CLAIMS

1. A method for monitoring and diagnosing deterioration of an inverter used to detect deterioration of an inverter supplying a driving current to a motor, comprising:

an inverter deterioration determination process for determining whether or not there is deterioration of the inverter, the inverter deterioration determination process measuring an output current of the inverter while the motor is in operation, and determining that the inverter is deteriorating when following (a) and/or (b) occurs: (a) a period abnormality in which a period of a current waveform acquired by the output current measurement fluctuates; and (b) a higher harmonic ratio abnormality in which a ratio of higher harmonics of a power-supply frequency $f_1$ obtained by conducting a frequency spectrum analysis for time series data of a current waveform acquired by the output current measurement fluctuates, and

wherein whether or not there is occurrence of the period abnormality is judged by comparing a criterial sine-wave signal waveform and the current waveform, the criterial sine-wave signal waveform calculated based on the power-supply frequency $f_1$.

2. The method for monitoring and diagnosing deterioration of an inverter set forth in claim 1,

wherein the period abnormality is determined to be occurring when a current period fluctuation ratio $T_R$, which

is calculated by using an equation (1) below from: a power-supply period $T_1$ that is a reciprocal of the power-supply frequency $f_1$; and a maximum half period $T_{max}$ and a minimum half period $T_{min}$ of the current waveform, becomes equal to or more than a preset criterial value of a period fluctuation ratio or has a tendency to increase with the lapse of time.

[Math. 1]

$$T_R = \frac{2\left(T_{max} - T_{min}\right)}{T_1} \quad . \ . \ . \quad (1)$$

3. The method for monitoring and diagnosing deterioration of an inverter set forth in claim 1 or 2,

wherein the inverter deterioration determination process determines that the inverter is deteriorating when an amplitude abnormality in which an amplitude of the current waveform fluctuates occurs in addition to occurrence of the period abnormality and/or the higher harmonic ratio abnormality.

4. The method for monitoring and diagnosing deterioration of an inverter set forth in claim 3,

wherein the amplitude abnormality is judged to be occurring when a current amplitude fluctuation ratio $P_R$, which is calculated by using an equation (2) below from: a maximum amplitude $P_{max}$; a minimum amplitude $P_{min}$; and a current effective value $I_{rms}$ each obtained from the current waveform, becomes equal to or more than a preset criterial value of an amplitude fluctuation ratio or has a tendency to increase

with the lapse of time.

[Math. 2]

$$P_R = \frac{P_{max} - P_{min}}{I_{rms}} \quad . \ . \ . \quad (2)$$

5. The method for monitoring and diagnosing deterioration of an inverter set forth in claim 3,

wherein the amplitude abnormality is judged to be occurring when a current amplitude fluctuation ratio $P_R$, which is calculated by using an equation (3) below from: a maximum amplitude $P_{max}$; a minimum amplitude $P_{min}$; and a current average value $I_{ave}$ each obtained from the current waveform, becomes equal to or more than a preset criterial value of an amplitude fluctuation ratio or has a tendency to increase with the lapse of time.

[Math. 3]

$$P_R = \frac{P_{max} - P_{min}}{I_{ave}} \quad . \ . \ . \quad (3)$$

6. The method for monitoring and diagnosing deterioration of an inverter set forth in any one of claims 1 to 5,

wherein the higher harmonic ratio abnormality is determined to be occurring when a specific higher harmonic ratio $I_R$, which is calculated by using an equation (4) below from: a current value $I_1$ of the power-supply frequency $f_1$; and a current value $I_{6i\pm1}$ of a $(6i \pm 1)$th-order higher harmonic of the power-supply frequency $f_1$, becomes equal to or more

than a preset criterial value of a higher harmonic ratio or has a tendency to increase with the lapse of time;

provided that n is a natural number of 1 or more and 8 or less.

[Math. 4]

$$I_R = \frac{\sqrt{\sum_{i=1}^{n} I_{6i\pm1}^2}}{I_1} \quad \ldots \quad (4)$$

7. The method for monitoring and diagnosing deterioration of an inverter set forth in any one of claims 1 to 5,

wherein the higher harmonic ratio abnormality is determined to be occurring when peaks of a (6i - 3)th-order higher harmonic and a (6i + 3)th-order higher harmonic of the power-supply frequency $f_1$ are both smaller than peaks of a (6i - 1)th-order higher harmonic and a (6i + 1)th-order higher harmonic;

provided that i is at least one of 1, 2, and 3.

8. The method for monitoring and diagnosing deterioration of an inverter set forth in any one of claims 1 to 7,

wherein the inverter deterioration determination process is carried out when a value of KI, which is calculated by using an equation (5) below from: a reference amplitude probability density function fr(x) obtained from a criterial sine-wave signal waveform made based on a power-supply frequency $f_1$ obtained by conducting a frequency

spectrum analysis for the time series data of the current waveform; and an at-diagnosis amplitude probability density function ft(x) obtained from the current waveform, becomes equal to or more than a preset criterial value of KI or has a tendency to increase with the lapse of time.

[Math. 5]

$$KI = \int_{-\infty}^{\infty} f_r(x) \, log \frac{f_r(x)}{f_t(x)} \, dx \quad . \; . \; . \quad (5)$$