PNL-9853

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December 12, 1967

BIOMEDICAL ELECTRONICS MEMORANDUM REPORT BME-5-67

TO: N. S. Porter, Manager, Biomedical Electronics Unit

FROM: K. L. Swinth, Biomedical Electronics Unit

IRRADIATION VESSEL TEMPERATURE CONTROL

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IRRADIATION VESSEL TEMPERATURE CONTROL

K. L. Swinth

This memorandum documents the calibration and operating characteristics of the temperature control unit used at the University of Washington's Fast Neutron Medical Research Facility. The designed unit maintains the irradiation vessel at a constant temperature during neutron exposures.

The temperature control unit uses a thermistor as the sensing element in a simple bridge circuit. Changes in the bridge output are sensed by a D.C. Bicon Controller[1] which controls the power to a heating element. An unregulated D.C. power supply provides power for the heating element which consists of two parallel wire-wound resistors located in the bottom of the irradiation vessel. During operation the resistors dissipate about 6 watts of power which heat the water bath to maintain the desired temperature. This low power output prevents temperature excursions and hot spots. Safety features include a low operating voltage (12 volts), the liberal use of insulation to reduce any potential shock hazard, and both input and output fuses.

Figure 1 shows the potentiometer setting in the bridge circuit versus the temperature at the center of the irradiation vessel. With the vessel filled with water the temperature is increased at the rate of 0.45°C/min. Because of the geometry, the unit will overshoot its control point during a wide temperature increase. During control unit tests, a 15°C increase overshot the set point by 1°C and took about 20 minutes to reach equilibrium.

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1. Robicon Corporation

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Due to the slow rate of temperature increase and the time required to reach equilibrium, it is recommended that the unit be filled with water at approximately the desired temperature before operation. Prior to use, time should be allowed for the unit to reach equilibrium.

The use of two indicating pilot lights provides monitoring during operation. A red light indicates when the unit is turned on and a yellow light indicates when power is being provided to the heating element. Off when the water bath is at the control temperature, the yellow light normally cycles off and on as heat losses are corrected.

Two 15 volt batteries, located in the control box, provide power for the bridge circuit. If these batteries fail, the unit will not heat the water.

Physical contacts with the heating elements must be avoided. Impairment of normal water circulation around the elements will create a hot spot. The elements are warm to the touch on momentary contact, but soon become uncomfortably hot if contact continues.

The control circuitry fits under the knee pads of the bed where, during operation, the controls and pilot lights can be seen. A cable with locking connector links the control circuitry to the irradiation vessel containing the heating element and the thermistor sensor.

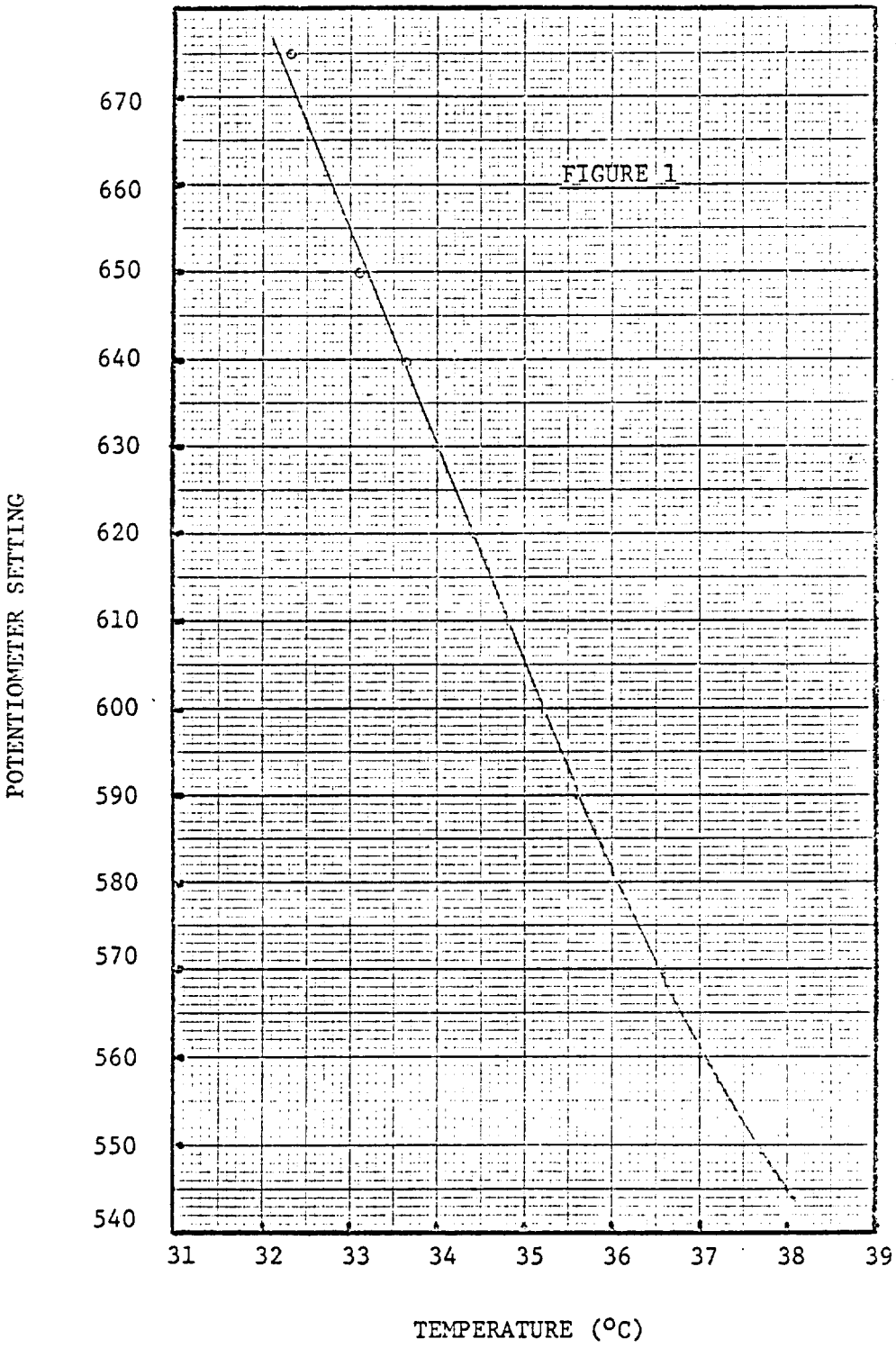
FIGURE 1
POTENTIOMETER SETTING
670
660
650
640
630
620
610
600
590
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570
560
550
540
31
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TEMPERATURE (°C)

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