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(54) Conveying apparatus for conveying paper material

(57) A conveying apparatus includes a feeding device (5), a belt-type conveying device (6), and an air suction device (7). The feeding device (5) is for loading paper material (3) thereon and for conveying the paper material (3) along a conveying direction (E). The belt-type conveying device (6) is disposed adjacent to the feeding device (5) for receiving the paper material (3) conveyed by the feeding device (5) and for conveying the paper material(3) along a conveying path. The belt-type conveying device (6) has a supporting side to support the paper material (3) and is formed with air vents (611) through the supporting side. The air suction device (7) is disposed to generate a suction force to enable the paper material (3) to stick to the supporting side of the belt-type conveying device (6).

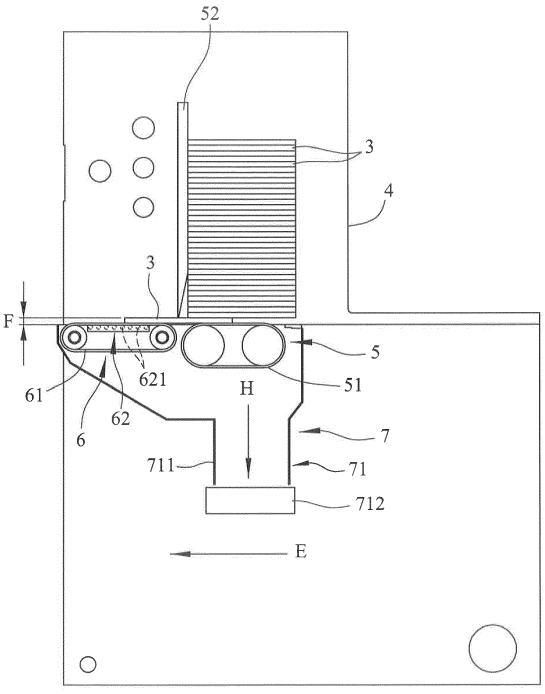

FIG.2

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Description

[0001] This invention relates to a conveying apparatus, more particularly to a conveying apparatus for conveying paper material.

[0002] Referring to FIG. 1, a conventional conveying apparatus 1 is operable to convey paper material 2 along a conveying direction (A), and includes a feeding device 11 and a conveying device 12 disposed adjacent to the feeding device 11. The feeding device 11 includes an endless conveying belt 111, an air suction device 112 disposed below the endless conveying belt 111 to generate a suction force in a downward direction (B), and a blocking piece 113 disposed at a level above the endless conveying belt 111. The blocking piece 113 has a bottom side which cooperates with the endless conveying belt 111 to confine a slit (C) for passage of the paper material 2 therethrough. The conveying device 12 includes two cylindrical rollers 121 that are vertically spaced apart from each other. The distance (D) between the rollers 121 is slightly smaller than the width of the slit (C).

[0003] In use, a stack of the paper material 2 is loaded on the endless conveying belt 111 of the feeding device 11. The air suction device 112 generates a suction force in the downward direction (B), so as to enable the bottommost sheet of the paper material 2 to stick onto the endless conveying belt 111 since the width of the paper material 2 is larger than the width of the endless conveying belt 111. The endless conveying belt 111 is operable to convey the bottommost sheet of the paper material 2 along the conveying direction (A) through the slit (C) toward the conveying device 12 while the remaining sheets of the paper material 2 on the endless conveying belt 111 are blocked by the blocking piece 113.

[0004] The rollers 121 rotate in opposite directions to guide the sheet of the paper material 2, which passes through the slit (C), to enter therebetween. Since the thickness of each sheet of the paper material 2 is slightly larger than the distance (D), the two rollers 121 may respectively press against the top and bottom surfaces of the sheet of the paper material 2 upon entrance, and in the meantime generate a friction force to the top and bottom surfaces of the sheet of the paper material 2, so that the sheet of the paper material 2 can be conveyed along the conveying direction (A) and to a follow-up processing station.

[0005] However, when the conventional conveying apparatus 1 is used to convey the paper material 2 having a larger thickness and exhibiting shock-absorbing capability, such as paperboards, cardboards, corrugated boards, etc., the aforementioned pressing by the rollers 121 may cause damage to the structure of the paper material 2, thereby affecting the shock-absorbing capability of the paper material 2.

[0006] Therefore, an object of the present invention is to provide a conveying apparatus for conveying paper material that can overcome the aforesaid drawback of the prior art.

[0007] According to the present invention, a conveying apparatus for conveying paper material includes a feeding device, a belt-type conveying device, and an air suction device. The feeding device is for loading the paper material thereon, and for conveying the paper material along a conveying direction. The belt-type conveying device is disposed adjacent to the feeding device for receiving the paper material conveyed by the feeding device and for conveying the paper material along a conveying path. The belt-type conveying device has a supporting side to support the paper material and is formed with air vents through the supporting side. The air suction device is disposed to generate a suction force to enable the paper material to stick to the supporting side of the belt-type conveying device.

[0008] Other features and advantages of the present invention will become apparent in the following detailed description of the embodiments of this invention, with reference to the accompanying drawings, of which:

FIG. 1 is a schematic view of a conventional conveying apparatus for conveying paper material;
FIG. 2 is a schematic view of the first embodiment of a conveying apparatus for conveying paper material according to the present invention;
FIG. 3 is a schematic view of a belt-type conveying device of the first embodiment;
FIG. 4 is a top view of the belt-type conveying device of the first embodiment;
FIG. 5 is a schematic view of the second embodiment of the conveying apparatus according to the present invention; and
FIG. 6 is a top view illustrating a variation of a feeding device of the first embodiment.

[0009] Before the present invention is described in greater detail, it should be noted that like elements are denoted by the same reference numerals throughout the disclosure.

[0010] Referring to FIGS. 2 to 4, the first embodiment of a conveying apparatus according to the present invention is shown for conveying paper material 3 along a conveying direction (E). The conveying apparatus includes a feeding device 5, a belt-type conveying device 6, an air suction device 7, and a housing 4 that houses the feeding device 5, the belt-type conveying device 6, and the air suction device 7 therein.

[0011] The feeding device 5 is loaded with a stack of the paper material 3 thereon and is operable to convey the paper material 3 along the conveying direction (E). The feeding device 5 includes an endless conveying belt 51, and a blocking piece 52 that is disposed at a level above the endless conveying belt 51, and that has a bottom side which cooperates with the endless conveying belt 51 to confine a slit (F) for passage of a sheet of the paper material 3 therethrough.

[0012] The belt-type conveying device 6 is disposed adjacent to the feeding device 5, and is operable to re-

ceive the paper material 3 conveyed by the feeding device 5 and to convey the paper material 3 along a conveying path. The belt-type conveying device 6 has a supporting side to support the paper material 3 and is formed with air vents 611 through the supporting side. The belt-type conveying device 6 is configured so as not to press a top surface of the paper material 3 conveyed thereby.

[0013] As shown in FIGS. 3 and 4, the belt-type conveying device 6 of this embodiment includes a plurality of endless conveying belts 61, a plurality of slide units 62, and a plurality of rails 63. The endless conveying belts 61 extend in the conveying direction (E), are disposed side by side with respect to each other, and are spaced apart from one another in a transverse direction (G) that is transverse to the conveying direction (E). The rails 63 are spaced apart from one another and extend along the conveying direction (E). In this embodiment, the endless conveying belts 61 cooperatively form the supporting side of the belt-type conveying device 6, and each of the air vents 611 is defined by two adjacent ones of the endless conveying belts 61 and by two adjacent ones of the rails 63 corresponding in position to the two adjacent ones of the endless conveying belts 61. Each of the slide units 62 is disposed in a respective one of the air vents 611 and has a plurality of rolling members 621 that are mounted rollingly in the respective one of the air vents 611. Adjacent ones of the rolling members 621 in each of the slide units 62 are spaced apart from each other in the conveying direction (E), and cooperatively form a plurality of spacings 622 therebetween. The rolling members 621 respectively have top edges that are disposed lower than top surfaces of the conveying belts 61.

[0014] In this embodiment, each of the rolling members 621 is a rolling pin having a central axis extending along the transverse direction (G), and two opposite ends mounted rotatably and respectively to two corresponding ones of the rails 63.

[0015] As shown in Figure 2, in this embodiment, the air suction device 7 is disposed below both the feeding device 5 and the belt-type conveying device 6, and is operable to generate a suction force substantially along a downward direction (H).

[0016] The air suction device 7 includes an air suction unit 71 disposed below both the feeding device 5 and the belt-type conveying device 6 for generating the suction force that enables the paper material 3 to stick to both the feeding device 5 and the belt-type conveying device 6.

[0017] The air suction unit 71 has a casing 711 surrounding both the feeding device 5 and the belt-type conveying device 6 , and a negative air pressure generator 712 which is connected to the casing 711 and which is operable to generate the suction force by creating negative air pressure in the casing 711. Since the structure of the negative air pressure generator 712 is not a feature of the present invention, and the mechanism of the negative air pressure generator 712 is conventional, such as by using a vacuum pump, further details of the same are omitted herein for the sake of brevity.

[0018] When in operation, the conveying belt 51 of the feeding device 5 is loaded with the paper material 3. The suction force generated by the negative air pressure generator 712 of the air suction unit 71 along the downward direction (H) enables the bottommost sheet of the paper material 3 to stick to the conveying belt 51 since the width of the paper material 3 is larger than the width of the endless conveying belt 51 (not shown). The conveying belt 51 of the feeding device 5 then conveys the bottommost sheet of the paper material 3 along the conveying direction (E) toward the conveying device 6 through the slit (F). In the meanwhile, the remaining sheets of the paper material 3 loaded on the feeding device 5 are blocked by the blocking piece 52 and stay on the conveying belt 51 of the feeding device 5. Thereafter, as shown in FIGS. 2 and 3, the bottommost sheet of the paper material 3 conveyed by the feeding device 5 is further conveyed onto the endless conveying belts 61 of the belt-type conveying device 6. The suction force generated by the air suction unit 71 of the air suction device 7 enables the sheet of the paper material 3 conveyed by the feeding device 5 to stick to the endless conveying belts 61 via the spacings 622 formed among the rolling members 621. Afterwards, the sheet of the paper material 3 is conveyed outwardly of the housing 4 by the conveying belts 61 to complete the conveying process.

[0019] It is worth noting that since the negative air pressure generated by the negative air pressure generator 712 of the air suction unit 71 enables the sheet of the paper material 3 to stick to the endless conveying belts 61 via the spacings 622 formed among the rolling members 621, and since the top edges of the rolling members 621 are disposed lower than the top surfaces of the endless conveying belts 61, the sheet of the paper material 3 conveyed onto the endless conveying belts 61 is usually not in contact with the rolling members 621. However, when the suction force generated by the air suction device 7 is too large, the sheet of the paper material 3 on the conveying belts 61 may deform to contact the rolling members 621, but in a rolling-contact manner such that the paper material 3 can be prevented from sticking too tightly onto the endless conveying belts 61 and may still be conveyed along the conveying direction (E) . In addition, the paper material 3 is less susceptible to permanent deformation owing to this rolling-contact manner with the rolling members 621.

[0020] Referring to FIG. 5, the second embodiment of the conveying apparatus according to the present invention is shown to be similar to that of the first embodiment. The difference between the first and second embodiments resides in that the air suction device 7 of the second embodiment includes a first air suction unit 72 disposed below the feeding device 5, and a second air suction unit 73 disposed below the belt-type conveying device 6.

[0021] The first air suction unit 72 has a casing 721

surrounding the feeding device 5, and a negative air pressure generator 722 connected to the casing 721. The second air suction unit 73 has a casing 731 surrounding the belt-type conveying device 6, and a negative air pressure generator 732 connected to the casing 731.

[0022] Each of the negative air pressure generators 722, 732 is operable to generate negative air pressure along the downward direction (H) respectively in the casings 721, 731, thereby enabling the paper material 3 to stick to a respective one of the feeding device 5 and the belt-type conveying device 6. This configuration allows the negative air pressure in the casings 721, 731 to be respectively adjustable, so that the suction force respectively applied to the feeding device 5 and the belt-type conveying device 6 can be therefore adjusted according to different demands and result in a relatively wide range of applications.

[0023] As shown in FIG. 2 and further referring to FIG. 6, it is worth noting that in other embodiments, the feeding device 5 may be configured similarly as the belt-type conveying device 6 of the first embodiment to further include a plurality of the endless conveying belts 51 (see FIG. 6), a plurality of slide units 53, and a plurality of rails (not shown). As shown in FIG. 6, the endless conveying belts 51 extend in the conveying direction (E), are disposed side by side with respect to each other, and are spaced apart from one another in the transverse direction (G). The endless conveying belts 51 cooperatively form a supporting side of the feeding device 5. The feeding device 5 is formed with air vents 511 through the supporting side, and each of the air vents 511 is defined by two adjacent ones of the endless conveying belts 51 and by two adjacent ones of the rails corresponding in position to the two adjacent ones of the endless conveying belts 51. Each of the slide units 53 is disposed in a respective one of the air vents 511 and has a plurality of rolling members 531 that are mounted rollingly in the respective one of the air vents 511. Adjacent ones of the rolling members 531 in each of the slide units 53 are spaced apart from each other in the conveying direction (E), and cooperatively form a plurality of spacings 532 therebetween. The rolling members 531 respectively have top edges that are disposed lower than top surfaces of the conveying belts 51.

[0024] To sum up, the suction force generated by the air suction device 7 enables the sheet of the paper material 3 to stick to the endless conveying belts 61 via the spacings 622 upon conveyance on the belt-type conveying device 6, so that the drawback of deformation of the paper material 3 due to pressing upon conveyance by using the aforementioned conventional conveying apparatus can be avoided. Moreover, the rolling members 621 can prevent damage to the surface of the paper material 3 when the suction force is too large while the paper material 3 is being conveyed by the conveying belts 61.

Claims

1. A conveying apparatus for conveying paper material (3), said conveying apparatus being **characterized by**:

   a feeding device (5) for loading the paper material (3) thereon, and for conveying the paper material (3) along a conveying direction (E);
   a belt-type conveying device (6) disposed adjacent to said feeding device (5) for receiving the paper material (3) conveyed by said feeding device (5) and for conveying the paper material (3) along a conveying path, said belt-type conveying device having a supporting side to support the paper material (3) and being formed with air vents (611) through said supporting side; and
   an air suction device (7) disposed to generate a suction force to enable the paper material (3) to stick to said supporting side of said belt-type conveying device (6).

2. The conveying apparatus as claimed in claim 1, further **characterized in that** said air suction device (7) includes an air suction unit (71) disposed below both said feeding device (5) and said belt-type conveying device (6) for generating the suction force that enables the paper material (3) to stick to both said feeding device (5) and said belt-type conveying device (6).

3. The conveying apparatus as claimed in claim 2, further **characterized in that** said air suction unit (71) has
   a casing (711) that surrounds both said feeding device (5) and said belt-type conveying device (6), and a negative air pressure generator (712) that is connected to said casing (711) and that is operable to generate negative air pressure in said casing (711) .

4. The conveying apparatus as claimed in claim 1, **characterized in that** said air suction device (7) includes a first air suction unit (72) disposed below said feeding device (5) and a second air suction unit (73) disposed below said belt-type conveying device (6), each of said first air suction unit (72) and said second air suction unit (73) being operable to generate the suction force that enables the paper material (3) to stick to a respective one of said feeding device (5) and said belt-type conveying device (6).

5. The conveying apparatus as claimed in claim 4, further **characterized in that** at least one of said first air suction unit (72) and said second air suction unit (73) has
   a casing (721, 731) that surrounds the respective one of said feeding device (5) and said belt-type conveying device (6), and

a negative air pressure generator (722, 732) that is connected to said casing (721, 731) and that is operable to generate negative air pressure in said casing (721, 731).

6. The conveying apparatus as claimed in any one of the preceding claims, further **characterized in that** said belt-type conveying device (6) includes a plurality of endless conveying belts (61) that extend in the conveying direction (E), that are disposed side by side with respect to each other, and that are spaced apart from one another in a transverse direction (G) transverse to the conveying direction (E), said endless conveying belts (61) cooperatively forming said supporting side of said belt-type conveying device (6), said air vents (611) being defined by adjacent ones of said conveying belts (61).

7. The conveying apparatus as claimed in claim 6, further **characterized in that** said belt-type conveying device (6) further includes a plurality of rolling members (621) that are mounted rollingly in said air vents (611), adjacent ones of said rolling members (621) being spaced apart from each other in the conveying direction (E).

8. The conveying apparatus as claimed in claim 7, further **characterized in that** said rolling members (621) have top edges that are disposed lower than top surfaces of said conveying belts (61).

9. The conveying apparatus as claimed in claim 7 or 8, further **characterized in that** each of said rolling members (621) is a rolling pin.

10. The conveying apparatus as claimed in any one of the preceding claims, further **characterized in that** said feeding device (5) includes a plurality of endless conveying belts (51), and a blocking piece (52) that is disposed at a level above said endless conveying belts (51), and that has a bottom side which cooperates with said endless conveying belts (51) to confine a slit (F) for passage of the paper material (3) therethrough.

11. The conveying apparatus as claimed in any one of the preceding claims, further **characterized by** a housing (4) that houses said feeding device (5), said belt-type conveying device (6), and said air suction device (7) therein.

12. The conveying apparatus according to Claim 1, further **characterized in that** said belt-type conveying device (6) is configured so as not to press a top surface of the paper material (3) conveyed thereby.

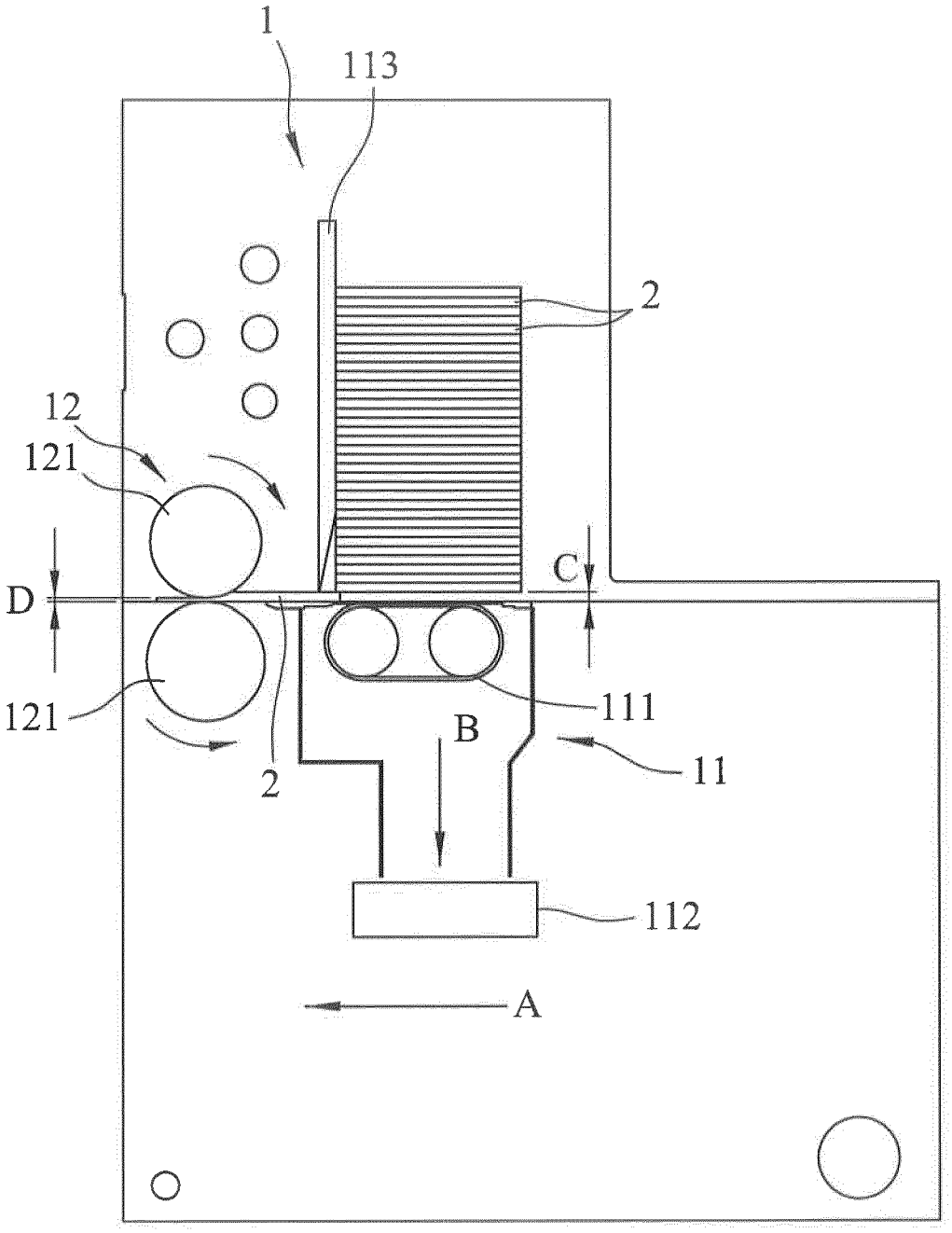

FIG.1
PRIOR ART

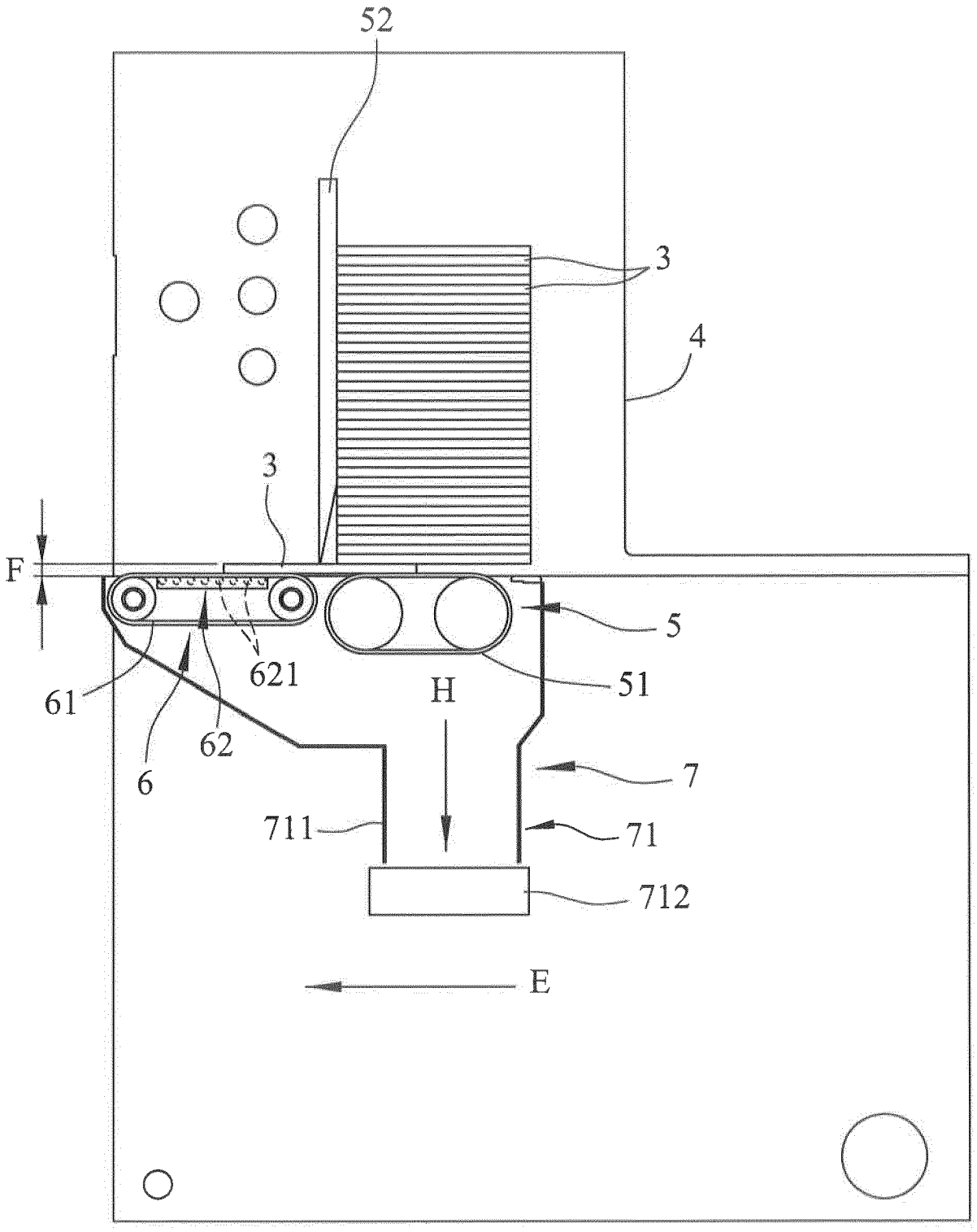

FIG.2

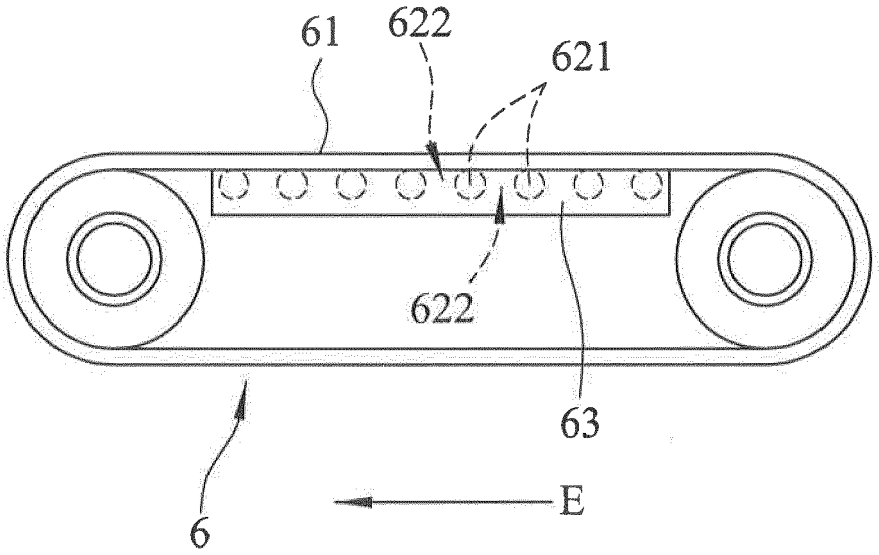

FIG.3

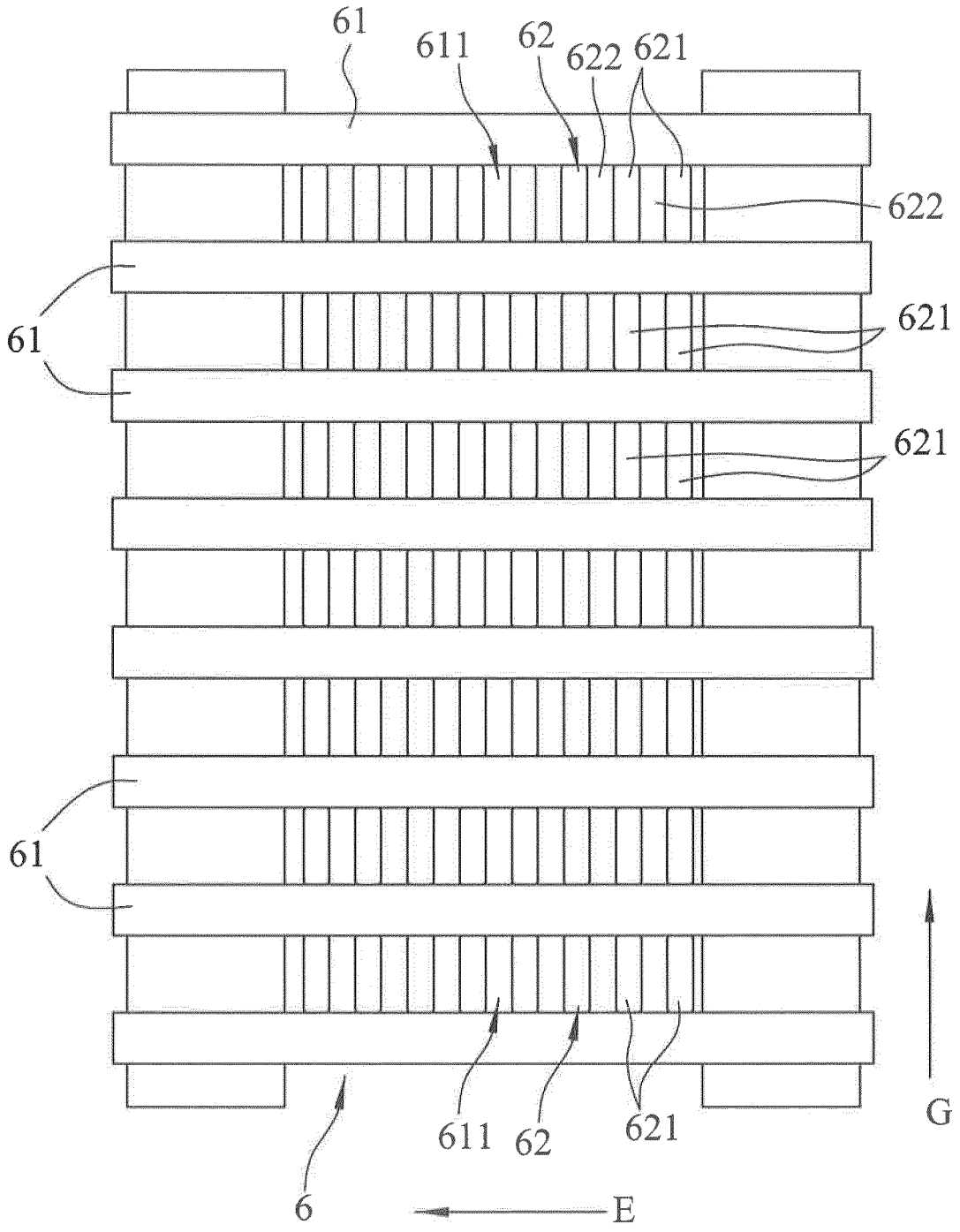

FIG.4

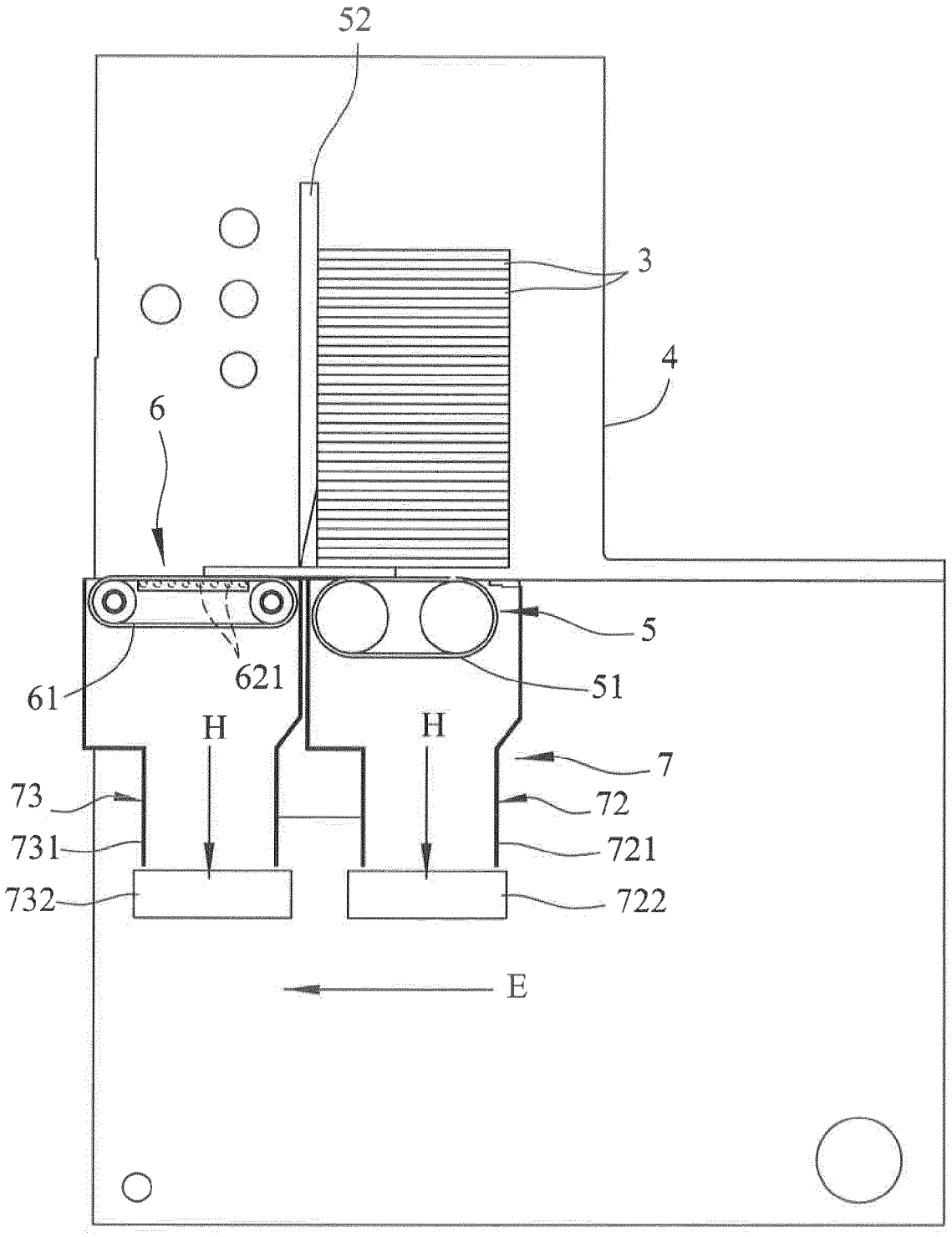

FIG.5

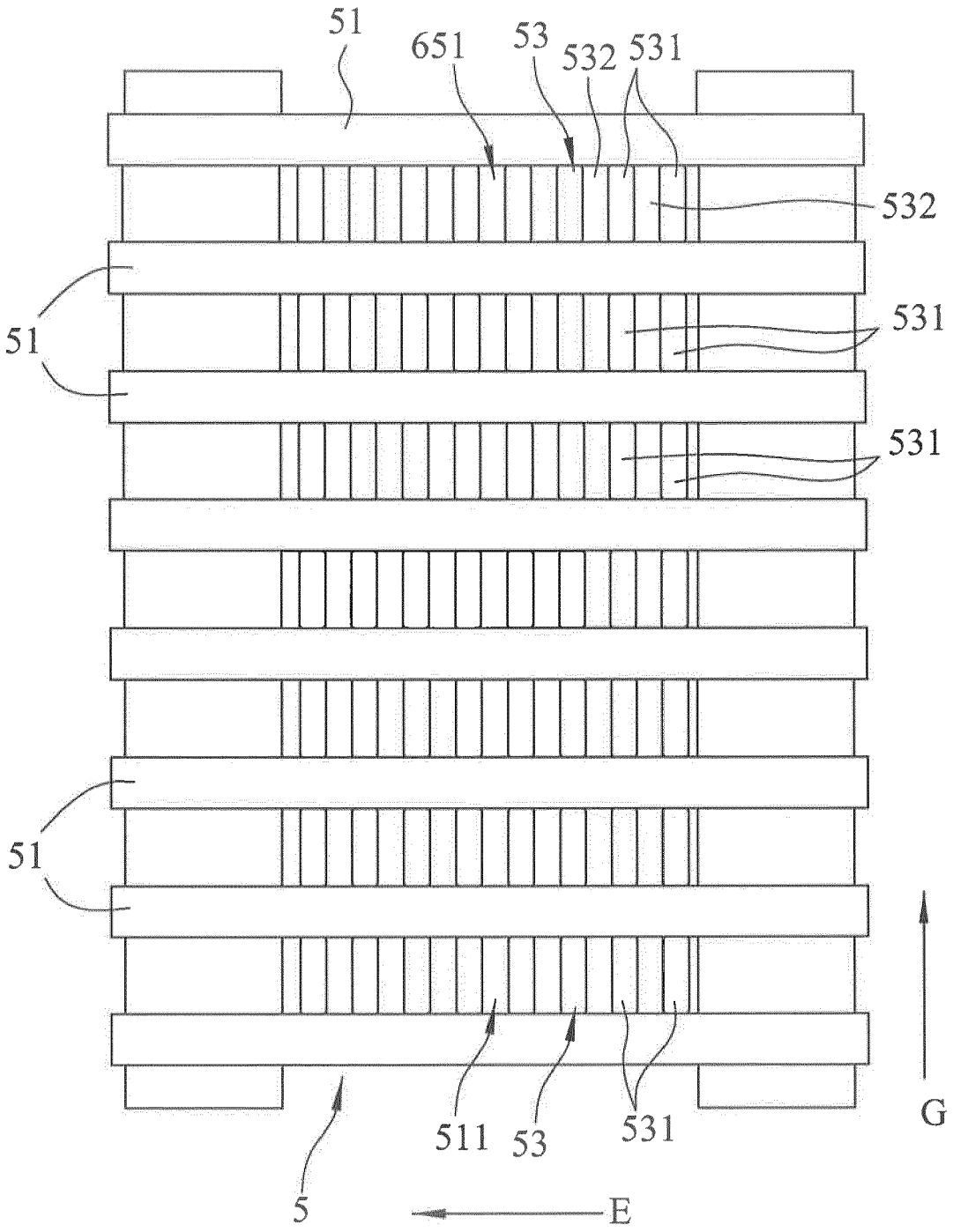

FIG.6

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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 7672

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 December 2015	Henningsen, Ole

CATEGORY OF CITED DOCUMENTS

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