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(54) APPARATUS FOR GENERATING ELECTRIC FIELD AND ELECTRIC DISCHARGE

VORRICHTUNG ZUR ERZEUGUNG VON ELEKTRISCHEN FELDERN UND ELEKTRISCHER
ENTLADUNG

CHAMP ÉLECTRIQUE, ET DISPOSITIF DE GÉNÉRATION DE DÉCHARGE

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Description

Technical Field

[0001] The present invention relates to an electric field and discharge generator that forms an electric field to generate discharge between electrodes.

Background Art

[0002] EP 1 782 843 A1 relates to a deodorizing apparatus that removes odorant gas components and hazardous volatile chemical substances to clean the air. The deodorizing apparatus efficiently decomposes and removes odorant gases and hazardous volatile chemical substances to clean the air with a low energy consumption. The deodorizing apparatus is placed in an air duct and includes a discharge electrode and a counter electrode to which a high voltage is applied and a catalyst unit for removing odorant gas components and hazardous volatile chemical substances. The discharge electrode is placed on the windward side of the air duct and is constituted by a flat electrode having projections. The counter electrode is placed on the leeward side of the air duct and has openings that are formed by a metal or an electrically conductive material.

[0003] Patent Literature 1 described below discloses related art on an electric dust collector.

[0004] The dust collector described in Patent Literature 1 includes a high-potential discharge electrode and a grounded counter electrode. The discharge electrode is formed of an ionizing line. An intermediate portion of the discharge electrode is supported by a support member. The support member is fixed to a main frame.

[0005] The counter electrode is produced by cutting a metal plate into a piece having a predetermined shape and bending the piece. The counter electrode is provided with an electrode portion that faces the discharge electrode. The counter electrode is attached to an upper frame.

Citation List

Patent Literature

[0006] Patent Literature 1: Japanese Patent Laid-Open No. 2-164466

Summary of Invention

Technical Problem

[0007] In the dust collector described in Patent Literature 1, the electrode portion of the counter electrode faces the discharge electrode when the upper frame is attached to the main frame. The positional relationship between the electrode portion of the counter electrode and the discharge electrode therefore tends to deteriorate, re-

sulting in nonuniform electric field formation in some cases. When a uniform electric field is not formed, a stable discharge state cannot be maintained, which means that the apparatus cannot provide intended performance.

[0008] In the process of bending a metal plate, it is difficult to produce a precisely angled piece. In the dust collector described in Patent Literature 1, since the electrode portion of the counter electrode is not supported by another member, the positional relationship between the electrode portion of the counter electrode and the discharge electrode tends to deteriorates. Further, in the dust collector described in Patent Literature 1, the angle of the electrode portion can be changed over time.

[0009] The present invention was made to solve the problems described above, and an object of the present invention is to provide an electric field and discharge generator capable of preventing the positional relationship between the discharge electrode and the counter electrode from deteriorating but forming a uniform electric field.

Solution to Problem

[0010] An electric field and discharge generator of the invention is described in claim 1.

Advantageous Effects of Invention

[0011] According to the electric field and discharge generator of the present invention, it is possible to prevent the positional relationship between the discharge electrode and the counter electrode from deteriorating and to form a uniform electric field.

Brief Description of Drawings

[0012]

Figure 1 is an exploded perspective view showing an electric field and discharge generator in a first embodiment according to the present invention.

Figure 2 is a cross-sectional view showing the electric field and discharge generator in the first embodiment according to the present invention.

Figure 3 is a perspective view showing an electrode support of the electric field and discharge generator in the first embodiment according to the present invention.

Figure 4 is a perspective view showing a main portion of the electric field and discharge generator in the first embodiment according to the present invention. Figure 5 is a perspective view showing a counter electrode of the electric field and discharge generator in the first embodiment according to the present invention.

Figure 6 is a diagram to explain a structure of supporting an electrode portion of the counter electrode. Figure 7 is a diagram showing another structure of

supporting the electrode portion of the counter electrode.

Figure 8 is a diagram showing another structure of supporting the electrode portion of the counter electrode.

Figure 9 is a perspective view showing a main portion of the electric field and discharge generator in a second embodiment according to the present invention. Figure 10 is a perspective view showing an electrode support of the electric field and discharge generator in the second embodiment according to the present invention.

Figure 11 is a diagram to explain a method for attaching a discharge electrode in the second embodiment according to the present invention.

Description of Embodiments

[0013] The present invention will be described in detail with reference to the accompanying drawings. In the drawings, the same or corresponding portions have the same reference signs. Redundant descriptions are appropriately simplified or omitted.

First Embodiment

[0014] Figure 1 is an exploded perspective view showing an electric field and discharge generator in a first embodiment according to the present invention. Figure 2 is a cross-sectional view showing the electric field and discharge generator in the first embodiment according to the present invention. In Figure 1, the upper side represents the upstream side of the apparatus, and the lower side represents the downstream side of the apparatus.

[0015] The electric field and discharge generator includes an upper frame 1, a discharge electrode 2, a spring 3, a power feeder 4, electrode supports 5 and 6, a counter electrode 7, and a lower frame 8, as shown in Figures 1 and 2. The exterior shape of the electric field and discharge generator is formed by the upper frame 1 and the lower frame 8. That is, the discharge electrode 2, the spring 3, the power feeder 4, the electrode supports 5 and 6, and the counter electrode 7 are disposed between the upper frame 1 and the lower frame 8.

[0016] The upper frame 1 forms a portion disposed on the most upstream side of the apparatus. The entire upper frame 1 is made, for example, of a resin. The upper frame 1 has openings 1a for introducing outside air into the apparatus (allowing outside air to pass through). The upper frame 1 has a lattice 9, an upper rib 10, and a handle 11.

[0017] The lattice 9 is provided to prevent a finger of a person from accessing the interior of the apparatus through any of the openings 1a. Holes produced by the lattice 9 form the openings 1a. The openings 1a are formed through the upper surface (surface parallel to X-Y plane in Figure 1) of the upper frame 1 across a region having a predetermined width (distance in X-axis direc-

tion in Figure 1) and a predetermined depth (distance in Y-axis direction in Figure 1).

[0018] The upper rib 10 is formed, for example, of a plate-shaped member having a triangular shape. The upper rib 10 is disposed in the lattice 9 and has a front end protruding inward (downward) in the apparatus. The upper rib 10 is so disposed that it is perpendicular to the surface of the upper frame 1 where the openings 1a are formed (hereinafter also referred to as an "opening surface" of the upper frame 1). One upper rib 10 or a plurality of upper ribs 10 are provided in the upper frame 1. The entire lattice 9 and upper ribs 10 are made, for example, of a resin and formed integrally with a main body of the upper frame 1.

[0019] The handle 11 is provided to allow a person to grasp the apparatus with a hand.

[0020] The lower frame 8 forms a portion disposed on the most downstream side of the apparatus. The entire lower frame 8 is made, for example, of a resin. The lower frame 8 has openings 8a for exhausting the air introduced into the apparatus through the openings 1a out of the apparatus (allowing inside air to pass through). The lower frame 8 has a lattice 12, a lower rib 13, support ribs 14, and protrusions 15.

[0021] The lattice 12 is provided to prevent a finger of a person from accessing the interior of the apparatus through any of the openings 8a. Holes produced by the lattice 12 form the openings 8a. The openings 8a are formed through the lower surface (surface parallel to X-Y plane in Figure 1) of the lower frame 8 across a region having a predetermined width (distance in X-axis direction in Figure 1) and a predetermined depth (distance in Y-axis direction in Figure 1). The surface of the lower frame 8 where the openings 8a are formed (opening surface) is disposed in parallel to the opening surface of the upper frame 1. When no part is present in the apparatus, the openings 8a are set apart from the openings 1a in the height direction (Z-axis direction in Figure 1) by a predetermined distance and face the openings 1a.

[0022] The lower rib 13 is formed, for example, of a plate-shaped member having a triangular shape. The lower rib 13 and the corresponding upper rib 10 form a pair of support members. The lower rib 13 is disposed in the lattice 12 and has a front end protruding inward (upward) in the apparatus. The lower rib 13 is so disposed that it is perpendicular to the opening surface of the lower frame 8. Number of the lower rib 13 disposed in the lower frame 8 is the same as that of the upper rib 10.

[0023] Each of the support ribs 14 is formed, for example, of a rod-shaped member having a rectangular cross-sectional shape. Each of the support ribs 14 is disposed in the lattice 12 and has a front end protruding inward (upward) in the apparatus. The support ribs 14 are so disposed that they are perpendicular to the opening surface of the lower frame 8. Further, the support ribs 14 are disposed in a central portion of the region where the openings 8a are disposed. A slit 14a (not shown in Figure 1 or 2) is formed in the upper surface of each of the sup-

port ribs 14 in the width direction of the openings 8a (X-axis direction in Figure 1).

[0024] The entire lattice 12, lower ribs 13, support ribs 14, and protrusions 15 are made, for example, of a resin and formed integrally with a main body of the lower frame 8.

[0025] A main portion of the discharge electrode 2 is formed of an elongated plate-shaped member made of a metal. The metal of which the discharge electrode 2 is made is preferably, for example, tungsten, copper, nickel, stainless steel, zinc, iron, or molybdenum. The discharge electrode 2 may be made of an alloy primarily containing any of the metals described above or any of the metals described above the surface of which is plated with silver, gold, platinum, or any other precious metal.

[0026] The discharge electrode 2 has a rectangular cross-sectional shape surrounded by shorter sides and longer sides. Each of the shorter sides of the cross section of the discharge electrode 2 has a length ranging, for example, from 0.01 to 0.1 mm, and each of the longer sides of the cross section of the discharge electrode 2 has a length ranging, for example, from 0.1 to 1.0 mm. A ring-shaped terminal 2a is attached to each end of the discharge electrode 2. The discharge electrode 2 is folded back in intermediate positions about two to four times and accommodated in the apparatus.

[0027] The spring 3 is provided to exert a predetermined tensile force on the discharge electrode 2. The spring 3 is formed of a member made of a metal. Each of the ends of the discharge electrode 2 is connected to the spring 3 via the corresponding terminal 2a. The discharge electrode 2, which is pulled in the longitudinal direction thereof by the spring 3, is attached to the power feeder 4.

[0028] The power feeder 4 is formed of a member made of a metal. The power feeder 4 is connected to a power supply (not shown) for supplying a voltage ranging from 4 to 7 kV to the discharge electrode 2 (between discharge electrode 2 and counter electrode 7).

[0029] Figure 3 is a perspective view showing the electrode support (electrode support 5) of the electric field and discharge generator in the first embodiment according to the present invention.

[0030] The electrode supports 5 and 6 are provided to support the discharge electrode 2 and the counter electrode 7 in the apparatus. The entire electrode supports 5 and 6 are made, for example, of a resin. The electrode support 5 is attached to an end portion of the lower frame 8 on one side thereof. The electrode support 6 is attached to an end portion of the lower frame 8 on the other side thereof. The discharge electrode 2 is changed in direction and supported by the electrode support 5 on the one end side of the apparatus and by the electrode support 6 on the other end side of the apparatus. Each of the electrode supports 5 and 6 is provided with a member for folding back the discharge electrode 2 and a member for placing the discharge electrode 2 in an appropriate position.

[0031] Figure 4 is a perspective view showing a main

portion of the electric field and discharge generator in the first embodiment according to the present invention. Figure 4 shows a structure that supports the discharge electrode 2 in a central portion of the apparatus.

[0032] The discharge electrode 2 is supported by the electrode support 5 on the one end side of the apparatus and supported by the electrode support 6 on the other end side of the apparatus, as described above. The discharge electrode 2 is supported by the support ribs 14 in the central portion of the apparatus. The slit 14a formed in the upper surface of each of the support ribs 14 is open upward. The opening of the slit 14a has a width ranging from 0.1 to 1.0 mm, for example. The discharge electrode 2 in the upright position is inserted into the slits 14a and supported by the support ribs 14 from below (from the side where the lower frame 8 is present).

[0033] The discharge electrode 2, when it is supported by the electrode supports 5 and 6 in the end portions of the apparatus and supported by the support ribs 14 in the central portion of the apparatus, is disposed as a whole perpendicular to the opening surface of the upper frame 1 (and the opening surface of the lower frame 8). When the discharge electrode 2 is appropriately supported in the apparatus, the surface that forms one of the shorter sides of the cross section (end surface) of the discharge electrode 2 faces the openings 1a, and the surface that forms the other shorter side (end surface) of the discharge electrode 2 faces the openings 8a.

[0034] Figure 5 is a perspective view showing the counter electrode of the electric field and discharge generator in the first embodiment according to the present invention.

[0035] The counter electrode 7 is produced by cutting and bending a plate-shaped member made of a metal. The metal of which the counter electrode 7 is made is preferably, for example, tungsten, copper, nickel, stainless steel, zinc, iron, or molybdenum. The counter electrode 7 may be made of an alloy primarily containing any of the metals described above or any of the metals described above the surface of which is plated with silver, gold, platinum, or any other precious metal.

[0036] The counter electrode 7 includes, for example, an electrode portion 7a, a bent portion 7b, and a horizontal portion 7c.

[0037] The electrode portion 7a has a plate-like shape having a width substantially equal to the width of each of the openings 1a (distance in X-axis direction in Figure 1) or greater than the width of each of the openings 1a. A plurality of the electrode portions 7a are provided in a row in the depth direction of the apparatus (Y-axis direction in Figure 1). The electrode portions 7a are arranged at equal intervals in parallel to each other. The electrode portions 7a are so obliquely disposed that they are inclined to the opening surface of the upper frame 1 (and the opening surface of the lower frame 8) by a predetermined angle.

[0038] The ends of adjacent electrode portions 7a are connected to each other via the bent portion 7b and the

horizontal portion 7c. The bent portion 7b is so bent that it protrudes toward the upper frame 1 to form a triangular shape. The bent portion 7b is provided at each end of each of the electrode portions 7a. The horizontal portion 7c has a flat-plate-like shape and is disposed in parallel to the opening surface of the upper frame 1. The horizontal portion 7c connects adjacent bent portions 7b to each other. Each end of the counter electrode 7 is formed of the bent portion 7b and the horizontal portion 7c alternately arranged to form a wavy shape.

[0039] The counter electrode 7 is fixed in a predetermined position when an end portion thereof on one side (that is, the wavy portion formed of the bent portions 7b and the horizontal portions 7c) is sandwiched between the electrode support 5 and the lower frame 8 from above and below. Triangular recess portions 5a corresponding to the bent portions 7b and flat portions 5b corresponding to the horizontal portions 7c are alternately formed along the lower surface of the electrode support 5. Similarly, the counter electrode 7 is fixed in a predetermined position when an end portion thereof on the other side is sandwiched between the electrode support 6 and the lower frame 8 from above and below. Triangular recess portions corresponding to the bent portions 7b and flat portions corresponding to the horizontal portions 7c are alternately formed along the lower surface of the electrode support 6.

[0040] When the counter electrode 7 is appropriately disposed in the apparatus, the side surfaces of each of the electrode portions 7a obliquely face the openings 1a and 8a. The bent portions 7b and the horizontal portions 7c do not face the openings 1a and 8a. The bent portions 7b and the horizontal portions 7c are not exposed to a portion where air flows in the apparatus. The bent portions 7b and the horizontal portions 7c therefore do not block an air flow generated in the apparatus.

[0041] A structure of supporting the electrode portions 7a will next be described in detail with also reference to Figures 6 to 8.

[0042] Figure 6 is a diagram to explain a structure of supporting the electrode portion of the counter electrode. An intermediate portion of each of the electrode portions 7a of the counter electrode 7 is supported by the upper rib 10 and the lower rib 13.

[0043] An end surface 10a of each of the upper ribs 10 is so formed that it is inclined to the opening surface of the upper frame 1, as shown in Figure 6. The upper rib 10 is so disposed that the end surface 10a faces the upward-facing side surface of the electrode portion 7a (side surface that faces openings 1a) from above (from the side where the upper frame 1 is present) with a slight gap. Alternatively, the upper rib 10 is so disposed that the end surface 10a faces the upward-facing side surface of the electrode portion 7a and comes into light contact with the upward-facing side surface. That is, the end surfaces 10a of the upper ribs 10 are formed in accordance with the inclination of the electrode portions 7a of the counter electrode 7 appropriately disposed in the appa-

ratus.

[0044] The upper ribs 10 and the lower ribs 13 form a pair of support members. The lower ribs 13 are disposed in parallel to the upper ribs 10 so that each of the lower ribs 13 and the corresponding upper rib 10 are present in the same plane. Each of the lower ribs 13 is so formed that an end surface 13a thereof is parallel to the corresponding end surface 10a. The end surface 13a is therefore obliquely disposed with respect to the opening surface of the upper frame 1. The lower rib 13 is so disposed that the end surface 13a faces the downward-facing side surface of the electrode portion 7a (side surface that faces openings 8a) from below (from the side where the lower frame 8 is present) with a slight gap. Alternatively, the lower rib 13 is so disposed that the end surface 13a faces the downward-facing side surface of the electrode portion 7a and comes into light contact with the downward-facing side surface. That is, the end surfaces 13a of the lower ribs 13 are formed in accordance with the inclination of the electrode portions 7a of the counter electrode 7 appropriately disposed in the apparatus.

[0045] Each of the electrode portions 7a is so supported that intermediate portions thereof are sandwiched by the upper ribs 10 and the lower ribs 13, whereby the position (inclination) of the electrode portion 7a is maintained. Each of the upper ribs 10 and the lower ribs 13 may have any shape having an end surface that holds the electrode portion 7a. Figures 7 and 8 are diagrams showing other structures of supporting the electrode portion of the counter electrode. Figure 7 shows a case where each of the upper ribs 10 and the lower ribs 13 has a semispherical shape. Figure 8 shows a case where each of the upper ribs 10 and the lower ribs 13 has a trapezoidal shape.

[0046] Each of the upper ribs 10 is preferably so configured that the length of the end surface 10a (A1 in Figure 6) is at least one-third the inclined length (that is, the distance between the edge portion close to the opening surface of the upper frame 1 and the edge portion close to the opening surface of the lower frame 8 (A in Figure 6)) of the electrode portion 7a. Similarly, each of the lower ribs 13 is also preferably so configured that the length of the end surface 13a is at least one-third the inclined length of the electrode portion 7a. The configuration described above allows the electrode portion 7a to be received by a wide area of each of the ribs and hence to be held in a reliable manner. Further, when the length of each of the end surfaces 10a and 13a is long enough, a base portion of each of the ribs can be thick and strong, which prevents the ribs from being broken, whereby the electrode portion 7a can be held in an appropriate position over a long period.

[0047] In the present embodiment, the lower end of each of the upper ribs 10 is positioned below the upper end of the corresponding lower rib 13 by about 1 to 10 mm. That is, a lower portion of the upper rib 10 and an upper portion of the lower rib 13 overlap with each other in the height direction (Z-axis direction in Figure 1). The

configuration described above allows the electrode portion 7a to be securely held from above and below, whereby the electrode portion 7a can be held with a greater force.

[0048] Further, the electrode portions 7a are preferably held at an inclination angle that does not cause the air flow in the apparatus (flow of air introduced through the openings 1a into the apparatus and exhausted through the openings 8a out of the apparatus) to be blocked. The inclination of the electrode portions 7a is preferably so set that the inclination angle with respect to the direction in which the air flows into the apparatus (direction of normal to opening surface of upper frame 1) (θ in Figure 6) is 45 degrees or smaller. When the apparatus is incorporated in a product, the apparatus blocks an air flow in the product, and the power consumption of the product therefore increases. When the electrode portions 7a are held within the inclination angle range described above, the apparatus incorporated in a product only increases the power consumption of the product by 1 W or lower.

[0049] In the electric field and discharge generator having the configuration described above, when a blowing fan (not shown) provided external to the apparatus is driven, outside air is introduced through the openings 1a into the apparatus. In this process, airborne germs, fungi, viruses and the like are also introduced through the openings 1a into the apparatus. In the electric field and discharge generator, the counter electrode 7 is grounded and a voltage ranging from 4 to 7 kV is applied to the discharge electrode 2. An electric field is formed between the discharge electrode 2 and the counter electrode 7, and corona discharge occurs.

[0050] The germs, fungi, and viruses having entered the apparatus through the openings 1a are applied to the electric field and discharge and are destroyed and dead when they pass through the space between the discharge electrode 2 and the counter electrode 7. The dead germs, fungi, and viruses are exhausted with air through the openings 8a out of the apparatus. The in-room, airborne, live germs, fungi, and viruses can thus be removed or inactivated.

[0051] A method for assembling the electric field and discharge generator having the configuration described above will next be described.

[0052] The lower frame 8 is first placed with the surface that forms the exterior shape of the apparatus facing downward. In this state, the lower ribs 13 and the support ribs 14 protrude upward. The counter electrode 7 is then placed on the upward-facing surface of the lower frame 8 in an appropriate position.

[0053] The protrusions 15 are provided in the lower frame 8 on both sides of the region where the openings 1a are formed. Each of the protrusions 15 has a triangular shape corresponding to the recessed shape of the bent portions 7b of the counter electrode 7. When the counter electrode 7 is so placed on the lower frame 8 that the protrusions 15 fit into the recesses of the bent portions 7b, the counter electrode 7 is disposed in a position ap-

propriate with respect to the lower frame 8.

[0054] In this state, the electrode portions 7a are so obliquely disposed that they are inclined to the opening surface of the lower frame 8 by a predetermined angle.

That is, the downward-facing side surfaces of the electrode portions 7a obliquely face the openings 8a. The lower ribs 13 are so disposed that they are perpendicular to the electrode portions 7a. To allow the end surfaces 13a to face from below the downward-facing side surfaces of the electrode portions 7a, the lower ribs 13 are disposed in parallel to the inclined surfaces of the electrode portions 7a described above (downward-facing side surfaces). The support ribs 14 are disposed between the electrode portions 7a.

[0055] The electrode support 5 is then attached to the one end portion of the lower frame 8. At this point, the electrode support 5 is so disposed that the bent portions 7b fit into the recess portions 5a, so that the electrode support 5 and the lower frame 8 sandwich an end portion of the counter electrode 7 on one side from above and below. Similarly, the electrode support 6 is attached to the other end portion of the lower frame 8. The electrode support 6 is so disposed that the bent portions 7b fit into the recesses formed in the lower surface of the electrode support 6, so that the electrode support 6 and the lower frame 8 sandwich an end portion of the counter electrode 7 on the other side from above and below. Both end portions of the counter electrode 7 are thus fixed.

[0056] The power feeder 4 is attached to the electrode support 6.

[0057] The discharge electrode 2 is then connected to the power feeder 4 with the spring 3 exerting a tensile force on the discharge electrode 2 in the longitudinal direction thereof. The discharge electrode 2 is inserted from above into the slits 14a of the support ribs 14 and slits formed in the electrode supports 5 and 6. Thus, the discharge electrode 2 is supported in the upright position by the support ribs 14 and the electrode supports 5 and 6 in such a way that the surfaces that form the longer sides of the cross section (side surfaces) of the discharge electrode 2 are perpendicular to the opening surface of the lower frame 8. Further, the discharge electrode 2 is so changed in direction by the electrode supports 5 and 6 that part of the discharge electrode 2 is disposed between two electrode portions 7a parallel to each other. One side surface of the discharge electrode 2 therefore obliquely faces a side surface of one of the two electrode portions 7a described above. The other side surface of the discharge electrode 2 obliquely faces a side surface of the other one of the two electrode portions 7a described above.

[0058] The upper frame 1 is then attached to the lower frame 8 from above. When the upper frame 1 is appropriately attached to the lower frame 8, the opening surface of the upper frame 1 becomes parallel to the opening surface of the lower frame 8. Further, the electrode portions 7a of the counter electrode 7 are so obliquely disposed that they are inclined to the opening surface of the

upper frame 1 by a predetermined angle. That is, the upward-facing side surfaces of the electrode portions 7a obliquely face the openings 1a. The upper ribs 10 are so disposed that they are perpendicular to the electrode portions 7a. To allow the end surfaces 10a to face from above the upward-facing side surfaces of the electrode portions 7a, the upper ribs 10 are disposed in parallel to the inclined surfaces of the electrode portions 7a described above (upward-facing side surfaces).

[0059] In the thus assembled electric field and discharge generator, the electrode portions 7a of the counter electrode 7 can be supported by the upper ribs 10 and the lower ribs 13, which sandwich the electrode portions 7a from above and below. In the present embodiment, in particular, the lower ends of the upper ribs 10 and the upper ends of the lower ribs 13 face each other with the electrode portions 7a sandwiched therebetween. Each of the electrode portions 7a can therefore be reliably maintained in an appropriate position (inclination angle) over a long period. Since the positional relationship between the discharge electrode 2 and (the electrode portions 7a of) the counter electrode 7 does not deteriorate, a uniform electric field can be formed between the discharge electrode 2 and the counter electrode 7 for a long period immediately after the assembly of the apparatus, and no decrease in performance of the apparatus will occur.

[0060] In the electric field and discharge generator having the configuration described above, since the lower ribs 13 face the electrode portions 7a from below and the upper ribs 10 face the electrode portions 7a from above, the assembly is readily performed. Since the discharge electrode 2 is so disposed that it is perpendicular to the opening surface of the upper frame 1 (and opening surface of lower frame 8), the discharge electrode 2 can also be readily attached.

[0061] Further, the discharge electrode 2 is supported by the electrode support 5 on the one end side of the apparatus, by the electrode support 6 on the other end side of the apparatus, and by the support ribs 14 from below in the central portion of the apparatus. The inter-electrode distance between the discharge electrode 2 and the counter electrode 7 can therefore be maintained at a fixed value across the width of the apparatus, whereby a stable discharge state can be maintained for a long period.

Second Embodiment

[0062] The first embodiment has been specifically described with reference to the arrangement in which an end surface of the discharge electrode 2 (the surface that forms a shorter side of the cross section of the discharge electrode 2) faces the opening surface of the upper frame 1 (and opening surface of lower frame 8). In the present embodiment, a description will be made of a case where the discharge electrode 2 is disposed in the lateral position.

[0063] Figure 9 is a perspective view showing a main portion of the electric field and discharge generator in a second embodiment according to the present invention. Figure 10 is a perspective view showing an electrode support of the electric field and discharge generator in the second embodiment according to the present invention. Figure 10 shows an electrode support 5 disposed on one end side of the apparatus.

[0064] In the present embodiment, a support rib 16 is provided in the electrode support 5. The support rib 16 is formed, for example, of a rod-shaped member having a rectangular cross-sectional shape. The support rib 16 is, for example, disposed on a member that is part of the electrode support 5 and folds back the discharge electrode 2. The support rib 16 is disposed in parallel to the opening surface of the lower frame 8 and has a front end protruding sideways. For example, a plurality of the support ribs 16 are provided with the electrode support 5 along the direction in which the discharge electrode 2 is folded back. A horizontal slit 16a is formed in the front end surface (surface facing sideways) of each of the support ribs 16.

[0065] The discharge electrode 2 is changed in direction by the electrode support 5 on the one end side of the apparatus. Further, in the present embodiment, the discharge electrode 2 is supported by the support ribs 16 on the one end side of the apparatus.

[0066] Figure 11 is a diagram to explain a method for attaching the discharge electrode in the second embodiment according to the present invention. In the present embodiment, the discharge electrode 2 is inserted sideways into the slit 16a of each of the support ribs 16 so that the support rib 16 supports the discharge electrode 2. The discharge electrode 2 is folded back along predetermined members of the electrode supports 5 and 6 and connected to the power feeder 4. In the first embodiment, the surface of the discharge electrode 2 that forms a longer side of the cross section thereof (side surface) is bent. In the present embodiment, the surface of the discharge electrode 2 that forms a shorter side of the cross section thereof (end surface) is bent.

[0067] The electrode support 6 is also provided as required with a support rib having the same configuration as that of the support ribs 16 described above. In this case, the discharge electrode 2 is also inserted sideways into the slit of the support rib provided in the electrode support 6.

[0068] In the present embodiment, no support rib 14 is provided in the lower frame 8.

[0069] When the discharge electrode 2 is appropriately supported in the apparatus, the upper surface of the discharge electrode 2 that forms one longer side of the cross section thereof (side surface) faces the openings 1a. Further, the lower surface of the discharge electrode 2 that forms the other longer side of the cross section thereof faces the openings 8a. That is, the end surfaces of the discharge electrode 2 are so disposed that they are perpendicular to the opening surface of the upper frame 1

and the opening surface of the lower frame 8. The discharge electrode 2 is changed in direction by the electrode supports 5 and 6, and part of the discharge electrode 2 is disposed between two electrode portions 7a parallel to each other. One of the end surfaces of the discharge electrode 2 therefore obliquely faces the side surface of one of the two electrode portions 7a. The other end surface of the discharge electrode 2 obliquely faces the side surface of the other one of the two electrode portions 7a.

[0070] According to the electric field and discharge generator having the configuration described above, the discharge electrode 2 can be stably supported in the lateral position. The inter-electrode distance between the discharge electrode 2 and the counter electrode 7 can therefore be maintained at a fixed value across the width of the apparatus, whereby a stable discharge state can be maintained over a long period.

[0071] The other configurations, assembling methods, and functions are the same as those in the first embodiment. The same advantageous effects provided by the first embodiment can therefore be provided by the apparatus having the configuration according to the present embodiment.

Industrial Applicability

[0072] The electric field and discharge generators according to the present invention can be incorporated in a room air conditioner, a package air conditioner, a cleaner, a hand dryer, an air cleaner, a humidifier, a dehumidifier, a refrigerator, and other similar products.

Reference Signs List

[0073]

1	upper frame
1a, 8a	opening
2	discharge electrode
2a	terminal
3	spring
4	power feeder
5, 6	electrode support
5a	recess portion
5b	flat portion
7	counter electrode
7a	electrode portion
7b	bent portion
7c	horizontal portion
8	lower frame
9, 12	lattice
10	upper rib
10a, 13a	end surface
11	handle
13	lower rib
14, 16	support rib
14a, 16a	slit

15 protrusion

Claims

1. An electric field and discharge generator comprising:

a discharge electrode (2);
a counter electrode (7) having an electrode portion (7a) that has a plate-like shape and faces the discharge electrode (2);
a first frame (1) and a second frame (8) that the discharge electrode (2) and the counter electrode (7) are disposed between; and
a first rib (10) provided in the first frame (1) and facing one side surface of the electrode (7a) portion from the first frame (1) side;

characterized by

a second rib (13) provided in the second frame (8) and facing the other side surface of the electrode portion (7a) from the second frame (8) side so that the first rib (10) and the second rib (13) maintain the position of the electrode portion (7a), and in that
the first frame (1) has a first opening (1a) that allows air to pass through the first frame (1),
the second frame (8) has a second opening (8a) that allows air to pass through the second frame (8),
the electrode portion (7a) is obliquely disposed with respect to an opening surface of the first frame (1) and an opening surface of the second frame (8), and
the first rib (10) and the second rib (13) are disposed so as to sandwich the electrode portion (7a).

2. The electric field and discharge generator according to claim 1, wherein

a surface (10a) of the first rib (10) that faces the electrode portion (7a) is obliquely formed in accordance with the inclination of the one side surface of the electrode portion (7a), and
a surface (13a) of the second rib (13) that faces the electrode portion (7a) is obliquely formed in accordance with the inclination of the other side surface of the electrode portion (7a).

3. The electric field and discharge generator according to claim 1 or 2, comprising:

a first electrode support (5), the first electrode support (5) and the second frame (8) sandwiching one end portion of the counter electrode (7) to support the counter electrode (7); and
a second electrode support (6), the second electrode support (6) and the second frame (8) sandwiching the other end portion of the counter elec-

trode (7) to support the counter electrode (7), wherein the discharge electrode (2) is changed in direction and supported by the first electrode support (5) and the second electrode support (6).

4. The electric field and discharge generator according to claim 3, comprising a support rib (16) provided in the first electrode support (5), wherein the discharge electrode (2) has a plate-like shape having a rectangular cross-sectional shape, and the support rib (16) supports the discharge electrode (2) in such a way that an end surface of the discharge electrode (2) faces the side surface of the electrode portion (7a).

5. The electric field and discharge generator according to any of claims 1 to 3, comprising:

a support rib (14) provided in the second frame (8), wherein the support rib (14) is disposed in a central portion of a region where the second opening (8a) is formed and supports the discharge electrode (2) from the second frame (8) side.

6. The electric field and discharge generator according to claim 5, wherein the discharge electrode (2) has a plate-like shape having a rectangular cross-sectional shape, and the support rib (14) supports the discharge electrode (2) in such a way that a side surface of the discharge electrode (2) faces the side surface of the electrode portion (7a).

7. An air conditioning apparatus comprising: the electric field and discharge generator according to any of claims 1 to 6.

8. The air conditioning apparatus according to claim 7, further comprising a blowing fan, wherein outside air is introduced into the electric field and discharge generator when the blowing fan is driven.

Patentansprüche

1. Elektrisches-Feld- und Entladungsgenerator, umfassend:

eine Entladungselektrode (2);
eine Gegenelektrode (7), aufweisend einen Elektrodenabschnitt (7a), der eine plattenähnliche Form aufweist und der Entladungselektrode (2) zugewandt ist;

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einen ersten Rahmen (1) und einen zweiten Rahmen (8), zwischen welchen die Entladungselektrode (2) und die Gegenelektrode (7) angeordnet sind; und

eine erste Rippe (10), die im ersten Rahmen (1) bereitgestellt ist und einer Seitenoberfläche des Elektrodenabschnitts (7a) von der Seite des ersten Rahmens (1) zugewandt ist;

gekennzeichnet durch

eine zweite Rippe (13), die im zweiten Rahmen (8) bereitgestellt ist und der anderen Seitenoberfläche des Elektrodenabschnitts (7a) von der Seite des zweiten Rahmens (8) zugewandt ist, so dass die erste Rippe (10) und die zweite Rippe (13) die Position des Elektrodenabschnitts (7a) aufrechterhalten, und darin, dass

der erste Rahmen (1) eine erste Öffnung (1a) aufweist, die es Luft ermöglicht, den ersten Rahmen (1) zu durchströmen,

der zweite Rahmen (8) eine zweite Öffnung (8a) aufweist, die es Luft ermöglicht, den zweiten Rahmen (8) zu durchströmen,

der Elektrodenabschnitt (7a) in Bezug auf eine Öffnungsoberfläche des ersten Rahmens (1) und einer Öffnungsoberfläche des zweiten Rahmens (8) schräg angeordnet ist, und

die erste Rippe (10) und die zweite Rippe (13) so angeordnet sind, um den Elektrodenabschnitt (7a) dazwischen aufzunehmen.

2. Elektrisches-Feld- und Entladungsgenerator nach Anspruch 1, wobei

eine Oberfläche (10a) der ersten Rippe (10), die dem Elektrodenabschnitt (7a) zugewandt ist, schräg ausgebildet ist in Übereinstimmung mit der Neigung der einen Seitenoberfläche des Elektrodenabschnitts (7a), und

eine Oberfläche (13a) der zweiten Rippe (13), die dem Elektrodenabschnitt (7a) zugewandt ist, schräg ausgebildet ist in Übereinstimmung mit der Neigung der anderen Seitenoberfläche des Elektrodenabschnitts (7a).

3. Elektrisches-Feld- und Entladungsgenerator nach Anspruch 1 oder 2, umfassend:

einen ersten Elektrodenträger (5), wobei der erste Elektrodenträger (5) und der zweite Rahmen (8) einen Endabschnitt der Gegenelektrode (7) zwischen sich aufnehmen, um die Gegenelektrode (7) zu stützen; und

einen zweiten Elektrodenträger (6), wobei der zweite Elektrodenträger (5) und der zweite Rahmen (8) den anderen Endabschnitt der Gegenelektrode (7) zwischen sich aufnehmen, um die Gegenelektrode (7) zu stützen; und wobei die Entladungselektrode (2) in ihrer Rich-

tung verändert wird und durch den ersten Elektrodenträger (5) und den zweiten Elektrodenträger (6) gestützt ist.

4. Elektrisches-Feld- und Entladungsgenerator nach Anspruch 3, umfassend eine Stützrippe (16), die im ersten Elektrodenträger (5) bereitgestellt ist, wobei die Entladungselektrode (2) eine plattenähnliche Form mit einer rechtwinkligen Querschnittsform aufweist, und die Stützrippe (16) die Entladungselektrode (2) in einer solchen Weise stützt, dass eine Endoberfläche der Entladungselektrode (2) der Seitenoberfläche des Elektrodenabschnitts (7a) zugewandt ist. 5 10 15
5. Elektrisches-Feld- und Entladungsgenerator nach einem der Ansprüche 1 bis 3, umfassend: 20
 - eine Stützrippe (14), die im zweiten Rahmen (8) bereitgestellt ist,
 - wobei die Stützrippe (14) in einem Mittelabschnitt eines Bereichs angeordnet ist, wo die zweite Öffnung (8a) ausgebildet ist, und die Entladungselektrode (2) von der Seite des zweiten Rahmens (8) stützt. 25
6. Elektrisches Feld- und Entladungsgenerator nach Anspruch 5, wobei die Entladungselektrode (2) eine plattenähnliche Form mit einer rechtwinkligen Querschnittsform aufweist, und die Stützrippe (14) die Entladungselektrode (2) in einer solchen Weise stützt, dass eine Seitenoberfläche der Entladungselektrode (2) der Seitenoberfläche des Elektrodenabschnitts (7a) zugewandt ist. 30 35
7. Klimaanlage, umfassend: den Elektrisches-Feld- und Entladungsgenerator nach einem der Ansprüche 1 bis 6. 40
8. Klimaanlage nach Anspruch 7, ferner umfassend einen Gebläselüfter, wobei Außenluft in den Elektrisches-Feld- und Entladungsgenerator eingetragen wird, wenn der Gebläselüfter betrieben wird. 45

Revendications 50

1. Générateur de champ électrique et de décharge comprenant :
 - une électrode de décharge (2) ;
 - une contre-électrode (7) ayant une partie d'électrode (7a) qui a une forme de type plaque et fait face à l'électrode de décharge (2) ;

un premier cadre (1) et un second cadre (8) entre lesquels sont disposées l'électrode de décharge (2) et la contre-électrode (7) ; et une première nervure (10) prévue dans le premier cadre (1) et faisant face à une première surface latérale de la partie d'électrode (7a) depuis le côté premier cadre (1) ;

caractérisé par

une seconde nervure (13) prévue dans le second cadre (8) et faisant face à l'autre surface latérale de la partie d'électrode (7a) depuis le côté second cadre (8) de sorte que la première nervure (10) et la seconde nervure (13) maintiennent la position de la partie d'électrode (7a), et en ce que le premier cadre (1) a une première ouverture (1a) qui permet à l'air de passer à travers le premier cadre (1), le second cadre (8) a une seconde ouverture (8a) qui permet à l'air de passer à travers le second cadre (8), la partie d'électrode (7a) est disposée obliquement par rapport à une surface d'ouverture du premier cadre (1) et une surface d'ouverture du second cadre (8), et la première nervure (10) et la seconde nervure (13) sont disposées de sorte à prendre en sandwich la partie d'électrode (7a).

2. Générateur de champ électrique et de décharge selon la revendication 1, dans lequel une surface (10a) de la première nervure (10) qui fait face à la partie d'électrode (7a) est formée obliquement selon l'inclinaison de la première surface latérale de la partie d'électrode (7a), et une surface (13a) de la seconde nervure (13) qui fait face à la partie d'électrode (7a) est formée obliquement selon l'inclinaison de l'autre surface latérale de la partie d'électrode (7a).
3. Générateur de champ électrique et de décharge selon la revendication 1 ou 2, comprenant un premier support d'électrode (5), le premier support d'électrode (5) et le second cadre (8) prenant en sandwich une partie d'extrémité de la contre-électrode (7) pour supporter la contre-électrode (7) ; et un second support d'électrode (6), le second support d'électrode (6) et le second cadre (8) prenant en sandwich l'autre partie d'extrémité de la contre-électrode (7) pour supporter la contre-électrode (7) ; dans lequel l'électrode de décharge (2) change de sens et est supportée par la première électrode de support (5) et la seconde électrode de support (6).
4. Générateur de champ électrique et de décharge selon la revendication 3, comprenant une nervure de support (16) prévue dans le premier support d'électrode (5),

dans lequel

l'électrode de décharge (2) a une forme de type plaque ayant une forme en coupe rectangulaire, et la nervure de support (16) supporte l'électrode de décharge (2) de telle manière qu'une surface d'extrémité de l'électrode de décharge (2) fait face à la surface latérale de la partie d'électrode (7a). 5

5. Générateur de champ électrique et de décharge selon l'une quelconque des revendications 1 à 3, comprenant : 10

une nervure de support (14) prévue dans le second cadre (8),
dans lequel la nervure de support (14) est disposée dans une partie centrale d'une région où la seconde ouverture (8a) est formée et supporte l'électrode de décharge (2) depuis le côté second cadre (8). 15

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6. Générateur de champ électrique et de décharge selon la revendication 5, dans lequel l'électrode de décharge (2) a une forme de type plaque ayant une forme en coupe rectangulaire, et la nervure de support (14) supporte l'électrode de décharge (2) de telle manière qu'une surface latérale de l'électrode de décharge (2) fait face à la surface latérale de la partie d'électrode (7a). 25

7. Appareil de climatisation comprenant : 30
le générateur de champ électrique et de décharge selon l'une quelconque des revendications 1 à 6.

8. Appareil de climatisation selon la revendication 7, comprenant en outre 35
un ventilateur soufflant,
dans lequel de l'air extérieur est introduit dans le générateur de champ électrique et de décharge lorsque le ventilateur soufflant est entraîné. 40

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Fig. 1

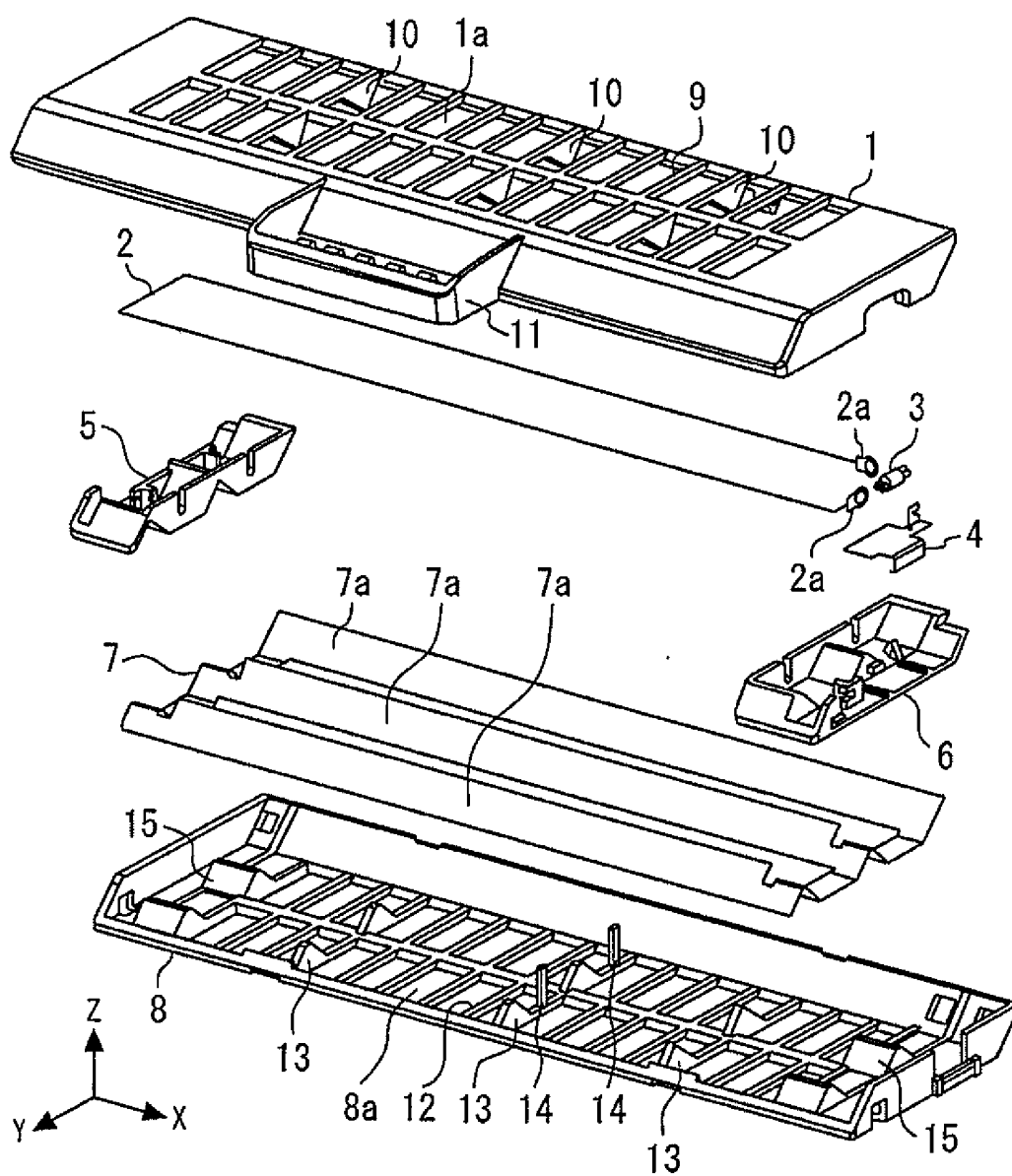


Fig. 2

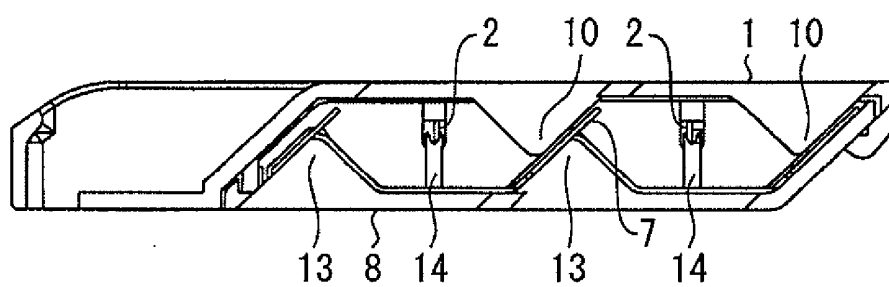


Fig. 3

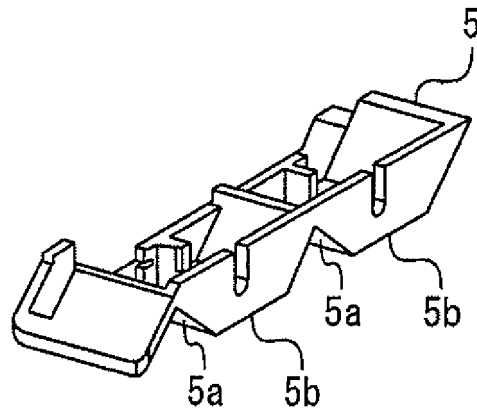


Fig. 4

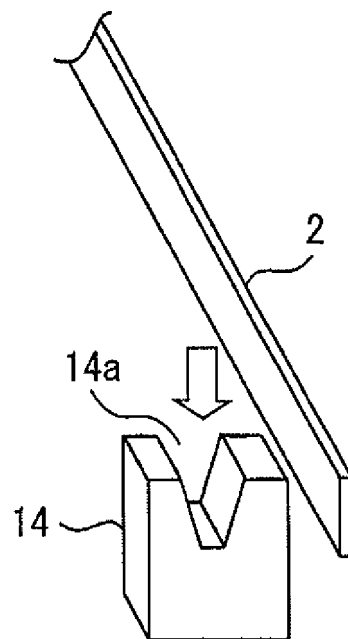


Fig. 5

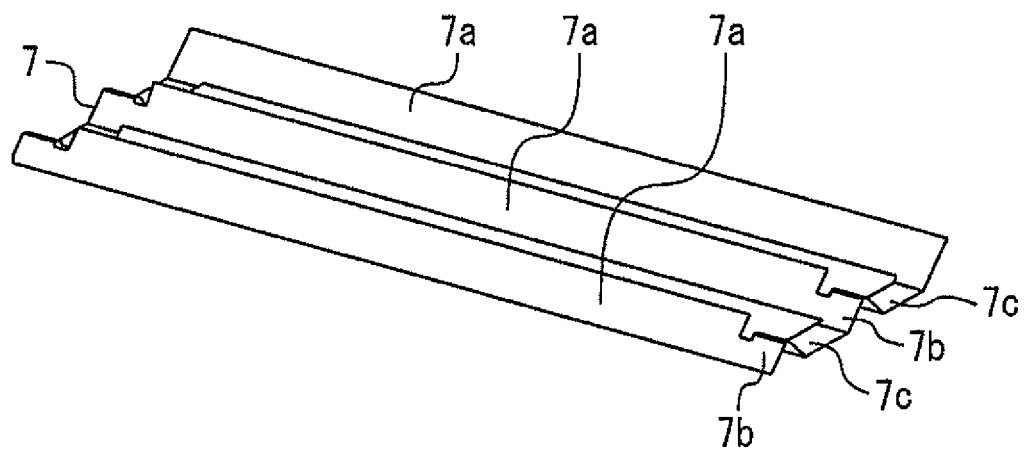


Fig. 6

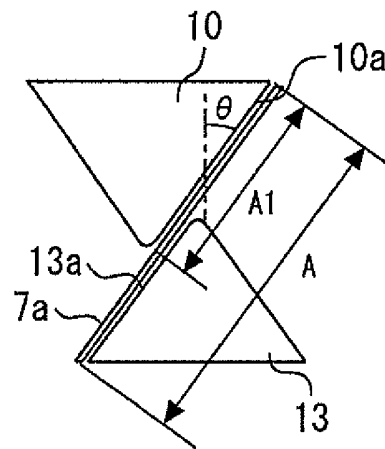


Fig. 7

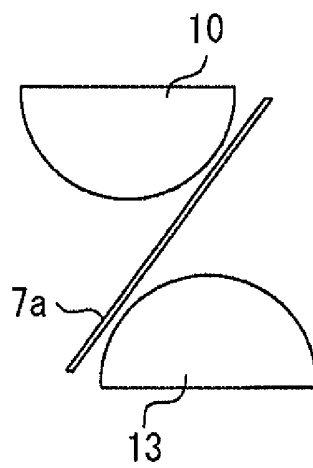


Fig. 8

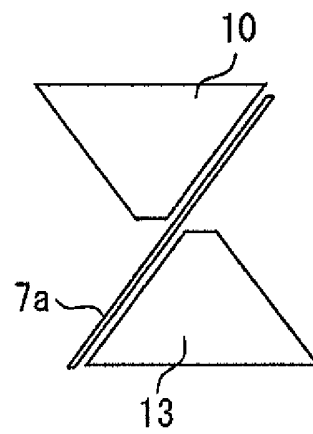


Fig. 9

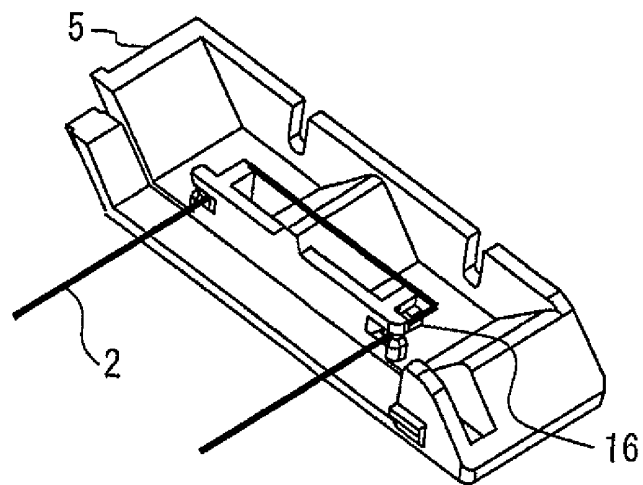


Fig. 10

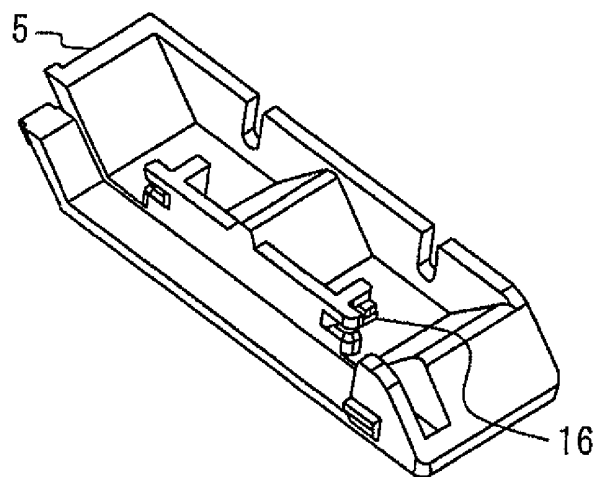
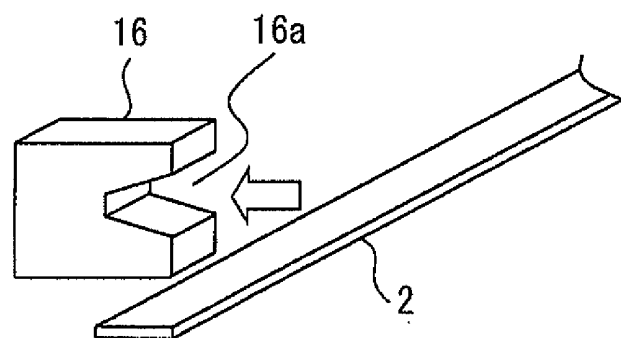


Fig. 11



REFERENCES CITED IN THE DESCRIPTION

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- EP 1782843 A1 [0002]
- JP 2164466 A [0006]