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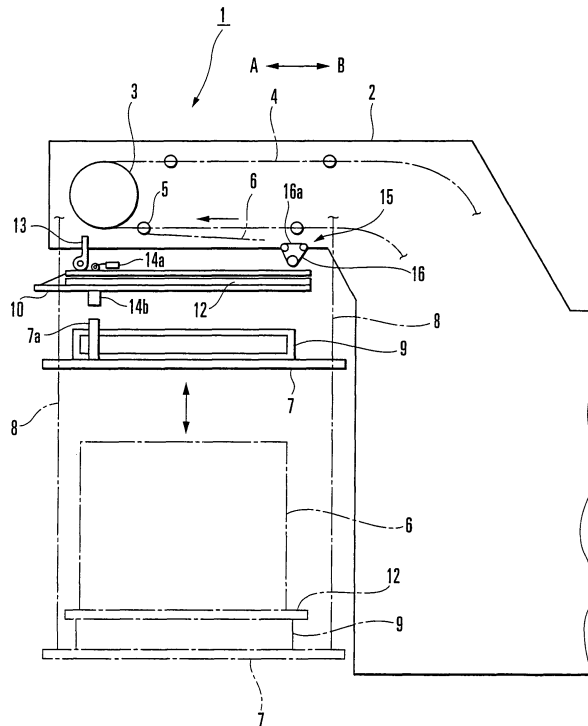
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(54) **Delivery device in sheet-fed offset rotary printing press**

(57) A delivery device in a sheet-fed offset rotary printing press includes a vertically movable pile board, suction unit, detection bar, and limit switch. A conveyed sheet is to be placed on the pile board. The suction unit is arranged on an upstream side in a sheet convey direction above the pile board and under a sheet to be

conveyed, and has a suction surface to suck the sheet while in slidably contact with it. The detection bar is supported under the suction unit to be movable in a vertical direction and extends in a widthwise direction of the sheet to be conveyed. The limit switch detects movement of the detection bar in the vertical direction.



**FIG. 1**

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## Description

### Background of the Invention

**[0001]** The present invention relates to a delivery device in a sheet-fed offset rotary printing press, which is arranged upstream of a pile board in a sheet convey direction and comprises a suction unit for decreasing a sheet convey speed.

**[0002]** A delivery device in a sheet-fed offset rotary printing press is provided with a pile board which is suspended by an elevating chain to move vertically. A printed sheet is stacked on a pallet mounted on the pile board. More specifically, after printing, a sheet from a printing unit which is gripped by the grippers of delivery chains and conveyed is released from the grippers at the convey terminal end and stacked on the pallet. In this case, each time several sheets are stacked, the pile board moves downward automatically, so the upper end of the sheets is always maintained at a constant height.

**[0003]** When the stacked sheets on the pallet reach a predetermined amount, so-called sheet delivery operation of unloading the sheets from the pile board as they are kept stacked on the pallet is performed. If the sheet delivery operation is performed with the printing press being stopped, the operating efficiency of the printing press decreases. Therefore, generally, the sheet delivery operation is performed by board insertion operation which is performed without stopping the printing press. The board insertion operation includes two types of operations, i.e., rack insertion operation and full stacking operation. According to the rack insertion operation, board insertion is performed several times each time a predetermined number of sheets are stacked, so setoff will not occur between sheets that are not dried yet sufficiently after printing. According to the full stacking operation, each time a full number of sheets are stacked, board insertion is performed once, because setoff does not occur.

**[0004]** A board insertion device which performs such board insertion operation comprises a pair of delivery pile plate guides which have U-shaped sections and are openable/closeable and movable to approach and be spaced apart from each other in a sheet dropping path, and a delivery pile plate which is to be horizontally inserted in the closed delivery pile plate guides.

**[0005]** In the delivery device having the above arrangement, in full stacking board inserting operation, when the number of stacked sheets reaches a predetermined number, the delivery pile plate guides are closed, and while letting sheets to continue dropping, the delivery pile plate is inserted in the delivery pile plate guides at an appropriate timing. While the delivery pile plate receives and stacks the sheets dropping onto it, the pile board is moved downward to a predetermined position at a constant speed by push button operation or the like, and the pallet mounted with the delivery pile plate on which the sheets are stacked is unloaded outside the printing press.

**[0006]** Subsequently, an empty pallet is placed on the pile board, and the pile board is moved upward at a constant speed by push button operation. When the upper surface of the pallet comes into contact with the lower surface of the delivery pile plate that is receiving sheets, the upward movement of the pile board stops. When the delivery pile plate guides are opened in this state, the delivery pile plate which is receiving the sheets is supported by the pallet that has moved upward. Then, the vertical movement of the pile board is switched from push button operation to automatic downward movement to shift to normal delivery operation.

**[0007]** In the rack type board insertion operation, while the delivery pile plate receives the sheets, the pile board on which sheets have been stacked slightly moves downward by a predetermined amount. Two or four corners slightly higher than the height of the stacked sheets are placed on the pallet on which the sheets have been stacked. Then, the pallet moves upward until the upper end faces of the corners come into contact with the lower surface of the delivery pile plate that is receiving sheets. Except for this, the operation is the same as in the case of the full stacking operation described above.

**[0008]** In the full stacking board insertion operation described above, sheets are continuously delivered onto the delivery pile plate even during the sheet delivery operation of exchanging the sheet-stacked pallet and empty pallet, and while the pile board moves upward after the sheet delivery operation. If the sheet delivery operation or the upward movement of the pile board takes time, the sheets stacked on the delivery pile plate become fairly high, particularly when the sheets are thick.

**[0009]** In a pile board device of this type, the delivery pile plate and the delivery pile plate guides which support it are fixed in the vertical direction so they cannot move vertically or can move vertically only by a predetermined amount. Hence, if the height of the sheets stacked on the delivery pile plate increases due to the reason described above, a delivery error occurs or printing is stopped automatically. In order to avoid this, the printing speed may be decreased. Then, however, the productivity decreases. If the upward moving speed of the pile board is increased, the pallet and delivery pile plate collide against each other due to the inertia accompanying the upward movement of the pile board. Hence, the upper end of the sheets stacked on the delivery pile plate may push up the sheet lay or suction wheels undesirably.

**[0010]** As a countermeasure against these problems, Japanese Utility Model Registration No. 2579171 (prior art reference 1) proposes a push-up preventive device for a pile board device, which comprises a pile board driven by a driving unit to move upward and an upward movement limit detector to detect the limit of the upward movement of the pile board. In this device, the upward movement limit detector stops the upward movement of the pile board immediately before the pallet collides against the delivery pile plate.

**[0011]** In the delivery device proposed in prior art ref-

erence 1, however, the upward movement limit detector detects only one certain portion of the pile board to stop its upward movement. When full stacking operation is to be performed after rack insertion, if corners after use for rack insertion are left on the pile board carelessly, before the upward movement limit detector detects the pile board, the corners may push up suction wheels or the like to break them.

### Summary of the Invention

**[0012]** It is an object of the present invention to provide a delivery device in a sheet-fed offset rotary printing press, in which corners or tools that are carelessly left on a pile board will not damage suction wheels or the like.

**[0013]** In order to achieve the above object, according to the present invention, there is provided a delivery device in a sheet-fed offset rotary printing press, comprising a vertically movable pile board on which a conveyed sheet is to be placed, a suction unit which is arranged on an upstream side in a sheet convey direction above the pile board and under a sheet to be conveyed and has a suction surface to suck the sheet while in slidable contact therewith, a detection body which is supported under the suction unit to be movable in a vertical direction and extends in a widthwise direction of the sheet to be conveyed, and detection means for detecting movement of the detection body in the vertical direction.

### Brief Description of the Drawings

#### **[0014]**

Fig. 1 is a side view schematically showing a delivery device for a sheet-fed offset rotary printing press according to an embodiment of the present invention; Fig. 2 is a front view schematically showing the delivery device shown in Fig. 1; Fig. 3 is a plan view showing the main part of the delivery device shown in Fig. 1; Figs. 4A and 4B are front views showing the main part of the delivery device shown in Fig. 1; Fig. 5 is an enlarged front view of the main part of the delivery device shown in Fig. 4B; Fig. 6 is a sectional view taken along the line VI - VI of Fig. 5; and Fig. 7 is a sectional view taken along the line VII - VII of Fig. 5.

### Description of the Preferred Embodiment

**[0015]** A delivery device for a sheet-fed offset rotary printing press according to an embodiment of the present invention will be described with reference to Figs. 1 to 7.

**[0016]** Referring to Fig. 1, a delivery device 1 for a sheet-fed offset rotary printing press comprises a pair of delivery frames 2 which oppose each other at a predetermined gap. A sprocket 3 is axially supported by the

pair of delivery frames 2. A pair of delivery chains 4 are looped between the sprocket 3 and a printing unit-side sprocket (not shown). A plurality of sets of gripper units 5 (schematically shown in Fig. 1) each comprising a gripper and gripper pad line up on each of gripper bars which are supported between the pair of delivery chains 4 at predetermined intervals. After printing, a sheet 6 which is gripped by the gripper units 5 and conveyed as the delivery chains 4 travel is released from the gripper units 5 and drops at the upstream side of the sprocket 3 in the sheet convey direction.

**[0017]** A pile board 7 with four corners suspended by four elevating chains 8 moves vertically when a motor (not shown) rotates clockwise/counterclockwise. A flat rectangular parallelepiped pallet 9 having a hole where the forks or the like of a fork lift can be inserted is placed on the pile board 7. As shown in Fig. 2, a pair of delivery pile plate guides 10 respectively having U-shaped sections of arrows A and B) are supported in the vicinity of the upward movement limit of the pallet 9 to be parallel to each other with their openings opposing each other. The pair of delivery pile plate guides 10 are supported by rods 11a of air cylinders 11 (see Figs. 4A and 4B) and move horizontally, when they are driven by the air cylinder 11, to be spaced apart from or approach each other to open or close.

**[0018]** A rectangular delivery pile plate 12 is inserted in the closed delivery pile plate guides 10 from the front opening and receives and stacks the dropping sheet 6 on it. A sheet lay 13 abuts against the front edge of the dropping sheet 6 to set the sheet 6 properly. An upward movement limit switch 14a arranged slightly above the delivery pile plate 12 is connected to the motor (not shown) for vertically moving the pile board 7. The motor stops when the pallet 9 placed on the pile board 7 which moves upward abuts against the contact of the upward movement limit switch 14a, to stop upward movement of the pile board 7. A pair of non-contact sensors 14b are arranged slightly below the upward movement limit switch 14a. A detection rubber member 7a projects from the upper surface of the pile board 7. The sensors 14b and detection rubber member 7a form a push-up preventive device. In this arrangement, when the pile board 7 moves upward until before the upward movement limit switch 14a to shield the non-contact sensors 14b, the sensors 14b output sensor signals to decelerate the motor for vertically moving the pile board 7.

**[0019]** On the upstream side (the direction of the arrow B) of the delivery device 1 in the sheet convey direction and under the sheet 6 under conveyance, as shown in Figs. 4A and 4B, five suction units 15a to 15e line up in the widthwise direction (directions of arrows C - D: a direction horizontally perpendicular to the sheet convey direction) of the sheet 6 under conveyance. The suction units 15a to 15e comprise suction belts 16 having suction surfaces 16a which are connected to an intake source (not shown) to suck and catch the sheet 6 in a slidable

contact state. When intake air is supplied to the suction units 15a to 15e, the upper surface of the trailing edge of the sheet 6 which is gripped and conveyed by the gripper units 5 is caught by the suction surfaces 16a while in slidable contact with them. Thus, movement of the trailing edge of the sheet 6 is regulated, and the sheet 6 becomes taut before it drops onto the pile board 7.

**[0020]** A detection device which detects the upward movement limit of the pile board 7 will be described with reference to Figs. 3 to 6. Referring to Fig. 3, two stays 22 and 23 horizontally extend and a driving shaft 24 is rotatably supported between a pair of subframes 21a and 21b which oppose each other at a predetermined gap. When a motor (not shown) rotates the driving shaft 24, the suction belts 16 travel through gears 25 in the direction of the arrow A at a speed lower than the convey speed of the sheet 6.

**[0021]** Support stays 31 and 27 which support the stays 22 and 23 are attached inside the subframes 21a and 21b. Two screw shafts 26 are rotatably supported between the support stay 27 and one subframe 21b with their movement in the axial direction being regulated. One end of each screw shaft 26 extends to the other subframe 21a side. When the projecting portions of the screw shafts 26 through the subframe 21b are manually rotated clockwise and counterclockwise, the suction units 15a, 15b, 15d, and 15e move in the directions of the arrows C and D.

**[0022]** A rotating shaft 28 is rotatably supported between the pair of subframes 21a and 21b. When the rotating shaft 28 is rotated by a motor (not shown) clockwise and counterclockwise, the subframes 21a and 21b move with respect to the delivery frames 2 in the directions of the arrows A and B through pinions 29 and racks (not shown) axially mounted on the two ends of the rotating shaft 28.

**[0023]** A pair of emergency limit switches 30 (detection means) are arranged at the two end sides in the widthwise direction of the sheet 6 to be conveyed. The limit switches 30 are attached to the stay 22 through the support stays 27 and 31, respectively. When the limit switches 30 detect an object such as a corner or tool left on the pile board 7, the motor (not shown) which vertically moves the pile board 7 is stopped to stop the upward movement of the pile board 7. A sheet lay 32, which abuts against the trailing end of the sheet 6 which drops onto the delivery pile plate 12 to set the sheet 6 properly, is attached to the stay 22 to extend in the directions of arrows C and D. The sheet lay 32 has many air vent holes 32a. Alternatively, one limit switch 30 may be arranged only on one end side in the sheet convey direction of the gripper units 5.

**[0024]** As shown in Figs. 4A and 4B, an elongated detection bar 33 (detection body) having the same length as or slightly longer than that of the pile board 7 in the sheet widthwise direction is supported below the stay 22 which corresponds to a portion between the suction units 15a and 15e. The detection bar 33 has two pairs of up-

wardly projecting support portions 34 in the vicinity of its each end. Each support portion 34 has an elongated hole 34a which extends vertically and has a width slightly larger than the diameter of a small shaft 40 (support member). Thus, the detection bar 33 is allowed to move in the widthwise direction of the sheet and obliquely upward. Dogs 35 are attached to the two ends of the detection bar 33. Each dog 35 has a detecting portion 35a which is bent obliquely, as shown in Fig. 5.

**[0025]** First blocks 37 are attached at four portions of the lower end of the stay 22. As shown in Fig. 6, a pin 38 projecting in the direction of the length of the stay 22 extends vertically from one side surface of each first block 37. As shown in Fig. 7, a second block 39 is rotatably supported by the pin 38 while the pin 38 is regulated from moving in the axial direction. The small shaft 40 with a flange extends vertically from an end face in the direction of the arrow A of the second block 39. The four small shafts 40 engage in the four elongated holes 34a of the detection bar 33. Normally, the weight of the detection bar 33 supports the detection bar 33 in a suspended state in the upper portion of the elongated hole 34a. Thus, the detection bar 33 is supported to be vertically movable through the small shafts 40. The detection bar 33 supported by the small shafts 40 is arranged under the suction units 15a to 15e., as shown in Figs. 4A and 4B.

**[0026]** The detecting portions 35a of the pair of dogs 35 arranged at the two ends of the detection bar 33 supported by the stay 22 through the four small shafts 40 come into contact with actuating portions 30a of the pair of limit switches 30.

**[0027]** The sheet stacking operation of the delivery device in the sheet-fed offset rotary printing press having the above arrangement will be described. Referring to Fig. 1, the sheet pile plate 12 corresponding to the delivery pile plate is placed on the pallet 9 on the pile board 7 which has moved downward. After that, the pile board 7 is moved upward until the upward movement limit, and printing operation is started. In this state, the printed sheet 6 is gripped by the gripper units 5 and conveyed by the delivery chains 4. At the convey terminal end, the sheet 6 is released from the gripper units 5 and drops.

**[0028]** The dropping sheet 6 becomes taut as its trailing portion is caught by the suction belts 16 of the suction units 15a to 15e in slidable contact with them. The sheet 6 is stacked on the delivery pile plate 12 with its leading edge being set in a proper state, because it abuts against the sheet lay 13. When the vertical movement of the pile board 7 is switched to automatic downward movement, each time several sheets 6 are stacked, the pile board 7 moves downward automatically by a small amount so the upper end face of the stacked sheets 6 maintains the same height.

**[0029]** When a full number of sheets 6 are stacked on the sheet pile plate 12, a sensor (not shown) detects this to stop the downward movement of the pile board 7. Subsequently, the air cylinders 11 are actuated to close the delivery pile plate guides 10 as indicated by alternate

long and two short dashed lines in Figs. 4A and 4B. The delivery pile plate 12 is inserted in the delivery pile plate guides 10 at an appropriate timing of the dropping sheets 6. Thus, the dropping sheets 6 drop onto the delivery pile plate 12 and are stacked on it. At this time, the automatic downward movement of the pile board 7 is switched to manual downward movement. By button operation, the pile board 7 is moved downward to a predetermined position. Then, for example, the forks of a fork lift are inserted in the hole of the pallet 9 to unload the sheets 6, together with the pallet 9, outside the printing press.

**[0030]** Subsequently, an empty pallet 9 is placed on the pile board 7 that has moved downward, and the pile board 7 is automatically moved upward at a comparatively high speed. When the upper end of the pallet 9 has moved upward to become close to the delivery pile plate 12 stacked with the sheets, the sensors 14b detect the rubber member 7a. When the sensors 14b output detection signals, the motor for winding up the elevating chains 8 is switched from high speed to low speed, so the pile board 7 moves upward at the low speed. Then, when the upward movement limit switch 14a detects the upward movement limit of the pile board 7, the motor for winding up the elevating chains 8 stops to stop the upward movement of the pile board 7. Then, the delivery pile plate guides 10 are opened, and the delivery pile plate 12 on which the dropping sheets have been stacked continuously transfers onto the pallet 9. When the manual vertical movement of the pile board 7 is switched to automatic movement, the pile board 7 is shifted to regular delivery and automatically moves downward.

**[0031]** According to this embodiment, the limit switch 14a detects the upward movement limit of the pile board 7. Thus, the pallet 9 can be prevented from colliding against the delivery pile plate 12 to push it up, or the stacked sheets 6 are prevented from pushing up the sheet lay 13 or suction units 15a to 15e or the like to damage them.

**[0032]** Even if a corner or tool is left at a position where it is not detected by the limit switch 14a, the detection bar 33 which extends in the entire widthwise direction of the sheet 6 to be conveyed detects the corner or tool left on the pile board 7 prior to detecting the pallet 9, to stop the upward movement of the pile board 7. Thus, the corner, tool, or the like left on the pile board 7 can be prevented from breaking a suction unit 15 or the like.

**[0033]** At this time, if the corner or tool that is left abuts against part of the detection bar 33, the detection bar 33 pivots in the widthwise direction of the sheet 6 to be conveyed. Thus, the actuating portion 30a of either one of the pair of limit switches 30 is actuated by the detecting portion 35a of the corresponding dog 35. No matter where the corner or tool that is left may be located, it can be detected. Thus, the suction unit 15 or the like can be reliably prevented from being broken by the corner or tool that is left.

**[0034]** When an external force erroneously acts on the detection bar 33, as shown in Fig. 7, the detection bar

33 pivots in the direction of the arrow B (upstream side in the sheet convey direction) about the pin 38 as the pivot center. Thus, the detection bar 33 can be prevented from being broken. The detection bar 33 is also pivoted when inserting the delivery pile plate 12 in the delivery pile plate guides 10. Thus, the detection bar 33 can be arranged such that its lower surface is located at a further lower position, so an object on the pallet 9 can be detected at an early stage. Even if the detection bar 33 projects to a position where the delivery pile plate 12 is to be inserted into the delivery pile plate guides 10, it will not interfere with the inserting operation of the delivery pile plate 12.

**[0035]** In this embodiment, each of the two sides of the detection bar 33 is supported by two pairs of small shafts 40. If the flex or the like of the elongated detection bar 33 need not be corrected, each side of the detection bar 33 may be supported by one pair of small shafts 40. The upward movement of the pile board 7 is stopped when the limit switches 30 detect the upward movement limit of the pile board 7. Alternatively, the operation of the entire printing press may stop.

**[0036]** The pin 38 pivotally supports the second block 39. Alternatively, the pin 38 may be fixed by the second block 39 and may pivot the second block 39. Although sheets are employed, the present invention is effected as far as sheet-type objects are employed.

**[0037]** According to the present invention, even if a corner or tool is left on the pile board carelessly, before the pile board is detected by the detection body, the member left on the pile board can be detected. Thus, the suction unit can be prevented by being broken by the member left on the pile board.

## Claims

1. A delivery device in a sheet-fed offset rotary printing press, **characterized by** comprising:

a vertically movable pile board (7) on which a conveyed sheet is to be placed;  
 a suction unit (15) which is arranged on an upstream side in a sheet convey direction above said pile board and under a sheet (6) to be conveyed and has a suction surface (16a) to suck the sheet while in slidable contact therewith;  
 a detection body (33) which is supported under said suction unit to be movable in a vertical direction and extends in a widthwise direction of the sheet to be conveyed; and  
 detection means (30) for detecting movement of said detection body in the vertical direction.

2. A device according to claim 1, wherein said detection body comprises an elongated detection bar supported to be vertically movable.

3. A device according to claim 2, wherein said detection bar is supported by a plurality of support members (40) which are arranged in the widthwise direction of the sheet to be conveyed.
4. A device according to claim 3, wherein said detection bar is arranged in the widthwise direction of the sheet to be conveyed and has a plurality of elongated holes (34a) respectively forming ellipses whose major axes are aligned in the vertical direction, and said plurality of support members are engaged in the elongated holes to suspend and support said detection bar.
5. A device according to claim 2, wherein said detection bar is movable obliquely.
6. A device according to claim 5, wherein the elongated holes have gaps in the widthwise direction with respect to said support members.
7. A device according to claim 1, wherein said detection means comprises a detection switch which is provided to one end side in the widthwise direction of the sheet to be conveyed and detects movement in the vertical movement of at least one end of said detection bar.
8. A device according to claim 1, wherein said detection means comprises a pair of detection switches which are provided on two end sides in the widthwise direction of the sheet to be conveyed and detect upward movement of two ends of said detection bar.
9. A device according to claim 1, wherein said detection body moves upon abutting against an object on said pile board.
10. A device according to claim 1, further comprising driving means (8) for driving said pile board to move upward, said driving means being stopped when said detection means detects movement of said detection body.
11. A device according to claim 1, wherein said detection body is pivotally supported in a sheet convey direction as well.
12. A device according to claim 11, further comprising a pair of delivery pile plate guides (10) with U-shaped sections which extend in the sheet convey direction in the vicinity of an upward movement limit of said pile board and are arranged parallel to each other such that openings thereof oppose each other, and a delivery pile plate (12) to be inserted and supported in the openings of said pair of delivery pile plate guides, wherein said detection body pivots when said delivery pile plate is inserted in said delivery pile plate guides.
13. A device according to claim 11, further comprising a stay (22) which is supported between a pair of frames (21a, 21b) that oppose each other at a predetermined gap, a block (39) which is pivotally supported by said stay, and a shaft (40) which is supported by said block and supports said detection body to be movable in the vertical direction.
14. A device according to claim 13, further comprising a pin (38) which is supported by said stay in a direction of length of said stay, wherein said block is pivotally supported by said pin.



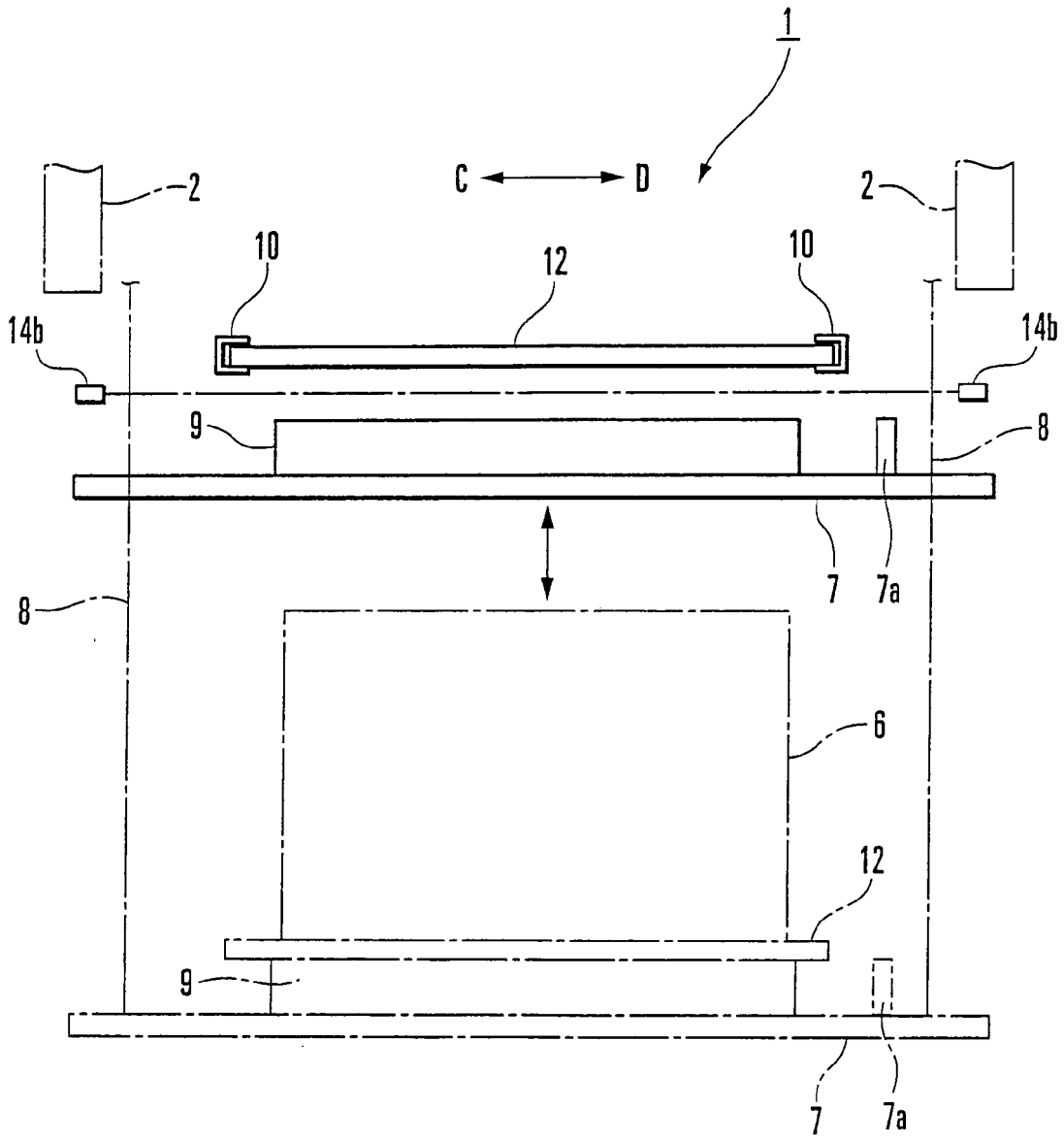


FIG. 2



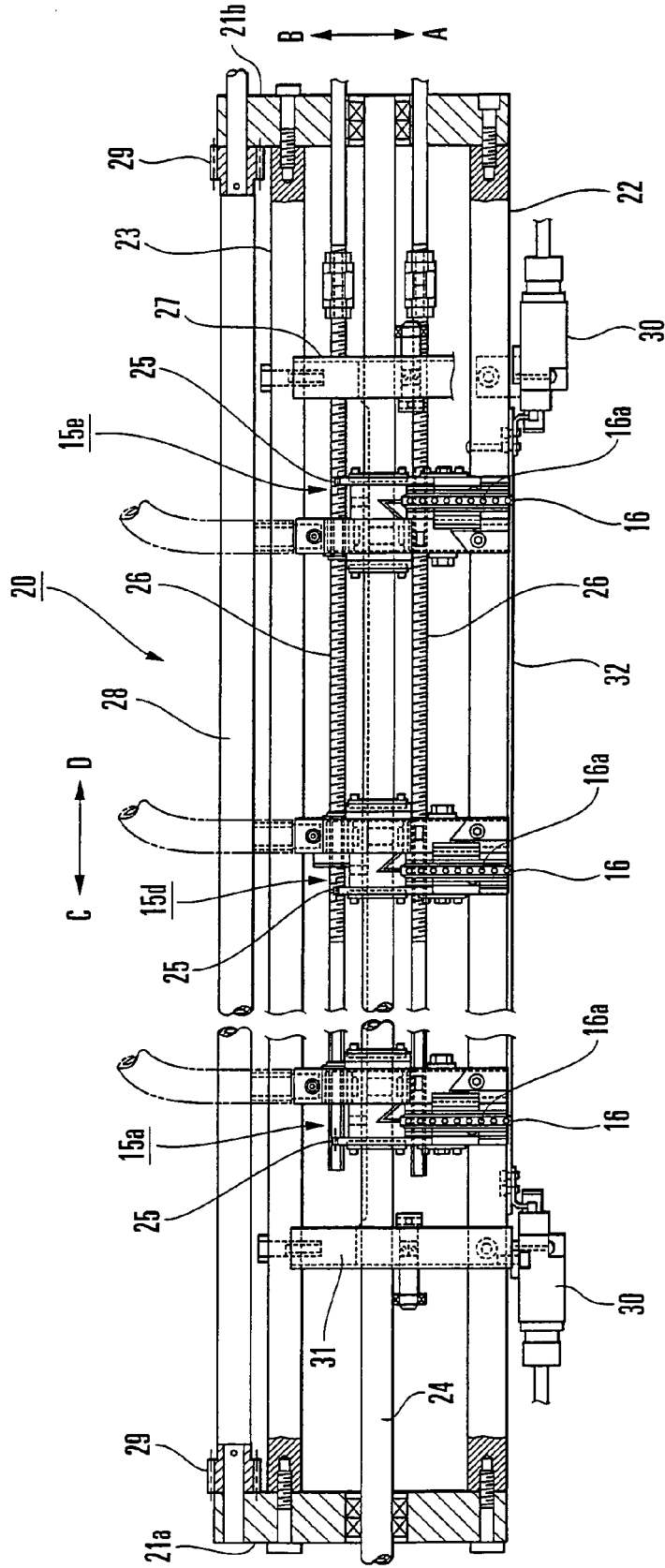


FIG. 3



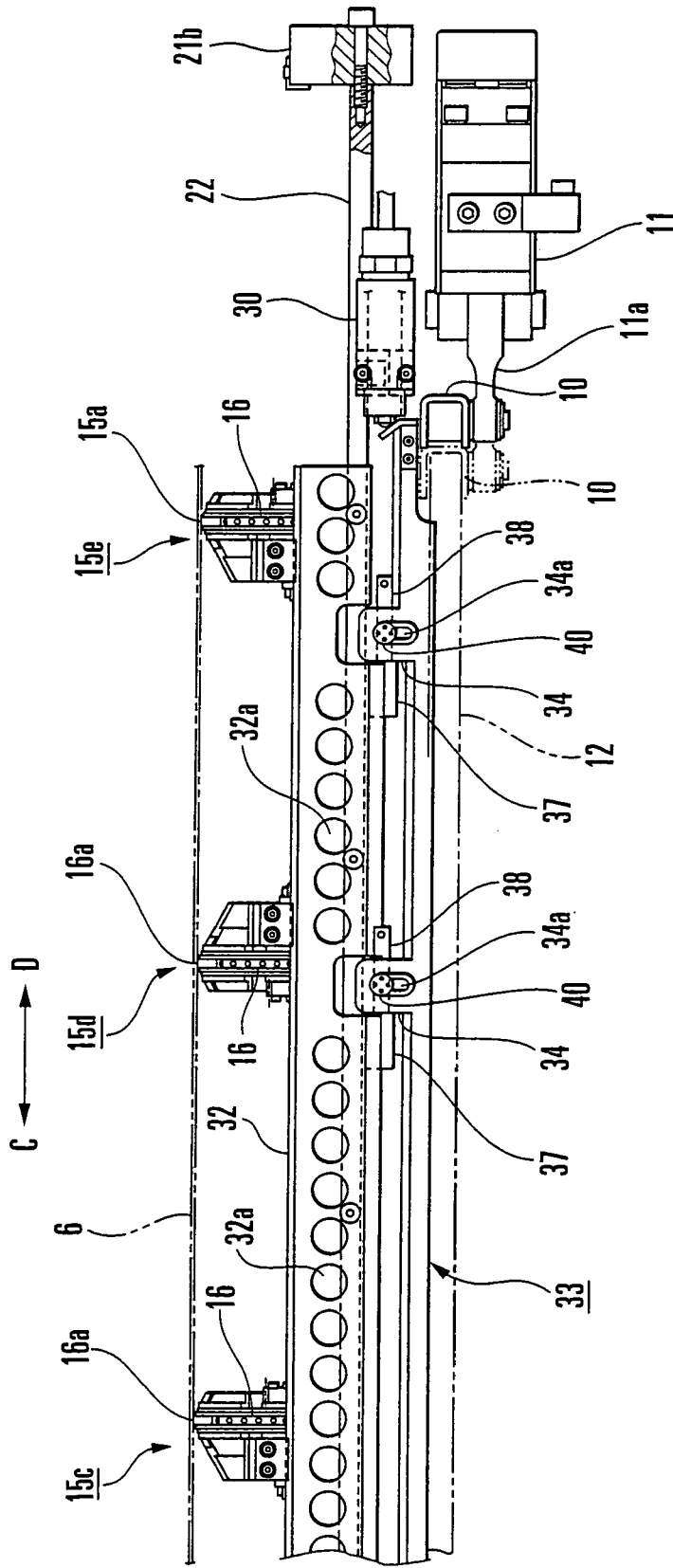


FIG. 4B

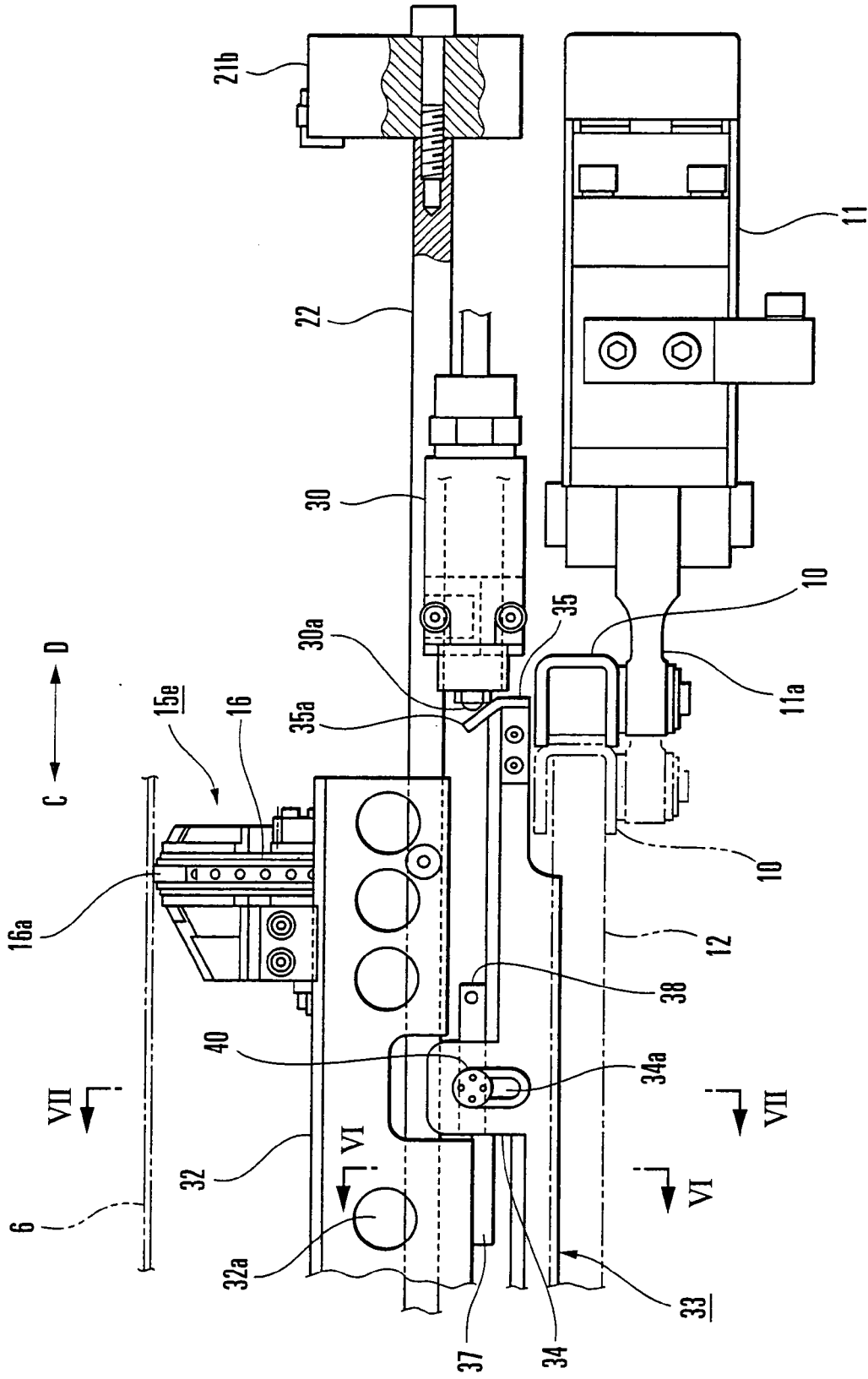


FIG. 5

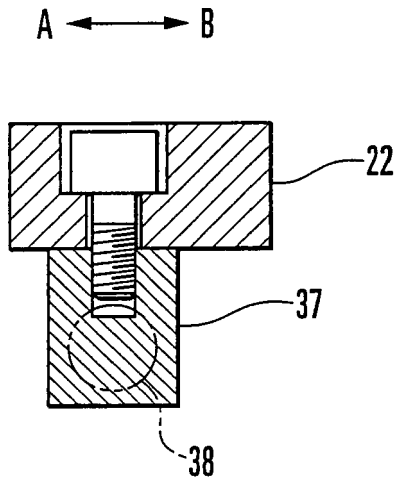


FIG. 6

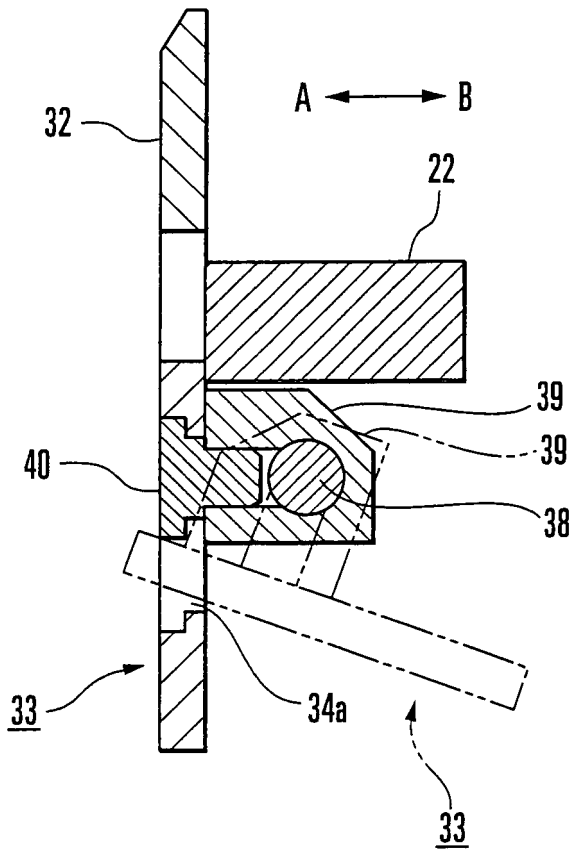


FIG. 7

**REFERENCES CITED IN THE DESCRIPTION**

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