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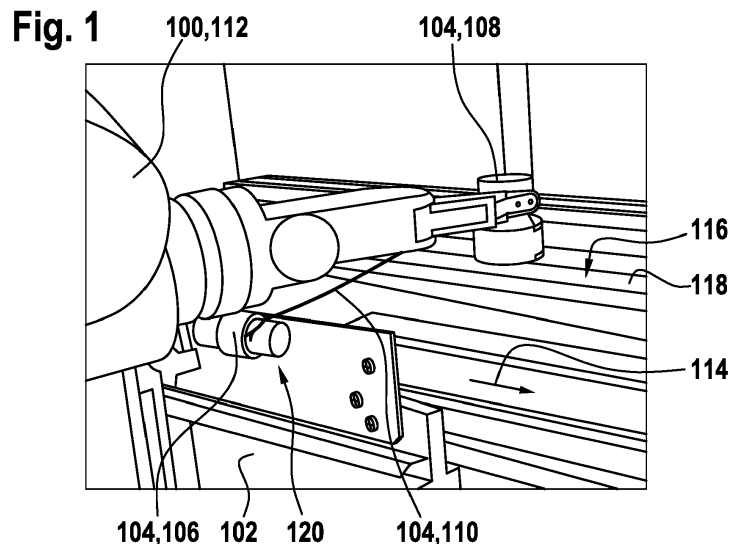
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(54) **METHOD OF OPERATING A LANDING DOOR OF AN ELEVATOR SHAFT AND DOOR OPENING TOOL FOR SUCH A DOOR**

(57) A method of operating a landing door (102) of an elevator shaft is proposed. The method comprises:
(i) manipulating a handle part (108) of an opening tool (104) comprising the handle part (108), a detachable part (106) reversibly attached to the handle part (108) and a tether (110) connecting the detachable part (106) and the handle part (108);
(ii) connecting the detachable part (106) to the landing door (102);
(iii) detaching the handle part (108) from the detachable part (106) and moving the handle part (108) away from

the detachable part (106) approximately in an opening direction (114) of the landing door (102), until the tether (110) is tensioned;
(iv) pulling the tethered detachable part (106) with the landing door (102) connected thereto by moving the handle part (108) further, until the landing door (102) is positioned at a desired position;
(v) holding the tether (110) tensioned and connecting the handle part (108) to a fixpoint (116), to keep the landing door (102) opened at the desired position.



Description

[0001] The present invention relates to a method of operating a landing door of an elevator shaft and to a door opening tool for a landing door of an elevator shaft.

[0002] An elevator has a car travelling inside an elevator shaft between connected floors of a building or a structure. The car has at least one car door. The elevator shaft has at least one landing door per connected floor. When the car stops in front of a landing door, a lock mechanism of the landing door is activated by the car and/or the car door and enables the landing door to open together with the car door. The landing door may be opened against a force generated by a closing mechanism such as a mechanical spring. The spring may support the closing of the landing door.

[0003] For maintenance or rescue purposes, the landing door may be opened when the car is situated at another floor. Therefore, the lock mechanism can be activated from outside of the elevator shaft with a specific tool or key. The landing door may then be opened against the force of the spring.

[0004] However, it has been found that for maintenance work it may be necessary to open landing doors from inside the elevator shaft.

[0005] Accordingly, there may be a need for an improved approach for operating a landing door of an elevator shaft. Furthermore, there may be a need for a door opening tool for a landing door of an elevator shaft being configured for establishing such approach.

[0006] Such needs may be met with the subject-matter of the independent claims. Advantageous embodiments are defined in the dependent claims and in the following specification.

[0007] According to a first aspect of the present invention, a method of operating a landing door of an elevator shaft is proposed. The method comprises at least the following steps, preferably in the indicated order:

- manipulating a handle part of an opening tool comprising the handle part, a detachable part reversible attached to the handle part and a tether connecting the detachable part and the handle part;
- connecting the detachable part to the landing door;
- detaching the handle part from the detachable part and moving the handle part away from the detachable part approximately in an opening direction of the landing door, until the tether is tensioned;
- pulling the tethered detachable part with the landing door connected thereto by moving the handle part further, until the landing door is positioned at a desired position;
- holding the tether tensioned and connecting the handle part to a fixpoint, to keep the landing door opened at the desired position.

[0008] According to a second aspect of the invention, a door opening tool for a landing door of an elevator shaft

is proposed. The tool comprises a detachable part, a handle part reversibly attachable to and detachable from the detachable part and a tether connecting the detachable part and the handle part. The detachable part comprises a first interface connectable to the landing door. The handle part comprises a second interface connectable to a fixpoint.

[0009] Ideas underlying embodiments of the present invention may be interpreted as being based, inter alia, on the following observations and recognitions.

[0010] As already briefly indicated above, a landing door of an elevator may be opened from inside a shaft of the elevator. The landing door may also be referred to as shaft door. During normal operation, the landing door may be opened and closed in conjunction with a car door of a car of the elevator. The landing door may be spring-loaded or weight-loaded and a certain amount of force may be required to move the door against the spring or weight. The force may also be necessary to keep the landing door open. During normal operation, the force may be provided by a motor of the car door.

[0011] The landing door may also be opened without connecting the car door to the landing door. The landing door may be opened by applying the necessary force to the landing door. The force may be applied at an interface of the landing door. The interface may be a specified force application point. The interface may be configured to transmit the necessary force into the door. The interface may be identical to an interface for connecting to the car door. The interface may also be specific for an opening tool.

[0012] The opening tool may be configured to match the interface. The opening tool may be configured to connect to the landing door and transmit the force to the landing door. The opening tool may be dividable in two components or parts. The components may be linked by a tether. The tether may be a rope, chain, webbing or similar. Each end of the tether may be connected to one of the components. The tether may be rolled up at one or more of the components, using a spring-loaded spool. One (first) component may stay connected to the landing door while the other (second) component is moved away, and the tether is extended between the components. The tether may be configured to transmit the force in a tensioned state. Until the tether is extended or tensioned, no force may be transmitted. The tether may transmit the force along a direction of its extension. The direction of extension may roughly match an opening direction of the landing door. The direction of extension may also be acute angled to the opening direction. Preferably, an angle between the direction of extension of the tensioned tether and the opening direction of the landing door is less than 50°, more preferably less than 30°. The handle part may be moved for an extension of the tether before the force may be applied. After the force is applied, the handle part may be moved on until the landing door is opened to a desired aperture or opening width. The handle part may then be connected to a fixpoint of the ele-

vator shaft.

[0013] The fixpoint may be part of a frame of the landing door. The fixpoint may also be part of a rail system of the elevator. The term "fixpoint" shall be interpreted broadly as referring to an area or portion at which the handle part may be stably and reversibly attached such as to transmit the forces generated at the tether to a fix structure of the elevator, particularly a fix portion of the landing door.

[0014] The landing door may have a lock mechanism. The interface may be located at the lock mechanism. The detachable part may be connected to the lock mechanism. The lock mechanism may be unlocked by tensioning the tether. The landing door may be opened after the lock mechanism is unlocked. The opening tool may be attached to the lock mechanism and the lock mechanism may be operated when the tether is tensioned. The unlocked lock mechanism may then transmit the force to the landing door.

[0015] Maintenance work is manpower intensive and routine maintenance work may alternatively be done by a robot. The robot may be temporally mounted on top the car and may be transported by the car from floor to floor. The robot may use the opening tool to open landing doors and keep an opened landing door open.

[0016] In principle, the robot could have a door opening arm and a working arm. The door opening arm could deactivate the lock mechanism and then move aside the landing door until it reaches a necessary opening width for the planned maintenance. The door opening arm would then be occupied by keeping the door open for a duration of the maintenance. The door opening arm would generally be unable to participate in the maintenance.

[0017] However, e.g. for cost reasons and/or for reducing complexity, it could be preferred to use a robot having only a single arm.

[0018] When using a robot with a single actuator arm exclusively the handle part may be manipulated or handled by the robot. The handle part may comprise a handling interface for the robot. The handling interface may be a specific gripping area for gripping the handle part with a robot claw of a manipulator robot arm. The handling interface may also be shaped to fit a counterpart on the robot. The handling interface may have target markers to facilitate coupling with the robot.

[0019] A movement of the handle part may be transmitted to the detachable part via a rigid connection between the handle part and the detachable part while connecting the detachable part to the landing door. The detachable part may be connected to the landing door while being connected to the handle part. The detachable part and the handle part may be moved towards the landing door and its interface together. The handle part may be manipulated directly. The detachable part may be manipulated indirectly via an inter-component interface of the detachable part and the handle part.

[0020] The inter-component interface may comprise an alignment geometry configured to align the detachable

part to the handle part in a connecting process. The alignment geometry may also provide form closure via positive form locking. The detachable part and the handle part may be magnetically connected via at least one magnet. The magnet may be configured to rigidly connect the detachable part to the handle part. A connecting force of the magnet may be strong enough to handle the detachable part while being connected to the handle part. The connecting force may be substantially smaller than the force necessary to open the landing door. This way, the handle part detaches itself from the detachable part before the landing door is pulled open.

[0021] The detachable part may be mechanically connected to the landing door with positive form locking. The detachable part may be hooked to the landing door. The interface between the landing door and the detachable part may create form closure between the detachable part and the landing door or the lock mechanism. For example, the landing door or the lock mechanism may have at least an opening or protrusion that matches an opening or protrusion of the detachable part.

[0022] The first interface may comprise a keyhole opening with a wide part and a laterally offset narrow part. The wide part may be configured to pass over a protruding roller of the landing door. The narrow part may be configured to slide behind the roller. A roller of the landing door may be part of the lock mechanism. During normal operation, the roller may roll onto an angled surface of the car or car door and be moved by the car and/or the car door while the car is aligned with the landing door. The motion of the roller may deactivate the lock mechanism and unlock the landing door. The roller may protrude into the elevator shaft. The roller may be easily reachable by the robot.

[0023] The handle part may be magnetically connected to the fixpoint. The second interface may comprise a base with a magnet, especially a strong magnet. The magnet may create enough friction between the base and the fixpoint to counteract the closing force of the landing door. The fixpoint may be a ferromagnetic object inside the elevator shaft. The fixpoint may be a metal plate. The handle part may be freely positioned on a surface of the fixpoint to accommodate different positions of the landing door. The base may have a friction enhancing material, for example a rubber or silicone material to create the necessary friction between the fixpoint and the base. The magnet in the base may also be part of the inter-component interface to connect the detachable part and the handle part. The base may be turned around during the movement from the detachable part to the fixpoint.

[0024] The handle part may be released after connecting to the fixpoint. The robot may let go of the handle part after opening the landing door. Thus, in this case the handle part is released after connecting to the fixpoint by the robot. Then the robot may carry out maintenance work with its single arm. After completion of the maintenance work, the robot may grab the handle part again

and close the landing door.

[0025] To close the opened landing door after performing the maintenance, the handle part may be detached from the fixpoint and may be moved approximately against the opening direction until the landing door is in a closed position and the tether is detensioned. The handle part may be connected to the detachable part and the joined opening tool may be disconnected from the landing door. The handle part and the detachable part may be disconnected from the landing door together. The two components may be rigidly joined at their intercomponent interface. The detachable part may be handled in conjunction with the handle part. Movements introduced into the handle part may be transferred into the detachable part via the rigid connection of the intercomponent interface.

[0026] The detachable part, while still being attached to the landing door, may be rotated into a vertical orientation by detensioning the tether. The handle part may then be arranged below the vertically oriented detachable part and may be moved upwards against the detachable part, to connect the detachable part and the handle part. The detachable part may be rotated by gravity. To facilitate the rotation, the detachable part may comprise an off-center weight in the proximity of the intercomponent interface. The weight may be a magnet of the intercomponent interface. When the detachable part is connected to the handle part, the detachable part may be lifted of the landing door or the lock mechanism.

[0027] It shall be noted that possible features and advantages of embodiments of the invention are described herein partly with respect to a method for operating a landing door of an elevator shaft and partly with respect to a door opening tool configured for implementing such method. One skilled in the art will recognize that the features may be suitably transferred from one embodiment to another, and features may be modified, adapted, combined and/or replaced, etc. in order to come to further embodiments of the invention. 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.

Fig. 1 shows a robot operating a landing door utilizing a door opening tool in accordance with an embodiment of the present invention;

Fig. 2 shows a detachable part of a door opening tool in accordance with an embodiment of the present invention;

Fig. 3 shows a handle part of a door opening tool in accordance with an embodiment of the present invention; and

Fig. 4 shows a connected door opening tool in accordance with an embodiment of the present inven-

tion.

[0028] The figures are only schematic and not to scale. Same reference signs refer to same or similar features.

[0029] Fig. 1 shows a robot 100 operating a landing door 102 utilizing a door opening tool 104 in accordance with an embodiment of the present invention. The door opening tool 104 comprises a detachable part 106, a handle part 108, that is detachable and reconnectable to the detachable part 106 and a tether 110 connecting the detachable part 106 and the handle part 108. When the handle part 108 and the detachable part are joined, a rigid connection between both parts results. Movements introduced into the handle part 108 are directly transferred into the detachable part 106 so that the handle part 108 and the detachable part 106 can be handled as a stiff unit.

[0030] The robot 100 has one manipulator arm 112. The manipulator arm 112 has a gripping claw. The gripping claw grips the handle part 108 at a gripping interface of the handle part 108. To open the landing door 102, the manipulator arm 112 connects the detachable part 106 to the landing door 102 while the detachable part 106 and the handle part 108 are connected. Then the manipulator arm 112 pulls on the handle part 108. Once a connection force between the handle part 108 and the detachable part 106 is exceeded, the handle part 108 separates from the detachable part 106. The detachable part 106 stays on the landing door 102. The disconnected detachable part 106 is held in a vertical position by gravity.

[0031] The manipulator arm 112 moves the handle part 108 away from the detachable part 106 approximately in an opening direction 114 of the landing door 102 to tension the tether 110. By tensioning the tether 110, the detachable part 106 is rotated into a pulling position approximately aligned to an extension of the tether 110.

[0032] After the tether 110 is tensioned, the manipulator arm 112 moves the handle part 108 further. The tether 110 transfers a pulling force of the robot 100 to the detachable part 106. The detachable part 106 transfers the pulling force to the landing door 102 and pulls the landing door 102 open.

[0033] The manipulator arm 112 moves the handle part 108 until the landing door 102 has reached a desired position or opening width. Then the manipulator arm 112 affixes the handle part 108 to a fixpoint 116.

[0034] Here, the fixpoint 116 is a static part of a frame 118 of the landing door 102. After affixing the handle part 108 to the fixpoint, the manipulator arm 112 releases the handle part 108 and carries out maintenance work on the landing door 102 and/or the frame 118. The tensioned tether 110 keeps the landing door 102 open in the meanwhile.

[0035] To reclose the landing door 102, the process is repeated reversely. The manipulator arm 112 grabs the handle part 108, disconnects the handle part 108 from the fixpoint 116 and moves the handle part 108 approx-

imately against the opening direction 114 until the landing door 102 reaches a closed position and the tether 110 is detensioned.

[0036] Gravity rotates the detachable part 106 back into the vertical position. Subsequently the manipulator arm 112 moves the handle part 108 to a coupling position underneath the detachable part 106. By moving the handle 108 part upwards, both components 106, 108 are coupled.

[0037] The manipulator arm 112 then moves the handle part 108 with the attached detachable part 106 further upwards and then away from the landing door 102, to disconnect the detachable part from the landing door 102.

[0038] In an embodiment, the detachable part 106 is connected to a lock mechanism 120 of the landing door 102. When the tether 110 is tensioned, the lock mechanism 120 is operated and the landing door 102 is unlocked.

[0039] In an embodiment, the lock mechanism 120 must move upward in an arc-shaped unlocking motion to reach an unlocked position. To facilitate the operation of the lock mechanism 120, the handle part 108 is moved higher than the lock mechanism 120 while being moved in the opening direction 114. This way the tensioned tether 110 exerts a force with an upward component to the lock mechanism 120 and less force is necessary to execute the unlocking motion. The tensioned tether 110 keeps the lock mechanism 120 in its unlocked position while the landing door 102 is pulled and kept open.

[0040] Fig. 2 shows a detachable part 106 of a door opening tool 104 in accordance with an embodiment of the present invention. The door opening tool 104 essentially corresponds to the door opening tool in Fig. 1. The detachable part 106 has a first interface 200 to connect the detachable part 106 to a force application point of the landing door or a locking mechanism of the landing door. The first interface 200 is a mechanical interface creating a form closure with the force application point.

[0041] In an embodiment, the first interface 200 has a keyhole opening 202. The keyhole opening 202 has a wide part 204 and a laterally offset narrow part 206. The wide part 204 is configured to fit over a protrusion of the landing door or a locking mechanism of the landing door. The protrusion has a wide end and an undercut. The narrow part 206 is configured to slide behind the wide end of the protrusion and create positive locking with the protrusion. In particular, the protrusion may be a roller of the landing door or the locking mechanism.

[0042] In an embodiment, the detachable part 106 has an intercomponent interface 208 to connect the detachable part 106 to the handle part of the door opening tool 104. The intercomponent interface 208 comprises an alignment geometry 210 to align the detachable part 106 to the handle part in a connection process. The alignment geometry 210 consists of two protrusions configured to fit into two matching depressions of the handle part.

[0043] In an embodiment, the intercomponent inter-

face 208 has two magnets 212 to create a magnetic connection to the handle part.

[0044] In an embodiment, the detachable part 106 has a trough hole 214 for the tether. The tether may be threaded through the through hole 214 and knotted onto itself to fix the tether to the detachable part 106.

[0045] Fig. 3 shows a handle part 108 of a door opening tool 104 in accordance with an embodiment of the present invention. The door opening tool 104 essentially corresponds to the door opening tool in Fig. 1. The handle part 108 has an essentially rotationally symmetric body and comprises a second interface 300 to connect the handle part 108 to a fixpoint. The second interface 300 comprises a wide base 302 with a flat surface 304 and a strong magnet 212. The strong magnet 212 is embedded in the base 302 behind the flat surface 304. The flat surface 304 provides a contact area to the fixpoint. The magnetic force of the magnet 212 creates friction between the base 302 and the fixpoint.

[0046] In an embodiment, at least a part of the flat surface 304 has a non-slip material to enhance the friction.

[0047] In an embodiment, the second interface 300 is configured to be part of the intercomponent interface 208. Since the handle part 108 is either connected to the fixpoint or the detachable part, the magnet 212 may have dual purpose. Here, the alignment geometry 210 in form of two depressions for the protrusions protruding from the detachable part is integrated into the flat surface 304 of the base 302. The depressions also have insertion slopes to facilitate the alignment of the detachable part and the handle part 108. To join the handle part 108 and the detachable part, the handle part 108 is rotated such that the second/intercomponent interface 300, 208 faces the detachable part. To affix the handle part 108 to the fixpoint, the handle part 108 is rotated such that the second/intercomponent interface 300, 208 faces the fixpoint.

[0048] In an embodiment, the handle part 108 has a handling interface 306. The handling interface 306 has at least two parallel gripping surfaces 308 for a robot claw. The gripping surfaces 308 enable a defined gripping position for an accurate coupling of the handle part 108 to the detachable part. The gripping surfaces 308 are located on opposing sides of the body of the handle part 108. The gripping surfaces 308 are aligned at right angles to the base of the second interface 300.

[0049] In an embodiment, the handle part 108 has a through hole 214 for the tether. The tether may be threaded through the through hole 214 and knotted onto itself to fix the tether to the handle part 108.

[0050] Fig. 4 shows a connected door opening tool 104 in accordance with an embodiment of the present invention. Here a detachable part 106 similar to the detachable part in Fig 2 and a handle part 108 similar to the handle part in Fig 3 are joined at the intercomponent interface 208. The detachable part 106 and the handle part 108 are connected by the detensioned tether 110. As in Fig. 3 the intercomponent interface 208 of the handle part 108 is part of the second interface 300. The detachable

part 106 is aligned to the handle part 108 by the alignment geometry of the intercomponent interface 208.

[0051] The door opening tool 104 is ready to be picked up by the robot. The first interface 200 is oriented perpendicular to the gripping surfaces 308, so that the robot may place the first interface 200 directly onto the force application point of the landing door.

[0052] Following hereinafter, possible implementations, details and advantages of embodiments of the method and device presented herein will be described once more with a slightly different wording.

[0053] The presented approach enables a single robot arm to open and lock an elevator door in open position. Leaving the door open enables the robot to do specific work on the door and would conventionally necessitate two arms.

[0054] The tool is used by a robot arm with one hand to open and lock elevator doors during maintenance. The door it works on is the one on the wall, not the one on the elevator cart.

[0055] The tool is made of three parts. A "ring" element to put around the roller of the lock, a base element with a magnet strong enough to be static on a metal component, but removable by the robot, and a rope between the two elements.

[0056] The ring element and the base element can be connected through a system of magnets to allow the robot to remove the ring element from the roller while holding the base element. Furthermore, the base element has a stronger magnet to give enough force to put it on a metal plate so that it does not go off unless the robot removes it.

[0057] The ring element has a passive locking system to stay on the roller and move the lock in an unlock position, allowing the door to be opened when the rope is pulled. By putting the base element on a static metal plate, the door is locked open by the robot.

[0058] To close the door, the inverse process is used.

[0059] Essential features of the presented approach include an adaptive mechanism to lock around a roller and enable upward motion by pulling of rope and a magnetic system to join and separate the two parts of the tool using only one robot arm.

[0060] To open the door, the robot grabs the base element. The base element and the ring element are linked by one or more magnets. The robot detects the roller using machine learning and puts the ring element around it. The robot pulls the base element away, disconnecting it from the ring element. The robot then moves the base element slightly up and pulls it away. Thanks to the rope between both elements and the passive alignment and lock system of the ring element, the lock of the door switches to the unlock position. The base element is then put on a static metal plate where its large magnet and the friction created by the magnet case allows it to stay without movement.

[0061] The robot can then perform tasks, such as cleaning of the rails.

[0062] Once the tasks are done, the robot grabs the

base element and moves it away from the metal plate. The robot brings the base element back to the roller and the ring element where the smaller magnet of the ring element enables the two parts to become one again.

[0063] The robot arm can now remove the ring element from the roller simply by moving the base element again.

[0064] The presented approach enables the use of a single robot arm, lowering the cost of operation and technique. Furthermore, no coordination of two robot arms is needed anymore. Thus, a broad range of possible tasks to be done is enabled. The use of a robot with one arm saves space when collaborating with fitters in the shaft and reduces the risk of accidents.

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

Claims

1. Method of operating a landing door (102) of an elevator shaft, wherein the method comprises:

- (i) manipulating a handle part (108) of an opening tool (104) comprising the handle part (108), a detachable part (106) reversible attached to the handle part (108) and a tether (110) connecting the detachable part (106) and the handle part (108);
- (ii) connecting the detachable part (106) to the landing door (102);
- (iii) detaching the handle part (108) from the detachable part (106) and moving the handle part (108) away from the detachable part (106) approximately in an opening direction (114) of the landing door (102), until the tether (110) is tensioned;
- (iv) pulling the tethered detachable part (106) with the landing door (102) connected thereto by moving the handle part (108) further, until the landing door (102) is positioned at a desired position;
- (v) holding the tether (110) tensioned and connecting the handle part (108) to a fixpoint (116), to keep the landing door (102) opened at the desired position.

2. Method of claim 1, wherein exclusively the handle part (108) is manipulated by a robot (100), the robot preferably having a single actuator arm.

3. Method of one of the preceding claims, wherein a movement of the handle part (108) is transmitted to the detachable part (106) via a rigid connection be-

- tween the handle part (108) and the detachable part (106) while connecting the detachable part (106) to the landing door (102).
4. Method of one of the preceding claims, wherein the detachable part (106) is mechanically connected to the landing door (102) with positive form locking. 5
 5. Method of one of the preceding claims, wherein the handle part (108) is magnetically connected to the fixpoint (116). 10
 6. Method of one of the preceding claims, wherein the handle part (108) is released after connecting to the fixpoint (116). 15
 7. Method of one of the preceding claims, wherein the detachable part (106) is connected to a lock mechanism (120) of the landing door (102), wherein the lock mechanism (120) is unlocked by tensioning the tether (110) and the landing door (102) is opened after the lock mechanism (120) is unlocked. 20
 8. Method of one of the preceding claims, wherein to close the opened landing door (102), the handle part (108) is detached from the fixpoint (116) and is moved approximately against the opening direction (114) until the landing door (102) is in a closed position and the tether (110) is detensioned, wherein the handle part (108) is connected to the detachable part (106), wherein the handle part (108) and the detachable part (106) are disconnected from the landing door (102) together. 25 30
 9. Method of claim 8, wherein the detachable part (106), still attached to the landing door (102), is rotated into a vertical orientation by detensioning the tether (110), wherein the handle part (108) is arranged below the vertically oriented detachable part (106) and moved upwards against the detachable part (106), to connect the detachable part (106) and the handle part (108). 35 40
 10. Method of one of the claims 8 or 9, wherein the detachable part (106) and the handle part (108) are magnetically connected. 45
 11. Door opening tool (104) for a landing door (102) of an elevator shaft, the door opening tool comprising a detachable part (106), a handle part (108) reversibly attachable to and detachable from the detachable part (106) and a tether (110) connecting the detachable part (106) and the handle part (108), wherein the detachable part (106) comprises a first interface (200) connectable to the landing door (102) and the handle part (108) comprises a second interface (300) connectable to a fixpoint (116). 50 55
 12. Door opening tool (104) of claim 11, wherein the first interface (200) comprises a keyhole opening (202) with a wide part (204) and a laterally offset narrow part (206), wherein the wide part (204) is configured to pass over a roller of the landing door (102) and the narrow part (206) is configured to slide behind the roller.
 13. Door opening tool (104) of one of the claims 11 to 12, wherein the handle part (108) comprises a handling interface (306) for a robot (100).
 14. Door opening tool (104) of one of the claims 11 to 13, wherein the second interface (300) comprises a base (302) with a magnet (212).
 15. Door opening tool (104) of to one of the claims 11 to 14, wherein an inter-component interface (208) of the detachable part (106) and the handle part (108) comprises an alignment geometry (210) configured to align the detachable part (106) to the handle part (108) in a connecting process.
 16. Door opening tool (104) of to one of the claims 11 to 15, wherein an inter-component interface (208) of the detachable part (106) and the handle part (108) comprises at least one magnet (212) configured to rigidly connect the detachable part (106) to the handle part (108).

Fig. 1

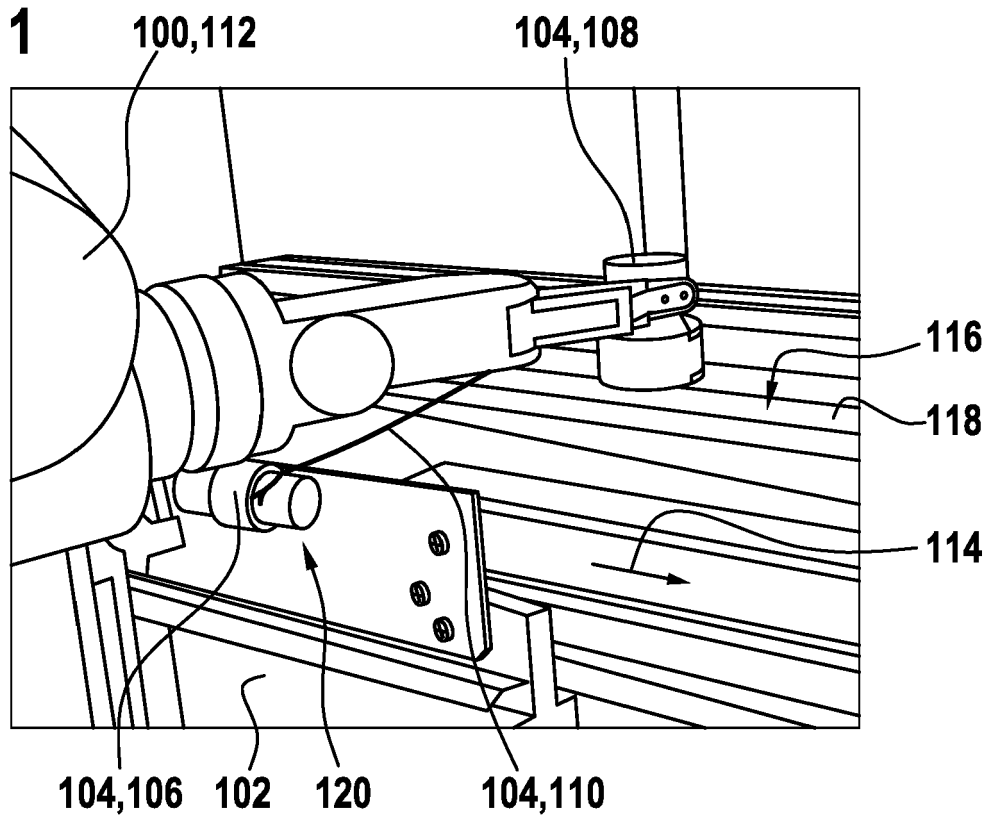


Fig. 2

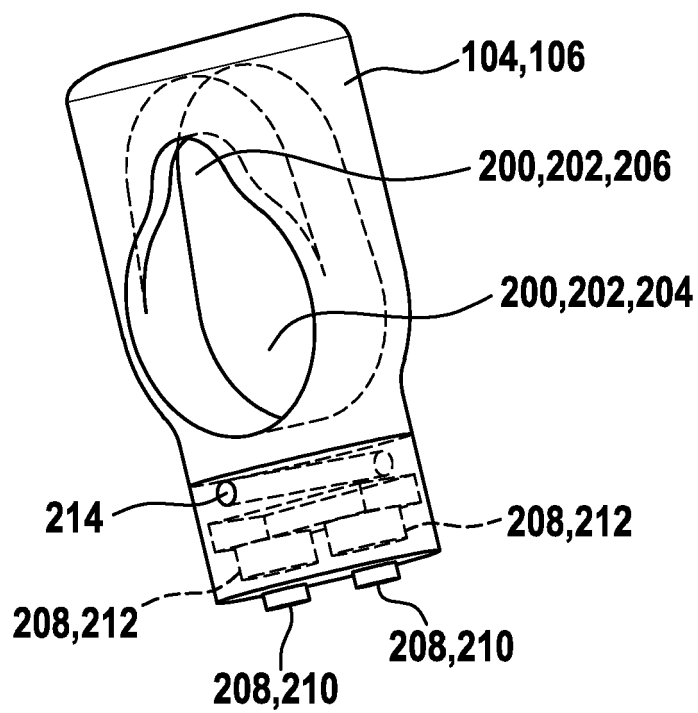


Fig. 3

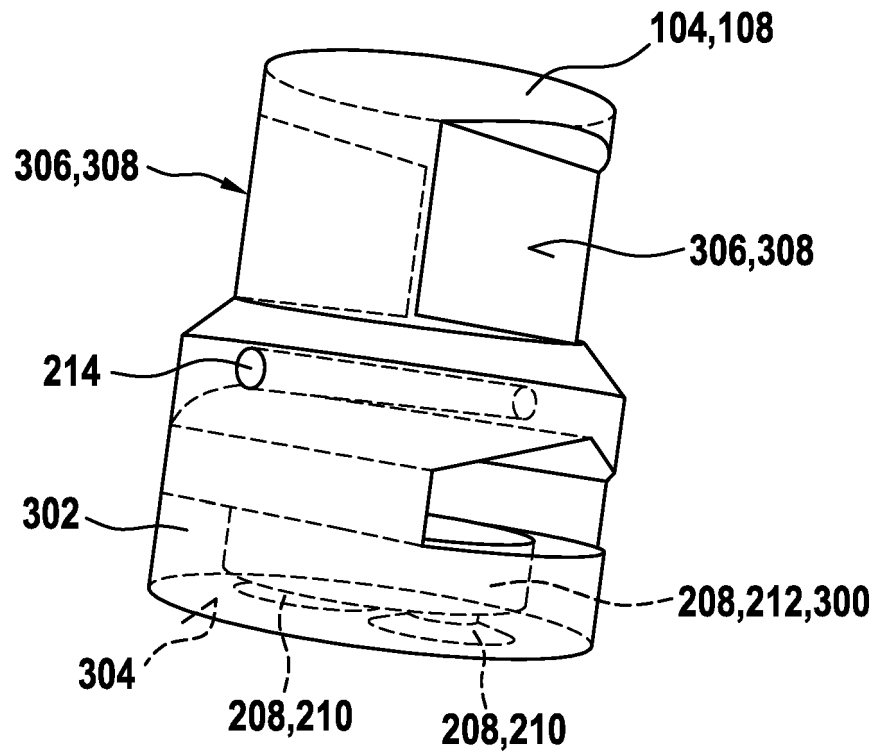
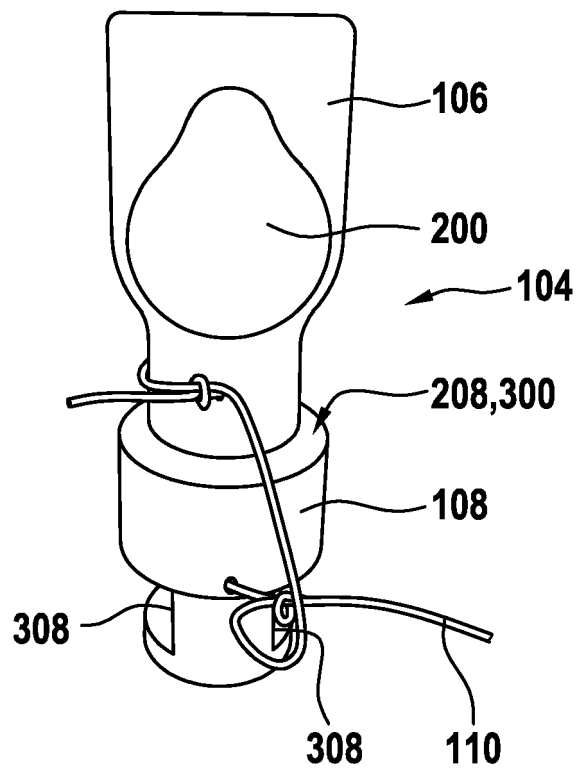


Fig. 4





EUROPEAN SEARCH REPORT

Application Number

EP 23 18 9353

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 6 827844 B2 (MITSUBISHI ELECTRIC BUILDING TECHNO SERVICE CO LTD) 10 February 2021 (2021-02-10) * abstract * * paragraphs [0018] - [0066] * * figures 3 - 8 * -----	1-16	INV. B66B5/00 B66B13/16
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EPO FORM 1503 03:82 (P04C01)

Place of search	Date of completion of the search	Examiner
The Hague	12 December 2023	Dogantan, Umut H.
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		

**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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