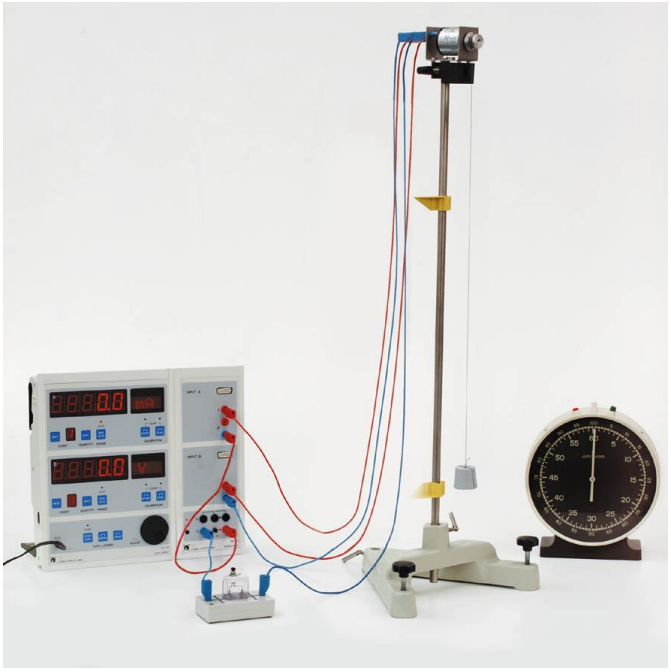
Object of the experiment

Determine the efficiency of a DC motor

Setup



Safety instructions:

Since the motor shaft continues to rotate after it is switched off (motor without gears), for safety reasons it is recommended the load used be a rubber stopper.

Preparations for measuring current and voltage:

- Set up the CASSY-Display connected to a Sensor-CASSY module.
- In order to measure current at input A, select the “mA” measuring range by pressing the NEXT (QUANTITY) button.
- In order to measure voltage at input B, select the “V” measuring range with the MAN/AUTO (RANGE) button.
- Use the potentiometer on the power supply to set a voltage of about 1.5 V.

Apparatus

1 Motor and tachogenerator, STE 4/19/50	579 43
1 Set of 2 fishing lines	309 48ET2
1 Rubber stopper, one 7-mm hole, 28-24 mm diam.	667 265
1 Plug-in board section, STE	576 71
1 Push button (NO), STE 2/19	579 10
1 Sensor-CASSY 2	524 013
1 CASSY-Display, USB	524 020USB
1 Metal rule, 0.5 m	460 97
1 Table stop-clock	313 05
1 Single pan balance	315 07
1 Stand base, V-shaped, large	300 01
1 Stand rod, 75 cm, 12 mm diam.	300 43
1 Support block	301 25
1 Pair of pointers	301 29
2 Pairs of connecting leads, 19 A, 100 cm, red/blue	501 46
1 Pair of connecting leads, 19 A, 50 cm, red/blue	501 45

Procedure

- Use the single pan balance to determine the mass of the load.
- Position pointer 1 on the stand in such a way that it is aligned with the bottom edge of the stopper.
- Position pointer 2 at a distance 50 cm from pointer 1.
- Press the button and start measuring time using the stop-clock.
- When the lower edge of the stopper passes pointer 2, stop the clock and simultaneously read off the current *I* and voltage *U* from the CASSY-Display.

Measurement results

$g = 9{,}81 \frac{\mathrm{m}}{\mathrm{s}^2}$

Voltage *U* in V	Current *I* in A	Time *t* in s	Distance *s* in m	Mass *m* in kg
1.5	0.063	2.8	0.5	0.027

Evaluation

$$E_{\text{El}} = U \cdot I \cdot t = 1{,}5\,\text{V} \cdot 0{,}063\,\text{A} \cdot 2{,}8\,\text{s} = 0{,}26\,\text{Ws}$$

$$E_{\text{Mec}} = m \cdot g \cdot h = 0{,}027\,\text{kg} \cdot 9{,}81 \frac{\text{m}}{\text{s}^2} \cdot 0{,}5\,\text{m} = 0{,}13\,\text{Nm} = 0{,}13\,\text{Ws}$$

$$\eta = \frac{E_{\text{Mec}}}{E_{\text{El}}} = \frac{0{,}13\,\text{Ws}}{0{,}26\,\text{Ws}} = 0{,}5$$

The efficiency η of the DC motor used here is 0.5.

That means that only half the electrical energy supplied to the motor is converted into mechanical energy.

The rest is converted into thermal energy and emitted from the motor in the form of heat.

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