A rotating machine is widely used as a motor or an electric generator. In particular, a permanent magnet synchronous rotating machine which is compact and highly efficient is in widespread use in fields from home appliances to industries. In accordance with worldwide trends toward energy conservation and global environmental protection in recent years, an increase in capacity of a permanent magnet synchronous electric motor (and a permanent magnet synchronous electric generator) is being promoted, which leads to applications in systems as large as several hundred kilowatts to several megawatts. New application products include an electric rail car, a wind generation system, and the like.

It is hard to directly drive such a permanent magnet synchronous rotating machine ("rotating machine" mentioned here denotes both an electric motor (motor) and an electric generator) by a commercial power supply, and a power converter, such as an inverter or a converter, needs to be used. The power converter is connected between AC (alternating current) power of the rotating machine and a DC (direct current) power supply for supplying power, and controls the rotating machine. The power converter includes switching elements by semiconductors on positive and negative sides with respect to the DC power supply, where the switching elements are provided according to the number of phases of the rotating machine.

However, in the event that a fault occurs in the power converter itself, the rotating machine connected to the power converter is affected, too. For example, the following patent documents describe techniques in the event of such a power converter fault.

In JP-A-2008-220045, in the event of a power converter fault, in order to protect switching elements other than a damaged switching element, all switching elements on the same polarity side as the faulty switching element are turned on to thereby short-circuit terminals of a rotating machine, thus suppressing an increase in current.

JP-A-2007-189763 describes the following protection method against demagnetization. A blowout of a fuse connected to a DC bus is detected, and then all upper arm switching elements or all lower arm switching elements of a power converter are turned on for protection against irreversible demagnetization.

JP-A-2002-339856 proposes a method of disposing, as an electric brake device of a permanent magnet synchronous electric generator, an external short-circuiting circuit on a connection line of the electric generator.

JP-A-10-12396 describes an over current prevention method when starting inverter driving while a permanent magnet synchronous motor is idling.

However, in the method described in JP-A-2008-220045, based on a premise that the rotating machine has a sufficiently large demagnetization tolerance, current waveforms in the event of a fault are averaged and whether a switching element on the positive or negative side has a short circuit fault is determined before determining which switching elements are to be turned on. Accordingly, a high-density rotating machine designed with a low demagnetization tolerance has a possibility of reaching a demagnetizing current before protection. Hence, it is problematic to directly apply this method to such a rotating machine.

In the method described in JP-A-2007-189763, the fuse needs to be introduced into the DC bus. However, it is difficult to introduce the fuse into a large-capacity converter as large as several hundred to several thousand kilowatts. In particular, since there is a need to reduce a wiring inductance for the DC bus, it is difficult to insert the fuse into the DC bus as in JP-A-2007-189763. Besides, there is also a problem that demagnetization may be caused as a result of an increase in current of the rotating machine during a period before fuse breaking.

In the method described in JP-A-2002-339856, it is possible to suppress an over current by activating the external short-circuiting circuit in the event of a fault, but there is no mention of any means from fault detection to protection.

The method described in JP-A-10-12396 is a measure for preventing demagnetization by a large current in a start sequence, and is based on a premise that the inverter (power converter) is in normal operation. Therefore, an abnormal current in the event of a power converter fault cannot be prevented by this method.

SUMMARY OF THE INVENTION

Thus, well known techniques are willingly disclosed from a viewpoint that contributes to information disclosure, and problems that can be found in the

related art for each of the disclosed techniques are mentioned. A direct object of the present invention is to prevent demagnetization of a permanent magnet synchronous rotating machine.

To achieve the stated object, a rotating machine control device according to the present invention is a rotating machine control device comprising: a power converter having a switch part on each of a positive side and a negative side for each phase; and a short circuit detection unit for detecting a short circuit of the switch part, wherein a command to turn on positive-side switches and negative-side switches of a plurality of phases of the switch part is issued in the case where the short circuit detection unit detects the short circuit.

A rotating machine system according to the present invention comprises: a permanent magnet rotating machine including a rotor and a stator positioned in opposition to the rotor with a predetermined gap there between, with a permanent magnet being disposed in the rotor; and the rotating machine control device.

[An electric vehicle or electric car according to the present invention comprises the rotating machine system and uses the rotating machine as a motor.

An electric generation system according to the present invention comprises the rotating machine system and uses the rotating machine as an electric generator.

According to the present invention, demagnetization of a permanent magnet synchronous rotating machine can be prevented.

See more at:
https://www.youtube.com/watch?v=fs942Gsn1K4&feature=youtu.be