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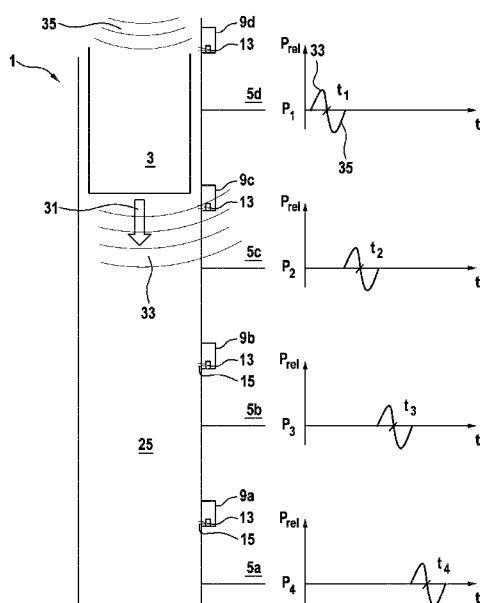
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- (54) Title: ELEVATOR ARRANGEMENT ADAPTED FOR DETERMINING POSITIONS OF FIXTURES AT VARIOUS FLOORS BASED ON PRESSURE MEASUREMENTS

Fig. 2

- (57) Abstract: An elevator arrangement (1) is proposed to comprise a cabin (3) which is displaceable between various floors (5) within a building, an elevator control (7) and a plurality of fixtures (9), each fixture (9) being located at one of the floors (5) and being connected to the elevator control (7) for an exchange of information. Each fixture (9) comprises a pressure sensor (13) for sensing at least one of an absolute environmental pressure (P_{abs}) and a change (P_{rel}) in environmental pressure over time. Preferably, the elevator arrangement (1) is adapted to perform a fixture position learning procedure comprising determining a position information for each of the fixtures (9) located at each of the floors (5) based on the at least one of the absolute environmental pressure (P_{abs}) and the change (P_{rel}) in environmental pressure over time sensed by the pressure sensor (13) comprised in the fixture (9) located at the respective floor (5) and storing the determined position information for subsequent identification purposes for each of the fixtures (9). For example, an absolute environmental pressure may indicate a height at which a fixture (9) is located. Alternatively, a change in environmental pressure may be detected e.g. when a travelling cabin (3) passes by and a position information may be derived taking into account a known position of the cabin (3) or from a succession with which the pressure fluctuation is measured by the pressure sensors (13) in the various fixtures (9).

**Elevator arrangement adapted for determining positions of fixtures at various floors
based on pressure measurements**

5 The present invention relates to an elevator arrangement. Particularly, the present invention relates to determining positions of various fixtures of the elevator arrangement. Furthermore, the invention relates to a method for determining such position information, to a computer program product enabling automated performing of such method and to a computer-readable medium comprising such computer program product stored thereon.

10 Elevators are typically used for transporting persons or items between various levels, i.e. for vertically transporting people or items in an elevator cabin for example between floors within a building.

15 Generally, at each of the floors, fixtures are provided. Such fixtures may serve various purposes. For example, a fixture may be provided in a form of a landing operation panel (LOP) and may be used by users in order to call a cabin of the elevator to come to a specific floor. Such landing operation panels typically comprise one or more call buttons or other means for determining a user's request. Other fixtures may serve for providing information to a user. For example, such fixtures may comprise a display, lights, indicators, loudspeakers etc. and may indicate
20 information for example about a current position of the elevator cabin and/or its moving direction. Other fixtures may be provided within the floors of the building for further purposes.

Typically, in order to be able to properly operate, an elevator arrangement must have information about the positions of each of its fixtures.

25 For example, in order to correctly control a motion of the elevator cabin, an elevator control must know the position of the LOP at which a user has pushed the call button. Only when the position of such fixture is known to the elevator control, the elevator control can control driving the cabin to the floor where the user is waiting.

Generally, it is beneficial to provide all fixtures serving for a same or similar purpose within a building with an identical hardware. Accordingly, when installing the elevator arrangement, each fixture may be mounted at any of the various floors within the building. This may save costs and simplify logistics.

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However, after installation, as the elevator control can initially not distinguish between the various fixtures located at the various floors, it is generally necessary to identify the position of each of the fixtures of the elevator arrangement such that, during subsequent normal operation of the elevator control, such information may be used by the elevator control for correctly controlling for example a cabin motion.

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Conventionally, identifying the position of a fixture has been carried out for example by means of several switches being included into each of the fixtures wherein the switching state of the switches provided for a unique identification pattern upon which the elevator control could distinguish between the various fixtures. In such conventional approach, installation personnel had to manually set in each instance and at every floor the several switches of each of the fixtures. Configurations manually carried out in such manner required a high outlay in terms of time and personnel. Furthermore, the switches represented costly components.

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An alternative approach is described in US 7,699,143 B2 disclosing a method of setting the floor associations of a plurality of operating units of an elevator installation.

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There may be a need for an elevator arrangement which enables determining of position information of fixtures located at various floors in a simple manner. Particularly, there may be a need for such elevator arrangement in which position information determination may be provided with minimum human labour, i.e. preferably semi-automatically or fully automatically. Furthermore, there may be a need for an elevator arrangement in which such position information determination may be provided at relatively low cost and/or at short time. Furthermore, there may be a need for a corresponding method for determining position information, a computer program product enabling such method when executed on a programmable elevator control and a computer-readable medium comprising such computer program product.

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At least one of such needs may be met with the subject-matter of the independent claims of the present application. Beneficial embodiments are defined in the dependent claims and described in the following specification.

5 According to a first aspect of the present invention, an elevator arrangement is proposed. The elevator arrangement comprises at least a cabin and, optionally, a counterweight which are displaceable between various floors within a building. Furthermore, the elevator arrangement comprises an elevator control and a plurality of fixtures. Each fixture is located at one of the
10 floors and is connected to the elevator control for an exchange of information. Each fixture comprises a pressure sensor for sensing an absolute environmental pressure and/or a change in environmental pressure over time.

Therein, according to a preferred embodiment, the elevator arrangement is adapted to perform a fixture position learning procedure comprising at least the following steps: a position
15 information is determined for each of the fixtures located at each of the floors based on the absolute environmental pressure and/or the change in environmental pressure over time sensed by the pressure sensor comprised in the fixture located at the respective floor. Then, this determined position information is stored for subsequent identification purposes for each of the fixtures.

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

As indicated in the introduction above, it may be beneficial to enable an elevator arrangement to
25 semi-automatically or fully-automatically learn the positions of each of its fixtures, i.e. to enable the elevator arrangement to uniquely identifying each of its fixtures and having information for example about the floor at which the fixture is arranged.

30 In order to enable such fixture position learning procedure, it is suggested to include a pressure sensor into each of the fixtures of the elevator arrangement. Such pressure sensor may measure an air pressure of ambient air in the pressure sensor's environment. The capability of measuring an air pressure in an environment of the elevator arrangement, particularly in an environment

directly adjacent to a fixture, may enable using results of such pressure measurements in order to derive information about positions of plural fixtures within the elevator arrangement.

In a first alternative, the pressure sensor may measure such pressure in absolute terms such that pressure measurements from various pressure sensors may be compared with each other. In a second alternative, the pressure sensor may at least measure the air pressure in relative terms, i.e. at least changes over time in the pressure of ambient air in the sensor's environment may be detected.

As will be described in more detail further below with respect to various embodiments of the invention, such measurements of absolute pressure or of pressure changes provided by various pressure sensors included in various fixtures at various floors may be beneficially used to identify a position of each of the fixtures. Such position information may later be used for identification purposes for each of the fixtures such that the elevator control may uniquely identify e.g. from which floor a passenger's request was acquired using the fixture provided in this floor.

Particularly and according to an embodiment, the pressure sensors each may be provided with a pressure transmitting connection to an elevator shaft in which the elevator cabin travels.

Therein, the "pressure transmitting connection" may be an arrangement or a connection of the pressure sensor which allows the pressure sensor to measure the air pressure within the elevator shaft in absolute terms or at least in relative terms. For example, the pressure sensor may be arranged within the fixture such that a pressure sensing surface of the sensor is in direct fluid connection, i.e. in connection e.g. via a hole or a pipe, with the elevator shaft. In many cases, such direct fluid connection can be easily established as the fixture comprises e.g. wirings which extend through a hole in a wall of the elevator shaft into an interior volume of the elevator shaft. Accordingly, any pressure change within the air comprised in the elevator shaft is directly transmitted to and measurable by the pressure sensor. Alternatively, the pressure sensor may be at least in indirect contact with an interior air volume within the elevator shaft such that pressure variations are at least indirectly transmitted to and measurable by the pressure sensor. For example, the pressure sensor may be encapsulated within the fixture using e.g. a thin membrane. Such membrane may prevent any fluid flow to the sensor such that e.g. the sensor is protected

against for example water or dirt but may allow that pressure variations are transmitted to the pressure sensing surface.

Preferably, the pressure sensor is arranged and/or adapted such that it mainly or only measures the absolute environmental pressure or the change in environmental pressure of air comprised within the elevator shaft.

In such arrangement where the pressure sensor measures, inter alia or exclusively, environmental pressures within the elevator shaft, the measurement results may be particularly meaningful for deriving information about the fixtures' positions.

For example, any perturbing influences which may affect pressure measurements when such measurements measure the air pressure within e.g. a floor of a building may be avoided. For example, while air in building floors may vary in air pressure e.g. due to open windows, ventilation, etc. such perturbing effects hardly occur in air enclosed within the elevator shaft, at least as long as the elevator cabin or a counterweight are not moving. Accordingly, absolute environmental pressures or relative pressure changes may be measured with high precision when referring to ambient air within the elevator shaft.

On the other hand, when the cabin or the counterweight are moving within the elevator shaft, pressure variations over time may be induced in the air comprised in the elevator shaft. As explained in more detail further below, measuring changes in environmental pressure in such air perturbed by a moving component in the elevator shaft may provide valuable information for deriving the position information of the fixtures when measured using pressure sensors comprised in the fixtures and connect with a pressure transmitting connection to the elevator shaft.

According to an embodiment, the elevator arrangement is adapted such that, in the fixture position learning procedure, each pressure sensor transmits information on a sensed absolute environmental pressure to the elevator control and the elevator control determines the position information for each of the fixtures based on a comparison of the transmitted information on the absolute environmental pressures.

According to such embodiment, benefit may be taken from the fact that the absolute environmental pressure generally varies depending on a height at which such pressure is measured. In other words, when measuring the absolute environmental pressure at different heights within an air column such as within the elevator shaft, the measurement results include information about the height position at which the measurement was performed. Such information may then be used by the elevator control in order to derive position information for each of the fixtures. The absolute environmental pressures may be measured by each of the pressure sensors at each of the fixtures simultaneously or in a time sequence. Particularly, simultaneous pressure measurement may render relative spacing of pressure values irrelevant.

Particularly in accordance with such an embodiment, in the fixture position learning procedure, the elevator control identifies an identity of each of the fixtures based on a unique identification code being transmitted from the fixture together with the transmitted information on the sensed absolute environmental pressure. Alternatively, the elevator control may identify the identity of each of the fixtures based on a hard-wiring connection between each one of the fixtures and the elevator control.

In other words, when a pressure sensor in a fixture has measured an absolute environmental pressure, the fixture does not only transmit the measurement result to the elevator control but may also transmit an identification code (ID) which may uniquely identify the respective fixture. Based on the various pressure measurement results received from the various fixtures, the elevator control may then derive the position information for each of the fixtures based on the order of measured absolute environmental pressures and knowing that the highest pressure is generally measured at the lowest floor and the lowest pressure is measured at the highest floor. The position information may then be stored together with the identification codes for subsequent identification purposes for each of the fixtures. In other words, e.g. a list may be stored in which each identification code is attributed to an associated one of the floors of the building.

Alternatively, instead of using unique identification codes for identifying each fixture, the identity of each fixture may be determined based on its hard-wiring to the elevator control. In other words, when each of the fixtures is hard-wired to the elevator control, upon receiving the information on the various absolute environmental pressures measured by the pressure sensors, the elevator control may create a list storing the information about an order of the measured

pressures together with the information about the hard-wiring via which this measured pressure is transmitted, i.e. about which pressure sensor has provided this measurement result in its fixture.

5 According to an alternative embodiment, the elevator arrangement is adapted such that, in the fixture position learning procedure, each pressure sensor transmits information on a change in environmental pressure over time to the elevator control and the elevator control determines the position information for each of the fixtures based on the transmitted information on the changes in environmental pressure over time.

10 In other words, the pressure sensors may continuously or repeatedly monitor a pressure such as an environmental pressure of ambient air e.g. within the elevator shaft. Upon such monitoring, the pressure sensors may detect changes in environmental pressure over time and may transmit corresponding information to the elevator control. Upon receiving such corresponding
15 information from each of the fixtures, the elevator control may determine the position information for each of the fixtures.

For example, according to an embodiment, the elevator arrangement may be adapted such that, in the fixture position learning procedure, the cabin is driven to each of the floors. Typically,
20 when an elevator cabin is driven through an elevator shaft, it slightly influences local pressure conditions within the elevator shaft. For example, when the cabin approaches towards a specific location in the elevator shaft, local pressure at this location may temporarily increase whereas when the cabin moves away from the location, local pressure at this location may temporarily decrease. Accordingly, when the cabin passes along the location, there will typically be a
25 detectable change in environmental pressure over time. Such temporary change in environmental pressure may be detected by the pressure sensors of the fixtures and, upon receiving corresponding signals from the fixtures, the elevator control may derive the position information for each of the fixtures.

30 Particularly, it may be beneficial that, in the fixture position learning procedure, the cabin and/or counterweight may be travelled continuously through several or all of the floors within a building without necessarily stopping at each of the floors. For example, the cabin and/or counterweight may be driven continuously from one end of the elevator shaft to the opposite

end without interruptions or stops. Thereby, the fixture position learning procedure may be performed in very short time and, preferably, no or little human interaction is necessary.

For example, when detecting the change in environmental pressure over time and, additionally, having e.g. an information about the current location of the cabin within the elevator shaft, such information being available for example from the elevator control, an information about the location of the fixture measuring the change in environmental pressure over time with its pressure sensor may be derived. Thus, in the fixture position learning procedure, the position information may be obtained for each of the fixtures by e.g. simply traveling the cabin through the entire elevator shaft and correlating information about each of multiple changes in environmental pressure over time measured by the various pressure sensors with information about the current position of the cabin.

According to an alternative embodiment, in determining the position information, the elevator control may take into account a time sequence with which an information on a similar change in environmental pressure over time is received by the elevator control from each of the fixtures. In other words, for example the cabin may be travelled within the elevator shaft to each of the floors of the building and environmental pressure is monitored by the pressure sensors in each of the fixtures such that, when a typical change in environmental pressure over time is detected by a pressure sensor, a corresponding signal is sent to the elevator control. From a sequence of such signals arriving at the elevator control and taking into account a traveling direction of the cabin, the elevator control may derive the position information, i.e. may determine which fixture is situated at which of the floors.

Therein, pressure indicating signals may be forwarded from the pressure sensors to the elevator control, which in turn may determine from the transmitted signals whether there are included information on a similar change in environmental pressure over time, i.e. whether there are typical changes in environmental pressure as they occur when e.g. the elevator cabin passes by at one the pressure sensors. Accordingly, the elevator control may be “intelligent”, i.e. may be able to processing pressure signals from the pressure sensors whereas the pressure sensors in the fixtures may only relay its pressure information to the elevator control. For example, the elevator arrangement may be enabled to process pressure signals or information only in a “learning mode”, i.e. during the fixture position learning procedure.

According to an embodiment, the pressure sensors are adapted to sense pressures with an accuracy of less than 1hPa, preferably less than 0.2hPa or even less than 0.05hPa. With such accurately measuring pressure sensors, an absolute environmental pressure or a change in environmental pressure over time may be detected with such high precision such that based on results of pressure measurements the elevator control can determine the position information. This means the elevator control may for example distinguish absolute environmental pressures such as to derive a sequence of measurement results corresponding to an order of the floors in which the fixture are located. Alternatively, with such high precision pressure measurements, changes in environmental pressure over time may be detected with sufficient resolution such that e.g. patterns corresponding e.g. to a typical pressure change occurring upon a passage of the elevator cabin along a pressure sensor may be reliably detected.

According to an embodiment, in a normal operation mode, the elevator control is adapted to identify each of the fixtures based on the information stored for subsequent identification purposes during the fixture position learning procedure. In other words, the position information or further information derived therefrom may be used by the elevator control during subsequent normal operation mode in order to uniquely identify the position of each of the fixtures of the elevator arrangement to thereby enable for example proper operation of the elevator arrangement.

According to an embodiment, the elevator arrangement is adapted to executing the fixture position learning procedure automatically, i.e. semi-automatically or fully automatically, under control of the elevator control. In other words, the fixture position learning procedure may be performed by the elevator arrangement without necessarily any human interaction, i.e. fully automatically, or with only limited human interaction, i.e. semi-automatically. Accordingly, when the elevator arrangement is installed within a building, the fixture position learning procedure may be initiated and may then automatically determine position information for all of the fixtures included in the elevator arrangement.

According to a second aspect of the invention, a method for determining position information for each of a plurality of fixtures of an elevator arrangement is proposed. Therein, the fixtures are located at various floors within a building and each fixture comprises a pressure sensor for sensing at least one of an absolute environmental pressure and a change in environmental pressure over time. The method comprises determining a position information for each of the

fixtures located at each of the floors based on the absolute environmental pressure and/or the change in environmental pressure over time sensed by the pressure sensor comprised in the fixture located at the respective floor and storing the determined position information for subsequent identification purposes for each of the fixtures.

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Such position information determination method may be specifically applied for use with an elevator arrangement according to an embodiment of the present invention. Particularly, the method may be performed semi-automatically or fully automatically. Therein, each of the method steps may be controlled for example by the elevator control of an elevator arrangement.

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According to a third aspect, a computer program product is described. Such computer program product comprises computer-readable instructions which are adapted to, when executed by a processor of e.g. a programmable elevator control, controlling the method according to the above described second aspect of the invention.

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Such computer program product may comprise computer-readable instructions in any programming language. The instructions may instruct the programmable elevator control to control e.g. travelling of the cabin, reading pressure sensor measurements and determining of position information by e.g. correlating information derived from read pressure sensor measurements for example with information on a current position of the cabin.

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According to a fourth aspect of the present invention, a computer-readable medium comprising a computer program product according to the above-mentioned third aspect of the invention stored thereon is suggested. Such computer-readable medium may be any physical memory which allows storing computer-readable instructions and/or which enables downloading of such computer-readable instructions. For example, the computer-readable medium may be a CD, a DVD, flash memory, EPROM, parts of the internet providing download options or similar.

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It shall be noted that possible features and advantages of embodiments of the invention are described herein partly with respect to an elevator arrangement and partly with respect to a method for determining position information for each of a plurality of fixtures of an elevator arrangement. One skilled person will recognize that features described for one embodiment may

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be suitably transferred, adapted, or modified for application with other embodiments and/or may be combined and/or replaced with other features described for other embodiments in order to come to further embodiments of the invention.

5 In the following, advantageous embodiments of the invention will be described with reference to the enclosed drawings. However, neither the drawings nor the description shall be interpreted as limiting the invention.

10 Fig. 1 shows a cross-sectional view through an elevator arrangement according to an embodiment of the present invention.

Fig. 2 shows a cross-sectional view through an elevator arrangement according to an alternative embodiment of the present invention.

15 Fig.3 visualized a correlation of measured absolute environmental pressures with identification numbers of floors for determining position information.

Fig. 4 visualized a correlation of a measured time dependence of changes in environmental pressure over time with identification numbers of floors for determining position information.

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The figures are only schematic representations and not to scale. Same reference signs refer to same or similar features.

25 Fig. 1 shows an elevator arrangement 1 according to an embodiment of the present invention. The elevator arrangement 1 comprises a cabin 3 and a counterweight 4 which are held by suspension members 23 such as ropes or belts. The suspension members 23 are wound around pulleys 27. The cabin 3 and the counterweight 4 may be vertically displaced within an elevator shaft 25 to different levels corresponding to various floors 5a, 5b, 5c within a building using a driving machine 21 driving the suspension members 23. An elevator control 7 may control
30 displacements of the cabin 3 between the various floors 5. During such displacements, the cabin

3 and/or the counterweight 4 are guided by guide rails 29 mounted along walls of the elevator shaft 25.

At each of the floor 5a, 5b, 5c, a fixture 9a, 9b, 9c is provided. In the example presented in the figure, the fixtures 9 are landing operation panels (LOP) and comprise a call button 11 which a user may press e.g. in order to announce his request to drive the cabin 3 to the floor where he is currently waiting.

However, in other examples, a fixture 9 may be any other device which may be provided at the floors 5 for acquiring or providing any information or services from and/or to users, such as e.g. acquiring requests from a user via any type of human machine interface (HMI) or providing information to a user e.g. via a display, a loudspeaker, etc.

Preferably, all fixtures 9 at all floors 5 may be provided with the same hardware. The fixtures 9 may be connected to the elevator control 7 for example via a hard-wiring 17. Such hard-wiring 17 typically extends along walls at an interior of the elevator shaft 25. Alternatively, the fixtures 9 may communicate with the elevator control 7 via a wireless connection, e.g. using a unique fixture ID.

Furthermore, each of the fixtures 9 comprises a pressure sensor 13. In the example shown, each pressure sensor 13 is in fluid communication with the interior volume of the elevator shaft 25 via a pressure transmitting connection 15 which, in the present example, is formed by a pipe extending through a wall of the elevator shaft 25. Any other type of pressure transmitting connection 15 such as a hole, a tube, etc. may be possible, wherein the pressure transmitting connection 15 may be open such that a gas exchange is possible or may be closed e.g. via a membrane such that only pressure may be transmitted but no gas exchange is possible. Via such pressure transmitting connection 15 the pressure sensor 13 may sense an air pressure within the elevator shaft 25.

By measuring an air pressure in its environment, the pressure sensor 13 may help in determining a position information of its fixture 9, such position information indicating at which floor 5 the fixture 9 is located. Based on such position information, the elevator control 7 may later know

for example at which floor 5 the fixture 9 is positioned from which a request or an information has been transmitted to the elevator control 7 and may e.g. send the cabin 3 to this floor 5.

As a first option, the pressure sensor 13 may be adapted for measuring an absolute environmental pressure P_{abs} . Such absolute environmental pressure may be measured for example inside the elevator shaft 25. In an air column such as in the volume of the elevator shaft 25, an absolute air pressure generally depends on a height 19 over a ground level. In other words, the higher a location at which the absolute environmental pressure P_{abs} is measured the lower the measured absolute environmental pressure P_{abs} will be. Generally, at approximately sea level, air pressure decreases by about 1hPa at every 8m increase in height.

Accordingly, when the pressure sensor 13 is sufficiently sensitive, i.e. when the pressure sensor 13 has for example a measurement sensitivity or accuracy of less than 1 hPa, preferably less than 0.2 hPa, measurements of various pressure sensors 13 comprised in the various fixtures 9 may provide sufficient information for determining the position information indicating at which of the floors each of the fixtures 9 is located.

For example, in a fixture position learning procedure performed prior to a normal operation of the elevator arrangement 1, i.e. for example directly after installation of the elevator arrangement 1, each fixture 9 measures the absolute environmental pressure P_{abs} at its height 19 over ground level using its pressure sensor 9. The absolute environmental pressures may be measured all simultaneously in a common process. Alternatively, absolute environmental pressures may be measured successively in a time sequence at the various pressure sensors in the multiple fixtures.

As visualized in Fig. 3, the pressure measurement results 37 for P_{abs} are then transmitted to the elevator control 7 and brought into correlation. For example, together with such measurement information transmission, each fixture 9 may identify itself for example by also transmitting its unique identification code to the elevator control 7. Alternatively, the elevator control 7 may identify each of the fixtures 9 based on a specific hard-wiring 17 via which the fixture 9 transmits its information to the elevator control 7 or based on a specific or hardcoding. The elevator control 7 may then compare all pressure measurement results 37 received from the various fixtures 9. Knowing that absolute environmental pressure P_{abs} decreases with height, the

elevator control 7 may then derive an order of the heights in which the fixtures 9 are located. Knowing furthermore the identity of each of the fixtures 9, the elevator control may derive the position information for each of the fixtures 9. For example, based on the measured values for P_{abs} , the elevator control 7 may derive a list in which an identification number 5a, 5b, 5c of each of the fixtures is associated with an absolute environmental pressure P_{abs} measured by the pressure sensor 13 of the respective fixture 9a, 9b, 9c, as shown in Fig. 3. As P_{abs} directly correlates with a height 19 over ground, such list includes information relating to each fixture 9a, 9b, 9c the number of the floor 5a, 5b, 5c at which the fixture is located is associated.

Finally, such position information may be stored for example in a memory within the elevator control 7 such that, upon later normal operation, the elevator control 9 can unambiguously identify a floor 5 at which e.g. a passenger is waiting for the cabin 3 after having pressed the call button 11 of the fixture 9 arranged at his floor 5.

In an alternative embodiments as visualized in Fig. 2, the pressure sensors 13 are not used to measure absolute environmental pressures P_{abs} . Instead, in the fixture position learning procedure, the pressure sensors 13 measure relative changes P_{rel} in environmental pressure.

Such embodiment may use the fact that if for example the cabin 3 or the counterweight 4 are moved within the elevator shaft 25, such movement will generally induce temporary pressure fluctuations within the elevator shaft. For example, when the cabin 3 is moved in a downward direction, as shown with the arrow 31 in fig. 2, a pressure fluctuation 33 with slightly increased air pressure will typically occur at a leading side of the cabin 3, i.e. in that case at the lower side, whereas a pressure fluctuation 35 with a slightly decreased air pressure will typically occur at a trailing side of the cabin 3, i.e. in that case at the upper side.

Accordingly, when the cabin 3 is travelling along the elevator shaft 25 it passes along each of the pressure sensors 13 comprised in the various fixtures 9a, 9b, 9c, 9d located at the various floors 5a, 5b, 5c, 5d. Each time before the cabin 3 passes along one the fixtures 9, first the leading side pressure fluctuation 33 will be sensed by the associated pressure sensor 13 as a temporary increased change P_{rel} in environmental pressure. Next, after the cabin 3 has passed along the fixture 9, the trailing side pressure fluctuation 35 will be sensed by the associated pressure sensor 13 as a temporary decreased change P_{rel} in environmental pressure.

The leading side pressure fluctuation 33 and the trailing side pressure fluctuation 35 may result in a typical pattern or behaviour of the change P_{rel} in environmental pressure. Upon detecting such similar changes P_{rel} in environmental pressure at each of the pressure sensors 13 in each of the fixtures 9 and transmitting corresponding information to the elevator control 7, the elevator control 7 may derive the required position information for each of the fixtures 9.

For example, in order to derive the position information, the elevator control 7 may take into account an information on a current position of the elevator cabin 3 during the fixture position learning procedure. Typically, in order to be able to precisely control displacements of the cabin 3, the elevator control 7 has precise information on a current position of the cabin 3 available. For example, the elevator control 7 precisely knows where the cabin 3 is actually positioned within the elevator shaft 25, i.e. at which of the floors 5 the cabin is e.g. currently stopped or between which of the floors 5 the cabin 3 is currently displaced. Accordingly, when the elevator control 7 receives the information from one of the fixtures 9 that its pressure sensor 13 has measured a change P_{rel} in environmental pressure showing pressure fluctuations typical for a cabin 3 passing by, the elevator control 7 may then instantly determine a position where the cabin 3 is currently located and may e.g. associate a floor identification number corresponding to this position to the identity of the fixture 9 which has send the information. The derived position information may then be stored for subsequent identification purposes during normal operation of the elevator arrangement 1.

Alternatively, and as indicated in Fig. 4, the elevator control 7 may take into account a time sequence with which an information on a similar change in environmental pressure is received from each of the fixtures 9. In other words, when e.g. travelling the elevator cabin 3 from an uppermost floor 5d towards a lowermost floor 5a, a typical pressure fluctuation will be measured at least at each of the fixtures 9 located between the uppermost floor 5d and the lowermost floor 5a when the cabin passes along the floor accommodating the respective fixture 9 (maybe at the uppermost floor 5d and/or the lowermost floor 5a itself, no such typical pressure fluctuation occurs as the cabin 3 is starting or stopping there, respectively). Accordingly, corresponding information will be send to the elevator control 7 at different points in time t_1 , t_2 , t_3 , t_4 , i.e. a fixture 9 arranged at an upper floor 5 will send the information about the occurrence of the typical change in environmental pressure at an earlier point in time t_i than a fixture 9 arranged at a lower floor 5. The elevator control 7 may analyse the continuously or repeatedly acquired signals from the pressure sensors 13 in order to find typical pressure fluctuation

patterns which may be interpreted as resulting from e.g. a cabin passing by at one of the pressure sensors. From the sequence t_i ($i = 1, 2, 3, \dots$) with which the information about the typical pressure fluctuation is received by the elevator control 7 from the fixtures 9a, 9b, 9c, 9d the elevator control 7 may derive in which floor 5a, 5b, 5c, 5d each of the fixtures 9 a, 9b, 9c, 9d is located, as visualized in Fig. 4. Such position information may be derived and then be stored for subsequent use.

Briefly summarized and using a different wording, it is proposed to provide each of the fixtures within an elevator arrangement with a barometric pressure sensor in order to enable detecting a position of the fixture. Two principle measurement scenarios appear to be feasible.

In a first approach, the sensor detects absolute air pressure. The sensors send a detected pressure level to the elevator control (possibly together with a unique ID and/or via a hardcoded connection) which can determine from the absolute values or from relative differences between values an order of succession of the fixtures. Since the elevator control knows e.g. how many floors are to be served, the sequence of fixtures can be determined and thus which fixture is arranged on which floor (identified by their ID or hardcoded connection).

In a second approach, the pressure sensor determines variations in pressure. A cabin may perform a complete trip (or possibly multiple trips in succession) for example between a topmost landing and a bottommost landing. When the cabin passes a floor, a brief alteration in pressure, i.e. possibly a pressure increase due to the cabin moving air towards the floor, can be detected with a subsequent further alteration in pressure, i.e. possibly a pressure decrease due to the cabin moving away from the floor. This modulation of an otherwise relatively constant pressure signal of a floor may establish a time succession of signals from which a succession of the fixtures may be determined. Possibly, a connection between a shaft and landing is present to allow a build-up and reduction of pressure from the shaft (moving cabin).

Of course, also a combination of the first and second approach may be possible.

Advantageously, positions of fixtures may be determined automatically, installation time and complexity may be reduced and a learning trip may be automatic.

Finally, it should be noted that terms such as “comprising” do 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.

List of reference signs

	1	elevator arrangement
	3	cabin
5	4	counterweight
	5	floor
	7	elevator control
	9	fixture
	11	call button
10	13	pressure sensor
	15	pressure transmitting connection
	17	hard-wiring to fixtures
	19	Height over Ground level
	21	machine
15	23	suspension member
	25	elevator shaft
	27	pulley
	29	guide rail
	31	motion direction
20	33	leading side pressure fluctuation
	35	trailing side pressure fluctuation
	37	pressure measurement results

Claims:

1. Elevator arrangement (1), comprising:
 - a cabin (3) which is displaceable between various floors (5) within a building;
 - an elevator control (7);
 - a plurality of fixtures (9), each fixture (9) being located at one of the floors (5) and being connected to the elevator control (7) for an exchange of information;wherein each fixture (9) comprises a pressure sensor (13) for sensing at least one of an absolute environmental pressure (P_{abs}) and a change (P_{rel}) in environmental pressure over time.
2. Elevator arrangement of claim 1, wherein the elevator arrangement (1) is adapted to perform a fixture position learning procedure comprising:
 - determining a position information for each of the fixtures (9) located at each of the floors (5) based on the at least one of the absolute environmental pressure (P_{abs}) and the change (P_{rel}) in environmental pressure over time sensed by the pressure sensor (13) comprised in the fixture (9) located at the respective floor (5) and storing the determined position information for subsequent identification purposes for each of the fixtures (9).
3. Elevator arrangement of claim 1 or 2, wherein the pressure sensors (13) each are provided with a pressure transmitting connection (15) to an elevator shaft (25) in which the elevator cabin (3) travels.
4. Elevator arrangement of one of the preceding claims, wherein the elevator arrangement (1) is adapted such that, in the fixture position learning procedure, each pressure sensor (13) transmits information on a sensed absolute environmental pressure (P_{abs}) to the elevator control (7) and the elevator control (7) determines the position information for each of the fixtures (9) based on a comparison of the transmitted information on the absolute environmental pressures.
5. Elevator arrangement of claim 4, wherein, in the fixture position learning procedure, the elevator control (7) identifies an identity of each of the fixtures (9) based on at least one of
 - a unique identification code being transmitted from the fixture (9) together with the transmitted information on the sensed absolute environmental pressure (P_{abs}) and

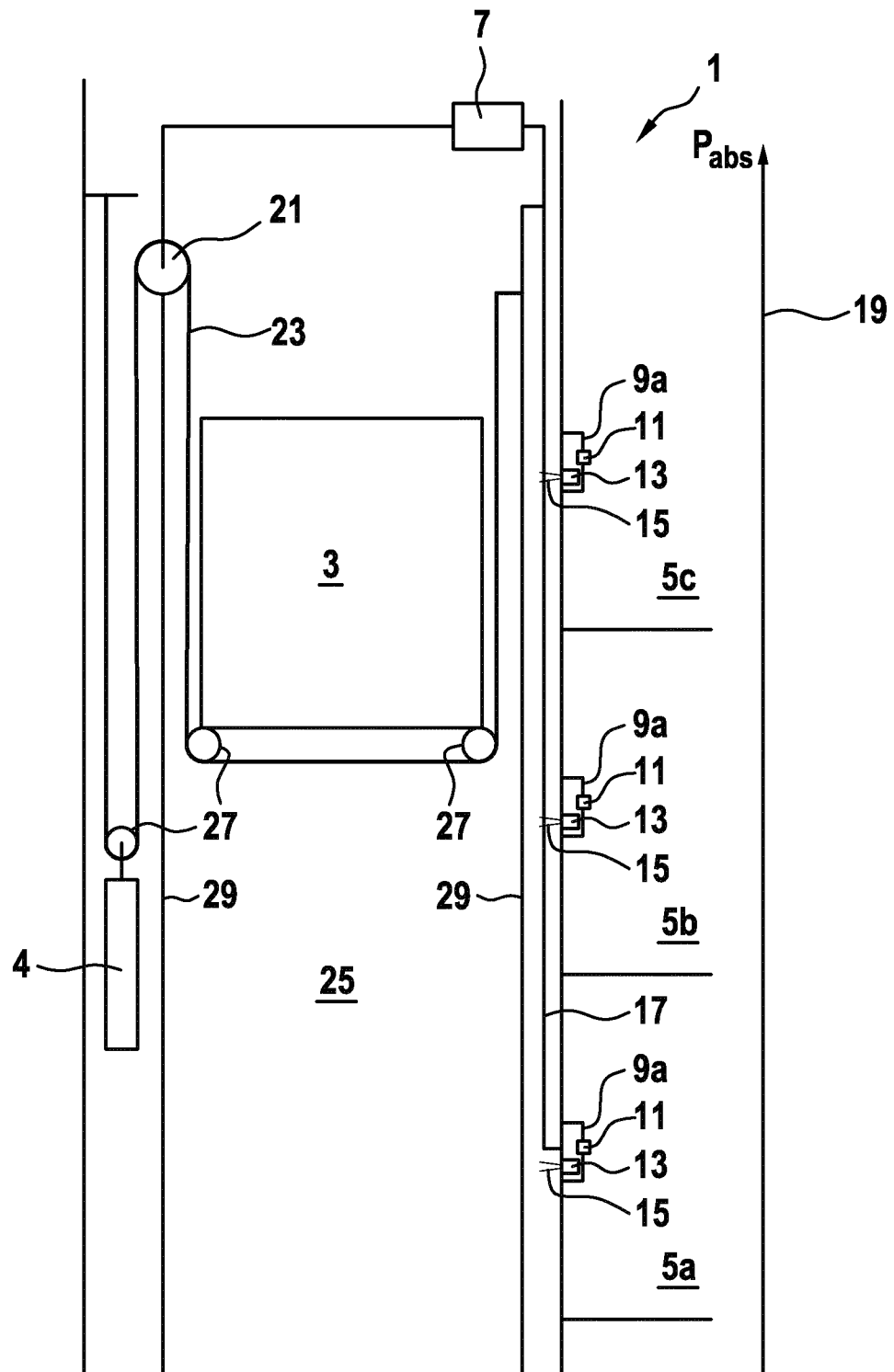
- a hard-wiring connection (17) between each one of the fixtures (9) and the elevator control (7).

- 5 6. Elevator arrangement of one of claims 1 to 3, wherein the elevator arrangement (1) is adapted such that, in the fixture position learning procedure, each pressure sensor (13) transmits information on a change (P_{rel}) in environmental pressure over time to the elevator control (7) and the elevator control (7) determines the position information for each of the fixtures (9) based on the transmitted information on the changes (P_{rel}) in environmental pressure over time.
- 10 7. Elevator arrangement of claim 6, wherein the elevator arrangement (1) is adapted such that, in the fixture position learning procedure, the cabin (3) is driven to each of the floors (5).
- 15 8. Elevator arrangement of one of claims 6 and 7, wherein, in determining the position information, the elevator control (7) takes into account an information on a current position of the elevator cabin (3).
- 20 9. Elevator arrangement of one of claims 6 to 8, wherein, in determining the position information, the elevator control (7) takes into account a time sequence with which an information on a similar change (P_{rel}) in environmental pressure over time is received by the elevator control (7) from each of the fixtures (9).
- 25 10. Elevator arrangement of one of the preceding claims, wherein the pressure sensor (13) is adapted to sense pressures (P_{abs} ; P_{rel}) with an accuracy of less than 1hPa.
- 30 11. Elevator arrangement of one of the preceding claims, wherein, in a normal operation mode, the elevator control (7) is adapted to identify each of the fixtures (9) based on the information stored for subsequent identification purposes during the fixture position learning procedure.
- 35 12. Elevator arrangement of one of the preceding claims, wherein the elevator arrangement (1) is adapted to executing the fixture position learning procedure automatically under control of the elevator control (7).

13. Method for determining position information for each of a plurality of fixtures (9) of an elevator arrangement (1), the fixtures (9) being located at various floors (5) within a building and each fixture (9) comprising a pressure sensor (13) for sensing at least one of an absolute environmental pressure (P_{abs}) and a change (P_{rel}) in environmental pressure over time, the method comprising:
- 5 determining a position information for each of the fixtures (9) located at each of the floors (5) based on the at least one of the absolute environmental pressure (P_{abs}) and the change (P_{rel}) in environmental pressure over time sensed by the pressure sensor (13) comprised in the fixture (9) located at the respective floor and storing the determined position
- 10 information for subsequent identification purposes for each of the fixtures (9).
14. Computer program product comprising computer readable instructions which are adapted to, when executed by a programmable elevator control (7), controlling the method of claim 13.
- 15 Computer readable medium comprising a computer program product of claim 14 stored thereon.

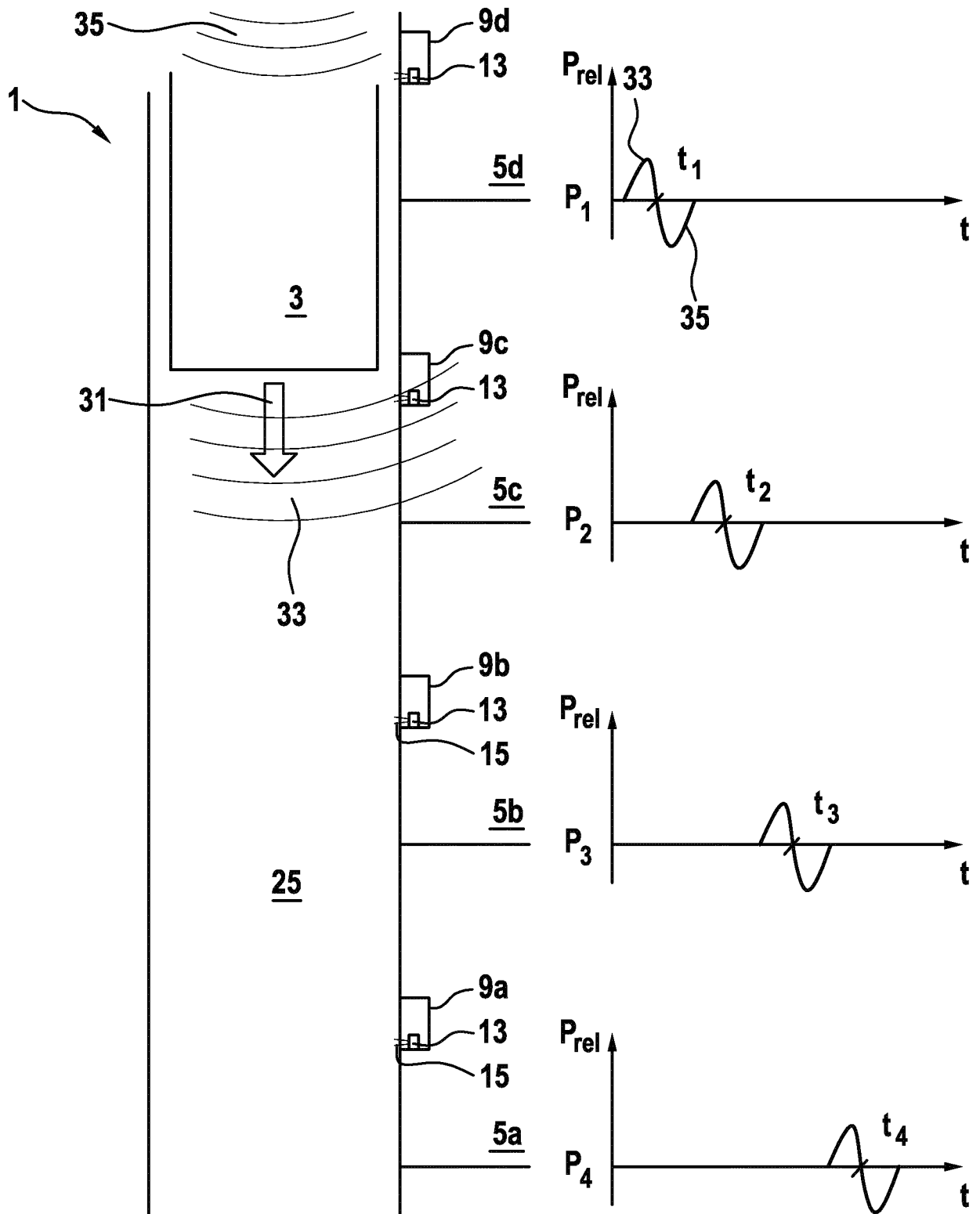
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Fig. 1



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Fig. 2



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Fig. 3

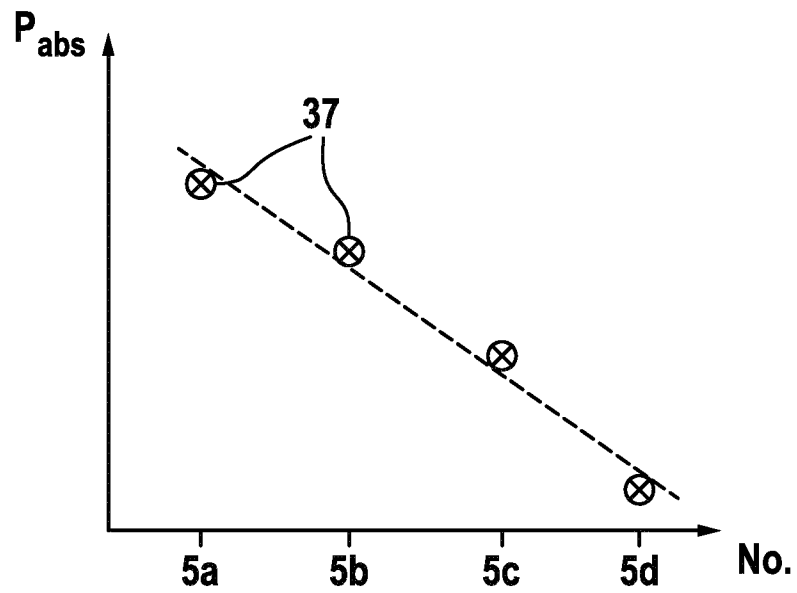
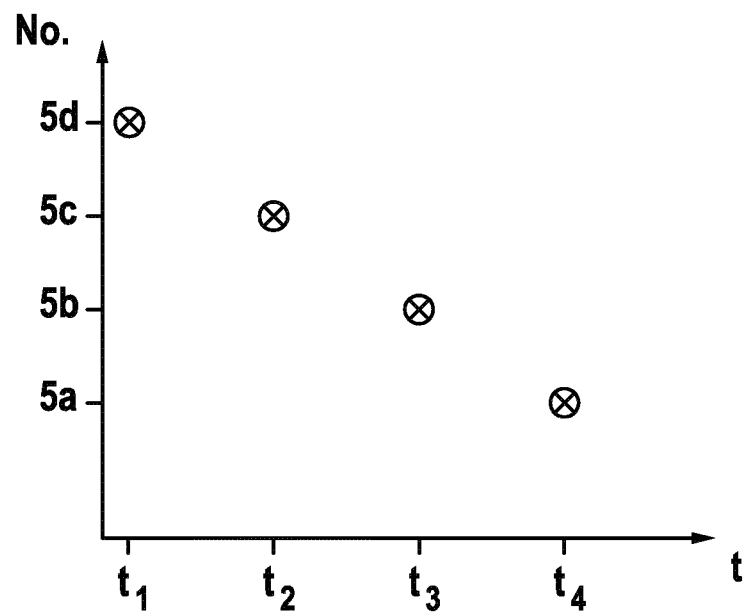


Fig. 4



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/067192

A. CLASSIFICATION OF SUBJECT MATTER
INV. B66B1/34
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B66B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 7 699 143 B2 (TSCHUEMPERLIN ERICH [CH] ET AL) 20 April 2010 (2010-04-20) cited in the application the whole document -----	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

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Date of the actual completion of the international search

29 September 2016

Date of mailing of the international search report

07/10/2016

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/067192

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