CLAIMS

1. A state monitoring device for a plate spring mounted on a railcar bogie,

the state monitoring device being configured to monitor a state of the plate spring, the plate spring including fiber-reinforced resin containing electrically conductive reinforced fibers containing reinforced fibers extending in a longitudinal direction of the plate spring,

the state monitoring device comprising:

an electrode pair provided at both width direction side end surfaces of the plate spring and sandwiching the plate spring, a width direction of the plate spring being perpendicular to the longitudinal direction of the plate spring and a thickness direction of the plate spring; and

a measuring unit electrically connected to the electrode pair and configured to measure an electrical characteristic of the plate spring.

2. The state monitoring device according to claim 1, wherein to detect delamination between a first fiber-reinforced resin layer of the plate spring and a second fiber-reinforced resin layer of the plate spring, the electrode pair is provided at both width direction side end surfaces of the first fiber-reinforced resin layer, electrical resistance of the second fiber-reinforced resin layer to current flowing in the width direction being smaller than electrical resistance of the first fiber-reinforced resin layer to current flowing in the width direction.

3. The state monitoring device according to claim 1 or 2, further comprising a determining unit configured to determine whether or not a value of the electrical characteristic measured by the measuring unit has exceeded a predetermined threshold.

4. The state monitoring device according to any one of claims 1 to 3, wherein the electrode pair is provided at an intermediate region of the plate spring, the intermediate region being located between a middle portion of the plate spring and an end portion of the plate spring, the middle portion being pressed by a car width direction end portion of a cross beam of the bogie from above, the end portion being supported by an axle box of the bogie from below.

5. The state monitoring device according to claim 4, wherein the electrode pair is provided at a position of the intermediate region of the plate spring, the position being located close to the end portion having a thickness that is relatively smaller than a thickness of the middle portion.

6. The state monitoring device according to any one of claims 1 to 5, wherein:

the electrode pair includes

a middle electrode element pair for voltage measurement and

side electrode element pairs for power supply, the side electrode element pairs being provided at both respective sides of the middle electrode element pair in the longitudinal direction of the plate spring;

the side electrode element pairs are connected to a power supply configured to supply constant current; and

the measuring unit measures the electrical characteristic of the plate spring based on a voltage of the middle electrode element pair.

7. The state monitoring device according to any one of claims 1 to 6, further comprising a correcting unit configured to correct a value measured by the measuring unit, wherein:

the electrode pair is one of a plurality of electrode pairs including a main electrode pair and a sub electrode pair, the main electrode pair and the sub electrode pair being provided at the plate spring;

stress generated by elastic deformation of the plate spring at a portion at which the sub electrode pair is provided is smaller than stress generated by the elastic deformation of the plate spring at a portion at which the main electrode pair is provided; and

the correcting portion corrects a value of a main electrical characteristic, measured based on current flowing through the main electrode pair, in such a manner as to subtract a value of a sub electrical characteristic measured based on current flowing through the sub electrode pair from the value of the main electrical characteristic.

8. The state monitoring device according to any one of claims 1 to 6, further comprising a correcting unit configured to correct a value measured by the measuring unit, wherein:

the electrode pair is one of a plurality of electrode pairs including a first electrode pair and a second electrode pair, the first electrode pair and the second electrode pair being provided at the plate spring, the plate spring being mounted on the bogie so as to extend in a longitudinal direction of the railcar;

the first electrode pair is arranged close to a front wheel located at a front side in a traveling direction of the bogie, and the second electrode pair is arranged close to a rear wheel

located at a rear side in the traveling direction of the bogie; and

the correcting portion corrects a value of a first electrical characteristic, measured based on current flowing through the first electrode pair, in such a manner as to (i) offset a time axis of time-series data of the first electrical characteristic relative to a time axis of time-series data of a second electrical characteristic by a delay time to a delay side, the second electrical characteristic being measured based on current flowing through the second electrode pair, the delay time being obtained by dividing a distance between a center of the front wheel and a center of the rear wheel in a car longitudinal direction by a traveling speed of the railcar and (ii) subtract the time-series data of the second electrical characteristic from the time-series data of the first electrical characteristic, or

the correcting portion corrects a value of the second electrical characteristic in such a manner as to (i) offset the time axis of the time-series data of the first electrical characteristic relative to the time axis of the time-series data of the first electrical characteristic by the delay time to the delay side and (ii) subtract the time-series data of the first electrical characteristic from the time-series data of the second electrical characteristic.