

Lift with minimum lift shaft pit depth and with permanent protective space

This invention relates to a lift which has either no shaft pit at all or, however, only a lift shaft pit with minimal pit depth. For constructional reasons in most conventional lift constructions the region above or the region below the lift cage has to be accessible and, in particular, regardless of where the lift cage happens to be located. If the region below the lift cage is to be accessible, there is the risk that a person, who is present there, is injured by downward travel of the lift cage unintentionally taking place. Safety precautions are therefore necessary to reliably prevent such an event. Accordingly, a temporary or permanent protective space has to be present of at least the size of a block F with the minimum dimensions of 0.5 metres x 0.6 metres x 0.8 metres on the upper cage side or 0.5 metres x 0.5 metres x 1.0 metre on the lower cage side so that even in the case of an upward or downward movement - which in fact is highly improbable - of the lift cage a service operative would be enclosed by the protective space and therefore protected from injuries. These protective measures as well as the constructions of most lifts prevent lift cages from being able to be moved down until quite close to the shaft floor or to be moved in upward direction until quite close below the shaft ceiling. In other words, the lift cage is always longer by a certain minimum dimension than the effective travel path of the lift cage and, more precisely, also longer than the effective maximum distance between lift cage roof in the uppermost position of the lift cage to below the floor of the lift cage in its lowermost position. This fact in many cases makes installation of a lift impossible, because it is not possible to realise the shaft pit to the necessary depth or the shaft head to prescribed shaft head height for constructional reasons.

As a central prescription it is necessary in new lift installations to avoid risk of crushing in the end settings of the lift cage, thus by free spaces or protective niches. Due to the wording of No. 2.2 in the Lifts Ordinance and EEC lift guidelines this means that for lawmakers optimum safety is achieved with a compulsory prescribed protective space. Thus, in Swiss Lift Ordinance 2.2 it states with respect to danger to persons outside the lift car, state of 1 July 2010: "Lifts are to be so designed and constructed that risks of crushing in the end settings of the lift car are excluded. This object is achieved if a free space or a protective niche is present either side of the end settings. If in exceptional cases, particularly in existing buildings, this solution cannot be realised, then other suitable means for avoidance of this risk can be provided, in which case the State Secretary for Economy is granted the possibility of prior consent."

The region below the lift cage in the lowermost access level represents a particular problem. Since it can commonly happen that there is somebody standing in the shaft pit, thus on the floor of the lift shaft, whether for maintenance purposes or cleaning purposes, strictly prescribed temporary or permanent protective precautions must be present to reliably prevent this person from being able to be injured or crushed in the case of unintended downward travel of the lift cage.

The object of the present invention is accordingly to create a lift without a lift shaft pit or with a minimal lift shaft pit depth, which nevertheless may permit the prescriptions of the Lift Ordinance with respect to free spaces against the risk of crushing to be fulfilled.

This object is fulfilled by a lift with a lift cage which is movable in a lift shaft to a plurality of access levels, and with a plurality of shaft doors which are arranged on the respective access levels and close off access to the lift shaft. The lift is distinguished by the fact that at least the shaft door of the lowermost access level does not have emergency unlocking means or is permanently locked.

By emergency unlocking means there is understood here an unlocking device which is actuable by a service operative for inspection or maintenance purposes from outside the lift shaft in order to unlock a shaft door and thus free access to the lift shaft. The emergency unlocking means is usually designed in such a manner that a service operative can unlock the emergency unlocking means by way of a box spanner which is introducible into a spanner opening in the region of a shaft door to be opened. The invention is not confined to this concrete embodiment of emergency unlocking means. It is open to the expert to realise further alternative embodiments of emergency unlocking means.

By permanently locked shaft door there is to be understood in connection with the present invention a shaft door which does not have emergency unlocking means. Accordingly, a permanently locked shaft door is not unlockable outside the lift shaft for inspection or maintenance purposes. Obviously, a shaft door lying on an access level moved to by a lift cage is temporarily unlocked in order to free access for passengers into or out of the lift cage. Moreover, provision is made for temporarily unlocking a permanently locked shaft door for the purposes of evacuation of passengers trapped in the lift cage. For that purpose the permanently locked shaft door can be unlocked from the interior of the lift

shaft or from the lift cage interior. In the case of evacuation a permanently locked shaft door is equally unlockable by way of a control of the lift if the shaft door is appropriately furnished with an electromechanically actuatable unlocking device. The control is then preferably set by a service operative into an evacuation mode in which the temporary unlocking of a permanently locked shaft door is only unlockable. In normal operation a permanently locked shaft door thus remains always locked apart from the above-mentioned exception of a lift cage standing opposite and is also not unlockable from outside the lift shaft for inspection or maintenance purposes.

By access to the lift shaft there is understood in connection with the invention a capability of walking into the lift shaft on the shaft floor or on the cage roof, wherein access to the shaft floor is made impossible by technical measures. For example, falling into the lift shaft below a lift cage onto the shaft floor from an access level above the lowermost access level does not count as access to the lift shaft.

An advantage of the permanently lockable shaft door on the lowermost access level is that access to the shaft pit is denied and thereby access to the region below the lift cage is made impossible. Consequently, a protective space does not have to be provided below the lift cage and a minimal lift shaft pit depth can be realised. In a particularly advantageous design of the lift shaft the shaft pit can even be eliminated.

By shaft pit there is understood here that sub-region of the lift shaft which in the case of a stop of the lift cage at the lowermost access level lies below the lift cage.

The lift is designed so that all maintenance operations to devices in the interior of the lift shaft can be carried out from the lift cage or by way of the lift cage. Accordingly, the permanent protective space F consists of the entire interior of the lift cage itself or is formed by way of the lift cage.

In a preferred embodiment of the lift one or more shaft doors above the shaft doors of the lowermost development plane have emergency unlocking means.

In a particularly preferred embodiment of the lift solely the shaft door of the uppermost access level has emergency unlocking means or all shaft doors of access levels thereunder are permanently locked. It is thus ensured that access to the shaft can take

place only above the lift cage or in the lift cage.

In yet another, particularly preferred embodiment of the lift all shaft doors are permanently lockable. With such a configuration a particularly deep or minimal shaft head height is additionally capable of realisation, since also the region above the lift cage remains denied to the service operative for access purposes and thus the protective space F, which is to be provided permanently, above the lift cage is eliminated.

If the lift cage stands in its lowermost access level and the distance from the floor of the lift shaft disposed thereunder is, for example, merely still 2 centimetres then also a person outside the lift cage is never at risk, because under no circumstances can any person ever climb down into the lift shaft pit, since this access is prevented by the claimed technical measures. The required free space or protective space for the service operative is formed by the lift cage itself when the operative is in the lift cage, or is formed above the same if the lift shaft head has a sufficient height, so that the required protective space on reaching the uppermost development plane is present. However, there can only be a question of a protective space formed by the lift cage itself if all maintenance operations can be performed from the interior of the lift cage and therefore a presence in the lift shaft, whether above or below the lift cage, is never necessary and therefore this access is made impossible from the outset by technical measures.

The principle is shown in the drawings and explained in the following on the basis thereof, wherein:

Figure 1 shows a lift with four access levels, with minimal lift shaft pit depth, with the lift cage in the uppermost access level;

Figure 2 shows this lift with four access levels, with the lift cage in the second-uppermost access level; and

Figure 3 shows this lift with four access levels, with the lift cage in the lowermost access level.

Figure 1 shows a cross-section through a building with four storeys 1 to 4, which are all accessed by the lift cage 6 of the lift. The principle on which this invention is based is

explained by way of this drawing. In that case, however, it is clear that such a lift can be guided over fewer or also many more storeys. In addition, the drive can be resolved differently from that illustrated here and includes all known drive variants, regardless of kind. The construction shown here is thus solely an exemplifying construction and is not in any way to be understood as restricting the scope of protection. The lift shaft 5 belonging to this lift is here virtually the same height as the distance between the floor 7 of the lowermost access level 1 and the ceiling 19 of the storey of the uppermost access level 4. The lift cage 6 is here in its uppermost position, i.e. on the uppermost access level 4. If the lift cage 6 subsequently lies in its lowermost position virtually on the lowermost access level 1 then the cage floor thereof, which does also have a certain thickness, lies by its upper side in the same plane as the finished floor covering 7 of the lowermost access level 1. The protective space F of this lift is always and permanently formed by the lift cage 6 itself, as will be still explained. The drive of this lift is carried out in the illustrated example by a drive unit in the form of a gearless external rotor, which is fastened in a frame 9 to the shaft wall and is supported on guide rails (not illustrated). The external rotor forms a drive tube 16 and the support means 10, which on the one hand carry the lift cage 6 and on the other hand the counterweights 15, run over this. The lift cage 6 is as usual guided along rails which are anchored to the lift shaft wall, but are not illustrated here. The lift cage 6 can in the illustrated example be moved past this drive unit. A wall part 18 of the lift cage 6 can be removed and then access to parts, which have to be maintained, is ensured for the service operative 20, so that the maintenance operations can be carried out by him or her from the lift cage 6, as described in detail in, for example, WO 2008/095324.

What is the situation with regard to the region below the lift cage? If anybody is there then this person would be crushed on downward movement of the lift cage to the lowermost access level 1. In the lowermost position of the lift cage 6 it virtually stands on the floor 8 of the lift shaft 5, as can be seen on the basis of Figure 3. How is it possible to thus securely and effectively prevent anybody from being trapped between the underside of the lift cage 6 and the floor 8 of the lift shaft 5. According to the invention that is managed in such a way that the entire region 17 below the lift cage 6, as it is designated in Figures 1 and 2, is safeguarded by technical precautions so as to never be able to be entered. Consequently, nobody can ever be in this region 17 and therefore also nobody can ever come to harm by complete downward movement of the lift cage 6 to the lowermost access level 1.

These technical precautions consist in that at least the shaft door 11 is permanently lockable. In a particularly preferred alternative embodiment the shaft doors 11 to 13, with the exception of the door 14 of the uppermost access level, are not opened as long as the lift cage 6 is stopped at the corresponding access level. In conventional lifts the shaft doors can usually be unlocked and opened in the case of emergency by a box spanner. Depending on where the lift cage is currently located it is then possible when the shaft door is open to look onto it from above or from below onto the lift cage located further above and access into the lift shaft is possible through any shaft door, even access into the lift shaft below the lift cage. If a conventional lift thus has a shaft pit, then this is always accessible in that the lift is moved into a position above the lowermost access level and thereafter the lowermost shaft door can be unlocked, whereafter it is possible to climb down into the shaft pit, for example to carry out whatever maintenance operations there, in order to clean something or, for example, in order to extract an object which unintentionally fell into the pit. This access has to be accompanied on every occasion by a temporary protective precaution which ensures that the lift cage cannot travel beyond the standing region in the shaft pit and thus that a minimum protective space F below the lift cage of at least the size of a block F with the minimum dimensions of 0.5 metres x 0.6 metres x 1.0 metre is always present. Thus, for example, a temporary support is mounted or downward travel of the lift cage is blocked by a temporary lock so as to ensure the presence of the protective space F.

In the case of the lift presented here, however, walking into the region 17 below the lift cage 6 is in general, i.e. in all conceivable cases, made absolutely impossible by way of technical precautions. Accordingly, there is also at no time a risk of a person being able to come to harm below the lift cage 6 by downward travel thereof. As mentioned, the technical precautions consist in that at least the shaft door 11 is always locked when the lift cage 6 is not currently located at the relevant access level. Thus, only when the lift cage 6, for example, stops on the access level 1 can the shaft door 11 present thereat open. At least the lowermost shaft door 11 accordingly has absolutely no emergency unlocking even if intended and therefore can never be opened from the outside if the lift cage is not currently stopped in front of this shaft door 11. The lift cage 6 can move away only if the previously opened shaft door 11 is firstly closed again and locked. The shaft door 11 offers solely access to the interior of the lift cage 6, but never into the interior of the lift shaft 17 above or below the lift cage. Only one or more shaft doors 12-14 allow both access to the interior of the lift cage 6 and access to the region above the lift cage 6

according to whether or not these shaft doors 12-14 have emergency unlocking means. Access to the lift cage 6 is made possible obviously when the lift cage 6 is stopped at one of the access levels 2-4. If, however, the lift cage 6 is stopped at an access level 1-3 below a shaft door 12-14 which is unlockable in emergency, the respective shaft door 12-14, by way of an intrinsic emergency unlocking, if present, makes possible access to the lift shaft 17, but exclusively to the region above the lift cage 6 and never below the same. In the case of a shaft door 12, which has emergency unlocking means, directly above the lowermost shaft door 11 and in the case of a position of the lift cage 6 above the shaft door 12, for example, access into the lift shaft 17 is equally impossible, since falling into the shaft pit does not count as access to the lift shaft.

The lift shaft 17 is thus accessible solely by way of the upper shaft doors 12-14, by way of emergency unlocking means, which is not intentionally present at least at the lowermost shaft door 11. Nothing can ever happen below the lift cage 6, because this region is for technical reasons never accessible and a protective space below the lift cage is therefore superfluous. The service operative is present on the cage with sufficient protective space or appropriate protective measures or only in the interior of the lift cage 6, which at the same time forms the permanent protective space. The special feature of a permanent protective space consists in that protection to the full scope is always and generally guaranteed in the lift cage without any form of measures having to be initially undertaken and without any form of special precautions or changes having to be initially carried out. A protective space, thereagainst, protruding only partly into the lift cage counts according to the regulations as temporary and thus not as a permanent protective space, because something firstly has to happen at the cage roof in order for it to arise. Similarly, only a temporary protective space is present when, for example, initially a safety circuit has to be activated or a drive has to be blocked or a support has to be set in place or folded down or any other kind of measures have to be undertaken in order to ensure the presence of a protective space.

In a further embodiment of the lift one or more shaft doors 12-14 above the shaft door 11 of the of the lowermost access level 11 have emergency unlocking means.

In yet another embodiment of the lift solely the uppermost shaft door 14 has emergency unlocking means.

In yet a further embodiment of the lift all shaft doors 11-14 are permanently lockable. In this embodiment neither access below the lift cage 6 to the lift shaft pit nor access above the lift cage 6 to the lift shaft 17 is possible. Thus, for maintenance purposes only the cage interior can be reached. Correspondingly, the lift cage 6 has a maintenance opening so as to enable maintenance operations from the cage interior of the lift cage 6.

In the three above-mentioned embodiments of the lift in addition to the lowermost shaft door 11 also further shaft doors 12-14 are permanently lockable. Correspondingly, these additional permanently lockable shaft doors 12-14 open only when a lift cage 6 travels into the region of the respect access level 2-4 or stops at this access level 2-4. Those shaft doors 12-14, which have emergency unlocking means, then free access to the lift shaft 17 in the region above the lift cage 6 when the lift cage 6 is positioned at an access level 11-13 below the respective shaft door 12-14.

For constructional reasons at least the lowermost shaft door 11 cannot, in fact, be unlocked if the lift cage 6 is not at the level of the shaft door concerned. Thereagainst, one or more upper shaft doors 12-14 are unlockable from outside depending on whether they have emergency unlocking means. If the lift cage 6 has stopped in front of a shaft door, the shaft door opens in conventional manner. In this case, the service operative can go into the interior of the lift cage 6 and check everything at the shaft door as well as at the lift cage door, which is also visible to normal lift users. However, in this position of the lift cage the service operative cannot check or repair at least the mechanism and control of the shaft doors 11. If further, upper shaft doors 12-14 are permanently lockable then also the mechanism and control thereof are checkable or repairable neither from outside nor from the cage interior. The door drive and the locking mechanism of the shaft doors 11-14 are disposed, in particular, above the interior ceiling of the lift cage. In order that these parts are nevertheless accessible for maintenance and possibly necessary repair this lift allows the possibility of movement into the service mode from the closed lift cage. For that purpose the lift cage 6 can have, for example, a removable cover part, wall part or light part, behind which the control of the lift drive for the service mode is concealed, for example in the form of a stationary control strip or a removable control strip, which hangs at a cable, so that the service operative has freedom of movement and can be in any desired position in the interior of the closed lift cage and nevertheless conveniently actuate the control and travel up and down in the service mode. The control unit can also be installed in a niche in the interior of lift cage, which is closable by a sliding door or panel

door, or by a separate cover which can be fitted in place. Moreover, the control unit can also be realised in that plug positions are provided at the inner side of the lift cage, for example USB plug positions. The service operative then brings his or her control apparatus with them or stores this at a suitable place in the lift, and the operative then produces by way of the plug positions the electrical connections with the drive and its electronic control system so that the operative can travel up and down in the closed lift cage in the service mode. The control unit can also be realised wirelessly. The service operative then has a transmitter which acts on the lift cage by way of a wireless interface. Finally, the control unit for travel of the closed lift cage in the service mode can also function through a specific button combination at an already-present keyboard, or through specific button combinations at a separate keyboard plugged into the lift cage in a niche. The service mode makes it possible to move the lift slowly as desired and stop it at any desired position. Correspondingly, the service operative can, from a specific access level in the service mode, move up somewhat slowly from the closed lift cage, for example approximately a metre, and then open the lift cage door. The operative is located directly in front of the shaft door drive in the upper region of the shaft doors of the associated access level. The shaft doors are now somewhat further down relative to the lift cage and the service operative is granted ideal access to all components of the shaft door drive. If necessary, the operative can close the cage doors again and travel somewhat further upwards or downwards centimetre-by-centimetre to any point desired by him or her. At the desired point the operative can thereafter open the cage doors again and carry out work.

If for whatever reasons an object should drop down between the cage door and a shaft door into the lift shaft then this can be secured again in that the floor of the lift cage 6 can be partly or entirely removed from the lift cage. The floor of the lift cage can for that purpose have slides or can have door panels 22 which can be folded up into the lift cage 6, so that the entire lift shaft floor is reachable by a tool and objects can be secured by him or her. In addition, if, for example, a liquid has been spilled or oil has run out then this could be readily removed from the shaft floor via this opening hatch.

Patent claims

1. Lift with a lift cage (6), which is movable in a lift shaft (17) to a plurality of access levels (1-4), and with a plurality of shaft doors (11-14), which are arranged on the respective access levels (1-4) and close off access to the lift shaft (17), characterised in that at least the shaft door (11) of the lowermost access level (1) is permanently lockable.
2. Lift according to claim 1, characterised in that one or more shaft doors (12-14) above the shaft door (11) of the lowermost access level (1) have emergency unlocking means.
3. Lift according to one of claims 1 and 2, characterised in that solely the uppermost shaft door (14) has emergency unlocking means.
4. Lift according to claim 1, characterised in that all shaft doors (11-14) are permanently lockable.
5. Lift according to any one of the preceding claims, characterised in that the floor of the lift cage (6) is at least partially openable so that when the lift cage (6) is stopped on the lowermost access level (1) the region of the shaft floor (8) of the lift shaft (17) is accessible for maintenance and servicing operations.
6. Lift according to claim 5, characterised in that the floor of the lift cage (6) has one or more panels which can be folded up in the lift cage interior in order to open the floor.
7. Lift according to claim 5, characterised in that the floor of the lift cage (6) has one or more base regions which are constructed as slides so that these are laterally displaceable in order to open the floor.
8. Lift according to any one of the preceding claims, characterised in that the lift cage (6), when the cage doors are closed, is controllable from its interior to be movable in the service mode.
9. Lift according to claim 8, characterised in that the lift cage (6), when the cage doors are closed, is controllable outside its interior to be movable in the service mode in that a

cable-supported control apparatus is accommodated in the interior of the lift cage (6) in an inserted niche which is covered and secured by a cover, a door or a slide and the control apparatus is removable when the niche is opened.

10. Lift according to claim 8, characterised in that the lift cage (6), when the cage doors are closed, is controllable from its interior to be movable in the service mode in that the lift cage has in its interior plug positions for creating a cable connection with portable control apparatus.

11. Lift according to claim 8, characterised in that the lift cage (6), when the cage doors are closed, is controllable from its interior to be movable in the service mode in that a wireless transmitter acts as control apparatus and the lift cage (6) is equipped with a wireless interface to a control of a lift drive.

12. Lift according to claim 7, characterised in that the lift cage (6), when the cage doors are closed, is controllable from its interior to be movable in the service mode in that a specific button combination for control of the service mode is assigned to the existing or a special keyboard in the interior of the lift cage (6).