United States Patent

Dyla et al.

[15] **3,688,475**

[45] **Sept. 5, 1972**

[54] **ELECTRO-PRECIPITATION**

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Oct. 17, 1969 Great Britain.....51,007/69

[52] **U.S. Cl.**.....**55/148,** 55/151
[51] **Int. Cl.**.....**B02c 3/41**
[58] **Field of Search**.....55/146, 147, 148, 150, 151, 55/152, 153

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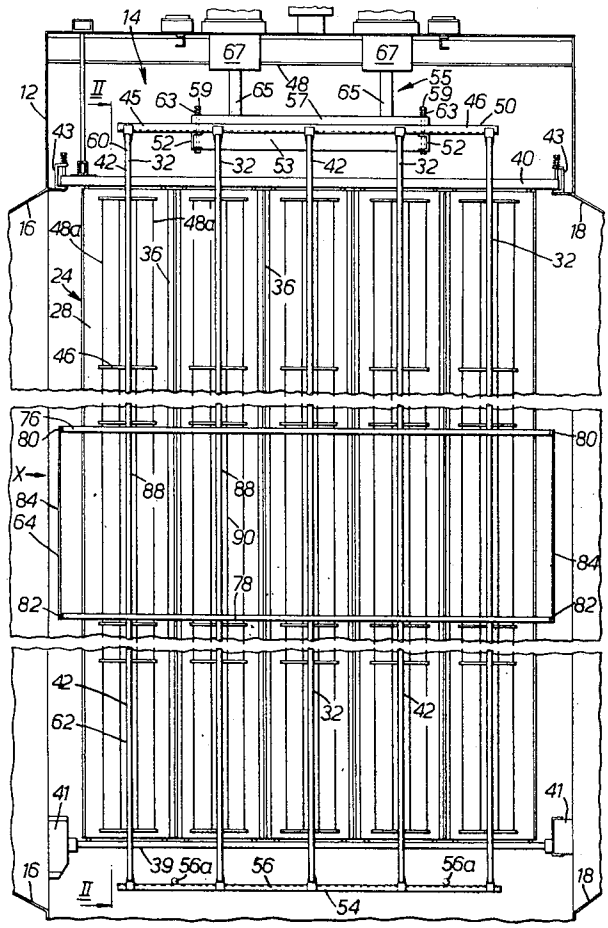
[57] **ABSTRACT**

An electro-precipitator discharge electrode support structure comprises an upper portion comprising a plurality of vertical elongated discharge electrode support masts which extend upwardly from a central region of the structure, and a lower portion also comprising a plurality of vertical elongated discharge electrodes support masts which are non integral with the support masts of the upper portion and extend downwardly from the central region. A rectangular bracing cage is provided at the central region to connect the support masts of the upper portion to the support masts of the lower portion so that relative movement between the upper and lower ends of the structure is minimized.

8 Claims, 11 Drawing Figures



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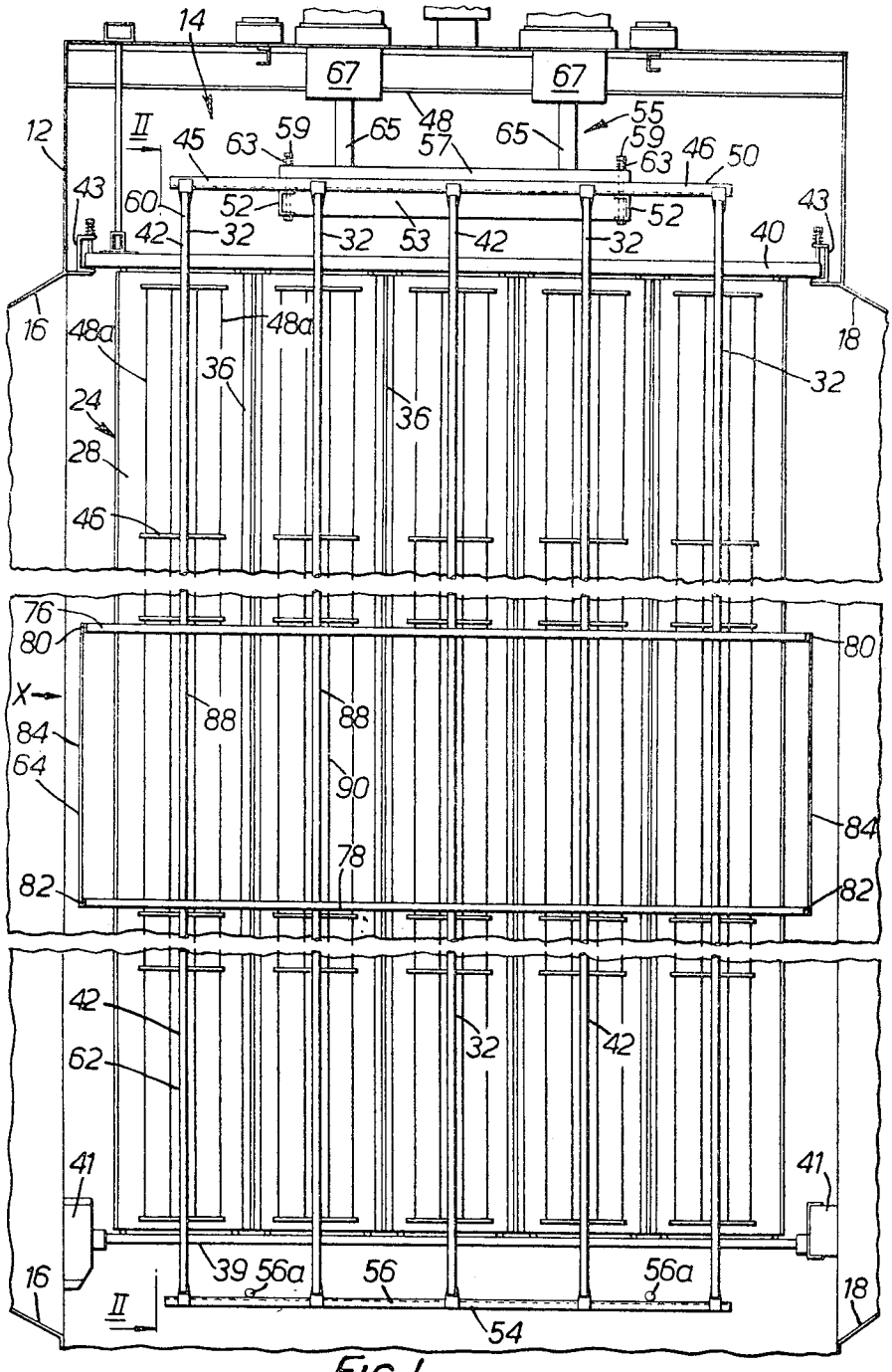

FIG. 1.

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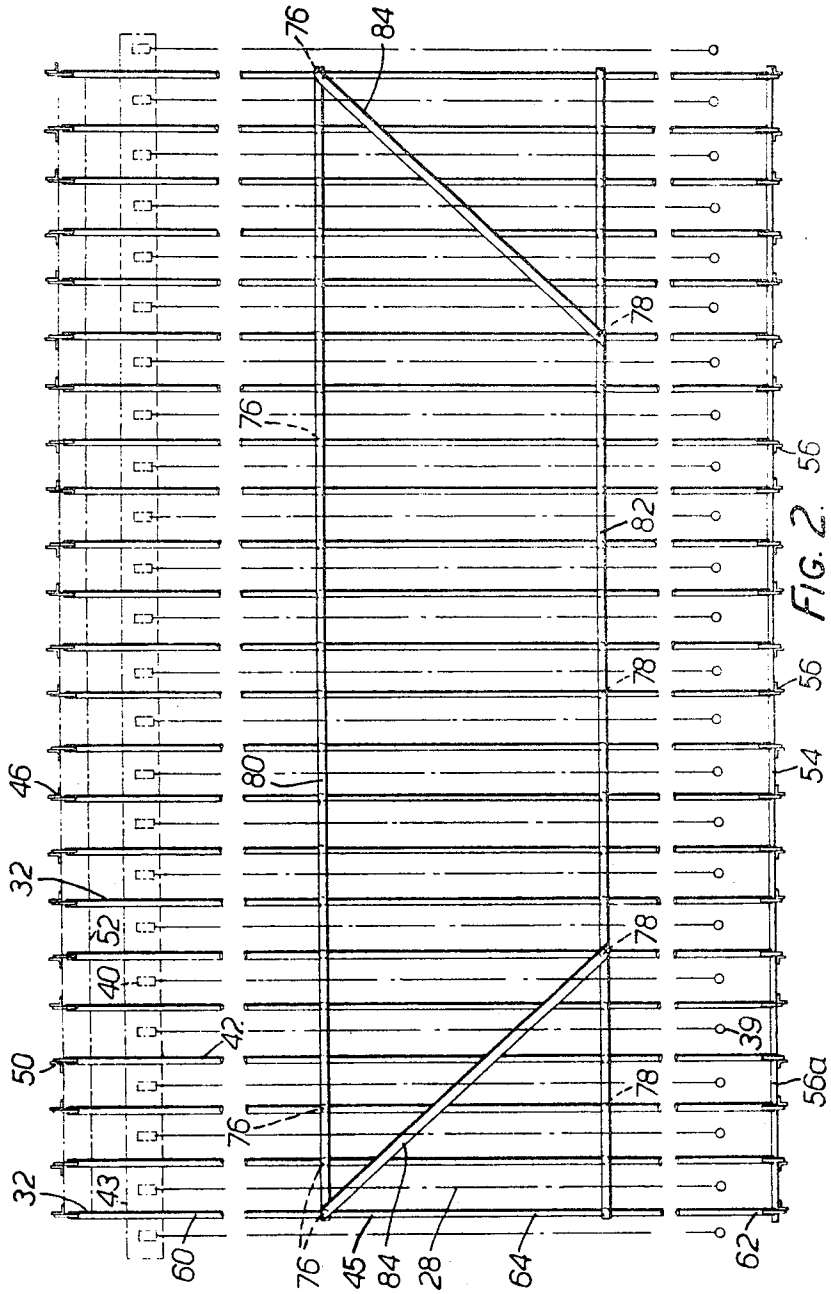

FIG. 2.

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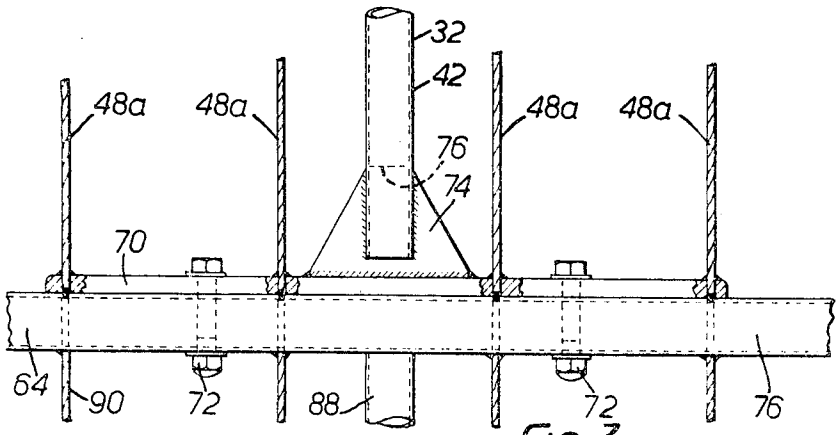

FIG. 3.

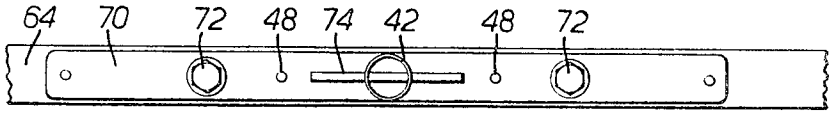

FIG. 4.

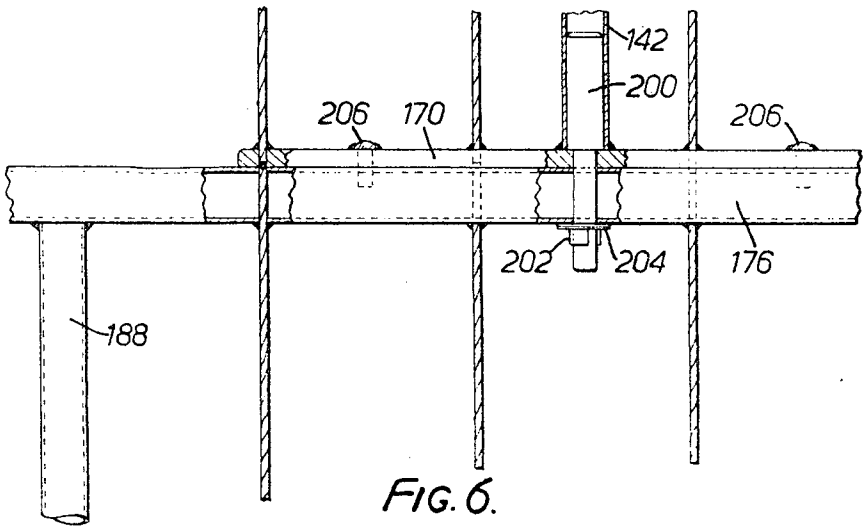

FIG. 6.

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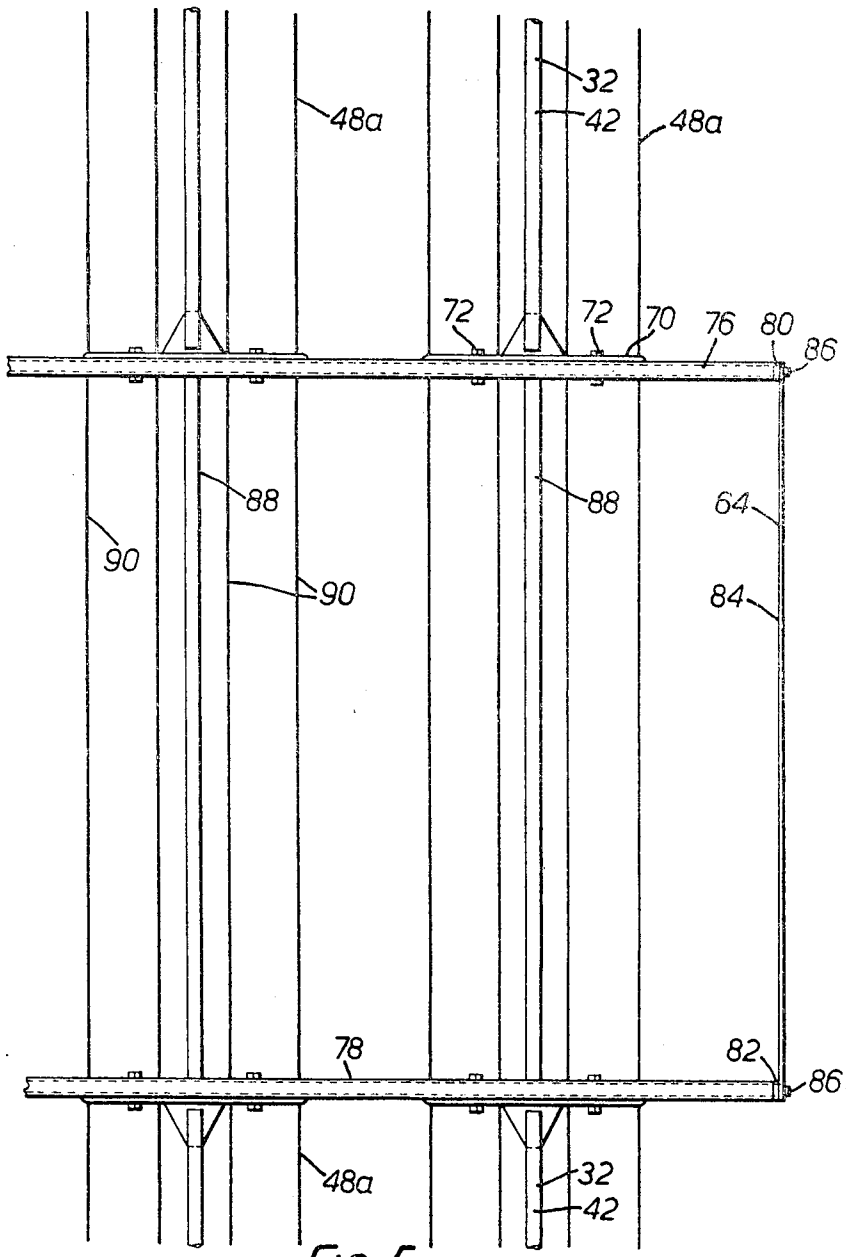

FIG. 5.

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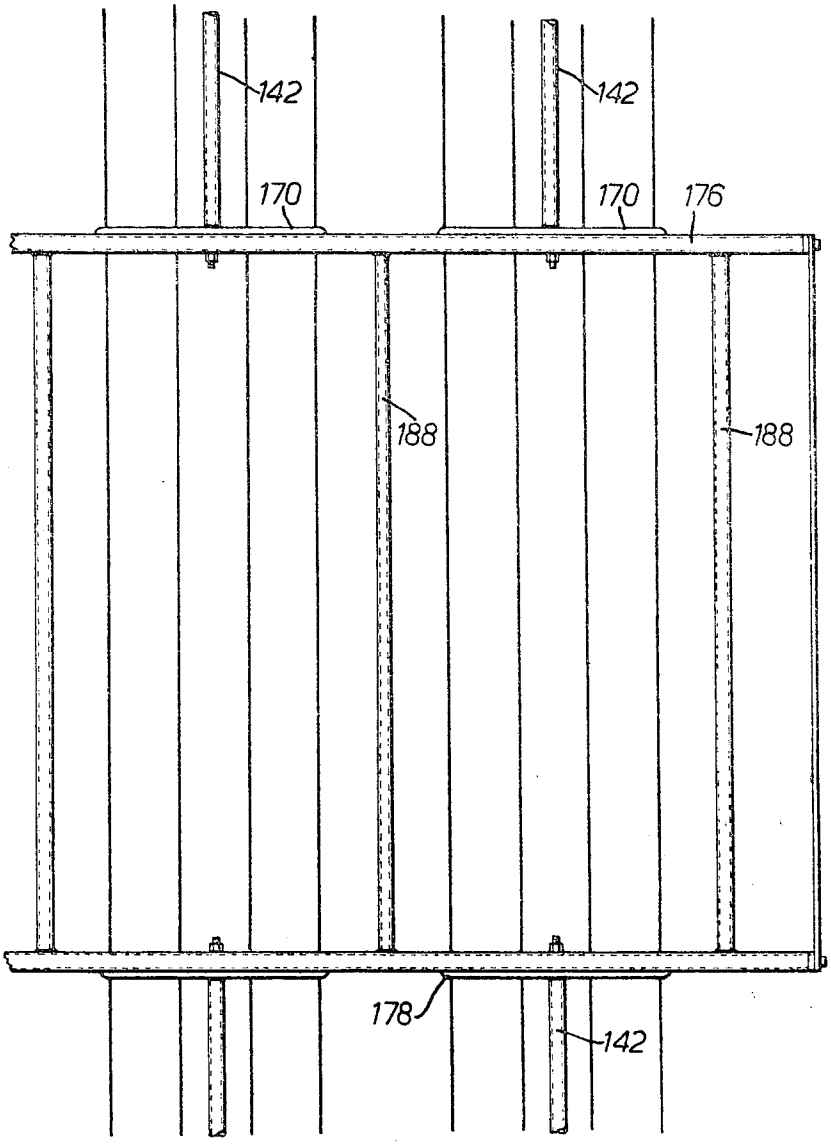

FIG. 7.

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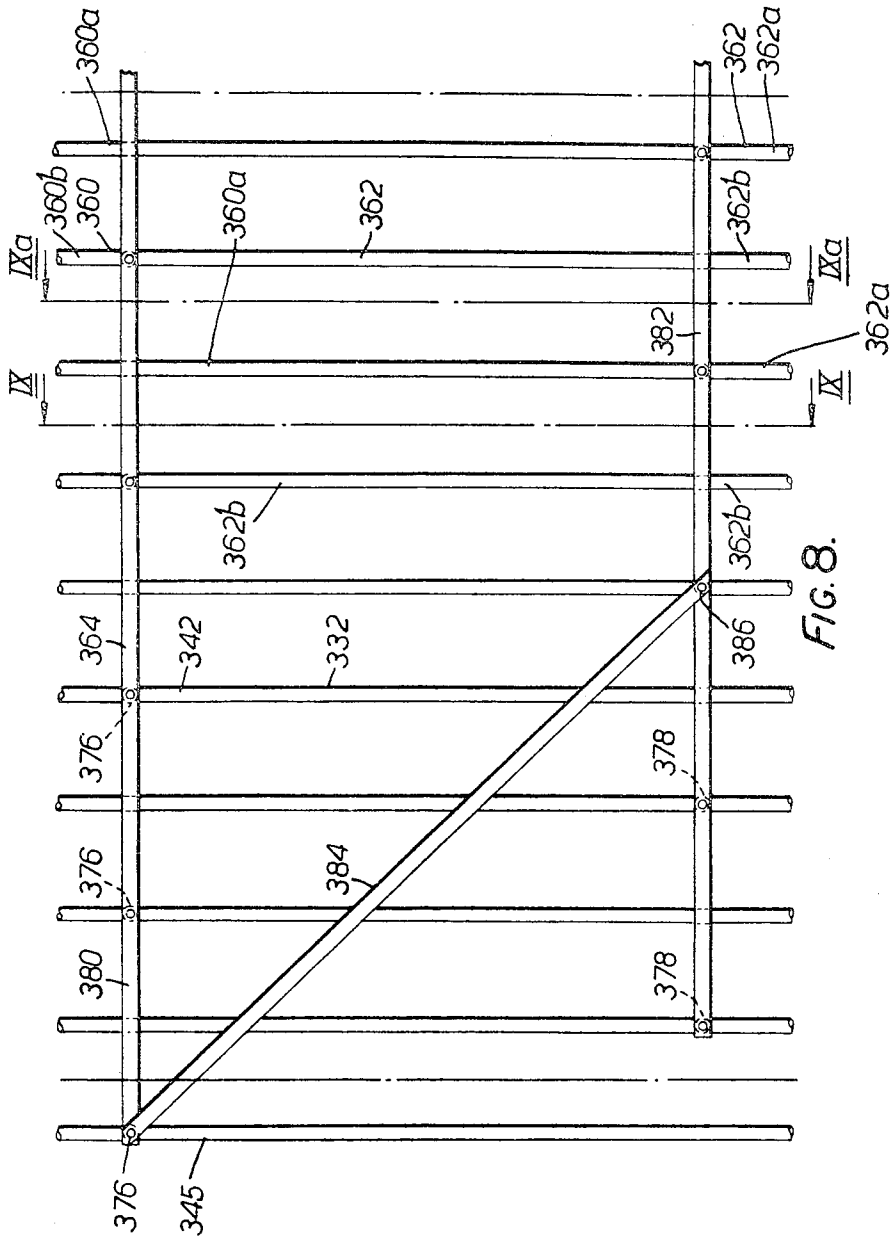

FIG. 8.

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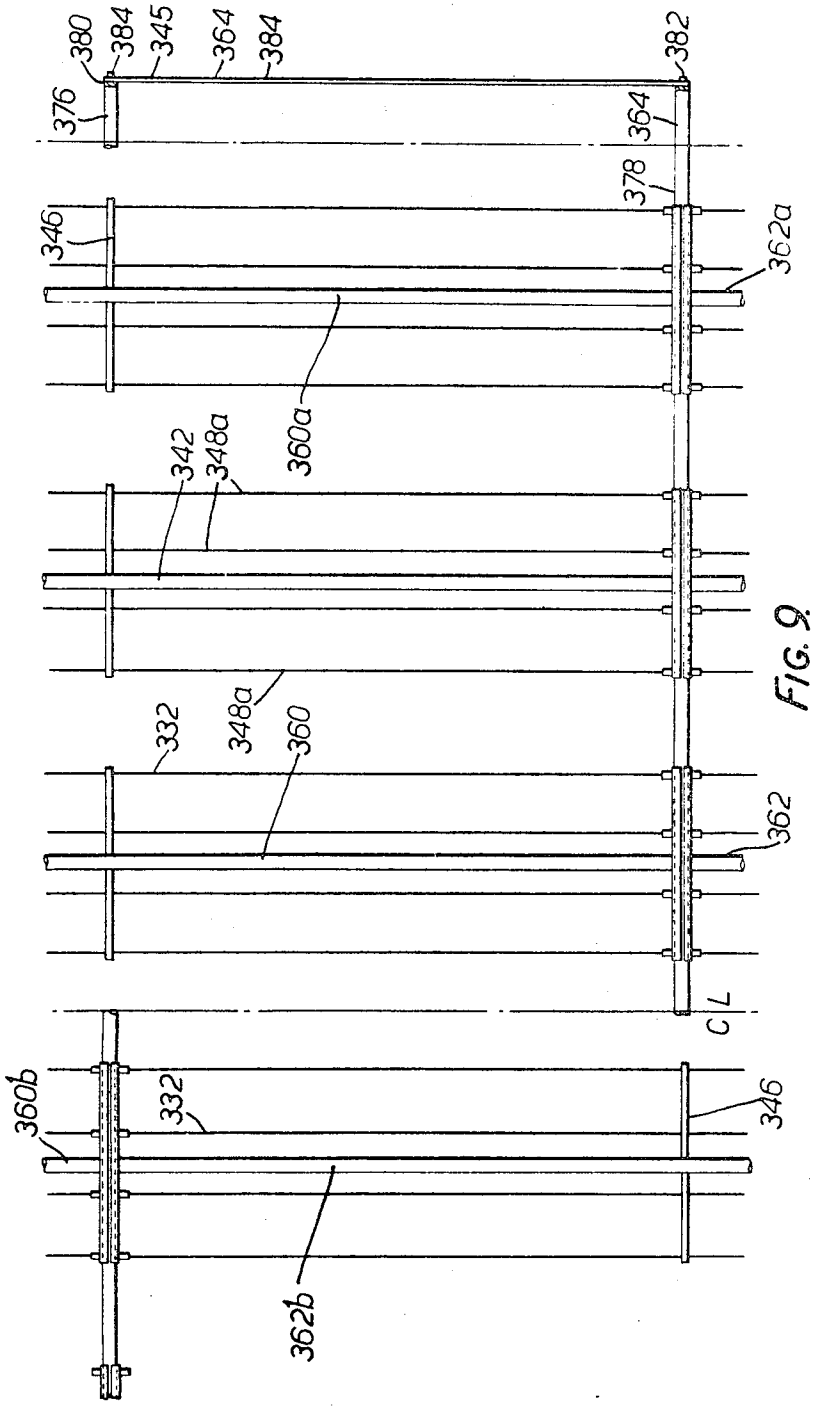

FIG. 9.

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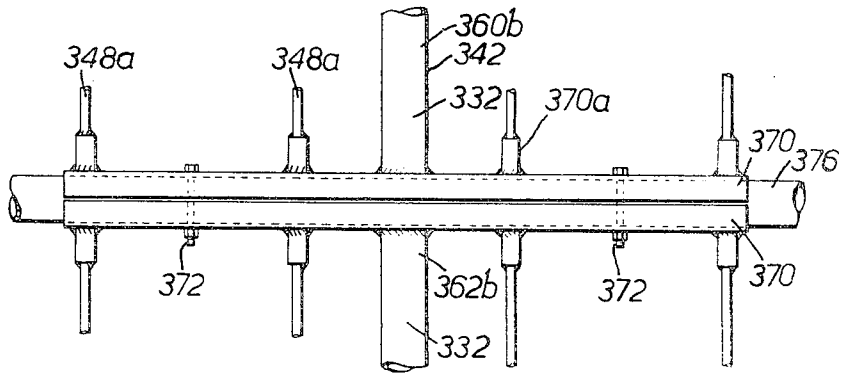

FIG. 10.

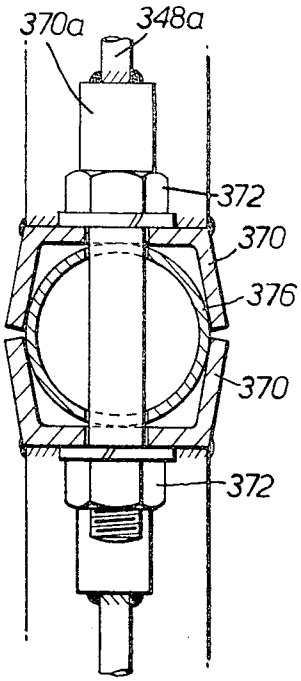

FIG. 11.

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ELECTRO-PRECIPITATION

This invention is concerned with improvements in or relating to electro-precipitators of the Cottrell type.

In the electro-precipitation of, for example, dust from gases, careful design of the electrode support structures is important. For example, problems may arise due to swinging movement of the discharge electrodes; this may lead to burning and breakage of discharge electrodes and poor discharge characteristics. Also problems may arise due to bowing of discharge electrodes. For example, these problems may be accentuated with the larger electro-precipitators where for example it may be required to have a discharge electrode assembly 40 feet or more in height.

It is an object of the invention to provide an improved electro-precipitator electrode support structure.

The invention also provides an electro-precipitator discharge electrode support structure which comprises an upper portion comprising a plurality of vertical elongated support members which extend upwardly from a central region of the structure, a lower portion also comprising a plurality of vertical elongated support members which are non integral with the support members of the upper portion and extend downwardly from the central region, and a braced cage which at the central region connects the support members of the upper portion to the support members of the lower portion.

The invention also provides an electro-precipitator comprising a casing, a plurality of collector electrodes mounted in the casing and a plurality of discharge electrodes located between adjacent collector electrodes and supported in a structure according to the invention.

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 drawings:

FIG. 1 shows a broken side view of parts of the electro-precipitator embodying the invention;

FIG. 2 shows a section generally on the line II—II of FIG. 1 with certain parts omitted;

FIG. 3 shows an enlarged view of parts shown in FIG. 1;

FIG. 4 shows a plan view corresponding to FIG. 3;

FIG. 5 shows another enlarged view of parts shown in FIG. 1;

FIG. 6 shows a view, corresponding to FIG. 3, of a modification;

FIG. 7 shows a view, corresponding to FIG. 5, of the modification;

FIG. 8 shows a side view of parts of a second electro-precipitator embodying the invention;

FIG. 9 shows to the left of the center line CL a broken sectional view generally on the line IX—IX of FIG. 8, and shows to the right of the center line CL a broken sectional view generally on the line IX*a*—IX*a* of FIG. 8.

FIG. 10 shows an enlarged view of parts shown in FIG. 9; and

FIG. 11 shows a sectional end view of parts shown in FIG. 10.

The precipitator embodying the invention comprises a large casing **12** adapted to provide a treatment chamber **14** for the precipitation of dust from gas flowing through the chamber **14** from an inlet **16** to an outlet **18**. In the operation of the precipitator, dust-laden gas to be treated flows in a generally horizontal direction through the treatment chamber **14** (the direction of the arrow X in Figure 1).

An electrode bank **24** is provided in the chamber **14**.

The electrode bank **24** comprises a plurality of vertical dust collector electrode plate members **28** and a plurality of elongated vertical discharge electrodes **32**. A planar row of discharge electrodes **32** is provided midway between each pair of adjacent plate members **28**. In the operation of the precipitator the plate members **28** are earthed and the discharge electrodes **32** are charged to a high potential; as a result dust is precipitated from the gas and collects on the plate members **28**. The precipitator also comprises rapping mechanism (not shown) of known type adapted to dislodge the collected dust from the plate members **28**.

Each plate member **28** is of a previously proposed type comprising a plurality of channel portions **36**, which provide troughs to either side of the member **28**, the troughs being open against the direction of gas flow; reference may be made to U.K. Pat. specification No. 1,172,854 for a more detailed description of the plate members.

Each plate member **28** is suspended from a beam **40** which is resiliently mounted in the casing **12** on girders **43**. A horizontal tube **39** is secured to a lower end portion of the plate member **28** and extends into units **41** which are secured to the casing **12** and assist in locating the plate member **28**.

Each discharge electrode **32** comprises a central vertical support mast tube **42** (FIGS. **1** to **3**) of uniform circular cross-section; secured in the tube **42** are a plurality of horizontal co-extensive uniformly spaced cross members **46** which extend in the direction of gas flow; the cross members **46** support four parallel long vertical twisted discharge wires **48***a* which are spaced from the tube **42**, two on either side thereof.

The electrode bank **24** comprises a discharge electrode support structure **45** comprising a first, upper end portion **60** comprising a plurality of vertical elongated support members provided by the tubes **42** of upper discharge electrodes **32** and extending upwardly from a central region of the structure; and a second, lower end portion **62** also comprising a plurality of vertical elongated support members provided by the tubes **42** of lower discharge electrodes **32** and extending downwardly from the central region. The tubes **42** of the upper end portion **60** are non-integral with and axially aligned with the tubes **42** of the lower end portion **62**. The structure also comprises at the central region thereof a rectangular braced cage **64** intermediate the end portions **60**, **62** which connects the tubes **42** of the end portion **60** to the tubes **42** of the end portion **62** and is adapted to minimize relative movement of the first and second end portions when the structure is in use. The cage **64** itself is adapted to provide a discharge electrode function so that there is no lack of continuity in this respect in the region of the cage **64**.

The structure **45** also comprises a first, upper, framework **46** and a second, lower framework **54**; the

frameworks **46, 54** support respectively the upper end portions of the upper discharge electrodes **32**, and the lower end portions of the lower discharge electrodes **32**. The upper discharge electrodes **32** are suspended from the framework **46** which is itself suspended from a roof portion **48** of the casing **12**. The framework **46** comprises a plurality of horizontal girders **50** extending in the direction of gas flow; to each girder **50** are secured the tubes **42** of the upper electrodes **32** of one row. The girders **50** are connected by two horizontal girders **52** which extend at right angles to the girders **50** and are braced by girders **53**. The two girders **52** are resiliently suspended from the roof portion **48** by two support assemblies **55** (only one of which is shown) of generally known type. Each assembly **55** comprises a girder unit **57** above the two girders **52** to which the girders **52** are resiliently secured by bolts **59**, corresponding nuts and springs **63**. The girder unit **57** is secured to two vertical members **65** which are secured in insulator assemblies **67** mounted in the roof portion **48**. Rapping mechanism (not shown) of known type is provided and is arranged to dislodge any dust collecting on the discharge electrodes **32**.

The framework **54** comprises a plurality of horizontal girders **56** extending in the direction of gas flow; to each girder **56** are secured tubes **42** of the lower electrodes **32** of one row. The girders **56** of the framework **54** are connected by two horizontal tubes **56*a*** which extend at right angles to the girders **56**.

The lower end portion of each upper electrode **32** is secured to a horizontal plate **70** (FIGS. **3–5**) which is bolted to the cage **64** by nuts and bolts **72**. The tube **42** of the electrode **32** is secured to the plate **70** by a bracket **74** which is secured in a slot **76** in the tube **42** and is welded to the plate **70**. The four wires **48*a*** of the electrode **32** are secured in the plate **70** by welding.

The cage **64** comprises a plurality of upper horizontal rectangular tubes **76** which extend in the direction of gas flow and to each of which the upper electrodes **32** of one row are secured by the plates **70** there being one tube **76** to each row or upper electrodes **32**.

The cage **64** also comprises a plurality of lower horizontal rectangular tubes **78** which are aligned with the tubes **76** and to which the upper end parts of each lower electrode **32** are secured in the same way as the upper electrodes **32** are secured to the tubes **76**.

Each outer end portion of each tube **76** is secured to a horizontal strut **80** of flat cross-section; the struts **80** extend at right angles to the tubes **76**. Similarly the outer end portions of the tubes **78** are secured to horizontal struts **82** of flat cross-section which extend at right angles to the tubes **78** and are aligned with the struts **80**. Each pair of aligned struts **80, 82** are connected by two inclined struts **84** of flat cross-section. Each strut **84** extends from the axis of an outermost tube **76** downwardly to the axis of an inner tube **78** at an angle of about 45°. The struts **84** are secured by bolts **86** each of which extends through a strut **84**, a strut **80** or **82** and is screwed into a captive nut (not shown) in the appropriate tube **76** or **78**. Each tube **76, 78** is secured to the struts **80, 82** respectively by such bolts and captive nuts.

Vertical tubes **88** extend between each aligned pair of aligned tubes **76, 78** being secured to said tubes **76, 78** by welding; each tube **88** is axially aligned with an axially aligned pair of upper and lower tubes **42** and corresponds thereto in cross-section; there is a tube **88** axially aligned with each axially aligned pair of upper and lower tubes **42**.

The discharge electrode function of the cage **64** is provided by vertical twisted wires **90** which extend between each pair of aligned tubes **76, 78** being secured in said tubes by welding; each wire **90** is axially aligned with an axially aligned pair of upper and lower wires **48*a***; there is a wire **90** axially aligned with each axially aligned pair of upper and lower wires **48*a***.

It will be realized that in the operation of the precipitator, the discharge electrodes **32** and the cage **64** are at the same electrical potential.

It will also be realized that the structure **45** is adapted to minimize relative swinging movement of the frameworks **46, 54** transversely of the structure in the direction of the arrow X and at right angles thereto, and is also adapted to minimize relative torsional movement of the frameworks **46, 54** transversely of the structure.

The distance between the frameworks **46, 54** is long, for example about 40 feet, the height of the cage being for example about 5 feet.

The modified electro-precipitator embodying the invention illustrated in FIGS. **6** and **7** resembles that described with reference to FIGS. **1** to **5** in many respects and is described in so far as it differs therefrom.

In the modified electro-precipitator a plate **170** corresponding to a plate **70** is directly welded to an upper tube **142** corresponding to tube **42** and the plate **170** is secured to a tube **176** corresponding to a tube **76** by a pin **200** which is secured in the tube **142** by welding and extends through the plate **170** and the tube **176**. The pin **200** is secured in the tube **176** by a bent key **202** which is secured in a corresponding transverse slot in the pin **200** and engages a washer **204** surrounding the pin **200** and engaging a lower surface of the tube **176**. Locating rivets **206** extend from the plate **170** into corresponding sockets in the tube **176**.

Lower tubes **142** are similarly secured to lower tubes **178** corresponding to the tubes **78**.

Tubes **188** corresponding to the tubes **88** are not aligned with the upper and lower tubes **142** but each tube **142** has a pair of tubes **188** evenly spaced to either side thereof.

In a further modification (not shown) the plate **170** is secured to the tube **142** by a bolt which extends through the tube **176** and the plate **170** and is screwed into a captive nut in the tube **142**.

The second precipitator embodying the invention resembles the precipitator described with reference to FIGS. **1** to **5** in many respects and is described in so far as it differs therefrom.

In the second precipitator embodying the invention the support structure **45** is replaced by a support structure **345**.

The electro-precipitator comprises a plurality of discharge electrodes **332** corresponding in many respects to the discharge electrodes **32**.

Each discharge electrode **332** comprises a central vertical support mast tube **342** of uniform circular cross-section; secured in the tube **342** are a plurality of horizontal co-extensive uniformly spaced cross mem-

bers 346 which extend in the direction of gas flow; the cross members 346 support four long vertical twisted wires 348*a* which are spaced from the tube 342.

The discharge electrode support structure 345 comprises a first, upper portion 360 comprising a plurality of elongated support members provided by the tubes 342 of upper discharge electrodes 332, and a second, lower portion 362 also comprising a plurality of elongated support members provided by the tubes 342 of lower discharge electrodes 332. The tubes 342 of the lower portion 362 are arranged in alternating rows 362*a*, 362*b* (FIG. 8). The tubes 342 of each row 362*a* extend upwardly to terminate at the lower end of a central region of the support structure 345 (FIGS. 8 and 9), while the tubes 342 of each row 362*b* extend upwardly to terminate at the upper end of the central region. The tubes 342 of the upper portion 360 are similarly arranged in alternating rows 360*a*, 360*b* axially aligned respectively with rows 362*a*, 362*b*; the tubes 342 of the rows 360*a* extend downwardly to terminate at the lower end of the central region of the support structure 345, while the tubes 342 of the rows 360*b* extend downwardly to terminate at the upper end of the central region. It will be realized that the tubes 342 of the upper portion 360 are non-integral with the tubes 342 of the lower portion 362. The structure also comprises a braced cage 364 which at the central region of the structure connects the tubes 342 of the portion 360 to the tubes 342 of the portion 362, the rows 360*a*, 360*b* being connected to the rows 362*a*, 362*b* respectively. The cage 364 is adapted to minimize relative movement of the first and second portions 360, 362 when the structure is in use.

The lower end portion of each electrode 332 of the rows 360*b* is secured to a half-tube 370 (FIGS. 10 and 11) of angular cross-section which is bolted to the cage 364 by nuts and bolts 372. The tubes 342 of the electrode 332 is welded to the half tube 370 and the four wires 348*a* of the electrode 332 are secured to the half tube 370 via welded sockets 370*a*. The upper end portion of the aligned electrode 332 of the appropriate row 362*b* is similarly secured to a half tube 370 which is bolted to the cage 364 by the same nuts and bolts 372 as the first mentioned half tube 370.

The cage 364 comprises a plurality of upper horizontal tubes 376 which extend in the direction of gas flow and to each of which the electrodes 332 of one row 360*b* and the corresponding electrodes 332 of one row 362*b* are secured by the half tubes 370 there being one tube 376 to each row 360*b* and 362*b*. Each bolt 372 passes through upper and lower half tubes 370 and through the appropriate tube 376 which is fitted within the half tube 370.

The cage 364 also comprises a plurality of lower horizontal tubes 378 which when viewed from above alternate with the tubes 376 and to which the upper end portions of the electrodes 332 of the rows 362*a* and the lower end portions of the electrodes 332 of the rows 360*a* are secured in the same way as the electrodes 332 of the rows 360*b*, 362*b* are secured to the tubes 376.

Each outer end portion of each tube 376 is secured to a horizontal strut 380 of flat cross-section; the struts 380 extend at right angles to the tubes 376. Similarly the outer end portions of the tubes 378 are secured to horizontal struts 382 of flat cross-section which extend at right angles to the tubes 378 and are aligned with the struts 380. Each pair of aligned struts 380, 382 are connected by two inclined struts 384 (only one of which is shown in FIG. 8) of flat cross-section. Each strut 384 extends from the axis of an outermost tube 376 downwardly to the axis of an inner tube 378 at an angle of about 45°. The struts 384 are secured by bolts 386 each of which extends through a strut 384, a strut 380 or 382 and is screwed into a captive nut (not shown) in the appropriate tube 376, or 378. Each tube 376, 378 is secured to the struts 380, 382 respectively by such bolts and captive nuts.

In a modification each half tube 370 is of semi-circular cross-section to correspond with the cross-section of the tube 376.

It will be appreciated that other known forms of discharge electrodes may be used instead of the twisted wire-type.

We claim:

1. An electro-precipitator discharge electrode support structure having a central region and said structure comprising
   a. an upper portion comprising a plurality of vertical elongated support members which extend upwardly from the central region of the structure,
   b. a lower portion also comprising a plurality of vertical elongated support members which are non integral with the support members of the upper portion and extend downwardly from the central region, and
   c. a braced cage which at the central region connects the support members of the upper portion to the support members of the lower portion.

2. A structure according to claim 1 wherein said braced cage is rectangular and connects the support members of the upper portion of the structure to the support members of the lower portion, the cage comprising
   i. a plurality of upper and lower horizontal members,
   ii. means for securing the support members to the cage,
   iii. horizontal struts interconnecting the upper horizontal members said struts extending transversely of said upper horizontal members,
   iv. further horizontal struts interconnecting the lower horizontal members said struts extending transversely of said lower horizontal members, and
   v. inclined struts connecting the upper horizontal struts to the lower horizontal struts.

3. In a structure according to claim 1, a plurality of discharge electrodes, each discharge electrode comprising a support mast, a plurality of cross members which extend from the support mast, and discharge wires supported by the cross members, the support masts providing said support members of the structure.

4. A structure according to claim 3 wherein each discharge electrode comprises four parallel discharge wires, two on either side of the mast.

5. A structure according to claim 3, comprising a plurality of horizontal half-tubes, means securing an appropriate end portion of the support mast of each electrode to a said horizontal half-tube, means securing the half-tube to the braced cage, and means securing the discharge wires of the electrode to the half-tube.

6. A structure according to claim 1 wherein the support members of the upper portion are provided in a first set of rows the support members of which rows extend downwardly to terminate at an upper end of the central region and a second set of rows which alternate with the first set and the support members of which extend downwardly to terminate at a lower end of the central region; and wherein the support members of the lower portion are provided in a first set of rows longitudinally aligned with the first set of rows of the upper portion and the support members of which rows of the lower portion extend upwardly to terminate at the upper end of the central region, and a second set of rows aligned with the second set of rows of the upper portion, and the support members of which extend upwardly to terminate at the lower end of the central region.

7. A structure according to claim 1 comprising a plurality of half-tubes, means securing and appropriate end portion of each support member to a said half-tube, and means securing the half-tubes to the braced cage.

8. An electro-precipitator comprising a casing, a plurality of collector electrodes mounted in the casing, a plurality of discharge electrodes located between adjacent collector electrodes, and a discharge electrode support structure in which the discharge electrodes are supported, said structure having a central region and said structure comprising

(a) an upper portion comprising a plurality of vertical elongated support members which extend upwardly from the central region of the structure,

(b) a lower portion also comprising a plurality of vertical elongated support members which are non integral with the support members of the upper portion and extend downwardly from the central region, and

(c) a rectangular braced cage which at the central region connects the support members of the upper portion to the support members of the lower portion, said braced cage comprising vertically spaced horizontal members and inclined bracing struts.

* * * * *