No. 686,836. Patented Nov. 19, 1901.

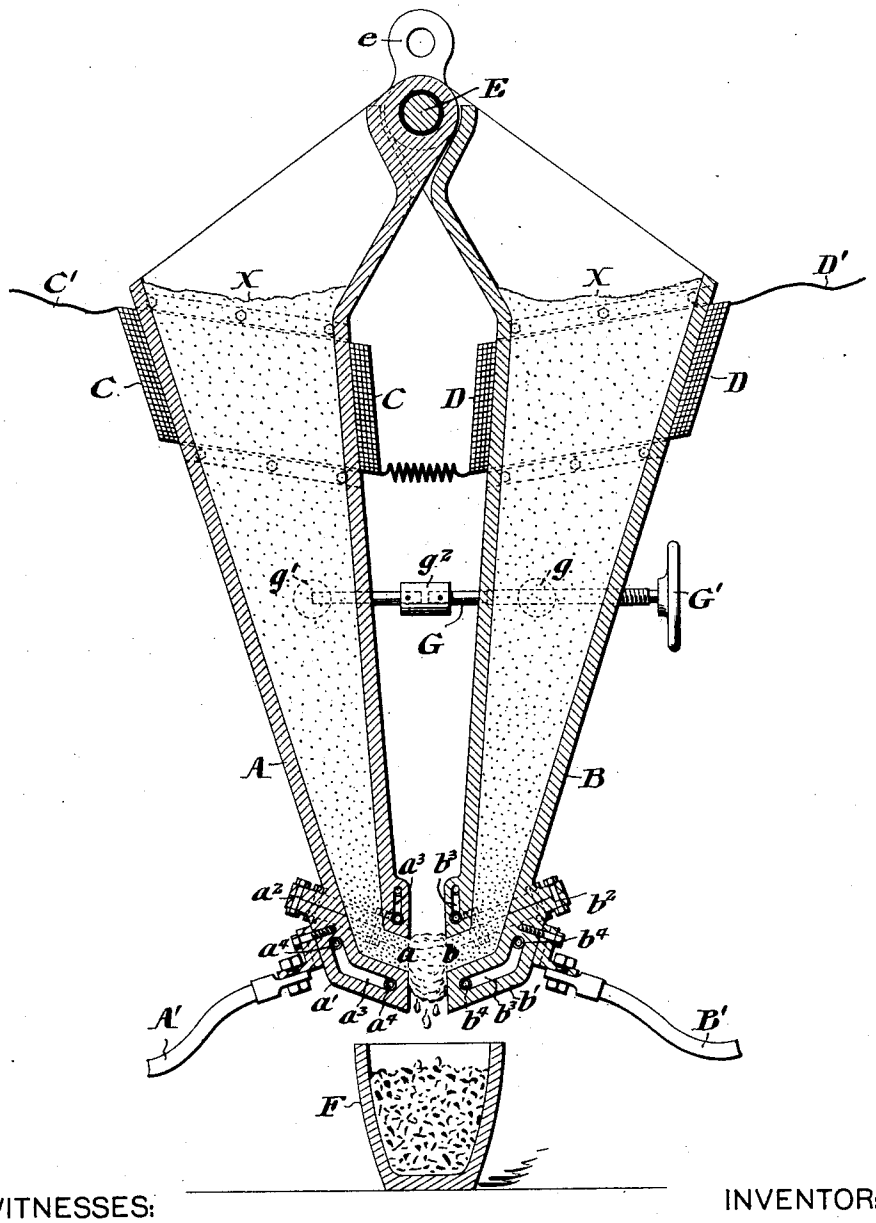
M. RUTHENBURG.

ELECTRIC FURNACE.

(Application filed Aug. 4, 1900.)

(No Model.) 4 Sheets—Sheet 1.

FIG. 1.



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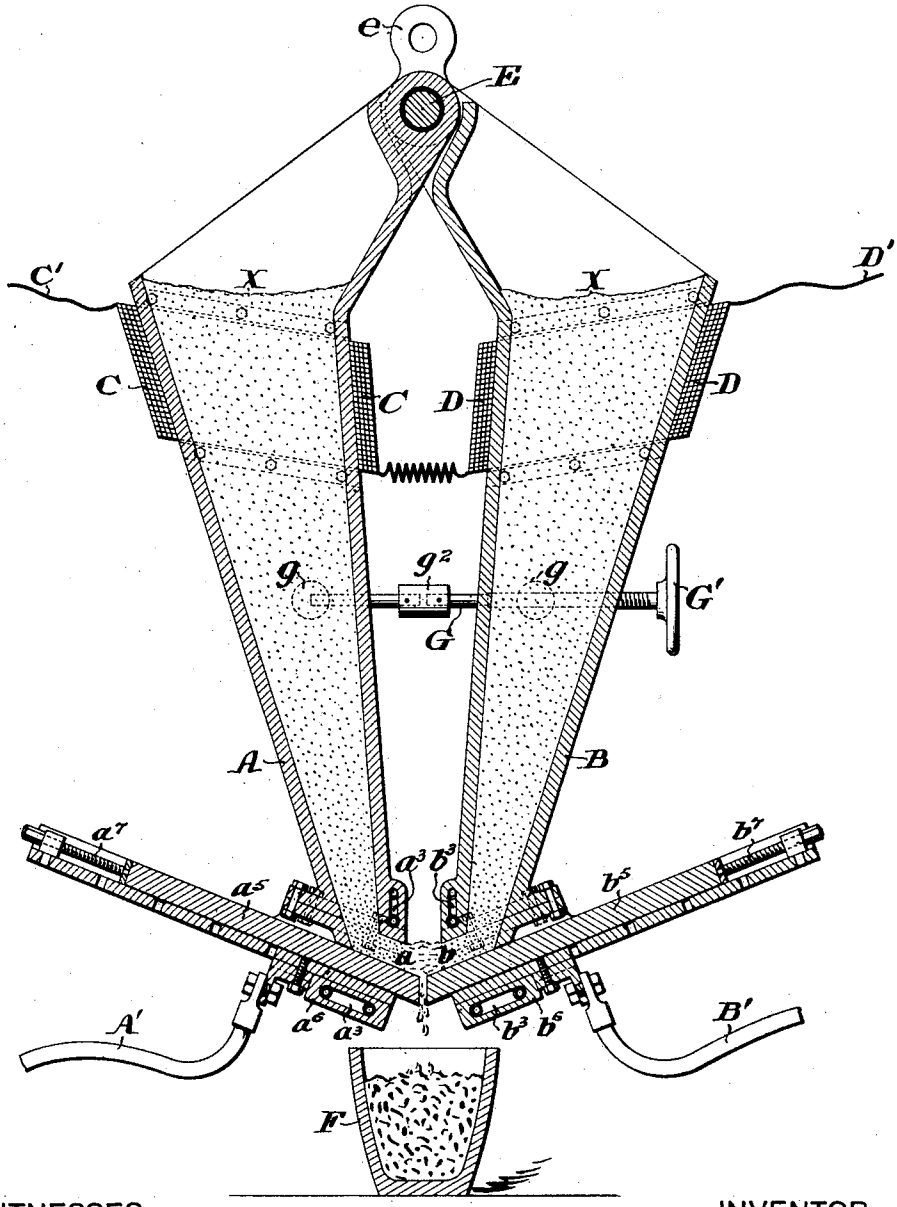
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FIG. 2.



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FIG. 3.

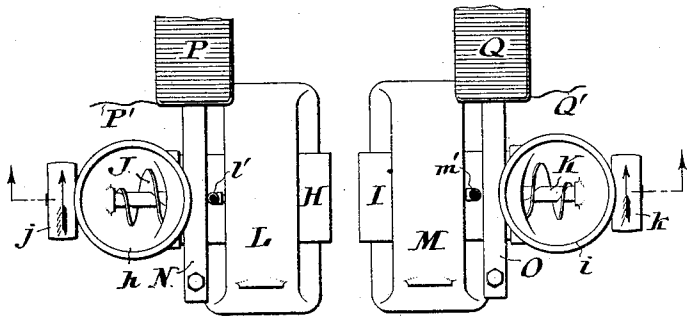


FIG. 4.

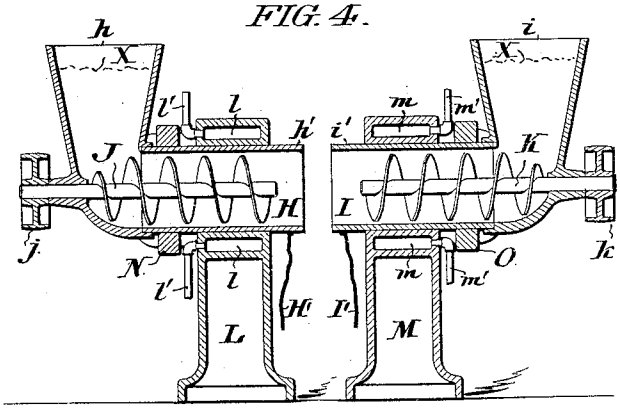
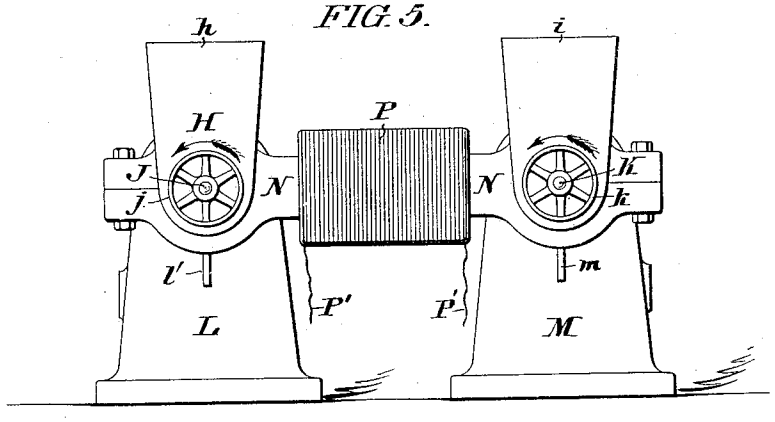


FIG. 5.



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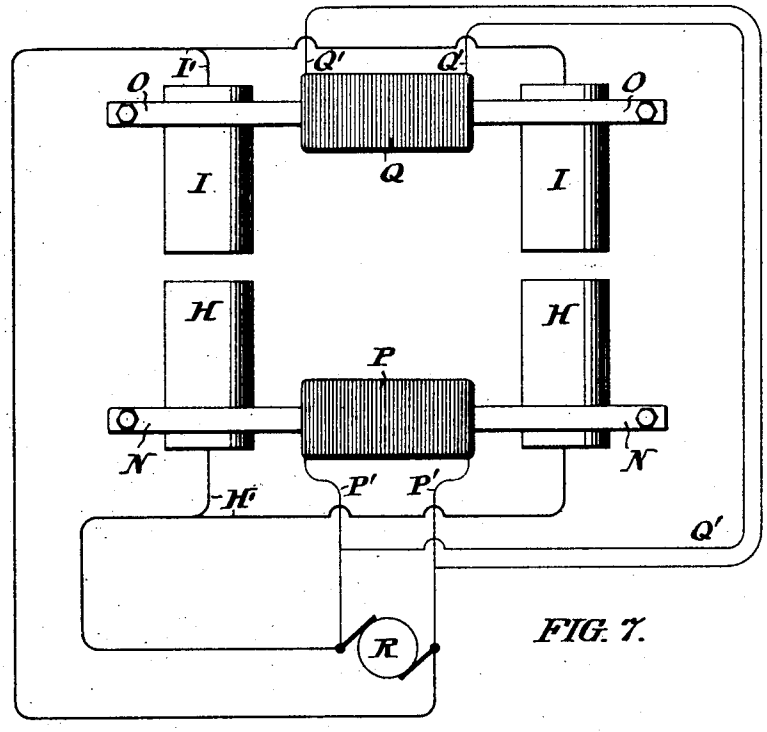
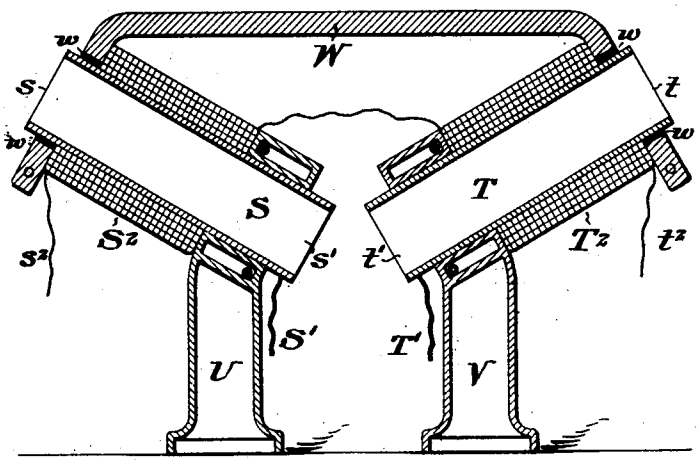


FIG. 7.

FIG. 6.



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UNITED STATES PATENT OFFICE.

MARCUS RUTHENBURG, OF PHILADELPHIA, PENNSYLVANIA.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 686,836, dated November 19, 1901.

Application filed August 4, 1900. Serial No. 25,863. (No model.)

To all whom it may concern:

Be it known that I, MARCUS RUTHENBURG, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Electric Furnaces, whereof the following is a specification, reference being had to the accompanying drawings.

It is the object of my invention to provide an electric furnace wherein the material treated is fused within a magnetic field. Such an arrangement is particularly advantageous in that intimate contact of the particles of the material treated is secured directly between the opposed electrodes of the fusing-circuit and the greatest temperature produced within said material instead of at the proximate surfaces of the electrodes, as in furnaces heretofore known.

I have found it convenient in practice to form a magnetic field at the fusing region of the furnace by constituting the opposed electrodes of the fusing-circuit cores of electromagnets, which cores are tubular and serve to convey the material to be treated to the fusing region. However, I do not desire to limit myself to the particular embodiment of my invention which I have chosen for illustration.

In the accompanying drawings, Figure 1 is a vertical sectional view of a furnace conveniently embodying my invention. Fig. 2 is a vertical sectional view of a furnace, showing a modification of my invention. Figs. 3, 4, and 5 are respectively plan, vertical sectional, and side views of a form of my invention comprising means to positively progress the material treated. Fig. 6 is a vertical sectional view showing a simplified form of my invention. Fig. 7 is a wiring diagram showing convenient circuit connections for a plurality of my improved furnaces.

Referring to the form of my invention shown in Fig. 1, A B are opposed electrodes of the fusing-circuit, which comprises the conductors A′ B′. Said electrodes are tubular in form and adapted to convey the supply of raw material X to and through the orifices *a b*, which are opposed at the lower extremities of the respective electrodes. Said electrodes are preferably of magnetizable material, such as cast-iron, and constituted electromagnets of respectively opposite polarity by the respective coils C D, which are energized by the circuit comprising the conductors C′ D′. Said electrodes A B are insulated from each other and pivotally supported upon the shaft E, which is conveniently provided with end links or eyes *e*, by which the entire device may be suspended in any convenient manner, thus affording a clear space below the fusing region in which to manipulate a crucible F or other receptacle for the product. Said electrodes A B being insulated at their upper extremities, the fusing-current conveyed by the conductors A′ B′ is compelled to traverse the gap between the orifices *a b*, and said gap may be increased or diminished in accordance with the adjustment of the thrust-bar G, which is in screw-threaded engagement with the electrode B at *g*, is provided with a suitable step-bearing *g′* upon the electrode A, and may be conveniently rotated by means of the hand-wheel G′. As indicated in Fig. 1, the opposite ends of the thrust-bar G are insulated by means of the collar g^2. However, any convenient means may be employed to prevent the thrust-bar from serving as a conductor for the fusing-current. In view of the fact that the lower extremities of the respective terminals A B are subjected to high temperature and tend to become more or less eroded during the operation of the furnace I prefer to provide said electrodes with respective shoes *a′ b′*, which are removably secured by means of bolts a^2 b^2 and may be renewed when necessary. Jacket-spaces a^3 b^3, having convenient inlets and outlets a^4 b^4 for water or other cooling media, may also be provided in both the body portion of the electrodes and in said shoes. The raw material X—for instance, comminuted iron ore—being magnetized becomes a part of the core of the electromagnets of opposite polarity at the fusing region and by the stress of the magnetic field is positively progressed through the electrodes and caused to bridge the gap between the respective orifices *a b* in the electrodes A B, substantially as shown in Fig. 1. However, the form of the fusing-bridge across said gap is of course dependent upon the nature of the material treated and the extent of the gap, the latter being adjustable at the will of the operator by means above described. The effect of the aforesaid magnetic bridging of

the gap is to localize the highest temperature within the mass of material extending across the gap between the electrodes, from which the fused product gravitates in globules or irregular lumps, as indicated in Fig. 1, the rate of discharge of the product being determined by the rate of progression of the raw material to the fusing region between said electrodes.

It is to be noted that in the form of my invention shown in Fig. 1 the magnetic field between the opposite poles of the electromagnets forms the sole support for the material at the fusing region. However, in treating some material I find it advantageous to provide the orifices *a b* with floors a^5 b^5, of carbon or other suitable refractory material, projecting, as shown in Fig. 2. Such floors of course limit the absorption of heat by the electrodes, and I provide the electrode-shoes a^6 b^6 (shown in Fig. 2) with means, such as the screws a^7 b^7, whereby as said floors a^5 b^5 become eroded they may be advanced toward each other at the will of the operator.

In the form of my invention shown in Figs. 3 to 5, H I are the opposed electrodes of the fusing-circuit, which comprises the conductors H′ I′. Said electrodes are tubular and arranged to deliver the supply of raw material X from their upper hoppers *h i* to and through their inner extremities *h′ i′*. Said material X is positively progressed through said electrodes H and I by means of the respective rotary screw conveyers J and K, which are provided with belt-wheels *j k* or other convenient means to effect their rotation in the direction of the arrows upon Figs. 3 and 5. As shown in the several figures, said electrodes H and I are supported from beneath by pedestals L and M, which comprise jacket-spaces *l m*, provided with suitable inlets and outlets *l′ m′* to maintain a circulation of water or other cooling media around said electrodes. In order to constitute the electrodes H and I magnets of opposite polarity, I prefer to group them in pairs, as shown in Fig. 5, and to connect the poles H by the bar N and the poles I by the bar O, the respective bars being provided with coils P and Q, energized by the electric circuit comprising the conductors P′ Q′.

The plural form of my improved furnace (shown in Figs. 3 and 5) may be conveniently connected with a source of current R, as indicated in the wiring diagram, Fig. 7, wherein the elements of the apparatus are lettered as in Figs. 3 to 5, inclusive.

I have shown a simplified form of my invention in Fig. 6, wherein S T are the opposed electrodes of the fusing-circuit, comprising the conductors S′ T′. Said electrodes are supported in inclined relation by means of the standards W V, so that raw material X, delivered in the respective outer ends *s t* of said electrodes, will gravitate to and through the inner ends *s′ t′* thereof without the employment of independent means to effect the progression of said material, as in the form last described. Said electrodes S T are constituted electromagnets by means of the coils S^2 T^2, energized by the circuit comprising the conductors s^2 t^2. Said electrodes S T are magnetically connected by the bar W, forming a horseshoe-magnet, of which said electrodes are the opposite pole-pieces. As indicated in said Fig. 6, the bar W is insulated from said electrodes at *w w*, so that said bar does not serve as a conductor for the fusing-current.

In the form of my invention shown in Fig. 7 the coils of the electromagnets are energized by a shunt-circuit from the fusing-circuit. However, it is of course to be understood that said electromagnets may be connected in series relation with said electrodes, and thus energized from the same source, or independent sources of current may be employed for the respective fusing and magnetizing circuits.

Although I prefer to form the electrodes of my improved furnace of magnetizable material, it is to be understood that said electrodes may be of non-magnetizable material and serve merely as conduits for the material to be treated, the latter being of magnetizable material and forming the path for the magnetic lines of force at the fusing region, as well as the path for the fusing-current at said region.

I do not desire to limit myself to the particular details of construction which I have shown and described, as it is obvious that various modifications may be made therein without departing from the spirit of my invention.

I claim—

1. In an electric furnace, the combination with an electric circuit, arranged to fuse the material treated, of opposed tubular electrodes for said fusing-circuit, means to supply the material to be treated through said electrodes, an electric circuit arranged to magnetize the material treated at the fusing region, and means to positively progress said material through the furnace, substantially as set forth.

2. In an electric furnace, the combination with an electric fusing-circuit; of opposed electrodes for said circuit formed of magnetizable metal; and means, distinct from said fusing-circuit, arranged to magnetize said electrodes with respectively opposite polarity, substantially as set forth.

3. In an electric furnace, the combination with opposed tubular electrodes formed of magnetizable metal; of means to supply the material to be treated through said electrodes; and means to magnetize the respective electrodes, substantially as set forth.

4. In an electric furnace, the combination with opposed tubular electrodes formed of magnetizable metal; of opposed discharge-orifices in the respective electrodes; means to supply the material to be treated through said electrodes; and means to magnetize the

respective electrodes, substantially as set forth.

5. In an electric furnace, the combination with opposed electrodes having a space between their ends; of means for presenting the material between said electrodes; and means for creating magnetic fields of opposite polarity whose lines of force extend across said space, whereby, any magnetizable portions of said material are caused to bridge said electrodes, substantially as set forth.

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Witnesses:
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