April 3, 1962 E. F. BURTON 3,028,130

CARGO HANDLING MEANS FOR AIRPLANES

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Fig. 1

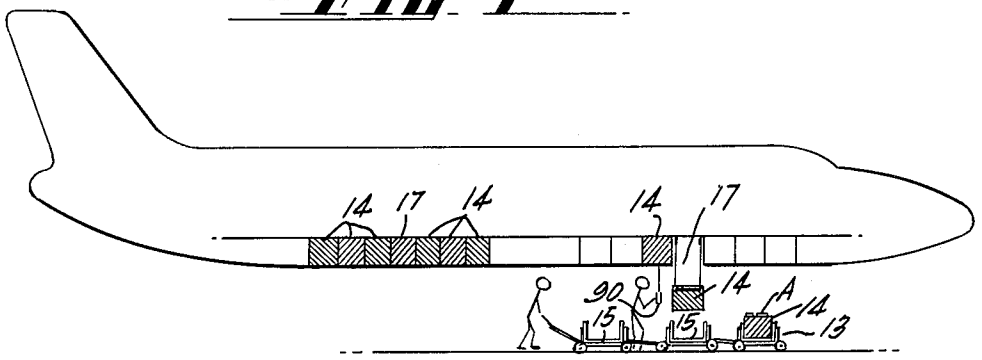


Fig. 2

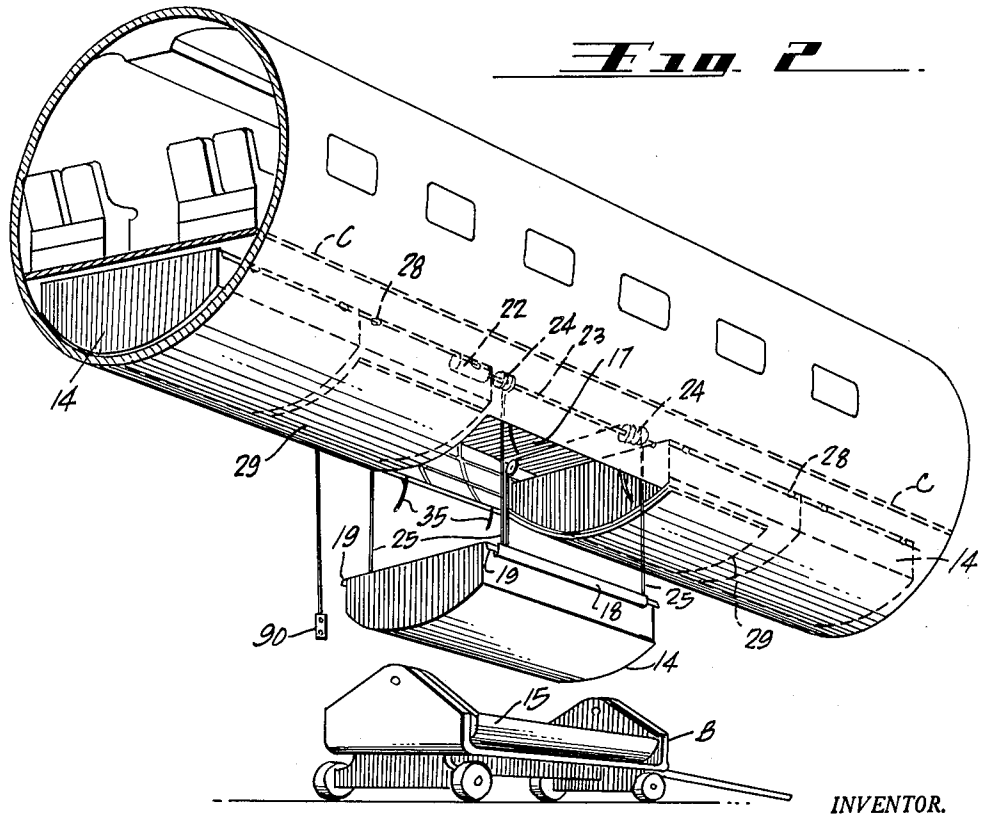


Fig. 3

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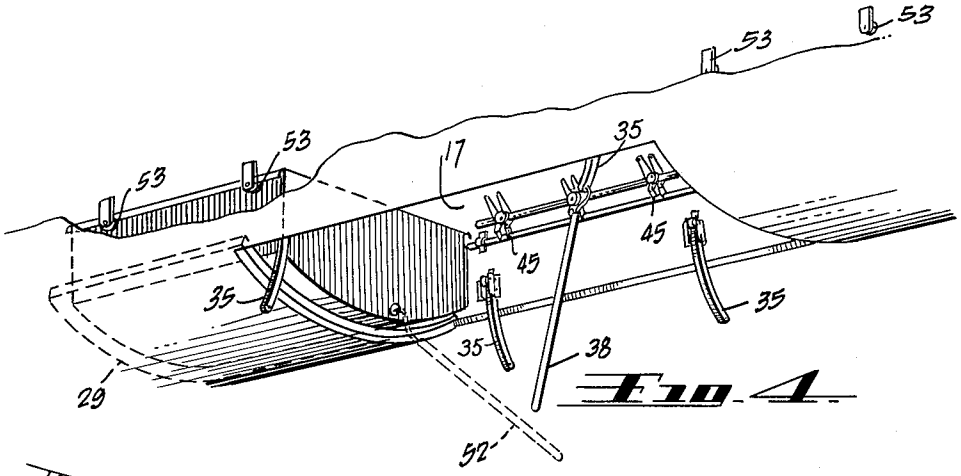


Fig. 4

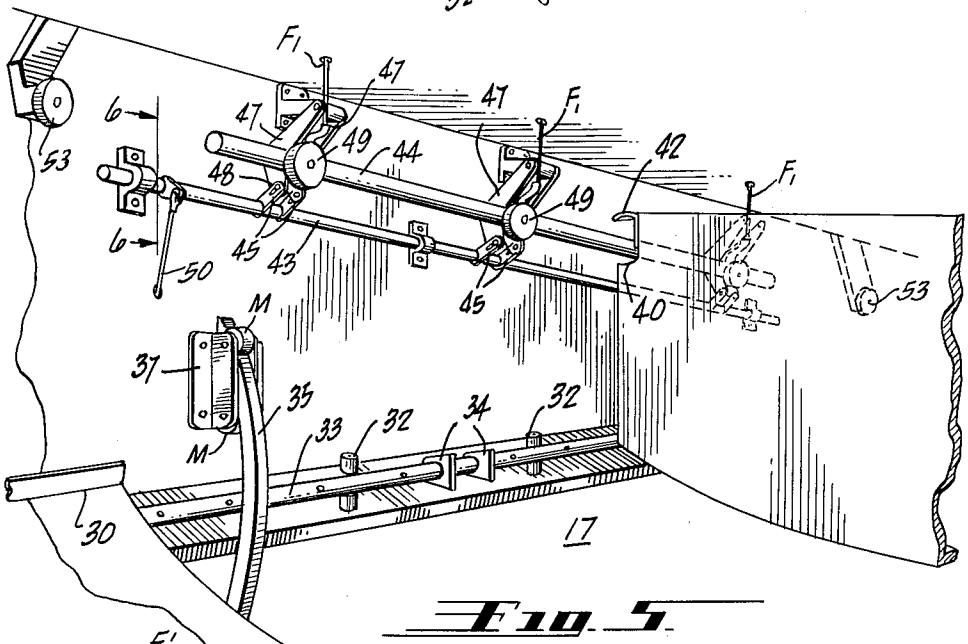


Fig. 5

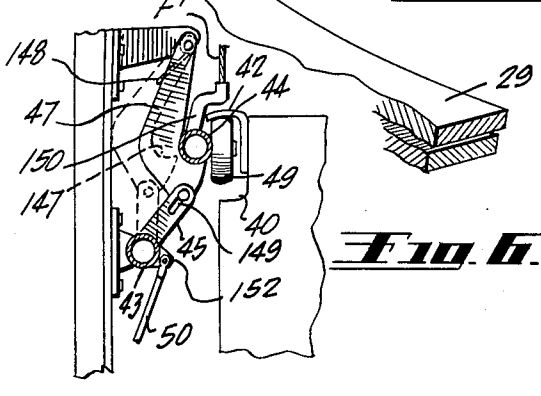


Fig. 6

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CARGO HANDLING MEANS FOR AIRPLANES

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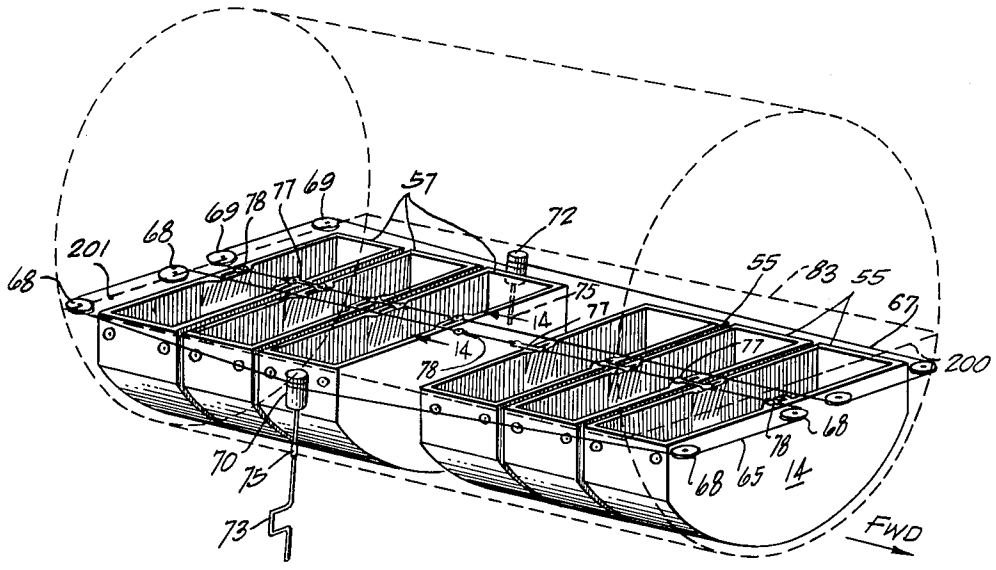


Fig. 7

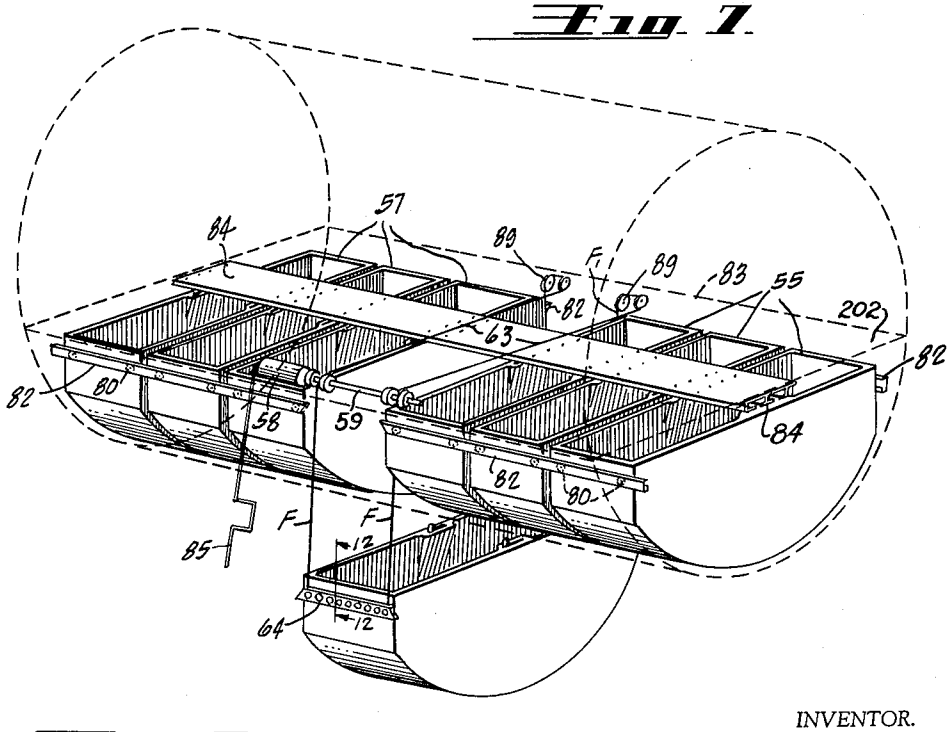


Fig. 8

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CARGO HANDLING MEANS FOR AIRPLANES

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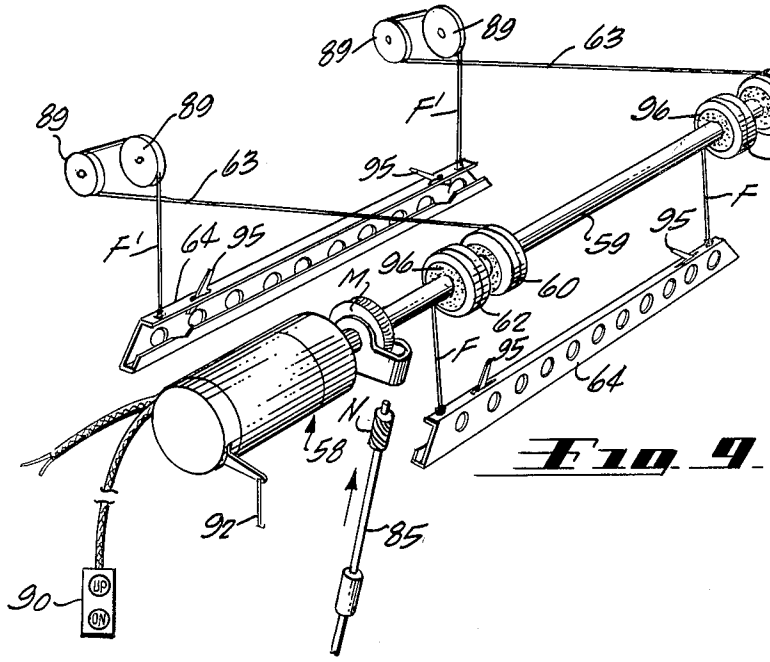


Fig. 9

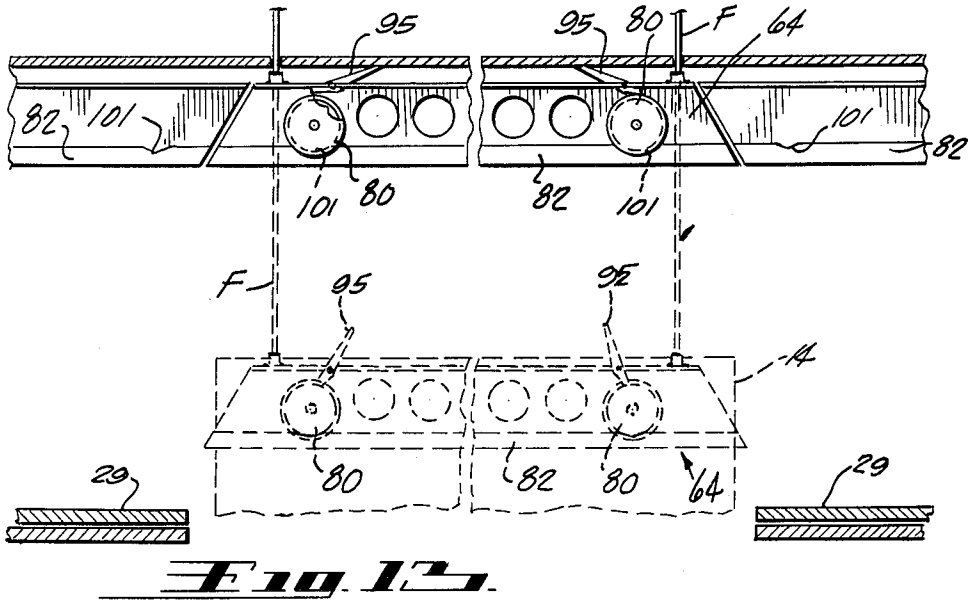


Fig. 12

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CARGO HANDLING MEANS FOR AIRPLANES

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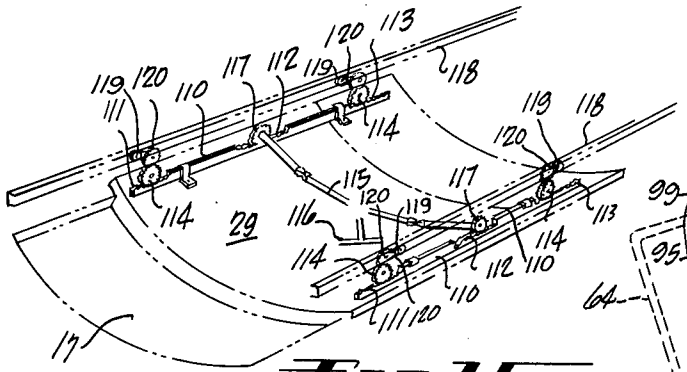


Fig. 15.

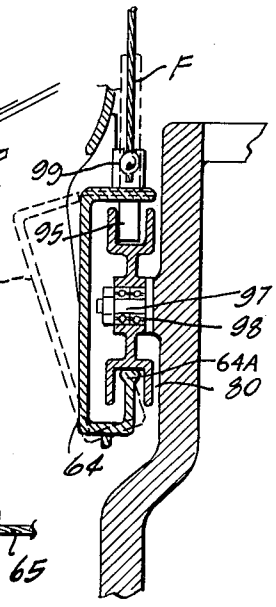


Fig. 12.

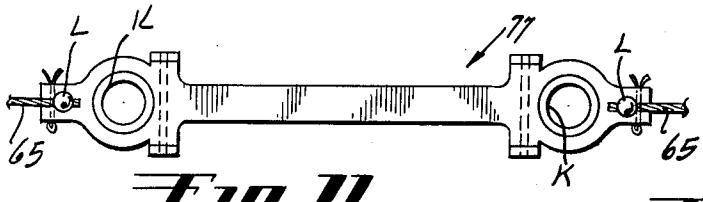


Fig. 11.

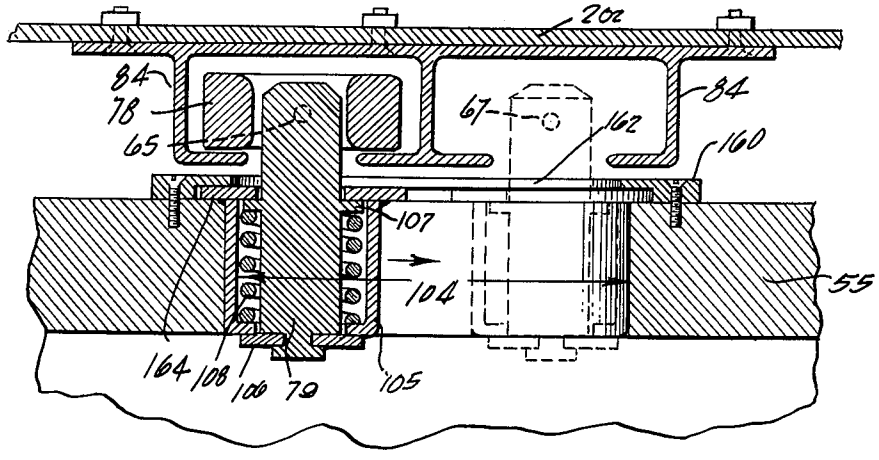


Fig. 14.

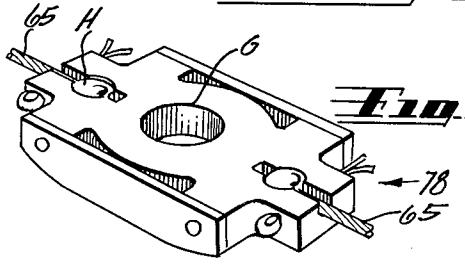


Fig. 10.

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3,028,130

CARGO HANDLING MEANS FOR AIRPLANES

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Filed Nov. 1, 1957, Ser. No. 693,899
10 Claims. (Cl. 244—118)

This invention relates to transport airplanes. Such airplanes may be either of the passenger-carrying type or of the exclusively cargo, or freight-carrying type. In either case, the airplane has an air pressurized cargo-space in the "belly" of the fuselage, occupying the spaces, both forward and aft of the low-mounted wing, that lie between the "main" deck and the lower contour of the belly's skin. This cargo-space usually loosely carries a large number of small, separate items of cargo, such as baggage, air express parcels, "parcels post," etc.

Usually, these smaller items are individually stowed by hand in the cargo space through side-openings therein. More than a little time and labor are required to thus load and unload the belly-spaces of a modern large transport airplane, and the present invention provides methods and means that materially reduce the time and labor required to fill these cargo spaces, no matter how great the number of these individual smaller items may be, within the limits of the volumetric capacity of the belly cargo space or spaces.

Briefly considered, this invention, first, provides, in the forward belly-space, and in the aft belly space, separated longitudinally by the low wing, a belly-skin opening and belly-space compartment which lie substantially centrally of the forward and aft cargo spaces. This opening lies almost completely on the lowermost periphery of the fuselage, thus obviating the usual "side" cargo-openings, and is provided with closure means that streamline into the skin's contour. Forward and aft of this opening, inside the skin, are a plurality of "stations" for a plurality of individual containers or baskets, each carrying a multiplicity of small cargo-items.

These containers are loaded at the loading dock of the departure-airport, rolled to the aforesaid central opening, hoisted by novel means, into same, and translated by novel means, forwardly or aftwardly in the cargo space to their predetermined stations. They are usually arranged to correspond with the order of destination of their contents. The last-hoisted container is of course left in the central compartment, whereafter the aforementioned doors are closed for flight. At the destination airport, the last-hoisted container is lowered first and the others are successively translated in the cargo space from their flight-stowage stations to the central opening therein, lowered through this opening into a pivotally mounted cradle on a cart, and hauled to the unloading dock, where they can be tilted to discharge their contents onto the dock. The means by which the loaded containers at the departure-airport are hauled to a locus underneath the central opening in the cargo-space may also consist of a cart carrying a cradle pivotally mounted thereto at each end of the cradle, each cradle being adapted to receive one of the aforesaid containers or baskets.

Means are provided in the cargo-space for securing the stowed containers in place during flight to prevent their being crushed against each other in stowing or shifting and damaging each other or their contents due to "pitching." Means for setting all the hoisting, container-translating, stowage, latching and unlatching, and closure operating means automatically "in train" may be provided and can be triggered by a "button" or switch in the baggagemaster's station in the airplane.

The invention incorporates certain other features of novel construction consequent upon, or enabling, performance of, the aforementioned novel methods of handling, that is, stowing and unstowing small cargo items for transportation in the belly cargo-spaces of transport airplanes. These novel structural features will either be made manifest, or become apparent, as this disclosure proceeds.

In order to render the inventive concepts more concrete, several embodiments thereof are illustrated in the accompanying drawings and are described hereinafter in conjunction with same, but merely by way of example.

In these drawings:

FIGURE 1 is a diagrammatic view illustrating the novel overall method of the present invention, combining the actions taking place at the takeoff airport and at the landing airport of the transport;

FIGURE 2 is a diagrammatic view taken at the takeoff airport, showing the fore belly cargo-spaces being loaded by the method of this invention, the belly cargo-spaces aft of the wing having previously been loaded;

FIGURE 3 is a perspective, enlarged detailed fragmentary view of a transport fuselage with the aft belly cargo-space being loaded, this cargo space being adapted to contain a plurality of novel cargo-containers, several of which have already been stowed;

FIGURE 4 is a fragmentary perspective view of a modified form of construction of the central loading station of an aft or forward belly cargo-space;

FIGURE 5 is an enlarged fragmentary perspective detailed view of the guide and track mechanism of FIGURE 4;

FIGURE 6 is a fragmentary sectional view taken on line 6—6 of FIGURE 5, sighting in the direction of the arrows;

FIGURE 7 is a phantom, diagrammatic perspective view of a fuselage belly cargo-space, the nose of the craft lying to the right, with all but one container stowed away, taken to illustrate the two cranking mechanisms and the two container-translating systems in a more or less representational manner;

FIGURE 8 is a similar view of this cargo space with six containers therein, taken to show details not feasibly showable in FIGURE 7, such as the container-supporting side-mounted tracks, the cable-and-detent guide tracks, the emergency means for operating the hoist, etc.;

FIGURE 9 is a fragmentary perspective detail of the container-hoisting and lowering mechanism located centrally of the forward or aft belly cargo-space, as the case may be;

FIGURE 10 is a detailed perspective view of one of the cable-carried blocks, called a "slider" block for engaging a lug on the "free" edge of certain containers, not abutted by an edge on an adjacent container, and operable by means of the cable to move the containers away from or toward the central, or "loading," opening in either stowing or unstowing the containers;

FIGURE 11 is a plan view of a double-ended, combined slider-and-spacer link employed in the actuating cables where two containers are in juxtaposition, to engage detent means on the upper edge portion of each of the two adjacent containers in order to stow and unstow the containers in a mutually spaced apart manner so as to prevent damage to the thin-walled containers which would ensue were the cables allowed to continue to move the containers tighter and tighter against each other;

FIGURE 12 is a fragmentary vertical section taken on line 12—12 of FIGURE 8 to show the mode and means by which the containers are engaged by and disengaged from the centrally located hoisting system;

FIGURE 13 is a fragmentary front view of a portion of the container hoisting and lowering system in the cen-

tral portion of the cargo-space, taken to show details of the mode and means of engaging and disengaging the containers with respect to the hoisting and lowering system; details of the means for stabilizing the containers against displacement due to pitching of the airplane, etc.;

FIGURE 14 is a section on line 14—14 of FIGURE 7, taken to show details of the mode and means of shifting the connection between the containers, as they are being loaded into the central space, from engagement with the one of the cable systems, for example, that for loading or unloading the forward cargo space, into engagement with the other cable system, namely, that for loading or unloading the aft cargo space, and

FIGURE 15 is a detailed perspective view of a lifting, guiding and translating arrangement and mechanism for a closure for the central opening in the belly-skin.

The method and basal means of the invention are broadly outlined in FIGURES 1–3, inclusive, and therein, as shown in FIGURE 1, a loading dock 12 is constructed to enable small items of cargo, A, to be readily loaded into a tiltably mounted container or basket 14 adjacent thereto, the container being pivotally mounted on a dolly or cart B, as later described.

The cart, or a train of carts, is then hauled to a position underneath the fuselage, as indicated in FIGURE 2, with the container or containers received in the pivoted cradle 15 of the cart. The container in the "leading" cart is loaded, as later described, through an opening 17 located centrally of the forward or aft belly-space, as the case may be, and conveyed forwardly therein by conveyor means later described. The "trailing" container is loaded last, to occupy the central space, whereafter closure means for the opening 17, later described, are closed and the airplane takes off.

When it lands at the destination airport, shown at the right in FIGURE 1, a cart, or train of carts carrying empty cradles 15, not shown in FIGURE 1, is hauled underneath the fuselage, and the loaded containers 14 are lowered successively into these cradles, starting with the central container. The cart or carts are then hauled into adjacency with the unloading dock 13, all as indicated in FIGURES 1 and 2.

For purposes of exemplifying the principles of the actual stowing and unstowing the baskets, one of the species of the invention is shown in FIGURE 3 in a diagrammatic manner as including, for cooperation with the typical container 14, typical cart B with pivoted cradle 15, a central opening 17 in an aft or forward large belly cargo space adapted to contain several loaded baskets 14. Into and out of opening 17 a pair of channel rails 18 is adapted to be raised or lowered by the powered hoisting, or cables-and-pulleys, system shown diagrammatically. Longitudinally extending along each of the longer sides of each basket are detent means 19 in the form of flanges adapted to be engaged and disengaged by rails 18. It should be understood that the number of containers stowed will depend upon the length of the fuselage and of the cargo spaces, forward and aft of the central opening. This numerical factor is not of prime importance in the execution of the invention.

The hoisting system in this species includes an electric, or other, motor 22 suitably driving shafts 23 bearing pulleys or sheaves 24 over which pass cables 25, all four of the runs of which cables are simultaneously taken up or let out in hoisting or lowering the rails 18 with the basket hooked onto them. A manually operable switch-system 90 is provided for actuating and de-energizing the motor.

When a basket is raised into the central space, 17, it can be manually pushed, forward or aft, into one of the storage spaces shown. To facilitate this storage, rollers 28 may be provided along the inside of the fuselage for cooperation with the flanges 19 on the longer edges of the basket as the latter are pushed longitudinally in the fuselage.

Closure means 29, contoured in conformation with the form of the belly-skin, are suitably mounted in longitudinal attitude inside the skin, and suitable simple and conventional roller-and-track means therefor, as shown, may obviously be provided to facilitate opening and closing these closure means.

The main deck, or floor, of the airplane is indicated at C, and rails 18, in stowed position, rest just below it in parallel contiguity therewith, in the central space 17 until lowered to engage another basket.

A refinement of the basket-stowing and unstowing mechanism which is indicated diagrammatically in FIGURE 3, merely to illustrate the method and principle of the invention, is detailed in FIGURES 4 and 5.

The species shown in FIGURES 4 and 5 provides a number of mechanical features that, combined, render the handling of the loaded containers while inside the fuselage or after they have been hoisted into the central opening 17 considerably more rapid, easy and controlled than the diagrammed generic means shown in the preceding figures. This species of construction also enables securer stowing of the containers in a position and manner that does not materially stress the skin structure of the aircraft.

To these, and other, ends the construction comprises the typical central opening and container space 17 with a pair of doors or obturators 29 therefore which are substantially the same as those previously described, each door 29 having a "bare" or squared off longer, or side, edge 30. To facilitate the longitudinal movement of doors 29, a system of vertical rollers 32 is disposed outwardly adjacent a door-edge supporting track 33, thereby to support and substantially frictionlessly guide and confine these doors. A pair of mutually spaced stops 34 is disposed medially of the track to obviate damage, jamming, etc., of the door edges if they should be slammed hard together in closing-off the opening 17.

To meet the contingency of a container being hoisted up "off center" with respect to opening 17 and therefore failing to register with same and with the tracks, the rollers, etc., or jamming in the "compartment," an outwardly concave, or arcuate, guide 35 is provided in the central compartment at each of the four corners thereof, being mounted to protrude downwardly therefrom at each corner region of the "compartment" opening 17, beside the path of the ascending or descending container so as to contact its sides and "center" it. The four guides 35 are individually bodily movably mounted at their upper ends between a pair of rollers M or other similarly functioning guide means. Rollers M are mounted in brackets 37 mounted to fuselage structure just above the tracks and laterally spaced away from the nearest sides of the containers. Thus, the curved upper end-portions of 35 are movably clamped, as it were, in brackets 37, but, by application of a downward force to the upper end of 35 or of an upward force to the end of 35, it can be lowered for cargo-loading and raised into the fuselage for stowage when not in use. To this end push-pull rods, or actuators, 38, for the guides are provided and are constructed as poles with a hooked upper end, similar to a conventional window pole, to engage a guide 35. By manually pulling down on them, the guides 35 are lowered into the operative positions shown, whereas an upward push of the actuators 38 will raise the guides bodily into stowed position in the central compartment on each of the longer sides of the finally stowed container then occupying the central compartment.

Preferably, in this species, each container is generally semi-cylindric, having flat ends, an open upper face and a lower face cylindrically, or otherwise, contoured to conform to the contour of the inner face of the skin in this cargo space region of the fuselage.

Each of the containers of this species bears means along each of its upper longitudinal edges for enabling disengageable engagement thereof by supporting, guiding and

motion-facilitating means mounted on the fuselage structure and extending longitudinally thereof in juxtaposition to the path of movement of the containers, forward and aft. The first said means may well comprise a groove 40 extending along the upper edge of each longitudinal face of each container, the groove having a recurved engaging and supporting lip or flange 42 thereon.

For cooperation with the groove and lip there is provided, at each side of entrance opening 17 a rod 44 carrying rollers 49. These rods are suspended from the falls F and are connected thereto by gooseneck fittings 150. In the lower position the rods are freely swingable and the rollers 49 can be readily engaged under lips 42, whereafter the falls F are raised until the basket is carried entirely within opening 17.

A series of rollers 53 is fixedly mounted to the inner structure at each side of the compartment in line with the rollers 49 when the latter are in the fully raised position as seen in FIGURE 5. The baskets can then be pushed fore or aft into the compartment, leaving rod 44 and rollers 49 free for use in raising another basket.

Since the last basket to be stowed will remain directly in the central opening 17, it will necessarily rest on rollers 49 during flight. To avoid applying the gravity and shock loads through rollers 49 and rods 44 to falls F during flight, a plurality of bracket means are provided in the form of hook-shaped members 47 pivotally mounted to the compartment structure and having detent portions 147 swingable under and into direct contact with rods 44. Each member 47 is provided with a spring 148 to bias it into the position shown in FIGURE 6. When a basket is raised by the hoisting mechanism, rods 44 cam the hook members out of the way against the spring bias and snap into supported position on the detents 147.

Mechanism to move the hook members out of the way for lowering a basket consists of a rod 43 pivotally mounted at each side of the supporting structure and provided with arms 45 fixed thereto. The free ends of these arms are slotted as indicated at 149 to receive pins in the ends of hook members 47. Each rod 43 is provided with a crank arm 152 which may be engaged by a push rod 50. When the rod 50 is pushed upwardly, rod 43 turns counterclockwise and, through the slotted connection 149, turns hook member 47 clockwise, thus removing it from the path of rod 44.

A hooked-end-push-pull actuator or the like, 52 is engageable with the proximal end-face of each basket in the same manner as a conventional window pole is engaged with a window to facilitate and expedite the forward or aft displacement thereof on the roller system 49 and 53 by an operator standing on the ground underneath the central opening 17.

A further species of the invention is shown in FIGURES 7–14, inclusive. In this embodiment, a group of seven containers or baskets is disposed in an air-pressurized belly cargo-space 200 located either forward or aft of the wing between the floor 201 of the fuselage and the skin thereof. A headlining 202 is provided, as shown.

Three containers 55 are disposed forwardly of a central, loading and unloading, aperature and space, 17 and three containers 57 are disposed aft of said opening, the opening or space 17 also encompassing a stowed container when the cargo space is fully loaded, bringing the number of containers up to the seven, or more, desired. The space 17 is loaded last and with the first container to be unloaded and so on.

In order to raise the containers successively into the central space 17 and successively to lower them therefrom, in loading and unloading the cargo space, hoist means are provided that, for both purposes, include as diagrammatically shown in FIGURE 8 and as illustrated in detail in FIGURE 9, later described, an electric, or other, hoist motor and gear box unit 58, a driving shaft 59 rotated thereby, drums 60 mounted thereon, at opposite sides of the space, force-direction changing pulleys 89, and power-transmitting cables 63 passing around pulleys 89 and enwrapping drums 60 and anchored at one end thereto. The drive shaft 59 also bears drums 62 to which are attached cables, or "falls," F passing around drums 62 and leading downwardly therefrom. Similar falls F^1 constitute the free ends of cables 63.

A pair of similar, laterally spaced track-segments 64 is provided with means for disengageably engaging the containers successively to enable their being hoisted into, and lowered from, central space 17 by the hoist-system aforementioned. Each segment 64 is disengageably engageable with means, shown in FIGURES 12 and 13, provided therefor at the edge of each of the upper portions of the individual laterally elongate, bottom-contoured containers 55 and 57.

Means, or a system, is provided in the cargo space and overlying the containers for translating the containers individually to stowage spaces in the compartment that are located either forward or aft of central space 17, as desired.

For translating the three containers 55 successively to the forward portion of the compartment, the translating system comprises an overhead endless or looped cable 65 lying in a horizontal plane just below the headlining of the cargo-space, and "bent" around guide pulleys 68, being provided with driver means 78, later described, for engaging pins or detents on the top of the containers in order to urge them along. The cable 65 also incorporates combined driver and spacer means 77, also later described, for translating the containers while proventing the successively stowed adjacent containers from accumulatively pressuring the first or second stowed container's rather thin face and edges. That is, means 77 prevent crushing of the containers.

Cable 65 is powered both clockwise and counterclockwise in the horizontal plane by means of a winding drum 70, which can be manually operated by means of a crank shaft 73 protruding through the skin and sealed air-tightly thereto by a pressure seal 75 of any suitable conventional construction. The portion of cable 65 that lies aft of opening 17 bears no "drive" blocks 78 or spacer links 77 and in fact only the forward, central "run," or bight of cable 65 bears such means.

For translating the three containers that are to be stowed aft in the compartment, a similar cable, pulley and slider block and spacer link system is provided and comprises a cable 67 overlying the tops of the aft container-spaces, rotary in the horizontal plane, and bearing drive-links or slider blocks 78 and spacer-and-drive links 77, similar to those hereinabove described. This cable 67 is rotated clockwise in the horizontal plane by means of a manual winding drum 72 and a crank shaft 74 similar to 73, in order to successively disengageably engage the containers as they are successively hoisted into the central opening 17.

By reversing the directions of rotations of the two winding drums, obviously the stowed containers can be successively translated from their stowed positions, forward or aft, successively into the central opening 17. In order to enable selective engagement of any container, in opening 17 with either cable-system 65 or system 67, there are provided shiftable-pin means on the container, shown in FIGURE 14, and later described and cooperative with cable 65 or cable 67, the cables being mounted and guided, respectively, in a double track guide 84. This guide is shown in FIGURE 14 and is hereinafter described in detail.

FIGURE 7 is diagrammatic in that it omits certain auxiliary features, which are disclosed in FIGURE 8. FIGURE 8 shows, among other things, a plurality of container-supporting rollers 80, a pair of rollers 80 being mounted to each end-face or lateral face of each container near the top thereof for engaging rollably in a track 82 mounted in registry therewith on the inside surface of the belly skin, as shown.

In FIGURE 8, to the headlining 202 of the cargo-space, and extending longitudinally coextensively with the center line of the cargo-space is disposed a double-track cable enclosing and guiding member 84, detailed in FIGURE 14, and described hereinafter, for guiding the cables 65 and 67 and supporting the slider-blocks or drive blocks 78 and the spacer-and-driver links 77.

This FIGURE 8 incidentally discloses an emergency crank shaft 85 for use in hoisting and lowering containers successively with reference to the central space 17 in case of failure of the hoist motor, 58.

In FIGURES 9, 12 and 13 the hoisting and lowering mechanism of FIGURES 7 and 8 is disclosed in detail, FIGURE 9 adding to the disclosure of FIGURES 7 and 8, an "up" and "down" switch and conductor path 90 for operating the electric hoisting motor and gear box 58; an emergency brake release arm and cable group 92 organized in the usual manner with the rotor of the motor; rubber centers 96 for the drums 60 and 62 to enable same to accommodate shocks of sudden starting and stopping of the hoisting system and latches 95 mounted pivotally on the upper edges of track segments 64. Latches 95 are pivoted, as shown in FIGURE 9, to members 64 so as to "work" in a vertical plane through the slots shown in 64 and move into and out of the grooved peripheries of the pulley-type supporting rollers 80, thereby to lock the lateral swinging segments 64 to the containers. They are also thereby aligned with the fixed-portions of the container supporting tracks mounted to the inside of the fuselage-skin. The latches 95 are swingable upwardly to release segments 64 from the containers.

The pulley or sheave type rollers 80 are mounted on shafts 97 fixed to the container-sides.

Each segment 64 has its lower edge, 64A, pivotally engaged in the grooved peripheries of the pulley-like rollers 80, so that, when unlatched, the tracks 64 can be swung laterally to enable disengagement from tracks 64 of the containers as they are successively hoisted into, or lowered from, central opening 17. Resilient sockets or grips 99 are provided on the upper edge of track-segments 64 for releasably engaging the lower, headed ends of falls F.

Detents 101, in the form of notches or depressions, are provided in the container-supporting tracks, including segment 64, in order to restrain forward and backward movement of the containers, due to the "pitching" of the airplane, when they have reached their proper stowed positions, and to positively but disengageably immobilize them.

The manual drive group 85 for use in hoisting and lowering the containers with reference to central aperture 17 upon failure of motor 58 is shown in more detail in FIGURE 9 as comprising a worm wheel M spline-connected to shaft 59 for ordinary driving of both by motor-unit 58, the wheel M being disconnectible from the motor to manually drive shaft 59 on failure of the motor. Thereupon, the shaft 85, bearing a worm N is inserted through the yoke shown and into engagement with worm wheel M, whereafter the containers may be hoisted and lowered by hand power.

Details of the drive, or slider, blocks 78 and spacer links 77, as well as of the pins, detents, or lugs 79 on the container tops which 78, 77 respectively engage and disengage in translating and releasing the containers, are shown in FIGURES 10 and 11. The container sliding or translating blocks 78 are two in number and are so disposed on the cables 65 and 67 that they engage pins 79 protruding from the upper surfaces of the innermost and outermost of the three containers 55 and 57. As shown, in FIG. 10, blocks 78 each comprise a central opening G and anchorages H for releasably engaging the ends of sections, "runs," or segments, of cables 65 and 67.

As shown in FIGURE 11, each combined spacer-and-driver link 77 comprises an elongate rigid member having an aperture K at each of its two ends for "taking" over a lug or pin 79 and apertures L to disengageably engage the ends of sections, segments of the cables 65 and 67.

In FIGURE 14, which is a section on line 14—14 of FIGURE 7, the "double-track" arrangement indicated in FIGURE 8, together with cooperative elements thereon, is shown in detail. The purpose of this arrangement is to effectuate engagement of a container with the proper cable system, 65 or 67, as the case may be, according as to whether it is desired to stow an "incoming" container either forwardly of the central space 17 or afterwardly thereof.

Generally to this end, the pin or lug 79 on the top of each container is so constructed and arranged that it can be shifted, on each container, from engagement with the cable lying in one of the tracks of the double track 84 to the cable lying in the other track.

There is but one lug, pin or detent 79 in each such station medially of each of the longer edges of each container and through the top of the container there is a laterally extending slot 104 underlying the double-track 84. Shiftably mounted in this slot is a housing 105 flanged as shown at each end, the top and bottom faces of the housing being centrally perforate. The pin 79 is mounted coaxially of the housing, its upper end extending into one of the tracks to engage either a spacer-and-driver block, or a driver block as shown in FIGURE 14. The lower end of 79 is constricted and is fixed in a plate 106 which is not attached to the lower flanged end of the housing. Medially of the pin is an annular flange 107 and coaxially surrounding the pin between 107 and the lower, housing-flange is a loading spring 108.

Overlying slot 104 is a recessed plate 160 secured to the upper edge of the container, the plate being formed with a slot 162 large enough to admit pin 79 but smaller than flange 164 of the housing 105, so that the plate and the container top combine to provide for limited lateral sliding movement of housing 105.

Thus, the pin, housing, etc., unit can be disengaged from the block on the cable and manually slid laterally in the slot 104 to the position shown in dotted lines, in FIGURE 14, the pin-unit yielding resiliently past the central web of the track when manually pulled downwardly sufficiently to enable it to start laterally. Since this engaging, manual disengaging, and manual shifting of the pin unit is performed in the central aperture, the use of a hand-tool, not shown, to depress and shift the pin-unit is readily feasible. The pin then springs upwardly into engagement with the particular block, 77 or 78, overlying it in the rightward track.

It will be noted that if the pin happens to be left in the center of its mounting slot so that it strikes the central web when the container is raised it will yield under the spring load and prevent damage to the parts.

In FIGURE 15, means and arrangements are shown, partly in phantom, operative in conjunction with a closure 29 for the central aperture 17 in order to move the closure, from its flight-position flush with the belly-skin, to the position, clear of opening 17, which it must occupy during the container stowing and unstowing operations.

The construction shown comprises, mounted to the inner face of closure 29, a pair of racks 110, longitudinally slidable in laterally spaced parallelism, outwardly adjacent the longer edges of 29. Each rack 110 is "toothed" in three spaced locations 111, 112, and 113. Engaging central teeth 112 is a pinion 117, one pinion on each end of a transversely extending U-jointed power shaft 115. Manual power is applied to shaft 115, in either direction, by means of a rotary handle 116 acting through conventional bevel gearing, not shown.

Pinions 114 mounted on fixed pivots on the inner face of closure 29 engage each rack-segment 111 and 113 and lie between each of the longer edges of 29 and each of a pair of parallel, laterally spaced tracks 118. Tracks 118 are fixed to the fuselage, longitudinally coextensive with opening 17 and in fact extend longitudinally beyond

17 a distance equal to the length of the door, so that the opened door 29 may be stowed, open, in these tracks.

In order to raise closure 29 from its position flush with the belly-skin and then slide it clear of opening 17, rollers 119 are provided and are restrainedly movable in tracks 118.

Sector gear unit 120 is also mounted on a fixed pivot on the inner face of closure 29 and in mesh with pinion 114 to be rotated thereby. Roller 119 is mounted on a pivot carried by sector gear 120 near its upper periphery. When gear 120 is rotated by pinion 114, the roller 119 swings downwardly in relation to closure 29 but, since it is restrained in track 118 the net result is to raise closure 29 to clear the structure of the belly-skin.

Thus, by operating the handle shown, closure 29 is first lifted out of co-planarity with the outer surface of the belly-skin, continued rotation of the handle causing the door 29 to rise above the inner surface of the belly skin, after which it can move rightwardly along said track 118.

Obviously, the opening 17 may be closed by two obturators, each like 29, and each provided, on each side of opening 17, with door lifting and translating mechanism similar to that aforedescribed.

Although certain specific shapes, geometrical relationships and parameters have been mentioned by way of concreteness, it is to be understood that the invention does not reside solely therein, being limited in its scope only by the ambit of the sub-joined claims.

I claim:

1. In an airplane having a fuselage with a floor and a belly cargo-enclosure or space between the floor and the belly-skin: means defining an aperture in the skin substantially centrally of the enclosure; hoisting-and-lowering means mounted to the fuselage inside said aperture; a cargo container adapted to be positioned registeringly sub-adjacent said aperture and to fit congruently in a predetermined station in said enclosure when hoisted thereinto; mutually cooperative means carried by the container and by said hoisting-and-lowering means adapted to disengageably engage each other when the container lies sub-adjacent said aperture as aforesaid and when said means are lowered into contiguity therewith; and means for activating said hoisting-and-lowering means whereby to position said container inside said enclosure; and container vertical translation guiding means mounted protractably and retractably to the fuselage adjacent the spatial path of vertical movement of said container and, when protracted, adapted to contact the sides of the so-moving container so as to maintain it centered on said central space.

2. In an airplane having a fuselage with a floor and a belly cargo-enclosure or space between the floor and the belly-skin: means defining an aperture in the skin substantially centrally of the enclosure; hoisting-and-lowering means mounted to the fuselage inside said aperture; a cargo container adapted to be positioned registeringly sub-adjacent said aperture and to fit congruently in a predetermined station in said enclosure when hoisted thereinto; mutually cooperative means carried by the container and by said hoisting-and-lowering means adapted to disengageably engage each other when the container lies sub-adjacent said aperture as aforesaid and when said means are lowered into contiguity therewith; and means for activating said hoisting-and-lowering means whereby to position said container inside said enclosure; and a pair of aligned obturators together constituting closure-means for said central aperture; obturator supporting means, said obturators normally being in endwise contiguity off said supporting means in said aperture with their outer surfaces flush with the outer surface of the belly-skin; and means on said airplane and operable from the ground surface on which the airplane rests for raising said obturators into supported engagement with said supporting means so as to position said obturators for individual movement longitudinally in opposite directions thereby to open the theretofore closed central aperture.

3. In an airplane having a fuselage with a floor and a belly cargo space constituting a compartment between the floor and the belly-skin: means defining an aperture in the skin substantially centrally of the compartment; hoisting-and-lowering means mounted to the fuselage inside the compartment; a cargo-container adapted to be positioned registeringly sub-adjacent said aperture and adapted to fit congruently in a predetermined station in said compartment when hoisted through said central aperture; mutually cooperative engaged-and-engaging means located on, respectively, the container and the hoisting means and adapted to disengageably engage each other when the container lies registeringly sub-adjacent said aperture; first and second sets of container-conveyor means located in the horizontal plane of said compartment sub-adjacent said floor, the first set being constructed, arranged and operable to translate successive containers appearing in the central spaced forwardly in said compartment toward the nose of the airplane and the second set being operable to translate successive such containers aft in the compartment toward the tail of the airplane; means for activating said conveyor means; first and second detent means carried by each conveyor-means in longitudinally spaced relationship thereon for engaging individual containers with the respective conveyor means, the portions of said conveyor means that include said detent-means extending in mutual parallelism and adjacency; and detained-means on the upper surface of each container for disengageable engagement by said detent means, said means on said container being shiftable laterally thereof to be selectively engaged by a detent-means on a selected one of said conveyor means so as to enable conveying of predetermined ones of said containers in a predetermined direction longitudinally of said compartment.

4. In an airplane having a fuselage with a floor and a belly cargo space constituting a compartment between the floor and the belly-skin: means defining an aperture in the skin substantially centrally of the compartment; hoisting-and-lowering means mounted to the fuselage inside the compartment; a cargo-container adapted to be positioned registeringly sub-adjacent said aperture and adapted to fit congruently in a predetermined station in said compartment when hoisted through said central aperture; mutually cooperative engaged-and-engaging means located on, respectively, the container and the hoisting means and adapted to disengageably engage each other when the container lies registeringly sub-adjacent said aperture; first and second sets of container-conveyor means located in the horizontal plane of said compartment sub-adjacent said floor, the first set being constructed, arranged and operable to translate successive containers appearing in the central space forwardly in said compartment toward the nose of the airplane and the second set being operable to translate successive such containers aft in the compartment toward the tail of the airplane; means for activating said conveyor means; first and second detent means carried by each conveyor-means in longitudinally spaced relationship thereon for engaging individual containers with the respective conveyor means, the portions of said conveyor means that include said detent-means extending in mutual parallelism and adjacency; and detained-means on the upper surface of each container for disengageable engagement by said detent means, said means on said container being shiftable laterally thereof to be selectively engaged by a detent-means on a selected one of said conveyor means so as to enable conveying of predetermined ones of said containers in a predetermined direction longitudinally of said compartment; container-supporting and guiding means mounted to the inside surface of the skin area that defines the compartment; said supporting and guiding means extending longitudinally of each side of said compartment laterally adjacent the spaces to be occupied by said containers; and anti-friction means mounted to

each side of each container and adapted to translatingly engage in the adjacent one of said supporting and guiding means; said supporting means being longitudinally segmented at said central space, the segments thereof being longitudinally coextensive with said central space and being fixedly engaged with the hoisting-and-lowering means for raising and lowering in unison thereby; means formed at the lower longitudinal edge of each of said segments for laterally-pivotally engaging same to said anti-friction means on said container; and detent means mounted to the upper longitudinal edge of each of said segments for disengageably engaging said upper edge to said anti-friction means, said detent means on said upper edge being constructed and arranged to be manually releasable from said upper edge so as to enable said segment to be disengaged from said container when the latter is in its hoisted and lowered positions.

5. Apparatus according to claim 3 and in which the first detent means carried by each of said conveyor-means comprises a flat elongate block having a central aperture for engaging around the detained means on the container tops and including means at each end for disengageably engaging the conveyor means carrying said block.

6. Apparatus according to claim 3, in which each of the second ones of said detent means comprises elongate, rigid members each having at each end an aperture for engaging the corresponding detent means on the container tops, thereby to enable translation of the containers mutually spaced apart in the direction that runs at right angles to the adjacent faces of adjacent containers.

7. Apparatus according to claim 3 having container supporting and guiding means comprising elongate, mutually laterally spaced members extending longitudinally of the compartment sub-adjacent the top-edges of the stowed containers, each of said elongate members including a track extending longitudinally thereof; anti friction means on the containers for cooperation with the track; and notches on the upper surface of each track for engaging the anti-friction means on said containers so as to maintain same in stowed position despite pitching of the airplane.

8. Apparatus according to claim 3, in which the laterally shiftable means on the containers comprise a laterally extending slot in the container-top; a housing laterally-slidably mounted in said slot; and a pin resiliently mounted coaxially of said housing and bodily shiftable laterally with said housing.

9. A method of handling the cargo of, or for, an airplane at a loading locus at its departure-point and at an unloading locus at its arrival-point, respectively, comprising: juxtaposing with a loading surface at a landing locus for an airplane, first and second, congruent, cargo-confining means, the first means being discrete from the second means; filling the first means with airplane cargo from said loading surface; translating on the ground the congruent pair of means and disposing them in sub-adjacency to a grounded airplane having an ingress and egress region superadjacent to the so-disposed jutaxposed congruent means; separating the cargo-occupied first means from the second means; translating the separated, filled first means through said ingress and egress region and into the airplane; flying the cargo-occupied airplane to an unloading locus, disposing a third means substantially identical with the second means in sub-adjacent juxtaposition to said ingress and egress region; translating the filled first means out of said airplane through said ingress and egress region, and into congruency with said third means; translating the congruent first and third means on the ground into juxtaposition with a cargo-unloading receiving surface at an airplane unloading locus; gravitationally discharging the contents of the filled first means onto said unloading surface; and sorting and routing on said unloading surface individual items of cargo.

10. In an airplane having a belly cargo-space; an aperture in the belly-skin; hoisting and lowering means mounted inside the cargo-space; a cargo-container adapted to fit in a predetermined station in said cargo-space; a pair of channel-section tracks extending longitudinally of said cargo-space laterally adjacent to the sides thereof; anti-friction rollers on each side of each container each roller being adapted to engage guidedly in one of said channel-section tracks; a separate piece of each of said tracks adapted also to receive and guide said rollers on occasion; said separate pieces being a part of the hoisting-and-lowering means so as to rise and fall with the latter; and disengageable detent means on said separate pieces for engaging said pieces with said rollers so that the container is prevented from inadvertent separation from said pieces; said detent means being relasable from said pieces so as to enable said pieces to be disengaged from a container engaged thereby when the container is in its fully hoisted position and in its fully lowered position.

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