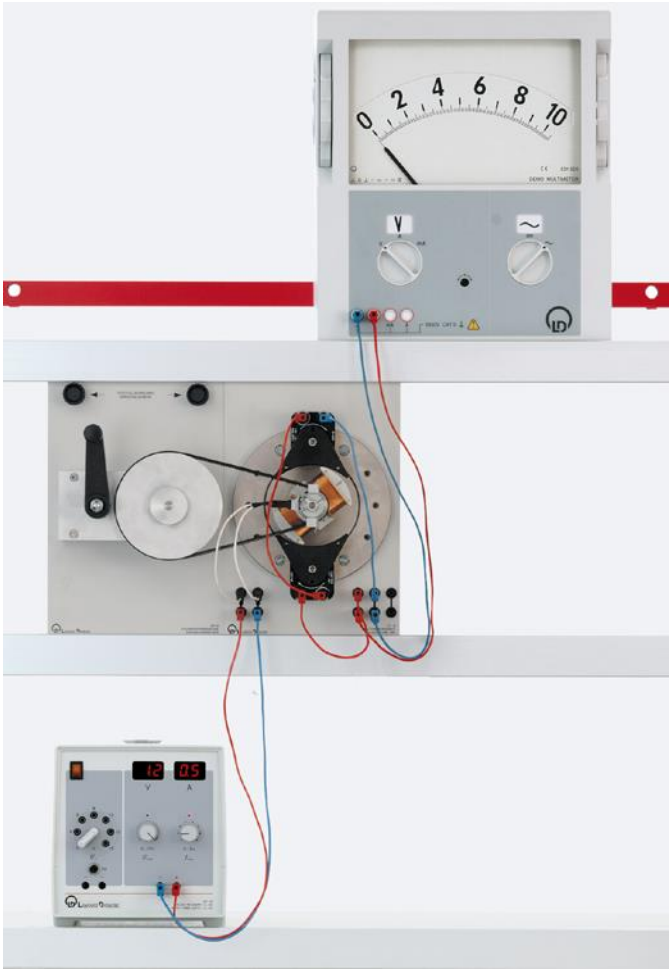
Stationary armature generator - dependence on induced voltage

Measurement of voltage using a demo-multimeter

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



Apparatus

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

Rotor current *I* in A	Induced voltage *U* in V
0.5	1.7
1.0	3.5
1.5	5

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 filed 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”).

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