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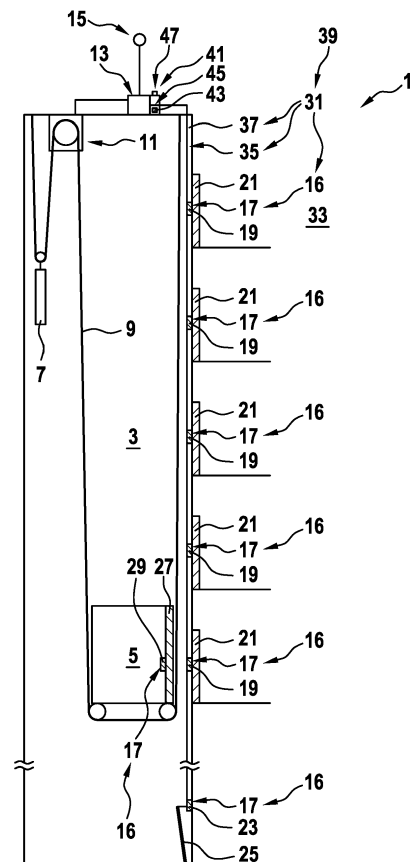
(54) **TESTING METHOD AND DEVICE FOR TESTING AN INTEGRITY OF AN ELEVATOR SIGNAL TRANSMISSION LINE IN AN ELEVATOR**

(57) A testing method and a testing device (41) for testing an integrity of an elevator signal transmission line (39) including a CAN bus communication cable in an elevator (1) and/or an electric series interconnection of several safety relevant components (16) in a safety chain (31) in an elevator (1) are described. The testing device (41) comprises a time domain reflectometer (43), a connection device (45) and an outputting device (47). The testing device (41) is configured for executing the testing method comprising:

- using the time-domain reflectometer (43) connected to the elevator signal transmission line (39) for transmitting an electric pulse generated by the time-domain reflectometer (43) through the elevator signal transmission line (39);
- detecting reflections of the electric pulse;
- determining an information about a location of a fault in the elevator signal transmission line (39) based on the detected reflections of the electric pulse; and
- outputting the information about the determined location of the fault.

With the proposed approach, information about an absolute position of a fault within the elevator signal transmission line (39) may be automatically acquired even in high-rise elevators (1) comprising a multiplicity of safety relevant components (16). The information may be output such that for example a technician may easily find and repair the detected fault.

Fig. 1



Description

[0001] The present invention relates to a testing method and a testing device for testing an integrity of an elevator signal transmission line including a CAN bus communication cable in an elevator and/or an electric series interconnection of several safety relevant components in a safety chain in an elevator.

[0002] In an elevator, an elevator cabin is generally displaced between various levels in a building using a driving machine. Operations of the elevator including controlling an operation of the driving machine is typically controlled by an elevator controller.

[0003] Therein, as the elevator shall transport human passengers, fulfilling safety requirements is of highest priority during elevator operation. For example, it must be guaranteed that the elevator cabin is not moved as long as one of a plurality of elevator doors is not closed and fully locked thereby preventing any passengers from entering or exiting the elevator cabin.

[0004] In order to enable fulfilling such safety requirements, various information has to be communicated throughout the elevator, i.e. between various elevator components located at different positions. For such communication, elevator signal transmission lines are generally arranged throughout the elevator installation. Such elevator signal transmission lines are generally adapted for transmitting low-power electrical signals.

[0005] For example, elevator components may communicate via a CAN bus (Controller Area Network bus). A CAN bus system comprises at least one CAN bus communication cable through which various signals may be transmitted simultaneously between various elevator components being members of the CAN bus system.

[0006] For example, the elevator controller may be connected via a CAN bus communication cable with a plurality of electric or electronic door lock switches, each door lock switch monitoring a locking status of an elevator door, such that the elevator controller may communicate with each of the door lock switches for checking the locking statuses of all elevator doors throughout the elevator arrangement. Furthermore, the CAN bus communication cable may connect the elevator controller to further safety relevant elevator components.

[0007] Additionally or as an alternative, an elevator arrangement may comprise a safety chain in which safety relevant elevator components are electrically connected in series. Such safety chain is closed only when all its participating elevator components, i.e. all safety chain links, are in a predefined closed status. For example, the safety chain may comprise an electrical series connection of several door lock switches each of which is closed only when the elevator door monitored by the respective door lock switch is fully closed and locked.

[0008] As the elevator signal transmission line such as the CAN bus communication cable and/or the electric series interconnection of safety relevant components in the safety chain of the elevator generally is essential for

guaranteeing a safe operation of the elevator arrangement, its own integrity has to be guaranteed. For example, it has to be guaranteed that there are no faults in the elevator signal transmission line such as interruptions or other malfunctions which may hinder or even block signal transmission through the elevator signal transmission line. Accordingly, any such fault should be detected as soon as possible after its occurrence and, in reaction thereto, elevator operation may have to be stopped and/or repairing the faults has to be initiated.

[0009] However, for repairing a fault in the elevator signal transmission line, the location of the fault has to be determined. Such location determination may require substantial efforts, particularly in case the elevator signal transmission line is very long such as for example in elevator arrangements in high-rise buildings.

[0010] For example, if one of multiple door lock switches of a safety chain in an elevator arrangement of a multi-story building does not operate properly, a technician may have to travel throughout the entire elevator arrangement and check all its door lock switches in order to find the faulty one. Such checking and testing procedure may require substantial efforts and time. Furthermore, there may be substantial risks for the technician as he might have to open various elevator doors during such checking and testing procedure, such opening of elevator doors possibly incurring risks of falling into the elevator shaft or other hazardous situations.

[0011] In order to simplify checking and testing an integrity of an elevator signal transmission line, various approaches have been proposed.

[0012] For example, US 6,193,019 B1 discloses a device for localisation of a door breakdown. Therein, a localising device includes a number of electric impedances respectively mounted in parallel with locks of landing doors, the locks being electrically connected in series. The localising device further comprises measuring devices for measuring the total impedance of the safety chain, a microprocessor which allows to compare said measured impedance with a cross reference table of floor impedances that provides all the impedance values of the safety chain obtained by opening one or the other of the landing doors, and a display which shows that floor or floors on which the breakdown occurred.

[0013] US 8,552,738 B2 discloses a device for checking a safety circuit of an elevator. Therein, a testing device for checking a safety circuit of an elevator apparatus includes at least one hardware-monitoring unit for monitoring at least one functionally relevant composite resistor in the safety circuit.

[0014] There may be a need for an alternative testing method and/or a testing device for testing an integrity of an elevator signal transmission line including a CAN bus communication cable in an elevator and/or an electric series interconnection of several safety relevant components in a safety chain in an elevator. Particularly, there may be a need for a testing method and/or a testing device which require few technical efforts, which may be

easy to install and/or which may provide precise and reliable information about a location of a fault occurring in the tested elevator signal transmission line. Furthermore, there may be a need for an elevator comprising such testing device.

[0015] Such needs may be met with the subject-matter of one of the independent claims. Advantageous embodiments are defined in the dependent claims and in the following specification.

[0016] According to a first aspect of the present invention, a testing method for testing an integrity of an elevator signal transmission line including one of a CAN bus communication cable in an elevator and an electric series interconnection of several safety relevant components in a safety chain in an elevator is proposed. The testing method comprises at least the following steps, preferably in the indicated order:

- using a time-domain reflectometer connected to the elevator signal transmission line for transmitting an electric pulse generated by the time-domain reflectometer through the elevator signal transmission line;
- detecting reflections of the electric pulse;
- determining an information about a location of a fault in the elevator signal transmission line based on the detected reflections of the electric pulse; and
- outputting the information about the determined location of the fault.

[0017] According to a second aspect of the invention, a testing device for testing an integrity of an elevator signal transmission line including one of a CAN bus communication cable in an elevator and an electric series interconnection of several safety relevant components in a safety chain in an elevator is described. The testing device is adapted for implementing the testing method according to an embodiment of the first aspect of the invention.

[0018] According to a third aspect of the invention, an elevator comprising a testing device according to an embodiment of the second aspect of the invention is proposed.

[0019] Ideas underlying embodiments of the present invention may be interpreted as being based, inter alia, on the following observations and recognitions.

[0020] As briefly stated in the above introductory portion, in conventional approaches for detecting faults for example in a safety chain of an elevator, either a technician had to go through the entire safety chain and check each and every of its safety relevant components for a correct functioning or technical means had to be provided for each of the safety relevant components for automatically testing its correct functioning.

[0021] The approach described herein avoids providing multiple technical checking devices, each checking device only checking the function of a single component or link in a safety chain of an elevator.

[0022] Instead, it is suggested to use a technique referred to as time-domain reflectometry. Time-domain reflectometry may be seen as a measurement technique allowing to determine characteristics of electrical lines.

5 Therein, one or more electrical pulses are emitted into the electrical line to be tested and reflected waveforms are observed. If there is any discontinuity within the electrical line, an impedance of the discontinuity may be determined from an amplitude of a reflected signal.

10 **[0023]** In order to use time-domain reflectometry for testing the integrity of an elevator signal transmission line, a time-domain reflectometer (TDR) is electrically connected to the elevator signal transmission line. Such time-domain reflectometer is an electronic instrument which is configured for using time-domain reflectometry to characterise and locate faults in elongate electric conductors such as cables, lines, etc.

15 **[0024]** Upon being activated, the time-domain reflectometer may generate an electric pulse and transmit this electric pulse through the elevator signal transmission line to be tested. The electric pulse may be a step or impulse of energy. A waveform of the generated and emitted electric pulse may be precisely known. For example, the electric pulse may have a square waveform, i.e. at a beginning of the electric pulse there is a very steep rise of the electric signal and at an end of the electric pulse, the electric signal is interrupted abruptly.

25 **[0025]** The electric pulse may then propagate through the elevator signal transmission line. If the elevator signal transmission line is of a uniform impedance and is properly terminated, then there will generally be no reflections of the transmitted electric pulse and a remaining incident signal of the electric pulse will be absorbed at a far-end by the termination. However, if there are impedance variations or inhomogeneities, a portion of the incident electric pulse will generally be reflected back to a source of the pulse, i.e. back to the reflectometer.

30 **[0026]** Accordingly, upon having transmitted the electric pulse into the elevator signal transmission line, occurring reflections of the electric pulse may be detected. As such reflections generally are the result of impedance variations or inhomogeneities and such impedance variations or inhomogeneities typically occur upon local faults being present in the elevator signal transmission line, information about a presence and even information about a location of a fault in the elevator signal transmission line may be determined based on the detected reflections of the electric pulse.

35 **[0027]** Finally, such information about the determined location of the fault may be output in a way such that it may be perceived by a human or another machine. For example, such information may be displayed on a display of the reflectometer or a display connected with the reflectometer. Alternatively, such information may be output acoustically by a loudspeaker of the reflectometer or a loudspeaker connected with the reflectometer. As a further alternative, such information may be output to another device such as for example a monitoring device

monitoring proper operation of the elevator. Such monitoring device may be part of the elevator. For example, the monitoring device may be integrated into the elevator controller. Alternatively, the monitoring device may be remote to the elevator. For example, the monitoring device may be part of a monitoring centre remotely monitoring a plurality of elevator arrangements.

[0028] Thus, the approach described herein basically differs in various points from prior art approaches for checking an integrity of signal transmission lines in an elevator and allows for various advantages.

[0029] For example, no technician has to travel throughout the entire elevator arrangement in order to be able to locally check the integrity of signal transmission lines at various locations throughout the elevator arrangement. Therefore, neither does a technician have to spend time and efforts nor are there any risks for the security and/or life of the technician during any signal transmission line integrity monitoring procedure.

[0030] There is also no need to replace the technician's manual local signal transmission line integrity monitoring actions by a multiplicity of technical sensors locally checking the integrity of the signal transmission line at various separate locations throughout the elevator arrangement.

[0031] Instead, the approach described herein allows using a single, relatively simple apparatus in the form of a time-domain reflectometer for implementing the signal transmission line integrity monitoring procedure.

[0032] Therein, the time-domain reflectometer may be electrically connected to the signal transmission line for example at a pre-known single location and may then serve for monitoring the integrity of the signal transmission line along the entire length of the signal transmission line.

[0033] More than this, the time-domain reflectometer may not only allow detecting the presence of any degradation anywhere along the signal transmission line but may even provide an information about the location at which the degradation occurs.

[0034] Therefore, the proposed use of the time-domain reflectometer may not only avoid a necessity of periodical monitoring procedures for checking the integrity of the signal transmission line as its integrity may be continuously be monitored by the time-domain reflectometer, but the use of the time-domain reflectometer may furthermore simplify the technician's job in case any degradation in the signal transmission line was detected as the time-domain reflectometer may provide information about the location of the detected degradation and this information may then be used by the technician for easily finding the degraded portion of the signal transmission line.

[0035] Accordingly, by intelligently employing the time-domain reflectometer in an elevator arrangement, various advantages may be realized such as avoiding excessive monitoring efforts to be provided by human technician as well as avoiding excessive hardware require-

ments in the form of multiple sensors to be installed at various places throughout the elevator arrangement. Particularly in high-rise elevators with very long signal transmission lines, the employing of the time-domain reflectometer may therefore allow avoiding both, efforts required by technicians and risks posed for technicians as well as significant costs for various hardware installations.

[0036] Furthermore, as the approach presented herein only requires a single time-domain reflectometer, any monitoring or, if required, repairing or replacing efforts in case of a malfunction of the time-domain reflectometer itself may be simple. In contrast hereto, in technical approaches using various sensors at various locations throughout the elevator arrangement, each of these sensors may show malfunctions and it may be complex and cumbersome to find a defect in one of these multiple sensors.

[0037] According to an embodiment, the location of the fault in the elevator signal transmission line is determined based on a run-time between emitting the electric pulse and detecting the reflections of the electric pulse.

[0038] In other words, the information about the location where the fault occurred within the elevator signal transmission line may be derived by measuring a time span between a point in time where the electric pulse is emitted by the reflectometer and a point in time where resulting reflections of the electric pulse are detected by the reflectometer. Knowing a signal velocity with which the electric pulse propagates throughout the elevator signal transmission line, this run-time may be used for calculating the distance of the impedance variation, at which the electric pulse is reflected, from the location of the reflectometer.

[0039] Particularly, according to an embodiment, the distance between the time-domain reflectometer and the fault in the elevator signal transmission line may be determined based on the run-time between emitting the electric pulse and detecting the reflections of the electric pulse and, furthermore, the information about the location of the fault in the elevator signal transmission line may be determined as an absolute location within a building accommodating the elevator based on the determined distance and taking into account information about a longitudinal extension of the elevator signal transmission line throughout the building.

[0040] In other words, the TDR may not only be used for determining the existence of a fault in the elevator signal transmission line and its distance from the TDR, but further information may be used for determining the absolute location of the fault in the elevator signal transmission line and/or the absolute location of the fault within the building accommodating the elevator. Particularly, information about the longitudinal extension of the elevator signal transmission line throughout the building, i.e. information indicating where the transmission line is installed within the building and how its length extends along for example various curves, bows or loops, may

be taken into account. As the transmission line is in most cases not arranged linearly along the extension direction of the elevator shaft, such additional information may be helpful for determining the absolute location of the detected fault in the elevator signal transmission line and in the building comprising this transmission line.

[0041] Accordingly, for example, the information about the determined location of the fault may not only be output as a distance from the TDR but for example as the position within the building accommodating the elevator. For example, the information may be output as indicating the number of the floor at which the fault in the elevator signal transmission line occurs. Based on such information, for example a technician may easily find the fault. For example, when the fault results from any malfunction within a door lock switch, the information indicating the floor number at which the fault occurs is generally sufficient for guiding the technician to the respective faulty door lock switch.

[0042] The information about the longitudinal extension and positional arrangement of the elevator signal transmission line may be determined for example upon installing the elevator arrangement with its transmission lines. The information may then be stored for example in the TDR itself, in the elevator controller or in a remote memory comprised for example in a remote server or a data cloud from which it may be downloaded.

[0043] According to an embodiment, the method proposed herein is executed exclusively in reaction to an elevator controller indicating a malfunction in an elevator operation relating to faults in the elevator signal transmission line.

[0044] In other words, there may be no continuous execution of the method. Instead, the method is only executed in case the elevator controller of the elevator detects a malfunction in the elevator operation and, based for example on the type of malfunction, it is known that this malfunction typically results from faults in the elevator signal transmission line.

[0045] For example, the elevator controller may continuously monitor the safety chain of the elevator. In case, the closing status of the safety chain does not change for longer than a predetermined time limit, this may be taken as indicating a high probability that a malfunction in the safety chain or one of its safety relevant components has occurred. In reaction to such fault detection, the elevator controller may then trigger executing the proposed testing method for determining the location of the fault in the safety chain.

[0046] By executing the proposed testing method only in reaction to a malfunction being indicated by the elevator controller, a risk of the testing method negatively interfering with the normal operation of the elevator may be minimised. For example, if a CAN bus communication cable is tested for an occurrence of faults using the proposed testing method, there may be a risk that the electric pulse transmitted through the cable by the TDR might interfere with other signals currently transmitted through

this cable. Accordingly, signal transmission through the CAN bus communication cable may have to be interrupted as long as the testing method is executed. By limiting the execution of the testing method to cases where there is a high probability of a fault within the elevator signal transmission line, i.e. when the elevator controller indicates a typical malfunction, such interruptions of the normal signal transmission may be limited to a minimum. Furthermore, energy consumption for executing the testing method may be minimised.

[0047] The testing device according to an embodiment of the second aspect of the present invention may be specifically configured for executing the steps of the testing method described herein.

[0048] Specifically, according to an embodiment, the testing device may comprise a time-domain reflectometer, a connection device and an outputting device. The time-domain reflectometer may be configured for emitting an electric pulse through the elevator transmission line, for detecting reflections of the pulse and for determining an information about a location of a fault forming an electric inhomogeneity within the elevator transmission line based on the detected reflections of the electric pulse. The connection device may be configured for electrically connecting the time-domain reflectometer to the elevator signal transmission line. The outputting device may be configured for outputting the information about the determined location of the fault.

[0049] The elevator according to an embodiment of the third aspect of the present invention may comprise such testing device. Generally, the testing device may be accommodated at an arbitrary location within the elevator. For example, the testing device may be comprised or integrated into the elevator controller. Accordingly, the testing device may be easily connected to elevator signal transmission lines such as the CAN bus communication cable or an end of the safety chain connecting the elevator controller with safety relevant components throughout the elevator arrangement.

[0050] According to an embodiment, the elevator controller may be configured for detecting a malfunction in an elevator operation relating to faults in the elevator signal transmission line. Furthermore, the elevator controller may be configured for, in reaction to detecting such malfunction, activating the testing device for executing the testing method according to an embodiment of the first aspect of the invention.

[0051] It shall be noted that possible features and advantages of embodiments of the invention are described herein partly with respect to a testing method, partly with respect to a testing device and partly with respect to an elevator comprising such testing device. One skilled in the art will recognize that the features may be suitably transferred from one embodiment to another and features may be modified, adapted, combined and/or replaced, etc. in order to come to further embodiments of the invention.

[0052] In the following, advantageous embodiments of

the invention will be described with reference to the enclosed drawing. However, neither the drawing nor the description shall be interpreted as limiting the invention.

[0053] Fig. 1 shows an elevator with a testing device according to an embodiment of the present invention.

[0054] The figure is only schematic and not to scale. Same reference signs refer to same or similar features.

[0055] Fig. 1 shows an elevator 1 according to an embodiment of the present invention. The elevator 1 comprises an elevator cabin 5 and a counterweight 7 which are both suspended by a multiplicity of ropes or belts forming a suspension traction member (STM) 9. The STM 9 may be displaced using a drive unit 11 in order to thereby effectuate displacing the elevator car 5 and counterweight 7 within an elevator hoistway 3 in a vertical direction. The drive unit 11 comprises a drive engine including e.g. an electric motor for rotatably driving a traction sheave.

[0056] An operation of the drive unit 11 is controlled by an elevator controller 13. Particularly, the elevator controller 13 controls or regulates power supply coming from a power source 15 to the drive unit 11. Particularly, a power supply to the drive engine comprised in the drive unit 11 may be controlled.

[0057] The elevator 1 furthermore comprises floor doors 21 at each of multiple floors 33 of a building, such floor doors 21 opening and closing an access from a floor 33 to the elevator hoistway 3. Each of the floor doors 21 is provided with a safety door switch 17 forming a landing door switch 19. Such landing door switch 19 is closed as long as the associated landing door 21 is closed and locked. Furthermore, a ladder 25 is provided close to a bottom of the elevator hoistway 3. Whether or not the ladder 25 is present and correctly stored is monitored with another safety switch 17 provided as a ladder presence switch 23. Furthermore, the elevator cabin 5 comprises a cabin door 27 opening and closing an access to the elevator cabin 5. The cabin door 27 is provided with another safety switch 17 forming a cabin door switch 29. Further safety switches 17 may be provided in the elevator 1 for other purposes. Furthermore, there may be further safety relevant components 16 additionally to the safety switches 17.

[0058] In a conventional elevator, all of such safety relevant components 16 including the safety switches 17 are interconnected in series with an electrical connection 35 such as an electric line 37 to form a safety chain 31 which is then connected to the elevator controller 13 such that the elevator controller 13 may be informed about closing states of all landing doors 21 and of the cabin door 27 as well as of other features such as the correct storing of the ladder 25. Taking into account such information from the safety relevant components 16 in the safety chain 31, the elevator controller 13 may then suitably control the drive unit 11. The electrical connection 35 together with the safety relevant components 16 connected in series by this electrical connection 35 may form an elevator signal transmission line 39.

[0059] Alternatively, the safety relevant components 16 may all be electrically connected to a CAN bus communication cable. This cable is also connected to the elevator controller 13 such that each of the safety relevant components 16 may communicate and exchange signals with the elevator controller 13. In this example, the CAN bus communication cable may form an elevator signal transmission line 39.

[0060] In order to enable testing an integrity of the elevator signal transmission line 39, the elevator 1 comprises a testing device 41. In the proposed example, this testing device 41 is included in the elevator controller 13.

[0061] The testing device 41 comprises a time-domain reflectometer 43, a connection device 45 and an outputting device 47. With the connection device 45, the time-domain reflectometer 43 may be electrically connected to the electric line 37 of the elevator signal transmission line 39. The outputting device 47 may output an information about a determined location of a fault within the elevator signal transmission line 39.

[0062] During operation of the elevator 1, the elevator controller 13 may continuously monitor operation characteristics of components of the elevator 1. As long as all elevator components operate normally, the time-domain reflectometer 43 remains inactive, i.e. is switched off.

[0063] For example, when the elevator controller 13 detects a malfunction in an elevator operation relating to a fault in the elevator signal transmission line 39, the elevator controller 13 sends an activation signal to the testing device 41. Upon receiving such activation signal, the time-domain reflectometer 43 is activated and generates an electric pulse. Such electric pulse for example with a rectangular waveform may be transmitted via the connection device 45 into the elevator signal transmission line 39. The electric pulse may then propagate through the elevator signal transmission line 39 until it reaches a location at which an impedance variation is present within the elevator signal transmission line 39. Such impedance variation may result from a fault within the elevator signal transmission line. For example, such fault may be a defect in one of the safety switches 17. At such impedance variation, at least part of the transmitted electric pulse is reflected and then travels back to the time-domain reflectometer 43. Upon arriving at the time-domain reflectometer 43, the reflected portions of the electric pulse may be detected and a run-time between the emission of the electric pulse and the detection of its reflected portions may be determined. Based on this run-time, the testing device 41 may determine an information about the location of the detected fault in the elevator signal transmission line 39. From this information and furthermore taking into account additional information about a longitudinal extension of the elevator signal transmission line 39 throughout the building housing the elevator 1, an absolute location of the fault, i.e. for example a number of the floor 33 at which one of the safety switches 17 is defective, may be determined. Finally,

such information may be output at the outputting device 47. By perceiving the output information, a technician may easily find and repair the fault within the elevator signal transmission line 39.

[0064] Summarising, with the proposed approach, information about an absolute position of a fault within the elevator signal transmission line 39 may be automatically acquired even in high-rise elevators 1 comprising a multiplicity of safety relevant components 16. The information may be output such that for example a technician may easily find and repair the detected fault.

[0065] Finally, it should be noted that the term "comprising" does not exclude other elements or steps and the "a" or "an" does not exclude a plurality. Also elements described in association with different embodiments may be combined. It should also be noted that reference signs in the claims should not be construed as limiting the scope of the claims.

Claims

1. Testing method for testing an integrity of an elevator signal transmission line (39) including at least one of a CAN bus communication cable in an elevator (1) and an electric series interconnection of several safety relevant components (16) in a safety chain (31) in an elevator (1), the testing method comprising:

- using a time-domain reflectometer (43) connected to the elevator signal transmission line (39) for transmitting an electric pulse generated by the time-domain reflectometer (43) through the elevator signal transmission line (39);
- detecting reflections of the electric pulse;
- determining an information about a location of a fault in the elevator signal transmission line (39) based on the detected reflections of the electric pulse; and
- outputting the information about the determined location of the fault.

2. Testing method of claim 1, wherein the location of the fault in the elevator signal transmission line (39) is determined based on a run-time between emitting the electric pulse and detecting the reflections of the electric pulse.

3. Testing method of one of the preceding claims, wherein a distance between the time-domain reflectometer (43) and the fault in the elevator signal transmission line (39) is determined based on a run-time between emitting the electric pulse and detecting the reflections of the electric pulse and the information about the location of the fault in the elevator signal transmission line (39) is determined as an absolute location within a building accommodating the eleva-

tor (1) based on the determined distance and taking into account information about a longitudinal extension of the elevator signal transmission line (39) throughout the building.

4. Testing method of one of the preceding claims, wherein the method is executed exclusively in reaction to an elevator controller (13) indicating a malfunction in an elevator operation relating to faults in the elevator signal transmission line (39).

5. Testing device (41) for testing an integrity of an elevator signal transmission line (39) including at least one of a CAN bus communication cable in an elevator (1) and an electric series interconnection of several safety relevant components (16) in a safety chain (31) in an elevator (1), the testing device (41) being configured for implementing the testing method according to one of claims 1 to 4.

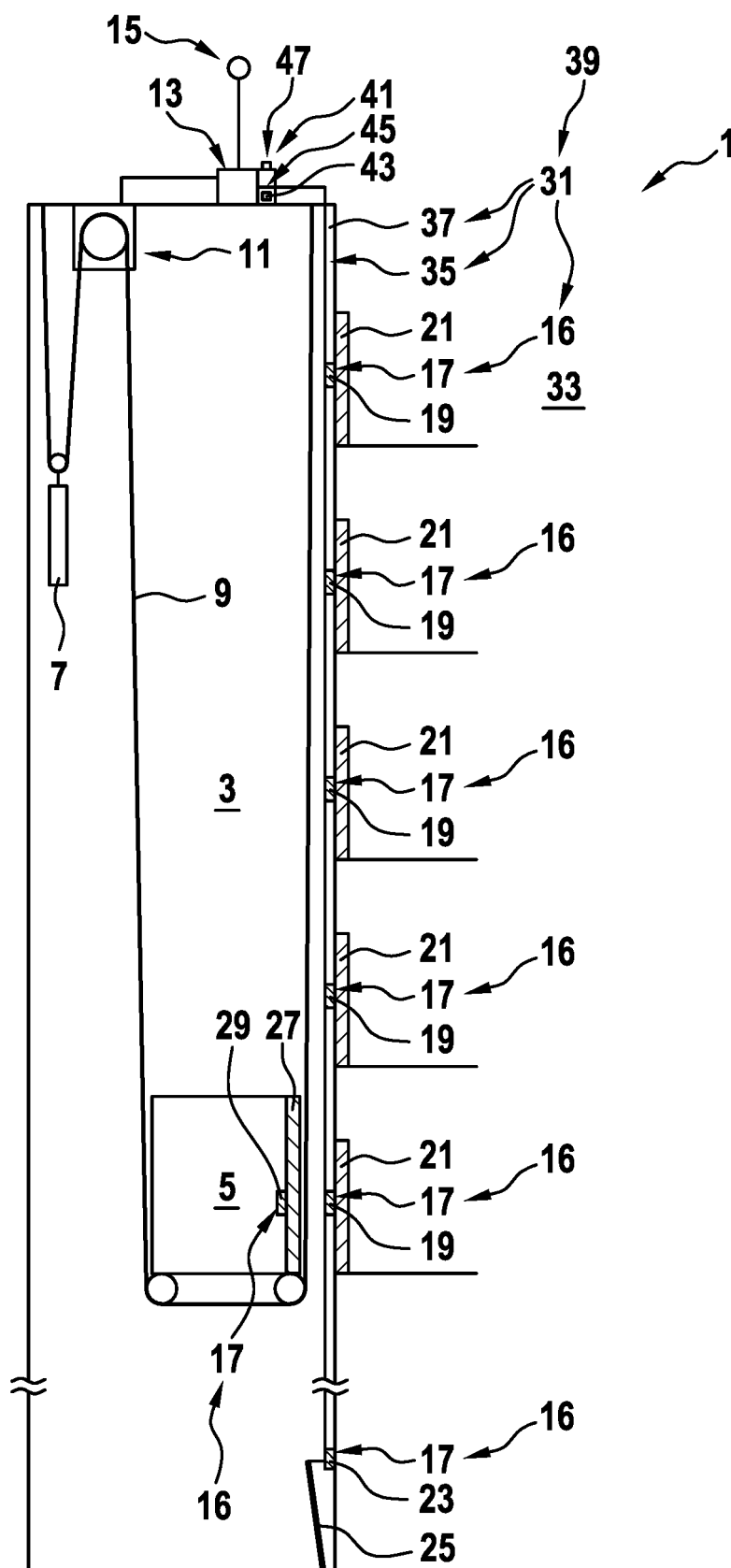
6. Testing device (41) of claim 5, comprising:

- a time-domain reflectometer (43) configured for emitting an electric pulse through the elevator transmission line (39), for detecting reflections of the pulse and for determining an information about a location of a fault forming an electric inhomogeneity within the elevator transmission line (39) based on the detected reflections of the electric pulse;
- a connection device (45) for electrically connecting the time-domain reflectometer (43) to the elevator signal transmission line (39); and
- an outputting device (47) for outputting the information about the determined location of the fault.

7. Elevator (1) comprising a testing device (41) according to one of claims 5 and 6.

8. Elevator of claim 7, wherein the elevator (1) further comprises an elevator controller (13) for controlling an operation of the elevator (1), wherein the elevator controller (13) is configured for detecting a malfunction in an elevator operation relating to faults in the elevator signal transmission line (39) and for, in reaction thereto, activating the testing device (41) for executing the testing method according to one of claims 1 to 4.

Fig. 1





EUROPEAN SEARCH REPORT

Application Number
EP 19 18 0782

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 19 18 0782

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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