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(54) AN ELECTRICAL GENERATOR AND A VOLTAGE REGULATOR THEREFOR WITH A DEVICE FOR DETECTING BEARING DAMAGE

(71) We, ROBERT BOSCH GmbH, a German company of Postfach 50, 7 Stuttgart 1, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an electrical generator and more particularly to a voltage regulator for an electrical generator and more particularly still to a device for detecting bearing damage in the generator.

A device for warning about bearing damage is already known, in which the parameter monitored is the bearing clearance which enlarges shortly before the bearing fails. In such warning devices, therefore, mechanisms are employed for sensing the bearing clearance which trigger an indicating device when the clearance is inadmissibly large. The disadvantage with these warning devices is that they present problems during assembly because the differences in bearing clearance, which have to be measured in order to detect the damage, are very small.

In accordance with this invention there are provided an electrical generator and a voltage regulator therefor in which the voltage regulator incorporates a device for detecting bearing damage of the electrical generator, such device comprising a temperature sensor disposed in the vicinity of a bearing of the generator, the sensor being so arranged in the circuitry of the voltage regulator that the sensor triggers the switching-on of a charging pilot lamp associated with the voltage regulator, if a predetermined bearing temperature is exceeded.

If the temperature of a monitored bearing increases in an inadmissible manner, then this is an indication of an imminent failure of the bearing. The bearing temperature is observed with the aid of the temperature sensor and, if the predetermined temperature threshold is exceeded, the pilot lamp is switched on.

By comparison with the known construction therefore, this invention has an advantage in that installation presents few problems since a temperature sensor can be brought within the vicinity of a bearing relatively easily. Another advantage resides in that, when the generator is used in motor vehicles, the charging pilot lamp which is already present in the motor vehicle is used as the warning sevice. Triggering can be effected by way of a switching transistor. The combination of the necessary electronic circuit of the device with the voltage regulator of the generator, so that the two form one unit, results in that only one additional plug contact for the pilot lamp becomes necessary.

The invention is further described hereinafter, by way of example with reference to the accompanying drawing, which is a circuit diagram of one embodiment of this invention.

The drawing shows an electronic field regulator (voltage regulator) for a generator in a motor vehicle. The device for detecting bearing damage in the generator and for producing an appropriate warning signal is combined with this electronic field regulator. The device comprises a temperature sensor 1 which is disposed in the vicinity of a bearing (not shown) in a schematically shown generator 2. The temperature sensor 1, which may, for example, be a hot conductor, is a component of a voltage divider which comprises the series connection of a resistor 3, the temperature sensor 1 and a resistor 4. The resistor 4 is connected on one side to earth, whilst the resistor 3 is connected to a terminal which is usually denoted by D+ in the motor vehicle and at which the generator exciter voltage, rectified by a rectifier 5, appears. A Zener diode 6, connected to the base of a switching transistor 7, is connected to the junction between the hot conductor 1 and the resistor 4.

The output of the generator 2 is connected to a rectifier bridge circuit, two diodes 8 and 9 thereof being shown in the drawing. These two diodes 8 and 9 form the load rectifiers

for the electrical loads of the motor vehicle, a battery 10 thereof being shown. An ignition switch 11, a charging pilot lamp 12 and a diode 13, which are in series, are connected between the terminal D+ and the positive pole B+ of the battery 10. The switching transistor 7, connected to the junction of the charging pilot lamp 12 and the diode 13, connects the charging pilot lamp 12 to earth. Thus, with appropriate triggering of the switching transistor 7 by way of the voltage divider 3, 1, 4, the lamp may be switched on.

The voltage regulator for switching on the exciter winding 14 operates in a manner as follows. The voltage located at the terminal D+ is also located across a voltage divider in the form of resistors 15, 16 and 17. If the generator 2 runs at a low speed, then the voltage at the terminal D+ is relatively low and so also is the voltage at the junction of the resistors 16 and 17. This low voltage causes a Zener diode 18, and hence a control transistor 19, to be blocked. When the transistor 19 is blocked, the collector potential of the transistor 19, as also the base potential of the power transistor (Darlington) 20, is almost at the full, positive operational voltage. The transistor 20, which is formed by a Darlington circuit, is thereby conductive and the exciter winding 14 has applied thereto the exciter voltage of the battery 10. If the speed of the generator 2 increases, then the voltage at the terminal D+ also increases, as well as the voltage at the junction of the resistors 16 and 17. If the voltage at the junction of the resistors 16 exceeds a specific threshold value, determined by the Zener diode 18, the control transistor 19 becomes conductive so that the collector potential of this transistor 19 almost drops to zero. This potential, which is also at the base of the power transistor 20, blocks the power transistor 20 so that the exciter winding 14 is switched off. The voltage at the terminal D+ thus drops again and the described process is repeated in rapid succession.

If damage occurs to the bearing of the generator, then the hot conductor 1 becomes of low impedance. This means that the potential at the junction of the hot conductor 1 and the resistor 4 rises very sharply. This in turn causes the switching transistor 7, which is blocked in the normal case, to reach its conductive state when a specific threshold value, determined by the Zener diode 6, is reached, the charging pilot lamp 12 is thereby connected to earth so that the charging pilot lamp 12 lights up. The diode 13 prevents the terminal D+ being simultaneously connected to earth. The lighting-up of the charging pilot lamp 12 indicates to the driver of the motor vehicle that there is a fault and that a bearing could be damaged. Because of this warning device, the driver of the motor vehicle is induced to seek a repair-shop as soon as possible which can deal with the damage before the generator becomes totally ruined. There is little fear of the signal, which indicates bearing damage, being confused with the normal lighting-up of the charging pilot lamp during operation of the generator, since the charging pilot lamp normally only lights up at low speeds of the generator when there is no bearing damage thereto.

WHAT WE CLAIM IS:—

1. An electrical generator and a voltage regulator therefor, in which the voltage regulator incorporates a device for detecting bearing damage of the electrical generator, such device comprising a temperature sensor disposed in the vicinity of a bearing of the generator, the sensor being so arranged in the circuitry of the voltage regulator that the sensor triggers the switching-on of a charging pilot lamp associated with the voltage regulator, if a predetermined bearing temperature is exceeded.

2. A generator and a voltage regulator as claimed in claim 1, in which the temperature sensor forms a part of a voltage divider to which the exciter voltage is applied and whose tapping is connected to a switching transistor which switches on the charging pilot lamp if the bearing temperature rises beyond the predetermined value.

3. A generator and a voltage regulator as claimed in claim 2, in which a switching path of the switching transistor is connected in series with the charging pilot lamp which is connected, on one side, to a common voltage supply line, and in which a diode is connected between the other connection of the charging pilot lamp and a terminal located at the exciter voltage so as to prevent the unrestricted flow of current from the terminal located at the exciter voltage along the switching path of the switching transistor.

4. An electrical generator and a voltage regulator therefor, the latter incorporating a bearing damage detecting device, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

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1594406 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*