**THE DC GENERATOR**

**SELF EXCITED COMPOUND CONNECTED GENERATOR**

**PURPOSE:**

This practical assignment will be used to examine the operation of a self excited compound connected generator.

**TO ACHIEVE THE PURPOSE OF THIS SECTION:**

At the end of this practical assignment the student will be able to:

* Complete a connection diagram for the terminal block of a compound connected dc motor
* Connect a self excited compound connected dc generator.
* Test a self excited compound connected generator to determine the effect on supplied voltage in regard to variations in load.
* Test a self excited compound connected generator to determine the effect on supplied voltage in regard to variations in speed.
* Reverse the polarity of supply produced by a self excited compound generator.

EQUIPMENT:

* 1x single variable dc power supply (24 volt 20 amp type – 240 volt ac plug in type)
* 1 x bench mounted 6 amp power supply
* 2 x Baldour dc machines
* 1 x 4 40 watt 32 volt lamp load panel
* 1 x Betts mounting plate
* 2 x digital multimeters
* 1 x tachometer
* 1 x single pole switch, for isolation of the load
* 4mm connecting leads
* 24 volt 50 Hz AC supply
* 1 x 1.5 volt battery (AA or C or D cell) with connection facilities to allow the battery to be connected to the generator field

**PROCEDURE**

In this practical exercise you will fit two compound connected dc machines together, with one connected and supplied as a motor, and the other connected as a separately excited generator.

After the generator has been operated as a separately excited generator, it will be reconfigured as a self excited generator, and load tested.

**Step 1**

Complete the following diagram of the motor connections to show a compound connected motor that has the machine supplied from a 0 – 24 volt 20 amp DC power supply. The field windings are to be connected to provide maximum field strength.

Shunt Winding

Shunt Winding

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F2

F4

F3

F1

Armature Winding

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Carbon

Brush

Carbon

Brush

A1

A2

Series

Winding

Series

Winding

Series

Winding

Series

Winding

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**Step 2**

Complete the following diagram to show the connections required to produce a separately excited compound generator. Include connections to the shunt field from a remote power source, to supply excitation current, and connections to a load.

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F2

F4

F3

F1

Armature Winding

C:\Documents and Settings\Jeff\My Documents\My Pictures\transformer coil1.bmp

Carbon

Brush

Carbon

Brush

A1

A2

Series

Winding

Series

Winding

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Winding

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**Step 3**

Fit the two machines to a mounting plate, coupled to provide a motor driven generator.

Connect the motor to a 24 volt 20 amp power supply, and the generator to a load bank containing four lamps, with an isolating switch. Use the 6amp power supply as a source of excitation current for the generator.

Connect the four lamp load panel to the generator, including an isolation switch to allow disconnection of the load.

Fit meters to measure the generated voltage and current provided by the generator.

**Step 4**

**Establishing a residual magnetic field**

Prepare to run the system for approximately one minute, in order to thoroughly magnetise the generator shunt fields, plus the series and armature fields. After this period you will be required to shut the system down, remove the excitation supply, and reconfigure the generator as a self excited compound generator.

Ensure that you are prepared, with a firm understanding of the circuit and connection requirements before proceeding.

**Step 5**

Run the system with the load of four lamps connected to the generator, with excitation current supplied to provide visible effect on the lamps.

**Step 6**

After approx. one minute, shut the system down, isolate the load from the generator using the isolation switch, and remove the excitation supply.

Connect the generator as a compound generator, without external excitation.

**Step 7**

With the load isolated from the generator, switch the motor on, and adjust motor speed to provide an open circuit voltage of 24 volts from the generator.

**Step 8**

Connect a load of one lamp to the generator, observing speed, output voltage and current. Record your results in the table below.

Increase the load by adding one lamp per step, recording your observations in the table below.

**Table 1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Observed results | No load | Load of  1 lamp | Load of  2 lamps | Load of  3 lamps | Load of  4 lamps |
| Generator output voltage |  |  |  |  |  |
| Generator output current |  |  |  |  |  |
| Machine speed |  |  |  |  |  |
| Motor supply volts |  |  |  |  |  |
| Motor supply current |  |  |  |  |  |
| Motor input power |  |  |  |  |  |

Shut supply to the motor down once you have completed your reading of output from the generator.

Isolate the load from the generator using the isolation switch.

**Step 9**

Plot the machine characteristics, showing the relationship between load and output voltage where the speed of the machine is not maintained as constant.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Max output voltage**  **Min output voltage** |  |  |  |  |  |  |  |  |  |
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| **Minimum load maximum load** | | | | | | | | |

**Step 10**

Repeat the experiment detailed previously, varying the motor input to maintain a constant output voltage from the generator.

Record your observations in the table below.

**Table 2**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Observed results | No load | Load of  1 lamp | Load of  2 lamps | Load of  3 lamps | Load of  4 lamps |
| Generator output voltage | 24 volts | 24 volts | 24 volts | 24 volts | 24 volts |
| Generator output current |  |  |  |  |  |
| Machine speed |  |  |  |  |  |
| Motor supply volts |  |  |  |  |  |
| Motor supply current |  |  |  |  |  |
| Motor input power |  |  |  |  |  |

Shut supply to the motor down once you have completed your reading of output from the generator.

Isolate the load from the generator using the isolation switch.

**Step 11**

Plot the machine characteristics, showing the relationship between load and speed output where the speed of the machine is varied in order to provide a **constant output voltage**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Max speed**  **Min speed** |  |  |  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |  |  |
| **Minimum load maximum load** | | | | | | | | |

**Step 12**

**Removing the residual magnetic field**

This step and the following steps involves destroying any residual magnetic field in the generator, and then re-establishing the field with the use of an external dc source, such as a battery.

This simulates the requirements to re-establish field where a self exciting generator has been unused for an extensive period, and the residual magnetic field within the generator has decayed to a level insufficient to allow the unit to function.

The field can be destroyed using a “degaussing” current such as the rapidly fluctuating supply from an AC source.

**Step 13**

Connect the 24 volt AC supply to the output of the generator for a very short period – approx. 1 second. This should destroy the residual magnetic field.

Remove the AC supply from the generator.

**Step 14**

Run the machine to test if any voltage is produced from the generator. If output is detected, repeat Step 13.

**Step 15**

Prepare the 1.5 volt battery to be used by connecting leads to the battery.

Run the machine with the load open circuit, observing that no voltage is produced from the generator.

Connect the 1.5 battery across the shunt field coils for a very brief period ( 0.5 to 1 second), removing the battery fully from connection immediately any output voltage is detected.

The battery can be severely damaged if exposed to the full output voltage of the generator.

***Leaving the battery connected creates a significant injury risk to the operator***.

**Step 16**

With the machine running, load test the generator by adding loads in steps, varying the motor speed, to check that the generator is behaving as in previous steps where output varied with load or speed.

**Step 17**.

Dismantle the machine and return all equipment to the correct storage points.

**OBSERVATIONS**

Where a self exciting generator is used, what is the most practical method of maintaining acceptable output voltage as load is varied?

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What is a likely problem to be encountered in a self exciting generator if the machine has not been used in a long time?

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