No. 830,975. PATENTED SEPT. 11, 1906.

A. DÉCHAUX.

APPARATUS FOR PRODUCING HIGHLY OZONIZED AIR OR OXYGEN.

APPLICATION FILED APR. 28, 1904.

3 SHEETS—SHEET 1.

Fig. 1.

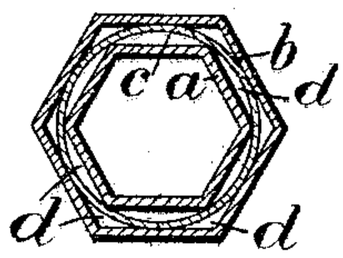


Fig. 2.

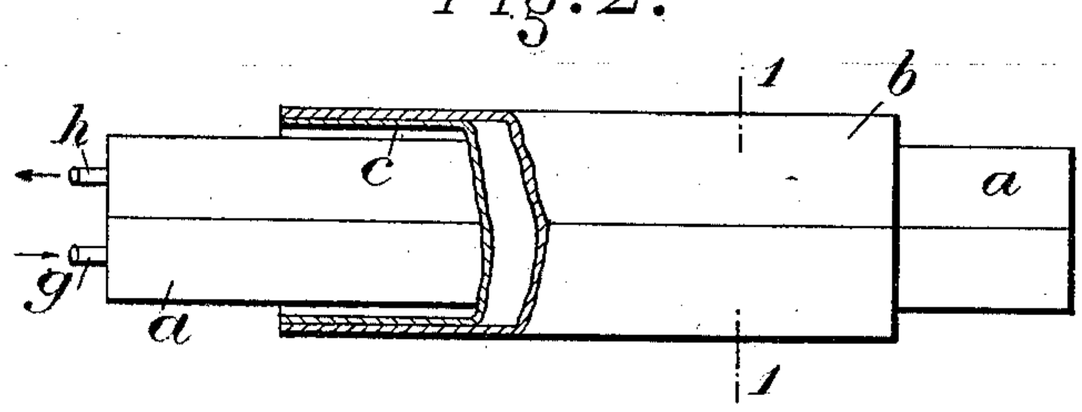


Fig. 3.

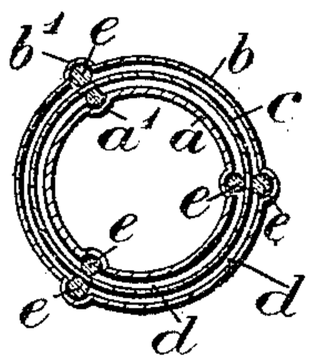


Fig. 4.

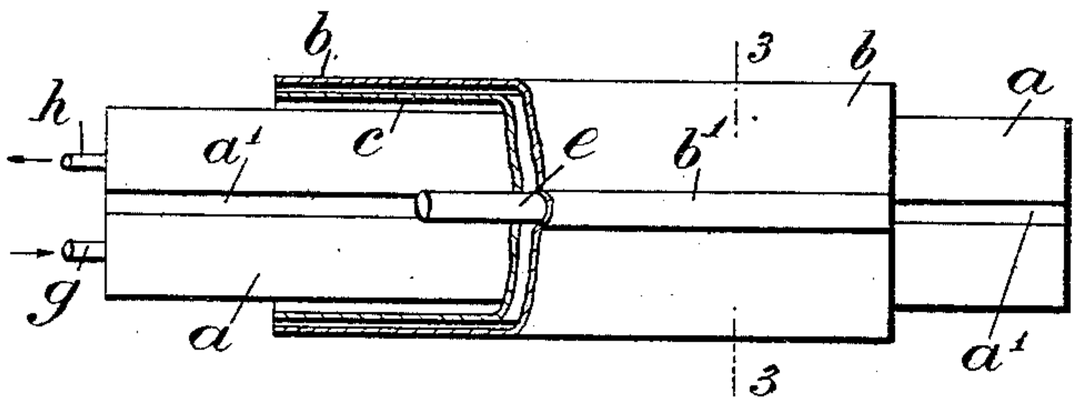


Fig. 5.

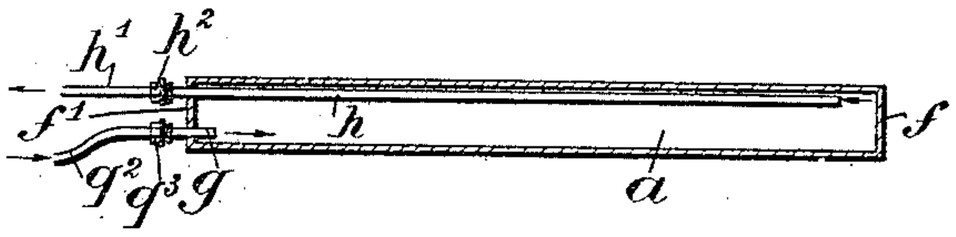
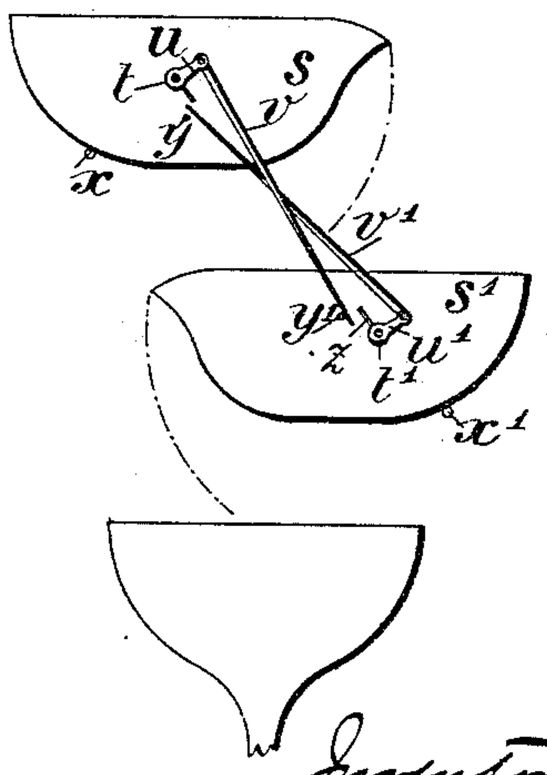


Fig. 7.



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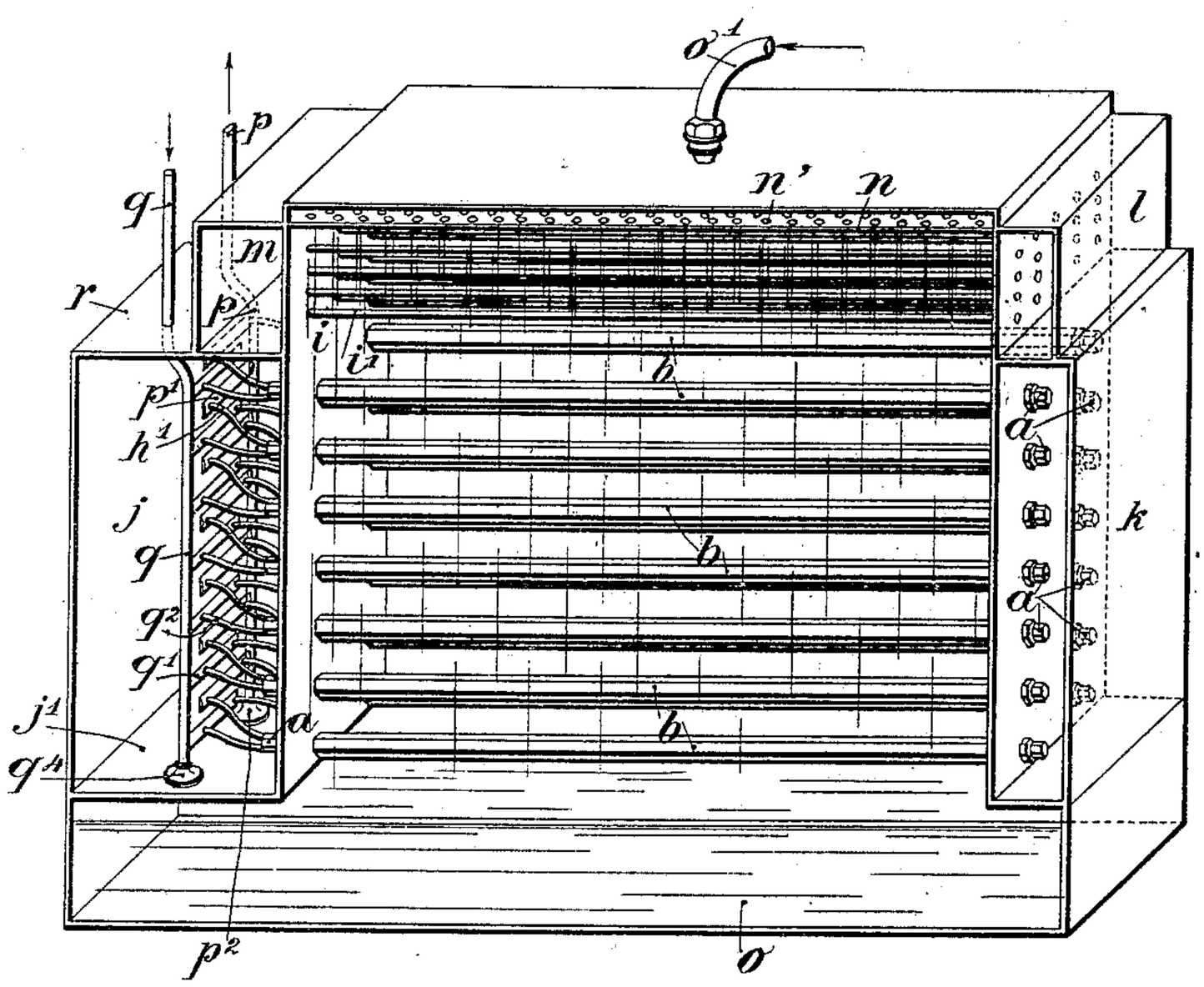
3 SHEETS—SHEET 2.

Fig. 6.



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3 SHEETS—SHEET 3.

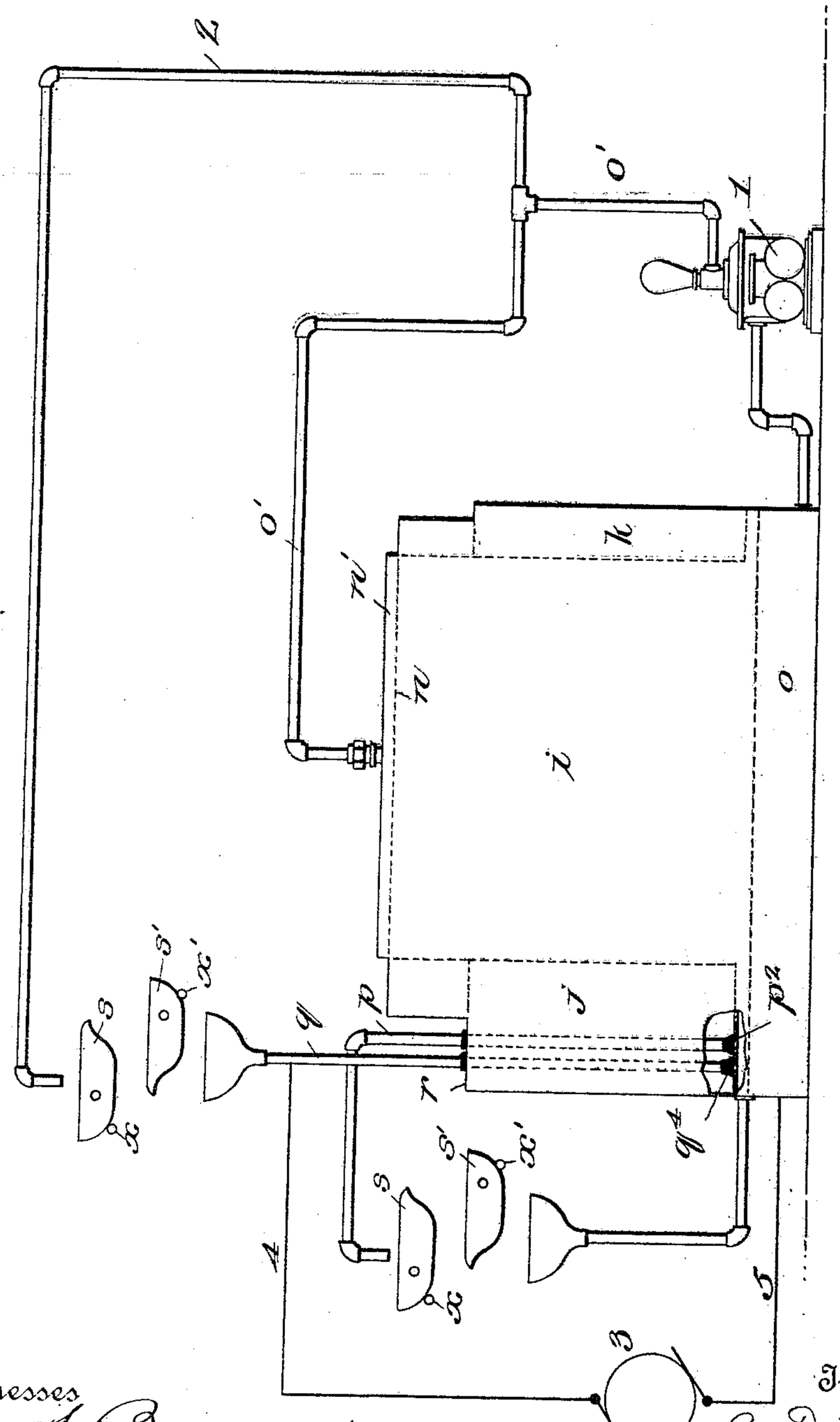

Fig. 8.

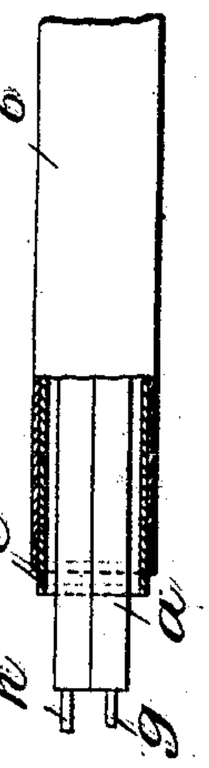

Fig. 9.

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UNITED STATES PATENT OFFICE.

AUGUSTE DÉCHAUX, OF PARIS, FRANCE, ASSIGNOR TO WILHEM MALLMANN, OF RUREMONDE, HOLLAND.

APPARATUS FOR PRODUCING HIGHLY-OZONIZED AIR OR OXYGEN.

No. 830,975. Specification of Letters Patent. Patented Sept. 11, 1906.

Application filed April 28, 1904. Serial No. 205,415.

To all whom it may concern:

Be it known that I, AUGUSTE DÉCHAUX, a citizen of the Republic of France, residing at Paris, France, have invented a certain new and useful Improvement in Apparatus for Producing Highly-Ozonized Air or Oxygen, (for which I have obtained Letters Patent in France under date of September 8, 1903, No. 335,092,) of which the following is a specification.

The present invention consists of an apparatus used in producing electric effluvia for generating highly-ozonized air or oxygen on a large scale.

This apparatus comprises a series of ozonizing elements or tubes so grouped as to form a considerable effluviating-surface within a small space and so combined as to operate economically at a low temperature.

Figure 1 is a cross-section on the line 1 1 of Fig. 2, showing one form of ozonizing element. Fig. 2 is a longitudinal view of the same, parts being broken away. Fig. 3 is a cross-section on the line 3 3 of Fig. 4, showing another form of ozonizing element. Fig. 4 is a longitudinal view of the same, parts being broken away. Fig. 5 is a longitudinal section of the inner tube of an ozonizing element with its piping. Fig. 6 is a perspective view of the herein-described apparatus with one side removed. Fig. 7 is a diagram, showing a mechanical arrangement to be hereinafter described. Fig. 8 is a diagrammatic side view, partly broken away, of the entire apparatus; and Fig. 9 is a side view, partly in section, of one end of an ozonizing unit or element, showing the three tubes of different lengths.

Each ozonizing element is formed of three tubes, two of which are made of some electrically-conducting material and the third of some non-conducting material fitted with slight friction within each other.

In the form illustrated in Figs. 1 and 2 the two conducting-tubes *a* and *b*, preferably made of metal, are polygonal. The non-conducting tube *c*, preferably made of glass, is cylindrical and is placed between the two tubes *a* and *b*. The three tubes are introduced into each other, as shown in end view in Fig. 1, the glass tube being made to protrude at each end for a sufficient distance to avoid direct discharges, as shown in Fig. 9. The outer conducting-tube *b* is connected to one pole of an electric generator, (not shown,) and the inner conducting-tube *a* is connected to the other pole. Under the action of the electric current effluvia are produced in the hollow spaces *d*, Fig. 1, formed between the various tubes. The sides of both tubes *a* and *b* are placed parallel to each other. The number of sides should be all the more great, as the sides are closer together.

In the form shown in Figs. 3 and 4 the conducting-tubes *a* and *b* are cylindrical, the metal being longitudinally depressed at *a'* and *b'* at three equidistant points, outwardly as regards the outer tube *b* and inwardly as regards the inner tube *a*. The semicylindrical depressions *a' b'* act to receive non-conducting rods *e*, preferably glass, which on the one hand project internally and on the other serve to insulate the cylindrical tube *c* and to keep it equidistant from the tubes *a* and *b*. Obviously the two metallic tubes *a* and *b* are of a different diameter in order to provide for the reception of the glass tube *c* and also to provide annular spaces *d*, wherein effluvia may be formed.

The cooling of the inner ozonizing metallic tube *a*, of either form shown in Figs. 1 and 2 or 3 and 4 is effected as follows: The said tube (shown separately in longitudinal section in Fig. 5) is closed at one end at *f*. The other end is closed by a wall or plug *f'*, through which pass two small pipes *g* and *h*, the one, *h*, ending near the end *f* and the other, *g*, beginning at the opposite end *f'*. The cooling liquid introduced through the pipe *g*, for instance, flows into the tube *a*, and after about filling the same it leaves through the pipe *h*.

I will now proceed to describe the manner in which the herein-described ozonizing elements are grouped together to form an apparatus having a large surface capable of operating economically at a low temperature, and consequently in the most favorable conditions for obtaining a maximum production.

Referring to Figs. 6 and 8, *i* represents a closed chamber, wherein are assembled a series of ozonizing elements or tubes, either of the form shown in Figs. 1 and 2 or of that shown in Figs. 3 and 4. One end of the tubes *a b* passes through one side wall of the chamber *i*, into which it is fastened, and opens into an air-chamber *j*, while the other end passes through the opposite wall of the chamber *i*,

into which it is likewise fastened, and opens into an ozone-chamber *k*. At the top of the chamber *i* are a series of small metal tubes *i'*, which are or may be fastened in the same manner as the ozonizing-tubes *a b* and are placed above the latter, one end of said tubes *i'* opening into an inlet-chamber *l* and the other into a chamber *m*. Above the tubes *i'* is a perforated plate *n*, acting as a bottom for a chamber *n'*, which receives the cooling liquid supplied from the vat *o* by a pump 1 connected to a feed-pipe *o'*. Inside the air-chamber *j*, which is in free communication with the chamber *m*, is placed what may be termed a "distributer," the purpose of which is to supply the cooling liquid to the whole of the central ozonizing tubes *a*. It comprises a feed-main *q*, from which branch off a series of feed-tubes *q'*, closed at their outer end and provided with a series of feed-pipes q^2, each of which is connected by a coupling q^3, Fig. 5, or otherwise with the inlet-pipe *g*. It also comprises an outlet-main *p*, from which likewise branch off a series of outlet-tubes *p'*, also closed at their outer end and provided with a series of outlet-pipes *h'*, each of which is connected by a coupling h^2, Fig. 5, or otherwise with the outlet pipe *h* of tube *a*. The mains *p* and *q* are supported upon non-conducting bases p^2 and q^4, insulating them from the bottom *j'*, which supports them. The said mains should be sufficiently distant from the inner walls of the chamber *j* to prevent direct discharges. They are insulated from the wall *r* by suitable non-conducting collars, (not shown,) through which they pass, the said mains acting, as will be readily understood, to also conduct the electric current to all the inner ozonizing-tubes *a*, Figs. 1, 3, and 6.

The cooling liquid raised from the vat *o* divides into two streams, one of which is led by the pipe *o'* to the chamber *n'* and falls onto the perforated bottom *n*, while the other is led to the feed-main *q*. Now as the cooling liquid is connected to one pole of the generator and as the distributer is connected to the other it necessarily follows that the current will be transmitted from one pole to the other through the liquid supplied to the said distributer. This inconvenience is prevented by the mechanical contrivance shown diagrammatically in Fig. 7, by means of which the liquid may be conveyed without current being transmitted. The contrivance comprises two superposed buckets *s s'*, insulated from each other, the axes *t t'* of which are mounted in suitably-insulated brackets. (Not shown.) The cranks *u u'*, fast upon the axes *t t'*, partake, together with the rods *v v'*, in the rocking movement of the buckets. When empty, the buckets, which are heavier at the rear, rest upon two supports *x x'* and assume the position shown. The rods *v v'* are suitably insulated and may slide with their free ends upon stationary stops *y y'*. The action is as follows: The liquid supplied from the vat *o* falls into the upper bucket *s*, and when it has risen therein to a given level equilibrium is destroyed and the bucket is tilted, its contents discharging into the bucket *s'*. At the same time the rod *v* moves downward and lies with its free end in front of the projection *z*, thus preventing the lower bucket *s'* from rocking forward under the weight of the charge therein contained. When empty, the upper bucket *s* resumes its original position and the rod *v* as it rises abandons the projection *z* and frees the lower bucket *s'*, which is then at liberty to rock. In so doing the upper bucket *s* is prevented from rocking and emptying its contents, owing to a mechanism similar to the one described. A like mechanical contrivance is provided for the return of the liquid to the vat *o*.

The air to be ozonized requires to be dried and deprived of impurities therein contained in suspension. To that end it is conveyed to apparatus wherein it is caused to travel through concentrated sulfuric acid, after which it is introduced into vessels containing caustic potash, wherein it is deprived of particles of acid which may have been entrained. The air is then led into the inlet-chamber *l*, Fig. 6, whence it passes through the series of cooled tubes *i'*, taking the temperature of the latter, and is then led to the chamber *m*, after which it passes to the air-chamber *j* and then through the spaces *d*, Figs. 1 and 3, of the ozonizing elements into the ozone-chamber *k*, it being then highly ozonized ready for use. During this time the liquid, suitably cooled in the vat *o* by an ice-machine or otherwise, is raised by the pump (not shown) and is partly conveyed into the chamber *n'* by the supply-pipe *o'*, falling through the perforated plate *n* onto the air-tubes *i'* and onto the outer tubes *b* of the ozonizing elements and returning to the vat *o*. The other part of the liquid is conveyed by the insulating contrivance shown in Fig. 7 into the feed main *q*, Fig. 6, and is returned by the outlet-main *p* and a like contrivance into the vat *o*.

One pole of the electric generator producing a current of sufficient tension is connected to the vat *o*, and the other is connected to the distributer *q*.

In Fig. 8 the entire apparatus is shown diagrammatically. *o* represents the tank in which the elements are located. From this tank the liquid is drawn by a pump 1 and forced through the pipe *o'* into the top of the tank, where it is showered down over the air-tubes and the ozonizing units or elements. The pipe *o'* is provided with a branch 2, which delivers liquid into the distributer *q* by means of tilting vessels. (Shown in detail in Fig. 7. (The liquid passes through the ozonizing elements, out through the outlet-main *p*,

through a current-interrupter, such as shown in Fig. 7, and back into the tank. The air or oxygen to be ozonized is circulated through the tank by any suitable means. (Not shown.) 3 represents an electric generator of any desired type, one connection 5 being led to the tank *o* and the other 4 to the distributer *q*. The distributer *q* and outlet-main *p* are of course insulated from the tank *o* in order to prevent short-circuiting.

It is obvious that either form of tubes shown in Figs. 1 and 2 or 3 and 4 may be used. The insulating-tubes may be made of glass, porcelain, micanite, or other like substance. The conducting-tubes may likewise be of any suitable metal, such as aluminium, copper, nickel, alloy, or plated metal.

The apparatus may be arranged for using cooled compressed air under pressure and expanded, thus enabling the temperature to be reduced materially.

The operation may be carried on in three manners—by forcing air or by suction or by forcing and suction combined.

In the event of the internal or external pressure exceeding an injurious limit two safety-valves may be supplied to the air-chamber *j*, one opening inwardly and the other opening outwardly, both valves being so regulated as to allow air to enter or escape the moment the external or internal pressure tends to become excessive.

The apparatus may be utilized for treating air, oxygen, and generally all gases capable of being ozonized.

It is evident that in the herein-described ozonizer it will be possible to employ compressed air which will have been under pressure and will be made to expand in the air-chamber.

I claim—

1. An ozonizing unit or element composed of an inner conducting-tube having both ends closed, and provided with an outlet-pipe extending nearly the whole length thereof, and also provided with an inlet-pipe, an outer conducting-tube, and an intermediate non-conducting tube, said tubes being so arranged relatively to each other that free spaces are left on each side of the non-conducting tube between it and the inner and outer conducting-tubes respectively, substantially as described.

2. An apparatus for producing ozonized air or oxygen, comprising a casing provided with air-chambers, a series of separate ozonizing units or elements supported in said casing, air-tubes connecting said chambers, means for distributing a cooling liquid through said casing, a feed-pipe for said liquid, said feed-pipe being adapted to deliver cooling liquid to said casing and to said ozonizing units or elements, and an outlet-main for the cooling liquid connected to said ozonizing units or elements and delivering said liquid back into said casing, substantially as described.

3. An apparatus for producing ozonized air or oxygen comprising a casing provided with air-chambers through one of which the air is admitted, a series of ozonizing units or elements supported in said casing, air-tubes connecting said air-chambers, means for supplying a cooling liquid to said casing, including a feed-main and a perforated partition, means connected with said feed-main for supplying a cooling liquid to each of the ozonizing units or elements, and an outlet-main connected to said ozonizing units or elements and delivering the liquid back into the casing, substantially as described.

4. An apparatus for producing ozonized air or oxygen comprising a casing provided with air-chambers through one of which air is introduced into the apparatus, and also provided with a chamber through which the ozonized air or oxygen is taken off, and another chamber containing the feed and discharge devices for the medium for cooling the ozonizing units or elements, air-tubes connecting said air-chambers, a perforated partition located near the top of said casing, a series of ozonizing units or elements mounted in said casing below said air-pipes, a feed-main for supplying a cooling medium to said casing, entering said casing above said partition, means connected with said feed-main for delivering cooling medium to the interior of each of said ozonizing units or elements, an outlet-main connected to each of said ozonizing units or elements and arranged to deliver the cooling material back into said chamber, substantially as described.

5. An apparatus for producing ozonized air or oxygen, comprising a casing, a series of ozonizing units or elements mounted in said casing, means for delivering a cooling medium into the upper part of said casing, a feed-main, a distributer receiving liquid from said feed-main and connected to each of said ozonizing elements, and an outlet-main also connected to each of said ozonizing elements and delivering the cooling medium back into said chamber, and means for interrupting the flow of liquid through said distributing device and through said outlet-main, substantially as described.

6. An apparatus for producing ozonized air or oxygen, comprising a casing provided with air-chambers into one of which the air is delivered, air-tubes connecting said chambers, a series of ozonizing units or elements mounted in said casing, means for delivering a cooling medium into said casing, including a pump and a feed-main, a distributer connected to each of said ozonizing elements for supplying a cooling medium thereto, an outlet-main also connected to said ozonizing units or elements and delivering the cooling medium back into the casing, means for in-

terrupting the flow of liquid from said feed-main into said distributer, means for interrupting the flow of liquid from the outlet-main back into said casing, an electric generator, and connections between said generator and said casing and distributer respectively, substantially as described.

7. An apparatus for producing ozonized air or oxygen, comprising a casing provided with air-chambers through one of which air is admitted to said casing, said casing being also provided with a chamber from which the ozonized air or oxygen is drawn off, and with another chamber in which the outlet-main and distributer are located, a series of ozonizing units or elements supported in said casing, air-tubes connecting said air-chambers, a perforated partition within said casing located above said air-tubes, a pump, connecting-pipes between said pump and the top and bottom of said casing respectively, a distributing device electrically insulated from said casing and connected to each of said ozonizing units or elements, pipe connections between said pump and said distributing device, means for interrupting the flow of liquid in said pipe connections, an outlet-main electrically insulated from said casing and connected to each of said ozonizing units or elements, connections between said outlet-main and the lower part of said casing, means for interrupting the flow of liquid in said last-named connections, an electric generator and connections between said generator and said casing and distributing device respectively, substantially as described.

8. In an apparatus for producing ozonized air or oxygen, means for supplying a cooling liquid thereto, including a series of pivoted buckets arranged to automatically discharge from one into the other, and devices for preventing more than one bucket from being tilted at a time, substantially as described.

In witness whereof I have hereunto set my hand, this 18th day of April, 1904, in presence of two subscribing witnesses.

AUGUSTE DÉCHAUX.

Witnesses:

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LOUIS RINNY.