

Safety brake with resetting means**Description**

The invention relates to a method for resetting a safety brake, which is released for braking, of a travel body of a lift installation and to a safety device in a lift installation.

The lift installation is installed in a building. It substantially consists of a cage which is connected by way of support means with a counterweight or with a second cage. The cage is moved along substantially vertical guide rails by means of a drive which acts selectably on the support means or directly on the cage or the counterweight. The lift installation is used in order to convey persons and objects within the building over individual or several storeys. The lift installation includes devices in order to safeguard the lift cage in the case failure of the drive or of the support means. For that purpose, use is usually made of safety brakes which in the case of need can brake the lift cage on the guide rails.

Safety brakes with an electromechanical retaining device are currently known, which device in an activated state can hold the safety brake in a readiness setting and which in a deactivated state releases the safety brake for braking. EP 1930282 discloses a safety brake of that kind. In order to reset this safety brake the electromechanical retaining device has to exert an aerodynamic force in order to overcome an air gap. For resetting, overcoming of the air gap obliges an appropriately dimensioned electromechanical device. Other safety brakes are equipped with electromechanical trigger devices. In that regard, the safety brake is held, for example mechanically locked, in the readiness setting and it is released by means of an activation signal for braking. The safety brake is automatically set into a braking setting by a subsequent movement of the lift cage or of the travel body. EP 1733992 shows, for example, a safety brake of that kind. This device requires a secure energy supply, which enables reliable triggering of the safety brake even in the case of a longer interruption of an energy mains.

The invention has the object of providing a method and a corresponding safety device in order to place a safety brake back in operation, for example in the case of a more lengthy interruption of energy or also after another switching-off not due to safety issues. The method shall obviously guarantee safety of the lift installation at all times.

The solutions described in the following allow fulfilment of this object.

According to one aspect of the invention the lift installation is equipped with a safety device. This comprises a safety brake which is provided with a safety switch which interrupts a brake safety circuit when the safety brake is released for braking. The safety device further comprises a brake safety control which when required releases the safety brake for braking if on the one hand a fault or a critical event is detected in the lift installation or also if on the other hand an event evaluated as non-critical occurs. An event assessed as non-critical is, for example, an energy interruption in the building or switching-off of a lift over a longer period of time or also an event carried out for the purpose of a test. The brake safety control stores, in the case of releasing of the safety brake for braking, preferably the cause, or the event, of releasing the safety brake. As soon as the lift control on the hand recognises that a lift safety circuit or the brake safety circuit is interrupted and on the other hand a non-critical cause for releasing the safety brake is reported by the brake safety control, the lift control initiates an automatic resetting of the safety brake. Automatic means that the process of resetting the safety brake is initiated substantially without human assistance.

According to one aspect of the invention the safety brake of a travel body of the lift installation is provided with a preferably electromechanical retaining device, which in a deactivated state releases the safety brake for braking. After releasing of the safety brake the safety brake is preferably reset in that in a first step the travel body is moved in a first travel direction. The safety brake is thereby at least partly stressed or at most re-stressed. At the same time or in the time period before or after this first movement the retaining device of the safety brake is activated in order to prepare it for retention of the safety brake in its readiness setting. The travel body is subsequently moved in a second travel direction opposite the first travel direction. The safety brake is thereby brought into the readiness setting where it is held by the activated retaining device. The safety brake is thus again in its readiness setting. Advantageously, this resetting can be carried out in an at least partly automated process. The procedure has the effect that the safety brake initially comes into a clamping region independently of an instantaneous engagement state. In the clamping region a bias is generated in the safety brake, which enables return guidance of the retaining device and the braking elements of the safety brake into the readiness setting.

If, for example, the safety brake as a consequence of a lengthy energy failure in the building has been activated, i.e. the retaining device deactivated, then, for example, a braking element of the safety brake has been adjusted relative to the rail. Since, however, no cage movement or no movement of a travel body takes place - since, of course, no energy is present in the building - the safety brake is not actually engaged. Accordingly, the safety brake is also not stressed. Since, however, in the case of safety brakes of the kind described in the preceding a resetting of the holding or safety brake into the readiness setting can take place by a relative movement between safety brake and brake rail, this resetting cannot act, since the safety brake is still not stressed. Through the selective travel movements carried out in accordance with this aspect of the invention the safety brake is stressed in a first movement and reset into the readiness setting in a second movement.

For preference, a downward travel direction is used as first travel direction and correspondingly an upward travel direction is used as second travel direction. This is advantageous, since many lift installations are provided merely with a safety brake for safeguarding against crashing down of the travel body. With selection of the downward travel direction as first travel direction a selection is thus defined which is appropriately usable for all lift installations. In addition, a maximum breakaway force is then available for movement in the second travel direction, since usually in an operating situation of that kind the lift cage is empty and thus an excess weight of the counterweight is available for the movement.

The retaining device of the safety brake is preferably activated prior to movement of the travel body in the second travel direction. Due to this preceding activation of the retaining device an accurate determination of the time of activation is superfluous. Since the retaining device attains its activated state some time in the course of the cage movement it is directly held in the case of preceding switching on. It is particularly advantageous if the retaining device of the safety brake is activated already before movement of the travel body in the first travel direction. A preparatory testing and preparing algorithm is thereby able to be of simple design.

The movement of the travel body in the first travel direction is preferably carried out until the safety brake at least partly clamps on a brake surface provided for the braking. The

brake surface provided for the braking is usually a brake rail or a guide web of a guide rail, which is at the same time the brake rail. It is ensured by this first movement of the travel body that the safety brake has a minimum biasing or that it is at least partly clamped on the brake rail.

The at least partial clamping, which is carried out, of the safety brake on the brake surface provided for braking is preferably detected in that either a travel path of the travel body is ascertained, preferably by means of measuring a rotational movement of the drive pulley, and compared with a travel target preset. As soon as the travel body has covered a defined travel path, which is usually determined experimentally, it can be assumed therefrom that a partial clamping of the safety brake has taken place. Usual lift drives already have measuring systems such as tachometers or incremental transmitters on the drive shaft in order to ascertain a travel path on the basis of the rotational movement of the drive pulley. This embodiment is accordingly advantageous.

Alternatively or additionally a drive torque of the drive engine can be detected, preferably by means of measurement of the drive current, wherein this drive torque is compared with a target torque. As soon as the drive torque reaches or exceeds a pre-defined value it can be assumed therefrom that an at least partial clamping of the safety brake has taken place. This embodiment is particularly reliable, since the drive torque provides a direct reference to the clamping that has taken place.

Alternatively, a time duration for the movement of the travel body in the first travel direction can also be ascertained and compared with a limit time value. Here, too, the required time duration can preferably be determined experimentally. This embodiment is a particularly economic embodiment, since no special sensors are required.

For preference, subsequently to the first movement of the travel body the movement of the travel body in the second travel direction is carried out. This second movement is carried out until the brake safety circuit is closed and the travel body has covered a pre-defined travel path. Closing of the brake safety circuit usually indicates that the safety brake is again in its readiness setting. In addition, it is ensured by the travel path which is covered that all components of the safety brake and at most the entire travel body are free.

Alternatively or additionally, the drive torque of the drive engine is also monitored and the

movement of the travel body in the second travel direction is ended if the drive torque attains an indicator value. A substantial drive torque is usually required for movement of the travel body in the second travel direction, since the safety brake has to be moved out of its clamping position. It can now be established by the measurement if the drive torque or the start-off torque exceeds a peak value and then returns to a substantially constant value or into the range of the indicator value.

For preference, termination criteria are defined which terminate or at least interrupt the movement of the travel body in the second travel direction if, for example, the drive torque of the drive engine reaches or exceeds a maximum limit value. A time limit can be attached to this limit value. This means that the movement of the travel body in the second travel direction is terminated if the drive torque of the drive engine exceeds a working limit value during a pre-defined time limit. Alternatively, a time limit duration can also be predetermined for time limitation of the second movement.

The movement of the travel body in the second travel direction is preferably similarly terminated if a limit position of the travel body in the lift shaft is passed or obviously also if an unsafe state of the lift installation is detected. For example, if on occasion an electronic speed limiter ascertains an excessive speed the retaining device of the safety brake is deactivated again which in every case leads to directly actuation of the brake regardless of the instantaneous reset status. Thus, special events can be taken into consideration in the resetting. Thus, for example, an energy failure in the building can coincidentally take place when the lift cage or the travel body is entirely at the top or at the bottom in an extreme position or in a limit position near a shaft end in the lift shaft. Since the lift cage in this situation can already be located near the shaft end it is obviously not possible for a large movement to take place in one of the travel directions. In individual cases of that kind possible damage is prevented by the termination criteria.

The resetting steps are preferably selectively repeated if after conclusion or after termination of the movement of the travel body in the second travel direction has taken place the brake safety circuit is not closed. This can be helpful if, for example, in the case of a first resetting attempt a start-off torque is not sufficient to break loose the travel body or the safety brake. The resetting process can then selectively be initiated again. This can, for example, be repeated two to three times. To the extent that after these multiple attempts the resetting cannot be successfully concluded, automatic resetting is preferably

terminated. The resetting procedure can then be initiated again, for example, only by an authorised person such as a service engineer.

The readiness setting of the safety brake is preferably monitored and a brake safety circuit of the lift installation is closed if the safety brake in the readiness setting thereof and the retaining device are activated. The brake safety circuit of the lift installation otherwise is or remains interrupted as long as the safety brake or the retaining device is not in the readiness setting thereof. It is thus ensured that the lift installation cannot transition into normal operation as long as the safety brake is not in its readiness setting.

The lift safety circuit is preferably checked before movement of the travel body in the first travel direction and the movement in the first travel direction is executed only when predetermined parts of the lift safety circuit have been found to be in order. Safety of the lift installation and any users in the environment of the lift installation is thereby ensured. The lift safety circuit is, for example, opened when accesses to the lift shaft are not closed or if important functional parts such as, for example, a cable tension, a buffer device, a position detection device or the speed measuring device, etc., are not functionally capable. The predetermined parts of the lift safety circuit preferably include, with the exception of the brake safety circuit, all remaining parts of the lift safety circuit. The brake safety circuit is preferably bridged over, since it is obviously open, because the safety brake is no longer in the readiness setting thereof when the retaining device is deactivated. Thus, it is necessary to exclude this part of the lift safety circuit for the assessment for starting the resetting.

For preference, in a first step prior to performance of the resetting steps a fault status of a brake control is interrogated and the appropriate procedure is selected in dependence on the fault status.

The resetting steps can, for example, be automatically initiated if the retaining device as a consequence of the event evaluated as non-critical was deactivated and at the same time the safety circuit of the lift installation designates the significant parts of the lift installation as safe. Non-critical events are, for example, an intentional deactivation of the retaining device as a consequence of an energy failure in order to save energy when the lift installation is at a standstill or if as a consequence of a self-test a deactivation of the retaining device takes place. Automatic initiation of the resetting steps signifies that a

control, for example a lift control, generates and executes an appropriate travel command by the drive of the lift installation being appropriately controlled.

The resetting steps can on the other hand also be manually initiated if the retaining device was not deactivated as a consequence of an event evaluated as non-critical or if the safety circuit of the lift installation does not designate the installation as safe. This means that assessment by a qualified or an authorised person is required. This person assesses the state of the lift, instigates necessary repairs or on occasion even carries these out himself or herself. After the state of the lift installation has been assessed by the authorised person as safe, he or she can by way of appropriate commands initiate resetting of the safety device or the safety brake, wherein then these resetting steps are selectably directly carried out by the authorised person or that person merely gives release for automatic initiation of the resetting steps. Through this method the safety of the lift installation is guaranteed to the best possible extent at any time and at the same time the lift installation is not unnecessarily taken out of operation.

Manual initiation of the resetting steps is, as explained in the preceding, preferably carried out by an authorised person. In this regard, advantageously an authorisation of the authorised person is checked in order to establish whether the person is actually authorised to perform the required actions competently. For this purpose, for example, an authorisation code has to be input into the brake control or into the lift control. In a simple check the control can establish whether this authorisation code corresponds with the presets. This authorisation code can be a code recorded in the service documents or it can correspond with a part of an identification number of the brake control.

Alternatively, a pre-defined command and action cycle for checking the authorisation can also be used. This is, for example, a double actuation of a lift call button followed by an actuation of a control button within a predetermined time.

Alternatively, a preferably personal key can also be connected with the brake control or the lift control. The key can be a mechanical key by which access to specific functions of the lift is made possible. It can also be an electronic key such as an electronic card, etc., by which access to specific functions of the lift is made possible. The various solutions allow attainment of a level of safety and serviceability matched to the lift installation.

Manual initiation of the resetting steps preferably includes manual actuation of the status of the brake control. This means that the authorised person has to acknowledge the status or fault status stored in the brake control, obviously after an exert assessment and repair. Subsequently, a manual movement of the travel body is carried out, preferably directly by the authorised person, by means of actuation of the lift drive in a first travel direction and a subsequent manual movement of the travel body in the second travel direction opposite the first travel direction. In this regard, the authorised person has complete control over the movement state. The person can immediately terminate the travels at any time if irregularities are ascertained.

The required control functions are preferably divided up between the lift control and the brake control. Thus, the brake control, which advantageously also includes a so-termed electronic speed limiter or is connected with such, for example the control of the retaining device, includes a device for bridging over the brake safety circuit and a communications interface with respect to the lift control. The brake control deactivates the retaining device of the safety brake in a fault case, for example excess speed, and opens the associated part of the safety circuit of the lift. However, it deactivates, for example, the retaining device of the safety brake also when the energy supply is interrupted over a predetermined longer period of time or when other events assessed as non-critical occur. The brake control stores this trigger event as non-critical in a non-volatile memory.

The lift control includes the parts required for control of the lift, in particular it is in a position of activating the lift drive for movement of the travel body of the lift and in a position of communicating with the brake control. After switching-off of the entire lift, for example if an energy mains of the building is switched off, the entire lift is in a current-free state and the brake control deactivates, in accordance with definition, the retaining device of the safety brake. After switching back on of the energy supply to the lift the lift control ascertains an interruption of the safety circuit at the safety brake, whereby starting-off of the lift is prevented. The brake control checks the actual safety status and on the one hand establishes - for example by means of a self-test function - that the function of the control and of the, for example integrated, electronic speed limiter is available and further establishes that the cause of switching-off was non-critical, since a corresponding entry was filed in the non-volatile memory. The brake control passes on this information to the lift control, which now initiates resetting of the safety brake. The lift control checks the status of the rest of the safety circuit and then triggers the corresponding resetting steps.

The aforesaid method and the corresponding safety device enable provision of a safer lift installation which can operate with minimum energy resources and which is nevertheless rapidly serviceable again in the case of specific events or after specific events.

The explained embodiments and solutions can be varied and supplemented by the expert. The expert selects the solutions preferred for a specific installation and combines them.

Exemplifying embodiments are explained in the following by way of examples and schematic embodiments, in which:

Fig. 1 shows a schematic view of a lift installation in side view,

Fig. 2 shows a schematic view of the lift installation in cross-section,

Fig. 3 shows a schematic flow chart of resetting of a safety brake,

Fig. 4 shows a schematic flow chart for initiation of resetting,

Fig. 5 shows a schematic flow chart for manual initiation of resetting,

Fig. 6 shows a schematic illustration of an electrically linked safety system,

Fig. 7s shows a side view of an embodiment of a safety brake in a first, unactuated position,

Fig. 7f shows a front view of the safety brake of Fig. 7s

Fig. 8s shows a side view of the safety brake of Fig. 7s in a second, actuated position and

Fig. 8f shows a front view of the safety brake of Fig. 8s.

The same references are used in the figures for equivalent parts in all figures.

Fig. 1 shows a lift installation 1 in an overall view. The lift installation 1 is installed in a building and serves for the transport for persons or articles within the building. The lift installation comprises a lift cage 2 which can move upwardly and downwardly along guide rails 6. The lift cage 2 is for that purpose provided with guide shoes 8 which guide the lift cage as accurately as possible along a predetermined travel path. The lift cage 2 is accessible from the building by way of shaft doors 12. A drive 5 serves for driving and holding the lift cage 2. The drive 5 is arranged in, for example, the upper region of the building and the cage 2 hangs by support means 4, for example support cables or support belts, at the drive 5. The support means 4 are led by way of the drive 5 onward to a counterweight 3. The counterweight compensates for a mass component of the lift cage 2 so that the drive 5 primarily merely has to compensate for an imbalance between cage 2 and counterweight 3. In the example, the drive 5 is arranged in the upper region of the building. It could obviously also be arranged at another location in the building or in the region of the cage 2 or the counterweight 3.

The lift installation 1 is controlled by a lift control 10. The lift control 10 receives user requests, optimises the operational course of the lift installation and controls, usually by way of a drive control 9, the drive 5. The drive 5 is equipped with an encoder or incremental transmitter 14. A rotational movement of an axle of the drive can thus be detected and communicated to the drive control 9 for the purpose of regulation of the drive. This incremental transmitter 14 can also be used for detecting the travel path of the lift cage 2 and thus for regulation and control thereof. The lift control 10 additionally monitors the safety state of the lift installation and interrupts the travel operation if an unsafe operational state arises. This monitoring is usually performed with use of a lift safety circuit in which all safety-relevant functions are integrated. In monitoring of that kind or in this lift safety circuit there are also incorporated, for example, shaft door contacts 13, which monitor correct closing of the shaft doors 12 and, for example, also limit positions of the travel body 2, 3 in the lift shaft are monitored by means of upper and lower limit switches 16, 17.

The lift cage 2 and, if required, also the counterweight 3 are further equipped with a brake system suitable for safeguarding and/or retarding the lift cage 2 in the case of an unexpected movement or in the case of excess speed. In the example, the brake system comprises two identical safety brakes 20, 20' which are installed on the travel body 2, 3 at both sides thereof. The safety brakes 20, 20' are, in the example, arranged below the

cage 2 and they are electrically activated by way of a brake control 11. This brake control 11 preferably also includes an electronic speed or travel plot limiter which monitors travel movements of the lift cage 2. A speed limiter, as is usually used, can accordingly be eliminated.

Fig. 2 shows the lift installation of Fig. 1 in a schematic plan view. The brake system comprises the two safety brakes 20, 20'. The two safety brakes 20, 20' are, in this example, coupled by means of a synchronisation rod 15 so that the two safety brakes 20, 20' are necessarily actuated together. An unintended one-sided braking can thus be avoided. The two safety brakes 20, 20' are preferably constructed to be identical or in mirror symmetry and they act on the brake rails 7 arranged on either side of the cage 2. The brake rails 7 are, in the example, identical with the guide rails 6.

It is also possible to dispense with the synchronisation rod 15. However, electrical synchronisation means, which ensure simultaneous triggering of safety brakes 20, 20' arranged on either side of the lift cage, are then recommended.

One possible example of the safety brake 20, 20' is shown in Figs. 7 and 8 and explained in the following. The two safety brakes 20, 20' are functionally identical, for which reason there is discussion in the following merely of the safety brake 20. The safety brake 20 comprises a brake housing 21 with a brake element 22. The brake housing 21 is held by a retaining device 28 in a readiness setting (Figs. 7s, 7f). The retaining device 28 is for that purpose fixed by means of a retaining magnet 29. This position of the retaining magnet 28 is controlled by a first brake contact 24. In the example, the first brake contact 24 comprises a contact bridge 25 and contact locations 26, which are led to a brake safety circuit 23. Alternatively or additionally, the readiness setting of the safety brake 20 can also be checked by way of a second brake contact 27. This second brake contact 27 monitors, in the example, the brake element 22 and this second brake contact 27 is also connected, on occasion in series with the first brake contact 24, with the brake safety circuit 23. The retaining magnet 29 is connected with the brake control 11 and with corresponding energy sources 30 and is controlled by the brake control 11.

As soon as the brake control 11 deactivates the retaining magnet 29 (Figs. 8s, 8f) the safety brake 20 is displaced into its braking position, wherein the brake element 22 is brought into contact with the brake or guide rail 6, 7. Insofar as the lift cage continues to

move in relation to the brake or guide rail 6, 7, this leads to a further engagement of the safety brake 20 and ultimately to secure braking of the lift cage 2. With deactivation of the retaining magnet 29 or of the retaining device 28 the first brake contact 24 is interrupted, the optional second brake contact 27 is also interrupted through the movement of the brake housing 21 and the brake element 22 and the brake safety circuit 23 is interrupted, whereby operation of the lift installation 1 is discontinued.

Fig. 6 shows a possible circuit diagram of an electrically coupled brake system. The brake contacts 24, 27 of the two safety brakes 20, 20' are, in the example, connected in series and led as brake safety circuit 23 to the brake control 11. The state of the brake safety circuit 23 is evaluated in the brake control 11 and integrated in the lift safety circuit 19. The brake control 11 includes an electronic speed limiter 18 which on the one hand monitors travel operation and a general state of the lift installation. The retaining magnets 29 of the two safety brakes 20, 20' are, in the example, similarly connected in series and led to the brake control 11, from wherein the retaining magnets 29 can be controlled and caused to conduct current by an energy source 30. Through the series circuit it is achieved that in the case of interruption of the electrical line both or all retaining magnets 29 of the safety brakes 20 are necessarily deactivated. The series circuit is preferably executed in the brake control 11. This means that the retaining magnets 29 of the two safety brakes 20, 20' are separately connected with the brake control and the series circuit is executed in the brake control 11.

The electronic speed limiter 18 can now, if required, interrupt not only the lift safety circuit 19, but also the holding current circuit of the retaining magnets 29, whereby the safety brake 20 is released for braking.

If the speed limiter 18 in a first case ascertains, for example, an excessive travel speed it interrupts the holding current circuit of the retaining magnet 29, whereby the lift cage 2 is braked. At the same time it interrupts, through opening of a first interrupter 31, the lift safety circuit 19, whereupon the lift control 10 brakes and shuts down the drive 5 of the lift installation. The speed limiter 18 stores the cause of the actuation as relevant or critical and provides the appropriate fault status signal S1 in a non-volatile memory.

If, in another case, the speed limiter 18 ascertains that the brake safety circuit 23 has, for example, opened without obvious reason, it interrupts the holding current circuit of the

retaining magnet 29 and the lift safety circuit 19 and thus stops the lift installation. It is thus achieved that in the case of an erroneous triggering of one of the safety brakes 20, 20' the second safety brake 20', 20 is also immediately actuated. A one-sided braking is thus prevented. The speed limiter 18 stores the cause of the actuation as relevant or critical and provides the appropriate fault status signal S1 in the non-volatile memory.

If, in a further case, the speed limiter 18 ascertains that, for example, the stopped lift installation is or is to be at standstill over a longer period of time it similarly interrupts the holding current circuit of the retaining magnet 29, although no relevant fault is present in the lift installation. The retaining device 28 is thereby released and the safety brake 20 is moved into the braking position without, however, braking, since the lift cage is at standstill and thus the safety brake 20 is not re-tightened. The speed limiter 18 stores the cause of the actuation as non-relevant or as non-critical and provides the appropriate fault status signal S1 in the non-volatile memory.

Moreover, the electronic speed limiter 18 can, on corresponding request, bridge over the brake safety circuit 23 by a bridge contact 32 in order to enable, in accordance with need, a controlled movement of the lift cage 2.

In this last-illustrated case, the safety brake 20 is correspondingly adjusted into a brake readiness position and the retaining device 28 is deactivated. Correspondingly, the brake safety circuit 23 is also interrupted and the lift safety circuit 19 is obviously also interrupted, on the one hand by the brake safety circuit 23, but also by opening the first interrupter 31.

If in this case the energy supply of the building or the lift installation is switched back on, the lift control 10 ascertains, after possible self-testing and initialisation routines have been run through, that the lift safety circuit 19 is interrupted, in particular in the region of the cage safety system. The lift control now starts, as illustrated in Fig. 4, an event analysis F. At the same time with the switching-on of the current supply, the brake control 11 has also run through possible internal tests and initialisation routines and has ascertained that in accordance with the stored fault status signal S1 the cause of the actuation was determined to be non-relevant or non-critical and that a function of the brake control S2 itself is evaluated as intact. The lift control interrogates the fault status signal S1 and the function readiness report S2 in the event analysis F and determines the further procedure therefrom. To the extent that the signal S1 communicates the report "non-critical" and the

signal S2 communicates the report "functional test passed" the lift control 10 starts, insofar as remaining parts of the lift safety circuit 19 are in order, an automatic resetting A, which is explained in more detail in the following under Fig. 3. Otherwise, further operation of the lift installation remains interrupted until a manual resetting M is carried out, as is explained later with reference to Fig. 5.

After start of the automatic resetting A (Fig. 3), in the example the functional integrity S2 of the brake control 11 as well as remaining parts of the lift safety circuit 19 is checked R0.1 and, in the case of a positive result "yes" an optional indication D2 or notification in the region of storeys or in the cage 2 is, for example, issued, which indicates that a resetting travel will shortly be carried out. Subsequently, the brake control 11 closes, after corresponding instruction by the lift control 10, the first interrupter 31 of the lift safety circuit 19 and temporarily bridges over the brake safety circuit 23. At the same time, the retaining device 28 of the safety brake is activated R1 in that a second interrupter 33 of the retaining device is closed and the retaining magnet 29 is current-conducting in order to prepare the retaining device 28 for holding the safety brake 20 in the readiness setting.

The lift control 10 subsequently gives corresponding travel commands in order to move R2 the cage 2 or on occasion the counterweight 3 in a first travel direction at a preferably low speed. The safety brake, which before the movement was merely adjusted against the rails 6, 7, but not actually clamped, is thus at least partly tightened or re-tightened. This movement in the first travel direction is preferably carried out until the safety brake at least partly clamps R2.1 on the brake surface, which is provided for braking, of a brake or guide rail. The clamping R2.1 which has been carried out can, for example, be ascertained in that a travel path of the travel body is ascertained, possibly by means of the signals of the incremental transmitter 14, and compared with a travel target preset. Alternatively or additionally a drive torque of the drive motor can also be ascertained, preferably by means of measuring the drive current, and compared with a target torque or also a time duration for the movement of the travel body in the first travel direction can simply be ascertained and compared with a limit time value.

Subsequently to the first movement R2 in the first travel direction the lift control 10 predetermines a reversal of the travel direction and the drive 5 correspondingly moves the lift cage or the counterweight in the opposite, second travel direction R3.

Through the movement R2 in the first travel direction the safety brake was brought into place for clamping with the rail. On occasion, depending on the respective form of construction of the safety brake 20, the retaining device 28 could also thereby be already brought into the holding position. The safety brake is reset into the actual operating position by the second movement R3. This second movement R3 in the second travel direction is basically continued until the safety brake has been reset R3.1. This can usually be ascertained in simple manner in that, for example, it is checked whether the safety brake circuit 23 is closed, thus the safety brake 20 is in the readiness setting, or in that a travel path is measured or, as a particularly reliable possibility, in that the drive torque of the drive motor is measured. As soon as the drive torque has attained an indicator value, which usually corresponds with the constant movement moment of the empty cage, the safety brake 20 is free, thus no longer in clamping state.

In the sequence according to Fig. 3 there is monitoring, by way of example, above all of the movement in the second travel direction in that every journey is interrupted R3.2 if an unsafe state of the lift installation is recognised. This monitoring preferably applies during every travel movement. Thus, in particular, the travel is interrupted if, for example, the drive torque of the drive motor reaches a maximum limit value, if the drive torque of the drive motor exceeds a working limit value during a time limit, if a limit time period is reached, if limit positions of the travel body in the lift shaft are passed or if the lift safety circuit 19 detects another unsafe state. In these cases, usually a manual resetting M is initiated or demanded.

The significant steps of the resetting R of the safety brake 20 thus include activating R1 of the retaining device of the safety brake in order to prepare it for holding the safety brake in a readiness setting, a movement of the travel body in a first travel direction R2 in order to at least partly tighten or re-tighten the safety brake and a movement of the travel body in a second travel direction R3, which is opposite the first travel direction, in order to bring the safety brake into the readiness setting, where it is held by the activated retaining device.

In the example of Fig. 3 the resetting steps R are possibly selectively repeated R4 is after conclusion of the movement of the travel body in the second travel direction the brake safety circuit is still not closed, but no fault in the lift installation has been ascertained. Since safety brakes can certainly require a high level of resetting energy or force, a first start-off is possibly not sufficient.

As already mentioned, the detection of unsafe states or departures from anticipated behaviour lead to termination or non-starting of the automatic resetting A. In these cases, manual resetting M has to be carried out, as is schematically illustrated in Fig. 5. For this purpose, an authorised person 35 is summoned. This summons is carried out by way of known service channels, either electronically targeted by the lift control or, for example, telephonically by persons concerned. The authorised person in a first step undertakes requisite expert diagnoses of the lift installation and instigates possible repairs M1. As soon as at least the primary functions and safety of the lift installation are given, the authorised person performs, for example, the resetting steps R by manual control. The person switches on the holding current circuit of the retaining device 28 and possibly bridges over the brake safety circuit 23. He or she subsequently moves the lift cage, for example through use of a so-called inspection control, in the first travel direction until he or she ascertains a small clamping resistance. He or she subsequently moves the lift cage downwardly against the first travel direction until the lift cage runs freely. He or she subsequently performs obviously appropriate final checks on the lift installation before releasing the lift installation again for normal use.

Alternatively, the authorised person 35 starts resetting through input of an authorisation code 36 into the lift control. The authorisation code 36 signals to the lift control 10 that the person 35 is, in fact, authorised to initiate an appropriate chain of commands. The authorisation code 36 can, for example, correspond with a part of an identification number of the brake control. Alternatively, a pre-defined command and action cycle can also be executed in agreement. This is, for example, a command by way of a control keyboard of the lift control followed by a reset command of the lift control within a time window of, for example, 10 seconds. These authorisation checks prevent spurious manipulations by the public.

Alternatively, the authorisation code 36 includes a preferably personal key 34 which is connected with the brake control 11 or the lift control 10. The key can be a mechanical key by which access to specific functions of the lift is made possible. It can also be an electronic key, such as an electronic card, etc., by which access to specific functions of the lift is made possible. Through use of the key 34 the bearer thereof is identifiable.

After input of the authorisation code 36 the brake control 11 or the lift control 10 checks the

authorisation M3 and in the case of a successful check initiates automatic resetting A as previously described. In every case a negative check result also here leads back to termination of automatic resetting.

The illustrated embodiments and sequences can be varied by the expert. The association of individual functions with the lift control 10 or brake control 11 can be exchanged or all functions can be combined in a control group. The authorisation check M3 can also be used for other part steps of the lift maintenance such as, for example, for authorising performance of test activities at the brake control 11 or the safety brakes 20.

Patent claims

1. Method of resetting a safety brake (20, 20'), which is released for braking, of a travel body (2, 3) of a lift installation (1) with a preferably electromechanical retaining device (28) which in a deactivated state releases the safety brake (20, 20') for braking, the method comprising at least the resetting steps (R) of:

- activating (R1) the retaining device (28) of the safety brake (20, 20') in order to prepare it for holding the safety brake in a readiness setting,
- moving (R2) the travel body (2, 3) in a first travel direction in order to at least partly tighten or re-tighten the safety brake (20, 20') and
- moving (R3) the travel body (2, 3) in a second travel direction opposite the first travel direction in order to bring the safety brake (20, 20') into the readiness setting where it is held by the activated retaining device (28),

wherein the retaining device (28) is activated before movement of the travel body (2, 3) in the second travel direction.

2. Method according to claim 1, wherein a downward travel direction is used as first travel direction and correspondingly an upward travel direction is used as second travel direction.

3. Method according to claim 1 or 2, wherein the retaining device (28) is activated before movement of the travel body (2, 3) in the first travel direction.

4. Method according to claim 3, wherein the movement of the travel body (2, 3) in the first travel direction is performed until the safety brake (20, 20') at least partly clamps (R2.1) on a brake surface, which is provided for the braking, of a brake rail or guide rail (6, 7).

5. Method according to claim 4, wherein the executed at least partial clamping (R2.1) of the safety brake (20, 20') on the brake surface provided for the braking is ascertained in that

- a travel path of the travel body (2, 3) is detected, preferably by means of measuring a rotational movement of the drive pulley, and compared with a travel target preset and/or
- a drive torque of the drive engine (5) is detected, preferably by means of

- measuring a drive current, and is compared with a target torque or
- a time duration for movement of the travel body (2, 3) in the first travel direction is detected and compared with a limit time value.
6. Method according to any one of claims 3 to 5, wherein the movement of the travel body (2, 3) is carried out in the second travel direction until the safety brake is reset (R3.1), wherein this is ascertained when a brake safety circuit (23) is closed, and
- the travel body (2, 3) has covered a pre-defined travel path and/or
 - the drive torque of the drive engine (5) attains an indicator value.
7. Method according to claim 6, wherein the movement of the travel body (2, 3) in the second travel direction is terminated (R3.2) when
- the drive torque of the drive motor (5) has reached a maximum limit value or
 - the drive torque of the drive motor (5) has exceeded a working limit value during a time limit or
 - a limit time period is reached or
 - limit positions of the travel body (2, 3) in the lift shaft are passed or
 - a lift safety circuit (19) detects an unsafe state.
8. Method according to any one of claims 1 to 7, wherein resetting steps (R) are selectively repeated (R4) if after conclusion of the movement of the travel body in the second travel direction the brake safety circuit (23) is not closed.
9. Method according to any one of claims 1 to 8, wherein the readiness setting of the safety brake (20, 20') is monitored and the brake safety circuit (23) of the lift installation is closed if the safety brake (20, 20') is in its readiness setting and the retaining device (28) is activated and the brake safety circuit (23) of the lift installation is interrupted if the safety brake (20, 20') or the retaining device (28) is not in the readiness setting thereof.
10. Method according to any one of claims 1 to 9, wherein prior to movement of the travel body (2, 3) in the first travel direction the lift safety circuit (19) is checked (R0.1) and the movement in the first travel direction is performed only if predetermined parts of the lift safety circuit (19) are found to be in order, wherein the predetermined parts of the lift safety circuit (19) preferably include, with the exception of the brake safety circuit (23), all remaining parts of the lift safety circuit (19).

11. Method according to any one of claims 1 to 10, wherein

- the resetting steps (R) are automatically (A) initiated when the retaining device (28) was deactivated as a consequence of an event evaluated as non-critical, a functional readiness report (S2) of a brake control (11) is present and the safety circuit (19) of the lift installation designates the installation as safe, and
- the resetting steps (R) are manually (M) initiated when the retaining device (28) has not been deactivated as a consequence of an event evaluated as non-critical, the functional readiness report (S2) of the brake control (11) is not present or the safety circuit (19) of the lift installation does not designate the installation as safe,

wherein the functional readiness report (S2) of the brake control (11) is interrogated in a first step (R0.2) prior to performance of the resetting steps (R).

12. Method according to claim 11, wherein the manual initiation (M) of the resetting steps (R) is performed by an authorised person (35), wherein an authorisation is checked (M2) in that

- a authorisation code (36) is input into the brake control (11) or into the lift control (10), wherein this authorisation code (36) corresponds with, for example, a part of an identification number of the brake control, or
- a predefined command and action cycle is performed or
- a preferably personal key (34) is connected with the brake control (11) or the lift control (10).

13. Method according to claim 11 or 12, wherein the manual initiation of the resetting steps includes:

- manual confirmation of the status of the brake control and
- a subsequent manual movement of the travel body in a first travel direction and
- a subsequent manual movement of the travel body in a second travel direction opposite to the first travel direction,

wherein the manual movement is performed by means of actuation of a lift drive.

14. Safety device in a lift installation, comprising

- a safety brake (20, 20') with a preferably electromechanical retaining device (28) which in a deactivated state releases the safety brake (20, 20') for braking,
- a lift control (10) which can initiate an automatic resetting (A) of the safety brake

when the safety brake (20, 20') as a consequence of an event evaluated as non-critical has been released for braking, wherein the automatic resetting (A) comprises method steps corresponding with any one of claims 1 to 10.