US 20070052160A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2007/0052160 A1

Maruyama et al. (43) Pub. Date: Mar. 8, 2007

(54) DELIVERY DEVICE IN SHEET-FED OFFSET ROTARY PRINTING PRESS

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(21) Appl. No.: **11/511,995**

(22) Filed: **Aug. 28, 2006**

(30) **Foreign Application Priority Data**

Sep. 2, 2005 (JP) 254520/2005

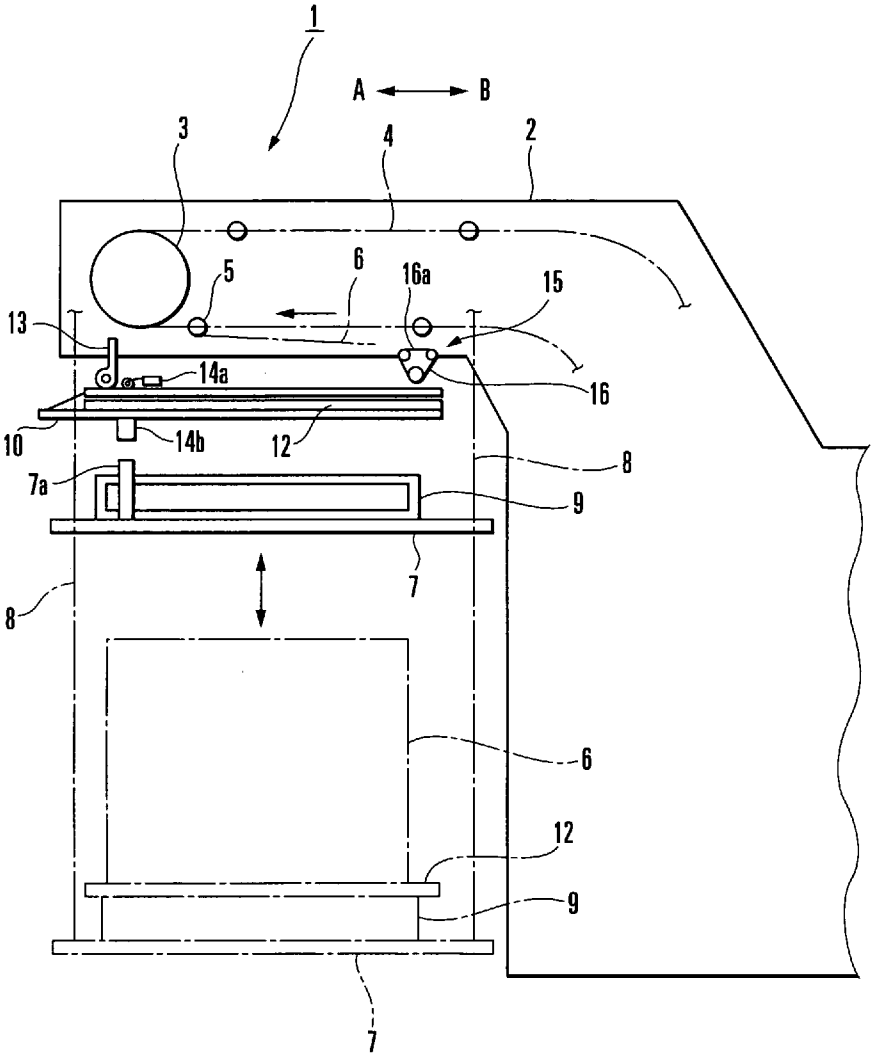
Publication Classification

(51) **Int. Cl.**
B65H 43/04 (2006.01)

(52) **U.S. Cl.** **271/198**

(57) **ABSTRACT**

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 slidable 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.



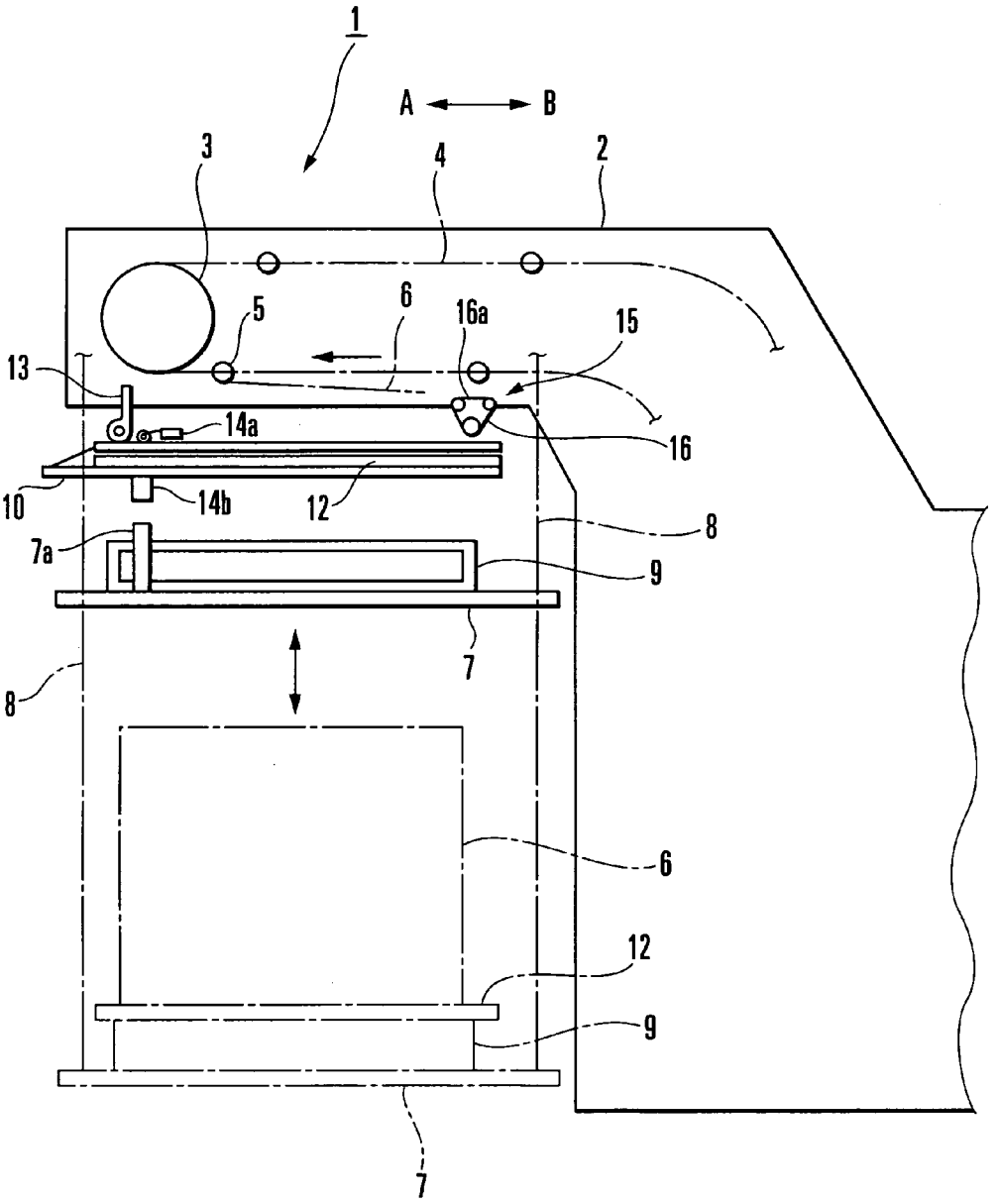


FIG. 1

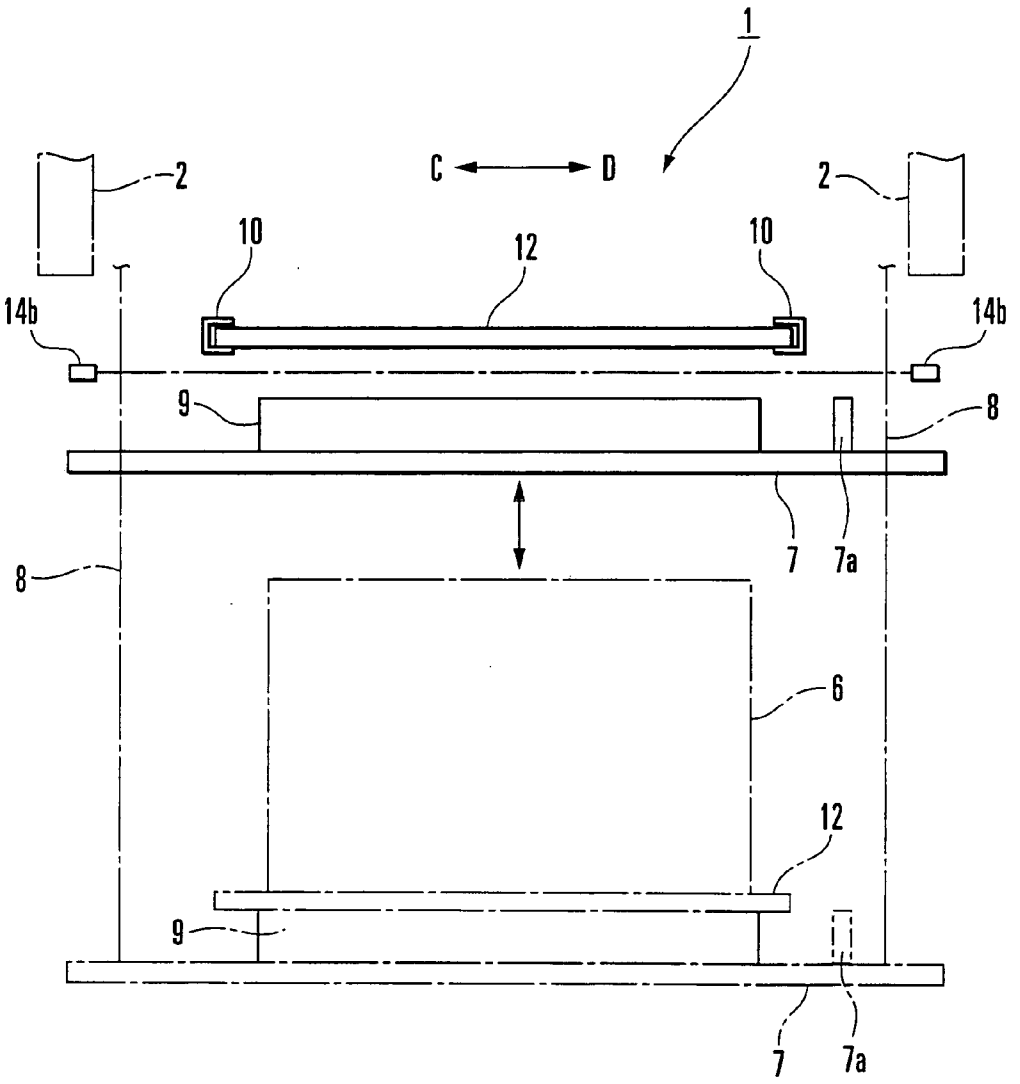
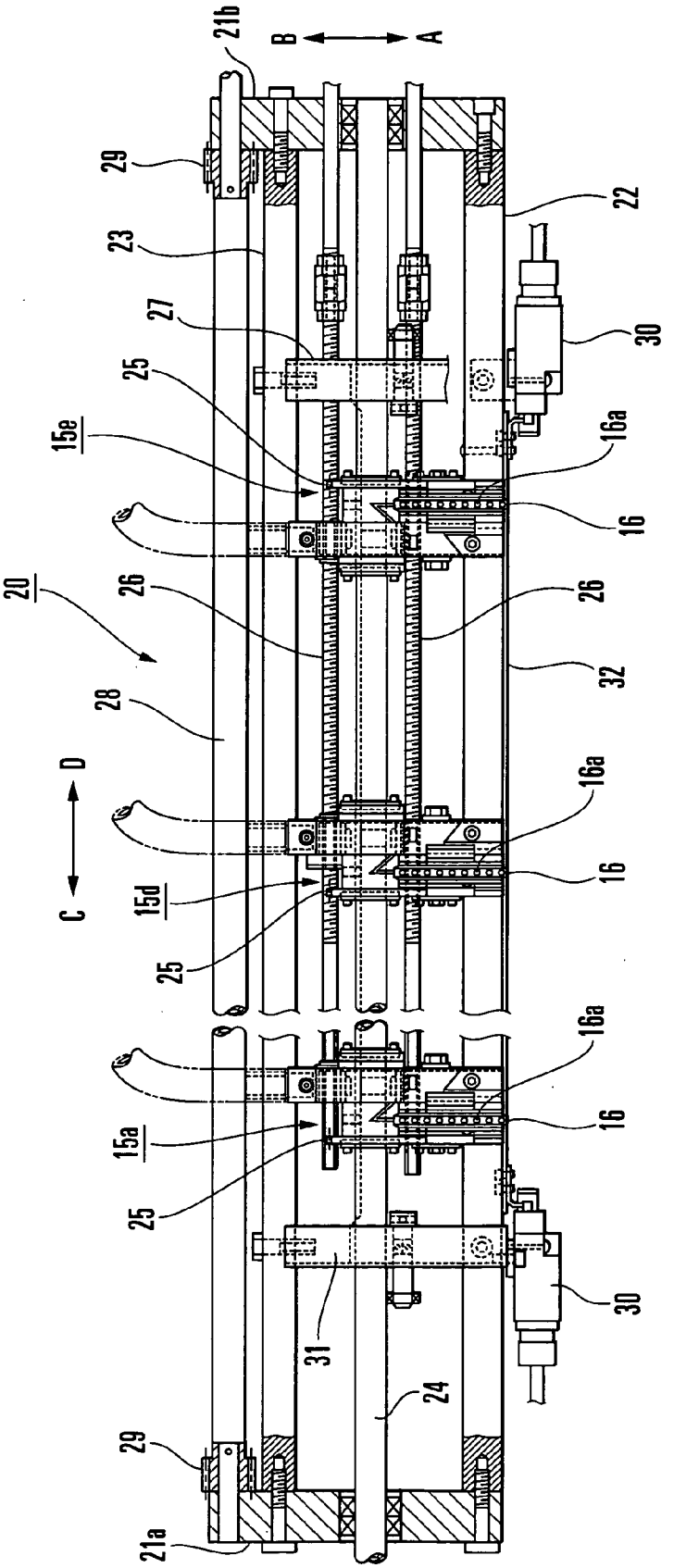


FIG. 2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B
A
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22
23
27
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25
15e
16a
16
20
26
26
32
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25
16a
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15a
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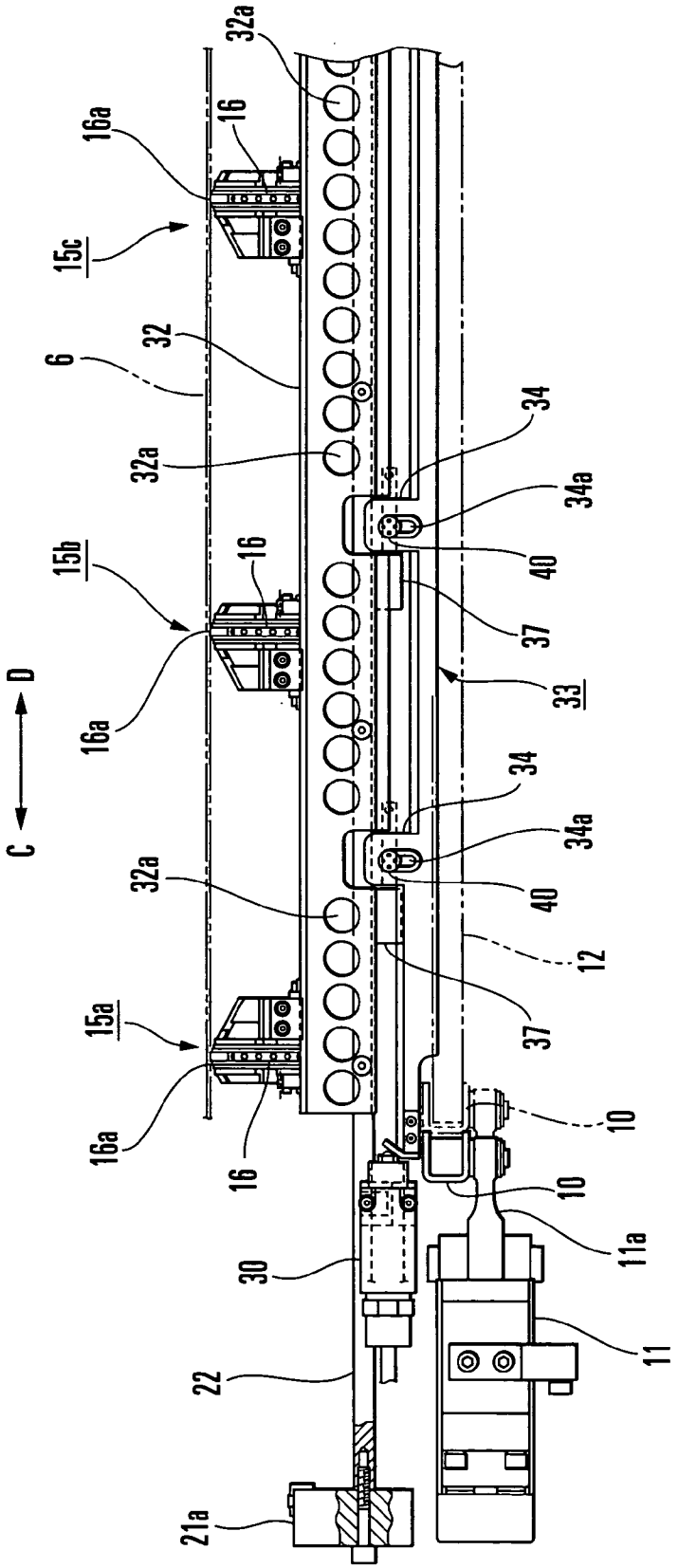
31
24
29
21a

FIG. 3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16
16a
15c
6
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32a
34a
40
15b
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33
C
D
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34a
32a
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12
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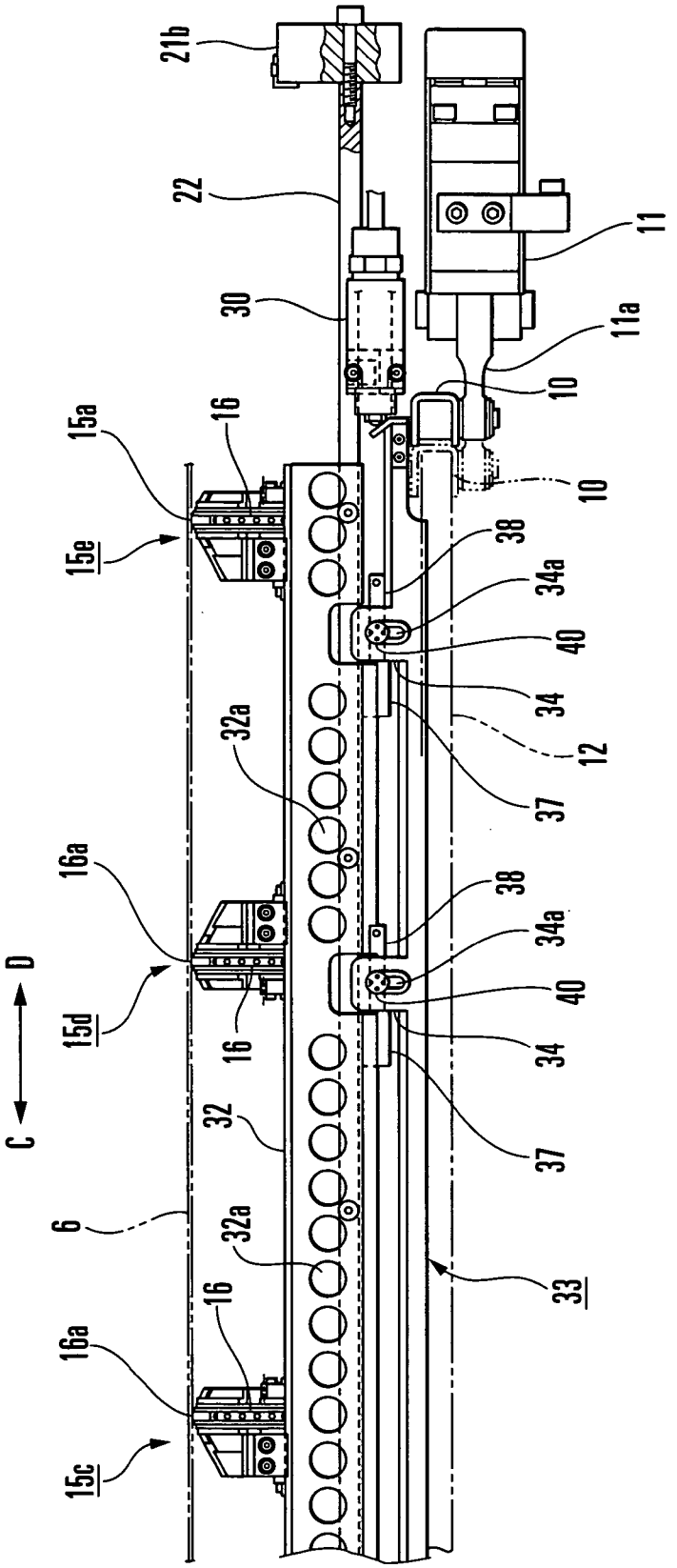
37
16a
16
10
10
11a
30
11
22
21a

FIG. 4A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22
30
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11a
10
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16
15e
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34a
40
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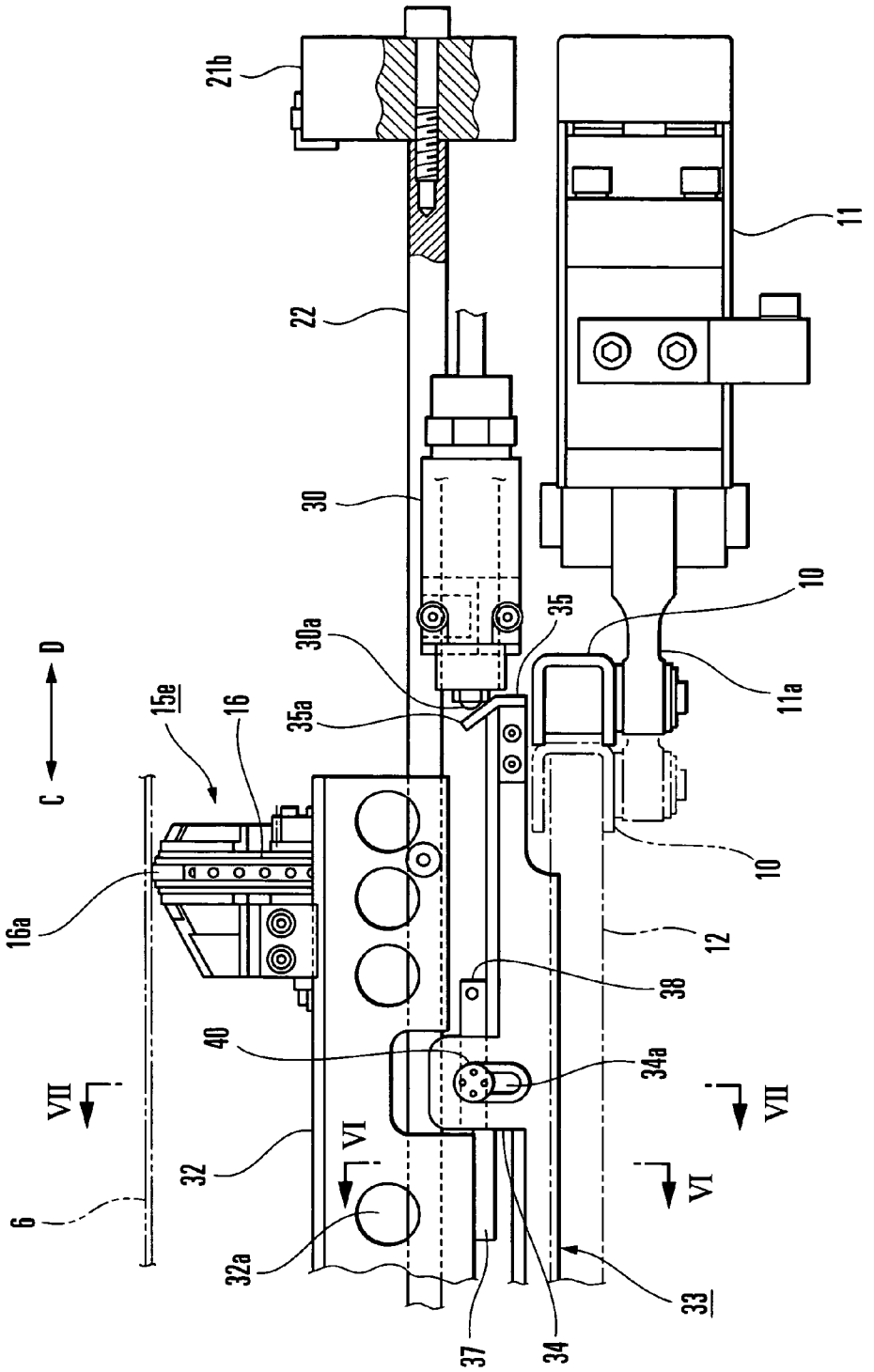
32a
16a
15d
16
C
D
32
6
32a
16
16a
15c
33

FIG. 4B


21b
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30
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35
10
11
11a
35a
15e
16
C
D
16a
12
38
40
34a
VII
VI
32
6
32a
33
37
34

FIG. 5

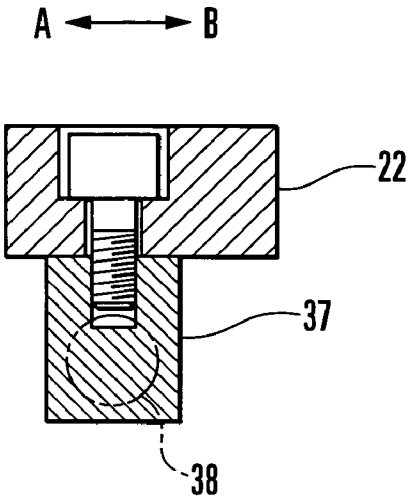

FIG. 6

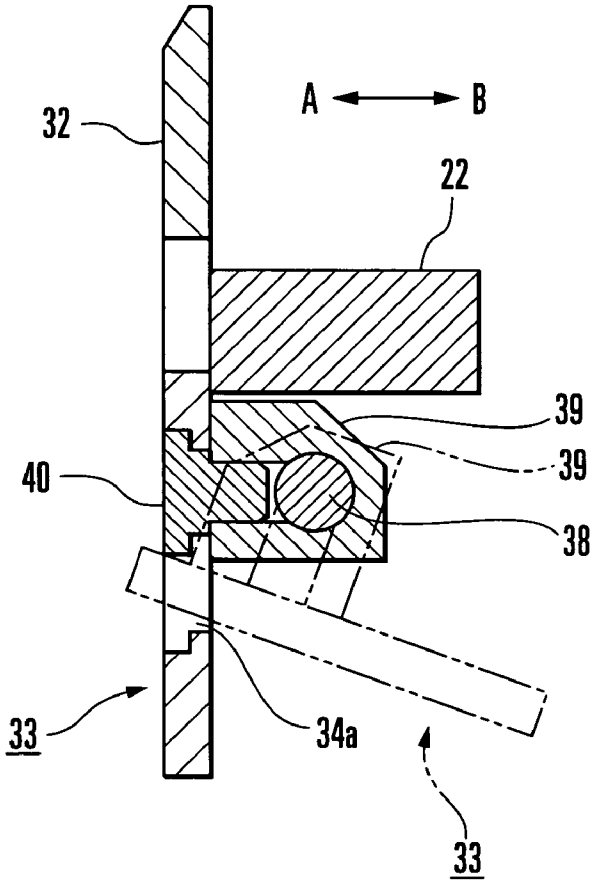

FIG. 7

DELIVERY DEVICE IN SHEET-FED OFFSET ROTARY PRINTING PRESS

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 reference 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;

[0015] FIG. **2** is a front view schematically showing the delivery device shown in FIG. **1**;

[0016] FIG. **3** is a plan view showing the main part of the delivery device shown in FIG. **1**;

[0017] FIGS. **4**A and **4**B are front views showing the main part of the delivery device shown in FIG. **1**;

[0018] FIG. **5** is an enlarged front view of the main part of the delivery device shown in FIG. **4**B;

[0019] FIG. **6** is a sectional view taken along the line VI-VI of FIG. **5**; and

[0020] FIG. **7** is a sectional view taken along the line VII-VII of FIG. **5**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0021] 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**.

[0022] 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 griper 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.

[0023] 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 and extending in the sheet convey direction (directions 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 **11***a* of air cylinders **11** (see FIGS. **4**A and **4**B) 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.

[0024] 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 **14***a* 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 **14***a*, to stop upward movement of the pile board **7**. A pair of non-contact sensors **14***b* are arranged slightly below the upward movement limit switch **14***a*. A detection rubber member **7***a* projects from the upper surface of the pile board **7**. The sensors **14***b* and detection rubber member **7***a* form a push-up preventive device. In this arrangement, when the pile board **7** moves upward until before the upward movement limit switch **14***a* to shield the non-contact sensors **14***b*, the sensors **14***b* output sensor signals to decelerate the motor for vertically moving the pile board **7**.

[0025] 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. **4**A and **4**B, five suction units **15***a* to **15***e* 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 **15***a* to **15***e* comprise suction belts **16** having suction surfaces **16***a* 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 **15***a* to **15***e*, 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 **16***a* 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**.

[0026] 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 **21***a* and **21***b* 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**.

[0027] Support stays **31** and **27** which support the stays **22** and **23** are attached inside the subframes **21***a* and **21***b*. Two screw shafts **26** are rotatably supported between the support stay **27** and one subframe **21***b* with their movement in the axial direction being regulated. One end of each screw shaft

26 extends to the other subframe **21***a* side. When the projecting portions of the screw shafts **26** through the subframe **21***b* are manually rotated clockwise and counterclockwise, the suction units **15***a*, **15***b*, **15***d*, and **15***e* move in the directions of the arrows C and D.

[**0028**] A rotating shaft **28** is rotatably supported between the pair of subframes **21***a* and **21***b*. When the rotating shaft **28** is rotated by a motor (not shown) clockwise and counterclockwise, the subframes **21***a* and **21***b* 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**.

[**0029**] 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 **32***a*. Alternatively, one limit switch **30** may be arranged only on one end side in the sheet convey direction of the gripper units **5**.

[**0030**] As shown in FIGS. **4**A and **4**B, 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 **15***a* and **15***e*. The detection bar **33** has two pairs of upwardly projecting support portions **34** in the vicinity of its each end. Each support portion **34** has an elongated hole **34***a* 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 **35***a* which is bent obliquely, as shown in FIG. **5**.

[**0031**] 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 **34***a* 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 **34***a*. 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 **15***a* to **15***e*, as shown in FIGS. **4**A and **4**B.

[**0032**] The detecting portions **35***a* 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 **30***a* of the pair of limit switches **30**.

[**0033**] 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.

[**0034**] The dropping sheet **6** becomes taut as its trailing portion is caught by the suction belts **16** of the suction units **15***a* to **15***e* 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.

[**0035**] 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. **4**A and **4**B. 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.

[**0036**] 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 **14***b* detect the rubber member **7***a*. When the sensors **14***b* 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 **14***a* 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.

[**0037**] According to this embodiment, the limit switch **14***a* 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 **15***a* to **15***e* or the like to damage them.

[**0038**] Even if a corner or tool is left at a position where it is not detected by the limit switch **14***a*, 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.

[**0039**] 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 **30***a* of either one of the pair of limit switches **30** is actuated by the detecting portion **35***a* 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.

[**0040**] 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**.

[**0041**] 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.

[**0042**] 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.

[**0043**] 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.

What is claimed is:

1. 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 said 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 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 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 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 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 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 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 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 which is supported between a pair of frames that oppose each other at a predetermined gap,

a block which is pivotally supported by said stay, and

a shaft 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 which is supported by said stay in a direction of length of said stay,

wherein said block is pivotally supported by said pin.

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