΔE finally by multiple sections of distribution and accumulation.

Brief Description of the Drawings

[0033]

Figure 1 is a three-dimensional effect diagram of a printing platform part of conventional printing equipment;
Figure 2 is a three-dimensional wireframe diagram of the printing platform part of the conventional printing equipment;
Figure 3 is a printing equipment platform with groove design on the market;
Figure 4 is a printing equipment platform with air suction ponds on the market;
Figure 5 is an actual measurement picture of ballooning and wrinkling of a printing platform;
Figure 6 is an actual measurement picture of ballooning and wrinkling of another printing platform;
Figure 7 is a three-dimensional effect diagram of a platform with conception of the present invention;
Figure 8 is a cross-section analysis schematic diagram of ballooning and wrinkling of the printing platform on the market;
Figure 9 is a schematic diagram of the structure principle of a platform according to the present invention;
Figure 10 is a schematic diagram of effect analysis of a platform structure according to the present invention;
Figure 11 is an actual application test picture according to the present invention;
Figure 12 is a three-dimensional design scheme of mated front and rear auxiliary platforms according to the present invention (embodiment 1);
Figure 13 is key points and working state annotation of mated front and rear auxiliary platforms according to the present invention (embodiment 1);
Figure 14 is advancement design according to the present invention (embodiment 2);
Figure 15 is a schematic diagram of embodiment 3 according to the present invention;
Figure 16 is a schematic diagram of embodiment 4 according to the present invention;
Figure 17 is a schematic diagram of embodiment 5 according to the present invention;
Figure 18 is a schematic diagram of embodiment 6 according to the present invention;
Figure 19 is a schematic diagram of embodiment 7 according to the present invention; and
Figure 20 is a schematic diagram of embodiment 8 according to the present invention.

[0034] In the drawings: a-air suction hole, b-sprayer ink trolley, c-pressure feed roller, d-printing platform, e-paper outlet platform, f-air suction hole and air suction groove; f'-auxiliary air suction pond, 1-printing platform, 2-convex plane, 3-concave plane, 11-air suction hole, and 12-groove.

Detailed Description of the Invention

[0035] Further illustration is performed on the present invention below in combination with the accompanying drawings:
Figures 1 to 6 show the conditions of printers of the prior art; Figure 1 is a three-dimensional effect diagram of a printing platform part of conventional printing equipment; Figure 2 is a three-dimensional wireframe diagram of the printing platform part of the conventional printing equipment; Figure 3 is a printing equipment platform with groove design on the market; Figure 4 is a printing equipment platform with air suction ponds on the market; Figure 5 is an actual measurement picture of ballooning and wrinkling of a printing platform; and Figure 6 is an actual measurement picture of ballooning and wrinkling of another printing platform.

[0036] A printing platform structure comprises vertical convex planes which are uniformly distributed along the X direction (that is, the printing width direction) of the whole platform with certain width; meanwhile, concave planes with certain width are provided in match with convex planes alternately. Furthermore, more air suction holes are distributed in the concave planes, and a certain quantity of air suction holes are distributed in the convex planes or are not distributed in the convex planes, as shown in Figure 7.

[0037] Figure 7 shows a schematic diagram of the structure of the present invention, the printing platform structure provided by the present invention comprises a printing platform located between a paper feeding platform and a paper outlet platform, a plurality of convex planes 2 and concave planes 3 is arranged on one side, in contact with a printing medium, of the printing platform 1, the convex planes 2 and the concave planes 3 are provided alternately along the length direction of the print-

ing platform 1, and stretch across the Y direction (along the paper delivery direction of the printing platform) of the printing platform 1. The concave planes 3 are provided in an opened manner, that is, other bulging structures do not exist at the outlet end of the concave planes. Air suction holes 11 are formed in the printing platform 1 located on the convex planes. The height difference H between the convex planes 2 and the concave planes 3 is greater than or equal to $\Delta E/(2N)$, ΔE is the length increased after the medium absorbs ink, and N is the number of the convex planes on the printing platform along the whole width in the X direction, as shown in Figure 8.

[0038] Preferably, the height difference H between the convex planes and the concave planes is greater than or equal to 0.1 mm and smaller than or equal to 0.8 mm; and the width of the concave planes in the X direction is greater than 4 mm.

[0039] As shown in figure 9, the convex parts and concave parts of the printing platform of the present invention are horizontally and uniformly distributed on the platform according to the widths of A and B. As shown in Figure 10, ΔE is digested and absorbed by a plurality of uniformly distributed convex and concave amounts. In actual test, after proper H amplitude is obtained, even in a most severe sensitive color, for example, a neutral grey and gradient color transition picture, the platform does not have visible influence on the printing effect. Figure 11 is the actual measurement of printing after implementation of the platform principle, and it may be seen that it is not in the bulging uncontrollable state like in Figure 5 and Figure 6 any more. The medium in Figure 11 may already be completely clung to the surface of the printing platform, and does not have especially abnormal bulging parts. In such a state, the printing quality may be improved greatly, and the fault problem of scratching of a printing head is solved, so that the equipment may work steadily for a long time under complicated working conditions.

[0040] As shown in Figures 12-13, guide sections B and C are additionally arranged between the paper feeding platform and the printing platform, a guide section E is additionally arranged between the paper outlet platform and the printing platform, and the height of the highest point of the sections B, C and E is smaller than the height of the concave planes of the printing platform. The height of the highest part of the paper outlet platform may be smaller than the height of the convex planes of the printing platform (the height of the highest part of the paper outlet platform may be also smaller than the height of the concave planes), and therefore, the medium may be sufficiently adsorbed to the concave planes under the combined action of the rolling-up tension and the air suction force as shown in the figures, so as to realize effective absorption and digestion of the swelling amount of the medium.

[0041] Preferably, as shown in figure 14, a plurality of air suction holes is formed in the printing platform 1 located on the convex planes 2, and in order to further improve the air suction effect of the printing platform, design of some grooves 12 or other small concave planes may be adopted as assistance, as shown in figure 14, the suction force distribution principle is that suction force on the concave planes is stronger than that on the convex planes.

[0042] According to the present invention, the shape of the convex planes is matched with the shape of the concave planes on the printing platform 1, as shown in Figures 15-19, the convex planes 2 and the concave planes 3 on the printing platform 1 may be of mutually matched shapes, for example, rectangles, triangles, wave shapes or other suitable shapes; as shown in figure 16, the concave planes are closed at the paper feeding end, and along the width direction of the printer, the width of the concave planes is gradually increased along the paper delivery direction, and is totally opened while reaching the paper delivery end.

[0043] As shown in Figure 19, a section of a convex plane a is further arranged between the convex planes of the printing platform 1, the convex plane a starts from the paper feeding end and ends at a certain position on the printing platform, and the convex plane a and the convex planes stretching across the overall width of the printing platform are provided alternately.

[0044] As shown in Figure 20, a plurality of printing platforms may be spliced with one another to form a relatively large printing platform, Figure 20 only shows splicing of part of printing platforms with the convex planes of different shapes of the present invention, and the present invention is not limited to what is shown in Figure 20.

[0045] Considering that multi-pass gradual increase of ink absorption amount is adopted for most ink absorbing printing, the concave area may be relatively narrow at the beginning, and is gradually widened towards the Y direction (the paper delivery direction, that is, the direction close to the paper rolling-up direction), as shown in Figure 15, the concave area is narrow in the front part and wide in the rear part, and is gradually increased, but both are opened.

[0046] Further extremely, as shown in Figure 16, the concave area at the front end is closed, this place is a printing starting area, and is completely flush with the convex planes; the rear end is completely opened at the paper delivery part, and this place is a printing ending area. This manner is possibly more suitable for multi-printing-head machines with relatively wide printing Y direction.

[0047] Deformed platform processing contains various pattern structures, and is illustrated but not limited by Figure 17.

[0048] The convex planes are shrunk to be ribs, as shown in Figure 18. This situation is relatively suitable for media with relatively strong tension and relatively high hardness, and may diffuse the radian change of some ribs relatively.

[0049] On the basis of the above embodiments, con-

sidering the gradual increase characteristic of the ink amount, relatively dense ribs are distributed at the initial section of the platform, and the paper delivery end is opened, as shown in Figure 19.

[0050] The printing platform disclosed by the present invention has the characteristic of being spliced along the longitudinal direction (Y direction), and may be applied to printing equipment with integration of more sprayers. As shown in Figure 20. All the embodiments have horizontal (X direction) infinite splicing characteristic. Splicing generally refers to the condition that the printing platforms are manufactured in a segmented manner by plastic moulds or metal cast moulds. If overall section processing is adopted, less splicing or no splicing may be needed.

Claims

1. A printing platform structure, comprising a printing platform located between a paper feeding platform and a paper outlet platform, wherein a plurality of convex planes and concave planes is formed on one side, in contact with a printing medium, of the printing platform, the convex planes and the concave planes are provided alternately along the X direction of the printing platform, and stretch across the Y direction of the printing platform; and the paper delivery ends of the concave planes are provided in an opened manner.

2. The printing platform structure according to claim 1, wherein an air suction hole is formed in the printing platform located on the concave plane.

3. The printing platform structure according to claim 1 or 2, wherein a plurality of air suction holes is formed in the printing platform located on the convex plane.

4. The printing platform structure according to claim 1, wherein the height difference H between the convex plane and the concave plane is greater than or equal to $\Delta E/(2N)$, ΔE is the length increased after the medium absorbs ink, and N is the number of the convex plane on the printing platform.

5. The printing platform structure according to claim 1, wherein the concave plane located at the paper feeding end is closed, and the width of the concave plane is gradually increased along the paper delivery direction of the printing platform.

6. The printing platform structure according to any one of claims 1 to 4, wherein a convex plane a with relatively small length is further provided on the printing platform, the convex plane a starts from the paper feeding end, and the convex plane a and the convex plane of the printing platform are provided alternately.

7. The printing platform structure according to any one of claims 1 to 4, wherein a plurality of grooves or other auxiliary air suction structure is formed in the convex plane and the concave plane of the printing platform.

8. The printing platform structure according to any one of claims 1 to 4, wherein the height of the highest part of the paper outlet platform is smaller than the height of the convex plane of the printing platform or smaller than the height of the concave plane.

9. The printing platform structure according to any one of claims 1 to 4, wherein guide sections B and C are additionally arranged between the paper feeding platform and the printing platform, a guide section E is additionally arranged between the paper outlet platform and the printing platform, and the height of the highest point of the sections B, C and E is smaller than the height of the concave plane of the printing platform.

10. The printing platform structure according to any one of claims 1 to 4, wherein the printing platforms may be mutually spliced.

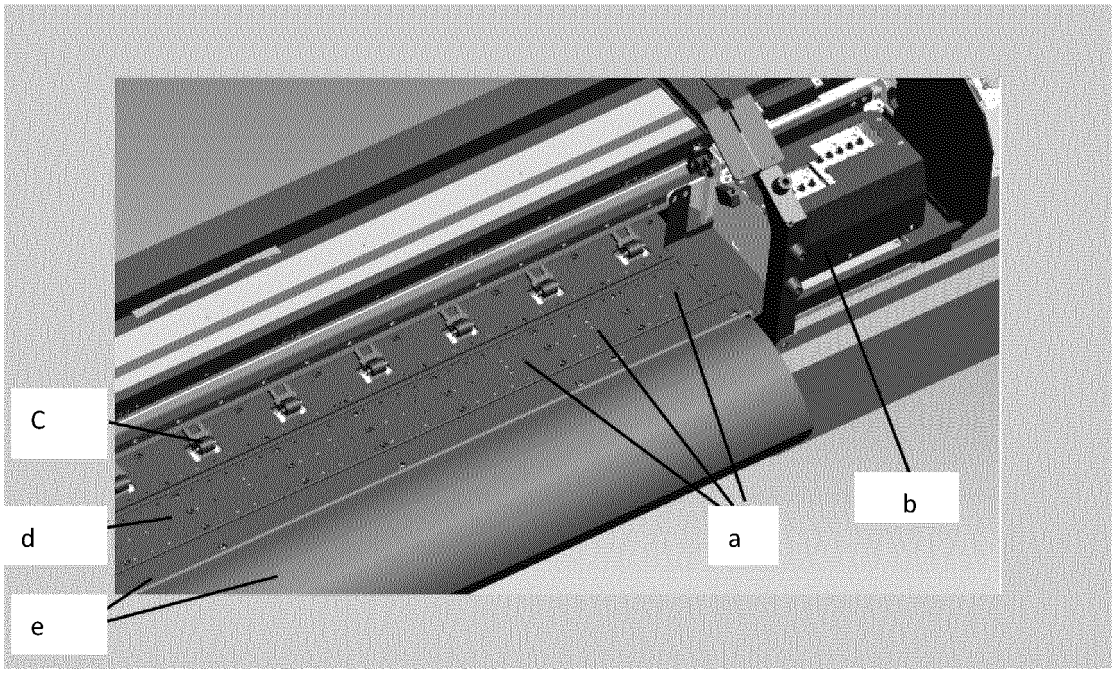

Figure 1

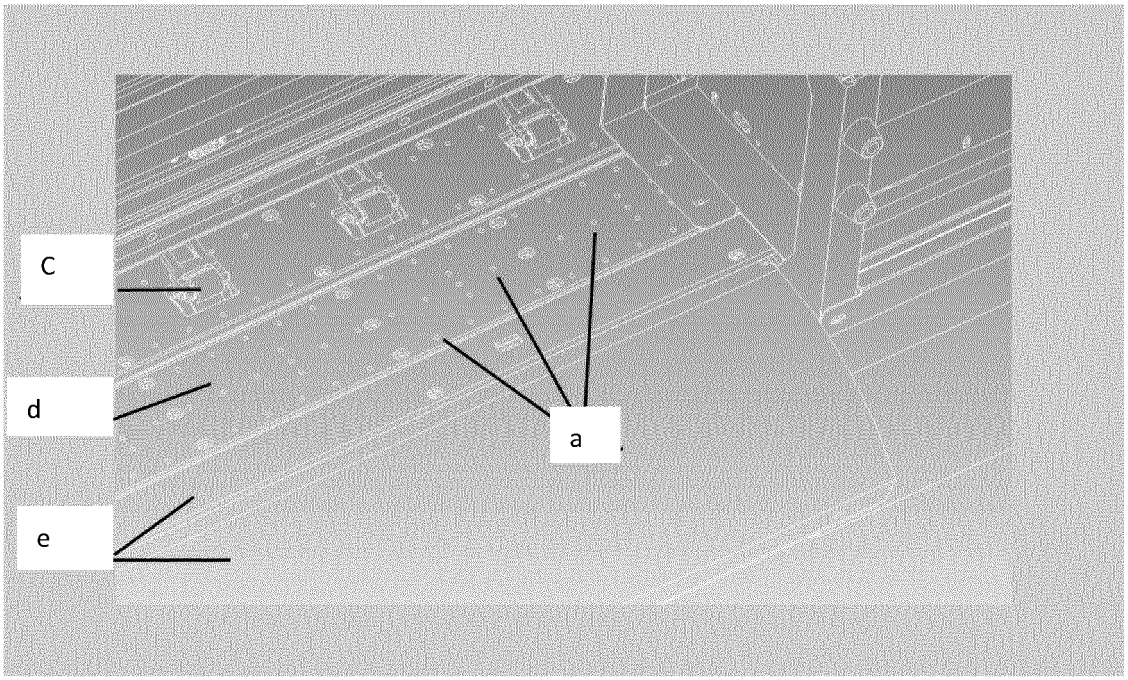

Figure 2

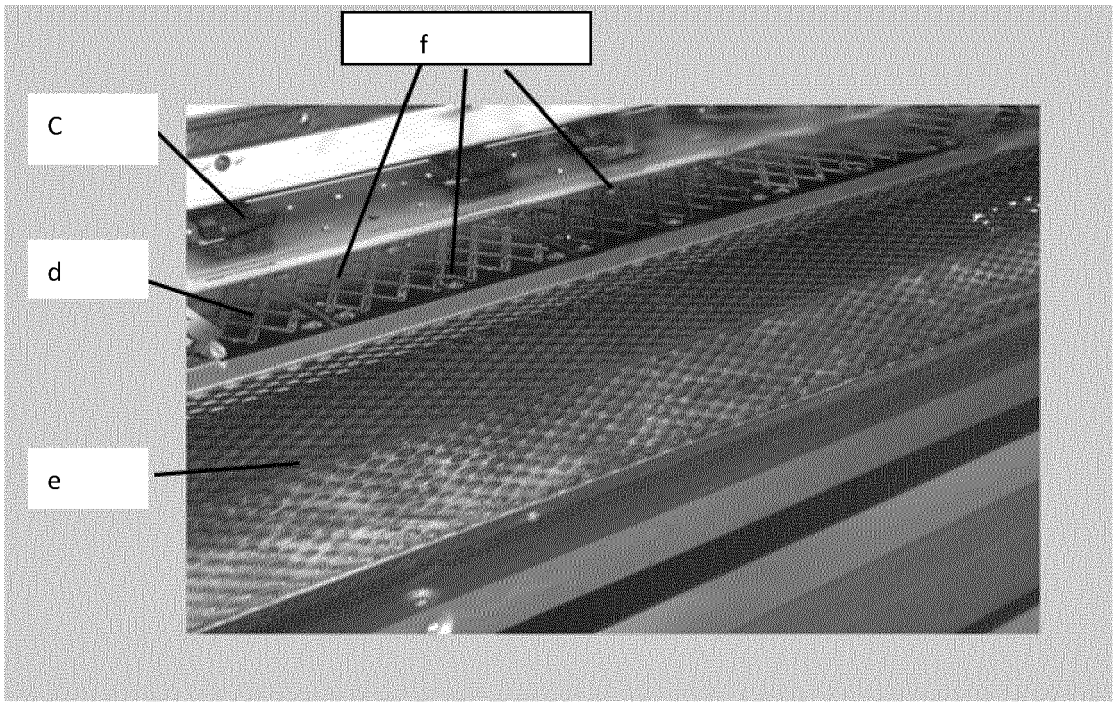

Figure 3

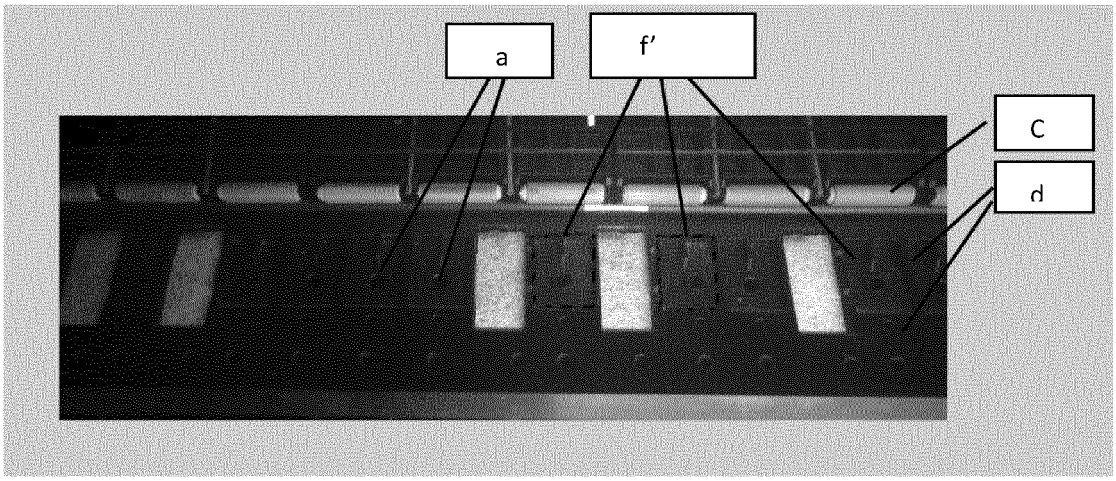

Figure 4

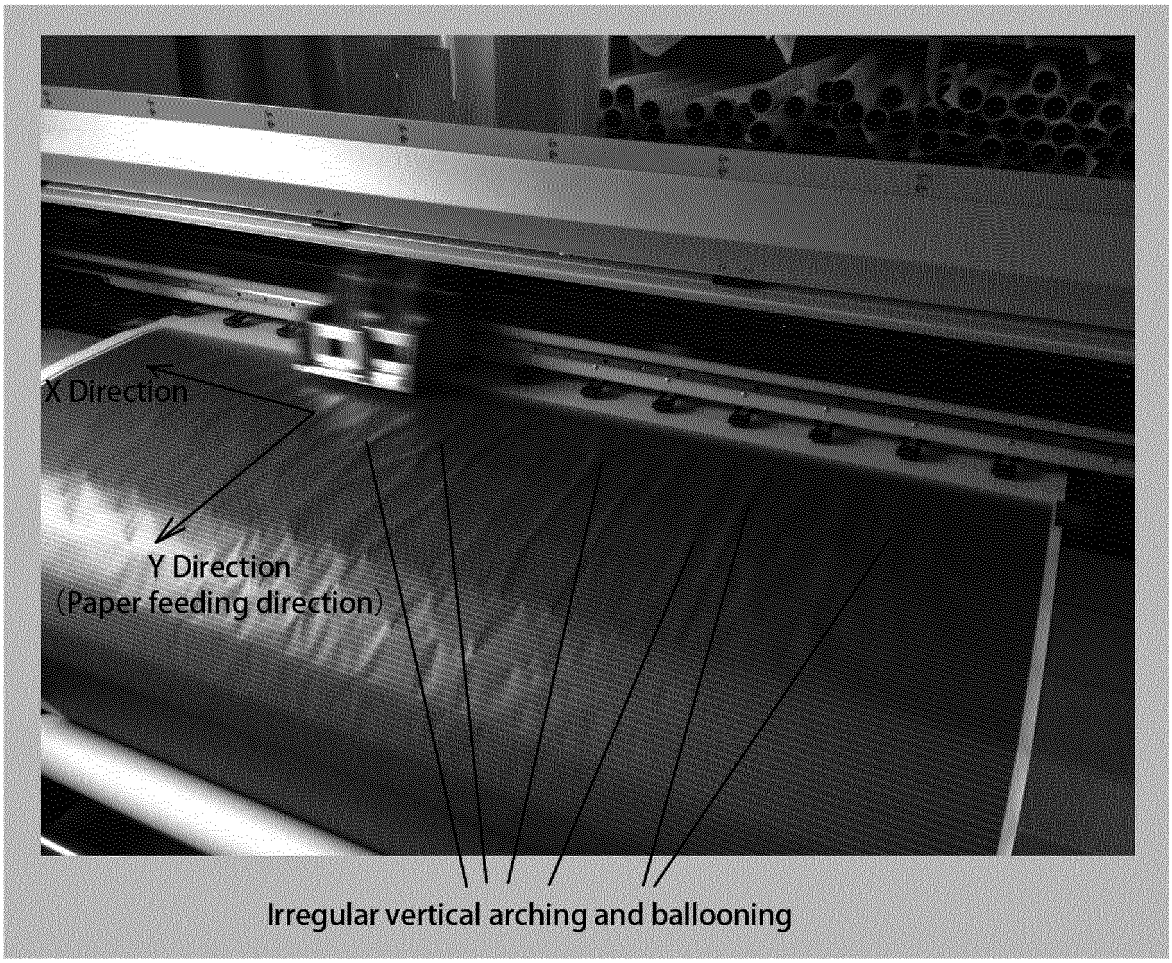
X Direction
Y Direction
(Paper feeding direction)
Irregular vertical arching and ballooning

Figure 5

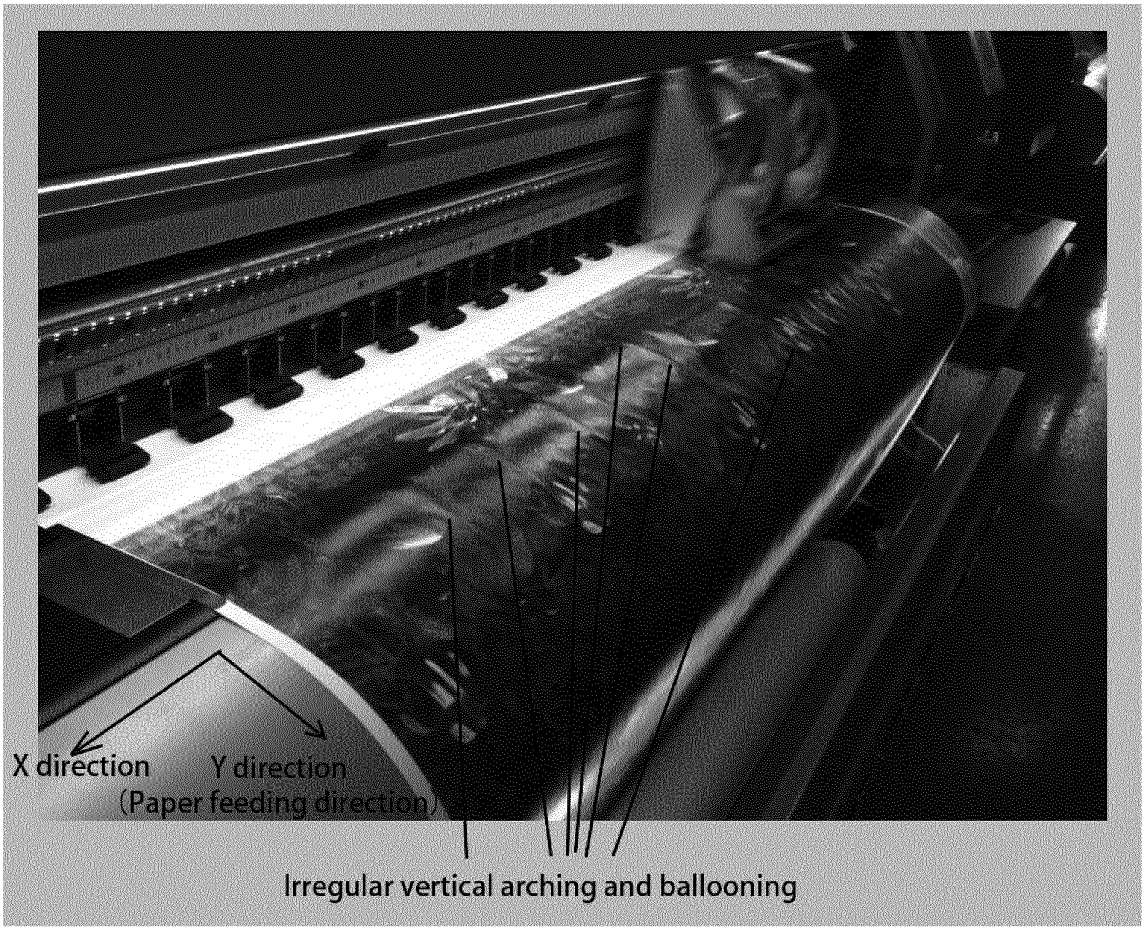

Figure 6

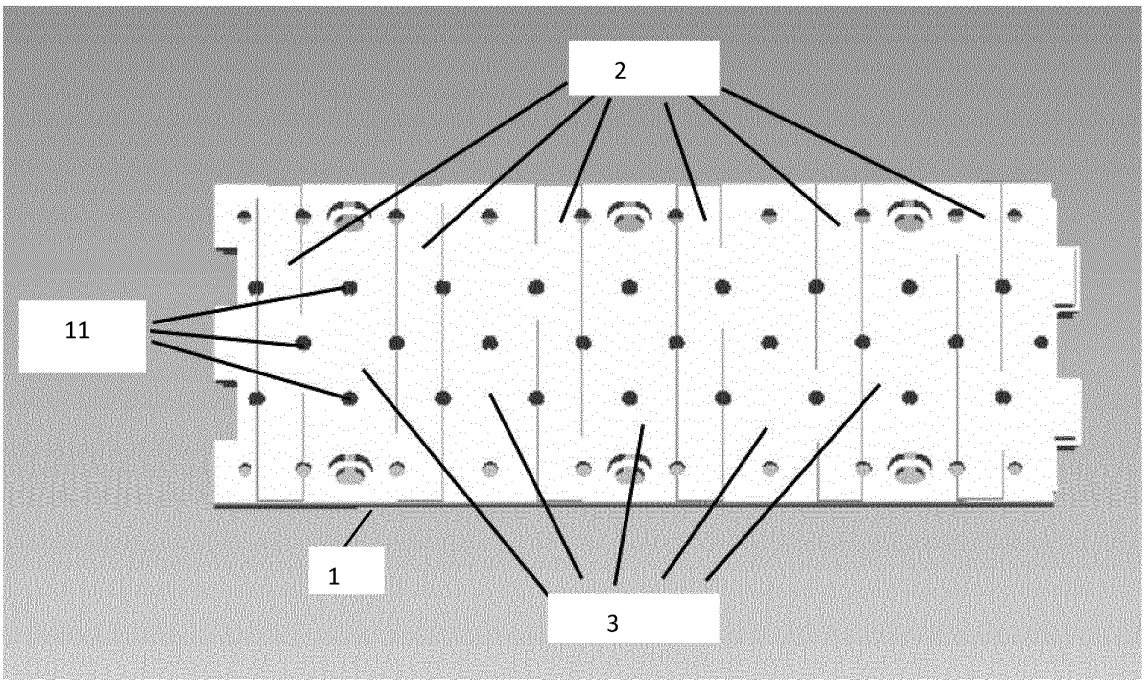

Figure 7

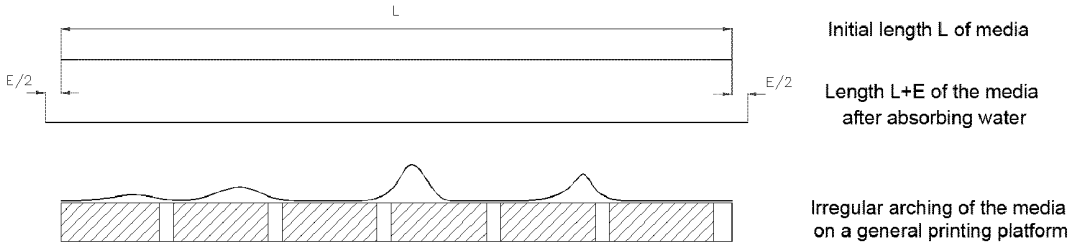

Figure 8

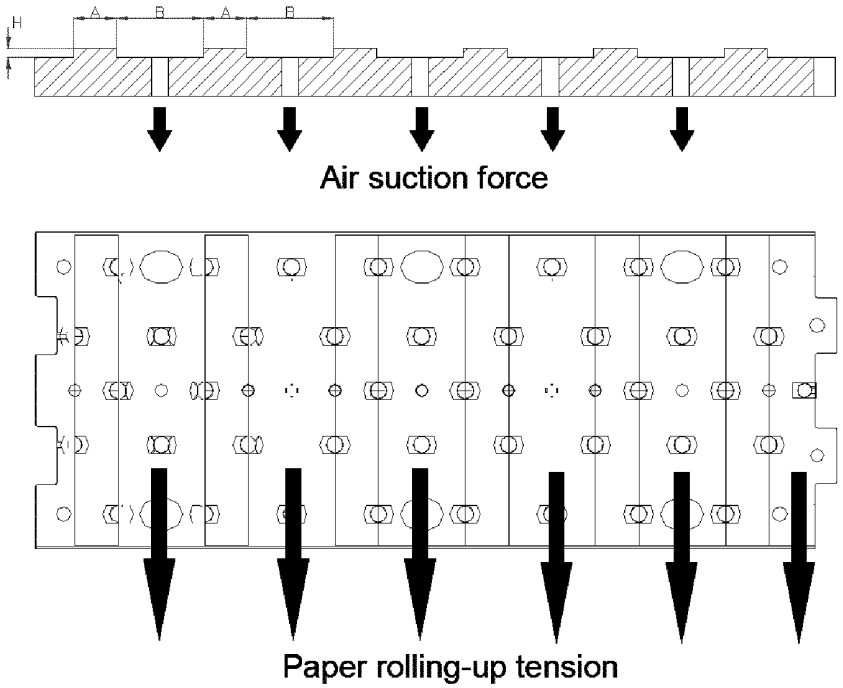

Figure 9

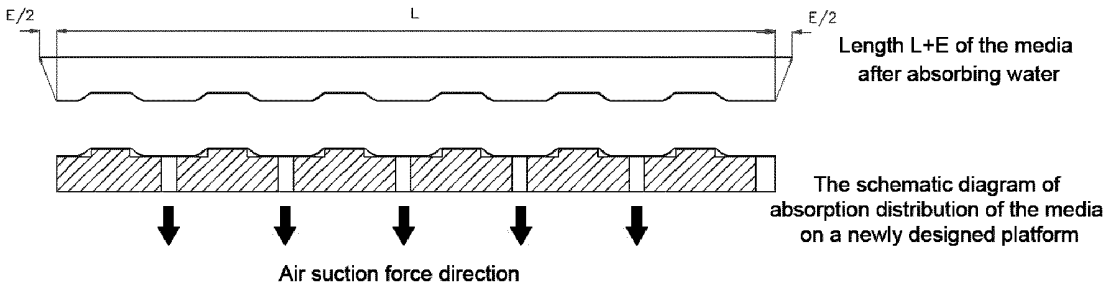

Figure 10

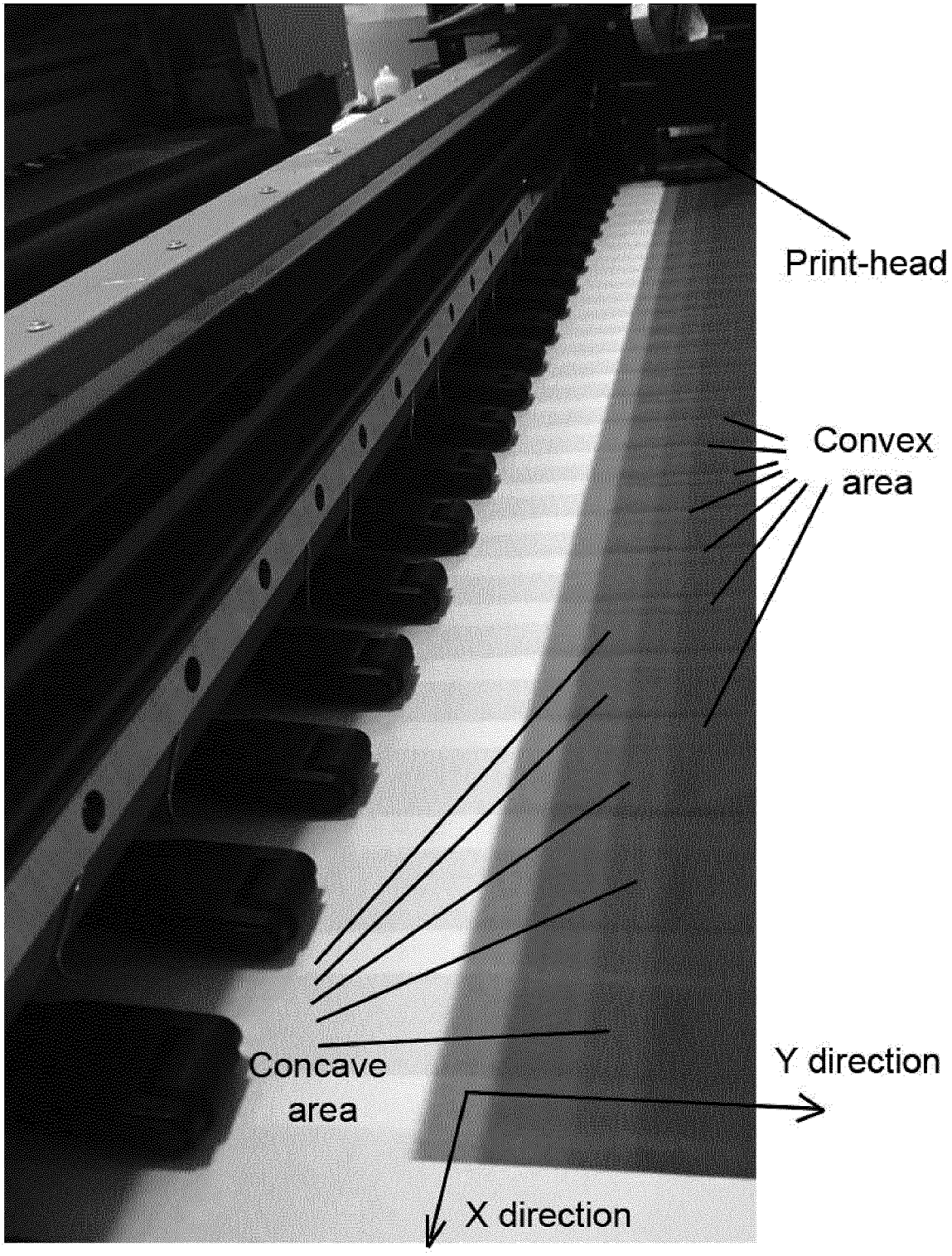
Print-head
Convex area
Concave area
Y direction
X direction

Figure 11

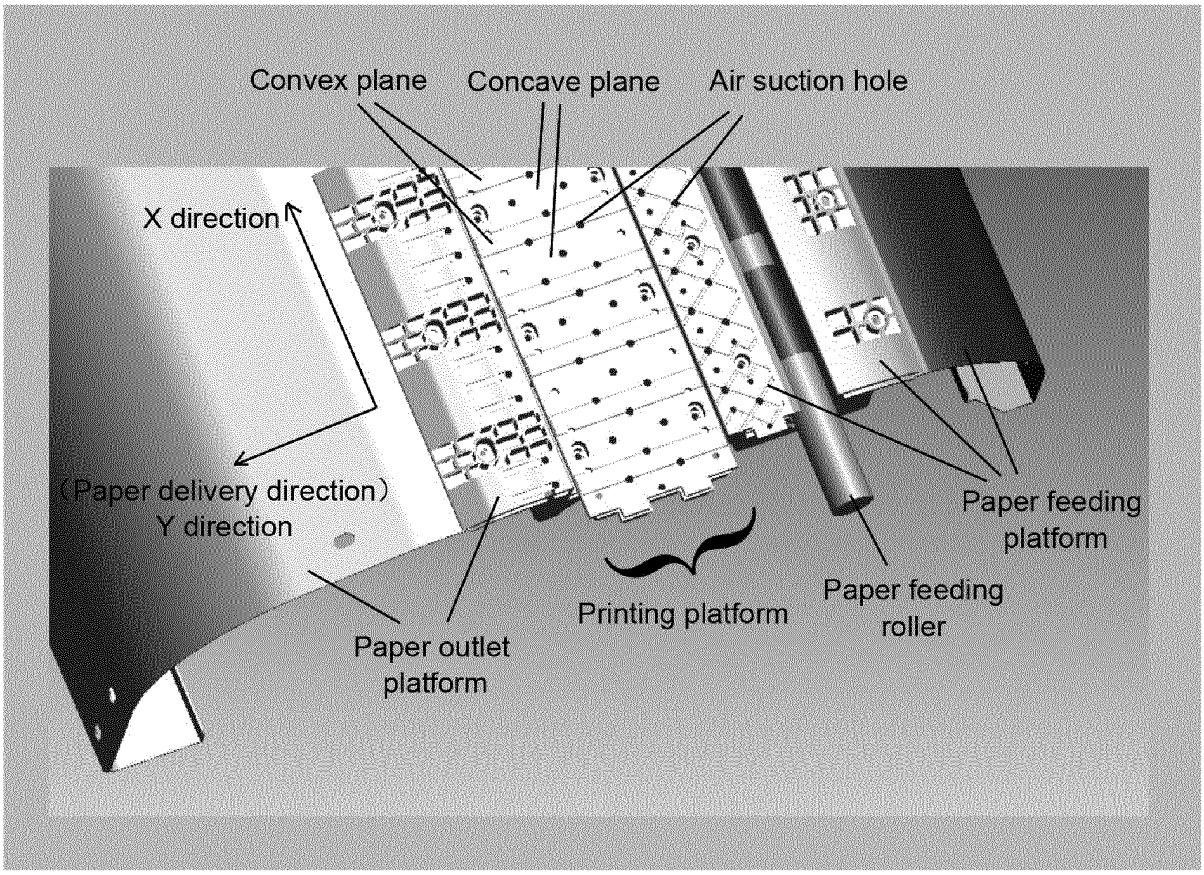

Figure 12

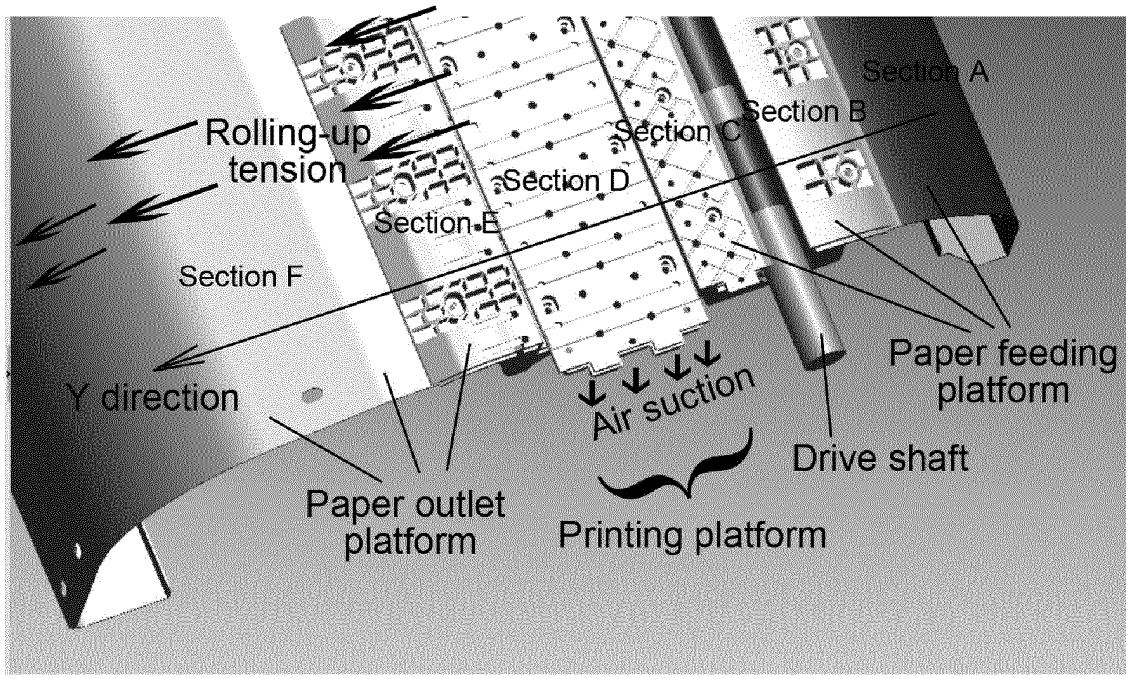

Figure 13

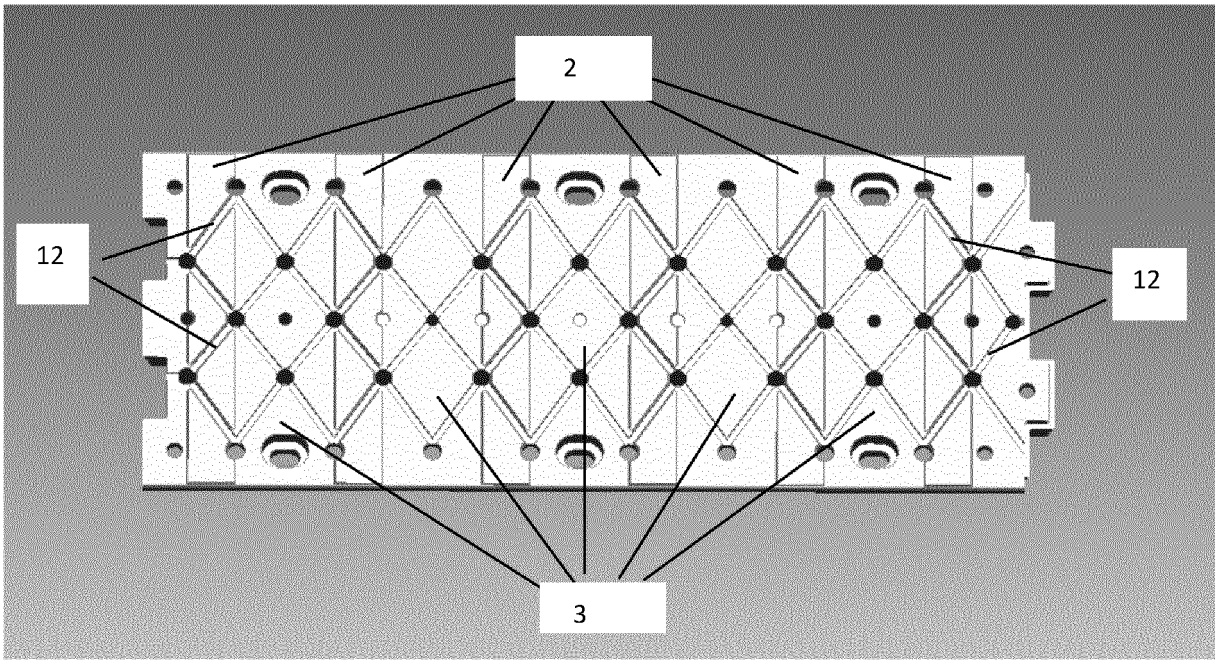

Figure 14

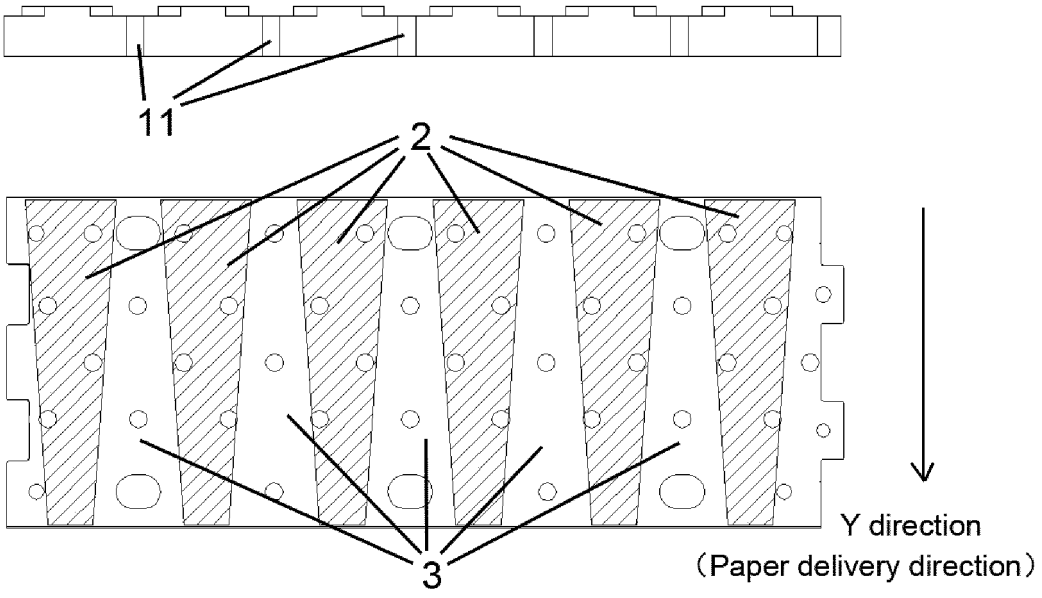

Figure 15

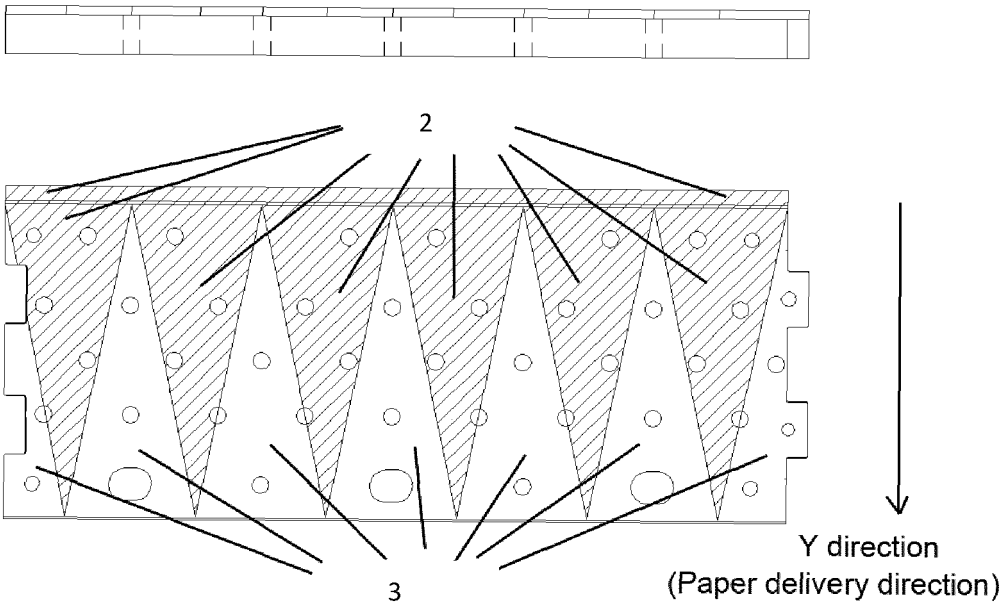

Figure 16

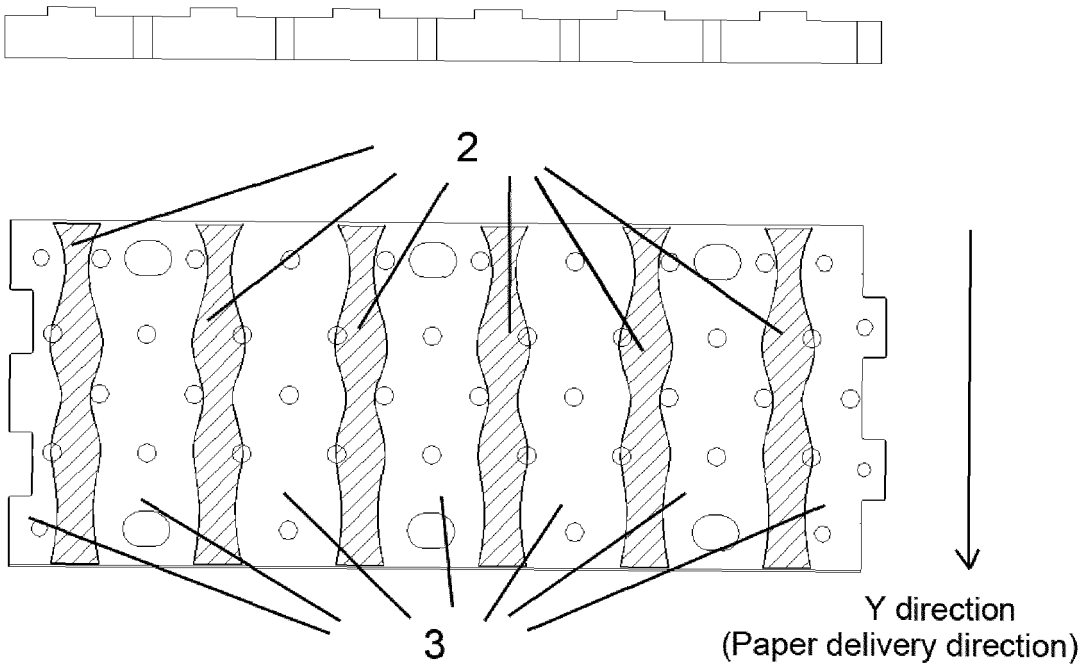

Figure 17

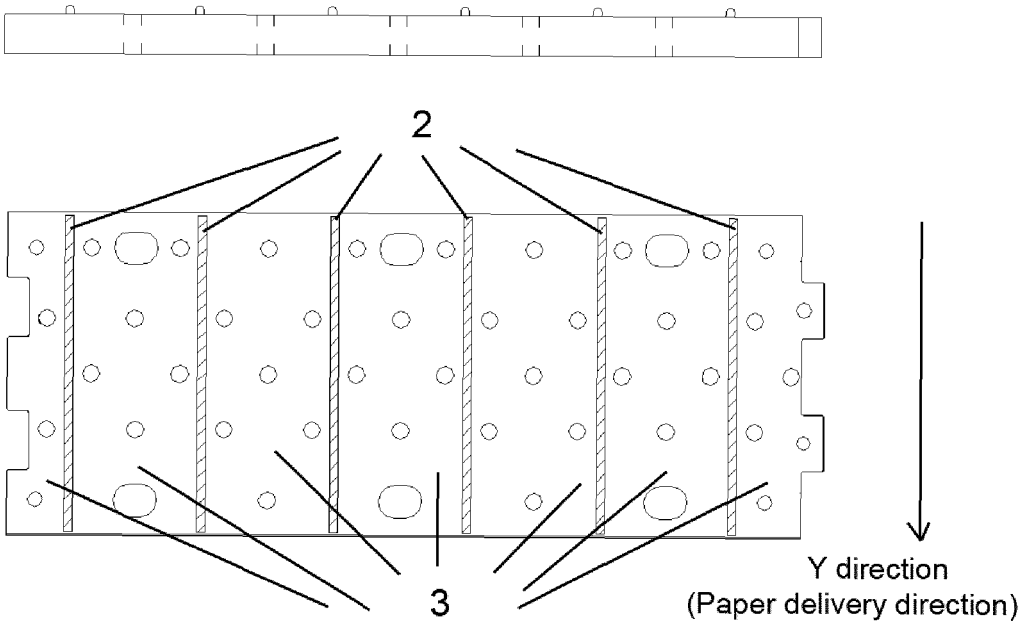

Figure 18

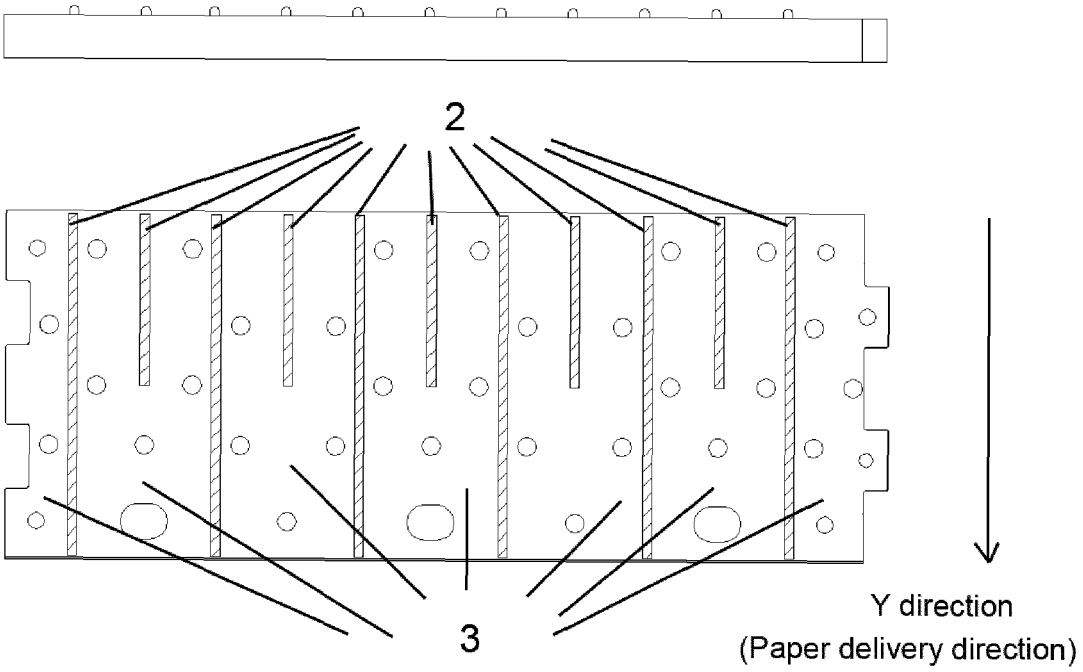

Figure 19

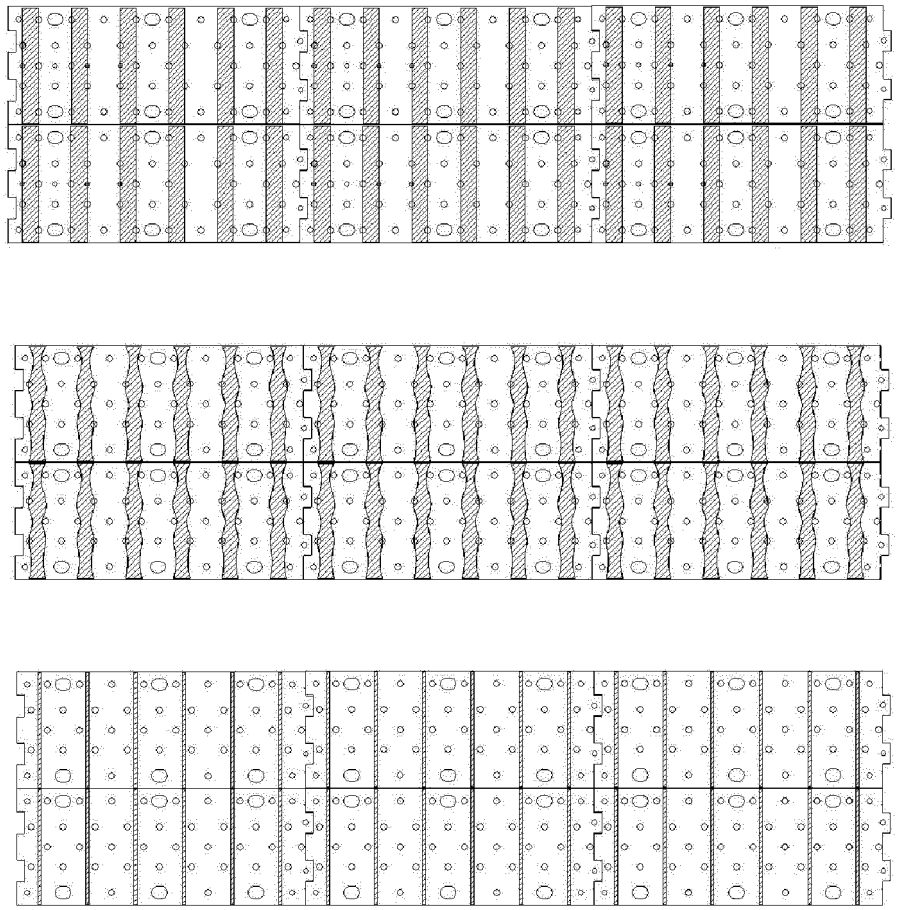

Figure 20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2018/095743

A. CLASSIFICATION OF SUBJECT MATTER

B41J 11/00(2006.01)i; B41J 2/01(2006.01)n

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS; CNTXT; SIPOABS; DWPI; CNKI; WOTXT; EPTXT; USTXT: 打印, 喷墨, 凹, 凸, 膨胀, 变形, 鼓, 皱, 口, 孔, 风, 吸, 负压, print+, float+, paper, suct+, hole? , opening? , convex, hold down, cockle, expansion, waveform, ridge?

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 107364242 A (HANGZHOU ZHUANSE DIGITAL TECHNOLOGY CO., LTD.) 21 November 2017 (2017-11-21) claims 1-10	1-10
E	CN 207736984 U (HANGZHOU ZHUANSE DIGITAL TECHNOLOGY CO., LTD.) 17 August 2018 (2018-08-17) claims 1-10	1-10
X	US 6270215 B1 (MUTCH IND. LTD.) 07 August 2001 (2001-08-07) description, columns 1-4, and figures 1-4	1-3, 10
X	EP 1182041 A1 (HEWLETT PACKARD CO.) 27 February 2002 (2002-02-27) description, paragraphs [0041]-[0086], and figures 2-4	1-3, 10
A	CN 1526568 A (SEIKO EPSON CORPORATION) 08 September 2004 (2004-09-08) entire document	1-10

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 September 2018	**25 September 2018**

Name and mailing address of the ISA/CN	Authorized officer
State Intellectual Property Office of the P. R. China **No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088** **China**	
Facsimile No. **(86-10)62019451**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2018/095743

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CN	207736984	U	17 August 2018	None			
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