

The invention relates to means for loading packages into a cargo hold of an aeroplane, in accordance with the preamble of claim 1.

Holds for luggage, for example, in smaller aircraft are frequently disposed with a low height in the bottom part of the fuselage and are relatively elongate in the longitudinal direction thereof. If packages such as passenger luggage are to be accommodated therein, the first packages must be placed deeply in the hold as far as the zone in front of the back wall thereof, whereafter the hold can be filled progressively from the back wall as far as the loading opening. This is complex and time-consuming.

To facilitate loading and unloading of such an aircraft hold, it is known, from SPEEDNEWS of 1 June 1984, to construct such means in accordance with the preamble of claim 1.

The conveyor means used there consists of three separate elements which are disposed at angles to one another to adapt to the curvature of the hold floor.

The first conveyor element, as the main element, is disposed centrally and horizontally and consists of two tension-resistant bands which can be wound on to reels at the rear end of the hold, and a transport support in the form of a carpet which adjoins the bands forwardly as considered in the direction of flight and can be wound on a front reel or roller in front of the loading opening as considered in the direction of flight. A hold back wall is disposed at the connection between

the two bands and the carpet-like transport support and is movable progressively rearwardly during loading, from a position adjacent the loading opening, the two bands being increasingly wound on to their reels while the transport support in the form of the carpet is increasingly unwound from its roller, until the hold back wall is finally in the region of the rear hold wall and the transport support in the form of the carpet extends over the entire length of the hold.

The second conveyor element is a transport support in the form of a carpet which is trained after the style of an endless belt around a front and rear reversing reel or roller, the rear reversing roller being disposed level with the rear take-up reel for the bands and the front reversing roller is disposed level with the front take-up roller for the central conveyor element, but they are inclined relatively to their axes. The second conveyor element is disposed on the hold side remote from the loading opening.

The third conveyor element is also a transport support in the form of a carpet which is trained after the style of an endless belt around a rear reversing roller level with the take-up reels for the bands and around a front reversing roller which, however, is disposed in the vicinity of the rear edge of the loading opening as considered in the direction of flight. Thus the third conveyor element is shorter than the first and the second conveyor element and its length clears the loading opening. The reversing rollers for the third conveyor element are disposed at an appropriate angle to the horizontal so that the horizontal first conveyor

element forms with the two lateral second and third conveyor elements a channel whose contour is approximately adapted polygonally to the curvature of the floor of the aircraft fuselage.

The substantially only graphic illustration to this passage of literature does not show any motor drive for the system. However, it is assumed that a motor drive is used. Because of structural conditions, it can logically only act on the loading back wall and move it, so that the same moves the central horizontal conveyor element to and fro in such manner that on a movement in the loading direction the bands are increasingly wound on the rear take-up reels and the transport support in the form of a carpet is unwound from its take-up roller, and conversely on a movement in the unloading direction. The loading back wall also spans the transport support of the two lateral conveyor elements and is obviously secured thereto so that by means of such a drive it is also possible to move the transport supports of the lateral transport elements, which supports are constructed after the style of an endless belt.

Although this known system allows all the luggage or the like to be deposited in the region of the loading opening without having to access the parts of the hold therebehind, and yet enables the hold to be completely filled and then appropriately unloaded, the known system has a number of serious disadvantages.

For example, when three separate and independently mounted transport supports are used, not only is the

cargo adversely affected by the gap between the conveyor elements, but it is particularly difficult to embody the drive in practice. Accordingly, the literature does not show any indication for the structurally specific construction of the drive. It must be remembered that the cargo has a very considerable weight and the transport support with the heavy cargo weight resting thereon must be pulled while overcoming the floor friction, and quite considerable forces are required for this purpose. If these forces are introduced via the loading back wall, the latter must accordingly withstand very considerable force introduction and therefore be specially constructed and guided, and there is no structural solution available for this. Drive elements disposed in the region of the loading back wall are also obstructive in the hold.

The maximum load acts on the horizontal central part of the transport means formed by the horizontal transport support of the first conveyor element, but there are also very considerable weight forces from the cargo acting on the peripheral lateral transport supports in the form of the bands. While the transport support of the first middle conveyor element can directly slide on the floor of the hold, so that acceptable sliding conditions can be ensured, the two portions of the lateral endless bands run one on another and move in opposite directions to one another during loading and unloading. As a result, very considerable frictional forces occur between the sections of the textile transport support and in turn require increased drive forces and result in rapid wear or damage to the lateral transport supports.

As a result of the inclination of the lateral transport supports, lateral forces acting towards the centre also occur there under the force of the weight of the cargo and tend to contract the lateral transport supports inwardly. As a result of the creasing produced thereby, friction peaks occur in conjunction with the poor sliding conditions and further considerably accelerate wear and destruction of the lateral transport supports.

Accordingly, the object of the invention is to provide a device of the type indicated in the generic clause of claim 1, wherein the frictional load on the transport support is considerably reduced, particularly when it moves under load, so that it is possible for it to move with a minimum amount of wear and damage and with reduced force.

This problem is solved by the characterising features of claim 1.

The use of a sliding panel to support the transport support against the weight of the cargo ensures that the transport support is borne on a surface having good sliding properties and can therefore also be moved with minimal friction under load. The suspension of the sliding panel at its side edges, for example with staying relatively to a profiled rail in the side wall of the hold, enables it to be so mounted as to avoid any bearing elements on the top or bottom of the sliding panel and minimise the supporting means and particularly the supporting weight. Since the suspension is such that a gap is left from the hold

support structure on the floor side, even under maximum nominal load, this ensures that a section of the transport support set back at the underside of the sliding panel is left free of any clamping forces and hence any friction under all load conditions occurring during loading or unloading, so that on a movement of the transport support under load there is in any case only the reduced friction to be overcome between the load-bearing section of the transport support and the frictionally optimum surface of the sliding panel. Only under extreme loading during flight can this gap at the underside of the sliding panel close, so that a set-back section of the transport support may jam there; under such conditions, however, any movement of the transport support is not only unnecessary, but also undesirable.

The sliding panel inevitably leads to a certain increase in the weight of the device, and this is basically undesirable in aircraft. However, the resulting excellent sliding conditions can be utilised to save structural weight in the region of the drive and in respect of supports for the drive forces, since the drive forces required are considerably lower. In addition, the sliding panel can form the hold termination on the floor side towards the support structure on the floor side so that the inner boarding of the support structure of the hold on the floor side can be dispensed with if necessary and in this way weight can again be saved. The support structure on the floor side itself is retained, however, at least in respect of its load-bearing parts, and serves to support the sliding panel if the latter is further

curved by additional loading, more particularly centrifugal forces in flight, and requires a support on the aircraft side relatively to excessive curvature.

According to claim 2, the lateral fixing of the sliding panel can be effected very advantageously by means of springs which are tensioned in the event of increased weight loading on the sliding panel. In this way, movements of the loaded sliding panel and of the centrifugal forces occurring in flight are controllably rendered possible while at the same time any introduction of excessive stresses into the sliding panel is obviated. For this purpose, according to claim 3, preferably, support rails extending in the longitudinal direction are provided in the central area of the floor of the hold and in the event of excessive lowering of the sliding panel form defined bearings for the same and thus support the latter cleanly without introducing undesirable forces in the event of load peaks during flight.

Very high load-carrying capacity of the sliding panel with low weight is obtained if the sliding panel is constructed according to claim 4 in a composite lightweight construction as a deflection-resistant cell or sandwich structure.

If the sliding panel is constructed continuously over the length of the hold, a mechanical retaining structure for the lateral edges of the transport support in accordance with claim 5 is preferably provided at the top of the sliding panel and secured by way of the sliding panel against the profiled rails or

the like on the aircraft side. If necessary, a corresponding retaining structure may also be provided on the underside of the sliding panel but substantial forces producing a lateral contraction of the transport support act solely on the top. According to claim 6, the mechanical retaining structure is preferably constructed as a securing rail with a gripping edge which engages retaining elements projecting on the top of the transport support, preferably with a clearance therebetween. The retaining elements may, for example, be plastic studs or the like secured to the top edge zone of the transport support, which can be moved in the longitudinal direction at a distance from the gripping edge in the unloaded state, while in the event of any tendency to lateral contraction of the corresponding edge of the transport support are prevented from an inward movement when they engage the gripping edge. In this way, in normal operation, minimal friction occurs and yet reliable securing of the lateral edge of the transport support. Any creasing which would increase the friction of the transport support on the surface of the sliding panel and, particularly, the wear of the transport support, is reliably precluded.

Further details, features and advantages of the invention will be apparent from the following description of one embodiment with reference to the drawing wherein:

Fig. 1 is a simplified diagrammatic section through the bottom part of an aircraft fuselage transversely of its longitudinal extent and

Fig. 2 is an enlarged-scale detail of the dot-dash rectangle XXI in Fig. 1.

In the drawing, reference 1 denotes an aircraft fuselage, of which only the bottom part is visible in Fig. 1, and contains a hold having the general reference 3. The basic construction of such holds 3, which are shut off by bulkheads inside the aircraft fuselage and are accessible via a hatch in the outer skin of the aircraft fuselage 1, is sufficiently well known.

To convey cargo into the depths of the hold 3 and out again in the area of the hatch, a transport support 18 (not shown in detail in Fig. 1 in order to avoid overloading the drawing) is provided in the region of the hold floor 14 and covers the latter after the style of a slidably movable carpet and can convey cargo deposited thereon in the longitudinal direction of the hold 3, basically as known from the literature SPEEDNEWS of 1 June 1984. In this particular example, however, in comparison with the known construction, a one-piece transport support 18 in the form of carpet is disposed between the two side edges of the floor 14 of the hold 3 and is of arcuate shape to approximate the shape of the floor 14 of the hold 3 and is supported with deflection in the region of the hatch and is pulled in one or other direction of movement by a drive (not shown in detail) disposed at the other end in the hold. For fuller details of the construction, we would refer to EP-A-305391, which should be consulted.

As shown in the drawing, the floor 14 of the aircraft fuselage 1 is bridged by a sliding panel 143 which is suspended from lateral section strips 31a and which leaves a gap 144 from the floor 14 over the entire width. In this particular example, the sliding panel 143 closes off the floor over the entire length of the hold 3 and is covered at the top and bottom by the transport support 18 or tension bands connected thereto. In this way, the transport support 18 can move freely in the gap 144 without this movement being obstructed by abutment, jamming or the like. For this purpose, the sliding panel 143 must be able to take appropriate tensile forces, and this can be achieved with low weight and a low overall height, by a suitable composite lightweight construction, e.g. sandwich construction or, more particularly, a cell construction, as will be explained in detail hereinafter. The arrangement is such that under the maximum superimposed nominal load there is an elongation of the sliding panel 143 at most to an extent such that the gap 144 is never completely closed so that there is always a free gap 144 available on loading and unloading.

Nevertheless, there may be flight situations in which considerable centrifugal forces act in the direction of the floor 14 and multiply the weight of the load resting on the sliding panel 143. In order to obviate damage of the panel 143 in the event of such deformation, the gap 144 is so selected, particularly in the central zone of the hold 3, that on excessive loading, for example, 1.5 times the maximum nominal load, any deformation of the sliding panel 143 is taken

by supports on the floor side, for example the floor 14 itself.

To compensate for the additional weight loading by the load-carrying sliding panel 143, some of the structure on the surface side, i.e. the boarding on the conventional floor 14, can be removed in the region of the hold 3, although the support structure 145 on the floor side, which is shown only diagrammatically, is maintained and in this particular example may comprise two supports 146 extending upright on either side of the longitudinal centre-line of the aircraft. Instead of the boarding in the flat zone of the floor 14, just two laterally stayed support rails 147 are provided and are supported, on the underside, on supports 146 and in turn serve as supports for the sliding panel 143 in the event of excessive deformation. In this way the deformability of the sliding panel 143 in unusual flight situations is limited.

In order to minimise the material deformation of the sliding panel 143 despite obtaining an adequate height of the gap 144, the sliding panel 143 is laterally supported by appropriately hard springs 148 as shown in Fig. 2. For this purpose, a retaining structure is provided in the profiled rail 31a and carries the externally screwthreaded retaining bolts 149. At its side edges the sliding panel 143 has a thickening 143a which has passage apertures 150 for the retaining bolts 149 and local recesses 151 for the provision of a lock nut 152 and the springs 148 which in this specific example are constructed as a set of cup springs. Vertical support of the edges of the sliding panel 143

in the region of the thickening 143a is provided on a support rail 153a of the profiled strip 31a. Fig. 2 shows the fully loaded condition of the sliding panel 143, in which the springs 148 are fully compressed and the thickening 143a has moved a distance x away from its outer abutment, against which it is pressed by the lock nut 152 in the inoperative position with a defined force by means of the springs 148. In this way, a spring travel x is available on both sides to allow the sliding panel 143 to yield under extraordinary loading and thus avoid deformation of its material. As shown in Fig. 2, in this particular example the sliding panel 143 consists of vertical cell walls 154 which can, for example, form adjoining hexagons and are closed on both sides by cover plates 155 and 156 on which the transport support 18 slides.

As will also be seen from Fig. 2, the position of the edges of the transport support 18 can be easily secured laterally. To this end, the lateral edges of the transport support 18 have retaining elements 157 in the form, for example, of riveted-on projecting plastic studs which, in the unloaded state of the transport support 18, are supported by the material stiffness thereof in their lateral position. However, as soon as the cargo results in forces which tend to pull the retaining elements 157 towards the centre-line of the aircraft, they engage a gripping edge 158 of a securing rail 159 and are thus prevented from any further inward movement.

In this way, in normal operation there is no frictional obstruction by retention of the lateral edges of the

transport support 16, but there is a clean lateral securing of the position in the event of counteracting forces originating from the cargo, since such forces then press the retaining elements 157 into contact with the gripping edge of the securing rail 159 engaging over the retaining elements 157.

Generally, it is sufficient to provide the securing rail 159 on the top of the sliding panel 143, in which case it can be mounted, e.g. screwed, at 160, on the thickening 143a, and thus be fixed against the profiled rail 31a only indirectly. On the underside, the material stiffness of the transport support 18 is sufficient to position the side edges, the retaining elements 157 which extend along the underside coming to lie immediately adjacent the thickening 143a in the gap 144 and thus being protected from crushing forces in the event of deformation of the sliding panel 143.



C L A I M S

1. Means for loading packages into a cargo hold (3) of an aeroplane,

comprising at least one conveyor which is motor-driven such as to be movable from a charging opening for said cargo hold (3) in the direction of the opposite end thereof and back,

said conveyor covering the surface of the floor (14) of said cargo hold (3) in the form of a carpet-type transport support (18) of a flexible textile material and providing for the possibility of transporting packages charged on to the conveyor in the area of the charging opening away from said charging opening into said cargo hold (3), and back again towards said charging opening for unloading,

characterised in that

said transport support (18) rests on a sliding panel (143), and

that said sliding panel (143) rests above the floor-side support structure (145) of said cargo hold (3) by being suspended by its lateral edges such that at a maximum nominal load on said transport support (18), said sliding panel (143) does not yet contact said floor-side support structure (145) of said cargo hold (3).



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2. Means according to claim 1, characterised in that lateral mounting of said sliding panel (143) is effected by means of springs (148) tensioned more particularly by the load on said transport support (18).

3. Means according to claim 1 or 2, characterised in that in the central area of said cargo hold (3), support rails (147) are provided in the longitudinal direction to form defined bearings for said sliding panel (143) when said sliding panel (143) is depressed excessively.

4. Means according to any one of claims 1 to 3, characterised in that said sliding panel (143) is provided in the form of a deflection resistant cell or sandwich structure in composite lightweight construction.

5. Means according to any one of claims 1 to 4, characterised in that the lateral edges of said transport support (18) are secured against undesirable lateral contracting movements by a mechanical retaining structure, and that said retaining structure is arranged on the upper side of said sliding panel (143).

6. Means according to claim 5, characterised in that said retaining structure comprises a securing rail (159) having a gripping edge (158) which engages projecting retaining elements (157) arranged on the upper side of said transport support (18), preferably with a clearance therebetween.