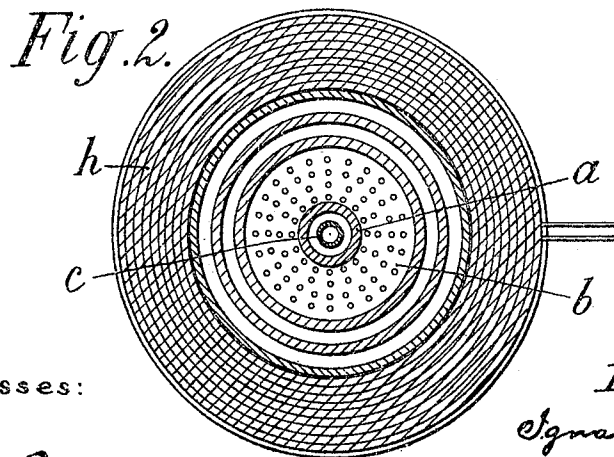
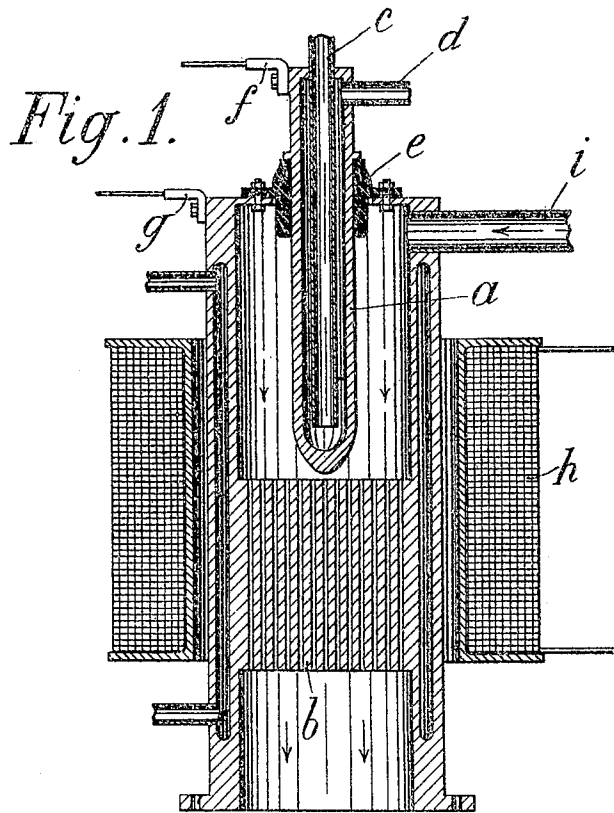


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ART OF TREATING GASES ELECTRICALLY.
APPLICATION FILED AUG. 6, 1907.

933,094.

Patented Sept. 7, 1909.



Witnesses:

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ART OF TREATING GASES ELECTRICALLY.

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Specification of Letters Patent.

Patented Sept. 7, 1909.

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To all whom it may concern:

Be it known that I, IGNACY MOSCICKI, electrician, a citizen of Russia, residing at Gambach, near Fribourg, in the Republic of Switzerland, have invented certain new and useful Improvements in the Art of Treating Gases Electrically; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the art of electrolytically or electrosynthetically treating gases and the same has particular reference to the production of oxids of nitrogen by electric furnace methods, although the same may be used for the production of other gases.

In the apparatus hitherto employed for the production of oxids of nitrogen by electric process the cooling of the gases which have been under reaction and which leave the electric arc is effected by conducting through or past the flame a larger quantity than that which can enter into reaction, so that the gaseous products formed by the action of the flame can cool directly after reaction in mixing with these quantities of gas. Now it is to be borne in mind that a large portion of electric energy which is expended in these apparatus is necessary for imparting to that portion of the gas passing through the apparatus and entering into reaction, the high temperature required for this reaction, while after the temperature has been increased only a smaller portion of the electric energy is necessary for the chemical reaction and is bound thereby. Calculation and practical experiments have shown that in order to insure a cooling of the gases to about 700° the quantity of gas employed cannot be much smaller than 2.5 m.³ per 1 kilowatt hour. If however the cooling to about 700° be not effected quickly enough decomposition of the nitrogen oxids just formed immediately after the flame reaction is unavoidable. It may be observed that even at 700° decomposition may follow but so slowly that it is not of practical importance. The circumstance that large excesses of gas must be conveyed with the quantities of gas entering into reaction involves as a consequence that it is not easily possible to obtain in the product leaving the apparatus more than 2% of nitric oxids of the total volume of gas given off.

It is the object of the present invention to produce gases such as oxids of nitrogen by electric process, which enables a much larger quality of oxids of nitrogen to be obtained in the product leaving the apparatus.

One form of apparatus embodying this invention is illustrated in the accompanying drawings, Figure 1 being a longitudinal section, and Fig. 2 a transverse section of the same.

Of the two electrodes *a*, *b* the one *a* is of cylindrical form but rounded off at the lower end, while the other electrode *b* is formed by a body containing a larger number of passages communicating above and below with hollow cylinders. Both electrodes are arranged for being cooled by means of a liquid, for example oil, water, etc. a tube *c* which is open at its lower end extending into the electrode *a* nearly to the point thereof, while in the case of the electrode *b* there is only a cooling jacket provided with an admission and a discharge pipe. The cooling of the electrode *a* is effected by the admission of the cooling liquid through the tube *c* and the discharge of the same through the pipe *d*. The two electrodes are mutually insulated by means of the sleeve *e* which is made of good insulating material. The electric energy is supplied through conductors *f* and *g*. The surface of the electrode *b* situated opposite the free end of the electrode *a* is flat and only slightly distant from the former. As shown, said electrode, *b*, extends entirely across the furnace chamber and forms its lower end wall. The middle portion of the electrode *b* is surrounded by a coil which is intended to produce a powerful magnetic field. The magnetic lines of force of this field are vertical to the said flat surface of the electrode *b*. The gases to be brought into reaction and required for the cooling enter through the pipe *i* pass the hollow space surrounded by the electrode *b* and force the flame against the surface of the electrode *b*, pass through the flame and go out of the apparatus through the passages in the electrode *b*. The apparatus is specially suitable for working under pressure.

The action of the described apparatus is based on the observation of the following novel phenomena. If an electric flame be produced in a powerful magnetic field between a plate shaped electrode, the surface of which is vertically intersected by the magnetic lines of forces, and a second elec-

tuated vertically to and at a slight distance from this plate it will revolve under the influence of the magnetic field sweeping early the whole extent of the plate electrode. When the plate of the electrode is looked at the impression made on it is that this plate is entirely covered with flame. As the electric flame sweeps over the whole upper surface of the electrode it discharges from the place of action (that is, the flame) to the metallic cooling plate by the products obtained through the arc is exceedingly short, in consequence of which, as the gases are forced violently through the metallic electrode this cooling of the body of the gases takes place wholly or suddenly after the reaction, that is, the gas has passed the electric arc and the quantity of gas serving for the reaction can be considerably reduced. Discharging passages are suitably arranged so that the cooling of the gas to the temperature at which the gases do not decompose is possible, meaning that all conditions and dimensions are suitable, only $\frac{1}{2}$ m.³ of gas will be required per watt hour flame energy.

If the area of passage for the gases in the zone of reaction the quantity of gas per kilowatt hour can be further reduced accordingly as the electrical expenditure is greater. The reason of this is that the velocity of the gas when the passage is uniform is the greater, the more the quantity forced through per unit area, and that correspondingly the time between the first cooling is effected by the products of reaction with cold is shorter, and that also correspondingly the greater velocity the earlier the cooling begins. In the case of alternating current the ignition of the flame is at every alteration of the direction of current between the electrode *a* and the electrode *b* situated at the distance therefrom, and the flame moves from this position which is vertical to the plate into a position in which it sweeps the plate and revolves describing the surface of a blunted cone. In the case of continuous current the flame when ignited constantly retains its largest size.

The heat given off from the electrode and from the cooling media used in connection with the same can be utilized for various purposes.

The electrodes are preferably formed of graphite, but if suitably protected, they may be formed of iron or other metals which at the time increase the magnetic lines of force. The electrode *a* the lower end of which is rounded off might also be replaced by an electrode having a central depression and opposite the electrode *b* or by suitably formed electrodes. More-

over instead of an electrode *b* furnished with a larger number of straight passages of circular cross section another electrode could be employed formed with zigzag passages or the like. This electrode might also be constructed after the manner of a flame tube boiler, so that a cooling liquid or vapors could be caused to circulate around pipes through which the gases would be carried off, or it could be suitably constructed like a water tube boiler. Further a grid shaped electrode made of solid bars or tubes through which cooling liquid would run might be employed.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In an electric furnace for the treatment of gases, the combination, with a furnace into which the gases to be treated may be led, of a pair of electrodes, one of which is arranged transversely to the direction of travel of the gases in the furnace chamber, and is provided with passages through which the gases may flow, and means for creating a magnetic field for moving the arc formed between the electrodes.

2. In an electric furnace for the treatment of gases, the combination with a furnace chamber, of a pair of electrodes in said furnace chamber, one of said electrodes comprising a relatively large mass of heat-conductive material provided with openings through which the gases may pass away from the arc, means for causing the arc to move, and means for supplying the gases to be treated to the furnace chamber.

3. In an electric furnace, the combination, with a furnace chamber, of a pair of electrodes arranged on opposite sides of a plane transverse to the furnace chamber, one of said electrodes comprising a relatively large mass of heat-conductive material provided with openings through which the gases may pass away from the arc, means for causing the arc to move, and means for supplying the gases to be treated to said furnace chamber.

4. In an electric furnace for treating gases, the combination, with a furnace chamber, of a perforated diaphragm of heat-conducting material extending transversely of said furnace chamber and serving as one electrode, means for cooling the said diaphragm, a second electrode facing the diaphragm electrode, means for causing the arc formed between the electrodes to move, and means for supplying gases to be treated to said furnace chamber.

5. In an electric furnace, the combination, with a furnace chamber, and a heat-conducting diaphragm arranged transversely to the furnace chamber and provided with passages for the exit of the gas from the arc, said

diaphragm serving as one electrode, of a second electrode facing the diaphragm electrode, means for circulating a cooling fluid within the said second electrode, means for
5 cooling the diaphragm electrode, means for causing the arc to move, and means for conducting gases to be treated to the furnace chamber.

6. An electric furnace for treating gases,
10 said furnace having an electrode extending entirely across the furnace chamber, forming the end wall thereof and perforated to serve as an exit device for the treated gases.

7. An electric furnace for treating gases,
15 said furnace having an electrode extending entirely across the furnace chamber, forming the end wall thereof, and perforated provided with a passage way for the exit of the treated gases, and means for maintaining
20 said electrode relatively cool.

8. An electric furnace for treating gases, said furnace having a relatively large mass of heat-conducting material arranged to contact with the gases immediately upon their
25 exit from the arc, and means for maintaining said heat-conducting material at a temperature less than that of the gases in the arc.

9. In an electric furnace for treating

gases, an electrode extending entirely across 30 the furnace chamber and arranged to serve as an exit device for the treated gases, and means for rotating the arc formed on said electrode.

10. The process of treating gases, which 35 consists in conveying a current of gas transversely through a rotating-electric arc and suddenly cooling substantially the entire body of said gases immediately after they have passed the arc. 40

11. The process of treating gases, which 40 consists in conveying a gas current at a high velocity transversely through a rotating electric arc and suddenly cooling substantially the entire body of said gases immediately after they have passed the arc. 45

12. The process of treating gases, which consists in conveying a current of gas transversely through a rotating electric arc, and maintaining the gases which have passed the 50 arc at a temperature not higher than 700° centigrade.

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

IGNACY MOSCICKI.

Witnesses:

FRIEDRICH NAEGELI,
NATHANAËL LEUBA.