

F. J. PATTEN.
ELECTRIC FURNACE.

No. 586,822.

Patented July 20, 1897.

Fig. 1.

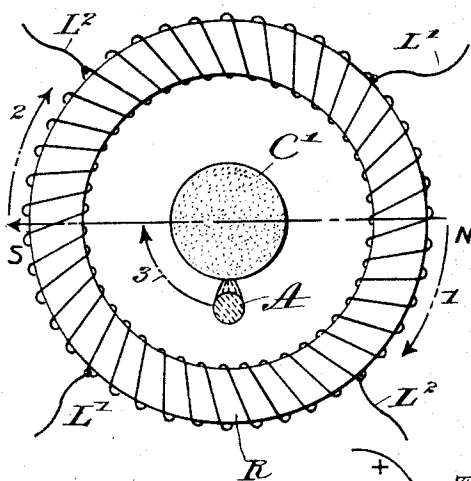


Fig. 3.

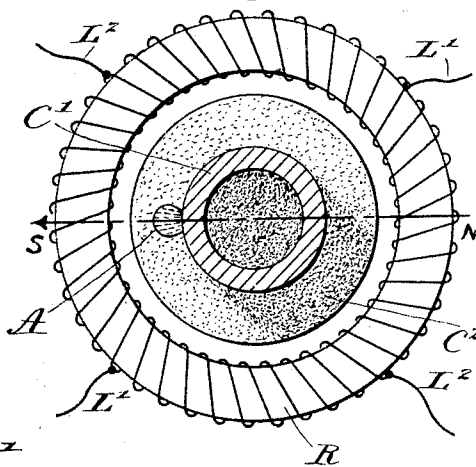


Fig. 2.

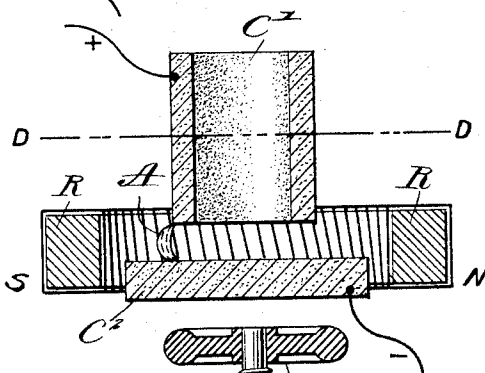
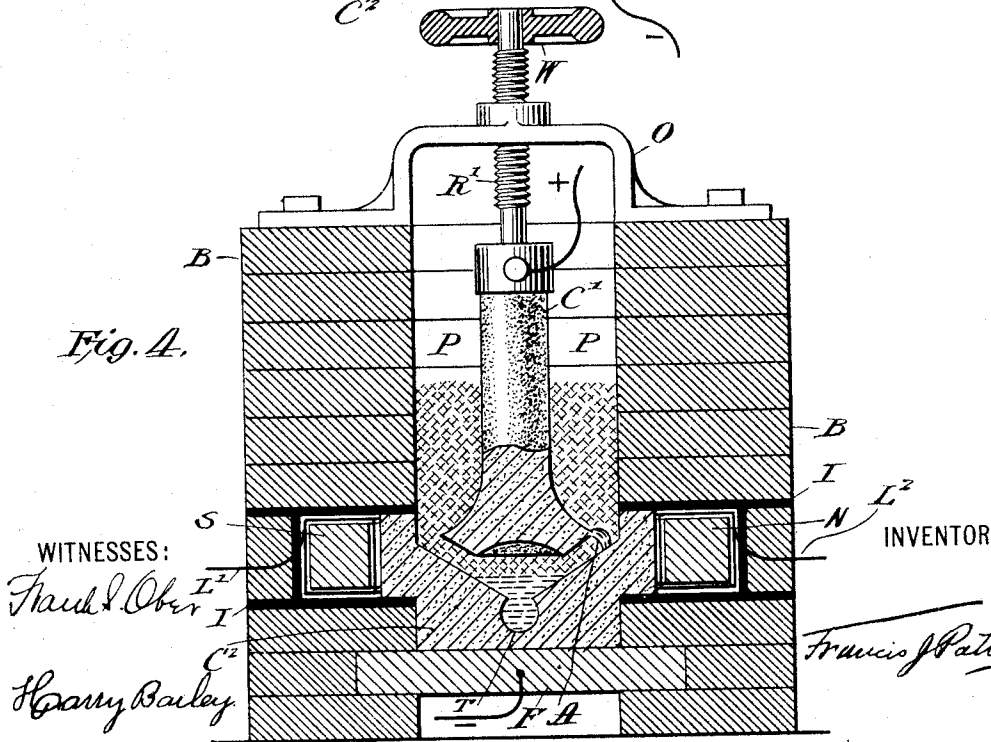


Fig. 4.



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Fig. 5.

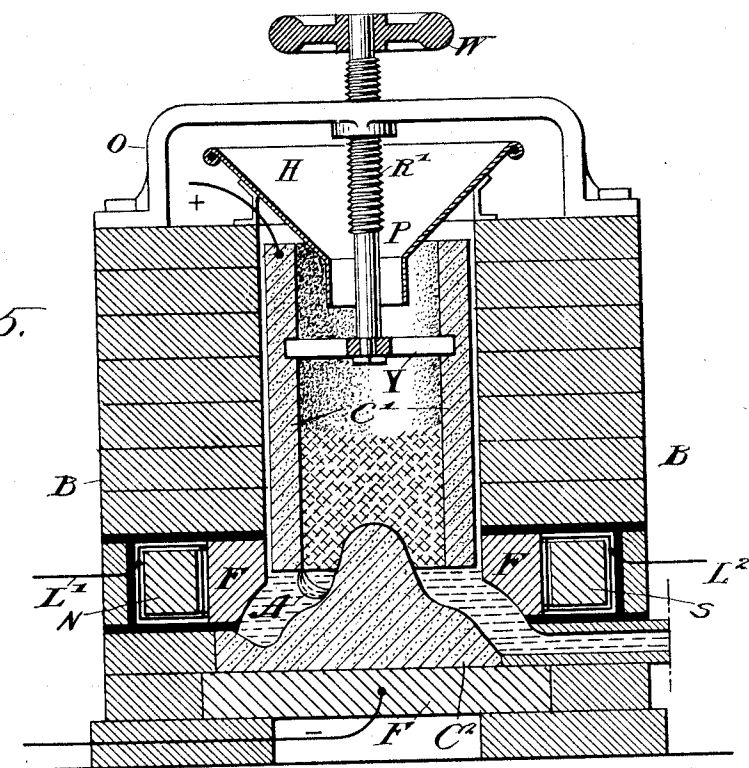
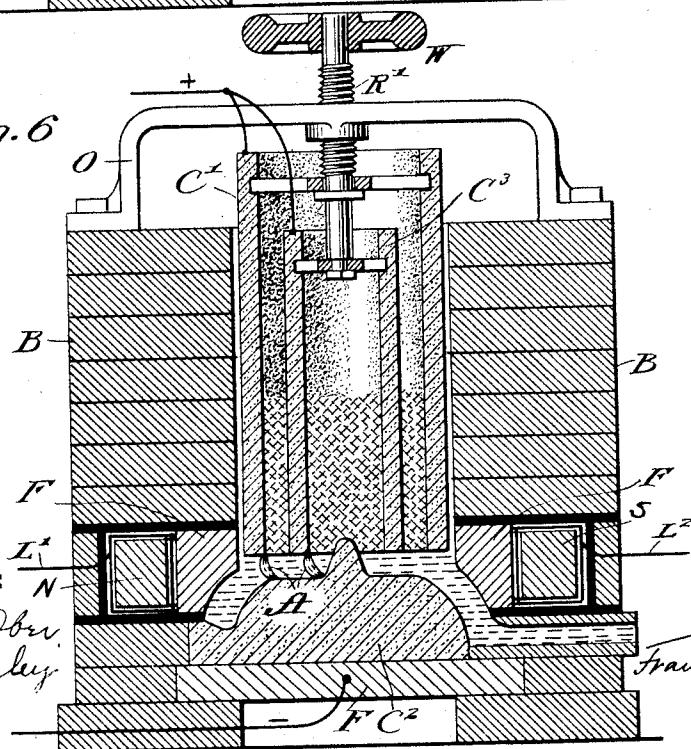


Fig. 6.



WITNESSES:
Frank E. Ober,
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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. 586,822, dated July 20, 1897.

Application filed September 14, 1896. Serial No. 605,848. (No model.)

To all whom it may concern:

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

My invention consists in a system of electric-furnace construction that involves the application of a principle that I have not heretofore seen in electric furnaces, and which will be understood from an examination of the accompanying drawings, in which—

Figures 1 to 3 illustrate the principle applied, and Figs. 4 to 6 show different applications of the principle.

Most electric furnaces depend upon the use of a fixed arc playing between two carbon electrodes, thereby producing the heat of fusion at or in the immediate vicinity of the arc. The extent of heat dispersion is thus necessarily small, and only that portion of the mixture that comes into the arc or very near to it is attacked by the desired temperature.

It is my purpose to largely extend the function of the arc in such furnaces by making it move about and attack parts of the material that could not be reached if the arc remained fixed or practically so. I give the arc motion, so that it will travel from point to point in the mass to be fused and attack a far greater quantity of the material than it possibly could if it remained at rest, or nearly so. The arc could be moved about by some method of moving the electrode, but this would involve mechanical difficulties of a rather serious nature. It is possible, however, to cause the arc or arcs alone to move about and attack a relatively large quantity of material without moving any material thing or mechanical part whatever, and my invention and system of construction rest upon this fact.

The system will be understood from a consideration of Figs. 1 to 3, designed to show the principle applied.

In Fig. 1, R R represent a magnetic ring having a closed Gramme-ring winding with four connecting-leads $L' L'$ and $L^2 L^2$, connected in pairs to separate alternate currents in quadrature relation. Supplied with such the interior of the ring will be the seat of a

rotary magnetic field or one in which the polar line N S revolves about an axis perpendicular to the plane of the ring and at a rate of rotation expressed by the current frequency in complete periods per second.

Now it is a well-known property of the electric arc that it tends to get out of or avoid a magnetic field. This peculiar action of the electric arc, combined with the rotating magnetic field, gives the means of moving the arc rapidly in space without moving any material thing whatever but the arc. Thus, referring to Fig. 1, C' represents in cross-section the upper of two carbon pencils. The magnetic field of the ring is supposed to have momentarily the polarity and direction indicated N S. Then an electric arc A would take the position shown to the left of the lines of force (looking from N toward S) and would remain there as long as the magnetic field of the ring remained unchanged in position and intensity.

With biphasic alternating currents introduced to the circuits $L' L'$ and $L^2 L^2$ the magnetic field will revolve in the plane of the ring, and the arc in its endeavor to keep out of it will likewise describe a circle about the carbons, between which if the magnetic field were not present it would flow in a nearly direct line from one to the other. In this way I am enabled to give the arc far greater amplitude than that usually formed between carbon points.

The remaining illustrations of the theory or principle applied require only brief notice.

In Figs. 2 and 3 we have a central tubular carbon C', forming an upper electrode, and a circular disk of carbon C², forming the lower electrode, and the magnetic ring R R, all parts being shown in vertical section in Fig. 2 and in horizontal projection in Fig. 3. In the case here presented as the magnetic field of the ring R R, Figs. 2 and 3, turns under the influence of the biphasic currents introduced to the ring-winding the arc A will revolve around the cylindrical carbon electrodes.

If a series of independent tubular electrodes be inserted one inside the other, as indicated in Fig. 6, each such carbon tube being insulated from its neighbor and a common lower electrode for all extends at arcing distance beneath their lower ends, then each tube would

have its own arc and each would revolve in its own circle under the influence of the revolving field, producing something in the nature of a sheet of fire between upper and lower electrodes.

Figs. 4, 5, and 6 represent in sectional elevation different forms of electric furnace embodying the foregoing principles.

In Fig. 4, B B represent a suitable inclosing fire-brick structure arranged to inclose the working elements, of which C' is the upper or positive electrode, a carbon stick flared at the lower end to give a circumference suited to the action of the revolving arc. The lower carbon C² is a dish-shaped piece of the same material having a trough in its central portion and an outlet or draft tube T. The space surrounding the vertical carbon is filled with the mixture to be fused and the carbons normally in contact are separated slightly, so that an arc is formed between their nearest points. The magnetic ring N S (shown in cross-section) is excited in the usual way by two circuits supplied with biphasic alternating currents which produce the revolving field, causing the arc A to revolve around the periphery of the flared upper carbon C', thus attacking the material to be fused as it passes down through the annular space between the upper and lower electrodes. F represents an iron slab on which the lower carbon rests and to which the negative lead is attached, while the positive one is connected to upper carbon. This furnace evidently differs from the ordinary arc furnace in the method of controlling the motion of the arc, causing it to attack the material to be fused in a definite manner.

In Fig. 5 is shown a slightly-different modification, involving, however, the same principle. In this form the upper carbon electrode is tubular, its central hollow core serving as a feeding pipe or tube to get the material to be fused into the arc-heated space. The lower carbon electrode C² is given such a form that the molten products resulting from the action of the arc will flow downward and outward to the draw-off tube T. In this form of furnace, as in that previously described, a magnetic ring N S, producing a rotary-field effect, controls the movement of the arc and causes it to move rapidly in a circle about the edge of the upper carbon, there attacking the material all around the annular opening between the two. A hopper H is fixed above the upper carbon for serving the mixture to be fused, and a yoke Y, secured to the upper carbon, is used to raise or depress this electrode to the arcing distance.

In Fig. 6 I show another slight modification of the form of furnace described. It involves the use of two concentric tubular carbons for upper electrodes instead of one, but is in other respects practically the same thing.

I preferably protect the ring and its windings from the heat of the arc in some suitable

manner. Thus in Fig. 4 a portion of the lower carbon C² forms a protecting-wall between the arcing-space and the ring, and in Fig. 5 a wall of protecting material, which may be of fire-clay, is similarly located. The upper carbon in each instance is circular, and the arc travels through the annular space between the outer edge of the upper carbon and the lower electrode. This gives a relatively long path to the arc. The material is fed or carried through this annular arcing-space either from the center outward or inward toward the center, and a comparatively broad stream of material is operated on in an economical manner and by a compact and simple form of furnace.

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

1. In an electric furnace, a furnace-wall, a pair of carbon electrodes inclosed within said wall, one of said electrodes being circular in cross-section, means for rotating the arc between and relatively to said electrodes and passages arranged to convey material through the annular arcing-space traversed by the rotating arc, substantially as described.

2. In an electric furnace, the combination with the electrodes, passages for conveying material through the arcing-space between the electrodes, a ring of magnetizable material surrounding said arcing-space, means for creating a rotating magnetic field in said ring, and means for protecting the ring and its windings from the heat of the arc, substantially as described.

3. In an electric furnace the combination with the furnace-wall, of two inclosed electrodes consisting of a lower carbon slab and an upper carbon of circular cross-section, means for rotating the arc about the axis of the upper carbon, means for adjusting the upper carbon, and passages arranged to convey the material through the annular arcing-space through which the rotating arc travels, substantially as described.

4. In an electric furnace the combination with electrodes consisting of a carbon slab and a tubular carbon electrode above said slab and separated therefrom by a suitable arcing-space, of passages for feeding material through the arcing-space between said electrodes, a ring of magnetizable material surrounding said space and means for creating a rotating magnetic field in said ring, whereby the arc is rotated through the annular arcing-space, substantially as described.

In testimony that the foregoing is my invention I have hereunto subscribed my name, in the presence of two witnesses, this 11th day of September, 1896.

FRANCIS JARVIS PATTEN.

Witnesses:

A. PRESTON COOPER,
A. LEONARD HALL.