number of man-hours of the alignment process depending on the skill level of the worker.

[0005] It is thus preferable to provide a rail installation assist device, a rail installation assist method, a rail installation assist system, and a computer program product which can perform an alignment process efficiently and accurately.

SUMMARY

[0006] According to a first aspect, there is provided a rail installation assist device including at least control circuitry. The control circuitry is configured to: perform rail behavior simulation/travelling simulation using a simulation model; acquire displacement information representing displacement of individual rail brackets and rail joints from a reference position, the rail brackets that fix guide rails in an elevator shaft, the rail joints that joins the guide rails together; estimate, from the displacement information, a change in the displacement information of the rail brackets and the rail joints when the rail brackets are moved to given target positions; calculate an evaluation value for variation in the displacement information before the change and an evaluation value for variation in the displacement information after the change; and set positions of the rail brackets based on a result of comparison between the evaluation values.

[0006a] According to a second aspect, there is provided a rail installation assist method to be performed by a rail installation assist device including at least control circuitry, the method including: by the control circuitry, performing rail behavior simulation/travelling simulation using a simulation model; acquiring displacement information representing displacement of individual rail brackets and

rail joints from a reference position, the rail brackets that fix guide rails in an elevator shaft, the rail joints that joins the guide rails together; estimating, from the displacement information, a change in the displacement information of the rail brackets and the rail joints when the rail brackets are moved to given target positions; calculating an evaluation value for variation in the displacement information before the change and an evaluation value for variation in the displacement information after the change; and setting positions of the rail brackets based on a result of comparison between the evaluation values.

[0006b] According to a third aspect, there is provided a rail installation assist method to be performed by a rail installation assist device including at least control circuitry, the method including: by the control circuitry, performing rail behavior simulation/travelling simulation using a simulation model; acquiring displacement information representing displacement of individual rail brackets and rail joints from a reference position, the rail brackets that fix guide rails in an elevator shaft, the rail joints that joins the guide rails together; estimating, from the displacement information, a change in the displacement information of the rail brackets and the rail joints when the rail brackets are moved to given target positions; estimating vibration to occur on an elevator car when travelling along the guide rails of a rail form which is based on each of the displacement information before the change and the displacement information after the change; calculating a vibration evaluation value for an estimate of the vibration based on the displacement information before the change and a vibration evaluation value for an estimate of the vibration based on the displacement information after the change; and setting positions of the rail brackets based on a result of comparison between the vibration evaluation values.

[0006c] According to a fourth aspect, there is provided a rail installation assist system, including: a rail installation assist device including at least control circuitry; and a server device including at least control circuitry, wherein the server device and the rail installation assist device are communicably connected to each other, wherein the control circuitry of the rail installation assist device, configured to: perform rail behavior simulation/travelling simulation using a simulation model; acquire displacement information representing displacement of individual rail brackets and rail joints from a reference position, the rail brackets that fix guide rails in an elevator shaft, the rail joints that joins the guide rails together, and transmit the displacement information to the server device, the control circuitry of the server device, configured to: estimate, from the displacement information received from the rail installation assist device, a change in the displacement information of the rail brackets and the rail joints when the rail brackets are moved to given target positions, calculate an evaluation value for variation in the displacement information before the change and an evaluation value for variation in the displacement information after the change, set positions of the rail brackets based on a result of comparison between the evaluation values, and transmit the positions of the rail brackets to the rail installation assist device.

[0006d] According to a fifth aspect, there is provided a computer program product including a non-transitory computer readable medium including programmed instructions as to rail installation assist, wherein the instructions, when executed by a computer, cause the computer to execute: performing rail behavior simulation/travelling simulation using a simulation model; acquiring displacement information representing displacement of individual rail brackets and

rail joints from a reference position, the rail brackets that fix guide rails in an elevator shaft, the rail joints that joins the guide rails together; estimating, from the displacement information, a change in the displacement information of the rail brackets and the rail joints when the rail brackets are moved to given target positions; calculating an evaluation value for variation in the displacement information before the change and an evaluation value for variation in the displacement information after the change; and setting positions of the rail brackets based on a result of comparison between the evaluation values.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a diagram for explaining a guide rail installation method according to an embodiment;

FIG. 2 is a diagram for explaining a rail installation assist method according to an embodiment;

FIG. 3 is a block diagram illustrating an exemplary functional configuration of a rail installation assist device according to an embodiment;

CLAIMS

1. A rail installation assist device, comprising at least control circuitry configured to:

perform rail behavior simulation/travelling simulation using a simulation model;

acquire displacement information representing displacement of individual rail brackets and rail joints from a reference position, the rail brackets that fix guide rails in an elevator shaft, the rail joints that joins the guide rails together;

estimate, from the displacement information, a change in the displacement information of the rail brackets and the rail joints when the rail brackets are moved to given target positions;

calculate an evaluation value for variation in the displacement information before the change and an evaluation value for variation in the displacement information after the change; and

set positions of the rail brackets based on a result of comparison between the evaluation values.

2. A rail installation assist method to be performed by a rail installation assist device comprising at least control circuitry, the method comprising:

by the control circuitry,

performing rail behavior simulation/travelling simulation using a simulation model;

acquiring displacement information representing displacement of individual rail brackets and rail joints from a reference position, the rail brackets that fix guide rails in an elevator shaft, the rail joints that joins the guide rails together;

estimating, from the displacement information, a change in the displacement information of the rail brackets and the

rail joints when the rail brackets are moved to given target positions;

calculating an evaluation value for variation in the displacement information before the change and an evaluation value for variation in the displacement information after the change; and

setting positions of the rail brackets based on a result of comparison between the evaluation values.

3. The rail installation assist method according to claim 2, further comprising:

by the control circuitry,

estimating vibration to occur on an elevator car when travelling along the guide rails of a rail form which is based on each of the displacement information before the change and the displacement information after the change;

calculating a vibration evaluation value for an estimate of the vibration based on the displacement information before the change and a vibration evaluation value for an estimate of the vibration based on the displacement information after the change; and

setting positions of the rail brackets based on a result of comparison between the vibration evaluation values.

4. The rail installation assist method according to either claim 2 or 3, wherein

each of the guide rails is provided with a plurality of rail brackets that fixes the guide rails in the elevator shaft, and

at least part of the displacement information of each of the plurality of rail brackets represents a constant.

5. The rail installation assist method according to any of claims 2 to 4, further comprising:

causing, by the control circuitry, a display to display arrangement information on the positions of the rail brackets.

6. A rail installation assist method to be performed by a rail installation assist device comprising at least control circuitry, the method comprising:

by the control circuitry,

performing rail behavior simulation/travelling simulation using a simulation model; acquiring displacement information representing displacement of individual rail brackets and rail joints from a reference position, the rail brackets that fix guide rails in an elevator shaft, the rail joints that joins the guide rails together;

estimating, from the displacement information, a change in the displacement information of the rail brackets and the rail joints when the rail brackets are moved to given target positions;

estimating vibration to occur on an elevator car when travelling along the guide rails of a rail form which is based on each of the displacement information before the change and the displacement information after the change;

calculating a vibration evaluation value for an estimate of the vibration based on the displacement information before the change and a vibration evaluation value for an estimate of the vibration based on the displacement information after the change; and

setting positions of the rail brackets based on a result of comparison between the vibration evaluation values.

7. A rail installation assist system, comprising:

a rail installation assist device comprising at least control circuitry; and

a server device comprising at least control circuitry, wherein the server device and the rail installation assist device are communicably connected to each other, wherein

the control circuitry of the rail installation assist device, configured to:

perform rail behavior simulation/travelling simulation using a simulation model;

acquire displacement information representing displacement of individual rail brackets and rail joints from a reference position, the rail brackets that fix guide rails in an elevator shaft, the rail joints that joins the guide rails together, and

transmit the displacement information to the server device,

the control circuitry of the server device, configured to:

estimate, from the displacement information received from the rail installation assist device, a change in the displacement information of the rail brackets and the rail joints when the rail brackets are moved to given target positions,

calculate an evaluation value for variation in the displacement information before the change and an evaluation value for variation in the displacement information after the change,

set positions of the rail brackets based on a result of comparison between the evaluation values, and

transmit the positions of the rail brackets to the rail installation assist device.

8. A computer program product comprising a non-transitory computer readable medium including programmed instructions as to rail installation assist, wherein the instructions, when executed by a computer, cause the computer to execute:

performing rail behavior simulation/travelling simulation using a simulation model;

acquiring displacement information representing displacement of individual rail brackets and rail joints from a reference position, the rail brackets that fix guide rails in an elevator shaft, the rail joints that joins the guide rails together;

estimating, from the displacement information, a change in the displacement information of the rail brackets and the rail joints when the rail brackets are moved to given target positions;

calculating an evaluation value for variation in the displacement information before the change and an evaluation value for variation in the displacement information after the change; and

setting positions of the rail brackets based on a result of comparison between the evaluation values.