

The invention relates to a means for loading packages into a cargo hold, more particularly of an aircraft, according to the preamble of claim 1.

Stowage spaces for luggage in small aircraft, for example, are frequently low and disposed in the bottom part of the fuselage and are relatively long in the longitudinal direction of the fuselage. For the purpose of stowing packages such as passengers' luggage, the first articles must be pushed deeply into the stowage space, near to the back wall thereof, after which the stowage space can progressively be filled, starting from the rear wall and up to the charging opening. This is complicated and time-consuming.

To facilitate charging and unloading a cargo hold in an aircraft, it is known from the literature reference SPEEDNEWS dated 1 June 1984 to construct a means according to the preamble of claim 1.

The conveyor in the citation comprises three separate elements which are bent relative to one another so as to adapt to the curvature of the floor of the hold.

The first or main transport element is disposed centrally and horizontally and comprises two traction-resistant belts for winding on to rollers at the rear end of the hold, and a carpet-like transport support which adjoins the belts in front in the direction of flight and can be wound on to a front roller which in the direction of flight is in front of the charging opening. A rear loading wall is disposed at the connecting place between the two belts and the carpet-like transport support and, during the charging process, is movable progressively backwards from a position near the charging opening, the two belts being progressively wound on to their rollers and the carpet-like transport support being progressively unwound from its roller, until finally the rear loading wall is near the rear wall of the hold, and the carpet-like transport support extends over the entire length of the hold.

The second transport element is a carpet-like transport support in the form of an endless belt guided around a front and rear deflection roller, the rear deflection roller being level with the rear rollers for winding the belts and the front deflection roller being level with the front roller for winding the middle transport element, but the belts are inclined relative to their

axes. The second transport element is disposed on the side of the hold remote from the charging opening.

The third transport element is likewise a carpet-like transport support in the form of an endless belt guided around a front deflecting roller and a rear deflecting roller level with the rollers for winding the belts, but is disposed near the rear edge, in the direction of flight, of the charging opening. As a result the third transport element is shorter than the first and the second transport element and longitudinally bypasses the charging opening. The deflecting rollers for the third transport element are correspondingly inclined to the horizontal, so that the horizontal first transport element co-operates with the two lateral second and third transport elements to form a channel having a polygonal cross-section which approximately matches the curve of the floor of the fuselage.

A motor drive for the means is not disclosed by the citation, which mainly consists of drawings. It is assumed, however, that a motor drive is used. Owing to the constructional conditions, the drive can advantageously only engage the rear loading wall and move it, by which means the rear loading wall moves the middle horizontal transport element in reciprocation in such a manner that during movement in the loading direction the belts are increasingly wound on to the rear rollers and the carpet-like transport support is unwound from its roller, and vice-versa during a movement in the unloading direction. The rear loading wall also extends over the transport supports of the two lateral transport elements and is apparently secured to them, so that the drive also drives the endless-belt transport supports of the lateral transport elements.

This known device can be used to stow all luggage or the like near the charging opening without entering the rear parts of the hold, while completely filling the hold and subsequently discharging it correspondingly. However, the known means has a number of serious disadvantages.

For example, when three separate independently-mounted transport supports are used, it is difficult to prevent the luggage being damaged by the gap between the transport elements. In particular there are practical difficulties in constructing the drive. The citation gives no hint regarding the specific construction of

the drive. Furthermore, the luggage is very heavy and the transport support with its heavy load must be pulled against friction over the floor, requiring considerable force. If the force is introduced via the rear charging wall, the wall has to withstand the introduction of very considerable force and therefore has to be specially constructed and guided, but no information is available about this. Drive elements disposed near the rear loading wall will obstruct the hold.

Admittedly the strongest loading occurs on the horizontal middle part of the conveyor, formed by the horizontal transport support of the first transport element. However, a very considerable weight of luggage acts on the rotating lateral belt-like transport supports. Whereas the transport support of the first middle transport element can slide directly on the floor of the hold, so that acceptable sliding conditions can be obtained, the two portions of the lateral endless belts run on one another and move in opposite directions during the loading and unloading process. This results in very considerable friction between the portions of the textile transport support, and these in turn necessitate increased drive forces and result in rapid wear or damage to the side transport supports.

As a result of the slope of the side transport supports, additional lateral forces acting towards the centre occur there, due to the weight of luggage, and tend to compress the lateral transport supports inwards. The resulting folding, in conjunction with the poor sliding conditions, results in friction peaks and a further considerable acceleration in wear and damage to the lateral transport supports.

Probably the most serious disadvantage, however, is that the forces applied by the drive for moving the conveyor have to be absorbed in some way by the aircraft frame. As a result, difficultly controllable forces are introduced into the aircraft frame, resulting in uncontrollable peak loads on load-bearing components and the consequent risk of overloading. This danger occurs not only during loading and unloading on the ground but also in flight, particularly when the hold is only partly filled and consequently the rear loading wall is in a central position in order substantially to prevent the luggage from moving through inertia. Consequently if, e.g.

when flattening out after a rapid descent or during an emergency landing, in which the forces of inertia may amount to one to five times the dead weight, the luggage presses against the rear loading wall, movement of the rear loading wall as a result of these considerable forces must be absorbed by the retaining power of the drive and the support thereof, resulting in a load on the aircraft frame which is similar to movement of the rear loading wall when the aircraft is stationary and when the hold is already partly full.

In any case it is difficult and dangerous, particularly in view of the unfavourable friction conditions, for the extremely powerful driving forces of the conveyor to be absorbed in the aircraft frame, since the frame is a difficult lightweight construction which, in spite of its lightest-possible construction, is subjected to considerable loads owing to the requirements of operation in flight, so that in contrast to conventional kinds of loads, untypical load peaks can result in damage with far-reaching consequences. In the case of other vehicles such as ships or land vehicles, there is perhaps less danger in introducing additional powerful tension peaks into the load-bearing construction, but it is highly undesirable in all cases.

Accordingly the aim of the invention is to devise a means according to the preamble of claim 1 in which the required driving forces are limited and introduction thereof into the load-bearing construction of the vehicle or the like is reduced or completely avoided.

This problem is solved by the operative features in claim 1.

Since the motor drive for the conveyor is disposed in the area of the rear end of the hold, it does not obstruct the useful space in the hold and provides a simple construction for introducing the driving forces via the rollers there for the traction-resistant flexible traction elements such as belts. The rear loading wall itself does not need to be incorporated in the driving train. In the area of the charging opening there is only one deflection on deflection rollers disposed on a guide profile between the upper and lower parts of the transport support, and consequently a drive of the rear rollers can be used both for the loading and for the unloading movement. Since the guide profile is braced by a sliding panel against the

rear drive, the upper and lower parts of the transport support are prevented from direct sliding over one another under load, low-friction sliding of the transport support under load is ensured and also and in particular the load-bearing wall parts of the hold are not stressed by drive forces. In both driving directions, the drive forces are absorbed in the front guide profile and returned via the sliding panel to the drive. The entire loading means is therefore substantially independent (apart from being fastened to the bearing construction of the hold, mainly for securing it in position) since the forces generated by the drive can be at least partly, or if required completely, re-absorbed in the loading means and not transmitted to the external construction. By this means the load-bearing construction of the hold is relieved from all peak loads. Since the traction-resistant flexible-belt traction elements are distributed across the entire width of the hold floor and can be guided on deflecting rolls on the guide profile, which can also be adapted to the shape of the hold, a single continuous transport support extending from side to side can be used, even if the hold floor and consequently the transport support is uneven. The parts of the flexible textile-material carpet-like transport support disposed between the belts are protected from excessive tensile stress by traction elements such as belts which bear the tensile load. The belts or the like can be treated as separate belts during winding, deflection or the like, without adverse effect on material between the belts. The rear rollers on which the belts are wound or deflected can be constructed in any desired manner, since the rollers act only on the belts without intervening textile material, since the transport support between the belts or the like does not come into the area of the rear rollers in any operating position.

The number of belts depends on the transmitted tensile forces, which can be very considerable when conveying a load of e.g. 600 kg per linear metre of cargo-hold surface. Basically therefore the belts are initially uniformly distributed over the width of the conveyor, so that when packages between the belts are pulled, the textile material between the belts is not excessively stressed. Advantageously the belts are made of a non-elastic textile material such as Kevlar; Kevlar is a registered trade mark of Messrs DuPont and stands for aramide fibres (poly(1,4-phenylene terephthalic amide) with extremely high resistance to stretching, high

strength and flexibility. Non-elastic belts avoid appreciable initial stretching under tensile load during transport of material, which would lead to abrupt acceleration of the material on transition from static friction to sliding friction between the transport support and the sliding panel. As a result of the non-elastic construction, every drive movement is converted substantially without delay into a corresponding following movement of the transport support with its load of packages.

The front ends and rear ends of the belts can be wound on to separate rollers, so that each belt end can be released without difficulty from the associated roller so as to dismantle or re-assemble the conveyor. If the belts on each winding and unwinding roller are substantially non-elastic under the loads which occur, however, there is a problem in that when the winding and unwinding rollers are synchronised, the lengths of belt released may vary owing to differences in the roller diameters, resulting in slack portions of belt in front of the transport support, as considered in the direction of pulling, which may cause disturbances in operation and thus require complicated compensation steps.

It is already known from US-A-3 876 089, in the case of a conveyor platform for a vehicle, for the traction elements of the conveyor to be deflected in the area of the discharge opening, the drive for the deflecting rollers being provided at the opposite end. The citation relates to a discharge device for a lorry trailer mainly for transporting bulk material, where the conveyor is in the form of a platform made up of rigid strips which abut or overlap in scale-like manner and form the flat bed, the bulk material being thrown over the rear deflection zone.

Preferably therefore, according to claim 2, the belts, at least with regard to their function, are in the form of endless belts which are deflected by the rollers at the end of the cargo hold remote from the charging opening. In that case there will be no problem regarding change of length due to winding or unwinding rollers. There is therefore no need for compensation steps and it is sufficient, when necessary, to use a spring element such as a spring roller with a short travel stroke for ensuring a desired minimum tension. In that case, however, care should be taken that the drive of the belts at the rollers occurs with minimal

or preferably no slip, so that the roller and the belt comprise positive drive means as per claim 3. To this end, the rollers can e.g. be spiked rollers with projections which engage in corresponding driving recesses in the belt, or alternatively the belt can be toothed at least in the region in contact with the roller, or the roller can be a toothed wheel in known manner. Obviously, the traction element need not be a belt in the narrower sense; it can be a chain or the like, but should be of plastics to save weight.

Particularly preferably, as per claim 4, a rear loading wall is disposed in the belts in the area of the rear end of the transport support, and is moved in reciprocation with the transport support. By this means the stowage space in use is given a defined boundary, and luggage or the like in the rear region of the stowage space can be neatly supported against the rear loading wall. During unloading, the rear loading wall ensures that all the articles in transit are conveyed without mishap. However, the rear loading wall is not essential for the drive.

According to claim 5, a complicated supporting construction introducing additional forces into the belt so as to hold up the rear charging wall can be avoided in that the rear charging wall is prevented from tilting by lateral projecting elements such as arms or walls and by supporting rollers spaced apart across the depth of the hold and running on rails on the side walls of the hold and/or provide support on the floor side against tilting to the rear. In that case the only function of the belts will be to drive the rear loading wall, whereas the wall is held upright directly via rails on the side walls of the hold and/or by the support on the floor.

Half-way during the loading or unloading process the front and rear portions of the transport support overlap behind the guide profile, as regarded in the charging direction. To prevent relative motion of superposed textile material, possibly under very high pressure, while ensuring favourable sliding properties, according to claim 6 the sliding panel adjacent the rear edge of the guide profile extends at least over approximately half the depth of the hold, i.e. over the part in which the portions of the transport support bear on one another. The sliding panel can be made of sheet-metal or similar material, but preferably have a surface of slidable plastics such as

polytetrafluoroethylene (Teflon®)) to save weight and to obtain optimum sliding properties, the sliding panel being made of pressure-resistant material such as carbon fibres with a Teflon surface. The back of the sliding panel abuts the drive, either directly or via suitable pressure connections.

For the purpose of transmitting compressive forces between the guide profile and the drive, according to claim 7 preferably the sliding panel directly supports the guide profile on the side remote from the deflecting edge. This avoids the expense of additional pressure means between the rear edge of the guide profile and the front edge of the sliding panel, which can substantially seamlessly abut the guide profile or can be made integral therewith.

For the purpose of serving as a support, the sliding panel can extend over the entire depth of the hold and be supported approximately on the rear gearbox, without the sliding panel having to be laterally secured for the purpose. Particularly preferably, however, according to claim 8 the sliding panel is fastened to the aircraft-side profiled rails on the side wall of the hold, and can thus act as a support even when it does not extend over the entire depth of the hold or is not otherwise supported at the back. When the guide profile, which is not rigidly supported on the floor of the hold between lateral securing places, is curved and particularly when it is flat, relatively pronounced sagging inevitably occurs when downward pressure is exerted by a load, as is unavoidable when there are packages.

In order to prevent the portion of the transport support being squashed by excessive compressive forces under the aforementioned compressive load, resulting in additional force required for moving the transport support, according to claim 9 in particular a rolling support is provided between the guide profile and the floor of the hold or the portion of the transport support running underneath. Corresponding rollers can be provided on the underside of the guide profile or on the top surface of the floor of the cargo hold or in both places, to prevent any powerful retaining forces from being introduced into the transport support under a pressure load. Also, the sliding capacity of the transport support under pressure on the top surface of the guide profile can be improved by supporting the belts on the top surface of the guide profile on the

aforementioned roller. The important factor is that all supporting rollers must be disposed in those regions, considered across the width of the guide profile, in which the belts run, to avoid introducing additional tensile forces into the textile material between the belts. The respective rollers do not need to absorb supporting forces all the time; they need not reach the supporting position until the guide profile has sagged to a permissible extent.

According to claim 10, the aforementioned supporting rollers on the floor side should always be disposed near, i.e. a relatively short distance behind, the deflecting edge, since a maximum sag of the hold towards the ground, in addition to sagging resulting from the weight of the load, occurs at this place as a result of torsion forces which, particularly at the beginning of an unloading process, are generated by the fact that the tensile forces for moving the entire load have to be deflected at the deflecting edge. This has the same effect as in self-reinforcing compression locking means, where an increased tension results in a correspondingly increased compression or clamping force. Preferably therefore, particularly in the front part, care should be taken to avoid compressing the transport support by pressure exerted by supporting rollers, even under extremely unfavourable loads.

Another result of concentrating the tensile forces on the belts, according to claim 11, is that supporting rollers need only be disposed in the area of the belts near the deflecting edge of the guide profile, in order to provide the belts with a rolling support when deflected. This drastically reduces the friction on the material drawn under pressure around the deflecting edge of the guide profile. In the regions between the belts, the textile material rests relatively loosely on the rounded surface of the deflecting edge; no substantial frictional forces occur, since the tension is concentrated on the belt region.

Any risk of soiling the space under the transport support or penetration of foreign bodies is avoided according to claim 12, in that a shutting device close to and in contact with the transport support is disposed in the area of the deflecting edge, so that this edge region is also protected against penetration of foreign bodies and dirt. The shutting device is preferably in the form of an array of brushes, which have a corresponding self-cleaning effect during

operation of the transport support. A tray can be disposed under the brush array, so that dirt can easily be periodically collected and removed.

According to claim 13, when the floor of the hold or of the transport support is curved, the rollers for guiding the drive-slide ends of the belts are secured to adjacent shafts inclined relative to one another and optionally connected e.g. by universal joints. This is the easiest method of deflecting the belts at the rear, while applying the drive forces.

Other details, features and advantages of the invention will be clear from the following description of embodiments with reference to the drawings, in which:

Fig. 1 is a perspective view of the interior of the bottom part of a vehicle fuselage, comprising a means according to the invention;

Fig. 2 shows a lateral portion of a rail for retaining the guide profile;

Fig. 3, corresponding to Fig. 2, shows a section along line III-III of Fig. 4;

Fig. 4 is a section along line IV-IV in Fig. 3;

Fig. 5 is a view of the retaining plate alone, in the direction of arrow V in Fig. 4;

Fig. 6 is a section along line VI-VI in Fig. 7, on a larger scale than in Fig. 7;

Fig. 7 is a view in the direction of arrow VII in Fig. 6, the transport support being partly cut away for clarity;

Fig. 8 is a larger-scale section along line VIII-VIII in Fig. 1;

Fig. 9, corresponding to Fig. 8, shows a variant embodiment of the invention;

Fig. 10 is a section through the rear loading wall region corresponding to the prolongation of line VIII-VIII in Fig. 1;

Fig. 11 shows a detail from circle XI in Fig. 10 on a larger scale, but without the transport support;

Fig. 12 is a view from the direction of arrow XII in Fig. 11;

Fig. 13 is a diagrammatically simplified section through the bottom part of the fuselage at the level of a rear loading wall of the conveyor;

Fig. 14 shows a detail from circle XIV in Fig. 13;

Fig. 15 is a larger-scale section along line XV-XV in Fig. 13;

Fig. 16 is a sectional view corresponding to Fig. 13 but through the region of the rear end of the hold and showing the drive;

Fig. 17 is a larger-scale section along line XVII-XVII in Fig. 16;

Fig. 18 shows a larger-scale detail from circle XVIII in Fig. 16, and

Fig. 19 is a longitudinal section corresponding to line VI-VI in Fig. 7 through a variant of the invention.

In the drawings, reference 1 denotes an aircraft fuselage, only the bottom part being shown in Fig. 1, the fuselage comprising a lateral bottom loading hatch 2 providing access to a cargo hold (general reference 3).

The cargo hold 3, which in the embodiment is intended for holding luggage in a small passenger aircraft, comprises a work region 4 situated near the loading hatch 2, followed by a charging opening 5 which in the example is formed by the entry cross-section of the hold 3 adjacent the working region 4, and is also formed by an end 6 remote from the charging opening 5 and bounded (not shown) by a bulkhead wall and in the neighbourhood of which a drive 8 is disposed in a casing 7. The drive 8 is for moving a conveyor 9 in reciprocation, the conveyor being adapted to move material delivered in the area of the loading opening 5 stepwise and intermittently from the opening 5 towards the opposite end 6 of the hold 3, so that the low, deep hold 3 can be completely loaded from the working area 4 without the operator having to leave the area 4.

As shown more particularly by a comparison between Figs. 1, 6 and 7, the conveyor comprises traction-

resistant belts 10 which in the area of the drive 8 are wound on rollers 11 as shown in detail in Figs. 16 and 17. In the area of the charging opening 5, the belts 10 are deflected slightly above the floor 14 of the hold 3 on a pin guide profile 13, which has a very low height of 30 mm in the example. The guide profile 13, which is rigidly secured in the area of side walls 15 of the hold 3 in a manner explained in detail hereinafter, has a front deflecting edge 16 for gently deflecting the belts 10 in a narrow space, and thus defines the distance between the deflection of the belts 10 and the drive 8.

In this manner the belts 10 can be pulled in reciprocation by appropriately driving the rollers 11 via the deflecting edge 16 of the guide profile 13, resulting in a corresponding transport movement into or out of the hold 3.

In order to ensure that loaded material such as luggage is entrained during the transport movement, the space between the belts 10 in the place where loaded material can rest is bridged by a carpet-like transport support 18 made of flexible textile material. For improved clarity, in subsequent Figures the carpet-like transport support 18 is sometimes shown as relatively thick when resting on the belts 10, but it should be noted that in reality the transport support 18 can consist of a single layer of nylon fabric, which is sewn to the belts 10 in the overlapping region and thus does not have any appreciable load-bearing capacity.

Fig. 1 shows an intermediate position in the loading or unloading process, arrow 19 denoting the direction of loading and arrow 20 the direction of unloading. The front end 21 of the transport support 18 in the loading direction 19 lies in a central region between the guide profile 13 and the drive 8 on the top surface of the transport support 9, whereas the rear end of the transport support 18 in the loading direction as per arrow 19 rests on the underside of the transport support 9 and, during subsequent motion of the transport support in the loading direction as per arrow 19, approaches the guide profile 13 from beneath. In the complete loading position, the rear end of the transport support 18 can lie in the area of the deflecting edge 16 of the guide profile 13, whereas the end 21 lies slightly in front of the casing 7 of the drive 8, so that the transport support 18 covers the entire useful depth of the cargo hold 3. In the

complete discharging position, on the other hand, the end 21, in the region starting from the working area 4, lies behind the loading opening 5 and the rear end is at a distance in front of the casing 7 of the drive 8. This ensures that in all cases the drive 8 only winds round the belts 10; no attempt must ever be made to wind round the area of the transport support 18.

A rear loading wall 23 is provided near the end 21 of the transport support 18 and bounds the loading area on the transport support 18 in use at any particular moment, on the side remote from the charging opening 5. By this means, luggage can be piled on the wall 23 without the risk of it falling off the transport support 18 in the direction towards the drive 8. As explained in detail hereinafter with reference to Figs. 10 to 12, the wall 23 is directly secured to the belts 10 and is therefore moved in reciprocation therewith. The wall 23 is adjacent a floor wall 24 secured to the belts 10, and lateral extension elements 25 in the form of side cheeks. If, as in the example, the transport support 18 is pulled over the floor wall 24 up to the vertical rear loading wall 23, it can move through lateral slits 26 between the floor wall 24 and the cheek-like extension elements 25, so as to be held in the area of the side walls 15 of the cargo hold 3 as explained in detail hereinafter, or alternatively the edges of the transport support 18 can be separately fastened to the floor wall 24 or to the cheek-like extension elements 25.

As a result of the operation explained in principle hereinbefore and the construction of the conveyor 9 explained in principle hereinbefore, the conveying system wastes the minimum amount of useful space in the cargo hold 3, but nevertheless the luggage is delivered from the work area 4 to the conveyor 9 in the area of the charging opening 5 and is transported to the hold 3 in steps of any desired length, and similarly during unloading the conveyor 9 moves forwards stepwise, so that the articles for unloading are brought in optimum manner within range for handling by the staff. Since only belts 10 have to be handled in the area of the drive 8, no difficulties arise even if the floor 14 of the hold 3 and consequently the conveyor 9 are curved, and likewise, since tensioned belts 10 are guided round the deflecting edge 16 of the guide profile 13, the guide profile 13 may without difficulty be curved as shown in Fig. 1, without any difficulties with regard

to the transport support 18, which bridges the belts 10 without being tensioned.

However, particularly in the cargo hold 3 of an aircraft, the local conditions result in a number of problems, particularly with regard to securing the guide profile 13 in position, guiding the side edges of the carpet-like transport support 18, or guiding the upper region of the rear loading wall 23. The solutions of these problems according to the invention are described in detail hereinafter.

As also shown in detail in Fig. 13, a profile rail 31 is recessed into each side wall 15 and (compare Figs. 3 and 4) has a box-shaped cross-section 32 with an entry slot 33, behind which the head 34 of a retaining bolt 35 can engage. A rail 31 of this kind, the construction and operation of which are described in detail hereinafter, is conventional in the side region of aircraft cargo holds, for the purpose of securing lockers at desired places, where luggage can be secured in position by clamping or lashing when required. The load-bearing rail 31 is therefore a highly load-bearing anchoring facility.

Fig. 1 shows the arrangement of the guide profile 13 between the side walls 15 of the hold 3; the transport support 18 is not shown in the area of the guide profile 13. As diagrammatically shown in Fig. 1 with regard to the distribution of belts 10, the belts 10 are disposed substantially symmetrically with the longitudinal central plane 49 of the conveyor 9, but are offset to the maximum extent outwards therefrom. This reduces the lever arm and consequently reduces the bending moment introduced into the guide profile 13 when a given tensile force is exerted by the belts 10. However, the guide profile 13 must be secured extremely securely to the side walls, so that the high tensile forces and bending moments are efficiently taken up.

As shown also in Figs. 2 to 5, the guide profile 13 on each side has a retaining rail 50 comprising two widely spaced-apart retaining portions 51 for securing to the profile rail 13. The wide spacing between the retaining portions 51 is important because, if the spacing is sufficiently large (e.g. more than 20 inches) it can be assumed that there will be no mutual influence between the retaining portions 51, in which case each retaining portion 51 can introduce the full permitted force into the profile rail 31.

As shown in detail in Fig. 2, each retaining portion 51 has a number of recesses (three in the example) 52, 53 and 54. Whereas the central recess 53 is circular, the outer recesses 52 and 54 each have an outward bulge 55, 56. As shown in Figs. 3 and 4, the recesses 52, 53, 54 are in line with corresponding recesses 41 or passage zones 42 in the profile rail 31, so that when the retaining portion 51 is laid on the rail 31, the heads 34 of retaining bolts 35 can extend through the recess 52 and 54 and also through the recesses 41 or passage zones 42 in the insertion slot 33 in the profile rail 31. From this position, the bolts 35 can be pushed laterally outwards, so that the bolt heads 34 enter the adjacent retaining zone 43 of the profile rail 31 and the bolt shanks 39 reach the area of the recess 55 or 56, where they can be received, optionally with clearance.

In this position a retaining plate 57 is placed over the retaining portion 51, and is formed with passage openings 58 for the bolt shanks 39, the openings being spaces so that when the shanks 39 extend through the openings 58 they can be secured in position at a spacing corresponding to the spacing between the recesses 55, 56, so that the retaining bolts 35 cannot return to the area of the passage zones 42 of the insertion slot 33. The retaining plate 57 also has a central journal 59 which enters substantially without clearance through the opening 58 in the retaining portion 51 and the passage zone 42 behind it in the insertion slot 33 of the profile rail 31, when the retaining plate 57 and the retaining portion 51 are secured by nuts 60 to the bolts 35. A suitably dimensioned projection 45 on the bolt head 34 prevents rotation by abutting the inside of the box cross-section 32, so that when the nut 60 is screwed, the bolt head 34 cannot rotate. In this manner the substantially clearance-free seat of the journal 59 in the recess 53 and in the passage zone 42 secures the retaining plate 57 in position and more particularly secures the retaining portion 51 in the longitudinal direction of the profile rail 31, whereas the nuts 60 provide the retaining force on the profile rail 31. In this manner the two widely-spaced retaining portions 51 on each side of the side profile 13 are securely fastened to the profile rail 31, so that the guide profile 13 is secured against the tensile forces of the belts 10.

Similarly, as shown in Fig. 1, a ramp 61 with lateral retaining portions 62 is mounted on the profile rail 31 in front of the guide profile 13 as seen in the loading direction along arrow 19. As shown particularly in Figs. 8 and 9, the ramp 61 forms a run-up slope 63 to the top surface of the guide profile 13, so as to secure the area of the deflecting edge 16 from damage and enable luggage to be slid on to the conveyor 9 in the area of the charging opening 5.

As shown particularly in Figs. 8 and 9, a shutting device 64 or alternatively a shutting device 65 is mounted on the ramp 61 for preventing dirt and foreign bodies from penetrating into the area under the guide profile 13.

In the example in Fig. 8 the shutting device 64 is a brush arrangement 66 comprising a bearing part 69 secured by springs 67 in a recess 68 in the ramp and pressing brushes 70 against the transport support 8, when guided at the deflecting edge 16. In the embodiment in Fig. 9, three rows of brushes 74a, 74b, 74c are mounted on a bearing part 71 of a brush arrangement 72 in a recess 73 in the ramp 61. The brushes vary in stiffness, and are therefore selectively operative against dirt and foreign bodies. A dirt-collecting tray 75 is disposed on the underside of the brush arrangements 66 or 72, and collects dirt travelling through the brush arrangement 66 or 72, so that the dirt can easily be disposed of.

A preferred embodiment of the area of the guide profile 13 is shown in detail in Figs. 6 and 7. The guide profile 13 comprises a main member 76.

Since the guide profile 13 is freely suspended between the lateral retaining rails 50 and consequently a gap 83 is left in the construction towards the floor 14 of the hold 3 for the belts 10 and the transport support 18 to pass through, it is likely that the main body 76 of the guide profile 13 will be moved out of its correct position by the high tensile forces on the belts 10. More particularly at the beginning of the unloading process, the belts 10 pull around the deflecting edge 16, so that the gap 83 may close and the belts 10 and the transport support 18 may be clamped between the floor 14 and the underside of the main body 76, more particularly near the deflecting edge 16, so that the conveying movement may be permanently impeded.

To counteract this, guide rollers 84 are provided in the area of the belts 10 on the deflecting edge 16, and are substantially in line with the contour of the deflecting edge 16 or project only slightly beyond it. The guide rollers 84, which are restricted to the area of the belts 10, prevent friction on the belts 10 when guided around the deflecting edge 16, and thus prevent tilting or pitching moments being introduced into the guide profile.

Another safeguard against clamping is obtained by support rollers 85 disposed on the underside of the main body 76 of the guide profile 13 in the area of the belts 10, the support rollers projecting slightly beyond the underside of the main member 76. If the main member 76 moves downwards towards the floor 14 of the hold 3, therefore, the rollers 85 provide a bracing support so that the belts 10 can keep moving. Friction against the floor can be additionally reduced if the support rollers 85 are disposed opposite support rollers 86 in the floor 14. In the case explained, the support rollers 85 abut the rollers 86 with interposition of the belts 10 or transport support 18, so that roller friction occurs on both sides. In view of the particularly critical conditions at the beginning of the discharging phase, a front supporting roller 85, 86 or a pair of rollers 85/86 should be disposed very near the deflecting edge 16, so that when the part of the main member sags under the forces in front of the supporting rollers 85 or 86, the sag can be kept within desired limits.

Motion of the belts 10 on the top surface of the main member 76 of the guide profile 13 can also be facilitated by supporting rollers 87, which are disposed in the area of the belts on the top surface of the guide profile 13, where they enable rolling friction to occur, thus further facilitating conveyance, particularly of heavy material.

As shown in Fig. 1, after the beginning of the charging process, the belts 10 or the transport support 18 bearing the loads would abut one another, whereupon the rear end would gradually move forward into the area of the guide profiles 13 and the mutual contact would cease. During the zone, extending approximately over half the useful depth of the hold 3, of possible mutual contact between belts 10 and the transport support 18 and its load, increased wear can occur through mutual friction, particularly at seams. To avoid this, as

shown in Fig. 19, a sliding panel 96 is provided adjacent the rear edge 17 of the guide profile 13 and prevents the belts 10 from abutting the transport support 18 in this region. The sliding panel 96, which can be made of sheet metal but is preferably made of plastics in view of the need to save weight in aircraft, produces low-wear sliding friction between the belts 10 and the transport support 18. Particularly good sliding properties are obtained if the sliding panel 96 has a surface of Teflon or another easily-sliding plastics, or is optionally made completely of Teflon. It is pointed out that in Fig. 19 and particularly the detail shown therein, the transport support 18 and the belts 10 are shown as rigid elements to simplify the drawing, but in practice, of course, the transport support 18, in the region between the belts 10, bears tightly against the sliding panel 96 under the pressure of the load, and is pressed by the belts 10 underneath in the example, in the area thereof from the sliding panel 96.

Of course the sliding panel 96 can be guided over a length longer than half the useful depth of the hold 3. As also shown in this connection in Fig. 19, the sliding panel 96 can be part of the guide profile 13 and can be of immediate use in additionally bracing the deflecting edge 16 of the guide profile 13, e.g. against the casing 7 of the drive 8. If such bracing of the guide profile 13 is aimed at in the case of a shorter sliding panel 96, the sliding panel 96 can be laterally anchored in pressure-resistant manner to the rails 31, as already explained in principle hereinbefore in the case of the guide profile 13. This results in additional reinforcement of the guide profile 13 together, if necessary, with separation of the upper and lower belts 10 and the transport support 18 over the entire depth of the hold 3. If necessary, support rollers 97 in the neighbourhood of the belts, additionally improving the sliding properties, can be provided on the top and/or bottom surface of the sliding panel 96, or at a corresponding place on the floor 14 of the hold 3, in similar manner to that explained in connection with Figs. 6 and 7. The important feature in this connection is that all the support rolls 85, 86, 87, and 97 need only to be disposed in the area of the belts 10, since this is the only area where such support is particularly important, since the belts are the only places where forces are concentrated.

Figs. 10 to 12 are more detailed views of a first embodiment showing the arrangement and mounting of the rear loading wall 23. As already explained, in addition to the vertical rear loading wall 23, the arrangement comprises a floor wall 24 secured thereto and lateral cheek-like extension elements 25, between which and the floor wall 24 a slot 26 for the passage of the transport support 18 is provided on both sides in the example.

Additional guidance of the rear loading wall 23 in its vertical position is obtained by a pair of support rollers 27, 28 which are spaced apart and disposed on the extension elements 25 and engage in grooves 98, 99 in the rail 29 and hold the rear loading wall 23 in the vertical position. The rollers 27, 28 are mounted so as to be rotatable on pivot pins which are secured to a bracket on the outside of the extension elements 25 so that the support rolls 27, 28 engage the rail 29 from above and from below.

As shown in detail in Figs. 10 to 12, the belts 10 run through under the floor wall 24 of the arrangement for the rear loading wall 23, but are connected to the floor wall 24 via front and rear tension loops 103. Alternatively of course the belts 10 can merge into the tension loops 103, so that the floor wall 24 is included in the tension connection of the belts 10. This however will increase the complexity in fastening the belts 10 to the floor wall 24 for transmitting higher tensile forces and it will also be necessary to ensure that no stretching occurs near the fastening places, since such stretching will spoil the non-elastic property of the belts. The belts 10 are made of aramide fibres, e.g. Kevlar, a material produced by Messrs DuPont, and have little tendency to stretch, but this could be partly offset by connection-places unless special precautions are taken.

As a result of the arrangement adopted, the rear loading wall 23 has no influence on the behaviour of the belts 10 but is simply entrained by them, another result being that the forces occurring in the area of the tension loops 103 are lower than if the wall were included in the tension connection. As shown more particularly in Figs. 11 and 12, the tension loops 103 are connected to the belts 10 by seams 104 and are closed by seams 105 to form the loop. The loop extends over a retaining web 106, which is connected to the floor wall 24 e.g. by lateral screws 107. Whereas only

the belts 10 are present at the side of the rear loading wall 23 remote from the charging opening 5, the textile material of the transport support 18 situated in front of the wall 23 towards the charging opening 5 is pulled via the tension loop 103 and the floor wall 24 and is suitably secured to the wall 24 at 108 (compare Fig. 10) near the rear wall 23.

This results in a substantially uniform, undisturbed loading surface in the direction of charging in front of the rear loading wall 23.

In the embodiment in Fig. 10 it is assumed that the rear loading wall 23 is self-supporting as such, e.g. is a solid metal plate or has a skeleton construction, thus somewhat increasing the weight of the conveyor 9, which is undesirable in an aircraft. The weight can be reduced by an embodiment of a rear loading wall 23a as per Figs. 13 to 15. In this embodiment, the floor wall 24 is provided on both sides with joints 109 to which extension elements 25a are pivoted. The extension elements 25a, as shown particularly in Fig. 15, are cheek-like only up to the level of the rail 29 and the support rollers 27 and 28, to provide the required support with a spacing in the direction of the depth of the hold 3, whereas above this support they are only in the form of retaining rods 110. The wall 23a is in the form of a textile covering 111, tensioned between the floor wall 24 and the extension elements 25a or the retaining rods 110. The textile cover 111 can e.g. be the same nylon fabric as the transport support 18. To obtain strong tension and resistance to sagging, the textile covering 111 is reinforced by belts 112 which extend between the extension elements 25a and more particularly enclose the upper edge of the textile covering 111, which can easily bulge outwards when luggage rests against it.

As shown particularly in Fig. 14, the retaining rods 110 are laterally clamped to the side walls 15 of the hold 3, in order to exert a desired tension on the belts 112 running between them. To this end an additional rail 29a is disposed in the upper region of the side walls 15 of the hold 3 and if necessary can be mounted (not shown) on profile rails 31, which are normally provided in this region of the hold 3 also. Clamping rollers 115, 116 engage in grooves 113, 114 in rail 29a but, unlike the support rollers 27 and 28, bear with aligned axis on the surface of the grooves 113, 114 remote from the side wall 15 and parallel to

the side wall 15 and are mounted on a carriage 117. The shanks of clamping screws 119 extending through the retaining rod 110 engage in a base plate 118 of the carriage 117. The result is a clamping device (general reference 120) by means of which a desired force can be applied to the neighbouring belt 112 secured to the retaining rod 111, by screwing the clamping screws 119 a suitable distance into the baseplate 118 of the carriage 117.

As Fig. 15 shows, in the example a corresponding carriage 117 is also provided on the guide rail 29, for correspondingly tensioning the lower belt 112 in the drawings, but this is not necessary in all cases, since the clamping to the upper rail 29a applies clamping forces to the joints 109 with an advantageous lever arm.

A trough-like floor wall 24 increases the weight and has to be secured by the rail 29 and rollers 27, 28 against the tilting force exerted by luggage adjacent the rear loading wall 23 or 23a. As an alternative, use can be made of a substantially only two-dimensional construction of the rear loading wall 23 or 23a, i.e. in which the additional construction shown in front of the retaining rod 110 in connection with the floor wall 24 can be omitted. Another advantage is that the rear loading wall 23 or 23a does not need an exact parallel guidance, but can without tilting occupy a slightly inclined position relative to the transverse plane of the aircraft, when loads or tensile forces are exerted by the belts 10. In this case the rear loading wall 23 or 23a can be prevented from tilting backwards under the weight of the adjacent luggage if supporting wheels on the floor side are provided at the rear side of the rear loading wall 23 or 23a opposite the floor wall 24, via suitable extension members (not shown) which provide a lever moment. This construction is particularly suitable in conjunction with a continuous sliding panel as per Fig. 19, since the support wheels on the rear side of the rear loading wall 23 or 23a will then rest in the area between the belts 10 immediately on the upper surface of the sliding panel 96, where they can abut the rear of the wall 23 and prevent it tipping over. The counteracting force producing an erecting moment directed against tilting over is the tensioning force of the belts 10 which, in the event of a tilting moment due to adjacent luggage, is considerably assisted precisely by the weight of this luggage. Slight tilting movements within the

clearance of the rollers 115, 116 on the guide rails 29 and 29a are harmless.

Fig. 16 shows one possible method of driving the conveyor 9 via rollers 11 for each belt 10, disposed opposite the charging opening 5.

In the embodiment in Fig. 16, a horizontal shaft 121 and adjacent inclined shafts 122 are provided and are each disposed in the casing 7 and braced via support bearings 123 against the floor 14 of the cargo hold 3. Universal bearings 124 are provided between shafts 121 and 122 and connect the shafts to obtain automatic synchronised rotation. All the shafts 121, 122 are driven by an electric motor (not shown) and a transmission system which drives the shafts 121 or 122 driving the rollers 11. Pressure springs 125 are disposed on the casing 7 above the rollers 11 and firmly hold the belts 10 on the means for driving the rollers 11 in rotation.

As Fig. 16 shows, the belts 10 are guided by the rollers 11 at a slight mutual vertical spacing so that, as shown in Fig. 1, they can run in through corresponding passages in the front wall of the casing 7, immediately into the area of the loading surface of the hold 3.

An arrangement of rollers 11 for winding the belt 10 on to and off different parallel shafts 121 and 122 can be used if necessary to drive the rollers 12 for the front ends separately from the rollers 11 for the rear ends of the belts 10, in order to introduce additional belt material into the area of the loading surface of hold 3 and reduce the tension there. To this end the transport support 18 and belts 10 can be raised a considerable distance, of course when the hold 3 is empty, and the regions underneath can be rapidly inspected in simple manner. In operation, however, automatic synchronous running can be achieved without difficulty.

As Fig. 17 shows, the rollers 11 on the shafts 121 or 122 are shaped so that the shanks of rollers 121, 122 themselves serve as winding cores for the roller members, and formation of the winding or guidance of the belt 10 is ensured by lateral cheeks 127 on the shaft 121 or 122. Fig. 18 shows the shaft 122 abutting a support bearing 123 and shows the shaft 121 connected via a universal joint 124.

Fig. 17 is a larger-scale view of a detail from the embodiment in Fig. 16. As shown, the casing 7 comprises a cover 130 which opens around a hinge 132, pressure springs 125 for exerting pressure on the loops 133 of the belts 10 on the rollers 11 being secured to the inside of the cover. The pressure springs 125 are ordinary curved plastics springs. When the cover 130 is opened, therefore, the top surface of the loop 133 is freely accessible.

The curved pressure springs 125 can be replaced (not shown) by a pressing-down element in the form of a block with a round bearing surface which is pressed on to the loop 133. In the case shown here, where an endless belt 10 approximately in the form of a toothed belt or the like is guided over a toothed wheel, an aforementioned pressure block, in the case of a hard spring-suspended or non-elastic bearing, can prevent any risk of the belt 10, in the form of a toothed belt or the like, jumping out of positive engagement.

The belts 10 leave the casing 7 through slots or passages 131 at a defined height. In the process the belts are guided by the previously-discussed holding-down means 126 in the form of guide rollers, which firmly hold the belts 10 in register with the respective passage slot 131.

If the belts 10 are endless and each belt 10 is guided by a single roller 11 which does not wind up any belt 10, it is only necessary to ensure that driving forces can be applied by the rollers 11 to the respective belt 10 substantially without slip. To this end the roller 11, which of course then rotates with the shaft 121, 122 is given a friction-increasing surface, e.g. of rubber or the like, and also the belts 10 are given a positive shape (not shown) e.g. in the form of toothed belts or with driving recesses for engaging elements for driving the rollers 11. If required, a tensioning device can maintain a minimum tension in the respective belt 10 in the portion of the belt 10 running between the rollers 11 and the holding-down means 126, whereas the actual drive can be as explained in connection with Fig. 16. The special construction of the belts 10 as toothed belts, perforated belts or the like suitable for a positive drive can be provided so as to obtain a tension element which is truly continuous along the entire length, but is functionally necessary only at that region of the belts 10 which comes into contact with the rollers 11 during reciprocating movement. In

the area of the transport support 18, therefore, the belts 10 can be different, e.g. flatter, if required, than in the actual drive region. This construction of an endless rotating belt 10 in a number of places may also be regarded as an endless belt in the functional sense. As in all the embodiments described hitherto, the drive is advantageously constructed so that when the driving motor is inoperative, the drive is locked, so that the rear loading wall 23 is locked in position against motion, either directly by drives provided there or via the belts 10.

The guide profile 13 and the sliding panel 96 prolonging it form the only dimensionally stable part disposed over the floor 14 of the hold 3 in the area of the charging opening 5. Since the guide profile 13 enables the belts 10 and the transport support 18 to pass between its underside and the floor 14 of the hold 3 in the gap 83, it sags slightly under a load on the guide profile 13 and reduces the gap 83, more particularly when support rollers 85, 86 are not present or the spacing between them allows such a movement. Consequently the state of tension in the guide profile 13 between the rails 15 is an indicator of the load on the conveyor 9 when at rest, so that the guide profile 13 can to some extent serve as an automatic machine for weighing the luggage on top of it. To this end at least one stretch-measuring element can be provided on the surface which is subjected to tension when the top side of the guide profile 13 is loaded under pressure. Advantageously of course the stretch-measuring element is disposed so that it is not subjected to a point load of luggage or other wearing or damaging forces. For example, the element can be recessed in an outer surface or disposed on an inner surface of the guide profile 13. Alternatively a number of stretch-measuring elements can be provided, e.g. in the form of strips, and a suitable evaluation means can provide an indicator for the weight. If the weight is too high, a simple electronic unit can switch on a display lamp or alternatively the drive of the conveyor 9 can be made inoperative. This reliably prevents overloading of the floor 14, and also local overloads can if necessary be detected by a suitable multiple arrangement and individual evaluation by sensors.

The profile rails 31 can serve their proper purpose, i.e. securing luggage, at all times in those parts not used for securing the ramp 81 (?) of the guide profile

13, the sliding panel 96 or the rail 29. In the special case in which the luggage must not move with the transport support 18 after being made fast, care must of course be taken that the drive for the conveyor 9 is not set in motion when the goods are strapped in position.

As the preceding description shows, numerous modifications and alterations of the invention are possible without departing from its scope. The essential feature in every case is that the conveyor 9 extends flat over the floor 14 of the hold 3 and owing to its small overall height does not appreciably reduce the loading volume. Another essential feature is that the conveyor 9 can be moved stepwise as required and so can serve as a conveyor as required in individual cases. Another particularly important feature is that all the tensile forces are concentrated on individual spaced-apart belts 10, so that even a curved floor 14 of the hold 3 does not present any problems if shafts 121 or 122 are suitably disposed on the one hand and if the correspondingly uneven guide profile 13 can be closely covered on the other hand, since the conveyor 9 can be adapted without difficulty to any floor contour. Additional securing methods, which are particularly difficult in the aircraft sector, can be avoided by using the profile rails 31 normally present in aircraft holds for clamping or lashing luggage, the rails being capable of withstanding strong forces, and all parts of the conveyor 9 in the area of the loading surface of the 3 can be used for storage if necessary.



C L A I M S

1. A means for loading packages into a cargo hold (3), more particularly in an aircraft,

comprising at least one motor-driven conveyor (9) movable from a charging opening (5) of the cargo hold (3) towards the opposite end (6) thereof and back,

the conveyor covering the surface of the floor (14) of the cargo hold (3) and being used to transport packages charged on to the conveyor (9) in the area of the charging opening (5) away from the charging opening (5) into the cargo hold (3) and back towards the charging opening (5) during unloading,

the conveyor (9) comprising a plurality of spaced-apart adjacent traction-resistant flexible traction elements (belts 10) held on rollers (11) at the end (6) of the cargo hold (3) remote from the charging opening (5),

the conveyor comprising a carpet-like transport support (18) made of flexible textile material on a portion at least approximately corresponding to the depth of the cargo hold, and

the conveyor being deflected on a plurality of rotatable deflection rollers (84) positioned in the area of the charging opening (5),

characterised in that

the deflection rollers (84) are fastened to a guide profile (13) positioned between the upper and lower parts of the conveyor (9),

the motor drive (8) for the conveyor (9) is disposed in the area of the end (6) of the cargo hold (3) remote from the charging opening (5), and

the guide profile (13), on its side remote from the deflecting rollers (84), is braced against the tensile stress of the conveyor (9) by a sliding panel (96) braced at the other end against the drive (8).

2. A means according to claim 1, characterised in that the belts (10), at least with regard to their function, are in the form of endless belts which are deflected by rollers (11) at the end (6) of the cargo hold (3) remote from the charging opening (5).



3. A means according to claim 2, characterised in that the belts are designed for positive motion drive, and are e.g. provided with drive recesses or are toothed belts.

4. A means according to any of claims 1 to 3, characterised in that a rear loading wall (23) forming part of the conveyor (9) is disposed on the belts (10) in the area of the rear end of the transport support (18), when considered in the charging direction (arrow 19).

5. A means according to claim 4, characterised in that the rear loading wall (23; 23a) is prevented from tilting by lateral projecting elements (25; 25a) comprising supporting elements (support rollers 27, 28) which are spaced apart in the direction of motion (arrows 19, 20) and run on rails (29) on the side walls (15) of the cargo hold (3) and/or are supported on the floor.

6. A means according to any of claims 1 to 5, characterised in that the sliding panel (96) adjacent the rear edge (17) of the guide profile (13) has a surface having good sliding properties and made e.g. of slidable plastics such as polytetrafluoroethylene (Teflon®) and extends at least over half the depth, preferably the entire depth, of the cargo hold (3).

7. A means according to claim 6, characterised in that the sliding panel directly supports the guide profile (13) on the side remote from the deflecting edge (16).

8. A means according to claim 6 or 7, characterised in that the sliding panel (96) is secured to the profiled rails (31; 31a) on the side of the aircraft, on the side walls (15) of the hold (3).

9. A means according to any of claims 1 to 8, characterised in that in the area of the belts (10), at least in the central part of the guide profile (13), support rollers (85, 86, 87, 97) are provided between the side walls (15) of the hold (3) in the floor (14) of the hold (3) and/or on the underside and/or the top side of the guide profile (13) and/or on an adjacent sliding panel (96).

10. A means according to claim 9, characterised in that support rollers (85, 86) are provided on the floor



near the deflecting edge (16) of the guide profile (13).

11. A means according to any of claims 1 to 10, characterised in that the deflecting rollers (84) are mounted in the guide profile (13) in the area of the belts (10) on the deflecting edge (16), and preferably project slightly it at all beyond the contour of the deflecting edge (16).

12. A means according to any of claims 1 to 11, characterised in that a shutting device (64, 65) close to or in contact with the transport support (18) is disposed on the side of the transport support (18) remote from the deflecting edge (16) of the guide profile (13), the shutting device (64, 65) preferably being an array of brushes (66; 72) underneath which a dirt-collecting tray (75) is advantageously disposed.

13. A means according to any of claims 1 to 12, characterised in that when the floor (14) of the hold (3) or of the transport support (18) is curved, the rollers (11) for deflecting the drive-side ends of the belts (10) are secured to adjacent shafts (121, 122) which are inclined relative to one another.