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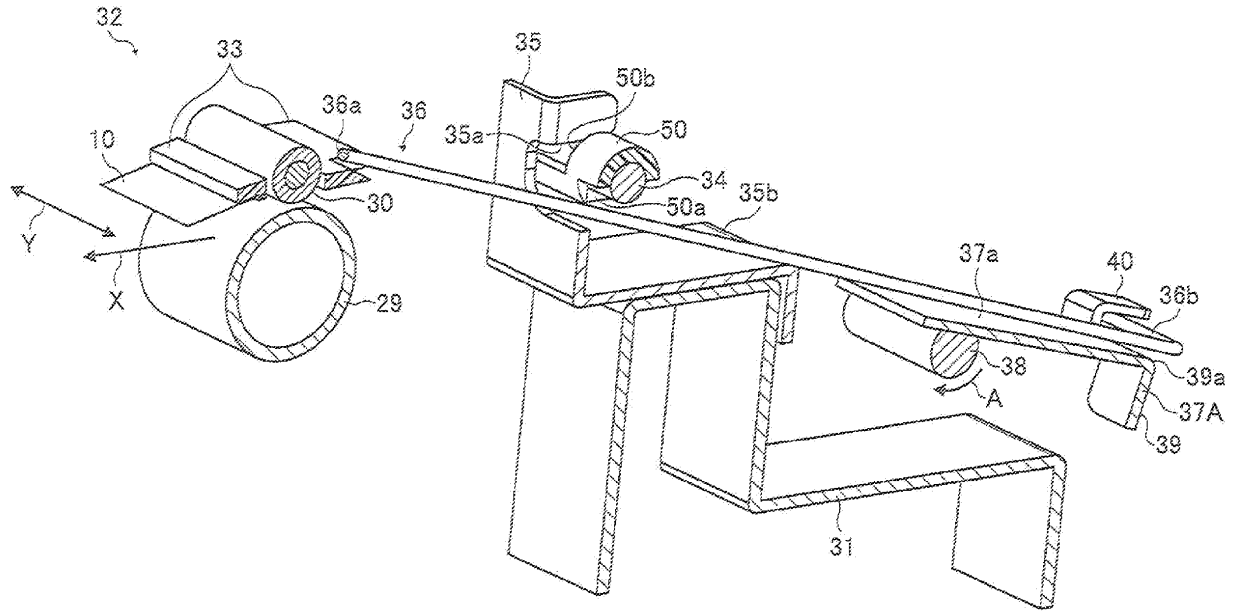
(54) **Image Forming Apparatus**

(57) A disclosed image forming apparatus includes an image forming unit forming an image on a transferred sheet, a pair of a driving roller member and a driven roller member arranged at an upstream side of the image forming unit, the driving roller member transferring the sheet toward an image forming region, the driven roller member being capable of being brought into contact with the driving roller member or detached from the driving roller member; and a pressurizing-releasing unit applying pressure to the driving roller member and releasing the applied pressure via the driven roller member. The pressurizing-releasing unit includes a pressing member having a first end attached to the driven roller member and a second end opposite to the first end based on a fulcrum shaft and a pressurizing-releasing member having a base-end attached to a pivoting shaft and a fore-end pivotally movable based on the pivoting shaft.

FIG.3



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Description

[0001] The invention generally relates to an image forming apparatus having a combined function of an ink-jet recording device, a copier and the like. More specifically, the invention relates to an image forming apparatus having components of a pressurizing-releasing unit to apply pressure via a driven roller to a driving roller for transferring a sheet to an image forming unit or release the applied pressure from the driving roller.

[0002] In the related art, there is disclosed an image forming apparatus that includes a carriage containing a recording head configured to record an image on the sheet by discharging ink while moving in a main scanning direction, and a roller pair having a driving roller and a driven roller, the roller pair being located upstream of a sheet transferring position relative to the carriage, where the roller pair picks and transfers the sheet to a recording position that faces the recording head. One example of such an image forming apparatus includes an ink-jet recording apparatus disclosed in Japanese Patent Application Publication No. 2006-160507 (hereinafter referred to as "Patent Document 1"). As illustrated in FIG. 1 of Patent Document 1, in the disclosed image forming apparatus, the driving roller (i.e., a transferring roller 27 in Patent Document 1) is arranged at a side that faces the recording head (i.e., recording head 7), the driven roller (i.e., edge pressure roller 25) is arranged at the same side as the recording head 7, and a linkage mechanism is arranged at an upper side of the driven roller so that the linkage mechanism moves the driven roller to apply pressure to the driving roller.

[0003] In addition, Japanese Patent No. 3782493 (hereinafter referred to as "Patent Document 2") discloses a sheet carrying device provided in an image forming apparatus. FIGS. 1 and 2 of Patent Document 2 illustrate a configuration of the sheet carrying device including a roller pair 3 and 5 configured to sandwich the sheet and transfer the sheet, where one (i.e., roller 3) of the pair pressurizes the other one (i.e., roller 5). As illustrated in FIG. 1 of Patent Document 2, the roller 5 is pressurized from an upper part of the roller 5 via a deflection cam 8 provided in a middle of a plate spring holder 6 extended from a shaft of the roller 5 in a transferring direction so that the rotationally resided roller 5 pressurizes the roller 3 due to elastic deformation of the plate holder 6. Further, in FIG. 2 of Patent Document 2, the roller 3 capable of moving in up-down directions is directly pressurized by a coil spring 22 attached at a lower part of the roller 3 from a lower side of the roller 3 toward a nip portion between the roller 3 and the roller 5.

[0004] However, the disclosed pressurizing configurations of Patent Document 1 and Patent Document 2 do not include a mechanism to release the pressurizing force from the driven roller and the driving roller. With such configurations, if the sheet is jammed and the pressurizing force is not released, the sheet may be damaged. Japanese Patent Application Publication No. 2006-231557 (hereinafter referred to as "Patent Document 3") discloses an image forming apparatus (ink-jet printer) having a pressurizing-releasing mechanism having a pressurizing unit and a releasing unit separately provided (i.e., a switching mechanism 5) configured to apply pressure to or release pressure from a transfer roller 41 by a nip roller 42. With this configuration, when the sheet is jammed, the sheet may be removed from the printer without damaging the sheet.

[0005] Meanwhile, the image forming apparatus such as an ink-jet recording apparatus, a copier, and a printer that includes a transfer unit to transfer sheets of different sheet sizes, and related art technologies disclose various methods for the transfer unit to stably transfer the sheets of different sizes without transfer failure such as skewing or deviation. Japanese Patent No. 2886451 (hereinafter referred to as "Patent Document 4") discloses one example of such methods. Patent Document 4 discloses an image forming apparatus (i.e., ink-jet printer) that includes a pressuring unit to apply pressing force to a transfer roller in order to prevent a recording sheet from becoming creased or skewed due to a distribution of pressure applied to end faces of a roller pair or an entire roller shaft when printing out a long continuous recording sheet.

[0006] In general, the image forming apparatus such as the ink-jet recording apparatus includes a guide member (see paragraph [0024] of Patent Document 1) such as a guide rail 2 to guide the carriage 3 in a main-scanning direction, an encoder sensor 43, and a part of a carriage container arranged at an upstream side or upper side of the roller pair 25 and 27 in a sheet-transferring direction, as illustrated in FIG. 1 of Patent Document 1. However, if the pressurizing-releasing mechanism (i.e., a switching mechanism 5) having separately provided pressurizing unit and releasing unit disclosed in Patent Document 3 is provided (added) in the above configuration of the image forming apparatus disclosed in Patent Document 1, the pressurizing-releasing mechanism may interfere with the carriage and other components arranged upstream of the roller pair 25 and 27 due to the separately provided pressurizing unit and releasing unit of the pressurizing-releasing mechanism. In addition, the number of components in the image forming apparatus may be increased. In order to configure the pressurizing-releasing mechanism not to interfere with the carriage and other components, a large amount of space may be required upstream of the roller pair 25 and 27 to accommodate the components, which may increase the size of the image forming apparatus.

[0007] By contrast, in the related art image forming apparatus disclosed in Patent Document 4, the transfer unit for transferring a recording sheet aligns the recording sheet on a plate along with one side of the platen for a recording sheet. However, with this configuration, it is rather complicated and difficult to adjust the recording sheet to uniformly apply pressure in a transfer roller shaft direction in order to stably transfer the recording sheet.

In addition, with this configuration, if a recording sheet to be transferred is narrower, it is difficult to prevent the recording sheet from becoming skewed with such adjustment.

[0008] Further, in the above described related art technologies, the pressure roller composed of plural rollers is arranged facing the transfer roller (driving roller) in order to apply a desired pressure distribution to the transfer roller. However, with this configuration, each of the rollers of the pressure roller separately needs fine adjustment. In particular, in the configuration in the related art technologies, since back tension is applied to the transferred recording sheet, the image forming apparatus generally includes a sheet transfer device in which the transfer roller has a large amount of friction with the recording sheet. However, in the image forming apparatus having such a configuration, even if there is a slight difference in the pressure applied to the pressure roller so that the applied pressure differs between left and right end portions of the recording sheet, the force to transfer the recording sheet may become unstable, which may result in skewing of the recording sheet.

[0009] It is a general object of at least one embodiment of the present invention to provide an image forming apparatus that substantially eliminates one or more problems caused by the limitations and disadvantages of the related art. Specifically, the embodiments have attempted to provide an image forming apparatus (i.e., an ink-jet recording apparatus having a carriage)that includes a simplified pressurizing-releasing mechanism configured to cause a driven roller (driving roller member) to apply pressure to or release pressure from a driving roller (driving roller member), and a mechanism that eliminates interference between the pressurizing-releasing mechanism and components arranged at an upper part of the image forming apparatus (e.g., the carriage), so that the size of the image forming apparatus may be prevented from increasing and the number of components in the image forming apparatus may be decreased.

[0010] Further, the embodiments have attempted to provide an image forming apparatus having a sheet transfer device capable of, instead of applying pressure having a uniform distribution to the transfer roller (i.e., driven roller member), switching pressure applied to the transfer roller such that a central portion of a transferred sheet includes a greatest pressure even if the recording sheets vary in size. As a result, the image forming apparatus capable of stably transferring recording sheets of various sizes may be obtained.

[0011] In one embodiment, there is provided an image forming apparatus that includes an image forming unit being configured to form an image on a sheet transferred thereto; a pair of a driving roller member and a driven roller member arranged at an upstream side of the image forming unit, the driving roller member being configured to transfer the sheet toward an image forming region of the image forming unit, the driven roller member being configured to be brought into contact with the driving roller member or be detached from the driving roller member; and a pressurizing-releasing unit configured to apply pressure to the driving roller member via the driven roller member and release the applied pressure therefrom via the driven roller member. In the image forming apparatus, the pressurizing-releasing unit includes a pressing member having a first end and a second end, the first end being attached to the driven roller member and the second end being located opposite to the first end based on a fulcrum shaft as a center residing between the first end and the second end; and a pressurizing-releasing member having a base-end and a fore-end, the base-end being attached to a pivoting shaft provided between the fulcrum shaft and the second end of the pressing member. The pressurizing-releasing member of the pressurizing-releasing unit includes a pressurizing portion and is configured to pivotally move, when pressure is applied, the fore-end based on the pivoting shaft as a center to raise the second end of the pressing member so that the pressing member is elastically deformed based on the pivoting shaft as the center to apply pressure to the driven roller member, and a releasing portion unitarily formed with the pressurizing portion and configured to, when the applied pressure is released, pivotally move the second end of the pressing member in a direction opposite to a direction in which the second end of the pressing member is raised based on the pivoting shaft as the center so that a predetermined distance is maintained between the driven roller member and the driving roller member.

[0012] Other objects and further features of embodiments will be apparent from the following detailed description when read in conjunction with the accompanying drawings, in which:

FIG. 1 is an external perspective view illustrating a main part of an ink-jet recording apparatus according to a first embodiment;

FIG. 2 is a schematic front view illustrating an overview of the ink-jet recording apparatus illustrated in FIG. 1;

FIG. 3 is a partial cross-sectional perspective view illustrating a main configuration and operation of a pressurizing-releasing mechanism when applied pressure is released;

FIG. 4 is a partial cross-sectional front view illustrating the main configuration and operation of the pressurizing-releasing mechanism when applied pressure is released;

FIG. 5 is a perspective view illustrating the main part of the pressurizing-releasing mechanism when applied pressure is released viewed from diagonally rear top right;

FIG. 6 is a perspective view illustrating the main part of a pressurizing-releasing member viewed from diagonally rear top right;

FIG. 7 is a view illustrating an approximately overall pressurizing-releasing mechanism from which a pressing member is detached viewed from diagonal-

ly rear top right;
FIG. 8 is an enlarged view illustrating a portion C enclosed by a broken line illustrated in FIG. 7 of the pressurizing-releasing mechanism to which the pressing member is attached;
FIG. 9 is a partial cross-sectional front view illustrating a configuration and operation of the pressurizing-releasing mechanism provided with a linkage mechanism when pressure is applied;
FIG. 10 is a front view illustrating pressurizing portions provided one at a central portion and one at each end of the pressurizing-releasing mechanism when pressure is applied;
FIG. 11 is a front view illustrating the pressurizing portion provided at the central portion of the pressurizing-releasing mechanism when pressure is applied;
FIG. 12 is a front view illustrating the pressurizing portion provided one at each end of the pressurizing-releasing mechanism when pressure is applied;
FIG. 13 is a schematic front view illustrating a principal configuration of a pressurizing-releasing mechanism according to a first modification of the first embodiment;
FIG. 14 is a schematic front view illustrating operation of the pressurizing-releasing mechanism when the pressure is applied;
FIG. 15 is a schematic front view illustrating operation of the pressurizing-releasing mechanism when applied pressure is released;
FIG. 16 is a diagram illustrating distributions of pressure applied to sheets of different sizes transferred based on a single-side locating reference in a pressurizing-releasing mechanism according to a second embodiment;
FIG. 17 is a schematic front view illustrating a switching unit of the pressurizing-releasing mechanism according to the second embodiment;
FIG. 18 is a perspective view illustrating the switching unit of the pressurizing-releasing mechanism according to the second embodiment viewed from diagonally rear top right;
FIG. 19A is a side view of shape of a rotational shaft to which pressure switching members are attached at different angles, and FIG. 19B is an external perspective view illustrating respective shapes of the pressure switching members utilized for setting different pressure distributions corresponding to different sheet sizes;
FIGS. 20A through 20D are front views illustrating simplified shapes of the pressure switching members utilized for setting different pressure distributions corresponding to different sheet sizes;
FIGS. 21A through 21E are schematic views illustrating pressure distributions switched corresponding to different sheet sizes;
FIG. 22A is an external view illustrating a main part of a switching unit according to a second modification, and FIG. 22B is an external view illustrating a pressure switching member of the switching unit according to the second modification in a rotational shaft direction; and
FIGS. 23A through 23D are cross-sectional views illustrating respective shapes of the pressure switching member of the switching unit according to the second modification in the rotational shaft direction.

[0013] In the following, embodiments for carrying out the present invention will be described by referring to the accompanying drawings. Same reference numerals are provided for same components (members and elements) having same functions and shapes throughout all embodiments and modifications insofar as they are not confused, and descriptions of such components, if previously made, are omitted. The components or elements that could be shown in the drawings but whose descriptions are considered as not particularly needed may be omitted without prior notice for simplifying drawings and their descriptions.

[FIRST EMBODIMENT]

[0014] A first embodiment is described with reference to FIGS. 1 through 12. Initially, an ink-jet recording apparatus (hereinafter also simply called a "recording apparatus") illustrated as one example of an image forming apparatus according to the first embodiment is described with reference to FIGS. 1 and 2. FIG. 1 is an external perspective view illustrating a main part of the recording apparatus and FIG. 2 is a schematic front view illustrating the recording apparatus in FIG. 1.

[0015] The ink-jet recording apparatus illustrated in FIGS. 1 and 2 is a serial ink-jet recording apparatus. In FIGS. 1 and 2, a reference numeral 1 is assigned to an apparatus main body case forming a framework of the recording apparatus. The apparatus main body 1 includes an image forming unit 3, a sheet suction-transfer unit 4, and a roll-sheet container 5. As illustrated in FIG. 2 an image reader unit (device) 2 is provided on the apparatus main body 1. The illustration of the image reader unit 2 is omitted from FIG. 1. The image reader unit 2 includes a function and a configuration to read an image, and the image forming unit 3 includes a function and configuration to form the image on a sheet 10 transferred as a recording medium sheet.

[0016] In a direction indicated by an arrow X (hereinafter also called a "sub-scanning direction") perpendicular to an up-down direction Z, an arrow pointed direction is a front face side (a left side in FIG. 2) and a back of the arrow X is a rear side (a right side in FIG. 2) of the apparatus main body 1 in FIG. 1. A main-scanning direction Y (see FIG. 1) corresponds to a sheet-width direction perpendicular to the up-down direction Z and the sub-scanning direction X.

[0017] As illustrated in FIG. 2, the image reader unit 2 includes a document setting table 11 on which a docu-

ment transferred from the front face side to the rear side of the apparatus main body 1 is set at an image reading position, a document feed roller 12 (i.e., provided as a document transfer unit) configured to transfer the document to the image reading position, a contact image sensor 14 (i.e., provided as image reading unit) configured to read an image of the document arranged at the image reading position, a document discharge roller 15 (i.e., provided as a document discharge unit) configured to discharge the document after having read its image, and a document discharge table 16 configured to receive the document discharged from the image reader unit 2.

[0018] The document (not shown) placed on the document table 11 is fed to a document transfer path 13 one sheet at a time by the document feed roller 12. The image of the document (not shown) transferred by the document feed roller 12 is read by the contact image sensor 14 at the image reading position of the document transfer path 13, and after the image of the document has been read, the document is discharged to the document discharge table 16 by the document discharge roller 15. The contact image sensor 14 has a long structure in the main-scanning direction Y (see FIG. 1) and is configured to include a light source illuminating the document and an image sensor. The light source of the contact image sensor 14 illuminates the document arranged in the document transfer path 13, the light reflected from the document is converged onto the image sensor 14 through a lens array, and the converged light is converted into the image signal to be output. Further, a pressing board 17 used as a white reference board to press the document is arranged such that the pressing board 17 faces a contact glass (not shown) forming the document transfer path 13 provided above the contact image sensor 14.

[0019] As illustrated in FIG. 1, the image forming unit 3 arranged inside the apparatus main body 1 includes a guide rod 18 and a guide rail (i.e., a guide member) 19 arranged between side panels of the apparatus main body 1. A carriage 20 is slideably supported by the guide rod 18 and the guide rail 19 in the main-scanning direction. The carriage 20 includes not shown liquid recording heads (hereinafter simply called "recording heads") that are liquid-jet heads configured to discharge respective ink colors of black (K), yellow (Y), magenta (M), and cyan (C). The recording heads include not-shown unitarily formed ink sub-tanks to which the respective colors of ink are supplied. Further, the recording heads are configured to discharge the colors of ink in a downward direction of the up-down direction Z.

[0020] A main-scanning mechanism configured to cause the carriage 20 to movably scan in the main-scanning direction Y includes a driving motor 21 arranged at a first side (i.e., diagonally upper left side in FIG. 1) in the main-scanning direction Y, a driving pulley 22 fixed on an output shaft of the driving motor 21 to be rotationally driven by the driving motor 21, a driven pulley 23 arranged at a second side (i.e., diagonally lower right side in FIG. 1) in the main-scanning direction Y, and a belt member 24 looped over the driving pulley 22 and the driven pulley 23. The driven pulley 23 has tension applied with a not-shown tension spring in a direction away from the driving pulley 22. The belt member 24 is partially fixed to a belt fixing unit provided on a rear side of the carriage 20 so that the carriage 20 is pulled in the main-scanning direction Y.

[0021] An encoder sheet (not shown) configured to detect a main-scanning position of the carriage 20 is arranged along the main-scanning direction Y of the carriage 20 so that an encoder sensor (not shown) provided on the carriage 20 is capable of reading the encoder sheet. In a recording region of a main-scanning region of the carriage 20, a sheet 10 transferred from a roll sheet 6 contained in the roll-sheet container 5 is intermittently transferred in the sub-scanning direction (hereinafter also called a "sheet transferring direction") X perpendicular to the main scanning direction Y of a carriage moving direction by a not-shown sheet feeder of the sheet suction-transfer unit 4.

[0022] Further, a first end region (i.e., diagonally rear bottom right region in FIG. 1) of the scanning region includes a maintenance-restoring mechanism 25 to maintain and restore the respective recording heads residing inside the carriage 20 and also main cartridges 26 containing the respective colors of ink to be supplied to the sub-tanks of the recording heads detachably attached to the apparatus main body 1.

[0023] As illustrated in FIG. 2, a cutter 27 is arranged in front of the image forming unit 3 as a sheet cutting unit to cut the sheet 10 in a predetermined length. The cutter 27 is fixed on a wire looped over plural pulleys one of which is coupled to the driving motor 21 so that the sheet 10 is cut in the predetermined length by the driving motor 21 that causes the wire to move in the main-scanning direction Y via the pulley. This technology is generally known to persons skilled in the art.

[0024] Next, the roll-sheet container 5 is described. The roll-sheet container 5 includes a function and a configuration to support and contain the roll sheet 6 while transferring the sheet 10 (i.e., a portion of roll sheet 6) from the roll sheet 6 via flanges 7 and flange receivers 8. As illustrated in FIGS. 1 and 2, the roll sheet 6 is set in the flange receivers 8 via the flanges 7 (not shown in FIG. 2) used as guide members (flange members). The roll sheet 6 to be set may come in various sizes in the width direction and be formed of various kinds of paper (sheet kind). For example, the size the roll sheet 6 in the width direction may correspond to as large a size as A0 or A1, and a kind of the roll sheet 6 may be varied from glossy expensive paper to ordinal inexpensive paper.

[0025] The roll sheet is generally formed by winding a long continuous sheet numerous times over a core tube (not shown) such as a cardboard tube. As illustrated in FIGS. 1 and 2, a front face of the apparatus main body 1 includes an opening 9 for allowing the roll sheet 6 to be set in the flange receivers 8 via the flanges 7 from the front face side.

[0026] As illustrated in FIG. 1, the roll sheet 6 is set in the apparatus main body 1 such that the flanges 7 used as the guide members are inserted into respective ends of the cardboard tube, and the flanges 7 fixed to the respective ends of the roll sheet 6 are placed into the corresponding flange receivers 8. Accordingly, the flanges 7 are coaxially fixed to the respective ends of the cardboard tube (i.e., core) of the roll sheet 6 (or a not-shown roll sheet arranged in a lower stage) along an axial direction of the cardboard tube. An outer diameter of the flange 7 is made smaller than a maximum outer diameter of the (unused) roll sheet 6.

[0027] A roll sheet feeding system includes a flange system and a spool system. The flange system exhibits excellent operability and workability while the spool system exhibits relatively low manageability where a long shaft such as a relatively heavy metallic spool or mandrill shaft is inserted into the ends of the cardboard tube of the roll sheet 6 to be fixed to the ends of the cardboard tube of the roll sheet 6. In the first embodiment, the flange system is illustrated as the roll sheet feeding system; however, the spool system may also be employed as the roll sheet feeding system.

[0028] Operation of the overall recording apparatus having the above configuration is described with reference to FIGS. 1 and 2. As illustrated in FIGS. 1 and 2, the roll sheet 6 is set in the flange receivers 8 via the flanges 7, and an end of the sheet 10 of the roll sheet 6 is set in a feeding roller pair 28 illustrated as a feeding unit in FIG. 2 such that the sheet 10 of the roll sheet 6 is ready to be fed via the feeding roller pair 28. A user sets a document (not shown) previously subjected to image formation on the document table 11 of the image reader unit 2 while setting various image forming conditions such as kind of the roll sheet, color of the roll sheet, and the number of image forming sheets by user's key operation of a not-shown operations unit arranged close to the image reader unit 2 of the apparatus main body 1. The recording apparatus is activated when signals for the above settings are input into a control unit (not shown). That is, the image reader unit 2 reads the above document image, and the contact image sensor 14 outputs the image signals based on the read document image.

[0029] When the feeding roller pair 28 is rotated by the not-shown motor rotationally driven by the user's key operation, the flanges 7 fixed to the flange receivers 8 are rotated in a sheet rollout direction so that the sheet 10 is fed (rolled out) from the roll sheet 6. The sheet 10 fed via the feeding roller pair 28 is transferred along a sheet transfer path from the rear side of the apparatus to a front side of the apparatus by a transfer roller pair 29 and 30 such that the sheet 10 is transferred to an ink-jet recording region (i.e., image forming region) of the image forming unit 3. Note that the transfer roller pair 29 and 30 includes a driving roller 29 that has functions of a resist unit and a sheet transfer unit and a pressure roller 30 that is rotationally driven by the driving roller 30. Thereafter, as illustrated in FIG. 1, the carriage 20 is moved in the main-scanning direction Y and the recording head ejects liquid drops based on image information while the sheet 10 is intermittently transferred by a not-shown feeder mechanism in the sheet transferring direction X. As a result, a desired image is formed on the sheet 10. Further, after the desired image is formed on the sheet 10, the cutter 27 shown in FIG. 2 is moved in the main-scanning direction Y to cut the sheet 10 to a predetermined length. The sheet 10 cut to the predetermined length is then transferred in a sheet discharge direction Xa to be discharged onto a not-shown sheet discharge tray arranged on the front side of the apparatus. The image information (image data) is not limited to the document image read by the image reader unit 2, and may be a document image sent via a computer such as a personal computer communicatively connected to the recording apparatus.

[0030] As illustrated in FIG. 2, the driving roller 29 is arranged at an upstream side in the sheet transferring direction X of the image forming unit 3. In the first embodiment, the driving roller 29 functions as a driving roller member to transfer the sheet 10 to the ink-j et recording region of the image forming unit 3. The pressure roller 30 is arranged to be brought into contact with the driving roller 29, such that the pressure roller 30 functions as a driven roller member to be driven by the driving roller 29 while being in contact with the driving roller 29. Thus, the transfer roller pair 29 and 30 functions as a pair of roller members in the first embodiment. A reference numeral 32 is assigned to a pressurizing-releasing mechanism used as a pressurizing-releasing member configured to press the pressure roller 30 onto the driving roller 29 to apply pressure to the driving roller 29 and detach the pressure roller 30 from the driving roller 29 to release the applied pressure from the driving roller 29. As illustrated in FIGS. 1 and 2, the image forming unit 3 is arranged above a nip position of the transfer roller pair 29 and 30.

[0031] The pressurizing-releasing mechanism 32 that functions as the pressurizing-releasing member of the first embodiment is described with reference to FIGS. 2 through 12. First, a main configuration of the pressurizing-releasing mechanism 32 is described with reference to FIGS. 3 through 8. FIG. 3 is a partial cross-sectional perspective view illustrating a main configuration and operation of the pressuring-releasing mechanism 32 when applied pressure is released; FIG. 4 is a partial cross-sectional perspective view illustrating the main configuration and operation of the pressuring-releasing mechanism 32 when applied pressure is released; FIG. 5 is a top perspective view illustrating the main part the pressuring-releasing mechanism 32 when applied pressure is released viewed from diagonally rear top right; FIG. 6 is a perspective view illustrating a main part of a pressuring-releasing member viewed from diagonally rear top right; FIG. 7 is a view illustrating the approximately overall pressuring-releasing mechanism 32 from which a pressing member is detached viewed from diagonally rear top right; and FIG. 8 is an enlarged view illustrating a portion C enclosed by a broken line illustrated in FIG. 7 of the

pressurizing-releasing mechanism 32 to which the pressing member is attached.

[0032] As illustrated in FIGS. 7 and 8, the transfer roller pair 29 and 30 used as the pair of roller members is configured as a sheet transferring system of the recording apparatus to transfer the sheet 10 based on a center locating reference CL. The pressure roller 30 includes plural pressure rollers 30 (i.e., four rollers arranged for each of four driving rollers 29 (4 * 4 = 16 rollers) in FIG. 7) arranged in a pressure roller shaft direction. The driving roller 29 includes plural driving rollers 29 that face the plural pressure rollers 30 (one driving roller 29 corresponding to four pressure rollers 30 in FIG. 7).

[0033] As illustrated in FIGS. 3 through 7, the pressurizing-releasing mechanism 32 mainly includes a pressure arm 33 configured to hold the pressure roller 30 onto or above the driving roller 29, a fulcrum shaft 34 configured to pivotally support the pressure arm 33, an arm holder 35 configured to support the fulcrum shaft 34, a pressing member 36 configured to generate a bias force (i.e., pressing force) to press the pressure roller 30 against the driving roller 29 via the pressure arm 33, a pressurizing-releasing member 37 configured to apply the generated force (i.e., pressure) to and release the applied pressing force via the pressing member 36, and a rotational shaft 38 configured to pivotally move the pressurizing-releasing member 37.

[0034] The pressure arm 33 is provided for each of the pressure rollers 30. A first end of the pressure arm 33 is configured to rotationally support two ends of a not-shown shaft of the pressure roller 30 and a second end of the pressure arm 33 extending toward the upstream side in the sheet transferring direction X is pivotally supported by the fulcrum shaft 34. That is, the second end of the pressure arm 33 functions as a supporting member. The pressure arm 33 is slidably in contact with a first end 36a of the pressing member 36 and the two (left and right) ends of the shaft (not shown) of the pressure roller 30. Accordingly, the pressure arm 33 is unitarily formed of an engineering plastic such as polyacetal resin (POM) that exhibits excellent slidability, high strength, and high durability. The pressure arm 33 is formed with reduced weight.

[0035] In the first embodiment, the fulcrum shaft 34 is arranged such that the fulcrum shaft 34 penetrates the pressure arm 33 to pivotally support the second end of the pressure arm 33. The fulcrum shaft 34 is also arranged above the pressing member 36 at a position between the first end 36a and a second end 36b of the pressing member 36. The fulcrum shaft 34 may be formed of metal such as steel or stainless steel. As illustrated in FIG. 3, the fulcrum shaft 34 is partially covered with a fulcrum shaft cover 50 made of appropriate resin (e.g., polyacetal resin(POM) or polyamide resin (PA)) that exhibits excellent slidability and durability. The fulcrum shaft cover 50 includes a first groove 50a via which the fulcrum shaft 34 is brought into contact with the pressing member 36 at a fixed position and a second groove 50b via which the fulcrum shaft 34 is brought into contact with a shaft deformation preventing portion 35a of the arm holder 35.

[0036] As illustrated in FIG. 4, the two (left and right) ends of the fulcrum shaft 34 in the sheet-width direction Y of the arm holder 35 are provided with retaining rings such that the fulcrum shaft 34 is prevented from coming off of the arm holder 35. The first groove 50a is provided for allowing the pressing member 36 to directly contact the accurately located fulcrum shaft 34 so that the pressing force (elastic force) of the pressing member 36 is applied to the driving roller 29 via the pressure roller 30 with high accuracy. The fulcrum shaft 34 is arranged below the nip position of the roller pair 29 and 30 formed of a pair of roller members.

[0037] The arm holder 35 is attached via not-shown screws to a main body frame 31 fixed to the apparatus main body 1 to function as the fulcrum shaft holding member to hold the fulcrum shaft 34. The arm holder 35 includes a pressure release fulcrum portion 35b bent at an approximately right angle (see FIGS. 3 and 4) and functions as a contact portion where the pressing member 36 is brought into contact with the arm holder 35 by a self weight of the pressing member 36 when the applied pressure is released. The arm holder 35 includes the shaft deformation preventing portion 35a also unitarily formed with the arm holder 35 in addition to the above pressure release fulcrum portion 35b. The arm holder 35 may be formed of a thin plate such as thin sheet metal. The above shaft deformation preventing portion 35a and the pressure release fulcrum portion 35b are unitarily formed with the arm holder 35. The arm holder 35 includes the shaft deformation preventing portion 35a to prevent the deformation of the fulcrum shaft 34 caused by the pressing force applied close to the central portion of the fulcrum shaft 34 via the pressing member 36 and accurately retain the position of the fulcrum shaft 34. The deformation of the fulcrum shaft 34 is caused by the pressing force of the pressing member 36 that is in contact near the central portion of the fulcrum shaft 34 when the pressure is applied.

[0038] One of the pressing members 36 is provided for each set of the pressure roller 30 and the pressure arm 33. The pressing member 36 includes the first end 36a pivotally attached to one end of the pressure arm 33 and the second end 36b located at an opposite end of the first end 36a based on the fulcrum shaft 34 as a center and extending below and beyond the fulcrum shaft 34 to reach the upstream side in the sheet transferring direction X. The pressing member 36 may be formed of a wire spring made of spring steel and is formed into a U-shape.

[0039] As described later, when the applied pressure is released, that is, when an engagement between a releasing portion of the pressurizing-releasing member 37 and the second end 36b of the pressing member 36 is released and the driving roller 29 and the pressure roller 30 are still in contact with each other, the pressing member 36 is arranged such that the not-attached second end

36b resides below the nip position of the roller pair 29 and 30. The pressing members 36 all have a same spring constant and a same shape and are provided for the respective pressure rollers 30 in order to prevent in advance attachment errors such as a wrong component attachment or attachment failure that may occur when the first end 36a of the pressing member 36 is attached to the second end of the pressure arm 33 or to reduce the number of components of the pressing member 36.

[0040] As illustrated in FIGS. 3 and 4, a base end of the pressurizing-releasing member 37 is attached to the rotational shaft 38 employed as a pivoting shaft. The base end of the pressurizing-releasing member 37 is located between the fulcrum shaft 34 and the second end 36b of the pressing member 36. When pressure is applied, a fore end (i.e., the pressing member raising portion 39) of the pressurizing-releasing member 37 raises the second end 36b of the pressing member 36 based on the rotational shaft 38 to allow the fore end of the pressurizing-releasing member 37 to abut a contact point of the pressing member 36 located beneath the fulcrum shaft 34 to raise the second end 36b of the pressing member 36. As a result, the pressing member 36 is deformed based on the contact point beneath the fulcrum shaft 34 by raising the second end 36b of the pressing member 36 so as to apply pressure to the driving roller 29 via the pressure roller 30. When the applied pressure is released, the pressing member lowering portion 40 of the pressurizing-releasing member 37 lowers the second end 36b of the pressing member 36 based on the rotational shaft 38 in a direction opposite to the direction in which the second end 36b of the pressing member 36 is raised. As a result, the roller pair 29 and 30 separate from each other while maintaining a predetermined space between the roller 29 and the roller 30. Note that the pressurizing-releasing member 37, the pressing member raising portion 39, and the pressing member lowering portion 40 are unitarily formed.

[0041] As illustrated in FIG. 9, an output lever 60 partially forming a later-described linkage mechanism 57 is attached to an end of the rotational shaft 38. The rotational shaft 38 is pivotally supported by the main body frame 31. The rotational shaft 38 may be formed of metal such as steel or stainless steel.

[0042] As illustrated in FIGS. 4, 7, and 8, the pressurizing-releasing member 37 includes two kinds of pressurizing-releasing members; that is, a pressurizing-releasing member 37A and a pressurizing-releasing member 37B have different pressing member raising portions 39 having different raising heights and different pressing member lowering portions 40 corresponding to different pressure rollers 30 and are unitarily formed as one pressurizing-releasing member 37. The pressing member raising portions 39 of the pressurizing-releasing member 37A and the pressurizing-releasing member 37B have different raising (pressing) heights corresponding to the pressure rollers 30 whereas the pressing member lowering portions 40 of the pressurizing-releasing member 37A and the pressurizing-releasing member 37B have partially different shapes. With this configuration, the pressurizing portion of the pressurizing-releasing member 37 causes the pressing member 36 to apply the pressure force (pressing force) to the driving roller 29 via the pressure roller 30 such that the pressure applied to the transferred sheet exhibits an approximately normal distribution with a central portion of the transferred sheet having a maximum (highest) pressure. However, unless otherwise specified, a general reference numeral 37 is assigned to the pressurizing-releasing member. Further, in the drawings, the pressurizing-releasing member 37 may be provided with different suffixes "A" and "B" to differentiate a location of the pressurizing-releasing member 37. Specifically, a suffix "A" provided with the pressurizing-releasing member 37 (i.e., a pressurizing-releasing member 37A) indicates that the pressurizing-releasing member 37A resides on the central portion in the pressure roller shaft direction whereas a suffix "B" provided with the pressurizing-releasing member 37 (i.e., a pressurizing-releasing member 37B) indicates that the pressurizing-releasing member 37B resides on one of the two sides in the pressure roller shaft direction. Similarly, the pressing member 36 may also be provided with different suffixes "A" and "B" to differentiate a location of the pressing member 36. Note that as described above, the same pressing members 36 are used for the corresponding pressure rollers 30.

[0043] As illustrated in FIG. 7, the pressurizing-releasing member 37A includes eight pressure rollers 30 (i.e., four pressure rollers arranged for each of the two driving rollers 29) arranged on a central portion of the pressurizing-releasing member mechanism 32 based on the center locating reference CL. In the pressurizing-releasing member 37A, the pressing member raising portions 39 are formed longer in the sheet transferring direction than the pressing member raising portions 39 formed in the pressurizing-releasing members 37B in view of an approximately planer aspect. By contrast, the pressurizing-releasing members 37B include eight pressure rollers 30, four (i.e., four pressure rollers for each driving roller 29) arranged on each side of the pressurizing-releasing member mechanism 32. In the pressurizing-releasing member 37B, the pressing member raising portions 39 are formed shorter in the sheet transferring direction than the pressing member raising portions 39 formed in the pressurizing-releasing member 37A in view of an approximately planer aspect (see FIG. 8).

[0044] As illustrated in FIGS. 3 to 5, the base end of the pressurizing-releasing member 37 is fixed to the rotational shaft 38. The pressurizing-releasing member 37 may be formed of a thin plate such as thin sheet metal. The pressurizing-releasing member 37 unitarily forms the above base end and the following portion. As illustrated in FIGS. 3 to 8, a releasing portion of the pressurizing-releasing member 37 includes an abutting face 37a (i.e., first abutting face) abutting the second end 36b of pressing member 36, the pressing member lowering por-

tion 40 formed as a step portion and having an abutting face (i.e., second abutting face) located at a position higher than the abutting face 37a abutting the second end 36b of pressing member 36 when the pressure is released, and a rotation stopper 41 (see FIGS. 4 and 6) formed as a first limiter to limit the lowering of the releasing portion by causing the rotation stopper 41 (i.e., first limiter) to abut the main body frame 31 on the arm holder 35 side after the engagement of the second end 36b of the pressing member 36 and the pressing member lowering portion 40 (i.e., step portion).

[0045] As illustrated in FIGS. 3 to 8, the pressurizing portion of the pressurizing-releasing member 37 includes the pressing member raising portion 39, a bending R portion 39a and a rotation stopper 42 formed as the rotational stopper 42 (i.e., second limiter) to limit pivotally moving of the pressurizing-releasing member 37 based on the rotational shaft 38 (i.e., pivoting shaft) by engaging the second limiter with the main body frame 31 when the pressure is applied. The bending R portion 39a and the rotation stopper 42 are unitarily formed. The pressing member raising portion 39 raises the pressing member 36 by frictionally pressing the pressing member 36 from beneath the pressing member 36 with the bending R portion 39a formed by bending the pressing member raising portion 39 made of the thin steel metal (so that the bending R portion 39a has increased strength). When the pressing member 36 is raised by the bending R portion 39a, the pressing member 36 may be raised without intruding on other parts with the edge of the bending R portion 39a. Note that oil, grease, or coating having excellent slidability may be applied to the bending R portion 39a for decreasing the frictional resistance generated between the bending R portion 39a and the pressing member 36. Note also that when the pressure is applied, the pressurizing portion pivotally moves toward the guide member and raises the second end of the pressing member such that a predetermined distance is maintained between the second end of the pressing member and a lower end of the guide member.

[0046] Next, the linkage mechanism 57 that pivotally moves and rotates the rotational shaft 38 is described. FIG. 9 is a partial cross-sectional front view illustrating a configuration and operation of the pressurizing-releasing mechanism 32 provided with the linkage mechanism 57 when pressure is applied. As illustrated in FIG. 9, the output lever 60 partially forming the linkage mechanism 57 is attached to a D-cut portion formed in the end of the rotational shaft 38. An operation lever 56 is pivotally attached via a fixing pin 58a attached to the main body frame 31 arranged on the front side of the apparatus main body 1.

[0047] The linkage mechanism 57 includes the operation lever 56, a first linkage member 59a attached to the operation lever 26 via a pivoting pin 58c, a second linkage member 59b attached to the main body frame 31 via a pivoting pin 58c and also attached to the first linkage member 59a via the pivoting pin 58c, a third linkage member 59c attached to the output lever 60 via a pivoting pin 58c and also attached to the second linkage member 59b via the pivoting pin 58c, and the output lever 60.

[0048] The first linkage member 59a and the third linkage member 59c may be unitarily formed using thin steel metal, and the second linkage member 59b and the output lever 60 may be unitarily formed using appropriate resin. Note that in the first embodiment, rotational driving force is transmitted to the rotational shaft 38 via the linkage mechanism 57 by manually operating the operation lever 59 (i.e., a manual driving system). However, a rotation transmission unit such as gears may be attached directly or via the output lever 60 to the rotational shaft 38 and the rotational driving force may be automatically transmitted to the rotational shaft 38 transmitted via a driving unit such as an electric motor (i.e., an electric driving system).

[0049] Next, operations of the pressurizing-releasing mechanism 32 are described with reference to FIGS. 3 through 12. FIG. 10 is a front view illustrating pressurizing portions of the pressurizing-releasing members 37A and 37B when pressure is applied; FIG. 11 is a front view illustrating the pressurizing portion of the pressurizing-releasing member 3 7A when pressure is applied; and FIG. 12 is a front view illustrating the pressurizing portion of the pressurizing-releasing member 37B when pressure is applied. Note that in FIGS. 9 through 12, for clarifying the difference in the pressurizing operation between the pressurizing-releasing member 37A and the pressurizing-releasing member 37B, the pressing member raising portion 39 unitarily formed with the pressurizing-releasing member 37A and the pressing member 36 formed corresponding to the pressurizing-releasing member 37A are provided with the suffixes "A" (i.e., the pressing member raising portion 39A and pressing member 36A) whereas the pressing member raising portion 39 unitarily formed with the pressurizing-releasing member 37B and the pressing member 36 formed corresponding to the pressurizing-releasing member 37B are provided with the suffixes "B" (i.e., the pressing member raising portion 39B and pressing member 36B).

[0050] First, operations of the pressurizing-releasing mechanism 32 when pressure is applied are described. In FIG. 9, when the operation lever 56 pivotally moves in an A1 direction, the rotational shaft 38 pivotally rotates in a B2 direction (i.e., counterclockwise direction) via the linkage mechanism 57 and the output lever 60 to reside in a position illustrated in FIG. 9, and the pressurizing-releasing members 3 7A and 37B are simultaneously moved in upright directions. The pressing members 36A and 36B located above the pressurizing-releasing members 37A and 37B are frictionally pushed in upward directions from lower sides of the pressing members 36A and 36B by the respective bending R portions 39a of the pressurizing-releasing members 37A and 37B while the pressing members 36A and 36B are sliding on the pressing member raising portions 39A and 39B. The pressing members 36A and 36B are brought into contact with re-

spective contact points 34a of the fulcrum shafts 34 while the pressing members 36A and 36B are being raised. The pressing members 36A and 36B are upwardly deformed at corresponding positions the pressing members 36A and 36B between the contact points 34a and the pressing member raising portions 39A and 39B based on the contact points 34a as a fulcrum.

[0051] When the pressing members 36A and 36B are upwardly deformed, the contact point 34a and an end of an attaching portion of the pressure arm 33 are lowered with counterforce. The pressure roller 30 attached to the end of the pressure arm 33 is thus pressed against the driving roller 29. In this process, the eight pressure rollers 30 arranged in the central portion of the pressurizing-releasing mechanism 32 based on the central locating reference CL have the pressure applied higher than the four pressure rollers 30 arranged at each side of the pressurizing-releasing mechanism 32 illustrated in FIG. 7 by pressing force generated due to the deformations of the pressing members 36A and 36B by the pressing member raising portions 39A and 39B having different raising heights.

[0052] When the operation lever 56 is further pivotally moved in the A1 direction in FIG. 9 and the rotational shaft 38 pivotally rotates in the B2 direction (i.e., counterclockwise direction) via the linkage mechanism 57 and the output lever 60, the raising levels (i.e., heights) may be further restricted by causing the rotation stopper 37 of the pressurizing-releasing member 37 to abut the main body frame 31 as illustrated in FIGS. 10 to 12. The rotation stopper 42 (or limiter) may be configured as a rotation limiter and arranged at the operation lever 56 side illustrated in FIG. 9.

[0053] Next, operations of the pressurizing-releasing mechanism 32 when pressure is released are described. In FIG. 9, when the operation lever 56 pivotally moves in a B1 direction, the rotational shaft 38 rotates in an A2 direction (i.e., clockwise direction) via the linkage mechanism 57 and the output lever 60, and the pressurizing-releasing members 37A and 37B are simultaneously moved in downward directions. As the pressurizing-releasing members 37A and 37B are lowered, amounts of the deformation of the pressing members 36A and 36B located above the pressurizing-releasing members 37A and 37B are decreased. When the pressing members 36A and 36B include no deformations, the pressing members 36A and 36B spontaneously lower by themselves as illustrated in FIGS. 3 and 4. In this process, there is no contact at the contact point 34a (see FIG. 10) between the fulcrum shaft 34 and the pressing member 36.

[0054] The pressing member 36 spontaneously lowered by itself contacts a pressure release fulcrum portion (not shown) of the arm holder 35, and the lowering pressing member 36 is thus stopped. The pressing member lowering portion 40 of the pressurizing-releasing member 37 (i.e., 37A and 37B) starts contacting the pressing member 36 stopped in this manner by further rotating the rotational shaft 38 in FIGS. 3 and 4 in the clockwise direction to thereby further lower the second end 36b of the pressing member 36. The pressure arm 33 is raised from the driving roller 29 in a direction where the pressure arm 33 moves away from the driving roller 29 by further lowering the second end 36b of the pressing member 36 in contact with the pressure release fulcrum portion (not shown). In this process, since the pressure arm 33 is pivotally supported on the fulcrum shaft 34, the pressing member may be moved in an amount that the second end 36b of the pressing member 36 is lowered without deformation.

[0055] When the operation lever 56 is further pivotally moved in the B 1 direction in FIG. 9 and the rotational shaft 38 further rotates in the A2 direction (i.e., clockwise direction) via the linkage mechanism 57 and the output lever 60, the raising levels (i.e., heights) may be further restricted by causing the rotation stopper 41 of the pressurizing-releasing member 37 to abut the main body frame 31 as illustrated in FIG. 4. The rotation stopper 41 (or limiter) may be configured as a rotation limiter and arranged at the operation lever 56 side illustrated in FIG. 9.

[0056] According to the first embodiment, the above described configuration and operation of the image forming apparatus may provide the following characteristics and advantages. First, since the image forming apparatus includes the pressurizing-releasing mechanism 32 as a pressurizing-releasing unit, pressure may be applied to the driving roller 29 (driving roller member) via the pressure roller 30 (driven roller member) and space between the pressure roller 30 and the driving roller 29 may be maintained without providing a large space to accommodate members that apply pressure or release pressure above the pressure roller 30 (driven roller member) while reducing in size of the image forming unit 3 by reducing the space above and around the pressure roller 30. Further, since the recording head is arranged immediately behind the roller pair 29 and 30 and the guide rail 19 is arranged near and above the pressure roller 30 as a guide member of the image forming unit 3, printing may be carried out without skewing and without having a large margin. Further, since the pressurizing-releasing member 37 is formed in one component, the apparatus configuration may be simplified to decrease the number of components of the image forming apparatus and reduce the size of the image forming apparatus.

[0057] Second, when an engagement between the releasing portion of the pressurizing-releasing member 37 and the second end 36b of the pressing member 36 are released (i.e., when the applied pressure is released) and the driving roller 29 and the pressure roller 30 are in contact with each other, the pressing member 36 is arranged such that the second end 36b of the pressing member 36 comes below the nip position of the roller pair 29 and 30. Accordingly, when the pressure is applied, a large area (i.e., great length) between the first end 36a and the second end 36b of the pressing member 36 subject to elastic deformation may be obtained and a large

pressing force may thus be generated.

[0058] Third, the pressurizing-releasing member 37 is arranged approximately in parallel with the pressing member 36 and the rotational shaft 38 is located near the pressing member that has lowered at the lowest point in order to prevent the size of the pressurizing-releasing member 37 from increasing and obtain a sufficient deformation amount of the pressing member 36. With this configuration, a rotation center (i.e., the rotational shaft 38) of the pressurizing-releasing member 37 may be provided close to the pressing member 36 and thus a large deformation amount (range) may be obtained by a small radius of rotation. Accordingly, the height of the upright pressurizing-releasing member 37 (37A, 37B) may be decreased, thereby the configuration of the pressurizing-releasing member 37 may be reduced. Thus, if the pressurizing-releasing member 37 (37A, 37B) is arranged approximately in parallel with the pressing member 36 and the pressurizing-releasing member 37 (37A, 37B) is arranged in the same plane as the contact face of the rotational shaft 38, the pressing member lowering portion 40 will not be hitched on the pressing member 36. Thus, the pressing member lowering portion 40 is arranged above the contact position between with the pressurizing-releasing member 37 (37A, 37B) and the pressing member 36. With this configuration, even if the pressurizing-releasing member 37 (37A, 37B) is arranged approximately in parallel with the pressing member 36, the pressing member lowering portion 40 of the pressurizing-releasing member 37 (37A, 37B) may still be capable of lowering the pressing member 36.

[0059] Fourth, as described above, the pressurizing-releasing member 37 may acquire necessary pressing force to lower the pressing member 36 while controlling an increase in the size of the pressurizing-releasing member 37. Note that the pressing member lowering portion 40 (step portion) of the pressurizing-releasing member 37 (37A, 37B) may be arranged below the contact position between with the pressurizing-releasing member 37 (37A, 37B) and the pressing member 36, the second end 36b of the pressing member is arranged below the contact position between with the pressurizing-releasing member 37 (37A, 37B) and the pressing member 36, and the pressurizing-releasing member 37 (37A, 37B) may be formed in a straight shape without forming the pressing member lowering portion 40 (step portion). However, with this configuration, the orientation of the pressing member 36 to be attached may be carefully checked, and thus, operability may be degraded.

[0060] Fifth, as illustrated in FIG. 7, with this configuration, the pressurizing-releasing members 37 (37A, 37B) may manage to control pressurizing or releasing of the respective four pressure rollers 30. There are two kinds of the pressurizing-releasing member 37, that is, the pressurizing-releasing members 37A and 37B arranged at different positions. The pressurizing-releasing members 37A and 37B have different heights (lengths) from the rotation center (i.e., the rotational shaft 38) to the pressing member raising portion 39, and the pressing force of the pressure roller 30 may be controlled based on the deformation amount of the pressing member 36. A distribution of the pressing force applied to the entire driving roller 29 may be changed into an approximately normal distribution by arranging the pressurizing-releasing members 37A and 37B having different heights (lengths) from the rotation center to the pressing member raising portion 39 in the shaft direction of the driving roller 29. Accordingly, when a sheet transferring reference for the sheet 10 is determined based on the central locating reference CL, the sheet 10 may be stably transferred while decreasing the number of components of the image forming apparatus.

[0061] Sixth, following advantages of the pressing member 36 may be obtained. In order to achieve two effects, that is, to prevent the first end 36a of the pressing member 36 attached to the pressure arm 33 from coming off from the pressure arm 33 due to the movement of the pressing member 36 in a thrust direction and to obtain a pressing portion to lower the pressing member 36, two pressing members that apply force to two ends of the pressure roller 30 are connected in a U-shape at the end opposite to the end where the two pressing members are attached to the pressure roller 30 via the pressure arm 33. With this configuration, the movement in the thrust direction of the two pressing members applying force to the pressure roller 30 may be limited by a side wall of the pressure arm 33 and the orthogonally connected ends of the pressing member 36. Further, the pressing member 36 may be lowered by hitching the pressing member lowering portion 40 on the orthogonally connected ends of the pressing member 36.

[0062] In addition, since the pressing member 36 is made of spring steel, the pressing member 36 may be deformed in a large deformation direction range. In general, it is difficult to make the pressing member 36 attached to the pressure arm 33 to come off from the pressure arm 33 due to the limited movement in the thrust direction. However, the pressing member 36 may be easily removed from the pressure arm 33 by applying force in an inner direction to deform the pressing member 36 in the inner direction. Thus, in the first embodiment, since the pressing member 36 is made of spring steel to decrease the spring constant, variability of the pressing force due to variability of the components and members related to the raising height of the pressing member may be reduced.

[FIRST MODIFICATION OF FIRST EMBODIMENT]

[0063] A first modification of the first embodiment is described with reference to FIGS. 13 through 15. FIG. 13 is a schematic front view illustrating a principle configuration of a pressurizing-releasing mechanism 52 according to the first modification of the first embodiment; FIG. 14 is a schematic front view illustrating operation of the pressurizing-releasing mechanism 52 when pressure

is applied; and FIG. 15 is a schematic front view illustrating operation of the pressurizing-releasing mechanism 52 when the applied pressure is released. As illustrated in FIGS. 13 to 15, an ink-jet recording apparatus according to the first modification differs from the above-described ink-jet recording apparatus according to the first embodiment in that the ink-jet recording apparatus according to the first modification includes the pressurizing-releasing mechanism 52 in place of the pressurizing-releasing mechanism 32 as illustrated in FIGS. 2 to 12. The principle configuration of the pressurizing-releasing mechanism 52 according to the first modification remains the same as that of the first embodiment except for the above difference (i.e., having the pressurizing-releasing mechanism 52 in place of the pressurizing-releasing mechanism 32).

[0064] A main difference between the pressurizing-releasing mechanism 52 and the pressurizing-releasing mechanism 32 according to the first embodiment is that the pressurizing-releasing mechanism 52 includes a rotational shaft 54 configured to pass through the pressing member 36 in place of the fulcrum shaft 34. The configuration of the pressurizing-releasing mechanism 52 according to the first modification remains the same as that of the first embodiment except for the above difference (i.e., having rotational shaft 54 passing through the pressing member 36 in place of the fulcrum shaft 34). The rotational shaft 54 includes a through hole 54a through which the pressing member 36 passes. With this configuration where the pressing member 36 passes through the through hole 54a, only one fulcrum is used for deforming the pressing member 36 when the pressure is applied to the driving roller 29 via the pressure roller, and also for moving the pressing member 36 to separate the pressure roller 30 from the roller pair 29 and 30.

[0065] In the first modification, the rotational shaft 54 needs to be used as the fulcrum shaft and the pressing member 36 needs to slide while in operation. Thus, it is preferable that the rotational shaft 54 be made of a material having excellent slidability or a shape that will not interrupt the sliding of the pressing member 36. In the first modification, since the arm holder 35 is not required, the number of components of the image forming apparatus may be further decreased. As a result, there is an advantage in addition to the advantaged obtained by the first embodiment in that the image forming apparatus according to the first modification may be formed smaller than the image forming apparatus according to the first embodiment.

[0066] As described above, based on the pressurizing-releasing mechanism 32 according to the first embodiment and the pressurizing-releasing mechanism 52 according to the first modification, a configuration necessary for a pressurizing-releasing unit as a principal part includes a pressing member having a first end and a second end, the first end being attached to a driven roller member (pressure roller 30) of a pair of a driving roller member and the driven roller member, the second end being located opposite to the first end based on a fulcrum shaft provided between the first end and the second end as a center; and a pressurizing-releasing member having a base-end and a fore-end, the base-end being attached to a pivoting shaft provided between the fulcrum shaft and the second end of the pressing member, the pressurizing-releasing member including a pressurizing portion and being configured to pivotally move, when pressure is applied, the fore-end based on the pivoting shaft (i.e., rotational shaft 38) as a center to raise the second end of the pressing member so that the pressing member is elastically deformed based on the fulcrum shaft as the center to apply pressure to the driven roller member, and a releasing portion unitarily formed in the pressurizing-releasing member together with the pressurizing portion and configured to, when the applied pressure is released, pivotally move the second end of the pressing member in a direction opposite to a direction in which the second end of the pressing member is raised based on the pivoting shaft (i.e., rotational shaft 38) as the center so that a predetermined distance is maintained between the driven roller member and the driving roller member.

[0067] That is, since the pressurizing-releasing unit is configured to rotationally support the driven roller member (i.e., pressure roller 30) via the pressing member and raise or lower the pressing member without allowing a nip position between the driven roller member (pressure roller 30) and the driving roller member (driving roller 29) to change in a range where a sheet transfer is adversely affected by appropriately setting a strength of the pressing member (spring constant and strength), regardless of the configuration of the pressurizing-releasing mechanism 32, the pressure arm 33 may not be a necessary component as a supporting member.

[0068] The pressurizing-releasing member may not be limited to the pressurizing-releasing according to the first embodiment or the pressurizing-releasing according to the first modification and may be configured to change a raising height or lowering height based on a size of a sheet. That is, in an image forming apparatus in which a sheet is transferred in a central locating reference CL, the pressing member raising portion or the pressing member lowering portion of the pressurizing-releasing member may be detachably formed or retractably formed, so that pressure may be applied to a transferred sheet to form an approximately normal distribution having a maximum pressure in a central portion of the transferred sheet based on a size of the transferred sheet.

[SECOND EMBODIMENT]

[0069] A second embodiment is described with reference to FIGS. 16 through 21. In the second embodiment, distributions of pressure applied to sheets of different sizes transferred based on a single-side locating reference SL are described with reference to FIG. 16. As illustrated in FIG. 16, the sheet 10 is stably transferred by applying pressure to the sheet 10 such that a highest pressure is

applied in the central portion in a length of a direction perpendicular to the sheet transferring direction (i.e., a sheet width direction). In FIG. 16, when the sheet 10 is transferred based on the single-side locating reference SL, a position of the sheet 10 where the highest pressure is applied may need changing based on a corresponding size of the sheet.

[0070] If the highest pressure is applied to left and right end portions of the sheet 10 in the sheet width direction instead of the central portion of the sheet 10, specifically in the image forming apparatus having a sheet transferring device configured to apply back tension to the transferring sheet 10, a transferring roller (not shown) needs to be made of a material capable of generating a large frictional force with the sheet 10. Accordingly, if the left and right end portions of the sheet 10 have slightly different pressures applied, differing transferring forces may be applied to the left and right end portions of the sheet 10 to skew the sheet 10. As a result, the sheet 10 is unstably transferred, thereby causing paper jamming or abnormal image formation. Further, if the pressure is set for a largest size of the sheet 10 such as an A0 size, the sheet 10 may be transferred based on the central locating reference CL by matching a central portion of the sheet 10 having the largest size to which pressure is applied and a central portion of a transferring range in the sheet transferring device.

[0071] A basic configuration example of the pressurizing-releasing mechanism having a switching unit according to the second embodiment is described with reference to FIGS. 17 and 18. FIG. 17 is a schematic front view illustrating a pressurizing-releasing mechanism having a switching unit configured to switch a pressure distribution in a shaft direction of plural pressure rollers based on a different size of a sheet transferred based on the single-side locating reference; and FIG. 18 is a top perspective view illustrating a main part of the pressuring-releasing mechanism having the switching unit viewed from diagonally rear top right. As illustrated in FIGS. 17 and 18, the second embodiment differs from the first embodiment in that a pressurizing-releasing mechanism 62 having a switching unit 63 is employed as a pressurizing-releasing unit in place of the pressurizing-releasing mechanism 32 in the first embodiment as illustrated in FIGS. 1 to 12. Other components and configurations of the second embodiment remain the same as those of the recording apparatus according to the first embodiment.

[0072] The pressurizing-releasing mechanism 62 in the second embodiment mainly differs from the pressurizing-releasing mechanism 32 according to the first embodiment in that pressurizing-releasing mechanism 62 includes the switching unit 63 in place of the rotational shaft 38, the pressurizing-releasing member 37, and the linkage mechanism 57. Below, an operation of the switching unit 63 differing from the first embodiment is described, and components and configuration similar to those of the first embodiment are omitted. Specifically, duplicated descriptions of the driving roller 29, plural pressure rollers aligned in the sheet width direction, the pressure arm 33 provided for each of the pressure rollers 30, the fulcrum shaft 34, the arm holder 35, and the pressing member 36 provided for each of the pressure rollers 30 are omitted. Similar to the first embodiment, the first end 36a of the pressing member 36 is pivotally attached near the pressure roller 30 attaching portion of the pressure arm 33. A length and the weight of the pressing member 36 are set such that a middle portion of the pressing member 36 is located below the fulcrum shaft 34 and the second end 36b of the pressing member 36 resides lower than the nip position of the roller pair 29 and 30.

[0073] As illustrated in FIG. 17, the switching unit 63 includes a pressure switching member 67 configured to deform the pressing member 36 based on the fulcrum shaft 34 as a center, a lever member 64 for switching a sheet size of the pressure switching member 67, and a linkage member 65 for transmitting an operation conducted by the lever member 64 to the pressure switching member 67. The pressure switching member 67 for slidably contacting or moving on the pressing member 36 may be made of polyacetal resin (POM) having excellent slidability and durability. As illustrated in FIGS. 17 and 18, the pressure switching member 67 is attached to the rotational shaft 68 such that the pressure applied to the pressing member 36 is switched by rotating the pressure switching member 67. The pressure switching member 67 may be formed of a combination of different kinds of steel metal. Note that the pressure switching member 67 (cam shape unitarily formed in an outer periphery of the rotational shaft 68) is omitted from FIG. 18; the position of the rotational shaft 68 is illustrated in FIG. 18.

[0074] As illustrated in FIG. 17, the lever member 64 is linked to the pressure switching member 67 via the linkage member 65 connected to the main body frame 31 (see FIG. 18) via a fixing pin 66. When the lever member is pivotally moved in A or B direction, the pressure switching member 67 rotates based on the movement in the A or B direction to change a deformed amount of the pressing member 36 deformed based on the fulcrum shaft 34 to switch the pressure distribution to a corresponding pressure distribution applied in the shaft direction of the driving roller 29. For example, in FIG. 17, if the lever member 64 is pivotally operated in the B direction (counterclockwise direction), the pressure switching member 67 is rotated in the B direction (counterclockwise direction) to change the deformed amount of the pressing member 36 deformed based on the fulcrum shaft 34 as a center. If the lever member 64 is pivotally operated in the A direction (clockwise direction), the pressure switching member 67 is rotated in the A direction (clockwise direction) to change the deformed amount of the pressing member 36 deformed based on the fulcrum shaft 34 as a center.

[0075] A shape of the lever member 64 is not limited to a bar shape and may be a dial shape. The linkage member 65 may be configured to transmit the operation state made by the lever member 64 to the pressure

switching member 67 in place of a gear train. The linkage member 65 may be configured to further include a drive source or a drive unit such as a drive motor or solenoid in place of the lever member 64 so that the pressure switching member 67 is automatically rotated corresponding to an appropriate sheet size.

[0076] Note that the second end 36b of the pressing member 36 in FIG. 18 is connected in the U shape. However, in order to avoid the pressure switching member 67 directly contacting or sliding on the pressing member 36, it is preferable that the second end 36b of the pressing member 36 rapidly fall by itself with its own weight when the applied pressure is released. A pair of the pressing members 36 may be connected via a plate member also used as weights at bottoms of the pressing member 36. The plate member is provided for each pair of the pressing members 36 so that the pressure switching member 67 may indirectly contact or slide on the pressing members 36 via the plate member.

[0077] Next, a shape of the pressure switching member 67 configured to switch the pressure applied to the pressure roller 30 is described with reference to FIGS. 19A through 20D. The pressure switching member 67 is eccentrically attached to the rotational shaft 68, so that the amount of deformation in the pressing member 36 is changed based on a rotational angle of the pressure switching member 67. Accordingly, a pressure distribution applied to the driving roller 29 via the pressure roller 30 in the shaft direction is switched.

[0078] For example, a section A-A (pressure switching portion 67a) in the shaft direction of a first angle of the pressure switching member 67 illustrates a simplified shape of the pressure switching portion 67a set for applying pressure corresponding to an A3 size of the sheet 10 to be transferred. If the sheet 10 is transferred based on the single-side locating reference SL and the size of the sheet 10 is A3, the pressure switching portion 67a is selected to deform the pressing member 36. The pressure switching portion 67a has a shape capable of applying the pressure to the transferred sheet 10 in an area of A3 size from the single-side locating reference SL side and in the central portion of the sheet 10 having a maximum pressure.

[0079] Similarly, a section B-B (pressure switching portion 67b) in the shaft direction of a second angle of the pressure switching member 67 illustrates a simplified shape of the pressure switching portion 67b for applying pressure corresponding to an A2 size; a section C-C (pressure switching portion 67c) in the shaft direction of a third angle of the pressure switching member 67 illustrates a simplified shape of the pressure switching portion 67c for applying pressure corresponding to an A1 size; and a section D-D (pressure switching portion 67d) in the shaft direction of a fourth angle of the pressure switching member 67 illustrates a simplified shape of the pressure switching portion 67d for applying pressure corresponding to an A0 size. The pressure switching portion 67a having the section A-A, the pressure switching portion 67b having the section B-B, the pressure switching portion 67c having the section C-C, and the pressure switching portion 67d having the section D-D are unitarily formed with the pressure switching member 67. The pressure switching portion 67a having the section A-A, the pressure switching portion 67b having the section B-B, the pressure switching portion 67c having the section C-C, and the pressure switching portion 67d having the section D-D are continuously or intermittently formed in the pressure switching member 67 in the shaft direction of the pressure switching member 67.

[0080] Pressure distribution switching states switched by the switching unit 63 of the pressurizing-releasing mechanism 62 are described with reference to FIGS. 21A through 21E. FIG. 21A is a schematic view illustrating the pressure roller 30 when the applied pressure is released; FIG. 21B is a schematic view illustrating the pressure roller 30 when pressure is applied corresponding to the A3 size (a minimum size capable of transferring and passing the sheet through the nip); FIG. 21C is a schematic view illustrating the pressure roller 30 when pressure is applied corresponding to the A2 size; FIG. 21D is a schematic view illustrating the pressure roller 30 when pressure is applied corresponding to the A1 size; and FIG. 21E is a schematic view illustrating the pressure roller 30 when pressure is applied corresponding to the A0 size (a maximum size capable of passing the sheet through the nip). FIGS. 21A through 21E schematically illustrate expansion and contraction of springs which represent levels of applied pressure. (FIG. 21A) Pressure roller 30 when applied pressure is released:

[0081] The pressure switching member 67 resides in a position to release the applied pressure so that the pressing member 36 is released from elastic deformation. The pressure roller 30 resides in a predetermined distance from the driving roller 29 (applied pressure is released).

This state is used when abnormal operation such as paper jamming has occurred. (FIG. 21B) Pressure roller 30 when pressure is applied corresponding to the A3 size (a minimum size capable of transferring and passing the sheet through the nip):

> The pressure switching member 67 resides at the first angle illustrated in FIG. 19A to generate the pressure applied to the pressure roller 30 by deforming the pressing member 36 attached to the pressure roller 30 arranged in an A3 size sheet passing area. With this configuration, pressure is applied to the sheet by setting a largest deformation amount of the pressing member 36 corresponding to a central portion of the A3 size sheet based on the shape of the pressure switching portion 67a of the pressure switching member 67 residing at the first angle.

[0082] (FIG. 21C) Pressure roller 30 when pressure is applied corresponding to the A2 size:

The pressure switching member 67 resides at the second angle illustrated in FIG. 19A to generate the pressure applied to the pressure roller 30 by deforming the pressing member 36 attached to the pressure roller 30 arranged in an A2 size sheet passing area. With this configuration, pressure is applied to the sheet by setting a largest deformation amount of the pressing member 36 corresponding to a central portion of the A2 size sheet based on the shape of the pressure switching portion 67b of the pressure switching member 67 residing at the second angle.

[0083] (FIG. 21D) Pressure roller 30 when pressure is applied corresponding to the A1 size:

The pressure switching member 67 resides at the third angle illustrated in FIG. 19A to generate the pressure applied to the pressure roller 30 by deforming the pressing member 36 attached to the pressure roller 30 arranged in an A1 size sheet passing area. With this configuration, pressure is applied to the sheet by setting a largest deformation amount of the pressing member 36 corresponding to a central portion of the A1 size sheet based on the shape of the pressure switching portion 67c of the pressure switching member 67 residing at the third angle.

[0084] (FIG. 21E) Pressure roller 30 when pressure is applied corresponding to the A0 size (a maximum size capable of passing the sheet through the nip):

The pressure switching member 67 resides at the fourth angle illustrated in FIG. 19A to generate the pressure applied to the pressure roller 30 by deforming the pressing member 36 attached to the pressure roller 30 arranged in an A0 size sheet passing area. With this configuration, pressure is applied to the sheet by setting a largest deformation amount of the pressing member corresponding to a central portion of the A0 size sheet based on the shape of the pressure switching portion 67d of the pressure switching member 67 residing at the fourth angle.

[0085] The driving roller 29 is a unitarily formed roller (roller member) and the pressure roller 30 includes plural (in this case, four) rollers (roller members) aligned in the shaft direction of the pressure roller 30 corresponding to the driving roller 29. The pressure roller 30 generates pressure determined based on the deformation amount of the pressing member 36, and the pressure generated by the pressure roller 30 is applied to the sheet 10 to drive the driving roller 29. As a result, the sheet 10 is transferred by driving the driving roller 29. The deformation amount of the pressing member 36 is controlled by the pressure switching member 67 capable of switching the applied pressure by abutting the pressing member 36. The pressure switching member 67 rotates at a position where the applied pressure is released when abnormal operation such as paper jamming has occurred so that the pressing member 36 is located at an angle where the deformation of the pressing member 36 is released. When the sheet 10 is transferred, the pressure switching member 67 is set at a rotational angle corresponding to a size of the sheet 10 by operating the lever member 64.

[0086] For example, if the sheet 10 is the A3 size, and the lever member 64 is operated to cause the pressure switching member 67 to deform the pressing member 36 at the first angle, plural pressure rollers 30 residing in the area corresponding to the A3 size from single-side locating reference SL side generate pressure to be applied to the sheet 10, and the highest pressure is applied to the central portion of the sheet 10. Note that a not-shown locking member is configured to lock the lever member 64 at a corresponding one of positions of the first to fourth angles, and in this process, the lever member 64 is locked at a position corresponding to the first angle. Accordingly, the transferring force is mainly applied to the central portion of the sheet 10, so that the skewness of the sheet 10 obtained due to differing pressures applied to two (left and right) ends of the sheet 10 in the sheet width direction may be prevented. As a result, the sheet 10 may be stably transferred.

[0087] In addition, since the pressure is not applied to the sheet 10 in an area outside of the sheet transferring area, the amount of force applied to the driving roller 29 may be reduced. Accordingly, a load applied to a not-shown drive source for the driving roller 29 may also be reduced.

[SECOND MODIFICATION OF SECOND EMBODIMENT]

[0088] In a second modification of the second embodiment, another configuration example of the pressure switching unit configured to switch a pressure distribution is described with reference to FIGS. 22A through 23D. As illustrated in FIGS. 22A through 23D, the second modification mainly differs from the second embodiment in that a pressurizing-releasing mechanism 72 having a switching unit 73 is employed as a pressurizing-releasing unit in place of the pressurizing-releasing mechanism 62 in the second embodiment as illustrated in FIGS. 17 through 21D.

[0089] The pressurizing-releasing mechanism 72 in the second modification mainly differs from the pressurizing-releasing mechanism 62 according to the second embodiment in that pressurizing-releasing mechanism 72 includes a pressurizing-releasing member 70 and a switching unit 73 having a pressure switching member 77 in place of the switching unit 63 having the pressure switching member 67. The configuration of the recording apparatus according to the second modification remains the same as that of the second embodiment except for the above differences. Below, configurations and operations of the pressurizing-releasing member 70 and the

switching unit 73 having the pressure switching member 77 differing from the second embodiment are mainly described, and duplicated descriptions of the driving roller 29, plural pressure rollers aligned in the sheet width direction, the pressure arm 33 provided for each of the pressure rollers 30, the fulcrum shaft 34, the arm holder 35, and the pressing member 36 provided for each of the pressure rollers 30 are omitted. Note that the fulcrum shaft 34 and the arm holder 35 are not shown in FIGS. 22A and 22B.

[0090] As illustrated in FIGS. 22A through 23D, the pressure switching member 77 in the second modification includes pairs of pressure switching members 77a, 77b, 77c, and 77d that are attached to the rotational shaft 68 corresponding to different sizes of the transferring sheet 10 in the rotational shaft 68 direction. The pressurizing-releasing members 70 are combined with the corresponding pairs of the pressure switching members 77a, 77b, 77c, and 77d. The pressurizing-releasing member 70 includes a step-shape and is rotationally attached to the rotational shaft 68. The pressurizing-releasing members 70 are located between the two switching members of the corresponding pairs of pressure switching members 77a, 77b, 77c, and 77d in the rotational shaft 68 direction.

[0091] As illustrated in FIGS. 23A through 23D, when the pressure switching members 77a, 77b, 77c, and 77d are operated such that rotational angles of the pressure switching members 77a, 77b, 77c, and 77d are in positions to release the pressure rollers 30, the second ends 36b of the pressing members 36 hitch on the step portions of the pressurizing-releasing members 70 so that the pressure rollers 30 are separated from the driving rollers 29 by moving the pressurizing-releasing members 70 in downward directions and the pressure rollers 30 are then retained at separated positions. Operations of pressurizing the driving rollers 29 are the same as those described in the second embodiment, and the descriptions thereof are thus omitted.

[0092] As described above, according to the second embodiment and second modification, the pressure applied to the sheet 10 by the pressure roller 30 may be appropriately switched in a stepwise fashion such that transfer force is applied to a central portion of the sheet 10 based on a corresponding one of different sizes of the sheet 10 (in a sheet size range of a narrow size to a wide size). As a result, a stable sheet transfer state in transferring the sheet may be obtained even if the sheet locating reference is any one of the single-side locating reference SL and the center locating reference CL.

[0093] As illustrated in FIG. 2, the image forming unit 3 according to the first embodiment, the second embodiment, the first modification, and the second modification (hereinafter simply called "embodiments") is arranged in an upper side of the nip position of the transfer roller pair 29 and 30. However, the image forming unit 3 according to the embodiments is not limited to being arranged in the upper side of the nip position of the transfer roller pair 29 and 30, and may be arranged in a lower side of the nip position of the transfer roller pair 29 and 30. In this case, (when the image forming unit 3 is arranged in the lower side of the nip position of the transfer roller pair 29 and 30) the pressurizing-releasing members 70 and the second ends of the pressing members are arranged at in the upper side that is an opposite side of the guide member of the image forming unit 3. Similarly, in the above embodiments, the pressure roller 30 (driven roller member) resides on the driving roller 29 (driving roller member) or on the upper side of the driving roller 29. However, the pressure roller 30 is not limited to residing on or above the driving roller 29. The pressure roller 30 may reside beneath the driving roller 29 and the driving roller 29 may be arranged on or above the pressure roller 30.

[0094] The descriptions of exemplary embodiments and modifications for implementing the invention have been provided heretofore. The present invention is not limited to these embodiments and modifications, but various combinations and variations thereof may be optionally made without departing from the scope of the present invention. For example, the material of the pressing member 36 is not limited to the spring wire, but may be a plate spring. Materials of the components and members are not limited to those described in the specification, and may be selected from known materials capable of implementing the corresponding functions. In addition, the image forming unit 3 is not limited to the serial ink-jet recording apparatus but may be a line ink-jet recording apparatus, an electrophotographic image forming apparatus, or a multifunctional peripheral or printing apparatus including combinations of these functions.

[0095] According to the embodiments, the novel image forming apparatus that substantially eliminates one or more problems caused by the limitations and disadvantages of the related art has been proposed. With the aforementioned embodiments, the following effects may be obtained.

[0096] In one embodiment, there is provided an image forming apparatus that includes an image forming unit configured to form an image on a sheet transferred thereto; a pair of a driving roller member and a driven roller member arranged at an upstream side of the image forming unit, the driving roller member being configured to transfer the sheet toward an image forming region of the image forming unit, the driven roller member being configured to be brought into contact with the driving roller member or be detached from the driving roller member; and a pressurizing-releasing unit configured to apply pressure to the driving roller member via the driven roller member and release the applied pressure therefrom via the driven roller member. In the image forming apparatus, the pressurizing-releasing unit includes a pressing member having a first end and a second end, the first end being ttached to the driven roller member and the second end being located opposite to the first end based on a fulcrum shaft as a center residing between the first end

and the second end; and a pressurizing-releasing member having a base-end and a fore-end, the base-end attached to a pivoting shaft provided between the fulcrum shaft and the second end of the pressing member. The pressurizing-releasing member of the pressurizing-releasing unit includes a pressurizing portion and is configured to pivotally move, when pressure is applied, the fore-end based on the pivoting shaft as a center to raise the second end of the pressing member so that the pressing member is elastically deformed based on the pivoting shaft as the center to apply pressure to the driven roller member, and a releasing portion unitarily formed with the pressurizing portion and configured to, when the applied pressure is released, pivotally move the second end of the pressing member in a direction opposite to a direction in which the second end of the pressing member is raised based on the pivoting shaft as the center so that a predetermined distance is maintained between the driven roller member and the driving roller member.

[0097] In another embodiment, there is provided an image forming apparatus in which the pressurizing-releasing unit further includes a supporting member having a first end configured to rotationally support the driven roller member and a second end configured to be pivotally supported by the fulcrum shaft.

[0098] In another embodiment, there is provided the image forming apparatus in which the releasing portion of the pressurizing-releasing unit includes a first abutting face configured to abut the second end of the pressing member and a step portion having a second abutting face configured to abut the second end of the pressing member at a position higher than the first abutting face abutting the second end of the pressing member.

[0099] With these configurations, the image forming apparatus according to the above embodiments may be capable of applying pressure on the driving roller member (driving roller 29) via the driven roller member (the pressure roller 30) and release the applied pressure from the driving roller member by retaining a distance between the driven roller member and the driving roller member without having a large space for accommodating the members that apply pressure and release the applied pressure. In addition, the image forming apparatus may be reduced in size by reducing space in the periphery of the driven roller member. Further, since the recording head is arranged immediately behind the roller member pair (the roller pair 29 and 30) and the guide member (the guide rail 19) is arranged near and above the driven roller member (the pressure roller 30) of the image forming unit (image forming unit 3), printing may be carried out without skewing and without having a large margin. Further, since the pressurizing-releasing member is formed in one component, the apparatus configuration may be simplified to decrease the number of components of the image forming apparatus and reduce the size of the image forming apparatus.

[0100] In another embodiment, there is provided the image forming apparatus in which when an engagement between the releasing portion of the pressurizing-releasing unit and the second end of the pressing member is released and the driven roller member is in contact with the driving roller member, and the second end of the pressing member is located below a nip position of the pair of the driving roller member and the driven roller member.

[0101] With this configuration, when the pressure is applied, a large area (i.e., great length) between the first end and the second end of the pressing member subj ect to elastic deformation may be obtained and the large pressing force may thus be generated.

[0102] In another embodiment, there is provided the image forming apparatus in which the pair of the driving roller member and the driven roller member is configured to transfer the sheet based on a center locating reference, where the driven roller member includes plural pressure rollers aligned in a shaft direction of the driven roller member, the driving roller member includes plural driving rollers located at positions to face the plural pressure rollers, the pressing member includes plural pressing members having a same spring constant and a same shape that are provided corresponding to the plural pressure rollers, and the pressurizing portion includes different pressing member raising portions having different raising heights corresponding to the plural pressure rollers such that pressure applied to the transferred sheet forms an approximately normal distribution where a central portion of the sheet includes a maximum pressure.

[0103] In another embodiment, there is provided the image forming apparatus that further includes a switching unit configured to switch a pressure distribution in the shaft direction of the plural pressure rollers based on a corresponding one of different sizes of transferrable sheets. In the image forming apparatus, the pair of the driving roller member and the driven roller member is configured to transfer the sheet based on a single-side locating reference, the driven roller member includes the plural pressure rollers aligned in the shaft direction of the driven roller member, and the driving roller member includes the plural driving rollers located at the positions to face the plural pressure rollers.

[0104] In another embodiment, there is provided the image forming apparatus in which the switching unit applies pressure to the transferred sheet such that the applied pressure forms an approximately normal distribution where a central portion of the transferred sheet includes a maximum pressure.

[0105] In another embodiment, there is provided the image forming apparatus in which the switching unit includes a lever member configured to switch pressure applied to the transferred sheet in a stepwise fashion so that the pressure applied to the transferred sheet is changed based on a corresponding one of plural sheet sizes of transferrable sheets.

[0106] In another embodiment, there is provided an image forming apparatus in which a sheet is capable of being transferred based on a single-side locating refer-

ence and a center locating reference by setting the pressure distribution switched by the switching unit corresponding to a maximum sheet size of plural sheet sizes of transferrable sheets.

[0107] In another embodiment, there is provided the image forming apparatus in which the image forming unit includes a carriage containing a recording head to ejects liquid drops to form the image on the sheet transferred thereto while moving in a main-scanning direction along a guide member provided at an upstream side in a sheet transferring direction of an image forming region of the image forming unit, the pressurizing-releasing member and the second end of the pressing member are arranged at a lower side of the guide member, and when the pressure is applied, the pressurizing portion pivotally moves toward the guide member to raise the second end of the pressing member such that a predetermined distance is maintained between the second end of the pressing member and a lower end of the guide member.

[0108] With this configuration, when a sheet transferring reference for the sheet is determined based on the central locating reference, the sheet may be stably transferred while decreasing the number of components of the image forming apparatus.

[0109] With these configurations, the pressure applied to the sheet by the driven roller member (pressure roller) may be switched such that transfer force is applied to a central portion of the sheet based on a corresponding one of different sizes of the sheet, so that a stable sheet transfer state may be obtained corresponding to one of the single-side locating reference SL and the center locating reference CL.

[0110] The descriptions of exemplary embodiments for implementing the invention have been provided heretofore. The present invention is not limited to these embodiments, but various variations and modifications may be made without departing from the scope of the present invention.

Claims

1. An image forming apparatus comprising:

   an image forming unit configured to form an image on a sheet transferred thereto;
   a pair of a driving roller member and a driven roller member arranged at an upstream side of the image forming unit, the driving roller member being configured to transfer the sheet toward an image forming region of the image forming unit, the driven roller member being configured to be brought into contact with the driving roller member or be detached from the driving roller member; and
   a pressurizing-releasing unit configured to apply pressure to the driving roller member via the driven roller member and release the applied pressure therefrom via the driven roller member,
   wherein the pressurizing-releasing unit includes
   a pressing member having a first end and a second end, the first end being attached to the driven roller member, the second end being located opposite to the first end based on a fulcrum shaft as a center residing between the first end and the second end; and
   a pressurizing-releasing member having a base-end and a fore-end, the base-end being attached to a pivoting shaft provided between the fulcrum shaft and the second end of the pressing member, the pressurizing-releasing member including
   a pressurizing portion and being configured to pivotally move, when pressure is applied, the fore-end based on the pivoting shaft as a center to raise the second end of the pressing member so that the pressing member is elastically deformed based on the pivoting shaft as the center to apply pressure to the driven roller member, and
   a releasing portion unitarily formed with the pressurizing portion and configured to, when the applied pressure is released, pivotally move the second end of the pressing member in a direction opposite to a direction in which the second end of the pressing member is raised based on the pivoting shaft as the center so that a predetermined distance is maintained between the driven roller member and the driving roller member.

2. The image forming apparatus as claimed in claim 1, wherein the pressurizing-releasing unit further includes a supporting member having a first end configured to rotationally support the driven roller member and a second end configured to be pivotally supported by the fulcrum shaft.

3. The image forming apparatus as claimed in claim 1 or 2,
   wherein when an engagement between the releasing portion of the pressurizing-releasing unit and the second end of the pressing member is released and the driven roller member is in contact with the driving roller member, the second end of the pressing member is located below a nip position of the pair of the driving roller member and the driven roller member.

4. The image forming apparatus as claimed in claim 1, 2 or 3,
   wherein the releasing portion of the pressurizing-releasing unit includes a first abutting face configured to abut the second end of the pressing member and a step portion having a second abutting face configured to abut the second end of the pressing member at a position higher than the first abutting face abut-

ting the second end of the pressing member.

5. The image forming apparatus as claimed in claim 4, further comprising:

a fulcrum shaft holding member attached to a main body of the image forming apparatus to hold the fulcrum shaft and including a contact portion on which the pressing member rests when the applied pressure is released,
wherein the pressurizing-releasing member includes a first limiter configured to limit, after the second end of the pressing member and the step portion are engaged, lowering of the releasing portion by causing the first limiter to abut a frame of the main body at a side of the fulcrum shaft holding member when the applied pressure is released.

6. The image forming apparatus as claimed in claim 5, wherein the fulcrum shaft holding member includes a shaft deformation preventing portion unitarily formed with the contact portion of the fulcrum shaft holding member and configured to prevent the fulcrum shaft from being deformed.

7. The image forming apparatus as claimed in any one of claims 1 to 6,
wherein the pressurizing-releasing member further includes a bending portion with which the pressing member is slidably in contact and a second limiter unitarily formed with the bending portion and configured to limit pivotally moving of the pressurizing-releasing member based on the pivoting shaft as the center by engaging the second limiter with a frame of the main body of the image forming apparatus when the pressure is applied.

8. The image forming apparatus as claimed in any one of claims 1 to 7,
wherein the fulcrum shaft is located below the nip position of the pair of the driving roller member and the driven roller member.

9. The image forming apparatus as claimed in any one of claims 1 to 8,
wherein the pair of the driving roller member and the driven roller member is configured to transfer the sheet based on a center locating reference,
the driven roller member includes plural pressure rollers aligned in a shaft direction of the driven roller member,
the driving roller member includes plural driving rollers located at positions to face the plural pressure rollers,
the pressing member includes plural pressing members having a same spring constant and a same shape that are provided corresponding to the plural pressure rollers, and
the pressurizing portion includes different pressing member raising portions having different raising heights corresponding to the plural pressure rollers such that pressure applied to the transferred sheet forms an approximately normal distribution where a central portion of the sheet includes a maximum pressure.

10. The image forming apparatus as claimed in any one of claims 1 to 8, further comprising:

a switching unit configured to switch a pressure distribution in the shaft direction of the plural pressure rollers based on corresponding different sizes of transferrable sheets,
wherein the pair of the driving roller member and the driven roller member is configured to transfer the sheet based on a single-side locating reference,
the driven roller member includes the plural pressure rollers aligned in the shaft direction of the driven roller member, and
the driving roller member includes the plural driving rollers located at the positions to face the plural pressure rollers.

11. The image forming apparatus as claimed in claim 10, wherein the switching unit applies pressure to the transferred sheet such that the applied pressure forms an approximately normal distribution where a central portion of the transferred sheet includes a maximum pressure.

12. The image forming apparatus as claimed in claim 10 or 11,
wherein the switching unit includes a lever member configured to switch pressure applied to the transferred sheet in a stepwise fashion so that the pressure applied to the transferred sheet is changed based on a corresponding one of plural sheet sizes of transferrable sheets.

13. The image forming apparatus as claimed in any one of claims 10 to 12,
wherein a sheet is capable of being transferred based on a single-side locating reference and a center locating reference by setting the pressure distribution switched by the switching unit corresponding to a maximum sheet size of plural sheet sizes of transferrable sheets.

14. The image forming apparatus as claimed in any one of claims 1 to 13,
wherein the image forming unit includes a carriage containing a recording head to ejects liquid drops to form the image on the sheet transferred thereto while moving in a main-scanning direction along a guide

member provided at an upstream side in a sheet transferring direction of an image forming region of the image forming unit,
the pressurizing-releasing member and the second end of the pressing member are arranged at a lower side of the guide member, and
when the pressure is applied, the pressurizing portion pivotally moves toward the guide member to raise the second end of the pressing member such that a predetermined distance is maintained between the second end of the pressing member and a lower end of the guide member.

FIG.1

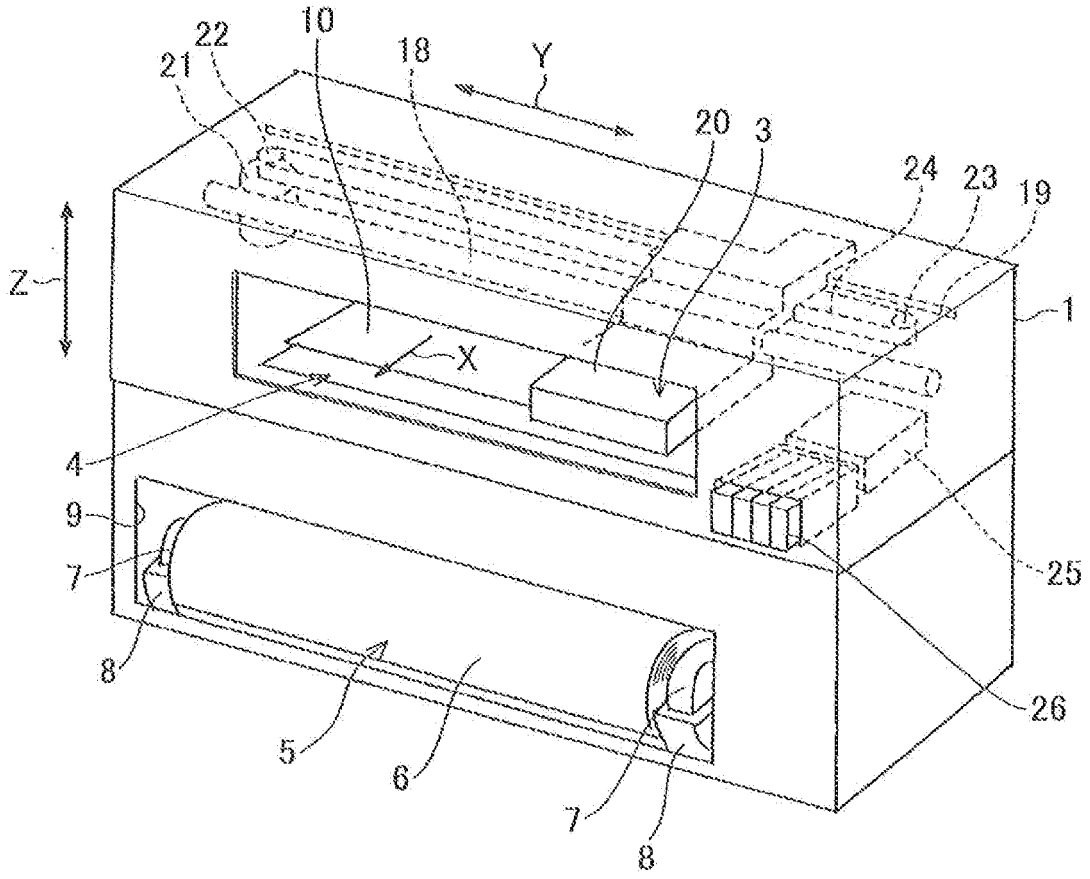


FIG.2

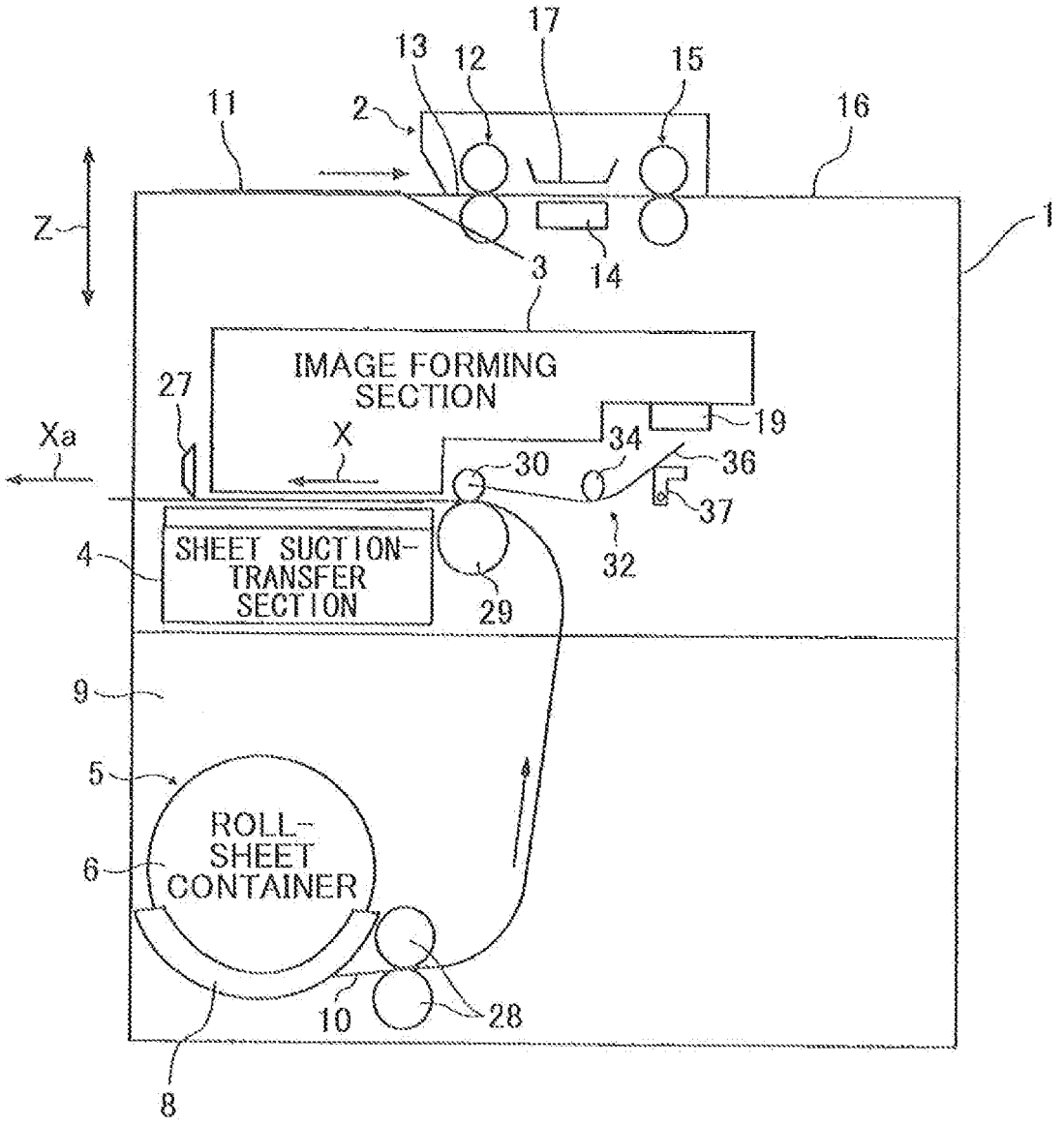

17
13
12
15
11
2
16
Z
1
3
14
IMAGE FORMING SECTION
27
19
Xa
X
34
30
36
37
SHEET SUCTION-TRANSFER SECTION
4
32
29
9
5
ROLL-SHEET CONTAINER
6
10
28
8

FIG.3

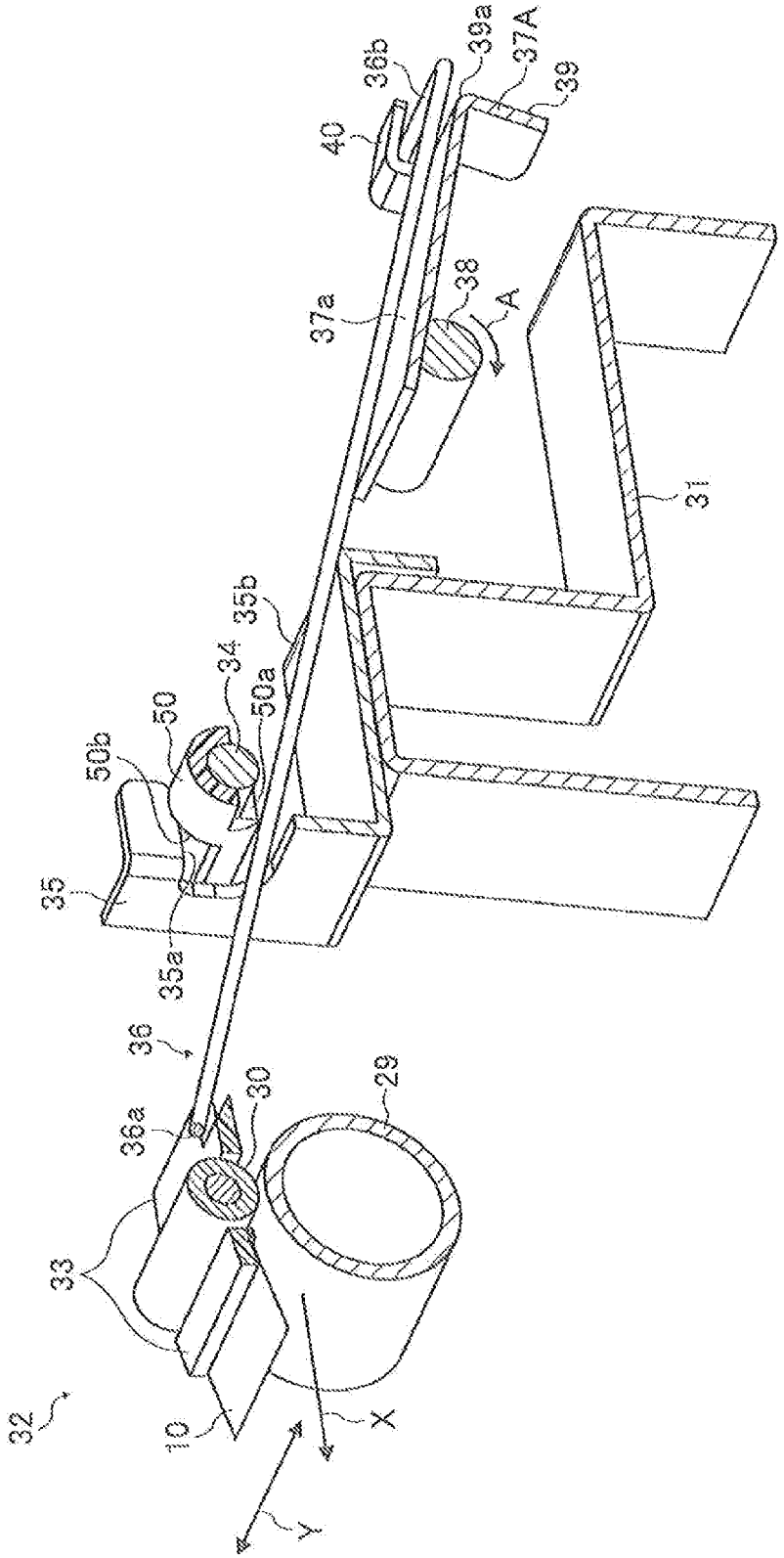

36b
39a
37A
39
40
37a
38
A
31
35b
34
50a
50
50b
35
35a
36
36a
30
29
33
32
10
X
Y

FIG.4

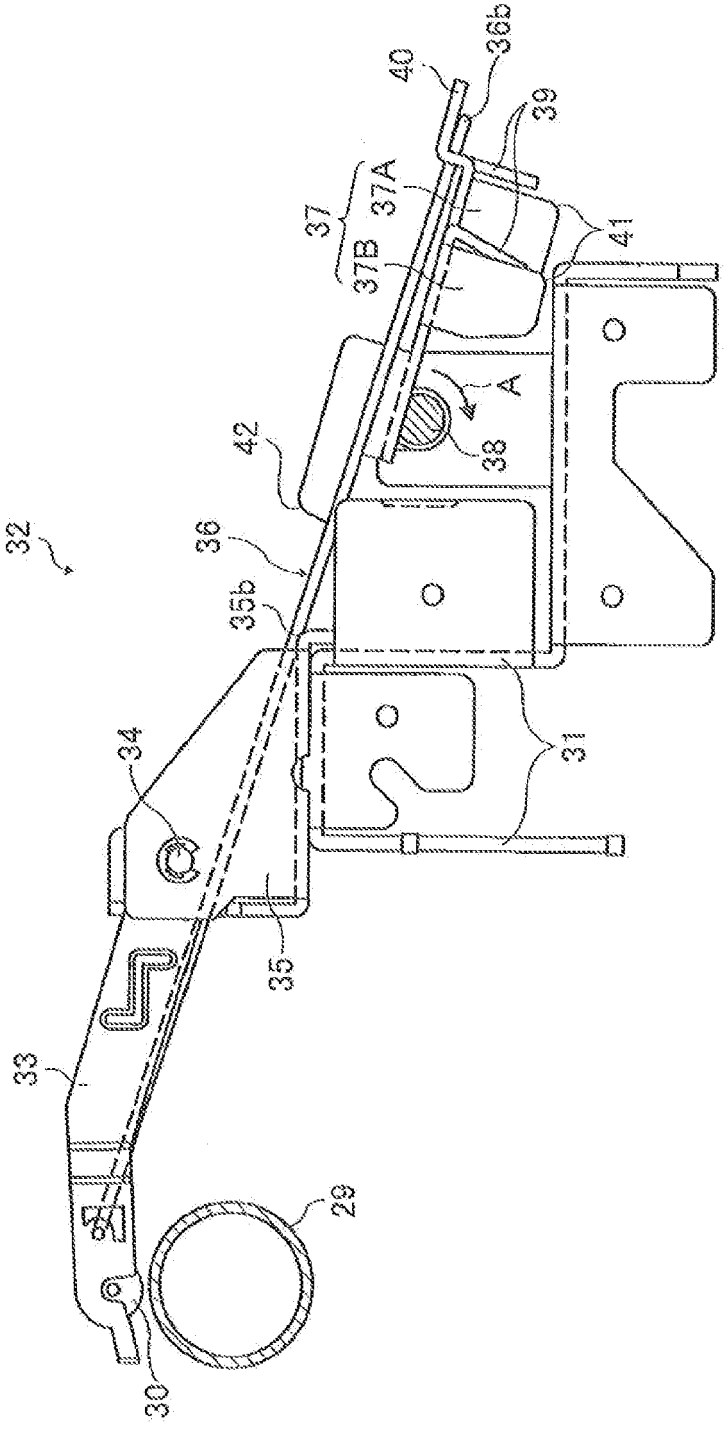


FIG.5

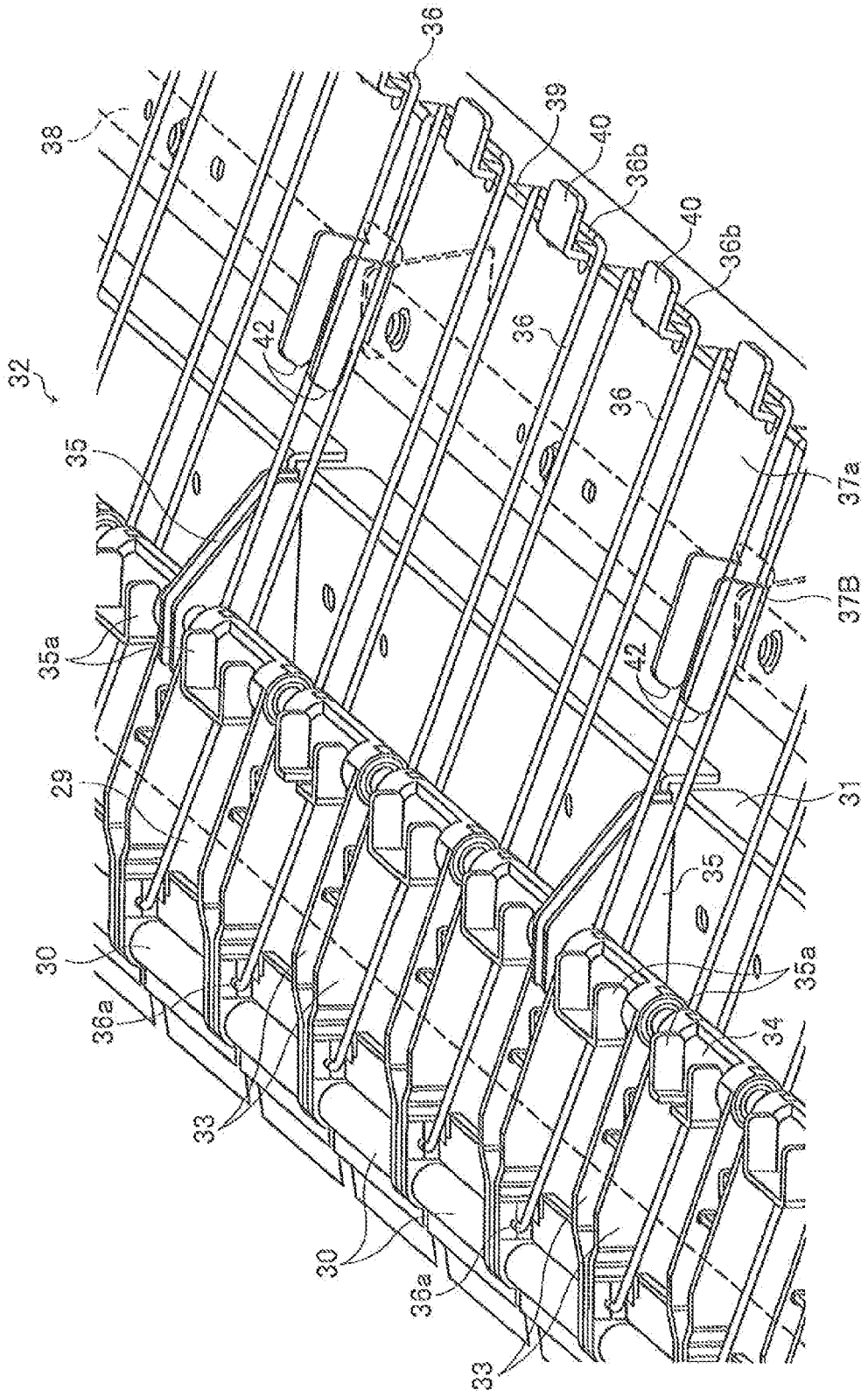

36
38
39
40
36b
40
36b
42
36
36
32
35
37a
37B
35a
42
29
31
35
30
35a
36a
34
33
30
36a
33

FIG.6

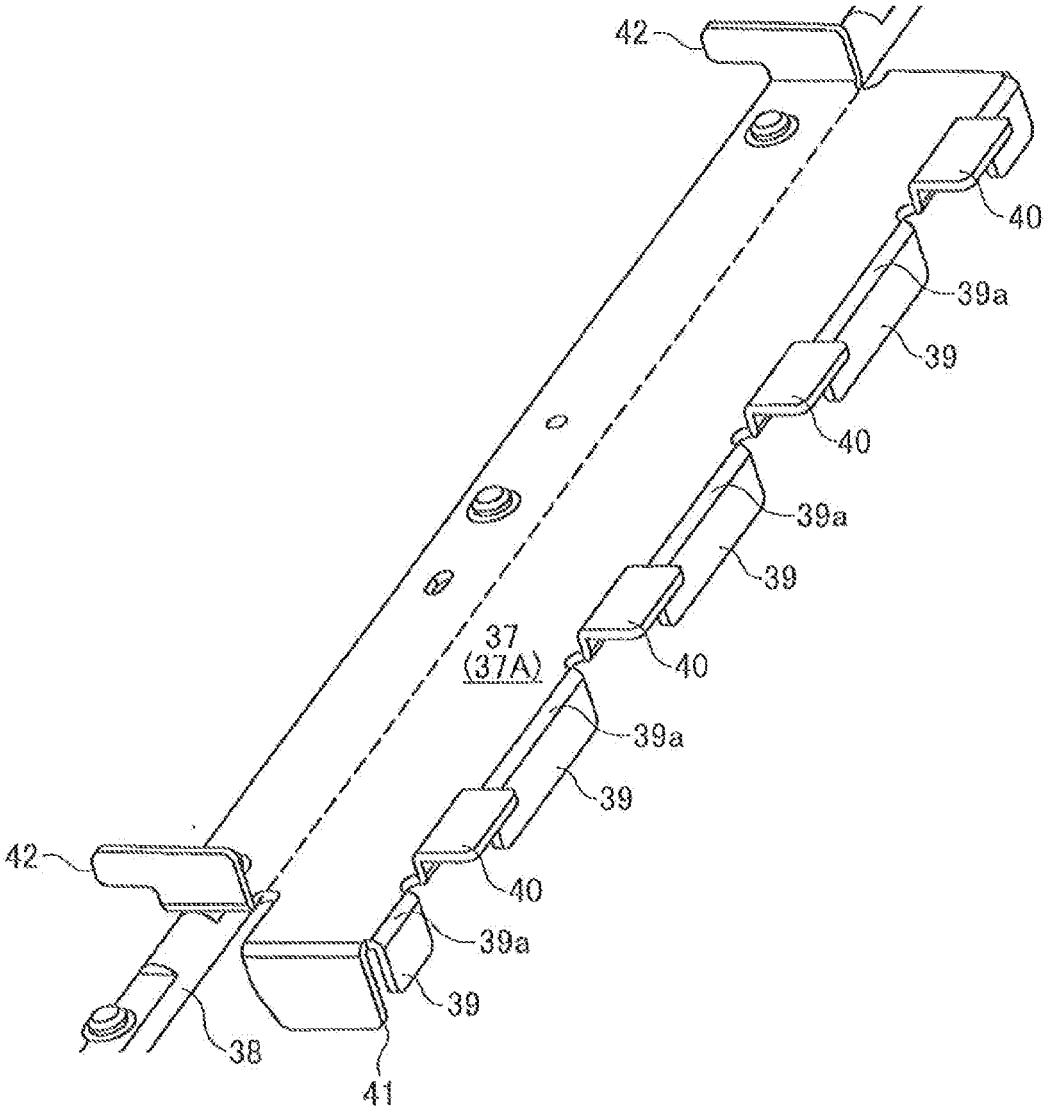


FIG.7

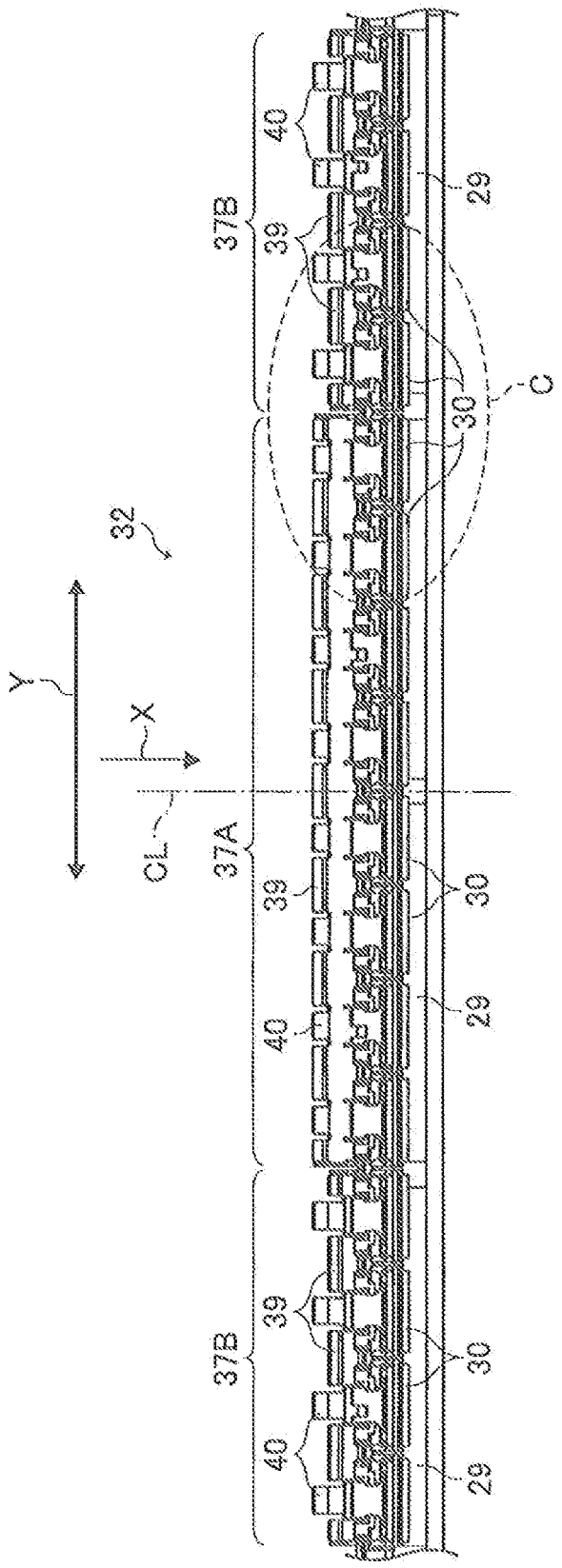


FIG.8

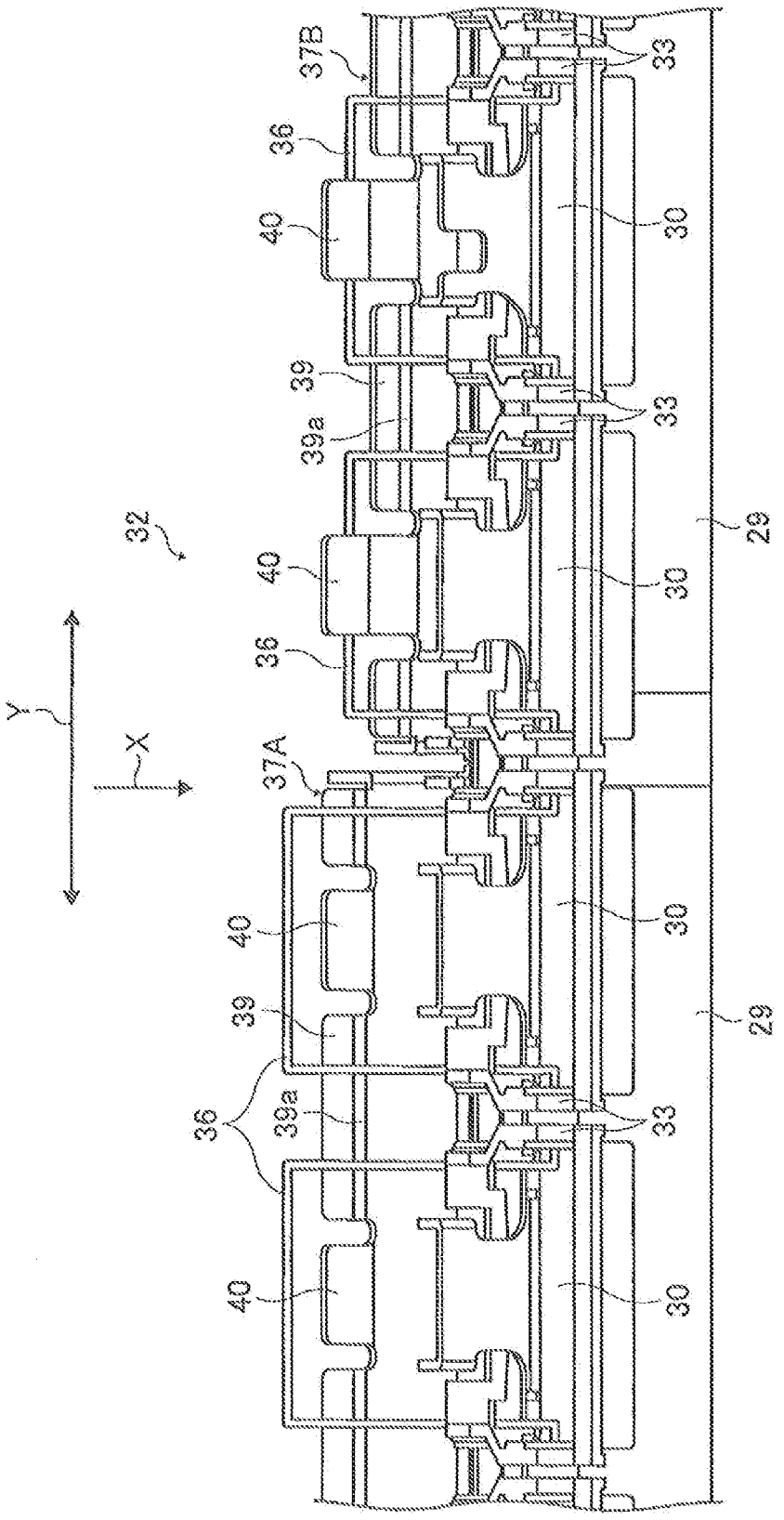


FIG.9

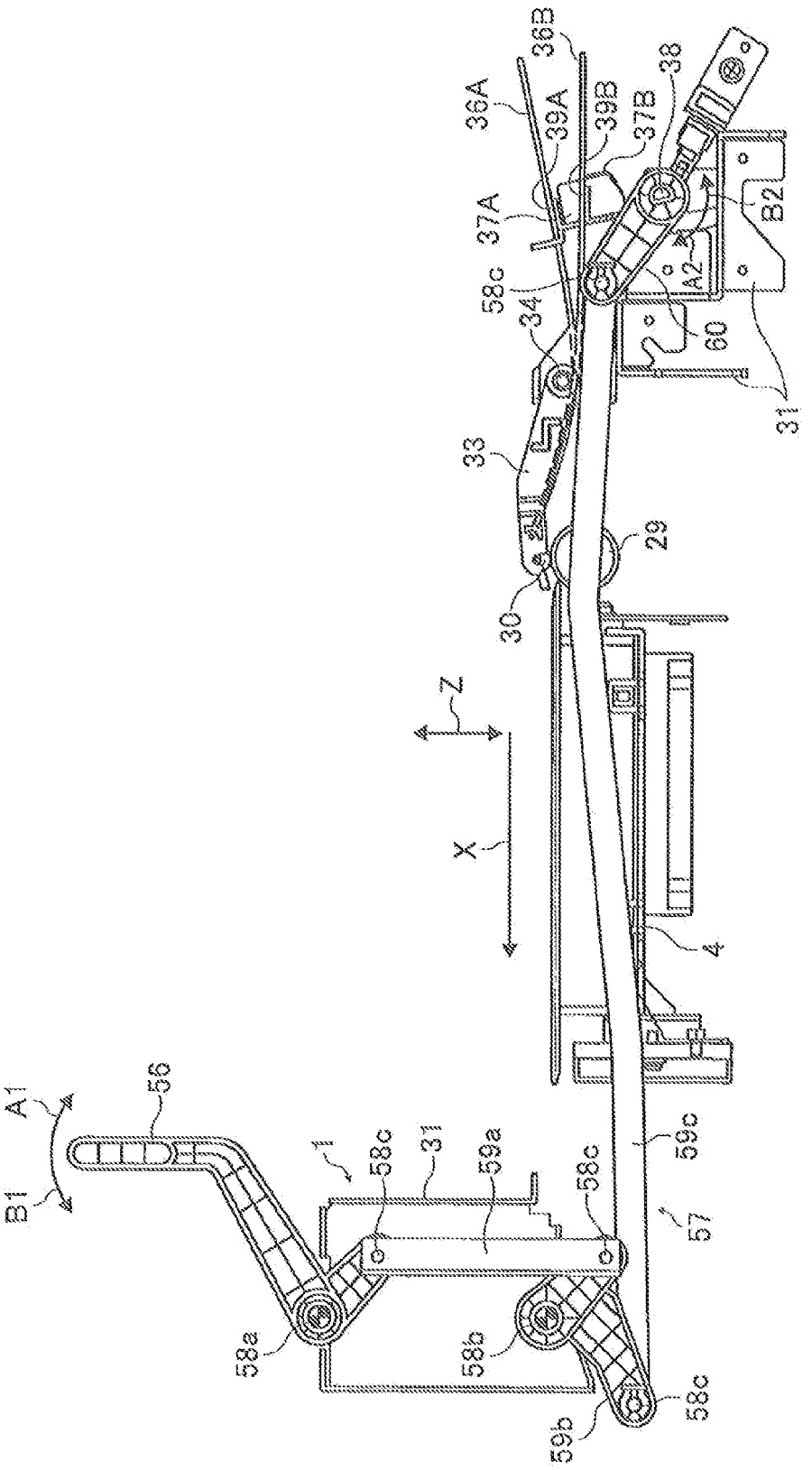

36B
36A
39A
39B
37B
38
37A
B2
A2
58c
34
60
31
33
29
30
Z
X
4
A1
56
B1
1
58c
31
59a
58c
59c
57
58a
58b
58c
59b

FIG.10

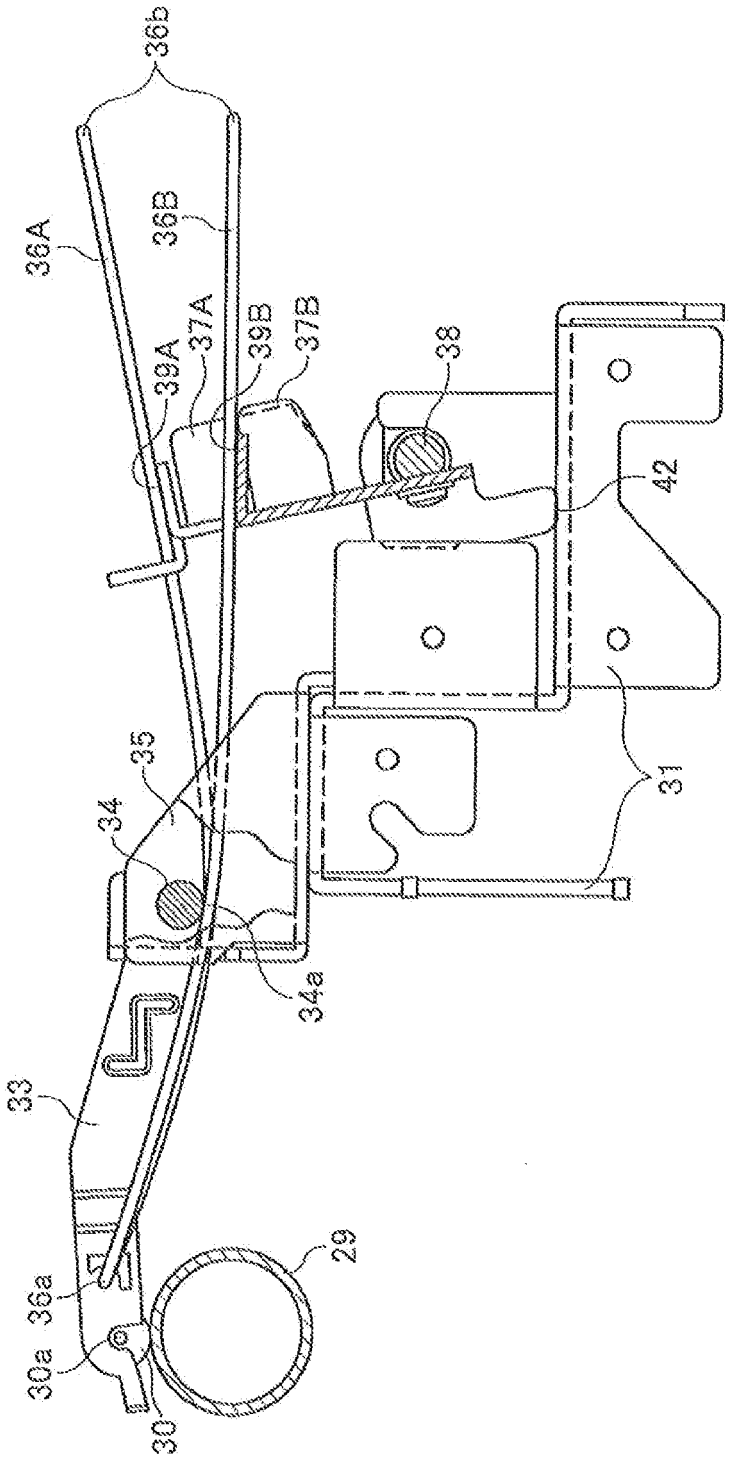


FIG.11

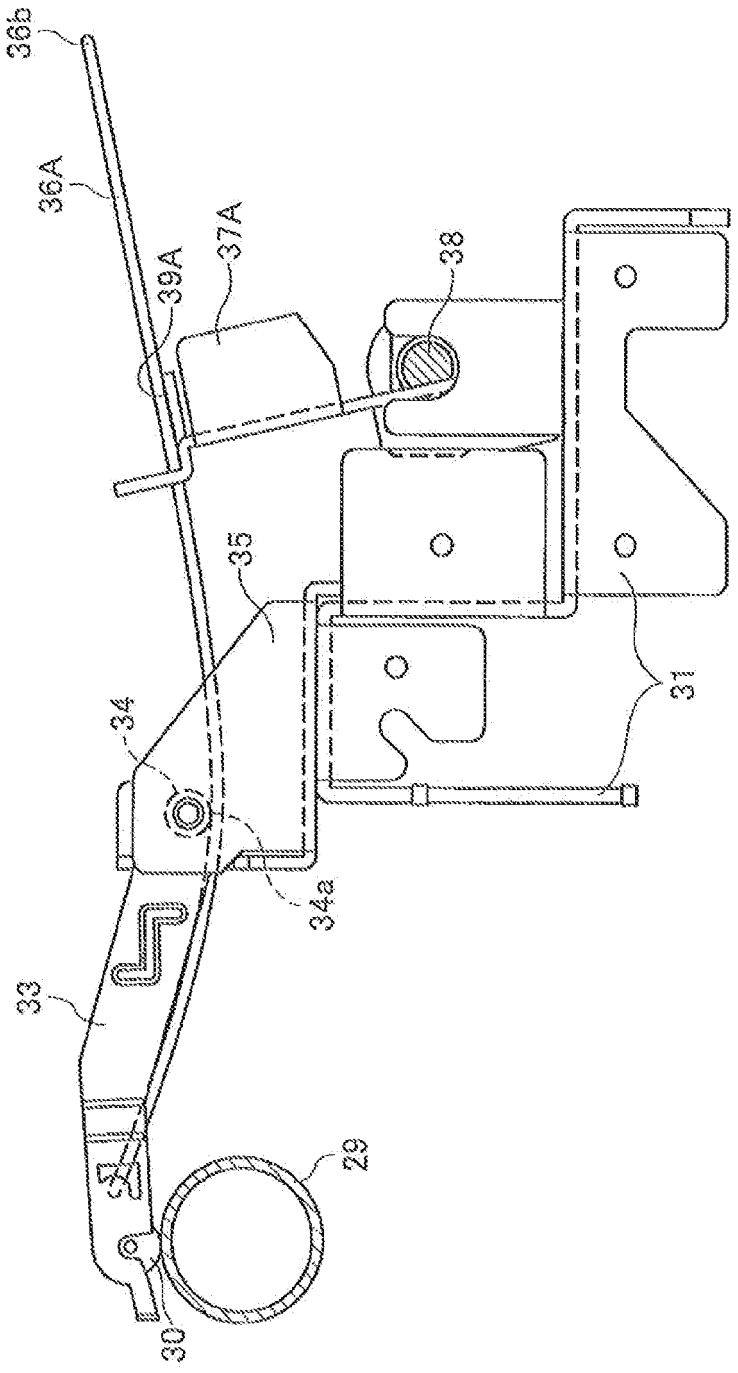


FIG.12

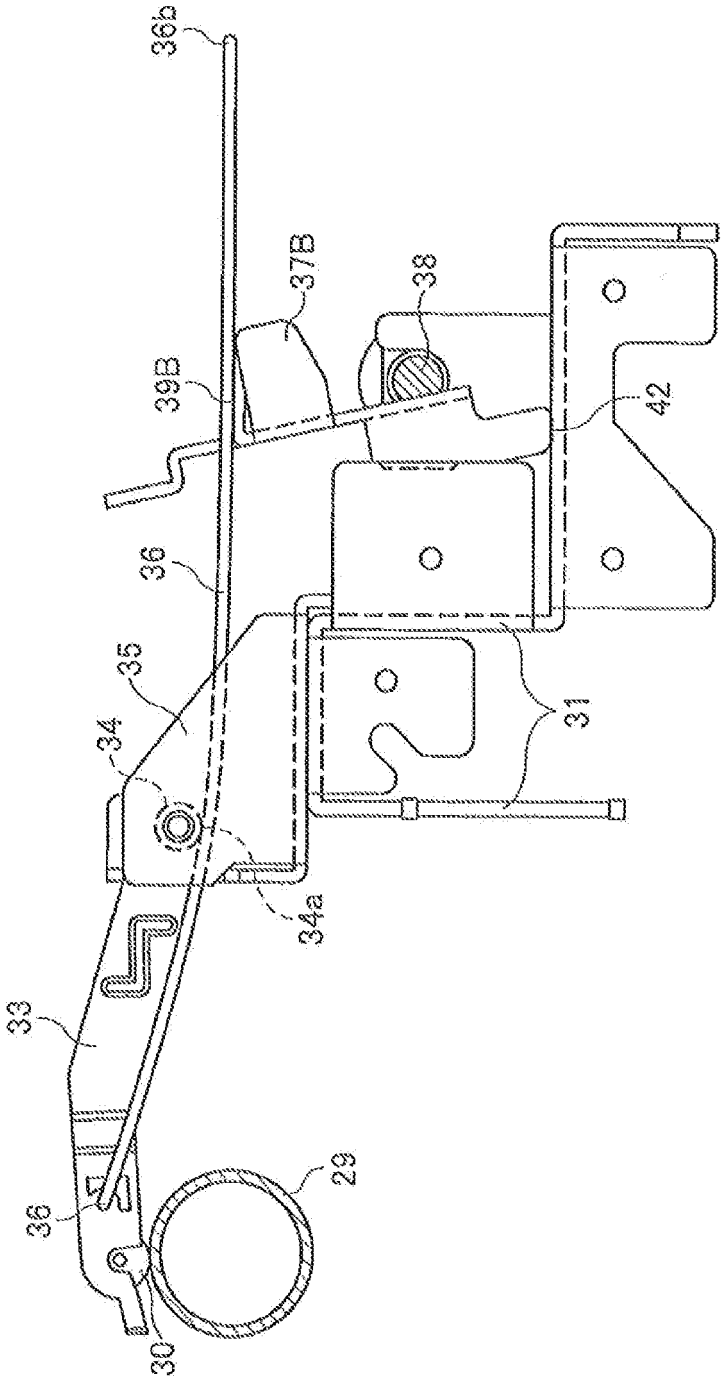


FIG.13

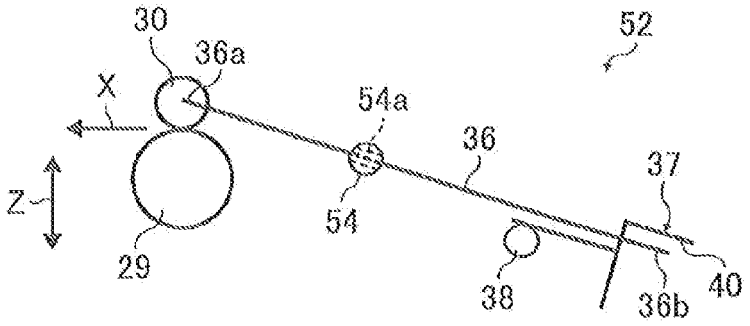


FIG.14

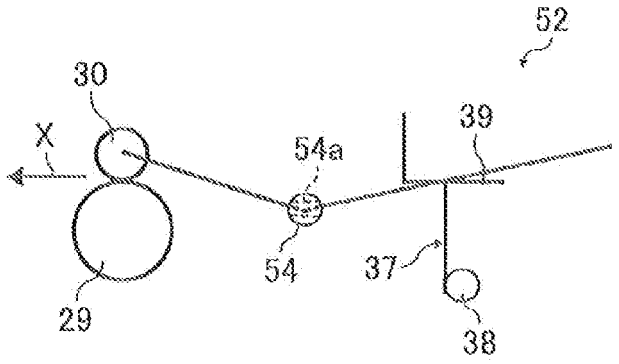


FIG.15

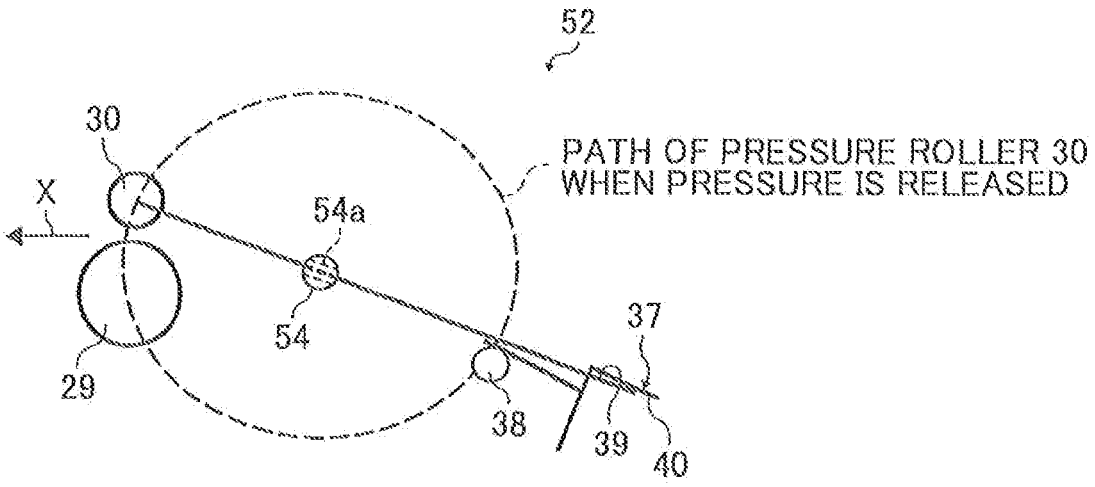

52
30
X
54a
54
29
37
38
39
40
PATH OF PRESSURE ROLLER 30
WHEN PRESSURE IS RELEASED

FIG.16

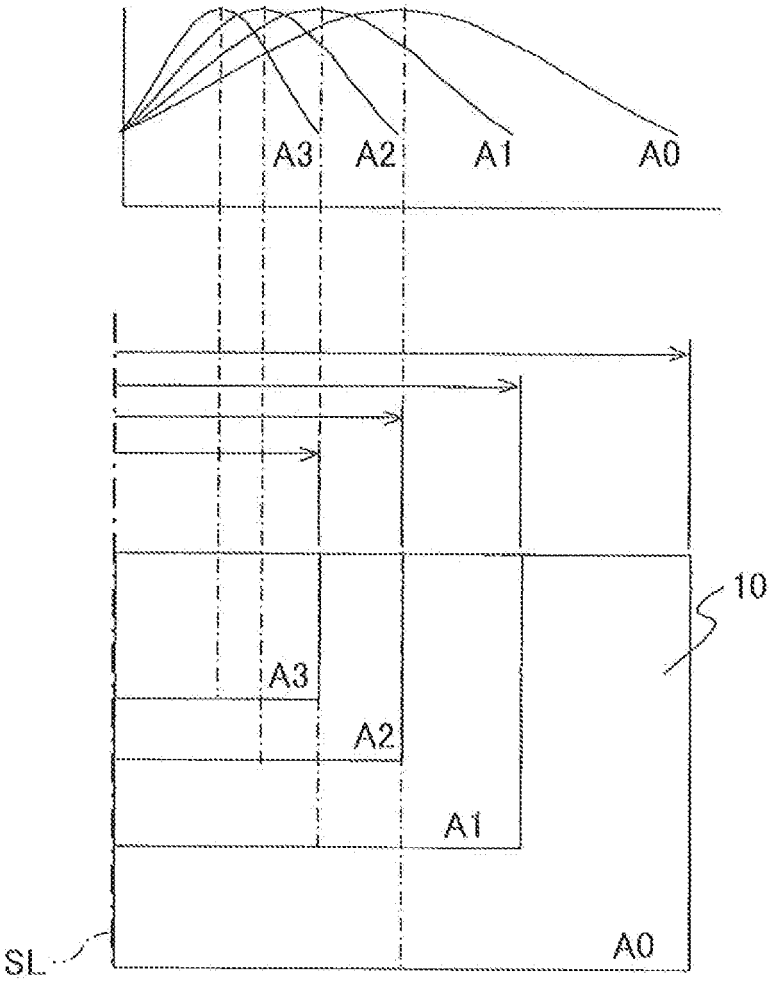


FIG.17

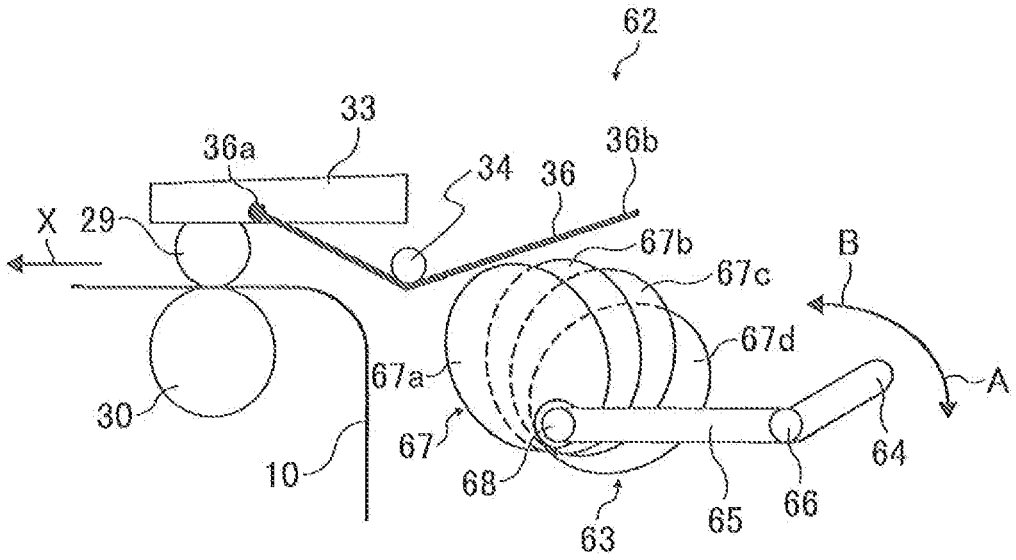


FIG.18

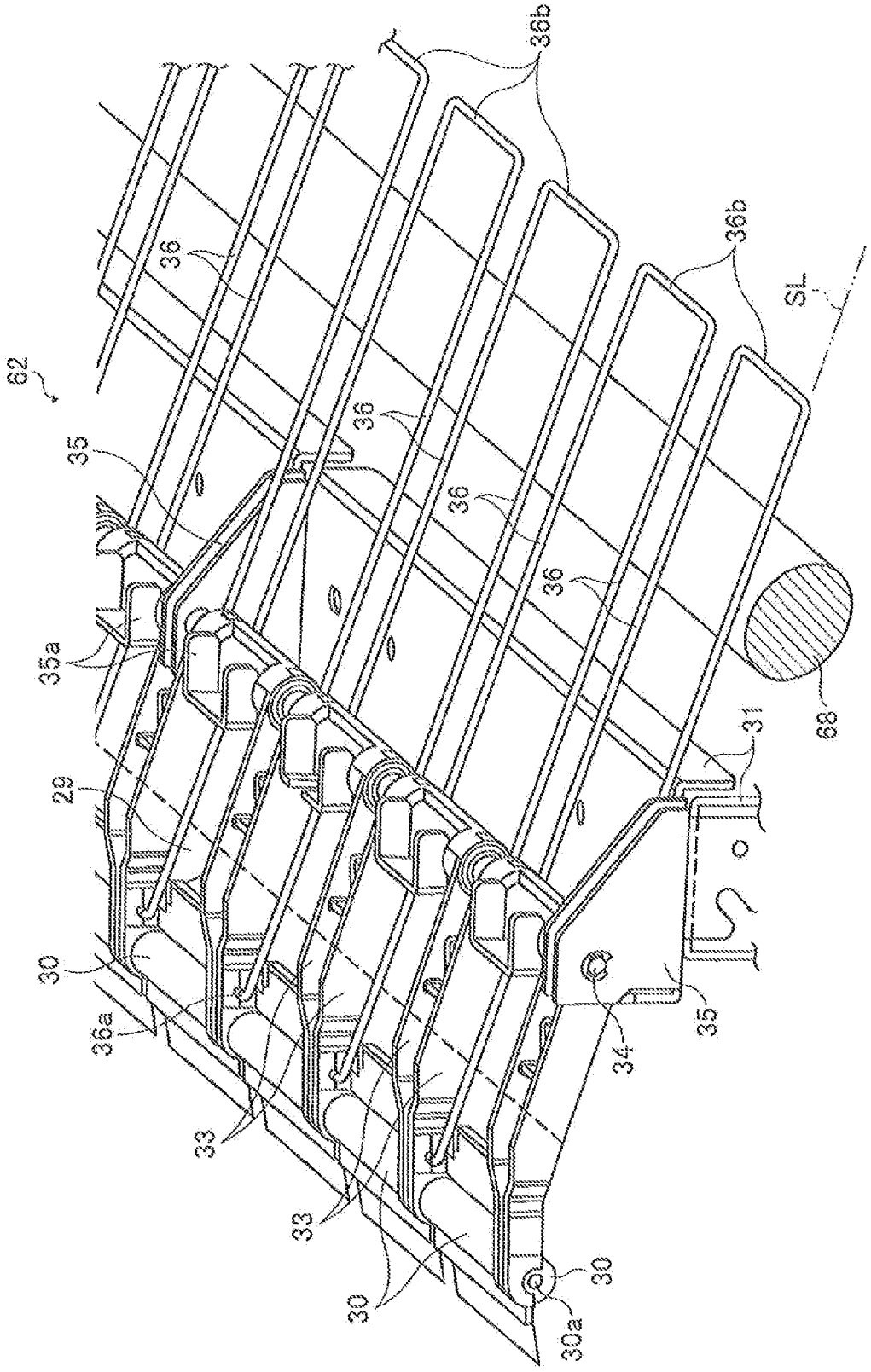


FIG.19A

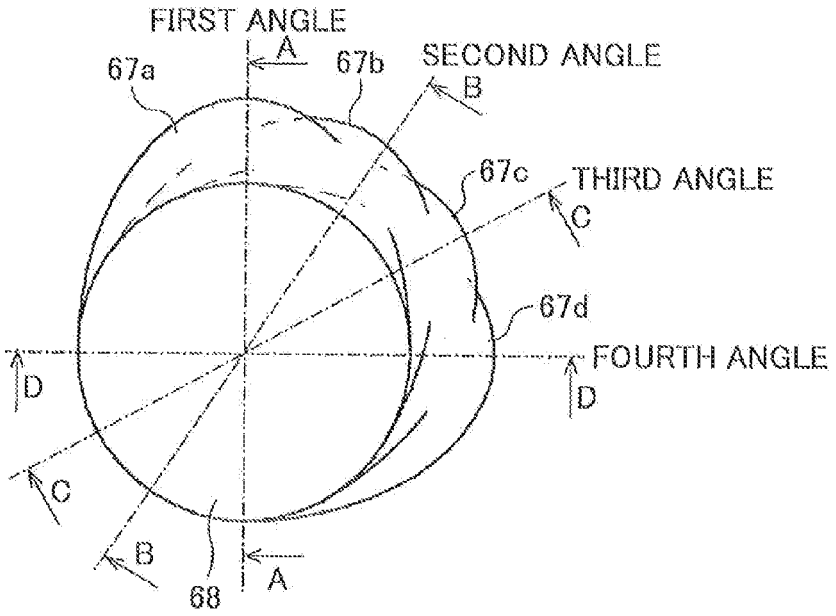


FIG.19B

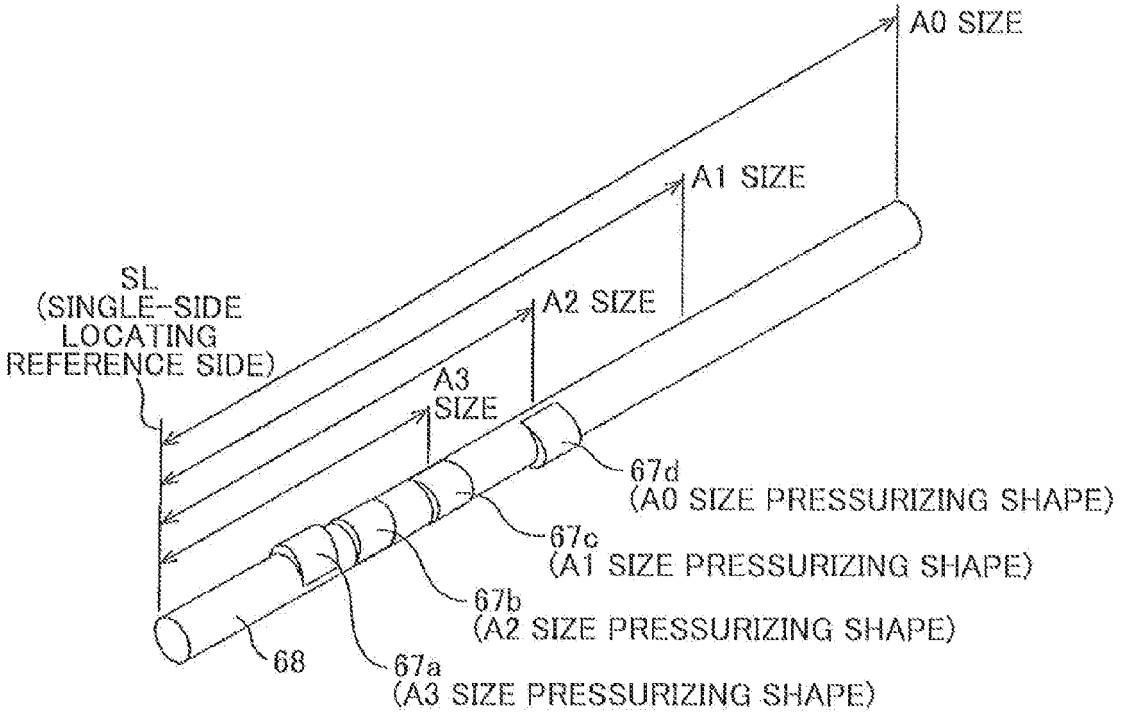


FIG.20A

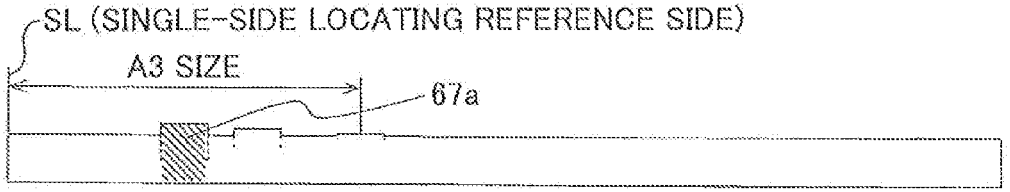


FIG.20B

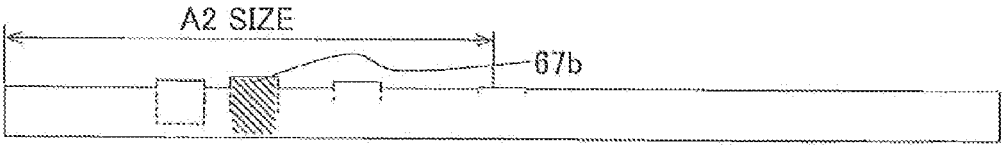


FIG.20C

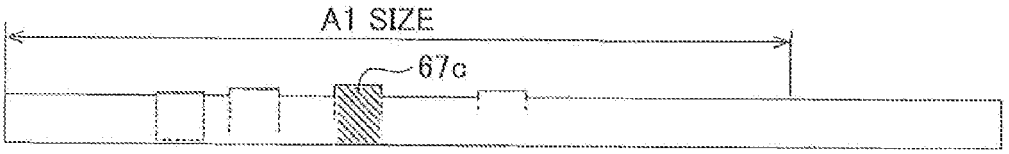


FIG.20D

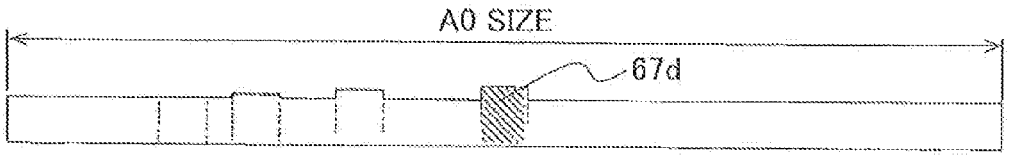


FIG.21A

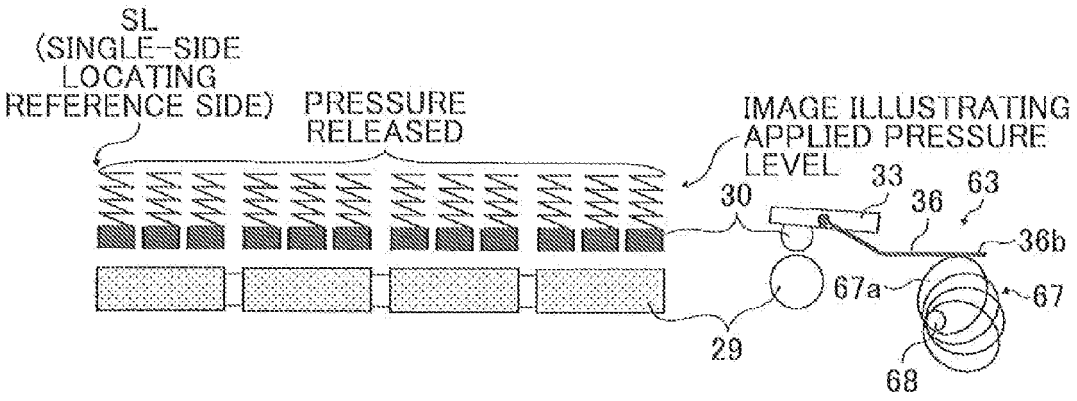


FIG.21B

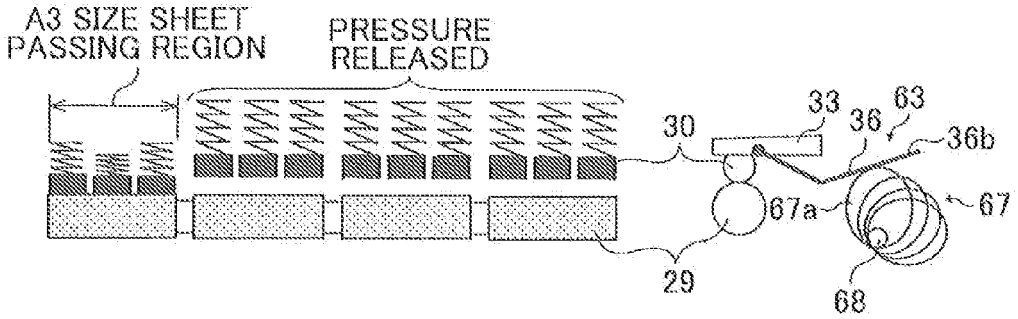


FIG.21C

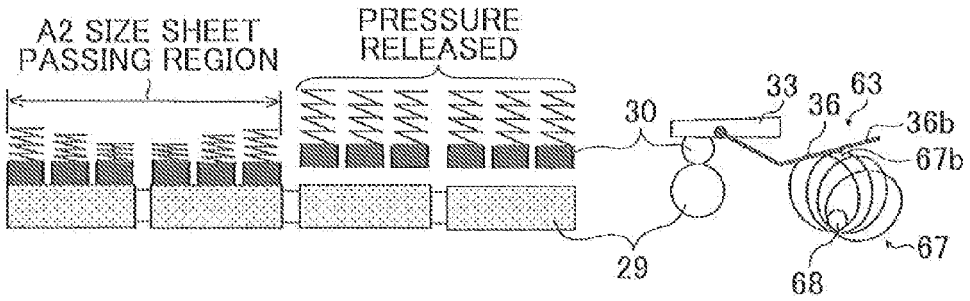


FIG.21D

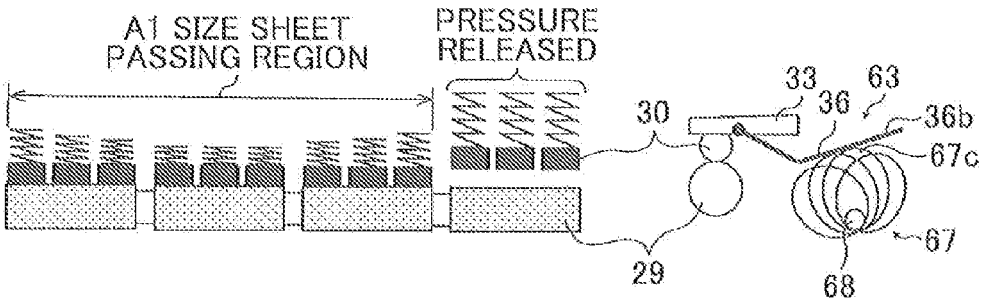


FIG.21E

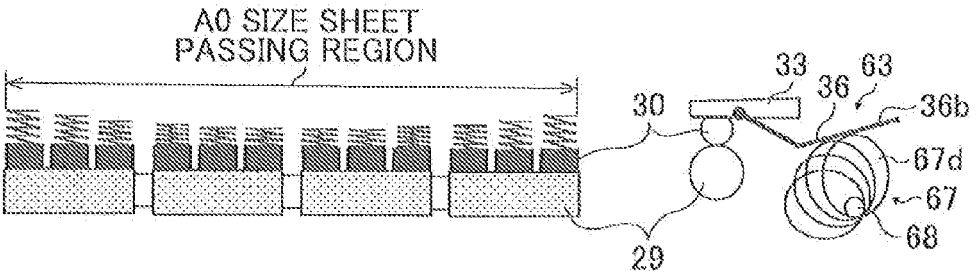


FIG.22A

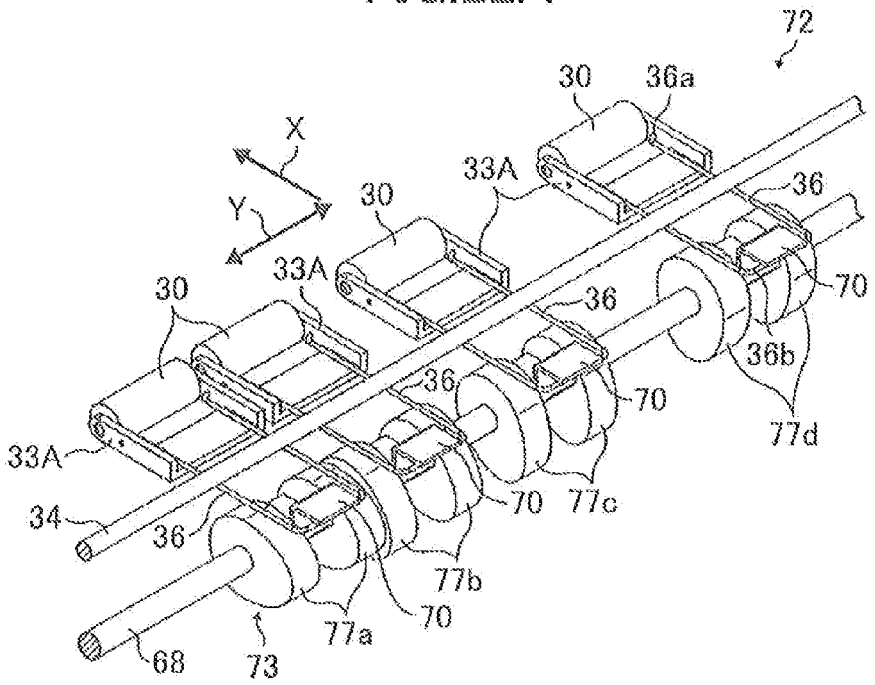


FIG.22B

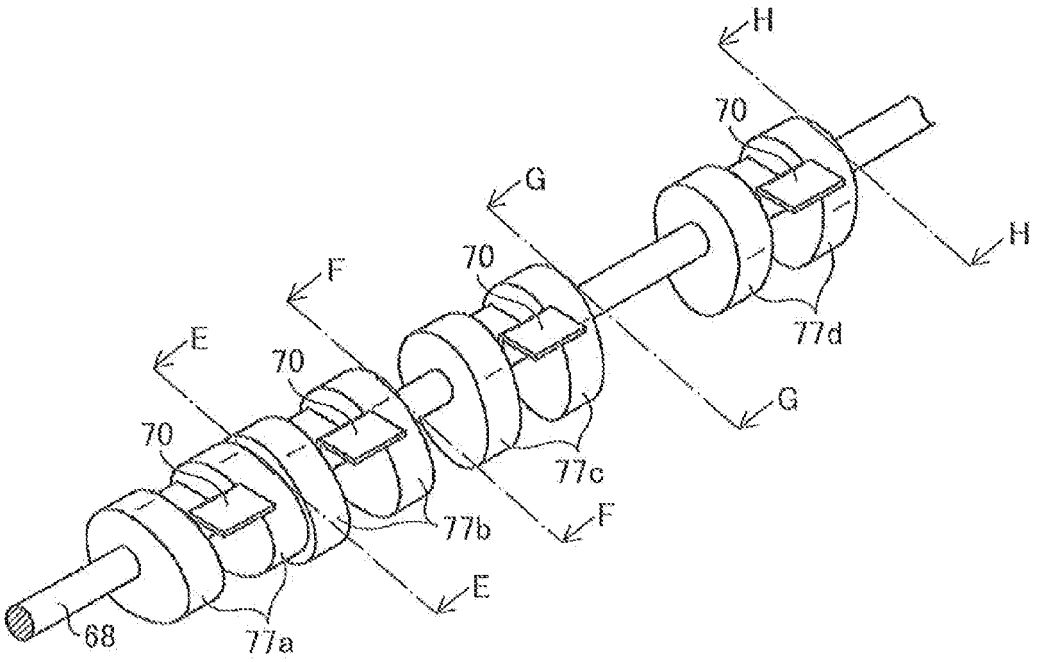


FIG.23D

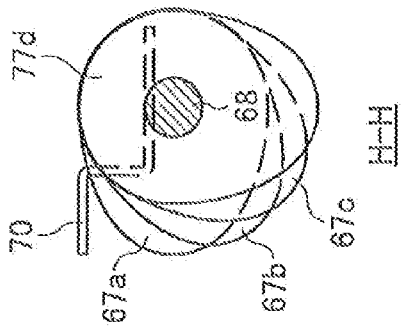


FIG.23C

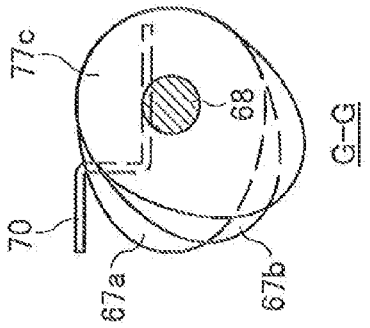


FIG.23B

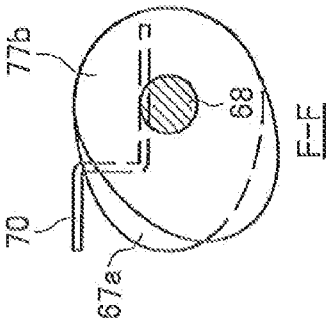
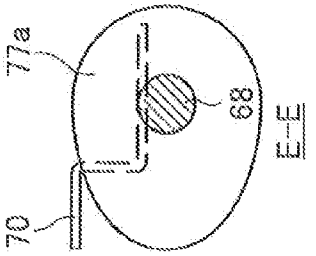


FIG.23A



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EUROPEAN SEARCH REPORT

Application Number
EP 10 19 3345

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2008/240834 A1 (TAKADA MASANORI [JP] ET AL) 2 October 2008 (2008-10-02) * paragraph [0048] - paragraph [0050]; figure 6B * -----	1	INV. B41J11/00 B41J13/02 B65H5/06
A,D	JP 2006 231557 A (KONICA MINOLTA MED & GRAPHIC) 7 September 2006 (2006-09-07) * abstract; figure 1 * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

B41J
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 April 2011	Wehr, Wolfhard

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19-04-2011

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- JP 3782493 B **[0003]**
- JP 2006231557 A **[0004]**
- JP 2886451 B **[0005]**