J. H. REID.

ELECTRIC FURNACE.

APPLICATION FILED AUG. 22, 1908.

910,581.

Patented Jan. 26, 1909.

2 SHEETS—SHEET 1.

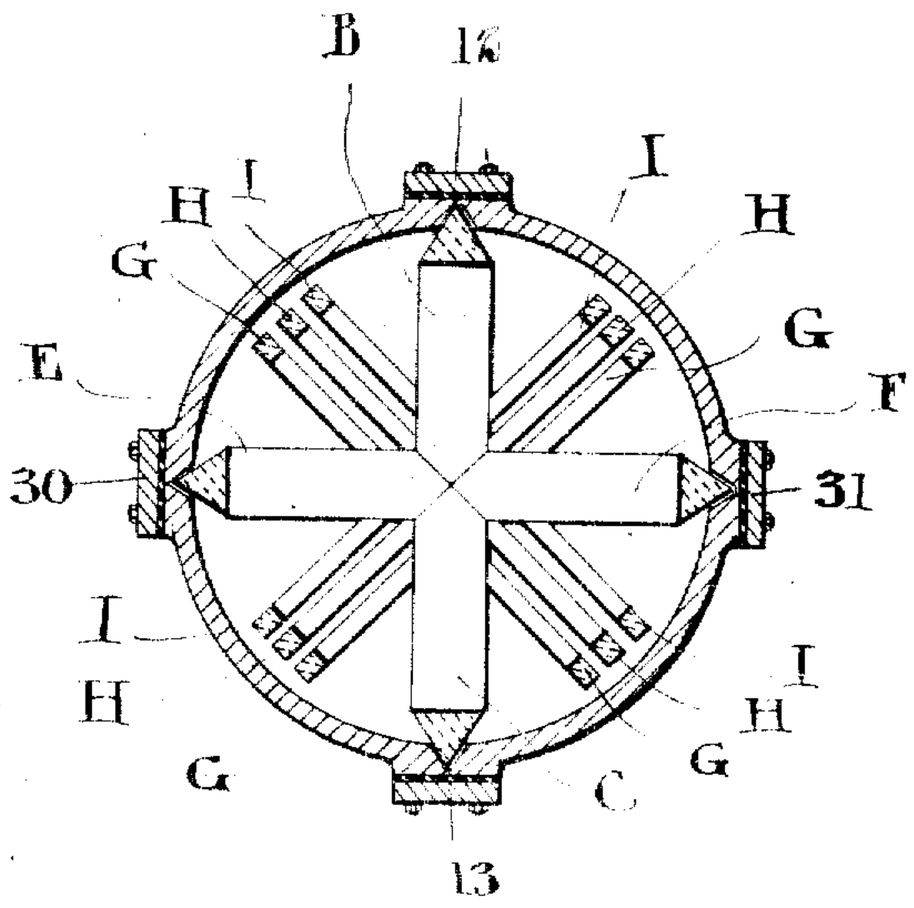

FIG. 1.

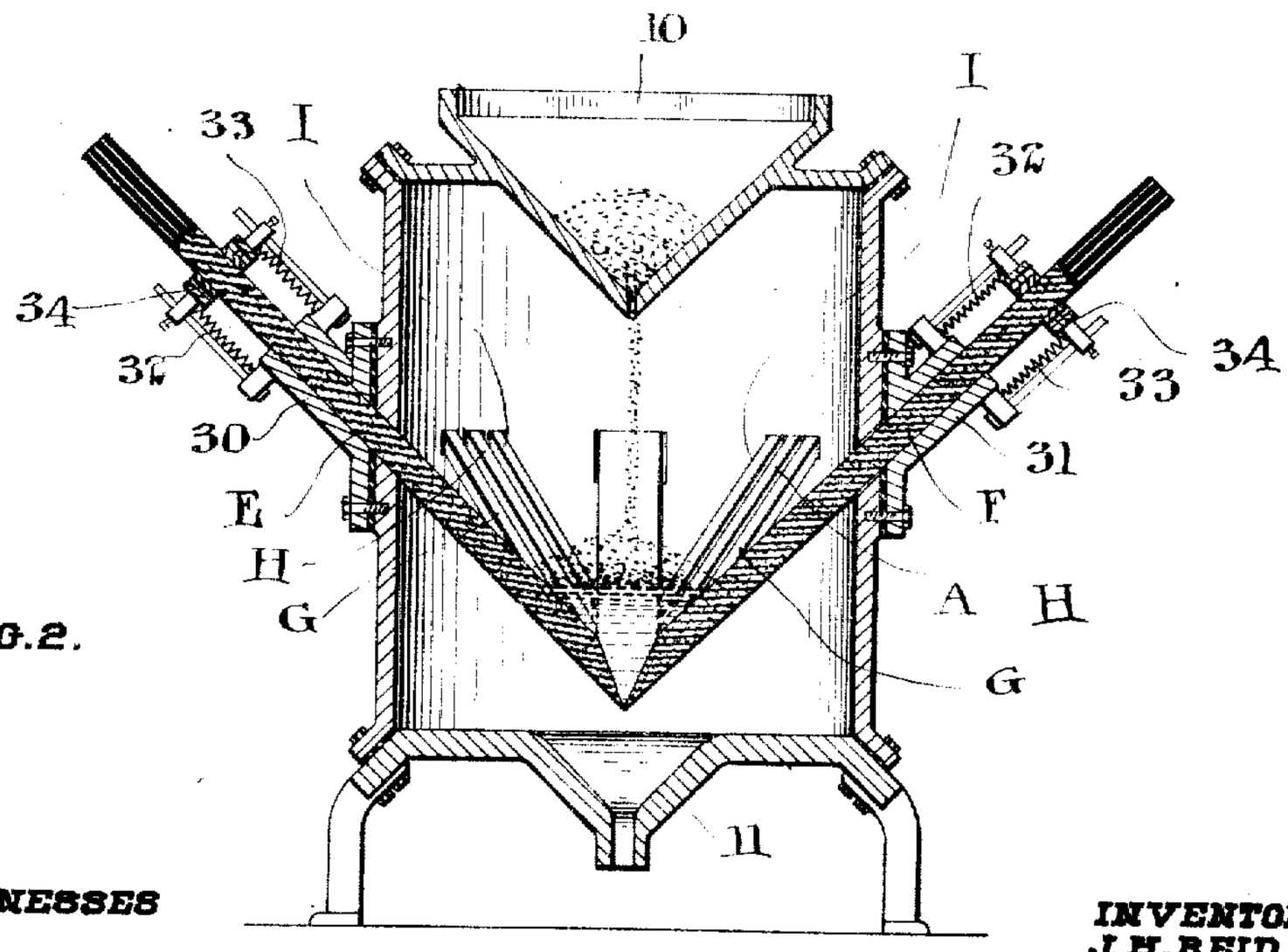

FIG. 2.

WITNESSES

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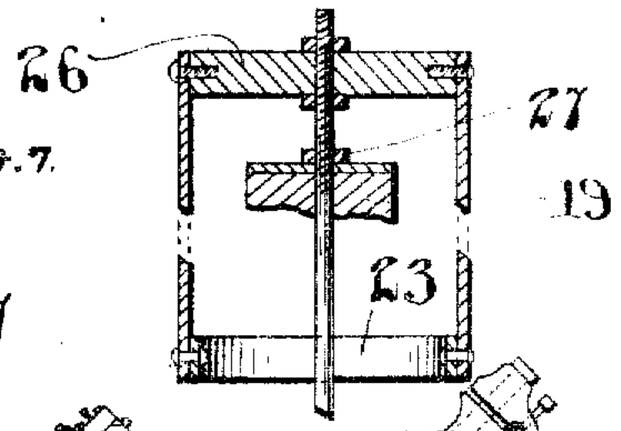

FIG. 7.

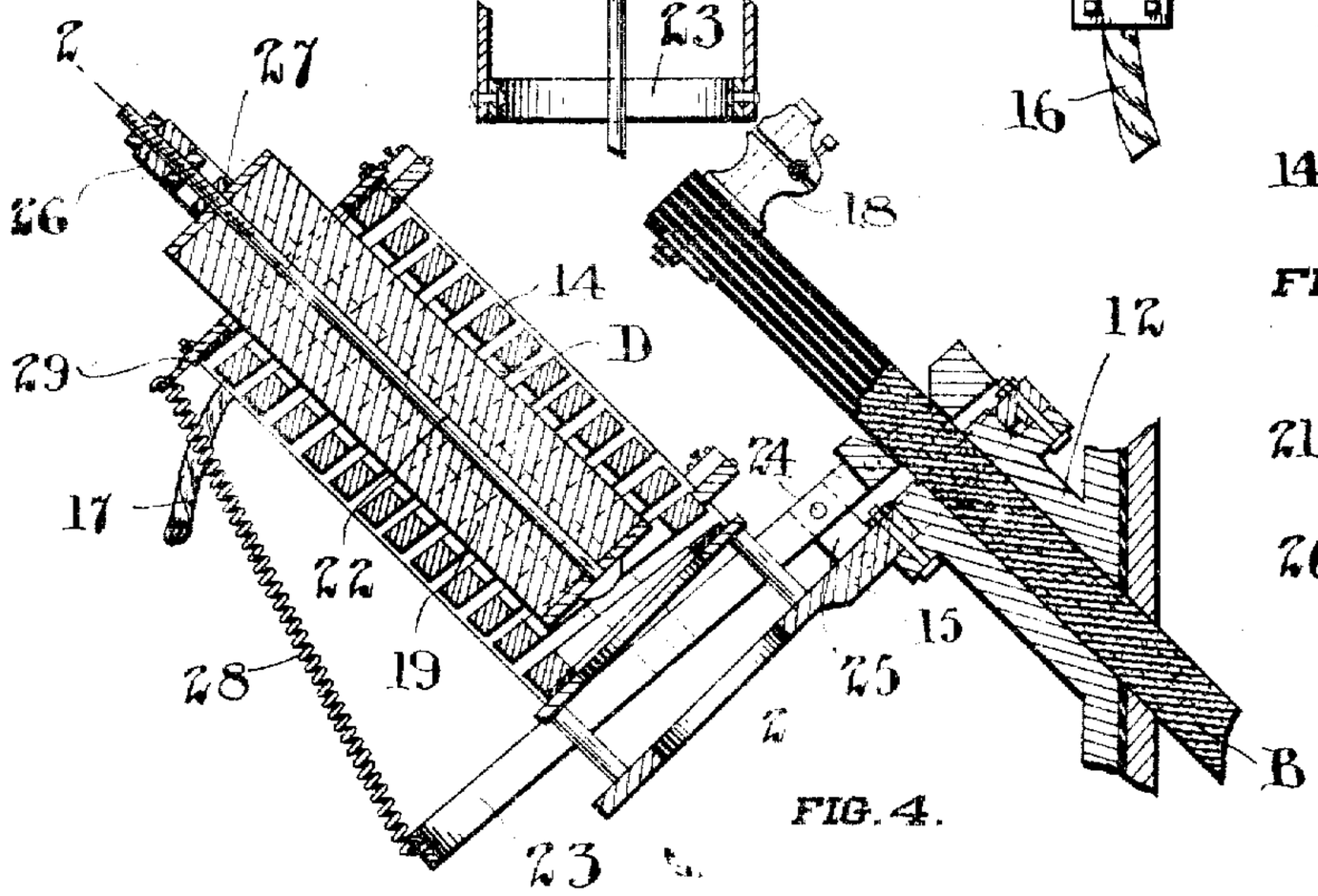

FIG. 4.

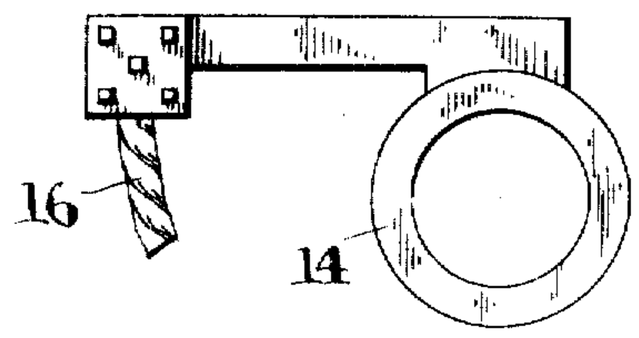

FIG. 5.

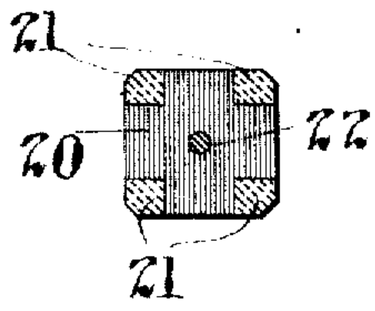

FIG. 6.

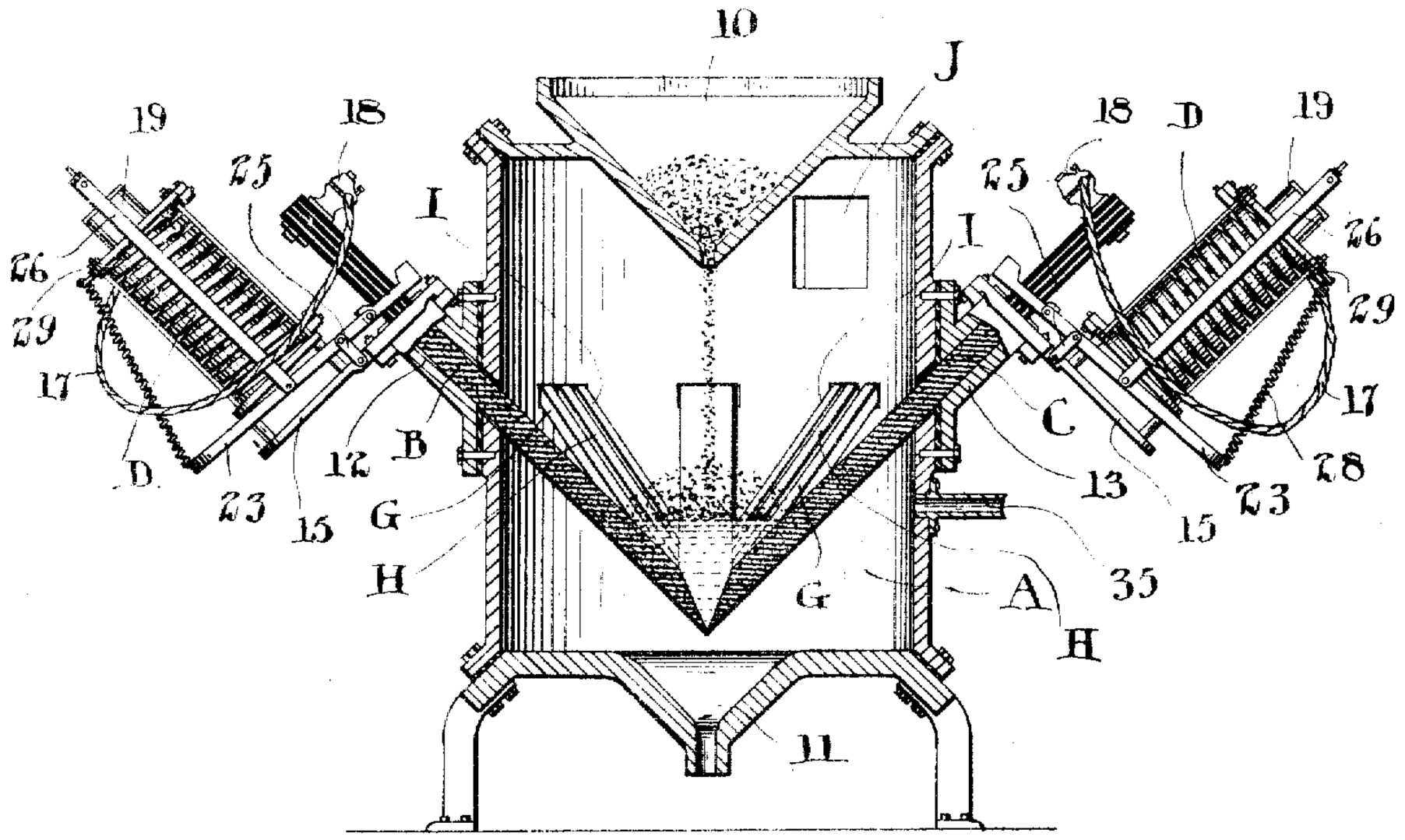

FIG. 8.

WITNESSES

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UNITED STATES PATENT OFFICE.

JAMES HENRY REID, OF NEWARK, NEW JERSEY.

ELECTRIC FURNACE.

No. 910,581. Specification of Letters Patent. Patented Jan. 26, 1909.

Application filed August 22, 1908. Serial No. 449,877.

To all whom it may concern:

Be it known that I, JAMES HENRY REID, of Newark, in the State of New Jersey, United States of America, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

My invention relates to improvements in electric furnaces and the general object of my invention is to effect the complete reduction of the ore in a single chamber and so interiorly regulate the passage of the charge that all the ore will be completely treated before it passes out of the furnace.

Further objects are to avoid the necessity of employing a lining for the furnace or if one is employed, to reduce the wear to a practically negligible quantity, to provide effective means for presenting the reducing agent to the ore, and to enable the charge to be subjected at the same time, to the action of the electric arc and heat produced through electric resistance, and finally to maintain the electrodes clean and free from the ore.

In carrying out the construction of the invention, a plurality of converging electrodes and resistance elements are employed, being adapted to form the outlines of a crucible, on which the ore may rest during treatment.

The arc producing electrodes themselves have automatic regulating devices adapted to adjust the position of the electrodes to correspond with the conductivity of the charge, the effect of which is to maintain them in constant movement and to maintain a constant degree of heat in the furnace. The reducing agent for the ore is preferably, obtained from the electrodes themselves, which may be formed of carbon with other suitable compounds according to the nature of the ore to be treated, and any slag collecting during reduction, may be raked off through suitable doors in the side of the furnace.

All these and other features of the invention are described more fully hereinafter in detail, in the accompanying specifications and drawings.

In the drawings, Figure 1 is a horizontal section through the furnace at the point at which the electrodes pass through the walls thereof. Fig. 2 is a vertical section through a pair of neutral electrodes. Fig. 3 is a vertical section through the arc producing electrodes. Fig. 4 is an enlarged sectional detail of the regulating device for the arc-producing electrodes. Fig. 5 is a detail showing the connection of the current conducting cable to the regulator. Fig. 6 is a sectional detail through the magnetic core of the regulator. Fig. 7 is a sectional detail on the line 2—2, Fig. 4

In the drawings, like letters of reference indicate corresponding parts in each figure.

Referring to the drawings, A represents the body portion of the furnace of suitable material, provided with a hopper 10 for introducing material at the top thereof, and a discharge outlet 11 in the bottom.

In the embodiment illustrated, no lining is illustrated in the furnace, as owing to the manner of supporting the ore on the electrodes, which practically constitutes a crucible therefor, this is not absolutely necessary. It is evident, however, that if desired, a lining of suitable heat-resisting material might be employed, instead of the metallic casing illustrated.

B and C represent the arc producing electrodes and F, E, G, H and I represent a plurality of resistance elements, similar in form to the electrodes, all the resistance elements and the electrodes converging to a single point within the furnace, whereby a crucible will be formed on which the charge will be retained until it is reduced and brought to a molten state, when the molten elements may drop between the resistance elements and the electrodes.

In using the furnace, the aim will be to bring all the metals to a reduced and molten state when they may flow past the electrodes, and any slag rising to the top of the ore during the reduction process may be raked off through suitable doors J. If desired, certain of the metals having a low vaporizing point may be vaporized and withdrawn through a suitable outlet pipe 35, as hereinafter described.

B and C are the arc-producing electrodes, which are convergingly and downwardly inclined towards the center of the furnace, and are slidably supported on the exterior in brackets 12 and 13. Each of these electrodes has a regulating device D adapted to bring the electrodes together, and separate them to correspond with the conductivity of the charge, whereby the current passing through, may remain constant. Each of these regulators, as shown in detail in Figs. 4, 5 and 6 is fomed with helical resistance

coils 14 constituting electromagnets and supported by a suitable bracket 15 connected to the bracket 12 or 13, the said resistance coils being placed in the electric circuit by means of a cable 16 connected to the lower end and a cable 17 on the upper end extending from the coil to a binding post 18 on the electrodes, suitable electrical insulation being provided between the coil and supporting bracket.

Adjustable within the helical coil is the laminated core 19 formed of cross-shaped sheets 20 of soft iron, assembled on a central rod 22, and having corners 21 of insulating material, such as marble or porcelain, and by means of which the conducting part of the core may be maintained out of contact with the wear of the helical resistance 14.

The movement of the core within the magnet is communicated to the electrode through the medium of a lever 23, connected at one end to the electrode and pivoted at 24 to a projection 25 from the bracket 15, and having a stirrup 26 pivotally connected to the same, beyond the bracket, the said stirrup extending along both ides of the core and being adjustably connected to the central rod 22 thereof, by means of suitable bolts 27. These bolts enable the core to be adjusted and this, as will hereinafter appear, will vary the amount of the current which will pass through the electrodes. The core is normally maintained in outermost position, and its inward motion is resisted by a tension spring 28 connecting the outer end of the lever 23 and with a plate 29 supported from the outer end of the coil 14, but insulated therefrom.

It will be seen that when the current passes through the coil, it tends to draw the core inwardly, and this is resisted by the spring 28. The core will then assume a position resulting from the balance of the pull on the magnet and the spring. Should the conductivity of the charge increase and an excessive current be passed through the electrodes, it will pull the core inwardly further, and this, through the medium of the lever 23, will withdraw the electrode and thus reduce the amount of current passing through. As the conductivity of the charge is constantly varying this action will maintain the electrode in constant movement cleaning the surface thereof and preventing the ore sticking to the same.

The resistance elements E and F, as well as constituting part of the crucible, are adapted to afford an electric heat-producing resistance, and they extend through brackets 30 and 31, in the side of the furnace, converge downwardly, and meet between the arc-producing electrodes B and C, the ends of the said resistance elements being held constantly in contact through the medium of springs 32 and 33 connecting the bracket 30 or 31 with rings 34 on the electrode. As these resistance elements meet between the point of the arc producing electrodes, arcs will be created at the contacting side of the resistance elements and the arc-producing electrodes, and the current passing through the end of the resistance elements will heat the same, thereby producing an electric resistance between the extremities of the arc-producing electrodes and the charge will thus be subjected to both the action of the electric arc and the heat of the electric resistance. To complete the crucible for the charge and also to increase the amount of electrical resistance within the furnace, a plurality of smaller resistance elements G, H and I may be provided between each of the larger resistance elements E and F, and the arc-producing electrodes D and C. These small resistance elements G, H and I are similar in form to the elements E and F, and are supported in a similar manner, being held in contact with the larger elements by gravity, which causes them to slide downwardly towards a converging central point.

The electrodes and resistance elements, as shown in the drawings, all converge to a central point and in order that these points may be of the maximum strength to support the charge, the under surfaces of the electrodes and resistance elements are made V-shaped in form, as appears in Fig. 1. The number of electrodes and resistance elements employed and converging in this manner, form substantially a crucible in the center of the furnace, and the charge introduced into the furnace rests on this and before it can pass through the electrodes and resistance elements it must be reduced to at least a molten form, which will enable it to slip through the small spaces between the electrodes. Thus, it is always insured that the ore has received the proper amount of treatment before it passes through the furnace. Any slag may be withdrawn through the door J and, if necessary, the volatile products may be withdrawn through the outlet 35.

In place of introducing an external reducing agent I propose to use the electrodes, or the resistance elements, to supply the reducing agent to the ore, and the carbon of the electrodes or resistance elements may, have a suitable reagent such as lime incorporated with it. The volatile or gaseous products resulting from the reduction of the ore may be withdrawn, through a suitable outlet pipe 35, preferably located below the electrodes.

It will be observed that owing to the manner of supporting the charge from the electrodes, and out of contact with the walls, it is not necessary to employ any lining in the furnace, and further the employment of the neutral electrodes makes a combined resistance and arc furnace. The volatile products are preferably exhausted through the pipe by suitable vacuum producing means, and

this, as well as exhausting the said products, will tend to maintain the chamber cool by the abstraction of the hot gases.

It will be observed that the furnace I have herein described enables a very complete treatment to be given to the ore. In the first place, the ore is subjected to both the electric arc and the resistance heat, and the amount of each of these can be adjusted and varied in order to produce the exact temperature and character of heat necessary to most effectually produce the reduction. The quantity of the reducing agent introduced in the ore may also be regulated by the current and being introduced through the electrodes is always uniform in character.

The metals obtained by the reduction may be either volatilized and withdrawn through the outlet 35 or brought to a molten state and allowed to pass through the electrodes and drop out the bottom of the furnace. In certain cases it may not be necessary to withdraw any of the volatile products and in this case, the electrodes would be more or less closely together in order to more effectually constitute the crucible for supporting the charge even when said charge is in a partially molten state.

As many changes could be made in the above construction and many apparently widely different embodiments of my invention could be made without departing from the spirit or scope thereof, it is intended that all matter contained in these specifications and drawings shall be interpreted as illustrative and not in a limiting sense. It is also to be understood that the language of the following claims is intended to cover such generic and specific features of the invention herein described, which, as a matter of language, might be said to be included thereby.

What I claim as my invention is:—

1. In an electric furnace, the combination with a pair of arc producing electrodes and a pair of neutral resistance elements having contacting ends extending between the ends of the arc producing electrodes, and means for maintaining the resistance elements in contact with each other.

2. In an electric furnace, the combination with a pair of arc producing electrodes, and automatic constant current regulators for the same, of a pair of neutral resistance elements having contacting ends extending between the ends of the arc producing electrodes.

3. In an electric furnace, the combination with a pair of arc producing electrodes, of a plurality of converging resistance elements between the arc producing electrodes adapted to at once constitute a crucible to support the charge and afford electric resistance to the passage of the current.

4. In an electric furnace, the combination with a plurality of arc-producing electrodes, of a plurality of resistance elements extending into the arc produced thereby, adapted with the electrodes, to form a crucible on which the charge may rest during treatment.

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

JAMES HENRY REID.

Witnesses:
RUSSEL S. SMART,
WM. A. WYMAN.