H. W. SQUIRES.

APPARATUS FOR THE ELECTRICAL TREATMENT OF GASES.

APPLICATION FILED JUNE 22, 1918.

1,342,651. **Patented June 8, 1920.**

7 SHEETS—SHEET 1.

Fig. 1.

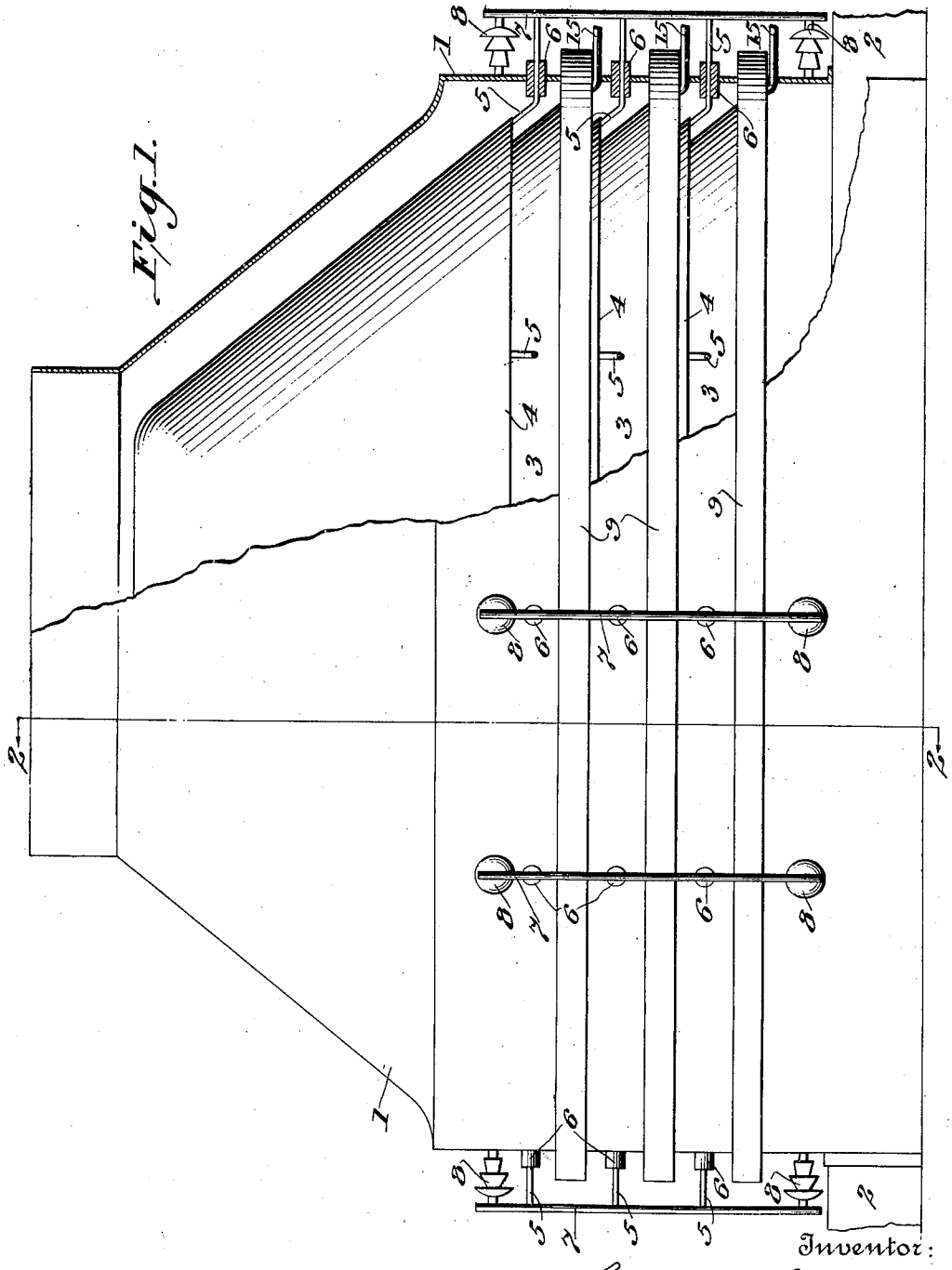

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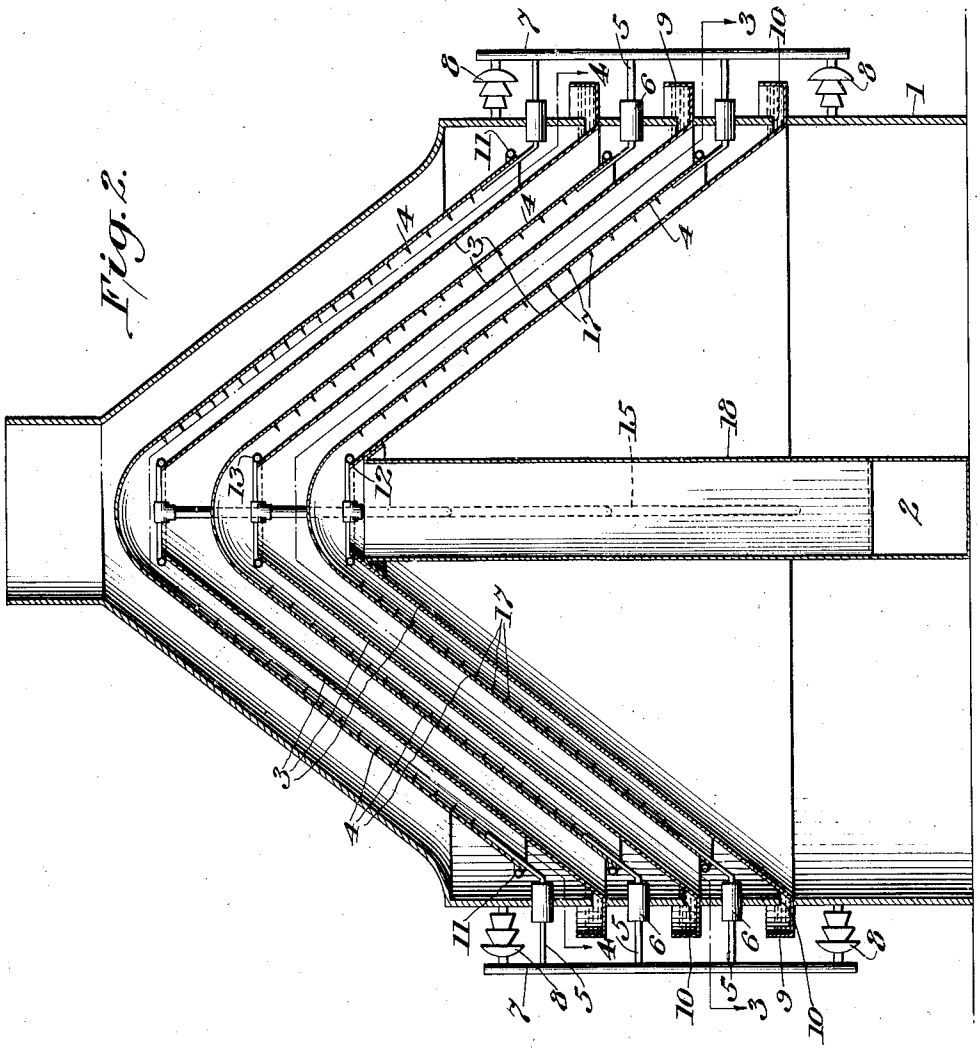
Fig. 2.



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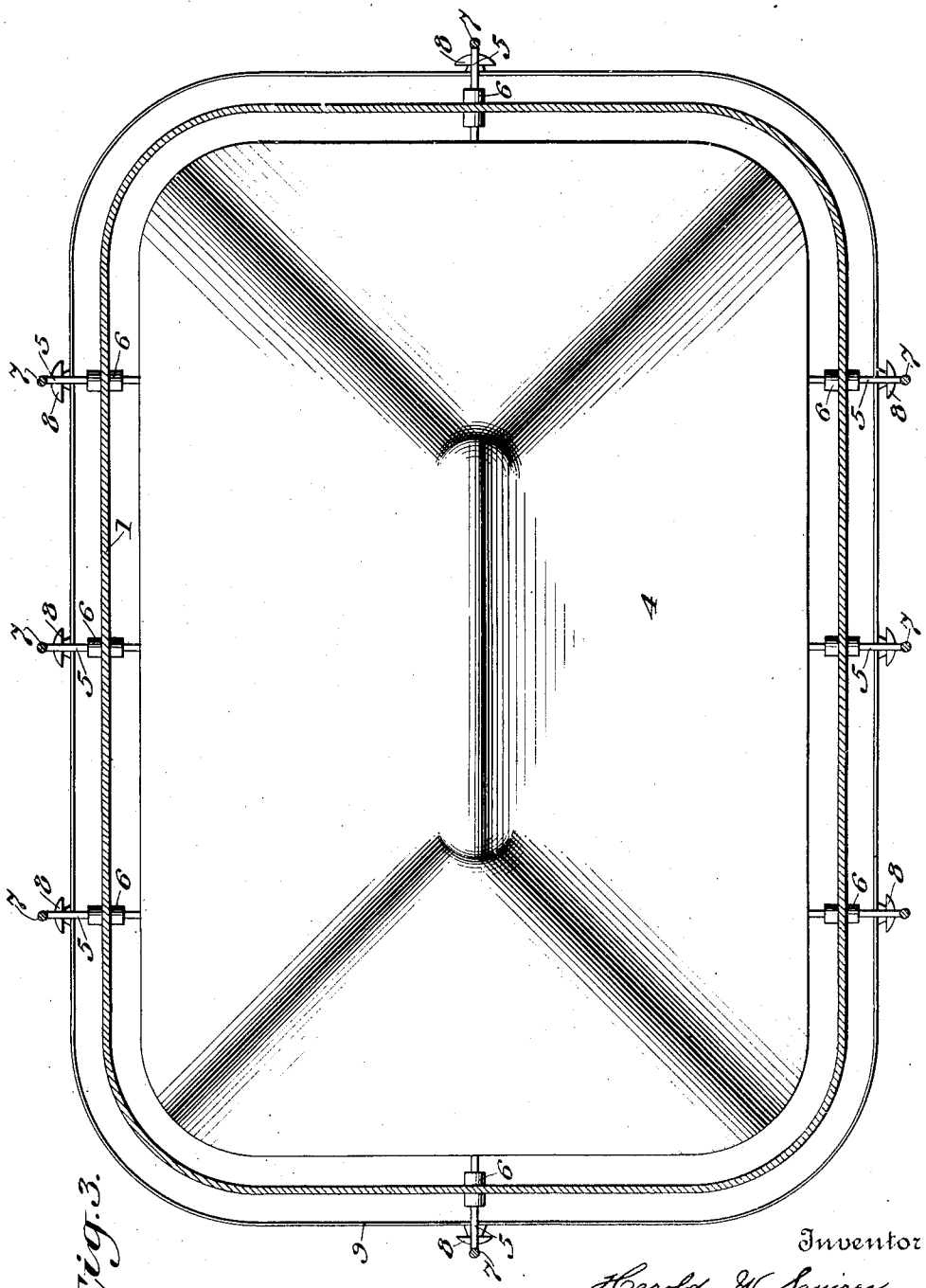

Fig. 3.

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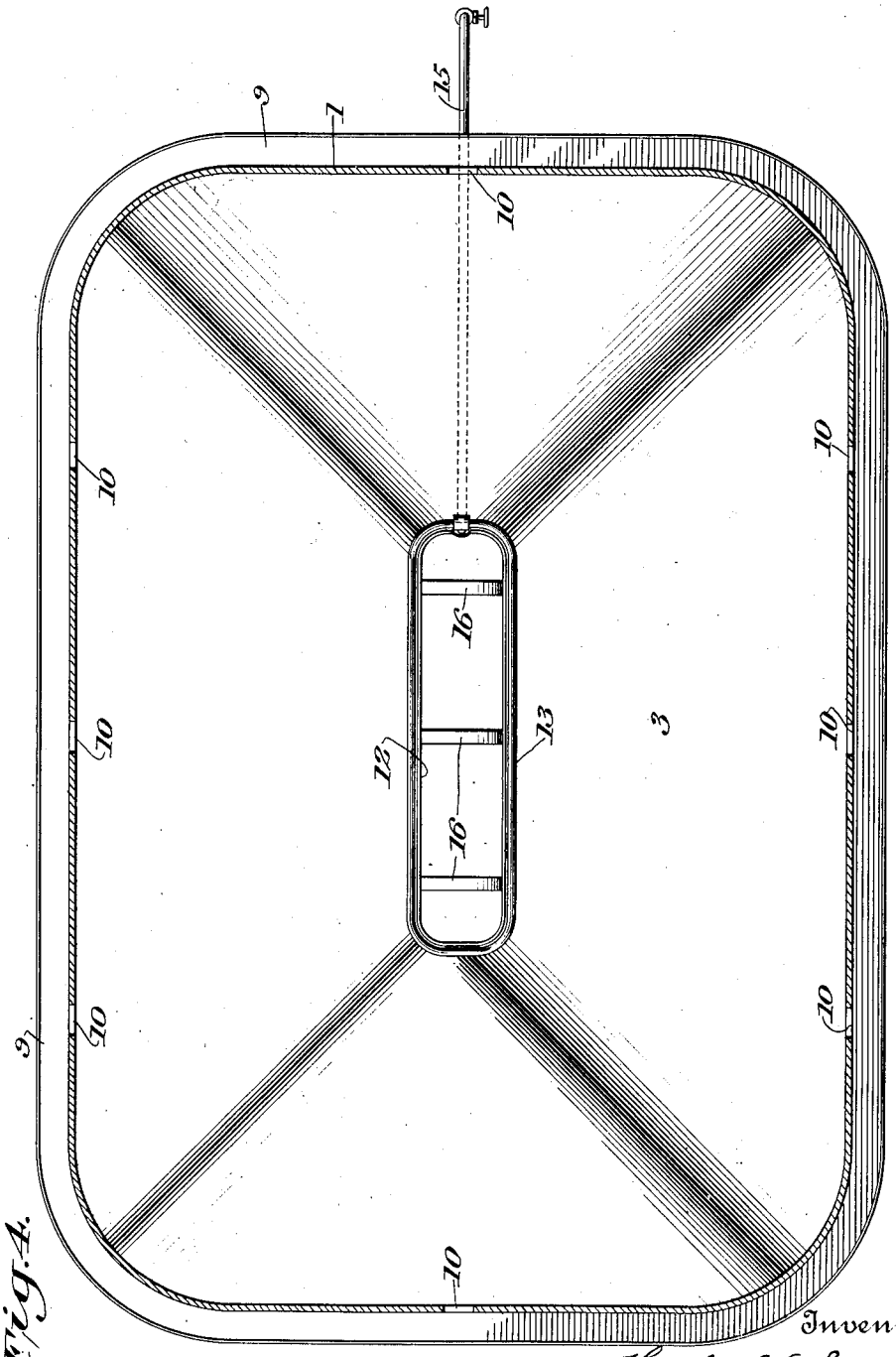

Fig. 4.

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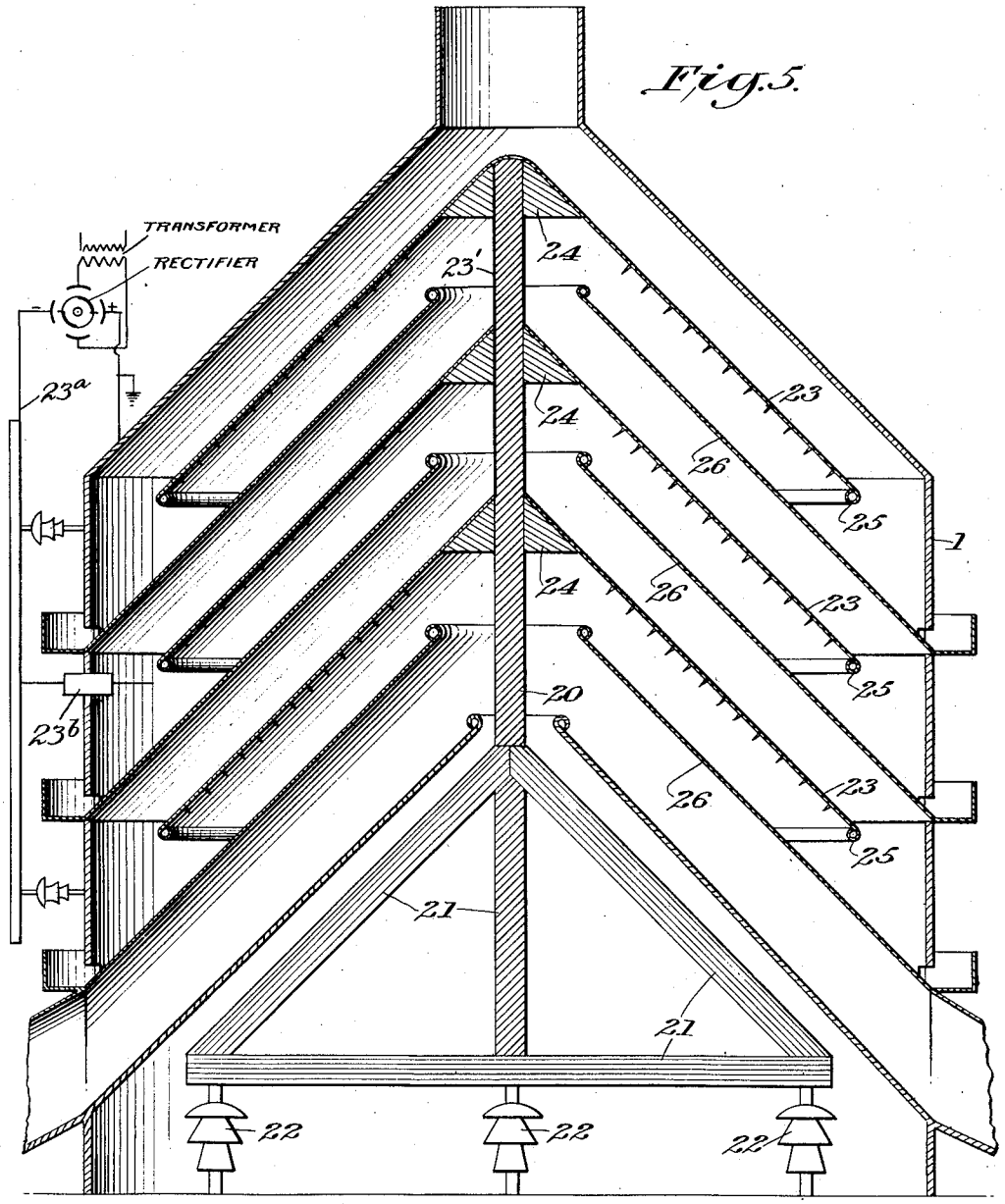
7 SHEETS—SHEET 5.

Fig. 5.



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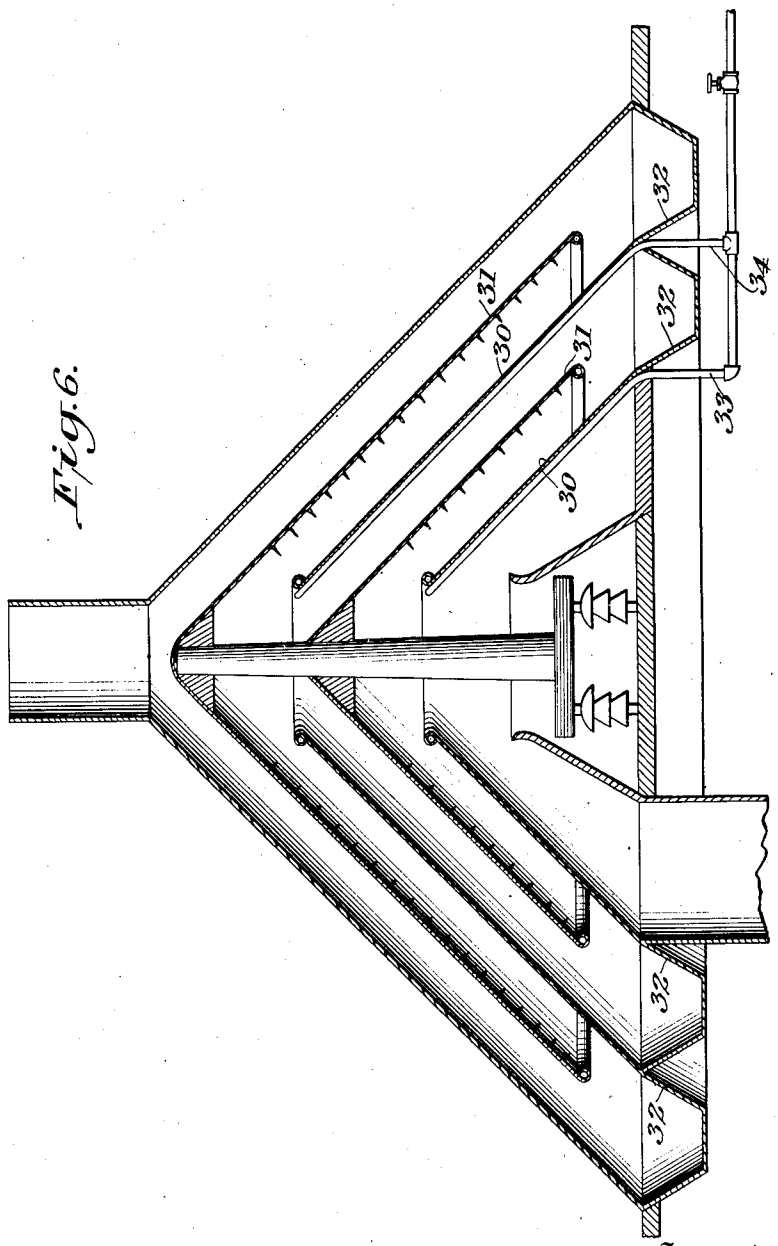
7 SHEETS—SHEET 6.

Fig. 6.



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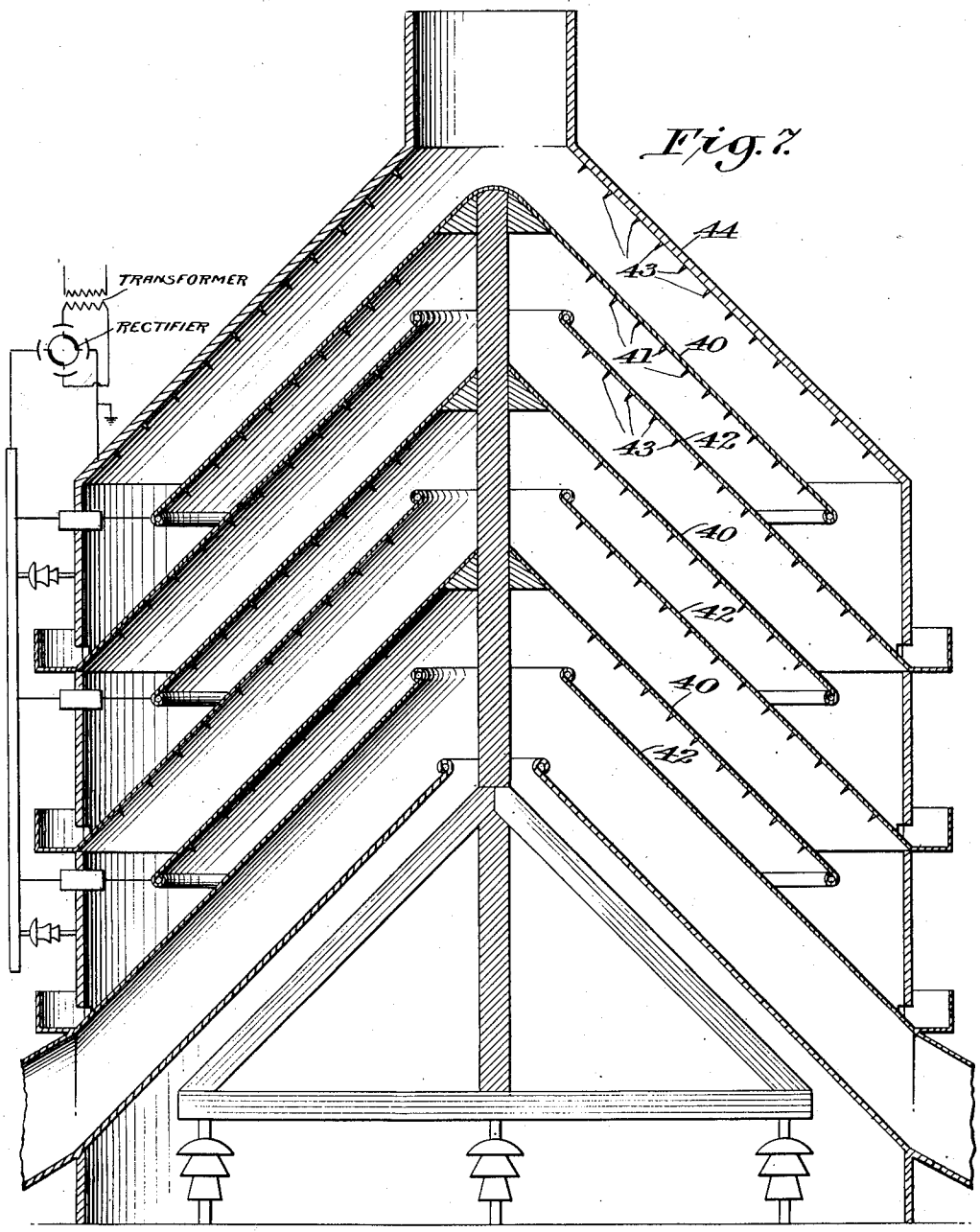
7 SHEETS—SHEET 7.

Fig. 7.



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UNITED STATES PATENT OFFICE.

HAROLD W. SQUIRES, OF AMITYVILLE, NEW YORK, ASSIGNOR TO RESEARCH CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

APPARATUS FOR THE ELECTRICAL TREATMENT OF GASES.

1,342,651. Specification of Letters Patent. Patented June 8, 1920.

Application filed June 22, 1918. Serial No. 241,430.

To all whom it may concern:

Be it known that I, HAROLD W. SQUIRES, a citizen of the United States, residing at Amityville, L. I., in the county of Suffolk and State of New York, have invented certain new and useful Improvements in Apparatus for the Electrical Treatment of Gases, of which the following is a specification.

This invention relates to apparatus for the electrical treatment of gases and more particularly to the class of apparatus used for separating from gases, particles held in suspension therein.

It is the purpose of the invention to provide an apparatus of the class referred to in which a maximum of the space taken up by the apparatus is effectively utilized.

With this object in view the invention consists in the construction and arrangement of parts more fully described in the specification and more particularly pointed out in the claims.

In the drawings which form a part of the specification,—

Figure 1 is an elevation of a device embodying the invention, a part of the casing being broken away;

Fig. 2 is a vertical section on line 2—2 of Fig. 1;

Fig. 3 is a section on line 3—3 of Fig. 2;

Fig. 4 is a plan view, the portion above the line 4—4, Fig. 2 being removed;

Fig. 5 is a vertical section through a modified form of treater;

Fig. 6 is a vertical section through another modification; and

Fig. 7 is a vertical section through still another modification.

Having reference to Figs. 1–4, 1 is a casing for the treater elements. The gas to be cleaned may be admitted through one or more flues 2 and the clean gas passes into the top of the apparatus from whence it may pass into the atmosphere or may be conducted to a place for additional treatment or for consumption. The arrangement, however, may be reversed so that the gases enter at the top and pass out at the bottom. The treater unit comprises a plurality of collecting electrodes 3 and a plurality of discharge electrodes 4 in alternating superposed relation. Both the collecting electrodes and the discharge electrodes have the form of hipped roofs and may be made of sheet iron or other suitable material.

The discharge electrodes are held in spaced relation to the walls of the casing 1 and insulated therefrom by suitable insulators. In the construction shown the discharge electrodes are supported by elements 5 of conducting material insulated from the casing by insulator bushings 6. These elements serve also the purpose of conducting the current to the electrodes from bus bars 7 which may be supported on the outer surface of the casing 1 by insulators 8.

The collecting electrodes extend to the walls of the casing and make a substantially air and water-tight connection therewith. Along the outer surface of the walls of the casing are disposed as many troughs 9 as there are collecting electrodes and these troughs are in communication with the collecting electrodes through a series of openings 10 in the walls of the casing. The top of the collecting electrodes may be perforated or entirely open to form a passage for the gases.

The lower edge of the discharge electrode 4 may be advantageously stiffened by a small pipe 11 and the edge defined by the opening 12 in the collecting electrode may be similarly stiffened by a pipe 13. This pipe 13 has additional significance as means for passing a film of water or other suitable liquid down the working surface of the collecting electrodes and thereby keeping them clean. To this end the pipes 13 may have a larger number of fine openings distributed all around the opening 12 and a feed pipe 15 may extend from each pipe 13 along the lower surface of the collecting electrode through the wall of the casing 1 and communicate with a suitable source of liquid under pressure. If desired, the collecting electrode structures may be additionally strengthened by braces across the openings 12.

The discharge electrodes are provided with prongs 17 to facilitate the formation of an intense corona discharge directed to the collecting electrodes. These prongs may be formed in any desired manner. In place of points 17 ribs might be formed on the surface of the electrodes. Such ribs placed transversely of the direction of gas flow would avoid a dead space adjacent the surface of the electrode.

The gas to be treated is admitted through

the flues 2, rises through a central flue or flues 18, then passes through the opening 12 of the lowermost collecting electrode 3 into the space defined by the latter and the first discharge electrode 4 down close to the wall of the casing, then flows upwardly through the space between the discharge electrode and the wall into the space between the discharge electrode and the next collecting electrode and upwardly therethrough, then through the opening 12 of the second collecting electrode and so on until it finally passes out through the top of the roof of the casing. During its passage through the electric field produced between the electrodes, the dust and other particles suspended in the gases are precipitated and deposited on the collecting electrodes as is well understood. The liquid discharged from pipes 13 forms a film or sheet of continuously flowing liquid which carries the particles down with it and discharges them through openings 10 into the troughs 9 where the material may be collected for further treatment or discharged.

As is particularly indicated in Fig. 2, the openings 10 and the troughs are so proportioned that the liquid in the trough forms a liquid seal for the gas in the treater.

While the application of liquid offers definite advantages, it is not necessary for successful operation of the apparatus. The precipitated particles may slide down the sloping surface of the collecting electrodes by gravity and may be collected in suitable receptacles outside the walls of the casing.

The spacing between consecutive pairs of electrodes may successively vary in accordance with the gradually changing conditions of the gas during its passage through the treater and the consequential change of the dielectric.

It is also obvious that the length of the discharge points or prongs 17 may be successively changed in proportion to the change of dielectric strength of the gas in the treater.

In the arrangement shown and described the space between alternately smooth surfaces of the electrodes may be narrower than the space between the working surfaces.

The arrangement shown can by slight modification be changed to a downdraft system. In this form of treater the direction of gas flow is abruptly changed at frequent intervals so that separation of suspended particles is facilitated by centrifugal force as well as by electric discharge.

The shape of the electrodes may be changed in various ways. Instead of a hipped roof, the electrodes may assume the form of a gable roof or of a cone as indicated in Fig. 5. In this case the frame is cylindrical. For relatively small units the discharge electrode system may be mounted on a central post 20 supported by a frame 21 carried upon insulators 22. The discharge electrodes 23 are directly connected to the post 20 and are rigidly held thereto by cone shaped pieces 24 of cast iron filling the spaces under the apexes of the cones. Pipes 25 or other stiffening means may be applied to the lower edge to prevent buckling similar to the construction shown in Figs. 1–4. The collecting electrodes 26 are in all respects similar to the collecting electrodes previously described. The discharge electrodes 23 are connected in the usual way to the source of current, preferably to the negative pole thereof. As indicated the discharge electrode may be interconnected by a conductor 23′ disposed on the pole 20 and one of them may be connected by a conductor 23^a passing through an insulator bushing 23^b to the negative pole of a rectifier, the positive pole being connected to the collecting electrodes and to ground.

In Fig. 6 is shown a device similar to that disclosed in Fig. 5. All the electrodes extend substantially to the same horizontal plane. The collecting electrodes 30 extend directly to the floor or other support, while the discharge electrodes 31 terminate a distance from it to provide insulation and afford a passage-way for the gas from one electrode unit to another. In this form the precipitated material may be collected in hoppers 32 or in a single hopper as desired. 33 and 34 are pipes for feeding liquid to the distributers.

In the form of device shown in Fig. 7 both electrodes are used as discharge and collecting electrodes. Prongs 41 are placed on the under side of the electrodes 40 which are connected to one terminal of the source of supply and prongs 43 are placed on the under side of the electrodes 42 which are connected to the opposite terminal. The prongs 41 cause substantially unidirectional migration of ions of one sign from electrode 40 to the smooth top surface of electrode 42 while the prongs 43 cause migration of ions from the electrode 42 to the smooth upper surface of the electrode 40 next following.

In connection with the use of A. C. the spacing of the electrodes is made uniform, while in connection with D. C. the electrodes are preferably alternately spaced for negative and positive discharge. It is well known that by causing the discharge to pass mainly from the negative electrode to the positive electrode the potential difference may be increased without disrupting the dielectric. Applying this principle to the present case, it is obvious that the discharge distance between the negatively charged prongs and the coöperating collecting surface may be smaller than the distance between the positively charged prongs and the correlated collecting surface.

In Fig. 7 the electrodes 40 are connected to the negative pole and the electrodes 42 to the positive pole of a source of unidirectional current. Prongs 43 are also provided on the roof 44.

The capacity of the treater is thus approximately doubled as compared with the forms of device shown in the preceding figures.

In the claims the term "roof-shaped" is intended to include all sloping structures having a plurality of angularly related sides.

The term "annular" is intended to define an area confined between two reëntrant lines or two lines closed upon themselves, irrespective of the exact shape.

I claim:

1. Apparatus for the electrical treatment of gases comprising a pair of sloping electrodes defining a passageway for the gas substantially annular in cross-section, and means for causing the gas to be treated to pass through said passageway.

2. Apparatus for the electrical treatment of gases comprising a pair of sloping electrodes defining a passageway for the gas substantially annular in cross-section, and means for irrigating the lower of said electrodes.

3. Apparatus for the electrical treatment of gases comprising a pair of sloping electrodes defining a passageway for the gas substantially annular in cross-section, means for causing all the gas to be treated to pass through said passageway, and means for collecting the precipitated matter at the bottom of the electrodes.

4. Apparatus for the electrical treatment of gases comprising a pair of sloping electrodes defining a passageway for the gas substantially annular in cross section, means for passing the gas through said passageway in a downward direction and away in an upward direction, and mean for collecting the precipitated matter at the bottom of the electrodes.

5. Apparatus for the electrical treatment of gases comprising a substantially air-tight casing having an inlet and an outlet, and a pair of sloping electrodes defining a passageway substantially annular in cross-section, said electrodes being so disposed within the casing that all the gas passing through the casing must pass through the said passageway.

6. Apparatus for the electrical treatment of gases comprising a substantially air-tight casing having an inlet and an outlet, and a pair of sloping electrodes defining a passageway substantially annular in cross-section, one of said electrodes being connected at its bottom with the casing to make a tight fit therewith and being open at its top, the other of said electrodes being spaced from the casing at its bottom and closed at its top.

7. Apparatus for the electrical treatment of gases comprising a substantially air-tight casing having an inlet and an outlet, and a pair of sloping electrodes defining a passageway substantially annular in cross-section, one of said electrodes being connected at its bottom with the casing to make a tight fit therewith and being open at its top, the other of said electrodes being spaced from the casing at its bottom and closed at its top, and means near the bottom of the electrodes for withdrawing precipitated material from the casing.

8. Apparatus for the electrical treatment of gases comprising a substantially air-tight casing having an inlet and an outlet, and a pair of sloping electrodes defining a passageway substantially annular in cross-section, one of said electrodes being connected at its bottom with the casing to make a tight fit therewith and being open at its top, the other of said electrodes being spaced from the casing at its bottom and closed at its top, means connected with the first of said electrodes for producing thereon a continuous film of flowing liquid, means near the bottom of said first electrode for drawing off the liquid from the casing, and means for forming a liquid seal.

9. Apparatus for the electrical treatment of gases comprising a plurality of roof-shaped elements arranged in superposed spaced relation to alternately form discharge electrodes and collecting electrodes, and means for successively conducting the gas to be treated through the spaces defined by the said elements.

10. Apparatus for the electrical treatment of gases comprising a substantially air-tight casing having an inlet and an outlet, a plurality of roof-shaped elements arranged in the casing in superposed spaced relation to alternately form discharge electrodes and collecting electrodes, said electrodes and said casing being so related that all the gas passing through the casing must pass successively through the spaces defined by said elements.

11. Apparatus for the electrical treatment of gases comprising a substantially air-tight casing having an inlet and an outlet, a plurality of superposed roof-shaped elements in the casing constituting alternately discharge electrodes and collecting electrodes, the collecting electrodes being connected at their bottom portion to the casing to make a tight fit therewith and being open at the top, the discharge electrodes being spaced from the casing and being closed at the top, and openings near the bottom of each collecting electrode through the walls of the casing for withdrawing precipitated material.

12. Apparatus for the electrical treatment of gases comprising an air-tight cas-

ing having an inlet and an outlet, a roof-shaped electrode within the casing forming a diaphragm, said electrode having a central aperture, a roof-shaped electrode in superposed relation to the first electrode to define a symmetrical passageway for the gas, said latter electrode being electrically insulated from the former and spaced from the walls of the casing to define a passageway for the gas.

13. Apparatus for the electrical treatment of gases comprising a plurality of spaced plates alternately connected to opposite poles of a source of electric current and defining gas passages, means on some of the plates for inducing a discharge to the plates opposite thereto and means for passing the gases successively through said passages.

14. Apparatus for the electrical treatment of gases comprising a plurality of spaced plates alternately connected to the opposite poles of a source of electric current, each plate having one surface smooth and the other surface provided with means for facilitating corona discharge, said means on all the plates facing in the same direction.

15. Apparatus for the electrical treatment of gases comprising a substantially air-tight casing having an inlet and an outlet, a plurality of roof-shaped elements arranged in the casing in superposed spaced relation and alternately connected to the opposite poles of a source of electric current, each element having one surface smooth and the other surface provided with means facilitating corona discharge, said means on all the said elements facing in one direction.

In testimony whereof I affix my signature.

HAROLD W. SQUIRES.