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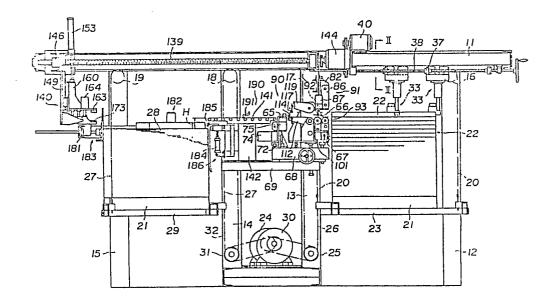
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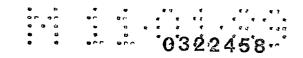
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(54) APPARATUS FOR AUTOMATICALLY STACKING PILES OF PAPER.

(57) This apparatus for automatically stacking a plurality of piles of paper is adapted to automatically carry out operations for taking out a plurality of piles of printing paper, each of which has been packaged in a respective packaging paper, from each packaging paper, and stacking the unpacked piles of printing paper in order. The apparatus is provided with a carry-out lifter (23) on which packages of paper (packaged piles of paper) (22) are stacked, a push means (33) for feeding forward the upper-most package of paper (22) on the carryout lifter (23), cutter means (65, 66) for cutting open the front end and both sides of the front portion of the packaging paper (34) when the package (22) is fed, a packaging paper peeling means (90) for peeling the opened packaging paper (34) upward and downward so as to expose the front portion of the sheets of paper (28) therein to the outside thereof, and a sheets of paper gripping means (140) for gripping the front end portion of a pile of paper (28), withdrawing the same from within the packaging paper (34) and stacking the same on a carry-in lifter (29). A paper slip-off preventing means (91) for furnishing the pile of paper (28) with firmness before the paper is withdrawn from the packaging paper (34), and a paper loosening means provided with a roller conveyor (141) and blower nozzles (191), which are used to loosen the sheets of paper (28) being transferred, are also installed when required.

Fig. 1







SPECIFICATION

Title of the Invention

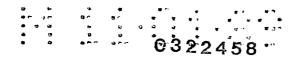
Automatic paper bundle stacking apparatus

Background of the Invention

This invention relates to an automatic paper bundle stacking apparatus which automatically performs a series of operations including taking only paper bundles out of a number of packaged paper bundles and stacking them in line.

When it is desired to load a paper pallet with a stack of paper bundles onto an automatic paper sheet feeder of a sheet-feed printing machine, it was previously necessary to unpack packages of paper bundles containing a specified number of sheets in each package (hereinafter referred to as "packaged paper bundle") and stack them on the paper pallet. Heretofore, the series of steps for stacking the paper bundles on the paper pallet has been carried out manually, in which a packaged paper bundle is first cut open by a hand cutter to take out the paper bundle from the wrapping paper surrounding it, then a twisting action is applied to the paper bundle to fan it, and then the paper bundle is put on the paper pallet.

However, when the size of the paper sheets is relatively small, the amount of work required to unpack the



a problem but, when the paper sheets are of a large size, such as B1 size or A0 size, the paper bundle itself increases in weight, requiring hard labor. Moreover, since such work is inefficient, it has sometimes been difficult to utilize the full capacity of the printing machine.

Summary of the Invention

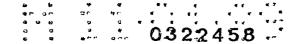
In accordance with the present invention, there is provided an automatic paper bundle stacking apparatus comprising a vertically movable carrying-out lifter for lifting the top packaged paper bundle in a stack stacked to a carry-in starting position, a longitudinally movable pushing device to push forward the packaged paper bundle at the carry-in starting position to an unwrapping table disposed in front of the carrying-out lifter, a wrapping paper cutting device disposed adjacent to the unwrapping table to horizontally cut open at least the front end side and both sides of the wrapping paper of the packaged paper bundle, an unwrapping device disposed above and beneath the unwrapping table to vertically peel at least the front portion of the wrapping paper of the packaged paper bundle on the unwrapping table to expose the paper bundle, a vertically movable carrying-in lifter disposed in front of the unwrapping table and having stacked on it with only the

paper bundle the packaged paper bundle to move the top surface of the paper bundle down to a carrying-in waiting position, and a paper bundle handle or gripping device movably disposed between the carrying-in lifter and the unwrapping table to grip the front end of the paper bundle of the packaged paper bundle and transfer it onto the carrying-in lifter.

In addition to the above-described arrangement, the automatic paper bundle stacking apparatus according to the present invention further comprises a paper bundle fanning device disposed between the unwrapping table and a carrying-in table to blow air into the paper bundle on the carrying-in table.

Automatic paper bundle stacking operation with the automatic paper bundle stacking apparatus according to the present invention is performed as follows:

As shown in Fig.22(A), a number of packaged paper bundles which were previously stacked on a carrying-out lifter (not shown) using a forklift or the like. The carrying-out lifter moves up and, when a top packaged paper bundle 22 is moved up to a predetermined carrying-out starting position, the carrying-out lifter stops moving up. Then, as shown in Fig.22(B), the top packaged paper bundle 22 is moved forward by a pushing device 33 to a predetermined position on the unwrapping table and, as the



top packaged paper bundle 22 is moved forward (longitudinally and horizontally), both side surface of a wrapping paper 34 is horizontally cut by a pair of right and left side wrapping paper cutting devices. Furthermore, the front end surface of the wrapping paper 34 is also horizontally cut at the unwrapping position by a wrapping paper cutting device which is moving laterally (in the width direction of the packaged paper bundle 22). Then, as shown in Fig.22(E), unwrapping devices disposed above and below the unwrapping position open the front portion of the wrapping paper 34 upward and downward to expose the front pertion of a paper bundle 28. After that, as shown in Fig. 22(I), the front end of the paper bundle 28 is gripped by a paper bundle gripping device 140 to pull the paper bundle 28 out from its wrapping paper 34 and carry it onto the carrying-in lifter which is located in front of the stack. As the paper bundle 28 is being carried, air is blown into the paper bundle 28 by the paper bundle fanning device.

Brief Description of the Drawings

Fig.1 is a schematic side view of an embodiment of the automatic paper bundle stacking apparatus according to the present invention. Fig.2 is a schematic front view of a pushing device as viewed along line II-II in Fig.1. Fig.3

is a schematic side view of the pushing device. Fig.4 is a schematic enlarged view as viewed along line IV-IV in Fig.4. Fig. 5 is a schematic enlarged sectional view as viewed along line V-V in Fig.2. Fig.6 is a schematic enlarged sectional view as viewed along line VI-VI in Fig.2. Fig.7 is a schematic sectional view of an unwrapping table, corresponding to a view as viewed along line VII-VII in Fig.11. Fig.8 is a schematic enlarged view of the unwrapping device and others in Fig.1. Fig.9 is a schematic front view showing part of a paper hang-down prevention device. Fig.10 is a schematic plan view of the paper hang-down prevention device, corresponding to a view as viewed along line X-X in Fig.8. Fig.11 is a schematic side view showing details of the unwrapping device. Fig. 12 is a schematic sectional view of the unwrapping device as viewed along the front line. Fig.13 is a schematic side view of a wrapping paper discharging mechanism. Fig.14 is a schematic sectional view of a paper bundle gripping device as viewed along the side surface. Fig. 15 is a schematic sectional view of the paper bundle gripping device under a different condition. Fig.16 is a schematic front view of the paper bundle gripping device with a sectional view of the left-half portion. Fig.17 is a schematic side view showing operation of the paper bundle gripping device. Fig. 18 is a schematic plan view showing the entire part of the paper



bundle gripping device. Fig.19 is a schematic plan view showing part of a paper bundle fanning device. Fig.20 is a schematic view of the paper bundle fanning device as viewed along line X-X in Fig.19. Fig.21 is a schematic oblique view of a roller conveyor for paper bundle fanning. Fig.22 is a schematic view showing the automatic paper bundle stacking process. Fig.23(A) and 23(B) are schematic views showing the paper bundle stiffening action.

Description of the Preferred Embodiment

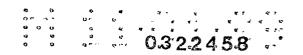
Referring to Fig.1 showing the entire structure of the automatic paper bundle stacking apparatus according to the present invention, sprockets 16, 17, 18, and 19 are mounted rotatably on posts 12, 13, 14, and 15 supporting a frame 11. One end of a chain 20 wound around the sprockets 16 and 17 is connected to a carrying-out lifter 23, on which packaged paper bundles 22 are to be stacked through a paper pallet 21, and the other of the chain 20 is connected with a counterweight (not shown). A driving sprocket 25, which is rotated forward and reverse by a carrying-out lifter driving motor 24, is attached to the bottom end of the post 13 to which the sprocket 17 is attached. An endless driving chain 26 is wound around the driving sprocket 25 and the sprocket 17, an an endless transmission chain (not shown) is wound around the sprocket 16 and 17.

Therefore, by the driving force of the carrying-out lifter driving motor 24, the carrying-out lifter 23 is moved up and down along the posts 12 and 13, and stops moving up when a limit switch (not shown) detects that the top packaged paper bundle 22 reaches a predetermined carrying-out starting position.

Similarly, one end of a chain 27 wound around the sprockets 18 and 19 is connected to a carrying-in lifter 29 on which only a paper bundle 28 is to be stacked through the paper pallet 21, and the other end of the chain 27 is connected to a counterweight (not shown). A driving sprocket 31 which is rotated forward and reverse by a carrying-in lifter driving motor 30 is attached to the bottom end of the post 14 to which is attached the sprocket 18. An endless chain driving chain 32 is wound around the driving sprocket 31 and the sprocket 18, and an endless transmission chain (not shown) is wound around the sprockets 18 and 19.

Therefore, by the driving force of the carrying-in lifter driving motor 30, the carrying-in lifter 29 is moved up and down along the posts 14 and 15, and stops moving up when a limit switch (not shown) detects that the top packaged paper bundle 22 reaches a predetermined carrying-out starting position.

Above the carrying-out lifter 23, there is disposed a



direction. The pushing device 33 is to push out the top packaged paper bundle 28 on the carrying-out lifter 23 forward over a predetermined distance, and also has a function to cut the rear portion of a wrapping paper 34 of the packaged paper bundle 28 at the pushing-out position. The pushing device 33 is shown in detail in Figs. 2 to 6.

Above the carrying-out lifter 23, there are provided two linear guide rails 35 parallel to the longitudinal direction (right/left direction in Fig.3), and supporting members 37 provided on the upper surface of a mount 36 of the pushing device 33 are slidably engaged with the linear guide rails 35. A driving threaded shaft 38 is provided parallel to and between the linear guide rails 35, and the threaded shaft 38 is screwed in a nut 39 provided on the upper surface of the mount 36 of the pushing device 33. The driving threaded shaft 38 is driven to rotate by a motor 40 disposed on the main unit of the paper bundle stacking apparatus through a chain 41. Therefore, when the driving threaded shaft 38 is rotated, the mount 36 and the pushing device 33 are moved longitudinally along the linear guide rails 35.

In the pushing device 33, a frame lifting cylinder 42 is provided downward at the center of the mount 36, and a frame 44 is mounted at an end (bottom end) of a rod 43. On

the lower surface of the mount 36 is provided guide cylinders 45 on the right and left sides of the mounting position of the cylinder 42, and two guide shafts 46 with their bottom ends linked to the frame 44 are slidably engaged with the respective guide cylinders 45. Therefore, by the function of the frame lifting cylinder 42, the frame 44 is exactly moved up and down, sliding on the guide shaft 46s and the guide cylinders 45.

The frame 44 comprises a lower plate 44a which is linked with the lower ends of the rod 43 and the guide shaft 46, an upper plate 44b located above the lower plate 44a, and side plates 44c connecting the lower and upper plates 44a and 44b at their both ends, and a front surface 44d of the lower plate 44a is a pushing surface to be pressed against the rear surface of the packaged paper bundle 22.

A rodless cylinder 47 is provided between both side plates 44c, and a moving part 48 of the rodless cylinder 47 is provided with a cutter 49 projecting to the front which is to cut open the upper edge of the rear surface of a wrapping paper 3 of a packaged paper bundle 3. Since the cutter 49 is to cut into the upper edge of the rear surface of the wrapping paper 34, its front edge is projected past the packaged paper bundle pushing surface 44d of the lower plate 44a.

Claw plate cylinders 50 are provided backward at two



each rod 51 is provided at its front end with a supporting plate 52, and each supporting plate 52 is provided at its lower end with a claw plate 53 extending to the front side. The claw plates 53 are located at a slightly upper side of the cutter 49, and their front portions are tapered down to the front side. These claw plates 53 are to be inserted into the lower side of the top surface of the wrapping paper 34 which is cut open by the cutter 49. In the figure, numeral 54 indicates a guide shaft attached to the supporting plate 52, which is slidably engaged with a guide hole 56 of a guide plate 55 provided on the upper plate 44b, to exactly guide the supporting plate 52 and the claw plate 53 when the claw plate cylinder 50 operates.

On the upper plate 44b of the frame 44, each claw plate cylinder 50 is provided upward at its inside with a holding cylinder 57, and a concaved supporting plate 59 is attached to an end (top end) of a rod 58 of the holding cylinder 57. Top ends of respective holding shafts 60 vertically and slidably penetrating the upper plate 44b are attached to right and left ends of the supporting plate 59 and, at the lower ends of the holding shafts 60, holding pieces 61 opposing the claw plates 53 at their forward positions (positions shown by solid lines in Fig.6) are mounted with

bolts or the like. The holding pieces 61, together with the claw plates 53, constitute gripping means to grip the top portion of the wrapping paper after being cut open, and the lower surfaces of the holding pieces are tapered according to the claw plates 53.

In the vicinity of the center of the supporting plate 59 are provided two suckers 63 extending downward through holes 62 provided in the upper plate 44b. A sucking part 63a of the sucker 63 is made from rubber or a soft plastic, and can adhere closely to the wrapping paper 34. A pipe 63b at the upper part of the sucker 63 is connected to an evacuation source such as a vacuum pump or the like. The sucker 63 is moved up and down together with the holding piece 61 by the supporting plate 59, and the position of the sucker 63 is regulated so that the lower end of the sucker 63 is positioned lower than the lower surface of the holding piece 61. In Figs. 5 and 6, the holding pieces 61 and the suckers 63 are shown at their top positions.

At the paper bundle carrying-out side of the carrying-out lifter 23, an unwrapping table 64 to receive the packaged paper bundle 28 being pushed out by the pushing device 63 is provided at a height according to the paper bundle being carried out. As shown in Fig.7, the unwrapping table 64 comprises two parallel roller conveyors 64a.

While the packaged paper bundle 22 is pushed out over a

predetermined distance to the unwrapping table 64 and after it is pushed out, the both sides of the front surface and the front edge of the wrapping paper 34 of the packaged paper bundle 22 is cut open by a wrapping paper cutting device.

The wrapping paper cutting device comprises a front circle cutter 65 to cut open the front edge in the right/left direction of the wrapping paper 34 of the packaged paper bundle 22 pushed out by a predetermined distance onto the unwrapping table 64, and a side cutter 66 to cut open the front part of both side of the wrapping paper 34 while the packaged paper bundle 22 is being pushed out and moving over the predetermined distance.

As shown in Fig. 8 which is an enlarged view of the central part of Fig. 1, the inside posts 13 and 14 are provided, fixed to, with a mounting stage 68 supporting a support table 67 which is vertically movable along the post 13 and 14 and a mounting plate 69 which is integral with the mounting stage 68. The front end of the mounting stage is provided, fixed to, with a rack 70 and a pair of guide rail 71 extending in the width direction of the packaged paper bundle 22, and a carrier 72, which is movable along the front guide rail 71, is provided with a carrier driving motor 74 having a pinion 73 engaging with the rack 70. Further, the carrier 72 is also provided with a front cutte

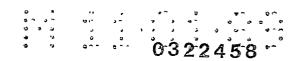
driving motor 75 connected with the front circle cutter 65 through a bracket 76 and, by the operation of the front cutter driving motor 75 and the carrier driving motor 74, the front circle cutter 65 cuts open horizontally the front surface of the wrapping paper 34 over the width direction.

A cross frame 77 is provided between the top ends of the posts 13 located at the right and left of the carrying-out side of the packaged paper bundle 22 on the carrying-out lifter 23, and a rail 78 is disposed on the front (or rear) surface of the frame 77. As shown in Fig.10 which is a view along line X-X in Fig.8, on both ends of the rail 78 are mounted supporting frames 82, fastened with bolts 83, which comprise three bracket plates 79 and 80 and two parallel rods 81 connecting the bracket plates 79 and In each of the supporting frames 82, on the two rods 80. 81, between the middle bracket plate 80 and the outer bracket plate 79, a cutter supporting frame 86 comprising two vertical plates 84 and a bottom plate 85 connecting the lower ends of the vertical plates 84 is disposed slidably using the rods 81 as a guide. On the bottom plate 85 of the cutter supporting frame 86, as shown in Fig.9 and Fig.10, a cutter driving motor 87 is mounted downward, and its rotary shaft 88 is provided with the side cutter 66 to cut open the front side surface of the wrapping paper 34 of the packaged paper bundle 22. A cylinder 89 is disposed outward on the

middle bracket plate 80 of the supporting frame 82, and its 2.4 90 is connected to the cutter supporting frame 86. Therefore, by the drive of the cylinder 89, the cutter supporting frame 82 is moved right and left to change the position of the side cutter 66.

During the operation of the cutter driving motor 87, when the packaged paper bundle 22 is pushed out by the pushing device 33 from the carrying-out starting position to the unwrapping position, the right and left front sides of the packaged paper bundle 22 halfway pass on the side cutters 66, and the right and left front sides of the wrapping paper 34 are cut by the side cutters 66.

The wrapping paper 34 with its front end and the right and left front sides cut open by the wrapping paper cutting device is to be peeled at its front portion upward and downward by the unwrapping device which will be described later herein. At this time, to prevent the front portion of the paper bundle 28 from hanging down when the wrapping paper 34 is peeled, the front portion of the paper bundle is bent prior to the peeling of the wrapping paper 34, thereby stiffening the front portion of the paper bundle. This operation is achieved by a paper hang-down prevention device 91. The paper hang-down prevention device 91 mainly comprises a holding roller 92 to hold the front upper surface of the packaged paper bundle 22 and pushing-up



rollers 93 to push up the packaged paper bundle 22 at the outside of the holding roller 92, and detail structure of the device is shown in Fig.8 and Fig.9.

A roller supporting member 94 is attached to the lower part of the middle bracket plate 80 of each of the supporting frames 82, the roller supporting member 94 is provided with a supporting shaft 95 parallel to the roller supporting member 94, and the holding roller 92, which is a main component of the paper hang-down prevention device, is rotatably mounted on the supporting shaft 95. The holding roller 92 comes in contact with the top surface of the packaged paper bundle 22 being carried to hold the packaged paper bundle 22.

The supporting frame 82 supporting the holding roller 92 and the side cutter 66 and other components can be moved along the rail 78 to change the position according to the size of the packaged paper bundle 22 to be handled.

Referring to Fig. 8, supporting plates 96 are disposed on the support table 67, at its both ends, and supporting plates 97 are disposed at positions closer to the center of the support table 67. Upper and lower guide shafts 98, parallel to each other, are provided in the cross direction between the supporting plates 96 and 97, and on these guide shafts 96 and 97 is mounted a pushing-up roller supporting frame 99, the position of which is adjustable by a guide

unit 100. A pushing-up cylinder 101 as a driving mechanism is disposed upward under the supporting frame 99, and a roller mount 103 is attached to the top end of a rod 102 of the pushing-up cylinder 101. Two guide shafts 104 are disposed on the lower surface of the roller mount 103, which respectively engage slidably with guide units 105 provided on the roller supporting frame 99. A pair of supporting plates 106 are disposed on the roller mount 103, and on the supporting plates 106 are provided the plurality of pushing-up rollers 93 arranged longitudinally, which, together with the holding rollers 92, constitute the main part of the paper hang-down prevention device. pushing-up roller 93 may be provided at least one. pushing-up roller 93 is positioned almost in line longitudinally with the holding roller 92, and in the cross direction, is offset outward by a predetermined value, as shown by " ℓ " in Fig.9. The offset value ℓ is determined according to the thickness and strength of the packaged paper bundle 22. As described above, the pushing-up roller supporting frame 99 is movable transversely along the guide shafts 98, and thus the position of the pushing-up rollers 93 is adjustable according to the size of the packaged paper bundle 22. Thus, in this embodiment, the paper hang-down prevention device mainly comprises the holding roller 92, the pushing-up rollers 93, and the pushing-up cylinder 101.

After the paper bundle 28 is stiffened by the function of the paper hang-down prevention device 91, the front portion of the wrapping paper is peeled upward and downward by an unwrapping device 90. The unwrapping device 90 is shown in detail in Fig.11 and Fig.12 which is a left side view of the device.

The supporting plate 96 disposed on the support table 67 is provided projectingly with upper and lower horizontal swing shafts 110 and 111 which are to clamp the packaged paper bundle at the unwrapping position from the upper and lower sides and to arrange it horizontally. The lower horizontal swing shaft 110 is connected with the rear portion of a front lower arm 112, and the front end of the lower arm 112 is provided with a positioning stopper 113. The packaged paper bundle 22 pushed out by the pushing device 33 comes in contact against the positioning stopper 113 of the horizontally disposed lower arm 112, where it is positioned and stopped. The lower arm 112 is provided with a plurality of vacuum pads 114, which can adhere to the lower surface of the wrapping paper 34 and are movable in the vertical direction in Fig. 12, through air cylinders 115. Similarly, the upper horizontal swing shaft 111 connected to the lower horizontal 110 through a pair of gears 116 is connected with an upper arm 119, and the upper arm 119 is provided with a plurality of vacuum pads 117, which can

3

adhere to the upper surface of the wrapping paper 34 and are movable in the vertical direction in Fig.12 by air cylinders 118. The crank 120, which is disposed integrally with the lower horizontal swing shaft 110, is pin-connected with a piston rod 122 of an unwrapping cylinder 121 connected to the post 13.

The vacuum pads 114 and 117 are connected to a vacuum pump (not shown). After the vacuum pads 114 and 117 attract the wrapping paper 34 from the upper and lower sides of the packaged paper bundle 22, which is positioned at the unwrapping position by the positioning stopper 113, when the piston rod 122 of the unwrapping cylinder 121 extends, the upper arm 119 and and the lower arm 112 open upward and downward to vertically open the front portion of the wrapping paper 34 which is cut open by the front circle cutter 65 and the side circle cutter 66 and to expose the front part of the paper bundle 28.

In this embodiment, the lower horizontal swing shaft 110 is driven by the unwrapping cylinder 121 through the crank 120. However, alternatively, the upper horizontal swing shaft 111 may be driven. Thus, either one of the horizontal swing shafts 110 and 111 can be driven by a motor through gears or the like.

The front end of the support table 67 is provided with a pushing-up cylinder 123, disposed vertically and

projectingly, to move up and down a pushing-up 124 which is to push up the center of the front portion of the paper bundle 28 at the unwrapping position from the lower side to prevent the paper bundle 28 from hanging down and to facilitate gripping of the front portion of the paper bundle 28 by a paper bundle gripping device 140 which will be described herein later.

Referring to Fig. 13, at the side of the paper bundle carrying-out position, the posts 12 and 13 are provided rotatably with both ends of upper and lower wrapping paper carrying-out rollers 125 and 126 to discharge the wrapping paper after removing the paper bundle 28 by the paper bundle gripping device out of the printing machine. wrapping paper carrying-out roller 125 is connected to a carrying-out drive motor 127 through a chain 128. wrapping paper carrying-out roller 126 is attached to the front end of an open/close lever 130 which is operated by an open/close cylinder 129, and can be vertically dislocated about a swing shaft 131 of the open/close lever 130 relative to the lower wrapping paper carrying-out roller 125. A vacuum pad 136, which can be moved up and down by an air cylinder 135, is attached at the front end of a piston rod 134 of a wrapping paper carrying-out cylinder 133 which is hung down on the frame 11 through a bracket 132. wrapping paper 34 attracted by the vacuum pad 136 is sent at its one side end in between the upper and lower wrapping paper carrying-out rollers 125 and 126 by the operation of the wrapping paper carrying-out cylinder 133, pinched between the wrapping paper carrying-out rollers 125 and 126, and then carried to the right in Fig.13 by the operation of the carrying-out drive motor 127.

After the front portion of the wrapping paper is opened up and down, the paper bundle 28 inside is gripped and pulled out by the paper bundle gripping device 140, carried on a paper fanning roller conveyor 141, and then carried onto the paper bundle 28 on the carrying-in lifter 29.

The paper fanning roller conveyor 141 is disposed on the front portion of the mounting plate 69 through a bracket 142.

The paper bundle gripping device 140 is shown in detail in Figs.14 to 18.

A carrying-in threaded shaft 143 extending parallel to the feed direction of the paper bundle 28 is rotatably mounted on the frame 11 above the carrying-in lifter 29. The carrying-in threaded shaft 143 is connected to a carrying-in threaded shaft drive motor 144 which is fixed to the frame 11, and the carrying-in threaded shaft 143 is rotated by the operation of the carrying-in threaded shaft drive motor 144. The main frame 145 of the paper bundle gripping device 140 extends in the right/left direction, and

part of the main frame 145 is provided with a nut unit 146 which engages with the carrying-in threaded shaft 143.

Guide rollers 147 are provided at both ends of the main frame 145, and these guide rollers 147 can roll over a guide rail 148 provided in the longitudinal direction along the frame 11. Thus, by the rotation of the carrying-in threaded shaft 143, the main frame 145 can be moved correctly forward and reverse.

Support pillars 149 are hung down at three locations on the main frame 145, at the center and both sides, and main units of the paper bundle gripping device are mounted on the individual support pillars 149. The individual main units are the same in configuration, and one of the main units will therefore be described.

The lower part of the support pillar 149 is attached to with a pair of parallel stopper plates 150 projecting to the carrying-in lifter 29 side. The stopper plate 150 is almost triangularly shaped as viewed from the side, and at its front end is formed a nearly horizontal stopper portion 150a. The support pillar 149 is provided at its front surface with a vertical guide rail 151.

The upper front side of the support pillar 149 is provided with an angular bracket 152, and an up/down cylinder 153 is attached downward to the bracket 152. The front end (lower end) of a rod 154 of the up/down cylinder

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is connected with a connecting unit 157 comprising upper and lever collars 155a and 155b and a shaft 156 connecting the collars 155a and 155b. The shaft 156 of the connecting unit 157 is engaged, with a clearance, with upper plates 159 of a claw supporting frame 160, which comprises a pair of side plates 158 and the upper plates 159 connecting the upper portions of the side plates 158. Thus, the claw supporting frame 160 can move freely between the collars 155a and 155b of the connecting unit 157. Normally, however, the claw supporting frame 160 is supported with the upper plate 159 contacting the lower collar 155b due to the weight of the upper plate 159. The lower ends of the pair of side plates 158 of the supporting frame 160 are connected with an upper claw plate 161. At the back side of the supporting frame 160, a guide 162 engaging with the guide rail 151 is provided through a back plate 160a. Therefore, by the operation of the up/down cylinder 153, the claw supporting frame 160 is moved up and down, being guided by the engagement of the guide 162 and the guide rail 151.

An upper gripping claw (upper claw) 163 is provided on the lower surface of the front end of the upper claw plate 161, and a gripping surface 163a of the upper claw 163 which comes in contact against with the top surface of the paper bundle 28 is curved upward along the feed direction (left direction in Fig.14) of the paper bundle 28. A paper

gripping cylinder 164 is disposed downward in the upper claw plate 161, and the lower end of a rod 165 extending downward of the paper bundle gripping cylinder 164 is screwed with a nut member 167 integral with a lower claw plate 166. The cylinder diameter (pressure receiving area) of the paper bundle gripping cylinder is greater than that of the up/down cylinder 153. The upper claw plate 161 is also provided with two ball cases 168, into which vertically movable guide shafts 170 are inserted through linear ball bearings 169, and lower ends of these guide shafts 170 are connected to the lower claw plate 166. Therefore, by the operation of the paper bundle gripping cylinder 164, the lower claw plate 166 is moved up and down, being guided by the guide shafts 170. The lower claw plate 166 is provided at its both side end surfaces with claw plates 171, and each of the claw plates 171 is provided on its side surface with a stopper roller 172 which can contact against a stopper 150a of the stopper plate 150. Further, at the front ends of the claw plates 171, a lower gripping claw (lower claw) 173 is provided opposing the upper gripping claw 163 and riding over both claw plates 171. A gripping surface 173a of the lower gripping claw 173 contacting against the lower surface of the paper bundle 28 is curved upward, as in the case of the upper gripping claw 163.

By the paper bundle gripping device 140 of the

-1

above-described arrangement, the paper bundle 28 are stacked one by one on the paper bundle 28 already stacked on the carrying-in lifter 29, and the newly stacked paper bundle 28 is to be arranged in line with the previously stacked paper bundle 28. For the purpose, sub-frames 181 surrounding the paper bundle 28, mounted on the post 14 and 15, are provided with a pair of paper bundle side registering devices 182 having vibrators (not shown) to register the paper bundle 28 in the right/left direction and a paper bundle front edge registering device 183 having a vibrator (not shown) to come in contact against the front edge of the paper bundle 28 and register the front edge of the paper bundle 28. Further, at the right end in Fig.1 of the sub-frame 181, a paper bundle shifting prevention device 186 having a holding claw 185 is provided opposing the paper bundle front edge registering device 183, which, by the function of an actuator 184, is to press the upper surface of the paper bundle 28 at the carrying-in waiting position and to prevent the already stacked paper bundle 28 from shifting when carrying in the paper bundle 28 by the paper bundle gripping device 140.

The paper bundle 28 is carried on the paper bundle fanning roller table 141 by the paper bundle gripping device 140. During the process of transportation, the paper bundle 28 is loosened by a paper bundle fanning device shown in Fig.19, and air is blown in between paper sheets.

The paper bundle fanning device 190 comprises the roller table 142 and a blowing nozzle 191 provided on both sides of the roller table 142. The roller table 141, as shown in Fig.21, comprises three rows of a plurality of rotatable rollers 141a, arranged in the right/left direction with logitudinal intervals. The blowing nozzle 191, as shown in Fig.19, is slanted backward with respect to the paper feed direction. The blowing nozzle 191 is mounted on the frame 14 with a bracket 192 and bolts 193. The blowing nozzle 191 is connected to an air supply (not shown) and, as shown in Fig.20, blows air from an S-shaped opening onto the side surface of the paper bundle 28.

Paper bundle stacking operation by the automatic paper bundle stacking device of the above-described arrangement will now be described.

The carrying-out lifter loaded with the packaged paper bundle 22 is stopped when the packaged paper bundle 22 reaches a predetermined position. At this time, the pushing device 33, as shown in Fig.22(A), is waiting in the vicinity of the rear surface of the top packaged paper bundle 1. In the pushing device 33, the cutter 49 is located at one end of the movable range of the rodless cylinder 47 as indicated by solid lines in Fig.2.

When the carrying-out lifter 24 stops, the pushing device 33 moves forward, its pushing surface 44d comes into

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bundle 22, and the cutter 49 is inserted into the upper edge of the surface of the wrapping paper 34. Then, the pushing device moves forward, and the packaged paper bundle 22 is moved forward as shown in Fig.2(B). Prior to this, as shown in Fig.8, the upper and lower arms 119 and 112 constituting the unwrapping device 90 are swinging and waiting on both sides of the transportation path of the packaged paper bundle 22, and the packaged paper bundle 22 pushed out by the pushing device 33 comes into contact against the positioning stopper 113 at the front end of the lower arm 112, where it is stopped.

After the packaged paper bundle 22 is stopped, the holding cylinder 57 of the pushing device 33 contracts to move down the suckers 63, and the suckers 63 are pushed against the rear upper surface of the packaged paper bundle 22 to attract the packaged paper bundle 22. Since the holding pieces 61 are located upper than the suckers 63, they do not come into contact with the upper surface of the packaged paper bundle 22. Therefore, the holding pieces 61 will not push nor bind the packaged paper bundle 22. Then, the rodless cylinder 47 of the pushing device 33 operates to move the cutter 49 along the rear surface of the packaged paper bundle 22 and cut open the rear upper edge of the wrapping paper 34. Thus, evacuation at the rear portion in

the wrapping paper 34 is broken.

After the rear upper edge of the wrapping paper 34 is cut open, the holding cylinder 57 extends to cause the suckers 61 to raise a rear upper surface 34a of the wrapping paper 34, as shown in Fig.22(C).

After that, the claw plates 53, which have been located at withdrawn positions as indicated by two-dots-bar lines in Fig.6 by the extension of the claw plate cylinder 50, are moved forward by the contraction of the claw plate cylinder 50 and go into the lower side of the rear upper surface 34a of the wrapping paper which are attracted and raised by the suckers 63, as shown in Fig.22(D).

Then, the holding cylinder 57 contracts again to move down the suckers 63 and holding pieces 61 and, as shown in Fig.22(E), the holding pieces 61 and the claw plate 53 pinch and hold the rear upper surface 34a of the wrapping paper. Figs.22(F) and 22(G) show plan views of this condition as viewed along line XXII-XXII in Fig.22(E).

When, as described above, the packaged paper bundle 22 is pushed out towards the positioning stopper 113, as shown in Fig.22(B), the wrapping paper 34 is cut open at its front end by the side cutters which are located at both sides of the transportation path of the packaged paper bundle 22 and driven to rotate. When the front end of the packaged paper bundle 22 comes into contact against the positioning stopper

113 to stop, the front circle cutter 65 moves laterally and cuts open the front portion of the wrapping paper 34 at the same cutting position as with the side cutters 66. Thus, the front portion of the wrapping paper 34 is cut open from three directions. After the wrapping paper 34 is cut open, the side cutters 66 are shifted to positions out of the packaged bundle 22 so that they do not disturb removal of the wrapping paper 34.

With the above condition, as shown in Fig.22(B), the lower surface at both front sides of the packaged paper bundle 22 is supported by the pushing-up rollers 93 of the paper hang-down prevention device 91, and its upper surface is held by the holding roller 92. From this condition, the pushing-up cylinder 101 operates to move up the plurality of pushing-up rollers 93, as shown in Fig.22(C). By the pushing-up of the pushing-up rollers 93, both sides of the packaged paper bundle 22 are bent at the outer side of the holding roller 92, from the condition as shown in Fig.23(A) to that as shown in Fig.23(B), to be stiffened. By the stiffening, hanging-down of the front portion of the paper bundle 28 is prevented, thereby preventing mis-gripping of the paper bundle gripping device 140.

After the paper bundle 28 is stiffened, the vacuum pads 117 and 114 of the upper and lower arms 119 and 112 adhere to an upper surface 34b and a lower surface 34c of the

cut-open wrapping paper 34 and, when the upper and lower arms 119 and 112 are withdrawn, the upper surface 34b and the lower surface 34c of the wrapping paper 34 are opened up and down to expose the paper bundle 28. At this time, when the lower arm 112 which substantially supports the front portion of the paper bundle 28 is withdrawn, the paper bundle is prevented from hanging down at the front portion since the paper bundle 28 is stiffened by the previous step. When the paper bundle 28 is not so large in width, it is sufficient to stiffen the paper bundle 28 but, when the paper bundle 28 is large in width, the paper bundle 28 tends to hang down at its center in the width direction, and the pushing-up cylinder 123 is operated to push up and hold the front portion of the paper bundle 28 by the front end of the pushing-up rod 124 as shown in Fig. 22(H).

After that, the pushing-up rollers 93 which have stiffened the paper bundle 28 are moved down to return the paper bundle 28 back to the normal transportation height.

Prior to the above operation, the paper bundle gripping device 140 is moved towards the paper bundle 28 from the state as shown in Fig.14 by the rotation of the carrying-in threaded shaft 143. thus, in the paper bundle gripping device, the up/down cylinder 153 extends to move down the rod 154 and the claw supporting frame 160 and, when the stopper rollers 172 at both sides of the claw plate 171 come

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plate 150 at the holding pillar 149 side, the up/down cylinder 153 stops (the state as shown in Fig.15). Then, the paper bundle gripping cylinder 164, due to the difference in diameter from the up/down cylinder 153, extends through the stopper roller 172, using the stopper plate 150 as a counter receiver. As a result, the entire supporting frame 160 together with the paper bundle gripping cylinder 164 are moved up by a margin stroke "lı" of the connecting unit 157 and stopped when the upper plate 159 comes into contact against the upper collar 155a (the state as shown in Fig.14), where they are held. Under this condition, the paper bundle gripping device 140 is moved towards the paper bundle 28.

When the paper bundle gripping device 140 is moved forward and stopped at a predetermined position, the upper and lower gripping claws 163 and 173, as shown in Fig.14 and Fig.22(I), are separate by a predetermined distance from the upper and lower surfaces of the end portion of the paper bundle 28. At this time, distance between the upper surface of the paper bundle 28 and the upper gripping claw 163 is equal to the margin stroke "l₁" of the connecting unit 157.

After that, when the paper bundle gripping cylinder 164 is operated to grip the end portion of the paper bundle 28 by the upper and lower gripping claws 163 and 173, the upper

claw plate 166, the claw plate 171, and the lower gripping claw 173 are moved up by the contraction of the rod 165, the stopper roller 172 is separated from the stopper portion 150a of the stopper plate 150, the entire supporting frame 160 is moved down to the position where the upper plate 159 comes in contact against the lower collar 155b, and the gripping surface 163a of the upper gripping claw 163 comes into contact against the upper surface of the paper bundle Thus, as indicated by two-dots-bar lines in Fig.17, the upper and lower gripping claws 163 and 173 simultaneously come into contact against the upper and lower surfaces of the paper bundle 28. By the operation of the paper bundle gripping cylinder 164, referring to Fig. 22(J), the end portion of the paper bundle 28 is bent upward and gripped by up-curved gripping surfaces 163a and 173a of the upper and lower gripping claws 163 and 173. By the upward bending, the end portion of the paper bundle 28 is stiffened, thereby preventing hanging-down of the paper bundle 28. Further, as described above, by gripping the paper bundle 28 simultaneously from the upper and lower surfaces, the paper bundle 28 is prevented from coming out of the claws due to its elasticity, thus ensuring positive gripping of the paper bundle 28.

After that, by the contraction operation of the up/down cylinder 153, the entire supporting frame 160 is moved up by

predetermined distance and then, by the reverse rotation of the carrying-in threaded shaft 143, the gripping device 140 is returned back and the paper bundle 28 is taken out of the wrapping paper 34. At this time, the rear portion of the wrapping paper has been cut open, the paper bundle 28 can be easily and smoothly taken out of the wrapping paper 34 with no negative pressure generated at the rear portion in the interior of the wrapping paper 34. To further facilitate removal of the paper bundle 28, air is blown in between the paper bundle 28 and the wrapping paper 34. An air-blowing nozzle for the purpose may be provided either separately or on the upper or lower gripping claws 163 or In this embodiment, the upper gripping nozzle 163 is provided with an air-blowing nozzle 201 which blows air into a gap 202 between the lower surface of the paper bundle 28 and the wrapping paper.

After the removal of the paper bundle 28, the wrapping paper 34 which remains gripped at the rear portion by the pushing device 33 is, by the operation of a wrapping paper carrying-out cylinder 133, attracted by a vacuum pad 136, guided between the carrying-out rollers 125 and 126, and discharged out of the apparatus.

The removed paper bundle 28, as shown in Fig.17 and Fig.21, is pulled by the paper bundle gripping device 140 and moved swinging on the fanning roller table 141. During

the moving, the paper bundle 28 is fanned. Further, referring to Fig.19, air is forcedly blown from the blowing nozzle 191 into between sheets of the paper bundle 28, thereby promoting fanning of the sheets.

The thus fanned paper bundle 28 is further pulled by the paper bundle gripping device 140 to be transferred from the fanning roller table 141 onto the paper bundle 28 on the carrying-in lifter 29. At this time, due to a level difference H between the upper surface of the roller table 141 and the top surface of the paper bundle 28, the paper bundle 28 is further fanned during falling over the level difference, thereby ensuring blowing-in of air.

After the paper bundle gripping device 140 is withdrawn and stopped at a predetermined position, the up/down cylinder 153 extends to move down the rod 154 and the supporting frame 160, the stopper rollers 172 at both sides of the claw plate 171 come into contact against the stopper portion 150a of the stopper plate 150, and then the up/down cylinder 153 stops. Then, the paper bundle gripping cylinder 164 extends to move up the entire supporting frame 164 together with the paper bundle gripping cylinder 164, and the end portion of the paper bundle 28 is released. When the paper bundle 28 is placed on the stacked paper bundle 28 on the carrying-in lifter 21, since the end portion of the paper bundle 28, as described above, is

will never be folded. Further, since the paper bundle gripping device 140 carries in the paper bundle 28 with its end portion raised, folding of the paper sheets during carrying in onto the stacked paper bundle 28 is prevented even if there is hanging-down of the paper bundle 28. Thus, paper folding is positively prevented.

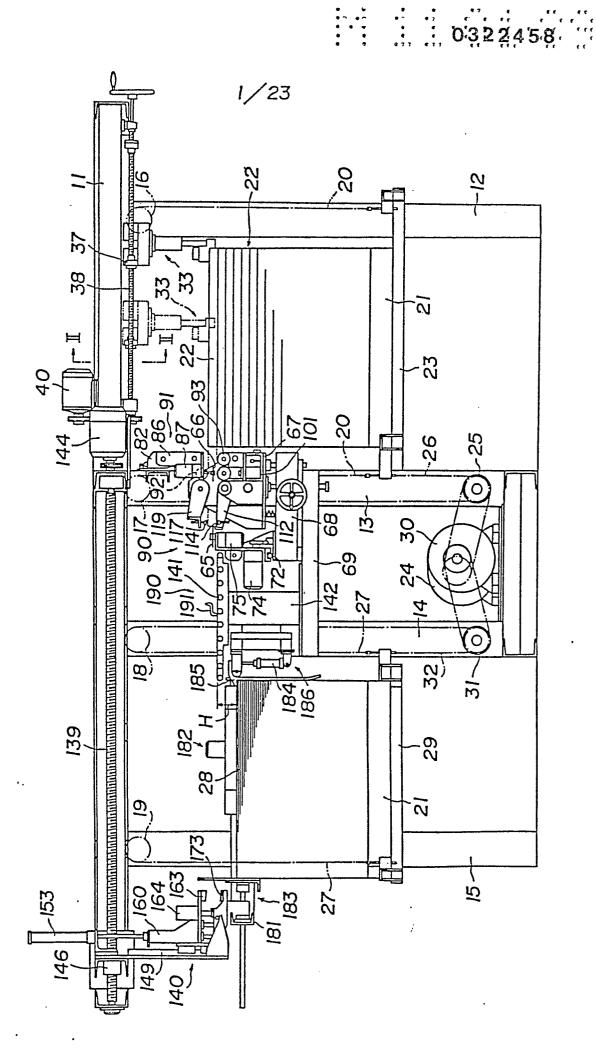
The paper bundle 28 placed on the stacked paper bundle 28 is registered by the paper bundle side registering devices 182 and 183. Now the automatic paper stacking process is completed.

Claims

- An automatic paper bundle stacking apparatus comprising a vertically movable first carrying means loaded with a stack of wrapped packaged paper bundles for moving the top one of said packaged paper bundles up to a starting position, a pushing means movable in a longitudinal direction for pushing said packaged paper bundles out to an unwrapping support means disposed in front of said first carrying means, a wrapping paper cutting means for horizontally opening at least the front end both sides of the wrapping paper of said packaged paper bundle, unwrapping means disposed above and below said unwrapping support means for vertically opening at least the front end portion of said wrapping paper of said packaged paper bundle on said unwrapping support means, a second vertically movable carrying means disposed in front of said unwrapping support means, means and a paper bundle gripping means movable between said second carrying means and said unwrapping support means for gripping the front end portion of said paper bundle in said packaged paper bundle on said unwrapping support means and transferring said paper bundle onto said second carrying means.
- 2. An automatic paper bundle stacking apparatus as claimed in Claim 1, further comprising a paper bundle fanning device

disposed between said unwrapping support means and said second carrying means for blowing air into said paper bundle in the course of its being carried.

- 3. An automatic paper bundle stacking apparatus as claimed in Claim 1, further comprising a paper hang-down prevention device having a holding roller to press the upper surface of said packaged paper bundle with at least the front side and front end of both sides of said packaged paper bundle horizontally cut and pushing up rollers for pushing the lower surface of said packaged paper bundle up to positions corresponding to outer sides of said holding roller.
- 4. An automatic paper bundle stacking apparatus as claimed in Claim 1, wherein said pushing means has a cutter for cutting the rear portion of said wrapping paper of said packaged paper bundle and gripping means for gripping the rear portion of said packaged paper bundle.



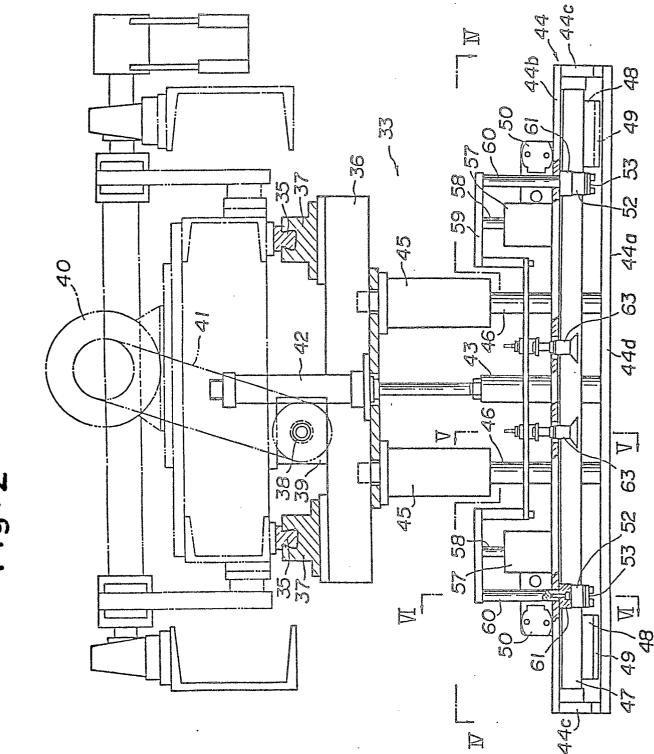


Fig. 2

3/23 -36

Fig.3

7/20

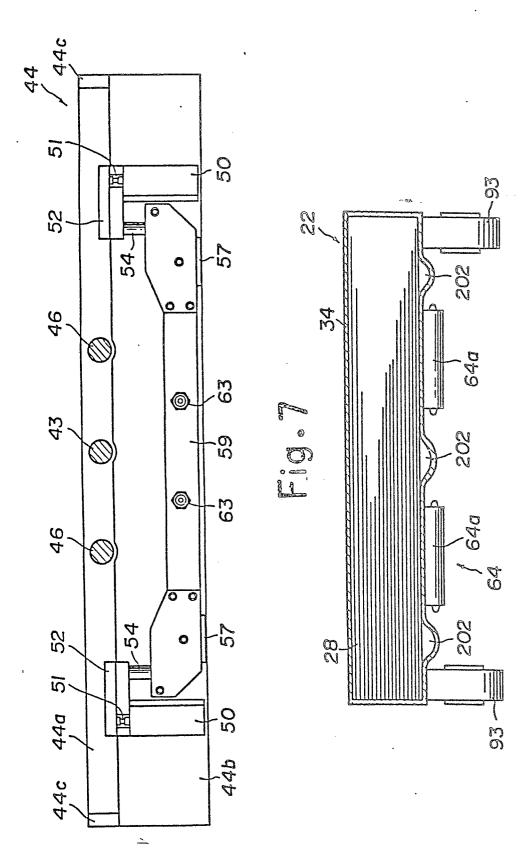


Fig.4

Fig.5

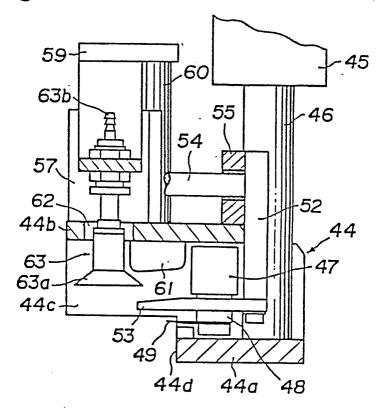


Fig.6

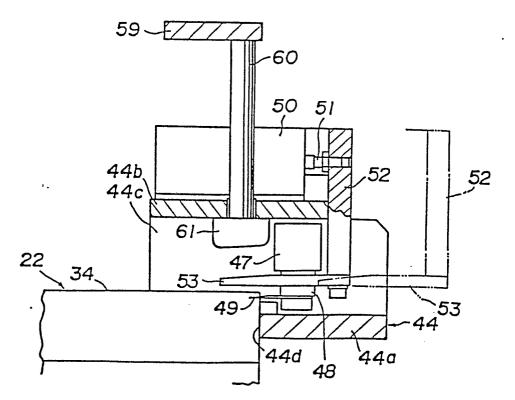


Fig. 0

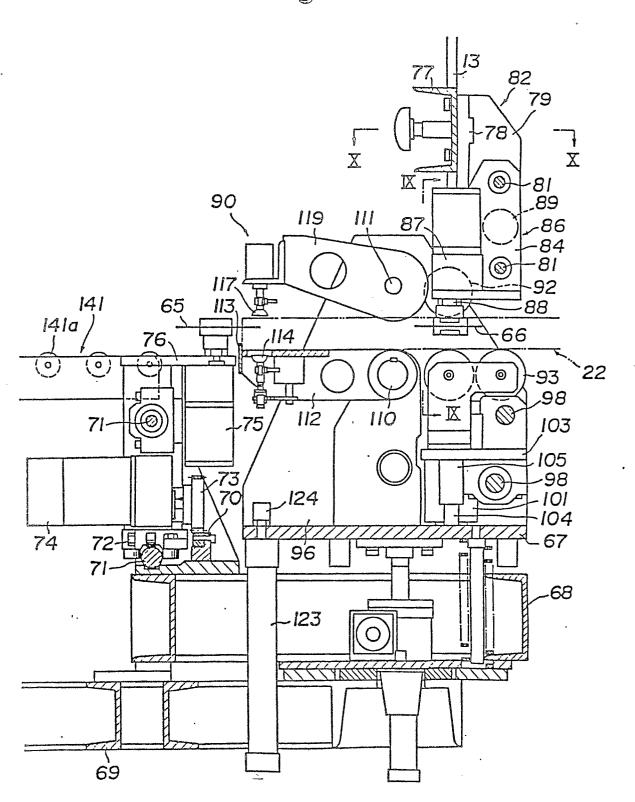
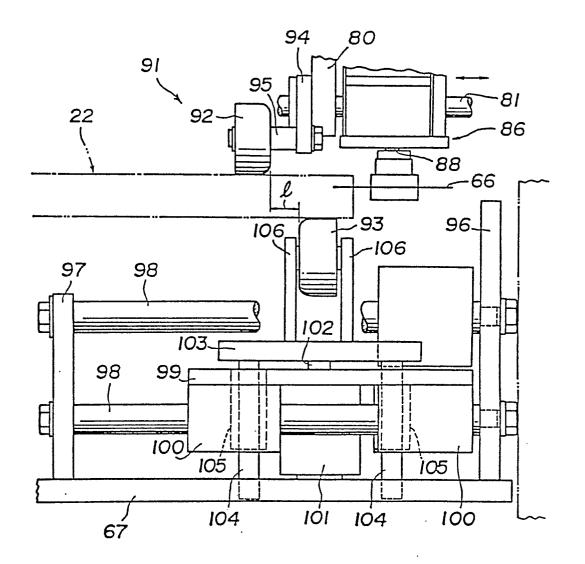
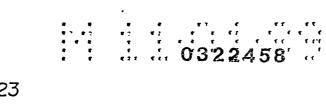




Fig.9

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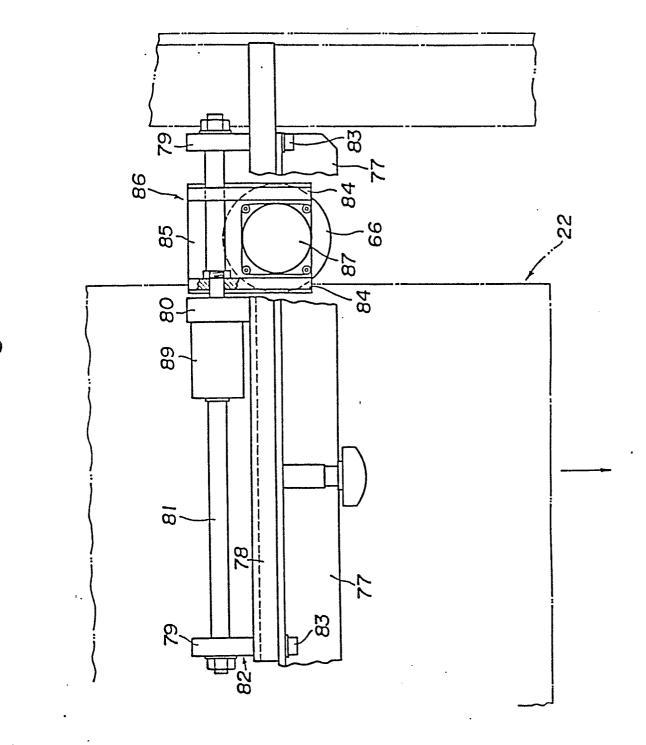
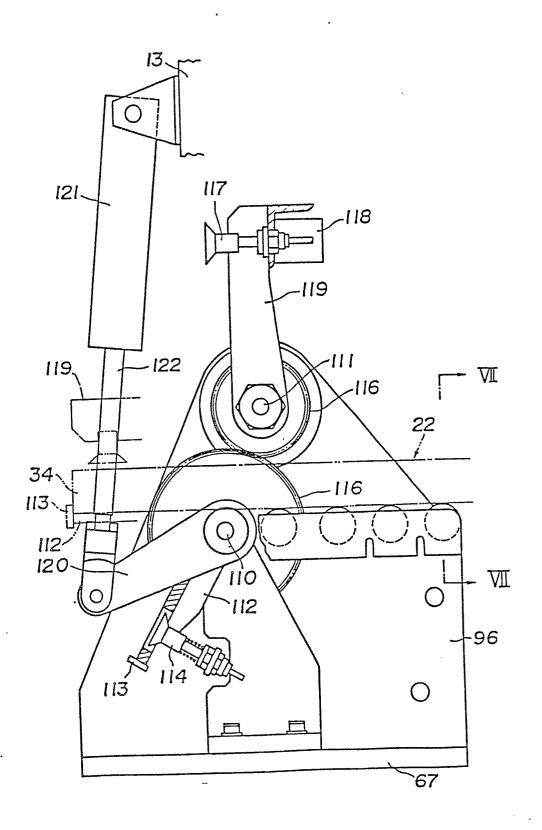


Fig. 10

Fig. !!



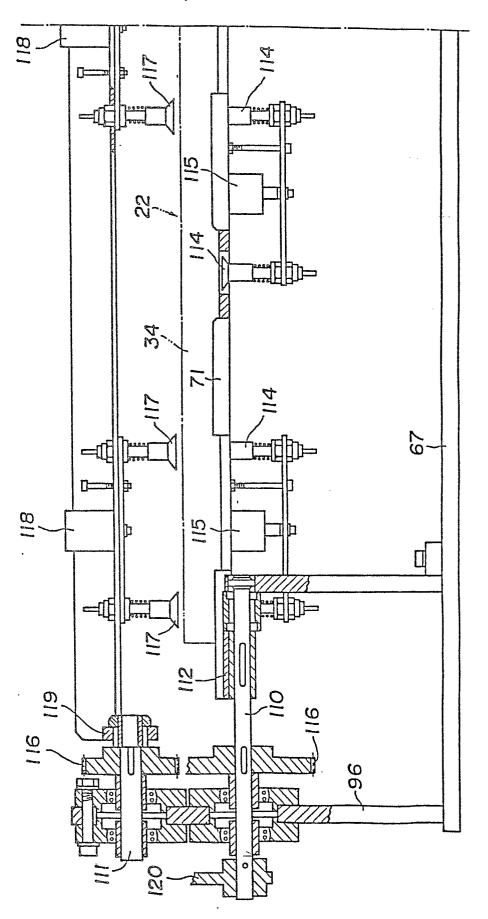


Fig. R

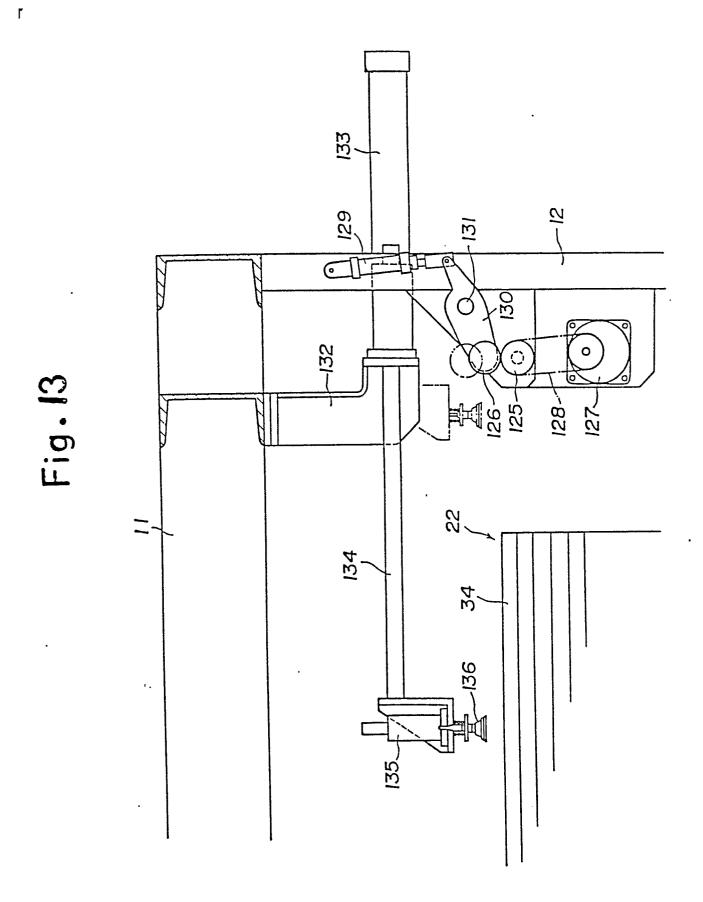
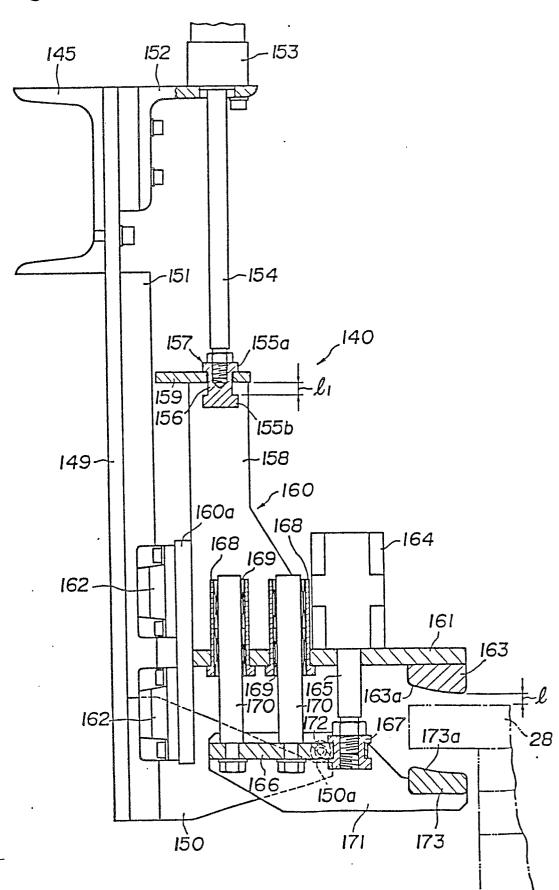


Fig. 14





13 /23

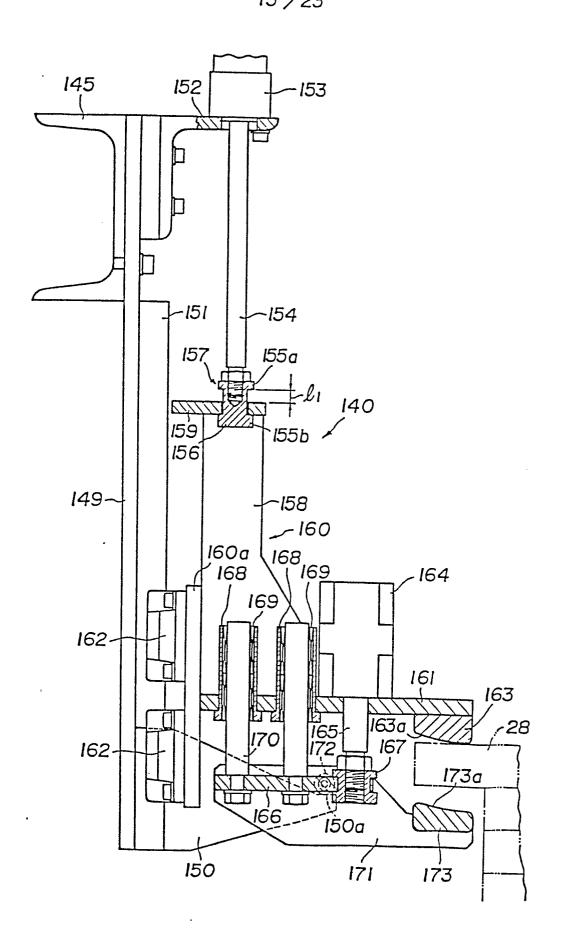
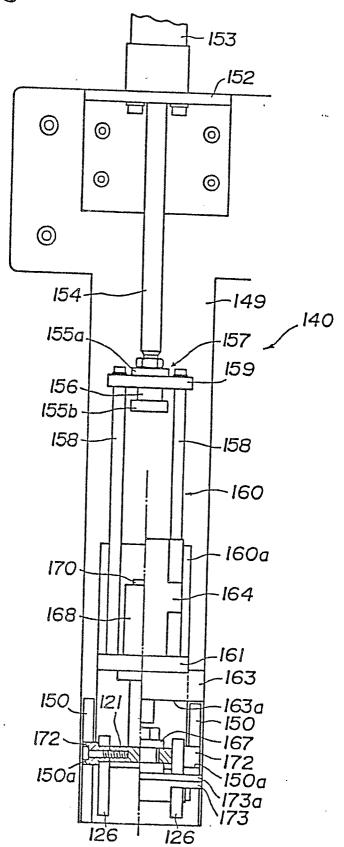


Fig. 16



15 /23 Fig. 17

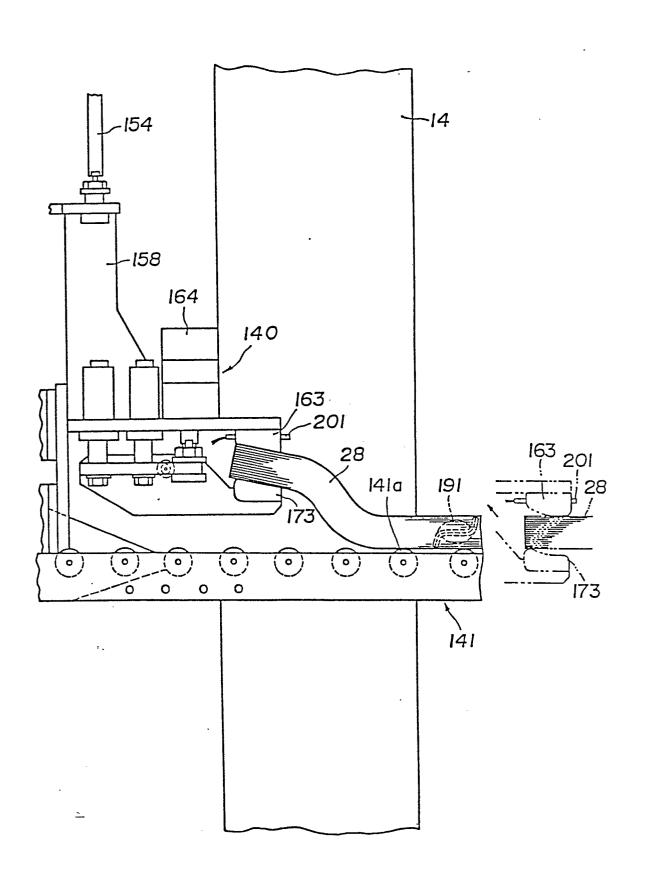
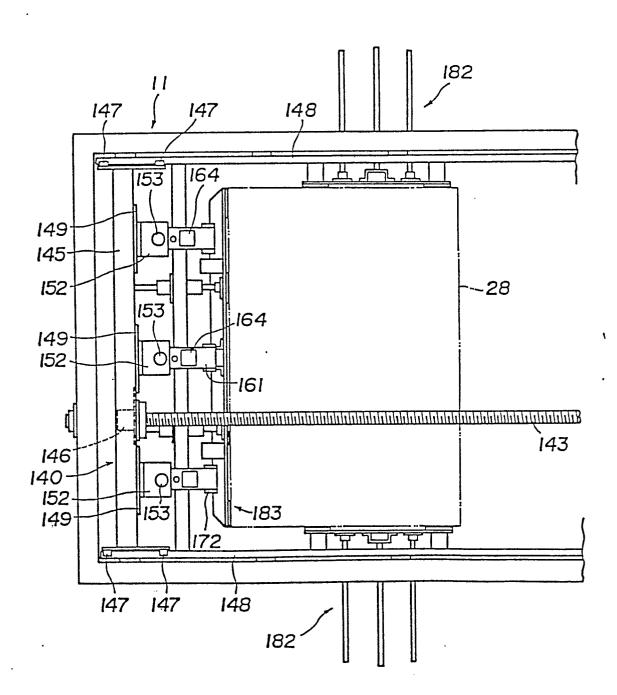


Fig. 18



17/23

Fig. 19

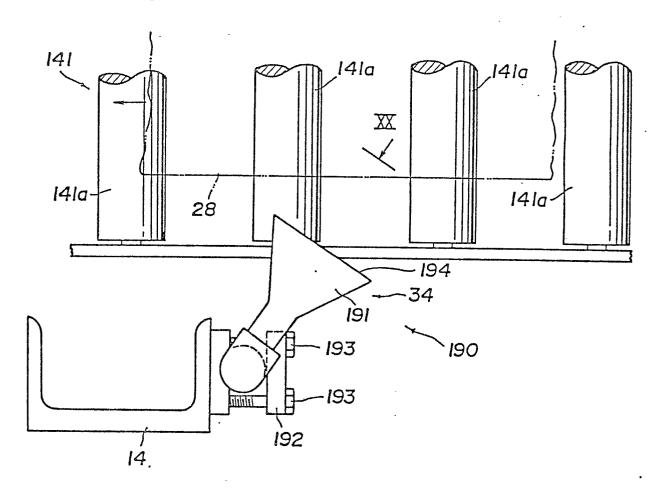
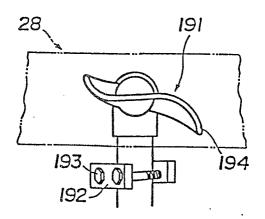
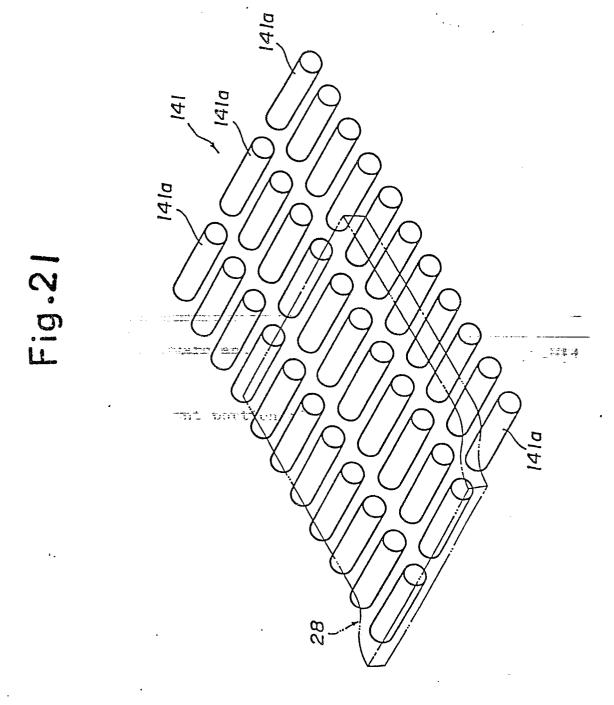


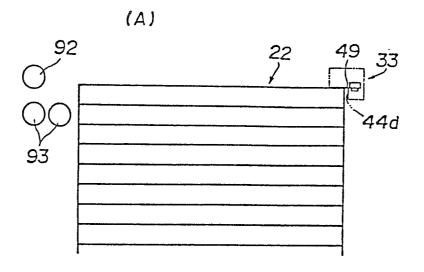
Fig.20

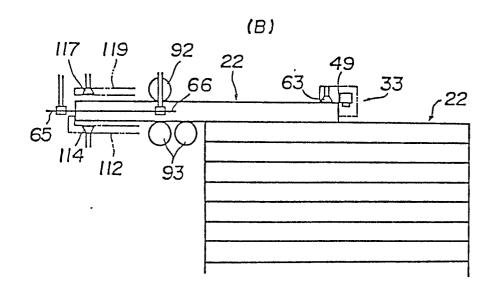




19/23

Fig.22





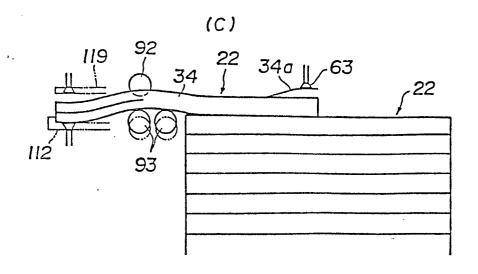
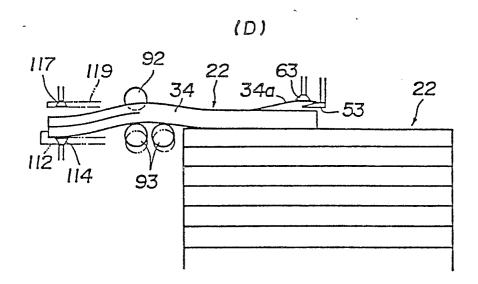


Fig.22



(E)

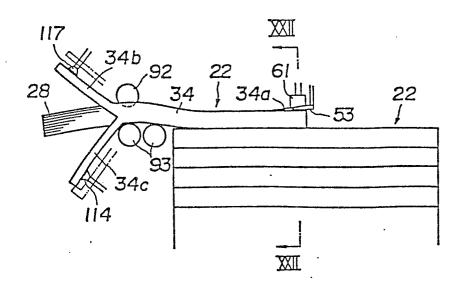
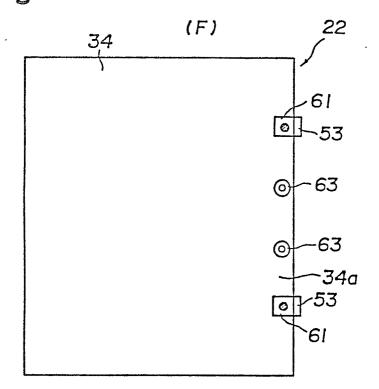


Fig.22



(G)

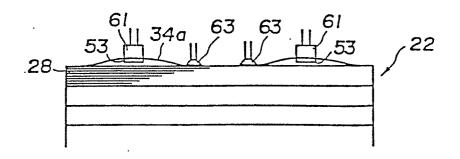
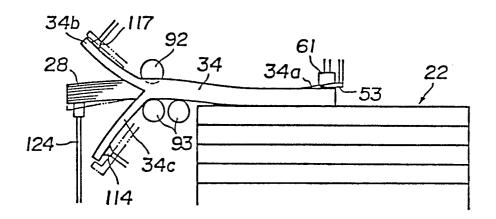


Fig.22

(H)



(I)

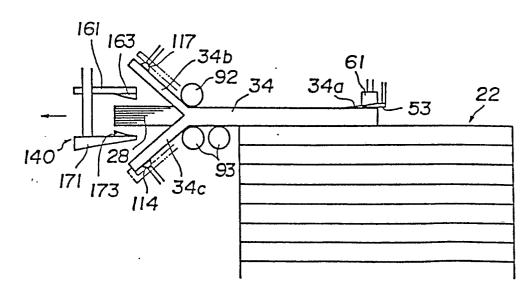


Fig.22

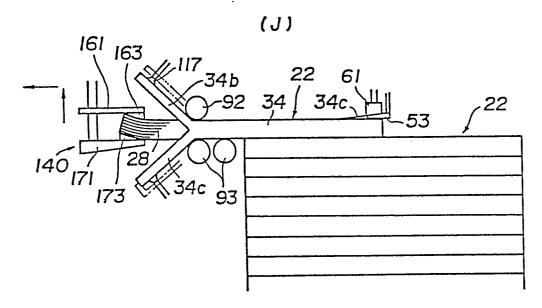
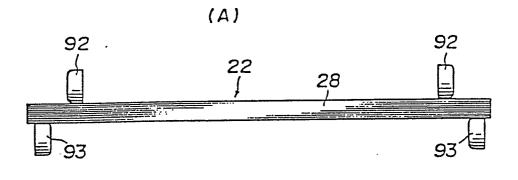
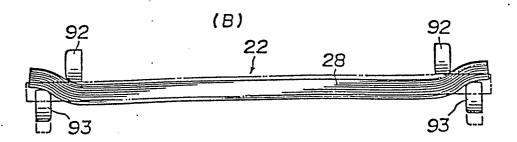


Fig.23





INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP88/00542

	IFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6	
	to International Patent Classification (IPC) or to both National Classification and IPC	
In	t.Cl4 B65H3/24, 1/26, 3/00, B65B69/00	
II. FIELD	S SEARCHED	
Classificati	Minimum Documentation Searched 7	
Classificati	on System Classification Symbols	
IP	С В65H3/00, 1/00, В65В69/00	
	Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 8	
	tsuyo Shinan Koho 1926 - 1987 kai Jitsuyo Shinan Koho 1971 - 1987	
III. DOCL	MENTS CONSIDERED TO BE RELEVANT 9	
Category *	Citation of Document, 11 with indication, where appropriate, of the relevant passages 12	Relevant to Claim No. 13
Y	JP, B2, 62-3056 (Shukosha Kabushiki	1-4
	Kaisha) 23 January 1987 (23. 01. 87) Column 4, line 25 to column 5, line 22 (Family: none)	
Y	JP, Bl, 49-48711 (Tenshin Kahei Keisanki Kabushiki Kaisha) 23 December 1974 (23. 12. 74) Column 2, line 20 to column 4, line 26 (Family: none)	1-4
Y	JP, A, 61-11330 (Mitsumura Genshokuban Insatsusho Kabushiki Kaisha) 18 January 1986 (18. 01. 86) Column 9, line 2 to column 10, line 20 (Family: none)	1-4
Y	JP, A, 61-33921 (Mitsubishi Heavy Industries, Ltd.) 18 February 1986 (18. 02. 86) Column 9, line 2 to column 12, line 11 (Family: none)	1-4
"A" doc con: "E" earl filin "L" doc whice cita' "O" doc othe "P" doc late	categories of cited documents: 16 If it is imment defining the general state of the art which is not bidered to be of particular relevance or document but published on or after the international date of the publication date of another ion or other special reason (as specified) If it is cited to establish the publication date of another ion or other special reason (as specified) If it is cited to establish the publication date of another ion or other special reason (as specified) If it is cited to establish the publication date of another ion or other special reason (as specified) If it is combined after the priority date and not in conflict with understand the principle or theory document of particular relevance; the considered novel or cannot be inventive step "Y" It is ter document published after the priority date and not in conflict with understand the principle or theory document of particular relevance; the considered novel or cannot be inventive step "Y" It is ter document published after the priority date and not in conflict with understand the principle or theory document of particular relevance; the considered novel or cannot be inventive step "Y" It is ter document published after the priority date and not in conflict with understand the principle or theory document of particular relevance; the considered novel or cannot be inventive step "Y" It is ter document published after the priority date and not in conflict with understand the principle or theory document of particular relevance; the considered novel or cannot be inventive step "Y" It is the priority date and not in conflict with understand the principle or theory document of particular relevance; the considered novel or cannot be inventive step "Y" It is the following the priority date and not in conflict with understand the priority date and not in conflict with understand the priority date and not in conflict with understand the priority date and not in conflict with understand the priority date and not in conflict with und	n the application but cited to underlying the invention he claimed invention cannot e considered to involve an he claimed invention cannot ve step when the document her such documents, such irson skilled in the art
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