Embodiments of the present invention seek to provide an elevator rope tension measurement system that can reduce measurement error when the tension of the rope of an elevator is quantitatively measured.

[Solution to Problem]

[0006]

An elevator rope tension measurement system according to an aspect of the present invention includes: a vibration waveform collection unit configured to collect a vibration waveform of a rope of an elevator; and a frequency calculation unit configured to select, based on a measurement resolution calculated from a collection time period and a collection cycle for collecting the vibration waveform by the vibration waveform collection unit, a method for calculating a frequency of the vibration waveform collected by the vibration waveform collection unit.

[0007]

An elevator rope tension measurement system as disclosed includes: a vibration waveform collection unit configured to collect a vibration waveform of a rope of an elevator, and configured to transmit information on the vibration waveform collected toward a frequency calculation unit that selects a method for calculating a frequency of the vibration waveform based on a measurement resolution calculated from a collection time period and a collection cycle for collecting the vibration waveform.

[0008]

An elevator rope tension measurement system according to another aspect of the present invention includes: a frequency calculation unit configured to receive information on a vibration

waveform from a vibration waveform collection unit that collects the vibration waveform of a rope of an elevator, and configured to select, based on a measurement resolution calculated from a collection time period and a collection cycle for collecting the vibration waveform, a method for calculating the frequency of the vibration waveform collected by the vibration waveform collection unit.

[Advantageous Effects of Invention]

[0009]

According to example embodiments, a method for calculating the frequency of the vibration waveform of a rope is selected based on the measurement resolution calculated from the collection time period and collection cycles for collecting the vibration waveform of the rope. Therefore, it is possible to reduce measurement error when the tension of the rope of an elevator is quantitatively measured.

[Brief Description of Drawings]

[0010]

Fig. 1 is a configuration diagram of an elevator system in which an elevator rope tension measurement system according to an embodiment 1 is used;

Fig. 2 is a block diagram of the rope tension measurement device utilized in the elevator rope tension measurement system according to the embodiment 1;

Fig. 3 is a perspective view of the rope tension measurement device utilized in the elevator rope tension measurement system according to the embodiment 1;

Fig. 4 is a graph showing the detection result of acceleration detected by the rope tension measurement device utilized in the elevator rope tension measurement system according to the embodiment 1;

the same reference symbols. The repeated description of such components will be simplified or omitted when appropriate.

[0012]

Embodiment 1.

Fig. 1 is a configuration diagram of an elevator system in which an elevator rope tension measurement system according to an embodiment 1 is used.

[0013]

In the elevator system shown in Fig. 1, a hoistway 1 penetrates through respective floors of a building not shown in the drawing. A plurality of halls 2 are provided to respective floors of the building. Each of the plurality of halls 2 faces the hoistway 1.

[0014]

A traction machine 3 is provided at the lower portion of the hoistway 1. A pair of car-side return sheaves 4 are provided at the upper portion of the hoistway 1. A counterweight-side return sheave 5 is provided at the upper portion of the hoistway 1.

[0015]

A plurality of ropes 6 are wound onto the traction machine 3, the pair of car-side return sheaves 4, and the counterweight-side return sheave 5. Both end portions of the plurality of ropes 6 are fixed to the upper portion of the hoistway 1. In Fig. 1, only one rope 6 is shown.

[0016]

A pair of car-side suspension sheaves 7 are supported by the ropes 6 at a position closer to one end portion side of the ropes 6 than the pair of car-side return sheaves 4. In Fig. 1, only one car-side suspension sheave 7 is shown. A counterweight-side

suspension sheave 8 is supported by the ropes 6 at a position closer to the other end portion side of the ropes 6 than the counterweight-side return sheave 5.

[0017]

A car 9 is provided in the hoistway 1. The lower portion of the car 9 is supported by the pair of car-side suspension sheaves 7. A counterweight 10 is provided in the hoistway 1. The upper portion of the counterweight 10 is supported by the counterweight-side suspension sheave 8.

[0018]

A control device 11 is provided at the lower portion of the hoistway 1. The control device 11 is electrically connected to the traction machine 3 and the like. The control device 11 is provided in such a manner that the control device 11 can perform overall control of the elevator.

[0019]

A monitoring device 12 is provided at the lower portion of the hoistway 1. The monitoring device 12 is electrically connected to the control device 11. The monitoring device 12 is provided in such a manner that the monitoring device 12 can monitor a state of the elevator based on information from the control device 11.

[0020]

An information center device 13 is provided to a place separated from the building provided with the elevator. For example, the information center device 13 may be provided to the maintenance company for the elevator. The information center device 13 is provided in such a manner that the information center device 13 can grasp the state of the elevator based on information from the monitoring device 12.

[0021]

As described above, the elevator rope tension measurement system according to the present invention can be utilized in an elevator system.

[Reference Signs List]

[0167]

1 hoistway, 2 hall, 3 traction machine, 4 car-side return sheave, 5 counterweight-side return sheave, 6 rope, 7 car-side suspension sheave, 8 counterweight-side suspension sheave, 9 car, 10 counterweight, 11 control device, 12 monitoring device, 13 information center device, 14 rope tension measurement device, 15 attachment jig, 16 touch panel unit, 17 storage unit, 18 vibration waveform collection unit, 19 accuracy calculation unit, 20 judgement unit, 21 frequency calculation unit, 22 extraction unit, 23 adjustment amount calculation unit, 24 battery unit, 25 housing unit, 26 angle detection unit, 27 storage device, 28 grip body, 28a grip part, 29 holder, 29a holding part, 29b movable part, 30 connecting body, 31 fall preventing body, 32 protruding part, 33 grip piece, 34 connecting piece, 35 communication unit, 36 server, 37 communication device, 100a processor, 100b memory, 200 hardware

[Claims]

[Claim 1]

An elevator rope tension measurement system comprising:

a vibration waveform collection unit configured to collect a vibration waveform of a rope of an elevator; and

a frequency calculation unit configured to select, based on a measurement resolution calculated from a collection time period and a collection cycle for collecting the vibration waveform by the vibration waveform collection unit, a method for calculating a frequency of the vibration waveform collected by the vibration waveform collection unit.

[Claim 2]

The elevator rope tension measurement system according to claim 1, wherein

the frequency calculation unit calculates the frequency of the vibration waveform based on calculation results of an autocorrelation function and a Fourier transform of the vibration waveform collected by the vibration waveform collection unit.

[Claim 3]

The elevator rope tension measurement system according to claim 1 or claim 2, wherein

the vibration waveform collection unit sets a time period for collecting the vibration waveform of the rope based on information on a height of a hoistway of the elevator or a length of the rope of the elevator, the height of the hoistway and the length of the rope being externally inputted.

[Claim 4]

The elevator rope tension measurement system according to any one of claim 1 to claim 3, wherein in calculating the frequency of the vibration waveform collected by the vibration waveform collection unit, the frequency calculation unit performs numerical value interpolation in a vicinity of a peak of the frequency to calculate a position of the peak.

[Claim 5]

The elevator rope tension measurement system according to any one of claim 1 to claim 4, wherein

in obtaining the frequency of the vibration waveform, collected by the vibration waveform collection unit, from a spectrum of the frequency calculated by a Fourier transform, the frequency calculation unit searches for a peak of the spectrum of the frequency only in a vicinity of a frequency obtained from an autocorrelation function.

[Claim 6]

The elevator rope tension measurement system according to any one of claim 1 to claim 5, wherein the frequency calculation unit judges, based on the frequency calculated, sufficiency of the collection time period for collecting the vibration waveform by the vibration waveform collection unit and, in a case where the frequency calculation unit judges that the collection time period for collecting the vibration waveform by the vibration waveform collection unit is insufficient, the frequency calculation unit outputs no information on the frequency calculated.

[Claim 7]

The elevator rope tension measurement system according to any one of claim 1 to claim 6, wherein

the vibration waveform collection unit includes

a photographing unit configured to photograph a vibrating state of the rope, and

an image processing unit configured to perform processing on an image photographed with the photographing unit.

[Claim 8]

The elevator rope tension measurement system according to any one of claim 1 to claim 6, wherein the vibration waveform collection unit is a sensor that detects a vibration of the rope.

[Claim 9]

The elevator rope tension measurement system according to any one of claim 1 to claim 8, wherein the vibration waveform collection unit performs resampling processing on the vibration waveform collected.

[Claim 10]

The elevator rope tension measurement system according to any one of claim 1 to claim 9, comprising:

a touch panel unit configured to receive an external input operation, and indicate the frequency calculated by the frequency calculation unit by a character or an image.

[Claim 11]

The elevator rope tension measurement system according to claim 10, comprising:

a storage unit configured to store information on calculation results for a plurality of ropes of the elevator.

[Claim 12]

The elevator rope tension measurement system according to claim 11, comprising:

an extraction unit configured to calculate dispersion of tension between the plurality of ropes from the information on the calculation results stored in the storage unit, and extract a rope for which a tension is outside of a designated value.

[Claim 13]

The elevator rope tension measurement system according to claim 12, comprising:

an adjustment amount calculation unit configured to calculate an adjustment amount for the rope extracted by the extraction unit.

[Claim 14]

The elevator rope tension measurement system according to claim 13, comprising:

a housing unit housing the vibration waveform collection unit, the frequency calculation unit, the touch panel unit, the storage unit, the extraction unit, and the adjustment amount calculation unit.

[Claim 15]

The elevator rope tension measurement system according to claim 13, comprising:

a housing unit housing the frequency calculation unit, the touch panel unit, the storage unit, the extraction unit, and the adjustment amount calculation unit; and

the vibration waveform collection unit.

[Claim 16]

The elevator rope tension measurement system according to claim 14 or claim 15, comprising:

a battery unit housed in the housing unit, and configured to supply power to respective units housed in the housing unit.

[Claim 17]

The elevator rope tension measurement system according to claim 13, comprising:

a communication unit configured to transmit information on the frequency calculated by the frequency calculation unit;

a housing unit housing the vibration waveform collection unit, the frequency calculation unit, the touch panel unit, the storage unit, the extraction unit, the adjustment amount calculation unit, and the communication unit; and

a server provided separately from the housing unit, and housing the storage unit.

[Claim 18]

The elevator rope tension measurement system according to claim 13, comprising:

a communication unit configured to transmit information on the frequency calculated by the frequency calculation unit;

a housing unit housing the frequency calculation unit, the touch panel unit, the storage unit, the extraction unit, the adjustment amount calculation unit, and the communication unit;

the vibration waveform collection unit; and

a server provided separately from the housing unit and the vibration waveform collection unit, and housing the storage unit.

[Claim 19]

The elevator rope tension measurement system according to claim 17 or claim 18, comprising:

a battery unit housed in the housing unit, and configured to supply power to respective units housed in the housing unit.

[Claim 20]

The elevator rope tension measurement system according to claim 13, comprising:

a communication unit configured to transmit information on the frequency calculated by the frequency calculation unit;

a housing unit housing the vibration waveform collection unit, the touch panel unit, and the communication unit; and

a server provided separately from the housing unit, and housing the frequency calculation unit, the storage unit, the extraction unit, and the adjustment amount calculation unit.

[Claim 21]

The elevator rope tension measurement system according to claim 13, comprising:

a communication unit configured to transmit information on the frequency calculated by the frequency calculation unit;

a housing unit housing the touch panel unit and the communication unit;

the vibration waveform collection unit; and

a server provided separately from the housing unit and the vibration waveform collection unit, and housing the frequency calculation unit, the storage unit, the extraction unit, and the adjustment amount calculation unit.

[Claim 22]

The elevator rope tension measurement system according to claim 20 or claim 21, comprising:

a battery unit housed in the housing unit, and configured to supply power to respective units housed in the housing unit.

[Claim 23]

The elevator rope tension measurement system according to claim 13, comprising:

a communication unit configured to transmit information on the frequency calculated by the frequency calculation unit;

a housing unit housing the vibration waveform collection unit;

a communication device housing the touch panel unit and the communication unit; and

a server provided separately from the housing unit and the communication device, and housing the frequency calculation unit, the storage unit, the extraction unit, and the adjustment amount calculation unit.

[Claim 24]

The elevator rope tension measurement system according to claim 13, comprising:

a housing unit housing a communication unit configured to transmit information on the frequency calculated by the frequency calculation unit;

a communication device housing the touch panel unit and the communication unit;

the vibration waveform collection unit; and

a server provided separately from the housing unit, the communication device, and the vibration waveform collection unit, and housing the frequency calculation unit, the storage unit, the extraction unit, and the adjustment amount calculation unit.

[Claim 25]

The elevator rope tension measurement system according to claim 23 or claim 24, comprising:

a battery unit housed in the housing unit, and configured to supply power to respective units housed in the housing unit.

[Claim 26]

An elevator rope tension measurement system comprising:

a frequency calculation unit configured to receive information on a vibration waveform from a vibration waveform collection unit that collects the vibration waveform of a rope of an elevator, and configured to select, based on a measurement resolution calculated from a collection time period and a collection cycle for collecting the vibration waveform, a method for calculating a frequency of the vibration waveform collected by the vibration waveform collection unit.