

21 SEP 2000

Description

Safety Circuit for an Elevator Installation

5 The invention relates to a safety circuit for an elevator installation consisting of a chain of switches connected in series to monitor the equipment serving the safety of the elevator operation, and of a source of electric voltage to supply the series chain, there being connected
10 to the end of the series chain at least one switching device which generates signals for an elevator control depending on the switching status of the switches.

A safety circuit for an elevator installation consists of
15 a chain of door contacts connected in series, a contact being provided for the purpose of, for example, monitoring the position of a hoistway door. Further contacts or switches for the purpose of monitoring, for example, the position of the car door, the position of the brake, or
20 other equipment serving the safety of the elevator operation, can be connected into the safety circuit. The safety circuit is usually supplied with impulses of direct voltage from either an AC or DC source of voltage, there being connected to the end of the safety circuit at least
25 one safety relay. If all contacts are closed, the safety relay is activated. The elevator control monitors the status of the safety relay and if the safety relay is activated the elevator control releases, for example, a pending travel command.

A disadvantage of this type of electrical supply to the safety circuit is that the output voltage of the voltage source is not regulated and is subject to voltage fluctuations which in turn makes relays with a wide
5 voltage range necessary. Furthermore, the voltage has a value greater than a safe low voltage, and to prevent electrical accidents must be protected with a fault-current safety switch.

10 It is here that the invention sets out to provide a remedy. The invention as characterized in Claim 1 provides a solution to avoiding the disadvantages of the known device and creating a safety circuit which operates safely irrespective of the travel height of the elevator.

15

The advantages derived from the invention are essentially that the voltage across the safety relay is held constant. The voltage across the safety relay therefore no longer depends on the length of the cabling of the safety
20 contacts, which is of particular significance on elevator installations with very high travel. The cabling of the door contacts extends over the full height of the elevator hoistway and, if there is no regulation, has a direct influence on the voltage across the safety relay. If the
25 voltage is regulated, power supply voltage fluctuations, or changing contact resistances on the contacts, or other loads in the safety circuit which influence the voltage, have no effect on the safety relay. If the voltage across the safety relay is regulated, a commercially available
30 standard relay can be used as the safety relay without detriment to the reliable operation of the safety circuit.

Moreover, the safety circuit can be operated with physiologically safe low voltage. In particular, measures for the protection of persons are not necessary. With regulated voltage across the safety relay, a safety
5 circuit can be made with high operational safety and low costs.

Further developments of the invention are possible with the measures stated in the dependent claims. When the
10 safety circuit is open, a limiter acting through a network of the regulating circuit limits the supply voltage to a specific value. Moreover, the safety circuit operates with a low voltage which is not dangerous to persons.

15 The invention is described in more detail below by means of an example and by reference to the attached drawings. The drawings show:

Fig. 1 a diagrammatic illustration of a safety circuit
20 regulated voltage across a switching device; and

Fig. 2 details of one of the networks serving to regulate the voltage.

25 In Fig. 1 a safety circuit is indicated by 1 which comprises switches or contacts 3 connected in a series chain 2, at least one switching device or safety relay 4, a voltage converter 10 serving as an electric power supply 5, and a monitoring device 6, the signal from the safety
30 relay 4 being transmitted to an elevator control 7. On an input line 8 there is, for example, a direct voltage of 24

V DC which is applied to a protective switch 9. The protective switch 9 is connected on its output side to the input In of the DC-DC voltage converter 10, which increases the 24 V DC to, for example, between 25 V and 50 V DC. One end of the series chain 2 of the contacts 3 is connected via a measuring resistor 11 to the output Out of the voltage converter 10, the other end of the series chain 2 is connected to the safety relay 4. The second connection of each safety relay 4 is connected to a common line symbolized by a downward pointing arrow. The switching status of the safety relay 4 is transmitted to a relay contact 12 across which the elevator control 7 applies a signal voltage. To protect the safety circuit 1 against voltage spikes resulting from the switching of inductances, a protective diode 13, for example, is connected across the safety relay 4.

The voltage across the safety relay 4 which is to be regulated is tapped at P1 and transmitted to a network 14 consisting of passive elements which is connected to the voltage converter 10. If all the contacts 3 of the series chain 2 are closed, the voltage across the safety relay 4 is held constant at, for example, 25 V DC. If the series chain 2 is open, the output voltage of the voltage converter 10 is held at, for example, 53 V DC by a limiter 15.

The monitoring device 6 consists of a first overvoltage detector 16, a second overvoltage detector 17, an undervoltage detector 18, and an overcurrent detector 19. The first overvoltage detector 16 monitors the voltage

across the safety relay 4 and generates an error message if the monitored voltage exceeds, for example, 28 V DC. The second overvoltage detector 17 monitors the voltage on the output Out of the voltage converter 10 and generates
5 an error message if the monitored voltage exceeds, for example, 55 V DC. The undervoltage detector 18 monitors the voltage on the output Out of the voltage converter 10 and generates an error message if the monitored voltage falls below, for example, 23 V DC. The overcurrent
10 detector 19 monitors the current flowing in the series chain 2 in the form of a voltage across the measuring resistor 11 and generates an error message if the monitored current exceeds, for example, 300 mA. The error messages from the detectors 16,17,18,19 are transmitted to
15 an error circuit 20 which in the presence of at least one error message opens the protective switch 9 which switches off the voltage on the input In of the DC-DC voltage converter 10. The error circuit 20 stores the errors that have occurred and they can be read out by, for example, a
20 superordinated diagnostic circuit. For the purpose of manually resetting the error circuit 20, a pushbutton switch 21 is provided.

Fig. 2 shows details of the network 14 and the limiter 15
25 for regulating the voltage across the safety relay 4. If the series chain 2 is open, the output voltage of the voltage converter 10 is held constant at, for example, 53 V DC by means of a zener diode Z1. A capacitor C1 reinforces the dynamic behavior of the limiter 15.

If all the contacts 3 of the series chain 2 are closed, the voltage at point P1 across the safety relay 4 is held constant at, for example, 25 V DC. Via a diode D1 which prevents reverse current, the voltage at point P1 is

5 applied to a voltage divider comprising a resistor R3 and resistor R2, the point of voltage division P2 being connected to the limiter 15 and a limiting resistor R1 which is connected at its other end to the feedback input of the voltage converter 10. The voltage converter 10 uses

10 the signal on the feedback input to regulate the voltage on the output Out. Voltage converter 10, series chain 2, and network 14 form a regulating circuit which holds the voltage at point P1 constant. Voltage deviations are detected by the detectors 16,17,18. The switching statuses

15 of the contacts 3, error messages from the detectors 16,17,18,19, and signals from the error circuit 20, can also be detected and analyzed by a superordinated diagnostic circuit.

Patent Claims

**Safety Circuit for an Elevator Installation**

5 1. Safety circuit for an elevator installation consisting
of a chain of switches connected in series to monitor
equipment serving the safety of the elevator operation,
and of a source of electric voltage to supply the series
chain, there being connected to the end of the chain of
10 switches at least one switching device which generates
signals for an elevator control depending on the
switching status of the switches,
characterized in that
a regulating circuit (10,14) is provided which holds the
15 voltage across the switching device (4) constant.

2. Safety circuit according to Claim 1,
characterized in that
the voltage across the switching device (4) is connected
20 to a network (14) whose output is connected to an input
(feedback) of a voltage converter (10) which serves as a
regulator and power supply and supplies the series chain
(2).

25 3. Safety circuit according to Claim 2,
characterized in that
an output (Out) of the voltage converter (10) is
connected to a limiter (15) which is connected to a
network (14) and which when the series chain (2) is open
30 limits the voltage on the output (Out).

4. Safety circuit according to Claims 2 or 3,
characterized in that



the voltage converter (10) supplies the series chain (2) and the switching device (4) with a low voltage which is not dangerous to persons.

- 5 5. Safety circuit according to one of the above claims, characterized in that
- 10 a monitoring device (6) is provided which monitors voltage and current in the series chain (2), the switching device (4), and the voltage converter (10), and in the event of a fault disconnects the voltage converter (10) from the input voltage by means of a protective switch (9).