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THERMOANEMOMETRIC METHOD FOR THE MEASUREMENTS OF FLOW VELOCITY AND TEMPERATURE

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The paper deals with some problems concerning the measurements of flow intensity. In such measurements appropriate variants of thermistor sensors are used. The methodology of measurements, the analysis and the visual representation of signals by means of measuring card PCL818 and package DasyLab are presented.

During experiments on and exploitation of hydraulic systems in various machines it is often necessary to measure flow intensity of an operating agent. Turbine flow meters are commonly used for this purpose. Indication errors of turbine flow meters are rather high and, to large extent, they depend on flow intensity. Because of that turbine flow meters require very precise calibration. Also, piston flow meters are used, which display many advantages, such as high accuracy of measurements, broad range of the measured intensity as well as the fact that the measurements are independent of viscosity. Unfortunately, piston flow meters are expensive [1].

So far, thermoanemometers have been applied for measurements of the parameters of flowing gas, i.e. velocity and temperature.

However, it appears plausible to apply sensors and convective thermoanemometer systems for the measurements of parameters of hydraulic oil. Many metrological and exploitation properties of these systems, such as low inertia, high sensitivity and high accuracy confirm this plausibility.

The basic component of a thermoanemometric probe is a thermoresistive sensor. The material of which it is made has a high value of a thermal resistivity coefficient.

Due to that, even slight cooling of the sensor resulting from an increase in flow velocity or from a change in temperature of the flowing medium yields a significant change in the resistance which is subsequently transposed into an electric output signal of the measuring system [2, 3].

One kind of a sensor which can be used here is a thermistor – a semiconductor element. Thermistors are mainly applied for temperature measurements, but sometimes they are also applied for the measurements of other quantities, e.g. flow intensity.

These measurements are based on the phenomenon of thermistor self-heating. In order to avoid self-heating, the current flowing through a thermistor must not exceed some value I_s . If current exceeds I_s the thermistor is heated and its resistance decreases. A self-heating thermistor cannot be used for temperature measurements because it would indicate its own temperature and not the temperature of the medium. Now the temperature of the thermistor depends on how fast the thermistor gives up the heat to the surrounding medium. Any changes occurring in the medium, e.g. in the flow velocity, will necessarily affect the speed of giving up the heat by the thermistor. The temperature of the thermistor, and consequently its resistance will also be affected, since the cooling conditions are affected. In this way, the thermistor can act as a converter of flow velocity into voltage [4,5,6]. The measurements of flow intensity is taken by means of two thermistors of identical characteristics (Fig. 1).

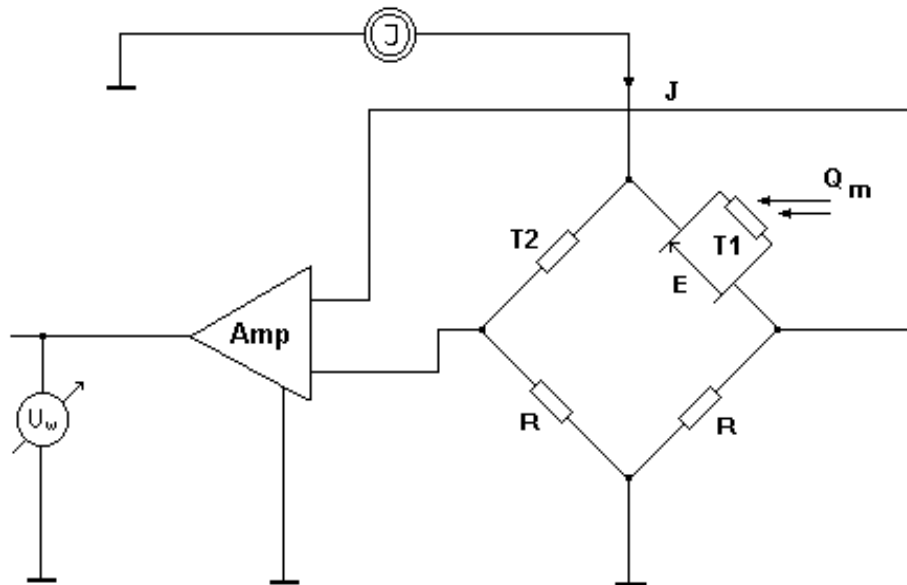


Fig.1 Measuring system of the convective thermoanemometer

When the flow intensity is zero, the output voltage at the bridge is also zero. With some positive flow, thermistor T1 gives up its heat faster than thermistor T2 placed in a stationary medium, in which the conditions of heat transfer do not change. The resistance of thermistor T1 increases, the bridge is out of equilibrium, and some voltage appears at the output.

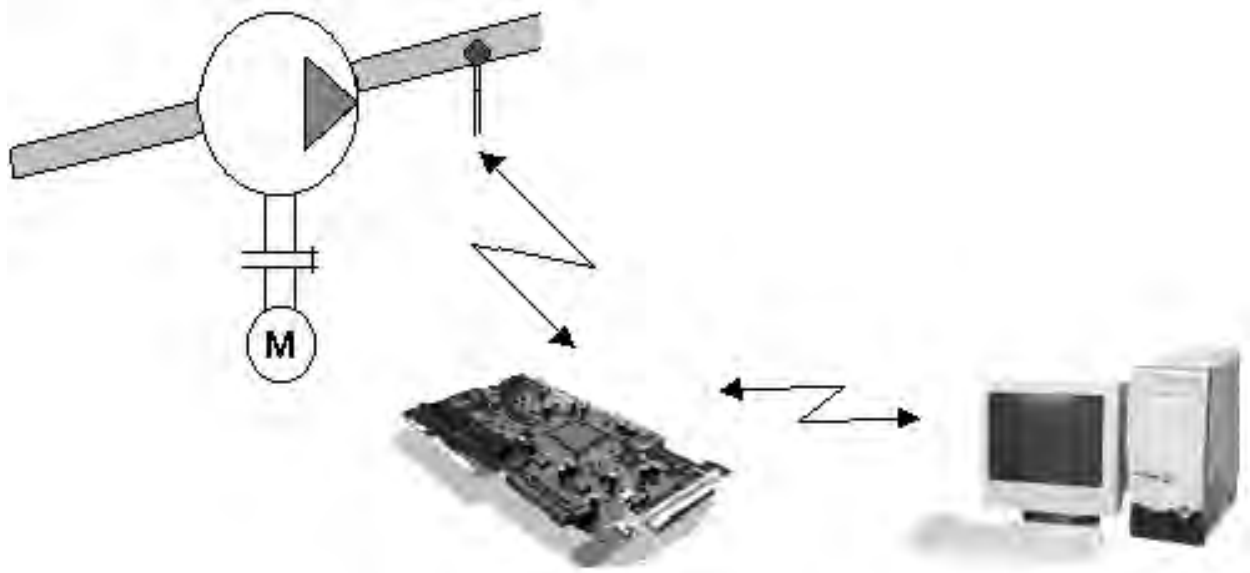


Fig. 2 Measuring system

The measuring system presented in Fig. 2 includes a semiconductor converter – thermistor, measuring PCL 818 and a PC with software DasyLab [7,8].

A measuring signal is analysed by means of the above mentioned software and the measuring card PCL 818 [9].

The system presented in Fig. 3 performs the following functions:

- readout of the value of electric signal from the measuring card (module PCL818L AD);

- filtering out the signal (module FILTR - FILTER);
- display – OSC;
- data saving – ZAPIS - SAVE;
- calculating the value of voltage at the sensor, proportional to the measured current – WSKAŹNIKU – U INDICATOR;
- determining the value of flow intensity (modules: OBLICZ, WSKAŹNIQ – CALCULATE, Q INDICATOR).

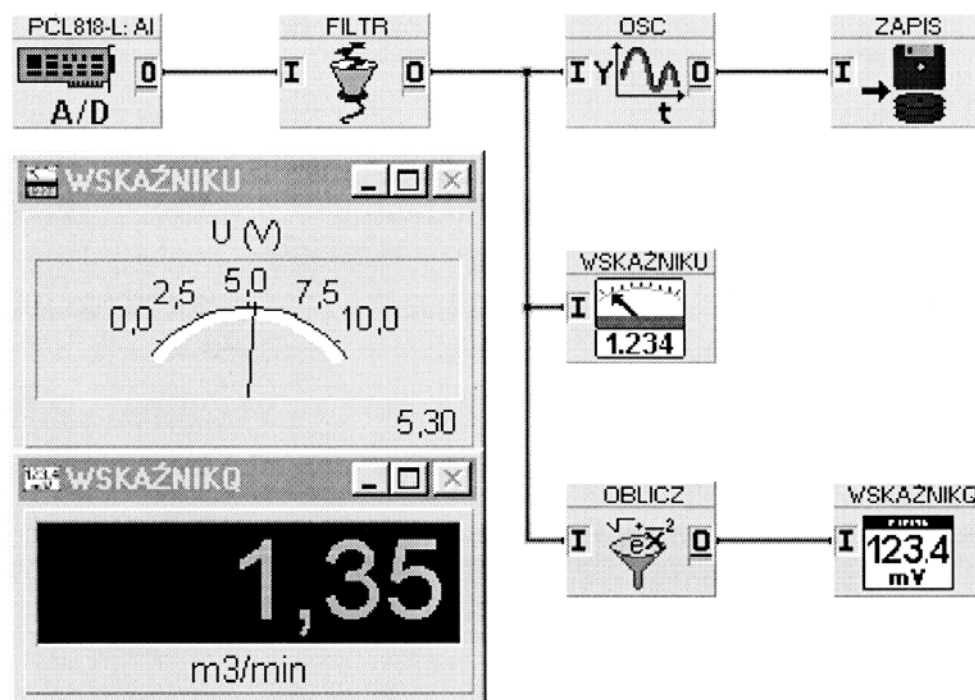


Fig. 3. System for the analysis of the measuring signal

- The following conclusions can be formulated on the basis of the experiment and its analysis:
- ⇒ thermoresistive measuring converter which converts flow intensity into voltage constitutes a crucial subsystem of a convective thermoanemometer
 - ⇒ the computer-based method of signal detection is fast and provides the possibility of initial checking the correct operation of the system;
 - ⇒ specialized software packages can be used for setting a desired configuration of a measuring system, for designing a data processing algorithm on the basis of available procedures, as well as for constructing one's own graphic interface for representing the results of measurements and processing;
 - ⇒ the accuracy and stability of signal parameters depends mainly on input - output systems (measuring bridge) mating with the measuring card;
 - ⇒ with DasyLab package it is possible to build a measuring system in the form of a diagram, using graphic program language;
 - ⇒ particular components and operations are represented as symbols, the connections between them conform to the direction of signal flow;
 - ⇒ it is possible to apply existing functions and procedures for signal generation;

- ⇒ the presented design of the measuring stand provides the possibility of increasing the number of measuring points and also of measuring and controlling other vital parameters of industrial processes;
- ⇒ the accuracy of measurements is high; there exist a vast potential for their processing and the analysis of the results;
- ⇒ the designed system is an open-ended solution, so it can be further extended and modified.

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MONITORING OF THE PARAMETERS OF PUMP OPERATION BY MEANS OF A COMPUTER-BASED MEASURING SYSTEM

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The paper presents a design of a computer-based measuring system for monitoring the basic operating parameters of an axial multipiston pump, which are subsequently used for determining the current efficiency of the pump. Besides, the paper contains a block diagram of a hydraulic experimental stand as well as the analysis of characteristics of measuring converters used in the computer-based measuring system.

Due to the high exploitation cost of machines and devices and also due to increasing expectations concerning reliability, designers and producers take measures towards lowering exploitation costs and improving reliability and durability of machines. Among the most important factors affecting the exploitation cost are unpredicted shutdowns and repairs [1].

Hydraulic drives and controls have many well-known advantages. Because of that they are applied in a number of devices. The basic component of each hydraulic system is a positive displacement pump, which changes mechanical energy into the energy of the pressure of a liquid operating agent. The energy of the agent is subsequently transmitted to a hydraulic engine, in which it is changed back into mechanical energy.