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(54) Method and apparatus for bobbin changing in roving frame.

(57) A method for changing bobbins of a roving frame to bobbin supporting members of a bobbin conveying device, and vice versa, and a bobbin changing machine for performing the method.

After full bobbins arranged in a zigzag arrangement are doffed from the roving frame by means of the bobbin changing machine, distance between bobbins corresponding to distances between bobbin wheels of the roving frame, are changed to the distances between bobbins on the creel of a spinning frame, and vice versa, by means of a lateral distance changing device of the bobbin changing machine. Simultaneous with or after the previous process, the zigzag arrangement of the bobbins is aligned, and vice versa, by means of a front and back distance changing device of the bobbin changing machine.

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METHOD AND APPARATUS FOR BOBBIN CHANGING
IN ROVING FRAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method for picking up full bobbins arranged in a zigzag arrangement from a roving frame and transferring the full bobbins to a bobbin conveying apparatus in a single row arrangement with a distance between bobbins the same as in a creel of a spinning frame, and vice versa, and an apparatus for performing the method.

2. Description of the Related Art

As shown in Fig. 3, a roving frame 1 usually has bobbin wheels 5a, 5b arranged in a zigzag arrangement in a front row and back row, each four bobbin wheels forming a group. The distances between adjacent bobbins in the roving frame, i.e., bobbin pitch P1, P2, and the distance L2 between the front row and the back row are determined on the basis of the size of the full bobbins and other factors. The distances P between bobbins of the creel of the spinning frame 501, however, differ from the distances P1, P2 in the roving frame as shown in Fig. 25.

To effectively change the bobbins from the roving frame 1 to the creel of the spinning frame 501, there are known the method of using bobbin carriages 504 having bobbin hangers 503 and slidably engaged with transferring rails 502 arranged on an upper portion of the spinning frame as shown in Fig. 26 and the method of using bobbin carriages 504 slidably engaged with preparatory transferring rails 505 arranged on the outside of the spinning frame as shown in Fig. 27.

There is a problem, however, in that it is necessary to change the distance of the bobbins in the roving frame to the distance in the creel and change the

zigzag arrangement to a single row arrangement before transferring the full bobbins from the roving frame to the bobbin carriages 504. Also, it is necessary to perform the reverse operation before transferring empty
5 bobbins from the bobbin carriages 504 to the roving frame.

Several methods and apparatuses have been proposed for overcoming the above problem. For example, in the apparatus disclosed in Japanese Unexamined Patent
10 Publication (Kokai) No. 50-89642, use is made of a bobbin changing machine capable of picking up two full bobbins of a zigzag arrangement, i.e., a full bobbin in the front row of the bobbin wheels and a full bobbin in the back row of the bobbin wheels, having a distance in
15 a lateral direction therebetween corresponding to the distance between the bobbins of the creel of the spinning frame, and conveying palettes having bobbin supporting members in a zigzag arrangement having the same distance as between the bobbins in the front row and the back row
20 of the roving frame. However, this bobbin changing machine can only doff two full bobbins in one doffing operation, so the efficiency of the doffing operation is low. Further, the conveying palettes have a large width corresponding to the width between the front row and the
25 back row of the roving frame, so it is necessary to increase the distance between the roving frame and the bobbin changing machine. Also, problems regarding the strength of the bobbin changing machine, especially, the bobbin supporting mechanism for picking up the bobbins
30 from the roving frame, have occurred.

In another prior art, disclosed in Japanese Unexamined Patent Publication (Kokai) No. 58-41919, use is made of a peg conveyor, having a plurality of pegs of the same zigzag arrangement as the bobbins in the roving
35 frame, and a bobbin alignment and doffing-inserting device. In this prior art, a peg conveyor and bobbin alignment and doffing-inserting device are necessary

for every roving frame. The peg conveyors are wide, increasing the size of the apparatus, and the cost performance is low. Further, another step to rearrange the bobbins doffed in the zigzag state on the peg

5 conveyor to a single row arrangement is necessary.

In another apparatus, disclosed in Japanese Examined Patent Publication (Kokoku) No. 51-38814, use is made a conveying device, slidably engaged on a rail arranged on a front side of the roving frame and having
10 bobbin supporting members spaced at distances the same as bobbins in the creel of the spinning frame, and a bobbin changing machine, capable of moving in a direction parallel to the lengthwise direction of the roving frame. When doffing the full bobbins from the roving frame, the
15 bobbins are transmitted from bobbin wheels of the roving frame to the bobbin supporting members of the conveying device by intermittently moving each bobbin supporting member to a position corresponding to the bobbin wheel of the roving frame.

20 In this apparatus, however, the bobbin changing machine must be moved every doffing operation of a full bobbin. Therefore, the doffing operation of this apparatus is inefficient.

SUMMARY OF THE INVENTION

25 The present invention aims to eliminate the above problems in the prior art and proposes a method and an apparatus for easily and efficiently changing roving bobbins from a roving frame to a bobbin conveying apparatus and vice versa.

30 The method for changing bobbins in the roving frame in accordance with the present invention is characterized in that a plurality of full bobbins are doffed to bobbin supporting members in a row of a bobbin conveying apparatus by repeating the following steps:

35 a. stopping a bobbin changing machine capable of moving along a front face of a double row type roving machine having upper hanging flyers arranged in a

zigzag arrangement, at a predetermined bobbin-changing position;

5 b. simultaneously taking out a plurality of adjacent full bobbins arranged on a front row and a back row of a bobbin rail of the roving frame by each bobbin changing arm of the bobbin changing machine;

10 c. changing the distance between full bobbins in the lateral direction, i.e., the lengthwise direction of the roving frame, to a distance between bobbins in each row of creels in a spinning frame;

15 d. aligning the front row and the back row of the full bobbins by moving either the front row or the back row in a direction perpendicular to the lateral direction of the roving frame at the same time as step C or after step C; and

 e. transferring the full bobbins to bobbin supporting members of a bobbin conveying apparatus arranged at the same distance as the distance between bobbins in each row of creels of the spinning frame.

20 In accordance with the present invention, there is also provided a bobbin changing machine of a roving frame capable of moving along a front face of a double-row type roving machine having upper hanging flyers arranged in a zigzag arrangement and capable of stopping at a
25 predetermined position. The bobbin changing machine is provided with at least one bobbin changing device capable of moving in a direction perpendicular to a lateral direction of the roving frame and in a vertical direction. Each bobbin changing device includes a
30 plurality of front row bobbin changing arms capable of approaching in parallel a plurality of the upper hanging flyers in a front row; a plurality of back row bobbin changing arms arranged alternately with the front row bobbin changing arms and capable of approaching in
35 parallel a plurality of the upper hanging flyers in a back row; a lateral distance changing device capable of changing the distance in the lateral direction, i.e.,

the lengthwise direction of the roving frame, between the front row bobbin changing arms and the back row bobbin changing arms; and a front and back distance changing device capable of changing the distance in the direction perpendicular to the lateral direction of the roving frame between the front row bobbin changing arms and the back row bobbin changing arms. The lateral distance changing device and front and back distance changing device are operated and bobbins are changed when the bobbin changing machine is stopped at a predetermined bobbin changing position.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described hereinafter in connection with the accompanying drawings showing preferred embodiments of the present invention, in which:

Fig. 1 is a front view of a bobbin changing machine according to the present invention;

Fig. 2 is a partially abbreviated cross-sectional side view of the bobbin changing machine;

Fig. 3 is a plan view of the bobbin changing machine;

Fig. 4 is a perspective view of a front and back movement mechanism and an ascent and descent mechanism for a bobbin changing device in the bobbin changing machine;

Fig. 5 is a side view of the ascent and descent mechanism;

Fig. 6 is a cross-sectional plan view of a bobbin changing device;

Fig. 7 is a front view of the overall construction of a front and back distance changing device and a lateral distance changing device for bobbin changing arms;

Fig. 8 is a plan view of front row changing arms and back row changing arms;

Fig. 9 is a cross-sectional view of the bobbin

changing device;

Fig. 10 is a cross-sectional front view along line I-I of Fig. 9;

5 Fig. 11 is a cross-sectional view of the connection of a double threaded portion;

Fig. 12(a) and Fig. 12(b) are plan views of arrangements of the bobbin changing arms, Fig. 12(a) showing the case where the arms are in a zigzag state and Fig. 12(b) the case where the arms are aligned;

10 Fig. 13 is a plan view of a bobbin conveying device transferring device;

Fig. 14 is an enlarged cross-sectional view along line II-II of Fig. 13;

15 Fig. 15(a) to Fig. 15(l) are explanatory views of steps of bobbin changing operations;

Fig. 16(a) to Fig. 16(d) are fragmentary front views of repeat operations of the bobbin changing machine;

20 Fig. 17 is a side view of the roving frame and the bobbin changing machine using a peg conveyor as a second embodiment of the bobbin conveying apparatus;

Fig. 18 is a plan view of the arrangement of the peg conveyor illustrated in Fig. 17;

25 Fig. 19(a) to 19(f) are explanatory views of steps of a bobbin changing operation in the case of using the peg conveyor;

Fig. 20 is a plan view of another embodiment of the lateral distance changing device;

30 Fig. 21, Fig. 22, and Fig. 23 are views showing still another embodiment of the lateral distance changing device, Fig. 21 showing a cross-sectional front view, Fig. 22 a plan view of a grooved cam, and Fig. 23 a side view of the grooved cam illustrated in Fig. 22;

35 Fig. 24 is a cross-sectional front view of still another embodiment of the lateral distance changing device;

Fig. 25 is a plan view of an arrangement of

roving bobbins and spinning bobbins in the spinning frame;

Fig. 26 is a front view of a creel having transferring rails on the spinning frame; and

5 Fig. 27 is a front view of a creel having preparatory transferring rails on the spinning frame.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figs. 1 to 6, a plurality of upper hang type flyers 3 are hung in a front row and a back row on
10 a top rail 2 of a roving frame 1. Four flyers 3 per staff constitute a group. The distance between adjacent flyers in the group in the lateral direction, i.e., the lengthwise direction of the roving frame, is defined as P1, the distance between a bobbin of one group and a
15 bobbin of another group adjacent to former group is defined as P2, and the distance between the front row and the back row is defined as L2. The flyers 3 are rotated at a high speed by means of a driving shaft and gears arranged in the top rail 2. A bobbin rail 4 is
20 arranged below the flyers 3. Bobbin wheels 5a, 5b concentric with each flyer and provided on the bobbin rail 4 are rotated at a high speed by means of the driving shaft and the gears. Top portions of the bobbin wheels 5a, 5b protrude from a top face of the bobbin
25 rail 4.

A bobbin changing machine AD will be now described. In the bobbin changing machine AD, each pair of travelling wheels 9, 9, fixed with a shaft 8 and arranged on a front side and a back side in a travelling direction,
30 are rotatably attached through a bearing 10 to a bottom plate 7 of a bobbin changing machine main body 6. The shaft 8 shown in the right side of Fig. 1, is fixed with a following sprocket wheel 11. A chain 14 surrounds the following sprocket wheel 11 and a driving sprocket wheel
35 13 associated with a driving motor 12 secured to the bottom plate 7. Each travelling wheel 9, 9 rotatably rides on travelling rails 15, 15 arranged on a front

side floor of the roving frame 1 and having at least a length corresponding to the length in a lateral direction of the roving frame. Reference numeral 16 indicates a plurality of positioning members arranged at a point
5 corresponding to a center of the distance P2 on a floor between the travelling rails 15, 15 and the roving frame 1 and arranged every distance P3 in the lateral direction of the roving frame. The distance P3 between the positioning members corresponds to two staffs of
10 the roving frame and can be calculated by the expression $P3 = 6 \times P1 + 2 \times P2$. Hereinafter, vertical planes including the positioning member 16 are indicated as bobbin change centers CL1 and CL2 in the roving frame. A proximity switch 17 capable of detecting the approach
15 of the positioning member is arranged on the bobbin changing machine main body 6. The proximity switch 17 is placed at a position corresponding to the center of the distance between the fourth front or back row bobbin changing arm and fifth back or front row bobbin changing
20 arm in a bobbin changing device 18a or 18b, described hereinafter. A vertical plane including the proximity switch 17 is indicated as a bobbin change center CL in the bobbin changing machine AD. When the motor 12 for driving the wheel 9 is activated, the bobbin changing
25 machine AD moves along the front face of the roving machine 1 on the travelling rails 15, 15. When the positioning member 16 faces the proximity switch 17, the bobbin changing machine stops. The position where the bobbin changing machine stops is the bobbin changing
30 position.

The bobbin changing devices 18a, 18b are capable of moving in a front and back direction, i.e., the direction perpendicular to the lateral direction of the roving frame, approaching the roving frame 1 and leaving the
35 roving frame 1, and ascending and descending. The front bobbin changing device 18a is arranged near the roving frame 1 and is used for doffing full bobbins. The back

changing device 18b is arranged remote from the roving frame 1 and used for inserting empty bobbins.

The constitution of the bobbin changing device 18a and the front and back moving mechanism thereof and ascending and descending mechanism thereof are the same as those of the bobbin changing device 18b. Therefore, the description will be limited to the bobbin changing device 18a and the front and back moving mechanism and ascending and descending mechanism thereof.

As shown in Fig. 4, reference numeral 19 indicates a cylinder for moving the bobbin changing device 18a in a front and back direction against the roving frame. The bobbin changing device 18a is secured on a middle plate 20 which is secured on bearings 10, 10 of the travelling wheels 9, 9. A cylinder rod 21 of the cylinder 19 is connected to a rack lever 22 for rotating a right side spline shaft. This rack lever is called the right rack lever 22 hereinafter. A bottom side of the right rack lever 22 is guided by guide wheels 23, 23 supported rotatably on a top face of the middle plate 20. A rear side of the right rack lever 22 is pushed by the guide wheels 23, 23. The right rack lever 22 can therefore be moved in a lateral direction on the horizontal plane. The right rack lever 22 is provided with racks 24a, 24b at its two ends on the sides facing the roving frame.

Reference numeral 25 indicates a rack lever for rotating a left side spline shaft. This rack lever is called the left rack lever 25 hereinafter. The left rack lever 25 is provided at its left end with a rack 26b on the side facing the roving frame, and with a rack 26a at its right end on a side facing the rack 24a. The left rack lever 25 is guided by the guide wheels 23, 23 to move in the horizontal plane. The rack 24a of the right rack lever 22 and the rack 26a of the left rack lever 25 opposite thereto are engaged with a pinion gear 27 mounted rotatably on the middle plate 20 by

means of a vertical shaft. Therefore, movement of the right rack lever 22 can be transmitted to the left rack lever 25.

Reference numerals 28a, 28b indicate a left side
5 spline shaft and a right side spline shaft, respectively. As shown in Fig. 4, upper ends and lower ends of each spline shaft are inserted into the upper bracket 30 and lower bracket 30 secured to side plates 29, 29 of the bobbin changing machine main body 6. Therefore, each
10 spline shaft is rotatably supported at the predetermined vertical position. Bottom ends of the spline shafts 28a, 28b are fixed with sector gears 31, 31 by a key and the like. The sector gears 31, 31 are engaged with the rack 26b of the left rack lever 25 and the rack 24b
15 of the right rack lever 22, respectively. As shown in Fig. 6, boss portions of swing arms 32, 32 engage slidably in the vertical direction with the left and right spline shafts 28a, 28b. As shown in Fig. 5, the boss portions have small diameter portions at their
20 lower ends. Ascent and descent guiding rings 33, 33 engage rotatably with these small portions. As shown in Fig. 6, the bobbin changing device 18a has slits 35, 35 arranged in the lengthwise direction on a left portion and a right portion of a bottom plate 34 of the bobbin
25 changing device 18a, respectively.

Guide rack levers 36, 36 are arranged on the bobbin changing device 18a in such way that they slidably contact inside faces of a front plate 37 and a back plate 38 and the bottom plate 34 and can be moved
30 only in the lateral direction by guide rollers 39, 39, supported rotatably on the bottom plate 34 by a vertical shaft. Each portion corresponding to a center of the bobbin changing device 18a of the guide rack levers 36, 36 is provided with mutually opposing racks 40, 40.
35 The racks 40, 40 engage with a carrier pinion gear mounted rotatably on the bottom plate 34 by a shaft, respectively. The each other end portions of the guide

rack levers 36, 36 are formed as attachment portions 36a, 36a having an L-shaped configuration and are also provided with attachment holes 36b, 36b. Sliding pins 42, 42 are rotatably inserted to the attachment
5 holes 36b, 36b, inserted also to the slits 35, 35 of the bobbin changing device 18a, and secured to top portions of the swing arms 32, 32.

Reference numeral 43 indicates an ascent and descent cylinder hung from a top plate 44 of the
10 bobbin changing machine main body 6 at the left side of the left spline shaft 28a. The top end of a cylinder rod 43a of the ascent and descent cylinder is provided with a sprocket holder 46 holding rotatably a pair of carrier sprockets 45a, 45b in the vertical direction.
15 An associated ascent and descent shaft 47, arranged in the horizontal direction on the lower portion of the bobbin changing machine main body 6 is supported rotatably by the bobbin changing machine main body 6. Both ends of the associated shaft 47 are connected to
20 drive sprockets 48a, 48b by keys. Reference numerals 49a, 49b are sprockets mounted rotatably on a horizontal shaft attached in the upper portions of the drive sprockets 48a, 48b to the left and right side plates 29, 29 of the bobbin changing machine main body 6. The
25 carrier sprockets 45a, 45b, the drive sprocket 48a, and the sprocket 49a are arranged so that they are positioned in the same vertical plane. The drive sprocket 48b and the sprocket 49b are also arranged so that they are positioned in the same vertical
30 plane. Reference numeral 50 indicates an ascent and descent chain secured to the top plate 44 of the bobbin changing device main body 6. An end of the ascent and descent chain 50 is wound on the upper sprocket 45a of the sprocket holder 46, the sprocket 49a, the drive
35 sprocket 48a, and the lower sprocket 45b of the sprocket holder 46. The other end of the chain 50 is secured to the bottom plate 7. A following chain 51 is wound

around the drive sprocket 48b and the sprocket 49b. The ascent and descent chain 50 and the following chain 51 are connected with the ascent and descent guiding rings 33, 33 in the position between the sprockets 49a, 49b and the drive sprockets 48a, 48b, respectively.

A description will now be given to a lateral distance changing device for changing the distances between four front row bobbin changing arms and four back row bobbin changing arms. As shown in Fig. 9, the bobbin changing device has a box-type configuration with an open upper face. Sliding faces 52, 52 are formed on the upper face. Reference numeral 53 indicates a front row slider including the front row bobbin changing arms, and reference numeral 54 a back row slider including the back row bobbin changing arms. These are arranged alternately on the sliding faces 52, 52 in the sequence of a back row bobbin changing arm and a front row bobbin changing arm from the left end, as shown in Fig. 3. Movement in the front and back direction of both bobbin changing arms is controlled by sliders 55, 55, secured to a front plate 37 and a back plate 38 of the bobbin changing device 18a, respectively. The arms can, however move freely in the lateral direction. The front row slider 53 and the back row slider 54 adjacent thereto are secured at lower side faces to threaded bodies 56, 57 such that the two threaded bodies face each other, as shown in Figs. 10 and 11. In the embodiment illustrated in Figs. 10 and 11, when the threaded bodies 56, 57 are attached to a left side of the front row slider 53 and the back row slider 54, the thread groove of the threaded bodies 56, 57 is right-handed. When the threaded bodies 56, 57 are attached to the right side, it is left-handed. All adjacent threaded bodies 56, 57 except the pair of the threaded bodies 56, 57 of the fourth front row slider 53 and the fifth back row slider 54, are connected by connecting nuts. As shown in Fig. 11 the threaded body 56 of the fourth front row slider 53

and the threaded body 57 of the fifth back row slider 54 are screwed through an intermediate threaded body 59 to a connecting nut 61. An outer surface of the intermediate threaded body 59 is provided with a left-hand
5 thread and a right-hand thread. Lateral movement of the connecting nut 61 against the bobbin changing device 18a is controlled, and the connecting nut 61 is fixed not to rotate. When the fourth front row slider 53 and the
10 fifth back row slider 54 are moved an equal distance from or toward the bobbin change center of the bobbin changing machine AD, the above double thread construction in this portion enables distances between the bobbins to be changed from the distance P2 between the flyers of the roving frame 1 to the distance P between the bobbins
15 of the creel of the spinning frame (determined by the above secured connecting nut 61), or vice versa.

A spline shaft 62 is rotatably supported along the lengthwise direction of the bobbin changing device 18a. The spline shaft 62 is freely engaged with the front row
20 slider 53, the back row slider 54, the threaded body 56, and the threaded body 57 and is slidably engaged with the intermediate threaded bodies 59, 60 and central holes 59a, 60a, and 58a of the connecting nut 58. A drive gear 63 is connected to an end of the spline shaft
25 62 by a key and connected through a coupling 64 to a motor 65 for changing the arrangement of the bobbin changing arms. When the motor 65 is rotated by an angle corresponding to the distance $(P - P1)/(2 \times p)$, the motor 65 is stopped by a suitable brake. In the above
30 expression, the mark "p" indicates the thread pitch of the threaded bodies 56, 57. In this embodiment, there is a relation " $P2 > P > P1$ " between the distances P1 and P2 between the flyers of the roving frame and the distance P between the bobbins of the creel of the
35 spinning frame. Thus when the spline shaft 62 is rotated in the right direction viewed from the motor 65, the sliders connected by the connecting nut 58 approach

each other and the distances between the sliders changes from P to P1. Since the difference between the moving length of an inner thread and an outer thread of the slider 53, 54 connected by the fixed connecting nut 61 is equal to the moving length of the slider, i.e., P2, a pitch p1 of the outer thread is determined by the following expression:

$$\frac{p1 \times (P - P1)}{(2 \times P)} - \frac{p \times (P - P1)}{2 \times p} = P2 - P$$

When the spline shaft 62 is rotated in the right direction, the distance between the slider 53 and the slider 54 is changed from P to P2. If the motor 65 is rotated in a reverse direction, the above distances are changed reversely.

The front row slider 53 is provided with a front row bobbin changing arm 66 capable of facing the upper hanging type flyers of the front row of the roving frame, i.e., the flyers facing the bobbin wheel 5a. The top end of the front row slider 53 is formed into a fork having two fingers and can be engaged from below with a rib of the top portion of the bobbin. A back row bobbin changing arm 68 is capable of facing the upper hanging type flyers of the back row of the roving frame, i.e., the flyers facing the bobbin wheel 5b. The back row bobbin changing arm 68 includes two guiding levers 69, 69 arranged on the sides of the arm 68. The levers 69, 69 have forks having two fingers arranged on top portions thereof. The guiding levers 69, 69 are inserted through sliding holes 70, 70 of the back row slider 54 and are slidable in the front and back direction. The guiding levers 69, 69 have racks 71 on bottom sides thereof, respectively. A pinion 72 supported rotatably in the back row slider 54 is engaged with the racks 71 and is slidably engaged with another spline shaft 73 arranged rotatably along the bobbin changing device 18a. The spline shaft 73 is freely engaged with the front row slider 53. The front and back distance changing device includes a driven gear 74

engaged with the drive gear 63 arranged at an end of the spline shaft 73.

In this embodiment, the numbers of teeth and the like are determined so that the relation between the module M of the pinion, the number of teeth of the pinion N, the number of teeth N1 of the drive gear 63, the number of teeth N2 of the driven gear 74, and the distance L2 between the front row and the back row of the bobbin wheel 5a, 5b of the roving frame satisfies the following expression:

$$M \times N \times \pi \times \left(\frac{N1}{N2}\right) \times \frac{P - P1}{2 \times p} = L2$$

Therefore, the operation of changing the state shown in Fig. 12(a), in which the arrangement of the bobbins coincides with the zigzag arrangement of the bobbin wheels 5a, 5b on the bobbin rail 4, to the state shown in Fig. 12(b), in which the arrangement of the bobbins coincides with the single-row bobbin arrangement of the creel of the spinning frame, and vice versa, can be synchronously performed by an arrangement changing motor.

LS1 and LS2 shown in Fig. 4 are an upper ascent end limit switch and a lower ascent end limit switch, respectively, LS3 and LS4 shown in Fig. 4 are an upper descent end limit switch and a lower descent end limit switch, respectively. The upper ascent end limit switch LS1 and the lower ascent end limit switch LS2 are arranged on the side plate 29 of the bobbin changing machine main body 6 and can detect a moving position in the vertical direction of the bobbin changing arms 66, 68 when the bobbin changing arms 66, 68 change the bobbins between a bobbin supporting member of a bobbin conveying device described hereinafter and the bobbin changing machine. The upper descent end limit switch LS3 and the lower descent end limit switch LS4 are also arranged on the side plate 29 of the bobbin changing machine main body 6 and can detect a moving position in the vertical direction of the bobbin changing arms 66, 68 when the

bobbin changing arms 66, 68 change the bobbins between the bobbin rail 4 and the bobbin changing machine.

Those four limit switches LS1, LS2, LS3, and LS4 are engaged with the ascent and descent guiding ring 33 on the right side. A forward end limit switch LS5 and a backward end limit switch LS6 arranged on the middle plate 20 are engaged with a convex portion 22a of a back face of the right rack lever 22 and can detect a forward end or backward end of the bobbin changing device 18a.

As shown in Fig. 1 positioning cylinders 75, 75 having positioning pins 76, 76 engaged with a positioning block of the bobbin conveying apparatus, described hereinafter, at the top ends thereof are arranged on the left side plate 29 and the right side plate 29 of the bobbin changing machine main body 6.

A description will now be made of a bobbin conveying device 81 in the bobbin conveying apparatus. Reference numeral 78 indicates conveyor rail hung from a base plate 77 connected to a ceiling above the bobbin wheel 5a of the front row of the roving frame 1. The conveyor rail 78 has a hollow and rectangular cross-section with an open lower side. The bobbin conveying device 81 is arranged movably in the conveyor rail 78 and includes wheels 79, 79, supported by a horizontal shaft, and wheel 80 supported by a shaft passed through the lower opening of the conveyor rail 78. A plurality of bobbin supporting members 83 arranged at distances corresponding to the distance P between the bobbins of the creel of the spinning frame in the lengthwise direction of the conveyor rail 78 are hung below a base plate 82 of the bobbin conveying device 81. In this embodiment, six bobbin supporting members 83 are used. Three index pins 84 having a twice the length P4 of the distance between the bobbin supporting member 83 are secured on an upper face of the base plate 82 as shown in Fig. 14. Both ends of each index pin 84 protrude from both sides of the base plate 82. The bobbin conveying devices 81

are connected through a connecting lever 85 by pins to maintain the distances between bobbin supporting members 83 in one bobbin conveying device 81 and another adjacent bobbin conveying device 81 at the distance P of the
5 creel of the spinning frame. Several connected bobbin conveying devices 81 are conveyed along the conveyor rail 78 by a suitable transferring device. The bobbin change center L1 of the bobbin conveying device 81 is defined as the center of the distance between the
10 fourth bobbin supporting member 83 and the fifth bobbin supporting member 83 of the bobbin conveying device 81. The bobbin changing centers L2, L3, and the like are defined every eight distances between the bobbin supporting members 83.

15 A stopping position determining device 86 for stopping several bobbin conveying devices 81 hanging the empty bobbin EB at a first delivering position of the empty bobbin or the full bobbin defined on the conveyor rail 78, i.e., the position in which the bobbin change
20 center L1 of the bobbin conveying device coincides with the bobbin change center CL1 of the roving frame, is provided on an upper portion of the conveyor rail 78. As disclosed in Japanese Utility Model Application No. 58-145526, filed by the same assignee as for this
25 application, this stopping position determining device includes a swing hook 87 having an L-shaped configuration, swingably supported by a horizontal shaft 88 and urged in the counterclockwise direction in Fig. 1. A roller 90 attached to an upper
30 portion of the swing hook 87 engages with a cylinder rod of a cylinder 91. When the cylinder rod moves into the cylinder 91, the swing hook 87 is swung in the counterclockwise direction by a spring, and an end hook 92 of the swing hook 87 catches a first index pin,
35 the bobbin conveying device 81 stops in the delivery position. After that, the piston rod is protruded and engagement between the end hook 92 and the index pin 84

is released.

A description will now be given of a bobbin conveying device transferring device. As shown in Fig. 14, a rail 93 having a hollow rectangular cross-section is arranged in the lengthwise direction of the roving frame on the base plate 77 arranged on the upper area of the roving frame. Two wheels 95, 95 supported by a horizontal shaft are arranged on two points of an upper plate of a transferring device main body 94, respectively. The two wheels move along the rail 93. Supporting brackets 96, 96 are secured to an inner face of an upper plate of the transferring device main body 94. A shaft 97 is supported rotatably on the supporting brackets 96, 96, as shown in Fig. 13. Swing arms 98, 98 having L-shaped configurations and capable of swinging in the front and back direction (lateral direction in Fig. 14) are freely engaged with the shaft 97 in the outer positions from the supporting brackets 96, 96. A feed drum 100 provided with a feed cam groove 99 on its outer circumference is rotatably supported by a supporting shaft 105 on lower portions of the swing arms 98, 98 such that the feed drum 100 is between the swing arms 98, 98. A stationary shaft 101 connecting the other ends of the swing arms 98, 98 is engaged with a broken engagement portion 104 of a connecting arm 103 secured to a top end of a solenoid 102, which is hung from the inside face of the upper plate of the transferring device main body 94. Following sprockets 106, 106 are connected to the two ends of the supporting shaft 105 of the feed drum 100 by means of keys. Driving sprockets 107, 107 are connected to positions of the shaft 97 facing the following sprockets 106, 106 by means of keys. Chains 108 are arranged between the sprockets 106, 106 and the sprockets 107, 107, respectively. A following gear 109 is connected to an outer position of the driving sprocket 107 at an end of the shaft 97 by means of a key, while a worm gear 110

is connected to an outer position of the driving sprocket 107 at the other end of the shaft 97 by means of a key. The following gear 109 engages with a driving gear 112 of a driving motor 111 and the worm gear 110 engages
5 with a worm wheel 113 supported rotatably on the inside face of the upper plate by a shaft. A cam plate 114 is concentrically fixed with the worm wheel 113. A limit switch 116 is arranged on the upper plate so that the limit switch 116 can engage with an engaging segment
10 115 secured to the cam plate 114 in the horizontal direction. A solenoid 117 attached to the inner face of a front plate of the transferring device main body 94 has a positioning pin 118 on its own top end and can move in the vertical direction. A positioning member
15 120 having a positioning hole 119 is secured to a front side of the rail 93 so that the positioning pin 118 can engage with the positioning hole 119 facing the positioning pin 118 when the transferring device main body 94 arrives at a waiting position on the rail 93,
20 i.e., a position facing the bobbin changing machine AD at a higher position than that when the bobbin changing machine is at the first bobbin changing position (Fig. 1). Connecting blocks 122, 122 having connecting holes 121, 121 are secured to the side portions of
25 the transferring device main body 94. The connecting holes 121, 121 of the connecting blocks 122, 122 facing to upper position of the positioning cylinder 75, 75 can engage with the positioning pins 76, 76 provided on the top end of the cylinder rod when the transferring device
30 main body 94 is in the waiting position on the rail 93 and the bobbin changing machine AD is in the first bobbin changing position (Fig. 16(a)). The angle of rotation of the feed drum 100 is determined so that the feed drum groove 99 of the feed drum 100 engages with the index
35 pin 84 of the conveying device 81 when the transmitting device main body 94 is in the waiting position, the conveying device 81 is in the delivery position, and

the feed drum 100 arrives from the unoperable position illustrated by a two-dot chain line in Fig. 4 to an engaging position. The worm gear 110 and the worm wheel 113 are constructed such that the worm wheel 113 turns just once and the limit switch 116 emits a stop signal to the driving motor 111 when the feed drum 100 is rotated and the index pin 84 moves by four distances, i.e., four times P4.

A description will now be given of the operation of the transferring device. First, the transferring device is positioned and stopped at the predetermined waiting position on the rail 93 by engagement of the positioning pin 118 to the positioning hole 119 of the positioning member 120. At this moment, the solenoid 102 is removed and the feed drum 100 is in the unoperable position. The swing hook 87 is held such that it protrudes to a moving path of the index pin 84 by spring 89. In this state, the conveying device 81 from which the empty bobbin EB hangs is moved by another suitable transferring device other than the bobbin conveying device transferring device. When a limit dog 123 provided on an end of the conveying device 81 engages a limit switch (not shown), driving of the above suitable transferring device is stopped at a position just before the first delivery position of the conveying device 81 by a signal of the limit switch. The conveying device 81 moves by inertia, and the first index pin 84 engages with the hook 92 of the top end of the swing hook 87. The bobbin change center L1 of the conveying device 81 then coincides with the bobbin change center CL1 of the roving frame 1, and the conveying device 81 stops at the first delivery position.

When a full bobbin instruction is emitted in the roving frame where the conveying device 81 is in the first delivery position and the transferring device main body 94 is in the waiting position, the bobbin changing machine AD approaches a front face of the roving frame 1

and is stopped at the first bobbin changing position where the first positioning member 16 faces the proximity switch 17. Then, each bobbin change center CL, L1, CL1 of the bobbin changing machine, the conveying devices 81, 5 and the roving frame 1 coincide, and the bobbin changing device 18a and the bobbin changing device 18b are aligned at a position corresponding to eight empty bobbins EB at the delivery position as shown in Fig. 12(b), respectively. Simultaneously, the positioning cylinders 75, 75 10 protrude upward, the positioning pins 76, 76 engage with the connecting holes 121, 121 of the connecting blocks 122, 122, and the bobbin changing machine main body 6 is connected with the transferring device main body 94. Further, the swing arm 98 is swung through 15 the connecting arm 103 toward the conveyor rail 78 by operating the solenoid 102 of the transferring device main body 94, the feed drum 100 provided on the swing arm 98 is moved from the unoperative state to the engaging state, and the feed cam groove 99 of the feed 20 drum 100 is engaged with the index pin 84 of the conveying device 81.

The positioning pin 118 of the solenoid 117 of the transferring device main body 94 is then moved rearward to release, at a suitable timing, the state wherein the 25 transferring device main body 94 is positioned. The cylinder rod of the cylinder 91 of the stop position detecting device 86 of the conveying device 81 protrudes to turn the hook 92 of the swing hook 87 against the spring 89 in the clockwise direction. The positioning 30 of the conveying device 81 is released by disengagement of the index pin 84 and the hook 92. Then operations of the bobbin changing device 18a for doffing full bobbins and the bobbin changing device 18b for inserting empty bobbins are simultaneously begun and the doffing of the 35 full bobbins and the inserting of the empty bobbins are performed in parallel.

A description will first be made of the doffing.

After the positioning state of the transferring device main body 94 and the conveying device 81 are released, the spline shaft 62 in the bobbin changing device 18a is rotated in the clockwise direction

5 viewed from the arrangement changing motor 65 by a predetermined number of rotations, i.e., $P - P1/2 \times p$, and the connecting nut 58 connecting the threaded bodies 56, 57 and the intermediate threaded bodies 59, 60 of the double threaded portion are rotated in the clockwise
10 direction. The front row slider 53 and the back row slider 54 connected with the former by the connecting nut 58 slide to approach each other so that the distances between the slider 53 and the slider 54 are changed from P to $P1$. Further, the threaded bodies 56, 57 are screwed
15 into the intermediate bodies 59, 60, respectively and the intermediate bodies 59, 60 are screwed out from the fixed connecting nut 61. Then, the front row slider 53 and the back row sliders 54 are moved in the left direction and the right direction by an equal distance
20 from the bobbin change center CL of the bobbin changing machine AD so that the distances between the slider 53 and the slider 54 are changed from P to $P2$.

During lateral distance changing of the front row bobbin changing arms and the back row bobbin changing
25 arms, the spline shaft 73 is rotated through the drive gear 63 and the driven gear 74, and the back row bobbin changing arms 68 and moved through the pinions 72 of the back row sliders 54 and racks 71, 71 of the back row bobbin changing arms 68 from the alignment state by
30 the distance $L2$. Then, the bobbin changing device 18a is changed from the single row arrangement shown in Fig. 12(b) to an arrangement corresponding to the zigzag arrangement of the bobbin wheel 5a, 5b of the roving frame 1 shown in Fig. 12(a) and faces the full bobbins
35 in the two staffs. The movement in the left direction of the cylinder rod of the front and back moving cylinder 19 caused by the suitable timing rotates the left spline

shaft 28a and the right spline shaft 28b through the left rack lever 25 and the right rack lever 22, the pinion 27, and the left sector gear 31 and the right sector gear 31. Then, the left swing arm 32 and the right swung arm 32 are swing toward the roving frame 1. When the swing arms 32, 32 swing, the sliding pins 42, 42 of the swing arms 32, 32 slide in the slots 35, 35 arranged on the left portion and the right portion of the bobbin changing device 18a and move the guiding rack levers 36, 36 to the left or right direction, respectively. Since the guiding rack levers 36, 36 engage with the carrier pinion gear 41, respectively, the bobbin changing device 18a advances straight without shifting in the lateral direction, and the forks 67 of the front row bobbin changing arms 66 and the back row bobbin changing arms 68 enter the lower portion of the rib B1 of the top portion of the full bobbins of the first two staffs, i.e., 8 spindles arranged on the front row and the back row of the bobbin rail 4 in the zigzag state. When the forward end limit switch LS5 detects a convex portion 22a of the right rack lever 22, the front and back moving cylinder 19 stops and the bobbin changing device 18a stops at the forward end (Fig. 15(c)). Then, the cylinder rod 43a of the ascent and descent cylinder 43 descends slightly, a portion of the ascent and descent chain 50 connected to the left ascent and descent guiding ring 33 ascends, and a portion of the following chain 51 connected to the right ascent and descent guiding ring 33 ascends. Thereby, the left and right swing arms 32, 32 ascend along the spline shafts 28a, 28b with the bobbin changing device 18a and the full bobbins FB are picked up by engagement of each fork 67 of the front row bobbin changing arms 66 and the back row bobbin changing arms 68 to the ribs B1 of the full bobbins FB.

When the upper descend limit switch LS3 detects the right ascent and descent guiding ring 33, the ascent

and descent cylinder 43 stops and the bobbin changing devices 18a stop in the upper descend end position (Fig. 15(d)). Next, the cylinder rod 21 of the front and back moving cylinder 19 moves to the right direction to rotate the left spline shaft 28a and the right spline shaft 28b in the direction opposite to the former operation. Then, the bobbin changing device 18a is moved backward with full bobbins FB held on the front row bobbin changing arms 66 and the back row bobbin changing arms 68.

When the backward end limit switch LS6 detects the convex portion 22a of the right rack lever 22, the bobbin changing device 18a stops at the backward end (Fig. 15(e)). Next, the arrangement changing motor 65 rotates in the direction opposite to the former operation to rotate the spline shaft 62 in the left direction viewed from the motor 65. Simultaneously, the spline shaft 73 is rotated to operate the lateral distance changing device in the mode opposite the former operation. Then, the sliders 53, 54 are changed from the zigzag arrangement shown in Fig. 12(a) to the single-line arrangement shown in Fig. 12(b) (Fig. 15(f)).

Next, the cylinder rod 43a of the ascent and descent cylinder 43 descends a large length. The lower ascent end limit switch LS2 detects the right ascent and descent guiding ring 33, and the ascent and descent cylinder 43 is stopped to stop the bobbin changing device 18a at the lower ascent end position (Fig. 15(g)). When the bobbin changing device 18a advances by moving leftward the cylinder rod 21 of the front and back moving cylinder 19 and the forward end limit switch LS5 detects the convex portion 22a of the right rack lever 22, the bobbin changing device 18a stops at the forward end, and the eight full bobbins FB hung in the single-row arrangement are positioned at the downward position corresponding to the eight bobbin supporting members 83 of the conveying device 81 with empty bobbins removed

(Fig. 15(h)). Then, the bobbin changing device 18a ascends by a slight descent of the cylinder rod 43a of the ascent and descent cylinder 43, and each bobbin supporting member 83 is inserted with the full bobbins FB. When the upper ascent end limit switch LS1 detects the right ascent and descent guiding ring 33, the ascent and descent cylinder 43 stops, and the bobbin changing device 18a stops at the upper ascent end position (Fig. 15(i)). Next, the cylinder rod 43a of the ascent and descent cylinder 43 ascends slightly to cause the bobbin changing device 18a to slightly descend. When the lower ascent end limit switch LS2 detects the right ascent and descent guiding ring 33, the bobbin changing device 18a stops at the ascent end position. Then the full bobbins FB are hung on the bobbin supporting member 83, and the upper faces of the forks 67 of the front bobbin changing arms 66 and the back bobbin changing arms 68 leave the under face of the rib portion B1 of the top portion of the full bobbins FB (Fig. 15(j)). Next, the cylinder rod 21 of the front and back moving cylinder 19 advances and the bobbin changing device 18a moves rearward. When the backward end limit switch LS6 detects the convex portion 22 of the right rack lever 22 the bobbin changing device 18a stops at the backward end and waits for the next operation (Fig. 15(k) and (l)). Thus, the doffing operation of the full bobbins FB is accomplished.

Next, a description will be made of an empty bobbin inserting operation performed with the full bobbin doffing operation. The bobbin changing device 18b, front row bobbin changing arms 66, back row bobbin changing arms 68, lateral distance changing device, a front and back distance changing device, and the like used in the empty bobbin inserting operation have an identical constitution to those described before. Therefore the description of those constitutions will be made from the standpoint of the state of arrangement

and upper and lower positions of the front row bobbin changing arms 66 and the back row bobbin changing arms 68.

5 The front row bobbin changing arms 66 and the back row bobbin changing arms 68 aligned in single-row state at the lower ascent end position move from the rearward end position (hereinafter, original position) (Fig. 15(a)) toward a forward end position (Fig. 15(b)). Those arms 66, 68 ascend slightly, stop at the upper
10 ascent end position, and pick up the empty bobbins (Fig. 15(c)). The forks 67 hook eight empty bobbins EB from the bobbin supporting members 83 in the delivery position by a descent movement of the arms (Fig. 15(d)). The arms 68, still in the single-row arrangement,
15 move backward to await the next operation (Fig. 15(e) and (f)). Then, the arms 68 descend a long distance and stop at the upper descent end position. The arrangement of the front row bobbin changing arms 66 and the back row bobbin changing arms 68 is changed from the single-
20 row arrangement shown in Fig. 12(b) to the zigzag arrangement shown in Fig. 12(a) by operating the lateral distance changing device and the front and back distance changing device (Fig. 15(g) and (h)). The arms 68 advance to a position which corresponds to the bobbin
25 wheels 5a, 5b in the zigzag state and is at a slightly higher position from the bobbins, and stop in that position. Then, the arms 68 descend slightly, stop at the lower descent end position, and insert the empty bobbins EB into the bobbin wheels 5a, 5b (Fig. 15(j)).
30 After that, they move backward to the backward end position. At this position, the front row bobbin changing arms 66 and the back row bobbin changing arms 68 are changed from the zigzag arrangement to the single-row arrangement (Fig. 15(k) and (l)).

35 When the bobbin changing operation is accomplished in the first bobbin change position as described hereinbefore, the driving motor 12 of the bobbin changing

machine AD is operated at a suitable timing, the sprocket wheels 11, 13 are rotated, and the travelling wheels 9, 9 are rotated through the chain 14. Then, the bobbin changing machine AD runs along the roving frame 1 with
5 the transferring device main body 94. When the proximity switch 17 detects a next positioning member 16 arranged at a position remote from the first position by the distance $P3 (= 6 \times P1 + 2 \times P2)$, the driving motor 12 stops and the bobbin changing machine AD stops at a
10 second bobbin change position (Fig. 16(b) and Fig. 1). The bobbin changing devices 18a, 18b return to the original positions, respectively, during movement of the bobbin changing machine. Further, the feed drum 100 is rotated until the engaging segment 115 on the cam
15 plate 114 rotated by the driving motor 111 of the transferring device main body 94 is detected by the limit switch 116. Then, the conveying device 81 is moved in the direction opposite to the moving direction of the bobbin changing machine AD by the length $4 \times P4$
20 by engaging the feed drum 100 with the index pin 84. Therefore, the conveying device 81 moves by the length $.4 \times P4 - P3$ against the roving frame 1 each bobbin change operation. Thus, as shown in Fig. 16(b), the next eight empty bobbins EB hung on the conveying
25 device 81 stop at the second delivery position; the bobbin change centers CL2, CL, and L2 of the roving frame 1, the bobbin changing machine AD, and the conveying device 81 coincide with each other; and the second bobbin changing operation is performed. When
30 the above-mentioned operation is repeated and the last bobbin changing operation is finished (the bobbin changing operation shown in Fig. 16(c) is also finished), the solenoid 102 of the transferring device main body 94 moves rearward at a suitable timing, the swing arms 98,
35 98 are swung, and the engagement between the cam groove 99 of the feed drum 100 provided on the end of the swing arms 98, 98 and the index pins 84 of the conveying

device 81 is released. Next, the bobbin changing machine AD is moved to the right by reverse rotation of the driving motor 12 and stops at the first bobbin change position. The transferring device main body 94 is positioned at the waiting position by protrusion of the positioning pin 118 and insertion of the positioning pin 118 to the positioning hole 119. After the positioning pins 76, 76 of the positioning cylinders 75, 75 of the bobbin changing machine main body 6 are removed from the connecting blocks 122, 122 of the transferring device main body 94, the bobbin changing machine main body 6 moves to the roving frame 1, which emits the next full bobbin instructions.

When the bobbin conveying devices 81 are arranged on the upper position in the vertical direction from the front row bobbin wheels 5a of the roving frame 1, as in this embodiment, the row of bobbin wheels of the roving frame in the case of the bobbin conveying apparatus installed in the factory may be used as a standard for actual installation of the apparatus. Therefore, installation work can be made easier and more precise and effective use can be made of the space above the roving frame. Further, the bobbins hung from the bobbin conveying devices 81 do not disturb the installation work. Further, the distances of the forward movement and the backward movement of the bobbin changing devices 18a, 18b for the full bobbins and the empty bobbins become equal when doffing and inserting the bobbins on the bobbin wheels and the bobbins hung from the bobbin conveying devices. This means that it is possible to make the bobbin changing machine AD simple and practical in construction.

In this embodiment, the forks 67 of the back row bobbin changing arms 68 arranged on the bobbin changing device 18b for inserting the empty bobbins can pass among the left guiding lever and the right guiding lever of the back row bobbin changing arms 68 arranged on the

bobbin changing device 18a for doffing the full bobbins. Therefore, the distance in the front and back direction between the front bobbin changing device 18a and the back bobbin changing device 18b may be made small, as shown
5 in Fig. 3. Further, since the changing operation of the front and back distance and the lateral distance of the front row bobbin changing arms 66 and the back row bobbin changing arms 68 can be performed synchronously by an arrangement changing motor 65, control of the
10 movement of the bobbin changing arms is simple and reliable and can be realized at a low cost.

A description will now be made of a second embodiment of the present invention.

The bobbin conveying device in this embodiment is a
15 peg conveyor 201 arranged on a floor of a factory and can run around the roving frame 1 as shown in Fig. 18. Portions the same or equal to the portions used in the first embodiment are given the same reference numerals, and descriptions thereof are omitted. The
20 peg conveyor 201 includes peg plates 203 moving slidably on a supporting plate 202 and pegs 204 arranged on the supporting plates 202. The distance between adjacent pegs 204 coincides with the distance P between the bobbins of the creel of the spinning frame. The peg
25 plates 203 are connected to a conveyor chain 205 moved by a suitable driving source. A full bobbin and empty bobbin handling apparatus 206 is arranged at an end of the rear portion of the roving frame 1. This apparatus 206 can feed empty bobbins EB to the peg conveyor 201,
30 pick up full bobbins from the peg conveyor 201, and insert full bobbins to conveying devices associated with the creel of the spinning frame. As shown in Fig. 17, in this bobbin changing machine AD, swing arms 32, 32 provided slidably in the vertical direction on the left
35 and right spline shafts 28a, 28b of the bobbin changing machine main body 6 are attached with bobbin changing devices 18a, 18b beneath the swing arms 32, 32. Each

bobbin changing device has front row bobbin changing arms 66, back row bobbin changing arms 68, a lateral distance changing device, and a front and back distance changing device. A guide rail 207 secured on a position in front of flyers of the roving frame 1 is mounted with guide rollers 208 supported rotatably on the upper portion of the roving frame 1.

In this embodiment, the empty bobbins EB are fed from the full bobbin and empty bobbin handling apparatus 206 to the peg conveyor 201 before the full bobbins are formed in the roving frame and are kept waiting behind the roving frame 1. The bobbin changing machine AD stops at a first bobbin change position upon a full bobbin instruction from the roving frame 1, and the peg conveyor 201 moves and stops at a delivery position where the first eight pegs are in the same positions as positions in the first embodiment. The bobbin changing device 18a for doffing the full bobbins changes the front row bobbin changing arms 66 and the back row bobbin changing arms 68 from a single-row arrangement to a zigzag arrangement in the original position and advances to pick up the full bobbins from the bobbin wheels 5a, 5b. The bobbin changing device 18b advances from the original position in the single-row arrangement and picks up eight empty bobbins in a single-row arrangement on the peg conveyor 201 (Fig. 19(a) and (b)). Next, the bobbin changing device 18a for doffing the full bobbin moves rearward and changes the bobbin changing arms 66, 68 from the zigzag arrangement to the single-row arrangement, and descend, while the bobbin changing device 18b moves rearward and ascend and then advances and descends (Fig. 19(c) and (d)). After this operation, the bobbin changing device 18a for doffing the full bobbins advances and descends to insert the full bobbins FB to the pegs 204 of the peg conveyor 201, then moves rearward and ascends to the original position. The bobbin changing device 18b for inserting the empty

bobbin changes the bobbin changing arms 66, 68 from the single-row arrangement to the zigzag arrangement, advances and descends to insert the empty bobbins EB onto the bobbin rail 4, moves rearward, changes the
5 bobbin changing arms 66, 68 from the zigzag arrangement to single-row arrangement, and descends to the original position (Fig. 19(e) and (f)). Next, the bobbin changing machine AD moves to a next bobbin changing position by the predetermined distance P3. The peg conveyor 201
10 also moves to stop next to eight empty bobbins at a next delivery position. The bobbin changing operations are repeated in accordance with the above described method. When bobbin changing operations of all bobbins in the roving frame are accomplished, the bobbin changing
15 machine AD moves to the waiting position W indicated in Fig. 18. At the same time, the peg conveyor 201 is moved to move the doffed full bobbins to behind the roving frame 1, and the roving frame 1 is reactivated. The full bobbins FB are picked up from the pegs 204 by
20 means of the full bobbin and empty bobbin handling apparatus 206.

Incidentally, in the above described two embodiments, the lateral distance changing device of the front row bobbin changing arms 66 and the back row bobbin
25 changing arms 68 may be constituted so that standard cylinders 302 having a stroke of $(P2 - P)/2$ are provided on each opposite face at a lower portion of fourth front row slider 53 and fifth back row slider 54 from the left side; each cylinder rod is connected to a screen-like
30 plate 18 extending from a lower plate of the bobbin changing device 18a in a place coinciding with a center of distance of the fourth slider 53 and the fifth slider 54; and cylinders 301 having a stroke of $(P - P1)$ are provided on a cylinder rod, as shown in Fig. 20.

35 Further, the lateral distance changing device of the front row bobbin changing arms 66 and the back row bobbin changing arms 68 can be constituted by using a

cylindrical cam 401 as shown in Figs. 21 to 23. In this case, a motor 65 is connected to the cylindrical cam 401 and a plurality of cam grooves 402a, 402b --- (in this embodiment, groups of four cam grooves are arranged
5 symmetrically on both sides of the bobbin change center CL of the bobbin changing machine) are cut. The pitch at an end portion (Fig. 23 point B) of the cam grooves 402a, 402b --- corresponds to the distance between the bobbins in the creel of the spinning frame. The pitch
10 at the other end portion rotated by an angle θ (Fig. 23 point A) is set to the distance P1, P2 between bobbins of the roving frame. Cam followers 403 are attached to lower ends of the front row sliders 53 and the back row sliders can move slidably in the lateral direction and
15 engage slidably with the corresponding cam grooves 402a, 402b ---. Therefore, when the cylindrical cam 401 is rotated from the point B to the point A by angle θ , the distances between the front row sliders 53 and the back row sliders 54 are changed from P to P1 or from P to P2.
20 If the cylinder cam 401 is rotated in the reverse direction, a distance change opposite to the former is performed. In this case, of course, the number of teeth of the drive gear 63 and the driven gear 64 are determined so that the back row bobbin changing arms 68
25 move by L2.

Another embodiment of the lateral distance changing device of the front row bobbin changing arms 66 and the back row bobbin changing arms 68 is illustrated in Fig. 24. In this embodiment of the lateral distance
30 changing device, the front row sliders 53 and the back row sliders 54 are engaged with the spline shaft 73, respectively. Two cam followers 604 each are provided on the bottom faces of the sliders 53, 54. Grooved cams 601 having cam grooves on both sides are spline-engaged
35 slidably with the other spline shaft 62. A ring groove 605 is formed in a grooved cam 602 arranged on the center portion of the spline shaft 62. A movement

limiting member 603 secured to the bobbin changing device 18a engages the ring groove 605, so that the grooved cam 602 is only limited in movement in the lateral direction. The two cam grooves of the grooved
5 cam 602 are formed such that the distance between the grooves is changed by a distance $P - P_1$ when the grooved cam 601 is rotated by a predetermined angle, i.e., an angle corresponding to angle θ in Fig. 23. It is preferable to form symmetrically two grooves on a
10 circumferential surface of the grooved cam 601, but it is possible to make the two grooves different shapes, e.g., grooves having different inclination angles against an axis of the grooved cam. The cam followers of the front row slider 53 and the back row slider 54
15 are engaged with the adjacent grooved cams, e.g., one grooved cam 601 and another grooved cam 601, or a grooved cam 601 and a grooved cam 602, so that, for example, a cam follower of a certain front row slider engages with a groove of a grooved cam and the other cam
20 follower of the same front row slider engages with a groove of the other grooved cam adjacent to the former grooved cam. Incidentally, the grooved cams arranged on both ends of the spline shaft 62 are made half the length of ordinary grooved cams and have only one
25 groove.

Above, a description was made of embodiments in which the distances between the bobbin wheels 5a, 5b differed every four bobbin wheels, i.e., P_1 and P_2 . However, the bobbin changing machine in accordance with
30 the present invention can be adapted to a roving frame having equal distances between all bobbin wheels. In this case, the lateral distance changing device may be constituted such that the distances in the lateral direction of the bobbin changing arms are changed from P
35 to P_1 and vice versa.

Further, a description was made of the operation of the bobbin changing machine in reference to the bobbins

of two staffs, each having four bobbin wheels. However, the bobbin changing machine in accordance with the present invention is not limited to two staffs, and can be also used for a bobbin changing machine having one
5 staff or a multiple of two bobbin wheels. Further, the standard position for limiting the lateral movement of the lateral distance changing device may be properly changed.

Further, in the embodiment described hereinbefore,
10 the doffing operation of the full bobbins and the feeding operation of the empty bobbins are performed simultaneously by the bobbin changing devices. However, the bobbin changing device for feeding the empty bobbins may be omitted by performing the feeding operation of
15 the empty bobbins by manual operation.

Since the present invention is constituted as described hereinbefore, it is possible to perform the operation for doffing the full bobbins from the roving frame, aligning the full bobbins from the zigzag
20 arrangement to a single-row arrangement and matching the distance between the bobbins with the distance between the bobbins of the creel of the spinning frame by one doffing operation of the bobbin changing machine. Therefore, it is possible to simplify the operation for
25 conveying the doffed full bobbins to the spinning frame. Further, since it is possible to make a small size bobbin conveying device by shortening the distances between the full bobbins in the front and back direction and the lateral direction, the space occupied by the
30 bobbin conveying device can be decreased. Further, in the case where the empty bobbins are fed from the bobbin conveying device having a bobbin arrangement different from the arrangement of the bobbin wheels in the roving frame to the roving frame, the operations can
35 be performed by one inserting operation of the bobbin changing machine.

Further, since the bobbin changing machine is

constituted as a portable type, the bobbin changing machine in accordance with the present invention can be used for a plurality of roving machines. The bobbin alignment device necessary for each roving frame
5 in the known doffing operation becomes unnecessary. Also, since a pair of the bobbin changing devices are provided, the operation for doffing the full bobbins and the operation for inserting the empty bobbins can be performed in parallel. Therefore, it is possible to
10 perform an effective bobbin change operation.

In addition to the features described hereinbefore, this invention has the further feature of decreased cost of the equipment.

CLAIMS

1. A method for changing bobbins in a roving frame, characterized in that a plurality of full bobbins are doffed to bobbin supporting members in a row of a bobbin conveying apparatus by repeating the following steps:

a. stopping a bobbin changing machine, capable of moving along a front face of a double-row type roving machine having upper hanging flyers arranged in a zigzag arrangement, at a predetermined bobbin-changing position;

b. simultaneously taking out a plurality of adjacent full bobbins arranged on a front row and a back row of a bobbin rail of the roving frame by each bobbin changing arm of said bobbin changing machine;

c. changing the distance between full bobbins in the lateral direction of the roving frame to a distance between bobbins in each row of creels in a spinning frame;

d. aligning the front row and the back row of the full bobbins by moving either the front row or the back row in a direction perpendicular to the lateral direction of the roving frame at the same time as step C or after step C; and

e. transferring said full bobbins in the single row to bobbin supporting members of a bobbin conveying apparatus arranged at the same distance as the distance of bobbin in each row of creels of the spinning frame.

2. A method for changing bobbins in a roving frame according to claim 1, characterized in that empty bobbin supporting members of the bobbin conveying apparatus are moved to a corresponding next bobbin changing position each time the bobbin changing machine takes out full bobbins on the bobbin rail of the roving frame and inserts a full bobbin to the bobbin supporting members of the bobbin conveying apparatus, and full

bobbins being inserted to the bobbin supporting member of the bobbin conveying apparatus when the bobbin changing machine is stopped at said bobbin changing position.

5 3. A bobbin changing machine of a roving frame capable of moving along a front face of a double-row type roving machine having upper hanging flyers arranged in a zigzag arrangement and capable of stopping at a predetermined position;

10 characterized in that said bobbin changing machine is provided with at least one bobbin changing device capable of moving in a direction perpendicular to the lateral direction of the roving frame and in a vertical direction;

15 each said bobbin changing device is comprised of a plurality of front row bobbin changing arms capable of approaching in parallel a plurality of the upper hanging flyers in a front row, a plurality of back row bobbin changing arms arranged alternately with
20 said front row bobbin changing arms and capable of approaching in parallel a plurality of the upper hanging flyers in a back row, a lateral distance changing device capable of changing a distance in the lateral direction of the roving frame between said front row bobbin
25 changing arms and said back row bobbin changing arms, and a front and back distance changing device capable of changing a distance in the direction perpendicular to the lateral direction of the roving frame between said front row bobbin changing arms and said back row bobbin
30 changing arms;

 whereby said lateral distance changing device and said front and back distance changing device are operated and bobbins are changed when said bobbin changing machine is stopped at said predetermined
35 position.

 4. A bobbin changing machine of a roving frame according to claim 3, characterized in that a pair of

bobbin changing devices arranged on a front side and a back side are provided.

5 5. A bobbin changing machine according to claim 3
or 4, characterized in that said front and back distance
changing device is comprised of a spline shaft rotatable
by a driving device and arranged along the bobbin
changing device on the bobbin changing device, each back
row bobbin changing arm being supported in a state of
free movement in a forward direction and a backward
10 direction by said bobbin changing device, and a rack
movable in a frontward direction and a backward direction
and arranged on said back row bobbin changing arm being
geared on a pinion engaged slidably with said spline
shaft.

15 6. A bobbin changing machine according to claim 3
or 4, characterized in that said lateral distance
changing device is comprised of a spline shaft rotated
by a driving device and arranged along said bobbin
changing device on said bobbin changing device, each
20 front row bobbin changing arm and each back row bobbin
changing arm being supported in a state of free movement
in a lateral direction, said front row bobbin changing
arms and back row bobbin changing arms being secured
with threaded bodies engaged freely with said spline
25 shaft, respectively, each said threaded bodies adjacent
to each other being connected by screwing said threaded
bodies to connecting nuts from both sides thereof, a
central aperture of the connecting nut being engaged
slidably with said spline shaft, and lateral movement
30 of one of the connecting nuts being limited.

 7. A bobbin changing machine according to claim 3
or 4, characterized in that, in said lateral distance
changing device, said each front row bobbin changing arm
and said each back row bobbin changing arm are supported
35 on said bobbin changing device in a state of free
movement, in the lateral direction, each front row
bobbin changing arm and back row bobbin changing arm

adjacent to each other are connected by a cylinder, and lateral movement of a cylinder determined as a standard cylinder lateral movement is limited.

8. A bobbin changing machine according to claim 3
5 or 4, characterized in that said lateral distance
changing device is comprised of two spline shafts
mounted rotatably on said bobbin changing device
and connected to a driving device, a plurality of
grooved cams provided with cam grooves on both sides
10 are spline-engaged to one of said spline shafts, one
of said grooved cams is provided with a ring groove
engaging a movement limiting member secured to said
bobbin changing device, another spline shaft is arranged
with said front row bobbin changing arm and said back
15 row bobbin changing arm having each two cam followers,
and said two cam followers of said front row bobbin
changing arm and said back row bobbin changing arm are
engaged with two cam grooves, one of which belongs to
one grooved cam and the other of which belongs to the
20 other grooved cam adjacent to the former grooved cam.

9. A bobbin changing machine according to claim 3
or 4, characterized in that

said lateral distance changing device is
comprised of a cylindrical cam connected to a driving
25 device and provided with a plurality of cam grooves cut
continuously, such that a pitch between adjacent cam
grooves corresponds to a pitch of creel of the spinning
frame at a certain place of the circumferential surface
of the cylindrical cam and corresponds to a pitch of
30 distance between bobbins on the roving frame at a place
rotated from the former place by a predetermined angle.

10. A bobbin changing machine according to claim 3
or 4, characterized in that

said lateral distance changing device and
35 said front and back distance changing device are driven
by a driving device connected through a transmission
mechanism to a spline shaft for said lateral distance

changing device and a spline shaft for said front and back distance changing device.

11. A bobbin changing machine according to claim 3 or 4, characterized in that a device for moving said
- 5 bobbin changing device in a direction perpendicular to a lateral direction of the roving frame is comprised of a pinion mounted rotatably on said bobbin changing device, two rack levers held slidably on said bobbin changing device and engaged with said pinion in an opposite
- 10 state, and two rocking arms having the same length and mounted slidably on each upright spline shaft arranged on a left hand and right hand side of said bobbin changing device, one of the two rocking arms being connected to one rocking lever and the other one being
- 15 connected to the other rocking lever, whereby said bobbin changing device is moved in a direction perpendicular to the lateral direction of the roving frame when said two upright spline shafts are simultaneously rotated in opposite directions.

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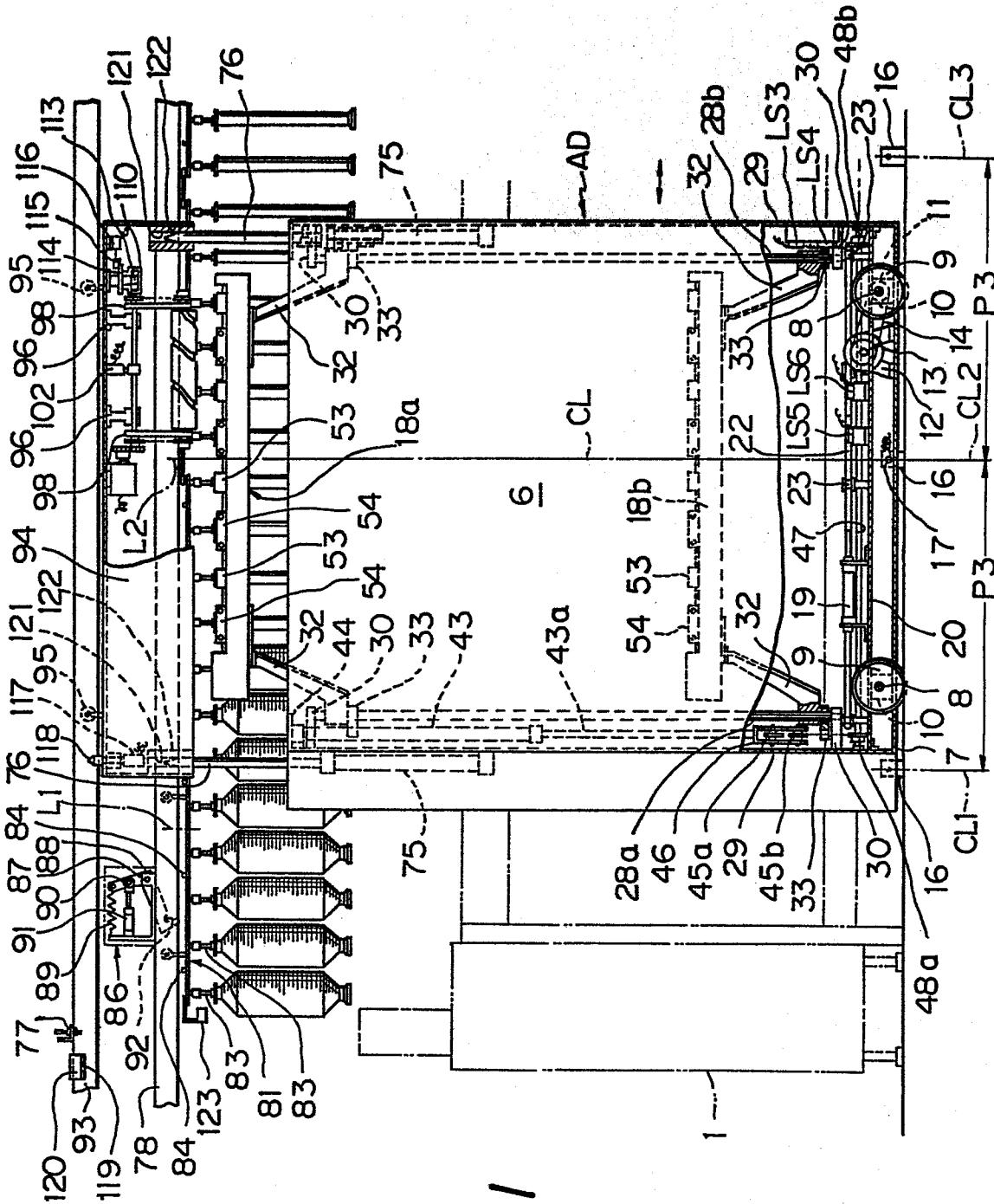
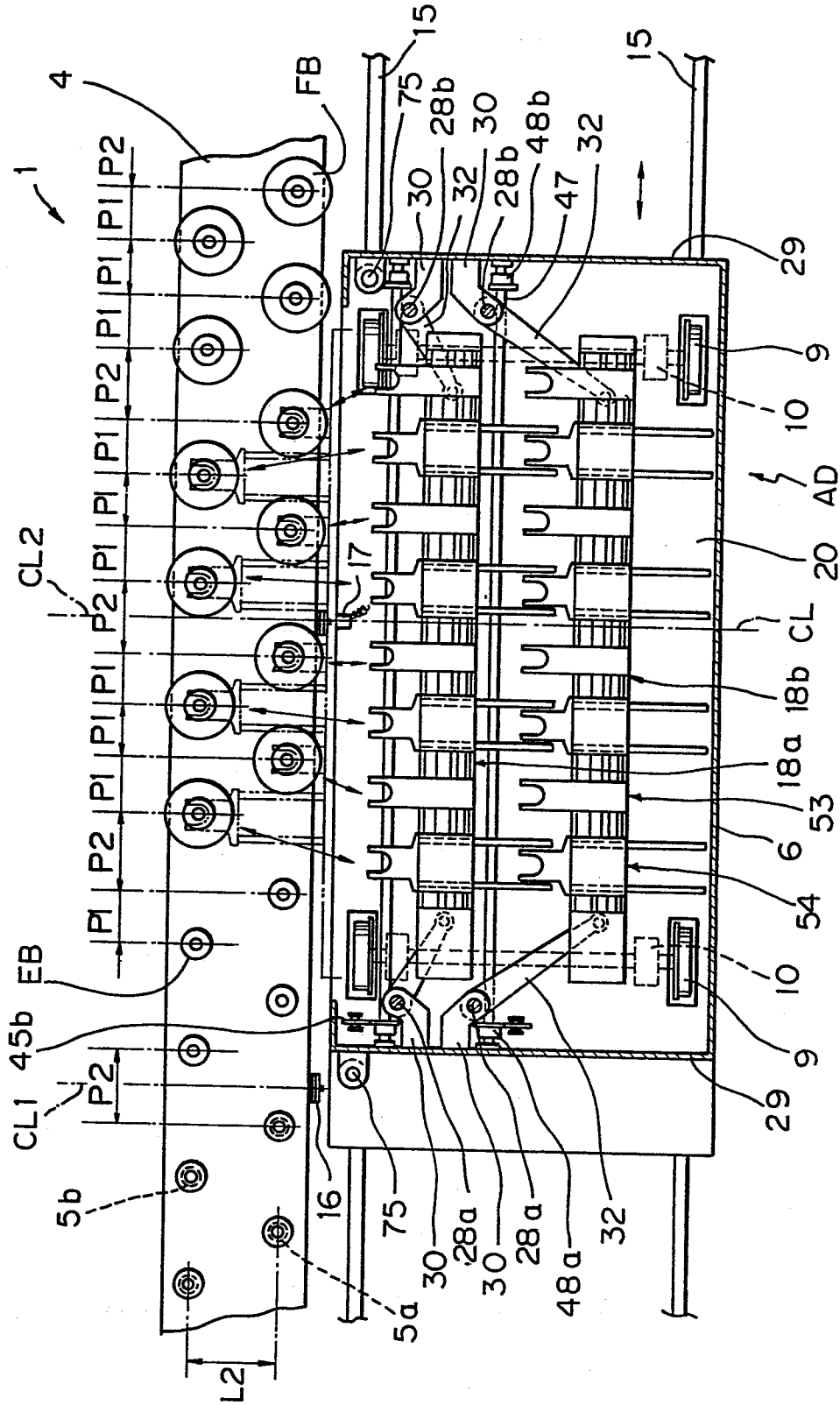


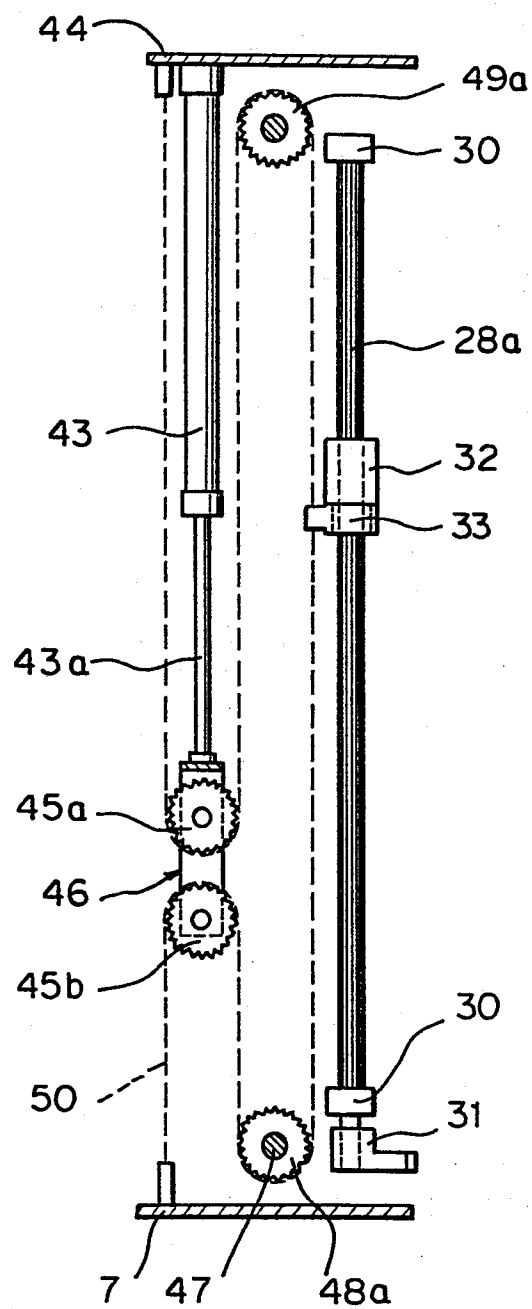
Fig. 1

Fig. 3



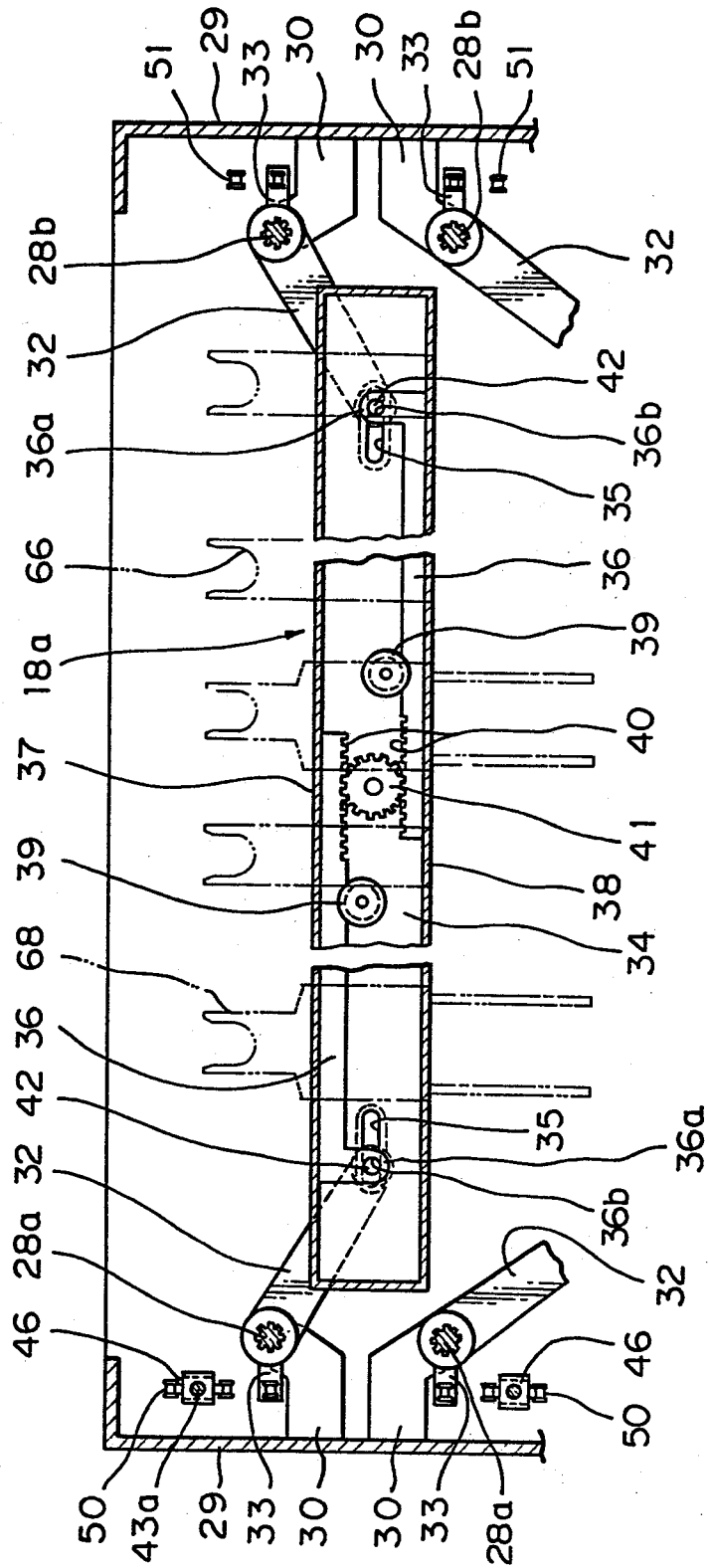
[illegible]

Fig. 5



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Fig. 6



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Fig. 7

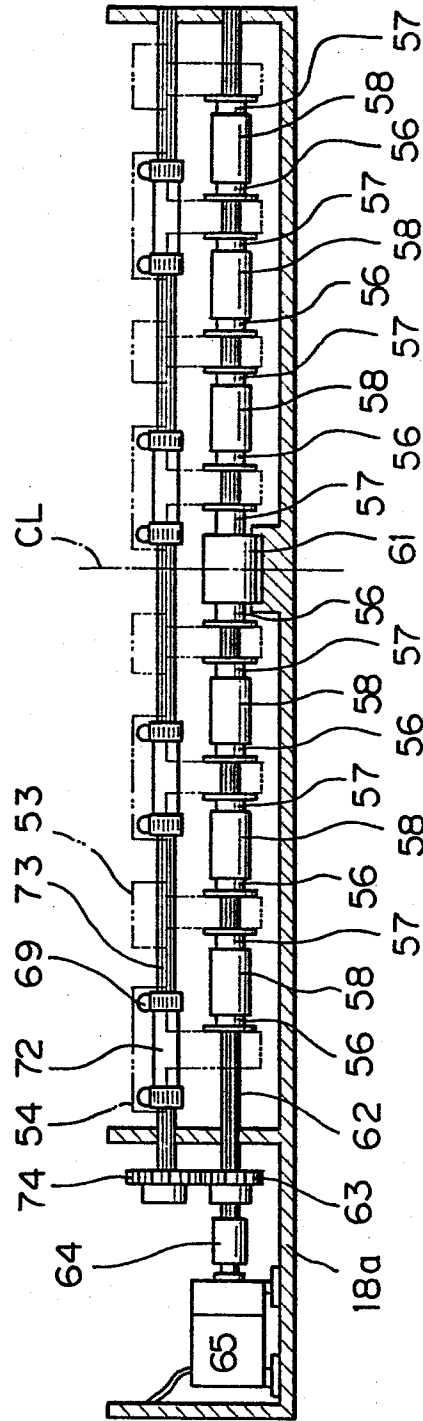
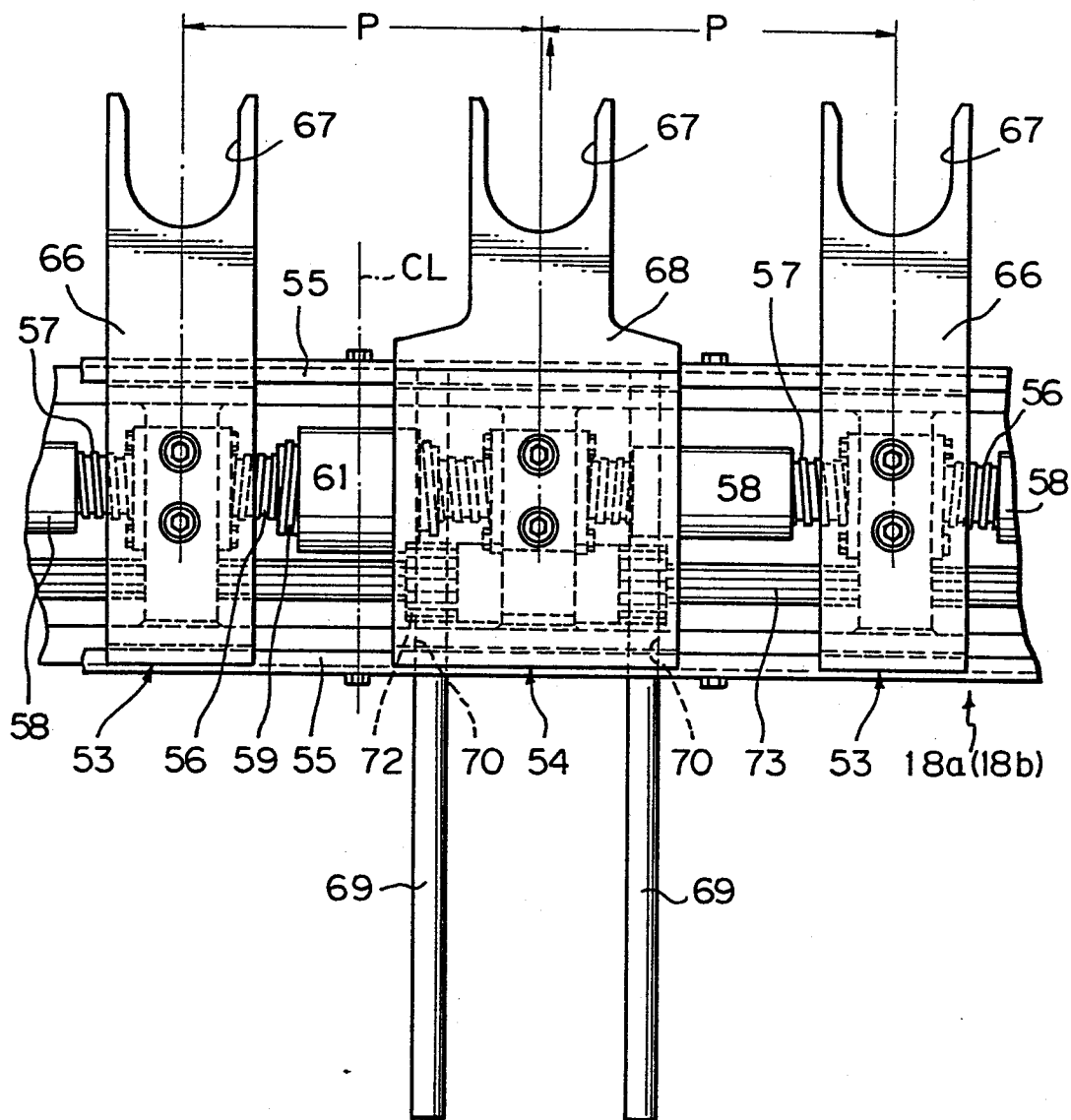


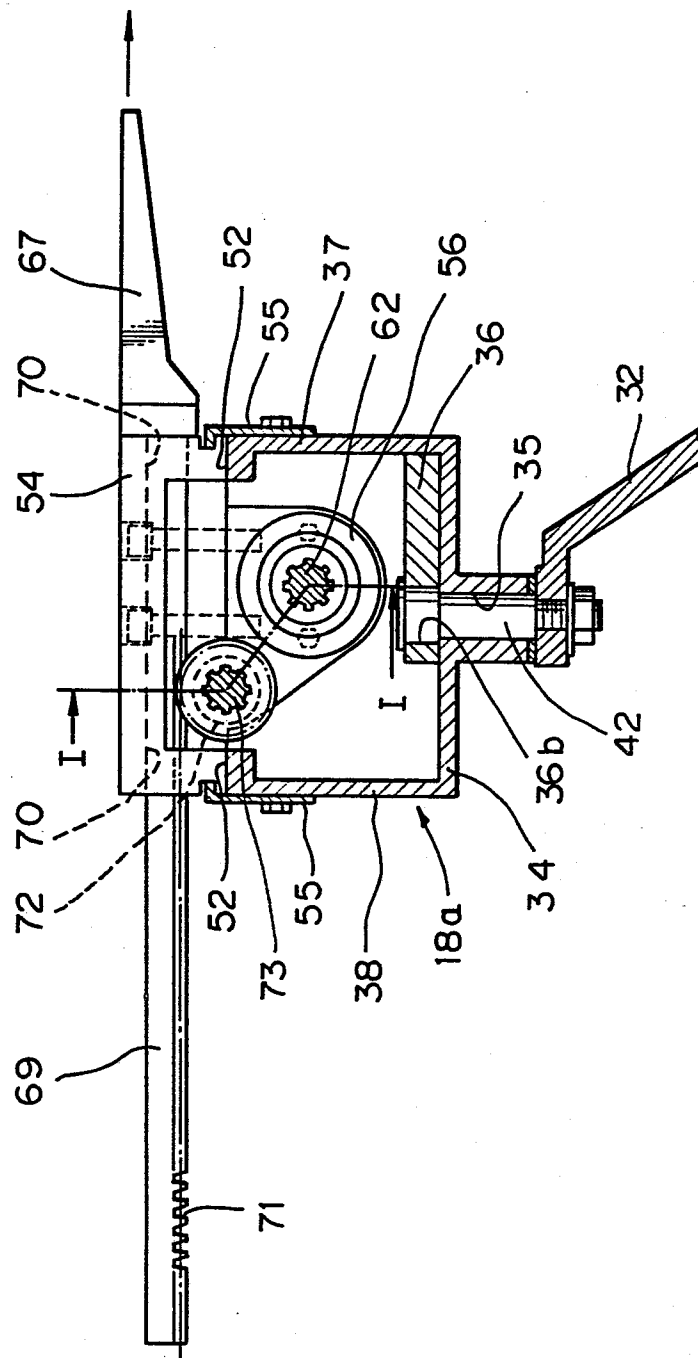
Fig. 8



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Fig. 9



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Fig. 10

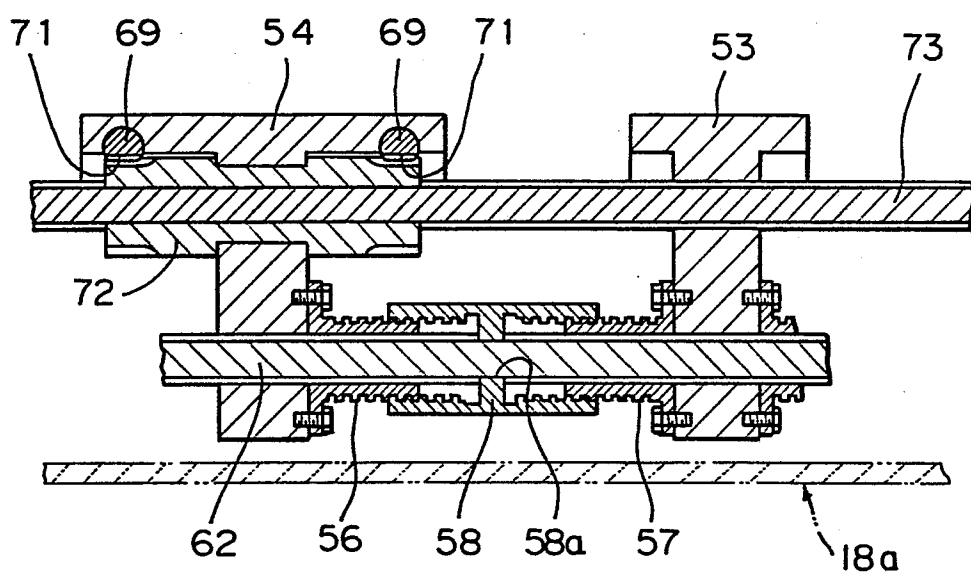
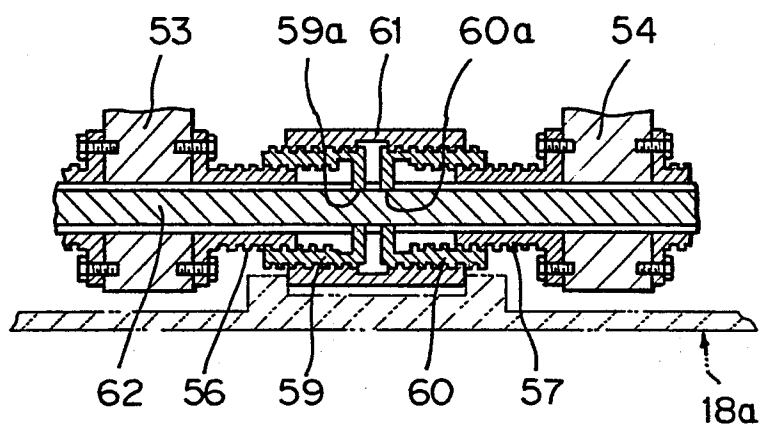


Fig. 11



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Fig. 12
(a)

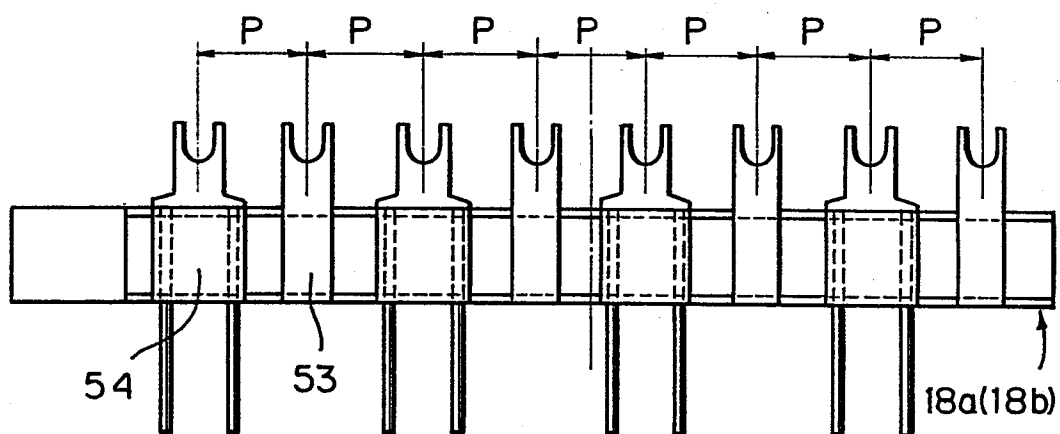
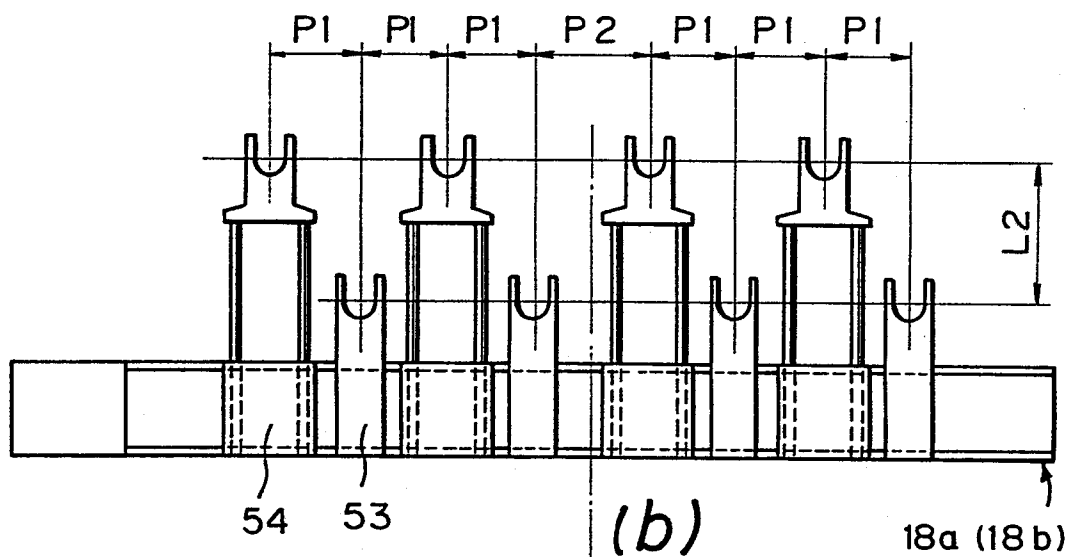


Fig. 13

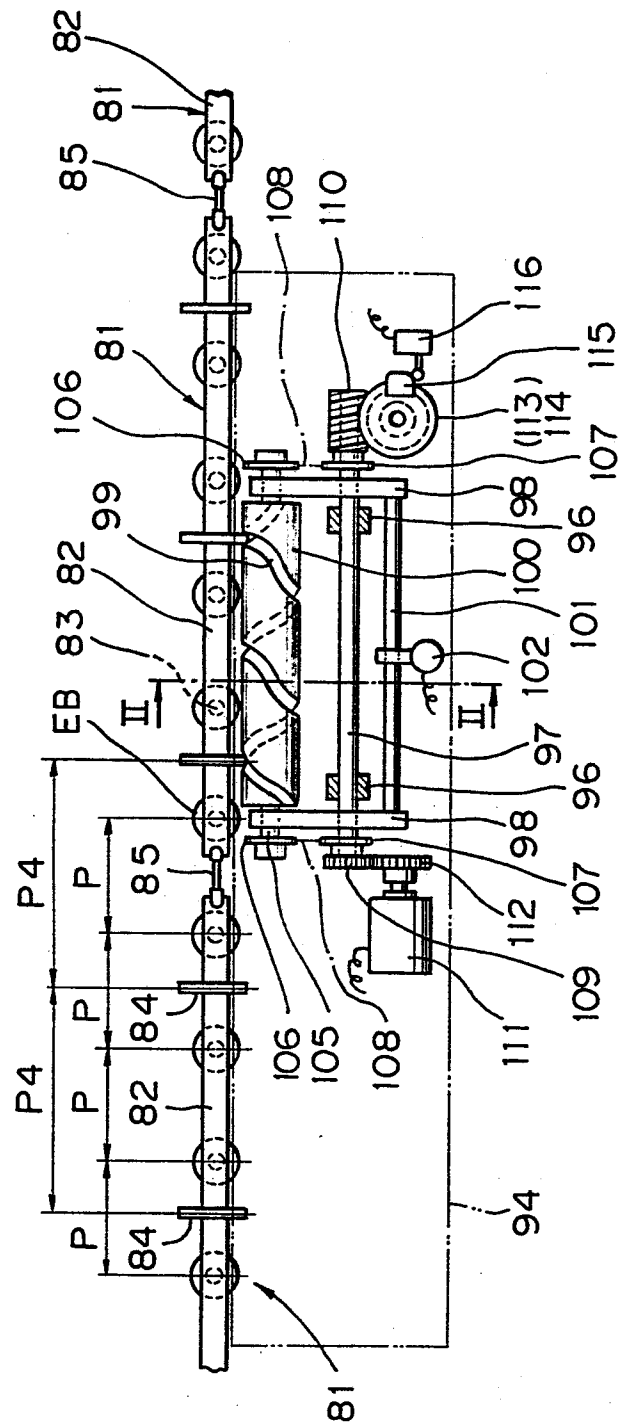


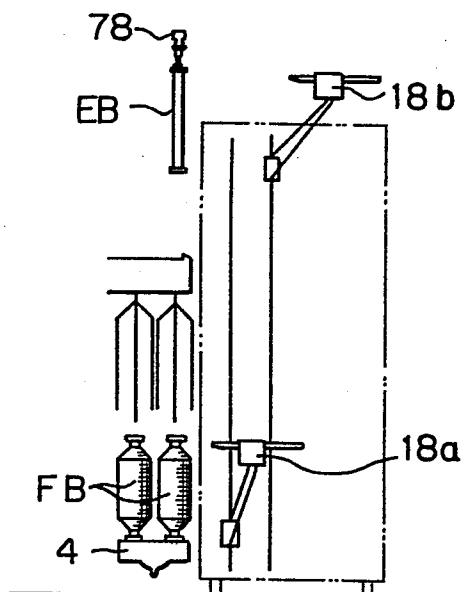
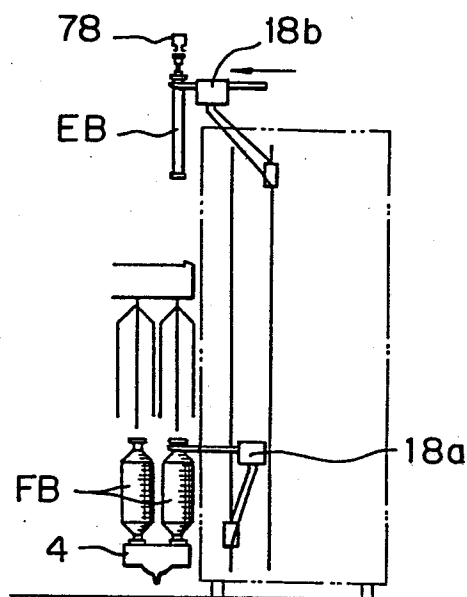
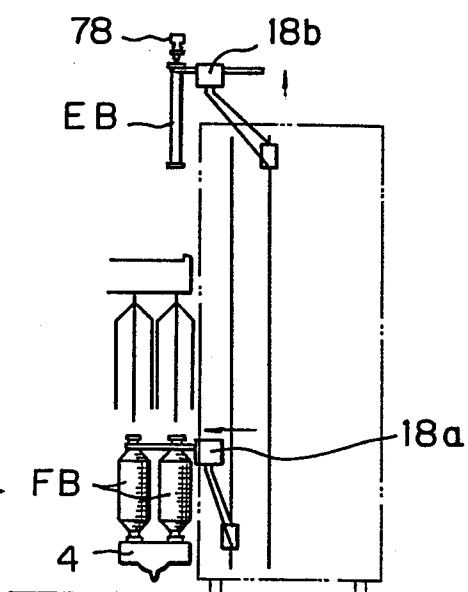
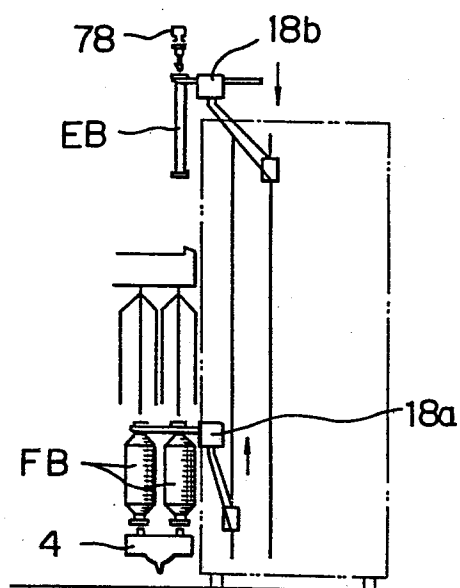
Fig. 15 a*Fig. 15 b**Fig. 15 c**Fig. 15 d*

Fig. 15 e

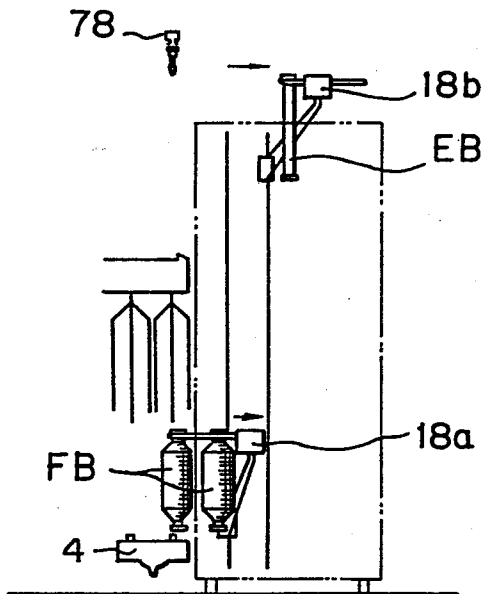


Fig. 15 f

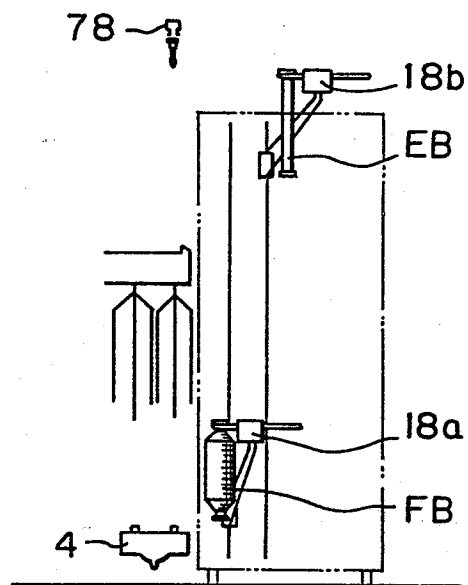


Fig. 15 g

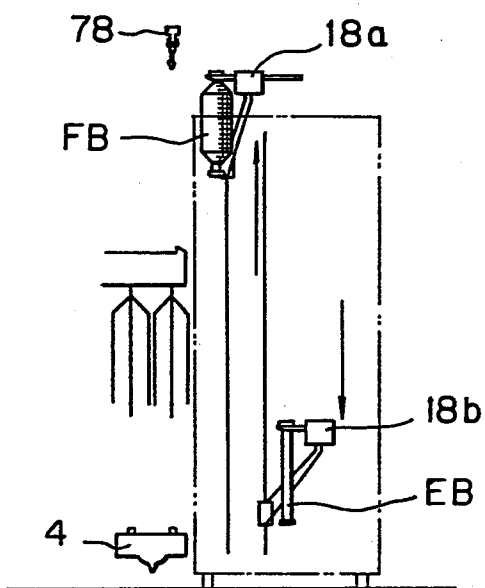


Fig. 15 h

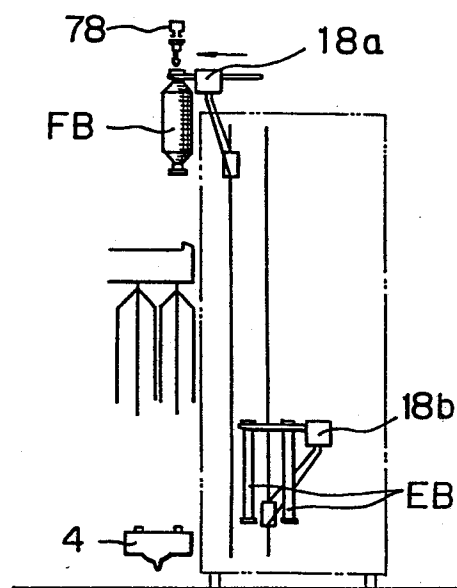


Fig. 15 i

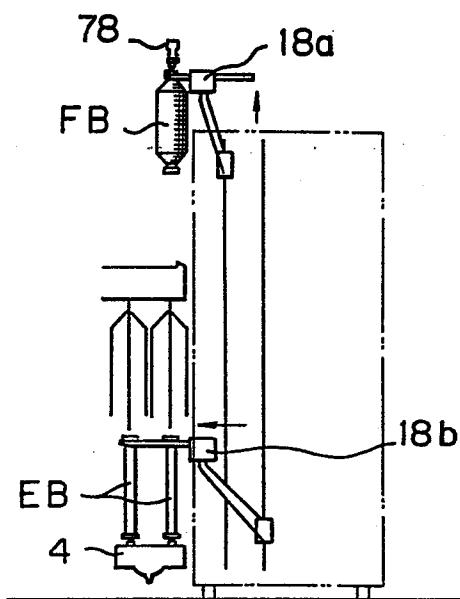


Fig. 15 j

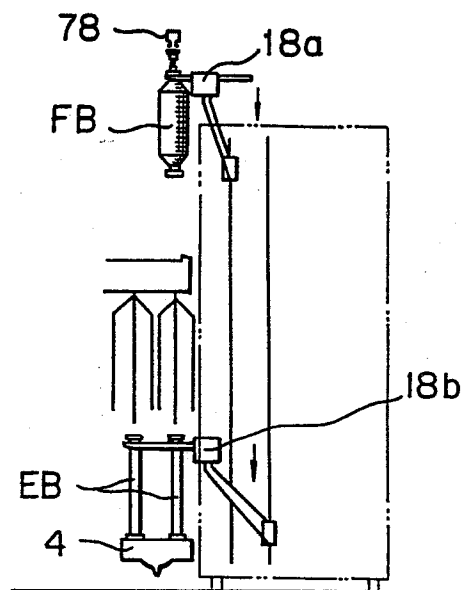


Fig. 15 k

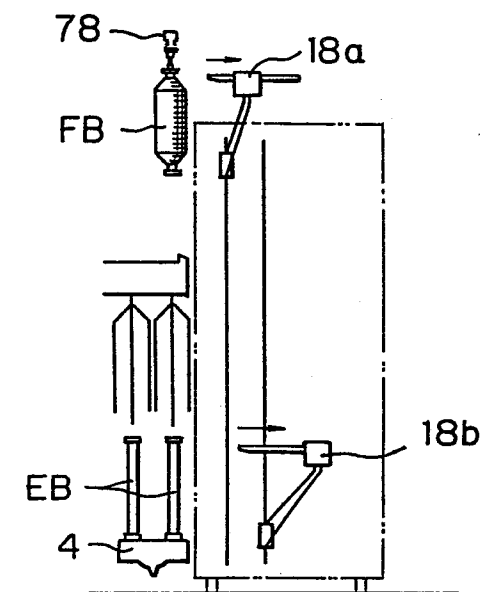
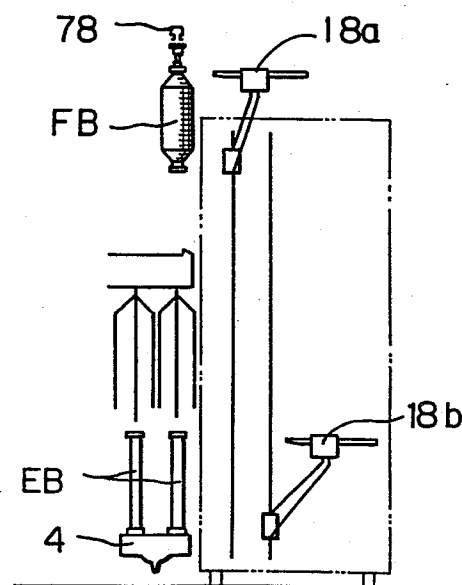


Fig. 15 l



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Fig. 16 a

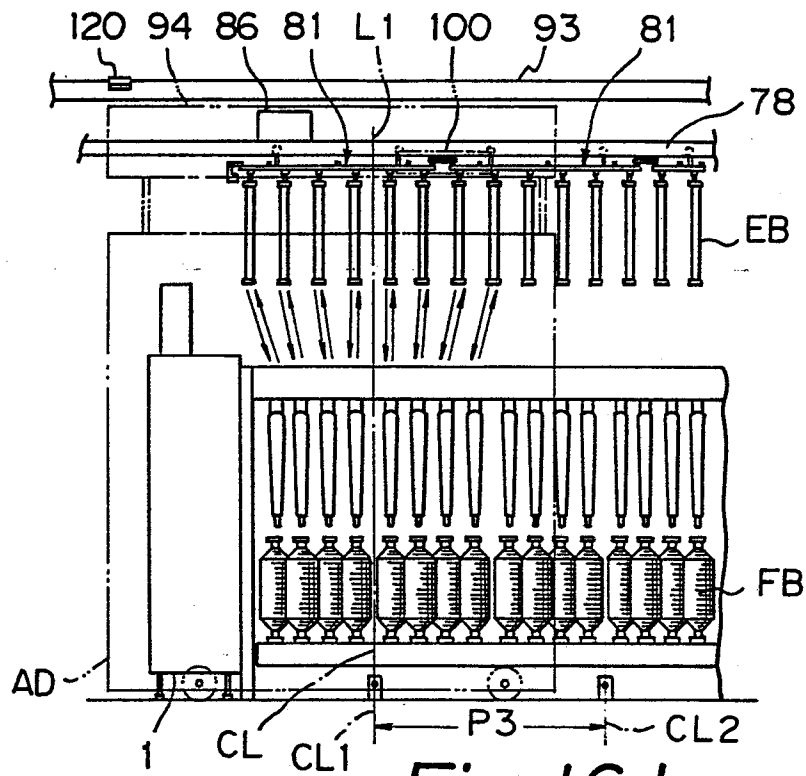


Fig. 16 b

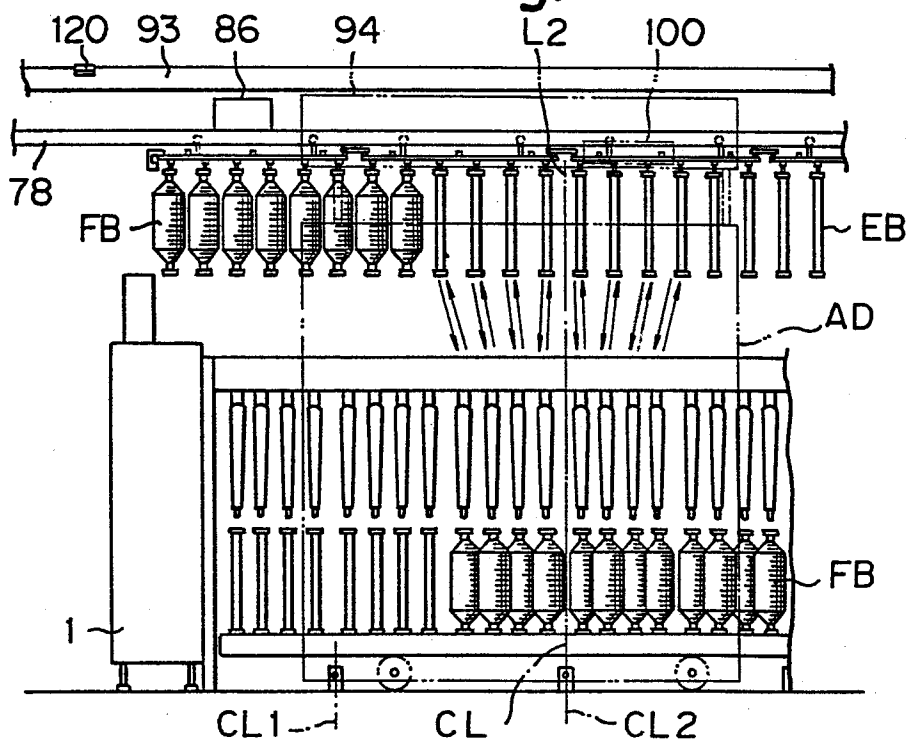
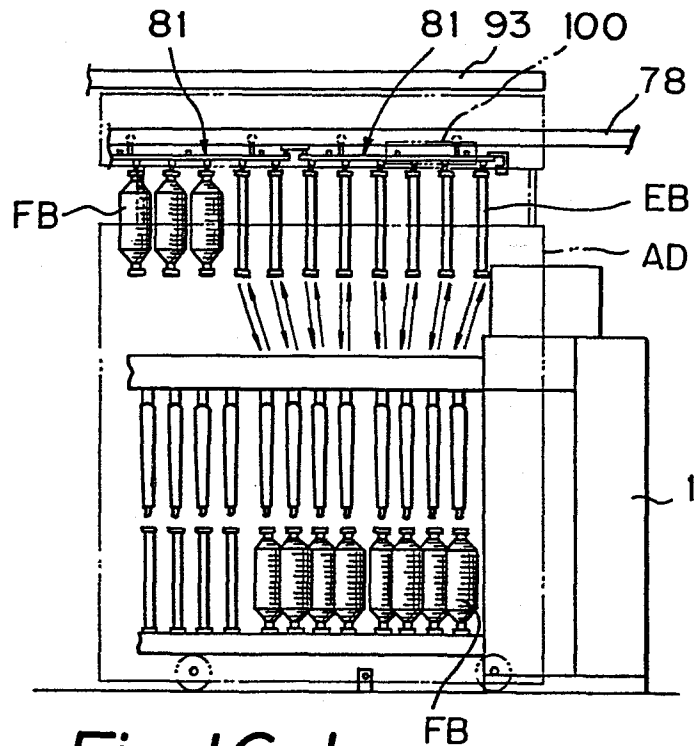
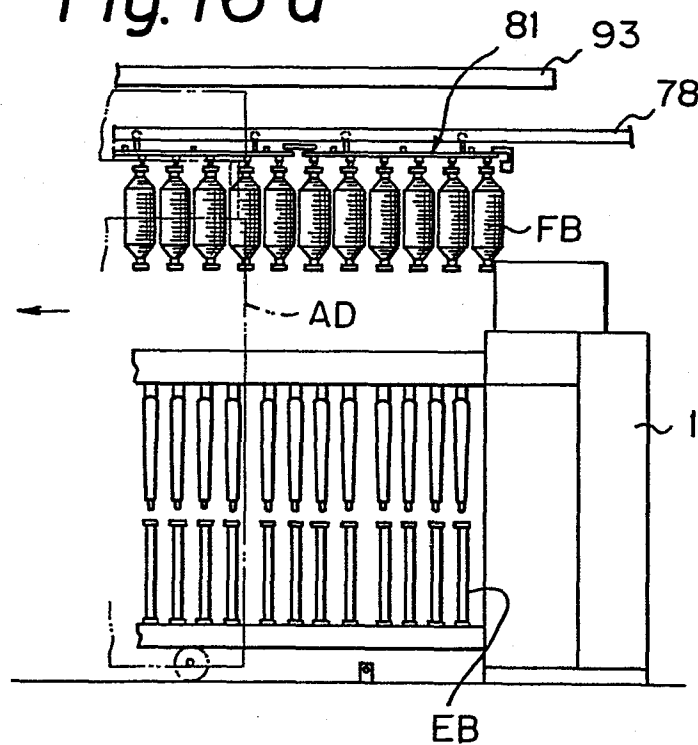
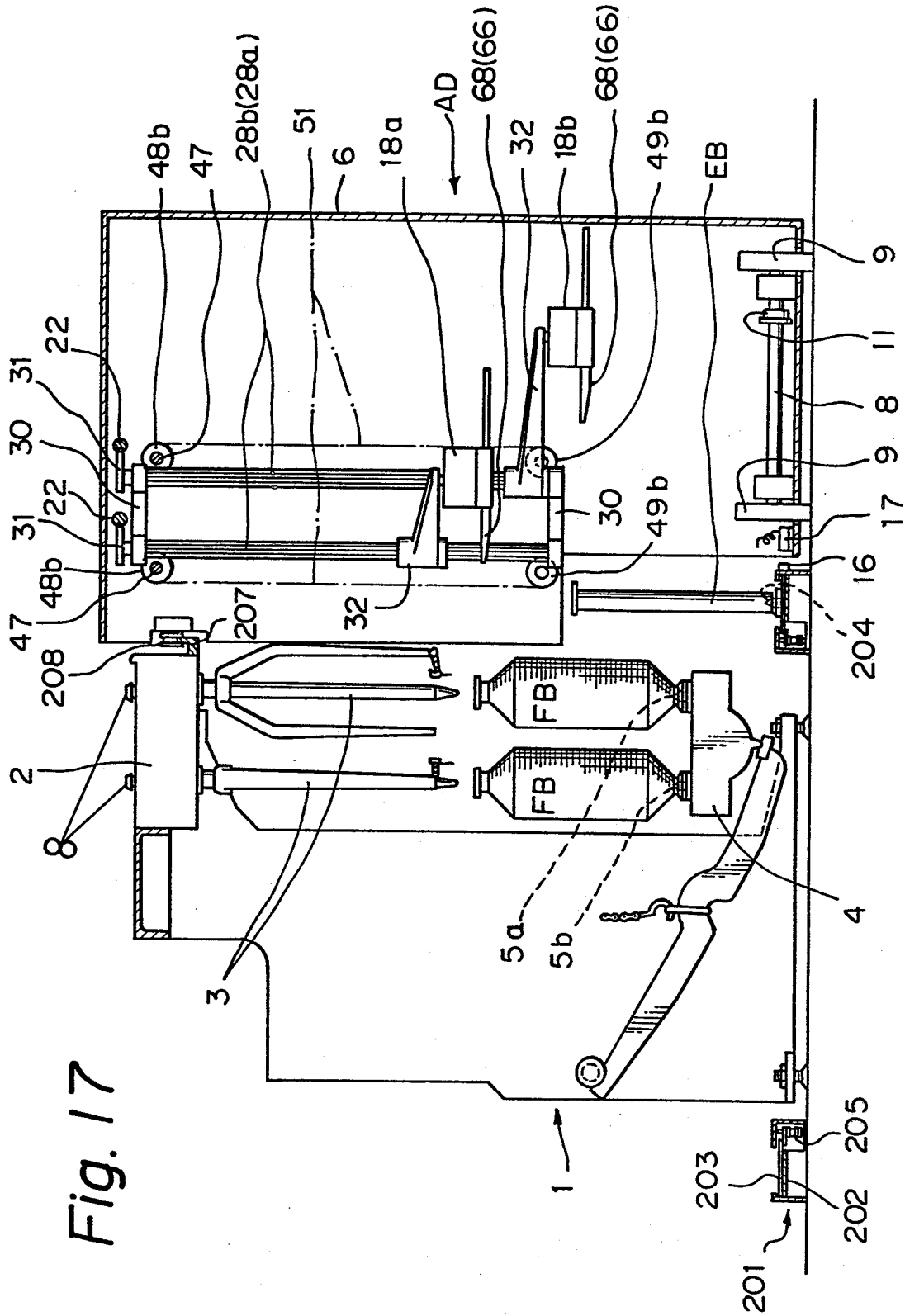


Fig. 16 c*Fig. 16 d*



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Fig. 18

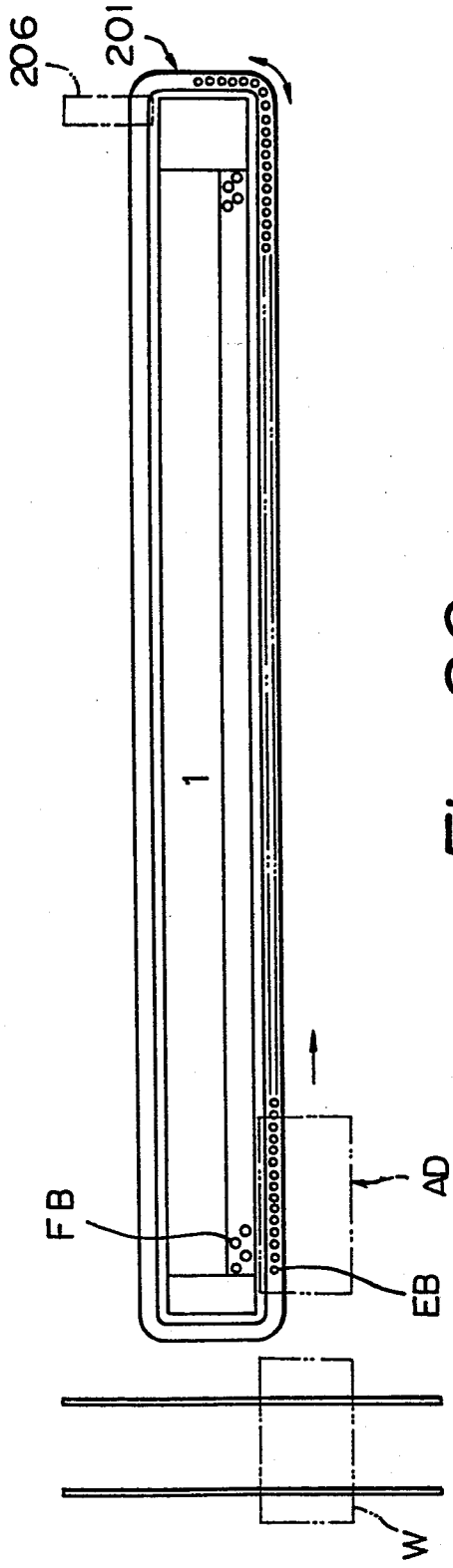


Fig. 20

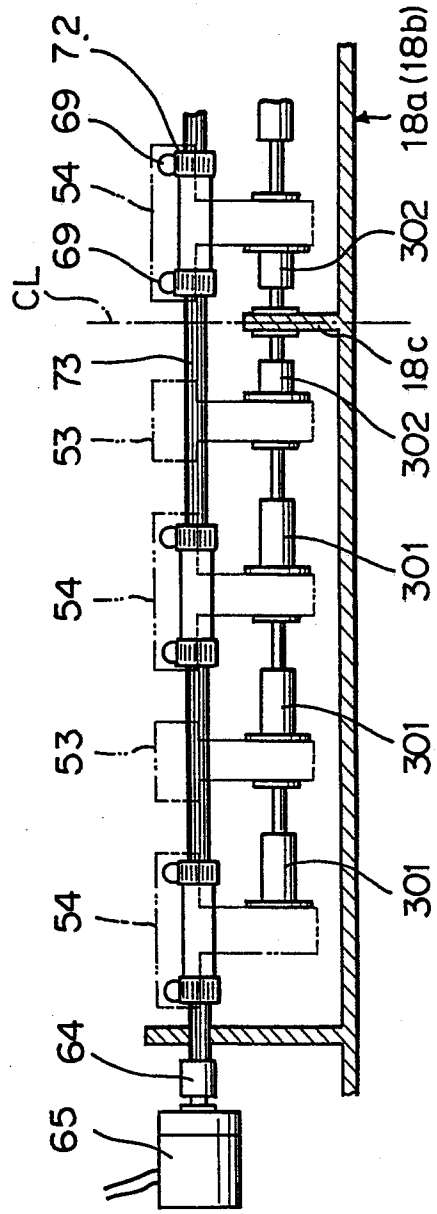


Fig. 19 a

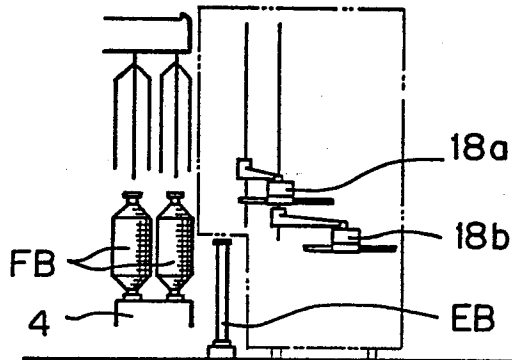


Fig. 19 b

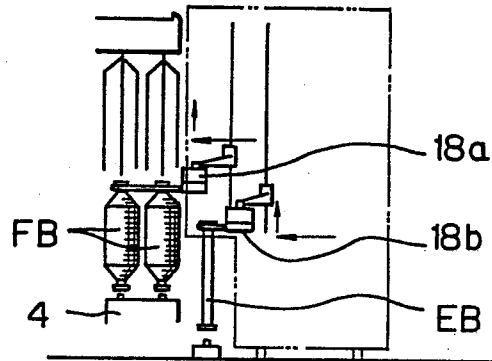


Fig. 19 c

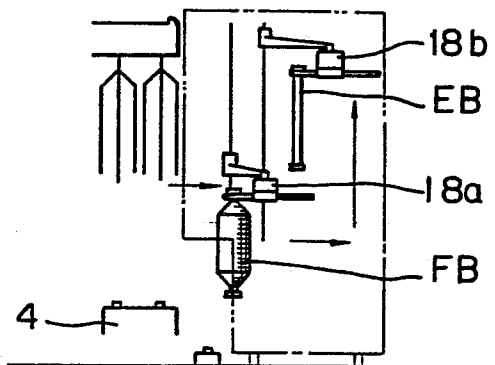


Fig. 19 d

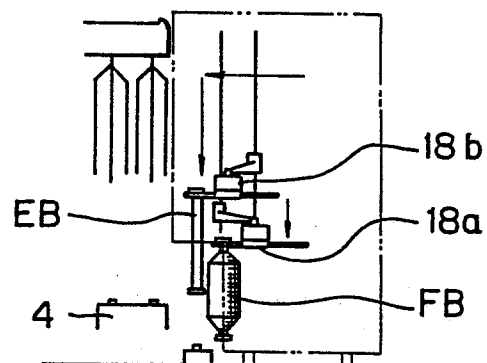


Fig. 19 e

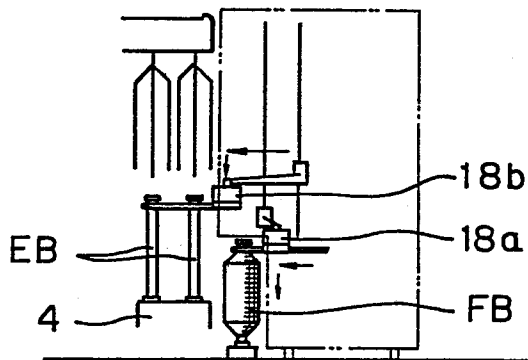
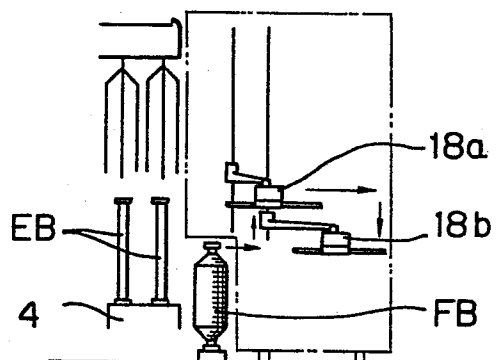


Fig. 19 f



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Fig. 21

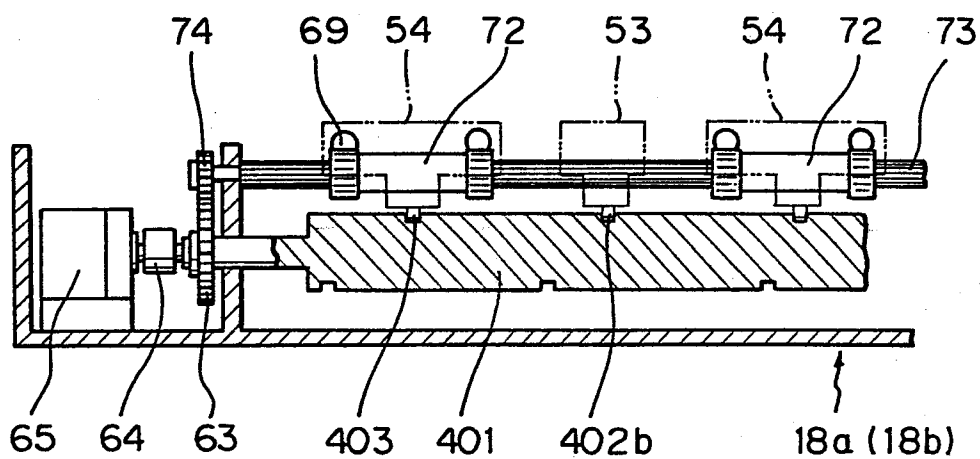


Fig. 22

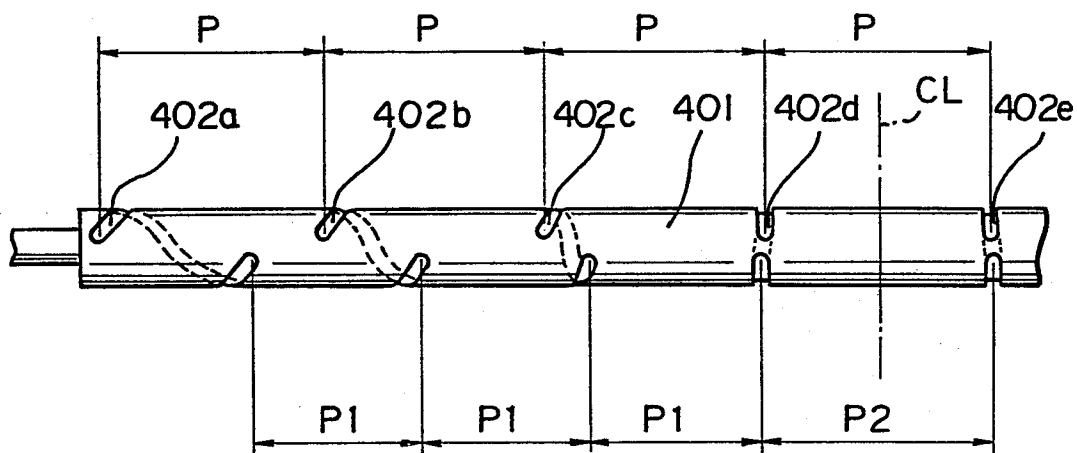


Fig. 23

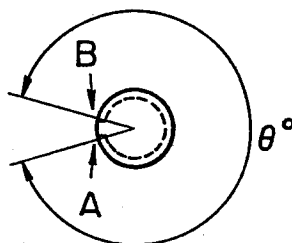


Fig. 24

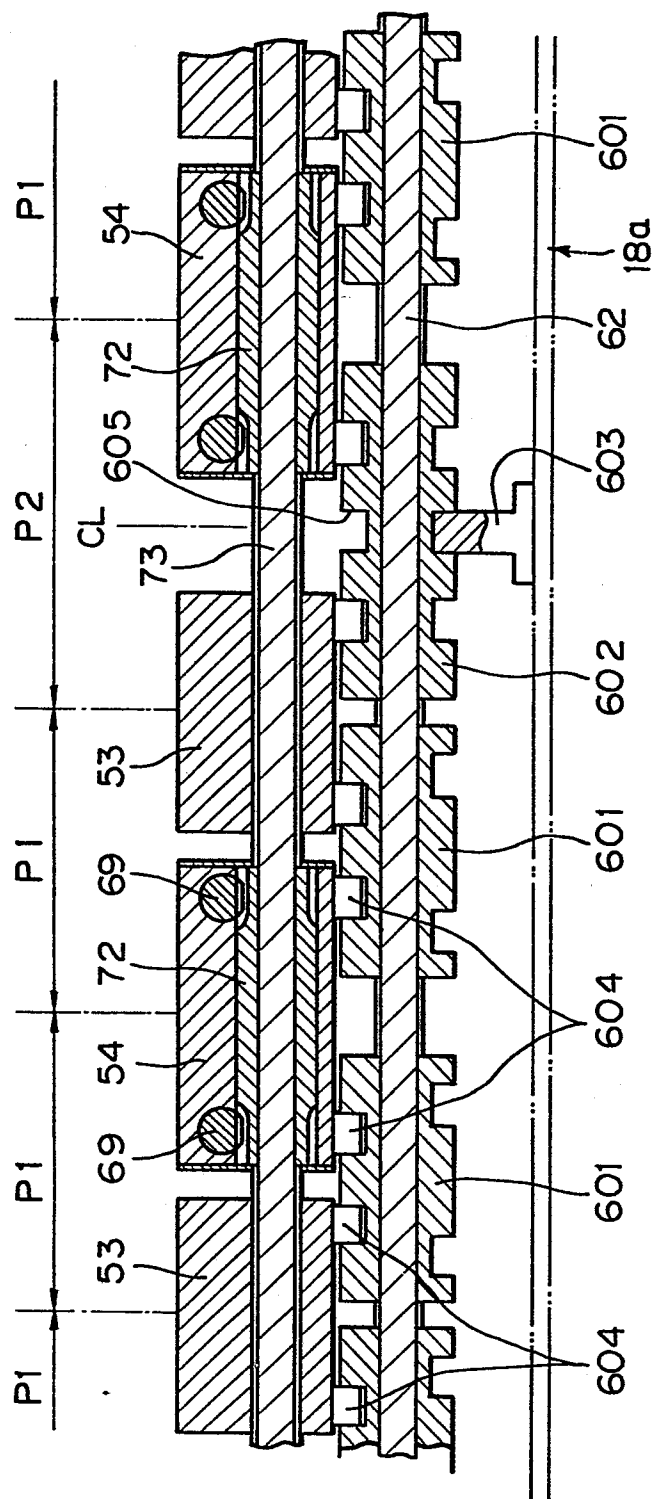


Fig. 25

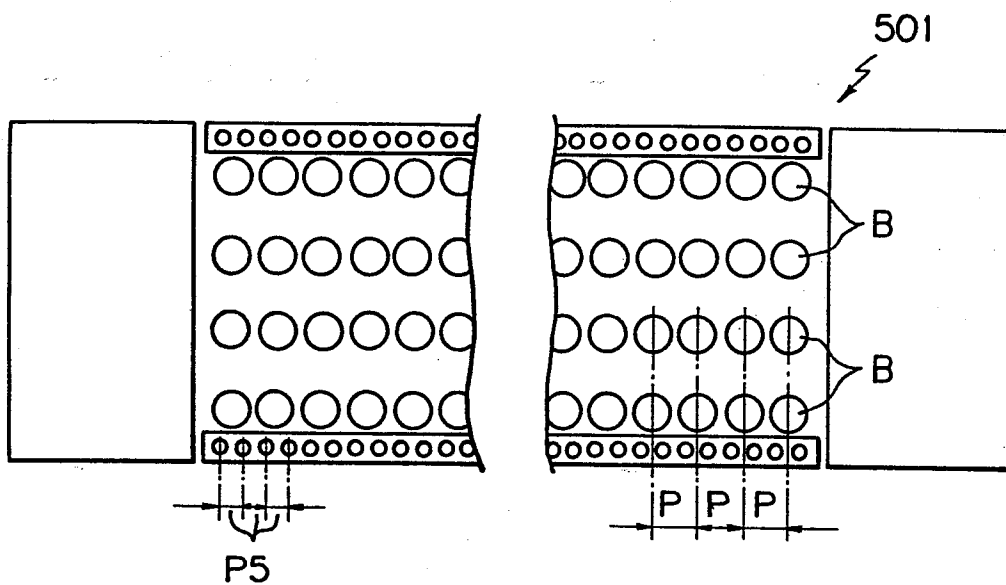


Fig. 26

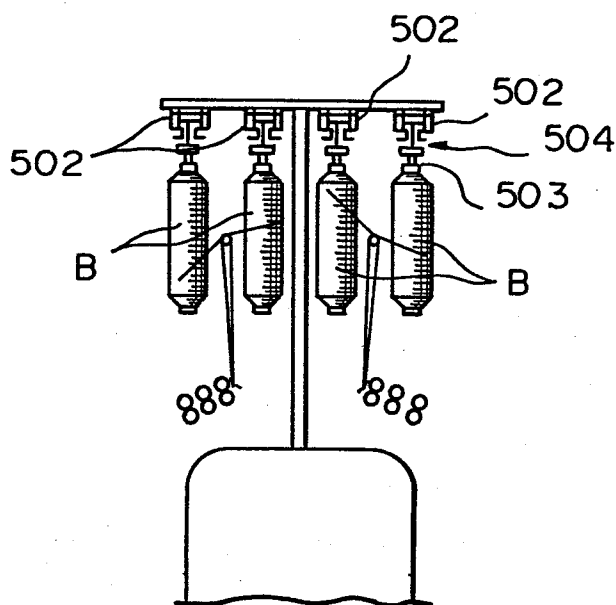


Fig. 27

