

Dec. 21, 1937.

K. ARNDT

2,102,604

PACKAGE AND PACKAGE HANDLING MEANS FOR AIRPLANES

Filed Jan. 5, 1935.

2 Sheets-Sheet 1

Fig. 2.

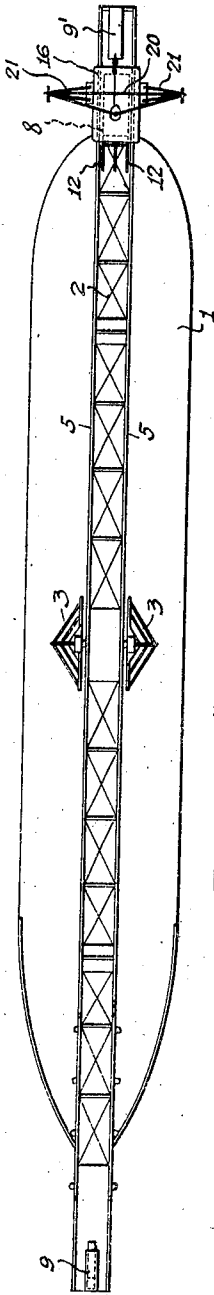


Fig. 8.

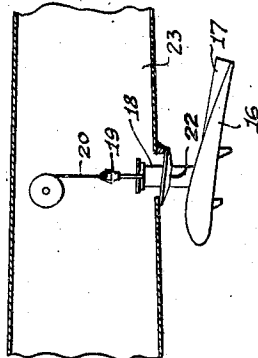


Fig. 9.

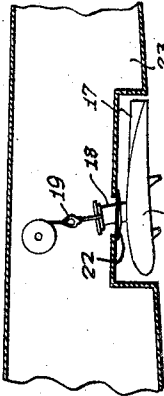


Fig. 3.

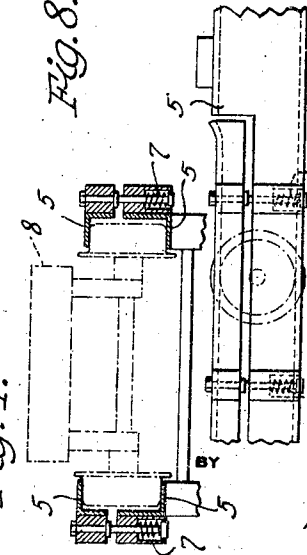


Fig. 4.

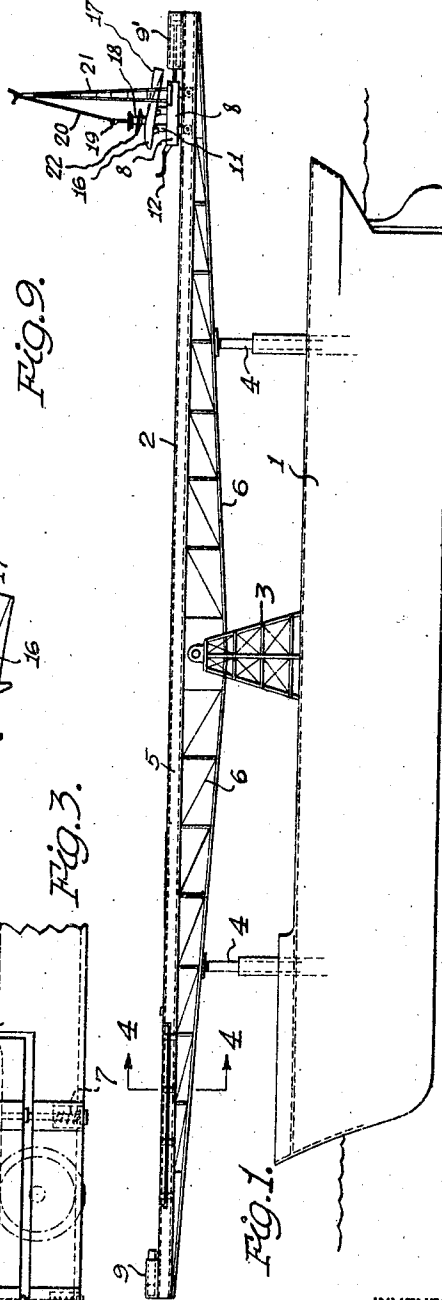
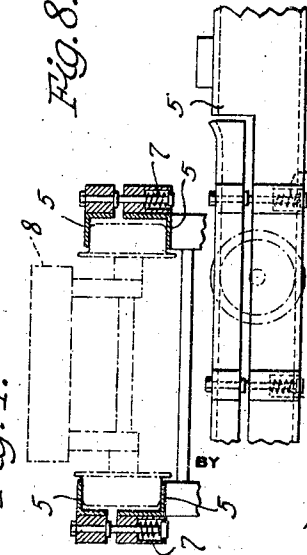


Fig. 1.

INVENTOR

Kurt Arndt,

[Signature]

ATTORNEYS

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K. ARNDT

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2 Sheets-Sheet 2

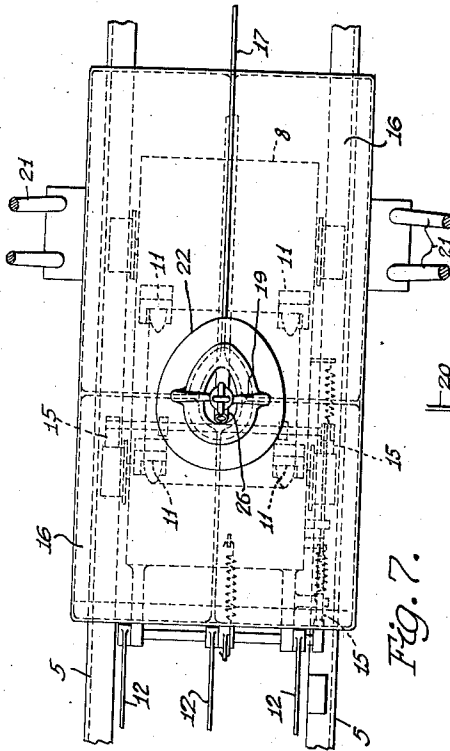


Fig. 7.

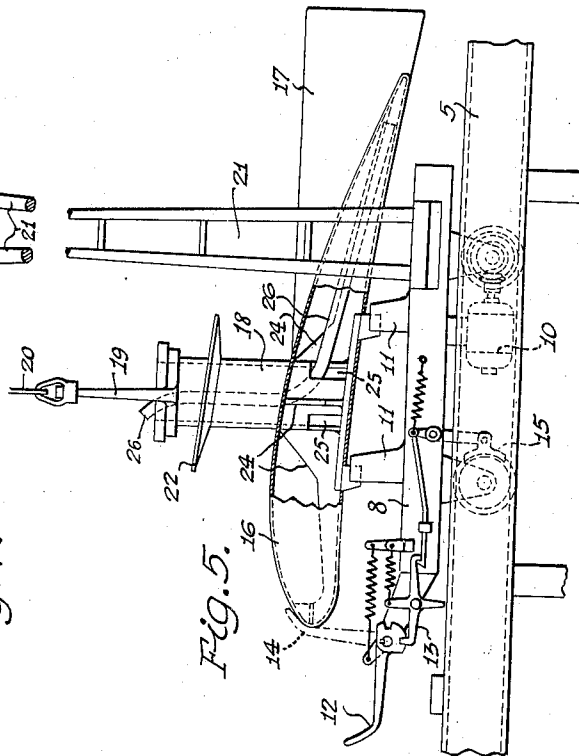


Fig. 5.

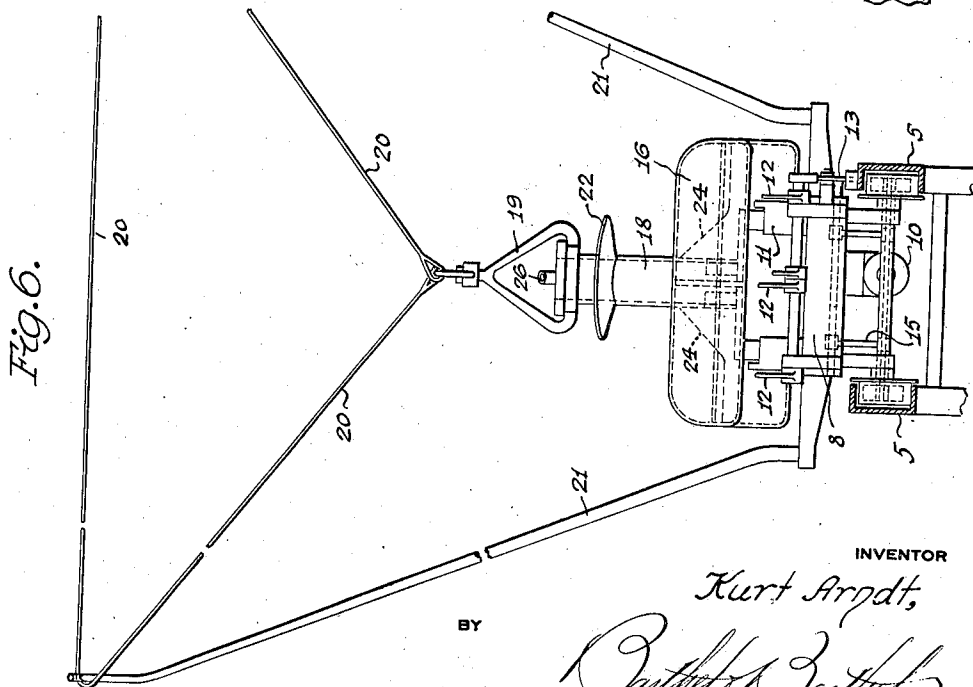


Fig. 6.

BY

INVENTOR

Kurt Arndt,

Carthage & Carthage

ATTORNEYS

UNITED STATES PATENT OFFICE

2,102,604

PACKAGE AND PACKAGE HANDLING MEANS
FOR AIRPLANES

Kurt Arndt, Detroit, Mich.

Application January 5, 1935, Serial No. 493

12 Claims. (Cl. 244—137)

This invention relates to airplane package pick-up or refueling systems and is a continuation in part of my application Serial No. 710,628, filed February 10, 1934, wherein a power car for carrying the package to be picked up, and an elongated rockable runway therefor is shown and described. The broad object of the invention therein described is to eliminate horizontal shock in transferring fuel or other weighty matter to a plane in flight.

The broad object of the present invention is to eliminate the vertical shock in transferring fuel or other weighty material to a plane in flight, the method, apparatus and teachings of the above referred to application being all substantially retained herein with the exception of the shape of the package and the runway package and car stop.

More particularly it is the object of this invention to provide a package to be picked up having the shape and characteristics of an airfoil whereby when sufficient speed is imparted thereto it will support itself in the air.

Another object is to provide a power car for transporting the package along a runway at speed, the package supports being such that the airfoil shape of the package is given an initial angle of incidence similar to that of an airplane wing when taking off.

A further object is to provide means for drawing the airfoil package against or partially within a plane in flight in such manner that it does not create an undue "drag", the pick-up harness including a fixed projection atop the package which is adapted for insertion through the bottom of the airplane fuselage whereby draining of the package may then be accomplished.

Another object is to provide a stop for the car at the end of the runway and a further stop in the form of bumper arms for the package itself in case contact with the plane fails.

Other objects including the method of operating the pickup system will become hereinafter more fully apparent as reference is had to the accompanying drawings, wherein my invention is illustrated and in which—

Figure 1 is a side elevation of a ship equipped with a runway, car and package in accord with this invention;

Fig. 2 is a plan view of the showing of Fig. 1; Fig. 3 is an enlarged detail showing a side elevation of the track brake;

Fig. 4 is a vertical section along the line 4—4 of Fig. 1;

Fig. 5 is a side elevation of the power car resting

on a track section, the package being in place thereon, and the package being broken away for illustrative purposes;

Fig. 6 is a front elevation of the showing of Fig. 5;

Fig. 7 is a top plan view of the showings of Figs. 5 and 6;

Fig. 8 is a diagrammatic partial vertical section through an airplane fuselage showing my improved package or fuel tank fixed thereagainst for draining, and

Fig. 9 is a modification of the illustration of Fig. 8 showing the fuel tank within the contour of the fuselage.

More specifically, 1 indicates a ship having a runway 2 pivotally supported thereabove by a tower 3 and having reciprocable connections with the runway at 4 to cause the runway to rock in counteractance of the pitching of the ship 1, at sea. This runway 2 is a relatively light structure composed of the track rails 5 and bracing 6. The rails 5 are split horizontally toward one end and spring means 7 are provided to draw the upper and lower parts together as illustrated in Figs. 3 and 4 to constitute a brake for the wheels 8 of the car 8. A bumper 9 is also provided at each end of the track, but any other desired form of brake may be substituted without departing from my invention.

The car 8 may, to accord with this invention, be powered in any manner by which it may be rapidly accelerated and then maintained at a substantially constant speed over a substantial length of the runway 2. As illustrated, an electric motor 10 is carried directly by the car and is adapted to be energized upon the approach of an airplane, as for instance in the manner described in my co-pending application Serial No. 710,628, previously referred to. The car 8 has upstanding supports 11 so constructed as to provide a proper angle of incidence for its package 16, as will be described.

The car 8 is also provided with arms 12, spring operated by a trip device 13 to assume the position 14 whereby to retain the package 16 against loss at the end of the track 2 in case contact with the airplane fails for any reason. This trip device 13 may also be suitably connected to the wheel brakes 15.

The package to be picked up is a fuel tank 16 of particular form and construction. The desired shape is that of an airfoil to which is added a stabilizing fin 17. A sturdy projection 18 extending outwardly of the tank 16 serves several purposes. It carries a bracket 19 at its outer end for attachment to a pick-up loop 20 which

is held in expanded position by the fork arms 21 rising from the car 8 whereby the hook of an airplane may engage it. Below the bracket 19 is a flange 22 adapted to find support against the fuselage of a plane 23, as illustrated in Figs. 8 and 9.

The projection 18 extends through the top of the tank, being rigidly secured thereto, for rigid attachment to the bottom of the tank and to bracing partitions 24 thereto in order that there will be no danger from localized stresses. These partitions 24 also serve to prevent surging of the fuel which would tend to upset the equilibrium of the tank in flight. The base of the projection 18 is ported at 25 in order that a hose 26 may be properly inserted into the tank.

The operation is as follows: Upon the approach of a plane flying a course directly above and parallel with the runway 2, the motor 10 is energized, causing rapid acceleration of the car 8 with the tank 16. After the attainment of a speed slightly less than that of the airplane, the speed of the car is constant for a substantial time during which contact by a hook lowered from the plane is made with the loop 20. This speed is insufficient to cause the tank 16 to leave its support,—that is, it will not fly at the maximum speed of the car under power of the motor 10. As the plane overpasses the car and tank, slack is taken out of the line 20 and the speed of the tank 16 is increased to flying speed by the connection with the plane. It will thereupon leave its supporting car and travel with the plane without undue shock in either horizontal or vertical direction. The car 8 will thereafter be stopped by its brakes, previously described, and if connection with the plane fails the container will be stopped also by the arms 12. After the pick up, the container is drawn upwardly by any suitable hoisting means as is well known in the art to a position illustrated in Figs. 8 or 9, the contents drained, and the container released. The airfoil shape makes it possible to drain the contents without taking the container internally of the plane because of the small drag, and this shape also makes it possible to release the package without destruction upon hitting the water (or ground) because of the gliding effect.

The advantages of the system thus described can be readily understood. The airfoil is indicated as designed more particularly for service in re-fueling planes at sea, although it is usable otherwise. In such service, to be practical, the volume of fuel transferred is of considerable amount, so that the weight of the container with its contents—constituting the package to be transferred—is fairly large. It is because of this that the use of an airfoil for the purpose is made possible, since it permits the development of speed conditions on the carrier to a point approaching that of the plane in flight without setting up the lifting action which the angle of incidence of the wings would provide in the absence of a load. Hence, it is possible to support the airfoil on the carrier without any tethering connection between them for preventing lift, and at the same time bring the speed of the carrier to a point approaching that of the plane, prior to the pick-up of the airfoil by the plane. Obviously, therefore, the airfoil, at the moment of pick-up, is advancing at a speed approaching that at which the angle of incidence will become active as a lifting agency, with the result that when the pick-up occurs, the greater speed of the plane will supply the additional speed to the

airfoil sufficient to quickly render the angle of incidence active to set up the lifting effect which transfers the load-supporting function from the carrier to the plane; this is done without material drag due to the fact that the differential in speed between the plane and the airfoil (on the carrier) is comparatively low in value, so that it can be readily absorbed by the plane without shock.

Since the plane pick-up structure is trailing relative to the plane, it will be readily understood that the instant the contact is made and the lifting begins, the weight of the package is then transferred to the plane and made active at the trailing end of a lengthy connecting cable then extending at a trailing angle to the perpendicular. Consequently, when this additional weight is suddenly added to the cable, the tendency would be, if not prevented, for the cable end to advance, under the action of the weight, in the direction of the perpendicular, and since this would also be a movement analogous to that of swinging through an arc, with the result that the swing would tend to lower the package, the extent of the drop depending upon the amount of the advancing swing. If this is not prevented, it would be possible for the load to drop sufficiently to contact with the ground or the sea, as the case may be, unless the pick-up structure were manipulated to take up slack at the instant of pick-up and at a rate equal to that of the development of the drop, an operation that is difficult of control.

The present invention meets the conditions by its airfoil shape. With the speed of the airfoil sufficient to raise it from the carrier, due to the activity of the angle of incidence of the wings, it will be understood that since the airfoil speed is not decreased—it is increased by the forward swing referred to—the angle of incidence activity will continue so that the airfoil takes on, for a short period, the characteristics of a glider; hence, instead of falling at the moment of transfer of load weight, the airfoil becomes momentarily self-sustaining without material drop, so that slack can be taken up rapidly without consideration of the weight, and thus permit the weight to be added to the plane without material shock, even though the weight be of considerable value.

The result is due to the fact that the angle of incidence of the airfoil wings is such that it does not become active as a lifting agency until the pick-up has added the additional speed provided by the plane in flight, but when that speed is attained, the wings themselves serve to support the airfoil similarly to the action of a glider, so that the soaring of the airfoil during this period not only prevents the tendency to fall, but permits taking up of the cable slack to controllably add the weight of the airfoil package to the plane without shock. At the same time, the arrangement permits the reduction in the speed differential between plane and airfoil to a low value so that when the pick-up takes place, no material shock is had, and the speed differential is rapidly eliminated due to its low value at such time. Consequently the load can be transferred without shock and without liability of the load itself setting up hazards by falling after passing from the container, a condition that is of importance in re-fueling operations at sea; should the load fall into the water, it would instantly become a drag upon the plane itself and present the possibility of plane disaster.

What I claim is:—

1. A container having the shape of an airfoil adapted for use with an airplane pick-up system, a stabilizing fin integral therewith, a rigid projection extending from rigid attachment to the bottom thereof through and outwardly of the top thereof, and means associated with said projection by which said container may be picked up by an airplane in flight.
2. A container having the shape of an airfoil adapted for use with an airplane pick-up system, a stabilizing fin integral therewith, a rigid projection extending from rigid attachment to the bottom thereof through and outwardly of the top thereof, a bracket secured to the top of said projection, and a loop secured to said bracket for engagement by a hook dangling from an airplane in flight.
3. A container having the shape of an airfoil adapted for use with an airplane pick-up system, a stabilizing fin integral therewith, a rigid projection extending from rigid attachment to the bottom thereof through and outwardly of the top thereof, partitions internally of said container for preventing surging, said partitions being secured to said projection whereby loading transmitted to said container by said projection is distributed throughout said container and partitions, and a pick-up loop secured to the top of said projection for engagement by a hook depending from an airplane in flight.
4. The combination as set forth in claim 1 wherein said projection is hollow for the reception of a hose therethrough and into said container.
5. The combination as set forth in claim 3 wherein said projection is hollow and laterally ported near its bottom end whereby a hose may be inserted therethrough and into said container between said partitions.
6. In an airplane pick-up system, an elongated runway, a car for said runway, a container of airfoil shape resting on said car at a low positive angle of incidence, means for impelling said car with said container over said runway at high speed, means on said container for attachment to a dangling hook from an airplane during travel over said runway, means for rapidly decelerating said car near the end of said runway, and arms on said car adapted to retain said container on said car during such deceleration in case of failure of attachment by said hook during travel over said runway.
7. In an airplane pick-up system, an elongated runway, a carrier movable along said runway, a container of airfoil shape and including wings and a stabilizing fin with the wings of flight-sustaining characteristic, and supports on the carrier for supporting the container thereon with the wings at an angle of incidence insufficient to cause lifting of the container during advance of the carrier, means for moving said carrier at speeds approaching those of an airplane in flight, whereby differential in speed between container and plane will be rapidly eliminated and such elimination will render the wings active for sustaining flight of the container.
8. A system as in claim 7 characterized in that the carrier includes upwardly projecting arms adapted to removably support a loop connected with the container while the container

is being carried by the carrier, said loop constituting the container pick-up element and adapted to be disengaged from the arms by the action of the plane pick-up structure, whereby the loop is positioned for pick-up throughout travel of the carrier to the pick-up point.

9. A system as in claim 7 characterized by means for bringing the carrier to a stop near the end of the run-way, and means operative to form a barrier against container rise and advance in the event of failure of the plane to provide pick-up connection with the container during such carrier travel.

10. A system as in claim 7 characterized in that the container includes a pick-up connection member integral therewith and extending upwardly from the top of the container immediately over the center of gravity of the container, said member carrying rigid means external of the member and adapted to co-operate with the plane to steady the container when the latter has been raised to the plane following the pick-up operation.

11. In systems for the transfer of packages from a position of rest to an airplane in flight, wherein the plane carries a pick-up mechanism adapted to contact and pick up the package during plane flight, and wherein a package-supporting carrier is movable along a runway at controlled speeds in the direction of the pick-up point, said system including a package partially simulating the fuselage, wings and a stabilizing fin of an airplane and having a pick-up loop adapted to co-operate with the plane pick-up mechanism when brought into co-operative relationship therewith, said package having the angle of incidence of its wings arranged to produce lift of the package from its carrier at a predetermined advancing speed of the package, and means for advancing the carrier with the package thereon in the direction of the pick-up point and at speeds such that as the carrier approaches the pick-up point its speed will approach the predetermined value required to render the angle of incidence active to lift the package to thereby present the package at the pick-up point under conditions where a slight increase in speed will render the wings active to lift the package from the carrier, whereby the package will remain at rest on the carrier during speed accretions of the carrier en route to the pick-up point in providing advancing package speed at the pick-up point approaching that of the plane speed, and whereby the pick-up co-operation between the package loop and the plane pick-up mechanism will provide complete transfer of package support from carrier to plane by the slight differential in speed between plane and package at the instant of pick-up and with the load weight of the package substantially compensated by the activity of the angle of incidence of the package wings.

12. A system as in claim 11 characterized in that the stabilizing fin of the package is rendered active by the transfer of support to the plane and by continued plane advance to thereby supplement the angle of incidence activity of the wings and cause substantial self-support of the package during the succeeding take up of slack and package movement to the plane.

KURT ARNDT.