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(54) ANTI-ENTRAPMENT SAFETY SYSTEM

(57) The present invention refers to an anti-entrapment safety system for a passenger moving system comprising preferably a first endless handrail belt and preferably a second endless handrail belt, wherein the safety system comprises a plurality of movable parts wherein a first movable part is adapted to respond to an entrapment force (F_e) applied thereto and wherein the response comprises an upwards rotation or a downwards rotation of the first movable part. The upwards rotation or the downwards rotation of the first movable part preferably activates the anti-entrapment safety system when the rotation exceeds a pre-determined threshold value. The threshold value is preferably defined as a rotation in the range of 0.5 to 20.0 degrees.

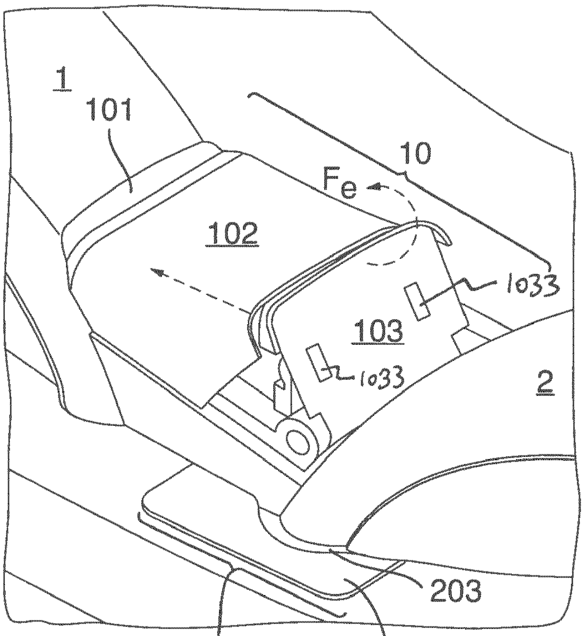

Fig. 1b

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Description

[0001] The invention refers to an anti-entrapment safety system, in particular to an anti-entrapment safety system for a passenger moving system such as those used in all manner of large-scale premises, for example, in airports and/or stations in which there is an aim to facilitate passenger movement. In particular, the invention refers to an anti-entrapment safety system for a passenger moving system comprising preferably a first endless handrail belt and preferably a second endless handrail belt, wherein the safety system comprises a plurality of movable parts wherein a first movable part is adapted to respond to an entrapment force (F_e) applied thereto and wherein the response comprises an upwards rotation or a downwards rotation of the first movable part. The upwards rotation or the downwards rotation of the first movable part preferably activates the anti-entrapment safety system when the rotation exceeds a pre-determined threshold value. The threshold value is preferably defined as a rotation in the range of 0.5 to 20.0 degrees.

[0002] Handrails and handrail systems for moving walking systems including variable speed moving walking systems are already known in the art.

[0003] JP H11 301857 discloses a device for a handrail of a variable speed moving walkway wherein the device is adapted to initiate an emergency stop of the moving walkway in the event of an entrapment about the handrail belt. The device comprises brushes which are arranged without gaps from the surface portion of the handrail to alert passengers about the approaching changeover of handrails and a separate detecting means provided therebelow for detecting an entrapment. The detecting means comprises a shielding plate, which is forced in the upwards direction via a spring positioned underneath so that any downward force will cause the shielding plate to rotate downwards and cause an emergency stop of the moving walkway. However, any downward force, be it intentional i.e., an entrapment, or unintentional i.e. no entrapment but accidental contact with the shielding plate, will cause the moving walkway to come to an emergency stop. This can be both inconvenient and dangerous for the passengers travelling on the moving walkway

[0004] JP2001106464 discloses a variable speed moving walkway having a foreign matter detection means positioned on the handrail at the point where a first handrail ends and a second handrail begins, wherein said detection means is comprised of a sliding mechanism which slides backwards upon an entrapment and activates a limit switch causing the moving walkway to stop. Again, any force, be it intentional i.e., an entrapment, or unintentional i.e., no entrapment but accidental contact with the sliding mechanism, will cause the moving walkway to come to an emergency stop. This can be both inconvenient and dangerous for the passengers travelling on the moving walkway

[0005] It is therefore an object of this invention to provide an alternative anti-entrapment safety system which is specifically designed to stop a passenger moving system in cases of entrapments only and thus avoids unnecessary stopping which can be counter-productive in terms of passenger safety. This object is solved by an anti-entrapment safety system according to claim 1, and a passenger moving system according to claims 4 and 7.

[0006] The inventive anti-entrapment system and a passenger moving system comprising the inventive anti-entrapment system are the subject of the appended claims and are described in further detail in the following embodiments and figure description. The invention relates to:

|1| An anti-entrapment safety system for a passenger moving system comprising a first endless handrail belt and a second endless handrail belt, wherein the anti-entrapment safety system comprises a plurality of movable parts. A first movable part is adapted to respond to an entrapment force (F_e) applied thereto, wherein the response comprises an upwards rotation or a downwards rotation of the first movable part characterized in that the upwards rotation or the downwards rotation of the first movable part activates the anti-entrapment safety system when the rotation exceeds a pre-determined threshold value. Preferably, the rotation of the first movable part activates a limit switch which causes the passenger moving system to come to a stop.
The threshold value is defined as a rotation in the range of 0.5 to 20.0 degrees. This advantageously ensures that any unintentional or accidental rotation of the first movable part which may occur during normal operation of the passenger moving system, does not cause an unnecessary shutdown thus avoiding "false alarms" and thereby improving passenger safety.

|2| In an embodiment of the invention, the threshold value is defined as a rotation in the range of 1.5 to 18.0 degrees which activates the anti-entrapment safety system.

|3| In an embodiment of the invention, the threshold value is defined as a rotation in the range of 3.0 to 15.0 degrees which activates the anti-entrapment safety system.

|4| In an embodiment of the invention, the threshold value is defined as a rotation in the range of 4.0 to 10.0 degrees which activates the anti-entrapment safety system.

|5| In an embodiment of the invention, the threshold value is defined as a rotation in the range of 7.0 to 9.0 degrees which activates the anti-entrapment safety system.

|6| In an embodiment of the invention, the first end-

less handrail belt preferably refers to the handrail belt at the beginning of the passenger moving system where a passenger embarks. The second endless handrail belt preferably refers to the handrail belt succeeding the first handrail belt in the direction of travel of the passenger moving system. The plurality of movable parts comprised within the anti-entrapment safety system is preferably at least one selected from the following group comprising: a deflector; an entrapment trigger; a movable part; an actuator; at least one cam; a sensor; a contacting means or any combination thereof. The first movable part of the anti-entrapment safety system preferably refers to the entrapment trigger wherein the entrapment trigger is preferably biased. Preferably any rotation of the entrapment trigger causes rotation of a cam. The actuator preferably comprises a spring and a spring housing.

|7| In an embodiment of the invention, the entrapment trigger is preferably adapted to rotate either upwards or downwards depending on the type of force applied to it. If the force applied is an entrapment force, the entrapment trigger preferably rotates upwards. If the force applied is an impact force, the entrapment trigger preferably rotates downwards. Thus the anti-entrapment safety system is able to differentiate between different kinds of forces and respond accordingly. The anti-entrapment safety system is only activated upon an upward rotation of the entrapment trigger provided that the degree of upward rotation exceeds the rotation threshold. This advantageously ensures that any inadvertent or accidental rotation of the entrapment trigger which may occur during normal operation of the passenger moving system, does not cause it to shutdown unnecessarily thus avoiding "false alarms" and thereby improving passenger safety.

|8| In an embodiment of the invention, the entrapment trigger is preferably adapted to rotate downwards upon an entrapment force. The anti-entrapment safety system is only activated upon downward rotation of the entrapment trigger provided that the degree of downward rotation exceeds the rotation threshold. This advantageously ensures that inadvertent or accidental rotations of the entrapment trigger which may occur during normal operation, do not cause unnecessary shutdowns of the passenger moving system i.e., "false alarms".

|9| In an embodiment of the invention, the entrapment trigger comprises the cam, such that they form a single movable body. In another embodiment of the invention, the entrapment trigger and the cam are individual units which contact each other.

|10| In an embodiment of the invention the entrapment trigger, comprises at least one rolling element, wherein a preferred example of a rolling element is a wheel.

|11| In an embodiment of the invention the at least one rolling element, e.g., wheel, contacts at least one endless handrail belt of the passenger moving system or at least one further movable part of the inventive anti-entrapment safety system. The further movable part is preferably a cam.

|12| In an embodiment of the invention, preferably the at least one wheel, preferably two wheels, are comprised on the underside of the entrapment trigger so as not to be contactable by a passenger's hand when using the handrail belt of the passenger moving system. Their positioning is such that they preferably avoid interfering with or contributing to any potential entrapment. The wheel or wheels contact the handrail belt of the passenger moving system and travel at the same speed and in the same direction as the handrail belt. In particular, due to the presence of the wheel or wheels, the outer surface of the entrapment trigger of the anti-entrapment safety system preferably rests above the handrail belt such that a gap of 0.01 mm to 5.0 mm exists there-between, preferably a gap of 1.0 mm to 2.5 mm exists there-between, preferably a gap of 1.2 mm to 1.7 mm exists there-between. This advantageously ensures that the entrapment trigger contacts the handrail belt at all times via the wheel or wheels, and its performance in detecting entrapments is enhanced.

|13| In an embodiment of the invention, at least one wheel, preferably two wheels are positioned on either side, preferably lengthwise, of the entrapment trigger of the anti-entrapment safety system wherein the wheel contacts a cam such that the wheel or wheels are able to travel along the outer surface of the cam. This advantageously provides for the rotation of entrapment trigger and consequently serves to activate the anti-entrapment safety system. This is explained in further detail in the figure description. Preferably a gap of 0.01 mm to 5.0 mm exists between the outer edge of the entrapment trigger and the handrail belt, preferably a gap of 1.0 mm to 2.5 mm exists between the outer edge of the entrapment trigger and the handrail belt, preferably a gap of 1.2 mm to 1.7 mm exists between the outer edge of the entrapment trigger and the handrail belt. This advantageously ensures that the entrapment trigger does not hinder the motion of the handrail belt yet it is in close enough proximity to the belt so as to respond appropriately to any entrapment.

|14| In an embodiment of the invention, the first movable part of the anti-entrapment safety system or a further movable part of the anti-entrapment safety

system or a combination of both first and further movable parts of the anti-entrapment safety system, is preferably adapted to determine the degree of rotation required to activate the anti-entrapment safety system, in particular to activate the sensor, e.g., a limit switch. The first movable part preferably refers to the entrapment trigger and the further movable part preferably refers to the cam. The combination of both first and further movable parts preferably refers to an entrapment trigger comprising a cam such that the entrapment trigger and the cam form a single movable part, or to an individual entrapment trigger and an individual cam which are adapted to contact each other. Control of the degree of rotation required can be achieved by various means, for example, the positioning of the movable parts within the safety system, altering the shape of the cam; introducing a spring bias of varying strength into the movable parts. This advantageously provides for an anti-entrapment safety system that can be adapted to respond to varying entrapment forces and therefore can be adapted according to specific safety requirements.

[0007] The invention also relates to:

|15| A passenger moving system comprising a first endless handrail belt, a second endless handrail belt and an inventive anti-entrapment safety system positioned there-between. Preferably the inventive anti-entrapment safety system is positioned such that it forms a bridge between the first endless handrail belt and the second endless handrail belt. The first movable part of the anti-entrapment safety system, i.e., the entrapment trigger, is preferably positioned adjacent to the succeeding endless handrail belt in the direction of travel of the passenger moving system, more preferably positioned above the balustrade comprising the succeeding endless handrail belt, wherein the succeeding endless handrail belt can be the first endless handrail belt or the second endless handrail belt. Preferably the at least one rolling element, preferably at least one wheel, contacts the succeeding endless handrail belt. The entrapment trigger is adapted to be rotated upwards about an axis (A), preferably in a direction away from the succeeding endless handrail belt, in the event of an entrapment. The force of entrapment F_e preferably causes a rotation of the entrapment trigger which is greater than the rotation threshold, e.g., a rotation of 8.0 degrees, thus activating the anti-entrapment safety system and causing the passenger moving system to come to a stop. This advantageously ensures that any inadvertent or accidental rotation of the entrapment trigger which may occur during normal operation of the passenger moving system, does not cause it to shutdown unnecessarily thus avoiding "false alarms" and thereby improving passenger safety. Furthermore, it advantageously provides a system that is capable of stopping the passenger moving system whilst also providing a gap in the vicinity of the handrail which could facilitate the release of the cause of the entrapment, e.g., a trapped piece of material or a small item. In an embodiment of the invention, the first movable part, i.e., the entrapment trigger is adapted such that a force (F) in a direction towards the succeeding endless handrail belt is supplied thereto via at least one further movable part of the inventive anti-entrapment safety system during normal operation of the passenger moving system. The further movable part is preferably the actuator. In other words, the entrapment trigger is preferably biased.

|16| In an embodiment of the invention, the inventive anti-entrapment safety system, in particular the first movable part, preferably the entrapment trigger, is adapted to differentiate between a force of impact (F_i) and a force of entrapment (F_e). The force of impact is preferably a downwards force upon the entrapment trigger, whereas the force of entrapment is preferably an upwards rotative force upon the entrapment trigger. The anti-entrapment safety system will only respond to a force of entrapment, moreover, it will only respond if the force of entrapment F_e causes a rotation of the entrapment trigger which is greater than the rotation threshold, e.g., a rotation of 8.0 degrees, therefore advantageously avoiding unnecessary stopping of the passenger moving system.

|17| In an embodiment of the invention, the passenger moving system comprises a variable speed passenger moving system or a constant speed passenger moving system.

[0008] The invention also relates to:

|18| A passenger moving system comprising a first endless handrail belt and a second endless handrail belt and at least one inventive anti-entrapment safety system, preferably a first inventive anti-entrapment safety system, preferably a first and a second inventive anti-entrapment safety system, preferably a first, second and a third inventive anti-entrapment safety system . Preferably, at least one anti-entrapment safety system is located within the balustrade comprising the first endless handrail belt and the second endless handrail belt such that the first movable part of the at least one inventive anti-entrapment safety system is adjacent to the first endless handrail belt or to the second endless handrail belt. Preferably the first movable part, preferably the entrapment trigger of the inventive anti-entrapment safety system is adapted to be rotated downwards about an axis (E) upon an entrapment. The force of entrapment F_e preferably causes a rotation of the entrapment trig-

ger which is greater than the rotation threshold, e.g., a rotation of 8.0 degrees, thus activating the anti-entrapment safety system and causing the passenger moving system to come to a stop. This advantageously ensures that inadvertent or accidental rotations of the entrapment trigger which may occur during normal operation, do not cause unnecessary shutdowns of the passenger moving system i.e., "false alarms". Furthermore, it advantageously provides a system that is capable of simultaneously stopping the passenger moving system whilst also providing a gap in the system which could facilitate the release of the cause of the entrapment, e.g., a trapped piece of material or a small item in the vicinity of the intersection between consecutive handrail belts

|19| In an embodiment of the invention, the first movable part of the inventive anti-entrapment safety system comprised within said passenger moving system is adapted such that the at least one rolling element, preferably a wheel, contacts at least one second movable part of the inventive anti-entrapment safety system, wherein the second movable part is preferably a cam and wherein the first movable part is preferably the entrapment trigger.

|20| In an embodiment of the invention, the first movable part, i.e., the entrapment trigger is adapted such that a force (F) preferably in a downwards direction is supplied thereto via at least one further movable part during normal operation of the passenger moving system. The at least one further movable part is preferably a deflector. In other words, the entrapment trigger is preferably biased.

|21| In an embodiment of the invention, the first movable part, i.e., entrapment trigger of the first anti-entrapment safety system is adapted such that a lateral compressive force is applied to it from at least one second movable part of the first anti-entrapment safety system during normal operation of the passenger moving system. Preferably, a lateral compressive force is applied at each side to the entrapment trigger, from two second movable parts. Preferably, the second movable part refers to a cam. This advantageously holds the entrapment trigger in position during normal operation mode.

|22| In an embodiment of the invention, a first anti-entrapment safety system is preferably comprised within the balustrade such that the first movable part, preferably the entrapment trigger, is adjacent to a first endless handrail belt or second endless handrail belt at the point where the first endless handrail belt or second endless handrail belt moves towards entering the balustrade or at the point where the first endless handrail belt or second endless handrail belt exit a balustrade. This advantageously ensures that the safety system is positioned at the point where entrapments are most likely to occur.

|23| In an embodiment of the invention, the first anti-entrapment safety system is positioned such that the first movable part, preferably the entrapment trigger, is adjacent to the first endless handrail belt at the point where the first endless handrail belt moves towards entering a balustrade to change travel direction.

|24| In an embodiment of the invention, the first anti-entrapment safety system is positioned such that the first movable part, preferably the entrapment trigger is adjacent to the second endless handrail belt at the point where the second endless handrail belt is exiting a balustrade to travel along the length of the passenger moving system.

|25| In an embodiment of the invention, the passenger moving system comprises within the balustrade a second first anti-entrapment safety system, wherein the first anti-entrapment safety system and second first anti-entrapment safety system preferably operate independently of each other. Preferably, the second first anti-entrapment safety system is located on the opposite side of the handrail belt to the first anti-entrapment safety system. This advantageously provides a passenger moving system that comprises a plurality of anti-entrapment safety systems around the handrail belt at the point at which entrapment is most likely to occur, wherein the safety systems are independent of each other and capable of simultaneously stopping the passenger moving system whilst also facilitating the release of any trapped material or item at any point about the handrail belt which can be contacted by a passenger. Thus, should one safety system fail, the other system is still able to detect entrapments and respond accordingly. Furthermore, it is not guaranteed that entrapments will occur only at a designated point on the handrail belt, therefore, having a plurality of independent anti-entrapment safety systems ensures any entrapment will be quickly and efficiently resolved thereby improving passenger safety.

|26| In an embodiment of the invention, the passenger moving system comprises a further inventive anti-entrapment safety system. Preferably the further anti-entrapment safety system is positioned between the first endless handrail belt and the second endless handrail belt forming a bridge there-between. The first movable part of the further anti-entrapment safety system, preferably the entrapment trigger, is preferably positioned adjacent to the succeeding endless handrail belt in the direction of travel of the passenger moving system, more preferably

positioned above the balustrade comprising the succeeding endless handrail belt, wherein the succeeding endless handrail belt can be the first endless handrail belt or the second endless handrail belt. Preferably the at least one rolling element comprised within the first movable part of the further anti-entrapment safety system, preferably at least one wheel, contacts the succeeding endless handrail belt. The first movable part, preferably the entrapment trigger, of the further inventive anti-entrapment safety system is adapted to be rotated upwards about an axis (A), preferably in a direction away from the succeeding endless handrail belt in the event of an entrapment. Each of the inventive anti-entrapment safety systems, i.e., the first anti-entrapment safety system, the second first anti-entrapment safety system and the further anti-entrapment safety system, is only activated upon a rotation of the respective entrapment trigger that exceeds the rotation threshold.

[0009] Preferably the further anti-entrapment safety system is adapted to differentiate between a force of impact (F_i) and a force of entrapment (F_e), wherein the further anti-entrapment safety system is adapted to respond to a force of entrapment only.

[0010] This advantageously ensures that inadvertent or accidental rotations of any entrapment trigger which may occur during normal operation, do not cause unnecessary shutdowns of the passenger moving system i.e., "false alarms". Furthermore, this advantageously provides a passenger moving system that comprises a plurality of inventive anti-entrapment safety systems around the handrail belt at the points where entrapment is most likely to occur, wherein the safety systems are independent of each other and capable of simultaneously stopping the passenger moving system whilst also facilitating the release of any trapped material or item at any point about the handrail belt which can be contacted by a passenger. Thus, should one safety system fail, the other system is still able to detect entrapments and respond accordingly. Furthermore, it is not guaranteed that entrapments will occur only at a designated point on the handrail belt, therefore, having a plurality of independent anti-entrapment safety systems ensures any entrapment will be quickly and efficiently resolved thereby improving passenger safety.

|27| In an embodiment of the invention, the passenger moving system comprises a variable speed passenger moving system or a constant speed passenger moving system.

[0011] The invention is described in more detail with the help of the figures, wherein it is shown schematically:

Fig. 1a a schematic top view of a passenger moving system comprising a plurality of inventive anti-entrapment safety systems, in particular a safety system according to a first embodiment of the invention and at least one safety system according to second embodiment of the invention when the passenger moving system is in normal operation mode;

Fig. 1b a schematic top view of a passenger moving system shown in fig. 1a, wherein the safety system according to the first embodiment of the invention is activated due to an entrapment;

Fig.2a a schematic cross-sectional view of the safety system according to a first embodiment of the invention when at rest position;

Fig. 2b a schematic cross-sectional view of two communicating parts of an inventive anti-entrapment safety system according to a first embodiment of the invention when at rest position;

Fig.3a a schematic cross-sectional view of two communicating parts of the inventive anti-entrapment safety system according to a first embodiment of the invention when at rest position

Fig. 3b a schematic cross-sectional view of the inventive anti-entrapment safety system according to a first embodiment of the invention before the limit switch is triggered, i.e., before the safety system is activated;

Fig. 3c a schematic cross-sectional view of the inventive anti-entrapment safety system according to a first embodiment of the invention when entrapment has occurred and the limit switch is triggered;

Fig. 3d a schematic cross-sectional view of component parts of the inventive anti-entrapment safety system according to a first embodiment of the invention when entrapment has occurred;

Fig. 4a a schematic representation of an inventive anti-entrapment safety system according to a second embodiment of the invention when in normal operation mode;

Fig. 4b a schematic top view of how the inventive anti-entrapment safety system according to a second embodiment of the invention reacts when entrapment occurs;

Fig. 5a to 5e a schematic representation of the inventive anti-entrapment safety system according to a second embodiment of the invention and the stages of movement starting from normal mode operation to entrapment;

Fig 6a to 6b; a schematic representation of the inventive anti-entrapment safety system according to a second embodiment of the invention when positioned on a handrail belt of a passenger moving system.

[0012] In fig. 1a, an anti-entrapment safety system 10 according to a first embodiment of the invention and an anti-entrapment safety system 20 according to a second embodiment of the invention are positioned about a first handrail belt 1 and a second handrail belt 2 wherein each system 10, 20 are shown to be at rest, i.e., the passenger moving system is in normal operation mode and no entrapments have occurred. The safety system 10 is positioned between a first handrail belt 1 and a second handrail belt 2 whereas the safety system 20 is positioned about handrail belt 2 only. The outer surface of the safety system 10, i.e., the surface contactable by a passenger of the passenger moving system, comprises a fixed part 101 adjacent to the first handrail belt 1, an entrapment trigger 103 adjacent to the second handrail belt 2 and a deflector 102 positioned there-between. The entrapment trigger 103 is adapted to move in particular, rotate upwards, when exposed to an entrapment force F_e wherein said force F_e must be sufficient to overcome the rotation threshold. The response of the safety system 10 to an entrapment is shown more clearly in fig. 1b.

[0013] In fig. 1b, the safety system 10 according to a first embodiment of the invention is shown after an entrapment has occurred. The movement of the entrapment trigger 103, in particular the rotation of the entrapment trigger 103 from the position shown in fig. 1a to the position shown in fig. 1b is caused by the entrapment force F_e. The upwards rotation of the entrapment trigger 103 exposes a larger surface area of the handrail belt 2 and causes the passenger moving system to stop. It also may help to relieve the entrapment. The upwards rotation of the entrapment trigger 103 also causes the deflector 102 to slide across the outer surface of the fixed part 101 (as shown by the straight dotted arrow). Fig. 1b also shows the presence of a rolling element 1033 on the underside of the entrapment trigger 103. In this particular example, two rolling elements 1033 are comprised within the entrapment trigger 103 wherein the rolling element 1033 is a wheel. The safety system 20 may also be activated via the same entrapment that activates the safety system 10. The mechanism by which the safety system 10 operates is explained further in figs. 2a to 3d. The mechanism by which the safety system 20 operates is explained further in figs 4a to 6b.

[0014] Fig. 2a shows a cross-sectional view of the component parts of the safety system 10 shown in figs. 1a and 1b. The safety system 10 is positioned between a first handrail belt 1 and a second handrail belt 2 and is in its "rest position" i.e., the passenger moving system is in normal operation mode. The safety system 10 further comprises an actuator 104, wherein the actuator 104 comprises a spring 1041 in a spring housing 1042; a movable part 105 and a sensor 106. It is possible to use a pre-loaded sensor 106 in order to reduce the reaction time when an entrapment occurs In this particular example the sensor 106 is a limit switch. The deflector 102 facilitates the holding of the movable part 105 in place and *vice versa.* The actuator 104 is comprised within the movable part 105 wherein said actuator 104 is in communication with the entrapment trigger 103. The actuator 104 and the entrapment trigger 103 are connected at a joint X, wherein the joint X is preferably a pin (shown in fig. 2b). The actuator 104 exerts a force, e.g., a biasing force, upon the entrapment trigger 103 via the spring 1041. The movable part 105 shares an interface I with the limit switch 106, as shown by a dashed line. At the interface I, the movable part 105 and limit switch 106 are in contact. The entrapment trigger 103 shown in this particular example comprises a groove G which complements a surface S of the actuator 104.Fig 2b shows a magnified representation P of the groove G and surface S. The entrapment trigger 103 rotates about point A when an entrapment occurs causing the groove G to move around the surface S of the actuator 104. This is shown more clearly in figs 3a to 3d.

[0015] Figs. 3a to 3c describe in detail how the safety system 10 according to the invention operates. Fig. 3a shows the safety system 10 in its "rest" position during normal operation of the passenger moving system (not shown); fig 3b shows the safety system 10 just before an entrapment force F_e causes the entrapment trigger 103 to fully rotate upwards and move from a vertical forwards position V_f to a vertical backwards position V_b, and thereby activating the safety system; fig. 3c shows the safety system 10 when activated and fig. 3d shows an exploded view of a cam 1032 in relation to a movable part 105.

[0016] Fig. 3a shows the safety system 10 as shown in fig 2a, with the exception of the fixed part 101. Fig 3a shows the points of rotation A, B of the entrapment trigger 103 and the actuator 104 respectively. The spring 1041 causes the actuator 104 to exert a force F upon the entrapment trigger 103, i.e., exerts a biasing force on the entrapment trigger. This establishes the rotation threshold. The entrapment trigger 103 leans towards the handrail belt (not shown) in a vertical forward direction V_f providing a gap of a distance of 1.5 mm between the contactable surface of the entrapment trigger 103 and the handrail belt. The entrapment trigger 103 leans towards the handrail belt at an angle that allows the wheels 1033 of the entrapment trigger 103, to contact the handrail belt (not shown) at all times. The wheels 1033 rotate according to the moving direction and moving speed of the handrail belt. The wheels 1033 are preferably positioned away from the edge of the entrapment trigger on the surface facing the handrail belt (this is shown more clearly in fig. 1b) The deflector 102 is held in position via the movable part 105 and *vice versa* during normal operation of the passenger moving system. The safety system 10 is adapted to distinguish between a force caused by entrapment F_e and a force caused by impact F_i. A force of the latter type is shown by the downwards arrow F_i, whilst a force of the former type is shown in fig. 3b by the curved arrow F_e. The safety system 10 will only respond to an entrapment force F_e, since this force will rotate the entrapment trigger 103 in the upwards direction in an amount sufficient to exceed the rotation threshold, which then activates the limit switch 106.

[0017] Fig. 3b shows the safety system 10 upon application of an entrapment force F_e. The entrapment trigger 103 rotates upwards about point A in an anti-clockwise direction, which causes a simultaneous rotation of the actuator 104 about point B in a downwards anti-clockwise direction. The downward rotational movement of the actuator 104, pulls the movable part 105 downwards via a rotation about point C in an anti-clockwise direction.

[0018] In the event the entrapment force F_e is lower than the rotation threshold established by the force F supplied by the actuator 104 on the entrapment trigger 103 via the spring 1041, the entrapment trigger 103 will not rotate any further upwards, the movable part 105 will not move further downwards thus the deflector 102 will not be released. This ensures that the passenger moving system is not unnecessarily stopped.

[0019] In the event the entrapment force F_e is higher than the rotation threshold established by the force F supplied by the actuator 104 on the entrapment trigger 103 via the spring 1041 or, a further entrapment force F_e has been applied, the safety system 10 will continue to react according to fig. 3c.

[0020] Fig. 3c shows how the actuator 104 rotates further about point B in an anti-clockwise direction such that rotation point B is moved to a position below that of rotation point A. The spring 1041 is released and comprised fully within the spring housing 1042. The entrapment trigger 103 now rotates further about point A in an anti-clockwise direction. During this rotation, a cam 1032 contacts the movable part 105 (shown more clearly in fig. 3d) and rotates the movable part 105 further about point C in a downwards direction thereby causing the release of the deflector 102. When released, the deflector 102 slides along the surface of the fixed part 101 (as shown in fig. 1b) whilst the downward force of the movable part 105 activates the limit switch 106 causing the passenger moving system to stop. The cam 1032 is adapted to contact and rotate the movable part 105 only when the momentum generated by the force of entrapment F_e is greater than the momentum generated by the force F supplied by the actuator 104 on the entrapment trigger 103 via the spring 1041, i.e., the rotation threshold. In this particular example, the shape of the cam 1032 is such that a rotation of 8.0 degrees causes it to contact and rotate the movable part 105 thereby stopping the passenger moving system.

[0021] Fig. 4a shows an inventive anti-entrapment safety system 20 according to a second embodiment of the invention when in its "rest position" i.e., the passenger moving system is in normal operation mode. The safety system 20 according to this embodiment comprises an entrapment trigger 203, a deflector 202, a sensor 206 - in this particular example the sensor is a limit switch 206. The deflector 202 and entrapment trigger 203 are connected such that they form a single movable part; however, only manipulation of the entrapment trigger 203 will cause a manipulation of the deflector 202. The entrapment trigger 203 is adapted to be manipulated by an external force, in particular an entrapment force F_e. A first set of torsion springs 2021 is located in the deflector 202 and a second set of torsion springs 2031 is located in the entrapment trigger 203. "Set" can comprise one or more torsion spring. This is shown in figs. 5a to 5c. The torsion springs 2031 located in the entrapment trigger 203 push the entrapment trigger 203 towards the deflector 202 whilst the torsion springs 2021 located in the deflector 202 force the deflector 202 downwards towards a cam 204. This renders the deflector 202 and consequently, the entrapment trigger 203 under a downward force F, i.e., they are biased.

[0022] The cam 204 comprises a groove G and is located at each lengthwise end of the entrapment trigger 203 such that at least a length of the lateral edges of the deflector 202 rests upon a vertical top surface of the cam 204 (shown more clearly in figs. 5a to 5d). The lateral edges of the deflector 202 refer to the edges of the shortest sides of the deflector 202, i.e., those which lie perpendicular to the direction of the handrail belt (not shown). The cams 204 are preferably identical and are positioned such that they form mirror-images of each other. Each cam 204 is rotatable about a point D. This is explained in further detail in figs. 5a to 5e. The entrapment trigger 203, in particular a wheel 2033 of the entrapment trigger 203 contacts the cam 204 at the groove G (shown more clearly in figs. 5a to 5e).

[0023] The limit switch 206 is located opposite the cam 204 and contacts the cam 204 on an outer surface via a spring mechanism 205 which comprises a contacting means 2051. The outer surface refers to a surface that is not facing or in contact with the deflector 202 or entrapment trigger 203. The contacting means 2051 exerts a compressive force F_c on the cam 204 via the spring 205 thereby pushing the cam 204 towards the entrapment trigger 203. The contacting means 2051 used in this example is a pin.

[0024] A further spring 205 comprising a further pin 2051 is placed in the same position to the cam 204 located at the opposite end of the deflector 202 and entrapment trigger 203. The further pin 2051 exerts a compressive force F_c on the opposite cam 204 via the spring 205 which pushes the opposite cam 204 towards the entrapment trigger 203. The entrapment trigger 203 thus experiences simultaneously a compressive force F_c from both cams 204 and a force towards the deflector F.

[0025] Fig. 4a shows only one limit switch 206 positioned opposite a cam 204, however, a further limit switch 206 can optionally be placed in connection with the further spring 205 comprising the further pin 2051 which is located at the opposite end of the cam 204 located at the opposite end of the deflector 202 and entrapment trigger 203. The safety system 20 can comprise one limit switch 206 located at a first end of a cam 204 or two limit switches 206 located at each end of the cams 204 and still be able to respond to an entrapment by stopping the passenger moving system.

[0026] Fig. 4b shows the safety system 20 of fig. 4a in the activated position, i.e., when an entrapment has occurred. For illustration purposes, the limit switch 206 is shown to be positioned opposite the cam 204 located at the opposite end of the deflector 202 compared to the position shown in fig. 4a. An entrapment force F_e (not shown) causes the entrapment trigger 203 to rotate downwards from its resting horizontal position H_0 to an activated vertical position V_a which serves to create a gap around the handrail belt (not shown). Rotation of the entrapment trigger 203 causes the deflector 202 to rotate also. The simultaneous downward rotation of the deflector 202 and the entrapment trigger 203 occurs along rod 208 which allows for a rotation with respect to the balustrade (not shown) of the passenger moving system. The forming of a gap causes the passenger moving system to stop and can even help to relieve the entrapment. The steps by which the safety system 20 moves from a horizontal "resting" position to a vertical "activated" position are explained in detail in figs. 5a to 5e.

[0027] Fig. 5a shows a cross-section of the safety system 20 shown in fig. 4a when in normal operation mode and no entrapment has occurred. The deflector 202 rests upon the vertical top surface of the cams 204 at point X. A first torsion spring 2021 and a second torsion spring 2021 are located in the deflector 202 and a first torsion spring 2031 and a second torsion spring 2031 are located in the entrapment trigger 203. The torsion springs 2031 push the entrapment trigger 203 towards the deflector 202 whilst the torsion springs 2021 force the deflector 202 towards the cams 204. This is shown more clearly in figs. 5b and 5c.

[0028] The entrapment trigger 203 comprises a wheel 2033 on each side wherein each wheel 2033 contacts its respective cam 204 in the groove G. The deflector 202 and the entrapment trigger 203 are held in place via the cams 204 due to the compressive force F_c supplied by the pin 2051 and spring 205 located on each respective side. In normal operation mode, the compressive force F_c exerted on the cams 204 and the forces F exerted on the deflector 202 via the torsion springs 2021 and the force exerted on the entrapment trigger 203 via the torsion springs 2031 create an equilibrium F_{Eq} and no movement of the entrapment trigger 203 occurs.

[0029] Figs. 5b and 5c demonstrate how the safety system 20 responds to the application of an external force, in particular to an entrapment force F_e. An entrapment force F_e causes the entrapment trigger 203 to rotate downwards about point E. The rotation point E can be seen in fig. 5e from a side cross-sectional perspective of the safety system 20. The rotation causes each wheel 2033 of the entrapment trigger 203 to move downwards along the groove G of the respective cam 204 (arrows 1) and in doing so, each cam 204 is pushed outward (arrows 2) via rotation about point D - rotation point D is shown in figs. 4a, 4b and 5d. As each respective cam 204 is rotated outwards, the cams 204 push against the respective pins 2051 comprised within the springs 205 (not shown). The deflector 202 now rests upon a vertical top surface of the cams 204 at point Y. At this point, less surface area of the vertical top surface of each cam 204 is provided for the deflector 202 to rest upon.

[0030] In the event the entrapment force F_e applied is less than the equilibrium force F_{eq} and the rotation threshold has not been exceeded, the entrapment trigger 203 will not rotate downwards any further and the deflector 202 will remain resting upon the cams 204 at position Y. The cams 204 whilst having been rotated, have not been rotated to such a degree that the limit switch 206 is activated. Therefore, the passenger moving system will not be unnecessarily stopped. In the event the entrapment force F_e applied is greater than the equilibrium force F_{eq} and the rotation threshold has been exceeded or, a further entrapment force F_e has been applied and the rotation threshold has been exceeded, the entrapment trigger 203 will continue to react according to fig. 5c.

[0031] In fig. 5c, the entrapment force F_e causes the entrapment trigger 203 to rotate further about point E (fig. 5e) such that each wheel 2033 of the entrapment trigger 203 continues to travel downwards along the groove G of the respective cam 204 (arrows 1) until it has reached the end of the groove G and then travels further downwards along a continuing straight inner surface S_i of each respective cam 204. The cams 204 are each pushed further outward (arrows 2) via further rotation about point D - rotation point D is shown in figs. 4a and 4b. At this point, the deflector 202 is comprised within the vertical top surface of the respective cams 204 at point Z. The further downward rotation of the entrapment trigger 203 and the subsequent further pushing outwards of the cams 204 simultaneously activates the limit switch 206 to stop the passenger moving system and creates a distance between the cams 204 which provides for the single movable part comprising the deflector 202 and entrapment trigger 203 to move from a horizontal resting position H_0 to a vertical activated position V_a (shown in fig. 5d). The horizontal to vertical movement creates a gap around a handrail belt (not shown) which can also provide for relief of the entrapment.

[0032] The range of degrees within which rotation can occur without activating the limit switch in this particular example is dependent upon the shape of the cam 204 and the groove G comprised therein. A deeper groove G can withstand a higher degree of rotation to release the deflector 202 whilst a shallower groove will require only a slight degree of rotation to release the deflector 202. In this particular example, the shape of the cam 204 is such that a rotation of 8.0 degrees causes it to activate the limit switch 206 and the single movable part comprising the deflector 202 and entrapment trigger 203 simultaneously moves from a horizontal resting position to a vertical activated position thereby stopping the passenger moving system, as shown in figs 1a and 1b.

[0033] Fig. 6a is a representation of a safety system 20 according to the second embodiment of the invention as shown in figs. 4a to 5e when positioned on a first single handrail belt 1 of a passenger moving system. In this particular example, only one safety system 20 is installed on a first side of the single handrail belt 1. The safety system 20 is arranged such that the entrapment trigger 203 is positioned adjacent to and encompasses the width of, the handrail belt 1. This positioning of the safety system 20 addresses the problem of entrapments occurring at the side of the handrail belt 1 where a passengers' hand is most likely to pass over, for example in the process of switching handrails thereby improving passenger safety. It is envisaged that the handrail 1 shown in fig 6a can further comprise a safety system 10 according to the first embodiment of the invention as described in figs 1a to 3d wherein the safety system 10 is positioned between the handrail belt 1 and the handrail belt 2 such that it forms a bridge there-between with the entrapment trigger 103 being adjacent to the handrail belt 2 and the fixed part 101 being adjacent to the handrail belt 1.

[0034] Fig. 6b is a representation of a safety system 20 according to the second embodiment of the invention as shown in figs. 4a to 5e when positioned on a first single handrail belt 1 of a passenger moving system. In this particular example, two safety systems 20a and 20b are installed on a first side of the single handrail belt 1 and a second side of the single handrail belt 1. Each safety system 20a, 20b is arranged such that the entrapment trigger 203 is positioned adjacent to and encompasses the width of, the handrail belt 1. The safety system 20b is shown without the deflector 202 and entrapment trigger 203. This positioning of the safety system 20 addresses the problem of entrapments occurring at the side of the handrail belt 1 where a passengers' hand is most likely to pass over, for example in the process of switching handrails. As a passenger grips the handrail belt 1, their thumb and fingers will be located on opposite sides of the belt 1, most likely their thumb will rest on one side whilst their fingers rest on the opposite side. In the event of an entrapment, a safety system 20 is in place on both sides, thereby further improving passenger safety.

[0035] In figs. 6a and 6b, the safety system 20 comprises only one limit switch 206. It is also possible that safety requirements necessitate two limit switches to be used. Whether one or two limit switches are used, the invention provides for the stopping of a passenger moving system in the event of an entrapment.

[0036] It is envisaged that the handrail 1 shown in fig 6b can further comprise a safety system 10 according to the first embodiment of the invention as described earlier and shown in figs 1a to 3d wherein the safety system 10 is positioned between the handrail belt 1 and the handrail belt 2 such that it forms a bridge there-between with the entrapment trigger 103 being adjacent to the handrail belt 1 and the fixed part 101 being adjacent to the handrail belt 2 or the entrapment trigger 103 being adjacent to the handrail belt 2 and the fixed part 101 being adjacent to the handrail belt 1.

[0037] It is to be understood that aspects of an embodiment described hereinabove may be combined with aspects of another embodiment while still falling within the scope of the present disclosure. Accordingly, the foregoing description is intended to be illustrative rather than restrictive.

Reference signs list

[0038]

1	handrail belt
2	handrail belt
10	safety system
11	balustrade
101	fixed part
102	deflector
103	entrapment trigger
1032	cam
1033	rolling element
104	actuator
1041	spring
1042	spring housing
105	movable part
106	sensor
A	rotation point of entrapment trigger 103
B	rotation point of actuator 104
C	rotation point movable part 105
F	force
F_e	entrapment force
F_i	impact force
G	groove
I	Interface
P	magnified representation
V_f	vertical forward
V_b	vertical backward
20	safety system
202	deflector
2021	spring
203	entrapment trigger
2031	spring
2033	rolling element
204	cam
205	spring
2051	contacting means
206	sensor
208	rod
D	rotation point of cam 204
E	rotation point of entrapment trigger 203
F_c	compressive force
F_{Eq}	equilibrium
H_0	horizontal rest position
V_a	vertical activated position
S_i	inner surface of cam 204
X, Y, Z	position of deflector 202 on cam 204

Claims

1. An anti-entrapment safety system (10, 20) for a passenger moving system comprising a first endless handrail belt (1) and a second endless handrail belt

(2), wherein the safety system (10, 20) comprises a plurality of movable parts (102, 202, 103, 203, 1032, 104, 204, 105)
wherein a first movable part (103, 203) is adapted to respond to an entrapment force (F_e) applied thereto;
wherein the response comprises an upwards rotation or a downwards rotation of the first movable part (103, 203);
characterized in that the upwards rotation or the downwards rotation of the first movable part (103, 203) activates the anti-entrapment safety system (10, 20) when the rotation exceeds a pre-determined threshold value;
wherein the threshold value is defined as a rotation in the range of 0.5 to 20.0 degrees.

2. The anti-entrapment safety system (10, 20) according to claim 1 **characterized in that** the first movable part (103, 203) comprises at least one rolling element (1033, 2033).

3. The anti-entrapment safety system (10, 20) according to any of claims 1 to 2, **characterized in that** the at least one rolling element (1033, 2033) contacts at least one endless handrail belt (1, 2) or at least one further movable part (204).

4. A passenger moving system comprising a first endless handrail belt (1), a second endless handrail belt (2) and an anti-entrapment safety system (10) according to any of claims 1 to 3 positioned there-between forming a bridge between the first endless handrail belt (1) and the second endless handrail belt (2),
wherein the first movable part (103) is positioned adjacent to a succeeding endless handrail belt (1, 2) in the direction of travel of the passenger moving system, wherein the succeeding endless handrail belt is the first endless handrail belt (1) or the second endless handrail belt (2), **characterized in**
that the first movable part (103) is adapted to be rotated upwards about an axis (A) in the event of an entrapment.

5. The passenger moving system according to claim 4, **characterized in, that** the at least one rolling element (1033) contacts the succeeding endless handrail belt (1, 2).

6. The passenger moving system according to claim 5, **characterized in,**
that the anti-entrapment safety system (10) is adapted to differentiate between a force of impact (F_i) and a force of entrapment (F_e) wherein the anti-entrapment safety system (10) is further adapted to respond to a force of entrapment (F_e) only.

7. A passenger moving system comprising a first endless handrail belt (1) and a second endless handrail belt (2) and at least a first anti-entrapment safety system (20) according to any of claims 1 to 3 positioned thereon
characterized in
that the first anti-entrapment safety system (20) is comprised within a balustrade (11) comprising a first endless handrail belt (1) and a second endless handrail belt (2), such that the first movable part (203) of the first anti-entrapment safety system (20) is adjacent to the first endless handrail belt (1) or to the second endless handrail belt (2),
wherein the first movable part (203) is adapted to be rotated downwards about an axis (E) upon an entrapment force (F_e).

8. The passenger moving system according to claim 7 **characterized in that** the first movable part (203) of the first anti-entrapment safety system (20) is positioned such that the at least one rolling element (2033) contacts at least one second movable part (204) of the first anti-entrapment safety system (20).

9. The passenger moving system according to claim 8, **characterized in that** the first movable part (203) of the first anti-entrapment safety system (20) is adapted such that a lateral compressive force (F_c) is applied to it from the at least one second movable part (204) of the first anti-entrapment safety system (20) during normal operation of the passenger moving system.

10. The passenger moving system according to any of claims 7 to 9, **characterized in that** it comprises within the balustrade (11) a second first anti-entrapment safety system (20), wherein the first anti-entrapment safety system (20) and the second first anti-entrapment safety system (20) are adapted to operate independently of each other.

11. The passenger moving system according to any of claims 7 to 10 **characterized in that** it comprises a further anti-entrapment safety system (10) according to any of claims 1 to 3 wherein the further anti-entrapment safety system (10) is positioned between the first endless handrail belt (1) and the second endless handrail belt (2) forming a bridge there-between;
wherein the first movable part (103) of the further anti-entrapment safety system (10) is positioned adjacent to the first endless handrail belt (1) or adjacent to the second endless handrail belt (2) **characterized in**
that the first movable part (103) is adapted to be rotated upwards about an axis (A) in the event of an entrapment.

12. The passenger moving system according to any of claims 7 to 11 **characterized in that** the at least one rolling element (1033) of the further anti-entrapment safety system (10) contacts the first endless handrail belt (1) or the second endless handrail belt (2).

13. The passenger moving system according to any of claims 4 to 12, **characterized in that** it is a variable speed passenger moving system or a constant speed passenger moving system.

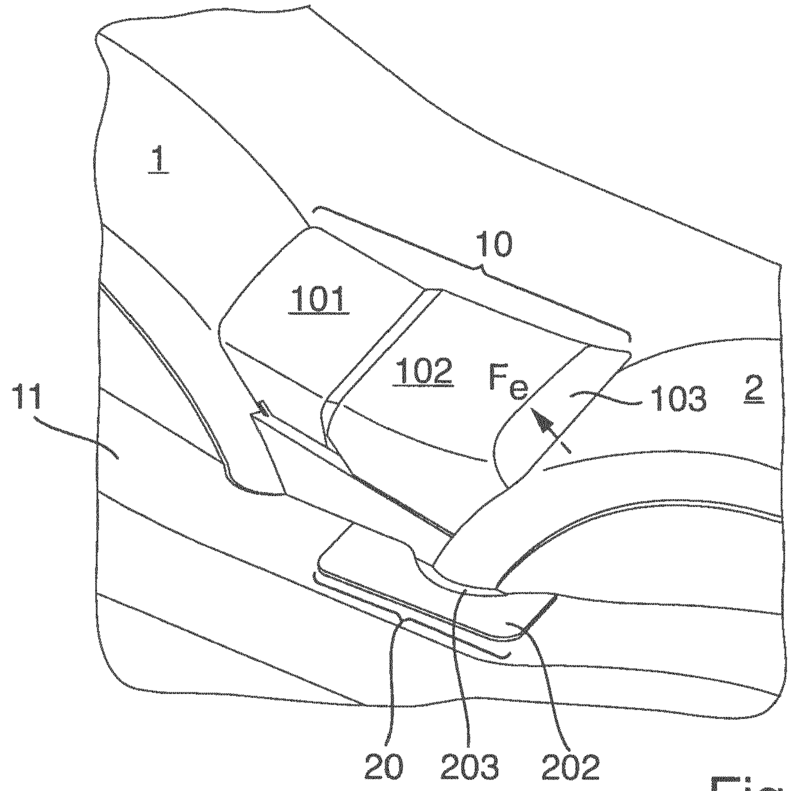
1
10
101
102
Fe
103
2
11
20
203
202

Fig. 1a

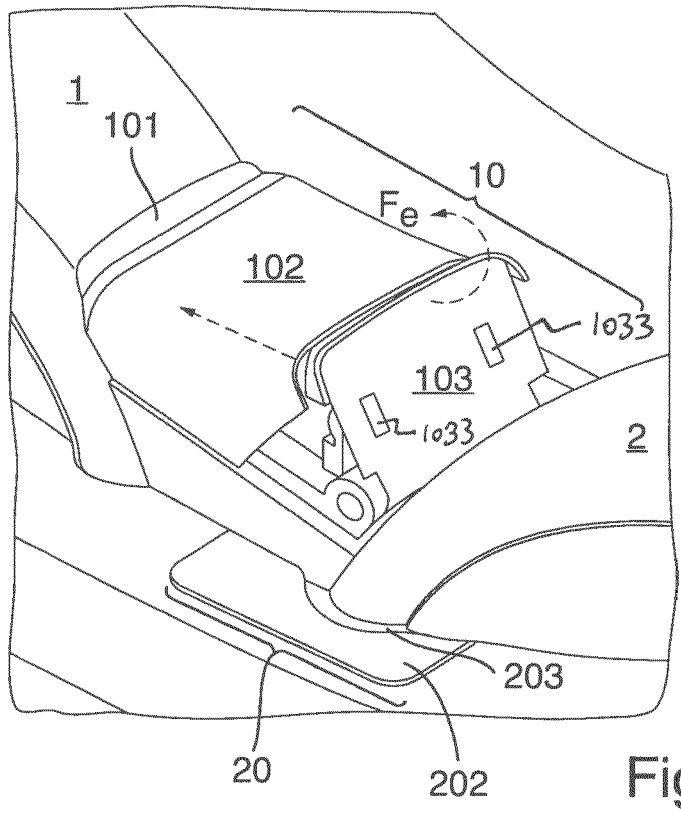
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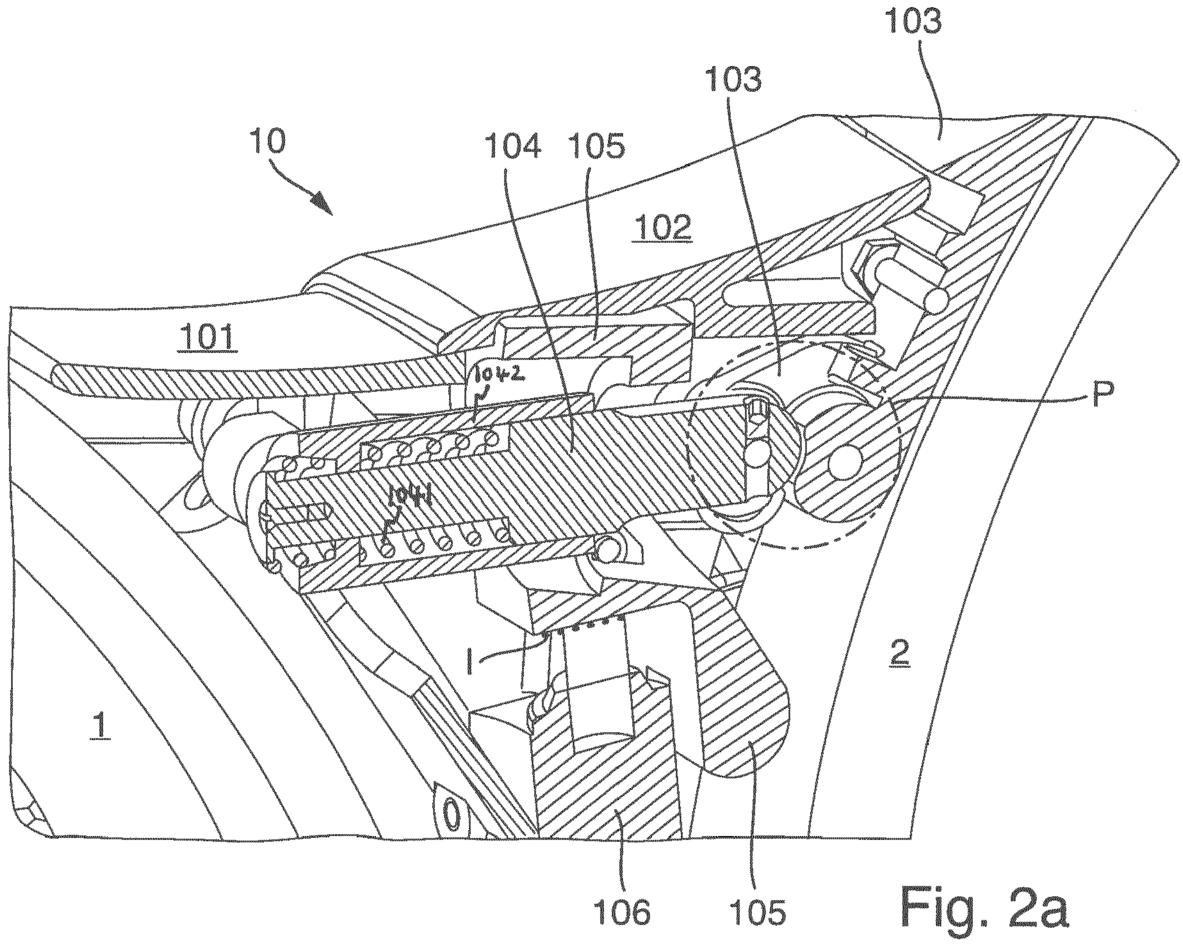
Fig. 1b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10
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102
101
1042
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1041
I
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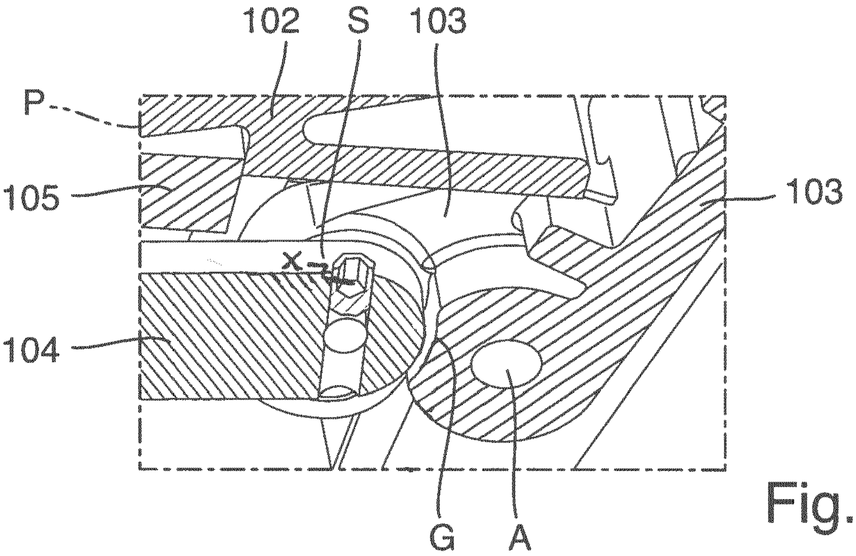
1
106
105

Fig. 2a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P
105
103
X
104
G A

Fig. 2b

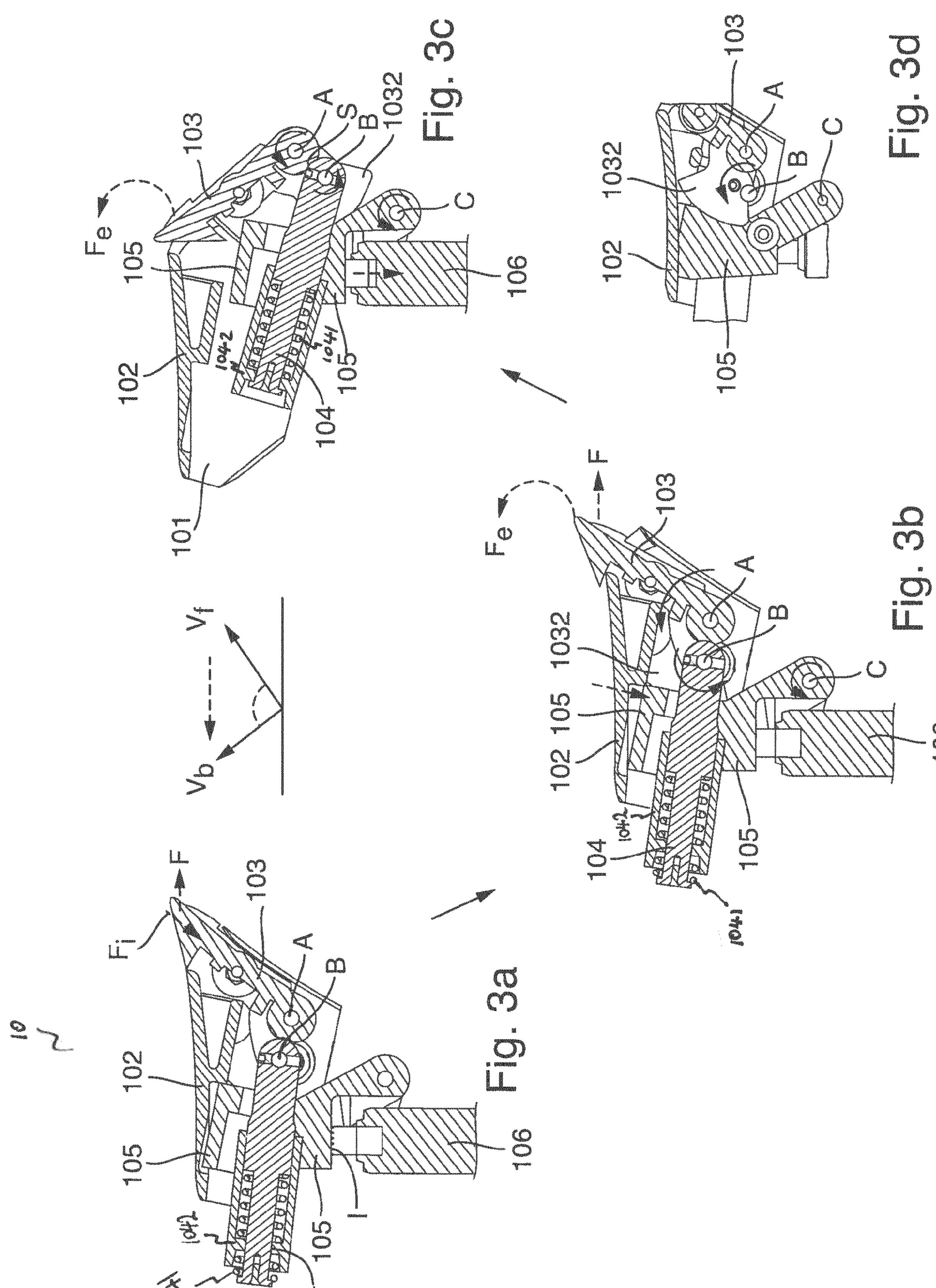
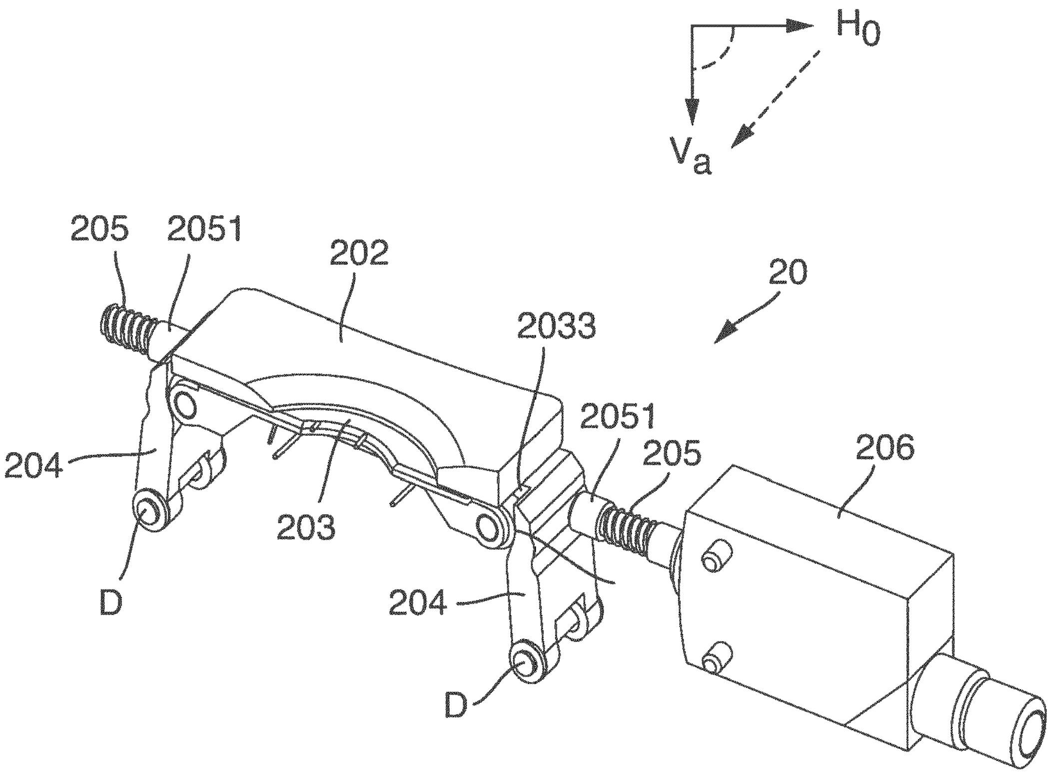


Fig. 3a

Fig. 3b

Fig. 3c

Fig. 3d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2051
202
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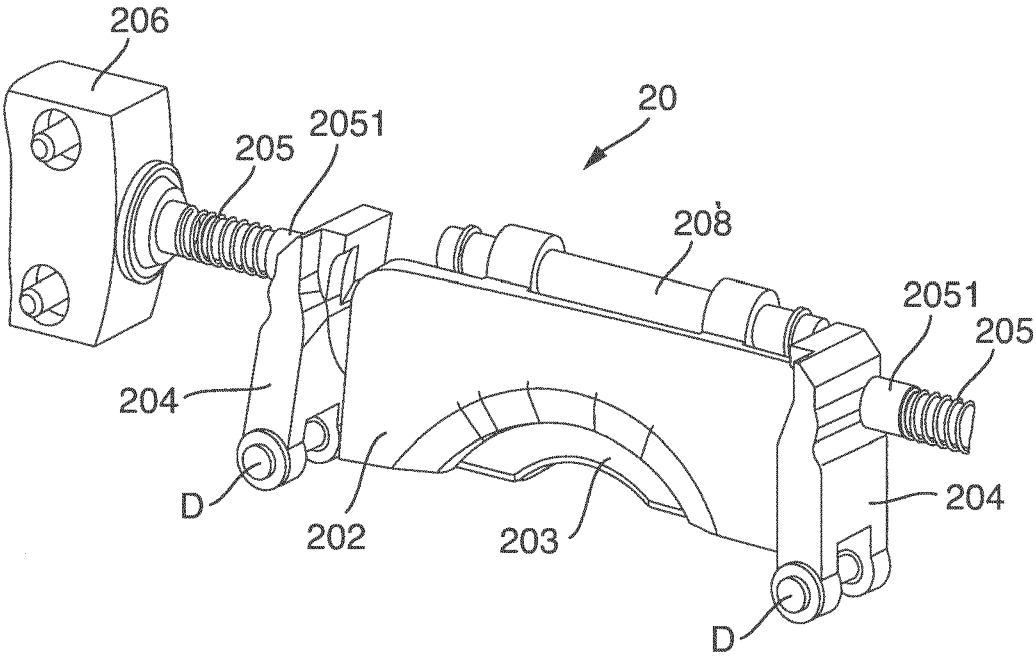
2033
2051
205
206
204
203
D
204
D

Fig. 4a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202
203
D

Fig. 4b

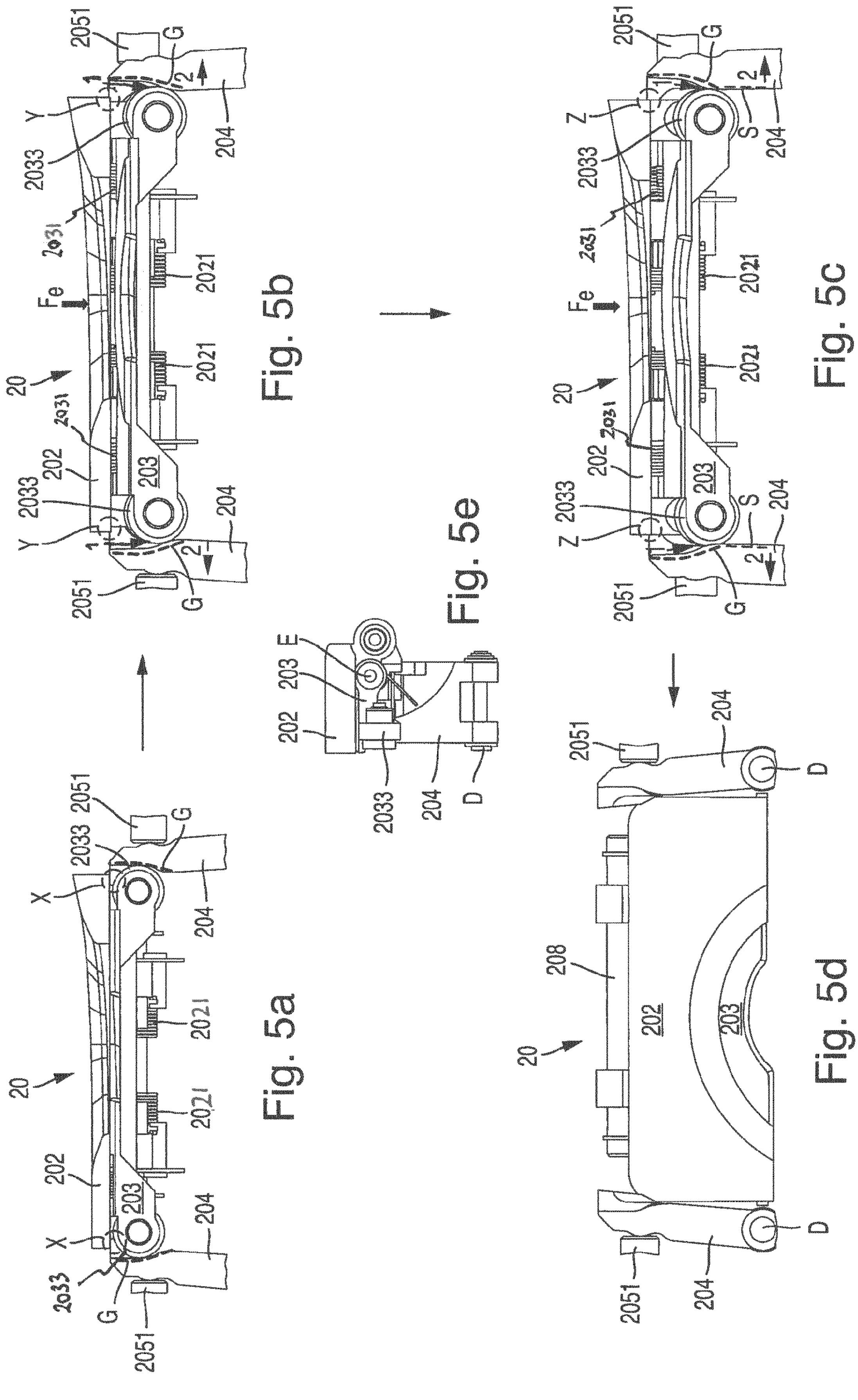

Fig. 5a

Fig. 5b

Fig. 5c

Fig. 5d

Fig. 5e

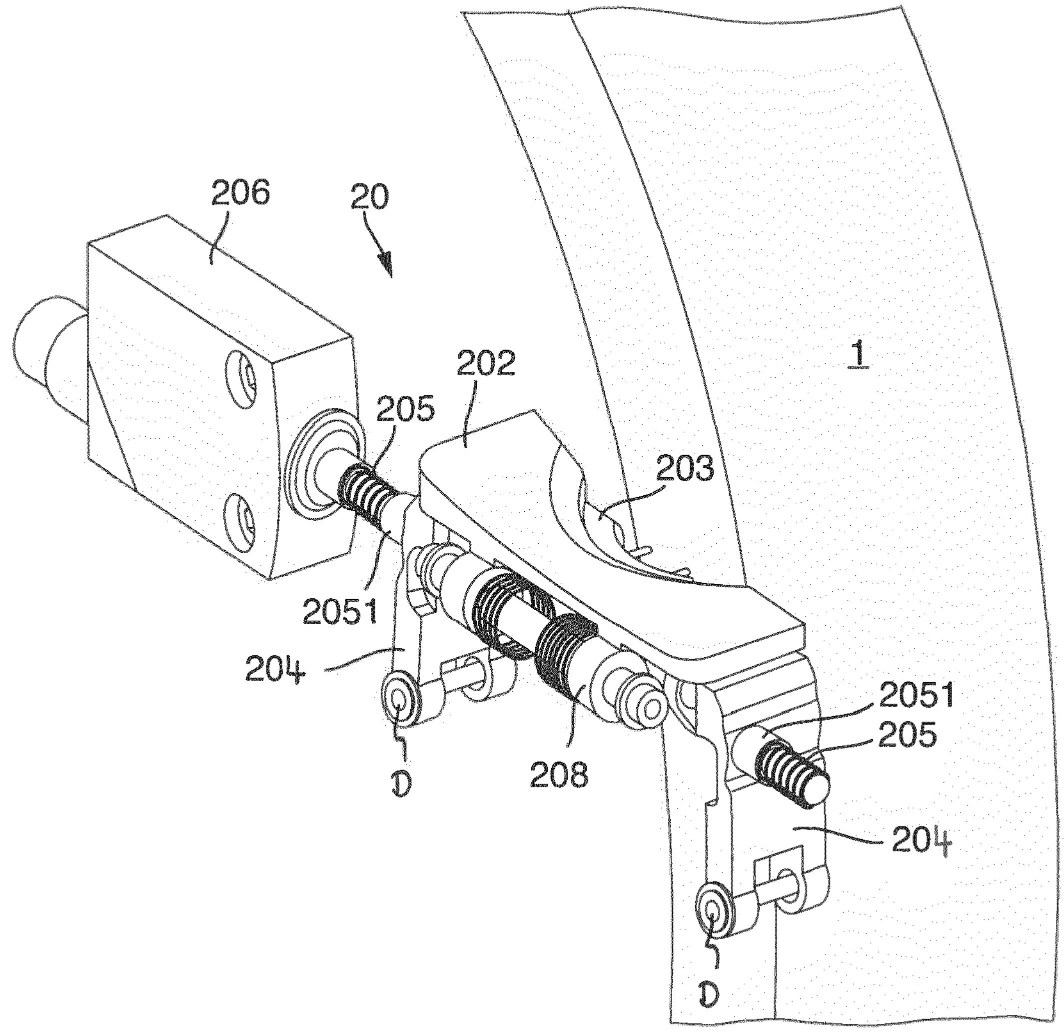

Fig. 6a

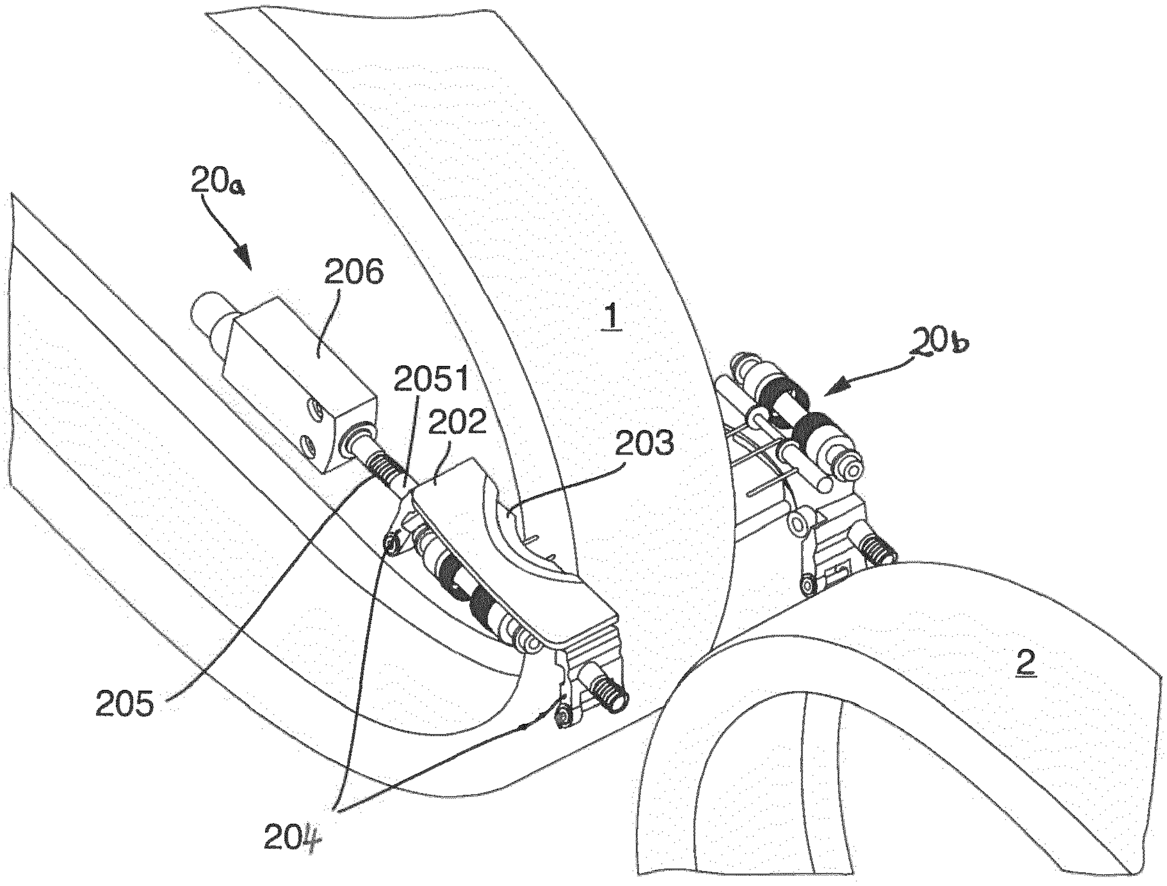

Fig. 6b

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EUROPEAN SEARCH REPORT

Application Number
EP 19 38 2338

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	WO 97/14644 A1 (LODERWAY PTY LTD [AU]; LODER JOHN LOUIS [AU]) 24 April 1997 (1997-04-24) * pages 1-7, columns 6-7; figures 3,4 *	1-3 4-13	INV. B66B29/04
X A	EP 3 229 249 A1 (OMRON TATEISI ELECTRONICS CO [JP]) 11 October 2017 (2017-10-11) * pages 1-11; figure 1 *	1-3 4-13	
X A	DE 20 54 640 A1 (RHEINSTAHL EGGERS KEHRHAHN) 10 May 1972 (1972-05-10) * pages 1-9; claim 1; figures 1-2 *	1 4-13	
A	JP 2001 106463 A (NIPPON KOKAN KK) 17 April 2001 (2001-04-17) * the whole document *	1-13	
A	DE 694 29 678 T2 (MITSUBISHI HEAVY IND LTD [JP]) 14 August 2002 (2002-08-14) * the whole document *	1-13	

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	22 November 2019	Lohse, Georg

3

CATEGORY OF CITED DOCUMENTS

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EP 19 38 2338

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22-11-2019

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
WO 9714644	A1	24-04-1997	EP	0946405	A1	06-10-1999
			KR	20000049262	A	25-07-2000
			US	6241070	B1	05-06-2001
			WO	9714644	A1	24-04-1997
EP 3229249	A1	11-10-2017	CN	107180723	A	19-09-2017
			EP	3229249	A1	11-10-2017
			JP	2017162671	A	14-09-2017
			US	2017263393	A1	14-09-2017
DE 2054640	A1	10-05-1972	NONE			
JP 2001106463	A	17-04-2001	NONE			
DE 69429678	T2	14-08-2002	DE	69417136	D1	22-04-1999
			DE	69417136	T2	26-08-1999
			DE	69429678	D1	28-02-2002
			DE	69429678	T2	14-08-2002
			EP	0646538	A2	05-04-1995
			EP	0837026	A1	22-04-1998
			KR	950011313	A	15-05-1995
			US	5571254	A	05-11-1996

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H11301857 B **[0003]**
- JP 2001106464 B **[0004]**