United States Patent

Buschman

[15] **3,678,653**

[45] **July 25, 1972**

[54] **ELECTROSTATIC PRECIPITATOR**

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[73] Assignees: **Kenneth Buschman,** Fairport, N.Y.; **William R. Price,** Louisville, Ky. ; part interest to each

[22] Filed: **May 11, 1970**

[21] Appl. No.: **36,244**

[52] **U.S. Cl.** **55/2,** 55/131, 55/137, 55/138, 55/143, 55/145, 55/146, 55/156, 204/312, 317/261

[51] **Int. Cl.** **B03c 3/45**

[58] **Field of Search**....................55/130, 136, 137, 138, 140, 55/141, 146, 155, 143, 154, 156, 2, 131; 317/242, 261; 204/186, 302, 312

[56] **References Cited**

UNITED STATES PATENTS

1,600,496	9/1926	Weiskopf	55/140 X
2,359,149	9/1944	Pegg	55/143 X
2,383,111	8/1945	Dahlman	55/116
2,488,712	11/1949	Dahlman	55/143
2,936,851	5/1960	Cook	55/131
2,969,127	1/1961	Cook	55/126
2,978,066	4/1961	Nodolf	55/157 X
3,027,970	4/1962	Mueller	317/261 X
3,137,550	6/1964	Fruth	55/131
3,178,869	4/1965	Cook	55/126
3,392,509	7/1968	Pelosi, Jr.	55/123
3,469,031	9/1969	Setchell	178/7.9
977,335	11/1910	Shaffner	55/129
1,541,704	6/1925	Gies	55/130
2,672,948	3/1954	Penney	55/141 X
2,700,429	1/1955	Wintermute	55/131
2,826,262	3/1958	Byerly	55/130
2,974,747	3/1961	Coolidge, Jr. et al.	55/130

FOREIGN PATENTS OR APPLICATIONS

625,963	8/1961	Canada	55/124
953,218	5/1949	France	55/127
428,607	5/1926	Germany	55/130
335,507	9/1959	Switzerland	55/128
114,444	1/1942	Australia	55/154
827,157	2/1960	Great Britain	55/142
693,948	7/1953	Great Britain	55/130
707,671	4/1954	Great Britain	55/129
548,448	10/1922	France	55/130

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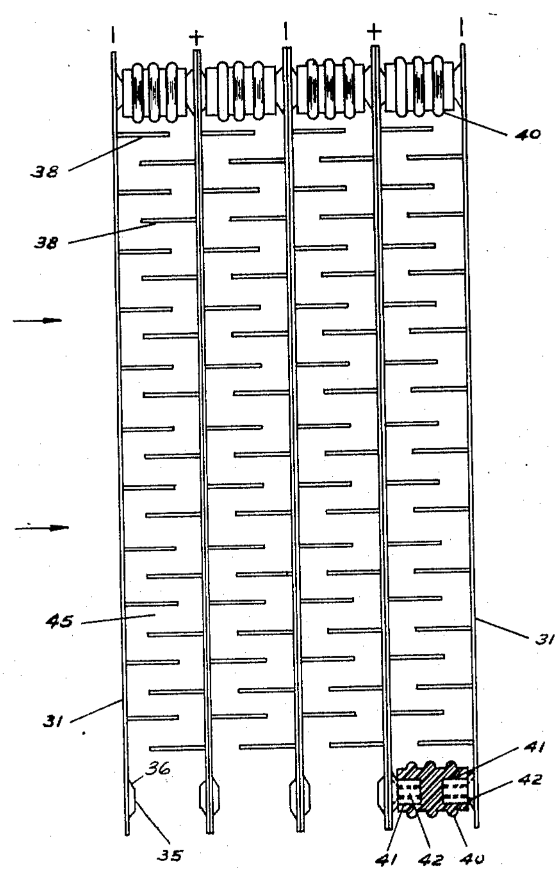
[57] **ABSTRACT**

Discloses an electrostatic precipitator of the two chamber type and specifically, a parallel plate electrostatic cell for the precipitation chamber of said precipitator. The parallel plate electrostatic cell is made up of a plurality of identical modular electrode units in the form of louvered plates, having reinforcing ribs and projecting vanes which are mounted so that the vanes of one plate are interleaved with the vanes of an oppositely charged plate and so that the plates are in parallel and insulated relationship one to the other. The projecting vanes form a plurality of open air passages and a plurality of electrostatic fields across said open air passages.

14 Claims, 12 Drawing Figures



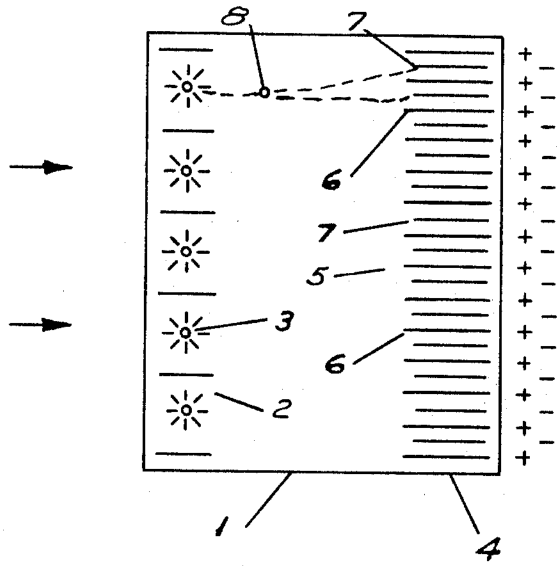


Fig. 1 PRIOR ART

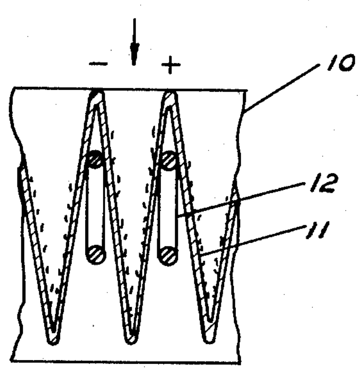


Fig. 2 PRIOR ART

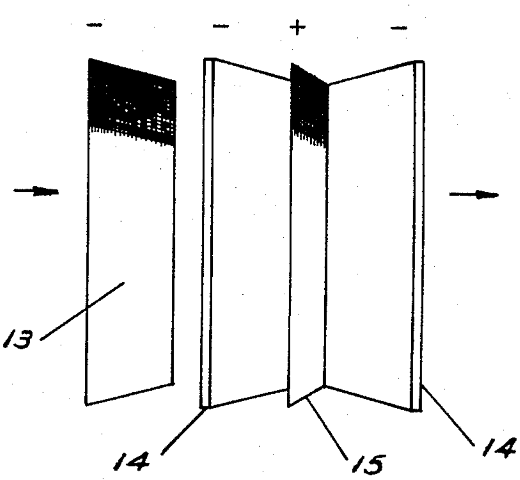


Fig. 3 PRIOR ART

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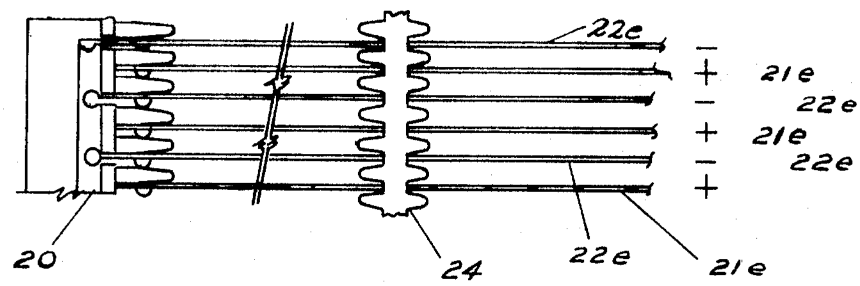

Fig. 4

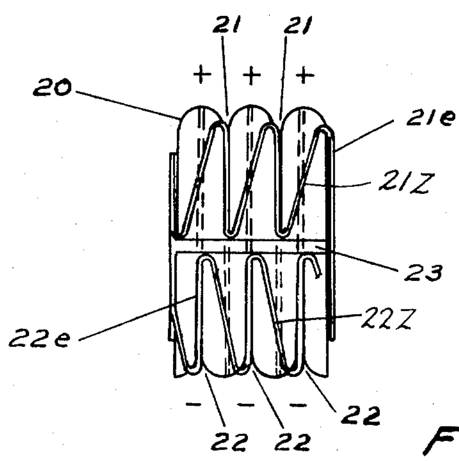

Fig. 5

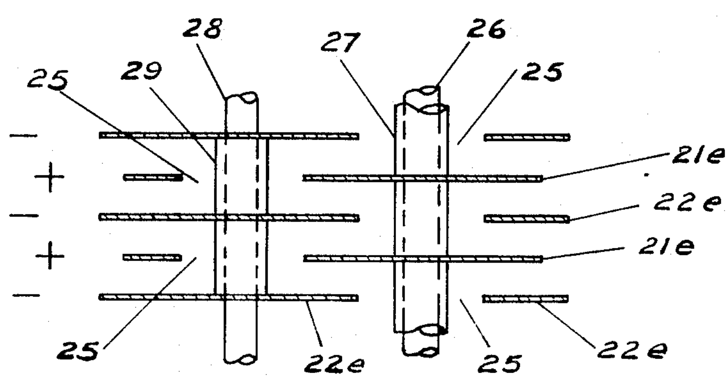

Fig. 6

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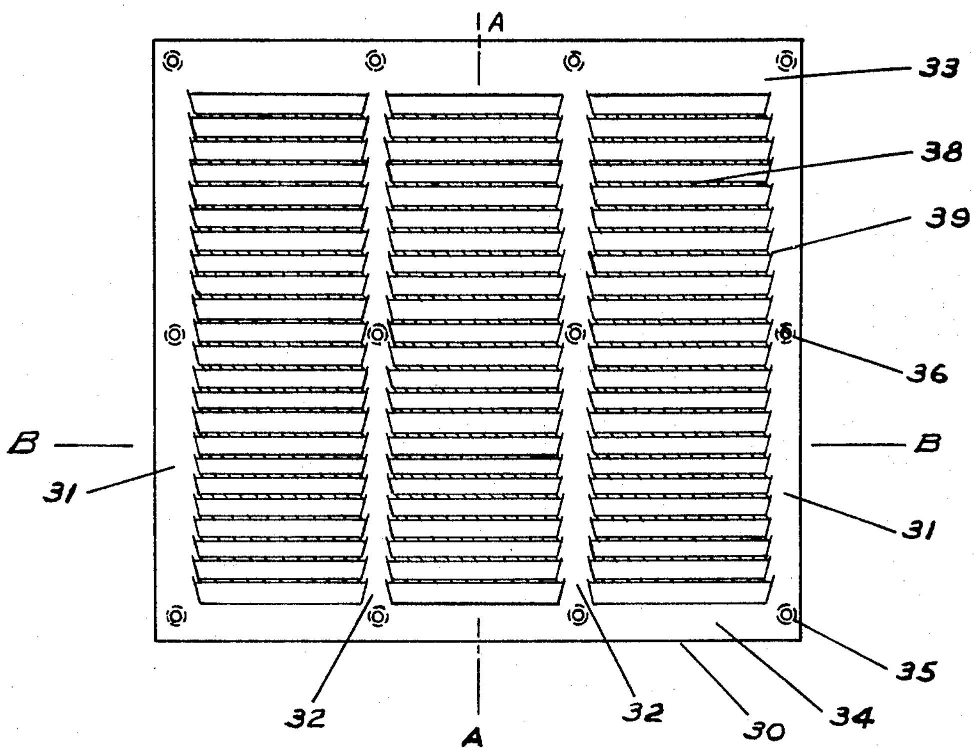

Fig. 7

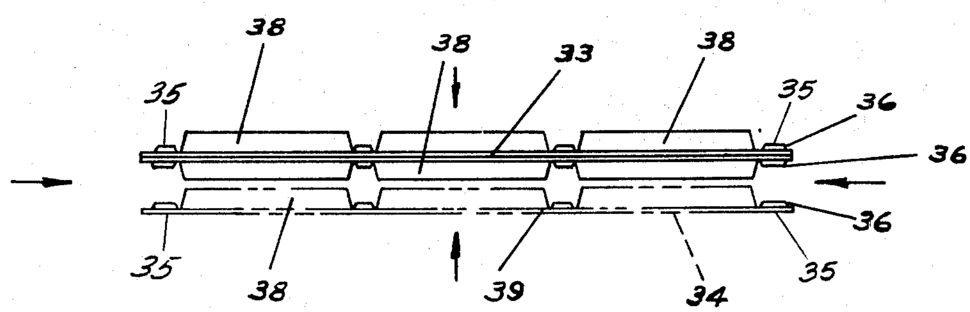

Fig. 8

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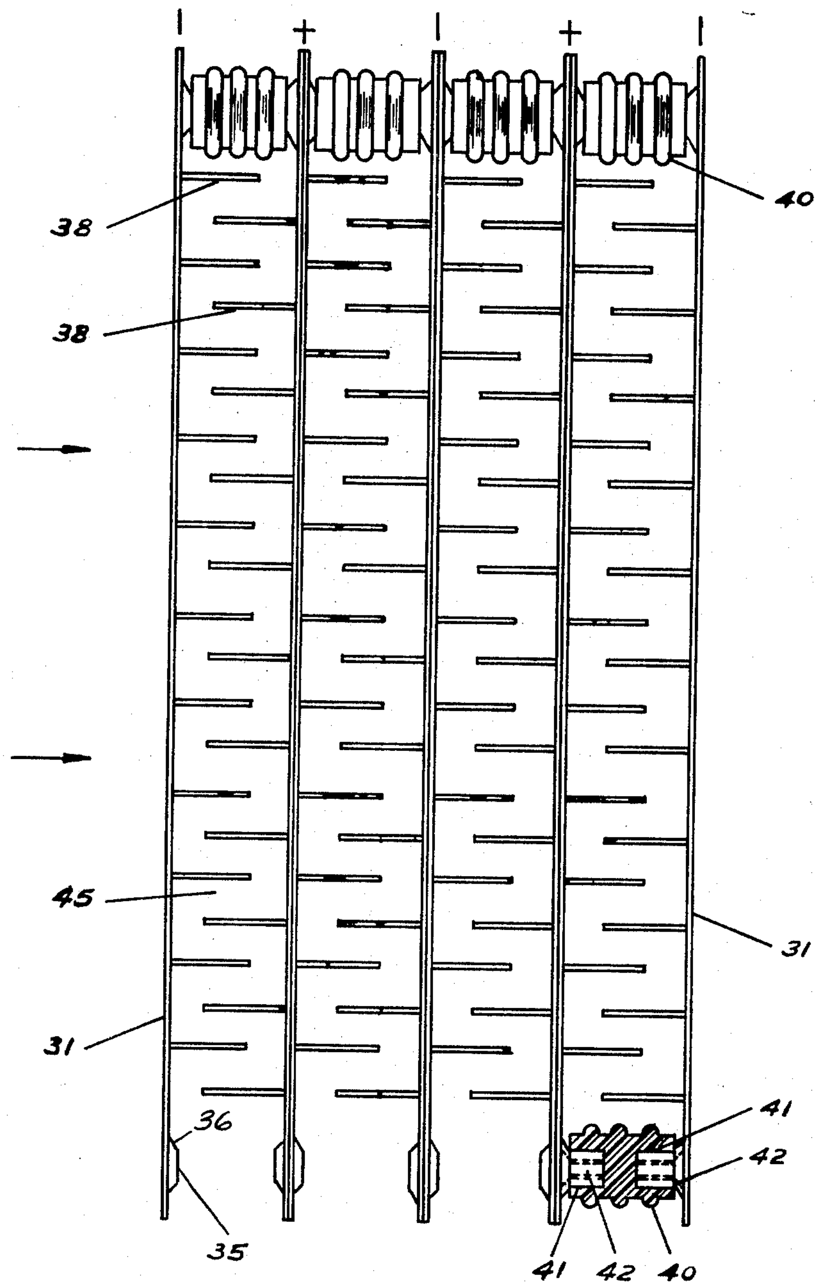

Fig. 9

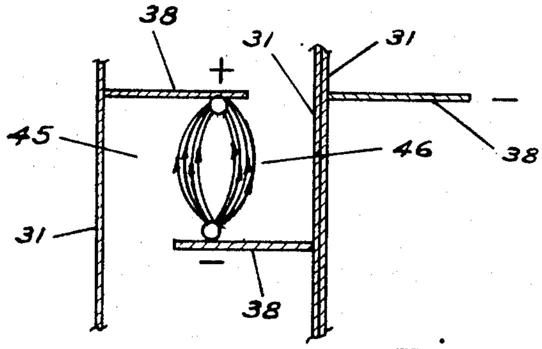

Fig. 10

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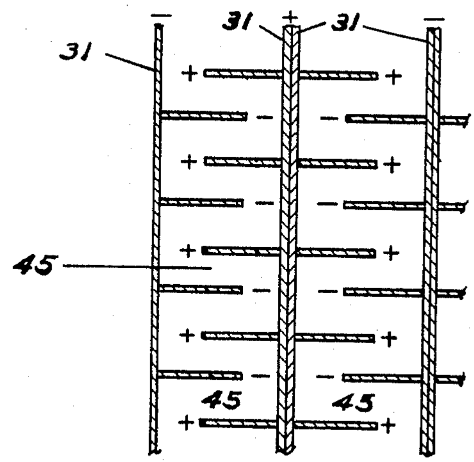

Fig. 11

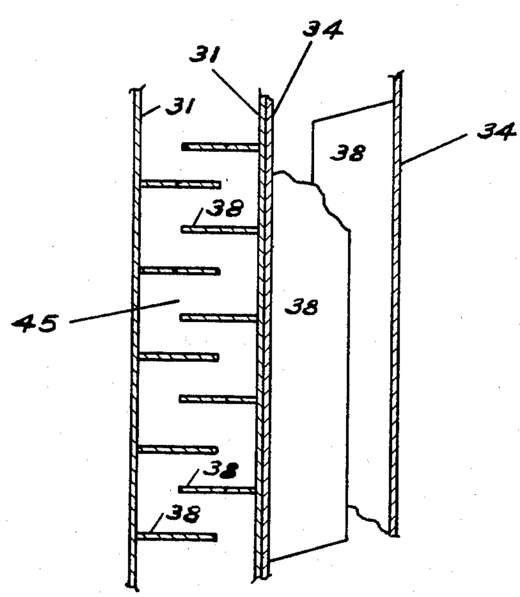

Fig. 12

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ELECTROSTATIC PRECIPITATOR

FIELD OF THE INVENTION

This invention relates to electrostatic precipitators and specifically, to modular electrode units for forming a parallel plate electrostatic cell in the precipitating section.

DESCRIPTION OF THE PRIOR ART

Various devices have been used or proposed for the electrostatic cleaning of gas streams. The operation of all of them requires the use of spaced electrodes, the impressing of high ionizing voltage on the electrodes to create an electrical field and the passage of dust or particle laden gas streams through the field whereby the particles are charged so that they gravitate to oppositely charged surfaces and are deposited thereon. In one form of known apparatus for precipitating particles from a gas stream, there are employed high voltageionizing or charging electrodes in an ionizing section and grounded collecting electrodes in the form of plates extending longitudinally along the path of the gas stream in the precipitating section of the apparatus. Credit for the first two stage electrostatic gas cleaner has been normally accorded to Gaylord W. Penney for the precipitator described in his U.S. Pat. No. 2,129,783. However, Penney credits two earlier patentees, i.e. Schmidt; U.S. Pat. No. 1,343,285 and Moller; U.S. Pat. No. 1,357,466 with the proposal to more or less separate the function of ionization and precipitation in two separate chambers. However, Penney has been generally regarded as a pioneer in completely separating the two functions of the electrostatic precipitator into ionizing and precipitation chambers so as to limit the voltage required in the ionizing chamber and in the precipitating chamber and thus limit the production of oxides of nitrogen and of ozone by the highly charged electrical ionizing wires. Both of these gases (i.e. oxides of nitrogen and ozone) have been indicted as causative agents in smog formation.

The fact that alternately charged plates in the parallel plate electrostatic cells are mounted in such a manner as to avoid arcing has resulted in the apparatus being rather bulky and heavy. Further, the mounting of the parallel plates in insulated relation one to the other has involved a further problem when removing the plates for periodic cleaning and when replacing the plates after cleaning.

For this reason, there have been proposed a series of electrostatic filters utilizing removable and disposable dielectric filter media. Thus, in one type of electrostatic apparatus, such as is illustrated in FIG. 2 of the present application, the dielectric filter media is disposed in zigzag relation over a series of electrodes on the upstream edge of the electrodes so as to protect the electrodes and prevent dirt and debris from collecting thereon. The dielectric media, per se, would be periodically removed and cleaned or discarded. Apparatus of this type has been disclosed by Powers in U.S. Pat. Nos. 2,814,355; 2,818,134; 2,864,460; 2,888,092 and 2,917,130.

Another known type of electrostatic gas cleaner illustrated more or less diagrammatically in FIG. 3 and which is commercially available is designed to avoid the problem of periodically cleaning the precipitated material from the collecting electrode. This type of electrostatic filter comprises upstream and downstream electrodes containing a porous dielectric or insulating filter media sandwiched between the electrodes. Particles which have become charged by the upstream electrode are attracted toward the second electrode and become lodged on the surfaces of the filter media. The disposable filter media devices offer certain advantages in that the media can be periodically removed and discarded but they present considerable drawback in that they soon become clogged and present an extremely high pressure drop. Further, unless the dielectric media is periodically removed, even in comparatively clean atmospheres, the filter becomes so clogged as to prevent an appreciable flow of gas therethrough.

The use of the two chamber electrostatic filters containing parallel plate electrostatic cells, as diagrammatically illustrated in FIG. 1 offer minimal pressure drop. However, because of the difficulty in mounting the parallel plates in sufficiently close spaced relation to minimize the voltage requirements, such apparatus is somewhat bulky and requires relatively high voltages to provide optimum operation. Further, the problem of mounting the parallel plates in insulated relation and close spaced relation without short circuiting difficulties involve expensive and time consuming mounting techniques. One of the major problems has been the difficulty in maintaining the plates in perfectly flat condition. This was pointed out in 1938 by the patentee Penney in U.S. Pat. No. 2,129,783 on pages 6 and 7 of his patent, (lines 66–75 of page 6 and lines 1–18 of page 7) as follows:

> "The spacing between the plates **19** and **20** of the collector cell assembly or precipitator chamber should be as small as considerations of short-circuit difficulties will permit. I have found that, with the larger plate spacings, the effects of accumulation of dirt particles in producing point discharges is more noticable so that as the plate spacing is increased, the voltage cannot be increased at as rapid a rate as the plate spacing, so that the wider spacings of the plates require apparatus which is somewhat larger in size than apparatus having the smaller plate spacings. One limit which is encountered as to the closeness with which the plates may be spaced is the impossibility of obtaining commercial plates which are sufficiently flat. For instance, commercial plates 8 inches square will usually vary from one sixty-fourth to one thirty-second inch from being perfectly flat. There is a range in plate spacing from about one-sixteenth or one-eighth inch up to one-half inch or even considerably larger that might be commercial. The plate spacing in the design which is shown in my drawings is approximately 0.22 inch, but this plate spacing may be very considerably reduced with some resulting economies in size of the equipment or it might be considerably increased if there was no particular necessity for reducing the size of the precipitator."

SUMMARY OF THE INVENTION

According to my invention, a simple economical and rugged modular electrode unit is presented along with a novel means of mounting said electrode unit in spaced and insulated relation to oppositely charged modular electrode units so as to form a parallel plate electrostatic cell. Basically, my invention envisions the use of a louvered metal plate prepared through a simple and economical punching operation whereby projecting vanes are formed. The projecting vanes are attached to reinforcing ribs so that the projecting vanes of one plate may be interleaved with the projecting vanes of an oppositely charged metal plate. In a preferred embodiment, the top or bottom reinforcing ribs of a louvered plate is offset so that the plates may be alternately turned upside down. Thus the projecting vanes of alternately charged plates are interleaved to form equidistantly spaced air passages and to form electrostatic fields across the vanes of alternate plates and across the air passages formed by said vanes when voltage is applied to one of the plates.

In still another embodiment, provision is made to mount louvered plates in back to back conductive relationship to form a modular electrode member of two louvered plates bearing the same electrical sign. Thus one could mount the projecting vanes of a first member into insulated and equidistantly spaced relation with projecting vanes of a second modular electrode member so as to provide and define open air passages between the vanes of alternately charged members and electrostatic fields between said plates normal to the direction of airflow through the air passages. In still another embodiment, provision is made so that the plates may be turned 90° to provide a certain amount of stiffness in the back to back assembly of similarly charged pairs of louvered plates to form a modular electrode member. A modular electrode member, then, is one or more louvered plates charged with the same electrical sign.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view illustrating a typical prior art two chamber fluid stream electrostatic particle precipitator comprising an ionizing chamber and a precipitating chamber.

FIG. 2 is a fragmentary elevational view, illustrating an electrostatic precipitator, utilizing a dielectric disposable filter media, located on the upstream side of the electrode units.

FIG. 3 is a fragmentary exploded view illustrating another type of commercial, electrostatic precipitator which utilizes a disposable dielectric filter media disposed between oppositely charged screens.

FIG. 4 is a fragmentary plan view illustrating a prior art commercial method of mounting parallel electrode plates in insulated relation to form a parallel plate electrostatic cell.

FIG. 5 is an end view of the electrode mounting arrangement shown in FIG. 4 illustrating the end insulator and the method of mounting oppositely charged electrode plates to form a parallel plate electrostatic cell.

FIG. 6 is a fragmentary and somewhat diagrammatic view of a prior art air gap method of mounting electrode plates in insulated relation to form a parallel plate electrostatic cell.

FIG. 7 is an elevational view of the louvered plate of this invention, with the edges of the louvered vanes shown in section so as to illustrate the fluid passages between vanes.

FIG. 8 is a partially exploded view from the top which illustrates in full lines the relationship of the vanes to the reinforcing ribs of the modular louvered electrode member of this invention formed by the back to back mounting of two lowered plates and which illustrates in phantom lines the relationship of said vanes to the vanes of an oppositely charged louvered plate which has been pulled away for sake of illustration. FIG. 9 is a side elevational view turned 90° from the view of the member of FIG. 7 which illustrates an assembly of modular louvered electrode members mounted to form a parallel plate electrostatic cell.

FIG. 10 is an enlarged fragmentary view of the structure illustrated in FIG. 9 which illustrates the formation of a fluid passage by vanes of differently charged electrode members and an electrostatic field across said fluid passage.

FIG. 11 is an enlarged fragmentary view of an assembly of modular louvered electrode plates similar to the assembly illustrated in FIG. 9 except that the back to back mounting of positively charged plates is such that the vanes of one plate of the modular electrode member plate but are located at the same level and in the same plane.

FIG. 12 illustrates a modification of the back to back mounting arrangement wherein one plate of the pair of positively charged plates forming the modular electrode member is turned 90° so that vane 38 lies in a perpendicular attitude relative to vane 38 of other plate of the pair.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to the drawings in detail, FIG. 1 illustrates a typical two chambered electrostatic precipitator 1 consisting of an ionizing section 2 formed by transversely disposed, positively charged ionizing wires 3 and a precipitating section 4 consisting of a parallel plate electrostatic cell 5 which includes positively charged plates 6 and negatively charged or grounded plates 7. Air enters the precipitator 1 in the direction of the arrows and a particle entering the ionizing section becomes charged at point 8 and is moved by the air stream through the precipitator toward the parallel plate electrostatic cell 5. As is somewhat diagrammatically illustrated, the charged particle 8 is repelled from the positively charged plate 6 and attracted to the negatively charged plate 7 where it is electrostatically attached. As previously indicated, due to the difficulty which has been encountered in producing a compact and lightweight electrostatic unit for domestic or home use, there has been proposed the use of dielectric filter media in conjunction with charged electrode units. Thus, as is disclosed in FIG. 2, the dielectric disposable filter media 11 is arranged in zigzag fashion in frame 10 on the upstream side of the electrode units 12. Air entering the unit in the direction of the arrow, contains particles which are attracted to the electrode units 12 and thereby become enmeshed in the dielectric disposable filter media 11. The filter media 11 is periodically removed and cleaned or discarded. FIG. 3 illustrates another type of disposable dielectric filter media which consists of an acrylic mesh material 14 sandwiched between negatively charged screen 13 and positively charged screen 15. Air entering the unit in the direction of the arrow is attracted toward a charged screen and becomes enmeshed in the dielectric filter media 14. This media 14 is periodically removed and discarded. While these units have offered considerable advantage for use in the home in areas in which the air is relatively clean, they are subject to the problem of excessive pressure drop, particularly in comparatively dirty atmospheres and areas in which the filters cannot be cleaned at very frequent intervals.

Accordingly, in areas in which the electrostatic filters are subjected to long continued heavy duty use in relatively dirty atmospheres, parallel plate electrostatic cells are more feasible. Nevertheless, as indicated, one of the problems is in obtaining sheet metal plate material which is sufficiently flat and which is sufficiently stiff so that the plates can be maintained in spaced and insulated relation. The amount of voltage required in the precipitating section as well as the space required increases somewhat proportionately to the amount of space between oppositely charged plates.

Further, the flat planar surfaces of the plates are subject to bending and deformation during installation, transportation and use. Such problems have evolved a series of mounting methods. As disclosed in FIG. 4 and FIG. 5, one commercially used method of mounting electrode plates involves the use of slotted end insulators 20 and intermediate lengthwise insulators and spacers 24. As will be noted, the slotted end insulators contain slots 21 and 22 and a separating ledge 23 between the two sets of slots. The positively charged plates 21E fit into slots 21 while the negatively charged plates 22E fit into the slots 22. A "Z" shaped extension of the positive plates 21Z is connected to the separating ledge 23 by means of a potting compound so that proper electrical connection can be made to the "Z" shaped member 21Z. 22Z is similarly connected to plates 22E. Nevertheless, because of the limber nature of the lengths of plate material, it was found necessary to insert insulating spacers 24 along the length of the electrostatic cell, to separate the parallel plates 21E and 22E.

Still another prior art method of mounting parallel plates, illustrated diagrammatically in FIG. 6, involves the use of a positively charged rod 26 surrounded by a conductor and spacing sleeve 27 which is in conducting relation with the similarly charged positive plates 21E, but is separated from the grounded plates 22E by air gap 25. Similarly, the negative or grounded plates 22E are conductively connected by rod 28 and a conductor and spacing sleeve 29. Sleeve 29 is separated from the positively charged plates 21E by means of air gap 25. This method of mounting provides good electrical conductivity and good stable rigid connection. However, it requires a plurality of rods which forms a relatively rigid and heavy parallel plate electrostatic cell. The real problem, of course, is that in order to utilize lightweight sheet metal plates, stiffness must be maintained throughout the length of the plate and the plate must be completely flat with little deformation. This is required so that the plates may be maintained in closely spaced parallel and insulated relation without encountering arcing or short circuiting difficulties. The slightest damage and deformation to one of the thin flexible, limber sheet metal plates takes the entire bundle forming the cell out of service if short circuiting occurs between oppositely charged plates.

Referring now to the preferred embodiment of this invention, a modular electrode unit in the form of a louvered electrically conductive plate 30 is illustrated in FIG. 7. This plate is preferably formed of thin, electrically conductive sheet metal and consists of side reinforcing ribs 31, middle reinforcing ribs 32, top reinforcing ribs 33 and bottom reinforcing ribs 34. It will be noted that the top reinforcing rib 33 is wider then the bottom reinforcing rib **34**. A series of apertures **35** are provided with a concave-convex boss **36** for connection to adjacent plates or to insulators as will be described. The vanes **38** are formed in a preferred modification by the well known punching technique whereby sheet metal is punched with a die so that the vanes are cut out and bent perpendicularly to the plane of the original sheet of metal. Thus, each vane **38** is connected to the reinforcing ribs **31** and **32** by means of a tab **39** which is contiguous with the rib and with the vane itself. In this manner, a large flexible piece of sheet metal can be formed into a plate having a series of projecting vanes which in conjunction with the vanes of an oppositely charged plate can be closely spaced without danger of arcing or short circuiting. These vanes define an air or fluid passage **45**. An electrostatic field **46** across the air passage **45** is formed by the oppositely charged vanes **38** which define the air passage **45**. As will be noted, in FIG. **8** two louvered plates **30** are mounted in back to back relation with the vanes of each member of the pair disposed in opposite direction to form a modular electrode member. Thus air flow can be in any of the directions illustrated by the arrows. The oppositely charged plate, shown in phantom lines and pulled away from the pair of plates, illustrates how the vanes face each other and are interleaved so as to define air passages **45**. An electrostatic field, **46**, is formed across each air passage **45**. Therefore, the direction the flow of air is immaterial, since two opposing vanes form an air passage **45** across which an electrostatic field **46** is formed for precipitation of particles from the air. This will be better understood by reference to FIGS. **9** and **10**, whereby a complete assembly is illustrated of the positively and negatively charged modular units. It will be noted that the units are separated from each other by means of an insulator **40**. A threaded nipple **41** in the insulator **40** receives bolt **42** which is inserted through the aperture **35** of the concavo-convex boss **36**. Similarly charged plates mounted in back to back relation are secured together with a bolt through the apertures **35** of the concavo-convex boss **36**. The opposed vanes **38** of oppositely charged plates form air passages **45** across which is formed an electrostatic field **46** as is shown diagrammatically in FIG. **10**. Thus, as air passes through the parallel plate electrostatic cell, it passes through a plurality of fluid passages **45** and a plurality of electrostatic fields **46** so as to efficiently and effectively precipitate the charged particles onto one or more of the vanes **38**. Since the vanes are relatively stiff because of their width and length, there is essentially little problem of bending or limberness so as to cause short circuiting or arcing. Therefore, the vanes can be closely placed to form a compact and sturdy parallel plate electrostatic cell for home and industrial use.

It will be noted that in FIG. **9** and FIG. **10**, the similarly charged plates of the modular members are arranged so that the vanes are disposed in opposite directions but not at the same level or on the same plane. This arrangement, however, can be made and it performs a preferred mounting arrangement as is fragmentarily illustrated in FIG. **11**. Further, as is shown in FIG. **7**, the axis B—B is more stiff than the axis A—A, so by turning one of the plates of a pair 90° as is shown in FIG. **12**, the stiffness across the B—B axis can be advantageously utilized in back to back mounting to produce a rigid stiff modular electrostatic member. Further, as previously indicated, the end reinforcing ribs are offset so that by alternately placing the top rib **33** at the bottom and the bottom rib **34** at the top, the spacing of opposed members is such that the vanes **38** are equidistantly spaced from each other and interleaved to form the fluid air passages **45** and the electrostatic fields **46** across said passages as previously indicated.

It will be appreciated that the modular louvered electrode units of this invention can be mounted in such a manner as to form a plurality of small cells which can easily be removed for cleaning or for repair or can be mounted into one large unit tied together by conventional means so that alternate plates or pairs of plates are oppositely charged so as to form a plurality of closely spaced fluid passages and a plurality of electrostatic fields across said passages for compact and efficient particle precipitation from fluid streams.

While modifications will occur to those skilled in the art from the detailed description of the drawings hereinabove given, it is intended that this description be non-limiting, except so as to be commensurate in scope with the appended claims.

I claim:

1. In a two stage fluid stream electrostatic particle precipitator, a collector electrode structure, adapted to be disposed in a fluid stream, comprising a stack of modular electrode members forming a parallel plate electrostatic cell in which a first modular electrode member is mounted in insulated relation to a second adjacent modular electrode member and in parallel relation one to the other, and in which said first and second modular electrode member are charged to a different electrical potential, the improvement in which:

A. each modular electrode member includes an electrically conductive louvered plate comprising:
   1. reinforcing ribs;
   2. a series of projecting vanes, and
   3. attachment means for attaching each of said vanes to a rib;
B. the improvement in said collector electrode structure in which:
   1. said first modular electrode member is mounted with its projecting vanes in opposed relation to the projecting vanes of a second modular electrode member,
      a. the projecting vanes of said first modular electrode member being interleaved with the projecting vanes of said second modular electrode member,
      b. the vanes of said first modular electrode member lying in spaced insulated and parallel relation to the vanes of said second modular electrode member;
C. the further combination therewith of a plurality of open fluid passages in said parallel plate electrostatic cell for passage of said fluid stream,
   1. said open fluid passages being defined by the projecting vanes of said first modular electrode member interleaved with the projecting vanes of said second modular electrode member; and,
D. a plurality of electrostatic fields extending between the interleaved projecting vanes of said first and second electrode members and across said open fluid passages, the direction of said electrostatic fields being perpendicular to said interleaved projecting vanes.

2. A precipitator, as defined in claim **1**, in which:

A. each of said vanes are of equal size.

3. A precipitator, as defined in claim **1**, in which each of said vanes are equidistantly spaced from adjacent vanes.

4. A precipitator, as defined in claim **2**, in which the vanes of said first electrode member are of equal size to the vanes of adjacent electrode members.

5. A precipitator, as defined in claim **3**, in which the vanes of a first modular electrode member are equidistantly spaced from adjacent vanes and the vanes in an adjacent modular electrode member are identically spaced relative to said first member.

6. A precipitator, as defined in claim **1**, in which:

A. each of said collector electrode members are formed into louvered plates from a piece of sheet metal;
B. the vanes of said member being formed by a punching operation on said sheet metal to cut a series of vanes and to bend said vanes into a projecting attitude,
C. the remaining uncut metal forming the reinforcing ribs for said louvered plates.

7. A precipitator, as defined in claim **6**, in which:

A. said attachment means is a tab of the original sheet metal remaining uncut in the punching operation and which is contiguous with a corner of said vane and said rib.

8. A precipitator, as defined in claim **1**, in which the projecting vanes are disposed in a plane perpendicular to the plane of said ribs.

9. A precipitator, as defined in claim **1**, in which:

A. said first modular electrode member includes a first pair of louvered plates mounted in conductive back to back relation with the vanes of one plate projecting in opposite direction to the vanes of the other plate of the pair; and

B. said second modular electrode member includes a second pair of louvered plates, mounted in conductive back to back relationship but in insulated relation to said first modular electrode member, with the vanes of one plate of said second pair projecting in the opposite direction to the vanes of the other plate of said second pair.

10. A precipitator as defined in claim **9**, in which:

A. the vanes of one plate of said first pair of louvered plates lie in the same plane as the vanes of the other plate of said first pair of louvered plates and,

B. the vanes of one plate of said second pair of louvered plates lie in the same plane as the vanes of the other plate of said second pair of louvered plates.

11. A precipitator, as defined in claim **1**, in which the louvered plate forming a modular electrode member is rectangular in shape.

12. A precipitator, as defined in claim **1**, in which the width of the reinforcing rib on one edge of said louvered plate is greater than the width of said reinforcing rib on the other edge of said louvered plate, so that the louvered plate may be mounted with its projecting vanes at one of two levels, equidistantly spaced from adjacent projecting vanes of adjacent louvered plates.

13. A method of mounting modular electrode members to form a parallel plate collector cell for disposition in a fluid stream of an electrostatic precipitator, which comprises the steps of:

A. mounting a first modular electrode member comprising an electrically conductive louvered plate having reinforcing ribs and projecting vanes in parallel and insulated relation to a second modular electrode member of identical configuration interleaving in spaced, insulated and parallel relationship to the vanes of said second modular electrode member; and

B. making electrical interconnections with said first and second modular electrode members interleaving one of said modular electrode members with an electric potential different than that of the other modular electrode member.

14. A method of mounting modular electrode members to form a parallel plate collector cell for disposition in a fluid stream in an electrostatic precipitator, which comprises the steps of:

A. forming a first modular electrode member by placing a first electrically conductive louvered plate, having reinforcing ribs and projecting vanes, in back to back conductive relation, with a louvered plate of identical configuration with the vanes of one plate projecting in opposite direction to the vanes of the other plate;

B. forming a second modular electrode member by placing a conductive louvered plate, having reinforcing ribs and projecting vanes, in back to back conductive relation with a louvered plate of identical configuration with the vanes of one plate of said second modular electrode member projecting in opposite direction to the vanes of the other plate of said second modular electrode member;

C. interleaving the projecting vanes of one plate of said first electrode member in spaced insulated and parallel relation to the vanes of a plate of said second modular electrode member; and,

D. making electrical interconnections with said first modular electrode member and said second modular electrode member and charging one of said modular members with an electric potential different from that of the other modular electrode member.

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