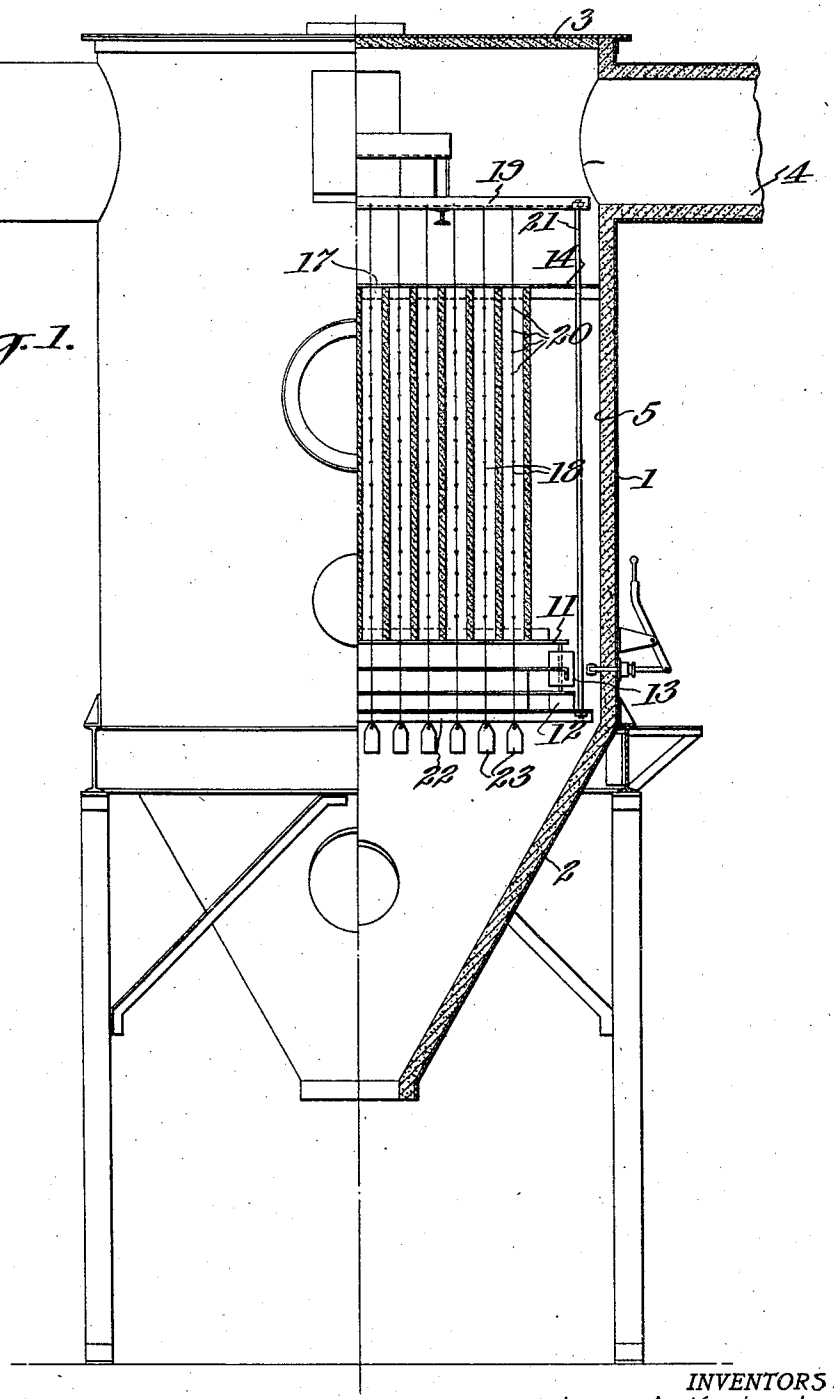
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ELECTRICAL PRECIPITATOR

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Fig. 1.



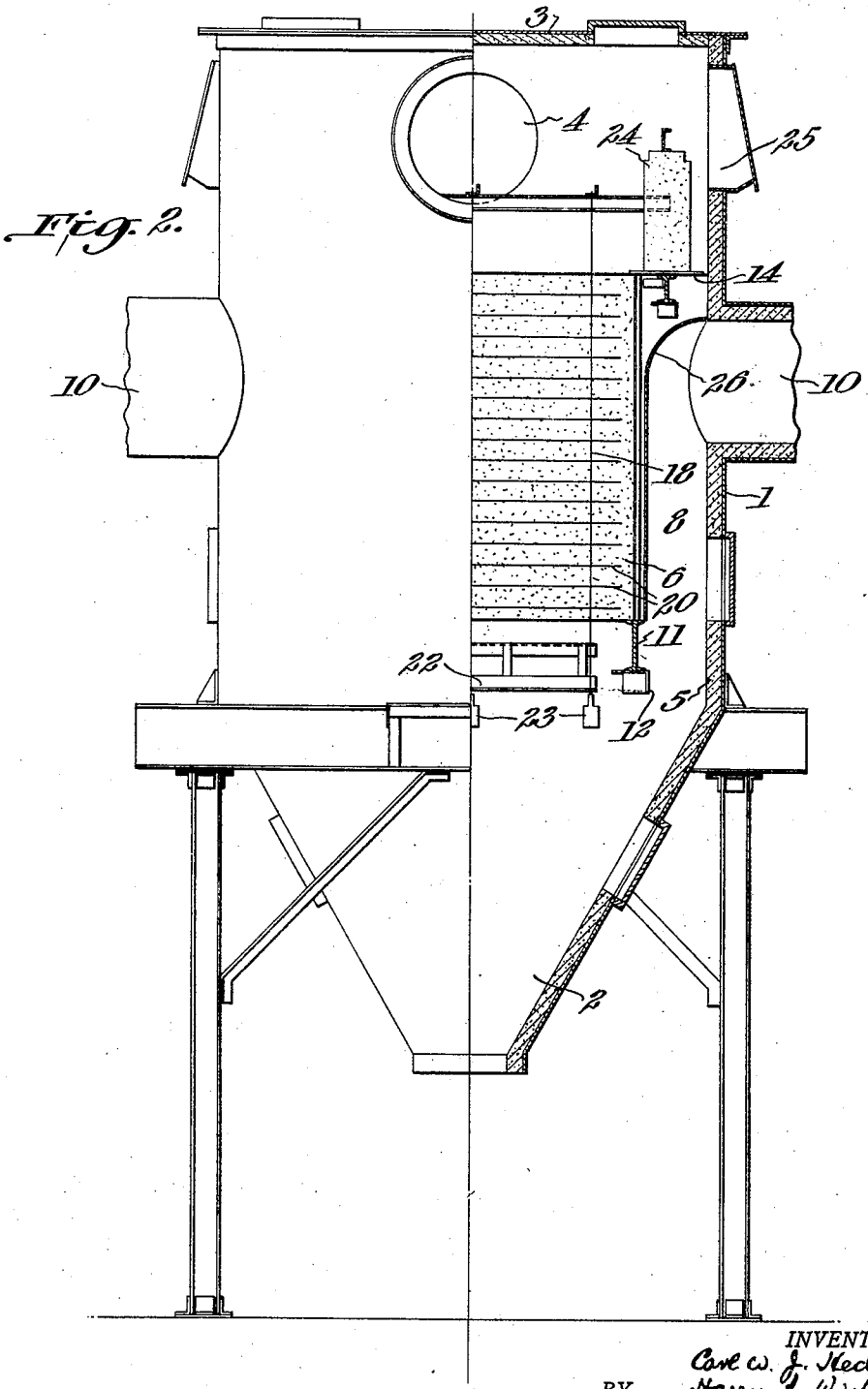
INVENTORS.
Carl W. J. Hedberg +
Harry A. Wintermute
BY Byrnes Townsend & Brinckerhoff
ATTORNEYS

March 31, 1931. H. A. WINTERMUTE ET AL 1,798,511

ELECTRICAL PRECIPITATOR

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Fig. 2.



INVENTORS
Carl W. J. Medberg +
Harry A. Wintermute
BY Byrnes Townsend & Brickenstein
ATTORNEYS

March 31, 1931. H. A. WINTERMUTE ET AL 1,798,511

ELECTRICAL PRECIPITATOR

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Fig. 4.

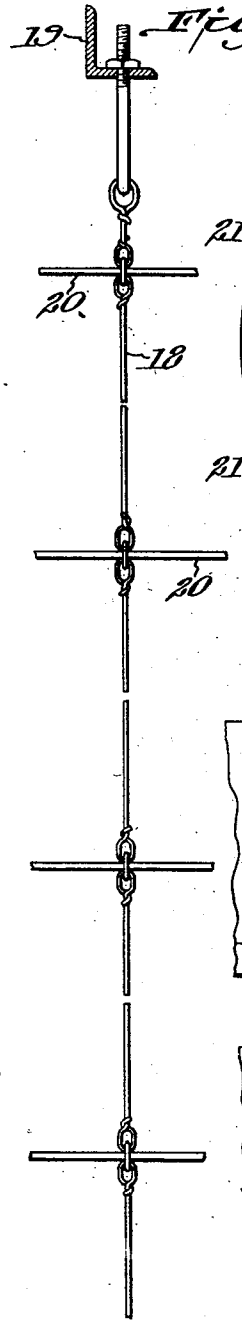


Fig. 3.

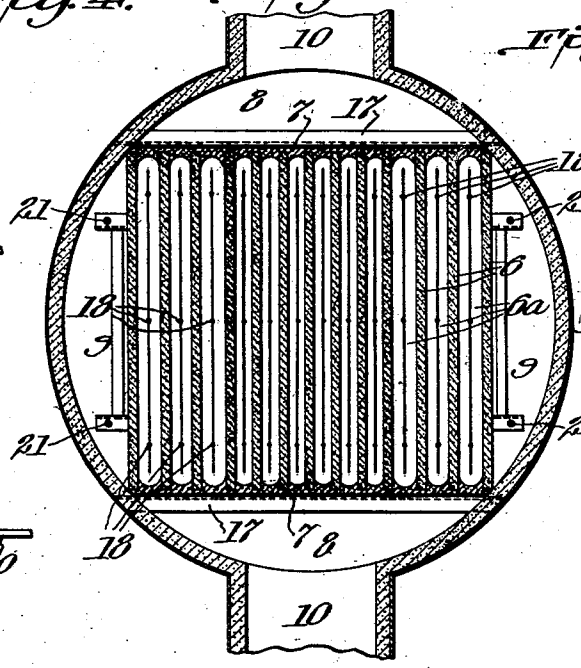
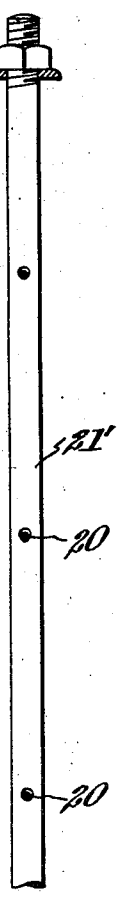


Fig. 5.



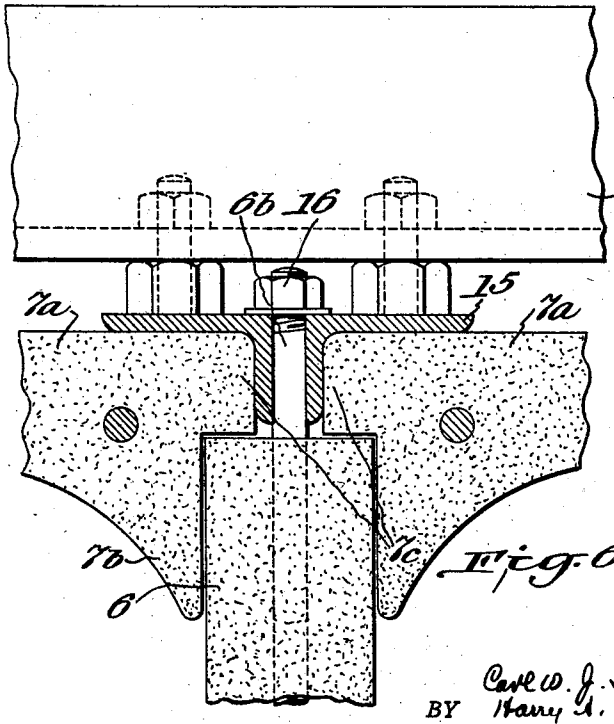


Fig. 6.

INVENTORS
Carl W. J. Stedberg +
Harry A. Wintermute
BY Byrnes Townsend & Brickenstein
ATTORNEYS

March 31, 1931. H. A. WINTERMUTE ET AL 1,798,511

ELECTRICAL PRECIPITATOR

Filed May 4, 1926 4 Sheets-Sheet 4

Fig. 7.

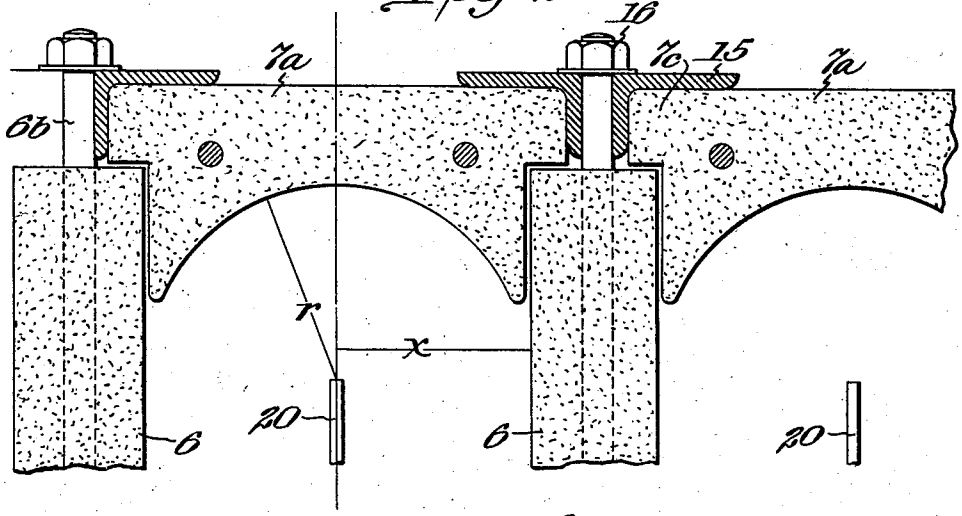
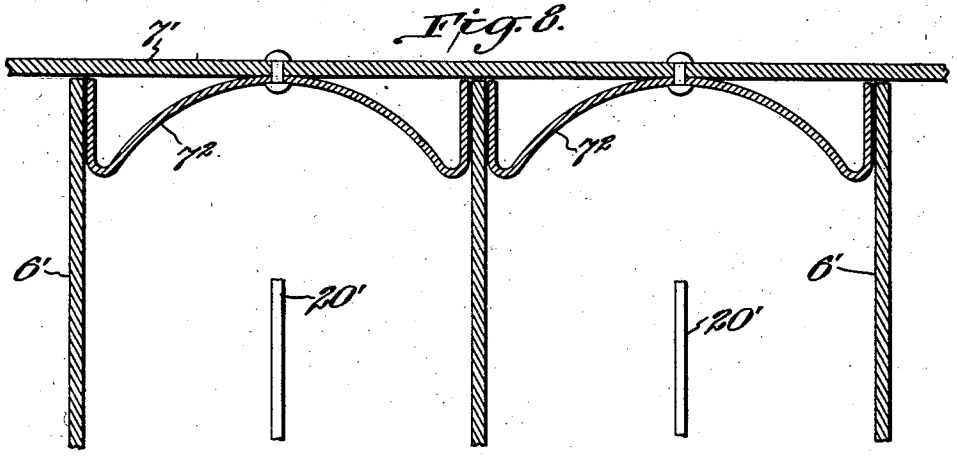


Fig. 8.



Inventors:
Carl W. J. Hedberg,
Harry A. Wintermute,
By Byron Townsend & Brickenstein,
Attorneys.

Patented Mar. 31, 1931 1,798,511

UNITED STATES PATENT OFFICE

HARRY A. WINTERMUTE, OF NEW YORK, N. Y., AND CARL WILLIAM JULIUS HEDBERG, OF MIDDLESEX BOROUGH, NEW JERSEY, ASSIGNORS TO RESEARCH CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

ELECTRICAL PRECIPITATOR

Application filed May 4, 1926. Serial No. 106,725.

This invention relates to electrical precipitators and more particularly to improvements in plate precipitators.

It is a general object of the invention to provide a plate precipitator of simple, cheap and rugged form.

An object is to provide a precipitator of the type mentioned, of such standard structural characteristics that it may be readily altered in size to suit capacity requirements with a minimum variation in details of design. Another object is to provide a precipitator of the type mentioned, in which there is a uniform distribution of gas to the several sections of the precipitator. A further object is to provide a precipitator of the type mentioned, which is gas-tight and suitable for cleaning combustible gas under suction or pressure. Another more specific object is a simple precipitator construction in which the plates may be of the steel or of the graded resistance plate type.

Other objects will appear from the description in connection with the accompanying drawings forming a part of the specification and the novel features will be particularly pointed out in the claims.

In the drawings,

Fig. 1 is an elevation, partly in section, of a construction embodying the invention;

Fig. 2 is a similar view at right angle to the view shown in Fig. 1;

Fig. 3 is a horizontal section;

Fig. 4 is a fragmentary side view of a preferred form of discharge electrode construction;

Fig. 5 is a fragmentary sectional view of a detail of a modified form of discharge electrode construction;

Fig. 6 is a sectional view on a large scale of a detail of the collecting electrode construction;

Fig. 7 is a similar sectional view illustrating the relative arrangement of the electrodes; and

Fig. 8 is an enlarged sectional view of an all-metal electrode construction.

In the drawings, the numeral 1 designates the casing of the precipitator, which casing has the form of a vertically arranged right cylinder merging into the conical hopper 2 and provided with a removable cover 3. A gas outlet, or preferably two aligned lateral outlets 4 are arranged near the top of the casing 1, and the casing and cover are preferably lined with heat-insulating material 5.

The collecting electrode structure has the form of an open-ended box inscribed within the casing. The collecting electrodes 6 comprise a plurality of parallel plates defining vertically disposed gas passages 6*a*. The lateral edges of the plates 6 are engaged by end walls 7 which provide gas-tight closures for the lateral edges of the several gas passages 6*a*. As illustrated in Fig. 3, the collecting electrode system is structurally a rectangular frame, open at the top and bottom and of such dimensions that the corner edges of the frame join the casing 1. This arrangement provides two vertical gas passages 8, 8 between the walls 7 of the electrode structure and the casing, and two similar compartments 9, 9 between the outer plates 6 and the casing. The raw gas is preferably introduced through one, or through both, of the passages 8 by inlets 10 located at the upper ends thereof. As shown, a gas inlet 10 is provided near the upper end of each gas passage, and while this is the preferred arrangement, the use of two inlets is not essential and a single inlet 10 may be used, if desired.

The collecting electrode structure is carried by cross-beams 11 arranged above or below the electrode frame and supported upon the casing in any desired manner, as for instance by means of lugs 12 and 13.

The use of a cylindrical shell of circular cross-section is quite important as this form is simple and economical to construct, and furthermore it is of maximum strength for a given weight and it can readily be made gas-tight. These latter features are particularly advantageous in connection with the treatment of blast furnace gases and other combustible gases. The cross-section of the collector electrode may be varied from the preferred or square form to meet particular conditions. For instance, in the case of the smaller diameter casings it may be preferable to use a rectangular or other cross-section

which will increase the chords of the segments in which the insulators are placed, thereby avoiding the use of larger size casings or of separate insulator compartments arranged outside of the casing.

The upper ends of the gas passages 8 and 9 are preferably closed by plates 14.

The end wall 7 may be provided in several ways, and in the case of electrodes of the graded resistance type preferably comprises a plurality of spacer blocks 7*a*, each having a portion 7*b* extending between adjacent plates 6 and portions 7*c* partly overlapping the edges of the plates. The inner surface of the portion 7*b* is concave and the radius of curvature r is equal to the spacing x of the main portions of the discharge and collecting electrodes. The portions 7*c* of adjoining spacer blocks are slightly spaced from each other to accommodate rods 6*b* laterally projecting from the plates 6 and adapted to be connected with plates or bars 15 bearing upon the outer surfaces of the spacer blocks. By means of nuts 16 or the like the plates 15 may be drawn up against the spacer blocks so that the latter constitute in effect a unitary end wall. The plates 15 may in turn be secured to beams 17.

The discharge electrode system preferably comprises chains 18 or similarly flexible pendant bodies suspended from a support 19. As indicated in Fig. 3, there may be three chains 18 in spaced relation to each passage between two adjacent plates 6, one at each end and one in the middle. These chains support rods 20 in parallelism in superposed relation. These rods 20 are the discharge electrodes proper. The three chains and superposed rods in each passage constitute a construction unit which is assembled outside of the precipitator and which, by virtue of the flexible vertical "pendant bodies", can be mounted on a board or rolled on a rod which can be easily brought into the precipitator and installed. Should failure occur in any part of the electrode unit, it can be removed in a similar manner and be replaced with a like spare unit. Several rods or pipes 21 may be used for suspending from the support 19 a spacer frame 22 through which the lower ends of the chains pass and by which they are held in definitely spaced relation, weights 23 holding the chains taut. The supporting members 21 are preferably arranged in the spaces 9, 9, between the electrode structure and the wall of the casing. If desired, however, the rods 21′ may be arranged in one of the gas passages where they may serve as the supports for electrodes 20, or they may be placed beyond the ends of the electrodes.

The supports 19 may be advantageously mounted upon insulators 24 vertically above the intake passages 8 and therefore substantially out of the gas stream, the gas outlets being disposed in a plane at right angle to the plane through the intake passages. An alternate arrangement consists of extending the end plates 7 or 7′ to the top of the precipitator, thus forming in effect substantially separate compartments for the insulators. Clean-out holes 25 are provided in the casing adjacent the insulators 24.

In the gas passages 8 are preferably provided deflector plates 26.

The collecting electrodes may be of the metal plate type as indicated in Fig. 8. In this form, the end walls 7′ lie against the edges of the plates 6′ and concave filler plates 7^2 carried by the side walls extend between adjacent plates to maintain the uniform spacing between the collector electrode and the discharge electrodes 20′. The several filler plates 7^2 act as guides or positioning means for the edges of the electrode plates 6′.

The operation is as follows:

Raw gas flows through inlets 10 into the passages 8, is then deflected downwardly by the plates 26 past the lower edge of the end walls 7, and then passes up the different ducts or passages of the collecting electrode system where it is subjected to the action of the discharge electrodes. From the point of entrance through inlets 10 to the level where the gas enters the passages of the collecting electrodes, the dynamic pressure of the gas is gradually reduced and the gas has expanded to uniformly fill the space. In addition, the gas flows around the lower edge of the walls 7 parallel to the plates 6 and thus streams uniformly into all the passages of the collecting electrodes.

By the arrangement described, mechanical separation of coarser suspended particles by changing the direction and the velocity of the gas stream is utilized in plate precipitators. We have found that in plate precipitators when the gas velocity through the electrode passages exceeds a certain critical point there is a preferential precipitation of material finer than 200 mesh with only a partially complete removal of material coarser than this. We have found, for example, that when 90 percent of the total suspended material in the gases entering plate precipitators are removed by precipitation, as much as 70 to 80 percent of the material remaining in the gases will be coarser than 200 mesh, whereas the material in the entering gases contained only 5 to 10 percent of this size. The mechanical separation described is particularly effective for material of this size, and with this arrangement the critical velocity above referred to is increased so that a smaller precipitator is required for equivalent gas volumes.

By the arrangement described, the sneakage factor, i. e. the possibility of raw gas passing through the precipitator without going through the required length of active elec-

trical zones of normal intensity, is reduced to a minimum for plate precipitators.

Other advantages are the ruggedness and mechanical simplicity combined with an excellent distribution of the gas. All factors such as diameter of shell, size of hopper, of plates, inlet gas passages, etc., are in simple mathematical relation to each other, the proportionality factor of which may remain the same for different sizes of treaters used for the same purposes and under like conditions. An adaptation for different conditions requires no more than simple changes in the relation of the several parts. Knowing the velocity at which a gas can be treated and the total volume, the particular relationship of parts and dimensions can be readily determined. The construction is thus well adapted for standardization. The factor "distribution of gas" is a substantially constant and known quantity irrespective of the size of the unit, instead of an indeterminate or wholly unknown quantity as is ordinarily the case.

The small chain members by which the discharge electrode members 20 are supported not only prevent warping but prevent sneakage as well.

In the foregoing we have pointed out the characteristic features of the invention. It is understood that various changes may be made within the scope of the disclosure.

We claim:

1. In an electrical precipitator, the combination of a vertical shell defining a casing, a collecting electrode assembly comprising a plurality of parallel plates and end walls defining with the end plates a substantially rectangular frame, means for closing the openings between the upper portion of the assembly and the casing against the passage of gas therethrough, said collecting electrode assembly being so dimensioned and supported in the shell that the vertical edges of said rectangular frame assembly contact with the inner shell surface to form therewith two passageways and two compartments of substantially segmental cross-section, and openings in said shell and in the upper portion of a shell segment defining one of said passageways, respectively, said openings permitting the flow of gas through said precipitator.

2. In an electrical precipitator the combination of a vertical shell defining a casing, a plurality of parallel collector plate electrodes defining with end walls a substantially rectangular frame and a plurality of parallel ducts therein, the transverse dimensions of said rectangular collector electrode frame being such that the vertical edges of said frame join the surface of said shell to form two separate vertical passageways and two compartments within said shell and outside of said frame, cover means closing the tops of said passageways and compartments, a gas inlet provided in said shell defined by an end wall of said rectangular frame and said shell, and a gas outlet provided in said shell above the closed tops of said passageways.

3. Apparatus according to claim 2, wherein the end walls are composed of spacer blocks each having a portion extending between adjacent plates and portions extending over the edges of adjacent plates and means for securing the spacer blocks to the plates.

4. Apparatus according to claim 2, wherein the top of said casing is closed and the latter is provided with opposite outlets disposed above the said assembly in a medial plane at a right angle to the plane through the gas inlets.

5. Apparatus according to claim 2, wherein the top of said casing is closed and the latter is provided with opposite outlets disposed above the said assembly in a medial plane at a right angle to the plane through the said inlet and insulators for supporting a discharge electrode system disposed above the assembly on opposite sides of the plane through the outlets and laterally out of the gas stream passing out of the assembly.

6. In an electrical precipitator, a collector electrode assembly of the graded resistance type comprising a plurality of parallel plates having rods embedded therein with the ends thereof projecting beyond the vertical ends of the plates, and an end wall at each side of the group of parallel plates and cooperating therewith to define a plurality of gas passages, and means cooperating with the said projecting ends of said rods for securing said end walls to said plates.

7. In an electrical precipitator, a collector electrode assembly of the graded resistance type comprising a plurality of parallel plates having rods embedded therein with the ends thereof projecting beyond the vertical ends of the plates, and an end wall at each side of the group of parallel plates and cooperating therewith to define a plurality of gas passages, the said end walls each comprising a series of spacer blocks arranged at the edges of each two adjacent plates, and means cooperating with the said projecting ends of said rods for securing said end walls to said plates.

In testimony whereof, we affix our signatures.

H. A. WINTERMUTE.
CARL WILLIAM JULIUS HEDBERG.