United States Patent [19]

D'Amato et al.

[11] **3,907,274**

[45] **Sept. 23, 1975**

[54] **SHEET DELIVERY APPARATUS FOR PRINTING PRESSES INCLUDING DOUBLE STACKER**

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[73] Assignee: **American Bank Note Company**, New York, N.Y.

[22] Filed: **June 21, 1973**

[21] Appl. No.: **372,066**

[52] **U.S. Cl.** **271/64**; 101/232; 271/183; 271/204; 271/218

[51] **Int. Cl.²** **B65H 29/04**

[58] **Field of Search** ..... 271/64, 204–206, 271/217, 218, 183, 57; 214/6 H; 101/232

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Assistant Examiner—Bruce H. Stoner, Jr.
Attorney, Agent, or Firm—Cooper, Dunham, Clark, Griffin & Moran

[57] **ABSTRACT**

The sheet delivery apparatus includes means for delivering sheets on a delivery conveyor either all to a selected one of two sheet stack receiving means, or alternate sheets to each stack receiving means. As another alternative, counted batches of sheets may be delivered alternately to the two sheet stack receiving means. A third sheet receiving means, of limited capacity is provided to receive selected sheets for inspection, and at times to receive other sheets. The sheet delivery chain carries sheet grippers and cam followers for operating the grippers to sheet releasing positions. The cam followers on alternate sheet grippers along the chain are spaced at one of two different locations laterally of the chain. Each sheet stack receiving means is provided with two retractable cams, spaced laterally corresponding to the two lateral locations of the followers. When any cam is moved from its retracted position to an active tripping position, it engages the cam followers on alternate grippers along the chain, so that alternate sheets are dropped from the chain at that location. Each sheet receiving means includes a stacker comprising two vertically extending opposed conveyors, each having retractable brackets projecting toward the opposite conveyor. Plates or pallets may be inserted on the brackets to receive the sheets. The conveyors are driven downwardly as the stack builds up. The brackets are retracted upon engagement with the edges of the stacked plates, so that the movement of the conveyors may continue after the motion of the plates is stopped.

12 Claims, 18 Drawing Figures

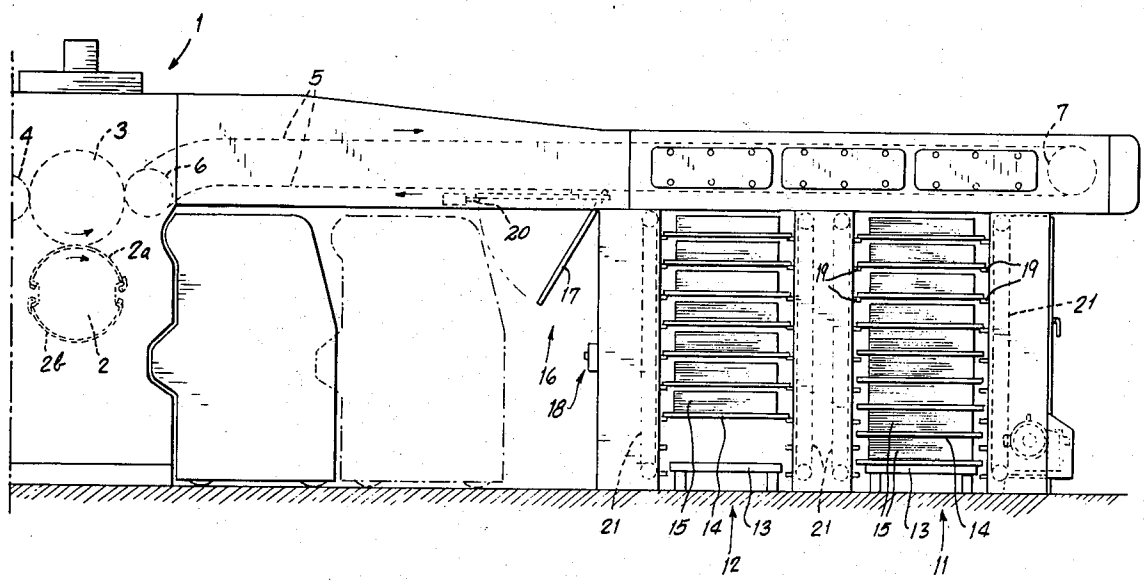
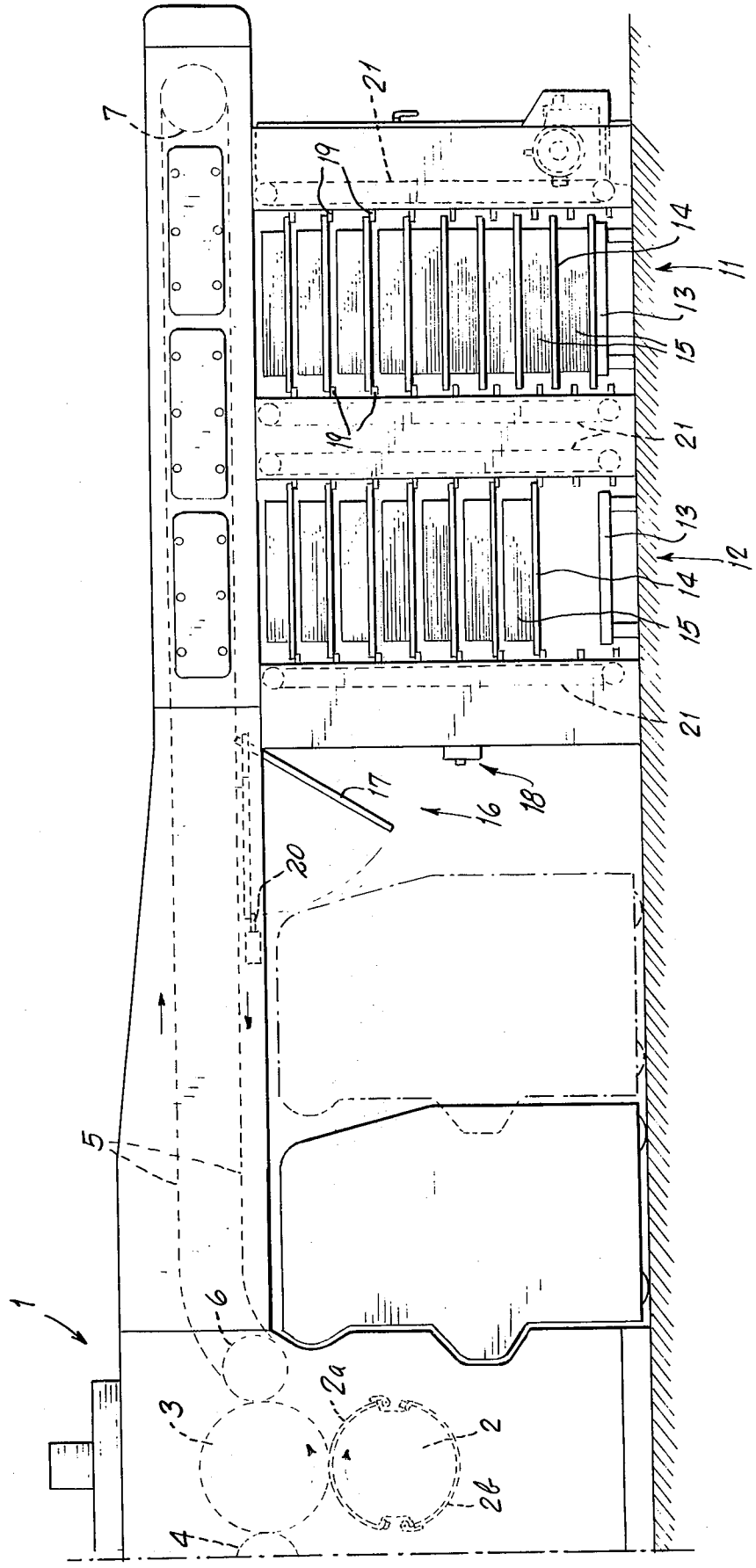


Fig. 1.



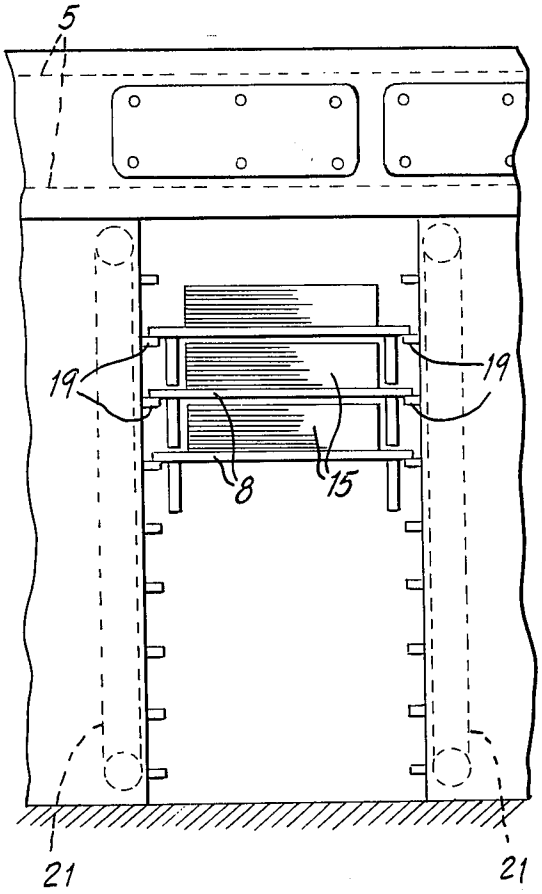


Fig. 1A.

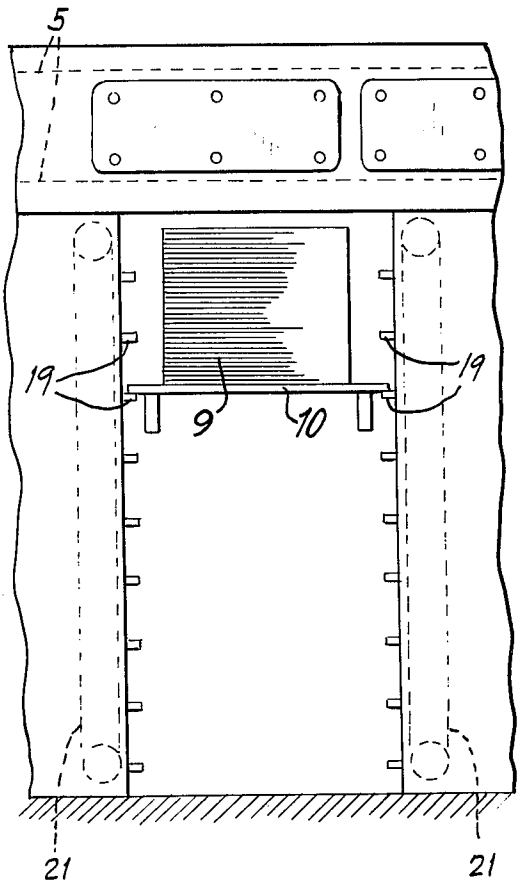
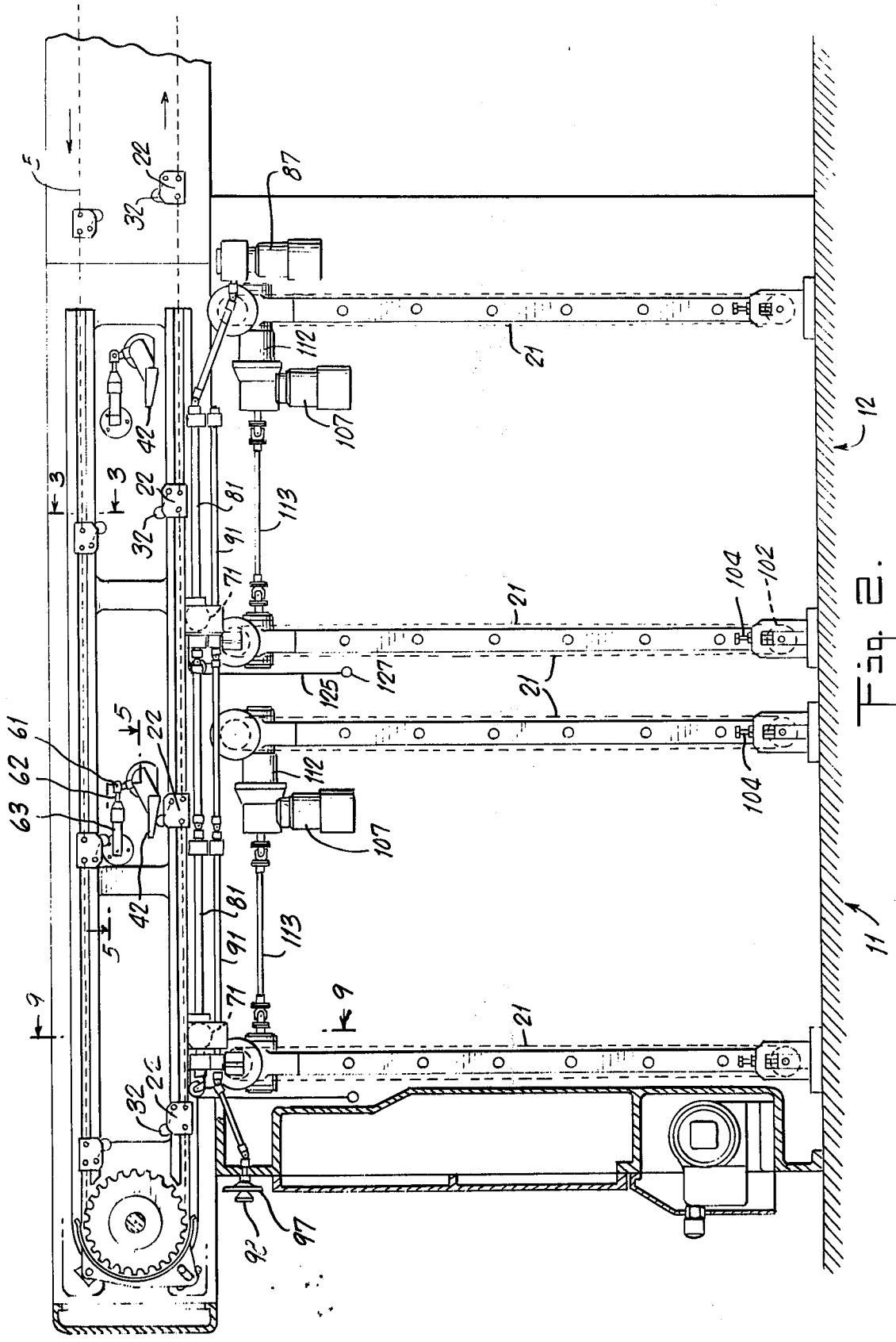


Fig. 1B.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22
32
112
107
21
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71
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104
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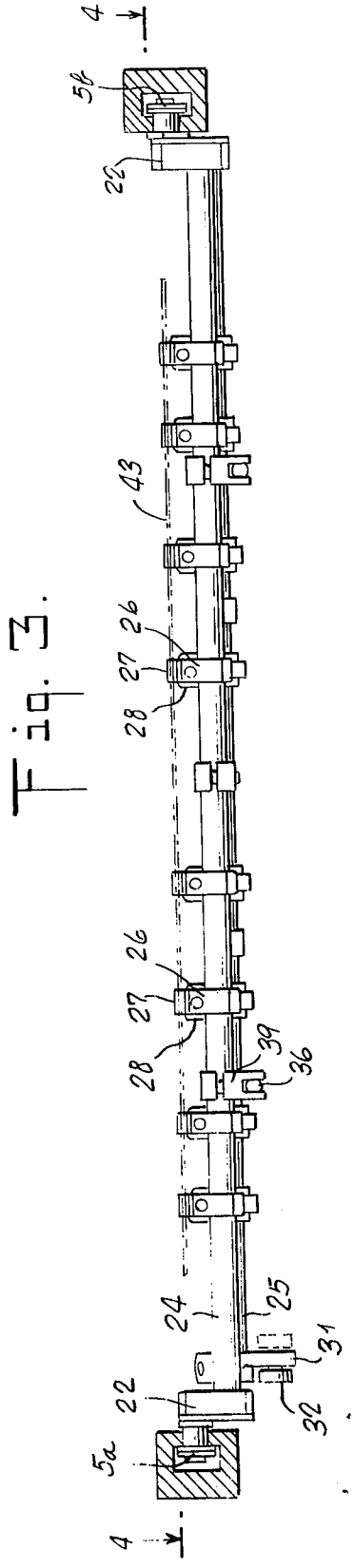
125
127
5
61
62
63
9
12
11

Fig. 2.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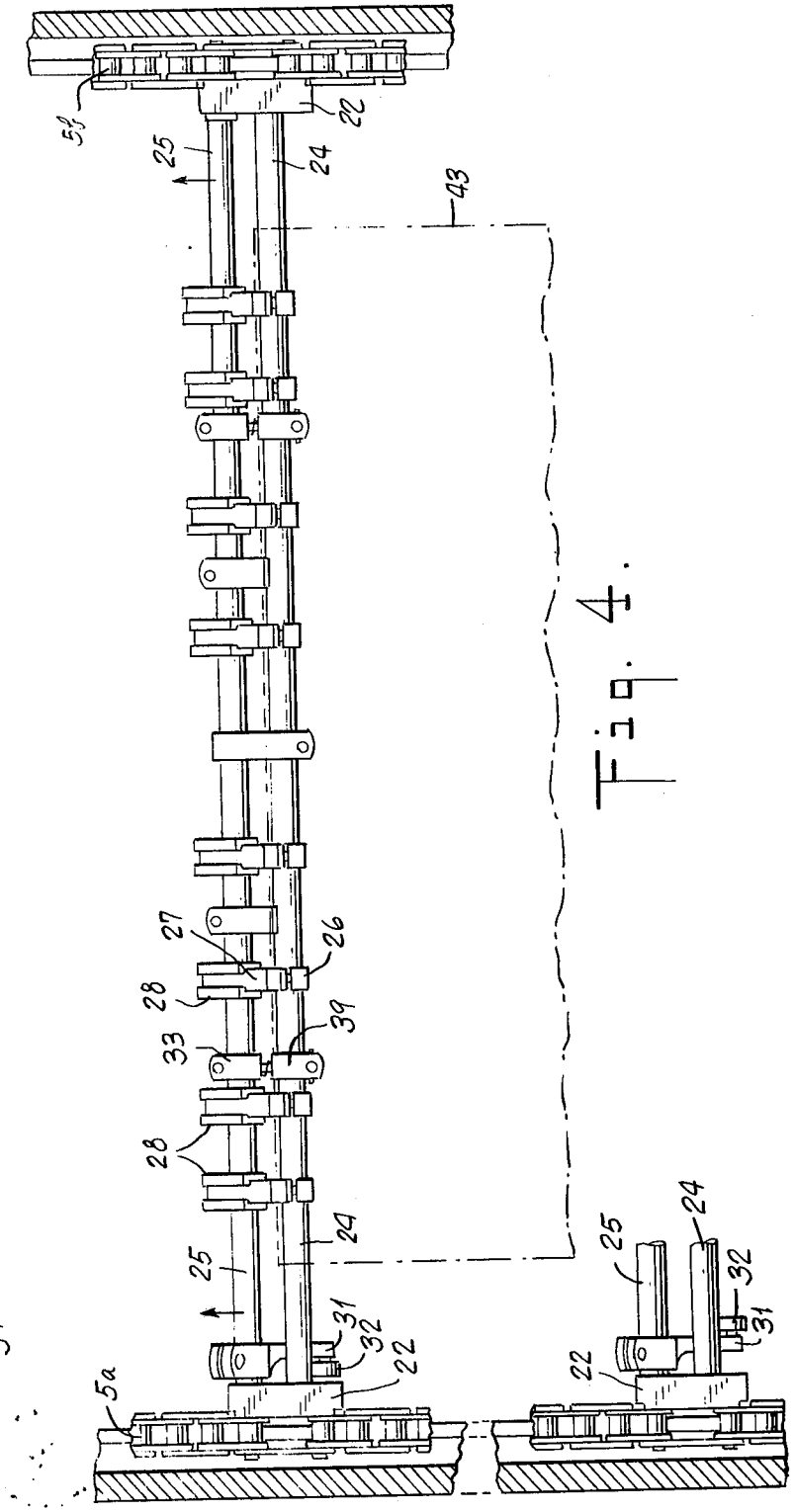
5b
22
43
26
27
28
39
36
24
25
31
32
22
5a
4

Fig. 3.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22
25
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43
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33
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25
31
32
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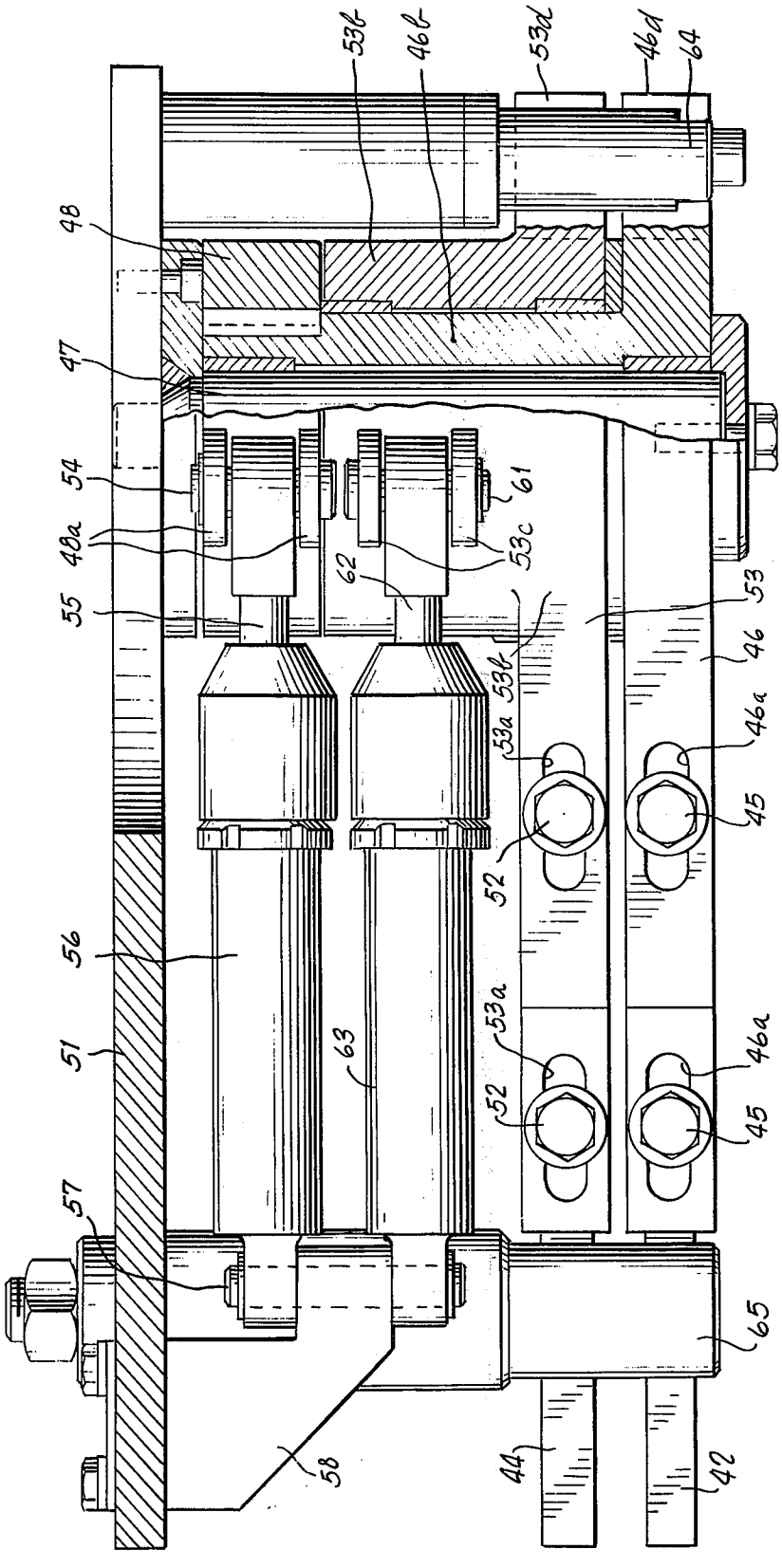
5a
22
25
24
32
31

Fig. 4.


53b
46b
53d
46d
64
48
47
54
61
48a
53c
62
55
53
46
53b
53a
46a
45
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63
57
65
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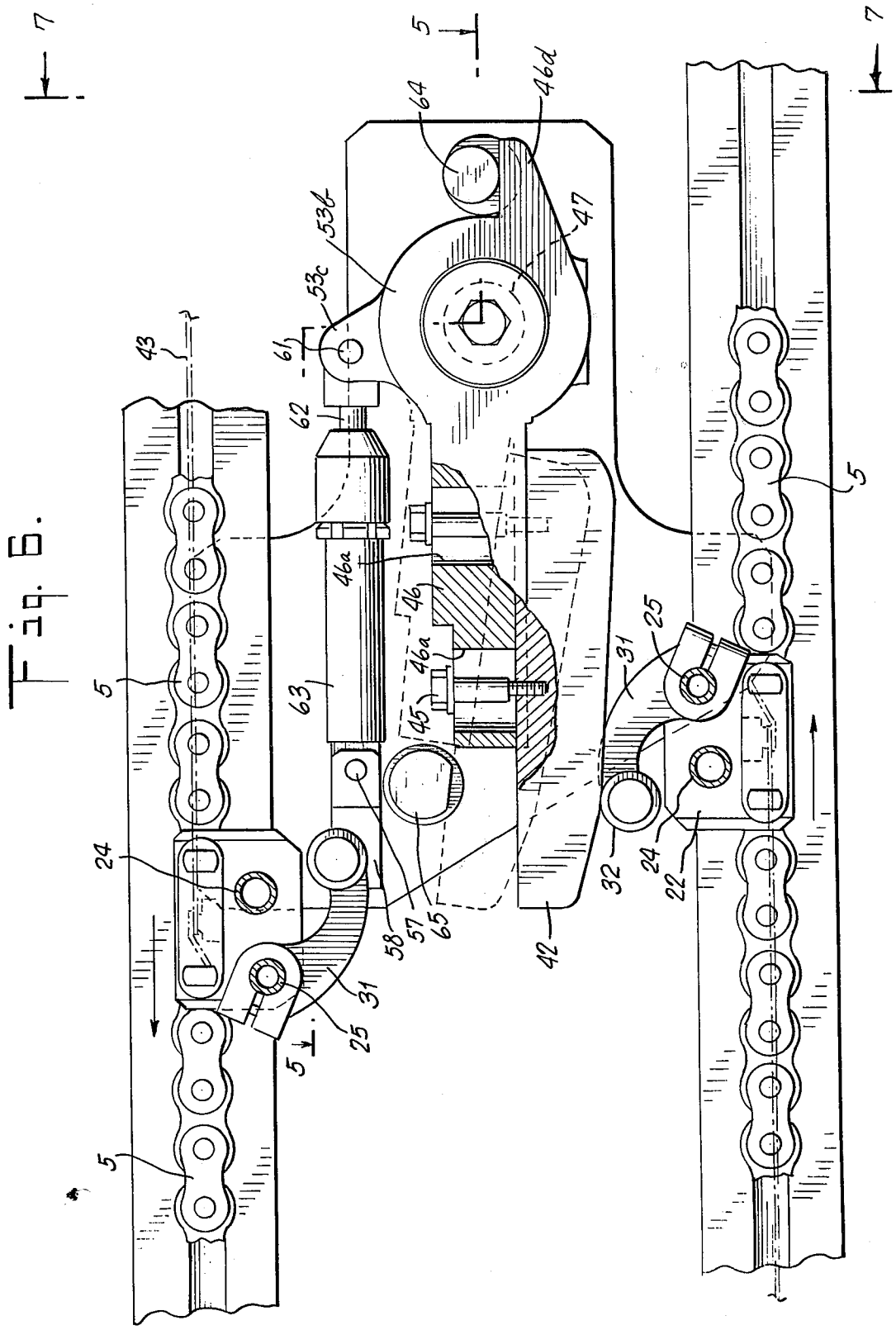
44
42

Fig. 5.


7
5
7
64
46d
47
53d
53c
61
43
62
46a
46
45
63
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31
32
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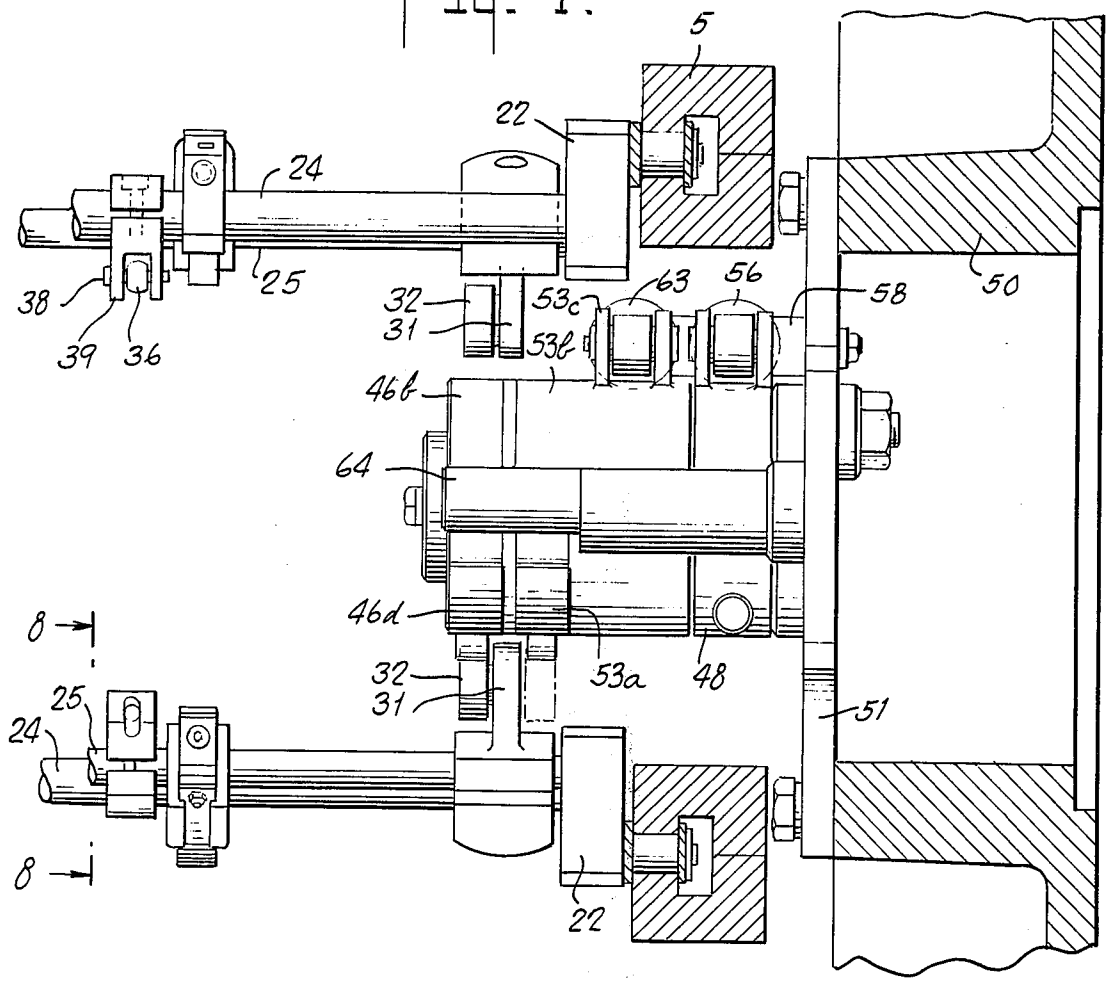
65
42

Fig. 6.

Fig. 7.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22
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38
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36
32
31
53c
53b
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56
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46b
64
46d
53a
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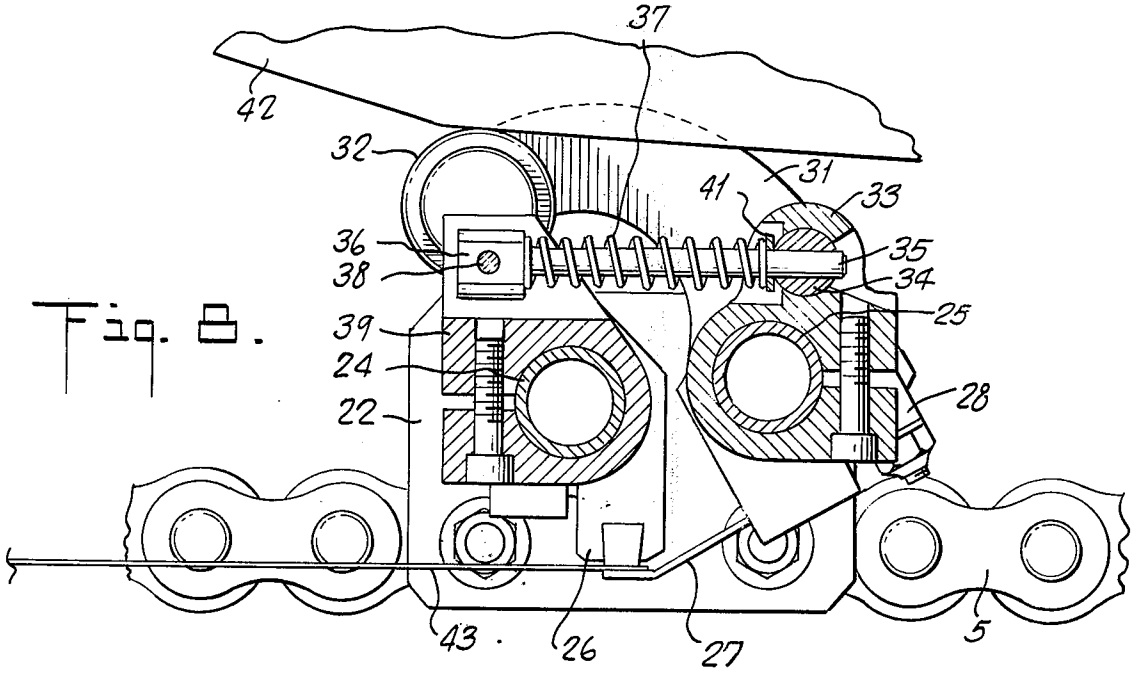
Fig. 8.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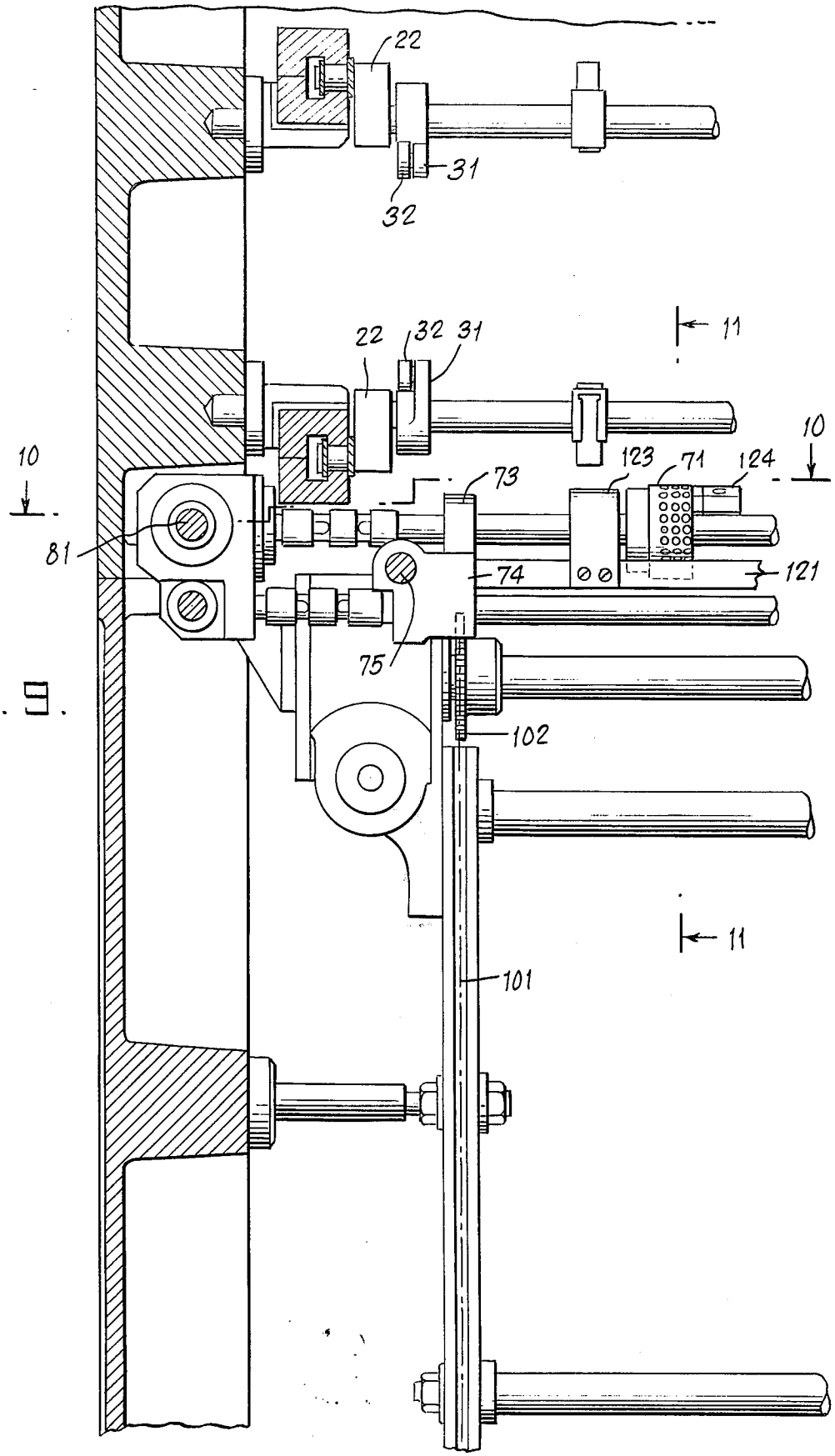
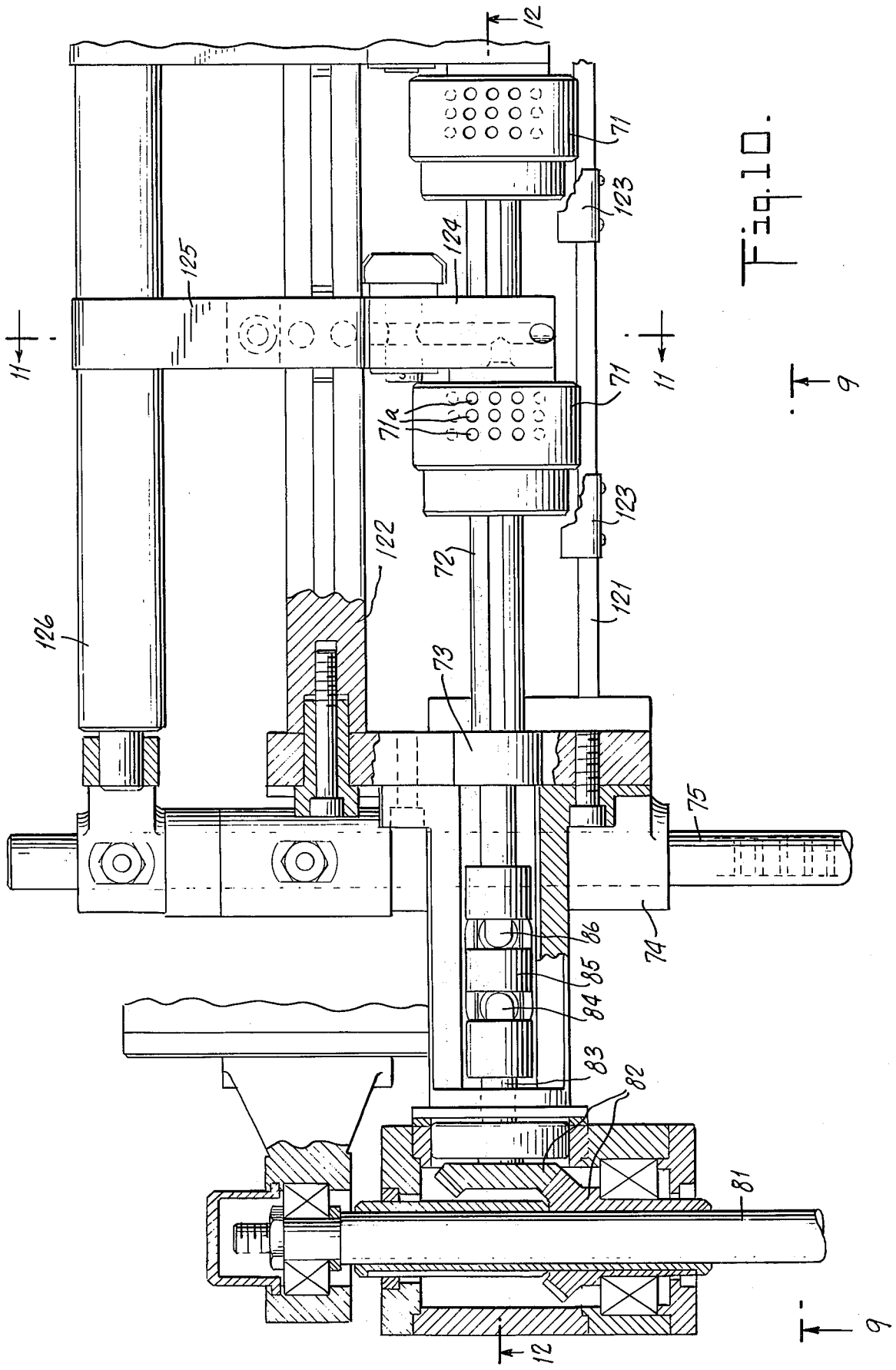


Fig. 9.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11
71
71a
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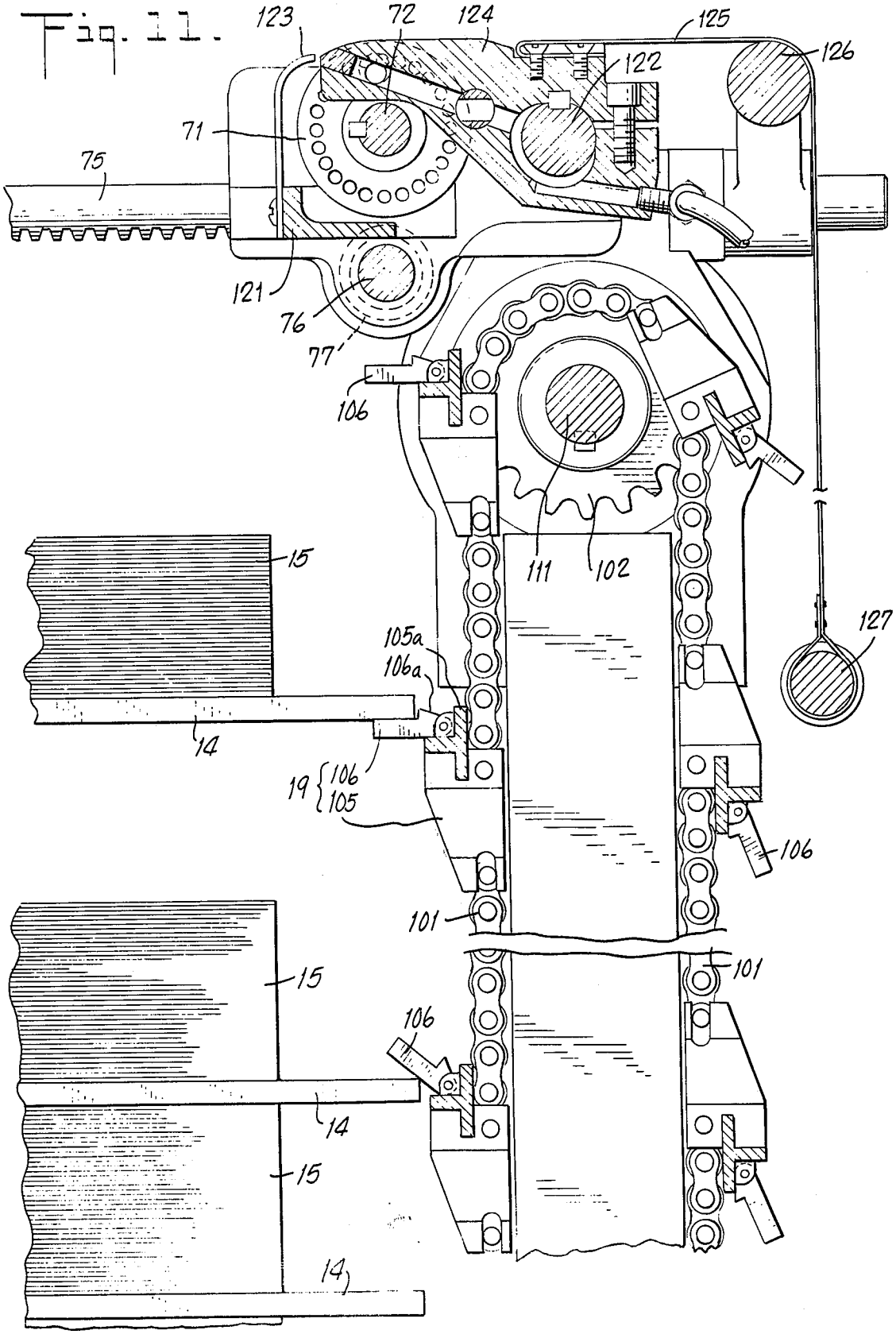
12

Fig. 10.

Fig. 11.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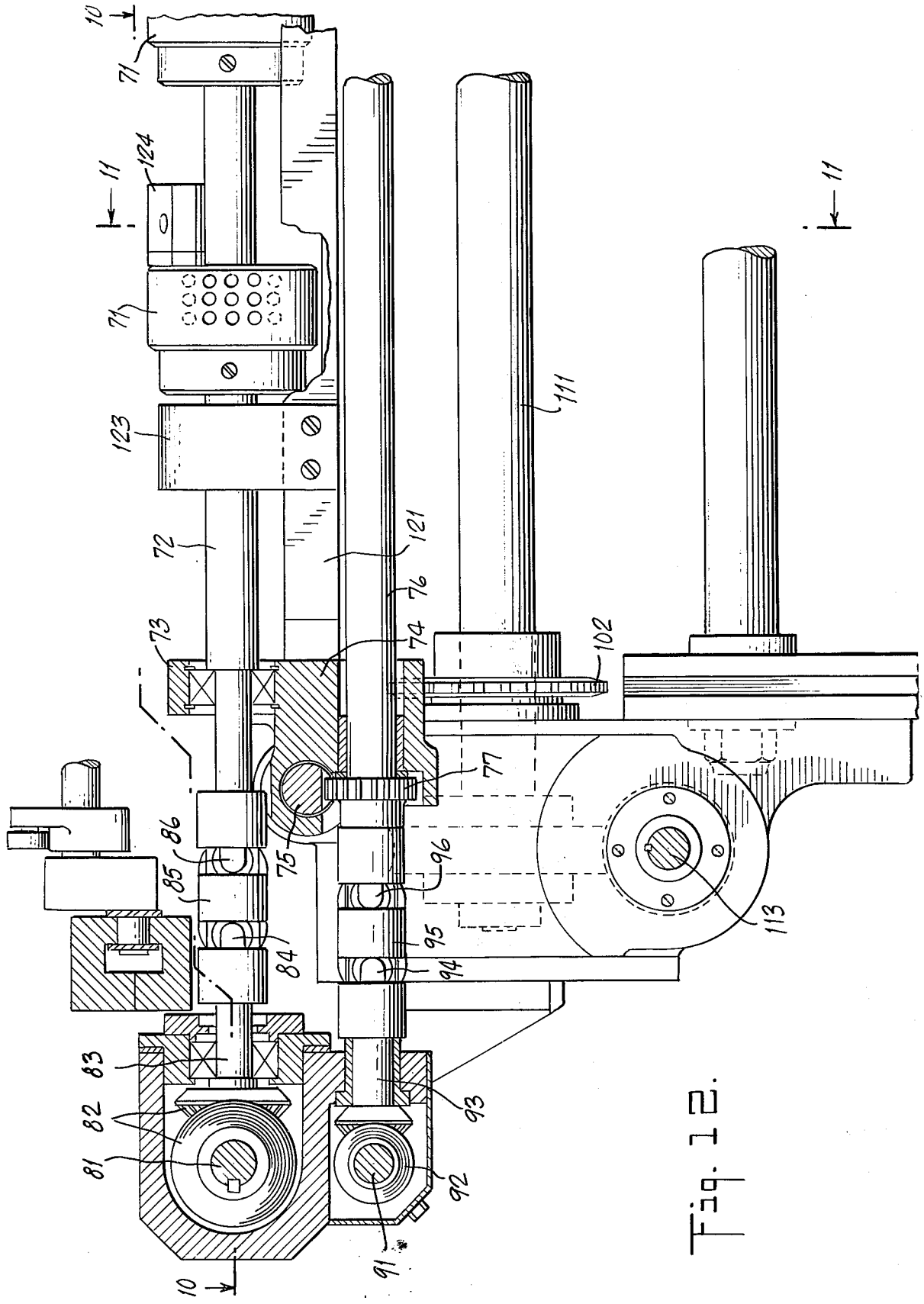
106
14
15
14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102
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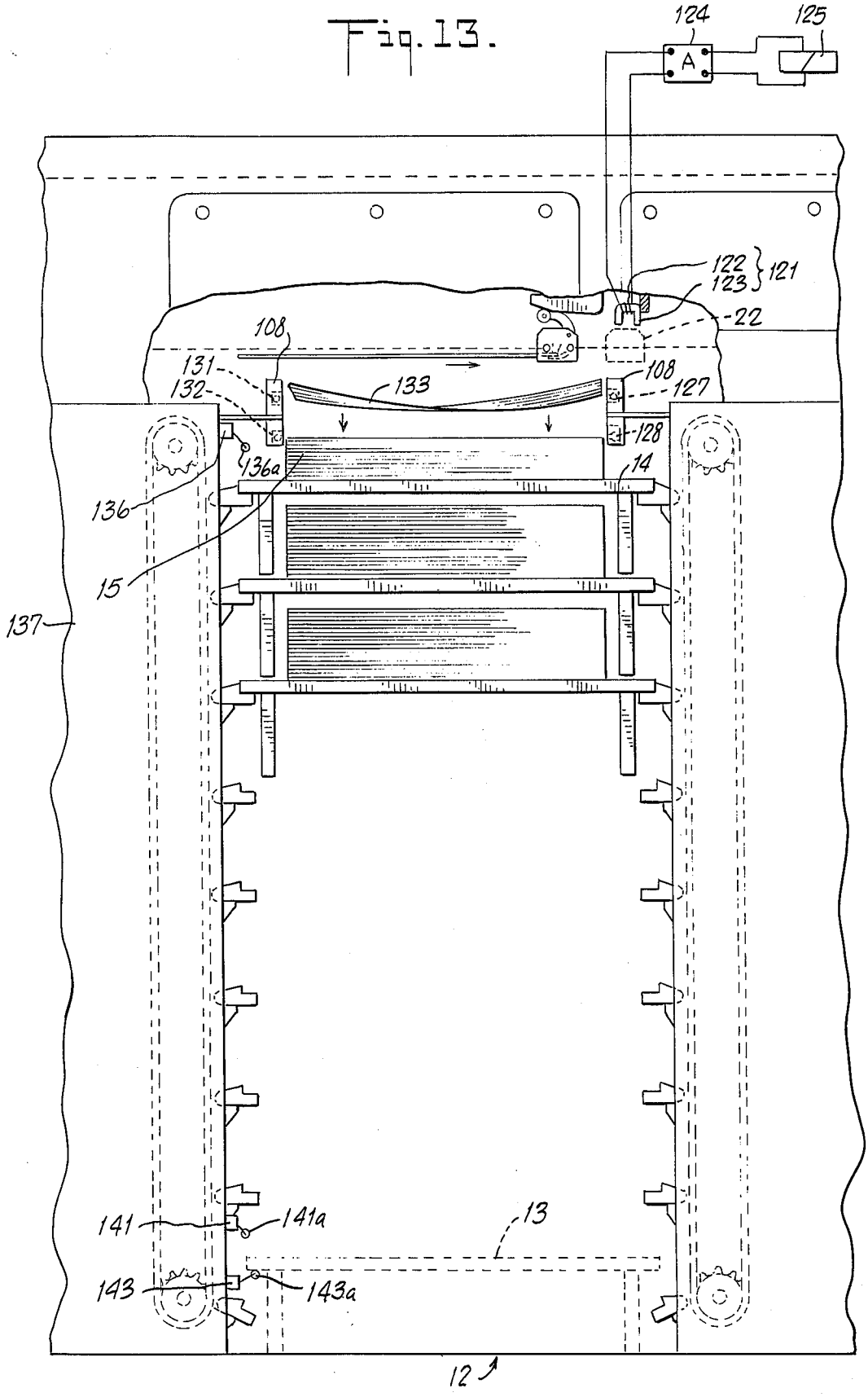
Fig. 12.

Fig. 13.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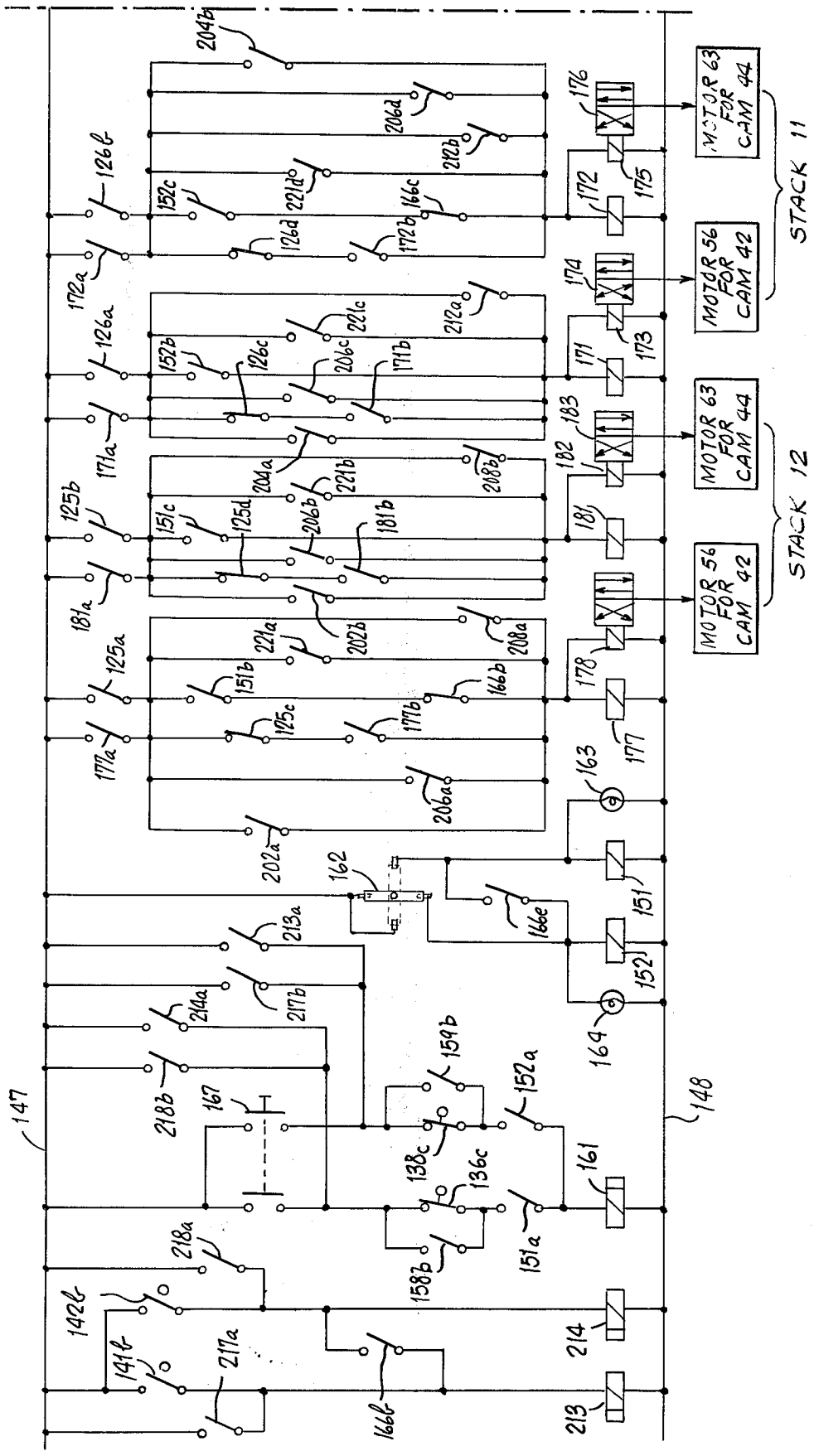
141
141a
13
143
143a
12

Fig. 14A.


MOTOR 63 FOR CAM 44
MOTOR 56 FOR CAM 42
MOTOR 63 FOR CAM 44
MOTOR 56 FOR CAM 42
STACK 11
STACK 12
147
148

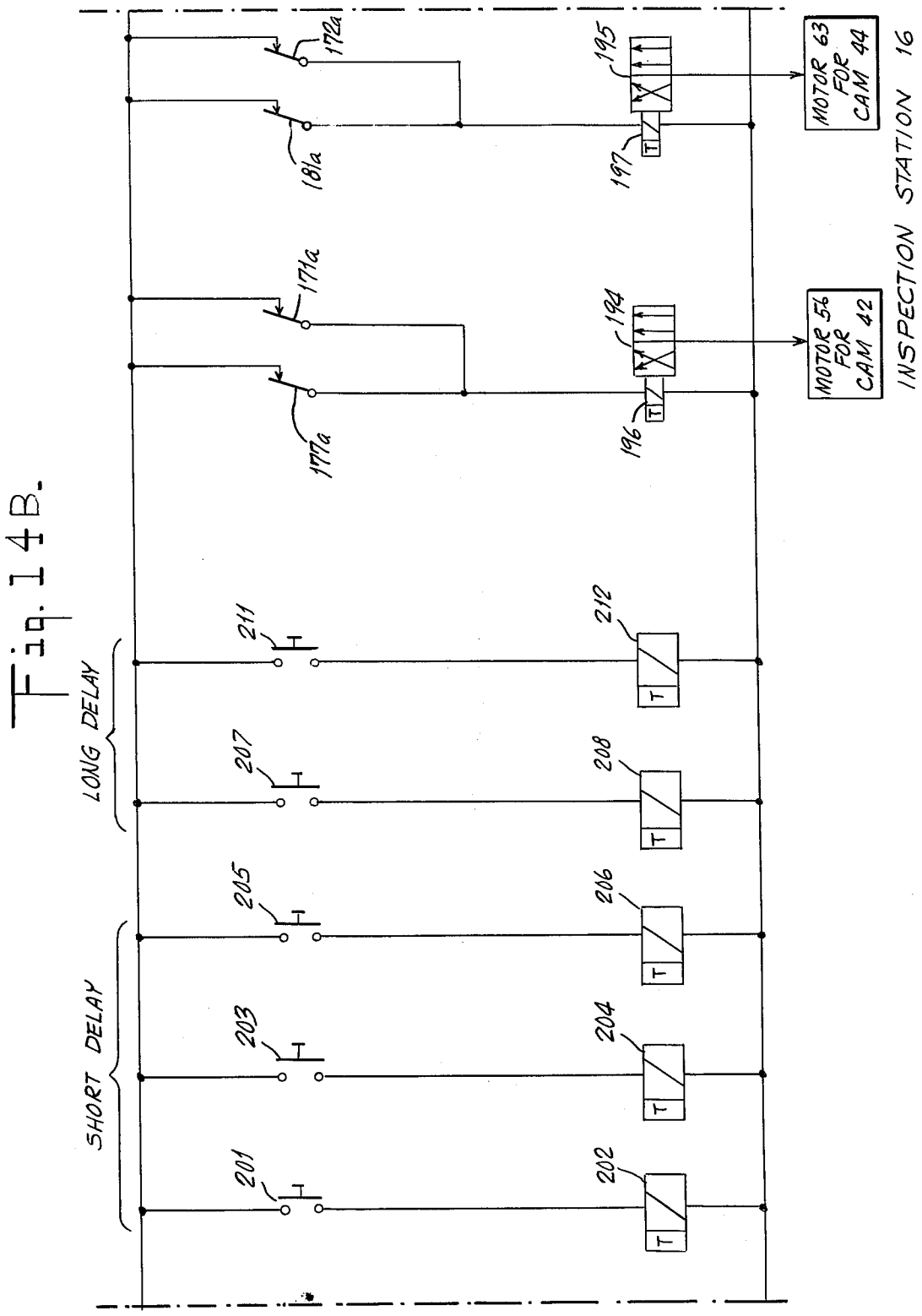
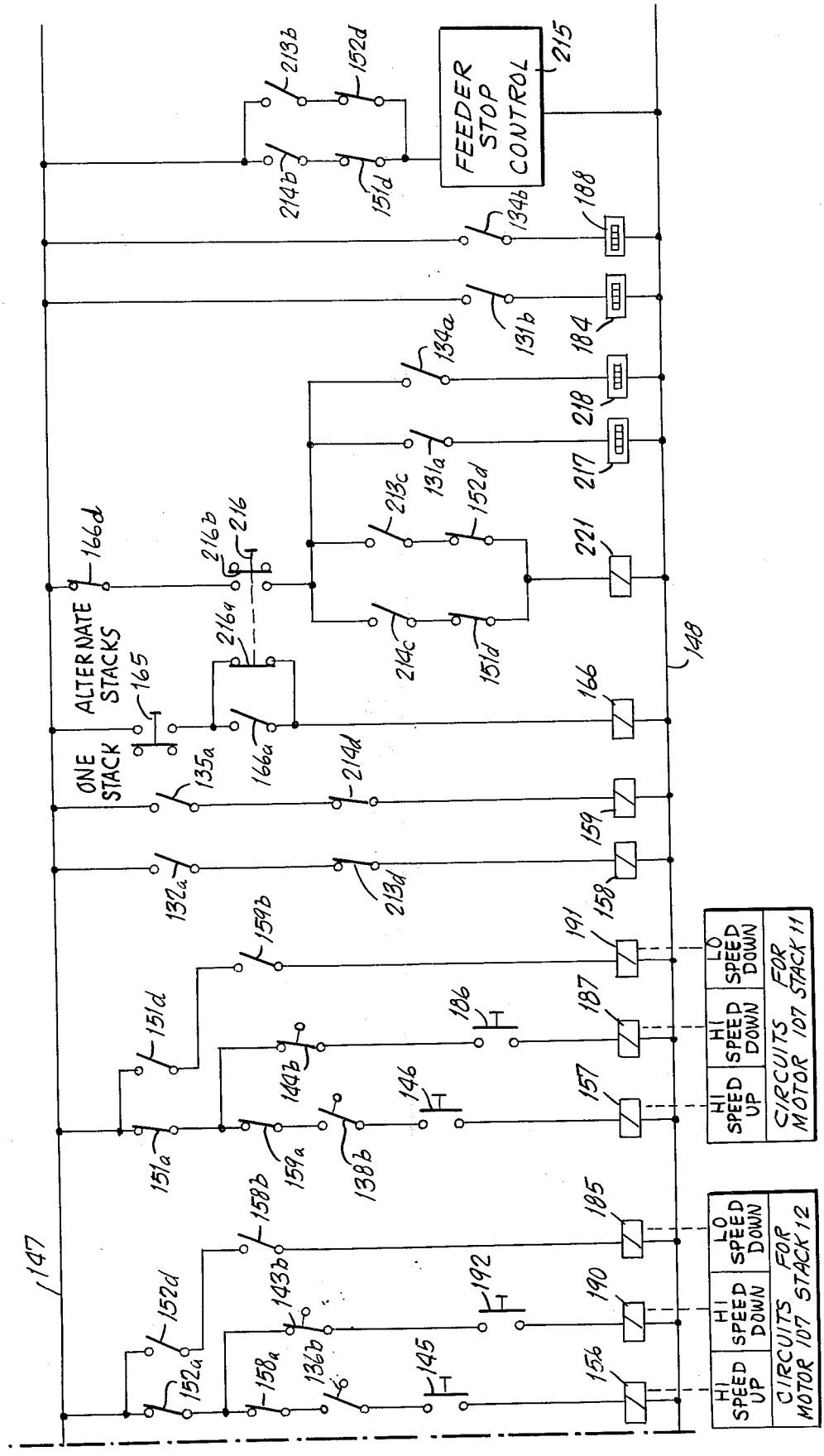

INSPECTION STATION 16
MOTOR 63 FOR CAM 44
MOTOR 56 FOR CAM 42
172a
181a
171a
177a
195
197
194
196
211
212
207
208
205
206
203
204
201
202
LONG DELAY
SHORT DELAY
T

Fig. 14B.

Fig. 14c.


FEEDER STOP CONTROL
215
ONE STACK
ALTERNATE STACKS
165
HI SPEED UP
HI SPEED DOWN
LO SPEED DOWN
CIRCUITS FOR MOTOR 107 STACK 12
CIRCUITS FOR MOTOR 107 STACK 11
147
148

SHEET DELIVERY APPARATUS FOR PRINTING PRESSES INCLUDING DOUBLE STACKER

CROSS-REFERENCES

U.S. Pat. application, Ser. No. 173,555, filed Aug. 20, 1971, by Ivaldo Gazzola et al., entitled "Plate Wiping Mechanism for Intaglio Press", now U.S. Pat. No. 3,762,319, issued Oct. 2, 1973 discloses an apparatus which may be used on the same press with the present invention.

U.S. Pat. Application, Ser. No. 195,364, filed Nov. 3, 1971, by Ivaldo Gazzola et al., entitled "Apparatus for Delivering Sheets Onto a Moving Strip of Material", now U.S. Pat. No. 3,749,330, issued July 31, 1973 discloses another apparatus which may be used on the same press with the present invention.

U.S. Pat. Application, Ser. No. 298,443, filed Oct. 17, 1972, by Ivaldo Gazzola et al., entitled "Printing Pressure Control Apparatus for Intaglio Press", discloses another apparatus which may be used on the same press with the present invention.

U.S. Pat. Application, Ser. No. 298,444, filed Oct. 17, 1972, by Ivaldo Gazzola et al., entitled "Paper Feed Mechanism for Cylinder Press", now U.S. Pat. No. 3,828,673, issued Aug. 13, 1974 discloses another apparatus which may be used on the same press as the preset invention.

U.S. Pat. Application, Ser. No. 298,376, filed Oct. 17, 1972, by Ivaldo Gazzola et al., entitled "Apparatus for Fitting Flexible Printing Plates and Rigging to Printing Press Cylinders", now Patent No. 3,828,672, issued August 13, 1974 discloses another apparatus which may be used on the same press as the present invention.

U.S. Pat. Application, Ser. No. 302,126, filed Oct. 30, 1972, by Ivaldo Gazzola et al., now Patent No. 3,822,644, issued July 9, 1974 entitled "Apparatus for Maintaining Registry Between the Plates of a Multiple Plate Cylinder Press and Sheets Supplied Thereto", discloses another apparatus which may be used on the same press as the present invention.

BRIEF SUMMARY OF THE INVENTION

The sheet delivery apparatus includes a delivery conveyor having a plurality of gripper means spaced along the conveyor, each gripper means being connected to a cam follower. Each gripper means is biased to a sheet gripping position and is shiftable to a sheet releasing position by its cam follower, which may be actuated to release its gripper means by a cam located along the path of the conveyor. The cam followers for two sets of alternate gripper means along the length of the conveyor are spaced at two different distances from the lateral edges of the conveyor. Two principal sheet stack receiving means are provided, where the delivered sheets can build up into stacks. A third auxiliary sheet receiving means has a limited capacity.

At each sheet receiving location there are two cams, each selectively movable between a retracted position and an active position in which it engages the cam followers on one of the two sets of passing gripper means and actuates them to their sheet releasing positions. The cams at each sheet receiving location are preferably placed side by side, at laterally spaced locations corresponding to the lateral positions of the cam followers on the grippers. The cam actuators include a shaft, concentric sleeves on the shaft, arms on the sleeves carrying the cams and hydraulic cylinders connected to crank arms on the respective sleeves for rotating the sleeves. The cylinders may be independently controlled, so that the cams may be set to release all sheets from the conveyor at any of three sheet receiving locations, or they may be set to release alternate sheets at one station, and the intervening sheets at the other station. Alternatively, all of the cams may be retracted so as to allow one or more sheets, as desired, to pass both of the stacking stations and go on to the third auxiliary sheet receiving location, sometimes referred to as the inspection station.

A stacker at each of the two stack receiving means comprises two horizontally spaced, downwardly traveling opposed vertical conveyor means. The sheets are delivered between these two conveyor means in a substantially horizontal orientation. Each conveyor means includes retractable brackets projecting toward brackets at the same levels on the opposite conveyor means. The two conveyors means are synchronously driven, so that the brackets remain at the same levels. A plurality of plates or pallets may be provided, each of which is insertable in the stacker so as to be supported on a set of opposed brackets. Each plate is adapted to receive a section of the stacked sheets. A bottom support for the stack is inserted between the two vertical conveyor means at the bottom thereof. Typically, this bottom support will be a pallet adapted for removal by a fork lift truck or the like.

Each stacker may be operated selectively in either of two modes. In one mode of operation, only a single pallet is used. The pallet is inserted at the bottom of the vertical conveyors, and is wide enough so that its marginal edges are supported by the brackets. The conveyors are driven to lift the pallet to its uppermost position. The stack builds up on the pallet, which is moved downwardly as the stack builds up. When the pallet reaches the bottom of the conveyor, the pallet is removed, carrying the stack supported by it.

In the other mode of operation, the stack is separated periodically into sections by the insertion of plates or pallets, which rest on the brackets on the conveyor. The pallet at the bottom of the stack may or may not rest on the brackets. The height of each section plus its supporting plate is less than the spacing between brackets. During the building up of the stack, the greatest weight to which any sheet can be subjected is the weight of one stack section. Hence, the possibility of transfer of printed images from one sheet to another because of the weight of overlying sheets is minimized.

The vertical conveyors may move at either of two speeds. When sheets are being delivered to a particular stack receiving location, the conveyors are always moving slowly downward under the control of photoelectric cells, so that the downward speed of the conveyors equals the speed with which the stack is built up. When no sheets are being delivered, the conveyors may be moved rapidly under manual control, for convenience in unloading a stack and inserting an unloaded pallet at the bottom of the conveyor and driving it upwardly to bring the pallet to its highest elevation where it receives the fresh sheets from the conveyor.

At each stack receiving means, there is provided an array of vacuum wheels over which the sheets approaching the stack receiving means are drawn. The vacuum wheels pull the trailing edges of the printed sheets taut and keep them from dragging on the apparatus over which they are passing. The vacuum wheels

are rotated so that their peripheral speed is less than the linear speed of the passing sheets. The wheels are thereby effective to pull the sheets away from the grippers. The two arrays of vacuum wheels are provided with a common drive so that they rotate synchronously. The common drive includes a drive shaft with two universal joints at its opposite ends, to permit adjustment of the array of vacuum wheels longitudinally of the direction of movement of the delivery chain. A common adjusting mechanism is provided for changing the longitudinal positions of both sets of vacuum wheels. This common adjustment mechanism includes, for each set of vacuum wheels, a set of pinions running along racks on the opposite sides of the press and driven through a similar common drive shaft and universal joints, which may be manually operated. The vacuum wheels of each array are laterally adjustable on their supporting shaft. Biasing means are provided for the supporting shaft so as to take up any lost motion between the racks and pinions. The biasing means is in the form of flexible straps connected to the supporting shaft and extending over a horizontal shaft and thence downwardly to a weight. The biasing force is independent of the longitudinal adjustment of the vacuum wheel array and is also independent of the lateral adjustment of the vacuum wheels on the support shaft.

DRAWINGS

FIG. 1 is an elevational view showing the delivery end of a printing press, and sheet delivery apparatus is accordance with the invention for delivering sheets from the press to two stack receiving positions.

FIG. 1A is a fragmentary view, similar to a portion of FIG. 1, illustrating a modification.

FIG. 2 is an elevational view taken from the rear of the sheet delivery apparatus as viewed in FIG. 1, on an enlarged scale, showing certain details of the stack receivers.

FIG. 3 is a fragmentary view, partly in section, taken along the line 3—3 of FIG. 2, on an enlarged scale, and with certain parts omitted.

FIG. 4 is a fragmentary sectional view taken along the line 4—4 of FIG. 3.

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 2, on an enlarged scale, and also along the line 5—5 of FIG. 6, with certain parts broken away, and other omitted.

FIG. 6 is an elevational view taken along the line 6—6 of FIG. 5, with certain parts broken away.

FIG. 7 is a fragmentary sectional view taken along the line 7—7 of FIG. 6.

FIG. 8 is a fragmentary sectional view taken along the line 8—8 of FIG. 7, on an enlarged scale.

FIG. 9 is a fragmentary sectional view taken along the line 9—9 of FIG. 2, on an enlarged scale, and with certain parts omitted.

FIG. 10 is a fragmentary sectional view taken along the line 10—10 of FIG. 9, on an enlarged scale, with certain parts broken away and others omitted.

FIG. 11 is a fragmentary sectional view taken along the line 11—11 of FIG. 9, on an enlarged scale, and with certain parts broken away.

FIG. 12 is a fragmentary sectional view taken along the line 12—12 of FIG. 10, with certain parts omitted.

FIG. 13 is a detailed view of stack 12 shown in FIG. 1.

FIGS. 14A, 14B, and 14C, taken together, are a wiring diagram of the controls for the sheet delivery apparatus of FIGS. 1–12.

DETAILED DESCRIPTION

FIG. 1

This figure illustrates a printing press, generally indicated at 1, provided with a sheet delivery apparatus in accordance with the invention. The printing press includes a plate cylinder 2 and a pressure cylinder 3. Sheets to be printed are supplied to the pressure cylinder 3 from a sheet supply cylinder 4, and the printed sheets are removed from the pressure cylinder 3 by an endless delivery conveyor 5, usually a pair of laterally spaced chains 5*a* and 5*b* (FIGS. 3 and 4), running over sprocket wheels 6 at the press and over sprocket wheels 7 at the end of the conveyor remote from the press. The sheets move away from the press on the upper run of the conveyor 5 and are carried around the sprocket wheel 7 and thereafter pass two sheet stack receiving means 11 and 12, hereinafter sometimes referred to simply as stacks 11 and 12. Each of the stacking stations includes a base support 13 for a stack of sheets, which may be a pallet, as shown, to facilitate removal of the stack of sheets by means of a fork lift truck. Each stack may include a plurality of separators, such as the stacking plates 14 of FIG. 1 or the pallets 8 of FIG. 1A, on each of which is supported a stack section 15.

After passing the stack receiving means 11 and 12, the chain 5 passes an inspection station 16, sometimes referred to as an auxiliary sheet receiving means, including a tray 17 which is movable between a normal sheet receiving position, shown in dotted lines in FIG. 1 and an inspection position shown in full lines. The tray 17 may be driven between its two positions by suitable motor means (not shown) controlled manually from a controller 18 located on the press frame under the tray. The tray 17 is latched in its sheet receiving position by a latch 20 releasable only from controller 18. This limited control of the latch 18 prevents accidental downward movement of the tray when a person is standing under it.

Each stacking station 11 and 12 also includes four vertical endless conveyors 21, one at each corner of the station. The conveyors 21, are typically chains and carry retractable brackets 19 which support the plates 14 during their downward travel, and which are pivoted so to retract upwardly (see FIG. 11) and pass by the ends of a plate 14, which has become stationary by virtue of reaching a resting position on one of the lower stack sections 15 or on the base support 13.

Instead of using the stacking plates 14, as shown in FIG. 1, the stack sections 15 may be received on a plurality of pallets 8, as shown in FIG. 1A. The pallets 8 are supported directly by the brackets 19. Note that the pallets 8 have legs which are longer than the height of the stack sections 15. Note also that the height of the legs plus the spacing thickness of the top of the pallets 8 is always less than the spacing between the tops of the brackets 19, as shown in FIGS. 1A and 13.

Another mode of operation of the stacking stations is illustrated in FIG. 1B, where all the sheets are gathered in a single stack 9 supported on a single pallet 10 at the bottom of the stack. The mode of operation illustrated in FIG. 1B is suitable only where the characteristics of the paper and ink being used are such that a tall stack can be built up without encountering objection-

able transfer of printing matter between adjacent sheets in the stack, when subjected to heavy pressure. Note that when the stack reaches its full height, and the pallet **10** is resting on the floor, the lowermost sheets in the stack are subjected to the pressure from the entire stack of sheets. In the modification shown in FIGS. **1** and **1A**, the maximum pressure to which any sheet is subjected during the building of the stack is the pressure due to the height of one stack section **15**, rather than the pressure due to the height of the full stack.

In the modification of FIG. **1**, the pallets **13** are narrower than the horizontal space between the brackets, and so rest upon the floor during the entire stacking operation. Alternatively, a wider pallet **8** or **10** could be used as in FIGS. **1A** and **1B**.

The pallets **8** of FIG. **1A** and the plates **14** of FIG. **1** are inserted from the front or rear sides of the stack, at the top of the stack. They may be inserted by hand or by machine.

FIGS. 2–8

The delivery conveyor **5** includes a plurality of gripper means, each including an associated gripper release mechanism, shown in FIGS. **2–8**.

As best seen in FIGS. **3** and **4**, each gripper means includes a pair of plates **22**, each fixed to one link of the chains **5***a* and **5***b* which make up the conveyor **5**. Each plate **22** is aligned with another plate **22** on the opposite side of the press. Each pair of opposed plates **22** is connected by a fixed rod **24** attached at its ends to the plates **22** and by a gripper release shaft **25**, which is rotatably mounted at its opposite ends in the plates **22**.

Each of the fixed rods **24** carries a plurality of spaced gripper blocks **26** (see FIG. **8**) which cooperate with an equal plurality of gripper fingers **27** carried by blocks **28** fixed on the rotatable shaft **25**. At one end, the shaft **25** has fixed thereto an arm **31** having a cam follower roller **32** rotatably mounted at its outer end. As best seen in FIG. **4**, the cam follower rollers **32** on one set of alternate gripper means are located on the left-hand sides of the arms **31**, while the cam follower rollers **32** for the other set of alternate gripper means are located on the right-hand sides of the arms **31**. Hence, one set of alternate cam followers **32** is spaced laterally of the conveyor **5** from the other set.

The shaft **25** has fixed thereto at spaced intervals, another set of crank arms **33** (FIGS. **4** and **8**) which are apertured at their outer ends to receive pivots **34** which are in turn apertured to receive one end of a rod **35**. The opposite end of rod **35** has a head **36** which is apertured to receive a pivot pin **38** fixed on a forked block **39** attached to the fixed rod **24**. A spring **37** is retained in compression between the head **36** and a spring retaining washer **41** on the rod **35**.

At times during the travel of the chain **5**, the cam follower roller **32** engages a cam **42** and rotates the arm **31** counterclockwise, as viewed in FIGS. **6** and **8**, thereby turning the shaft **25** counterclockwise and separating the gripper fingers **27** from the gripper block **26**, so as to release the leading edge of a sheet **43** which has been retained between the finger **27** and the gripper block. After the cam follower **32** has passed on the cam **42**, the springs **37** are effective to restore the arm **31** and the gripper fingers **27** to their normal gripping positions.

At each of the stack receiving means **11** and **12**, there are two retractable cams, shown at **42** and **44** in FIG. **5**, spaced laterally of the conveyor at locations corresponding to the positions of the two sets of cam followers **32**, described above. The cam **42** is adjustably mounted by means of bolts **45** on a crank arm **46** having slots **46***a* to receive the bolts **45**. The crank arm **46** is integral with a sleeve **46***b* rotatable on a stub shaft **47**, which is fixed in a mounting plate **51** attached to a side frame member of the sheet delivery apparatus.

The sleeve **46***b* is keyed to a crank **48** having a forked crank arm **48***a* which receives at its end a pivot pin **54** to which one end of a piston rod **55** is pivotally connected. The piston rod **55** extends to a piston (not shown) in a hydraulic cylinder **56** whose opposite end is pivoted on a pin **57** mounted on a bracket **58** attached to the mounting plate **51**.

The other cam **44** is similarly mounted on a crank arm **53** by means of bolts **52**, which extend through slots **53***a*. The crank arm **53** is integral with a sleeve **53***b* which is concentric with and rotatable on the outside of the sleeve **46***b*.

The sleeve **53***b* has an integral forked crank arm **53***c* supporting a crank pin **61** which serves as a pivot for one end of a piston rod **62** cooperating with a piston (not shown) in a hydraulic cylinder **63** which is also pivotally mounted at its opposite end on the pivot pin **57**.

The sleeves **46***b* and **53***b* have integrally formed thereon projecting arms **46***d* and **53***d* which engage a stop pin **64** to limit the rotation of the sleeves in the counterclockwise direction as viewed in FIG. **6**. The stop pin **64** is fixed in the mounting plate **51**. The clockwise movement of the sleeves **46***b* and **53***b* is limited by another stop pin **65** which is in the path of movement of the upper sides of the cams **42** and **44**.

The auxiliary sheet receiving means **16** is provided with a pair of selectively operable cams (not shown), similar to the cams **42** and **44**, and similarly actuated, as explained below. It is alternatively possible to provide only one cam at each of the stack receiving means **11** and **12**, but the auxiliary sheet receiving means **16** must have two.

FIGS. 9–12

The cams **42** and **44** control the release of the leading edges of sheets over the stack receiving means **11** and **12**, as may be best seen in FIG. **2**. The trailing edges of the sheets are supported as they approach the stack receiving means **11** and **12** by arrays of vacuum wheels **71**, which appear in dotted lines in FIG. **2**, and in full lines in FIGS. **9–12**. The vacuum wheels **71** at each stack receiving station are keyed on a common shaft **72** which is journaled in a pair of upwardly extending projections **73** on a pair of housings **74** which may be moved longitudinally of the sheet delivery apparatus on a pair of rack rods **75**. Each housing **74** slidably receives a rack rod **75** which has the rack teeth formed on its under side, as best seen in FIG. **12**. Each pair of housings **74** also rotatably carries a shaft **76** which extends across the sheet delivery apparatus and has fixed thereon a pair of pinions **77** which cooperate with the racks **75**.

The shafts **72** for both of the stack receiving means **11** and **12** are continuously rotated by a common drive shaft **81** through two sets of bevel gears **82**. One of each set of bevel gears **82** is fixed on the common drive shaft **81** and the other is fixed on a stub shaft **83** (FIG. **12**) whose opposite end is connected by a universal joint **84**

to one end of a drive shaft **85**. The other end of drive shaft **85** is connected through a universal joint **86** to an end of the vacuum wheel supporting shaft **72**. The common drive shaft **81** is driven by a motor **87** (FIG. **2**) through an appropriate shaft linkage including supported sections journaled in the frame of the sheet delivery apparatus and connected by universal joints to unsupported sections of the shaft to accommodate minor misalignments between the supported sections as may be required. The motor drives the vacuum wheels **71** at a peripheral speed slower than the speed of the passing sheets, so that the wheels **71** are effective to maintain the sheets under tension.

The pinion supporting shaft **76** of each of the stack receiving means **11** and **12** is driven from a common drive shaft **91** through a pair of bevel gears **92**, a stub shaft **93**, a universal joint **94**, a drive shaft **95** and another universal joint **96** connected to the end of one of the shafts **76**. The common drive shaft **91** for the two shafts **76** and their pinions **77** is rotatable by means of a hand wheel **97** (FIG. **2**) provided with a locking wheel **98**. The shaft **91** extends lengthwise of the sheet delivering mechanism, and includes supported sections and unsupported sections which are connected by universal joints between their ends and the supported sections.

By loosening the lock wheel **98** and adjusting the hand wheel **97**, the vacuum wheels **71** for both stack receiving means may be moved lengthwise of the sheet delivery apparatus as may be required to accommodate sheets of different widths received from the press. It is not expected that the range of adjustment required will be great, and should of course be within the capability of movement of the drive shaft linkages including the universal joints **84, 86, 94, 96.**

The bolts **45, 52** and slots **46***a*, 53*a* allow adjustment of the cams **42** and **44** to provide a similar accommodation for sheets of different dynamic characteristics. In other words, some sheets present less air resistance than others, so that some sheets drop more quickly away from the conveyor when they are released. The sheets that drop more quickly must be carried along the conveyor a greater distance before they are released, if they are to drop in substantially the same stack location.

Between the two housings **74**, on the opposite sides of the sheet delivery apparatus, there are provided two beams **121** and **122** (FIGS. **10** and **12**). The beam **121** adjustably supports a plurality of guides **123** which cooperate with the vacuum wheels **71** to keep the trailing edges of the sheets of paper from following too closely the periphery of the vacuum wheels, so that the sheets are separated completely from the vacuum wheels and fall onto the stacks **15** without being delayed unduly by the presence of the vacuum wheels.

Adjacent each of the vacuum wheels **71**, there is fixed on the beam **122** a manifold **124** through which a source of vacuum (not shown) is connected to the peripheral ports **71***a* on the vacuum wheels. A flexible strap **125**, preferably of metal, is attached to the top of each manifold **124** and extends over a rotatable transverse shaft **126** and thence downwardly. The lower end of the strap **125** carries a weight **127**. The weights **127** are effective to bias the entire vacuum assembly, including housings **74** and the parts associated therewith toward the shaft **126** and thereby to take up all lost motion in the driving connections for the shafts **72** and **76**. Note that this bias is equally effective in all positions of the vacuum wheel assembly as it is adjusted longitudinally of the sheet delivery apparatus. It is also equally effective in any lateral adjustment of any of the vacuum wheels **71**. In other words, the biasing force provided by this mechanism remains constant regardless of adjustments made in either the longitudinal position or the lateral positions of the vacuum wheels.

Each of the stack receiving means **11** and **12** comprises vertical conveyor means including four endless chains **101**, each extending over an upper sprocket **102** and a lower sprocket **103**. The lower sprocket **103** is provided with a conventional tension adjustment **104**. Each chain **101** has fixed thereon at spaced intervals brackets **19**, each bracket **19** comprising a link **105** (FIG. **11**) supporting a pivoted arm **106**. The arms **106** are biased by gravity so that as they move over the top sprocket **102** in the counter-clockwise direction as viewed in FIG. **11**, they fall to horizontal positions. As viewed in FIG. **11**, the bias acts counter-clockwise on the arms **106**. Each arm **106** has a shoulder **106***a* which cooperates with a flange **105***a* on the link **105** to limit the rotation of the arm **106** in a clockwise direction. The brackets on the four chains **101** are at the same levels, and the four chains are maintained in synchronism since they are driven from a common drive motor **107** (FIG. **2**). As each pair of brackets **106** starts to move downwardly, a plate **14** is inserted either manually or by a suitable apparatus (not shown), so as to be supported on an array of four brackets at the same level. Each stack section **15** builds up on the uppermost plate **14** being supported and guided and aligned thereon by a conventional jogger mechanism, shown only diagrammatically in FIG. **13** as a pair of vertical plates **108**, which are horizontally reciprocated by means not shown. As the plates **14** and the stack sections **15** thereon move downwardly on the chains **101**, the lowermost plate **14** eventually comes to rest on the pallet **13** and the plate **14** immediately above it later comes to rest on the lowermost stack section **15**. The subsequent stack plates and stack sections all come to rest, one after the other, on the stack sections below them. The arrangement just described gives the sheets a substantial drying time for the ink to set before they are subjected to the pressure of more than the small number of sheets represented by a single stack section **15**. The lowermost stack section does not begin to receive pressure from stack sections above it until it has reached the pallet **13** and is supported by the pallet.

After a particular plate **14** is supported either by the pallet **13** or by a stack section **15** immediately under it, then the brackets **19** move downwardly away from the plate which is so supported. The arms **106** are pivoted by engagement of the lower plates and pass by them without interference.

Instead of using gravity bias to hold the arms **106** in their projected positions, springs may be employed for this purpose. The particular biasing arrangement employed does not affect the operation, as long as it permits the arms to move to their retracted positions to pass the stationary plates **14** without interference.

Each pair of front and rear sprockets **102** is fixed on a shaft **111**, which extends from front to rear across the sheet delivery apparatus. The two shafts **111** for each stacking station are driven by a motor **107** (FIG. **2**) through a reduction gear **112** and a suitable shaft **113**. The lower sprockets **103** are similarly fixed on rotat-

able shafts. The sprockets **103** are idler sprockets, and are not driven except through the chains **101.**

FIGS. 13 AND 14A-14C

FIG. **13** illustrates the various position sensing controls used on one of the two stacks, illustrated as the stack **12.** FIGS. **14A–14C** taken together provide a wiring diagram including the controls shown in FIG. **13** and a similar set of controls for the other stack, together with various manual controls.

Near the top of FIG. **13,** there is shown a proximity detector **121** for producing a signal upon passage of one of the gripper means supporting plates **22.** The proximity detector **121** comprises a coil **122** mounted on a core **123.** Upon passage of a plate **22,** the reluctance of the magnetic circuit of coil **122** varies substantially so as to produce an impulse in the coil **122.** Coil **122** is connected through a suitable amplifier **124** to an electromagnet **125** which operates contacts **125***a* and **125***b* (FIG. **14A**) which are open where there is no plate **22** adjacent the core **123** and contacts **125**c and **125**d which are closed when there is no plate **22** adjacent the core **123.** Upon the passage of a core, current is induced in coil **122,** the contacts **125***a* and **125***b* are closed, and the contacts **125***c* and **125***d* are opened. The contacts **125***c* and **125***d* open before the contacts **125***a* and **125***b* close.

One of the opposed jogger plates **108** carries light sources **127** and **128** producing beams directed respectively toward light sensitive cells **131** and **132** carried by the other jogger plate. The mounting of these light sources and the light sensitive cells on the jogger plates is for convenience only. They could alternatively be supported by stationary parts of the sheet delivery apparatus.

The light source **127** produces an impulse at the light sensitive cell **131** whenever a sheet **133** being delivered to stack **12** interrupts the beam of light.

The cell **131** is connected through an amplifier to an electromagnet which controls contacts **131***a* and **131***b* (FIG. **14C**) so as to close those contacts whenever a sheet **133,** being delivered to stack **12,** interrupts the beam from light source **127.** A similar photoelectric apparatus (not shown) is provided for stack **11** and controls contacts **134***a* and **134***b* in FIG. **14C.** Contacts **131***a* and **134***a* control preset batch counters **217** and **218.** Contacts **131**b and **134***b* control sheet counters **184** and **188.**

The cell **132** is connected in a circuit which produces a signal whenever the beam of light from source **128** is interrupted by the top of the accumulating stack section **15.** That signal is utilized to control a contact **132***a* in FIG. **14C,** so as to close that contact whenever the light beam from the light source **128** is interrupted. A similar photocell (not shown) for stack **11** controls a contact **135***a* in FIG. **14C.** Contacts **132***a* and **135***a* control circuits for relays **158** and **159,** respectively.

A limit switch **136** is mounted on a frame member **137** of the delivery apparatus and is provided with an actuating lever **136***a* which is engaged by the uppermost pallet **14** when it is in its top position. The switch **136** includes a contact **136***b*, shown diagrammatically in FIG. **14C.** Contact **136***b* is opened when the pallet **14** is in its uppermost position, and is closed whenever the pallet **14** is in any other position. The switch **136** also has a contact **136***c* (FIG. **14A**), which is normally closed and which is open when the uppermost pallet **14** reaches its top position. The corresponding switch on stack **11** is shown at **138***c*. Another switch **141** is mounted on the frame member **137** a short distance above the lower limiting position of the pallet **14.** The switch **141** has an actuating lever **141***a*, which is constructed so as to permit the pallet to move downwardly pas the switch **141** after having actuated the lever. Switch **141** includes a contact **141***b* (FIG. **14A**) which is closed whenever the lowermost pallet is at or below the switch **141,** which may be four inches above the underlying floor. When the lowermost pallet **14** is above the position of switch **141,** the contact **141***b* is open. A similar switch (not shown) operating a similar contact **142***b* is provided for the stack **11.** A lower limit switch **143** is mounted on the frame member **137** and is provided with an actuating lever **143***a* so that the switch is actuated whenever the lowermost pallet **14** is resting on the floor. Switch **143** has a contact **143***b* (FIG. **14C**) which is closed when the lowermost pallet **14** is above the floor, but which is open when the pallet **14** is resting on the floor. A similar switch (not shown) having a similar contact **144***b* is provided for the stack **11.**

OPERATION

Assume that the operation starts with both stacks **11** and **12** empty. The first step is to insert a pallet **14** at the lowermost position in the stack, as shown in dotted lines in FIG. **13.** This insertion may be accomplished by a fork lift truck or other suitable apparatus. The motors **107** driving the vertical conveyor chains **101** for the stacks **11** and **12** may then be energized to move the pallets **14** upwardly at a rapid rate by closing pushbutton switches **145** and **146.** Note that switches **136***b* and **138***b* are closed when the pallets **14** are inserted at their lowest positions. Closure of switch **145** completes a circuit from one power line **147** through a contact **152**a, a contact **158***a* of a relay **158,** closed contact **136***b*, and the contacts of pushbutton **145** to the winding of a relay **156.** Relay **156** controls a circuit for driving the motor **107** of stack **12** at a high speed in the upward direction.

Closure of pushbutton switch **146** completes a similar circuit for energizing a relay **157** which in turn closes a circuit for driving a motor **107** of stack **11** rapidly in the upward direction. This circuit may be traced from the upper power line **147** through a closed contact **151***a* of a relay **151,** closed contact **159***a* of a relay **159,** closed contact **138***b*, pushbutton **146** and the winding of relay **157** to the lower power line **148.**

The two vertical conveyors of stacks **11** and **12** are thereby driven upwardly until their respective pallets engage the arm **136***a* of switch **136,** the arm of the corresponding switch (not shown) for stack **11,** and open the contacts **136***b* and **138***b*, thereby de-energizing the motor circuits and stopping the conveyors with the pallets **14** at their uppermost positions. This also closes the contacts **136***c* and **138***c* in FIG. **14A.** These contacts are connected in the energizing circuit of a winding **161** which operates a stepping switch **162.** Each energization of the winding **161** rotates the switch **162** through 90°, i.e., from the full line position shown in FIG. **14A** to the dotted line position, or vice versa, so that one of two stack selection relays **151** and **152** is always energized, depending upon the position of switch **162.**

Alternatively, the high speed upward movement of a pallet having a stack of sheets thereon will be stopped by the action of photocell **132** or its counterpart in

stack 11, contact 132*a* or 135*a*, relay 158 or 159, and contact 158*a* or 159*a*.

Energization of relay 151 causes the delivery of sheets into the stack 11 only and energization of relay 152 causes the delivery of sheets into the stack 12 only. If both relays 151 and 152 are energized, the sheets are delivered alternately into the stacks 11 and 12. A signal lamp 163 is connected in parallel with the winding of relay 151 and a signal lamp 164 is connected in parallel with the winding of relay 152. The lamps 163 and 164 indicate which of the two stacks 11 and 12 has been selected to receive sheets or whether both stacks have been selected.

Hence, when the pallet 14 have been driven to their uppermost positions, the apparatus can start delivering sheets to one stack or the other, depending upon the position of switch 162. If both stacks are indicated by the lamps 163 and 164 and only one stack is desired to receive sheets, then a selector switch 165 (FIG. 14C) may be opened to de-energize relay 166 to open the contacts 166*a* and 166*b* and 166*e*. The contact 166*e* connects the two circuits controlled by switch 162, so that when contact 166*b* is closed both circuits are energized. If contact 166*b* is open only one of the lamps 163 and 164 is lit, and only one stack is receiving sheets. If the stack so selected is not the proper one, then the operator closes a stack change switch 167, (FIG. 14A), which completes a circuit from the upper power line 147 through the switch 167, and thence either through contact 138*c* and contact 152*a* of relay 152 or through contact 136*c* and contact 151*a* of relay 151, for energizing the winding 161 to step the switch 162 to its alternate position, thereby transferring the stack selection from relay 151 to relay 152, or vice versa.

The setting of the selector switch 165 and stack change switch 167 may take place when the system is first energized, prior to the loading of pallets 14.

Assume that only relay 152 is energized and the lamp 164 is lighted. As described below, this selects stack 12 to receive sheets. Energization of relay 152 closes contacts 152*b* and 152*c* (FIG. 14A). The next time that the proximity switch 121 for stack 11 receives an impulse due to the passage of a gripper bar support plate 22, contacts 126*a* and 126*b* are closed, thereby completing pick-up circuits for relays 171 and 172. Energization of relay 171 closes contacts 171*a* and 171*b*, completing a holding circuit for relay 171. This holding circuit has one branch extending from contact 171*a* over contact 152*b* to winding 171. This branch is completed as long as contact 152*b* remains closed. A parallel branch extends from contact 171*a* over contact 126*c* and contact 171*b* to winding 171. This latter branch is open at branch 126*c* only when a gripper means passes the proximity detector for stack 11. Thus, once the relay winding 171 has been energized, it remains energized as long as contact 152*b* is closed and thereafter until the next passage of a gripper means past the proximity detector 121 for stack 11, whereupon contact 126*c* opens and de-energizes relay 171.

Contact 171*b* guards against the possibility of a "sneak" circuit through contacts 126*a* and 126*c*, which might energize winding 171 if the contact 126*c* remained closed until after contact 126*a* closed.

An electromagnet 173 is connected in parallel with the winding of relay 171 and controls a selector valve 174 which determines the direction of supply of hydraulic fluid to the motor 56 operating cam 42 for stack 11.

A similar array of circuits for a relay winding 172 is provided corresponding to the circuits for relay winding 171. An electromagnet 175 is connected in parallel with relay winding 172 and controls a selector valve 176 which in turn controls the motor 63 (FIG. 5) which retracts the cam 44 for stack 11.

When electromagmets 173 and 175 are energized, the motors 56 and 63 are operated to retract the cams 42 and 44 at station 11 for both sets of cam followers, so that no sheets are delivered into stack 11. On the other hand, the cams 42 for stack 12 are not retracted and consequently all of the gripper release mechanisms are actuated as they pass the stack 12 and all sheets are delivered into that stack.

A similar array of circuits are provided for controlling a relay 177 and an electromagnet 178 controlling the motor 56 driving cam 42 for stack 12. Still another array of circuits is provided for controlling a relay 181 and an electromagnet 182 for operating a selector valve 183 which controls motor 63 operating cam 44 for stack 12.

When any of the electromagnets 173, 175, 178 and 182 is energized, its associated valve is operated to cause the controlled motor to drive its cam to the retracted position shown in dotted lines in FIG. 6, in which it does not engage the passing cam followers and hence does not select sheets for delivery to the associated stack.

Assume that having selected stack 12 to receive all the sheets the press is started and delivers sheets to that stack. These sheets interrupt the light beam between source 127 and photocell 131, and are thereby counted. Photocell 131 controls a contact 131*b* in the circuit of a counter 184 (FIG. 14C).

As the stack builds up on the pallet 14, it interrupts the beam between source 128 and photocell 132. This completes an energizing circuit for driving the stack motor downwardly at a low rate of speed. This circuit appears in FIG. 14C and may be traced from the upper supply line 147 through a contact 152*d* of relay 152, contact 158*b* of relay 158 controlled by photocell 132 and now closed because the light beam on that photocell is interrupted, and thence through the winding of a relay 185 having contacts connected in a circuit (not shown) for driving the motor downwardly at a low rate of speed. This downward motion continues only until the top of the stack again falls below the level of the light beam impinging on the photocell 132, whereupon contact 158*b* is again opened, stopping the downward travel of the conveyors.

At this time, the stack 11 has not been selected to receive sheets, and its motor can be operated downwardly at a high speed under manual control by means of a pushbutton 186. The circuit may be traced from upper power line 147 through contact 151*a*, contact 144*b*, pushbutton 186 and the winding of relay 187 to the lower power supply line 148. If this circuit is held closed by the pushbutton 186, it remains closed until the pallet engages the operating lever of the switch on stack 11 corresponding to switch 143, thereby opening the contact 144*b* and terminating the downward energization of the conveyor.

A similar high speed downward drive relay winding 190 is provided for the motor 107 of stack 12, and a similar low speed downward drive relay 191 is provided

for the motor 107 of stack 11. Thus the arrays of relays and circuits controlling the two motors are similar. The pushbutton for controlling the rapid downward speed of motor 107 for stack 12 is shown at 192.

The inspection station 16 is provided with a set of cams 42 and 44 operated respectively by hydraulic cylinders 56 and 63, similar to the sets of cams and hydraulic cylinders supplied for the stacks 11 and 12 and shown in FIGS. 5 and 6.

The motors 56 and 63 which move the cams 42 and 44 for the inspection station 16 are controlled by valves 194 and 195 (FIG. 14B), respectively operated by electromagnets 196 and 197. Energization of electromagnet 196 is controlled by an obvious circuit including contacts 171*a* and 177*a* in parallel. Energization of solenoid 197 is controlled by an obvious circuit including contacts 172*a* and 181*a* in parallel. The cam 42 at the inspection station 16 must be in its active position to engage the cam followers of one set of gripper release mechanisms at any time when the corresponding cams 42 at the stacks 11 and 12 are both in their retracted positions. Hence, its energizing circuit includes in parallel contacts 177*a* and 171*a*, both of which contacts are opened when their associated windings are energized to retract their associated cams 42.

Similarly, electromagnet 197 is de-energized whenever both the cams 44 of stacks 11 and 12 are retracted. The energizing circuit for electromagnet 197 includes contacts 181*a* and 172*a* in parallel. The windings 196 and 197 may be de-energized to deliver sheets to the inspection station 16 either for the purpose of inspecting those sheets or for the purpose of receiving sheets which would otherwise be delivered at one of the stacks 11 and 12, when the stack receiving means at that location is for some reason disabled.

When the delivery apparatus is operating and delivering all sheets into one of the stacks 11 and 12, the delivery may be shifted to the other stack by momentarily closing the stack change switch 167. This energizes winding 161 to advance stepping switch 162 and transfers the stack selection to the opposite stack from one previously selected.

For example, if stack 12 was previously selected, as described above, by energization of the relays 152, 171 and 172, then when the stack change switch 167 is closed, winding 161 is energized to advance switch 162 one step, relay 152 is de-energized immediately by operation of the stepping switch 162. Relays 171 and 172 remain energized over their holding circuits until the next time the proximity switch 121 for stack 11 opens the contacts 126*c* and 126*d*. Relay 151 is energized when the stepping switch 162 operates, but the circuits for energizing relays 177 and 181 are not completed until a gripper support plate 22 passes the proximity switch 121 at stack 12, closing the contacts 125*a* and 125*b*.

The spacing between the proximity switches 121 at the two stacks is substantially greater than the spacing between gripper bars along the chain 5. It is possible during any stack transfer operation, that following an actuation of the stepping switch 162, either proximity switch 121 for one stack 11 or 12 may sometimes actuate its contacts before the proximity switch 121 for the other stack.

Assuming that stack 12 was the stack previously selected, then if the proximity switch 121 for stack 11 actuates its contacts first after the stepping switch 162 moves, then the electromagnets 173 and 175 are de-energized before the electromagnets 178 and 182 are energized. Consequently, there is a period during which both stacks are in condition to receive sheets, since the cams 42 and 44 for both stacks 11 and 12 move to their cam follower engaging positions when their respective controlling electromagnets are de-energized. This does not create a problem, since only one or two sheets will go to the stack 12 after stack change switch 167 is actuated.

On the other hand, if the proximity switch for stack 12 actuates its contacts first following an operation of the stepping switch 162, and the proximity switch 121 for stack 11 actuates its contacts 126*a* and 126*b* at a later time, then there may be an interval during which all four of the electromagnets 173, 175, 178 and 182 are energized, and all four cams at stacks 11 and 12 are in their retracted positions. However, during this period, the gripper bar which actuated the proximity switch 121 for stack 12 will be empty since it is located just past the point where the cams engage the cam followers. The proximity switch 121 for stack 11 will be actuated before the next gripper bar carrying a sheet approaches the cams 42 and 44 for stack 12, so that the cams 42 and 44 will be in their cam follower engaging positions before any gripper bar carrying a sheet can approach those cams.

When transferring the sheet delivery from stack 11 to stack 12, the cams for the stack 11 may be retracted before the cams for stack 12 are adanced to their sheet releasing positions, and a sheet may possibly pass both stacks without being released. Under those circumstances, however, there will be a brief deenergization of the electromagnets 196 and 197 (FIG. 14B), due to the fact that the back contacts 177*a*, 171*a*, 181*a*, and 172*a* are all open. The electromagnets 196 and 197 control the cams 42 and 44 for the inspection station 16, and move those cams to sheet selecting positions when the electromagnets are de-energized. Hence, any sheet which passes the stacks 12 and 11 is delivered to the inspection station 16.

When the stack 12 has been selected to receive sheets, its cams 42 and 44 of stack 11 are in their active positions, and the relays 177 and 181 are de-energized. The relays 171 and 172 are energized. Under those conditions, if it is desired to deliver a single sheet to the inspection station 16 instead of having it delivered to the stack 12, the operator depresses momentarily a pushbutton switch 201 (FIG. 14B), thereby energizing a time delay relay winding 202. The term "pushbutton switch ", as used in this specification, is intended to be a generic term covering any manual control member biased to a normal position, movable to an active position, and returning to its normal position when released. Energization of winding 202 closes contacts 202*a* and 202*b* in pickup circuits for relays 177 and 181. Winding 202 has a time delay characteristic such that once it closes its contacts they remain closed for a time sufficient for two successive gripper bars to pass a proximity switch 121. When the next gripper bar passes the proximity switch 121 for stack 12, contacts 125*a* and 125*b* are closed, thereby completing pickup circuits for the relays 177, 181 and for electromagnets 178, 182. Energization of electromagnets 178 and 182 operate the cams 42 and 44 at station 12 to their retracted positions. Since the cams 42 and 44 at station 11 are already at their retracted positions, the next

sheet passes both stations 12 and 11 and goes on to the inspection station 16. Relays 177, 171, 181 and 172 now are energized and their respective contacts 177*a*, 171*a*, 181*a* and 172*a* are open, so that electromagnets 196 and 197 are de-energized, and valves 194 and 195 are operated to positions in which the cams 42 and 44 at the inspection station 16 are moved to their sheet selecting positions, shown is full lines in FIG. 6. Those cams 42 and 44 engage the cam followers on the gripper bars carrying the sheets which have passed the stacks 12 and 11 and release those sheets at the inspection station 16.

Electromagnets 196 and 197 have a quick drop-out characteristic and a slow pick-up, so that once they are de-energized, valves 194 and 195 remain in their sheet selecting positions for a time long enough to insure that all sheets that pass both stacks 12 and 11 are released at inspection station 16. If valves 194 and 195 remain in their sheet selecting position for an unnecessarily long time, no harm is done. It simply means that one or more of the gripper releasing cam followers are actuated when there is no sheet in their associated grippers.

After a momentary energization, the time delay relay 202 will release its contacts before the next gripper bar passes, except for the rare occasions when the pushbutton 201 is actuated exactly at the time that the gripper bar is passing the proximity detector 121. In that case, two sheets may be delivered to the inspection station, rather than one. If more than one sheet is desired, the operator holds the switch 201 closed manually long enough to get the required number of sheets at the inspection station 16.

When sheets are being delivered to the station 11 rather than the station 12, the operator may select a sheet to be delivered to inspection station 16 by actuating a pushbutton 203 to energize the winding 204 of a time delay relay similar to the time delay relay 202. This closes contacts 204*a* and 204b similar in function to the contact 202*a* described above, except that they are connected in the array of circuits for relay 171 and 172.

When the apparatus is set to deliver sheets at both stacks 11 and 12 and it is desired to deliver sheets from both stacks to the inspection station 16, the operator actuates a pushbutton switch 205 to energize a time delay relay 206 having a contact 206*a* in the circuit of relay 177, a contact 206*b* in the circuit of relay 181, a contact 206*c* in the circuit of relay 171 and a contact 206d in the circuit of relay 172.

When it is desired to interrupt the delivery of sheets to stack 12 for a longer period of time (e.g., a minute or so), the operator actuates a pushbutton switch 207 to energize the winding of a time delay relay 208, which operates contacts 208*a* in the circuit of relay 177 and 208*b* in the circuit of relay 181. This retracts both cams from stack 12, thus preventing delivery of sheets to the stack 12 for whatever time period is established by the characteristics of relay 208. Such an interruption in the delivery of sheets to a particular stack is commonly desired, for example, when the stack has become filled, and it is desired to remove the filled supporting pallet and to introduce an empty pallet 13. This operation can be readily accomplished in about a minute, so that after the new pallet is inserted and moved to its uppermost position, the relay 208 will drop its contacts so that sheets will again be delivered to the stack 12. The operator may dispose of the sheets deposited at the inspection station 16 by transferring them manually to the stack 12. Hence, the stacks may be unloaded and replaced by empty pallets without stopping the press.

A similar pushbutton switch 211 controls a time delay relay 212 operating a contact 212*a* in the circuit of relay 171 and a contact 212*b* in the circuit of relay 172. Thus, the operation of pushbutton 211 interrupts delivery of sheets to the stack 11 in the same fashion that operation of pushbutton 207 interrupts delivery to the stack 12.

When the manual switch 165 is open, as shown in FIG. 14C, the apparatus delivers all sheets into one stack only. Under these conditions, as the stack fills up, the pallet 13 moves downwardly until it actuates the switch 141. This closes a contact 141*b* which completes an energizing circuit for a relay 213 (FIG. 14A). Relay 213 has a contact 213*a* connected in series with contact 138*c*, of the upper limit switch of the second stack 11, in the circuit for energizing winding 161 of stopping switch 162. A contact 159*b* is connected in parallel with the contact 138*c*, and a contact 152*a* of the stack selector relay 152 is connected in series with that parallel array. Contact 152*a* is closed during delivery of sheets to the stack 12. When contact 213*a* closes, and either contact 138*c* or 159*b* is closed, then an energizing circuit is completed for the winding 161 which steps the switch 162 to its alternate position, thereby de-energizing the stack selecting relay 152 and energizing the stack selecting relay 151. The delivery of sheets is thereby transferred from stack 12 to stack 11 so that it is possible without interference with incoming sheets, to unload stack 11 with a fork lift truck or the like and insert an empty pallet 13 into that stack so that it will be ready for the next shift from stack 11 back to stack 12. That next transfer between the two stacks is controlled by a relay 214 having a contact 214*a* and controlled in turn by contact 142*b* of the switch associated with stack 11 and corresponding to switch 141 of FIG. 13.

Relay 213 also has a normally open contact 213*b* connected in series with a normally closed contact 152*c* of relay 152. These two contacts are connected in parallel with a similar pair of contacts 214*b* of relay 214 and 151*c* of relay 151. These parallel sets of contacts are connected in series with a feeder stop control generally indicated at 215. Consequently, if at any time a stack builds up to the point of closing contact 141*b* or 142*b*, so that contact 213*b* or 214*b* closes, and the required transfer of delivery to the other stack does not take place, then contact 152*c* or 151*c* remains closed and the feeder stop control 215 is energized to stop the supply of sheets to the press and hence to stop delivery of sheets to the stack which has been receiving them.

Relay 213 has a contact 213*d* in series with the winding of relay 158. Relay 214 has a contact 214*d* in series with the winding of relay 159. The contacts 213*d* and 214*d* are normally closed, i.e., they are closed when their actuating relays are de-energized, and open when their actuating relays are energized. Whenever one of the stacks is filled so that its supporting pallet 13 has moved downward and closed the switch 141 (FIG. 13) then either switch 141*b* or 142*b* (FIG. 14A) is closed, thereby completing a circuit to energize either relay 213 or 214. At such a time, it is desirable not to drive the fully loaded stack downward any farther under the control of the low speed relays 185 or 191. The contact 213*d* or 214*d* then opens the circuit to the relay 158 or

159, thereby opening the contact 158*b* or 159*b* in the energizing circuit for relay 185 and 191, so that the fully loaded stack cannot be driven downward farther under automatic control.

The delivery apparatus may alternatively be set to deliver a fixed number of sheets (e.g., 100) to one stack and then to deliver a corresponding number of sheets to the other stack. This is done by actuating a manual switch 216 (FIG. 14C) from the position shown in the drawing to an alternate position in which the circuit of relay 166 is open at the contact 216*a* and a circuit to two counters 217 and 218 is closed at a contact 216*b*. The counter circuits are also controlled by contacts 131*a* and 134*a* of the counting photocells, so that the counters 217 and 218 are then effective to count the sheets supplied to the respective stacks. When the predetermined number is reached, the counter 217 closes contacts 217*a* and 217*b* or the counter 218 closes contacts 218*a* and 218*b*. (FIG. 14A) thereby energizing one of the relays 213 and 214 to switch the delivery from one stack to the other.

Contact 216*b* of manual switch 216 also controls a circuit to a relay winding 221 which operates contacts 221*a*, 221*b*, 221*c* and 221*d* in circuits of all the stack selection relays 177, 181, 171 and 172. Between the contact 216*b* and the relay 221 there are two parallel branch circuits. One branch circuit includes in series a normally open contact 214*c* and a normally closed contact 151*d*. The other branch circuit includes a normally open contact 213*c* and a normally closed contact 152*d*. Contact 214*c* is closed by relay 214 only in response to an indication (by closure of contact 142*b*) that the stack 11 is full or by closure of contact 218*a* that the stack 11 has received the required number of sheets established by the counter 218. When that contact 214*c* closes, contact 151*d* should be opened by actuation of the stepping switch 162, so that relay 221 should, under normal conditions, not be energized. The same is true of the branch circuit through contact 213*c* and 152*d*. However, if a change from one stack to the other is called for, resulting in closure of contact 213*c* or 214*c* and a change is not promptly made, opening the series contacts 152*d* or 151*d*, not promptly made, opening the series contacts 152*d* or 151*d*, then relay 221 is energized, and closes all its contacts, energizing all of the electromagnets 178, 182, 174 and 176, and retracting all of the cams 42 and 44 at both of the stacks 12 and 11. The cams remain retracted until the appropriate contact 151*d* or 152*d* is opened. During the period that the cams remain retracted, the sheets pass along to the inspection station 16, which at this time has its electro magnets 196 and 197 de-energized by the action of the relays 177, 171, 181 and 172. During this period when the sheets are being fed to the inspection station 16, the relays 213 and 214 cooperate with relays 151 and 152 to energize the feeder stop control 215 and terminate the supply of sheets to the press, as described above.

It is sometimes desirable to deliver sheets alternately to the two stacks. For example, if the press is running with two plates 2*a* and 2*b* on the plate cylinder 2 (FIG. 1), it may be desirable to deliver the sheets alternately to the two stacks so that all the sheets printed by plate 2*a* will be delivered to one stack and all the sheets printed by plate 2*b* will be delivered to the other stack. If such an alternate delivery is provided, then in the event that a defect appears in one plate, any defective sheets which may have been printed by that plate are all collected in one stack and are easily located without the necessity of sorting the two stacks of sheets.

In order to operate the apparatus with alternate delivery of sheets to the two stacks, the switch 165 is moved to its right-hand position while the switch 216 is in its right-hand position, thereby completing a circuit for energizing the winding of relay 166. That relay has a contact 166*a* in parallel with contact 216*a* of switch 216, a normally closed contact 166*b* in the pick-up circuit for relay 177 and electromagnet 178, a normally closed contact 166*c* in the pick-up circuit for relay 172 and electromagnet 175, a noramlly closed contact 166*d* in the circuit for relay 221, and a normally open contact 166*e* connected across the output terminals of switch 162, so that both relays 151 and 152 may be energized in any position of switch 162. When relay 166 is energized, it opens pick-up circuits for relay 177 and electromagnet 178 controlling cam 42 for stack 12, so that cam remains in its selecting position. It also opens the pick up circuits for relay 172 and electromagnets 175 controlling the cam 44 for stack 11, so that cam also remains in its sheet selecting position. Since the relays 151 and 152 are both energized, the relays 181 and 171 and their associated electromagnets 182 and 173 are also energized. The cam 44 for stack 12 is retracted and the cam 42 for stack 11 is retracted. Hence, all sheets on those grippers having followers which engage cam 42 are delivered at stack 12 and the alternate sheets on grippers having followers which engage cams 44 are delivered at stack 11.

Switch 165, when in its right-hand position selects operation of the delivery apparatus and delivers sheets alternately to the stacks 11 and 12. Switch 216 when in its left-hand position selects operation of the apparatus to deliver counted batches of sheets alternately to the stack 11 and 12. Since these two instructions to the delivery apparatus are conflicting, provision must be made so that the switch 216 is taken out of control when the switch 165 is actuated to its right-hand position, and similarly switch 165 must be out of control when switch 216 is in its left-hand position. For that purpose, switch 216 operates a contact 216*a* which is closed when switch 216 is in its right-hand position, and which must be closed in order to energize relay 166. Consequently, in order to energize relay 166 and start the apparatus delivering sheets to the two stacks alternately, switch 216 must be placed in its right-hand position.

Similarly, once the switch 165 is in its right-hand position, selecting the alternate delivery and the relay 166 is energized, that relay closes a contact 166*a* which shunts the contact 216*a*, so that relay 166 remains energized. Relay 166 when energized also opens a contact 166*d* in series with contact 216*b* of switch 216, so that switch 216 is ineffective, the batch counters 217, 218 cannot be started when switch 165 is in its right-hand position and the relay 166 is energized. Hence, the two switches 165 and 216 are electrically interlocked so that they cannot be simultaneously operated to give conflicting control instructions to the apparatus.

I claim:

1. Sheet delivery apparatus for receiving sheets from a printing press and carrying the sheets selectively to either of two sheet receiving positions, comprising:

a. two sheet receiving means, one at each of said positions;

b. an endless delivery conveyor extending from between the printing press, past the two sheet receiving means in succession;
c. means for driving the conveyor;
d. a plurality of gripper means spaced along the conveyor, each gripper means being shiftable between a sheet gripping position and a sheet releasing position;
e. a gripper release mechanism in each gripper means including a cam follower biased to a position in which the gripper means engages a sheet, and movable therefrom to a retracted, sheet releasing position;
1. the cam followers for a first set of gripper means being spaced laterally of the direction of movement of the conveyor from the cam followers of a second set;
f. two cams in each sheet receiving means, respectively aligned with the two sets of cam followers, for engaging the cam followers and thereby operating the gripper release mechanisms to their sheet releasing positions; and
g. separate actuator means for each cam, each said actuator means being operable to move its associated cam between a retracted position in which the cam does not engage any of the cam followers, and an active position in which it engages the cam followers of one set of gripper means.

2. Sheet delivery apparatus as in claim **1,** in which the separate actuator means for the two cams in each sheet receiving means comprises:
a. a shaft;
b. a pair of concentric sleeves on said shaft;
c. a pair of arms, each connected to one of said sleeves and each carrying one of said cams; and
d. separate motor means for driving each sleeve through a partial rotation on said shaft to drive the cam connected to said sleeve between said retracted position and said active position.

3. Sheet delivery apparatus as in claim **2,** in which said cams are adjustable on said arms.

4. Sheet delivery apparatus as in claim **1,** in which:
a. each said sheet receiving means includes means for stacking a multiplicity of sheets;
b. an auxiliary sheet receiving means of limited capacity as compared to the other two;
c. two cams in the auxiliary sheet receiving means, respectively aligned with the two sets of cam followers;
d. separate cam actuator means for the last-mentioned cams; and
d. means for controlling the last-mentioned cam actuator means so as to maintain each cam in the auxiliary sheet receiving means in its retracted position unless all of the cams for the corresponding set of cam followers in the first two sheet receiving means are in their retracted positions.

5. Sheet delivery apparatus for receiving sheets from a printing press and carrying the sheets selectively to either of two sheets receiving positions, comprising:
a. an endless delivery conveyor extending between the printing press and the stack receiving positions;
b. means for driving the conveyor;
c. a plurality of gripper means spaced along the conveyor, each gripper means being shiftable between a sheet gripping position and a sheet releasing position;
d. a gripper release mechanism in each gripper means including a cam follower movable from a gripping position in which the gripper means engages a sheet to a sheet releasing position;
1. the cam followers for a first set of gripper means being spaced laterally of the direction of movement of the conveyor from the cam followers of a second set; and
e. two stack receiving means, one at each of said shehet receiving positions, each said stack receiving means including:
1. at least one cam for engaging the cam followers of one of said sets of gripper means and thereby operating the gripper release mechanisms to their sheet releasing positions;
2. a row of wheels extending across the path of movement of sheets on the conveyor, said wheels having peripheral ports movable tangentially to the sheets and connected to a source of vacuum and effective to restrain and control the movement of the trailing edges of the sheet;
3. stacker means for receiving and stacking sheets released by the gripper means;
f. common drive means for rotating the vacuum wheels at both of said receivers, including:
1. a longitudinal shaft extending parallel to the direction of movement of the delivery conveyor;
2. a cross shaft at each stack receiving position carrying a row of said peripherally ported wheels; and
3. drive means connecting both cross shafts to the longitudinal shaft, said drive means including, for each cross shaft:
i. a drive shaft;
ii. a pair of universal joints, one connected to each end of said drive shaft;
iii. a set of bevel gears connecting said longitudinal shaft to one of said universal joints;
iv. means connecting the other universal joint to the cross shaft; and
4. means for rotating said longitudinal shaft; and
g. common means for adjusting longitudinally of the delivery conveyor the vacuum wheels at both said stack receiving means.

6. Sheet delivery apparatus as in claim **5,** in which said common adjusting means includes:
a. a pair of racks extending longitudinally on each side of the delivery conveyor;
b. a second cross shaft at each stack receiving station;
c. means on each second cross shaft supporting the corresponding first cross shaft;
d. two pinions on each second cross shaft engaging said racks; and
e. drive means for each cross shaft including:
1. a first universal joint connecting the second cross shaft to a second drive shaft, and a second universal joint connecting the drive shaft to a bevel gear;
2. a longitudinally extending shaft carrying bevel gears cooperating with the bevel gears connected to the second cross shafts; and
3. means for rotating said londitudinal shaft.

7. Sheet delivery apparatus as in claim **6,** including:
a. means for laterally adjusting the position of the peripherally ported wheels along the cross shaft;

b. means biasing the cross shaft to maintain it at right angles with the longitudinal shaft and to take up lost motion in the rack and pinions.

8. Sheet delivery apparatus as in claim 7, in which said biasing means comprises:

a. a housing attached to each vacuum wheel and slidable on said cross shaft and non-rotatable with respect to the cross shaft;

b. a transverse rod;

c. a flexible strap attached at one end to the housing and extending over the transverse rod;

d. a weight carried at the opposite end of said flexible strap and biasing said housing toward said transverse rod.

9. Sheet delivery apparatus for receiving sheets from a printing press and carrying the sheets selectively to either of two sheet receiving positions, comprising:

a. an endless delivery conveyor extending between the printing press and the stack receiving positions;

b. means for driving the conveyor;

c. a plurality of gripper means spaced along the conveyor, each gripper means being shiftable between a sheet gripping position and a sheet releasing position;

d. a gripper release mechanism in each gripper means including a cam follower movable from a gripping position in which the gripper means engages a sheet to a sheet releasing position;

1. the cam followers for a first set of gripper means being spaced laterally of the direction of movement of the conveyor from the cam followers of a second set; and

e. two stack receiving means, one at each of said sheet receiving positions, each said stack receiving means including:

1. at least one cam for engaging the cam followers of one of said sets of gripper means and thereby operating the gripper release mechanisms to their sheet releasing positions;

2. a row of wheels extending across the path of movement of sheets on the conveyor, said wheels having peripheral ports movable tangentially to the sheets and connected to a source of vacuum and effective to restrain and control the movement of the trailing edges of the sheet;

3. stacker means for receiving and stacking sheets released by the gripper means, each said stacker means comprising:

i. two horizontally spaced, downwardly traveling, opposed conveyor means;

ii. retractable brackets on each said conveyor means projecting toward brackets on the opposite conveyor means;

iii. common drive means for the two conveyor means; and

iv. a plurality of separators, insertable in said stacker so as to be supported on a set of opposed brackets for receiving sheets;

v. said brackets being retracted by engagement with any separator which has reached its limit of downward movement in an accumulating stack;

f. common drive means for rotating the vacuum wheels at both of said receivers; and

g. common means for adjusting longitudinally of the delivery conveyor the vacuum wheels at both said stack receiving means.

10. Sheet delivery apparatus for receiving sheets from a printing press and carrying the sheets selectively to either of two principal receiving positions or to an auxiliary sheet receiving position, comprising:

a. an endless delivery conveyor extending between the printing press and the stack receiving positions;

b. means for driving the conveyor;

c. a plurality of gripper means spaced along the conveyor, each gripper means being shiftable between a sheet gripping position and a sheet releasing position;

d. two stack receiving means, one at each of said principal sheet receiving positions;

e. stack selector means operable to select delivery of all sheets to either one of said stacks or of alternate sheets to both of said stacks;

f. sheet receiving means of limited capacity at said auxiliary stack receiving position;

g. means for transferring to said auxiliary shehet receiving position all sheets which pass said principal stack receiving positions;

h. time controlled means for operating said transferring means to disable the stack selector means for a predetermined time and during that time to deliver to the auxiliary sheet receiving means all sheets selected by the stack selector means for delivery to at least one stack; and

i. means for selectively setting said time-controlled means to disable the stack selector means either for a first predetermined time of the order of the time required to deliver one sheet to the auxiliary receiving means, or for a second predetermined time of the order of one minute.

11. Sheet delivery apparatus for receiving sheets from a printing press and carrying the sheets selectively to either of two principal receiving poistions or to an auxiliary sheet receiving position, comprising:

a. an endless delivery conveyor extending between the printing press and the receiving positions;

b. means for driving the conveyor;

c. a plurality of gripper means spaced along the conveyor, each gripper means being shiftable between a sheet gripping position and a sheet releasing position;

d. a gripper release mechanism in each gripper means including a cam follower movable from a gripping position in which the gripper means engages a sheet to a sheet releasing position, the cam followers for a first set of gripper means being spaced laterally of the direction of movement of the conveyor from the cam followers of a second set;

e. two principal stack receiving means, one at each of said principal sheet receiving positions;

f. auxiliary stack receiving means of limited capacity at said auxiliary stack receiving position;

e. each of said receiving means including two cams respectively aligned with the two sets of cam followers for engaging the cam followers of said two sets of gripper means and operating the respective gripper release mechanisms to their sheet releasing positions;

h. separate actuator means for each cam, each said actuator means being operable to move its associated cam between a retracted position in which the cam does not engage any of the cam followers, and an active position in which it engages the cam followers of one set of gripper means; and

i. means responsive to the retraction of the cams for operating one set of gripper release mechanisms at both of said principal sheet receiving positions to operate the corresponding cam at the auxiliary sheet receiving position to its active position.

12. Printing apparatus, comprising:

a. a cylinder carrying two printing plates;

b. a single feeder for feeding sheets to said cylinder so that successive sheets from the feeder are alternately printed by the two plates; and

c. double stacking means for delivering sheets from the press alternately to two stacks, so that all of the sheets printed by one plate are delivered to one stack and all of the sheets printed by the other plate are delivered to the other stack, said double stacking means comprising;

1. two sheet receiving means, one at each of two spaced positions;

2. an endless delivery conveyor extending from between the printing press, past the two sheet receiving means in succession;

3. means for driving the conveyor;

4. a plurality of gripper means spaced along the conveyor, each gripper means being shiftable between a sheet gripping position and a sheet releasing position;

5. a gripper release mechanism in each gripper means including a cam follower biased to a position in which the gripper means engages a sheet, and movable therefrom to a retracted, sheet releasing position;

i. the cam followers for a first set of gripper means being spaced laterally of the direction of movement of the conveyor from the cam followers of a second set; and

6. two cams in each sheet receiving means, respectively aligned with the two sets of cam followers, for engaging the cam followers and thereby operating the gripper release mechanisms to their sheet releasing positions; and

7. separate actuator means for each cam, each said actuator being operable to move its associated cam between a retracted position in which the cam does not engage any of the cam followers, and an active position in which it engages the cam followers of one set of gripper means.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,907,274
DATED : September 23, 1975
INVENTOR(S) : Salvatore F. D'Amato et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 27, "preset" should read -- present --.
Col. 3, line 30, "is" should read -- in --;
line 35, "Fig. 1B is a fragmentary view, similar to a portion of Fig. 1A, illustrating another modification." was omitted.
Col. 10, line 7, "pas" should read -- past --.
Col. 11, line 14, "pallet" should read -- pallets --;
line 54, "branch" should read -- contact --.
Col. 14, line 30, "adanced" should read -- advanced --.
Col. 15, line 40, "relay" should read -- relays --.
Col. 17, lines 43 and 44, "not promptly made, opening the series contacts 152d or 151d," should be deleted.
Col. 22, line 19, "shehet" should read -- sheet --;
line 36, "poistions" should read -- positions --.

Signed and Sealed this

third Day of *February 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

UNITED STATES PATENT AND TRADEMARK OFFICE

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