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(54) Title: LIFT STRUCTURE COMPRISING A FLAT BELT

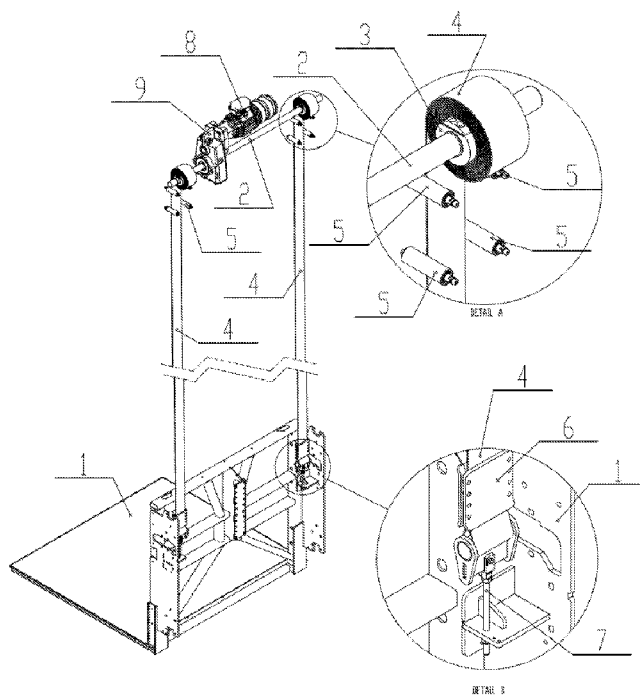


FIG 1

(57) Abstract: This description provides a new invention related to lifts. The lift drive structure comprising a flat belt, where the belt is firmly attached to the pulley, on which the belt is wound and unwound, is provided. The other part of the belt extends and is attached to the lift platform. In the present invention, the belt comprising tensile (e. g. steel) yarns, cords and protective materials (e. g. polyurethane) that protect yarns from wear due to friction and moisture is used. The belt is wound on the top of the part of the belt which is already wound, not close to it, thus avoiding friction with sides. The lift structure has the belt guides for proper winding of the belt on the pulley. Also, such lift does not require a counterweight to balance the platform. The lift of this type of structure uses the space of the lift shaft more effectively, a simpler structure is used, because there is no counterweight in comparison to the known related art, only one pulley is used for one belt. The surface of the belt may be flat, without bumps, protrusions increasing traction.



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LIFT STRUCTURE COMPRISING A FLAT BELT

FIELD OF THE INVENTION

The invention relates to the technical field of elevators, lifts, in particular to a lift drive mechanism structure comprising a flat belt wound/unwound on a pulley.

DESCRIPTION OF THE RELATED ART

This description provides a technical solution for transmitting a rotation force of the electric motor to a lift platform, and, in particular, unlike traditional solutions, where a rope, cable which is wound, rewound on coils, pulleys is used, closed loops are used, in this new case, a belt that is wound and unwound from a dedicated pulley. In the present invention, the belt extends straight from the pulley to the lift platform, no additional pulleys are used, there are no counterweights which balance the platform - thus, the lift drive structure becomes simpler and takes up less space in a lift shaft. The lift drive mechanism is attached to the upper part; the belt extends downwards and is attached to the lift platform.

The belt as usual is not a closed loop structure, i.e. the belt is attached at one end to the pulley on which it is wound and its other end is attached to the lift platform. When using the belt instead of a traditional rope, cable, it makes possible to wind a belt when the newly wound belt is wound on the pulley by winding the belt on the top of the previously wound belt, and not close to it as using a traditional rope, thus the sliding sideways of the belt when winding and unwinding on / from the pulley is eliminated. This winding method eliminates the rubbing of the cable with sides, thus reducing the wear of the cable. In the present invention, the belt comprises load bearing steel yarns, cords coated with a protective material (in this case polyurethane).

Document US2014027211 (A1) (published on 30 January 2014) provides a technical solution where a lift is attached using a hanging element (a rope, belt) that is coated with a protective coating. The lifting mechanism does not wind and unwind the belt, and when the counterweight which balances the lift is used, it gives the extra force required for lifting and / or lowering the lift by rewinding the hanging element. The lift structure is complex, it has a large number of pulleys for directing the hanging mechanism of coils, to rewind, the counterweight is used to balance the platform; these

elements require additional space in the lift shaft. It also does not provide the means to ensure sufficient friction (sufficient grip) between the drive pulley and the hanging element.

Document US2015158701 (A1) (published on June 11 2015) provides a lift structure where the used "flat hanging structural element" (rope, cable, belt) is wound and unwound on the pulley. The hanging element extends from the pulley towards the lift platform, proceeding on the two pulleys attached to the lower part of the platform, bypassing the lift platform through the bottom of the platform, rising upwards, where it is stably attached to the upper part of the lift shaft. In such structure, the lift cabin acts as a hung pulley, the structure has many components, is sufficiently complex, requires a long cable, rope or belt to hang a lift platform; When the lift moves, a cable, rope, belt comes in contact with at least three pulleys, which increases wear and tear. There is also no mention of whether the surface of the hanging element is covered with a protective, wear-reducing coating.

Summarizing the related art according to the cited documents, the following drawbacks are distinguished:

- a complex lift structure with more than one pulley for one cable;
- a counterweight which balances the platform is used, wherefore the structure becomes more complex, requires additional space in the lift shaft;
- a hanging element of normal structure and shape is used: i.e. the surface of the hanging element is not covered with an additional, protective cover; a cross-sectional shape resembles the circle, wherefore the hanging element wears faster;
- if the hanging element is not wound and unwound on the pulley, but only it is rewound from one structural element to the other by the driving pulley, then, in order to create sufficient friction between the hanging element and the driving circle, the hanging element and the driving circle may require toothed surfaces to interact with each other.

This description provides a technical solution that does not have the above deficiencies.

SUMMARY

This description provides a new invention related to lifts. The lift drive structure comprising a flat belt, where the belt is firmly attached to the pulley, on which the belt is wound and unwound, is provided. The other part of the belt extends and is attached to

the lift platform. In the present invention, the belt comprising tensile (e. g. steel) yarns, cords and protective materials (e. g. polyurethane) that protect yarns, cords from wear due to friction and moisture is used. The belt is wound on the top of the part of the belt which is already wound, not close to it, thus avoiding friction with sides. The lift structure has the belt guides for proper winding of the belt on the pulley. Also, such lift does not require a counterweight to balance the platform.

The lift of this type of structure uses the space of the lift shaft more effectively, a simpler structure is used, because there is no counterweight in comparison to the known related art, only one pulley is used for one belt. The surface of the belt may be flat, without bumps increasing traction.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a part of a lift structure comprising a lifting mechanism, a belt, a belt fastening element, a platform, and other structural elements related to the present invention. The belt winding pulley with guides and the belt fastening structure attached to the lifting platform are also enlarged. The figure is marked with the following numbers: 1 – a lift platform, 2 – an axle, 3 – a pulley, 4 – a belt, 5 – a guide, 6 – a plate for fastening a belt, 7 – an oblong fastening rod, 8 – an electric motor, 9 – a gear unit.

The presented drawings are more illustrative, scale, proportions and other aspects do not necessarily correspond to a real technical solution.

THE PREFERRED EMBODIMENTS

In this description, the term “lift” refers to a lift, elevator or other device for transferring objects from one height level to another, usually a non-high speed lift (movement speed of about 0.15 m / s).

A lift cabin, platform is driven by a drive unit, such as an electric motor, in conjunction with devices changing rotation movement of the motor (gear units, transmission chains and / or other). Typically, the platform movement force is transmitted from the drive unit by a rope, cable, or other means connecting, attaching the lift platform to the drive unit. In other cases, more rarely a belt is used, i. e. the said rope, cable of flat cross-sectional shape. In this way, one edge (diameter) of cross-sectional shape is several times longer than the short edge (diameter) perpendicular to this long edge. In the present invention, a belt (4) is used, i. e. a hanging element whose

cross-sectional shape is flat (one of two diameters perpendicular to each other passing through the cross-section are several times longer than the other, the belt thickness being several times smaller than the belt width).

The new technical solution presented in this description allows to simplify the lift drive and takes up little space, which makes it possible to more efficiently utilize the shaft for movement of the lift, to use the lift platform (1) of larger area than the usual size in shafts of the same size. The mentioned technical solution, in addition to the traditional structural elements of the lift, comprises at least the following components:

- a drive unit comprising an electric motor (8), gear unit (9) or other device changing the movement of the motor, an axle (2);
- pulleys (3) fixedly mounted on the axle (2), to which the belts (4) are firmly attached at one of its ends;
- belts (4), to which the lift platform is attached at the other its end (at the other than the pulley (3) is attached);
- other structural elements.

The drive device is designed to create a rotation movement for lifting, lowering the lift platform. In the present invention, an electric motor (8), whose axle of rotation is firmly connected to the planetary gear unit (9), is used. The toothed gear unit (9) transmits the axial rotation of the electric motor (8) to the axle of the lift (2), on which the pulleys (3) are attached to the belts (4). When transmitting rotation, the toothed gear unit (9) reduces the speed of rotation, increases torque. The gear unit (9) is firmly connected to the axle (2), whose length is close to the width of the lift platform (1). Close to the ends of the said axle (2), the pulleys (3), on which belts (4) are wound are firmly, securely attached.

Pulleys (3) on which the belt (4) is wound and unwound are mounted on the said axle (2) of the gear unit (9). In the present invention, two pulleys (3) are mounted close to the ends of the said axle (2); only the belt (4) which is wound on that specific pulley (3) is wound on each of these pulleys (3). In other cases, one or more than two pulleys (3) and a belt (4) for each pulley (3) may be used. The said pulley (3) in its shape resembles a cylinder with a hole formed in the centre through which the axle (2) rotated by the gear unit (9) is inserted and firmly fastened.

The pulley (3) has technical means for firmly fastening the end of the belt (4) to the pulley (3); in the present invention, a part of the pulley (3) as if it were cut off, separated from the pulley (3) with which it is possible to press the belt (4) against the pulley (3), to


screw the said separated part to the pulley (3), thus pressing the belt (4) to the pulley (3). When the pulley (3) rotates, the belt (4) surrounds the pulley (3), the belt is wound on the pulley (3), the newly wound part of the belt (4) touches the surface of the pulley (3), then it is wound on the previously wound part of the belt (4).

By this winding method, this invention differs from traditional solutions when a rope, cable is used, initially it is wound next to a previously part of the belt, when winding in such way, the rope is rubbing against the previously wound rope, thus the rope is more intensively worn. When the belt (4) is wound on the top of the previous part of the belt, the belt (4) prevents rubbing with its sides, i. e. the cause of such wear is eliminated. Another technical problem solved by the use of such belt (4) compared with the traditional rope is the elimination of internal stresses. In particular, if a rope with a large cross-section is used and it is wound on the pulley, thus the rope is bended, and while bending inner yarns, cords of the rope which are bended at a smaller angle undergo crushing, while the outer yarns, cords of the rope which are bended at a larger angle undergo tensile strength, due to the different angle of bending yarns are rubbing each other, thus increasing wear. In the case of the belt (4), the width of the belt (4) is considerably higher than the thickness, thus belt (4) which is not thick undergoes considerably lower internal friction due to the different angle of bending, which reduces wear and prolongs the life of the belt (4). Using the belt (4) of such cross-sectional form (4) allows to wind the belt (4) on the pulley (3) of a small diameter.

In the present invention, the belt (4) which, as mentioned, has a width several times greater than the thickness is used. In the present invention, a belt (4) comprising at least two components – steel yarns, cords ensuring tensile strength that are interconnected, otherwise interconnected or not interconnected – are used. The said yarns are placed from all sides, surrounded by friction reducing material, in the present invention, polyurethane. In the middle of the cross-section of the belt (4), along the width of the belt (4) there are steel yarns ensuring resistance to tensile force. Around these steel yarns polyurethane or other material that eliminates and protects steel yarns from friction is used. The other purpose of the material of the belt (4) surrounding the steel is to protect the steel yarns from moisture. Other materials having physical and chemical properties similar to mentioned ones are used too.

As mentioned above, the belt (4) is attached to the pulley (3) at one end and the other end of the belt (4) extends straight to the lift platform (1), where it is attached to the lift platform (1). In the present invention, a loop is formed at the end of the belt (4), into which the axle of the belt (4) is placed. When forming the said loop, the folded part

of the belt (4) encircles the axle of the belt (4), the folded part of the belt (4) is tucked together with the part of the belt (4) extending towards the loop, hard, rigid plates (6) (e. g. of metal) with which the folded part and the part of the belt (4) extending towards the loop are compressed, the plates (6) are pressed against each other and fixed using screws with nuts or other fastening means, are used. Holders, which are interconnected by a connecting element to which an oblong fastening rod (7) is fastened, are attached to ends of the said belt axle located in the loop of the belt (4) are fastened to the belt (4). The fastening rod (7) is used to attach the belt (4) to the lift platform (1); the said rod (7) has a thread for a nut, which engages the fastening element of the lift platform (1). The angle of roll of the lift platform (1) is adjusted by tightening or loosening the said nut on the oblong rod (7). In other embodiments, a sensor for measuring the tensile force of the belt (4) can be fitted to the oblong rod (7).

As mentioned above, the belt (4) is firmly attached to the pulley (3), in the present invention, the belt (4) has two ends (i. e., not closed, not looped), the belt itself is wound, unwound on the pulley and not just rewound as in other solutions, and therefore the problem of sufficient grip (sufficient friction) between the drive pulley (3) and the belt is not relevant. Therefore, in this case, it is not necessary to manufacture a belt with additional technical means to create sufficient friction, for example a belt with  (toothed, with protrusions) surface, a belt with a flat surface (4) is enough.

The guides (5) of the belt course are mounted in the upper part of the lift structure, below the pulleys (3) on which the belt (4) is wound (4). The said guides (5) of the belt (4) comprise cylindrical rollers put on the axle of the guide (5) and capable of rotating on that axle. The said guides (5) are firmly fastened in a fixed lift structure. In the present invention, two guides (5) from one edge of the belt (4) and two guides (5) from the other edge of the belt (4) are used to direct the belt (4). The guide of the belt (4) is designed for that when winding the belt (4) on the pulley (3), the part of the newly wound belt (4) would lie directly on the part of the belt (4) which is already wound, the plane of the belt (4) must overlap over the width of the belt (4) as large as possible, the edges of the wound belt (4) on one side must be moved to each other as little as possible in such a way that the parts of the belt (4) would overlap as large as possible.

As mentioned above, the belt (4) is wound on the pulley (3), the guides (5) direct the part of the newly wound belt (4) to cover as much of the plane of the part of the wound belt as possible (4). In this way, when lifting the lift, the belt (4) wound on the pulley (3) forms a coil of an ever-larger diameter. If the motor (8) rotates pulleys (3) at the same angular speed through the gear unit (9), thus in the case of a thicker coil,

spool (when more of the belt (4) is wound on the pulley (3), i. e. the platform (1) is above) the platform (1) moves faster. To overcome this problem, the speed of rotation of the motor (8) is adjusted according to the diameter of the coil, spool (height of the lift platform (1)): until the diameter of the coil, spool is small (the platform (1) is below), the motor (8) rotates more quickly than when the coil already has a larger diameter (i. e., the lift platform (1) is above) in order to maintain a uniform movement speed of the platform (1).

In order to illustrate and describe the invention, the description of the most suitable embodiments is presented above. This is not a detailed or restrictive description to determine the exact form or embodiment. The above description should be viewed more than the illustration, not as a restriction. It is obvious that specialists in this field can have many modifications and variations. The embodiment is chosen and described in order to best understand the principles of the present invention and their best practical application for the various embodiments with different modifications suitable for a specific use or implementation adaptation. It is intended that the scope of the invention is defined by the definition added to it and its equivalents, in which all of these definitions have meaning within the broadest limits, unless otherwise stated.

In the embodiments described by those skilled in the art, modifications may be made without deviating from the scope of this invention as defined in the following definition.

CLAIMS

1. A lift drive mechanism structure comprising a flat belt which is wound on a pulley having at least the following components:

- a drive unit comprising an electric motor (8), gear unit (9) or other device changing the movement of an motor, axle (2),
- pulleys (3) fixedly mounted on the axle (2), to which the belts (4) are firmly attached at one of its ends,
- belts (4), to which the lift platform is attached at the other their end (other than the pulley (3) is attached to),

characterized in that

the belt (4) is firmly fixed to the pulley (3) at one end and the other end of the belt (4) extends directly toward the lifting platform (1), to which it is attached by fastening elements.

2. The lift drive mechanism structure according to claim 1, **characterized in that** the platform counterweight is not used.

3. The lift drive mechanism structure according to the preceding claims, **characterized in that** the belt (4) is wound and unwound from the pulley (3).

4. The lift drive mechanism structure according to the preceding claims, **characterized in that** the belt (4) comprises high tenacity yarns, cords surrounded by a protective material.

5. The lift drive mechanism structure according to the preceding claims, **characterized in that** the thickness of the belt (4) is several times smaller than the width of the belt (4).

6. The lift drive mechanism structure according to the preceding claims, **characterized in that** the speed of rotation of the motor (8) is adjusted according to the diameter of spool of the belt (4).

7. The lift drive mechanism structure according to the preceding claims, **characterized in that** the guides (5) for proper winding of the belt (4) on the pulley (3)

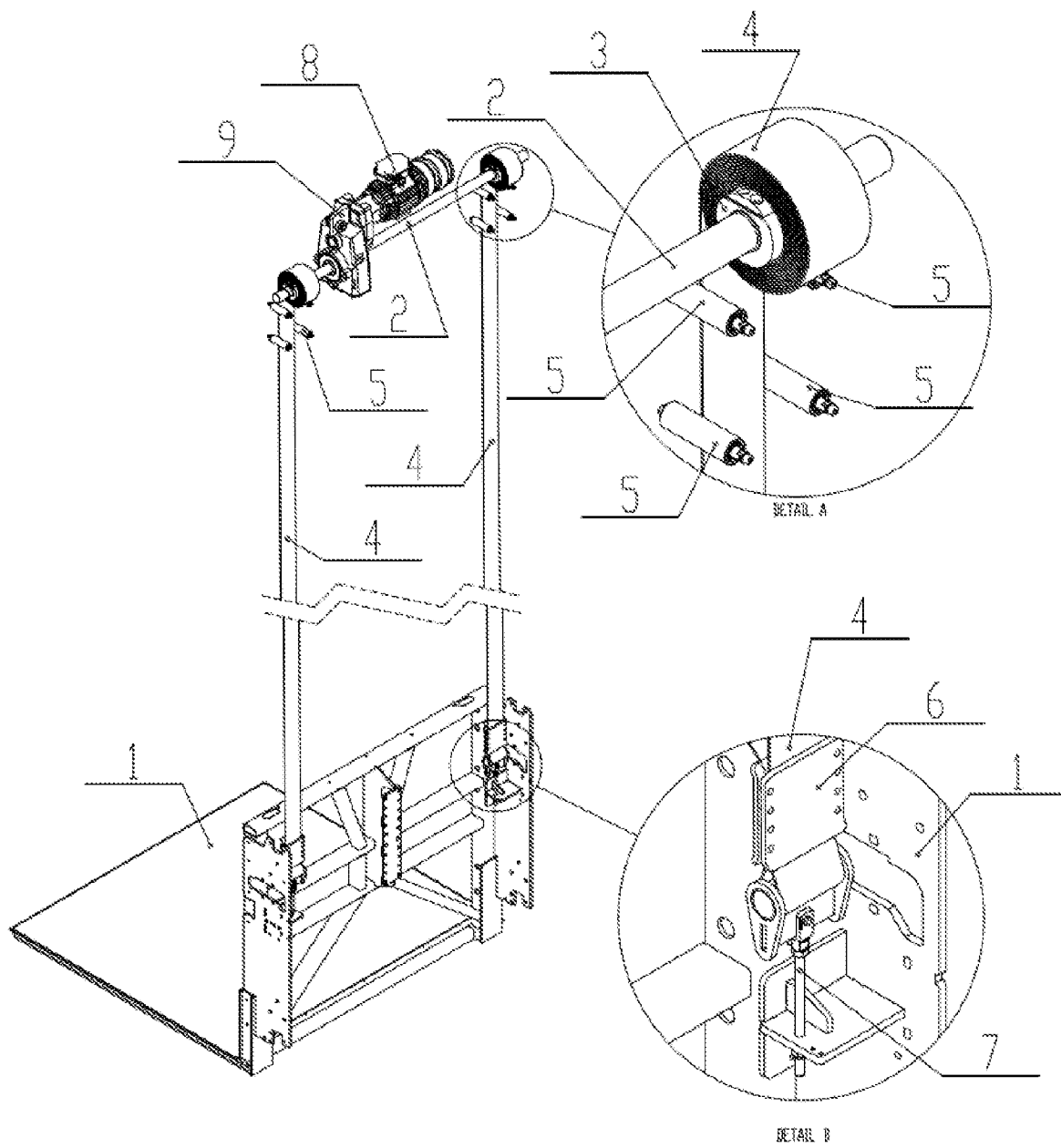
are firmly attached to the fixed lift structure to ensure that winding parts of the belt (4) would overlap as large as possible.

8. The lift drive mechanism structure according to the preceding claims, **characterized in that** the belt (4) is attached to the platform (1) using an oblong rod (7), and an angle of inclination of the lift platform (1) is adjusted by tightening or loosening a nut on the oblong rod (7).

9. The lift drive mechanism structure according to the preceding claims, **characterized in that** the belt (4) used has a flat surface, without bumps, protrusions.

10. The lift drive mechanism structure according to the preceding claims, **characterized in that** two guides (5) from one side of the belt (4) and two guides (5) from the other side of the belt (4) are used.

11. The lift drive mechanism structure according to the preceding claims, **characterized in that** pulleys (3) are mounted close to the ends of a rotation axle (2) which is rotated by the motor (8) and the gear unit (9), i.e. 2 pulleys (3) put on and mounted close to ends of the axle (2) transmits the movement to the lift platform (1).



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/053505

A. CLASSIFICATION OF SUBJECT MATTER

INV. B66B11/06
ADD.

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)
B66B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 210 848 A1 (INVENTIO AG [CH]) 28 July 2010 (2010-07-28)	1-6,8,9
A	abstract paragraphs [0030] - [0039] figures 1-3	7,10,11
X	DE 10 2013 008719 A1 (WEETS UND KASTEL BESITZGMBH & CO KG [DE]) 27 November 2014 (2014-11-27)	1,3-6,8, 9,11
A	abstract paragraphs [0021] - [0025] figures 1-3	2,7,10
X	ES 2 627 604 A2 (AMIANO SALAVERRIA SANTIAGO [ES]) 28 July 2017 (2017-07-28)	1-6,8,9
A	abstract figures 1-4	7,10,11
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" 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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search

5 February 2019

Date of mailing of the international search report

20/02/2019

Name and mailing address of the ISA/

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Oosterom, Marcel

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2018/053505

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>WO 00/40497 A1 (OTIS ELEVATOR CO [US]) 13 July 2000 (2000-07-13) abstract figures 1, 2</p> <p style="text-align: center;">-----</p>	8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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