**THE DC GENERATOR**

**SEPERATELY EXCITED COMPOUND CONNECTED GENERATOR**

**PURPOSE:**

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

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

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

* Connect a separately excited compound connected dc generator.
* Test a separately excited compound connected generator to determine the effect on supplied voltage in regard to load and speed where excitation is constant.
* Test a separately excited compound connected generator to determine the effect on supplied voltage in regard to load and speed where excitation is varied
* Reverse the polarity of supply produced by a separately 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
* 1 x Baldour dc machine
* 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
* 1 variable speed drive system, comprised of a delta connected 41,5 volt three phase motor, driven by a VFD

**PROCEDURE**

**Step 1**

Complete the following diagram to show the connections required for a separately excited compound wound generator, connected to a load. Show the connections of supply to both the excitation fields and the armature outputs.

Shunt Winding

Shunt Winding

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

F2

F4

F3

F1

Armature Winding

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Carbon

Brush

Carbon

Brush

A1

A2

Series

Winding

Series

Winding

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Winding

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**Step 2**

Fit the Baldor machine and the three phase motor to the mounting plate, and such that one machine will be used as a generator, and the other as a variable speed drive.

Connect the variable speed drive to the 41.5 volt AC system, to supply the three phase delta connected motor.

Connect the lamp panel to the output of the generator, where the generator is connected as a separately excited generator. Ensure that you install the isolation switch in this part of the circuit, to allow isolation of the load from the generator output. Connect only one lamp as load for the initial part of this practical experiment.

Connect the 6 amp power supply to the generator field windings, to provide excitation current

You will require meters connected to the output of the generator to measure output voltage and current.

*Have the teacher check your connections.*

**Step 3**

Ensure that the coupling on the generator is arranged to provide a suitable signal for a photo operated tachometer.

**Step 4**

Ensure that the excitation power source is connected and adjusted to zero volts, with current set to maximum.

**Step 5**

With the isolation switch to the load bank of lamps switched off, to isolate the load from the generator, switch supply on to all components, and run the machine.

Set the excitation supply to produce an open circuit voltage of 24 volts from the generator, recording the excitation voltage and current in the table below.

Record your observations in the table below, noting that these values will be maintained as constant for this part of the exercise.

**Step 6**

Switch the load four lamps connected in series, recording speed of the machine, output voltage and current in the table below.

Increase the load in steps, by reducing one lamp from the series connection with each step..

Record speed of the machine, output voltage and load current for each step, recording your results in the table below.

**Table 1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Observed results | No load | Load of  4 lamps in series | Load of  3 lamps in series | Load of  2 lamps in series | Load of  1 lamp |
| Excitation volts |  |  |  |  |  |
| Excitation current |  |  |  |  |  |
| Generator output volts | 24 volts |  |  |  |  |
| Generator output current | zero |  |  |  |  |
| Generator output power (watts) | zero |  |  |  |  |
| Machine speed |  |  |  |  |  |

**Step 7**

Using the results obtained, plot the speed to load characteristics of the machine when the shunt **field excitation is constant.**

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

**Step 8**

Using the results obtained, plot the speed to output voltage characteristics of the machine when the **shunt** **field excitation is constant**.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Max output volts**  **Min output volts** |  |  |  |  |  |  |  |  |  |
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| **Minimum speed maximum speed** | | | | | | | | |

**Step 9**

In this part of the practical exercise you will examine the relationship between excitation and load where a constant output voltage is required.

With the isolation switch to the load bank of lamps switched off, to isolate the load from the generator, switch supply on to all components, and run the machine.

Set the excitation supply to produce an open circuit voltage of 24 volts from the generator, recording the excitation voltage and current in the table below.

Record your observations in the table below, noting that these values will be varied in order to maintain a constant output voltage from the generator.

**Step 10**

Switch the load of one lamp on, recording speed of the machine, output voltage and current, and excitation voltage and current in the table below.

Increase the load in steps, by adding one lamp to the load per step. Remember that you will need to connect the lamps in parallel to increase the load.

Record speed of the machine, output voltage and load current and excitation voltage and current for each step, recording your results in the table below.

**Table 2**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Observed results | No load | Load of  4 lamps in series | Load of  3 lamps in series | Load of  2 lamps in series | Load of  1 lamp |
| Excitation volts |  |  |  |  |  |
| Excitation current |  |  |  |  |  |
| Generator output volts | 24 volts | 24 volts | 24 volts | 24 volts | 24 volts |
| Generator output current | zero |  |  |  |  |
| Generator output power (watts) | zero |  |  |  |  |
| Machine speed |  |  |  |  |  |

**Step 11**

Using the results obtained, plot the speed to load characteristics of the machine when the **shunt** **field excitation is varied in order to maintain a constant output voltage.**

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

**Step 12**

Using the results obtained, plot the excitation current to output load characteristics of the machine when the field excitation is varied to maintain a constant output voltage.

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| **Max excitation current**  **Min excitation current** |  |  |  |  |  |  |  |  |  |
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| **Minimum load maximum load** | | | | | | | | |

**Step 13**

In this part of the practical exercise you will examine the relationship between excitation, output voltage and load where a constant speed is available.

With the isolation switch to the load bank of lamps switched off, to isolate the load from the generator, switch supply on to all components, and run the machine.

Set the excitation supply to produce an open circuit voltage of 24 volts from the generator, recording the excitation voltage and current in the table below.

Record your observations in the table below, noting that these values will be varied in order to maintain a constant speed from the motor driving the generator. The excitation current will be maintained as constant.

**Step 14**

Switch the load of four lamps in series, adjusting the supply to the motor in order to maintain a constant speed, recording speed of the machine, output voltage and current, and excitation voltage and current in the table below.

Increase the load in steps, by reducing one series connected lamp to the load per step.

Record speed of the machine, output voltage and load current and excitation voltage and current for each step, recording your results in the table on the following page.

**Table 3**

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| --- | --- | --- | --- | --- | --- |
| Observed results | No load | Load of  4 lamps in series | Load of  3 lamps in series | Load of  2 lamps in series | Load of  1 lamp |
| Constant excitation volts |  |  |  |  |  |
| Excitation current |  |  |  |  |  |
| Generator output volts |  |  |  |  |  |
| Generator output current | zero |  |  |  |  |
| Generator output power (watts) | zero |  |  |  |  |
| Constant machine speed |  |  |  |  |  |
| Motor supply volts |  |  |  |  |  |
| Motor supply current |  |  |  |  |  |
| Motor input power |  |  |  |  |  |

**Step 15**

Using the results obtained, plot the speed to load characteristics of the machine when the **motor input power is varied in order to maintain a constant speed.**

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

**Step 16**

Using the results obtained, plot the relationship between input power and output power when **motor input power is varied to maintain a constant speed.** .

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| **Max motor input power**  **Min motor input power** |  |  |  |  |  |  |  |  |  |
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| **Minimum load maximum load** | | | | | | | | |

**OBSERVATIONS**

Where the input power to a generator is constant, what is the effect on speed of the machine as load on the generator is increased?

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For a separately excited compound connected generator, what is the relationship between output voltage and excitation current if speed is maintained as constant, but load is varied?

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For a separately excited compound connected generator, what is the relationship between speed and load if excitation is constant?

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For a separately excited compound connected generator, what is the relationship between excitation current and load if speed is constant?

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For a separately excited compound connected generator, is it practical to maintain constant output voltage as load is varied, by the use of variable excitation current?

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For a separately excited compound connected generator, is it practical to maintain constant output voltage as load is varied, by the use of variable speed?

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For a separately excited compound connected generator, is it practical to maintain constant output voltage as load is varied, by the use of variable excitation current and speed?

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