

TRANSPORT CARRIER

Technical Field

5 [0001] The present invention relates to a transport carrier, in particular to a transport carrier for a stairway.

Background

10 [0002] With more countries facing challenges in ageing population, elderly may find climbing a stairway or a slope to be physically demanding. Hence, there is a need to assist in transporting a person and/or an object between points of differing elevation with minimum alteration to the stairway.

15 Summary

 [0003] The present invention provides a transport carrier for transporting a user or an object between points of differing elevation. According one embodiment, a transport carrier comprises a support frame (100) mountable along a stairway (60); a carriage (200)
20 movably coupled to the support frame (100), and a cable coupled between the support frame (100) and the carriage (200). The carriage (200) is movable relative to the support frame (100) between a first position and a second position elevated and horizontally shifted relative to the first position. Pulling of the cable causes the carriage to move towards the second position, and releasing of the cable allows the carriage to move towards the first
25 position.

 [0004] Preferably, the transport carrier further comprises a drum (406) disposed in and rotatably coupled to the support frame (100), the drum being rotatable relative to the support frame along a first rotational direction to wind the cable around the drum, and along
30 a second rotational direction countering to the first rotational direction to unwind the cable off the drum.

[0005] Preferably, rotation of the drum along the first rotational direction tensions the cable to move the carriage towards the second position, and rotation of the drum along the second rotational direction releases the cable (500) to allow the carriage to move towards the first position.

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[0006] Preferably, winding of the cable around the drum moves an unwind segment of the cable along a first linear direction parallel to a center axis of the drum, and unwinding of the cable off the drum moves the unwind segment along a second linear direction opposite to the first linear direction.

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[0007] Preferably, the drum is rotatable about a drum axis, the transport carrier further comprise a pulley shaft slidably coupled to the support frame and a pulley rotatably coupled to the pulley shaft and engaged to the cable, wherein the pulley shaft is oriented orthogonal to the drum axis, wherein winding of the cable around the drum causes the pulley shaft and the pulley to move along the first linear direction, and wherein unwinding of the cable off the drum causes pulley shaft and the pulley to move along the second linear direction.

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[0008] Preferably, the transport carrier further comprises a guide rod to which the pulley shaft is coupled, the guide rod being oriented parallel to the drum axis and fixed to the support frame, wherein the pulley shaft is slidable relative to the guide rod (4086) in a direction (4420/4421) parallel to the first linear direction (4418) to vary the position of the pulley relative to the drum.

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[0009] Preferably, the transport carrier further comprises a support rod coupled to the pulley shaft and a biasing member disposed between the guide rod and the support frame, wherein the biasing member exerts a force against the support rod to urge the pulley moving towards a balance position.

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[0010] Preferably, the transport carrier further comprises a rack coupled to the support frame and a pawl coupled to the carriage, wherein release of the cable causes the pawl to engage the rack to prevent the carrier from moving towards the first position.

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[0011] Preferably, tensioning the cable disengages the pawl from the rack, and when the tension in the cable is removed, the pawl engages the rack preventing the carriage to move towards the first position.

5 [0012] Preferably, the transport carrier further comprises a biasing member (249, 247) to bias the pawl to engage the rack.

[0013] Preferably, the biasing member (247) comprises a compression spring (247) abutting against the carriage.

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[0014] Preferably, the transport carrier further comprises a pedal (232) pivotally coupled to the carriage, the pedal being pivotable relative to the carriage between a close position (232a) and an open position (232c).

15 [0015] Preferably, the transport carrier further comprises a biasing member (236) to urge the pedal toward the close position.

[0016] Preferably, the transport carrier further comprises a pedal actuator (262) to move the pedal towards the open position.

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[0017] Preferably, the transport carrier further comprises a connector (268, 269) coupled to the pedal, the pedal actuator drives the connector to move the pedal between the close and open position.

25 [0018] Preferably, the transport carrier further comprises a pedal sensor (2668, 2669) to detect a position of the connector relative to the carriage.

[0019] Preferably, the transport carrier further comprises a proximity sensor (238) coupled to the pedal to detect an obstacle during a movement of the carriage relative to the support member.

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[0020] Preferably, the transport carrier further comprises a guide member (300, 302, 114, 116) coupled to the support frame and engaged with the carriage.

[0021] Preferably, the transport carrier further comprises a sleeve (220) coupled to the carriage, wherein the guide member is a rod (300) received in the sleeve.

5 [0022] Preferably, the transport carrier further comprises a bushing (224) coupled to the sleeve, and engaged with the rod.

[0023] Preferably, the transport carrier further comprises a nipple (226) coupled to the sleeve for providing a lubricant between the rod and the sleeve.

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[0024] Preferably, the guide member is a rail (302) and the transport carrier further comprises grooved wheels coupled to the carriage and engaged with the rail to guide the movement of the carriage.

15 [0025] Preferably, the guide member is a channel (114,116) formed on the support frame and the transport carrier further comprises guide wheels (222) coupled to the carriage and engaged with the channel to guide the movement of the carriage.

[0026] According to another embodiment, a transport carrier (10) comprises a
20 support frame (100) mountable to a stairway; a carriage (200) movable along a line of movement (800) relative to the support frame between a first position and a second position elevated relative to the first position; a pedal (232) pivotally coupled to the carriage, the pedal configured to pivot between a close position (232a) substantially parallel to a side surface (102a) of the support frame and an open position (232c) substantially perpendicular
25 to the side surface of the support frame; an actuating assembly (400); and a cable (500) coupled between the actuating assembly and the carriage, the actuating assembly holds the carriage in position through a tension in the cable. The actuating assembly is configured to pull on the cable to move the carriage towards the second position, and to release on the cable to move the carriage towards the first position.

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[0027] Preferably, the actuation assembly comprises a rotatable drum (406) configured to pull on or release the cable (500).

[0028] Preferably, the drum is configured to wind the cable forming a plurality of adjacent windings in a traverse winding direction (4418) parallel to a rotational axis of the drum, and the drum is configured to unwind the adjacent windings in a traverse unwinding direction (4419) opposite to the traverse winding direction.

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[0029] Preferably, the actuation assembly further comprising a pulley (4408) coupled between the drum and the carriage to maintain tension to the cable.

[0030] Preferably, the pulley (4408) is moveable along a guide rod (4086) in a direction (4420/4421) substantially parallel to the traverse winding direction (4418), the movement of the pulley reduces a fleet angle formed between the cable and a neutral axis (4417) of the drum.

[0031] Preferably, the pulley is urged by the cable to move (4420) in the traverse winding direction (4418) in tandem with the winding of the cable.

[0032] Preferably, the pulley is biased (4082) towards the traverse unwinding direction (4419) such that the pulley moves (4421) in the traverse unwinding direction (4419) in tandem with the unwinding of the cable.

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[0033] Preferably, the pulley is biased (5082) towards the traverse winding direction (5418) such that the pulley moves (5422) in the traverse winding direction (5418) in tandem with the winding of the cable.

[0034] Preferably, the pulley is urged by the cable to move (5423) in the traverse unwinding direction (5419) in tandem with the unwinding of the cable.

[0035] According to a further embodiment, a transport carrier (10) comprises a support frame (100) mountable along a stairway; a carriage (200) movable along a line of movement (800) relative to the support frame between a first position and a second position elevated relative to the first position; a pedal (232) pivotally coupled to the carriage, the pedal configured to pivot between a close position (232a) substantially parallel to a side surface (102a) of the support frame and an open position (232c) substantially perpendicular

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to the side surface of the support frame; an actuating assembly (400); and a safety assembly (240) coupled between the cable and the carriage, the safety assembly engages the support frame preventing the carriage to move towards the first position when the tension in the cable is removed. The actuating assembly is configured to pull on the cable to move the carriage towards the second position, and to release on the cable to move the carriage towards the first position.

[0036] Preferably, the support frame comprises a rack (112) and the safety assembly comprises a pawl (244) coupled to the cable, wherein the tension in the cable disengages the pawl from the rack, and when the tension in the cable is removed, the pawl engages the rack preventing the carriage to move towards the first position.

[0037] Preferably, the safety assembly further comprises a biasing member (249, 247) configured to bias against the pawl to engage the rack.

[0038] Preferably, the biasing member (247) comprises a compression spring (247) configured to provide damping to the carriage when the actuation assembly pulls on or releases the cable.

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Brief description of drawings

[0039] Fig. 1A is a schematic diagram of a transport carrier configured for a stairway setting according to one embodiment of the present invention;

[0040] Fig. 1B is a schematic diagram of a transport carrier according to a step setting;

[0041] Fig. 1C is a schematic diagram of a transport carrier according to a slope setting;

[0042] Fig. 1D is a schematic diagram of a transport carrier according to an uneven terrain setting;

[0043] Fig. 1E is a schematic diagram of a transport carrier according to a valley setting;

[0044] Fig. 2 is a side view of a transport carrier according to an embodiment;

[0045] Fig. 3 is a side view of a transport carrier according to another embodiment;

[0046] Fig. 4 is a side view of a carriage according to the embodiment of Fig. 3;

[0047] Fig. 5 is a side view of a carriage in cooperation with a support frame, according to the embodiment of Fig. 3;

[0048] Fig. 6 is a sectional view of view A-A according to the view of Fig. 5;

[0049] Fig. 7 is a top view of a pedal according to the embodiment of Fig. 3;

[0050] Fig. 8A is a detailed view of a wire sensor when the pedal is unfolded, according to the embodiment of Fig. 3;

[0051] Fig. 8B is a detailed view of the wire sensor when the pedal is folded, according to the embodiment of Fig. 10A;

[0052] Fig. 9A is a side view of a sleeve according to the embodiment of Fig. 3;

[0053] Fig. 9B is a top view of the sleeve according to the embodiment of Fig. 7A;

[0054] Fig. 9C is a front view of the sleeve according to the embodiment of Fig. 7A;

[0055] Fig. 10A is a detailed view of a safety assembly in cooperation with a rack, according to the embodiment of Fig. 3;

[0056] Fig. 10B is a detailed view of the safety assembly during normal operation disengaging from the rack, according to the embodiment of Fig. 8A

5 [0057] Fig. 10C is a detailed view of the safety assembly during failure of cable in engagement with the rack according to the embodiment of Fig. 8A;

[0058] Fig. 11 is a side view of a transport carrier according to another embodiment;

10 [0059] Fig. 12A is a detailed view of a pedal assembly according to another embodiment;

[0060] Fig. 12B is a top view of the pedal assembly according to the embodiment of Fig. 12A;

15 [0061] Fig. 12C is a sectional view B-B of the pedal assembly in a “close” position, according to the embodiment of Fig. 12A;

[0062] Fig. 12D is a sectional view B-B of the pedal assembly in a “ready” and an
20 “operating” position, according to the embodiment of Fig. 12A;

[0063] Fig. 13A is a detailed view of the pedal assembly in the “operating” position showing a wire anchor, according to the embodiment of Fig. 12A;

25 [0064] Fig. 13B is a detailed view of the pedal assembly in the “close” position showing the wire anchor, according to the embodiment of Fig. 13A;

[0065] Fig. 14 is a side view of a transport carrier according to yet another embodiment;

30 [0066] Fig. 15A is a detailed view of the actuation assembly according to the embodiment of Fig. 14;

[0067] Fig. 15B is a sectional view B-B of the actuation assembly;

[0068] Fig. 16A to 16H are detailed views of a drum and pulley in the winding and unwinding process according to the embodiment of Fig. 15A;

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[0069] Fig. 17 is a detailed view of a actuation assembly according to another embodiment;

[0070] Fig. 18A to 18H are detailed views of a drum and pulley in the winding and unwinding process according to the embodiment of Fig. 17;

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[0071] Fig. 19A is a front view of a carriage and a pedal assembly in the “close” position according to the embodiment of Fig. 14;

[0072] Fig. 19B is a front view of the carriage and the pedal assembly in the “open” position according to the embodiment of Fig. 14;

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[0073] Fig. 20A is a detailed view of the carriage and the pedal assembly in the “close” position according to the embodiment of Fig. 19A;

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[0074] Fig. 20B is a detailed view of the carriage and the pedal assembly in the “open” position according to the embodiment of Fig. 19B;

[0075] Fig. 21A is a detailed view of a safety assembly in cooperation with a rack, according to the embodiment of Fig. 14;

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[0076] Fig. 21B is a detailed view of the safety assembly during normal operation disengaging from the linear rack, according to the embodiment of Fig. 21A

[0077] Fig. 21C is a detailed view of the safety assembly during failure of cable in engagement with the linear rack according to the embodiment of Fig. 21A;

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[0078] Fig. 22 is a side view of a pedal assembly in the “open” position according to another embodiment;

[0079] Fig. 23A is an enlarged view of the pedal assembly of Fig. 22 showing a
5 mechanical hard stop in a close position;

[0080] Fig. 23B is an enlarged view of the pedal assembly of Fig. 22 showing a mechanical hard stop in an open position.

10 Detailed Description

[0081] It will be readily understood that the components of the embodiments, as generally described and illustrated in the figures herein, may be arranged and designed in a wide variety of different configurations in addition to the described example embodiments.
15 Thus, the following more detailed description of the example embodiments, as represented in conjunction with the figures, is not intended to limit the scope of the embodiments, as claimed, but is merely representative of example embodiments.

[0082] Reference throughout this specification to “one embodiment”, “another embodiment” or “an embodiment” (or the like) means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the appearance of the phrases “in one embodiment” or “in an embodiment” or the like in various places throughout this specification are not necessarily all referring to the same embodiment.
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[0083] Furthermore, the described features, structures, or characteristics may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided to give a thorough understanding of embodiments. One skilled in the relevant art will recognize, however, that the various embodiments can
25 be practiced without one or more of the specific details, or with other methods, components, materials, etc. In other instances, some or all known structures, materials, or operations may not be shown or described in detail to avoid obfuscation.

[0084] Figs. 1A, 1B, 1C, 1D and 1E illustrate a transport carrier 10 for use in various operational environments. The transport carrier 10 is configured to carry and move a person and/or an object between an upper point 40 and a lower point 50 of differing elevation and differing horizontally shifted locations. In one example as shown in Fig. 1A, a transport carrier 10 may be deployed along a stairway 60 between an upper point 40 of the stairway 60 and a lower point 50 of the stairway. In the example as shown in Fig. 1B, a transport carrier 10 may be deployed between a step 70 with an upper point 40 and a lower point 50. In further examples shown in Figs. 1C, 1D and 1E,, a transport carrier 10 may be deployed along a slope 80 with an upper point 40 and a lower point 50, or over an uneven inclining terrain 90 with an upper point 40 and a lower point 50, etc. Further, the transport carrier 10 may also be used between an upper point 40 and a lower point 50 such as across a valley 99 between two peaks 40/50, and in various other settings.

[0085] Fig. 2 shows a transport carrier 10 according to one embodiment, used along a stairway 60. The transport carrier 10 comprises a support frame 100 spanning along the stairway 60 and mounted to the sidewall of the stairway, a carriage 200 movably coupled to the support frame 100 and movable along a line of movement 800, and an actuation assembly 400 mounted to the stairway 60.

[0086] The support frame 100 has an upper end 101 located near the upper point 40 or the top level of the stairway 60, and a lower end 109 located near a lower point 50 or the bottom level of the stairway 60. The actuation assembly 400 is positioned adjacent to the upper point 40, and has a cable 500 connected to the carriage 200. Upon activation of the actuation assembly 400, the cable 500 pulls the carriage 200, to move the carriage 200 towards the upper end 101 along the line of movement 800. Upon the actuation assembly 400 being deactivated, the cable 500 releases the carriage 200, to allow the carriage 200 to move towards the lower end 109 along the line of movement 800, by the gravity of the carriage 200 the user / load borne by the carriage 200. When it is desired to carry a user or a load upstairs, the actuation assembly 400 is activated to draw the cable 500 to move the carriage 200 towards the upper end 101 of the support frame 100. Conversely, when it is desired to carry a user or a load downstairs, the actuation assembly 400 is deactivated to release the cable 500, to allow the carriage 200 to move towards the lower end 109 of the support frame 100, by the gravity of the user / load or the carriage 200. The location of the

carriage 200, or in other words the relative position of the carriage 200 and the support frame 100 is controlled by the pulling and releasing operations of the cable 500 by the actuation assembly 400.

5 [0087] The transport carrier 10 may further include a guide member such as a rod 300 coupled on both ends to the support frame 100. As an example, the rod 300 is oriented generally the same inclination angle of the stairway 60. Alternatively, according to differing environment and requirements, the rod 300 can be arranged oblique to the stairway 60 inclination. The carriage 200 is partially enclosed in the support frame 100, and is slidable
10 along the rod 300, hence the rod 300 guides the movement of the carriage 200 relative to the support frame 100 along a line of movement 800. The rod 300 may be of a circular profile in cross section, or may otherwise be of a different profile, for example a non-circular curved profile, a polygonal profile or a combination thereof. Alternatively, the cross-sectional profile may also be configured to be non-uniform along a length of the rod 300.

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 [0088] According to another embodiment, as illustrated in Fig. 3, the actuation assembly 400 comprises a housing 402, an actuator such as a motor 404 mounted in the interior of the housing 402, a drum 406 coupled to an output of the motor 404 for winding and unwinding the cable 500, and pulleys 408/410 coupled to the supporting frame 100 and
20 engaged to the cable 200. The actuation assembly may further includes a controller 412 configured to operate the motor 404 and other electrical components to provide electrical power thereto, and for controlling the operation of the actuation assembly 400.

 [0089] The cable 500 is so arranged such that the pulling force applied by the cable
25 500 on the carriage 200 is generally parallel to the rod 300 and the line of movement 800. This allows for smooth movement of the carriage 200 relative to the support frame 100. Alternatively, the pulling force applied by the cable 500 on the carriage 200 can be configured to be oblique to the line of movement 800. The cable 500 is wound around the drum 406. Rotation of the drum 406 in a first rotational direction winds the cable 500 around
30 the drum 406, and rotation of the drum 406 in a second rotational direction countering to the first rotational direction unwinds the cable 500 off the drum. Winding the cable 500 around the drum 406 pulls the cable 500 which in turn pulls the carriage 200 to move towards the first end 101. Unwinding the cable 500 off the drum 406 releases the cable 500

which in turn released the carriage 200. Speed reduction gears may be provided in the actuation assembly 400 and coupled to the motor 404. Reduction gears reduce the turning speed of the output shaft of the motor 404, but increases the output torque as well as the holding torque on the drum 406.

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[0090] The support frame 100 may further comprise an upper positioning sensor 104 coupled to the upper end 101 of the support frame 100, a lower positioning sensor 106 coupled to the lower end 109 of the support frame 100, a cable drag chain 108 coupled between the carriage 200 and the controller 412 for allowing electrical communication
10 therebetween, and a guide tray 110 for holding and guiding the cable drag chain 108.

[0091] The positioning sensors 104/106 are electrically coupled to the controller 412, and the positioning sensors 104/106, such as micro switches, contact sensors, optic sensors, induction sensors, etc. are configured to detect the position of the carriage 200
15 relative to the support frame 100. When the carriage 200 near the upper end 101 or lower end 109 of the support frame 100 is positioned beyond a critical position, the positioning sensors 104/106 will detect the position of the carriage 200 and send a signal to the controller 412 to slow down and/or stop the motor 404. This halts the movement of the carriage 200 and prevents the carriage 200 from colliding with the support frame 100. The flexible cable
20 drag chain 108 is configured to hold electrical cables adapted for establishing electrical connection between the controller 412 and the carriage 200. When the carriage 200 moves relative to the support frame 100, the cable drag chain 108 bends to a curvature according to the position of the carriage 200 aided/guided by the guide tray 110, allowing continuous electrical connection between the controller 412 and the carriage 200. Alternatively, a
25 wireless configuration can be used for electrical communication between the controller 412 and the carriage 200 such as using radio frequency, infrared, sonar, acoustics, optics, electro-magnetic induction methods, etc.

[0092] Figs. 4, 5, and 6 illustrate carriage 200 according to one embodiment of the
30 present invention. The carriage 200 comprises a carriage frame 210 which maintains the mechanical structure of the carriage 200, a sleeve 220 coupled to a bottom side of the carriage frame 210, an upper guiding assembly 270 and a lower guiding assembly 280 configured to guide and support the movement of the carriage 200 relative to the support

frame 100, a pedal assembly 230 movably coupled to the carriage 200 for allowing a user to stand on or load to be disposed on, and a pedal actuation assembly 260 for folding and unfolding the pedal assembly 230 relative to a side surface 102a of the the support frame 100. The carriage 200 may also include a safety module 240 coupled to the sleeve 220 for
5 engaging the support frame 100 and preventing the carriage 200 from moving towards the first position when the tension in the cable is lost/removed.

[0093] The carriage 200 may further include a sensor plate 212 extending outwardly from the carriage frame 210. Sensor plate 212 is configured to be detected by the positioning
10 sensors 104/106 attached to support frame 100. When the carriage 200 moves to a position adjacent to the upper end 101 or lower end 109 of the support frame 100, the positioning sensors 104/106 detect the presence of the sensor plate 212, and determines that the carriage 200 is approaching. Upon the carriage 200 moving closer to a critical position, the positioning sensors 104/106 send a signal to the controller 412 to stop the motor 404, hence
15 halting the movement of the carriage 200. Further, as another form of safety feature, the sensor plate 212 may act as a mechanical hard stop for the carriage 200. In this regard, the sensor plate 212 is configured to be able to abut against the support frame 100 in preventing further movement of the carriage 200 beyond the critical position.

[0094] The carriage 200 may further include a handle 250 coupled to a top side of the carriage frame 210. The handle 250 may further comprise an up-button 252 and a down-button 254. Both the up-button and the down-button 252/254 are electrically connected to the controller 412 through the cable drag chain 108. The up-button and down-button 252/254 allow a user to control the movement and the position of the carriage 200 relative
20 to the support frame 100, by sending electrical signals to the controller 412 which in turn controls the motor 404 of the actuation assembly 400 to pull or release the cable 500. There may further be control buttons (not shown) disposed on the support frame 100, or a remote controller (not shown) to be activated for use, etc. configured in allowing a user to control the position of the carriage 200 in relative to the support frame 100. The handle 250 and the
25 pedal assembly 230 are configured to partially extend outwardly from the support frame 100. For example, portions of the pedal assembly 230 extend outwardly from the support frame 100 to receive a user thereon, and portions of the handle extends outwardly from the support frame 100 for a user standing on the pedal to hold thereto.

[0095] Figs. 5, 6, 7 illustrate the connection between the pedal assembly 230 and pedal actuation assembly 260. The pedal assembly 230 includes a pedal support arm 234 coupled to the sleeve 220, a pedal 232 pivotally coupled to the pedal support arm 234, a
5 biasing member 236 coupled between the pedal 232 and the pedal support arm 234, and an anchor 239 coupled to a distal edge of the pedal 232. The location of the pedal support arm 234 relative to the sleeve 220 is configured such that the weight of the pedal assembly 230 is generally along the center of mass of the carriage 200. With the pedal assembly 230 so configured, the stability of the carriage 200 during movement is improved. The pedal
10 assembly 230 is disposed partially outside the support frame 100, hence allowing easy maintenance and parts replacement.

[0096] The pedal actuation assembly 260 includes a pedal actuator such as a motor 262, a tension member 264 coupled between the carriage frame 210 and a connector such
15 as a wire rope 268, the wire rope 268 wraps around the motor 262 forming a friction coupling with the motor 262. The wire rope 268 further extends to a wire sensor 266 and couples with an anchor 239 formed on the pedal 232. To reach the anchor 239, the wire rope 268 extends from interior of the carriage frame 210, through the pedal support arm 234 and across a bottom side of the pedal 232. Optionally, guide member 214 are attached to the
20 carriage frame 210 to guide the wire sensor 266 and the wire rope 268 in the carriage frame 210. The motor 262 is configured to pull or release the wire rope 268 to move the pedal 232. Tensioning member 264 functions to apply tension on the wire rope 268 to eliminate slack in the wire rope 268 and to reduce the torque requirement of the motor 262. The wire sensor 266 is configured to detect the relative position of the pedal 232 through monitoring various
25 parameters such as the displacement of the wire rope 268, position of the wire rope 268, the tension force in the wire rope 268, etc. The wire sensor 266 may be configured such that the wire rope 268 is connected on both ends of the wire sensor 266, or the wire sensor 266 may be configured such that the wire rope 268 passes through the wire sensor 266.

30 [0097] As illustrated in Figs. 8A and 8B, the wire sensor 266 include a biasing member 2662 coupled to the carriage frame 210, a movable frame 2660 coupled to the biasing member 2662 and configured to move relative to carriage frame 210 with movement guided by a guide member 214, a pair of contact plates 2664/2666 coupled to both ends of

the movable frame 2660, respectively, and corresponding pair of contact sensors 2668/2669 coupled to the carriage frame 210 and configured to cooperate with and detect the position of the contact plates 2664/2666. Wire ropes 268 are coupled to both ends of the movable frame 2660, with wire rope 268a on the upper end of the movable frame 2660 coupled to the motor 262 and wire rope 268b on the lower end of the movable frame coupled to the pedal 232. The guide member 214 formed on or coupled to the carriage frame 210 guides and restricts the movement of the movable frame 2660 to be relatively parallel to the transverse direction 740 hence ensuring wire rope 268 is taut.

[0098] Fig. 8A illustrates the state of the wire sensor 266 when the pedal 232 is in the unfolded, “operating” position. Wire rope 268a is pulled by motor 262 to overcome the spring force of the biasing member 2662, to an extended state and causes movable frame 2660 to move towards the motor 262 along the transverse direction 740. Movement of movable frame 2660 pulls on wire rope 268b by overcoming the spring force of the biasing member 236, and unfold the pedal 232. Consequentially, contact plate 2664 and contact sensor 2668 are brought into physical contact due to movement of movable frame 2660, while contact plate 2666 is moved away from contact sensor 2669 to form a gap therebetween.

[0099] Conversely, when wire rope 268a is released by motor 262, the biasing member 2662 is allowed to resume a non-extended state and causes movable frame 2660 to move away from the motor 262 along the transverse direction 740. The movement of the movable frame 2660 releases on wire rope 268b, allowing biasing member 236 to fold the pedal 232 to the “close” position, as illustrated in Fig. 8B. Consequentially, contact plate 2666 is brought into contact with contact sensor 2669, while contact plate 2664 is moved away from contact sensor 2668 to form a gap therebetween. The detection of contact plates 2664/2666 by contact sensors 2668/2669 allows the controller 412 to determine the position of the pedal 232.

[00100] With reference to Fig. 6, when the transport carrier 10 is not in operation, the pedal 232 is folded by the biasing member 236 to a “close” position 232a, at which, the wire sensor 266 detects the pedal 232 to be in the “close” position 232a. When a user intends to use the transport carrier 10, the user operates the transport carrier 10 and the

controller 412 sends a signal to the pedal actuation assembly 260 for the motor 262 to pull on the wire rope 268. The wire rope 268, in turn, overcomes the spring force of the biasing member 236, thus unfolding the pedal 232 to a “ready” position 232b. The wire sensor 266 detects the pedal 232 to be in the “ready” position 232b. In the “ready position” 232b, a user and/or an object stepping or being placed on the pedal 232 further unfolds the pedal 232 to the generally horizontal “operating” position 232c, wherein the holding torque of motor 262 holds the pedal 232 at the “operating” position. Concurrently, the wire sensor 266 detects the pedal to be in the “operating” position 232c and sends a signal to the controller 412, allowing the up and down buttons 252/254 on the handle 250 to be operable, the control buttons (not shown) disposed on the support frame 100, or a remote controller (not shown) to be activated for use, etc. A user can thus control the position of the carrier assembly 200 relative to the support frame 100 through the various means.

[00101] Upon reaching the destination, e.g. the top level of the stairway, a user and/or object dismounts from the pedal 232, the pedal 232 resumes to the “ready” position 232b awaiting subsequent carrying operation. The wire sensor 266 detects the pedal to be back in the “ready” position 232b, communicates with the controller 412 to deactivate the various means of controlling the position of the carrier assembly 200, to prevent any accidental movement of the carriage 200. Upon no further operation, the controller 412 sends a signal to the pedal actuation assembly 260 for the motor 262 to release the wire rope 268, allowing the biasing member 236 to fold the pedal 232 back to the “close” position 232a.

[00102] The pedal assembly 230 may further include contact sensors 238 coupled to a peripheral of the pedal 232. When the carriage 200 is in motion, the contact sensors 238 are configured such that when in contact with an object/person, the contact sensors 238 send a “contacted” signal through the cable drag chain 108 to the controller 412, the controller 412 in turn halts the movement of the carriage 200 by stopping motor 404 from pulling or releasing the cable 200. This prevents accidents or damages to the transport carrier 10 due to large obstruction.

[00103] Referring to Figs. 5 and 6, the upper guiding assembly 270 comprises three upper guide wheels 272 each configured to cooperatively roll over a corresponding

guide member such as an upper guiding channel 114 of the support frame 100. The lower guiding assembly 280 comprises two lower guide wheels 282 each configured to cooperatively roll in another corresponding guide member such as a lower guiding channel 116 of the support frame 100. The upper and lower guiding assemblies 270/280 aid in preventing the carriage 200 from tilting in a roll direction 720 hence rolling over during movement of the carriage 200. Further, the multiple guide wheels 272/282 are lined up along the direction of the guiding channels 114/116 to prevent the carriage 200 from tilting over in a pitch direction 710 during movement of the carriage 200.

10 [00104] Referring to Figs. 5, 6, 9A, 9B, and 9C, the sleeve 220 has a bore 228, for example a circular, non-circular, polygonal, or other cross-sectional profile, extending through the sleeve 220. The bore 228 is configured to receive the rod 300 with a corresponding profile, hence allowing the carriage 200 to be guided by the rod 300 during the carriage 200 movement relative to the support frame 100. The configuration of the sleeve 220 and the rod 300 restricts the carriage 200 from displacing/moving in the lateral direction 730 and the transverse direction 740 relative to the support frame 100, hence improving stability during movement. For non-circular apertures, the carriage 200 is also restricted from rotating relative to the rod 300 about a longitudinal axis of the rod 300.

20 [00105] Guiding wheels 222 are coupled to sleeve 220 to roll along channels formed to the support frame 100 to support the weight of the carriage 200. The sleeve may further include bushings 224 coupled to both ends of the bore 228. The bushings 224 are disposed between the sleeve 220 and the rod 300 to lower the friction between the rod 300 and the sleeve 220 during the relative movement, hence allowing the sleeve 220 to slide smoothly along the rod 300. A grease nipple 226 may also be disposed in the sleeve 220, for example at a top side of the sleeve 220 in allowing a controlled release of lubricating grease between the sleeve 220 and the rod 300.

30 [00106] Referring to Figs. 10A and 10B, detailed view 240a shows the safety assembly 240 comprising a plate member 242 fixed to the sleeve 220, a pawl 244 pivotally coupled to the plate member 242 about pivot 244a, a lever 246 pivotally coupled to the plate member 242 about pivot 246a, a first biasing member 249 coupled between the plate

member 242 and the lever 246, and a second biasing member 248 coupled between the pawl 244 and the lever 246.

[00107] During normal operation of the transport carrier 10, cable 500
5 coupled to the lever 246 provides a pulling force to the carriage 200 in an inclined upward direction 810. The pulling force provided by the cable 500 overcomes the spring force of the biasing member 249, to rotate the lever member 246 relative to plate member 242 in a rotating direction 820 about a pivot 246a. A stopping protrusion 242a of plate member 242 is disposed to abut against the lever member 246 to form a hard stop on the lever member
10 246, to prevent further rotation of the lever member 246. Consequentially, the rotation of lever member 246 about pivot 246a pulls on the biasing member 248 to urge and rotate pawl member 244 relative to plate member 242 in a rotating direction 840 about a pivot 244a, to disengage the pawl member 244 from the rack 112 of the support frame 100. Fig. 10B illustrates the safety assembly 240 during the normal operation wherein pawl member 244
15 is disengaged from the rack 112, allowing relative movement between the carriage 200 and the support frame 100.

[00108] With reference to Fig. 10C, during a failure or a loss of tension in the cable 500, the pulling force previously applied to biasing member 249 is released. The
20 release of pulling force in turn allows the biasing member 249 to urge the lever member 246 to rotate in a rotating direction 830, which is opposite to rotating direction 820, about pivot 246a and away from stopping protrusion 242a. The rotation of the lever member 246 subsequently urges against the pawl member 244 through biasing member 248, resulting in pawl member 244 rotating about pivot 244a in a rotating direction 850, which is opposite to
25 rotating direction 840. Consequentially, the pawl member 244 rotates in the rotating direction 850 and engaging the rack 112 of support frame 100. Engagement of pawl member 244 with rack 112 prevents relative motion between the carriage 200 and the support frame 100, hence stopping the carriage 200 from moving towards the lower end of the support frame 100 by self-weight.

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[00109] Alternatively, the lever member 246 and the pawl member 244 may be combined as a single biased pawl member (not shown) such that the cable 500 pulls on a biased pawl member overcoming the bias force, to disengage the biased pawl member

from the rack during normal operation. When tension in the cable 500 is released, the biased pawl member is urged to engage the rack to prevent the carriage 200 from moving towards the lower end of the support frame 100.

5 [00110] Fig. 11 illustrates another embodiment, in which, a transport carrier 20 is deployed along a stairway 60. The transport carrier 20 comprises a support frame 2100 spanning along the stairway 60, a carriage 2200 movably coupled to the support frame 100, an actuation assembly 2400 disposed at a lower point 50 of the stairway 60 and an cable 2500 coupled between the actuation assembly 2400 and the carriage 2200. The support
10 frame 2100 further comprises a pulley assembly 2600, wherein a set of pulleys 2602/2604/2606/2608 guides the cable 2500 from the actuation assembly 2400 along a top side of the support frame 2100, dropping down to a bottom side of the support frame 2100 and coupling with the carriage 2200. The pulley assembly 2600 guides the cable 2500 such that the pulling force applied by the cable 2500 on the carriage 2200 is generally parallel to
15 the rod 2300, to improve the operational efficiency between the cable 2500 and the carriage 2200. This allows for a smooth movement of the carriage 2200 relative to the support frame 100.

 [00111] As illustrated in Fig. 12A, 12B, 12C, 12D, 13A, and 13B, according
20 to another embodiment, a pedal assembly 3230 includes a pedal support arm 3234 coupled to the sleeve 3220, a pedal 3232 pivotally coupled to the pedal support arm 3234, a biasing member 3236 coupled between the pedal 3232 and the pedal support arm 3234, a spring-loaded stopper 3238 coupled to the pedal support arm 3234, contact sensors coupled to a peripheral of the pedal 3232, and a wire anchor 3239 coupled to the pedal 3232 configured
25 to connect with the wire rope 3268. The wire anchor 3239 is provided with an arc 3239a to guide the wire rope 3268 during the folding and unfolding of the pedal 3232. The arc 3239a aids to keep a constant tension in the wire rope 3268, hence preventing failure in the wire rope 3268 due to stress build up.

30 [00112] When not in operation, as illustrated in Fig. 12C and Fig. 13B, biasing member 3236 biases the pedal 3292 to a “close” position 3232a. When activated, a controller (not shown) sends a signal to the pedal actuation assembly (not shown) to pull on wire rope 3268. The wire rope 3268 in turn pulls on the wire anchor 3239 applying a rotation

on the pedal 3292 and overcoming the force of the biasing member 3236, allowing the pedal 3232 to assume a “ready” position 3232b. In the “ready position” 3232b, as illustrated in Fig. 12D, a user and/or an object mount the pedal 3232 overcomes the force of the spring loaded stopper 3238, unfolding the pedal 3232 to the generally horizontal “operating” position 3232c wherein the pedal 3232 abuts against the stopper 3237. Stopper 3237 prevents the pedal 3232 from further unfolding due to the weight of the user and/or the object, hence reducing the holding torque requirement of the motor 3262. Further, the hard stop maintains the “operating” position 3232c of the pedal 3232 to be generally horizontal, alleviating the need for fine control requirement of the pedal actuation assembly and ensures operation even when there is over pulling from the wire rope 3268. The spring-loaded stopper 3238 also provides damping to the pedal 3232 during mounting of the user and/or object.

[00113] In another embodiment, an actuation assembly 4400 of a transport carrier 40 is shown in Figs. 14 to 16H. The actuation assembly 4400 comprises a housing 4402, a motor 4404 coupled to the housing 4402, a drum 4406 coupled to an output of the motor 4404 for winding and unwinding the cable 4500, and pulley 4408 and pulley 4410 coupled to the support frame 4100 to provide tension against the cable 4500. The actuation assembly 4400 further comprising a pulley movement mechanism 4080 cooperatively coupled to pulley 4408. The pulley movement mechanism 4080 includes a pulley shaft 4084 coupled to the pulley 4408, a guide rod 4086 coupled to the pulley shaft 4084. The guide rod 4086 is slidable relative to the housing 4402, and is configured to guide the movement of the pulley 4408. The guide rod 4086 is generally parallel to a rotational axis 4821 of the drum 4406, hence the pulley movement mechanism 4080 allows the pulley 4408 to move relative to the drum 4406 along the guide rod 4086. Further, the pulley movement mechanism may include a support rod 4088 and a biasing element 4082 for biasing the pulley 4408 towards a balance position.

[00114] Referring to Figs. 16A to 16D, drum 4406 includes grooves 4062 disposed on a spooling surface for receiving cable 4500 to form adjacent windings 4064 around the drum 4406. Alternatively, the spooling surface of the drum 4406 may be smooth and the cable 4500 forms adjacent windings 4064 via tension in the cable 4500. Fig. 16A shows the pulley 4408 in an original balance position where the pulley 4408 remains

stationary. The pulley assumes the original balanced position which is force-balanced between the load (i.e. weight of carriage, user, etc.) and the biasing element 4082. As the drum 4406 rotates to wind the cable 4500 thereon, the cable 4500 forms a plurality of adjacent windings 4064 around the drum 4406, to pull the carriage 4200 towards and
5 inclined upward position. The adjacent windings 4064 form up in a traverse winding direction 4418 which is generally parallel to the rotational axis 4821 of the drum 4406. As the drum 4406 winds the cable 4500 forming the adjacent windings 4064, as the pulley 4408 is within the path of the cable 4500, the cable 4500 exerts a force on the pulley 4408, urging the pulley 4408 to move in a direction 4420 parallel to the traverse winding direction 4418
10 along the guide rod 4086. This causes the pulley 4408 to be displaced in tandem with the winding of the cable 4500, and consequentially overcoming the spring force of the biasing element 4082, to move in the direction 4420, to establish new balanced positions 4408a.

[00115] Figs. 16E to 16H in conjunction with Figs. 16A to 16D illustrate the
15 unwinding of cable 4500 off the drum 4406. As the drum 4406 rotates to unwind the cable 4500 off the drum 4406 to release the cable 4500, the adjacent windings 4064 unwinds in a traverse unwinding direction 4419. As the unwinding process moves the cable 4500 away from the pulley 4408, the pulley 4408 is urged by the biasing element 4082 of the pulley movement mechanism 4080 to move in direction 4421 parallel to the traverse unwinding
20 direction 4419 back to the original balanced position.

[00116] Fig 16A illustrates a fleet angle 4822, which is defined by the angle
between the cable 4500 and a neutral axis 4417 of the drum 4406. The neutral axis 4417 is generally perpendicular to the rotational axis 4821 of the drum 4406 and is defined as a
25 fixed reference geometry for determining fleet angle. According to engineering standards, a large fleet angle 4822 is a compromise on safety due to possibility of cable slipping. However, on the flip side, a small fleet angle 4822 will often require a larger distance between the drum 4406 and the pulley 4408 thus resulting in a larger spatial requirement. Referring again to Figs. 16B to 16D, as the adjacent windings 4064 form, the movement of
30 the pulley 4408 in direction 4420 establishes new balanced positions 4408a, with reduced fleet angles 4822a between the pulley 4408 and the drum 4406. The fleet angles 4822a are smaller in comparison to fleet angles 4822b (dashed arrows) of a stationary pulley 4408b. Hence, the pulley movement mechanism 4080 achieves the dual advantage of reduced fleet

angle and a reduced spatial requirement. The same reduction in fleet angle is maintained during the unwinding of the adjacent windings 4064, as shown in Figs. 16E to 16H whereby the fleet angle 4822a is reduced due to biasing element 4082 urging the movement of the pulley 4408 along direction 4421.

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[00117] As illustrated in Figs. 17, 18A to 18H, an alternate embodiment of the actuation assembly is shown. Fig. 17 shows a pulley movement mechanism 5080 comprising a pulley 5408 and biasing element 5082. Fig. 18A shows a pulley 5408 in an original balanced position where the pulley 5408 remains stationary, the pulley 5408
10 assumes the original balanced position which is force-balanced between the load (i.e. weight of the carriage, a user, objects, etc.) and the biasing element 5082 of the pulley movement mechanism 5080. Referring to Figs. 18A to 18D, conversely, as the drum 5406 rotates to wind the cable 5500, the biasing element of the pulley movement mechanism 5080 urges the pulley 5408 to move in direction 5422 parallel to the traverse winding direction 5418.
15 Similarly, the pulley 5408 establishes new balanced positions 5408a as force balances between the cable 5500 and the biasing element 5082 during winding.

[00118] Now referring to Figs. 18E to 18H in conjunction with Figs. 18A to 18D, as the drum 5406 rotates to unwind the cable 5500 off the drum 5406 to release the
20 cable 5500, the cable 5500 urges the pulley 5408 to move in a direction 5423 parallel to the traverse unwinding direction 5419 along the guide rod (not shown), in tandem with the unwinding of the cable 5500. In the process, the pulley 5408 overcomes and biases against the biasing element 5408 of the pulley movement mechanism 5080 to move in the direction 5423. Similarly, due to the movement of pulley 5408, the fleet angle 5822a between the
25 pulley 5408 and the drum 5406 is reduced in comparison to fleet angle 5822b of a stationary pulley 5408b.

[00119] Transport carrier 40 further includes a support frame 4100, a carriage 4200 and a pedal actuation assembly 4260 as illustrated by Fig. 19A to 20B. The carriage
30 4200 includes groove wheels 4223 mounted to the bottom of the carriage 4200. The groove wheels 4223 are configured to cooperate with a guide member such as a rail 4302 disposed on support frame 4100 to guide the carriage 4200 movement between the first and second position. The pedal actuation assembly 4260 is configured for folding and unfolding the

pedal 4232 relative to the support frame 4100. The pedal actuation assembly 4260 includes a pedal actuator such as a linear motor 4263, a connector such as a rigid shaft 4269 coupled to the linear motor 4263, a mechanical hard stop 4237 for the pedal 4232 and a flexible chain 4267 coupled between the rigid shaft 4269 and an anchor 4239 formed on the pedal 4232. The flexible chain 4267 converts a linear movement in the rigid shaft 4269 to a rotational movement of the pedal 4232 by overcoming the spring force of the biasing element 4236.

[00120] The pedal actuation assembly 4260 may further include contact sensors 4668/4669 configured to detect the relative position of the pedal 4232 through monitoring various parameters such as the position, displacement, velocity, acceleration, etc. of the rigid shaft 4269.

[00121] A transport carrier 40 may include a safety assembly 4240 as illustrated by Fig. 21A, 21B and 21C. The safety assembly 4240 comprises a plate member 4242 fixedly coupled to the sleeve 4220, a pawl member 4244 pivotally coupled to the plate member 4242 about pivot 4244a, a lever member 4246 pivotally coupled to the plate member 4242 about pivot 4246a, a compressive biasing member 4247 coupled between the plate member 4242 and the lever member 4246 to provide damping to the carriage when the actuation assembly pulls on or releases the cable, and a biasing member 4248 coupled between the pawl 4244 and the lever 4246.

[00122] With reference to Fig. 21A and 21B, during normal operation, the cable 4500 is coupled to the lever 4246 provides a pulling force to the carriage 4200 in a direction 4810. The pulling force provided by the cable 4500 compresses and overcomes the spring force of the biasing member 4247, rotating lever member 4246 relative to plate member 4242 in a rotating direction 4820 about a pivot 4246a. As the biasing member 4247 is compressive in nature, the biasing member 4247 acts as a damper to the pulling force applied by the cable 4500, hence preventing the carriage 4200 from jerking during the starting or the stopping of movement. A stopping protrusion 4242a of plate member 4242 is disposed to abut against the lever member 4246 to form a hard stop on the lever member 4246, preventing further rotation of the lever member 4246. Consequentially, the rotation of lever member 4246 about pivot 4246a pulls on the biasing member 4248 to urge and

rotate pawl member 4244 relative to plate member 4242 in a rotating direction 4840 about a pivot 4244a. The rotation of pawl member 4244 disengages the pawl member 4244 from the rack 4112 of the support frame 4100. Fig. 21B, illustrates the safety assembly 4240 during the normal operation wherein pawl member 4244 is disengaged from the rack 4112, allowing relative motion between the carriage 4200 and the support frame 4100.

[00123] With reference to Fig. 21C, during a failure or a loss of tension in the cable 4500, the pulling force previously applied to the biasing member 4247 is released. Similarly, the release of pulling force allows the biasing member 4247 to urge the lever member 4246 to rotate in a rotating direction 4830, which is opposite to rotating direction 4820, about pivot 4246a and away from stopping protrusion 4242a. The rotation of the lever member 4246 subsequently urges on pawl member 4244 through the biasing member 4248, resulting in pawl member 4244 to rotate about pivot 4244a in a rotating direction 4850, which is opposite to rotating direction 4840. Consequentially, the pawl member 4244 rotates in rotating direction 4850 engaging the rack 4112 of support frame 4100.

[00124] Figs. 22, 23A and 23B illustrate an alternate embodiment of the pedal actuation assembly 5260. The pedal actuation assembly 5260 is configured for folding and unfolding the pedal 5232 relative to the support frame 5100. The pedal actuation assembly 5260 further comprises a mechanical hard stop assembly 5237. The mechanical hard stop assembly comprises a cylinder 5241, a biasing element 5247 coupled between a first end 5241a of the cylinder 5241 and the support frame 5100, a shaft 5239 disposed in the bore of cylinder 5241 and is moveable relative to the cylinder 5241, and a pair of contact sensors 5245a and 5245b. The shaft 5239 has a biased first end 5239a and a second end 5239b opposite to the first end 5239a. The biased first end 5239a and a first end 5241a of the cylinder 5241 acts as a mechanical hard stop to the pedal 5232 for preventing further movement/rotation of the pedal 5232

[00125] Referring to Fig. 23A, when the pedal 5232 is in the “close” position, the first end 5239a of the shaft 5239 protrudes out of cylinder 5241 and second end 5239b abuts contact sensor 5245a but does not abut contact sensor 5245b, signaling to the controller (not shown) that the pedal 5232 has not reached the mechanical hard stop. When the pedal 5232 is actuated to the “open” position as illustrated in Fig. 23B, the pedal 5232

abuts against the biased first end 5239a of shaft 5239, by overcoming the biased first end 5239a. The pedal 5232 movement pushes the first end 5239a into the cylinder 5241, and hence pushing the shaft 5239 to move relative to the cylinder 5241. Due to movement of the shaft 5239, the second end 5239b abuts against both contact sensor 5245a and contact sensor 5245b, signaling to the controller (not shown) that the pedal 5232 has reached the mechanical hard stop. When more weight is put on the pedal 5232, the first end 5241a of cylinder 5241 acts to prevent further movement/rotation of the pedal 5232. The biasing element 5247 acts as a damping element providing cushioning to the pedal 5232 when it the pedal 5232 hits the hard stop.

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[00126] As used herein, the singular “a” and “an” may be construed as including the plural “one or more” unless clearly indicated otherwise.

[00127] This disclosure has been presented for purposes of illustration and description but is not intended to be exhaustive or limiting. Many modifications and variations will be apparent to those of ordinary skill in the art. The example embodiments were chosen and described in order to explain principles and practical application, and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

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[00128] Thus, although illustrative example embodiments have been described herein with reference to the accompanying figures, it is to be understood that this description is not limiting and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the disclosure.

25

CLAIMS

1. A transport carrier (10), comprising:
 - a support frame (100) mountable along a stairway (60);
 - 5 a carriage (200) movably coupled to the support frame (100), the carriage (200) being movable relative to the support frame (100) between a first position and a second position elevated and horizontally shifted relative to the first position;
 - a cable coupled between the support frame (100) and the carriage (200),
 - 10 wherein pulling of the cable causes the carriage to move towards the second position, and releasing of the cable allows the carriage to move towards the first position.
2. The transport carrier as recited in claim 1, further comprising a drum (406) disposed
15 in and rotatably coupled to the support frame (100), the drum being rotatable relative to the support frame along a first rotational direction to wind the cable around the drum, and along a second rotational direction countering to the first rotational direction to unwind the cable off the drum.
- 20 3. The transport carrier as recited in claim 2, wherein rotation of the drum along the first rotational direction tensions the cable to move the carriage towards the second position, and rotation of the drum along the second rotational direction releases the cable (500) to allow the carriage to move towards the first position.
- 25 4. The transport carrier as recited in claim 3, wherein winding of the cable around the drum moves an unwind segment of the cable along a first linear direction parallel to a center axis of the drum, and unwinding of the cable off the drum moves the unwind segment along a second linear direction opposite to the first linear direction.
- 30 5. The transport carrier as recited in claim 4, wherein the drum is rotatable about a drum axis, the transport carrier further comprise a pulley shaft slidably coupled to the support frame and a pulley rotatably coupled to the pulley shaft and engaged to the cable, wherein the pulley shaft is oriented orthogonal to the drum axis, wherein

winding of the cable around the drum causes the pulley shaft and the pulley to move along the first linear direction, and wherein unwinding of the cable off the drum causes pulley shaft and the pulley to move along the second linear direction.

- 5 6. The transport carrier as recited in claim 5, further comprising a guide rod to which the pulley shaft is coupled, the guide rod being oriented parallel to the drum axis and fixed to the support frame, wherein the pulley shaft is slidable relative to the guide rod (4086) in a direction (4420/4421) parallel to the first linear direction (4418) to vary the position of the pulley relative to the drum.

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7. The transport carrier as recited in claim 6, further comprising a support rod coupled to the pulley shaft and a biasing member disposed between the guide rod and the support frame, wherein the biasing member exerts a force against the support rod to urge the pulley moving towards a balance position.

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8. The transport carrier as recited in claim 2, further comprising a rack coupled to the support frame and a pawl coupled to the carriage, wherein release of the cable causes the pawl to engage the rack to prevent the carrier from moving towards the first position.

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9. The transport carrier as recited in claim 8, wherein tensioning the cable disengages the pawl from the rack, and when the tension in the cable is removed, the pawl engages the rack preventing the carriage to move towards the first position.

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10. The transport carrier as recited in claim 9, further comprising a biasing member (249, 247) to bias the pawl to engage the rack.

11. The transport carrier as recited in claim 10, wherein the biasing member (247) comprises a compression spring (247) abutting against the carriage.

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12. The transport carrier as recited in claim 1, further comprises a pedal (232) pivotally coupled to the carriage, the pedal being pivotable relative to the carriage between a close position (232a) and an open position (232c).

13. The transport carrier as recited in claim 12, further comprises a biasing member (236) to urge the pedal toward the close position.
- 5 14. The transport carrier as recited in claim 13, further comprising a pedal actuator (262) to move the pedal towards the open position.
15. The transport carrier as recited in claim 14, further comprising a connector (268, 269) coupled to the pedal, the pedal actuator drives the connector to move the pedal
10 between the close and open position.
16. The transport carrier as recited in claim 15, further comprises a pedal sensor (2668, 2669) to detect a position of the connector relative to the carriage.
- 15 17. The transport carrier as recited in claim 15, further comprises a proximity sensor (238) coupled to the pedal to detect an obstacle during a movement of the carriage relative to the support member.
18. The transport carrier as recited in claim 1, further comprises a guide member (300,
20 302, 114, 116) coupled to the support frame and engaged with the carriage.
19. The transport carrier as recited in claim 18, further comprising a sleeve (220) coupled to the carriage, wherein the guide member is a rod (300) received in the sleeve.
25
20. The transport carrier as recited in claim 19, further comprising a bushing (224) coupled to the sleeve, and engaged with the rod.
21. The transport carrier as recited in claim 19, further comprising a nipple (226)
30 coupled to the sleeve for providing a lubricant between the rod and the sleeve.

22. The transport carrier as recited in claim 19, wherein the guide member is a rail (302) and the transport carrier further comprises grooved wheels coupled to the carriage and engaged with the rail to guide the movement of the carriage.
- 5 23. The transport carrier as recited in claim 19, wherein the guide member is a channel (114,116) formed on the support frame and the transport carrier further comprises guide wheels (222) coupled to the carriage and engaged with the channel to guide the movement of the carriage.
- 10 24. A transport carrier (10), comprising:
a support frame (100) mountable to a stairway;
a carriage (200) movable along a line of movement (800) relative to the support frame between a first position and a second position elevated relative to the first position;
15 a pedal (232) pivotally coupled to the carriage, the pedal configured to pivot between a close position (232a) substantially parallel to a side surface (102a) of the support frame and an open position (232c) substantially perpendicular to the side surface of the support frame;
an actuating assembly (400);
20 a cable (500) coupled between the actuating assembly and the carriage, the actuating assembly holds the carriage in position through a tension in the cable,
wherein the actuating assembly is configured to pull on the cable to move the carriage towards the second position, and to release on the cable to move the
25 carriage towards the first position.
25. The transport carrier as recited in claim 24, wherein the actuation assembly comprises a rotatable drum (406) configured to pull on or release the cable (500).
- 30 26. The transport carrier as recited in claim 25, wherein the drum is configured to wind the cable forming a plurality of adjacent windings in a traverse winding direction (4418) parallel to a rotational axis of the drum, and the drum is configured to unwind

the adjacent windings in a traverse unwinding direction (4419) opposite to the traverse winding direction.

27. The transport carrier as recited in claim 26, wherein the actuation assembly further comprising a pulley (4408) coupled between the drum and the carriage to maintain tension to the cable.
28. The transport carrier as recited in claim 27, wherein the pulley (4408) is moveable along a guide rod (4086) in a direction (4420/4421) substantially parallel to the traverse winding direction (4418), the movement of the pulley reduces a fleet angle formed between the cable and a neutral axis (4417) of the drum.
29. The transport carrier as recited in claim 28, wherein the pulley is urged by the cable to move (4420) in the traverse winding direction (4418) in tandem with the winding of the cable.
30. The transport carrier as recited in claim 29, wherein the pulley is biased (4082) towards the traverse unwinding direction (4419) such that the pulley moves (4421) in the traverse unwinding direction (4419) in tandem with the unwinding of the cable.
31. The transport carrier as recited in claim 28, wherein the pulley is biased (5082) towards the traverse winding direction (5418) such that the pulley moves (5422) in the traverse winding direction (5418) in tandem with the winding of the cable.
32. The transport carrier as recited in claim 31, wherein the pulley is urged by the cable to move (5423) in the traverse unwinding direction (5419) in tandem with the unwinding of the cable.
33. A transport carrier (10) comprising:
a support frame (100) mountable along a stairway;
a carriage (200) movable along a line of movement (800) relative to the support frame between a first position and a second position elevated relative to the first position;

- a pedal (232) pivotally coupled to the carriage, the pedal configured to pivot between a close position (232a) substantially parallel to a side surface (102a) of the support frame and an open position (232c) substantially perpendicular to the side surface of the support frame;
- 5 an actuating assembly (400);
- a safety assembly (240) coupled between the cable and the carriage, the safety assembly engages the support frame preventing the carriage to move towards the first position when the tension in the cable is removed,
- 10 wherein the actuating assembly is configured to pull on the cable to move the carriage towards the second position, and to release on the cable to move the carriage towards the first position.
34. The transport carrier as recited in claim 33, wherein the support frame comprises a rack (112) and the safety assembly comprises a pawl (244) coupled to the cable,
- 15 wherein the tension in the cable disengages the pawl from the rack, and when the tension in the cable is removed, the pawl engages the rack preventing the carriage to move towards the first position.
35. The transport carrier as recited in claim 34, wherein the safety assembly further
- 20 comprises a biasing member (249, 247) configured to bias against the pawl to engage the rack.
36. The transport carrier as recited in claim 35, wherein the biasing member (247) comprises a compression spring (247) configured to provide damping to the carriage
- 25 when the actuation assembly pulls on or releases the cable.