No. 704,993. Patented July 15, 1902.

F. C. WEBER.

ELECTRIC SMELTING FURNACE.

(Application filed Jan. 8, 1900. Renewed May 16, 1902.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 4.

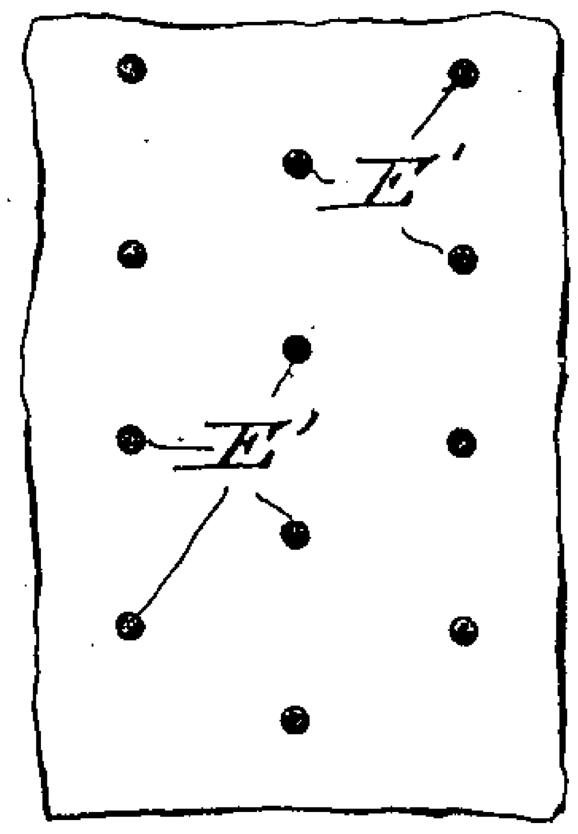

Fig. 1.

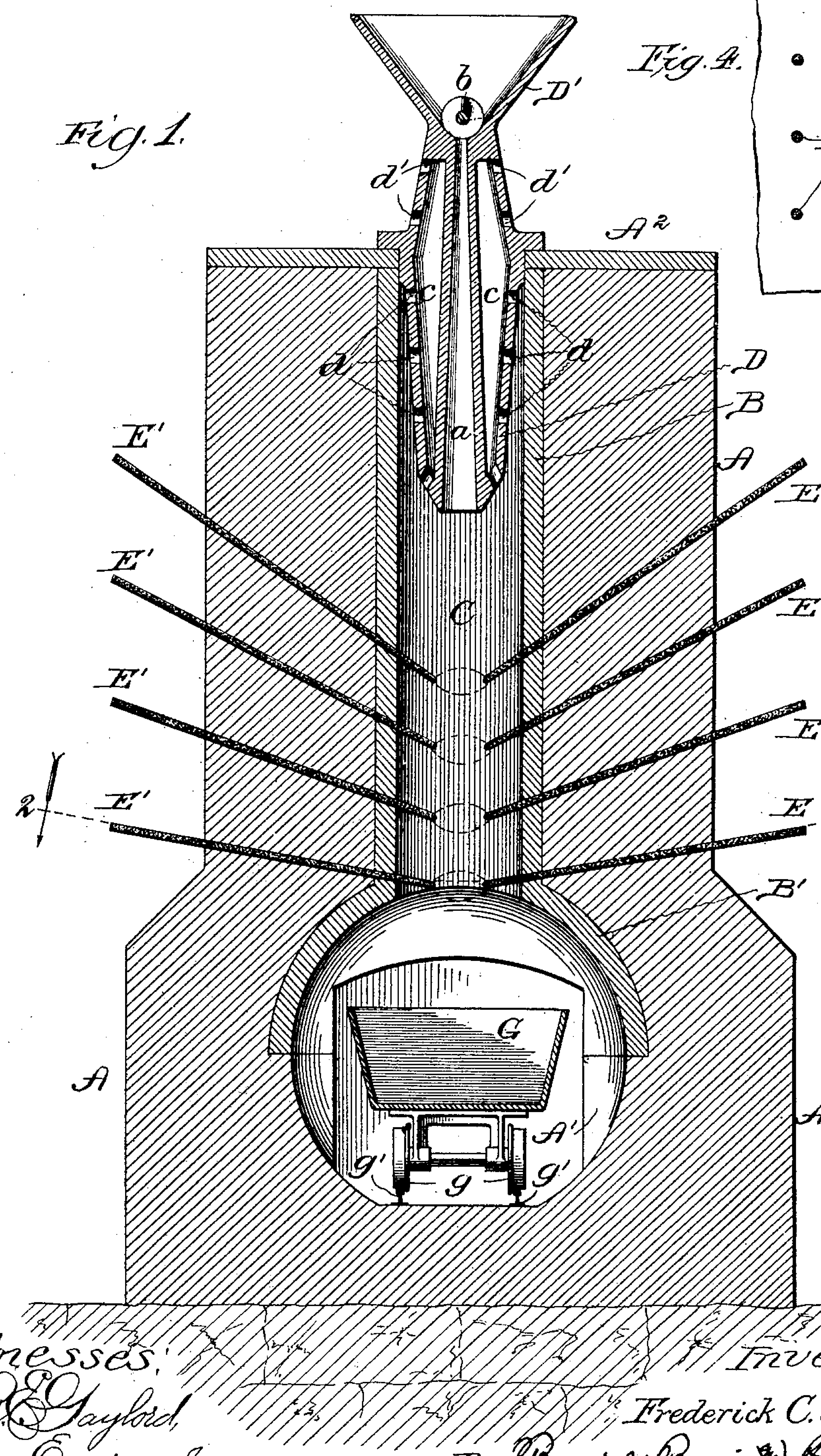

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Fig. 3.

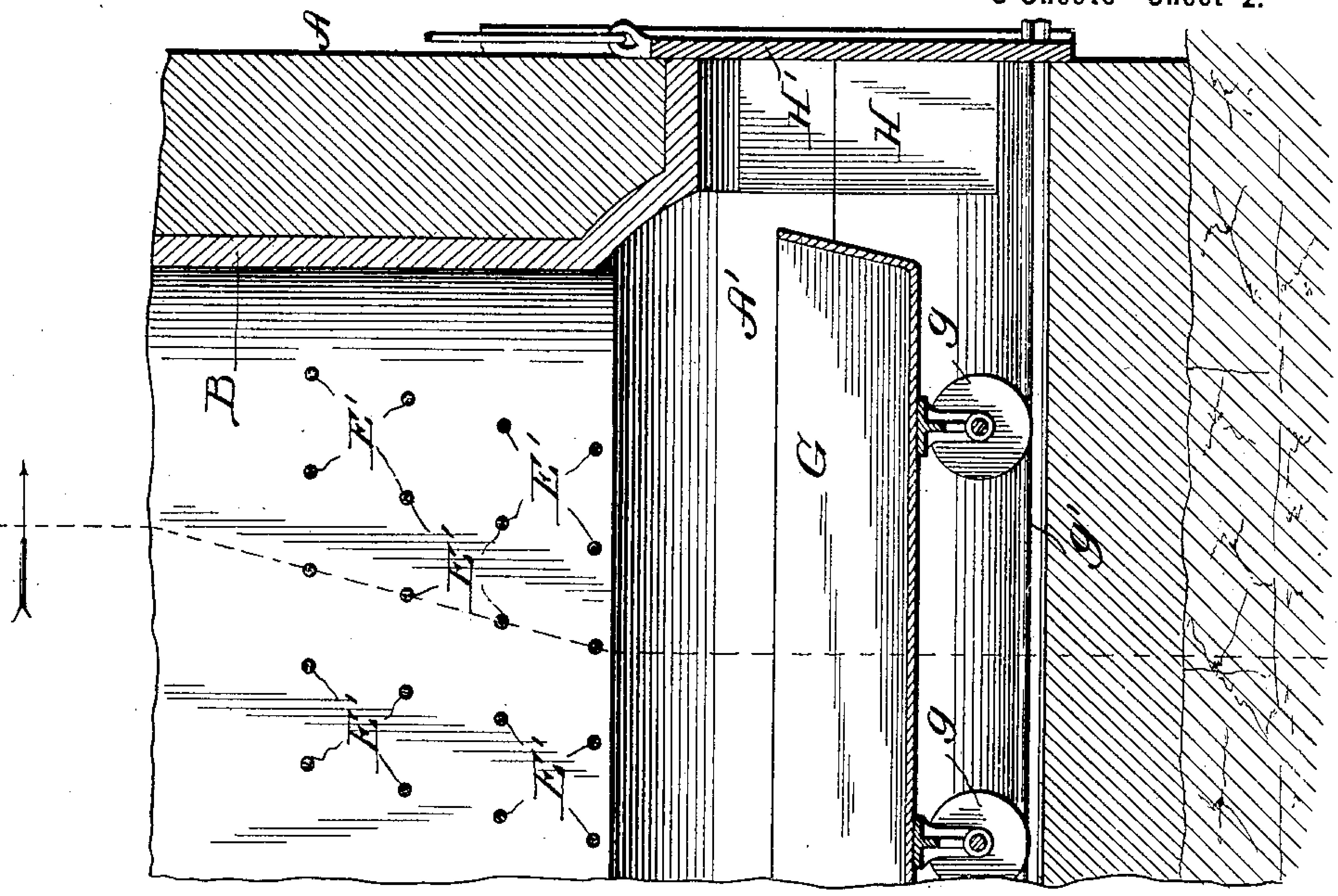
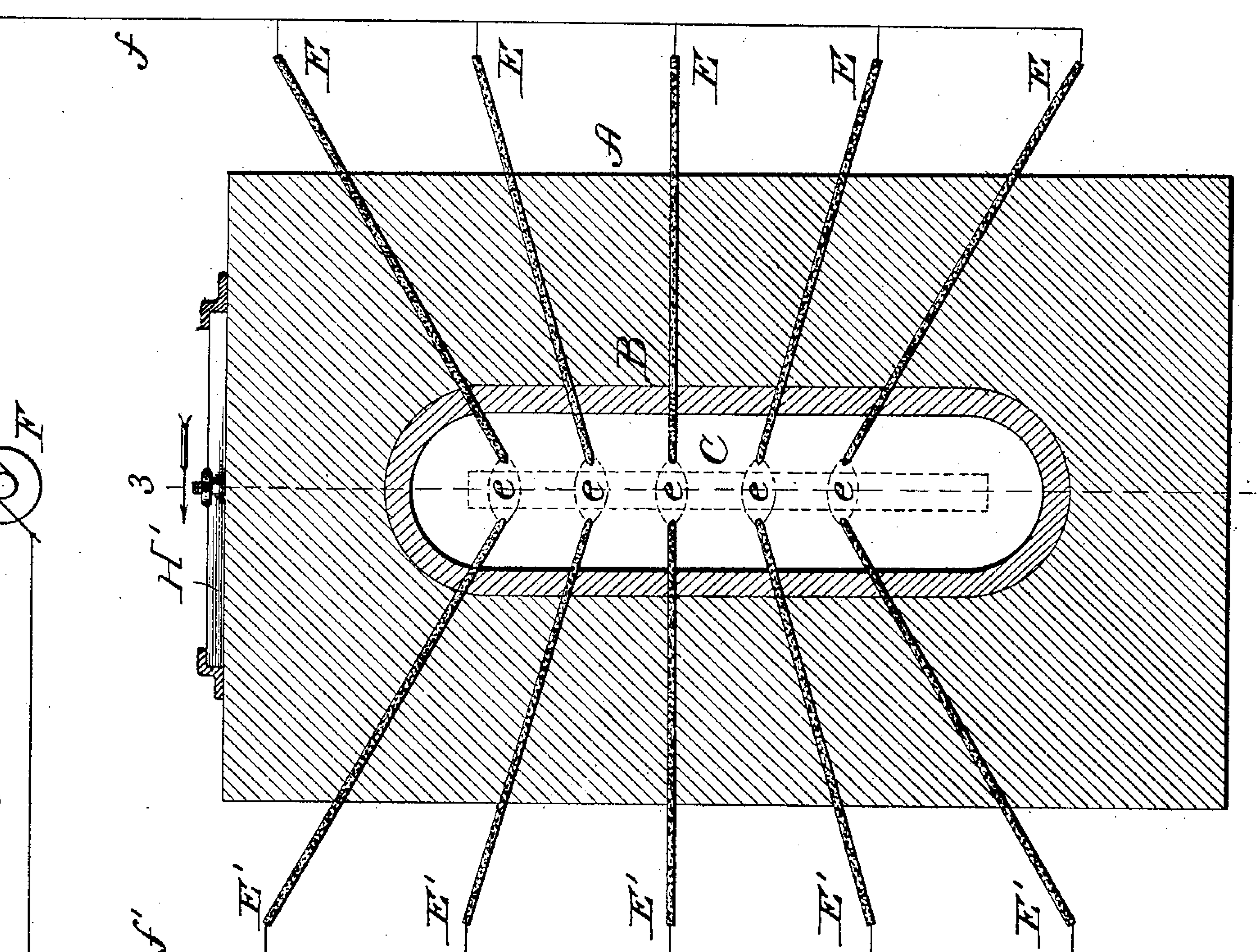


Fig. 2.



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No. 704,993. Patented July 15, [illegible]2.

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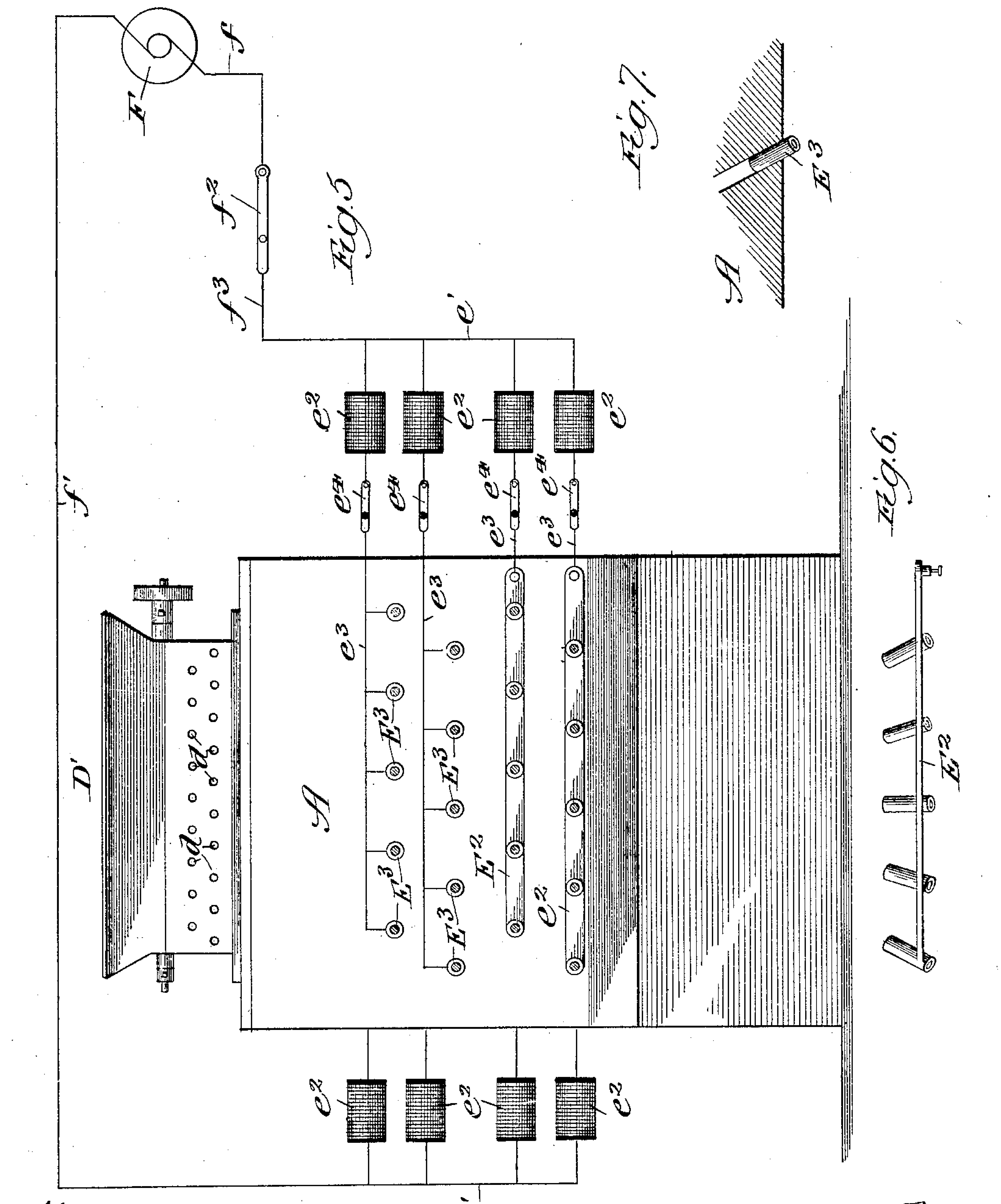

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UNITED STATES PATENT OFFICE.

FREDERICK C. WEBER, OF CHICAGO, ILLINOIS.

ELECTRIC SMELTING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 704,993, dated July 15, 1902.

Application filed January 8, 1900. Renewed May 16, 1902. Serial No. 107,553. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK C. WEBER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Smelting-Furnaces, of which the following is a specification.

It is desirable in constructing electric smelting-furnaces for use in smelting or reducing various materials that such furnaces should possess certain features in order to render them reliable and uniform in operation. Among some of the features which are desirable and necessary for electric smelting-furnaces may be mentioned a feed for the material in such manner as to subject it to the full heat of the carbon electrodes in its passage through the furnace-chamber, to so arrange the electrodes in relation to each other and to the feed as to insure the smelting or fusing of the material in its passage through the arcing space of the electrodes, to prevent radiation of heat from the furnace-chamber and have the material subjected to the entire heat of the arc, to permit the escape of gases produced from the smelting or reducing of the material without deleterious and injurious effects on the material or on the furnace, and to enable the smelted or desired material to be readily and quickly withdrawn without affecting the condition of the furnace-chamber as regards the admission of outside air to an injurious extent. These objects and other objects which will appear from the description hereinafter of the parts and operation are attained by my invention in smelting-furnaces.

The invention consists in the features of construction and combination of parts hereinafter described and claimed.

In the drawings illustrating my improved electric smelting-furnace, Figure 1 is a vertical sectional elevation on line 1 of Fig. 3 looking in the direction of the arrow; Fig. 2, a transverse sectional elevation on line 2 of Fig. 1 looking in the direction of the arrow; Fig. 3, a sectional elevation of the parts shown on line 3 of Fig. 2 looking in the direction of the arrow; Fig. 4, a detail showing a modification in the arrangement of the electrodes; Fig. 5, a side elevation showing diagrammatically an arrangement for controlling, regulating, and graduating the voltage or temperature of the several superposed series of electrodes; Fig. 6, a detail showing an edge elevation of an electrode-carrying plate or holder for a number of electrodes, and Fig. 7 a detail in perspective of a single electrode plate or holder.

In carrying out my invention I construct a furnace having an exterior A, of fire-brick or other suitable material and of the form shown in the drawings or other suitable form, so as to have a base portion with an opening or chamber A′ for the deposit of the smelted or fused material. The wall or casing A, as shown, has a central vertical chamber having a lining B, of non-conductive and non-fusible material, so as to form within the lining the furnace-chamber proper, C, which opens into the receiving or delivery chamber A′. The upper portion of the receiving or delivery chamber is provided with a lining B′, which may be a continuation of the lining B and of the same material or may be an independent lining possessing heat-retaining properties made of any suitable non-conductor of heat.

The material is fed into the furnace-chamber C by means of a feed or delivery spout D, formed with or suitably secured to a hopper D′. The top of the furnace is provided with a suitable cover A^2, of metal or other material that will stand heat, which cover is provided with an opening in line with the furnace-chamber for the passage of the feed or delivery tube, and, as shown, the feed or delivery tube has an annular exterior flange which when the top is in place rests upon the cover. The feed or delivery tube has a central opening or passage *a* communicating with the bottom of the hopper, which passage or opening widens from its point of communication with the hopper to its delivery or discharge mouth, so as to have a taper widest at the delivery end, and thereby prevent liability of clogging in the passage of the material through the tube. The material is fed into the opening or passage by a feed-screw *b*, located in the bottom of the hopper, or by any other suitable means that will insure a positive delivery of the material from the hopper into the discharge opening or passage.

Around the wall of the discharge opening or passage is a chamber c, into which a series of holes in the outer wall of the feed or delivery tube enter, so as to establish communication between the furnace-chamber and the chamber of the tube, and from the chamber of the tube a series of holes d' lead through the outer wall of the tube to the atmosphere. The chamber c in connection with the induction-holes d and the eduction-holes d' furnish an escape for the gases thrown off in the operation of smelting or fusing the material, so that such gases can pass out free and clear and without coming in contact with the material being fed into the furnace. This provision enables the gases to escape without injuring, contaminating, deteriorating, or affecting in any manner the material, and thereby insures the delivery of the material in its natural state into the arcing space to be smelted, fused, or reduced.

The furnace-chamber has introduced thereinto from opposite sides a series of carbon electrodes E and E', which electrodes are projected into the furnace-chamber opposite and in line with each other, so as to leave an arcing space between the inner end of companion electrodes. The electrodes are arranged in parallel series or rows in a bank or tier on each side, so as to have arcing spaces one above the other, through which the material must pass in its downward movement through the furnace-chamber. The electrodes are made of carbon, as usual, and are set so as to converge toward the center in both directions, as clearly shown in Figs. 1 and 2, and this manner of converging the electrodes toward a common central space is one by which liability of short-circuiting is overcome owing to the wide spread given to the electrodes at their outer ends.

The arrangement of the electrodes in banks or tiers on opposite sides of the furnace-chamber results in subjecting the material to the heat of the first line of electrodes, by which the material will be acted upon partially, and further action will be had as the material continues to descend from the successive series or rows of electrodes until with the action of the last series or row of electrodes the material will have been brought into its smelted, fluxed, or desired condition of composition by a series of continued actions through a gradual reduction, increasing as the material descends until the final action is had. This arrangement will be found very effectual in operating on the material, as it starts with an initial reduction and continues the operation in successive steps until the final action is reached, producing a thorough and complete smelting, fusing, or reducing of the material.

The electrodes receive an electric current from any suitable source of supply or energy. As shown, the current is supplied from a dynamo F through suitable conducting-wires f and f', leading to and having suitable connection with the various electrodes of the respective series. The dynamo F preferably is of the alternating type supplying an alternating current, but may be of the direct type supplying a direct current, if desired.

The material in its finished condition passes from the furnace-chamber into the receiving or delivery chamber A', and in the arrangement shown the material is discharged into a car or truck G, mounted on suitable carrying-wheels g, running on a track g'; but the material can be otherwise discharged, according to the use to which the furnace is to be applied and the nature of the material with which the furnace is used. The car or truck is entered into and withdrawn from the furnace-chamber A' through a doorway or passage H, having a suitable door H', which closes tightly and prevents the admission of outside air when the furnace is in operation.

The operation will be readily understood from the foregoing description, but, briefly stated, is as follows: The material in a ground or pulverized state or otherwise and in proper proportions mixed or fluxed is deposited in the hopper and by the action of the endless screw or other discharging means is entered into the discharge opening or passage in the feed or delivery tube, to pass therefrom into the arcing space between the electrodes. The current is supplied from the dynamo, and passing through the carbon electrodes, which are properly separated for the arcing space required, produces the required degree of heat for smelting, fluxing, or reducing the different materials, as such materials in their passage through the furnace-chamber from the discharge or feed tube pass between the several series of electrodes to the point of discharge, and in such passage, owing to the action of the heat in the extended and continued arcing space, the material is smelted, fluxed, or reduced, as before described.

The electrodes on each side are arranged in a bank or tier, each bank or tier having therein several series or rows of electrodes, and the electrodes of the different series or rows in the bank or tier can be located, as shown in Fig. 3, on an inclination, or they can be located, as shown in Fig. 4, in alternating spaces, so that the electrodes of each alternate row will be one above the other and the electrodes of the intervening row will be midway or approximately so between the electrodes of the series or row on each side. The preferred arrangement is the one shown in Fig. 4; but it is to be understood that the arrangement can be otherwise than as shown in either Figs. 3 or 4 so long as the arrangement is one which forms an extended and continued arcing space between the ends of the electrodes, leaving a clear passage for the material through such arcing space to be subjected to the heat of the several series or rows of electrodes. The two companion electrodes in each series or row stand opposite each other and the alternating staggering or other arrangement should be one to form, in effect, a continuous heating or smelting space from the uppermost to the lowermost series or rows of electrodes.

The electrodes are preferably supplied with a current of differing voltage or temperature, and for ordinary and general use the uppermost tier or row is to have the lowest voltage or temperature, such voltage or temperature increasing in proper ratio or proportionately with the descent of the electrodes until the final series or row is reached which is to have the necessary voltage or temperature for the final operation on the material.

It is to be understood that while the arrangement of temperature is preferably as just described the voltage or temperature can be varied as may be required for operation on different material, it being the intention to regulate the voltage or temperature according as circumstances or the material may require, as in some cases the temperature of the bottom series or row may be the lowest, and under certain conditions and with some materials the voltage or temperature may be the same for the entire bank or tier of electrodes. It is to be understood that in any event the temperature of the top or upper series or row of electrodes should be one as to properly work on the material without producing explosions or other effects that might create injurious results.

An arrangement for supplying the several series of electrodes with current of differing voltage, and thereby creating a difference in temperature between the series of superposed electrodes, is illustrated in Fig. 5. One wire from a dynamo leads to the electrodes on one side of the furnace and the other wire to the electrodes on the opposite side. As shown, the wire f connects with a switch f^2, which is arranged to engage the contact of a wire f^3, leading to a cross-wire e', from which wire connection is had with a separate regulator or reducer e^2 for each series of electrodes, each regulator or reducer e^2 having a conducting-wire e^3 leading therefrom to supply the current to its line of electrodes. Each wire e^3 has an interposed switch e^4, by means of which any one of the series of electrodes can be separately cut out. The electrodes of a series may be mounted or supported in a retaining or holding plate E^2, adapted to carry the number of electrodes in the series, and the conducting-wire e^3 connects with the plate, as shown in the two lower series of electrodes in Fig. 5. Each plate has a separate socket for the passage of an electrode, and any usual and well-known means may be provided for advancing the electrodes as they burn away.

Instead of having a plate or holder common to all of the electrodes of a series each electrode of a series may have an independent holder E^3, with any of the usual and well-known means for advancing each electrode, and this arrangement is shown in the upper series of the electrodes in Fig. 5, each electrode having an independent connection with a conducting-wire e^3. The opposite side of the furnace is provided with a similar arrangement of regulators or reducers e^2 and conducting-wires e^3. The opening of the main switch f^2 breaks the current for the entire series of electrodes, and the opening of any switch e^4 breaks the current for any one series of electrodes and throws that series out of use.

Each series or row of electrodes may have its own independent switch, as shown, or other controlling means for the current, so that any one series or row can be cut out or in, as may be required for the work to be done or for repairs or other purposes, and the electrodes may be provided with suitable feeding means for automatically advancing the electrodes or pencils as they burn away or are consumed. The finished material instead of being discharged into a delivery car or truck may be discharged by tapping or in some other suitable and well-known manner, and the delivery-chamber may be in the form of a smelter pot or receiver or other suitable form adapted to receive and discharge the final material or product.

I claim—

1. In an electric smelting-furnace, the combination of a horizontally-elongated furnace-chamber, several superposed series of electrodes projected laterally into the furnace from opposite sides thereof, each series having a different angle of downward convergence in relation to the other series and toward a central space with an arcing space between the companion downward-converging electrodes of each series and forming an extended horizontal arcing space downwardly projected between the several superposed series of electrodes, and a feed or discharge for the material from above in direct line with the arcing space, substantially as described.

2. In an electric smelting-furnace, the combination of a horizontally-elongated furnace-chamber, several superposed series of electrodes projected laterally into the furnace-chamber from opposite sides thereof, each series having a downward convergence horizontally and an inward convergence at the ends of all the series with an arcing space between the companion electrodes of each series and forming an extended vertical arcing space between the several superposed series of electrodes having a downward and inward convergence toward a central space, and a feed or discharge for the material from above in direct line with the arcing space, substantially as described.

3. In an electric smelting-furnace, the combination of a furnace-chamber, several superposed series of electrodes laterally projected at different planes of inclination into the furnace-chamber from opposite sides thereof, with an arcing space between the companion electrodes of each series forming a vertical downwardly projected and extended unobstructed and continued smelting and arcing

space between the superposed series of electrodes, and a feed or discharge for the material from above into the vertically-extended smelting and arcing space, substantially as described.

4. In an electric smelting-furnace, the combination of a furnace-chamber, several superposed series of electrodes each series projected laterally at different planes of inclination into the furnace-chamber from opposite sides thereof with an arcing space between the companion electrodes of a series forming a graded vertically extended and continued smelting and arcing space, means for producing a graduated voltage or temperature for each series of electrodes and a feed or discharge for the material from above into the arcing space, substantially as described.

5. In an electric smelting-furnace, the combination of a furnace-chamber, several superposed series of electrodes projected laterally into the furnace-chamber from opposite sides thereof at different planes of inclination, with an arcing space between the companion electrodes of each series for the superposed arcing space to form a graded vertical downwardly extended and continued smelting and arcing space, means for regulating and graduating the voltage or temperature of each separate series of electrodes, and a feed or delivery spout projected downwardly into the furnace-chamber in juxtaposition to the arcing and smelting space at the commencement thereof and having a central opening for discharge of the material in line with the smelting and arcing space for an initial subjection of the material to the heat as it is discharged and a final subjection of the material in its passage through the arcing space, substantially as described.

6. In an electric smelting-furnace, the combination of a furnace-chamber, several superposed series of electrodes projected laterally into the furnace-chamber from opposite sides thereof at different planes of inclination, with an arcing space between the companion electrodes of each series for the superposed arcing space to form a downwardly vertically extended and continued smelting and arcing space, means for regulating and graduating the voltage or temperature of each separate series of electrodes, and a feed or delivery spout projected downwardly into the furnace-chamber in juxtaposition to the arcing and smelting space and having a central opening for the passage of the material in line with the smelting and arcing space and having a surrounding chamber with inlet and outlet openings for the escape of the evolved gases, for such gases in their escape to impart heat to the delivery or feed spout, substantially as described.

7. In an electric smelting-furnace, the combination of an elongated furnace-chamber, several superposed series of electrodes having the electrodes of each series projected laterally into the furnace-chamber from opposite sides thereof with a downward and inward convergence and with an arcing space between the companion electrodes of each series for the several superposed arcing spaces to form a graded vertically extended and continued arcing space between the superposed series of electrodes, and means for producing different voltages or temperatures throughout the several series of electrodes, substantially as described.

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