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Dyla et al.

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[54] ELECTRO-PRECIPITATORS

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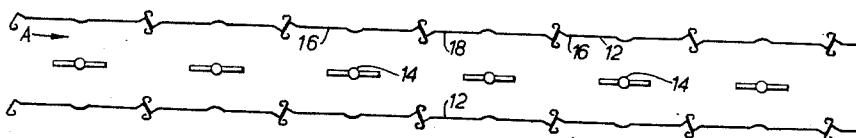
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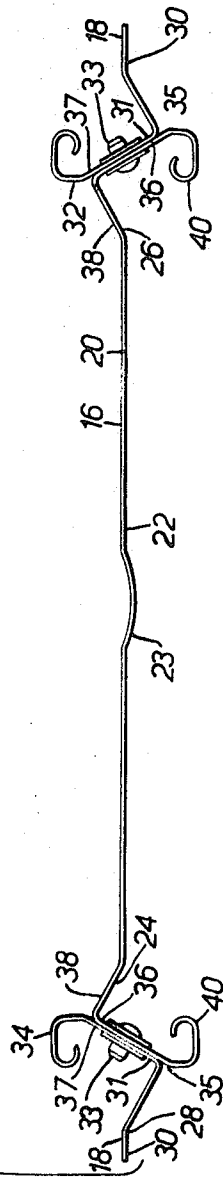
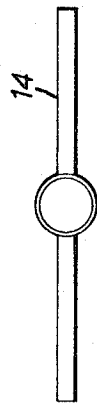
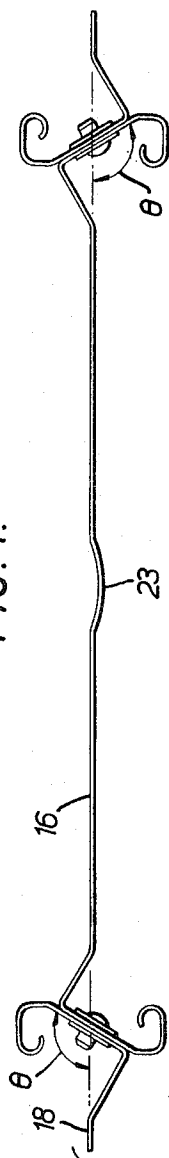
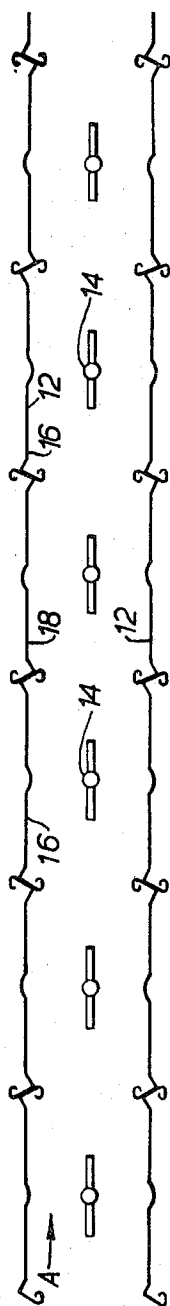
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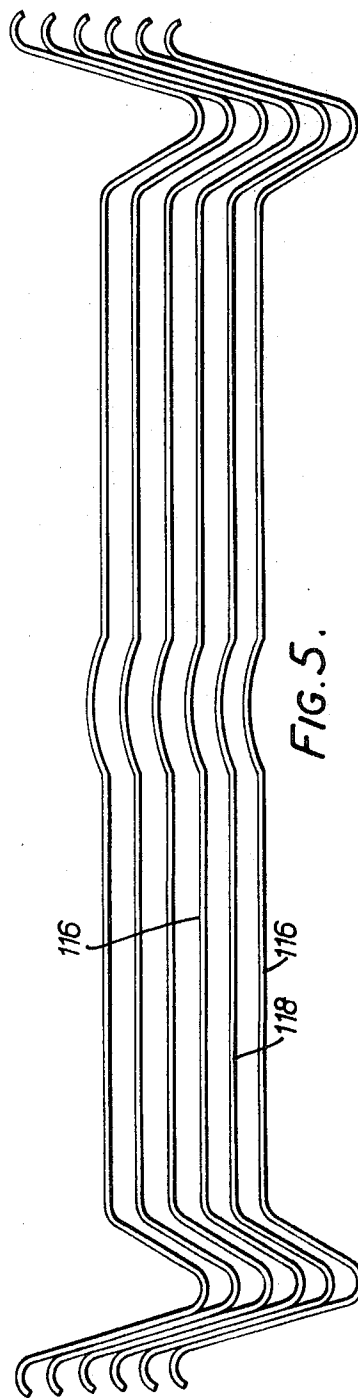
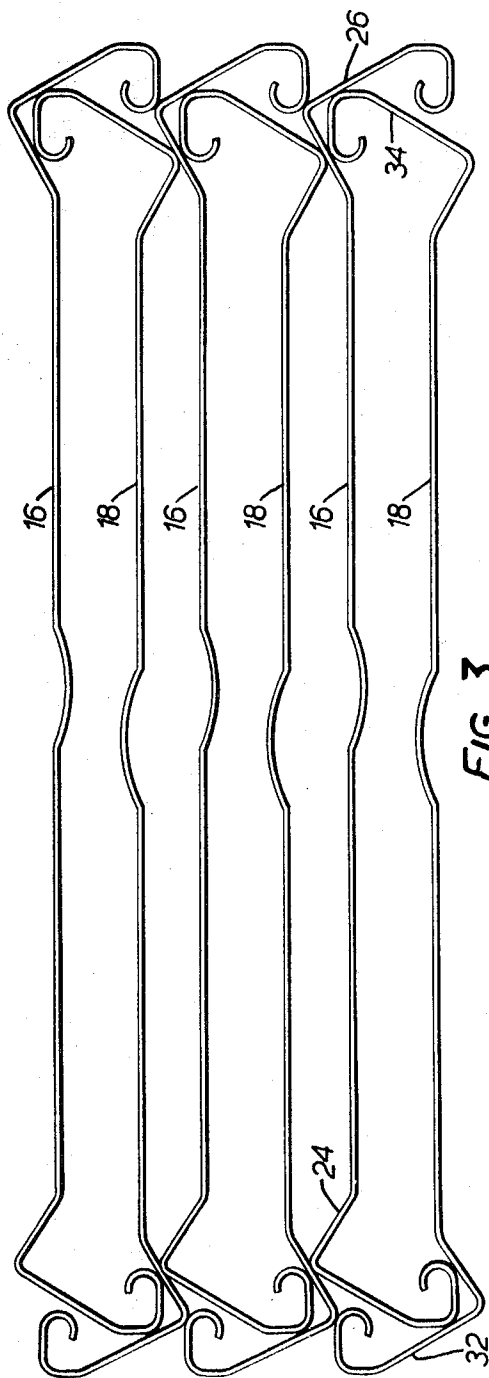
[57] ABSTRACT

An electro-precipitator collector electrode comprises a plurality of elements each comprising a plate member which comprises (in profile) a substantially straight central portion and two bent end portions extending from either end of the central portion. Each bent end portion engages and is directly and positively secured to an adjacent bent end portion of an adjacent element, and each bent end portion comprises a surface which (in profile) is generally inclined at an angle greater than 90° to said central portion and engages a corresponding surface of the said adjacent bent end portion; this angle of the surface facilitates access of a fastening tool during erection. Adjacent collector electrodes are braced together along top edges thereof.

11 Claims, 10 Drawing Figures







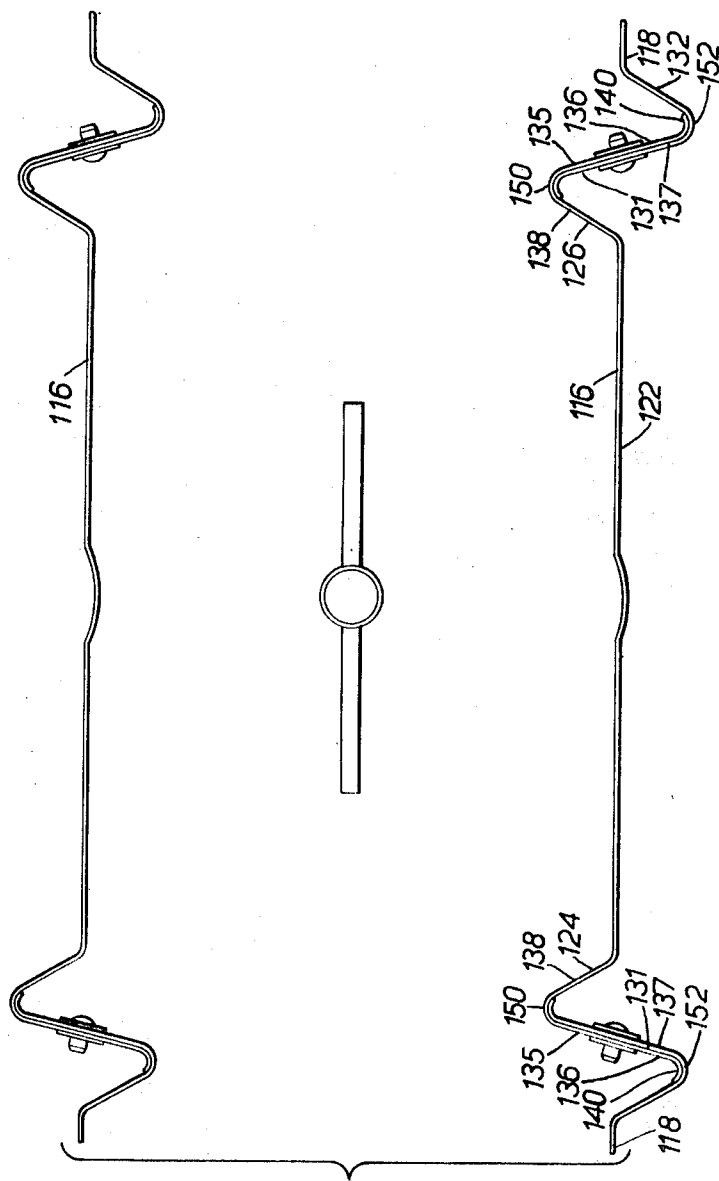


FIG. 4.

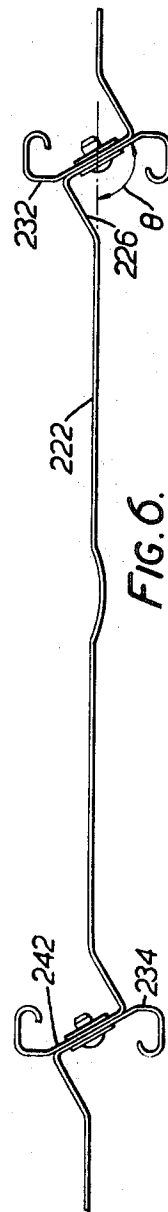


FIG. 6.

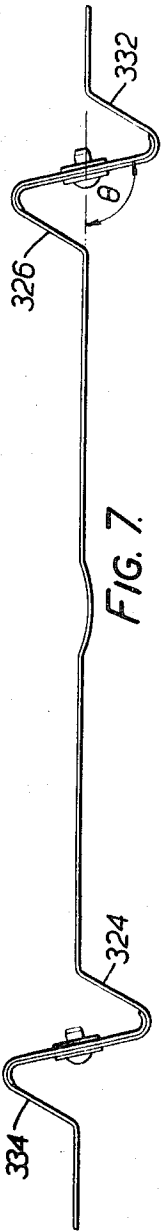


FIG. 7.

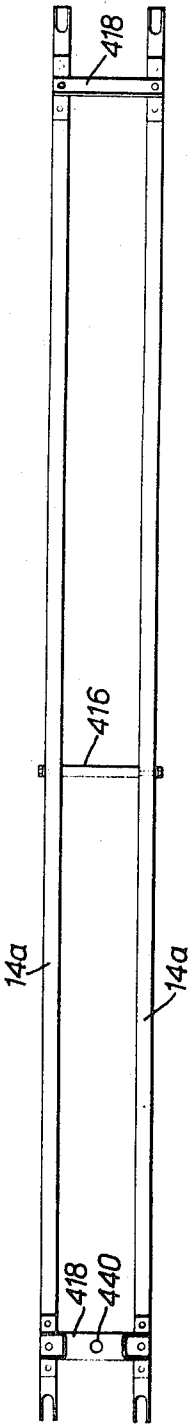


FIG. 10.

ELECTRO-PRECIPIATORS

This invention is concerned with improvements in or relating to Cottrell electro-precipitators suitable for use in removing dust and the like from gases.

A Cottrell electro-precipitator is a well known type of electro-precipitator which generally comprises a casing, a plurality of spaced collector electrodes in the casing, a plurality of discharge electrodes located in the spaces between the collector electrodes, and means for supporting the collector electrodes and discharge electrodes in the casing. The discharge electrodes are charged to a high potential and the collector electrodes are grounded; corona discharge takes place between the discharge electrodes and the collector electrodes resulting in dust and the like being collected in the collector electrodes. For a full discussion of Cottrell electro-precipitators reference may be made to "Chemical Engineers Handbook" by John H. Perry.

In such electro-precipitators design of the collector electrodes on which the dust is precipitated is important.

It is an object of the invention to provide an improved electro-precipitator collector electrode element.

It is another object of the invention to provide an improved electro-precipitator collector electrode.

It is another object of the invention to provide an improved electro-precipitator collector electrode assembly comprising a plurality of collector electrodes braced together.

It is another object of the invention to provide an improved electro-precipitator.

The invention provides in a Cottrell electro-precipitator a collector electrode assembly comprising a plurality of spaced collector electrodes and bracing means bracing the electrodes together each electrode comprising a plurality of elements each comprising a plate member which comprises (in profile) a substantially straight central portion and two bent end portions extending from either end of the central portion and each bent end portion engaging and being directly and positively secured to an adjacent bent end portion of an adjacent element, and each bent end portion comprising a surface which (in profile) is generally inclined at an angle greater than 90° to said central portion and engages a corresponding surface of the said adjacent bent end portion.

Said surface is preferably flat but it will be realized that it may be curved somewhat.

The adjacent bent end portions may be secured together by, for example, a load-bearing non-reversible fastener.

By the expression "non-reversible fastener" we mean a fastener which once fastened is devoid of any normal unfastening function. Examples of non-reversible fasteners include various forms of rivets, but nuts and bolts would not be included.

The electrode elements are preferably shaped for ease of stacking for storage and transport.

The invention also provides an electro-precipitator comprising a casing, a plurality of spaced collector electrode assemblies, and a plurality of discharge electrodes located in spaces between the collector electrodes of the assemblies, each collector electrode assembly comprising (a) two vertical generally planar parallel collector electrodes each of which is secured to a horizontally elongated tubular support member mounted in the casing and from which the collector electrode extends downwardly, and which electrode is also secured to a lower support member from which the collector electrode extends upwardly, and (b) bracing means connecting together the support members of said assembly said bracing means comprising a tubular assembly which extends between the support members at right angles thereto and comprises two horizontal tubular members one secured in each support member said two tubular members being opposite and aligned, a further tubular member aligned with and extending between said two aligned tubular members and a fastener extending through the three aligned tubular members to secure said tubular members together; each collector electrode comprising a plurality of elements each comprising a plate

member which comprises (in profile) a substantially straight central portion and two bent end portions extending from either end of the central portion and each bent end portion engaging and being directly and positively secured to an adjacent bent end portion of an adjacent element, and each bent end portion comprising a surface which (in profile) is generally inclined at an angle greater than 90° to said central portion, whereby access of fastening means is facilitated, and engages a corresponding surface of the said adjacent bent end portion; each collector electrode together with its upper and lower support members providing a stressed skin-deep beam construction.

There now follows a description, to be read with reference to the accompanying drawings, of an electro-precipitator embodying the invention. This description is given by way of example of the invention only and not by way of limitation thereof.

In the accompanying drawings:

FIG. 1 shows a plan view of parts of an electro-precipitator embodying the invention;

FIG. 2 shows an enlarged plan view of parts shown in FIG. 1;

FIG. 3 shows a stack of electrode elements;

FIG. 4 shows a view corresponding to FIG. 2 of parts of a modified electro-precipitator embodying the invention;

FIG. 5 shows a stack of modified electrode elements;

FIG. 6 shows a plan view of parts of a collector electrode of another modified electro-precipitator embodying the invention;

FIG. 7 shows a view corresponding to FIG. 6 of parts of a collector electrode of a further modified electro-precipitator embodying the invention;

FIG. 8 shows a diagrammatic view of an electro-precipitator;

FIG. 9 is a sectional end view of parts of an electro-precipitator collector electrode assembly; and

FIG. 10 is a top plan view showing parts shown in FIG. 9.

The electro-precipitator embodying the invention comprises (FIG. 8) a casing 2, a plurality of spaced collector electrode assemblies 4 (only one of which is shown) independently supported in the casing 2, and a plurality of discharge electrodes 14 of known type supported in the casing 2 and located in the spaces between the collector electrodes (see FIG. 1). The precipitator comprises a gas inlet 3 and a gas outlet 5, through which dust-laden gas to be cleaned is passed in the direction of the arrows X. The casing has a roof 7 and an outlet opening 9 for precipitated dust. The precipitator also comprises means (not shown) for supplying high potential to the discharge electrodes 14.

Each collector electrode assembly 4 comprises two (FIG. 9) spaced vertical generally planar parallel collector electrodes 12 which are braced together. Each collector electrode 12 is secured to and extends downwardly from a horizontally elongated tubular support member 14a (FIGS. 9 and 10) of vertically elongated, rectangular cross-section; each support member 14a is mounted in the casing of the electro-precipitator by brackets 10.

In the operation of the apparatus the collector electrodes 12 are earthed and the discharge electrodes 14 are charged to a high potential; as a result dust is precipitated from the gas and collects on the collector electrodes 12.

The discharge electrodes 14 are arranged in generally planar rows (only one of which is shown in FIG. 1) parallel to the direction of gas flow which is indicated by the arrow A in FIG. 1, the rows alternating with the collector electrodes 12.

Each collector electrode 12 (FIGS. 1 and 2) comprises a plurality of electrode elements 16, 18 and elements 16 alternating with the elements 18. Each element 16 has the same plan view profile and comprises a cold rolled light gauge metal vertically elongated plate member 20 (FIG. 2) which comprises (in plan view profile) a long substantially straight central portion 22 and two short bent end portions 24, 26 integral with the portion 22 and extending from either end thereof; the

end portion 24 is leading with respect to the gas flow and the end portion 26 trailing; the end portions 24, 26 lead off from the same side of the central portion 22; the central portion 22 comprises a small curved portion 23 for rigidity. Each element 18 also has the same plan view profile, which is complementary to that of the elements 16, and comprises a light gauge metal vertically elongated plate member 28 which comprises (in plan view profile) a long substantially straight central portion 30 and two short bent end portions 32, 34 integral with the portion 30 and extending from either end thereof; the end portion 32 is leading with respect to the gas flow and the end portion 34 trailing; the end portions 32, 34 lead off from the opposite side of the central portion 28 to the end portions 24, 26. The central portions 22, 30 of each electrode element 16, 18 are collinear, and adjacent end portions 24, 34 and 26, 32 engage and are secured together directly and positively.

Each pair of adjacent end portions 24, 34 and 26, 32 are secured together directly and positively by a rivet 33 which extends through the adjacent end portions. The rivet 33 is for example, a load-bearing non-reversible rivet of the kind known as an "Avdel" rivet; alternatively the rivet 33 is replaced by a conventional load-bearing bolt and nut or the securing together may be carried out by welding. Each end portion 24, 26 comprises a straight central portion 35 providing an outer flat surface 31 which is inclined at an angle θ greater than 90° to the central portion 22 and is in superficial engagement with a corresponding outer flat surface 36 of a straight central portion 37 of the adjacent end portion 34, 32; the appropriate rivet 33 passes through the central portions 35, 37.

Each end portion 24, 26 comprises (in profile) a straight portion 38 which is inclined to the central portion 22 and leads therefrom to the central portion 35 which extends at right angles from the portion 38 across the plane of the central portion 22. Each end portion 24, 26 also comprises a hook-shaped end portion 40 which leads from the central portion 35 in a direction generally away from the adjacent end portion 34, 32. The end portions 34, 32 are of complementary profile to the end portions 24, 26.

The end portions 26, 34 define pockets which face the direction of gas flow in the operation of the electro-precipitator and serve to facilitate collection of precipitated dust.

It will be realized that the electrode elements 16, 18 are shaped for ease of stacking for storage and transport prior to erection. A stack of elements 16, 18 is shown in FIG. 3 which illustrates the manner of stacking in which the end portions 24, 34 are received within the end portions 32, 26 respectively.

The modified form of electro-precipitator parts of which are shown in FIG. 4 resembles the electro-precipitator described with reference to FIGS. 1 and 2 in many respects and is described in so far as it differs therefrom.

Said modified form comprises elements 116, 118 corresponding generally to the elements 16, 18. Each element 116 comprises end portions 124, 126 corresponding to the end portions 24, 26 and end portions 132, 134 corresponding to the end portions 32, 34.

Each end portion 124, 126 comprises a straight central portion 135 providing an inner flat surface 131 which is in superficial engagement with a corresponding inner flat surface 136 of a straight central portion 137 of the adjacent end portion 134, 132.

Each end portion 124, 126 comprises (in profile) a straight portion 138 which is inclined to a central portion 122 of the element 116 and leads from the central portion 122 to a curved portion 150 of said end portion 124, 126 which curved portion 150 leads from the portion 138 to the central portion 135. Each end portion 124, 126 also comprises a curved end portion 140 which leads from the central portion 135 generally along the contour of the adjacent end portion 134, 132 so that the end portion 140 is in superficial engagement with an inner surface of a curved portion 152 of the adjacent end portion 134, 132 which portion 152 corresponds to the portion 150 of each end portion 124, 126; thus the portion

152 shields the portion 140 to minimize the risk of flashover from a discharge electrode to the end of the portion 140.

Again it will be realized that the elements 116, 118 are easily stacked and a stack of elements 116, 118 is illustrated in FIG. 5, the stacked elements 116, 118 being in nested relationship.

FIG. 6 shows parts of a modified collector electrode corresponding in many respects to the collector electrodes 16; in the modified electrode end portions 224, 226 corresponding to the end portions 24, 26 lead off from opposite sides of a central portion 222, corresponding to the central portion 22, instead of from the same side thereof. End portions 232, 234 corresponding to the end portions 32, 34 similarly lead off from opposite sides.

FIG. 7 shows parts of a modified collector electrode, corresponding in many respects to the collector electrodes 116; in this modified electrode end portions 324, 326 corresponding to the end portions 124, 126 lead off from opposite sides in a similar fashion to the end portions 224, 226. End portions 332, 334 corresponding to the end portions 132, 134 similarly lead off from opposite sides.

It will be realized that the angle and general arrangements of the central portions 35, 37 and corresponding parts shown in FIGS. 4 to 7, facilitate access of fastening means during erection; for example, access is facilitated of the rivets themselves and of a fastening tool to fasten the rivets, or of other fasteners and other kinds of fastening tools as appropriate.

The central portions 35, 37 and corresponding parts shown in FIG. 6 are preferably inclined at an angle (θ) between 95° and 175° (more preferably between 95° and 150°) to the central portion 22, for example about 120° . The central portions 135, 137 and corresponding parts shown in FIG. 7 are preferably at an angle between 95° and 175° (more preferably between 95° and 150°) to the central portion 122, for example about 105° .

The collector electrode assembly shown in FIGS. 9 and 10 comprises bracing means connecting together the support members 14a of the assembly to brace the collector electrodes of the assembly together. The bracing means comprises a tubular assembly 416 extending between the support members 14a at right angles thereto and being centrally located intermediate end portions of the tubular members 14a. The bracing means also comprises girder members 418 extending between the support members 14a and located adjacent opposite end portions thereof.

The tubular assembly 416 comprises a tubular member 420 of circular cross-section extending transversely through and secured in one member 14a and a tubular member 422 also of circular cross-section extending transversely through and secured in the other member 14a; each member 420, 422 is flush with the outside of its member 14a and the member 420 is opposite to and aligned with the member 422; the assembly 416 also comprises a tubular member 424 which is aligned with and extends between the tubular members 420, 422; the appropriate collector electrode 12 is connected to the tubular member 14a by bolting (or riveting—not shown) to a series of straps 500 which are welded to the tubular member 14a and bolted (or riveted by Avdel rivets not shown) to the central portions 22 of the collector electrode elements 16, 18 the straps 500 being horizontally spaced along the collector electrode 12 (FIG. 8) with a pair of straps 500 on either side of each pair of adjacent bent end portions 24, 34; 26, 32. The tubular assembly also comprises a rod 428 which extends through the channel members 426, the tubular members 420, 422 and the tubular member 424 and is threaded at either end, with nuts 430 screwed thereonto to secure the tubular members 420, 422, 424 together, thereby connecting the members 14a together. Each collector electrode 12 is also secured to a bottom bar 431 (FIG. 8) from which the electrode 12 extends upwardly. The electrode 12 is connected to the bar 431 by straps 502 similar to the straps 500, the straps 502 being welded to the bar 431 and bolted (or riveted by "Avdel rivets" not shown) to the central portions 22 of the collector elec-

trode elements 16, 18 the straps 502 being horizontally spaced in a corresponding manner to the straps 500 (FIG. 7) from which the electrode 12 extends upwardly. The bottom bars 431 are not braced together but are restrained against excessive movement by means not shown. Each collector electrode 12 together with its upper support member 14a and its bottom bar 431 provides a stressed skin-deep beam construction. In a modification the straps 500 are replaced by straps (not shown) which extend around the cross-section of the tubular member 14a, being secured therearound by bolts and nuts or "Avdel" rivets which also secure the collector electrode to the straps.

The girder members 418 are bolted (or riveted by "Avdel" rivets not shown) to the tubular members 14a and one girder member 418 comprises an upstanding rapping anvil 440 arranged to receive rapping blows by rapping mechanism (not shown) in the operation of the electro-precipitator to dislodge precipitated dust from the electrodes 12 of the assembly.

We claim:

1. In a Cottrell electro-precipitator, a collector electrode assembly comprising a plurality of spaced collector electrodes and bracing means bracing the electrodes together, each electrode comprising

a plurality of elements, each comprising a plate member which comprises, in profile, a substantially straight central portion and two bent end portions extending from either end of the central portion, each bent end portion engaging an adjacent bent end portion of an adjacent element, and each bent end portion comprising a surface which, in profile, is generally inclined at an angle greater than 90° to said central portion and engages a corresponding surface of the said adjacent bent end portion, and

means for directly and positively securing the adjacent bent end portions together;

the assembly also comprising a plurality of collector electrode support members, and means for securing each electrode of said assembly to a said collector electrode support member from which the electrode extends downwardly when the assembly is in use, and wherein the bracing means connects together adjacent support members of different collector electrodes of said assembly;

said bracing means comprising a tubular assembly which extends between two adjacent support members and comprises two outer tubular members, one secured to each support member and said two tubular members being opposite and aligned, a further, inner tubular member aligned with and extending between said two aligned tubular members and a fastener extending through the three aligned tubular members to secure said tubular members together.

2. An electrode assembly according to claim 1 wherein in each collector electrode each said surface is flat and said surfaces are in superficial engagement.

3. An electrode assembly according to claim 1, wherein in each collector electrode each bent end portion comprises

a straight central part providing said surface and extending across the plane of the straight central portion of the plate member,

a straight part which is inclined to the straight central portion of the plate member and leads therefrom to the central part, and

a hook-shaped end part which leads from the central part in a direction generally away from the adjacent bent end portion.

4. An electrode assembly according to claim 3 wherein in

each collector electrode the bent end portions define pockets adapted to face the direction of gas flow.

5. An electrode assembly according to claim 3 wherein in said collector electrode each surface is inclined at an angle of about 120° to the central portion.

6. An electrode assembly according to claim 1 wherein in each collector electrode each bent end portion comprises a straight central part providing said surface and extending across the plane of the straight central portion of the plate member,

a straight part which is inclined to the straight central portion of the plate member and leads therefrom,

a curved part which leads from said last-mentioned straight part to said central part, and

a curved end part which leads from the central part generally along the contour of the adjacent bent end portion.

7. An electrode assembly according to claim 6 wherein in said collector electrode each surface is inclined at an angle of about 105° to the central portion.

8. An electrode assembly according to claim 1 wherein in each collector electrode the securing means comprises load-bearing non-reversible fasteners extending through said surfaces of the bent end portions.

9. An electrode assembly according to claim 1 wherein in each collector electrode each surface is inclined at an angle between 95° and 175° to the central portion.

10. A collector electrode assembly according to claim 1 comprising two, only, collector electrodes.

11. An electro-precipitator comprising a casing, a plurality of spaced collector electrode assemblies, a plurality of discharge electrodes located in spaces between the collector electrodes of the assemblies, and means for supporting the collector electrodes and discharge electrodes in the casing each collector electrode assembly comprising (a) two upper horizontally elongated tubular support members (b) two lower horizontally elongated support members (c) two vertical generally planar parallel collector electrodes each of which is secured to a said upper support member from which the collector electrode extends downwardly and which electrode is also secured to a said lower support member from which the collector electrode extends upwardly, and (d) bracing means connecting together the support members of said assembly said bracing means comprising a tubular assembly which extends between the support members at right angles thereto and comprises two horizontal tubular members one secured in each support member said two tubular members being opposite and aligned, a further tubular member aligned with and extending between said two aligned tubular members and a fastener extending through the three aligned tubular members to secure said tubular members together; each collector electrode comprising (i) a plurality of elements each comprising a plate member which comprises (in profile) a substantially straight central portion and two bent end portions extending from either end of the central portion and each bent end portion engaging an adjacent bent end portion of an adjacent element, and each bent end portion comprising a surface which (in profile) is generally inclined at an angle greater than 90° to said central portion, whereby access of fastening means is facilitated, and engages a corresponding surface of the said adjacent bent end portion and (ii) means for directly and positively securing the adjacent bent end portions together; each collector electrode together with its upper and lower support members providing a stressed skin-deep beam construction.

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