

Method of operating a lift installation, a lift installation operable by this method and safety equipment for this lift installation

The invention relates to a method of operating a lift installation, in particular for a multi-mobile lift installation with several lift cages in a shaft. Moreover, the invention relates to a corresponding lift installation operable by this method and to safety equipment for this lift installation in order to prevent collisions between these lift cages.

The lift cages in such multi-mobile lift installations are typically each equipped with an own drive and an own braking system. The electronic control of the entire lift installation is frequently designed so that no collisions of the individual lift cages should happen. Particularly in the case of an emergency stop or even in the case of a normal storey stop of a cage, it cannot be ensured in all circumstances that a further lift cage disposed above or below the same lift shaft can still stop in good time in order to avoid a collision. This could be avoided by presetting, via the control, sufficient spacings between the individual lift cages and also appropriately adapted vertical speeds. However, the conveying capacity of a multi-mobile lift installation is not fully utilised due to such a preset, which has an influence on the cost/utilisation efficiency.

A multi-mobile lift installation is now known from European Patent Specification EP 765 469 B1, which comprises means for opening the safety circuit of a lift cage if an undesired approach to another lift cage occurs. According to the stated patent specification there are present, at each lift cage, safety modules which evaluate the cage positions and speeds so as to be able to trigger, in a given case, braking processes even at other lift cages. The individual safety modules have to constantly know and evaluate the cage positions and speeds of the other participating lift cages in order to be able to correctly react to an emergency situation. A special decision module is needed for that purpose, which is responsible for determination of the stop commands in the emergency case.

A similarly complicated solution is known from International Patent Application WO 2004/043841 A1.

With consideration of the known arrangements it is the object of the present invention to provide a multi-mobile lift installation where, on approach of lift cages, the cages prior to collision are automatically stopped without a more complicated exchange of information

between the lift cages being necessary.

Stated in other words, the object is improvement of safe operation of multi-mobile lift installations by simple and reliable means.

It is regarded as a further object of the invention to so execute a 'collision protection' that no additional shaft cross-section is used up or occupied.

Fulfilment of the object takes place by the features of claim 1. Advantageous developments of the invention are realised by the dependent patent claims.

The method according to the invention for operating a lift installation comprises at least one upper lift cage and at least one lower lift cage, which are both vertically movable substantially independently in a common lift shaft of the lift installation, and a first electromechanical switching mechanism arranged in a lower region of the upper lift cage, wherein the first electromechanical switching mechanism comprises a weight fastened to an elongate run, the first electromechanical switching mechanism being kept in a travel setting by the weight force of the weight fastened to the run. A second electromechanical switching mechanism is arranged in an upper region of the lower lift cage vertically below the weight fastened to the run, wherein the weight impinges on the second electromechanical switching mechanism in the event of undesired approach of the two lift cages. A safety circuit of the lower lift cage is opened by means of the second electromechanical switching mechanism by the impinging of the weight. A safety circuit of the upper lift cage is opened by means of the first electromechanical switching mechanism by a diminishing of the weight force.

Advantageously the first electromechanical switching mechanism comprises a lever element, a force store and a switch, wherein the run is so fastened to the lever element that the lever element is kept in the travel setting by the weight force of the weight fastened to the run. The force store is so connected with the lever element that the lever element is transferred from the travel setting to an emergency setting when the weight force diminishes and the switch is then actuated and the safety circuit opened.

Advantageously the second electromechanical switching mechanism comprises a lever element, a force store and a switch, wherein the force store is so connected with the lever

element that the lever element is kept in a travel setting. The second electromechanical switching mechanism is transferred from the travel setting to an emergency setting when the weight impinges on the lever element and the switch is then actuated and the safety circuit opened.

Advantageously the second electromechanical switching mechanism comprises a collecting element which is so designed that the weight impinges on the lever element of the second electromechanical switching element even when slight oscillations occur during approach of the lift cages.

Moreover, a lift installation is operable in accordance with the inventive method, which installation comprises a drive and a holding brake for each lift cage and wherein not only the drives of the two lift cages are stopped, but also the holding brakes of the two lift cages are triggered by the opening of the safety circuits.

Advantageously the first electromechanical switching mechanism and the second electromechanical switching mechanism form an electromechanical safety system in the lift installation for precluding collision of the two lift cages.

In addition, a safety equipment is a component of the lift installation operable by the inventive method. This safety equipment comprises a first and a second electromechanical switching mechanism.

An advantage of the present invention lies in the simplicity and reliability of the solution. The switching mechanism can be advantageously produced with standard elements. In addition, on actuation of the switching mechanism the safety circuit of one cage is opened independently of a communication between the lift cages and the safety equipment. Thanks to the simple mode of construction and the autonomous functional capability the safety equipment is not susceptible to disturbances. Moreover, the described solution is simple to initialise when placing in operation, since only a few systems have to be matched to one another.

A further advantage of the invention is apparent if the safety equipment is disposed in communication with a control unit of the lift installation, because, when the weight impinges, the trigger mechanisms of the upper and lower lift cages are actuated

simultaneously. The control unit thus has available redundant information about an undesired approach of the lift cages and can actuate appropriate reactions such as triggering of a safety brake or holding brake. This redundant design of the safety equipment increases the safety of the lift installation.

The invention is described in more detail in the following on the basis of examples of embodiment and with reference to the drawings, which are not to scale and in which:

Fig. 1 shows a schematic side view of a first multi-mobile lift installation according to the invention; and

Fig. 2 shows a schematic side view of a part of a second multi-mobile lift installation according to the invention.

A first form of embodiment of the invention is described in connection with Fig. 1. A simple multi-mobile lift installation 10 with an upper lift cage A1 of a third lift cage (not shown) and a lower lift cage A2 of a third lift cage (not shown) is shown, the two lift cages being vertically movable substantially independently in a lift shaft 11 of the lift installation 10. For this purpose the lift cages A1, A2 can be provided with own drives or, for example, be individually couplable to a central drive system so as to enable individual movement in the lift shaft 11. Numerous possibilities also exist for positioning of the drive. Thus, this can be positioned in stationary location in a separate engine space or directly in the lift shaft (11) laterally of or above or below the lift cages. Lift concepts are also known in which the drives are component of the lift cage A1, A2. A number of approaches are thus available for selection by the expert in order to be able to individually move the lift cages of a multi-mobile lift installation.

A safety equipment 20 comprising a first electromechanical switching mechanism 21 and a second electromechanical switching mechanism 22 is provided.

The first electromechanical switching mechanism 21 is, as schematically indicated, fastened in the lower region of the upper lift cage A1, for example in the floor region. The first electromechanical switching mechanism 21 comprises a weight 23 fastened to an elongate run 24, which keeps the first electromechanical switching mechanism 21 in a so-called travel setting (normal setting) by the weight force G of the weight 23 fastened to

the run 24.

The second electromechanical switching mechanism 22 is arranged and fastened in an upper region of the lower lift cage A2 vertically below the weight 23, which is fastened to the run 24, so that in the case of an undesired approach of the two lift cages A1 and A2 the weight 23 impinges on the second electromechanical switching mechanism 22.

The two switching mechanisms 21 and 22 are so constructed and arranged that a safety circuit of the lower lift cage A2 is automatically opened by means of the second electromechanical switching mechanism 22 by the impinging of the weight 23 and that a safety circuit of the upper lift cage A1 opens by means of a first electromechanical switching mechanism 21 almost simultaneously by a diminishing of the weight force G and the reduction, which is connected therewith, of the tensile stress on the run 24.

A multi-mobile lift installation 10 has, preferably for each lift cage A1, A2, an own safety circuit in which several safety elements such as, for example, safety contacts and safety switches are arranged in series connection. The corresponding lift cage A1 or A2 can be moved only when the safety circuit and thus all safety contacts integrated therein are closed. The safety circuit is connected with the drive or the braking unit of the lift installation 10 so as to interrupt the travel operation of the corresponding lift cage A1 or A2 if, for example, the safety circuit is opened by actuation of the electromechanical switching mechanism.

Switching-off of the two drives and triggering of the holding brakes of the two lift cages A1 and A2 is preferably effected by the opening of the respective safety circuits.

The invention can, however, also be used in lift installations 10 which are equipped with a safety bus system instead with the mentioned safety circuit.

The described safety equipment 20 is a pure electromechanical system which does not require any exchange of information between the lift cages or also any intervention (as far as incorporation in the safety circuits or safety bus systems of the participating lift cages) in the lift control, i.e. the safety equipment 20 operates completely autonomously and therefore functions even in such cases where disturbances occur in the control.

Details of a second form of embodiment are explained in connection with Fig. 2, wherein the same and similar components or components with the same function are provided in all figures with the same reference numerals. In the second form of embodiment as well, use is made of two switching mechanisms 21 and 22 which are so constructed and arranged that the safety circuit of the lower lift cage A1 is automatically opened by means of the second electromechanical switching mechanism 23 by the impinging of the weight 23 and that the safety circuit of the upper lift cage A1 opens by means of the first electromechanical switching mechanism 21 almost simultaneously by a diminishing of the weight force G.

The first electromechanical switching mechanism 21 comprises an elongate lever element 25, a force store 30 and a switch 26. The run 24, for example a rope or cable, is so fastened to the lever element 25 that the lever element 25 is kept in the travel setting by the weight force G of the weight 23 fastened to the run 24. As force store 30 use is made of an element which is so connected with the lever element 25 that the lever element is automatically transferred from the travel setting to an emergency setting when the weight force G diminishes and in that case the switch 26 is actuated. A spring-based mechanism is particularly suitable as force store 30, which mechanism in the case of the arrangement shown in Fig. 2 is placed in the region of a pivot axis 32 of the lever element 25 and predetermines there a torque in order to move the lever element 25 about the pivot axis 32 in clockwise sense when the run 24 is relieved. However, a spring-based mechanism which pulls the lever 25 or presses this can also serve as force store.

In every case the force store 30 must apply sufficient force in order to set the lever element 25 in motion and to trigger the switch 26 as soon as the strain on the run 24 significantly diminishes.

As switch 26 use is preferably made of an element which is mechanically connected directly or indirectly with the element 25 and which is triggered as soon as the lever element 25 rotates about the pivot axis 32 to some extent in clockwise sense. A form of embodiment of the switch 26 is shown in Fig. 2 which comprises a short lever with an end roller 33. On pivotation of the lever 26 the short lever moves and the switch 26 is actuated.

The second electromechanical switching element 32 also comprises a lever element 28, a

force store 31 and a switch 29. The force store 31 is so connected with the lever element 28 that the lever element 28 is kept in a travel setting. When the weight 23 impinges on the lever element 28 of the second electromechanical switching mechanism 22 this is transferred from the travel setting to an emergency setting and in that case actuates the switch 29. The safety circuit of the lower lift cage A2 is opened by the switch 26.

The second electromechanical switching mechanism 22 preferably comprises a collecting element 27 which is so designed that the weight 23 impinges on the lever element 28 of the second electromechanical switching mechanism 22 even in the case of slight oscillations during approach of the lift cages A1, A2. In the illustrated example of embodiment a funnel serves as collecting element 27. This element 27 is, however, optional.

As switch 29 use is preferably made of an element which is mechanically connected directly or indirectly with the lever element 28 and which is triggered as soon as the lever element 28 rotates about a pivot axis to some extent in counter-clockwise sense. In Fig. 2 a form of embodiment of the switch 29 is shown which comprises a short lever with an end roller 34. On pivotation of the lever element 28 the short lever moves and the switch 29 is actuated.

A simple, safe and robust electromechanical advance switching-off can be realised, in order to prevent collision of the lift cages, by the means which were described in connection with the first and second form of embodiment. Through the described safety equipment 20 an emergency stop is automatically triggered when a minimum spacing S is fallen below (see Fig. 1). The normal state is shown in Fig. 1 where both lift cages A1 and A2 are disposed at a sufficient spacing from one another. If now the lift cages A1 and A2 have further approached, wherein the spacing R reduces to zero, the weight 23 impinges on the second electromechanical switching mechanism 22 and triggers, by way of the switch 29, immediate stopping of the lower lift cage A2. At almost the same time the upper element 25 drives upwardly and immediate stopping of the upper lift cage A1 is also triggered by way of the switch 26.

If several lift cages travel in the same shaft 11, then a corresponding safety equipment 20 can also be provided between these lift cages.

Patent Claims

1. Method of operating a lift installation (10)
 - with at least one upper lift cage (A1) and at least one lower lift cage (A2), which are both vertically movable substantially independently in a common lift shaft (11) of the lift installation (10),
 - with a first electromechanical switching mechanism (21) arranged in a lower region of the upper lift cage (A1), wherein the first electromechanical switching mechanism (21) comprises a weight (23) fastened to an elongate run (24), the weight force (G) of the weight (23) fastened to the run (24) keeping the electromechanical switching mechanism (21) in a travel setting,
 - with a second electromechanical switching mechanism (21) arranged in an upper region of the lower lift cage (A2) vertically below the weight (23) fastened to the run (24),
 - wherein in the case of an undesired approach of the two lift cages (A1, A2) the weight (23) impinges on the second electromechanical switching mechanism (22),
 - a safety circuit of the lower lift cage (A2) is opened by means of the second electromechanical switching mechanism (22) by the impinging and
 - a safety circuit of the upper lift cage (A1) is opened by means of the first electromechanical switching mechanism (21) by a diminishing of the weight force (G).

2. Method according to claim 1, characterised in that the first electromechanical switching mechanism (21) comprises a lever element (25), a force store (30) and a switch (26), wherein the run (24) is so fastened to the lever element (25) that the lever element (25) is held in the travel setting by the weight force (G) of the weight (23) fastened to the run (24) and wherein the force store (30) is so connected with the lever element (25) that the lever element (25) is transferred from the travel setting to an emergency setting when the weight force (G) diminishes and the switch (26) is then actuated and the safety circuit opened.

3. Method according to claim 1 or 2, characterised in that the second electromechanical switching mechanism (22) comprises a lever element (28), a force store (31) and a switch (29), wherein the force store (21) is so connected with the lever element (28) that the lever element (28) is kept in a travel setting and wherein the second

electromechanical switching mechanism (22) is transferred from the travel setting to an emergency setting when the weight (23) impinges on the lever element (28) and the switch (29) is then actuated and the safety circuit opened.

4. Method according to claim 3, characterised in that the second electromechanical switching mechanism (22) comprises a collecting element (27) so designed that the weight (23) impinges on the lever element (28) of the second electromechanical switching mechanism (22) even when slight oscillations occur during approach of the lift cages (A1, A2).

5. Lift installation (10) operable according to the method according to one of the preceding claims, characterised in that the lift installation (10) comprises a drive and a holding brake for each lift cage (A1, A2) and wherein not only the drives of the two lift cages (A1, A2) are stopped, but also the holding brakes of the two lift cages (A1, A2) are triggered by opening of the safety circuits.

6. Lift installation (10) according to claim 5, characterised in that the first electromechanical switching mechanism (21) and the second electromechanical switching mechanism (22) form an electromechanical safety system for precluding collision to the two lift cages (A1, A2).

7. Safety equipment (20) for a lift installation (10) operable in accordance with the method according to any one of claims 1 to 4, characterised in that the safety equipment (20) comprises a first and second electromechanical switching mechanism.