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(54) **IMAGE FORMING APPARATUS**

(57) An image forming apparatus (1) includes an endless belt member (23), an image forming section (3) that forms an image in an image forming area facing the belt member, a supporting member (4) that supports an entire width direction of the belt member at a position corresponding to the image forming area of the belt member, and a pulling section (6, 7) that pulls an end section of the supporting member toward outside the belt member.

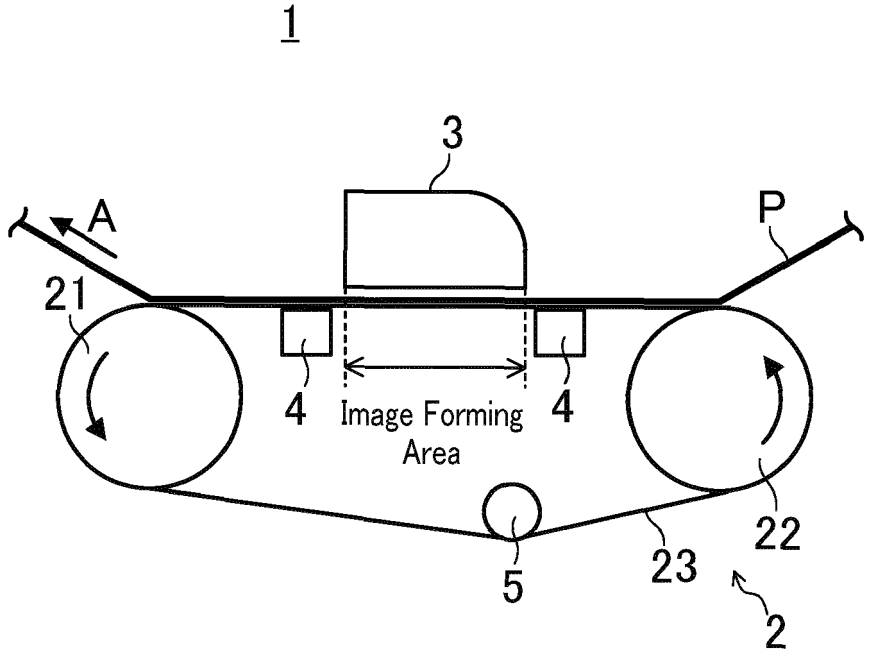

FIG. 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an image forming apparatus.

2. Description of Related Art

[0002] An image forming apparatus including an endless belt and an image forming section that forms an image in an image forming area facing the belt member is known. For example, Japanese Patent Application Laid-Open No. H08-156353 discloses a configuration that supports a range corresponding to an image forming area of the belt member with two rollers. This configuration enables to restrain a fluctuation in tension of the belt member when adjusting a gap between the belt member and the image forming section in the range.

SUMMARY OF THE INVENTION

[0003] Incidentally, in the configuration described in Japanese Patent Application Laid-Open No. H08-156353, both end sections in an axial direction of the roller member are fixedly supported to a predetermined section of the apparatus. By both end sections of the roller member being fixedly supported, a central part in the axial direction of the roller member is lowered by its own weight, thereby causing the roller member to deform to a state in which the central part is deflected, and there is a risk that the belt member deflects accordingly. Consequently, the flatness of the belt member cannot be secured, and moreover, there is a risk that the gap between the belt member and the image forming section cannot be accurately adjusted. Further, there is another risk that the configuration becomes complicated when an adjustment mechanism is provided in order to eliminate the deflection of the belt member.

[0004] An object of the present invention is to provide an image forming apparatus that is capable of securing flatness of a belt member by a simple configuration.

[0005] To achieve at least one of the above-mentioned objects, according to an aspect of the present invention, an image forming apparatus reflecting one aspect of the present invention includes:

an endless belt member;
an image forming section that is disposed so as to face the belt member and that forms an image in an image forming area facing the belt member;
a supporting member that is extended in a width direction of the belt member and that entirely supports the width direction of the belt member at a position corresponding to the image forming area of the belt member; and
a pulling section that pulls an end section of the supporting member toward outside the belt member.

BRIEF DESCRIPTION OF DRAWINGS

[0006] The advantages and features provided by one or more embodiments of the invention will become more fully understood from the detailed description given hereinbelow and the appended drawings which are given by way of illustration only, and thus are not intended as a definition of the limits of the present invention:

FIG. 1 is a diagram illustrating a schematic configuration of an image forming apparatus according to an embodiment of the present invention;
FIG. 2 is a block diagram indicating a main functional configuration of the image forming apparatus;
FIG. 3 is an enlarged view near an end section of a supporting member;
FIG. 4 is a diagram explaining a state of deflection deformation of a supporting member in a conventional example;
FIG. 5 is a diagram explaining the state of deflection deformation of the supporting member according to the present embodiment;
FIG. 6 is a diagram illustrating an example in which a fixing point of a screw member of the supporting member is changed;
FIG. 7 is a diagram illustrating an example in which a shape of the supporting member is changed;
FIG. 8 is a diagram illustrating another example in which the shape of the supporting member is changed;
FIG. 9 is a diagram illustrating another example in which the shape of the supporting member is changed;
FIG. 10 is a diagram illustrating an example of a configuration in which only a first end section of the supporting member is pulled;
FIG. 11 is a diagram illustrating an example of the configuration in which an air cylinder serves as a pulling section; and
FIG. 12 is a diagram illustrating an example of the configuration in which the pulling section includes an energizing member.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0007] Hereinafter, one or more embodiments of the present invention will be described with reference to the drawings. However, the scope of the invention is not limited to the disclosed embodiments.

[0008] An embodiment of the present invention will be described in detail below based on the accompanying drawings. FIG. 1 is a diagram illustrating a schematic configuration of image forming apparatus 1 according to the embodiment of the present invention.

[0009] As illustrated in FIG. 1, image forming apparatus 1 is an ink jet image forming apparatus including belt conveying device 2, recording head 3, supporting members 4, and the like.

[0010] Belt conveying device 2 includes endless conveying belt 23 of a predetermined width suspended under tension around driving roller 21 and driven roller 22 that are disposed in parallel at a predetermined interval. The upper surface of conveying belt 23 suspended around driving roller 21 and driven roller 22 is a mounting surface for placing recording medium P in close contact therewith. Conveying belt 23 corresponds to "belt member" of the present invention.

[0011] Note that the surface of conveying belt 23 is coated with an adhesive so called *"Jibari"* in order to place recording medium P being conveyed in close contact with the upper surface of conveying belt 23. Driving roller 21 is driven by a sub scanning motor (not shown).

[0012] In belt conveying device 2, driving roller 21 rotates at a predetermined speed in a counterclockwise direction (see an arrow) in FIG. 1 by a rotational drive of the sub scanning motor, thereby causing conveying belt 23 suspended around driving roller 21 and driven roller 22 to rotationally move. By such an operation, recording medium P mounted on the upper surface of conveying belt 23 is conveyed in a direction of arrow A, which is a sub scanning direction, in the figure.

[0013] For recording medium P, recording medium commonly used in inkjet recording, such as paper, fabric, plastic films, glass plates, and the like, can be used. Recording medium P may be a sheet-like medium cut to a predetermined size, or may be a long medium continuously fed out from an original winding wound in a roll shape.

[0014] Note that a belt cleaning device (not shown) is provided on the other side of a conveying surface of recording medium P in belt conveying device 2. The belt cleaning device removes a foreign substance adhering to conveying belt 23.

[0015] Recording head 3 includes a plurality of ink jet heads, and is disposed at a predetermined interval so as to face above the surface of conveying belt 23 where recording medium P is placed. Recording head 3 ejects ink droplets from a number of nozzles provided on its lower surface to a predetermined image forming area.

[0016] The predetermined image forming area is a facing area of recording head 3 and conveying belt 23. The length of the predetermined image forming area in a conveying direction of conveying belt 23 corresponds to the length of recording head 3 in the conveying direction.

[0017] Recording head 3 records a desired image on recording medium P that is conveyed by a rotational movement of conveying belt 23 and passes through the image forming area. Recording head 3 corresponds to "image forming section" of the present invention.

[0018] A shuttle-type recording head is used as recording head 3 in the present embodiment. The shuttle-type recording head refers to one that is mounted at a carriage (not shown) and reciprocates in a main scanning direction orthogonal to a conveying direction of recording medium P that is intermittently conveyed. In this case, at a time of recording, driving of driving roller 21 is controlled so that conveying belt 23 performs an intermittent operation of repeating a standby state and a driving state.

[0019] Note that recording head 3 may be a line-type recording head that is suspended fixedly in a width direction of conveying belt 23 and records images by ejecting ink droplets onto recording medium P that is continuously conveyed. In this case, at a time of recording, driving of driving roller 21 is controlled so that conveying belt 23 continuously moves (rotationally operates).

[0020] Supporting members 4 are each a member that supports a position corresponding to the image forming area of conveying belt 23 from the inner periphery side of conveying belt 23. Supporting members 4 are provided at two positions in the conveying direction: an upstream side and a downstream side of the image forming area. Details of supporting member 4 will be described later.

[0021] In addition, tension roller 5 is provided at an opposite side to supporting member 4 on the inner peripheral surface of conveying belt 23. Tension roller 5 is a roller that applies tension to conveying belt 23. Note that a roller provided on the inner peripheral surface of conveying belt 23 may be a roller that corrects meandering of conveying belt 23.

[0022] FIG. 2 is a block diagram indicating a main functional configuration of image forming apparatus 1. Image forming apparatus 1 includes control section 100, recording head driving section 110, conveyance driving section 120, and input/output interface 130.

[0023] Control section 100 includes a central processing unit (CPU) 101, a random access memory (RAM) 102, a read only memory (ROM) 103, and storage section 104.

[0024] CPU 101 reads a program and setting data for various controls stored in ROM 103, stores them in RAM 102, executes the program, and performs various arithmetic processing. CPU 101 also integrally controls an entire operation of image forming apparatus 1.

[0025] RAM 102 provides CPU 101 with a working memory space and stores temporary data. Note that RAM 102 may include a nonvolatile memory.

[0026] ROM 103 stores a program and setting data for various controls executed by CPU 101. Note that instead of ROM 103, a rewritable nonvolatile memory such as an electrically erasable programmable read only memory (EEPROM) or a flash memory may be used.

[0027] Storage section 104 stores a print job (an image recording instruction) input from an external device 140 through input/output interface 130 and image data related to the print job. As storage section 104, a hard disk drive (HDD) is used, for example, and a dynamic random access memory (DRAM) or the like may be used together.

[0028] Recording head driving section 110 supplies a driving signal corresponding to image data at an appro-

priate timing to recording head 3 based on a control of control section 100, and thereby an amount of ink corresponding to a pixel value of the image data is ejected from a nozzle of recording head 3.

[0029] Conveyance driving section 120 supplies a driving signal to a sub scanning motor of driving roller 21 based on the control of control section 100, thereby rotationally moving conveying belt 23 at a predetermined speed and timing.

[0030] Input/output interface 130 mediates transmission and reception of data between external device 140 and control section 100. Input/output interface 130 includes, for example, either one of various serial interfaces or various parallel interfaces, or a combination thereof.

[0031] External device 140 is, for example, a personal computer, and supplies an image recording instruction (a print job) and image data to control section 100 through input/output interface 130.

[0032] Next, supporting member 4 will be described in detail. FIG. 3 is an enlarged view near an end section of supporting member 4. Note that a lateral direction in FIG. 3 corresponds to a width direction of conveying belt 23.

[0033] As illustrated in FIG. 3, supporting member 4 is a quadrangular-prism-shaped metal member (e.g., aluminum) extending in the width direction of conveying belt 23, and entirely supports the width direction of conveying belt 23 from the inner periphery side of conveying belt 23. Note that, only one side of the end section of supporting member 4 (a right end section in FIG. 3) is illustrated in FIG. 3, and an illustration and a description of the other end section of supporting member 4 are omitted because a configuration around supporting member 4 is symmetrical on both sides in the width direction.

[0034] End section 4A of supporting member 4 is fixed to side wall 6 provided on both sides in the width direction of conveying belt 23, which is the outside of end section 4A of supporting member 4, in image forming apparatus 1. A square flat part of the rectangular-prism-shaped supporting member 4 is disposed so as to face conveying belt 23. Side wall 6 corresponds to "fixing member" of the present invention.

[0035] End section 4A of supporting member 4 is formed with hole 4B in which screw member 7 can be inserted. In addition, side wall 6 is also formed with hole 6A in which screw member 7 can be inserted through. Screw member 7 fixes end section 4A of supporting member 4 to side wall 6 by being inserted into hole 4B of supporting member 4 via side wall 6. That is, end section 4A of supporting member 4 is fixedly supported by side wall 6 and screw member 7.

[0036] End section 4A of supporting member 4 is pulled toward outside the width direction of conveying belt 23 (see an arrow) by being fixed in this manner. Specifically, because side wall 6 is an immovable part of image forming apparatus 1, supporting member 4 is relatively moved to a side of side wall 6 with respect to the immovable side wall 6 and screw member 7 by inserting screw member 7 into end section 4A of supporting member 4. That is, side wall 6 and screw member 7 apply a load to pull supporting member 4 to the side of side wall 6. Side wall 6 and screw member 7 correspond to "pulling section" of the present invention.

[0037] Both end sections of supporting member 4 are pulled to opposite sides to each other by side walls 6 and screw members 7 since the configuration around supporting member 4 is symmetrical on both sides in the width direction as described above. In other words, a first end section of supporting member 4 in the width direction (e.g., a right end section in FIG. 3), and a second end section of supporting member 4 in the width direction (e.g., a left end section that is not shown in FIG. 3) are pulled opposite to each other by side walls 6 and screw members 7 that correspond to the respective end sections.

[0038] FIG. 4 illustrates an example of a configuration of fixedly supporting both end sections of predetermined supporting member 10. In such a configuration, a central part in a width direction of supporting member 10 is lowered by its own weight, thereby causing supporting member 10 to deform to a state in which the central part is deflected. Therefore, belt member 11 supported by supporting member 10 also possibly deflects in response to the deflection, and there is a risk that a flatness of belt member 11 cannot be secured. Thus, a gap between belt member 11 and an image forming section cannot be accurately adjusted at the time of adjusting the gap.

[0039] In addition, for example, although adopting a configuration of providing an adjustment mechanism that adjusts deflection can be considered in order to eliminate the deflection of supporting member 10, this possibly makes the configuration of the apparatus complicated as a whole.

[0040] In the present embodiment in contrast, end section 4A of supporting member 4 is pulled toward outside the width direction of conveying belt 23 as illustrated in FIG. 5. This configuration, as a result, reduces a deflection amount of a central part of supporting member 4 caused by the central part in the width direction of supporting member 4 being lowered by its own weight That is, side walls 6 and screw members 7 are configured to pull end sections 4A of supporting member 4 so as to correct a deflection deformation of the central part of supporting member 4, thereby reducing a deflection of conveying belt 23 in response to the deflection of supporting member 4.

[0041] Thus, the flatness of conveying belt 23 can be secured in the present embodiment. Consequently, a desired image can be formed on recording medium P passing through an image forming area, and a gap between conveying belt 23 and recording head 3 can be accurately adjusted at the time of adjusting the gap.

[0042] Further, a tensile load applied to supporting member 4 enables to have a simple configuration because it is not necessary to provide an adjustment mechanism. In addition, it is possible to save space and cost of an apparatus since it is not necessary to provide an

adjustment mechanism.

[0043] Further, supporting member 4 is configured to be fixed so as not to rotate since both end sections of supporting member 4 are fixed to side walls 6 by screw members 7.

[0044] When supporting member 4 is rotatably fixed, there is a risk that the flatness of conveying belt 23 is deteriorated by rotation of supporting member 4. For example, when a section corresponding to a corner of supporting member 4 in a rectangular prism shape faces to conveying belt 23, a state of conveying belt 23 is fluctuated by the corner, and thus the flatness is deteriorated.

[0045] In the present embodiment, however, a flat part of supporting member 4 remains faced to conveying belt 23 since supporting member 4 cannot rotate. As a result, it is possible to restrain conveying belt 23 from deteriorating its flatness caused by the rotation of supporting member 4, and also it is possible to improve the flatness of conveying belt 23.

[0046] In addition, since both end sections of supporting member 4 are individually fixed in this configuration, when a manufacturing error occurs at each end, for example, a tightening degree of screw member 7 on both sides can be adjusted separately. As a result, adjusting a fixed state of supporting member 4 for each end section makes it easy to maintain the flatness of conveying belt 23 by supporting member 4.

[0047] Further, two supporting members 4 are provided at two positions, specifically, upstream and downstream sides of the portion of conveying belt 23 corresponding to the image forming area, in such a manner that the image forming area is positioned between two supporting members 4. Consequently, the flatness of the section corresponding to the image forming area of conveying belt 23 can be maintained by both the upstream side and the downstream side, and thus the flatness of the section corresponding to the image forming area of conveying belt 23 can be further easily secured.

[0048] In the embodiment described above, the fixing portions of the end sections of supporting member 4 are provided in the central part in a direction in which supporting member 4 and conveying belt 23 face each other (a vertical direction), but the present invention is not limited thereto. For example, the fixing point of the end section of supporting member 4 may be a portion closer to conveying belt 23 from the central part of supporting member 4 (see a broken line C) in the facing direction as illustrated in FIG. 6. In other words, side wall 6 and screw member 7 (pulling section) pull a portion closer to conveying belt 23 from the central part of supporting member 4 in the facing direction.

[0049] In this manner, a working point of the tensile load applied to supporting member 4 can be brought close to conveying belt 23. As a result, the side of supporting member 4 facing conveying belt 23 can be easily deformed, and thus it is possible to easily secure the flatness of conveying belt 23.

[0050] Further, pulling a portion closer to conveying belt 23 from the central part of supporting member 4 in the facing direction allows to weaken a pulling force compared to a configuration of pulling an opposite side portion to conveying belt 23 from the central part. As a result, it is possible to reduce the load applied to supporting member 4, thereby causing a durability of supporting member 4 to improve. Further, weakening the force for pulling supporting member 4 makes it possible to easily adjust conveying belt 23. Accordingly, force required for adjustment of conveying belt 23 can be reduced, thereby improving an adjustability of conveying belt 23.

[0051] In addition, in the configuration illustrated in FIG. 6, the side of supporting member 4 facing conveying belt 23 is easily deformed by positioning the fixing point of supporting member 4 on the side of conveying belt 23, but the present invention is not limited thereto. For example, the section modulus of first portion 41 of supporting member 4 may be configured to be lower than the section modulus of second portion 42 of supporting member 4 as illustrated in FIG. 7. Incidentally, a lateral direction in FIGS. 7 to 9 corresponds to a conveying direction of conveying belt 23.

[0052] First portion 41 is a portion closer to conveying belt 23 from the central part of supporting member 4 (see a broken line C) in the facing direction of supporting member 4 and conveying belt 23. Second portion 42 is a portion other than first portion 41 of supporting member 4 and is on the opposite side of conveying belt 23 with first portion 41 therebetween.

[0053] Supporting member 4 shown in FIG. 7 is configured to have a trapezoidal shape in a cross-sectional view, and surface 41A of first portion 41, which is an upper bottom part in FIG. 7, is shorter than surface 42A of second portion 42, which is a lower bottom part in FIG. 7.

[0054] First portion 41 is also more easily deformed than second portion 42 in such a manner. That is, the side of supporting member 4 facing conveying belt 23 can be easily deformed, and thus it is possible to easily secure the flatness of conveying belt 23.

[0055] Further, the material of first portion 41 may be softer than the material of second portion 42 as illustrated in FIG. 8.

[0056] For supporting member 4 illustrated in FIG. 8, first portion 41 is made of plastic such as polyacetal (POM), and second portion 42 is made of metal.

[0057] First portion 41 is more easily deformed than second portion 42 even in such a manner. That is, the side of supporting member 4 facing conveying belt 23 can be easily deformed, and thus it is possible to easily secure the flatness of conveying belt 23.

[0058] Further, first portion 41 may be formed with hollow section 41B as in a configuration illustrated in FIG.9. In other words, supporting member 4 includes hollow section 41B that is located closer to conveying belt 23 from the central part (see a broken line C) in the facing direction of supporting member 4 and conveying belt 23. Hollow section 41B extends in the width direction and

penetrates supporting member 4.

[0059] First portion 41 is more easily deformed than second portion 42 even in such a manner. That is, the side of supporting member 4 facing conveying belt 23 can be easily deformed, and thus it is possible to easily secure the flatness of conveying belt 23.

[0060] In this configuration in particular, when supporting member 4 is formed of a resin member or the like rather than a metal member that has high rigidity, the rigidity of the entire supporting member 4 can be secured by second portion 42 that is not formed with a hollow section.

[0061] In addition, when supporting member 4 is formed of a member having high rigidity such as a metal member, hollow section 41B may be formed not only in first portion 41 but also in the entire supporting member 4 in the facing direction, for example.

[0062] Note that both end sections of supporting member 4 are each fixed by side wall 6 and screw member 7 in the embodiment described above, but the present invention is not limited thereto, and only one of the end sections of supporting member 4 may be fixedly supported by side wall 6 and screw member 7.

[0063] In a case of such supporting member 4, as illustrated in FIG. 10, first end section 4A of supporting member 4 in a width direction of an apparatus (a right end section in FIG. 10) is fixedly supported by a right side wall 6 and screw member 7. First end section 4A is disposed at a space from the right side wall 6. Further, second end section 4C of supporting member 4 in the width direction (a left end section in FIG. 10) is fixedly supported by a left side wall 6 of the apparatus. Specifically, second end section 4C is fixed by being fitted into side wall 6.

[0064] That is, supporting member 4 is configured so that second end section 4C is fixed to the left side wall 6 (a member other than pulling section) and first end section 4A is fixedly supported by the right side wall 6 and screw member 7 (pulling section).

[0065] It is possible to reduce a deflection deformation of supporting member 4 even in such a configuration. In addition, since the second end section is fixedly supported without using the screw member, it is only necessary to provide screw member 7 corresponding to the first end section, and thus it is possible to reduce the number of parts.

[0066] Further, pulling section is composed of side wall 6 and screw member 7 in the embodiment described above, but the present invention is not limited thereto, and it may be composed of an air cylinder, for example.

[0067] Specifically, as illustrated in FIG. 11, pulling section 8 includes piston section 81 that is fixed to an end section of supporting member 4, and a cylinder section 82 that supports piston section 81 movably in a lateral direction.

[0068] Pulling section 8 enables piston section 81 to pull supporting member 4 outward by adjusting air pressure in cylinder section 82.

[0069] The flatness of conveying belt 23 can be secured even with this configuration, and thus the gap between conveying belt 23 and recording head 3 can be accurately adjusted.

[0070] Further, as illustrated in FIG. 12, pulling section may be configured to include energizing member 83 that energizes the end section of supporting member 4 toward outside of conveying belt 23.

[0071] Extension member 43 is provided on end section 4A of supporting member 4 that is illustrated in FIG. 12. Extension member 43 includes extension section 43A extending from end section 4A of supporting member 4, and press section 43B provided at a distal end of extension section 43A.

[0072] Extension section 43A is formed in a cylindrical shape, and is supported by side wall 6 that is provided outside of end section 4A of supporting member 4 in image forming apparatus 1. Pressing section 43B is configured to have a larger diameter than extension section 43A, and is located outside side wall 6.

[0073] Energizing member 83 is a spring provided between side wall 6 and pressing section 43B. Energizing member 83 energizes press section 43B outward with respect to side wall 6. Side wall 6, extension member 43 and energizing member 83 correspond to "pulling section" of the present invention.

[0074] In this manner, the outward energizing force to pressing section 43B pulls supporting member 4 outward. As a result, the flatness of conveying belt 23 can be secured, and thus the gap between conveying belt 23 and recording head 3 can be accurately adjusted. Note that extension member 43 may be separate from supporting member 4.

[0075] Incidentally, supporting member 4 has the square prism shape in the embodiment described above, but the present invention is not limited thereto, and may have a cylindrical shape, for example. Further, when a supporting member has a cylindrical shape, it may be fixed so as to be rotatable.

[0076] In addition, supporting member 4 has the quadrangular prism shape in the embodiment described above, but the present invention is not limited thereto, and may have a triangular prism shape or other polygonal prism shapes. However, from a viewpoint of stabilizing the flatness of conveying belt 23, it is preferable that a flat part of the prismatic shape is placed to face conveying belt 23.

[0077] Further, conveying belt 23 that conveys recording medium P is exemplified as the belt member in the embodiment described above, but the present invention is not limited thereto, and it may be an intermediate transfer belt or the like, for example.

[0078] Further, a configuration based on the inkjet printing system is exemplified as the image forming section using an example of recording head 3 including inkjet heads in the embodiment described above, but the present invention is not limited thereto, and other configurations than the inkjet printing system may be used as the image forming section.

[0079] In addition, two supporting members 4 are provided in the embodiment described above, but the present invention is not limited thereto, and it is sufficient to have one or more.

[0080] In addition, supporting members 4 are provided with the image forming area in between in the embodiment described above, but the present invention is not limited thereto. For example, supporting member 4 may be provided at any position as long as the position corresponds to the image forming area such as within the range of the image forming area, the range between driving roller 21 and the end of the image forming area, and the range between driven roller 22 and the other end of the image forming area.

[0081] In addition, any of the embodiment described above merely illustrates one example of embodiment for carrying out the present invention, and the technical scope of the present invention shall not be construed in a limited manner thereby. That is, the present invention can be carried out in various forms without deviating from the gist or essential characteristics of the present invention.

[0082] Although embodiments of the present invention have been described and illustrated in detail, the disclosed embodiments are made for purposes of illustration and example only and not limitation. The scope of the present invention should be interpreted by terms of the appended claims.

Reference Signs List

[0083]

1 Image forming apparatus
2 Belt conveying device
3 Recording head
4 Supporting member
4A End section
4B Hole
5 Tension roller
6 Side wall
6A Hole
21 Driving roller
22 Driven roller
23 Conveying belt
100 Control section
110 Recording head driving section
120 Conveyance driving section
130 Input/output interface

Claims

1. An image forming apparatus (1) comprising:

an endless belt member (23);
an image forming section (3) that is disposed so as to face the belt member (23) and that forms an image in an image forming area facing the belt member (23);
a supporting member (4) that extends in a width direction of the belt member (23) and that entirely supports the width direction of the belt member (23) at a position corresponding to the image forming area of the belt member (23); and
a pulling section (6, 7, 8, 43, 83) that pulls an end section (4A) of the supporting member (4) toward outside the belt member (23).

2. The image forming apparatus (1) according to claim 1, wherein the pulling section (6, 7, 8, 43, 83) pulls the end section (4A) of the supporting member (4) so as to correct a deflection deformation of a central part of the supporting member (4) in the width direction.

3. The image forming apparatus (1) according to claim 1 or 2, wherein the pulling section (6, 7, 8, 43, 83) pulls a portion closer to the conveying belt (23) from the central part of the supporting member (4) in a facing direction of the supporting member (4) and the belt member (23).

4. The image forming apparatus (1) according to any one of claims 1 to 3, wherein
the supporting member (4) includes a first portion (41) that is closer to the belt member (23) from the central part of the supporting member (4) in the facing direction of the supporting member (4) and the belt member (23), and a second portion (42) that is a portion other than the first portion (41); wherein
a section modulus of the first portion (41) is lower than a section modulus of the second portion (42)

5. The image forming apparatus (1) according to claim 4, wherein a material of the first portion (41) is softer than a material of the second portion (42).

6. The image forming apparatus (1) according to any one of claims 1 to 5, wherein the supporting member (4) is fixed so as not to rotate.

7. The image forming apparatus (1) according to any one of claims 1 to 6, wherein:

the pulling section (6, 7, 8, 43, 83) is provided on a side of a first end section (4A) of the supporting member (4) in the width direction;
a second end section (4C) of the supporting member (4) in the width direction is fixedly supported by a member other than the pulling section (6, 7, 8, 43, 83); and
the first end section (4A) of the supporting member (4) in the width direction is fixedly supported by the pulling section (6, 7, 8, 43, 83).

8. The image forming apparatus (1) according to any one of claims 1 to 6, wherein:

the pulling section (6, 7, 8, 43, 83) is provided corresponding to each of the both ends of the supporting member (4) in the width direction; and
the first end section (4A) of the supporting member (4) in the width direction and the second end section (4C) of the supporting member (4) in the width direction are fixedly supported by respectively corresponding pulling sections (6, 7).

9. The image forming apparatus (1) according to any one of claims 1 to 8, wherein:

at least two of the supporting members (4) are provided;
and the at least two supporting members (4) are disposed such that the image forming area is positioned between the at least two supporting members (4).

10. The image forming apparatus (1) according to any one of claims 1 to 9, wherein the pulling section (6, 7) comprises:

a fixing member (6) located outside the end section (4A) of the supporting member (4); and
a screw member (7) inserted into both the fixing member (6) and the end section (4A) of the supporting member (4).

11. The image forming apparatus (1) according to any one of claims 1 to 9, wherein the pulling section (8) is an air cylinder comprises:

a piston section (81) that is fixed to the end section (4A) of the supporting member (4); and
a cylinder section (82) that movably supports the piston section (81).

12. The image forming apparatus (1) according to any one of claims 1 to 9, wherein the pulling section (6, 43, 83) includes an energizing member (83) that energizes the end section (4A) of the supporting member (4) toward outside the belt member (23).

13. The image forming apparatus (1) according to any one of claims 1 to 12, wherein the supporting member (4) includes a hollow section (41B) extending in the width direction.

14. The image forming apparatus (1) according to claim 13, wherein the hollow section (41B) is located closer to the belt member (23) from the central part of the supporting member (4) in the facing direction of the supporting member (4) and the belt member (23).

15. The image forming apparatus (1) according to any one of claims 1 to 14, wherein the supporting member (4) is in a prism shape or a cylindrical shape.

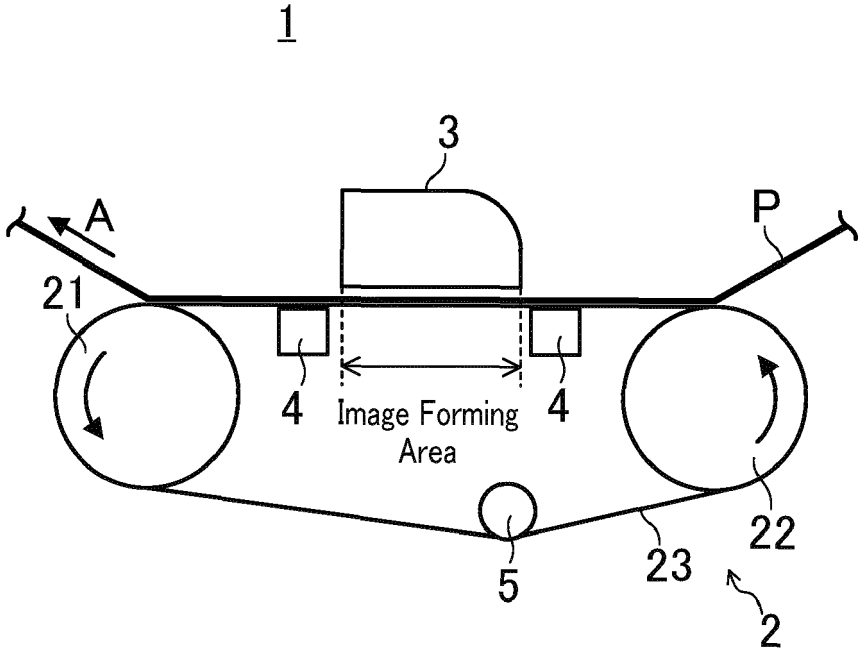

FIG. 1

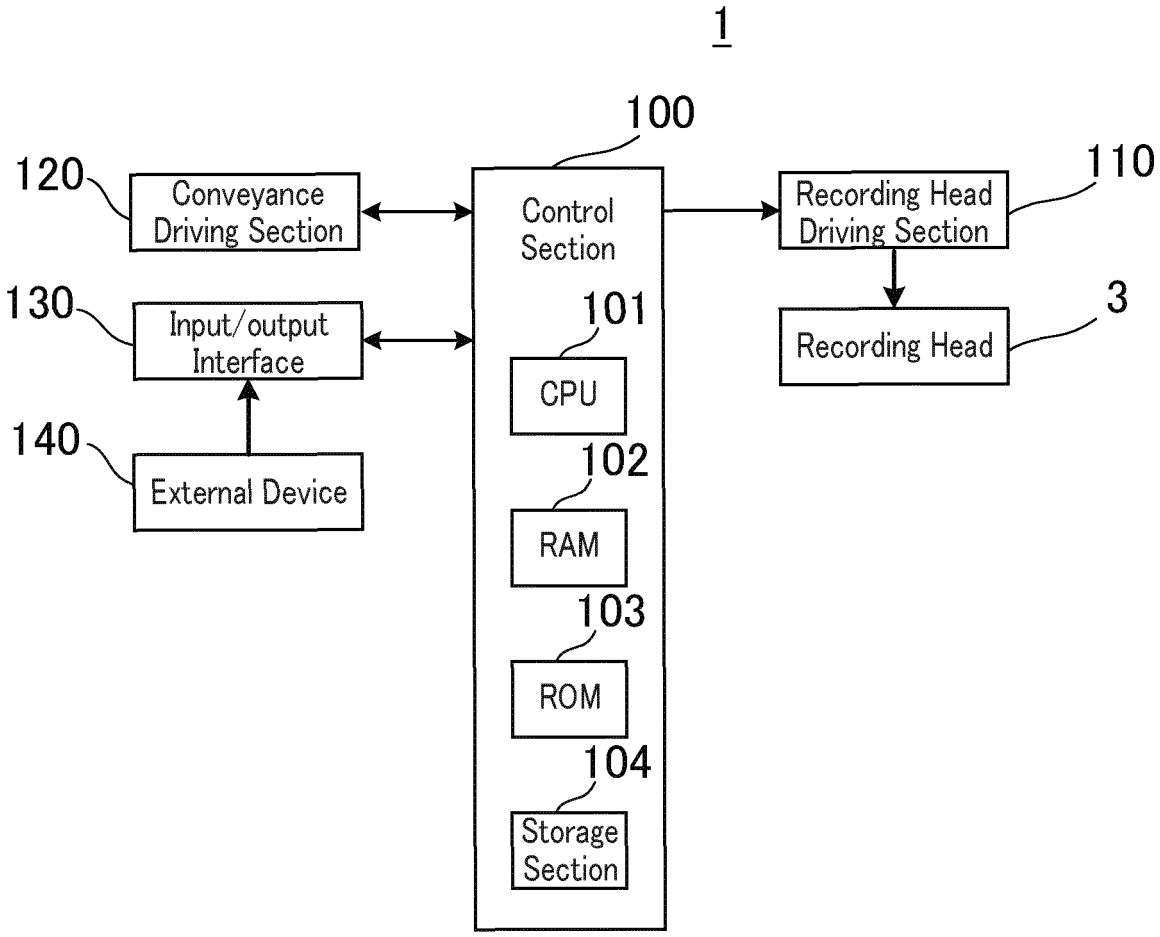
1
100
120
Conveyance Driving Section
Control Section
110
Recording Head Driving Section
130
Input/output Interface
101
CPU
3
Recording Head
140
External Device
102
RAM
103
ROM
104
Storage Section

FIG. 2

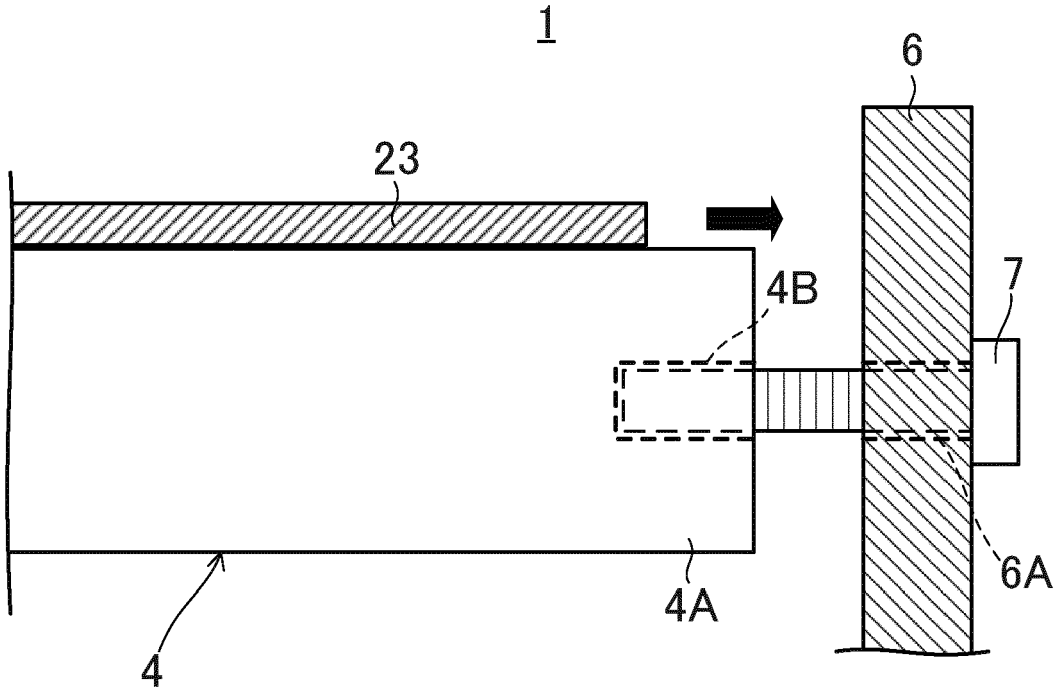

FIG. 3

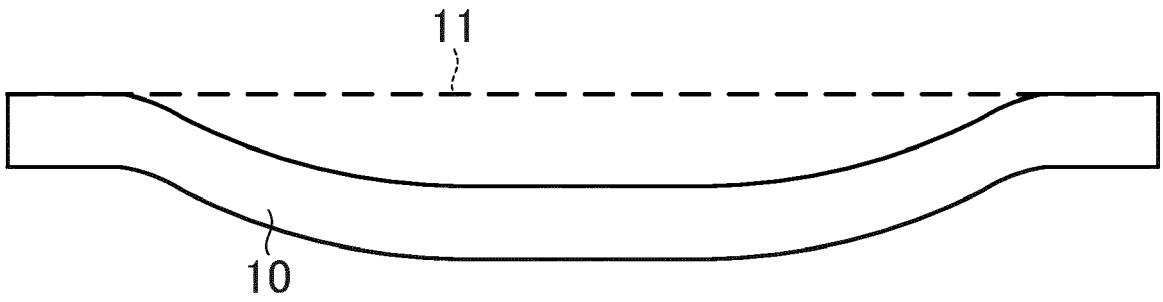

FIG. 4

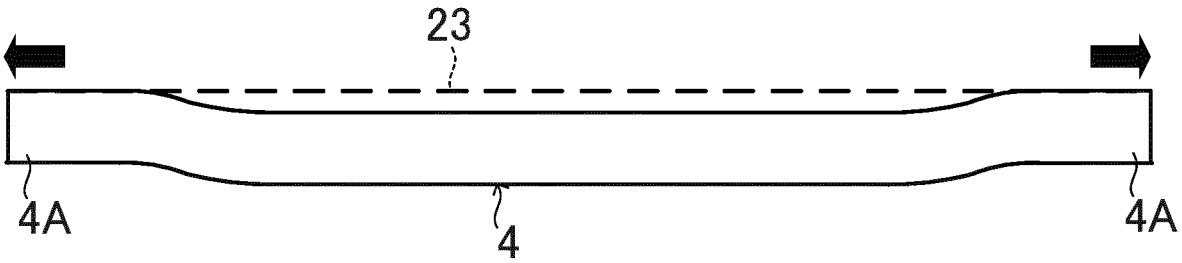

FIG. 5

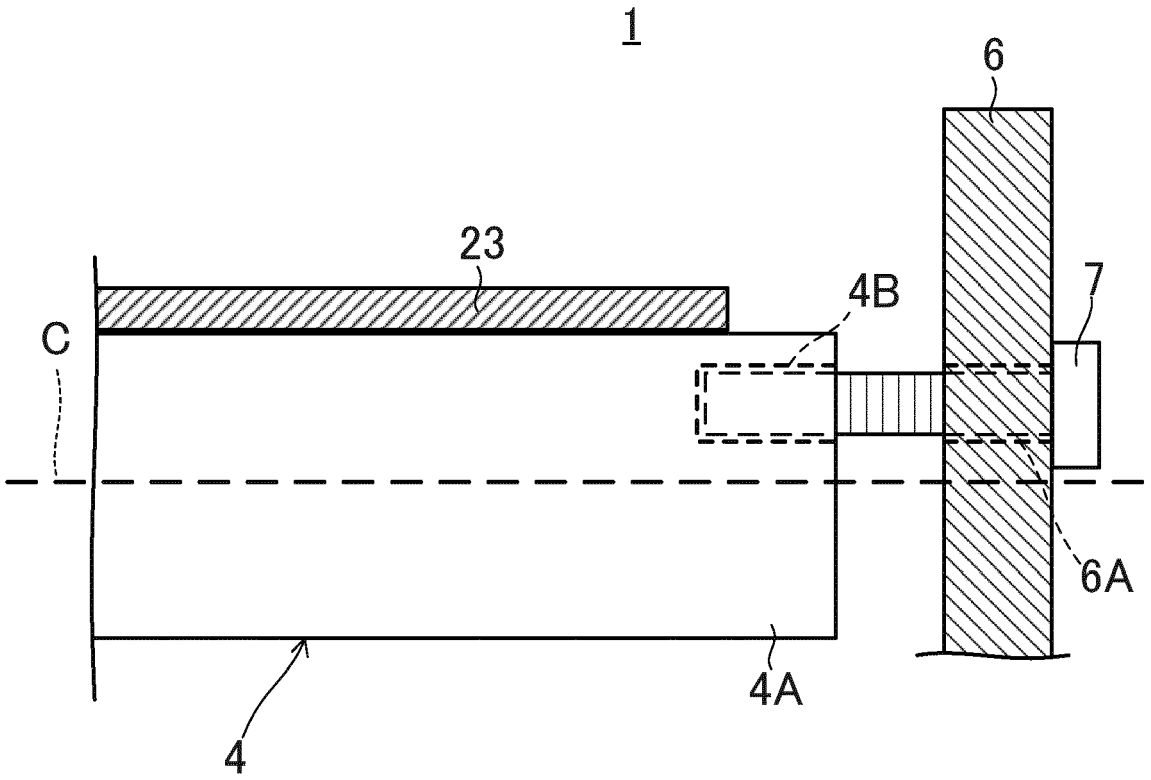

FIG. 6

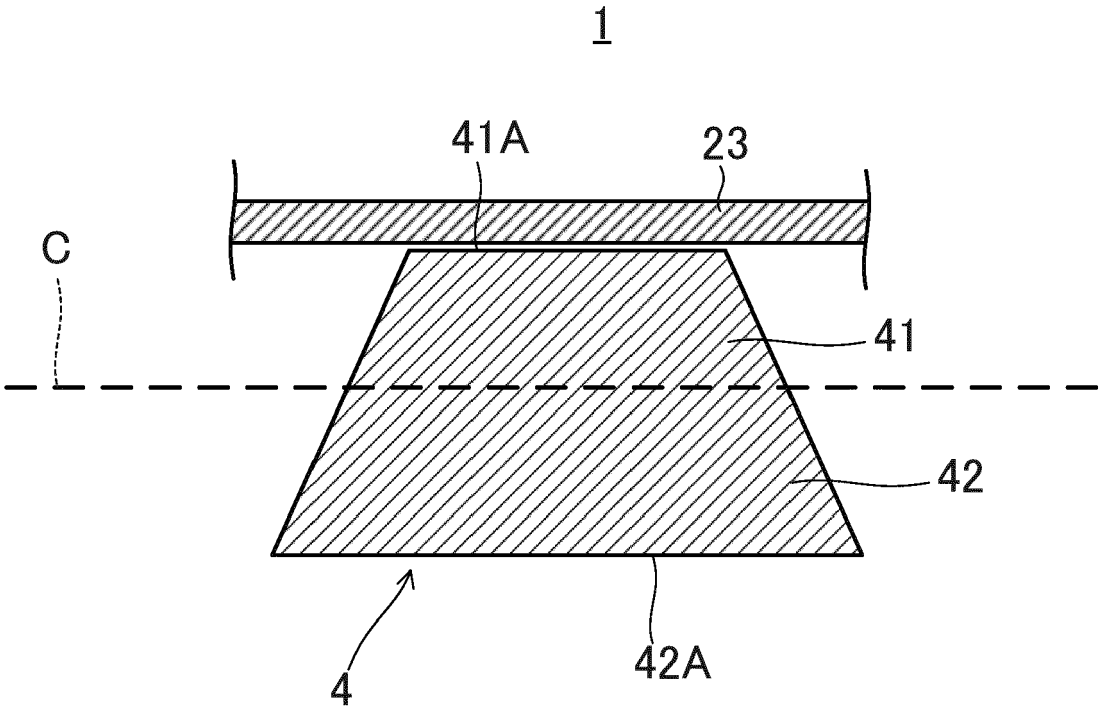

FIG. 7

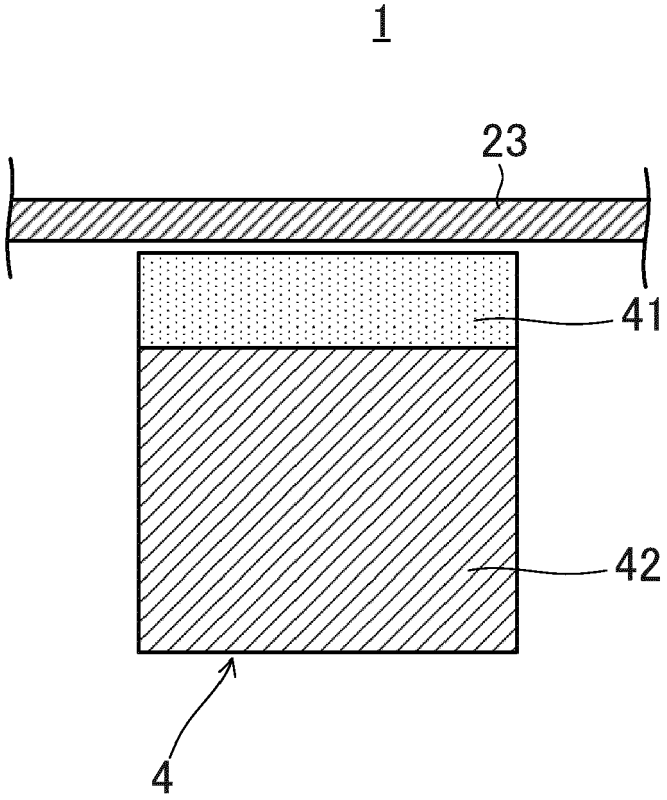

FIG. 8

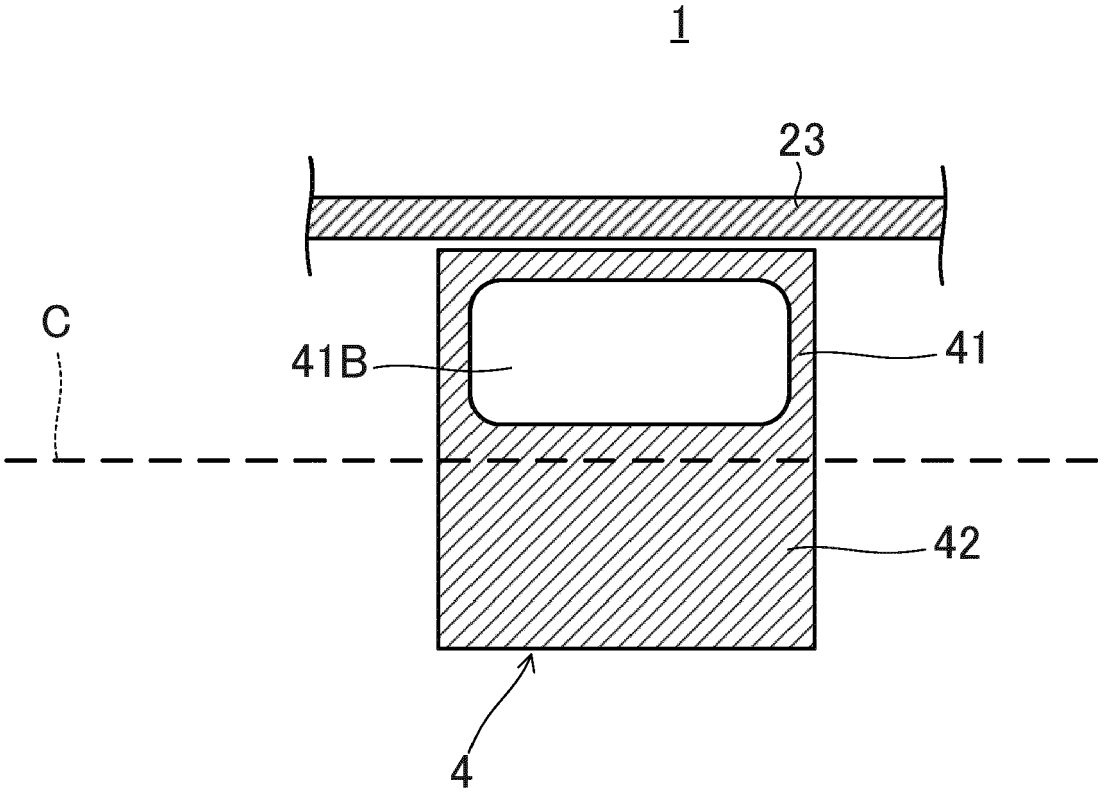

FIG. 9

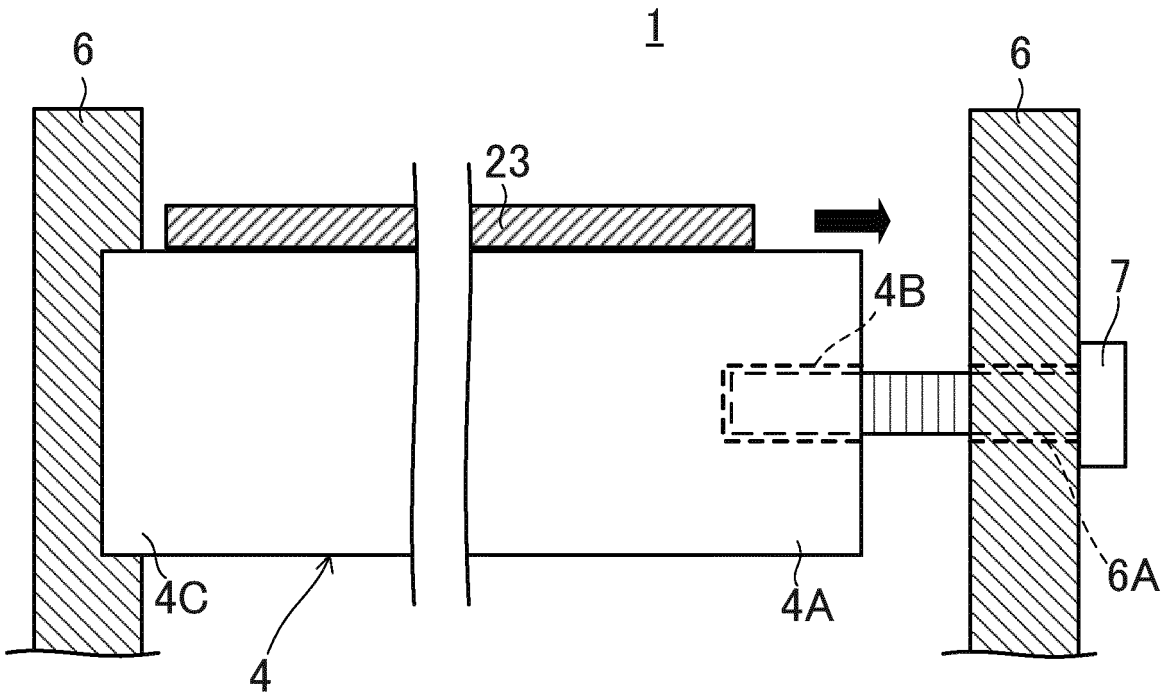

FIG. 10

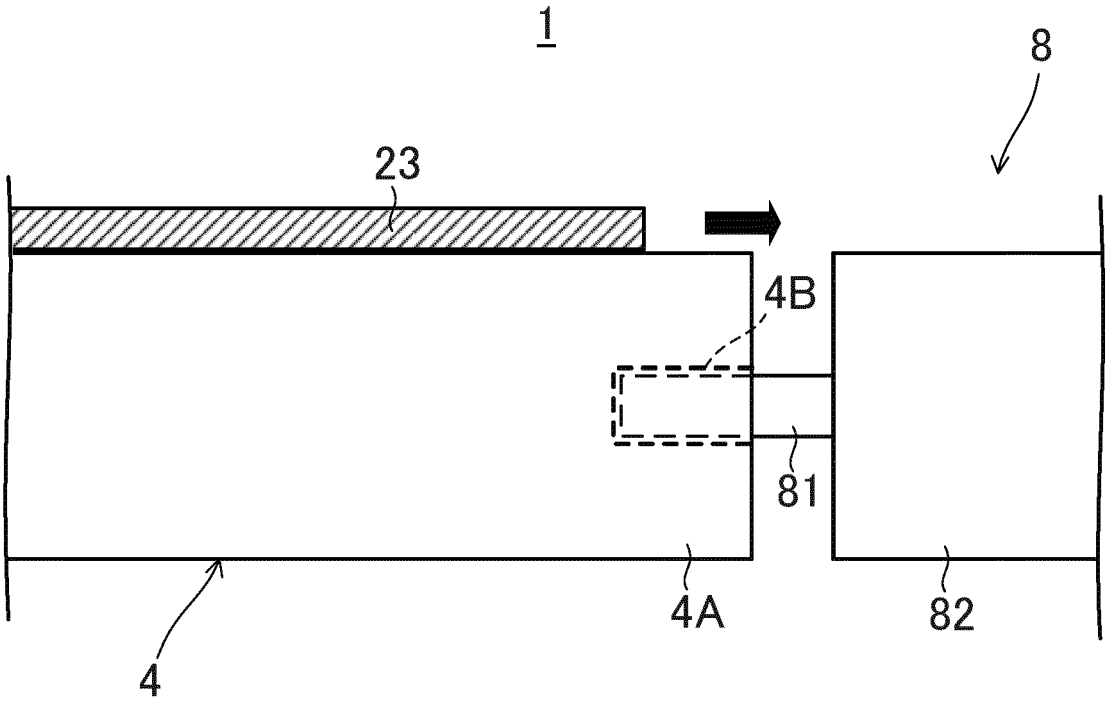

FIG. 11

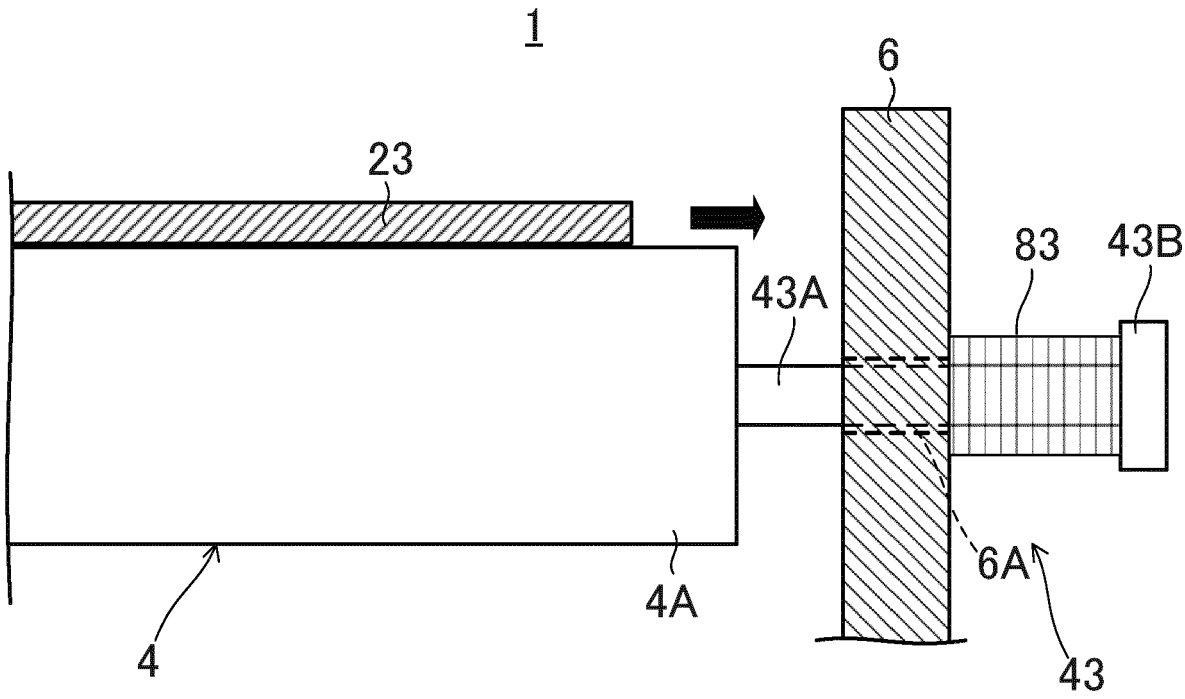

FIG. 12

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 20 19 6952

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 A	US 6 594 460 B1 (WILLIAMS LLOYD A [US] ET AL) 15 July 2003 (2003-07-15) * Embodiments 1, 2, 3; figures 2-4 *	1,2,4-15 3	INV. G03G15/16
X A	US 2003/076405 A1 (SANCHEZ RENE [US] ET AL) 24 April 2003 (2003-04-24) * paragraphs [0011] - [0013]; figures 1,2 *	1,2,4-15 3	
A	JP 2010 042628 A (OLYMPUS CORP) 25 February 2010 (2010-02-25) * abstract; figures *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC) G03G B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 January 2021	Urbaniec, Tomasz

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EPO FORM 1503 03.82 (P04C01)

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21-01-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6594460 B1	15-07-2003	NONE	
US 2003076405 A1	24-04-2003	JP 4212329 B2	21-01-2009
		JP 2003140475 A	14-05-2003
		US 2003076405 A1	24-04-2003
JP 2010042628 A	25-02-2010	JP 5193738 B2	08-05-2013
		JP 2010042628 A	25-02-2010

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 H08156353 B **[0002] [0003]**