GENERATOR REPAIR TIPS

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A generator is a machine that converts mechanical power to electrical power, either ac or dc. The mechanical power can be provided by a number of different sources; such as, a diesel or gasoline engine, water wheel, windmill, or electric motor. An alternator is a specific type of generator that converts mechanical power to ac electrical power. We will be focusing on alternators in this paper.

EXCITATION METHODS

There are different options for excitation methods. First is a self-excited system. The output from the alternator provides the power for the Automatic Voltage Regulator (AVR) as well as the sensing voltage to the regulator.

The second form of excitation is the separately excited method using a permanent magnet generator (PMG). This configuration has a small PMG mounted on the non-drive end that supplies power for the AVR. The main generator output still supplies the sensing voltage.

Another form of excitation uses an Auxiliary Winding. The auxiliary winding is a separate single-phase winding which is inserted into the main stator in the same slots as the main output winding.

HOW DOES IT WORK?

In the case of the PMG method of excitation the PMG rotor produces a high frequency ac voltage in the PMG stator which the AVR uses to supply dc to the exciter fields. This generates three phase ac power in the exciter rotor which is rectified and fed into the main rotating fields. The main dc fields generates ac output from the main stator which provides feedback to the AVR.

Using the PMG allows the AVR excitation to remain at full capacity when sudden loads are applied to the generator, giving better motor starting performance.

Component Characteristics and Testing

The number of exciter poles are normally more than the main generator poles. This provides a higher frequency that when rectified gives a cleaner dc. The exciter fields are dc fields and can be voltage dropped just like a field in a dc motor. If you need to rewind the exciter rotor it must have the same number of poles as the exciter fields.

The diode bridge has a positive rectifier plate and a negative rectifier plate. There is usually a suppressor across the rectifier plates that protects the diodes as well as the main stator. A multimeter will read between 0.4 and 0.7 volts on the diode scale with the positive lead on the anode and negative lead on the cathode. If you swap the leads it will read open. If it reads open in both directions or shorted in both directions then the diode needs to be replaced.

The best way to test the PMG is while it is in service on the generator. Find the tag on the AVR to find the sensing voltage required and the required PMG output. With a multimeter measure these voltages to verify that they are within range. If the output from the PMG is too low then either the PMG is weak or there is a fault in the PMG stator.

A variac with both a rectified dc output and ac output is a very useful tool in testing a generator. It can be used to voltage drop the main rotor and the exciter fields with the controlled ac supply. The controlled dc supply can be used to bypass the AVR and separately excite the exciter field. While applying dc directly to the exciter field of an unloaded generator you can measure the required dc input voltage and current to generate full voltage. This can be useful in sourcing an aftermarket AVR.

A resistive load, such as an incandescent light bulb, is required to test the AVR. Connect the light bulb to F+/F- of the AVR. Apply required supply voltage and sensing voltage to the AVR. Use a dc voltmeter to measure the output across F+ and F-. Adjust the pot to dim and brighten the bulb. Return the pot to the original output voltage.

If You Have to Rewind the Generator

Before burnout, identify the leads. If there are leads other than output power leads, they may be taps or auxiliary windings to provide voltage for the AVR. If there are taps or auxiliary windings present it is best to burn out the stator without cutting the coil end.

There can be more than one auxiliary winding. Some manufacturers use a single-phase transformer auxiliary winding and a load dependent booster winding. For the auxiliary windings it is all about location, location, location just like in real estate. Mark a slot as #1, the main lead #1 is a good reference. Draw a diagram of the auxiliary windings in reference to the marked slot. Insert the main windings and auxiliary windings in the same slots. The main winding acts as the primary of a transformer and the auxiliary winding acts as the secondary. If the coils are not placed back in the same orientation, it may have incorrect voltage supplied to the AVR.

When there are taps, count the number of coils to the main lead and to the non-output lead. A tap may be within a coil so count the number of turns to the tap.

It is best to maintain the original winding data. It is common for a manufacturer to use a 2/3 pitch to eliminate third harmonics in the output. Always verify that the number of poles in the main stator matches the number of poles in the main rotor.

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