

No. 685,042.

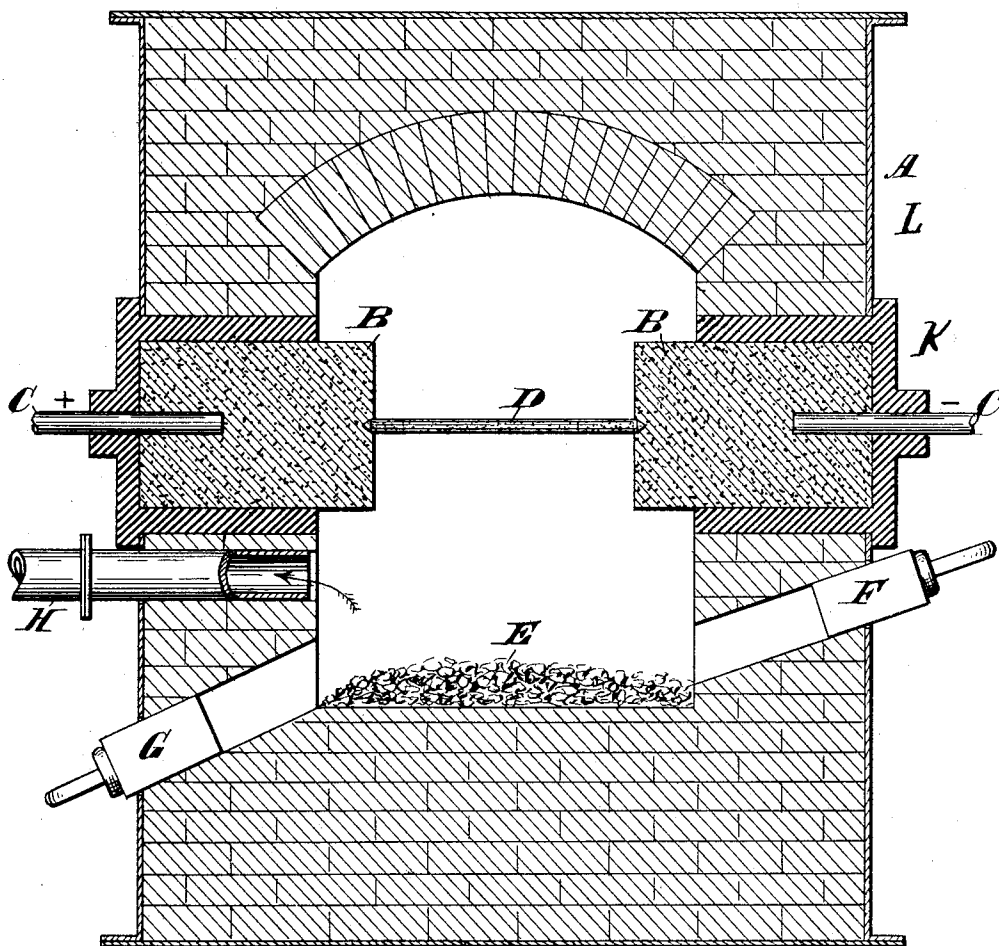
Patented Oct. 22, 1901.

W. T. GIBBS.
ELECTRIC FURNACE.
(Application filed Oct. 14, 1897.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.



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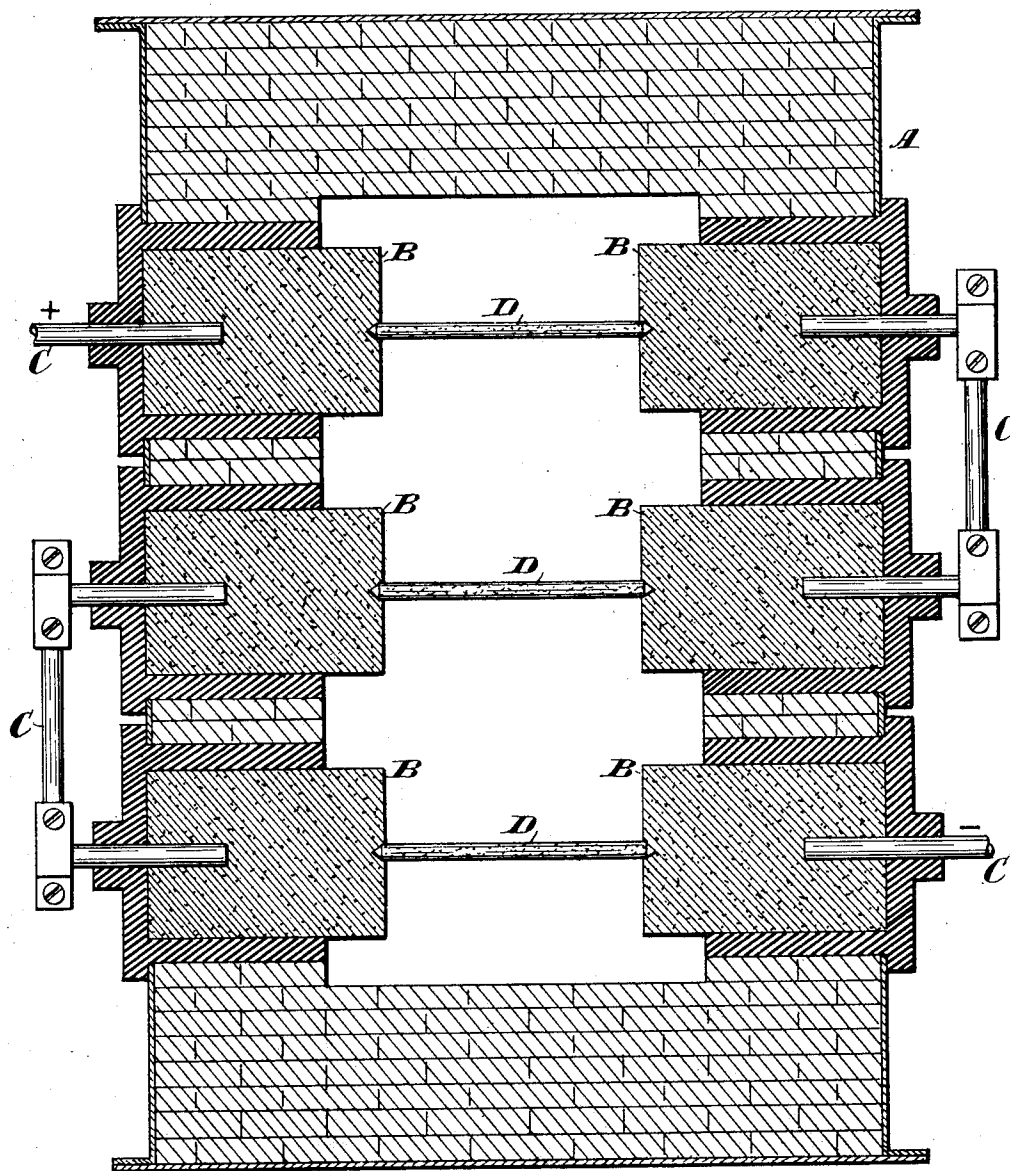
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2 Sheets—Sheet 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLIAM T. GIBBS, OF BUCKINGHAM, CANADA.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 685,042, dated October 22, 1901.

Application filed October 14, 1897. Serial No. 655,111. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM T. GIBBS, a subject of the Queen of Great Britain, residing at Buckingham, county of Ottawa, and Province of Quebec, Dominion of Canada, have invented certain new and useful Improvements in Electric Furnaces, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

My invention relates to furnaces for the fusion or reduction of minerals and analogous purposes in which the heat is produced by an electric current. Hitherto it has been thought necessary to either use an arc or to pass the current through the material itself or a high-resistance medium placed in immediate contact with the material. All of these methods involve serious disadvantages. An arc requires constant manual regulation. Thus the wearing away of the carbon makes it necessary to frequently bring the rods toward each other, and the variable condition of the gases in the retort varying the conductivity of the space between the poles makes necessary from time to time other and corresponding variations in the positions of the carbons. Again, the carbons are subject to continuous destruction in the arc, requiring frequent replacement and distributing carbon-dust throughout the product of the furnace, thereby making a pure product impossible and seriously interfering with the usefulness of the furnace. Again, the temperature of the arc is not capable of regulation, and it is also subject to the disadvantage that it is accompanied by extremely high local temperature, which is very disadvantageous, since the temperature of the arc is much higher than is required for any smelting operation and is productive of injurious results. Again, the arc gives forth vapor of carbon, which injures the product in many cases. When the current is passed through a high-resistance medium placed in immediate contact with the material, that medium is sometimes in a granular form and sometimes in the shape of a comparatively small rod.

The disadvantages of that form of furnace in which a granular high-resistance mass is placed in contact with the material to be reduced are that the contact of the material

with the incandescent carbon causes more or less oxidation of the carbon and consequent diffusion of the carbon through the material reduced, interfering, as in the case of the arc, with the purity of the product. Again, the current in passing from one portion to another of a granular mass makes a large number of small arcs, which have the same effect in the formation of carbon-dust and vapor of carbon and of an injuriously high local temperature as a single large arc. Again, a furnace of this kind requires the continuous attention of an operator, because, owing to the change in position of the granular particles, the resistance of the mass of carbon is continually varying, requiring constant attention to the regulation of the current. Again, there are many uses for a furnace in which it is not practicable to bring the incandescent material into contact with the articles to be heated.

There is another form of furnace in which a comparatively small carbon rod is placed in immediate contact with the material to be reduced. In this case the carbon rod merely furnishes a path for the current at the beginning of the smelting operation. The carbon rod does not last more than a few minutes, when it is replaced by an arc or else the current passes through the molten material itself. In the latter case, of course, the resistance will be continually varying with the ebullition of the molten mass, the circuit at times being intercepted by large quantities of gas and at times traversing a nearly-continuous path through the molten material. Such a furnace involves most of the disadvantages incident to the arc-furnaces above referred to.

The use of a furnace in which the current is passed through the material itself is of course not generally applicable, since most metals have too high a degree of conductivity, and its use is limited to those materials which have a relatively high resistance, and of course where used the operation is subject to great irregularity on account of the changing condition and ebullition of the molten mass. There have also been suggested heaters or ovens in which the conductors are placed in the sides or walls of the chamber which holds the material to be reduced. These conductors have usually been of metal. Ovens or

heaters of this construction are not adapted and so far as I am aware their use has not been attempted for metallurgical operations, since the degree of heat which they are capable of developing is not suitable therefor. I am aware that suggestions have been made that heaters of such construction could be used as furnaces; but I know that this could not be done in metallurgical operations. Moreover, even if a sufficiently-high degree of heat could be developed therein for metallurgical purposes, the material treated when fused would come into contact with the conductor, producing oxidation, contaminating the material under treatment, and in some instances short-circuiting the current, thereby rendering the process impracticable. In some cases it has been proposed to inclose the material being treated in such a heater in a crucible placed between the material under treatment and the conductor. The interposition of the crucible would of course very greatly reduce the amount of heat available, and for this reason also, as well as on account of the contamination of the material under treatment by contact with the carbon of the crucible, such a construction of heater could not be employed for metallurgical operations.

My invention is intended to overcome these difficulties. It consists of a furnace in which the heat is developed by the passage of the current through a continuous high-resistance medium, as a carbon rod in a furnace, and out of contact with the material to be treated. The heat is transmitted from the conductor to the material under treatment by radiation and reflection. The furnace in which the operation is carried on is therefore in form substantially a reverberatory furnace. The conductor consists, preferably, of a carbon rod supported by carbon abutments fixed in the walls of the furnace. Above the carbon rod the roof of the furnace, preferably of arched form, reflects the heat downward upon the material to be reduced, which is placed below the carbon rod on the bottom of the furnace. The carbon being out of contact with the material to be reduced at all times, both when said material is in solid and fused form, and not being subject to material disintegration by the action of the current, as in the case of the arc, the material to be reduced is not subjected either to carbon-dust or carbon-vapor. The heat given off by the rod is subject to absolute regulation from the lowest to the highest temperatures. As the flow of the current is constant and uniform, except as variations are introduced by changing the adjustment, the continuous attention of an operator becomes unnecessary. The carbon rod, not being subject to disintegration by the current, has an indefinite life, and the process is continuous instead of being intermittent, as it is where an arc is the source of heat. There are no local extremely high temperatures, as in the case of the arc, but a substantially uniform and adjusted

temperature throughout the conductor, the furnace, and its contents. The action of the furnace is upon all the material in the furnace instead of upon only a portion of the material, as is the case where the incandescent conductor is placed in the material to be reduced. The heat is also applied to the material directly and without the loss which would be occasioned by the interposition of a crucible or other thing between the conductor and the material under treatment and without the disadvantages above referred to as incident to the use of a crucible or contamination of the material under treatment. The process is absolutely continuous. It need not be interrupted for the introduction of new material or the removal of the reduced product or of slag. It is, so far as I am aware, the only furnace hitherto discovered in which the material to be treated can be wholly preserved from contact with carbon and carbon-vapor, and it has the numerous advantages over the furnaces in common use which have been pointed out above.

In the drawings annexed, forming part of this specification, Figure 1 is a vertical section of a furnace adapted for use in the practice of my invention, and Fig. 2 is a plan view of a modification.

The furnace A is a chamber built of any suitable refractory material, as fire-brick or carbon, having preferably an arched roof, although this is not essential to the furnace. The current is preferably introduced to the furnace through the conductors C C, which connect with carbon blocks or abutments B, between which extends the resistance-rod D. The material E to be treated rests upon the bottom of the chamber and may be introduced through the inlet-pipe F, and the fused material may be drawn off through the exit G.

H is an outlet-pipe for the escape of gas and in case of a volatile product for drawing off the product. The blocks B may be fixed in the furnace in any suitable manner. I find a good construction to be the insertion of the blocks in the iron sockets K. It is frequently desirable to use an inclosing metal casing L about the furnace.

It is an advantage of the construction of furnace which I have described in this application that by its use a furnace can be built to utilize almost any desired amount of power. This may be done by providing the furnace with a number of resistance-conductors and passing the current in series through them, as shown in diagram in Fig. 2, in which a furnace is illustrated containing three sets of abutments, the current passing in succession through each. A furnace of this construction, of course, will be impracticable where arcs are employed, since it is not feasible to operate arcs in series in the case of a furnace.

It will be observed that the furnace above described has, in addition to what has been set forth above, the important advantage over a furnace employing an arc that in smelting

some metals—as, for instance, zinc—it is impossible to obtain an arc, owing to the conductive properties of the vapor of the metal, and in such cases my furnace may be used where a furnace involving the use of an arc would be impracticable. By “continuous conductor” herein I mean such a conductor that the current flows through the same without any interruption, such as would be produced by the separation of two portions of the conductor after the manner of the carbon rods in an electric-arc lamp.

What I claim is—

1. An electric furnace consisting of a continuous rod forming part of an electric circuit, and a chamber inclosing said rod and provided with a reflecting-roof above and out of contact with the rod and a space below for the reception of the material to be reduced or fused, the whole of said conductor being above said space, so that said material remains out of contact with the conductor both

when in a solid and fused condition and without the protection of a crucible or envelop, substantially as described.

2. An electric furnace consisting of a continuous carbon rod forming part of an electric circuit, and a chamber inclosing said rod and provided with a reflecting-roof above and out of contact with the rod and a space below for the reception of the material to be reduced or fused, the whole of said conductor being above said space, so that said material remains out of contact with the conductor both when in a solid and fused condition and without the protection of a crucible or envelop, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

WILLIAM T. GIBBS.

Witnesses:

N. MAGUIRE,
T. F. KEHOE.