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(71) Applicant: **Funai Electric Co., Ltd.**
Daito city
Osaka 574-0013 (JP)

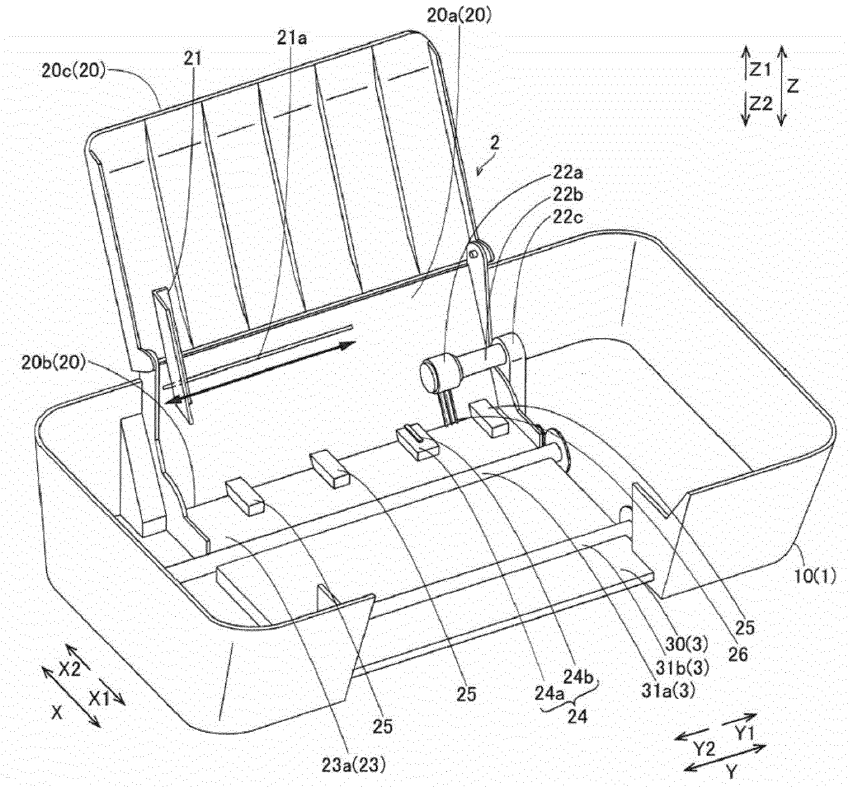
(72) Inventor: **FUKUYAMA, Shoichi**
Osaka, Osaka 574-0013 (JP)

(74) Representative: **Osha Liang**
2, rue de la Paix
75002 Paris (FR)

(54) IMAGE FORMING APPARATUS

(57) An image forming apparatus includes a placement portion that include a first surface (20a) on which a medium is placed and a protruding portion (26), a feed roller (22a) that opposes the placement portion, a second surface (23a) that forms an obtuse angle with the first surface, and a restriction portion disposed downstream of the feed roller (22a) in a conveyance direction on the placement portion and that restricts movement of the medium to a predetermined direction. The protruding portion (26) is disposed between the feed roller (22a) and the restriction portion.

FIG. 2



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Description

[Technical Field]

[0001] The present invention generally relates to an image forming apparatus, and more particularly to an image forming apparatus including a sheet feed roller.

[Background Art]

[0002] Conventional image forming apparatuses include a sheet feed roller (for example, see patent literature 1).

[0003] According to patent literature 1, an image forming apparatus comprises a placement plane on which a sheet (medium) is placed, a sheet feed roller disposed opposing the placement plane, a protruding portion provided directly downstream from the sheet feed roller, and a friction member provided downstream from the protruding portion (a friction pad and a friction roller opposing the friction pad). The protruding portion is provided in a position apart from a region in the vicinity of the sheet feed roller. When the sheet is bent into a concave shape by the pressure of the sheet feed roller, the image forming apparatus causes the bent concave-shaped portion of the sheet to contact the protruding portion, which helps prevent collision of the sheet against the friction pad and sheet jamming (sheet feed failure). The protruding portion and the friction member are in opposing positions in the rotational axis direction of the sheet feed roller.

[Citation List]

[Patent Literature]

[0004] [Patent Literature 1] Japanese Patent Application Publication No. 2012-76909

[0005] However, in the image forming apparatus of patent document 1, for example, when correcting the concave-shaped portion of the sheet with the protruding portion, the sheet may be separated from the friction member, and sometimes, the sheet may not contact the friction member, and as a result, the uppermost sheet cannot be separated (that is, multiple sheets may be fed).

[Summary of the Invention]

[0006] An image forming apparatus according to one or more embodiments of the present invention can help prevent multiple feeding of the medium without deforming the medium (e.g., forming a concave-shaped portion on the medium from the sheet feed roller).

[0007] According to one or more embodiments of the present invention, an image forming apparatus may comprise a placement portion that include a first surface on which a medium is placed and a protruding portion, a feed roller that opposes the placement portion, a second surface that forms an obtuse angle with the first surface, and a restriction portion disposed downstream of the feed roller in a conveyance direction on the placement portion and that restricts movement of the medium to a predetermined direction. The protruding portion may be disposed between the feed roller and the restriction portion.

[0008] In the image forming apparatus according to one or more embodiments of the present invention, the protruding portion may be disposed downstream in a conveyance direction of the feed roller on the first surface and be disposed between a plurality of restriction portions in a width direction that is a rotational axis direction of the feed roller on the second surface. This helps prevent the predetermined deformation of the sheet (medium) accompanying the feeding of the sheet by the feed roller due to the protruding portion, and thus, sheet jamming due to the protruding portion can be prevented without multiple feeding due to the restriction portions. Furthermore, because the protruding portion is disposed on the downstream side directly below the feed roller, where concave-shaped portions (valley fold portions) are formed easily in the medium, the formation of concave-shaped portions in the medium due to the feed roller can be more effectively prevented beforehand, and sheet jamming can also be more effectively prevented.

[0009] The image forming apparatus according to one or more embodiments of the present invention may further comprise one or more restrictions portions. The restriction portions may comprise supporters that support the medium placed on the placement portion. According to one or more embodiments of the present invention, the supporters may comprise a first supporter and a second supporter. A second friction coefficient of the second supporter may be larger than a first friction coefficient of the first supporter. The protruding portion may be disposed between the first supporter and the second supporter. As a result, the protruding portion may help prevent sheet jamming without multiple feeding due to friction of the second supporter.

[0010] According to one or more embodiments of the present invention, the first friction coefficient may be smaller than a friction coefficient of the first surface. As a result, the sheet contacting the first supporter is conveyed smoothly during feeding without sheet jamming.

[0011] According to one or more embodiments of the present invention, when the second friction coefficient is larger than the first friction coefficient, the feed roller, the protruding portion, and the second supporter may be disposed on one end-part side in a rotational axis direction of the feed roller on the first surface and the second surface. As a result, the device configuration can be simplified because it is possible to configure the feed roller as a cantilever shape.

[0012] According to one or more embodiments of the present invention, when the second friction coefficient is larger than the first friction coefficient, a length of the second supporter from the second surface is greater than a length of the first supporter from the second surface. As a result, because the sheet can be made to contact

the second supporter preceding the first supporter, multiple feeding of the sheet can be better prevented by friction force of the second supporter relative to the sheet.

[0013] According to one or more embodiments of the present invention, when the second friction coefficient is larger than the first friction coefficient, the second supporter may be a friction part mounted on the first supporter.

[0014] According to one or more embodiments of the present invention, when the second friction coefficient is larger than the first friction coefficient, the first supporter and the second supporter are formed from different materials.

[0015] According to one or more embodiments of the present invention, a length of a region on which the protruding portion is formed on the first surface in a rotational axis direction of the feed roller may be at least one third of a length of the feed roller in the rotational axis direction. As a result, when compared to a case wherein the overall length of the region on which the protruding portion is formed on the first surface in the rotational axis direction is comparatively small (when the overall length of the protruding portion in the rotational axis direction is less than one third of the length of the feed roller in the rotational axis direction), the protruding portion can contact the medium in a wider range. This allows the formation of concave-shaped portions (valley fold portions) in the medium due to the feed roller to be more effectively prevented beforehand. This also helps prevent sheet jamming.

[0016] According to one or more embodiments of the present invention, the protruding portion is disposed within a length of the feed roller in a rotational axis direction of the feed roller.

[0017] According to one or more embodiments of the present invention, a length of the protruding portion from the first surface may be one seventh or more and one fourth or less of a radius of the feed roller. For example, if the length of the protruding portion from the first surface is too small (less than one seventh of the radius of the feed roller), a concave-shaped portion (valley fold portion) may be formed on the medium. On the other hand, if the length of the protruding portion from the first surface is too large (larger than one fourth of the radius of the feed roller), creases from peak folding of the medium may remain. Thus, by setting the length of the protruding portion from the first surface to be a value within the range of at least one seventh and no more than one fourth of the radius of the feed roller, creasing of the medium can be effectively prevented.

[0018] According to one or more embodiments of the present invention, an end part on a feed roller side of the protruding portion is disposed below the feed roller in a direction perpendicular to the first surface. Thus, because the feed roller and the end part on the feed roller side of the protruding portion are disposed in close proximity, the part of the medium contacting the feed roller can reach the protruding portion earlier, compared to when the position directly below the feed roller overlapping with the feed roller is not reached. As a result, the formation of concave-shaped portions in the medium due to the feed roller can be more securely prevented beforehand, even when the medium has high rigidity.

[0019] In the image forming apparatus according to one or more embodiments of the present invention, an end part on a feed roller side of the protruding portion may be slanted in a direction approaching the first surface as the end part separates from the second surface. As a result, the end part of the sheet roller side of the protruding portion does not prevent conveyance and placement of the medium (such as sheets) because the angle between the end part of the protruding portion and the first surface is an obtuse angle.

[0020] In the image forming apparatus according to one or more embodiments of the present invention, the protruding portion may contact the second surface.

[0021] In the image forming apparatus according to one or more embodiments of the present invention, the protruding portion may be separated from the second surface by a predetermined interval.

[0022] In the image forming apparatus according to one or more embodiments of the present invention,a length of the protruding portion in a rotational axis direction of the feed roller may be shorter than half a length of the feed roller in the rotational axis direction.

[0023] In such case, for example the image forming apparatus according to one or more embodiments of the present invention may further comprise one or more protruding portions. A plurality of protruding portions may be disposed in the rotational axis direction, and an interval between the protruding portions may be a predetermined interval.

[0024] In the image forming apparatus according to one or more embodiments of the present invention, a length of the protruding portion in a rotational axis direction of the feed roller may be greater than or equal to half a length of the feed roller in the rotational axis direction.

[0025] In the image forming apparatus according to one or more embodiments of the present invention, the blocks may be lined up in the conveyance direction, and a longitudinal direction of the blocks may be the rotational axis direction.

[0026] According to one or more embodiments of the present invention, a corner of the protruding portion may be rounded. As a result, it is possible to feed sheets more smoothly than the protruding portion having a square-shaped corner.

[0027] According to the present invention, an image forming apparatus can help prevent multiple feeding of the medium while also preventing the formation of a concave-shaped portion on the medium from the feed roller.

[Brief Description of Drawings]

[0028]

FIG. 1 is a side view illustrating a pattern of an overall configuration of an image forming apparatus according to one or more embodiments of first to third examples of the present invention.
FIG. 2 is a diagonal-view drawing illustrating a sheet feeder and a conveyor of the image forming apparatus according to one or more embodiments of the first example of the present invention.
FIG. 3 is a partial magnified drawing illustrating a rib, the sheet feed roller, and a friction member of the image forming apparatus according to one or more embodiments of the first example of the present invention.
FIG. 4 is a cross-sectional view along the line 500-500 of FIG. 3.
FIG. 5A is a drawing illustrating an example of prevention of valley folding when feeding sheet according to one or more embodiments of the first example of the present invention.
FIG. 5B is a drawing for illustrating an example of prevention of valley folding when feeding sheet according to a comparative example.
FIG. 6 is a diagonal-view drawing illustrating a sheet feeder and a conveyor of the image forming apparatus according to one or more embodiments of the second example of the present invention.
FIG. 7 is a diagonal-view drawing illustrating a sheet feeder and a conveyor of the image forming apparatus according to one or more embodiments of the third example of the present invention.
FIG. 8 is a partial magnified drawing illustrating a rib, a sheet feed roller, and a friction member of the image forming apparatus according to one or more embodiments of a first modified example of the present invention.
FIG. 9 is a partial magnified drawing illustrating a rib, a sheet feed roller, and a friction member of the image forming apparatus according to one or more embodiments of a second modified example of the present invention.
FIG. 10 is a partial magnified drawing illustrating a block, a sheet feed roller, a friction member of the image forming apparatus according to one or more embodiments of a third modified example of the present invention.
FIG. 11 is a partial magnified drawing illustrating a rib, a sheet feed roller, and a friction member of the image forming apparatus according to one or more embodiments of a fourth modified example of the present invention.

[Detailed Description of Embodiments]

[0029] Embodiments of the present invention will be described below, with reference to the drawings. In embodiments of the invention, numerous specific details are set forth in order to provide a more thorough understanding of the invention. However, it will be apparent to one of ordinary skill in the art that the invention may be practiced without these specific details. In other instances, well-known features have not been described in detail to avoid obscuring the invention.

(First Example)

[0030] A configuration of an image forming apparatus 100 according to one or more embodiments of the first example of the present invention will be described with reference to FIGs. 1 to 4.

(Configuration of Image Forming Apparatus)

[0031] The image forming apparatus 100 according to one or more embodiments of the first example of the present invention includes a housing 1. The image forming apparatus 100 includes a sheet feeder 2, a conveyor 3, and a printing part 4.

[0032] In the description below, the direction in which a sheet P is conveyed over the downstream plane 23a, which is described below, is the forward and backward direction (X direction). Within the forward and backward direction (X direction), the direction in which the conveyed sheet P faces is the forward direction (X1 direction), and the reverse direction is the backward direction (X2 direction). The direction in which the sheet feed roller 22a, which is described later, extends (the axial direction of the sheet feed roller 22a) is the width direction (Y direction, rotational axis direction). The width direction (Y direction) is also a direction orthogonal to the forward and backward direction (X direction) and the vertical direction (Z direction (predetermined direction)) which is the direction of the gravitational field. Within the width direction (Y direction), one direction is the right direction (Y1 direction), and the other direction is the left direction (Y2 direction). The downstream plane 23a is an example of the "second surface" of one or more embodiments of the present invention.

[0033] The housing 1 includes a main body 10, a lid 11, a guide support 14, and a sheet guide 15. The main body 10 is formed in a box shape with the upward direction (Z1 direction) open. The lid 11 may block the open portion of the main body 10. The housing 1 includes a sheet supply aperture 12 and a sheet ejection aperture 13. The sheet supply aperture 12 may be provided on the backward direction end part of the upper side (Z1 direction). The sheet ejection aperture 13 may be provided in the forward direction (X1 direction). The guide support 14 supports the printing part 4. The sheet guide 15 has a triangular shape when viewed from the side (seen from the Y direction). Further, the sheet guide 15 guides the sheet P supplied from upstream (from the sheet feed roller 22a), and directs the sheet P between a pair of conveying rollers 31a, which are described later. The sheet guide 15 is fixed to the guide support 14. A frame for supporting the upper roller of the pair of conveying rollers 31a is provided as one body on the sheet

guide part 15.

(Configuration of Sheet Feeder)

[0034] The sheet feeder 2 includes, as illustrated in FIG. 2, a slanted board part 20, a sheet guide member 21, a sheet feed roller 22a, a supporter 22c for supporting the sheet feed roller 22a via a shaft 22b, a lower board 23, a friction member 24, a sliding member 25, and a rib 26. The rib 26 is positioned downstream in a conveyance direction of the sheet P of the sheet feed roller 22a on a placement plane 20a. The friction member 24 and the sliding member 25 are formed to contact the placement plane 20a and a downstream plane 23a. The rib 26 is an example of the "protruding portion" of one or more embodiments of the present invention. The friction member 24 is an example of the "second supporter" and the "supporter" of one or more embodiments of the present invention. The sliding member 25 is an example of the "first supporter" and the "supporter" of one or more embodiments of the present invention. The placement plane 20a is an example of the "first surface" of one or more embodiments of the present invention. Furthermore, a configuration including the placement plane 20a and the rib 26 is an example of "placement portion" of one or more embodiments of the present invention. Furthermore, a configuration including the friction member 24 and the sliding member 25 is an example of "restriction portion" of one or more embodiments of the present invention.

[0035] The slanted board part 20 is formed in a flat board shape that is slanted in the backward direction (X2 direction) from the downward direction end part 20b to the upward direction end part 20c. The slanted board part 20 includes a placement plane 20a in the forward direction (X1 direction) on which the sheet P is placed. On the placement plane 20a, a stack of a plurality of sheets P (see FIG. 1) is disposed in a diagonal state along the placement plane 20a.

[0036] The sheet guide member 21, in general, is disposed in the left direction (Y2 direction) on the placement plane 20a. The sheet guide member 21 moves in a predetermined range (a range illustrated by the black arrows) in the width direction (Y direction) along the guide groove 21a extending in the width direction (Y direction) provided on the slanted board part 20. The sheet guide member 21 guides the sheet P to a predetermined position (to the standby position before printing begins) by pressing the sheet P disposed on the placement plane 20a on the left side end part.

[0037] The sheet feed roller 22a is disposed opposing the placement plane 20a as illustrated in FIG. 3. For example, the sheet feed roller 22a is disposed such that the entirety of the sheet feed roller 22a is in a position overlapping the placement plane 20a when viewed from the direction orthogonal relative to the placement plane 20a (see the V direction in FIG. 4). The sheet feed roller 22a is disposed on the right side end part (Y1 direction end part) of the placement plane 20a.

[0038] The sheet feed roller 22a feeds the sheet by rotating and moving the uppermost sheet P of the stack. For example, the sheet feed roller 22a has a higher coefficient of friction than the sheet P. As an example, the sheet feed roller 22a is formed of a rubber material or the like. As a result, by beating the friction force between the sheets P with the sheet feed roller 22a, the uppermost sheet P only can be fed.

[0039] The sheet feed roller 22a is supported rotatably by a shaft 22b that acts as the center of rotation. The shaft 22b is formed in a round bar shape extending in the width direction (Y direction). The left side end part (Y2 direction side end part) of the shaft 22b is a free end.

[0040] The right side end part (Y1 direction side end part) of the shaft 22b is connected to the supporter 22c. The supporter 22c is formed as a block shape extending in the vertical direction (Z direction). The supporter 22c is configured rotatably so the upward direction end part leans in the approximately forward direction (X1 direction) with the downward direction end part (not pictured) as the center. The supporter 22c includes a biasing member (not pictured). The biasing member biases the sheet feed roller 22a in the direction pressing against the sheet P (approximately the backward direction (X2 direction)) via the shaft 22b. This allows the sheet feed roller 22a to always maintain a state of contact with the sheet P, regardless of the number of sheets of sheet P.

[0041] The lower board 23 is formed as a flat board shape extending in the horizontal direction (X direction and Y direction). The lower board 23 includes the downstream plane 23a on one side of the upward direction side (Z1 direction side). The downstream plane 23a is positioned downstream of the placement plane 20a. The downstream plane 23a contacts the placement plane 20a at an obtuse angle to each other. That is, the downstream plane 23a extends in the direction (forward direction) of an obtuse angle α (see FIG. 1 and FIG. 4) formed from the downward direction end part 20b of the sheet feed direction of the placement plane 20a to the placement plane 20a. That is, the downstream plane 23a is provided extending from the placement plane 20a so it extends in the forward direction (X1 direction) from the downward direction end part 20b in the sheet feed direction of the placement plane 20a.

[0042] For example, the sheet feeder 2 may include one friction member 24. The friction member 24 may be disposed on the downstream plane 23a separated only a predetermined distance in the left direction (Y2 direction) from the sheet feed roller 22a and the rib 26 in the width direction (Y direction). The friction member 24 includes a pedestal 24a and a friction part 24b. The pedestal 24a includes a function for smoothly sliding the sheet P when feeding sheet, in the same manner as the sliding member 25. The pedestal 24a may include the same configuration as the sliding member 25. That is, the friction member 24 may be configured by placing the friction part 24b on the sliding member 25.

[0043] The pedestal 24a may be attached to the down-

stream plane 23a. The pedestal 24a may be formed in a block shape extending in the forward and backward direction (X direction). The friction part 24b is disposed on the upper plane of the pedestal 24a, and is formed as a long and thin shape extending in the forward and backward direction (X direction). The backward direction end part of the pedestal 24a and the friction part 24b extend until the placement plane 20a. The friction part 24b has a coefficient of friction that is larger than the sliding member 25 and the pedestal 24a. As an example, the friction part 24b is formed from a rubber material.

[0044] As illustrated in FIG. 4, the length of (the upper plane of) the friction part 24b from the placement plane 20a is slightly longer than the length of (the upper plane of) the sliding member 25 from the placement plane 20a. Because of this, the friction part 24b can securely contact the downward direction end part of the sheet P when the sheet P is disposed on the placement plane 20a. That is, the friction member 24 (the friction part 24b) can securely feed just one sheet P (the uppermost sheet P) by contacting the sheet P preceding the sliding member 25. Further, the friction part 24b restricts the movement of the sheet P in the sheet feed direction by friction force when in standby (when not printing). That the function (operation) of the friction part 24b in sheet feeding is described later.

[0045] For example, the sheet feeder 2 may include three sliding members 25, as illustrated in FIG. 2. One of the three sliding members 25 is disposed on the downstream plane 23a on the right direction side (Y1 direction side) of the rib 26 (relative to the rib 26, the opposite side of the side on which the friction member 24 is disposed) in the width direction (Y direction). The other two sliding members 25 are disposed on the left direction side (Y2 direction side) of the friction member 24. The three sliding members 25 and the friction member 24 are disposed on the downstream plane 23a so that the three sliding members 25 and the friction member 24 have substantially the same spacing in the width direction (Y direction).

[0046] The sliding member 25 may be formed in a block shape extending in the forward and backward direction (X direction). The sliding member 25 has a smaller coefficient of friction than the placement plane 20a. The sliding member 25 is configured so that it is possible to smoothly move the sheet P that is fed in the direction of feed, when the sheet is being fed. For example, the sliding member 25 may be formed out of POM (polyacetal).

[0047] For example, the sheet feeder 2 may include three ribs 26. Each of the three ribs 26 may be formed in a convex shape protruding from the placement plane 20a. Further, one end (end part 26a) of the rib 26 is provided in the vicinity directly beneath the sheet feed roller 22a, and the other end is provided in the vicinity of the downstream plane 23a. The rib 26 is disposed downstream of the sheet feed roller 22a in the conveyance direction (C direction). For example, the one end (end part 26a) of the rib 26 is provided downstream directly below the sheet feed roller 22a. The other end of the rib 26 is in contact with the downstream plane 23a. That is, the rib 26 is provided extending from the downstream side directly below the sheet feed roller 22a and contacts the downstream plane 23a. The three ribs 26 are disposed in the width direction (Y direction) within the range where the sheet feed roller 22a is disposed. That is, the width of the three ribs 26 are configured to be a length such that they fit within the width of the sheet feed roller 22a. Further, the three ribs 26 are disposed so that the three ribs 26 have equal spacing in the width direction. The three ribs 26 are disposed on the right direction end part side (Y1 direction end part side) of the placement plane 20a. For example, the three ribs 26 are disposed between the friction member 24 and the sliding member 25. Three ribs 26 may be separated at regular intervals in the width direction. For example, at least two ribs 26 may be disposed in the width direction and an interval between the ribs 26 may be an identical interval (predetermined interval). Furthermore, the rib 26 may be disposed within a length of the sheet feed roller 22a in the rotational axis direction.

[0048] As illustrated in Fig. 3, the overall length of the three ribs 26 in the width direction (Y direction) W1 (the total of the width of the three ribs 26 and the two gaps between the three ribs 26) (that is, a length of the placement plane 20a corresponding to a region on which the ribs 26 are formed) is at least one third of the length W2 of the sheet feed roller 22a in the width direction (Y direction). For example, the length W1 is at least one half of the length W2 of the sheet feed roller 22a in the width direction (Y direction). Each rib 26 is smaller than one half of the length W2 of the sheet feed roller 22a in the width direction. The length W1 is an example of the "length of the protruding portion in the rotational direction" of one or more embodiments of the present invention.

[0049] As illustrated in FIG. 4, the height H of the rib 26 from the placement plane 20a is fixed. The height H of the rib 26 from the placement plane 20a is at least one seventh of the radius R of the sheet feed roller 22a and at most one fourth. The predetermined range that defines the height H of the rib 26 can help prevent bends in the sheet P when feeding it, through setting the right height H to the rib 26 in the predetermined range.

[0050] In the present specification and as illustrated in FIG. 4, the direction orthogonal to the placement plane 20a is the V direction. The end part 26a of the rib 26 is disposed in a position directly below the sheet feed roller 22a and the sheet feed roller 22a when looking from the V direction. That is, the end part 26a of the rib 26 is disposed within a range of positions separated only by distance radius R of the sheet feed roller 22a downstream in the conveyance direction of the sheet P from the contact point Q between the placement plane 20a and the sheet feed roller 22a in the diagonal direction (C direction). The end part 26a may be slanted in a direction approaching the downstream plane 23a as the end part 26a separates from the placement plane 20a.

[0051] The end part 26a of the rib 26 forms an acute

angle β with the placement plane 20a so as not to block the placement of sheet P.

(Configuration of Conveyor)

[0052] As illustrated in FIG. 1, the conveyor 3 includes a path 30 that the sheet P is conveyed over, and conveying rollers 31a and 31b for conveying the sheet P inside the path 30.

[0053] The path 30 extends in the forward and backward direction (X direction) to connect the forward direction end part of the sheet feeder 2 (lower board part 23) with the sheet ejection aperture 13. The path 30 passes through the printing part 4 while the sheet P is being conveyed.

[0054] The conveying roller 31a and 31b are each disposed upstream (X2 direction) and downstream (X1 direction) of the print part 4. The conveying rollers 31a and 31b are disposed as a pair so that they face each other in the direction orthogonal relative to the sheet P that is conveyed (the vertical direction). The pair of conveying rollers 31a and 31b are each configured to convey (eject) the sheet P toward the sheet ejection aperture 13 by holding the sheet P between them and rotating in a predetermined direction.

(Configuration of Printing Unit)

[0055] The print part 4 performs printing (to form an image) on the sheet P. For example, the print part 4 includes an ink cartridge (not pictured). The print part 4 is configured to move the ink cartridge back and forth over a predetermined range corresponding to the width direction (Y direction) of the sheet P. The ink cartridge deposits ink a tiny amount at a time while moving back and forth relative to the sheet P conveyed by the conveyor 3.

(Preventing valley folding of the sheet)

[0056] Next, with reference to FIG. 5, prevention of valley folding of the sheet while feeding is described by comparing a first example having a rib 26 (see FIG. 5A) and a comparative example not having a rib (see FIG. 5B). The configuration of the comparative example is a configuration wherein the rib has been removed from the configuration of one or more embodiments of the first example of the present invention (the configuration other than the rib is the same).

[0057] In the comparative example illustrated in FIG. 5B, the portion of the sheet that contacts the sheet feed roller is moved in the sheet feed direction by the rotation of the sheet feed roller. At this time, the movement of the downward direction end part of the sheet is restricted because the downward direction end part of the sheet is in contact with the friction member. This causes an expansion warp (a peak fold warp) in the forward direction (X1 direction) in the vicinity of the contact portion of the sheet and the friction member (friction part). Then, along with the formation of an expansion warp in the forward direction (X1 direction) in the vicinity of the contact portion of the sheet and the friction member, an expansion warp (valley fold warp) is caused in the reverse direction (backward direction) on the part of the sheet between the friction member and the sliding member. Then, due to the valley fold warp, the downward direction end part of the sheet may stop moving. That is, the sheet may not be released from the restriction of the friction member. In this case, the sheet will jam.

[0058] Next, in one or more embodiments of the first example of the present invention illustrated in FIG. 5A, it is the same as the comparative example until the expansion warp is caused in the forward direction (X1 direction) in the vicinity of the contact part of the sheet and the friction member 24. Then, in contrast to the comparative example, in the portion of the sheet P between the friction member 24 and the sliding member 25, because a rib 26 is provided on the reverse direction (backward direction) side of the sheet P, the expansion warp (valley fold warp) in the reverse direction (backward direction) of the sheet P is restricted by the rib 26. As a result, even in the vicinity of the rib 26 of the sheet P, an expansion warp (peak fold warp) in the forward direction (X1 direction) is caused. Then, at the point where the warp of the sheet P has reached a predetermined amount, the downward direction end part of the sheet P beats the friction force of the friction member 24, and the sheet is released from the restriction of the friction member 24 and fed by popping up in the forward direction (X1 direction).

(Effect of the First Example)

[0059] The following effects can be obtained from one or more embodiments of the first example of the present invention.

[0060] In one or more embodiments of the first example of the present invention, as described above, the rib 26 is disposed downstream in the conveyance direction of the sheet feed roller 22a on the placement plane 20a and is disposed to be positioned between the sliding member 25 and the friction member 24 in the width direction (rotational axis direction) on the downstream plane 23a (the rib 26 is disposed to be interposed between the sliding member 25 and the friction member 24). Because of the rib 26, the predetermined deformation of the sheet P that accompanies sheet feeding by the sheet feed roller 22a can be prevented, which in turn helps prevent sheet jamming via the rib 26 and multiple feeding by the friction member 24.

[0061] In one or more embodiments of the first example of the present invention, as described above, the sheet feeder 2 includes the sliding member 25 and the friction member 24 having the larger coefficient of friction than the coefficient of friction of the sliding member 25. Furthermore, the rib 26 is disposed between the sliding member 25 and the friction member 24. As a result, the rib 26 may prevent sheet jamming, while the friction of the fric-

tion member 24 helps prevent multiple feeding.

[0062] In one or more embodiments of the first example of the present invention, the coefficient of friction of the sliding member 25 is made smaller than the coefficient of friction of the placement plane 20a. This leads to smooth conveying of the sheet P that contacts the sliding member 25 when feeding, and sheet jamming can be prevented.

[0063] In one or more embodiments of the first example of the present invention, the sheet feed roller 22a and rib 26, and the friction member 24 are each disposed on one end side of the width direction (rotational axis direction) in the placement plane 20a and the downstream plane 23a. This allows the sheet feed roller 22a to be configured as a cantilever shape, and the device configuration can be simplified.

[0064] In one or more embodiments of the first example of the present invention, the length of the friction member 24 from the downstream plane 23a may be longer than the length of the sliding member 25 from the downstream plane 23a. As a result, the sheet P can be made to contact the friction member 24 preceding the sliding member 25, multiple feeding of the sheet P can be better prevented by the friction force of the friction member 24 relative to the sheet P.

[0065] In one or more embodiments of the first example of the present invention, the length W1 of a region on which the rib 26 is formed on the placement plane 20a (the overall region on which the rib 26 is provided) in the width direction (rotational axis direction) of the sheet feed roller 22a is at least one third of the length W2 of the sheet feed roller 22a in the width direction. As a result, compared to a case where the overall length W1 of the rib 26 in the width direction is comparatively small (when the overall length W1 of the rib 26 in the width direction (the length of the region on which the rib 26 is formed on the placement plane 20a) is less than one third of the size of the sheet feed roller in the width direction), this allows the rib 26 to be made to contact the sheet P in a wider range. This allows the formation of concave-shaped portions (valley fold portions) in the sheet P due to the sheet feed roller 22a to be more effectively prevented beforehand. This also helps prevent sheet jamming more effectively.

[0066] In one or more embodiments of the first example of the present invention, the rib 26 is disposed above the sheet feed roller 22a in the conveyance direction. Because the rib 26 is disposed on the downstream side directly below the sheet feed roller 22a, where concave-shaped portions (valley fold portions) are formed easily in the sheet P, the formation of concave-shaped portions in the sheet P due to the sheet feed roller 22a can be more effectively prevented beforehand, and sheet jamming can also be more effectively prevented.

[0067] In one or more embodiments of the first example of the present invention, the length of the rib 26 from the placement plane 20a is at least one seventh of the radius of the sheet feed roller 22a and no more than one fourth. If the length of the rib 26 from the placement plane 20a is too short (less than one seventh of the radius of the sheet feed roller 22a), a (valley fold portion) may be formed on the sheet P. On the other hand, if the length of the rib 26 from the placement plane 20a is too long (longer than one fourth of the radius of the sheet feed roller 22a), creases from peak folding of the sheet P may remain. Thus, by setting the length of the rib 26 from the placement plane 20a to be a value within the range of at least one seventh and no more than one fourth of the radius of the sheet feed roller 22a, creasing of the sheet P can be effectively prevented. The predetermined range for defining the height of the rib 26 is a range obtained experimentally.

[0068] In one or more embodiments of the first example of the present invention, the end part 26a on the sheet feed roller 22a side of the rib 26 is disposed in a position directly below the sheet feed roller 22a so it overlaps with the sheet feed roller 22a, when viewing from a direction orthogonal to the placement plane 20a. Because the sheet feed roller 22a and the end part 26a on the sheet feed roller 22a side of the rib 26 are disposed in close proximity, the part of the sheet P contacting the sheet feed roller 22a can reach the rib 26 at a faster step, compared to when the position directly below the sheet feed roller 22a overlapping with the sheet feed roller 22a is not reached. As a result, the formation of concave-shaped portions in the sheet P due to the sheet feed roller 22a can be more securely prevented beforehand, even when the sheet P has high rigidity.

[0069] In one or more embodiments of the first example of the present invention, as above, the end part 26a on the sheet feed roller 22a side of the rib 26 may be slanted in a direction approaching the placement plane 20a as being separated from the downstream plane 23a. As a result, because the angle between the end part 26a of the rib 26 and the placement plane 20a becomes the obtuse angle, the end part 26a of the sheet feed roller 22a side of the rib 26 does not prevent conveyance and placement of the sheet P.

(Second Example)

[0070] Next, embodiments of a second example of the present invention will be described with reference to FIG. 1 through FIG. 6. In one or more embodiments of the second example of the present invention, as opposed to one or more embodiments of the first example of the present invention where the rib 26 and the sheet feed roller 22a were disposed in the vicinity of the right direction end part of the placement plane 20a in the width direction (Y direction), an example will be described where a rib 226 and a sheet feed roller 222a are disposed in the vicinity of the center of the placement plane 20a. The configurations that are the same as in one or more embodiments of the first example of the present invention are given the same symbols as one or more embodiments of the first example of the present invention, and

their description is omitted. The rib 226 is an example of the "protruding portion" of one or more embodiments of the present invention.

(Configuration of Sheet Feeder)

[0071] As illustrated in FIG. 6, in an image forming apparatus 200 (see FIG. 1) according to one or more embodiments of the second example of the present invention, the sheet feeder 202 includes two sheet feed rollers 222a, a rib 226, a friction member 224, and a sheet guide member 221. The two sheet feed rollers 222a, the rib 226, and the friction member 224 are disposed in the vicinity of the center of the placement plane 20a in the width direction (Y direction). The friction member 224 is an example of the "second supporter" of one or more embodiments of the present invention.

[0072] The two sheet feed rollers 222a are disposed with a predetermined gap between them in the width direction (Y direction). The rib 226 is disposed in the center of the two sheet feed rollers 222a so as to be sandwiched by the two sheet feed rollers 222a. The friction member 224 is disposed on the left direction side (Y2 direction side) of the rib 226 in the width direction (Y direction).

[0073] The sheet guide member 221 is provided as a pair on the left and right sides. The pair of sheet guide members 221 are configured to be able to move a predetermined range (the range illustrated by the arrow in FIG. 6) in the width direction (Y direction) along a guide groove 221a extending in the width direction (Y direction) provided on the slanted board part 20. The pair of sheet guide members 221 each guide the sheet P to a predetermined position (the standby position before starting printing) by pressing against the left side end part and the right side end part of the sheet P (see FIG. 1) disposed on the placement plane 20a.

(Effect of the Second Example)

[0074] The results like those given below can be obtained from one or more embodiments of the second example of the present invention.

[0075] In one or more embodiments of the second example of the present invention, in the same manner as in one or more embodiments of the first example of the present invention, the rib 226 is disposed between the sheet feed roller 222a and the downstream plane 23a on the placement plane 20a, and is disposed between the sliding member 25 and the friction member 224 in the width direction (rotational axis direction) on the downstream plane 23a. This allows multiple feeding of the sheet P to be prevented while also preventing the formation of concave-shaped portions on the sheet P from the sheet feed roller 222a. The friction member 224 is an example of the "second supporter" of one or more embodiments of the present invention.

[0076] In one or more embodiments of the second example of the present invention, the sheet feed roller 222a is disposed in the vicinity of the center in the width direction of the placement plane 20a. This allows sheet feeding to be performed by contacting the sheet feed roller 222a to the vicinity of the center of a variety of sizes of the sheet P, in the width direction Thus, the sheet P can be fed in a stable state.

(Third Example)

[0077] Next, embodiments of a third example of the present invention are described with reference to FIG. 1 through FIG. 7. In one or more embodiments of the third example of the present invention, as opposed to one or more embodiments of the second example of the present invention where the shaft 22b was configured as a cantilever beam, an example wherein the shaft 322b is configured as a double-end supported beam is described. The configurations that are the same as in one or more embodiments of the second example of the present invention are given the same symbols as one or more embodiments of the second example of the present invention, and their description is omitted.

(Configuration of the Image Forming Apparatus)

[0078] As illustrated in FIG. 7, an image forming apparatus 300 (see FIG. 1) according to one or more embodiments of the third example of the present invention, a sheet feeder 302 includes two sheet feed rollers 222a, a supporter 22c for supporting via the shaft 22c and 322c. That is, both ends of the shaft 322b are each supported by the supporter 22c and 322c.

[0079] For example, the right direction side end part (Y1 direction side end part) of the shaft 322b is supported by the supporter 22c. The left direction side end part (Y2 direction side end part) of the shaft 322b is supported by the supporter 322.

(Effect of the Third Example)

[0080] The results like those given below can be obtained from one or more embodiments of the third example of the present invention.

[0081] In one or more embodiments of the third example of the present invention, in the same manner as in one or more embodiments of the second example of the present invention, the rib 226 is disposed between the sheet feed roller 222a and the downstream plane 23a on the placement plane 20a, and also, on the downstream plane 23a, in the width direction which is the rotation axis direction of the sheet feed roller 222a, is disposed between the sliding member 25 and the friction member 224. This helps prevent multiple feeding of the sheet P as well as the formation of concave-shaped portions on the sheet P from the sheet feed roller 222a.

[0082] In one or more embodiments of the third example of the present invention, the shaft 322b that supports the sheet feed roller 222a is configured as a double-end

supported beam. Compared to image forming apparatuses with a cantilever beam, they can support the sheet feed roller 222a and keep it steady, so stable sheet feeding can be performed.

(Modified Examples)

[0083] The examples disclosed here are examples at every point, and should not be thought of as limiting. The scope of the present invention is shown by the scope of patent claims, and not by the description of the examples, and further, it includes all average meanings within the scope of patent claims and all changes within gather range (modified examples).

[0084] In one or more embodiments of the first through third examples of the present invention above, examples were illustrated wherein the image forming apparatus included a sliding member, but the present invention is not limited to this. In the present invention, the image forming apparatus may not include a sliding member.

[0085] In one or more embodiments of the first through third examples of the present invention above, examples were illustrated wherein the protruding portion of the present invention was a rib (a relatively narrow protruding portion), but the present invention is not limited to this. In the present invention, the protruding portion of the present invention may be made a relatively wide protruding portion.

[0086] In one or more embodiments of the first through third examples of the present invention above, examples were illustrated with three ribs provided, by the patent is not limited to this. In the present invention, one rib, two, or four or more may be provided.

[0087] In one or more embodiments of the first through third examples of the present invention above, examples were shown where the width (overall width) in the Y direction (sideways direction) of the rib was made smaller than the width in the Y direction of the sheet supply roller, but the present invention is not limited to this. In the present invention, the Y direction width (overall width) of the rib may be bigger than the width of the sheet feed roller in the Y direction.

[0088] In one or more embodiments of the first through third examples of the present invention above, examples were illustrated where the height of the rib from the placement plane was a predetermined value between one seventh and one fourth of the radius of the sheet feed roller, but the present invention is not limited to this. In the present invention, the height of the rib from the placement plane may be less than one seventh, and higher than one fourth of the sheet feed roller.

[0089] In one or more embodiments of the first through third examples of the present invention above, examples were illustrated where the end part of the downstream side of the rib were provided to extend to the downstream plane, but the present invention is not limited to this, and as in one or more embodiments of a first modified example of the first example of the present invention illustrated in FIG. 8, the end part 26b of the downstream side of the rib 126 may be provided at a position separate from the downstream plane 23a. The end part 26b is disposed on the side closer to the sheet feed roller 22a than the friction part 24b of the friction member 24, in the C direction. The distance D between the friction part 24b and the end part 26b in the C direction is no more than 2 mm. The rib 126 is an example of a "protruding portion" of one or more embodiments of the present invention.

[0090] In one or more embodiments of the first through third examples of the present invention, examples were shown where the rib was provided extending toward the downstream side (in the C direction) from the upstream side, but the present invention is not limited to this, and as in one or more embodiments of a second modified example of the first example of the present invention illustrated in FIG. 9, the block 126a corresponding to the rib 126 may be provided extending in the width direction (Y direction). There may be three blocks 126a. The three blocks 126a are disposed to line up with predetermined gaps in the C direction (conveyance direction). The size of the width direction (Y direction) of the block 126a is substantially the same size as the size W1 of the main body of the three protruding portions 26 of one or more embodiments of the first example of the present invention illustrated in FIG. 3. Among the three blocks 126a, the end part 26b on the downstream side of the most downstream block 126a is disposed on the side closer to the sheet feed roller 22a than the friction part 24b of the friction member 24. Further, the distance D between the friction part 24b and the end part 26b in the C direction is no more than 2 mm. The block 126a is an example of the "protruding portion" of one or more embodiments of the present invention.

[0091] Furthermore, while in one or more embodiments of the first through third examples of the present invention, examples wherein the protruding portion of the present invention was formed in a rib shape (was made a rib) were illustrated, but the present invention is not limited to these, and as in one or more embodiments of a third modified example of the first example of the present invention illustrated in FIG. 10, the protruding portion of the present invention may be formed as a block shape (as the block 126b). The end part 26c of the downstream side of the block 126b extends until the downstream plane 23a.

[0092] Furthermore, both end planes in the width direction (Y direction) of the block 126b, and a plane 26d that is parallel to the placement plane 20a of the block 126b, are connected by a rounded R shape.

[0093] The plane of end part 26a on the upstream side of the block 126b and the plane 26d are connected by a rounded R shape. In essence, the block 126b has a roundedness to it overall.

[0094] The block 126b is configured as one body with the slanted board part 20. The size of the block 126b in the width direction is at least one half of the length W2 of the sheet feed roller 22a. The block 126b may be con-

figured as a separate part from the slanted board part 20, and may be configured to be attachable and removable relative to the slanted board part 20. In detail, the block 126b may be configured to be attachable and removable from the slanted board part 20 by providing to each of the block 126b and the slanted board part 20 an engagement part for engaging each other and an engaged part (not pictured). At this point, the coefficient of friction of the block 126b relative to the sheet can be adjusted by forming it from a different material than the slanted board part 20, or out of a member of different surface shape. The block 126b is an example of the "protruding portion" of one or more embodiments of the present invention.

[0095] In FIG. 10, an example is illustrated wherein the end part 26c of the downstream side of the block 126b extends until the downstream plane 23a, but the present invention is not limited to this, and the end part 26c of the downstream side of the block 126c may be provided at a position apart from the downstream plane 23a, as in one or more embodiments of the fourth variation of the first example of the present invention illustrated in FIG. 11. The block 126c is an example of the "protruding portion" of one or more embodiments of the present invention.

[Explanation of References]

[0096]

20a Placement Plane (First Surface)
22a, 222a Sheet Feed Roller (Feed Roller)
23a Downstream Surface (Second Surface)
24, 224 Friction Member (Second Supporter, Supporter, Restriction Portion)
25 Sliding Member (First Supporter, Supporter, Restriction Portion)
26, 126, 126a, 226 Rib (Protruding Portion)
26a End Part
100, 200, 300 Image Forming Apparatus
126b, 126c Block Part (Protruding Portion)

Claims

1. An image forming apparatus, comprising:

a placement portion that include a first surface (20a) on which a medium (P) is placed and a protruding portion (26, 126, 126a, 226);
a feed roller (22a, 222a) that opposes the placement portion;
a second surface (23a) that forms an obtuse angle with the first surface; and
a restriction portion disposed downstream of the feed roller (22a, 222a) in a conveyance direction on the placement portion and that restricts movement of the medium (P) to a predetermined direction, wherein
the protruding portion (26, 126, 126a, 226) is disposed between the feed roller (22a, 222a) and the restriction portion.

2. The image forming apparatus according to claim 1, further comprising one or more restriction portions, wherein the restriction portions comprise supporters (24, 224, 25) that support the medium (P) placed on the placement portion.

3. The image forming apparatus according to claim 2, wherein

the supporters comprise a first supporter (25) and a second supporter (24, 224),
a second friction coefficient of the second supporter (24, 224) is larger than a first friction coefficient of the first supporter (25), and
the protruding portion (26, 126, 126a-c, 226) is disposed between the first supporter (25) and the second supporter (24, 224).

4. The image forming apparatus according to claim 3, wherein the first friction coefficient is smaller than a friction coefficient of the first surface (20a).

5. The image forming apparatus according to claim 3 or 4, wherein the feed roller (22a), the protruding portion (26, 126, 126a-c), and the second supporter (24) are disposed on one end-part side in a rotational axis direction of the feed roller on the first surface (20a) and the second surface (23a).

6. The image forming apparatus according to any one of claims 3 to 5, wherein a length of the second supporter (24, 224) from the second surface (23a) is greater than a length of the first supporter (25) from the second surface.

7. The image forming apparatus according to any one of claims 1 to 6, wherein a length (W1) of a region on which the protruding portion (26, 126, 126a-c, 226) is formed on the first surface in a rotational axis direction of the feed roller is at least one third of a length (W2) of the feed roller (22a, 222a) in the rotational axis direction.

8. The image forming apparatus according to any one of claims 1 to 7, wherein the protruding portion (26, 126, 126a-c, 226) is disposed within a length of the feed roller (22a, 222a) in a rotational axis direction of the feed roller.

9. The image forming apparatus according to any one of claims 1 to 8, wherein a length (H) of the protruding portion from the first surface (20a) is one seventh or more and one fourth or less of a radius (R) of the

feed roller (22a, 222a).

10. The image forming apparatus according to any one of claims 1 to 9, wherein an end part (26a) on a feed roller side of the protruding portion is disposed below the feed roller in a direction perpendicular to the first surface (20a).

11. The image forming apparatus according to any one of claims 1 to 10, wherein an end part (26a) on a feed roller side of the protruding portion is slanted in a direction approaching the first surface (20a) as the end part separates from the second surface (23a).

12. The image forming apparatus according to any one of claims 1 to 11 wherein

a length of the protruding portion (26, 126, 226) in a rotational axis direction of the feed roller is shorter than half a length (W2) of the feed roller in the rotational axis direction.

13. The image forming apparatus according to any one of claims 1 to 12, further comprising protruding portions, wherein the protruding portions (26, 126, 226) are disposed in the rotational axis direction, and an interval between the protruding portions is a predetermined interval.

14. The image forming apparatus according to any one of claims 1 to 11, wherein

a length of the protruding portion (126a-c) in a rotational axis direction of the feed roller is greater than or equal to half a length (W2) of the feed roller in the rotational axis direction.

15. The image forming apparatus according to claim 14, further comprising one or more protruding portions, wherein

the protruding portions (126a) are lined up in the conveyance direction, and
a longitudinal direction of the protruding portions is the rotational axis direction.

FIG. 1

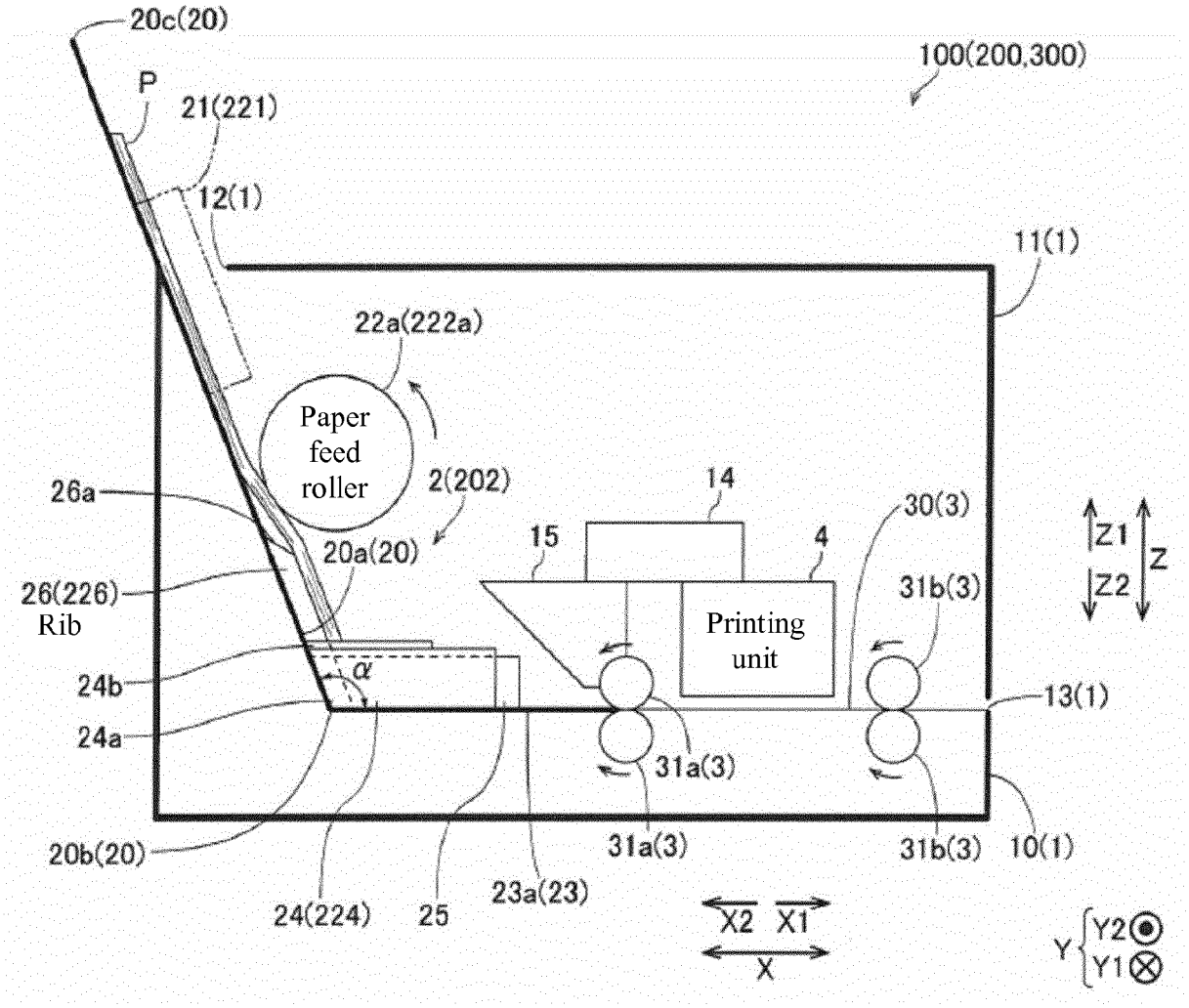
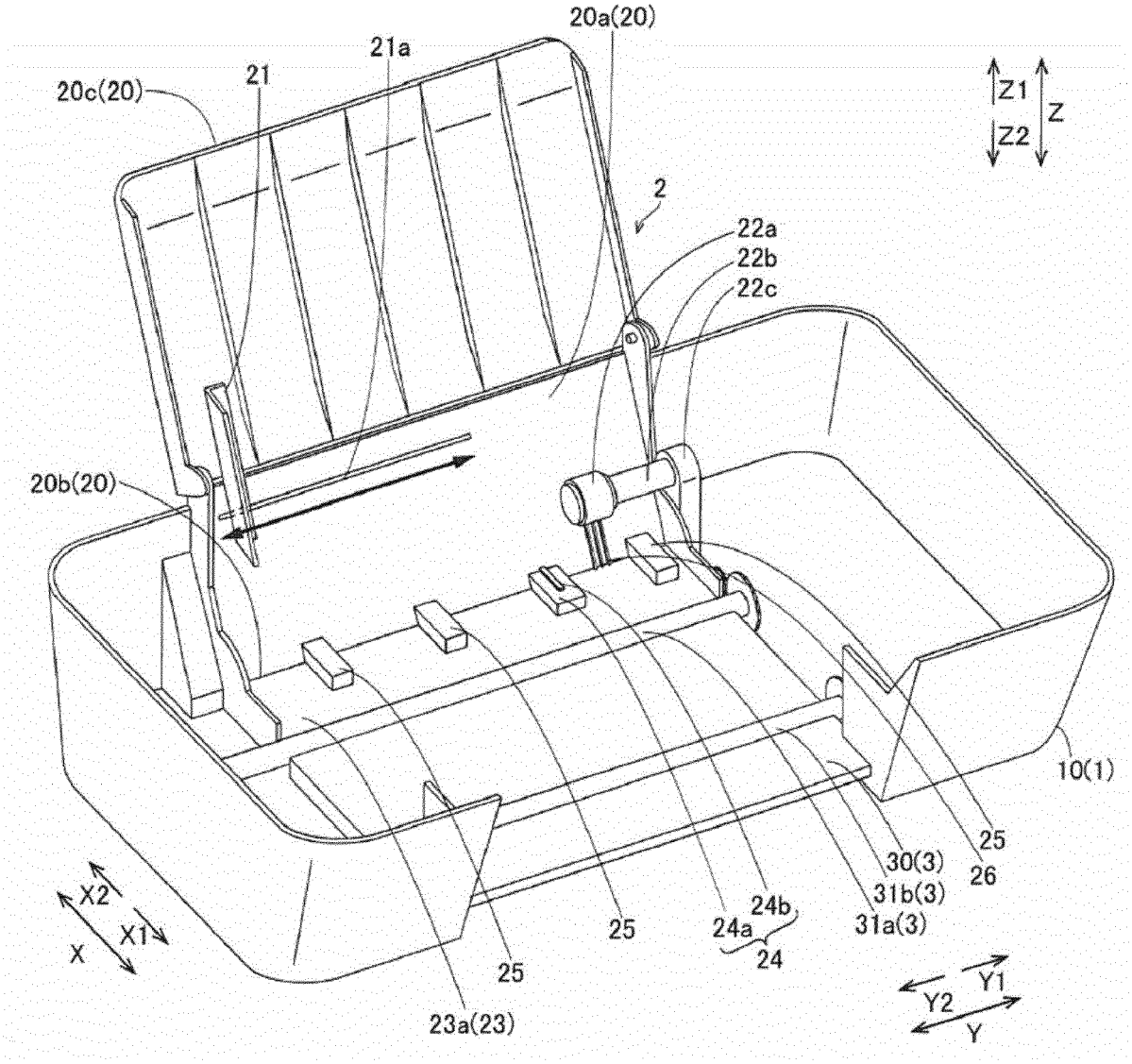

20c(20)
P
21(221)
12(1)
100(200,300)
11(1)
22a(222a)
Paper feed roller
2(202)
26a
20a(20)
14
15
4
30(3)
26(226)
Rib
Printing unit
31b(3)
Z1
Z2
Z
24b
α
24a
13(1)
31a(3)
20b(20)
31a(3)
31b(3)
10(1)
24(224)
25
23a(23)
X2
X1
X
Y
Y2
Y1

FIG. 2


20a(20)
21a
20c(20)
21
Z1
Z2
Z
2
22a
22b
22c
20b(20)
10(1)
25
30(3)
26
31b(3)
24b
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X2
X1
X
Y1
Y2
Y
23a(23)

FIG. 3

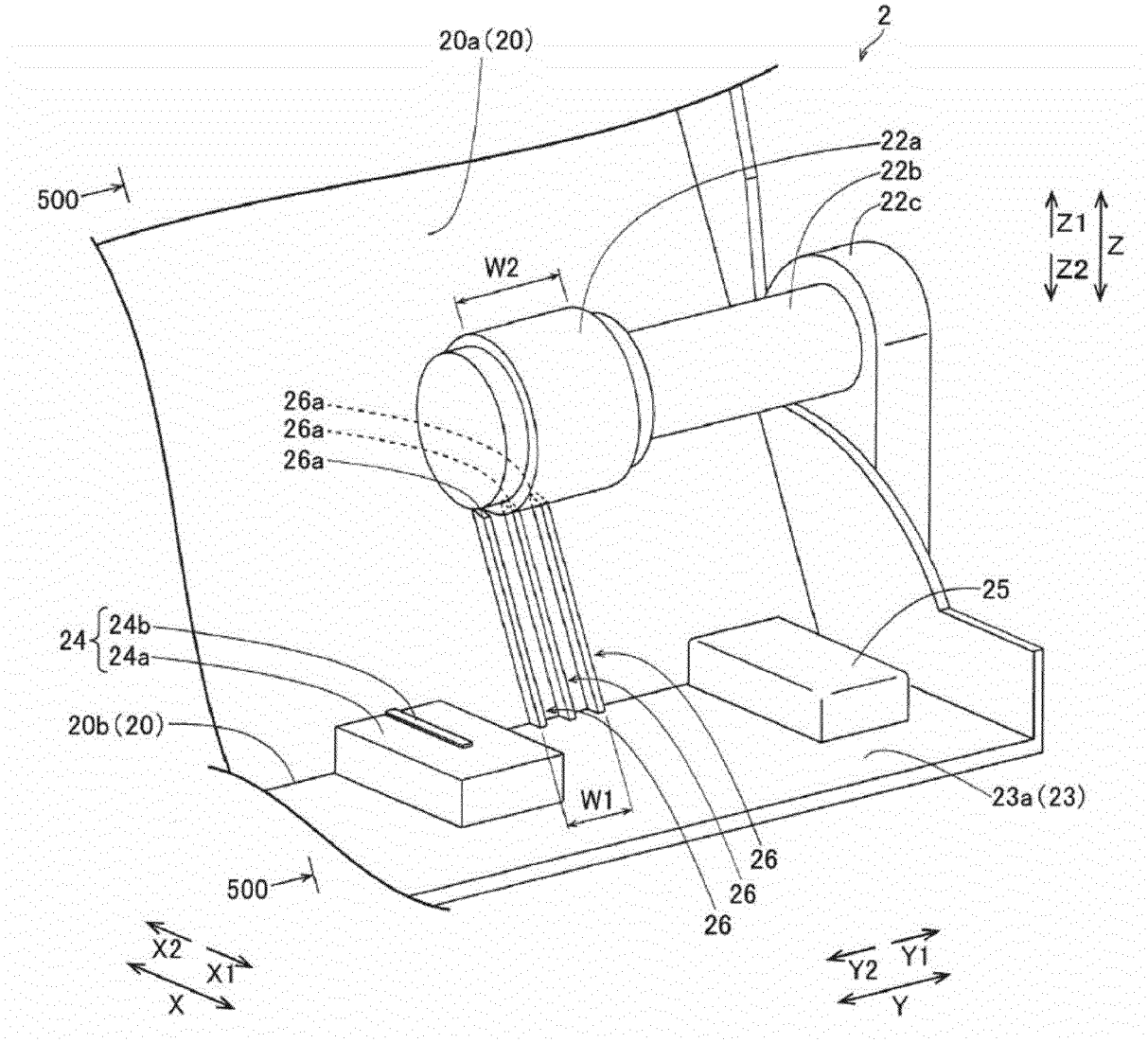

2
20a(20)
22a
22b
22c
500
Z1
Z2
Z
W2
26a
26a
26a
25
24
24b
24a
20b(20)
W1
23a(23)
26
26
26
500
X2
X1
X
Y2
Y1
Y

FIG. 4

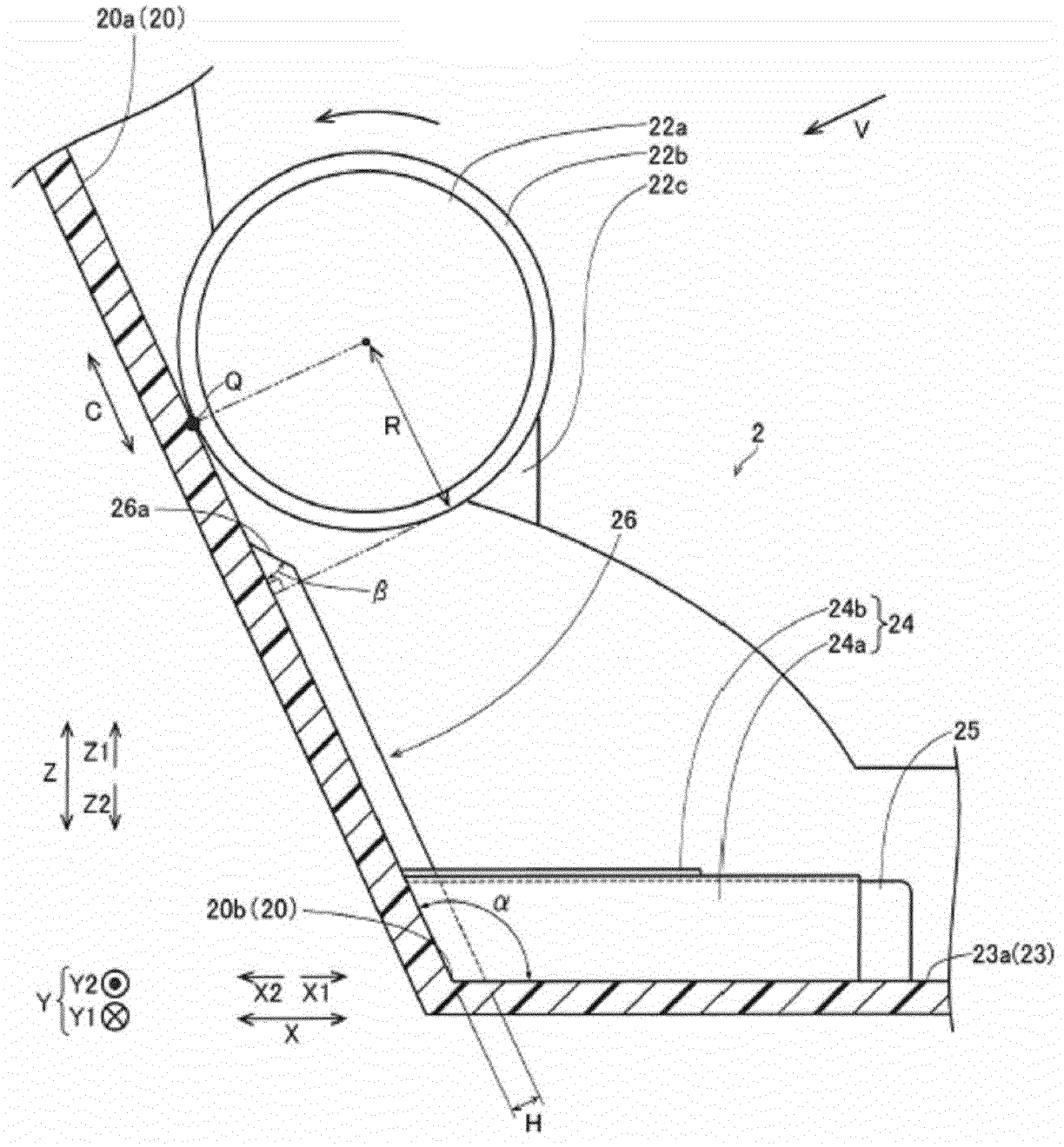

20a (20)
22a
22b
22c
V
Q
C
R
2
26a
26
β
24b
24a
24
25
Z
Z1
Z2
20b (20)
α
23a(23)
Y
Y2
Y1
X2
X1
X
H

FIG. 5A

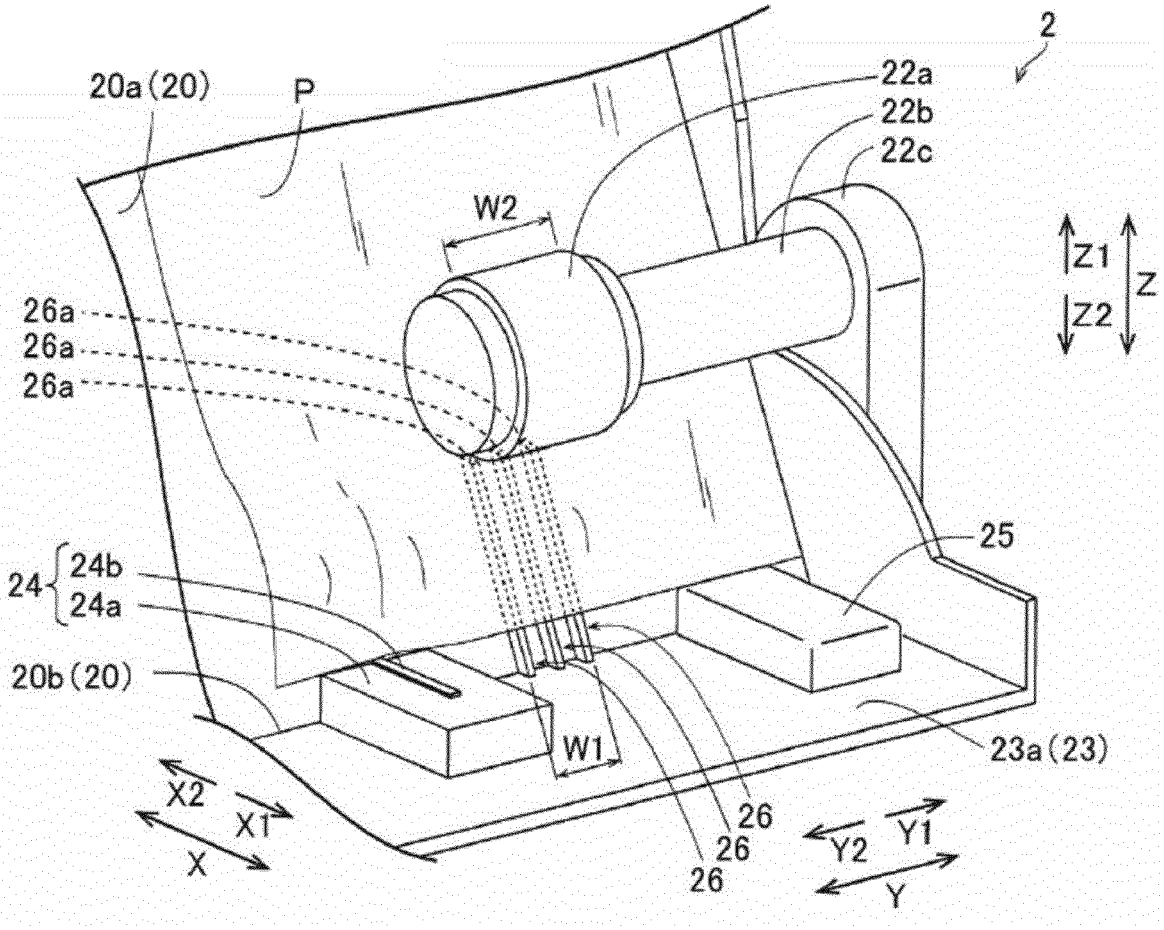

2
20a(20)
P
22a
22b
22c
W2
Z1
Z2
Z
26a
26a
26a
24
24b
24a
25
20b(20)
W1
23a(23)
X2
X1
X
26
26
26
Y2
Y1
Y

FIG. 5B

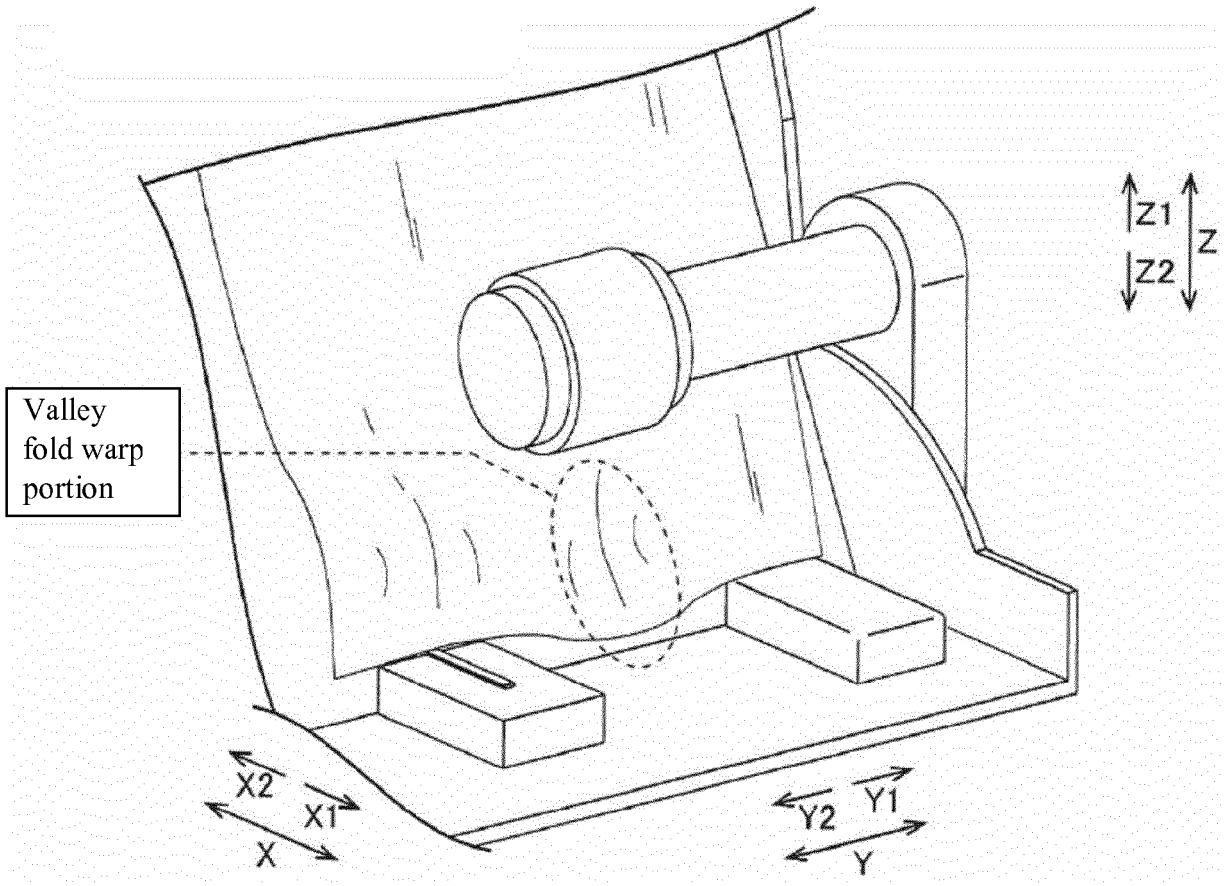


FIG. 6

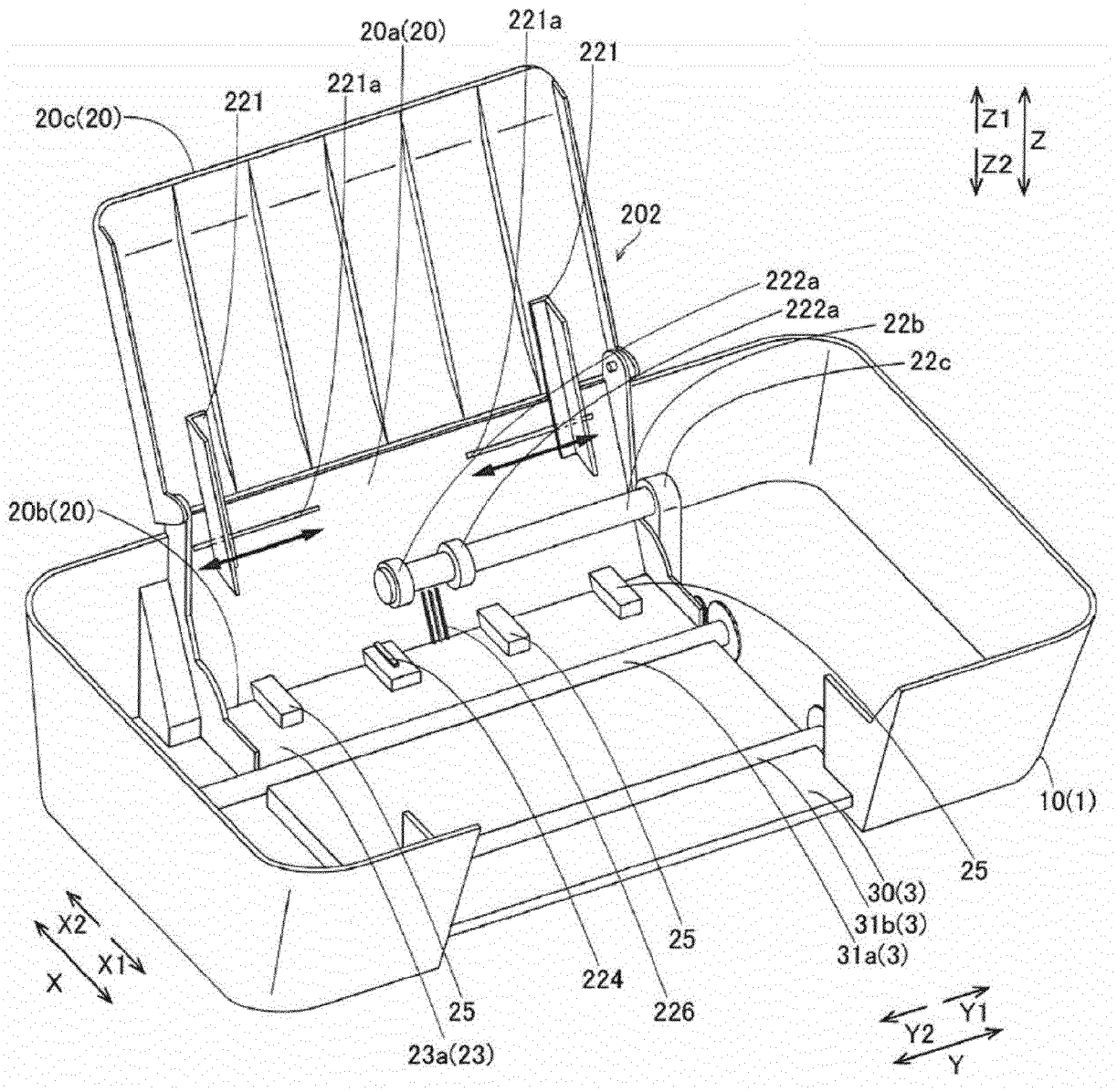

20a(20)
221a
221
221a
221
20c(20)
Z1
Z2
Z
202
222a
222a
22b
22c
20b(20)
10(1)
25
30(3)
31b(3)
31a(3)
25
224
226
25
23a(23)
X2
X1
X
Y1
Y2
Y

FIG. 7

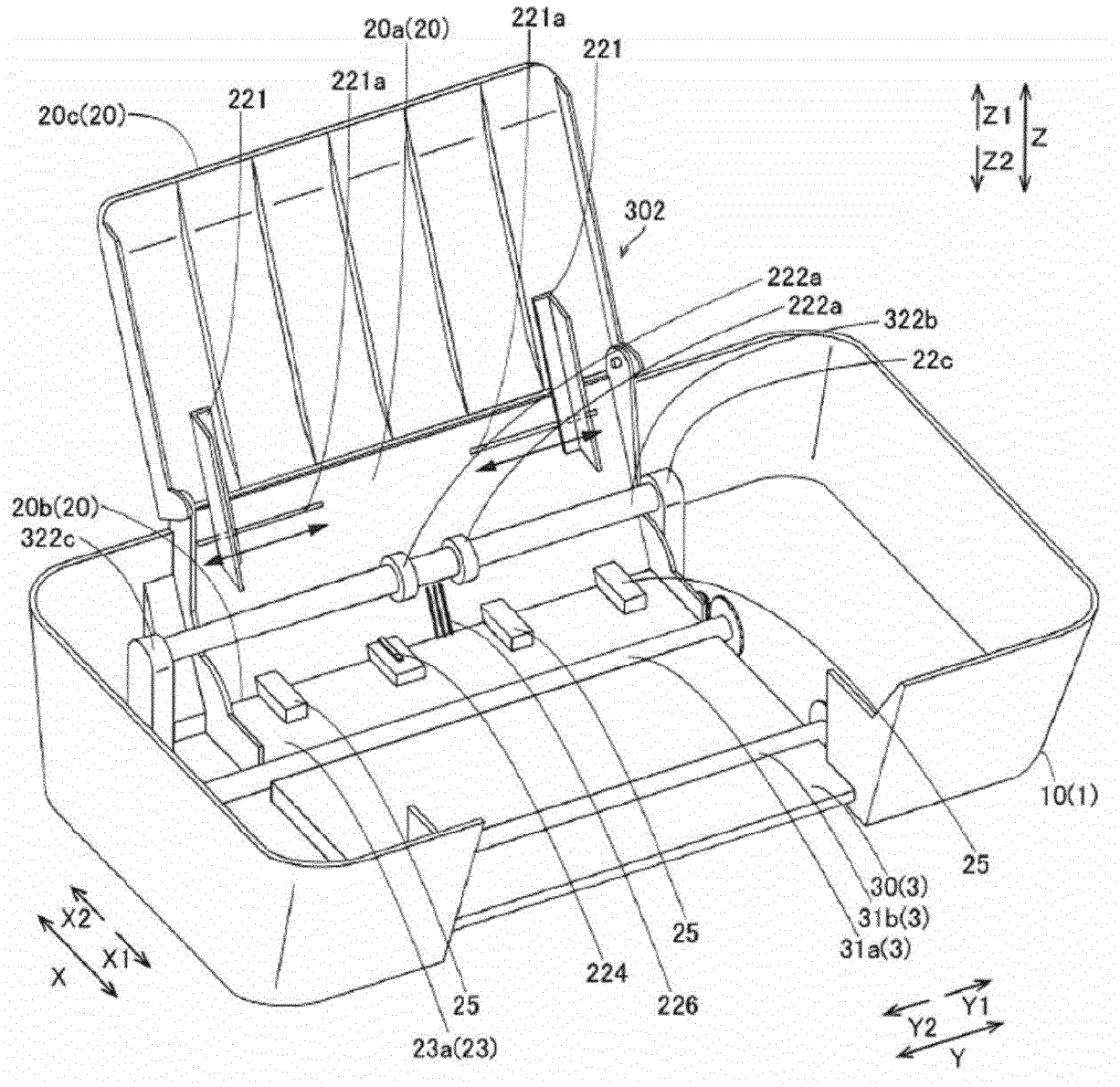

20a(20)
221a
221
221a
221
20c(20)
Z1
Z2
Z
302
222a
222a
322b
22c
20b(20)
322c
10(1)
25
30(3)
31b(3)
31a(3)
25
224
226
25
23a(23)
X2
X1
X
Y1
Y2
Y

FIG. 8

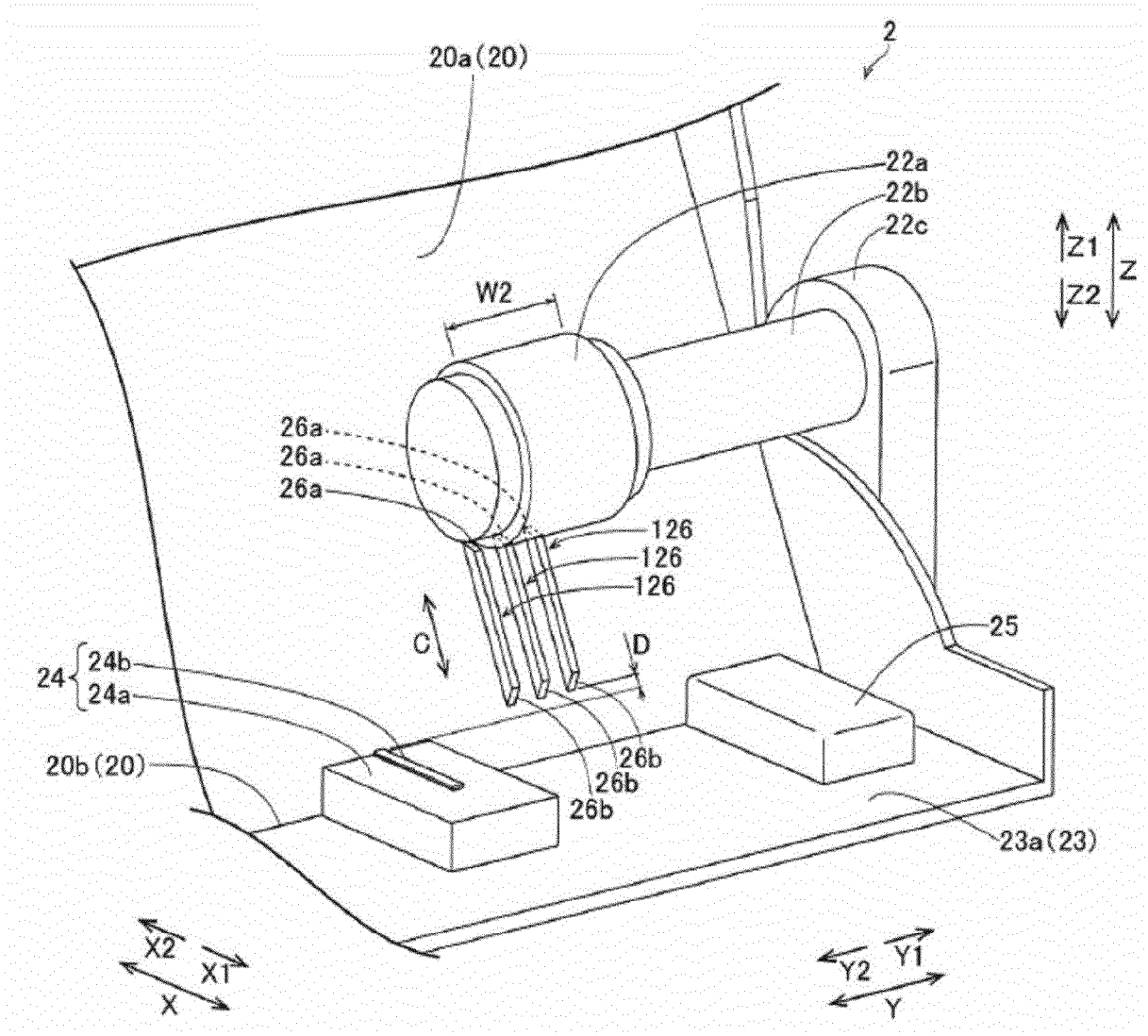

2
20a(20)
22a
22b
22c
Z1
Z2
Z
W2
26a
26a
26a
126
126
126
C
D
25
24
24b
24a
20b(20)
26b
26b
26b
23a(23)
X2
X1
X
Y2
Y1
Y

FIG. 9

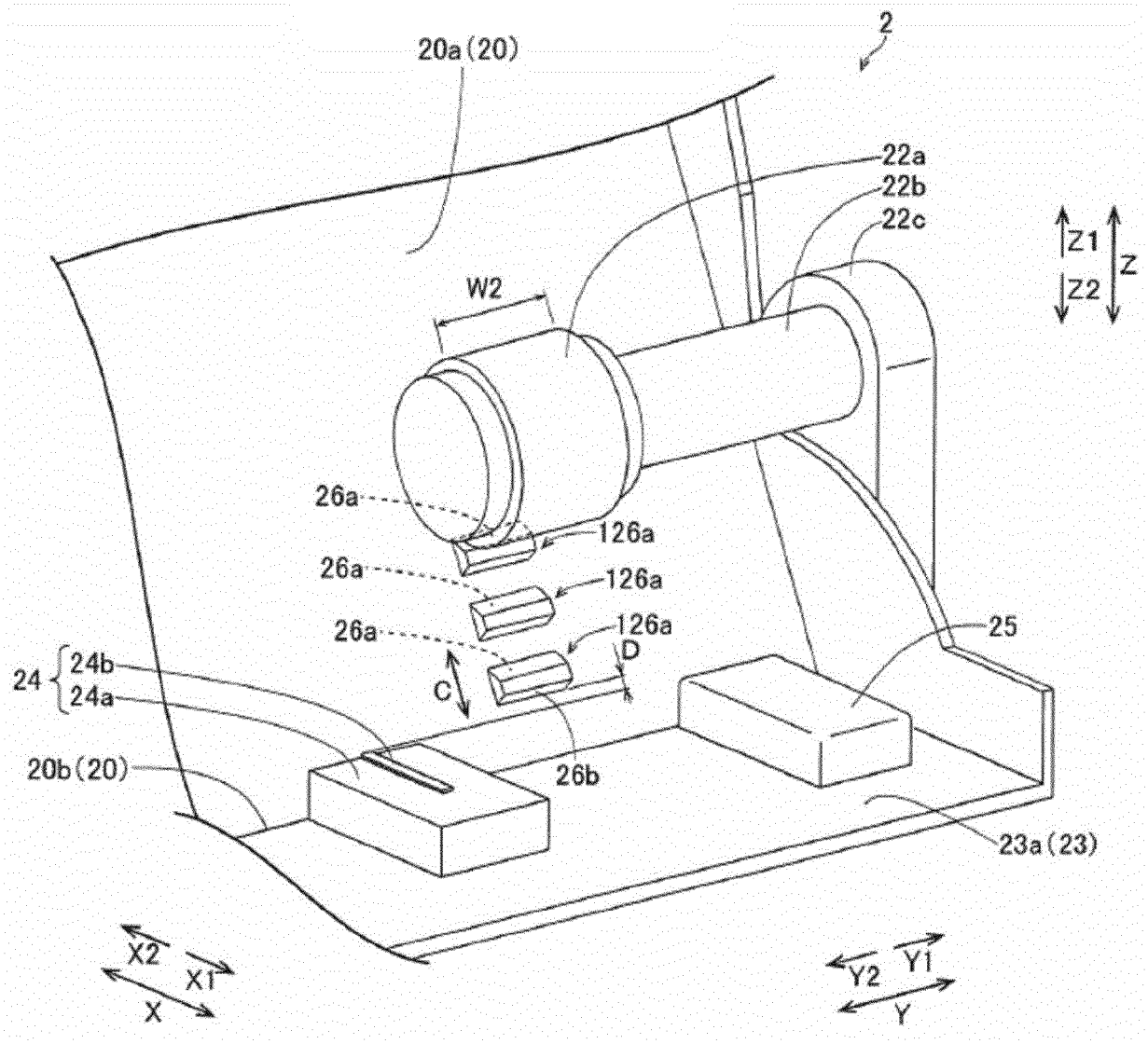

2
20a(20)
22a
22b
22c
Z1
Z2
Z
W2
26a
126a
26a
126a
26a
126a
D
C
25
24
24b
24a
20b(20)
26b
23a(23)
X2
X1
X
Y2
Y1
Y

FIG. 10

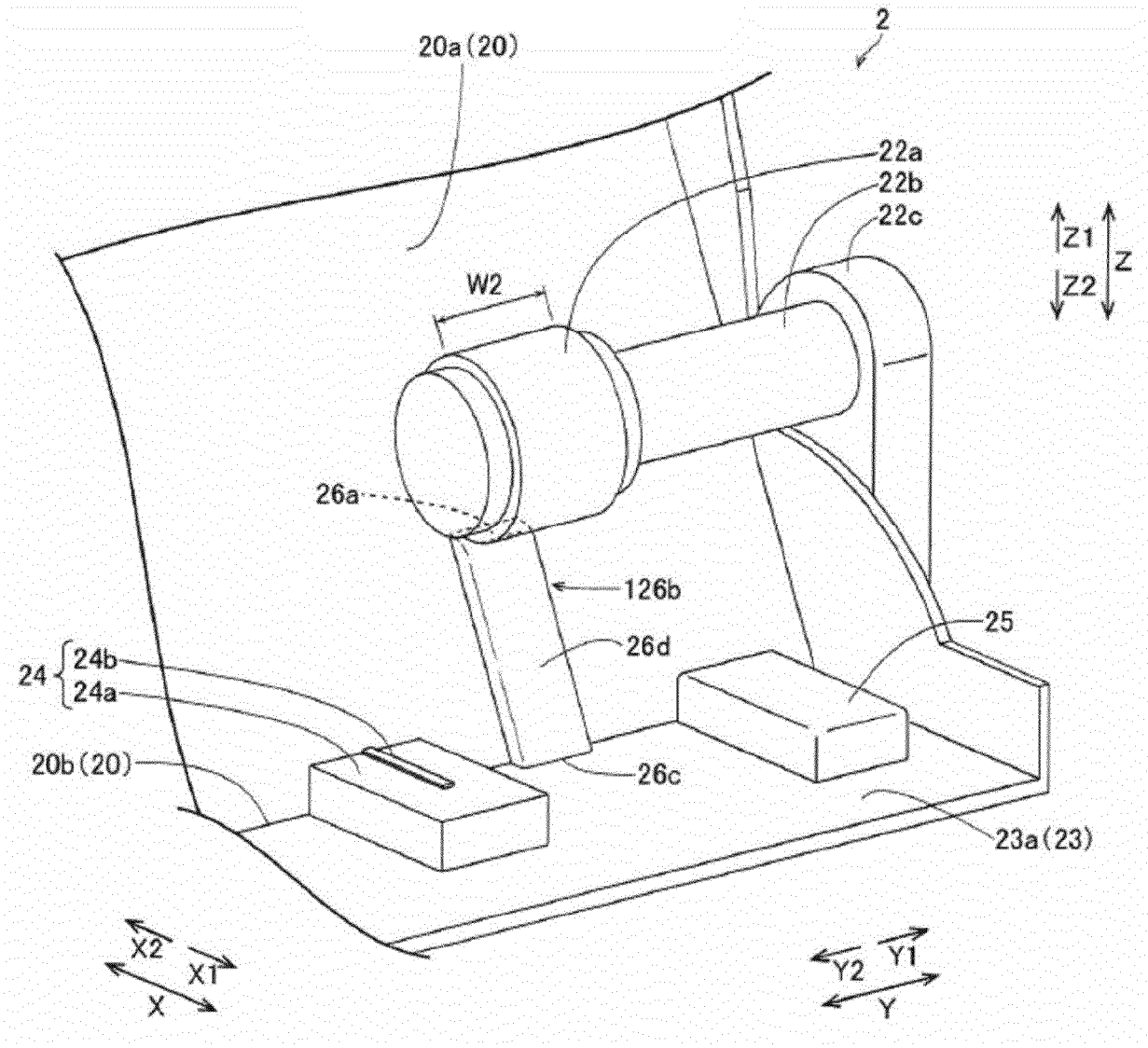
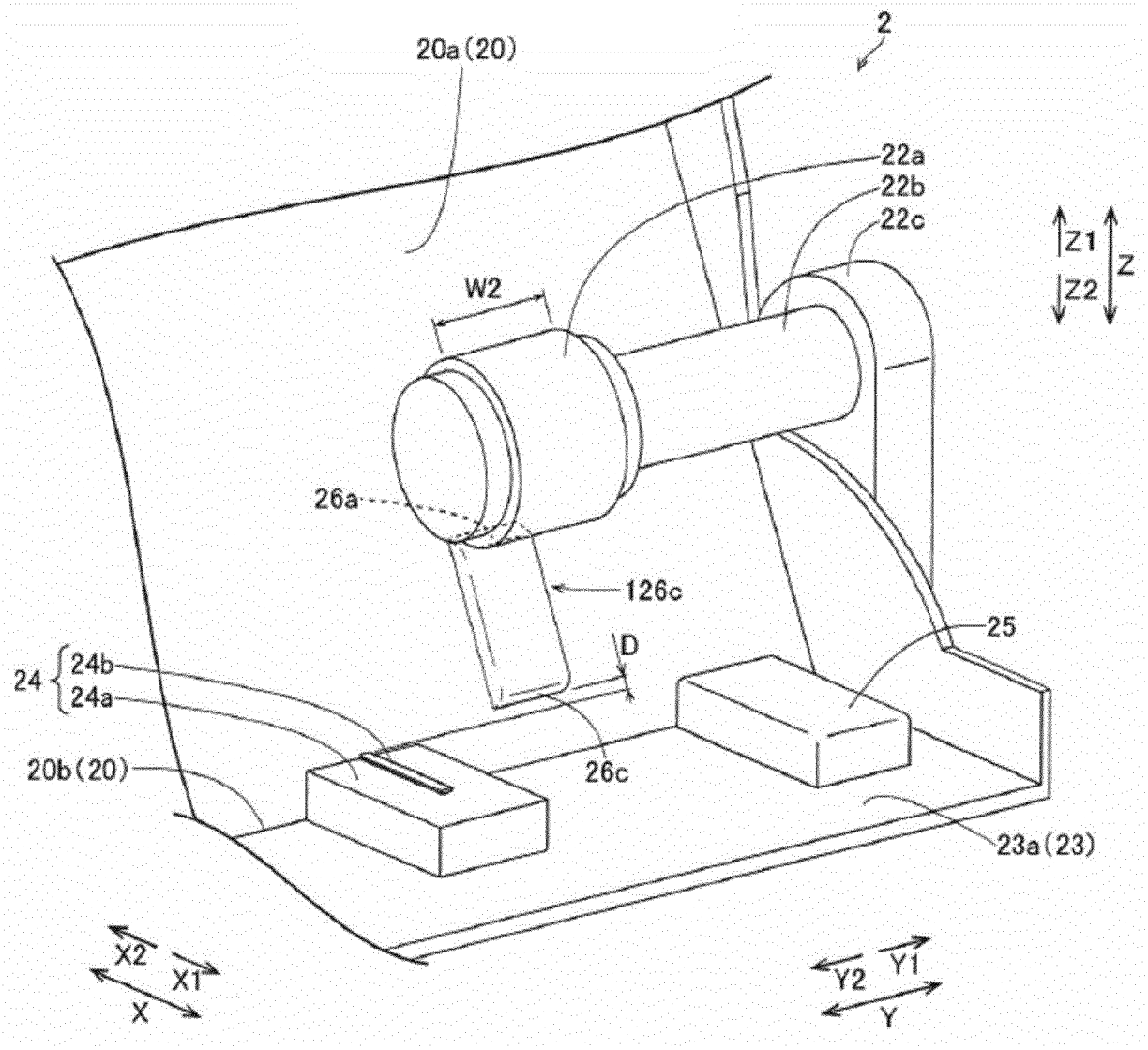

2
20a(20)
22a
22b
22c
Z1
Z2
Z
W2
26a
126b
25
26d
24
24b
24a
20b(20)
26c
23a(23)
X2
X1
X
Y2
Y1
Y

FIG. 11


2
20a(20)
22a
22b
22c
Z1
Z2
Z
W2
26a
126c
D
25
24
24b
24a
20b(20)
26c
23a(23)
X2
X1
X
Y2
Y1
Y

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EUROPEAN SEARCH REPORT

Application Number
EP 16 17 3151

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TECHNICAL FIELDS SEARCHED (IPC)

B65H
B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 October 2016	Henningsen, Ole

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