

Floor for a lift cage

The invention relates to a floor for a lift cage according to the preamble of claim 1. Lift cages are, for example, installed in cage frames which in turn are guided at rails fastened in lift shafts and are moved up and down by drive engines via wire cables or other support means. Stiff cage floors can be executed in composite structure mode of construction or sandwich mode of construction, whereby the floor is distinguished by a high static and dynamic capability of loading and by a comparatively low weight. A 'sandwich' floor of that kind can be constructed substantially from the following components: a first plate (base plate) for predetermining a lower side, a second plate (top plate) spaced from the first plate and a support structure arranged therebetween.

A comparable floor of this category has become known from EP 1 004 538 A1. The support structure arranged between two plates consists of a plurality of intersecting flat profile members which in EP 1 004 538 A1 are termed slats. The longitudinal and transverse profile members are joined together by way of mutually complementary slots to form a grating-like composite structure and are subsequently welded together. In practice it has proved that even this floor, which is stiff in bending, is no longer sufficient for, primarily, purposes of use with very high mechanical loads.

A floor in sandwich mode of construction has become known from EP 566 424 A1, which comprises two layers, which are arranged one above the other and separated from one another by an intermediate plate, with a honeycomb structure. Each honeycomb layer has honeycombs of identical construction uniformly distributed over the entire area. The two honeycomb layers in that case have honeycombs of different size. The honeycomb layers superimposed in plan view define a packing density which remains unchanged over the entire floor area.

It is accordingly an object of the present invention to avoid the disadvantages of the prior art and, in particular, to create a floor of the kind stated in the introduction which even under particularly high mechanical loads satisfies high demands with respect to stiffness and capability of loading. Moreover, the floor shall be capable of production simply and economically.

According to the invention these objects are fulfilled by a floor with the features of claim 1. The flat lower side for the floor can be formed by a metallic plate, for example of steel. A second plate for predetermination of the flat upper side can be arranged approximately planoparallely to this base plate. This top plate can, like the base plate, similarly consist of steel or another metallic material. However, it would obviously also be conceivable to provide other materials or

compositions for the mentioned plates. The plates for predetermination of the lower side and upper side could, for example, be constructed from fibre-reinforced materials or from layers laminated together. In order to stiffen the floor a support structure having, in general, a first packing density is located between the upper side and the lower side. The first packing density is in that case predetermined by a first arrangement with walls or wall segments distributed approximately uniformly with respect to a plan view. The plan view in that case arises through viewing in the direction of the surface normals of a base surface of the base. In the installed state the plan view is accordingly defined by a vertical direction or by the travel direction of the cage. For local stiffening of the floor the support structure has in the reinforced region a second packing density which is higher by comparison with the first packing density. In order to form this local reinforcement the support structure has a second arrangement which is disposed in the first arrangement and overlaps the first arrangement in a region of overlap. Locally reinforced in that case means that the support structure is additionally reinforced not over the entire floor area, but only in a sub-region of the floor area. In other words, the support structure has the first packing density at least in a region outside - with respect to the plan view - the region of overlap. The support structure could comprise a honeycomb structure (for example, a bee honeycomb structure). Conventional honeycomb structures are distinguished by uniformly distributed and identically constructed honeycomb. According to the present invention the local reinforcement of the honeycomb structure can be created by the structure comprising a zone (reinforced region) with smaller cells. The smaller cells could - in correspondence with the first arrangement predetermining the basic structure - have the form of a bee honeycomb. The cells can obviously have other shapes. The zones with smaller cells are distinguished, by comparison with the zone with the first packing density, by an apparent higher packing density. Due to the local reinforcement in accordance with the invention of the cage floor it is possible, for example, to optimally absorb high impact energies on the lower side of the floor.

The floor can comprise a support structure forming a layer or sandwich course. The first arrangement and the second arrangement would then be in the same layer or sandwich course. A floor with several support structure layers would obviously also be conceivable.

The support structure can have walls or wall segments which extend from the lower side to the upper side or bridge over the spacing between lower side and upper side and which are associated with the first arrangement as well as the second arrangement. The walls or wall segments can consist of the same material as the base plate and top plate. However, other materials for the support structure would obviously also be conceivable. Moreover, it would also be conceivable to

dispense with a base plate for specific cases of use. In these variants the lower side of the floor would be predetermined by the support structure.

According to the invention the support structure comprises a first arrangement with walls or wall segments distributed approximately uniformly over the floor area and predetermining the first packing density. The support structure further comprises a second arrangement, which is superimposed on the first arrangement, for local reinforcement. The second arrangement can be a separate component (or subassembly) which is separate from the first arrangement and which is placed in or on the first arrangement and optionally connected therewith by, for example, welding. The floor construction can be produced particularly simply and in a few working steps.

The walls or wall segments of the second arrangement can, for example, be connected with the walls or wall segments of the first arrangement by shape-locking and/or force-locking couple. Thus, for fixing a support structure composed of first and second arrangements the second arrangement can be welded to the first arrangement.

The first arrangement, as mentioned in the introduction, with the first packing density can consist of a plurality of intersecting profile members which stand on edge and which form a kind of grating. A simple floor with a grating configuration of that kind is described in EP 1 004 538 A1. In addition to the first grating arrangement the support structure can comprise a second grating arrangement or even a plurality of second grating arrangements. In the last-mentioned case the individual second grating arrangements can be distributed uniformly or non-uniformly over the floor area. Through the superimposition of the first grating by a second grating there arises in the region of superimposition or overlap a structure with a second packing density which is higher by comparison with the first packing density of the base structure. Excellent values with respect to mechanical capability of loading and to stiffness can thereby be achieved in particularly simple mode and manner. In particular, through this local reinforcement undesired deformations of the floor after collision with a buffer arranged at the shaft floor or another object can be avoided in simple manner.

It can be advantageous if a respective profile member of the second arrangement is arranged between two adjacent profile members of the first arrangement. However, it is also conceivable for two or more profile members of the second arrangement to be disposed in each instance between two adjacent profile members of the first arrangement.

In terms of production engineering it can be advantageous if not only the profile members of the first arrangement, but also the profile members of the second arrangement are provided with slots, which are associated with crossing points, for reception of intersecting profile members. The intersecting profile members of the first arrangement and the intersecting profile members of the second arrangement have, respectively, mutually facing slots. In order to join together the first arrangement and the second arrangement the respective profile members can be provided with further slots. For this purpose, the already joined longitudinal and transverse profile members of the first arrangement can have slots, which are oriented in the same direction, for receiving the joined longitudinal and transverse profile members of the second arrangement, which in turn have corresponding slots oriented as a group in the same direction. The second grating (assembled second arrangement) can thus be connected in a single working step with the first grating (assembled second arrangement) particularly by placing on from one side. The two grating arrangements, i.e. the first and second arrangements, can prior to being joined together advantageously each be formed as a rigid subassembly. For example, the arrangements formed as rigid subassemblies can comprise profile members fixed in the crossing position by means of welding, glueing or another method.

For a floor having a specific width and length it can be advantageous if the profile members of the second arrangement extend in profile member length direction in each instance over at least half the width or length of the floor. This form of embodiment would be particularly advantageous for second arrangements positioned approximately centrally in the floor. However, other dimensions for the profile member lengths of the second arrangement could also be advantageous.

It can additionally be advantageous if the profile members of the first arrangement and the profile members of the second arrangement have the same material thickness. Production outlay and costs can be further reduced in this way.

It can be advantageous for specific purposes of use if the local reinforcement is arranged centrally in the floor with respect to a plan view.

The intersecting profile members of the first and second arrangements can form chambers which can be partly or entirely filled with a suitable filler material for weighting and balancing the cage. The most diverse materials suitable for weighting the lift cage can be used as filler material. Thus, cement, aggregate, stones, liquids, oils, metal bodies, particularly lead bodies, etc., are conceivable. In that case, the filler material can be embedded in an embedding mass such as, for example, a

silicon, gel, rubber, cement, plastics material, etc. Thus, for example, undesired movements of the filler material can be prevented. The filler material can be filled into, or in a given case also removed or emptied from, at least one of the chambers of the support structure of the lift cage during production of the lift cage floor, during assembly of the lift installation and/or within the scope of maintenance of the lift installation.

A further aspect of the invention relates to a lift with a lift cage with the floor described in the foregoing.

If the lift has in the shaft floor a buffer element for catching a lift cage in an end position it can be advantageous if the lift cage is so constructed that the local reinforcement is arranged in a region which overlaps, with respect to a plan view, the buffer element and if the end position the buffer element is supported directly on the floor. By contrast to conventional lifts in which the support takes place by way of a horizontally extending frame profile member associated with the cage at the floor side the present design has some significant advantages. Apart from the considerable saving in weight, less bulky and thus more slender cage constructions can thereby also be achieved.

Further individual features and advantages of the invention are evident from the following description of exemplifying embodiments and from the drawings, in which:

- Figure 1 shows a substantially simplified perspective illustration of a lift with a lift cage,
- Figure 2 shows a plan view of a support structure for a floor, according to the invention, of a lift cage,
- Figure 3 shows an exploded perspective illustration of a floor, according to the invention, for the lift cage,
- Figure 4 shows the floor of Figure 3 from a different viewing angle,
- Figure 5 shows the floor according to Figure 4 with a support structure assembled to finished state,
- Figure 6 shows a detail view of the support structure of Figure 5 and

Figure 7 shows a perspective illustration with respect to the basic construction of the support structure.

Figure 1 shows a lift, which is denoted generally by 1, with a cage 3 fastened to support means 4. The shaft is illustrated schematically and denoted by 2. Such or similar lifts have been known for a long time and are customary. In the embodiment according to Figure 1 a resiliently mounted buffer element 9 for catching the cage 3 in an end position is located at the shaft floor. The buffer element 9 is disposed approximately centrally below a floor 5 of the cage 3. The floor 5 is constructed in such a manner that the buffer element 9 can be supported directly or without intermediary on the floor. In order to accept an impact on the buffer, the floor 5 is in addition reinforced centrally. This reinforcement is described in detail in the following with reference to Figures 2 to 6.

A possible variant, which is denoted by 6, for a support structure according to the invention for the floor of the lift cage is illustrated in plan view in Figure 2. The support structure substantially consists of two arrangements 10 and 11 formed in the manner of a grating. The first arrangement 10, which defines a form of base structure which embraces approximately the entire floor area as seen in plan view, consists of a plurality of parallelly extending longitudinal profile members 12 and transverse profile members 13. The substantially uniformly distributed longitudinal and transverse profile members 12 and 13 are arranged to intersect at right angles and define a first packing density. By the term "packing density" there is to be understood in this application the ratio of the volume of the individual chambers or cells, which are formed by walls or wall segments, to a total volume (corresponding in the present embodiment substantially to the total volume of the support structure). Since the walls or wall segments extend vertically with respect to the plane of the floor, the packing density can be derived from the area ratio. The support structure 6 comprises, by way of example, thirteen longitudinal profile members 12 and eighteen transverse profile members 13, wherein the respective spacings between the profile members are equal. The first arrangement 10 is in itself formed almost identically to the composite structure core, which is already known from the prior art, with the grating arrangement. With respect to further constructional details for this arrangement reference is accordingly made to EP 1 004 528 A1, which thus expressly counts as part of the disclosure of this application. A second arrangement 11 superimposed on the first arrangement 10 is disposed in the reinforcement region indicated by S. The second arrangement 11 is designed to be fundamentally approximately identical to the first arrangement 10 and differs from the first arrangement 10 substantially only by the evidently smaller external size as well as the consequently smaller number of profile members.

The longitudinal and transverse profile members 12 and 13 of the first arrangement form a plurality of chambers in checkerboard distribution. The profile members 14 and 15 (four longitudinal profile members 14, five transverse profile members 15) respectively crossing at right angles divide the chambers associated with the first arrangement with the profile members 12 and 13 into four chambers of equal size. Through the superimposition of the second grating arrangement 11 on the first grating arrangement 10 a multiplication of the packing density accordingly results. The thickness of the profile members for the support structures as well as the profile member spacings and thus the packing densities are dependent on, in particular, the floor loading, top plate thicknesses and overall constructional height and can be optimised, for example, by means of FEM calculations.

As readily apparent from the plan view according to Fig. 2 the support structure 6 for formation of the local reinforcement has a second arrangement 11 disposed in the first arrangement 10 and superimposed on the first arrangement 10 in a region of overlap. The support structure 6 obviously has outside the region of overlap the first packing density, which is predetermined only by the profile members 12 and 13.

Constructional details with respect to the construction of the cage floor 5 according to the invention can be inferred from the exemplifying embodiment according to Figures 3 to 6. The floor 5 comprises a base plate 7, a top plate 8 and a support structure 6, which is provided with a plurality of chambers, arranged therebetween. The floor is laterally closed by longitudinally and transversely extending side parts 20 and 21. The top plate is omitted in Figure 4 for better understanding of the floor construction. The centrally arranged, locally reinforced zone with the multiple packing density is particularly clear from Figure 4. The arrangement 11, which to a certain extent forms a double grating, has a square form in plan view. The external dimensions of the second arrangement 11 can be, for example, adapted to the constructional size of a component acting on the floor (cf. Fig. 1; for example, buffer element). The second arrangement could in plan view also comprise overall a rectangle with the same size ratios as the floor.

The components 6, 7 and 8 as well as 20 and 21 consist, for example, of sheet steel and can be produced and connected together by means of cutting, bending and welding methods. One possible method for producing the floor is, by way of example, apparent from Figure 5. The profile members, which are joined together to form gratings, for the first and second arrangements 10 and 11 are fixed by, for example, welding and thus rigidly connected together. The second grating arrangement 11 is in the illustration according to Figure 5 placed from above on the first grating

arrangement 11. Respective mutually facing slots 16, 17 and 18, 19 are provided for approximately precisely fitting connection of the two arrangements 10 and 11.

According to the present embodiment the floor 5 has, as is evident, a single-layer support structure 6. The second arrangement 11 is disposed in the first arrangement 10 and thus in the same layer. Instead of a single layer or sandwich layer with the first arrangement 10 and the second arrangement 11 a floor with multiple support structure layers of that kind would also be conceivable in accordance with the respective purpose of use.

As is evident from the detailed illustration of the second grating arrangement 11 according to Figure 6 the slots 18, 19 extend approximately at right angles to a plane of the floor or to the profile member longitudinal direction. The slots 18 and 19 in that case extend from a profile member end face at the floor side up to approximately the centre of the profile members 14, 15, whereby in the assembled state all profile members come to lie at the same level.

As evident from Figure 7, the profile members of the second arrangement are respectively disposed between two profile members of the first arrangement. In Figure 7, a profile member adjacent to the profile member 12 is denoted by 12'. The profile member 14 of the second arrangement is disposed approximately centrally between the profile members 12 and 12' which are spaced from one another at a spacing a . The central positioning and alignment is indicated by a spacing $a/2$. The profile spacing a can be between 5 centimetres and 20 centimetres and preferably between 10 centimetres and 15 centimetres. In the present embodiment the profile members of the second arrangement - by contrast to the preceding embodiment according to Figure 6 - are at the same time joined with the respective identically oriented profile members of the first arrangement to form the support structure. The thereby formed walls or wall segments of the segment arrangement (illustrated in Fig. 7 by way of example by the profile member 14) are mechanically positively connected by way of the slots with the walls or wall segments, which are formed by the profile members 12 and 13, of the first arrangement. In order to fix a support structure composed of the first and second arrangements the second arrangement is advantageously welded to the first arrangement.

Patent claims

1. Floor for a lift cage with a flat lower side (7) and a flat upper side (8) arranged at a spacing from the lower side, wherein arranged between the upper side and the lower side is a support structure (6) having a first arrangement (10) with walls or wall segments which are approximately uniformly distributed with respect to a plan view and which predetermine a first packing density, characterised in that the support structure (6) has for local reinforcement of the floor a second arrangement (11) which is disposed in the first arrangement (10) and is superimposed on the first arrangement in a region of overlap, wherein the support structure in the region of overlap has a second packing density which is higher by comparison with the first packing density and that with respect to the plan view the support structure (6) has outside the region of overlap the first packing density at least in a region.
2. Floor according to claim 1, characterised in that at least the first arrangement and preferably equally the second arrangement (11) each consist of an intersecting profile members (12, 13, 14, 15) which stand on edge, in the form of a grating.
3. Floor according to claim 1 or 2, characterised in that each profile member (11, 15) of the second arrangement is disposed between each two adjacent profile members (12, 13) of the first arrangement.
4. Floor according to claim 2 or 3, characterised in that not only the profile members (12, 13) of the first arrangement, but also the profile members (14, 15) of the second arrangement are provided with slots (16, 17, 18, 19), which are associated with intersection points, for reception of intersecting profile members.
5. Floor according to any one of claims 2 to 4, characterised in that the floor has a width and a length and the profile members (14, 15) of the second arrangement respectively extend in profile length direction less than half the width or length of the floor.
6. Floor according to any one of claims 1 to 5, characterised in that the profile members (12, 13) of the first arrangement (10) and the profile members (14, 15) of the second arrangement have the same material thickness.
7. Floor according to any one of claims 1 to 6, characterised in that the local reinforcement is

arranged centrally in the floor (5) with respect to a plan view.

8. Lift with a lift cage having a floor (5) according to any one of claims 1 to 7.
9. Lift according to claim 8, characterised in that the lift (1) has in the shaft floor a buffer element (9) for catching the lift cage (3) in an end position and that the lift cage is so formed that the local reinforcement is arranged in a region of overlap with respect to the buffer element (9) and the buffer element (9) in the end position is supported directly on the floor (5).