

Installation with support means for driving a lift cage, and corresponding support means

The invention relates to a lift installation according to the introductory part of claim 1 with means for driving a lift cage and a corresponding support means according to the introductory part of claim 10. The invention additionally relates to a method according to claim 12 for providing overrun protection in a lift installation.

Lift installations comprise support means so as to be able to support and set in motion a lift cage. For this purpose the support means typically runs around a drive pulley driven by a drive. In most cases at least one counterweight is provided and the lift cage and counterweight move in opposite sense as soon as the drive sets the drive pulley in motion. The traction between the drive pulley and the support means is designed so that even when the lift cage is loaded the rotation of the drive pulley is converted, as free as slip as possible, into a movement of the support means.

With present-day lift installations the lift cages are lighter than in the case of conventional installations. The risk therefore exists that in the event of failure of the drive control the drive pulley is driven on and an empty, or almost empty, lift cage is also then conveyed in the direction of an upper shaft end when the counterweight has already moved against a buffer and no longer contributes to lifting the lift cage. A spacing between lift cage and shaft end therefore always has to be ensured, since this spacing defines a protective space which, for example, protects assembly personnel against being caught. Penetration of the lift cage into this protective space has to be prevented. This problem is amplified due to the fact that modern support means are provided with casings or surface profiles which, due to the high coefficients to friction, enable a high level of traction.

It is therefore the object of the invention to offer a reliable solution for use in a lift installation which makes it possible to prevent drawing up the empty or almost empty lift cage (termed overrunning) in the case of failure of the drive control, faulty operation or other faults in the lift installation. Moreover, the invention shall also be usable for preventing overrun of the counterweight in a lift shaft.

According to the invention this task is fulfilled, for a lift installation, by the features of claim 1.

According to the invention this task is fulfilled, for a support means, by the features of claim 10.

This task is fulfilled by a method according to the invention with the features of claim 12.

Preferred developments of the invention are defined by claims 2 to 8 dependent on claim 1, by claim 10 dependent on claim 9 and by claim 12 dependent on claim 11.

The invention is described in more detail in the following on the basis of examples and with reference to the drawing, in which:

- Fig. 1A shows a schematic sectional view of a lift cage according to the invention, wherein a lift cage is disposed in a lower end position in the lift shaft;
- Fig. 1B shows a schematic sectional view of the lift cage according to Fig. 1A, wherein the lift cage is disposed in an upper end position in the lift shaft;
- Fig. 1C shows a schematic sectional view of the lift installation according to Fig. 1A, wherein the lift cage is shown in an overrun situation;
- Fig. 2 shows a schematic view of a further lift installation according to the invention;
- Fig. 3 shows a schematic perspective view of a section of a first belt-like support means according to the invention; and
- Fig. 4 shows a schematic side view of a section of a second belt-like support means according to the invention.

Components which are the same and have similar or same effect are provided in all figures with the same reference numerals.

A first form of embodiment of the invention is illustrated in Figures 1A to 1C. The example shown in Figures 1A to 1C is a conventional lift installation 10 comprising a lift cage 11

which is looped underneath, supported and moved by a support means 13. The support means 13 is so arranged that it is fastened at the two free ends in or at the lift shaft 14. These fastening points are denoted by F. The support means 13 runs downwardly along the lift shaft 14 considered from the first fastening point F. It then loops under the lift cage 11, which has rollers 11.2. On the other side of the lift cage 11 the support means 13 runs upwardly and loops around a drive pulley 16, which, for example, can be driven by a motor 15. Considered from the drive pulley 16, the support means 13 again runs downwardly, loops around a counterweight roller 12.2 at which the counterweight 12 hangs, and extends from there to the second fixing point F.

In the illustrated example of embodiment a shaft ceiling 14.1 or a form of bridge or beam, which can carry parts of a drive, is arranged at the upper shaft end. The region over which the lift cage 11 can move is thereby upwardly limited, wherein in the lift shaft 14 in uppermost position (denoted by X in Figs. 1B and 1C) is defined which may not be overrun. The invention is obviously not restricted to lifts with an engine room, but is equally usable for lifts without engine rooms. In addition, buffers 11.1 for the lift cage 11 and buffers 12.1 for the counterweight 12 are provided.

In Figures 1A to 1C it is indicated that the support means 13 comprises a safety section 17 which is so arranged that the safety section 17 comes into interaction with the drive pulley 16 when the lift cage 11 after overrunning the upper position X approaches the upper shaft end 14.1 or if the counterweight 12 after overrunning an upper position W approaches the upper shaft end 14.1. According to the invention the safety section 17 is so constructed that a slipping through results due to interaction between the drive pulley 16 and the support means 13. Travel of the cage into the uppermost region of the shaft is thereby made impossible. The following descriptions essentially refer to overrunning of the lift cage 11. In terms of meaning there is understood, without being specially mentioned, also overrunning of the counterweight 12 in reverse direction.

Slipping through describes a state in which the drive pulley 16 rotates without the support means 13 resting on the drive pulley 16 making a substantial movement. A friction force present between drive pulley 16 and support means 13 or safety section 17 is not sufficient to move the support means 13. This state of slipping through can also be termed high slip.

By slip there is denoted the behaviour of technical element - in this case the support belt 13 - which should actually be moved in synchronism with another element - in this case the drive pulley 16 - and in the case of which, however, the movement departs from this synchronous relationship. In that case the driven element usually always 'limps' somewhat 'behind' the driving element. In normal operation of a lift installation this slip is very low.

The function of the overrun protection is now explained in more detail by reference to Fig. 1C, which by contrast to the two 'normal states' shown in Figures 1A and 1B shows the moment of overrunning the upper position X.

In Fig. 1C there is schematic indication of the moment when, in the case of a lift installation 10 according to the invention, the lift cage 11 overruns the upper position X. This can occur, for example, because the drive is defective and does not stop in the usual manner when the lift cage 11 has reached the uppermost floor. If the drive 15 runs on, then the drive pulley 16 draws the support means 13 and thus also the lift cage 11 further upwardly.

According to the invention the support means 13 has a safety section 17 which is so arranged that this safety section 17 interacts with the drive pulley 16 when the lift cage 11 approaches the upper shaft end (for example, 14.1). In Fig. 1C there is shown a state in which the safety section 17 of the support means has already run onto the drive pulley 16. Since the safety section 17 is intentionally constructed so that a higher degree of slip between the drive pulley 16 and the support means 13 results, the drive is no longer in a position of conveying the lift cage 11 further upwardly.

In that case the safety section 17 is constructed so that slipping through occurs under the following preconditions:

- (1) The counterweight 12 no longer pulls on the support means run 13.1 after the lift cage 11 has overrun the uppermost position X, since the counterweight 12 sits on a counterweight buffer 12.1. In Fig. 1C it is indicated that tension is no longer on the run 13.1 from settling of the counterweight 12 on the buffer 12.1.
- (2) The lift cage 11 exerts a certain minimum total weight producing a downwardly directed counter-force G at the support means run 13.2.

This means that the safety section 17 has to be constructed so that even in the case of an empty lift cage 11 or an only lightly loaded lift cage 11 a strongly pronounced degree of slippage sets in as soon as the safety section 17 comes into interaction with the drive pulley 16. Since at this point in time the counterweight 12 is seated on the counterweight buffer 12.1 and consequently merely the mass of the support means run 13.1, which is at the counterweight side, acts from the counterweight side on the drive pulley 16 a maximum permissible coefficient of friction between safety section 17 and drive pulley 16 is derived from the ratio of the weight of the empty lift cage 11 to the weight of the support means run 13.1 at the counterweight side. Obviously in that case the respective mode of suspension, a looping angle, etc., have to be taken into consideration. The safety section 17 is correspondingly constructed.

Another lift installation 10 according to the invention is shown in Fig. 2. In this case the support means 13 is connected at one end F1 with the lift cage 11 and at the other end F2 with the counterweight 12. The lift installation 10 thus does not have underslinging of the lift cage 11. A support means 13 according to the invention can also be used in this form of configuration. The safety section 17 is, as shown, provided at at least one point of the support means 13 located at a spacing A in front of the end F1 of the support means. The spacing A is dependent on the specifications of the lift installation. The available shaft head height, the arrangement and construction of the drive or the travel speed as well as further data conclusively determine this spacing A. A second safety section 17 can be constructed at a comparable spacing from the end F2 of the support means, as indicated in Fig. 2. Overrunning of the counterweight 12 in the shaft head is thus reliably prevented when the lift cage 11 is seated on the buffers 11.1 at the cage side.

In a particularly preferred form of embodiment of the invention the safety section 17 has a length L (parallel to a longitudinal axis Y of the support means 17) corresponding with at least $3.14 \cdot (B)$ times the value of radius R of the drive pulley 16. These figures, however, apply only in the case of lift installations in which the support means 13 loops around the drive pulley by 180° . The determination of the length L of the safety section 17 is carried out with consideration of the drive pulley radius R, a looping angle of the drive pulley, a permissible overrun travel, a buffer stroke and the consideration of dynamic stopping paths as well as a safety margin. The length L of the safety section 17 is so designed in every case that the support means cannot sway back and forth as a consequence of dynamic processes between the safety section 17 and the remaining support means region. In a

concrete example the length of the safety section 17 is 200 millimetres for a drive pulley radius R of 35 millimetres.

The invention can use not only belt-like support means 13, as shown in Fig. 3, but also cable-like support means, for example unsheathed steel cables, or the like.

If belt-like support means 13 are used, then these usually have longitudinal or transverse ribs as surface structure on one side. The belt-like support means 13 shown in Fig. 3 has a poly-V-structure with several longitudinal ribs 13.3 extending parallel to the longitudinal axis Y of the support means 13. In a preferred form of embodiment the longitudinal or transverse ribs are of different construction, or entirely absent, in the region of the safety section 17. Fig. 3 shows a form of embodiment in which one of the longitudinal ribs 13.5 extends over the entire length of the support means 13 (inclusive of the length L of the safety section 17). The other longitudinal ribs have an interruption in the region of the safety section 17. Through such a form of embodiment of the support means 13 it is ensured on the one hand that even when the safety section 17 of the support means 13 interacts with the drive pulley 16 a sufficient lateral guidance is guaranteed by the longitudinal rib 13.5, whilst on the other hand an 'intended slipping' of the support means due to deliberately provoked slippage comes about since the traction between drive pulley 16 and safety section 17 is less than between another section of the support means 13 and the drive pulley 16.

A further belt-like support means 13 according to the invention is shown in Fig. 4. The illustrated support means 13 is a form of cogged belt with teeth 13.6 extending perpendicularly to the longitudinal direction Y of the support means 13. In the region of the safety section 17 having the length L the surface structure of the support means 13 is changed so as to reduce the traction between a drive pulley 16 and the support means 13 when the safety section 17 runs onto the drive pulley 16. In the illustrated example the teeth 13.6 of the cogged belt were reduced in their tooth height or approximately removed.

In another form of embodiment the belt-like support means 13 comprises a traction-reducing coating in the region of the safety section 17. By this means, as well, the traction can be selectively reduced so as to trigger slipping-through in the case of overrunning.

Belt-like support means 13 are particularly preferred in which not only the surface structure

in the region of the safety section 17, but also the surface properties were changed (for example by application of a traction-reducing coating, such as, for example, a slide means).

There can thus be applied, for example by a spray, a slide means which has good adhesion to the support means 13 and which changes the surface property in the safety section 17. Advantageously, the adjoining regions of the support means 13 are covered beforehand by means of protective tape or template. The protective tape or the template can be removed again after a certain drying time of the adhering slide means.

This method is particularly advantageous, since after assembly of the lift installation the installation can be measured or investigated in order to be able to then establish the position of the safety section 17 at the support means 13. Then, as described, the safety section can be 'produced' in situ and be tested after drying of the slide means.

If cable-like support means 13 are used, then support means 13 comprising a traction-reducing coating in the region of the safety section 17 are particularly suitable.

According to the invention support means 13 constructed especially for use in a lift installation 10 are also provided. The above-mentioned factors (weight of the lift cage, looping around of the drive pulley 16, property of the drive pulley 16, etc.) must be taken into consideration in the design of the support means 13. In order to ensure the safety action in the case of overrunning, the support means 13 according to the invention must comprise a safety section 17 and have in the region of the safety section 17 a surface structure and/or surface property different than in other length sections of the support means 13.

The length L of the safety section 17 preferably extends parallel to the longitudinal axis Y of the support means 13. The ratio between the length L and the overall length of the support means 13 is dependent on the conveying height, the form of lift suspension and the drive pulley radius R. Thus, for example, in the case of a conveying height of 20 metres the support means 13 is approximately 50 metres long when the cage is underslung (see Fig. 2). In the case of drive pulley radius of 35 millimetres a length L of the safety section 17 of preferably approximately 200 millimetres results. The length ratio between the safety section 17 and the overall length of the support means 13 thus is, in

this example, $0.2/50 = 0.4\%$.

With all these considerations, however, it must be taken into account that the load-bearing capability of the support means 13 must not be put at risk by the application or provision of the safety section 17. For this purpose, a belt-like support means 13 can be equipped with, for example, steel cables 13.4 or steel strands, as shown in Fig. 3.

The invention thereby makes possible that the section of the support means where the safety section 17 is provided interacts with the drive pulley only in an emergency situation, namely on overrunning of the upper position X. In normal operation the safety section 17 never runs onto the drive pulley 16.

The lift installation is preferably designed so that the drive is switched off by a running time control and/or a slipping-through control and/or a torque monitoring or other safety circuits as soon as the interaction between safety section 17 and drive pulley 16 occurs. The torque monitoring detects, for example, when as a consequence of a sudden change in torque - because the drive capability suddenly changes - the motor current rapidly changes and shuts down the drive. Through these supplementary measures, but also particularly through the arrangement of the safety section 17 according to the invention, the lift installation is protected against further damage such as, for example, excessive heating of the drive and the support means. If, for example, there is slipping through of the drive pulley 16 in the case of a lift installation without safety section 17 there results in short time a strong heating up of the support means region concerned, which in certain circumstances can lead to melting of a casing of the support means, in the contact region of support means with respect to the drive pulley. The construction of the safety region 17 with the illustrated traction-reducing measures significantly reduces the friction work and thus the heat loading.

Patent claims

1. Lift installation (10) with support means (13) and drive pulley (16) for driving the support means (13), wherein the support means (13) at least partly loops around the drive pulley (16), characterised in that the support means (13) comprises a safety section (17) which produces a slipping through by interaction between the drive pulley (16) and the safety section (17) of the support means (13).
2. Lift installation (10) according to claim 1, characterised in that the support means (13) has in the region of the safety section (17) a surface structure and/or surface property different than in other length sections of the support means (13).
3. Lift installation (10) according to claim 1 or 2, characterised in that the safety section (17) has parallel to a longitudinal axis of the support means (17) a length (L) corresponding with at least $3.14 (B)$ times the radius (R) of the drive pulley (16).
4. Lift installation (10) according to claim 1, 2 or 3, characterised in that the support means (13) is a belt-like support means.
5. Lift installation (10) according to claim 1, 2 or 3, characterised in that the support means (13) is a cable-like support means.
6. Lift installation (10) according to claim 4, characterised in that belt-like support means (13) has longitudinal or transverse ribs as surface structure, wherein the longitudinal or transverse ribs are of different construction or entirely absent in the region of the safety section (17).
7. Lift installation (10) according to claim 4 or 6, characterised in that the belt-like support means (13) comprises a traction-reducing coating in the region of the safety section (17).
8. Lift installation (10) according to claim 5, characterised in that the cable-like support means (13) comprises a traction-reducing coating in the region of the safety section (17).

9. Lift installation (10) according to one of claims 1 to 8, characterised in that the safety section (17) interacts with the drive pulley (16) when the lift cage (11) after overrunning an upper position (X) or a counterweight (12) after overrunning an upper position (W) approaches an upper shaft end (14.1).
10. Support means (13) for use in a lift installation (10) in which the support means (13) at least partly loops around a driven drive pulley (16) and the drive pulley (16) drives the support means (13), characterised in that the support means (13) comprises a safety section (17) which by interaction between the drive pulley and the safety section (17) of the support means (13) causes a slipping through.
11. Support means (13) according to claim 10, characterised in that the support means
- is a belt-like support means (13) having longitudinal or transverse ribs as surface structure, wherein the longitudinal or transverse ribs are of different construction or entirely absent in the region of the safety section (17), or
 - is a belt-like support means (13) comprising a traction-reducing coating in the region of the safety section (17), or
 - is a cable-like support means (13) comprising a traction-reducing coating in the region of the safety section (17).
12. Method of providing overrun protection in a lift installation (10) with a support means (13) and a driven drive pulley (16) for driving the support means (13), wherein the support means (13) at least partly loops around the drive pulley (16), characterised by the following steps:
- establishing a safety section (17) at the support means (13),
 - covering a part of the support means (13) by means of protective tape or template, wherein the part covered by means of protective tape or template adjoins the safety section (17),
 - applying a slide means, which adheres to the support means (13), in the region of the safety section (17) and
 - removing the protective tape or the template.
13. Method according to claim 12, characterised in that the slide means is sprayed on.
14. Method according to claim 12 or 13, characterised in that the safety section (17) is

so arranged that the safety section (17) interacts with the drive pulley (16) when a lift cage (11) after overrunning an upper position (X) or a counterweight (12) after overrunning an upper position (W) approaches an upper shaft end (14.1), wherein a slipping through results in the region of the safety section (17) through the interaction between the drive pulley (16) and the support means (13).