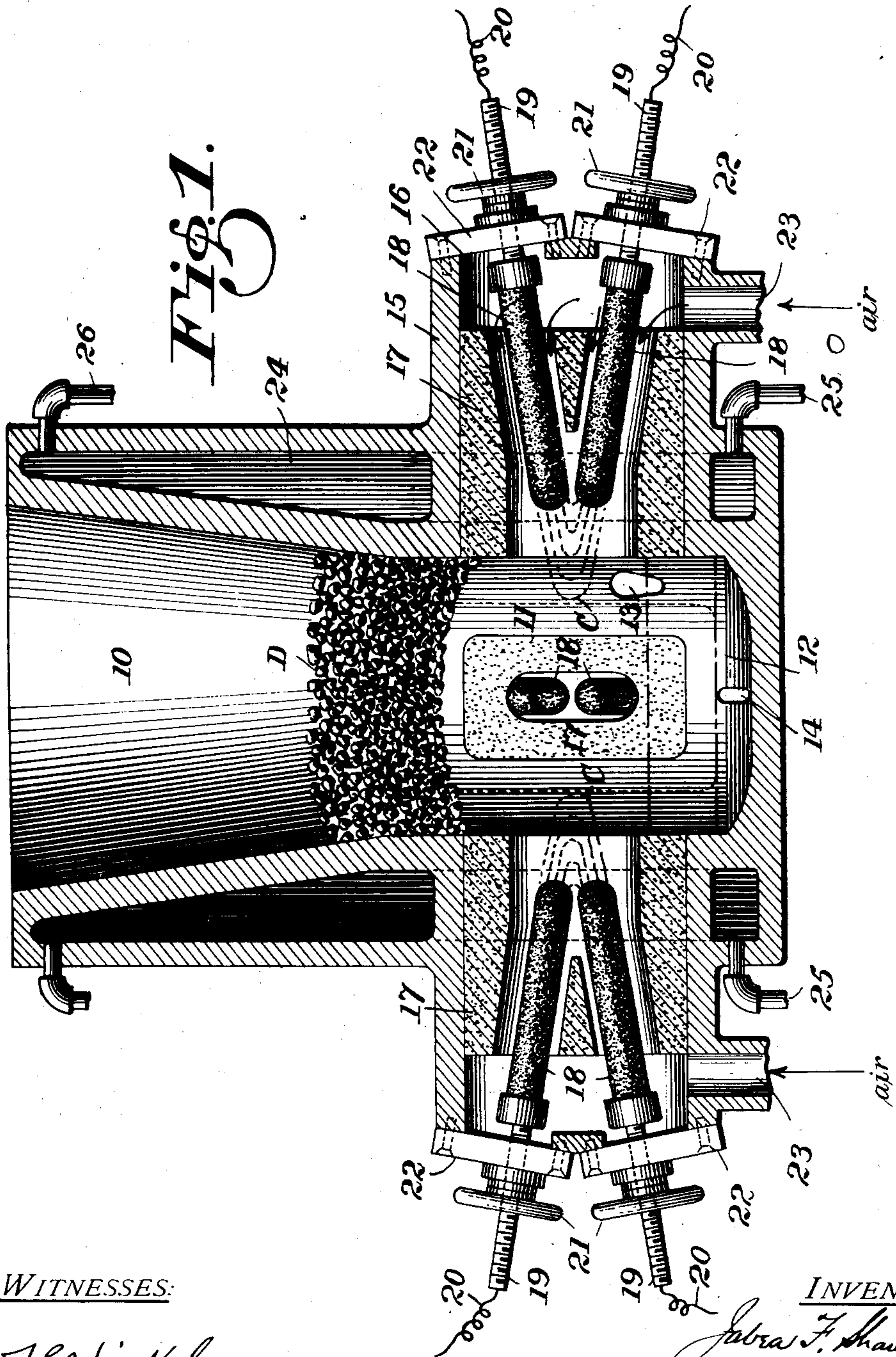


J. F. SHAWHAN.  
ELECTRIC FURNACE AND METHOD FOR OPERATING SAME.  
APPLICATION FILED JUNE 16, 1909.

951,458.

Patented Mar. 8, 1910.

2 SHEETS—SHEET 1.



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INVENTOR:

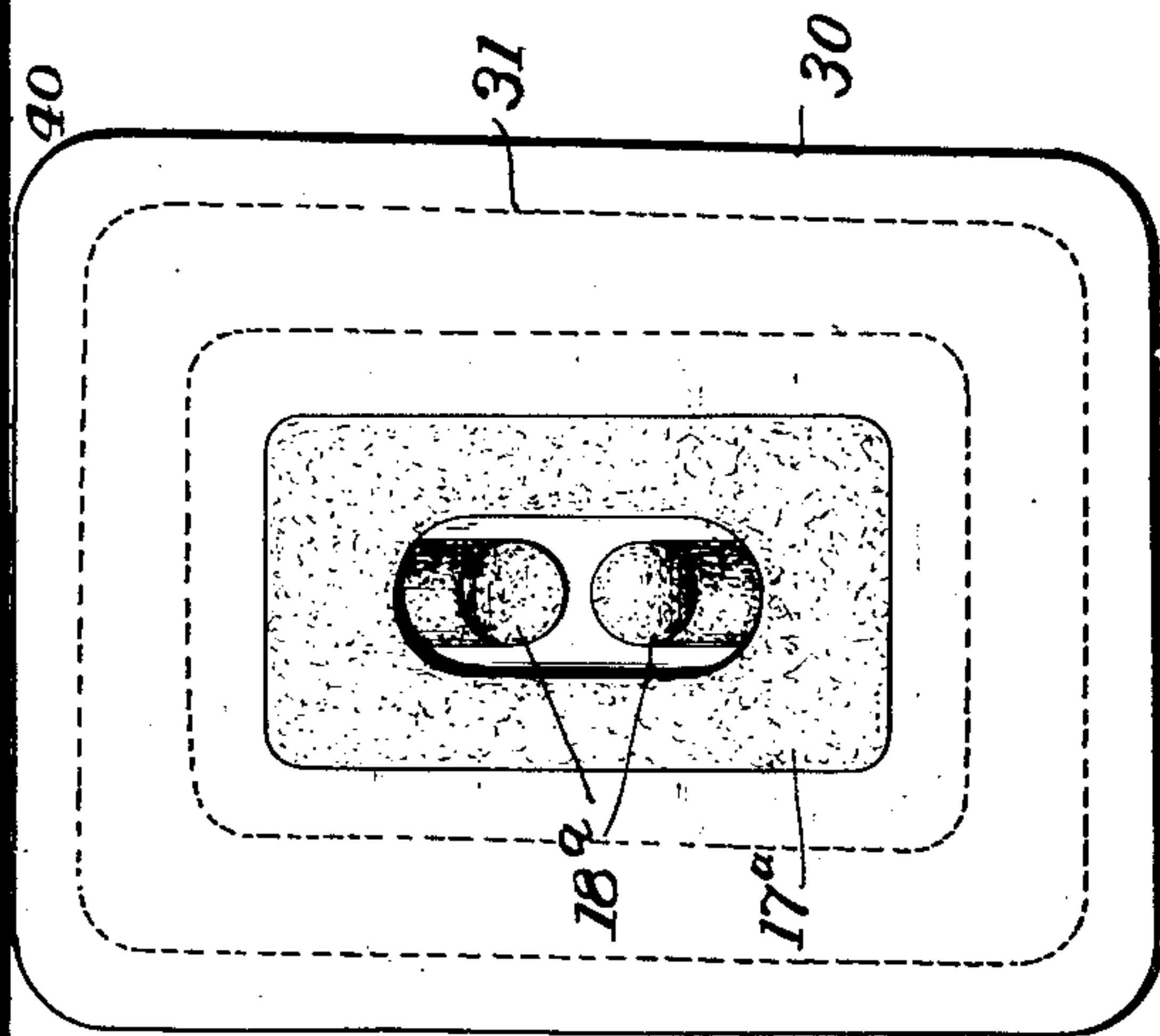
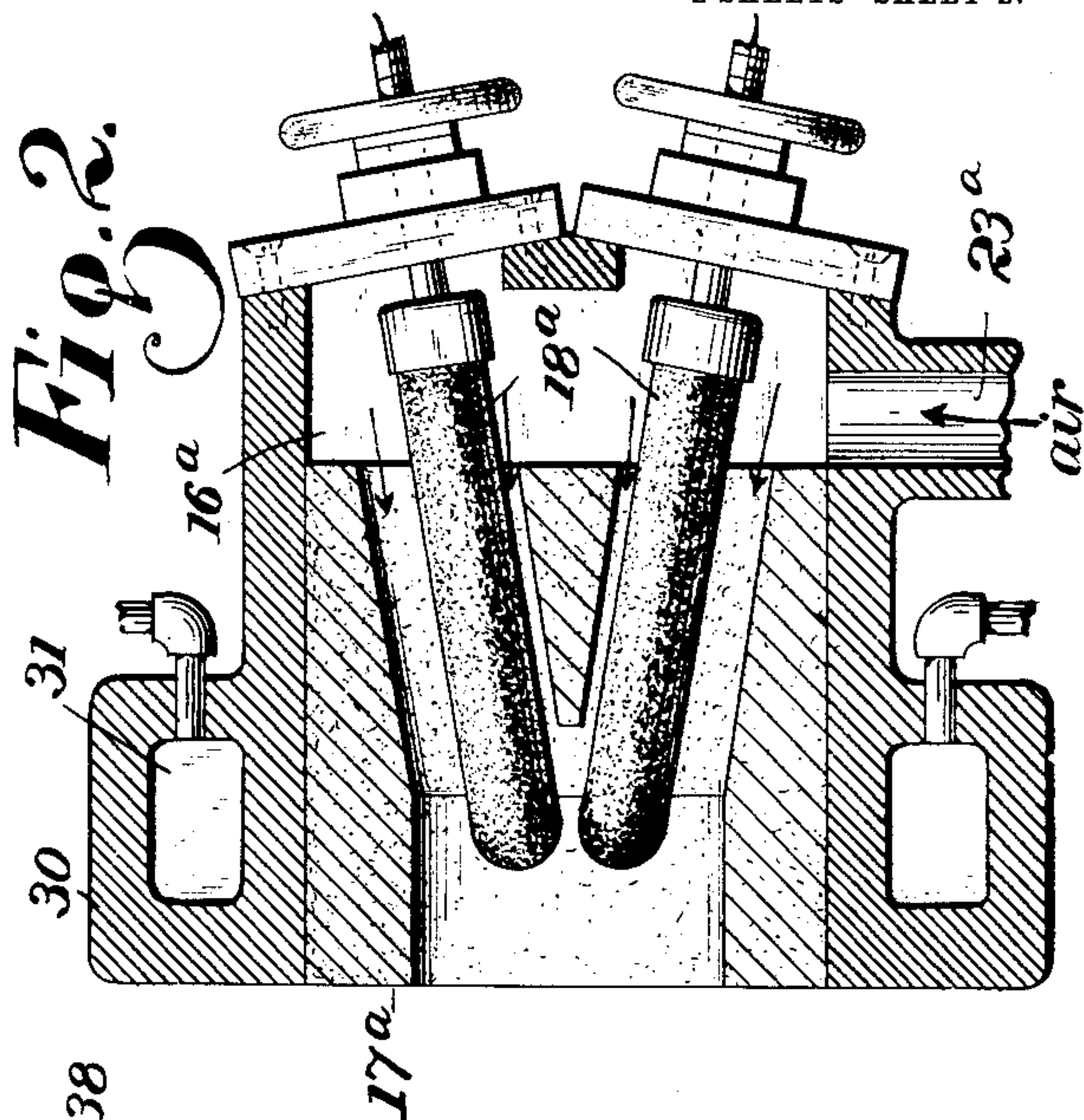
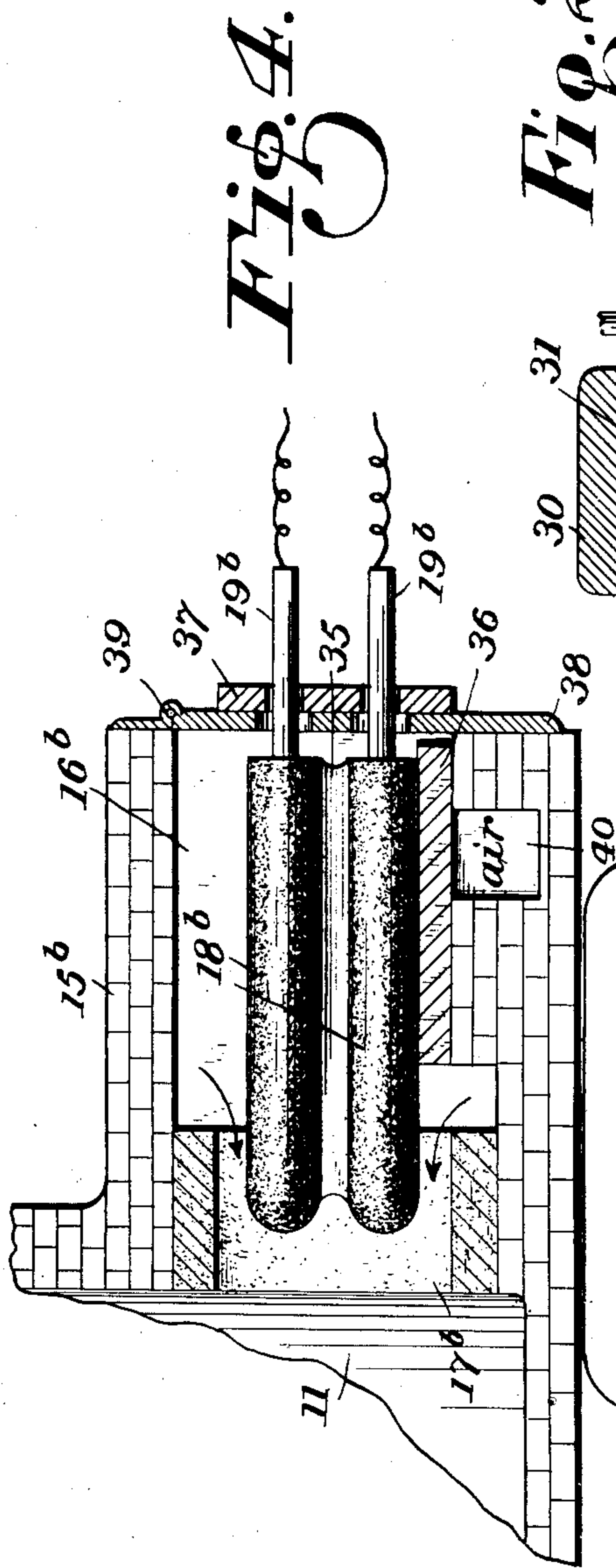
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2 SHEETS—SHEET 2.



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# UNITED STATES PATENT OFFICE.

JABEA F. SHAWHAN, OF DAYTON, OHIO.

ELECTRIC FURNACE AND METHOD FOR OPERATING SAME.

951,458.

Specification of Letters Patent.

Patented Mar. 8, 1910.

Application filed June 16, 1909. Serial No. 502,567.

*To all whom it may concern:*

Be it known that I, JABEA F. SHAWHAN, a citizen of the United States, and resident of Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Electric Furnaces and Methods for Operating the Same, of which the following is a specification.

My invention relates to electric furnaces, and in particular to electric furnaces of the arc type.

The objects of this invention are to construct a furnace which is adapted to be used as an ore reduction furnace and also as a refining furnace, which is simple in construction and efficient in its operation and avoids the undesirable contact between the electrodes and the molten material.

The invention broadly considered consists in passing a current of air over an electric arc formed between a set of electrodes, and passing the heated air into a working chamber which may be the hearth chamber of a reduction furnace or of a reverberatory furnace. The electrodes are preferably placed outside of the furnace, and the arc is formed in a twyer sleeve of refractory material opening into the working chamber. The air is passed through this sleeve and becomes heated by contact with the arc and with the radiating walls of the muffle. The air blast is preferably forced at such a pressure that the arc is drawn out and deflected into the working chamber. This blast of air performs a threefold function; it carries the heat necessary for the reducing or refining operation, it furnishes the oxygen necessary in the reducing operation for oxidation, and it blows up the slag.

In the drawings: Figure 1 is a section through a furnace; Fig. 2 is a section showing another form of this invention; Fig. 3 is a front elevation of the form shown in Fig. 2; and Fig. 4 is a section showing another form of this invention.

Referring to the drawings, the furnace is shown as comprising a charging shaft 10, a hearth chamber 11, and a crucible 12.

13 designates the slag hole and 14 the tap hole for the molten material.

The body of the furnace is provided with a number of off-set portions 15 housing the electrodes and forming chambers 16. Since the construction of these housings and electrodes is the same only one will be described in detail. A sleeve 17 of refractory material

is mounted in the chamber 16 and opens into the hearth chamber 11. A pair of electrodes 18, 18 preferably of carbon are mounted upon carriers 19 of conducting material electrically connected with a source of current 20. These carriers are mounted in blocks 22 of insulating material which form the closures for the chamber 16. A pair of hand wheels 21 are provided for adjusting the electrodes. An air inlet 23 opens into the chamber 16 and is connected to any source of air supply, as a fan or the like. The furnace is provided with the water jacket 24 connected with a supply pipe 25 and a discharge pipe 26. Since the sleeve 17 performs in part the function of a twyer, it will be for convenience called a twyer or twyer sleeve.

In the operation the arc is formed between the electrodes in the twyer sleeve 17, and this sleeve is heated to incandescence. The air is drawn or forced in through the inlet 23, and passing over the arc and radiating walls of the sleeve 17 is heated to a high temperature and discharged into the hearth chamber 11. Since the air is supplied to the chamber 16 under pressure the arc C will be drawn out and deflected into the hearth chamber, and since the current of air will pass up through the charge D the arc will ordinarily follow this current and may be deflected directly against the charge if desired, this depending altogether upon the pressure of the air. The current of air drawn over the arc and through the twyer sleeve furnishes the necessary heat, furnishes the necessary oxygen for the oxidation of the charge, and in addition blows up the slag.

Another advantage of drawing out the arc in a furnace of this type is that the arc is maintained at the extremities of the electrodes. If no means were provided for drawing out or deflecting the arc the electrodes would not burn evenly; but by keeping the arc at the extremities of the electrodes the extremities of the electrodes will keep their rounded form and will burn off evenly. The air which enters the inlet 23 is relatively cool, and in passing over the rear ends of the electrodes it keeps them cool and at the same time takes up their heat.

The furnace is preferably provided with a number of twyer sleeves 17 and sets of electrodes forming the arcs within the sleeves. In a circular furnace these arc



placed in a circle, and in a furnace of the rectangular type they are placed on opposite sides of the working chamber. Since the refractory members inclosing the arcs are in the form of sleeves, they may be easily removed. These sleeves may also be made in separate molds and a number kept in stock for replacing worn out ones. In addition this provides a convenient construction where the body of the furnace is of metal.

In the form shown in Fig. 1 the off-set portions 15 are cast integrally with the furnace body.

In the form shown in Figs. 2 and 3 the housings for the electrodes and the twyer sleeves are shown as separate castings, which may be suitably secured to the furnace or built into the brick work when the furnace body is constructed of brick. The twyer sleeve 17<sup>a</sup> and the electrodes 18<sup>a</sup> are of substantially the same construction as in the form shown in Fig. 1. The forward portion 30 of the casting is provided with an annular chamber 31 forming a water jacket. The air is introduced into the chamber 16<sup>a</sup> through the air inlet 23<sup>a</sup>. In the construction of a furnace of this type the castings 30 will be placed around the working chamber in the same manner as in the form shown in Fig. 1.

In the form shown in Fig. 4 the furnace is shown as a brick structure. The twyer sleeve 17<sup>b</sup> is built into the brick work. The electrodes 18<sup>b</sup>, preferably of rectangular form, are separated by a refractory and insulating slab 35 and rest upon another refractory and insulating slab 36 mounted upon the brick work. The shanks 19<sup>b</sup> extend through apertures in the insulating block 37 mounted upon a swinging door 38 pivoted at 39 upon the body. The air is introduced in any suitable manner into an air chamber 40, and discharges into the chamber 16<sup>b</sup>. The direction of the currents of air is shown by the arrows. The operation of this form is the same as the form shown in Figs. 1, 2 and 3. In this form, as in the previous forms, a number of chambers 16<sup>b</sup> are placed around the hearth chamber.

In all of the forms of the invention the electrodes are shown mounted one above the other, that is in a vertical plane. It is obvious, however, that these electrodes may be mounted in a horizontal plane. This is especially true of the form shown in Figs. 2 and 3 which can be placed in either position.

I have described the arc as drawn out by a blast of air. It is possible under certain conditions to draw out this arc and to deflect it into the hearth chamber by means of an electromagnet of the polar or solenoid type. It is advantageous, however, to draw this arc out by an air blast, as thereby the air is

heated in passing over the arc, and at the same time this air furnishes the oxygen necessary for the oxidation of the fuel and in addition blows up the slag. When, however, an electromagnet is used to draw out the arc, the air may be supplied through the ordinary set of twyers.

I have shown this invention as applied to a reduction furnace; it is obvious, however, that this invention may be applied to refining furnaces and to furnaces of the reverberatory type. In all of the above enumerated types it is advantageous to draw the air over the arc and through the twyer sleeve as shown and described, so as to heat the air and also draw out the arc and deflect it into the working chamber, it is therefore to be understood that I do not intend to limit this method or the apparatus to any particular type of furnace.

By locating the electrodes outside of the furnace all contact between the electrodes and the fluid metal is avoided. The heat is conducted into the working chamber from the heat generating electrodes by a current of air. The heat will also be more or less deflected into the chamber by the parts located back of the arc.

It is obvious that various changes may be made in the details of construction without departing from the spirit of this invention, and it is therefore to be understood that this invention is not to be limited to the specific constructions shown and described.

What I claim is:

1. In an electric furnace, the combination with a chamber adapted to receive a charge, of a set of electrodes adapted to form an arc, and means whereby a blast is caused to pass over the arc so as to deflect the arc and the heated blast into the chamber.

2. In an electric furnace, the combination with a chamber, of a set of electrodes located outside of the chamber, and means whereby an air blast is caused to pass over the arc to deflect the arc into the chamber and to heat the air.

3. In an electric furnace, in combination, a furnace wall, a twyer sleeve in said wall, and a set of electrodes positioned to form an arc in the twyer sleeve, said twyer sleeve being constructed so that air may be passed over its radiating surfaces.

4. In an electric furnace, in combination, a twyer, a set of electrodes positioned to form an arc in the twyer, and means for directing air over the radiating surfaces of the twyer and for deflecting the arc.

5. In an electric furnace, in combination, a twyer, a set of electrodes positioned to form an arc in the twyer, and means for directing a blast of air through the twyer to pass the air over its radiating surfaces and to deflect the arc.

6. In an electric furnace, the combination



with a chamber, of a set of electrodes forming an arc, and means for directing an air blast upon the arc to deflect the arc and discharge the air into the chamber.

5 7. In an electric furnace, the combination with a chamber, of a set of electrodes forming an arc and located outside of the chamber, and means for directing an air blast upon the arc to deflect the arc and discharge the air into the chamber.

10 8. In an electric furnace, the combination with a hearth chamber and a charging shaft, of a set of electrodes forming an arc, and means for directing a blast over the arc and into the hearth chamber.

15 9. In an electric furnace, the combination with a hearth chamber and a charging shaft, of a set of electrodes forming an arc, and means whereby air is caused to pass over the arc and into the hearth chamber.

20 10. In an electric furnace, the combination with a hearth chamber and a charging shaft, of a set of electrodes forming an arc, and means for directing an air blast on the arc to deflect the arc and discharge the air into the hearth chamber.

25 11. In an electric furnace, the combination with a hearth chamber and a charging shaft, of a set of electrodes forming an arc and located outside of the hearth chamber, and means for directing an air blast on the arc to deflect the arc and discharge the air into the hearth chamber.

30 12. In an electric furnace, the combination with a hearth chamber and a charging shaft, of a set of electrodes forming an arc and located outside of the chamber, a housing for the electrodes opening into the hearth chamber, and an air supply connected to the housing.

40 13. In an electric furnace, the combination with a hearth chamber and a charging shaft, of a plurality of sets of electrodes forming arcs, one set located on one side of the chamber and another set located on the opposite side of the chamber, and means for deflecting the arcs into the chamber and for supplying heated air thereto.

45 14. In an electric furnace, the combination with a chamber, of a plurality of sets of electrodes forming arcs, one set located on one side of the chamber and another set located on the opposite side of the chamber, and means for directing an air blast on each of the arcs to deflect the arcs into the chamber.

50 15. In an electric furnace, the combination with a hearth chamber and a charging shaft, of a plurality of sets of electrodes forming arcs, one set located on one side of the chamber and another set located on the opposite side of the chamber, and means for directing an air blast on each of the arcs to deflect the arcs and discharge the air into the chamber.

55 16. In an electric furnace, the combination

with a hearth chamber, a crucible, and a charging shaft, of a set of electrodes forming an arc, and means for directing an air blast on the arc to deflect the arc and discharge the air into the chamber.

70 17. In an electric furnace, the combination with a chamber, of a set of electrodes forming an arc, a separate twyer sleeve of refractory material surrounding the arc and opening into the chamber, and means whereby a current of air is caused to flow over the arc and through the sleeve into the chamber.

18. In an electric furnace, the combination with a chamber, of a set of electrodes forming an arc, a separate twyer sleeve of refractory material surrounding the arc and opening into the chamber, and means whereby a current of air is caused to flow over the arc and through the sleeve into the chamber.

85 19. In an electric furnace, the combination with a charging shaft, a hearth chamber, and a crucible, of a twyer opening into the chamber, and a set of electrodes positioned to form an arc in the twyer.

90 20. In an electric furnace, the combination with a charging shaft, a hearth chamber, and a crucible, of a set of electrodes positioned so as to form an arc in the hearth chamber and means whereby a blast may be directed on the arc.

21. In an electric furnace, the combination with a charging shaft, a hearth chamber, and a crucible, of a set of electrodes positioned so as to form an arc, and means whereby a current of air may be passed over the arc into the hearth chamber.

22. In an electric furnace, the combination with a charging shaft, a hearth chamber, and a crucible, of a set of electrodes positioned so as to form an arc, and means to direct an air blast on the arc to deflect it and discharge the air into the hearth chamber.

23. In an electric furnace, the combination with a charging shaft, a hearth chamber, and a crucible, of a twyer opening into the hearth chamber, a set of electrodes positioned to form an arc in the twyer, and means to direct an air blast through the twyer to deflect the arc into the hearth chamber.

24. In an electric furnace, the combination with a hearth chamber and a charging shaft, of a set of electrodes positioned to form an arc, and means for deflecting the arc into the hearth chamber.

25. In an electric furnace, the combination with a hearth chamber and a charging shaft, of a set of electrodes positioned to form an arc, and means for deflecting the arc into the hearth chamber and for supplying the chamber with air.

26. In an electric furnace, the combination with a hearth chamber and a charging shaft,

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of a set of electrodes positioned to form an arc, means for deflecting the arc into the hearth chamber, and means for regulating the position of said electrodes.

5 27. The method of operating on a charge in an electric furnace of the metallurgical type, which consists in passing a blast over an arc formed between a set of electrodes and into the hearth chamber, so that the  
10 blast will heat and chemically react with the charge therein.

28. The method of operating on a charge in an electric furnace of the metallurgical type, which consists in directing a blast on  
15 an arc formed between a set of electrodes so as to deflect the arc and the heated blast into the hearth chamber.

29. The method of operating on a charge in an electric furnace, which consists in di-  
20 recting a blast of air against an arc formed between a set of electrodes and directing the arc and air blast against the charge.

30. The method of operating an electric furnace, which consists in directing a blast of air on an electric arc to deflect the arc, 25 and passing the heated blast into the hearth chamber of the furnace.

31. The method of operating an electric furnace, which consists in directing a blast of air on an electric arc to deflect the arc 30 into the hearth chamber and passing the heated blast into the hearth chamber.

32. The method of operating an electric furnace, which consists in directing a blast of air on an electric arc to deflect the arc 35 into the working chamber and passing the heated blast into the working chamber.

In testimony whereof I affix my signature in presence of two witnesses.

JABEA F. SHAWHAN.

Witnesses:

J. H. BRUNINGA,

ARTHUR L. BRYANT.