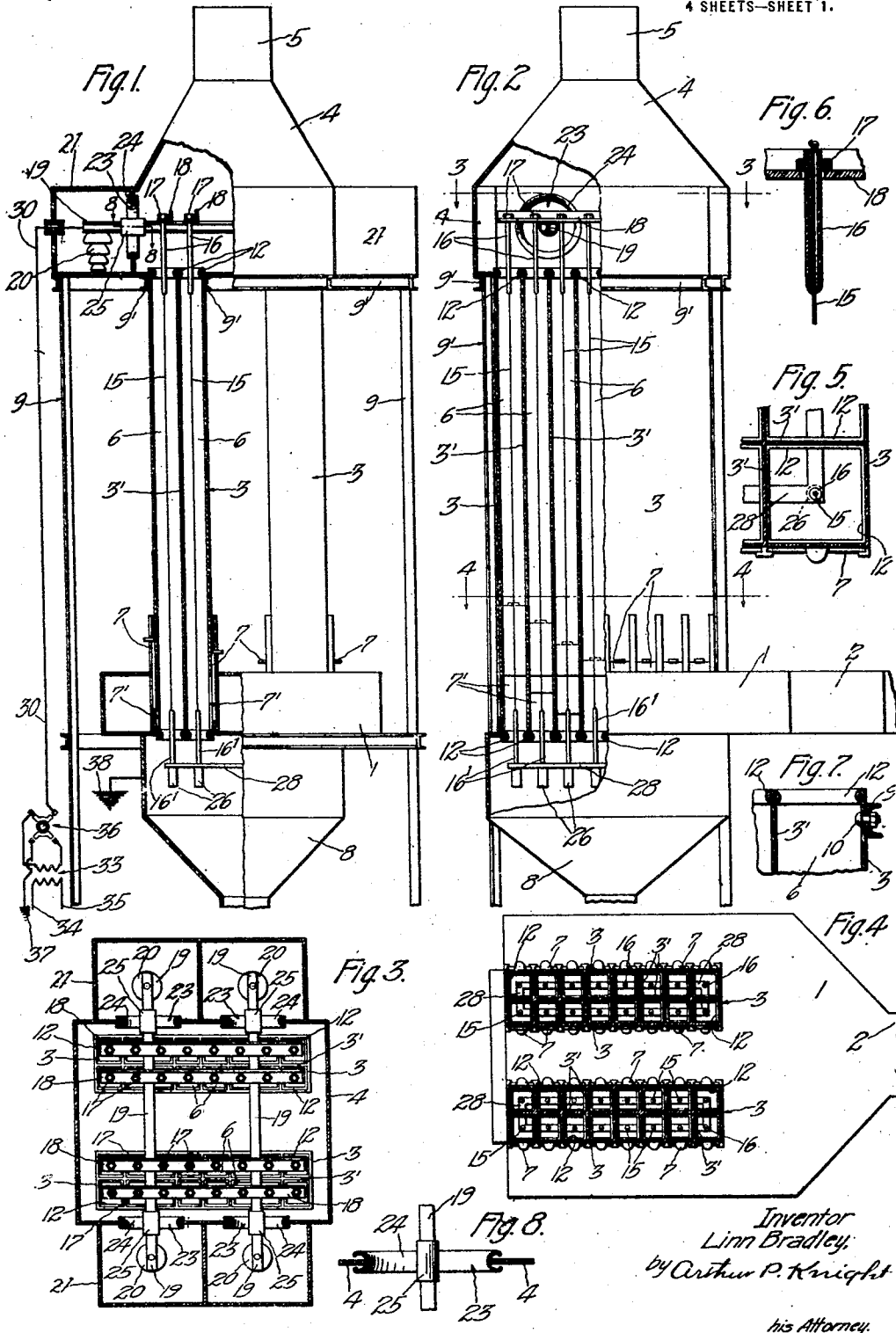


L. BRADLEY.
 APPARATUS FOR ELECTRICAL TREATMENT OF GAS.
 APPLICATION FILED FEB. 18, 1916.

1,325,136.

Patented Dec. 16, 1919.

4 SHEETS—SHEET 1.



Inventor
 Linn Bradley
 by Arthur P. Knight

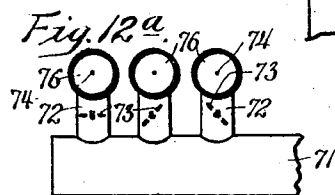
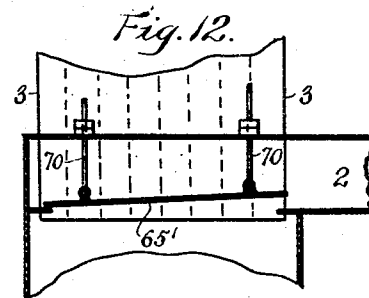
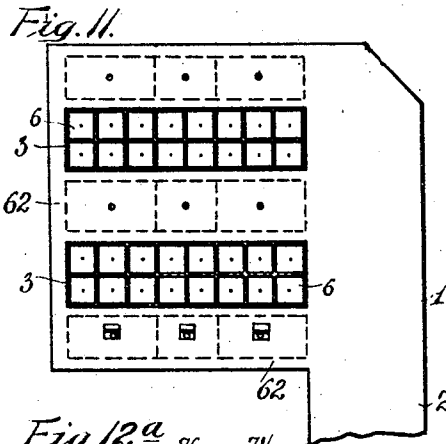
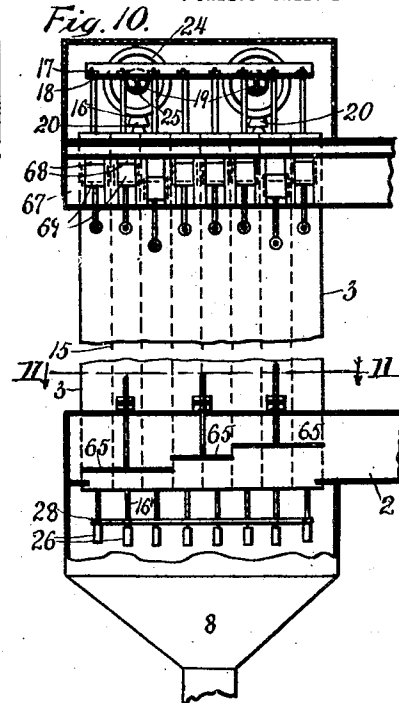
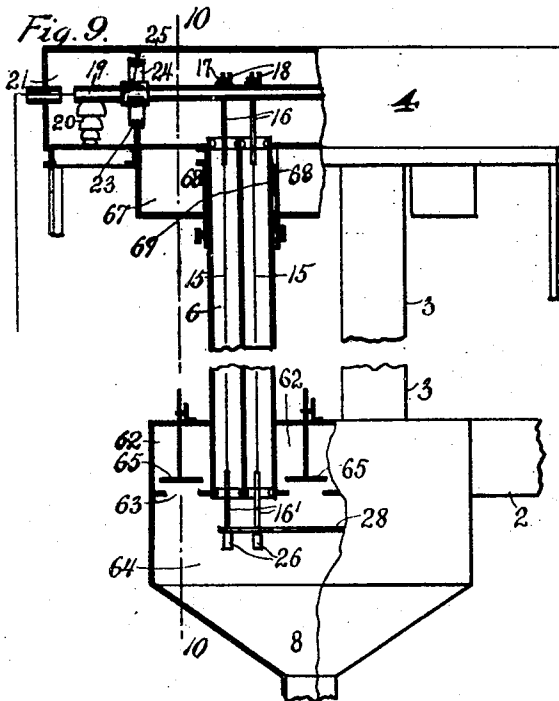
his Attorney.

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4 SHEETS—SHEET 2.



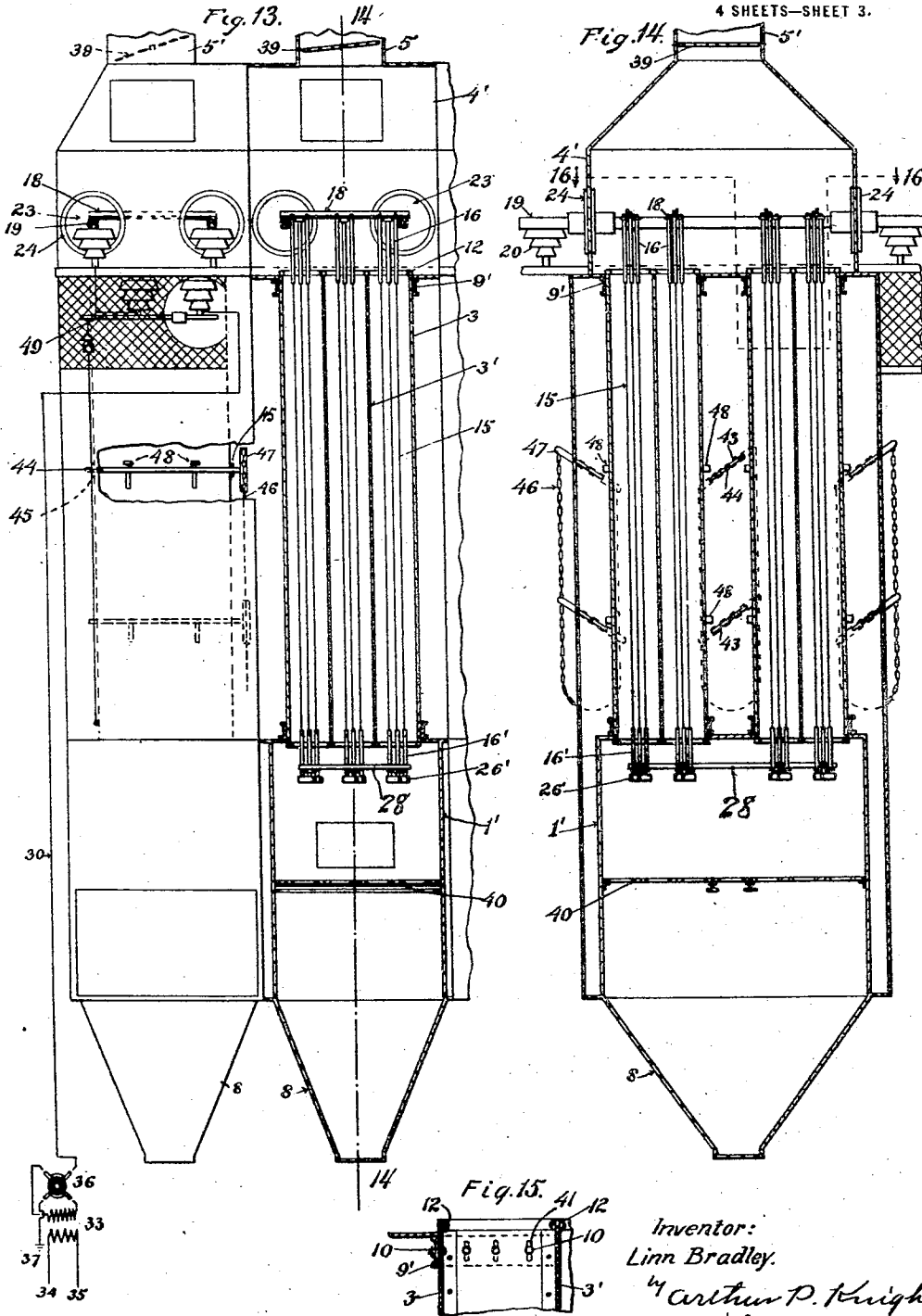
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4 SHEETS—SHEET 3.



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4 SHEETS—SHEET 4.

Fig. 16.

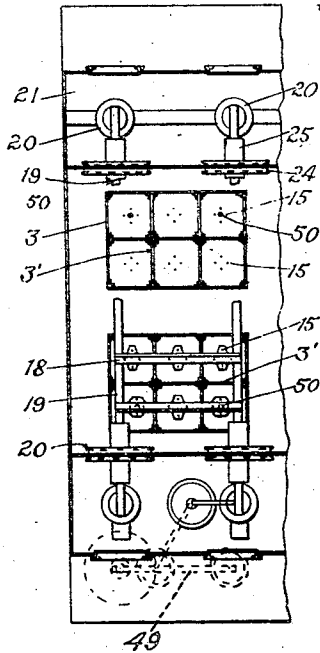


Fig. 17.

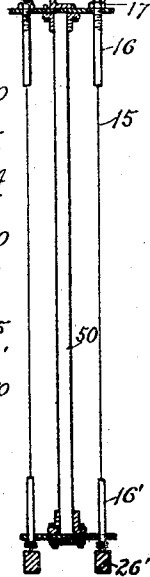


Fig. 18.

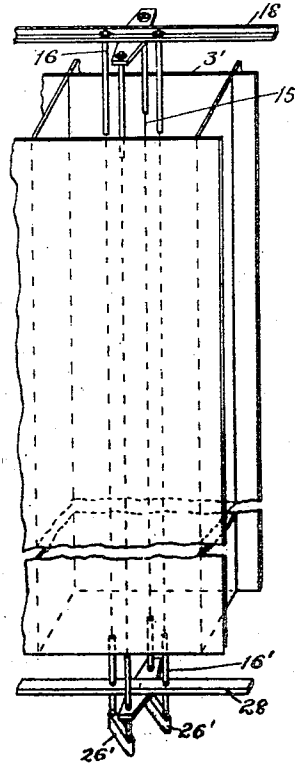


Fig. 19.

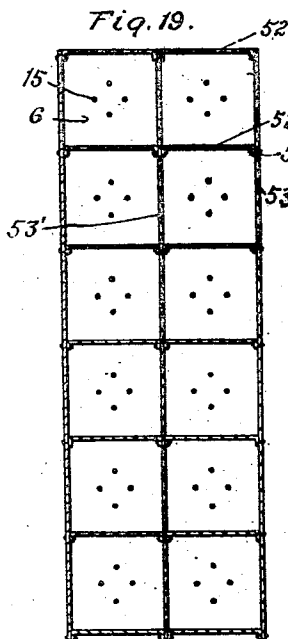


Fig. 20.

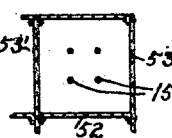
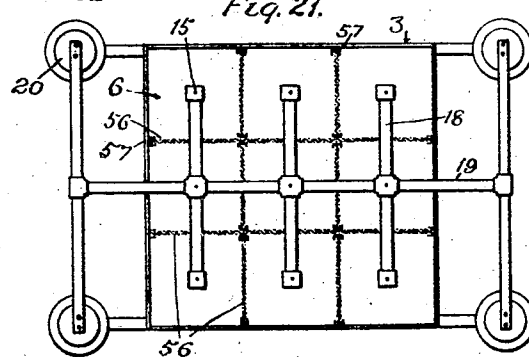


Fig. 21.



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UNITED STATES PATENT OFFICE.

LINN BRADLEY, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO RESEARCH CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

APPARATUS FOR ELECTRICAL TREATMENT OF GAS.

1,325,136.

Specification of Letters Patent.

Patented Dec. 16, 1919.

Application filed February 18, 1916. Serial No. 79,066.

To all whom it may concern:

Be it known that I, LINN BRADLEY, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented a new and useful Apparatus for Electrical Treatment of Gases, of which the following is a specification.

This invention relates to apparatus for treatment of gases by electrical action, and particularly to apparatus of the type in which the gas to be treated is passed through flues or pipes in which it is subjected to the action of a high-tension electrical field; for example, for the separation of suspended particles from the gas by electrical action.

The main object of the invention is to provide an improved flue or pipe construction for such an apparatus, whereby considerable economies are effected in cost of construction for a plant of given capacity.

Another object of the invention in connection with an apparatus requiring a multiplicity of flues, is to minimize the loss of heat by radiation from such flues.

Another object of the invention is to provide for control of distribution of the gases throughout a treater of this kind, comprising a multiplicity of flues.

A further object of the invention is to prevent discharge from parts of the apparatus at which discharge is not desirable.

Another object of the invention is to provide an apparatus in which the gas is passed through flues, with supply means so constructed as to reduce to a minimum the height and ground space required for the apparatus.

The accompanying drawings illustrate embodiments of my invention particularly adapted for the precipitation of suspended particles from gas, and referring thereto:

Figure 1 is a partly sectional end elevation of one form of the invention.

Fig. 2 is a partly sectional side elevation thereof.

Fig. 3 is a section on line 3—3 in Fig. 2.

Fig. 4 is a section on line 4—4 in Fig. 2.

Fig. 5 is a horizontal section of one of the flue elements.

Fig. 6 is a vertical section of one of the supports for the discharge electrodes.

Fig. 7 is a vertical section of the upper part of one of the flue elements.

Fig. 8 is a section on line 8—8 in Fig. 1.

Fig. 9 is a partly sectional end elevation of another form of the invention.

Fig. 10 is a partly sectional side elevation of the form shown in Fig. 9.

Fig. 11 is a section on line 11—11 in Fig. 10.

Fig. 12 is a horizontal section of another form of the invention.

Fig. 12^a is a horizontal section of another modification of the gas distributing means.

Fig. 13 is a partly sectional side elevation of another form of the apparatus.

Fig. 14 is a section on line 14—14 in Fig. 13.

Fig. 15 is a vertical section of a portion of one of the flue elements of the form shown in Fig. 13.

Fig. 16 is a section on line 16—16 in Fig. 14.

Fig. 17 is a perspective view of one of the flue elements.

Fig. 18 is a vertical section of a discharge electrode element, especially adapted for support of the retaining frame at the lower end of the electrodes.

Fig. 19 is a horizontal section of another form of the flue apparatus.

Fig. 20 is a horizontal section of one of the flue elements showing a modified arrangement of the discharge electrodes.

Fig. 21 is a plan view of another form of the invention.

Referring to Figs. 1 to 4, the apparatus comprises a header or supply chamber, 1, connected by inlet 2 to any flue or pipe conveying the gases to be treated, and one or more flue casings 3 connected to said header to receive the gas therefrom and open at their upper ends either into the outer air or into an upper header or headers in outlet chamber 4, connected to outlet pipe 5. The flue casings 3 are each subdivided into a plurality of pipes or flues by partitions 3'. Each flue casing 3 is preferably rectangular in cross section and the partitions 3' extend at right angles to one another and to the walls of the flue casing so as to divide the flue space into square or rectangular flues or passages 6.

As shown in these figures, the lower header 1 may embrace the vertical flue casings and communicate with the respective flues by openings 7' formed in the outer walls of such flues. This construction re-

duces considerably the height required for the apparatus, inasmuch as the lower header does not add to such height. In order to provide for uniform distribution of the gas flow to the different flues, I may, as shown in these figures, provide separate dampers or gates 7 for controlling the openings 7' through which the gas flows to the respective flues, each gate controlling the passage of gas to one or more flues. A bin or hopper 8 is provided below the flue casings 3 to receive the material collected on the walls of flues 6, which serve as collecting electrodes, or elsewhere. The walls of the flues 6 may be formed of sheet metal plates fastened to horizontal girders 9' of a supporting frame 9 in any suitable manner, for example, by bolts 10. The upper and lower ends of said walls may project beyond said girders, and are preferably provided with rounded beads 12 which prevent undue electric field intensity at such parts, thereby preventing or reducing discharge from these parts, which are, in general, at the low tension side of the electric conducting system, but which are liable to produce discharge by reason of the edges presented thereby.

Discharge electrodes 15 are mounted in the respective flues 6, said electrodes consisting, for example, of fine wires suspended from screw sleeves which are carried by nuts 17 resting on bars 18, which are supported by girders 19 carried by insulators 20. Said insulators are preferably mounted in chambers 21 extending outside of the upper header 4, the wall of said header being provided with openings 23 where these girders pass through the same. To prevent discharge between the girder and the wall of the header, a collar 24 is secured in said opening 23, said collar for example, being formed as a sheet metal ring with its edges bent outwardly and turned over to give a rounded edge. A cylindrical thimble or sleeve 25 may also be provided around the girder 19 where it passes through the opening 23, to give a further safeguard against discharge at this point. This construction enables the openings through which the conductor members 19 pass, to be contracted, so that the insulator chambers are kept as free as possible of the impurities present in the gas being treated. To facilitate the mounting of the fine wires 15, they may be threaded through the sleeves 16 and knotted at their upper ends. Sleeves 16' may be provided on wires 15 where they pass the lower edges of the flues, these sleeves being similar to sleeves 16 but being without nuts. These sleeves act as sheaths and assist in reducing discharge at the parts where the discharge electrodes pass the upper and lower edges of the collecting electrodes. The wires 15 are held taut or tensioned by weights 26 on their lower ends or by other suitable means, with

sufficient tension to hold them substantially rigid when subjected to the action of the electric field or of rapidly running gases, and said wires may be retained from lateral displacement by a retaining frame 28 which may be supported by resting on said weights 26. The retaining frame 28 may be held from swinging either by weighting the same, or by anchoring it from the sides of the header 1, by suitable insulating means known in the art (not shown).

Girders 19 and bars 18 form a frame, which is connected to electric circuit means for supplying high tension current. For this purpose the said frame may be connected by a wire 30, to the high tension source, consisting preferably of a step up transformer 33, connected to an alternating current circuit, indicated at 34 and 35, a rectifier 36 being preferably included in the connection so as to rectify the current passing to the discharge electrodes. Said rectifier 36 may be provided with a ground connection 37 and the metal casing of the apparatus, including the flue casings 3 and the partitions 6, which act as electrodes, may also be grounded as indicated at 38.

The apparatus above described is designed with special reference to the precipitation of suspended particles from gases containing the same, and for such purpose the gases to be treated are passed through the flues 6, from the header 1, and so passing are subjected to the action of a high tension electric discharge from the discharge electrodes 15, with the result that solid or liquid particles suspended in the gas are precipitated by the electrical action and are collected in the bins or hoppers 8. The apparatus may, however, be used for the electrical treatment of gases by high tension discharge in any manner, and for any purpose, whether the discharge be unidirectional or alternating. In any case, the flow of the gas through the different flues may be equalized by opening or closing the respective dampers or gates 7. By reason of a strong wind blowing past the apparatus, or by reason of difference in temperature of different parts of the apparatus or for other reasons, there may be a tendency for the gas to flow more rapidly through some of the pipes than through others, and this condition may be corrected by means of these dampers.

As shown in Figs 9 to 11, several dampers 65 may be provided for each opening 63, so as to enable variable control at different parts of such opening; or as shown in Fig. 12, a single damper plate 65' may be flexibly connected to operating means 70, so as to provide for such variable control.

Any suitable damper means may be provided for the flues. For example, as shown on Figs. 9 to 11, the supply header indicated at 1 may communicate with lateral

headers 62 leading alongside the respective flues and communicating through openings 63 with a chamber 64 extending below and communicating with all of the flues 6, control of distribution being in this case obtained by varying the resistance to the gas flow through the several openings 63 by means of dampers 65. I have also shown in these figures distribution control means at the top of the flues which may be used either alternatively or conjointly with the above described control means, the outlet header 4 being connected with lateral flues 67 extending between the rows of flues 6 and communicating therewith through openings 68. Said openings 68 may be smaller than the cross sections of the respective flues to which they are connected so as to provide a constricted passage acting as an automatic control device, the resistance to the gas flow being concentrated at these constricted passages, so that any increase in the gas velocity in any flue, relatively to the other flues, will produce an increase in the resistance at the corresponding constricted passage, said resistance increasing approximately as the square of the velocity, so that it would tend to choke any excess of gas flow and equalize the flow in all the flues. If desired, however, dampers or gates 69 may also be used for adjusting the constriction at openings 68. The construction of the other parts of the apparatus may be as above described.

This feature of my invention, namely, the provision of a relatively constricted passage for the gas which traverses each flue, and independent regulation of the amount of constriction, if desired, is not limited in its application to any particular shape or arrangement of flues, but is applicable to flues of any shape whatsoever, arranged in any desired manner. Thus, in Fig. 12^a an embodiment of this feature of my invention is shown, in which a header 71 is connected by lateral ducts 72 to a plurality of round pipes 76 serving as the flues in which the gas is treated, the discharge electrodes 74 being suspended vertically in said pipes. Ducts 72 may serve as constricting passages and may be provided with dampers 73 whereby the amount of constriction may be varied.

By forming the collecting electrodes as square or rectangular pipes, in the manner above described, I am enabled to provide a large number of pipes, having a very extensive electrode surface, in a comparatively limited space and at minimum expense. This feature of my invention is not limited to any specific means of conducting the gas to or from the pipes or flues. For example, as shown on Figs. 13 and 14, the lower header 1' may extend wholly below the vertical flues 6, which are formed in the flue casings 3 by means of partition walls 3'

as above described. In this form of the invention baffle or spreader plates 40 are shown for equalizing the distribution of gas to the different flues and separate dampers 39 are provided for the different outlets 5' of the upper header 4' to enable inequality of gas flow to be corrected. The walls of the flues 3 may, as shown in Fig. 15, be fastened at their upper parts to the supporting girders 9' by means of bolts 10 which extend through vertical slots 41 in the wall plates of the flues so as to permit of expansion or contraction of such plates due to changes of temperature.

In order to dislodge or knock the deposits from the collecting electrodes constituted by the walls of the flue casings 3 and the partitions 3', hammers may be provided consisting of levers or arms 43 mounted on shafts 44 journaled in bearings 45 and provided with operating means, consisting, for example, of chains 46 connected to levers 47 on said shafts. The hammer arms 43 are adapted to strike lugs or angle irons 48 on the respective flue casings 3. In this form of my invention a switch 49 is shown in the connection 30 from the insulated supporting frame member 9 to the rectifier 36, one of these switches being provided for each flue casing. This allows connecting or disconnecting any section of the apparatus at will.

In the form of the invention shown in Figs. 13 to 18, the discharge electrodes are formed as fine wires 15, supported by an insulated frame as above described, but a plurality of such wires are provided in each flue 6, said wires being hung opposite to the respective sides or walls of the square or rectangular pipes or flues, as shown in Figs. 13 and 14, and tensioned by weights 26' each of which may be hung on two of such wires. In order to conveniently support the retaining frame 28 for the lower portions of the discharge electrodes, said frame may be mounted on hanger bars 50, shown in Fig. 17 suspended from the insulated upper frame 18, and extending in each of the four corner flues of the system, so as to extend within the set of discharge electrodes 15 in such flue, as shown in Fig. 18. Except for the differences above described, the construction and operation of the form of the invention shown in Figs. 13 to 18 may be the same as in the form shown in Figs. 1 to 8.

As shown in Fig. 19, the partitions may be formed as vertical plates 52 formed with flanges 52' whereby they are secured to the outer walls 53 of the flue casing and to an intermediate sheet metal plate 53', extending parallel to said side walls. Fig. 20 shows a modified arrangement of the discharge electrodes 15, said electrodes being arranged opposite the corners of the respective flues 6, instead of opposite the centers of the side walls of said flues in Figs. 10 and 13.

The partitions may consist of sheet metal plates as shown in Figs. 2 to 11, or of screens of wire mesh or equivalent foraminous material, as shown at 56 in Fig. 21, said screens forming collecting electrodes which receive the deposits of solid material, but permit passage of the gas tending to equalize the gas flow in the different flues. In this case the partitions are shown as removably mounted within the flue casing, being supported by guides formed as channel irons 57, within which the screen plates 56 are mounted to slide.

While I have shown the flues of the apparatus as substantially square in cross section, it will be understood that they may be of any suitable polygonal shape, and the several faces or sides of each flue may be of different width and disposed at any desired angles. It will be understood that the gas to be treated may be passed through the flues either upwardly or downwardly, as may be desirable in any particular case. The flues are herein shown as vertically arranged, but they may be arranged in any desired position.

I have found that in many cases it is desirable to use a single discharge electrode formed as a single fine wire, or flexible member, in each flue or pipe constituting a collecting electrode, as shown in Figs. 1 to 9; but more than one of such wires may be used if desired.

An important advantage of the construction above described, wherein a flue casing is subdivided into a plurality of flues by partitions, is that each partition serves as the wall for two adjoining flues, thereby economizing in material used and in cost of construction. Another advantage is that the ground space required is reduced to a minimum, as there are no open spaces wasted between the flues. A further important advantage is that the subdivision of the flues may be carried out to any desired extent, and may even be changed at any time by changing the numbers of the partitions, in order to provide for more effective operation. The partitions may be arranged in any desired manner so as to provide for any desired number or arrangement of rows of flues.

Each of the flue casings above described may be considered as a treater unit, comprising a cellular or subdivided flue system, and in constructing any plant these units may be set up as sections and assembled in any desired relation to one another, and in any desired number, according to the capacity required for the plant, thereby standardizing the manufacture of the apparatus. This sectional unit feature is especially advantageous in connection with the rectangular flues described, but is applicable in connection with any form of flues.

The cellular construction of the flue unit with intersecting partitions gives an inherent rigidity thereto which enables the unit to be used as a structural element without reinforcement.

What I claim is:

1. In a multi-flue apparatus for electrical treatment of gases, a plurality of flues having rectangular cross section and having walls constituting an electrode, and discharge electrode means extending longitudinally in said flue.

2. In a multi-flue apparatus for electrical treatment of gases, a plurality of flues of polygonal cross section having walls forming an electrode, and discharge electrode means extending longitudinally in said flue.

3. In a multi-flue apparatus for electrical treatment of gases, a plurality of flues having polygonal cross section and having walls constituting an electrode, and opposing electrodes extending longitudinally in said flue, opposite the respective polygonal faces thereof.

4. An apparatus for electrical treatment of gases, comprising a header, a plurality of electrode flues of polygonal cross-section in contiguous relation and an opposing electrode in each flue.

5. An apparatus for electrical treatment of gases, comprising a header, a flue casing connected thereto, a plurality of partitions dividing said flue casing into a plurality of flues of polygonal cross section, said casing and partitions constituting electrode means, and discharge electrodes extending longitudinally in said flues.

6. An apparatus for electrical treatment of gases comprising a header, a flue casing extending therefrom, a plurality of partition walls in said casing to form a plurality of flues and a discharge electrode in each of said flues.

7. An apparatus for electrical treatment of gases, comprising a header, a flue casing extending vertically therefrom, a plurality of partition walls extending vertically in said casing to form a plurality of vertical flues, and discharge electrodes extending vertically in the respective flues.

8. In an apparatus for electrical treatment of gases, a flue casing, partitions dividing the space within said casing into a plurality of flues, discharge electrodes in said flues and means for passing the gas through said flues.

9. In an apparatus for electrical treatment of gases, supply and outlet headers, a flue casing connected to said headers, partitions dividing the space within said flue casing into separate flues, discharge electrodes in said flues and means for passing the gas through said flues.

10. In an apparatus for electrical treatment of gases, a discharge electrode, a col-

lecting electrode having edge portions provided with a rounded head to minimize discharge therefrom and a sheath surrounding the discharge electrode adjacent said head.

- 5 11. In an apparatus for electrical treatment of gases, the combination with the discharge electrode system and an inclosing casing, provided with an opening and an insulated conductor extending through said

openings, and a collar mounted in said 10 opening and having its edges formed to present rounded surfaces for minimizing discharge.

In testimony whereof I have hereunto set my hand, at Washington, D. C., this 15th 15 day of February, 1916.

LINN BRADLEY.