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(54) AN ARRANGEMENT AND A METHOD FOR MEASURING AND MARKING AN ELEVATOR SHAFT

(57) The arrangement comprises two vertically in the shaft (20) extending temporary support members (51, 52). An upper end of each temporary support member is fixed in an upper fixing point (F1, F3) and a lower end of each temporary support member is fixed in a lower fixing point (F2, F4). A measuring and marking device (60) is movably supported on the temporary support members so that the measuring and marking device is movable upwards and downwards along the temporary support members.

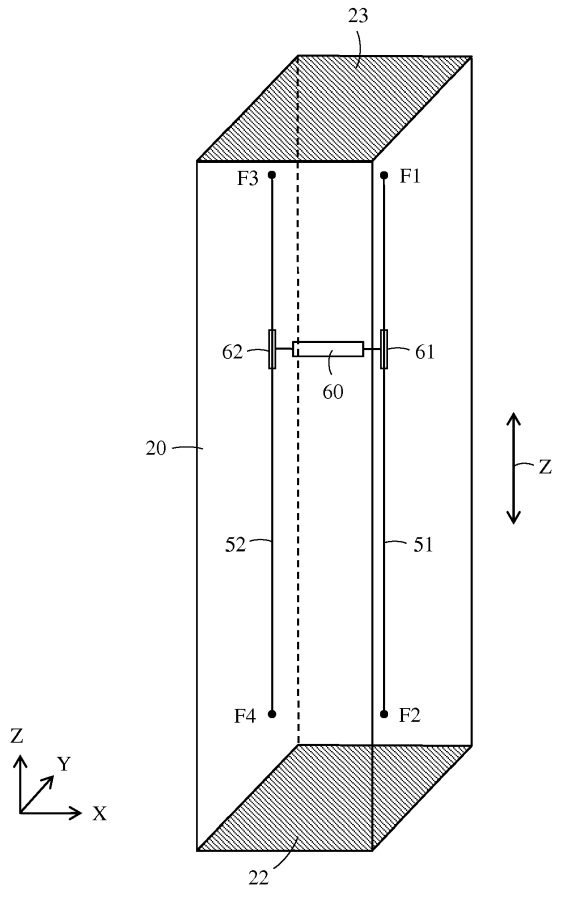

FIG. 2

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Description

FIELD OF THE INVENTION

[0001] The invention relates to an arrangement and a method for measuring and marking an elevator shaft.

BACKGROUND ART

[0002] An elevator may comprise a car, a shaft, lifting machinery, ropes, and a counterweight. A separate or an integrated car frame may surround the car.

[0003] The lifting machinery may be positioned in the shaft. The lifting machinery may comprise a drive, an electric motor, a traction sheave, and a machinery brake. The lifting machinery may move the car upwards and downwards in the shaft. The machinery brake may stop the rotation of the traction sheave and thereby the movement of the elevator car.

[0004] The car frame may be connected by the ropes via the traction sheave to the counterweight. The car frame may further be supported with gliding means at guide rails extending in the vertical direction in the shaft. The guide rails may be attached with fastening brackets to the side wall structures in the shaft. The gliding means keep the car in position in the horizontal plane when the car moves upwards and downwards in the shaft. The counterweight may be supported in a corresponding way on guide rails that are attached to the wall structure of the shaft.

[0005] The car may transport people and/or goods between the landings in the building. The walls in the shaft may be formed as solid walls and/or as an open steel structure.

[0006] During the installation of the equipment needed for the elevator in an elevator shaft, measurements and marking has to be done in the shaft. It is a rather difficult and time consuming task to measure the shaft. The most used prior art method has been to arrange one or several plumb lines in the shaft, whereby the plumb lines form vertical reference lines in the shaft. The lateral position of the equipment to be installed in the shaft is then measured based on these plumb lines. The vertical position of the equipment to be installed in the shaft may be measured based on earlier measured and marked height positions in the shaft or based on a separate height measurement in the shaft. The plumb lines may be formed of thin wires hanging in the shaft and having a weight at the lower end of the wire. This is, however, a rather time consuming method requiring a lot of manual work. There is thus a need for a more efficient way to measure and mark the shaft.

BRIEF DESCRIPTION OF THE INVENTION

[0007] An object of the present invention is to present a novel arrangement and method for measuring and marking an elevator shaft.

[0008] The arrangement for measuring an elevator shaft is defined in claim 1.

[0009] The method for measuring and marking an elevator shaft is defined in claim 11.

[0010] The arrangement for measuring and marking an elevator shaft comprises:

two vertically in the shaft extending temporary support members, an upper end of each temporary support member being fixed in an upper fixing point and a lower end of each temporary support member being fixed in a lower fixing point,
a measuring and marking device being movably supported on the temporary support members so that the measuring and marking device is movable upwards and downwards along the temporary support members.

[0011] The method for measuring and marking an elevator shaft comprises:

arranging two vertically extending temporary support members in the shaft,
fixing an upper end of each temporary support member in an upper fixing point and a lower end of each temporary support member in a lower fixing point,
supporting a measuring and marking device movably on the temporary support members,
measuring the shaft with a measuring apparatus supported on the measuring and marking device during an upwards and/or downwards movement of the measuring and marking device along the temporary support members,
marking the shaft with a marking apparatus supported on the measuring and marking device based on the results of the preceding measuring phase during an upwards and/or downwards movement of the measuring and marking device along the temporary support members.

[0012] The invention provides an efficient and accurate solution for measuring and marking the shaft. The walls of the shaft may be marked so that each individual mark indicates the position of a fastening means. The fastening means may be in the form of an anchor to be inserted into a hole in the shaft wall. The fastening means may be used to attach e.g. the guide rails for the car and for the counterweight. The position of the fastening means may naturally also indicate the position of fastening means for other equipment to be installed into the shaft e.g. landing doors.

[0013] The invention may be used in any kind of elevator shafts. The walls in the shaft may be formed as solid walls and/or as an open steel structure. The invention may be used in connection with a new elevator installation and in connection with a renovation of an elevator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The invention will in the following be described in greater detail by means of preferred embodiments with reference to the attached drawings, in which:

Figure 1 shows a side view of an elevator,
Figure 2 shows an axonometric view of an elevator shaft provided with the inventive arrangement,
Figure 3 shows an upper support structure for the temporary support members in the shaft,
Figure 4 shows a lower support structure for the temporary support members in the shaft,
Figure 5 shows a measuring and marking device.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0015] Fig. 1 shows a side view of an elevator.

[0016] The elevator may comprise a car 10, an elevator shaft 20, lifting machinery 30, ropes 42, and a counterweight 41. A separate or an integrated car frame 11 may surround the car 10.

[0017] The lifting machinery 30 may be positioned in the shaft 20. The lifting machinery may comprise a drive 31, an electric motor 32, a traction sheave 33, and a machinery brake 34. The lifting machinery 30 may move the car 10 in a vertical direction Z upwards and downwards in the vertically extending elevator shaft 20. The machinery brake 100 may stop the rotation of the traction sheave 33 and thereby the movement of the elevator car 10.

[0018] The car frame 11 may be connected by the ropes 42 via the traction sheave 33 to the counterweight 41. The car frame 11 may further be supported with gliding means 27 at guide rails 25 extending in the vertical direction in the shaft 20. The gliding means 27 may comprise rolls rolling on the guide rails 25 or gliding shoes gliding on the guide rails 25 when the car 10 is moving upwards and downwards in the elevator shaft 20. The guide rails 25 may be attached with fastening brackets 26 to the side wall structures 21 in the elevator shaft 20. The gliding means 27 keep the car 10 in position in the horizontal plane when the car 10 moves upwards and downwards in the elevator shaft 20. The counterweight 41 may be supported in a corresponding way on guide rails that are attached to the wall structure 21 of the shaft 20.

[0019] The car 10 may transport people and/or goods between the landings in the building. The walls 21 in the elevator shaft 20 may be formed of solid walls and/or of an open steel structure.

[0020] Figure 2 shows an axonometric view of an elevator shaft provided with the inventive arrangement.

[0021] The arrangement comprises two vertically in the shaft 20 extending temporary support members 51, 52. An upper end of each temporary support member 51, 52 is fixed in an upper fixing point F1, F3 and a lower end of each temporary support member 51, 52 is fixed in a lower fixing point F2, F4.

[0022] A measuring and marking device 60 may be movably supported on the temporary support members 51, 52. The measuring and marking device 60 may thus be movable upwards and downwards along the temporary support members 51, 52.

[0023] The movable support of the measuring and marking device 60 on the temporary support members 51, 52 may be realized with cylindrical support elements 61, 62 gliding on the temporary support members 51, 52.

[0024] The lateral position of the measuring and marking device 60 in the X-Y direction may thus be maintained when the measuring and marking device 60 moves upwards and downwards along the temporary support members 51, 52 guided by the cylindrical support elements 61, 62.

[0025] The temporary support members may extend from an upper portion of the shaft 20 or from a machine room above the shaft 20 to a lower portion of the shaft 20 e.g. to a bottom of a pit in the shaft 20. Each of the temporary support members 51, 52 may be formed of a wire. The wire may be firmly tightened between the upper fixing point F1, F3 and the lower fixing point F2, F4. Each of the wires 51, 52 should be tightened so that swaying of the wires 51, 52 is minimized.

[0026] The upper end of the first temporary support member 51 may be fixed at a first upper fixing point F1 to the shaft 20. The lower end of the first temporary support member 51 may be fixed at a first lower fixing point F2 to the shaft 20. The upper end of the second temporary support member 52 may be fixed at a second upper fixing point F3 to the shaft 20. The lower end of the second temporary support member 52 may be fixed at a second lower fixing point F4 to the shaft 20.

[0027] Figure 3 shows an upper support structure for the temporary support members in the shaft.

[0028] The upper support structure 80 may be situated in an upper portion of the shaft 20 or in a machine room positioned above the shaft 20. The upper support structure 80 may be formed of horizontally and vertically extending support bars forming a parallelepiped. The upper support structure 80 is in the figure positioned in a machine room over an opening 23A in the floor of the machine room. The opening 23A in the floor in the machine room may be an opening for the ropes of the car 10 or on opening for the ropes of the counterweight 42. The opening that is closer to the centre of the shaft 20 may preferably be used. The opening 23A forms thus a passage from the machine room to the shaft 20.

[0029] The temporary support members 51, 52 may be positioned on a rope reel 51A, 52A. The rope reel 51A, 52A may be supported on a rotatable shaft so that the temporary support members 51, 52 may be wound from the rope reel when lowered into the shaft 20.

[0030] Each of the temporary support members 51, 52 may be supported with a cylindrical upper support element 53, 54 on a respective horizontal support bar 81,

82 in the upper support structure 80. Each temporary support member 51, 52 is thus passing from the rope reel 51A, 52A through a respective cylindrical upper support element 53, 54 down to the shaft 20.

[0031] The cylindrical upper support elements 53, 54 may be provided with brake means so that the temporary support members 51, 52 may be locked into the cylindrical support elements 53, 54. The temporary support members 51, 52 become thereby also locked to the upper support structure 80 and thereby in relation to the shaft 20. The locking may be activated when the temporary support members 51, 52 have been tightened to a desired tightness. The tightening of the temporary support members 51, 52 may be done with the rope reels 51A, 52A or with a separate apparatus suitable for tightening of the temporary support members 51, 52.

[0032] The cylindrical upper support elements 52, 54 may form the upper fixing points F1, F3 for the temporary support members 51, 52.

[0033] The two horizontal support bars 81, 82 supporting the temporary support members 51, 52 may be parallel and positioned at a distance from each other. There may be a third horizontal support bar 83 extending between the said two horizontal bars 81, 82. The third support bar 83 may be parallel with the said two support bars 81, 82. All three support bars 81, 82, 83 may be positioned in a common horizontal plane.

[0034] A plumb line 71 may be supported on the third support bar 83. The plumb line 71 may be positioned in a centre point C1 of the upper support structure 80. The horizontal distance A1 from the centre point C1 of the upper support structure 80 to the first upper fixing point F1 may be equal to the horizontal distance A2 from the centre point C1 of the upper support structure 80 to the second upper fixing point F2. The centre point C1 and the upper fixing points F1, F3 may all be positioned on a first straight line L1. The plumb line 71 may form a vertical reference line along the height of the shaft 20.

[0035] The upper support structure 80 may, instead of being positioned in the machine room, be positioned in an upper portion of the shaft 20. The construction of the upper support structure 80 may in such case be such that it is suitable for being attached on a wall 21 of the shaft 20.

[0036] Figure 4 shows a lower support structure for the temporary support members in the shaft.

[0037] The lower support structure 90 may be positioned in a lower portion of the shaft 20 e.g. on the bottom of the pit in the shaft 20. The lower support structure 90 may have the form of a plate. The lower support structure 90 may comprise cylindrical lower support members 55, 56 corresponding to the cylindrical upper support members 53, 54. The cylindrical lower support members 55, 56 may form the lower fixing points F2, F4 for the temporary support members 51, 52.

[0038] The lower support structure 90 may further comprise a centre point C2 corresponding to the centre point C1 of the plumb line 71 at the upper support structure 80. The horizontal distance A1 from the centre point C2 of the lower support structure 90 to the first lower fixing point F2 may be equal to the horizontal distance A2 from the centre point C2 of the lower support structure 90 to the second lower fixing point F4. The centre point C2 and the lower fixing points F2, F4 may all be positioned on a second straight line L2. The said horizontal distances A1, A2 in the lower support structure 90 may be equal to the corresponding horizontal distances A1, A2 in the upper support structure 80.

[0039] The lower support structure 90 may be positioned so that the sharp edge of the weight 72 attached to the lower end of the plumb line 71 is pointing exactly to the centre point C2 of the lower support structure 90. The centre point C2 of the lower support structure 90 will thus be positioned exactly vertically under the centre point C1 of the upper support structure 80. The angular position of the lower support structure 90 in the horizontal plane should further be adjusted so that the second straight line L2 coincides with the first straight line L1. This means that the first lower fixing point F2 is positioned exactly vertically under the first upper fixing point F1 and the second lower fixing point F4 is positioned exactly vertically under the second upper fixing point F3. This can easily be determined at the lower support structure 90 by adjusting the line F2-F4 to pass through the plumb line 71. If the floor below the lower support structure 90 is not straight i.e. on the same horizontal level as horizontal plane passing through the upper fixing points F1-F3, this has to be taken into consideration. If the lower support members 55, 56 are positioned perpendicularly in relation to the lower support 90, the length of the lower support members 55, 56 are 100 mm, and the lower support structure 90 has an inclination of 5 degrees, then there may be an error of 9 mm between the upper end of the lower end of the lower support member 55, 56. If the lower support members 55, 56 are positioned so that they extend vertically in the same direction as the plumb line 71 i.e. they extend vertically so that the upper end of the lower support members 55, 56 are in a correct position, then the inclination of the bottom of the pit does not matter.

[0040] Figure 5 shows a measuring and marking device.

[0041] The measuring and marking device 60 may be formed of a drone supported on the temporary support members 51, 52. The drone forms the driving motor of the measuring and marking device 60. The measuring and marking device 60 may be moved upwards and downwards in the shaft 20 along the temporary support members 51, 52 with the drone.

[0042] The measuring and marking device 60 may be supported with cylindrical support elements 61, 62 on the temporary support members 51, 52. The length Z1 of the cylindrical support elements 61, 62 may be such that swaying of the measuring and marking device 60 is minimized. The movement upwards and downwards along the temporary support members 51, 52 and the stopping

of the measuring and marking device 60 may cause swaying. Swaying may also occur when marking of the shaft 20 is performed. The use of a marking apparatus may also cause the measuring and marking device 60 to sway.

[0043] The cylindrical support elements 61, 62 may be provided with brake means so that the measuring and marking device may be locked in any desired position along the temporary support members 51, 52. The brake means may be of any suitable type comprising means that are able to grip on the temporary support members 51, 52. Stopping of the measuring and marking device 60 may be done so that the first brake at a first end of the measuring and marking device 60 is first closed after which the measuring and marking device 60 is set into a horizontal position by lowering or raising the opposite second end of the measuring and marking device 60 after which the second brake at the second end of the measuring and marking device 60 is closed.

[0044] The measuring and marking device 60 may be provided with a measuring apparatus 110 for scanning the shaft 20. The measuring apparatus 110 may be formed of one or more lasers. The measuring apparatus should be able to scan the shaft 20 at least in a horizontal direction. The measuring apparatus may on the other hand also be able to scan the shaft 20 in a vertical and/or in a diagonal direction in order to be able to scan the top portion and the bottom portion of the shaft 20 properly.

[0045] The measured values may be stored in the measuring apparatus and transferred to a computer e.g. a PC when the measurement phase has been completed. Another possibility is to transfer the measured values online during the measurement phase to the computer. The transfer of information may be by a wire communication or by a wireless communication.

[0046] When the measurement phase has been completed, the measured data may be used for producing a 3D model of the shaft 20. The 3D model of the shaft 20 and the elevator equipment in the shaft 20 made by the manufacturer of the elevator defines the exact location of all the fixing holes to be drilled into the shaft 20 as well as the other important points (which typically are measured during the installation of the elevator) of the elevator installation. This position information can now be combined with the real, scanned picture of the shaft 20.

[0047] The calculated data can also be combined with a Building Information Model (BIM) of the building into which the elevator is to be installed. As the shaft 20 extends vertically through the building, the measured information of the shaft 20 can be used by the builder to verify real measured shaft data with the original shaft data in the BIM model.

[0048] The system can calculate exact positions of the elevator car 10 and the counterweight ropes, so that e.g. bed plate and diverting pulleys can be installed immediately into a correct position.

[0049] The position of the upper fixing points F1, F3 of the temporary supporting elements 51, 52 in relation to the upper end of the shaft 20 must be determined or calculated beforehand. The measurement of the shaft 20 is determined in relation to the known position of the temporary support elements 51, 52.

[0050] The measuring and marking device 60 may further be provided with a marking apparatus 120 for marking the shaft 20. The marking apparatus 120 may be formed of one or several paint-ball guns. Bullets with different colours may be used in the paint-ball guns in order to differentiate the markings. The colour may e.g. indicate the size (smaller or bigger bolt) of the hole and/or the purpose (guide rail, landing doors, shaft trunking etc.) of the hole. The paint-ball guns may be adjusted horizontally in order to mark the shaft. The paint ball guns may also be adjusted vertically in order to be able to mark the top of the shaft 20 and the pit of the shaft 20.

[0051] The vertical height position of the measuring and marking device 60 in the shaft 20 can be measured with a laser based distance sensor 130 form the top of the shaft 20 or from the bottom of the pit of the shaft 20. The vertical height position of the measuring and marking device 60 can also be measured from the temporary supporting members 51, 52, if they are marked with lines, codes, etc. The vertical height position of the measuring and marking device 60 can further be measured from a separate third wire positioned in place of the plumbing line 71.

[0052] The use of a drone as the driving means in the measuring and marking device 60 is an advantageous embodiment of the invention. Another possibility would be to use an electric motor being connected via a driving wheel to a third temporary support wire positioned in place of the plumb line. The speed of the measuring and marking device 60 may be rather low e.g. 1 cm/s = 36 m/h = 864 m/d.

[0053] The plumb line 71 used to install the temporary support members 51, 52 vertically may be substituted with a laser and a prism. The laser may be positioned at the bottom of the pit in the shaft 20 and a prism may be used to indicate the position of the laser beam in the shaft 20.

[0054] The measuring and marking device 60 may be used to measure and mark any kind of elevator shaft e.g. an elevator shaft having solid concrete walls or open walls made of steel structures. The walls of the shaft 20 may be marked so that each individual mark indicates the position of a fastening means. The fastening means may be in the form of an anchor to be inserted into a hole in a concrete wall or in the form of a bolt to be inserted into a hole in a steel structure. The fastening means may be used to attach e.g. the guide rails for the car 10 and the guide rails for the counterweight 42. The fastening means may further be used to install any equipment that is needed in connection with the elevator in the shaft e.g. guide rails and landing doors.

[0055] The measuring apparatus in the measuring and marking device may advantageously be based on at least one laser. It is, however, possible to use any distance

measurement method in the measurement apparatus. An Electric Distance Measurement (EDM) method could be used. Distances are measured electronically by determining the number of full and partial waves of transmitted electromagnetic energy that are required to traveling the distance between the EDM and an object e.g. a prism.

[0056] The marking device in the measuring and marking device may advantageously be an ink-ball weapon. It is, however, possible to use any suitable marking method in the measurement apparatus. A paint sprayer or a bullet of a weapon could e.g. be used. The marking apparatus should be able to achieve a precisely allocated marking at a desired distance. The maximum distance is, however, rather limited e.g. in the order of about 3 m. The speed of the object (bullet) to be used for the marking should be high enough so that the gravity does not influence the path of the object too much. The speed should also remain rather constant in order to achieve a high precision. The marking could be achieved with an object (bullet) that will be able to clatch onto the wall of the shaft. The use of a fire gun with "normal" bullets would produce a marking in the wall, but it may be difficult to detect the mark that the bullet leaves on the wall.

[0057] The use of the invention is not limited to an elevator shaft equipped with an elevator disclosed in the figures. The invention can be used for measuring and marking a shaft for any type of elevator e.g. also for elevators lacking a machine room and/or a counterweight. The counterweight is in the figures positioned on the back wall of the elevator shaft. The counterweight could be positioned on either side wall of the shaft or on both side walls of the elevator shaft. The lifting machinery may be positioned in the shaft or in a machine room at the top of the shaft. The lifting machinery could be positioned within the shaft at the bottom or at the top or at some point between the top and the bottom of the shaft.

[0058] The invention may be used in connection with installations of an elevator to a new building and in connection with renovations of an existing elevator. The old elevator equipment is first removed from the shaft and the shaft is then measured and marked according to the invention.

[0059] It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. An arrangement for measuring and marking an elevator shaft comprising:

   two vertically in the shaft (20) extending temporary support members (51, 52), an upper end of each temporary support member (51, 52) being fixed in an upper fixing point (F1, F3) and a lower end of each temporary support member (51, 52) being fixed in a lower fixing point (F2, F4),

   a measuring and marking device (60) being movably supported on the temporary support members (51, 52) so that the measuring and marking device (60) is movable upwards and downwards along the temporary support members (51, 52).

2. The arrangement according to claim 1, wherein each of the temporary support members (51, 52) is formed of a wire being firmly tightened between the upper fixing point (F1, F3) and the lower fixing point (F2, F4) so that the lateral position of the measuring and marking device (60) is maintained during the upwards and downwards movement of the measuring and marking device (60).

3. The arrangement according to claim 1 or 2, wherein the measuring and marking device (60) is formed on a drone so that the drone provides the upwards and downwards movement of the measuring and marking device (60).

4. The arrangement according to any one of claims 1 to 3, wherein the measuring and marking device (60) is provided with a measuring apparatus (110) and a marking apparatus (120).

5. The arrangement according to claim 4, wherein the measuring apparatus (110) is based on at least one laser.

6. The arrangement according to claim 4 or 5, wherein the marking apparatus (120) is based on at least one ink-ball weapon.

7. The arrangement according to any one of claims 1 to 6, wherein the measuring and marking device (60) is supported with cylindrical support elements (61, 62) on the support members (51, 52).

8. The arrangement according to claim 7, wherein each of the cylindrical support elements (61, 62) is provided with brake means.

9. The arrangement according to any one of claims 1 to 8, wherein the upper fixing points (F1, F3) are arranged on an upper support structure (80) arranged in an upper portion of the shaft (20) or within a machine room above the shaft (20).

10. The arrangement according to any one of claims 1 to 9, wherein the lower fixing points (F2, F4) are arranged on a lower support structure (90) arranged in a lower portion of the shaft (20) preferably on the

bottom of a pit in the shaft (20).

11. A method for measuring and marking an elevator shaft comprising
arranging two vertically extending temporary support members (51, 52) in the shaft (20),
fixing an upper end of each temporary support member (51, 52) in an upper fixing point (F1, F3) and a lower end of each temporary support member (51, 52) in a lower fixing point (F2, F4),
supporting a measuring and marking device (60) movably on the temporary support members (51, 52),
measuring the shaft (20) with a measuring apparatus (110) supported on the measuring and marking device (60) during an upwards and/or downwards movement of the measuring and marking device (60) along the temporary support members (51, 52),
marking the shaft (20) with a marking apparatus (120) supported on the measuring and marking device (60) based on the results of the preceding measuring phase during an upwards and/or downwards movement of the measuring and marking device (60) along the temporary support members (51, 52).

12. The method according to claim 11 comprising
forming each of the temporary support members (51, 52) of a wire,
tightening the wire firmly between the upper fixing point (F1, F3) and the lower fixing point (F2, F4) so that the lateral position of the measuring and marking device (60) is maintained during the upwards and downwards movement of the measuring and marking device (60).

13. The method according to claim 11 or 12 comprising
forming the measuring and marking device (60) on a drone so that the drone provides the upwards and downwards movement of the measuring and marking device (60).

14. The method according to any one of claims 11 to 13 comprising
using a laser as the measuring apparatus (110).

15. The method according to any one of claims 11 to 14 comprising
using an ink-ball weapon as the marking apparatus (120).

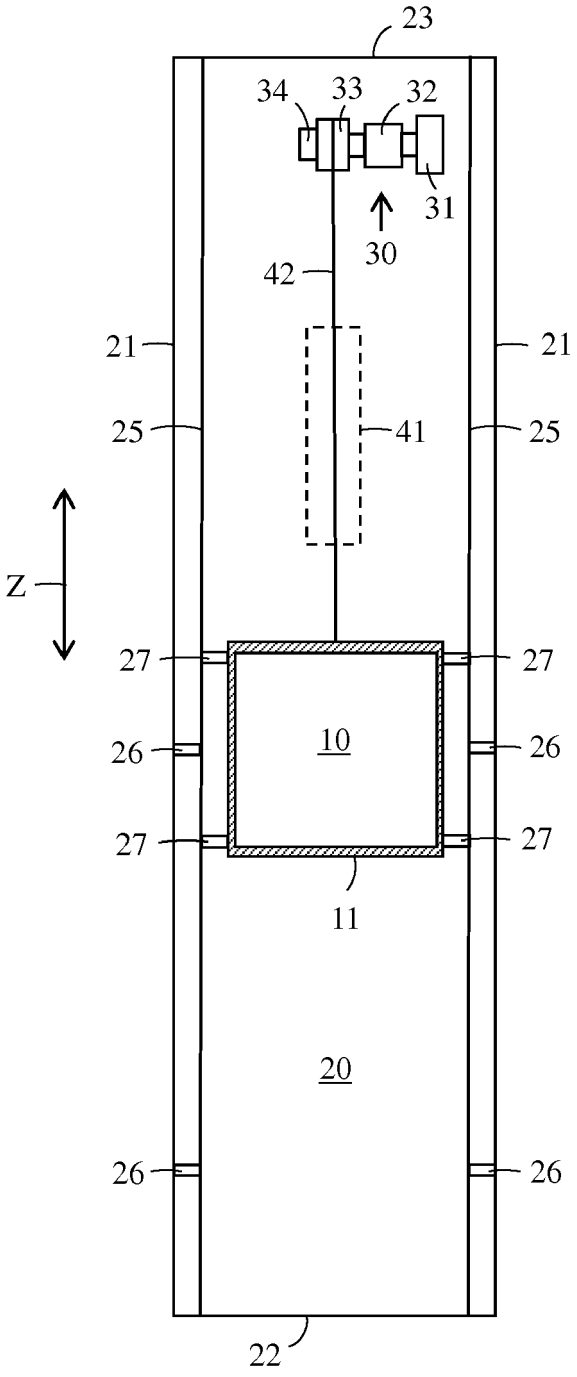


FIG. 1

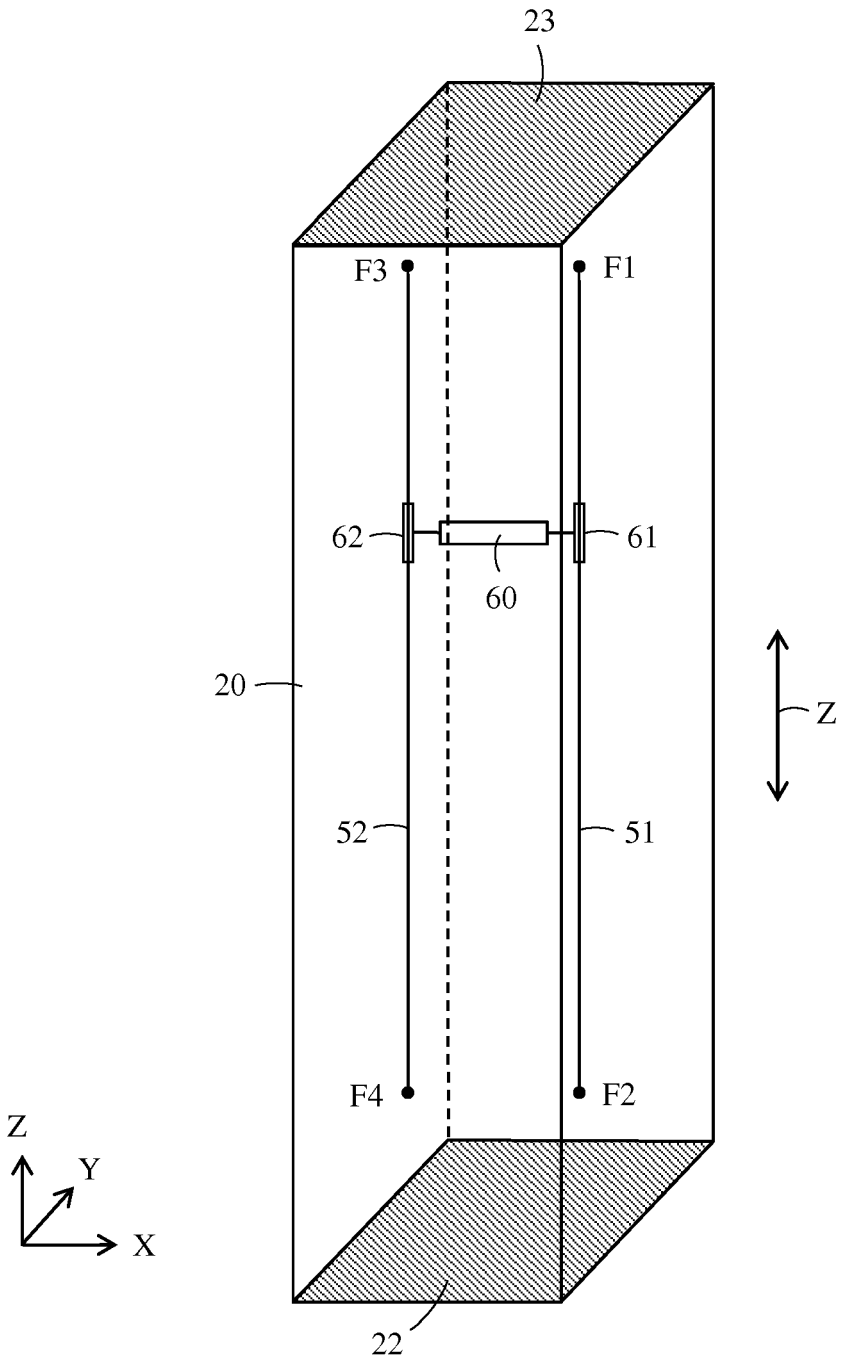
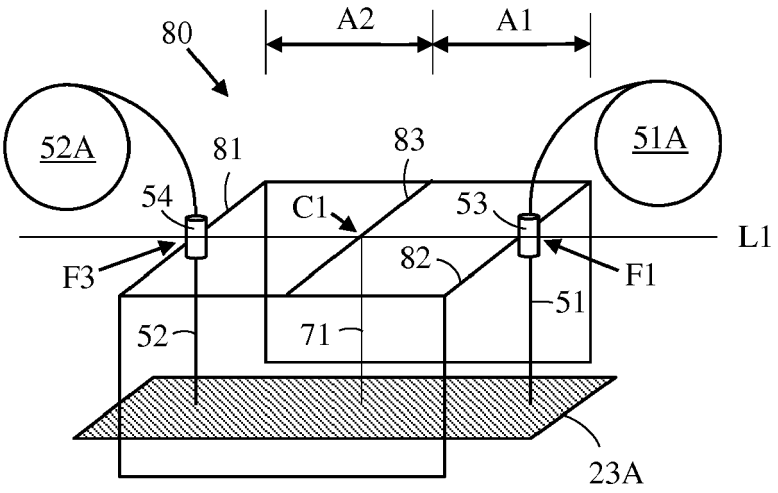


FIG. 2


80
A2
A1
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F3
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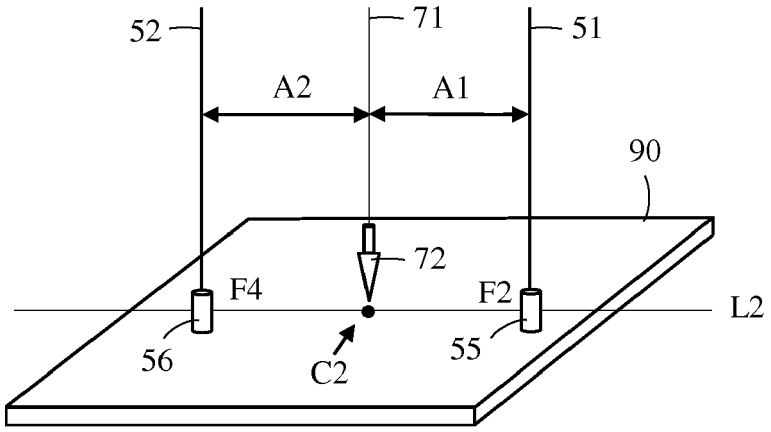
23A

FIG. 3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C2
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FIG. 4

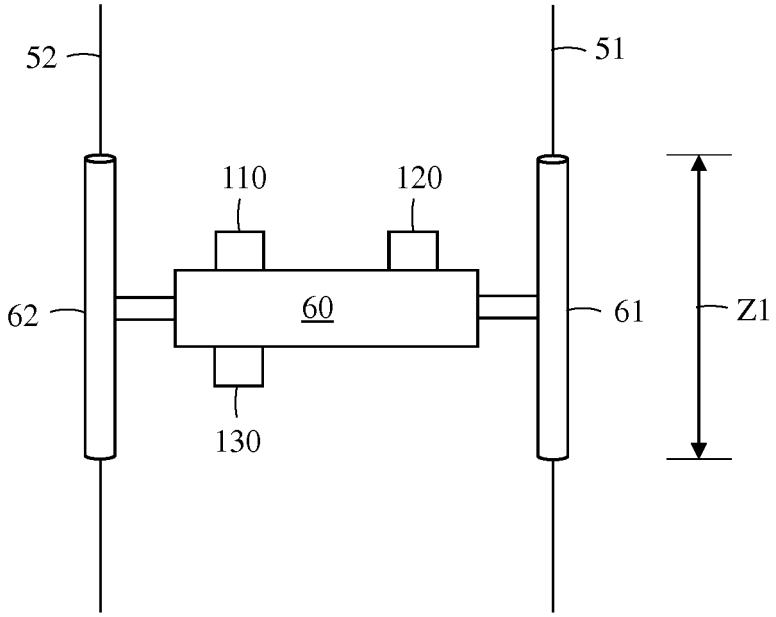

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 18 17 7667

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	JP H03 232680 A (HITACHI ELEVATOR ENG & SERVICE) 16 October 1991 (1991-10-16) * figures 1,2 *	1,4,5, 7-11,14 2,3,6, 12,13,15	INV. B66B19/00
X	US 2015/154324 A1 (REILIO ESA [FI] ET AL) 4 June 2015 (2015-06-04) * paragraphs [0076], [0086]; figure 1 *	1,4,5, 9-11,14	
A	WO 2017/167719 A1 (INVENTIO AG [CH]) 5 October 2017 (2017-10-05) * abstract *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

B66B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 November 2018	Lenoir, Xavier

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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