(No Model.) 2 Sheets—Sheet 1.

F. J. PATTEN.

ELECTRIC FURNACE.

No. 577,370. Patented Feb. 16, 1897.

Fig. 3.

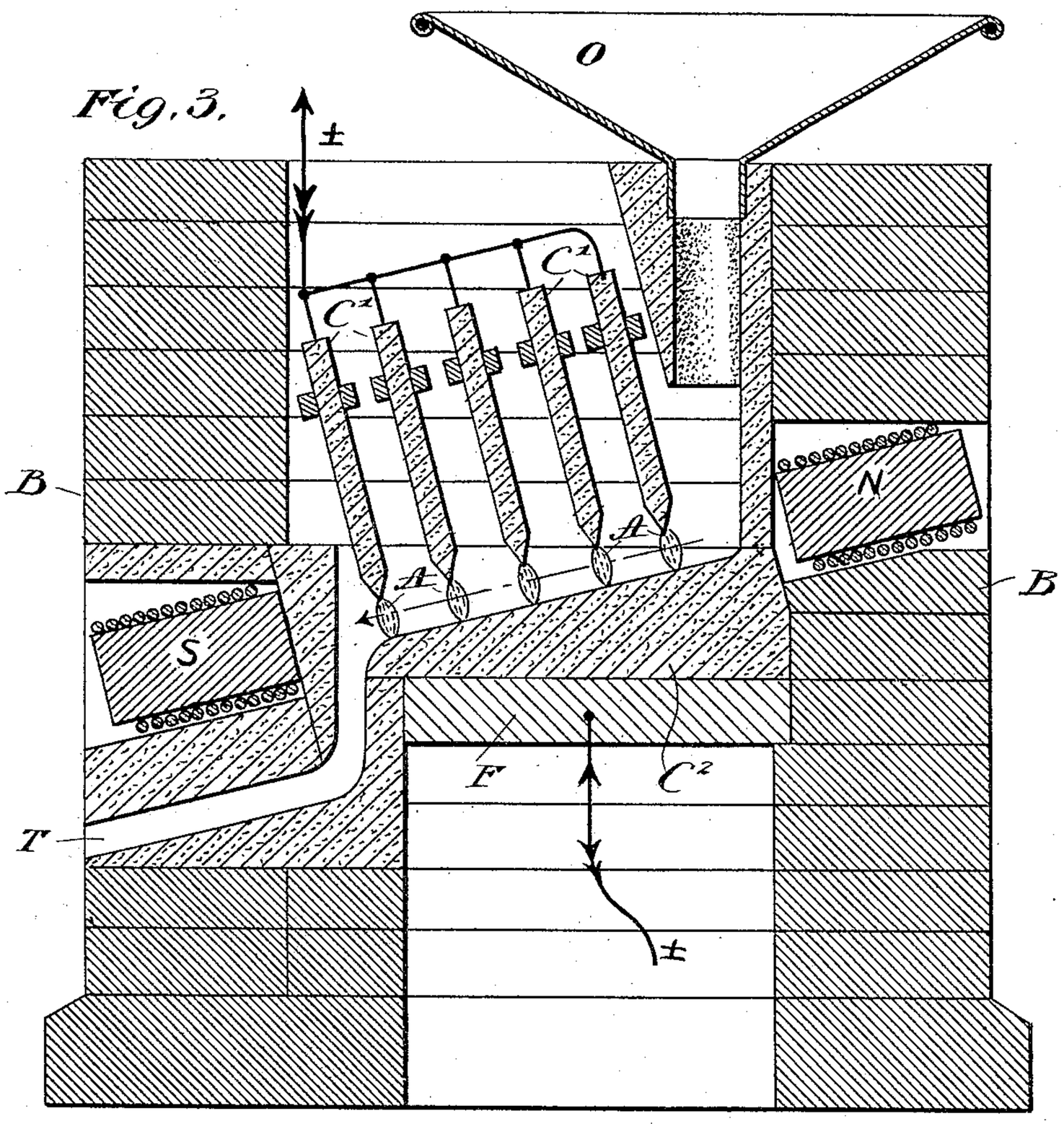


Fig. 1.

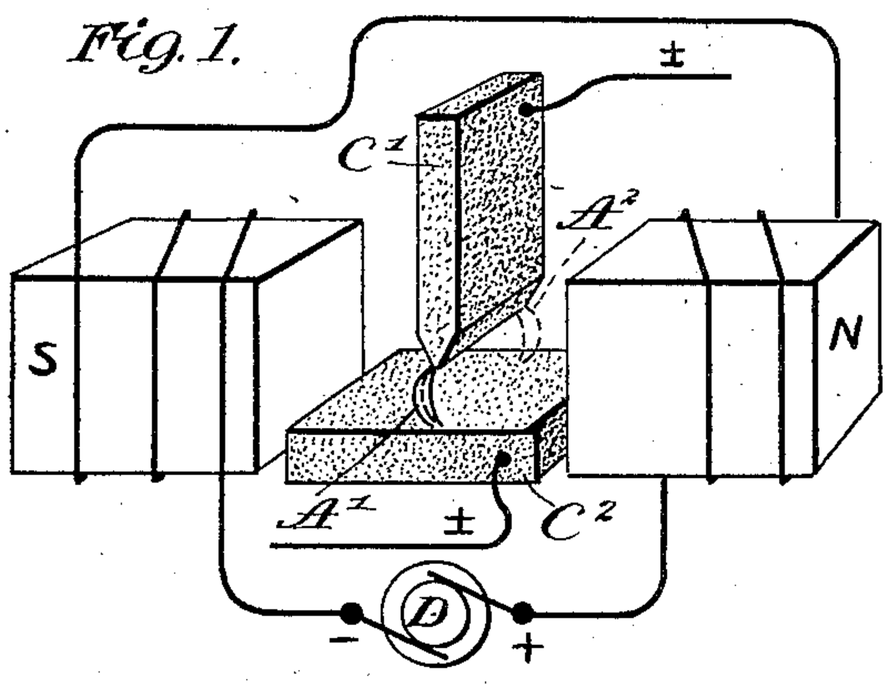
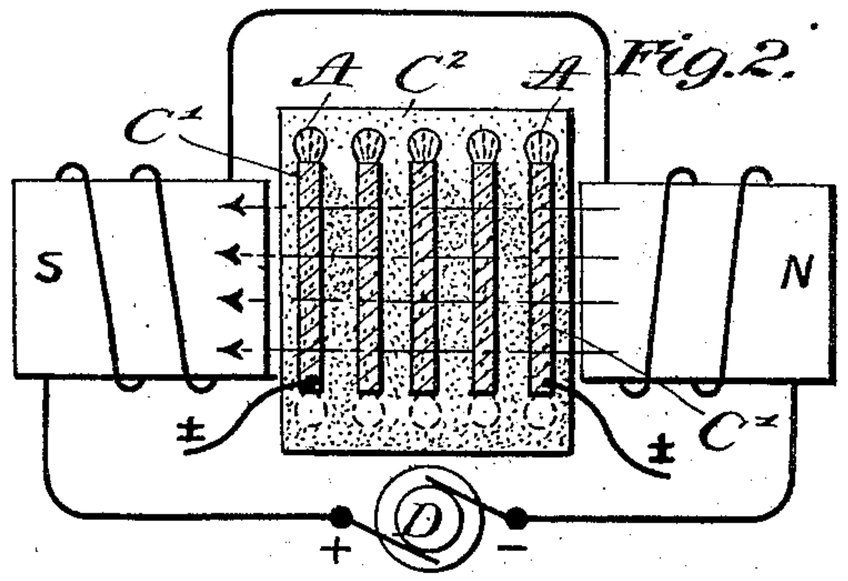


Fig. 2.



WITNESSES:

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Harry Bailey

INVENTOR

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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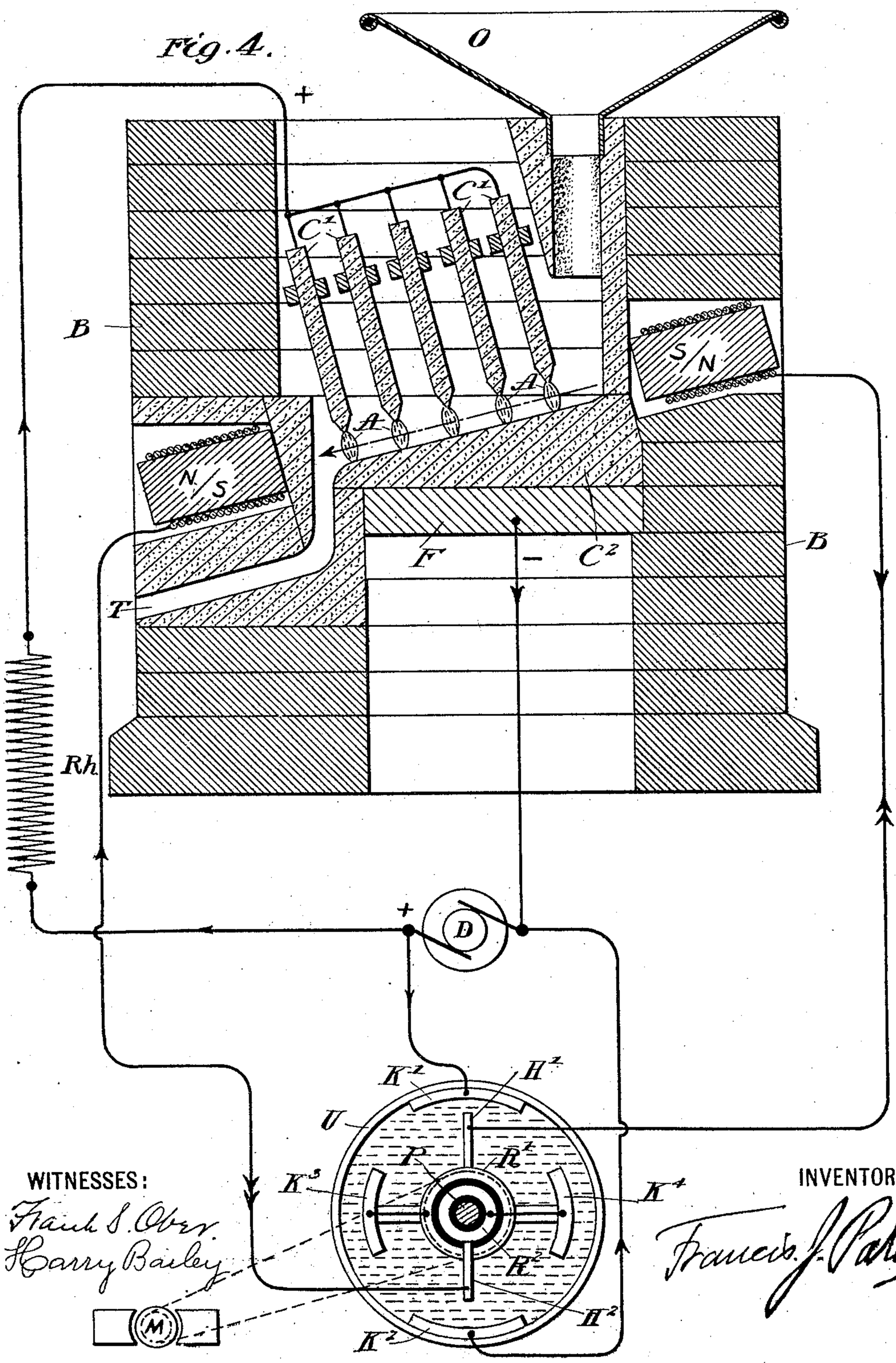
Fig. 4.



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UNITED STATES PATENT OFFICE.

FRANCIS JARVIS PATTEN, OF NEW YORK, N. Y.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 577,370, dated February 16, 1897.

Application filed November 6, 1896. Serial No. 611,213. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS JARVIS PATTEN, a citizen of the United States, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a description.

My invention consists in a system of electric-furnace construction in which an electric arc being established between electrodes is made to move by magnetic influence from one point to another, so as to arrive at and affect material that it would not reach if it remained practically steady at one point or in a fixed position.

The invention is illustrated by Figures 1, 2, 3, and 4 of the accompanying drawings, in which—

Figs. 1 and 2 illustrate the principle applied; and Figs. 3 and 4 show forms of furnace construction in which a different electric-circuit system is used, of which I will call that shown in Fig. 4 the preferred form.

It is a well-known physical fact that an electric arc will move out of a magnetic field if free to do so and in a definite direction determined by the direction of the lines of force of the field, viewed from north to south as positive, and the direction of current flow in the arc. Thus in Fig. 1, where C′ represents an upright slab of carbon placed at arcing distance from the horizontal carbon slab C^2, which with the first are designated the "electrodes" of the furnace, and N S are the poles of an electromagnet, so placed that the arc between electrodes A is normally in the field of the magnet of which the lines of force will be assumed to flow from N to S, then the arc between carbons will assume a position dependent upon the direction of current flow and the lines of force. Thus if the lines of force have the direction N to S and the current flows from the upper to the lower carbon then the arc will assume the position A′ at the left-hand corner of the upright carbon slab. Now if either the current should change direction or the magnetic field should reverse then in either case the arc would pass over to the right-hand edge or corner of the upper carbon slab, assuming the position A^2. In these physical conditions, therefore, lies the possibility of moving the arc to and fro across the edge of the upper carbon slab. It is only necessary to let the arc be produced by a slowly-alternating current and place the electrodes in a strong magnetic field, as indicated in Fig. 1. Then the arc will move across the lower edge of the upper electrode from one side to the other at each alternation of current. It makes no difference whether the current between electrodes is alternated or the current be constant in one direction and the magnetic field be reversed in direction. The result will be the same. The arc will traverse back and forth from one side to the other with each reversal of current or magnetism. It is upon these different lines of accomplishing the same result that my two forms of furnace construction herein shown are based.

Fig. 2 shows an arrangement of a number of upright parallel electrodes placed in juxtaposition to a carbon base or slab forming the other electrode. The current between the series of upper electrodes and the lower one is indicated as reversing or alternating, whereas the magnetic field is constant. The several arcs in such case between upper and lower electrodes will traverse back and forth from side to side of the upper carbon with each alternation of current, and if material is passed between the upper and lower carbons on the lower carbon slab it would be attacked by the electric arcs A A in rapid succession as they vibrated to and fro over the passing material.

Fig. 3 shows in cross-sectional elevation a furnace constructed on the plan of using an alternating current between electrodes and a fixed magnetic field. The lower electrode C^2 is given a slanting position, so that the material between electrodes will roll, slide, or flow down its surface from right to left while the arcs between the several upper electrodes and the lower one are traversing back and forth from one side of the magnetic field N S to the other, thus maintaining practically a sheet of electric flame, through which the material must pass.

B B, Fig. 3, represent in cross-section a surrounding and supporting brick structure.

F is an iron slab on which the lower carbon electrode C^2 rests, and to which one terminal of the working circuit ± is attached, the

plus-minus sign indicating a reversing or alternating current.

C′ C′ are the upper carbon electrodes, all attached to the other working-circuit terminal, and N S are the poles of an electromagnet of fixed polarity. The part O indicates a hopper through which the material to be fused is admitted, and T indicates a draw-off tube from which the material when in the liquid or molten form is taken from the furnace.

Fig. 4 represents what I will designate the preferred form, in which the current between electrodes is of constant direction and the magnetic field is slowly reversed.

Of course it will be understood that the current should not reverse too rapidly in the system shown in Fig. 3, but should preferably have a comparatively slow period or rate of movement, preferably much slower than the period or rate of ordinary alternating currents as used for lighting. It is also a ready inference that if the current between electrodes be direct and the magnetic field be reversed in order to move the arc then this magnetic reversal should also be comparatively slow; otherwise excessive heating and loss of energy would be the consequence. In the preferred form shown in Fig. 4 these features are all provided for.

A direct-current dynamo D, Fig. 4, supplies the continuous direct current sent through the electrodes C′ C′ and C^2 of the furnace having the same general structure as that previously described, and shown in Fig. 3. A shunt-circuit taken from the brushes of the dynamo D is led to the two plates of conducting material K′ K^2 of the liquid current-reverser shown at the bottom of the figure. This is a current-reverser of special form adapted to reverse currents of considerable strength without sparking or rupture of the circuit.

The circular part U represents in horizontal projection a tub or vessel. At its center is a spindle P, that carries an arm at the extremities of which are two other conducting-plates K^3 K^4, which, revolving with the spindle P, driven by the motor M, thus pass the fixed plates K′ K^2 each half-revolution.

The revolving plates are connected each to an insulated sliding-ring contact R′ R^2, on which brushes H′ H^2 bear, and as a result of the rotation of the plates K^3 K^4 a slowly-reversing alternating current is delivered to the circuit that includes the windings of the electromagnet N S S N, the magnetism of which is thus slowly reversed, causing the arc between the electrodes C′ C′ and C^2 to be traversed back and forth with the changing magnetism. Thus I have a direct-current system throughout, with slowly-reversing magnetism in this last form.

Having thus described my invention, what I desire to secure by Letters Patent is the following:

1. The method of operating an electric furnace which consists in passing the material to be operated on between electrodes, subjecting the arc to the influence of a magnetic field whose lines of force are substantially transverse to the direction of the arc, and reversing or alternating either the current in the arc or the magnetic field, whereby the arc is reciprocated transversely to the path of the material, substantially as described.

2. The method of operating an electric furnace which consists in passing the material to be operated on between electrodes, subjecting the arc to the influence of a magnetic field whose lines of force are substantially transverse to the direction of the arc, passing a direct current through the electrodes, and reciprocating the arc by reversing or alternating the magnetic field, substantially as described.

3. In an electric furnace a lower electrode, and an upper electrode consisting of a plate, an electromagnet having its poles so arranged that the lines of force pass through the arc and are normal to the upper electrode, and means for reversing or alternating either the arc-producing current or the magnet-exciting current, whereby the arc reciprocates along the lower edge of the plate, substantially as described.

4. In an electric furnace, electrodes consisting of a block and a plate above said block having its edge at arcing distance therefrom, an electromagnet having its poles so arranged that the lines of force pass through the arc and are normal to the upper electrode, means for passing a direct current through the electrodes, and means for reversing or alternating the magnet-exciting current, substantially as described.

5. In an electric furnace, the combination with a lower electrode, a plate-electrode having its lower edge at arcing distance above said lower electrode, means for feeding material between the electrodes, means for creating a magnetic field having its lines of force passing through the arcing-space, and means for alternating or reversing said field, whereby the arc is reciprocated transversely to the path of the material, substantially as described.

6. An electric furnace having for a lower electrode an inclined block or slab over which the material is fed and for its upper electrode a series of plates having their lower edges transverse to the movement of said material, means for passing a direct current through said electrodes, and means for creating a reversing magnetic field having its lines of force transverse to the upper electrode, whereby the arcs produced are caused to reciprocate across the material being operated on, substantially as described.

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

FRANCIS JARVIS PATTEN.

Witnesses:

FRANK S. OBER,

HARRY BAILEY.