



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.03.2007 Bulletin 2007/12

(51) Int Cl.:
B41J 29/02 ^(2006.01) **B41J 29/04** ^(2006.01)
B41J 29/38 ^(2006.01) **B41J 19/04** ^(2006.01)

(21) Application number: **06254780.7**

(22) Date of filing: **14.09.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(72) Inventor: **Shinichiro, Naruse**
Fujisawa-shi,
Kanagawa (JP)

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

(30) Priority: **16.09.2005 JP 2005269495**

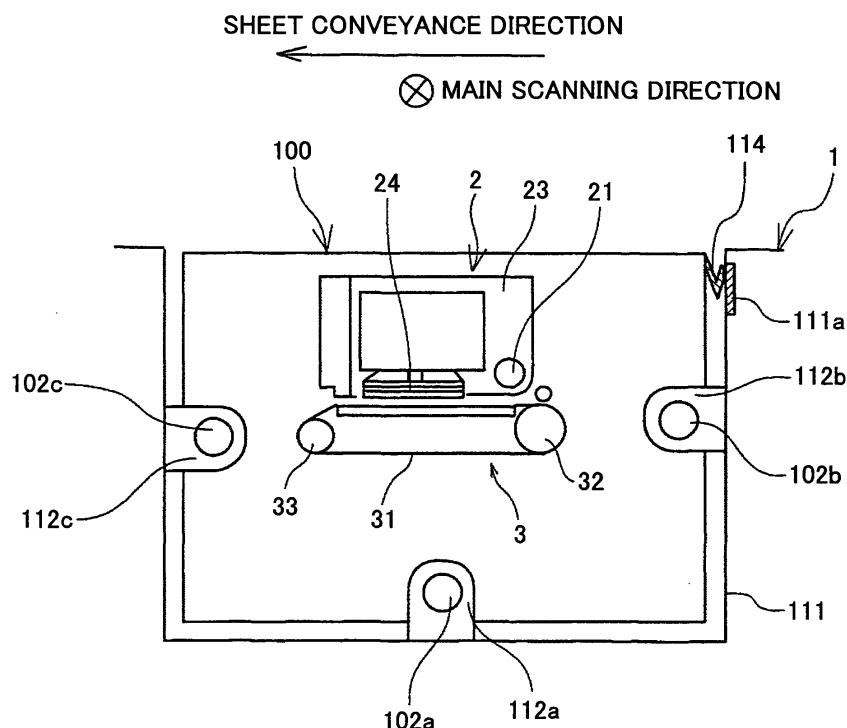
(71) Applicant: **Ricoh Company, Ltd.**
Tokyo 143-8555 (JP)

(54) **Image forming apparatus**

(57) An image forming apparatus wherein an engine unit (100) is detachably provided in an apparatus main body (1), the image forming apparatus is characterized in that:
the engine unit (100) is formed by unitizing an image

forming part (2) configured to jet a liquid drop of recording liquid so that an image is formed on a recording medium (5), and a conveyance part (3) configured to convey the recording medium (5); and the engine unit (100) is three-point (102a-c) supported by a housing (111) of the apparatus main body (1).

FIG.3



Description

[0001] The present invention generally relates to image forming apparatuses, and more particularly, an image forming apparatus having a structure where an engine unit can be detachably provided in an apparatus main body.

[0002] An inkjet recording apparatus, for example, is known as an image forming apparatus such as a printer, facsimile, copier or a multiple function processing machine of the printer, facsimile, and copier. In the above-mentioned inkjet recording apparatus, while a recording medium is conveyed, a liquid drop of recording liquid (hereinafter "ink drop") is adhered to the recording medium by using a recording head (image forming part) having a liquid jet head configured to jet the liquid drop of the recording liquid, so that image forming such as recording or printing is performed. Hereinafter, the recording medium is called a paper or transferred material. However, there is no limitation of material for the paper or the transferred material.

[0003] In such an inkjet recording apparatus, in order to correspond to personal use and office use, it is preferable that maintenance be performed when the user sees. Because of this, for example, in a serial type inkjet recording apparatus, an engine unit is formed by unitizing a recording head configured to jet a liquid drop of recording liquid so that an image is formed on the recording medium, a carriage having the recording head, a scanning mechanism of the carriage, a conveyance mechanism configured to convey the recording medium, and others. In addition, this engine unit is detachably provided in the apparatus main body.

[0004] Japanese Patent No. 3404060 discloses a vibration preventing mechanism for an image reader having the following structure. That is, this mechanism is constituted from optical scanning means exposing and scanning an original guide means supporting and guiding the scanning means, leg parts which are provided on both ends positioned in the sub-scanning direction of the scanning means and at a central position dividing both ends and which are brought into contact with the guide means, rotating members which are provided on the scanning means and moved while press-contacting and pressuring a contact glass and a pressure means adding such pressure force that the balancing point of the force of the scanning means is positioned at the leg part positioned at the center, the weight of the scanning means is equally added on the leg parts positioned on both ends and the moment at the balancing point of the force is balanced on the rotating members.

[0005] In a case where the engine unit including the image forming part and the sheet conveyance part can be detachably provided in the apparatus main body, the following problems may happen.

[0006] In a case where a belt conveyance device is configured to electrostatically attract the sheet to the conveyance belt and convey the sheet in order for the sheet

to have high planarity with the recording head, if the engine unit is provided in the apparatus main body and bending or straining of the frame of the engine unit is generated, bending or straining of the conveyance belt is generated. Because of this, the sheet may not be conveyed with high planarity with the recording head. In addition, in the case of the serial type, straining of a guide member configured to guide a carriage having a recording head is generated so that main scanning may not be smoothly implemented and the distance between the recording head and the sheet may be changed.

[0007] Thus, by unitizing the engine part, while the maintenance ability is improved, the gap between the sheet and the recording head required for inkjet recording and the planarity of the sheet may not be kept. Therefore, unevenness of positions where liquid drops are attached may happen so that image quality may be degraded.

[0008] In addition, vibration due to the conveyance of the sheet by the sheet conveyance part, especially vibration in a case where the sheet is intermittently conveyed, and vibration due to reciprocal movement of the carriage having the recording head are generated so that the entire engine unit is vibrated.

[0009] In this case, although the vibration may be prevented by completely fixing the engine unit to the apparatus main body, bending or straining of the engine unit per se may be easily generated.

[0010] Accordingly, embodiments of the present invention may provide a novel and useful image forming apparatus in which the above-mentioned problems are alleviated or eliminated.

[0011] More specifically, the embodiments of the present invention may provide an image forming apparatus whereby degradation of image quality is prevented and maintainability is improved, as mentioned in claim 1.

[0012] The embodiments of the present invention may provide an image forming apparatus whereby degradation of the image quality is prevented, the maintainability is improved, and vibration is prevented, as mentioned in other claims.

[0013] The embodiments of the present invention may provide an image forming apparatus wherein an engine unit is detachably provided in an apparatus main body, the image forming apparatus characterized in that:

the engine unit is formed by unitizing an image forming part configured to jet a liquid drop of recording liquid so that an image is formed on a recording medium, and a conveyance part configured to convey the recording medium; and
the engine unit is three-point supported by a housing of the apparatus main body.

[0014] According to the embodiments of the present invention, the engine unit is supported at three points (three-point supported) by the housing of the apparatus main body so that four points are not fixed in where the engine unit is provided in the apparatus main body.

Therefore, bending or straining a frame of the engine unit may not be generated. Hence, it is possible to keep a gap between a recording head and the recording medium such as a sheet and planarity of the recording medium. Therefore, it is possible to prevent degradation of image quality and improve maintainability.

[0015] Other objects, features, and advantages of the present invention will become more apparent from the following detailed description of exemplary embodiments and the accompanying drawings, in which:

FIG. 1 is a schematic structural view showing a whole structure of an image forming apparatus of an embodiment of the present invention;

FIG. 2 is a plan view of an image forming part and a sub-scanning conveyance part of the image forming apparatus shown in FIG. 1;

FIG. 3 is a structural view of a part where the engine unit of the image forming apparatus is provided;

FIG. 4 is a perspective view showing a state where the engine unit is fixed;

FIG. 5 is a perspective view showing a state where the engine unit of the image forming apparatus is provided in an apparatus main body;

FIG. 6 is a perspective view showing a state where the engine unit of the image forming apparatus is taken out from the apparatus main body;

FIG. 7 is a perspective view of the engine unit seen from a rear side of the apparatus main body;

FIG. 8 is a perspective view of the engine unit seen from a front side of the apparatus main body;

FIG. 9 is a side view of the engine unit;

FIG. 10 is a perspective view showing another example of three-point support of the engine unit;

FIG. 11 is a perspective view showing another example of the engine unit seen from a rear side of the apparatus main body;

FIG. 12 is a perspective view showing another example of the engine unit seen from a front side of the apparatus main body;

FIG. 13 is a structural view for explaining an installing position of a vibration preventing part;

FIG. 14 is a structural view for explaining an installing position of another example of the vibration preventing part;

FIG. 15 is a structural view for explaining an installing position of another example of the vibration preventing part;

FIG. 16 is a perspective view showing an example where the vibration preventing part is detachably provided in the apparatus main body;

FIG. 17 is a perspective view showing a state where a member having the vibration preventing part is taken out from the apparatus main body; and

FIG. 18 is a block diagram for explaining another embodiment of the present invention.

given, with reference to FIG. 1 through FIG. 18 including embodiments of the present invention.

[0017] First, an embodiment of an image forming apparatus of the embodiment of the present invention is discussed with reference to FIG. 1 and FIG. 2. Here, FIG. 1 is a schematic structural view showing a whole structure of an image forming apparatus of an embodiment of the present invention, and FIG. 2 is a plan view of an image forming part and a sub-scanning conveyance part of the image forming apparatus shown in FIG. 1. In the following description, the image forming apparatus has a structure where an image forming part (image forming means) 2 configured to form an image while a sheet is conveyed, a sub-scanning conveyance part (sub-scanning conveyance means) 3 configured to convey the sheet, and others are provided inside of an apparatus main body (housing) 1. Recording media (hereinafter "Sheets" not limited to papers) 5 are fed one by one from a sheet feeding part (sheet feeding means) including a sheet feeding cassette provided at a bottom part of the apparatus main body 1. While the sheet 5 is intermittently conveyed at a position facing the image forming part 2 by the sub-scanning conveyance part 3, a liquid drop is jetted onto the sheet 5 by the image forming part 2 so that an image is formed (recorded) on the sheet 5. After that, in a case of one side printing, the sheet 5 is discharged on a sheet discharging tray 7 formed on an upper surface of the apparatus main body 1 via a sheet discharge conveyance part (sheet discharge conveyance means) 6.

[0018] As an input system of image data (printing data) formed by the image forming part 2, the image forming apparatus includes an image reading part (scanner part) 11 configured to read the image. The image reading part is provided at an upper part of the sheet discharging tray 7 situated at an upper part of the apparatus main body 1. In the image reading part 11, a scanning optical system 15 includes a lighting source 13 and a mirror 14 and a scanning optical system 18 includes mirrors 16 and 17 that are moved so that the image of a manuscript provided on a contact glass 12 is read out. A scanned manuscript image is read out as an image signal by an image reading element 20 provided at the back of a lens 19. The image signal that is read out is digitalized and image-processed so that printing data that are image-processed can be printed. A pressure plate 10 is provided on the contact glass 12 so as to press the manuscript.

[0019] As shown in FIG. 2, the image forming part 2 of the image forming apparatus has a structure where a carriage 23 is held movably in a main scanning direction by a guide rod 21 and a guide rail 22 (not shown). The carriage 23 can move in the main scanning direction driven by an endless timing belt 29 wound around and tensioned between a driving pulley 28A and an idler pulley 28B and driven by a main scanning motor 27.

[0020] A recording head 24 is mounted on the carriage 23. The recording head 24 is formed by a liquid drop jet head configured to jet a liquid drop of each color. The carriage 23 is moved in a main scanning direction. While

[0016] A description of the present invention is now

the sheet 5 is intermittently sent in a sheet conveyance direction (sub-scanning direction) by a sub-scanning conveyance part 3, the liquid drops are jetted from the recording head 24 which is a shuttle type head so that the image is formed.

[0021] The recording head 24 includes two liquid drop jet heads 24k1 and 24k2 configured to jet black (Bk) ink, a liquid drop jet head 24c configured to jet cyan (C) ink, a liquid drop jet head 24m configured to jet magenta (M) ink, and a liquid drop jet head 24y configured to jet yellow (Y) ink. Color ink is supplied from respective sub tanks 25 provided in the carriage 23.

[0022] On the other hand, as shown in FIG. 1, ink cartridges 26 of respective colors can be detachably arranged from a front surface of the apparatus main body 1 to a cartridge arranging part. Black (Bk) ink, cyan (C) ink, magenta (M) ink, and yellow (Y) ink are received in the ink cartridges. Inks (recording liquid) are supplied from the ink cartridges 26 to the corresponding sub tanks 25 via tubes not shown. The black (Bk) ink is supplied from a single ink cartridge 26 to two sub tanks 25.

[0023] As the recording head 24, a piezoelectric type recording head, a thermal type recording head, an electrostatic type recording head, and others can be used. In a case of the piezoelectric type recording head, a piezoelectric element is used as pressure generation means (actuator means) for putting ink under pressure in an ink path (pressure generation room) and a vibration plate forming a wall surface of the ink path is deformed so that the volume of the ink path is changed and the ink drop is jetted. In a case of the thermal type recording head, the ink drop is jetted by pressure based bubbles generated by heating the ink in the ink path by using a heat generation resistant body. In a case of an electrostatic type recording head, a vibration plate forming a wall surface of an ink path and an electrode face each other and the vibration plate is deformed by an electrostatic force generated between the vibration plate and the electrode so that the volume of the ink path is changed and the ink drop is jetted.

[0024] In a non-printing area at one side in a scanning direction of the carriage 23, as shown in FIG. 2, a keeping and recovering apparatus 121 configured to restore and maintain a state of the nozzle of the recording head 24 is provided. The keeping and recovering apparatus 121 includes five caps 122a, 122b, 122c, 122d, and 122e, a wiper blade 124, a test jet receiving member 125, and others. The caps 122 are configured to cap the nozzle surfaces of the recording heads 24. The wiper blade 124 is configured to wipe the nozzle surfaces of the recording heads 24. The test jet receiving member 125 is used for test jetting that is jetting of the liquid drops not contributing to recording (image forming).

[0025] Furthermore, in a non-printing area at another side in the scanning direction of the carriage 23, as shown in FIG. 2, a test jet receiving member 126 is provided. The test jet receiving member 126 is used for test jetting that is jetting of the liquid drops not contributing to re-

cording (image forming) from five recording heads 24. As corresponding to the recording head 24, five openings 127a, 127b, 127c, 127d, and 127e are formed in the test jet receiving member 126.

[0026] The sub-scanning conveyance part 3 includes an endless conveyance belt 31, an electrostatic charging roller 34, a guide member 35, a pressing roller 36, two rollers 37, and a separation claw (not shown). The endless conveyance belt 31 is wound around a conveyance roller 32 which is a driving roller and an idler roller 33 which is a tension roller so that the conveyance direction of the sheet 5 fed from a lower part is changed by about 90 degrees and the sheet 5 is conveyed so as to face the image forming part 2. The electrostatic charging roller 34 is an electrostatic charging part configured to apply a high voltage that is an AC (alternating current) voltage from a high voltage electric power source so that a surface of the conveyance belt 31 is charged. The guide member 35 guides the conveyance belt 31 in an area facing the image forming part 2. The pressing roller 36 presses the sheet 5 to the conveyance belt 31 at a position facing the conveyance roller 32. The rollers 37 press at upper and lower sides of the sheet 5 where the image is formed by the image forming part 2. The separation claw is configured to separate the sheet 5 where the image is formed from the conveyance belt 31.

[0027] The conveyance roller 32 is rotated by the sub-scanning motor 131 via a timing belt 132 and a timing roller 133, so that the conveyance belt 31 of the sub-scanning conveyance part 3 goes around in a sheet conveyance direction, namely a sub-scanning direction, in FIG. 2.

[0028] The sheet feeding part 4 includes a sheet feeding cassette 41, a sheet feeding roller 42, a friction pad 43, and resist rollers 44. The sheet feeding cassette 41 is provided detachably from the front surface side of the apparatus main body 1 and holds a large number of the sheets 5. The sheet feeding roller 42 separates and sends the sheets 5 provided in the sheet feeding cassette 41 one by one. The fed sheet 5 is conveyed to the sub-scanning conveyance part 3 by the resist rollers 44. The sheet feeding roller 42 and the resist rollers 44 are driven and rotated by the sheet feeding motor 45 such as an HB type stepping motor via an sheet feeding clutch not shown.

[0029] The sheet discharge conveyance part (sheet discharge conveyance means) 6 has sheet discharge rollers 61, 62 and 63 and a sheet discharge roller 64. The sheet discharge rollers 61 and 62 convey the sheet 5 where the image is formed. The sheet discharge rollers 63 send the sheet 5 out to the sheet discharge tray 7.

[0030] In the image forming apparatus having the above-discussed structure, a rotational amount of the conveyance roller 32 configured to drive the conveyance belt 31 is detected. Corresponding to the detected rotational amount, a sub-scanning motor 131 is controlled.

[0031] By applying a high voltage of a rectangular wave positive negative electrode that is an AC voltage

from an AC bias supply part to an electrostatic charge roller 34, positive and negative electrical charges are reciprocally applied to the surface layer of the conveyance belt 31 in a belt shape against the conveyance direction of the conveyance belt 31 because the electrostatic charge roller 34 comes in contact with the insulation layer (surface layer) of the conveyance belt 31. As a result of this, unequal electrical fields are generated due to electric charges being generated on the conveyance belt 31 at a designated charge width.

[0032] In a case where the sheet 5 is fed from the sheet feeding part 4 and the electric charge of the positive and negative electrodes is formed between the conveyance roller 32 and the pressing roller 36 so that the sheet 5 is sent to the conveyance belt 31 where unequal electric field is generated, the sheet 5 is immediately polarized following the direction of the electric field. As a result of this, the sheet 5 is adhered on the conveyance belt 31 by an electrostatic attraction force so as to be conveyed by the movement of the conveyance belt 31.

[0033] While the paper 5 is conveyed intermittently by the conveyance belt 31, the liquid drops are jetted from the recording head 24 onto the paper 5 corresponding to the printing data so that the image is formed (printed). A head end of the paper 5 where the image is formed is separated from the conveyance belt 31 by the separation claw 38. And then, the paper 5 is discharged to the sheet discharge conveyance part (sheet discharge conveyance means) 6.

[0034] During waiting for printing, the carriage 23 is moved to a side of the keeping and recovering apparatus 121. A nozzle surface of the recording head 24 is capped by the cap 122 so that a wetted state of the nozzle is maintained and improper jetting due to ink dry can be prevented. In addition, where the recording head 24 is covered by the cap 122a, the recording liquid is suctioned from the nozzle, that is nozzle suction or head suction is performed, and a recovering operation for discharging bottled up recording liquid or air bubbles is done.

[0035] Wiping with the wiper blade 124 is done so that the ink adhered to the nozzle surface of the recording head 24 due to this recovering operation is removed. Furthermore, before recording is started or during the recording, test jet recording is performed so that liquid drops not contributing to recording (image forming) are jetted to the test jet receiving member 125. As a result of this, it is possible to maintain a stable jetting ability of the recording head 24.

[0036] Next a supporting structure and a vibration control structure of the engine unit in the image forming apparatus are discussed with reference to FIG. 3 through FIG. 9.

[0037] Here, FIG. 3 is a structural view of a part where the engine unit of the image forming apparatus is provided. FIG. 4 is a perspective view showing a frame 101 where the engine unit 100 is fixed. FIG. 5 is a perspective view showing where the engine unit 100 of the image forming apparatus is provided is an apparatus main body

1. FIG. 6 is a perspective view showing where the engine unit 100 of the image forming apparatus is taken out from the apparatus main body 1. FIG. 7 is a perspective view of the engine unit 100 seen from a rear side of the apparatus main body 1. FIG. 8 is a perspective view of the engine unit 100 seen from a front side of the apparatus main body 1. FIG. 9 is a side view of the engine unit 100.

[0038] In this image forming apparatus, as shown in FIG. 3 and FIG. 5 through FIG. 9, an image forming part 2 and a sub-scanning conveyance part 3 as a conveyance part are unitized so as to form the engine unit 100.

[0039] The image forming part 2 includes a carriage 23 having a recording head 24, a main scanning moving mechanism of the carriage 23, the keeping and recovering apparatus 121, and others. The sub-scanning conveyance part 3 includes the conveyance belt 31 and a driving mechanism of the conveyance belt 31.

[0040] As shown in FIG. 3 and FIG. 5 through FIG. 9, this engine unit 100 can be attached to or detached from the apparatus main body 1 via the front side of the apparatus main body 1. A belt cover 108 configured to cover the timing belt 132 is attached to a front surface of the engine unit 100 at a side of the apparatus main body 1. In addition, an operations part 9 is provided at an upper part at an entire surface side of the apparatus main body 1.

[0041] In this engine unit 100, the image forming part 2, the sub-scanning conveyance part 3, and others are supported by the frame 101. Furthermore, supporting pins 102a through 102c are provided at the upstream side and the downstream side in a sheet conveyance direction and at a lower part of the frame 101 so as to support the engine unit 100 in the apparatus main body 1.

[0042] As shown in FIG. 7 through FIG. 9, the supporting pins 102a through 102c are fixed to frame plates 101a through 101c forming the frame 101 by fixing means. Here, a supporting point by the supporting pin 102a is called a first supporting point. A supporting point by the supporting pin 102b is called a second supporting point. A supporting point by the supporting pin 102c is called a third supporting point. On the other hand, as shown in FIG. 3, holding parts 112a through 112c are provided at a housing 111 of the apparatus main body 1. The holding parts 112a through 112c have engaging holes where the supporting pins 102a through 102c are engaged when the engine unit 100 is inserted into the housing 101.

[0043] While the frame 101 is indicated in a permeating state in FIG. 3 for the convenience of explanation, direction of the supporting pins 102a through 102c are as shown in Fig. 7 through FIG. 8, that is an apparatus main body depth side direction, namely a direction where the engine unit 100 is inserted.

[0044] Therefore, when the engine unit 100 is provided in the apparatus main body 1 (housing 111) as shown in FIG. 5, the supporting pins 102a through 102c are inserted in and engaged by the holding parts 112a through 112c as shown so as to be supported in FIG. 3. Accordingly, in the apparatus main body 1 (housing 111), the

engine unit 100 is three-point supported. In this case, the supporting pins 102a through 102c of the engine unit 100 can be rotated against the holding parts 112a through 112c of the housing 111 of the apparatus main body 1 and are supported in a state where the supporting pins 102a through 102c can be moved in a main scanning direction.

[0045] Thus, since the engine unit 100 is three-point supported, stress in a case where the frame 101 of the engine unit 100 is fixed to the housing 111 of the apparatus main body 1 is not generated and therefore bending or straining is not generated. Therefore, the engine unit 100 can be provided in the apparatus main body 1 in a state where the image forming part 2 and the sub-scanning conveyance part 3 are held in a correct state or position.

[0046] Because of this, it is possible to prevent the conveyance belt 31 being deformed or twisted so that change of the gap between the recording head 24 and the sheet conveyed by the conveyance belt 31 is prevented. Alternatively, it is possible to prevent an increase of unevenness of positions on the sheet where liquid drops jetted from the recording head 24 land, the unevenness being due to shift of the guide rod 21 guiding the carriage 23 so as to be parallel to the surface of the conveyance belt 31. In addition, it is possible to prevent the carriage 23 from sliding. Therefore, while maintainability is improved by unitization, degradation of the image quality can be prevented.

[0047] In other words, if the above-discussed three-point supporting is not applied but instead, for example, as shown in FIG. 4, the flange part 1101 provided to the frame 101 of the engine unit 100 is fixed to the housing 111 of the apparatus main body 1 by fixing members such as the screws 1102, it is possible to tightly fix the frame to the housing 111 so that vibration of the engine unit 100 due to main scanning of the carriage 23, conveyance of the sheet by intermittent driving of the conveyance belt 31, or the like can be prevented.

[0048] However, in the case where the frame 101 is fixed to the housing 111 of the apparatus main body 1 by the fixing members, stress due to an arrangement position error is applied to the frame 101. As a result of this, as indicated by arrows A1 and A2 of FIG. 4, the engine unit 100 may be fixed to the apparatus main body 1 so that the frame 101 is twisted in different directions at the corresponding ends in the main scanning direction. If a twist or strain of the frame 101 is generated, influence is given to the conveyance belt 31 or the guide rod 21 so that unevenness of positions on the sheet where liquid drops jetted from the recording head 24 land is generated and the image quality is degraded. Thus it is not possible to both improve the maintainability and improve the image quality.

[0049] On the other hand, in the case where the engine unit 100 is three-point supported in the apparatus main body 1, it is possible to reduce generation of twisting or straining of the frame 101.

[0050] In this case, since the frame 101 can be moved due to the main scanning of the carriage 23 or intermittent conveyance driving by the conveyance belt 31, the engine unit 100 per se can be moved. The vibration of the engine unit 100 may be transferred to the housing 111 of the apparatus main body 1 so that noise may be generated.

[0051] Because of this, in this embodiment as shown in FIG. 3, a vibration prevention member (a plate spring in the example shown in FIG. 3) 114 is provided between the frame 101 of the engine unit 100 and a part 11a of the housing 111 of the apparatus main body 1. The vibration prevention member 114 is fixed to the housing 111 and presses the frame 101 of the engine unit 100 from an upstream side to a downstream side in the sheet conveyance direction, namely a recording medium conveyance direction.

[0052] Under this structure, since the engine unit 100 can be rotated with respect to the supporting pin 102a, the whole of the engine unit 100 is pressed by the vibration prevention member 114 toward the downstream side in the sheet conveyance direction in FIG. 3. As a result of this, the vibration of the engine unit 100 per se due to the main scanning of the carriage 23 or intermittent conveyance driving by the conveyance belt 31 is prevented. Hence, it is possible to prevent the vibration of the apparatus main body 1 so that generation of noise can be prevented.

[0053] In the meantime, the three-point support of the engine unit 100 is not limited to the above-discussed supporting pins. An example shown in FIG. 3 can be applied. Here, FIG. 10 is a perspective view showing another example of three-point support of the engine unit. As shown in FIG. 10, in the frame 101 of the engine unit 100, a corner part at a main apparatus body depth side may be a first supporting point 201, a corner part at a side opposite to the first supporting point 201 may be a third supporting point 203, and a corner part at a side of the first supporting point 201 of the apparatus main body front side may be a second supporting point 202.

[0054] Alternatively, examples show in FIG. 11 and FIG. 12 can be applied. Here, FIG. 11 is a perspective view showing other example of the engine unit seen from a rear side of the apparatus main body. FIG. 12 is a perspective view showing other example of the engine unit seen from a front side of the apparatus main body. As shown in FIG. 11, in the frame 101 of the engine unit 100, a corner part at a main apparatus body depth side may be the first supporting point 201, a corner part at a side of the first supporting point 201 of the apparatus main body front side may be the second supporting point 202 (See FIG. 11), and a center part at a side opposite to the sheet conveyance direction may be a third supporting point 203 (See FIG. 12).

[0055] In addition, an arrangement position of the vibration prevention member 114 is not limited to the above-discussed examples. Examples shown in FIG. 13 through FIG. 15 may be applied. Here, FIG. 13 is a struc-

tural view for explaining an installing position of a vibration preventing part, FIG. 14 is a structural view for explaining an installing position of another example of the vibration preventing part, and FIG. 15 is a structural view for explaining an installing position of other example of the vibration preventing part.

[0056] As shown in FIG. 13, the vibration prevention member 114 may be arranged in at least either direction of the main scanning directions of the engine unit 100, namely moving directions of the image forming part. As shown in FIG. 14, the vibration prevention member 114 may be arranged at least at either upper side or downstream side of the sub-scanning direction of the engine unit 100. As shown in FIG. 15, the vibration prevention member 114 may be arranged in either upper or lower direction of the engine unit 100. The vibration prevention member 114 may be arranged by combining the examples shown in FIG. 13 through FIG. 15. It is preferable that the vibration prevention member be arranged at a part where the vibration can be decreased most, corresponding to the vibration of the engine unit 100 in the image forming apparatus.

[0057] In addition, as the vibration prevention member, other than a plate spring, an elastic member such as a coil spring, sponge member, rubber member or mechanical shock absorbing device such as an oil dumper may be used.

[0058] In addition, by detachably providing the vibration prevention part to the apparatus main body, it is possible to correspond to time-based change of the vibration of the engine unit 100. FIG. 16 is a perspective view showing an example where the vibration preventing part is detachably provided in the apparatus main body. FIG. 17 is a perspective view showing a state where a member having the vibration preventing part is taken out from the apparatus main body.

[0059] As shown in FIG. 16, the vibration prevention member (plate spring) 114 may be provided at the cover member 111A arranged to the housing 111 in the apparatus main body 1. In this case, as shown in FIG. 17, the vibration prevention member 114 can be removed by taking out the cover member 111A.

[0060] FIG. 18 is a block diagram for explaining another embodiment of the present invention. As shown in FIG. 18, the image forming apparatus may have vibration prevention parts 214A and 214B provided at upstream side and down stream side in the sheet conveyance direction of the engine unit 100 where the vibration prevention parts 214A and 214B are configured to press the engine unit 100 in opposite directions, a vibration detection part 221 configured to detect vibration of the engine unit 100, and a vibration prevention control part 221 configured to detect vibration based on a detection signal of the vibration detection part 221 and control vibration prevention parts 214A and 214B in a direction where the detected vibration is prevented.

[0061] According to the above-discussed embodiments of the present invention, it is possible to provide

an image forming apparatus wherein an engine unit is detachably provided in an apparatus main body, the image forming apparatus characterized in that: the engine unit is formed by unitizing an image forming part configured to jet a liquid drop of recording liquid so that an image is formed on a recording medium, and a conveyance part configured to convey the recording medium; and the engine unit is three-point supported by a housing of the apparatus main body.

[0062] In the image forming apparatus, a vibration prevention part may be provided between the engine unit and the housing so as to prevent vibration of the engine unit. The vibration prevention part may be come in contact with the engine unit and the housing.

[0063] The vibration prevention part may be provided at least for either of moving directions of the image forming part of the engine unit. The vibration prevention part may be provided at least at one of an upstream side and a down stream side of the conveyance direction of the recording medium by the conveyance part of the engine unit. The vibration prevention part may be provided at least for one of an upper direction and a lower direction of the engine unit.

[0064] The vibration prevention part may be a coil spring. The vibration prevention part may be a plate spring. The vibration prevention part may be an oil dumper. The vibration prevention part may be a sponge member. The vibration prevention part may be a rubber member.

[0065] The vibration prevention part may be fixed to the housing and has a plate spring configured to press in a recording medium conveyance direction from the housing side to the engine unit side. The vibration prevention part may be detachable.

[0066] The vibration prevention part may include a part configured to vibrate the engine unit in a direction opposite to a vibration direction based on a detection result of vibration of the engine unit.

[0067] The present invention is not limited to these embodiments, but variations and modifications may be made without departing from the scope of the present invention.

Claims

1. An image forming apparatus wherein an engine unit is detachably provided in an apparatus main body, the image forming apparatus **characterized in that:**

the engine unit is formed by unitizing an image forming part, which is configured to jet a liquid drop of recording liquid so that an image is formed on a recording medium, and a conveyance part, which is configured to convey the recording medium; and
the engine unit is three-point supported by a housing of the apparatus main body.

2. An image forming apparatus according to claim 1, wherein:

a vibration prevention part is provided between the engine unit and the housing so as to prevent vibration of the engine unit.

5

3. An image forming apparatus according to claim 2, wherein:

the vibration prevention part comes in contact with the engine unit and the housing.

10

4. An image forming apparatus according to claim 2 or 3, wherein:

15

a vibration prevention part is provided at either or both sides of the image forming part of the engine unit relative to its direction of movement.

20

5. An image forming apparatus according to any one of claims 2 through 4, wherein:

a vibration prevention part is provided at least at one of an upstream side and a down stream side of the conveyance direction of the recording medium by the conveyance part of the engine unit.

25

6. An image forming apparatus according to any one of claims 2 through 5, wherein:

30

a vibration prevention part is provided either above or below the engine unit or both above and below the engine unit.

35

7. An image forming apparatus according to any one of claims 1 through 6, wherein:

the vibration prevention part comprises at least one of :

40

a coil spring;
a plate spring;
an oil damper;
a sponge member;
a rubber member.

45

8. An image forming apparatus according to any one of claims 1 through 3, wherein:

50

the vibration prevention part is fixed to the housing and has a plate spring configured to press in a recording medium conveyance direction from the housing side to the engine unit side.

55

9. An image forming apparatus according to any one of claims 1 through 3, wherein:

the vibration prevention part is detachable.

10. An image forming apparatus according to any one of claims 1 through 3, wherein:

the vibration prevention part includes a part configured to vibrate the engine unit in a direction opposite to a vibration direction based on a detection result of vibration of the engine unit.

FIG. 1

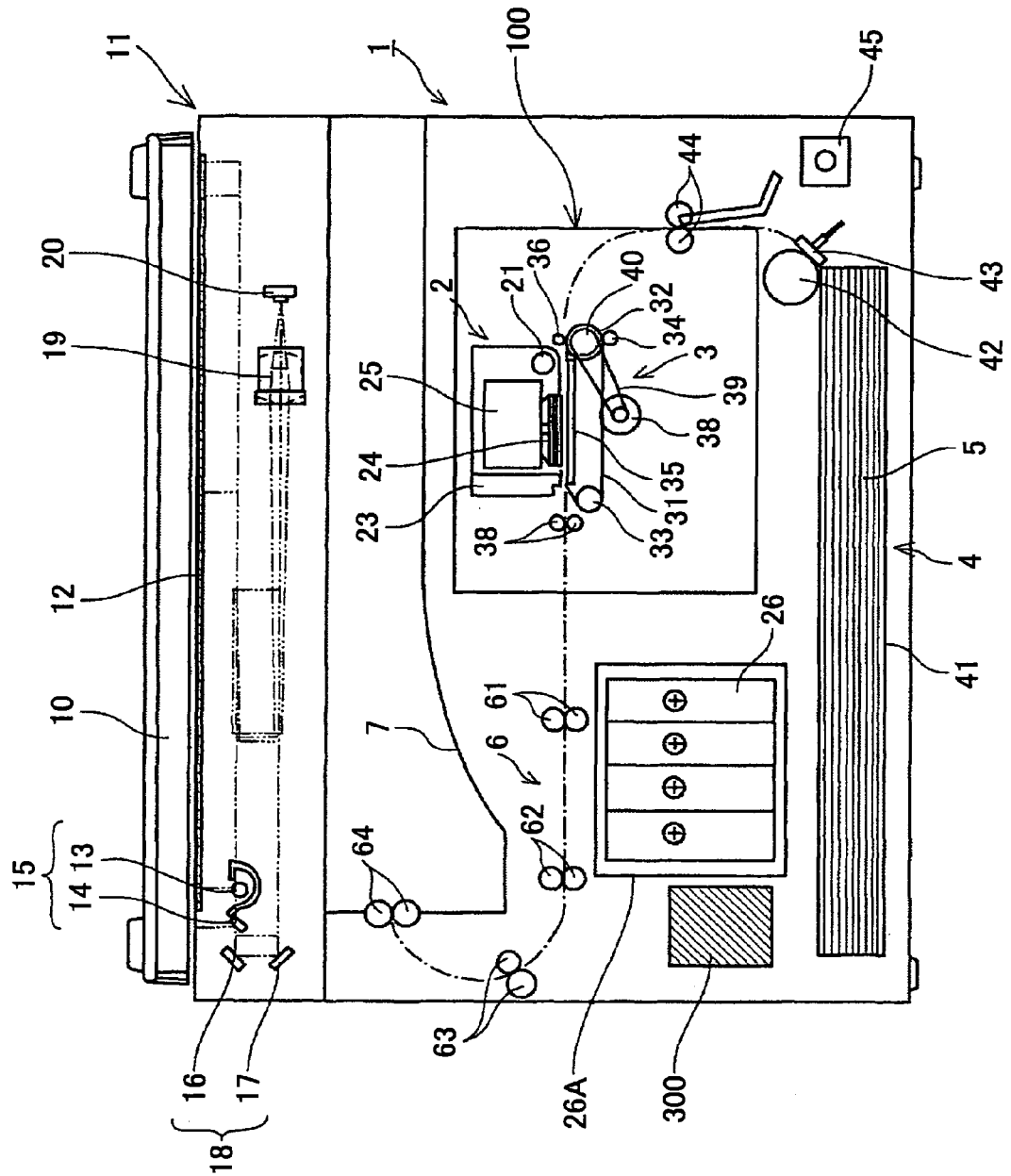
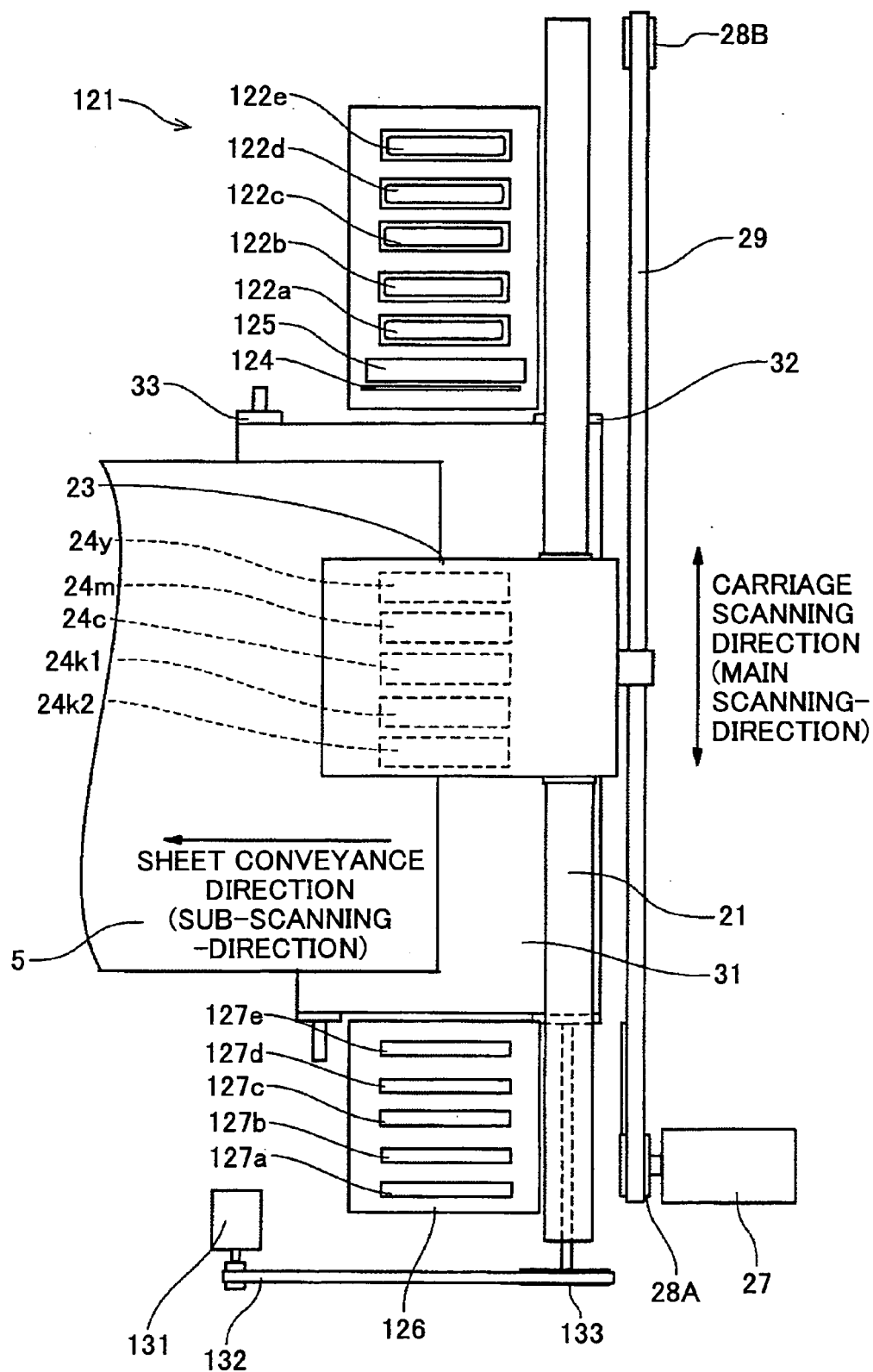


FIG.2

APPARATUS REAR SIDE (REAR SURFACE SIDE)



APPARATUS FRONT SIDE (FRONT SURFACE SIDE)

FIG.3

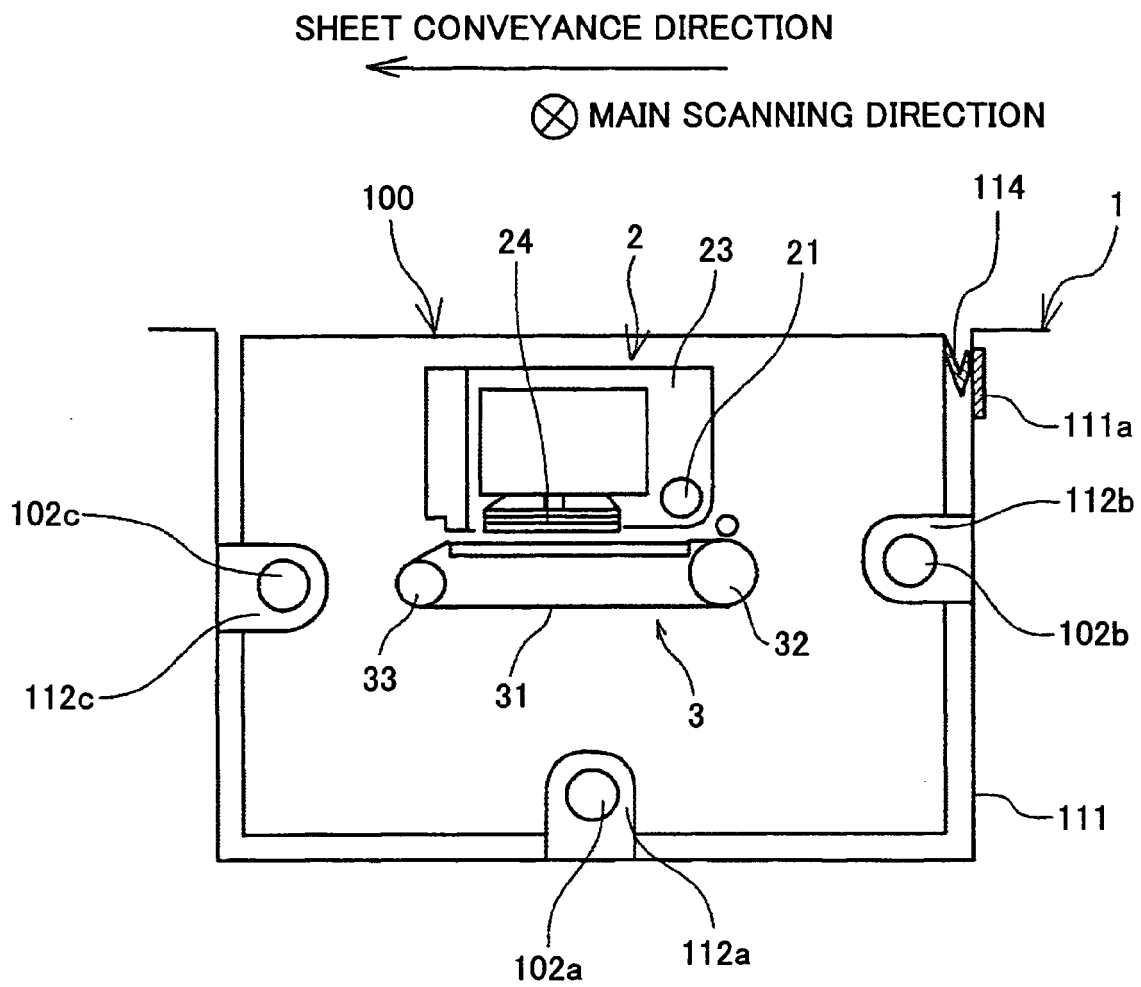


FIG.4

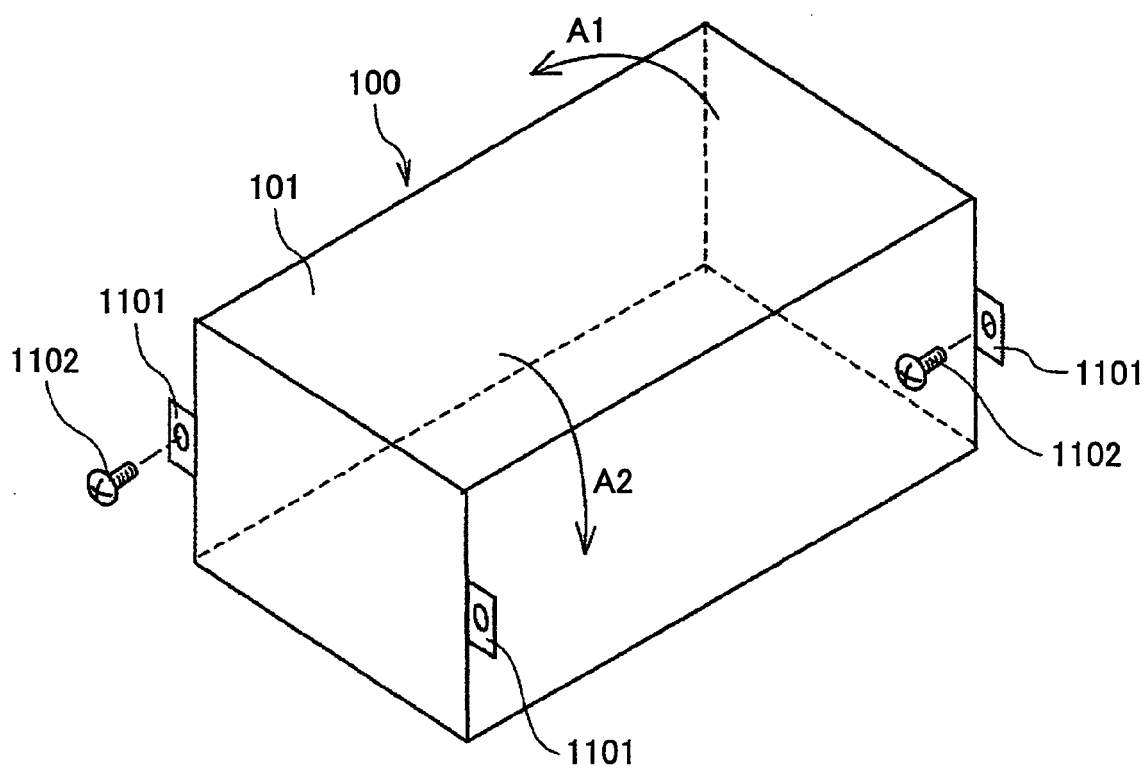


FIG.5

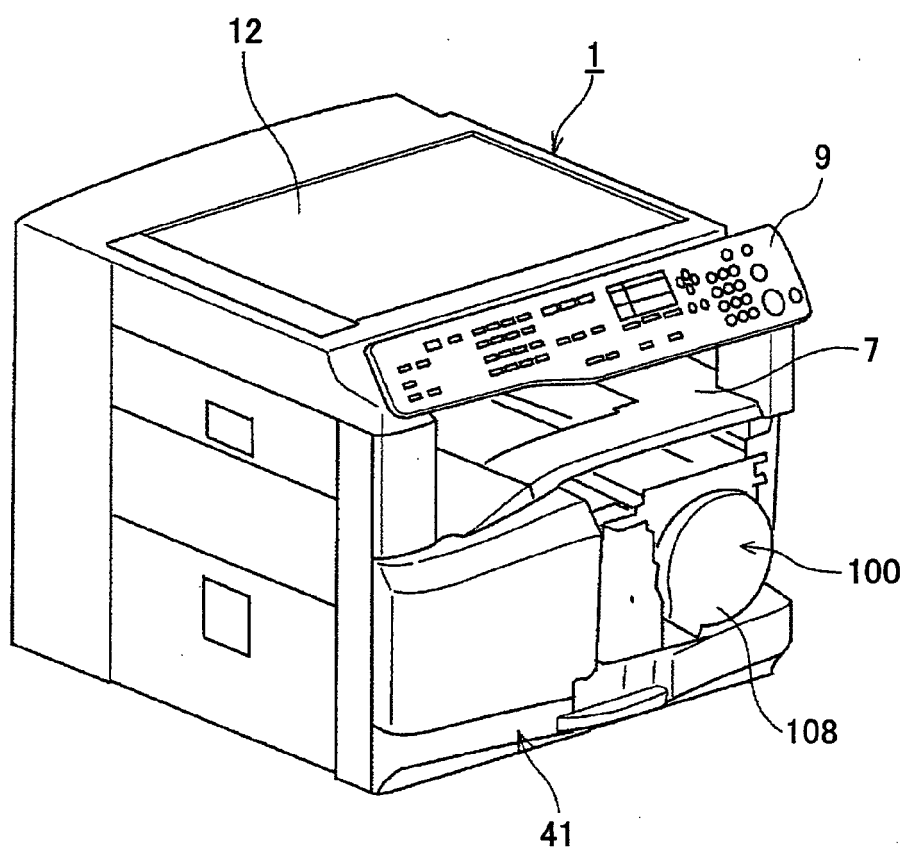


FIG.6

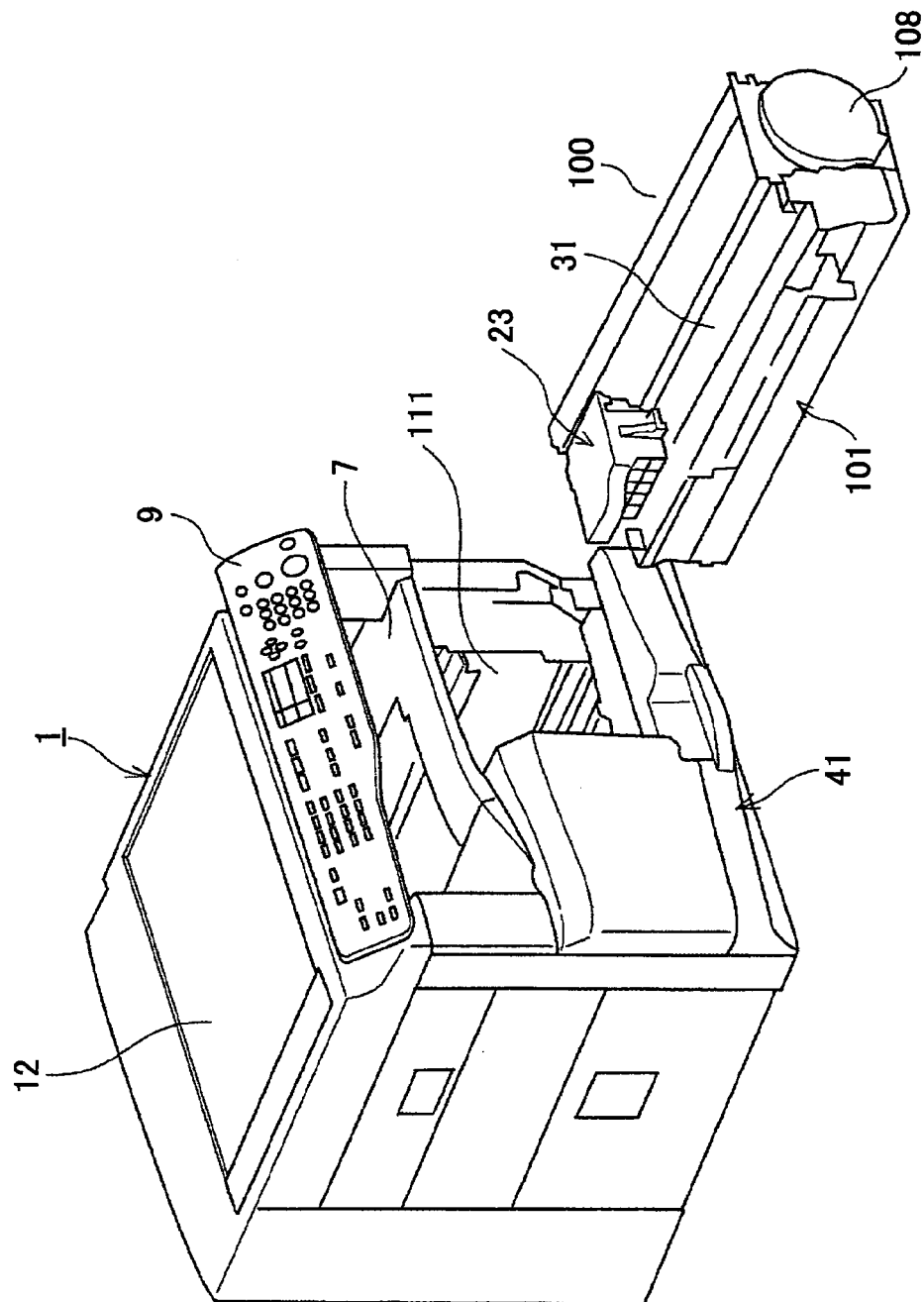


FIG.7

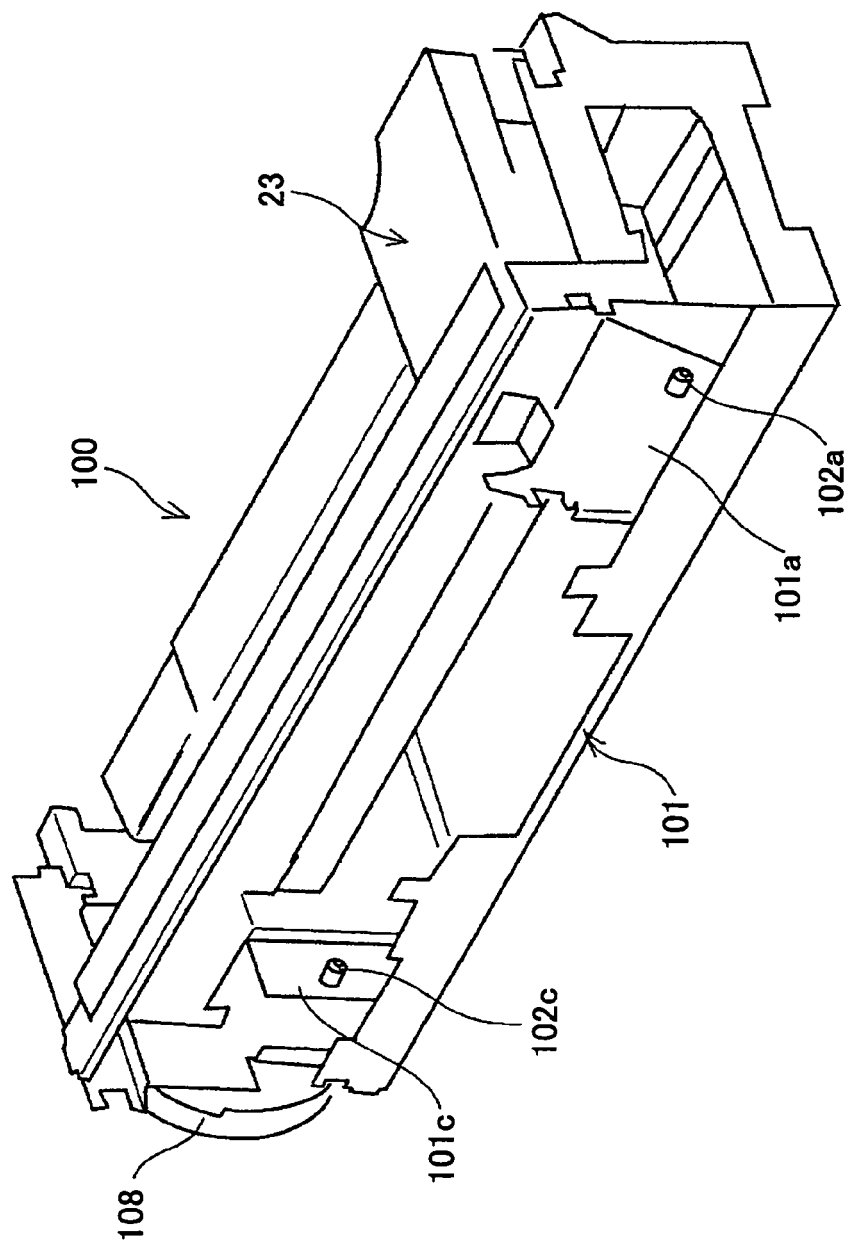


FIG.8

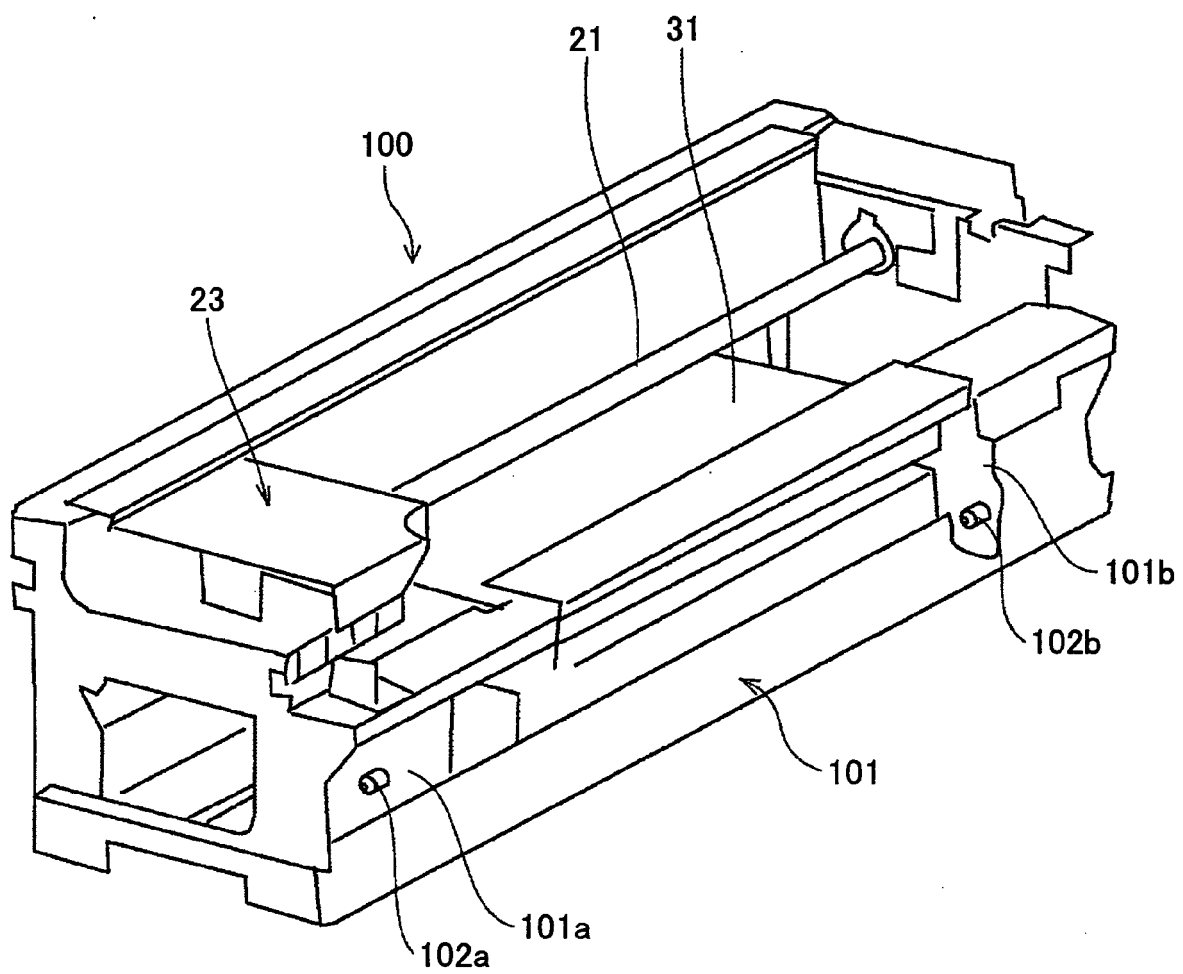


FIG.9

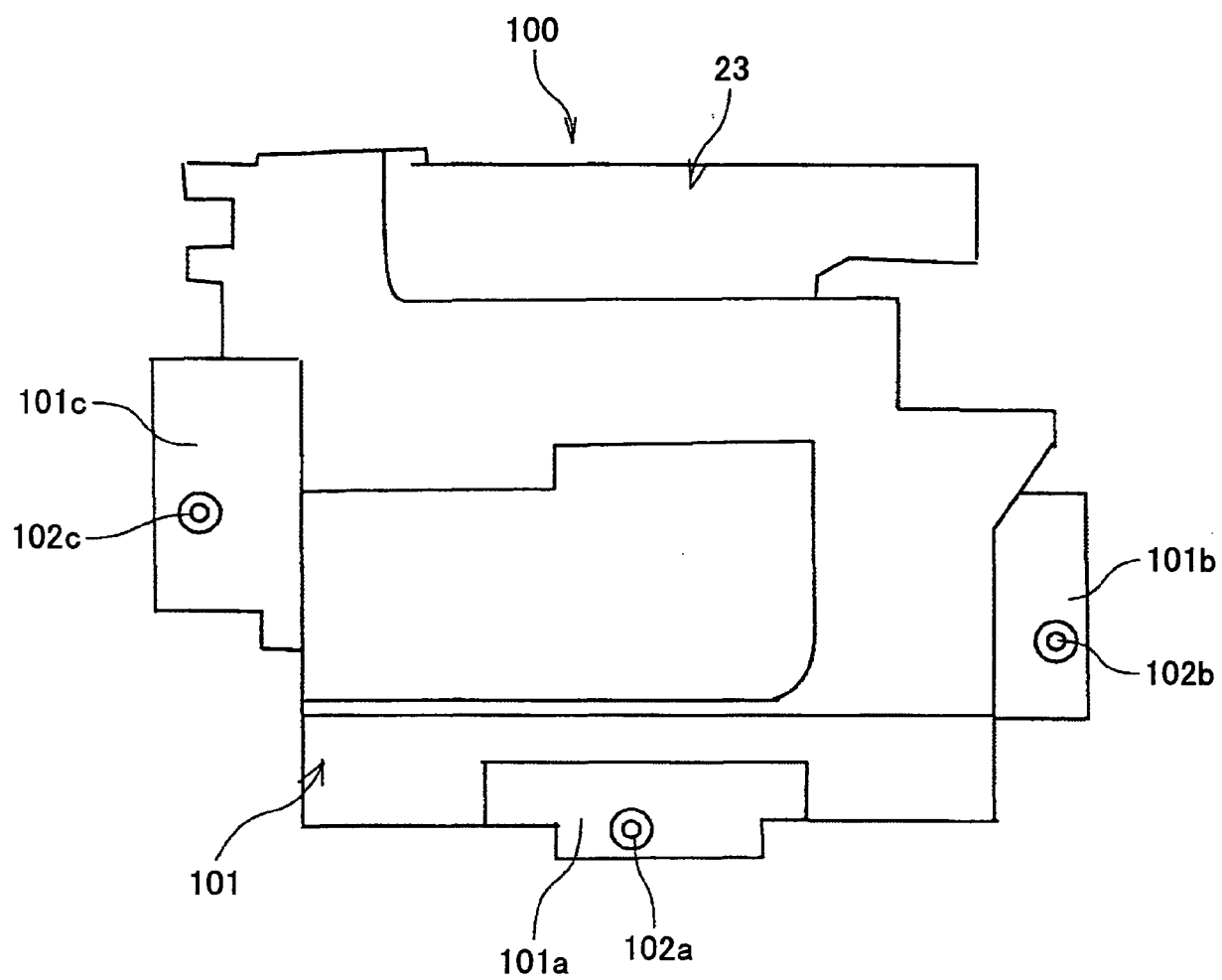


FIG.10

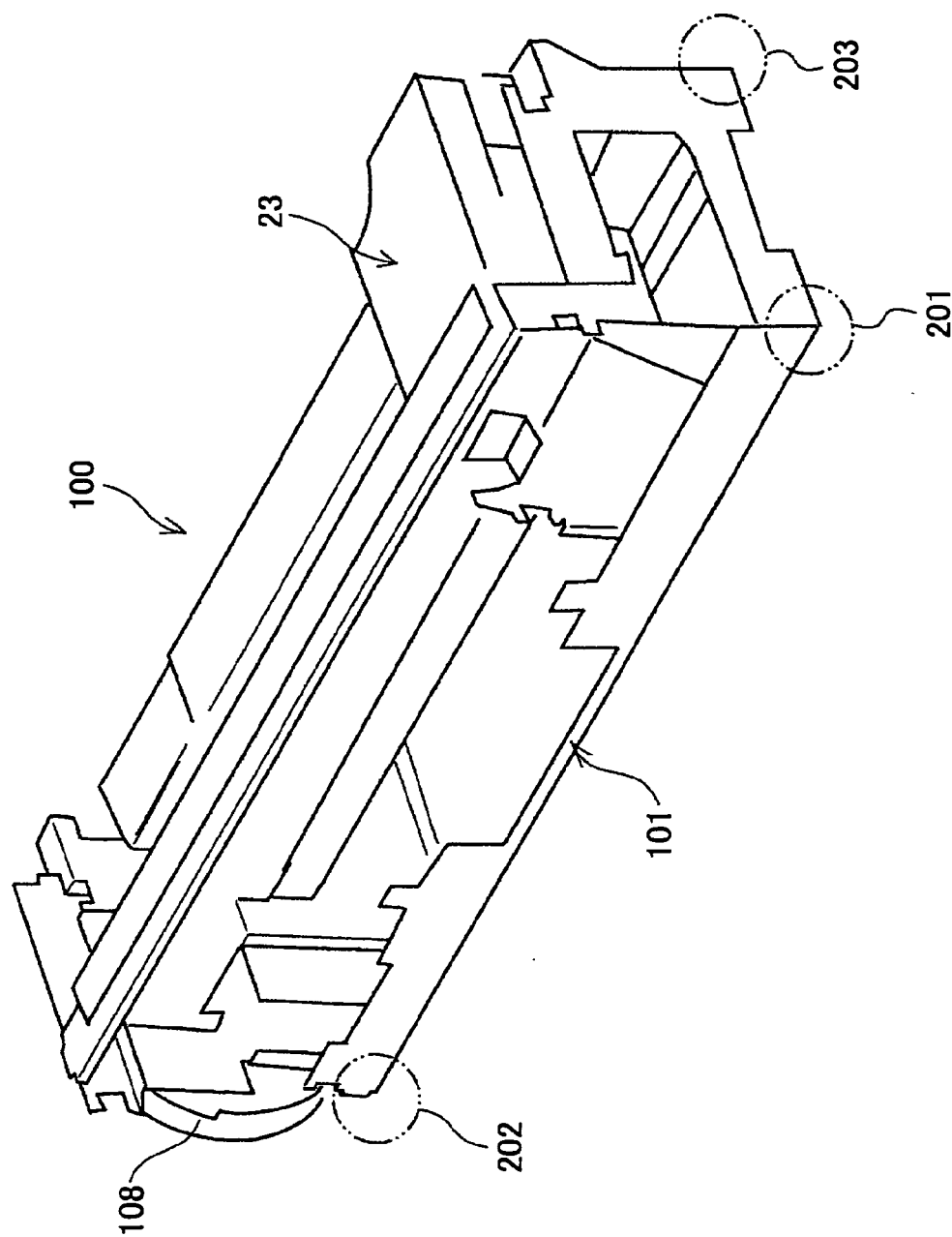


FIG.11

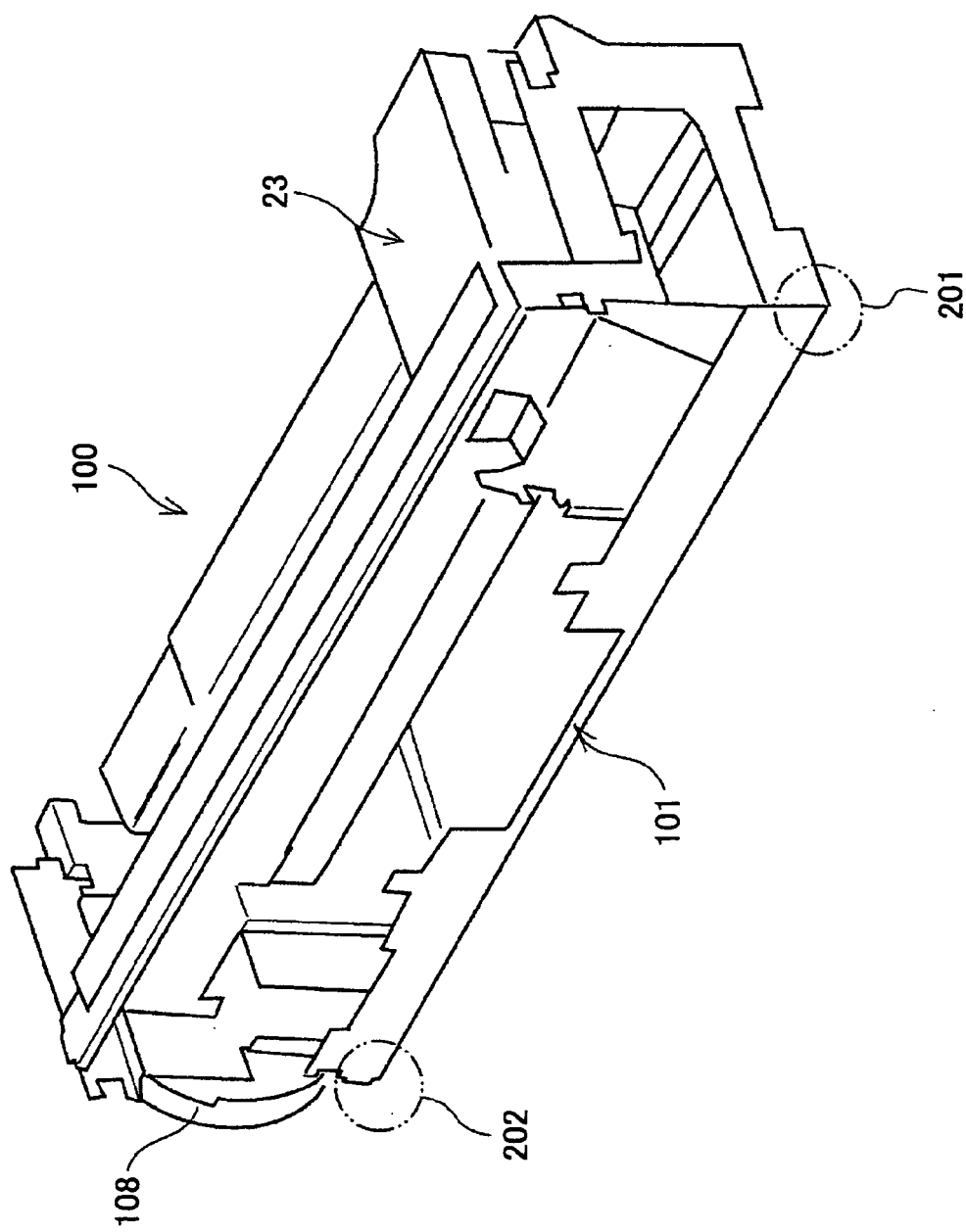


FIG.12

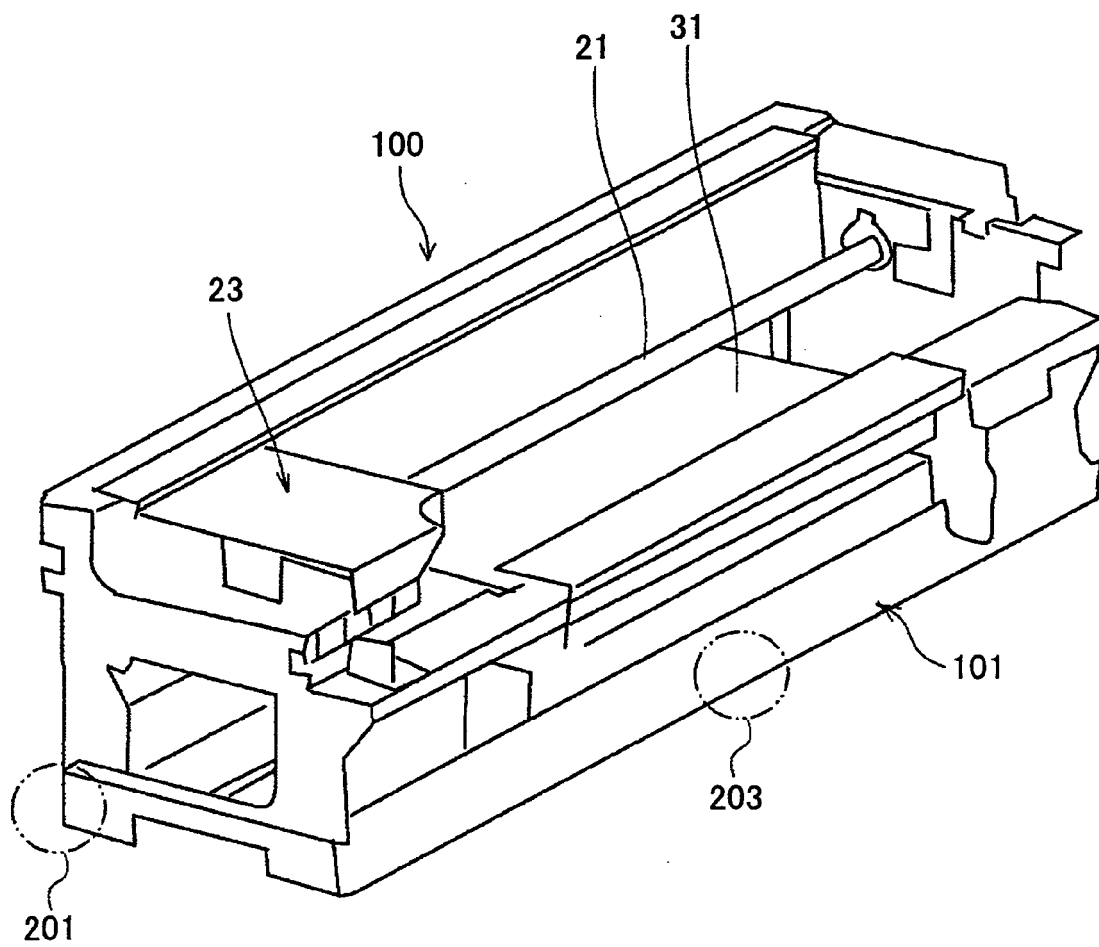


FIG.13

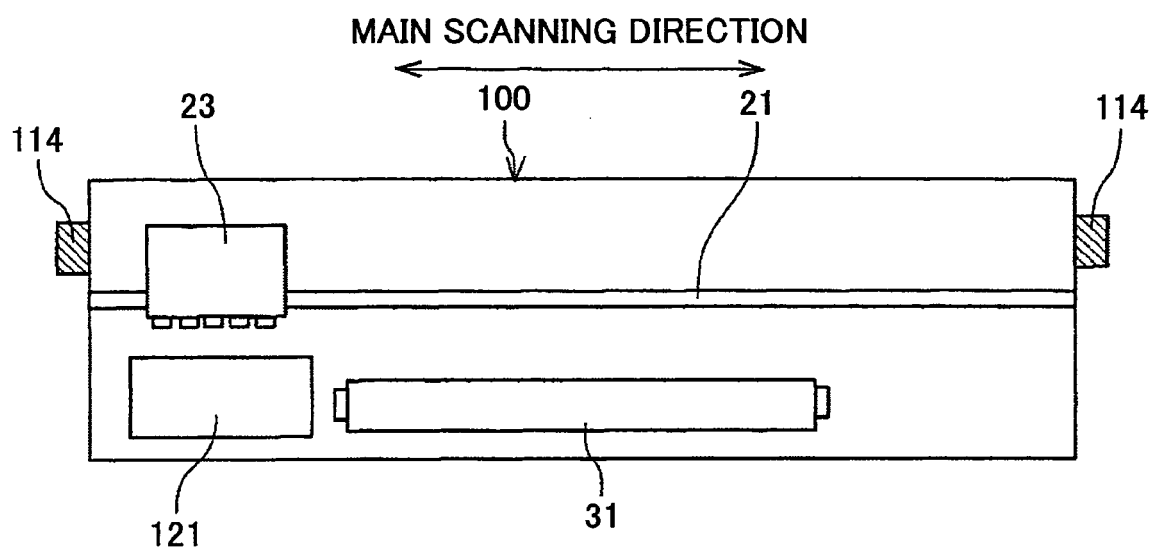


FIG.14

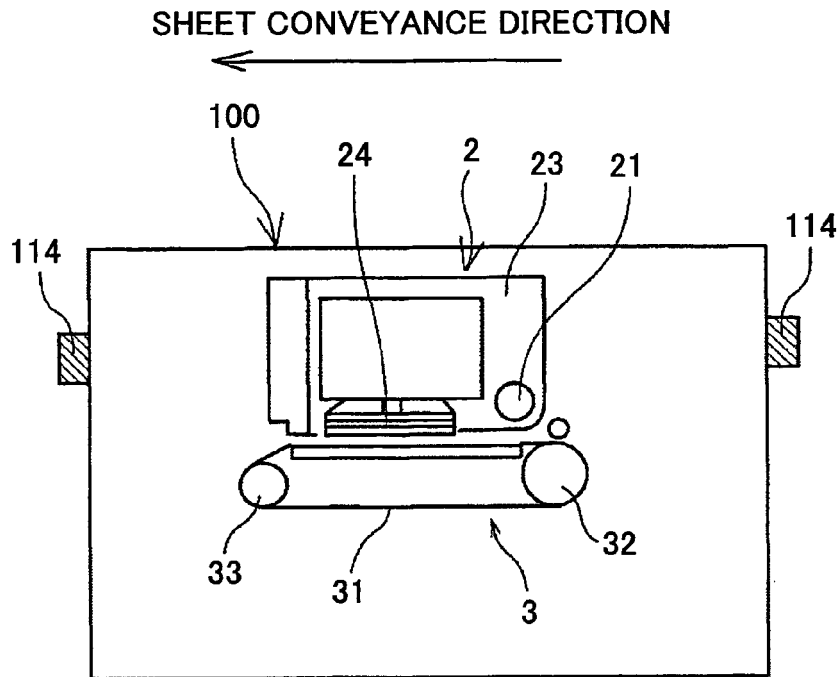


FIG.15

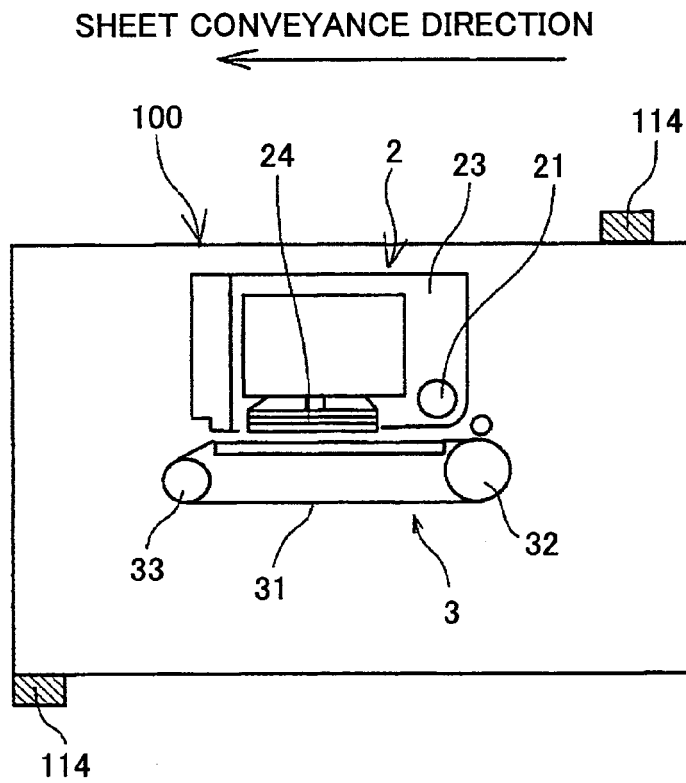


FIG.16

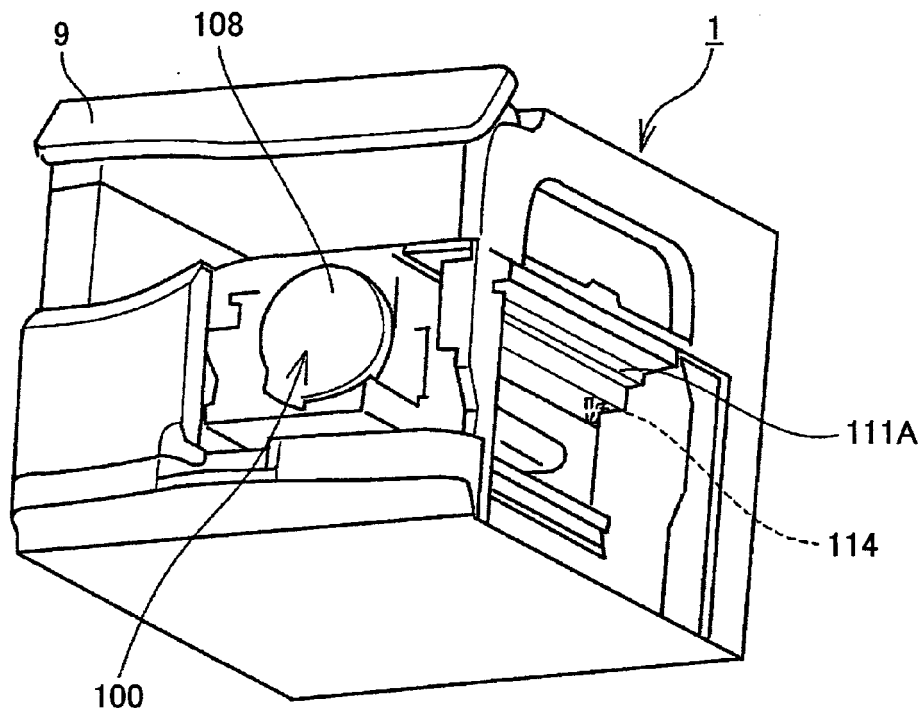


FIG.17

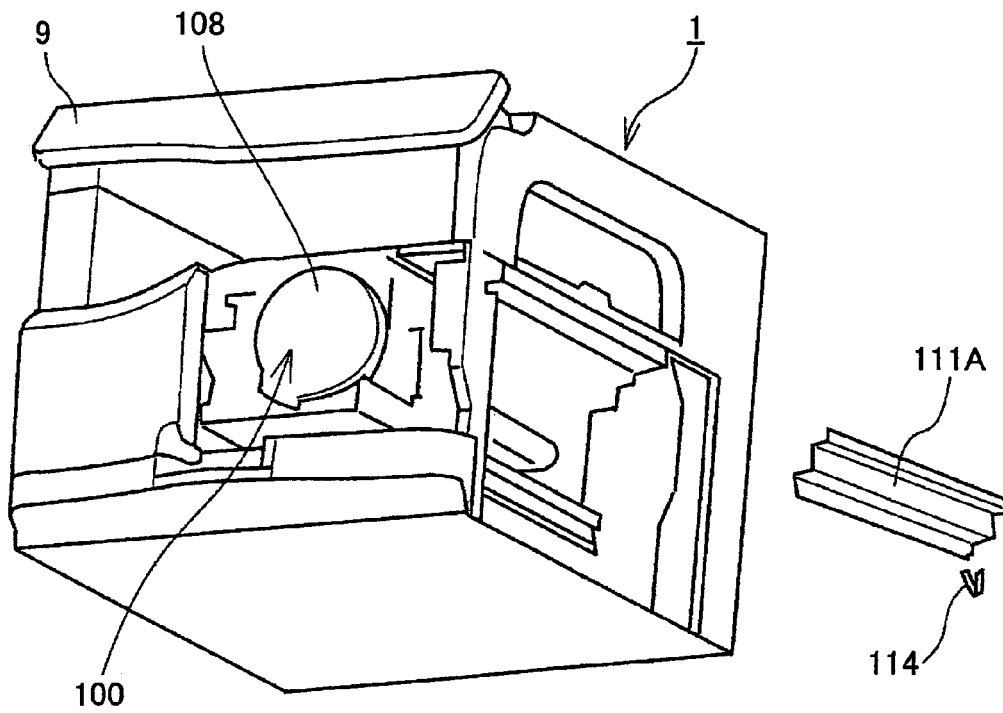
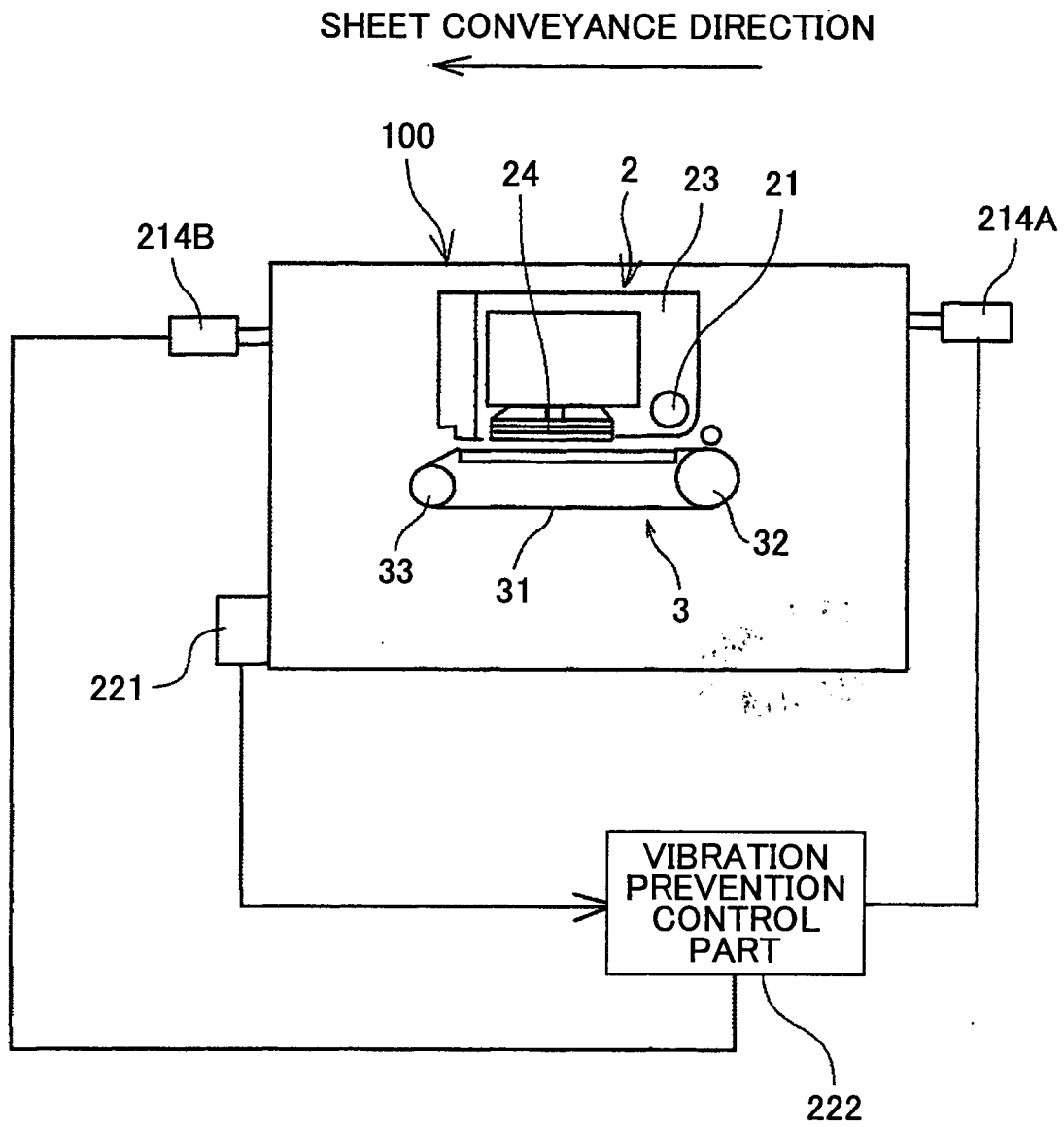


FIG.18



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 3404060 B [0004]