AN ELECTRICALLY HEATED AND ELECTRICALLY CONTROLLED THERMOSTAT.

BY S. W. YOUNG.

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I RECENTLY found myself, on account of a very irregular and inferior gas supply, forced to devise some other means than the one usually employed, for heating and regulating the thermostat. After a few preliminary experiments the apparatus herein described was developed, and has, after considerable experience, shown itself to be thoroughly satisfactory,—in many respects more satisfactory than the usual form with gas-heating.

For this latter reason it seemed worth while to publish a brief description of the apparatus, in the hope that use might be made of it by others. As will be readily seen, the principle allows of very ready application to thermostats for biological laboratories, such as are used for the purpose of maintaining constant temperatures in paraffin baths for imbedding, etc., and for incubators and the like. Some forms of the apparatus for these purposes are being tested and, if successful, will perhaps be described elsewhere, later.

The apparatus consists of four essential parts: (1) the bath (not shown in diagram); (2) the heater; (3) the interrupter; (4) the regulator.

1. *The Bath.*—This may be of any desired form. For my purposes, I used a cylindrical agate-ware can covered with felt. The capacity was about 30 to 35 liters. The general arrangement of the bath is identical with that of the usual Ostwald thermostat and needs no further description.

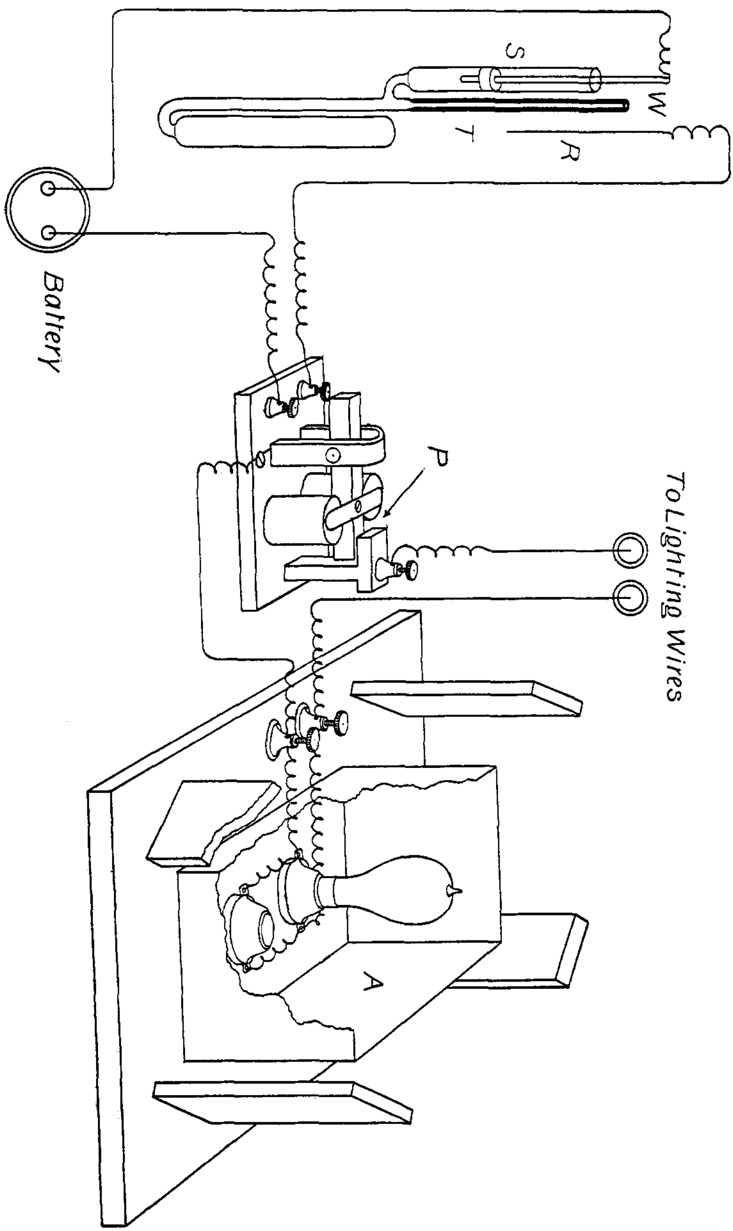
2. *The Heater.*—This consists of a square board of convenient dimensions, upon which near the center are screwed two or more incandescent light receptacles, which are wired up parallel, as usual. Surrounding these is an asbestos box open at top and bottom, which serves to economize heat. For heating purposes incandescent lamps are used and have been found very satisfactory for low temperatures, although it may be questionable whether they would prove sufficiently durable at higher temperatures. For maintaining my 30-liter thermostat at 25° C., I have found that one 16 c. p. and one 8 c. p. 100 v. lamp acting

together were wholly sufficient. The four uprights at the corners of the base-board serve as supports for the bath.

3. *The Interrupter.*—This I made by the reconstruction of a telegraphic sounder. The wiring of the current to the lamps is so arranged that when the armature is raised the current passes through it and the lamps remain lighted. When the armature is pulled down the current to the lamps is interrupted at P, and the lights go out. It goes without saying that platinum contacts are preferable.

4. *The Regulator.*—This is a modification of the ordinary form of the gas regulator. The principal modification lies in the side tube S. This is provided with a piston carrying a stout iron or platinum wire W. In filling the regulator, it is so arranged that the whole space below the piston is filled with mercury and a layer of mercury is placed on the top of the piston. This allows: (1) connection between the mercury of the regulator and the battery cell; (2) it allows of the regulation of the height of the mercury in the capillary tube T, by raising and lowering the piston. In this way the regulator can be set for any desired temperature. The piston may be made of a piece of cork, fastened to the wire by cement. There is no particular difficulty in making such a piston mercury-tight. Finally the wire R is so arranged that it can be placed at any desired height in T. It serves to complete the circuit through regulator, battery, and interrupter when, by warming, the mercury shall have risen in T to such a height that contact is made with R. It also serves for the final, exact regulation of the temperature.

The action of the whole apparatus is then as follows: The bath is placed over the heater and the regulator in the bath (which must naturally be mechanically stirred); the current is turned on through the lamps which warm the bath; this warming expands the mercury and toluene in the regulator, until finally contact is made between the wire R and the mercury in T; this closes the circuit through the battery and interrupter, drawing down the armature of the latter and interrupting the current through the lamps; cooling follows, the contact between the mercury and R is broken and the current again made through the lamps. Thus the temperature in the bath is maintained constant to within small limits. In general the temperature of my thermostat never varied more than from two- to three-hundredths of a degree. By


S
W
T
R
Battery
P
To Lighting Wires
A

taking special precautions (avoidance of draughts, etc.), I have been able to avoid any variation greater than one-hundredth degree for over four hours. Temperature variations were noted with the aid of a Beckmann thermometer.

I should like to state here that, from my experience with thermostats, I have been convinced that the fineness of the regulation of the temperature demands not so much sensitiveness, *i. e.*, large linear motion for small temperature change in that part of the regulator where the cut-off is, but rather rapidity of response on the part of the expansive medium to temperature changes. In the ordinary bulb regulator, the lag of the expansion and contraction of the toluene is the most fruitful source of variation, when the sensitiveness of the regulator has been otherwise highly developed. This defect is to be best met, not by increasing the quantity of expansive liquid, but by distributing it in such a way that there will be greater surface exposed; *i. e.*, in annular or spiral bulbs. I have made no experiments in this direction as the apparatus above described was wholly sufficient for my purposes.

Certain modifications of the above apparatus will naturally suggest themselves, such as use of platinum wires instead of lamps, etc., but the apparatus as described has worked so satisfactorily that I have let well enough alone.

Certain advantages, such as affording no danger from fire, cleanliness, etc., need not be enumerated here.

A METHOD FOR THE DETERMINATION OF THE AVAILABILITY OF ORGANIC NITROGEN IN COMMERCIAL FERTILIZERS.

BY JOHN PHILLIPS STREET.

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OF the three essential plant-food elements, nitrogen, phosphoric acid, and potash, nitrogen is by far the most important, not only because it is the most expensive, but also because it is the chief factor from a fertilizing standpoint in the early growth of the plant. The nitrogen of sodium nitrate and that of ammonium sulphate, on account of their solubility in water, are known to be readily available to the plant, and satisfactory methods for their detection exist. The great demand for nitrogen by the farmers, however, and the desire to utilize as far as possible