Objects of the experiment

1. Investigate how the induced voltage depends on current in the rotor
2. Investigate how the induced voltage depends on the speed of the rotor

Setup

![Image of a stationary armature generator setup]

**Apparatus**

1. Basic machine unit .................................................. 727 81
2. ELM hand-cranked gear .......................................... 563 303
3. ELM two-pole rotor .................................................. 563 22
4. ELM brush holder rack ............................................. 563 18
5. ELM brushes .......................................................... 563 13
6. ELM wide pole pieces for coils .................................. 563 101
7. ELM coils, 250 windings .......................................... 563 11
8. ELM centring disc ..................................................... 563 17
9. Allen key .................................................................. 563 16
10. Demo multimeter, passive ......................................... 531 905
11. AC/DC power supply, 0...15 V / 0...5 A ....................... 521 50
12. Connecting lead, 19 A, 25 cm, red ........................... 500 411
13. Pair of connecting leads, 19 A, 25 cm, ..................... 501 44
14. Pair of connecting leads, 19 A, 50 cm, ..................... 501 45
15. Demonstration panel frame ....................................... 301 300
16. Equipment shelves ................................................... 301 310
17. Profile rail ................................................................. 301 311
18. Bench clamps with pin .............................................. 301 05

Procedure

1. Investigate how the induced voltage depends on current in the rotor:
   - Select a measuring range of 10 V (AC) in the demo multimeter.
   - Place the brushes in contact with the slip rings of the rotor and connect them to the DC output of the power supply.
   - Use the power supply as a constant current source. To do this, turn the voltage limiting knob to its maximum.
   - Set the current \( I \) via the adjustment knob to a value of about 0.5 A.
   - Turn the crank to set the rotor moving at a uniform speed and read off the induced voltage \( U \) from the demo multimeter.
   - Increase the current first to 1 A and then to 1.5 A, while maintaining a uniform rotor speed. For each of the current values \( I \), read off the induced voltage \( U \) from the demo multimeter.

2. Investigate how the induced voltage depends on the speed of the rotor:
   - Set the rotor current to 1.5 A and select a measuring range of 30 V (AC) on the demo-multimeter.
   - Turn the crank handle to make the rotor turn faster and faster, then compare how the induced voltage \( U \) changes with increasing speed.

**Measuring example**

<table>
<thead>
<tr>
<th>Rotor current ( I ) in A</th>
<th>Induced voltage ( U ) in V</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>1.7</td>
</tr>
<tr>
<td>1.0</td>
<td>3.5</td>
</tr>
<tr>
<td>1.5</td>
<td>5</td>
</tr>
</tbody>
</table>

The faster the rotor turns, the greater the induced voltage \( U \) in the stator coils becomes.

Evaluation

In a stationary armature generator with an electromagnetic rotor, an alternating (AC) voltage is generated which can be tapped directly from the ends of the induction coils. The higher the rotor current in the electromagnetic rotor, the stronger the magnetic field around the rotor coils becomes. The stronger the magnetic field becomes, the greater the voltage induced in the stator coils will be if the speed remains constant. The faster the rotor is turned with the rotor current kept constant, the greater the voltage induced in the stator coils becomes.

Remark:
Power station generators are stationary armature generators with electromagnetic rotors. However, they are designed in such a way that they produce three-phase alternating voltage (cf. D 3.6.2.6.b “Generation of a three-phase alternating voltage”).