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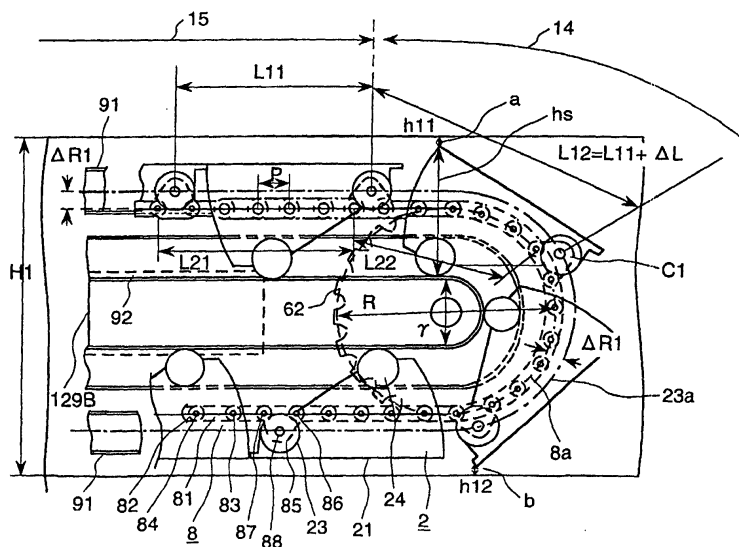
(54) **ESCALATOR DEVICE**

(57) An escalator apparatus for moving an endless chain with many steps connected is structured so that in the section where the chain is mated with sprockets, the moving track of the connection portions of the steps with the chain is positioned outside the rotation track of the outer periphery of the teeth of the sprockets.

By use of such a constitution, there is no need to

set the teeth of the sprockets to a multiple of the number of chain pitches between the connection portions of the steps with the chain. Therefore, the degree of freedom of selection of sprockets is increased, and sprockets smaller than conventional sprockets can be used, and the thickness of an escalator apparatus can be made smaller.

**FIG. 6**



## Description

### BACKGROUND OF THE INVENTION

#### [Field of the Invention]

**[0001]** The present invention relates to improvement of an escalator apparatus and provides an escalator apparatus that the thickness from the floor of the getting on and off platform of the escalator to the bottom of the escalator body is made thinner.

#### [Prior Art]

**[0002]** The basic constitution of an escalator apparatus is that many steps are connected to and moved by the chain via the front wheel shafts of the steps and by doing this, passengers are transferred. In this constitution of the escalator, the thickness from the floor of the getting on and off platform of the escalator to the bottom of the escalator body is decided by the rotation diameter of the steps at both ends of the escalator.

**[0003]** In Japanese Patent Application Laid-Open 58-207207, it is described that the connection portions of the front wheel shafts of the stops and chain are shifted from the center line of the moving direction of the chain and the breaking strength of the chain is improved.

### SUMMARY OF THE INVENTION

**[0004]** An object of the present invention is to provide an escalator apparatus that the thickness is made smaller.

**[0005]** The chain connecting many steps is wound over the drive sprocket and follower sprocket. The chain is composed of many chain links and the chain links are connected by link pins.

**[0006]** The connection of the steps and chain has a constitution that the front wheel shafts of the steps are connected to the chain and generally, the number of chain pitches (chain links) between the front wheel shafts of the neighboring steps is an even number. The reason is that the chain is structured so that the chain links having different structures are alternately connected in the order of outside, inside, outside (see Fig. 4) and the front wheel shafts are to be connected to the chain links having the same structure.

**[0007]** As a result, the number of chain pitches between the front wheel shafts is considered to be an even pitch such as 4, 6, 8, 10, 12, and so on.

**[0008]** However, in a chain having 4 pitches between the front wheel shafts, the interval per each pitch (chain link) is large and the chain cannot move smoothly at the turning portion. In the case of 10 or 12 pitches, the interval per each pitch (chain link) is short and the teeth mating strength of the chain and sprocket is weakened.

**[0009]** Therefore, it is desirable for the chain that the number of chain pitches between the front wheel shafts

is 6 or 8.

**[0010]** In the embodiment described later, the number of chain pitches between the front wheel shafts is set at 6.

5 **[0011]** Although the drawing and explanation are omitted, in a conventional chain, there are connection portions between the front wheel shafts of the steps and the chain on the same track as the moving track of the chain, so that in a conventional drive sprocket, the teeth of the sprocket meeting the connection portions require special teeth (hereafter called special teeth) having concavities in them so as to prevent interference between the connection portions and the front wheel shafts. To mate the chain links connected to the front wheel shafts with the special teeth in correspondence, the special teeth must be provided at a rate of one tooth per 6 teeth or one tool per 8 teeth according to the number of chain pitches between the front wheel shafts.

10 **[0012]** Therefore, the number of teeth of the drive sprocket is decided by a multiple of the number of chain pitches between the front wheel shafts and as mentioned above, in the case of 6 pitches, the number of teeth is 12, 18, 24, or 30 and in the case of 8 pitches, the number of teeth is 16, 24, 32, or 40.

15 **[0013]** When the number of teeth of a drive sprocket is 24, the diameter of the drive sprocket is large and although it is smaller than the diameter of the drive sprocket of a conventional escalator apparatus, the thickness of the escalator is still large.

20 **[0014]** When the number of teeth of a drive sprocket is set to 12 for 6 pitches or 16 for 8 pitches, the diameter of the drive sprocket becomes excessively small, so that the interference between the neighboring steps becomes great and there is no possibility of eliminating the interference and turning the steps found.

25 **[0015]** Next, when a combination of a chain of 6 pitches between the front wheel shafts and a drive sprocket having 18 teeth is examined, slight interference is caused between the neighboring steps after all and the steps cannot be turned smoothly in this state.

30 **[0016]** However, as mentioned above, the number of teeth of the drive sprocket is decided by a multiple of the number of chain pitches among the front wheel shafts, so that the size of the drive sprocket cannot be selected freely. Therefore, to prevent interference from being caused between the neighboring steps at the turning portion, it is necessary to prepare a large drive sprocket having 24 teeth.

35 **[0017]** The same may be said with a combination of a follower sprocket and a chain.

40 **[0018]** Therefore, one characteristic of the present invention is that an escalator apparatus moving with an endless chain connected with many steps is structured so that in the section where the chain is mated with the sprocket, the moving track of the connection portions of the steps and chain is positioned outside the moving track of the outer periphery of the teeth of the sprocket.

45 **[0019]** By use of such a constitution, there is no need

to set the number of teeth of the sprocket to a multiple of the number of chain pitches between the connection portions of the steps and chain. Therefore, the degree of selection of a sprocket increases and even if the number of chain pitches of the front wheel shafts is 6 or 8, a sprocket of 19 to 23 teeth can be selected and used. Namely, no interference is caused between the neighboring steps at the turning portion, and a sprocket smaller than a conventional sprocket can be selected, and the aforementioned thickness of an escalator can be made smaller than the convention one.

## BRIEF DESCRIPTION OF THE DRAWINGS

### [0020]

Fig. 1 is a side view showing the whole constitution of an escalator apparatus of the present invention that a part of thereof is notched. Fig. 2 is a cross sectional view of the inclined portion along the line II-II shown in Fig. 1. Fig. 3 is a cross sectional view of the flat portion of upper floor along the line III-III shown in Fig. 1. Fig. 4 is a plan view of the flat portion of upper floor along the line IV-IV shown in Fig. 1 which is viewed from above. Fig. 5 is a drawing showing the constitution of a step. Fig. 6 is an enlarged view of the flat portion of upper floor of an escalator apparatus of an embodiment of the present invention. Fig. 7 is a side view and perspective view of a chain of an escalator apparatus of an embodiment of the present invention.

Fig. 8 is an enlarged view of the flat portion of upper floor of an escalator apparatus of another embodiment of the present invention. Fig. 9 is a side view and perspective view of the chain of the escalator apparatus shown in Fig. 8. Fig. 10 is a schematic view of the guide rails of the front and rear wheels at the turning portion.

Fig. 11 is a schematic plan view showing the installation condition of the rack mechanism of an escalator apparatus corresponding to a wheelchair. Fig. 12 is a front view viewed in the direction of the arrow X shown in Fig. 11. Fig. 13 is a schematic enlarged side view showing the inside of the flat portion of upper floor of an escalator apparatus corresponding to a wheelchair. Fig. 14 is a schematic enlarged side view showing the inside of the flat portion of lower floor of an escalator apparatus corresponding to a wheelchair. Fig. 15 is a partial cutaway view showing a moving step with a wheelchair loaded. Fig. 16 is a partial cutaway view showing a moving step with a wheelchair loaded.

### [Description of the Preferred Embodiments]

**[0021]** An embodiment of the present invention will be explained hereunder.

**[0022]** Firstly, with respect to an escalator apparatus

of the present invention, the constitution common to a general escalator apparatus will be explained by referring to Figs. 1 to 5.

**[0023]** An escalator apparatus 1 moves many steps 2 endlessly connected and transfers passengers between an upper floor 31 and a lower floor 32. For safety of passengers, the escalator 1 has a hand rail 4 moving in synchronization with the steps 2 and a parapet 10 supporting the hand rail 4. The steps 2, hand rail 4, and parapet 10 are supported by a main frame 5 and both ends of the main frame 5 are fixed to the upper floor 31 and lower floor 32 of the building. The escalator apparatus 1 has a flat portion of upper floor 11 and a flat portion of lower floor 12 where passengers get on and off and an inclined portion 13 connecting both flat portions and transferring passengers. In a machine room of upper floor 6 of the flat portion of upper floor 11, a driving machine 61 is installed and drives a drive sprocket 62. The driving machine 61 has a motor 611, a sprocket 612, an output shaft 613 of the motor 611, a gear (not shown in the drawing) attached to the output shaft 613, a shaft 614 of the sprocket 612 installed in parallel with the output shaft 613 of the motor 611, and a gear (not shown in the drawing) attached to this shaft and the gear attached to the output shaft 613 and the gear attached to the shaft 614 mate with each other and constitute a deceleration transfer mechanism. In a machine room of lower floor 7 of the flat portion of lower floor 12, a follower sprocket 71 is installed and between the drive sprocket 62 and the follower sprocket 71, an endless chain 8 is wound and rotates so as to change the direction at both ends of the escalator. To the chain 8, many steps 2 are connected.

**[0024]** These steps 2, as shown in Fig. 5, have a step plate 21, a riser 22, a front wheel 23, and a rear wheel 24 respectively. Here, the length of the step plate 21 of each step 2 in the moving direction is defined as a length  $L_s$  of the step plate 21, the dimension from the step surface of the rear wheel 24 to the top of the riser 22 as a maximum thickness  $h_s$  of the steps 2, and the height from the step plate 21 to the rear wheel 24 as a height  $h_h$  of the steps 2.

**[0025]** The front wheel 23 of each step 2 is connected to the chain 8 with its shaft and as the chain moves, the front wheel 23 also moves.

**[0026]** Fig. 2 is a cross sectional view of the inclined portion 13 shown in Fig. 1 and (a) and (b) show different embodiments. Fig. 3 is a cross sectional view of the flat portion of upper floor 11 shown in Fig. 1 and (a) and (b) show different embodiments. Fig. 4 is a drawing of the flat portion of upper floor along the line IV-IV shown in Fig. 3 which is viewed from above.

(a) and (b) of Fig. 2 and (a) and (b) of Fig. 3 show different embodiments respectively. However, the common parts to a general escalator are the same, so that Fig. 2(a) and Fig. 3(a) will be mostly explained.

**[0027]** As shown in Figs. 2 and 3, each step 2 has a pair of front wheels 23 which are shaft-supported by

front wheel shafts 231 protruded on both sides in the width direction so as to freely rotate and a pair of rear wheels 24 which are shaft-supported by rear wheel shafts 241 at narrower intervals than the front wheels 23 so as to freely rotate.

**[0028]** The front wheels 23 are positioned outside (on both left and right sides shown in Figs. 2 and 3) the rear wheels 24 and in the forward path (upper side) of the steps 2, the front wheels 23 are arranged above the rear wheels 24. The front wheel shafts 231 are connected to the chain 8 and move the steps 2 in correspondence with movement of the chain 8.

**[0029]** As shown in Fig. 4, the front wheels 23 are arranged outside the rear wheels 24 and roll and move on a front wheel guide rail 91. The rear wheels 24 roll and move on a rear wheel guide rail 92 arranged inside the chain 8.

**[0030]** In addition to the aforementioned constitution, a pair of parapets 10 are installed along both sides in the moving direction of the steps 2. The parapets 10, as shown in Fig. 2, are respectively composed of a parapet panel 101, a railing frame 102 installed on the periphery of the parapet panel 101, an inner deck cover 103 and an outer deck cover 104 covering the base of the parapet panel 101, and a skirt guard 105 installed under the inner deck cover 103. The periphery of each parapet 10, that is, the railing frame 102 guides the hand rail 4 moving in synchronization with the steps 2. The outer surface of the main frame 5 is covered with an outer plate 16 such as a decorative laminated sheet for safety and design.

**[0031]** The thickness H of the escalator apparatus shown in Fig. 1 is decided by the moving diameter of the steps 2 at both ends of the escalator. Namely, the thickness H of the escalator apparatus is a value obtained by adding the diameter of the drive sprocket 62, the peripheral moving track of the steps 2 rotating round it and turning, and the safety distance reserved up and down.

**[0032]** An embodiment of the present invention for making the thickness of the escalator apparatus smaller will be explained hereunder.

**[0033]** Fig. 6 shows a schematic structure of the chain 8 and the steps 2 at the turning portion 14 (see Fig. 1) of the escalator apparatus 1 and is a drawing for explaining a moving (rotating) track 8a of the chain 8 and a moving (rotating) track 23a of the front wheels 23 of the steps. Fig. 7 shows the chain 8 in this embodiment and (a) is a side view and (b) is a perspective view.

**[0034]** In the drawing, the chain 8 wound over the drive sprocket 62 is composed of many chain links 81 and the chain links 81 have respectively two pin holes 82 and 83 and link pins 84 to be inserted into the pin holes so as to connect the neighboring chain links 81. Therefore, the interval between the two pin holes 82 and 83 is the length P of one chain pitch. The pitch length P is a length obtained by dividing a distance L11 between the front wheel shafts of the neighboring steps 2 by the number of pitches 6 between the front wheel shafts.

**[0035]** According to this embodiment, the moving track of the connection portion of the chain 8 with the front wheel shafts 231 of the steps 2 passes outside the outer periphery of the teeth of the drive sprocket 62 and hence there is no need to install the aforementioned special teeth in the drive sprocket 62. Therefore, the size of the drive sprocket 62 can be selected freely and the thickness of the escalator apparatus can be made smaller. Concretely, when the number of chain pitches is 6, a drive sprocket 62 having 19 to 23 teeth other than a multiple of 6 can be used and the thickness of the escalator apparatus can be made smaller. The same may be said with the constitution of the follower sprocket 71 and the chain 8.

**[0036]** The constitution will be explained hereunder.

**[0037]** The structural improvement point is that, as shown in Figs. 6 and 7, the link of the chain 8 for connecting the front wheel shafts 231 of the steps 2 is a specific link 85 in a convex triangular shape with the vertex thereof looking toward the outside of the moving (rotating) track 8a of the chain 8. Namely, among the links 81 of the chain 8, one of six links is a triangular specific link 85. Also in the triangular specific links 85, two pin holes 86 and 87 are formed respectively and for these two pin holes 86 and 87, another pin hole 88 is formed at the location of the vertex of the triangle. The front wheel shafts 231 (see Fig. 2(a), Fig. 3(a), or Fig. 4) of the steps 2 pass through the added pin hole 88, thereby the pin hole 88 can be used as a hole for connecting the front wheel shafts 231 to the chain 8. Namely, outside the two link pins 84, a connection portion C1 with the front wheel shafts 231 of the steps is structured. In this embodiment, the specific links 85 are arranged in the inside links of the chain 8. However, they may be arranged in the outside links.

**[0038]** The connection portion C1 is structured  $\Delta R1$  above so that it is prevented from touching the outer periphery of the teeth of the drive sprocket 62 at the turning portion 14. Namely, the moving track 23a of the front wheels 23 of the steps 2 is lifted up  $\Delta R1$  above the moving track 8a of the chain 8 by the triangular specific links 85 of the chain 8 and the moving track 23a of the front wheels 23 is located outside the track of the outer periphery of the teeth of the drive sprocket 62.

**[0039]** The front wheels 23 and the rear wheels 24 of the steps 2 rotate and move respectively on the front wheel guide rail 91 and the rear wheel guide rail 92 as the chain 8 moves.

**[0040]** As mentioned above, according to the present invention, in the section where the chain 8 and the drive sprocket 62 mate with each other, the connection port C1 of the chain 8 with the front wheel shafts 231 of the steps 2 is structured to be located outside the track of the outer periphery of the teeth of the drive sprocket 62. In other words, the connection port C1 of the chain 8 with the front wheel shafts 231 of the steps 2 is structured to be located outside the outer end of the chain 8. The section where the connection port C1 of the chain

8 with the front wheel shafts 231 of the steps 2 is located outside the moving (rotating) track of the outer periphery of the teeth of the drive sprocket 62 may not be the aforementioned section where the chain 8 and the drive sprocket 62 mate with each other and it may be the semicircular section in the direction of the end of the drive sprocket 62 or the section in the direction of the end from the center of the drive sprocket 62.

**[0041]** When the connection portion C1 is located outside like this, the connection portion C1 of the chain 8 with the steps 2 can be prevented from interference with the teeth of the drive sprocket 62 and as a result, there is no need to install the aforementioned special teeth in the drive sprocket 62 and the teeth of the drive sprocket 62 can be made in the practically same shape. The practically same shape means the same shape as long as the participation in the front wheel shafts 231 is concerned though the shape is changed and in other words, it means that there are no special teeth processed free of interference with the front wheel shafts 231.

**[0042]** Even if the front wheel shafts 231 of the steps 2 to be connected with the chain 8 are structured so as to bent to be located outside the rotation track of the outer periphery of the teeth of the drive sprocket 62 at least within the range of the width  $W_c$  (see Fig. 4) of the chain 8, interference with the teeth of the drive sprocket 62 can be prevented and the drive sprocket 62 may not be provided with special teeth.

**[0043]** By use of the aforementioned constitution, when the pitch of the chain 8 between the front wheel shafts 231 is  $N$  pitches, the number of teeth of the drive sprocket may be set to  $AN+B$  ( $A, B$ : natural numbers,  $1 \leq B \leq N$ ). Therefore, there is no need to always decide the number of teeth of the drive sprocket 62 by a multiple of the number of chain pitches between the front wheel shafts 231 and if the number of teeth is within the range of less than 24 teeth meeting the desired thickness  $H$  of the escalator apparatus, it can be decided freely. Namely, by use of the constitution of this embodiment, a drive sprocket 62 having 19 to 23 teeth can be selected. Since the number of teeth of the drive sprocket 62 is not set to a multiple of the number of chain pitches like this, the chain 8 and the drive sprocket 62 shift and mate with each other. Namely, according to this embodiment, the number of teeth of the drive sprocket 62 is 21, so that whenever the drive sprocket 62 makes one rotation, it shifts by 3 teeth ( $21 \text{ teeth} - 6 \text{ pitches} \times 3$ ) and the chain 8 and the drive sprocket 62 mate with each other.

**[0044]** According to this embodiment, according to the number of teeth of the drive sprocket 62, the diameter of the drive sprocket 62 can be made smaller and the thickness of the escalator apparatus can be made smaller.

**[0045]** This embodiment is structured so that the moving track 23a of the front wheel shafts 231 of the steps 2 is located outside the moving track 8a of the chain 8. By use of such a constitution, the interference between the steps can be reduced more than the conventional.

The reason for it will be described hereunder.

**[0046]** As shown in Fig. 6, since the chain 8 rotates round the diameter  $R$  of the drive sprocket 62 and draws a circular arc, the linear distance  $L_{21}$  between 6 pitches on the horizontal portion 15 is shortened to the linear distance  $L_{22}$  between 6 pitches on the turning portion. Therefore, when the front wheel shafts 231 of the steps 2 are directly connected to the links 81 of the chain 8, the moving track 8a of the chain 8 draws a circular arc, so that the linear distance between the front wheel shafts 231 of the neighboring steps 2 is also shortened. On the horizontal portion 15, the neighboring step plates 21 move at a minimum gap for safety of transferring persons. Therefore, at the turning portion 14, when the minimum gap of the neighboring step plates 21 is shortened, the neighboring steps 2 interfere with each other and are not held mechanically.

**[0047]** To prevent mutual interference with the neighboring steps 2, in this embodiment, the aforementioned linear distance is shortened as shown below.

**[0048]** As shown in Fig. 6, the moving track 23a of the front wheels 23 of the steps 2 is lifted up  $\Delta R_1$  above the moving track 8a of the chain 8 by the triangular specific links 85 of the chain 8. On the horizontal portion 15, the distance  $L_{11}$  between the front wheel shafts of the neighboring steps 2 and the distance  $L_{21}$  between the two neighboring specific links of the chain 8 are the same.

**[0049]** However, on the turning portion 14, the distance  $L_{12}$  between the front wheel shafts of the two neighboring steps 2 is longer by an extended circumference of  $\Delta L$  in correspondence to an extended radius of  $\Delta R_1$  than the distance  $L_{22}$  between the specific links of the chain 8 and  $L_{12} = L_{11} + \Delta L$  is held. As a result, interference between the neighboring steps 2 can be eliminated.

**[0050]** Therefore, on the turning portion 14, interference is not generated between the neighboring steps 2, and even if the same steps 2 are used, a drive sprocket 62 smaller than a conventional one can be used, and the thickness  $H_1$  of the escalator apparatus can be made smaller.

**[0051]** The same may be said with mating of the follower sprocket 71 with the chain 8 and interference with the steps 2.

**[0052]** Next, another embodiment of the present invention will be explained by referring to Figs. 8 and 9.

**[0053]** Fig. 8 is a schematic view of the chain 8 and the steps 2 on the turning portion 14 of an escalator apparatus and a drawing for explaining the moving track 8a of the chain 8 and the moving track 23a of the front wheels 23 on the turning portion 14. Fig. 9 is a drawing showing the chain 8 in this embodiment and (a) is a side view and (b) is a perspective view.

**[0054]** In the drawings, the constitution of the chain link 81 of the chain 8 wound over the drive sprocket 62, the pin holes 82 and 83, and the link pins 84 is the same as that of the aforementioned embodiment. According

to this embodiment, the link of the chain 8 to which the front wheel shafts 231 of the steps 2 are connected is the triangular specific link 89 having a different hole from that of the aforementioned embodiment. The respect that two pin holes 891 and 892 are formed in the triangular specific link 89 is the same as that of the aforementioned embodiment. However, a long pin hole 893 (hereinafter called an elongated hole) is formed perpendicularly to the moving direction of the escalator apparatus at the center part of the specific link 98 and when the front wheel shafts 231 of the steps 2 pass through the added elongated hole 893, the front wheel shafts 231 are connected to the chain 8. The top 8931 of the elongated hole 893 is the section where the chain 8 mates with the drive sprocket 62 and the elongate hole is structured longer on the outside so that it is located outside the rotation track of the outer periphery of the teeth of the drive sprocket 62. The elongated hole 893 is used to change the connection position of the elongated hole 893 with the front wheel shafts 231 of the steps 2 on the horizontal portion 15 and the turning portion 14. In this embodiment, the specific link 89 is arranged in the inside links of the chain 8. However, it may be arranged in the outside links.

**[0055]** The displacement of the connection position of the elongated hole 893 with the front wheel shafts 231, as mentioned next, is decided by the track of the front wheels 23 of the steps 2 which is guided and moved by the front wheel guide rail 91.

**[0056]** The moving track 23a of the front wheels 23 and the moving track 8a of the chain 8 will be explained hereunder in detail.

**[0057]** According to this embodiment, the front wheel guide rail 91 for guiding the front wheels 23 is arranged so that the moving track 23a of the front wheel shafts 231 of the steps 2 draws the same track as the moving track in the sixth embodiment shown in Fig. 6.

**[0058]** On the horizontal portion 15, the front wheels 23 rotate and move on the moving track on the same straight line as that of the moving track 8a of the chain 8 on the front wheel guide rail 91. In this case, as shown in Fig. 2(b), the front wheel shafts 231 of the steps 2 are connected to the lowest part of the elongated hole 893. However, on the turning portion 14, the moving track 23a of the front wheels 23 starts to draw a different track from the moving track 8a of the chain 8 by under the guidance of the front wheel guide rail 91. In this case, the front wheel shafts 231 of the steps 2 gradually move toward the outside of the elongated hole 893. The connection portion C2 of the chain 8 with the front wheel shafts 231 of the steps 2, in the section that the chain 8 mates with the drive sprocket 62, moves outside the outer end of the teeth of the drive sprocket 62. As also shown in Fig. 3(b), the front wheel shafts 231 are located outside the chain 8.

**[0059]** At the outermost end of the turning portion 14, the front wheel shafts 231 of the steps 2 are connected to the top 3931 (at this position, the elongated hole 893

is almost in the sideways state) of the elongated hole 893 and hereafter slowly returned to the original state.

**[0060]** Therefore, the connection portion C2 of the chain 8 with the steps 2 can be prevented from interference with the teeth of the drive sprocket 62, and there is no need to use a drive sprocket having the aforementioned specific teeth, and a drive sprocket 62 having an optional number of teeth can be used, and the desired thickness H of the escalator apparatus can be met.

**[0061]** On the turning portion 14, the moving track 23a of the front wheels 23 are shifted toward the end of the escalator apparatus more than the moving track 8a of the chain 8, so that interference between the neighboring steps 2 is not caused, and a drive sprocket 62 smaller than a conventional device can be used, and the thickness H2 of the escalator apparatus can be made smaller.

**[0062]** Furthermore, according to this embodiment, the space between the forward and backward paths of the chain 8 is wider on the horizontal portion 15 than the turning portion 14. The reason will be explained hereunder.

**[0063]** As shown in Fig. 8, on the turning portion 14, the diameter R of the drive sprocket 62 is the moving diameter of the chain 8 as it is and on the other hand, on the horizontal portion 15, the space between the forward and backward paths of the chain 8 is widened to  $R+2\Delta R2$ . The reason is that as shown in Fig. 8, the thickness H2 of the escalator apparatus is decided by the turning portion 14 and on the horizontal portion 15, there is an allowance up and down. Namely, the thickness H2 of the escalator apparatus is decided by the moving diameter r of the rear wheels 24, the maximum thickness hs of the steps 2 on the turning portion 14, and the upper and lower safety distances h21 and h22 ( $H2 = r + 2hs + h21 + h22$ ) and on the horizontal portion 15, compared with on the turning portion 14, there is an allowance up and down respectively.

**[0064]** Therefore, the space between the forward and backward paths of the chain 8 is widened up and down and the space generated between the forward and backward paths of the chain 8 on the horizontal portion 15 is used effectively. However, it is not essential to widen the space and it can be narrowed inversely.

**[0065]** Fig. 10 is a schematic view of the front wheel guide rail 91 and the rear wheel guide rail 92 in the embodiment shown in Fig. 8 and the center 23b of the moving track 23a of the front wheels 23 is shifted by D toward the outer end of the escalator apparatus from the center 24b of the moving track 24a of the rear wheels 24.

**[0066]** According to this embodiment, as shown in Fig. 10(c), the space S1 between the front wheel guide rail 91 and the rear wheel guide rail 92 on the horizontal portion 15 is a space perpendicular to the moving direction of the escalator apparatus. The horizontal space S2 between the front wheel guide rail 91 and the rear wheel guide rail 92 on the turning portion 14 is larger than the space S1 perpendicular to the moving direction of the

escalator apparatus. The reason is that to prevent the step 2 from interference with the preceding step 2, as shown in Fig. 10(a), on the turning portion 14, the moving track 23a of the front wheels 23 is guided by the front wheel guide rail 91 so as to be shifted by D from the center 24b of the moving track 24a of the rear wheels 24 toward the outer end of the escalator apparatus.

**[0067]** When the moving track 23a of the front wheels 23 is shifted toward the outer end of the escalator apparatus more than the moving track 8a of the chain 8, there is no need that the moving track 23a of the front wheels 23 is in a semicircular shape and it may be in an ellipse shape or in combination of circular arcs of two different diameters (double curve).

**[0068]** Next, the relation of size as an escalator apparatus will be explained.

**[0069]** An example of each dimension of a conventional escalator apparatus will be explained below. The thickness from the floor of the getting on and off platform of the escalator to the body bottom of the escalator is 1000 mm, and the length of the step plates 21 of the steps 2 is 408 mm, and the maximum thickness of the steps 2 is 360 mm, and the height of the steps 2 is 335 mm, and the diameter of the moving track of the rear wheels 24 is 264 mm, and the upper and lower safety distances are about 20 mm respectively. The diameter of the drive sprocket is 654.36 mm, and the number of teeth is 30, and the number of pitches of the chain 8 between the neighboring steps 2 is 6.

**[0070]** The size of the steps 2 of this embodiment will be explained by referring to Fig. 5. The length Ls of the step plates 21 is 408.5 mm, and the maximum thickness hs of the steps 2 is 278 mm, and the height hh of the steps 2 is 245.5 mm. The diameter R of the drive sprocket is 429.91 mm.

**[0071]** In this case, the thickness H of the escalator apparatus, as shown in Fig. 6, is decided by the diameter r of the moving track of the rear wheels 24, the maximum thickness hs of the steps 2 in the forward and backward paths of the escalator, and the upper and lower safety distances h11 and h12, so that the thickness H1 of the escalator apparatus is  $H1 = r + 2hs + (h11 + h12)$ . Concretely, the moving diameter r of the rear wheels 24 is  $r = 124$  mm, and the maximum thickness hs of the steps 2 is  $hs = 278$  mm, and the upper and lower safety distances h11 and h12 are 25.5 mm and 18 mm respectively, and  $(h11 + h12) = 43.5$  mm, so that when these are calculated,  $H1 = 124 + (2 \times 278) + 43.5 = 723.5$  mm is obtained. The dimension H1 = 723.5 mm is calculated on the assumption that the maximum thickness hs of the steps 2 is related, also in the backward path, to the same thickness H1 of the escalator apparatus as that of the forward path. However, actually, under the turning portion 14, a dimension slightly smaller than the maximum thickness hs of the steps 2 is related to the thickness H1 of the escalator apparatus. Therefore, the thickness H of the escalator apparatus can be set to thinner than 723.5 mm.

**[0072]** In this constitution, as indicated in the embodiments shown in Figs. 6 and 8 respectively, there are only two steps 2 in total on the turning portion 14. The thickness H1 or H2 of the escalator apparatus is decided by a dimension that to the distance between the two points a and b on the turning portion 14 where the two steps 2 approach, some safety distance is added. Therefore, the thickness H of the escalator apparatus is not more than the length of two step plates 21 with a length of Ls and in this embodiment, it is less than 817 mm. Namely, the thickness from the floor of the getting on and off platform of the escalator to the bottom of the escalator body can be set to a value which is more than two times of the height of the steps 2 and less than two times of the step plates 21 in the moving direction.

**[0073]** The aforementioned is a case of an escalator apparatus in the ordinary use state. However, to the aforementioned escalator apparatus 1, as shown in Fig. 1, a wheelchair transfer function is added so as to be used by a wheelchair user. The escalator apparatus 1, to realize the wheelchair transfer function, has, for example, three neighboring specific step groups 100 in the line of the steps 2. The specific step groups 100 are not limited to three and depending on the installation location and the type of a loading wheelchair, a constitution of various combinations such as two or four steps is available.

**[0074]** The specific step groups 100, during the normal operation, are operated in the same form in the appearance as that of the other steps 2. The two steps 102 and 103 of the specific step groups 100 are structured so that the step plates 102F and 103F can move up and down and when a wheelchair transfer instruction is issued, the step plates 102F and 103F are structured so that they are maintained at the same height as that of the step plate of the upper step 101 so as to form a wheelchair loading surface.

**[0075]** As mentioned above, the middle step 102 and the lower step 103 during the normal operation, when a wheelchair transfer instruction is issued, form a wheelchair loading surface in close connection with the upper step 101 and after the end of wheelchair transfer, return to the same form as that of the normal steps 2, so that in the fixing portions in the neighborhood of the step change units in the flat portion of upper floor 11 and the flat portion of lower floor 12 respectively, connection devices 129A and 129B which are forming and release mechanisms of the wheelchair loading surface are installed.

**[0076]** During the moving-up (down) operation, the connection device 129A (129B), for example, when a wheelchair transfer instruction is issued, stops in the neighborhood of the getting-on portion or is connected to the specific step group 100 moving at low speed in the neighborhood of the getting-on portion, operates the drive mechanism of the specific step group 100, and forms a wheelchair loading surface. On the other hand, when the formed wheelchair loading surface approach-

es the getting-down portion, the connection device 129B (129A) is connected to the specific step group 100, operates the drive mechanism of the specific step group 100, and releases the wheelchair loading surface.

**[0077]** The basic constitution and operation regarding forming and release of the wheelchair loading surface will be explained hereunder by referring to Figs. 11 to 16.

**[0078]** The middle step 102 and the lower step 103 respectively support the step plates 102F and 103F so as to move in the vertical direction for the step frames 102W and 103W and in the step plate depth direction. In the upper step 101 and the middle step 102, connection means 118 and 119 (Fig. 11) for forming and releasing the wheelchair loading surface for connecting the step plates 102F and 103F of the steps on the lower side are respectively installed and furthermore, in the lower step 103, a wheel stopper 120 (Fig. 11) coming out and in from the lower side of the step plate 103F is installed.

**[0079]** Since the connection means 118 and 119 which are movable parts and the wheel stopper 120 are driven like this, to the steps 101 and 102, the sprockets 121 to 123 and 121R to 123R (Fig. 11) are shaft-supported and a part of these sprockets is protruded under the step frames 101W, 102W, and 103W respectively. In the sprockets 121 and 121R, 122 and 122R, and 123 and 123R, gears are installed on the coaxial line respectively and power transfer mechanisms 124 to 126 (Fig. 11) are composed of other gears mating with these gears and still other gears. By the rotation force at the last stage of these power transfer mechanisms 124 to 126, the connection means 118 and 119 and the wheel stopper 120 move forward or backward.

**[0080]** In the flat portions of upper floor and lower floor 11 and 12 of the frame body on the fixing side, at the position between the forward path and backward path of the steps 2 and 101 to 103, the connection devices 129A and 129B are supported at the height where they are mated with the sprockets 121 to 123 and 121R to 123R during transfer of the wheelchair. The connection devices 129A and 129B, during the normal operation, move to the no-connection position separated from the passing position of the sprockets 121 to 123 and 121R to 123R and during transfer of the wheelchair, the connection devices move to the connection position opposite to the passing position of the sprockets 121 to 123 and 121R to 123R in the horizontal direction, that is, in the direction along the step surface of the step plate of the step.

**[0081]** Including the rack 127 or 128, the connection devices 129A and 129B including the drive means therefor have the same constitution, so that the connection device 129A including the rack 128 will be explained as an example.

**[0082]** Firstly, to move the rack 128 to the connection position and no-connection position through which the sprockets pass, the main frame 5 on the fixing side is horizontally fixed to the base 130. The base 130 may be formed so as to serve as a cross beam itself of the

main frame 5 or may be put and formed on the cross beam. The base 130 displayed here is formed so as to serve as the cross beam itself of the main frame 5. The base 130 guides a push car 131 so as to move the rack 128 horizontally only in the width direction of the steps 2 and the rack 128 is fixed to the push car 131 so as to be parallel with the passing direction of the sprockets.

**[0083]** To the base 130, a drive means 132 horizontally adjacent to the push car 131 is fixed. The drive means 132, in this embodiment, is composed of a screw bar 133 screwed in the push car 131 and a drive motor 135 connected to the other end of the screw bar 133 via a reduction mechanism 134.

**[0084]** In this case, the height Ht of the connection device 129A, as shown in Fig. 12, is within the interval Hu between each step 2 on the forward path side and each step 2 on the backward path side in the vertical direction and is installed within the range of the width Ws of each step 2.

**[0085]** As a drive means 132, instead of the screw bar 133, the reduction mechanism 134, and the drive motor 135, a drive means in another form such as a hydraulic jack and an electromagnetic plunger may be used.

**[0086]** Next, the operation of the aforementioned constitution during moving up an escalator apparatus 1 corresponding to a wheelchair will be explained.

**[0087]** When a wheelchair transfer instruction is issued, the drive motor 135 of the drive means 132 is driven, rotates the screw bar 133, moves the push car 131 on the passing position side of the sprockets 121 to 123 of the specific step group 100, and makes the rack 128 correspond to the passing position of the sprockets 121 to 123. When it is detected that the rack 128 is positioned at the passing position of the sprockets 121 to 123, the operation in the wheelchair transfer mode is started.

**[0088]** When the operation in the wheelchair transfer mode is started and each step 2 is moved, the sprockets 121 to 123 protruded below the specific step group 100 are mated one after another by the relative movement with the rack 128, rotate by the force generated by the relative movement, and drive the connection means 118 and 119 and the wheel stopper 120 via the power transfer mechanisms 124 to 126. By the drive of the sprockets 121 to 123, as shown in Figs. 15 and 16, the connection means 118 and 119 connect the step plates 101F and 102F of the upper step 101 and the middle step 102 which are protruded under the step plate of the neighboring lower step 2 and the step plates 102F and 103F of the middle step 102 and the lower step 103 and as a result, form a horizontal wheelchair loading surface by the three step plates 101F, 102F, and 103F. By the drive of the sprocket 123, the wheel stopper 120 is protruded upward from the end of the step plate 103F of the lower step 103 on the riser 103R side and prevents the wheelchair 142 in operation from a fall accident.

**[0089]** When the specific step group 100 moves to the inclined portion 13 with the wheelchair 142 loaded, as

shown in Fig. 16, in the normal steps 2, a level difference is generated between the neighboring upper and lower steps 2 and a terraced state is formed. However, the step plates 101F, 102F, and 103F are connected respectively and the step plates 102F and 103F of the middle step 102 and the lower step 103 are supported so as to be moved in the vertical direction and in the step plate depth direction for the step frames 102W and 103W, so that the upper step 101, the middle step 102, and the lower step 103 are lifted up from the step frames 102W and 103W and hold the horizontal wheelchair loading surface.

**[0090]** When the specific step group 100 advances and moves to the flat portion of upper floor 11, the ascended step plates 102F and 103F return to the specified positions of the step frames 102W and 103W. When the specific step group 100 advances to the flat portion of upper floor 11, the rack 127 of the connection device 129B installed in the space between the forward path and the backward path of the steps 2 and 101 to 103 in the flat portion of upper floor 11 already stands by on the passing position of the sprockets 121R to 123R of the steps 101 to 103 and connects with the sprockets 121R to 123R of the specific step group 100. By the force generated by the connection and relative movement, the sprockets 121R to 123R rotate and drive the connection means 118 and 119 and the wheel stopper 120 in the opposite direction via the power transfer mechanisms 124 to 126. By the drive in the opposite direction, the connection means 118 and 119 are pulled out from the lower side of the neighboring step plate and returned to their original positions. Therefore, the connection of each of the step plates 101F, 102F, and 103F is released and the wheel stopper 120 is moved backward from the surface of the step plate 103F from which it is protruded and returned to its original position, so that the appearance of each of the steps 101, 102, and 103 becomes the same as that of the normal steps 2 (Fig. 13).

**[0091]** A wheelchair user or a person in charge, when the specific step group 100 advances and approaches an upper getting on and off floor 108 of the flat portion of upper floor 11, releases the brake of the wheelchair 142 and hence runs on the upper getting on and off floor 108 and can get off on the upper floor side. During the operation of getting off the wheelchair 142, the escalator apparatus 1 corresponding to the wheelchair may stop the operation once or may continue the operation as it is without stopping.

**[0092]** When the specific step group 100 passes through the upper getting on and off floor 108 of the flat portion of upper floor 11 (Fig. 13), the operation in the wheelchair transfer mode is released and the operation is returned to the normal operation mode.

**[0093]** When the wheelchair 142 is transferred from an upper floor to a lower floor by the escalator apparatus 1 in the down operation inversely, the connection device 129B on the side of the flat portion of upper floor 11

moves the rack 127 from the no-connection position to the passing position of the sprockets 121R to 123R. In this state, when the sprocket 123R of the lower step 103 which is the top of the specific step group 100 passes through the position of the rack 127, it is mated with the rack 127 and driven. The relative moving direction of the sprocket 123R with the rack 127 is opposite to that during the up operation, so that the operation of moving back the wheel stopper 120 during the up operation is changed to an operation of projecting the wheel stopper 120 this time.

**[0094]** In the state that the wheel stopper 120 is projected, the specific step group 100 stops it so as to be flush with the upper getting on and off floor 108. When it is stopped, the specific step group 100 makes the wheelchair 142 run on the floor. The wheelchair 142, since the wheel stopper 120 is already projected, can run up to the top of the wheelchair loading surface in safety.

**[0095]** When the running of the wheelchair 142 is completed and the specific step group 100 is restarted to move, the sprockets 122R and 121R of the middle step 102 and the upper step 101 are sequentially mated with the rack 127, drive the connection means 119 and 118, connect the three step plates 101F, 102F, and 103F, and hold them in the horizontal state.

**[0096]** When the specific step group 100 approaches the side of the lower getting on and off floor 109, to the rack 128 moved to the mating position with the sprockets 121 to 123, the wheel stopper 120 projected by mating with the sprocket 123 of the lower step 103 first is moved backward. Thereafter, the sprockets 122 and 121 are mated with the rack 128 one after another, drive the connection means 119 and 118, and release the connection of the three step plates 101F, 102F, and 103F (Fig. 14). Therefore, when the wheelchair 142 moves in the moving direction as it is and moves to the lower getting on and off floor 109, the user can get off on the lower floor.

**[0097]** According to the aforementioned embodiment, the wheelchair loading surface is structured so as to connect a plurality of specific steps. However, the present invention is not limited to it and a constitution that a single specific step forms a wheelchair loading surface may be used.

**[0098]** Even if such a drive mechanism is installed, according to this embodiment, the size of the drive sprocket 62 and the follower sprocket 71 can be freely selected, so that when a space sufficient enough to install the aforementioned connection devices 129A and 129B is reserved, even in an escalator apparatus 1 corresponding to a wheelchair, an escalator apparatus with a small thickness can be realized.

## Claims

1. An escalator apparatus having a chain structured

so as to mate with sprockets at both ends and change a moving direction at said both ends, many steps connected to said chain so as to turn said moving direction at said both ends, and drive means for driving one of said sprockets, wherein connection portions of said steps with said chain are structured so that a moving track of said connection portions is positioned outside a rotation track of the outer periphery of teeth of said sprockets in the section where said chain is mated with said sprockets.

2. An escalator apparatus having a chain structured so as to mate with sprockets at both ends and change a moving direction at said both ends, many steps connected to said chain so as to turn said moving direction at said both ends, and drive means for driving one of said sprockets, wherein all teeth of said sprockets are substantially in the same shape.
3. An escalator apparatus having a chain structured so as to mate with sprockets at both ends and change a moving direction at said both ends, many steps connected to said chain so as to turn said moving direction at said both ends, and drive means for driving one of said sprockets, wherein said sprockets do not have teeth in a shape that interference with connection portions of said chain with said steps is avoided.
4. An escalator apparatus having a chain structured so as to mate with sprockets at both ends and change a moving direction at said both ends, many steps connected to said chain so as to turn said moving direction at said both ends, and drive means for driving one of said sprockets, wherein said apparatus is structured so as to drive said chain by shifting mating of said chain with said sprockets.
5. An escalator apparatus having a chain structured so as to mate with sprockets at both ends and change the direction at said both ends, many steps connected to said chain so as to turn the moving direction at said both ends, and drive means for driving said steps, wherein whenever said sprockets make one rotation, the relative position of connection portions of said chain with said steps to teeth of said sprockets is structured so as to be different from the relative position of said connection portions to said teeth of said sprockets before one rotation.
6. An escalator apparatus having a chain structured so as to mate with sprockets at both ends and change the direction at said both ends, many steps connected to said chain so as to turn the moving direction at said both ends, and drive means for driving one of said sprockets, wherein said chain

has six chain links in the interval between connection portions of neighboring steps and said chain and said sprockets have 19 to 23 teeth.

7. An escalator apparatus having a chain having flat portions of upper and lower floors and an inclined portion which is structured so as to mate with sprockets at both ends and change the direction at said both ends, many steps including at least one step forming a wheelchair loading surface which are connected to said chain so as to turn the moving direction at said both ends, drive means for driving one of said sprockets, and a connection device which is installed between the forward and backward paths of said steps in said flat portions of upper and lower floors and connected with said step for forming said wheelchair loading surface and forms and releases said wheelchair loading surface, wherein in the section where said chain is mated with said sprockets, a moving track of connection portions of said steps with said chain is structured so as to be positioned outside a rotation track of the outer periphery of teeth of said sprockets.
8. An escalator apparatus having a chain structured so as to mate with sprockets at both ends and change the direction at said both ends, many steps connected to said chain so as to turn the moving direction at said both ends, and drive means for driving one of said sprockets, wherein in the section where said chain is mated with said sprockets, a moving track of connection portions of said steps with said chain is structured so as to be positioned outside a rotation track of the outer end of said chain.
9. An escalator apparatus according to one of Claims 1 to 8, wherein guide means for lengthen the linear distance between each connection portion of said two neighboring steps which is to be shortened by drawing a circular arc by said chain at said both ends is installed at said both ends.
10. An escalator apparatus according to one of Claims 1 to 8, wherein said steps have front wheels and rear wheels respectively, and said apparatus has means for guiding said front wheels and said rear wheels of said steps respectively at least on the horizontal portion and at the end of said escalator, and the interval between said guide means of said front wheels and said guide means of said rear wheels is made wider at said end of said escalator than on said horizontal portion.
11. An escalator apparatus according to one of Claims 1 to 8, wherein said steps have front wheels and rear wheels respectively, and said apparatus has means for guiding said front wheels and said rear

wheels of said steps respectively at least on the horizontal portion and the turning portion, and the interval between said guide means of said front wheels and said guide means of said rear wheels is made wider on said turning portion than on said horizontal portion.

12. An escalator apparatus according to one of Claims 1 to 8, wherein said steps have front wheels and rear wheels respectively and means for shifting the center of a moving track of said front wheels of said steps at said both ends toward the end of said escalator from the center of a moving track of said rear wheels of said steps is installed.

13. An escalator apparatus according to one of Claims 1 to 8, wherein means for shifting said moving track of said connection portions of said steps with said chain at said both ends toward the end of said escalator from a moving track of said chain is installed.

14. An escalator apparatus according to one of Claims 1 to 8, wherein said apparatus has means for guiding said chain so that a moving track of said chain at said both ends is in a circular arc shape and said moving track of said connection portions of said steps with said chain at said both ends is in an elliptical shape.

15. An escalator apparatus according to one of Claims 1 to 8, wherein the thickness from the floor of the getting on and off platform of said escalator to the bottom of said escalator body is set to a value which is more than two times of the height of said steps 2 and less than two times of step plates in the moving direction.

16. An escalator apparatus having a chain installed so as to mate with sprockets at both ends and change the direction at said both ends and structured so as to be connected to many links, many steps having step plates, risers, front wheels, and rear wheels which are connected to said links of said chain so as to turn the moving direction at said both ends, and drive means for driving one of said sprockets, wherein connection portions of said steps with said links of said steps are structured so as to be positioned outside a rotation track of the outer periphery of teeth of said sprockets in the section where said chain is mated with said sprockets.

17. An escalator apparatus having a chain installed so as to mate with sprockets at both ends and change the direction at said both ends and structured so as to be connected to many links, many steps having step plates, risers, front wheels, and rear wheels which are connected to said links of said chain so as to turn the moving direction at said both ends,

and drive means for driving one of said sprockets, wherein elongated holes formed in said links connecting said steps that the tops thereof are positioned outside a rotation track of the outer periphery of teeth of said sprockets in the section where said chain is mated with said sprockets and means for guiding so that connection portions of said chain with said links of said steps are connected by said tops of said elongated holes in the section where said chain is mated with said sprockets.

18. An escalator apparatus having a chain installed so as to mate with sprockets at both ends and change the direction at said both ends, many steps having step plates, risers, front wheels, and rear wheels which are connected to said chain so as to turn the moving direction at said both ends, and drive means for driving one of said sprockets, wherein when the number of pitches of chain links existing between connection portions of said neighboring steps with said chain is set to N, the number of teeth of said sprockets is set to  $AN+B$  (A, B: natural numbers,  $1 \leq B \leq N-1$ ).

19. An escalator apparatus having a chain endlessly installed so as to mate with sprockets at both ends and change the direction at said both ends, many steps having step plates and risers which are connected to said chain so as to turn the moving direction at said both ends, and drive means for driving one of said sprockets, wherein the length of said steps in the moving direction is 408.5 mm or more and the thickness from the floor of the getting on and off platform of said escalator to the bottom of said escalator body is less than 817 mm.

**FIG. 1**

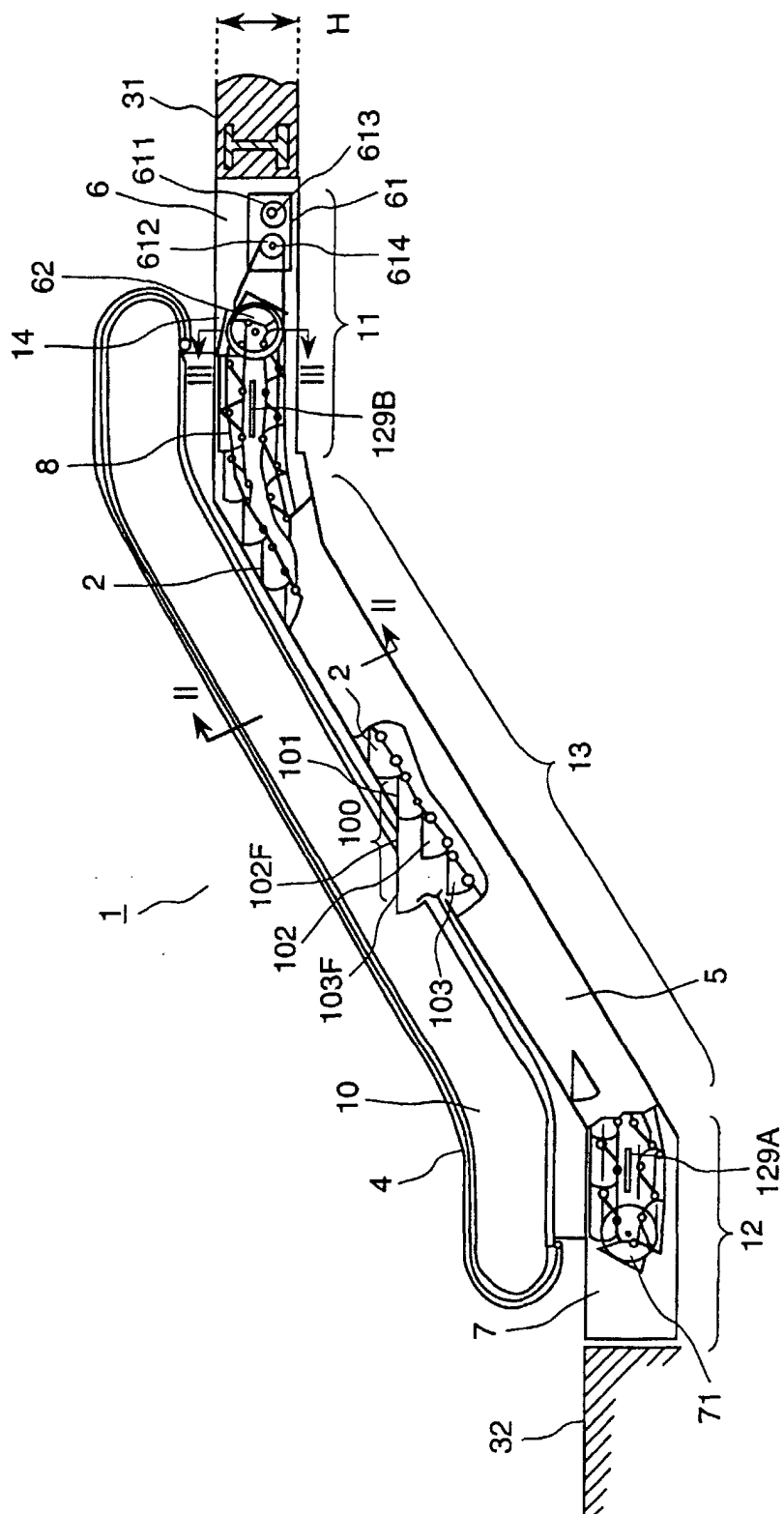
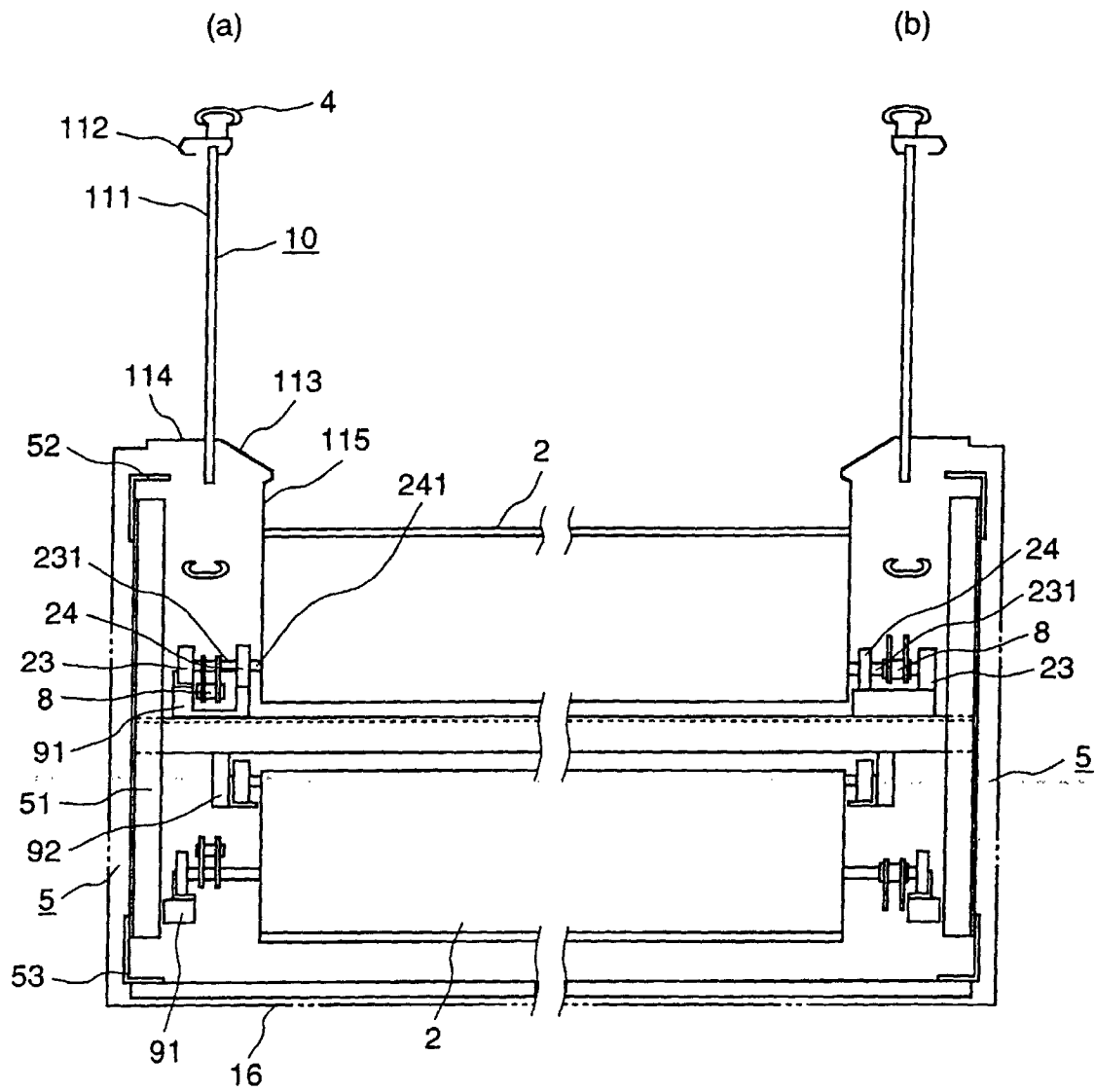
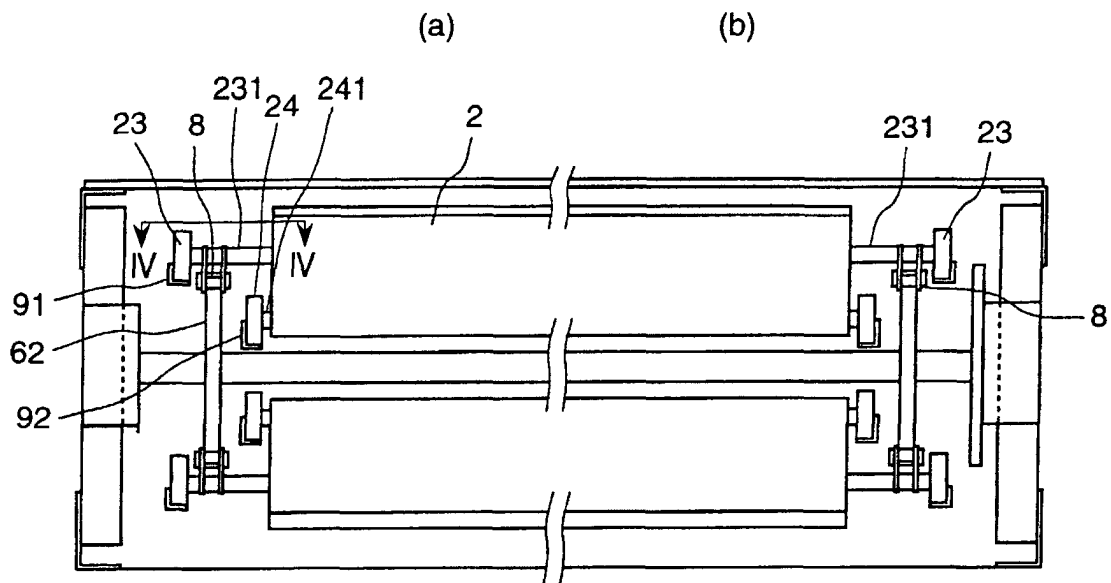


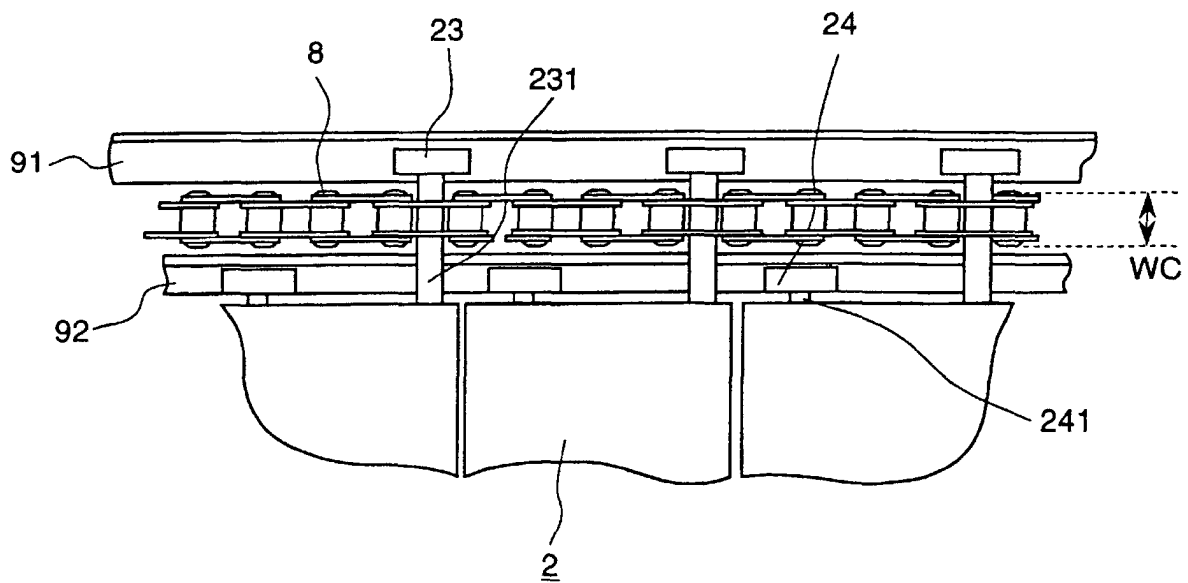
FIG. 2



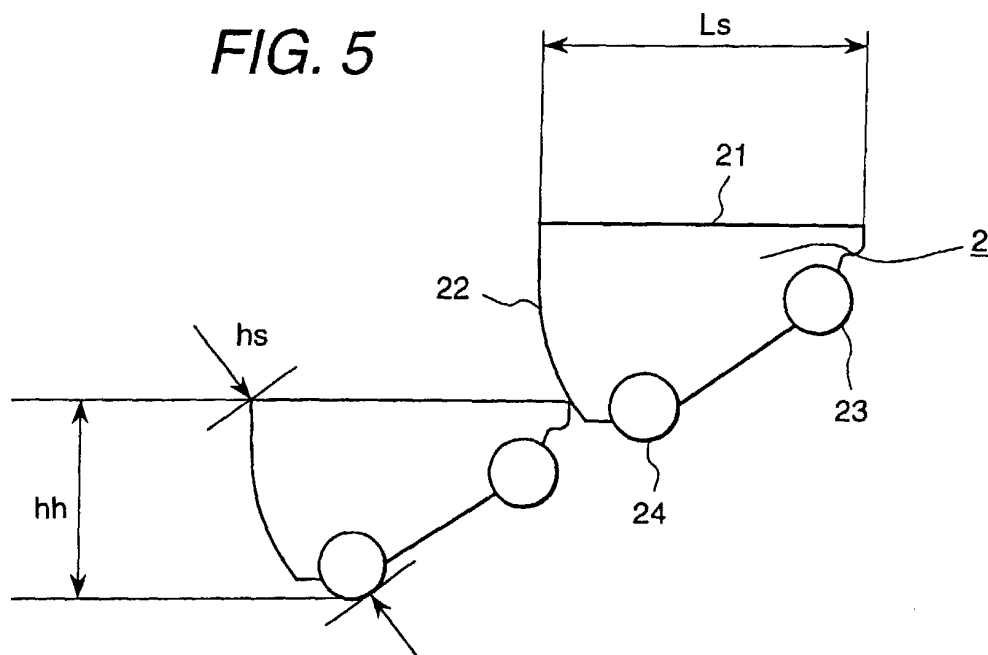
**FIG. 3**



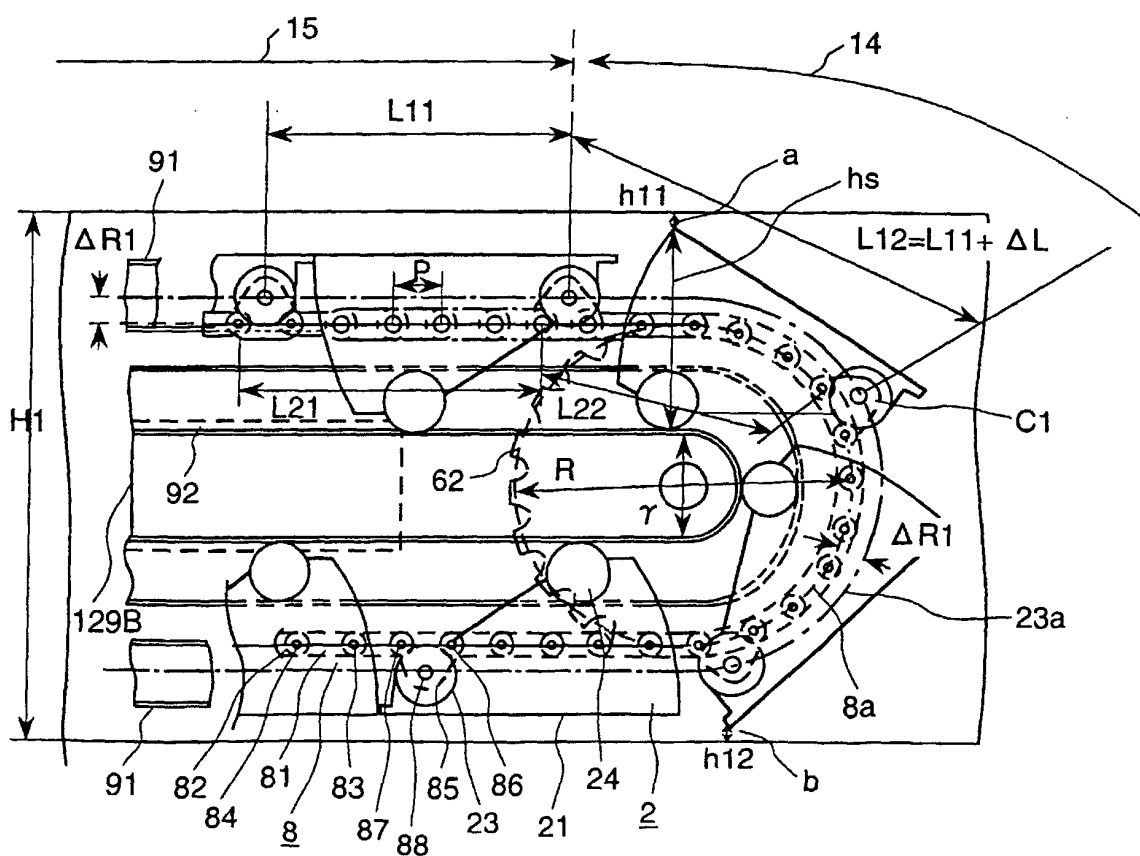
**FIG. 4**



**FIG. 5**



**FIG. 6**



**FIG. 7**

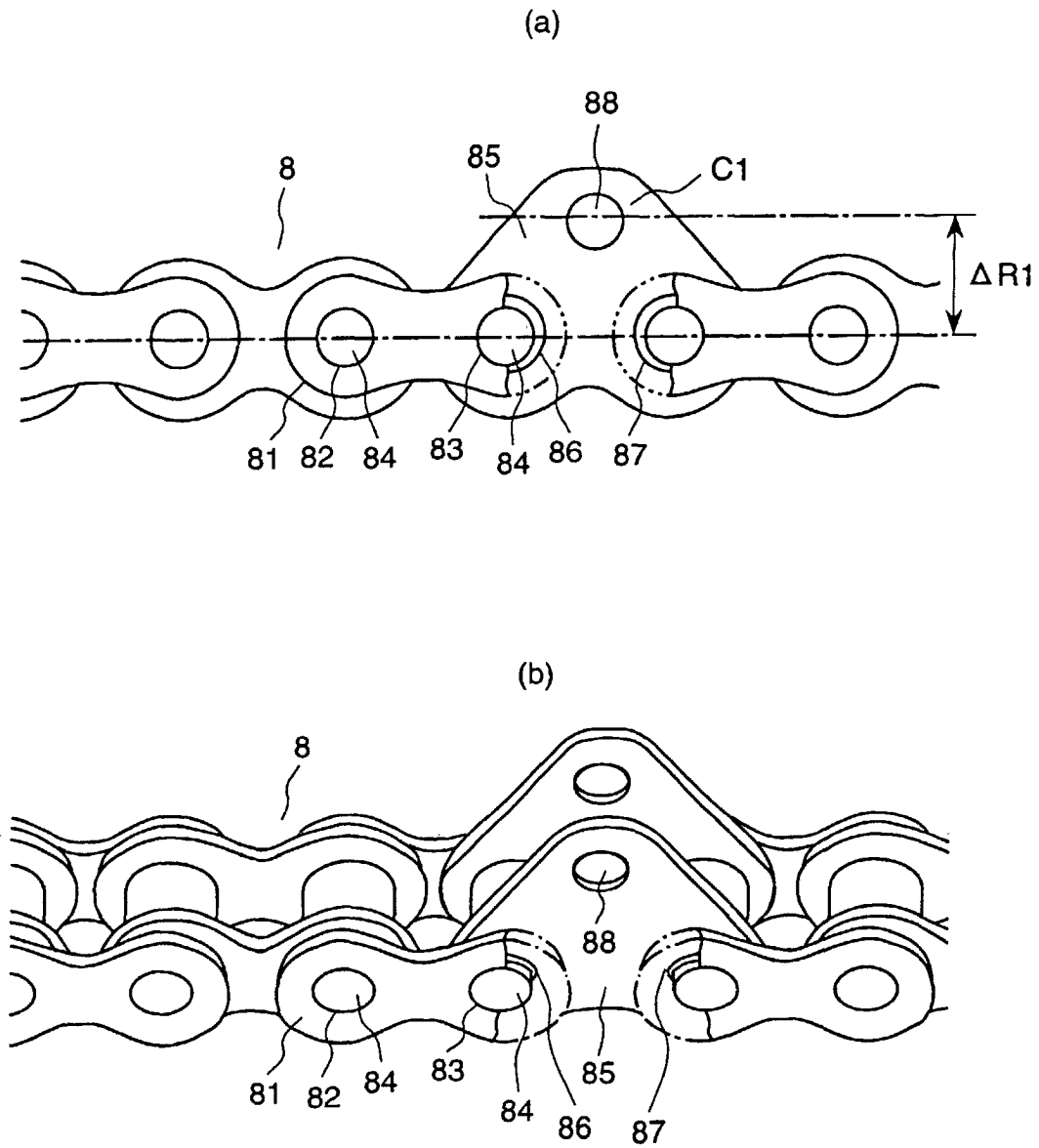
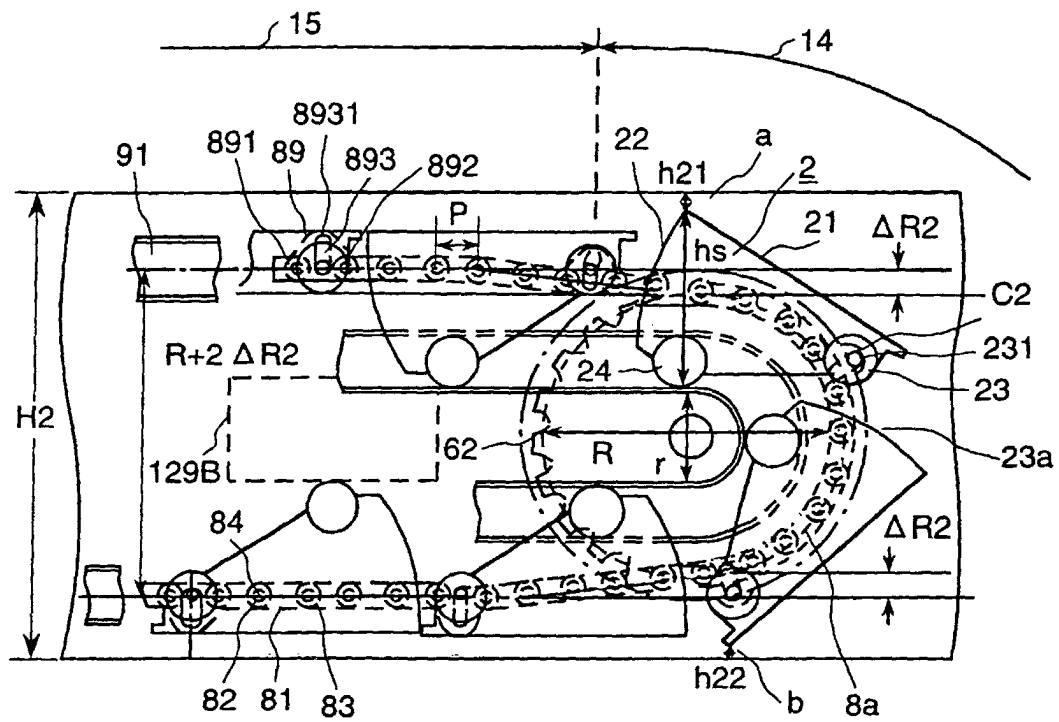


FIG. 8



**FIG. 9**

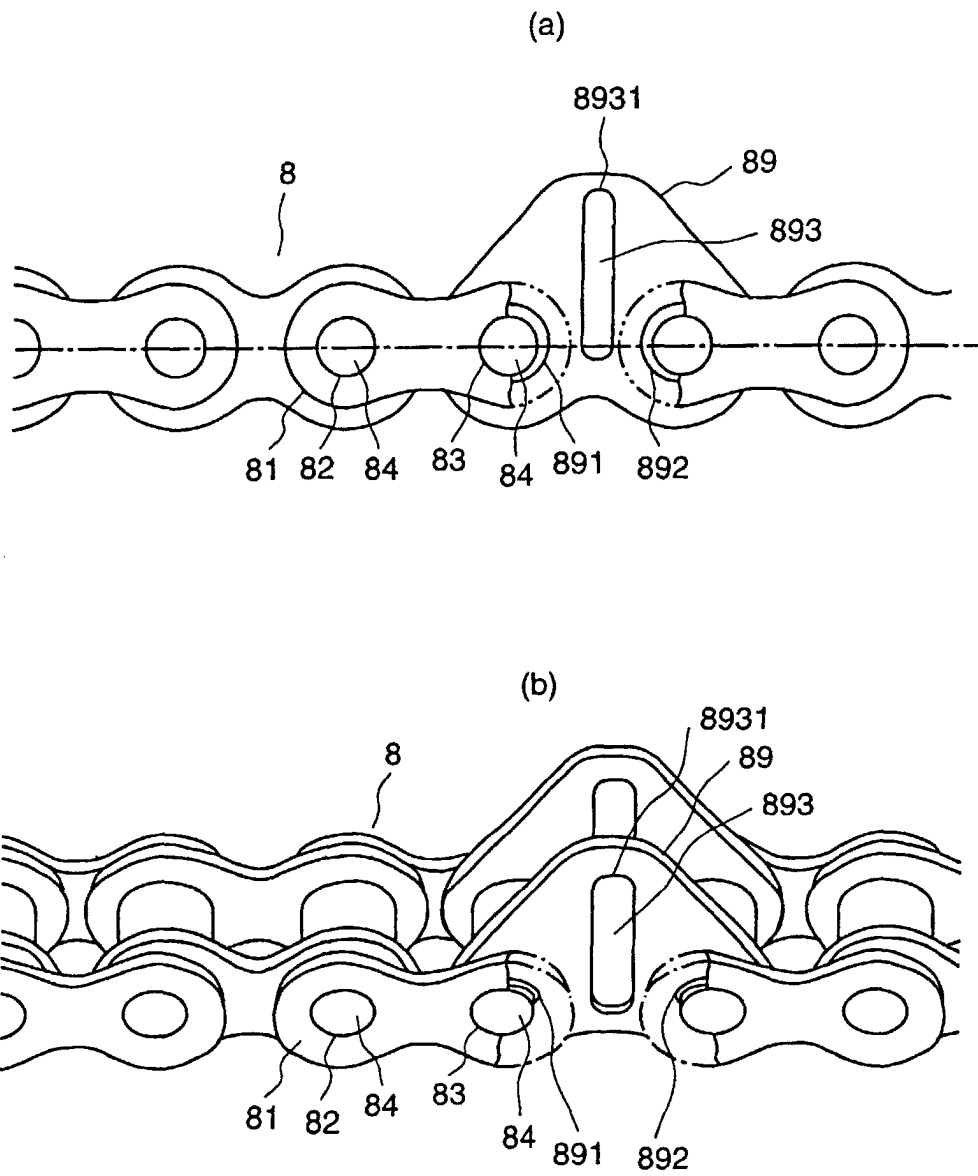


FIG. 10

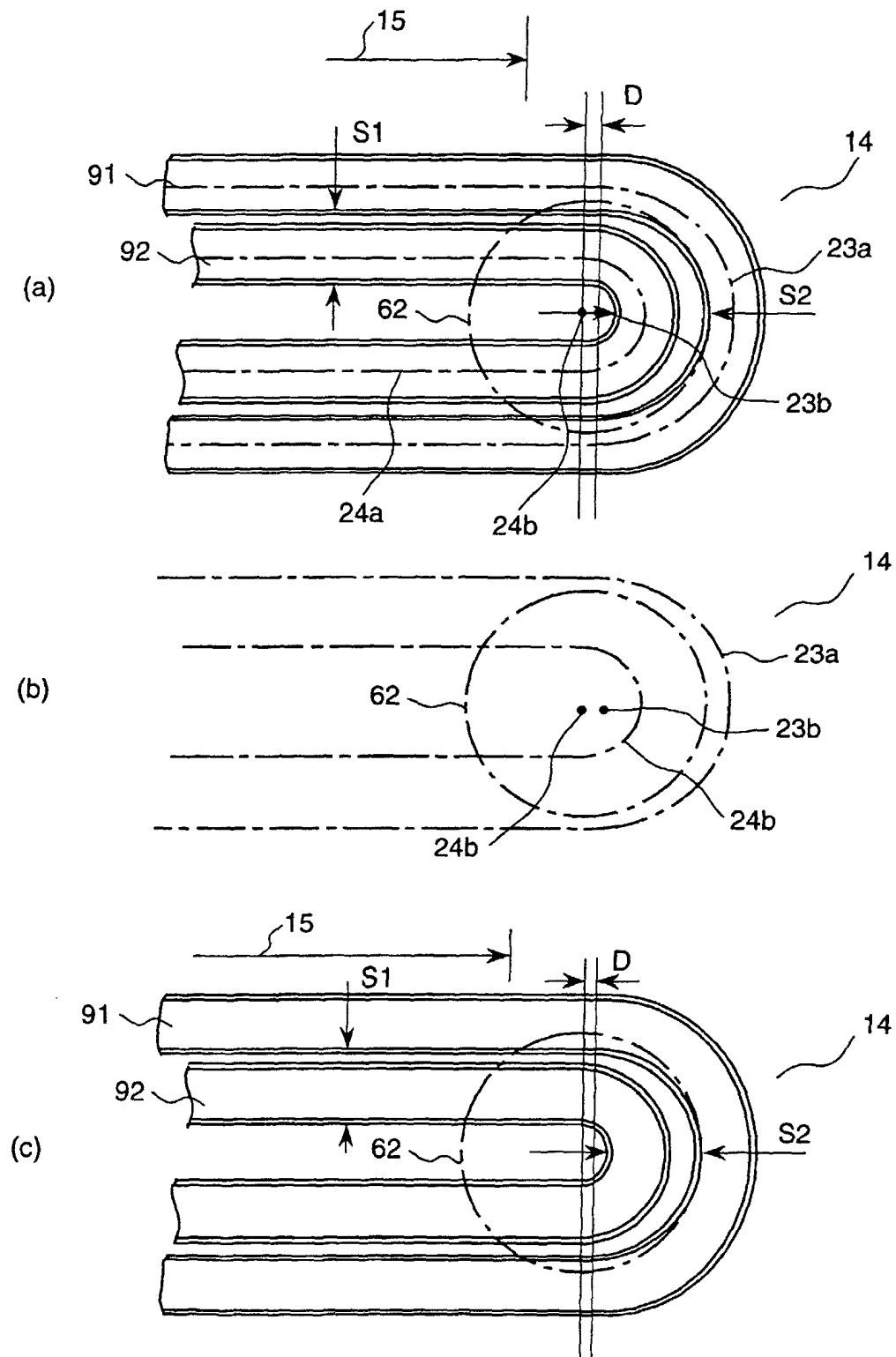


FIG. 11

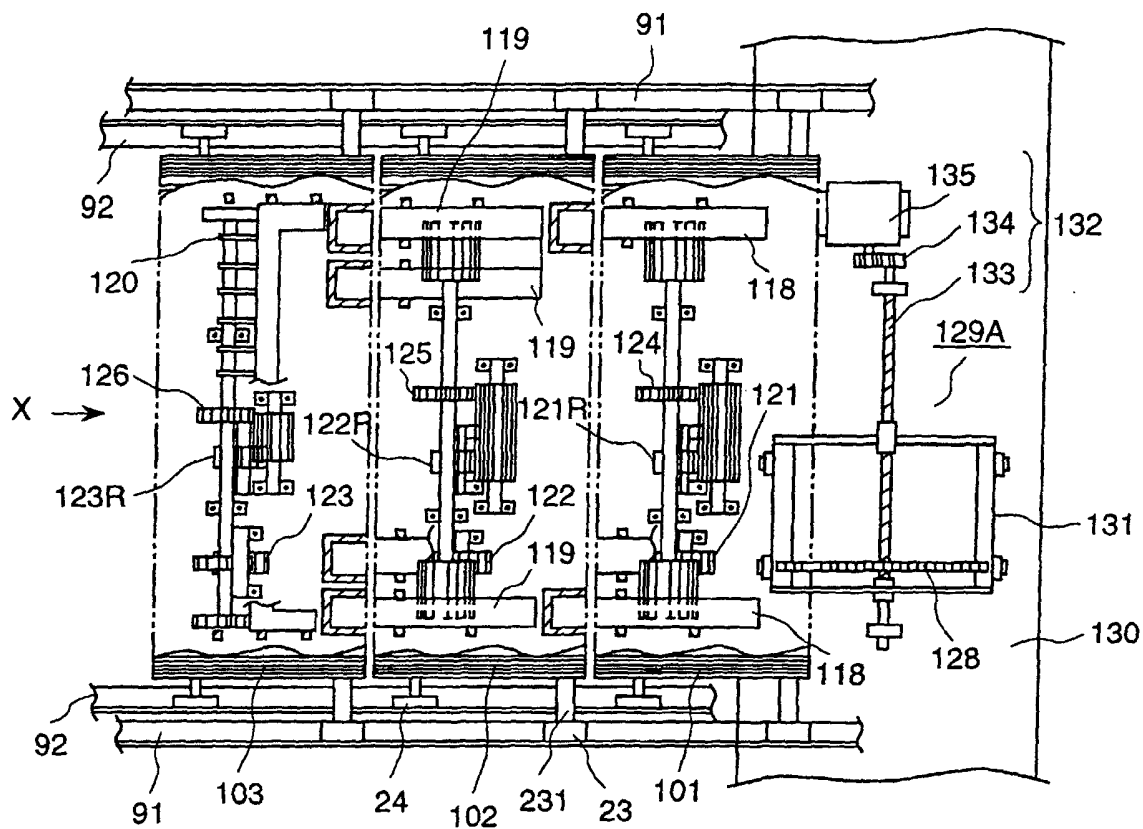


FIG. 12

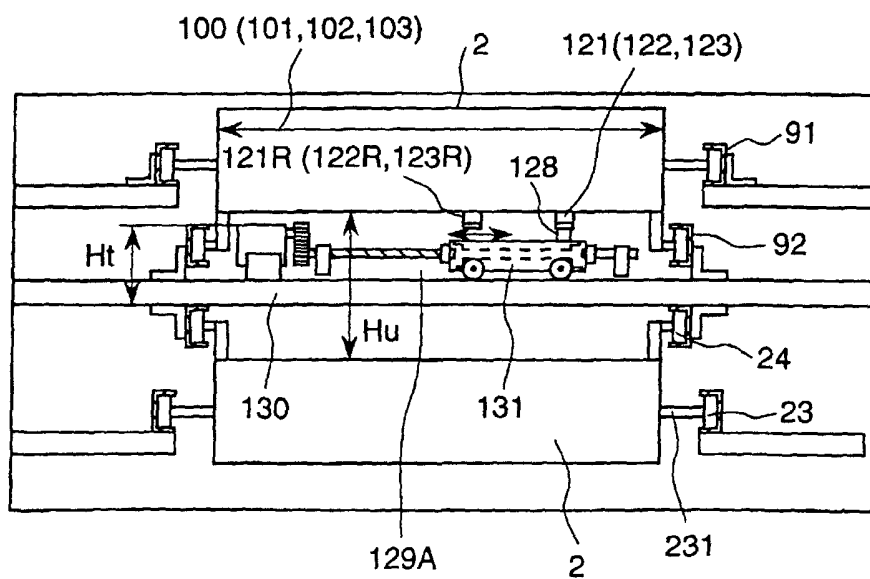


FIG. 13

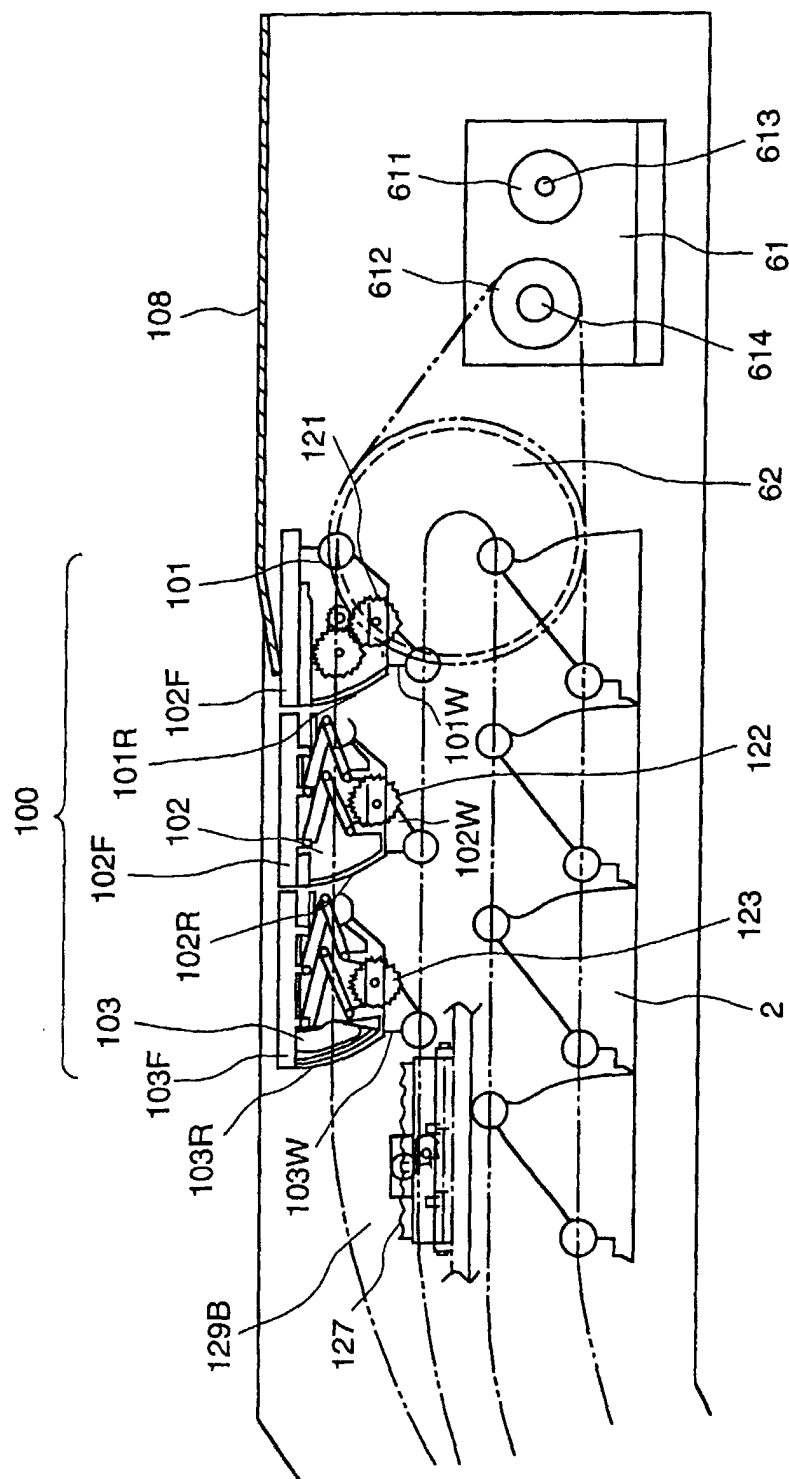


FIG. 14

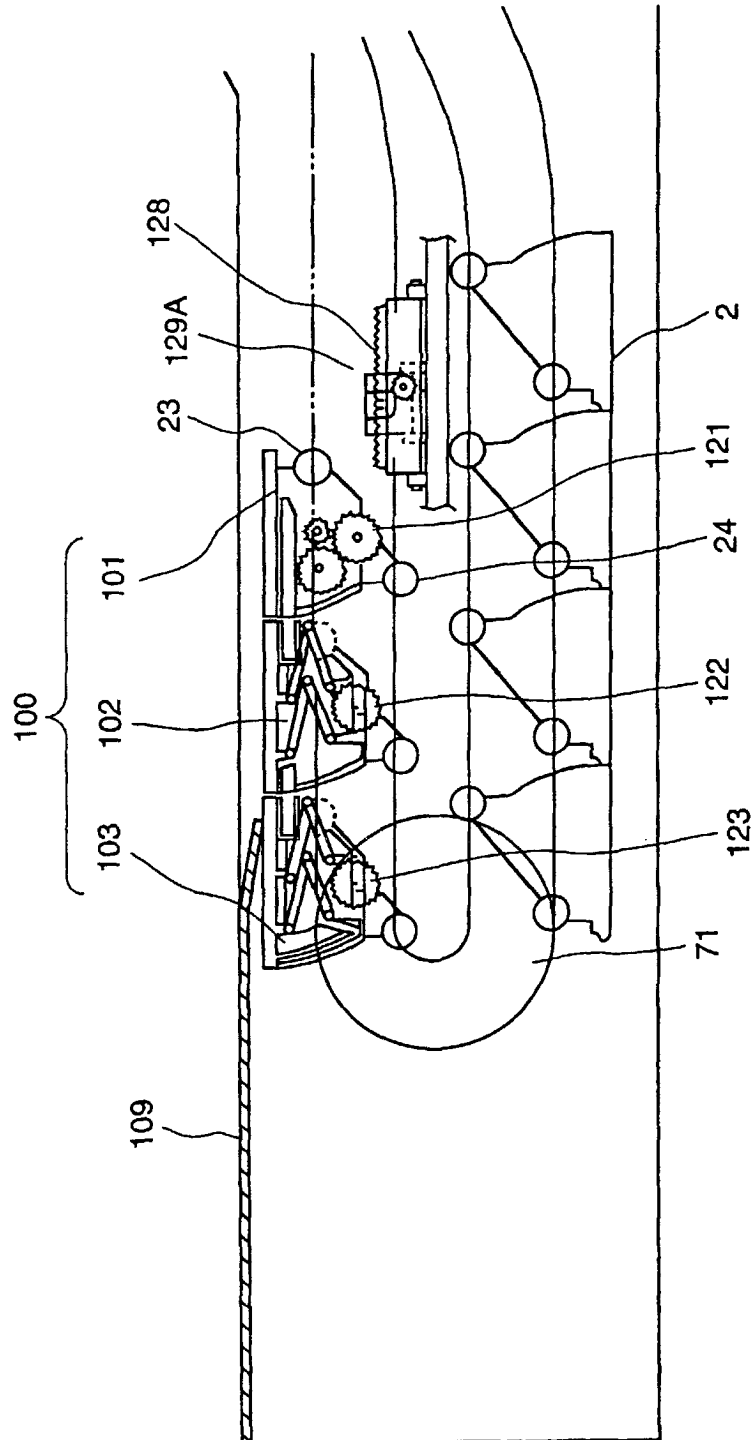


FIG. 15

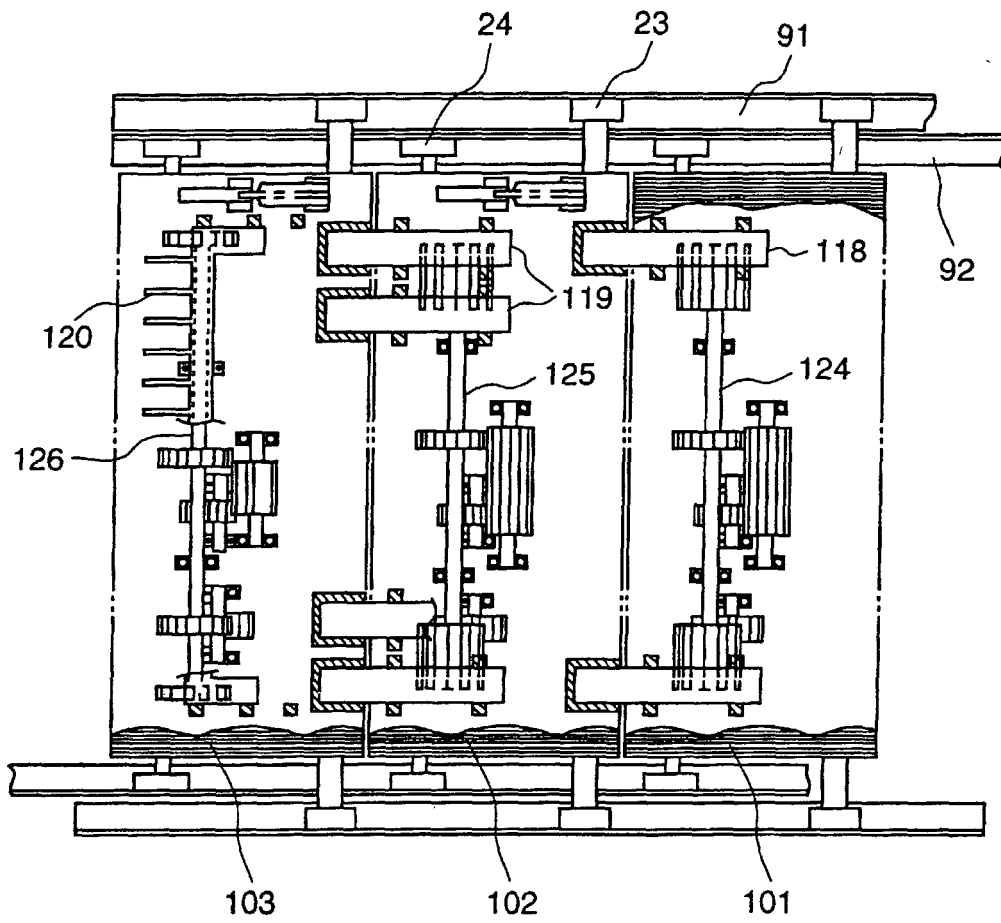
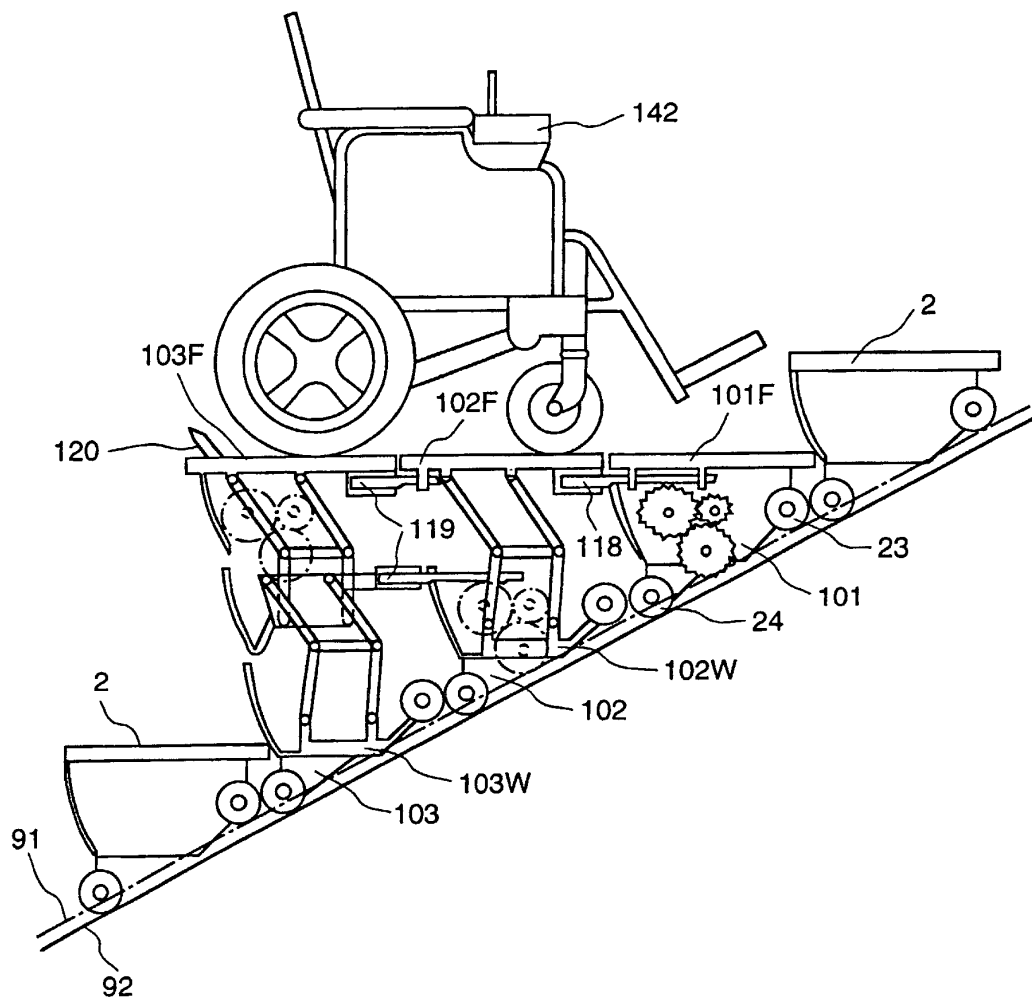


FIG. 16



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/05946

| A. CLASSIFICATION OF SUBJECT MATTER<br>Int.Cl <sup>7</sup> B66B 23/02                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| B. FIELDS SEARCHED                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Minimum documentation searched (classification system followed by classification symbols)<br>Int.Cl <sup>7</sup> B66B 21/00-B66B 31/02                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched<br>Jitsuyo Shinan Koho 1926-1996 Jitsuyo Shinan Toroku Koho 1996-2000<br>Kokai Jitsuyo Shinan Koho 1971-2000 Toroku Jitsuyo Shinan Koho 1994-2000 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Category*                                                                                                                                                                                                                                                                       | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Relevant to claim No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| X<br>A                                                                                                                                                                                                                                                                          | JP 2552745 B2 (Mitsubishi Electric Corporation),<br>13 November, 1996 (13.11.96)<br>& DE 4101145 A1 & JP 4-72289 A<br>& KR 9405950 A & US 5184710 A                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1, 7-13, 16<br>4-6, 14, 17-18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| X                                                                                                                                                                                                                                                                               | JP 52-11833 B2 (Shouhei KIDA),<br>02 April, 1977 (02.04.77)<br>& JP 49-56382 A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1, 7-9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| X<br>A                                                                                                                                                                                                                                                                          | JP 3-115084 A (Otis Elevator Company),<br>16 May, 1991 (16.05.91)<br>& EP 0412836 A1 & EP 0412836 B1<br>& HK 145594 A & US 4953685 A                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2-3<br>4-6, 14, 17-18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| X                                                                                                                                                                                                                                                                               | JP 62-60357 B2 (Mitsubishi Electric Corporation),<br>16 December, 1987 (16.12.87)<br>& JP 59-12066 A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2-3, 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| X<br>A                                                                                                                                                                                                                                                                          | JP 11-222370 A (Nippon Fillesta Co., Ltd.),<br>17 August, 1999 (17.08.99)<br>& AU 8033298 A & EP 0990616 A1<br>& WO 98/57880 A1                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 19<br>4-6, 14, 17-18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| *<br>"A"<br>"E"<br>"L"<br>"O"<br>"P"                                                                                                                                                                                                                                            | Special categories of cited documents:<br>document defining the general state of the art which is not considered to be of particular relevance<br>earlier document but published on or after the international filing date<br>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)<br>document referring to an oral disclosure, use, exhibition or other means<br>document published prior to the international filing date but later than the priority date claimed | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention<br>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone<br>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art<br>"&" document member of the same patent family |
| Date of the actual completion of the international search<br>12 December, 2000 (12.12.00)                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Date of mailing of the international search report<br>19 December, 2000 (19.12.00)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Name and mailing address of the ISA/<br>Japanese Patent Office                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Authorized officer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Facsimile No.                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Telephone No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

Form PCT/ISA/210 (second sheet) (July 1992)

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/05946

**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

A matter common to Claims 1 to 19 is an escalator device comprising a chain having both end parts meshing with sprockets and formed so as to change a moving direction at the both end parts, a plurality of steps connected to the chain so that the moving direction is reversed at the both end parts, and drive means to drive either of the sprockets. However, our investigation has evidenced that the device is not novel because it is disclosed in the document JP, 52-11833, B2 (Hitachi Ltd.), 2, April, 1977 (02, 04, 77). As a result, the device is still at a level of a prior art, the common matter (above device) is not a special technical feature in the meaning of the second sentence of PCT rule 13.2. Therefore, there is no common matter in all Claims. Because the other common matter considered to be a special technical feature in the meaning of the second sentence of PCT rule 13.2 is not present in Claims 1, 2, 4, and 19, any technical relation in the meaning of PCT rule 13 cannot be found between these inventions different from each other. Accordingly, it is clear that Claims 1 to 19 do not fulfil requirement of unity of invention, and the number of the inventions is four.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest ☐ The additional search fees were accompanied by the applicant's protest.  
☒ No protest accompanied the payment of additional search fees.