L. E. SAUNDERS.

METHOD OF SHRINKING MAGNESIA.

APPLICATION FILED JULY 28, 1917. RENEWED FEB. 17, 1920.

1,352,388. **Patented Sept. 7, 1920.**

Fig. 1.

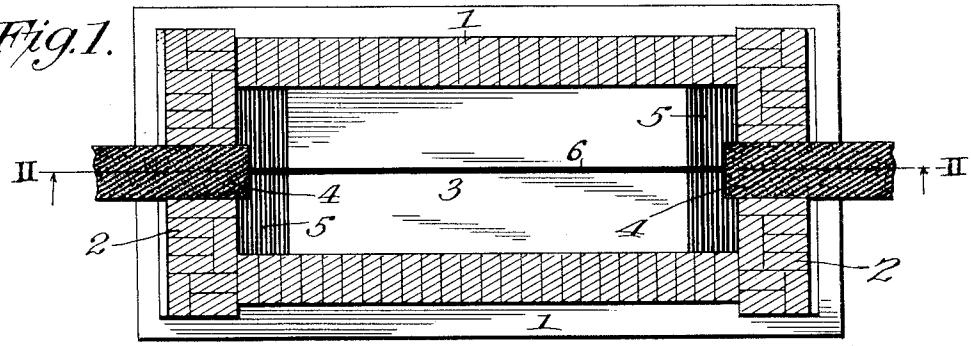


Fig. 2.

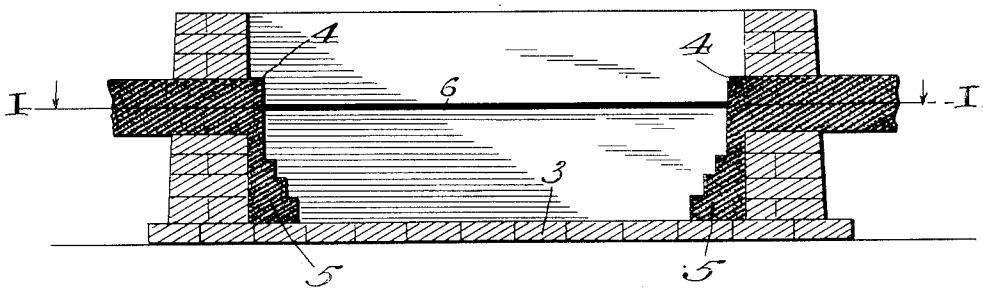
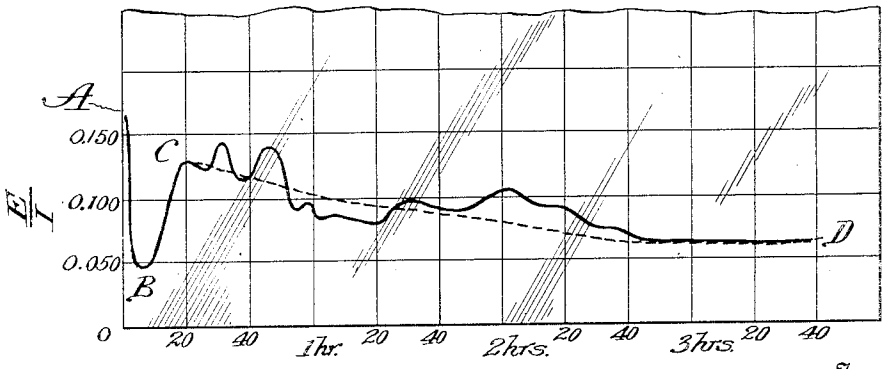


Fig. 3.



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METHOD OF SHRINKING MAGNESIA.

1,352,388. Specification of Letters Patent. Patented Sept. 7, 1920.

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To all whom it may concern:

Be it known that I, LEWIS E. SAUNDERS, a citizen of the United States, residing at Worcester, in the county of Worcester, and State of Massachusetts, have invented certain new and useful Improvements in Methods of Shrinking Magnesia, of which the following is a specification.

This invention is an electric-furnace method of heating magnesia.

It is well known that magnesia, when subjected to sufficiently high temperatures, progressively increases in specific gravity and decreases in volume, this being commonly termed "shrinking." At sufficiently high temperatures, the magnesia is sintered or agglomerated into a solid mass, and at temperatures easily attainable in the electric furnace, may be fused. This invention relates to an electric-furnace method by which the magnesia may be heated to the desired temperature, usually that at which sintering or agglomeration occurs, by electrically-applied heat, in a highly economical and advantageous manner. The approximate temperature at which the sintering of pure magnesia occurs is 2600° C. Commercial magnesia sinters at a somewhat lower temperature.

It is known that magnesia, at sufficiently high temperatures and in the form of coherent bodies, is electrically-conductive; whereas at ordinary temperatures, it is practically non-conductive. This invention contemplates establishing a current-path through a charge of magnesia by suitable application of heat along a restricted line or lines, and thereafter electrically heating and converting the surrounding portion of the charge by means of an electric current traversing those portions of the charge which have been thus rendered electrically conductive.

The method may be carried into effect in a furnace of the character illustrated in the accompanying drawing, wherein—

Figure 1 is a horizontal section of the furnace on line I—I of Fig. 2;

Fig. 2 is a central longitudinal section on line II—II of Fig. 1; and

Fig. 3 is a resistance curve under specific conditions, as described below.

The furnace illustrated has side walls 1, 1, end walls 2, 2, and a base 3, all of which may be of fire-brick or other suitable refractory material, preferably basic in character. Magnesia brick may be used. The terminal electrodes 4, 4 are of carbon and may extend from side to side of the furnace, as shown. Below the electrodes 4, 4, the end walls are internally faced with carbon, as indicated at 5, this facing preferably having a step-like formation, as shown, for the purpose of supporting those portions of the charge which are in contact with the terminal electrodes. The carbon rod 6 termed the "starting rod" of relatively small diameter is illustrated as extending between the electrodes and contacting therewith. This starting rod may if desired consist of two or more sections which are initially in electrical contact with each other, and therefore afford a continuous path for the current between the terminals 4, 4.

The method as carried out in a simple furnace of this kind is as follows: The magnesia, preferably calcined, is charged into the furnace completely filling the same and being packed under and around rod 6 and in close contact with the terminal electrodes 4, 4. A heavy current is then applied, which in the first instance, traverses the carbon rod 6. At the beginning of the operation, the amperage and the voltage of the current are so adjusted with reference to the cross-section of the rod 6, that the portion of the charge immediately surrounding the rod is caused to agglomerate and to become electrically conductive. At the high temperatures thus developed in the rod, the carbon disappears completely in the course of a very few minutes, being presumably oxidized by the magnesia, the reduced magnesium being reoxidized to magnesia in the course of its passage through the charge. It is essential to the success of the operation that in the very short interval of time before the rod is destroyed a sufficient cross-section of the surrounding charge should be brought to a sufficiently conductive state, so that the magnesia thus converted may, usually under a somewhat higher impressed voltage, assume the role of a resistance body, as the carbon rod fails. As a rule, it is necessary to increase the impressed voltage at a rapid rate as the carbon rod disappears in order properly to maintain the load.

The resistance curve, Fig. 3, will serve to illustrate the changes occurring in a furnace during the course of a particular run,

it being understood, however, that such fluctuations as are here indicated are not necessarily characteristic of the practice of the method. In the curve, the solid line represents the actual fluctuations of the resistance, and the dotted line represents a simplified expression of the changes in resistance. In the run referred to, two parallel carbon rods were used, each three-fourths inch in diameter and eighty-eight inches long, each rod consisting of two lengths joined by a sleeve midway between the electrodes. The interior length of the furnace was 94 inches, its width 30 inches, and its depth 37½ inches. The total charge, including additions during the operation, consisted of about 3500 pounds of a commercial calcined magnesia. The initial current was 365 amperes at 50 volts, and was increased by short stages to 2330 amperes at 109 volts at the end of four minutes. The resistance then rapidly increased over a period of about 16 minutes, during which the voltage was progressively increased so as approximately to maintain the load, the voltage after 20 minutes being 190 and the amperes 1460. The resistance then gradually declined, subject to fluctuations, the conditions ultimately becoming approximately constant at 131 volts and 2,000 to 2,100 amperes.

It will be observed that this particular curve indicates three well-defined stages of the operation. It may be assumed that the rapid fall in resistance from A to B corresponds to the increase of conductivity of the carbon rod under the rapidly rising temperature; the following rise in resistance from B to C probably corresponds to the destruction of the rod, by oxidation; from the point C the current was carried chiefly or entirely by the magnesia, the gradual decline in resistance corresponding to the increase in cross-section of the magnesia core, by conversion of the surrounding charge, subject to fluctuations which in part at least are due to temperature changes, and in part to the presence of molten magnesia.

At the conclusion of the run, after cooling the furnace, the magnesia was found in the form of a sintered mass or pig weighing about 1900 pounds and bedded in the unconverted portions of the charge. The latter portions being unsintered, were easily brushed off, and were immediately available, with the necessary additions, for a repetition of the operation. The pig consisted of fully shrunk material having a specific gravity of 3.547. No vestige of the carbon rod remained.

During the course of the run, the charge decreases gradually in volume, and is preferably maintained by adding further portions of magnesia as required. Such additions under ordinary conditions may amount approximately to the weight of the charge originally taken.

It is of course to be understood that the invention is not restricted to such details of a specific operation as are above given for the purpose of a clear and full explanation of the nature of the invention.

I claim:—

1. The electrical method of shrinking magnesia, which consists in locally heating a charge of magnesia under conditions to establish a current path therethrough, and progressively shrinking further portions of said charge by means of an electric current traversing the conductive portions thereof.

2. The electrical method of shrinking magnesia, which consists in establishing a current path of electrically-conductive magnesia in the body of a substantially non-conductive charge of magnesia, and progressively shrinking said charge by means of heat developed by an electric current traversing the conductive portions thereof.

In testimony whereof, I affix my signature.

LEWIS E. SAUNDERS.