No. 887,476. PATENTED MAY 12, 1908.

D. HELBIG.

APPARATUS FOR ELECTRIC OXIDIZING OF ATMOSPHERIC NITROGEN.

APPLICATION FILED JAN. 6, 1906.

2 SHEETS—SHEET 1

Fig. 1

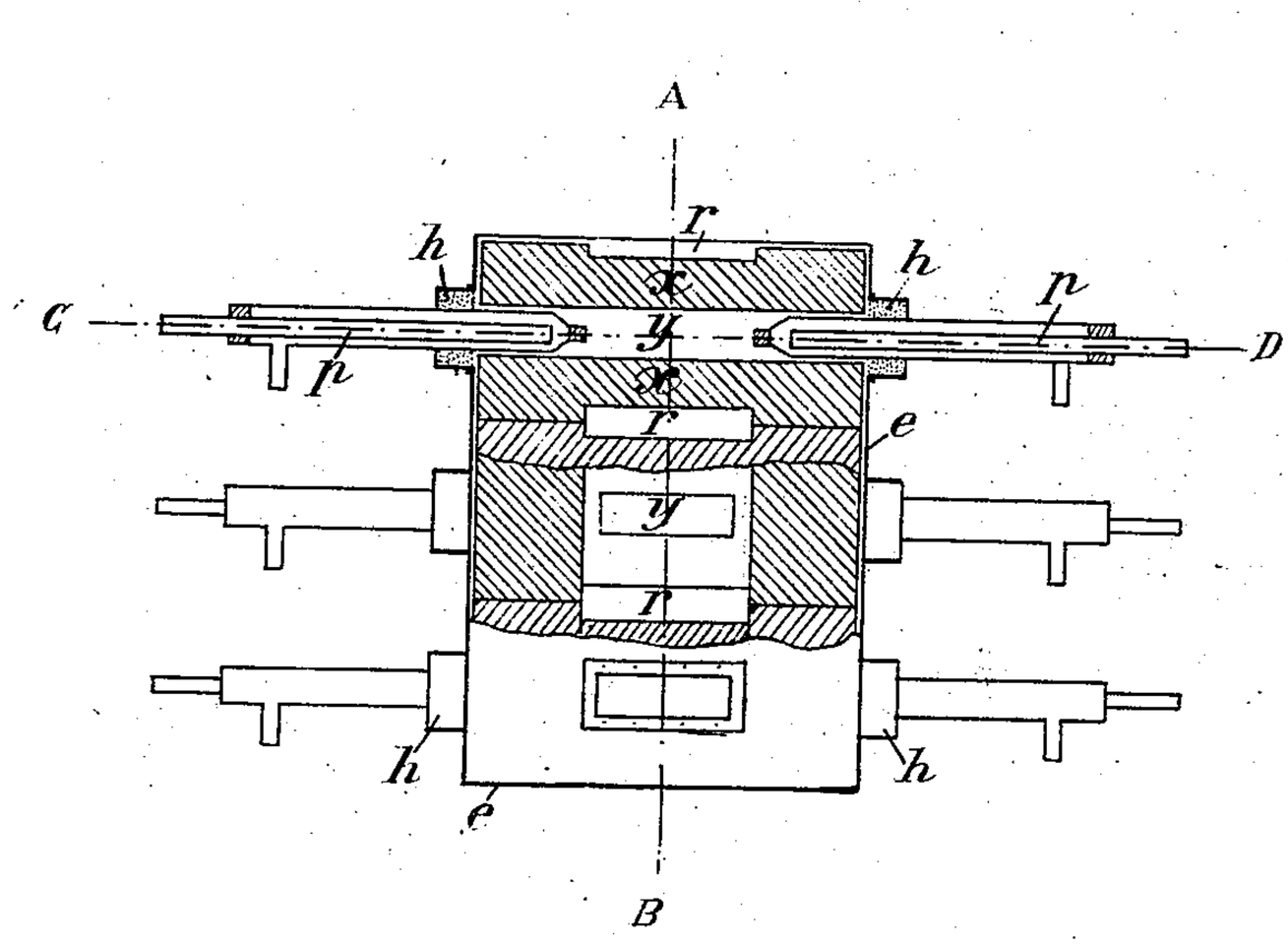


Fig. 4.

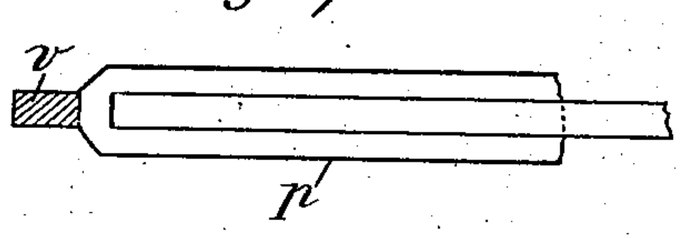
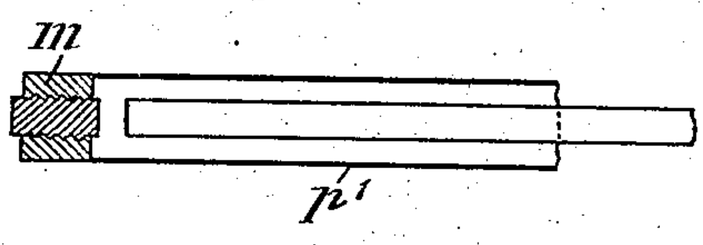


Fig. 5.



Witnesses:
H. Fleischer,
John C. Seifert.

Inventor:
Demetrio Helbig,
By his Attorney,
F. A. Richards

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2 SHEETS—SHEET 2.

Fig. 2

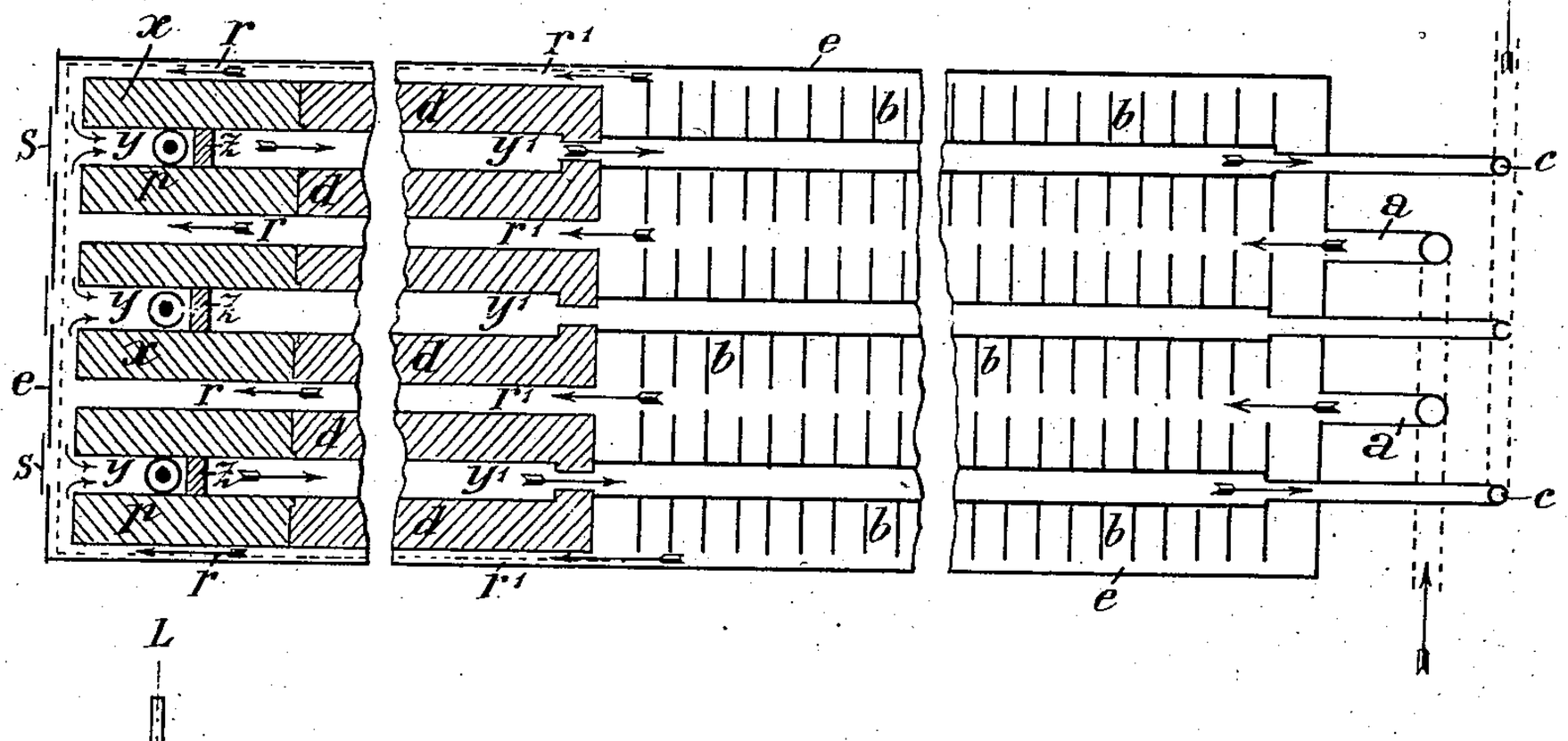
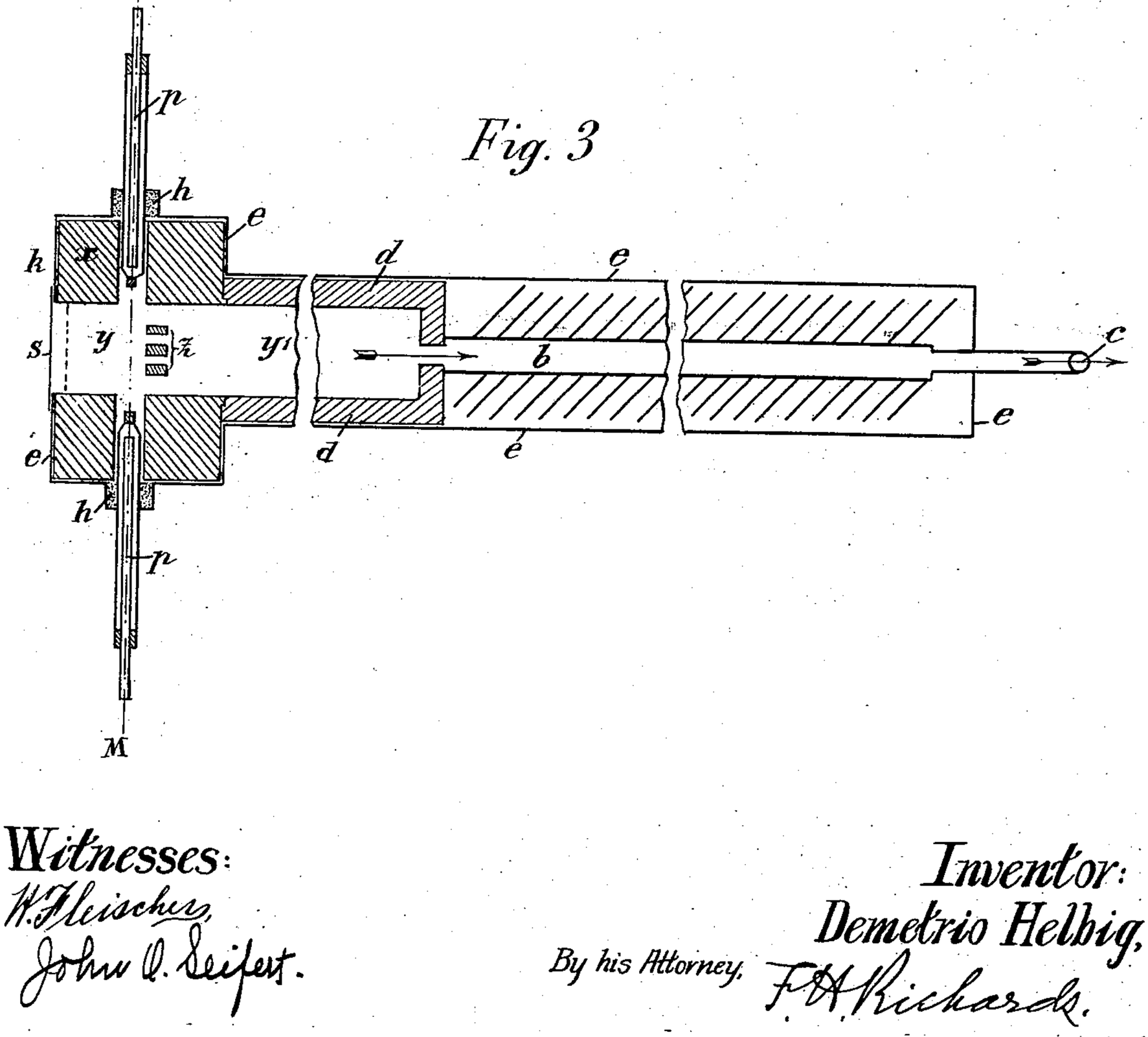


Fig. 3



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UNITED STATES PATENT OFFICE.

DEMETRIO HELBIG, OF ROME, ITALY.

APPARATUS FOR ELECTRIC OXIDIZING OF ATMOSPHERIC NITROGEN.

No. 887,476. Specification of Letters Patent. Patented May 12, 1908.

Application filed January 5, 1906. Serial No 294,678.

To all whom it may concern:

Be it known that I, DEMETRIO HELBIG, professor of electrochemistry at the University of Rome, a subject of the King of Italy, residing at Rome, Italy, have invented new and useful Improvements in Apparatus for Electric Oxidizing of Atmospherical Nitrogen, of which the following is a specification.

My present invention has for its object an apparatus in which nitrogen is combined with oxygen by means of electric flames (arcs), which are surrounded by special materials (metallic oxids, f. i. calcium or magnesium oxids) having the property of rendering conductive (ionizing) at high temperatures the gases in their vicinity so that the electric tension necessary for obtaining such flames in the nitrogen and oxygen mixture may be much lower than that required if such material were not present. The flames obtained under such conditions have very high temperatures and resist perfectly without being extinguished to the passage of, even rapid, gas currents. To perform their action the above said materials must limit or respectively closely surround the flame by forming a lining which causes the gases to pass through it in their totality.

The gases containing the formed oxids of nitrogen leave the flame in a very hot condition; this heat in my apparatus instead of being lost is recovered and given back to the fresh gases which are being led to the flame, by means of an arrangement of reversed current thermical interchange. The same ionizing material surrounding the flame participates of the interchange, a sufficiently thin layer of it being beaten on one face by the fresh gases while on the other face it is exposed to the electric flame and to the hot gases which have passed through it. The gases thereby enter the flame in a previously heated condition whereby the amount of electrical energy required for heating them up to the temperature of the flame is considerably diminished.

The electrodes may be made of any suitable conductive material. If they are metallic I prevent the melting down or volatilizing of their points by means of a cooling arrangement.

To further increase the ionizing effect I surround the points of electrodes with a lining made of one of the above said ionizing materials, which leaves only the utmost end of the electrodes uncovered, thereby obtaining a further diminution of the tension necessary for maintaining the flame.

In the apparatus shown in the drawings accompanying and forming a part of this specification, Figure 1 is a partly vertical cross sectional view of a form of apparatus embodying my present improvements and taken, where shown as sectional, in about the line L. M. of Fig. 3. Fig. 2 is a vertical longitudinal sectional view thereof on line A. B. of Fig. 1. Fig. 3 is a horizontal longitudinal sectional view thereof on line C. D. of Fig. 1. Fig. 4 illustrates a form of electrode; and Fig. 5 illustrates another form of electrode with covered point.

A plurality of flames obtained under the conditions above set forth may be employed in practice. Each of these flames is maintained between the electrodes *p*. The flame is surrounded by the walls of chamber *y* provided in block *x* made of ionizing material (f. i. magnesium oxid) into which chamber the electrodes penetrate as far as the passage *y*. At a certain distance from the electrodes in passage *y* a row *z* of small pieces of ionizing material is placed. The solid point *v* of electrodes *p*, if metallic, is secured on a metallic tube pervaded by a liquid current: the cooling produced by the latter keeps points *v* below the fusion temperature. Point *p'*, Fig. 5 is provided with a coating *m* of ionizing material. As an extension of block *x* a long piece *d* of fireproof material is provided which has passing through its length a passageway *y'* extending from the chamber *y*. In the same pieces, passages *r'* are provided of which passages *r* of block *x* form extensions. At the free end of each of the passages *y'* a radiator *b* is secured, from which leads an outlet tube *c*.

The apparatus may be formed by the superposition of a number (three in the present illustration) of the described elements and inclosed in a casing of iron sheet provided with inlet tubes *a* for the admission of the gas mixture to be treated, insulated stuffing boxes *h* for the passage of the electrodes, and small mica windows *s* for inspecting the flames.

Each of the flames is started like an ordinary arc by moving the electrodes into contact with each other and then away from each other until the flame fills the whole section of the chamber *y* contained between their points. The gas mixture to be treat-

ed is then admitted through tubes *a*, then by passages *r* and *r'* enter chamber *y* where they are submitted to the flame, flow through passages *y'* and through the body of radiator *b* and then discharged through outlet tube *e* which leads them to some point of storage or of utilization.

Under the action of the gas flow the flame is arc-like and is deflected so as to be caused to beat the pieces of ionizing material *z*, heating these; as soon as these pieces of ionizing material are heated to a red color the conductivity of the gases in the proximity of the flame is increased and the flame rendered absolutely steady.

When passing through the chamber *y* and the passage *y'* the hot gases give up a large amount of their heat, carried away from the flame, to the material constituting the walls of said chamber and passage. This heat transmitted through the walls is communicated to the fresh gases passing through passages *r'* and *r* and in flowing to the entrance of the chamber *y* the radiator *b* completes the thermical interchange.

It is obvious that the shown superposition of several flames obtained under the above said conditions allows of better recovering the heat than is obtained by a single flame.

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

1. The combination with a chamber having a wall surface of ionizing material and a gas entrance and a gas exhaust, of electrodes at opposite sides of said chamber and located adjacent to the walls thereof for producing an electric arc across the same.

2. The combination with a chamber having a lining comprised of magnesium oxid, and having a gas entrance and a gas exhaust, of electrodes of magnesium oxid disposed upon opposite sides of the chamber.

3. The combination with a chamber having a lining comprised of magnesium oxid and a gas entrance and a gas exhaust, of electrodes of magnesium oxid upon opposite sides of the chamber, and bodies of magnesium oxid situated between the plane of the electrodes and the exhaust.

4. The combination with a body of magnesium oxid having a gas passage, of means for producing an electric arc through said passage.

5. The combination with a body of magnesium oxid having a gas passage, of means for producing an electric arc through said passage, and a block of magnesium oxid adjacent to said arc producing means and in position to receive the arc-flame when this is deflected by the gas current in its flow through said passage.

6. The combination with a gas passage having walls of ionizing material, of means for producing an electric arc from one side to the other of said passage and embodying electrodes and ionizing material partly surrounding the electrodes.

7. The combination with a gas passage having walls of ionizing material, of means for producing an electric arc across said passage and embodying electrodes and ionizing material partly surrounding the said electrodes, and bodies of ionizing material within said passage adjacent to the arc producing means.

8. In a device of the character specified, the combination with a block of magnesium oxid, of a series of passages through said block, electrodes for producing arcs across some of said passages, means for conducting gas to the other of said passages, and means for conducting the gas from said other passages to the passages traversed by said arc.

9. In a device of the character specified, the combination with a block of magnesium oxid provided with two series of gas passages, of electrodes extending into the passages of one series, each of said electrodes embodying conductive material associated with ionizing material, a block of fireproof material provided with passages registering with the passages in said magnesium oxid block, tubes connected with the passages provided with the electrodes for carrying away the product of the apparatus, radiation plates secured to said tubes, a casing surrounding said radiation plates and in communication with the other of said series of passages, means of communication between the passages of one series and the passages of the other series, and means for admitting the gas for treatment into said casing.

10. In a device of the character specified, the combination with a body having a series of chambers lined with ionizing material, of means for producing an electric arc through each of said chambers, and said body also having a series of passages communicating with a source of supply and with said chambers, the walls of said passages being adjacent to the walls of said chambers and lined with ionizing material.

In witness whereof I have hereunto set my signature in the presence of two witnesses.

DEMETRIO HELBIG.

Witnesses:

PIO RINALDINI,

A. RAZZI.