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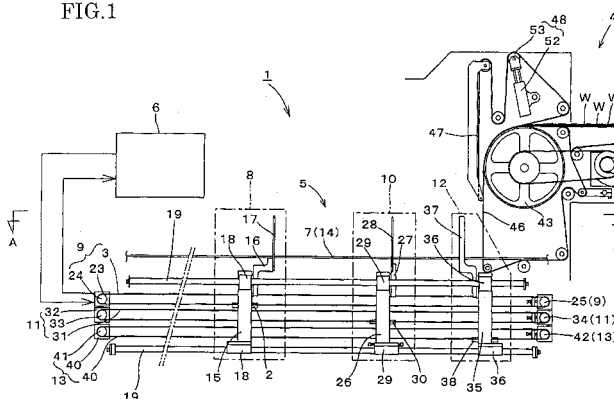
(54) **SHEET MATERIAL STACKING METHOD AND SHEET MATERIAL STACKING DEVICE**

(57) Provided are a sheet material accumulating method and a sheet material accumulating apparatus capable of performing a proper accumulation of a sheet material that does not produce a defective in the next process even when an overlap condition of a conveyed sheet material, such as a printed sheet, varies.

Provided is a sheet material accumulating method for accumulating the sheet material (W) continuously conveyed from the above while a part of the sheet ma-

terial (W) is overlapped, with the sheet material standing on a lower horizontal table (7), including the steps of detecting a backpressure (F) that a bundle of sheet materials applied to a holders (8) for preventing a head side collapse of a bundle of sheet materials accumulated on the table during an accumulation process; and controlling a movement of the holder in an accumulation direction so that a backpressure may maintain a predetermined magnitude.

FIG.1



Description

TECHNICAL FIELD

[0001] The present invention relates to a method for accumulating a sheet material, such as a printed sheet, and a sheet material accumulating apparatus.

BACKGROUND ART

[0002] There is disclosed a printed sheet accumulating apparatus for performing works: accumulating printed sheets (printed matter on which no processing of book-binding etc. is performed) that are printed by a rotary press, are overlapped being shifted gradually, and are conveyed continuously from the above into a rectangular parallelepiped in a state where being aligned in orientation, being arranged for the four corners, and being made to stand; and binding an accumulated bundle of printed sheets with binding band (Patent documents 1, 2).

[0003] The printed sheet accumulating apparatus for performing such works has an accumulation plane on which the accumulated bundle of printed sheets is placed in a stand-up state, support means adapted to support the printed sheets that are afresh conveyed and added to one end of the bundle so that it may not fall down, and a holder for preventing the bundle of printed sheets from collapsing at the other end of the bundle of printed sheets. The accumulation plane is a conveyance face of a belt conveyor having a plurality of thin belts, for example.

[0004] The patent document 2 discloses a printed sheet accumulating apparatus such that a belt conveyer having a plurality of thin belts is installed at one end of a bundle of printed sheets so accumulated that its conveyance plane may move from the above to a lower part and conveys the a new printed sheet to the accumulation plane, and a supporting device (auxiliary guide plate) is provided slightly in the rear of the belt.

Moreover, also the patent document 2 discloses a holder (support) that moves so as to go away from the supporting device as the bundle of printed sheets accumulated on the conveyance plane becomes large.

Patent-document 1: Japanese Unexamined Patent Publication No.2000-118511

Patent-document 2: Japanese Unexamined Patent Publication No. HEI10-35984

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] Note that in a printed sheet accumulating apparatus for continuously conveying the printed sheets to an accumulation plane in a lower location from the above and accumulating the printed sheets, normally an overlap condition of the preceding and following the printed sheets is constant, but in an actual accumulation work,

various causes may produce a variation in an overlap condition of the printed sheets. However, since the holder supporting one end of the accumulated bundle of printed sheets moves at a constant speed based on the premise that the bundle of printed sheets grows at a constant speed; when the overlap condition of the conveyed printed sheets varies, a growth rate of the bundle of printed sheets varies. Then, when the growth rate of the bundle of printed sheets and the moving speed of the holder lost a balance, nonconformities as follow sometimes occurred: a part of the printed sheets might jump out from the bundle of printed sheets accumulated in order until then; or a part of the printed sheets might bend and be sandwiched among the bundle of printed sheets.

[0006] Such nonconformities deteriorate an appearance of the bundle of the printed sheets, hinder a stable conveyance of the printed sheets, and cause an occurrence of defectives in bookbinding process etc. in the next processing.

The present invention is made in view of the above-mentioned problem, and has as its object to provide a sheet material accumulating method and the sheet material accumulating apparatus whereby proper accumulation producing no defective in the next process can be performed even when an overlap condition of the conveyed sheet material, such as printed sheets, varies.

MEANS ADAPTED TO SOLVE THE PROBLEMS

[0007] In order to attain the object, the following technical means were adopted in the present invention.

That is, a sheet material accumulating method according to the present invention is a sheet material accumulating method for accumulating a sheet material continuously conveyed from the above while a part of the sheet material is overlapped, with the sheet material standing on a lower horizontal table, wherein a backpressure from a bundle applied to the holder for preventing a head side collapse of the bundle of sheet materials accumulated on the table and a movement of the holder in an accumulation direction is controlled so that the backpressure may maintain a predetermined magnitude.

This control is performed both in an accumulation process during when the bundle of sheet materials grows and in a retreat process of retreating an accumulated bundle of printed sheets in order to bind it.

[0008] Preferably, detection of the backpressure from the bundle is performed by detecting a load current to the electric motor for moving the holder, and control of the movement of the holder is performed by controlling an applied current to the electric motor.

[0009] A sheet material accumulating method according to other aspect of the present invention is a sheet material accumulating method for accumulating the sheet material continuously conveyed from the above while a part of the sheet material is overlapped, with the sheet material standing on a lower horizontal table, wherein in a process of retreating the bundle in order to

perform afresh accumulation of the sheet material after the bundle of sheet materials has grown to a certain size, a head side of the bundle to be retreated is supported by a first holder, a back end side of the bundle is supported by a second holder, a backpressure from the bundle applied to the first holder and a backpressure from the bundle applied to the second holder are detected, and movements of the first holder and the second holder are controlled so that the respective backpressures may maintain respective predetermined magnitudes.

[0010] Preferably, detection of the each backpressure is performed by detecting a load current to the each electric motor in order to retreat the first holder and the second holder, and a control of movements to retreat the first holder and the second holder is performed by controlling applied currents to the respective electric motors.

[0011] A sheet material accumulating apparatus according to one aspect of the present invention is a sheet material accumulating apparatus that accumulates the sheet material continuously conveyed from the above while a part of the sheet material is overlapped, with the sheet material standing on a lower horizontal table, having: a holder for preventing a head side collapse of the bundle of the sheet materials accumulated on the table; backpressure detecting means adapted to detect a backpressure from the bundle applied to the holder, holder moving means adapted to make the holder move in the accumulation direction of the sheet material; and control means adapted to control an operation of the holder moving means; wherein the control means is configured to control the movement of the holder caused by the holder movement means based on a backpressure detected by the backpressure detecting means.

[0012] Preferably, the holder moving means has an electric motor, the backpressure detecting means has a load current detecting device of the electric motor, and the control means is configured to control the movement of the holder caused by the electric motor based on the load current detected by the load current detecting device.

[0013] Further, preferably, the electric motor is a servomotor, and the control means is configured to control the applied current to the servomotor based on the load current detected by the load current detecting device.

[0014] A sheet material accumulating apparatus according to other aspect of the present invention is a sheet material accumulating apparatus that accumulates a sheet material continuously conveyed from the above while a part of the sheet material is overlapped, with the sheet material standing on a lower horizontal table, having: a first holder for preventing a head side collapse of the bundle of sheet materials accumulated on the table; a second holder for supporting a back end side of the bundle; backpressure detecting means adapted to detect one or both of a backpressure from the bundle applied to the first holder and a backpressure therefrom applied to the second holder; first holder moving means adapted to make the first holder move in an accumulation direction

of the sheet material; second holder moving means adapted to make the second holder move in the accumulation direction of the sheet material; and control means adapted to control one or both of operations of the first holder moving means and the second holder moving means; wherein the control means is configured to control one or both of movements of the first holder and the second holder by the first holder moving means and the second holder moving means based on the backpressure detected by the backpressure detecting means.

[0015] Preferably, the first holder moving means and the second holder moving means each have an electric motor, the backpressure detecting means has a load current detecting device of the each electric motor, and the control means is configured to control the movements of the first holder and the second holder caused by the electric motor based on respective load currents detected by the load current detecting means.

[0016] Here, the "head side of the bundle of sheet materials" in the above means a side on which the sheet material first conveyed in the accumulation direction is accumulated. Moreover, "is made to retreat" and "retreat" mean that the bundle of sheet materials accumulated to a predetermined size is made to move to a position at which the bundle no longer hinders growth of the bundle of another sheet material being afresh accumulated and such a movement, respectively.

EFFECTIVENESS OF THE INVENTION

[0017] According to the present invention, there can be provided a sheet material accumulating method and a sheet material accumulating apparatus making it possible to perform proper accumulation that produce no defective in the next process even when an overlap condition of the conveyed sheet material, such as the printed sheets, varies.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

[Fig. 1] Fig. 1 is a view showing an outline of a sheet material accumulating apparatus according to the present invention.

[Fig. 2] Fig. 2 is a view in a direction of an arrow A-A in Fig. 1.

[Fig. 3] Fig. 3 is a view showing a state where a fixture is fixed to a driving belt.

[Fig. 4] Fig. 4 is a view showing the outline of a conveyance unit.

[Fig. 5] Fig. 5 is a view showing an operation of an accumulation unit.

[Fig. 6] Fig. 6 is a view showing an operation of the accumulation unit.

[Fig. 7] Fig. 7 is a view showing an operation of the accumulation unit.

[Fig. 8] Fig. 8 is a view showing an operation of the

accumulation unit.

[Fig. 9] Fig. 9 is a view showing an operation of the accumulation unit.

DESCRIPTION OF REFERENCE NUMERALS

[0019]

1 Sheet material accumulating apparatus
 2 Backpressure detecting means (Fixture)
 3 Backpressure detecting means (Driving belt)
 6 Backpressure detecting means, Control means (Torque control unit)
 7 Table
 8 Holder, First holder (First holder unit)
 9 Holder moving means, First holder moving means (First holder driving unit)
 10 Second holder (Second holder unit)
 11 Second holder moving means (Second holder driving unit)
 23 Electric motor, Servomotor (Motor)
 32 Electric motor (Motor)
 F, F' Backpressure
 P Bundle of sheet material (Bundle of printed sheets)
 W Sheet material (Printed sheets)

BEST MODE FOR CARRYING OUT THE INVENTION

[0020] Fig. 1 is a view showing a sheet material accumulating apparatus 1 according to the present invention, Fig. 2 is a view of Fig. 1 in a direction of an arrow A-A, Fig. 3 is a view showing a state where a fixture 2 is fixed to a driving belt 3, and Fig. 4 is a view showing the outline of a conveyance unit 4.

In Figs. 1 and 2, the sheet material accumulating apparatus 1 includes an accumulation unit 5, a conveyance unit 4, a torque control unit 6, etc.

[0021] The accumulation unit 5 includes a table 7, a first holder unit 8, a first holder driving unit 9, a second holder unit 10, a second holder driving unit 11, a fork unit 12, and a fork driving unit 13, etc.

The table 7 is a place on which the sheet material, such as printed sheets W, is accumulated as a bundle, and is made of two thin belts 14, 14 of the belt conveyer.

Hereafter, the left-hand side in Figs. 1 and 2 is called a downstream or a downstream side, and a right-hand side is called an upstream or an upstream side. Moreover, a longitudinal direction in Fig. 2 is called an accumulation direction.

[0022] The first holder unit 8 includes a support unit 15, a pair of support arms 16, 16, holders 17, 17, sliders 18, ..., 18, a fixture 2, etc.

The outer shape of the support unit 15 is formed to a rectangular frame and is disposed perpendicularly to an accumulation direction. A plurality of driving belts 3, 31, 39 that will be described later penetrate an inside of the frame. On an upper part of the upstream side of the support unit 15, lower ends of the two support arms 16, 16

are mounted on positions that are at a distance in the horizontal direction and at which their movements in the vertical direction are not hindered by the two belts 14, 14.

[0023] The support arm 16 is in the form of a crank and its upper end extends to an upper part of an upstream side. Each upper end is integrated with the holder 17. The support arms 16, 16 each have a sliding unit that can slide in a trench provided vertically in the support unit 15 in the vertical direction in its lower end, and make vertical movements simultaneously being connected with a slider of a rodless cylinder fixed to the support unit 15.

The holder 17 is made up of a rectangular plate with its end in the longitudinal direction becoming thinner gradually, and is integrated with the support arm 16 in the lower end thereof so that the holder 17 may become parallel to the support unit 15 and an edge point becoming thinner may become an upper part.

[0024] The sliders 18, ..., 18 are arranged at four corners of the support unit 15 and are integrated it. Each of the sliders 18, ..., 18 has a hole that penetrates in the accumulation direction and each of guide bars 19, ..., 19 goes through the each hole in a freely slidable manner. The guide bars 19, ..., 19 are arranged parallel to the accumulation direction, two of them being in an upper location and two of them being in a lower location, and fixed to a rack, and guide the sliders 18, ..., 18 and make the first holder unit 8 perform a stable reciprocation in the accumulation direction.

[0025] The fixture 2 includes a serrated toothed plate 20, a backup plate 21, etc. referring to Fig. 3. In the serrated toothed plate 20 is such that one of its surrounding sides is provided with a tooth capable of engaging with a tooth form of a later-described driving belt 3 that is for making the first holder unit 8 performs a reciprocation in the accumulation direction.

[0026] The backup plate 21 has the surrounding side that can connect with the plane of the serrated toothed plate 20 on which a tooth is formed and is fixed to the support unit 15. The backup plate 21 is integrated with the serrated toothed plate 20 with bolts 22, ..., 22, while the driving belt 3 is made to engage with the tooth of the serrated toothed plate 20, being sandwiched between the plate 20 and the backup plate 21.

The first holder driving unit 9 includes a motor 23, a driving pulley 24, a driven pulley 25, and the driving belt 3.

The motor 23 is fixed to the rack of the accumulation unit 5 in the downstream side of the first holder unit 8. A servomotor is used for the motor 23.

[0027] The driving pulley 24 is a timing pulley directly coupled with a driving shaft of the motor 23.

The driven pulley 25 is disposed on an upstream-side end of the accumulation unit 5 so that its rotation shaft may be parallel to a driving shaft of the motor 23 in a horizontal plane including the driving shaft of the motor 23. The driven pulley 25 is a timing pulley capable of freely rotating around the rotation shaft.

The driving belt 3 is for coupling the driving pulley 24 and

the driven pulley 25 and a timing belt is used for this. As explained above, the driving belt 3 is sandwiched by the serrated toothed plate 20 of a fixture 2 and the backup plate 21, and is fixed and integrated with them. Therefore, when the driving belt 3 is driven by rotation of the motor 23 (driving pulley 24), the first holder unit 8 with which the fixture 2 is integrated will move in the actuation direction. Moreover, an external force applied to the first holder unit 8 is transmitted to the driving pulley 24 through the driving belt 3.

[0028] The second holder unit 10 includes a support unit 26, support arms 27, 27, holders 28, 28, sliders 29,..., 29, a fixture 30, etc.

The second holder unit 10 is disposed on the upstream side of the first holder unit 8.

Like the support unit 15 in the first holder unit 8, the outer shape of the support unit 26 is formed to a rectangular frame, the support unit 26 is disposed perpendicularly to the accumulation direction, and a plurality of driving belts 3, 31, 39 go through the inside of the frame. On an upper part of the upstream side of the support unit 26, lower ends of the two support arms 27, 27 are mounted on positions that are at a distance in a horizontal direction and at which their movements in the vertical direction are not hindered by the two belts 14, 14.

[0029] The support arms 27, 27 are straight columnar bodies, and lower ends thereof are mounted on the support unit 26 in a vertically movable manner so that their longitudinal directions lie in a vertical direction. The holder 28 is integrated with each support arm 27 near the upper end thereof. The support arms 27, 27 have each a vertically movable sliding unit that slides in a trench running vertically provided in the support unit 26 in a lower end, and moves vertically simultaneously by being connected to a rod of a fluid pressure cylinder fixed to the support unit 26.

The holder 28 is made up of a rectangular plate with its end in the longitudinal direction becoming thinner gradually, and is integrated with the support arm 27 in the lower end of the holder 28 so that the holder 28 may become parallel to the support unit 26 and the edge point becoming thinner may become the upper part.

[0030] The sliders 29,..., 29 are arranged at four corners of the support unit 26, each of the sliders 29,..., 29 has a hole that allows it to go through, a guide bar 19 goes through the each hole, and the second holder unit 10 reciprocates stably in the accumulation direction by the sliders 29,..., 29 being guided by the guide bars 19,..., 19, which is the same as in the first holder unit 8.

A structure of the second holder driving unit 11 is substantially the same as a structure of the first holder driving unit 9.

That is, the second holder driving unit 11 includes a motor 32, a driving pulley 33, a driven pulley 34, and the driving belt 31.

The motor 32 is disposed beside the motor 23 of the first holder driving unit 9, and is fixed to the rack. A servomotor is used for the motor 32.

[0031] The driving pulley 33 is a timing pulley directly coupled with the driving shaft of the motor 32.

The driven pulley 34 is disposed on an upstream-side end of the accumulation unit 5 so that a rotation shaft may be parallel to a driving shaft of the motor 32 in a horizontal plane including the driving shaft of the motor 32. The driven pulley 34 is a timing pulley that can rotate freely around the rotation shaft.

The driving belt 31 couples the driving pulley 33 and the driven pulley 34, and a timing belt is used for this. The driving belt 31 is sandwiched by a serrated toothed plate of the fixture 30 and a backup plate, and is fixed and integrated with them movably. Therefore, the second holder unit 10 moves in the accumulation direction by rotation of the motor 32 like the first holder unit 8.

[0032] The fork unit 12 includes a support unit 35, sliders 36,..., 36, a pair of forks 37, 37, a fixture 38, etc. The fork unit 12 is disposed on an upstream side of the second holder unit 10.

Structures of the support unit 35 and the sliders 36,..., 36, are the same as structures of the support units 15, 26 in the first holder unit 8 and the second holder unit 10 and structures of the sliders 18,..., 18, 29,..., 29, 36,..., 36, respectively. A guide bar 19 goes through each of holes of the sliders 36,..., 36, and the fork unit 12 is configured to be movable in the accumulation direction, which is also the same as the first holder unit 8 and the second holder unit 10.

[0033] The forks 37, 37 are each in the form of a crank and their lower ends are fixed to an upper part of the downstream-side support unit at a distance in a horizontal direction, respectively. The forks 37, 37 are disposed at positions at which they can move vertically between the two belts 14, 14 and, when each of them rises, each movement in the accumulation direction is not hindered by a conveyance belt 45 and by an inner belt 46 both of which will be described later. Moreover, either of the forks 37, 37 is disposed slightly on the inner side of the holders 17, 17 in a plan view so as not to overlap the holders 17, 17 of the first holder unit 8. Each of the forks 37, 37 is connected to a slider of a rodless cylinder fixed to the support unit 35, and is simultaneously configured to be movable vertically.

The fixture 38 includes a backup plate, a serrated toothed plate having a tooth engageable with a tooth profile of the driving belt 39, etc. These constituents sandwich the driving belt 39 and are integrated with bolts to be fixed to the support unit 35, which is the same as in the first holder unit 8 and the second holder unit.

[0034] The fork driving unit 13 is fixed to the rack, while its motor 40 is disposed beside the motor 32 of the second holder driving unit 11. The motor 40, a driving pulley 41, a driven pulley 42, and the driving belt 39 are substantially the same as counterparts of the first holder driving unit 9 and those of the second holder driving unit 11. The driving belt 39 is fixed and integrated with the fixture 38 movably and the fork unit 12 moves in the accumulation direction by rotation of the motor.

Referring to Fig. 4, the conveyance unit 4 includes a drum 43, a motor 44 for rotating the drum 43, the conveyance belt 45, the inner belt 46, an outer belt 47, a tension adjusting actuator 48, etc.

[0035] The drum 43 has a horizontal rotation shaft perpendicular to a conveyance direction and makes counterclockwise rotation in Fig. 4 by the motor 44 linked therewith by a driving belt 49.

The conveyance belt 45 links the drum 43 and a roller 50 on an upstream side of the drum 43, and circulates an outside of the drum 43 so that rotation of the drum 43 makes a conveyance plane 51 move from an upstream side to a downstream side. The conveyance belt 45 conveys printed sheets W in a state where an end part of the printed sheets W located on an upstream side overlaps on an end part of the printed sheets W located on a downstream side on the conveyance plane 51. The conveyance belt 45 is made up of a plurality of thin belts each having a spacing to the others. Since the conveyance belt 45 is driven by a rotation of the drum 43, a conveyance speed is the same as a circumferential speed of the drum 43.

[0036] The inner belt 46 is in contact with one fourth of an outer circumference of the drum 43 so that an angle of contact with a topmost part of the drum 43 as a starting point may become approximately 90°. Moreover, the inner belt 46 is wound around an outer circumference of the drum 43 in each space between two of the plurality of conveyance belts 45. While keeping a constant spacing without overlapping with the conveyance belt 45, the inner belt 46 is disposed being supported by the plurality of rollers to be able to circulate the outside of the drum 43 so as to surround the drum 43.

The outer belt 47 is wound around the drum 43 to overlap a portion where the inner belt 46 contacts the drum 43, and is disposed being supported by the tension adjusting actuator 48 and the plurality of rollers to be able to circulate the upper outside of the drum 43 so as to surround the drum 43. The outer belt 47 leaves the inner belt 46 immediately after leaving the drum 43 in a lower part of the drum 43. The outer belt 47 performs a function of sandwiching printed sheets W conveyed by the conveyance belt 45 with the inner belt 46 at a portion where the outer belt 47 is wound around the drum 43, changing its conveyance direction of the printed sheets W, and sending it out to the accumulation unit 5 provided in a lower part.

The tension adjusting actuator 48 increases/decreases a tension of the outer belt 47 with a tension roller 53 through an expansion/contraction operation of a pneumatic cylinder 52, and adjusts a clamping force when the outer belt 47 and the inner belt 46 convey the printed sheets W.

The torque control unit 6 includes a computer, a servo controller (amplifier), etc.

[0037] Next, operations of the sheet material accumulating apparatus 1 will be explained.

Figs. 5 through 9 are views showing operations of the

accumulation unit 5.

In an initial stage of the accumulation work of the printed sheets W, as shown in Fig. 5, the support arms 16, 16 of the first holder unit 8 are elevated so that the holders 17, 17 may be able to support an end of the bundle P of the printed sheets W, and a support arm of the second holder unit 10 and a fork of the fork unit 12 are retreated into under the table 7. The first holder unit 8 moves to the downstream side according to the amount (thickness) of the bundle P of the printed sheets W that increases by being accumulated.

[0038] A movement of the first holder unit 8 to the downstream side is performed while a force pressing (pushing) the accumulated bundle P of the printed sheets W by the holders 17, 17 is kept constant or maintained in a predetermined range so that an accumulation of the printed sheets W to be continuously conveyed from the conveyance unit 4 may be performed smoothly and the accumulated bundle P of the printed sheets W may not collapse. The force that the holders 17, 17 push the bundle P of the printed sheets W is also a force F (hereinafter referred to a "backpressure F") that the bundle P of the printed sheets W pushes the holders 17, 17 back.

In order to maintain the backpressure to be a magnitude within a predetermined range, the torque control unit 6 makes the first holder unit 8 move, while controlling a driving torque of a motor 23 (a driving torque is a product of a force F' (F' is nearly equal to F) applied to the fixture 2 and a pitch circle radius R of the driving pulley 24) so that it may become a predetermined value (Fig. 3).

[0039] Specifically, the control of a movement of the first holder unit 8 by the torque control unit 6 is performed in such a way that a set load current value (load torque) of the motor 23 inputted into the servo controller beforehand may become constant, or that it may be maintained in the predetermined range (torque control). That is, the torque control unit 6 detects a load current (armature current) of the motor 23 with the servo controller, feeds back the detected load current, and determines a current value to be applied to the motor 23.

[0040] For example, a torque control is performed as follows.

In a case where the printed sheets are conveyed when several sheets overlap completely in part following the printed sheets W that overlap with a normal shift and are conveyed continuously to the accumulation unit 5 from the conveyance unit 4, or in the similar case, since a growth of the bundle P of the printed sheets W is quick, the backpressure F applied to the holders 17, 17 rises. The fixture 2 is integrated with the driving belt 3 fixedly, and the backpressure F at that time is transmitted to the motor 23 through the fixture 2 and the driving pulley 24. Since a load increases in the motor 23, a load current flowing through the motor 23 increases. The torque control unit 6 detects an increase in the load current, makes a servo controller decrease an applied current so that the driving torque of the motor 23 is decreased to attain a predetermined value, and thereby promotes a move-

ment of the first holder unit 8 to a downstream side.

Moreover, in a case where a mutually overlapping part of the conveyed printed sheets W and the printed sheets W becomes smaller than usually or in similar cases, the growth of the bundle P of the printed sheets W becomes slower, and accordingly a backpressure F applied to the holders 17, 17 decreases. Then, the load torque of the motor 23 will decrease and a load current will decrease. The torque control unit 6 detects that the load current is decreased, controls the applied current so that the load current may increase, and delays a movement of the first holder unit 8 to the downstream side so that the force of the holders 17, 17 pushing the bundle P of the printed sheets W may become an appropriate magnitude.

[0041] In the sheet material accumulating apparatus 1, by controlling the backpressure F from the bundle P of the printed sheets W applied to the holders 17, 17, i.e., by controlling the load torque of the motor 23 at a constant value, an accumulation environment, for example, resistance when the printed sheets are newly inserted in the accumulated printed sheets W etc. can always be made constant. As a result, even when an overlap condition of the printed sheets W conveyed from the conveyance unit 4 varies, an accumulation of the printed sheets W can be stably performed, and it is possible to obtain a well-ordered bundle P of the printed sheets W.

Moreover, when the load torque falls quickly, it is also possible to move the first holder unit 8 to the upstream side in order to recover a predetermined load torque. Now, when the accumulated bundle P of the printed sheets W reaches a predetermined quantity, a fluid pressure cylinder will expand in the fork unit 12, and the forks 37, 37 will rise, as shown in Fig. 6, and support the accumulated bundle P of the printed sheets W at the upstream side. Subsequently, the fork unit 12 moves to the downstream side to a position at which the holder 28 of the second holder unit 10 retreats. At this time, the first holder unit 8 moves to the downstream side together with the fork unit 12.

[0042] As shown in Fig. 7, the second holder unit 10 expands a fluid pressure cylinder to make the holder 28 move to the upstream side of the bundle P of the printed sheets W, and supports the bundle P of the printed sheets W. The bundle P of the printed sheets W already accumulated is supported by the first holder unit 8 and by the second holder unit 10 at both ends thereof, respectively, and moves to the downstream side of the table 7. The moved bundle P of the printed sheets W is bound with binding band etc. at a movement destination. In the meantime, the newly conveyed printed sheets W are accumulated between upstream-side planes of the forks 37, 37 and the inner belt 46, as shown in Fig. 8.

Whether the accumulated bundle P of the printed sheets W reaches a predetermined quantity is determined by checking whether the first holder unit 8 reaches a predetermined position, and a detection of the first holder unit 8 reaching the predetermined position is performed by a limit switch attached to the guide bar 19, for example.

[0043] When binding of the accumulated bundle P of the printed sheets W is completed, a fluid pressure cylinder of the first holder unit 8 and a fluid pressure cylinder of the second holder unit 10 perform contraction operations, respectively, and make the holders 17, 17 and the holders 28, 28 move into under the table 7. The second holder unit 10 moves to the location in which it was located in an initial stage of the accumulation work, and the first holder unit 8 moves to a position at which upstream-side planes of the holders 17, 17 are abreast with upstream-side planes of the forks 37, 37 (a plane that supports a newly accumulated bundle P of the printed sheets W). The moved first holder unit 8, as shown in Fig. 9, elevates the upstream-side planes of the holders 17, 17 to the downstream side of the bundle P of the printed sheets W by expanding the fluid pressure cylinder, and supports the bundle P of the printed sheets W. Subsequently, in the fork unit 12, the fluid pressure cylinder performs a contraction operation, which makes a fork move into under the table 7, and the fork unit 12 moves to a retreating position on an upstream side of the inner belt 46, as shown in Fig. 5.

A series of operations of the sheet material accumulating apparatus 1 explained above forms one bundle P in which the printed sheets W are accumulated.

[0044] Since the support arms 16, 16 of the first holder unit 8 are each in a shape of extruding its upper end to the upstream side and the forks 37, 37 are each in the shape of extruding its upper end to the downstream side, as shown in Fig. 9, changeover of the support of the bundle P of the printed sheets W from the fork unit 12 to the first holder unit 8 can be performed smoothly without causing the support arms 16, 16 and the forks 37, 37 to interfere with each other.

In addition, when the first holder unit 8 and the second holder unit 10 move to the downstream side, while supporting the accumulated bundle P of the printed sheets W by sandwiching it (Fig. 8), the sheet material accumulating apparatus 1 can perform a torque control so that forces with which the holders 17, 17 push the bundle P of the printed sheets W may be a previously set value or be within a previously set range, respectively. Moreover, when the fork unit 12 supports the printed sheets W on its upstream-side plane and makes it accumulate (Fig. 8), the torque control may be performed in such a way that a force with which the fork pushes the accumulated bundle P of the printed sheets W may become a previously set value or be within a previously set range.

[0045] In the above-mentioned embodiment, a backpressure by the accumulated bundle P of the printed sheets W can be controlled by other methods. For example, a strain gauge installed between the holder and the support arm may detect a backpressure applied to the holder, and driving of a motor of the first holder driving unit may be controlled so that the backpressure may be within a predetermined range.

The first holder driving unit 9, the second holder driving unit 11, and the fork driving unit 13 may be driven by a

rotary screw and a drive nut, or by a rack and pinion, not by the belt driving described above.

Detection of the backpressure, movement of the first holder unit, etc. may be performed by methods other than the above-mentioned method.

In addition, the sheet material accumulating apparatus 1 as well as construction, shape, dimensions, number, material, etc. of each component or the whole of the sheet material accumulating apparatus 1 may be altered and changed appropriately in adherence with the spirit of the present invention.

INDUSTRIAL APPLICABILITY

[0046] The present invention can be used for a sheet material accumulating method and apparatus for conveying a sheet material, such as the printed sheets W, in a state where overlapping is shifted to the downstream side of the conveyance direction and accumulating it.

Claims

1. A sheet material accumulating method for accumulating a sheet material continuously conveyed from the above while a part of the sheet material is overlapped, with the sheet material standing on a lower horizontal table, comprising the steps of:

detecting a backpressure from a bundle applied to a holder for preventing a head side collapse of the bundle of the sheet materials accumulated on the table; and

controlling a movement of the holder in an accumulation direction so that the backpressure may maintain a predetermined magnitude.

2. The sheet material accumulating method according to claim 1, wherein detection of the backpressure from the bundle is performed by detecting a load current to an electric motor for moving the holder, and the control of the movement of the holder is performed by controlling an applied current to the electric motor.

3. A sheet material accumulating method for accumulating a sheet material continuously conveyed from the above while a part of the sheet material is overlapped, with the sheet material standing on a lower horizontal table, wherein in a process of retreating a bundle of sheet materials in order to accumulate afresh the sheet material after the bundle of sheet materials has grown to a predetermined size, a head side of the bundle to be retreated is supported by the a first holder and a back end side of the bundle is supported by a second holder,

a backpressure from the bundle applied to the first holder and a backpressure applied from the bundle to the second holder are detected, and movements of the first holder and the second holder in an accumulation direction are controlled so that the respective backpressures may maintain respective predetermined magnitudes.

4. The sheet material accumulating method according to claim 3, wherein detection of the respective backpressures is performed by detecting the load currents to the respective electric motors for retreating the first holder and the second holder, and control of movements to retreat the first holder and the second holder is performed by controlling applied currents to the respective electric motors.

5. A sheet material accumulating apparatus for accumulating a sheet material continuously conveyed from the above while a part of the sheet material is overlapped, with the sheet material standing on a lower horizontal table, comprising:

a holder for preventing a head side collapse of a bundle of sheet materials accumulated on the table;

backpressure detecting means adapted to detect a backpressure from the bundle applied to the holder;

holder moving means adapted to make the holder move in an accumulation direction of the sheet material; and

control means adapted to control an operation of the holder moving means; wherein the control means is configured to control a movement of the holder caused by the holder moving means based on a backpressure detected by the backpressure detecting means.

6. The sheet material accumulating apparatus according to claim 5, wherein the holder moving means has an electric motor, the backpressure detecting means has a load current detecting device of the electric motor, and the control means is configured to control a movement of the holder caused by the electric motor based on a load current detected by the load current detecting device.

7. The sheet material accumulating apparatus according to claim 6, wherein the electric motor is a servomotor, and the control means is configured to control an applied current to the servomotor based on the load current detected by the load current detecting device.

8. A sheet material accumulating apparatus for accu-

mulating a sheet material continuously conveyed from the above while a part of the sheet material is overlapped, with the sheet material standing on a lower horizontal table, comprising:

- 5
a first holder for preventing a head side collapse of a bundle of sheet materials accumulated on the table;
a second holder for supporting a back end side of the bundle; 10
backpressure detecting means adapted to detect one or both of a backpressure from the bundle applied to the first holder and a backpressure applied therefrom to the second holder;
first holder moving means adapted to make the first holder move in an accumulation direction of the sheet material; 15
second holder moving means adapted to make the second holder move in the accumulation direction of the sheet material; and 20
control means adapted to control one or both of operations of the first holder moving means and the second holder moving means; wherein the control means is configured to control one or both of movements of the first holder and the second holder by the first holder moving means and the second holder moving means based on a backpressure detected by the backpressure detecting means. 25
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9. The sheet material accumulating apparatus according to claim 8, wherein
the first holder moving means and the second holder moving means each have an electric motor,
the backpressure detecting means has a load current detecting device of the each electric motor, and 35
the control means is configured to control movements of the first holder and the second holder caused by the electric motor based on the respective load currents detected by the load current detecting devices. 40
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- 50
- 55

FIG. 1

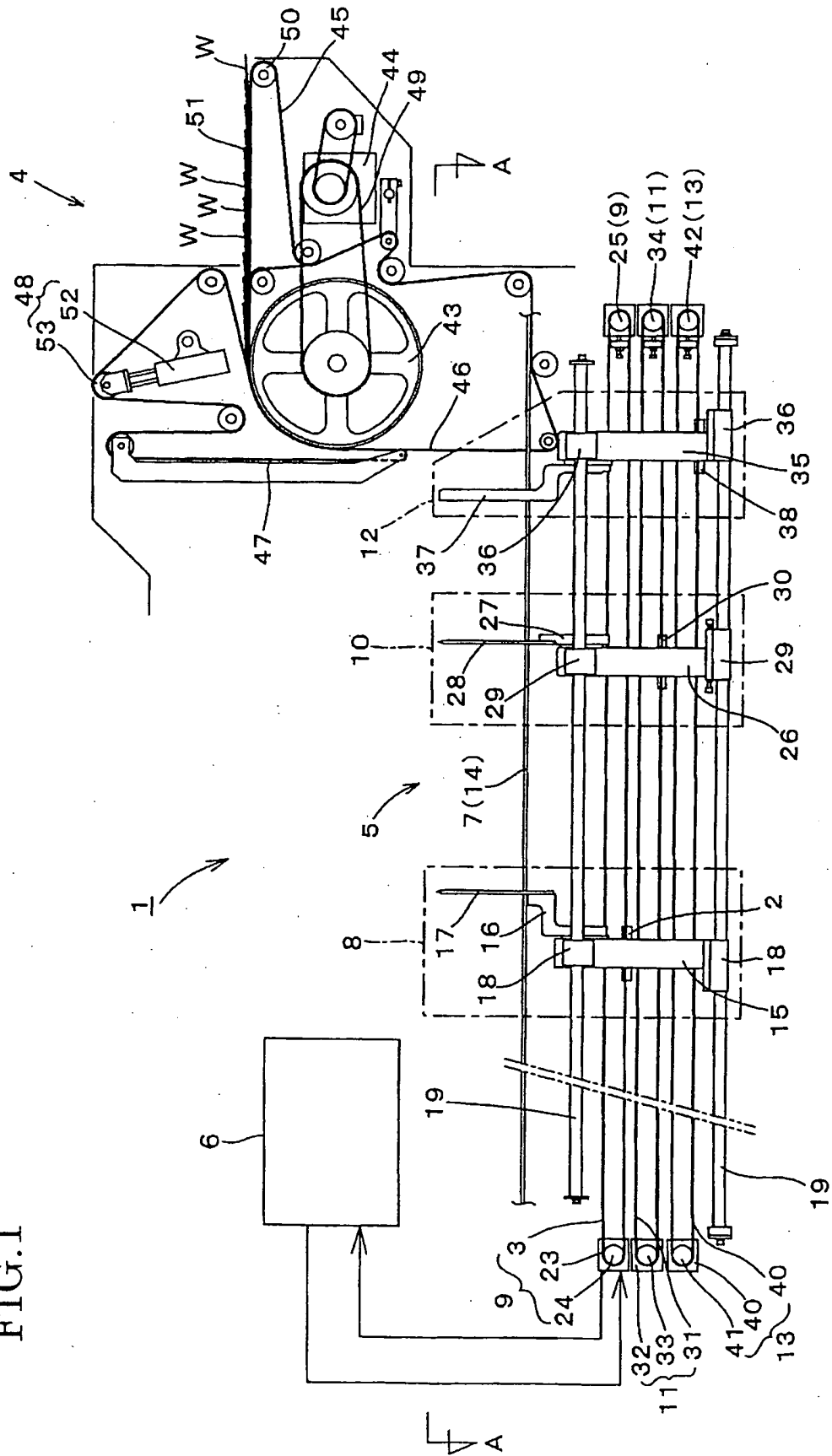


FIG. 2

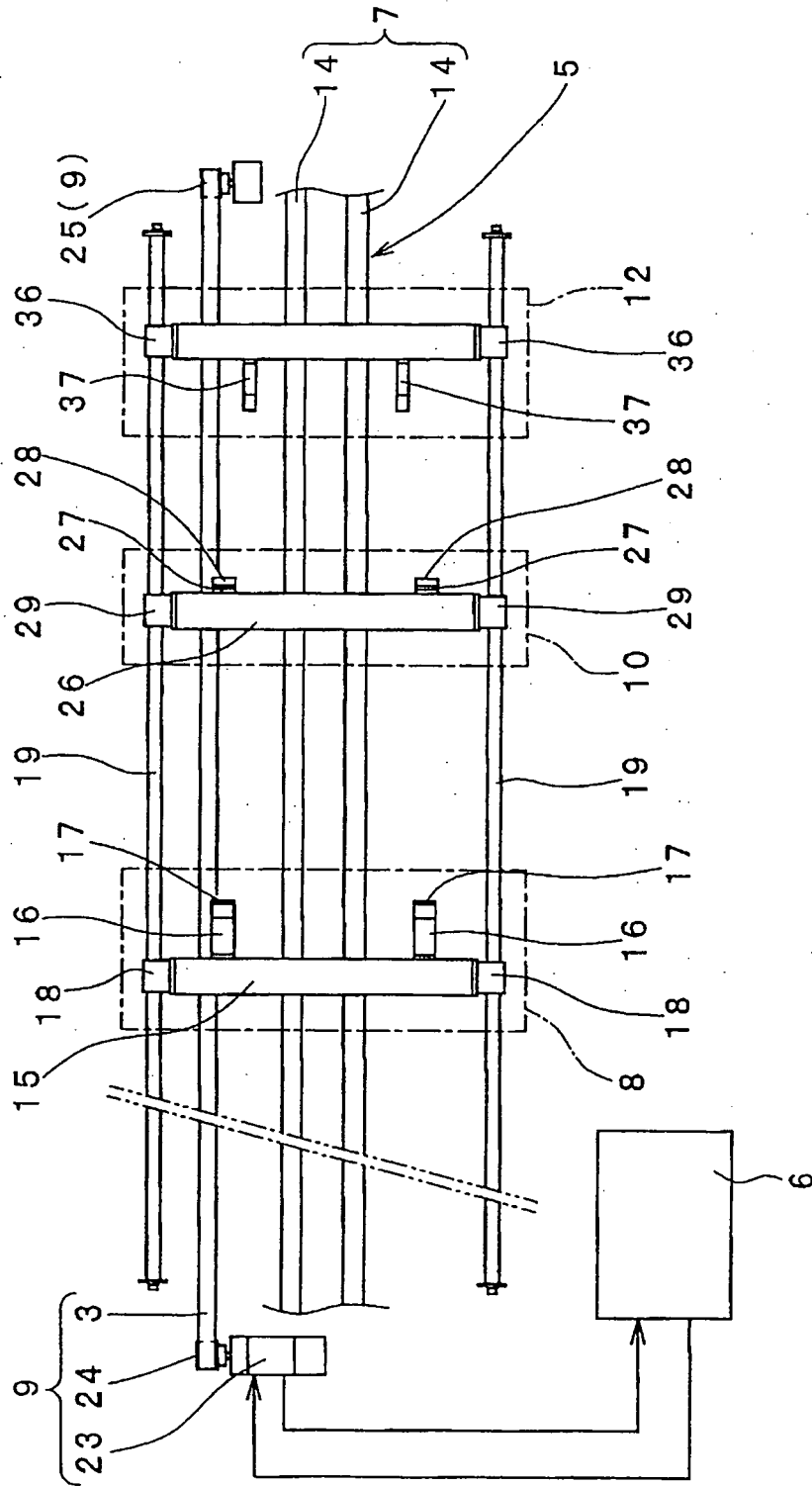


FIG.3

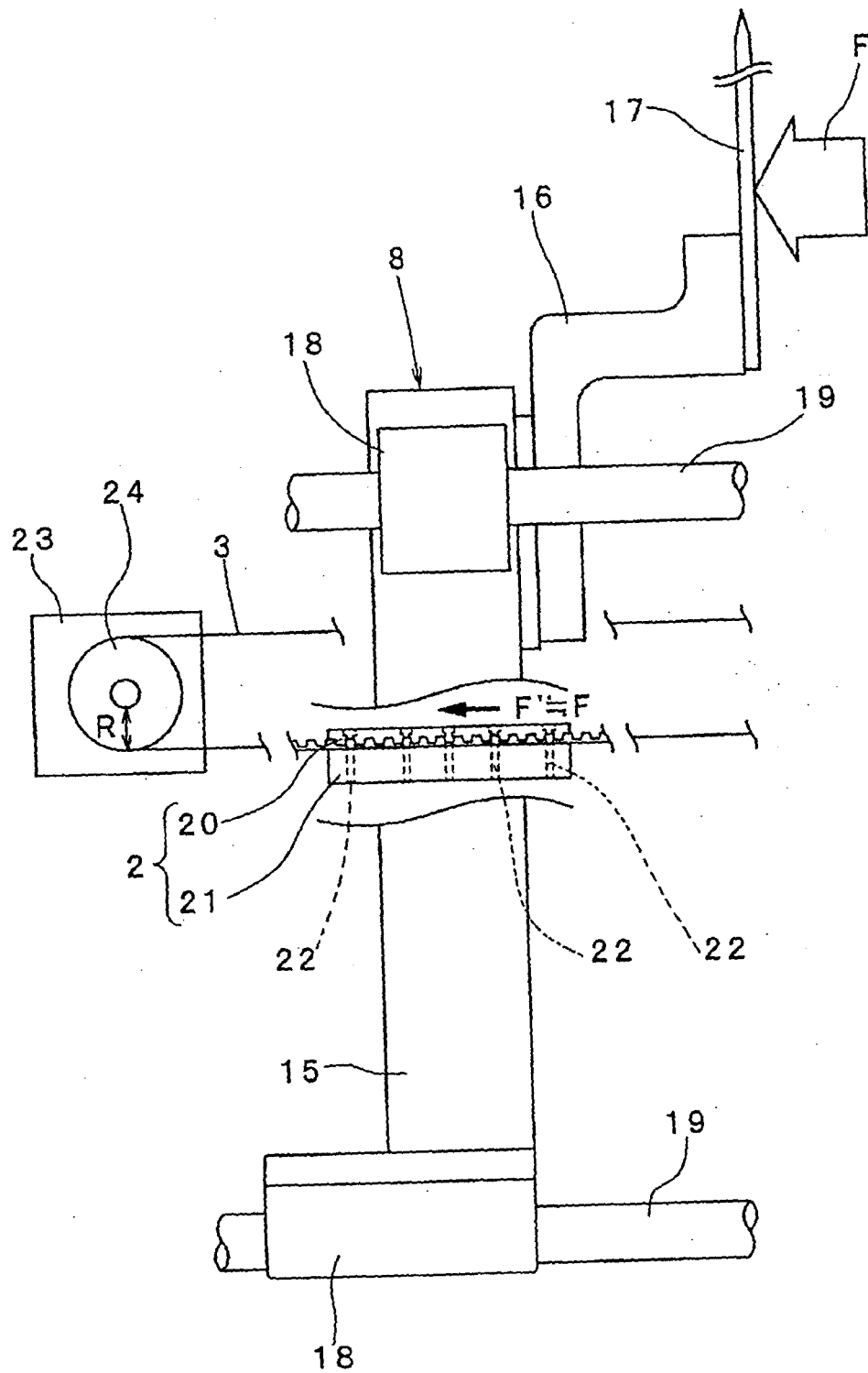


FIG.4

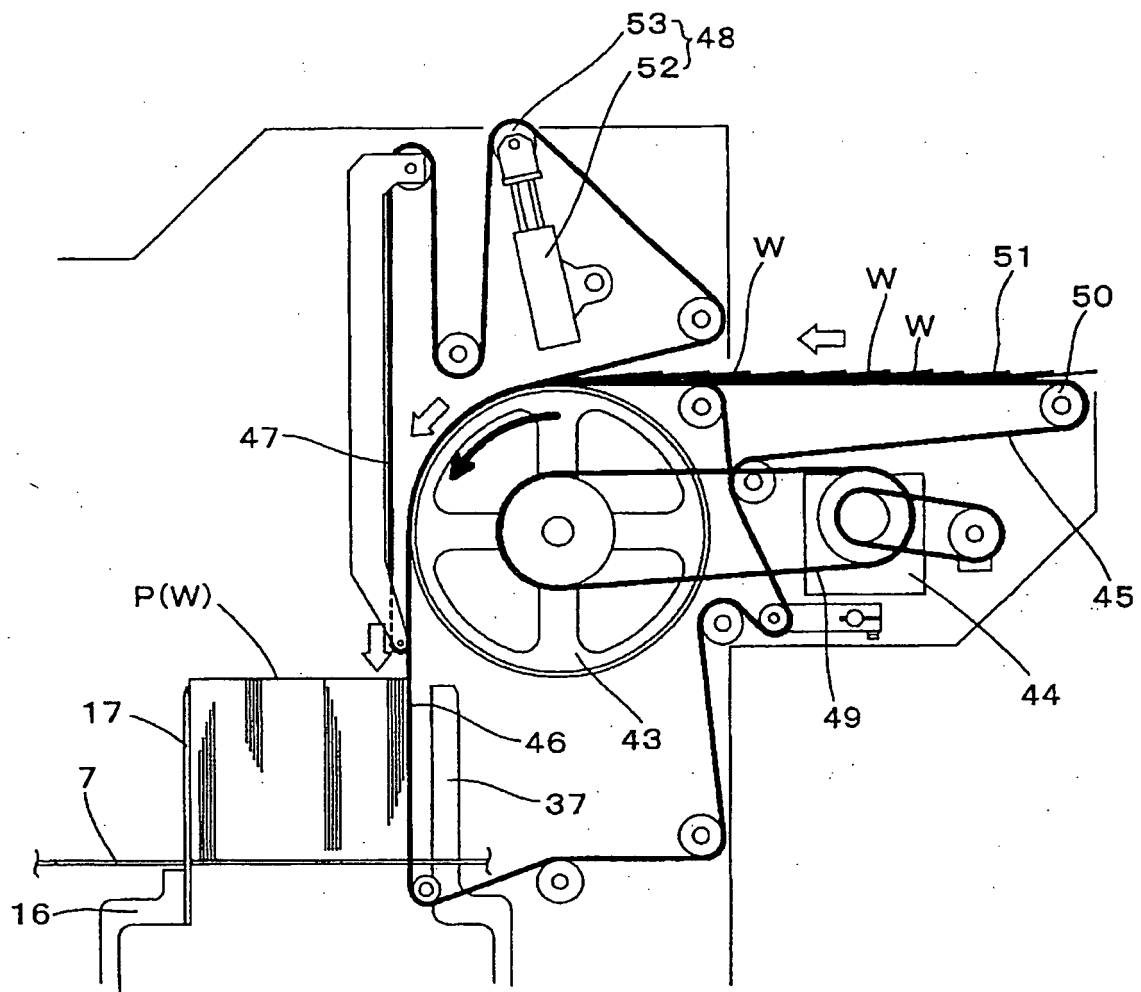


FIG.5

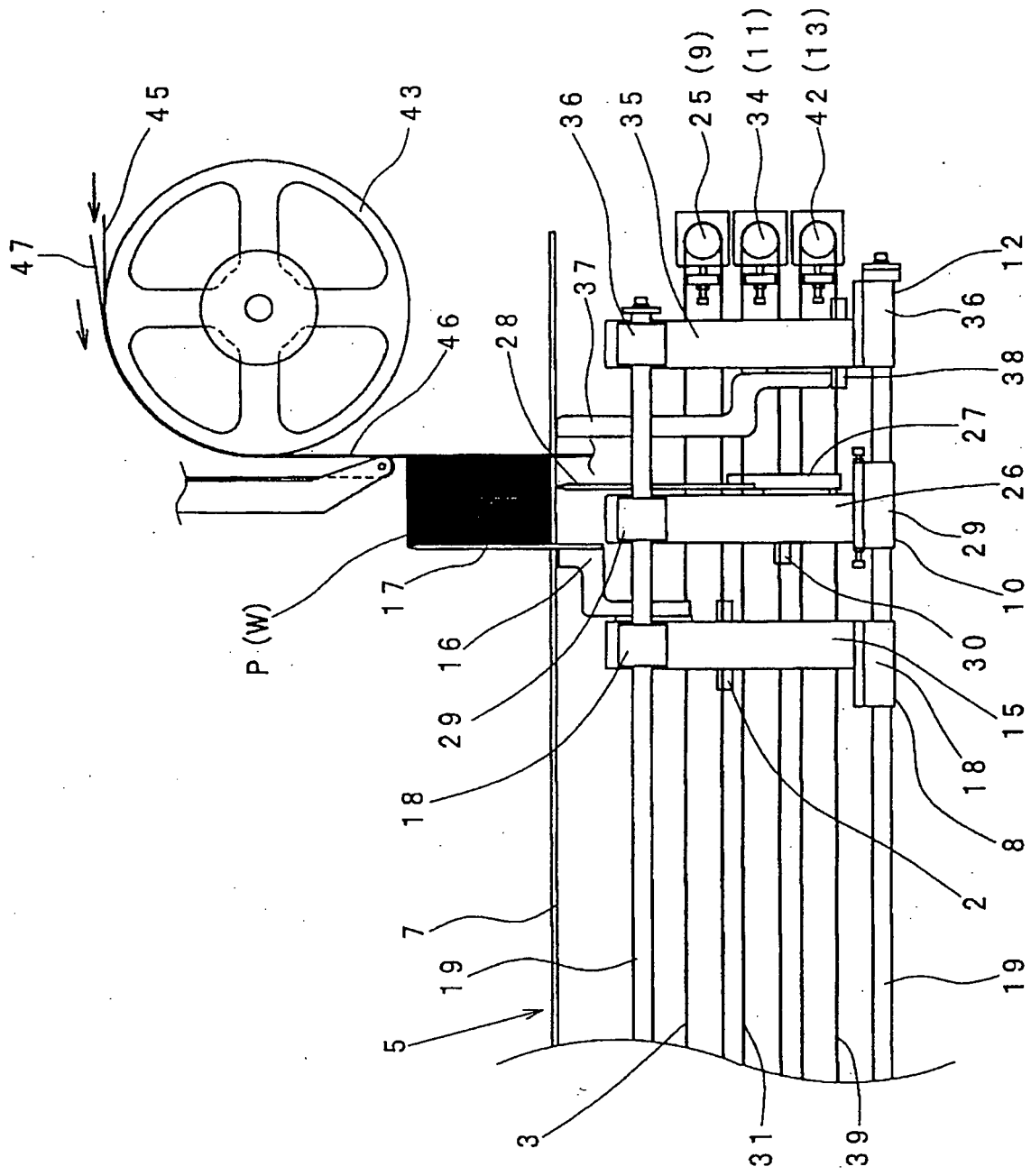


FIG.6

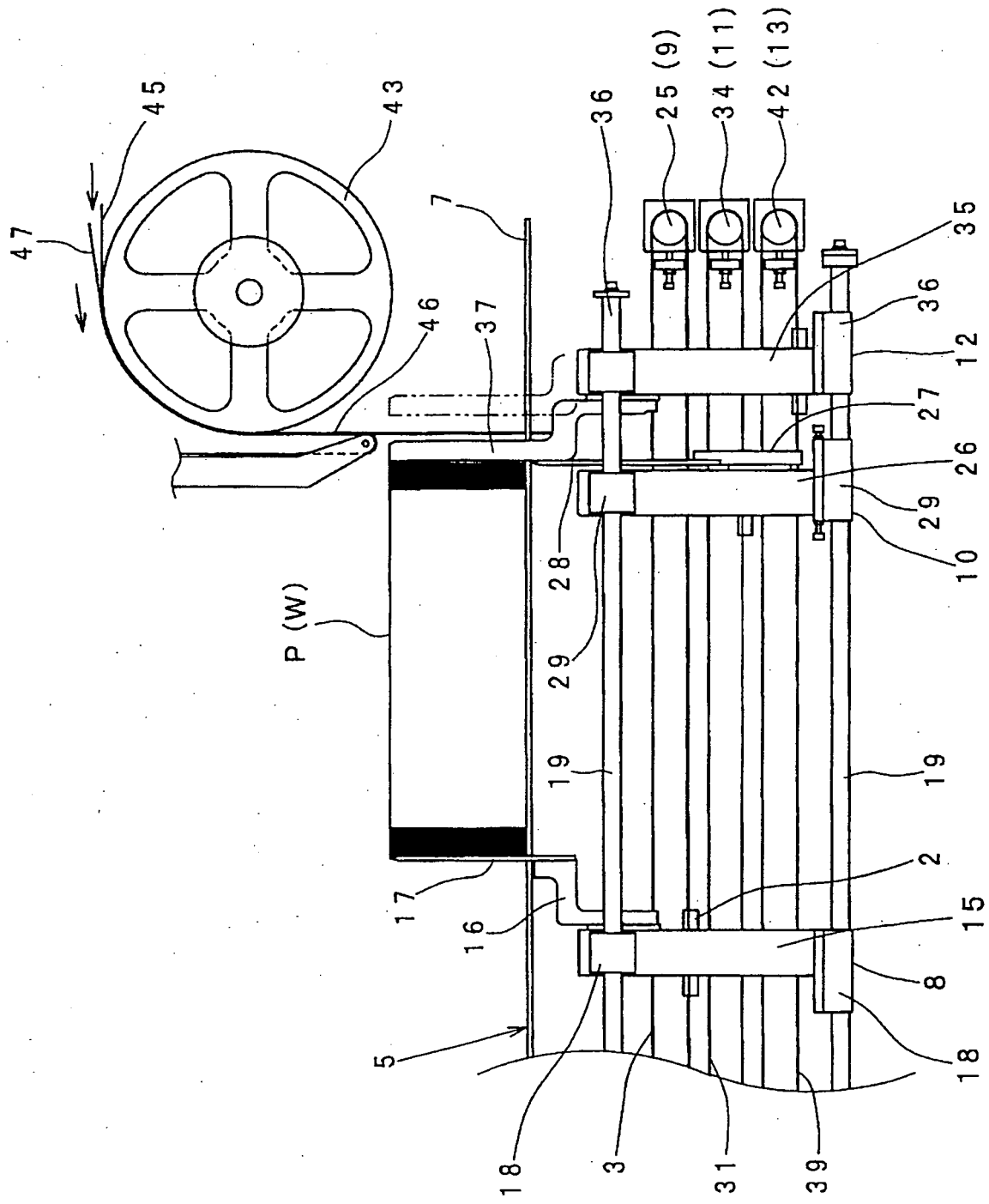


FIG. 7

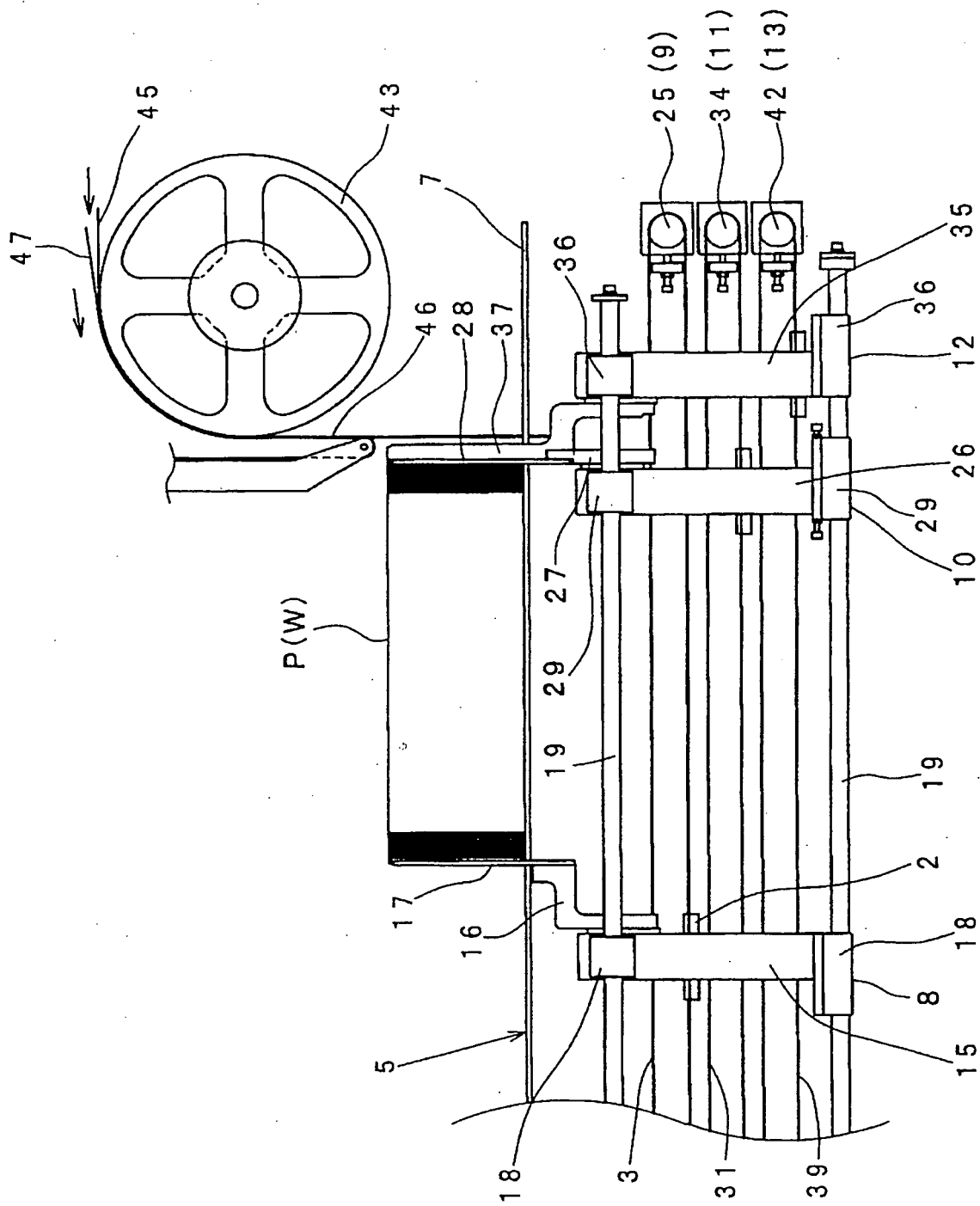


FIG.8

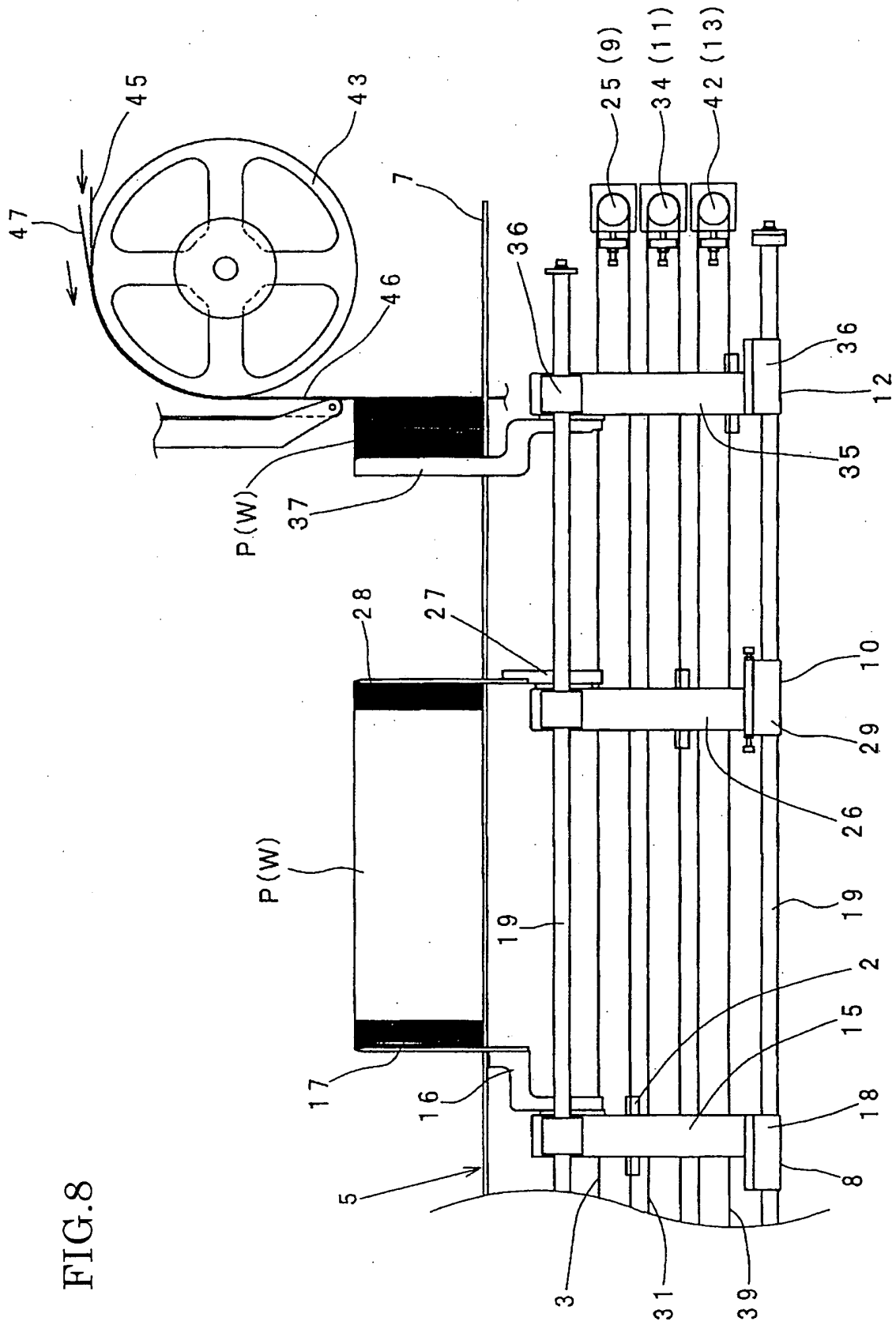
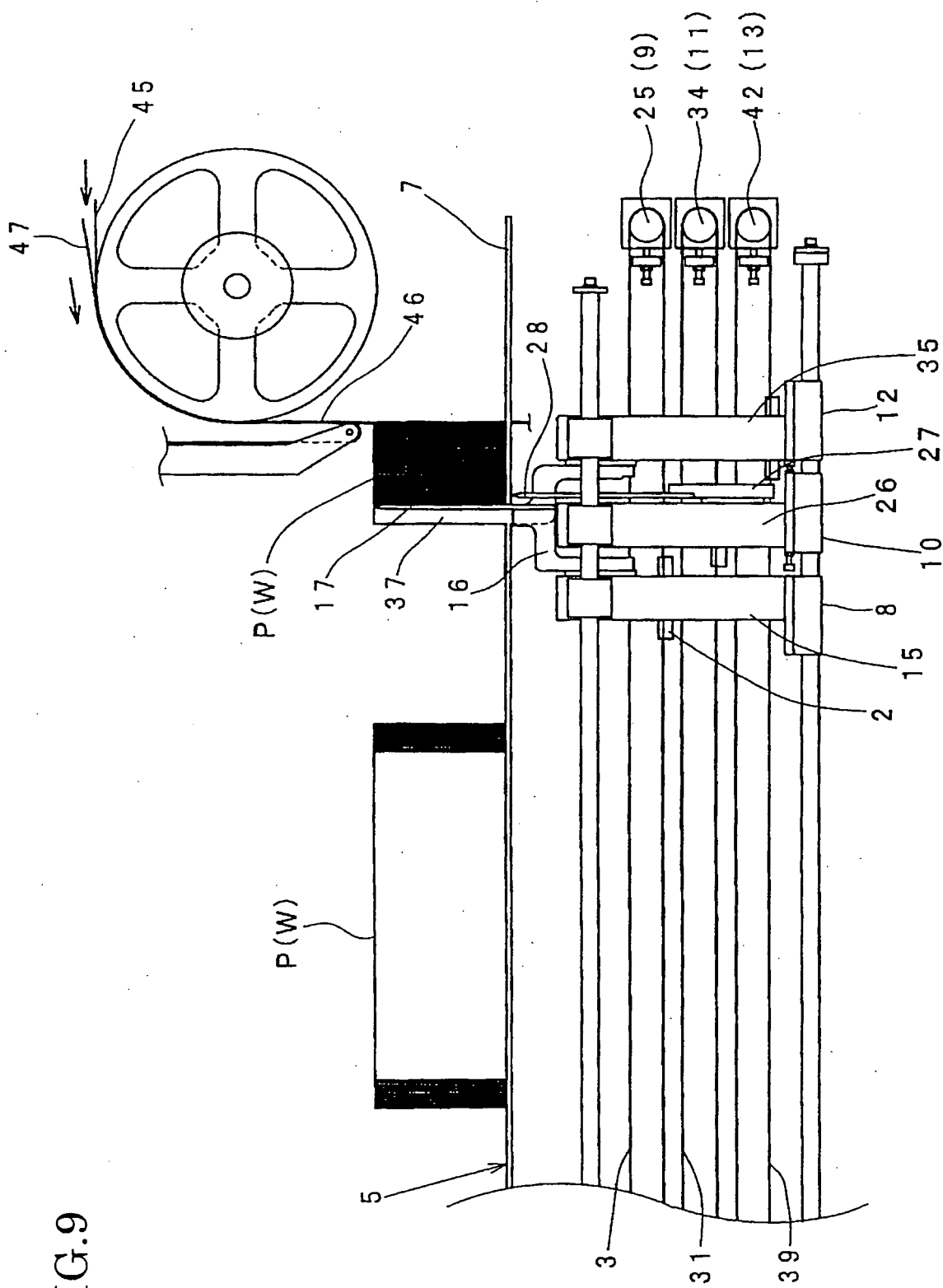


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/308801

A. CLASSIFICATION OF SUBJECT MATTER B65H31/06 (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B65H31/06 (2006.01)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2006 Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 7-53110 A (Dainippon Printing Co., Ltd.), 28 February, 1995 (28.02.95), Par. No. [0013] (Family: none)	1, 5 2-4, 6-9
Y	JP 1-231735 A (Sharp Corp.), 18 September, 1989 (18.09.89), (Family: none)	2, 4, 6, 7, 9
Y	JP 8-2779 A (Dainippon Printing Co., Ltd.), 09 January, 1996 (09.01.96), Figs. 6 to 9 (Family: none)	3, 4, 8, 9
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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Date of the actual completion of the international search 17 May, 2006 (17.05.06)		Date of mailing of the international search report 23 May, 2006 (23.05.06)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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- JP 10035984 A [0004]