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 [73] Assignee **Westinghouse Electric Corporation,**
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[54] **COLLAPSIBLE AND DISPOSABLE COLLECTING CELL FOR ELECTROSTATIC PRECIPITATOR**
4 Claims, 6 Drawing Figs.

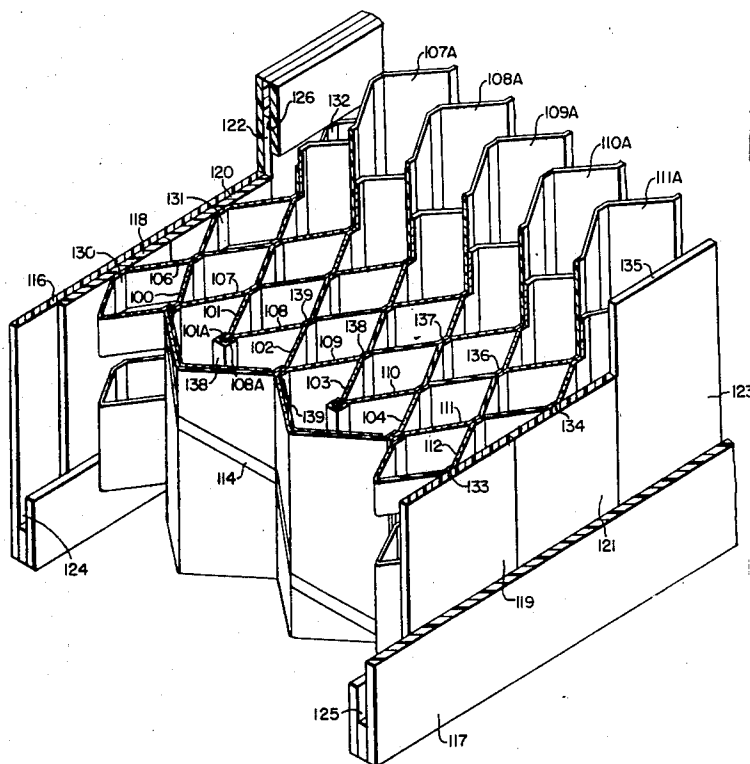
[52] U.S. Cl. **55/142,**
55/143, 55/149, 55/155, 55/156, 55/278, 55/521,
55/529, 156/197, 161/68
 [51] Int. Cl. **B03c 3/45**
 [50] Field of Search **55/138-**
—156, 278, 521, 529; 156/197; 161/68

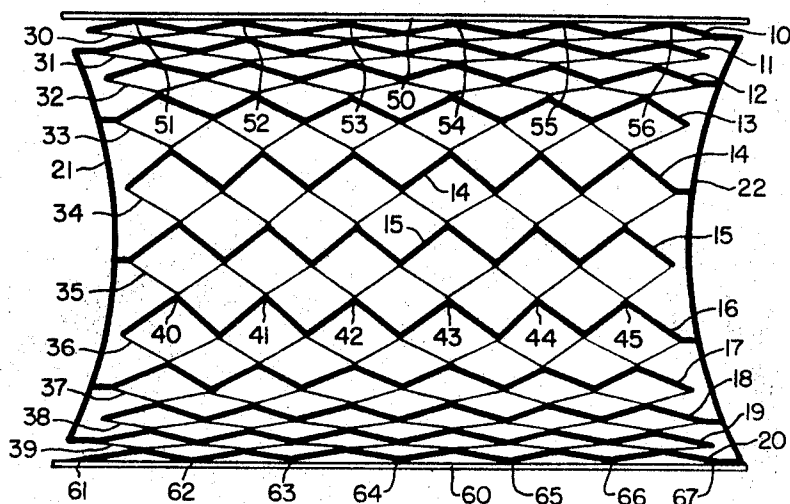
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ABSTRACT: A collapsible and disposable collecting cell for an electrostatic precipitator comprising a plurality of conducting sheets of first and second overlying series adapted to be interconnected to opposite polarities of a voltage, the conducting sheets of the first series being alternately disposed between the conducting sheets of the second series. A respective insulating sheet is disposed between each conductive sheet and all sheets are interconnected in a manner to form a honeycomb-like cell, when expanded, so as to receive air therethrough in one direction. An uppermost and a lowermost sheet is respectively connected to respective oppositely positioned supporting base sheets in a flexible manner such as by means of movable support bars extending along spaced connecting portions in the one direction but which are movable to permit limited movement at right angles to and in the same plane of the connecting portions to thereby allow contraction of the cell in the direction of limited movement as it is expanded in another direction perpendicular thereto. The insulating sheets between conducting sheets are longer in the connecting direction to provide an overhang at respective opposite cell ends.





PRIOR ART
ARRANGEMENT
EXPANDED

FIG. 1.

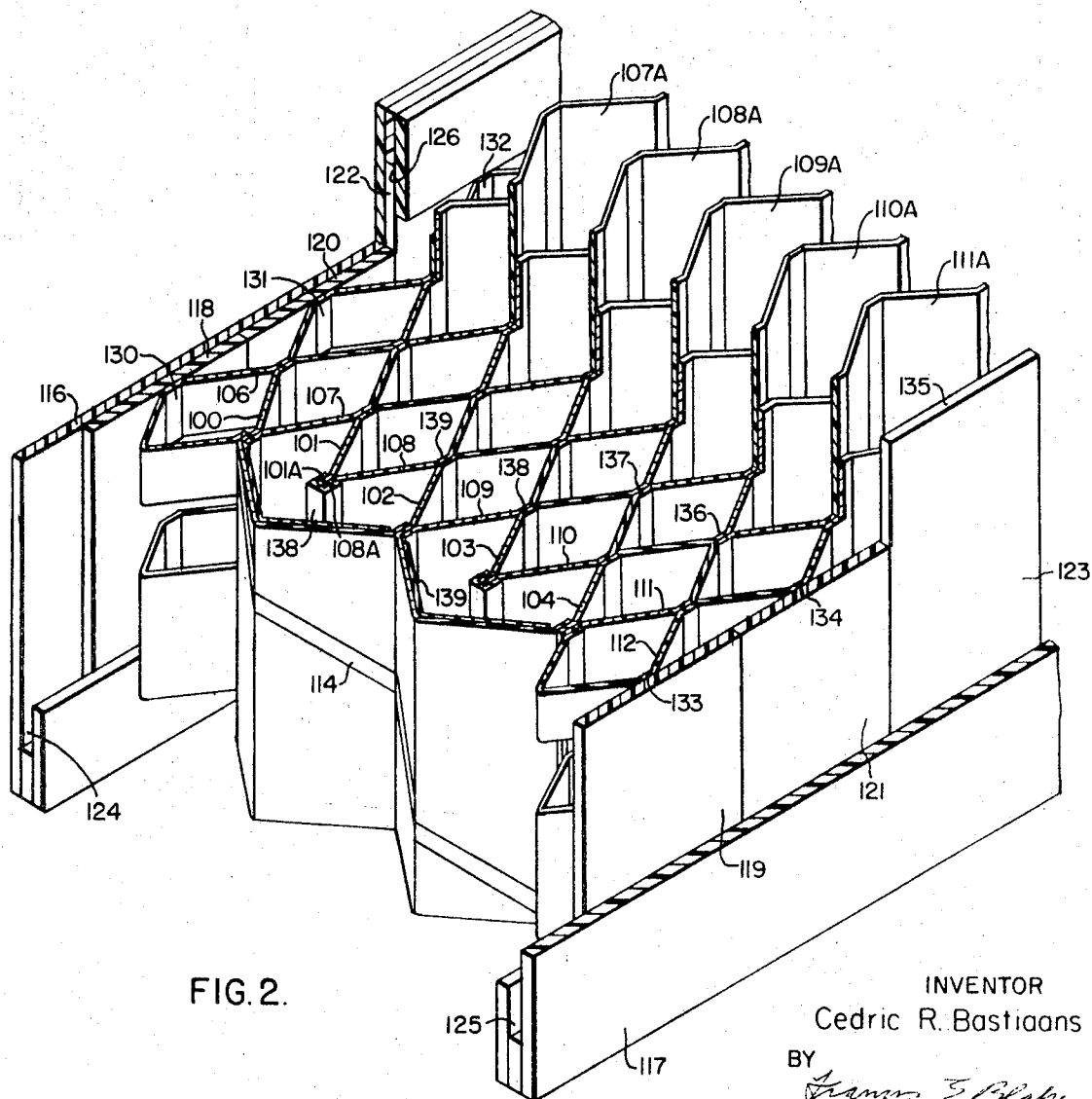


FIG. 2.

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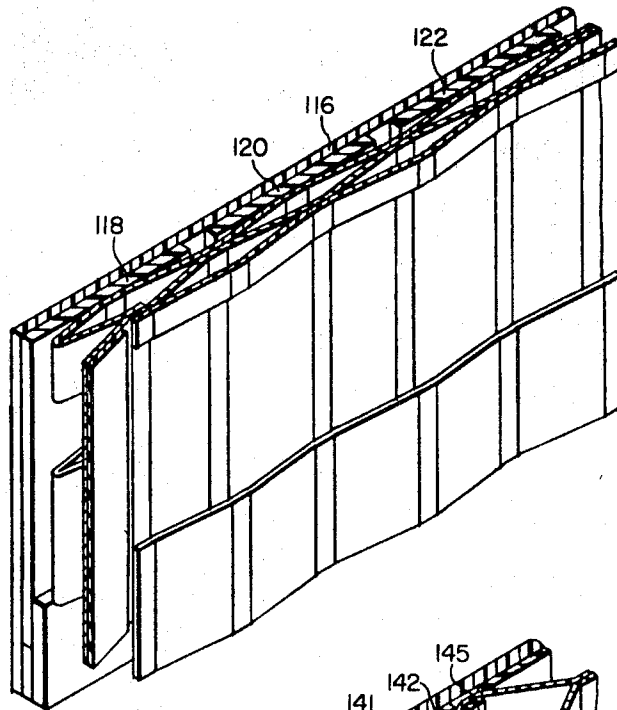


FIG. 3.

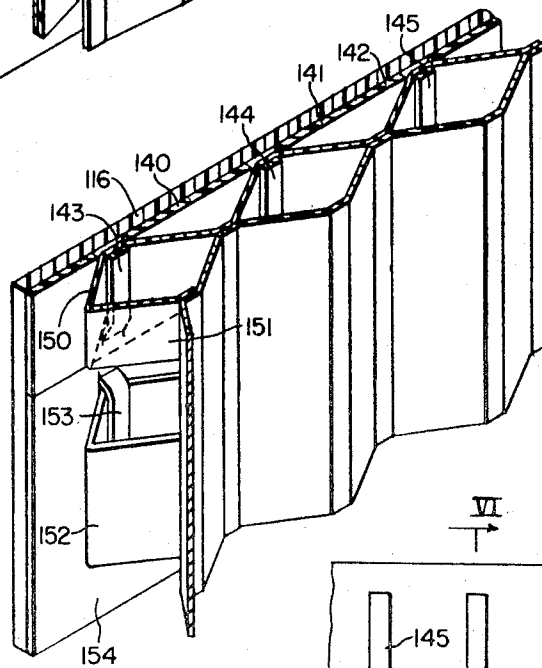


FIG. 4.

FIG. 5

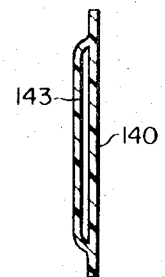
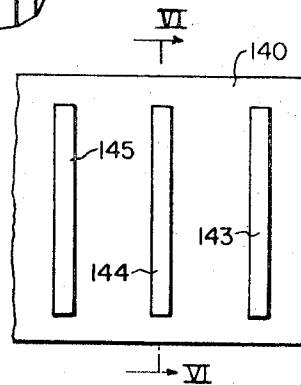


FIG. 6.

COLLAPSIBLE AND DISPOSABLE COLLECTING CELL FOR ELECTROSTATIC PRECIPITATOR

CROSS-REFERENCES TO RELATED APPLICATIONS

So far as is known this invention is not related to any copending patent applications in the United States.

BACKGROUND OF THE INVENTION

Collapsible and disposable collecting cells formed of sheets of conducting and insulating papers are well known and for example the U.S. Pat. to DiVette, No. 2,885,026, issued on May 5, 1959 discloses a collapsible cell of honeycomb structure for which the present invention is an improvement. For most satisfactory results in application, such a precipitator cell should have equal spacing between the conducting cell walls of oppositely connected electrical polarities throughout all of the cell layers when the honeycomb is expanded for use. When the top and bottom layers or sheets respectively of are connected to respective suitable supporting sheets in the fixed spatial arrangement as shown in the aforementioned patent, it is difficult if not impossible to expand the honeycomb cell uniformly without a bowed waistline and with the spacings between conductive sheets of the outermost honeycomb layers less than the spacings between the innermost honeycomb layers as shown by FIG. 1 of the attached patent drawings.

PRIOR ART

Reference may be made to the aforementioned U.S. Pat. No. 2,885,026, issued to DiVette on May 5, 1959 for which the present invention is an improvement.

SUMMARY

In accordance with this invention, the connecting portions of the respective top and bottom sheets of the stack of overlying sheets are connected to respective oppositely positioned supporting base sheets in a flexible manner such as through movable support bars that are arranged to be movable in directions at right angles to but in the same plane as the connecting portion directions thus allowing for contraction of the cell in the movable direction when it is expanded in the direction perpendicular thereto as the supporting base sheets are moved apart. Thus the form of the cell as expanded has a straight waistline and the spacings between opposing conductive sheet cell walls are uniform throughout all of the layers of the cell. Another feature of the present invention provides that each one of the insulating sheets is longer in the connecting portion direction than the lengths of the conducting sheets in the same direction so as to provide an overhang of insulating sheets at opposite ends to thereby increase the corona and leakage current paths between adjacent conducting sheet ends.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic end view looking in the direction of airflow through an expanded collapsible precipitator cell constructed as described by the prior art U.S. Pat. No. 2,885,026 previously mentioned and showing a disadvantage of the prior art;

FIG. 2 is a perspective view partly in section of the improved form of collapsible precipitator cell of this invention as shown in the expanded form;

FIG. 3 is a fragmentary view similar to FIG. 2 but showing the form of the cell in the collapsed state;

FIG. 4 is a fragmentary view similar to FIG. 3 but showing a slightly modified form of the invention as regards the flexible manner of attaching an uppermost layer or sheet to the movable support bars and the supporting base sheet;

FIG. 5 is a detail plan view of one of the support bars used with FIG. 4; and

FIG. 6 is a section on the line 6-6 of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring first to FIG. 1 of the drawings, wherein the prior art collapsible precipitator cell is shown in a manner to emphasize the disadvantages of the prior art arrangement, it will be seen that the collapsible precipitator cell consists of superposed layers or sheets of conducting material such as shown at 10 through 20. Alternate conducting sheets such as the odd numbered sheets 11-19 are electrically connected together by conductive side sheet structure 21 while the remaining conductive sheets even numbered 10-20 are electrically connected together by the side sheet 22 of electrical conductive material. Interposed between each conductive sheet 10-20 is an insulating sheet 30-39 and adjacent ones of the conductive sheets are connected to adjacent ones of the insulating sheets at spaced points such as shown at 40-45. Each of the connecting portions 40-45 extends in one direction along the direction of airflow and layers of cells having opposing sidewalls of conductive material connected with opposite polarities such as the sidewalls 14 and 15 are thereby provided in a honeycomb structure when the cell is expanded as shown. A supporting base sheet or end plate 50 is secured at fixed spaced points 51-56 to the uppermost sheet 10. Similarly a supporting base sheet or end plate 60 is secured at fixed spaced points 61-67 to the lowermost sheet 20. It will be noted that the relatively rigid arrangement for connecting the end plates 50 and 60 to their respective conducting plates 10 and 20 at the fixed spaced apart points causes a distortion of the cell shape or configuration to take place when the cell is expanded so that the waistline formed by the conductive sheets 21 and 22 is bowed inwardly thus making it difficult to adapt the shape of the expanded cell to structural sidewalls (not shown) within which the cell is intended to be placed while expanded for purposes of cleaning the gas passing therethrough. Another major disadvantage of the prior art arrangement being described in connection with FIG. 1, is that the spacing between the outermost layers of the cells such as shown between conducting walls 19 and 20 and 10 and 11 for example is considerably less than the spacing between the innermost cell layers 14 and 15. It should be noted that the distortion of the cell structure upon expansion as described is due to the fact that the spaced points of securing the outermost layers to the respective end plates 50 and 60 are spaced apart with the same spacing between the points 51-56 and 61-67 when the cell is either expanded or contracted. I have found that if the cell is to be expanded in one direction as the end plates 50 and 60 are moved apart, the width of the cell in the direction extending at right angles to the direction of connecting portion 51-56 should be allowed to decrease so that a straight waistline of reduced space between the two waistlines 21 and 22 can be provided and uniform spacing between all of the conductive layers of the cell from top to bottom can also be obtained. With a uniform spacing for all layers as provided by the present invention, the applied voltage can be as high as practicable for the minimum layer spacing which is substantially uniform throughout and is not reduced, to any extent as is the case with the outer cell layers of the prior art referred to.

Referring now to FIGS. 2 and 3 of the drawings, the novel arrangement of the present invention will be described in particular detail. The cell may be comprised of superposed conducting layers 100-104 separated by intervening insulating sheets 107-110 in addition to the upper and lower connecting insulating sheets 106, 111 and 112. Alternate ones of the conducting sheets such as the even numbered sheets 100, 102 and 104 constitute a first series which are physically and electrically connected together by side sheets and a conducting strip 114. Similarly the other conducting sheets with the odd numbers 101 and 103 constitute a second series which are physically and electrically connected together by a side sheet opposite to the side sheet 114 and a similar conducting strip not shown.

The adjacent joined edges of conducting and insulating sheets each is shown at 101A and 108A may be overlapped with a sheet of insulating material 138 in order to minimize corona. Also an overlay of insulating sheet material such as shown at 139 may be provided to minimize corona.

Oppositely positioned end plate structures or base sheets 116 and 117 are provided with a plurality of movable supporting strip members such as the strip members 118, 120 and 122 for the base sheet 116 and movable strip members 119, 121 and 123 for the base supporting sheet 117. The respective movable supporting trip members 118, 120 and 122 are positioned within slots 124 and 126 of the base strip 116 on the opposing face thereof. Similarly, the movable support strips 119, 121 and 123 are supported in similar groove structures including the groove structure 125 on the opposing surface of the support sheet 117. The arrangement of the movable supporting base strips 118—123 is such that they may move from spaced positions such as shown by FIG. 3 of the drawings when the cell is in the collapsed state towards each other to abutting side-by-side positions with the sidewalls immediately adjacent each other as shown by FIG. 2 of the drawings when the cell is expanded and vice versa. By suitably proportioning the width of the supporting strips 118—123 the degree of movement of the strips toward each other as the cell is expanded may be limited to thereby in effect limit the expanded dimension of the cell.

As shown by FIGS. 2 and 3 of the drawings the insulating strip 106 is secured at 130 to the support strip 118 at 131 to the support strip 120 and at 132 to the support strip 122. Similarly the lowermost layer or insulating sheet 112 is secured at 133 to the movable support strip 119, at 134 to the movable support strip 121, and at 135 to the movable support strip 123. Similarly, the intervening insulating strips 107, 108, 109, 110 and 111 are secured to respective conducting sheets at spaced points such as 136—139, etc. to form a honeycomb structure when the cell is expanded by moving apart the supporting base sheets 116 and 117.

It should now be apparent, that upon expansion of the cell when the supporting end plates 116 and 117 are moved apart, the spacings between adjoining connecting portions such as 130, 131, and 132 are decreased in a direction extending at right angles to but in the same plane as the direction of the connections 130, 131 and 132. Similarly the supporting strips 119—123 are moved together to contract the spacing between the connecting strip portions 133, 134 and 135 so that a uniform expansion of the cell in the direction between the movable end plates 116 and 117 is uniformly obtained with a minimum of distortion, and with a corresponding contraction between the side waistline such as the side waistline 114 and its opposing side waistline (not shown). Thus, the spacing between the conductive electrode layers 100—104 is uniform throughout the entire cross section of the cell when the cell is expanded.

The uppermost and lowermost layers of the cell may be secured to the respective movable supporting strips by any suitable manner such as gluing or the like. Also, depending upon desired design criteria, the uppermost and lowermost layer of a particular cell as constructed in accordance with this invention may be either a conducting layer or an insulating layer. The supporting base sheets 116, 117, and the movable support strips 118—123 are formed of suitable insulating material such as cardboard or the like. It is not believed necessary to refer to any particular type or sheet material for the respective conducting and insulating sheets forming the cell layers since various materials are well known to those skilled in the art having the desired properties of insulation or conduction respectively.

Referring to FIGS. 4—6 of the drawings a somewhat modified form of the invention is shown wherein the flexible or movable connections between the outermost layers of the cell is provided by passing a flexible connecting strip member such as the member 151 loosely through loops such as shown at 143—145 of a supporting strip or bar 140 that is affixed in

any suitable manner to the supporting base sheet 116. Similarly, a connecting strip member 152 may be passed loosely through loops such as the loop shown at 153 of a supporting strip 154. Any number of supporting strips or bars such as strips 116, 154 and associated flexible connecting strips 151, 152 may be provided depending on desired cell parameters such as the width of the strips 151, 152 relative to the height of the complete cell that has only been fragmentarily shown by FIG. 4 of the drawings.

Referring again to FIG. 2 of the drawings, it will be seen that the insulating sheets 107—111 adjacent to the conducting sheets 100—104 are of greater width than the conducting sheets in the connecting direction to provide overhangs such as are shown at 107A—111A. This greater width has been defined to extend in a direction of the connecting portions such as connecting portions 136 and 137 and provides an overhang not only as shown at 107A—111A but a similar overhang at the opposite end of the sheet structures (not shown by the drawings). The overhang provided by the greater width of the insulating sheets 107—111 relative to the conducting sheets 100—104 provides an extremely long leakage path and hence a lessened possibility of corona for the cell when it is in operation with a voltage of about 6,000 volts applied with opposite polarities respectively to the respective series of conducting electrode sheet members.

It should be understood that this invention is not limited to any particular number of conducting sheets or insulating sheets and that various arrangements for securing either conductive or insulating sheets as the outermost layers to the movable supporting strips on the opposing supporting base sheets may be used.

It is now apparent that the collapsible and disposable precipitator cell formed and constructed as described by the present invention of inexpensive material such as conductive and insulating paper and cardboard may be readily discarded after use instead of resorting to tedious procedures as used in the past for cleaning the accumulated dirt from a used precipitator cell. Since the collapsible cell of the present invention is not distorted in the expanded form, and uniform spacing between the conductive electrodes is obtained a cross section of response of the cell is more uniform and higher voltages may be used throughout the cell for improved efficiency. Also, the tendency for heavy buildup of dirt in one part of the cell relative to another part of the cell to thus become clogged will be avoided. Thus the usable lifetime of the cell is extended since the accumulations of dirt within the cell will be more uniformly dispersed and there will not be any undesired clogging as would be obtained when there are relatively narrow spacings between the conducting electrodes of opposite polarity as disclosed by the prior art.

Although it is not shown or described, it should be understood that any simple supporting framework of rectilinear configuration may be provided within which the expanded precipitator cell will be contained during its operation and this invention is not concerned with any particular supporting frame configuration.

Various modifications will occur to those skilled in the art.

I claim:

1. A disposable and collapsible cell for an electrostatic gas cleaner gas cleaner comprising, a first set of electric conducting sheets, a second set of electric conducting sheets, each of said sheets of said first set being interposed between adjacent sheets of said second set so that every other conducting sheet is of the same set, a plurality of electric insulating sheets each being interposed between adjacent conducting sheets, thus starting with a conducting sheet at one side there is a sheet of said first set, an insulating sheet, a sheet of said second set, an insulating sheet and so on, throughout the cell, means for connecting adjacent sheets along common portions running on one direction, said common portions for said first set of sheets and said insulating sheets on opposite sides thereof being spaced a predetermined distance along said first sheet of said first set in a second direction at right angles to said one

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direction, every other of said common portions of said first sheets being connected to the insulating sheet on the opposite side of said first sheet, said common portions for said second set of sheets and said insulating sheets on opposite sides thereof being spaced a predetermined distance along said sheet of said second set in said second direction, every other of said common portions of said second set being connected to the insulating sheet on the opposite side of said second sheet, thus said insulating sheets are alternatively connected to a conducting sheet of said first set and a conducting sheet of said second set, the three sets of sheets upon being expanded from a collapsed position forming a honeycomblike cell adapted to receive air therethrough in said one direction, means adapted to connect said first set of sheets to a source of power, means adapted to connect said second set of sheets to a source of power, first and second oppositely positioned supporting base sheets adapted to be brought together when said cell is collapsed and drawn apart when said cell is expanded, means flexibly connecting respective portions extending in the one direction of the uppermost one of said superposed sheets to said first base sheet in a manner to permit movement of the connections in the same plane but at right angles to the directions of connection, and means flexibly connecting respective portions extending in the one direction of the lowermost one of said superposed sheets to said second base sheet in a manner to permit movement of the connections in the same plane but at right angles to the direction of the connection so as to allow for contraction of the cell in the direction at right angles to the one direction when it is ex-

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panded in another direction perpendicular thereto.

2. The invention of claim 1 in which there are a plurality of first support bars slidably mounted on the opposing face of said first base sheet for movement in the same plane but at right angles to said one direction, a plurality of second support bars slidably mounted on the opposing face of said second base sheet of movement in the same plane but at right angles to said one direction, the uppermost one of said superposed sheets being connected along respective portions extending in the one direction to respective ones of said first support bars, and the lowermost one of said superposed sheets being connected along respective portions extending in the one direction to respective ones of said second support bars in a manner such that said first and second support bars are movable towards each other when said cell is expanded from the collapsed state and are movable away from each other as said cell is contracted back to the collapsed state.

3. The invention of claim 1 in which the widths of the insulating sheets between adjacent conducting sheets are greater than in width in the one direction than the widths of the conducting sheets extending in the one direction whereby to provide an overhang of insulating sheets in the one direction relative to the conducting sheets at each end.

4. The invention of claim 2 in which the widths of each of said support bars in their directions of movement are chosen to cause the bars to abut each other and limit the degree of movement of the bars towards each other as the cell is expanded and thereby limit the expansion of the cell.

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