

EXPERIMENTS ON HEAT INSULATION.\*

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At the twentieth general meeting of this society a paper<sup>1</sup> was presented describing an electric furnace experiment in which it was found that the heat losses were so great that the furnace was not commercially practicable. It was also observed that by placing a layer of special heat insulating bricks wherever practicable on the outer walls of the furnace the heat losses were much diminished.

The very serious consequences of not attending properly to heat insulation led to an attempt to study the subject of heat losses, and the following paper describes some of the preliminary experiments.

Energy which should be usefully employed in the electric furnace is lost in various ways: Current leakage, generation of heat in the cables and other means for conducting the current into the furnace, conduction, convection and radiation of heat by the furnace walls, etc. In many furnaces there can be little doubt that the most serious loss of energy is that due to the escape of heat through the walls.

In the study of this subject we have no data which enables us to make calculations of the heat losses which will occur with different materials and under various conditions. No doubt there have been careful and valuable investigations made on the heat conductivity of materials and some experiments on the emissivity of hot bodies. Little information is available as regards convection. When such data as we

loss through the walls is such a large percentage of the total heat generated in the furnace.

The ideal method of studying the subject would be to make the necessary experiments to determine the heat conductivity of the various materials to be used in constructing the walls of furnaces, to make measurements of the emissivity of the heated walls and so forth. But when the plans for such an investigation are made it is soon seen that much time and expense is involved. Under these circumstances

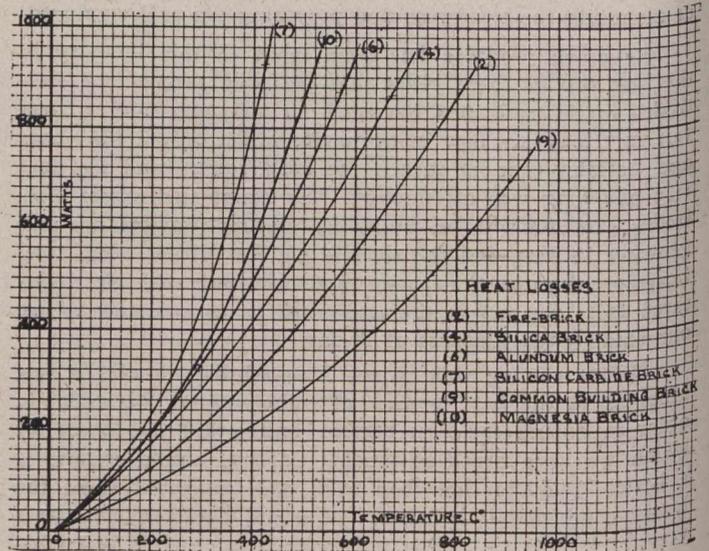


Fig. 2.

it was thought to be more immediately useful to determine by comparatively simple experiments what materials would give the minimum loss of heat. By such work a great many materials could be immediately rejected and those which gave good results would be more fully investigated.

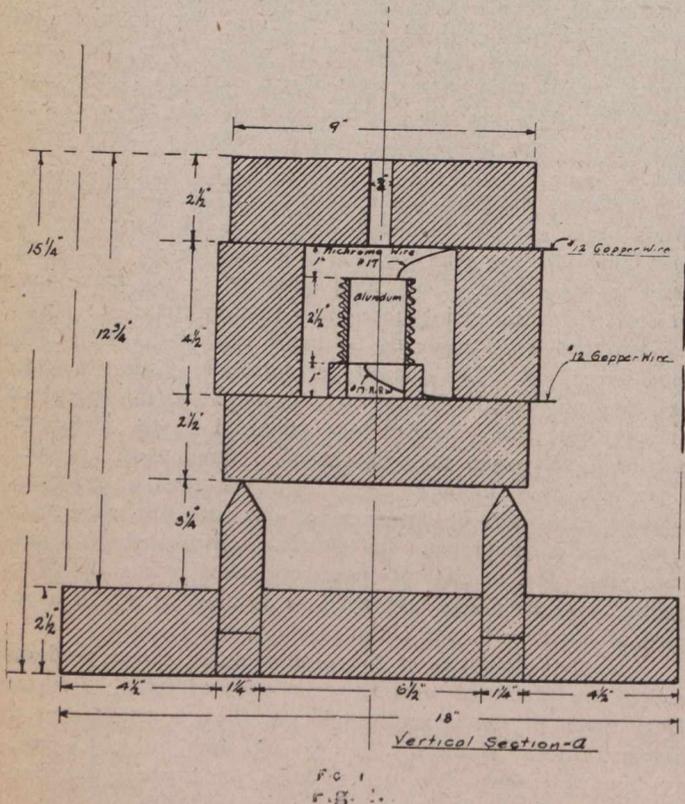
The apparatus used in the experiments is shown in Fig. 1. The furnace is constructed of the bricks under investigation and is heated by means of a resistor of "Nichrome" wire through which the current is passed. The resistor is connected to the source of current through a rheostat so that the rate of generation of energy in the resistor can be regulated, and means are provided for accurately measuring this rate. The method of making a test is to regulate the current so that a definite temperature is reached in the furnace and then to continue heating until the temperature becomes perfectly constant. As a rule a single determination takes several hours and the temperature is not considered constant until the readings of the pyrometer show no variation for at least two hours. When the temperature is constant the rate of generation of energy in the resistor is determined and this gives the rate at which heat is escaping through the furnace walls, neglecting what escapes by conduction through the leads going to the resistor and through the wires of the pyrometer thermo-couple. In nearly all cases four determinations at temperatures ranging from 200° to 900° were made for each of the materials tested.

From the data obtained as described above, curves were plotted in which the abscissas are temperatures and the ordinates watts.

In Fig. 2 are shown the curves obtained with several different bricks.

No. 2 is a fire brick of moderately good quality, that is to say, it is not of any special make. It was the brick used in constructing the furnace referred to in the paper mentioned above.<sup>2</sup> The maximum temperature reached in the brick testing furnace was 800°.

<sup>2</sup> Ibid.



have on these various causes of heat loss are examined and an attempt made to calculate probable losses the results are usually most unsatisfactory. On the other hand it is still more unsatisfactory to construct electric furnaces and find that they are commercially impracticable because the heat

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<sup>1</sup> "Note on an Unsuccessful Furnace Experiment," F. A. J. FitzGerald. Transactions 20, 89 (1911).