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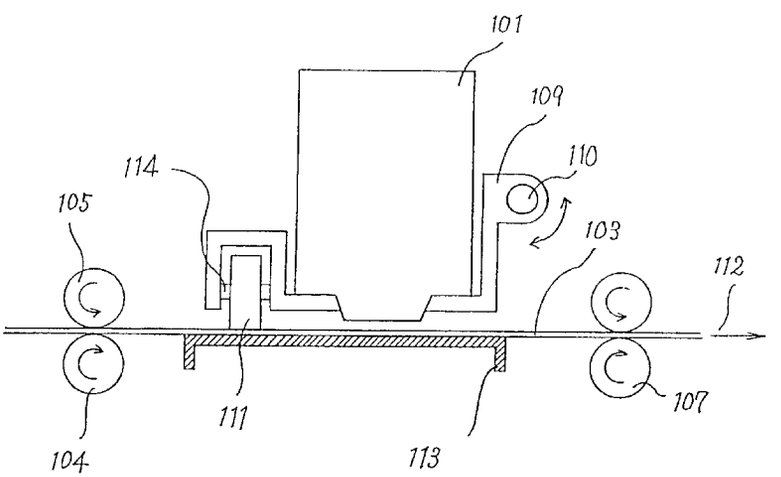
(54) Ink jet recording apparatus and head gap retaining mechanism for use therein

(57) It is the object to convey a printing medium while ensuring a fixed gap distance between an ink jet head and the printing medium even when the constituent parts are not required to have a high machining precision and high assembling precision, and to maintain this state as it is for a long period of time. On a main body of a ink jet cartridge 101 or on a surface of a head carrier 109 for carrying the ink jet cartridge 101, which is located upstream in the feeding direction of paper, there is mounted a guide roller 111, whereby it is arranged that the guide roller 111 runs on the surface of a printing medium 103. Also, it is arranged that blades , sponge roller or the like for cleaning the outer-peripheral surface of the guide roller 111 is mounted on the ink jet cartridge. Further, when feeding the printing medium, the ink jet cartridge has been retracted to outside the printing medium.

F I G. 1



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Description

BACKGROUND OF THE INVENTION

The present invention relates to an ink jet recording apparatus that is equipped with an ink jet cartridge for jetting a recording liquid onto a printing medium and thereby causing it onto the printing medium to thereby perform recording and a gap retaining mechanism for retaining the gap between the ink jet cartridge and the printing medium, which gap retaining mechanism is used in the ink jet recording apparatus.

An ink jet recording method is one which generates droplets of ink and makes flight thereof and causes attachment of a part or the whole thereof onto a printing medium such as a sheet of paper to thereby perform recording, by the use of various recording liquid jetting systems such as a system wherein ink is attracted and jetted by electrostatic force, a system wherein mechanical vibration or displacement is imparted to recording liquid with the use of a piezoelectric element, or a system wherein recording liquid is heated and bubbled whereby the resulting pressure is utilized.

A paper conveying mechanism that is used in a conventional ink jet recording mechanism will now be explained with reference to the drawings. In Fig. 2, an ink jet cartridge 201 is disposed with a necessary gap (g) being kept between itself and a platen 202. The platen 202 is made rotatable by being made using a rubber roller or is formed using a highly slidable resin into a somewhat curved convex configuration and this platen is in a positional relation wherein a printing medium 203 is in contact with the apex of the convex portion of the platen. The printing medium 203 is conveyed up to a printing zone that is composed of the ink jet cartridge 201 and the platen 202 by being clamped between a capstan 204 and a pinch roller 205. At this time, in many cases, in order to ensure the paper feeding precision, the capstan 204 is made using a material of high rigidity such as stainless steel and the pinch roller 205 is made using an elastic material such as rubber.

Explaining briefly the operation of the ink jet recording apparatus, as illustrated in Fig. 3, with a recording apparatus 302 being composed of a power-supply unit 303 for supplying a power to each element, an image processing circuit 304 for performing data conversion as the necessity arises with respect to input image data, a controller 305 for performing data transmission and data reception between the units and controlling the operational sequence between the units, etc., the recording apparatus operates in such a way as to receive, according to the instructions from the controller 305, the image data input from an external device 301 such as a personal computer, perform data conversion such as color conversion and edge emphasis in the image processing circuit 304, and cause ink to be jetted from an ink jet head unit 306 in correspondence with the converted data to thereby cause an image to be formed on the printing medium 307.

By the way, since the image that is formed is generally two-dimensional and the ink jet openings of the ink jet head unit 306 are disposed one-dimensionally, in order to perform printing over a relevant entire region it becomes necessary to use paper feeding means and ink jet head carrying means (not illustrated) which are for the purpose of sequentially feeding both of the head unit 306 and printing medium 307 in directions perpendicular to each other to thereby repeat the printing operation. In addition, when performing the printing by moving the both elements, it is necessary to maintain the gap distance between the ink jet head and the printing medium to be at a fixed value. In the prior art, as illustrated in Fig. 2, this end has hitherto been accomplished by mounting a guide roller 211 onto a head carrier 209 having mounted thereon an ink jet cartridge 201 and sliding the guide roller 211 on a guide rail 208. It is to be noted that the guide rail 208 is fixed to a frame member by being fastened thereto by means of screws or the like.

However, in the conventional ink jet recording apparatus having the above-mentioned construction, a certain range of tolerance is needed to be provided for the degree of parallelization between a sliding surface 212 of the guide rail 208 and a printing surface 213 and the flatness of the sliding surface 212 itself of the guide rail 208, etc. Assuming that the distances as measured from a base 211 to the sliding surface 212 and from the base 211 to the printing surface 213 be represented by (a) and (b) respectively, since each of these distances is not always a fixed value as illustrated in, for example, Fig. 4, (l) which is the difference between (a) and (b) is not a fixed value. Accordingly, it results that a gap distance (g) has the same degree of variation as that of (l). Actually, to the configuration tolerances of the above-mentioned parts as single items of parts there are added assembling tolerances such as the mounting tolerance of the guide rail 208, with the result that the degree of variation of the gap (g) becomes inconveniently a relatively large value of, for example, 0. 1 to 0. 2 mm or so. Although in order to make the variation degree of the gap distance lower it is sufficient to enhance the machining precision and assembling precision of the constituent parts such as the guide rail 208, such enhancement has relevancy to the cost and therefore is not advisable.

Also, as illustrated in Fig. 5, in a case of providing an ink jet cartridge 501 and an opposing electrode 503 and applying an electric field therebetween with the use of a d.c. power source 502 to thereby fly an electrically charged ink droplet 505, the force that acts on the ink droplet 505 is proportional to the field intensity between the ink jet cartridge 501 and the opposing electrode 505. Accordingly, the variation in the gap distance (g) is in direct correspondence with the variation in the force that acts on the ink droplet 505, which results in the deterioration of the image quality due to the variation in the

printing conditions.

SUMMARY OF THE INVENTION

In a first aspect, there is provided an ink jet recording apparatus comprising ink jetting means for jetting a recording liquid onto a printing medium in correspondence with input image data, characterised by gap retaining means for maintaining a distance between the printing medium and the ink jetting means to be at a predetermined value, paper feeding means for for feeding the printing medium and head carrying means for carrying the ink jetting means in a direction that is substantially perpendicular to feeding direction of the printing medium.

In a second aspect, there is provided a gap retaining mechanism of an ink jet recording apparatus comprising ink jetting means for jetting a recording liquid onto a printing medium in correspondence with input image data, paper feeding means for carrying the ink jetting means in a direction in which the printing medium is fed, characterised by a roller member rotatably mounted on the ink jet means or head carrying means and moveable in such a way as to rotate on the printing medium to maintain a distance between the printing medium and the ink jetting means to be at a fixed value.

On this account, in the present invention, there has been provided a mechanism wherein a guide roller is mounted on an ink jet cartridge or head carrier for carrying the ink jet cartridge and this guide roller is disposed such that its mounting position is situated on a surface of the ink jet cartridge or head carrier which is upstream in the paper feeding direction, whereby the guide roller runs on the surface of the printing medium but not runs on the guide rail as in the prior art. By using this mechanism it results that the ink jet cartridge follows, while being in contact with, the surface of the printing medium, with the result that only if the dimensions are strictly determined with regard to only the circularity of the guide roller and the eccentricity thereof at the time of mounting thereof, even when the machining precision of the remaining constituent parts is decreased, the variation degree of the gap distance can be maintained to be at an appreciably small value. In addition, since the guide roller runs on the printing surface on a side that is upstream in the paper feeding direction, the guide roller does not touch the ink after printing has been performed and therefore does not stain the printed surface.

Also, there has been made a structure of mounting onto a head carrier or ink cartridge cleaning means such as blades and roller for cleaning the outer-peripheral surface of the guide roller. By using this structure, since the outer-peripheral surface of the guide roller is always kept cleaned by the scratching action of the blade or sliding movement of the roller, it does not happen that the variation in the gap distance occurs with the lapse of time. Especially, since when having mounted the cleaner with respect to the ink cartridge the replacement of the ink cartridge being now used results in simultaneous replacement of the cleaning means such as the blades or roller, a fixed gap distance is maintained almost permanently.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view illustrating an embodiment wherein in an ink jet recording apparatus according to the present invention a guide roller has been provided on a head carrier.

Fig. 2 is a side view illustrating a printing portion in particular of a conventional ink jet recording apparatus.

Fig. 3 is a block diagram illustrating the operation of the ink jet recording apparatus.

Fig. 4 is a schematic diagram illustrating the relationship of the distance between the sliding surface of the guide rail and a base and the distance between the printing surface and the base, with the head position as viewed in the main scanning direction.

Fig. 5 is a schematic diagram illustrating the operation that is performed when applying an electric field to an electrically charged ink droplet.

Fig. 6 is an upper surface view illustrating the operation of the ink jet recording apparatus according to the present invention.

Fig. 7 is a schematic diagram illustrating that the gap distance can be maintained to be fixed in the ink jet recording apparatus according to the present invention.

Fig. 8 is a schematic diagram illustrating an embodiment of cleaning means for cleaning the guide roller of the ink jet recording apparatus according to the present invention.

Fig. 9 is a schematic diagram illustrating another embodiment of the cleaning means for cleaning the guide roller of the ink jet recording apparatus according to the present invention.

Fig. 10 is a side view illustrating an embodiment wherein in the ink jet recording apparatus according to the present invention the guide roller has been provided on the ink jet cartridge. And,

Fig. 11 is a side view illustrating an embodiment wherein in the ink jet recording apparatus according to the present invention the guide roller and cleaning means have been provided on the ink jet cartridge.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the ink jet recording apparatus of the present invention, there has been provided a mechanism wherein in order to maintain the gap distance between the ink jet cartridge and the printing medium the guide roller is provided to the ink jet cartridge or head carrier and this guide roller is made to run on the surface of the printing medium and, in addition, this guide roller is disposed on a side that is upstream in the printing direction. Further, means for cleaning the outer-peripheral surface of the

guide roller has been mounted on the ink jet cartridge or head carrier.

(First Embodiment)

An embodiment of the present invention will now be explained by taking as an example a case of applying an electric field to an electrically charged ink droplet and thereby causing it to fly (a case such as that which is illustrated in Fig. 5) . In Fig. 1, an ink jet cartridge 101 is structured such that the ink jet cartridge 101 is removably mounted on a head carrier 109, whereby when the ink has been used up, the ink jet cartridge as a whole is replaced by a new cartridge or otherwise is demounted once and, after ink is supplemented, is mounted again. The head carrier 109 is arranged to be able to make its reciprocating movements in directions perpendicular to the paper surface and make its rocking movements about a guide shaft. This reciprocating movement is performed with a pulse motor (not illustrated) or the like in order to be synchronized with transfer of data to the ink jet cartridge 101. Also, since the center of gravity of the entire head carrier is located on the left side of the guide shaft 110, the moment acts on the entire head carrier due to the gravitational force in the counterclockwise direction, which results in that a guide roller 111 runs on the surface of a printing medium 103 in such a way as to follow this surface while being in contact therewith.

On a rear side of the printing medium 103 there is provided an opposing electrode 113, which is formed to have a size that can cover not only a region permitting it to oppose the ink jet surface of the ink jet cartridge 101 but also a region permitting it to oppose even a position at which it opposes the guide roller 111.

Fig. 6 is an illustration wherein the printing portion that is constructed in Fig. 1 has been viewed from above. The right side of a printing medium 603 as viewed from the head carrier 609 is in a state where print images are already formed. The head carrier 609 is designed so that the home position thereof is located at a point (E). The printing medium 603 is fed from a pinch roller 605 side and is conveyed in a direction (C). Also, an ink jet cartridge 601 and the head carrier 609 are so arranged as to be able to make their reciprocating movements in directions (A) and (B).

Actual printing operations are performed in units of a single line, or simultaneously in units of several lines, according to the number of ink jet openings of the ink jet head 601, while the head carrier 609 is moving in the direction of (A). At this time, the printing medium 603 is in stoppage. Upon completion of one line or several lines printing, the head carrier is retracted once to the home position E, during which the printing medium 603 is sequentially fed by a distance that corresponds to the printed line or lines number in the direction of (C). Thereafter, the head carrier 609 is returned in the direction of (B) and then, while being moved in the direction of (A), performs the next one line or several lines printing. Here, since the rolling direction of the guide roller 611 (the directions (A) and (B)) and the feeding direction of the printing medium (the direction (C)) intersect each other at right angles, unless when the printing medium 603 is fed the head carrier 609 is retracted to the home position (E), the conveying operation of the printing medium 603 ceases to be performed smoothly, with the result that according to cases, the paper feeding precision is inconveniently decreased.

Next, the reason why the gap distance is maintained to be fixed will be explained. The illustration that is made of Fig. 6 from the side of the pinch roller 605 is presented in Fig. 7. Although the same thing has been stated also in connection with the prior art, it is general that the configuration of the opposing electrode 713 is not always completely flat and has more or less an undulation or inclination. As illustrated in, for example, Fig. 7, the opposing electrode has an undulation of δ at maximum, and this value is considered to be from approximately 0. 3 to 0. 6 mm or so with respect to the printing of an A3 paper having a printing width/short side of 210 mm. Since as explained in connection with Fig. 1 the head carrier is given a clearance that permits it to rotate about the guide shaft, if the vertical variation of the head carrier is to an extent of from approximately 0. 3 to 0. 6 mm or so, the head carrier 709 can run on the surface of the printing medium 703 while being rocked about the guide shaft 710 and following this surface configuration thereof. Since the ink jet cartridge 701 is mounted on the head carrier 709, the distance between the ink jet surface of the head and the opposing electrode 713 is always maintained to be fixed for the above-mentioned reasons.

Although in this embodiment illustration has been made of the construction using a single roller as the gap retaining means for maintaining the distance between the ink jet cartridge constituting the ink jetting means and the printing medium to be fixed, such gap retaining means can be constructed by using even a plurality of roller members.

Meanwhile, since the gap roller such as the guide roller for maintaining the gap is arranged to run on the surface of the printing medium as mentioned above, there is supposed also a case where as the number of printed sheets of paper increases the outer-peripheral surface of the gap roller becomes stained due to the paper dust powder. In such a case, it is effective for the gap roller to have a cleaning mechanism such as that which is illustrated in Fig. 8. In the ink jet recording apparatus of Fig. 8, although almost all of the constituent parts are the same as those which have been hereinbefore stated, the ink jet recording apparatus of Fig. 8 differs from the preceding one in the respect of being structured such that as illustrated in Fig. 8(b) an arm 812 is extended from an ink jet cartridge 801 and, as illustrated in Fig. 8(a), a plate spring 814 and rubber blades 815 and 816 are mounted on a forward end of this arm 812. When the printing is performed while the head carrier

809 is being moved in the direction of (A), since the guide roller 811 is rotated in the direction of (C), the stains that have attached onto the outer-peripheral surface of the guide roller 811 are scratched away by the rubber blades 815. Also, when one-time scanning is completed whereby the head carrier 809 is moved in the direction of (B) in order to return again to the position at which the printing is started, the cleaning is performed by the rubber blade 816 that is opposite to that which has been mentioned above. In the case of this embodiment, when the ink within the ink jet cartridge is used up and this ink jet cartridge is replaced by a new ink jet cartridge, since the cleaning blades are also replaced simultaneously, defective cleaning is prevented due to the wear of the rubber blades.

Another embodiment of this cleaning mechanism is illustrated in Figs. 9(a) and 9(b). This embodiment differs from Fig. 8 in that scratching-away of the stains is performed not by the rubber blades but by pressing a cleaning roller 914 such as that which has been formed using a foamable sponge or the like against the outer-peripheral surface of a guide roller 911 and sliding the cleaning roller with respect to this outer-peripheral surface. Especially, if the peripheral velocities of the cleaning roller 914 and the guide roller 911 are made to differ from each other whereby the guide roller 911 is slid at the surface of contact therebetween, scratching-away of the stains is performed more effectively. In this case, also, since the cleaning roller is simultaneously replaced by the ink jet cartridge being replaced, the cleaning function is maintained to be performed almost permanently.

It is to be noted that in this embodiment there has been shown the cleaning system that uses the rubber blades or cleaning roller, the invention is not limited thereto and permits other cleaning systems to be of course used with the same effect being brought about.

(Second Embodiment)

A case where the gap retaining means is contained in the ink jet cartridge will now be explained by way of example as a second embodiment of the present invention with reference to the drawings. As illustrated in Fig. 10, a guide roller 1011 is incorporated in an ink jet cartridge 1001 and this guide roller 1011 is made rotatable about a rotating shaft 1114. This ink jet cartridge 1001 is removably mounted to a head carrier 1009 and this ink jet cartridge is structured such that when the ink therein has been used up, it is replaced by a new cartridge or is demounted once whereby ink is supplemented and then the resulting cartridge is mounted again. In the case of the structure illustrated in this embodiment by way of example, since the gap distance can be maintained to be fixed without being influenced by the tolerance of mounting between the ink jet cartridge 1001 and the head carrier 1009, the variation in the gap distance can be suppressed to be smaller than in the above-mentioned case (First Embodiment).

Also, as illustrated in Fig. 11, a guide roller 1111 for maintenance of the gap is not only incorporated but there maybe also incorporated a cleaning sponge 1115 as the cleaning means for cleaning the outer-peripheral surface of the guide roller 1111. While Fig. 11(a) is a sectional view taken along a line A-A, illustration is made of a structure wherein the cleaning sponge 1111 is slid on the outer-peripheral surface of the guide roller 1111 to thereby wipe off the stains such as paper dust powder from this outer-peripheral surface.

Incidentally, since the operation, the reason why the gap distance is maintained to be fixed, etc. have been explained in the preceding embodiment, their re-explanation is omitted.

Although in this embodiment illustration has been made of the cleaning system that uses the cleaning sponge, the invention is not limited thereto and permits even other cleaning systems to be also used such as the cleaning systems illustrated in the preceding embodiment.

The present invention is worked out in the above-mentioned forms of embodiments and brings about the effects that are described as follows.

Since the ink jet recording apparatus has been structured such that on the ink jet cartridge or head carrier there is mounted the guide roller for regulating the gap distance between it and the printing medium whereby the guide roller is caused to run on the surface of the printing medium, the ink jet cartridge or head carrier follows the surface configuration of the printing surface while being in contact therewith, with the result that the gap distance between the jet surface of ink and the printing surface is maintained always to be fixed. In consequence, the jetted state of ink becomes uniform over an entire region of printing, whereby the printed images become stable with the result that the thickness unevenness, positional displacement, color drift, etc. become difficult to occur. This effect is great particularly when electrically charging the ink droplets and accelerating them by the electrostatic force.

Also, since the guide roller is located upstream in the feeding direction of paper and, when feeding the printing medium, the ink jet cartridge or head carrier having the guide roller mounted thereon is retracted to outside the printing medium, the printing medium can be conveyed without influencing the paper feeding precision. Since the ink jet recording apparatus is structured such that the guide roller is kept out of contact with the ink surface after printing, it is also possible to avoid the fear of staining the images.

Further, since in order to clean the outer-peripheral surface of the guide roller the rubber blades or sponge roller has been constructed integrally with the ink cartridge, it results that the stains or the like which cause the variation of the gap distance are always eliminated. Also, when the ink cartridge is replaced, the above-mentioned cleaning means are also replaced simultaneously, with the result that it does not happen that the clean-

ing performance deteriorates.

In addition, since if the clearances are made somewhat severe with respect to only the machining precision of the guide roller and the mounting thereof a desired value of gap distance can be ensured even when the tolerance is eased with respect to the remaining constituent parts and assembling thereof, there can be decreased the parts cost and assembling cost as viewed from the apparatus as a whole.

Claims

1. An ink jet recording apparatus comprising ink jetting means (101, 801, 901, 1001) for jetting a recording liquid onto a printing medium (103, 803, 903, 1003) in correspondence with input image data, characterised by gap retaining means (111, 811, 911, 1011) for maintaining a distance between the printing medium and the ink jetting means to be at a predetermined value, paper feeding means for (104, 105, 107; 1004, 1005) for feeding the printing medium and head carrying means (109, 809, 909, 1009) for carrying the ink jetting means in a direction that is substantially perpendicular to feeding direction of the printing medium.

2. An ink jet recording apparatus as set forth in claim 1, wherein the gap retaining means has a construction of having one or a plurality of roller members and being mounted to a surface of the ink jetting means or head carrying means which is situated upstream in the paper feeding direction.

3. An ink jet recording apparatus as set forth in claim 2, wherein the roller member of the gap retaining means is arranged for running on a printing surface of the printing medium.

4. An ink jet recording apparatus as set forth in claim 2 or 3, wherein the roller member is mounted (114) on the ink jetting means.

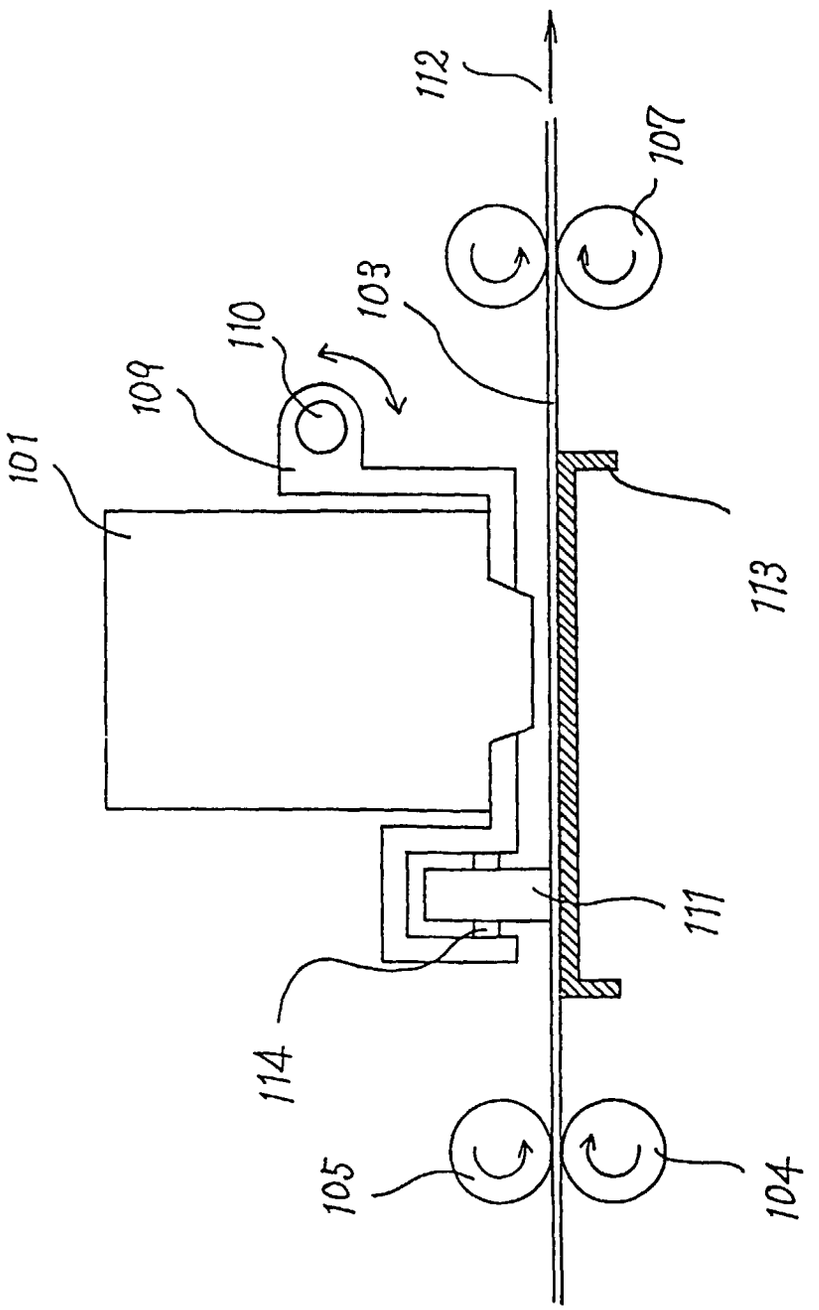
5. An ink jet recording apparatus as set forth in claim 2 or 3, wherein the roller member is mounted (114) on the head carrying means.

6. An ink jet recording apparatus as set forth in any of claims 2 to 5, wherein the gap retaining means includes cleaning means (814-816; 914) for cleaning an outer-peripheral surface of the roller member.

7. An ink jet recording apparatus as set forth in any of claims 1 to 6, wherein the head carrying means causes the ink jetting means to be retracted to outside the printing medium (E) when the printing medium is fed.

8. A gap retaining mechanism of an ink jet recording apparatus comprising ink jetting means (101, 801, 901, 1001) for jetting a recording liquid onto a printing medium in correspondence with input image data, paper feeding means (104-107; 1004, 1005) for feeding the printing medium and head carrying means (109, 809, 909, 1009) for carrying the ink jetting means in a direction that is substantially perpendicular to a direction in which the printing medium is fed, characterised by a roller member (111, 811, 911, 1011) rotatably mounted on the jetting means or head carrying means and moveable in such a way as to rotate on the printing medium to maintain a distance between the printing medium and the ink jetting means to be at a fixed value.

FIG. 1



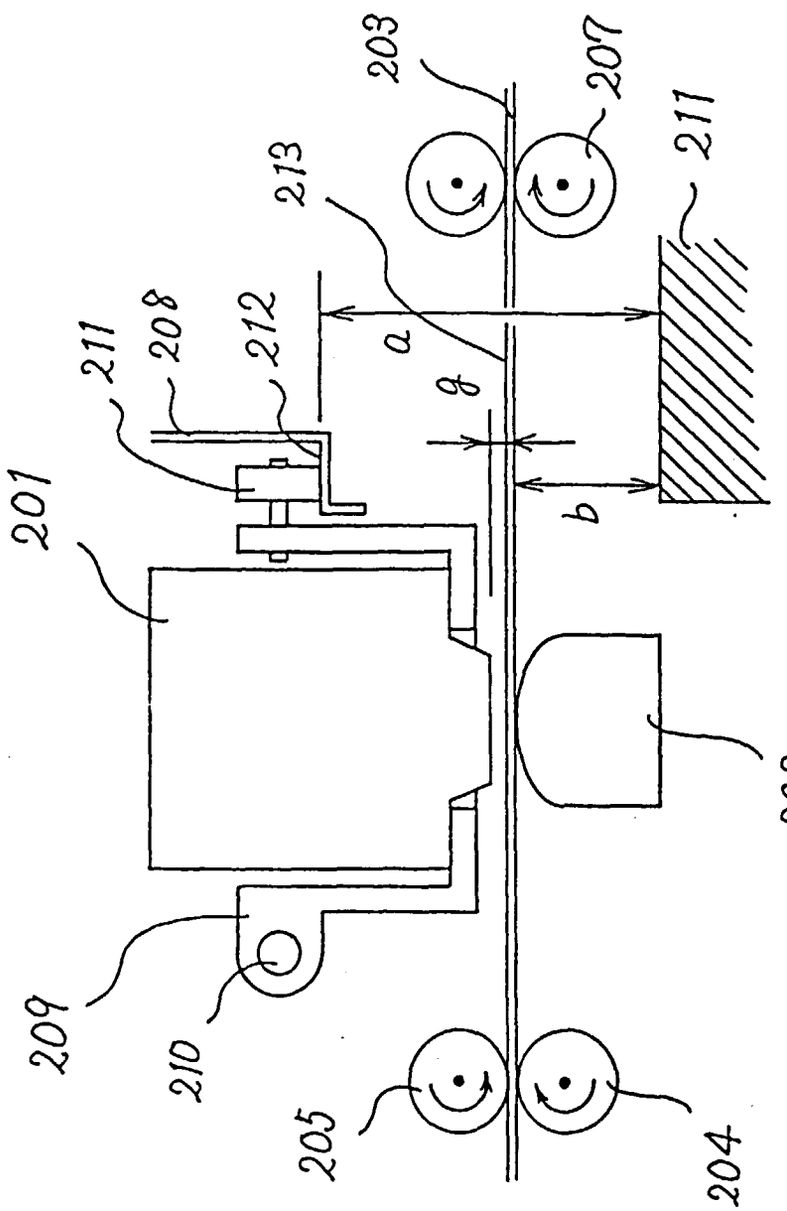


FIG. 2
PRIOR ART

FIG. 3

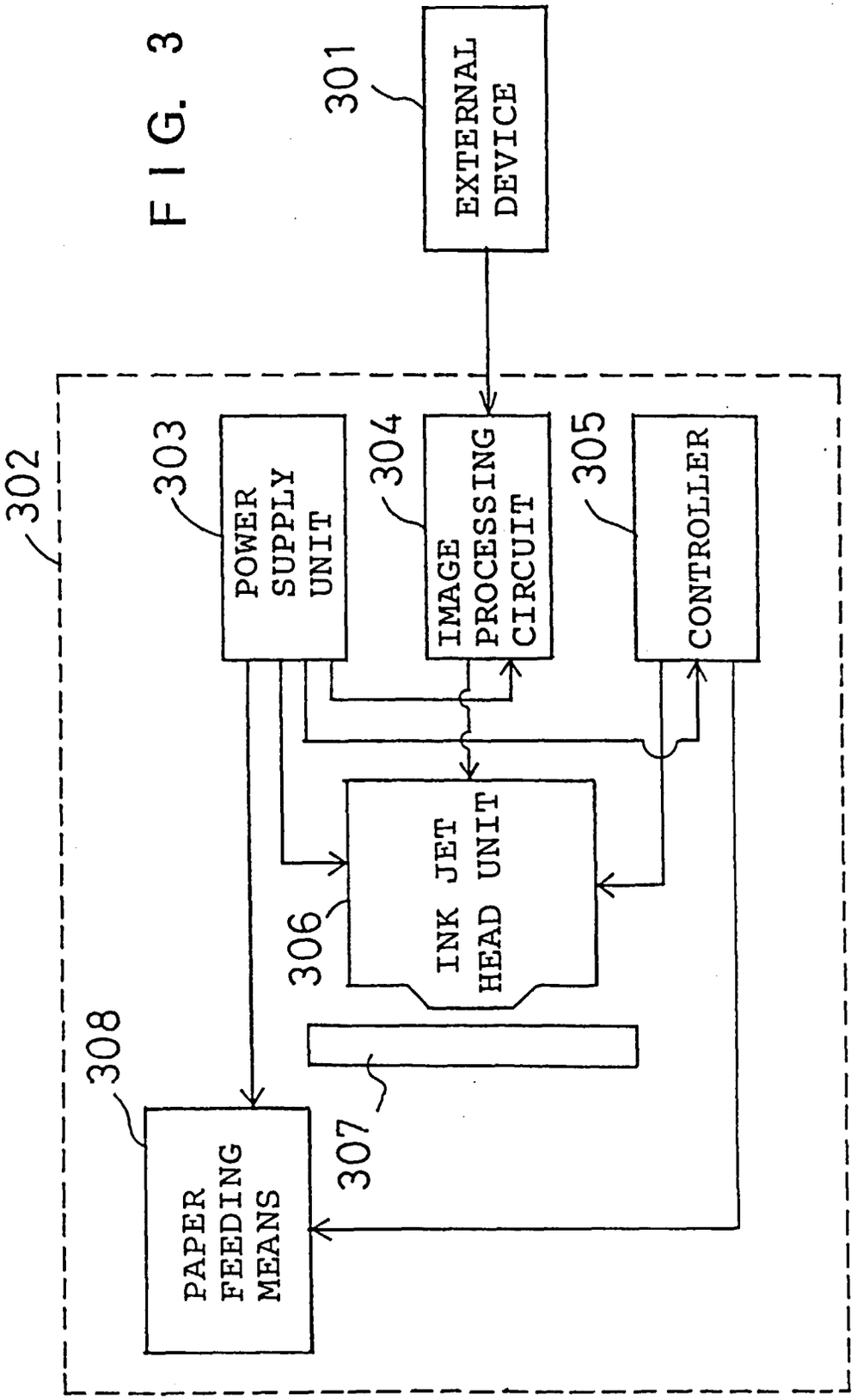
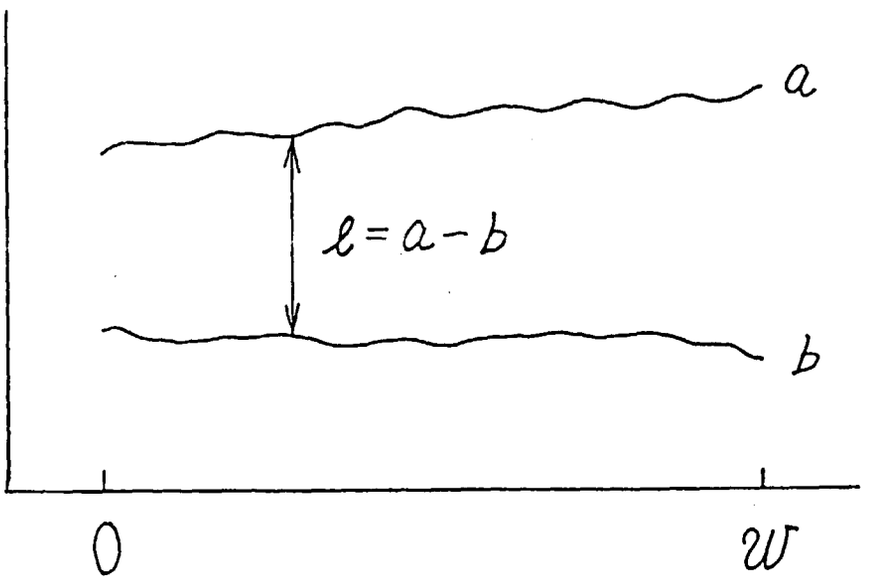

301
EXTERNAL DEVICE
302
303
POWER SUPPLY UNIT
304
IMAGE PROCESSING CIRCUIT
305
CONTROLLER
306
INK JET HEAD UNIT
307
308
PAPER FEEDING MEANS

FIG. 4



HEAD POSITION IN THE MAIN SCANNING DIRECTION

FIG. 5

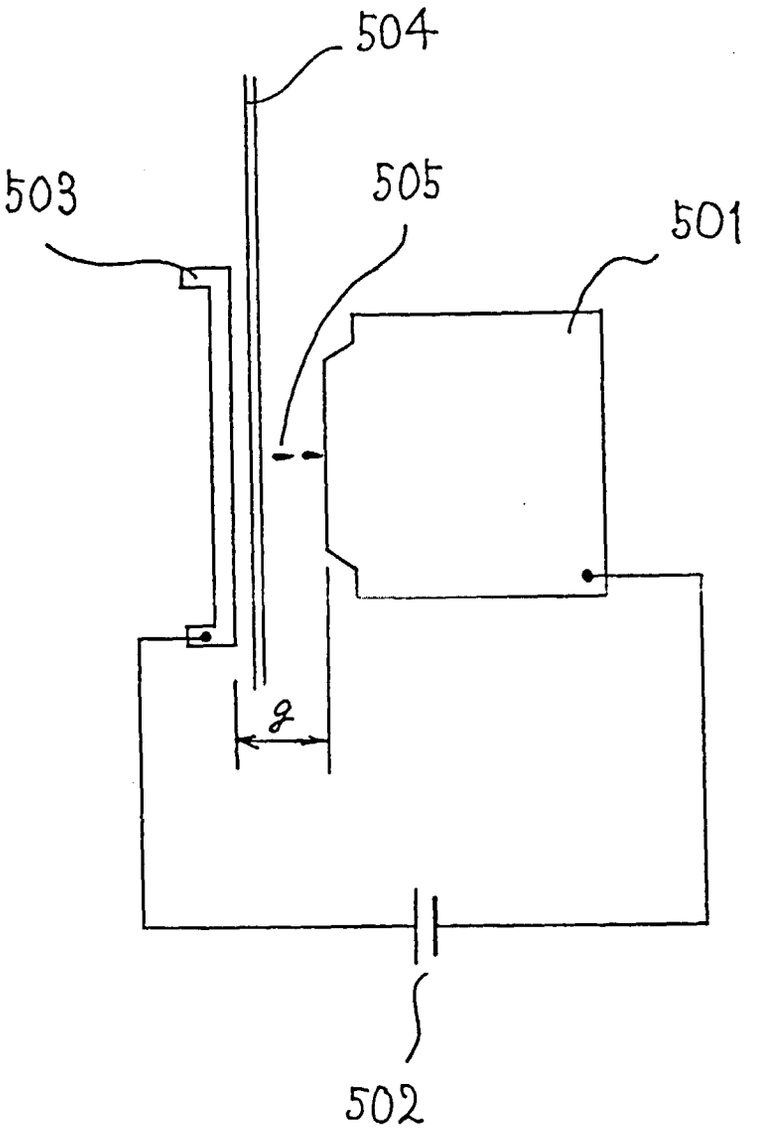


FIG. 6

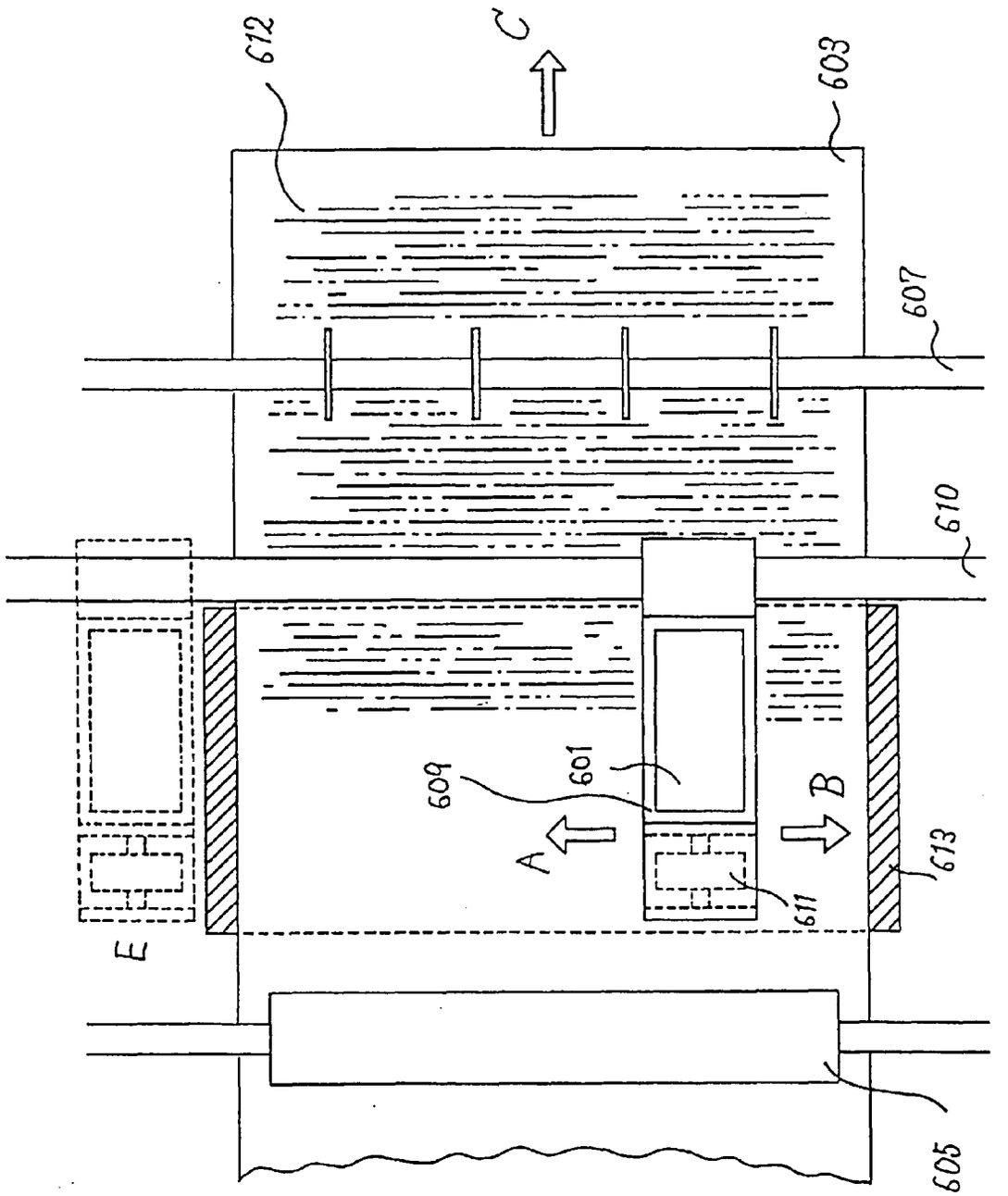
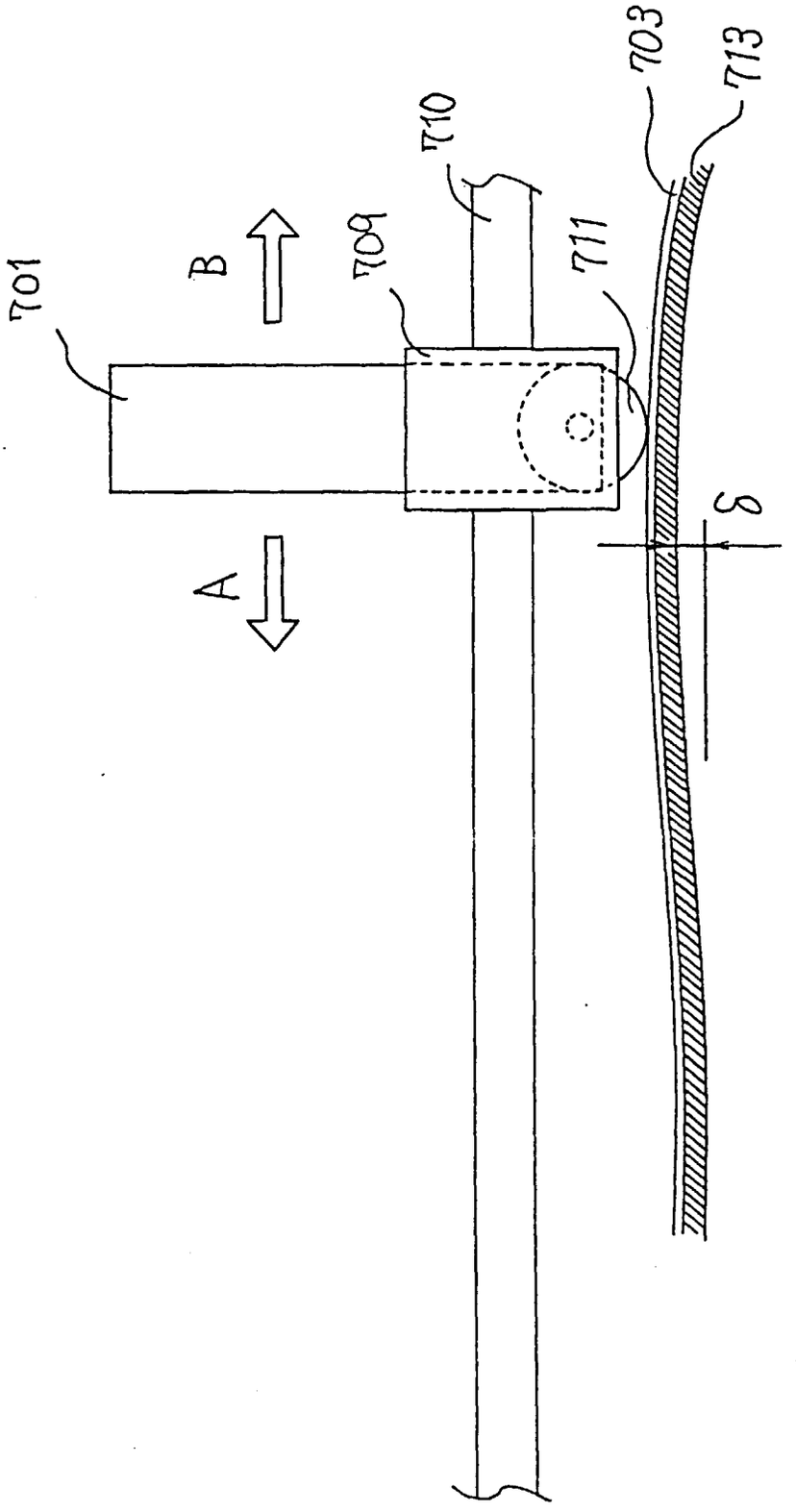


FIG. 7



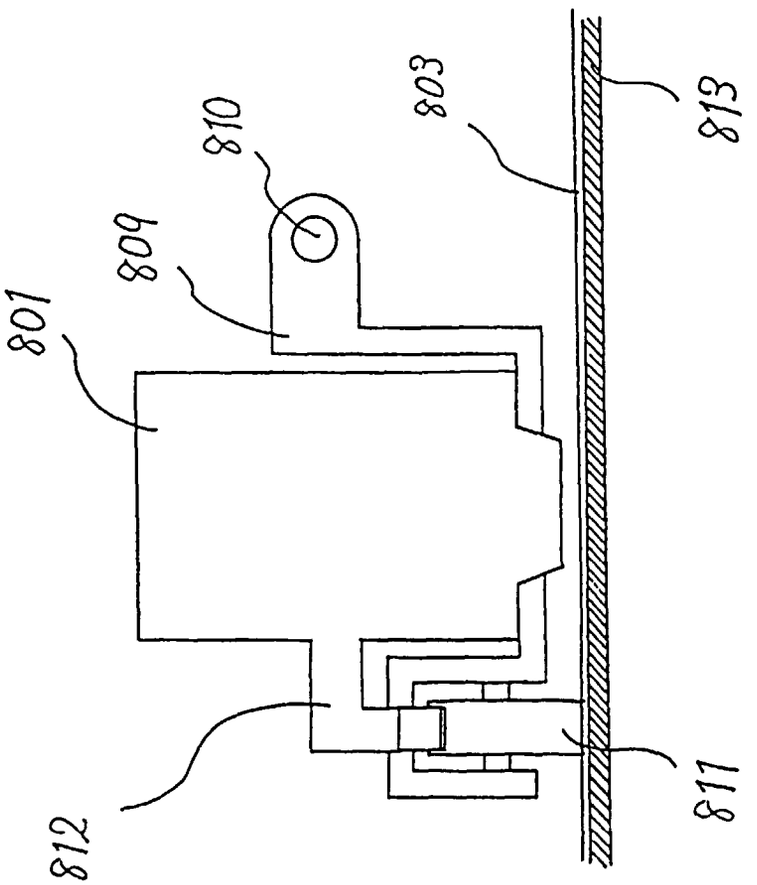


FIG. 8(B)

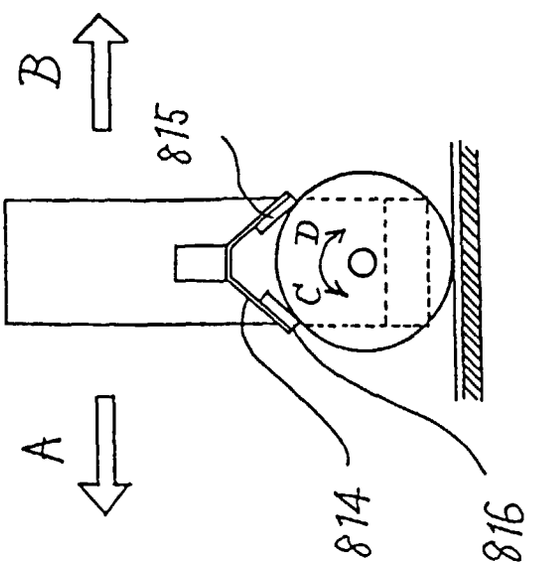


FIG. 8(A)

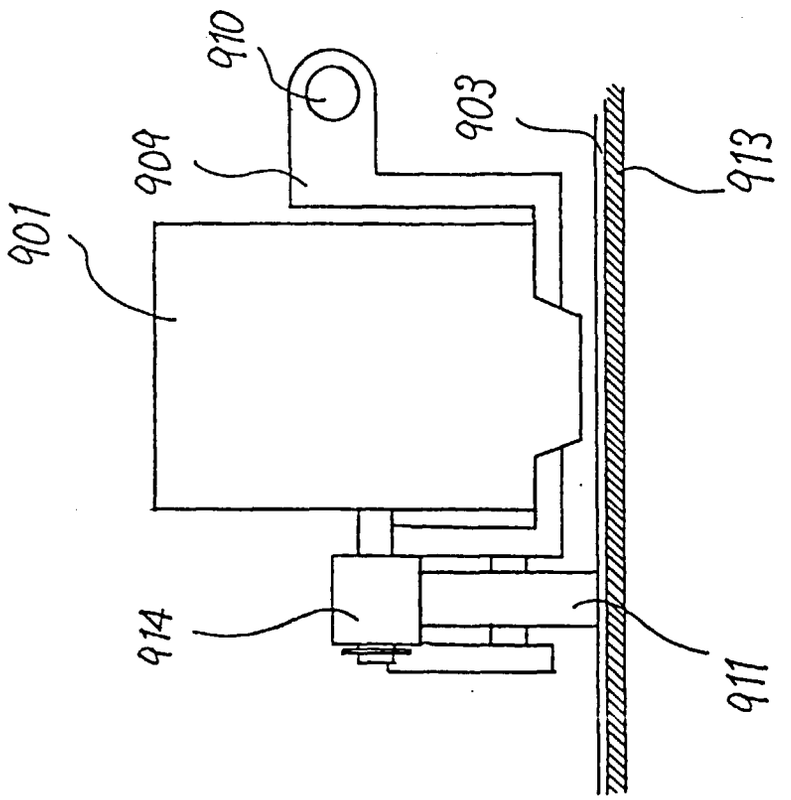


FIG. 9(B)

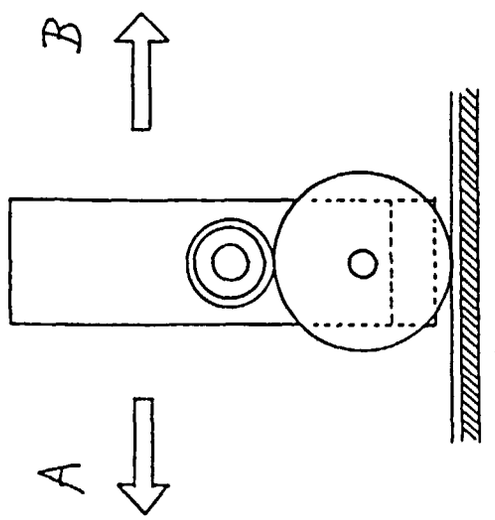


FIG. 9(A)

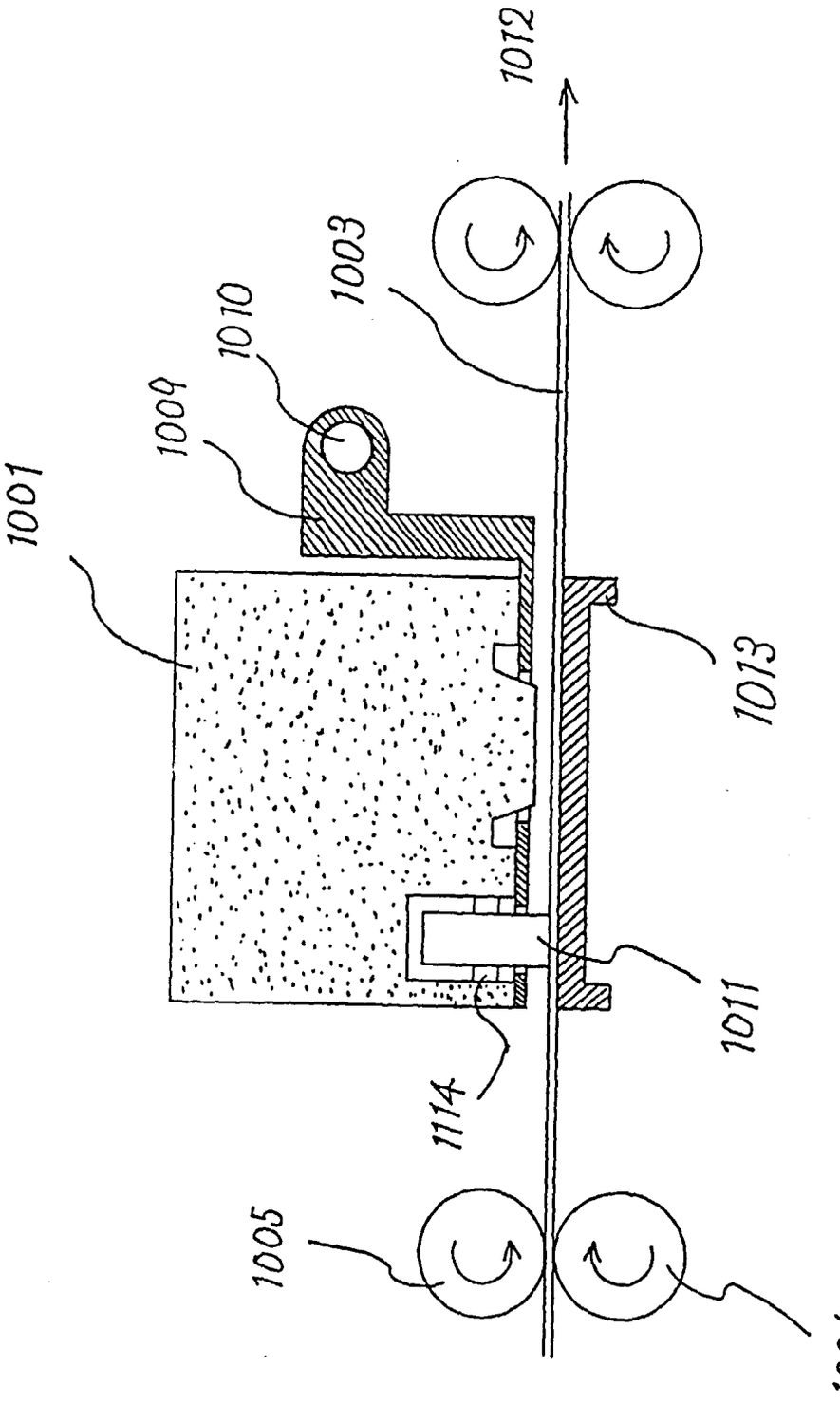


FIG. 10

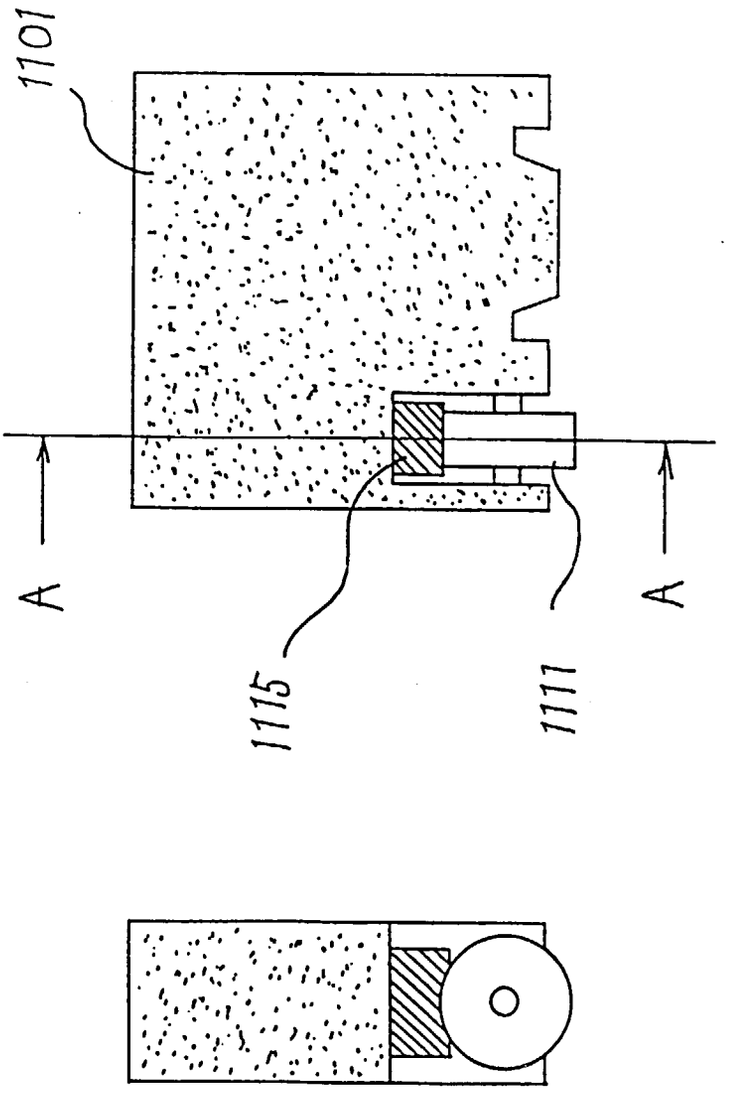


FIG. 11(A)

FIG. 11(B)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 4272

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 5 065 169 A (VINCENT KENT D ET AL) 12 November 1991 * column 3, line 40 - column 5, line 58 *	1-4,8	B41J25/308
X	DE 29 02 037 A (OLYMPIA WERKE AG) 24 July 1980 * page 5 - page 6 *	1-4,8	
X	PATENT ABSTRACTS OF JAPAN vol. 017, no. 021 (M-1353), 14 January 1993 & JP 04 247975 A (TOKYO ELECTRIC CO LTD), 3 September 1992, * abstract *	1-3,5,7, 8	
Y		6	
X	EP 0 529 606 A (CANON KK) 3 March 1993 * column 5, line 10 - line 35 *	1-3,5,7, 8	
Y		6	
Y	PATENT ABSTRACTS OF JAPAN vol. 016, no. 226 (M-1254), 26 May 1992 & JP 04 044853 A (CANON INC), 14 February 1992, * abstract *	6	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B41J
X	PATENT ABSTRACTS OF JAPAN vol. 016, no. 214 (M-1251), 20 May 1992 & JP 04 039076 A (SEIKO EPSON CORP), 10 February 1992, * abstract *	1-3,5,8	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 October 1997	Van Oorschot, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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