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

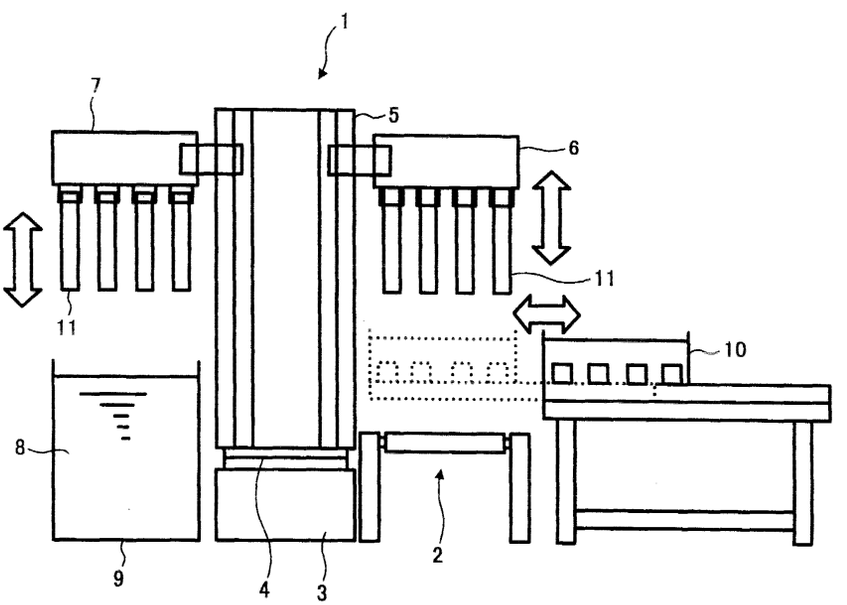
(72) Inventors:
- **Iiyama, Akihiro**
  Susono-shi, Shizuoka (JP)
- **Yamaguchi, Yoshihiro**
  Sunto-gun, Shizuoka (JP)
- **Tsunakawa, Shuichi**
  Numazu-shi, Shizuoka (JP)
- **Suzuki, Sakae**
  Numazu-shi, Shizuoka (JP)
- **Egawa, Go**
  Numazu-shi, Shizuoka (JP)

(74) Representative: **Schwabe - Sandmair - Marx**
Stuntzstrasse 16
81677 München (DE)

(54) Coating system and system for producing photoconductive elements for electrophotography

(57) A coating system of the present invention includes a bath storing a coating liquid for coating conductive cores. An end processing device removes films formed on the end faces of the cores coated with the coating liquid. At least two elevation devices are mounted on a single rotatable shaft each for gripping the cores and selectively raising or lowering the cores. Cores to be coated and cores to be processed by the end processing device are replaced in position with each other to thereby effect coating and end face processing in parallel.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a coating system for forming films on the surfaces of various works and a system for producing photoconductive elements for electrophotographic image forming apparatuses.

Description of the Background Art

[0002] An electrophotographic copier, for example, includes a photoconductive element for forming a toner image thereon. After the surface of the photoconductive element has been uniformly charged to preselected polarity, a light beam scans the charged surface in accordance with image data to thereby form a latent image. Toner is deposited on the latent image for thereby forming a corresponding toner image. The toner image is transferred from the photoconductive element to a sheet or recording medium and then fixed thereon by heat and pressure. After the image transfer, cleaning means removes the toner left on the photoconductive element.

[0003] The photoconductive element is made up of a cylindrical, conductive core formed of, e.g., aluminum and a laminate formed on the core. The laminate includes a photoconductive layer, an under layer, and a protection layer. While various methods including dip coating, spray coating and ring coating are available for forming such layers, dip coating is predominant because it is relatively easy to effect and has high productivity.

[0004] A coating liquid should preferably be absent on the end face of the conductive core to which other parts are expected to be connected. Dip coating, however, coats the entire core with a coating liquid and therefore must be followed by a step of removing the coating liquid from the end face of the core. Specifically, on a production line using dip coating, a conveyor conveys conductive cores to a gripping device mounted on an elevatable, slidable arm. The gripping device grips the cores and then moves them to a position above a bath storing a coating liquid. The arm is then lowered to dip the cores in the coating liquid. Subsequently, the arm is raised to lift the coated cores out of the bath at a preselected rate. The arm is then moved to a position above an end processing device for removing films from the end faces of the cores. Thereafter, the cores are again loaded on the conveyor. Such a procedure constitutes a single cycle. The extra step of removing films from the end faces of the cores increases the tact time.

[0005] To reduce the tact time, Japanese Patent Laid-Open Publication No. 3-48851, for example, discloses a coating system including three arms. A first arm grips cores and turns to a position above a bath storing a coating liquid. The bath is then raised to coat the cores held by the first arm. At the same time, a second arm moves to a core gripping position and grips the next cores. Subsequently, the first arm moves to an end processing device while the second arm moves to the position above the bath. At this instant, a third arm moves to the core gripping position. The end processing device is raised to remove films from the end faces of the cores while the bath is raised to coat the cores held by the second arm. At the same time, the third arm grips the next cores. This coating system, however, has a problem that raising the bath and end processing device in the coating step and end processing step, respectively, makes the construction complicated.

[0006] Japanese Patent Laid-Open Publication No. 5-94028 teaches a coating system including two independent elevators. A first elevator moves to a conveyor, grips cores positioned on the conveyor, and then moves to a position above a bath storing a coating liquid. The cores are then lowered and dipped in the coating liquid. The first elevator then places the coated cores at a position between the first elevator and a second elevator. The second elevator grips the coated cores, turns to locate them above an end processing device, and then lowers the cores for thereby removing films from the end faces of the cores. At this instant, the first elevator has gripped other cores and started coating them. After the removal of films from the end faces of the cores, the second elevator again turns to load the cores on the conveyor. In this manner, coating and end processing are effected in independent steps to thereby reduce the tact time. This coating system does not have to raise the bath or the end processing device, but needs two elevators that scale up the entire system. Moreover, the hand-over of the cores between the elevators increases the tact time.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide a coating system capable of reducing the tact time with a simple construction, and a system for producing photoconductive elements for electrophotography.

[0008] A coating system of the present invention includes a bath storing a coating liquid for coating desired works. An end processing device removes films formed on the end faces of the works coated with the coating liquid. At least two elevation devices are mounted on a single rotatable shaft each for gripping the works and selectively raising or lowering the works. Works to be coated and works to be processed by the end processing device are replaced in position with each other to thereby effect coating and end face processing in parallel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The above and other objects, features and advantages of the present invention will become more ap-

parent from the following detailed description taken with the accompanying drawings in which:

FIG. 1 is a front view showing a coating system embodying the present invention;
FIG. 2 is a plan view showing the illustrative embodiment; and
FIG. 3 is a view showing an elevation mechanism included in the illustrative embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0010] Referring to FIGS. 1 through 3, a coating system embodying the present invention is shown and generally designated by the reference numeral 1. As shown, the coating system 1 is arranged along a conveyor 2 that conveys cylindrical, conductive cores for forming photoconductive elements in the form of drums. The coating system 1 includes a base 3 on which a support shaft 5 is mounted via a rotation mechanism 4. A first arm 6 and a second arm 7 are located at opposite sides of the support shaft 5 and spaced from each other by an angle of 180°. A bath 9 and an end processing device 10 are also located at opposite sides of the support shaft 5 and spaced from each other by an angle of 180°. The bath 9 stores a coating liquid 8 for forming photoconductive layers on the cores. The arms 6 and 7 include a plurality of core grippers or work grippers 11 each.

[0011] As shown in FIG. 3, the coating system further includes an elevation mechanism 12 for moving the first arm 6 and second arm 7 up and down. The elevation mechanism 12 includes motors 13a and 13b for raising and lowering the arms 6 and 7, respectively. Guide shafts 14a and 14b guide the arms 6 and 7, respectively. Pulleys 15 and 16 are respectively positioned at the top and the bottom of the guide shaft 14a. A plain belt 17 is passed over the pulleys 15 and 16. Likewise, pulleys 15 and 16 are respectively positioned at the top and the bottom of the other guide shaft 14b while a plain belt 17 is passed over the pulleys 15 and 16. A balance weight 18 is affixed to each of the belts 17.

[0012] In operation, a plurality of conductive cores or works are loaded on a pallet in a vertical position. The conveyor 2 conveys the pallet to a core gripping position 19. The motor 13a is driven to lower the first arm 6, so that the grippers 11 mounted on the arm 6 grip the conductive cores. The motor 13a is then driven in the reverse direction for raising the arm 6. At this instant, the balance weight 18 affixed to the plain belt 17, which moves the arm 16, reduces a load to act on the motor 13a. Further, the balance weight 8 reduces vibration to act on the arm 6 more than a timing belt and therefore allows the conductive cores to be raised and lowered without any vibration.

[0013] Subsequently, the rotation mechanism 4 turns the elevation mechanism 12 by 180° to replace the first arm 6 and second arm 7, positioning the arm 6 above the. bath 9. The motor 13a is then driven to lower the arm 6 so as to dip the conductive cores held by the core grippers 11 in the coating liquid 8, which is stored in the bath 9.

[0014] When the next pallet loaded with conductive cores arrives at the core gripping position 19, the other motor 13b is driven to lower the second arm 7, so that the grippers 11 mounted on the arm 7 grip the cores. The motor 13b is then driven in the reverse direction for raising the arm 7 and waits until the end of coating of the cores held by the first arm 6.

[0015] After the cores held by the first arm 6 have been fully coated, the motor 13a raises the arm 6 away from the bath 9. Subsequently, the rotation mechanism 4 again turns the elevation mechanism 12 by 180° so as to replace the arms 6 and 7 such that the arms 6 and 7 are positioned above the core gripping position 19 and bath 9, respectively. In this condition, the end processing device 10 is slid to a position above the core gripping position 19. Thereafter, the motor 13a again lowers the first arm 6 and allows the end processing device 10 to remove films from the end faces of the cores. At the same time, the motor 13b lowers the second arm 7 so as to dip the cores held by the arm 7 in the coating liquid 8.

[0016] The end processing device 10 removed the films from the end faces of the cores is again slid away from the core gripping position 19. Subsequently, the coated cores held by the first arm 6 are again loaded on the pallet positioned on the conveyor 2. The conveyor 2 then conveys the pallet away from the core gripping position 19. When the next pallet loaded with conductive cores is brought to the core gripping position 19, the core grippers of the arm 6 grip the cores and waits until the end of coating of the cores held by the arm 7. By repeating such a procedure, the system coats consecutive cores and removes films from the end faces of coated cores at the same time.

[0017] In summary, it will be seen that the present invention provides a coating system capable of reducing the tact time with a simple construction, and stably coating works while stably removing films from the end faces of coated works to thereby efficiently form high-quality films. Further, the coating system occupies a minimum of space and allows the works with processed end faces to be easily conveyed out of the system. In addition, the coating system reduces the tact time of a production line for producing photoconductive elements for thereby increasing yield.

[0018] Various modifications will become possible for those skilled in the art after receiving the teachings of the present disclosure without departing from the scope thereof.

[0019] Further, the present invention comprises the following embodiments:

A. A coating system comprising:

a bath storing a coating liquid for coating works;

an end processing device for processing films formed on end faces of the works coated with the coating liquid; and
at least two elevation devices mounted on a single rotatable shaft each for gripping the works and selectively raising or lowering said works;

wherein works to be coated and works to be processed by said end processing device are replaced in position with each other to thereby effect coating and end face processing in parallel.

B. The system as claimed in embodiment 1, wherein said elevation devices each comprise work grippers for gripping the works.

C. The system as claimed in embodiment 1, wherein said elevation devices each comprise a plain belt to be driven by a motor and a balance weight affixed to said plain belt.

D. The system as claimed in embodiment 3, wherein said elevation devices each further comprise work grippers for gripping the works.

E. The system as claimed in embodiment 1, wherein said end processing device is movable between an inoperative position outside of an operating range and an operative position where the works are gripped and loaded.

F. The system as claimed in embodiment 5, wherein said elevation devices each comprise a plain belt to be driven by a motor and a balance weight affixed to said plain belt.

G. The system as claimed in embodiment 6, wherein said elevation devices each further comprise work grippers for gripping the works.

H. The system as claimed in embodiment 1, wherein said elevation devices are movable independently of each other.

I. The system as claimed in embodiment 8, wherein said elevation devices comprise two elevation devices mounted on said rotatable shaft at positions spaced by an angle of 180°.

J. The system as claimed in embodiment 9, wherein said end processing device is movable between an inoperative position outside of an operating range and an operative position where the works are gripped and loaded.

K. The system as claimed in embodiment 10, wherein said elevation devices each comprise a plain belt to be driven by a motor and a balance weight affixed to said plain belt.

L. The system as claimed in embodiment 11, wherein said elevation devices each further comprise work grippers for gripping the works.

M. In a system for producing photoconductive elements for electrophotography and comprising a coating system including a bath storing a coating liquid for coating conductive cores, an end processing device for processing films formed on end faces of said conductive cores coated with said coating liquid, and at least two elevation devices mounted on a single rotatable shaft each for gripping said conductive cores and selectively raising or lowering said conductive cores, wherein conductive cores to be coated and conductive cores to be processed by said end processing device are replaced in position with each other to thereby effect coating and end face processing in parallel,

the conductive cores are dipped in the coating liquid stored in said bath, and then said end processing device processes films formed on end faces of said conductive cores coated with said coating liquid.

N. A method of producing photoconductive elements for electrophotography, comprising the steps of:

causing at least two elevation devices to grip conductive cores; and
replacing the photoconductive elements located at a coating position for coating said photoconductive elements with a coating liquid and the photoconductive elements located at an end processing position for processing films formed on end faces of the photoconductive elements coated, thereby executing coating and end face processing in parallel.

O. The method as claimed in embodiment 14, wherein said elevation devices are movable independently of each other.

Claims

1. A coating system comprising:

a bath (9) storing a coating liquid (8) for coating works;
an end processing device (10) for processing films formed on end faces of the works coated with the coating liquid (8); and
at least two elevation devices (12) mounted on a single rotatable shaft (5) each for gripping the works and selectively raising or lowering said

works;

wherein works to be coated and works to be processed by said end processing device (10) are replaced in position with each other to thereby effect coating and end face processing in parallel.

2. The system as claimed in claim 1, wherein said elevation devices (12) are movable independently of each other.

3. The system as claimed in claim 1 or 2, wherein said elevation devices (12) comprise two elevation devices mounted on said rotatable shaft (5) at positions spaced by an angle of 180°.

4. The system as claimed in any of the preceding claims, wherein said end processing device (10) is movable between an inoperative position outside of an operating range and an operative position where the works are gripped and loaded.

5. The system as claimed in any of the preceding claims, wherein said elevation devices (12) each comprise a plain belt (17) to be driven by a motor (13a; 13b) and a balance weight (18) affixed to said plain belt (17).

6. The system as claimed in any of the preceding claims, wherein said elevation devices (12) each further comprise work grippers (11) for gripping the works.

7. In a system for producing photoconductive elements for electrophotography and comprising a coating system including a bath (9) storing a coating liquid (8) for coating conductive cores, an end processing device (10) for processing films formed on end faces of said conductive cores coated with said coating liquid, and at least two elevation devices (12) mounted on a single rotatable shaft (5) each for gripping said conductive cores and selectively raising or lowering said conductive cores, wherein conductive cores to be coated and conductive cores to be processed by said end processing device (10) are replaced in position with each other to thereby effect coating and end face processing in parallel,

the conductive cores are dipped in the coating liquid (8) stored in said bath (9), and then said end processing device (10) processes films formed on end faces of said conductive cores coated with said coating liquid (8).

8. A method of producing photoconductive elements for electrophotography, comprising the steps of:

causing at least two elevation devices to grip conductive cores; and

replacing the photoconductive elements located at a coating position for coating said photoconductive elements with a coating liquid and the photoconductive elements located at an end processing position for processing films formed on end faces of the photoconductive elements coated, thereby executing coating and end face processing in parallel.

9. The method as claimed in claim 8, wherein said elevation devices are movable independently of each other.

FIG. 1

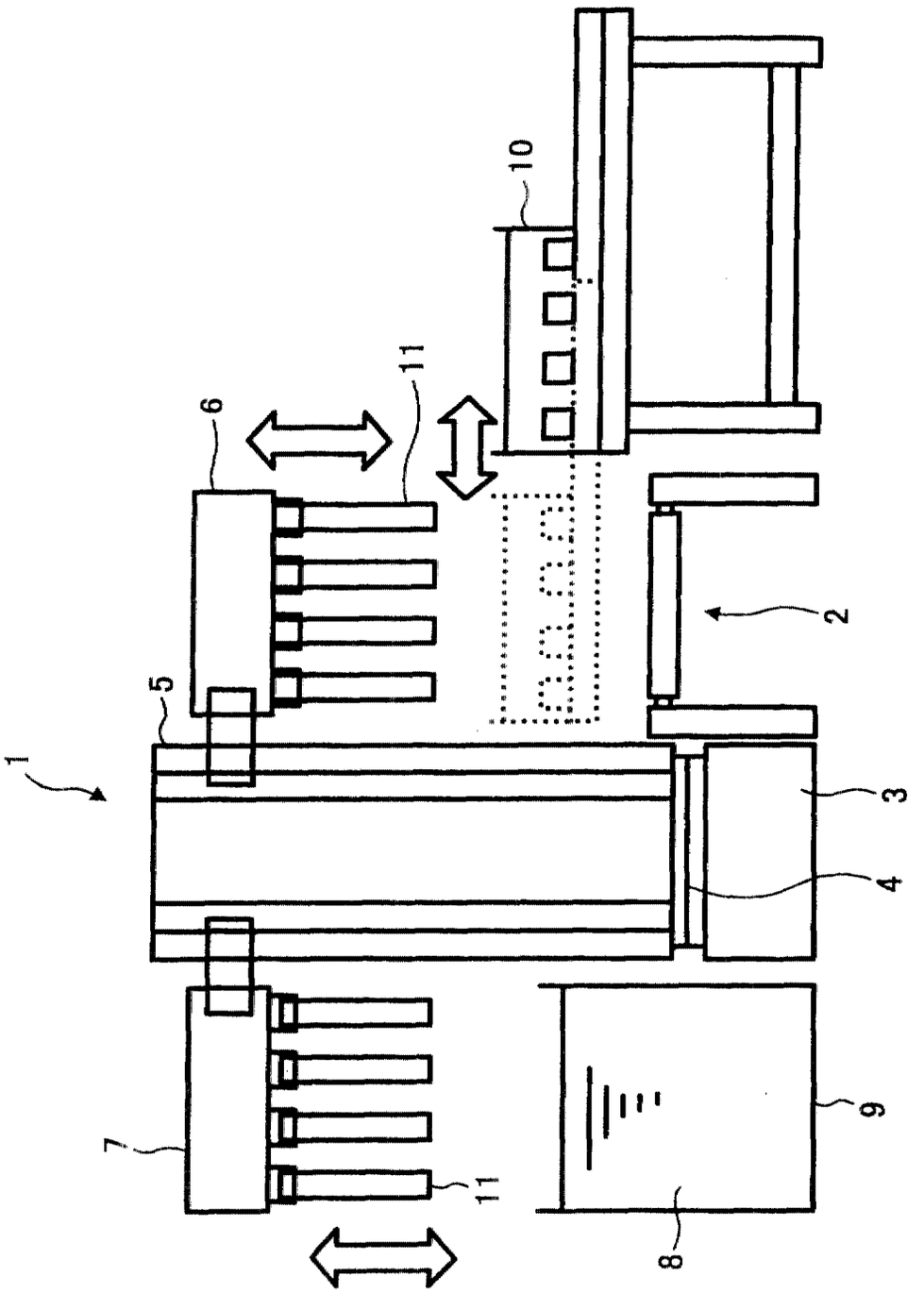

FIG. 2

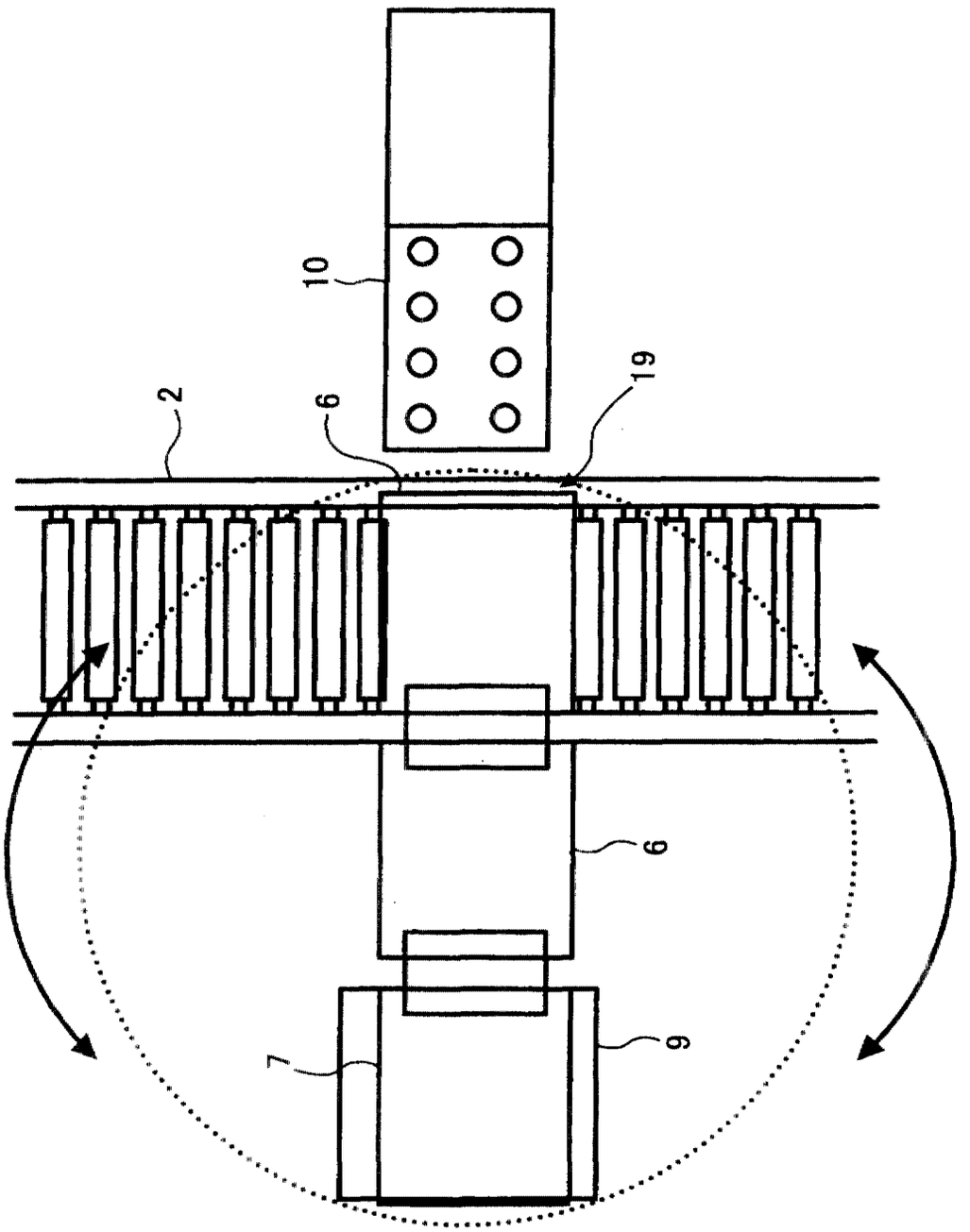

FIG. 3