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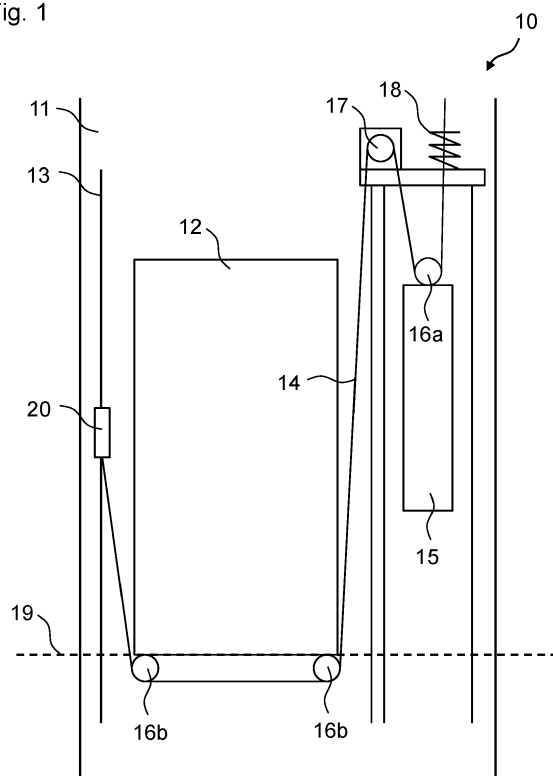
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BALANCING DEVICE FOR SUSPENSION MEANS

- (57)

The invention relates to a balancing device (20) for coupling two suspension means (14) of an elevator system (10), comprising two parallelly and axially dis-
- placeable arranged mounting fixtures (31), each of the mounting fixtures (31) being configured to couple to a suspension mean termination (24).

Fig. 1



Description

[0001] The present invention refers to a balancing device for two suspension means of an elevator system, comprising two parallelly and axially displaceable arranged mounting fixtures, each of the mounting fixtures being configured to couple to a suspension mean termination and being pivotably connected to a lever and the lever being pivotably connected to one of two arms of a rotatably mounted balancing rocker.

[0002] Typically elevator systems comprise a number of suspension elements, for example belts or ropes, for supporting and driving an elevator cabin in an elevator shaft. Such suspension means may be fixed in an area of a counterweight, carry a counterweight, be deflected on an upper (drive) sheave, run underneath the elevator cabin, e.g. in the form of an underslung/overslung, and may be fixed on the opposite side of the elevator cabin.

[0003] As a result of accumulated tolerances in such suspension systems, differences in load on suspension means may result in uneven wear of the suspension belts. Therefore, in such installations, especially if only two suspension means or belts are used, they need to be levelled in order to reduce or prevent wear on the suspension means. This often is achieved by using springs, but usually entails a necessity to include levelling means in such suspension systems.

[0004] Against this background, it is an object of the present invention to provide an improved balancing device for an elevator system and an improved elevator system in order to increase operating safety and particularly enable improved balancing and/ or leveling for two suspension means.

[0005] In order to solve the above problem, a balancing device and an elevator system according to the independent claims are proposed. Further embodiments and/ or features of the invention are subject of the dependent claims and the description below.

[0006] According to one aspect of the present invention, a balancing device for coupling two suspension means of an elevator system is proposed. The balancing device comprises two parallelly and axially displaceable arranged mounting fixtures, each of the mounting fixtures being configured to couple to a suspension mean termination and being pivotably connected to a lever. The lever is pivotably connected to one of two arms of a rotatably mounted balancing rocker, wherein two guiding elements are provided alongside a displacement path of the mounting fixtures.

[0007] According to another aspect of the present invention, an elevator system is proposed, the elevator system comprising an elevator shaft and an elevator cabin, which is arranged to travel in the elevator shaft and is supported by two suspension means. The two suspension means terminations of the respective two suspension means are mounted to a balancing device as described herein.

[0008] This balancing device enables levelling respec-

tive suspension means tensions by means of the balancing rocker and at the same time, by employing pivotable levers as connecting means between the rocker arms and mounting fixtures or respectively the suspension means/ suspension means terminations, the proposed balancing device can provide more stroke than a simple rocker whilst maintaining a predetermined distance between the suspension means. The two guiding elements are provided alongside a displacement path of the mounting fixture, such that the mounting fixture is guided along a predetermined, in particular vertical axis. This contains a movement of the mounting fixtures, therefore enabling the maintenance of the set distance between the suspension means and avoiding misalignment of the suspension system.

[0009] The elevator system generally comprises an elevator cabin and a counterweight which are mounted in an elevator shaft of a building for vertical movement between pre-determined travel limits e.g. floor landings. A sheave and suspension mean arrangement for driving the cabin and its counterweight comprises at least two suspension means, which run essentially parallel to one another. At one end of the suspension means, these, respectively their suspension mean terminations, are fixed to the proposed balancing device. Therefrom, each of the suspension elements may, in particular supported by means of idler pulleys, loop under or over the elevator cabin and around a traction sheave, which may be arranged in an upper area of the elevator shaft. The suspension means further traverse to a further idler pulley atop the counterweight and extend therefrom, in particular supported by means of a spring arrangement, to a dead end hitch, which may include springs. The pulleys may each be provided in pairs as to each divert one of the suspension means.

[0010] The traction sheave may be powered by a traction drive machine, which may include an AC or DC drive motor, to drive the traction sheave causing the elevator cabin and the counterweight to be vertically displaced in an opposing motion relationship. It is, of course, contemplated that the configuration of the suspension and/ or drive components may vary. For example, idler pulleys may be positioned atop the cabin and/ or an idler pulley may be positioned beneath the counterweight.

[0011] The two suspension means, respectively their suspension mean ends or suspension mean terminations, may be or are each mounted to one of the mounting fixtures of the balancing device. The mounting fixtures are arranged to move in a direction parallel to the extension of the suspension means. Each of the mounting fixtures is pivotably or rotatably connected to a first end of the lever or linking rod, allowing for a swivel motion of each of the levers in relation to the mounting fixtures. On the respective second end, each lever is pivotably or rotatably connected to one of the two opposite arms of the rocker, allowing for a swivel motion of each of the levers in relation to the balancing rocker, reciprocally. This balancing rocker is, particularly in its center portion and/ or

intermediate to the two rocker arms or arm ends, which the levers are connected to, rotatably arranged or pivoted, allowing for a rocking motion in order to prevent unequal loading of the two suspension means.

[0012] The invention is among other things based on the consideration, that a possible misalignment of the two suspension means, which may be caused by a tilting movement of a simple rocker system, especially when the rocker is out of its horizontal position, should be avoided. By providing the two pivoted levers, the mounting fixtures may follow a predetermined in particular vertical path, thereby allowing the balance device to maintain a set distance between the two suspension means and therefore ensures alignment of the suspension means. Furthermore, a lever stroke of the balancing mechanism may be enlarged due to the levers and therefore a potential stroke length for the suspension mean terminations, which may be balanced out by the balancing device, may be enlarged.

[0013] By prescribing a predetermined length of the lever and/ or base angle between lever and mounting fixtures and/ or lever and rocker arm, a stroke length for the suspension mean terminations may be appropriated to constructive needs.

[0014] According to one embodiment the suspension means is a belt or a rope or any other suitable means of suspending an elevator cabin. Thereby, the balancing device may be used in various suspension systems in order to support sustainable mounting i.e. attachment and/ or movement of the cabin.

[0015] According to one embodiment the guiding elements are at least partially provided with gliding means. Such gliding means may comprise bushings, gliding pads or a low friction coating and may be provided on a side facing the mounting fixture of the guiding elements. The gliding means may mitigate the effects of friction occurring during displacement of the mounting fixture(s), thereby increasing the balancing effect obtainable by the balancing device.

[0016] According to one embodiment the balancing device comprises a support element, wherein the balancing rocker is rotatably and/ or by means of a pivot mounted to the support element. In addition other elements of the balancing device such as the levers and/ or the mounting fixtures may be contained and/ or movably mounted in or on the support element. Hence the support element may provide for a simplified mounting option and safeguard against contamination or damage.

[0017] The support element may be formed as a stop plate having at least one stop projection formed or arranged thereon which limits movement of components of the balancing device, e.g. the rotary movement of the rocker. Therefore, in case one of the suspension means loses its tension, the stop plate may confine the rocker, such that the other suspension means is prohibited from dropping excessively as a result of imbalanced net forces.

[0018] According to one embodiment a connection

unit, e.g. a pivot, of the lever and the mounting fixture is guided by means of an oblong slot provided in the support element. The connection mechanism e.g. the pivot connecting the mounting fixture and the lever may be slidably arranged and/ or guided within these slots in order to maintain equal distance for the suspension means. In particular, the oblong slots may be disposed parallel and at a predetermined distance of each other, a length of the slot particularly resembling a maximal threshold distance of an allowed balancing distance for the suspension means. In some embodiments the guiding elements may be disposed at opposing edges of the oblong slots in order to enhance the guiding function.

[0019] If a shift in the tension in the suspension means and therefore in the balancing mechanism occurs, these oblong guidance holes may prevent a lateral movement of the mounting fixtures and thereby of the suspension means. Hence, the proposed balancing device provides redundancy, to mitigate the risk of Single Point of Failure in case of the breakage of the hinge of the lever.

[0020] According to one embodiment the balancing device comprises an actuating arm, arranged such, that a movement above a predetermined threshold distance of at least one of the mounting fixtures triggers a motion of the actuating arm. The actuating arm may be for example pivotably hinged and arranged such, that in a neutral position, an edge of the actuating arm overlaps with an end portion of the oblong holes of the support element. Thus, if the mounting fixture is moved over a predetermined threshold distance, the mounting fixture may contact the actuating arm and thereby inducing or triggering a motion of the actuating arm, in particular an angular offset of the actuating arm. Hence a detection of suspension mean slack and/ or suspension mean breakage may be detected.

[0021] The actuating arm may be arranged such that it may produce a trigger reaction, in particular to safety stop of the elevator cabin. By means of such an arrangement, the detection of a deviation in tension of the suspension means may be enabled or enhanced, as the actuating arm is mechanically connected to a region where such deviation may straightforwardly recognized, thereby increasing detection probability.

[0022] According to one embodiment the actuating arm is, particularly mechanically, coupled with a limit switch, such that a, in particular triggered, motion of the actuating arm may actuate the limit switch. The actuating arm is being designed and/ or arranged to effect an emergency stop by a distortion of the mounting fixtures caused by, for example, a change in the tension of the suspension means.

[0023] According to one embodiment a load cell may be arranged at at least one or both of the suspension mean terminations. Such load cell, respectively arranged at one of the two suspension means, may suffice for a load weighing of the cabin, as a tension in both suspension means may be equalized by means of the balancing device.

[0024] By prescribing a predetermined threshold distance value for the permissible movement of the mounting fixtures, a degree to which a movement or adjustment of the suspension means is permissible and does not trigger the limit switch or respectively a halt of the elevator cabin may be defined. Therefore, a harmless divergence does not automatically arrest a conveying mechanism. The actuating arm may provide an uncostly but resilient detection means for producing a safety stop for the elevator cabin or the elevator system.

[0025] According to one embodiment the balancing device is mounted at a guide rail arranged in the elevator shaft. The guide rail is typically mounted in the elevator shaft and designed for guiding the elevator cabin vertically. The balancing device may be attached to the guide rail directly or by means of additional fixings or fastening elements for example means for fixing a speed governor. In other embodiments the balancing device may be mounted to a wall of the elevator shaft.

[0026] For example, the balance device may be fixed to such guide rail by means of a console and attached thereto by means of screwing, riveting, welding, clamping or the like. Such console may also comprise a speed governor, which may be arranged such, that it may, by means of the console, be placed one side of the guide rails, wherein the balancing device is disposed on the other side of the guide rail. This may enable a simple means of installation while also providing spatial proximity of the balancing device with the speed governor for improved maintenance.

[0027] According to one embodiment, the balancing device is arranged in vicinity of a last landing of the elevator shaft. In particular the balancing device is arranged on the guide rail near to the top last landing of the elevator shaft, at approximately a half of a cabin height, measured from the bottom or top of such landing. A typical (inside) cabin height being roughly between 2200mm and 2300mm. With such positioning of the balancing device and in particular the speed governor in the shaft a use of minimal suspension means length is enabled, thereby contributing to cost reduction.

[0028] Further features, advantages and possible applications of the invention result from the following description in connection with the figures. In general, features of the various exemplary aspects and/ or embodiments described herein may be combined with one another, unless this is clearly excluded in the context of the disclosure.

[0029] In the following part of the description, reference is made to the figures, which are presented to illustrate specific aspects and embodiments of the present invention. It is understood that other aspects may be employed and structural or logical changes may be made in the illustrated embodiments without departing from the scope of the present invention. The following description of the figures is therefore not to be understood as limiting.

[0030] Illustrating are

Fig. 1 a schematic representation of an exemplary elevator system according to the present invention;

5 Fig. 2 a schematic representation of an exemplary balance device for an elevator system according to the present invention; and

10 Fig. 3a - 3c schematic representations of an exemplary balance device in more detail for an elevator system according to the present invention.

15 **[0031]** In the following, identical reference symbols refer to identical or at least similar features.

[0032] Fig. 1 illustrates a schematic representation of an exemplary embodiment of an elevator system 10 described herein. In the depicted embodiment, the elevator system 10, which comprises an elevator shaft 11, an elevator cabin 12 configured to vertically travel in said shaft 11 and at least one guide rail 13 mounted in the shaft 11 for guiding the elevator cabin 12 vertically.

[0033] Two suspension means 14, which run essentially parallel to one another, are provided to move the cabin 12 and a counterweight 15. At one end of the suspension means 14, the same are fixed to the guide rail 13 via a balancing device 20. The balancing device 20 is arranged in vicinity of a top last landing 19 of the elevator shaft 11, in particular at approximately a half of a cabin height, measured from the bottom of said landing 19. Therefrom, each of the suspension means 14 loops under the elevator cabin, loops around a driven traction sheave 17 and carries the counterweight 15.

[0034] In the example shown, the suspension means 14 carry the counterweight 15 by the suspension means 14 revolving around idler pulleys 16a and are, in particular supported by means of a spring arrangement 18, fixed to a dead end hitch means not shown in Fig. 1. In the embodiment shown, the elevator cabin 12 is looped under with second idler pulleys 16b which are each provided in pairs.

[0035] Fig. 2 illustrates a schematic representation of an embodiment of the balancing device 20 and a mounting solution 50 thereof for the elevator system 10 shown in Fig. 1 according to the present invention.

[0036] The mounting solution 50 comprises a console 21 configured to be mounted to the guide rail 13 of the elevator system 10. Thereon a speed governor 22 is disposed on one side of the guide rail 13 and on the opposing side, the balancing device 20 for coupling the two suspension means 14 of the elevator system 10 is provided. This the balancing device 20 i.e. hitch plate and the speed governor 22 may be attached to the guide rail 13 on the same attachment element i.e. the console 21. This has the effect that the speed governor 22 and its weight may balance the forces acting on the balancing device 20 and a torque may be balanced.

[0037] At one of the two suspension means 14 or suspension mean terminations 24 thereof, a load sensor or load cell 23a may be provided and configured to be connected with a DMC-Box 23b in order to determine a cabin load.

[0038] Fig. 3a to 3c illustrate a schematic representation of an exemplary balancing device 20 for the elevator system 10 of Fig. 1 and Fig. 2 according to the present invention and a working principle thereof.

[0039] Fig. 3a depicts the balancing device 20 in a neutral respectively balanced position in a vertically aligned mounting position. A support element 30 of the balancing device 20 houses two parallelly and axially displaceable arranged mounting fixtures 31. Each of the mounting fixtures 31 being configured to couple to a suspension mean termination 24 of the suspension means 14. The mounting fixtures 31 are each pivotably connected to a lever 32, wherein a connecting first pivot 33 of this connection is movably arranged and guided in a vertical direction in an oblong slot 34 provided in the support element 30.

[0040] Alongside both of the oblong guiding slots 34 respectively alongside a displacement path of the mounting fixtures 24, two guiding elements 35 are provided in order to support and/ or guide a lateral movement of the mounting fixtures 31. The guiding elements 35 are at least partially provided with gliding means 36 to reduce friction during a motion of the mounting fixtures 31.

[0041] Each of the levers 32 is pivotably connected to one of two arms of a balancing rocker 37, the balancing rocker 37 is rotatably mounted in the support element 30. Underneath the balancing rocker 37, two locking holes 40 are arranged in order to secure the balancing rocker 37 in a balanced, e.g. a horizontal position. These locking holes 40 may for example be utilized during installing or adjusting the balancing device 20, by inserting a pin in each of the locking holes 40. The pins may serve to hold the balancing rocker 37 in place so that it does not slip back and forth. As soon as the balancing device 20 is adjusted and/ or the two suspension means are in balance, the pins may be pulled out enabling the balancing rocker 37 to perform its function.

[0042] Fig. 3b depicts the balancing device 20 in an engaged position, wherein one of the mounting fixtures 31, in the pictured example the left mounting fixture 31 is displaced vertically upwards, e.g. in response to a loss of tension in the left suspension means 14. As a result, the left lever 32 is pushed upwards, tilting the balancing rocker 37 at an angle around a second pivot 38 in a clockwise direction, thereby pivotingly pushing the right lever 31 in a downward direction. Followingly the right mounting fixture 24 is moved downwards, balancing respectively evening out the tension in both suspension means 14.

[0043] Fig. 3c depicts the balancing device 20 in an engaged position, in an exemplary case of a suspension means brakeage, to an extent, where the limit switch 25 is activated by means of an actuating arm 26 of the balancing device 20. The actuating arm 26 is coupled with

the limit switch 25, such that a triggered motion of the actuating arm 26 actuates the limit switch 25. In Fig. 3c the balancing mechanism is shifted comparably to the depiction of Fig. 3b but to a greater extent, as due to an exemplary suspension mean brakeage (symbolized by the flash icon), no tension is applied at the left mounting fixture 31.

[0044] In response to this, the left one of the mounting fixtures 31 is displaced vertically upwards, until the left pivot 33 reaches an upper end of the oblong slot 34 and is thereby arrested in this position. The left lever 32 resultingly is moved upwards, tilting the balancing rocker 37 at an angle around the second pivot 38 in a clockwise direction, until a movement of the balancing rocker 37 is blocked by an upper stop plate projection 39 of the support element 30. Due to the pivot connection, the right lever 32 is moved in a downward direction until the movement of the right lever 32 is blocked by a lower wall of the right oblong slot 34 of the support element 30, thereby limiting a movement of the right mounting fixture 31, blocking the remaining right suspension mean 14 from slipping above a predetermined threshold distance.

[0045] The actuating arm 26 is pivotably connected to the support element 30 and arranged such, that a predetermined movement of at least one of the mounting fixtures 31, e.g. entering into a lower end portion of the oblong holes 34, triggers a tilting motion of the actuating arm 26. The actuating arm 26 may, in a resting or neutral position, overlap with the end portion of the oblong holes 34 of the support element 30. Thus, as is depicted in Fig. 3c, if one of the mounting fixtures 31, here the right mounting fixture 31, is moved over a predetermined threshold distance, the mounting fixture 31 pushes the actuating arm 26 in a downward direction and thereby causing a motion of the opposite end 26a of the actuating arm 26. This results in an angular offset of the opposite end 26a of the actuating arm 26, which in turn actuates the limit switch 25. It is understood that the same working principle is valid for each of the suspension means 14, suspension mean terminations 24 and/ or mounting fixtures 31 equally.

List of reference signs

[0046]

10	elevator system
11	elevator shaft
12	elevator cabin
13	guide rail
14	suspension mean
15	counterweight
16	idler pulley
17	traction sheave
18	spring arrangement
19	elevator landing
20	balancing device
21	console

22 speed governor
 23a load cell
 23b DMC-Box
 24 suspension mean termination
 25 limit switch
 26 actuating arm
 30 support element
 31 mounting fixture
 32 lever
 33 pivot
 34 oblong slot
 35 guiding elements
 36 gliding means
 37 balancing rocker
 38 second pivot
 39 stop plate projection
 40 locking hole
 50 mounting solution

7. Balancing device (20) according to claim 6, wherein a load cell (23a) is arranged at at least one of the suspension mean terminations (24).

5 8. Elevator system (10) comprising an elevator shaft (11), an elevator cabin (12), which is arranged to travel in the elevator shaft (11) and is supported by at least two suspension means (14), wherein two suspension mean terminations (24) of said suspension means (14) are attached to a balancing device (20) according to at least one of the preceding claims.

10 9. Elevator system (10) according to claim 8, wherein the balancing device (20) is mounted at a guide rail (15) arranged in the elevator shaft (11).

15 10. Elevator system (10) according to claim 8 or 9, wherein the balancing device (20) is arranged in vicinity of a last landing (19) of the elevator shaft (11).

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Claims

1. Balancing device (20) for at least two suspension means (14) of an elevator system (10), comprising two parallelly and axially displaceable arranged mounting fixtures (31), each of the mounting fixtures (31) being configured to couple to a suspension mean termination (24) and being pivotably connected to a lever (32) and the lever (32) being pivotably connected to one of two arms of a rotatably mounted balancing rocker (37), wherein two guiding elements (35) are provided alongside a displacement path of the mounting fixtures (31). 25
2. Balancing device (20) according to claim 1, wherein the suspension means is a belt or a rope. 35
3. Balancing device (20) according to one of the preceding claims, wherein the guiding elements (35) are at least partially provided with a gliding means (36). 40
4. Balancing device (20) according to one of the preceding claims, comprising a support element (30), wherein the balancing rocker (37) is rotatably mounted to the support element (30). 45
5. Balancing device (20) according to claim 4, wherein a connection unit (33) of the lever (32) and the mounting fixture (31) is guided by means of an oblong slot (34) provided in the support element (30). 50
6. Balancing device (20) according to one of the preceding claims, comprising an actuating arm (26), arranged such, that a movement above a predetermined threshold distance of at least one of the mounting fixtures (24) triggers a motion of the actuating arm (26). 55

Fig. 1

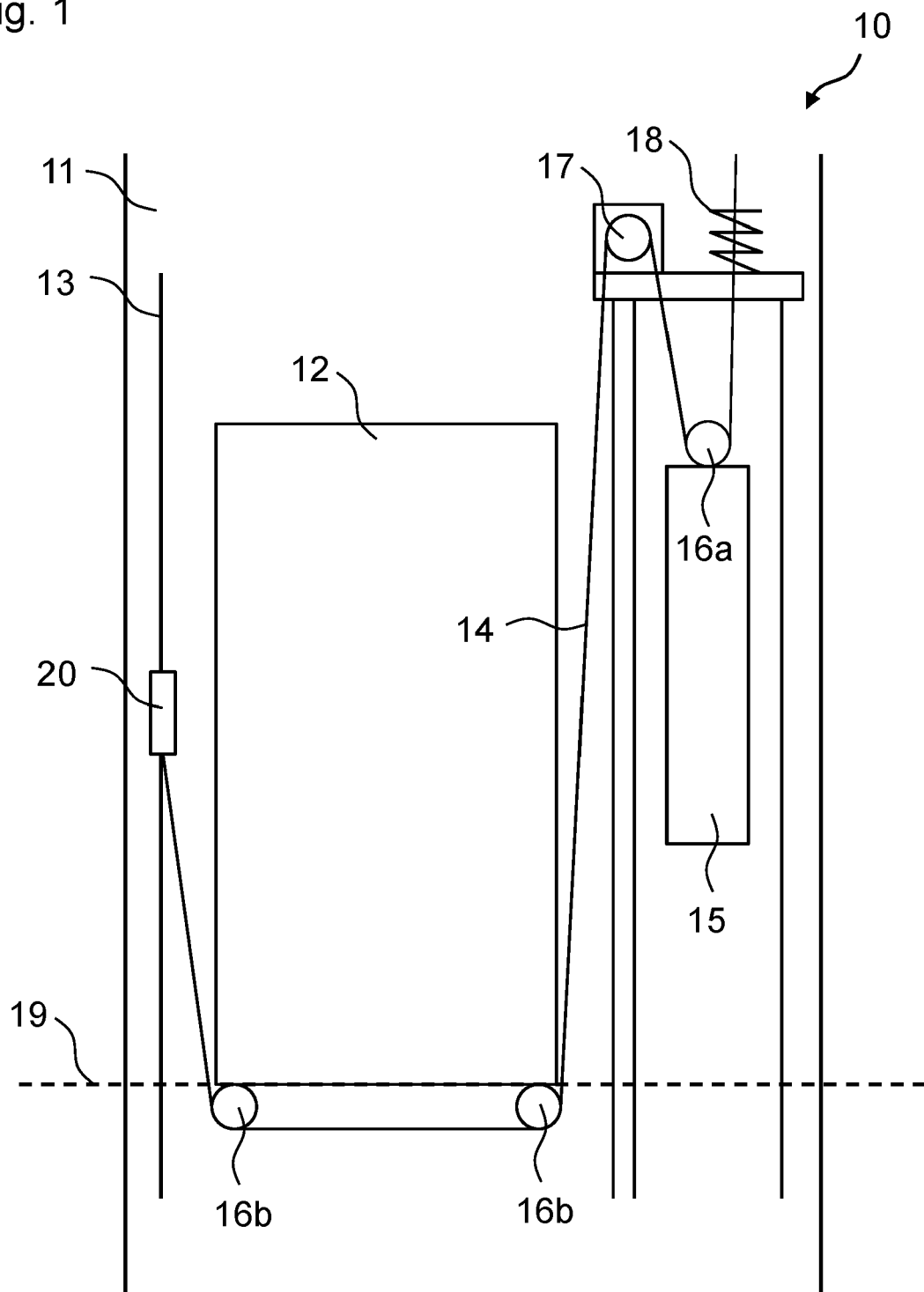


Fig. 2

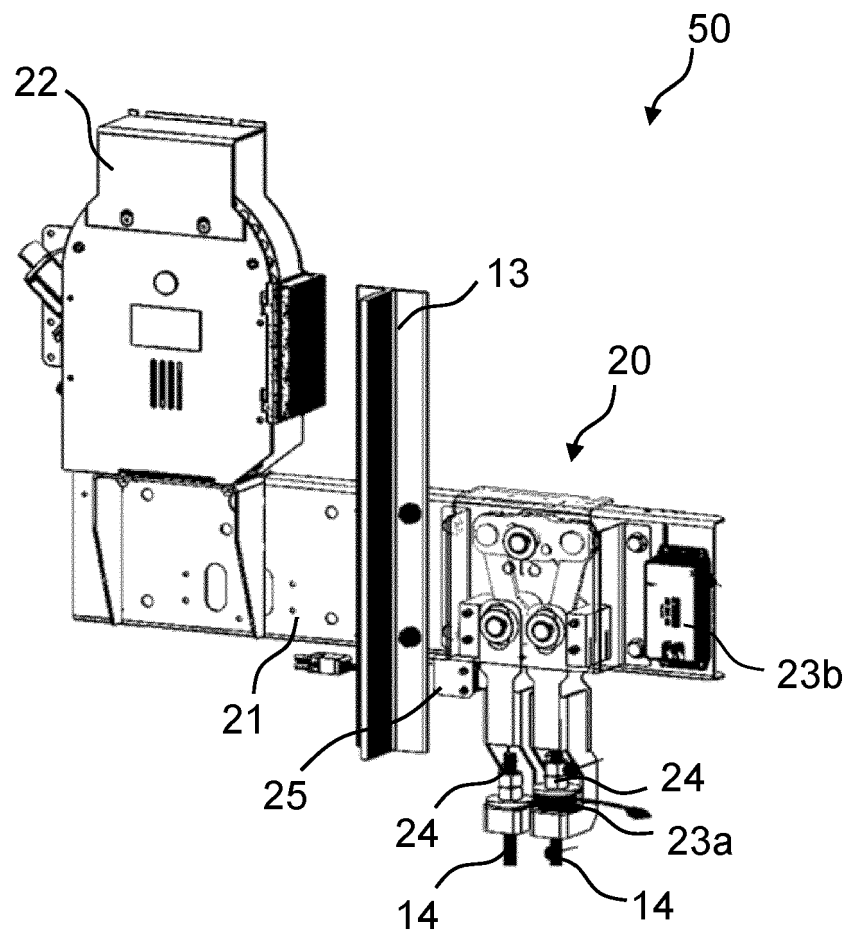


Fig. 3a

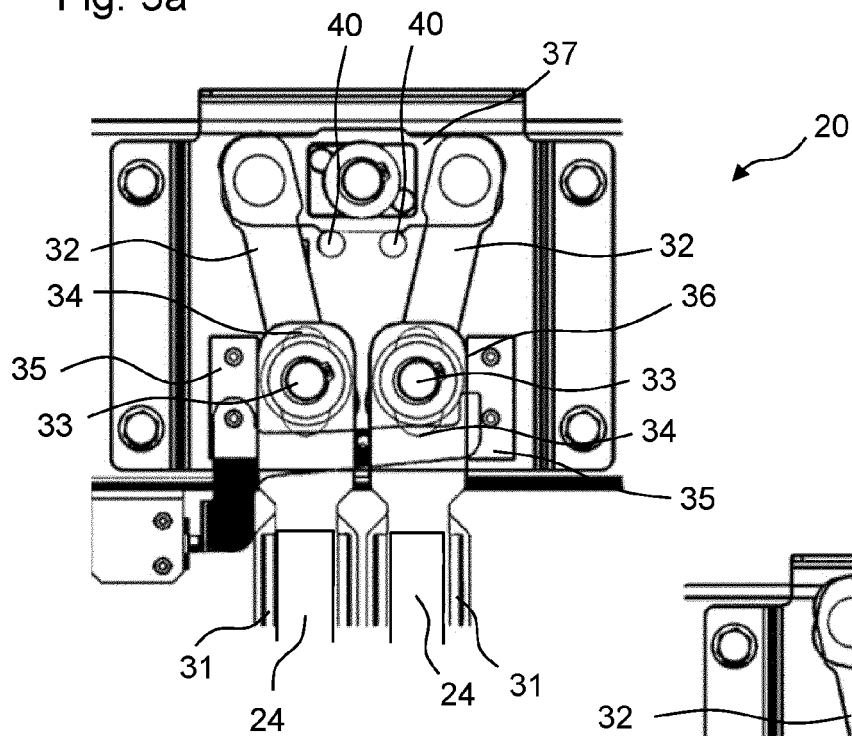


Fig. 3b

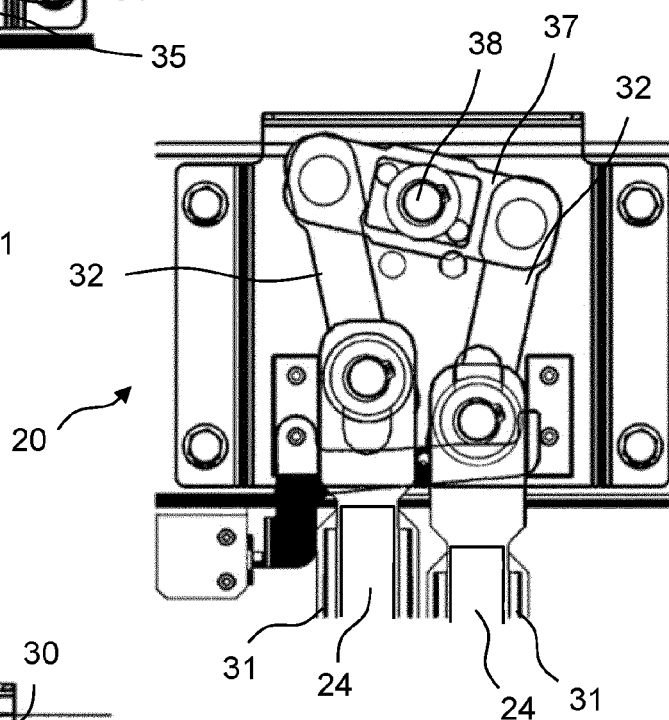
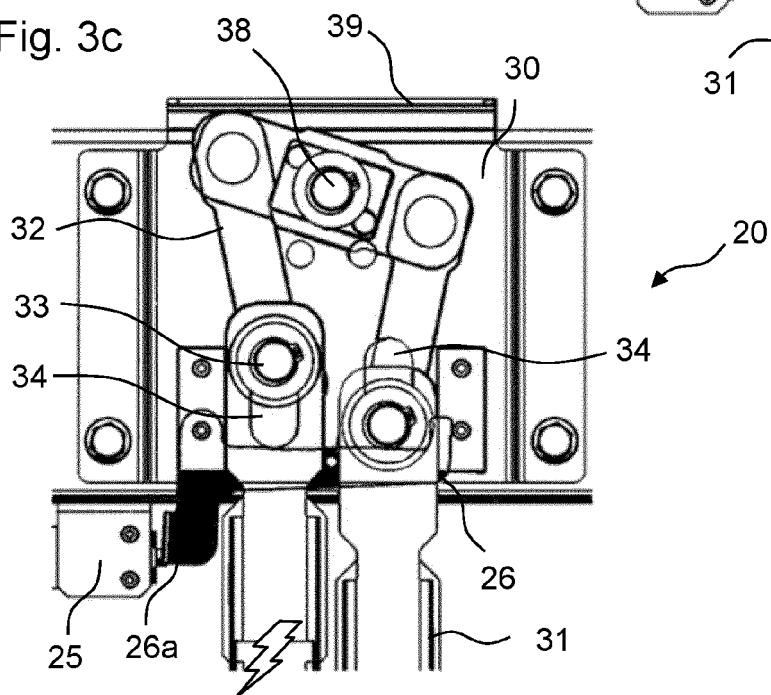


Fig. 3c





EUROPEAN SEARCH REPORT

Application Number

EP 22 38 2928

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 3 124 423 A1 (INVENTIO AG [CH]) 1 February 2017 (2017-02-01) * pages 1-8, paragraph 0062; figure 3 * -----	1-10	INV. B66B7/10
A	EP 1 508 545 A1 (INVENTIO AG [CH]) 23 February 2005 (2005-02-23) * the whole document * -----	1-10	
A	DE 873 121 C (GUTEHOFFNUNGSHUETTE OBERHAUSEN) 9 April 1953 (1953-04-09) * the whole document * -----	1-10	
			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 10 March 2023	Examiner Lohse, Georg
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	

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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10-03-2023

10	Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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