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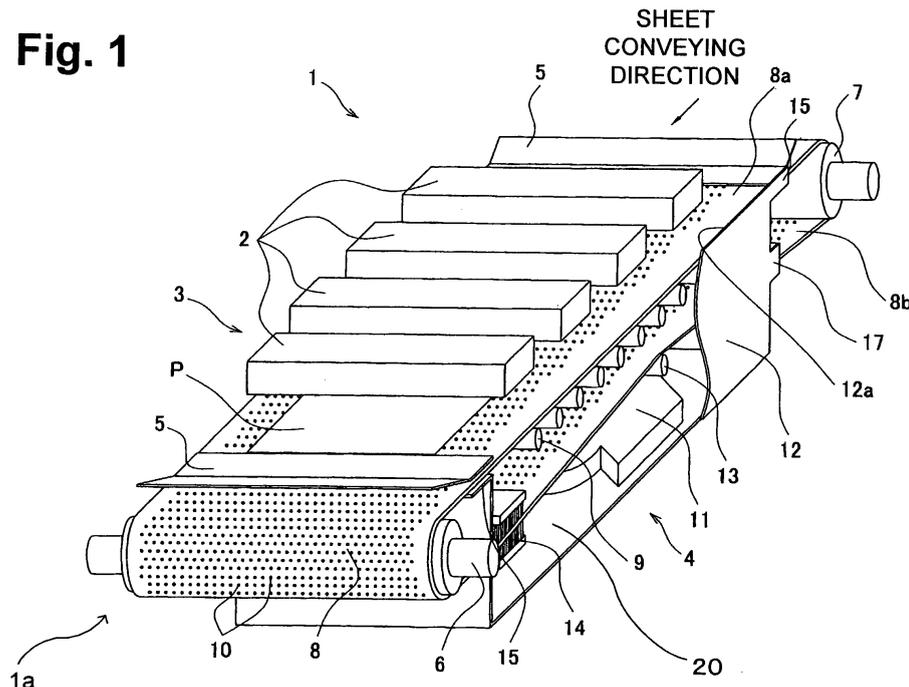
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(54) **Sheet conveying device**

(57) A sheet conveying device (3) includes a belt (8) having a plurality of throughholes (10), a fan (11) disposed so as to interpose a portion of the belt placed in a return run position (8b) between the fan and a portion of the belt placed in the forward run position (8a), and a case (12) that defines a chamber (20) with a portion of the belt placed in the forward run position. The fan (11) creates a negative pressure within the chamber (20) by

drawing air through the throughholes of the endless belt, thereby removing dust and other unwanted particles and debris from the endless belt. In one or more examples, a brush (14) may also be included to provide further removal of unwanted dust and particles. Further, in one or more configurations, the sheet conveying device may also include belt rollers (6,7) and/or supporting members (9).

Fig. 1



Description

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority from Japanese Patent Application No. 2006-260067, which was filed on September 26, 2006, the disclosure of which is herein incorporated by reference in its entirety.

BACKGROUND

1. TECHNICAL FIELD

[0002] Embodiments relate to a sheet conveying device configured to convey sheets.

2. Description of Related Art

[0003] Current systems include sheet conveying devices comprising a belt mechanism configured to convey the recording medium and a platen disposed adjacent to an inner surface of a belt of the belt mechanism. In the sheet conveying device, a belt of the belt mechanism is moved by a pair of rollers in a running (i.e., a conveying) direction. The belt is formed of foamed material having breathability or air permeability. The platen has a suction opening and a suction fan to cause negative pressure in an interior of the platen. A recording medium is conveyed by the belt while being suctioned or pulled toward a surface of the belt via the suction opening and the negative pressure.

[0004] In the sheet conveying device, the suction fan is disposed inside the platen, so that foreign matters attached to a portion of the belt placed in a forward run position can be removed. However, foreign matters attached to a portion of the belt placed in a return run position will not be removed. Therefore, as a portion of the belt in the return run position to which foreign matters become attached comes to the forward run position, the foreign matters may rise and adhere to nozzles of the print head, leading to printing failures.

[0005] In addition, because the suction fan is disposed inside the platen, distance between the forward run position and return run position of the belt might need to be increased. Accordingly, the diameters of a pair of rollers might also need to be increased. As the diameters of the rollers increase, the belt may start to move slower, which ultimately reduces printing speeds.

SUMMARY

[0006] Therefore, a need has arisen for sheet conveying devices which overcome or at least reduce these and other shortcomings of the related art. Aspects described herein relate to a sheet conveying device that removes foreign matters attached to a conveying belt.

[0007] A sheet conveying device may include an endless belt having a plurality of throughholes passing there-

through in a thickness direction of the belt. The belt passes a forward run position at which the belt conveys a sheet in a sheet conveying direction and a return run position opposite to the forward run position. The sheet conveying device may further include a fan disposed such that a portion of the belt placed in the return run position is positioned between the fan and a portion of the belt placed in the forward run position, and a case that defines a chamber with a portion of the belt placed in the forward run position. The chamber accommodates a portion of the belt placed in the return run position and the fan therein. Additionally, in one or more examples, the case may include an inlet through which the belt moves to the return run position and an outlet through which the belt moves away from the return run position. The fan generates a negative pressure in the chamber, thereby drawing air into the chamber via the throughholes provided on a portion of the belt placed in the forward run position. The air flows into the fan via the throughholes provided on a portion of the belt placed in the return run position.

[0008] In the sheet conveying device, foreign matters attached to both portions of the belt placed in the forward run position and the return run position may be removed by the fan via the air current and negative pressure. A portion of the belt placed in the return run position is disposed between the fan and a portion of the belt placed in the forward run position. Therefore, diameters of one or more belt rollers to which the belt is attached may be reduced so as to shorten distance between the forward run position and the return run position of the belt. Thus, the belt may start to move smoothly and an initial print time (e.g., the print time for a first page of a document) may be reduced.

[0009] According to at least one embodiment, the throughholes are evenly disposed on substantially the entire surface of the belt. Thus, force of suctioning the sheet toward the belt may be equal or similar at any position on the belt.

[0010] Further, in one or more configurations, a supporting member for supporting a portion of the belt may include a plurality of platen rollers arranged in the sheet conveying direction and each platen roller extends in the same direction as axes of the belt rollers and is supported by the case so as to rotate in the same direction as the belt rollers. As a result of the supporting member including a plurality of rotatable platen rollers, the belt may smoothly move with reduced resistance.

[0011] In addition, in one or more examples, the plurality of platen rollers are equidistantly arranged in the sheet conveying direction. Thus, the platen rollers may evenly support a portion of the belt placed in the forward run position.

[0012] A tension roller configured to apply tension to a portion of the belt placed in the return run position may be disposed in the case in one or more arrangements. Accordingly, tension may be applied to the belt and its flexing amount may be adjusted.

[0013] Further, in one or more examples, a brush may be disposed near the inlet, either on the inside or the outside of the case, so as to contact a surface of the belt. Thus, foreign matters (e.g., debris, particles, unwanted material) attached to the surface of the belt may be removed effectively.

[0014] Additionally or alternatively, a guide configured to press the sheet onto the belt may be disposed at each end of an opening of the case. For example, when the sheet is pressed against and separated from the belt by a roller for pressing the sheet against the belt, changes in speed of the belt may be prevented. Thus, printing failure and reduction in print quality due to changes in speeds of the belt may also be prevented.

[0015] Other objects, features, and advantages will be apparent to persons of ordinary skill in the art from the following detailed description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] For a more complete understanding of aspects and embodiments of the present invention, needs satisfied thereby, and the objects, features, and advantages thereof, reference now is made to the following description taken in connection with the accompanying drawings.

[0017] Fig. 1 is a perspective view of an inkjet printer according to an illustrative embodiment.

[0018] Fig. 2 is a side view of the inkjet printer of Fig. 1.

[0019] Fig. 3 is a plane view of the inkjet printer of Fig. 1.

DETAILED DESCRIPTION

[0020] Embodiments are described in detail with reference to the accompanying drawings. One or more embodiments may be applied to inkjet printers that form characters and/or images by ejecting ink onto recording sheets.

[0021] As shown in Figs. 1 and 2, a color inkjet printer 1 comprises four print heads 2, and a sheet conveying device 1a including a conveyor unit 3 and a suction unit 4.

[0022] Inkjet printer 1 may be a line printer comprising four print heads 2, each of which corresponds to one of four ink colors (e.g., magenta, yellow, cyan and black) arranged in a sheet conveying direction. Each of the four print heads 2 may be of a hexahedral shape elongated in a direction perpendicular to the sheet conveying direction. Bottom surfaces of print heads 2 face a conveying belt 8. Ink droplets of each color are ejected to a print area defined on an upper print surface of a sheet P when sheet P, conveyed by the conveying belt 8 sequentially, passes under print heads 2. Thus, a color image is formed on the print area of sheet P.

[0023] Conveyor unit 3 comprises belt rollers 6, 7, an endless conveying belt 8 looped around belt rollers 6, 7, and a tension roller 13.

[0024] Belt roller 6 is rotated by drive force from a motor

(not shown) in a counterclockwise direction in Fig. 2, as indicated by the arrow A. Belt roller 7 is rotated by a force applied from conveying belt 8 as belt roller 6 rotates.

[0025] As shown in Figs. 1 and 3, through holes 10 are evenly provided on a substantially entire surface of conveying belt 8. Conveying belt 8 is adjusted to such a length that a predetermined tension is applied to conveying belt 8, when looped around belt rollers 6, 7, via tension roller 13. Portions of conveying belt 8, which loop around belt rollers 6, 7, are positioned on two parallel planes, each including a line tangent to both belt rollers 6, 7. A portion of conveying belt 8 positioned on one of the two parallel planes that faces print heads 2 is defined as a portion of conveying belt 8 placed in a forward run position 8a. A portion of conveying belt 8 positioned on the other one of the two parallel planes is defined as a portion of conveying belt 8 placed in a return run position 8b. Sheet P is conveyed in a sheet conveying direction by a portion of conveying belt 8 placed in forward run position 8a. A portion of conveying belt 8 placed in return run position 8b moves in a direction opposite to the sheet conveying direction. Conveying belt 8 is configured to convey sheet P while suctioning sheet P toward a portion of belt 8 placed in forward run position 8a, via through-holes 10 using air current generated by a turbofan 11.

[0026] In Fig. 2, tension roller 13 is disposed at a substantially middle portion between rollers 6, 7, such that an upper portion of tension roller 13 contacts a portion of belt 8 disposed in return run position 8b. Tension roller 13 is rotatably supported by a suction box 12 that extends perpendicularly to a sheet (e.g., sheet P) of Fig. 2. Tension roller 13 is pressed against a portion of belt 8 placed in return run position 8b from below by a spring (not shown), so that tension is applied to conveying belt 8 and so that a flexing amount of belt 8 may be adjusted.

[0027] Suction unit 4 comprises a suction box 12 of a case, two sheet guides 5 disposed outside suction box 12, platen rollers 9, a turbofan 11, and a brush 14.

[0028] Suction box 12 is disposed to cover a print area of conveying belt 8, as shown in Figs. 1 and 2. Suction box 12 may be of a hexahedral shape with an opening 12a provided at an entire upper end of suction box 12. A side surface of suction box 12 extends perpendicularly upward from its bottom surface. An upper end of suction box 12 slightly protrudes from a portion of conveying belt 8 placed in forward run position 8a. An extension plate 15 extends outward from each of the right and left ends of suction box 12 in Fig. 2. A portion of conveying belt 8 placed in forward run position 8a covers opening 12a of suction box 12 and is placed on two extension plates 15. Suction box 12 has an inlet slit 16 and an outlet slit 17 at its right and left surfaces in Fig. 2 lower than the middle portion of suction box 12 in its height direction. Slits 16, 17 are elongated in a horizontal direction. Slits 16, 17 are disposed at an end or tip of portions outwardly protruded from the side surfaces of suction box 12. A portion of conveying belt 8 placed in return run position 8b passes from slit 16 into suction box 12 and out of suction box 12

from slit 17.

[0029] A chamber 20, as shown in Fig. 1, is defined by suction box 12 and a portion of conveying belt 8 placed in forward run position 8a. Chamber 20 is divided by a portion of conveying belt 8 placed in return run position 8b into a first chamber 20a and a second chamber 20b, as shown in Fig. 2.

[0030] In the embodiment of Fig. 1, sheet guides 5 are plate members. A portion of each sheet guide 5 near its inner end (i.e., an end closer to print heads 2) faces an upper surface of corresponding extension plate 15. Each sheet guide 5 is bent upward at a middle portion thereof, so that sheet guide 5 gently slopes from its middle portion to its outer end (i.e., an end furthest from print heads 2). Sheet guide 5 and extension plate 15 are disposed to have a distance therebetween sufficient to pass, in one or more configurations, only one sheet P conveyed on a portion of conveying belt 8 placed in forward run position 8a. With sheet guides 5 and extension plates 15, sheet P is pressed against a portion of conveying belt 8 placed in forward run position 8a. With such a structure, for example, a pressing roller for pressing sheet P against a portion of conveying belt 8 placed in forward run position 8a might not have to be provided. In addition, without a pressing roller pressing against sheet P, changes in speed of conveying belt 8 may be prevented. Thus, printing failure due to changes in speeds of conveying belt 8 might not occur, which further prevents reduction of print quality.

[0031] In one or more embodiments such as the one illustrated in Fig. 1, platen rollers 9 are equidistantly disposed along the sheet conveying direction so as to contact an undersurface of a portion of conveying belt 8 placed in forward run position 8a. Platen rollers 9 extend in a direction perpendicular to the sheet conveying direction. Platen rollers 9 are supported at side surfaces of suction box 12 so as to rotate in the same direction as belt rollers 6, 7. Platen rollers 9 support the undersurface of a portion of conveying belt 8 placed in forward run position 8a. Because platen rollers 9 are rotatable, conveying belt 8 may smoothly move with reduced resistance. Platen rollers 9 are equi-distantly disposed, so that a portion of conveying belt 8 placed in forward run position 8a may be evenly supported by platen rollers 9.

[0032] Brush 14 is disposed inside suction box 12 near slit 16 so as to contact upper (inner) and lower (outer) surfaces of a portion of conveying belt 8 placed in return run position 8b. Brush 14 extends in a direction perpendicular to the sheet conveying direction. Brush 14 is supported at side surfaces of suction box 12. When a portion of conveying belt 8 placed in forward run position 8a moves to return run position 8b, brush 14 brushes off sheet dust, sheet fibers or foreign matters attached to the outer and inner surfaces of conveying belt 8. Sheet dust, sheet fibers or foreign matters are further suctioned by turbofan 11. Thus, they may be effectively removed.

[0033] Turbofan 11 is disposed inside suction box 12 between a portion of conveying belt 8 placed in return

run position 8b and a bottom surface of suction box 12. As turbofan 11 rotates, negative pressure is generated in second chamber 20b. Negative pressure is also generated in first chamber 20a, via throughholes 10 provided on a portion of conveying belt 8 placed in return run position 8b. Therefore, an air current from a print head 2 side of conveying belt 8 toward first chamber 20a, as indicated by arrows B in Fig. 2, are generated via throughholes 10 provided on a portion of conveying belt 8 placed in forward run position 8a. With the air current, sheet P, conveyed on a portion of conveying belt 8 and placed in forward run position 8a by sheet guide 5, is suctioned downward onto conveying belt 8 via throughholes 10. Throughholes 10 may be evenly disposed across substantially the entire surface of conveying belt 8. Therefore, force of suctioning sheet P toward belt 8 may be even at any position along conveying belt 8. The air current further flows from first chamber 20a to second chamber 20b via throughholes 10 provided on a portion of conveying belt 8 placed in return run position 8b. The air current is eventually discharged out of inkjet printer 1 by turbofan 11. With the air current, sheet dust, sheet fibers or foreign matters attached to both portions of conveying belt 8 placed in forward run position 8a and return run position 8b may be removed by suctioning of turbofan 11. In addition, brush 14 is disposed near slit 16. Therefore, sheet dust, sheet fibers or foreign matters brushed off by brush 14 may move toward turbofan 1 with air current flowing in from slit 16 and may be discharged out of inkjet printer 1 by turbofan 11. Preferably, a filter (not shown) may be disposed on an air current discharge path to the outside of inkjet printer 1, to collect sheet dust, sheet fibers or foreign matters before the air current is discharged outside inkjet printer 1.

[0034] Referring to Fig. 2, operations of inkjet printer 1 will be described. Sheet P is supplied from a sheet tray (not shown). One sheet P passes between conveying belt 8 and right sheet guide 5 in Fig. 2 while being pressed therebetween, in accordance with the movement of conveying belt 8. Sheet P, passed through between right sheet guide 5 and a portion of conveying belt 8 placed in forward run position 8a, is pulled downward onto belt 8 via throughholes 10 by an air current generated by turbofan 11. When sheet P passes directly below print heads 2, ink droplets of various colors are ejected from print heads 2 toward the print surface of sheet P. Subsequently, sheet P passes between conveying belt 8 and left sheet guide 5 in Fig. 2 and is discharged to a discharge tray (not shown). Sheet dust, sheet fibers and foreign matters, such as ink mists resulting from ink droplets ejected from print heads 2, are suctioned with the air currents generated by turbofan 11. Sheet dust, sheet fibers and foreign matters remaining on portions of conveying belt placed in forward run position 8a and return run position 8b without being suctioned by turbofan 11 are brushed off by brush 14 and removed by suctioning of turbofan 11 with the air current.

[0035] In inkjet printer 1 according to the embodiment

of Fig. 2, turbofan 11 is disposed so as to sandwich a portion of conveying belt 8 placed in return run position 8b between turbofan 11 and platen rollers 9 (i.e., turbofan 11 is disposed outside an area enclosed by conveying belt 8). A portion of conveying belt 8 placed in return run position 8b is disposed inside suction box 12. As air currents are generated by turbofan 11, sheet dust, sheet fibers and foreign matters attached to both portions of conveying belt 8 placed in forward run position 8a and return run position 8b may be removed by the air currents. Since, in the embodiment of Fig. 2, turbofan 11 is not disposed in an area enclosed by conveying belt 8, the diameters of belt rollers 6, 7 may be reduced as much as possible. Thus, an inertial moment of belt rollers 6, 7 may be reduced and conveying belt 8 may start to move smoothly. Accordingly, an initial print time may be reduced. With reduced inertial moment, angle control for belt rollers 6,7 may be made with high accuracy, which may result in high-quality printing.

[0036] The embodiment is described in conjunction with a sheet conveying device 1a of inkjet printer 1. However, sheet conveying device 1a may be applied to other types of printers, such as laser printers and thermal printers.

[0037] Conveying belt 8 has throughholes 10. However, mesh or foamed material having a level of breathability or air permeability may be used for conveying belt 8 (e.g., in addition to or in place of throughholes 10). Further, according to one or more configurations, throughholes 10 may be unevenly disposed on conveying belt 8.

[0038] Additionally or alternatively, platen rollers 9 may be arranged non-equidistantly. Further, other components or members that dispersedly support an undersurface of a portion of conveying belt 8 placed in forward run position 8a may be used instead of (or in addition to) platen rollers 9.

[0039] In the embodiment described above, tension roller 13 configured to apply tension to conveying belt 8 is provided. However, other components or members that can adjust flexing amounts of conveying belt 8 may be used other than (or in addition to) tension roller 13. Thus, in one or more embodiments, tension roller 13 might not have to be provided.

[0040] Further, brush 14 is disposed inside suction box 12 near slit 16 in the embodiment described above. However, it is to be understood that brush 14 may be disposed outside suction box 12 near slit 16. Components, such as a cleaning roller, configured to remove sheet dust, sheet fibers and foreign matters attached to conveying belt 8 may be employed instead of or in addition to brush 14. Thus, in one or more embodiments, brush 14 might not have to be provided.

[0041] Sheet guides 5 configured to press sheet P onto conveying belt 8 are provided. However, other components, such as a pressing roller, configured to feed one sheet P onto conveying belt 8 may be employed other than or in addition to sheet guides 5. With the use of components other than sheet guides 5 such as a pressing

roller similar effects to the above-described embodiment may be achieved. Further, sheet guides 5 might not have to be provided.

[0042] While the invention has been described in connection with various example structures and illustrative embodiments, it will be understood by those skilled in the art that other variations and modifications of the structures and embodiments described above may be made without departing from the scope of the invention. Other structures and embodiments will be apparent to those skilled in the art from a consideration of the specification or practice of the invention disclosed herein. For example, aspects described herein may be used with a black and white inkjet printer rather than a color printer (e.g., print heads 2 may include all black ink or, alternatively, the printer may include only one print head). It is intended that the specification and the described examples are illustrative with the true scope of the invention being defined by the following claims.

Claims

1. A sheet conveying device comprising:

an endless belt (8) for conveying sheets (P) wherein the endless belt (8) has an inner surface, an outer surface and a thickness therebetween and allows passage of air through the thickness and wherein the endless belt (8) extends lengthwise along a forward portion (8a) and back along a return portion (8b) and is movable lengthwise so as to convey a sheet (P) along the forward portion (8a); and
a fan (11) for generating a negative pressure on the inner surface of the endless belt (8) at the forward portion (8a) so as to pull a sheet (P) onto the outer surface of the endless belt (8) at the forward portion (8a); wherein
the inner surface of the endless belt (8) at the forward portion (8a) is in fluid communication with the inner surface of the endless belt (8) at the return portion (8b); and
the fan (11) is arranged to provide a negative pressure to the outer surface of the endless belt (8) at the return portion (8b) so as to create the negative pressure at the inner surface of the endless belt (8) at the forward portion (8a).

2. The sheet conveying device according to claim 1 further including:

a case (12) having side surfaces extending from the inner surface of the endless belt (8) at the return portion (8b) to the inner surface of the endless belt (8) at the forward portion (8a) so as to duct the negative pressure at the outer surface of the endless belt (8) at the return portion

- (8b) to the inner surface of the endless belt (8) at the return portion (8b).
3. The sheet conveying device according to claim 2 wherein the forward portion (8a) extends lengthwise between two respective opposite ends, the return portion (8b) extends lengthwise between two respective opposite ends and said side surfaces of the case (12) extend between corresponding ends of the forward and return portions (8a, 8b). 5
 4. The sheet conveying device according to claim 2 or 3 wherein the case (12) includes side surfaces extending away from the outside surface of the endless belt (8) at the return portion (8b) such that the case (12), in conjunction with the endless belt (8) at the forward portion (8a), defines a chamber (20) accommodating the endless belt (8) at the return portion (8b). 10
 5. The sheet conveying device according to claim 4, wherein the case (12) includes an inlet (16) through which the endless belt (8) moves to the return portion (8b) and an outlet (17) through which the endless belt (8) moves from the return portion (8b) and towards the forward portion (8a). 15
 6. The sheet conveying device according to claim 5, further comprising a brush (14) disposed near the inlet (16) so as to contact at least one of the inner and outer surfaces of the endless belt (8). 20
 7. The sheet conveying device according to claim 6, wherein the brush (14) is disposed in the chamber (20). 25
 8. The sheet conveying device according to any one of claims 4 to 7, wherein the chamber (20) comprises a first chamber (20a) and a second chamber (20b) divided by the endless belt (8) at the return portion (8b) and wherein the fan (11) is disposed in the second chamber (20b). 30
 9. The sheet conveying device according to claim 8, further comprising a tension roller (13) configured to apply tension to the endless belt (8) at the return portion (8b), the tension roller (13) being disposed in the second chamber (20b). 35
 10. The sheet conveying device according to claim 8 or 9, further comprising a support member (9) disposed in the first chamber (20a), the support member (9) configured to support the endless belt (8) at the forward portion (8a). 40
 11. The sheet conveying device according to any one of claims 1 to 9, further comprising a support member (9) configured to support the endless belt (8) at the forward portion (8a). 45
 12. The sheet conveying device according to any one of claims 2 to 9, further comprising a support member (9) configured to support the endless belt (8) at the forward portion (8a), wherein the support member (9) is supported by the case (12). 50
 13. The sheet conveying device according to claim 10, 11 or 12 wherein the support member (9) comprises a plurality of platen rollers (9) arranged in the sheet conveying direction, each extending in the same direction as axes of one or more belt rollers (6, 7) and supported so as to rotate in the same direction as the one or more belt rollers (6, 7). 55
 14. The sheet conveying device according to claim 13, wherein the plurality of platen rollers (9) are equidistantly arranged in the sheet conveying direction.
 15. The sheet conveying device according to any one of claims 1 to 8, further comprising a tension roller (13) configured to apply tension to the endless belt (8) at the return portion (8b).
 16. The sheet conveying device according to any preceding claim wherein the endless belt (8) includes a plurality of throughholes (10) passing through the thickness of the endless belt (8).
 17. The sheet conveying device according to claim 16, wherein the plurality of throughholes (10) are evenly disposed throughout substantially the entire surface of the endless belt (8).
 18. The sheet conveying device according to any preceding claim, further comprising a pair of guides (5) configured to press a sheet (P) onto the endless belt (8), a first guide of the pair of guides being disposed upstream of the forward portion (8a) in the sheet conveying direction and a second guide of the pair of guides being disposed downstream of the forward portion (8a) in the sheet conveying device.
 19. The sheet conveying device according to any preceding claim wherein the fan (11) is located adjacent the outer surface of the endless belt (8) at the return portion (8b).

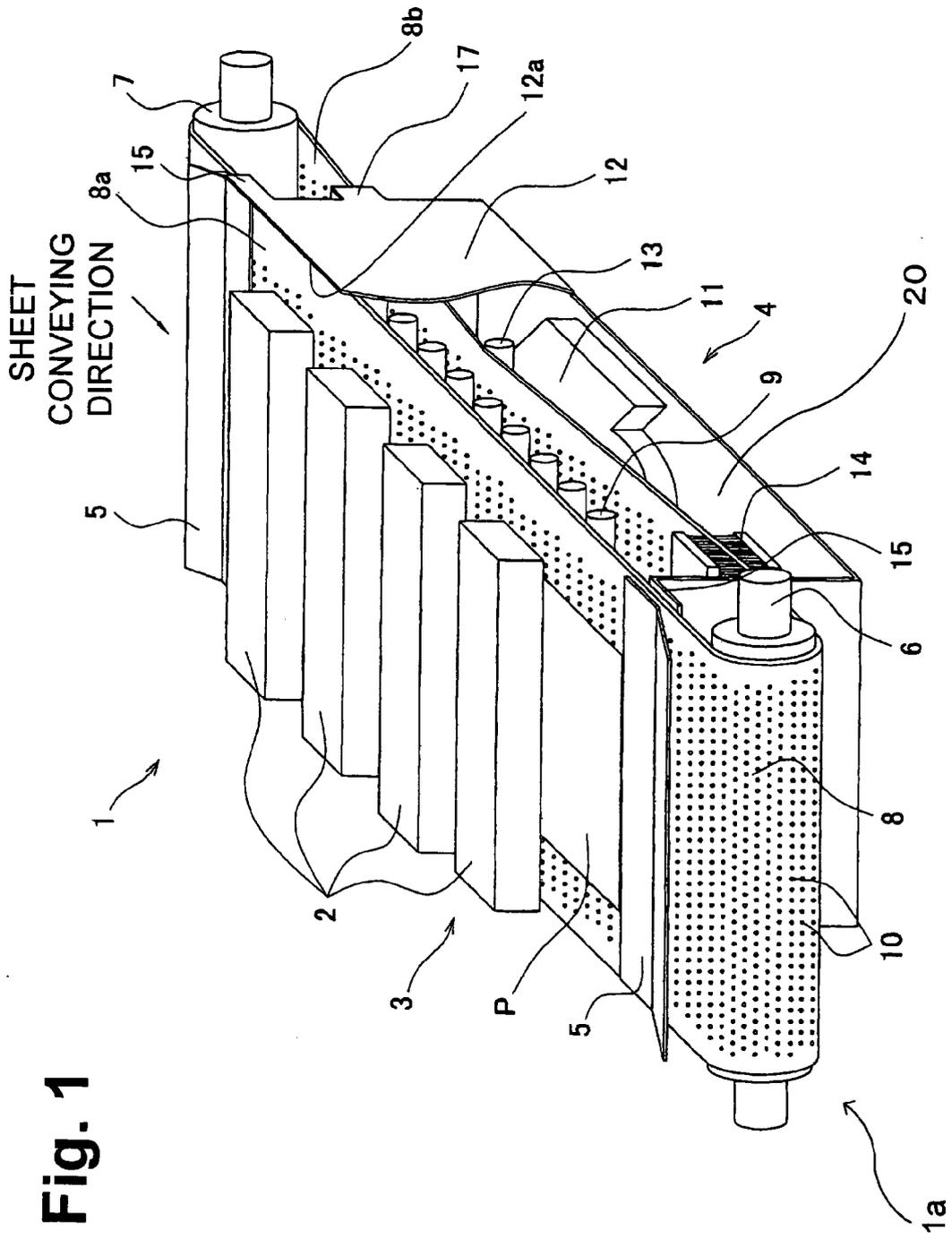


Fig. 1

Fig. 2

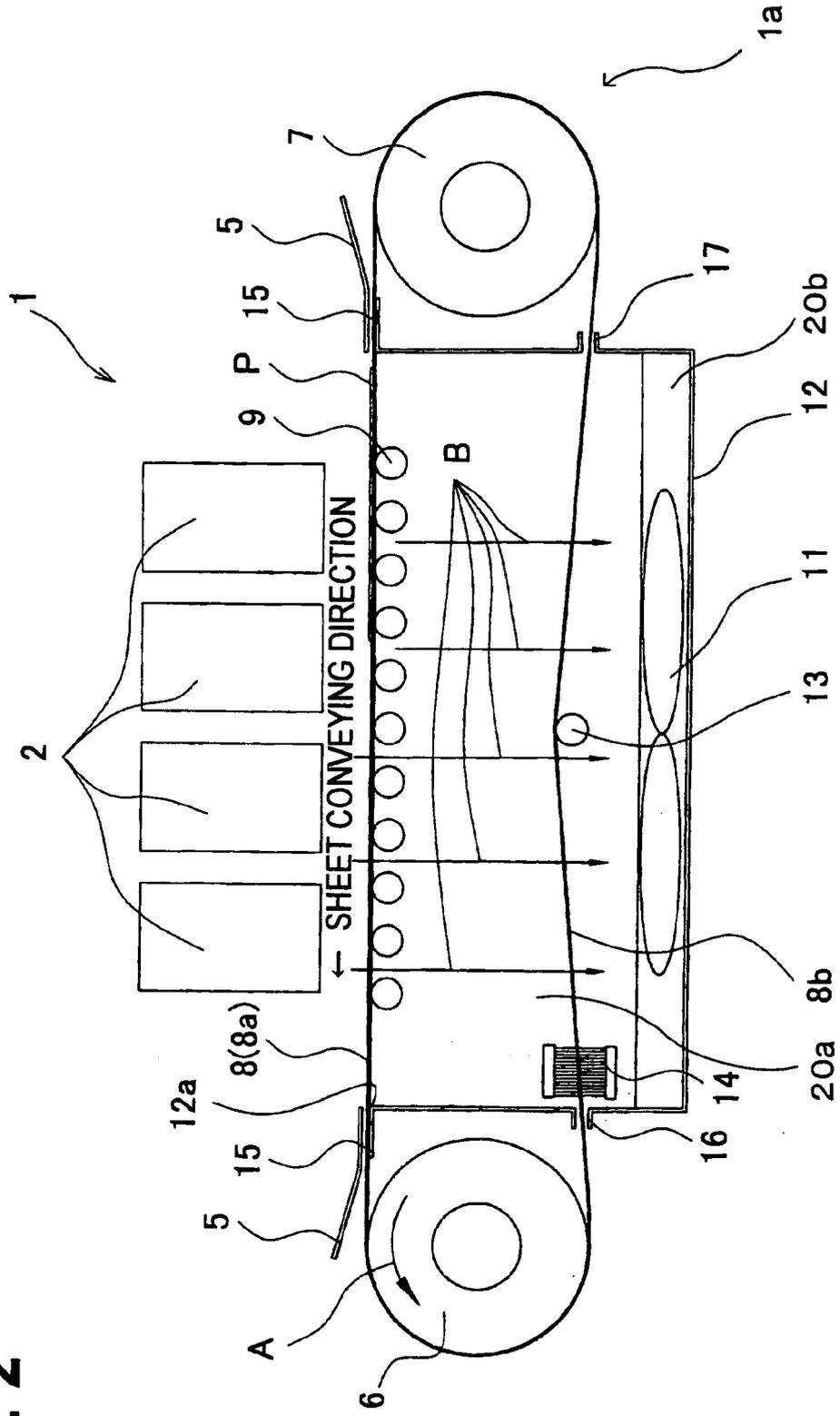
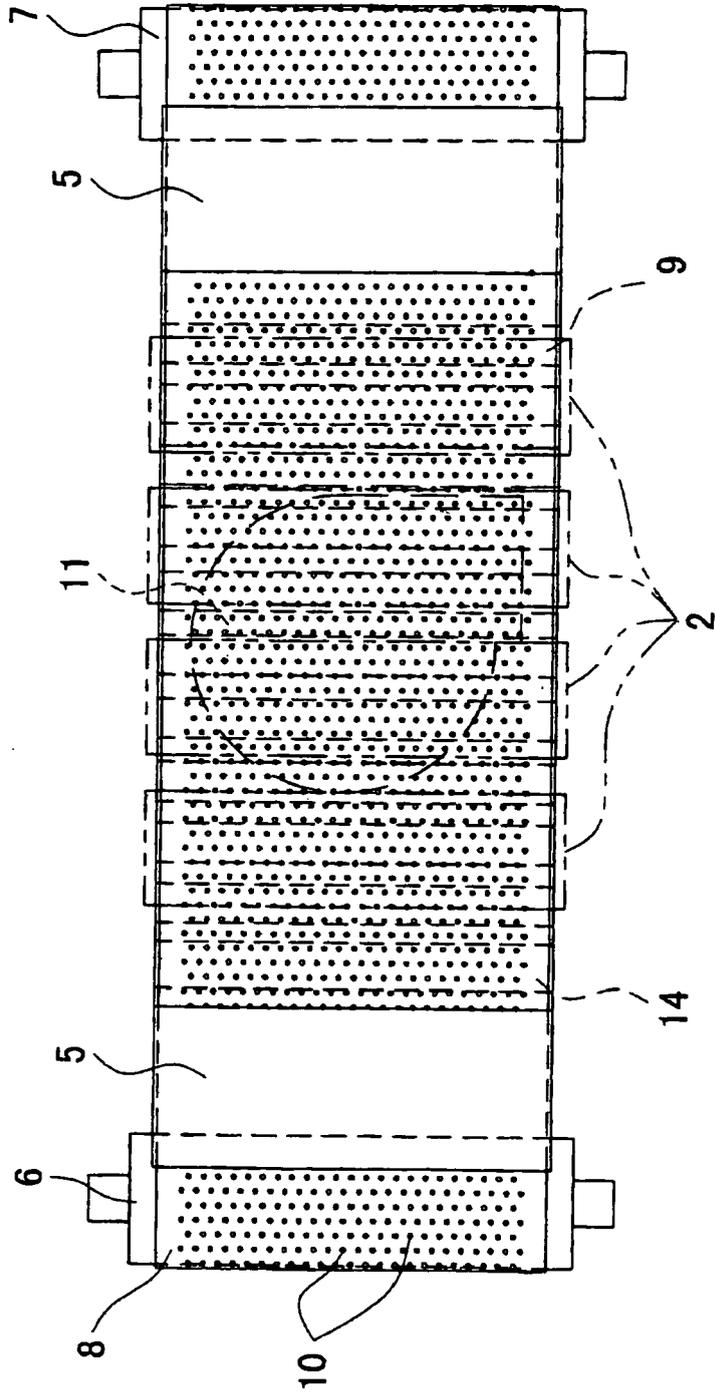


Fig. 3



REFERENCES CITED IN THE DESCRIPTION

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