

Safety circuit in an elevator system

The present invention relates to a lift installation in which at least one lift cage and at least one counterweight are moved in opposite sense in a lift shaft, wherein the at least one lift cage and the at least one counterweight run along guide rails and are carried by one or more support means. The or each support means is or are guided by way of a drive pulley of a drive unit which has a drive brake. Moreover, the lift installation comprises a safety circuit which, inter alia, activates the drive brake in the case of an emergency and includes bridging-over of the door contact so that on opening of the doors the safety circuit remains closed. The present invention relates particularly to the safety circuit.

In conventional lift installations electromechanical switches are employed for bridging over the door contacts. Particularly in the case of lift installations in office buildings, however, the number of journeys of the lift cage can be more than 1,000 per working day, in which case bridging-over of the door contacts takes place twice in each journey. Thus, a number of approximately 520,000 switchings per year results for the electromechanical switches. This number is so high that the electromechanical switches become the principal limiting factor for the reliability of the bridging-over of the door contacts.

Due to the high number of switching actions and the high demands the bridging-over of the door contacts is classified as a so-called high-demand safety function. In general, the Standard IEC 61508 defines high-demand safety functions as functions which in disturbance-free normal operation of the lift installation switch on average more than once per year, whereas by low-demand safety functions there are designated such functions which are provided only for emergency situations of the lift installation or only for an emergency operation of the lift installation, in which a disturbance is present and on average switch less frequently than once per year.

A significant element of this International Standard IEC 61508 is the determination of the safety requirement stage (Safety Integrity Level - SIL; there are SIL1 to SIL4). This is a measure for the necessary or achieved risk-reducing effectiveness of the safety functions, wherein SIL1 has the lowest demands. Provided as essential parameter for the reliability of the safety function of apparatus or installations are the calculation bases for PFH (probability of dangerous failure per hour) and PFD (probability of dangerous failure on demand). The first parameter PFH relates to high-demand systems, thus to those with a

high demand rate, and the second parameter PFD to low-demand systems, the time of their service life being virtually equal to non-actuation. The SIL can be read off from these parameters.

A further definition, which can be found in technical media on the basis of this Standard (IEC 61508-4, section 3.5.12), of the low-demand mode of operation (Low-Demand Mode) and the high-demand mode of operation (High-Demand Mode or continuous operating mode) specifies the distinction thereof not on the basis of the low or high (continuous) demand rate, but in the following terms: A (low-demand) safety function, which operates in demand mode, is executed only on demand and brings the system to be monitored into a defined safe state. The executive elements of this low-demand safety function have no influence on the system to be monitored prior to occurrence of a demand for the safety function. Thereagainst, a (high-demand) safety function operating in continuous mode, always keeps the system, which is to be monitored, in its normal safe state. The elements of this high-demand safety function thus constantly monitor the system to be monitored. Failure of the elements of this (high-demand) safety function has the direct consequence of a risk if no further safety-related systems or external measures for risk reduction are effective. Moreover, a low-demand safety function is present when the demand rate is not more than once per year and not greater than twice the frequency of the routine inspection. A high-demand safety function or continuous safety function is, thereagainst, present when the demand rate is more than once per year or greater than twice the frequency of the routine inspection (see also IEC 61508-4, section 3.5.12).

The object of the present invention is to propose a safety circuit for a lift installation which embraces a more reliable and safer fulfilment of a frequently switching high-demand safety function such as, for example, the bridging-over of the door contacts and thus enhances safety, as well as also cost efficiency and minimised maintenance, of the entire lift installation.

Fulfilment of the object consists at the outset in the selective replacement by electronic semiconductor switches of those conventional electromechanical switches which are subject to a high number of switchings (high-demand safety function). Such a high-demand safety function is, for example, the bridging-over of the door contacts, but other safety functions which are switched in disturbance-free normal operation also come into consideration and, in particular, those which are frequently switched.

Such semiconductor switches, for example with metal-oxide semiconductor field-effect transistors (MOSFET: Metal-Oxide Semiconductor Field-Effect transistor), are based generally on transistors which withstand millions of switching cycles per day. The only disadvantage is the tendency thereof to cause a short-circuit on failure, which has the consequence of a permanent bridging-over of all door contacts. In other words, if for reasons of redundancy two semiconductor switches (in order to fulfil safety category SIL2) for bridging over the door contacts are for preference provided and these two semiconductor switches should fail due to a short-circuit, the high-risk situation arises that the lift cage and the counterweight can be moved with open shaft and/or cage doors, because the semiconductor short-circuit simulates closed doors.

In general, for avoidance or detection of a short-circuit in a semiconductor switch complicated and cost-intensive solutions for a so-called failsafe capability have been proposed.

The published specification EP-A2-1 535 876 discloses a drive which is connected with an electronic device having power semiconductors, wherein provided between the drive and the electronic device is at least one main contactor which is connected with a safety circuit comprising door switches connected in series. These serially connected door switches are in turn bridged over by switches on opening of the doors. This published specification thus does indeed disclose the use of semiconductors/power-semiconductors in an electronic device of the drive, but not within the safety circuit, as well as also no failsafe solution for avoidance of the tendency of semiconductors to short-circuit, but rather retention - which serves for avoidance of noise - of the at least one main contactor and checking of the latter by a time element and/or a counter.

According to the invention, in the case of a safety circuit in accordance with the present application an individual failsafe solution for the respective electronic semiconductor switches is not provided, but another electromechanical safety relay, which is present in any case, is - for the avoidance or detection of a possible short-circuit - incorporated in one of the electronic semiconductor switches. In this regard it is intended in accordance with the invention that in the case of a short-circuit in one of the electronic semiconductor switches, which according to the invention and for reasons of redundancy (safety category SIL2) are provided in double form for bridging-over of the door contacts, for the moment

still nothing happens. If, however, the second electronic semiconductor switch also fails - which due to possible overload peaks can take place more rapidly - there is intervention not by an individual failsafe solution provided for that purpose or an extra safety relay provided for that purpose in order to open the safety circuit, but by at least one electromechanical safety relay which is present in any case and which would open the safety circuit within the scope of another safety function if an irregularity were to be present within this latter safety function. Alternatively, opening of the safety circuit can also take place on failure of the first semiconductor switch.

This - at least one - other electromechanical safety relay of the first safety-relevant function of the lift installation is preferably provided for a so-called low-demand safety function, i.e. for a safety function which is exposed to few switching processes in that, for example, it switches only in the case of emergency situations outside normal operation (see the definition of Low-Demand Mode and High-Demand Mode in the third to fifth paragraphs).

According to the invention another form of safety relay can be, for example, a so-called ETSL relay circuit, wherein ETSL stands for Emergency Terminal Speed Limiting, thus for a speed-dependent emergency-situation shaft-end retardation control. Such ETSL relay circuits are known from the prior art. This ETSL relay circuit is a so-called low-demand safety component which is not used in normal operation. It comes into function only extremely rarely, namely only if the lift cage should happen to move out of its normal range. This ETSL relay circuit is electromechanical, i.e. it comprises not semiconductors, but relay contacts and electromechanical safety relays and according to the invention is, in addition to its original shaft-end retardation control function, incorporated into the monitoring of the semiconductor switches. These semiconductor switches are according to the invention used for a high-demand safety function, for example for bridging-over of the door contacts, but expressed more generally for a series connection of contacts which are closed in the case of disturbance-free normal operation, but which are opened in the case of specific operating conditions and then can be bridged over so that the entire safety circuit remains active.

In other words, the elements of the electromechanical relay circuit - or at least parts thereof - are in accordance with the invention used for the purpose of opening the safety circuit in the case of a short-circuit of one or both semiconductor switches.

According to the invention monitoring of the semiconductor switches takes place by means of a monitoring circuit which is processor-controlled. If the monitoring reveals that the semiconductor switches are short-circuited, the processor is or processors are in accordance with the invention in a position of letting the safety circuit of the lift installation open preferably by way of another electromechanical relay circuit present in any case, for example an ETSL relay circuit.

In a first solution it is provided that at least one processor on the one hand is in a position of controlling the semiconductor switches (for example for bridging over the door contacts) and at the same time the monitoring of the semiconductor switches. On the other hand, the at least one processor is in accordance with the invention at the same time in a position, in the case of a short-circuit detected by way of the monitoring, of providing direct control intervention at relay contacts again connected in series for that purpose or at one or more electromechanical safety relays of the other electromechanical relay circuit. In other words, it is preferred in accordance with the invention that the other relay circuit itself no longer has a possible individual processor and the above-mentioned at least one processor controls not only the semiconductor switches, but also the monitoring thereof and additionally also the original function of the electromechanical relay circuit.

Consequently, in the exemplifying case of the electromechanical relay circuit detecting the ETSL function of the lift installation this means that the ETSL function no longer has any processors or any individual processors. The at least one processor for the semiconductor switches and the monitoring thereof also takes over the ETSL function. This merely requires appropriate lines and the corresponding connection with the processor now executing both safety-relevant functions and provides a considerable cost advantage.

However, as a further alternative it is also possible to make further use of the controlling processor or processors of the electromechanical relay circuit and to pass on the controlling processor or processors of the semiconductor switches for opening the safety circuit due to a short-circuit of the semiconductor switches to the controlling processor or processors of the electromechanical relay circuit

Moreover, it would also be possible to make further use of the controlling processor or processors of the electromechanical relay circuit not to pass on to the controlling processor or processors of the electromechanical relay circuit the control command of the

processors for the semiconductor switches for opening of the safety circuit, but to let the processors of the semiconductor switches intervene directly at the relay contacts or at electromechanical safety relays connected therewith.

As already mentioned, the bridging-over of the series connection of contacts can be a frequently switching high-demand function, for example the bridging-over of the door contacts which in accordance with the invention is carried out by semiconductor switches. However, notwithstanding this use of semiconductor switches the same level of safety as with electromechanical safety relays is achieved in that in the case of a failure (short-circuit) of the bridging-over of the door contacts use is preferably made of the ETSL safety relay or relays in order to re-open the safety circuit and avoid risky situations.

In order to achieve at least the same or an increased level of safety it is basically necessary to take into consideration only those electromechanical safety relays in the incorporation, in accordance with the invention, for bypassing a bridging-over - which is no longer functional due to a short-circuit - of the door contacts by means of semiconductor switches which with respect to their connections, design and level of safety (so-called SIL category, wherein SIL stands for Safety Integrity Level, see fourth paragraph) are provided for a safety function which cannot be bridged over by mechanical operation, i.e. the electromechanical safety relay has to be designed so that it at least covers a safety function which is of such fundamental importance that it can be bridged over only intentionally by manual operation or even can never be bridged over.

As already mentioned, the two conventional electromechanical relays for bridging over the door contacts are in accordance with the invention replaced by, for example, two MOSFETs. Moreover, in accordance with the invention the two MOSFETs are each monitored by a respective processor or microprocessor and a monitoring circuit or check circuit in that a voltage measurement is carried out at an input and an output of the MOSFETs separately for each channel. If one MOSFET or both MOSFETs should be damaged (which in the case of such switches usually means a short-circuit) the respective processor will recognise this state and open the ETSL relay contact or contacts. A further advantage is thus that it is even possible for both MOSFETs to be damaged at the same time; in this way, however, the device or the lift installation always remains safe.

In addition, in accordance with the invention an indicating means is provided which

supplies information if a short-circuit is bypassed in one of the semiconductor switches by one of the electromechanical safety relays or the contacts thereof.

The MOSFETs are normally always closed when the doors are open. Consequently, provision is made for the respective processor to briefly open the MOSFETs at a regular interval of a few seconds in order to check the voltage drop at the MOSFET without the safety relay of the safety circuit dropping out and thus the corresponding relay contact of the safety circuit opening. This switch-off period is in accordance with the invention short enough for the purpose of measurement of the voltage drop, but not of such length as to allow the relay of the safety circuit to drop out.

It remains open to an expert to realise the just-described checking not by means of measurement of voltage drop, but by means of measurement of amperage, preferably inductively and contactlessly.

The present invention thus presents a hybrid solution which economically combines the proven safety of electromechanical relays with the high level of reliability - particularly with respect to the number of switching cycles - of transistors.

A bridging-over connection in accordance with the invention thus comprises semiconductor switches preferably for frequently switching high-demand safety functions, such as, for example, the bridging-over of the door contacts, and a processor-controlled check circuit for these semiconductor switches as well as preferably incorporation of an electromechanical safety relay, which is normally responsible for another seldom-switching low-demand safety function, for bypassing the semiconductor switches in the case of a semiconductor short-circuit and opening of the safety relay.

Moreover, the safety circuit includes the usual features and switching arrangements appropriate to current lift installations - not least due to the applicable standards - and familiar to an expert in the field of construction of lift installations. Such features are, for example, the serial arrangement of all shaft door contacts, the similarly serial arrangement of the cage door contact or contacts, the monitoring of the travel of the lift cage by limit switches (EEC - Emergency End Contact), the monitoring of the travel speed of the lift cage by sensors at the shaft end (ETSL), brake contacts and at least one emergency off-switch.

Further or advantageous embodiments of a safety circuit according to the invention form the subjects of the dependent claims.

The invention is explained in more detail symbolically and by way of example on the basis of figures. The figures are described conjunctively and generally. The same reference numerals denote the same components and reference numerals with different indices indicate functionally equivalent or similar components.

In that case:

Fig. 1 shows a schematic illustration of an exemplifying lift installation;

Fig. 1a shows a schematic illustration of the safety circuit of Fig. 1; and

Fig. 2 shows a schematic illustration of an arrangement in accordance with the invention of two semiconductor switches for bridging over a series connection of contacts, a monitoring circuit for these two semiconductor switches, an electromechanical relay circuit and the integration in accordance with the invention of this arrangement in a conventional safety circuit according to Fig. 1 or Fig. 1a and the thus-resulting safety circuit according to the invention.

Fig. 1 shows a lift installation 100, for example in illustrated 2:1 support means guidance. A lift cage 2 is movably arranged in a lift shaft 1 and is connected by way of a support means 3 with a movable counterweight 4. In operation, the support means 3 is driven by means of a drive pulley 5 of a drive unit 6, these being arranged in, for example, the uppermost region of the lift shaft 1 in an engine room 12. The lift cage 2 and the counterweight 4 are guided by means of guide rails 7a or 7b and 7c extending over the shaft height.

The lift cage 2 can at a conveying height h serve an uppermost storey with storey door 8, further storeys with storey doors 9 and 10 and a lowermost storey with storey door 11. The lift shaft 1 is formed from shaft side walls 15a and 15b, a shaft ceiling 13 and a shaft floor 14, on which a shaft floor buffer 19a for the counterweight 4 and two shaft floor

buffers 19b and 19c for the lift cage 2 are arranged.

The support means 3 is fastened at a stationary fastening point or support means fixing point 16a to the shaft ceiling 13 and is guided parallelly to the shaft side wall 15a to a support roller 17 for the counterweight 4. From here it goes back again over the drive pulley 5 to a first deflecting or support roller 18a and a second deflecting or support roller 18b, looping under the lift cage 2, and to a second stationary fastening point or support means fixing point 16b at the shaft ceiling 13.

A safety circuit 200 comprises on each of the storeys 8 to 11 a respective shaft door contact 20a to 20d, which contacts are arranged in series in a shaft door circuit 21. The shaft door circuit 21 is connected with a PCB (Printed Circuit Board) 22 which, for example, is arranged in the engine room 12. The PCB 22 is connected by a connection 23, which is to be understood only in symbolic terms, with the drive 6 or a drive brake 24 so that in the case of fault reports of the safety circuit 200 the drive of the drive unit 6 or the rotation of the drive pulley 5 can be stopped.

The connection 23 is to be understood only in symbolic terms because in reality it is significantly more complicated and as a rule includes the lift control. It additionally comprises a relay 40 of the safety circuit 200 and connecting points 41a and 41b. Between the latter there is realised a shaft-end retardation control function 42, which usually has two channels in order to fulfil the safety category SIL2, in that a first ETSL channel and a second ETSL channel are serially arranged in the safety circuit 200. The two ETSL channels are symbolically illustrated as switches 31a and 31b, but are switching relays with switch contacts.

Not only the shaft doors have a shaft door circuit 21 for control of the opening of the shaft doors 21, but in addition the lift cage 2 has a cage door circuit 25 for control of the opening of two schematically indicated cage sliding doors 27a and 27b. This cage door circuit 25 comprises a cage door contact 26. Signals from the cage door circuit 25 are conducted by way of a hanging cable 28 of the lift cage 2 to the PCB 22, where they are included in the safety circuit 200 in series with the shaft door contacts 20a to 20d.

The lift installation 100 further comprises a bridging-over connection 29 for the shaft door contacts 20a to 20d arranged in a series connection 43 and the similarly serially arranged

cage door contact 26. The bridging-over connection 29 comprises switching relays which are arranged in parallel between two further connecting points 41c and 41d and the switch contacts of which are symbolically illustrated as switches 30a and 30b.

In Fig. 1a the safety circuit 200 of the lift installation 100 of Fig. 1 is illustrated separately so that the connections and switchings thereof are clearer. The shaft-end retardation control connection 42 and the door-contact bridging-over connection 29 are independent of one another; they are merely serially integrated in the safety circuit 200.

In Fig. 2 it is illustrated how on the one hand a bridging-over connection 29a according to the invention for bridging over the contacts 20a to 20d and 26 of Figs. 1 and 1a is executed between the connecting points 41c and 41d of the safety circuit 200 of Fig. 1 and how on the other hand an electromechanical relay circuit 42a is arranged in accordance with the invention between the connecting points 41a and 41b of the safety circuit 200 of Fig. 1, as well as how the bridging-over connection 29a and the electromechanical relay circuit 42a are in accordance with the invention connected together and thus a safety circuit 200 according to the invention and a lift installation 100 according to the invention result. The electromechanical relay circuit 42a is preferably represented by a relay circuit for performance of a low-demand safety function of the lift installation 100.

In order to take over a high-demand safety function such as, for example, the bridging-over function of the door contacts a microprocessor 34c with a semiconductor switch or transistor 36a is appropriately connected into a first circuit 300a. The transistor 36a is by way of example represented as MOSFET transistor, but other types of transistors are also suitable.

Also indicated is a monitoring circuit 37a which is connected with an input 38a and an output 39a of the semiconductor switch 36a. The processor 34c controls the periodic cycles of measurement of the voltage or amperage at the input 38a and output 39a. The connecting point 38a can obviously also be represented by the output of the semiconductor switch 36a and the connecting point 39a by the input of the semiconductor switch 36a.

The bridging-over connection 29a, with which - as apparent from Figs. 1 and 1a - all door contacts 20a to 20d, 26 are serially connected by way of the connecting points 41c and

41d, is of two-channel construction for reasons of redundancy or fulfilment of the SIL2 safety category. The second channel comprises, analogously to the first channel, a circuit 300b, a semiconductor switch 36b and a monitoring circuit 37b for the semiconductor switch 36b, which is connected with an input 38b and an output 39b of the semiconductor switch 36b and is controlled by a microprocessor 34d. The microprocessors 34c and 34d are connected together for a bidirectional signal exchange. It is also possible to provide more than two channels.

The microprocessor 34c is additionally connected with an electromechanical relay 35c, a change contact 32c and a resistance 33c of a first ETSL channel or, with omission of a possible ETSL processor, the remaining elements of an electromechanical relay circuit 42a. The microprocessor 34d is in turn connected with an electromechanical relay 35d, a change contact 32d and a resistance 33d of a second ETSL channel. These two ETSL channels guarantee the shaft-end retardation control function, which is thus to SIL2 safety category, wherein the retardation control connection 42 necessary for that purpose is connected between the connecting points 41a and 41b of the safety circuit 200 of Fig. 1.

The shaft-end retardation control connection 42 used for the purpose according to the invention no longer has individual microprocessors, because the control of the retardation control connection 42 is carried out by means of the microprocessors 34c and 34d, in addition to the control of the bridging-over connection 29a and in addition to the control of the monitoring circuits 37a and 37b.

Also optionally possible is an arrangement with a single microprocessor which controls not only the two illustrated channels of the bridging-over connection 29a, but also the two illustrated channels of the electromechanical relay circuit 42a and the retardation control connection 42.

Fig. 2 schematically illustrates an exemplifying arrangement of a parallelly arranged two-channel bridging-over of door contacts connected in series (not only the shaft door contacts 20a to 20d, but also the cage door contact 26) of the lift installation 100a, or in general a possible combined detection in accordance with the invention of a first safety-relevant function, preferably a low-demand safety function (for example the shaft-end retardation control ETSL) and a further safety-relevant function, preferably a high-demand safety function (for example the bridging-over of the door contacts).

If a check of the semiconductor switches 36a and 36b by means of the monitoring circuits 37a and 37b yields a defect or a short-circuit of one of the semiconductor switches 36a and 36b or both semiconductor switches 36a and 36b the microprocessor and/or microprocessors 34c and/or 34d is or are according to the invention in a position of controlling the conventional electromechanical safety relays 35c and 35d of the electromechanical relay circuit 42a for opening of the safety circuit 200. This takes place additionally to the intended original shaft-end retardation of the lift cage 2, which the electromechanical relay circuit 42a could originally exercise. This intended original safety function does not cease to apply due to the assumption of the opening function of the safety circuit 200, preferably because the microprocessors 34c and 34d control not only the shaft-end retardation control connection of the lift cage 2 of the lift installation 100, but also the bridging-over connection 29a with the semiconductor switches 36a and 36b as well as monitoring of the semiconductor switches 36a and 36b.

The bridging-over connection 29a equipped with the semiconductor switches 36a and 36b comes into consideration not only for frequently switching high-demand functions, but also for any low-demand functions such as, for example, the EEC function, wherein EEC stands for Emergency End Contact, thus for a travel limitation of the lift cage 2 by means of limit switches beyond its normal travel path. The bridging-over connection 29a, which according to the invention can be combined with an electromechanical relay circuit 42a as disclosed, is also used, for example, for the braking function or for emergency evacuation.

Patent claims

1. Safety circuit (200) in a lift installation (100) with at least one series circuit (43) of safety-relevant contacts (20a-20d, 26) which are closed in case of disturbance-free operation of the lift installation (100), wherein at least one contact (20a-20d, 26) in the case of specific operating conditions in which this at least one contact (20a-20d, 26) is opened can be bridged over by means of semiconductor switches (36a, 36b) and wherein the semiconductor switches (36a, 36b) can be controlled by means of at least one processor (34c, 34d) and monitored with respect to a short-circuit by means of at least one monitoring circuit (37a, 37b), as well as with at least one electromechanical relay circuit (42a) with relay contacts (31c, 31d) connected in series with the contacts (20a-20d, 26) of the series connection (43) able to be bridged over, wherein the relay circuit (42a) is controllable by means of the at least one processor (34c, 34d) and the bridgeable-over series connection (43) can be interrupted by means of the relay contacts (31c, 31d) in the case of a short-circuit of the semiconductor switches (36a, 36b).
2. Safety circuit (200) according to claim 1, characterised in that the at least one processor (34c, 34d) is also provided for - apart from controlling and monitoring the semiconductor switches (36a, 36b) and the relay circuit (42a) - control of a further safety-relevant control connection (42) which interrupts the series connection (43) by means of the relay circuit (42a).
3. Safety circuit (200) according to one of the preceding claims, characterised in that the semiconductor switches (36a, 36b) are metal-oxide semiconductor field-effect transistors.
4. Safety circuit (200) according to any one of the preceding claims, characterised in that the voltage at an input (38a, 38b) and an output (39a, 39b) of the semiconductor switches (36a, 36b) is measurable in the monitoring circuit (37a, 37b).
5. Safety circuit (200) according to any one of the preceding claims 1 to 3, characterised in that the amperage at the input (38a, 38b) and the output (39a, 39b) of the semiconductor switches (36a, 36b) is measurable in the monitoring circuit (37a, 37b).
6. Safety circuit (200) according to any one of the preceding claims, characterised in

that an indication of the bypassing of a short-circuit in one of the semiconductor switches (36a, 36b) is indicated by way of one of the relay contacts (31c, 31d) in the lift installation (100).

7. Lift installation (100) with at least one safety circuit (200) according to any one of the preceding claims 1 to 6.

8. Method of monitoring semiconductor switches (36a, 36b) of a lift installation (100) according to claim 7, comprising the following steps:

- a) periodically measuring the voltage or the amperage at the input (38a, 38b) and at the output (39a 39b) of the semiconductor switches (36a, 36b); and
- b) opening the series connection (43) of the safety circuit (200) by means of at least one relay contact (31c, 31d) if the measurement under step a) reveals a short-circuit.

9. Use of semiconductor switches (36a, 36b) for bridging over safety-relevant contacts (20a-20d, 26) of a series connection (43) of the lift installation (100), wherein in the case of a short-circuit of the semiconductor switches (36a, 36b) the bridgeable-over series connection (43) can be interrupted by means of an electromechanical relay circuit (42a) with relay contacts (31c, 31d).

10. Use according to claim 9, characterised in that the relay circuit (42a) is also usable, apart from the case of a short-circuit of the semiconductor switches (36a, 36b), for a further control connection (42) and in the case of impermissible operational states of the lift installation (1) the bridgeable-over series connection (43) can be interrupted by means of the relay contacts (31c, 31d) of the relay circuit (42a).