A. J. PETERSSON.

METHOD O STRIKING VOLTAIC ARCS.

APPLIC TION FILED NOV. 3, 1905.

905,572. Patented Dec. 1, 1908.

2 SHEETS—SHEET 1.

Fig: 1.

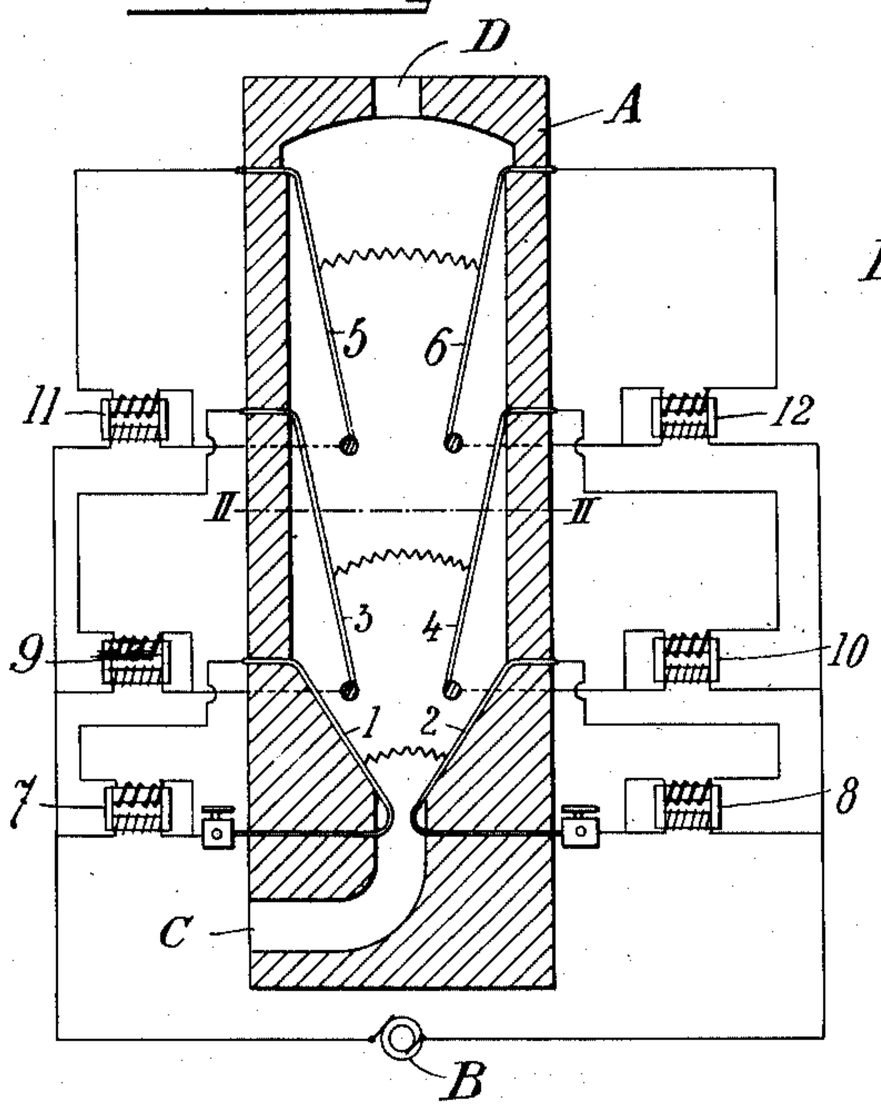


Fig: 5.

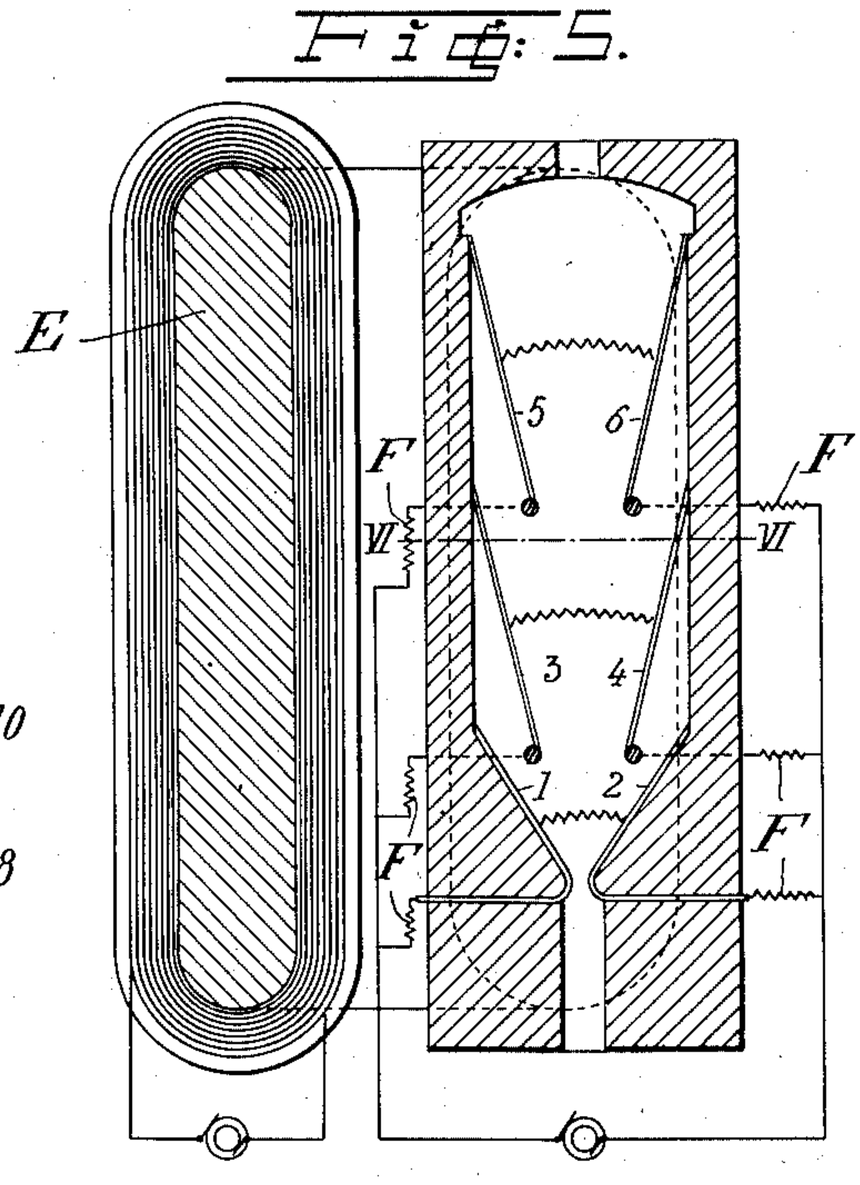


Fig: 2.

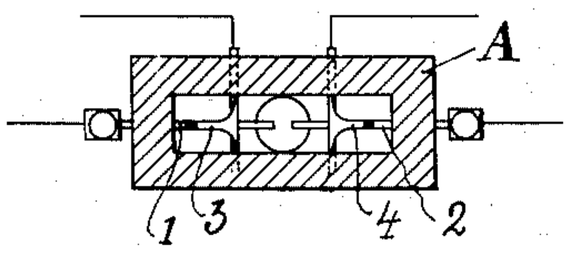


Fig: 6.

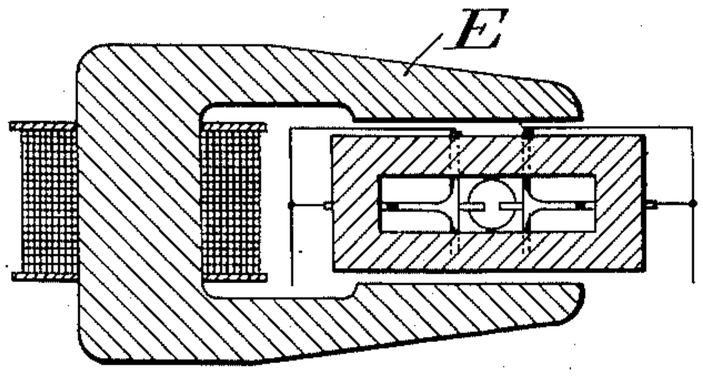


Fig: 3.

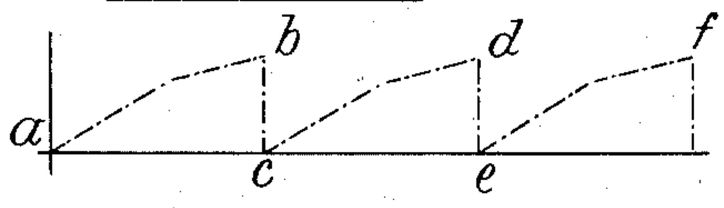
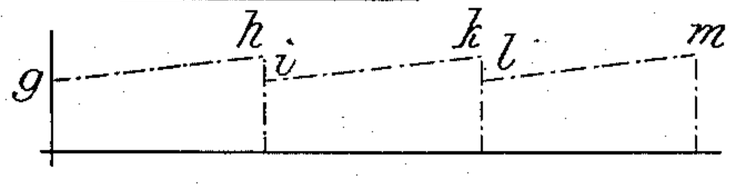


Fig: 4.



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2 SHEETS—SHEET 2.

Fig: 7.

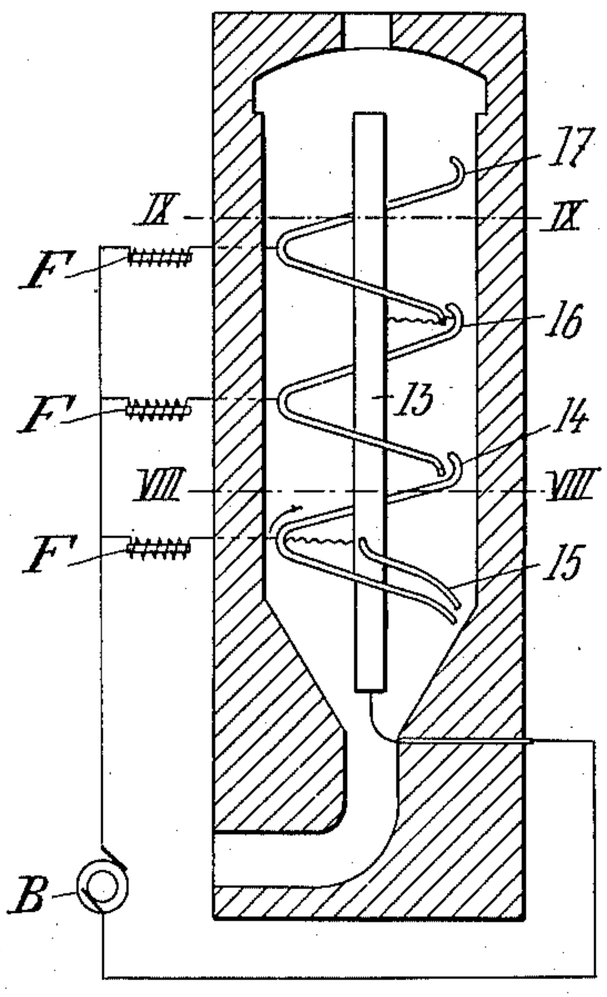


Fig: 8.

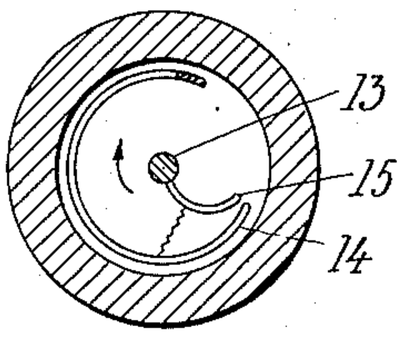


Fig: 9.

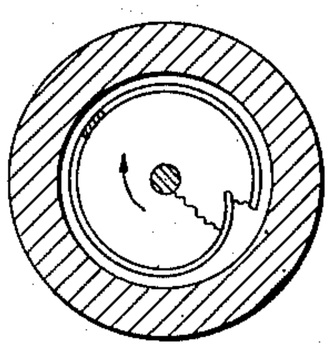


Fig: 10.

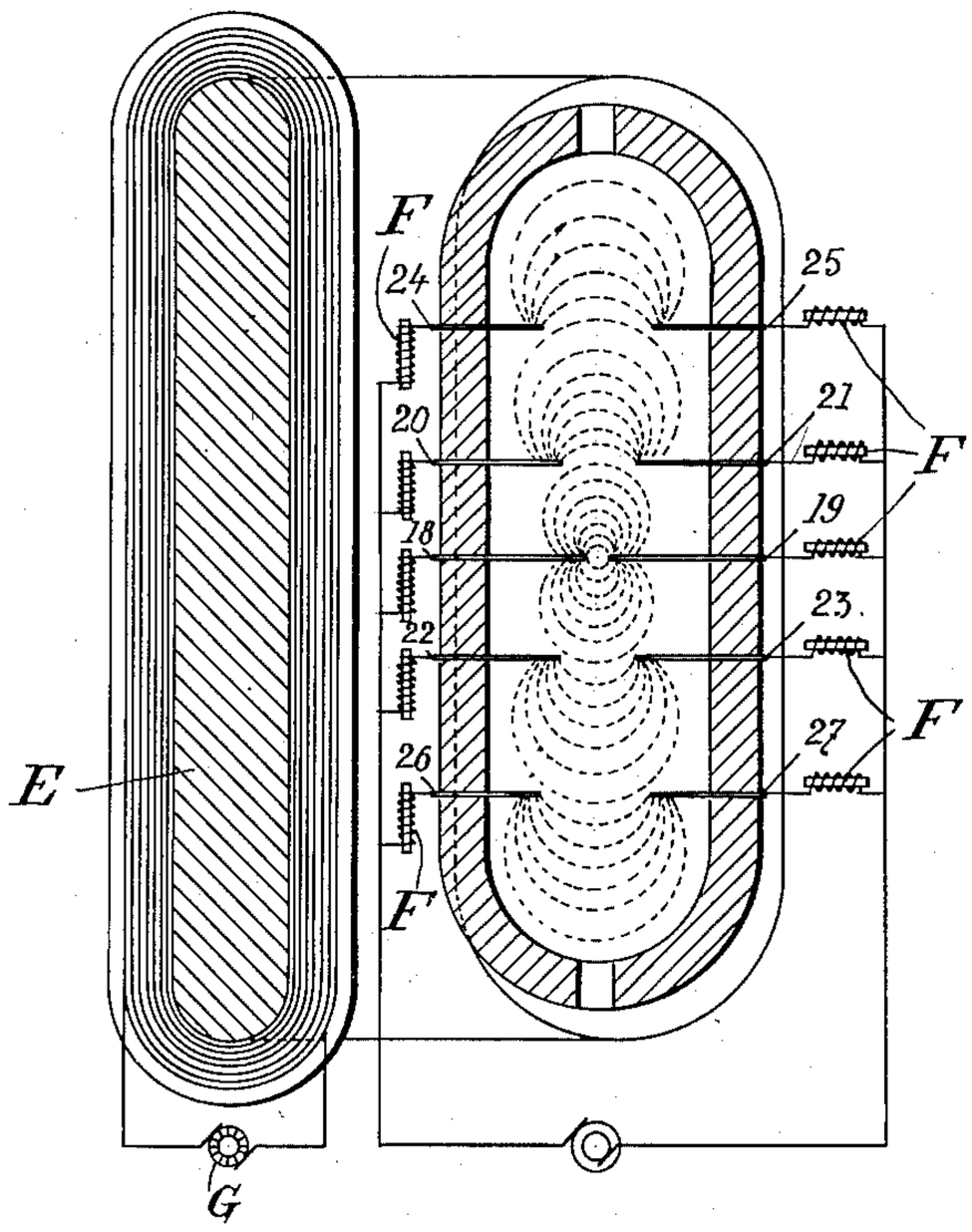
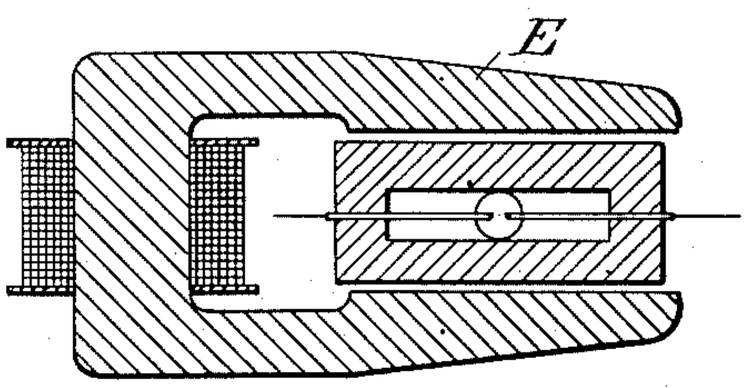


Fig: 11.



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METHOD OF STRIKING VOLTAIC ARCS.

No. 905,572. Specification of Letters Patent. Patented Dec. 1, 1908.

Application filed November 3, 1905. Serial No. 285,883.

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 Methods of Striking Voltaic Arcs, of which the following is a specification, reference being had to the drawing accompanying and forming a part hereof.

This invention relates to a method of striking voltaic arcs between electrodes at arbitrary distance from each other, especially adapted for use when treating gases or gas-mixtures by means of such arcs.

When gases or gas-mixtures for effecting chemical reactions in the same are treated by voltaic arcs created by electric currents of high voltage and moved through the mass of gas by the influence of magnetic fields created by magnets or electric currents, it is generally necessary for striking the arcs to arrange the electrodes at a very short distance from each other at the place where the arcs are to be struck, owing to the fact that the mass of gas offers an essentially greater resistance before the striking of the arc than after the current has commenced to pass through the same. In fact the striking of the arc acts in such a device practically as a short-circuit which does not cease until the arc increases its length, when moving away from the place of striking by the movement of the mass of gas and by the influence of the magnetic field. In order to prevent injurious influences on the supply circuit and the source of power by the said short-circuiting it is necessary to insert a comparatively great self-induction in the supply-circuit. The said self-induction, however, causes a very disadvantageous power factor for the working current especially in the moment of striking, and the said power factor increases first according as the resistance of the arc is increased by the extension of the latter, so that the average value of the same will be comparatively low.

In order to obviate the said inconvenience and to obtain a more favorable power factor it is therefore necessary to obviate as far as possible the use of arcs having a small initial resistance. This is the object of the present invention according to which it is possible to consume the essential part of the working current in voltaic arcs between electrodes which along their whole length are at a comparatively great distance from each other, the arcs between the said electrodes being struck by arcs created by suitable means between special electrodes and moved to the first mentioned electrodes. The initiating of the arcs may, for instance, be accomplished by means of electrodes placed so close to each other at a certain point that the striking of the arc at the said point may be accomplished by the existing voltage or a voltage which may be conveniently obtained in the supply circuit, whereupon the arc is moved to the first mentioned electrodes and there closes the circuit between the same.

The present invention thus, principally, consists in striking voltaic arcs between the electrodes of one circuit by means of other arcs created between electrodes of another circuit and moved by magnetic or electrodynamic influence to the first-mentioned electrodes. By this method of striking the arcs it is possible to have a great minimum distance between the electrodes between which the arcs are struck by means of other arcs, whereby the power factor of the circuit or circuits of the said electrodes may be made favorable. Another advantage is that a number of arcs may be obtained simultaneously in one and the same furnace, inasmuch as each pair of electrodes may contain one arc whereby the furnace space may be better utilized than is the case when only one pair of electrodes is provided.

In the accompanying drawing I have shown diagrammatically some examples of devices for carrying out the method.

Figure 1 shows a vertical section and Fig. 2 a horizontal section on line II—II in Fig. 1 of a furnace constructed in accordance with my present invention. Figs. 3 and 4 are diagrams showing the variations of the resistance in the arcs according to the old and new methods. Fig. 5 is a vertical section and Fig. 6 a horizontal section on line VI—VI in Fig. 5 of a second form of the invention. Fig. 7 shows in vertical section and Figs. 8 and 9 in horizontal sections on lines VIII—VIII and IX—IX respectively in Fig. 7 a third constructional form. Fig. 10 shows a vertical section and Fig. 11 a horizontal section on line XI—XI in Fig. 10 of a fourth constructional form.

In the constructional form shown in Figs. 1 and 2 is used a pair of electrodes 1 and 2 which are arranged in the usual manner in a furnace A having an inlet C for the gases to be treated and an outlet D for the treated gases,

and between which electrodes the voltaic arcs are struck, the electrodes at the points are placed close to each other, and the same from the said point diverge upwards. Somewhat below the upper ends of the said electrodes are provided the lower ends of another pair of electrodes 3 and 4, the said ends of the latter being flattened or enlarged in order that an arc driven upwards between the electrodes 1 and 2 may with certainty be moved over to the electrodes 3 and 4. The minimum distance between the latter is comparatively great so that the resistance in an arc driven upwards between the same will be rather constant. Somewhat below the upper ends of the electrodes 3 and 4 and between the same are placed the lower ends of a third pair of electrodes 3 and 4. The electrodes 1, 3, 5 and 2, 4, 6 respectively are connected in parallel to each pole of a suitable source of alternating electric current B of high voltage. Each electrode is also in well known manner inserted in a closed circuit with the secondary winding of transformers 7, 8, 9, 10, 11 and 12 respectively, the primary windings of which are connected to the working-circuits of the respective pairs of electrodes.

The working of an apparatus as shown in Figs. 1 and 2 may be considered to be as follows: When the difference of potential between the electrodes 1 and 2 has become sufficiently great to cause the striking of an arc between the parts of the electrodes located nearest to each other and an arc has struck between them, the said arc will be driven upwards by the electrodynamic action of the working-current as well as and especially by the currents induced by the said transformers in the circuits of electrodes closed through the transformers 7 and 8. As soon as the said arc arrives to the lower ends of the electrodes 3 and 4 the working current of the latter will be closed, whereupon the central part of the arc will continue upwards between the electrodes 3 and 4, while arcs will remain between the electrodes 1, 3 and 2, 4 respectively and keep the circuit of the electrodes 1 and 2 closed through the electrodes 3 and 4 and the arc therebetween. This will continue until the arc between the electrodes 3 and 4 has been extended so much and the total resistance in the circuit of the electrodes 1 and 2 has been increased to such an amount that the discharge-potential has been reached at the shortest distance between the said electrodes. A new arc is now struck between the latter and acts as short-circuit for the arcs between the electrodes 1, 3 and 2, 4 respectively, whereby the said arcs will be extinguished, while the arc between the electrodes 3 and 4 remains, in as much as the latter are also directly connected to the source of current B. The last mentioned arc will continue upwards between the electrodes 3 and 4 until it comes into contact with the lower ends of the electrodes 5 and 6 and closes the circuit of the latter, arcs remaining between the electrodes 3, 5 and 4, 6 respectively, either until the arc between the electrodes 5 and 6 has been extended so much that the resistance in the circuit of the electrodes 3 and 4 through the electrodes 5 and 6 and the arc of the same has become so great that the circuit of electrodes 3 and 4 will be broken, or until the next arc between the electrodes 3 and 4 is struck and closes the circuit of the same on a shorter way. In as much as the arc can remain even if the current changes its direction, it will be understood that a number of arcs may simultaneously be maintained in the furnace and thereby an increased effect on the mass of gas will be obtained compared with the case where only one pair of electrodes is used and consequently only one arc can be maintained between the electrodes.

The variations of the resistance are diagrammatically illustrated in Figs. 3 and 4. In Fig. 3 are as an example shown the variations of the resistance in the circuit of the electrodes 1 and 2 with three successive arcs. The resistance is represented by the ordinates of the broken line *a*—*f* which shows that the resistance at the striking of each arc practically is reduced to null and is thereupon increased successively to a maximum value at which the arc is extinguished by the striking of a new arc. The variations of the resistance at the pair of electrodes 3 and 4 or 5 and 6 are represented by the ordinates of the broken line *g*—*m*, Fig. 4, the said resistance being much more uniform than in the circuit of the electrodes 1 and 2, whereby it will be possible to obtain a more favorable value of the power factor of the circuits of the electrodes 3, 4 and 5, 6 than in the case in which the resistance is reduced to null in each striking of an arc. In order to prevent the arcs from influencing each other in a disturbing manner it is necessary to provide in each circuit of the electrodes a certain self-induction which in the apparatus shown in Fig. 1, is effected by the transformers 7, 8, and 9, 10, and 11, 12 respectively. The said self-induction causes, as will be easily understood, an essential decrease of the power factor of the circuit if the ohmic resistance of the same is small, which, however, is not the case with the circuits of the electrodes 3, 4 and 5, 6 respectively. In order that the circuit of the electrodes 1 and 2, which under all circumstances will have a comparatively low power factor, may have the smallest possible influence on the power factor of the source of power B the said circuit is, preferably, arranged for the smallest possible consumption of energy.

The constructional form shown in Figs. 5 and 6 differs from that shown in Figs. 1 and

2 substantially in that an electromagnet E is used for displacing the arcs. In as much as the electrodes 1 and 2 are arranged in the lower end of the furnace, so that the arc can be driven only upwards, it is necessary to use either direct current for supplying the magnet as well as for creating the arc, or, if alternating current be used for the latter, it is necessary to supply the magnet with an alternating current synchronous therewith. Obviously it is possible to use direct current for supplying the magnet and alternating current for the circuits of the electrodes, if the electrodes 1 and 2 be placed in the middle of the magnetic field and the other electrodes both upwardly and downwardly.

In the furnace shown in Figs. 7–9 is in well known manner used a central electrode 13 and around the same a spiral-shaped conductor divided in sections 14, 16, 17 extending beyond each other. The arcs are struck between the lowermost section 14 of the said spiral-shaped conductor and a conductor 15 extending from the central electrode 13 and are thereupon driven upwards along a screw-surface between the electrode 13 and the successive sections 14, 16 and 17 each of which may by a suitable self-induction coil F or the like be connected to the one pole of a common source of current B the other pole of which is connected to the central electrode 13. Eventually transformer-devices, such as shown in Fig. 1, or other corresponding devices of any well known or suitable kind may be used for obtaining a strengthened driving action on the arcs.

In the constructional form shown in Figs. 10 and 11 is used a number of electrodes arranged in pairs the one above the other, and the electrodes in each pair are arranged in line with each other, all the pairs of electrodes being placed in a plane at right angles to a magnetic flux created by an electromagnet E excited by means of a continuous current source G. The electrodes 18 and 19, between which the arcs are initiated, are arranged at a short distance from each other. The arcs struck between the same are driven either upwards or downwards depending on the direction of the current and are extended until they arrive into contact with the next pair of electrodes 20, 21 or 22, 23 and close the circuit of the same, whereupon the arc from the same will continue until the first mentioned arcs are extinguished and the circuit of the next pair of electrodes 24, 25 or 26, 27 is closed, and so on. The working is thus analogous with that described with reference to Figs. 1 and 2. In all the circuits are, as in the forms described above, provided suitable reactance coils F in order to prevent the striking or extinguishing of an arc in one circuit from having a disturbing influence on eventual arcs in the other circuits. The successive development of the arcs is in Fig. 10 indicated by dotted curved lines.

Instead of a single source of current for all the circuits of the electrodes one may, of course, use separate sources of current for each or two or more of the said circuits. Any number of pairs of electrodes and circuits may obviously be used. Eventually the several pairs of electrodes may be supplied with currents of different phase. For instance, the pair of electrodes 20, 21 and 22, 23 respectively in Fig. 10 may be supplied with one and the same alternating current that is displaced 180° or less in relation to the alternating current that is supplied to the electrodes 18 and 19, and the pairs of electrodes 24, 25 and 26, 27 respectively may be supplied with an alternating current which, for instance, is in phase with the current supplied to the electrodes 18 and 19, and so on. Other combinations of multi-phase currents with their phases in different relations to each other may obviously be used.

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

1. The method of treating gases by means of electric discharges, which consists in leading gases through a furnace chamber, striking electric arcs between electrodes in the said furnace connected to an electric circuit, and moving the said arcs to electrodes of another circuit for closing the latter, substantially as and for the purpose set forth.

2. The method of treating gases by means of electric discharges, which consists in leading gases through a furnace chamber, striking electric arcs between electrodes in the said furnace connected to an electric circuit, and creating a magnetic field in the said furnace chamber for moving the said arcs to electrodes of another circuit for closing the latter, substantially as and for the purpose set forth.

3. The method of treating gases by means of electric discharges, which consists in leading gases through a furnace chamber, striking electric arcs of low intensity between electrodes in the furnace connected to an electric circuit, and moving the said arcs by means of magnetic action to electrodes of other circuits for striking arcs of higher intensity between the last mentioned electrodes, substantially as and for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALBERT JOHAN PETERSSON.

Witnesses:
JOHN DELMAR,
ELLEN LOVÉN.