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(54) **Communications between an elevator car and an elevator control unit**

(57) There is provided an elevator arrangement, a method for elevator arrangement and radio frequency transceiver for an elevator arrangement. The elevator arrangement comprises an elevator car and a hoistway extending in a hoisting direction and said hoistway comprising openings to floors, wherein the elevator car is arranged movable between the floors, and an elevator

control unit for controlling the hoisting of the elevator car, said elevator car including a communications unit for communicating with the control unit, wherein the elevator control unit is connected to the communications unit of the elevator car by radio frequency signals communicated on a leaky feeder cable extending between the elevator car and the elevator control unit.

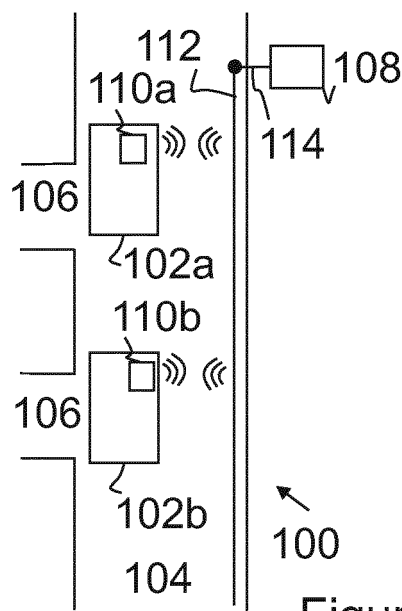


Figure 1

Description

FIELD

[0001] The present invention relates to elevators and more particularly to communications between an elevator car and an elevator control unit.

BACKGROUND

[0002] The following description of background art may include insights, discoveries, understandings or disclosures, or associations together with disclosures not known to the relevant art prior to the present invention but provided by the invention. Some such contributions of the invention may be specifically pointed out below, whereas other such contributions of the invention will be apparent from their context.

[0003] Typical elevator arrangements include an elevator car hoisted in a vertical direction in an elevator shaft. Hoisting machinery connects to the elevator car by ropes to move the elevator car in the shaft. One or more elevator cars may be installed to the same shaft. Elevator cars include electrical appliances such as lights that are powered by electrical cabling that run through the shaft to the elevator car. A control panel is located within the elevator car to allow passengers in the elevator car to enter information regarding their desired destination floor. The control panel may be equipped with a speaker and microphone functionalities to allow voice communications with the passengers carried within the elevator car in case of emergencies.

[0004] The control panel connects by cabling to a control unit that is typically at a fixed location in the shaft of in a maintenance room close to the shaft and the hoisting machinery. The ropes, electrical and communications cabling travel in the elevator shaft and some space needs to be reserved for their passage. However, the space reserved for the cabling is away from floor space of the buildings, where the elevators are deployed. Moreover, the cabling adds weight to the elevator car. Thereby, in hoisting the elevator car, power is consumed also in hoisting the cabling.

[0005] On the other hand, deployment scenarios of elevators may vary in terms of the direction, where the elevator car is moved. Depending on the scenario, elevator cars may be moved also in other directions than the conventional vertical direction. Indeed, it is possible that elevator cars move both in an inclined direction, where the movement takes place both in the vertical and the horizontal direction. In different deployment scenarios, the conventional cabling for providing communications and power to the elevator car becomes difficult, since the cabling is drawn in the vertical direction by the gravity and special care has to be taken in designing and installation of the elevator to ensure that the cabling does not get into the way of the elevator car, when the elevator car is moved in inclined or horizontal directions in the

shaft. If the cabling gets into the path of the elevator car, this might lead to breaking the cabling and to electric shocks from broken power cabling.

5 SUMMARY

[0006] The following presents a simplified summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not an extensive overview of the invention. It is not intended to identify key/critical elements of the invention or to delineate the scope of the invention. Its sole purpose is to present some concepts of the invention in a simplified form as a prelude to the more detailed description that is presented later.

[0007] Various embodiments of the invention comprise an elevator arrangement, a method for an elevator arrangement, a radio frequency transceiver, an elevator control unit and a computer program product as defined in the independent claims. Further embodiments of the invention are disclosed in the dependent claims.

[0008] According to an aspect there is provided an elevator arrangement comprising an elevator car, a hoistway extending in a hoisting direction and said hoistway comprising openings to floors, wherein the elevator car is arranged movable between the floors, and an elevator control unit for controlling the hoisting of the elevator car, said elevator car including a communications unit for communicating with the elevator control unit, and, wherein the elevator control unit is connected to the communications unit of the elevator car by a radio frequency signals communicated on a leaky feeder cable extending between the elevator car and the elevator control unit.

[0009] According to an aspect there is provided a method by a radio frequency transceiver for an elevator arrangement according to an aspect, the method comprising communicating radio frequency signals between the elevator car and the elevator control unit through the leaky feeder cable that extends between the elevator car and the elevator control unit.

[0010] According to an aspect there is provided a radio frequency transceiver for communicating radio frequency signals in an elevator arrangement according to an aspect, the radio frequency transceiver comprising, connecting means for connecting to the leaky feeder cable, and communications means for communicating radio frequency signals through the leaky feeder cable that extends between the elevator car and the elevator control unit.

[0011] According to an aspect there is provided an elevator control unit comprising a transceiver according to an aspect.

[0012] According to an aspect there is provided a computer program product comprising executable code that when executed, cause execution of functions of a method according an aspect.

[0013] According to an aspect there is provided a struc-

ture engageable into a swinging movement, for example a marine vessel, an inland waterway vessel or a high-rise building, including an elevator arrangement according to an aspect, wherein the elevator arrangement is arranged to the structure such that the hoistway is in a direction that is substantially perpendicular to a direction of the swinging movement.

[0014] Some embodiments improve efficiency of hoisting an elevator car by reducing the need for cabling between the elevator car and the elevator control unit and/or an electrical power supply feeding electricity to the elevator car. With less cabling, less power is required for hoisting the elevator car. Also smaller elevator shafts may be designed, whereby floor space consumed by elevator shafts in building may be reduced. The reduced cabling also facilitates deploying elevators into scenarios, where the elevator car is moved in inclined directions to the vertical direction and/or in directions perpendicular to the vertical direction. Further advantages will become apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] In the following the invention will be described in greater detail by means of preferred embodiments with reference to the attached drawings, in which

Figure 1 illustrates an elevator arrangement, according to an embodiment;

Figures 2a and 2b illustrate elevator arrangements having a plurality of hoistways, according to an embodiment;

Figure 3 illustrates an apparatus according to an embodiment;

Figure 4 illustrates a block diagram of an elevator control unit including transceivers for two leaky feeders,

Figure 5 illustrates a block diagram of an elevator control system including a single transceiver for communicating with two elevator cars through two leaky feeders;

Figure 6a illustrates an elevator arrangement comprising a wireless energy transfer to an elevator car, according to an embodiment; and

Figure 6b illustrates an elevator arrangement, where the elevator car is powered by a power rail installed to a hoistway.

DETAILED DESCRIPTION

[0016] In the following description like elements in the Figures are referenced by like numerals.

[0017] Figure 1 illustrates an elevator arrangement 100, according to an embodiment. An elevator car 102a, 102b is arranged movable between floors 106. The elevator car is moved along a hoistway 104 that may be determined by a direction, where the elevator car is hoisted. In the illustration the floors are separated in a vertical

direction. Accordingly, the hoistway extends in a vertical direction such that the elevator car is moved from floor to floor, when it is hoisted. It should be appreciated that the vertical direction is typically defined by the direction of gravitation. However, the hoistway may extend also in directions that are at an angle, i.e. inclined, to the vertical direction. These directions comprise at least a horizontal direction and a combination of both the horizontal and vertical direction, where the elevator car may be moved in both the horizontal and the vertical direction.

[0018] Conventionally hoisting may be effected by hoisting machinery that connects to the elevator car by ropes. The elevator car is then moved by reeling the ropes up or down. Electrical power may be supplied using in a conventional way to the elevator car, for example by electrical cabling. However, to reduce the cabling and adapt the elevator arrangement to endure swinging movement even more, the power rails described in Figures 6a and 6b may be used for supplying electricity to the elevator car.

[0019] Elevator cars are typically installed in elevator shafts. An elevator shaft is a part of a structure of a building. A single shaft may have one or more hoistways and corresponding elevator cars. It is also possible that the hoistways of the elevator cars in the shaft are the same. The hoistways may be the same for example, when two elevator cars are connected one upon another and they are hoisted by ropes attached to the upper elevator car.

[0020] An elevator control unit 108 provides control to the movement of the elevator car between the floors. The movement may be controlled by controlling applied by the control unit to a hoisting functionality, for example the hoisting machinery. The control may be applied by electrical signals that adjust operation of electrical motor driving the hoisting functionality. The elevator control unit may further provide communications between a service centre (not shown) of the elevator arrangement and the elevator car. A typical service centre has personnel on duty for answering alerts and/or calls.

[0021] The elevator car may include a communications unit 110a, 110b for communicating with the elevator control unit. In this way the elevator control unit may transmit data, signals and/or messages to the elevator car and/or receive data, signals and/or messages from the elevator car. Accordingly, the communications unit may provide for example voice calls between passengers onboard the elevator car and a service center via the control unit. The voice calls may be actuated by the onboard passengers via a control panel of the elevator car as is typical in present elevator cars.

[0022] In one example, various kinds of information may be communicated from the elevator car to the control unit, the information comprising but not limited to: traffic measurements, passenger floor selection, a voice call and alerts. The elevator car may be equipped with various sensors and user interface equipment to obtain the information to be communicated to the control unit.

[0023] In one example, various kinds of information

may be communicated from the control unit to the elevator car, the information comprising but not limited to: information for displaying to passengers and a voice call. A user interface such as a display and/or a speaker may be housed within the elevator car to communicate the received information to the passengers onboard.

[0024] Accordingly, in some embodiments, the elevator car may comprise a user interface that allows data, signals, voice calls and/or messages to be communicated from the passengers to the communications unit and towards the control units, and/or from the control units towards the passengers onboard.

[0025] The communications between the elevator car and the elevator control unit may be one-way or two-way communications. Various examples of the different communications may be combined in practical implementations of elevator arrangements.

[0026] The elevator control unit may process the information received from the elevator car and use the processed information, or directly the received information, to control the movement of the elevator.

[0027] The communications unit and the control unit may include radio frequency transceivers for wireless communications between the elevator car and the elevator control. In this way, the elevator arrangement may be designed and deployed with less cabling. Moreover, movement of the elevator car is not strained by cabling for the communications.

[0028] In one example, the radio frequency transceiver comprises a wireless local area network WLAN transceiver. The WLAN transceiver may be implemented according to the IEEE 802.11 family of standards. The WLAN employs the industrial scientific and medical ISM frequency bands for communications, which makes it use especially attractive option to be used in elevator arrangements, due the freedom in the availability of the frequencies.

[0029] In an embodiment, the wireless communications between the elevator car and the elevator control unit is provided by a leaky feeder cable 112. The leaky feeder may be arranged to extend between the elevator car and the elevator control unit. The leaky feeder cable receives radio frequency signals from a radio frequency transceiver and radiates the received radio frequency signal along the length of the feeder cable. The leaky feeder may be connected to the radio frequency transceiver of the elevator control unit thereby operating as an antenna for reception and transmission of radio frequency signals.

[0030] The leaky feeder extends along the elevator hoistway. Accordingly, the leaky feeder extends in the hoisting direction of the elevator car, whereby the leaky feeder may be substantially parallel to the elevator car, when the elevator car is moved in the hoistway. Preferably the leaky feeder has a length that spans in the hoistway such that the elevator car is located within a coverage area of the radio frequency signals radiated by the leaky feeder. The coverage area may be defined as an

area, where the radio frequency signals radiated from the leaky feeder may be received by the communications unit of the elevator car.

[0031] In an embodiment, the elevator arrangement may comprise more than one, for example, two, three or four elevator cars. Each of the cars may have communications units that enable communications with the control units via the leaky feeder as described above. The elevator cars may have the same hoistway, such that they are moved one upon the other in the hoistway, according to the illustration. In practice this may be implemented for example by structurally attaching the elevator cars, such that they are all moved, when the upper most elevator car is hoisted. In this way a single shaft may serve a larger number of traffic, e.g. passengers, than if only one elevator car was used.

[0032] When the leaky feeder is arranged to extend along the hoistway of two or more elevator cars, the leaky feeder may provide communications to a plurality of elevator cars at a time.

[0033] The leaky feeder cable may be feeder cable suitable for transmission of amplified radio frequency signals. The radio frequency signals are amplified signals on their transmission frequency. Typically such radio frequency signals are modulated to a higher frequency band form a baseband frequency or an intermediate frequency. The feeder cable is connected to a radio frequency section of a transceiver for reception and transmission of radio frequency signals between the transceiver and a wireless medium, e.g. the air. One example of the feeder cable is a coaxial cable. Typically feeder cables have a shielding against radiating radio frequency signals out of the feeder cable. On the other hand the shielding may also provide shielding against coupling of interfering signals to the radio frequency signals in the feeder cable. In coaxial cables, this shielding is a conductor, for example braided copper wire, arranged around the periphery of the coaxial cable.

[0034] The leaky feeder cable is adapted to leak, i.e. radiate, the radio frequency signals it is carrying. The leakage may be provided by openings for example slots in the shielding of the feeder cable. In one example the leakage may be provided by constructing the shielding of the feeder cable of two parts that are separated from each other in a longitudinal direction of the feeder cable. In one example the two parts may each have a cross-section of the shape of half-circle and the separation of the parts is provided by different diameters of the half-circles. In this way, in a cross-sectional view of the shielding, edges of the half-circles are separated, thereby enabling radiation of the radio frequency signals.

[0035] In an embodiment, a radio frequency transceiver may be connected to a leaky feeder by a feeder cable 114 having a smaller radio frequency signal leakage than the leaky feeder cable. In one example the difference between the leakages of the cables is provided by the shielding of the cables. Accordingly, the cable with a smaller leakage may have a shielding that prevents ra-

diation of radio frequency signals and the cable with the higher leakage, the leaky feeder cable, may have a shielding that allows radiation of the radio frequency signals. In one example the leaky feeder cable may be a coaxial cable that is modified such that it allows the radiation. The modifying may comprise for example replacing the outer peripheral shielding of a conventional coaxial cable by two separated parts or otherwise arranging slots to the shielding to enable the leakage. Then the lower leakage may be providing by an unmodified coaxial cable having an unslotted shielding.

[0036] Figures 2a and 2b illustrate elevator arrangements 200, 220 having a plurality of hoistways, according to an embodiment. Elevator cars 202a, 202b, 222a, 222b are arranged movable between floors 206a, 206b, 226a, 226b in corresponding hoistways 204a, 204b, 224 similar to described in Figure 1. The elevator arrangements include control units 208, 228 that are connected to the communications units 210a, 210b, 230a, 230b of the elevator cars by radio frequency signals communicated on a leaky feeder cable 212a, 212b, 232 extending between the elevator cars 202a, 202b, 222a, 222b and the elevator control units, similar to described in Figure 1.

[0037] As a difference to Figure 1, in Figure 2a the elevator control unit is connected to two leaky feeders 212a, 212b that each extend along hoistways in different shafts. The radio frequency signals may be transferred between the control unit and each of the shafts by feeder cables 214a, 214b that have lower leakage of radio frequency signals than the leaky feeders in the shafts.

[0038] The control unit may comprise separate transceivers for each leaky feeder cable. In this way, interference of transmissions between the elevator control unit and the elevator car in different shafts may be reduced. Moreover transmission power to both leaky feeders may be controlled separately, whereby radio conditions of each shaft may be adapted independently. The separate transceivers may have a common baseband section towards the elevator control unit. In one example the transceivers connect to the elevator control unit by a local area network connection such as an Ethernet interface. An embodiment with separate transceiver is described in more detail with Figure 4.

[0039] On the other hand a single transceiver may suffice for both leaky feeders, when a splitter is used to separate the branches of radio frequency signals to each shaft. An embodiment with a single transceiver is described in more detail with Figure 5.

[0040] As a difference to Figure 1, in Figure 2b the elevator cars have their own hoistways that are separate from each other. Accordingly, the elevator car 222a is hoisted between the floors 226a and the elevator car 222b is hoisted between the floors 226b. Then the leaky feeder cable is arranged to the shaft such that the communications units of both of the elevator cars are within the coverage area of the leaky feeder. Similar to the above embodiments, the leaky feeder may be connected to the control unit by a shielded feeder cable 234 that

has less leakage than the leaky feeder.

[0041] An embodiment involves method by a radio frequency transceiver for an elevator arrangement. The elevator arrangement may be constructed as described in the above embodiments. The transceiver may be arranged in the communications unit of the elevator car and/or the control unit. In the method, radio frequency signals are communicated between the elevator car and the elevator control unit through the leaky feeder cable that extends between the elevator car and the elevator control unit. The communications may involve transmission and/or reception of communications signals. The communications signals may be a WLAN signal according to the IEEE 802.11 family of standards.

[0042] The leaky feeder radiates the communicated radio frequency signals thereby forming a coverage area of radio frequency communications along the elevator hoistway or an elevator shaft comprising the hoistway. When the elevator car is within the coverage area, the communications, e.g. successful reception and transmission of data, signals and/or messages, between the elevator car and the control units is possible.

[0043] It should be appreciated that preferably, at least the communications unit of the elevator car and particularly an antenna or other adaptor that communicates the radio frequency signals between the wireless medium and the elevator car should be located within the coverage area, to allow communications between the elevator car and the elevator control unit.

[0044] Figure 3 is a general block diagram of an apparatus according to an embodiment. The apparatus may be an elevator control unit or a communications unit of an elevator car described in the embodiments. Although the apparatus has been depicted as one entity, different modules and memory may be implemented in one or more physical or logical entities.

[0045] The apparatus 300 comprises an interfacing unit 302, a central processing unit (CPU) 308, and a memory 310, that are all being electrically interconnected. The interfacing unit comprises an input 306 and an output unit 304 that provide, respectively, the input and output interfaces to the apparatus. The memory may comprise one or more applications that are executable by the CPU. The input and output units may be configured or arranged to send and receive data, and/or messages according to one or more protocols used in communication standards including but not limited to IEEE 802.11 WLAN.

[0046] In an embodiment the input unit may provide circuitry for obtaining data, user input and/or messages to the apparatus. The obtaining may comprise receiving radio frequency signals by an antenna, for example. In another example, the obtaining may comprise receiving wired transmissions via an Ethernet adapter. In yet another example, the obtaining may comprise receiving input from a user via a user input device including one or more of a button, and/or a touch screen.

[0047] In an embodiment the output unit may provide

circuitry for transmitting data, user output signals and/or messages from the apparatus. The transmitting may comprise transmitting radio frequency signals by an antenna, for example. In another example, the transmitting may comprise transmitting wired transmissions via an Ethernet adapter. In yet another example, the transmitting may comprise displaying visual information and/or producing audible signals such as voice.

[0048] In various embodiments, a display, such as a touch screen, may be used for both input and output of information to users. The touch screen may both display information and receive user input by detecting user gestures.

[0049] In an embodiment, the output unit operating on radio frequency signals may include a splitter. The output unit may produce an amplified radio frequency signal for transmission. The radio frequency signal is fed to the splitter that splits the amplified radio frequency signal into two or more separate sig signal branches. The branches transfer the radio frequency signals to different leaky feeders that are arranged into different elevator shafts.

[0050] In an embodiment the input unit operating on radio frequency signals includes a combiner. The combiner receives radio frequency signals from separate signal branches that include leaky feeders in different elevator shafts. The combiner outputs a combined radio frequency signal for processing by the input unit.

[0051] The splitter and combiner may be used in input and output units of the elevator control unit of figure 2a, to split and to combine the radio frequency signals between the leaky feeder cables in different shafts.

[0052] Figure 4 illustrates a block diagram of an elevator control unit 402 including two transceivers 404, 406 for a corresponding number of leaky feeder cables. The elevator control unit may be the elevator control unit in Figure 2a, for example. The elevator control unit and the transceivers may be implemented by the block diagram of Figure 3, but with two interfacing units corresponding to the transceivers in Figure 4. The transceivers may connect the elevator control unit by internal buses or by a local area network connection, for example over Ethernet.

[0053] Figure 5 illustrates a block diagram of an elevator control unit 502 including a single transceiver 504 for communicating with two elevator cars through two leaky feeders. The elevator control unit may be the elevator control unit in Figure 2a, for example. A splitter and a combiner are connected to the transceiver to allow splitting, by the splitter, a radio frequency signal from the transceiver to the leaky feeders and to allow combining, by the combiner, a radio frequency signal from the leaky feeders to the transceiver. The elevator control unit and the transceiver may be implemented by the block diagram of Figure 3, where the interfacing unit may correspond to the transceiver connected with the splitter and a combiner that may be implemented as single or separate units.

[0054] Accordingly, in various embodiments, for exam-

ple in Figures 4 and 5, transceivers connect to the elevator control unit by electrical signals communicated on baseband frequencies and towards the leaky feeder on radio frequency signals modulated to the communications frequency, for example the WLAN frequencies on the ISM frequency band of 2.4 GHz.

[0055] Referring back to Figure 3, the CPU may comprise a set of registers, an arithmetic logic unit, and a control unit. The control unit is controlled by a sequence of program instructions transferred to the CPU from the memory. The control unit may contain a number of microinstructions for basic operations. The implementation of micro-instructions may vary, depending on the CPU design. The program instructions may be coded by a programming language, which may be a high-level programming language, such as C, Java, etc., or a low-level programming language, such as a machine language, or an assembler. The electronic digital computer may also have an operating system, which may provide system services to a computer program written with the program instructions. The memory may be a volatile or a non-volatile memory, for example EEPROM, ROM, PROM, RAM, DRAM, SRAM, firmware, programmable logic, etc.

[0056] The apparatus 300 may be implemented as an electronic digital computer, which may comprise a working memory (RAM), a central processing unit (CPU), and a system clock. The CPU may comprise a set of registers, an arithmetic logic unit, and a control unit. The control unit is controlled by a sequence of program instructions transferred to the CPU from the RAM. The control unit may contain a number of microinstructions for basic operations. The implementation of microinstructions may vary, depending on the CPU design. The program instructions may be coded by a programming language, which may be a high-level programming language, such as C, Java, etc., or a low-level programming language, such as a machine language, or an assembler. The electronic digital computer may also have an operating system, which may provide system services to a computer program written with the program instructions.

[0057] In Figures 6a and 6b an elevator arrangements are illustrated that may have corresponding elements as described with the elevator arrangement of Figure 1.

[0058] Figure 6a illustrates an elevator arrangement 600 comprising a wireless energy transfer to an elevator car 102a, 102b, according to an embodiment. An electrical power supply 128 is provided that supplies electricity to the elevator car 102a via wireless energy transfer means. The wireless energy transfer means may be connected to the electrical power supply by a feeder cable 124 to avoid radiating the energy outside the hoistway 104. It should be appreciated that in some embodiments the feeder cable may not be needed and the wireless energy transfer means may be connected directly to the electrical power supply. In one example the wireless energy transfer means is provided by a structure 122 that radiates electromagnetic waves and an energy harvester 120a installed to the elevator car. The energy harvester

receives the radiated waves and supplies the energy from the waves as electrical energy to the equipment located in the elevator car. Preferably the energy is supplied to the equipment as an electrical current having a voltage suitable for the equipment that is powered by the current. In one example, the structure that radiates electromagnetic waves comprises an inductive power rail. The electrical current is fed from the power supply to the inductive power rail and induced to the elevator car, where the induced current is received by the energy harvester, provided for example by an arrangement including a coil.

[0059] Figure 6b illustrates an elevator arrangement 650, where an elevator car 102a, 102b is powered by a power rail 132 installed to the hoistway 104. The power rail provides a galvanic connection for the transfer of electricity from an electrical power supply 138 to the elevator car via the power rail. Accordingly, the power rail is a galvanic power rail. The elevator car is installed with a connector 133 attached to the rail to allow supply of electrical current from the power rail to the elevator car. The connector and the power rail are fitted together such that their attachment is maintained, when the elevator car is moved along the hoistway. The power rail may be connected to the electrical power supply by a feeder cable 134 such that the power rail may be contacted only within the hoistway. In this way the power rail may not be contacted outside the hoistway and electrical shocks from the rail may be prevented. It should be appreciated that in some embodiments the feeder cable may not be needed and the power rail may be connected directly to the electrical power supply.

[0060] An embodiment involves an elevator arrangement having a plurality of elevator hoistways, where electrical power is transferred to the elevator car by an inductive power rail and/or a galvanic power rail. Accordingly, it is possible that all the power rails are galvanic power rails or inductive power rails or a mixture of inductive and galvanic power rails may be used to supply power in the hoistways.

[0061] An embodiment provides a computer program embodied on a distribution medium, comprising program instructions which, when loaded into an electronic apparatus, cause the execution of a method according to an embodiment.

[0062] The computer program may be in source code form, object code form, or in some intermediate form, and it may be stored in some sort of carrier, which may be any entity or device capable of carrying the program. Such carriers include a record medium, computer memory, read-only memory, electrical carrier signal, telecommunications signal, and software distribution package, for example. Depending on the processing power needed, the computer program may be executed in a single electronic digital computer or it may be distributed amongst a number of computers.

[0063] The apparatus according to an embodiment may be implemented as comprising one or more inte-

grated circuits, such as application-specific integrated circuits ASIC. Other hardware embodiments are also feasible, such as a circuit built of separate logic components. A hybrid of these different implementations is also feasible.

[0064] Apparatuses, such as elevator control units, transceivers, communications units and/or other corresponding devices or apparatuses implementing the functionality of a corresponding apparatus described with an embodiment comprise not only prior art means, but also means for communicating radio frequency signals between an elevator car and an elevator control unit through a leaky feeder cable that extends between the elevator car and the elevator control unit in an elevator arrangement.

[0065] More precisely, the apparatuses described with an embodiment may comprise means for implementing functionality of a corresponding apparatus described with an embodiment and they may comprise separate means or units for each separate function, or means may be configured to perform two or more functions. Present apparatuses comprise processors and memory that can be utilized in an embodiment. Programs, also called program products, including software routines, applets and macros, can be stored in any apparatus-readable data storage medium and they include program instructions to perform particular tasks. All modifications and configurations required for implementing functionality of an embodiment may be performed as routines, which may be implemented as added or updated software routines, application circuits (ASIC) and/or programmable circuits. Further, software routines may be downloaded into an apparatus. The apparatus, such as an elevator control unit, a transceiver or a corresponding component, may be configured as a computer or a microprocessor, such as single-chip computer element, including at least a memory for providing storage area used for arithmetic operation and an operation processor for executing the arithmetic operation. An example of the operation processor includes a central processing unit. The memory may be removable memory detachably connected to the apparatus.

[0066] Various commercially available products may be used to provide the functionalities of the described embodiments. Examples of the products comprise, processors, wireless transceivers provided as chips or adapters, and cables, for example coaxial cables.

[0067] The present invention is applicable to any elevator arrangement, where wireless communications are used to communicate with an elevator car. The operations of an apparatus according to an embodiment may be implemented in one or more physical or logical entities.

[0068] It should be appreciated that the described embodiments are applicable to one, two, three, or four or any number of elevator cars.

[0069] It should be appreciated that different embodiments may be applied to elevators installed in various

locations. Especially beneficial is to apply the above described solutions to high-rise buildings that exceed 35 meters in height and which currently reach heights of hundreds of meters. In high-rise buildings, hoistways of the elevator cars are also long, whereby cabling attached to the elevator car introduces particular challenges which may be observed in the weight of the cabling. Moreover, very high buildings swing by the wind, whereby space has to be reserved in elevator shafts to accommodate any swinging cabling that runs between an elevator car and an elevator control unit. The swinging is also present in other locations where elevators are installed in structures that may engage into a swinging movement, for example ships, oil rigs, and/or other vessels used on water to carry goods in inland waterways or in the sea, e.g. marine vessels. It should be appreciated that also airborne vessels, e.g. airplanes, may be engaged into a swinging movement by the wind or when landed on the sea or a lake. The structures may be of concrete, steel or their combination to support the elevator arrangement in the structure. As is well-known by a skilled person, present vessels and high-rise buildings include elevator arrangements, where elevator cars are moved between floors along hoistways.

[0070] Accordingly, an embodiment comprises a structure engageable in a swinging movement, for example a vessel or a high-rise building, including an elevator arrangement comprising an elevator car, a hoistway extending in a hoisting direction and said hoistway comprising openings to floors, wherein the elevator car is arranged movable between the floors, and an elevator control unit for controlling the hoisting of the elevator car, said elevator car including a communications unit for communicating with the elevator control unit, and, wherein the elevator control unit is connected to the communications unit of the elevator car by a radio frequency signals communicated on a leaky feeder cable extending between the elevator car and the elevator control unit. Further detail of the elevator arrangement is provided by the above description.

[0071] Accordingly, the swinging movement may be provided to vessels and high-rise buildings by wind or the waves. The shape and structure of the vessel and the high-rise building affect the amount of swinging. Accordingly, vessels and high-rise buildings they may be designed to minimize the swinging and/or limit the swinging to a predominant direction. Typically an elevator arrangement is installed to structures engageable into a swinging movement such that that the hoistway is in a direction that is substantially perpendicular to a direction of the swinging movement.

[0072] Various embodiments described above may be especially suitable for off-shore deployments of elevators into marine vessels and to on-shore deployments of the elevators into structures that are located on the shore or partly on land and partly on water. Both off-shore and on-shore deployments of the elevators are exposed to weather conditions that typically introduce swinging

movement to the vessels and structures by the prevailing weather conditions typically including string windiness and waves. It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. An elevator arrangement (100, 200, 220, 600, 650) comprising:

an elevator car (102a, 102b, 202a, 202b, 222a, 222b);

a hoistway (104, 204a, 204b, 224) extending in a hoisting direction and said hoistway comprising openings to floors (106), wherein the elevator car (102a, 102b, 202a, 202b, 222a, 222b) is arranged movable between the floors (106, 206a, 206b, 226a, 226b); and an elevator control unit (108, 208, 218) for controlling the hoisting of the elevator car (c);

said elevator car (102a, 102b, 202a, 202b, 222a, 222b) including a communications unit (110a, 110b, 210a, 210b, 230a, 230b) for communicating with the elevator control unit (108, 208, 218); and, wherein the elevator control unit (108, 208, 218) is connected to the communications unit (110a, 110b, 210a, 210b, 230a, 230b) of the elevator car (102a, 102b, 202a, 202b, 222a, 222b) by a radio frequency signals communicated on a leaky feeder cable (112, 212a, 212b, 232) extending between the elevator car (102a, 102b, 202a, 202b, 222a, 222b) and the elevator control unit (108, 208, 218).

2. An elevator arrangement (100, 200, 220, 600, 650) according to claim 1, wherein the elevator arrangement (100, 200, 220, 600, 650) comprises a plurality of elevator cars (102a, 102b, 202a, 202b, 222a, 222b), and one or more leaky feeder cables (112, 212a, 212b, 312) connect the elevator control unit (108, 208, 218) to the communications units (110a, 110b, 210a, 210b, 230a, 230b) of the elevator cars (102a, 102b, 202a, 202b, 222a, 222b).

3. An elevator arrangement (200) according to any one of the preceding claims, wherein the elevator arrangement (200) comprises a plurality shafts each including at least one elevator car (202a, 202b) and a corresponding hoistway (202a, 202b), whereby the elevator arrangement (200) comprises leaky feeder cables (212a, 212b) extending along each of the shafts between the elevator cars (202a, 202b) of the shafts and the elevator control unit (208).

4. An elevator arrangement (600, 650) according to any one of the preceding claims, wherein an inductive power rail (122) or galvanic power rail (132) is installed to the hoistway (104) for supplying electrical power to the elevator car. 5
5. An elevator arrangement (100, 200, 220, 600, 650) according to any one of the preceding claims, wherein the hoistway extends in a direction that is inclined to a vertical direction. 10
6. A method by a radio frequency transceiver for an elevator arrangement (100, 200, 220, 600, 650) according to any one of claims 1 to 5, the method comprising: 15

communicating radio frequency signals between the elevator car (102a, 102b, 202a, 202b, 222a, 222b) and the elevator control unit (108, 208, 218) through the leaky feeder cable (112, 212a, 212b, 232) that extends between the elevator car (102a, 102b, 202a, 202b, 222a, 222b) and the elevator control unit (108, 208, 218). 20
7. A method according to claim 6, comprising: 25

forming a coverage area of radio frequency communications along the elevator hoistway (104, 204a, 204b, 224) or an elevator shaft comprising the hoistway (104, 204a, 204b, 224). 30
8. A radio frequency transceiver for communicating radio frequency signals in an elevator arrangement (100, 200, 220, 600, 650) according to any one of claims 1 to 5, the radio frequency transceiver comprising: 35

connecting means for connecting to the leaky feeder cable (112, 212a, 212b, 232); and 40

communications means for communicating radio frequency signals through the leaky feeder cable (112, 212a, 212b, 232) that extends between the elevator car (102a, 102b, 202a, 202b, 222a, 222b) and the elevator control unit (108, 208, 218). 45
9. A radio frequency transceiver according to claim 8, wherein the radio frequency transceiver is connected to the leaky feeder cable (112, 212a, 212b, 232) by a cable (114, 214a, 214b, 234) having a smaller radio frequency signal leakage than the leaky feeder cable. 50
10. A radio frequency transceiver according to claim 9, wherein the cable (114, 214a, 214b, 234) connecting the radio frequency transceiver to the leaky feeder cable (112, 212a, 212b, 232) has a peripheral conductive shield having a smaller leakage of radio frequency signals than a peripheral conductive shield of the leaky feeder cable (112, 212a, 212b, 232). 55
11. A radio frequency transceiver according to any one of claims 8 to 10, wherein the radio frequency transceiver is a wireless local area network WLAN transceiver.
12. An elevator control unit comprising, a transceiver according to any one of claims 8 to 11.
13. An elevator control unit according to claim 12, comprising a plurality of said transceivers, each of which connects to a leaky feeder cable in a different shaft, wherein the transceivers have a common baseband section towards the elevator control unit.
14. An elevator control unit according to claim 12, wherein leaky feeder cables are arranged in different shafts and the leaky feeders are connected to the elevator control units by a splitter and a combiner.
15. A computer program product comprising computer program code that when executed by an apparatus, cause the apparatus to perform the steps of the method according to claims 6 or 7.
16. A structure engageable into a swinging movement, for example a marine vessel, inland waterway vessel or a high-rise building, including an elevator arrangement according to any one of claims 1 to 5, wherein the elevator arrangement is arranged to the structure such that the hoistway is in a direction that is substantially perpendicular to a direction of the swinging movement.

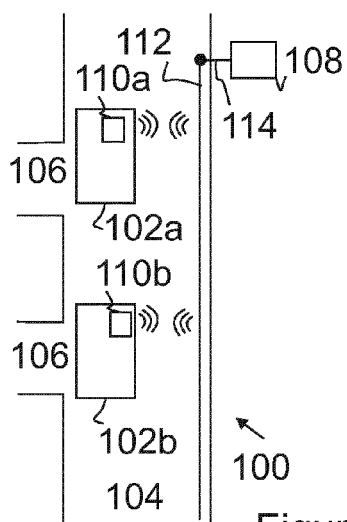


Figure 1

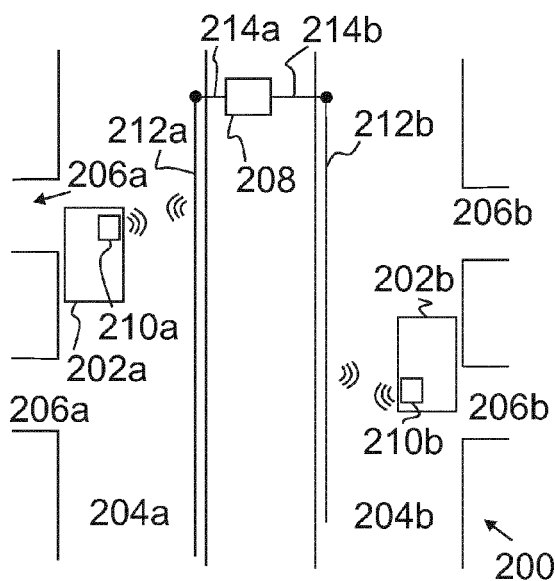


Figure 2a

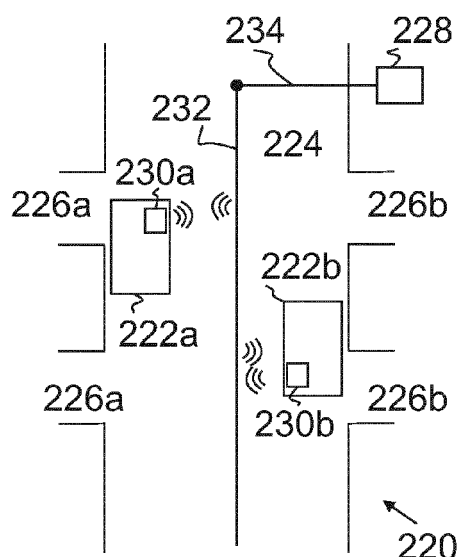


Figure 2b

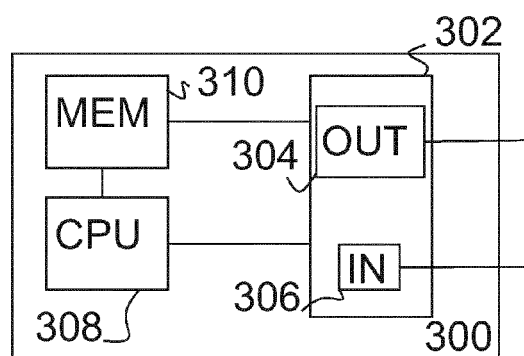


Figure 3

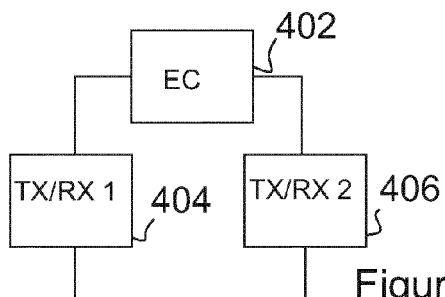


Figure 4

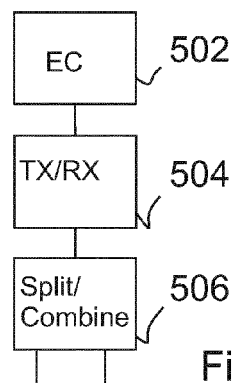


Figure 5

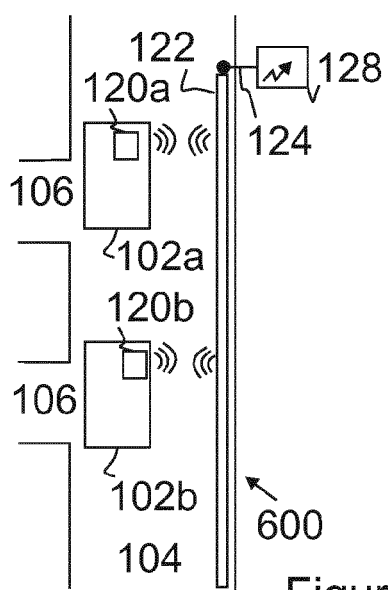


Figure 6a

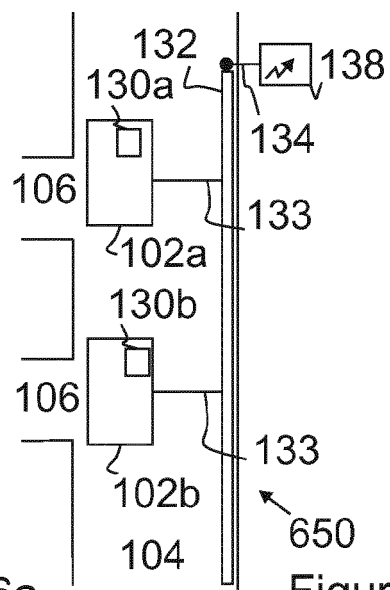


Figure 6b



EUROPEAN SEARCH REPORT

Application Number
EP 13 18 1357

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2009 040589 A (TOSHIBA ELEVATOR CO LTD) 26 February 2009 (2009-02-26) * abstract; figures 1-9 * * paragraphs [0030] - [0071] * -----	1-4, 6-13,15, 16	INV. B66B1/34
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			TECHNICAL FIELDS SEARCHED (IPC)
			B66B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 24 January 2014	Examiner Bleys, Philip
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	

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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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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24-01-2014

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