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(72) Inventors:
• **SAIGA, Soichi**
Tokyo, 143-8555 (JP)
• **NARUSE, Shinichiro**
Tokyo, 143-8555 (JP)
• **NIIHARA, Takayuki**
Tokyo, 143-8555 (JP)

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(71) Applicant: **Ricoh Company, Ltd.**
Tokyo 143-8555 (JP)

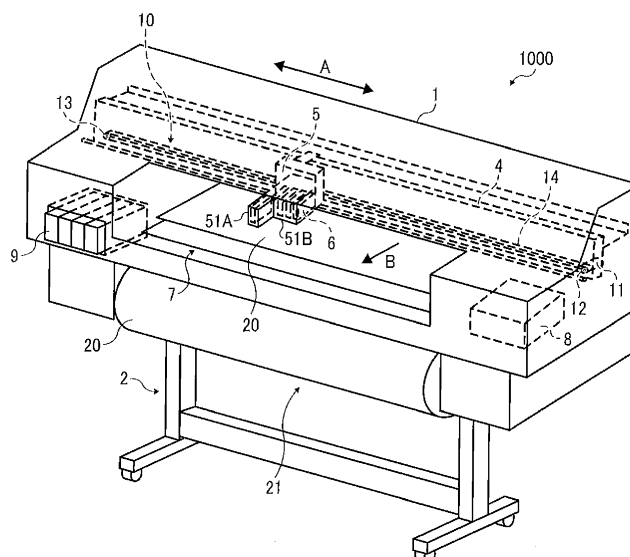
(74) Representative: **Leeming, John Gerard**
J A Kemp
14 South Square
Gray's Inn
London WC1R 5JJ (GB)

(54) **Image forming apparatus**

(57) An image forming apparatus includes a guide member (3), a plurality of recording heads (6), a plurality of head holders (51A, 51B), a carriage (5), and an adjustment member (30). The guide member (3) extends in a main scanning direction (A). The recording heads (6) eject droplets. Each of the head holders (51A, 51B) holds at least one of the recording heads (6). The head holders (51A, 51B) are held side by side on the guide

member (3). The carriage (5) holds the head holders (51A, 51B), is movable along the guide member (3), and has a reference member (71) extending in the main scanning direction (A). The adjustment member (30) is disposed in vicinity of front ends of the head holders (51A, 51B) in a sub scanning direction (B) and adjusts a gap between adjoining ones of the head holders (51A, 51B).

FIG. 1



Description

BACKGROUND

Technical Field

[0001] Embodiments of this disclosure relate to an image forming apparatus incorporating recording heads.

Related Art

[0002] Image forming apparatuses are used as printers, facsimile machines, copiers, plotters, or multi-functional devices having two or more of the foregoing capabilities. As one type of image forming apparatus, an inkjet recording apparatus is known that uses, as a recording head, a liquid ejection head (or droplet ejection head) to eject droplets of ink. For image formation in such an image forming apparatus using a liquid-ejection recording method, image quality is affected by the landing accuracy of droplets ejected from nozzles of the recording head. Poor droplet landing accuracy causes a reduction in image quality. Therefore, in a case where a plurality of recording heads is used, a relative position among the recording heads is determined with high accuracy.

[0003] In order to determine the relative position at high accuracy, for example, the relative position among the recording heads is adjusted by adjusting mounting positions of the recording heads in a carriage holding the recording heads. Alternatively, an image forming apparatus includes a mechanism for adjusting the relative position among recording heads. In such a case, the relative position among the recording heads is adjusted, as needed, in the actual image forming apparatus after the recording heads are mounted.

[0004] JP 2007-190867-A discloses an arrangement in which a carriage includes a plurality of sub-carriages that are disposed on a surface of the carriage and surrounded by the carriage, and an adjustment assembly that adjusts a relative position among the sub-carriages is disposed on the surface of the carriage on which the sub-carriages are arranged.

[0005] JP 2012-194927-A, which was proposed by the inventors of the present invention earlier, discloses an arrangement in which a carriage includes a reference member from which sub-carriages are hung, and a relative position among the sub-carriages is adjusted by adjusting a difference in the degree of inclination among the sub-carriages through displacement of sub reference positions supporting the sub-carriages.

[0006] The former arrangement, i.e., the arrangement disclosed in JP 2007-190867-A has the following problem. Specifically, it is necessary to increase the size of the carriage in order to allow the sub-carriages and the adjustment assembly to be disposed in the carriage. This increases the width of the carriage and the width of the apparatus. As a result, an installation area of the apparatus undesirably increases accordingly.

[0007] The latter arrangement, i.e., the arrangement disclosed in JP 2012-194927-A has the following problem. Specifically, the adjustment of the degree of inclination of the sub-carriages changes a distance (gap) between each recording head and a printing surface. This also changes a landing timing on the printing surface. It therefore becomes difficult to control a landing position. Moreover, in a case where the gap is too small, the recording heads may contact a sheet during a printing operation and be damaged.

BRIEF SUMMARY

[0008] In light of the above-described problems, an object of the present invention is to provide an image forming apparatus capable of adjusting a shift of ink landing position without changing a printing gap in the actual image forming apparatus.

[0009] To achieve the object, in an aspect of the present invention, there is provided an image forming apparatus including a guide member, a plurality of recording heads, a plurality of head holders, a carriage, and an adjustment member. The guide member extends in a main scanning direction. The recording heads eject droplets. Each of the head holders holds at least one of the recording heads. The head holders are held side by side on the guide member. The carriage holds the head holders, is movable along the guide member, and has a reference member extending in the main scanning direction. The adjustment member is disposed in vicinity of front ends of the head holders in a sub scanning direction and adjusts a gap between adjoining ones of the head holders.

[0010] According to the present invention, shift of ink landing position among a plurality of recording heads can be adjusted without increasing the width of a carriage and changing a printing gap in an actual image forming apparatus

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0011] The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Fig. 1 is a perspective view showing a configuration of an inkjet recording apparatus serving as an image forming apparatus according to an embodiment of the present invention;

Fig. 2 is a perspective view of a carriage scanning assembly of the inkjet recording apparatus;

Fig. 3 is a schematic perspective view of a carriage section illustrating a state in which head holders of the recording apparatus have not been mounted to a carriage;

Fig. 4 is a perspective view of the carriage section illustrating a state in which the head holders have been mounted to the carriage;

Fig. 5 is a side view of the carriage section illustrating a pressing structure;

Fig. 6 is a schematic perspective view of a state in which a holder pressing cover member, which is a pressing member, is attached;

Fig. 7 is a schematic plan view illustrating a configuration of a carriage according to an embodiment of the present invention;

Fig. 8 is a schematic side view illustrating the configuration of the carriage according to the embodiment;

Fig. 9 is a schematic plan view illustrating ink landing positions in the embodiment;

Fig. 10 is a schematic plan view illustrating position adjustment of head holders in the embodiment;

Fig. 11 is a schematic plan view illustrating ink landing positions after the position adjustment of the head holders in the embodiment;

Fig. 12 is a schematic side view illustrating a different carriage configuration in the embodiment;

Fig. 13 is a schematic plan view illustrating the ink landing positions in the embodiment;

Fig. 14 is a schematic plan view illustrating the position adjustment of the head holders in the embodiment;

Fig. 15 is a schematic plan view illustrating the ink landing positions after the position adjustment of the head holders in the embodiment;

Fig. 16 is a schematic plan view illustrating a configuration of a carriage according to a second embodiment of the present invention;

Fig. 17 is a schematic plan view illustrating landing positions of ink in the embodiment;

Fig. 18 is a schematic plan view illustrating position adjustment of head holders in the embodiment;

Fig. 19 is a schematic plan view illustrating the ink landing positions after the position adjustment of the head holders in the embodiment;

Fig. 20 is a schematic side view illustrating a configuration of a carriage according to a third embodiment of the present invention;

Fig. 21 is a schematic front view illustrating how two head holders are disposed in the embodiment;

Fig. 22 is a schematic front view illustrating an adjustment member in the embodiment;

Fig. 23 is a schematic plan view illustrating the adjustment member in the embodiment;

Fig. 24 is a schematic perspective view of a cam member provided in the adjustment member;

Fig. 25 is a schematic perspective view of a leaf spring provided in the adjustment member;

Fig. 26 is a schematic front view illustrating the adjustment member in the embodiment; and

Fig. 27 is a schematic front view illustrating the adjustment member in the embodiment.

[0012] The accompanying drawings are intended to depict exemplary embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

DETAILED DESCRIPTION

[0013] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this patent specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that operate in a similar manner and achieve similar results.

[0014] For example, in this disclosure, the term "sheet" used herein is not limited to a sheet of paper but be, e.g., an OHP (overhead projector) sheet, a cloth sheet, a grass sheet, a substrate, or anything on which droplets of ink or other liquid can be adhered. In other words, the term "sheet" is used as a generic term including a recording medium, a recorded medium, a recording sheet, or a recording sheet of paper.

[0015] The terms "image formation" are used as a synonym for "image recording" and "image printing". The term "image forming apparatus" refers to an apparatus that ejects ink or any other liquid onto a medium to form images on the medium. The medium is made of, for example, paper, string, fiber, cloth, leather, metal, plastic, glass, timber, and ceramic. The term "image formation", which is used herein as a synonym for "recording" or "printing", includes providing not only meaningful images, such as characters and figures, but meaningless images, such as patterns, to the medium (in other words, the term "image formation" includes only causing liquid droplets to land on the medium).

[0016] The term "ink" as used herein is not limited to "ink" in a narrow sense unless specifically distinguished and includes any types of liquid useable for image formation, such as recording liquid, fixing solution, DNA sample, resist, pattern material, and resin.

[0017] The term "image" used herein is not limited to a two-dimensional image and includes, for example, an image applied to a three dimensional object and a three dimensional object itself formed as a three-dimensionally molded image.

[0018] The term "image forming apparatus" includes both serial-type image forming apparatus and line-type image forming apparatus.

[0019] Although the exemplary embodiments are described with technical limitations with reference to the attached drawings, such description is not intended to limit the scope of the invention and all of the components or elements described in the exemplary embodiments of this disclosure are not necessarily indispensable to the present invention.

[0020] Referring now to the drawings, wherein like reference numerals designate identical or corresponding

parts throughout the several views, embodiments of the present disclosure are described below.

[0021] First, an image forming apparatus according to an embodiment of the present invention is described with reference to Figs. 1 and 2.

[0022] Fig. 1 is a perspective view of an entire configuration of an image forming apparatus 1000 according to this embodiment. Fig. 2 is a perspective view of a carriage scanning assembly in this embodiment.

[0023] The image forming apparatus 1000 according to this embodiment is a serial-type inkjet recording apparatus, and includes an apparatus body 1 and a support 2 that supports the apparatus body 1. In the apparatus body 1, a guide rod 3 and a guide stay 4, each serving as a guide member, are provided so as to extend from one side plate to the other side plate. The guide rod 3 and the guide stay 4 hold a carriage 5 so that the carriage 5 is slidable in a direction (main scanning direction) indicated by arrow A.

[0024] The carriage 5 is provided with recording heads 6, which include liquid ejection heads that eject ink droplets of black (K), yellow (Y), magenta (M) and cyan (C), respectively. In each of the recording heads 6, a head tank that supplies ink to each recording head is provided to form a single unit with the recording head.

[0025] A main scanning unit 10 that moves the carriage 5 for scanning includes a driving motor 11 disposed on one side of the main scanning direction A, a driving pulley 12 driven for rotation by the driving motor 11, a driven pulley 13 disposed on the other side of the main scanning direction A, and a timing belt 14 which is a dragging member wound between the driving pulley 12 and the driven pulley 13. To the driven pulley 13, tension is given in an outward direction (a direction away from the driving pulley 12) by a tension spring.

[0026] To a recording region, which is part of a main scanning region for the carriage 5, a sheet 20 is intermittently conveyed by a sucking conveyance unit 7 in a direction (sub scanning direction or sheet conveyance direction indicated by arrow B) orthogonal to the main scanning direction A of the carriage 5.

[0027] On one end region of the main scanning region, a maintenance and recovery unit 8 that does maintenance and recovery of the recording heads 6 is provided. Outside a carriage movement range in the main scanning direction A or on the other end region of the main scanning region, main cartridges 9 that contain respective color inks to be supplied to the sub-tanks of the recording heads 6 are detachably mounted to the apparatus body 1.

[0028] On a sheet feeder 21, a sheet roll (hereinafter referred to as a "sheet") 20 is placed.

[0029] It is to be noted that, for example, sheet rolls having different sizes in the width direction can be placed on the sheet feeder 21. The sheet 20 fed from the sheet feeder 21 is conveyed to the recording region by the conveyance unit from the back side to the front side of the apparatus body 1. Then, onto the sheet 20 conveyed by the sucking conveyance unit 7, droplets are ejected by

driving the recording heads 6 in accordance with image data while moving the carriage 5 in the main scanning direction A. In this way, a required image is formed on the sheet 20. Then, the sheet 20 is intermittently conveyed by the sucking conveyance unit 7. By thus repeating the conveyance and formation of an image, image formation is completed. The sheet 20 on which the image has been formed is cut to a predetermined length and is then discharged into a discharge tray disposed on the front side of the apparatus body 1.

[0030] Next, with reference to Figs. 3 and 4, the following describes a configuration of a carriage 5 of an image forming apparatus according to an embodiment of the present invention.

[0031] Fig. 3 is a schematic perspective view of a carriage section illustrating a state in which head holders have not been mounted to the carriage of the image forming apparatus. Fig. 4 is a perspective view of the carriage section illustrating a state in which the head holders have been mounted to the carriage.

[0032] In the carriage 5, a head holder 51A for black and a head holder 51B for the other colors are held. In the head holder 51A, two recording heads 6A and 6B that eject black droplets are provided in staggered manner in the sub scanning direction B in FIG. 1. In the head holder 51B, three recording heads 6C, 6D, and 6E that eject yellow, magenta and cyan droplets, respectively, are provided so that their positions in the sub scanning direction are same as that of the recording head 6B. It is to be noted that these recording heads are referred to as the "recording heads 6", as previously described, in a case where they are not distinguished from each other. It should also be noted that the number of the recording heads 6 held in each of the head holders 51A and 51B may be one.

[0033] In the carriage 5, a reference shaft 71 that serves as a reference member is provided in the same direction as the direction in which the guide rod 3 is provided. Each of the head holders 51A and 51B (hereinafter collectively referred to as "head holders 51" unless not distinguished) has a hook portion 53 having a hook shape that is to be engaged with the reference shaft 71 so as to be detachably attachable to the reference shaft 71. The head holders 51A and 51B are held in parallel with each other in the carriage 5 with the hook portions 53 hooked on the reference shaft 71. The shape of the reference shaft 71 is not limited to a cylindrical column shape, and can be, e.g., a polygonal column shape.

[0034] By thus disposing the reference shaft 71 in the same direction as the direction in which the guide rod 3 for the carriage 5 is disposed, positioning accuracy of inclination in the sub scanning direction, height direction, tilt direction and main scanning direction is improved. In the present embodiment, when heads are replaced with new ones, for example, when the recording heads 6A and 6B are replaced with new ones, the head holder 51 is detached from the reference shaft 71, and then the head holder 51 in which the new heads are mounted is

hooked and held on the reference shaft 71.

[0035] This allows the head holder 51, in which the new heads are mounted, to be attached at the same position as before. Consequently, it is possible to achieve high relative positioning accuracy with respect to the other head holder 51. As described so far, the image forming apparatus includes recording heads each having a plurality of nozzles from which droplets are ejected, one or more head holders each of which holds one or more of the recording heads, and a carriage which holds the head holders. The carriage is movable along a guide member disposed in the main scanning direction. The carriage has the reference shaft 71 serving as a reference member disposed in the same direction as the direction in which the guide member is disposed. The head holders are hooked and held on the reference member so as to be detachably attachable to the reference member. This arrangement makes it possible to easily determine positions of the recording heads with high accuracy and to easily replace the recording heads.

[0036] Next, the following describes a pressing structure of the head holders in the recording device with reference to Figs. 5 and 6.

[0037] Fig. 5 is a side view of the carriage section illustrating the pressing structure. Fig. 6 is a schematic perspective view of a state in which a holder pressing cover member serving as a pressing member is attached.

[0038] As shown in Fig. 5, each of the head holders 51A and 51B has at least one abutting portion 58, which is a contact portion that makes contact with the carriage 5. Although Fig. 5 shows a state in which each of the head holders 51A and 51B has a single hook portion 53 in the main scanning direction, it is also possible to employ an arrangement in which each of the head holders 51A and 51B has a plurality of hook portions. For example, each of the head holders 51A and 51B may have the hook portion 53 at its opposed ends in the main scanning direction.

[0039] Furthermore, a holder pressing assembly 80 is provided. The holder pressing assembly 80 is a pressing unit that presses the head holders 51 toward the carriage 5 by being rotated about the reference shaft 71. The holder pressing assembly 80 has a cover member 82 for holder pressing whose rear end 82b is supported by the carriage 5 so as to be rotatable about a shaft 81. The cover member 82 is, for example, a member having a shape of a substantially flat plate as shown in Fig. 6.

[0040] Although Fig. 6 shows a case where a single cover member 82 is shared by the two head holders 51A and 51B, a cover member may be provided for each of the head holders 51A and 51B.

[0041] The cover member 82 has a cover part 180 to cover an area above and oppose the head holders 51A and 51B. The cover member 82 also has, on its front end side, a pressing part 181 with pressing portions 182 (a collective term for pressing portions 182a, 182b, and 182c) to contact upper portions of the head holders 51. Between the cover member 82 and the carriage 5, an

elastic member 83 such as a helical extension spring is provided. By elastic extension force of the elastic member 83, the pressing section 182 of the cover member 82 for pressing the holder presses (pushes) the head holders 51 in a direction indicated by arrow D1.

[0042] The cover member 82 thus causes the head holders 51 to be rotated about the reference shaft 71 and urged in a clockwise direction in Fig. 5 (the direction indicated by arrow D1) and to be pressed against the reference shaft 71 and the carriage 5. This defines the posture of the head holders 51A and 51B. That is, the posture of the head holders 51 can be determined just by hooking the head holders 51 on the reference shaft 71 and closing the cover member 82 (covering the upper portions of the head holders 51).

[0043] As a result, even in a case where a user replaces recording heads, the user can easily determine positions of the recording heads with high accuracy. This allows the user to easily replace the recording heads.

[0044] Next, an embodiment of the present invention is described with reference to Figs. 7 through 11.

[0045] Fig. 7 is a schematic plan view of a configuration of a carriage according to this embodiment. Fig. 8 is a schematic side view of the configuration of the carriage according to this embodiment. Fig. 9 is a schematic plan view of ink landing positions in this embodiment. Fig. 10 is a schematic plan view illustrating position adjustment of head holders in this embodiment. Fig. 11 is a schematic plan view illustrating ink landing positions after the position adjustment of the head holders in this embodiment.

[0046] Head holders 51A and 51B are held in a carriage 5 by a reference shaft 71 and pushed toward one side of the carriage 5 by a pressing unit 85 (indicated by arrow representing a pressing direction) disposed in the carriage 5. In the example of Fig. 7, the head holders 51A and 51B are pushed toward the right side by the pressing unit 85 such as a pressing spring. The pressing unit 85 causes a contact face 54A of the head holder 51A and a contact face 54B of the head holder 51B to contact each other in the vicinity of the reference shaft 71, thereby determining the distance in the main scanning direction between the head holders 51A and 51B. The contact faces 54A and 54B are on an identical line.

[0047] In the vicinity of front ends of the head holders 51A and 51B in the sub scanning direction B, i.e., on the downstream end side of the sheet conveyance direction, an adjustment member 30 is disposed. With the adjustment member 30, the head holders 51A and 51B are connected to each other. Accordingly, since the head holders 51A and 51B contact each other via their contact faces 54A and 54B on the upstream end side of the sub scanning direction B and the adjustment member 30 is provided on the downstream end side of the sub scanning direction B, the gap in the main scanning direction B between the head holders 51A and 51B at the connecting portion can be adjusted by the adjustment member 30.

[0048] Since the adjoining head holders 51A and 51B are separate members, there is a possibility that a pos-

ture in which the head holder 51A is hung on the reference member 71 differs from that of the head holder 51B due to parts variation. Such a difference in posture shifts a landing position of ink ejected from the head holder 51A and a landing position of ink ejected from the head holder 51B from each other. This makes it impossible to form a desired image. In view of this, in the present embodiment, the distance between the head holders 51 is adjusted by the adjustment member 30 so that the shift of ink landing position between the head holders 51 can be finely adjusted in the actual image forming apparatus.

[0049] In a case where the head holder 51B is attached to the carriage in a state in which its front end in the sub scanning direction B is situated at a lower position than the head holder 51A in the height direction as shown in Fig. 8, ink ejected from the head holders 51A and 51B lands in a shape of two lines that have a wider distance at their bottom side than their top side as shown in Fig. 9. The landing position of ink ejected from the recording heads 6 of the head holder 51B is shifted more in the upstream side of the main scanning direction indicated by arrow A as the recording heads are lowered and located closer to a sheet. Accordingly, ink ejected from the head holder 51B lands in a shape of a tilted line whose downstream side of the sub scanning direction B is tilted toward the upstream side of the main scanning direction A although ink ejected from the head holder 51A lands in a shape of a line parallel with the sub scanning direction B. This, as a whole, forms a shape of two lines that have a wider distance at their bottom side than their top side.

[0050] In such a case, the head holder 51B is rotated in a yawing direction R1 by narrowing the distance in the main scanning direction A between the front ends of the head holders 51 by use of the adjustment member 30, as shown in Fig. 10. That is, the head holder 51B is moved for adjustment in a direction in which the gap between the head holders 51A and 51B becomes narrower while maintaining a gap from the sheet. As a result, ink ejected from the head holder 51B also lands in a shape of a line parallel with the sub scanning direction B as shown in Fig. 11. That is, both of ink ejected from the head holder 51A and ink ejected from the head holder 51B land in line parallel with the sub scanning direction B. It is therefore possible to adjust the shift of ink landing position between the head holders 51A and 51B through adjustment in one direction in the actual image forming apparatus, without increasing the carriage width and without changing a printing gap.

[0051] There are also cases where the head holder 51B is attached to the carriage in a state in which its front end in the sub scanning direction B is situated at a higher position than the head holder 51A in the height direction, as shown in Fig. 12. Fig. 12 is a schematic side view illustrating a configuration of the carriage according to this embodiment. Fig. 13 is a schematic plan view illustrating ink landing positions in this embodiment. Fig. 14 is a schematic plan view illustrating position adjustment of head holders in this embodiment.

[0052] Fig. 15 is a schematic plan view illustrating the ink landing positions after the position adjustment of the head holders in this embodiment.

[0053] In this case, ink ejected from the head holders 51A and 51B lands in a shape of two lines that have a wider distance at their top side than their bottom side as shown in Fig. 13. Specifically, ink ejected from the head holder 51B lands in a shape of a tilted line whose downstream side is tilted toward the downstream side of the main scanning direction A, although ink ejected from the head holder 51A lands in a shape of a line parallel with the sub scanning direction B. This, as a whole, forms a shape of two lines that have a wider distance at their top side than their bottom side.

[0054] In such a case, the head holder 51B is rotated in a yawing direction R2 by widening the distance in the main scanning direction A between the front ends of the head holders 51 by use of the adjustment member 30, as shown in Fig. 14. As a result, ink ejected from the head holder 51B also lands in a line parallel with the sub scanning direction B as shown in Fig. 15. That is, both of ink ejected from the head holder 51A and ink ejected from the head holder 51B land in parallel with the sub scanning direction B. It is therefore possible to adjust shift of ink landing position between the head holders 51A and 51B. It should be noted that the landing positions shown in Figs. 9 and 13 are exaggerated. The angle of the tilted line is actually very small because the shift of landing position occurs due to a cause such as parts variation.

[0055] Next, an embodiment of the present invention is described with reference to Figs. 16 to 19.

[0056] Fig. 16 is a schematic plan view illustrating a configuration of a carriage according to this embodiment. Fig. 17 is a schematic plan view illustrating ink landing positions in this embodiment. Fig. 18 is a schematic plan view illustrating position adjustment of head holders in this embodiment. Fig. 19 is a schematic plan view illustrating the ink landing positions after the position adjustment of the head holders in this embodiment.

[0057] The center of a reference member 71 is slightly deformed toward the front side due to the weight of head holders 51 and pressure applied by a cover member 82, as shown in Fig. 16. In a case where the deformation of the reference member 71 is large, ink ejected from the head holders 51A and 51B lands in two lines that have a wider distance at their bottom side than their top side as shown in Fig. 17. That is, the ink ejected from the head holder 51A lands in a tilted line whose downstream side of the sub scanning direction B is tilted leftward, and the ink ejected from the head holder 51B lands in a tilted line whose downstream side of the sub scanning direction B is tilted rightward. This, as a whole, forms two lines that have a wider distance at their bottom side than their top side.

[0058] In such a case, both of the head holders 51 are rotated in yawing directions R3 and R4 by narrowing the distance in the main scanning direction A between the front ends of the head holders 51 by use of an adjustment

member 30, as shown in Fig. 18. As a result, it is possible to adjust shift of ink landing positions between the head holders 51, as shown in Fig. 19.

[0059] Next, an embodiment of the present invention is described with reference to Figs. 20 through 27.

[0060] Fig. 20 is a schematic side view illustrating a configuration of a carriage according to this embodiment. Fig. 21 is a schematic front view illustrating how two head holders are disposed in this embodiment. Fig. 22 is a schematic front view illustrating an adjustment member 30 in this embodiment. Fig. 23 is a schematic plan view illustrating the adjustment member 30 in this embodiment. Fig. 24 is a schematic perspective view of a cam member 31 in the adjustment member 30. Fig. 25 is a schematic perspective view of a leaf spring 32 in the adjustment member 30. Fig. 26 is a schematic front view illustrating the adjustment member 30 in this the present embodiment. Fig. 27 is a schematic front view illustrating the adjustment member 30 in this embodiment.

[0061] Fig. 20 shows an attachment position of the adjustment member 30 according to the present embodiment. The adjustment member 30 is disposed in the vicinity of a front end of a head holder 51B in the sub scanning direction B. The position of the adjustment member 30 in the height direction is the same as that of each contact face 54 between the head holders 51A and 51B.

[0062] The head holders 51A and 51B are in contact with each other at two points, i.e., the contact surface 54 and the adjustment member 30. For this arrangement, for example, if the adjustment member 30 is disposed at a lower portion of the head holders 51, a change in the distance between the head holders 51A and 51B by the adjustment member 30 causes one of the head holders to rotate about the contact surface 54 in a pitching direction of a reference member 71, as shown in Fig. 21. Hence, in this embodiment, the adjustment member 30 is located at the same position as the contact surface 54 in the height direction, thus allowing adjustment without rotating the head holders 51 in the pitching direction of the reference shaft 71.

[0063] The adjustment member 30 may be, for example, configured to include, as adjusters, the cam member 31 and the leaf spring 32 as shown in Figs. 22 to 25. The leaf spring 32 draws the head holders 51A and 51B toward each other. The cam member 31, which is disposed between the head holders 51A and 51B, can change a gap between the head holders 51A and 51B depending on its position where the head holders 51A and 51B are made in contact with each other. The adjustment member 30 has a bracket 30a disposed between the head holders 51A and 51B as shown in Figs. 22 and 23. The head holders 51A and 51B are movable in a direction, in which they contact each other or are separated from each other. A shaft 30c penetrates through the bracket 30a. The cam member 31 is provided at a lower end of the shaft 30c, and a knob 30b is provided on the opposite side. The distance between the holders can be adjusted by rotating the cam member 31 by manipulation of the knob. This

makes it possible to provide a space-saving adjustment member 30 between the head holders that does not affect the carriage width and to linearly change the distance between the head holders with accuracy of the cam member. Although the above description has discussed a case where the leaf spring 32 is used as a drawer for drawing the head holders 51A and 51B together, the drawer may be a tension spring or the like.

[0064] Alternatively, it is also possible to have such an arrangement in which tension springs 33 and a screw 34 are disposed between the head holders 51 and the distance between the head holders 51 is changed depending on how much the screw 34 sticks out, as shown in Fig. 26. This arrangement makes it possible to provide a space-saving adjustment member 30 between the head holders 51 that does not affect the carriage width and to linearly adjust the distance between the head holders with accuracy of feeding of the screw 34.

[0065] Alternatively, it is also possible to have such an arrangement in which a compression spring 35 and a screw 36 are disposed between the head holders 51 and the distance between the head holders 51 is changed by drawing the head holders 51 toward each other with the screw, as shown in Fig. 27. Although the above description has discussed a case where a combination of the leaf spring 32 and the cam member 31 is used and a case where the tension springs 33 are used, the adjusters may be anything provided that they can change the distance between the head holders 51.

Claims

1. An image forming apparatus, comprising:

- a guide member (3) extending in a main scanning direction (A);
- a plurality of recording heads (6) to eject drop-lets;
- a plurality of head holders (51A, 51B) each of which holds at least one of the plurality of recording heads (6), the plurality of head holders (51A, 51B) being held side by side on the guide member (3);
- a carriage (5) holding the plurality of head holders (51A, 51B), the carriage (5) being movable along the guide member (3) and having a reference member (71) extending in the main scanning direction (A); and
- an adjustment member (30) disposed in vicinity of front ends of the plurality of head holders (51A, 51B) in a sub scanning direction (B), the adjustment member (30) adjusting a gap between adjoining ones of the plurality of head holders (51A, 51B).

2. The image forming apparatus according to claim 1, wherein the adjustment member (71) connects the

adjoining ones in vicinity of front ends of the adjoining ones at a shorter distance in the main scanning direction (A) than in other portions of the adjoining ones in the sub scanning direction (B), and adjusts the adjoining ones to increase the distance in the vicinity of the front ends. 5

3. The image forming apparatus according to claim 1, wherein the adjustment member (71) connects the adjoining ones in vicinity of front ends of the adjoining ones at a greater distance in the main scanning direction (A) than in other portions of the adjoining ones in the sub scanning direction (B), and adjusts the adjoining ones to decrease the distance in the vicinity of the front ends. 10 15
4. The image forming apparatus according to any one of claims 1 to 3, further comprising a pressing unit (85) pressing, in vicinity of the reference member (71), the plurality of head holders (51A, 51B) in the main scanning direction (A), the adjoining ones of the plurality of head holders (51A, 51B) being in contact with each other via contact faces (54A, 54B) of the plurality of head holders (51A, 51B) that are on the same line as the pressing unit (85), and the adjustment member (30) being located at the same height as each of the 20 25
5. The image forming apparatus according to any one of claims 1 to 4, wherein the adjustment member (30) includes an elastic member (32) connecting the adjoining ones of the plurality of head holders (51A, 51B) in the vicinity of the front ends, in the sub scanning direction (B), of the plurality of head holders (51A, 51B) and a cam member (31) to change the distance in the main scanning direction between the adjoining ones of the plurality of head holders. 30 35
6. The image forming apparatus according to any one of claims 1 to 4, wherein the adjustment member (30) includes an elastic member (33) connecting the adjoining ones of the plurality of head holders (51A, 51B) in the vicinity of the front ends, in the sub scanning direction (B), of the plurality of head holders (51A, 51B) and a screw (34) to change the distance in the main scanning direction between the adjoining ones of the plurality of head holders. 40 45

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FIG. 1

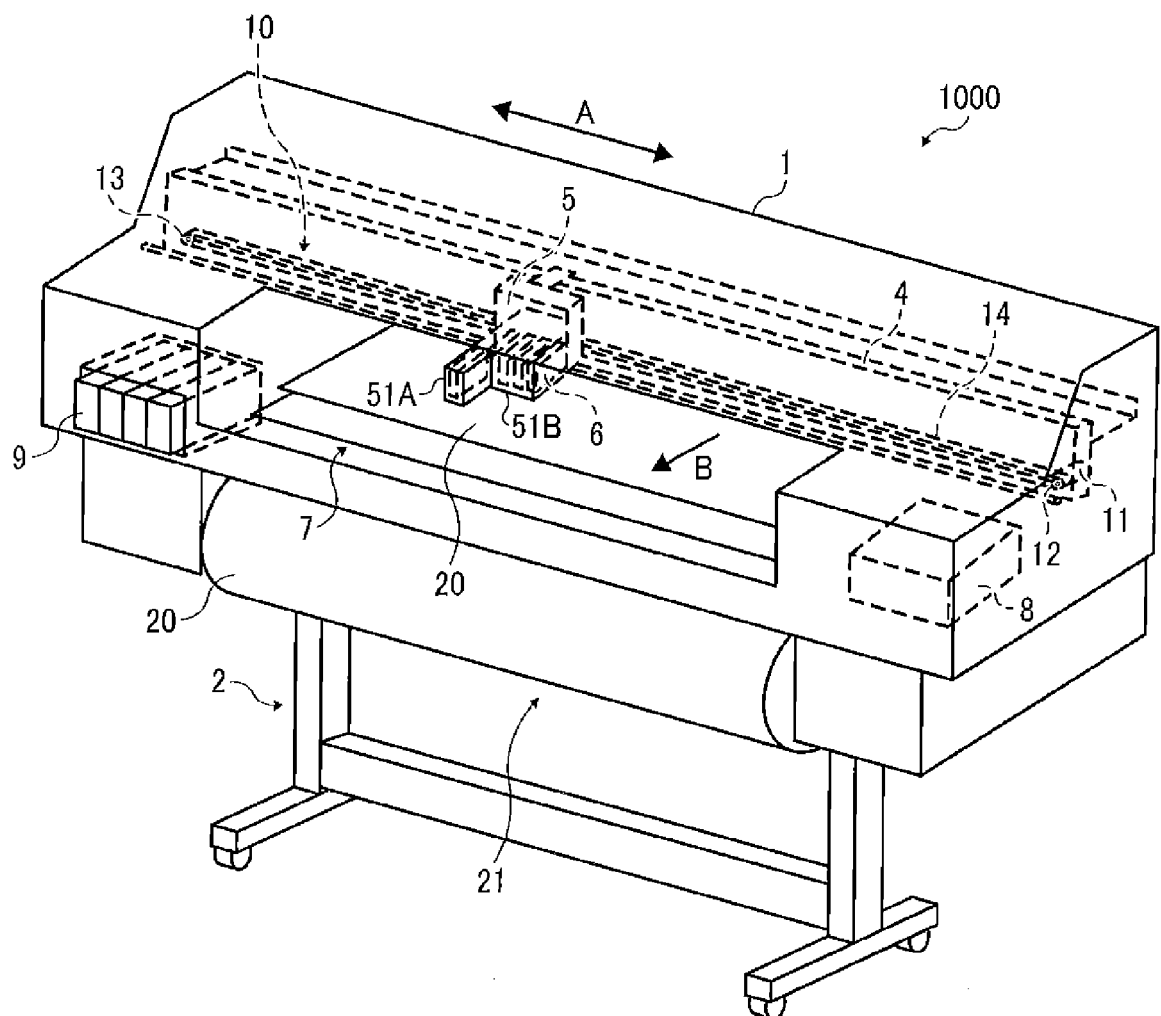


FIG. 2

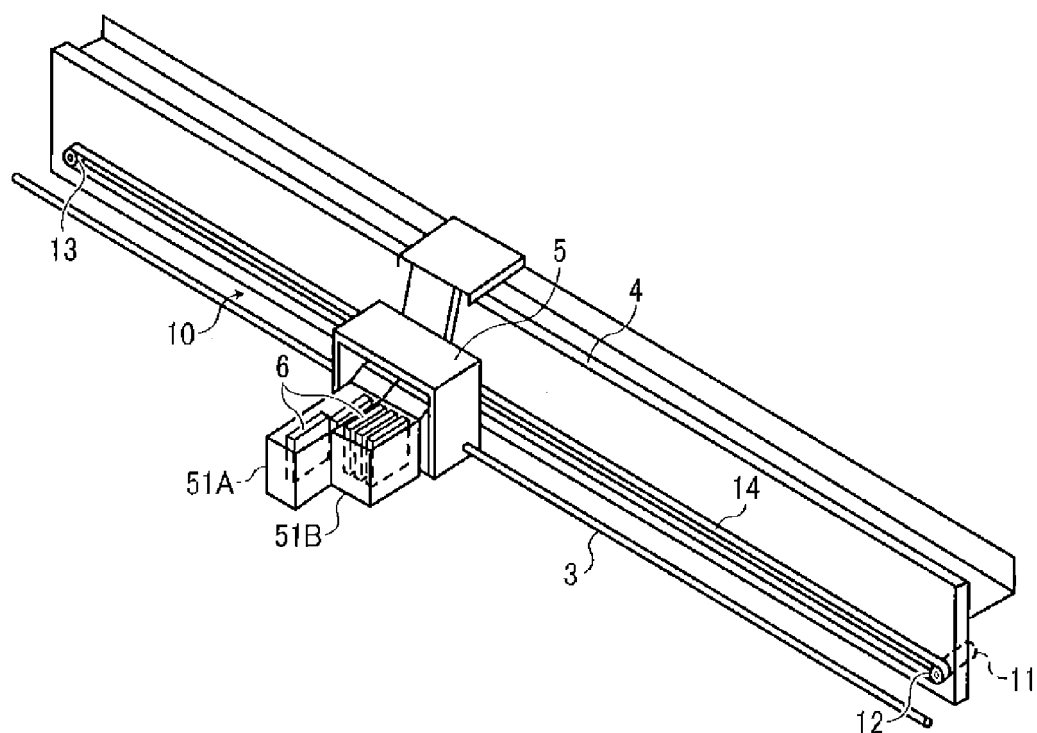


FIG. 3

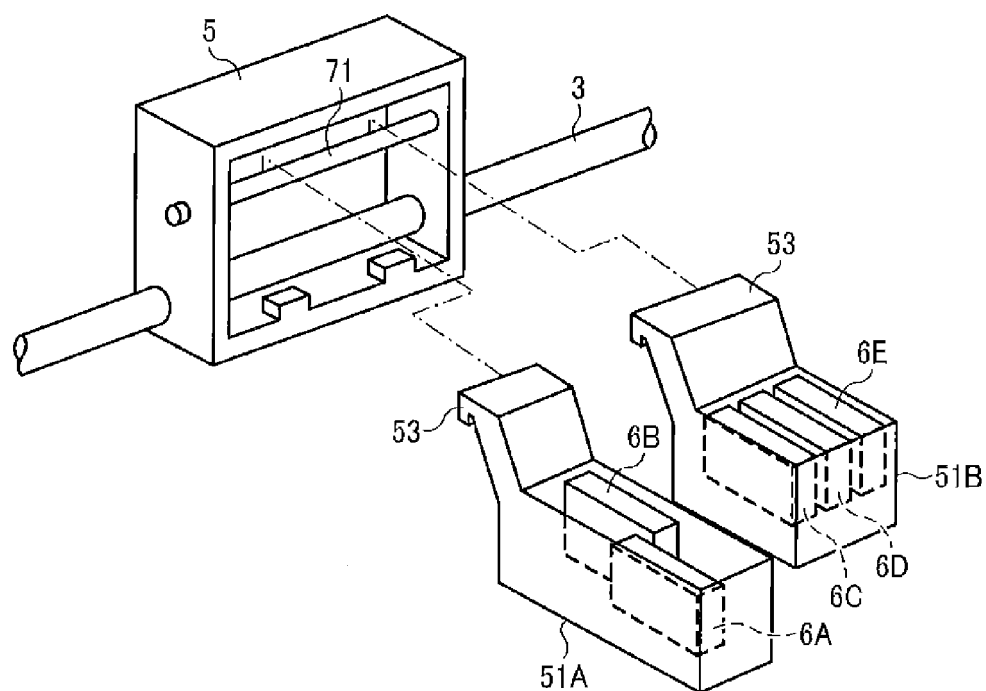


FIG. 4

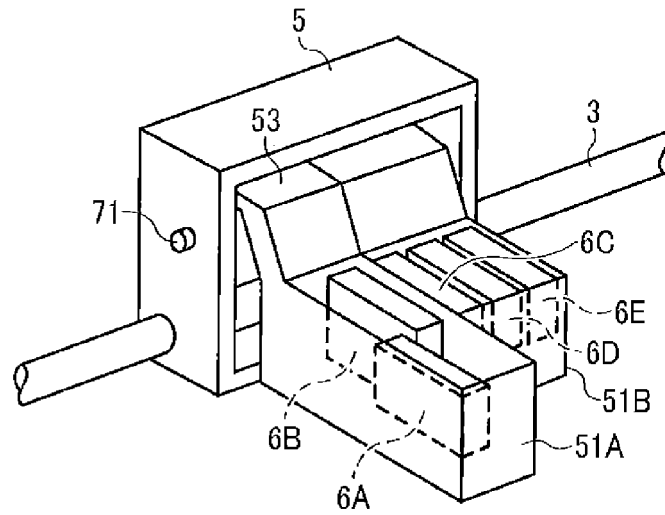


FIG. 5

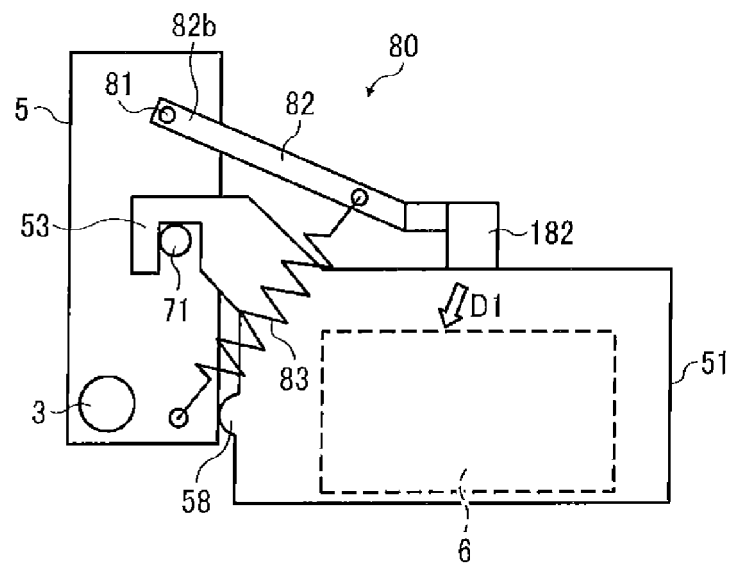


FIG. 6

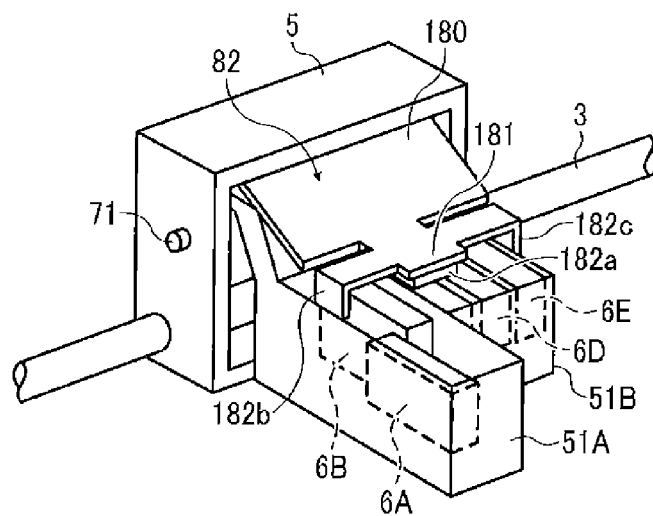


FIG. 7

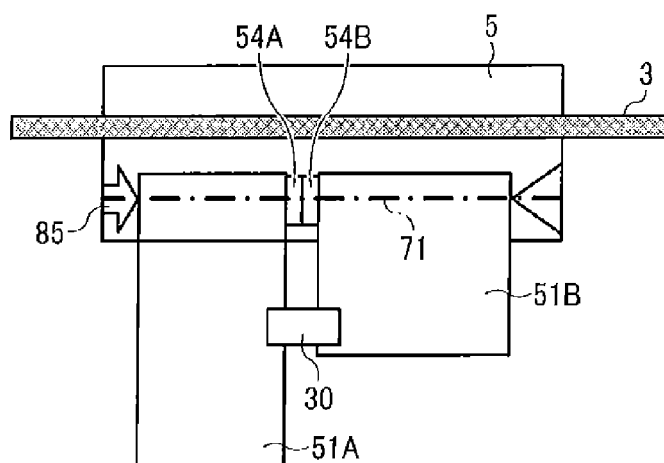


FIG. 8

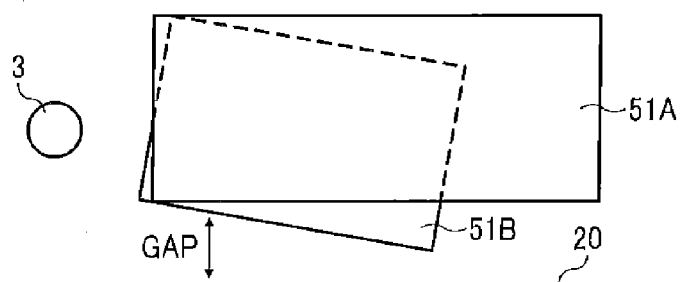


FIG. 9

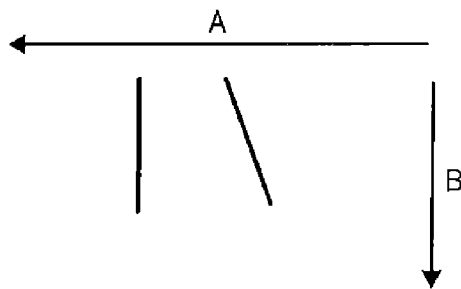


FIG. 10

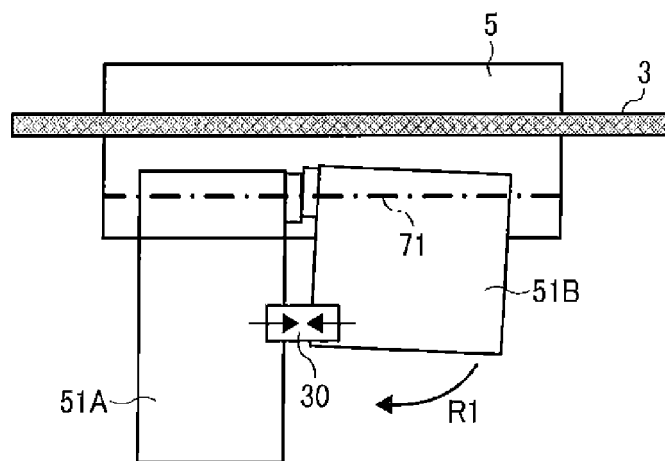


FIG. 11

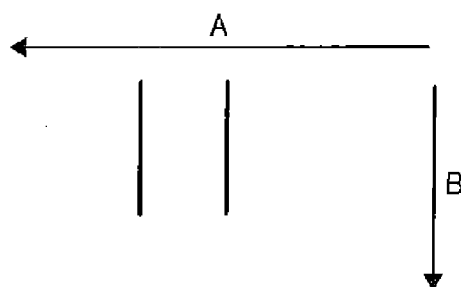


FIG. 12

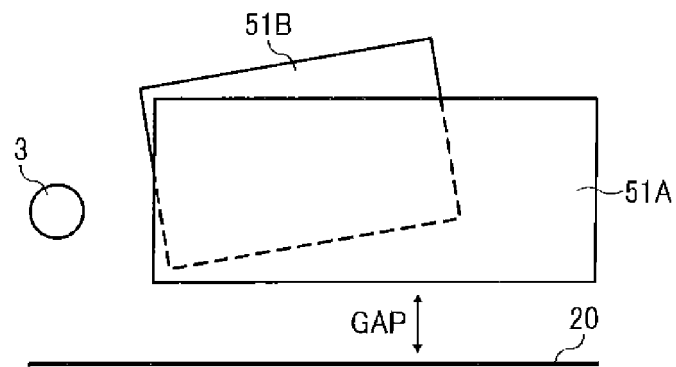


FIG. 13

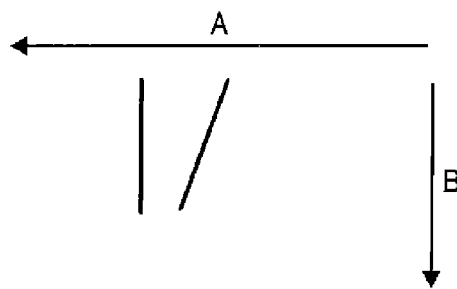


FIG. 14

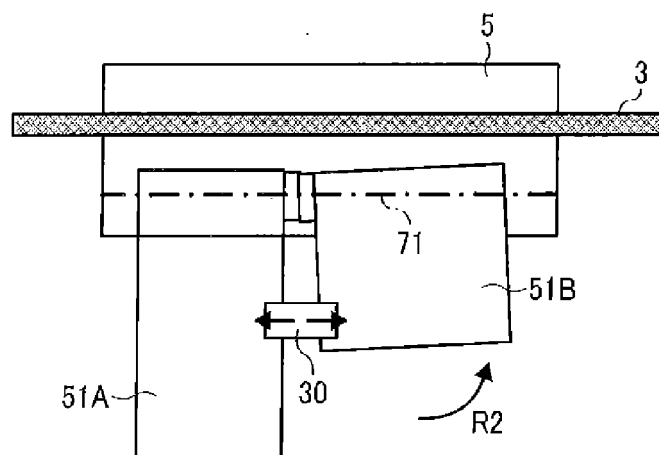


FIG. 15

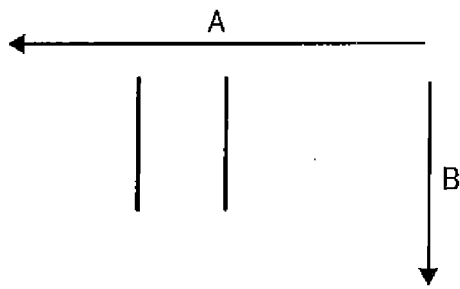


FIG. 16

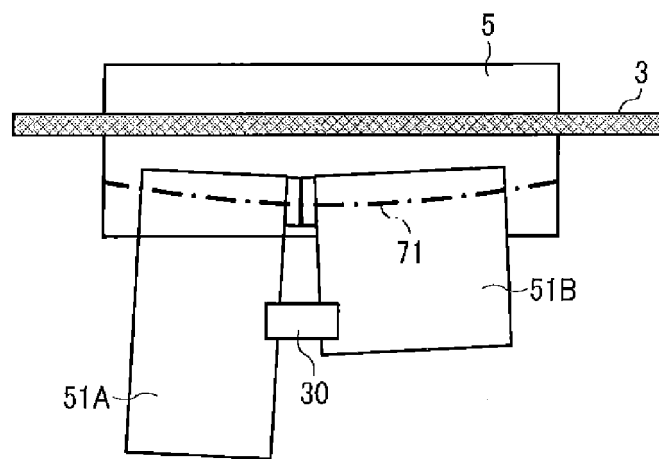


FIG. 17

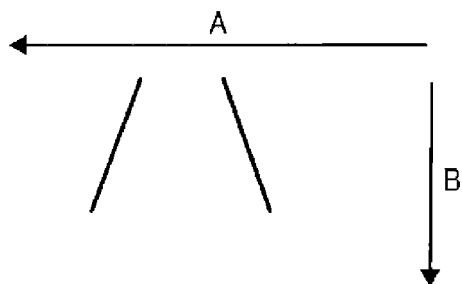


FIG. 18

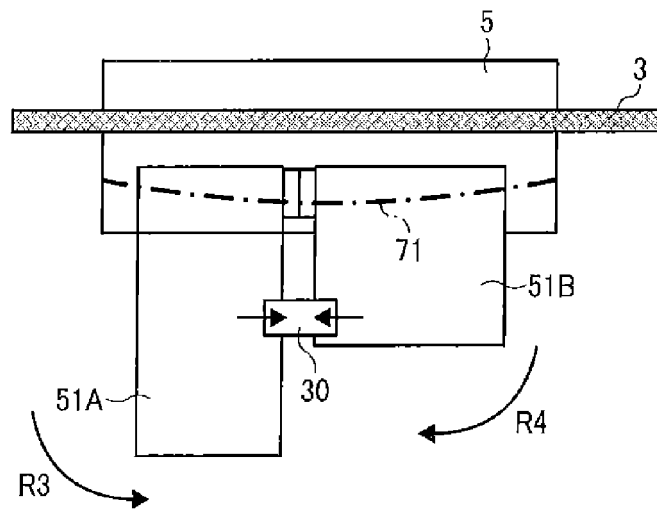


FIG. 19

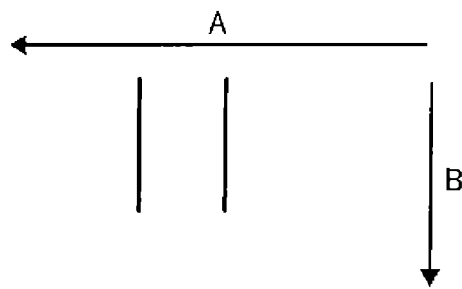


FIG. 20

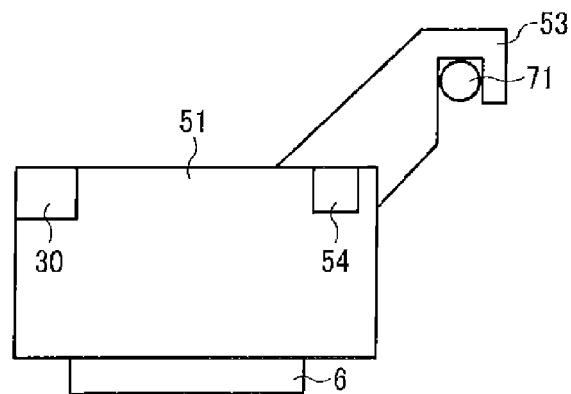


FIG. 21

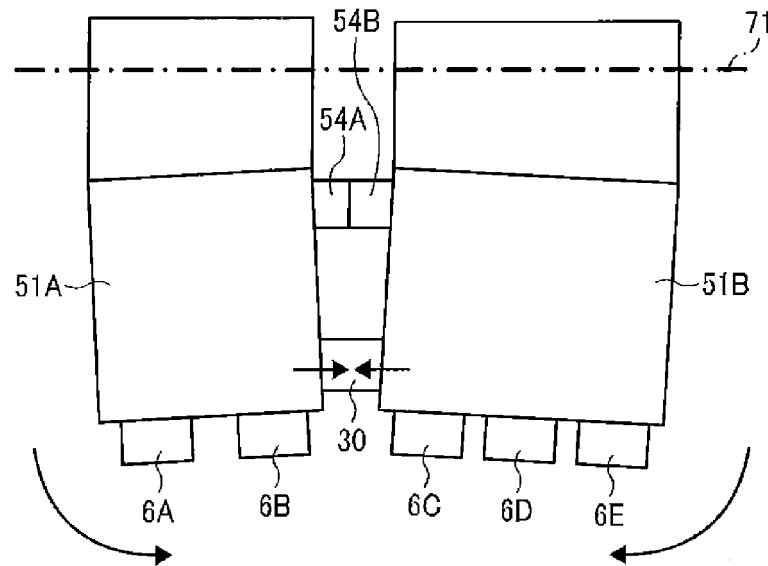


FIG. 22

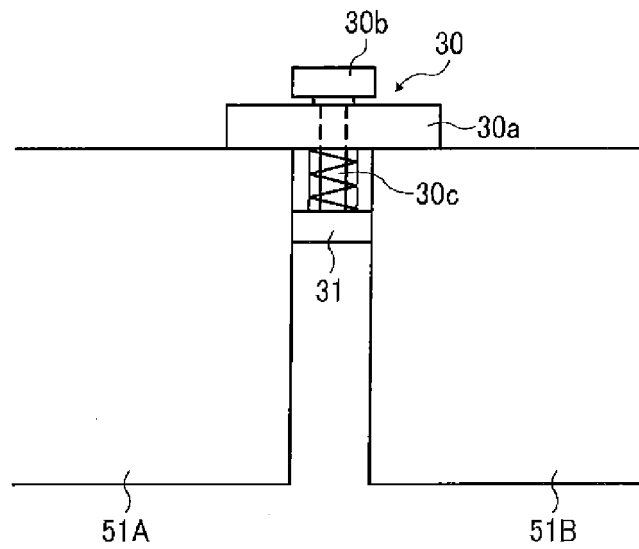


FIG. 23

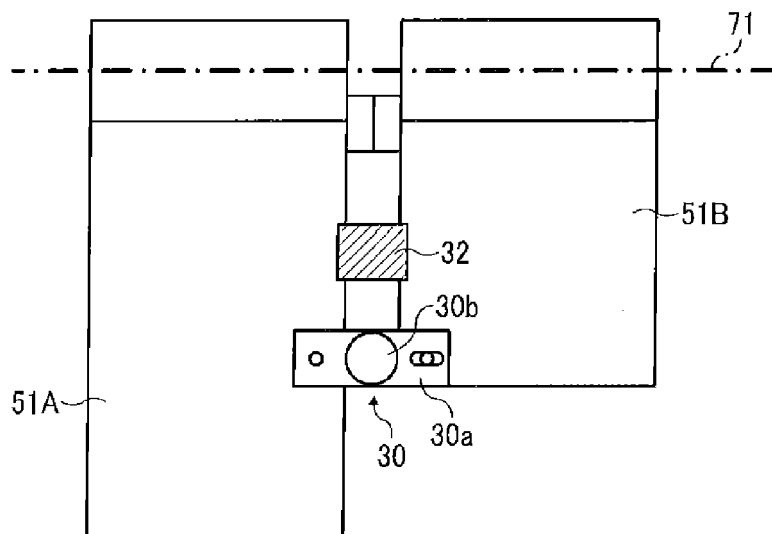


FIG. 24

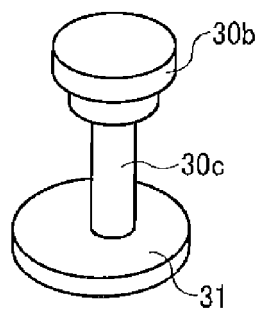


FIG. 25

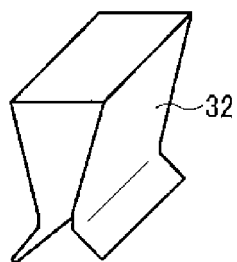


FIG. 26

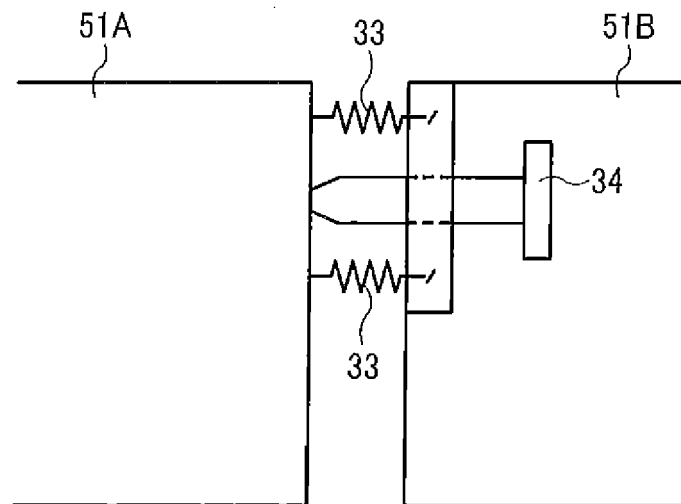
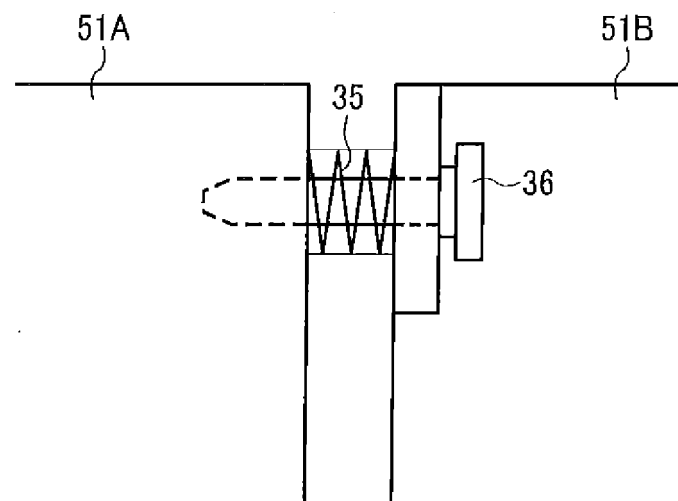


FIG. 27





EUROPEAN SEARCH REPORT

Application Number
EP 14 18 3239

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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 2013/070022 A1 (OGAWA MASATO [JP] ET AL) 21 March 2013 (2013-03-21)	1	INV. B41J25/34
A	* paragraphs [0080] - [0087]; figures 9, 10 *	2-6	
X	EP 0 824 074 A2 (SEIKO EPSON CORP [JP]) 18 February 1998 (1998-02-18) * column 3, line 31 - column 4, line 32; figures 1,2 *	1	
A	US 5 909 226 A (TAKEDA AKIO [JP]) 1 June 1999 (1999-06-01) * column 17, line 42 - column 18, line 21; figure 16 *	1-6	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B41J
Place of search		Date of completion of the search	Examiner
Munich		19 January 2015	Urbaniec, Tomasz
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		& : member of the same patent family, corresponding document	

 1
EPO FORM 1503 03.82 (P04C01)

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ON EUROPEAN PATENT APPLICATION NO.**

EP 14 18 3239

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19-01-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013070022 A1	21-03-2013	NONE	
EP 0824074 A2	18-02-1998	DE 69722326 D1	03-07-2003
		DE 69722326 T2	27-11-2003
		DE 69735276 T2	10-08-2006
		EP 0824074 A2	18-02-1998
		EP 1281534 A1	05-02-2003
		JP H10109458 A	28-04-1998
		US 6270184 B1	07-08-2001
		US 2001055045 A1	27-12-2001
US 5909226 A	01-06-1999	JP 3376216 B2	10-02-2003
		JP H0986014 A	31-03-1997
		US 5909226 A	01-06-1999

EPO FORM P0459

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

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Patent documents cited in the description

- JP 2007190867 A [0004] [0006]
- JP 2012194927 A [0005] [0007]