Claims

1. Brake controller (7) for controlling the electromagnetic brake (9A, 9B) of an elevator, which brake controller (7) comprises:

an input (29A, 29B) for connecting the brake controller to the DC intermediate circuit (2A, 2B) of the frequency converter driving the hoisting machine of the elevator;

an output (4A, 4B) for connecting the brake controller (7) to an electromagnet (10) of the brake;

a solid-state switch (8A, 8B) for supplying electric power from the DC intermediate circuit (2A, 2B) of the frequency converter driving the hoisting machine of the elevator via the output (4A, 4B) to the electromagnet (10) of a brake (9A, 9B); and also

a processor (11), with which the operation of the brake controller (7) is controlled by producing control pulses in the control pole of the switch (8A, 8B) of the brake controller.

2. Brake controller according to claim 1, characterized in that the brake controller (7) comprises an input circuit (12) for a safety signal (13), which safety signal (13) can be disconnected/connected from outside the brake controller (7).

3. Brake controller according to claim 2, characterized in that the brake controller (7) comprises brake switching logic (16), which is connected to the input circuit (12) and is configured to prevent passage of the control pulses to the control pole of the switch (8A, 8B) of the brake controller when the safety signal (13) is disconnected.

4. Brake controller according to claim 3, characterized in that the brake switching logic (16) is configured to allow passage of the control pulses to the control pole of the switch (8A, 8B) of the brake controller when the safety signal (13) is connected.

5. Brake controller according to claim 3 or 4, characterized in that the brake controller (7) comprises indicator logic (17) for forming a signal (18) permitting startup of a run.

and in that the indicator logic (17) is configured to activate, and on the other hand to disconnect, the signal (18) permitting startup of a run on the basis of the status data of the brake switching logic (16).

6. Brake controller according to any of claims 3 - 5, characterized in that the signal path of the control pulses travels to the control pole of the switch (8A, 8B) of the brake controller via the brake switching logic (16);

and in that the electricity supply to the brake switching logic (16) is arranged via the signal path of the safety signal (13).

7. Brake controller according to any of claims 3 - 6, characterized in that the signal path of the control pulses from the processor (11) to the brake switching logic (16) is arranged via an isolator (22).

8. Brake controller according to any of claims 3 - 7, characterized in that the brake switching logic (16) comprises a bipolar or multipolar signal switch (24), via which the control pulses travel to the control pole of the switch (8A, 8B) of the brake controller;

and in that at least one pole of the signal switch (24) is connected to the input circuit (12) in such a way that the signal path of the control pulses through the signal switch (24) breaks when the safety signal (13) is disconnected.

9. Brake controller according to any of claims 6 - 8, characterized in that the electricity supply occurring via the signal path of the safety signal (13) is configured to be disconnected by disconnecting the safety signal (13).

10. Brake controller according to any of claims 3 - 9, characterized in that the brake controller (7) is implemented without any mechanical contactors.

11. Brake controller (7) for controlling the electromagnetic brake (9A, 9B) of an elevator, comprising:

an input (29A, 29B) for connecting the brake controller (7) to the DC electricity source (2A, 2B);

an output (4A, 4B) for connecting the brake controller (7) to the electromagnet (10) of the brake;

a transformer (36), which comprises a primary circuit and a secondary circuit;

a rectifying bridge (37), which is connected between the secondary circuit of the transformer and the output (4A, 4B) of the brake controller;

characterized in that the input comprises a positive (29A) and a negative (29B) current conductor;

and in that the brake controller (7) comprises:

a high-side switch (8A) and also a low-side switch (8B), which are connected in series with each other between the aforementioned positive (29A) and aforementioned negative (29B) current conductor;

a processor (11), with which the electricity supply to the electromagnet (10) of the brake is controlled by producing control pulses in the control poles of the high-side switch (8A) and low-side switch (8B);

two capacitors (19A, 19B), which are connected in series with each other between the aforementioned positive (29A) and the aforementioned negative (29B) current conductors;

and in that the primary circuit of the transformer is connected between the connection point (22) of the aforementioned high-side switch (8A) and aforementioned low-side switch (8B) and the connection point (24) of the aforementioned capacitors (19A, 19B).

12. Brake controller according to any of the preceding claims, characterized in that the brake controller (7) comprises two outputs (4A, 4B) to be controlled with a processor (11) independently of each other, via the first output of which electric power is supplied from the DC intermediate circuit (2A, 2B) of the frequency converter (1) driving the hoisting machine (6) of the elevator to the first electromagnet (10) of a

brake and via the second output electric power is supplied from the DC intermediate circuit (2A, 2B) of the frequency converter (1) driving the hoisting machine (6) of the elevator to the second electromagnet (10).

13. Brake controller according to claim 12, characterized in that the brake controller comprises two controllable switches, the first of which is configured to supply electric power to a first electromagnet (10) of a brake and the second is configured to supply electric power to a second electromagnet of the brake;

and in that the processor (11) is configured to control the electricity supply to the first electromagnet by producing control pulses in the control pole of the first switch;

and in that the processor (11) is configured to control the electricity supply to the second electromagnet by producing control pulses in the control pole of the second switch.

14. Brake controller according to claim 12 or 13, characterized in that the processor (11) comprises a communications interface, via which the processor (11) is connected to the elevator control (20, 35);

and in that the brake controller (7) is configured to disconnect the electricity supply to the first electromagnet (10) but to continue the electricity supply from the DC intermediate circuit (2A, 2B) of the frequency converter to the second electromagnet (10) after it has received from the elevator control (20, 35) an emergency stop request for starting an emergency stop to be performed at a reduced deceleration.

15. Brake controller according to claim 14, characterized in that the brake controller (7) is configured to disconnect the electricity supply to the first and to the second electromagnet after it has received from the elevator control (20, 35) a signal that the deceleration of the elevator car is below a threshold value.

16. Elevator system, characterized in that the elevator system comprises a brake controller (7) according to any of claims 1 – 15 for controlling the brake (9A, 9B) of the hoisting machine of an elevator.

17. Elevator system according to claim 16, characterized in that the elevator system comprises:

a hoisting machine (6);

an elevator car;

a frequency converter (1), with which the elevator car is driven by supplying electric power to the hoisting machine (6);

sensors (28) configured to monitor the safety of the elevator;

an elevator control (20, 35), which comprises an input for the data of the aforementioned sensors (28);

and in that the elevator control (20, 35) is configured to form an emergency stop request for starting an emergency stop to be performed at a reduced deceleration, when the data received from the sensors (28) indicates that the safety of the elevator is endangered.

18. Elevator system according to claim 17, characterized in that the elevator system comprises an acceleration sensor, which is connected to the elevator car;

and in that the elevator control (20, 35) comprises an input for the measuring data of the acceleration sensor;

and in that the elevator control (20, 35) comprises a memory, in which is recorded a threshold value of the deceleration of the elevator car;

and in that the elevator control (20, 35) is configured to compare the measuring data of the acceleration sensor to the threshold value for the deceleration of the elevator car recorded in memory;

and in that the elevator control (20, 35) is configured to form a signal that the deceleration of the elevator car is below the threshold value.

19. Method for performing an emergency stop with an elevator hoisting machine (6) driven with a frequency converter (1), in which method:

- one of the brakes (9A, 9B) of the hoisting machine is connected by disconnecting the electricity supply to the electromagnet (10) of the aforementioned brake, but

characterized in that:

- the other brakes (9A, 9B) of the hoisting machine are still kept open by continuing the electricity supply from the DC intermediate circuit (2A, 2B) of the frequency converter to the electromagnets (10) of the aforementioned other brakes (9A, 9B) of the hoisting machine.

20. Method according to claim 19, characterized in that:

- the deceleration during an emergency stop of the elevator car is measured, and
- and after a set period of time has passed also at least one second brake (9A, 9B) of the hoisting machine is connected after the deceleration of the elevator car is below a set threshold value.

Claims

1. A brake controller for controlling an electromagnetic brake of an elevator, which brake controller comprises:

an input for connecting the brake controller to a DC intermediate circuit of a frequency converter driving a hoisting machine of the elevator;

an output for connecting the brake controller to an electromagnet of the brake:

a solid-state switch for supplying electric power from the DC intermediate circuit of the frequency converter driving the hoisting machine of the elevator via the output to the electromagnet of the brake; and also

a processor, with which the operation of the brake controller is controlled by producing control pulses in a control pole of the switch of the brake controller.

2. The brake controller according to claim 1, characterized in that the brake controller comprises an input circuit for a safety signal, which safety signal can be disconnected/connected from outside the brake controller.

3. The brake controller according to claim 2, characterized in that the brake controller comprises a brake switching logic, which is connected to the input circuit and is configured to prevent passage of the control pulses to the control pole of the switch of the brake controller when the safety signal is disconnected.

4. The brake controller according to claim 3, characterized in that the brake switching logic is configured to allow passage of the control pulses to the control pole of the switch of the brake controller when the safety signal is connected.

5. The brake controller according to claim 3 or 4, characterized in that the brake controller comprises indicator logic for forming a signal permitting startup of a run,

and in that the indicator logic is configured to activate, and on the other hand to disconnect, the signal permitting startup of a run on the basis of a status data of the brake switching logic.

6. The brake controller according to any of claims 3 - 5, characterized in that the signal path of the control pulses travels to the control pole of the switch of the brake controller via the brake switching logic;

and in that the electricity supply to the brake switching logic is arranged via the signal path of the safety signal.

7. The brake controller according to any of claims 3 - 6, characterized in that the signal path of the control pulses from the processor to the brake switching logic is arranged via an isolator.

8. The brake controller according to any of claims 3 - 7, characterized in that the brake switching logic comprises a bipolar or multipolar signal switch, via which the control pulses travel to the control pole of the switch of the brake controller;

and in that at least one pole of the signal switch is connected to the input circuit in such a way that the signal path of the control pulses through the signal switch breaks when the safety signal is disconnected.

9. The brake controller according to any of claims 6 - 8, characterized in that the electricity supply occurring via the signal path of the safety signal is configured to be disconnected by disconnecting the safety signal.

10. The brake controller according to any of claims 3 - 9, characterized in that the brake controller is implemented without any mechanical contactors.

11. The brake controller for controlling an electromagnetic brake of an elevator, comprising:

an input for connecting the brake controller to a DC electricity source;

an output for connecting the brake controller to an electromagnet of the brake:

a transformer, which comprises a primary circuit and a secondary circuit;

a rectifying bridge, which is connected between the secondary circuit of the transformer and the output of the brake controller;

characterized in that the input comprises a positive current conductor and a negative current conductor;

and in that the brake controller comprises:

a high-side switch and a low-side switch, which are connected in series with each other between the positive current conductor and the negative current conductor;

a processor, with which the electricity supply to the electromagnet of the brake is controlled by producing control pulses in the control poles of the high-side switch and the low-side switch;

two capacitors, which are connected in series with each other between the positive current conductor and the negative current conductors;

and in that the primary circuit of the transformer is connected between a connection point of the high-side switch and the low-side switch and a connection point of the two capacitors.

12. The brake controller according to any of the preceding claims, characterized in that the brake controller comprises two outputs to be controlled with a processor independently of each other, via the first output of which electric power is supplied from a DC intermediate circuit of a frequency converter driving a hoisting machine of the elevator to a first electromagnet of a brake, and via the second output of which electric power is supplied from the DC intermediate circuit of the frequency converter driving the hoisting machine of the elevator to a second electromagnet.

13. The brake controller according to claim 12, characterized in that the brake controller comprises two controllable switches, the first of which is configured to supply electric power to the first electromagnet of the brake and the second is configured to supply electric power to the second electromagnet of the brake;

and in that the processor is configured to control the electricity supply to the first electromagnet by producing control pulses in a control pole of the first switch;

and in that the processor is configured to control the electricity supply to the second electromagnet by producing control pulses in a control pole of the second switch.

14. The brake controller according to claim 12 or 13, characterized in that the processor comprises a communications interface, via which the processor is connected to an elevator control;

and in that the brake controller is configured to disconnect the electricity supply to the first electromagnet but to continue the electricity supply from the DC intermediate circuit of the frequency converter to the second electromagnet after it has received

from the elevator control an emergency stop request for starting an emergency stop to be performed at a reduced deceleration.

15. The brake controller according to claim 14, characterized in that the brake controller is configured to disconnect the electricity supply to the first electromagnet and to the second electromagnet after it has received from the elevator control a signal that the deceleration of the elevator car is below a threshold value.

16. An elevator system, characterized in that the elevator system comprises a brake controller according to any of claims 1 – 15 for controlling a brake of a hoisting machine of an elevator.

17. The elevator system according to claim 16, characterized in that the elevator system comprises:

a hoisting machine;

an elevator car;

a frequency converter, with which the elevator car is driven by supplying electric power to the hoisting machine;

sensors configured to monitor the safety of the elevator;

an elevator control, which comprises an input for a data of the aforementioned sensors;

and in that the elevator control is configured to form an emergency stop request for starting an emergency stop to be performed at a reduced deceleration, when the data received from the sensors indicates that the safety of the elevator is endangered.

18. The elevator system according to claim 17, characterized in that the elevator system comprises an acceleration sensor, which is connected to the elevator car;

and in that the elevator control comprises an input for the measuring data of the acceleration sensor;

and in that the elevator control comprises a memory, in which is recorded a threshold value of the deceleration of the elevator car;

and in that the elevator control is configured to compare the measuring data of the acceleration sensor to the threshold value for the deceleration of the elevator car recorded in memory;

and in that the elevator control is configured to form a signal that the deceleration of the elevator car is below the threshold value.

19. A method for performing an emergency stop with an elevator hoisting machine having a plurality of brakes and driven with electricity power supply from a DC intermediate circuit of a frequency converter, and a brake controller according to any one of claims 1-15, characterized in that:

a first brake of the hoisting machine is connected by disconnecting the electricity supply to an electromagnet of the first brake; and

characterized in that:

the other brakes of the hoisting machine are still kept open by continuing the electricity supply from the DC intermediate circuit of the frequency converter to the electromagnets of the other brakes of the hoisting machine.

20. The method according to claim 19, characterized in that:

deceleration during an emergency stop of the elevator car is measured; and

after a set period of time has passed at least a second brake of the hoisting machine is connected after the deceleration of the elevator car is below a set threshold value.