Claims

[Claim 1]

A railroad equipment state determination apparatus comprising:

a storage unit that stores a plurality of pieces of operation data corresponding to drive information of a motor relating to one cycle of operation of railroad equipment in which a mechanical part in a stopped state performs the operation with the motor as a power source and then turns into the stopped state;

an evaluation criteria generation unit that generates evaluation criteria operation data relating to the one cycle of operation, based on the stored plurality of pieces of operation data;

an abnormality transition calculation unit that sequentially associates and compares the new operation data of the railroad equipment with the evaluation criteria operation data from the start to end of the one cycle of operation, thereby to calculate transition of the degree of abnormality in the one cycle of operation relating to the new operation data;

a total abnormality calculation unit that synthesizes the transition of the degree of abnormality to calculate total degree of abnormality relating to the one cycle of operation; and

a determination unit that determines whether the new operation data is abnormal by comparing the total degree of abnormality with a given determination criteria.

[Claim 2]

The railroad equipment state determination apparatus as defined in claim 1, further comprising:

a total abnormality storage unit that stores the total degrees of abnormality calculated in the past; and

a determination criteria setting unit that sets the given determination criteria based on the stored total degrees of abnormality.

[Claim 3]

The railroad equipment state determination apparatus as defined in claim 2, wherein

the storage unit stores the operation data in association with an operation date,

the total abnormality storage unit stores the total degree of abnormality in association with accompanying information of the operation relating to the total degree of abnormality, the accompanying information including at least one of the operation date, operation time, operation environment information, and weather information,

the evaluation criteria generation unit generates the evaluation criteria operation data based on the operation data for a predetermined number of latest dates, and

the determination criteria setting unit extracts, from the total degrees of abnormality stored in the total abnormality storage unit, the total degree of abnormality satisfying a predetermined proximity condition to the accompanying information relating to the new operation data, and sets the determination criteria based on the extracted total degree of abnormality.

[Claim 4]

The railroad equipment state determination apparatus as defined in any one of claims 1 to 3, wherein

the operation includes at least a displacement operation of displacing a moving part by the mechanical part,

the operation data is data in which transition of the drive information of the motor in the one cycle of operation is associated with a displacement position of the moving part, and

the abnormality transition calculation unit performs the sequential comparison based on the displacement position of the moving part in the one cycle of operation.

[Claim 5]

The railroad equipment state determination apparatus as defined in any one of claims 1 to 3, wherein

the operation includes at least a displacement operation of displacing a moving part by the mechanical part,

the operation data is data in which transition of the drive information of the motor in the one cycle of operation is associated with a lapse of time from start to end of displacement of the moving part,

the evaluation criteria generation unit normalizes the stored plurality of pieces of operation data on a time axis to generate the evaluation criteria operation data in which time of the one cycle of operation is set as a predetermined normalized time, and

after the normalization of the new operation data on the time axis, the abnormality transition calculation unit performs the sequential comparison based on the lapse of time in the one cycle of operation.

[Claim 6]

The railroad equipment state determination apparatus as defined in claim 5, further comprising:

an evaluation criteria operation time generation unit that generates an evaluation criteria operation time based on an operation time relating to the one cycle of operation in each of the stored plurality of pieces of operation data; and

an operation time determination unit that determines that the new operation data is abnormal if the operation time relating to the new operation data satisfies a predetermined abnormal time length condition based on the evaluation criteria operation time.

[Claim 7]

The railroad equipment state determination apparatus as defined in any one of claims 1 to 6, wherein the drive information is information of torque or current.

[Claim 8]

The railroad equipment state determination apparatus as defined in any one of claims 1 to 7, wherein the railroad equipment is any of switch machine, railroad crossing gate, and platform door.

[Claim 9]

A railroad equipment state determination method comprising:

an evaluation criteria generation step of generating evaluation criteria operation data relating to one cycle of operation, based on accumulated operation data corresponding to drive information of a motor relating to the one cycle of operation of railroad equipment in which a mechanical part in a stopped state performs the operation with the motor as a power source and then turns into the stopped state;

an abnormality transition calculation step of sequentially associating and comparing the new operation data of the railroad equipment with the evaluation criteria operation data from the start to end of the one cycle of operation, thereby to calculate transition of the degree of abnormality in the one cycle of operation relating to the new operation data;

a total abnormality calculation step of synthesizing the transition of the degree of abnormality to calculate total degree of abnormality relating to the one cycle of operation; and

a determination step of determining whether the new operation data is abnormal by comparing the total degree of abnormality with a given determination criteria.