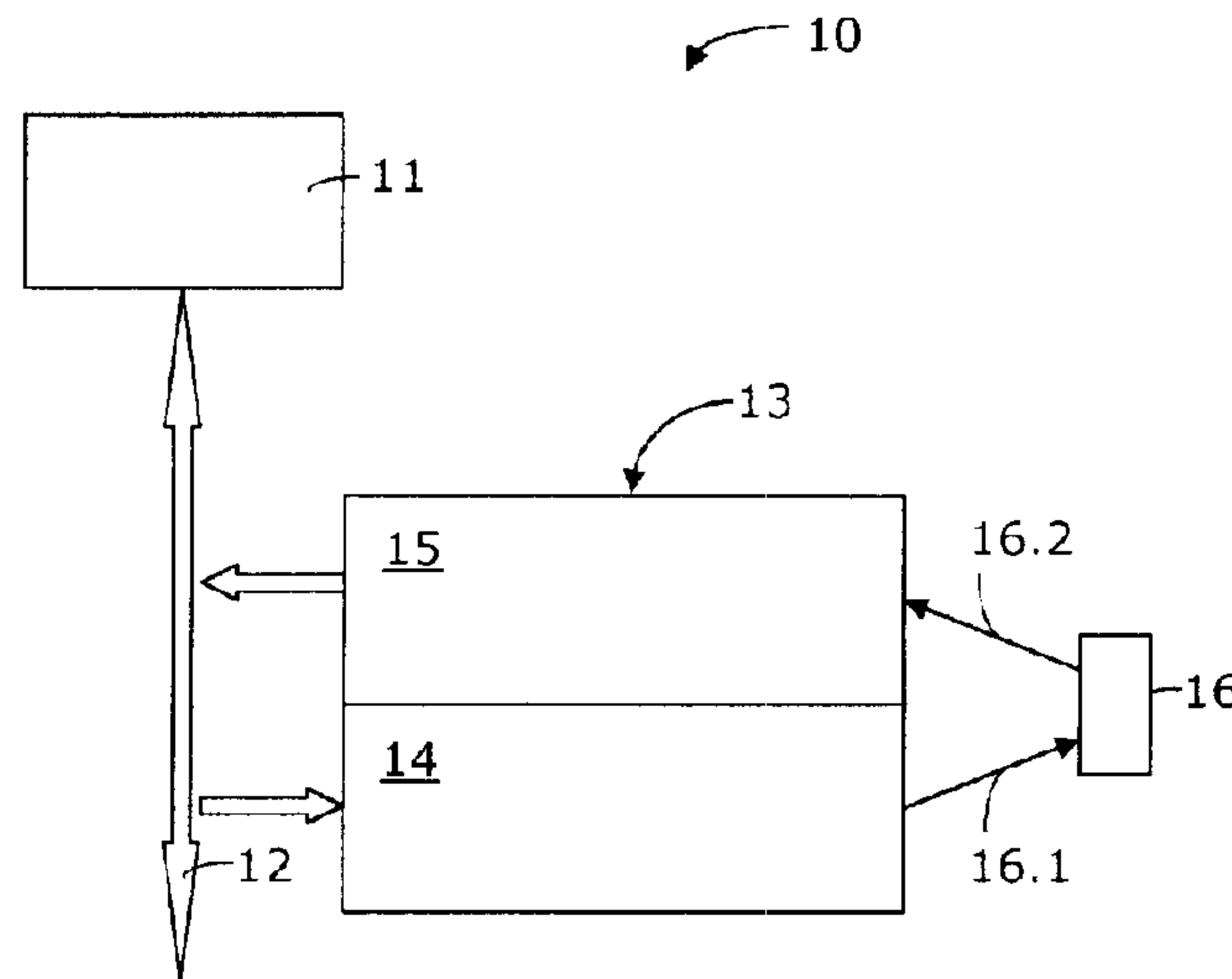




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(54) **Titre : PROCÉDE DE SURVEILLANCE D'UN APPAREIL D'ELEVATION**
 (54) **Title: METHOD FOR MONITORING A LIFT INSTALLATION**



(57) **Abrégé/Abstract:**

The monitoring method of a lift installation comprises a control unit (11) and at least one bus junction (13), which bus junction (13) comprises a receiver (14), a transmitter (15) and a safety element (16). The control unit (11) and the bus junction (13) communicate by way of a bus (12). The monitoring method has the following steps: a digital default signal is transmitted by the control unit (11) to the receiver (14); the digital default signal is converted by the receiver (15) into an analog signal; the safety element (16) is acted on (16.1) by the receiver (14) with the analog signal; if the safety element (16) is closed the analog signal is detected (16.2) by the transmitter (15); for a detected analog signal, a digital signal of the control unit (11) is provided by the transmitter (15); wherein on detection of an analog zero signal a digital signal is transmitted by the transmitter (15) to the control unit (11).

Abstract

The monitoring method of a lift installation comprises a control unit (11) and at least one bus junction (13), which bus junction (13) comprises a receiver (14), a transmitter (15) and a safety element (16). The control unit (11) and the bus junction (13) communicate by way of a bus (12). The monitoring method has the following steps: a digital default signal is transmitted by the control unit (11) to the receiver (14); the digital default signal is converted by the receiver (15) into an analog signal; the safety element (16) is acted on (16.1) by the receiver (14) with the analog signal; if the safety element (16) is closed the analog signal is detected (16.2) by the transmitter (15); for a detected analog signal, a digital signal of the control unit (11) is provided by the transmitter (15); wherein on detection of an analog zero signal a digital signal is transmitted by the transmitter (15) to the control unit (11).

(Figure 1)

Method for Monitoring a Lift Installation

The invention relates to a monitoring method of a lift installation according to the definition of the introductory part of the independent patent claim.

Conventional lift installations have safety circuits consisting of safety elements connected in series. These safety elements monitor, for example, the status of shaft or cage doors. Such a safety element can be a contact. An open contact shows that, for example, a door is open and a potentially impermissible door state has occurred. If, now, with the contact opened an impermissible open state of the door is identified then the safety circuit is interrupted. This has the consequence that a drive or brake, which acts on the travel of a lift cage, brings the lift cage to a standstill.

A safety system for a lift installation is known from the patent specification WO2005/000727, which comprises a control unit as well as at least one bus junction and bus. The bus enables communication between the bus junction and the control unit. The bus junction monitors, for example, the state of shaft and cage doors by means of a safety element, which is a component of the bus junction. Moreover, the bus junction consists of a receiver and a transmitter. In that case the receiver is so designed that it reads digital default signals from the control unit, converts these into an analog signal and thus acts on the safety element. The transmitter in turn measures, after the safety element, the analog signal and converts this into a digital signal. The transmitter makes these digital data available to the control unit. These data are either sent by the bus junction as digital signals to the control unit or demanded by the control unit by means of interrogation.

In order that safe operation of the lift installation is guaranteed and the current state of the lift installation known digital data has to be exchanged between the control unit and the bus junction at short time intervals. This means that the control unit has to have high computing capacities in order to be able to evaluate a multiplicity of digital signals and items of information. In addition, the bus is strongly loaded by signals, which are transmitted between the control and the bus junction, and accordingly has high data transmission capacities.

The object of the present invention is thus to provide a monitoring method of a lift installation with a reduced data exchange between control unit and bus junction and with a

control unit having lower computing capacities.

The object is fulfilled by the invention in accordance with the definition of the independent claim.

The monitoring method of a lift installation in accordance with the invention has a control unit and at least one bus junction. This bus junction comprises a receiver, a transmitter and a safety element. The control unit and bus junction communicate by way of a bus. The method executes the following steps:

a digital default signal is transmitted by the control unit to the receiver;

the digital default signal is converted by the receiver into an analog signal;

the safety element is acted on by the receiver with the analog signal;

if the safety element is closed the analog signal is detected by the transmitter;

for a detected analog signal, a digital signal of the control unit is provided by the transmitter; and

on detection of an analog zero signal a digital signal is transmitted by the transmitter to the control unit.

The advantage of this monitoring method resides in the small data exchange between control unit and bus junction. Since the bus junction when the safety element is open, thus when, for example, a shaft door or cage door is open, communicates this potentially risky state to the control unit, a constant short-cyclic communication between control unit and bus junction is eliminated. As a consequence, use can be made of control units with lesser computing capacities as well as buses with smaller data transmission capacities, which leads to lower costs.

Advantageously, the digital default signal is transmitted by the control unit to the receiver at time intervals. During this time interval the safety element is acted on by the receiver with an analog signal corresponding with the preceding digital default signal. In normal

operation the digital signal provided by the transmitter is interrogated by the control unit at time intervals. These time intervals are preferably selected to be in the order of magnitude of 100 seconds.

The advantage of these relatively long default and interrogation time intervals is a further relief of the bus between the control unit and the bus junction and a further reduction of the signals and data to be processed by the control unit.

Advantageously, on detection of an analog zero signal a digital signal is spontaneously transmitted by the transmitter to the control unit. This is the case, for example, when with the safety element open an analog zero signal is detected by the transmitter. By virtue of the spontaneous transmission of the digital signal, measures are undertaken by the control unit in order to bring the lift to a safe operational state.

The advantage of the spontaneous transmission of a digital signal by the transmitter to the control unit is based on the fact that the lift can be safety operated notwithstanding relatively long default and interrogation intervals.

Advantageously, the monitoring method also includes a test procedure. In this test procedure a bus junction is tested by the control unit at time intervals. This test procedure is performed by the control unit at least once per day. In that case, the bus junction is acted on by the control unit with a digital zero default signal which is converted by the receiver into an analog zero signal. Accordingly, the transmitter measures an analog zero signal. Thus, in the case of correct functioning a corresponding digital signal is spontaneously transmitted by the bus junction to the control unit.

The advantage of this test procedure resides in the simple and reliable checking of the functional capability of a bus junction or of the spontaneous transmission behaviour of the transmitter. In this test procedure an open safety element is simulated and the corresponding spontaneous transmission behaviour of the transmitter provoked. The functional capability of the bus junction for normal operation is tested in every default-interrogation cycle.

The invention is clarified and further described in detail in the following by way of several exemplifying embodiments and three figures, in which:

Fig. 1 shows a schematic view of a safety system according to the invention;

Fig. 2 shows a schematic view of a second form of embodiment of a safety system according to the invention; and

Fig. 3 shows a schematic view of a third form of embodiment of a safety system according to the invention.

The present monitoring method is particularly suitable for lift installations, as was described in the introduction. Fig. 1 shows a form of embodiment of a safety system 10 according to the invention which is technically adapted to perform the monitoring method. The safety system 10 has a control unit 11 and at least one bus junction 13. The communication between the control unit 11 and the bus junction 13 takes place by way of a bus 12. Data can thus be sent in both directions between the bus junction 13 and the control unit 11 by way of the bus. The bus junction 13 itself consists of a receiver 14, a transmitter 15 and a safety element 16. The receiver 14 and the transmitter 15, respectively, are each so designed that the former receives default signals from the control unit 11 and the latter provides status data as signals of the control unit 11.

The control unit 11, the bus 12 and the at least one bus junction 13 form a bus system. Within this bus system each bus junction 13 has an individual, unique address. The establishing of a communication between the control 11 and a bus junction 13 takes place by way of this address.

The control unit 11 sends digital default signals to the receiver 14 by way of the bus 12. The control unit in that case addresses a specific bus junction 13 and communicates the default signal to its receiver 14. The receiver 14 receives this default signal and generates an analog signal which corresponds with the default signal and which acts on the safety element 16. The action of the analog signal is symbolised by the arrow 16.1. The analog signal can be a defined voltage, current strength or frequency.

The safety element 16 shows the state of a safety-relevant element. Thus, the safety element 16 finds use as, for example, a door contact, lock contact, buffer contact, flap contact, sensor, actuator, travel switch or emergency stop switch. The safety element 16

is in that case so designed that a closed safety element 16 represents a safe state and an open safety element 16 represents a potentially risky state of a lift installation.

When the safety element 16 is closed the transmitter 15 behind the safety element 16 measures the arriving analog signal. This measuring process is represented by the arrow 16.2. After the measurement, the transmitter 15 converts the measured analog signal into a digital signal. Finally, the transmitter 15 prepares the digital signal for the control unit 11.

In normal operation the control unit 11 transmits a current, voltage or frequency value default signal to a selective bus junction 13 by means of statement of the address of the bus junction 13 and a current, voltage or frequency value in digital form. This default signal is repeated at specific time intervals, i.e. the control unit 11 transmits a new current, voltage or frequency value to the bus junction 13. The new value preferably differs from the preceding value. Within such a time interval the receiver generates, according to the default signal, a specific analog signal. If the safety element is closed the transmitter 15 measures this analog signal and prepares the measured value as a digital signal. At the cyclic rate of the above-mentioned time interval the control unit 11 addresses the transmitter 15 of the bus junction 13 and by way of a reading function obtains the data of the current, voltage or frequency value prepared as a digital signal .

The time intervals between such default-interrogation cycles are in principle freely settable and primarily depend on the reliability of the bus junction components. For preference these time intervals last for several seconds. In the case of high reliability, time intervals of 100 seconds or longer can also be set.

The control unit 11 performs this method with all bus junctions 13 of the series and checks the resonance thereof, i.e. the default signals and the digital signals provided by the respective transmitters 15 are compared by the control unit 11. If the default signals correspond with the prepared digital signals, the control unit recognises that the receiver 14 and the transmitter 15 function correctly.

A fault current, a fault voltage or a fault frequency is present if the transmitter 15 measures a current of 0 mA, a voltage of 0 mV or a frequency of 0 Hz. This corresponds with the state of an open safety element, thus, for example, an open cage or shaft door. If now, for example, a fault current is measured by the transmitter 15, the transmitter 15

spontaneously sends the transmitted value to the control unit 11. Thanks to the unique address of the bus junction 13 the control unit 11 is capable of precisely localising the fault. The control unit 11 optionally resorts to measures in order to eliminate the fault or to transfer the lift to a safe operating mode. These operating modes comprise, inter alia, maintenance of a residual capability of the lift in a safe travel range of the lift cage, the evacuation of trapped passengers, an emergency stop or, ultimately, the warning of maintenance and service personnel to free trapped passengers and/or eliminate a fault not able to be removed by the control unit.

The safe operation of a bus junction 13 primarily depends on the functional capability of the receiver 14 and transmitter 15. Since the receiver 14 and the transmitter 15 are already tested in normal operation in each default-interrogation cycle with respect to the functional capability thereof, the bus junction 13 needs a separate test in order to check the spontaneous transmission behaviour of the transmitter 15 on occurrence of a fault.

In this separate test an open safety element 16 is simulated. The control unit 11 simulates the open safety element 16 in that a default signal of 0 mA, 0 mV or 0 Hz is passed to a specific bus junction 13. A zero default test is thus concerned in that case. In the case of fault-free functioning of the bus junction 13 the bus junction 13 or the transmitter 15 thereof must spontaneously report to the control unit 11. This test guarantees that every opening of a safety element 16 leads to a spontaneous transmission of a digital signal of the bus junction 13 to the control unit 11.

This test is carried out repeatedly in time for each bus junction 13. Since during this test the control unit 11 cannot recognise any real data about the state of the safety element 16 of a tested bus junction 13 the test time is kept as short as possible and the test is carried out only as often as necessary. The test time is in that case largely dependent on the speed of data transmission by way of the bus 12 and usually amounts to 50 to 100 milliseconds. The frequency of the zero default test is oriented primarily to the reliability of the transmitter 15 used. The more reliable the transmitter 15, the less frequently does this have to be tested so that a safe operation of the lift can be guaranteed.

As a rule the zero default test is carried out at least once per day. However, this test can also be repeated in the order of magnitude of minutes or hours.

Fig. 2 shows a second form of embodiment of the safety system 10 according to the invention. By contrast to the safety system 10 of Fig. 1 the safety element 16 is of redundant design. Each bus junction 13 thus has at least two safety elements 16.a, 16.b, 16.n. In Fig. 2, for example, three safety elements 16.a, 16.b, 16.n monitor the state of a safety-relevant element of the lift. In that case each safety element 16.a, 16.b, 16.n preferably lies at a separate output 16.1.a, 16.1.b, 16.1.n of the receiver 14, which acts on the safety elements 16.1, 16.b, 16.n in accordance with the default signal of the control unit 11 by an analog signal. These signals can have the same or different values. In the case of closed contacts 16.a, 16.b, 16.n the transmitter 15 measures the arriving analog signal at each of separate inputs 16.2.a, 16.2.b, 16.2.n. In normal operation the transmitter 15 makes available the measured analog values as digital signals of the control unit 11, which regularly interrogates the bus junctions 13. If an analog zero signal is measured at an input 16.2.1, 16.2.b, 16.2.n, the transmitter 15 spontaneously reports this to the control unit 11.

The advantage of this form of embodiment is that it is also possible to make use of more advantageous, but not secure, safety elements 16.a, 16.b, 16.n. A safe status monitoring of the lift is guaranteed by the redundant design thereof.

A third form of embodiment of the safety system 10 according to the invention is shown in Fig. 3. In this form of embodiment the states of several safety-relevant elements of the lift are detected by means of a bus junction 13. Each state of a safety-relevant element is detected by a safety element 16.d, 16.e, 16.m. The combining of the safety elements 16.d, 16.e, 16.m in a bus junction 13 is preferably realised when the safety-relevant elements to be monitored lie physically close to one another, such as, for example, upper adjacent shaft doors or the cage door and an alarm button mounted on the lift cage.

The control unit 11 preferably sends, for each safety element 16.d, 16.e, 16.m, different default signals to the receiver. The receiver 14 converts the default signals into a corresponding analog signal and acts on the respective safety element 16.d, 16.e, 16.n by way of a separate output 16.1.d, 16.1.e, 16.1.m. If the safety elements 16.d, 16.e, 16.m are closed the transmitter 15 measures, for each safety element, the arriving analog signal at a separate input 16.2.d, 16.2.e, 16.2.m. Here, too, in normal operation of the transmitter the measured analog values are provided as digital signals of the control unit 11, which regularly interrogates the bus junctions 13. The transmitter 15 preferably also provides

information about at which input 16.2.d, 16.2.e, 16.2.m the analog signal was measured. If an analog zero signal is measured at an input 16.2.d, 16.2.e, 16.2.m, the fault source can be uniquely localised thanks to the separate inputs 16.2.d, 16.2.e, 16.2.m.

The advantage of this form of embodiment is the smaller number of bus junctions 13 required and the costs saving thereby achievable.

The examples illustrated in Figs. 2 and 3 can also be combined. Thus, bus junctions 13 can be designed in such a manner that the state of several safety-relevant elements of the lift is detected by a respective redundant safety element 16.

The bus junctions 13 described in Figs. 2 and 3 are tested not only in normal operation in each default-interrogation cycle for the resonance thereof, but also by means of a zero default signal. This test is preferably carried out separately for each safety element 16.a, 16.b, 16.n; 16.b, 16.e, 16.m. The functional capability of all outputs of the receiver 14 and all inputs of the transmitter 15 are thus individually tested together.

Claims

1. Monitoring method of a lift installation with a control unit (11) and at least one bus junction (13), which bus junction (13) comprises a receiver (14), a transmitter (15) and a safety element (16); the control unit (11) and the bus junction (13) communicate by way of a bus (12); comprising the following steps: a digital default signal is transmitted by the control unit (11) to the receiver (14); the digital default signal is converted by the receiver (14) into an analog signal; the safety element (16) is acted on (16.1) by the receiver (14) with the analog signal; if the safety element (16) is closed the analog signal is detected (16.2) by the transmitter (15); for a detected analog signal, a digital signal of the control unit (11) is provided by the transmitter (15), characterised in that on detection of an analog zero signal a digital signal is spontaneously transmitted by the transmitter (15) to the control unit (11).
2. Monitoring method according to claim 1, characterised in that the digital default signal is transmitted by the control unit (11) to the receiver (14) at time intervals and that during this time interval the safety element (16) is acted on by the receiver (14) with an analog signal corresponding with the preceding digital default signal.
3. Monitoring method according to one of claims 1 and 2, characterised in that in normal operation the digital signal provided by the transmitter (15) is interrogated by the control unit (11) at time intervals.
4. Monitoring method according to one of claims 2 and 3, characterised in that 100 seconds is selected as time interval.
5. Monitoring method according to one of claims 1 to 4, characterised in that when the safety element (16) is open an analog zero signal is detected by the transmitter (15).

6. Monitoring method according to claim 1, characterised in that by virtue of the spontaneous transmission of the digital signal, measures are undertaken by the control unit (11) in order to bring the lift into a safe operating state.
7. Monitoring method according to one of claims 1 to 6, characterised in that the bus junction (13) is tested by the control unit (11) at time intervals.
8. Monitoring method according to claim 7, characterised in that the bus junction (13) is acted on by the control unit (11) with a digital default signal and the bus junction (13) is interrogated by the control unit (11).
9. Monitoring method according to one of claim 7 and 8, characterised in that 100 seconds is selected as time interval.
10. Monitoring method according to claim 7, characterised in that the bus junction (13) is acted on by the control unit (11) with a digital zero default signal, which default signal is converted by the receiver (14) into an analog zero signal, and a digital signal is spontaneously transmitted by the bus junction (13) to the control unit (11).
11. Monitoring method according to claim 10, characterised in that the bus junction (13) is tested by the control unit (11) at least daily.
12. Monitoring method according to one of claims 10 and 11, characterised in that the bus junction (13) is tested by the control unit (11) hourly.
13. Monitoring method according to any one of claims 10 to 12, characterised in that the bus junction (13) is tested by the control unit (11) by the minute.
14. Safety system (10) adapted for performance of the monitoring method according to one of claims 1 to 13.
15. Lift with a safety system (10) according to claim 14.

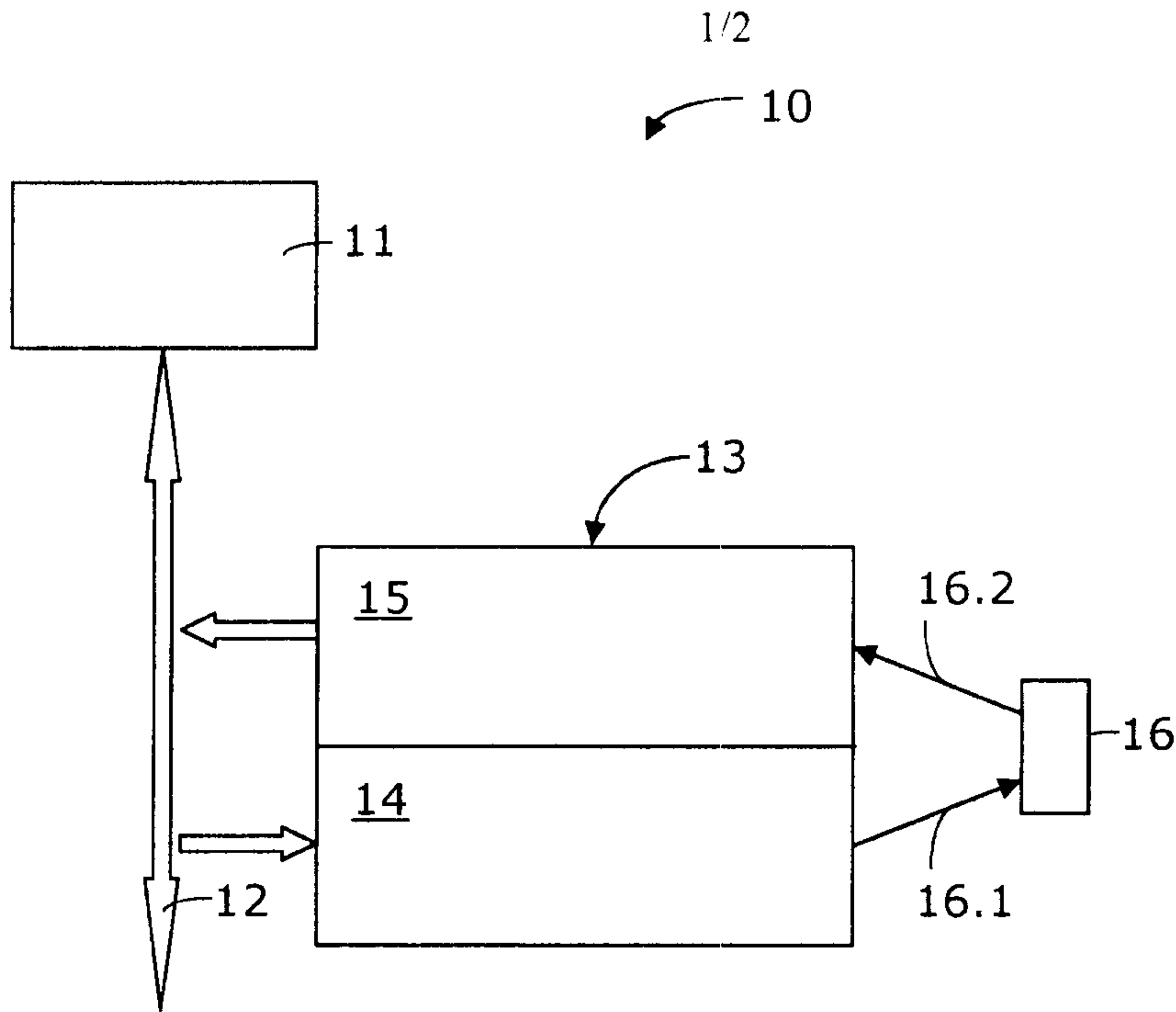


Fig. 1

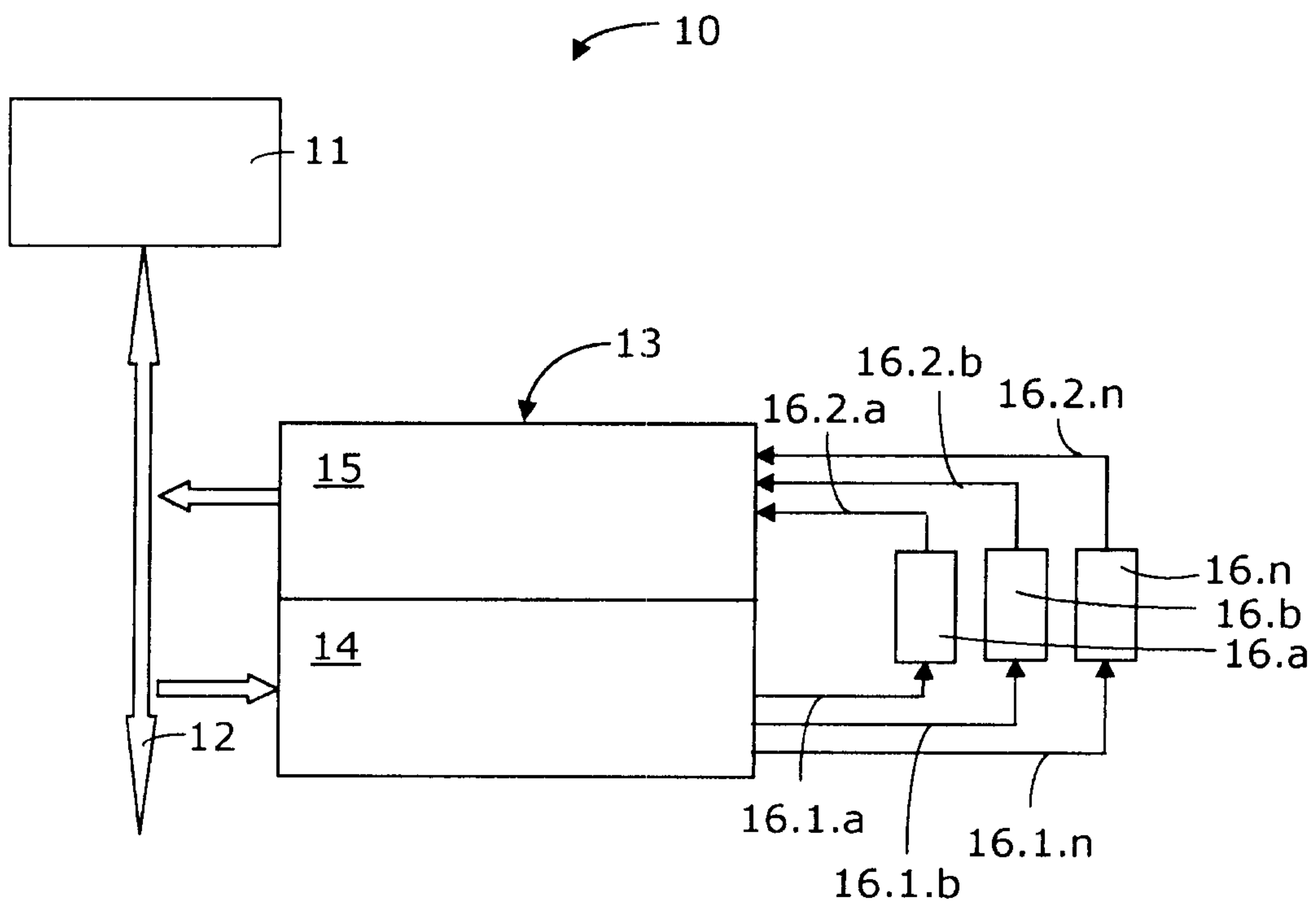


Fig. 2

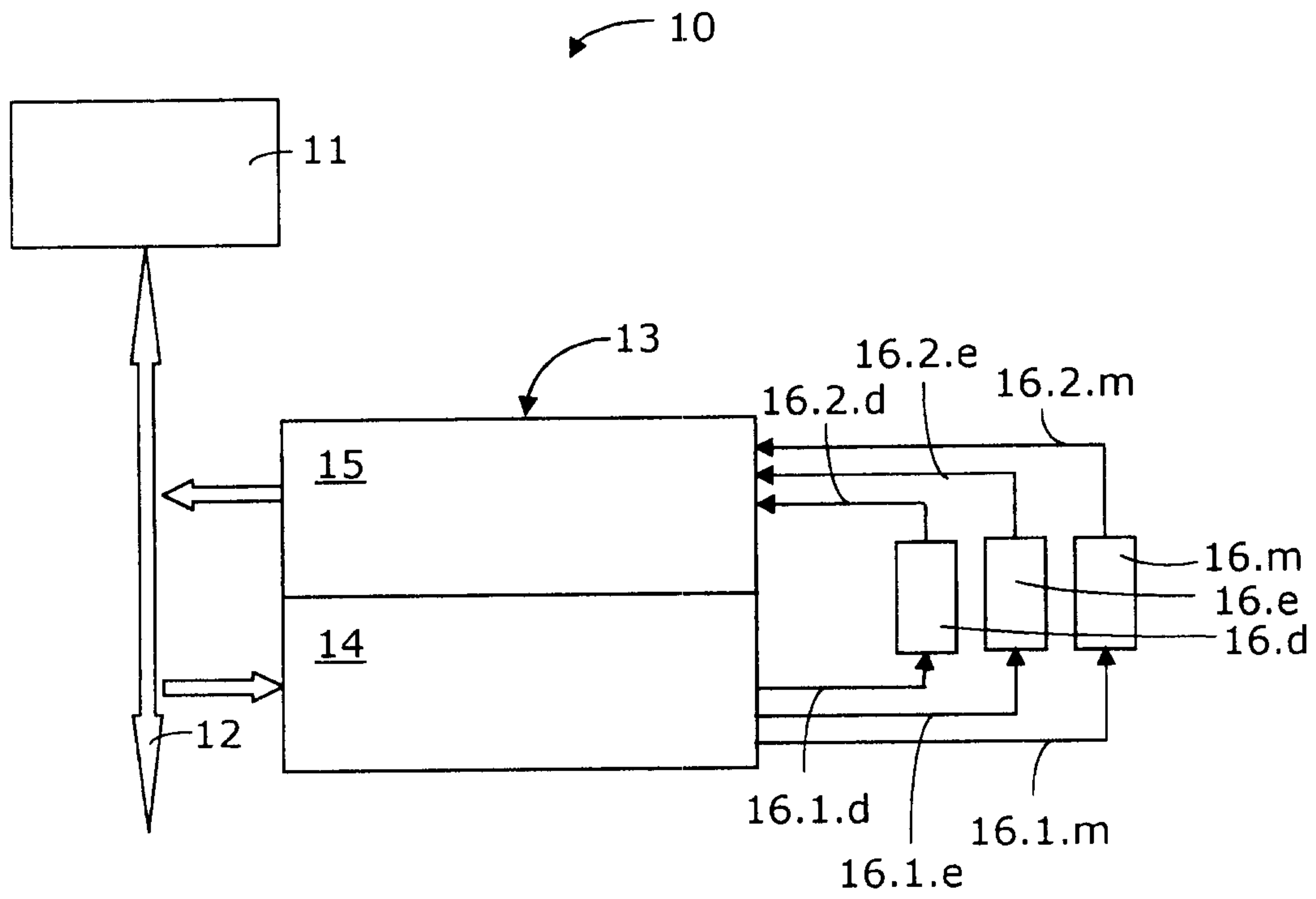


Fig. 3

