No. 889,857. PATENTED JUNE 2, 1908.

A. J. PETERSSON.

ELECTRIC FURNACE.

APPLICATION FILED APR. 13, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

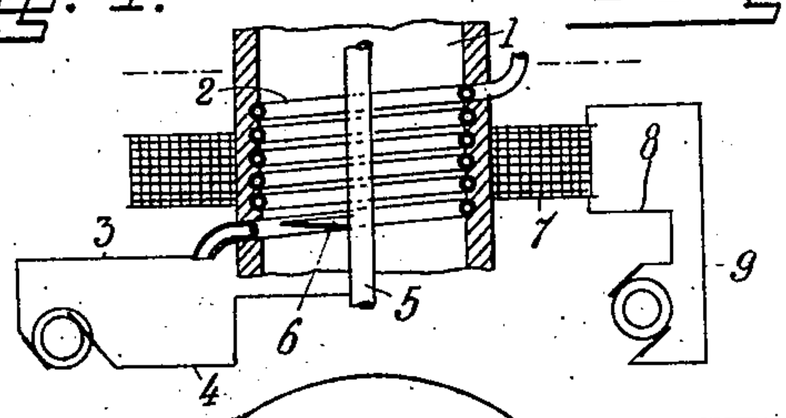


Fig. 3.

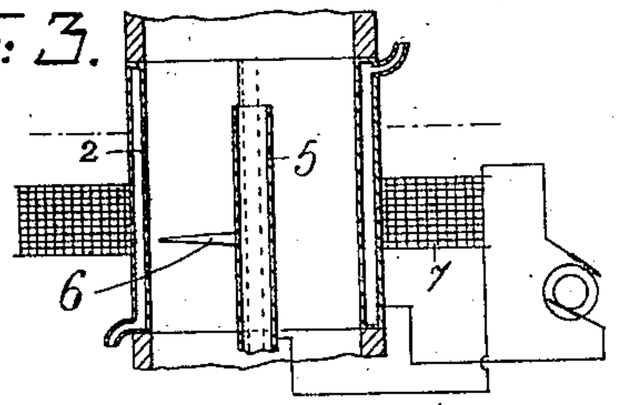


Fig. 2.

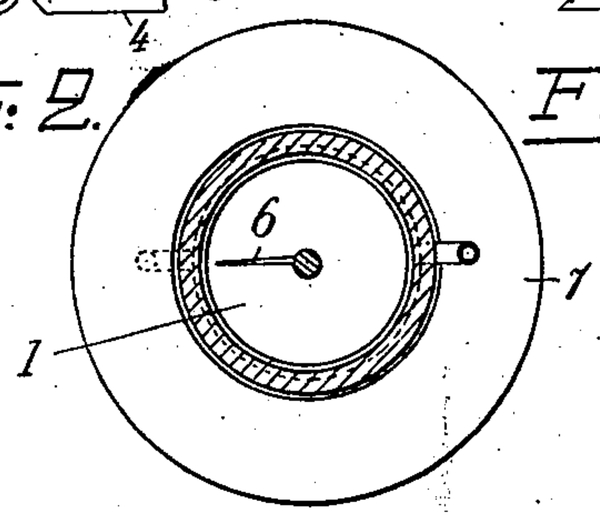


Fig. 4.

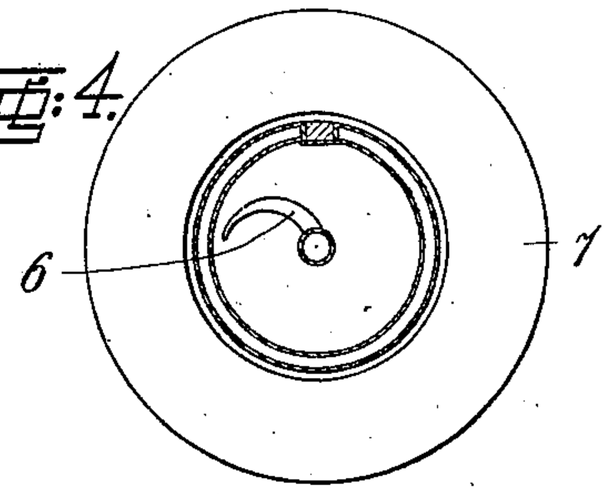


Fig. 5.

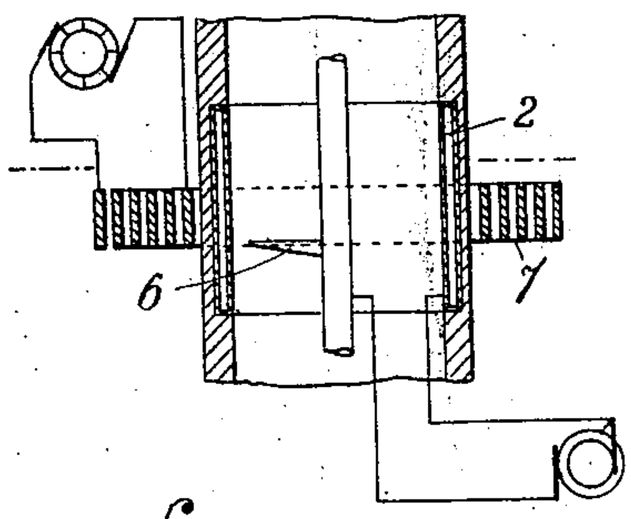


Fig. 7.

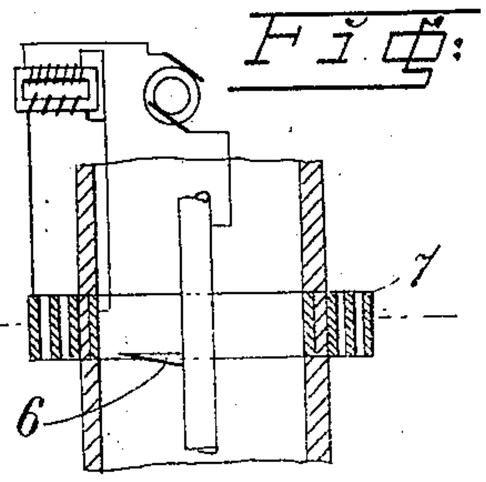


Fig. 6.

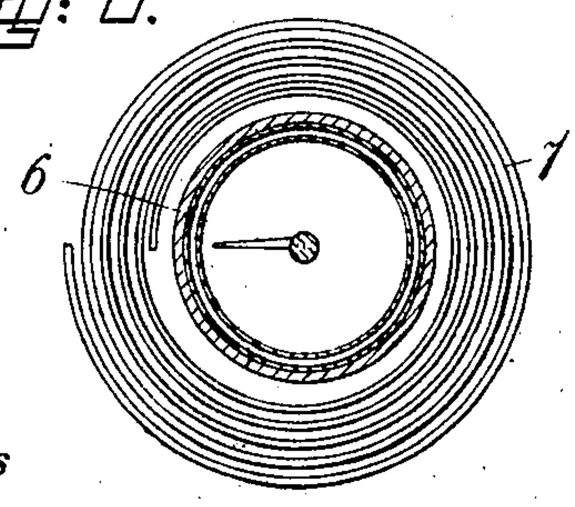
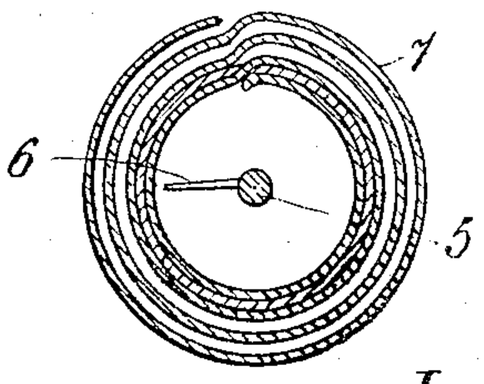


Fig. 8.



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2 SHEETS—SHEET 2.

Fig: 9.

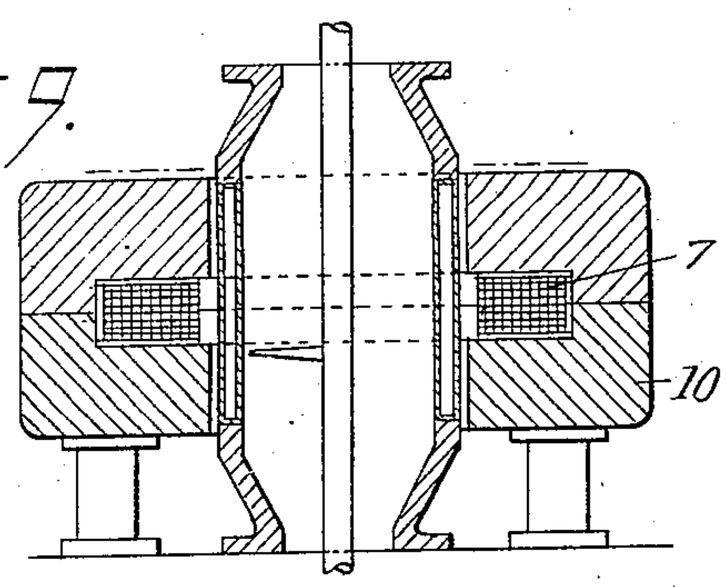


Fig: 10.

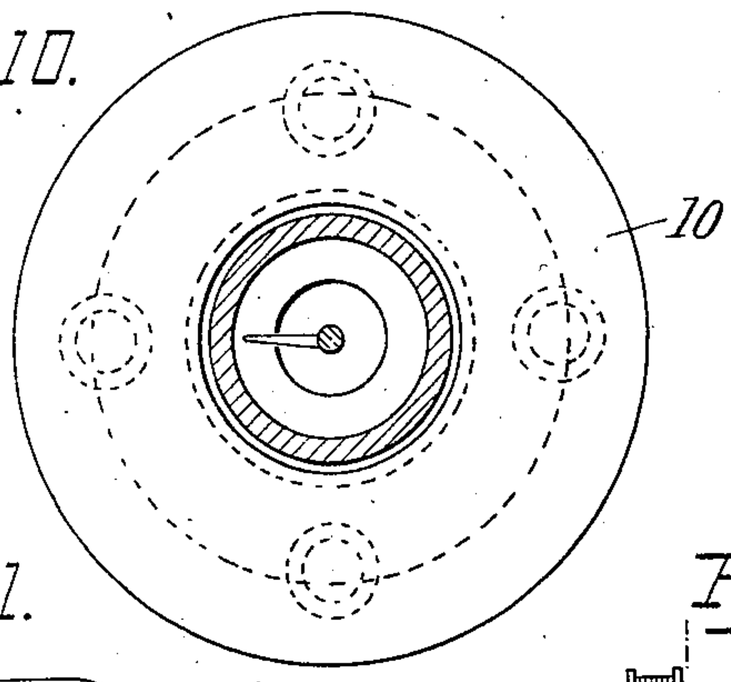


Fig: 11.

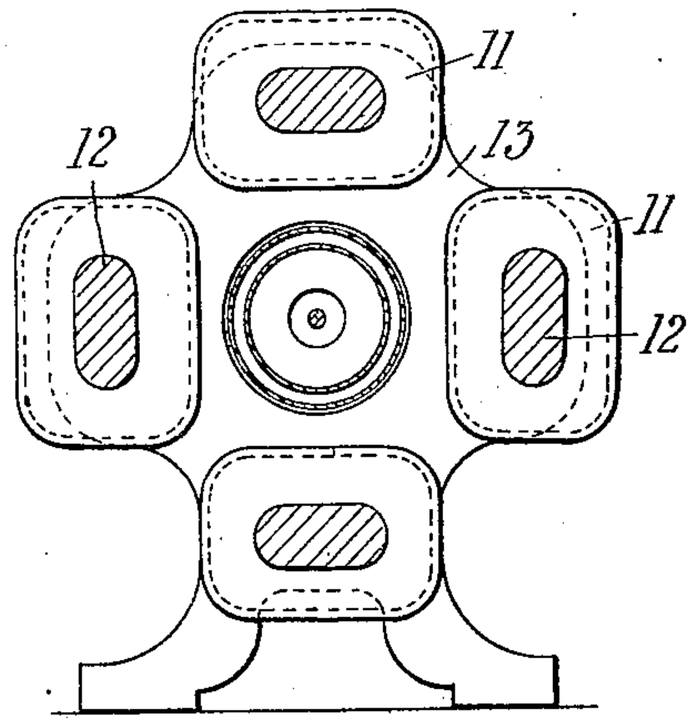
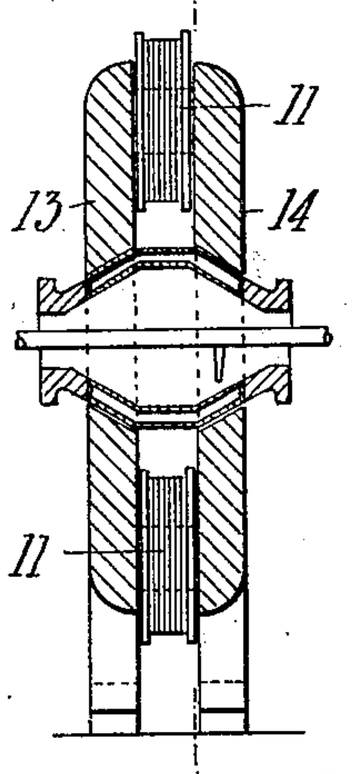


Fig: 12.



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UNITED STATES PATENT OFFICE.

ALBERT JOHAN PETERSSON, OF ALBY, SWEDEN.

ELECTRIC FURNACE.

No. 889,857. Specification of Letters Patent. Patented June 2, 1908.

Application filed April 13, 1906. Serial No. 311,407.

To all whom it may concern:

Be it known that I, ALBERT JOHAN PETERSSON, a subject of the King of Sweden, and resident of Alby, Sweden, have invented new and useful Improvements in Electric Furnaces, of which the following is a specification, reference being had to the drawings accompanying and forming a part hereof.

This invention relates to improvements in electric furnaces for treating gases by means of electrodynamically or electro-magnetically actuated voltaic arcs.

In treating gases by means of voltaic arcs, which by their heating action effect reversible chemical reactions in the gases, it is desirable that the gases thus treated do not again come within the range of the arc, inasmuch as in the repeated treating the average temperature of the gas can be increased to such an extent that the fixation of the conversion will be rendered more difficult. Heretofore it has, however, not been practically possible to avoid that a quantity of gas thus treated is again struck by the arc, inasmuch as the condition of the magnetic field generally has made it necessary to cause the mass of gas to move chiefly in the same plane in which the arcs are moving.

The object of the present invention is to obviate the said inconveniences and to provide an electric furnace in which any desired or required speed of movement of the arc through an arbitrary concentration of the magnetic power will be obtained and simultaneously the direction of movement of the mass of gas may be transverse or substantially transverse relative to the direction of movement of the arcs or to the plane in which the arc is displaced. In accordance therewith a furnace embodying my present invention is provided with a reaction chamber, as other well known furnaces of the kind in question, and a central electrode therein, and a ring-shaped or spiral-shaped (screw-shaped) electrode surrounding the latter, the discharge between the said electrodes taking place radially or substantially radially through the mass of gas moving axially and, moreover, the furnace is provided with excitation-devices around the reaction chamber or the outer electrode for creating within the latter a magnetic field of substantially axial direction. By the said arrangement of the electrodes and the magnetic field in relation to each other, it will be possible to obtain the power, by which the arc is displaced, proportional or approximately proportional to the length of the path that each part of the arc has to run, whereby the various points of the arc will be displaced at substantially the same angular velocity thus obviating the risk of the arc being disrupted. Moreover, the reaction chamber will be easily accessible and the exciting devices will at a certain strength of field be of small sizes.

For creating the arc I prefer to use alternating currents on account of the facility of generating such currents of high voltage. It may, however, be understood that continuous current of high voltage may be used, if desired. For creating the magnetic field either continuous or alternating currents may be used. In the former case, while using alternating currents in the arc, the latter during the one alternation will rotate in the one direction and during the other alternation in the other direction. In the latter case the direction of rotation of the arc, while using a magnetic field alternating synchronously with the alternating currents in the arc, will be constant, which will be the case also if continuous currents be used both in the arc and for the excitation of the field. If continuous currents be used in the arc and in the field the loading of the source of current will obviously be practically uniform as soon as the arc has been struck, the latter being brought to rotate at uniform length during the whole working. This is an essential advantage relative to such furnace constructions where the voltaic arcs continually are renewed between a pair of electrodes at short distance from each other. It is, however, possible even while using alternating currents to obtain a constantly maintained arc by connecting in parallel to the electrodes self-inductions which are capable of storing a quantity of energy sufficient to maintain the arc while the alternating current passes its zero-point whereby the most uniform load possible of the source of currents may be obtained.

In the accompanying drawing I have diagrammatically illustrated several embodiments of my invention.

Figs. 1 and 2 show vertical and horizontal sections respectively of one form of the invention. Figs. 3 and 4 show similar views of a second form. Figs. 5 and 6 show similar views of a third form. Figs. 7 and 8 show similar views of a fourth form. Figs. 9 and 10 show vertical section and side-view,

partly in section, of a fifth form. Figs. 11 and 12 show a vertical cross-section and a vertical longitudinal section respectively of a sixth form.

The construction shown in Figs. 1 and 2 has a tube-shaped reaction-chamber 1, suitably of circular cross-section, through which the gas to be treated is led in axial direction. One part of the wall of the said chamber is formed by a spirally arranged conductor 2, preferably tube shaped in order that the same, if desired, may be cooled by leading through the same a cooling fluid, the said conductor constituting the one electrode of the working circuit 3 and 4. The other electrode 5 is constituted by a central solid or tube-shaped conductor from which suitably extends a conductor 6 towards the electrode 2 for striking the arc in well known manner. Around the reaction chamber is provided an energizing coil 7 supposed to be supplied with continuous current from an electric circuit 8 and 9. The plane of the said coil is substantially transverse in relation to the reaction chamber and in such a position relative to the outer electrode that the latter incloses the most powerful part of the magnetic field of the coil, which has a substantially axial direction. An arc struck between the electrodes will by this arrangement be put in rotation around the central conductor in a plane substantially parallel to the plane of the coil, or eventually it will be moved upwards following the turns of the outer electrode if the same are insulated from each other. In using alternating current of a frequency of 25 periods a second in the arc it is possible by the said arrangement to obtain without difficulty 8–10 full revolutions of every single arc created by half a period of the alternating current, *i. e.*, a speed of rotation of several hundred revolutions a second. As the axial movement of the arc can be made as small as desired and in any case is almost independent of the magnetic power displacing the arc, it is obvious that a repeated treating of the mass of gas that has already been exposed to the action of the arc in a sufficient degree may be easily obviated.

The form illustrated in Figs. 3 and 4 differs from that shown in Figs. 1 and 2 chiefly in that the outer electrode 2 is constituted by a hollow cylinder and the energizing coil is connected in series with the arc and is thus supplied with alternating current. The direction of rotation of the arc hereby will be constant and by suitably dimensioning the energizing coil the latter may be used as an impedance in the circuit of the arc for preventing injuries on the source of energy in striking the arc and for steadying the arc. For preventing injurious screening action from the outer electrode the latter, as is shown in Fig. 4, should, preferably, be made in the shape of an open ring in such a manner that shortcircuited currents in the same will be prevented, while the arcs will pass the cuts without hindrance.

Referring to Figs. 5 and 6, the energizing coil 7 is constituted by a big cable in the shape of a ribbon wound spirally around the reaction chamber and being supplied with continuous current of low voltage and great volume. Figs. 7 and 8 show a modification thereof, in which the innermost turn of the energizing coil also constitutes the outer electrode of the furnace, the said coil being supplied with alternating current from a transformer, the primary winding of which is connected in series with the arc.

In all the above described forms the energizing coil exerts only an electro-dynamic action on the arcs. However, iron may also be provided outside the furnace for closing the magnetic circuit whereby a strengthened action within the space inclosed by the outer electrode will be obtained at a given number of ampere turns in the energizing coil. Such a furnace-construction is shown in Figs. 9 and 10, in which the coil 7 is provided in a ring-shaped iron-core 10 of U-shaped cross-section, which may be arranged horizontally, as is shown, or vertically, as desired. By suitably shaping the pole-surfaces of the magnet, or by providing recesses or extra windings at the poles the strengths of the field within the space inclosed by the outer electrode may be varied so as to obtain a uniform displacing action on the arcs.

The form illustrated in Figs. 11 and 12 differs from that shown in Figs. 9 and 10 chiefly in that the iron-core is arranged vertically and provided with a number of coils 11 placed on cross-pieces 12 between two ring-shaped magnet-cores 13 and 14. By the continuous pole-surfaces at the sides facing the reaction chamber a continuous field will nevertheless be maintained within the space inclosed by the magnet, the said field causing the arc to rotate at the desired speed.

It will be easily understood that all the constructions described above are forms of one and the same invention and the latter may be varied within wide limits without deviating from the principle of the invention. In the forms shown in Figs. 9–12 alternating or continuous currents may be used in the field, as desired. If it is desired to avoid the axial movement of the arc it is sufficient to make the one or both of the electrodes of small axial extension, whereby the rotation of the arcs will take place chiefly in one and the same plane.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. In an electric furnace for treating gases by means of voltaic arcs the combination, of a furnace chamber, an inner central elec-

trode, an outer electrode concentric therewith, means around the furnace for creating a magnetic field in the space within the said outer electrode, and means for moving gases through the said furnace chamber, substantially as and for the purpose set forth.

2. In an electric furnace for treating gases by means of voltaic arcs the combination, of a furnace chamber, an inner central electrode, an outer electrode concentric therewith, a ring-shaped iron-core around the furnace, means for energizing the said iron-core, and means for moving gases through the said furnace chamber, substantially as and for the purpose set forth.

3. In an electric furnace for treating gases by means of voltaic arcs the combination, of a furnace chamber, an inner central electrode, an outer electrode concentric therewith, an energizing coil around the said outer electrode, means for connecting the said coil in series to the arc between the said electrodes, the said coil forming an inductive resistance for the arcs, and means for moving gases through the said furnace chamber, substantially as and for the purpose set forth.

4. In an electric furnace for treating gases by means of voltaic arcs the combination, of a furnace chamber, an inner electrode, an outer electrode concentric therewith, a ring-shaped iron-core, an energizing coil in the said core, means for connecting the said coil in series to the arcs between the said electrodes, and means for moving gases through the said furnace chamber, substantially as and for the purpose set forth.

5. In an electric furnace for treating gases by means of voltaic arcs the combination, of a furnace chamber, an inner electrode, an outer electrode concentric therewith, an energizing coil around the latter consisting of a spirally wound ribbon-shaped cable, and means for moving gases through the said furnace chamber, substantially as and for the purpose set forth.

6. An apparatus for producing chemical reactions in a mass of gases, consisting of means for forming an electric arc and causing the latter to play in the mass of gases, the said arc being subjected to the action of a magnetic field produced by a stationary source of magnetism, the said magnetic field causing the arc to rotate in one plane about the axis of one of the electrodes.

In testimony whereof I have hereunto set my hand to this specification in the presence of two subscribing witnesses.

ALBERT JOHAN PETERSSON.

Witnesses:
EVARD DELMAR,
EMIL WAHEBERG.