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(54) METHODS AND SYSTEMS FOR TESTING A FALL ARREST DEVICE

(57) A testing system (1) for testing a fall arrest device (130) of an elevator system (100) is provided. The testing system comprises a supporting structure (10), a safety wire (20) extending up and down with respect to the supporting structure, a counterweight (30) connected to the safety wire, and a traction element (40) connected to the counterweight (30) and configured to be pulled from above the supporting structure. The testing system (1) may be configured to release the tension on the safety wire (20) when the counterweight (30) is lifted. An elevator system (100) comprising a testing system (1) according to any of the examples herein described is also provided. Methods for testing a fall arrest device of an elevator system and methods for retrofitting elevator systems are also disclosed.

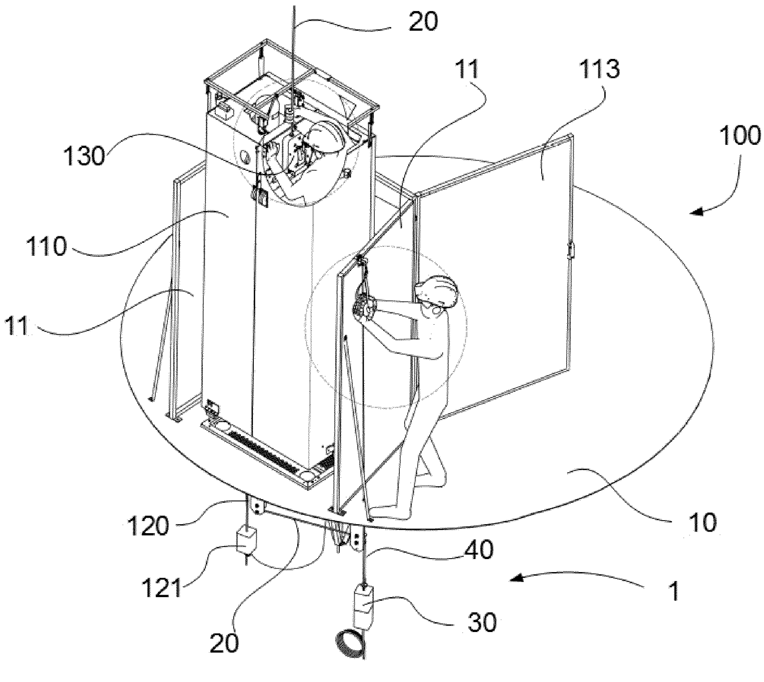

Figure 4

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Description

[0001] The present disclosure relates to a system for testing a fall arrest device of an elevator system, an elevator system comprising a system for testing a fall arrest device and further relates to methods for testing a fall arrest device and for retrofitting elevator systems.

BACKGROUND

[0002] Modern wind turbines are commonly used to supply electricity into the electrical grid. Wind turbines generally comprise a rotor mounted on top of a wind turbine tower, the rotor having a rotor hub and a plurality of blades. The rotor is set into rotation under the influence of the wind on the blades. The operation of the generator produces the electricity to be supplied into the electrical grid.

[0003] When maintenance works are required inside wind turbines, hoists are often used in the form of elevator-like structures where a lift platform or a cabin for the transportation of people and/or equipment is hoisted up and/or down within the wind turbine tower. Wind turbines are often provided with working platforms arranged at various heights along the height of the tower with the purpose of allowing workers to leave the cabin and inspect or repair equipment where intended.

[0004] Elevator systems, in general, include an elevator cabin suspended within a hoistway or elevator shaft by wire ropes. The term wire rope is herein used to denote a relatively thick cable. But in the art, the terms cables and wire ropes are often used interchangeably. In some systems, e.g. for some electric elevators, a counterweight may be provided depending on e.g. the available space. Other systems normally do not comprise a counterweight.

[0005] The service elevators may incorporate some form of traction device mounted on or attached to the elevator. The traction device may comprise a housing including a traction mechanism, e.g. a motor driven traction sheave. The motor may typically be an electrical motor, although in principle other motors could be used.

[0006] Service elevators may further incorporate an electromagnetic brake. In addition to this brake, a "secondary safety device" or "fall arrest device" can be mounted on or attached to the elevator cabin, directly or through supporting structures. Such a fall arrest device serves as a back-up for the main electromagnetic brake for example in case of failure of the service elevator or breakdown of the traction wire rope. The fall arrest device may typically incorporate some form of sensing mechanism to monitor the elevator's speed. The secondary safety device or the fall arrest device may automatically block the elevator and inhibit any further downward movement if the sensing mechanism detects an overspeed of the elevator cabin, i.e. when the elevator cabin might be falling. The speed detection mechanism in this sense acts as an overspeed detector.

[0007] A hoisting wire rope of the service elevator or a dedicated safety wire rope may pass through an entry hole in the safety device, through the interior of the safety device and exit the safety device through an exit hole at an opposite end. Some form of clamping mechanism for clamping the hoisting wire rope or the safety wire rope when an unsafe condition exists (i.e. when the overspeed detector trips) may be incorporated in the safety device.

[0008] Fall arrest devices, when fitted to an appropriate wire rope, can be of the type that comprises internal rollers and a clamping mechanism (e.g. involving clamping jaws) which closes onto the safety wire rope. A safety wire and a safety wire rope are herein used interchangeably. These devices may comprise a centrifugal overspeed detector.

[0009] Such an overspeed detector may be provided inside the housing of the fall arrest device and may comprise a driven roller coupled with movable parts that are forced outwardly as the roller rotates when it is driven by the safety wire rope passing along it. A pressure roller ensures the contact between the safety wire rope and the driven roller of the centrifugal overspeed detector. If the safety wire passes through the safety device too rapidly, the brake trips and the jaws clamp onto the wire, thus blocking the safety device on the wire rope by the frictional pressure exerted by the clamping jaws onto the wire.

[0010] Blocking the safety device has to be fast enough for adequately stopping the elevator cabin when an overspeed is detected. Therefore, the fall arrest device needs to be precisely calibrated.

[0011] Fall arrest devices are therefore periodically inspected to detect operation failures. Before using the elevator system, checking the correct functioning of the fall arrest device may be required or at least recommended. A fall arrest device may be checked by performing an acceleration test. In an acceleration test, a fall of the elevator cabin is simulated and the fall arrest device is thus forced to act. The safety wire is forced to pass through the safety device sufficiently fast for activating the jaws. The safety wire is clamped by the jaws and the fall arrest device thus blocks the safety wire.

[0012] It is known to perform an acceleration test by disconnecting the fall arrest device from the elevator cabin, raising it and dropping it along the safety wire. If it works properly, the fall arrest is stopped when a sufficient relative speed between the fall arrest device and the safety wire is reached. However, performing this test requires disconnecting the fall arrest device from the elevator cabin and then connecting it again. As the fall arrest has to be securely connected to the elevator cabin, connecting and disconnecting operations may require a relatively long time. In addition, repeating these operations can cause assembly errors.

[0013] Another known method for performing an acceleration test involves disconnecting a tensioning spring attached below the bottom landing platform of the elevator system from the safety wire, uncoiling the end of the safety wire, removing two wire rope locks which fix the spring in a tensioned position and sliding down the spring by the safety wire. As a result, the tension on the safety wire is released. Then an operator grabs the safety wire in a position above the fall arrest device and performs a fast hard jerk. A fast relative movement between the safety wire and the fall arrest device is thus produced. If the fall arrest device blocks the safety wire before passing through it a predetermined distance, for example approximately 12 centimeters, the fall arrest works correctly. After that, the tensioning spring is again fixed by the two wire locks in the tensioned position and provides tension to the safety wire. However, this method requires a long time for connecting and disconnecting the tensioning springs and an operator has to go beneath the bottom landing platform of the elevator system for performing these connecting and disconnecting operations. Therefore, this method requires operators working in an uncomfortable position. As in other known methods, repeating connecting and disconnecting operations may cause assembly errors. In addition, this method may require disconnecting the wind turbine from the electrical power grid. In some wind farms, wind turbines are not individually connected to the electrical power grid and disconnecting one wind turbine may therefore imply disconnecting other wind turbines from the electrical power grid. Consequently, the energy output of the wind farm may be reduced.

[0014] As these known methods require a relatively long time, some elevator users can be tempted to use the elevator system without previously performing an acceleration test. Therefore, the safety of the elevator users and of the whole elevator system may be compromised.

[0015] The present disclosure provides examples of systems and methods that at least partially resolve some of the aforementioned disadvantages.

[0016] Service elevators and related safety devices such as fall arrest devices and testing system are not only used in wind turbine towers, but instead may be found in many different sites and structures.

SUMMARY

[0017] In a first aspect, a testing system for testing a fall arrest device of an elevator system is provided. The testing system comprises a supporting structure; a safety wire configured to run through a fall arrest device of an elevator system and extending upwards and downwards with respect to the supporting structure; and a counterweight connected to the safety wire and arranged below the supporting, i.e. at a lower height than the supporting structure. Furthermore, the testing system comprises a traction element for lifting the counterweight extending from a first end to a second end, the first end being connected to the counterweight and the second end being arranged above the supporting structure, i.e. at a height above the supporting structure, and being configured to be pulled from above the supporting structure. The system is further configured to release the tension on the safety wire when the counterweight is lifted by pulling the traction element.

[0018] In this aspect, the system allows testing a fall arrest device of an elevator system, e.g. an acceleration test, in a quick and safe way since the tension on the safety wire may be easily released by pulling the traction element connected to the counterweight from above the supporting structure. As the safety wire is not tensioned, the safety wire may be quickly pulled up and this quick movement of the safety wire with respect to the fall arrest device activates the blocking system of the fall arrest device.

[0019] As a result, the risk of not testing the fall arrest device before using the elevator is reduced, and the safety of the operators inside towers may thus be improved. In addition, as the system allows testing the fall arrest device in a very short time, the performance of operations involving the use of the elevator cabin inside a tower structure may be improved. Therefore, the costs of these operations can be reduced, e.g. maintenance or inspection operations. In addition, in those cases where the elevator system is mounted in a wind turbine tower, not only the cost of maintenance or inspection operations may be reduced, but the availability of the wind turbine may also be improved. Consequently, the energy generated by a wind turbine, and by extension a wind farm, may be increased.

[0020] The system may be permanently mounted in an elevator system arranged on tower structures, e.g. wind turbine towers. Therefore, repeating assembly operations before each use of the elevator as in the prior art methods, e.g. disconnecting and connecting the fall arrest device from or to the elevator cabin, may be avoided and assembly errors may consequently be reduced.

[0021] Supporting structures may be arranged substantially perpendicular to the longitudinal axis of the tower structure at a height of the tower structure, e.g. wind turbine tower. Therefore, supporting structures may be arranged in a substantially horizontal direction.

[0022] In some examples, the supporting structure may be a beam having supports for connecting it to the tower structure. In some of these examples, the traction element may pass through the supporting structure, e.g. a beam, for being lifted up from above the supporting structure. In some examples, a guiding system for guiding a portion of the safety wire extending below the supporting structure to the counterweight may be connected to the supporting structure.

[0023] In some examples, a separate platform for holding an operator may be placed within the tower structure. In these examples, an operator positioned on such a separated platform may pull the traction element from above the supporting structure.

[0024] Alternatively, the supporting structure may be a platform for accessing an elevator cabin or an elevator car. In these examples, the traction element may be pulled from the platform. In addition, by lifting the counterweight from the platform the ergonomics of the system may be improved. In some of these examples, the platform is a landing platform arranged at the bottom part of the tower structure.

[0025] In some examples, the platform may substantially cover a cross-sectional area of the tower structure, i.e. the platform has substantially the same diameter as the internal diameter of the tower structure. In these examples, the safety wire and the traction element pass through the platform.

[0026] Alternatively, the platform may have a smaller size than the internal diameter of the tower structure, i. e. the platform does not completely cover the cross-sectional area of the tower structure. The platform may therefore only cover a portion of a cross-sectional area of the tower structure. In some of these examples, the platform may comprise a hole for allowing the movement of the elevator cabin. In some of these examples, the safety wire does not extend upwards and downwards with respect to the platform by passing through the platform, but by running relatively close to the platform, i.e. the safety wire extends from a height above to a height below the platform along a path close to the platform but not passing through the platform. Additionally or alternatively, the traction element may extend relatively close to the platform to a position above the platform rather than passing through the platform.

[0027] In all of these examples, the size of the platform is sufficient for accessing the elevator cabin and for holding at least one user of the elevator.

[0028] Above the supporting structure or above the platform shall mean at a higher altitude than the supporting structure or the platform. Therefore, an object above the platform shall mean that the object is positioned at a higher altitude than the platform, irrespective of the horizontal position of the object with respect to the platform and the size of the platform.

[0029] Below the supporting structure or below the platform shall mean at a lower altitude than the supporting structure or the platform. Therefore, an object below the platform shall mean that the object is positioned at a lower altitude than the platform, independently of the horizontal position of the object with respect to the platform and the size of the platform.

[0030] The testing system may additionally comprise a guiding system for guiding a portion of the safety wire extending below the supporting structure to the counterweight.

[0031] In some examples, the guiding system may guide a portion of the safety wire arranged below the supporting structure, i.e. the portion of the safety wire that is arranged at a lower height than the supporting structure, to the counterweight.

[0032] In some examples, the guiding system avoids the safety wire interfering with the elements of the elevator system arranged below the platform. Several parts of the elevator system such as a counterweight attached to the traction wire rope, a cable collect bin or a basket for storing a part of the elevator power supply cable, may be arranged below the platform, e.g. on the basement of the elevator system. Therefore, the space on the basement may be limited. In some examples, the guiding system may allow placing the counterweight in an area below the platform that is substantially free from obstacles and in area than the counterweight can be pulled up vertically from above the supporting structure, e.g. from the platform. Alternatively or additionally, the guiding system may allow the safety wire not to interfere with the elements arranged below the supporting structure, e.g. the platform, when the tension on the safety wire is released.

[0033] According to these aspects, the guiding system may comprise a first deflector assembly and a second deflector assembly. In this way, the safety wire may sag between the first and the second deflector assembly when the safety wire is not tensioned, e.g. when the counterweight is lifted.

[0034] In some of these examples, the first deflector assembly and/or the second deflector assembly orients the safety wire from a substantially vertical to a substantially horizontal direction or *vice versa.* The counterweight may thus be positioned away from the most crowded area of the basement and outside the area of the platform protected by a fence surrounding the elevator system.

[0035] In some examples, the guiding system may be arranged below the area covered by the supporting structure, e.g. in those examples wherein the platform has substantially the same size as the internal cross-sectional area of the tower structure. In other examples, only a portion of the guiding system may be arranged below the area covered by the supporting structure, e.g. platform. In other examples the guiding system may be arranged below the supporting structure, i.e. at a lower height than the supporting structure, but not below the area covered by the supporting structure, e.g. in those examples wherein the platform has a smaller size than the internal cross-sectional area of the tower structure. Therefore, the guiding system may be arranged below the supporting structure, e.g. platform, at different horizontal positions within the tower structure irrespective of the size and of the horizontal position of the supporting structure.

[0036] In some examples, the system may comprise a pulley system arranged above the supporting structure, e.g. platform, for guiding the traction element. Such a pulley system may allow directing the traction element to a position where an operator may easily pull up the counterweight, for example to a position relatively close to the platform or on the platform in those cases wherein the supporting structure is a platform. The pulley system may further allow directing the traction element for being pulled downward for lifting the counterweight. According to this aspect, the traction element may extend from the first end to the pulley system in a substantially upwards vertical direction and the pulley system may orient the traction element in a substantially downwards vertical direction to the second end. The system may thus be configured to lift the counterweight by pulling the second end of the traction element downwards. Pulling the traction element downwards improves the ergonomics of the testing system.

[0037] In a further aspect, an elevator system is provided that comprises an elevator cabin, a moving system for lifting and lowering the elevator cabin, a fall arrest device connected to the elevator cabin and a testing system according to any of the examples herein described. The fall arrest device comprises an overspeed detector and a blocking system for blocking the elevator cabin when an overspeed is detected by the overspeed detector. In addition, the safety wire of the testing system runs through the fall arrest device. The blocking system may thus clamp the fall arrest device onto the safety wire when the overspeed is detected.

[0038] In some examples, the moving system of the elevator system comprises a traction wire. In other examples, the moving system comprises a rack and pinion system.

[0039] In yet a further aspect, the present disclosure provides a wind turbine comprising such an elevator system.

[0040] In yet a further aspect, a method for testing a fall arrest device of an elevator system is provided. The method comprises providing a testing system according to any of the examples herein disclosed. The method additionally comprises gripping the safety wire in a gripping position above the fall arrest device, lifting and holding the counterweight of the testing system by pulling the traction element for releasing the tension on the safety wire. Furthermore, the method comprises pulling up the safety wire from the gripping position and testing whether the safety wire is blocked by the fall arrest device before a displacement of the safety wire reaches a predetermined distance, e.g. approximately 12 centimetres.

[0041] In some examples, gripping and pulling up the safety wire may be performed by a first operator and lifting and holding the counterweight may be performed by a second operator. Alternatively, these operations may be automated. For example, lifting and holding the counterweight may be performed by a hydraulic or pneumatic system.

[0042] In some examples, the method for testing a fall arrest device may comprise marking the safety wire above the fall arrest device before pulling it up and measuring the displacement of the mark with respect to the fall arrest device. The distance run by the safety wire through the fall arrest device before being completely blocked, i.e. the displacement of the safety wire with respect to the fall arrest device, may thus be more easily measured.

[0043] In yet a further aspect, the present disclosure provides a method for retrofitting an elevator system comprising an elevator cabin, a moving system for lifting and lowering the elevator cabin, a platform for accessing the elevator cabin, a safety wire extending upwards and downwards with respect to the platform, a fall arrest device for blocking the elevator cabin on the safety wire, and at least one tensioning spring connected to the safety wire for tensioning the safety wire. The method comprises disconnecting the at least one tensioning spring from the safety wire, providing a counterweight below or lower than the platform and connecting the counterweight to the safety wire. The method additionally comprises providing a guiding system for guiding a portion of the safety wire partially extending below the platform to the counterweight and arranging the safety wire on the guiding system. Furthermore, the method comprises providing a traction element for pulling the counterweight having a first end and a second end, and connecting the first end to the counterweight and arranging the second end above or higher than the platform for pulling the counterweight from the platform.

[0044] According to this aspect, existing elevator systems having a tensioning spring for tensioning the safety wire may be retrofitted and provided with the additional functionality herein described as releasing the tension on the safety wire by lifting a counterweight connected to the safety wire from the platform.

[0045] In some examples, the method may further comprise providing a supporting structure for supporting the guiding system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] Non-limiting examples of the present disclosure will be described in the following, with reference to the appended drawings, in which:

Figure 1 shows a part of an elevator system comprising an example of a testing system;

Figure 2 shows a part of an elevator system comprising an example of a testing system;

Figure 3 shows a zoomed-in view of a first deflector assembly of the testing system of Figure 2;

Figure 4 represents a partial view of an example of an elevator system while the fall arrest device is being tested;

Figure 5 shows a zoomed-in view of the first operator of Figure 4;

Figure 6 shows a zoomed-in view of the second operator of Figure 4.

DETAILED DESCRIPTION OF EXAMPLES

[0047] In these figures the same reference signs have been used to designate matching elements.

[0048] Figure 1 shows a part of an elevator system comprising an example of a testing system 1 for testing a fall arrest device of an elevator system. The elevator system may comprise an elevator system (not shown in

Figure 1), a traction wire 120, a counterweight 121 attached to the traction wire 120, a basket 123 for storing a trailing cable (not shown) not being in used and a testing system 1. The testing system 1 comprises a platform 10 (only shown a part of it), a safety wire 20 extending upwards and downwards with respect to the platform 10, e.g. with respect to the height of the platform. In this example, the platform is a landing platform placed at the bottom portion of the elevator path and covers completely the cross-sectional area of the tower structure. The safety wire extends from the basement, i.e. below the landing platform 10, along the whole path of the elevator cabin. In this example, the landing platform 10 comprises an opening for allowing the safety wire 20 running up and down through the landing platform for example when an operator pulls up the safety wire from above the fall arrest device.

[0049] In other examples, for example when the platform has a smaller size than the internal diameter of the tower structure, the safety wire does not interfere with the platform, i.e. the safety wire is placed away from the area covered by platform.

[0050] A counterweight 30 is connected to the safety wire 20 below the landing platform. The weight of the counterweight may provide enough tension to the safety wire. The counterweight may weigh for example from 10 to 40 kilograms. The counterweight may be formed by a set of weights, e.g. by two weights of approximately 11 kilograms.

[0051] The testing system 1 of Figure 1 comprises a guiding system 50 for guiding a portion of the safety wire 20 that extends below the landing platform 10 to the counterweight 30. In this way, the safety wire 20 may run along the guiding system 50. In this example, the guiding system comprises a first deflector assembly 51 and a second deflector assembly 52. In Figure 1, the safety wire 20 may partially extend from below the landing platform, to the first deflector assembly 51 in a substantially vertical direction. The first deflector assembly 51 may orient, i.e. guide, the safety wire 20 to a substantially horizontal direction towards the second deflector assembly 52. In addition, the safety wire 20 may partially extend from the first deflector assembly 51 to the second deflector assembly 52 in a substantially horizontal direction and the second deflector assembly 52 may orient the safety wire 20 to a substantially vertical direction towards the counterweight 30.

[0052] In this example, the first deflector assembly 51 and the second deflector assembly 52 are connected to the platform. In other examples, for example when the supporting structure is a beam, the first deflector assembly and the second deflector may be connected to the supporting structure.

[0053] The testing system comprises a traction element 40 connected to the counterweight 30. The traction element 40 comprises a first end 41 connected to the counterweight 30 and a second 42 end arranged above the landing platform 10, e.g. the traction element may run up and down with respect to the landing platform through an opening formed in the landing platform. In other examples, the traction element may run up and down with respect to the height of the platform in a location relatively close to the platform, i.e. not passing through the platform. The traction element is further configured to be pulled from the landing platform.

[0054] The traction element may be a wire rope or a cable. In some other examples, the traction element may be a textile or a plastic rope.

[0055] The first end 41 of the traction element may be connected directly or indirectly to the counterweight. In some examples, such a first end may be rigidly connected to the safety wire and consequently, the traction element is indirectly connected to the counterweight.

[0056] In Figure 1, the counterweight may be lifted by pulling up the traction element. In other examples, lifting the counterweight may comprise pulling down the traction element.

[0057] In some examples, the second end 42 of the traction element may be connected to a handle 43 for manually pulling the traction element 40.

[0058] In other examples, the traction element may be pulled by a hydraulic or a pneumatic device.

[0059] Figure 2 shows a part of an elevator system comprising another example of a testing system 1 for testing a fall arrest device of an elevator system. Similar to the example of Figure 1, the testing system 1 comprises a landing platform 10, a safety wire 20 connected to a counterweight 30, a guiding system 50 and a traction element 40.

[0060] In some examples, the counterweight 30 may be connected to the end of the safety wire 20. Alternatively, the safety wire 20 may extend through the counterweight and may end in a coiled portion below the counterweight. In this aspect, a fixing element 31 may fix the counterweight 30 to the safety wire 20.

[0061] The guiding system 50 of Figure 2 comprises a first deflector assembly 51 and a second deflector assembly 52 similar to the example of Figure 1. In some examples, each of the deflector assemblies comprises a bracket 53 and a roller 54 rotatably mounted on the bracket 53. The safety wire 20 may engage the roller 54 and may thus be guided. In other examples, the guiding system may comprise more than two deflector assemblies.

[0062] In some examples, the roller 54 of the first deflector assembly 51 and the roller 54 of the second deflector assembly 52 are arranged substantially at the same height with respect to the landing platform.

[0063] In other examples, the guiding system may be mounted on the supporting structure or attached to the tower structure.

[0064] In other examples, the guiding system 50 may comprise a conduit or several short conduits, for example elbow conduits. The safety wire may be put into the conduit or the conduits. In this way, a first elbow conduit may reorient a vertical direction of the safety wire 20 going down from the height of the platform 10 to a horizontal direction towards a second elbow conduit. Such a second elbow conduit can reorient to safety wire to a vertical direction towards the counterweight.

[0065] The traction element 40 of Figure 2 comprises a stopper 44 for limiting the vertical displacement of the counterweight while the counterweight is being lifted. In some examples, the stopper may have a diameter greater than an opening formed in the landing platform or than e.g. a tube or sleeve arranged close to the landing platform, allowing the traction element going up and down with respect to the landing platform. In this way, when the stopper connected to the traction element reaches the opening or the tube, the stopper cannot pass through it and the vertical displacement of the traction element is thus limited.

[0066] Alternatively, the stopper may be placed in a portion of the traction element above the platform and the displacement of the counterweight is limited in a similar way to those examples when the stopper is below the platform.

[0067] In other examples, the safety wire 20 may comprise a stopper connected relatively close to the counterweight. Such a stopper of the safety wire may also block the vertical displacement of the counterweight in a similar manner to the stopper of the traction element. However, in these examples, the stopper connected to the safety wire cannot pass through the second deflector assembly and the lifting of the counterweight may therefore be limited.

[0068] The testing system of Figure 2 comprises a pulley system 45 arranged above the landing platform 10 for guiding the traction element 40. Such a pulley system directs the traction element to a positon where an operator may easily lift the counterweight. In these examples, the traction element may be pulled down and the counterweight may thus be lifted. Pulling down the cable instead of pulling up the cable may improve the ergonomics of the system. As in Figure 1, the traction element 40 may comprise a handle 43 for manually pulling the cable. The pulley system 45 may be placed in a height with respect to the platform that the cable may be pulled down by an operator in an easy manner.

[0069] The pulley system 45 may be mounted above the platform on an elevator fence 11 of the elevator system for protecting the elevator cabin when the elevator cabin is positioned on the landing platform. In this way, an existing structure, i.e. the elevator fence 11 of the elevator system, is used for supporting the pulley system 45.

[0070] In other examples, the pulley system may be attached to the tower or may be mounted on a dedicated support mounted on landing platform.

[0071] Figure 3 shows a zoomed-in view of a first deflector assembly 51 of the testing system of Figure 2. The first deflector assembly 51 of Figure 2 may be similar to the first deflector assembly 51 of Figure 1. Figure 3 shows a safety wire 20 running along a roller 54 rotatably connected to a bracket 53 of the first deflector assembly 51. The roller 54 may comprise a guide or a groove 55 for partially engaging the safety wire 20.

[0072] The deflector assembly of Figure 3 comprises a retainer 56 to prevent the safety wire from going out of the groove 55. In some examples, the retainer 56 may be an anti-derailment bushing bolted to the bracket. In other examples, the retainer 56 may be a shaft welded to the bracket 53. The retainer 56 may be positioned below the roller 54. In other examples, the retainer may be positioned above the roller as described below with respect to the second deflector assembly.

[0073] In some examples, the bracket 53 may be made from steel, in particular from steel having a hot dip galvanized protection.

[0074] A second deflector assembly may be similarly as described with respect to the first deflector assembly. In some examples, the retainer 56 of a second deflector assembly may be positioned above the roller 54, e.g. having an opposite configuration than the first deflector assembly.

[0075] Figure 4 represents a partial view of elevator system 100 having a testing system 1 according to any of the examples herein described while the fall arrest device 130 is being tested. The elevator system of Figure 4 comprises an elevator cabin 110 and a fall arrest device 130 mounted inside the elevator cabin. The safety wire 20 runs through the fall arrest device 130 and extends below the landing platform 10. Below the landing platform 10, the safety wire 20 is guided by the guiding system and a counterweight 30 is connected to the safety wire and to a first end of the traction element 40.

[0076] The traction element 40 extends above the landing platform 10 and an operator standing on the landing platform close to the fence may lift the counterweight to release tension on the safety wire.

[0077] In some examples, the fall arrest device 130 is mounted inside the elevator cabin 110, in particular on the top of the elevator cabin. In other examples, the fall arrest device may be externally attached to the elevator cabin.

[0078] In some examples, the elevator cabin 110 may comprise a hatch arranged on the top that allows an operator to leave the elevator cabin from the top or generally reach a space above the elevator cabin. Steps arranged inside the elevator cabin 110 may allow an operator to go up for leaving the elevator. An operator supported by the steps can grip the safety wire above the elevator cabin, e.g. above the fall arrest device, and perform a fast hard jerk.

[0079] In the example of Figure 4, two operators are performing a method for testing the fall arrest device of the elevator system.

[0080] In these examples, a first operator goes inside the elevator cabin 110 through the door 113, opens the elevator top hatch and climbs some steps installed inside the elevator cabin 110. The operator may be supported by the steps in a position that allows grabbing the safety wire 20 above the elevator cabin 110. The first operator then grips the safety wire with one or both hands in a gripping position. In some examples, the operator may additionally mark the safety wire. In other examples, the safety wire may comprise some pre-established marks. Figure 5 shows a zoomed-in view of the first operator of Figure 4 while is pulling up the safety wire 20 from the gripping position. The operator grips and pulls up the safety wire from above the fall arrest device 130. In these examples, the fall arrest device 130 is mounted on an internal structure of the elevator cabin.

[0081] While the first operator is gripping the safety wire, a second operator lifts and holds the counterweight by pulling down the traction element 40 from the platform 10. The tension of the safety wire 20 is thus released. Figure 6 shows a zoomed-in view of the second operator of Figure 4 while the counterweight is about to be lifted. The traction element 40 extends above the landing platform 10. The testing system 1 according to Figure 4, and by extension according to Figure 6, comprises a pulley system 45 arranged on the elevator fence 11. According to this aspect, the counterweight 30 may be lifted by pulling down a handle 43 connected to the second end 42 of the traction element. An operator on the landing platform may thus lift the counterweight to release tension on the safety wire.

[0082] As the safety wire is gripped by the first operator, the safety wire 20 does not drop by the action of releasing the tension. While the second operator is holding the counterweight 30, the first operator pulls up the safety wire 20 from the gripping position. If the fall arrest device works properly, it detects the speed and the acceleration of the safety wire 20 running through the fall arrest device 130 and arrests the safety wire. The first operator then tests if the safety wire has been arrested by the fall arrest device before the displacement of the safety wire has reached a predetermined distance, e.g. less than 12 centimeters. If the operator has previously marked the safety wire, the first operator may easily measure the distance run by the safety wire before being blocked by the fall arrest device.

[0083] If the safety wire is arrested by the fall arrest device during the pulling up, i.e. fast hard jerk, and the displacement is less than or equal to the predetermined length, the fall arrest device is working correctly. Before using the elevator cabin, the safety wire may be tensioned again. For tensioning the safety wire, the first operator manually disengages the fall arrest device from the safety wire, and the second operator releases the traction element until the counterweight reaches the previous position, i.e. before being lifted. The safety wire may therefore be tensioned again. Then, the first operator may move up the elevator cabin e.g. 0,5 meters above the landing platform, and engages again the fall arrest device, i.e. blocks again the fall arrest device. The first operator may continuously engage and disengage the fall arrest device, i.e. blocking and unblocking the fall arrest device with respect to the safety wire for gradually descending the elevator cabin. By these blocking and unblocking operations, the operators or the elevator users can check if the elevator cabin is correctly held by the fall arrest device when the fall arrest device is in the blocking position and if the elevator cabin moves down when the fall arrest device is in the unblocking position. After that, the fall arrest device may finally be disengaged, i.e. unblocked for allowing the safety wire to run through it and ready for actuating when an overspeed is detected, and the elevator cabin may go down until the position of the landing platform. The elevator system may thus be ready to be used.

[0084] In those cases where the safety wire runs longer than the predetermined distance through the fall arrest device, the fall arrest device does not work correctly. Therefore, the fall arrest device needs to be repaired and the elevator system must not be used.

[0085] Although only a number of examples have been disclosed herein, other alternatives, modifications, uses and/or equivalents thereof are possible. Furthermore, all possible combinations of the described examples are also covered. Thus, the scope of the present disclosure should not be limited by particular examples, but should be determined only by a fair reading of the clauses that follow.

Claims

1. A testing system for testing a fall arrest device of an elevator system comprising:

   a supporting structure;
   a safety wire configured to run through a fall arrest device of an elevator system and extending upwards and downwards with respect to the supporting structure;
   a counterweight connected to the safety wire and arranged below the supporting structure;
   a traction element for lifting the counterweight extending from a first end to a second end, the first end being connected to the counterweight and the second end being arranged above the supporting structure and being configured to be pulled from above the supporting structure; and
   wherein the system is configured to release the tension on the safety wire when the counterweight is lifted by pulling the traction element.

2. A testing system according to claim 1, wherein the supporting structure is a platform for accessing an elevator cabin of an elevator system.

3. A testing system according to any of claims 1 - 2, wherein the testing system comprises a guiding system for guiding a portion of the safety wire extending below the supporting structure to the counterweight.

4. A testing system according to claim 3, wherein the

guiding system comprise a first deflector assembly and a second deflector assembly.

5. A testing system according to claim 4, wherein the first deflector assembly and/or the second deflector assembly orients the safety wire from a substantially vertical to a substantially horizontal direction or *vice versa.*

6. A testing system according to claim 5, wherein the safety wire partially extends below the supporting structure to the first deflector assembly in a substantially vertical direction and the first deflector assembly orients the safety wire to a substantially horizontal direction towards the second deflector assembly, and optionally the safety wire partially extends from the first deflector assembly to the second deflector assembly in a substantially horizontal direction and the second deflector assembly orients the safety wire to a substantially vertical direction towards the counterweight.

7. A testing system according to any of claims 1 - 6, wherein the traction element comprises a stopper for limiting the displacement of the counterweight after pulling the traction element from above the supporting structure.

8. A testing system according to any of claims 1 - 7, wherein the system comprises a pulley system arranged above the supporting structure for guiding the traction element.

9. A testing system according to claim 8, wherein the traction element extends from the first end to the pulley system in a substantially upwards vertical direction and the pulley system orients the traction element in a substantially downwards vertical direction from the pulley system to the second end; and the system is configured in such a way that the counterweight is lifted when the second end of traction element is pulled downwards.

10. A testing system according to any of claims 1 - 9, wherein the second end of the traction element is connected to a handle for manually pulling the traction element.

11. An elevator system comprising:

an elevator cabin;
a moving system for lifting and lowering the elevator cabin;
a fall arrest device connected to the elevator cabin and comprising an overspeed detector and a blocking system for blocking the elevator cabin when an overspeed is detected by the overspeed detector;
a testing system according to any of claims 1 - 10;

wherein the safety wire of the testing system runs through the fall arrest device and the blocking system clamps the fall arrest device onto the safety wire when an overspeed is detected.

12. A method for testing a fall arrest device of an elevator system comprising:

providing a testing system according to any of claims 1 - 10;
gripping the safety wire in a gripping position above the fall arrest device;
lifting and holding the counterweight of the testing system by pulling the traction element for releasing the tension on the safety wire;
pulling up the safety wire from the gripping position;
testing whether the safety wire is blocked by the fall arrest device before a displacement of the safety wire reaches a predetermined distance.

13. A method for testing a fall arrest device according to claim 12, wherein lifting and holding the counterweight is performed by a first operator and gripping and pulling up the safety wire is performed by a second operator.

14. A method for testing a fall arrest device according to claim 13, wherein the method comprises marking the safety wire above the fall arrest device before pulling up the safety wire and measuring the displacement of the mark with respect to the fall arrest device.

15. A method for retrofitting an elevator system, the elevator system comprising:

an elevator cabin;
a moving system for lifting and lowering the elevator cabin;
a platform for accessing the elevator cabin;
a safety wire extending upwards and downwards with respect to the platform;
a fall arrest device for blocking the elevator cabin on the safety wire;
at least one tensioning spring connected to the safety wire for tensioning the safety wire; and

wherein the method comprises:

disconnecting the at least one tensioning spring from the safety wire;
providing a counterweight below the platform and connecting the counterweight to the safety wire;

providing a guiding system for guiding a portion of the safety wire extending below the platform to the counterweight;
arranging the safety wire on the guiding system;
providing a traction element having a first and a second end for pulling the counterweight; and
connecting a first end of the traction element to the counterweight and arranging a second end of the traction element above the platform for pulling the counterweight from the platform.

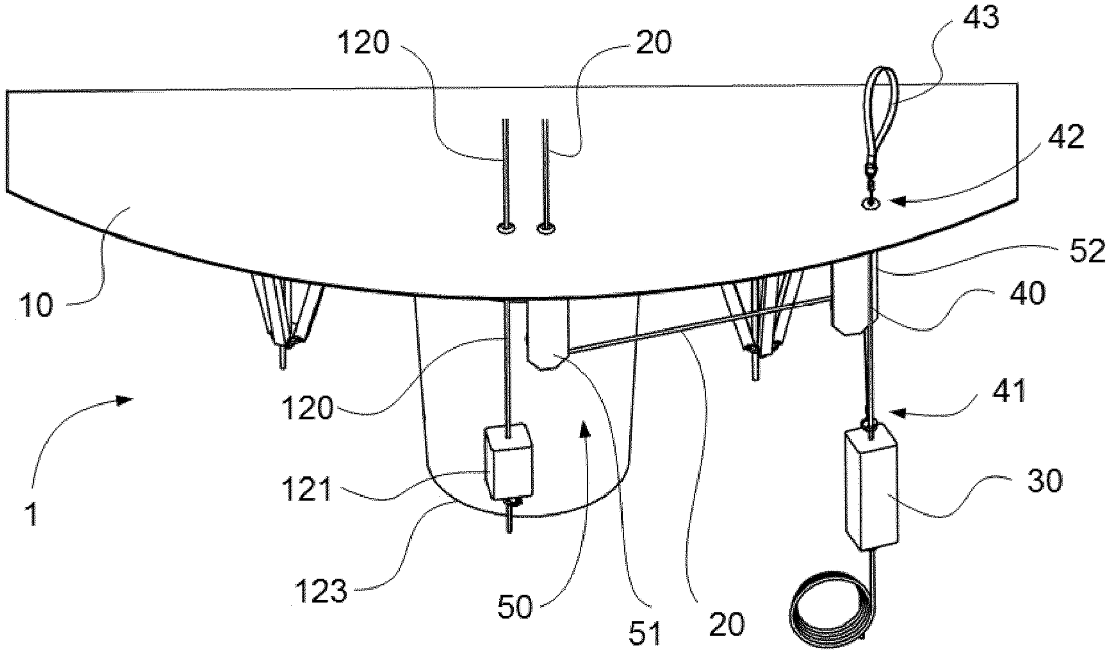

Figure 1

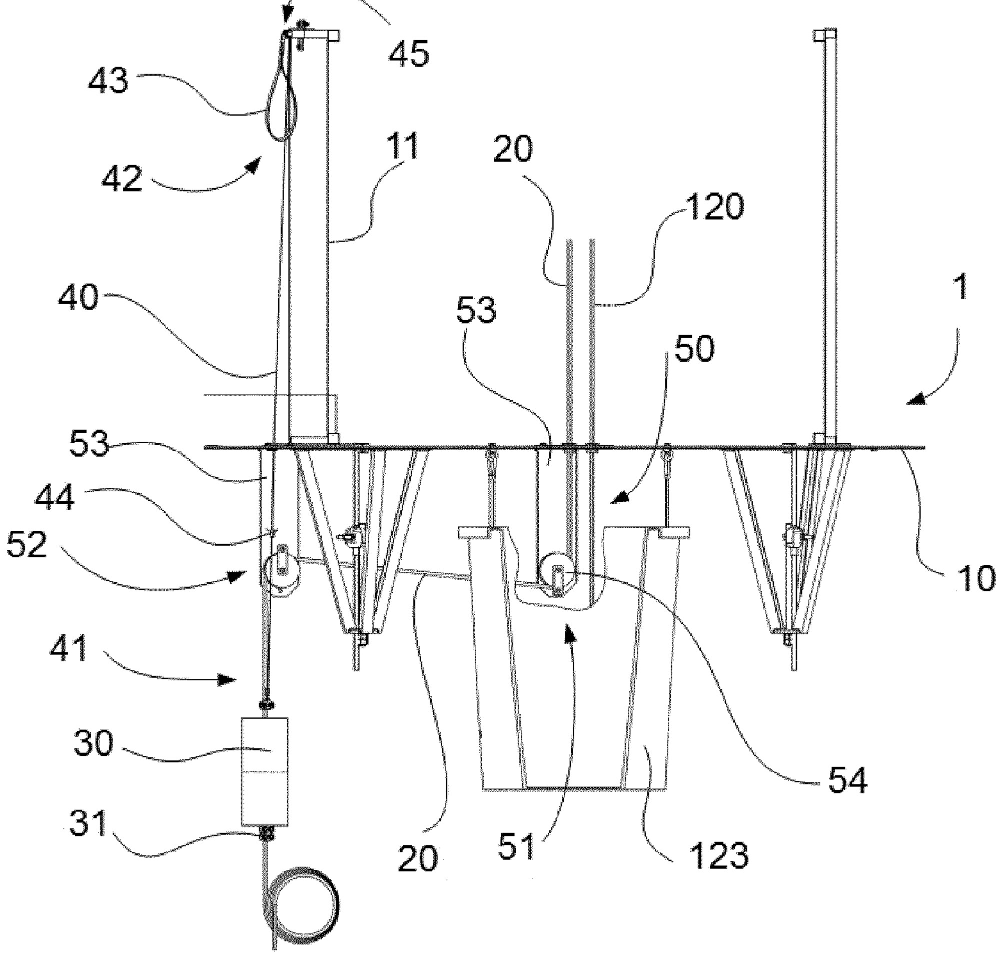

Figure 2

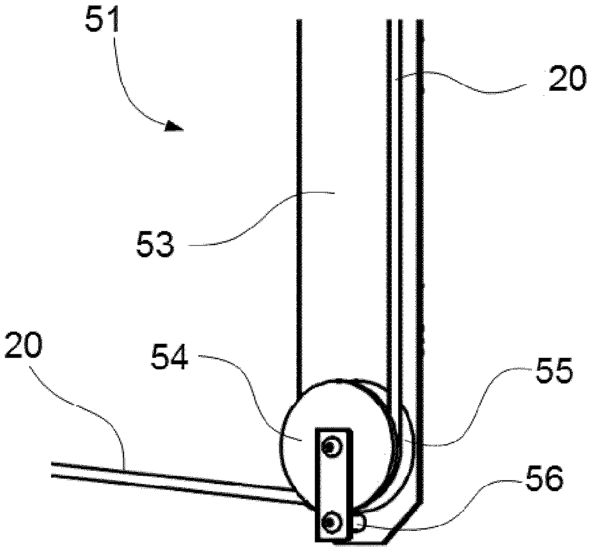

Figure 3

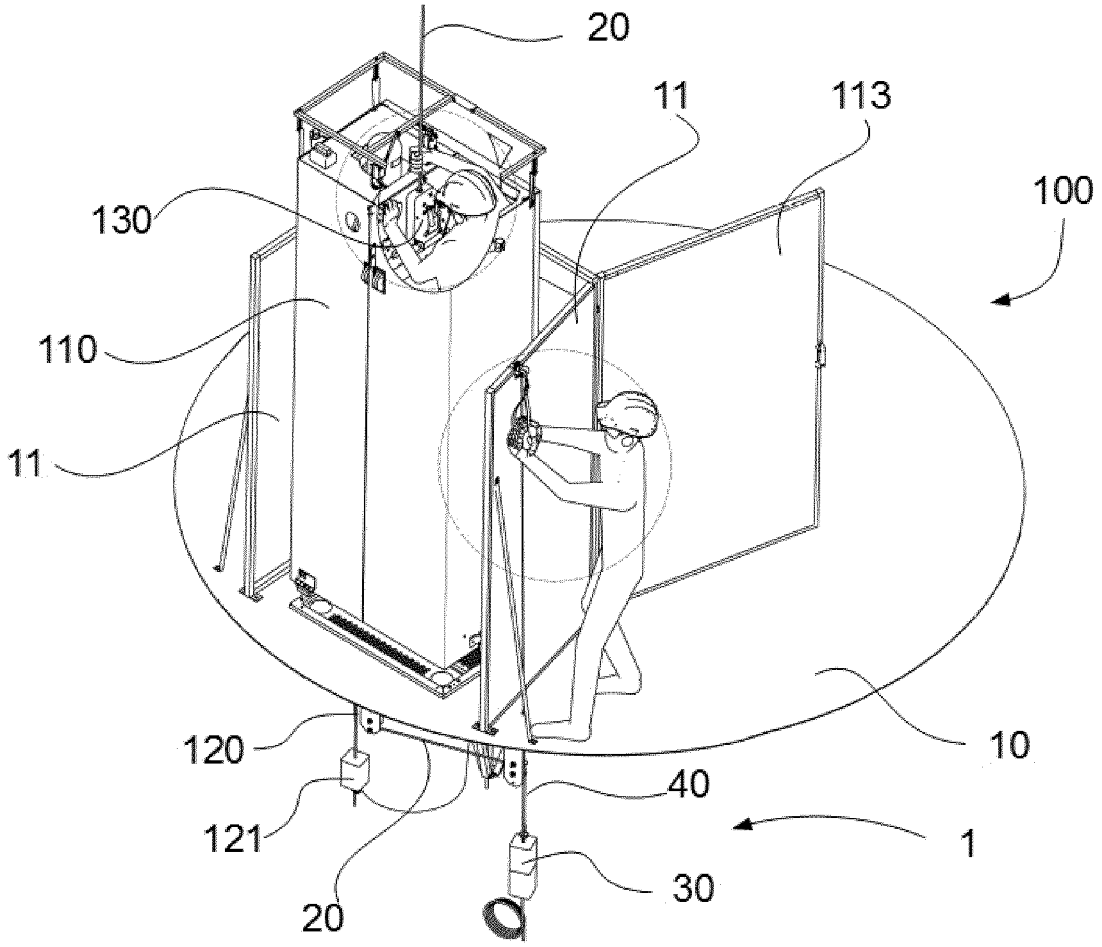

Figure 4

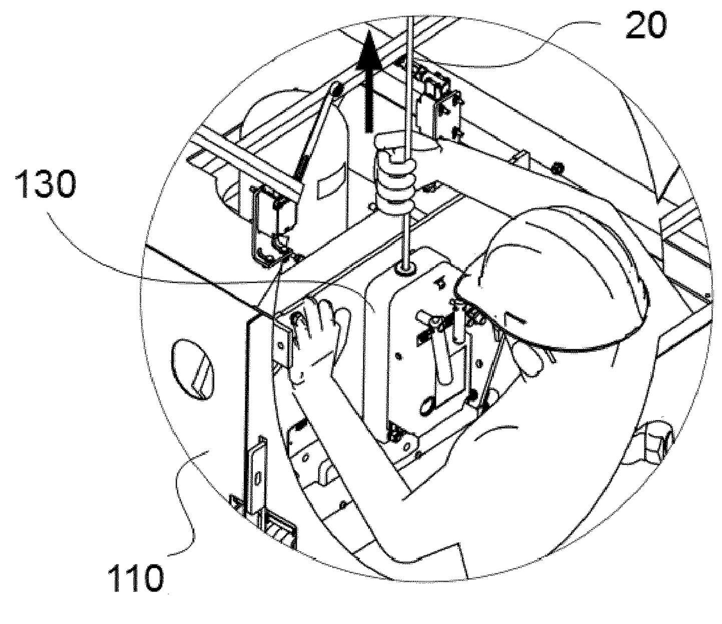

Figure 5

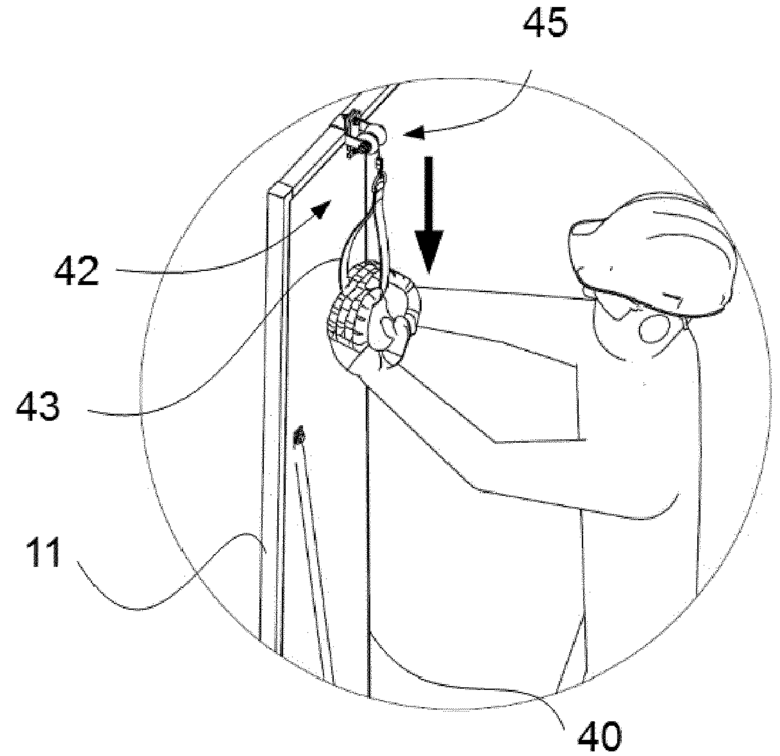

Figure 6

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EUROPEAN SEARCH REPORT

Application Number
EP 17 38 2575

DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	15 May 2018	Bleys, Philip

CATEGORY OF CITED DOCUMENTS

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15-05-2018

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