A DEVICE AT ELEVATORS FOR MECHANICAL UNLOCKING AND LOCKING OF CLOSED DOORS, GATES, BARS OR WICKETS
This invention relates to a device for mechanical unlocking and locking of closed doors, gates, bars or wickets comprising a locking means arranged at the door, gate, bar or wicket and including a locking bolt moved to a locking position by a spring.

A device for guided vertical or dip transports between predetermined levels (holding floors) by means of a guided, power-driven load plane is intended by the term elevator.

As the load as a rule is applied by persons and may per se constitute persons (cf. passenger elevators), it is generally required that measures are taken preventing passengers from being injured by the movable parts of the elevator equipment in normal use.

With respect to the purpose of use of the elevator set-up, its location and its technical construction, the responsible authorities all over the world have established different security levels in the form of differentiated security rules for elevators, it being understood that a higher security level as a rule causes a higher price of the elevator installation. Concurrently with the technical development, according to which the elevator speed and consequently the transport capacity of the elevator installation tend to increase, and where different problem complexes are solved in an increasingly cheap way, the technical security level is raised.

It is apparent from the above that high speed elevators allowed for passengers and open to the public make the greatest demands for security, and only the costs of security limits their applicability for other types of
For elevators open to the public it is necessary to surround as a first measure the whole set-up with walls, bottom and roof (hoist shaft) and to provide the resulting openings for holding floors with doors.

By also providing the load plane with walls and roof (elevator cage) the direct contact of using persons with the elevator set-up is reduced to comprise an elevator cage with entrance openings and holding floors with the same.

For elevators not to be used by the public, e.g., elevators for industrial purposes, building elevators and the like, the abovementioned first measure can be limited to such places of the relative set-up, where any form of passenger traffic can occur, which is always the case at the holding floors. This also applies to material elevators, where the load is manually applied.

In order to prevent personal injuries at the openings of the holding floors all types of elevators are provided with openable means, e.g., doors, gates, bars and the like, where the purely mechanical design of the device as well as the design of the relative locking means derive from the pre-requisite conditions mentioned above. The term "locking means" as herein used signifies a device which operates mechanically and/or electrically to lock the means for closing the entrances to the holding floors. For the sake of simplicity these closing means have below merely been called shaft doors. Here the logical conditions can be laid down regarding when a shaft door of an elevator can be opened in normal use with a maximum of security for using persons, in the following way:
A. A shaft door may be opened only provided the elevator cage (the load plane) is at the holding floor, where it is intended to be stopped or is stopped.

B. An elevator may be started or kept in motion only if all shaft doors are in a completely closed position and all shaft doors are made so that they cannot be opened.

Every manufacturer of elevators with responsibility for those using the elevators aims at satisfying the logical conditions indicated above as much as possible, by using more and more secure locking systems with the relative locking means for the shaft doors of the elevator.

The logical conditions mentioned above also relate to the openable devices of the elevator cage (load plane), where such are present, e.g., elevators, where a so-called plain hoist shaft is lacking, high-speed elevators and the like. At present only high-speed elevators satisfy these conditions, as the present systems are very expensive and therefore cannot be used in other cases than when the security demands of the authorities make them absolutely necessary.

In previously known locking devices a movable locking path adapted on the elevator cage has been used, which can be moved outwardly towards the walls of the hoist shaft, when it is desired to open a door lock, and actuate directly mechanically a lever of the door lock, which opens the door lock when being inserted, when the elevator is being braked or has stopped at the holding floor, where it is to be stopped. As a rule elevators provided with cage gates or the like have no mechanical locking to keep the elevator doors
locked in a moving lift, as a conventional locking with a locking path would be too expensive.

All these previous devices have the disadvantage that a careful mechanical adjusting method is required between door lock and movable locking path.

The disadvantages mentioned above are removed by means of the device of the invention characterized in that the locking bolt is movable against the action of the spring to a non-locking position by an electromagnetic means actuated by an electric circuit, which means is arranged to be activated by means of a lock activating device adapted on the load plane (elevator cage) when the load plane is at a holding floor, at which it is to be stopped, and that the locking means engages an electrically conductive element following the motion of the locking bolt, which element is adapted to close an electric circuit when the bolt is in locking position, which circuit must be closed in order that the elevator should be able to be moved from the holding floor, an electrically controlled and operable locking being thereby obtained. In this way a locking that is electrically controlled and mechanically operated, is obtained.

By means of the invention the mechanical adjusting method between details applied to the cage and the mechanical details belonging to locks of shaft doors will be eliminated to a large extent keeping rigorous security demands (the device of the invention satisfies in all respects the requirements according to security rules for elevators in Sweden in view of what is stated there about locks of shaft doors as well as those of cage doors), the installation work with the elevator being substantially simplified. In case of
using a locking path and contacts operated by the locking path a certain adjustment between these means is required, but their location is not dependent on the location of the door but can be selected, where the adjustment can be effected most easily, e.g., near the guides.

One way of making the adjustment still more independent of a close adjustment between details applied to the elevator cage and the details belonging to the lock of the shaft door is obtained according to an embodiment of the invention by having a lock activating device adapted on the elevator cage touch free operating a door locking contact which upon this operating activates an electric circuit of the locking means of the respective holding floor, when the elevator cage is at a holding floor, at which it is intended to stop. The lock activating device can for instance emit a directed, strong magnetic field, which operates a reed switch, which is closed by the emitted magnetic field, or else the magnetic field can operate a magnetic field controlled semi-conductor element or the like. The lock activating device can also comprise a light source actuating a switch included in the door locking means and activated by light. Also other types of emitter and receiver means are of course possible.

When the elevator cage door is also to be provided with a door this should be kept locked by a locking means of the same type as those at the holding floors, the locking means of the elevator cage preferably being unlockable by means of an electric circuit, which is activated when the elevator cage is at a holding floor, where it is to be stopped. The electromagnetic means of the elevator cage has
also a security contact, which is connected in series with the security contact of the holding floors or operates a contact in series with the security contacts of the holding floors. In this way it is secured that the elevator cannot be started from a holding floor, if all the shaft doors and the cage door of the elevator cage are not completely closed to a locked position.

The invention is described below more in detail with reference to the accompanying drawings, where Fig. 1 shows an elevator with two holding floors and with a door locking means according to the invention, Fig. 2 shows a section through a door locking means, Fig. 3 shows a circuit diagram of the device of the invention for an elevator without cage door or cage gate and with a locking activator and a lock activating device, which is not in mechanical contact with each other, Fig. 4 shows a circuit diagram of an embodiment of the invention for an elevator with a cage door or cage gate and with no mechanical cooperation between locking activator and lock activating means, and Figs. 5, 6 and 7 show different designs of transmitting operation between elevator cage and hoist shaft.

With reference to Fig. 1 a movable elevator cage guided along a mast 2 and driven by a wire 3, as in the Figure; or by another suitable driving means such as a driven gear arranged in the elevator cage and engaging a rack arranged along the mast is designated by the numeral 1.

Along the travel path of the elevator cage 1 there is a plurality of holding floors, the number of which is two in the example, i.e., a lower holding floor 4 and an upper holding floor 5. Sliding doors 6, 7 and 8, respectively,
which can be locked in the closed position by the locking means 9, 10 and 11, respectively, are arranged on the elevator cage 1 as well as at holding floors. These locking means are operated electrically by door locking actuators 12 and 13 arranged at the relative holding floor, which locking actuators are in turn operated by a lock actuating means 14 fitted on the elevator cage 1, which means has been given the form of a locking path in this Figure. As will be explained more in detail in the following, the lock actuating means 14 ensures that cage door 6 as well as holding floor door 7 or 8 will be openable when the elevator cage is at the relative holding floor.

An embodiment of the locking means 9, 10 and 11, which are preferably reciprocally alike, is shown in detail in Fig. 2. 21 is a housing, in which a locking bolt 22 is displaceably mounted, which is also the armature of a magnetic coil 23. A compression spring 24 tends to push the bolt 22 out of the housing 21 into a latching position of the relative sliding door 6, 7 or 8. Upon connection of electric current to the coil 23 this will draw the bolt 22 upwardly against the action of the spring 24 and release the sliding door, which will be free to be pushed to the right, as is seen in Fig. 2. The compression spring 24 is preferably of such strength as to overcome the dead weight of the bolt 22, and therefore the locking means can be mounted in all positions (also with the armature turned upwardly).

When the elevator cage reaches a holding floor and slows down preparatory to stopping, the coils 23 of the door locking means of the holding floor as well as of the door locking means of the elevator cage will thus be fed with current from the appropriate locking actuator 12 or 13 and be magnetized in this way so as to draw the bolt 22 out of its
locking position. In order to make sure that the bolt 22 has
extended completely (as the door 6, 7 or 8 can be incompletely
closed, the bolt 22 being prevented by the laths of the sliding
door from being completely pushed out) to locking position
after breaking the magnetizing current to the coil 23, when
the elevator is again to be moved, the locking means is provided
with a security contact 25 which closes a security or stop
circuit, when the bolt 22 is completely restored to locking
position. This security contact 25 includes a washer 27 loaded
by a spring 26 and consisting of electrically conductive mater-
ial, which washer is located at the upper end of rod 28
connected with the bolt 22 and projecting from this, which rod
has a coating of electrically non-conductive material along a
portion being at least the length of the stroke of the bolt.
When the bolt 22 enters locking position, i.e., a completely
extended position, the washer 27 will short circuit two or more
contact elements 29 arranged around the rod 28, said security
or stopping circuit being actuated. By this embodiment it is
ensured that the stop circuit cannot be closed with absolute
security if the bolt is not in its locking position. The
locking means is moreover provided with means for making it
possible to unlock the bolt 22, in an emergency situation, when
there is no magnetizing current for the coil 23. This emergency
opening means includes a washer 30 located at the upper end
of the rod 28, which washer can be lifted together with the
rod 28 and the bolt 22 by means of a suitable tool being
inserted into an aperture 31 in the housing after removal of
a plug 32.
Of course many other types of locking means are possible, what is essential for the locking means used with the device of the invention is only that there is an electrically conductive element accompanying the motion of the bolt, which element closes an electric circuit, when it gets into intimate contact with at least two conductive contact pins at locking end position of the bolt. These contact pins must be located relatively far from each other to satisfy the security rules in force as to flash-over between the pins. Then the electrically conductive component can assume the form of a washer, a wire adapted between pins or the like. The stroke of the bolt is of course also adapted so that with absolute certainty no flash-over can take place via the electrically conductive element, when the bolt is in unlocked position.

The operation of the locking means can be effected by letting the relative locking have the form of switches, which are operated mechanically by a movable lock path of conventional type. The locking path and the locking are placed where it is most simple to achieve the setting between them, e.g., near the guides.

The use of a movable locking path actuating a contact means has however certain disadvantages even if the location of the door locking here does not need to be dependent on the location of the lock itself. The number of movable parts is great, which considerably limits the use of the system with outdoor elevators, especially where temperatures below 0°C do occur. The constructive embodiment is as a rule so complicated that the system is not used at all. These disadvantages give rise
to several shut-downs.

Therefore an embodiment of the invention has been produced which does not have any of these disadvantages and whose outer movable parts have been limited to one, i.e., the bolt. This system is further built so that no mechanical contact between components mounted on a cage and components mounted on a holding floor (shaft door locks). Moreover the construction is such that the built-in shaft door locks do not need to correspond to components mounted on the cage.

According to this embodiment the lock actuating means arranged on the cage consists of a locking magnet with an electrically controlled magnetic field achieving the desired functions via magnetic switches arranged at the holding floors, which switches under magnetic influence close the circuit to the electromechanical door lock, to which the relative switch is connected. The magnetic switches are always broken, when they are not in a magnetic field. The position of the locking magnet is not predetermined by the location of the doors, and therefore its built-in position is preferably selected in the vicinity of the guides, it being possible to eliminate completely the influence of the mechanical tolerances.

In Fig. 3 a circuit diagram of this embodiment of elevators without cage door or gate is shown. The function is as follows. When the elevator stops at a holding floor, the contact 51, lying between one pole of an a.c. voltage supply source V, e.g., mains voltage and one input terminal of a rectifier means 52, e.g., of bridge type is closed. The other input terminal of the rectifier means is connected to the other pole of the voltage supply source. An electromagnet 53, hereafter called the locking magnet, is placed over the output
of the rectifier means. This magnet is arranged to produce a strong, directed magnetic field when current passes through its current coil, and can preferably be of a type as described in the Swedish patent application 7303335-9. The electromagnet is controlled by means of the contact 51. The door locking actuator 54 comprises in the example shown a reed switch, which is closed upon actuation of the magnetic field of the locking magnet. However, switch means other than reed switches can be considered, e.g., magnetically operated semi-conductor elements.

In certain cases, where it is possible to consider several movable parts but where a touch free operation of the switch is advantageous, the controllable magnetic field can be obtained by moving a permanent magnet towards the magnetic field controlled switch, when operation is desired. The permanent magnet can for instance be located on a movable locking path of conventional type. It is also possible to control the magnetic field controlled switches by placing a disc of ferromagnetic material in front of a fixed permanent magnet, when operation from the magnet is not desired, and which disc is moved aside during operation.

A series connection of a voltage supply source lies across the door locking actuator, which source can be the same source as the voltage supply source of the locking magnet, and connection of the input of a rectifier means 55 of e.g., bridge type. The output of the rectifier means 55 is connected to the current coil 23 of the electromechanical door lock, which is preferably of the type as described in connection with Fig. 2. Upon actuation of a magnetic field the contact 54 is closed and current is fed through the current coil 23 of the door lock, the door locking being released and the security
contact 25 following the locking means 22 being broken. The security contact 25 is connected in the stop circuit of the elevator. Therefore the elevator cannot be started.

When the elevator starts from a holding floor the door is closed and a starting impulse is emitted. The contact 51 is broken, and the field 53 of the locking magnet does no longer exist. The contact in the door locking contact 54 is broken so that the magnet of the door lock loses its attractive force. The return spring locks the lock, and the built-in contact 25 is closed so that the elevator can be started.

If the door should not be completely closed the door lock cannot enter the locked position, and thus the built-in contact 25 is not closed either, resulting in the elevator not being able to be started in this case.

If the elevator should be stopped between two holding floors, the locking magnet 53 is actuated as described above. However, no door locking actuator is adjacent the locking magnet, and therefore all the door locks remain locked.

Fig. 4 shows the same embodiment of the invention as Fig. 3, but here enlarged so as to apply to elevators having a lockable cage door or gate as well as the shaft door. In this device there is, in addition to the arrangement mentioned above, another door locking actuator 54 comprising a reed switch at each storey, all these door locking actuators being connected in parallel with each other and this parallel connection being connected between a series connection of a voltage supply source and the input of a bridge type rectifier means 57. The door locking actuators are only closed under the influence of magnetic field. The output of the rectifier means 57 is

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connected to the magnet coil 58 of a door lock of the cage gate or door of the same type as for the shaft doors. Also this door lock has a security contact 59, which is connected in series with the security contacts in the locks of the shaft doors and opens the stop circuit of the elevator when being broken so that the elevator cannot start from the holding floor; when one of the security contacts of the shaft doors or of the cage door or gate of the elevator is broken. This has the effect that the elevator cannot be started from a holding floor, if both the shaft door and the cage door or gate are not accurately closed so that the bolt has entered the locked position, as the security contacts follow the locking means.

If the elevator should stop between different holding floors the contact 51 is closed and the locking magnet is fed with current, these magnetic fields being formed. However, there is no door locking actuator within its field of action, and all the bolts remain in locked position.

It is also possible to use in the connections mentioned above a lock actuating means which emits light when it is actuated, which light actuates a switch included in the door locking means.

In Figs. 5, 6 and 7 different embodiments are shown schematically which can replace the devices shown in
Figs. 3 and 4, i.e., the electromagnet 53 and the reed switches 54 and 56. Fig. 5 shows the use of a movable locking path 63 of conventional type, which—when it is desired to open a door lock by means of a circuit of the same type as the circuit 51, 52 in Figs. 3 and 4—can be moved outwards towards one or several door locking actuators placed in the hoist shaft and designed as switches 64. The locking path 63 is shown with a continuous line in activated position and with a dashed line in inactivated position. Fig. 6 shows a permanent magnet 75 arranged on a locking path 73 of the same type and with the same function as the locking path 63 in Fig. 5, which magnet actuates a switch means 74 operated by a magnetic field, which can be a reed switch or comprise magnetically controlled semi-conductor elements. The movable way of the locking path and the power of the permanent magnet are adapted so that the switch 74 is closed when the locking path 73 has been moved outwards and is opened when the locking path 73 is in the inactivated position indicated with a dashed line. Finally Fig. 7 shows a permanent magnet 79, which is to influence a magnetic field operated switch means. A disc 80 of ferromagnetic material is normally placed in front of the magnet so that the magnetic field from the magnet is shielded by the disc. Upon activation of the circuit 51, 52 in Figs. 3 and 4 a device 81, which moves the disc 80 aside so that the magnetic field from the permanent magnet can reach a means positioned opposite to the magnet. In the case shown the spring 82 represents a compression spring, which moves the disc 80 in front of the permanent magnet 79 when there is no activation of the device 81.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A device for the mechanical unlocking and locking of closed elevator doors comprising a locking means located at the door and including a locking bolt movable to a locking position by a spring characterised in that the locking bolt is movable against the action of the spring to a non-locking position by an electromagnetic means actuated by a first electric circuit activated by means of a lock actuation device located on an elevator load carrier when the load carrier is stopped at a holding floor, and that the locking means engages an electrically conductive element following motion of the locking bolt, said element being adapted to close a second electric circuit when the bolt is in locking position, which second circuit must be closed in order that the elevator load carrier should be able to be moved from the holding floor.

2. A device as claimed in claim 1, characterised in that the electromagnetic means in the locking means is energised through a door locking actuator arranged at each holding floor which actuator is actuable by means of a lock activating means arranged on an elevator cage so that upon actuation of the lock activating means the electric circuit activates the locking means of the appropriate holding floor, when the elevator cage is at a holding floor.

3. A device as claimed in claim 1 or 2, characterised in that all the electric circuits belonging to every holding floor with door locking actuators and electromagnetic means are connected in parallel to a common current source.

4. A device as claimed in claim 2 or claim 3 when appended to claim 2, characterised in that the lock activating means is a locking path with reciprocating action, which is
movable outwards towards the wall of the elevator shaft, when a door lock is to be opened in order directly and mechanically to operate a door locking actuator in the form of a switch.

5. A device as claimed in any of claims 1 - 3, characterised in that the lock activating means comprises an emitter which actuates the door locking actuator in a non-mechanical manner.

6. A device as claimed in claim 5, characterised in that the emitter is arranged to emit a directed magnetic field, which actuates the door locking actuator so that upon actuation this activates the electric circuit of the locking means of the relative holding floor when the elevator cage is at the holding floor, at which it is to stop.

7. A device as claimed in claim 6, characterized in that the directed magnetic field is arranged to be produced by means of an electromagnet, by which the magnetic field is controllable.

8. A device as claimed in claim 6, characterised in that the directed magnetic field is arranged to be produced by means of a permanent magnet, which is located on a locking path with reciprocating action, the magnetic field reaching the door locking actuator thereby being controllable.

9. A device as claimed in claim 6, characterised in that the directed magnetic field is arranged to be produced by means of a permanent magnet with a disc of ferromagnetic material normally placed in front of the magnet, which, when the magnetic field is to be emitted, is arranged to be moved aside so that the magnetic field from the permanent magnet can reach the door locking actuator located opposite to the magnet.

10. A device as claimed in claim 6, characterised in that the door locking actuator comprises a normally opened
contact of a reed switch, which is closed upon actuation of the emitted magnetic field.

11. A device as claimed in claim 6, characterised in that the door locking actuator comprises magnetically operated semiconductor elements.

12. A device as claimed in claim 5, characterised in that the lock activating means comprises a light source, which actuates a switch included in the door locking actuator and operated by light.

13. A device as claimed in any of the preceding claims, when the elevator cage is provided with a door, characterised in that this door is kept locked by a locking means of the same type as the locking means at the holding floors and that the locking means of the elevator cage can be unlocked by an electric circuit which is arranged to be activated when the elevator cage is at a holding floor, at which it is to be stopped.

14. A device as claimed in claim 13, characterised in that the locking means of the elevator cage comprises an electrically conductive element following the bolt and having the same function as the element for each locking means of the doors arranged at the holding floors.

15. A device for the mechanical unlocking and locking of closed elevator doors substantially as hereinbefore described with reference to, and as shown in, any of the Figures of the accompanying drawings.

DATED THIS 26th DAY OF APRIL, 1976

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