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(54) **CONVEYING SYSTEM OF AN ESCALATOR**

(57) The invention relates to a conveying system (100) of an escalator comprising a lower transition area (102) at the lower end of the escalator, an upper transition area (101) at the upper end of the escalator and a step chain (110), wherein the step chain (110) comprises a plurality of chain links (111) and inner rollers (112). Further, the conveying system (100) comprises a plurality of steps (120), wherein each step (120) is connected to the step chain (110) via at least a first supporting point on each side of the step (120), and wherein each step (120) comprises a tow roller (121). Further, the conveying system (100) comprises a tow roller guide rail (103) to guide the tow rollers (121) of the steps (120). Especially, the step chain (110) comprises outer rollers (113), wherein the outer rollers (113) are adjusted to the chain links (111) of the step chain (110), wherein the outer rollers (113) are guided within an outer guide rail (106).

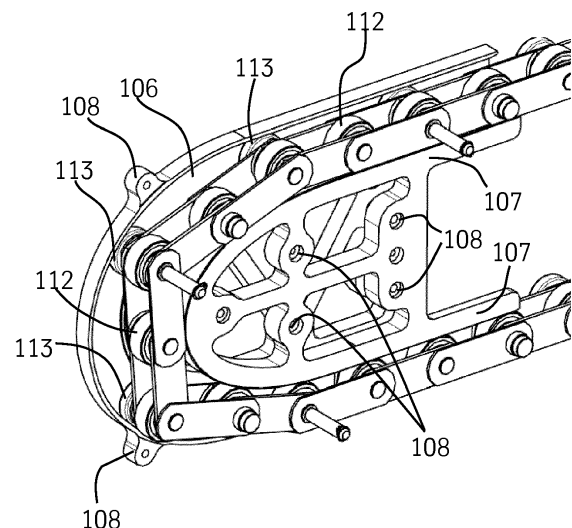


Fig. 2b

Description

[0001] The invention relates to a conveying system of an escalator comprising a lower transition area at the lower end of the escalator, an upper transition area at the upper end of the escalator and a step chain, wherein the step chain comprises a plurality of chain links and inner rollers. Further, the conveying system comprises a plurality of steps, wherein each step is connected to the step chain via at least a first supporting point on each side of the step. Each step comprises a tow roller. Further, the conveying system comprises a tow roller guide rail to guide the tow rollers of the steps.

[0002] A typical escalator comprises a lower transition area at the lower end of the escalator and an upper transition area at the upper end of the escalator, wherein in the transition areas the steps of the escalator are turned around.

[0003] To provide enough space for a turnaround of the steps the escalator requires a pit of approximately 1 meter in depth.

[0004] In some cases it could be necessary to reduce the pit size e.g. if there are specific installations underneath the escalator which require space such as a garage or a piping system, or if the escalator has to be installed in an existing building and the effort to provide a large pit is very high.

[0005] It could also be very interesting to reduce the pit size of escalators used for barking and debarking passengers from an airplane, wherein the escalator is usually transported in a truck.

[0006] Therefore, the objective task of the invention is to provide a conveying system for an escalator to reduce the pit size of an escalator. Thereat, the construction of the escalator should be simple and should not require high costs. Especially, the construction of a typical escalator should not be changed in large parts, so a large part of standard components can be used.

[0007] To solve the problem a conveying system of an escalator is proposed according the independent claim. Further, advantageous arrangements of the invention are described in the dependent claims and the description as well as shown in the figures.

[0008] The solution of the problem provides a conveying system of an escalator comprising a lower transition area at the lower end of the escalator, an upper transition area at the upper end of the escalator and a step chain, wherein the step chain comprises a plurality of chain links and inner rollers. Further the conveying system comprises a plurality of steps, wherein each step is connected to the step chain via at least a first supporting point on each side of the step and comprises a tow roller. Further, the conveying system comprises a tow roller guide rail to guide the tow rollers of the steps.

[0009] Especially, the step chain comprises outer rollers, wherein the outer rollers are adjusted to the chain links of the step chain. Especially, a ratio between the outer rollers and the chain links is $1:n$, wherein $n > 1$, es-

pecially $\{n \in \mathbb{Q} | n > 1\}$. Especially, the outer rollers are guided within an outer guide rail.

[0010] In an arrangement the outer rollers are adjusted to the step chain at connection points connecting two adjacent chain links.

[0011] In a preferred arrangement the ratio between the outer rollers and the chain links is $1:2$, wherein one of the outer rollers is adjusted to every second chain link.

[0012] During the turnaround of the steps in the transition areas the step chain has to be guided in a turn. Thereat, a polygon effect occurs. By adjusting the outer rollers to the chain links, wherein the ratio between the outer rollers and the chain links is $1:n$, wherein $n > 1$, the number of edges of the polygon formed by the step chain in the turnaround is reduced. In that way the turning radius of the step chain can be reduced.

[0013] In an arrangement one of the inner rollers is adjusted at every connection point of two adjacent chain links.

[0014] The adjustment of an inner roller at every connection point of two adjacent chain links leads to a stable guidance of the step chain.

[0015] In an arrangement the conveying system comprises an inner guide rail at the lower transition area as well as at the upper transition area to guide the inner rollers of the step chain during a turnaround of the step chain.

[0016] In an arrangement the outer guide rail and the inner guide rail are constructed such as during a turnaround the outer rollers contact an inner face of an outer edge of the outer guide rail, and for maximum, the half of the inner rollers contact the inner guide rail. Especially every second inner roller of the step chain, contact the inner guide rail.

[0017] During the turnaround the outer rollers are guided along the inner face of the outer edge of the outer guide rail. By adjusting the outer rollers to the chain links, wherein the ratio between the outer rollers and the chain links is $1:n$, wherein $n > 1$, and wherein the outer rollers are adjusted to the step chain at connection points connecting two adjacent chain links and by guiding the outer rollers along the inner face of the outer edge of the outer guide rail during the turnaround, the inner rollers adjusted to the same connection points as the outer rollers do not contact the inner guiderail, which inner guide rail is of a smaller curve radius than the outer guide rail. In that way the number of edges of the polygon formed by the step chain in the turnaround is reduced and therefore, the turning radius of the step chain can be reduced.

[0018] In an arrangement the steps of the conveying system comprise a tread and a riser.

[0019] In a further arrangement the riser and the tread of the steps are connected to each other via a hinge.

[0020] In a further arrangement the steps are configured to be folded at least during a turnaround. Especially, the steps are configured to be folded via the hinge.

[0021] A usage of foldable steps in the conveying sys-

tem according to the invention the turning radius in the transition areas of the escalator can be reduced enormously.

[0022] Further, positive details, features and functions of the invention are explained in association with the examples shown in the figures.

It is shown in:

Fig. 1 in a schematic diagram the state of the art of a typical conveying system of an escalator;

Fig. 2a in a schematic diagram a guidance of the step chain in a transition area of a conveying system according to the invention in a side view;

Fig. 2b in a schematic diagram a guidance of the step chain in a transition area of a conveying system according to the invention in a turned side view;

Fig. 3 in a schematic diagram a guidance of the step tow rollers in a transition area of the conveying system according to the invention; and

Fig. 4 in a schematic diagram a front view of Fig. 3.

[0023] Fig. 1 shows a schematic diagram showing the state of the art of a typical conveying system 100 of an escalator.

[0024] The conveying system 100 of the escalator comprises an upper transition area 101 in the upper end of the escalator and a lower transition area 102 in the lower end of the escalator.

[0025] Further, the conveying system 100 comprises a step chain 110. The step chain 110 is driven by a drive gear 104. The step chain is guided by a gearwheel 105 at the lower end of the escalator and a gearwheel 105 at the upper end of the escalator. Thereat, the gearwheels 105 join in between the inner rollers 112 of the step chain 110.

[0026] Further, the conveying system comprises a plurality of steps 120, wherein each step is connected to the step chain 110 via at least a first supporting point on each side of the step. The steps 120 are moved by the step chain 110 and turned around in the transition areas 101, 102.

[0027] Each step 120 of the conveying system 100 comprises a tow roller 121. The tow roller 121 of the step 120 is guided by a tow roller guide rail 103.

[0028] When the steps 120 are to transport persons, the tow roller 121 is guided over the outer side of the upper part of the tow roller guide rail 103'. When the steps 120 are returned, the tow roller 121 is guided over the inner side of the lower part of the tow roller guide rail 103".

[0029] The radius of the turnaround of the steps 120 in the transition areas 101, 102 is given by the height and the width of the steps 120.

[0030] The height is defined by the riser of the step and the width is defined by the tread of the step.

[0031] Fig. 2a and Fig. 2b show the guidance of the step chain 110 in a transition area of a conveying system 100 according to the invention out of two different directions.

[0032] The step chain 110 comprises a plurality of chain links 111. At each connection point connecting two adjacent chain links 111 to each other there is an inner roller 112 adjusted within the step chain 110. Further, at every second connection point an outer roller 113 is adjusted to the outer side of the step chain 110.

[0033] The outer rollers 113 are guided within an outer guide rail 106 of the conveying system 100.

[0034] Within the transition areas of the conveying system 100 the inner rollers 112 of the step chain 110 are guided around a curved inner guide rail 107. Thereat, the turning radius of the inner guide rail 107 is smaller than the turning radius of the outer guide rail 106.

[0035] During a turnaround the outer rollers 113 of the step chain 110 are pressed to the inner surface of the outer edge of the outer guide rail 106. Consequently, the inner rollers 112 adjusted to the same connection points as those outer rollers 113 are not guided by the inner guide rail 107 during the turnaround. At the same time, the other inner rollers 112 adjusted to the connection points to which no outer roller 113 is adjusted to, are in contact with the inner guide rail 107 during the turnaround.

[0036] The adjustment of outer rollers 113 only to every second chain link leads to a reduction of the number of edges during the occurrence of the polygonal effect during the turnaround of the step chain. Accordingly, the turning radius within the transition areas can be reduced significantly compared to the state of the art shown in Fig. 1.

[0037] The outer guide rail 106 as well as the inner guide rail 107 are constructed as a frame in the transition area. The outer guide rail 106 and the inner guide rail 107 are fastened at least indirectly to the escalator supporting construction via fastening elements 108.

[0038] The reduction of the turning radius within the transition areas requires a special arrangement of the steps and the guidance of the tow rollers of the steps which is shown in Fig. 3.

[0039] In Fig. 3 the inner rollers 112 and outer rollers 113 of the step chain are guided by the inner guide rail 107 and the outer guide rail 106 as shown in detail in Fig. 2.

[0040] The tow rollers 121 of the steps 120 are guided by the tow roller guide rail 103. As shown in Fig. 3 the tow roller guide rail 103 describes a closed curved guide rail. Thereat, the turning radius of the tow roller guide rail 103 is smaller than the turning radius of the inner guide rail 107.

[0041] To avoid any collision of the steps 120 during turnaround the steps are foldable. Thereat, the tread 122 and the riser 123 of a step 120 are connected to each other via a hinge 124. During turnaround the riser 123 of a step 120 is folded towards the lower side of the tread

122. Thereat, the lower side of a step 120 pushes back the riser 123 of the subsequent step 120. When the step is turned around the riser 123 is released again.

[0042] Fig. 4 shows a front view of Fig. 3. The outer guide rail 106 guiding the outer rollers 113 of the step chain 110 has a larger turning radius than the inner guide rail 107 guiding the inner rollers 112 of the step chain 120. The inner guide rail 107 has a larger turning radius than the tow roller guide rail 103 guiding the tow rollers 121 of the steps 120.

[0043] So, the outer guide rail 106, the inner guide rail 107 and the tow roller guide rail 103 are arranged in different levels to each other. Additionally, the vertical projections of the outer guide rail 106, the inner guide rail 107 and the tow roller guide rail 103 differ from each other at least partially.

Reference numbers

[0044]

100 Conveying system
101 Upper transition area
102 Lower transition area
103 Tow roller guide rail
104 Gear drive
105 Gearwheel
106 Outer guide rail
107 Inner guide rail
108 Fastening element

110 Step chain
111 Chain link
112 Inner roller
113 Outer roller

120 Step
121 Tow roller
122 Tread
123 Riser
124 Hinge

Claims

1. Conveying system (100) of an escalator comprising:

- a lower transition area (102) at the lower end of the escalator,
- an upper transition area (101) at the upper end of the escalator,
- a step chain (110), wherein the step chain (110) comprises a plurality of chain links (111) and inner rollers (112)
- a plurality of steps (120), wherein each step (120) is connected to the step chain (110) via at least a first supporting point on each side of the step

(120) and

wherein each step (120) comprises a tow roller (121)

- a tow roller guide rail (103) to guide the tow rollers (121) of the steps (120)

characterized in

that the step chain (110) comprises outer rollers (113), wherein

the outer rollers (113) are adjusted to the chain links (111) of the step chain (110), wherein the outer rollers (113) are guided within an outer guide rail (106).

2. Conveying system (100) of claim 1,

characterized in

that the outer rollers (113) are adjusted to the step chain (110) such that a ratio between the outer rollers (113) and the chain links (111) is 1:n, wherein $n > 1$.

3. Conveying system (100) of one of the claims 1 to 2, **characterized in**

that the outer rollers (113) are adjusted to the step chain (110) at connection points connecting two adjacent chain links (111).

4. Conveying system (100) of one of the claims 2 or 3, **characterized in**

that the ratio between the outer rollers (113) and the chain links (111) is 1:2, wherein one of the outer rollers (113) is adjusted to every second chain link (111).

5. Conveying system (100) of one of the previous claims,

characterized in

that one of the inner rollers (112) is adjusted at every connection point of two adjacent chain links (111).

6. Conveying system (100) of one of the previous claims,

characterized in

that the conveying system (100) comprises an inner guide rail (107) at the lower transition area (102) as well as at the upper transition area (101) to guide the inner rollers (112) of the step chain (110) during a turnaround of the step chain (110).

7. Conveying system (100) of one of the previous claims,

characterized in

that the outer guide rail (106) and the inner guide rail (107) are constructed such that during a turnaround the outer rollers (113) contact an inner face of an outer edge of the outer guide rail (106), and some inner rollers (112), especially for maximum, the half of the inner rollers (112), especially every second inner roller (112) of the step chain (110), contact the inner guide rail (107).

8. Conveying system (100) of one of the previous claims,
characterized in
that within the transition area the turning radius of the outer guide rail (106) is larger than the turning radius of the inner guide rail (107). 5
9. Conveying system (100) of one of the previous claims,
characterized in 10
that the steps (120) each comprise a tread (122) and a riser (123), wherein
the riser (123) and the tread (122) of the steps (120) are connected to each other via a hinge (124). 15
10. Conveying system (100) of claim 9,
characterized in
that the steps (120) are configured to be folded at least during a turnaround. 20
11. Escalator comprising a conveying system of one of the claims 1 to 10. 25

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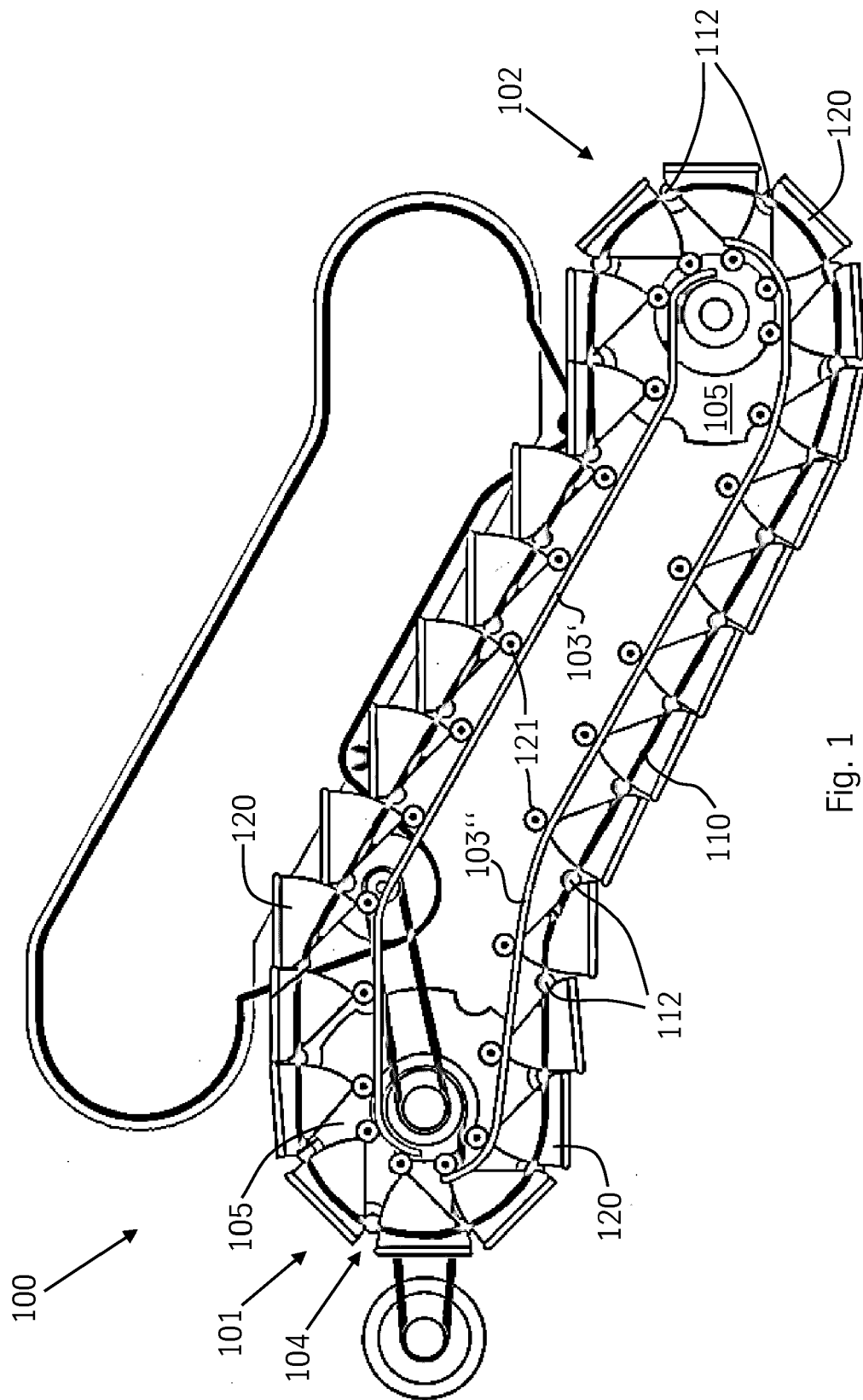
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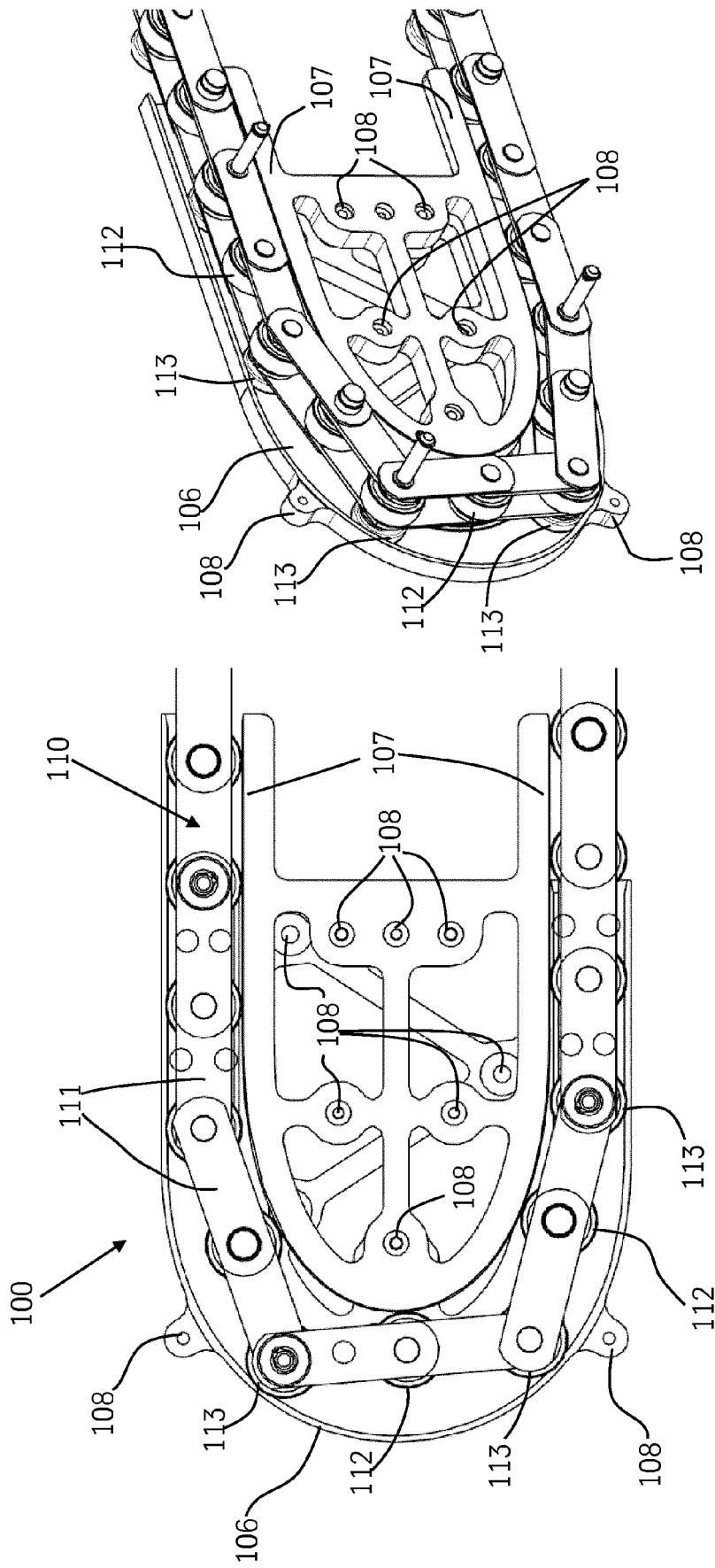


Fig. 2a

Fig. 2b

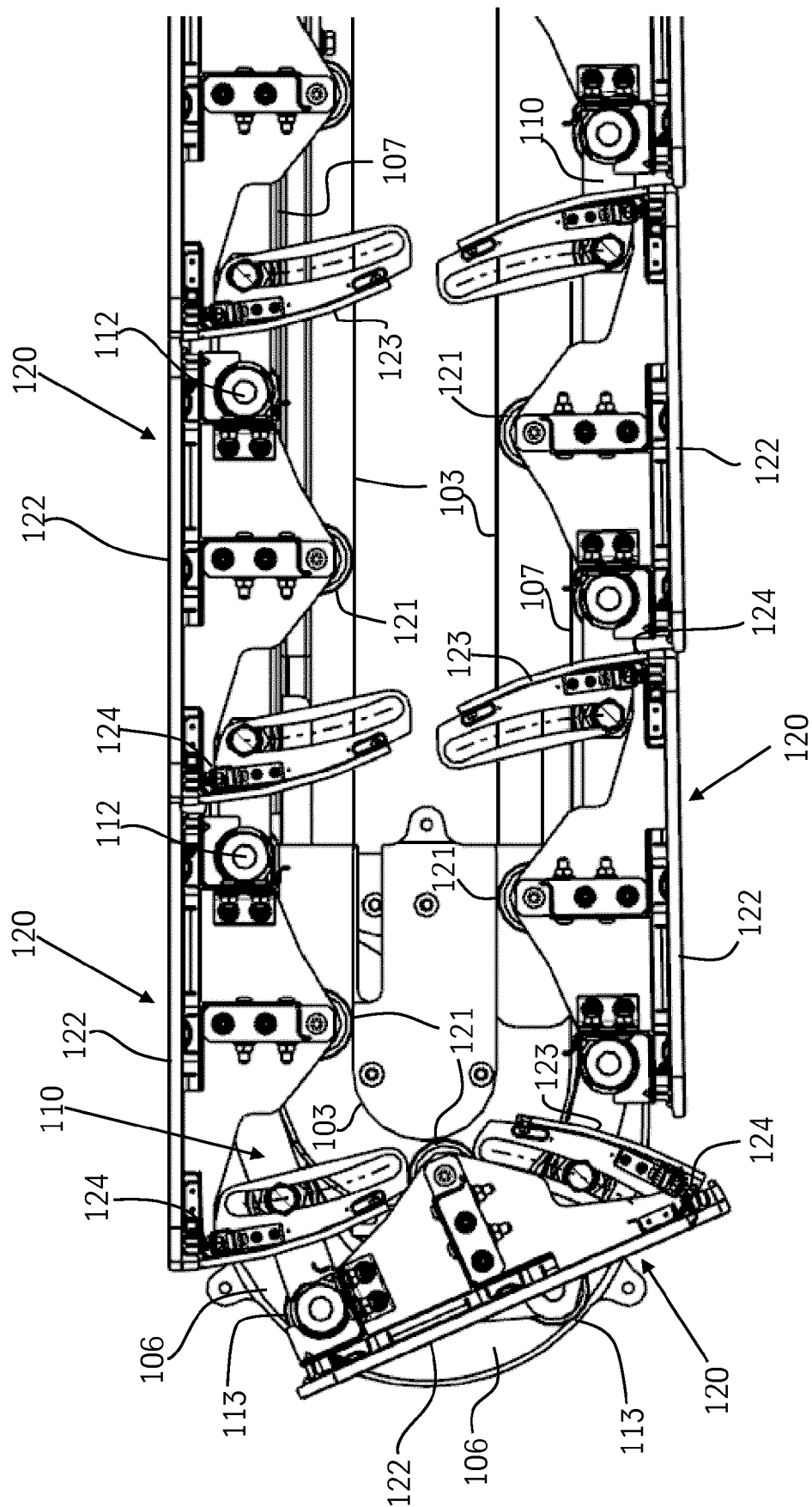


Fig. 3

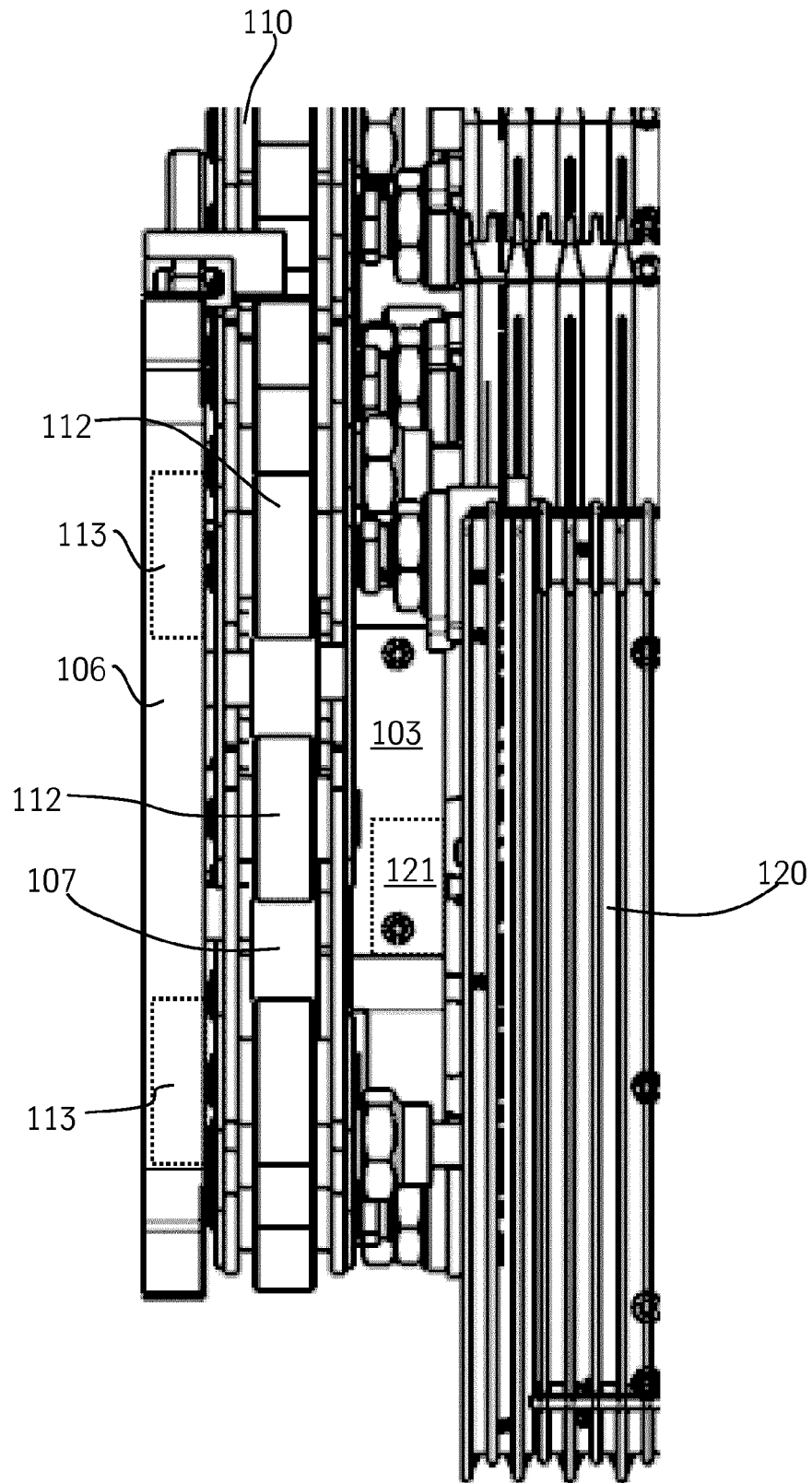


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 19 38 2336

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A	EP 3 231 761 A1 (OTIS ELEVATOR CO [US]) 18 October 2017 (2017-10-18) * figures 5-14 *	1-11	
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			TECHNICAL FIELDS SEARCHED (IPC)
			B66B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 October 2019	Examiner Szován, Levente
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 19 38 2336

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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