

ELEVATOR MAIN ROPE REPLACING METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001]

The present invention relates to an elevator main rope replacing method for replacing an old main rope as a subject to be replaced with a new main rope for new replacement.

2. Description of the Background Art

[0002]

Fig. 6 is a view for explaining an elevator main rope replacing method according to the background art.

[0003]

As shown in Fig. 6, generally, an elevator has a hoistway 100, a machine room 101 which is provided in an upper portion of the hoistway 100, and a machine beam 102 which is provided in the machine room 101. The elevator also has a cage 27 which is provided in the hoistway 100, a counter weight 20 which moves up and down relatively to the cage 27, a main rope which suspends the cage 27 and the counter weight 20 in the hoistway 100 and which will be described later, and a pair of guide rails 21a and 21b which guide the counter weight 20.

[0004]

The machine room 101 has a traction machine (not shown) which is mounted on the machine beam 102, a hoist 26 which rotates with power supplied thereto, and a beam pulley 25 which is disposed near the hoist 26 and provided rotatably. On the other hand, the cage 27 has a pulley 28 provided rotatably in its upper portion. Similarly, the counter weight 20 also has a pulley 24 provided rotatably in its upper portion. The main rope is wound around the pulley 24 in the upper portion of the counter weight 20, the beam pulley 25 in the machine room 101, the hoist 26, and the pulley 28 in the cage 27, and the opposite ends of the main rope are attached to rope sockets 23 and 29 respectively.

[0005]

Since the main rope laid thus in the hoistway 100 in order to move up and down the cage 27 and the counter weight 20 smoothly is elongated or damaged due to long-term use, an old main rope 4a, 4b as a subject to be replaced which has been laid has to be replaced with a new main rope 1 for new replacement. Much labor or time spent for the work of the main rope replacement has become an issue. Therefore, various devices are heretofore provided in the hoistway 100 in order to facilitate the work

when the old main rope 4a, 4b is replaced with the new main rope 1.

[0006]

For example, a main rope replacing jig for a 2:1 roping elevator, which has a pair of pulleys 2a and 2b, a pair of coupling members (not shown), a crossbar member 60 and a pair of guide members 7a and 7b has been proposed as one of the background-art techniques (for example, see JP-A-10-167612). The pulleys 2a and 2b are attached to a U-shaped hanging portion 1a in the state where the new main rope 1 is wound around the pulleys 2a and 2b. The U-shaped hanging portion 1a is a lower corner portion of the new main rope 1 hung like a U-shape from the machine room 101 side and above the counter weight 20 placed in a pit 104 of the hoistway 100. The coupling members are provided to protrude downward from the pulleys 2a and 2b respectively. The crossbar member 60 is provided between the pair of guide rails 21a and 21b for the counter weight 20, and linked with the pair of coupling members. The guide members 7a and 7b are fixedly provided on opposite end portions of the crossbar member 60 and attached to the guide rails 21a and 21b so as to be slidable thereon.

[0007]

Next, the main rope replacing method using the main rope replacing jig according to the background art will be described with reference to Fig. 6.

[0008]

First, as shown in Fig. 6, the counter weight 20 is fixedly supported by a support member 105 of the counter weight 20 disposed in the pit 104 of the hoistway 100, while the cage 27 is fixedly hung in the neighborhood of a highest floor 103a by means of a chain of a chain block 32b placed on the machine beam 102 of the machine room 101. After that, the old main rope 4a, 4b which has been laid is cut off and removed. Next, a rope let-off reel 37 on which the new main rope 1 for new replacement has been wound is placed on the highest floor 103a. The new main rope 1 paid out from the rope let-off reel 37 sequentially is wound on the pulley 28 of the cage 27, the hoist 26 in the machine room 101, and the beam pulley 25, and introduced into the machine room 101.

[0009]

A front end portion of the new main rope 1 introduced into the machine room 101 is fixed to the rope socket 23 on the counter weight 20 side, of the rope sockets 23 and 29. Thus, a portion of the new main rope 1 on the counter weight 20 side

in the hoistway 100 is hung like a U-shape above the counter weight 20 and from the machine room 101 side. Accordingly, the main rope replacing jig 50 according to the background art is attached to a lower side of the U-shaped hanging portion 1a. That is, after the pulleys 2a and 2b are attached to the lower corner parts of the U-shaped hanging portion 1a of the new main rope 1 respectively, the crossbar member 60 is placed between the guide rails 21a and 21b on the counter weight 20 side by means of the guide members 7a and 7b so that the pulleys 2a and 2b are integrated with the crossbar member 60.

[0010]

When the main rope replacing jig 50 according to the background art is thus attached to the lower side of the U-shaped hanging portion 1a of the new main rope 1, the U-shaped hanging portion 1a is guided by the guide rails 21a and 21b so as to move downward gradually due to the own weight of the main rope replacing jig 50. The U-shaped hanging portion 1a thus moves down to the neighborhood of the pulley 24 for the counter weight 20. The new main rope 1 is detached from the pulleys 2a and 2b so that the U-shaped hanging portion 1a is wound around the pulley 24 for the counter weight 20.

[0011]

Next, one of the opposite ends of the new main rope 1 on the cage 27 side is wound on the pulley 28 for the cage 27, and this end is then fixed to the rope socket 29 on the cage 27 side, of the rope sockets 23 and 29. Thus, the main rope replacing work for removing the old main rope 4a, 4b and laying the new main rope 1 is terminated. Then, the main rope replacing jig 50 according to the background art is disassembled and removed from the guide rails 21a and 21b on the counter weight 20 side. The main rope replacing jig 50 is transported to the neighborhood of the highest floor 103a. The procedure of the aforementioned replacing work is carried out in the same manner on all the other old main ropes which have been laid.

SUMMARY OF THE INVENTION

[0013]

The main rope replacing method using the aforementioned background-art main rope replacing jig 50 for a 2:1 roping elevator disclosed in JP-A-10-167612 is designed in such a manner that a laying work of laying the new main rope 1 for new replacement is performed after the take-up work of cutting and taking up the old main rope 4a, 4b which has been laid is performed. Therefore, there is a problem that the two works, that is, the work of taking up the old main rope 4a, 4b and the work of laying

the new main rope 1 cannot be carried out simultaneously, but it takes much time after the start of the main rope replacing work and before the termination of the main rope replacing work.

[0014]

In addition, in the main rope replacing method using the background-art main rope replacing jig 50 for a 2:1 roping elevator, when the old main rope 4a, 4b is cut off, the cut-off old main rope 4a, 4b may fall down on the pit 104 of the hoistway 100 or be scattered and lost according to the work condition, so that there is a possibility that the old main rope 4a, 4b may be caught and entwined with a device in the hoistway 100. In this case, when a worker 36 on a lowest floor 103b wants to take up the old main rope 4a, 4b onto the rope take-up reel 38, the worker 36 may not be able to take up the old main rope 4a, 4b smoothly. Thus, there is a fear that it may take extra time accordingly.

[0015]

Further, in the main rope replacing method using the background-art main rope replacing jig 50 for a 2:1 roping elevator, tension whose magnitude is high enough to prevent torsion or deflection from occurring in the U-shaped hanging portion 1a must be given to the new main rope 1 when the main

rope replacing jig 50 moves down from the upper portion of the hoistway 100 to the pulley 24 for the counter weight 20. The aforementioned main rope replacing method is designed so that the tension having the aforementioned magnitude is given to the new main rope 1 by the main rope replacing jig 50 whose own weight is made heavier. Thus, there is a fear that a burden on workers for the main rope replacing work including the work of carrying the main rope replacing jig 50 to the site and the work of installing the main rope replacing jig 50 in the site may increase.

[0016]

The present invention has been accomplished in consideration of such actual circumstances in the background art. An object of the invention is to provide an elevator main rope replacing method by which a main rope replacing work can be performed rapidly and the burden on workers engaging in the main rope replacing work can be lightened.

[0017]

In order to attain the foregoing object, the elevator main rope replacing method according to the invention is an elevator main rope replacing method which is applied to an elevator including a cage provided in a hoistway, a counter

weight suspended with the cage by a main rope, a pair of guide rails for guiding the counterweight, and a machine room provided in an upper portion of the hoistway, and in which an old main rope as a subject to be replaced is replaced by a new main rope for new replacement using an elevator main rope replacing jig including a crossbar member which is provided between the pair of guide rails and disposed above the counterweight, guide members which are fixedly provided on opposite end portions of the crossbar member and attached to the pair of guide rails so as to be slidable thereon, a pulley which is attached to the crossbar member in the state where the new main rope is wound on the pulley, and a rope connection unit which is provided on the crossbar member so as to connect the old main rope therewith, the main rope replacing method including: a mounting step of suspending the new main rope from the machine room and mounting the new main rope on the pulley; a connecting step of connecting the old main rope with the rope connection unit; and a moving step of moving the crossbar member downward.

[0018]

According to the invention configured thus, when the old main rope as a subject to be replaced is replaced with the new main rope for new replacement, in the mounting step, the new

main rope is wound on the pulley and the pulley in this state is attached to the crossbar member provided between the guide rails. In the connecting step, the old main rope is connected to the rope connection unit provided on the crossbar member. In the moving step, the crossbar member is then moved down along the guide rails by the guide members while holding the new main rope and the old main rope. While the new main rope is paid out into the hoistway, the old main rope can be taken up from a lower portion of the hoistway. Thus, two works including the work of taking up the old main rope and the work of laying the new main rope can be carried out simultaneously. It is therefore possible to carry out the main rope replacing work efficiently.

[0019]

In addition, as described above, in the moving step, the old main rope is held by the crossbar member till the crossbar member moves down and reaches the lower portion of the hoistway. Accordingly, when a worker waiting in the lower portion of the hoistway detaches the old main rope from the rope connection unit, the worker can take up the old main rope easily without entwining the old main rope with any device in the hoistway. Thus, the work of taking up the old main rope can be carried

out so smoothly that the time spent for the main rope replacing work can be shortened.

[0020]

Further, according to the invention, the old main rope is connected to the rope connection unit in the connecting step so that tension can be applied to the new main rope due to the load of the old main rope on the crossbar member. Accordingly, it is possible to lighten each member correspondingly. Thus, workers can carry each member for use easily into the hoistway so that the workers can assemble or disassemble the member easily. In this manner, the main rope replacing work can be carried out rapidly, and the burden on the workers for the main rope replacing work can be lightened.

[0021]

In addition, according to the invention, there is provided an elevator main rope replacing method in the aforementioned configuration, wherein: the main rope replacing jig further includes a hoist which is provided in a top portion of the hoistway and which hangs the crossbar member; and in the moving step, the crossbar member is moved downward by the hoist of the main rope replacing jig. With this configuration, the load of the old main rope on the crossbar member can be shared between the

hoist and the new main rope. Accordingly, the hoist does not have to have performance required for holding the whole load of the old main rope. It is therefore possible to lighten the weight of the hoist.

[0022]

In addition, according to the invention, there is provided an elevator main rope replacing method in the aforementioned configuration, further including: a lifting-up step of lifting up the crossbar member by means of the hoist of the main rope replacing jig after the moving step is carried out. With this configuration, the operation of moving up/down the crossbar member can be controlled by the hoist. Accordingly, when the crossbar member which has moved down to the lower portion of the hoistway in the moving step is lifted up by the hoist in the lifting-up step, the crossbar member can be brought back to the upper portion of the hoistway again. Thus, it is unnecessary to disassemble the main rope replacing jig and reassemble it in order to take up another remaining old main rope which has been laid. Accordingly, it is possible to enhance the efficiency of the main rope replacing work.

[0023]

According to the elevator main rope replacing method

according to the invention, the new main rope is attached to the crossbar member by the pulley in the mounting step, the old main rope is connected to the rope connection unit provided on the crossbar member in the connecting step, and the crossbar member is moved down along the guide rails by the guide members in the moving step. Thus, two works including the work of taking up the old main rope and the work of laying the new main rope can be carried out simultaneously. Particularly since the old main rope in downward movement is held by the crossbar member in the moving step, the old main rope can be removed and taken up easily in the lower portion of the hoistway. In addition, the crossbar member can be moved down using the load of the old main rope so that each member can be lightened. In this manner, the main rope replacing work can be carried out rapidly while the burden on workers for the main rope replacing work can be lightened. Thus, higher workability than in the background art can be secured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

Fig. 1 is a flow chart for explaining the configuration of an embodiment of an elevator main rope replacing method according to the invention;

Fig. 2 is a view showing the configuration of a main rope replacing jig for use in the embodiment of the elevator main rope replacing method according to the invention;

Fig. 3 is a view showing the configuration of a 2:1 roping elevator to which the embodiment of the elevator main rope replacing method according to the invention is applied;

Fig. 4 is a view for explaining the embodiment of the elevator main rope replacing method according to the invention, which view explains a mounting step and a connecting step;

Fig. 5 is a view for explaining the embodiment of the elevator main rope replacing method according to the invention, which explains a moving step; and

Fig. 6 is a view for explaining the work of replacing a main rope using an elevator main rope replacing jig according to the background art.

DETAILED DESCRIPTION OF THE INVENTION

[0025]

An embodiment of an elevator main rope replacing method according to the present invention will be described below with reference to the drawings. Parts the same as those in the aforementioned description of the background art will be referred to by the same numerals and signs correspondingly.

[0026]

For example, an elevator to which the embodiment of the elevator main rope replacing method according to the invention is applied includes a cage 27 provided in a hoistway 100 and stopping at every floor, a counter weight 20 suspended with the cage 27 by means of a main rope 4, and a pair of guide rails 21a and 21b for guiding the counter weight 20, as shown in Fig.

3. In this embodiment, the elevator consists of a 2:1 roping elevator, and the main rope replacing work which uses the embodiment is chiefly performed at a highest floor 103a and a lowest floor 103b of the floors, as will be described later. In addition, a plurality of main ropes 4 have been laid.

[0027]

The hoistway 100 has a machine room 101 provided in an upper portion thereof, a machine beam 102 provided in the machine room 101, and a pit 104 to which a support member 105 which will be described later is attached. In addition, the machine room 101 has a traction machine (not shown) which is mounted on the machine beam 102, a hoist 26 which rotates with power supplied thereto, a beam pulley 25 which is disposed near the hoist 26 and provided rotatably, and rope ends 22 and 30 which fix opposite ends of the main rope 4 to the machine beam 102

through rope sockets 23 and 29.

[0028]

On the other hand, the cage 27 has a pulley 28 which is rotatably provided in an upper portion thereof. Similarly, the counter weight 20 also has a pulley 24 which is rotatably provided in an upper portion thereof. The main rope 4 is wound on the pulley 24 in the upper portion of the counter weight 20, the beam pulley 25 in the machine room 101, the hoist 26, and the pulley 28 in the cage 27. The opposite ends of the main rope 4 are attached to the rope sockets 23 and 29 respectively.

[0029]

For the sake of convenience, in the embodiment, the part of the old main rope 4 between the rope socket 23 and the center wound around the pulley 24 of the counter weight 20 is referred to as an old main rope 4a, the part of the old main rope 4 between the center wound around the pulley 24 of the counter weight 20 and a top portion of the hoistway 100 is referred to as an old main rope 4b, and the part of the old main rope 4 between the top portion of the hoistway 100 and the rope socket 29 is referred to as an old main rope 4c, as shown in Fig. 3.

[0030]

In the embodiment, as shown in Fig. 2, a main rope replacing jig 11 used for replacing an old main rope 4 as a subject to be replaced with a new main rope 1 for new replacement has a crossbar member 6 which is provided between the pair of guide rails 21a and 21b and disposed above the counter weight 20, guide members 7a and 7b which are fixedly provided on opposite end portions of the crossbar member 6 and attached to the pair of guide rails 21a and 21b so as to be slidable thereon, a pair of pulleys 2a and 2b which are attached to the crossbar member 6 in the state where the new main rope 1 is wound on the pulleys 2a and 2b, and rope connection units 5a and 5b which will be described later and which are provided on the crossbar member 6 so as to connect the old main ropes 4a and 4b therewith.

[0031]

Specifically, the crossbar member 6 consists of a pair of single bars 6a and 6b each of which is, for example, formed into an L-shape in section. The single bars 6a and 6b are provided to be put on top of each other so as to be slidable on each other. That is, a pair of long holes 9a and 9b are provided in one of opposite ends of one piece of each single bar 6a, 6b, and a guide member 7a, 7b is provided in the other end of the single bar 6a, 6b.

[0032]

Of pieces of the single bars 6a and 6b, the pieces where the long holes 9a and 9b are provided are put on top of each other so that the single bar 6a is located on the upper side and the single bar 6b is located on the lower side. Bolts 8a1 and 8b1 are inserted into the long holes 9a and 9b of the single bars 6a and 6b through plain washers 8a2 and 8a2. The bolts 8a1 and 8b1 are fastened to nuts 8a5 and 8b5 through plain washers 8a3 and 8b3 and spring washers 8a4 and 8b4.

[0033]

Accordingly, the single bars 6a and 6b are slid in their longitudinal direction in the state where the bolts 8a1 and 8b1 put into the long holes 9a and 9b of the single bars 6a and 6b respectively are loosely inserted into the long holes 9a and 9b before the bolts 8a1 and 8b1 are entirely fastened to the nuts 8a5 and 8b5. Thus, the total length of the crossbar member 6 can be adjusted. The long hole 9a and the long hole 9b provided in each single bar 6a, 6b are symmetric with respect to a perpendicular line L at the center of the crossbar member 6.

[0034]

In addition, the crossbar member 6 has a pair of protrusion

portions 3a and 3b which are provided to protrude upward on upper surfaces of the pieces of the single bars 6a and 6b where the long holes 9a and 9b are provided. The protrusion portions 3a and 3b are located on opposite sides of the long holes 9a and 9b. The protrusion portions 3a and 3b are disposed symmetrically with respect to the perpendicular line L at the center. The aforementioned pair of pulleys 2a and 2b are engaged with these protrusion portions 3a and 3b in the state where a lower corner portion of the new main rope 1 suspended like a U-shape from the machine room 101 side, that is, a U-shaped hanging portion 1a has come into sliding contact with the pulleys 2a and 2b. When side face parts of the pulleys 2a and 2b are removed, the new main rope 1 can be attached thereto or detached therefrom.

[0035]

The rope connection units 5a and 5b consist of a pair of through holes 5a1 and 5b1 and a pair of rope connection portions. Each through hole 5a1, 5b1 is provided in the piece of the single bar 6a, 6b where the protrusion portions 3a and 3b are provided. The through hole 5a1, 5b1 is located between the protrusion portion 3a, 3b and the guide member 7a, 7b. The rope connection portions are inserted into the through holes 5a1 and 5b1

respectively. A male thread is formed in one end of each rope connection portion, and the old main rope 4a, 4b is linked with the other end thereof. For example, each rope connection portion consists of an eyebolt 5a2, 5b2, a plain washer 5a3, 5b3 and a spring washer 5a4, 5b4 inserted onto the eyebolt 5a2, 5b2, and a nut 5a5, 5b5 screwed to the male thread of the eyebolt 5a2, 5b2. The through holes 5a1 and 5b1 are symmetric with respect to the perpendicular line L at the center of the crossbar member 6.

[0036]

As shown in Fig. 4, the main rope replacing jig 11 has a hoist 31a for suspending the crossbar member 6. The hoist 31a is provided in the top portion of the hoistway 100. The crossbar member 6 has a mounting hole 10 into which a hoist rope 31b paid out from the hoist 31a is inserted. The mounting hole 10 is provided in the piece of the upper single bar 6a where the long holes 9a and 9b are not provided. The mounting hole 10 is disposed at the center of the crossbar member 6 so that the single bars 6a and 6b can be kept horizontal.

[0037]

Next, an embodiment of the main rope replacing method according to the invention will be described in detail based

on the flow chart of Fig. 1 and with reference to Figs. 4 and 5.

[0038]

Fig. 1 is a flow chart for explaining the configuration of the embodiment of the elevator main rope replacing method according to the invention. Fig. 4 is a view for explaining the embodiment of the elevator main rope replacing method according to the invention, which view explains a mounting step and a connecting step. Fig. 5 is a view for explaining the embodiment of the elevator main rope replacing method according to the invention, which view explains a moving step.

[0039]

The embodiment of the elevator main rope replacing method according to the invention includes a mounting step of suspending a new main rope 1 from the machine room 101 and mounting the new main rope 1 on the pulleys 2a and 2b, a connecting step of connecting old main ropes 4a and 4b with the rope connection units 5a and 5b, a moving step of moving the crossbar member 6 downward, and a lifting-up step of lifting up the crossbar member 6 by means of the hoist 31a of the main rope replacing jig 11 after the moving step is carried out. In this embodiment, the crossbar member 6 is moved down by the hoist 31a in the

moving step, and the crossbar member 6 is lifted up by the hoist 31a in the lifting-up step.

[0040]

Specifically, as shown in Fig. 4, first, a worker (not shown) on the lowest floor 103b places the support member 105 for supporting the counterweight 20 in the pit 104 of the hoistway 100, while a worker 33 on the cage 27 drives and lifts up the cage 27 so as to move the counter weight 20 down to the support member 105. The counter weight 20 is fixed to the support member 105. After that, the worker 33 on the cage 27 fixes the cage 27 to the machine beam 102 by means of a chain of a chain block 32b which is provided on the cage 27 side of the machine beam 102 in the machine room 101. Thus, the cage 27 is suspended near the highest floor 103a (Step (hereinafter abbreviated to "S") 1).

[0041]

The worker 33 on the cage 27 installs the aforementioned main rope replacing jig 11 between the guide rails 21a and 21b on the counter weight 20 side. On this occasion, the single bars 6a and 6b of the crossbar member 6 of the main rope replacing jig 11 are slid in their longitudinal direction to adjust the total length suitably to put the main rope replacing jig 11

between the guide rails 21a and 21b so that the guide members 7a and 7b are engaged with the guide rails 21a and 21b. Then, the hoist rope 31b of the hoist 31a placed on the machine beam 102 in the machine room 101 is inserted into the mounting hole 10 of the crossbar member 6 (S2).

[0042]

Next, the worker 33 connects the old main rope 4a to the chain of the chain block 32a provided on the counter weight 20 side of the machine beam 102, and removes the old main rope 4a from the rope socket 23 on the counter weight 20 side. Next, the worker 33 operates the chain block 32a so as to move the removed old main rope 4a to the neighborhood of the rope connection unit 5a.

[0043]

Next, the worker 33 couples an upper end of the old main rope 4a to the eyebolt 5a2 and inserts one of the opposite ends of the eyebolt 5a2 where a male thread is formed, into the through hole 5a1 of the single bar 6a in an upward direction, as shown in Fig. 2. Then, the worker 33 screws the nut 5a5 to the male thread of the eyebolt 5a2 at the one end of the eyebolt 5a2 through the plain washer 5a3 and the spring washer 5a4. After that, the worker 33 removes the chain of the chain block 32a

from the old main rope 4a (S3).

[0044]

Next, the worker 33 connects the old main ropes 4b and 4c of the old main rope 4 to the chain of the chain block 32a and cuts the old main rope 4 in the part which is located in the top portion of the hoistway 100. Thus, the old main rope 4 is separated into the old main rope 4b and the old main rope 4c. The worker 33 operates the chain block 32a so as to move the old main rope 4b to the neighborhood of the rope connection unit 5b.

[0045]

Next, the worker 33 couples an upper end of the old main rope 4b to the eyebolt 5b2 and inserts one of the opposite ends of the eyebolt 5b2 where a male thread is formed, into the through hole 5b1 of the single bar 6b in an upward direction, as shown in Fig. 2. Then, the worker 33 screws the nut 5b5 to the male thread of the eyebolt 5b2 at the one end of the eyebolt 5b2 through the plain washer 5b3 and the spring washer 5b4. After that, the worker 33 removes the chain of the chain block 32a from the old main rope 4b (S4).

[0046]

On this occasion, tension applied to the old main ropes

4a and 4b is released so that the old main ropes 4a and 4b are loosened. Accordingly, a worker 36 on the lowest floor 103b places an access platform 106 in the lower portion of the hoistway 100. The access platform 106 is set to be substantially as high as the counter weight 20. The worker 36 gets on the access platform 106 and removes, from the pulley 24 of the counter weight 20, the lower corner portion of the old main rope 4 suspended like a U-shape from the machine room 101 side, that is, the U-shaped hanging portion. The worker 36 on the access platform 106 cuts the center of the U-shaped hanging portion of the old main rope 4 so as to separate the old main rope 4 into the old main rope 4a and the old main rope 4b (S5).

[0047]

Next, a worker 35 in the machine room 101 pulls up one of the opposite ends of the old main rope 4c on the counter weight 20 side from the hoistway 100, removes the old main rope 4c from the beam pulley 25 and the hoist 26 and pulls up the old main rope 4c to the machine room 101. Then, the worker 33 on the cage 27 removes the old main rope 4c from the rope socket 29 on the cage 27 side. On this occasion, the opposite ends of the old main rope 4c are released. Accordingly, the worker 33 on the cage 27 lets off the old main rope 4c from

above the cage 27 toward the worker 35 in the machine room 101. The worker 35 in the machine room 101 receives, pulls up and takes up the old main rope 4c (S6).

[0048]

When the worker 35 in the machine room 101 then hangs a hemp rope (not shown) into the hoistway 100, the worker 33 on the cage 27 receives one end of the hemp rope and lets off the hemp rope to a worker 34 on the highest floor 103a. The worker on the floor 103a receives the hemp rope from the worker 33 on the cage 27, pulls out the new main rope 1 from the rope let-off reel 37 having the new main rope 1 wound thereon, and connects the new main rope 1 to the hemp rope (S7).

[0049]

When the worker 34 on the highest floor 103a then lets off the new main rope 1 together with the hemp rope toward the worker 33 on the cage 27, the worker 33 on the cage 27 receives the hemp rope and the new main rope 1 and pulls them out onto the cage 27 (S8). Then, the worker 35 in the machine room 101 receives the hemp rope and the new main rope 1 from the worker 33 on the cage 27, and pulls up them into the machine room 101. The worker 35 winds the new main rope 1 around the hoist 26 and the beam pulley 25 and then lets off the new main rope 1

toward the counter weight 20 side in the hoistway 100 (S9).

[0050]

Next, the worker 33 on the cage 27 winds the new main rope 1 let off toward the counter weight 20 side in the hoistway 100, around the pulleys 2a and 2b of the main rope replacing jig 11, and attaches a front end of the new main rope 1 to the rope socket 23 on the counter weight 20 side (S10). Thus, the main rope replacing jig 11 holds the new main rope 1 attached in the step S10, the old main rope 4a connected in the step S3 and the old main rope 4b connected in the step S4.

[0051]

Next, the worker 33 on the cage 27 operates the hoist 31a to let off the hoist rope 31b from the hoist 31a as shown in Fig. 5. Thus, the main rope replacing jig 11 is moved down along the guide rails 21a and 21b through the guide members 7a and 7b. That is, the own weight of the main rope replacing jig 11 and the loads of the old main ropes 4a and 4b are supported by the hoist rope 31b and the new main rope 1. When the hoist rope 31b is let off, the main rope replacing jig 11 moves in the direction of an arrow 39 due to its own weight and the loads of the old main ropes 4a and 4b.

[0052]

As the main rope replacing jig 11 moves down on this occasion, the worker 34 on the highest floor 103a holds the rope let-off reel 37 while rotating it to let off the new main rope 1 in the direction of an arrow 42. As the main rope replacing jig 11 moves down, the worker 35 in the machine room 101 lets off the new main rope 1 in the direction of an arrow 41 while pressing the beam pulley 25. Thus, the new main rope 1 is let off in the direction of an arrow 40 on the counter weight 20 side in the hoistway 100 (S11).

[0053]

On the other hand, the worker 36 on the access platform 106 moves to the lowest floor 103b while pulling out the hanging old main ropes 4a and 4b, and connects the lower ends of the old main ropes 4a and 4b to the rope take-up reel 38 (S12). Then, the worker 36 on the lowest floor 103b winds up and takes up the old main ropes 4a and 4b around the rope take-up reel 38 (S13).

[0054]

Next, when the main rope replacing jig 11 moves down to the neighborhood of the pulley 24 of the counter weight 20 and the new main rope 1 is laid in the hoistway 100 so as to have a length with which the new main rope 1 can be wound around

the pulley 24, the worker 36 on the floor 103b enters the hoistway 100, gets on the access platform 106, detaches the U-shaped hanging portion 1a of the new main rope 1 from the pulleys 2a and 2b and winds the U-shaped hanging portion 1a around the pulley 24 of the counter weight 20. At the same time, the worker 33 on the cage 27 attaches the other end of the new main rope 1 to the rope socket 29 on the cage 27 side (S14).

[0055]

Next, the worker 36 on the lowest floor 103b detaches, from the eyebolts 5a2 and 5b2, one ends of the old main ropes 4a and 4b connected to the rope connection units 5a and 5b of the main rope replacing jig 11, and winds up all the old main ropes 4a and 4b around the rope take-up reel 38. Thus, the old main ropes 4a and 4b are taken up in the direction of arrows 43 and 44 (S15). Next, the worker 33 on the cage 27 determines whether the work of replacing all the main ropes has been completed or not (S16).

[0056]

When the worker 33 on this occasion concludes that the work of replacing all the main ropes has not been completed, the worker 33 operates the hoist 31a to wind up the hoist rope 31b of the hoist 31a so that the main rope replacing jig 11

which has moved down to the neighborhood of the pulley 24 of the counter weight 20 in the step S11 is lifted up to the top portion of the hoistway 100 (S17). Then, the procedure returns to the operation of the step S3. After that, the operation of the steps S3 to S15 is carried out upon another old main rope as a next subject to be replaced among the remaining old main ropes 4.

[0057]

On the other hand, when the worker 33 concludes in the step S16 that the work of replacing all the main ropes has been completed, the worker 33 removes the main rope replacing jig 11 from the guide rails 21a and 21b (S18), and terminates the main rope replacing work using the embodiment.

[0058]

According to the embodiment configured thus, when the old main rope 4 as a subject to be replaced is replaced with the new main rope 1 for new replacement, the crossbar member 6 of the main rope replacing jig 11 as described in step S11 in the moving step moves down along the guide rails 21a and 21b by means of the guide members 7a and 7b while holding the new main rope 1 and the old main ropes 4a and 4b. Accordingly, the old main ropes 4a and 4b can be taken up from the lower

portion of the hoistway 100 while the new rope 1 is paid out into the hoist way 100. Thus, two works, i.e. the work of taking up the old main ropes 4a and 4b and the work of laying the new main rope 1 can be carried out simultaneously. It is therefore possible to carry out the main rope replacing work efficiently.

[0059]

In addition, as in described the step S11 in the moving step, the old main ropes 4a and 4b are held by the crossbar member 6 till the main rope replacing jig 11 moves down and reaches the neighborhood of the pulley 24 of the counter weight 20. Accordingly, when the worker 36 on the access platform 106 detaches the old main ropes 4a and 4b from the rope connection units 5a and 5b, the old main ropes 4a and 4b can be taken up easily in the steps S11 to S13 without being entwined with any device in the hoistway 100. Thus, the work of taking up the old main ropes 4a and 4b can be carried out smoothly. It is therefore possible to shorten the time spent for the main rope replacing work.

[0060]

Particularly when the building where the elevator is installed is a high-rise building, the old main ropes 4a and 4b which have been laid are heavy. As described above, the

old main ropes 4a and 4b can be moved down to the lower portion of the hoistway 100 easily by the main rope replacing jig 11. Accordingly, it is possible to save the labor for installing a high-capacity rope let-down apparatus used for letting down heavy main ropes.

[0061]

Further, as described in the steps S3 and S4 in the connecting step, the old main ropes 4a and 4b are connected to the rope connection units 5a and 5b, so that tension is applied to the new main rope 1 due to the loads of the old main ropes 4a and 4b on the crossbar member 6. It is therefore possible to lighten each member correspondingly. Thus, workers can carry each member for use easily into the hoistway 100 so that the workers can assemble or disassemble the members easily. In this manner, the main rope replacing work can be carried out rapidly, and the burden on the workers for the main rope replacing work can be lightened. Thus, high workability can be secured.

[0062]

In addition, according to the embodiment, the loads of the old main ropes 4a and 4b on the crossbar member 6 of the main rope replacing jig 11 can be shared between the hoist 31a

and the new main rope 1 in the moving step. Accordingly, the hoist 31a does not have to have performance required for holding all the loads of the old main ropes 4a and 4b. It is therefore also possible to lighten the weight of the hoist 31a. Thus, it is easy to carry the hoist 31a. Accordingly, the worker 35 in the machine room 101 can install the hoist 31a on the machine beam 102 easily. It is also possible to carry out preparation for the main rope replacing work rapidly.

[0063]

In addition, according to the embodiment, the hoist 31a is provided in the top portion of the hoistway 100, and the hoist rope 31b of the hoist 31a is inserted into the mounting hole 10 of the main rope replacing jig 11. Accordingly, the operation for moving up/down the main rope replacing jig 11 can be controlled by the hoist 31a. Therefore, when the main rope replacing jig 11 moving down to the neighborhood of the pulley 24 of the counter weight 20 as described in the step S11 in the moving step is lifted up to the top portion of the hoistway 100 by the hoist 31a in the lifting-up step, the main rope replacing jig 11 can be moved back to the top portion of the hoistway 100 again. Thus, it is unnecessary to disassemble the main rope replacing jig 11 provided between the guide rails

21a and 21b, and reassemble it in order to take up another remaining old main rope 4 which has been laid. Accordingly, it is possible to enhance the efficiency of the main rope replacing work.

[0064]

Although the aforementioned embodiment has been described in the case where the rope connection portions of the rope connection units 5a and 5b include the eyebolts 5a2 and 5b2, the invention is not limited to the case. The rope connection portions may be any members if they can support the loads of the old main ropes 4a and 4b which have been cut off. For example, the rope connection portions may be members such as bind wires which can fasten the ropes or members such as rope sockets which can pinch the ropes.

What is claimed is:

1. An elevator main rope replacing method which is applied to an elevator including a cage provided in a hoistway, a counter weight suspended with the cage by a main rope, a pair of guide rails for guiding the counter weight, and a machine room provided in an upper portion of the hoistway, and by which an old main rope as a subject to be replaced is replaced by a new main rope for new replacement using an elevator main rope replacing jig including:

a crossbar member which is provided between the pair of guide rails and disposed above the counter weight;

guide members which are fixedly provided on opposite end portions of the crossbar member and attached to the pair of guide rails so as to be slidable thereon;

a pulley which is attached to the crossbar member in the state where the new main rope is wound on the pulley; and

a rope connection unit which is provided on the crossbar member so as to connect the old main rope therewith;

the main rope replacing method comprising:

a mounting step of suspending the new main rope from the machine room and mounting the new main rope on the pulley;

a connecting step of connecting the old main rope with

the rope connection unit; and

a moving step of moving the crossbar member downward.

2. An elevator main rope replacing method according to Claim 1, wherein:

the main rope replacing jig further includes a hoist which is provided in a top portion of the hoistway and which hangs the crossbar member; and

in the moving step, the crossbar member is moved downward by the hoist.

3. An elevator main rope replacing method according to Claim 2, further comprising:

a lifting-up step of lifting up the crossbar member by the hoist of the main rope replacing jig after the moving step is carried out.