

D. HELBIG.
 PROCESS FOR OXIDIZING ATMOSPHERIC NITROGEN BY ELECTRICITY.
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926,413.

Patented June 29, 1909.

Fig. 1

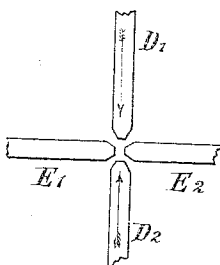


Fig. 2

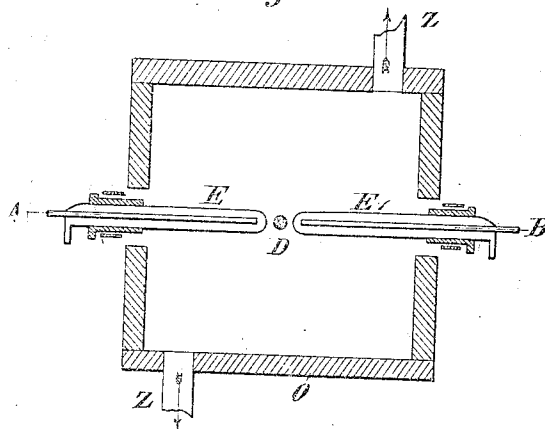


Fig. 3

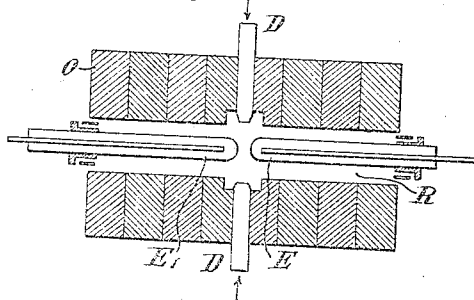


Fig. 4

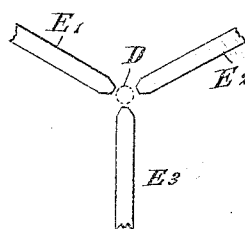
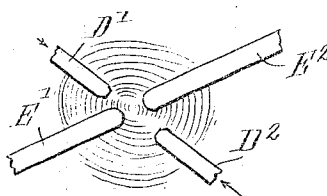


Fig. 5.



WITNESSES :

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PROCESS FOR OXIDIZING ATMOSPHERIC NITROGEN BY ELECTRICITY.

No. 926,418.

Specification of Letters Patent.

Patented June 29, 1909.

Application filed January 7, 1908. Serial No. 409,664.

To all whom it may concern:

Be it known that I, DEMETRIO HELBIG, a subject of the King of Italy, residing at Rome, Italy, professor of chemistry, have invented a certain new and useful Improved Process for Oxidizing Atmospheric Nitrogen by Electricity, of which the following is a specification.

This invention consists in employing an electric high pressure flame arc blown in a special manner by means of air for the purpose of oxidizing atmospheric nitrogen.

Referring to the accompanying drawings, Figure 1 is a diagrammatic view illustrating one modification of the invention. Fig. 2 is a section taken through the axes of the carbons and at right angles to the axes of the nozzles of one form of apparatus for carrying the invention into effect. Fig. 3 is a section of the same apparatus on the line A B Fig. 2. Fig. 4 is a diagrammatic view illustrating another modification of the invention. Fig. 5 is a view similar to Fig. 1, with the air nozzles arranged at different angles to the electrodes from that shown in said figure and showing the shape of the arc.

Let $E^1 E^2$ (Fig. 1) be electrodes of some suitable material, such as water-cooled electrodes for strong currents. As soon as a current is supplied from a suitable source, for instance, an alternating current generator, of sufficient electromotive force and the electrodes are a suitable distance apart, there takes place in the well-known manner a discharge in the form of an arc permanently burning between the points of the electrodes. If, however, a sufficiently strong current of air is projected against the said arc by means of two opposite concentric nozzles $D^1 D^2$, the arc will be converted into two wide flat flame sheaves which spread out along the electrodes and develop in a plane normal to the axis of the nozzles. These flames or sheaves consist in their appearance and their behaviour of a large number of spark-like discharges which take place in the space between the electrodes and are widened out along the electrodes by the speed of the current of air. Owing to the high temperature of the said discharges and the great speed with which the air passes through the same, the nitrogen contained in the said air current enters in an ample manner into combination with the oxygen mixed with it.

For practically carrying out this process the apparatus preferably used is illustrated

in Figs. 2 and 3, in which Fig. 3 is a section on line A—B of Fig. 2. Electrodes $E^1 E^2$ passing through insulating sleeves and provided with a water-cooling device, project into an iron furnace O, the walls of which are lined inside with fire-proof bricks. Between the electrodes and the fire-proof lining there is left a narrow space up to which project nozzles D secured in the lateral walls of the furnace. Their position is such that their openings lie exactly opposite the space between the electrodes where the arc forms.

The air is supplied to the nozzles at a pressure of several atmospheres, it escapes from the same and modifies in the hereinbefore-mentioned manner the arc between the electrodes into two sheaves of flames developing upward and downward and then escapes from the openings Z carrying with it oxids of nitrogen.

If a single-phase alternating current is used, the flame burning in such conditions behaves like a series of explosions which have the same periodicity as the number of phases. The discharge takes place with loud sound, which is an indication of the suddenness with which the temperature of the mass of air rises on reaching the pressure required for jumping over the discharge. This quick fluctuation of temperature brings about a great change in the electric resistance of the mass of air and thus of the intensity of current. This is noticeable by the great slip between the current and the pressure-curves, whereby an unfavorable utilization of the electric installation would have been brought about. This disadvantage can be obviated by the arrangement shown in Fig. 4 in which the flame is produced between three electrodes E^1, E^2, E^3 by means of a three-phase current, instead of by means of a single-phase current between two electrodes the air current being projected against the arc by means of opposite concentric nozzles $D^1 D^2$ as before. This results in the following advantage.

The quantity of energy which becomes effective every moment, remains practically constant, the flame, however, continually wanders in a circle from one pair of points to the next, and is already operative between one pair while the flame between the preceding pair is not yet extinguished. There is, therefore, never a dead point such as is to be expected every time the pressure of a single phase current becomes equal to zero. In

that way the efficiency is considerably increased.

Having now fully described my said invention and the manner in which the same is to be performed, what I claim and desire to protect by Letters Patent of the United States, is:—

1. A process for oxidizing atmospheric nitrogen by electricity in which compressed air is projected by two opposite nozzles arranged in line, against an arc produced between suitable electrodes, whereby two sheaves of flame are produced which spread out along the electrodes in a plane normal to the direction of the nozzles.

2. A process for oxidizing atmospheric ni-

trogen by electricity in which compressed air is projected by means of two opposite nozzles arranged in line against an arc produced by a three-phase current between three suitable electrodes arranged at an angle of 120° relatively to each other, whereby a flame disk is produced which spreads out in a plane at a right angle to the axis of the nozzle.

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

DEMETRIO HELBIG.

Witnesses:

A. ROGG,

DUILIO NARDONI.