

Moving Freight with Passenger Shuttle Elevators

Technical Field

This invention relates to moving freight utilizing passenger elevator shuttles of the type in which a passenger cab is transferred between roped elevator car frames and off-hoistway loading/unloading landings and/or between a car frame and landings to another car frame in the adjacent hoistway for carrying freight when not needed for passenger service.

Background Art

In order to extend the use of roped elevator systems beyond the limit imposed by rope weight, so as to serve the needs of hypertall buildings (e.g., over one hundred stories), a recent innovation transfers elevator cabs between the car frames of adjacent hoistways so as to form a multi-hoistway, unitary elevator shuttle, as described in commonly owned, copending U.S. patent application 08/564,754, filed on November 29, 1995. To save time and ensure that the hoistways are utilized fully, provision is made for cabs to pass at transfer floors where the hoistways overlap, one cab traveling upwardly, the other cab traveling downwardly, so that cabs are traveling simultaneously in each hoistway of the shuttle in multi-deck car frames, as disclosed in commonly owned copending U.S. patent applications Serial No. 08/564,703 filed on November 29, 1995; Serial No. 08/588,577, filed January 18, 1986; and Serial No. 08/729,553, filed October 11, 1996. To avoid having idle hoistways awaiting the loading and unloading of passengers, offshaft passenger loading and unloading may be utilized as described in commonly owned

copending U.S. patent application Serial No. 08/565,606, filed November 29, 1995.

In hypertall buildings, it is anticipated that there may be many tens of thousands of occupants during normal business hours. Although such buildings are contemplated as having significant 24-hour population, a large capacity morning up peak and evening down peak shuttle elevator capability is still required. Thus, elevator shuttles in hypertall buildings will carry passengers in horizontally transferable cabs between passenger lobbies which may be vertically separated by, for instance, between eighty and two hundred or more floors, with no passenger service lobbies in between.

Because of the difficulty of traveling to the ground level to seek commercial services, and because of the large support to commercial services which can be provided by the numerous tenants of the highest levels of hypertall buildings, there will be provided significant commercial services at various high levels of hypertall buildings. In addition to restaurants, these services will include retail stores, not only for convenience items, but for staple foods, clothing, home furnishings, appliances, and others, as well. Because every passenger and every item of freight which reaches the upper stories of a building must pass through the lower stories of the building, the amount of space devoted to elevators (called the "building core") can become prohibitively large in buildings that exceed one hundred stories. Therefore, the building core must be used most effectively.

Disclosure of Invention

Objects of the invention include providing efficient and effective use of elevator capacity in

hypertall buildings, and provision of means for readily handling freight in hypertall buildings which utilize horizontally transferable passenger cabs in passenger elevator shuttles.

According to the present invention, the passenger cabs of passenger elevator shuttles which can be transferred horizontally between adjacent car frames and between passenger landings and car frames, are removed from the car frames when the shuttles are not needed for passenger service, and freight containers are transferred onto the elevator shuttles for transferring freight from low levels of a building to high levels thereof within the hoistways of the passenger elevator shuttles. According further to the invention, freight containers are transferred off the car frame of the elevator shuttle at freight landings on levels in which the freight is to be delivered, the car frame returning downwardly to receive additional freight containers for upward travel to additional freight landings.

In still further accord with the present invention, ballast weights may be transferred onto car frames as freight containers are transferred off, thereby to provide balance so as to not exceed the load or traction capabilities of a roped elevator system. This aspect of the invention may be used with single deck elevator car frames, or multi deck elevator car frames, which include double deck car frames and triple deck car frames, as well as extra deck car frames of the type described in the applications referred to hereinbefore.

According further to another aspect of the invention, a multideck elevator system has one of the passenger cabs removed therefrom when the shuttle system is not being utilized for passenger service,

the other deck is alternatively empty or either carrying a full freight container upwardly or carrying an empty freight container downwardly.

By using suitable rope wrapping at the sheave and a traction machine with sufficient capacity to handle the unbalanced load of the elevator counterweight, the invention may be practiced by moving car frames which carry full or empty freight containers alternately with being empty.

In accordance with the invention, full freight containers are carried upwardly in the building during the early night time (evening) hours, and empty freight containers are carried downwardly in the building during late night time (early morning) hours.

Other objects, features and advantages of the present invention will become more apparent in the light of the following detailed description of exemplary embodiments thereof, as illustrated in the accompanying drawing.

Brief Description of the Drawings

Fig. 1 is a partially sectioned, partially broken away, simplified, stylized, schematic perspective view of an elevator shuttle system known to the prior art.

Fig. 2 is a partially sectioned, partially broken away, simplified, stylized, schematic perspective view of a shuttle system incorporating the present invention.

Fig. 3 is a partially sectioned, partially broken away, simplified, stylized, schematic perspective view of a shuttle system of the invention, illustrating further details.

Fig. 4 is a simplified side elevation view of a car frame exchanging an elevator cab and a ballast weight.

Fig. 5 is a simplified, partially broken away side elevation view of horizontal motive means for moving cabs, freight containers, and ballast weights between mutually adjacent car frames, as well as between landings and car frames adjacent thereto.

Fig. 6 is a partial, simplified side elevation view of a double deck car frame with a freight container in the lower deck.

Fig. 7 is a partial, simplified side elevation view of a double deck car frame with an empty lower deck.

Best Mode for Carrying Out the Invention

Referring now to Fig. 1, a plurality of shuttle elevators are shown within a horizontal and vertical passenger transport system of the type described in commonly owned copending U.S. patent application Serial No. (Attorney Docket No. OT-2933) filed on November 14, 1996. A system of lower elevator shuttles 10 include upper hoistways 11 which overlap with lower hoistways 12 at a transfer floor 13, at which elevator cabs can be transferred from the car frame in one of the hoistways 11, 12 into the car frame of the adjacent one of the hoistways 12, 11. The hoistways extend from a horizontal transport level 16 past a ground floor lobby level 17 and upwardly to a floor 18 at which cabs can be transferred either to an upper shuttle system 19 or to a horizontal transport pathway 20. The horizontal transport level 16 includes a pathway 23 along which cabs can be moved so as transfer passengers to another part of this building or to another building in this complex. The

passenger lobby level 17 includes elevator cab landings 24, 25 onto which passenger cabs may be transferred to allow access of passengers between passenger cabs and the lobby level 17, through hoistway doors 26, 27. The elevators 19 may comprise local elevators or express, shuttle elevators. The pathway 20 may serve other banks of elevators or simply carry passengers to stations on the floor 18. It is contemplated that the floors 17 and 18 may be separated by well over 100 floors, such as between 120 and 250 floors. On the other hand, similar systems may have the floors 17 and 18 separated by a lesser number of floors, on the order of 50 or 80 floors, with no passenger transfer lobbies on any of the intervening floors. As used herein, the term "passenger transfer lobby" does not include emergency exit doors, which might be provided along the shuttle elevator hoistways to allow passengers egress during an emergency, while not permitting passenger transfer during normal elevator operation.

An embodiment of the invention shown in Fig. 2 provides a freight landing 30 having hoistway doors 31 to provide access to a commercial business on a floor 32. The floor 32 does not have passenger service provided by the lower shuttle elevators 12; instead, passengers are provided service to floor 32 by other, local elevators (not shown). The landing 30 is shown extending to two of the shuttle elevators, which may be preferred to ensure that freight service can be provided even though one of the elevators is inoperative.

In Fig. 2, the upper shuttle elevators 11 are shown provided with a double deck freight landing 36 having decks 37 and 38 at which freight containers may be placed in order to service commercial businesses on

corresponding floors 39, 40 through related hoistway doors 41, 42. The double deck landing 36 might be utilized for a two-story department store, or in association with a two-story mall, serving a number of commercial businesses. The shuttle systems of Figs. 1 and 2 are illustrated as utilizing single deck with single deck passenger landings as would be used with single deck car frames (not shown).

Referring now to Fig. 3, a shuttle elevator system 47 utilizes elevator car frames 48 having two decks 49, 50. A ground level passenger transfer lobby complex includes lower passenger cab landings 52, 53 having hoistway doors 54, 55 that lead to lower passenger lobbies 56, 57. The ground level passenger transfer lobby complex also includes upper passenger cab landings 60, 61 having hoistway doors 62, 63 that provide passenger access to upper passenger lobbies 64, 65.

Below the lobbies 56, 57 there is a freight receiving area 68 and a passenger cab parking area 69; these areas may be on a level 70 which may also serve as a horizontal transportation level. Although only one passenger cab 71 is shown in Fig. 3, more than one passenger cab may be offloaded from a multi-deck car frame, such as the double deck car frame 48, in the night time hours when the shuttles 47, or some of them, are not needed for transport of passengers. Freight may be removed from a truck 72 and loaded into a freight container 73, which may thereafter be exchanged for the passenger cab on the deck 49 (or alternatively, the deck 50) of the car frame 48. The freight may, however, arrive from some remote point on a horizontal transport facility, such as described in said application Serial No. (Attorney Docket No. OT-2933), instead of by truck. The freight container 73

may then be raised on the car frame 48 to a floor 76 where a commercial business is to receive the freight through the hoistway doors 77 leading to a freight landing 78. Opposite the freight landing 78, there is a ballast landing 79 with a ballast weight 80, in accordance with one embodiment of the invention, parked in readiness to be utilized to counterbalance the car frame 48. As seen in Fig. 4, when the car frame 48 comes to rest with its platform 49 aligned with the landings 78, 79, the freight container 76 will be transferred onto the landing 78 at the same time that the ballast weight 80 is transferred from the landing 79 onto the car frame 48. The mechanism for transferring the cabs, the freight containers, and the ballast weights 80 may take any suitable form, which may however be of the type described in commonly owned copending U.S. patent application Serial No. 08/663,869, filed on June 19, 1996, as described briefly with respect to Fig. 5.

In Fig. 5, the bottom of the container 76 has a fixed, main rack 83 extending from front to back (right to left in Fig. 5), and a sliding rack 84 that can slide outwardly to the right, as shown, or to the left. There are a total of four motorized pinions on each of the car frame platforms. First, an auxiliary motorized pinion 85 turns clockwise to drive the sliding auxiliary rack 84 out from under the container into the position shown, where it can engage an auxiliary motorized pinion 86 on a landing 87, which is the limit that the rack 84 can slide. Then, the auxiliary motorized pinion 86 will turn clockwise pulling the auxiliary rack 84 (which now is extended to its limit) and therefore the entire container 76 to the right as seen in Fig. 5 until such time as an end 90 of the main rack 83 engages a main motorized pinion

(not shown) which is located just behind the auxiliary motorized pinion 86 in Fig. 5. Then, that main motorized pinion will pull the entire container 76 fully onto the landing 87 by means of the main rack 83, and as it does so a spring causes the slidable auxiliary rack 84 to retract under the container 76. Auxiliary motorized pinions 88, 89 can assist in moving a cab to the right to a landing 90 and can also assist in moving the container 76 from the landing 90 onto the car frame 48.

To load the container 76 from the platform 87 to the car frame 48, the auxiliary pinion 86 will operate counterclockwise, causing the sliding, auxiliary rack 84 to move outwardly to the left until its left end 93 engages the auxiliary pinion 85. Then the auxiliary pinion 85 pulls the auxiliary rack 84 and the entire container 76 to the left until the left end 94 of the main rack 83 engages a main motorized pinion (not shown) located behind the auxiliary motorized pinion 85, which then pulls the entire container 76 to the left until it is fully on the car frame 48.

The same rack and pinion operation will move the passenger cabs on and off the car frames, landings and storage areas, and will move the ballast weights on and off their parking areas and the storage areas. In Fig. 4, the pinions 86, 88 are omitted for clarity; in Fig. 5, the wheels 96 of the freight container 73 are omitted for clarity.

Operation of an embodiment utilizing ballast weights 80 will have the car frame 48 advance to the position, for instance, shown in Fig. 3 in which its platform 49 is aligned with the receiving area 68 and the cab storage area 69. Then, a passenger cab, such as passenger cab 71, will be offloaded from the platform 49 of car frame 48 and parked, as shown in

Fig. 3, as a container such as container 73 will be loaded on the platform 49. The car frame 48 may then be lowered so as to have the platform 50 aligned with the loading level 68 and the parking level 69, so that another passenger cab can be exchanged for another container of freight. Then the car frame 48 may be raised to a destination, such as the freight landing 78, where the container is offloaded from the car frame 48 onto the landing 78, while simultaneously the ballast weight 80 is loaded from the parking landing 79 onto the car frame 48. The car frame 48 may then go to another floor and exchange the other container for another ballast weight. Then the car frame will return to the position shown in Fig. 3 to remove the ballast weight 80 and load an additional container, such as the container 73. The car frame may then move down and offload another ballast weight in exchange for a freight container. After that, the car frame will again go upwardly in the building to the destinations for the freight and exchange the freight for the ballast weights that are disposed opposite the freight landings, as seen in Fig. 3. This type of operation may continue until all freight has been moved up into the building or until it is time to bring the freight containers back down. The time when the freight container should be brought back down may be determined by workers at the freight landing pressing a hall call button when the freight container is empty, so that the system can move the freight container at its leisure, or the entire system may be on a real timed schedule such that the first freight container which is delivered to a freight landing will be picked up at a set time, and thereafter, the pick up of freight containers will proceed in the same order in which they were initially delivered. Or any

other suitable method may be used. When it is time to bring empty containers down, the last ballast weights which were loaded on the car frames will still be on them. A car frame may then go to any of its related freight landings and pick up the empty freight containers at the same time that the ballast weights are offloaded onto the ballast weight landings such as the landing 79. The car frame will then move to another landing to pick up another empty freight container and offload another ballast weight. Then the car frame will return to the receiving level 68 shown in Fig. 3 to offload an empty freight container, such as container 73 and load the ballast weight which was previously parked in the parking area 69. Then the car frame would be lowered to exchange another empty freight container for another ballast weight. The car frame would then go upwardly to a freight landing where there is an empty freight container, and exchange it with one of the ballast weights, and so forth. In this way, during the early nighttime hours, the shuttle elevators will carry freight upwardly and carry ballast weights downwardly; during the later nighttime hours, the shuttle elevators will carry ballast weights upwardly and empty freight containers downwardly.

The invention may also be practiced, as soon as any empty freight containers are available to be returned to the receiving level, by exchanging a ballast weight for an empty freight container, returning to the receiving level and exchanging an empty freight container for a full freight container, delivering the full freight container by exchanging it for the ballast weight, going to another empty freight container and exchanging the ballast weight therefor, and returning to the receiving area. In other words,

the ballast weights may simply be moved a few floors in the high end of the building rather than carried all the way up and down, once containers become empty and therefore available to be returned to the lower level.

When the last empty freight container that was moved by a particular car frame has been brought to the receiving and parking levels 68, 69, the empty freight container will be exchanged for a passenger cab, such as the cab 71. Then the car frame will move down so as to exchange another empty freight container with the other of its passenger cabs. The car frame is then ready to move up two levels and commence to carry passengers from the ground level passenger transfer lobby complex.

The invention may be practiced in another embodiment in shuttle systems having multiple decks in a manner illustrated in Figs. 5 and 6. Fig. 5 illustrates the car frame 48 as it may be traveling upwardly during the early night time hours delivering the freight container 73 to a freight landing. In this embodiment, the ballast weights 80 are not utilized, and system balance is partially maintained by virtue of leaving one passenger cab 71 on the car frame at all times so as to reduce the difference between the maximum loaded weight (Fig. 6) and the minimum unloaded weight (Fig. 7). Therefore, the size of the traction machine and the nature of roping, while more severe than in the embodiment described with respect to Figs. 3 and 4, is less than would be the case of using a car frame that is totally empty to return to pick up the next freight container. However, the invention can be practiced by simply removing the passenger cabs from the car frame, and then using the car frame to carry loaded freight

containers upwardly in the building and returning empty for subsequent loaded freight containers, as well as for returning empty freight containers downwardly and traveling empty upwardly to retrieve more empty freight containers. This, of course, requires special roping for increased traction to compensate for less car weight, and a larger machine to compensate for the unbalanced pull of the counterweight. This aspect of the invention may be practiced with elevator car frames having two, three, four or more decks, in systems in which some of the decks are not used in each movement of the car frame during normal transport, or in systems which simply carry cabs in all decks at all times. For instance, with triple deck car frames, the invention may be practiced by moving the car frame with one passenger cab, one freight container, and one empty deck in one direction, and moving the car frame with one passenger cab and two empty decks in the other direction. Or the invention may be practiced by moving two freight containers and one passenger cab in one direction and two empty decks and one passenger cab in the other direction. Or the invention may be practiced by moving two passenger cabs and a car frame in one direction, and moving two passenger cabs and an empty deck in the other direction. And of course, this aspect of the invention can be combined with the ballast weight aspect of the invention in any desired fashion.

While the car frame is stationary in the hoistway and ballast weights and/or passenger cabs and freight containers are being exchanged, the car frame may preferably be rigidly locked to the building by suitable car/floor locks, such as those disclosed in commonly owned copending U.S. patent application

08/565,648, filed November 29, 1995. While the ballast weight and/or the passenger cabs and freight containers are being moved on an elevator car frame, or on a horizontal carriage or bogey, they are preferentially locked to the car frame, carriage or bogey, and similarly, when standing at a landing, they are preferentially locked to the landing. The locks may take the form of any suitable cab/car locks, such as those described in commonly owned copending U.S. patent application 08/565,658, filed November 29, 1995, or otherwise.

All of the aforementioned patent applications are incorporated herein by reference.

Thus, although the invention has been shown and described with respect to exemplary embodiments thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions and additions may be made therein and thereto, without departing from the spirit and scope of the invention.

We claim:



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Claims

1. A method of utilizing shuttle elevators, having horizontally moveable passenger cabs and which extend between a lower passenger transfer lobby and an upper passenger transfer lobby separated from said lower lobby by a large number of intermediate floors which have no passenger transfer lobbies, for transporting freight, comprising:

(a) providing a plurality of freight landings adjacent to the hoistways of said shuttle elevators, said landings capable of receiving horizontally-moveable freight containers from elevator car frames which travel to said landings within corresponding ones of said hoistways;

(b) at a first point along one of said hoistways, exchanging a passenger cab on a corresponding one of said car frames for a freight container;

(c) moving said one car frame carrying said freight container to a selected one of said freight landings; and

(d) transferring said freight container from said one car frame to said one freight landing.

2. A method according to claim 1 further comprising:

(e) after said step (d), leaving said freight container at said one freight landing for a period of time for the unloading thereof;

(f) moving said one car frame to a point along said hoistway which is adjacent to another freight container;

(g) then transferring said another freight container onto said one car frame;



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(h) moving said another freight container on said one car frame to another one of said freight landings; and

(i) transferring said another freight container from said one car frame to said another landing.

3. A method according to claim 1 further comprising:

(j) after said step (d), leaving said freight container at said one freight landing for a period of time for the unloading thereof;

(k) moving said one car frame in said hoistway away from said one freight landing;

(l) after said period of time, moving said one car frame in said hoistway to a point adjacent to said one freight landing;

(m) transferring said freight container from said one freight landing to said one car frame;

(n) moving said one car frame along said hoistway to said first point; and

(o) exchanging said freight container for a passenger cab on said one car frame.

4. A method according to claim 1 further comprising:

(p) providing a plurality of ballast weight landings adjacent to the hoistways of said shuttle elevators, there being one of said ballast weight landings for each of said freight landings, each of said ballast weight landings being directly on the opposite side of the related hoistway from the corresponding one of said freight landings;

(q) providing a horizontally moveable ballast weight in each of said ballast weight landings; and



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(r) wherein said step (d) comprises exchanging said freight container for one of said ballast weights disposed in a corresponding one of said ballast weight landings.

5. A method according to claim 4, further comprising:

(s) after said step (d), leaving said freight container at said one freight landing for a period of time for the unloading thereof;

(t) moving said one car frame to a point along said hoistway which is adjacent to another freight container;

(u) exchanging said another freight container for said one ballast weight on said one car frame;

(v) moving said another freight container on said one car frame to another one of said freight landings; and

(w) exchanging said another freight container on said one car frame with another ballast weight disposed on a ballast weight landing opposite to said another freight landing.

6. A method according to claim 4, further comprising:

(x) after said step (d), leaving said one freight container at said one freight landing for a period of time for the unloading thereof;

(y) moving said one car frame in said hoistway away from said one freight landing;

(z) after said period of time, moving said one car frame in said hoistway to a point adjacent to said one freight landing;

(aa) exchanging said one freight container for a ballast weight on said car frame;



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(bb) moving said one car frame along said hoistway to said first point; and

(cc) exchanging said one freight container for a passenger cab on said car frame.

7. A method according to claim 4, further comprising:

(dd) after said step (d), leaving said one freight container at said one freight landing for a period of time for the unloading thereof;

(ee) moving said one car frame in said hoistway away from said one freight landing;

(ff) after said period of time, moving said one car frame in said hoistway to a point adjacent to said one freight landing;

(gg) exchanging said one freight container for a ballast weight on said car frame;

(hh) moving said one car frame along said hoistway to said first point; and

(ii) exchanging said one freight container for another freight container on said car frame.

8. A method of utilizing shuttle elevators having multi-deck car frames, each for simultaneously carrying a plurality of horizontally moveable passenger cabs and which extend between a lower passenger transfer lobby and an upper passenger transfer lobby separated from said lower lobby by a large number of intermediate floors which have no passenger transfer lobbies, for transporting freight, comprising:

(a) providing a plurality of freight landings adjacent to the hoistways of said shuttle elevators, said landings capable of receiving horizontally-moveable freight containers from elevator car frames



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which travel to said landings within corresponding ones of said hoistways;

(b) moving one of said car frames to a first point along a corresponding one of said hoistways with said plurality of passenger cabs therein;

(c) at said first point, exchanging a passenger cab on said one car frame for a freight container;

(d) moving said one car frame carrying said freight container and the remainder of said plurality of passenger cabs to a selected one of said freight landings; and

(e) transferring said freight container from said one car frame to said one freight landing.

9. A method according to claim 8 further comprising:

(f) after said step (d), leaving said freight container at said one freight landing for a period of time for the unloading thereof;

(g) moving said one car frame with said remainder of cabs thereon to a point along said hoistway which is adjacent to another freight container;

(h) then transferring said another freight container onto said one car frame;

(i) moving said another freight container and said remainder of cabs on said one car frame to another one of said freight landings; and

(j) transferring said another freight container from said one car frame to said another landing.

10. A method according to claim 8 further comprising:



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(k) after said step (d), leaving said freight container at said one freight landing for a period of time for the unloading thereof;

(l) moving said one car frame with said remainder of cabs thereon in said hoistway away from said one freight landing;

(m) after said period of time, moving said one car frame in said hoistway with said remainder of cabs thereon to a point adjacent to said one freight landing;

(n) transferring said freight container from said one freight landing to said one car frame;

(o) moving said one car frame along said hoistway to said first point; and

(p) exchanging said freight container for a passenger cab on said one car frame.

11. A method according to claim 8 further comprising:

(q) after said step (d), leaving said freight container at said one freight landing for a period of time for the unloading thereof;

(r) moving said one car frame with said remainder of cabs thereon in said hoistway away from said one freight landing;

(s) after said period of time, moving said one car frame in said hoistway with said remainder of cabs thereon to a point adjacent to said one freight landing;

(t) transferring said freight container from said one freight landing to said one car frame;

(u) moving said one car frame along said hoistway to said first point; and

(v) exchanging said freight container for another freight container on said one car frame.



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12. An elevator system for a building, comprising:

- an elevator hoistway in said building;
- a lower passenger transfer lobby adjacent said hoistway;
- an upper passenger transfer lobby adjacent said hoistway, separated from said lower lobby by a large number of intermediate floors which have no passenger transfer lobbies;
- a freight receiving landing adjacent said hoistway at the lower end of said building;
- a freight delivery landing on one of said intermediate floors, said hoistway interconnecting all of said lobbies and landings;
- a car frame vertically moveable in said hoistway between all of said lobbies and landings;
- a horizontally moveable passenger cab;
- a horizontally moveable freight container; and
- horizontal motive means for exchanging said passenger cab on said car frame for said freight container at said freight receiving landing and for transferring said freight container from said car frame to said freight delivery landing.

13. A system according to claim 12 wherein said car frame is a single deck car frame.

14. A system according to claim 12 wherein said car frame is a multideck car frame.

15. A system according to claim 12 further comprising:



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a ballast weight landing disposed directly on the opposite side of said hoistway from said freight receiving landing;

a ballast weight disposed when not in use on said ballast weight landing; and wherein said horizontal motive means comprises:

means for exchanging said passenger cab on said car frame for said freight container at said freight receiving landing and for exchanging said freight container for said ballast weight at said freight delivery landing.