A MERCURY-IN-GLASS THERMOREGULATOR.

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(Received Nov. 1, 1933).

ABSTRACT.

A mercury-in-glass thermoregulator capable of controlling bath temperatures to within 0.001°C. is described.

The apparatus described below was developed in an attempt to eliminate some of the more obvious disadvantages of the ordinary liquid (e. g. toluene)-in-glass thermoregulator and has proved to be very satisfactory. It consists essentially of a closely wound spiral or helix (shaped to fit the bath in which it is to be used) of flattened thin-walled glass tubing which is filled with distilled mercury. (Such tubing may be obtained by special order from some laboratory glass manufacturers). Each end of the spiral is sealed to ordinary glass tubing in such a way that when placed vertically in the thermostat the tubes project above the surface of the bath liquid. One of the vertical tubes includes a stopcock (below the bath surface) while the other ends in a capillary containing a fixed pointed platinum or tungsten contact centered in the tube below the liquid surface by means of a fused on glass bead. The second platinum contact may be fused through the other tube below the stopcock which serves to regulate the amount of mercury in the system and thus change the setting of the instrument. The capillary may be open to the atmosphere or, in case a poor relay necessitates the use of a current large enough to cause sparking, may be evacuated or filled with inert gas to prevent oxidation of the mercury.

This instrument possesses several distinct advantages over the ordinary toluene regulator. The fact that the "dV/dT" is much greater in the case of the latter is of little significance in view of the fact that only the layer of toluene next to the glass wall has time to expand before the reverse change becomes necessary and the surface layer must contract to an even greater extent than it should in order to offset the ex-

pansive effect of the heat wave travelling toward the centre of the toluene. The speed of volume change is thus of greater importance than the magnitude of volume change. The former may be increased by increasing the surface volume ratio of the liquid and by using a liquid of high thermal conductivity. If the regulator is made of glass it is also important to have the walls as thin as possible. A steel spiral would probably be more satisfactory.

The following are the approximate dimensions of one of these regulators that has been in use for some months. The length of the mercury column (16 turns) is 160 cm. The width and thickness are 0.8 and 0.15 cm. respectively. The volume and surface of the mercury are approximately 19 $cm.^3$ and 300 $cm.^2$ giving about 20 times the volume and about 3 times the surface volume ratio of an ordinary Beckmann thermometer. The diameter of the capillary at the fixed platinum contact is about 0.3 mm. In a vigorously stirred bath this regulator will respond to temperature changes that are not noticeable on a Beckmann thermometer placed within the spiral, i. e. the temperature is regulated to within 0.001°.

These regulators have several other advantages over the type usually employed. They are very easy to fill—distilled mercury is simply poured into the clean spiral by means of a capillary funnel passing through the stopcock. They are easy to adjust as the contact is permanently fixed and centered in the capillary which may be made very narrow just at the platinum point. By employing only one liquid a great source of inconvenience is avoided and, as the liquid is mercury, the temperature range over which the instrument may be used is greatly increased. They take up little room in the bath, need only a small quantity of mercury and integrate over the whole depth of water more efficiently than a bulb regulator. The fact that the use of an inflammable liquid is avoided is an important consideration particularly if used to control a gas heated thermostat.

This type of thermoregulator made to specifications may be obtained from the Fisher Scientific Co. of Montreal.