US010864393B2

(12) **United States Patent**
Burke

(10) **Patent No.: US 10,864,393 B2**
(45) **Date of Patent: Dec. 15, 2020**

(54) **FALL CONTROL SYSTEM AND METHOD OF CONTROLLING A MOVEMENT DURING FALL EVENT**

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(73) Assignee: **2INNOVATE LLC**, Metamora, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/475,799**

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Related U.S. Application Data

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(51) **Int. Cl.**
A62B 35/00 (2006.01)
F16D 63/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***A62B 35/0081*** (2013.01); ***A62B 35/0093*** (2013.01); ***B60T 17/00*** (2013.01); ***B61H 9/02*** (2013.01); ***F16D 63/008*** (2013.01)

(58) **Field of Classification Search**
CPC E04F 11/1863; B66B 9/08; A62B 35/0043; A62B 35/0056; A62B 35/0062;
(Continued)

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(57) **ABSTRACT**

A fall control system is described. The fall control system comprises an elongate guide rail extending along an axis, a trolley for moving along the elongate guide rail, a tether attached to the trolley at a first end, a second end of the tether for attaching to a user, and a speed control system for controlling a speed of the trolley along the elongate guide rail. The speed control system comprises one or more than one speed control track attached to the elongate guide rail and extending along the axis, a background speed controller coupled to the trolley and engaged with the one or more speed control track when the speed control system or the trolley is in a travelling orientation and controlling the speed of the trolley along the elongate guide rail to not exceeded a maximum walking speed. The speed control system also includes a speed controller coupled to the trolley and engagable with the one or more than one speed control track, the speed controller displaceable from a first position when the speed control system or the trolley is in the travelling orientation, and the speed controller is not engaged with the speed control track, to a second position when the speed

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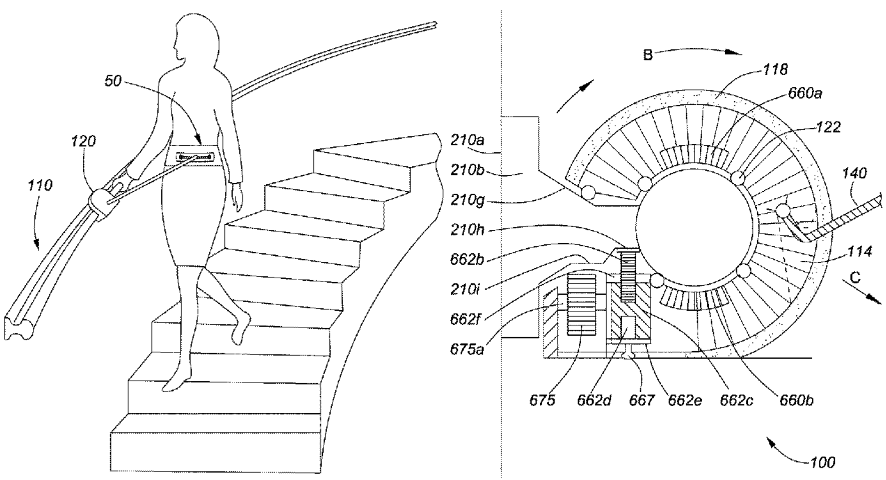

control system or the trolley is in a falling orientation and the speed controller is engaged with the speed control track. The speed controller for controlling the speed of the trolley along the guide rail in the falling orientation to not exceed a maximum fall speed.

17 Claims, 30 Drawing Sheets

(51) **Int. Cl.**
B61H 9/02 (2006.01)
B60T 17/00 (2006.01)

(58) **Field of Classification Search**
CPC . A62B 35/0081; F16D 63/008; F16D 63/004; F16D 2121/18; F16D 2129/065
USPC 187/200, 201; 182/36, 37
See application file for complete search history.

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WO	2014116628	A1	7/2014
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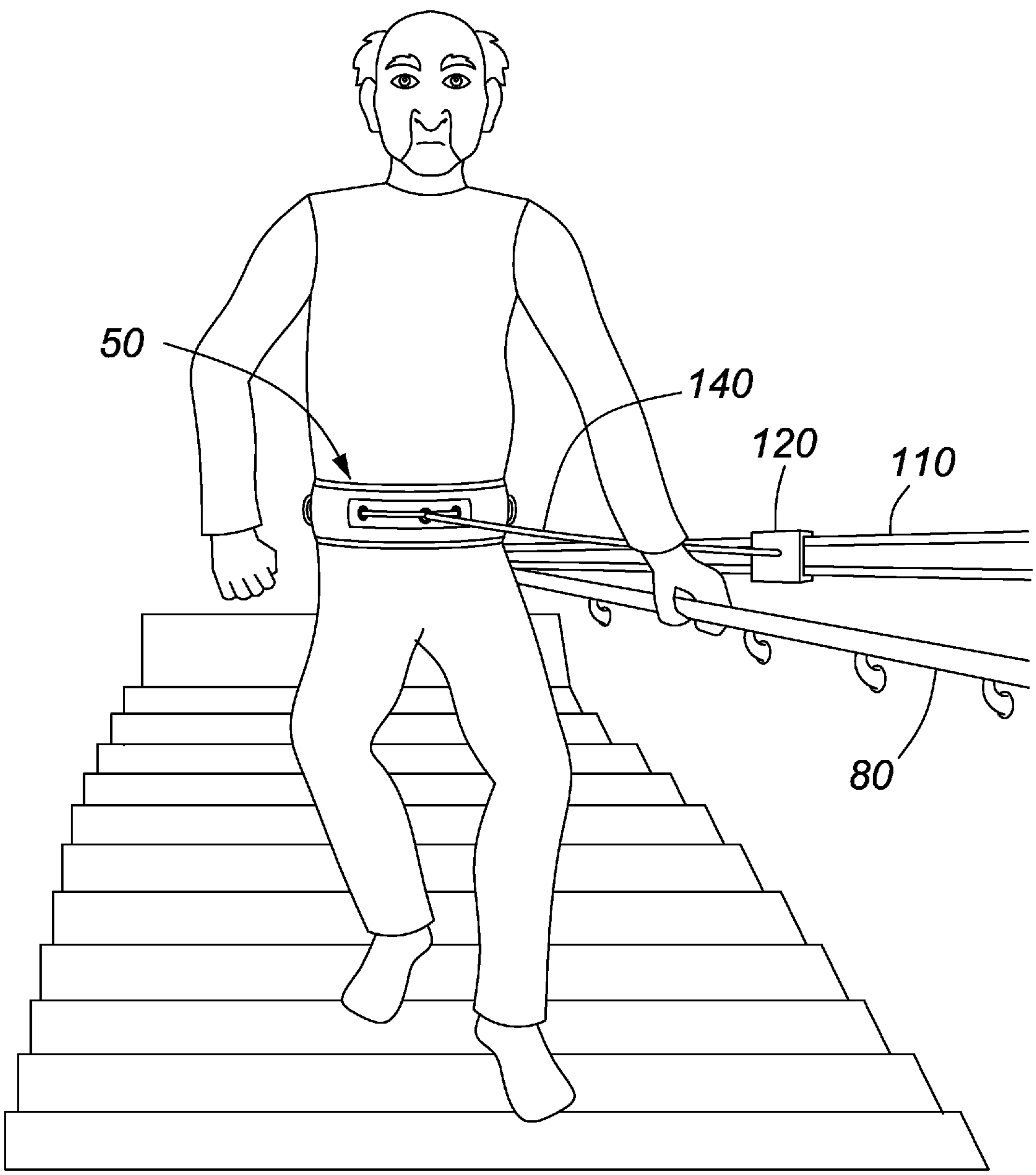


FIG. 1(a)

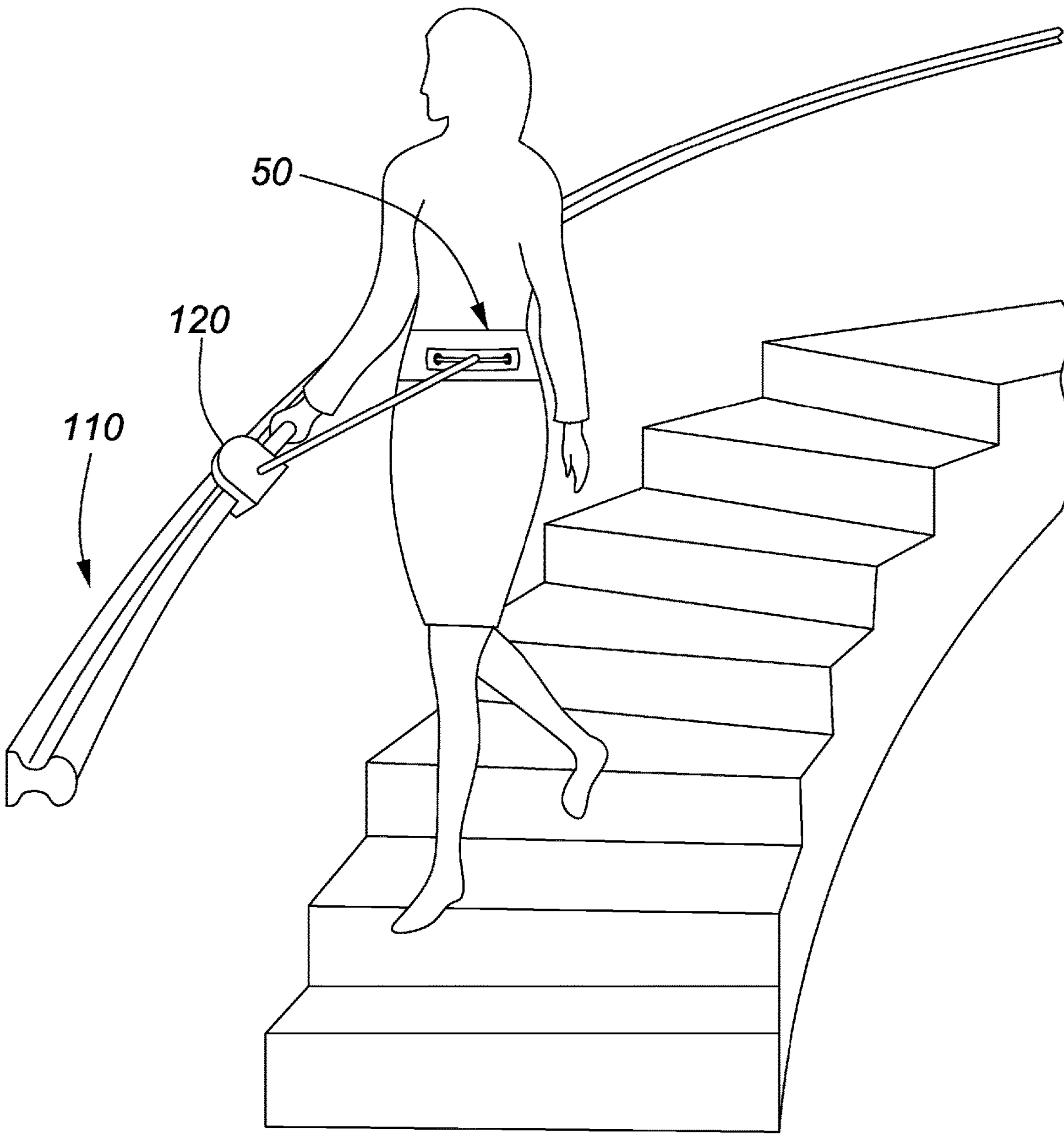
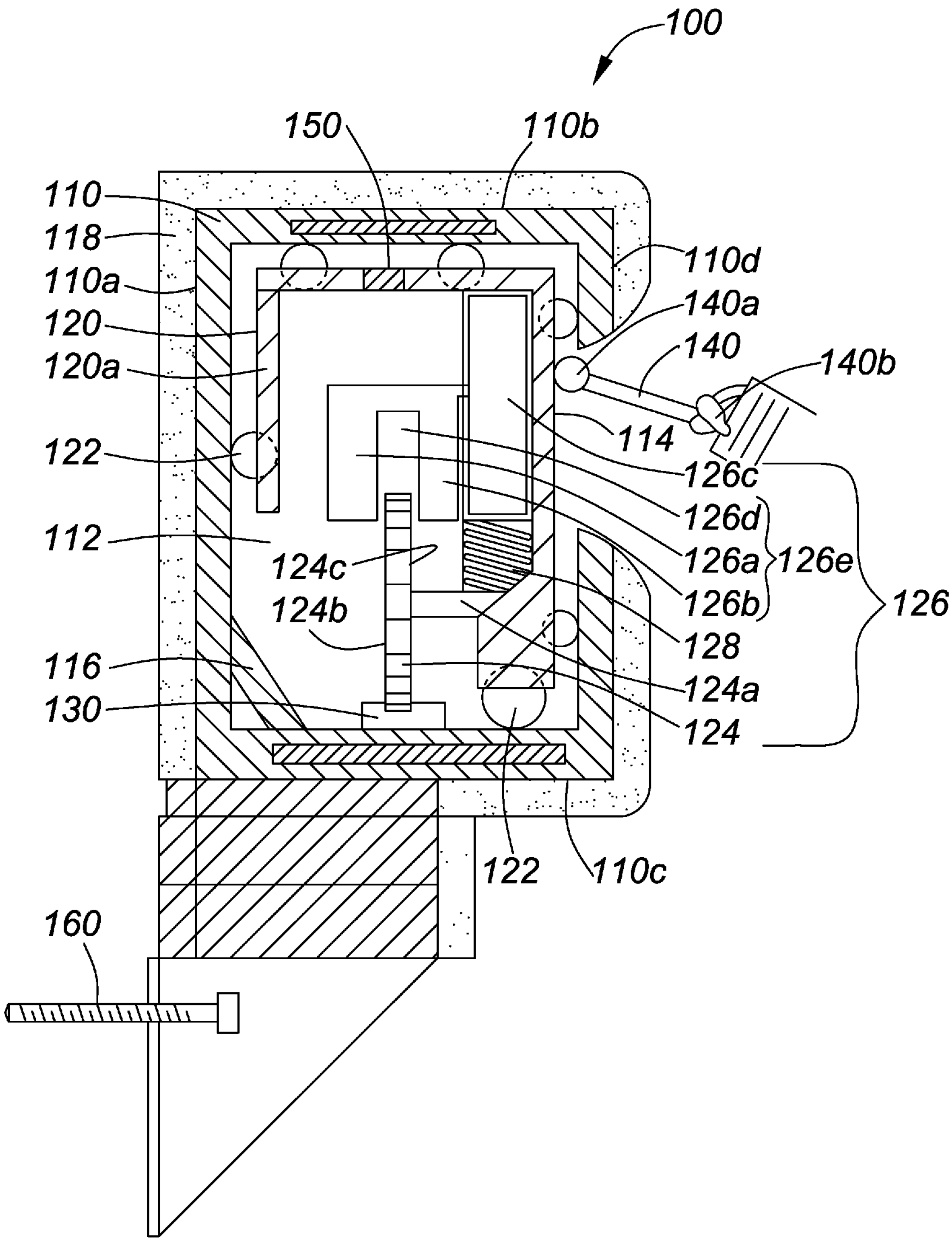


FIG. 1(b)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120a
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112
116
130
110d
140a
140
140b
114
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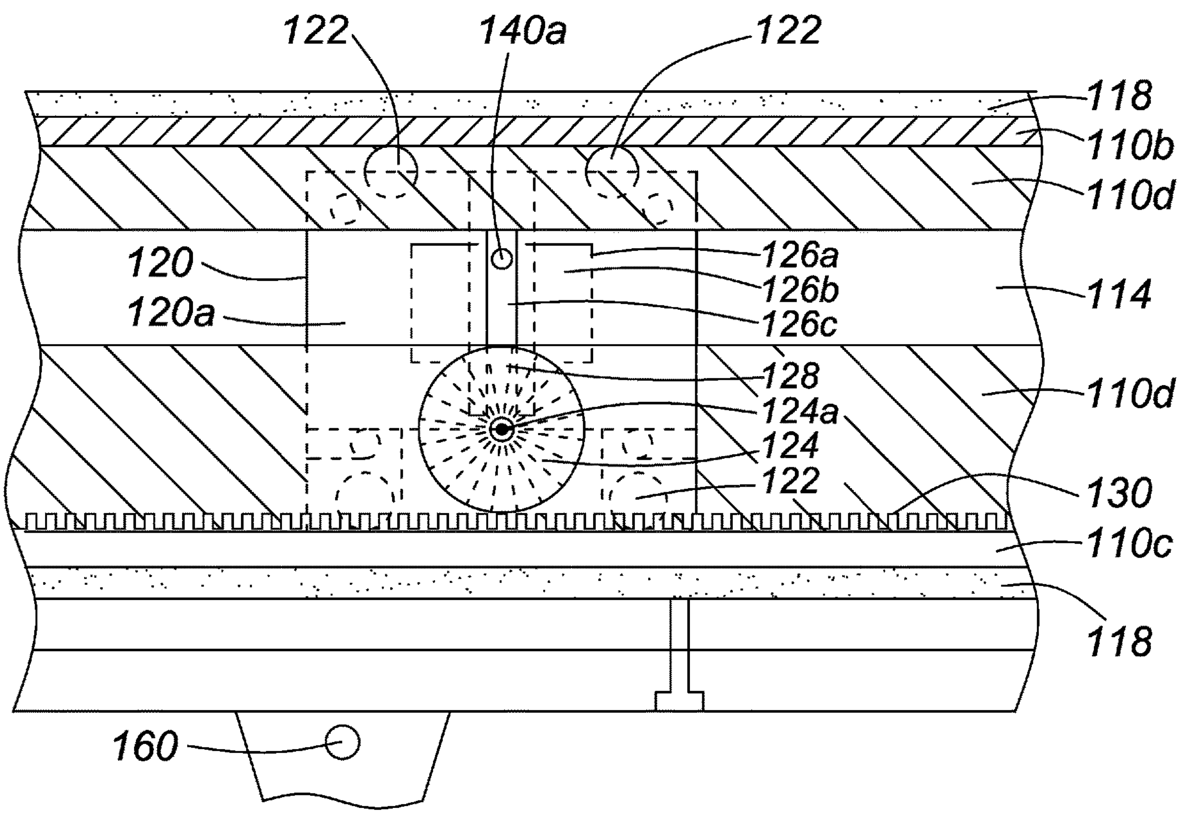
110c
160

FIG. 2(a)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110d
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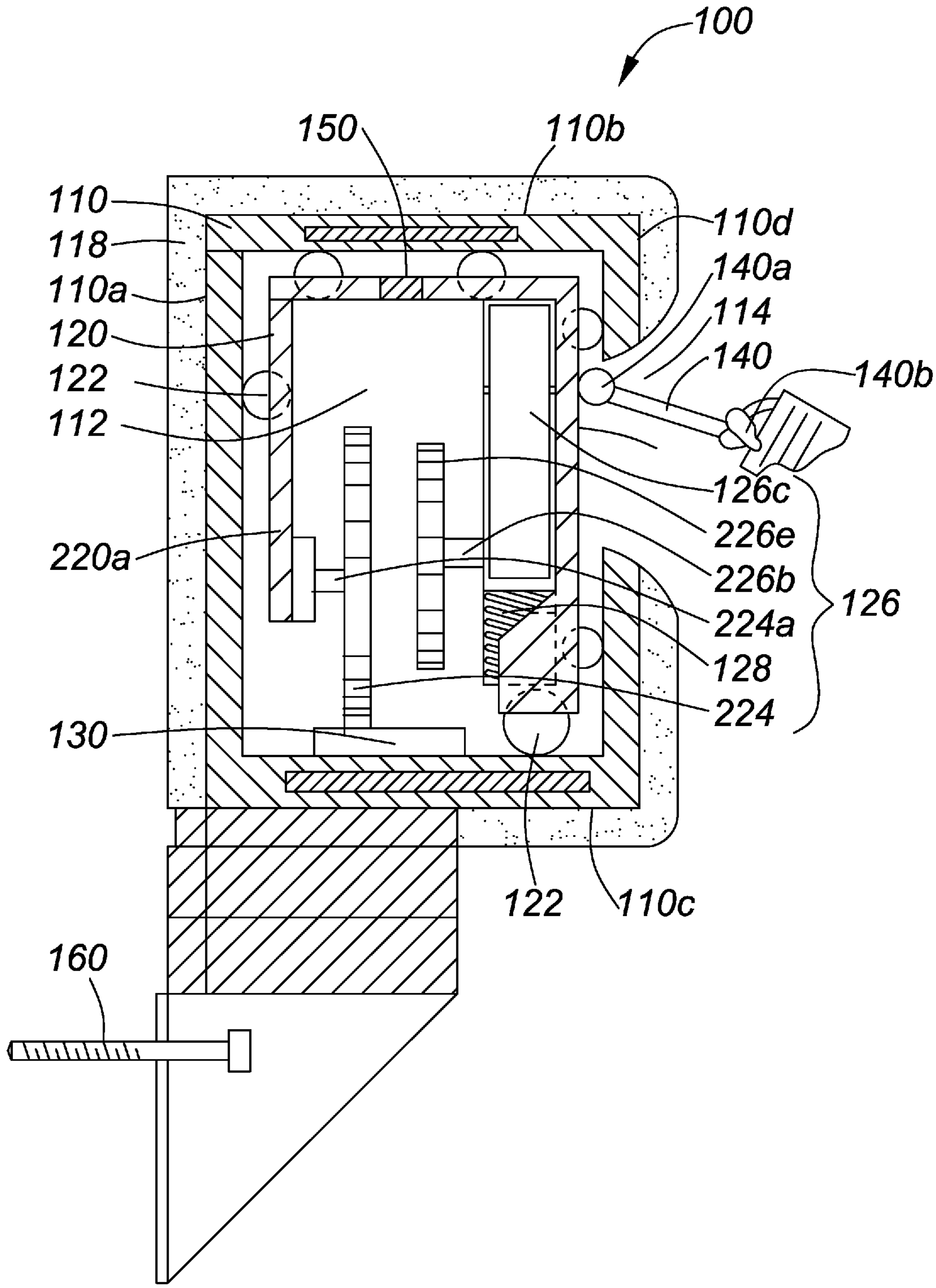
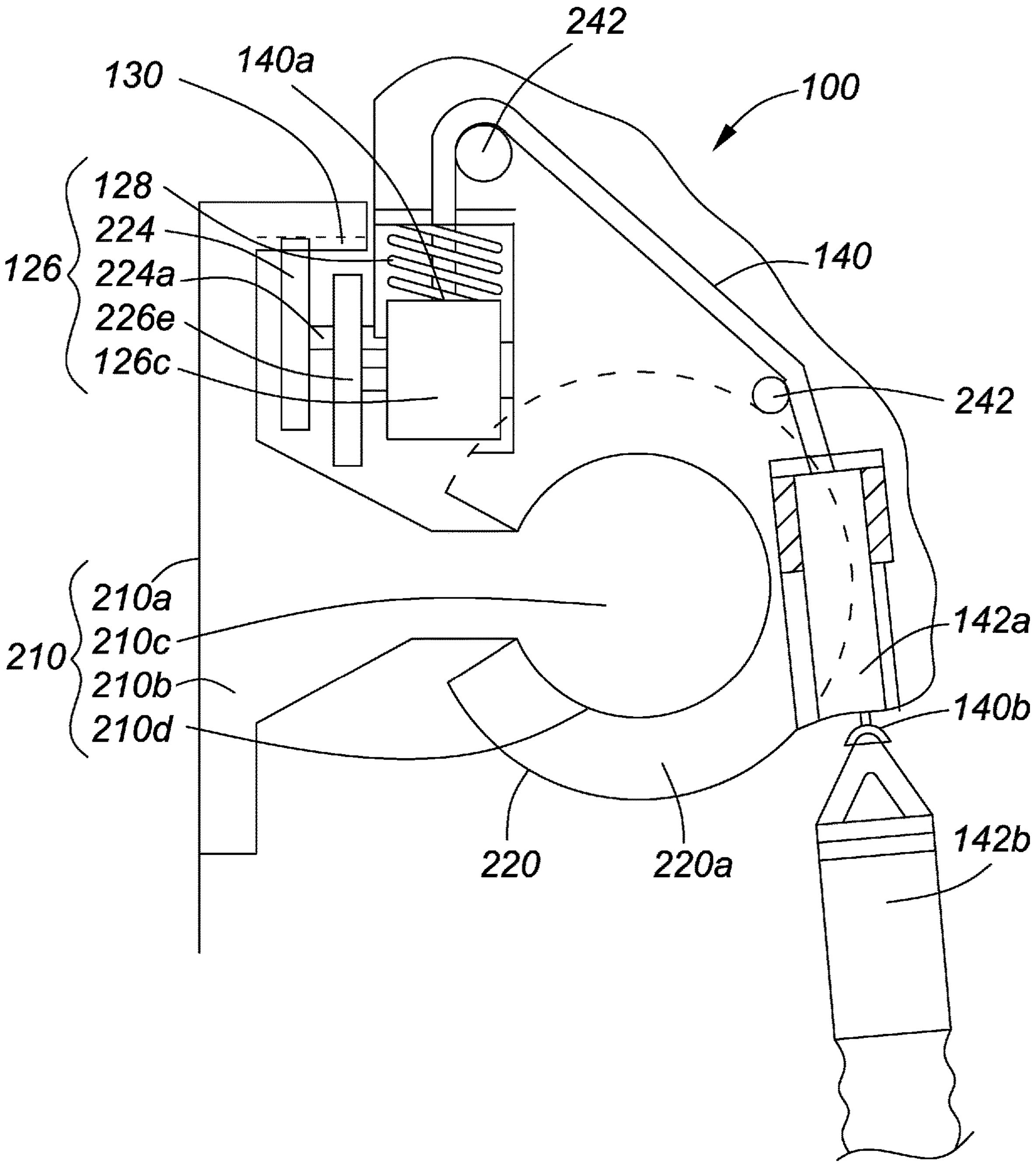
126a
126b
126c
114
128
124a
124
122
110d
130
110c
118
160

FIG. 2(b)



100
150
110b
110
118
110a
120
122
112
110d
140a
114
140
140b
126c
226e
226b
224a
128
224
126
220a
130
122
110c
160

FIG. 3(a)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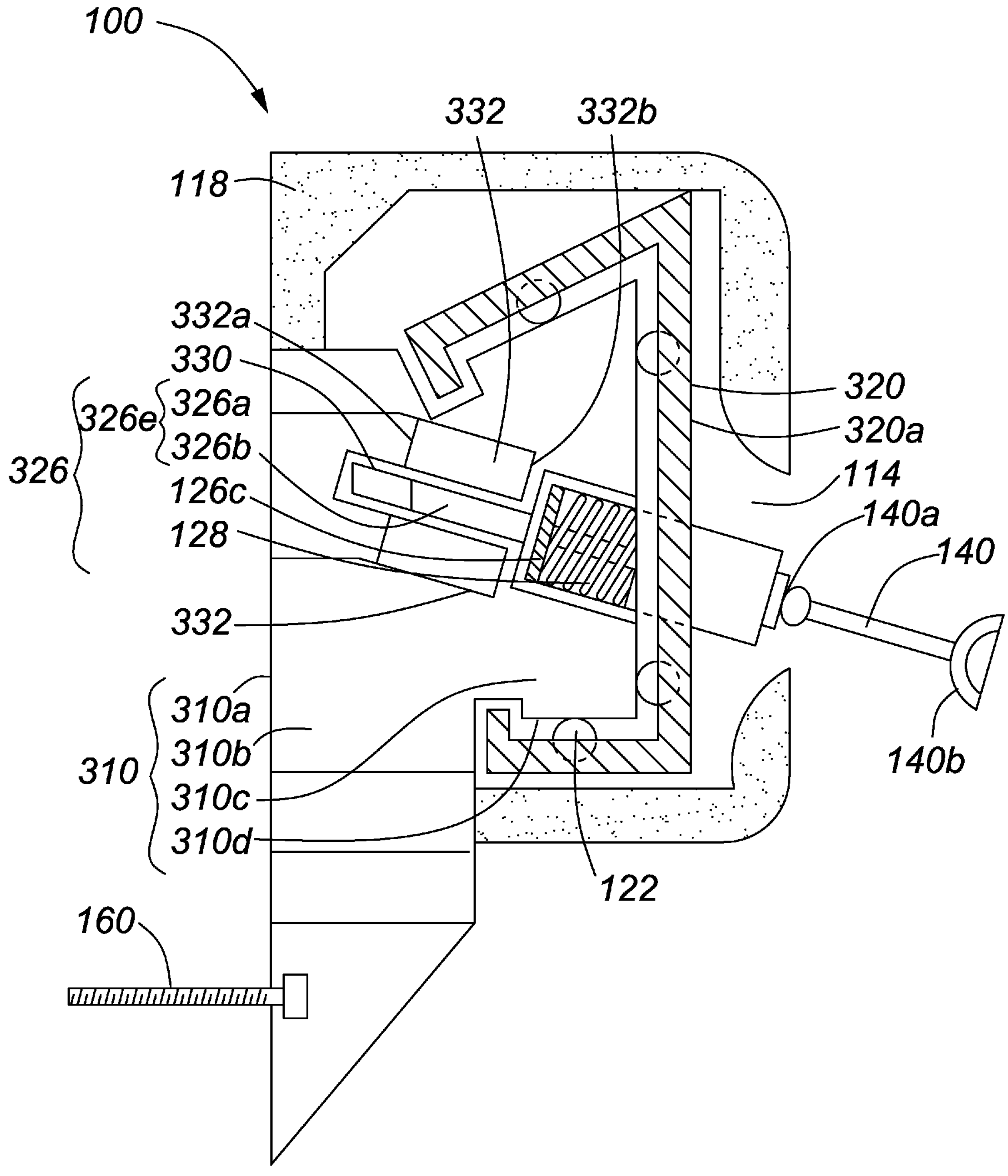
128
224
126
224a
226e
126c
140
242
210a
210
210c
210b
210d
142a
140b
220
220a
142b

FIG. 3(b)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332
332b
118
332a
330
326a
326e
326b
326
126c
128
332
310a
310b
310
310c
310d
160
320
320a
114
140a
140
140b
122

FIG. 4

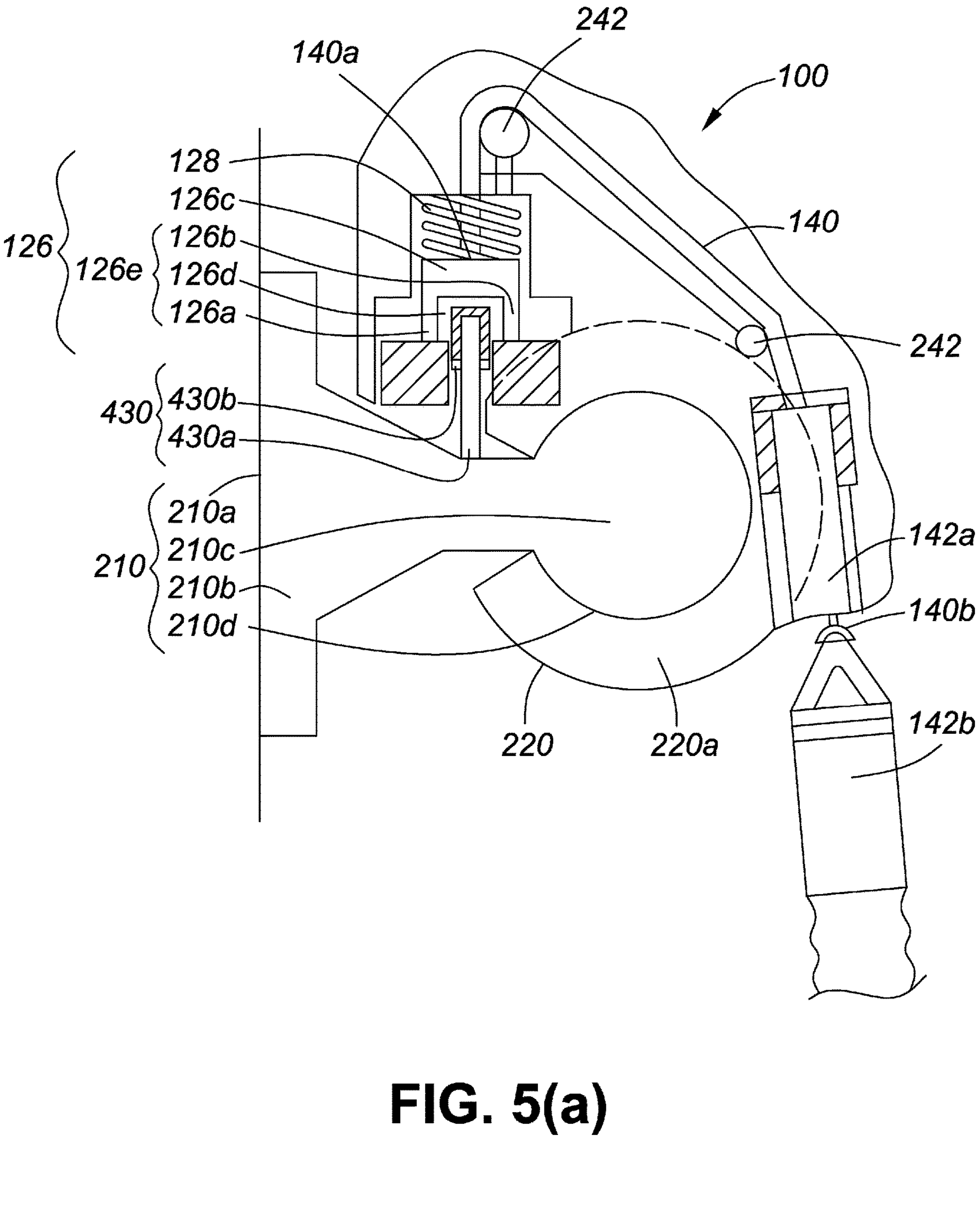

242
140a
100
128
126c
126
126e
126b
126d
126a
140
242
430
430b
430a
210a
210
210c
210b
210d
142a
140b
220
220a
142b

FIG. 5(a)

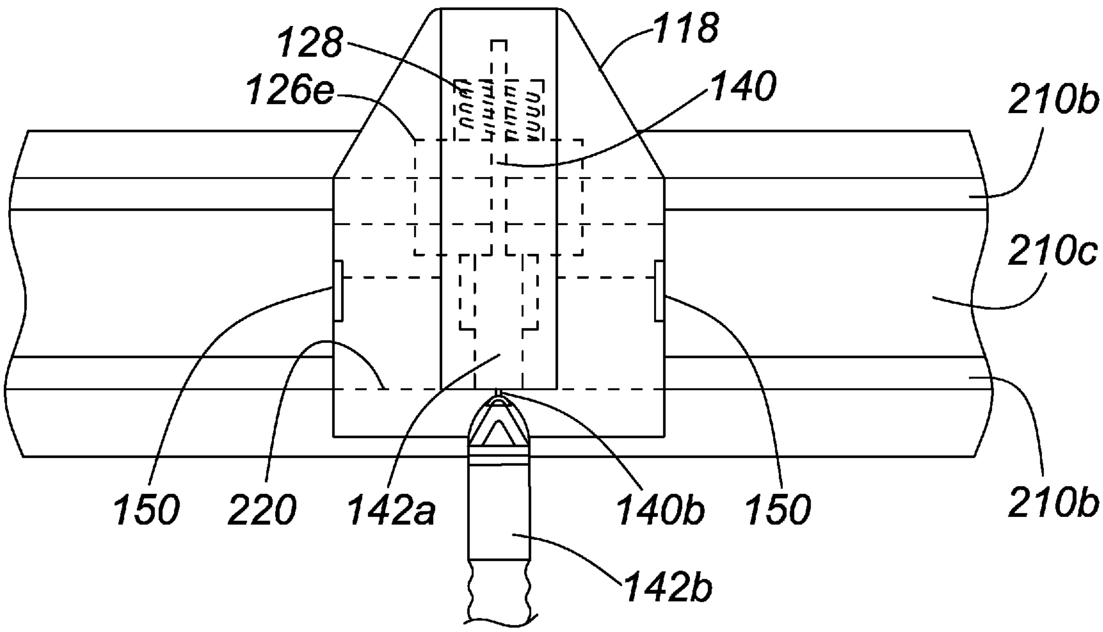

128
126e
118
140
210b
210c
150
220
142a
140b
150
210b
142b

FIG. 5(b)

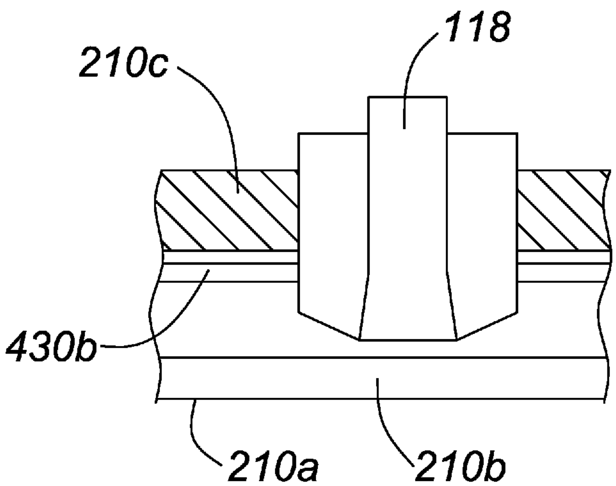

118
210c
430b
210a
210b

FIG. 5(c)

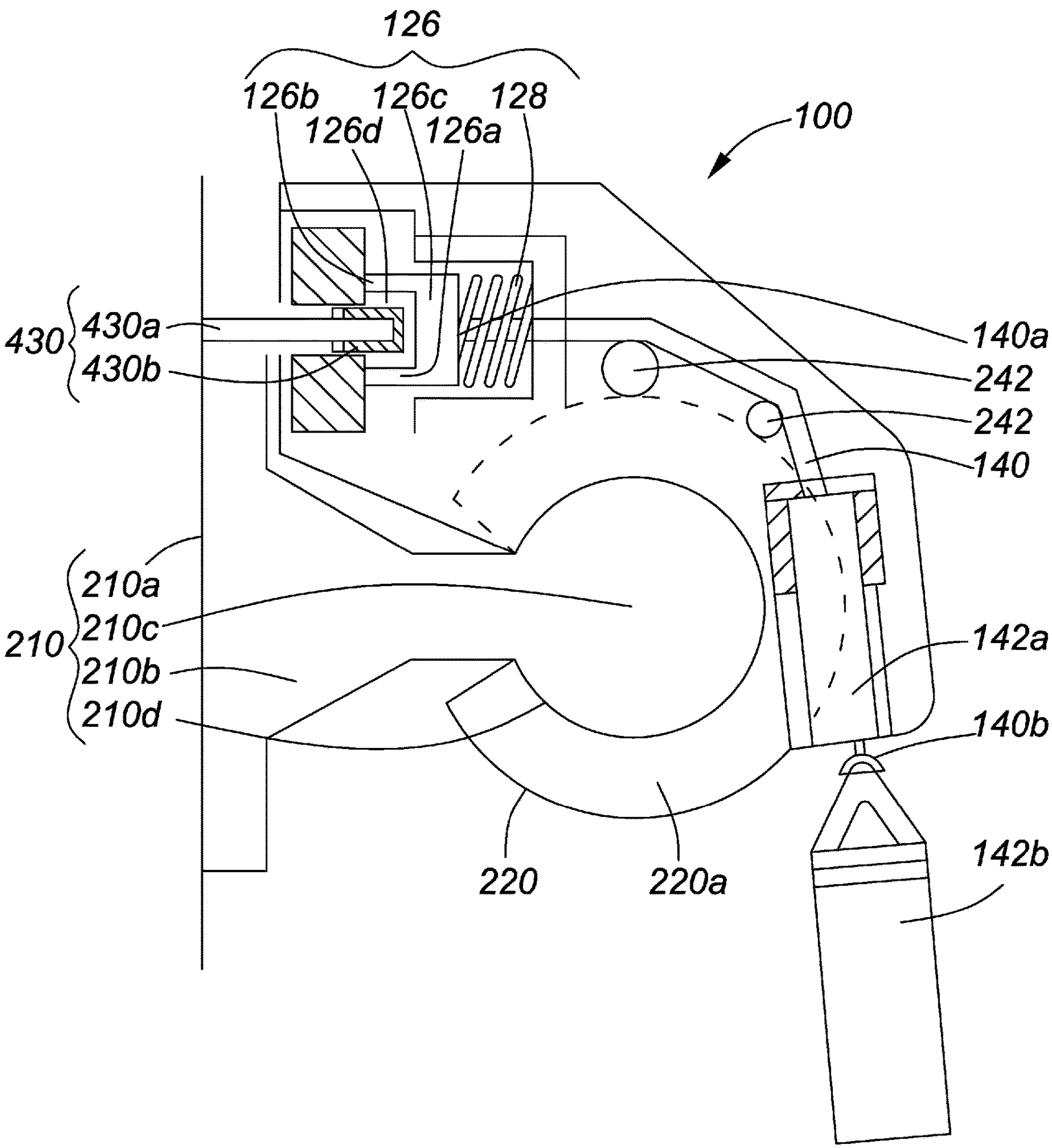

126
126b
126c
128
126d
126a
100
430
430a
430b
140a
242
242
140
210a
210c
210
210b
210d
142a
140b
142b
220
220a

FIG. 5(d)

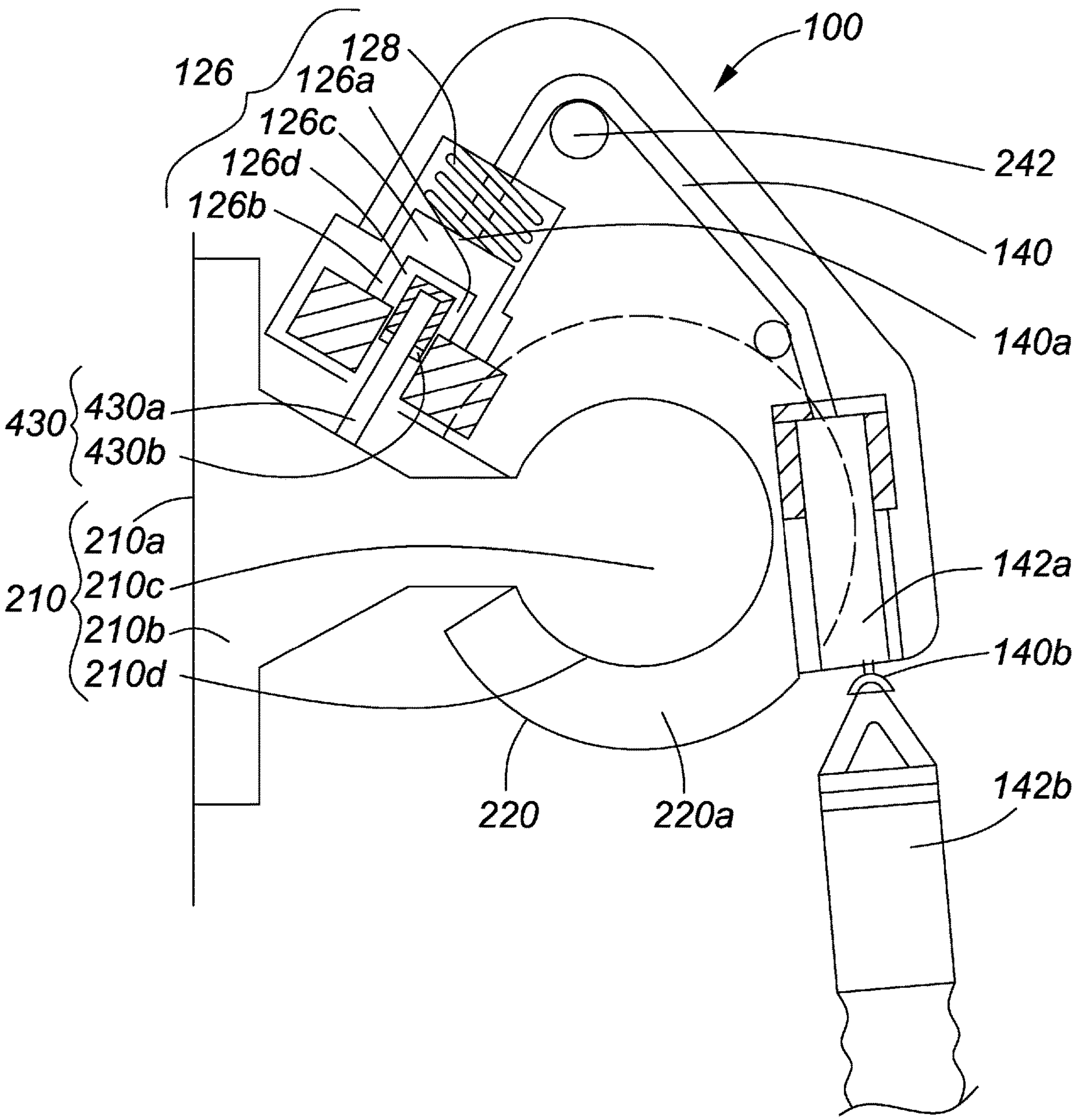

100
126
128
126a
126c
126d
126b
242
140
140a
430
430a
430b
210
210a
210c
210b
210d
142a
140b
142b
220
220a

FIG. 5(e)

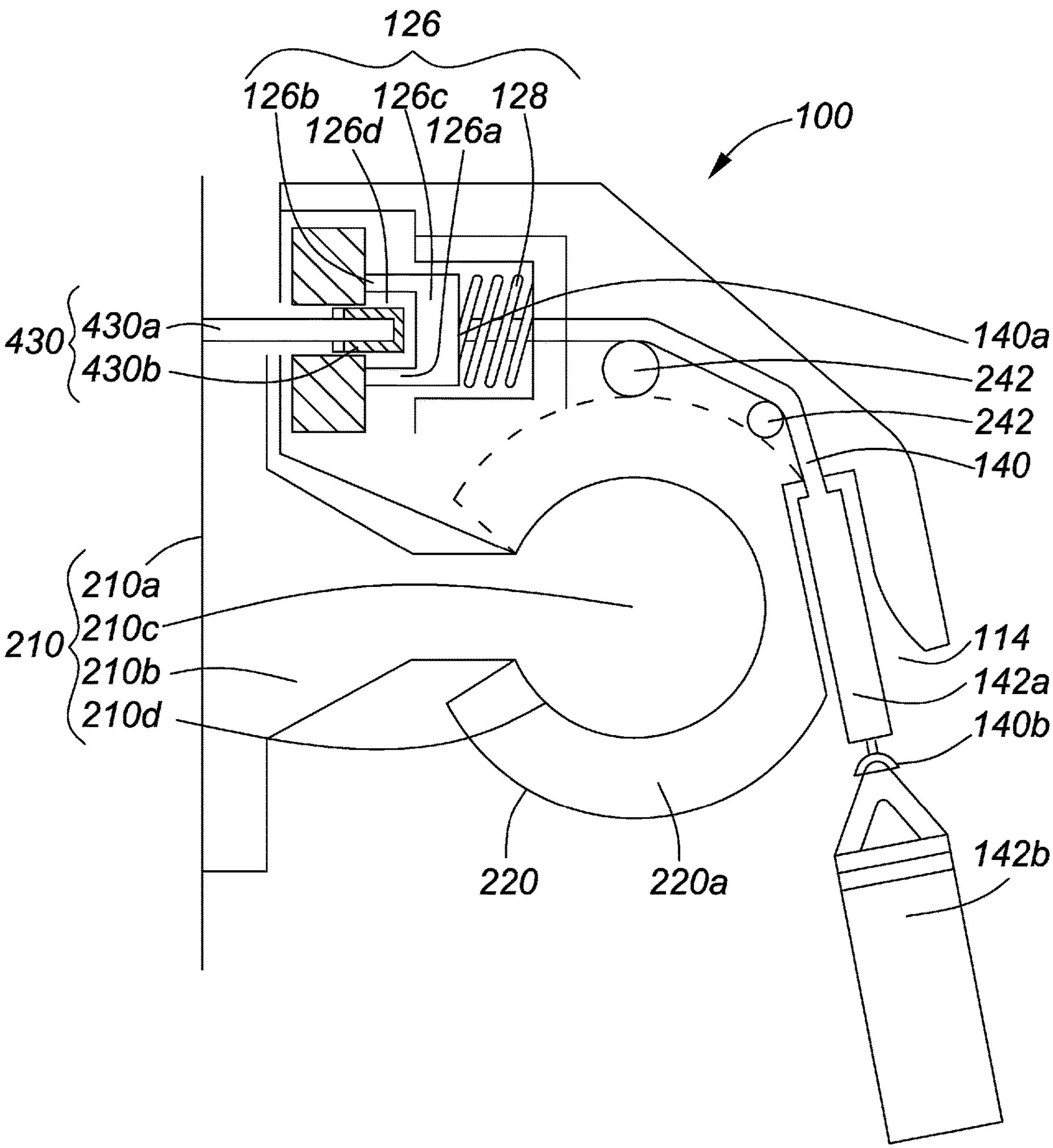
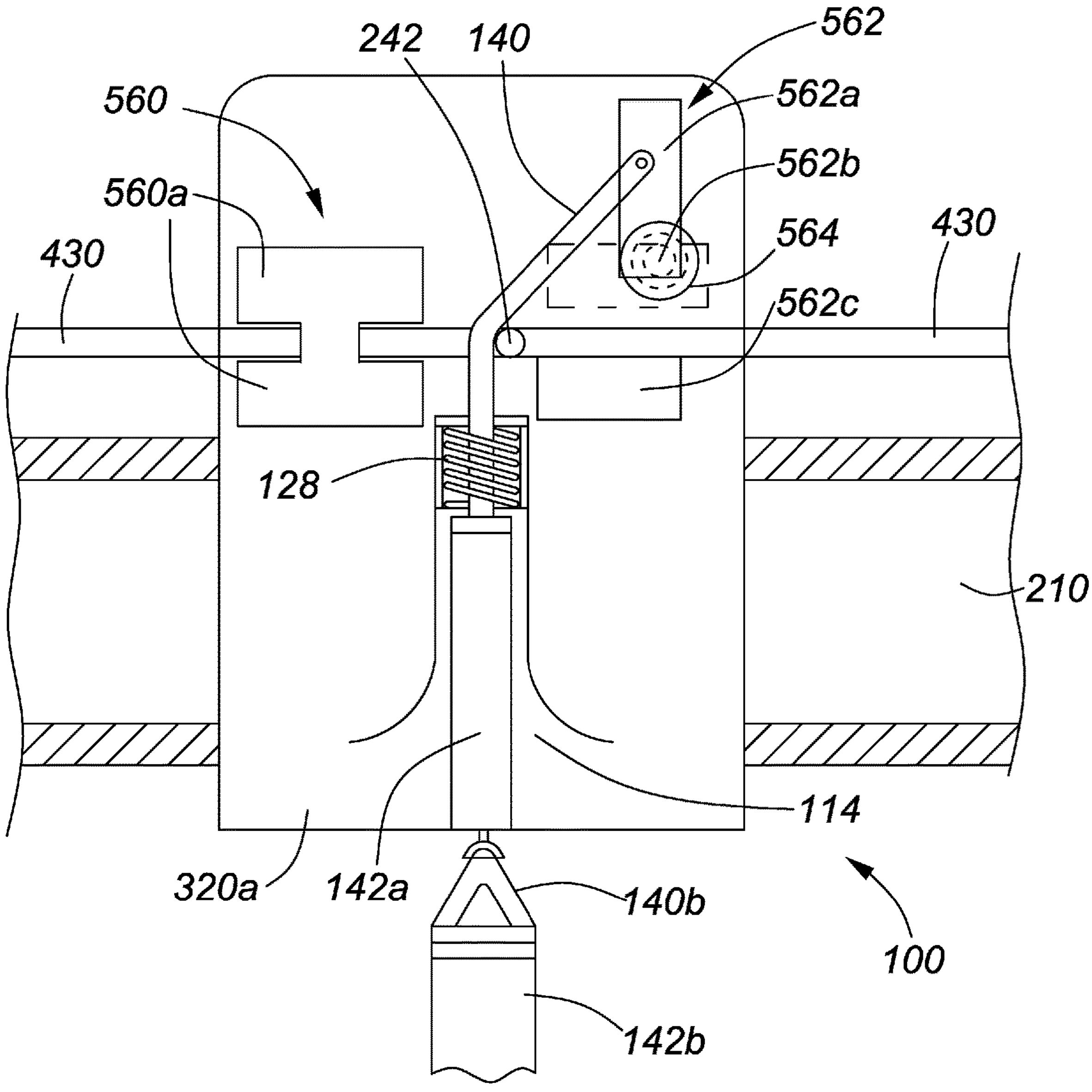

126
126b
126c
128
126d
126a
100
430
430a
430b
140a
242
242
140
210a
210
210c
210b
210d
114
142a
140b
142b
220
220a

FIG. 6(a)



562
242
140
562a
560
562b
560a
430
564
430
562c
128
210
114
320a
142a
140b
100
142b

FIG. 6(b)

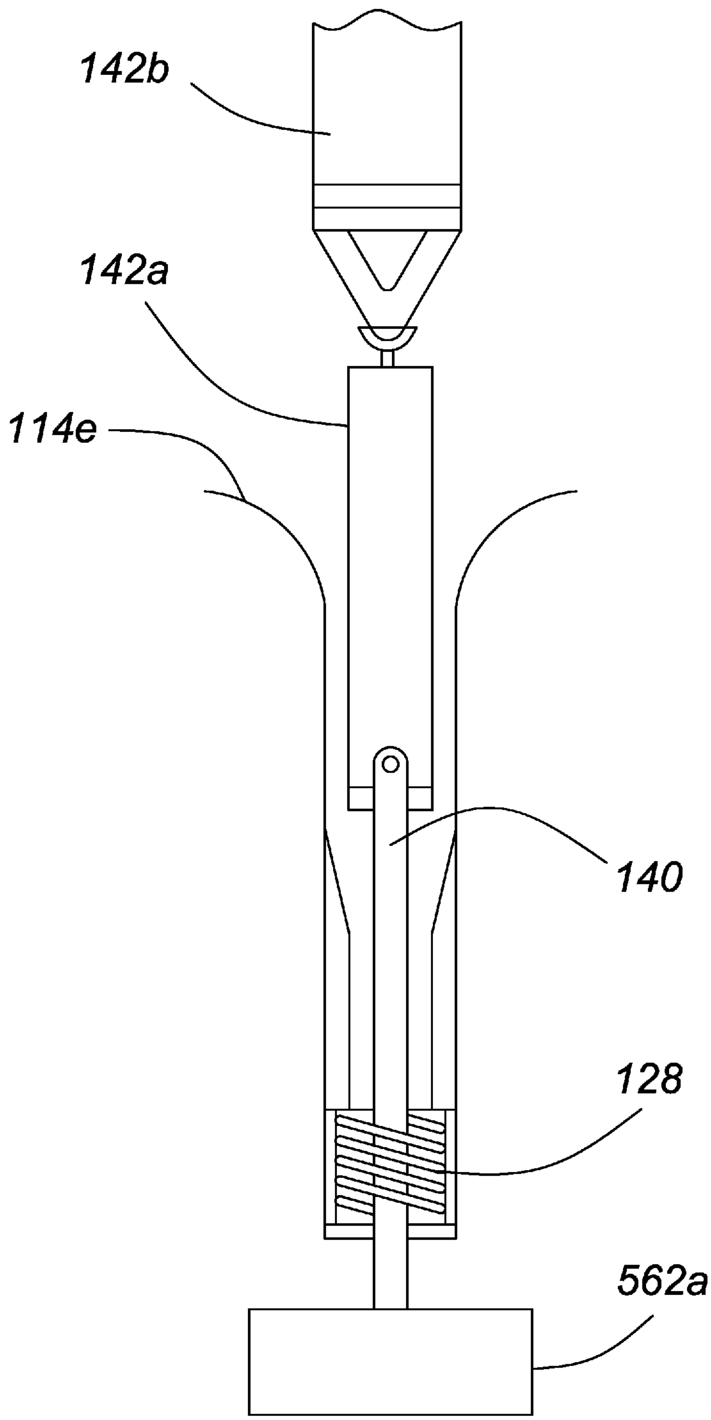


FIG. 6(c)

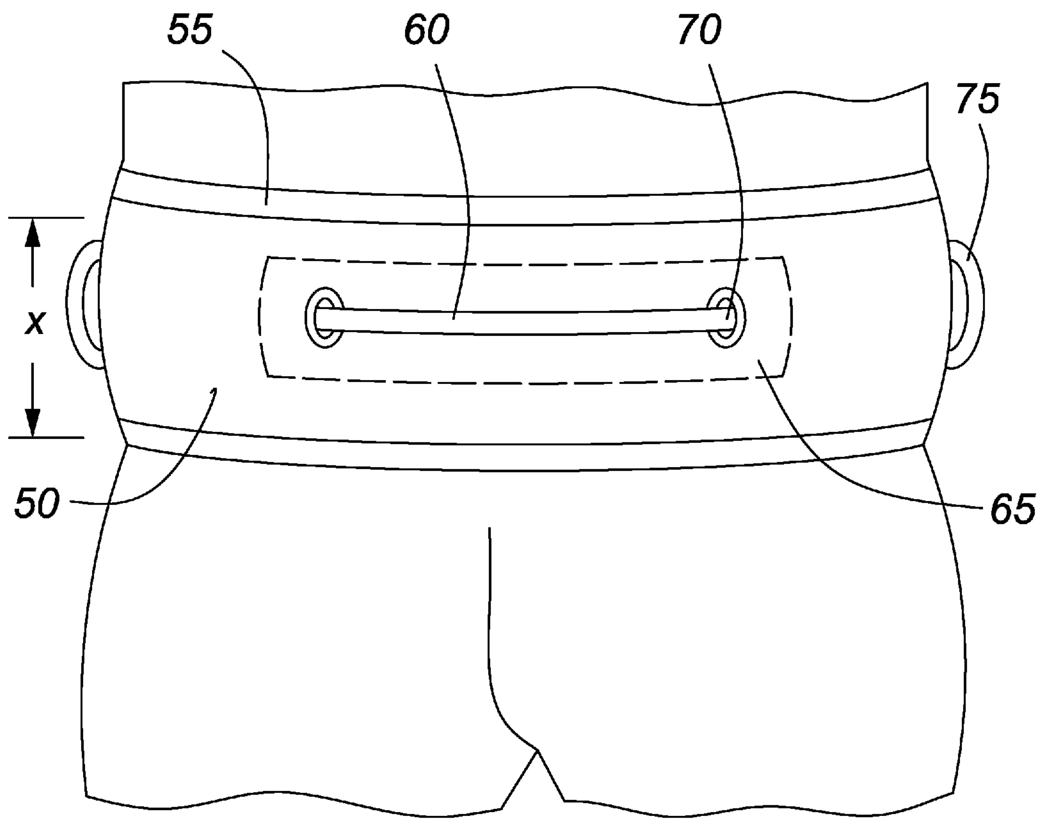


FIG. 7(a)

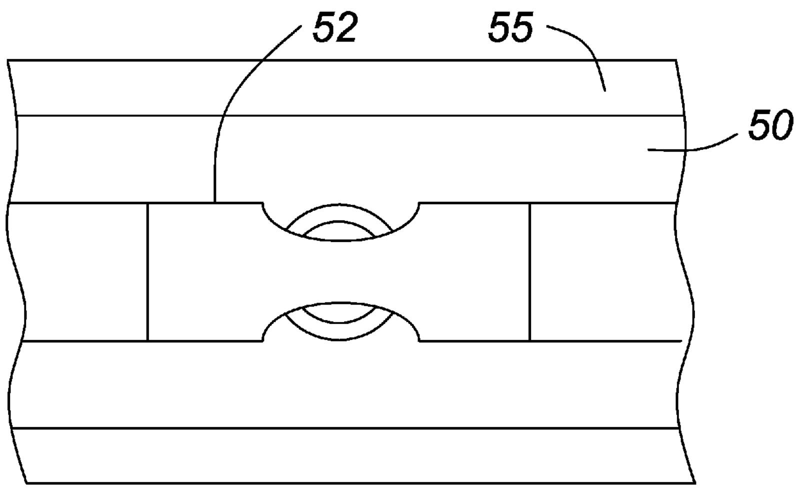


FIG. 7(b)

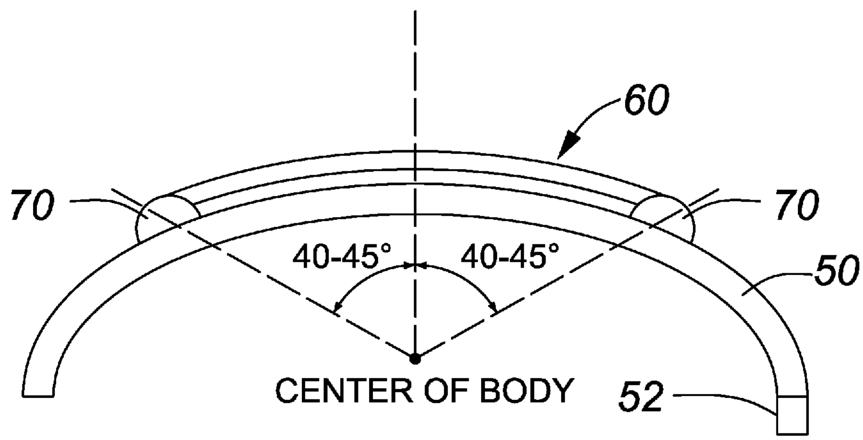


FIG. 7(c)

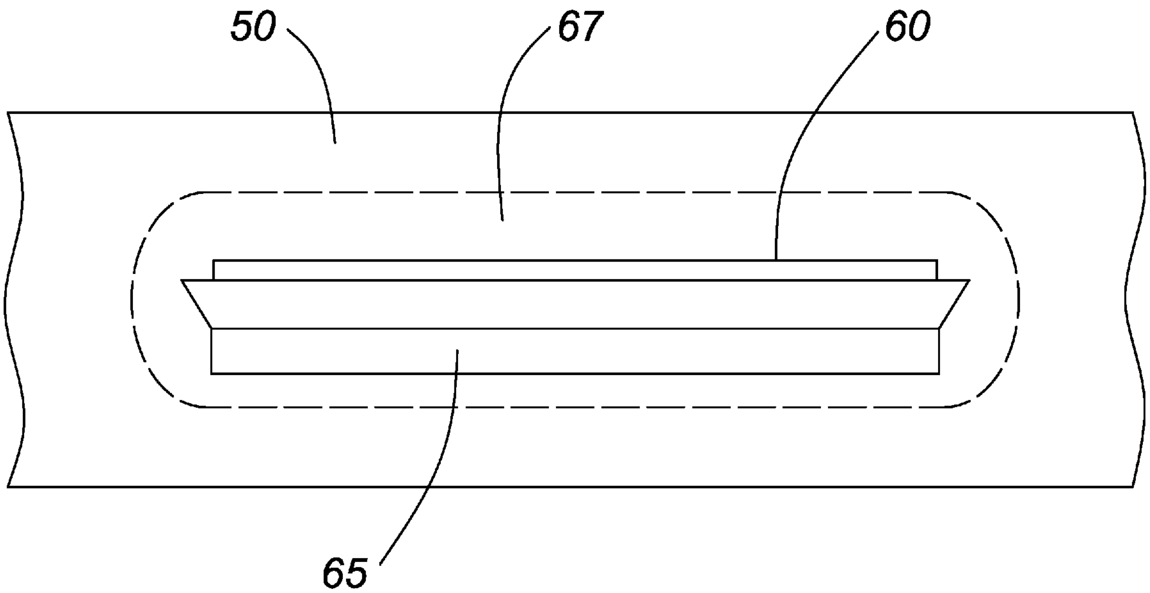


FIG. 7(d)

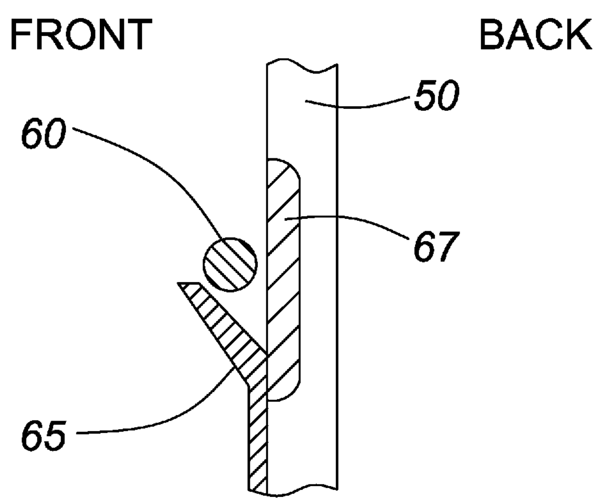


FIG. 7(e)

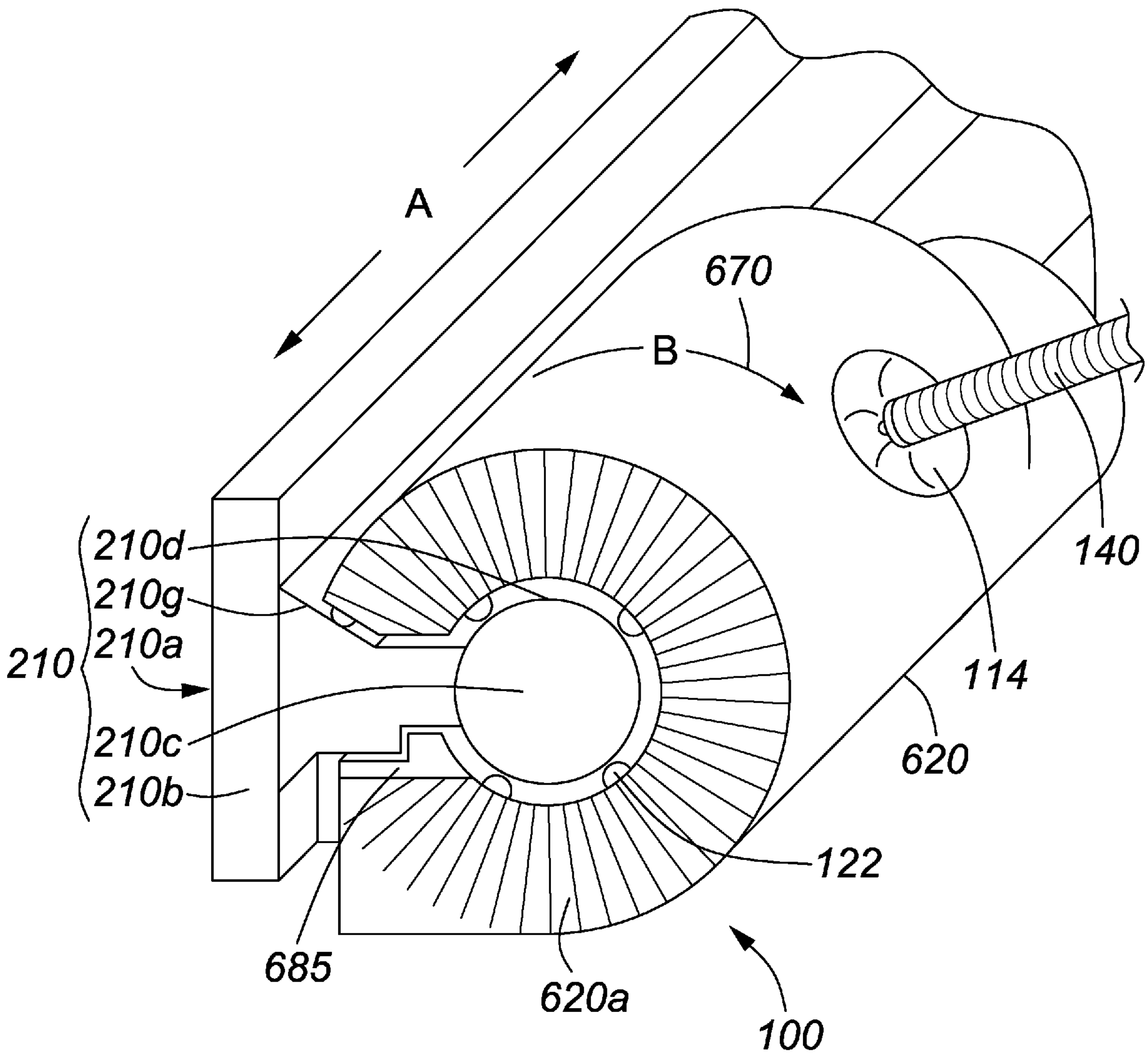
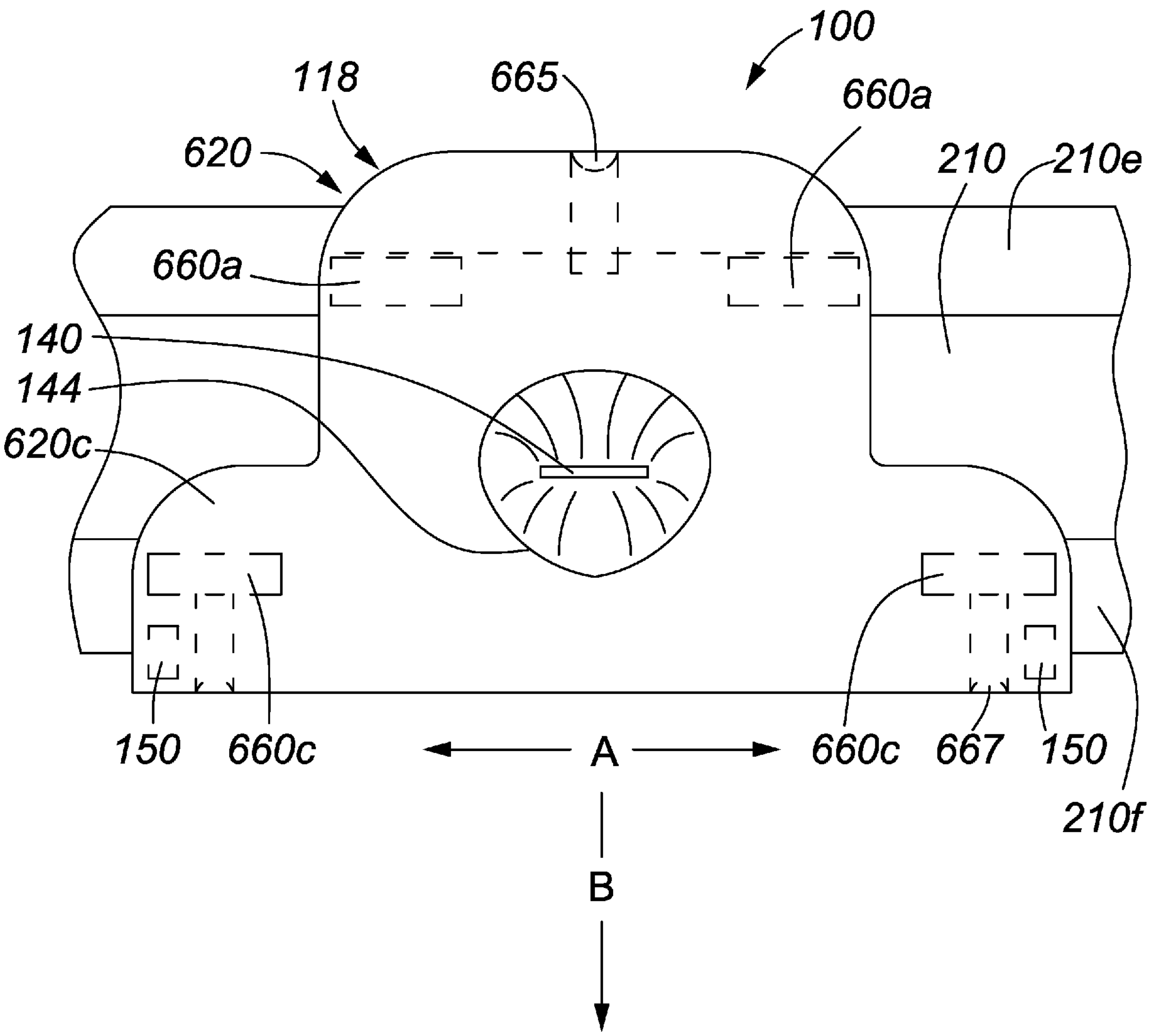

A
B
670
140
114
210
210d
210g
210a
210c
210b
620
122
685
620a
100

FIG. 8(a)


100
118
665
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620
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140
144
620c
150
660c
A
660c
667
150
210f
B

FIG. 8(b)

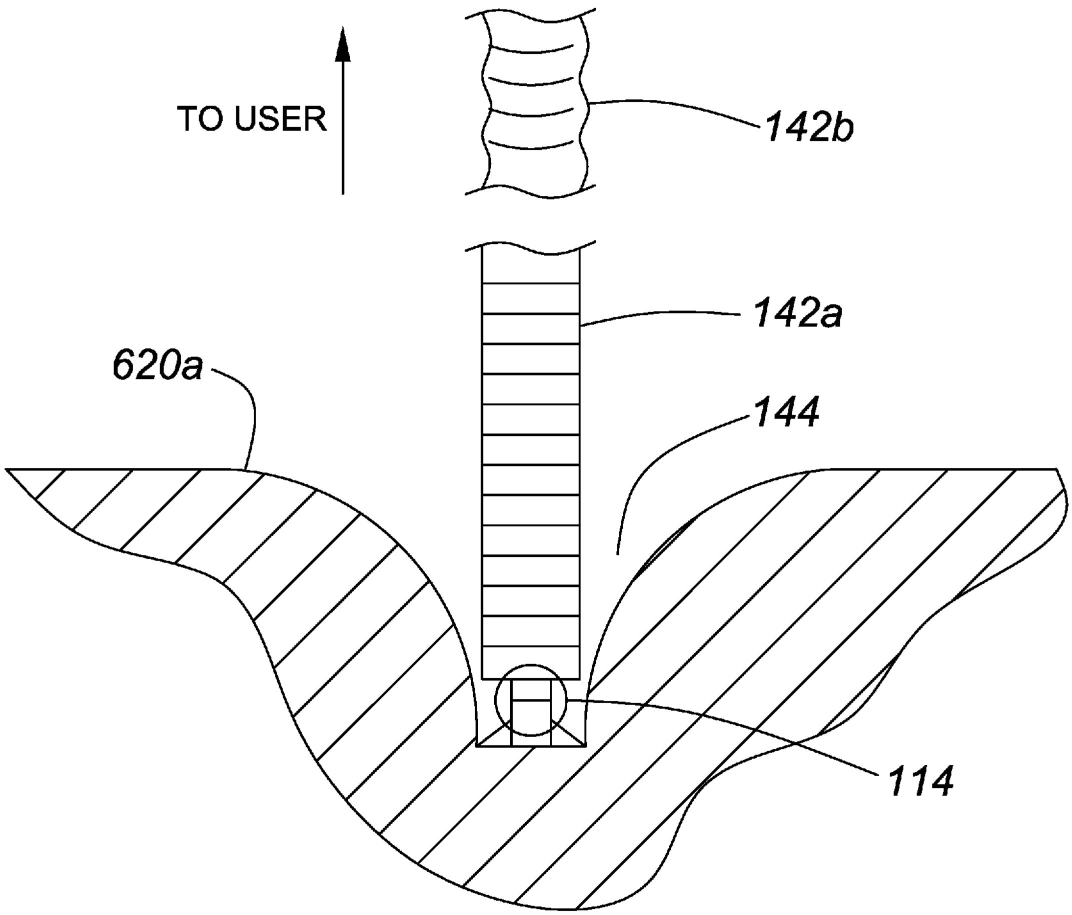


FIG. 8(c)

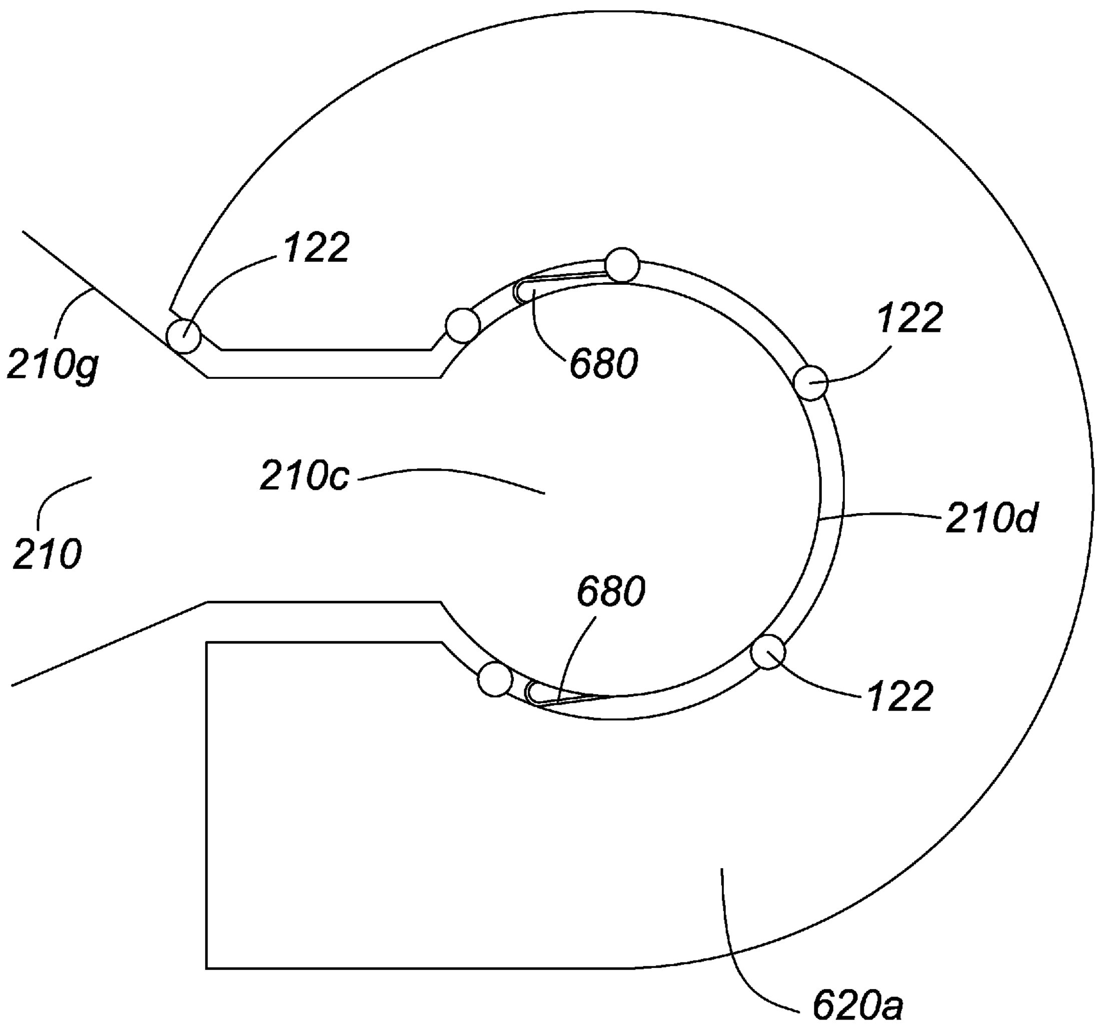


FIG. 8(d)

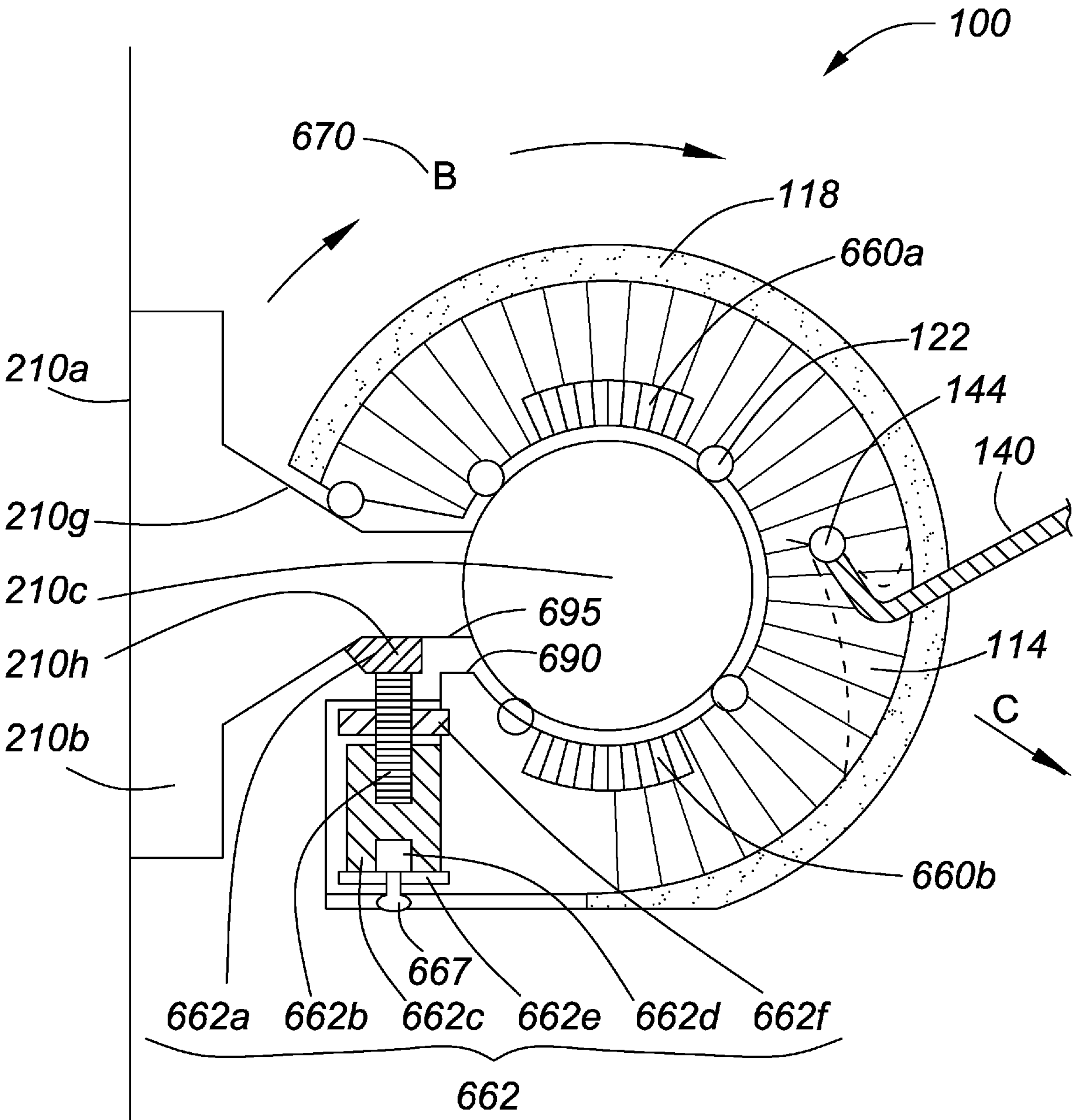
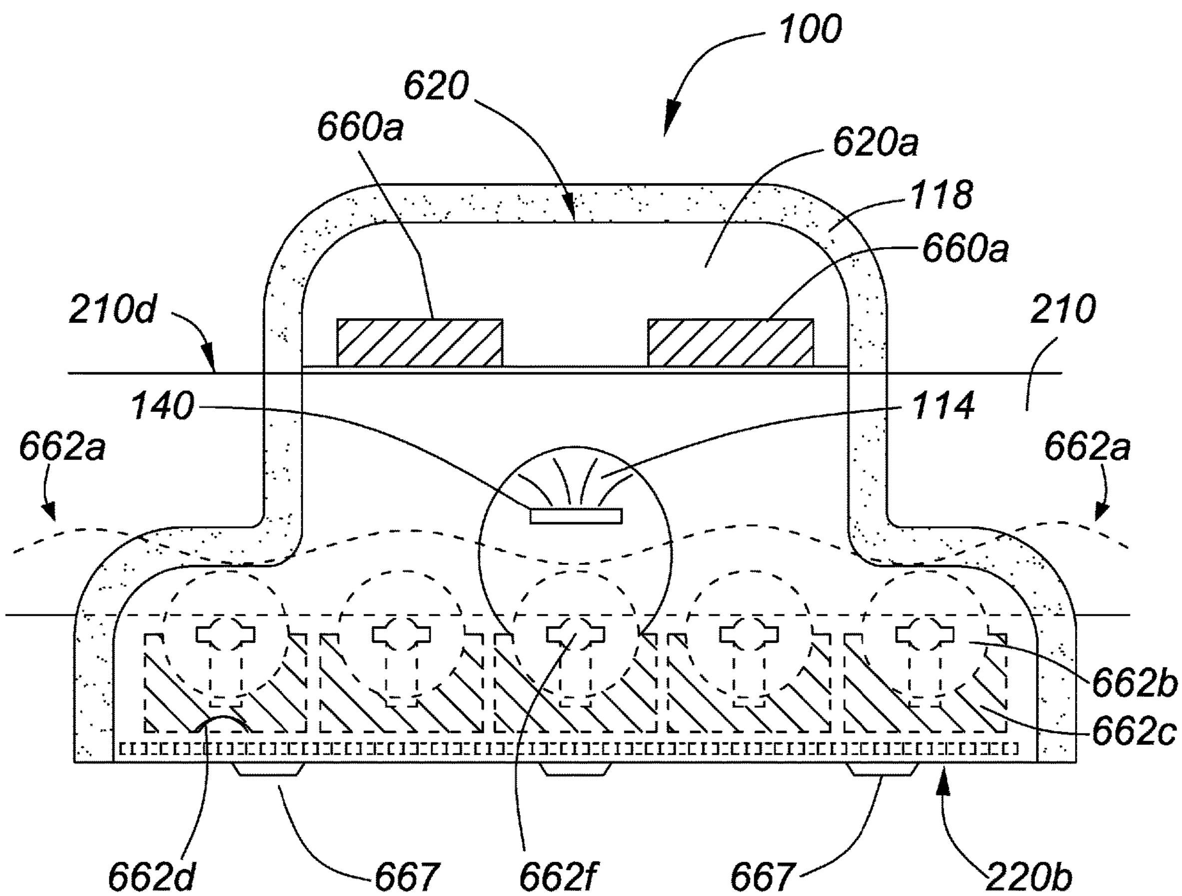
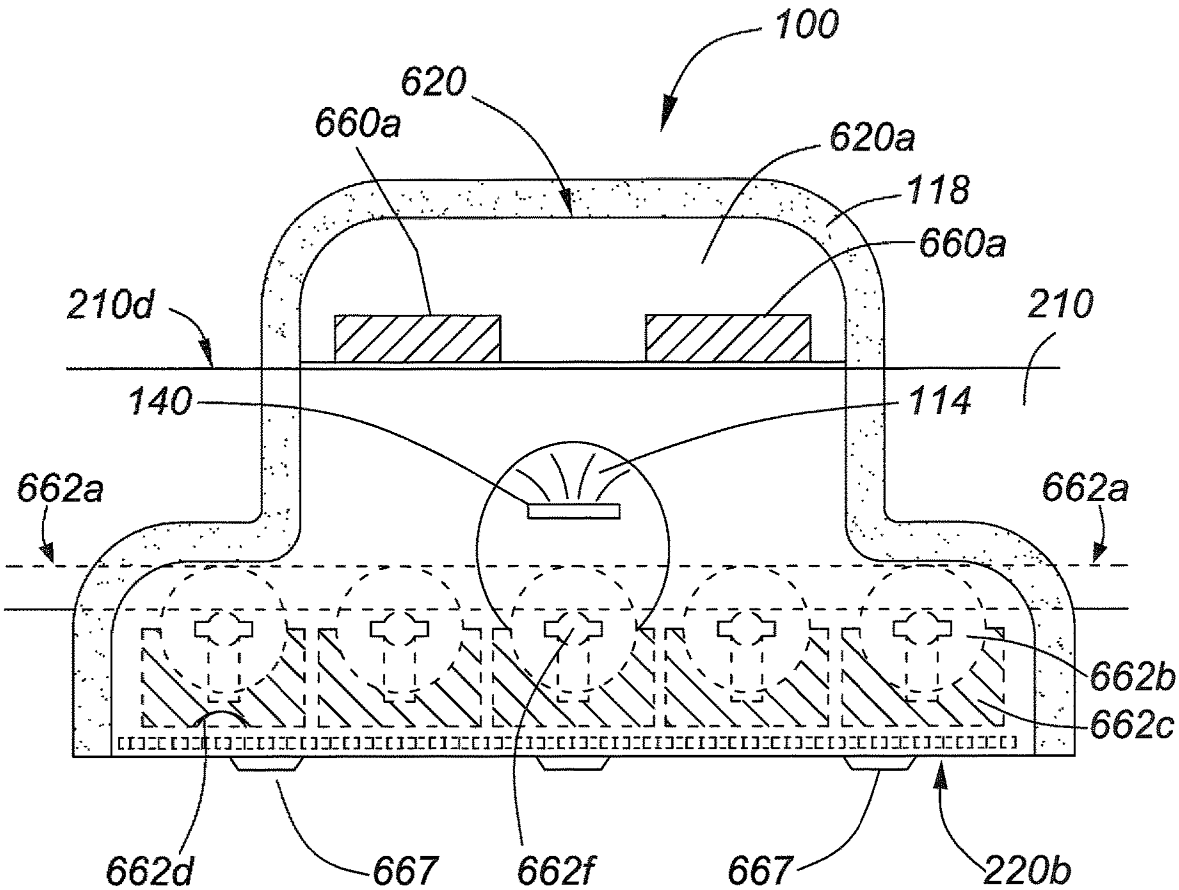

100
670
B
118
660a
122
144
140
210a
210g
210c
695
210h
690
114
C
210b
660b
667
662a
662b
662c
662e
662d
662f
662

FIG. 9(a)



100
620
660a
620a
118
660a
210d
210
140
114
662a
662a
662b
662c
662d
667
662f
667
220b

FIG. 9(b)


100
620
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660a
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140
114
662a
662a
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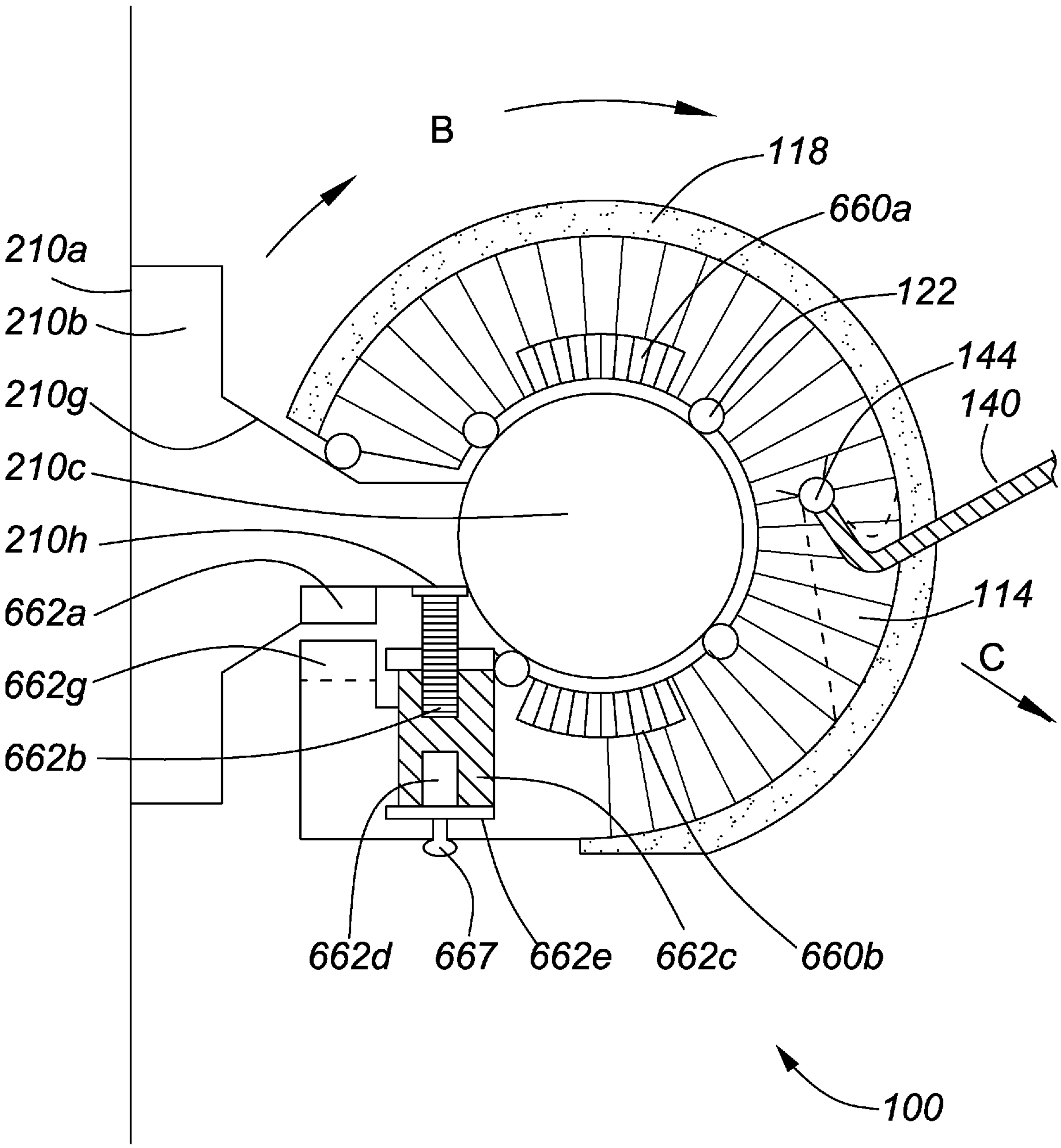
662c
662d
667
662f
667
220b

FIG. 9(c)


B
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210a
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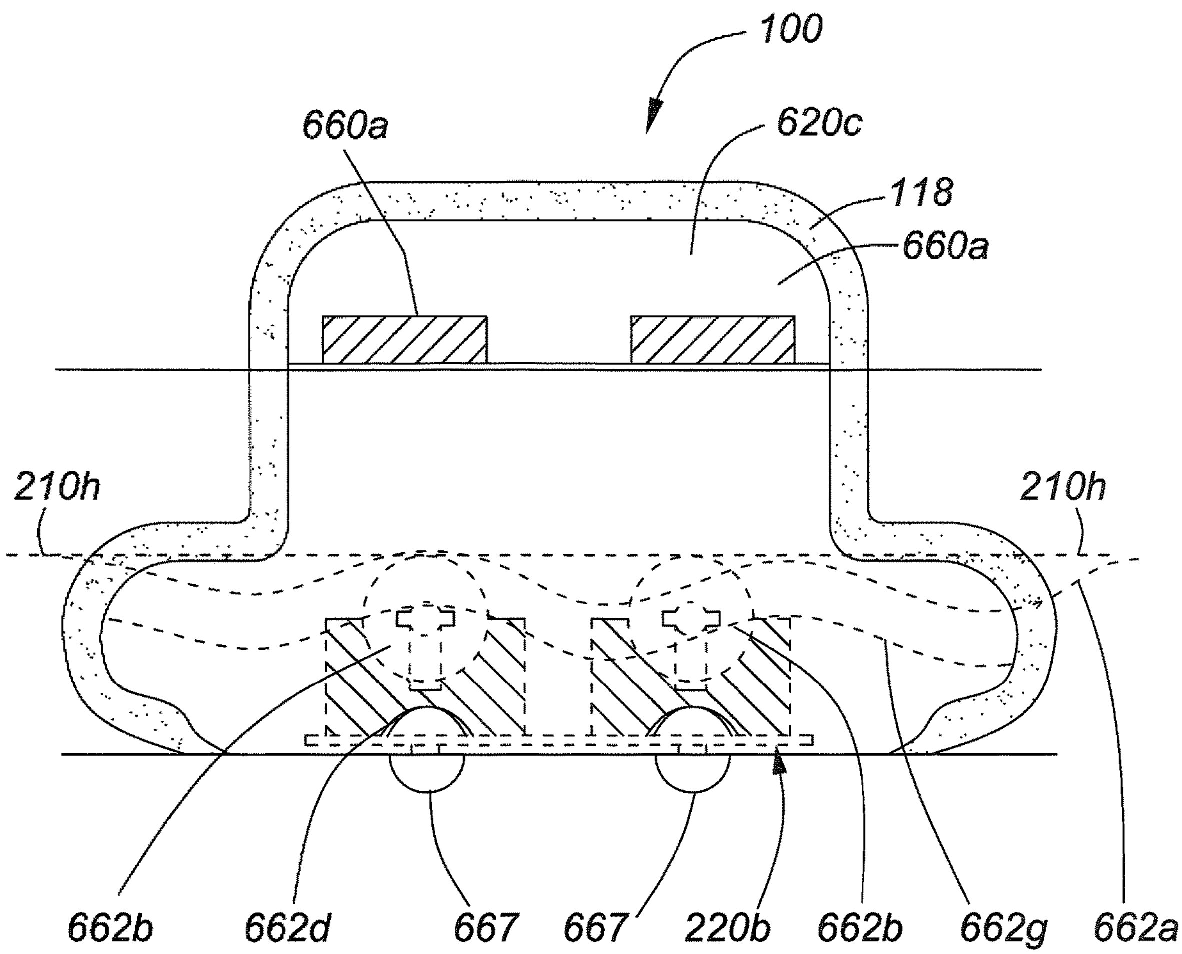
114
C
662d
667
662e
662c
660b
100

FIG. 10(a)


100
660a
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210h
662b
662d
667
667
220b
662b
662g
662a

FIG. 10(b)

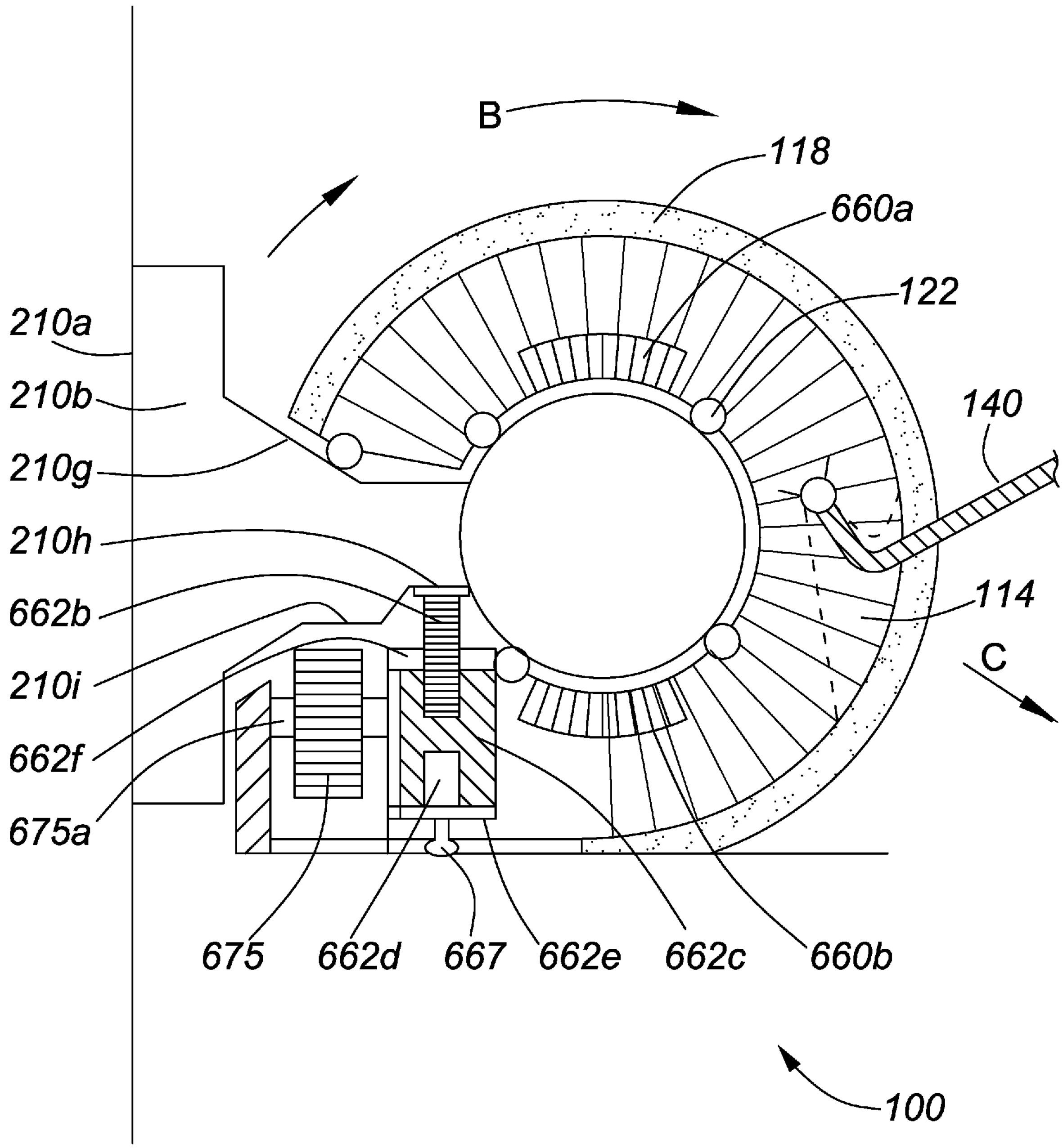
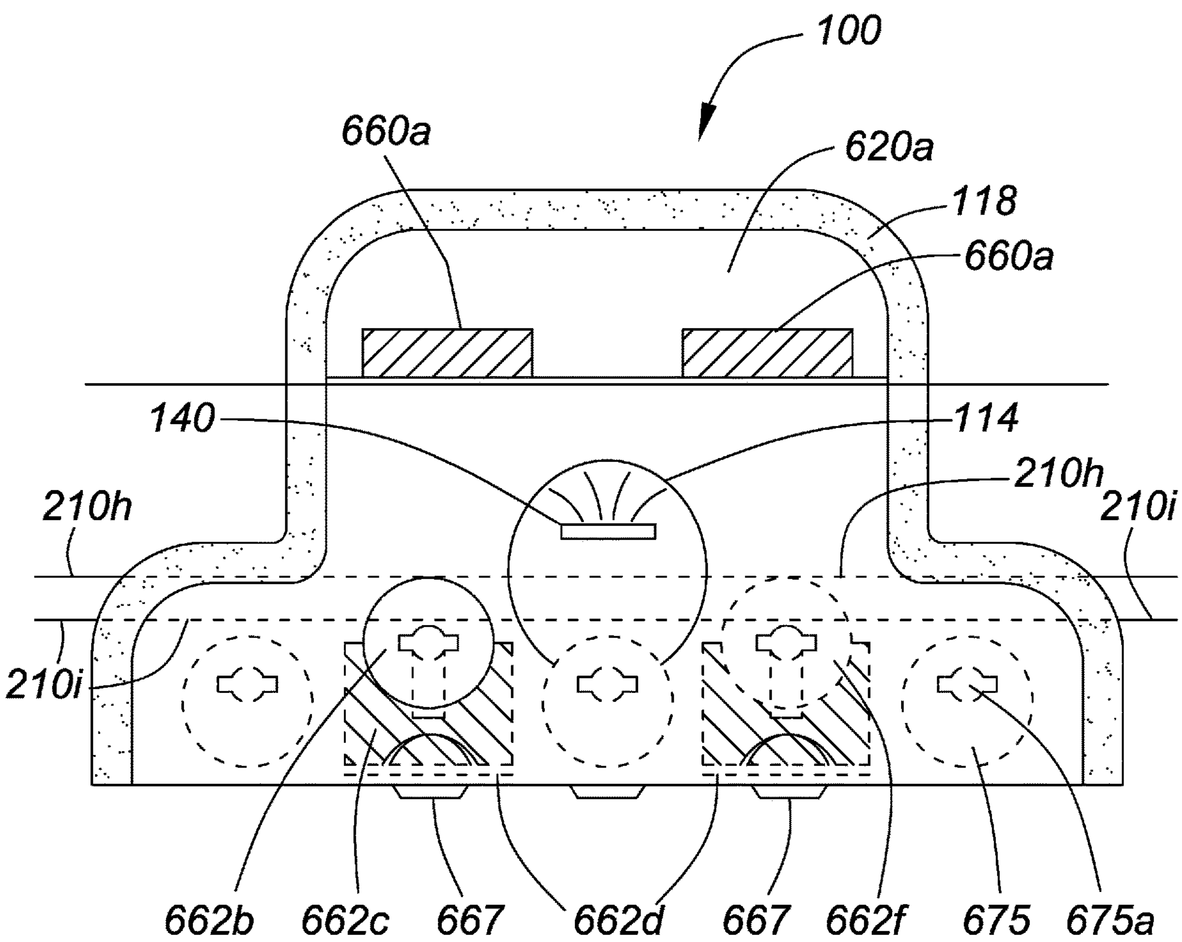

B
118
660a
122
140
114
C
210a
210b
210g
210h
662b
210i
662f
675a
675
662d
667
662e
662c
660b
100

FIG. 11(a)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210i
662b
662c
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662d
667
662f
675
675a

FIG. 11(b)

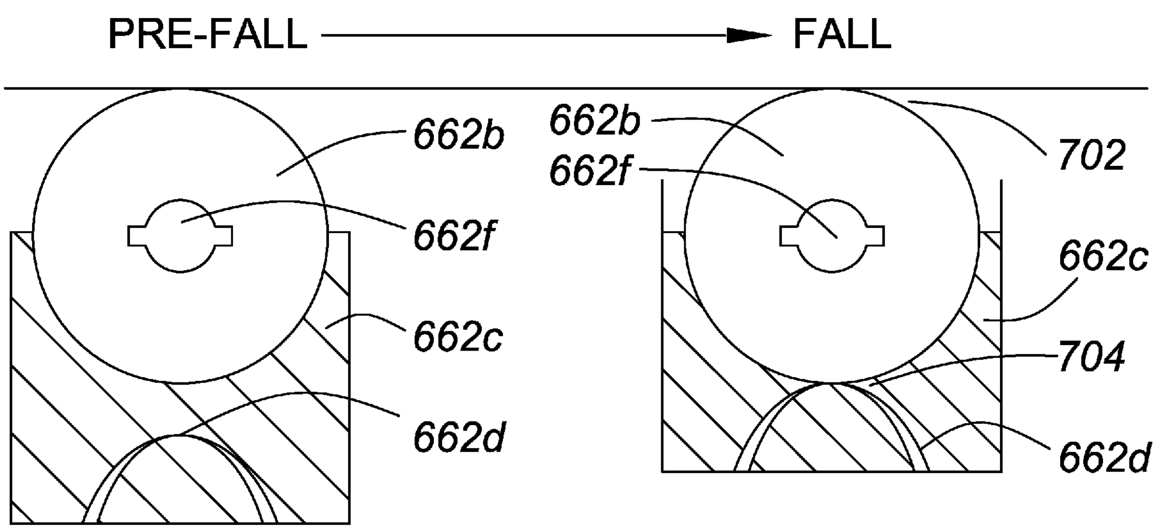

FIG. 12(a)

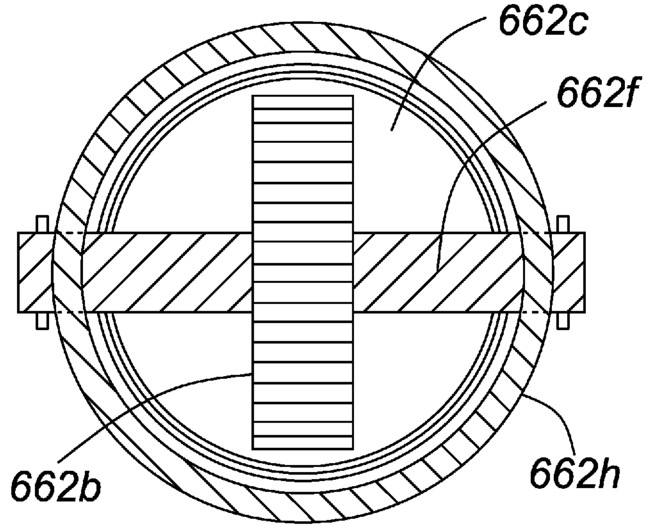

FIG. 12(b)

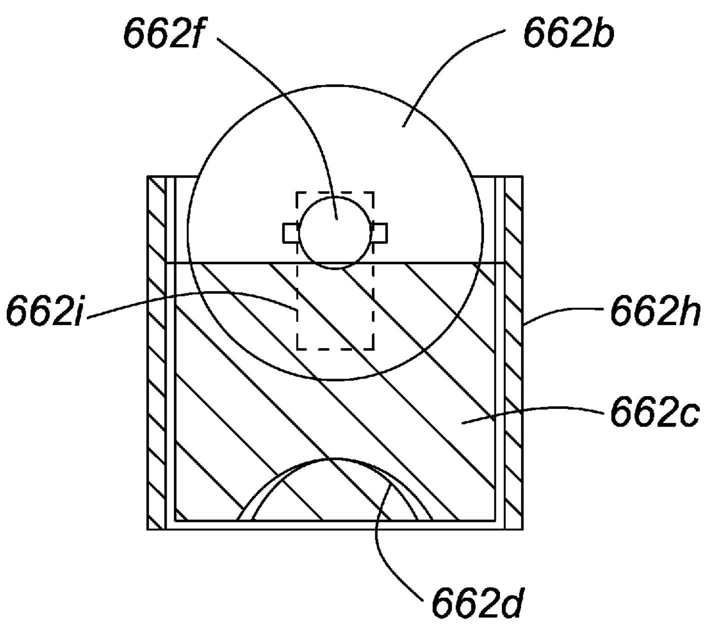

FIG. 12(c)

FALL CONTROL SYSTEM AND METHOD OF CONTROLLING A MOVEMENT DURING FALL EVENT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. provisional application Ser. No. 62/316,420 filed Mar. 31, 2016, the disclosure of which is hereby incorporated in its entirety by reference herein.

TECHNICAL FIELD

The present disclosure relates to a fall control system and a method of controlling a movement during a fall event.

BACKGROUND

Unintentional falls are a leading cause of non-fatal injuries treated in hospital emergency departments. The Centers for Disease Control and Prevention (USA), reported that unintentional falls in the elderly resulted in more non-fatal injuries in 2013 than the top 2 to top 10 leading causes of injuries in that age category (>65 years of age) combined.

Fall assist or fall arrest systems have been developed to lessen the frequency of injuries arising from unintentional falls, see for example EP 2,522,399, U.S. Pat. No. 7,883,450, US 2007/0004567, WO 2014/116628. In known fall assist systems, a person is attached to a harness that is coupled to a trolley that runs along a guiding track. During regular use, the person exerts a pulling force on the trolley, thereby moving the trolley along the guiding track. During a fall event, a braking system within the trolley is activated and the trolley comes to a complete stop thereby arresting the person from further movement and preventing the person from impacting the ground. Braking systems typically used in fall assist systems include friction engagement systems, for example as described in CA2,800,185, and WO2002/074389, or ratchet-like engagement braking systems, for example as described in EP 2,870,982, US 2012/0031701 or US 2015/0217151.

Other mobility aiding systems have also been developed. For example, stairlift systems transport a person over a flight of stairs. Generally, such systems comprise a guide rail, an electrical motorized trolley for moving along the guide rail (with or without a backup battery), and a passenger seat or platform attached to the trolley. In use, a passenger sits on the seat, or stands on the platform, attaches a seat-belt like device, and is carried from a first point to a second point along the guide rail. No movement on the passenger's part, other than to board and alight the seat or platform, is required.

SUMMARY

The present disclosure relates to a fall control system and a method of controlling a movement during a fall event.

It is an object of the present disclosure to provide an improved fall control system.

As described herein there is provided a fall control system that allows a user to ascend and descend stairs, or travel along a level surface, on their own accord. The fall control system decreases the user's ground impact speed during a fall event, and does not completely stop a user from impacting or contacting the ground during a fall event.

A fall control system comprising, an elongate guide rail extending along an axis, a trolley for moving along the elongate guide rail, a tether attached to the trolley at a first end, a second end of the tether for attaching to a user, and a speed control system for controlling a speed of the trolley along the elongate guide rail is provided. The speed control system comprises one or more than one speed control track attached to the elongate guide rail and extending along the axis, a surface of the speed control track selected from a flat surface, a wave-like surface, a toothed or geared surface, or a combination thereof. The speed control system also comprise a background speed controller, and a speed controller. The background speed controller coupled to the trolley and engaged with the one or more speed control track when the speed control system or the trolley is in a travelling orientation, the background speed controller selected from the group of one or more than one background eddy current brake, one or more than one background pre-tensioned gear, one or more than one background on-set wheel, and a combination thereof, the background speed controller for controlling the speed of the trolley along the elongate guide rail in the travelling orientation to not exceed a maximum walking speed. The speed controller coupled to the trolley and engagable with the one or more than one speed control track, the speed controller displaceable from a first position when the speed control system or the trolley is in the travelling orientation and the speed controller is not engaged with the speed control track, to a second position when the speed control system or the trolley is in a falling orientation and the speed controller is engaged with the speed control track, the speed controller selected from the group of one or more than one eddy current brake, one or more than one pre-tensioned gear, one or more than one on-set wheel, one or more than one off-set wheel, a wave-like surface on the body of the trolley, a flat surface on the body of the trolley, and a combination thereof, the speed controller for controlling the speed of the trolley along the guide rail in the falling orientation to not exceed a maximum fall speed. The maximum walking speed being greater than the maximum fall speed, and the maximum walking speed and the maximum fall speed being greater than zero.

Also described herein is the fall control system as described above, wherein one of the one or more than one speed control track is a background speed control track, the background speed control track engaged with the background speed controller, and a second of the one or more than one speed control track is for engaging the speed controller. For example, the background speed control track and the speed control track may be the same, or alternatively, the background speed control track and the speed control track may be separate.

Also provided is the fall control system as described above, wherein the background speed control track, the speed control track, or the background speed control track and the speed control track is conductive. For example, a circular shaft of the elongate guide rail may be conductive, or one or more than one elongate portion of the guide rail is conductive, and the background speed controller is the background eddy current brake. Furthermore, the background speed controller may comprise one or more than one background magnet coupled to the trolley and positioned on the trolley so that when the trolley is mounted on the elongate guide rail, the one or more than one background magnet is adjacent the background speed control track and the background eddy current brake is activated when the trolley moves along the guide rail.

The fall control system as described above is also provided, wherein the surface of the speed control track is a wave-like surface and the speed controller is the wave-like surface on the body of the trolley, or the on-set wheel. Alternatively, the surface of the speed control track may be a flat surface and the speed controller is the one or more than one off-set wheel. For example, when the trolley is in the travelling orientation, the wave-like surface on the body of the trolley, or the on-set wheel, is separated from the speed control track by a sufficient distance that the speed controller is not active, and when the trolley moves to the falling orientation the trolley rotates about the circular shaft and the axis, of the elongate guide rail, from the first position to the second position, in the second position the wave-like surface on the body of the trolley, or the on-set wheel, is brought into contact with the speed control track.

The speed control track of the fall control system, as generally descried above, may comprise the one or more than one elongate portion of the guide rail that is conductive, and the speed controller may comprise one or more than one magnet coupled to the trolley and positioned on the trolley so that when the trolley is in the travelling orientation, the one or more than one magnet is separated from the speed control track by a sufficient distance that the eddy current brake is not active, and when the trolley moves to the falling orientation the trolley rotates about the circular shaft and the axis, of the elongate guide rail, from the first position to the second position, in the second position the one or more than one magnet of the speed controller is brought into a position adjacent the one or more than one elongate portion of the guide rail that is conductive, thereby activating eddy current brake.

A fall control system is provided as described above, wherein a surface of the background speed control track is the toothed or geared surface, and the background speed controller is the one or more than one background pre-tensioned gear, and the speed control track is the toothed or geared surface and the speed controller is the one or more than one pre-tensioned gear.

A fall control trolley for moving along an elongate guide rail is also provided. The trolley comprises, a body, a background speed controller coupled to the body, and a speed controller coupled to the body. The background speed controller for engaging with one or more speed control track when the trolley is mounted on a guide rail and in a travelling orientation, the background speed controller selected from the group of one or more than one background magnet, one or more than one background pre-tensioned gear, one or more than one background on-set wheel, and a combination thereof, the background speed controller for controlling the speed of the trolley along the elongate guide rail in the travelling orientation to not exceed a maximum walking speed. A speed controller for engaging with the one or more than one speed control track, when the speed controller is displaced from a first position, when the trolley is in the travelling orientation and the speed controller is not engaged with the speed control track, to a second position when the trolley is in a falling orientation and the speed controller is engaged with the speed control track. The speed controller selected from the group of one or more than one magnet, one or more than one pre-tensioned gear, one or more than one on-set wheel, one or more than one off-set wheel, a wave-like surface on the body of the trolley, a flat surface on the body of the trolley, and a combination thereof, the speed controller for controlling the speed of the trolley along the guide rail in the falling orientation to not exceed a maximum fall speed, wherein the maximum walking speed being greater than the maximum fall speed, and the maximum walking speed and the maximum fall speed being greater than zero.

The fall control trolley as described above may move from the travelling orientation to the falling orientation by rotating about a circular shaft and an axis, of the elongate guide rail.

A method for controlling a movement of a movable object during a fall event is also described herein. The method comprising:

(a) coupling a first end of a tether to a trolley, the trolley being moveable along an elongate guide rail extending along an axis, the trolley comprising a background speed controller and a speed controller, the background speed controller active while the trolley is in a first position, in a travelling orientation, and the speed controller active when the trolley is in a second position, in a falling orientation;

(b) coupling a second end of the tether to the moveable object;

(c) exerting a pulling force, through the tether, on the trolley that is sufficient to move the trolley along the elongate guide rail while in the travelling orientation, the background speed controller controlling the speed of the trolley along the elongate guide rail to not exceed a maximum walking speed;

(d) during the fall event, exerting a falling force, through the tether, on the trolley that is sufficient to displace the trolley from the first position to the second position, the speed controller for controlling the speed of the trolley along the guide rail in the falling orientation to not exceed a maximum fall speed; and

(e) allowing the moveable object to descend to a ground at a controlled speed.

Preferably the maximum walking speed is greater than the maximum fall speed, and the maximum walking speed and the maximum fall speed are greater than zero.

Also provided herein is a transfer belt comprising, a padded belt for placement about a user's waist, an attachment cable fixed to the belt at a first and a second end and located along a forward-facing portion of the belt, the attachment cable for receiving a tether and providing side-to-side movement of the tether from the first end to the second end when the tether is attached to attachment cable, a cable backing attached to the belt and placed behind the belt attachment cable, the cable backing extending at least between the first and the second end, a cable cover attached to the padded belt below the attachment cable and comprising a free end protruding out from the belt and partly or fully overlapping the attachment cable, the cable cover extending at least between the first and the second end.

The fall control system described herein allows the user, following a fall, to crawl along the floor or stairs while still attached to the fall control system should he or she be injured and/or too weak to stand back up. The trolley of the fall-control system is typically pulled along by the user (when ascending stirs or moving along a flat surface), or by gravity (when descending stairs) and does not require an external power source. However, an external power source may be used to move the trolley if desired.

The guide rail of the fall control system described herein may also be used as a standard height hand rail (for example, approximately 30-37 inches from the floor or stairs), or can be installed in addition to a standard hand rail. If installed as a separate rail, then the guide rail may be located at some distance above and parallel to the standard hand rail. Since the trolley will lag behind the user travelling upstairs, and lead the user travelling downstairs, there would be room for the users hand on the rail ahead of the trolley walking upstairs, and behind the trolley walking downstairs (given an adequate and proper tether length). Similarly, on a level surface the trolley would lag behind the user, allowing room for the hand in front of the trolley.

The outer surface of the trolley (not including the funnel-like opening for the tether) may be padded with high density foam to decrease the chance of injury should the user fall forwards, backwards, or sideways and strike their head or other part of their body on the trolley.

This summary does not necessarily describe the entire scope of all aspects of the disclosure. Other aspects, features and advantages will be apparent to those of ordinary skill in the art upon review of the following description of specific embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, which illustrate one or more exemplary embodiments:

FIG. **1**A shows a perspective view of a person ascending a set of stairs using an example of a fall control device as described herein.

FIG. **1**B shows a perspective view of a person descending a set of curved stairs using of another configuration of an example of a fall control device as described herein.

FIG. **2**A shows a cross-sectional side view of an example of a fall control system as described herein.

FIG. **2**B shows a front view of the fall control system of FIG. **2**A. In this example, the fall control system comprises an eddy current brake speed control system. The eddy current brake speed control system comprising a pair of magnetic arms and a conductive gear wheel rotatable therebetween.

FIG. **3**A shows a cross-sectional side view of an example of a fall control system as described herein. In this example, the fall control system comprises a speed control system. The speed control system comprises a first pre-tensioned gear wheel (background speed control system) that is engaged to a speed-control track, and a second pre-tensioned gear wheel (speed retarding subsystem) that is engageable to the speed-control track (rail)

FIG. **3**B shows a cross-sectional side view of an alternate example of a fall control system comprising a circular rail and trolley interface, as described herein. In this example, the fall control system comprises a speed control system. The speed control system comprises a first pre-tensioned gear wheel (background speed control system) that is engaged to a speed-control track, and a second pre-tensioned gear wheel (speed retarding system) that is engageable to the speed-control track (rail).

FIG. **4** shows a cross-sectional side view of an example of a fall control system as described herein. In this example, the fall control system comprises an eddy current brake speed control system, the eddy current brake speed control system comprising a conductive element that is displaceable into a magnetized slot within a speed-control track (rail).

FIG. **5**A shows a cross-sectional side view of an example of a fall control system as described herein.

FIG. **5**B shows a front view of the fall control system of FIG. **5**A.

FIG. **5**C shows a top view of the fall control system of FIG. **5**A. In this example, the fall control system comprises an eddy current brake speed control system, the eddy current brake speed control system comprising a pair of magnets that is displaceable relative to a conductive element running a length of a speed-control track (rail).

FIG. **5**D shows a cross-sectional side view of another variant of the fall control system of FIG. **5**A.

FIG. **5**E shows a cross-sectional side view of another variant of the fall control system of FIG. **5**A.

FIG. **6**A shows a cross-sectional side view of an example of a fall control system comprising one eddy current brake speed control system.

FIG. **6**B shows a front view (with protective cover removed) of another variant of a fall control system comprising two eddy current brake speed control system.

FIG. **6**C shows a close-up front view of the fall control system of FIG. **6**B.

FIG. **7**A shows a front view of a transfer belt that may be used in conjunction with the fall control systems as described herein.

FIG. **7**B shows a close-up side view of an example of a fastener of the transfer belt of FIG. **7**A.

FIG. **7**C shows a top view of a portion of the front of the transfer belt of FIG. **7**A.

FIG. **7**D shows a detail of a front view of the transfer belt of FIG. **7**A showing the arrangement of the belt cable and belt cover.

FIG. **7**E shows a detail of a cross-sectional side view of the transfer belt of FIG. **7**A showing the arrangement of the belt cable and belt cover.

FIG. **8**A shows a perspective view of another example of a fall control system as described herein.

FIG. **8**B shows a front view of the fall control system of FIG. **8**A.

FIG. **8**C shows a top view of a detail of the fall control system of FIG. **8**B showing an example of tether attachment to the trolley body.

FIG. **8**D shows a cross-sectional side view of the trolley and a portion of the guide rail shown in FIG. **8**A.

FIG. **9**A shows a cross-sectional side view of another example of a fall control system as described herein in the travelling orientation.

FIG. **9**B shows a front view of the fall control system of FIG. **9**A in which the speed control track **662***a* is a sinusoidal wave surface. FIG. **9**C shows a front view of the fall control system of FIG. **9**A in which the speed control track **662***a* is a flat surface.

FIG. **10**A shows a cross-sectional side view of another example of a fall control system as described herein in the travelling orientation.

FIG. **10**B shows a front view of the fall control system of FIG. **10**A.

FIG. **11**A shows a cross-sectional side view of another example of a fall control system as described herein in the travelling orientation.

FIG. **11**B shows a front view of the fall control system of FIG. **11**A.

FIG. **12**A shows, on the left hand side, a cross sectional front detail view of the wheel assembly of the speed control system as described herein in a pre-fall, or an un-compressed state. In this view retainer **662***c* is separating the wheel (on-set wheel) **662***b* from the leaf spring **662***d*. The wheel assembly of the speed control system during a fall or in a compressed state is shown on the right hand side, with retainer **662***c* compressed and wheel (on-set wheel) **662***b* is pressed against an upper contact point **702** of the guide rail and a lower contact point **704** or the leaf spring **662***d*.

FIG. **12**B shows a top view of the wheel assembly of the speed control system FIG. **12**A.

FIG. **12**C shows a front detail view of the wheel assembly of the speed control system as described herein in a pre-fall, or an un-compressed state.

DETAILED DESCRIPTION

The present disclosure relates to a fall control system and a method of controlling a movement during a fall event.

Directional terms such as "top," "bottom," "upwards," "downwards," "vertically," and "laterally" are used in the following description for the purpose of providing relative reference only, and are not intended to suggest any limitations on how any article is to be positioned during use, or to be mounted in an assembly or relative to an environment. The use of the word "a" or "an" when used herein in conjunction with the term "comprising" may mean "one," but it is also consistent with the meaning of "one or more," "at least one" and "one or more than one." Any element expressed in the singular form also encompasses its plural form. Any element expressed in the plural form also encompasses its singular form. The term "plurality" as used herein means more than one, for example, two or more, three or more, four or more, and the like.

As used herein, the terms "comprising," "having," "including" and "containing," and grammatical variations thereof, are inclusive or open-ended and do not exclude additional, un-recited elements and/or method steps. The term "consisting essentially of" when used herein in connection with a composition, use or method, denotes that additional elements, method steps or both additional elements and method steps may be present, but that these additions do not materially affect the manner in which the recited composition, method or use functions. The term "consisting of" when used herein in connection with a composition, use or method, excludes the presence of additional elements and/or method steps.

As described herein there is provided a non-electrical fall control system that allows a user to ascend and descend stairs or level surface on their own accord (travelling orientation of the fall control system). The fall control system generally comprises an elongate guide rail and a trolley that moves along the elongate guide rail. The trolley generally moves by being pulled by the user, and no external electrical power source is used to move the trolley. The fall control system decreases the user's ground impact speed during a fall event (falling orientation of the fall control system), and does not completely stop a user from impacting or contacting the ground during a fall event. The fall control system described herein allows the user, following a fall, to crawl along the floor or stairs while still attached to the fall control system should he or she be injured and/or too weak to stand back up. The general arrangement of the various fall control systems described herein is shown in FIGS. **1**A and **1**B.

With reference to FIG. **1**A there is shown a user ascending a set of stairs while attached to a fall control system as described herein. The fall control system may be used while the user is moving along a horizontal surface, or while the user is descending or ascending stairs of any pitch or steepness. In the example shown in FIG. **1**A, the user is wearing a belt **50** that is connected to a trolley **120** by an adjustable length tether **140**. While the user ascends the stairs in a travelling orientation, trolley **120** moves along guide rail **110** by being pulled by the user along the guide rail **110** via tether **140**. The trolley is not electric, or powered by an external power source.

In the example shown in FIG. **1**A, the guide rail **110** is separate from the handrail, and the user may hold onto a regular hand rail if desired. As shown in FIG. **1**B, the guide rail **110** may also be used as a standard height hand rail (approximately 30-37 inches from the floor or stairs), or it can be used along with a standard hand rail (FIG. **1**A). If both a hand rail and a guide rail are used, then the guide rail **110** is generally placed parallel to the standard hand rail **80** and at a suitable height, for example above the hand rail. In use, the trolley **120** will move along guide rail **110** and lag behind the user travelling upstairs (FIG. **1**A), and lead the user travelling downstairs (FIG. **1**B). As a result, the user may place their hand on the hand rail ahead of the trolley walking upstairs, or behind the trolley walking downstairs. The user may also use the guide rail **110** as a hand rail on a level surface as the trolley would lag behind the user, allowing room for their hand in front of trolley **120**.

FIG. **1**B also shows an alternate configuration of a fall control system described herein where the guide rail **110** is curved to match the curve of the curved stair case. In this example, the user is descending the stairs and the trolley is moving along the guide rail under the influence of gravity.

The trolley (**120**, FIGS. **2**A, **2**B, **3**A; **220**, FIGS. **3**B, **5**A-**5**D, **6**A; **320**, FIGS. **4**, **6**B; **620**, FIGS. **8**A, **8**B, **9**A, **9**B, **10**A, **10**B, **11**A, **11**B), is typically of a light weight and the outer layer or surface **118** of the trolley may be padded (e.g. FIGS. **9**A, **9**B, **10**A, **10**B), for example, with a high density foam. This arrangement may help to decrease chance of injury should the user fall forwards, backwards, or sideways and strike their head or other part of their body on the trolley. Additionally, in some examples described herein, that comprise the trolley **120** disposed within a C-shaped guide rail **110**, the outer surface or layer **118** of the guide rail **110** may be padded (FIGS. **2**A, **2**B, **3**A, **4**) to decrease chance of injury should the user fall forwards, backwards, or sideways and strike their head or other part of their body on the C-shaped guide rail.

The trolley comprises a speed control system comprising one or more than one background speed control system, and one or more than one speed retarding subsystem, which interact with the guide rail, a portion of the guide rail, a speed control track, a background speed control track, or a combination thereof. Collectively, the speed control system controls movement of the trolley along the guide rail. The trolley can transition from a first position (or travelling orientation) to a second position (or falling orientation). At the first position when the trolley in a travelling orientation, the trolley may be in a resting position (not moving along the guide rail), or the trolley may be moving along the guide rail at speed controlled by the background speed control system. In the travelling orientation the trolley moves at a speed that does not greatly exceed a usual maximum walking speed of the user. At a second position, or fall orientation, the trolley moves along the guide rail at a speed that is less than the usual walking speed and significantly less than a maximum fall speed. If the user falls, the fall control system transitions to the second position (fall orientation) and the one or more than one speed retarding subsystem is activated. When the speed retarding subsystem is activated, the movement of the trolley along the guide rail is reduced, thereby slowing the speed of user's fall and minimizing any injury that would occur as a result of the fall.

By "travelling orientation" or 'first position" it is meant the relative position of the trolley, one or more than one trolley component, or a combination thereof with respect to the guide rail, a background speed control track, a speed control track, or combination thereof. The travelling orientation is achieved when the trolley is in a resting position (i.e. not moving along the guide rail) or when the trolley is attached to a user and the trolley moving along the guide rail as the user is walking, ascending, or descending stairs. In the travelling orientation the background speed control system may be activated.

By "falling orientation" or 'second position" it is meant the relative position of the trolley, one or more than one trolley component, or a combination thereof with respect to the guide rail, the background speed control track, the speed control track, or combination thereof. The falling orientation is achieved when the trolley is attached to a user and the user falls thereby imparting a force on the tether, the trolley body, one or more than one trolley component, or a combination thereof. In the falling orientation the speed retarding subsystem is activated.

A "speed control system" as used herein refers to the combination of the background speed control system and the speed retarding subsystem, of the fall control system.

A "background speed control system" as used herein refers to a combination of elements that control the speed of the trolley when the trolley is in the travelling orientation. The background speed control system may comprise a background speed control track, located along, beside, on the surface of, or within, the guide rail, and one or more than one background speed controller attached to the trolley body. The background speed controller interacts with the background speed control track when the trolley is the travelling orientation.

A "background speed controller" refers to an element or a combination of elements that are a part of the trolley body and that engage directly or indirectly with the background speed control track, or the speed control track, when the fall control system is in the travelling orientation. The background speed controller may include one or more than one magnet, a pre-tensioned wheel, a pre tensioned gear wheel, one or more than one on-set wheel (i.e. the axel is on the center of rotation of the wheel), or a combination thereof.

A "background speed control track" refers to a track that located along, beside, on the surface of, or within, the guide rail. The background speed control track may comprise a flat surface, a toothed (gear) surface, a wave-like surface, a conductive surface, a conductive body, or a combination thereof. In some examples described herein the background speed control track and the speed control track may be the same element.

A "speed retarding subsystem" as use herein refers to a combination of elements that control the speed of the trolley when the trolley is in a falling orientation. The speed retarding subsystem comprises a speed control track located along, beside, on the surface of, or within, the guide rail, and a speed controller located in the trolley body. The speed controller engages or interacts with the speed control track when the trolley is the falling orientation.

A "speed controller" as used herein refers to an element or a combination of elements that are a part of the trolley body that engage or interact with the speed control track. The speed controller may include one or more than one magnet, a pre-tensioned wheel, a pre tensioned gear wheel, one or more than one on-set wheel, one or more than one off-set wheel (i.e. the axel is off the center of rotation of the wheel), a wave-like surface of the trolley body, or a combination thereof.

A "speed control track" as used herein refers to a track that is located along, beside, on the surface of, or within, the guide rail. The speed control track may comprise a flat surface, a toothed (gear) surface, a wave-like surface, a conductive surface, a conductive body, or a combination thereof. In some examples described herein the speed control track and the background speed control track may be the same element.

Referring to FIGS. **2**A and **2**B, there is provided an example of a fall control system **100** comprising an elongate guide rail **110**, a trolley **120** for moving along an elongate guide rail **110**, and an adjustable length tether **140** that passes through an opening in the trolley **120** and couples to support **126***c*, of a speed control system **126**. In this example, the guide rail has a general C shape when viewed in cross section.

The guide rail **110** comprises a mounting surface **110***a*, a top surface **110***b*, a base surface **110***c*, and a surface **110***d* that is opposite the mounting surface **110***a*. The surfaces **110***a*, **110***b*, **110***c*, and **110***d* of the guide rail **110** define a spatial volume **112**. One or more reinforcing supports **116** for connecting a surface **110***a*, **110***b*, **110***c*, or **110***d* to an adjacent surface (e.g. the mounting surface **110***a* and the base surface **110***c* as depicted in FIG. **2**A) may be provided for improving the structural integrity of the guide rail **110**. The outer surface of the guide rail **110** may also be surrounded with a protective cover **118**, for example, but not limited to, a metallic cover, high density foam, or a plastic rail cover. An elongate opening **114** is defined within the surface **110***d* of the guide rail **110** and defines the C-shape of the guide rail. The opening **114** extends along a length, and an elongate axis, of the guide rail **110**.

The guide rail **110** may be manufactured of any material suitable in the art, for example, but not limited to, a suitable metal, aluminum, an alloy, or a resilient polymeric material, and manufactured in a manner that when installed to a weight bearing surface, the guide rail can support a weight capacity of a person that may be attached to the guide rail, for example, a person with a weight of from about 20 (10 kg) to about 400 pounds (185 kg), or any weight therebetween.

The guide rail **100** may be formed as one continuous rail, or by a plurality of guide rail sections (not shown) coupled together. The guide rail **100** may be linear or curved so that they may be fitted against a bearing surface, for example a wall, a ceiling, support posts, wall studs, rafters or overhead beams, within a stair well, a room, a hall or passageway. Where a plurality of guide rail sections (not shown) are coupled together to form the guide rail **110**, the plurality of guide rail sections are coupled together as would be known in the art, for example, but not limited to, interlocking sections, snap-fit sections, friction-fit sections, or the sections may be attached using screws, bolts, rivets, welding, solvents, compression clips and the like, or a combination thereof. In practice, the mounting surface **110***a* of the guide rail **110** is mounted onto a weight bearing surface (not shown; e.g. a wall, ceiling, post, rafter, stud and the like) by any suitable attachment or fastener **160** known in the art, for example, but not limited to, wall screws lag bolts, bolts, anchor bolts, expansion plugs, expansion anchors, expansion bolts.

The guide rail **110** may also comprise a speed-control track **130** that is formed along with, or attached to, the guide rail **110**. The speed control track **130** extends along the length, and the elongate axis of, the guide rail **110**. In this example the background speed control track and the speed control track are the same element.

If the speed control track **130** is formed separately from the guide rail **110**, then it may be attached to the guide rail **110** using any suitable attachment for example but not limited to screws, bolts, rivets, snap-locks, clips, welding, solvents and the like, or a combination thereof of these devices. If the speed control track **130** is formed separately from the guide rail **110**, then it may be formed as one continuous track, or by a plurality of speed-control track sections (not shown) that are coupled together in a similar manner as sections of the guide rail **110** described above. For example, the sections mat be coupled together using interlocking sections, snap-fit sections, friction-fit sections, or the sections may be attached using screws, bolts, rivets, welding, solvents, compression clips and the like, or a combination thereof.

The trolley **120** comprises a trolley body **120***a* and a speed control system **126** that is coupled to the trolley body **120***a*. An adjustable length tether **140** is attached to support **126***c* of the speed control system **126**. Trolley **120** is disposed within the spatial volume **112**, of the guide rail **110**, and contacts inner surfaces **110***a*, **110***b*, **110***c*, and **110***d* of the guide rail through one or more rolling elements **122**, or through a low resistance contact surface, for example, the outer surface of the trolley body **120***a* may be made from a low resistance material, for example, TEFLON® (polytetrafluoroethylene, PTFE) or other polymer as would be known in the art that permits the trolley **120** to easily slide within the guide rail **110**.

The rolling elements **122** are attached to the trolley **120** in a rotating relationship, and they support the trolley **120** within the guide rail **110**. Motion of the trolley **120** relative to, and within, the guide rail **110** causes the one or more rolling elements **122** to roll therebetween with preferably low rolling resistance and minimal sliding. Rolling elements **122** may include, but are not limited to, train wheels, heavy duty ball transfers, flying saucer ball transfers (e.g. Hudson Hauler or Hudson Super Mover, from Hudson Bearings), castor bearing, a roller-bearing, a needle bearing, cylindrical roller, roller ball bearing, and the like. If desired, the roller element may be made of a non-magnetic material. Examples of a non-magnetic rolling element include elements made from resilient polymeric materials, carbon reinforced polymers, carbon graphite, or roller elements that comprises austenite, and the like.

The trolley **120** may be manufactured of any material suitable in the art, for example, but not limited to, a suitable metal, alloy, resilient polymeric material, epoxy resin, fibreglass cloth-fibreglass resin composition, carbon-fibre-fibreglass resin composition, fibreglass cloth-epoxy resin composition, carbon fibre cloth epoxy resin composition, and manufactured in a manner that can support a weight capacity of a person that may be attached to the trolley **120**, for example, a person with a weight of from about 20 (10 kg) to about 400 pounds (185 kg), or any weight therebetween. Preferably, the material with which the trolley **120** is manufactured is not conductive.

The speed control system, collectively shown as **126** in FIG. **2**A, comprises a conductive gear wheel **124**, a speed controller **126***e*, magnetic arms **126***a*, **126***b*, support **126***c* and retainer **128**. The conductive gear wheel **124** is coupled to the trolley body **120***a* by axle **124***a*, and engages and rotates along the speed-control track **130**. The conductive gear wheel **124** is made of any conductive material, for example but not limited to, metal, steel, copper, aluminum, nickel, tungsten, zinc, iron, tin, titanium, stainless steel, nichrome, or an alloy of these metals. The conductive gear wheel **124** is optionally pre-tensioned as is known in the art. By pre-tensioned it is meant that the speed of rotation of the conductive gear wheel **124** along speed-control track **130** is limited to a pre-determined typical speed for the average user, thereby controlling the speed at which the trolley **120** moves along the guide rail **110**. In this example, the background speed control system and the speed retarding subsystem may share the same components. As explained below, the relative position of the components within the trolley body may determine which subsystem is actively engaged to control the speed of movement of trolley **120** along guide rail **110**.

Pre-tensioning of the conductive gear wheel may be achieved by any known mechanism, for example, through the use of a governor, an additional gear mechanism, use of an inertia flywheel, tensioned bearings, and the like. Pre-tensioning may also be determined by using a "first position" or "biased position" of the eddy-current brake as described below. In this manner, the conductive gear wheel **124** is characterized as having two rotational speed ranges, the first speed range may be set by pre-tensioning of the conductive gear wheel **124** (background speed control system), and the second speed range is determined by the degree of engagement of the eddy-current brake (speed retarding subsystem). As an alternate or additional option, the first speed range can also be set by the eddy-current brake having a starting position that overlaps with the wheel thereby functioning as a background speed control system. When the eddy current brake is partially or fully engaged, the magnetic arms drop down further over the gear wheel, causing further slowing (speed retarding subsystem). The first speed range is set to approximate the range in walking speeds of a person, so that the trolley **120** moves along the guide rail **110**, at a speed that is less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be from about 0.5 to about 5 km/hr, or any amount therebetween, or from about 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 km/hr, or any amount therebetween. The second speed range, is less than that of the first speed range, and it is achieved when the eddy-current brake is partially or fully engaged and the components are acting as a speed retarding subsystem. The eddy-current brake is partially or fully engaged by a person that trips or loses their footing and falls while walking along a flat or inclined surface, or while ascending or descending stairs. Therefore, the second speed range of trolley **120** as it moves along the guide rail **110**, helps control the falling speed of the person.

By "first maximum speed" or "maximum walking speed" as used herein, refers to the typical speed achieved by the average user (and when attached by tether to the trolley, the speed of the trolley), of the fall control system described herein. As would be evident to one of skill, the maximum walking speed will vary depending on the age, weight, and physical impairments or abilities of the user.

By "maximum fall speed" as used herein, refers to the typical speed of the trolley travelling along the elongate axis when all the components of the speed control system are activated by the average user in the event of a fall. As would be evident to one of skill, the maximum fall speed will vary depending on certain factors, such as the angle of guide rail relative to a horizontal plane and the weight of the user. The maximum fall speed does not refer to the fall speed of the user attached to the trolley just before or after the trolley reaches maximum fall speed. It is expected that the speed at which the user travels in the event of a fall, just before or after the trolley attains maximum fall speed, will initially be greater than the maximum fall speed of the trolley, but the speed will be considerably reduced (slowed) by the slower trolley speed and the elastic properties of the tether attaching the user to the trolley prior to the user contacting the steps or level surface.

The speed controller generally comprises the elements shown as **126***e* in FIG. **2**A, comprises a pair of magnetic arms **126***a*, **126***b*. The magnetic arms **126***a* and **126***b* may be made of any magnetic material, for example a paramagnetic, ferromagnetic material, or a combination thereof, a rare earth magnet, or a neodymium magnet. Magnetic arms **126***a*, **126***b* of the speed controller **126***e* are for interacting with the conductive gear wheel **124** to form an eddy-current brake which is described in more detail below. The speed controller **126***e* is also attached to a support **126***c*. Support **126***c* includes an attachment point for attaching the tether **140** to the speed retarding subsystem (and the background speed control subsystem) **126**.

The retainer **128**, is located between the support **126***c* and the trolley body **120***a*, the retainer **128** is for providing a retaining or biasing force, that biases the speed controller **126***e* away from the conductive gear wheel **124**. The retainer may comprise, for example but not limited to, a spring, compressible rubber, or other biasing device. The biasing force of the retainer **128** is of sufficient force to counteract any minor pulls or tugs that a person may apply against the support **126***c* via tether **140** as the trolley **120** moves along the guiderail **110**. However, if a force is applied to support **126***c* the exceeds a threshold force of the retainer, then the retainer is compressed and the support **126***c* is moved from its biased position (first position) shown in FIG. **2**A, towards a compressed position (second position; not shown) that compresses the retainer and moves the magnetic arms **126***a* and **126***b*, that are attached to the support **126***c*, to engage an increased surface area of conductive gear wheel **124**. Preferably, the retainer **128** has a biasing force of about 20 to about 35 pounds/inch, or any amount therebetween. However, the biasing force of the retainer **128** may be of any suitable magnitude, for example, but not limited to, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50 pounds/inch, or any amount therebetween.

The pair of magnetic arms **126***a*, **126***b* are positioned so that they overlap a first surface **124***b* and a second surface **124***c* of the conductive gear wheel **124**, and form a channel **126***d* therebetween. The conductive gear wheel **124** rotates within channel **126***d*. The range of overlap between the pair of magnetic arms **126***a*, **126***b*, and the conductive gear wheel **124** extends from a first, or biased position through to a second, compressed position. It is to be understood that the overlap between the magnetic arms **126***a* and **126***b* and the conductive gear **124** may be at any position between the first and second positions, and depends upon the force used to compress the retainer **128**.

At the first position (or biased position, travelling orientation), the speed controller **126***e* is maximally biased away from the conductive gear wheel **124** by the retaining force exerted by the retainer **128** against the support **126***c*. At the first position, the pair magnetic arms **126***a*, **126***b* of the speed controller **126***e* and the conductive gear wheel **124** exhibit no, or a minimal overlap. The amount of overlap between the pair of magnetic arms **126***a*, **126***b* and the conductive gear wheel **124** at the first position may be set to create an electromagnetic drag force which limits the rotation speed of the conductive gear wheel **124** along the speed-control track **130** to a first maximum speed so that the speed controller and gear wheel act as a background speed control system (i.e. a background eddy current brake). By setting the first position to provide an overlap of the magnetic arms with respect to the conductive gear wheel **124**, a pre-tensioning the conductive gear wheel may be established. That is, the spatial relationship between the pair of magnetic arms **126***a*, **126***b* and the conductive gear wheel **124**, and the rotation of the conductive gear wheel **124** through the channel **126***d*, creates a corresponding electromagnetic drag force that prevents the conductive gear wheel **124** from rotating beyond the first maximum speed of the first speed range of the trolley **120** along guide rail **110** (e.g. a maximum walking speed). As contemplated in this embodiment, the first maximum speed of the movement of the trolley **120** along guide rail **110**, in the travelling orientation, is less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be from about 12 to about 14 inches/second, or any amount therebetween. However, in other embodiments the first maximum speed of the movement of the trolley **120** along guide rail **110** may be adjusted to any desired speed, provided the speed is less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be about 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 inches/second, or from 0.5 to 5 km/hr, or any amount therebetween, or from about 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 km/hr, or any amount therebetween, in order to approximate the range in walking speeds of a person.

In an embodiment wherein the conductive gear wheel **124** is pre-tensioned, for example using a governor, an additional gear mechanism, use of an inertia flywheel, tensioned bearings, and the like, the pair of magnetic arms **126***a*, **126***b* may or may not overlap the conductive gear wheel **124** at the first position. In this arrangement (i.e. magnets that may or may not overlap the conductive gear wheel) the pre-tensioned conductive gear wheel is functioning as part of the part of the background speed control system.

The second speed range, in a falling orientation, of the speed controller **126***e* is determined by the degree of engagement of the magnetic arms **126***a* and **126***b* of the speed controller **126***e*, with the conductive gear wheel **124**, thereby engaging the "eddy-current brake". In the second position, when the speed retarding subsystem is fully engaged the speed controller **126***e* is minimally biased away from the conductive gear wheel **124**. That is, the retaining force exerted by the retainer **128** against the support **126***c*, to bias the speed controller magnet **126***a*, **126***b*, towards the first position, is completely overcome. In the engaged or second position, the pair of magnetic arms **126***a*, **126***b* and the conductive gear wheel **124** are overlapped and the speed retarding subsystem is activated. The amount of overlap between the pair of magnetic arms **126***a*, **126***b* and the conductive gear wheel **124** at the second position creates an electromagnetic drag force which limits the rotation speed of the conductive gear wheel **124** along the speed-control track **130** to a second maximum speed (e.g. a fall speed less than the expected fall speed without the speed controller) of the movement of the trolley **120** along guide rail **110**.

When fully engaged in the falling orientation, the second maximum speed of the trolley **120** as it moves along guide rail **110**, is from about 3 to about 6 inches/second, or any amount therebetween. The second maximum speed of the movement of the trolley **120** along guide rail **110** may be adjusted to any desired speed, for example, but not limited to 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 inches/second, or any amount therebetween. The second speed range, is achieved when the eddy-current brake may be partially or fully engaged by a person that trips or loses their footing and falls while walking along a flat or inclines surface, or while ascending or descending stairs. The second speed range thereby helps to control the falling speed of the person. It is to be understood that the second speed range will vary depending upon the degree of engagement between the speed controller **126***e* and the conductive gear wheel **124**. The values stated above for the second maximum speed are for a fully engaged eddy-current brake. However, a partially engaged eddy current brake may result in movement of the trolley **120** along the guide rail **110** anywhere from 5 to about 20 inches/second or any amount therebetween for example, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 inches/second, or any amount therebetween (the first speed range; travelling orientation), to about 1 to about 10 inches/second, for example, from about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 inches/second, or any amount therebetween (the second speed range).

The speed control system **126** does not comprise a brake that brings the trolley **120** to a complete stop during its travels along the guide rail **110**. Therefore, the first maximum speed of the trolley **120** is greater than the second maximum speed of the trolley **120**, and neither the first maximum speed nor the second maximum speed is zero. In the arrangement of the speed control system **126** described herein, both the first maximum speed and the second maximum speed are greater than zero, and the trolley **120** is never fully arrested, even when the speed controller **126***e* is displaced fully in the second position. The conductive gear wheel **124** is rotatable in the channel **126***d* between the pair of magnetic arms **126***a*, **126***b*, and the conductive gear wheel **124** moves along the speed-control track **130** regardless of whether the speed controller **126***e* is positioned at the first position, the second position, or any position therebetween.

An adjustable length tether **140** is attached to the trolley **120** at a first end **140***a*, and affixed to a person either directly, or via a harness or a transfer belt (also see FIGS. **7**A to **7**E) at a distal second end **140***b*. A non-limiting example of a suitable transfer belt is a SafteySure® Transfer Belt (available from health suppliers, for example, Healthcare Solutions, MTS Medical Supply, or SCAN Medical). An alternate transfer belt with several useful unique features is illustrated in FIGS. **7**A to **7**E and described herein. As contemplated in this embodiment, the tether **140** is couplable to the support **126***c* through a slot (not shown) that is formed in the part of the trolley body **120***a* that is adjacent to the support **126***c*. In order to permit movement of the support **126***c* in response to a pull on the tether **140**, the slot is oriented in the same plane as that of the movement of the speed controller **126***e* from the first position to the second position. The tether **140** may be an elasticized cord or belt, flexible cord or belt, non-elastic flexible cord or belt, a bungee-type cord, or a combination thereof, and may be of any length suitable for attachment to the person and the trolley **120** to permit movement along the guide rail **110**.

In an example of a use of the fall control system **100**, a tether **140** is coupled to a support **126***c* at first end **140***a*, and coupled to a person at second end **140***b*. When the person is walking, the person exerts a first pulling force on the speed controller **126***e* (at support **126***c*), through the tether **140**. The first pulling force is sufficient to move the trolley **120** along the guide rail **110**, but insufficient to displace the speed controller **126** from the first position. In other words, the first pulling force exerted on the speed controller **126***e* is not sufficient to overcome the retaining force of the retainer **128**. Owing to the pre-tensioning of conductive gear wheel **124**, for example, using electromagnetic drag force created as a result of the conductive gear wheel **124** rotating through the channel **126***d*, the person would be permitted to walk or move only as quickly as the first maximum speed.

When the person falls, the person exerts a downward pulling force on the support **126***c* and speed controller **126***e*, through the tether **140**, that is sufficient to both move the trolley **120** along the guide rail **110**, and displace the speed controller **126***e* from the first position to the second position by overcoming the retaining force of the retainer **128**. The overlap between the pair of magnetic arms **126***a*, **126***b* and the conductive gear wheel **124** increases, and as a result, increases the electromagnetic drag force created as the conductive gear wheel **124** rotates through the channel **126***d*. At the second position, or a partial second position, the trolley **120** therefore is permitted to move only as quickly as the second maximum speed, or a speed between the first and second maximum speed, respectively.

When the person has regained composure (e.g. stands back up and proceeds walking again), the downward pulling force against the retainer **128** is alleviated and the retainer **128**, displaces or the speed controller **126***e* from the second position to the first position, at which point the person is permitted again to proceed at a walking speed that is no quicker than the first maximum speed. For example, the person may proceed at a walking speed that may be less than 20 inches per second, although greater walking speeds are possible. Alternatively, if desired, the person may crawl down the stairs, or along a surface, while still attached to the trolley, and the movement of the trolley would not substantially impede their movement. As the minimum speed of the second position, when all speed control systems are activated, is never zero, the person can crawl up or down the stairs, or along a surface, even when the speed controller is fully engaged. This may be important as a disabled individual, that is unable to crawl up or down the stairs (as a result of a fall control system that impedes all movement), could potentially become stuck on stairs or floor for several hours or days until help arrived.

When the fall control system **100** is not in use, the trolley **120** may be secured in place at one end of guide rail **110** by coupling a contact **150** to a corresponding component (not shown) located at either end of the guide rail **110**. For example, the trolley **120** may be secured in place by any suitable device known in the art, including but not limited to a magnet, a snap clip, a lever, a clasp, a clip, a cord, a hook, and the like.

Referring to FIGS. **3**A and **3**B, there are provided additional examples of a fall control system **100** of the present invention, characterized in that both of these fall control systems have an alternate speed control system **126** when compared to the embodiment described in FIGS. **2**A and **2**B. However, several of the components of the fall control systems described below and shown in FIGS. **3**A and **3**B are similar or analogous to those described above with reference to FIGS. **2**A and **2**B, and include for example, a guide rail **110** (FIG. **3**A) or **210** (FIG. **3**B), a trolley **120** (FIG. **3**A), or **220** (FIG. **3**B), for moving along the guide rail **110** or **210**, and an adjustable length tether **140** that couples to a speed control system **126** therein.

The C-shaped guide rail **110** in FIG. **3**A, comprises a mounting surface **110***a*, a top surface **110***b*, a base surface **110***c*, and a surface **110***d* that is opposite the mounting surface **110***a*. The surfaces **110***a*, **110***b*, **110***c*, and **110***d* define a spatial volume **112** (see FIG. **3**A). The outer surface of the guide rail **110** may also be surrounded with a protective cover **118**. An opening **114** is provided through the surface **110***d*, the opening **114** extending along a length of the guide rail **110**.

As noted above in respect to the fall control system of FIG. **2**A, the guide rail **110** may be manufactured of any material suitable in the art, for example, but not limited to, a suitable metal, aluminum, an alloy, or a resilient polymeric material, and manufactured in a manner that when installed to a weight bearing surface, the guide rail can support a weight capacity of a person that may be attached to the guide rail, for example, a person with a weight of from about 20 (10 kg) to about 400 pounds (185 kg), or any weight therebetween.

The guide rail **110** may be formed as one continuous rail, or by a plurality of guide rail sections (not shown) coupled together. The guide rail **110** may be linear or curved so that they may be fitted against a bearing surface, for example a wall, a ceiling, support posts, wall studs, rafters or overhead beams, within a stair well, a room, a hall or passageway. Where a plurality of guide rail sections (not shown) are coupled together to form the guide rail **110**, the plurality of guide rail sections are coupled together as would be known in the art, for example, but not limited to, interlocking sections, snap-fit sections, friction-fit sections, or the sections may be attached using screws, bolts, rivets, welding, solvents, compression clips and the like, or a combination thereof. In practice, the mounting surface **110***a* of the guide rail **110** is mounted onto a weight bearing surface (not shown; e.g. a wall, ceiling, post, rafter, stud and the like) by any suitable attachment or fastener **160** known in the art, for example, but not limited to, wall screws lag bolts, bolts, anchor bolts, expansion plugs, expansion anchors, expansion bolts.

The guide rail **110** also comprises a speed-control track **130** that is formed along with, or attached to, the guide rail **110**. The speed control track **130** extends along the length, and the elongate axis of, the guide rail **110**. In this example the background speed control track and the speed control track are the same element.

If the speed control track **130** is formed separately from the guide rail **110**, then it may be attached to the guide rail **110** using any suitable attachment for example but not limited to screws, bolts, rivets, snap-locks, clips, welding, solvents and the like, or a combination thereof of these devices. If the speed control track **130** is formed separately from the guide rail **110**, then it may be formed as one continuous track, or by a plurality of speed-control track sections (not shown) that are coupled together in a similar manner as sections of the guide rail **110** described above. For example, the sections may be coupled together using interlocking sections, snap-fit sections, friction-fit sections, or the sections may be attached using screws, bolts, rivets, welding, solvents, compression clips and the like, or a combination thereof.

The trolley **120** comprises a trolley body **120***a* and a speed control system **126** that is coupled to the trolley body **120***a*. An adjustable length tether **140** is attached to support **126***c* of the speed control system **126**. Trolley **120** is disposed within the spatial volume **112** (see FIG. **3**A), of the guide rail **110**, and contacts inner surfaces **110***a*, **110***b*, **110***c*, and **110***d* of the guide rail through one or more rolling elements **122**, or through a low resistance contact surface, for example, the outer surface of the trolley body **120***a* may be made from a low resistance material, for example, TEFLON® (polytetrafluoroethylene, PTFE) or other polymer as would be known in the art that permits the trolley **120** to easily slide within the guide rail **110**.

The rolling elements **122** are attached to the trolley **120** in a rotating relationship, and they support the trolley **120** within the guide rail **110**. Motion of the trolley **120** relative to, and within, the guide rail **110** causes the one or more rolling elements **122** to roll therebetween with preferably low rolling resistance and minimal sliding. Rolling elements **122** may include, but are not limited to, train wheels, heavy duty ball transfers, flying saucer ball transfers (e.g. Hudson Hauler or Hudson Super Mover, from Hudson Bearings), a roller-bearing, a needle bearing, cylindrical roller, roller ball bearing, and the like. If desired, the roller element may be made of a non-magnetic material. Examples of a non-magnetic rolling element include elements made from resilient polymeric materials, carbon reinforced polymers, carbon graphite, or roller elements that comprises austenite, and the like.

The trolley **120** may be manufactured of any material suitable in the art, for example, but not limited to, a suitable metal, alloy, resilient polymeric material, epoxy resin, fibreglass cloth-fibreglass resin composition, carbon-fibre-fibreglass resin composition, fibreglass cloth-epoxy resin composition, carbon fibre cloth epoxy resin composition, and manufactured in a manner that can support a weight capacity of a person that may be attached to the trolley **120**, for example, a person with a weight of from about 20 (10 kg) to about 400 pounds (185 kg), or any weight therebetween. Preferably, the material with which the trolley **120** is manufactured is not conductive.

With reference to FIG. **3**B, the guide rail **210** comprises body of the guide rail **210***b* and **210***c*, a mounting surface, or base **210***a*, and a curved outer surface **210***d* that interfaces with trolley **220**. The guide rail **210** further comprises a speed-control track **130** coupled to a surface of the guide rail **210**. In this example the background speed control track and the speed control track are the same element.

The guide rail **210** may be made from steel, stainless steel, aluminum, anodized aluminum, or similar material. The outer surface **210***d* of guide rail **210** may be coated in a ceramic, or other low friction material to facilitate movement of trolley **220** along the guide rail **210**. An example, that is not to be considered limiting, of such a rail-trolley arrangement is a linear bearing system using round shaft technology from PBC Linear (Pacific Bearing Company), for example, Simplicity® 60 Plus® Shafting, and accompanying bearing. The bearing component may be modified to include the components of the trolley described herein.

The trolley **220** comprises a trolley body **220***a* and a speed control system **126** that is coupled to the trolley body **220***a*. An adjustable length tether **140** is attached to support **126***c* of the speed control system **126**. The tether **140** may pass over guides **242** within the trolley **220**. An inner surface of trolley **220** slides along outer surface **110***d* of guide rail **110** through a low resistance contact surface, for example, the inner surface of the trolley body **220** may be made from a low resistance material, for example, TEFLON® (polytetrafluoroethylene, PTFE) or other polymer as would be known in the art that permits the trolley **220** to easily slide along guide rail **210**. The trolley **220** may also move along guide **210***c* using rolling elements as shown for example in FIGS. **8**A, **9**A, **10**A, **11**A.

The trolley **220** may be manufactured of any material suitable in the art, for example, but not limited to, a suitable metal, alloy, resilient polymeric material, epoxy resin, fibreglass cloth-fibreglass resin composition, carbon-fibre-fibreglass resin composition, fibreglass cloth-epoxy resin composition, carbon fibre cloth epoxy resin composition, and manufactured in a manner that can support a weight capacity of a person that may be attached to the trolley **120**, for example, a person with a weight of from about 20 (10 kg) to about 400 pounds (185 kg), or any weight therebetween.

The speed control system **126** shown in the examples of the fall control system **100** presented in FIGS. **3**A and **3**B comprises: a pre-tensioned first gear wheel (or a background pre-tensioned gear wheel; an on-set wheel) **224** that is coupled to the trolley body **220***a* by axle **224***a*, the background pre-tensioned gear wheel **224** (background speed control system) for engaging and rotating along the speed-control track **130**; a speed controller assembly comprising a support **126***c* and a pre-tensioned second gear wheel an on-set second wheel) **226***e* coupled to the support **126***c* via an axle **226***b*; and a retainer **128** disposed between the support **126***c* and the trolley body **120** (FIG. **3**A) or **220** (FIG. **3**B; speed retarding subsystem). The retainer **128** provides a biasing force that biases the second gear wheel **226***e* of the speed controller **126**, away from the speed-control track **130**. In this example, the background speed control track and the speed control track are the same.

The first gear wheel **224** of the background speed control system, and the second gear wheel **226***e* of the speed retarding subsystem, are pre-tensioned to provide different speed ranges of the trolley **120** or **220**, as it moves along the guide rail **110** or **210**, using methods known to one of skill in the art. Pre-tensioning of the first **224** and second **226***e* gear wheel may be achieved by any known mechanism, for example, through the use of a governor, an additional gear mechanism, an inertia flywheel, tensioned bearings, and the like. The tension on the first, the second, or both the first and the second gear wheels can be custom set by means of a dial, or screw, or the like, allowing a customized pre-set tension of the gear wheels that matches the approximate weight of the user.

In this manner, the speed control system **126** is characterized as having two rotational speed ranges, the first speed range of the background speed control system (travelling orientation) is set by pre-tensioning of the first (backgound) gear wheel **224**, and the second speed range of the speed retarding subsystem, is determined by pre-tensioning of the second gear wheel **226***e*. The first speed range is set to approximate the range in walking speeds of a person, so that the trolley **120** or **220**, moves along the guide rail **110** or **210**, and is less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be from 0.5 to 5 km/hr, or any amount therebetween. The second speed range (falling orientation), is less than that of the first speed range, and it is achieved when the second gear wheel **226***e* is engaged with speed control track **130**. The second gear wheel **226***e* becomes engaged with speed control track **130** when a person attached to the trolley trips or loses their footing and falls while walking along a flat or inclined surface, or while ascending or descending stairs. Therefore, the speed range of trolley **120** as it moves along the guide rail **110** is determined by the pre-tensioned second gear wheel, and helps control the falling speed of the person.

As contemplated in this example, the first gear wheel **224** of the background speed control system is in constant contact with the speed-control track **130**, and rotates along the speed-control track **130** when the trolley **120**, or **220**, is moving along the guide rail **110** or **210**. The first gear wheel **224** is pre-tensioned to an amount such that the speed at which the first gear wheel **224** may rotate along the speed-control track **130** is limited to a maximum speed of the movement of the trolley **120** or **220** along guide rail **110** or **210** is less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be from about 12 to about 14 inches/second, or any amount therebetween. However, in other embodiments the first maximum speed of the movement of the trolley **120** or **220** along guide rail **110** or **210** may be adjusted to any desired speed, for example, but not limited to, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 inches/second, or from 0.5 to 5 km/hr, or any amount therebetween, for example, from about 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 km/hr, or any amount therebetween, in order to approximate the range in walking speeds of a person.

Similarly, the second gear wheel **226***e* of the speed retarding subsystem is preferably pre-tensioned to an amount such that the second maximum speed of the trolley **120** or **220** as it moves along guide rail **110** or **210**, is from about 4 to about 6 inches/second, or any amount therebetween. The second maximum speed of the movement of the trolley **120** or **220** along guide rail **110** or **210** may be adjusted to any desired speed, for example, but not limited to 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 inches/second, or any amount therebetween.

The support **126***c*, retainer **128**, axel of second gear wheel **226***b* and the second gear wheel **226***e*, of speed controller **126** are collectively moveable between a first position and a second position. At the first position (shown in FIGS. **3**A and **3**B), the second gear wheel **226***e* is maximally biased away, and disengaged with the speed-control track **130** by the retaining force exerted by the retainer **128** against the support **126***c* of the speed controller. In this position, the second gear wheel **226***e* is not engaged with the speed-control track **130** when the speed controller **126** and support **126***c* are located at the first position. In the second position, the retaining force exerted by the retainer **128** on the support **126***c* of the speed controller **126** has been overcome by an external pulling force, for example a pull from tether **140** when the user falls (fall event) in any direction. At the second position, the second gear wheel **226***e* of the speed retarding subsystem is brought into rotational engagement with the speed-control track **130**. Upon engagement of the second gear wheel **226***e* with the speed-control track **130**, the speed at which the trolley **120** or **220**, moves relative to the guide rail **110** is limited to the speed at which the pre-tensioned second gear wheel **226***e* rotates along the speed-control track **230** (i.e. the second speed).

In FIG. **3**A, the second gear wheel **226***e* of the speed controller **126** is depicted as engaging the speed-control track **130** during a fall event by moving down, towards the speed control track **130**. The components of the fall control system may be re-configured, as would be apparent to a person skilled in the art, such that a second geared wheel **226***e* is pulled upwards, for example as shown in FIG. **3**B, or to the side, or obliquely, to engage a speed-control track **130** during a fall event.

The speed control system **126** does not comprise a brake that brings the trolley **120** or **220** to a complete stop during its travels along the guide rail **110** or **210**. Therefore, the first maximum speed of the trolley **120** or **220** is greater than the second maximum speed of the trolley **120** or **220**, and neither the first maximum speed nor the second maximum speed is zero. In the arrangement of the speed control system **126** described herein, both the first maximum speed and the second maximum speed are greater than zero, and the trolley **120** or **220** is never fully arrested, even when the speed controller **126** is displaced fully in the second position.

An adjustable length tether **140** is attached to the support **126***c* of the trolley **120** or **220**, at a first end **140***a*, and affixed to a belt or cord **140***b* for attachment to the user, either directly, or via a harness or a transfer belt (see FIGS. **7**A to **7**E). A non-limiting example of a belt that may be used is a SafteySure® Transfer Belt (available from health suppliers, for example, Healthcare Solutions, MTS Medical Supply, or SCAN Medical).

A customized transfer belt **50** is also described herein (see FIGS. **7**A to **7**E) which may be used with any of the fall control systems **100** described herein. Tether **140** (not shown in FIGS. **7**A to **7**E) may be attached to the transfer belt via attachment cable **60**. This arrangement provides movement of tether **140** about a 30-45 degree radius on each side of the midline (FIG. **7**C; anterior aspect of belt) to permit tether **140** to slide to either side (see FIGS. **7**A and **7**C), or remain midline, relative to the users body. Tether **140** may attached to cable **60** via a carabiner or other secure clip mechanism. For example, the carabiner may be spring-loaded to open easily when pushed and close automatically when released. Attachment cable **60** may be a coated cable, coated with rubber, vinyl, or a similar smooth material. The diameter of the cable itself (without any coating material) may be from about ¼ to about ½ inch. By permitting the sliding motion of tether **140** along attachment cable **60**, the user can ambulate sideways facing the trolley and guide rail if desired. The cable **60** may be attached to belt **50** at attachment points **70**, using for example D rings, by riveting the cable, or by stitching the cable to the belt.

The belt **50** may be removed from the user via buckle **52** (FIG. **7**B), allowing it to dangle from tether **140** that is attached to the trolley. Then if the user decides to travel in the opposite direction, the user can put the transfer belt **50** back on without having to undo the tether **140** from the transfer belt **50**. Should the user for some reason be unable to crawl up or down the stairs when attached to the trolley, the user can undo buckle **52** and release the user from belt **50**.

The portion of belt **50** that is behind cable **60** may comprise a semi-rigid plastic support, or cable backing, **67** (FIGS. **7**D and **7**E), or other similar material, that facilitates movement of the tether **140** along cable **60** and that assist in reducing wear of the belt resulting from the sliding tether **140**. Cable backing **67** may also prevent or lessen the chances of a "pinching effect" in the event of a fall if the cable **60** is pulled with a force perpendicular to the user.

Attachment cable **60** and rings **70** may also be partially covered with shield, or cable cover, **65** (FIGS. **7**D and **7**E) to reduce catching or snagging of cable **60** to objects when the belt is worn. For example, the cable cover may be an angled plastic sleeve. The cable cover is meant to deflect such objects away from getting caught up in attachment cable **60**, but still allow attachment to the cable by a carabiner or other attachment mechanism. Shield, or cable cover **65** may be made of plastic or other suitable material that is flexible but partially covers cable **60** and rings **70**.

The belt **50** may be padded **55**, and have a width "X" (FIG. **7**A) that is comfortable for use, for example width "X" may be from about 1 to about 5 inches or any amount therebetween. The belt may also comprise handles **75**.

Therefore, a transfer belt is also provided herein. The transfer belt comprising, a padded belt for placement about a user's waist, an attachment cable fixed to the belt at a first and a second end and located along a forward-facing portion of the belt, the attachment cable for receiving a tether and providing side-to-side movement of the tether from the first end to the second end when the tether is attached to attachment cable, a cable backing attached to the belt and placed behind the belt attachment cable, the cable backing extending at least between the first and the second end, a cable cover attached to the padded belt below the attachment cable and comprising a free end protruding out from the belt and partly or fully overlapping the attachment cable, the cable cover extending at least between the first and the second end.

The adjustable length tether **140** may be an elasticized cord or belt, flexible cord or belt, non-elastic flexible cord or belt (for example made from nylon, a durable material or cable), an elastomeric cord, a bungee-type cord, or a combination thereof, and may be of any length suitable for attachment to the person and the trolley to permit movement along the guide rail **110**. The tether may also be comprised of a flexible band (for example a cable or nylon band) that is attached to an elasticized cord (for example an elastomeric or bungee-type cord) that then attaches to the transfer belt being worn by the user.

During use of the fall control system **100**, with a pulling force from the user that is insufficient to overcome the retaining force of the retainer **128**, the trolley **220** moves along the guide rail **110** or **210** at a speed that is no greater than the first speed (first maximum speed, travelling orientation). During a fall event (falling orientation), a pulling force that is sufficient to overcome in part or in whole the retaining force of the retainer **128** is exerted through the tether **140** and on the speed controller **126**. As a result, the speed controller **126** is displaced from the first position to the second position. In the examples shown in FIGS. **3**A and **3**B, in the second position, the second gear wheel **226***e* engages the speed-control track **130**, and the speed of the trolley **120** or **220**, to move along the guide rail **110** or **210** is limited to a speed that is no greater than the second speed (second maximum speed). By reducing the speed of the person from the first speed to the second speed during a fall event, the ground-impact speed is reduced, and the speed at which a person descends to the ground is controlled.

When the person has regained composure (e.g. stands back up and proceeds walking again), the downward pulling force against the retainer **128** is alleviated and the retainer **128** displaces the speed controller **126** from the second position to the first position, at which point the person is permitted again to proceed at a walking speed that is no quicker than the first maximum speed. Alternatively, if desired, the person may crawl up or down the stairs, or along a level surface, while still attached to the trolley, and the movement of the trolley would not impede their movement.

When the fall control system **100** is not in use, the trolley **120** or **220** may be secured in place at one end of guide rail **110** or **210** by coupling a contact **150** (e.g. see FIGS. **2**A and **3**A) to a corresponding component (not shown) located at either end of the guide rail **110** or **210**. For example, the trolley **120** or **220**, may be secured in place by any suitable device, or coupling contact **150**, known in the art, including but not limited to a magnet, a snap clip, a lever, a clasp, a clip, a cord, a hook, and the like.

Referring to FIG. **4**, **5**A to **5**E and **6**A, there are provided additional variants of the fall control system **100**. The variants described with reference to FIGS. **4**, and **5**A to **5**E each include an eddy-current braking system. The basic components of the fall control system **100** in the examples below are similar to those already described with reference to FIGS. **2**A, **2**B (use of an eddy-current braking system), and FIGS. **3**A, **3**B (use of pre-tensioned gear wheels). In these examples the background speed control track and the speed control track are the same.

In the fall control system **100** described below, and with reference to FIGS. **4**, **5**A to **5**E and **6**A, the fall control system comprises a guide rail **310** or **210**, a trolley **320** or **220** for moving along the guide rail **310** or **210**, an adjustable length tether **140** for coupling to a speed-retarding subsystem of a trolley **320** or **210**.

With reference to FIG. **4**, the guide rail **310** comprises a mounting surface **310***a* for mounting the guide rail to a surface, an outer surface **310***d* upon which the trolley **320** moves along, and a speed-control track **330**. An outer case, or protective cover **118** may surround the guide rail **310** and trolley **320**.

In this example, and with reference to FIG. **4**, the speed-control track **330** comprises two magnets **332** with surfaces that define a channel formed within the guide rail **310**. The speed control track **330** extends along a length of the guide rail **310**. The two magnets **332** are positioned between **332***a* and **332***b*, and exert a magnetic field within the speed control track **330**. The magnets may be made of any magnetic material, for example a paramagnetic, ferromagnetic material, or a combination thereof, a rare earth magnet, or a neodymium magnet.

Trolley **320** comprises a trolley body **320***a*, and a speed control system **326** that is coupled to the trolley body **320***a* and indirectly, to tether **140**. Trolley **320** is slides along the outer surface **310***d* of the guide rail **310** via one or more rolling elements **322** as previously described.

With reference to FIGS. **5**A-**5**E and **6**A, the guide rail **210** comprises a mounting surface or base **210***a* for mounting onto a substrate, a wall, or fixture, an elongate guiding shaft **210***c* with a circular cross-section, a body portion **210***b* connecting the base **210***a* to the elongate guiding shaft **210***c*, and a speed-control track **430** extending away from a surface of the guide rail **210**. The elongate guiding shaft comprises an outer surface **210***d* on which a trolley **220** moves along. The speed-control track **430** comprises a body **430***a*, that may be mild to moderately conductive, and a more strongly conductive cap **430***b* (a conductive cap) that is disposed at an end of the less conductive body **430***a* (a base conductive element) so that conductive cap **430***b* extends away from the surface of the guide rail **210**.

The guide rail **210** may be made from steel, stainless steel, aluminum, anodized aluminum, or similar material. The outer surface **210***d* of guide rail **210** may be coated in a ceramic, or other low friction material to facilitate movement of trolley **220** along the guide rail **210**. An example, that is not to be considered limiting, of such a rail-trolley arrangement is a linear bearing system using round shaft technology from PBC Linear (Pacific Bearing Company), for example, Simplicity® 60 Plus® Shafting, and accompanying bearing. The bearing component may be modified to include the components of the trolley described herein. The trolley **220** may also move along guide **210***c* using rolling elements, for example, as shown for example in FIGS. **8**A, **9**A, **10**A, **11**A.

The trolley **220** comprises a trolley body **220***a* and a speed control system **126** that is coupled to the trolley body **220***a*. An adjustable length tether **140** is attached to support **126***c* of the speed control system **126**. The trolley **220** also comprises a channel (not shown) for receiving the tether **140**, and one or more rollers or guides **242** for supporting the tether **140** in the channel within the trolley **220**. An inner surface of trolley **220** slides along outer surface **110***d* of guide rail **110** through a low resistance contact surface, for example, the inner surface of the trolley body **220** may be made from a low resistance material, for example, TEFLON® (polytetrafluoroethylene; PTFE) or other polymer as would be known in the art that permits the trolley **220** to easily slide along guide rail **210**.

The trolley **220** may be manufactured of any material suitable in the art, for example, but not limited to, a suitable metal, alloy, resilient polymeric material, epoxy resin, fibreglass cloth-fibreglass resin composition, carbon-fibre-fibreglass resin composition, fibreglass cloth-epoxy resin composition, carbon fibre cloth epoxy resin composition, and manufactured in a manner that can support a weight capacity of a person that may be attached to the trolley **120**, for example, a person with a weight of from about 20 (10 kg) to about 400 pounds (185 kg), or any weight therebetween

With reference to FIG. **4**, the speed control system **326** comprises a speed controller **326***e* comprising a conductive element **326***a* (conductive cap) at the tip of the speed controller, that is connected to a support **126***c* by a non-conductive or mildly conductive element **326***b* (base conductive element), and a retainer **128** for providing a retaining force that biases the conductive element **326***a* away from the magnetized second section formed between magnets **332** within the speed control track **330**. Non-conductive or mildly conductive element **326***b* is manufactured of a suitable material known in the art, for example, but not limited to, an austenite-containing composition, a resilient polymeric material, epoxy resin, fibreglass cloth-fibreglass resin composition, carbon-fibre-fibreglass resin composition, fibreglass cloth-epoxy resin composition, carbon fibre cloth epoxy resin composition, and the like. Alternatively, the mildly conductive material may be composed of metal, steel, copper, aluminum, nickel, tungsten, zinc, iron, tin, titanium, stainless steel, nichrome, or an alloy of these metals.

Conductive element **326***a* (conductive cap) is manufactured of a suitable material known in the art, for example, any conductive material, for example but not limited to, metal, steel, copper, aluminum, nickel, tungsten, zinc, iron, tin, titanium, stainless steel, nichrome, or an alloy of these metals.

Support **126***c* comprises a body portion and at least a portion of the body of the support **126***c* is traversable through an opening (not shown) in the trolley body **320***a*. A first end of support **126***c* is attached to the non-conductive or mildly conductive element **326***b*, while the second end of the speed retarding subsystem **326** is attached to a first end of tether **140***a* by any suitable coupling. The support **126***c* is preferably manufactured of a non-conductive material known in the art as described above. Support **126***c* may be hollow and so that the retainer **128** is disposed within support **126***c*, between the first end, and an inner surface of the trolley body **320***a*. Alternatively, the support **126***c* may be hollow or solid, and the retainer **128** is placed outside of the support so that the retainer surrounds at least a portion of the body of the support **126***c* and is positioned between the first end of the support **126***c* and the trolley body **320***a*.

In use, a portion of the speed controller **326** is disposed within the speed control track **330** to provide a first maximum speed (as described above) of the trolley **320** along the guide rail **310**. Speed controller **326***e* is displaceable within the speed-control track **330**, from a first position (travelling orientation) to a second position (falling orientation). The first position is shown in FIG. **4**. In this example the background speed control system and the speed retarding subsystem share many of the some components.

At the first position, the speed controller **326***e* is maximally inserted within the speed control track **330**, so that the speed controller **326***e* is fully inserted within the slot of the speed control track **330**. At the first position the non-conductive or mildly conductive element **326***b* (base conductive element) substantially overlaps with the magnetic field created between magnets (surfaces) **332**, while the interaction of the more strongly conductive element **326***a* (conductive cap) with the magnetic field is minimal and functions as a background eddy current brake, but sufficient to establish (or aid in stabilizing) a first maximum speed of the movement of the trolley **320** along guide rail **310**. The retainer **128** provides a retaining force against support **126***c* to bias the speed controller **326***e* towards the first position. In this configuration the components of the speed control system function as the background speed control system.

At the second position, the speed controller **326***e* is withdrawn from the slot of the speed control track **330**, and the overlap between the speed controller **326***e* and the magnetic field within the speed control track **330** increases. The more strongly conductive element **326***a* (conductive cap) is displaced from the first position, and pulled into the magnetic field by an external pulling force on support **126***c*. The pulling force, for example a fall, compresses the retainer **128** and displaces the conductive element **326***a* into the region between surfaces **332**, within the slot of the speed control track **330**. In other words, at the second position, the overlap between the more strongly conductive element **326***a* (conductive cap) and the magnetic field is greatest and the components function as a speed retarding system. The amount of overlap between the conductive element **326***b* and the magnetic field at the second position creates an electromagnetic drag force that is greater than that produced at the first position. The created electromagnetic drag force limits the speed at which the trolley **320** may move along the guide rail **310**, to one that does not exceed a second maximum speed. In a manner similar to the examples previously described in relations to FIGS. **2**A, and **2**B, the second maximum speed is less than the first maximum speed.

With reference to FIGS. **5**A to **5**E and **6**A, the speed control system, collectively shown as **126**, comprises a speed controller **126***e*, magnetic arms **126***a*, **126***b*, support **126***c* and retainer **128**. The magnetic arms **126***a* and **126***b* are connected to magnetic material that is larger in surface area than the arm. There is a space between the magnetic arms **126***a* and **126***b* for receiving the speed-control track **430**. In these examples the background speed control track and speed control track are the same. Similarly, the background speed control system and the speed retarding subsystem share many of the same components The magnetic material may be made of any magnetic material, for example a paramagnetic, ferromagnetic material, or a combination thereof, a rare earth magnet, or a neodymium magnet. Magnetic arms **126***a*, **126***b* of the speed controller **126***e* interact with the speed-control track **430** to form an eddy-current brake. The speed controller **126***e* is also attached to a support **126***c*. Support **126***c* includes an attachment point for attaching the first end of tether **140***a* to the speed retarding subsystem **126**.

The retainer **128**, is located between the support **126***c* and the trolley body **220***a*, the retainer **128** is for providing a retaining or biasing force, that biases the speed controller **126***e* away from the conductive cap **430***b* (i.e. towards elongate rail **210**) of the speed-control track **430**. In this configuration the components of the speed control system functions as a background speed control system.

The retainer **128** may comprise, for example but not limited to, a spring, compressible rubber, or other biasing device. The biasing force of the retainer **128** is of sufficient force to counteract any minor pulls or tugs that a person may apply against the support **126***c* via tether **140** as the trolley **220** moves along the guiderail **210**. However, if a force is applied to support **126***c* that exceeds a threshold force of the retainer, then the retainer **128** is compressed and the support **126***c* is moved from its biased position (first position; shown in FIGS. **5**A to **5**E, and **6**A), towards a compressed position (second position) that compresses the retainer and moves the magnetic arms **126***a* and **126***b*, and the magnetic tips of these arms, to engage an increased surface area of the speed-control track **430** and engage the speed retarding subsystem. The cap (**430***b*; conductive cap) is composed of a more strongly conductive element than **430***a* (base conductive element). The base conductive element, **430***a*, has some conductive properties to impede the trolley's speed to approximately 12-14 inches per second, or any amount therebetween, for the average user, or just slightly more, for example, approximately 10-18 inches per second, or any amount therebetween, when the braking mechanism is not fully engaged. Preferably, the retainer **128** has a biasing force of about 20 to about 35 pounds, or any amount therebetween. However, the biasing force of the retainer **128** may be of any suitable magnitude, for example, but not limited to, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50 pounds/inch or nay amount therebetween.

The pair of magnetic arms **126***a*, **126***b* are positioned so that they overlap the less conductive body of the speed-control track **430** and function as a background eddy current brake. The range of overlap between the pair of magnetic arms **126***a*, **126***b*, and the speed-control track **430** extends from a first, or biased position (background speed control system engaged) through to a second, compressed position (speed retarding subsystem engaged). It is to be understood that the overlap between the magnetic arms **126***a* and **126***b* and the speed-control track **430** may be at any position between the first and second positions, and depends upon the force used to compress the retainer **128**.

At the first position (biased position), the speed controller **126***e* is maximally biased away from the more strongly conductive cap **430***b* (conductive cap) of the speed-control track by the retaining force exerted by the retainer **128** against the support **126***c*, functioning as a background eddy current brake. At the first position, the pair magnetic arms **126***a*, **126***b* of the speed controller **126***e* and the more strongly conductive cap **430***b* (conductive cap) of the speed-control track **430** exhibit no, or a minimal overlap, while maximizing the amount of overlap between the magnetic elements and the less conductive body **430***a* (base conductive element) of the speed-control; track **430**. As noted above, in this configuration the components of the speed control system function as a background speed control system.

The amount of overlap between the pair of magnetic arms **126***a*, **126***b* and the speed-control track **430** at the first position may be set to create an electromagnetic drag force which limits the movement of the trolley **220** along the guide rail **210** to a first maximum speed. That is, the spatial relationship between the pair of magnetic arms **126***a*, **126***b* and the speed-control track **430** creates a corresponding electromagnetic drag force that prevents the trolley **220** from moving more than the first maximum speed of the first speed range, along guide rail **210** (e.g. a maximum walking speed at the upper range of normal). The first maximum speed of the movement of the trolley **220** along guide rail **210** is less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be from about 12 to about 14 inches/second, or any amount therebetween. However, in other embodiments the first maximum speed of the movement of the trolley **220** along guide rail **210** in a travelling orientation may be adjusted to any desired speed, for example, but not limited to, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 inches/second, or from 0.5 to 5 km/hr, or any amount therebetween, for example, from about 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 km/hr, or any amount therebetween, in order to approximate the range in walking speeds of a person.

The second (compressed or falling orientation) position the speed range of the speed controller **126***e* is determined by the degree of engagement of the magnetic arms **126***a* and **126***b* of the speed controller **126***e*, the speed-control track **430**, thereby engaging the "eddy-current brake". At the fully engaged, second position, the speed controller **126***e* is pulled along the height (or depth) of the speed-control track **430**. In this position, the magnetic field produced from the magnetic tips of the magnetic arms **126***a* and **126***b* fully interact with conductive cap **430***b* of the speed-control track **430**. In the second position the retaining force exerted by the retainer **128** against the support **126***c*, to bias the speed controller **126** towards the first position, is completely overcome. In the engaged or second position, the pair of magnetic tips of the magnetic arms **126***a*, **126***b* and the more strongly conductive cap **430***b* (conductive cap) of the speed-control track **430**, overlap. The amount of overlap between the pair of magnetic arms **126***a*, **126***b* and the conductive cap **430***b* at the second position creates an electromagnetic drag force which limits the movement of the trolley **220** along the guide rail **210** to a second maximum speed (e.g. a fall speed). In this configuration the components of the speed control system function as a speed retarding subsystem.

When fully engaged in a falling orientation, the second maximum speed of the trolley **220** as it moves along guide rail **210**, is from about 3 to about 6 inches/second, or any amount therebetween. The second maximum speed of the movement of the trolley **220** along guide rail **210** may be adjusted to any desired speed, for example, but not limited to 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 inches/second, or any amount therebetween. The second speed range, is achieved when the eddy-current brake may be partially or fully engaged by a person that trips or loses their footing and falls while walking along a flat or inclined surface, or while ascending or descending stairs. The second speed range thereby helps to control the falling speed of the person. It is to be understood that the second speed range will vary depending upon the degree of engagement between the magnetic tips of magnetic arms **126***a* and **126***b* of speed controller **126***e* and the cap on the speed-control track (**430***b*).

The speed control system **126** does not comprise a brake that brings the trolley **220** to a complete stop during its travels along the guide rail **210**. Therefore, the first maximum speed of the trolley **220** is greater than the second maximum speed of the trolley **220**, and neither the first maximum speed nor the second maximum speed is zero. In the arrangement of the speed control system **126** described herein, both the first maximum speed and the second maximum speed are greater than zero, and the trolley **220** is never fully arrested, even when the speed controller **126***e* is displaced fully in the second position.

An adjustable length tether **140** is attached to the end of the support **126***c* of support **126***c*, at the first end of the tether **140***a*. In an example of a use of the fall control system **100**, the tether **140** is coupled to a person either directly, or via a harness or a transfer belt (see FIGS. **7**A to **7**E) at one end, and coupled to the support **126***c* of the speed controller **326** at another end, **140***a*. A non-limiting example of a transfer belt is a SafteySure® Transfer Belt" or modified version of such (available from health suppliers, for example, Healthcare Solutions, MTS Medical Supply, or SCAN Medical). The transfer belt as shown in FIGS. **7**A to **7**E, and as previously described, has several unique features that allows attachment to the transfer belt in a 30-45 degree radius on each side of the midline (anterior aspect of belt) to allow the attachment from the elasticized cord to the transfer belt to slide to either side (see FIGS. **7**A and **7**C), or remain midline relative to the users body. This design of belt permits the user to remove the belt, allowing it to dangle from tether **140** that is attached to the trolley **220**. Then if the user decides to travel in the opposite direction, the user can put the transfer belt back on without having to undo tether **140** from the transfer belt.

The tether **140**, as previously described, may be an elasticized cord or belt, flexible cord or belt, non-elastic flexible cord or belt (for example made from nylon, a durable material or cable), an elastomeric cord, a bungee-type cord, or a combination thereof, and may be adjustable in length, or of any length, suitable for attachment to the person and the trolley **120** or **220** to permit movement along the guide rail **110**. For example, a belt portion of tether **140** may be attached to an elasticized cord or cord portion, band or cable at **140***b*, and the cord, cord portion, band or cable attached to the user. The tether may also be comprised of a flexible band (for example a cable or nylon band) that is attached to an elasticized cord (for example an elastomeric or bungee-type cord) that then attaches to the transfer belt being worn by the user.

When the user or person is walking, for example using the speed control system **100** show in FIG. **4**, the person exerts a pulling force on the speed controller **326**, through the tether **140**, that is sufficient to move the trolley **320** along the guide rail **310**, and the speed controller **326** along the speed control track **330**, but insufficient to displace the speed controller **326** from the first position. Due to the minimal overlap between the conductive element **326***a* the magnetic field between surfaces (magnets) **332**, the electromagnetic drag force determines the first maximum speed. A person tethered to the trolley **320** is permitted to walk easily up to the first maximum speed permits. When the person falls, the person exerts a downward pulling force on the speed controller **326**, through the tether **140**, that is sufficient to overcome the retaining force of the retainer **128**, and displaces the speed controller **326** from the first position to the second position. The overlap between the more strongly conductive element **326***a* (conductive cap) and the magnetic field increases as a result, and increases the magnitude of the electromagnetic drag force created by the speed-retarding subsystem. While the speed controller is in the second position, the trolley **320** is only permitted to move as quickly as the second maximum speed (the speed achieved by the average user when the speed controller is in the second position). The second maximum speed is less than the first maximum speed and both the first maximum speed and the second maximum speed are greater than zero. A similar mechanism of action applies to the speed control systems **100** as shown in FIGS. **5**A to **5**E and **6**A.

When the person has regained composure, the pulling force against the retainer **128** is alleviated, the biasing force of the retainer **128** overcomes the pulling force exerted against the retainer **128**, the speed controller **326** is displaced from the second position to the first position, and the person is permitted again to proceed at the first maximum speed.

While the speed controller **126** is depicted in FIG. **5**A as oriented parallel to a surface onto which the guide rail **210** is mounted, the orientation of the speed controller relative to the surface onto which the guide rail **210** is mounted may vary as shown for example in FIGS. **5**D, **5**E and **6**A. For example, the speed controller **126** may be oriented perpendicular or obliquely to the surface onto which the guide rail **210** is mounted.

FIG. **6**B shows another variant of the fall control system **100**, wherein the speed control system utilizes multiple eddy-current brakes. In this non-limiting example, two separate eddy-current brakes are shown. One eddy-current brake is always operational and functions as background speed controller **560**, that interacts with speed control track **430** and collectively function as a background speed control system (i.e. a background eddy current brake) to limit the maximum walking speed. A second eddy-current brake, speed controller **562**, comprises top magnet **562***a*, bottom magnet **562***c* and pivot **562***c*, with the top magnet **562***a* attached to tether **140**. Top magnet **562***a* that pivots from a disengaged (first) position (shown in FIG. **6**B) to an engaged (second) position (top magnet dotted position FIG. **6**B) about pivot **562***b* when the user falls, thereby engaging the speed retarding subsystem as magnet **562***a* interacts with speed control track **430** thereby increasing the effect of the eddy current brake. One or more than one background speed controller (background eddy current brake) **560** may be used, one or more than one speed controller **562** may be used, or a combination of the background speed controller **560** and speed controller **562** may be used. In this example, the background speed control track and the speed control track are the same component.

As in other designs herein described, a retainer **128** provides a retaining force that biases the speed controller **562** of the speed retarding subsystem towards a first position, the retainer **128** located between the trolley body **220***a* and the speed controller **562**. A plate or similar part (not shown) may be attached perpendicular to the cable **140** above the retainer **128** that limits the excursion of **140** as it is pulled down against the retainer **128**. A second retainer **564**, for example a spring, attached to the top magnet **562***a*, about pivot point **562***b*, of the speed control eddy-current brake **562**, may be used to provide additional resistance if needed to return the top magnet **562***a* to an upright position as shown in FIG. **6**B. The positions of the magnets, top magnet **562***a* and bottom magnet **562***c*, of the speed control eddy-brake as shown in FIG. **6**B can be altered so that one or both magnets **562***a* and **562***b* swivel on a horizontal plane, a vertical plane, or a combination of both, to align the poles of the magnets to optimize the electromagnetic drag force relative to the speed control track **430**. For example, in the first (disengaged) position, magnet **562***a* does not interact with the speed control track **430** (and only the background speed control system is active which would also include the magnet **562***c* acting on the speed control track **430**). Swiveling magnet **562***a* about pivot **562***b*, brings magnet **562***a* into alignment with the speed control track **430** resulting in engagement of the speed controller **562** (second position; dotted in FIG. **6**B). In a similar manner bottom magnet **562***c* can be configured to pivot about a pivot point as described for magnet **562***a* and engage speed control track **430** to collectively function as a speed retarding subsystem. The retaining forces, for example of the second retainer (spring) **564**, needed to return magnet **562***a* (or **562***c*, or both **562***a* and **562***c*) to the resting position may be of any suitable force as required to separate magnet **562***a* from magnet **562***c* and the speed control track **430**, back to the resting (disengaged) position. For example the force of the second retainer may be from about 5 to 50 pounds of force, or any amount therebetween. When the speed controller **562** is engaged with sped control track **430**, the magnet poles of magnets **562***a* and **562***c* align optimally to provide the greatest amount of electromagnetic drag force, thereby slowing the trolley's **220** speed to the fall speed. As described in the previous examples, the maximum walking speed is greater than the maximum fall speed, and the maximum walking speed and the maximum fall speed are both greater than zero.

The background speed controller **560** may also be comprised of one or more magnets **560***a* located within the trolley **320** and they may be positioned on one or both sides of a conductive guide rail **430** upon which the trolley moves. In the example shown in FIG. **6**B, one magnet of the background eddy-current brake **560** is positioned within the trolley housing **320***a* and magnet **560***a* is located above and below the guide rail **210**, and magnet **562***c* also functions as part of the background speed control system as it positioned to interact with speed control track **430**. In an alternative example, the guide rail **210** may be conductive and function as a background speed control track along with the background speed controller **560**. If the guide rail **210** functions as a background speed control track, then magnet **560** may comprise one or more than one separate magnets each attached to and positioned within trolley **320** and placed to that they are adjacent to guide rail **210** so as to operate as a background speed control system (functioning as an eddy current brake). Speed controller **562** may be configured to engage speed control track **430** as described above.

In order to ensure that a smooth force from the tether **140** is applied to the speed control mechanism **526** during a fall, for example if the user does not fall straight down but rather to the side, the trolley may comprise a funnel like, or funnel shaped opening **114** (see FIG. **6**B, **6**C). The funnel like opening **114** in the trolley housing **320***a* may be made of a low friction material that would allow a cable, belt, elasticised belt, bungee cord, or cord (as described above) of the tether **140** to slide easily within opening **144**, thereby activating the speed control system **526** without snagging or becoming struck within the trolley housing.

With reference to FIGS. **8**A to **8**D, **9**A, **9**B, **10**A, **10**B, **11**A and **11**B there are provided alternate fall control systems **100** that share a common feature involving the trolley **620** moving in two aspects about guide rail **210**. In the first aspect, trolley **620** moves along the length of guide rail **210** in a travelling orientation (in a first direction; indicated by the letter "A"; see FIG. **8**A), when in a first position, similar to the previous examples of the fall control systems that have been previously described. When the user is walking along with trolley **620**, in a regular manner, up or down stairs or along a flat surface, the trolley **620** is positioned in a travelling orientation about circular guide shaft **210***c*, and tether **140** may pull and rotate trolley **620** upward, in direction opposite to the arrow "B" **670** (shown in FIGS. **8**A, **9**A, **10**A, and **11**A). In the second aspect, when in a second position (a falling orientation) trolley **620** rotates about circular guide shaft **210***c* in a rotatable direction (a second direction **670**, indicated by the letter "B"; see FIG. **8**A). For example, trolley **620** rotates (in a direction "B"; **670**) about circular guide shaft **210***c*, of guide rail **210**, when tether **140** is pulled in general a falling direction (fall orientation) as indicated by the letter "C" (see FIGS. **9**A, **10**A, **11**A) and activates a speed control system that is described in more detail below. In the second position the minimum speed, when the speed control system (i.e. both the background speed control system and the speed retarding subsystem) is activated is never zero, therefore the person can crawl up or down the stairs, or along a surface, even when the speed controller is fully engaged. This may be important as a disabled individual, that is unable to crawl up or down the stairs (as a result of a fall control system that impeded all movement), could potentially become stuck on stairs or floor for several hours or days until help arrived.

After a fall, when the user is resting on the stairs or level surface, the downward force on tether **140** and trolley **620** is significantly decreased in comparison to the forces imparted on the tether and trolley during a fall. As a result, trolley **620** may rotate back to its initial resting position (travelling orientation), releasing pressure between the areas of friction between the components of the trolley and the guide rail and associated components (as described in more detail below), allowing trolley **620** to move more freely on guide rail **210** so that the user may move or crawl up or down the stairs or level surface. If desired, small weights (not shown) may be placed within trolley **620** to maintain trolley body **620***a* in the travel orientation, or first position, about cylindrical shaft **210***c* when trolley is stationary, or moving in the travel orientation along guide rail **210**.

In the examples presented in FIGS. **8**A to **8**D, **9**A, **9**B, **10**A, **10**B, **11**A and **11**B, guide rail **210** comprises a body of the guide rail **210***b* and a circular shaft **210***c* with a curved outer surface **210***d*, a mounting surface (or base) **210***a*, and an upper guide rail shoulder **210***g*. The curved outer surface **210***d* of circular shaft **210***c* may interface with trolley **620** via rolling elements **122**, or the inner surface of the trolley may slide along the outer surface of the guide rail **210***d* as previously described. Additionally, guide rail shoulders or surfaces **210***g*, **210***h*, **210***i*, **662***a*, and **695** may interface with trolley **620** via rolling elements (e.g. **122**), a roller wheel (e.g. on-set wheel **662***b*), an off-set wheel (e.g. **675**), or a surface of the trolley body (e.g. **662***g* or **690**) when trolley **620** is rotated about circular guide shaft **210***c* as described below. The use of rolling elements **122** may assist with movement of trolley **620** along a guide rail **210** comprising linear sections as shown in FIG. **1**A, or curved sections as shown in FIG. **1**B.

Trolley **620** may rotate about the cylindrical guide shaft **210***c* in a clockwise or counter-clockwise direction, depending on which wall the guide rail **210** is placed. The on-set wheels, **662***b*, off-set wheels **675**, and frictional surfaces **210***h* (FIGS. **8**A, **9**A), **210***i* (FIG. **8**A, **11**A), **662***a* (FIG. **9**A), **690** and **695** (FIG. **9**A) in the resting position may be angled slightly away from a true 90° (perpendicular) position, so that when the trolley is rotated the wheels and/or frictional surfaces contacting the opposing surface are in alignment.

As previously described, the guide rail may be formed as one continuous rail, or by a plurality of guide rail sections (not shown) coupled together and may be linear or curved so that they may be fitted against a bearing surface, for example a wall, a ceiling, support posts, wall studs, rafters or overhead beams, within a stair well, a room, a hall or passageway. The guide rail **210** may be made from steel, stainless steel, aluminum, anodized aluminum, a metal alloy, a polymeric material, or a combination thereof. The outer surface **210***d* of guide rail **210** may be coated in a ceramic, or other low friction material to facilitate movement of trolley **620** along the guide rail **210**. The guide rail **210** is manufactured in a manner that when installed to a weight bearing surface, the guide rail can support a weight capacity of a person that may be attached to the guide rail, for example, a person with a weight of from about 20 pounds (10 kg) to about 400 pounds (185 kg), or any weight therebetween. An example, that is not to be considered limiting, of such a rail-trolley arrangement is a linear bearing system using round shaft technology from PBC Linear (Pacific Bearing Company), for example, Simplicity® 60 Plus® Shafting, and accompanying bearing. However, the components are modified to include the components of the trolley **620** as described herein.

Part of the cylindrical or circular shaft **210***c* may be at least partially conductive (e.g. ferromagnetic) as it may function as a background speed control track, as part of the linear eddy current brake as descried in more detail below. For example, a portion of the outer surface of the cylindrical shaft **210***c*, located adjacent (background) magnets **660***a*, **660***b* (see FIGS. **8**B, **9**A, **9**B, **10**A, **10**B, **11**A, **11**B), may be comprised of a conductive or ferromagnetic material, the inner core of the circular shaft **210***c* may be a non-conductive or comprised of a weakly conductive or ferromagnetic material, or a combination thereof.

In the travelling orientation there may be a gap between the lower inner surface of trolley **620** and the lower surface (e.g. **662***a*, FIGS. **9**A and **10**A; or **210***i*, FIG. **11**A) of guide rail **210**. This gap may be filled using a compressible, resilient plug **685** (see FIG. **8**A). Plug **685** may be made from a rubber, a foam, a silicone, or other flexile polymeric material provided that plug **685** can compress and rebound back to its original form during use of trolley **620**. When trolley **620** is moving along in the travelling orientation, plug **685** is in an uncompressed state. When trolley **620** is pulled in the general direction “C” and rotated about circular guide shaft **120***c* during a fall (in the fall orientation), then plug **685** will be compressed against the lower surface (e.g. **662***a*, FIGS. **9**A and **10**A; or **210***i*, FIG. **11**A) of guide rail **210**. Plug **685** helps keep fingers, and other items, out of the space between the trolley and the guide rail.

A bell like device (not shown) may be installed at either end of guide rail **210** so that when trolley **620** reaches either end of guide rail **210**, the trolley may strike the bell, or similar device, to produce a sound that alerts the user that they have reached the end of the guide rail and that they may either remove the safety belt **50** from around their waist, or undo a clip connecting them to tether **140**. The bell or similar device would be an added safety feature, acting as a reminder, so that the user does not continue walking when the trolley has come to a complete stop at either end of the guiderail, and avoiding the user being jerked backwards, losing balance, and falling.

When the fall control system **100** is not in use, the trolley **620** may be secured in place at one end of guide rail **210** by coupling a contact **150** (FIG. **8**B) to a corresponding component (not shown) located at either end of the guide rail **210**. For example, the trolley **620** may be secured in place by any suitable device known in the art, including but not limited to a magnet, a snap clip, a lever, a clasp, a clip, a cord, a hook, and the like.

An adjustable length tether **140**, may be as previously described, for example an elasticized cord or belt, a flexible cord or belt, a non-elastic flexible cord or belt, a bungee-type cord, or a combination thereof and may be of any length suitable for attachment to the person and the trolley **620** to permit movement along the guide rail **210**. The adjustable length tether **140** may comprise belt **142***a* and elastic cord **142***b* (FIG. **8**C), with the belt **142***a* attached to trolley body **620***a* using any suitable connector **144** (FIG. **8**C). For example connector **144** may be a swivel connector, a ring connector, a detachable clip, or tether **140**, or belt **142***a* may be integrally formed with, or pass through an opening and become wedged within, trolley body **620***a*. The region about the attachment point of tether **140** or belt **142***a* to the trolley body **620***a* may comprise a funnel-shaped opening **114** and this area may be coated with a low friction material to ensure that tether **140** does not snag on trolley body **620***a*. For example, the funnel shaped opening **114** may be covered by TEFLON® (polytetrafluoroethylene; PTFE), ceramic or other low friction material.

The funnel shaped opening **114** may comprise an asymmetric profile, with a tighter upper curvature (see for example FIGS. **9**A, **10**A, **11**A), this profile may prevent or limit rotation of trolley **620** about the cylindrical shaft **210***c* toward the user during normal walking, for example, when going up stairs. Keeping the position of tether **140** lower on trolley **620** may keep the trolley from rotating during use in a travelling orientation, where rotational forces acting on the trolley moving along the cylindrical shaft are at a minimum.

Tether **140** may be a wide, thin band, for example, a nylon band at the location of attachment **144** to trolley **620**. In the event of a fall, should the user reach up and grab tether **140** at a point within the firm& shaped opening **114**, a wide thin band may cause less injury than a small diameter cord or cable that could result in the fingers or other part of the hand become pinched between the tether **140** and the funnel shaped opening **114**. The adjustable length tether **140** (or **142***b*, FIG. **8**C) may be made from a material is strong enough to support a user during a fall event, and that is partially flexible, for example, allowing for expansion of about 2 to about 5 times the length of the tether. For example, bungee jumping cord has a maximum stretch of 600% at break. This would allow a relatively short tether from the use) to the trolley **620**, but allow for significant stretch to allow the user to experience a controlled descent upon falling to the floor, stairs, or ground. The length of tether **140** should be customized to the user's size (height and width) and the user's walking style (i.e. walking close to the guide rail, versus farther away). Depending on where the guide rail **210** is installed on the wall, the length of the tether may be between about 12 and about 16 inches in length. With this length, when trolley **620** lags behind the user walking upstairs, or leads the user walking downstairs, the trolley is still close to the user's center of mass. The tether is affixed to a person either directly, or via a harness or a transfer belt (FIGS. **7**A to **7**E) at a distal second end. A non-limiting example of a suitable transfer belt is a Saftey-Sure® Transfer Belt (available from health suppliers, for example, Healthcare Solutions, MTS Medical Supply, or SCAN Medical). See also the transfer belt optimized for use with this fall control system in FIGS. **7**A to **7**E (as described herein).

The trolley **620** may be manufactured of any material suitable in the art, for example, but not limited to, a suitable metal, alloy, resilient polymeric material, epoxy resin, fibreglass cloth-fibreglass resin composition, carbon-fibre-fibreglass resin composition, fibreglass cloth-epoxy resin composition, carbon fibre cloth epoxy resin composition, and manufactured in a manner that can support a weight capacity of a person that may be attached to the trolley **620**, for example, a person with a weight of from about 20 (10 kg) to about 400 pounds (185 kg), or any weight therebetween.

In the examples presented in FIGS. **8**A, **9**A, **10**A, and **11**A, trolley **620** is shown to move along the outer surface **210***d* guide rail **210** via one or more than one roller bearing **122**. However, the inner surface of trolley **220** may also slide along outer surface **210***d* of guide rail **110**, as previously described above (with reference to FIGS. **3**B, **5**A-**5**E, and **6**A) through a low resistance contact surface, for example, the inner surface of the trolley body **220** may be made from a low resistance material, for example, TEFLON® (polytetrafluoroethylene, PTFE) or other polymer as would be known in the art that permits the trolley **620** to easily slide along guide rail **210**. As previously described, trolley **620** may comprise a soft cover **118** (e.g. FIGS. **9**A, **10**A, **11**A) and rounded corners (e.g. FIGS. **9**B, **10**B, **11**B) to protect the user if they encounter trolley **620** during a fall.

The trolley **620** comprises a trolley body **620***a*, a background speed control system and a speed retarding subsystem, a coupled to the trolley body **620***a*. The background speed control system is always engaged and controls the speed of trolley **620** while the trolley is moving along guide rail **120**, for example in a first position, or in a travelling orientation. For example, with reference to FIGS. **8**B, **9**A, **10**A, and **11**A there are shown several types of background speed control systems that comprise a background eddy current brake. In these examples, the guide rail **210**, or a portion of the guide rail, for example the upper and lower portions of circular guide shaft **210***c*, is mildly to moderately conductive and functions as a background speed control track. Trolley **620** may comprise one or more than one background magnet, for example **660***a*, **660***b* that engages with the conductive circular guide shaft **210***c* (background speed control track) to form an eddy current brake in a manner similar to the eddy control brakes previously described, where an electromagnetic drag force is created when the magnetic element glides over the ferromagnetic surface material, and the magnetic element and ferromagnetic surface thereby function to act as a linear eddy current brake.

In the example shown in FIG. **8**B, trolley **620** comprises a background speed control system comprising one or more than one background magnet **660***a* positioned above a conductive (e.g. comprising a ferromagnetic surface material) circular guide shaft **210***c* to act as a background eddy current brake. Similarly, one or more magnets **660***b* may be positioned below conductive circular guide shaft **210***c* to act as a background eddy current brake. However, a separate conductive background speed control track, as previously described, may also be used. As previously described, an electromagnetic drag force is created when the magnet glides over the conductive, or ferromagnetic surface material functioning as a linear eddy current brake. The strength of the electromagnetic drag force is determined by the position, strength, shape, poles, and size of the magnet and these properties may readily be determined by one of skill.

Background magnets **660***a* and **660***b* may be square, rectangular, curved, arc shaped, or comprise any suitable shape in order to fit within trolley **620** and interact with the background speed control track. For smooth operation, background magnet **660***a* may be positioned symmetrically about trolley **620**. The eddy current brake force retards the trolley's speed along guide rail **210** to a maximum walking speed. The linear eddy current brake, by its mechanism of action, reduces the trolley's top speed and does not stop or lock the trolley along the guide rail.

The position of background magnet **660***a* may be adjusted by an adjustment plate and screw **665**. Additional magnets for example **660***b*, may be used and positioned about circular guide shaft **120***c* as shown in FIGS. **9**A, **10**A and **11**A. A similar adjustment mechanism **667** may be used to adjust position of magnet **660***b*. The position, or distance, of the one or more than one background magnet **660***a* (and/or **660***b*) from the outer curved surface of guide rail **210***d*, may be adjusted using an adjustment screw **665**, or **667**, or a similar device, to obtain the desired effect of the eddy current brake in controlling a first maximum speed of the movement of the trolley **620** along guide rail **210** that is less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be of about 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 inches/second, or from 0.5 to 5 km/hr, or any amount therebetween, for example, from about 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 km/hr, or any amount therebetween, in order to approximate the range in walking speeds of a person.

In a falling orientation or second position, trolley **620** rotates about circular guide shaft **210***c* and activates the speed retarding subsystem in order to slow movement of the trolley along guide rail to a second maximum for example, but not limited to 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 inches/second, or any amount therebetween. In the example of FIG. **8**B, as the trolley body rotates into a second position, one or more than one magnet **660***c* is brought in closer proximity to a conductive portion of guide rail **210** (the speed control track) thereby actuating the eddy current brake in order to slow trolley movement along the guide rail. The conductive portion of guide rail **210** may be located along the circular shaft **210***c* in a location adjacent magnet **660***c* when in the trolley **620** is in the second position, the conductive portion (e.g. comprising a ferromagnetic surface material) may be located on the lower guide rail shoulder **210***h*, **210***i*, or both **201***h* and **210***i*, or as described in earlier examples, a separate conductive speed control track may also be used. The location of magnet **660***c* in the second position may be adjusted using one or more than one adjustment mechanism **667** for example, a screw or similar device. The adjustment mechanism **667** may be attached to a plate **220***b* (see for example FIGS. **9**A, **10**B) so that position of one on-set wheel **662***b*, or several on-set wheels **662***b*, may be adjusted. The one or more adjusting mechanism **667** may be used to adjust the functionality of trolley **620** in accordance with the user's weight. For example, for a heavier user, plate **220***b* could be raised in order to increase the resistance applied by retainer **662***c* against on-set wheel **662***b*, while for a lighter user, plate **220***b* may be lowered to decrease resistance of retainer **662***c*. For multiple users of the same trolley **620** an average setting may be employed. While the adjustment mechanism **667** is shown located at the base of the trolley body it may be located in any convenient location. The adjustment mechanism **667** may comprise a dial-like device, and in some environments where frequent changes may be required, for example, in a physiotherapy clinic or hospital where patient weights may vary significantly, a larger, more prominent dial may be used.

In order to limit the extent of rotation of the trolley body **620***a* the outer surface of the guide rail may comprise one or more than one longitudinal ridges, or stops, **680** (FIG. **8**D) that butt against roller elements **122** thereby restricting rotation or horizontal displacement of the trolley body. Rotation of the trolley body may also be limited by the trolley body pressing against lower guide rail shoulder **210***h*, **210***i*, **662***a* (FIGS. **9**A, **10**A, **11**A) or a trolley body ridge **690** (surface of the trolley body) may butt against a lower abutment surface of the guide rail **695** (second surface of the speed control track) as shown in FIG. **9**A, as described in alternative embodiments below. Ridges **680** may prevent the rolling elements **122**, if used, from getting wedged against the cylindrical shaft **210***c* when the trolley body **620***a* is forcefully pulled perpendicular to the guide rail (horizontally displaced), or forcefully pulled at an angle close to perpendicular during a fall. Ridges **680** may be smooth, as in some instances the cylindrical shaft **210***c* of guide rail **210** may be used as a hand rail.

With reference to FIGS. **9**A and **9**B there is shown an alternate fall control system **100** comprising similar elements to those as previously described. The user is attached to trolley **620** via tether **140** at linkage **144**. Trolley **620** moves along guide rail **210** in a first direction (travelling orientation) using, for example, one or more than one roller element **122**. A background speed control system comprising a background eddy current brake comprising one or more than one background magnet **660***a*, **660***b* interacting with a conductive guide rail **210***c* (background speed control track), controls a first maximum speed of the trolley so that it is less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be from about 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 inches/second, or from 0.5 to 5 km/hr, or any amount therebetween, for example, from about 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 km/hr, or any amount therebetween, in order to approximate the range in walking speeds of a person. The strength of the electromagnetic drag force is determined by the position, strength, shape, poles, and size of the magnet and these properties may readily be determined by one of skill. Background magnet **660***a*, **660***b* may be square, rectangular, curved, arc shaped, or comprise any suitable shape in order to fit within trolley **620** and interact with the speed control track. Background magnet **660***a*, **660***b* may be positioned symmetrically about trolley **620**.

In this example, guide rail **210** is as previously described, comprises a body of the guide rail **210***b*, a circular shaft **210***c* with a curved outer surface **210***d*, mounting surface (or base) **210***a*, and an upper guide rail shoulder **210***g*. As shown in FIGS. **9**A and **9**B, the lower guide rail surface **210***h* further comprises an elongate undulating wave-like surface **662***a* (first surface of the speed control track) with the surface of the undulating wave-like form comprises peaks and troughs relative to the lower guide rail surface **210***h*. The trolley body ridge **690** (surface of the trolley body) may butt against a lower abutment surface of the guide rail **695** (second surface of the speed control track) as shown in FIG. **9**A. For example, which is not to be considered limiting, in side view, the undulating surface may describe a sine wave (a curve representing periodic oscillations of constant amplitude) as shown by the dotted line in FIG. **9**B. The wave-like speed control track, **662***a*, may also be termed a sine curve speed control track. However, other wave forms or shapes of surface **662***a* may also be used provided that the wave-form is a smoothed wave form permitting on-set wheel **662***b* of the trolley, when engaged with the surface of the speed control track **662***a*, to move along guide rail **210** so that trolley **620** does not come to an abrupt stop when the trolley is in the second position. The width of the speed control track **662***a* may approximate the width of on-set wheel **662***b* as shown in FIG. **9**A. Furthermore, the wave like surface **662***a* of the speed control track, the surface of on-set wheel **662***b*, or both, may be angled so that when the trolley is rotated into the second position the on-set wheel **662***b* and speed control track **662***a* optimally interface.

When trolley **620** is in the first position and moves along guide rail **210** in a travelling orientation, one or more of on-set wheel **662***b* may touch the "peaks" of the undulating wave-like surface **662***a*, for example as shown in FIG. **9**B. However, in this configuration, on-set wheel **662***b* does not impart any significant resistance in the travelling orientation and therefore does not participate in slowing movement of the trolley along the guide rail.

If the user falls and pulls the trolley body in the general direction of "C", the trolley body **620***a* rotates about circular guide shaft **210***c* in direction "B" into the second position, thereby engaging the speed retarding subsystem **662** (FIG. **9**A). The trolley **620** comprises components as previously described for example with reference to FIGS. **8**A and **8**B however, the second speed control system **662** comprises a speed control track **662***a* with a wave-like surface that interacts with one or more than one on-set wheel **662***b* of trolley **620** when the trolley is rotated about circular shaft **210***c* (in the second position, or a falling orientation). The undulating waves of the speed control track **662***a* are designed to act as "speed bumps" to retard forward or reverse movement of the one or more than one on-set wheel **662***b*, thereby retarding movement of the trolley **620** along guide rail **210**. In the examples shown in FIGS. **9**A, **9**B, **10**A, **10**B, **11**A, **11**B there may be 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or more on-set wheels **662***b*, the number of wheels being selected to ensure effective speed reduction of trolley **620** along guide rail **210** when in the second position (falling orientation).

On-set wheel **662***b* and axel **662***f* sit atop a retainer **662***c* which biases wheel **662***b* towards the lower guide rail surface **210***h* (also see FIG. **12**A). On-set wheel **662***b* and retainer are placed within housing **662***h* (FIGS. **12**B, **12**C). Wheel **662***b* is able to move from the first position (or pre-fall position) as shown in FIG. **12**A (left-hand panel) to a second position (compressed or fall position; FIG. **12**A, right-hand panel). When on-set wheel **662***b* moves to the second position, for example, when on-set wheel **662***b* is pressed against lower guide rail surface **210***h*, at **702** (of the undulating wave-form surface of the speed control track **662***a*), retainer **662***c* is compressed so that axel **662***h* travels within slot **662***i*. When one or more than one on-set wheel **662***b* engages the wave-like surface **662***a*, they impart a speed control effect to trolley **620** by pressing against the "peaks", the "troughs", or both the "troughs" and "peaks" of the wave-like surface of the speed control track **662***a*. The wheel should be of sufficient diameter so that when retainer **662***c* is fully compressed, the housing **662***h* does not contact the wave-form or level surface. In the second position, with the speed retarding subsystem engaged, trolley **620** may only migrate along guide rail **210** when the compression force of each of retainer **662***b* is overcome, thereby permitting the associated on-set wheel **662***b* to move past a trough or peak of the sine curve speed control track **662***a*. The combined resistance of the background speed control system (background eddy current brake) and all of the retainers **662***c* housed within trolley **620** when in their most compressed state, and biasing on-set wheel **662***b* presses against the lower guide rail surface **210***h*, **210***i*, the speed control track **662***a*, or a combination thereof (see FIGS. **9**A, **9**B, **10**A, **10**B, **11**A, **11**B), that is, the force required to compress all retainers **662***c* so that on-set wheels **662***b* reach their respective positions on the lower guide rail surface or speed control track when the trolley is in the fall orientation, should be less than the force generated by the user when he or she falls so that the speed controller system may be properly activated. When engaged, the second speed control system slows movement of the trolley along guide rail to a second maximum for example, but not limited to 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 inches/second, or any amount therebetween. In the second position trolley **620** may or may not to come to a full stop. In the event it does come to a full stop, the braking mechanisms described herein should not limit the user (while still attached to the trolley) from crawling up or down the stairs, or across a level surface.

Also within housing **662***h* is a second retainer **662***d* that may interact with wheel **662***b*, at **704**, when on-set wheel **662***b* is in the second position. In this manner, on-set wheel **662***b* may frictionally engage the second retainer **662***d*, at point **704**, further slowing movement of trolley along the guide rail.

Second retainer **662***d* may be a flexible leaf spring, a U-shaped part with a radius the same or larger than the radius of on-set wheel **662***b*, made of a resilient material. As the trolley **620** returns towards its travelling orientation or resting position, the second retainer **662***d* decompresses and returns to its pre-fall configuration, and on-set wheel **662***b* is allowed to roll again freely. The amount by which the on-set wheel **662***b* deforms the second retainer **662***d* to increase friction without totally locking the wheels can be readily determined. The top surface of the second retainer **662***d* can be metal, rubber, a sandblasted surface, or some other surface material to increase friction.

The placement of the on-set wheel **662***b* and housing **662***h* within trolley **620** and relative to the undulating wave-form surface **662***a* may be adjusted using adjustment mechanism **667**. In order to avoid hitting on-set wheel **662***b* against surface **662***a* during a hard fall and potentially damaging the second speed control system, the trolley body **620***a* may comprise ridge **690** that buts against a lower abutment surface **695** of the guide rail when trolley is rotated in direction "B".

In the example of the fall control system **100** presented in FIGS. **9**A, **9**B, in the event of a fall, the trolley **620** rotates clockwise or counter-clockwise around the cylindrical shaft **210***c* and brings into contact one or more than one on-set wheel **662***b* with the (sine curve) speed control track **662***a*; or off-set wheel **675** (FIGS. **11**A, **11**B) with lower guide rail surface **210***i* and engaging the speed retarding subsystem, the trolley body **620***a* rotation results in a forceful point of contact between the wheels and the respective guide rail surface which causes significant friction, thereby helping to slow the trolley **620** along guide rail **210**. The solid contact of wheel and/or guide rail surfaces coming together assists in keep the forces acting on the wheels constant, irrespective of the users weight. In the pre-fall state, one or more on-set wheels **662***b* lightly contact or smoothly glide over the outer crests of the speed control track **662***a*, When the user falls, and the trolley rotates all the wheels make contact with the speed control track **662***a*. In the event that the user suffers a downward fall towards the stairs or level surface, the trolley body **620***a* rotates clockwise or counter clockwise on its long axis on the circular guide shaft **210***c*, pushing the spring loaded on-set wheel(s) **662***b* further into the speed control track **662***a*, thereby engaging all the wheel(s) **622***b* into the speed control track **662***a*, significantly slowing down, but not completely stopping, the trolley **620**. The amplitude of the sine curve (i.e. the height of the crest and troughs of the sine curve/wave) and the optimal frequency of oscillations (distance between troughs or crests) of the speed control track **662***a* can be determined by experimentation to optimize the functionality of the fall control device **100**, so that the trolley is significantly slowed in the event of a fall, but does not become stuck, preventing the user, still attached to the trolley, from crawling up or down the stairs.

With reference to FIGS. **10**A and **10**B there is shown an alternate fall control system **100** comprising similar elements to those as previously described. The user is attached to trolley **620** via tether **140** at linkage **144**. Trolley **620** moves along guide rail **210** in a first direction (travelling orientation), for example, using one or more than one roller element **122**. A background speed control system comprising a background eddy current brake comprising one or more than one background magnet **660***a*, **660***b* interacting with a conductive guide rail (background speed control track, comprising for example a ferromagnetic surface material) **210***c*, or as described in earlier examples, a separate conductive background speed control track, controls a first maximum speed of the trolley is less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be from about 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 inches/second, or from 0.5 to 5 km/hr, or any amount therebetween, for example, from about 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 km/hr, or any amount therebetween, in order to approximate the range in walking speeds of a person. The strength of the electromagnetic drag force is determined by the position, strength, shape, poles, and size of the magnet and these properties may readily be determined by one of skill. For example, background magnet **660***a*, **660***b* may be square, rectangular, curved, arc shaped, or comprise any suitable shape in order to fit within trolley **620** and interact with the speed control track. Background magnet **660***a*, **660***b* may be positioned symmetrically about trolley **620**.

Guide rail **210** is as previously described, comprising body of the guide rail **210***b*, a circular shaft **210***c* with a curved outer surface **210***d*, mounting surface (or base) **210***a*, and an upper guide rail shoulder **210***g*. As shown in FIGS. **10**A and **10**B, the lower guide rail surface **210***h* comprises two portions, a first portion that comprises a flat surface (first surface of the speed control track) that is in contact with on-set wheel **662***b* when trolley **620** is in the first (travelling orientation) or second (rotated) position, and a second portion comprising an elongate sine curve speed control track **662***a* comprising an undulating wave-like surface, (second surface of the speed control track). The surface of the speed control track comprises peaks and troughs relative to the lower guide rail surface **210***h*. For example, which is not to be considered limiting, in side view, the wave-like surface of the speed control track may describe a sine wave as shown by the dotted line **662***a* in FIG. **10**B. However, other wave forms or shapes of the surface of speed control track **662***a* may also be used provided that the wave-form is a smoothed wave form permitting a corresponding trolley wave-like surface **662***g* of trolley **620**, when engaged with the speed control track **662***a*, to move along guide rail **210** so that trolley **620** does not come to an abrupt stop when the trolley is in the second position. A flat surface on the body of the trolley may also be used to engage the wave-like surface of the speed control track. Preferably, if a flat surface of the trolley body is used, then the flat surface is of a size that engages and continuously presses against the wave-like surface and does not glide over the peaks of the wave-like surface. The width of the each of the first and second (speed control track **662***a*) portion of the lower guide rail surface **210***h* may approximate the width of on-set wheel **662***b* and the width of trolley wave-like surface **662***g* (as shown in FIG. **10**A). Friction is the primary mechanism responsible for slowing the trolley when the trolley wave like surface **662***g* comes in contact with the guide rail **662***a*.

As described with reference to FIGS. **9**A and **9**B, on-set wheel **662***b* and axel **662***f* sit atop retainer **662***c* which biases on-set wheel **662***b* toward the lower guide rail surface **210***h* as shown in FIGS. **10**B and **12**A. Wheel **662***b* and retainer are placed within housing **662***h* (FIGS. **12**B, **12**C). On-set wheel **662***b* is able to move from the first position (or pre-fall position) as shown in FIG. **12**A (left-hand panel) to a second position (compressed or fall position; FIG. **12**A, right-hand panel), with axel **662***h* traveling within slot **662***i*. Second retainer **662***d* may interact with on-set wheel **662***b*, at **704**, when wheel **662***b* is in the second position, so that on-set wheel **662***b* may frictionally engage the second retainer **662***d*, at point **704**, further slowing movement of trolley along the guide rail. The placement of the on-set wheel **662***b* and housing **662***h* within trolley **620** and relative to the lower guide rail surface **210***h* may be adjusted using adjustment mechanism **667**.

When trolley **620** is in the first position and moves along guide rail **210** in a travelling orientation as shown in FIG. **10**B, on-set wheels **662***b* are in contact with lower guide rail surface **210***h*, while the trolley wave-like surface **662***g* does not contact the "peaks" of the undulating wave-like form surface **662***a*. In this configuration, on-set wheel **662***b*, and trolley wave-like surface **662***g* do not impart any significant resistance and they do not participate in slowing movement of the trolley along the guide rail.

If the user falls and pulls the trolley body in the general direction of "C", the trolley body **620***a* rotates about circular guide shaft **210***c* in direction "B" into the second position, and activates the speed retarding subsystem comprising trolley wave-like surface **662***g* that engages the wave-like surface of the speed control track **662***a*. Furthermore, if trolley body **620***a* is fully rotated during a fall, and on-set wheel **662***b* is pressed against lower guide rail surface **210***h* so that retainer **662***c* is fully compressed, on-set wheel **662***b* may engage surface **662***d* at point **704** (see FIG. **12**A, right hand side) further slowing the movement of trolley **620** along guide rail **210** and in this configuration, functioning as part of the speed retarding subsystem. The combined resistance of the background speed control system (background eddy current brake) and all of the retainers **662***c* housed within trolley **620** when in their most compressed state and biasing on-set wheel **662***b* against the lower guide rail surface **210***h*, **210***i*, the (sine curve) speed control track **662***a*, or a combination thereof (see FIGS. **9**A, **9**B, **10**A, **10**B, **11**A, **11**B), that is, the force required to compress all retainers **662***c* so that on-set wheels **662***b* reach their respective positions on the lower guide rail surface or speed control track when the trolley is in the fall orientation, should be less than the force generated by the user when he or she falls so that the speed controller system may be properly activated. When engaged, the speed retarding subsystem slows movement of the trolley along guide rail to a second maximum for example, but not limited to 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 inches/second, or any amount therebetween. In the second position trolley **620** may or may not to come to a full stop. In the event trolley **620** does come to a full stop, the speed control system described herein should not limit the user (while still attached to the trolley) from crawling up or down the stairs, or across a level surface.

In the fall control system **100** just described (with reference to FIGS. **10**A and **10**B), in the event of a fall, the trolley **620** rotates around the circular or cylindrical shaft **210***c* towards the user, bringing into contact the trolley wave-like surface **662***g* on the trolley **662***g* with the corresponding (sine curve) speed control track **662***a* on the guide rail **210**. The friction created by the two surfaces rubbing against each other helps to slow down movement of the trolley **620** along guide rail **210**. The solid points of contact resulting from the fall orientation of the trolley would keep any frictional forces constant, irrespective of the user's weight. The material of the trolley wave-like surface **662***g* and the (sine curve) speed track **662***a* can be the same material, or different materials. One or both surfaces can be, for example, a smooth metal, or to increase the friction, one or both surfaces can be a hard rubber, a polymeric material, or a material, for example a metal, a rubber, a polymeric material, that is sandblasted to increase friction. Alternatively, a replaceable brake pad (analogous to a car brake pad) can be used on one or both surfaces, with the surfaces being wave-like or flat. This may be advantageous in a commercial setting (i.e. physiotherapy gym) where the speed control system might be activated several times a day, resulting in one or more braking surfaces needing to be replaced.

An alternate fall control system **100** is provided with reference to FIGS. **11**A and **11**B. This fall control system comprises similar elements to those as previously described, with the user attached to trolley **620** via tether **140** at linkage **144**, and trolley **620** moving along guide rail **210** in a first direction (travelling orientation), for example, using one or more than one roller element **122**. The fall control system **100** comprises a background speed control system comprising a background eddy current brake comprising one or more than one background magnet **660***a*, **660***b* interacting with a conductive portion (e.g. a ferromagnetic surface material) of guide rail **210***c* (background speed control track), or as described in earlier examples, a separate conductive background speed control track, to control a first maximum speed of the trolley is less that the expected maximum fall velocity of the user in the event of a fall. For example which is not to be considered limiting, the first maximum speed may be of about 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 inches/second, or from 0.5 to 5 km/hr, or any amount therebetween, for example, from about 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 km/hr, or any amount therebetween, in order to approximate the range in walking speeds of a person. The strength of the electromagnetic drag force is determined by the position, strength, shape, poles, and size of the magnet and these properties may readily be determined by one of skill. For example, background magnet **660***a*, **660***b* may be square, rectangular, curved, arc shaped, or comprise any suitable shape in order to fit within trolley **620** and interact with the speed control track. Background magnet **660***a*, **660***b* may be positioned symmetrically about trolley **620**.

Guide rail **210** is as previously described, comprising body of the guide rail **210***b*, a circular shaft **210***c* with a curved outer surface **210***d*, mounting surface (or base) **210***a*, and an upper guide rail shoulder **210***g*. As shown in FIGS. **11**A and **11**B, the lower guide rail surface **210***h* may comprises two surfaces, a first surface **210***h* that comprises a flat surface that is in contact with on-set wheel **662***b* when trolley **620** is in the first (travelling orientation), and second (fall orientation; trolley rotated) position, where a second surface comprising a second flat surface **210***i*, analogous to a speed control track, and engages off-set wheel **675** (see FIG. **11**B). Offset wheel **675** is off-set with respect to axel **675***a* so that when wheel **675** rotates about axel **675***a*, an outer surface of the wheel circumscribes an eccentric path, and when engaged with the speed control track collectively function as a speed retarding subsystem. When off-set wheel **675** engages with second off-set surface **210***i*, movement of trolley **620** is reduced since rotation of wheel about axel **675***a* requires additional effort in order to roll along the speed control track **210***i*. When off-set wheel **675** is in contact with the speed control track **210***i*, the trolley **620** does not come to an abrupt stop.

As described with reference to FIGS. **9**A, **9**B, **10**A, and **10**B, on-set wheel **662***b* and axel **662***f* sit atop retainer **662***c* which biases wheel **662***b* toward the lower guide rail surface **210***h* as shown in FIGS. **11**B and **12**A. On-set wheel **662***b* move from the first position (or pre-fall position) as shown in FIG. **12**A (left-hand panel) to a second position (compressed or fall position; FIG. **12**A, right-hand panel), and in doing so, second retainer **662***d* may interact with, and frictionally engage, wheel **662***b*, at **704**, further slowing movement of trolley **620** along the guide rail. The placement of the on-set wheel **662***b* and housing **662***h* within trolley **620** and relative to the lower guide rail surface **210***h* may be adjusted using adjustment mechanism **667**.

When trolley **620** is in the first position and moves along guide rail **210** in a travelling orientation as shown in FIG. **11**B, on-set wheels **662***b* are in contact with lower guide rail surface **210***h*, while the off-set wheels **675** do not contact the speed control track **210***i*. In this configuration, off-set wheel **675**, and speed control track **210***i*, do not participate in slowing movement of the trolley along the guide rail, and retainer **662***c* acting on on-set wheel **662***b* helps maintains the trolley in the travelling orientation.

If the user falls and pulls the trolley body in the general direction of "C", the trolley body **620***a* rotates about circular guide shaft **210***c* in direction "B" into the second position, and activates the speed retarding subsystem system comprising off-set wheel **675** engaging speed control track **210***i*. Furthermore, if trolley body **620***a* is fully rotated during a fall, and on-set wheel **662***b* is pressed against lower guide rail surfaced **210***h* so that retainer **662***c* is fully compressed, on-set wheel **662***b* may engage surface **662***d* at point **704** (see FIG. **12**A, right hand side) further slowing the movement of trolley **620** along guide rail **210**. In this configuration, on-set wheel **662***b* is functioning as part of the speed retarding subsystem. The combined resistance of the background speed control system (background eddy current brake) and all of the retainers **662***c* housed within trolley **620** when in their most compressed state and biasing on-set wheel **662***b* against the lower guide rail surface **210***h*, speed control track **210***i*, **662***a*, or a combination thereof (see FIGS. **9**A, **9**B, **10**A, **10**, **11**A, **11**B), that is, the force required to compress all retainers **662***c* so that on-set wheels **662***b* reach their respective positions on the lower guide rail surface or speed control track when the trolley is in the fall orientation, should be less than the force generated by the user when he or she falls so that the speed retarding subsystem may be properly activated. When engaged, the speed retarding system slows movement of the trolley along guide rail to a second maximum for example, but not limited to 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 inches/second, or any amount therebetween. In the second position trolley **620** may or may not to come to a full stop. In the event it does come to a full stop, the speed control system described herein should not limit the user (while still attached to the trolley) from crawling up or down the stairs, or across a level surface.

The off-set wheels (off center of rotation wheels) **675** act in an analogous manner as the "speed bumps" of speed control track **662***a*, with the friction of the two surfaces (wheel **675** and speed control track **210***i*), when in contact, slowing down movement of trolley **620** along guide rail **210**, without causing the trolley to lock up completely. Also contemplated is the use of off-set wheels **675** comprising a gear (spline) that connect the one or more of the off-set wheels **675** with one or more onset center of rotation (regular) guide wheels that comprise a mating gear/spline (not shown). In this variation, both sets of wheels would rotate in opposite directions, so that when engaged when trolley **620** is in a fall orientation, the off-set wheels **675** would lock with the guide wheels and prevent any significant rotation of any of the wheels until the user stood back up. The user standing back up would relieve pressure from the retainer **662***c* (compression springs) under each the guide wheels (as described with reference to FIGS. **12**A to **12**C). Alternatively, a third gear wheel (between the two gear wheels just described) may be added which would result in both the off-set center wheels **675** and the on-center of rotation wheels travelling in the same direction in the event of a fall, but the on center of rotation wheels would be significantly slowed due to the slower speed of the off-set center of rotation wheels, resulting from their off-set center of rotation.

In the fall control systems described above with reference to FIGS. **8**A to **8**D, **9**A, **9**B, **10**A, **10**B, **11**A, **11**B, and **12**A to **12**C, the speed retarding subsystem may comprise any combination of on-set wheel(s) **662***b*, with or without retainers **662***c*, off-set wheels **675**, and speed control tracks **662***a* and **662***g*, in order to optimize functionality of the fall control system **100**. Furthermore, where the trolley **620** comprises one or more than one on-set wheel **662***b* that is biased by retainer **662***c*, the retainer **662***c* may be a resilient material for example, a resilient rubber material, a polymeric material, a metal spring, a polymeric spring, for example the retainer may be a compression spring that is round, oval, rectangular or other shape. The ends of the springs may have any suitable configuration for example a closed, square, or double closed end. The retainer may also comprise a resilient, compressible, rubber tube that when compressed permits on-set wheel **662***b* to interface with second retainer **662***d*.

In the event of a fall, when the person is resting on the stairs or level surface, the downward force on the tether connecting the user to the trolley is significantly decreased in comparison to the forces through the tether during a fall; with less compression of the springs under the wheel(s), the trolley is allowed to rotate back fully or partially to its initial resting position, releasing pressure between the areas of friction between the trolley and external surface (or between the wheel(s) and the external speed control track), allowing the trolley to move more freely on the circular rail, moving with the user as he or she crawls up or down the stairs.

It is contemplated that any part of any aspect or embodiment discussed in this specification can be implemented or combined with any part of any other aspect or embodiment discussed in this specification. While particular embodiments have been described in the foregoing, it is to be understood that other embodiments are possible and are intended to be included herein. It will be clear to any person skilled in the art that modification of and adjustment to the foregoing embodiments, not shown, is possible.

What is claimed is:

1. A fall control system comprising, an elongate guide rail extending along an axis and comprising a conductive circular shaft, a trolley for moving along the conductive circular shaft of the elongate guide rail, a tether attached to the trolley at a first end, a second end of the tether for attaching to a user, and a speed control system for controlling a speed of the trolley along the elongate guide rail, the speed control system comprising:

one or more than one speed control track formed along with or attached to the elongate guide rail, and extending along the axis of the elongate guide rail, the one or more than one speed control track comprising a first surface and a second surface;

a background speed controller coupled to the trolley and engaged with the conductive circular shaft, the background speed controller comprising one or more than one magnet, the background speed controller for controlling the speed of the trolley along the elongate guide rail in a travelling orientation while the user is walking, ascending stairs, or descending stairs;

a speed controller coupled to the trolley, the trolley rotatably displaceable about the circular shaft from a first position when the trolley is in the travelling orientation and the speed controller does not reduce speed, or temporarily stop movement, of the trolley along the elongate guide rail, to a second position when the trolley is in a falling orientation and the speed controller reduces speed, or temporarily stops movement, of the trolley along the elongate guide rail,

the speed controller comprising one or more than one wheel assembly comprising: an onset wheel with a first axel on a first center of rotation of the onset wheel and a first retainer for biasing the onset wheel towards the first surface of the one or more than one speed control track,

the speed controller further comprising a surface of the trolley for interacting with the second surface of the one or more than one speed control track, or further comprising an offset wheel with a second axel off a second center of rotation of the offset wheel, the offset wheel for interacting with the second surface of the one or more than one speed control track,

the speed controller for controlling the speed of the trolley along the elongate guide rail in the falling orientation, and

the second surface of the speed control track, the surface of the trolley of the speed controller, or both the second surface of the speed control track and the surface of the trolley of the speed controller, is a material selected from a group consisting of: metal, sandblasted metal, rubber, sandblasted rubber, polymeric material, and sandblasted polymeric material; or, both the second surface of the speed control track and the surface of the trolley of the speed controller comprise a brake pad.

2. The fall control system of claim **1**, wherein the conductive circular shaft is made of a material selected from a group consisting of aluminum, anodized aluminum, steel, stainless steel, a metal alloy, a ceramic coated aluminum, a ceramic coated anodized aluminum, a ceramic coated steel, a ceramic coated stainless steel and a ceramic coated metal alloy.

3. The fall control system of claim **1**, wherein the conductive circular shaft is made of a ferromagnetic material.

4. The fall control system of claim **1**, wherein the conductive circular shaft is made of aluminum.

5. The fall control system of claim **1**, wherein:

the first surface of the speed control track is a sinusoidal wave surface,

the speed controller comprises the surface of the trolley, and

the second surface of the speed control track and the surface of the trolley of the speed controller are both flat surfaces.

6. The fall control system of claim **5** wherein the wheel assembly of the speed controller further comprises a second retainer for frictionally engaging the onset wheel when the trolley is in the falling orientation.

7. The fall control system of claim **1**, wherein:

the first surface of the speed control track is a flat surface,

the speed controller comprises the surface of the trolley, and

the second surface of the speed control track and the surface of the trolley of the speed controller are both flat surfaces.

8. The fall control system of claim **7** wherein the wheel assembly of the speed controller further comprises a second retainer for frictionally engaging the onset wheel when the trolley is in the falling orientation.

9. The fall control system of claim **1**, wherein:

the first surface of the speed control track is a flat surface,

the speed controller comprises the surface of the trolley, and the second surface of the speed control track and the surface of the trolley of the speed controller are both sinusoidal wave surfaces.

10. The fall control system of claim **1**, wherein:

the first and second surfaces of the speed control track are flat surfaces, and

the speed controller comprises the offset wheel.

11. A fall control trolley for moving along an elongate guide rail, the elongate guide rail comprising a conductive circular shaft and one or more than one speed control track, the speed control track comprising first and second surfaces,

the fall control trolley comprising a body, a background speed controller coupled to the body, and a speed controller coupled to the body,

the background speed controller for engaging with the conductive circular shaft of the elongate guide rail when the trolley is mounted on the elongate guide rail and in a travelling orientation, the background speed controller comprising one or more than one background magnet, the background speed controller for controlling the speed of the trolley along the elongate guide rail in the travelling orientation while the user is walking, ascending stairs or descending stairs;

the speed controller coupled to the trolley, the trolley rotatably displaceable from a first position, when the trolley is in the travelling orientation and the speed controller does not reduce speed, or temporarily stop movement, of the trolley along the elongate guide rail, to a second position when the trolley is in a falling orientation and the speed controller reduces speed, or temporarily stops movement, of the trolley along the elongate guide rail,

the speed controller comprising one or more than one wheel assembly comprising: an onset wheel with a first axel on a first center of rotation of the onset wheel and a first retainer for biasing the onset wheel towards the first surface of the one or more than one speed control track of the elongate guide rail,

the speed controller further comprising a surface of the trolley for interacting with the second surface of the one or more than one speed control track, or further comprising an offset wheel with a second axel off a second center of rotation of the offset wheel, the offset wheel for interacting with the second surface of one or more than one speed control track;

the speed controller for controlling the speed of the trolley along the elongate guide rail in the falling orientation;

wherein the background speed controller and the speed controller are not the same,

wherein the surface of the trolley of the speed controller is a material selected from a group consisting of: metal, sandblasted metal, rubber, sandblasted rubber, polymeric material, and sandblasted polymeric material; or, the surface of the trolley of the speed controller comprise a brake pad.

12. The fall control trolley of claim **11**, wherein the trolley moves from the travelling orientation to the falling orientation by rotating about an axis of the conductive circular shaft.

13. The fall control trolley of claim **11**, wherein:

the speed controller comprises the surface of the trolley, and

the surface of the trolley of the speed controller is a flat surface.

14. The fall control trolley of claim **11**, wherein:

the wheel assembly of the speed controller further comprises a second retainer for frictionally engaging the onset wheel when the trolley is in the falling orientation.

15. The fall control trolley of claim **11**, wherein:

the speed controller comprises the surface of the trolley, and

the surface of the trolley of the speed controller is a sinusoidal wave surface.

16. The fall control trolley of claim **11**, wherein:

the speed controller comprises the offset wheel.

17. A method for controlling a movement of a movable object during a fall event using the fall control system of claim **1**, the method comprising:

(a) coupling the first end of the tether to the trolley of the fall control system, the trolley being moveable along the elongate guide rail extending along the axis of the elongate guide rail, the trolley comprising the background speed controller and the speed controller, the background speed controller active while the trolley is in the first position, in the travelling orientation, and the speed controller active when the trolley is in the second position, in the falling orientation;

(b) coupling the second end of the tether to the movable object;

(c) exerting a pulling force, through the tether, on the trolley that is sufficient to move the trolley along the elongate guide rail while in the travelling orientation, the background speed controller controlling the speed of the trolley along the elongate guide rail to not exceed a maximum walking speed;

(d) during the fall event, exerting a falling force, through the tether, on the trolley that is sufficient to displace the trolley from the first position to the second position, the speed controller for controlling the speed of the trolley along the guide rail in the falling orientation to not exceed a maximum fall speed; and

(e) allowing the moveable object to descend to a ground at a controlled speed,

wherein the maximum walking speed is greater than the maximum fall speed, and the maximum walking speed and the maximum fall speed are greater than zero.

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