In view of the fact that existing instruments for measuring the speed of air flows do not cover low speeds, V. M. Maevskaya and A. A. Sviridonov of the Eastern Scientific Research Institute for safety precautions in the mining industry have developed a miniature portable thermoelectric anemometer ATE-1 for measuring air speeds over a wide range from 0.001 to 20 m/sec.

The operation of the instrument is based on the cooling by the air flow of the heater of a thermal detector. The thermo-anemometer consists of the following basic units: a transducer with a thermal detector, a measuring instrument, a supply battery, and a circuit with switches and a controlling rheostat.

The transducer (Fig. 1) consists of a hollow texolite cylinder 1 with ebonite handle 2. The cylinder has a diameter of 55 mm, is 20 mm long and has a wall thickness of 2.5 mm.

Along its circumference the cylinder carries 25 series-connected thermocouples made of 0.3 mm constantan and steel wire. The thermocouple junctions protrude inside the cylinder in two rows, one of which is formed by the cold junctions 3 and the other by the hot junctions 4. The protruding ends of the cold junctions are 10 mm long, and the hot junctions 15 mm long. The hot junctions are heated by means of nichrome wires glued to them with bakelite lacquer. Several coats of the bakelite lacquer over the junctions prevent any possibility of short circuits. The conductors to the supply and measuring circuits are taken out through the bakelite handle.

The use of a thermopile consisting of thermocouples connected in a series in two rows of different lengths raises considerably the sensitivity of measurements and the placing of both the cold and hot junctions inside the cylinder eliminates the effect of ambient temperature on the instrument readings.

An attachment is used with the transducer in order to raise the resistance to the air flow when speeds exceeding 0.3 m/sec are measured. The use of this attachment extends the measurement range.

The attachment (Fig. 2) consists of two aluminum lids placed over the transducer. Front lid 1 and rear lid 2 have 3 mm holes 3 and 1 mm holes 4 drilled in them. The diameter of the circumference on which the holes are located is equal to that of the nichrome wire heaters. The front lid carries rotating disc 5 with two holes in it. For measuring medium speeds in the range of 0.3-6 m/sec the disc is placed in the position for which the two small holes are closed and the two large ones open. For measuring speeds in the range up to 20 m/sec, the disc is set so that the small holes are open and the large closed.
A 40-Ω microammeter M24-18 is used for recording purposes.

Three 1.5-v dry cells 1 (type KS-U-3) connected in series are used as a source of supply. The recording instrument, source of supply and other circuit components are placed in a light aluminum alloy casing.

Microammeter type M24-18 (Fig. 3) is connected by means of tumbler switch 2 type TP-1-1 either to supply battery 3 or thermocouples 4. In the first position the voltage fed to filament 5 is measured. This voltage is adjusted by means of a 50-Ω variable resistor 6, which is connected in series with the filament and serves to compensate for a drop in the battery voltage due to its prolonged use. A multiplier 16-kΩ resistor 7 is connected in series with the microammeter. In the second position the microammeter measures the thermocouple emf, which depends on the speed of the air flow. A rising air speed increases the cooling of the hot junctions and reduces the emf.

The supply battery is switched in and out by switch 8, which is incorporated in the variable resistor. The same switch also short circuits the microammeter. The transducer is connected to the instrument by means of a plug and socket 9.

The thermo-anemometer is calibrated at low speeds on special laboratory equipment (Fig. 4). Pipe 1 of this equipment is 1.5 m long and has an internal diameter equal to that of the transducer, which is placed in a socket half-way up the tube in such a way that the heater is on the side of the air supply. Such an arrangement ensures greater sensitivity of the transducer. The tube is connected by means of a flexible rubber hose to gas meter 3 type 1-G86-400, which is connected by means of a rubber output hose to a vacuum pump 4 type VN-461. The air speed is controlled by means of a screw pinch valve 5 placed over the hose and branch pipe 6. Vessel 7 serves to attenuate the pulsation of the jet which arises during the operation of the pump. Microammeter 8 has a uniform scale graduated from 0 to 100, which serves for measuring air speeds by taking readings corresponding to certain emfs and, hence, to definite air speeds.

Before calibration it is necessary to set the instrument pointer to the maximum division on the scale, with the transducer placed in the tube whose air is stationary, since without air movement the emf will be at a maximum. The microammeter is then switched to measure the voltage supplied to the heater filament. In subsequent operation of the instrument it is necessary to check periodically the supply voltage and to readjust it to the initial value by means of the control rheostat.

The instrument is calibrated by establishing in the tube air flows of various speeds \( v_X \) and recording the corresponding microammeter \( M_X \) readings. The speed of flow is measured by the quantity of air \( Q \) cm\(^3\) which passes through the gas meter over a definite period \( t \) sec, and by the cross sectional area of the transducer \( S \) cm\(^2\), i.e.

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v_X = \frac{Q}{t} \cdot \frac{S}{cm^2}
\]

The speed of the flow is adjusted by means of pinch valve 5. The speed of flow is set at integral intervals of the microammeter \( M_X \) scale, for instance, at every 5 divisions of the scale. From the values of \( Q \), \( M_X \) and \( t_X \) the value of \( v_X \) is calculated.

The thermo-anemometer is calibrated together with the transducer by taking a series of independent readings from which the curve \( v_X = f(M_X) \) is plotted in coordinates of \( v_X \) and \( M_X \).

In calibrating the ATE-1 set for medium speeds between 0.3 and 6.0 m/sec, and high speeds from 1.0 to 20 m/sec, the transducer is covered by the above mentioned attachment in which the large or small holes are opened,