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A DESIGN FOR ELECTRICAL REGULATION OF HIGH TEMPERATURE OVENS.

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In growing Tellurium crystals, a temperature within a few degrees of 450 centigrade must be maintained constantly. The electrical oven available consisted of a porcelain tube five centimeters in diameter and thirty centimeters long, covered with asbestos. The need for making a regulator arose from the fact that nowhere in the catalogues available was there a regulator advertised that would be contained within the tube without completely closing it. Nearly all temperature regulators for electrically heated apparatus break the heating current when the temperature rises to a given point, and make it when the apparatus cools, and the difference between these two temperatures is the regulation of the device. It requires 10 amperes to heat this particular oven to 500 degrees centigrade, and simple expansion could not be relied upon to make a gap sufficiently wide to prevent sparking and at the same time give any very close regulation.

Any device using electricity to break the heating circuit must operate with a very small current because of sparking across the gap made by the contraction of the contacts. This contraction should be as great as possible, and in the oven for which this device was made there was not sufficient room to use levers to increase the gap. A mercury-in-glass device was first used, in which the circuit through a storage cell and relay was completed by the rising surface of the mercury coming in contact with a platinum point. This was discarded because the oxide and vapor formed at each contact made it necessary to keep vigilant watch to assure its working. Another device consisting of a strip of brass and copper riveted together, and using the unequal expansion of the two to bend the strips and make contact against a suitably placed point was discarded because of its lack of fine regulation. The present device utilizes the geometric principle that if the base of a right triangle be kept constant, the perpendicular increases more rapidly than the hypotenuse, and especially for small increments.

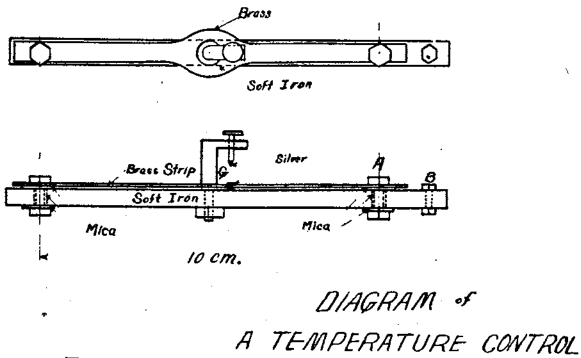

FIG. 11.—Apparatus for temperature control.

Thus, in the apparatus shown in figure 11, in which the base is made of soft iron, and the flexible part of brass, for each degree rise in temperature for each centimeter of length, there is a difference in expansion of .000007 centimeters. By making the length of the metal between rivets to be 10 centimeters, the half length which forms the triangle is five centimeters, and for 400 degrees rise in temperature,

the brass is $5 + .000019 \times 400 \times 5 = 5.038$ cm. in length, and the iron is $5 + .000012 \times 400 \times 5 = 5.024$ cm. in length. This gives a rise of $\sqrt{(5.038)^2 - (5.024)^2} = \sqrt{.14} = .375$ cm. or 3.75 mm., which is equivalent to the expansion of 50 centimeters of brass. The device operates on one-fourth ampere of current, and regulates to one degree. Its action is clearly shown in the diagram, figure 12.

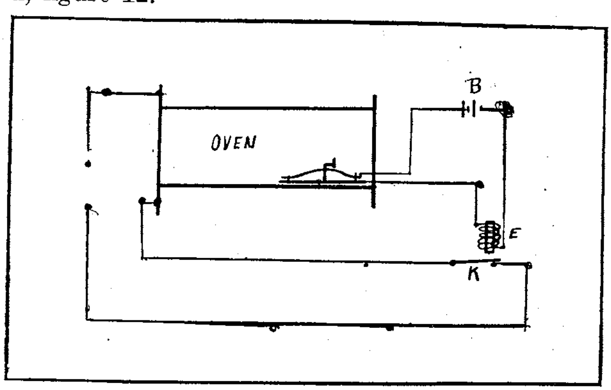

FIG. 12.—Diagram of apparatus installed.