(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 524 080 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.03.2025 Bulletin 2025/12

(21) Application number: **23382929.0**

(22) Date of filing: **13.09.2023**

(51) International Patent Classification (IPC):
B66B 23/24 *(2006.01)* ***B66B 25/00*** *(2006.01)*
B66B 29/04 *(2006.01)* *B66B 23/20* *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B66B 23/24; B66B 25/006; B66B 29/04;
B66B 23/20

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(71) Applicant: **TK Escalator Norte, S.A.**
33682 Mieres (ES)

(72) Inventors:
- **Canteli Álvarez, Francisco**
  33204 Gijón (ES)
- **Muslera Fernández, Ignacio**
  33211 Gijón (ES)
- **Fernández Suárez, Iván**
  33204 Gijón (ES)
- **Fernández Fernández, Ana**
  33440 Luanco (ES)

(74) Representative: **Michalski Hüttermann & Partner Patentanwälte mbB**
Kaistraße 16A
40221 Düsseldorf (DE)

(54) **ESCALATOR AND METHOD TO DETECT EXCESS TENSION AT A HANDRAIL**

(57) The invention refers to an escalator (1), comprising: a support structure (2), a number of steps (3) or pallets or a moving belt guided in a circulating manner and forming a path (4), a first handrail (7.1) guided in a circulating manner and being turned around by newels (9.1, 9.2), a first tensioning device for tensioning the first handrail (7.1), a first temperature sensor (11.1) provided at the first handrail (7.1) for measuring the first handrail's (7.1) temperature, a first reference temperature sensor (12.1) for the first temperature sensor (11.1) and a processing unit (16) configured to receive measuring values from the first temperature sensor (11.1) and the first reference temperature sensor (12.1), wherein the processing unit (16) is configured to compare the measuring values of the first temperature sensor (11.1) and the measuring values of the first reference temperature sensor (12.1).

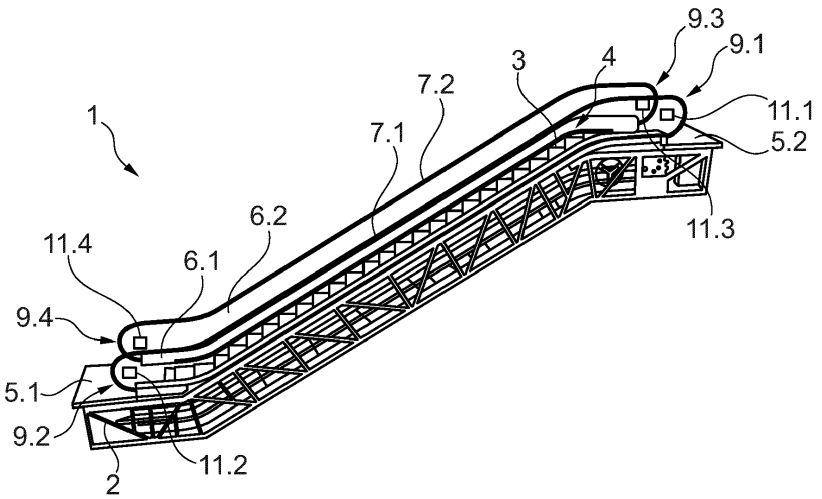

Fig. 1a

EP 4 524 080 A1

Description

Field of the invention

[0001] The present disclosure generally relates to escalators, including moving walks. In particular, the present disclosure relates to an escalator, comprising: a support structure, a number of steps or pallets or a moving belt guided in the support structure in a circulating manner and forming a path, at least a first handrail guided in a circulating manner and being turned around by a first upper newel and a first lower newel respectively and at least a first tensioning device for tensioning the first handrail. The present disclosure further relates to a method to detect excess tension at a handrail of such an escalator.

Background of the invention

[0002] Escalators for transporting people and goods are an integral part of modern residential and commercial buildings. A typical escalator includes a support structure, e.g. a welded frame, and steps, pallets or a moving belt providing a path. The steps, pallets or the belt may therefore be connected to travel rails or at least to each other and be deflected by two shafts at the ends of the path. At least one of the shafts may be a drive shaft or may be connected to a drive shaft. The path leads upwards, even or up; this is the term escalator is understood to also include moving walkways.

[0003] Usually, an escalator comprises means to protect passengers from hazards, such as balustrades against the hazard of falling off and handrails for a safe hold. Handrails are usually guided in a circulating manner parallel to the path in order that there is no relative speed between the handrail and the components forming the path. Therefore, handrails are made from rubber or alike materials to be able to be deflected at the ends of the escalator by newels. As due to the deflection the handrails get bended, they are subject to wear, which increases if tension in the handrail provided by the tensioning device is too high. At the same time, a certain tension is needed for smooth running of the handrail. While too low tension can easily be detected during initial adjustment of the escalator, excessive tension can hardly be detected. Therefore, often excessive tension is set accidentally by technicians, which leads to short lifetime of the handrails.

Description of the invention

[0004] In view of the before said, it is an object of the invention to provide an escalator, in which excessive tension in the handrail can be detected and/or prevented.

[0005] This object is solved by the features of the independent claims. Advantageous embodiments are indicated in the dependent claims. Where technically possible, the features of the dependent claims may be combined as desired with the features of the independent claims and/or other dependent claims.

[0006] In particular, the object is solved by an escalator, comprising: a support structure, a number of steps or pallets or a moving belt guided in the support structure in a circulating manner and forming a path, at least a first handrail guided in a circulating manner and being turned around by a first upper newel and a first lower newel respectively, at least a first tensioning device for tensioning the first handrail, at least a first temperature sensor provided at the first handrail for measuring the first handrail's temperature, at least a first reference temperature sensor for the first temperature sensor and at least one processing unit configured to receive measuring values from the first temperature sensor and the first reference temperature sensor, wherein the processing unit is configured to compare the measuring values of the first temperature sensor and the measuring values of the first reference temperature sensor.

[0007] As far as elements are designated with the aid of numbering, for example "first component", "second component" and "third component", this numbering is provided purely for differentiation in the designation and does not represent any dependence of the elements on one another or a compulsory sequence of the elements. This means in particular that, for example, a device or a method does not have to have a "first element" in order to have a "second element". The device can also comprise a "first element" and a "third element" without necessarily having a "second element". There may also be several units of an element of a single numbering, for example several "first elements".

[0008] An escalator according to the present understanding includes a path which is formed by steps, pallets or a moving belt supported by a support structure. The steps, pallets or the belt are/is therefore connected to travel rails or at least to each other and get/s deflected by two shafts at the ends of the path. At least one of the shafts may be a drive shaft or may be connected to a drive shaft. The escalator's path may be running upwards, downwards or may also run only horizontal to form a moving walk, which is be included within the term escalator.

[0009] As far as the handrail is guided in a circulating manner on the escalator, it is affixed to a mount moving along a circular trajectory, e.g. partly formed by a balustrade of the escalator. An upper part of the trajectory is preferably parallel to the path, such that a person on the path reaches the handrail at the same distance along the entire path. Furthermore, the handrail moves along the circular trajectory at the same speed as the steps, pallets or the belt move/s along the path in order to avoid speed differences.

[0010] A tensioning device for the handrail may be incorporated with one of the newels or may be separate from the newels. In particular, the tensioning device is formed by a wheel or another form of guide, on which the handrail is deflected. The wheel or the other guide can be

offset in order to slightly extend or slightly reduce the trajectory's length. Thus, if the tensioning device is incorporated with one of the newels, this newel can e.g. be offset.

[0011] As far as a temperature sensor is provided for measuring one of the handrail's temperature, the temperature of the handrail is measured either directly or indirectly, e.g. at a surface of the handrail or via the temperature of a component in contact with the handrail, e.g. a newel. A reference temperature sensor is provided to measure any other temperature at or around the escalator, which can be used to incorporate the invention as described below. In particular, the reference temperature sensor measures an ambient temperature or the temperature of another handrail.

[0012] A processing unit may be provided integral with a central controller unit of the escalator or may be a separate unit. Moreover, the person skilled in the art understands, that means are provided to connect the temperature sensors to the processing unit, such as wires, and to supply the sensors with supply voltage, such as a supply unit. In particular, the escalator comprises at least one gateway in connection with the processing unit to connect the sensors to as a supply unit. Further, the escalator may comprise a conversion unit to interpret the sensor's data and provide a data format to the processing unit, which is readable for the processing unit. Thus, the conversion unit and/or the processing unit may be capable of acquiring data through different communication protocols and processing them.

[0013] Comparing two values may comprise building their ratio or solving/verifying a mathematical equation including both values or more than one mathematical equation each including one of the values. The comparison may be executed with the measuring values directly or any suitable values derived therefrom.

[0014] The described escalator comprises the teaching that by comparing the handrail's temperature with a reference temperature, thus by comparing the measuring values of the first temperature sensor and the measuring values of the first reference temperature sensor, excess tension in the handrail can be detected. With too high tension, the flexing work and consequently the wear occurring on the handrail increases and occurrence of aging and cracks is promoted. Thus, the lifetime of the handrail is decreased. However, the increased flexing work is converted into heat and accordingly, at excessive tension the heat input at the handrail is increased and the temperature can be expected to be higher in comparison to a handrail without the heat input of the additional flexing work. This delta can be detected by the predescribed escalator by comparing the measuring values of the first temperature sensor and the measuring values of the first reference temperature sensor. E.g., the handrail's temperature can be compared to another handrail's temperature, at which handrail less tension is set, or to an ambient temperature, which is the main impact on the handrail's temperature. If in any of the two cases an unexpected proportion between the compared values is determined, this can be interpreted as indication for excess tension in the respective handrail. Thus, excess tension can be detected and measures to reduce the tension can be taken to prevent damage.

[0015] In one embodiment of the escalator, the first temperature sensor is provided at the first upper newel, wherein a second temperature sensor is provided at the first lower newel for measuring the first handrail's temperature, wherein the processing unit is configured to receive measuring values from the second temperature sensor and wherein the processing unit is configured to compare the measuring values of the second temperature sensor and the measuring values of the first reference temperature sensor. By providing the temperature sensors at the newel, they are advantageously placed close to the area, where flexing work and according heat input occurs. Thus, the effect on the temperature by the heat input is the highest in this area and is therefore detectable most easily. Further, by providing the first temperature sensor and the second temperature sensor, each at one of the newels, significant comparison can be provided for both driving directions of the escalator, as with the driving direction the driving side of the handrail changes and the main heat input occurs at different newels.. Also, the measuring values of both temperature sensors, or more particular their individual comparison with the reference temperature sensor, can be compared for double checking, whether excess tension is to be interpreted from the respective measuring value.

[0016] In a further embodiment, the escalator comprises: the first handrail on a first side of the path and a second handrail on a second side of the path, wherein the second handrail is guided in a circulating manner and is turned around by a second upper newel and a second lower newel respectively, a second tensioning device for tensioning the second handrail, a third temperature sensor provided at the second handrail for measuring the seconds handrail's temperature and a second reference temperature sensor for the third temperature sensor, wherein the processing unit is configured to receive measuring values from the third temperature sensor and the second reference temperature sensor, wherein the processing unit is configured to compare the measuring values of the third temperature sensor and the measuring values of the second reference temperature sensor. Thus, within this embodiment, the before described teaching is applied for both handrails of the escalator.

[0017] In a preferred configuration of the before said escalator, the third temperature sensor is provided at the second upper newel, wherein a fourth temperature sensor is provided at the second lower newel for measuring the second handrail's temperature, wherein the processing unit is configured to receive measuring values from the fourth temperature sensor and wherein the processing unit is configured to compare the measuring values of the fourth temperature sensor and the measuring values of the second reference temperature sensor.

Thus, again the temperature sensors are provided at the newel and therefore close to the area, where flexing work and according heat input occurs. Also, by providing the third temperature sensor and the fourth temperature sensor, each at one of the newels, significant comparison can be provided for both driving directions of the escalator, as with the driving direction the driving side of the handrail changes and the main heat input occurs at different newels. Also, the measuring values of both temperature sensors, or more particular their individual comparison with the reference temperature sensor, can be compared for double checking, whether excess tension is to be interpreted from the respective measuring value.

[0018] In a further preferred configuration of the before said escalator, the processing unit is configured to use the third temperature sensor or the fourth temperature sensor as the first reference temperature sensor and/or the first temperature sensor or the second temperature sensor as the second reference temperature sensor. In this embodiment, the temperature of both handrails is compared. As at both handrails, tension is set individually, excess tension is unlikely to occur on both handrail at the same time and same level. Therefore, a handrail with excess tension will most likely show a higher temperature than the other handrail. Advantageously, as both handrails - beside the heat input from potential excess tension - are subjected to the same heat sources and heat sinks in their environment, the measuring values of the temperature sensors and the reference temperature sensor can be compared directly to detect excess tension.

[0019] In another preferred embodiment of the escalator, which may also be combined with the before said embodiment, the first reference temperature sensor and/or the second reference temperature sensor is/are provided at the escalator for measuring an ambient temperature. As the environment, in which the ambient temperature is present, is the main heat source or heat sink of the handrail, it can be assumed that under regular tension, the handrails' temperature is mostly a function of the ambient temperature and the time, at least in sufficient approximation. Thus, when a change in the ambient temperature occurs, the handrail's temperature will follow this change according to a certain function of the time, which results from the laws of heat transfer. Most advantageously, by comparing the temperature of the according handrail with the ambient temperature, the comparison is independent of further heat sources or heat sinks, other components of the escalator may be subjected to. In the case, that this embodiment is combined with the before said embodiment, two first reference sensors are provided, one at the other handrail and one for measuring the ambient temperature, wherein the measuring values of the respective temperature sensor is compared with the values of one or both of the first reference sensors.

[0020] In one particular configuration of the before said embodiment of the escalator, the first reference temperature sensor and/or the second reference temperature sensor is/are provided at a comb plate or a floor plate. Most preferred, the first reference temperature sensor and/or the second reference temperature sensor is/are provided at a central position at the comb plate or the floor plate. At this position, the reference temperature sensor is placed most remote from other components of the escalator and therefore the ambient temperature can be measured free from interference of the other component's temperature. Further, at the comb plat or floor plat, sufficient installation space is provided.

[0021] In another configuration of the before said embodiment of the escalator, the first reference temperature sensor and the second reference temperature sensor are provided as a single sensor. As ambient temperature is the same for both handrails and at both ends of the escalator, a single reference temperature sensor is sufficient to supply reference measuring values regarding the environment. Alternatively, two reference sensors may be provided, wherein both sensors' measuring values may be used for each comparison in order to archive redundancy.

[0022] In a preferred embodiment of the escalator, the processing unit is configured to record received measuring values. In particular, when comparing measuring values of the temperature sensors with measuring values of reference temperature sensors measuring the ambient temperature, the comparison depends on the values over time. Thus, by recording measuring values, their development over time can be compared in order to detect excess tension.

[0023] In one embodiment of the escalator, at least one temperature sensor is a contact sensor and/or at least one temperature sensor is an infrared sensor. With these sensors, temperature can be measured precisely without damaging the handrail. The handrail's temperature may also be measured indirectly, e.g. at the newel or another component in direct contact to the handrail.

[0024] In a further embodiment the escalator comprises: a first balustrade, wherein the first handrail is mounted and guided on the first balustrade and/or a second balustrade, wherein the second handrail is mounted and guided on the second balustrade. In particular, the upper and lower newels are incorporated in the balustrade or mounted at ends of the balustrade.

[0025] The object is further solved by a method to detect excess tension at a handrail of an predescribed escalator, the method comprising the steps: receiving the measuring values of the first temperature sensor, the second temperature sensor, the third temperature sensor and/or the fourth temperature sensor, receiving the measuring values of the first reference temperature sensor and/or the second reference temperature sensor, comparing the measuring values of at least one temperature sensor and it's assigned reference temperature sensor and indicating excess tension in the respective handrail in case an unexpected proportion between the compared values is determined.

[0026] The assigned reference temperature sensor according to the predescribed is the first reference temperature sensor for the first temperature sensor and the second temperature sensor and the second reference temperature sensor for the third temperature sensor and the fourth temperature sensor. Indicating excess tension may include a readable notice in a protocol implemented in the processing unit, but may also include a notification to a user, a manufacturer or a technician. It may also include an alarm notification at the escalator, e.g. on a display or and audio alarm.

[0027] With the before said method, excess tension in a handrail can be detected in a simple manner with simple means, namely with only two sensors, one temperature sensor and one reference temperature sensor. The method is based on the teaching, that due to excess tension, additional heat input on the handrail occurs. Due to the fact, that the handrail - beside the heat input due to the excess tension - is subjected only to known/-calculatable heat sources and heat sinks, the heat input by excess tension can be detected. The method may further be laid out according to the predescribed embodiments of the escalator. In particular, the third temperature sensor or the fourth temperature sensor may be used as the first reference temperature sensor and/or the first temperature sensor or the second temperature sensor may be used as the second reference temperature sensor, in order to compare the temperatures of two handrails. Alternatively or additionally, one reference temperature sensor is provided to measure an ambient temperature.

[0028] According to one embodiment of the method, at least one out of the first temperature sensor, the second temperature sensor, the third temperature sensor and the fourth temperature sensor is used as a reference temperature sensor, wherein an unexpected proportion is determined in that the measured values of the first handrail and the second handrail deviate from each other beyond a threshold. This is, as the handrails have the same environment and - beside potential excess tension - are subjected to the same heat sources and heat sinks, it is to be expected that the handrails have the same temperature or at least that an offset between their temperatures is small and constant. Therefore, measuring an offset beyond an according threshold indicates excessive tension on the one of the handrails having the higher temperature.

[0029] According to another embodiment, the method further comprises the step: recording the measuring values of at least one temperature sensor and it's assigned reference temperature sensor over at least a first time period. By recording the measuring values, he time may be considered in the comparison as a variable. In particular, an unexpected proportion is determined, when the recorded measuring values of the temperature sensor deviate from a predetermined function having the measuring values of the assigned reference temperature sensor and the time as variables. In particular, with the reference temperature sensor measuring the/an ambient temperature, the handrail temperature can be expected to follow the ambient temperature time-delayed and therefore time should be considered in the comparison.

Brief description of the figures

[0030] In the following, the invention is explained in more detail with reference to the accompanying figures using preferred examples of embodiments. The formulation figure is abbreviated in the drawings as Fig.

- Fig. 1a is a perspective view of an escalator according to on embodiment of the invention, wherein details are illustrated schematically;
- Fig. 1b is a detail view of the end of an escalator according to fig. 1a and an newel which is provided at this end for guiding the handrail;
- Fig. 1c is a detail view of a floor plate of an escalator according to fig. 1a;
- Fig. 2 is a schematic illustration of sensors, a supply unit, a conversion unit and a processing unit of an escalator according to figs. 1a-1c; and
- Fig. 3 is a schematic illustration of a method according to an aspect of the invention.

Detailed description of the embodiments

[0031] The described embodiments are merely examples that can be modified and/or supplemented in a variety of ways within the scope of the claims. Any feature described for a particular embodiment example may be used independently or in combination with other features in any other embodiment example. Any feature described for an embodiment example of a particular claim category may also be used in a corresponding manner in an embodiment example of another claim category.

[0032] Figure 1a shows an escalator 1 having a support structure 2 and a number of steps 3 received and guided in a circular manner in the support structure 2. The steps form a path 4, which connects a lower floor plate 5.1 on a first height level with an upper floor plate 5.2 on a second height level. Further, mounted on the support structure 2, the escalator 1 comprises a first balustrade 6.1, on which a first handrail 7.1 is mounted and guided in a circular manner, and a second balustrade 6.2 on which a second handrail 7.2 is mounted and guided in a circular manner. Fig. 1b shows an upper end of the second balustrade 6.2 in detail, where the second handrail 7.2 is deflected from its upper flank back into a skirt 8 of the escalator 1. For guiding the second handrail 7.2 during deflection, a newel 9 is mounted on the second balustrade 6.2, on which the second handrail 7.2 is mounted/-guided. The newel 9 is made from metal and in direct contact with the second handrail 7.2. At all ends of the balustrades 6.1, 6.2, the handrails 7.1, 7.2 are mounted and guided according to fig. 1b.

[0033] As schematically illustrated in fig. 1a, at an

upper end of the first balustrade 6.1, thus at a first upper newel 9.1, a first temperature sensor 11.1 is mounted for measuring the first handrail's 7.1 temperature in the area of the first upper newel 9.1. Further, at a lower end of the first balustrade 6.1, thus at a first lower newel 9.2, a second temperature sensor 11.2 is mounted for measuring the first handrail's 7.1 temperature in the area of the first lower newel 9.2. In the same manner, at an upper end of the second balustrade 6.2, thus at a second upper newel 9.3, a third temperature sensor 11.3 is mounted for measuring the second handrail's 7.2 temperature in the area of the second upper newel 9.3. Further, at a lower end of the second balustrade 6.2, thus at a second lower newel 9.4, a fourth temperature sensor 11.4 is mounted for measuring the second handrail's 7.2 temperature in the area of the second lower newel 9.4. As exemplarity and schematical illustrated in fig. 1b for the third temperature sensor 11.3 and applicable for all temperature sensors 11.1, 11.2, 11.3, 11.4, the sensor may be provided in the skirt 8 as an infrared sensor directed to the according handrail 7.1, 7.2 or newel 9.1, 9.2, 9.3, 9.4. Alternatively, but not illustrated in detail, the temperature sensors 11.1, 11.2, 11.3, 11.4 may be provided as contact sensors in contact with the newels 9.1, 9.3, 9.2, 9.4 for indirect measurement or in contact with the handrails 7.1, 7.2 for direct measurement.

[0034] Fig. 1c illustrates the upper floor plate 5.2 of the escalator 1 according to fig 1a, wherein the most upper steps 3 and the skirts 8 on both sides of the steps 3 are shown. On the upper floor plate, a reference temperature sensor 12 is provided measuring the ambient temperature of the environment of the escalator 1. The reference temperature sensor 12 is used a first reference temperature sensor 12.1 and as a second reference temperature sensor 12.2 at the same time.

[0035] Fig. 2 schematical illustrates the electrics used for the temperature sensors 11.1, 11.2, 11.3 11.4 and the reference temperature sensor 12 in an exemplary set-up. All of these sensors 11.1, 11.2, 11.3 11.4, 12 are connected to a supply unit 13 formed as a gateway by wires 14. The supply unit 13 provides a supply voltage to the sensors 11.1, 11.2, 11.3 11.4, 12 and receives their signals, e.g. analog signals. The supply unit 13 is further connected to a conversion unit 15 for converting the signals to a data format readable for a processing unit 16, which the conversion unit 15 is connected to. Thus, the conversion unit 15 interprets the sensor's 11.1, 11.2, 11.3 11.4, 12 data and provide a data format to the processing unit 16, which is readable for the processing unit 16. In the processing unit 16, a method according to fig. 3 may be executed. The processing unit 16 further comprises a non-volatile storage 16.1 for recording received values from the sensors 11.1, 11.2, 11.3 11.4, 12. The processing unit 16 may be a central control unit of the escalator 1.

[0036] Fig. 3 schematically illustrates a method 20 to detect excess tension in one of the handrails 7.1, 7.2 of the escalator 1 according to figs. 1a to 1c. In a first step 21, the measuring values of the first temperature sensor 11.1, the second temperature sensor 11.2, the third temperature sensor 11.3 and/or the fourth temperature sensor 11.4 are received by the processing unit 16. In a second step 22, the measuring values of the first reference temperature sensor 12.1 and/or the second reference temperature sensor 12.2 are received by the processing unit 16. In a third step 23, the measuring values of at least one temperature sensor 11.1, 11.2, 11.3, 11.4 and it's assigned reference temperature sensor 12.1, 12.2 are recorded over at least a first time period on the non-volatile storage 16.1. In a fourth step 24, the measuring values of at least one temperature sensor 11.1, 11.2, 11.3, 11.4 and it's assigned reference temperature sensor 12.1, 12.2 are compared by the processing unit 16. In a fifth step 25, excess tension in the respective handrail 7.1, 7.2 is indicated in case an unexpected proportion between the compared values is determined.

Reference list

[0037]

1	escalator
2	support structure
3	steps
4	path
5.1	lower floor plate
5.2	upper floor plate
6.1	first balustrade
6.2	second balustrade
7.1	first handrail
7.2	second handrail
8	skirt
9	newel
9.1	first upper newel
9.2	first lower newel
9.3	second upper newel
9.4	second lower newel
11.1	first temperature sensor
11.2	second temperature sensor
11.3	third temperature sensor
11.4	fourth temperature sensor
12	reference temperature sensor
12.1	first reference temperature sensor
12.2	second reference temperature sensor
13	supply unit
14	wires
15	conversion unit
16	processing unit
16.1	non-volatile storage
20	method to detect excess tension in a handrail
21	first step of the method - receiving measuring values of the temperature sensors
22	second step of the method - receiving measuring values of the reference temperature sensors
23	third step of the method - recording the measuring values over a first time period

24 fourth step of the method - comparing the measuring values
25 fifth step of the method - indicating excess tension

Claims

1. An escalator (1), comprising:

a support structure (2);
a number of steps (3) or pallets or a moving belt guided in the support structure (2) in a circulating manner and forming a path (4);
at least a first handrail (7.1) guided in a circulating manner and being turned around by a first upper newel (9.1) and a first lower newel (9.2) respectively;
at least a first tensioning device for tensioning the first handrail (7.1);
at least a first temperature sensor (11.1) provided at the first handrail (7.1) for measuring the first handrail's (7.1) temperature;
at least a first reference temperature sensor (12.1) for the first temperature sensor (11.1); and
at least one processing unit (16) configured to receive measuring values from the first temperature sensor (11.1) and the first reference temperature sensor (12.1);
wherein the processing unit (16) is configured to compare the measuring values of the first temperature sensor (11.1) and the measuring values of the first reference temperature sensor (12.1).

2. Escalator (1) according to claim 1,

wherein the first temperature sensor (11.1) is provided at the first upper newel (9.1);
wherein a second temperature sensor (11.2) is provided at the first lower newel (9.2) for measuring the first handrail's (7.1) temperature;
wherein the processing unit (16) is configured to receive measuring values from the second temperature sensor (11.2); and
wherein the processing unit (16) is configured to compare the measuring values of the second temperature sensor (11.2) and the measuring values of the first reference temperature sensor (12.1).

3. Escalator (1) according to claim 1 or 2, comprising:

the first handrail (7.1) on a first side of the path (4) and a second handrail (7.2) on a second side of the path (4), wherein the second handrail (7.2) is guided in a circulating manner and is turned around by a second upper newel (9.3) and a second lower newel (9.4) respectively;
a second tensioning device for tensioning the second handrail (7.2);
a third temperature sensor (11.3) provided at the second handrail (7.2) for measuring the seconds handrail's (7.2) temperature; and
a second reference temperature sensor (12.2) for the third temperature sensor (11.3);
wherein the processing unit (16) is configured to receive measuring values from the third temperature sensor (11.3) and the second reference temperature sensor (12.2);
wherein the processing unit (16) is configured to compare the measuring values of the third temperature sensor (11.3) and the measuring values of the second reference temperature sensor (12.2).

4. Escalator (1) according to claim 3,

wherein the third temperature sensor (11.3) is provided at the second upper newel (9.3);
wherein a fourth temperature sensor (11.4) is provided at the second lower newel (9.4) for measuring the second handrail's (7.2) temperature;
wherein the processing unit (16) is configured to receive measuring values from the fourth temperature sensor (11.4); and
wherein the processing unit (16) is configured to compare the measuring values of the fourth temperature sensor (11.4) and the measuring values of the second reference temperature sensor (12.2).

5. Escalator (1) according to claim 3 or 4, wherein the processing unit (16) is configured to use the third temperature sensor (11.3) or the fourth temperature sensor (11.4) as the first reference temperature sensor (12.1) and/or the first temperature sensor (11. 1) or the second temperature sensor (11.2) as the second reference temperature sensor (12.2).

6. Escalator (1) according to any of the preceding claims, wherein the first reference temperature sensor (12.1) and/or the second reference temperature sensor (12.2) is/are provided at the escalator (1) for measuring an ambient temperature.

7. Escalator (1) according to claim 6, wherein the first reference temperature sensor (12.1) and/or the second reference temperature sensor (12.2) is/are provided at a comb plate or a floor plate (5.1, 5.2).

8. Escalator (1) according to claim 6 or 7, wherein the first reference temperature sensor (12.1) and the second reference temperature sensor (12.2) are provided as a single sensor (12).

9. Escalator (1) according to any of the preceding claims, wherein the processing unit (16) is configured to record received measuring values.

10. Escalator (1) according to any of the preceding claims, wherein at least one temperature sensor (11.1, 11.2, 11.3, 11.4) is a contact sensor and/or at least one temperature sensor (11.1, 11.2, 11.3, 11.4) is an infrared sensor.

11. Escalator (1) according to any of the preceding claims, comprising

a first balustrade (6.1), wherein the first handrail (7.1) is mounted and guided on the first balustrade (6.1); and/or
a second balustrade (6.2), wherein the second handrail (7.2) is mounted and guided on the second balustrade (6.2).

12. Method (20) to detect excess tension at a handrail (7.1, 7.2) of an escalator (1) according to any of the preceding claims, the method (20) comprising the steps:

receiving the measuring values of the first temperature sensor (11.1), the second temperature sensor (11.2), the third temperature sensor (11.3) and/or the fourth temperature sensor (11.4) (21);
receiving the measuring values of the first reference temperature sensor (12.1) and/or the second reference temperature sensor (12.2) (22);
comparing the measuring values of at least one temperature sensor (11.1, 11.2, 11.3, 11.4) and it's assigned reference temperature sensor(12.1, 12.2) (24); and
indicating excess tension in the respective handrail (7.1, 7.2) in case an unexpected proportion between the compared values is determined (25).

13. Method (20) according to claim 12, wherein at least one out of the first temperature sensor (11.1), the second temperature sensor (11.2), the third temperature sensor (11.3) and the fourth temperature sensor (11.4) is used as a reference temperature sensor (12), wherein an unexpected proportion is determined in that the measured values of the first handrail (7.1) and the second handrail (7.2) deviate from each other beyond a threshold.

14. Method (20) according to claim 12 or 13, further comprising the step:
recording the measuring values of at least one temperature sensor (11.1, 11.2, 11.3, 11.4) and it's assigned reference temperature sensor (12.1, 12.2) over at least a first time period (23).

15. Method (20) according to claim 14, wherein an unexpected proportion is determined, when the recorded measuring values of the temperature sensor (11.1, 11.2, 11.3, 11.4) deviate from a predetermined function having the measuring values of the assigned reference temperature sensor (12.1, 12.2) and the time as variables.

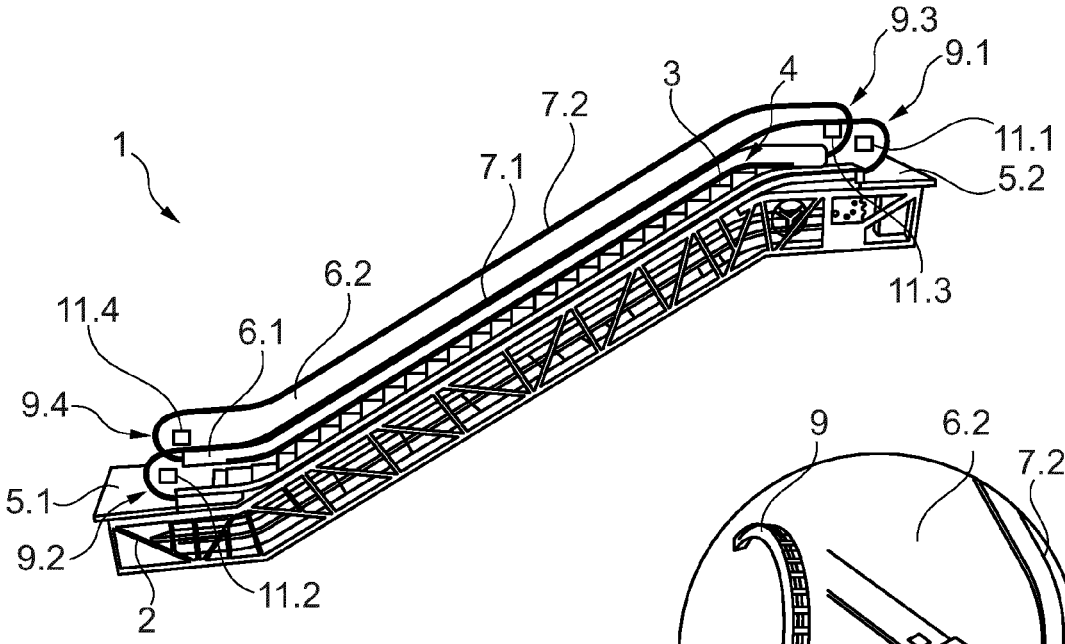

Fig. 1a

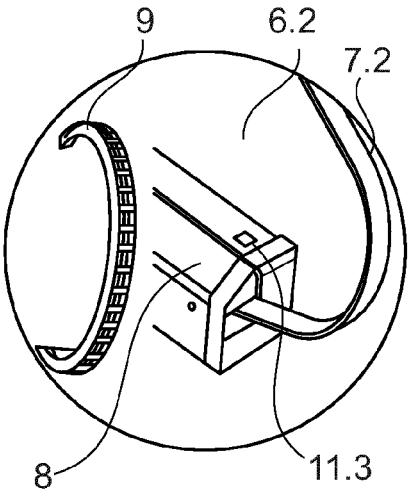

Fig. 1b

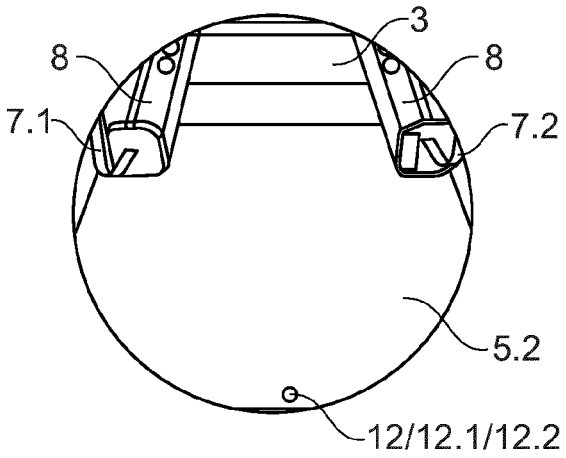

Fig. 1c

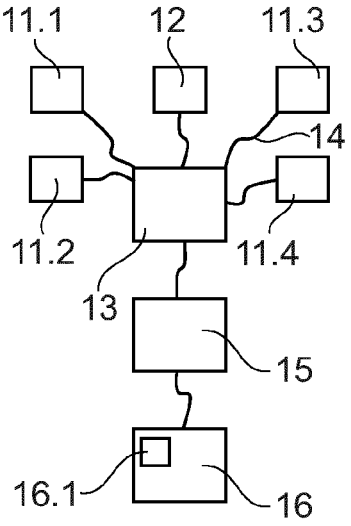

Fig. 2

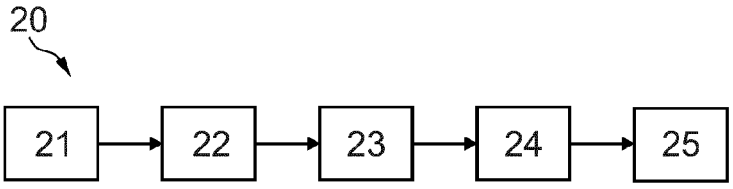

Fig. 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 38 2929

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	JP 2020 093914 A (TOSHIBA ELEVATOR CO LTD) 18 June 2020 (2020-06-18) * paragraphs [0024] - [0029]; figures 1-3 *	1-15	INV. B66B23/24 B66B25/00 B66B29/04
A	US 2020/087116 A1 (CAI QINGXI [CN] ET AL) 19 March 2020 (2020-03-19) * paragraphs [0042], [0053], [0054]; figures 1,2 *	1-15	ADD. B66B23/20
A	US 2022/348438 A1 (KUSSEROW MARTIN [CH] ET AL) 3 November 2022 (2022-11-03) * paragraphs [0048] - [0050], [0060]; figures 2,3 *	1-15	
A	CN 113 928 964 B (CN RAILWAY SIYUAN SURVEY & DES; WUHAN THINKING STAR TECH CO LTD) 20 June 2023 (2023-06-20) * figures 1,2 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

B66B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 February 2024	Miklos, Zoltan

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 38 2929

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

28-02-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2020093914 A	18-06-2020	CN 211871129 U	06-11-2020
		JP 6611902 B1	27-11-2019
		JP 2020093914 A	18-06-2020
US 2020087116 A1	19-03-2020	CN 110921478 A	27-03-2020
		EP 3647250 A1	06-05-2020
		US 2020087116 A1	19-03-2020
US 2022348438 A1	03-11-2022	AU 2017311429 A1	24-01-2019
		BR 112019000440 A2	30-04-2019
		CN 109641717 A	16-04-2019
		EP 3497046 A1	19-06-2019
		EP 4101802 A1	14-12-2022
		US 2019152744 A1	23-05-2019
		US 2022348438 A1	03-11-2022
		WO 2018028989 A1	15-02-2018
CN 113928964 B	20-06-2023	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82