

Holding brake with locking mechanism

The invention relates to a holding brake for a lift installation, to a correspondingly equipped lift installation, i.e. a lift installation which has at least one such holding brake, and to a method of operating such a lift installation.

Lift systems of conventional kind generally comprise a drive, a drive control associated with the drive and a braking system.

Holding brakes which must fulfil prescriptions with regard to safety regulations are employed at the lift cages.

A hydraulically actuable disc brake is known from patent specification EP 0 648 703 B1, in which, in the case of braking, brake plates engage a guide rail and the lift cage is secured at a storey stop against impermissible upward movements and downward movements.

A locking device which is engageable from outside and which in company with the movement in upward direction or downward direction of the lift cage builds up the necessary braking force in order to fix the lift cage is known from Patent Application EP 0 999 168 A2/A3.

A lift installation with a cage brake has become known from EP 1 840 068 A1, in which brake wedges slide on tracks extending obliquely with respect to a guide rail. In the case of braking a respective hydraulic actuator pushes a respective brake wedge along the track against the travel direction of the lift cage. As soon as the brake wedge comes into contact with the guide rail the brake wedge moves further on the track and wedges between the guide rail and the track in brake-amplifying manner.

The object is therefore set of providing a corresponding holding brake which combines a simple construction with a safe function. In particular, the holding brake shall exert a direct braking action. Moreover, the object is to provide a corresponding lift installation and a method of operating such a lift installation.

Details of the lift system according to the invention and of the corresponding holding brake are defined by the respective independent patent claims.

The corresponding holding brake of the invention is distinguished by the fact that it is equipped with a locking mechanism, preferably a double-acting locking mechanism, for holding a lift cage in a fixed shaft position.

The holding brake exerts a form of symmetrical clasp action. The clasp action arises due to unilaterally acting traction elements of the locking mechanism.

In one form of embodiment the holding brake comprises a double-acting brake which acts symmetrically. In that case, two opposite brake shoes act as active brake shoes and produce a braking force at a guide rail.

Use is preferably made of a holding brake which is designed specifically for use in a lift installation comprising a lift cage. The holding brake is designed for application of a mechanical braking action relative to a guide rail of the lift installation so that the lift cage or the counterweight after actuation of the holding brake keeps its vertical position. For this purpose the holding brake comprises a locking mechanism, preferably a double-acting locking mechanism, which is so designed that it acts on the guide rail from two mutually opposite sides and amplifies the braking force.

It is an advantage of the invention that a minimum vertical movement of the lift cage or of the counterweight is sufficient in order to trigger an amplified or self-amplifying locking function of the holding brake. This locking function can be triggered by use of the locking mechanism not only if the lift cage or the counterweight should move a small amount upwardly (here termed impermissible movement), but also if the lift cage or the counterweight should move a small amount downwardly (here termed impermissible movement).

It is an advantage of the invention that the holding brake has a self-locking function, since even in the case of a small undesired movement of the lift cage the braking action increases quasi automatically.

Advantageous developments of the invention are distinguished by the fact that the locking mechanism is equipped with at least one actuator in order to be able to so adjust, in an initial movement or adjusting movement, brake bodies that in the activation case they only

have to execute a small closing movement (engagement movement) in order to more firmly fix the lift cage.

Advantageous developments of the lift system according to the invention are defined by the dependent patent claims.

The invention is described in detail in the following on the basis of exemplifying embodiments and with reference to the figures.

Fig. 1 shows a lift installation with a first holding brake, in substantially simplified schematic illustration;

Fig. 2 shows details of a first holding brake; and

Fig. 3 shows details of a second holding brake.

Fig. 1 shows a first form of embodiment of the invention in a schematic overall illustration. A lift installation 10 is shown in strongly schematic form. The lift installation 10 comprises a lift cage 12 and a corresponding counterweight 19, which are guided to be vertically movable in opposite sense in a lift shaft. The lift cage 12 can serve several storeys (here two storeys A and B are shown). The lift cage 12 can be moved by a drive 11 which, by way of example as indicated in Fig. 1, is disposed at the upper shaft end. Apart from the drive 11, the lift installation 10 comprises a drive control 15, which is associated with the drive 11, and a braking system 13. The lift cage 12 is here connected with the counterweight 19 by way of a support means 18 which runs around a drive pulley of the drive 11. The linking, in terms of control, of the drive control 15 with the elements of the lift installation 10 is schematically indicated by a double arrow 16, which symbolises a connection between the drive 11 and the drive control 15. The drive control 15 typically receives signals by way of, for example, the control link 16. These signals are converted into control magnitudes. If the drive 11 sets the lift cage 12 in motion, at least one holding brake 20, which is arranged at the lift cage 12 and mechanically interacts with at least one guide rail 17 in the lift shaft 14, is released.

On reaching a destination storey (for example storey B in Fig. 1) the speed of the drive 11 is slowed down and the braking system 13 is activated. When the correct vertical position

in the lift shaft 14 has been reached, the holding brake 20 comes into action in order to hold the lift cage 12 exactly at the correct vertical position.

The holding brake 20, which is described in more detail in two different forms of embodiment with reference to Figures 2 and 3, is designed for use in a lift installation 10. The holding brake 20 serves for application of a mechanical braking action relative to a stationary guide rail 17 of the lift installation 10. The lift cage 12 is held in its vertical position in the lift shaft 14 by the holding brake 20 after actuation thereof.

The holding brake 20 is distinguished by the fact that it comprises a locking mechanism 21, preferably a double-acting locking mechanism 21. The locking mechanism 21 is so designed and constructed that it acts on the guide rail 17 from two mutually opposite sides S1, S2.

A view of the holding brake 20 is shown in each of Figs. 2 and 3 in which the double-acting locking mechanism 21 acts from the left (side S1) and from the right (side S2) on the guide rail 17. In the case of action on the guide rail 17 the locking mechanism 21 exerts an advancing force BK1 and an oppositely directed advancing force BK2 on the guide rail 17.

The locking mechanism 21 preferably comprises a first brake body 22.1 and a second brake body 22.2. These brake bodies 22.1, 22.2 are opposite one another. The first brake body 22.1 has a first brake shoe 23.1 on a side facing the second brake body 22.2. The second brake body 22.2 has a second brake shoe 23.2 on a side facing the first brake body 22.1. The first brake body 22.1 presses together with the first brake shoe 23.1 by the advancing force BK1 or by a force proportional to the advancing force BK1 from the side S1 against the guide rail 17. The second brake body 22.2 presses together with the second brake shoe 23.2 by the advancing force BK2 or by a force proportional to the advancing force BK2 from the side S2 against the guide rail 17.

The first brake body 22.1 and the second brake body 22.2 are so movably mounted at a guide body 26 that in all forms of embodiment they are movable towards and away from one another.

The locking mechanism 21 is so designed in all forms of embodiment that the two advancing forces BK1 and BK2 are of equal magnitude. It is thereby achieved that the

double-acting locking mechanism 21 is constructed/arranged to be symmetrical mechanically and/or in terms of force with respect to the longitudinal axis L of the guide rail 17.

The locking mechanism 21 is preferably realised in all forms of embodiment by a traction device 24 acting from one side, as is shown in Figures 2 and 3.

This traction device 24 or the locking mechanism 21 is so constructed/arranged symmetrically with respect to the first brake body 22.1 and the second brake body 22.2 that two traction elements 24.1, 24.2 of the traction device 24 are connected with the first brake body 22.1 and two further traction elements 24.3, 24.4 of the traction device 24 are connected with the second brake body 22.2

The traction device 24 or the locking mechanism 21 preferably comprises a traction cable (for example a steel cable) which is arranged so that four cable sections 24.1, 24.2, 24.3, 24.4 of the traction cable result, as shown in Fig. 2. The four cable sections 24.1, 24.2, 24.3, 24.4 preferably form a form of lozenge or parallelogram with lateral corner points or lateral points UL, UR at the two distal ends of the brake bodies 22.1, 22.2 and with an upper distal point or upper deflection point UO at a fastening element 25 of the holding brake 20 and with a lower distal point or lower deflecting point UU at the fastening element 25 of the holding brake 20.

The traction cable of the traction device 24 is preferably fixedly connected at the lateral deflecting points UL, UR with the respective brake body 22.1 or 22.2. Preferably provided at the upper deflecting point UO and at the lower deflecting point UU are (deflecting) rollers 27 (as shown in Fig. 2) or slide posts, so that the traction cable can run around or slide around these deflecting points UO and UU. The axes R1, R2 of these rollers 27 or slide posts are perpendicular to the plane E (which here coincides with the plane of the drawing).

The holding brake 20 in all forms of embodiment preferably comprises a fastening element 25 and a guide body 26, as shown in Figs. 2 and 3. The fastening element 25 is designed for fastening the holding brake 20 to the lift cage 12 and the guide body 26 is mounted to be displaceable along the fastening element 25. The corresponding displacement movement is indicated in Fig. 2 and Fig. 3 by the double arrow P1.

The guide body 26 preferably has two mutually parallel extending rails or slide surfaces 28, which in the mounted state run parallel to the longitudinal axis L. In addition, the guide body 26 comprises a cross member 29 which is fixedly connected with the rails or slide surfaces 28.

The fastening element 25 and the cross member 29 are preferably arranged perpendicularly to one another and form a kind of cross.

The cross member 29 preferably carries (horizontal) guides 30 for horizontal guidance of the brake bodies 22.1, 22.2. The two brake bodies 22.1, 22.2 are mounted to be so movable in, at or between the guides 30 that they can execute an advancing movement in the direction of the guide rail 17.

Particularly preferred are forms of embodiment in which at least one active actuator is employed in order to be able to actively execute initial movements or advancing movements. These movements serve the purpose of bringing the locking mechanism 21 into a position in which this can build up the holding force with a minimum advance travel. In the case of the form of embodiment shown in Fig. 2, use is preferably made of a total of three actuators 31.1, 31.2, 31.3. The actuator 31.1 advances the brake body 20.1 in the direction of the guide rail 17 so that the first brake shoe 23.1 presses, when required, against the guide rail 17. The actuator 31.2 advances the brake body 22.2 in the direction of the guide rail 17 so that the second brake shoe 23.2 presses, also when required, against the guide rail 17. For preference use is made of a middle (restoring) actuator 31.3 in order to be able to urge the brake shoes 23.1, 23.2 apart for release of the holding brake 20. The position of the brake shoes 23.1, 23.2 can be optimally preset and in the case of need also re-adjusted by co-operation of the actuators 31.1, 31.2, 31.3. The actuators 31.1, 31.2 trigger a first braking action. The actuator 31.3 releases the holding brake 20 again.

The presetting of a minimum braking force by one or more actuators can also be employed so that the holding brake 20 does not automatically open in the case of a corresponding transition through the zero position when a load change from an empty lift cage 12 to a full lift cage takes place.

In Fig. 3 only a central actuator 32 is employed, which extends parallelly to the longitudinal axis L and is seated between the upper deflecting point UO and the lower deflecting point UU. This central actuator 32 combines the braking action and the release of the holding brake 20 in one. The actuator 32 thus replaces the actuators 31.1, 31.2, 31.3.

Advantageous developments of the invention are thus distinguished by the fact that the locking mechanism 21 is equipped with at least one actuator in order to be able to so advance the brake bodies 22.1, 22.2 in an initial movement that they exert a braking action in order to fix the lift cage 12.

All actuators preferably comprise a spring and an active actuator element which expands or contracts by, for example, application of a voltage. An actuator in the sense of the present invention is a component or an element which converts a signal of a regulating means into mechanical work or movement. The signal can be an electrical, a hydraulic or a pneumatic signal. Electrically operated actuators are preferred in connection with the present invention.

The locking mechanism 21 preferably comprises a traction cable with several sections 24.1 to 24.4, as shown in Fig. 2. The rollers 27 serve as deflecting rollers around which the traction cable is guided. The traction cable is fastened at the points UL and UR so as to be able to build up a traction force which by virtue of the symmetrical disposition/path of the traction cable acts at the points UL and UR perpendicularly in the direction of the guide rail 17.

However, the locking mechanism 21 can also comprise, instead of the traction cable, a linkage 33 with several rods 34.1 to 34.4 loadable in tension and compression, as shown in Fig. 3. In order that this locking mechanism 21 according to Fig. 3 is equivalent in effect to the locking mechanism according to Fig. 2, a short length of a traction cable 35 is attached at each of the deflecting points UO and UU. These traction cables 35 are tensioned between the points UO1 and UO or between UU1 and UU.

The traction cable of Fig. 2 and the linkage 33 inclusive of the short traction cables 35 constitute a so-termed traction element acting from one side. The action of this unilaterally acting traction element is as follows:

When the lift cage 12 is located at a storey (for example storey B in Fig. 1), the holding brake 20 comes into play as follows:

The brake bodies 22.1, 22.2 are advanced by the actuators 31.1, 31.2 and the brake shoes 23.1, 23.2 come into interaction with the guide rail 17. A first braking action thereby results. If the lift cage 12 should now drop a small amount, for example because a large load is contained in the lift cage 12, the fastening element 25, which is fixed to the lift cage 12, displaces downwardly in company with the lift cage 12 a few millimetres. At the same time the traction elements 24.2 and 24.3 pull obliquely downwardly at the points UL and UR. By virtue of this symmetrically acting traction force the brake bodies 22.1, 22.2 are further advanced and the brake shoes 23.1, 23.2 press even more firmly from both sides symmetrically against the guide rail 17.

By virtue of its unilateral character, the traction elements 24.1 and 24.4 do not exert any pressing force on the brake shoes 23.1, 23.2, which would impair the braking action.

The converse takes place if the lift cage 12 should move upwardly a small amount, for example if a large load is removed from the lift cage 12. Here the traction elements 24.1, 24.4 come into play.

In a form of embodiment according to Fig. 3 in which the unilaterally acting traction element comprises a linkage 33 with traction cables 35 the manner of effect is in principle the same. In the case of a downward movement of the lift cage 12 the lower cable length 35 pulls at the point UU and the rods 34.2, 34.3 symmetrically pull at the points UL, UR. Through this symmetrically acting traction force the brake bodies 22.1, 22.2 are further advanced and the brake shoes 23.1, 23.2 press even more firmly from both sides symmetrically against the guide rail 17.

The converse takes place if the lift cage 12 should move a small amount upwardly. Here the upper cable length 35 pulls at the point UO and the rods 34.1, 34.4 pull symmetrically at the points UL, UR.

As a result, every smallest positional deviation of the lift cage 12 is immediately converted into an amplified braking action of the holding brake 20. In the case of a form of embodiment according to Fig. 2 the (deflecting) rollers 27 guarantee that the respective traction elements 24.1 to 24.4 pull with the same forces symmetrically at the points UL,

UR. In the case of a form of embodiment according to Fig. 3, the short traction cables 35 ensure a uniform traction effect as long as the lengths of the rods 34.1 to 34.4 are identical and the positions of the points UO and UU are central.

In order to release the braking action of the holding brake 20 use is made of the actuator 31.3 or 32 which urges the brake shoes 23.1, 23.2 apart. The release of the holding brake 20 typically takes place only when the drive 11 has applied sufficient torque (termed pre-torque) for driving the lift cage 12.

Depending on the respective form of embodiment it is even optionally possible to eliminate a load measurement in the lift cage 12, since the actuator can open the holding brake 20 only when there is sufficient pre-torque. For this purpose the pre-torque can be increased until the actuator is in a position of releasing the holding brake 20. This form of embodiment also offers the following additional advantage. In the case of incorrect pre-torque, release of the holding brake 20 is hardly possible, which leads to improved safety. In the case of the form of embodiment of Fig. 3, the actuator 32 is shortened and thereby urges, due to the stiffness of the rods of the linkage 33, the brake bodies 22.1, 22.2 outwardly. Release of the holding brake 20 takes place here in this manner.

The holding brake 20 of the invention is thus a braking device which symmetrically engages a stationary guide rail 17 on both sides.

Such a holding brake 20 can be mounted on the lift cage 12 and/or the counterweight 19.

The holding brake 20 prevents drifting of the lift cage 12 away from the storey level. Regulations by the lift drive 11 are eliminated.

Patent claims

1. Holding brake (20) for a lift installation (10), comprising brake shoes (23.1, 23.2), which are actuatable by means of actuators (31.1, 31.2) and which in the case of braking produce a braking force at a guide rail (17) of the lift installation (10), characterised in that a locking mechanism (21) with a traction device (24) is provided, wherein the brake shoes (23.1, 23.2) are arranged at a cross member (29) which in the case of braking is movable relative to the traction device (24) and wherein the traction device (24) amplifies the braking force of the brake shoes (23.1, 23.2) at the guide rail (17).
2. Holding brake (20) according to claim 1, characterised in that the locking mechanism (21) is a double-acting locking mechanism (21) comprising a first brake body (22.1) and a second brake body (22.2) which are arranged opposite one another, wherein the first brake body (22.1) has a first one of the brake shoes (23.1) at a side facing the second brake body (22.2) and wherein the second brake body (22.2) has a second one of the brake shoes (23.2) at a side facing the first brake body (22.1).
3. Holding brake (20) according to claim 1 or 2, characterised in that the locking mechanism (21) comprises a traction device (24) acting at one side.
4. Holding brake (20) according to claim 3, characterised in that the traction device (24) is arranged symmetrically with respect to the first brake body (22.1) and the second brake body (22.2) and two traction elements (24.1, 24.2) of the traction device (24) are connected with the first brake body (22.1) and two further traction elements (24.3, 24.4) of the traction device (24) are connected with the second brake body (22.2).
5. Holding brake (20) according to any one of the preceding claims, characterised in that it comprises a fastening element (25) and a guide body (26), wherein the fastening element (25) is designed for fastening the holding brake (20) to the lift cage (12) and the guide body (26) is mounted to be displaceable along the fastening element (25).
6. Holding brake (20) according to claim 5, characterised in that the first brake body (22.1) and the second brake body (22.2) are so movably mounted on the guide body (26) that they are movable towards and away from one another.

7. Holding brake (20) according to any one of the preceding claims, characterised in that it comprises an actuator (31.3; 32) for releasing the holding brake (20).

8. Lift installation (10) with a locking mechanism (21) according to any one of the preceding claims.

9. Method of operating a lift installation (10) according to claim 8, characterised by the following steps:

- engaging the brake shoes (23.1, 23.2) by means of actuators (31.1, 31.2, 32) for fixing the lift cage (12) or the counterweight (19) at the guide rail (17) and
- exerting an additional braking force by means of a locking mechanism (21) in the case of an impermissible movement of the lift cage (12) or of the counterweight (19).

10. Method according to claim 9, characterised in that the following steps are performed for releasing the holding brake (20):

- building up a holding force by a drive (11) whilst the locking mechanism (21) diminishes the holding force,
- releasing the brake shoes (23.1, 23.2) when sufficient holding force by the drive (11) is present and
- holding the lift cage (12) or the counterweight (19) in a rest position by the drive (11).