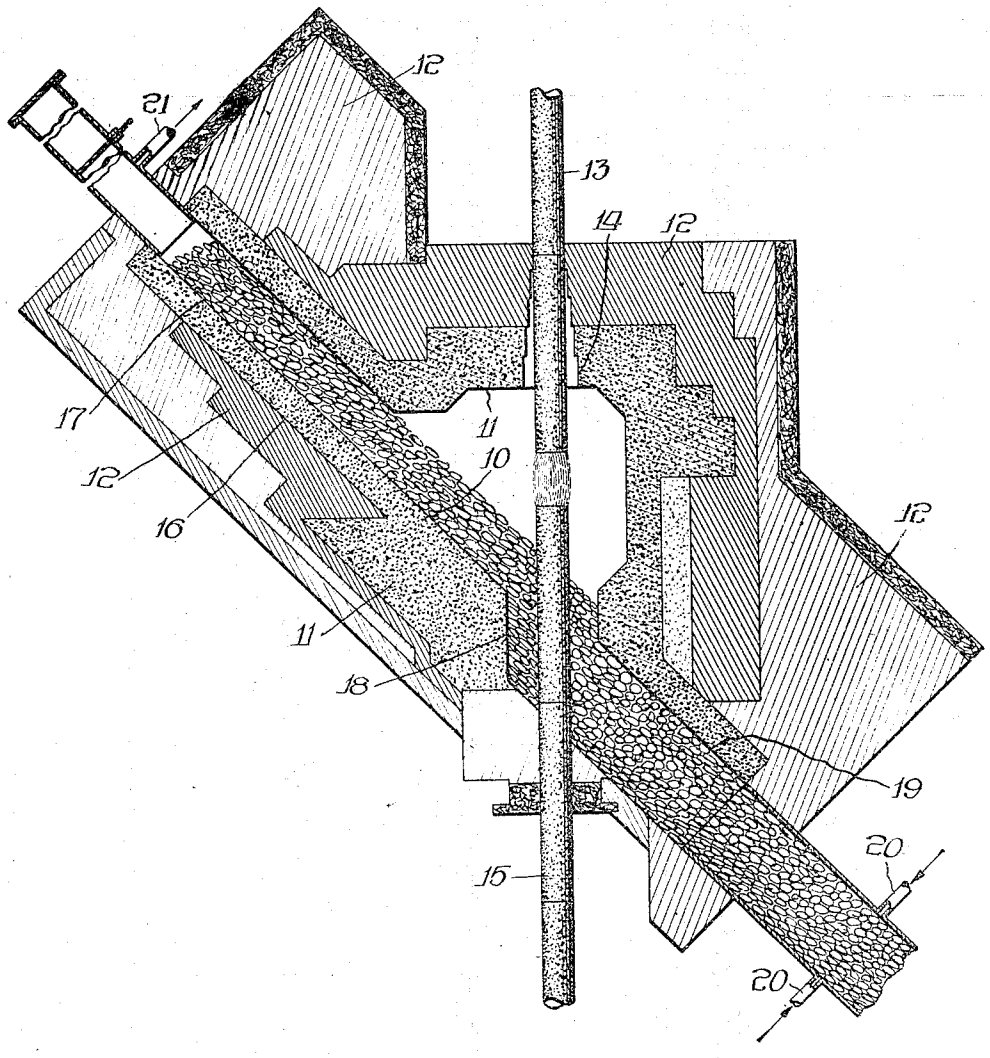
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ELECTRIC FURNACE.

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ELECTRIC FURNACE.

1,274,798. Specification of Letters Patent. **Patented Aug. 6, 1918.**

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To all whom it may concern:

Be it known that I, MARK SHOELD, a subject of the King of Sweden, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

The present invention pertains to improvements in electric and similar furnaces adapted to be operated under great heat, such, for example, as those used for the production of aluminum nitrid, which are run at a temperature in the neighborhood of 2000° centigrade.

The prime object or purpose of the invention is the provision of a furnace of this type which shall be capable of successfully withstanding such high temperatures for an indefinite period and which shall so bring the solid material to be acted upon or chemically changed by reason of the heat into such adequate, intimate, and uniform association with the gas employed that all of such material will be chemically converted into the desired product, rather than only a portion thereof because of insufficient or uneven distribution and intermixing of the material and gas. In other words, the furnace is so designed and constructed that a desirable, thorough, and even dispersion of the gas through the material is certain to take place at the point of greatest heat. The resistance of the furnace to the destructive action of the intense heat is effected by the nature of the lining employed, the disposition and arrangement of the parts, and the use of a gas which at the high temperature employed will not detrimentally act on the lining.

A further object of the preferred embodiment of the invention is to provide the heat for the furnace by means of an electric arc between terminals or electrodes in the heating chamber and to conduct or convey the material to be acted upon through such chamber in the most efficient manner without conflict with such electrodes or arc. Preferably, the furnace is designed to convey or transport the material through it automatically by gravity by reason of an inclined chute or passage offset vertically directly beneath the arc, which, of course, is the region of the greatest heat, whereby the gas traveling through the material in the opposite direction tends to become evenly and uniformly distributed therethrough in such vertical portion of the chute or passage, and, consequently, there is a complete, uniform, and full chemical reaction throughout the entire body of material at this point. If such chute, channel, or passage were straight and inclined without such upright or offset portion the gas would have a tendency to pass through the upper portion only of the material, thus not coming into proper and full contact with the lower or underlying strata.

To permit those skilled in this art to have a full and complete understanding of this invention and its various advantages, and the means whereby the foregoing objects may be attained by an appliance of simple structure, I have illustrated a preferred embodiment of the same in the accompanying drawing forming a part of this specification, but it is to be understood that the invention is susceptible of a variety of embodiments and is not limited and restricted to the precise and exact structural features illustrated in the drawing and described below.

This figure of the drawing shows one desirable form of the improved furnace in a vertical section.

Turning to such drawing, it will be apparent that the heating compartment or chamber 10 which may be of any suitable shape and size is lined or walled with carbon 11, (graphite may be used as a lining but carbon is preferred) formed or shaped to provide a heat chamber or cavity of the desired conformation and to supply the inclined, offset chute or passage hereinafter described. The furnace, as a whole, is heat insulated at 12 by any approved means, which, of course, require no description, as this invention is not dependent upon the particular material employed for such purpose either as to substance or form.

The carbon lining referred to and the outer or inclosing heat-insulating material are recessed at the top of the furnace for the

accommodation of an upper, vertically-arranged graphite electrode or terminal 13 which is insulated from the carbon lining, as shown, by reason of its aperture 14 being larger in cross-section than the corresponding dimensions of the electrode. The companion lower graphite electrode 15 is also insulated from the carbon lining as indicated in the drawing.

An inclined chute 16 extends through the furnace, the heating chamber 10 forming a central enlargement thereof. This passage comprises an upper inclined section 17 leading downwardly to the electrode chamber 10, gradually and uniformly delivering the solid material to be treated (such as briquets composed of comminuted alumina and carbon with suitable binder) by gravity to the lower portion of the heating chamber beneath the electric-arc between the electrodes, such arc being practically in the middle of the chamber, as shown. Directly beneath the arc and centrally accommodating the lower electrode 14, as well as the gradually-descending body of material traveling down the chute and disposed around such electrode, the chute has a somewhat short, vertical section or portion 18 which in turn connects or communicates with a lower or delivery inclined part 19. By this means the moving body of material, although fed into the furnace by sliding down an inclined plane, travels vertically at the hottest point in the furnace or rather descends vertically while it is heated to its highest temperature, and is then delivered out of the furnace through a downwardly-sloping extension.

Gas, such as nitrogen, either pure or slightly impure, by reason of the presence of a small percentage of carbon-monoxid, is admitted to the lower part of chute 19 at 20, 20, and is caused to travel up such passage, being discharged at 21 near the top, thus traversing the chute in a direction the opposite of the direction of movement of the solid material. If the whole length of the chute were inclined, that is to say, if it did not have the vertical offset specified, such gas would have a tendency to traverse the material with which the chute is filled only through its upper portion, thus resulting in its uneven distribution throughout the cross-section of the material, with an obvious inefficient and incomplete reaction, because some of the parts of the material would be subjected either to no gas or to an insufficient quantity to produce the chemical reaction required. By making the portion of the chute adjacent to the arc vertical, the gas has no tendency to pass more easily through any particular portion of the body of material than any other portion and hence at this part of the furnace such gas is substantially evenly and uniformly dispersed or distributed through the material and the desired chemical effect occurs under the action of the high heat, the degree or amount of which can be easily regulated by adjusting the position of the arc up or down as occasion may require.

It is to be understood, of course, that the top and bottom ends of the chute are maintained closed in any approved manner not shown, whereby the gas will necessarily traverse the path indicated, the solid material being more or less continuously admitted and discharged.

The positioning of the electrodes vertically is not necessarily required, as they may be otherwise located, and, so far as the broader features of the invention are concerned, it is not essential that the heat chamber be heated from the interior. Since, however, the electrodes are somewhat fragile and subject to unnecessary strains when not located one above the other in alinement, the device illustrated is preferable in this respect.

As has been explained the apparatus set forth is designed to continuously carry out the process and there is a desirable and economical tendency therein to concentrate the heat in the center of the furnace. The cool incoming body of material is initially or preliminarily heated more or less by the upwardly traveling heated gas, such material is also subjected sidewise to the heat of the arc as it enters the heat chamber and before it descends the vertical central portion of the chute, and the hot body of solid material as it descends the lower sloping or inclined part of the chute transmits its heat to the incoming gas, traveling through it in the opposite direction, thus desirably raising the temperature of the gas and reducing the temperature of the material soon to be discharged from the furnace.

The important features of this invention to be borne particularly in mind are, first, that the feed of material is continuous and automatic; second, that the gas is caused to act uniformly on such material at the point of highest temperature where the chemical reaction occurs; third, that a carbon lining is employed and such gas is used as will not cause the lining to deteriorate or be consumed under the high temperatures employed; fourth, that the appliance is simple in structure, effective in action, not readily damaged or injured, and is capable of sustained high heat without detrimental effects; and, fifth, that the structure is such that the electric arc is contained in the heat chamber, the body of material being caused to pass through such compartment without coming into contact with the arc and without injuring the electrodes.

As has been indicated, this furnace is not

restricted to any particular use and it may be modified in structure in many minor features without departure from the substance and essence of the invention and without sacrificing any of its substantial benefits and advantages. It is not essential that the chute offset be vertical or that the furnace have a single passage only, one of the features being the change of direction of travel of the solid material, or the gas, or both to secure their complete and uniform intermingling.

I claim:

1. In an electric-furnace of the character described, the combination of a heat-chamber, a carbon-lining for said chamber, and electrodes in said chamber exclusive of said lining adapted to maintain between them an electric-arc to heat said chamber, substantially as described.

2. In an electric-furnace of the character described, the combination of a heat chamber, a carbon-lining for said chamber, and means exclusive of said lining and outside of the body of the material being treated to electrically heat said chamber, substantially as described.

3. In an electric-furnace of the character described, the combination of a heat chamber, a carbon-lining for said chamber, and means exclusive of said lining to produce an electric-arc in said chamber outside of the body of material being treated, substantially as described.

4. In an electric-furnace of the character described, the combination of a heat chamber, a carbon-lining for said chamber, means exclusive of said lining to produce an electric-arc in said chamber outside of the body of the material being treated, and means to substantially continuously feed the material to be acted upon by the heat through said chamber, substantially as described.

5. In an electric-furnace of the character described, the combination of a heat-chamber, an electrically-conductive lining for said chamber, and electrodes in said chamber exclusive of said lining adapted to maintain an electric-arc between them to heat said chamber, substantially as described.

6. In an electric-furnace of the character described, the combination of a heat chamber, a carbon lining for said chamber, means to electrically heat said chamber, means to feed the solid material to be acted upon by the heat of said chamber through the latter, and means to pass a gas through said chamber, substantially as described.

7. In an electric-furnace of the character described, the combination of a heat chamber, a carbon-lining for said chamber, means exclusive of said lining to produce an electric-arc in said chamber, means to substantially continuously feed the solid material to be acted upon by the heat through said chamber, and means to pass a gas through said chamber, substantially as described.

8. In an electric-furnace of the character described, the combination of a heat chamber, means to electrically heat said chamber, and means to feed the material to be treated through said chamber and change its direction of travel while it is substantially at its hottest temperature, substantially as described.

9. In an electric-furnace of the character described, the combination of a heat chamber, means to produce an electric-arc in said chamber, and means to feed the material to be treated through said chamber and change its direction of travel adjacent to the position of said arc, substantially as described.

10. In an electric-furnace of the character described, the combination of a heat chamber, means to electrically heat said chamber, and means to pass a gas through said chamber and change its direction of travel while it is substantially at its hottest temperature, substantially as described.

11. In an electric-furnace of the character described, the combination of a heat chamber, means to produce an electric-arc in said chamber, and means to pass a gas through said chamber and change its direction of travel adjacent to the position of said arc, substantially as described.

12. In an electric-furnace of the character described, the combination of a heat chamber, means to electrically heat said chamber, means to feed the solid material to be treated through said chamber and change its direction of travel while it is substantially at its hottest temperature, and means to pass gas through said material in a direction opposite of that of its travel, substantially as described.

13. In an electric-furnace of the character described, the combination of a heat chamber, means to produce an electric-arc in said chamber, means to feed the material to be treated through said chamber and change its direction of travel adjacent to said arc, and means to pass a gas through said material in a direction substantially the opposite of that of its direction of travel, substantially as described.

14. In an electric-furnace of the character described, the combination of a heat chamber, means to produce an electric-arc in said chamber, means to feed the material to be treated through said chamber beneath said arc and change its direction of travel substantially beneath such arc, substantially as described.

15. In an electric-furnace of the character described, the combination of a heat chamber, means to produce an electric-arc in said chamber, means to feed the solid material to be treated through said chamber be-

neath said arc and change its direction of travel substantially beneath said arc, and means to pass gas through said material in a direction substantially the opposite of that of its travel, substantially as described.

16. In an electric-furnace of the character described, the combination of a heat chamber, and means to electrically heat said chamber, said furnace having an inclined passage therethrough for conveying the material to be treated, said passage being offset at practically the point of hottest temperature of the material, substantially as described.

17. In an electric-furnace of the character described, the combination of a heat chamber, and means to electrically heat said chamber, said furnace having an inclined passage therethrough for conveying the material to be treated, said passage being offset substantially vertically at practically the point of hottest temperature of the material, substantially as described.

18. In an electric-furnace of the character described, the combination of a heat chamber, and means to electrically heat said chamber, said furnace having an inclined passage therethrough for conveying gas, said passage being offset at the point of hottest temperature of the gas, substantially as described.

19. In an electric-furnace of the character described, the combination of a heat chamber, and means to electrically heat said chamber, said furnace having an inclined passage therethrough for conveying gas, said passage being offset substantially vertically at the point of hottest temperature of the gas, substantially as described.

20. In an electric-furnace of the character described, the combination of a heat chamber, and means to electrically heat said chamber, said furnace having an inclined passage therethrough for conveying downwardly the material to be treated and conveying upwardly the gas, said passage being offset at the point of hottest temperature of the material, substantially as described.

21. In an electric-furnace of the character described, the combination of a heat chamber, and means to electrically heat said chamber, said furnace having an inclined passage therethrough for conveying downwardly the material to be treated and conveying upwardly the gas, said passage being offset substantially vertically at the point of hottest temperature of the material, substantially as described.

22. In an electric-furnace of the character described, the combination of a heat chamber, and means to produce an electric-arc in said chamber, said furnace having an inclined passage therethrough for conveying the material to be treated and for the gas to be used, said passage being offset at a point substantially beneath such arc, substantially as described.

23. In an electric-furnace of the character described, the combination of a heat chamber, and means to produce an electric-arc in said chamber, said furnace having an inclined passage therethrough for conveying the material to be treated and for the gas to be used, said passage being offset substantially vertically at a point substantially beneath such arc, substantially as described.

24. In an electric-furnace of the character described, the combination of a heat chamber, and vertically-arranged electrodes adapted to sustain an electric arc between them in said chamber, said furnace having an inclined passage therethrough for conveying the material to be treated and for directing the passage of gas, said passage being offset practically vertically substantially at a point beneath the arc between said electrodes, substantially as described.

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