Solution to the Problems

[0007] In order to solve the above-described problems, the invention of the first aspect is a dust collection device constructed by laminating a first insulation type electrode including a sheet-shaped first electrode at least one surface of which is coated by a first insulating layer and to which a first voltage is applied, and a second insulation type electrode including a sheet-shaped second electrode at least one surface of which is coated by a second insulating layer and to which a second voltage different from the first voltage is applied, alternately via an insulating spacer, wherein a plurality of first ventilation holes penetrating from the first insulating layer to the first electrode and exposing a part of the first electrode inside, are provided in the first insulation type electrode, a plurality of second ventilation holes penetrating from the second insulating layer to the second electrode and exposing a part of the second electrode inside, are provided in the second insulation type electrode, and the second ventilation holes are disposed so that their positions deviate by a predetermined distance from positions of the first ventilation holes in a planar view.

With this construction, when the first voltage is applied to the first electrode of the first insulation type electrode and the second voltage is applied to the second electrode of

the second insulation type electrode, a potential difference occurs between the first electrode and the second electrode, and the first electrode and the second electrode are electrically charged with polarities reverse to each other. In addition, near the first electrode exposed inside the first ventilation hole and near the second electrode exposed inside the second ventilation hole, a high-density electric field is generated, and so-called corona discharge occurs near the first electrode exposed inside the first ventilation hole and near the second electrode exposed inside the second ventilation hole. Therefore, when air containing dust passes through, for example, the first ventilation hole of the first insulation type electrode on the front surface, the dust is electrically charged by corona discharge occurring near the first electrode exposed inside the first ventilation hole.

The electrically charged dust flows into the dust collection device together with air.

At this time, the second ventilation holes of the second insulation type electrode deviate by a predetermined distance from the first ventilation holes, so that the air and dust flowing into the portion between the first insulation type electrode and the second insulation type electrode move in a lateral direction from the first ventilation holes toward the second ventilation holes, and flow into the portion between the second

insulation type electrode and the first insulation type electrode via the second ventilation holes. At this time, dust that is not electrically charged by corona discharge near the first electrode exposed inside the first ventilation hole is electrically charged by corona discharge near the second electrode exposed inside the second ventilation hole.

Thereafter, in the same manner, air containing electrically charged dust flows while meandering inside the device.

Thus, when air containing electrically charged dust flows inside the dust collection device, dust electrically charged with a polarity reverse to the charging polarity of the first electrode is electrostatically attracted to the first electrode side, dust electrically charged with a polarity reverse to the charging polarity of the second electrode is electrostatically attracted to the second electrode side, and only clean air is flowed out of the dust collection device. Further, since air flows while meandering inside the device as described above, a time of flow inside the device becomes longer, and accordingly, a larger amount of dust is reliably electrostatically attracted.

If the position of the first electrode exposed inside the first ventilation hole and the position of the second electrode exposed inside the second ventilation hole are close to each other, spark discharge may occur between the first

electrode and the second electrode before corona discharge occurs. However, in the dust collection device according to this invention, the first electrode exposed inside the first ventilation hole and the second electrode exposed inside the second ventilation hole are positioned to deviate by a predetermined distance from each other, so that spark discharge hardly occurs between these electrodes.

The dust collection device described above can be constructed by laminating a first insulation type electrode including a sheet-shaped first electrode and a first insulating layer coating the first electrode and a second insulation type electrode including a sheet-shaped second electrode and a second insulating layer coating the second electrode alternately via a thin spacer, so that the dust collection device can be entirely formed into a sheet shape that is lightweight and thin, and does not require a large space. As a result, maintenance of the device, such as washing out contamination on the device, can be easily performed.

Further, as described above, the dust collection device is structured to collect dust by suctioning air containing the dust in a surface direction of the dust collection device, so that the device can be installed in accordance with a window, etc., in a room.

For example, it is possible that two dust collection

devices are fitted in accordance with a window frames provided in a room as an enclosed space, and after outside air is flowed into the room space via one dust collection device, the air can be flowed out of the room space from the other dust collection device to the outside. That is, outside air is cleaned and guided into a room space by one dust collection device, and inside air is cleaned and exhausted to the outside by the other dust collection device, so that the dust collection device can clean air in the room while ventilating it. Cleaned air is exhausted to the outside, so that air outside the room space can also be cleaned. In addition, since fresh air is supplied into the room space, oxygen inside the room can be prevented from decreasing.

This dust collection device does not need an ionization unit that has a complicated structure and easily malfunctions, so that the device has high operation reliability.

[0008] The invention of the second aspect is the dust collection device according to the first aspect, constructed so that the first electrode inside the first ventilation hole is exposed in a donut shape as viewed from the first insulating layer side, and the second electrode inside the second ventilation hole is exposed in a donut shape as viewed from the second insulating layer side.

With this construction, by the donut-shaped exposed

portion, a contact area between air and the first and second electrodes is enlarged, so that the capacity for electrically charging dust of the first electrode exposed inside the first ventilation hole and the second electrode exposed inside the second ventilation hole is improved.

[0009] The invention of the third aspect is the dust collection device according to the first aspect, constructed so that the first electrode inside the first ventilation hole is formed into a brush-shaped electrode made of conductive fibers directed toward a center side from an inner circumference of the first ventilation hole, and the second electrode inside the second ventilation hole is formed into a brush-shaped electrode made of conductive fibers directed toward a center side from an inner circumference of the second ventilation hole.

With this construction, by the exposure in the brush shape, a contact area between air and the first and second electrodes is enlarged. In addition, the holes of the first and second electrodes through which air passes become small, so that dust with a large diameter cannot pass through the first and second ventilation holes.

[0010] The invention of the fourth aspect is the dust collection device according to the first aspect, constructed so that a plurality of small holes communicating with the holes of the first insulating layer are formed in the first electrode

inside the first ventilation hole, and a plurality of small holes communicating with the holes of the second insulating layer are formed in the second electrode inside the second ventilation hole.

With this construction, dust with a large diameter is blocked by the small holes of the first and second ventilation holes.

[0011] The invention of the fifth aspect is the dust collection device according to any of the first to fourth aspects, constructed so that both surfaces of the first electrode of the first insulation type electrode are coated by the first insulating layers, both surfaces of the second electrode of the second insulation type electrode are coated by the second insulating layers, the first ventilation holes penetrate across the first insulating layers and the first electrode in a state that a part of the first electrode is exposed inside, and the second ventilation holes penetrate across the second insulating layers and the second electrode in a state that a part of the second electrode is exposed inside.

[0012] The invention of the sixth aspect is the dust collection device according to any of the first to fifth aspects, constructed so that the first voltage with a positive potential or a negative potential is applied to the first electrode, and the second voltage with zero potential is applied to the second

electrode.

[0013] The invention of seventh aspect is the dust collection device according to any of the first to sixth aspects, constructed so that each of the second ventilation holes is disposed so as to be positioned at substantially the center between two first ventilation holes adjacent to each other provided in the first insulation type electrode in a planar view.

Effects of the Invention

[0014] As described in detail hereinbefore, since the dust collection device of the present invention is structured to collect dust by suctioning air containing the dust in a surface direction of the dust collection device, so that an excellent effect of installing the dust collection device in accordance with a window, etc., in a room is obtained. As a result, by fitting a plurality of dust collection devices to a plurality of windows provided in a room as an enclosed space, an effect of cleaning air in the space while ventilating it is obtained. Since fresh air is supplied into the room space, an effect of securing fresh oxygen in the room space and preventing a decrease

in oxygen in the room space is obtained. In addition, unwanted contaminants, water vapor, and odors in a room space can be eliminated.

Further, the entire dust collection device can be formed into a sheet shape that is lightweight and thin, and does not require a large space, so that an effect of easily performing maintenance such as washing is obtained.

In addition, since the first electrode exposed inside the first ventilation hole and the second electrode exposed inside the second ventilation hole are disposed to deviate by a predetermined distance from each other, so that an effect of preventing spark discharge between these electrodes is obtained.

Since the device does not need an ionization unit that has a complicated structure and easily malfunctions, an effect of providing a downsized and thin dust collection device that has high operation reliability and includes a small number of components is obtained.

[0015] The invention of the second aspect brings about an effect of improving dust attraction capacity of the device.

The invention of the third and fourth aspects brings about an effect of not only improving the capacity of the device for electrically charging dust but also reliably eliminating dust with a large diameter.

Brief Description of the Drawings

[0016]

Fig. 1 is a partially cutaway perspective view of a dust collection device according to a first embodiment of the present invention.

Fig. 2 is an exploded perspective view of the dust collection device according to the first embodiment.

Fig. 3 is a sectional view of the dust collection device.

Fig. 4 is an exploded perspective view of a first insulation type electrode.

Fig. 5 is an exploded perspective view of a second insulation type electrode.

Fig. 6 is a sectional view describing operation and effects of the dust collection device.

Fig. 7 is a schematic view showing a usage example of the dust collection device.

Fig. 8 is a sectional view showing a dust collection device according to a second embodiment of the present invention.

Figs. 9 are plan views of insulation type electrodes, Fig. 9(a) shows a first insulation type electrode and Fig. 9(b) shows a second insulation type electrode.

Fig. 10 is a partial enlarged view of first and second

CLAIMS

1. A dust collection device comprising:

a first insulation type electrode including a first sheet-shaped electrode having at least one surface coated with a first insulating layer, a first voltage being applied to the first sheet-shaped electrode, and

a second insulation type electrode including a second sheet-shaped electrode having at least one surface coated with a second insulating layer, a second voltage different from the first voltage being applied to the second sheet-shaped electrode, the second insulation type electrode being laminated with the first insulation type electrode via an insulating spacer,

wherein provided in the first insulation type electrode is a plurality of first ventilation holes penetrating from the first insulating layer to the first sheet-shaped electrode and exposing a part of the first sheet shaped electrode inside,

provided in the second insulation type electrode is a plurality of second ventilation holes penetrating from the second insulating layer to the second sheet-shaped electrode and exposing a part of the second sheet shaped electrode inside, and

the second ventilation holes are disposed and positioned to deviate by a predetermined distance from the first ventilation holes in a plan view.

2. The dust collection device according to claim 1, wherein

the first sheet-shaped electrode inside each of the first ventilation holes is exposed in a donut shape as viewed from the first insulating layer side, and

the second sheet-shaped electrode inside each of the second ventilation holes is exposed in a donut shape as viewed from the second insulating layer side.

3. The dust collection device according to claim 1, wherein

the first sheet-shaped electrode inside each of the first ventilation holes is formed into a brush-shaped electrode made of conductive fibers directed toward a center side from an inner circumference of the first ventilation hole, and

the second sheet-shaped electrode inside each of the second ventilation holes is formed into a brush-shaped electrode made of conductive fibers directed toward a center side from an inner circumference of the second ventilation hole.

4. The dust collection device according to claim 1, wherein

a plurality of small holes is formed in the sheet-shaped first electrode inside each of the first ventilation holes, and

a plurality of small holes is formed in the second sheet-shaped electrode inside each of the second ventilation holes.

5. The dust collection device according to claim 1, wherein

the first insulating layer is coated on each of two surfaces of the first sheet-shaped electrode of the first insulation type electrode,

the second insulating layer is coated on each of two surfaces of the second sheet-shaped electrode of the second insulation type electrode,

the first ventilation holes penetrate across the first insulating layer on each side of the first sheet-shaped electrode in a state that a part of the first sheet-shaped electrode exposes inside, and

the second ventilation holes penetrate across the second insulating layer on each side of the second sheet-shaped electrode in a state that a part of the second sheet-shaped electrode inside.

6. The dust collection device according to claim 1, wherein

the first voltage with a positive potential or a negative potential is applied to the first sheet-shaped electrode, and the second voltage with zero potential is applied to the second sheet-shaped electrode.

7. The dust collection device according to claim 1, wherein

each of the second ventilation holes is disposed so as to be positioned at substantially a center between two of the first ventilation holes adjacent to each other provided in the first insulation type electrode in a plan view.