

The vapor pressure of tungsten.

The vapor pressure of platinum.

The determination of the temperature of tungsten filaments.

The reaction between oxygen and platinum.

Two new kinds of hydrogen clean-up.

The electrochemical and electrical clean-up of nitrogen.

The dissociation of oxygen into atoms.

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NEW DESIGNS FOR SPECIFIC HEAT APPARATUS.

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In the prosecution of an investigation of the specific heats of milk and milk derivatives recently carried out at Iowa State College it was found necessary to work out a design of a specific heat apparatus of simple construction which would lend itself to the attaining of results very rapidly, as well as accurately. Two designs have been evolved. In both the electric current is used for heating, but with one a variable voltage may be used, while with the other a very constant voltage is necessary.

Apparatus No. 1, for Variable Voltage.

The outer insulating walls (1) of the apparatus consist of pressed cork, such as is used in the construction of refrigerators and thermostats. In the cylindrical cavity (2), which may be gouged out with a sharp paring knife, is the copper (or glass) calorimeter vessel (3) (Diam. = 6.25 cm. Height = 8.75 cm.) for holding 100 grams of sample. (4) is another copper vessel (D. = 4.7 cm., H. = 8.1 cm.) with a capacity of 100 grams of water, in which is immersed an electric light bulb and a thermometer to which a stirrer is attached. The vessel is arranged with a tight-fitting cap having a bayonet catch. Leads from the electric lamp pass up through a fiber or glass tube (5) which also serves as a handle for the whole vessel and its contents which we may call the "heater." The upper portion (6) of the cork insulating vessel has cut through it a cylindrical hole just a trifle greater in diameter and deeper than the heater. Between the upper and lower portions of the cork container is a heavy asbestos board partition (7), the middle third of which is a slide that may be readily inserted or withdrawn.

The operation of the apparatus is as follows: 100 grams of water are weighed in the vessel (3), which is placed in the cork thermostat. A

thermometer (8) reading to $\frac{1}{10}^{\circ}$ is then inserted. The electric current is turned on the heater (4) and this allowed to come to a suitable temperature outside of the thermostat. If the temperature of the liquid is say, 20° , it will be sufficient to heat to about 45° . It is then placed in the cavity (9) and allowed to come to a condition such that radiation

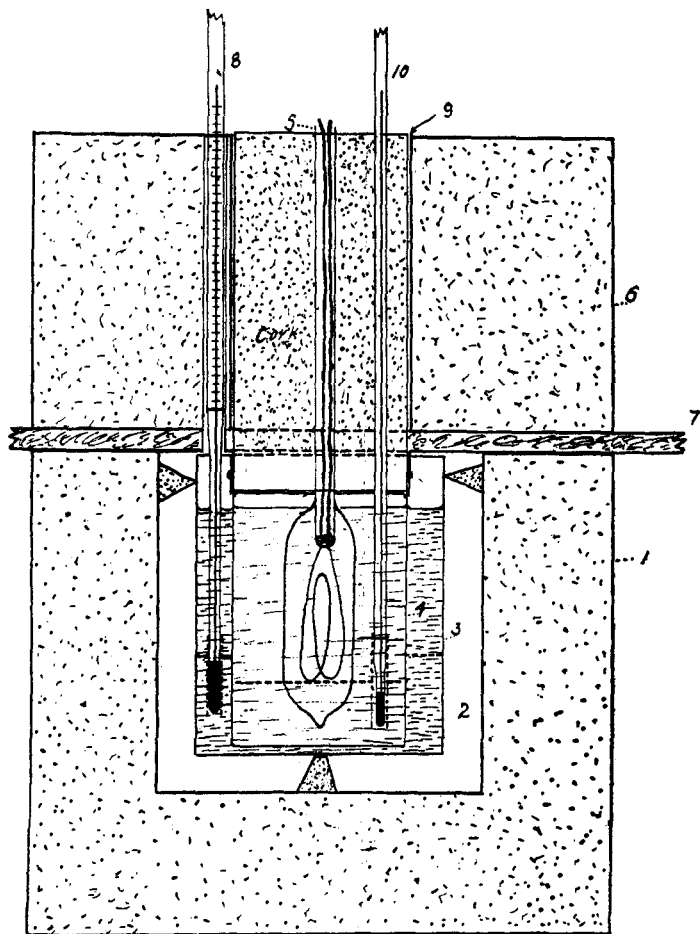


Fig. 1.

takes place regularly, the thermometer (8) is read, and when the mercury of the thermometer (10) comes to a chosen mark the heater is dropped down into the liquid in the calorimeter vessel. The liquids of both vessels are agitated regularly until the thermometer (8) shows the maximum rise of temperature. Results are gotten for water and the substance in hand for the same range of temperature. The specific heat of the substance

is inversely proportional to the temperature rise, the rise being compared with that of water under like conditions. Corrections for radiation and the water equivalent of calorimeter must, of course, be applied.

Apparatus No. 2, for Constant Voltage.

Fig. 2 is a cross-section drawing of a very satisfactory apparatus not only for milk but for any liquid which is not appreciably volatil at ordinary

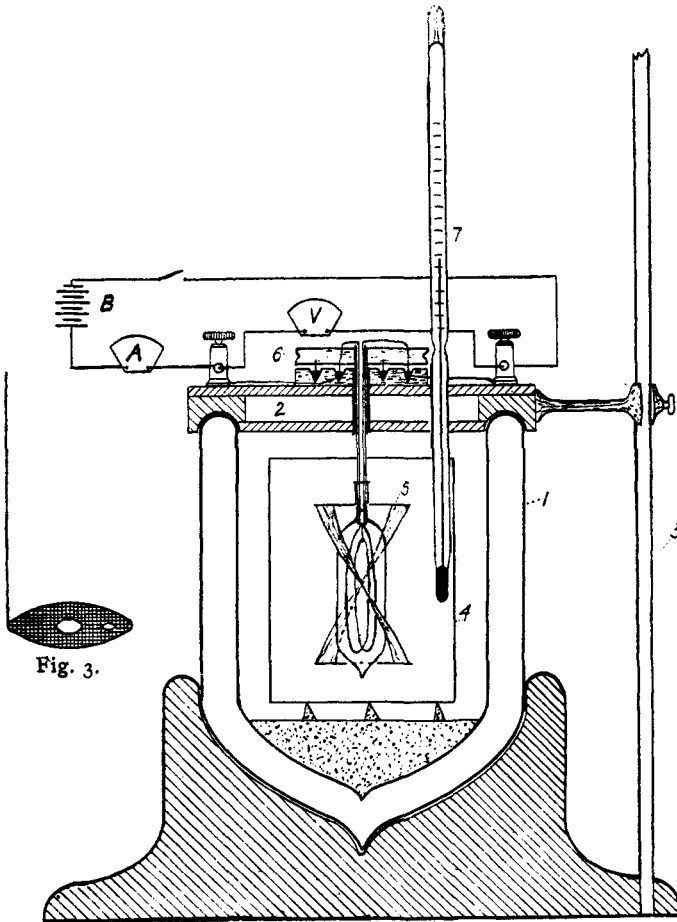


Fig. 2.

temperatures. (1) is a Dewar flask supported in a wooden base and provided with a hollow wooden cover (2). This cover is attached in a clamp which slides up or down on the rod (3). From the cover of the vessel a small, narrow shank, 8 c. p. electric lamp projects down into the calorimeter vessel (4). The calorimeter vessel is made of thin copper or

glass as desired, with a capacity of 500 cc. Smaller vessels may, of course, be used. The Dewar vessel should be about 12.5 cm. in internal diameter and 15.0 cm. deep. The bottom is provided with a cork, false bottom and small cork pyramids for the calorimeter to rest upon. A stirrer (5) in the form of a propellor may be clamped on to the lamp and the whole rotated by a motor belted to the pulley (6), or a reciprocating stirrer may be provided. A good reciprocating stirrer of fine wire gauze soldered on two concentric wire rings is shown in Fig. 3. The two holes are for admitting the lamp and thermometer. If a Dewar flask is not obtainable, a cork thermostat may be provided. Such a thermostat has been used by the authors and found to give very satisfactory results. As shown diagrammatically in Fig. 3 the lamp is connected in series with a storage battery, ammeter and switch. A voltmeter is placed across the lamp.

The specific heat of a liquid may be determined by either of two methods: a weighed sample of water is placed in the calorimeter, the temperature noted on the thermometer (7), the current turned on for, say, five minutes, and readings of the temperature taken every minute. (Stop-watch used.) The same procedure is then gone through for an equal weight of the substance whose specific heat is desired. Corrections for radiation are best obtained by allowing the apparatus to cool for same length of time, within the same temperature range, as was devoted to the heating, and adding this value to the rise in temperature obtained by heating for five minutes. If working below room temperature there will be a gain in temperature, on standing five minutes with lamp off, which must be subtracted from the reading obtained by heating five minutes. The specific heat of the substance is then found by comparing its temperature rise with that of distilled water (equal weight).

By the second method the respective amounts of electrical energy expended on the substance and water to raise them the same interval of temperature may be compared by multiplying the drop across the lamp (voltage) into amperes into time and dividing by 4.26 to reduce to calories. If the source of electric energy gives a constant voltage, the first two terms, drop and amperage, will be constant and we may compare the time terms only.

Both of the above types of apparatus have been found very satisfactory for liquids which are not appreciably volatil at ordinary temperatures. Apparatus No. 2 is particularly accurate, it being very easy to get a series of reading with aniline, for instance, which vary no more than 0.2% from the mean.