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TEMPERATURE STUDIES IN THE BRAKING REGION OF THE GIESELER PLASTOMETER

by

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Some concern has arisen with regard to temperature fluctuations within the brake of the Gieseler Plastometer during operation. The plastometer used at the Canadian Metallurgical Fuel Research Laboratory, CANMET, Department of Energy, Mines and Resources (Ottawa) is equipped with a modified General Electric (Model CR9540) tension-braking system which applies a constant torque to the stirrer in the coal sample. The desired torque (40 ± 1 gm/inch) is achieved by adjusting the distance of a hysteresis ring from a spinning (280 rpm) permanent Alnico 13 magnet. During a test any changes in temperature at the brake could alter the magnetic field at the hysteresis ring and, as a result, the applied torque to the stirrer. It is difficult to place a thermocouple inside the brake near the hysteresis ring because of the rotation of the inner and outer shafts of the system. The thermocouple was placed at various positions along the outer casing of the brake (see Figure 1) and the minimum and maximum temperatures recorded during the course of a test. Temperature measurements were also recorded under simulated test conditions but with the motor off, or with the motor on and the hand brake on. A temperature study was also made with the motor on and the hand brake on but with no heating of the sample.

Four tests were made with the thermocouple on the floor of the brake enclosure (Point A, Figure 1). The minimum temperatures were recorded at the start of the tests (bath temperature = 330°C) and were in the range 29.5 to 31.0°C. The maximum temperatures recorded were 49.0 to 55.0°C at position A when the solder bath reached a temperature of 480°C. Similar temperature measurements were made at positions B, D and E in which the temperatures rose from 30 to 41.5, 28.0 to 45.0 and 27.5 to 41.8°C respectively. The temperatures at positions B and E were also recorded when a sample was heated under simulated test conditions but with the motor to the hysteresis brake off. The temperatures changed from 28 to 32 and 27.5 to 33.0°C respectively during the test. It appears that changes in temperatures at the brake are the result of heat

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coming from the spinning shafts as well as heat conducted by the shaft from the temperature bath. Temperature measurements at position F indicated the temperature increased from 28 to 33°C with the shaft spinning (motor on, brake on) but with no heating of the sample. The temperature changes during an actual test are similar at positions B, E and F. They are in the 27.5 - 31.5°C range at the beginning of the tests and 39 - 41.5°C range at the end of the tests.

An attempt was also made to examine the effect of temperature upon the rate of rotation of the shaft. Two (1-inch) pulleys were attached to the brake as done during calibration. A 40 g weight was suspended from the shaft and indicated the torque of the system was balanced at 40 g-inch. Excess weight (3.44 g) was added so that the weight descended and the shaft rotated slowly. A heating tape was wrapped around the base of the brake and heated so that a temperature of 56 - 58°C was maintained (the maximum temperature observed during an actual experiment). At this temperature the weight caused the shaft to rotate at an average rate of 2.21 ddm (3 experiments) with a standard error of 0.18 ddm. At a base temperature of 28 - 30°C the average rate for two experiments was 2.07 ddm with a standard error of 0.15 ddm. Each experiment lasted for one complete revolution of the shaft or 100 dial divisions. The numbers would suggest that at higher temperatures the torque applied to the shaft has decreased slightly. The difference between the average rates is small and less than the standard errors themselves. It is difficult to assess whether this small change is significant. The temperature changes in the region of the magnets and hysteresis ring (positions E and F) were found to go through similar temperature changes during an actual experiment. Any small change in torque associated with the temperature should be constant for all experiments performed on the same plastometer.

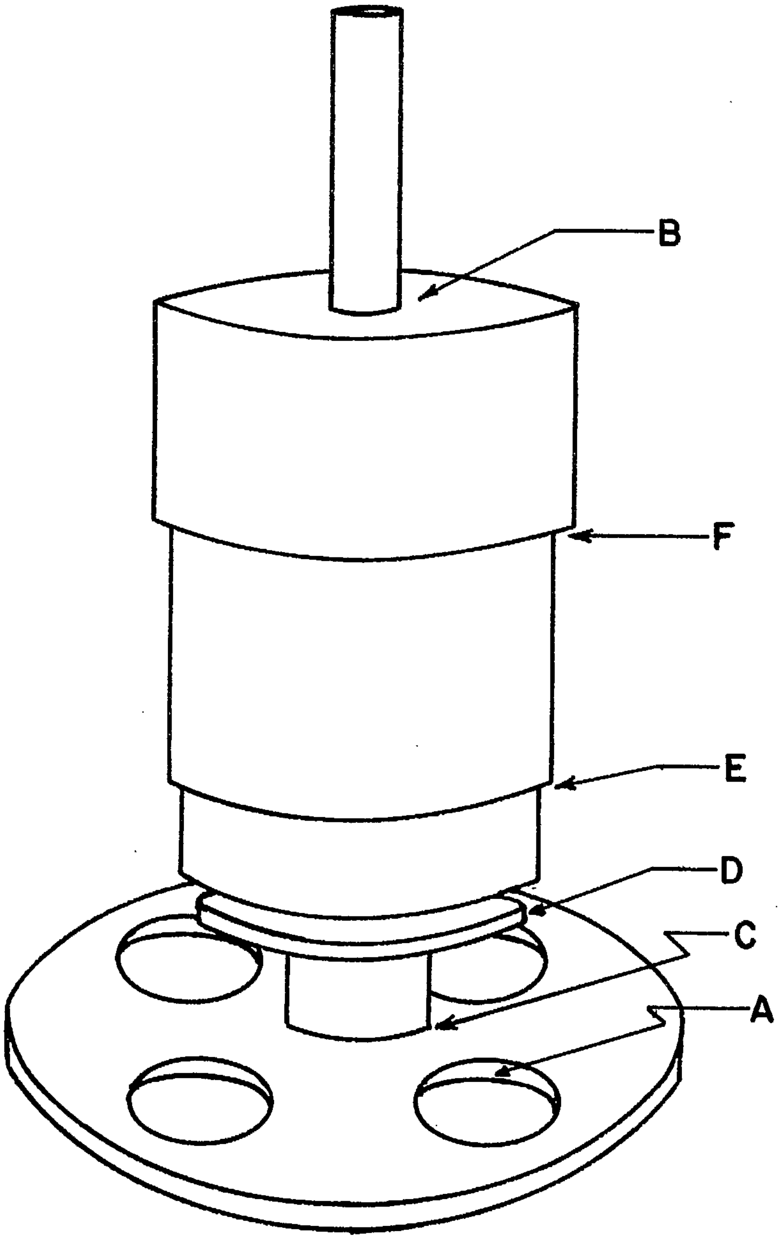

FIG. 1 BRAKING SYSTEM OF GIESELER PLASTOMETER