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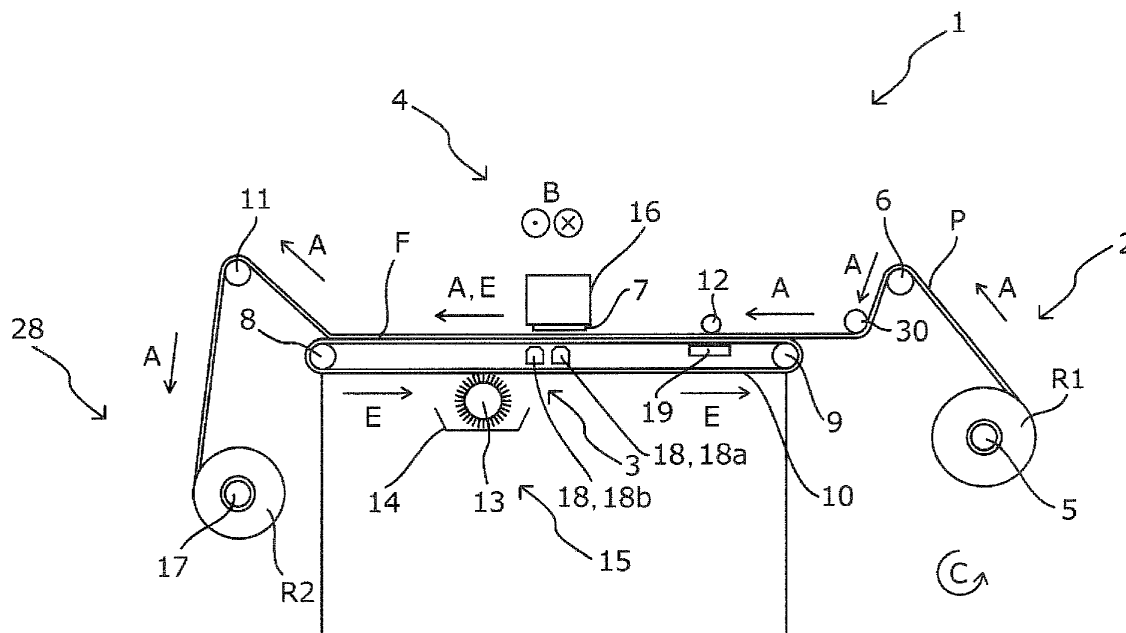
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(54) **RECORDING APPARATUS AND CALCULATION METHOD OF TRAVEL DISTANCE OF TRANSPORT BELT**

(57) A recording apparatus (1) includes a transport belt (10) that transports a medium (P), a recording unit (7) that performs recording on the medium supported by the transport belt, a plurality of imaging units (18a, 18b) provided on an upstream side and a downstream side in a transport direction of the medium, and configured to shoot a moving object including at least one of the transport belt and the medium, and a calculation unit that cal-

culates a distance travelled by the transport belt in a predetermined time, on a basis of a position of a part of the moving object in an image picked up by the upstream imaging unit of the plurality of imaging units, and a position of the part of the moving object in an image picked up by the downstream imaging unit of the plurality of imaging units, the predetermined time after the image pick-up by the upstream imaging unit.

FIG. 1



Description

BACKGROUND

1. Technical Field

[0001] The present invention relates to a recording apparatus, and a calculation method of a travel distance of a transport belt.

2. Related Art

[0002] Various types of recording apparatuses have thus far been utilized, including a type that includes a transport belt for transporting a medium so as to perform recording on the medium transported by the transport belt. In such a recording apparatus that includes the transport belt for transporting the medium, the recording position may be shifted owing to variability of the travel distance of the transport belt.

[0003] Accordingly, recording apparatuses configured to suppress the variability of the travel distance of the transport belt have been proposed, for example as disclosed in JP-A-2013-1512, JP-A-2013-199048, JP-A-2010-260242, and JP-A-2011-73143.

[0004] Recently, the recording apparatuses have been attaining faster recording speed. Accordingly, the moving speed of the transport belt has also come to be moved at a higher speed, which makes it difficult for a measurement unit to accurately measure (calculate) the travel distance of the transport belt, depending on the design of the measurement unit. This is because the increase in travel distance of the transport belt per unit time may exceed the measurable range of the measurement unit. Therefore, it is still difficult to suppress the variability of the travel distance of the transport belt even with the techniques disclosed in the above-cited documents and, consequently, it is difficult to minimize the shift of the recording position originating from the variability of the travel distance of the transport belt.

SUMMARY

[0005] An advantage of some aspects of the invention is to provide a recording apparatus capable of accurately calculating travel distance of a transport belt.

[0006] In a first aspect, the invention provides a recording apparatus including a transport belt that transports a medium, a recording unit that performs recording on the medium supported by the transport belt, a plurality of imaging units provided on an upstream side and a downstream side in a transport direction of the medium, and configured to shoot a moving object including at least one of the transport belt and the medium, and a calculation unit that calculates a distance travelled by the transport belt in a predetermined time, on a basis of a position of a part of the moving object in an image picked up by the upstream imaging unit of the plurality of imaging units,

and a position of the part of the moving object in an image picked up by the downstream imaging unit of the plurality of imaging units, the predetermined time after the image pickup by the upstream imaging unit.

[0007] In the recording apparatus thus configured, the distance travelled by the transport belt in the predetermined time is calculated on the basis of the position of the part of the moving object in the image picked up by the upstream imaging unit and the position of the part of the moving object in the image picked up by the downstream imaging unit the predetermined time after the image pickup by the upstream imaging unit. With the mentioned arrangement, the measurable range of the travel distance of the transport belt can be prevented from being exceeded despite a high moving speed thereof, by adjusting the position of the downstream imaging unit with respect to the upstream imaging unit according to the moving speed, and therefore the travel distance of the transport belt can be accurately calculated.

[0008] In a second aspect of the invention, the recording apparatus may further include a correction unit that corrects the travel distance of the transport belt according to a calculation result of the calculation unit.

[0009] With the mentioned configuration, the travel distance of the transport belt can be corrected according to the calculation result of the calculation unit. Accordingly, the accurately calculated travel distance of the transport belt can further be corrected, and therefore the recording position can be prevented from shifting owing to the variability of the travel distance of the transport belt.

[0010] In the recording apparatus according to a third aspect of the invention, the transport belt may intermittently transport the medium, the recording unit may move, with respect to the medium supported by the transport belt, in a scanning direction intersecting the transport direction of the medium, and eject a liquid according to ejection data through a nozzle row including a plurality of nozzles aligned in a nozzle alignment direction intersecting the scanning direction, and the imaging unit may shoot the moving object each time the transport belt stops in the intermittent transport of the medium.

[0011] With the mentioned configuration, in what is known as a serial type recording apparatus, the imaging unit shoots the moving object each time the transport belt stops in the intermittent transport of the medium. Therefore, the travel distance of the transport belt can be accurately calculated, for example each time the transport belt makes one movement in the intermittent transport of the medium.

[0012] In the recording apparatus according to a fourth aspect of the invention, at least one of the plurality of imaging units may be configured to move toward at least one of the upstream side and the downstream side.

[0013] In this aspect, at least one of the plurality of imaging units may be configured to move toward at least one of the upstream side and the downstream side. Therefore, even when the recording apparatus is configured to perform a plurality of recording modes in which

the transport belt is set to move at a different speed, the travel distance of the transport belt can be accurately calculated in each of the recording modes, by moving the imaging unit according to the recording mode.

[0014] In a fifth aspect of the invention, the recording apparatus may include three or more imaging units.

[0015] In this aspect, the recording apparatus includes three or more imaging units. Therefore, even when the recording apparatus is configured to perform a plurality of recording modes in which the transport belt is set to move at a different speed, the travel distance of the transport belt can be accurately calculated in each of the recording modes, by adopting the images shot by different imaging units selected according to the recording mode.

[0016] In the recording apparatus according to a sixth aspect of the invention, the moving object may be the transport belt.

[0017] In this aspect, the moving object is the transport belt. While the medium has a uniform surface appearance in general, the transport belt often has marks that can serve as an index, such as a scratch. Therefore, adopting the transport belt as moving object to be shot by the imaging unit enables the travel distance of the transport belt to be calculated with improved accuracy.

[0018] In a seventh aspect, the invention provides a calculation method of a travel distance of a transport belt to be performed by a recording apparatus including the transport belt that transports a medium, a recording unit that performs recording on the medium supported by the transport belt, a plurality of imaging units provided on an upstream side and a downstream side in a transport direction of the medium, and configured to shoot a moving object including at least one of the transport belt and the medium. The method includes calculating the distance travelled by the transport belt in a predetermined time, on a basis of a position of a part of the moving object in an image picked up by the upstream imaging unit of the plurality of imaging units, and a position of the part of the moving object in an image picked up by the downstream imaging unit of the plurality of imaging units, the predetermined time after the image pickup by the upstream imaging unit.

[0019] With the method arranged as above, the distance travelled by the transport belt in the predetermined time is calculated on the basis of the position of the part of the moving object in the image picked up by the upstream imaging unit and the position of the part of the moving object in the image picked up by the downstream imaging unit the predetermined time after the image pickup by the upstream imaging unit. With the mentioned arrangement, the measurable range of the travel distance of the transport belt can be prevented from being exceeded despite a high moving speed thereof, by adjusting the position of the downstream imaging unit with respect to the upstream imaging unit according to the moving speed, and therefore the travel distance of the transport belt can be accurately calculated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, wherein like numbers reference like elements.

Fig. 1 is a schematic side view showing a recording apparatus according to an embodiment of the invention.

Fig. 2 is a schematic plan view showing an essential part of the recording apparatus according to the embodiment of the invention.

Fig. 3 is a schematic side cross-sectional view showing an essential part of the recording apparatus according to the embodiment of the invention.

Fig. 4 is a block diagram showing a configuration of the recording apparatus according to the embodiment of the invention.

Fig. 5 is a schematic plan view showing an essential part of the recording apparatus according to the embodiment of the invention.

Fig. 6 is another schematic plan view showing an essential part of the recording apparatus according to the embodiment of the invention.

Fig. 7 is a graph for explaining a control example of the recording apparatus according to the embodiment of the invention.

Fig. 8 is a schematic bottom view showing a recording head of the recording apparatus according to the embodiment of the invention.

Fig. 9 is a flowchart showing a calculation method of travel distance of the transport belt that can be performed by the recording apparatus according to the embodiment of the invention.

Fig. 10 is a flowchart showing another calculation method of travel distance of the transport belt that can be performed by the recording apparatus according to the embodiment of the invention.

Fig. 11 is a flowchart showing still another calculation method of travel distance of the transport belt that can be performed by the recording apparatus according to the embodiment of the invention.

DESCRIPTION OF EXEMPLARY EMBODIMENT

[0021] Hereafter, a recording apparatus according to an embodiment of the invention will be described in detail, with reference to the drawings.

[0022] First, the outline of the recording apparatus 1 according to the embodiment of the invention will be described.

[0023] Fig. 1 is a schematic side view of the recording apparatus 1 according to this embodiment of the invention. Fig. 2 is a schematic plan view showing a transport mechanism 3, which is an essential part of the recording apparatus 1 according to this embodiment.

[0024] The recording apparatus 1 according to this em-

bodiment includes a feeding unit 2 configured to unwind and deliver a roll R1 of a recording medium P (exemplifying the medium in the invention) on which the recording is to be performed. The recording apparatus 1 also includes a transport mechanism 3 configured to transport the recording medium P in a transport direction A, with an adhesive belt 10 (endless belt, exemplifying the transport belt in the invention) supporting the recording medium P on a support surface F coated with an adhesive. In addition, the recording apparatus 1 includes a recording mechanism 4 that performs recording (ejects ink, exemplifying the liquid in the invention) on the recording medium P, by causing a carriage 16 having thereon a recording head 7, exemplifying the recording unit in the invention, configured to eject the ink for the recording, to reciprocate (perform reciprocal scanning) in a scanning direction B intersecting the transport direction A of the recording medium P. The recording apparatus 1 further includes a cleaning mechanism 15 for the adhesive belt 10, and a take-up mechanism 28 including a take-up shaft 17 around which the recording medium P is wound. Here, the term "scanning" refers to causing the carriage 16 to move in the scanning direction B including, for example, causing the carriage 16 to move in the scanning direction B while ejecting the ink from the recording head 7 during the recording operation.

[0025] Printing materials may be employed as the recording medium P. The printing materials refer to fabrics, clothing, and other garments that can be subjected to a printing process. Examples of the fabrics include woven fabrics, knitted fabrics, and non-woven fabrics made of natural fibers such as cotton, hemp, silk, and wool, synthetic fibers such as nylon, or conjugated fibers of the cited materials. Examples of the clothing and other garments include sewn T-shirts, handkerchiefs, scarves, towels, tote bags, and cloth bags, furniture such as curtains, sheets, and bed covers, and fabrics already cut or yet to be cut, prepared as parts for sewing.

[0026] Other than the cited printing materials, paper sheets exclusively for ink jet printing, for example plain paper, wood-free paper, and glossy paper, may also be employed as the recording medium P. Alternatively, for example, a plastic film not subjected to surface treatment for the ink jet printing (i.e., without an ink absorption layer), a paper sheet coated with plastic or to which a plastic film is adhered, may be employed as the recording medium P. Although the type of the plastic is not specifically limited, for example polyvinyl chloride, polyethylene terephthalate, polycarbonate, polystyrene, polyurethane, polyethylene, and polypropylene may be preferably employed.

[0027] The feeding unit 2 includes a rotary shaft 5 which also serves for the positioning of the roll R1 of the recording medium P used for the recording, and is configured to deliver the recording medium P from the roll R1 set on the rotary shaft 5 to the transport mechanism 3 through slave rollers 6 and 30. When the recording medium P is delivered to the transport mechanism 3, the

rotary shaft 5 rotates in a rotation direction C.

[0028] The transport mechanism 3 includes the adhesive belt 10 that transports the recording medium P delivered from the feeding unit 2 and mounted on the adhesive belt 10, a drive roller 8 having a motor M (see Fig. 2) to move the adhesive belt 10 in a direction E, and a slave roller 9. The recording medium P is pressed by a pressure roller 12 against the support surface F of the adhesive belt 10, thus to be stuck thereto. When the recording medium P is transported, the drive roller 8 rotates in the rotation direction C.

[0029] The endless belt exemplifying the transport belt is not limited to the adhesive belt. For example, an electrostatic adsorption type endless belt may be employed.

[0030] In this embodiment, a support member 19 that supports the adhesive belt 10 is provided thereunder, in a region opposite to the pressure roller 12 across the adhesive belt 10. The support member 19 supporting the adhesive belt 10 serves to prevent the adhesive belt 10 from vibrating when being moved.

[0031] In this embodiment, in addition, the pressure roller 12 is configured so as to reciprocate (swing) along the transport direction A, to prevent a trace of contact from being marked on the recording medium P, because of the contact of the pressure roller 12 with the same position of the recording medium P for a certain period of time. However, such a configuration of the pressure roller 12 is not mandatory.

[0032] In this embodiment, imaging units 18 configured to measure, by image processing, the travel distance of the adhesive belt 10 are provided under the adhesive belt 10, in a region opposite to the recording head 7 across the adhesive belt 10. To be more detailed, as shown in Fig. 1 and Fig. 2, the imaging units 18 include an upstream imaging unit 18a located on the upstream side in the transport direction A and a downstream imaging unit 18b located on the downstream side in the transport direction A. In addition, as shown in Fig. 2, the upstream imaging unit 18a and the downstream imaging unit 18b are located at positions corresponding to an end portion of the adhesive belt 10 in the scanning direction B. Alternatively or in addition, for example, another upstream imaging unit 18a and downstream imaging unit 18b may be provided at positions corresponding to the other end portion of the adhesive belt 10 in the scanning direction B. This is because providing the imaging units 18 on both end portions of the adhesive belt 10 in the scanning direction B allows the adhesive belt 10 to be shot by at least the imaging units 18 on one of the end portions, even when the adhesive belt 10 meanders, and also enables the amount of meandering to be measured with high accuracy.

[0033] Although the imaging units 18 according to this embodiment are configured to shoot the inner circumferential surface 20 of the adhesive belt 10 (see Fig. 3), the imaging units 18 may be configured to shoot the support surface F or the lateral edge of the adhesive belt 10 in the scanning direction B, or the recording medium P. In

other words, the imaging units 18 may be configured to shoot any desired position of at least one of the adhesive belt 10 and the recording medium P, corresponding to the moving object in the invention.

[0034] Further details of the imaging units 18 according to this embodiment will be subsequently described.

[0035] The recording mechanism 4 includes a carriage moving unit 29 (see Fig. 4) that causes the carriage 16, having the recording head 7 mounted thereon, to reciprocate in the scanning direction B. In Fig. 1, the scanning direction B corresponds to the depth direction with respect to the sheet face.

[0036] Whereas the carriage 16 having the recording head 7 mounted thereon is caused to perform reciprocal scanning in the recording operation, the transport mechanism 3 stops the transport of the recording medium P during the recording scanning (while the carriage 16 is moving). In other words, in the recording operation the reciprocal scanning of the carriage 16 and the transport of the recording medium P are alternately performed. Thus, in the recording operation the transport mechanism 3 intermittently transports the recording medium P (adhesive belt 10), in response to the reciprocal scanning of the carriage 16.

[0037] Although the recording head 7 of the recording apparatus 1 according to this embodiment ejects the ink while reciprocating in the scanning direction B, the recording apparatus may include what is known as a line head, composed of a plurality of nozzles that each eject ink aligned in a direction intersecting the transport direction of the recording medium P.

[0038] Here, the term "line head" refers to a recording head installed in a recording apparatus in which the region of the nozzles aligned in the direction intersecting the transport direction of the recording medium P is provided so as to cover the entire width in the intersecting direction, and the recording head or the recording medium P is relatively moved so as to form an image. Here, it is not mandatory that the nozzle region of the line head extending in the intersecting direction covers the entire width of all types of the recording medium P with which the recording apparatus is compatible.

[0039] Further, although the recording head 7 according to this embodiment is configured to perform the recording by ejecting the ink onto the recording medium P, for example a transfer recording unit that transfers a color material onto a medium may be employed.

[0040] The cleaning mechanism 15 for the adhesive belt 10 includes a cleaning brush 13 composed of a plurality of cleaning rollers connected in the axial direction, and a tray 14 containing detergent for cleaning the cleaning brush 13.

[0041] The take-up mechanism 28 serves to take up the recording medium P that has undergone the recording process and been transported from the transport mechanism 3 through a slave roller 11, and includes a take-up shaft 17 on which a paper tube or the like is mounted so that the recording medium P can be wound

thereon, to form a roll R2 of the recording medium P.

[0042] Here, Fig. 1 illustrates the case where the recording medium P is formed into the roll R1 with the recording surface oriented outward, and into the roll R2 with the recorded surface oriented outward. Accordingly, the rotary shaft 5 and the take-up shaft 17 both rotate in the rotation direction C. In the recording apparatus 1 according to this embodiment, however, the roll R1 formed with the recording surface oriented inward may be employed, and also the roll R2 may be formed with the recorded surface oriented inward. In this case, the rotary shaft 5 and the take-up shaft 17 rotate in the direction opposite to the rotation direction C.

[0043] Hereunder, the imaging units 18, constituting the essential part of the recording apparatus 1 according to this embodiment, will be described in detail. Although the recording apparatus 1 according to this embodiment includes the upstream imaging unit 18a and the downstream imaging unit 18b as imaging units 18 as already mentioned, since the upstream imaging unit 18a and the downstream imaging unit 18b have the same configuration these units will be collectively referred to as imaging unit 18.

[0044] Fig. 3 is a schematic side cross-sectional view showing the imaging unit 18, constituting part of the recording apparatus 1 according to this embodiment. As shown in Fig. 3, the imaging unit 18 according to this embodiment includes a light emitting unit 22, a condenser lens 23, and an image sensor 24, which are provided inside a case 26.

[0045] The case 26 has a cylindrical shape with a truncated conical portion, and constitutes the outer shell of the imaging unit 18. A translucent or transparent glass 21 is attached to the leading (upper) end portion of the case 26. The glass 21 is opposed to the inner circumferential surface 20 of the adhesive belt 10 (opposite to the support surface F), with a gap therebetween.

[0046] The light emitting unit 22 emits light to the inner circumferential surface 20 of the adhesive belt 10 through the translucent glass 21, and is located inside the case 26 at a position and an angle that allow the light reflected by the inner circumferential surface 20 to be collected by the condenser lens 23. Although the type of the light emitting unit 22 is not specifically limited, a light emitting diode (LED) may be typically employed.

[0047] The image sensor 24 picks up the reflected light collected by the condenser lens 23 as image, and includes an imaging plane 27 at the position where the image is formed.

[0048] Although the condenser lens 23 is attached to a generally central position of the case 26 by means of a retainer 25, and the image sensor 24 is located on the inner bottom face of the case 26 in the imaging unit 18 according to this embodiment as shown in Fig. 3, a different configuration may be adopted. The condenser lens 23 and the image sensor 24 may be located at desired positions, provided that the reflected light collected by the condenser lens 23 can be formed into an image in

the image sensor 24.

[0049] It is to be noted that the imaging unit 18 according to this embodiment, which performs the measurement by image processing provides an advantage in that the variability of the travel distance of the adhesive belt 10 can be detected with higher accuracy, compared with a measurement unit of the travel distance of the adhesive belt 10 based on other methods.

[0050] An electrical configuration of the recording apparatus 1 according to this embodiment will now be described hereunder.

[0051] Fig. 4 is a block diagram showing a configuration of the recording apparatus 1 according to this embodiment.

[0052] A control unit 31 serves to control the recording apparatus 1. The control unit 31 includes an interface (I/F) 32, a CPU 33, and a storage unit 35.

[0053] The I/F 32 is utilized for transmission and reception of data, such as ejecting data, to and from a PC 36 which is an example of external devices. The CPU 33 is a processing device for overall control of the recording apparatus 1 based on, for example, input signals from a sensor group 37 including the imaging unit 18. The storage unit 35 includes a ROM containing control programs to be executed by the CPU 33, and a RAM and an EEPROM for securing the storage region for the programs executed by the CPU 33 and the operation region.

[0054] The CPU 33 controls, by means of a control circuit 34, the drive roller 8 for moving the adhesive belt 10 in the transport direction A, the carriage moving unit 29 for moving the carriage 16, having the recording head 7 mounted thereon, in the scanning direction B, the recording head 7 that ejects the ink onto the recording medium P, and other non-illustrated functional components.

[0055] The control unit 31 configured as above according to this embodiment is capable of calculating the travel distance of the adhesive belt 10, through comparison of imaging data acquired by the imaging unit 18 before and after one to several times of the intermittent transport of the adhesive belt 10.

[0056] Hereunder, a specific control operation of the control unit 31, performed during the recording operation of the recording apparatus 1 according to this embodiment, will be described.

[0057] Fig. 5 and Fig. 6 are schematic plan views showing a portion of the adhesive belt 10 in the vicinity of imaging ranges 38 of the imaging units 18, a part of the recording apparatus 1 according to this embodiment. As shown in Fig. 1 to Fig. 3, the upstream imaging unit 18a and the downstream imaging unit 18b of the imaging units 18 according to this embodiment are both located on the side of the inner circumferential surface 20 of the adhesive belt 10, so as to shoot the inner circumferential surface 20 of the adhesive belt 10. Regarding the imaging ranges 38, an imaging range 38a corresponds to the imaging range of the upstream imaging unit 18a, and an imaging range 38b corresponds to the imaging range of the downstream imaging unit 18b.

[0058] In the recording apparatus 1 according to this embodiment, the upstream imaging unit 18a and the downstream imaging unit 18b are movable along a non-illustrated rail extending in the transport direction A. Accordingly, the interval between the upstream imaging unit 18a and the downstream imaging unit 18b can be set to a length corresponding to the distance travelled by the adhesive belt 10 in the one or several times of intermittent movements.

[0059] Here, Fig. 5 and Fig. 6 illustrate the case where the interval between the upstream imaging unit 18a and the downstream imaging unit 18b is set to the length equal to the distance travelled by the adhesive belt 10 in one intermittent movement.

[0060] The recording apparatus 1 according to this embodiment causes the control unit 31 to compare between an image picked up by the upstream imaging unit 18a before the one intermittent movement of the adhesive belt 10 and an image picked up by the downstream imaging unit 18b a predetermined time after the image pickup by the upstream imaging unit 18a (after the adhesive belt 10 is intermittently transported once). The control unit 31 then calculates the travel distance realized by the adhesive belt 10 during the predetermined time (travel distance realized by the one intermittent movement of the adhesive belt 10).

[0061] In short, the recording apparatus 1 according to this embodiment includes the adhesive belt 10 for transporting the recording medium P, the recording head 7 that performs recording on the recording medium P supported by the adhesive belt 10, and the plurality of imaging units 18 provided on the upstream side and the downstream side of the recording medium P in the transport direction A, and configured to shoot the moving object, which is at least one of the adhesive belt 10 and the recording medium P.

[0062] The control unit 31 serves as the calculation unit to calculate the distance travelled by the adhesive belt 10 in a predetermined time, on the basis of a position of a part of the adhesive belt 10 in the image picked up by the upstream imaging unit 18a (singular point S, see Fig. 5 and Fig. 6), and a position of the part of the adhesive belt 10 in the image picked up by the downstream imaging unit 18b the predetermined time after the image pickup by the upstream imaging unit.

[0063] Under the mentioned configuration, the recording apparatus 1 according to this embodiment adjusts the position of the downstream imaging unit 18b with respect to the upstream imaging unit 18a according to the moving speed of the adhesive belt 10, thereby preventing the measurable range (imaging range 38) with respect to the travel distance of the adhesive belt 10 from being exceeded owing to a high moving speed. Therefore, the travel distance of the adhesive belt 10 can be accurately calculated.

[0064] Since the adhesive belt 10 is intermittently transported in the recording apparatus 1 according to this embodiment, it is preferable to set the predetermined

time to a time corresponding to one or a plurality of times of intermittent movements of the adhesive belt 10. In a recording apparatus in which the adhesive belt 10 is continuously moved, the predetermined time may be set as desired according to the moving speed of the adhesive belt 10.

[0065] From another viewpoint, the recording apparatus 1 according to this embodiment, which includes the adhesive belt 10 for transporting the recording medium P, the recording head 7 that performs recording on the recording medium P supported by the adhesive belt 10, and the plurality of imaging units 18 provided on the upstream side and the downstream side of the recording medium P in the transport direction A, and configured to shoot the moving object, which is at least one of the adhesive belt 10 and the recording medium P, can be utilized to perform a calculation method of the travel distance of the transport belt, for calculating the distance travelled by the adhesive belt 10 in a predetermined time, on the basis of a position of a part of the adhesive belt 10 in the image picked up by the upstream imaging unit 18a, and a position of the part of the adhesive belt 10 in the image picked up by the downstream imaging unit 18b the predetermined time after the image pickup by the upstream imaging unit.

[0066] With the mentioned calculation method of the travel distance of the transport belt, the measurable range (imaging range 38) of the travel distance of the transport belt (adhesive belt 10) can be prevented from being exceeded despite a high moving speed thereof, by adjusting the position of the downstream imaging unit 18b with respect to the upstream imaging unit 18a according to the moving speed. Therefore, the travel distance of the transport belt can be accurately calculated.

[0067] To be more detailed, the recording apparatus 1 according to this embodiment causes the control unit 31 to identify a singular point (e.g., a scratch or trace on the adhesive belt 10, or irregularity of the fiber of the recording medium P) S, which is a characteristic point in the image picked up by the upstream imaging unit 18a, as an example of the position of a part of the image picked up by the imaging units 18 (upstream imaging unit 18a and the downstream imaging unit 18b). Then the control unit 31 calculates the travel distance of the adhesive belt 10, on the basis of the position of the singular point S in the image picked up by the downstream imaging unit 18b after the adhesive belt 10 is intermittently transported once or a predetermined number of times. Here, the "position of a part of the moving object" serving as index for calculating the travel distance is not limited to the singular point S, but may be, for example, a mark formed in advance on the adhesive belt 10.

[0068] Fig. 5 illustrates the stage where a singular point S1 has been identified in the image picked up by the upstream imaging unit 18a. Fig. 6 illustrates the stage where, after the adhesive belt 10 is intermittently transported once from the state shown in Fig. 5, the singular point S1 has been identified in the image picked up by

the downstream imaging unit 18b, and another singular point S2 has been identified in the image newly picked up by the upstream imaging unit 18a.

[0069] In addition, the imaging units 18 according to this embodiment can also pick up images in a form of a movie (shoot the movement of the adhesive belt 10). Accordingly, the control unit 31 can decide (calculate), during the intermittent movement, whether the travel distance of the singular point S (i.e., the travel distance of the adhesive belt 10) is likely to be an appropriate travel distance, on the basis of the position of the singular point S shot by the upstream imaging unit 18a and the position of the singular point S shot by the downstream imaging unit 18b during the intermittent movement. Then the control unit 31 adjusts, according to the decision result, the travel distance of the adhesive belt 10 during the intermittent movement to the appropriate travel distance.

[0070] Fig. 7 is a graph for explaining a control example performed by the control unit 31 with respect to the travel distance of the adhesive belt 10.

[0071] The horizontal axis of Fig. 7 represents the travel distance of the adhesive belt 10 (transport distance of the recording medium P in the transport direction A) during one intermittent movement, and the vertical axis of Fig. 7 represents the moving speed of the adhesive belt 10 in the direction E (transport speed of the recording medium P in the transport direction A).

[0072] When the travel distance of the adhesive belt 10 is appropriate, the adhesive belt 10 moves from a point d0 to a point d1 in an acceleration mode, from the point d1 to a point d3 in a constant speed mode, and from the point d3 to a point d7 in a deceleration mode. Thus, the distance between point d0 and the point d7 represents the appropriate travel distance of the adhesive belt 10.

[0073] When the adhesive belt 10 erroneously finishes the constant speed mode from the point d1 at a point d2, which is anterior to the point d3, and enters the deceleration mode from the point d2 (broken lines in Fig. 7), the control unit 31 lowers the deceleration rate at a point halfway through the deceleration mode (point d4), so as to allow the adhesive belt 10 to move as far as the point d7.

[0074] In contrast, when the adhesive belt 10 erroneously maintains the constant speed mode from the point d1 to a point d5 beyond the point d3 and enters the deceleration mode from the point d5 (dash-dot lines in Fig. 7), the control unit 31 raises the deceleration rate at a point halfway through the deceleration mode (point d6), so as to cause the adhesive belt 10 to stop at the point d7.

[0075] The control unit 31 according to this embodiment determines the timing at which the adhesive belt 10 has entered the deceleration mode, on the basis of the time that the downstream imaging unit 18b has started shooting the singular point S after one intermittent movement of the adhesive belt 10 started. However, without limitation to such an arrangement, for example a measurement result of a non-illustrated encoder may be

utilized.

[0076] As described above, the recording apparatus 1 according to this embodiment is capable of correcting the travel distance of the adhesive belt 10 according to the calculation result of the control unit 31, in which case the control unit 31 also corresponds to the correction unit in the invention.

[0077] With the recording apparatus 1 configured as above according to this embodiment, the accurately calculated travel distance of the adhesive belt 10 can further be corrected, and therefore the recording position can be prevented from shifting owing to the variability of the travel distance of the adhesive belt 10.

[0078] The recording head 7 according to this embodiment will now be described hereunder.

[0079] Fig. 8 is a schematic bottom view showing the recording head 7 according to this embodiment.

[0080] As shown in Fig. 8, the recording head 7 according to this embodiment includes nozzle rows N1 to N8, each composed of a plurality of nozzles N aligned in the transport direction A (intersecting the scanning direction B). Here, the recording apparatus 1 according to this embodiment is configured to eject cyan ink, magenta ink, yellow ink, and black ink, and the nozzle rows N1 and N5 correspond to the cyan ink, the nozzle rows N2 and N6 correspond to the magenta ink, the nozzle rows N3 and N7 correspond to the yellow ink, and the nozzle rows N4 and N8 correspond to the black ink.

[0081] With the recording head 7 configured as above, the recording apparatus 1 according to this embodiment intermittently transports the recording medium P on the adhesive belt 10. The recording head 7 moves relative to the recording medium P supported by the adhesive belt 10, in the scanning direction B intersecting the transport direction A of the recording medium P, when the adhesive belt 10 is at a stop, and ejects the ink through the nozzle rows N1 to N8 each including the plurality of nozzles N aligned in the direction intersecting the scanning direction B, according to the ejection data. The imaging units 18 shoot the adhesive belt 10, corresponding to the moving object, each time the adhesive belt 10 stops while intermittently transporting the recording medium P.

[0082] Thus, in the serial-type recording apparatus 1 the imaging units 18 shoot the adhesive belt 10 each time the adhesive belt 10 stops while intermittently transporting the recording medium P. Therefore, the travel distance of the adhesive belt 10 can be accurately calculated, for example each time the adhesive belt 10 makes one movement in the intermittent transport of the recording medium P.

[0083] The recording apparatus 1 according to this embodiment can also calculate the travel distance of the adhesive belt 10 each time the adhesive belt 10 moves a plurality of times, in addition to calculating the travel distance of the adhesive belt 10 each time the adhesive belt 10 makes one movement in the intermittent transport of the recording medium P as described above.

[0084] As also described above, in the recording ap-

paratus 1 according to this embodiment, the upstream imaging unit 18a and the downstream imaging unit 18b are movable along the non-illustrated rail extending in the transport direction A. Although such a configuration is not mandatory, it is preferable that at least one of the plurality of imaging units 18 is movable toward at least one of the upstream side and the downstream side in the transport direction A. With the mentioned configuration, even when the recording apparatus 1 is configured to perform a plurality of recording modes in which the transport belt is set to move at a different speed (travel distance by one movement, as in the recording apparatus 1 according to this embodiment in which the adhesive belt 10 is intermittently transported, or moving speed of the transport belt in a recording apparatus in which the transport belt is continuously moved), the travel distance of the adhesive belt 10 can be accurately calculated in each of the recording modes, by moving the imaging units 18 according to the recording mode.

[0085] Alternatively, three or more imaging units 18 may be provided. With three or more imaging units also, even when the recording apparatus 1 is configured to perform a plurality of recording modes in which the transport belt is set to move at a different speed (travel distance by one movement, as in the recording apparatus 1 according to this embodiment in which the adhesive belt 10 is intermittently transported, or moving speed of the transport belt in a recording apparatus in which the transport belt is continuously moved), the travel distance of the adhesive belt 10 can be accurately calculated in each of the recording modes, by adjusting the interval between the imaging units 18 according to the recording mode, and calculating the travel distance using image pickup results from different imaging units 18 selected according to the recording mode.

[0086] For example, when the recording apparatus 1 has three types of recording modes in which the travel distance of the adhesive belt 10 by one intermittent movement is set to a first travel distance, a second travel distance, and a third travel distance respectively, three imaging units 18 may be provided, such that the interval between the most upstream imaging unit 18 and the intermediate one in the transport direction A is set according to the first travel distance, the interval between the intermediate imaging unit 18 and the most downstream one in the transport direction A is set according to the second travel distance, and the interval between the most upstream imaging unit 18 and the most downstream one in the transport direction A is set according to the third travel distance.

[0087] In the recording apparatus 1 according to this embodiment, the moving object is the adhesive belt 10 exemplifying the transport belt. While the recording medium P has a uniform surface appearance in general, the transport belt such as the adhesive belt 10 often has marks that can serve as index, such as a scratch. Therefore, adopting the transport belt as moving object to be shot by the imaging units 18 facilitates identifying the

singular point S, thereby enabling the travel distance of the transport belt to be calculated with improved accuracy. However, the mentioned configuration is not mandatory.

[0088] Hereunder, the calculation method of the travel distance of the transport belt that can be performed by the recording apparatus 1 according to this embodiment will be described in further detail with reference to a flowchart.

[0089] Fig. 9 is a flowchart showing an example of the calculation method of the travel distance of the transport belt that can be performed by the recording apparatus according to this embodiment. This flowchart corresponds to the control example of the travel distance of the adhesive belt 10 performed by the control unit 31, described with reference to Fig. 7. In addition, the flowchart of Fig. 9 represents the calculation method of the travel distance of the transport belt by one intermittent movement of the adhesive belt 10.

[0090] When the recording apparatus 1 according to this embodiment receives inputs of the ejection data from the PC 36 and starts the calculation of the travel distance of the transport belt according to Fig. 9, first the upstream imaging unit 18a shoots the adhesive belt 10 at step S110, where also the control unit 31 identifies the singular point S and recognizes the position thereof. Although the recording apparatus 1 according to this embodiment measures the travel distance of the adhesive belt 10 by image processing by shooting the inner circumferential surface 20 thereof, the measurement of the travel distance of the adhesive belt 10 by image processing may be performed by shooting the support surface F or the lateral edge of the adhesive belt 10. Alternatively, the travel distance of the adhesive belt 10 may be indirectly measured by image processing, by shooting the recording medium P.

[0091] At step S120, the adhesive belt 10 starts to be moved (recording medium P starts to be transported) so as to cover a predetermined travel distance (corresponding to one intermittent movement of the adhesive belt 10).

[0092] At step S130, the downstream imaging unit 18b shoots the adhesive belt 10, and also the control unit 31 recognizes the position of the singular point S and the stop position of the adhesive belt 10 is predicted. This prediction may be made, for example, on the basis of the travel distance of the singular point S per unit time, or on the basis of the position of the singular point S, the position corresponding to the appropriate travel distance (stop position), and the number of remaining driving pulses to be inputted to the motor M of the drive roller 8.

[0093] At step S140, the control unit 31 decides whether the travel distance of the adhesive belt 10 is likely to be an appropriate travel distance. When it is decided that the appropriate travel distance is not likely to be achieved, the travel distance of the adhesive belt 10 is adjusted at step S150 as in the control example of the travel distance of the adhesive belt 10 performed by the control unit 31, described with reference to Fig. 7, and the process re-

turns to step S130. When it is decided that the appropriate travel distance is likely to be achieved, the process proceeds to step S160.

[0094] At step S160, it is checked whether the adhesive belt 10 has stopped. Before the adhesive belt 10 stops, step S130 to step S160 are repeated, and when the adhesive belt 10 stops the calculation of the travel distance of the transport belt according to Fig. 9 is finished and the recording based on the ejection data is started. The start of the recording herein refers to execution of ejection corresponding to one scanning (one path), in other words the recording action of the recording head 7 in one stroke in the scanning direction B, either in the forward or backward direction.

[0095] By the mentioned calculation method of the travel distance of the transport belt, the travel distance of the adhesive belt 10 is calculated during the period between the start of the movement of the adhesive belt 10 at step S120 and the stopping of the adhesive belt 10 at step S160, and therefore the travel distance of the adhesive belt 10 can be efficiently adjusted.

[0096] Hereunder, another calculation method of the travel distance of the transport belt that can be performed by the recording apparatus 1 according to this embodiment will be described in further detail with reference to a flowchart.

[0097] Fig. 10 is a flowchart showing another example of the calculation method of the travel distance of the transport belt that can be performed by the recording apparatus according to this embodiment. In this flowchart of the calculation method of the travel distance of the transport belt, step S130 to step S150 in the flowchart shown in Fig. 9 are omitted, and instead step S170 to step S200 are added. Therefore, the description of step S110, step S120, and step S160 which are the same as those of Fig. 9 will not be repeated, and only step S170 and subsequent steps will be described.

[0098] In the calculation method of the travel distance of the transport belt shown in Fig. 9, the travel distance of the adhesive belt 10 is calculated and adjusted, during the period between the start of the movement of the adhesive belt 10 at step S120 and the stopping of the adhesive belt 10 at step S160.

[0099] In contrast, in the calculation method of the travel distance of the transport belt shown in Fig. 10, the travel distance of the adhesive belt 10 is calculated and adjusted after the adhesive belt 10 both starts to move at S120 and then stops moving at step S160.

[0100] In the calculation of the travel distance of the transport belt according to Fig. 10, when the adhesive belt 10 stops moving at step S160, the downstream imaging unit 18b shoots the adhesive belt 10 at step S170.

[0101] At step S180, the control unit 31 calculates an amount of shift of the travel distance of the adhesive belt 10 according to the position of the singular point S.

[0102] At step S190, the control unit 31 decides whether the travel distance of the adhesive belt 10 that has resulted is appropriate, according to the shift amount cal-

culated at step S180. When it is decided that the travel distance is not appropriate, the adhesive belt 10 is moved (travel distance of the adhesive belt 10 is adjusted) according to the shift amount at step S200, and then the process returns to step S170, and step S170 to step S200 are repeated until the appropriate travel distance is achieved. When the travel distance is decided to be appropriate, the calculation of the travel distance of the transport belt according to Fig. 10 is finished.

[0103] When the adhesive belt 10 is moved at step S200, the adhesive belt 10 may be moved in the direction opposite to the transport direction A, not only in the transport direction A.

[0104] By the mentioned calculation method of the travel distance of the transport belt, the travel distance of the adhesive belt 10 is calculated after the adhesive belt 10 starts to move at S120 and then stops moving at step S160, and therefore the travel distance of the adhesive belt 10 can be accurately adjusted.

[0105] Hereunder, still another calculation method of the travel distance of the transport belt that can be performed by the recording apparatus 1 according to this embodiment will be described in further detail with reference to a flowchart.

[0106] Fig. 11 is a flowchart showing another example of the calculation method of the travel distance of the transport belt that can be performed by the recording apparatus according to this embodiment. This flowchart of the calculation method of the travel distance of the transport belt is composed of the flowchart according to Fig. 9 with the addition of step S170 to step S200 out of the flowchart according to Fig. 10. Therefore, the description of step S110 to step S200, which are the same as those of Fig. 9 and Fig. 10, will not be repeated.

[0107] By the calculation method of the travel distance of the transport belt shown in Fig. 9, the travel distance of the adhesive belt 10 is calculated and adjusted during the period between the start of the movement of the adhesive belt 10 at step S120 and the stopping of the adhesive belt 10 at step S160. By the calculation method of the travel distance of the transport belt shown in Fig. 10, the travel distance of the adhesive belt 10 is calculated and adjusted after the adhesive belt 10 starts to move at S120 and then stops moving at step S160.

[0108] In contrast, by the calculation method of the travel distance of the transport belt shown in Fig. 11, the travel distance of the adhesive belt 10 is calculated and adjusted, both during the period between the start of the movement of the adhesive belt 10 at step S120 and the stopping of the adhesive belt 10 at step S160, and thereafter. Therefore, the calculation method of the travel distance of the transport belt according to Fig. 11 allows the travel distance of the adhesive belt 10 to be adjusted, both efficiently and accurately.

[0109] It is a matter of course that the present invention is not limited to the foregoing embodiment but may be modified in various manners within the scope of the present invention set forth in the appended claims, and

that such modifications are duly included in the scope of the present invention.

[0110] For example, a recording apparatus including a line head and a transport belt set to continuously transport a medium, not intermittently, may be employed, and the travel distance of the transport belt may be calculated each time a predetermined time elapses, by picking up images with an upstream imaging unit and a downstream imaging unit each time the predetermined time elapses.

Claims

1. A recording apparatus (1) comprising:

a transport belt (10) configured to transport a medium (P);
a recording unit (14) configured to perform recording on the medium supported by the transport belt;
a plurality of imaging units (18a, 18b) provided on an upstream side and a downstream side in a transport direction (A) of the medium, and configured to shoot a moving object including at least one of the transport belt and the medium; and
a calculation unit (33) configured to calculate a distance travelled by the transport belt in a predetermined time, on a basis of a position of a part (S) of the moving object in an image picked up by the upstream imaging unit (18a) of the plurality of imaging units, and a position of the part of the moving object in an image picked up by the downstream imaging unit (18b) of the plurality of imaging units, the predetermined time after the image pickup by the upstream imaging unit.

2. The recording apparatus according to Claim 1, further comprising a correction unit configured to correct the travel distance of the transport belt according to a calculation result of the calculation unit.

3. The recording apparatus according to Claim 1 or Claim 2,
wherein the transport belt (10) is configured to intermittently transport the medium,
the recording unit moves, with respect to the medium supported by the transport belt, in a scanning direction (B) intersecting the transport direction of the medium, and to eject a liquid according to ejection data through a nozzle row (N1-N8) including a plurality of nozzles (N) aligned in a nozzle alignment direction intersecting the scanning direction, and
a said imaging unit (18) configured to shoot the moving object each time the transport belt stops in the intermittent transport of the medium.

4. The recording apparatus according to any one of the preceding claims, wherein at least one of the plurality of imaging units is configured to move toward at least one of the upstream side and the downstream side. 5
5. The recording apparatus according to any one of the preceding claims, comprising three or more of the imaging units. 10
6. The recording apparatus according to any one of the preceding claims, wherein the moving object is the transport belt.
7. A calculation method of a travel distance of a transport belt (10) to be performed by a recording apparatus (1) including: 15
- the transport belt (10) that transports a medium; 20
- a recording unit (4) that performs recording on the medium supported by the transport belt; and
- a plurality of imaging units (18a, 18b) provided on an upstream side and a downstream side in a transport direction (A) of the medium, and configured to shoot a moving object (S) including at least one of the transport belt and the medium, 25
- the method comprising calculating the distance travelled by the transport belt in a predetermined time, on a basis of a position of a part of the moving object in an image picked up by the upstream imaging unit (18a) of the plurality of imaging units, and a position of the part of the moving object in an image picked up by the downstream imaging unit (18b) of the plurality of imaging units, the predetermined time after the image pickup by the upstream imaging unit. 30
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FIG. 1

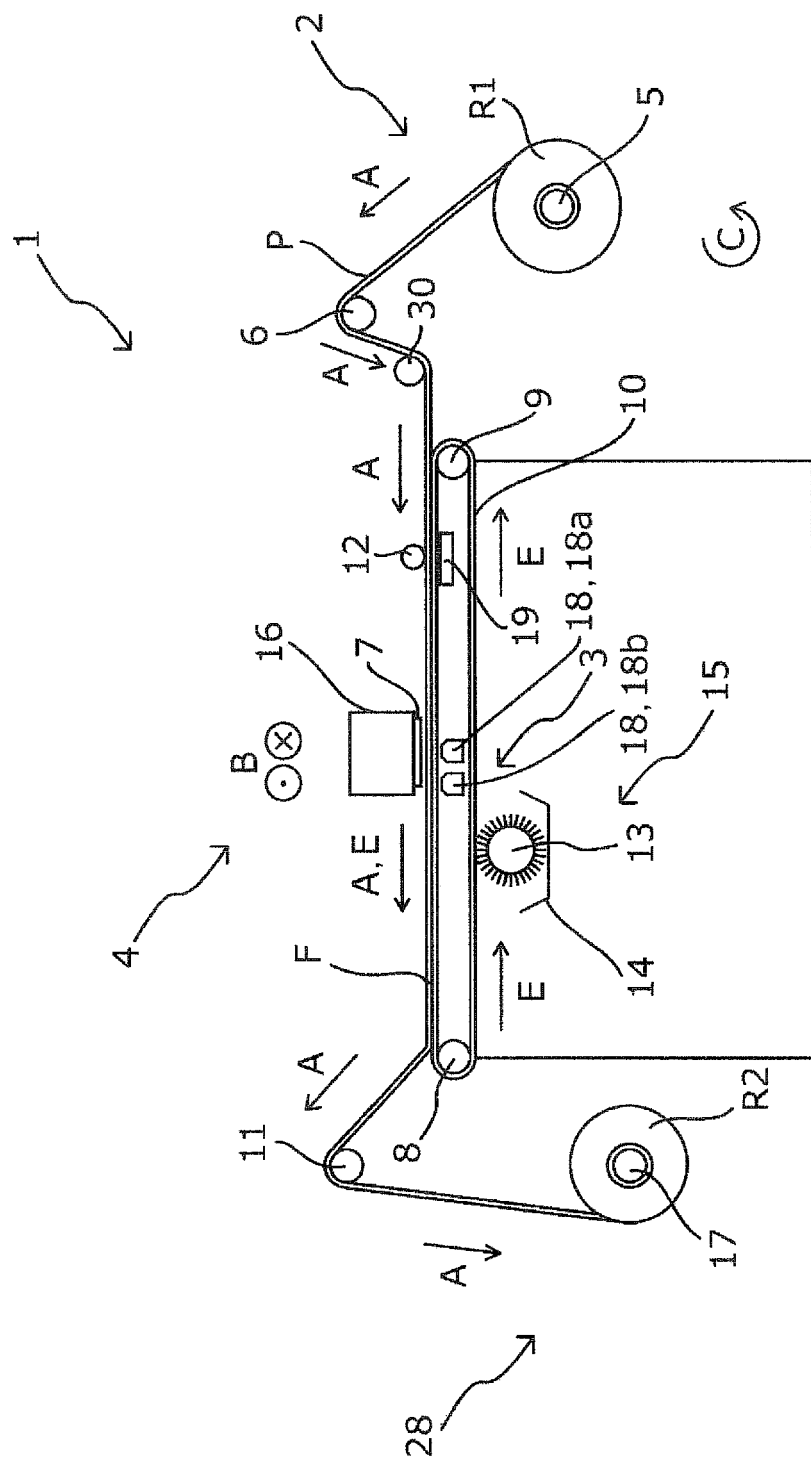


FIG. 2

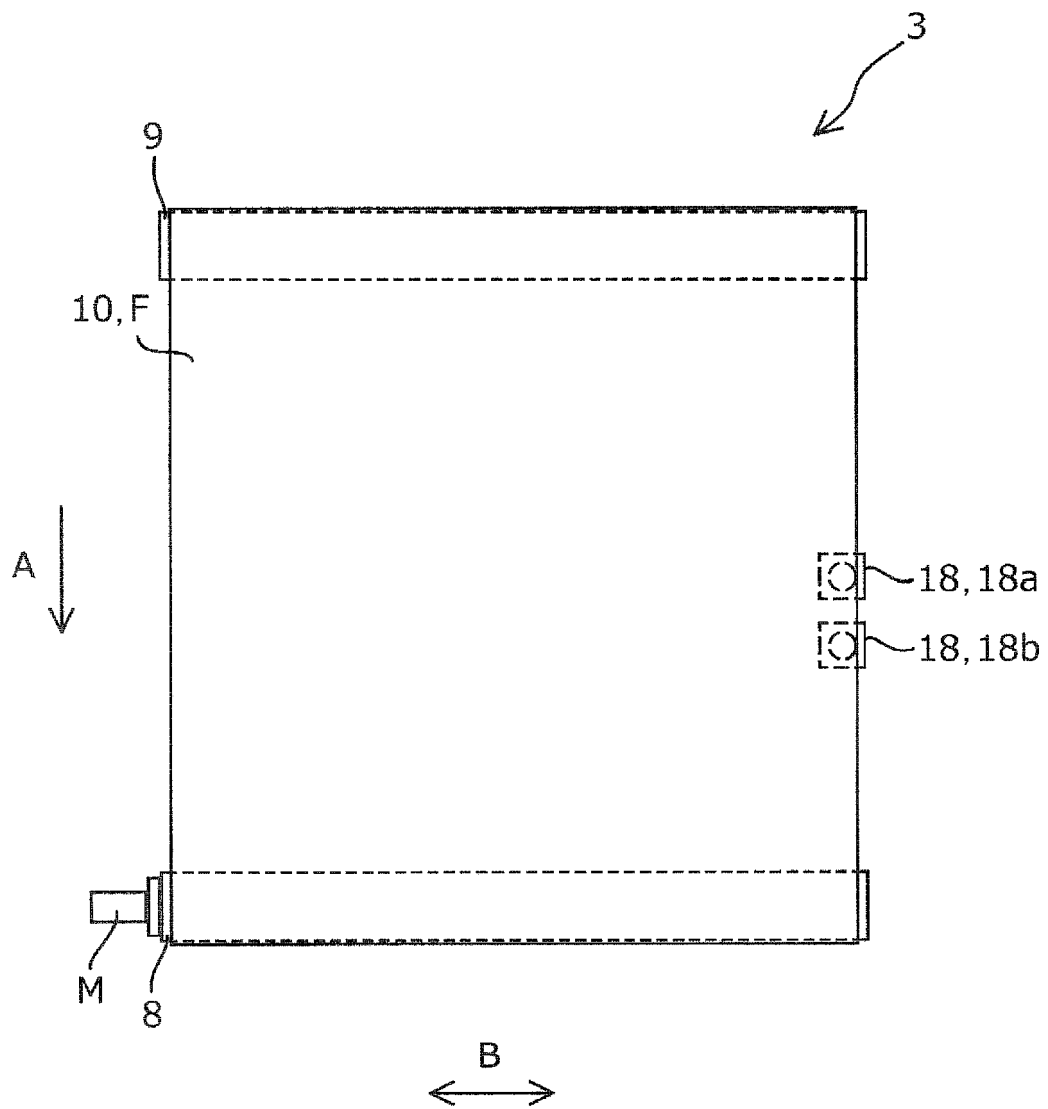


FIG. 3

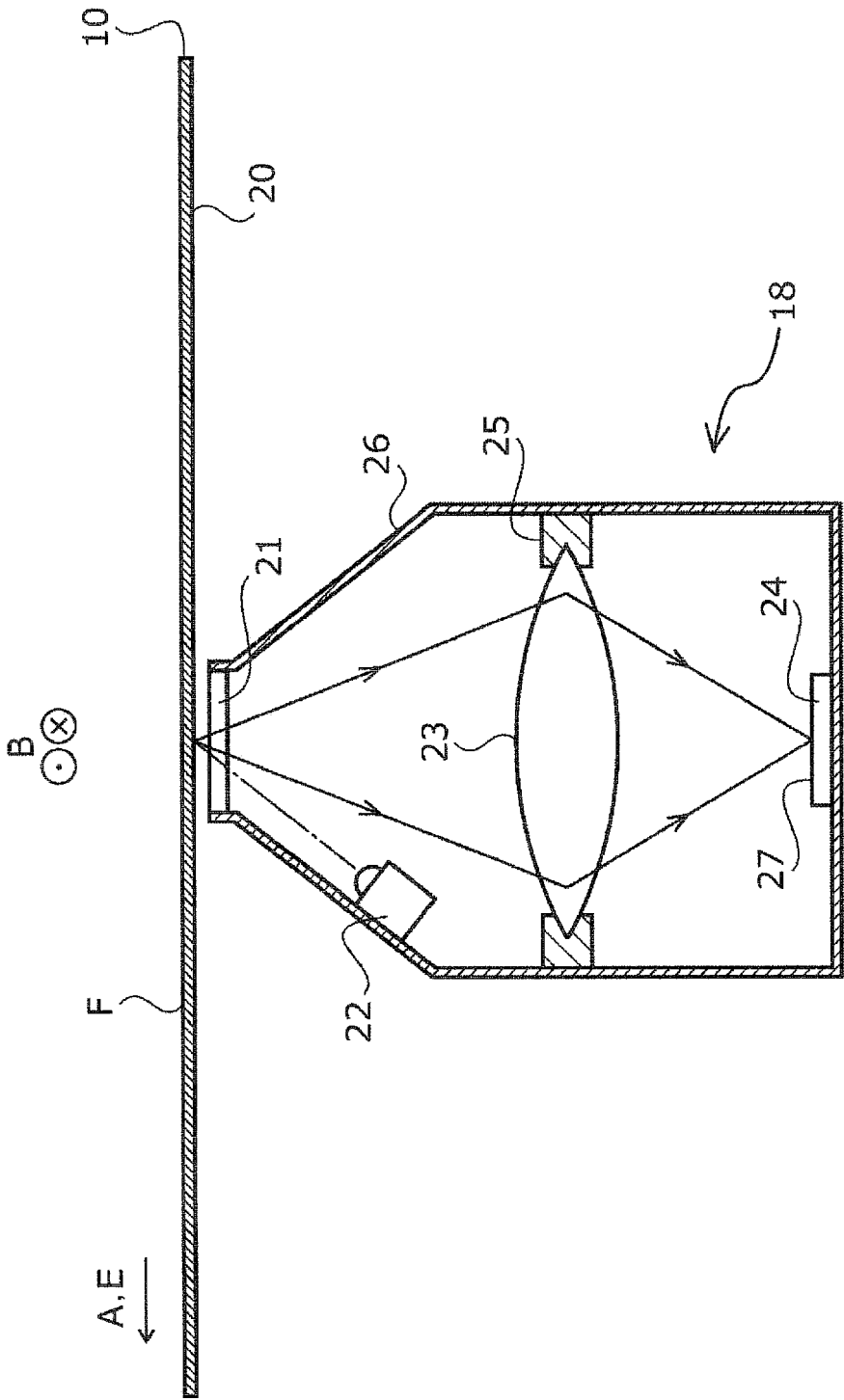


FIG. 4

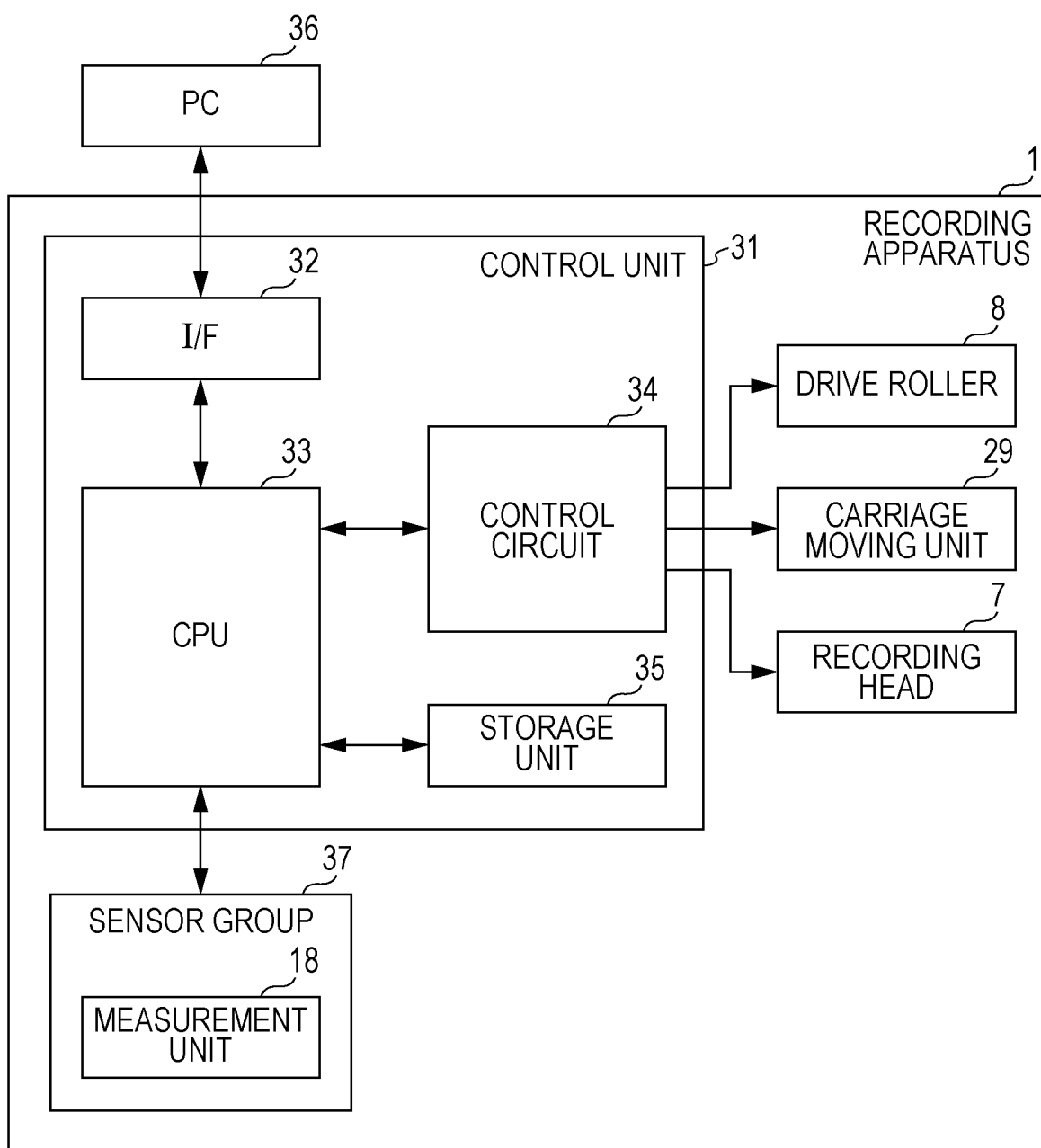


FIG. 5

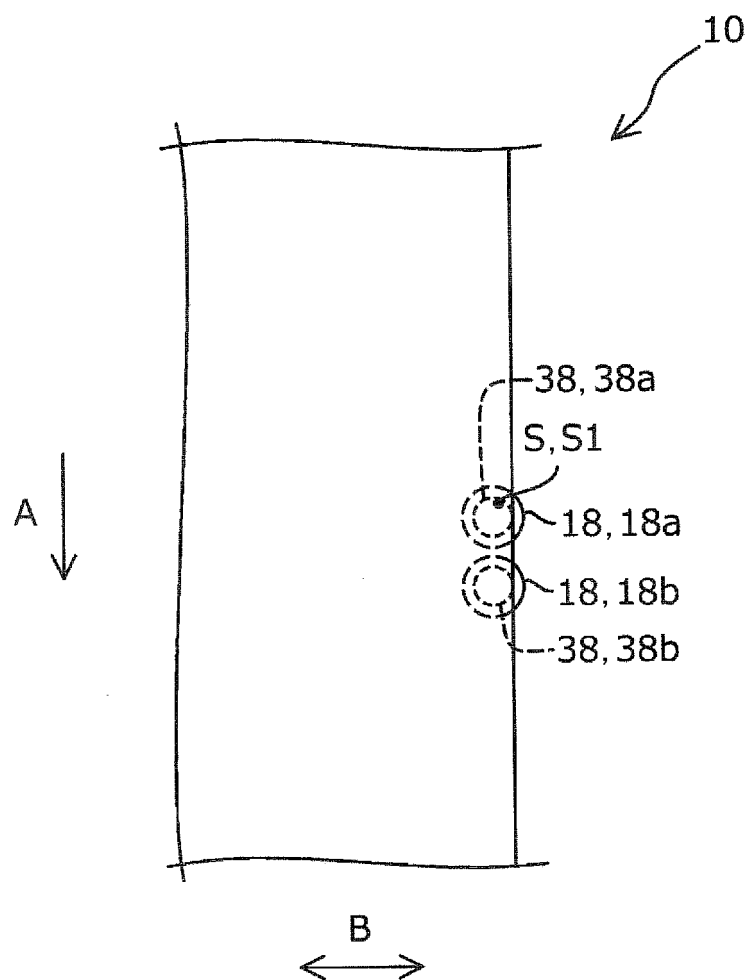


FIG. 6

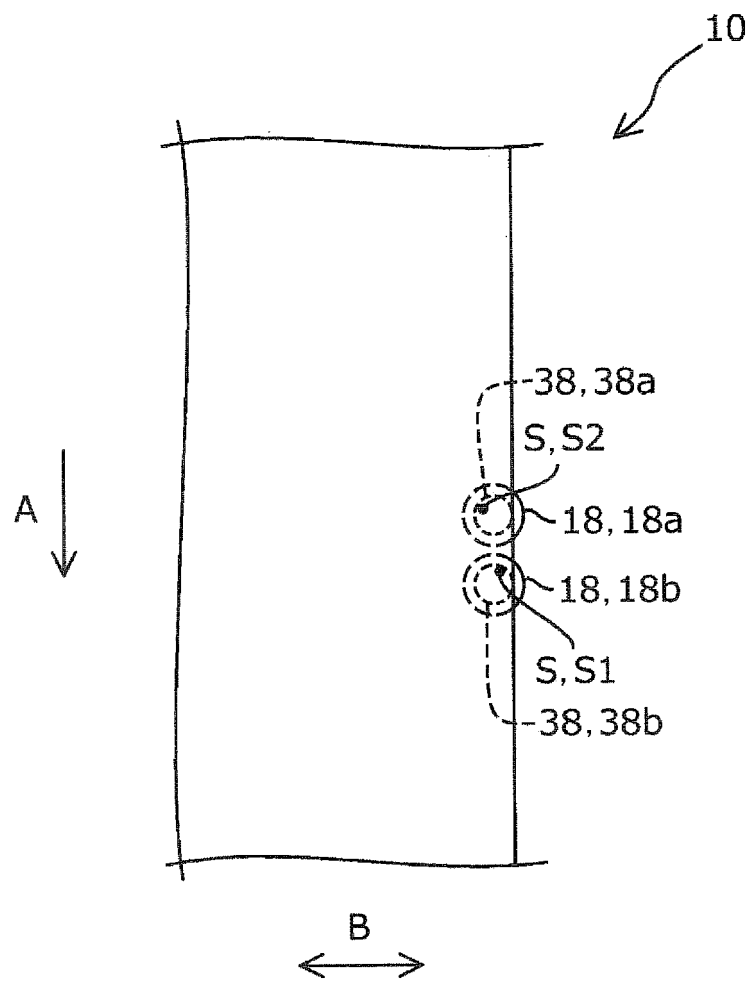


FIG. 7

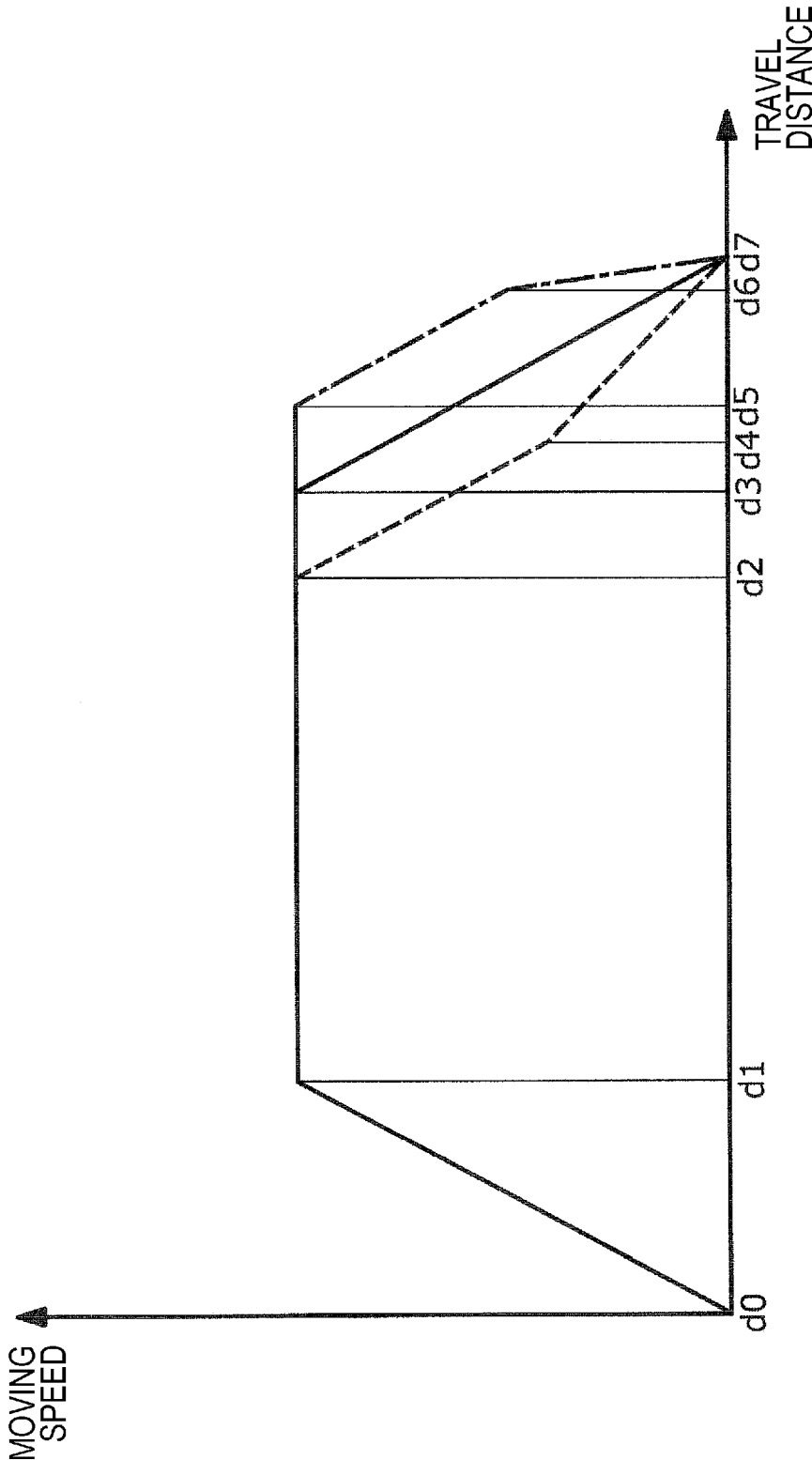


FIG. 8

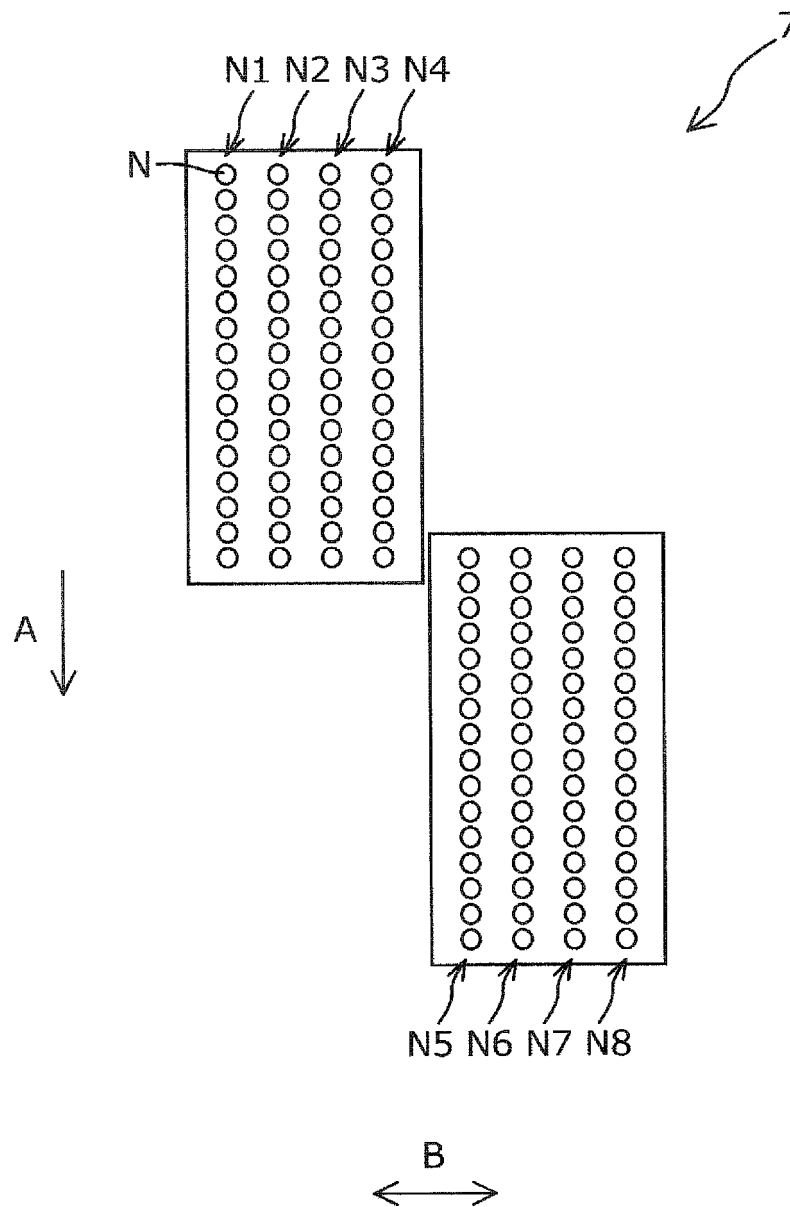


FIG. 9

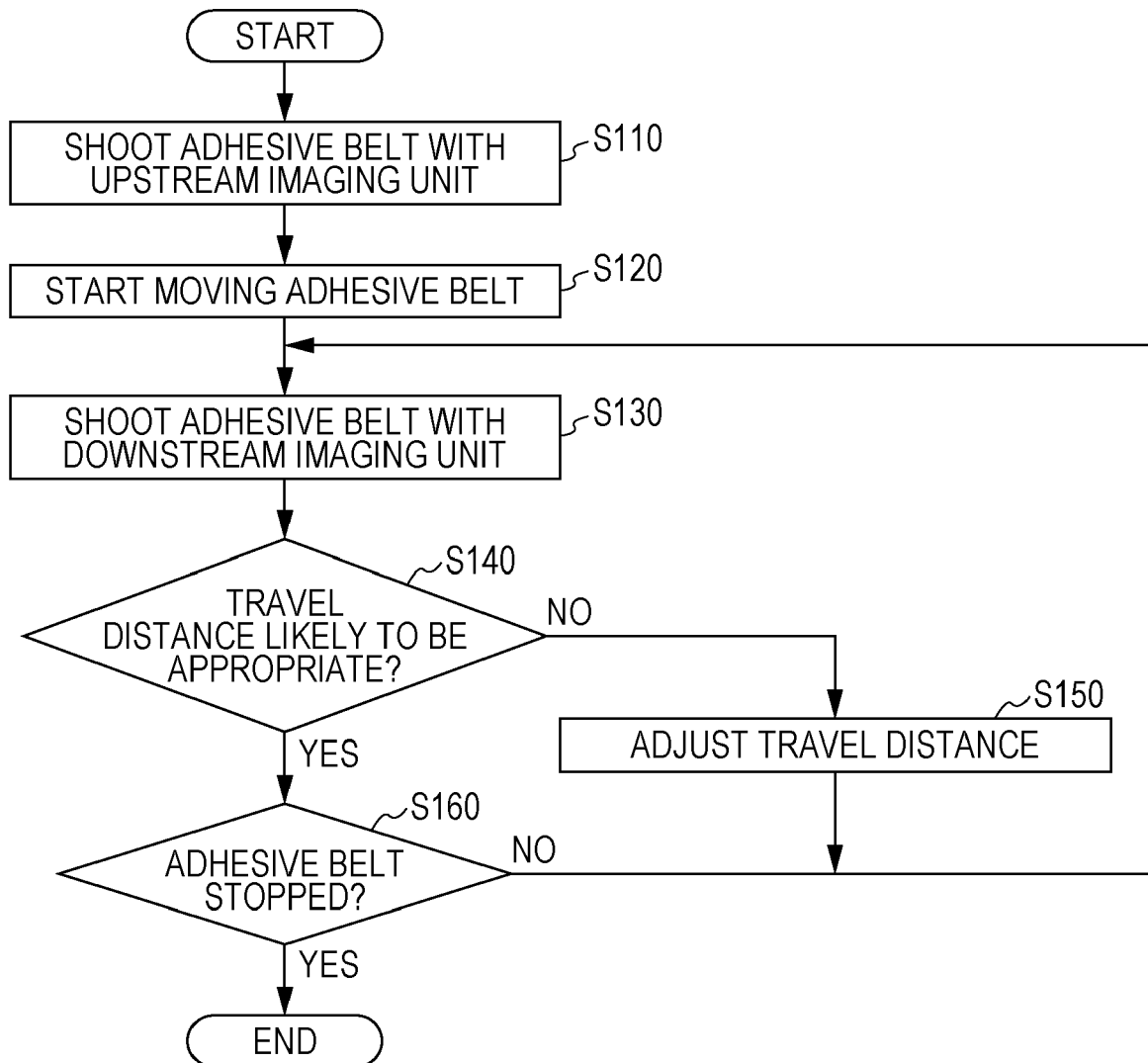


FIG. 10

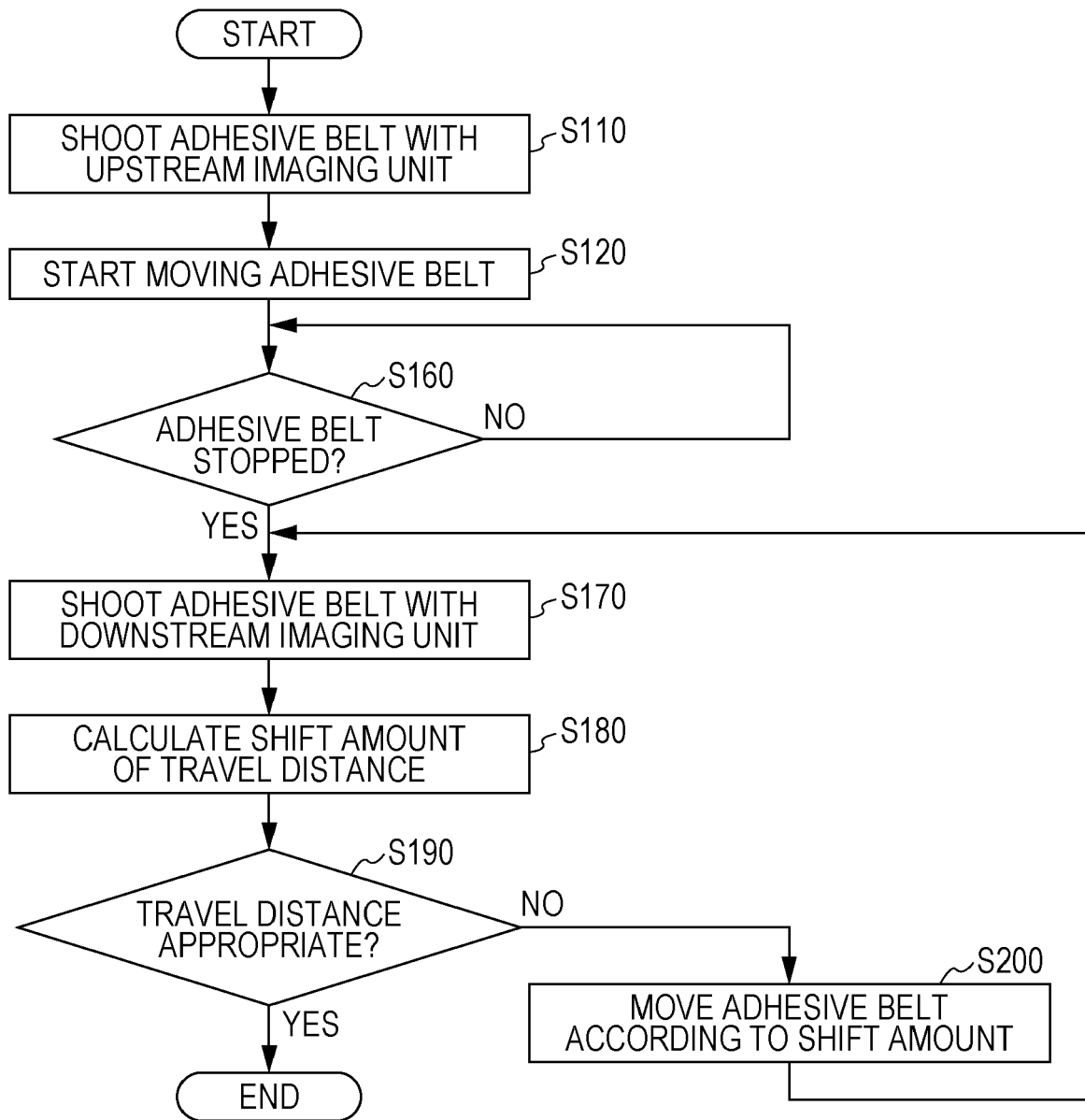
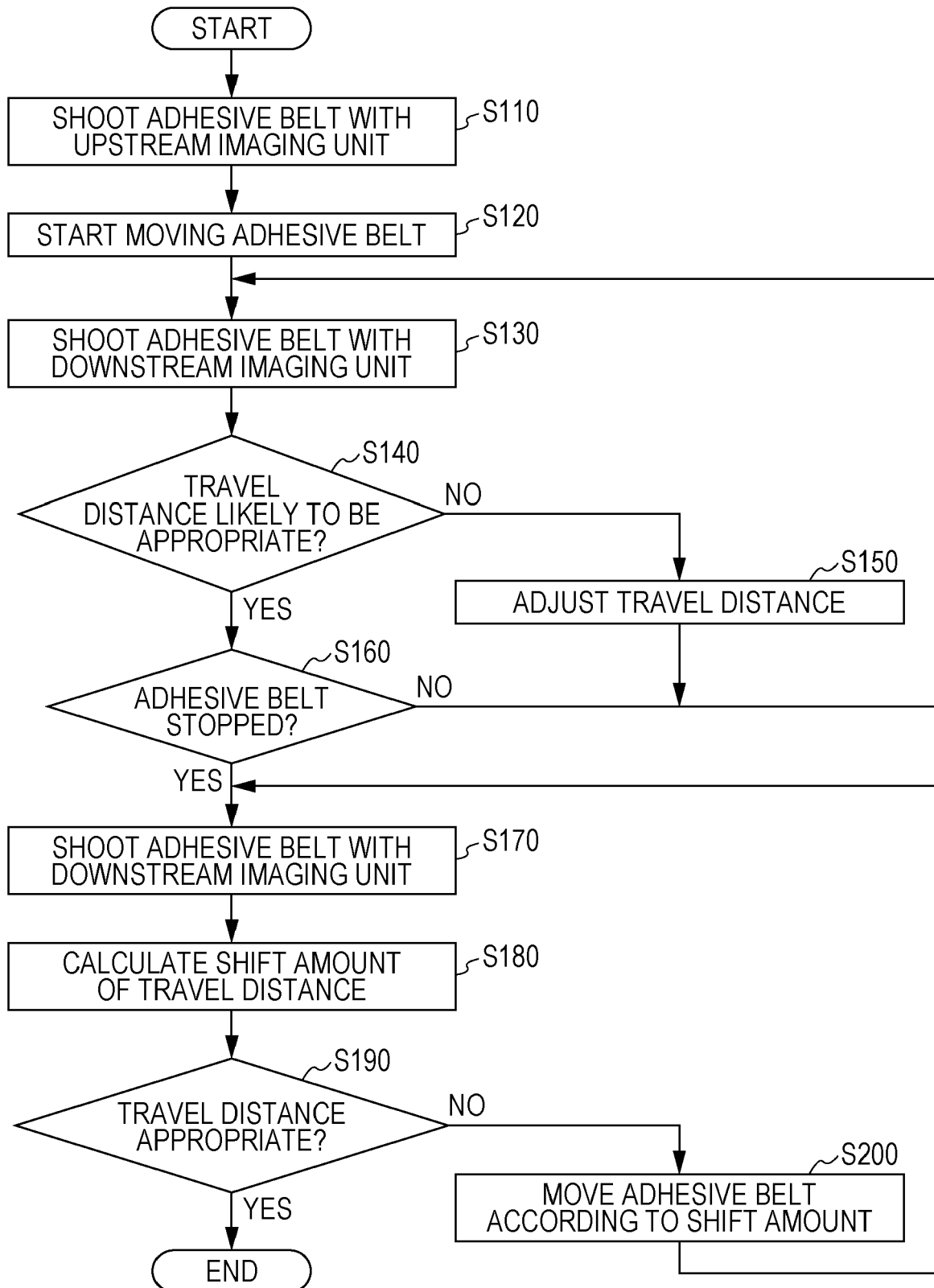


FIG. 11





EUROPEAN SEARCH REPORT

Application Number
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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	JP H11 291468 A (CANON KK) 26 October 1999 (1999-10-26) * abstract; figure 1 * -----	1-3,5-7 4	INV. B41J11/00 B41J3/407
			TECHNICAL FIELDS SEARCHED (IPC)
			B41J
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 September 2017	Examiner Wehr, Wolfhard
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 & : member of the same patent family, corresponding document			

12-09-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H11291468	A	26-10-1999	NONE

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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