

Jan. 16, 1962

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3,016,980

ELECTROSTATIC PRECIPITATOR

Filed March 9, 1959

3 Sheets-Sheet 1

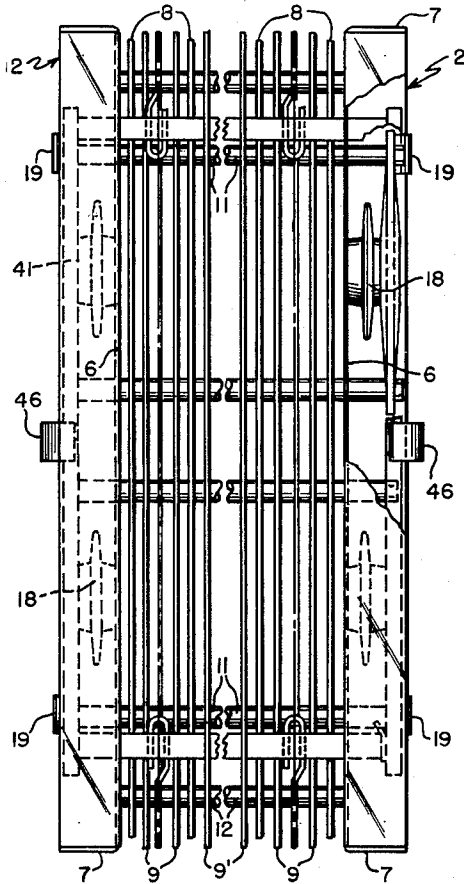


FIG. 1

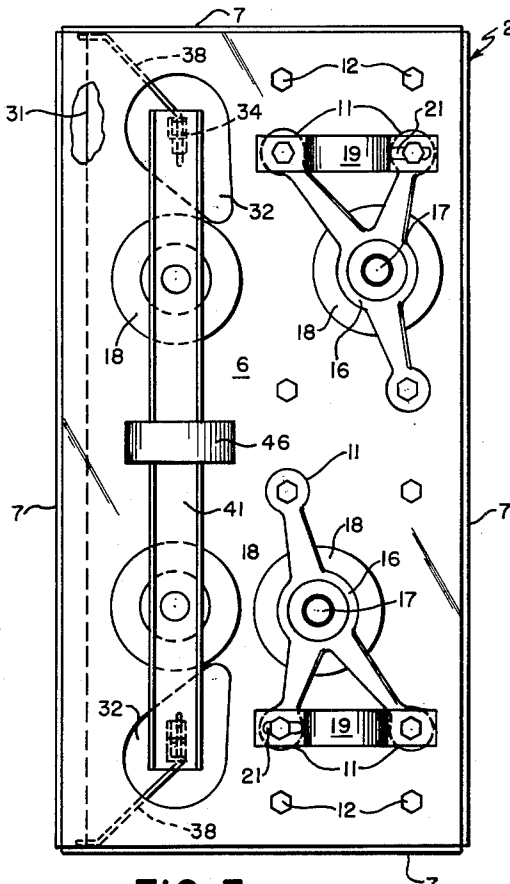


FIG. 3

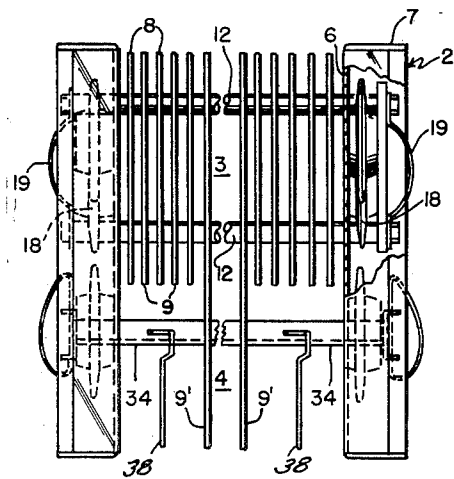


FIG. 2

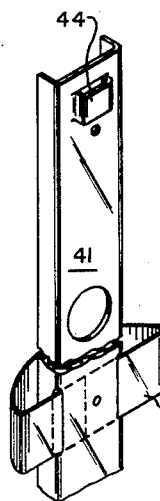


FIG. 5

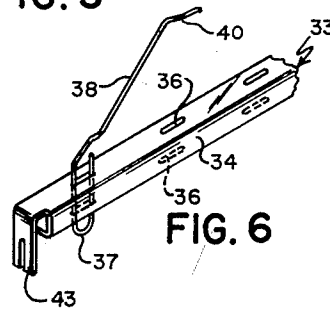


FIG. 6

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3 Sheets-Sheet 2

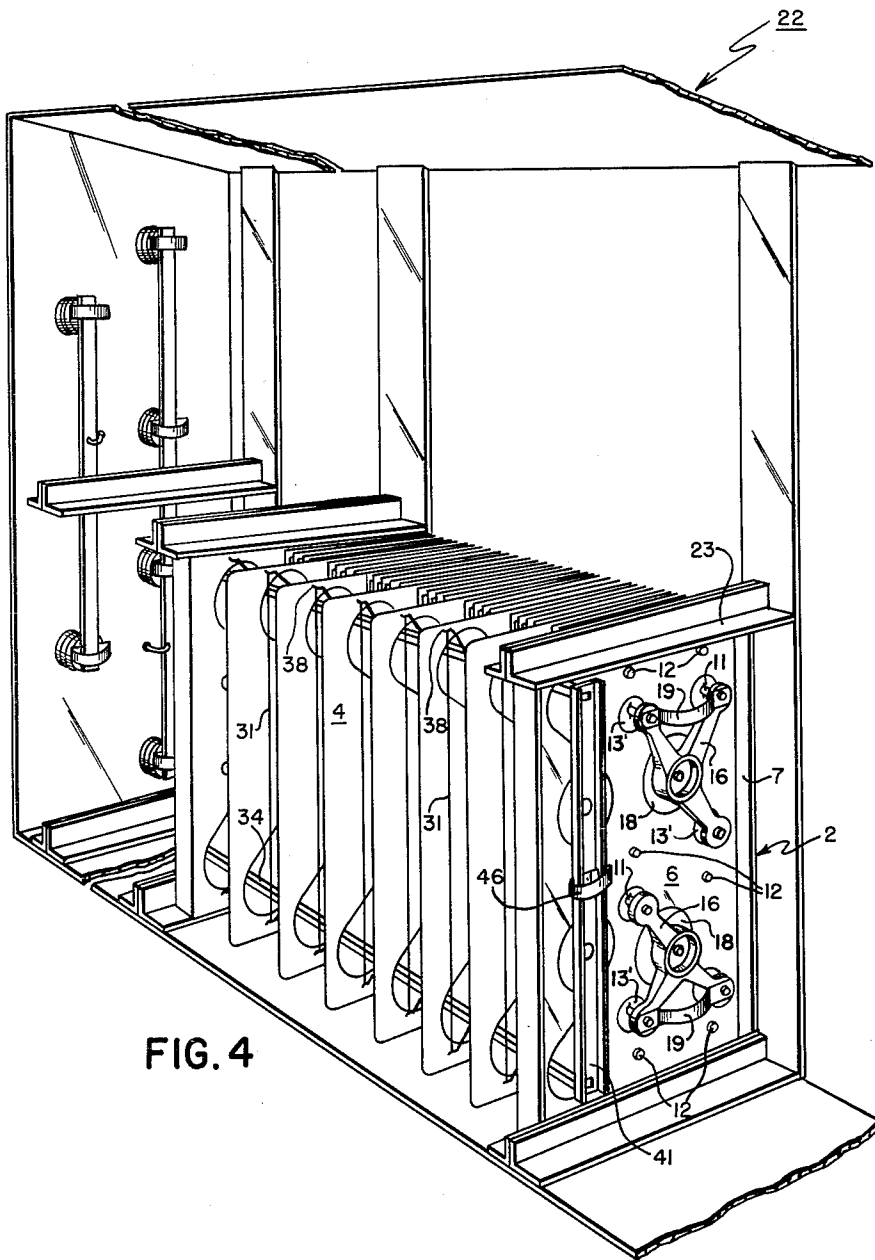


FIG. 4

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3 Sheets-Sheet 3

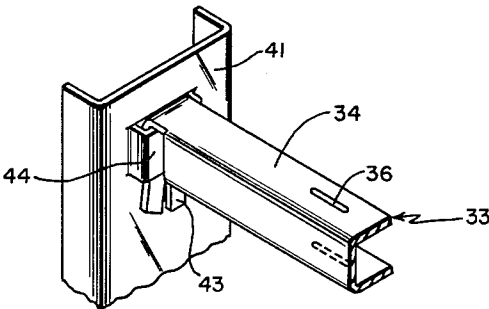


FIG. 7

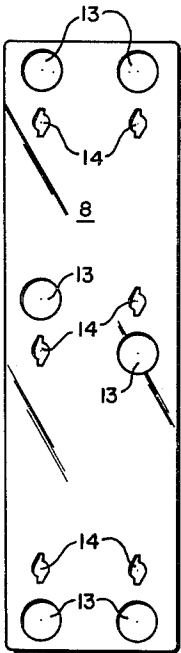


FIG. 8

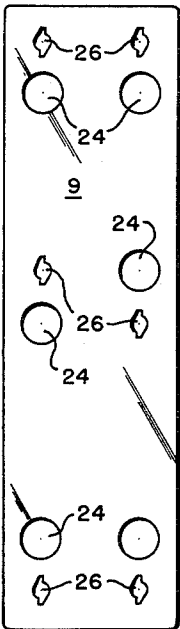


FIG. 9

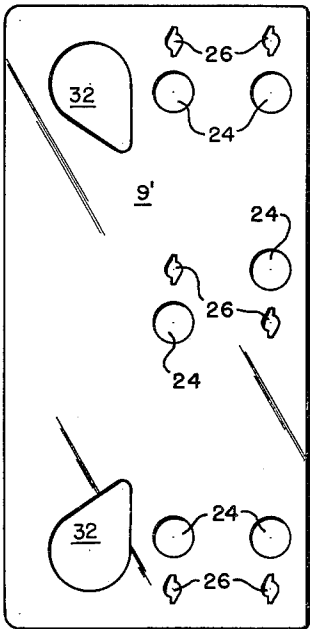


FIG. 10

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ELECTROSTATIC PRECIPITATOR

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19 Claims. (Cl. 183—7)

This invention relates to electrostatic precipitators and more particularly to an improved plate electrode assembly for an electrostatic precipitator.

It is known in the art of electrical precipitation to provide a precipitator housing structure with one or more removable plate electrode assemblies, such assemblies including a collector zone and an ionizer zone. For the most part, these plate electrode assemblies have not only been complex in their construction and in the assembly of the several parts but, in addition, they have been heavy, have required considerable time to install after assembly and have occupied a considerable amount of space after installation, such space including complex support structure for discharge electrodes positioned in the ionizer zone.

In accordance with the present invention, the disadvantages of past plate electrode assemblies are avoided, the present invention providing a plate electrode assembly which requires fewer parts, less material, less space, and less support structure, including less support structure in the fluid stream of the ionizer zone than has been required in past assemblies. In addition, the present invention provides a plate electrode assembly which is light in weight, which is easily handled for installation and maintenance, which requires a minimum of electrical hardware, and which is sturdy and durable over long periods of operation.

Various other features of the present invention will become obvious to one skilled in the art upon reading the disclosure set forth herein.

More particularly the present invention provides a plate electrode assembly for an electrostatic precipitator including an ionizer zone and a collector zone comprising a plurality of spaced plates disposed in the collector zone and extending into the ionizer zone, spaced discharge ionizing electrode members disposed in the ionizer zone alternately with that portion of the plates extending into the ionizer zone, and support means disposed and extending within the ionizer zone in insulated relationship to and transverse the spaced plates to support the discharge ionizing electrode members. In addition, the present invention provides an improved arrangement for the support means for the discharge ionizing electrode members and an improved arrangement for the supports for the spaced plates in the electrode assembly, including an improved arrangement for the insulators associated with such supports.

It is to be understood that various changes can be made by one skilled in the art in the arrangement, form and construction of the several parts of the structure disclosed herein without departing from the scope or spirit of the present invention.

Referring to the drawings which disclose one advantageous embodiment of the present invention:

FIGURE 1 is a partially broken front elevational view of the inventive plate electrode assembly;

FIGURE 2 is a partially broken plan view of the electrode assembly of FIGURE 1;

FIGURE 3 is an end view of the assembly of FIGURES 1 and 2;

FIGURE 4 is a reduced, perspective view of the assembly of FIGURES 1-3, and includes a housing in which

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the assembly can be mounted for operation in parallel arrangement with other similar assemblies;

FIGURE 5 is an enlarged perspective view of a portion of one of the bus bar members of the assembly of FIGURES 1-4;

FIGURE 6 is an enlarged perspective view of a portion of one of the support members for the discharge ionizing electrodes of the assembly;

FIGURE 7 is an enlarged perspective view of one end of a support member as disclosed in FIGURE 6 interlocked with one end of a bus bar member as disclosed in FIGURE 5;

FIGURE 8 is a slightly reduced end view of one of the plates of the charged electrode plate set included in the collector zone of the plate electrode assembly;

FIGURE 9 is a slightly reduced end view of one of the plates of the grounded electrode plate set included in the collector zone of the plate electrode assembly;

FIGURE 10 is a slightly reduced end view of one of the plates disposed in the collector zone of the plate electrode assembly which extends into the ionizer zone of the assembly.

Referring to FIGURES 1-4 of the drawings an inventive plate electrode structure is disclosed in assembled arrangement. This assembly includes spaced end plate members 2 which define therebetween a collector zone, indicated generally by the reference numeral 3, and an ionizer zone, indicated generally by the reference numeral 4. Each of the end plate members 2, which are herein disclosed to be of substantially rectangular shape, includes a vertical panel portion 6 and a border member 7 integral with such panel portion and extending at right angles thereto, the border members 7 of one end plate member 2 extending from its panel portion in a direction opposite to the border member of the other end plate member 2. As will be seen hereinafter, the border members 7 of end plate members 2 serve to shield several parts of the assembly immediately adjacent the outside faces of the panel portion 6 from the gas stream to be filtered and further serve as lifting and resting surfaces for the plate assembly of which they are a part.

Positioned between and supported from spaced end plate members 2 in collector zone 3 are a set of spaced charged plates 8 and a set of spaced grounded plates 9, the charged plates 8 being alternately disposed in spaced parallel relationship with the grounded plates 9. These sets of plates 8 and 9 in the advantageous embodiment of the invention disclosed are spaced from each other and supported from end members 2 by spacer bar members 11 and 12 respectively. Although not set forth in detail, the spacer bar members advantageously can be of a type like that disclosed in assignee's copending application, Serial No. 779,387, or, if desired, other types of spacer bar members can also be used.

Referring to FIGURE 8 of the drawings, it can be seen that each plate 8 is provided with a pair of clearance apertures or cut-aways 13 at either end of the plate and at the mid portion thereof, these apertures being of sufficient clearance to permit free and insulated passage therethrough of spacer bar members 12 which space and support the grounded plates 9 of the assembly. Each of plates 8 further is provided with a pair of spacer bar apertures 14 at either end of the plates and at the mid portions thereof, the spacer bar apertures 14 disclosed being contoured to cooperate with spacer bar members 11. As aforementioned, spacer bar members 11 are similar in nature to the spacer bars disclosed in assignee's copending application above noted and, when they are properly in position in the assembly, the charged plates 8 are spaced correctly and cannot be changed until spacer bars 11 are changed in position for removal. It is to be

noted (FIGURES 2 and 4) that spacer bars 11 are arranged in the assembly in such a manner that opposite ends thereof pass through clearance apertures or cut-aways 13 in the panel portions 6 of spaced end plate members 2, the ends of the spacer bars being spaced an insulated distance from the border members 7 which form part of the end plate members 2. Each end of each of bars 11 is threaded and is fastened by a nut to one arm of a bus bar member 16. In this connection, it is to be noted that each bus bar member 16 is con-
 10 toured in the form of a spider and, in the embodiment of the invention disclosed, two such bus bar members 16 of spider form, having three spider arms each are provided for each end plate member 2 to accommodate six spacer bar members 11 used to space and support the charged
 15 plates 8. It also is to be noted that the hub portion of each bus bar member 16 can be of circular contour and that it has a slot centrally disposed therein. This slot serves to accommodate one of two peg portions 17 extending from opposite sides of a disc shaped insulator member 18, the other peg portion of such insulator mem-
 20 ber 18 engaging in a slot provided therefor in panel portion 6 of end plate member 2. It further is to be noted that the diameter of each of the hub portions of the spider contoured bus bar members 16 is substantially less than the diameter of the disc shaped insulator member 18, this arrangement permitting ready accessibility to such insulator member 18 for cleaning purposes. In addition, it is to be noted that the peg and slot arrange-
 25 ment between bus bar member 16 and the insulator member 18 with which it cooperates, as well as the peg and slot arrangement between such insulator member 18 and the end plate members 2 from which the insulator mem-
 30 ber 18 is supported, permits for ready erection of the electrode plate assembly, a minimum of parts and operating steps being required.

To insure positive electrical contact to charged plates 8 through spacer bars 11 of the inventive electrode plate assembly, an electrical contact member 19 in the form of a flexible copper strip is provided for each of bus bar
 40 members 16. Each strip 19 extends between the ends of two of the arms of the member 16, one end of strip 19 being firmly connected to one arm of the member 16 and the opposite end being provided with a slot 21 (FIGURE 3) surrounding the end of spacer bar 11 to permit limited
 45 movement of contact 19. With such an arrangement, when the plate electrode assembly is mounted in a precipitator housing, the contact 19 yieldably engages against a mating contact in such housing, the movement of one end of contact 19 through the slot 21 connection with bar 11 avoiding metal fatigue which might other-
 50 wise occur from assembly and disassembly.

It is to be noted that in the plate electrode assembly disclosed the apertures 14 of charged plates 8 are arranged in such a manner that they are spaced from the edges of the plates (FIGURE 8). As a result, spacer bar members 11 are spaced from the edges of the plates with which they are associated and the ends of such
 55 spacer bar members 11, along with the electrical connections associated therewith including bus bars 16 and contacts 19, are spaced from the border members 7 of end plate members 2. Accordingly, it is possible to stack a number of plate electrode assemblies on support mem-
 60 bers positioned in a suitably grounded precipitator housing without incurring problems of electrical short circuiting, attention being directed to FIGURE 4 which schematically discloses such a housing 22 with support ledges 23 for the plate electrode assembly. It is to be understood that the plate electrode assembly of the present invention can be incorporated in any one of a num-
 65 ber of types of housing arrangements and that it is not limited in its use to the housing arrangement disclosed.

Referring to FIGURES 9 and 10 of the drawings, it can be seen that each of grounded plates 9 of the inven-
 70 tive plate electrode assembly, like each of plates 8, is

provided with a pair of clearance apertures or cut-aways 24 at either end of the plate and at the mid portion thereof, these apertures being of sufficient clearance to permit free and insulated passage therethrough of spacer
 5 bar members 11 which space and support the charged plates 8 of the assembly. Each of plates 9 further is provided with a pair of spacer bar apertures 26 at either end of the plates and at the mid portions thereof, the spacer bar apertures 26 being contoured to cooperate
 10 with spacer bar members 12. Like spacer bar members 11, spacer bar members 12 can be similar in nature to the spacer bars disclosed in assignee's copending applica-
 15 tion Serial No. 779,387 and, when they are properly in position in the assembly, grounded plates 9 are spaced correctly and cannot be changed until spacer bars 12 are changed in position for removal. In this connection, it is to be noted (FIGURES 2 and 4) that the opposite ends
 20 of spacer bars 12 are fastened to grounded panel portions 6 of the spaced end members 2, each end of each spacer bar 12 being threaded and fastened to the panel by a suitable cap nut. It also is to be noted that spacer bars 12 for the grounded plates are spaced closer to the
 25 edges of the plate electrode assembly than the spacer bars 11 so as to obtain maximum plate support, the spacer bars 11 for the charged plates being spaced only the required insulating distance from the edges of the grounded plates. It is to be understood that the fasten-
 30 ing means used at the ends of spacer bars 11 and spacer bars 12 is not to be restricted to the structure disclosed and other fastening means can be used if so desired.

Referring particularly to FIGURE 2, it can be seen that certain select plates of the set of grounded plates include portions which extend beyond the other plates of the set into what has been referred to above as the ionizer
 35 section 4 of the plate electrode assembly. Such select plates are herein designated by the reference numeral 9', attention being directed to FIGURE 10 of the drawings which discloses an end view of one of such plates. The portions of plates 9' which extend into ionizer zone 4
 40 serve as collector plates for the ionizer zone, cooperating with the spaced discharge ionizing electrode wires 31 which are disposed in ionizer zone 4 in alternate manner with such extended plate portions. Although the col-
 45 lector plates of ionizer section 4 are disclosed in the present embodiment of the invention as being extended portions of certain select plates of the set of grounded plates in the collector zone 3, it is to be understood that select plates of the set of charged plates 8 in the collector
 50 zone 3 also could be extended into the ionizer zone for this purpose, so long as a proper voltage gradient was maintained during cleaning operations between such charged plates and the discharge electrodes 31.

To support discharge electrodes 31 in vertically extended fashion between the extending portions of plates 9', the present invention provides a unique support ar-
 55 rangement which permits a short electrode plate assembly package that requires a minimum of parts and that can be readily assembled and installed. In addition, the present invention provides a support arrangement which occupies a minimum of space and thus presents a mini-
 60 mum of resistance to the fluid stream which passes through ionizer zone 4.

Referring particularly to FIGURES 4 and 10 of the drawings, it can be seen that the portions of selected
 65 plates 9' which extend into ionizer zone 4 and the portions of spaced end plate member 2 which define such ionizer zone 4 are each provided with a pair of spaced apertures 32, these apertures being so arranged that cor-
 70 responding apertures in the plates 9' and end plate members 2 are in alignment with each other. In the advantageous embodiment of the invention disclosed, aper-
 75 tures 32 are of tear-drop cross sectional contour and are arranged with respect to the discharge ionizing wires 31 to provide maximum plate area adjacent such wires. It is to be noted in the description set forth hereinafter

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that the tear-drop contour of aligned apertures 32 is of such dimension that it permits for the passage there-through of one of a pair of spaced assembled support means 33 used to support discharge electrode wires 31 in vertical position relative plates 9'.

Referring to FIGURES 4-7 of the drawings, it can be seen that each support means 33 includes a U-shaped channel member 34 arranged to extend transversely to plates 9' and end plate members 2 through the aligned apertures 32 in the plates 9' and end plate members 2. Each channel member 34 includes a row of slots 36 in each side of such channel, the slots of one row being in alignment with the slots of the other row to form aligned slot pairs. These slot pairs are spaced in such a manner relative each other as to alternate between extended portions of selected plates 9' when the channel is in assembled position. Each of the slot pairs is adapted to receive a resilient U-shaped end portion 37 of an electrode support pin 38 which end portion engages in the slot pair in spring-urged fashion. With portion 37 of each pin engaging snugly in spring-like fashion with the two aligned slots 36 to hold pin 38 firmly in place in channel 34, the opposite end of the pin is free to support a discharge electrode wire end. Once the pair of spaced support means, each including channel 34 and electrode support pins 38 assembled thereon, is properly in place in the electrode assembly, discharge electrode wires 31 are extended vertically between corresponding pins 38, the ends of wires 31 being fastened at indentations 40 provided near the ends of pins 38 opposite the U-shaped portions 37. In this connection, it is to be noted that pins 38 are so dimensioned and the indentations 40 so positioned thereon that the ends of discharge electrode wires 31 fasten to such indentations at points bordering horizontal planes determined by corresponding upper and lower edges of the plate 9' of the plate electrode assembly. Thus, a maximum length of the discharge electrode wires 31 can be utilized for ionization to provide maximum ionizing efficiency. It further is to be noted that the free ends of pins 38 are so contoured as not to extend beyond the edges of the plate electrode assembly so as to create undesirable protrusions.

To support channel members 34 in aligned and extended position through aligned apertures 32 of the electrode plate portions 9', a unique arrangement is provided in the present invention. Such arrangement not only is easy to assemble, requiring a minimum of parts for the assembly operation, but, in addition, it incorporates the electrical circuitry necessary to carry an electrical charge to discharge electrode wires 31. Referring to FIGURES 1-5 and 7 of the drawings, it can be seen that the inventive plate electrode assembly is disclosed to include a pair of spaced bus bar members 41 extending transverse to channel members 34 and fastened in insulated manner to opposite end plate members 2. In this connection, it is to be noted that each bus bar 41 is in the form of a narrow U-shaped channel member and has a pair of spaced slots disposed in the base portion thereof. Each of these slots serves to accommodate one of two peg portions 17, which peg portions extend from opposite sides of a disc shaped insulator member 18 similar to the disc shaped insulator members used for supporting the spider type bus bar members 16 above described. The other peg portion of each such insulator member 18 engages in a slot provided in panel portion 6 of end plate member 2. Similar to the insulator arrangement used for bus bar members 16, it is to be noted that the breadth of bus bar member 41 is substantially less than the diameter of each of disc shaped insulator members 18. This dimensioning permits ready accessibility to such insulator members 18 for cleaning purposes.

Once bus bar members 41 are mounted so that the pegs on one side of spaced insulator members 18 engage the slots in such bus bar members and the pegs on the opposite sides of such insulator members 18 engage their

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slots in panel portion 6 of end member 2, the pair of assembled support means 33, including channel members 34 and pins 38 mounted thereon, are passed through aligned apertures 32 in the extended plate portions of plates 9' and end plate members 32. When this has been accomplished, the ends of channel members 34 are then interlocked with the ends of bus bar members 41 in the manner described hereinafter.

Provided at each of the ends of each channel member 34 is a bifurcated right angle tab member 43. Tab member 43 is so sized that it interlocks with a slot in the form of a protruding saddle member 44 provided at either end of each bus bar member 41. In the advantageous embodiment of the invention disclosed, each saddle member 44 is integral with and formed from its bus bar member 41 and each tab member 43 is integral with and formed at an end of channel member 34. It is to be noted that channel members 34 are of such selected length that when tab members 43 interlock with saddle members 44, the channel members serve to hold the slots in the base of bus bar members 41 in engagement with the pegs 17 on one side of insulator members 18 and the pegs 17 on the opposite side of such insulator members in engagement with the slots in the panel portion 6 of end member 2. It is to be understood that, if desired, the bus bar members 41 can be made from slightly flexible material and the channel members 34 can be so dimensioned that their length is slightly less than the distance between corresponding bus bar members 41 when they have been mounted for assembly on opposite panel portions 6 of end members 2. With such an arrangement, when tabs 43 engage saddles 44, the bus bars 41 are slightly flexed to be held firmly in place with respect to their insulators 18 and to hold such insulators firmly in place with respect to panel portions 6.

In order to effect electrical contact from the bus bars in a main housing in which a plate electrode assembly is mounted to bus bars 41, each bus bar is provided with a conductive contact strip 46 (FIGURE 5). One end of strip 46 can be fastened by some suitable means such as riveting to the base of U-shaped bus bar member 41. The other end is allowed to float free relative such base to provide yieldability and to avoid possible metal fatigue which might otherwise occur in the strip from assembly and disassembly of the electrode plate assembly of which the strip is a part.

It is to be understood that the assembly of the sets of plates 3 and 9 is effected in a manner similar to that described in copending application Serial No. 779,387 with the use of a suitable jig (not shown). Once the sets of plates 3 and 9 have been assembled, the discharge ionizing electrode wires 31 are assembled between the extended portions of selected plates 9' in the rapid, straightforward manner described above. From the description herein, it should be obvious that such assembly can be accomplished with a minimum of operation, a minimum of parts, and without the special tools which have been required so often in assembling plate electrode units of the past.

The invention claimed is:

1. A plate electrode assembly for an electrostatic precipitator including an ionizer zone and a collector zone comprising a plurality of spaced plates disposed in said collector zone and extending into said ionizer zone, spaced discharge ionizing electrode members disposed in said ionizer zone alternately with that portion of said spaced plates extending into said ionizer zone, and support pins entirely disposed within said ionizer zone in insulated relationship to and transverse said spaced plates to support said discharge ionizing electrode members.
2. A plate electrode assembly for an electrostatic precipitator including an ionizer zone and a collector zone comprising a plurality of spaced plates disposed in said collector zone and extending into said ionizer zone, spaced discharge ionizing electrode members disposed in said ionizer zone alternately with that portion of said spaced

plates extending into said ionizer zone, support means for said discharge ionizing electrode members, and aperture means in said spaced plates to accommodate said support means extended in an insulated relationship therethrough.

3. A plate electrode assembly for an electrostatic precipitator including an ionizer zone and a collector zone comprising a plurality of spaced plates disposed in said collector zone and extending into said ionizer zone, spaced discharge ionizing electrode members disposed in said ionizer zone alternately with that portion of said spaced plates extending into said ionizer zone, support means for said discharge ionizing electrode members including support member means having spaced support pins assembled thereto and extending therefrom in a direction substantially normal to the longitudinal axis of such support member means, and aperture means in said spaced plates to permit said support means to extend therethrough in spaced insulated relationship therewith, said aperture means having a cross-sectional area greater than the cross-sectional area of said support means to permit insertion of said support means therethrough in assembled form, such cross-sectional area having a contour to provide maximum plate area adjacent said discharge ionizing members.

4. A plate electrode assembly for an electrostatic precipitator including an ionizer zone and a collector zone comprising sets of alternately arranged plates disposed in said collector zone with selected plates of one set having a portion thereof extending into said ionizer zone, spaced discharge ionizing electrode members disposed in said ionizer zone alternately with that portion of said selected plates extending into said ionizer zone, a pair of spaced apertures in that portion of each of said selected plates extending into said ionizer zone, the apertures in one selected plate being aligned with corresponding apertures in the selected plate adjacent thereto, and a pair of spaced support members extending transverse said plates through said pairs of aligned apertures in spaced insulated relationship with said selected plates to support said discharge ionizing electrode members therebetween.

5. A plate electrode assembly for an electrostatic precipitator including an ionizer zone and a collector zone comprising a pair of spaced end plate members defining said ionizer and collector zones therebetween, sets of alternately arranged plates disposed in said collector zone between said end plate members with selected plates of one set having a portion thereof extending into said ionizer zone, spaced discharge ionizing electrode members disposed in said ionizer zone alternately with that portion of said selected plates extending into said ionizer zone, a pair of spaced apertures in each of said selected plates which extend into said ionizer zone and in each of said end plate members, said aperture pairs being so arranged that corresponding apertures in the selected plates and end plate members are in alignment with each other, a pair of spaced support members extending transverse said selected plates and end plate members through said pairs of aligned apertures in spaced insulated relationship with said selected plates and end plate members, and a pair of spaced bus bar members fastened in insulated manner to opposite end plate members, said bus bar members extending in a direction transverse to and between said support members with the ends of said bus bar members being fastened to adjacent ends of said support members to maintain said support members in extended position through said apertures.

6. A plate electrode assembly for an electrostatic precipitator including an ionizer zone and a collector zone comprising a pair of spaced end plate members defining said ionizer and collector zones therebetween, sets of alternately arranged plates disposed in said collector zone between said end plate members with selected plates of one set having a portion thereof extending into said ionizer zone, spaced discharge ionizing electrode members disposed in said ionizer zone alternately with that portion of

said selected plates extending into said ionizer zone, a pair of spaced apertures in each of said selected plates extending into said ionizer zone, the apertures in one selected plate being aligned with the corresponding apertures in the selected plate adjacent thereto, a pair of spaced support members extending transverse said plates through said pairs of aligned apertures in spaced insulated relationship with said plates, a pair of spaced insulator members fastened to said end plate members in such a manner that one of said insulator members is fastened to the face of an end plate member which is the mirror image of the face of the plate end member to which the other insulator member of the pair is fastened, a pair of spaced bus bar members fastened through peg and slot arrangements to said insulator members, said bus bar members extending in a direction transverse to and between said support members with the ends of said bus bar members being removably interlocked with adjacent ends of said support members to maintain said support members in extended position through said aligned apertures, said support members being dimensioned to hold said bus bar members in peg and slot engagement with said insulator members.

7. The apparatus of claim 6, said insulator members engaging said end members through peg and slot arrangements.

8. A plate electrode assembly for an electrostatic precipitator including an ionizer zone and a collector zone comprising a pair of spaced end plate members defining said ionizer and collector zones therebetween, sets of alternately arranged plates disposed in said collector zone between said end plate members with selected plates of one set having a portion thereof extending into said ionizer zone, spaced discharged ionizing electrode members disposed in said ionizer zone alternately with that portion of said selected plates extending into said ionizer zone, a pair of spaced apertures in each of said selected plates extending into said ionizer zone and in each of said end plate members, the corresponding apertures in the selected plates and end plate members being in alignment with each other, a pair of spaced support members extending transverse said selected plates and said end plate members through said aligned apertures in spaced insulated relationship with said selected plates and end plate members, insulator members having peg portions at opposite ends thereof, said end plate members having slots disposed therein to receive the peg portions on one side of said insulator members and support the same along the outer faces of said end plate members, a pair of spaced bus bar members having slots therein to engage with the peg portions on the opposite sides of said insulator members, said bus bar members extending in a direction transverse to and between said support members with the ends of said bus bar members removably interlocking with adjacent ends of said support members to maintain said support members in extended position through said aligned apertures, said support members being dimensioned to hold said slots of said bus bar members in engagement with the pegs on one side of said insulator members and the pegs on the opposite side of said insulator members in engagement with the slots of said end plates members.

9. The apparatus of claim 8, said support members including support pins for said discharge ionizing electrode members, each of said support pins having an end portion fastened to said support member and an opposite end portion extending free to support an end of a discharge ionizing electrode member, said opposite end portion of each of said pins including indentation means to receive an end of a discharge electrode member to be fastened thereto, said support pin being so dimensioned and said indentation so positioned thereon that the end of a discharge electrode member fastens to said indentation at a point bordering a horizontal plane determined by corresponding edges of said selected plates of the plate electrode assembly.

10. The apparatus of claim 9, said apertures in said selected plates and end plate members being sized to permit insertion therethrough of said support members with said support pins assembled therein.

11. The apparatus of claim 9, the end portions of said support pins engaging with said support members being of U-shaped contour, said support members being formed from a U-shaped channel and including a row of slots in each side of said channel alternately between said plates with the slots in one row being aligned with corresponding slots in the other row so that the U-shaped end portions of said support pins engage in aligned slots to be held firmly in position.

12. In an electrostatic precipitator having a plurality of spaced plates with discharge ionizing electrode members extending alternately therebetween to form a plate electrode assembly, a support arrangement for said discharge ionizing electrode members comprising a support member and support pins for said discharge ionizing electrode members, each of said support pins having an end portion fastened to said support member and an opposite end portion extending free to support an end of a discharge ionizing electrode member, said opposite end portion of each of said pins including indentation means to receive an end of a discharge electrode member to be fastened thereto, each of said support pins being so dimensioned and said indentation so positioned thereon that the end of a discharge electrode member fastens to said indentation at a point substantially within a plane parallel to the gas flow path through said precipitator and determined by corresponding edges of said spaced plates of the plate electrode assembly.

13. In an electrostatic precipitator having a plurality of spaced plates positioned between a pair of spaced end plate members and having discharge electrode members extending alternately between said spaced plates, a support arrangement for said discharge electrode members comprising pairs of spaced apertures in each of said spaced plates, the apertures in one plate being aligned with the apertures in the plate adjacent thereto, a pair of spaced support members extending transverse said plates through said pairs of aligned apertures in insulated relationship with said plates, a pair of spaced insulator members connected to said end plate members in such a manner that one of said insulator members is fastened to the face of an end plate member which is the mirror image of the face of the other end plate member to which the other insulator member of the pair is fastened, a pair of spaced bus bar members fastened through peg and slot arrangements to said insulator members, said bus bar members extending in a direction transverse to and between said support members with the ends of said bus bar members being removably interlocked with adjacent ends of said support members to maintain said support members in extended position through said aligned apertures in said spaced plates, said support members being dimensioned to hold said bus bar members in peg and slot engagement with said insulator members.

14. The apparatus of claim 13, said insulator members engaging said end plate members through peg and slot arrangements.

15. In an electrostatic precipitator having a plurality of spaced plates positioned between a pair of spaced end plate members and having discharge electrode members extending alternately between said plates, a support arrangement for said discharge electrode members comprising pairs of spaced apertures in each of said spaced plates and in said end plate members, the corresponding apertures in said spaced plates and end plate members being in alignment with each other, a pair of spaced support members extending transverse said spaced plates and end plate members through said aligned apertures in spaced insulated relationship with said spaced plates and said end plate member, a pair of spaced bus bar members extend-

ing in a direction transverse to and between said support members with the ends of said bus bar members removably interlocking with adjacent end of said support members, and insulator members positioned between said bus bar members and said end plate members to insulate said bus bar members from said end plate members, said insulator members engaging with said end plate members and with said bus bar members in peg and slot arrangements, said support members being dimensioned to hold said bus bars in engagement with said insulator members and said insulator members in engagement with said end plate members, said support members thus being maintained in extended spaced insulated position through said aligned apertures.

16. A plate electrode assembly for an electrostatic precipitator including an ionizer zone and a collector zone comprising a pair of spaced end plate members defining said ionizer and collector zones therebetween, sets of spaced charged and grounded plates alternately disposed in said collector zone between said end plate members with selected plates of said set of grounded plates having a portion thereof extending into said ionizer zone, spaced discharge ionizing electrode members disposed in said ionizer zone alternately with that portion of said grounded plates extending into said ionizer zone, a first spacer bar support means disposed in said collector zone for said charged set of plates extending transverse said charged, grounded and end plate members in insulated relationship with said grounded and end plate members, a second spaced bar support means disposed in said collector zone for said grounded set of plates extending transverse said grounded and charged plates in insulated relationship with said charged plates and connected to said end plate members, said first spacer bar support means being spaced an insulated distance from said second spacer bar support means and from the edges of said end plate members, a third support means disposed within said ionizer zone to support said discharge ionizing electrode members, insulator means connected to said end plate members, bus bar means connected to said insulator means and to said first and third support means, said bus bar means being of narrower cross section than said insulator means to permit ready access to said insulator means for cleaning, and yieldable electrical contact strips connected to said bus bar means, said contact strips having one end fastened to said bus bar means and the other floatingly mounted with respect to said bus bar means to permit limited transverse movement of said strips.

17. A plate electrode assembly for an electrostatic precipitator housing comprising sets of alternately disposed spaced charged and grounded plates, a first spacer bar support means for said charged set of plates extending transverse said charged and grounded plates in insulated relationship with said grounded plates, and a second spacer bar support means for said grounded plates extending transverse said charged and grounded plates, said second support means being insulated from said first support means and said charged plates, said first spacer bar support means for said charged set of plates being spaced only the required insulating distance from the edges of said grounded plates to provide electrical clearance when said plate assembly is inserted into its electrostatic precipitator housing and said second spacer bar support means being spaced closer to the edges of said assembly than said first spacer bar support means to permit maximum support of the plates of said assembly.

18. A plate electrode assembly for an electrostatic precipitator housing comprising a pair of spaced end plate members, sets of spaced charged and grounded plates alternately disposed between said end plate members, spacer bar support means for said sets of charged and grounded plates extending transverse said plates, insulator means having one side thereof connected to said end plate members and bus bar means connected to the other side of said insulator means and to said spacer bar support means

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for said set of charged plates, said bus bar means being of narrower cross section than said insulator means to permit ready access to said insulator means for cleaning.

19. In a plate electrode assembly having sets of alternately disposed charged and grounded plates and including a bus bar member electrically connected to said charged plates, an electrical contact arrangement for said bus bar member comprising a bowed, flexible electrical contact strip, said strip having one end thereof fastened firmly to said bus bar member and having the opposite end connected to said bus bar member through a slot and pin

arrangement, the slot being sized with respect to the diameter of the pin to permit relative movement therebetween.

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