

Experiment 232

Investigation of convection phenomenon

Before the reader study the manual one should go into the following theories:

- 1) Thermal expansion of solid state bodies and fluids
- 2) The methods of the heat transfer. The phenomenon of the convection
- 3) Archimedes' principle.

The aim of the exercise

To study the role of convection in the process of the heat transfer

Methodology of the measurement

In this exercise one compares the temperature of the liquid in two vessels. One of the vessels is heated from above, which prevents from convection and limits the heat transport to the conduction mechanism only. The another vessel is heated from the bottom, which supports the convection mechanism and gains the heat transport from the bottom of the vessel to the top.

The measurement setup is shown at Fig. 1. It consists of cylindrical vessel fulfilled with the oil. The electric heater divides the vessel on two equal parts. The liquid in the bottom part of the vessel is heated from the top, while the same amount of the liquid in the upper part of the vessel is heated from below. Using the electric thermometer one can measure the temperature of the liquid close to the top and the bottom of the vessel.

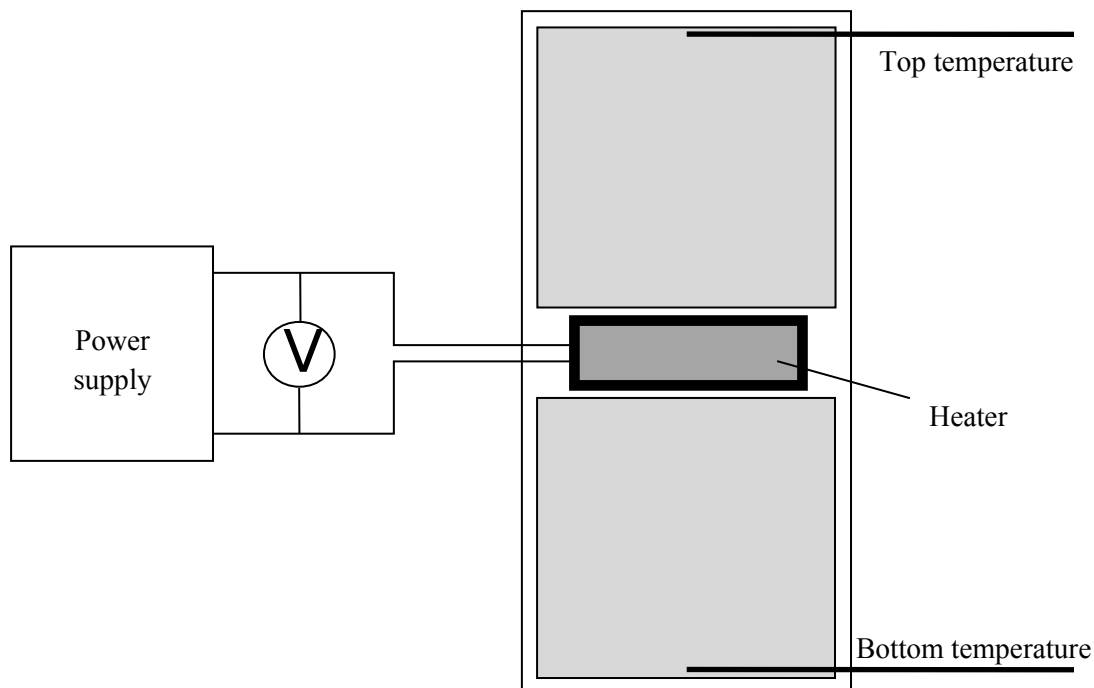


Fig. 1 Scheme of the experimental setup.

The measurement process

The temperature of the liquid is measured in both parts of the vessel as a function of heating time. Such experiment allows the comparison of two methods of the heating. First method for which the heat source is located above the liquid and heat is transported by the means of heat conduction and the second method, which combines the conduction and convection for heat source located from below the liquid.

Procedure

- 1) Set the voltage U applied to the heater, record the value of the voltage and the current.
- 2) Turn on the timer
- 3) Record the temperature in the top (T_t) and bottom (T_b) of the vessel with 1 minute step. The measurement should be terminated while both temperatures are converged.
- 4) Repeat the measurement for larger input voltage.
- 5) Estimate the temperature measurement error ΔT and time measurement error Δt .
- 6) Collect the results of the experiment in the tables.

$U=$	$\Delta T=$	$\Delta t=$								
t [min]										
T_b [K]										
T_t [K]										

Report preparation

The report should contain:

- 1) A short description of the experimental method.
- 2) The experimental data collected in the table.
- 3) The figures of $T_t(t)$ and $T_b(t)$ for all voltages. The measurement errors should be marked at the figures.
- 4) Conclusions