Cupless anemometer has diode wind-sensor

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Working well as a differential thermometer, this simple circuit can also be used to find wind speed by detecting the difference in junction voltage between two forward-biased diodes. Here, one junction is heated to a fixed temperature, and the other's temperature-dependent junction potential is made to vary with the cooling effect of the wind. Being totally solid-state, the unit eliminates all mechanical difficulties. The unit can also function as a psychrometer, or humidity indicator, if the heated junction is wetted down instead.

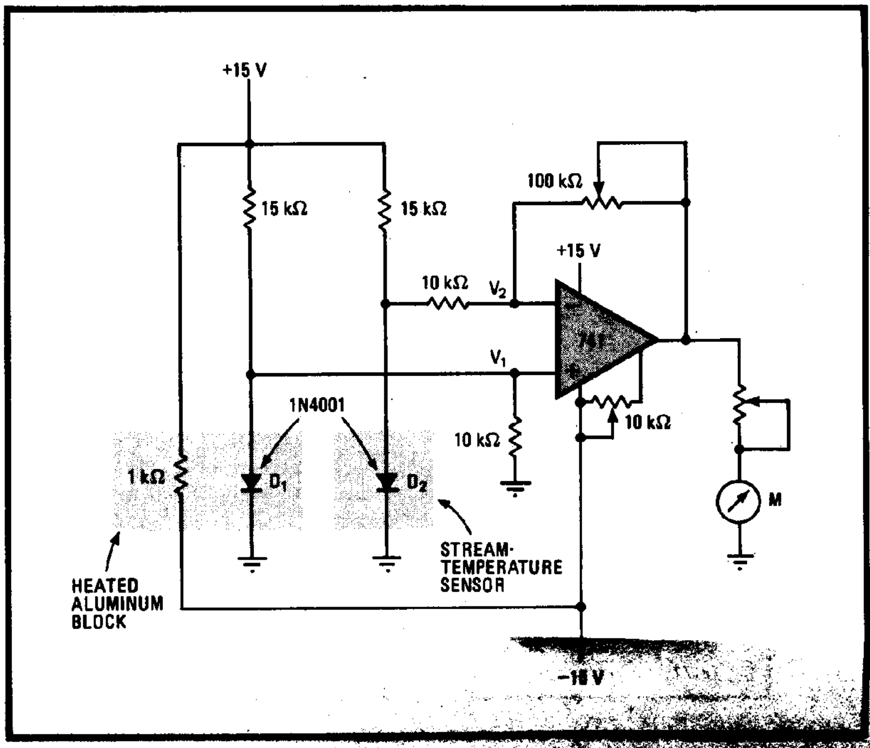
Diode D_1 and a resistor are situated within the confines of a small one-of-a-kind aluminum enclosure built for this circuit. D_1 is heated by the power dissipated by the resistor. The enclosure maintains a constant temperature throughout, independent of environmental changes, as in an oven. Although the absolute temperature reached by the diode junction is of little importance in this circuit, it will be a direct function of the power supplied to the block, the area of the block available for heat transfer, and its heat transfer coefficient.

The same general considerations exist for the stream-temperature sensor, D_2, which is placed in a similar aluminum block to reduce temperature variations due to changes in wind speed (settling time ≈ 2 minutes). Here, however, the power supplied to the block is small, being about 1 milliwatt to activate D_2, and heat variations reach the junction from the outside.

Generally, the output from the 741 op amp is $e_o = K(V_1 - V_2)$, where K is a constant and V_1 and V_2 are functions of the temperature associated respectively with the heated block sensor and the wind speed. The voltages across both D_1 and D_2 drop by 2.5 millivolt for each degree Celsius rise, and so $V_{d1} \approx 0.7 - 2.5(10^{-3})T_f$, and $V_{d2} \approx 0.7 - 2.5(10^{-3})T_w$, where temperature T_f corresponds to V_1 and T_w to V_2. As a result, $e_o = K(-2.5)(10^{-3})(T_f - T_w)$, and so the output of the op amp will be proportional to the temperature difference. The current that flows through ammeter M will thus vary linearly with temperature.

The relation between the wind's cooling factor and temperature is nonlinear, however, and because the initial zero-wind current in meter M is a function of the block temperature (and thus block size), and because the sensor temperature, and D_1 and D_2 are not driven from true constant-current sources, the calibration will not be uniform for any two units.

Although it would be ideal to have access to a wind tunnel for calibration, good results can be obtained with the aid of an automobile. Placing the sensor on the auto's antenna, with the meter set at maximum for zero wind speed, the unit can be calibrated satisfactorily on a windless day by noting M's output as a function of the car's speed. □



Ceaseless wind. Temperature difference between heat oven surrounding diode junction D_1 and stream sensor D_2, whose junction temperature varies with wind speed, is reflected as a change in current at M. Unit can be satisfactorily calibrated with auto's speedometer on a calm day.