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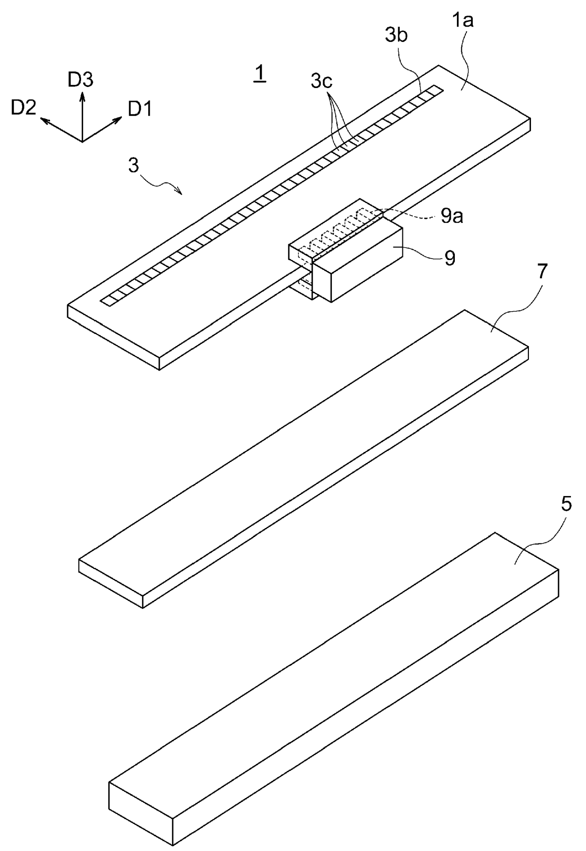
(54) THERMAL HEAD AND THERMAL PRINTER

(57) A thermal head having a protective layer having a preferable surface shape is provided. In a thermal head 1, a plurality of heat generating parts 23a are aligned in a D1 direction on a major surface of a substrate 11. A plurality of lead parts 27c, when viewed on a plane, are connected on the +D2 side with respect to the plurality of heat generating parts 23a. A plurality of connection parts 29a, when viewed on a plane, are connected on the -D2 side with respect to the plurality of heat generating parts 23a. A protective layer 35 covers the plurality of heat generating parts 23a, plurality of lead parts 27c, and plurality of connection parts 29a. In the protective layer 35, a plurality of first recessed parts 53 are positioned among the plurality of lead parts 27c when viewed on a plane. A plurality of second recessed parts 55 are positioned among the plurality of connection parts 29a when viewed on a plane. A plurality of third recessed parts 57 are positioned among the plurality of heat generating parts 23a when viewed on a plane and are shallower than the plurality of first recessed parts 53 and second recessed parts 55.

FIG.1



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Description

Technical Field

[0001] The present disclosure relates to a thermal head and thermal printer.

Background Art

[0002] Known in the art is a thermal head performing printing by applying heat to heat-sensitive paper or by applying heat to **an ink film (ink ribbon) for thermal transfer printing (for example** Patent Literature 1). Such a thermal head has for example heat generating parts, electrodes which apply voltage to the heat generating parts, and a protective layer covering the same. The protective layer for example contributes to protection of the heat generating parts from friction with a recording medium or an ink film. Patent Literature 1 discloses the art of forming relief shapes on the upper surface of the protective layer and thereby suppressing sticking. Note that, "sticking" means the phenomenon of the recording medium or ink film adhering to the thermal head.

Citation List

Patent Literature

[0003] [Patent Literature 1] Japanese Patent Publication No. 2002-370397A

Summary of Invention

Technical Problem

[0004] It is desired to provide a thermal head and thermal printer having a protective layer with a preferable surface shape.

Solution to Problem

[0005] A thermal head according to one aspect of the present disclosure includes a plurality of heat generating parts, a plurality of first electrode parts, a plurality of second electrode parts, and a protective layer. The plurality of heat generating parts are aligned on a predetermined surface in a first direction along the predetermined surface. The plurality of first electrode parts are connected with respect to the plurality of heat generating parts on one side of a second direction crossing the first direction in a plan view of the predetermined surface. The plurality of second electrode parts are connected with respect to the plurality of heat generating parts on the other side of the second direction in a plan view of the predetermined surface. The protective layer covers the plurality of heat generating parts, the plurality of first electrode parts, and the plurality of second electrode parts. The protective layer includes a plurality of first recessed parts, a plurality of second recessed parts, and a plurality of third recessed parts positioned. The plurality of first recessed parts are positioned among the plurality of first electrode parts in a plan view of the predetermined surface. The plurality of second recessed parts are positioned among the plurality of second electrode parts in a plan view of the predetermined surface. The plurality of third recessed parts are positioned among the plurality of heat generating parts in a plan view of the predetermined surface and are shallower than the plurality of first recessed parts and the plurality of second recessed parts.

[0006] In an example, the second direction is perpendicular to the first direction, and the third recessed parts extend in a direction inclined relative to the second direction in a plan view of the predetermined surface.

[0007] In an example, in the third recessed parts, parts are positioned on the edge parts of the heat generating parts in the first direction.

[0008] In an example, in the third recessed parts, parts on the other side of the second direction are connected with the second recessed parts in the second direction.

[0009] In an example, in the third recessed parts, the parts on the one side of the second direction are adjacent to (are connected side by side with) the first recessed parts in the first direction.

[0010] In an example, each sum of widths of the mutually adjoining parts (the parts connected side by side) of the first recessed parts and the third recessed parts in the first direction is larger than each width of the second recessed parts in the first direction.

[0011] In an example, the third recessed parts include parts with widths in the first direction each smaller than the each of widths of the first recessed parts and the second recessed parts in the first direction.

[0012] A thermal head according to one aspect of the present disclosure includes a plurality of heat generating parts, a plurality of first electrode parts, a plurality of second electrode parts, and a protective layer. The plurality of heat generating parts are aligned on a predetermined surface in a first direction along the predetermined surface. The plurality of first electrode parts are connected with respect to the plurality of heat generating parts on one side of a second direction crossing the first direction in a plan view of the predetermined surface. The plurality of second electrode parts are connected with respect to the plurality of heat generating parts on the other side of the second direction in a plan view of the predetermined surface. The protective layer covers the plurality of heat generating parts, the plurality of first electrode parts, and the plurality of second electrode parts. The protective layer includes a plurality of first recessed parts, a plurality of second recessed parts, and a plurality of third recessed parts positioned. The plurality of first recessed parts are positioned among the plurality of first electrode parts in a plan view of the predetermined surface. The plurality of second recessed parts are positioned among the plurality of second electrode parts in a plan view of the predetermined surface. The third recessed parts includes portions which are adjacent to the plurality of first recessed parts in the first direction in a plan view of the predetermined surface. The portions are shallower than the plurality of first recessed parts and the plurality of second recessed parts.

[0013] A thermal printer according to one aspect of the present disclosure has the thermal head described above, a conveying mechanism conveying a recording medium onto the thermal head, and a platen roller which presses the recording medium against the top of the thermal head.

Advantageous Effects of Invention

[0014] According to the above configuration, the surface shape of the protective layer in the thermal head can be formed in a preferable shape.

Brief Description of Drawings

[0015]

[FIG. 1] A disassembled perspective view schematically showing the configuration of a thermal head according to an embodiment.
[FIG. 2] A plan view showing the configuration of a head base body of the thermal head in FIG. 1.
[FIG. 3] A cross-sectional view taken along the III-III line in FIG. 2.
[FIGS. 4] FIG. 4A and FIG. 4B are enlarged perspective views of a part of the head base body in FIG. 2.
[FIG. 5] A plan view showing a protective layer of the head base body in an enlarged state.
[FIGS. 6] FIG. 6A, FIG. 6B, and FIG. 6C are cross-sectional views taken along the VIa-VIa line, VIb-VIb line, and VIc-VIc line in FIG. 5.
[FIG. 7] A schematic view showing the configuration of a thermal printer having the thermal head in FIG. 1.
[FIG. 8] A perspective view showing a part of a thermal head according to a modification in an enlarged state.

Description of Embodiments

[0016] Below, a thermal head 1 according to an embodiment will be explained with reference to the drawings. Note that, in the drawings, for convenience, an orthogonal coordinate system comprised of a D1 axis, D2 axis, and D3 axis will be attached. In the thermal head 1, any direction may be defined as "above" or "below" . However, for convenience, the positive side of the D3 axis will be defined as "above", and the "upper surface" or other terms will be sometimes used.

(Overall Configuration of Thermal Head)

[0017] FIG. 1 is a disassembled perspective view schematically showing the configuration of a thermal head 1.

[0018] The thermal head 1 is configured so as to perform printing on a recording medium which is conveyed in the D2 direction (for example +D2 direction) at the positive side of the D3 axis thereof. The recording medium is for example heat-sensitive paper on which printing is carried out by heat given from a major surface 1a of the thermal head 1 facing the positive side of the D3 axis. Otherwise, for example, the recording medium is paper, other than heat-sensitive paper, on which printing is carried out by heat given from the major surface 1a of the thermal head 1 to an ink film superimposed on the paper and thermal transfer printing is carried out. Note that, in the following description, sometimes heat-sensitive paper will be taken as an example as the recording medium. Further, the "major surface" designates the broadest surface (front face or back face) of a plate-shaped member.

[0019] The thermal head 1 for example has a head base body 3 configuring the major surface 1a thereof, a heat dissipation plate 5 positioned on the back face of the head base body 3, a bonding member 7 interposed between the head base body 3 and the heat dissipation plate 5, and a connector 9 connected to the head base body 3.

[0020] The head base body 3 has a heating line 3b on the major surface 1a side which gives heat to the heat-sensitive paper (or ink film). The heating line 3b is configured by a plurality of heating parts 3c aligned in the D1 direction. Note that, in FIG. 1, boundaries of the plurality of heating parts 3c are shown. However, the boundaries do not always show up in the appearance of the head base body 3. The temperatures of the plurality of heating parts 3c are individually controlled when the heat-sensitive paper slides over the heating line 3b in the D2 direction (strictly speaking, it may include a component of the D3 direction as well), whereby any two-dimensional image is formed on the heat-sensitive paper.

[0021] The head base body 3 is for example formed in a rectangular shape having long sides extending in the D1 direction and short sides extending in the D2 direction when viewed on a plane. The heating line 3b is for example positioned closer to one side (one long side in the shown example) than the center of the head base body 3 and extends along (for example in parallel with) this one side. The side opposite to the one side along which the heating line 3b is arranged (the side of the other long side in the shown example) is made the terminal side to which the connector 9 is connected.

[0022] The heat dissipation plate 5 forms a rectangular cuboid shape. The heat dissipation plate 5 is for example formed by copper, iron, aluminum, or another metal material and has a function of dissipating heat which does not contribute to the printing of the image in the heat generated in the heating line 3b of the head base body 3. The bonding member 7 bonds the head base body 3 and the heat dissipation plate 5.

[0023] The connector 9 electrically connects the head base body 3 and an electronic circuit outside of the thermal head 1. By inputting an electrical signal (voltage) from an external electronic circuit through the connector 9 to the head base body 3, the temperatures of the plurality of heating parts 3c are individually controlled. The connector 9 for example has a plurality of pins 9a abutting against a plurality of terminals 3d of the head base body 3 (see FIG. 2). The plurality of pins 9a are for example sealed by resin. Note that, in place of the connector 9 having such a configuration, use may be made of a flexible printed circuit board (FPC) as well.

(Configuration of Head Base Body)

[0024] FIG. 2 is a plan view showing the configuration of a principal part of the head base body 3. FIG. 3 is a cross-sectional view taken along the III-III line in FIG. 2. Note that, in FIG. 2 and FIG. 3, part of the members (explained later) are not illustrated or are indicated by lines other than solid lines. Further, in FIG. 2, part of the members (explained later), in order to facilitate illustration, are shown with hatching attached to the surfaces (faces which are not cross-sections). Further, in FIG. 3, parts on the negative side of the D2 axis are omitted or schematically shown since the illustration becomes difficult if details thereof are correctly reflected.

[0025] The head base body 3 has a substrate 11 and various layers stacked on the surface thereof. Below, members configuring the head base body 3 will be explained.

(Substrate)

[0026] The substrate 11 is formed by an alumina ceramic or other electrically insulating material or single crystal silicon or other semiconductor material. The shape of the substrate 11 is substantially the same as the shape of the head base body 3. That is, in the present embodiment, the shape of the substrate 11 is substantially plate-shaped when defining the D3 direction as the thickness direction. The shape thereof when viewed on a plane is a rectangle having long sides extending in the D1 direction and short sides extending in the D2 direction.

(Reinforcement Conductive Layer)

[0027] On the substrate 11, a reinforcing conductive layer 13 (FIG. 3) is provided. The reinforcing conductive layer 13 for example contributes to reduction of wiring resistance by being superimposed on a later explained common electrode 27 etc. and performing an action similar to one make the electrode thicker. The position thereof when viewed on a plane may be suitably set. The material of the reinforcing conductive layer 13 may be a suitable metal. For example, it is silver (Ag) or copper (Cu) or an alloy of the same. The reinforcing conductive layer 13 is for example formed by adding and mixing an organic solvent or the like with an Ag or Cu or other metal powder to obtain a predetermined conductive paste, coating it on the upper surface of the substrate 11 by screen printing or the like, and firing it.

(Glaze Layer)

[0028] On the substrate 11 (on the reinforcing conductive layer 13 at the position of arrangement thereof), a glaze layer 15 (FIG. 3) is provided. The glaze layer 15 has a first glaze 17 configuring the internal part side of the heating line 3b and a second glaze 19 which is separated from the first glaze 17 and expands in a relatively wide range. The first glaze 17 for example contributes to heat accumulation and/or contributes to formation of the surface of the heating line 3b in a suitable shape. The second glaze 19, for example, when formed flatter than the surface of the substrate 11, reduces apprehension of disconnection and/or short circuiting of the conductive layer which is formed on that.

[0029] The first glaze 17 for example linearly extends along (for example in parallel with) the D1 direction with a constant width. The shape of the cross-section of the first glaze 17, which is perpendicular to the D1 axis, is for example a dome shape (curved shape projecting to the outside) . The height, width, and curvature thereof may be suitably set. Further, the curve may be an arc of a circle or may change in curvature like an arc of an ellipse.

[0030] Note that, the cross-sectional shape of the first glaze 17, other than the dome shape, may be for example a shape with a flat upper surface (for example a rectangle or trapezoid), may be a shape that projects out more than a shape imagined as a dome shape (for example a frustum state having a flat or curved upper side), or may be a shape in which a projecting part projects out from the upper surface of the dome shape (two-stage shape).

[0031] Since the surface of the first glaze 17 is a curved surface, the layers above the first glaze 17 also become curved surfaces. In the following description, when referring to "the planar shape (sometimes simply referred to as "the shape") of the layers above the first glaze 17, it designates for example the shape viewed in the D3 direction (shape projected onto the major surface of the substrate 11). Note, the planar shape may be grasped as a shape of a curved surface opened up in a planar shape as well.

[0032] The second glaze 19 is for example provided over substantially the entire area of the major surface of the substrate 11 and is separated from the first glaze 17.

[0033] The thicknesses of the first glaze 17 and second glaze 19 may be suitably set. For example, the thicknesses of the first glaze 17 and second glaze 19 are 30 μm to 80 μm.

[0034] The first glaze 17 and second glaze 19 can be prepared by for example mixing a suitable organic solvent with glass powder to obtain a predetermined glass paste, printing it, and firing the glass paste.

(Foundation Layer)

[0035] On the glaze layer 15, a foundation layer 21 (FIG. 3) is provided. The foundation layer 21, for example, contributes to a reduction of the liability of the layer below the foundation layer 21 being etched when etching the layer above the foundation layer 21 in the process of manufacturing the head base body 3. The foundation layer 21, for example, is provided over substantially the entire surface of the major surface of the substrate 11 and is directly superimposed on the major surface of the substrate 11 in a region where the glaze layer 15 is not arranged.

[0036] The foundation layer 21 can be formed by using for example SiC, SiN, or SiAlON or another material by sputtering or another thin film forming technique. The thickness of the foundation layer 21 may be suitably set and is for example 0.01 μm to 1 μm. Note that, it is not always necessary to provide the foundation layer 21.

(Heat Generating Layer)

[0037] On the foundation layer 21, a heat generator layer 23 is provided. In FIG. 2, hatching is attached to the surface of the heat generator layer 23. The heat generator layer 23 includes a plurality of heat generating parts 23a (parts in the heat generator layer 23 which are exposed from the conductive layer 25 which will be explained later) inside the heating line 3b (above the first glaze 17). The heat generated in these heat generating parts 23a is given to the recording medium or ink film.

[0038] The planar shape (pattern) of the heat generator layer 23 as a whole is for example the same as the planar shape of the conductive layer 25 which will be explained later excluding the plurality of heat generating parts 23a. Note that, the heat generator layer 23 may be configured by just the plurality of heat generating parts 23a or just the heat generating parts 23a and parts around them. The thickness of the heat generator layer 23 may be suitably set. It is for example 0.01 μm to 0.5 μm.

[0039] The plurality of heat generating parts 23a are for example linearly aligned on a line along (for example in parallel with) the D1 direction. The pitch of the plurality of heat generating parts 23a (pitch of the plurality of heating parts 3c) is for example constant. The number and density of the plurality of heat generating parts 23a may be suitably set. For example, the density is 100 dpi (dot per inch) to 2400 dpi. In the drawing of the present embodiment, the heat generating parts 23a are shown at the peak of the first glaze 17. However, the heat generating parts 23a may be deviated to the -D2 side or +D2 side relative to the peak of the first glaze 17 as well.

[0040] The heat generator layer 23 is for example formed by a TaN-based, TaSiO-based, TaSiNO-based, TiSiO-based, TiSiCO-based, NbSiO-based, or other material having a relatively high electrical resistance. For this reason, when voltage is applied to the heat generating parts 23a, the heat generating parts 23a generate heat by Joule's heat-generation.

[0041] The heat generator layer 23 is for example formed by forming a thin film by a sputtering process or another thin film forming technique, then working the thin film to a predetermined pattern by using photo-etching or the like. Note that, the etching of the heat generator layer 23 may be carried out together with the etching of the conductive layer 25 as well (excluding the etching above the heat generating parts 23a).

(Conductive Layer)

[0042] On the heat generator layer 23, a conductive layer 25 is provided. The conductive layer 25 includes for example a common electrode 27 and plurality of individual electrodes 29 which apply voltage to the plurality of heat generating parts 23a, a plurality of wirings 31 (FIG. 2) performing various electrical connections, and a ground electrode 33 (FIG. 2) given a ground potential (reference potential).

[0043] The common electrode 27 is commonly connected to the plurality of heat generating parts 23a and gives potentials which are the same as each other to the plurality of heat generating parts 23a. The plurality of individual electrodes 29 are separately connected to the plurality of heat generating parts 23a (for example, separately one by one) and give potentials to the plurality of heat generating parts 23a independently from each other. Due to this, when viewed on a plane, voltages are applied to the plurality of heat generating parts 23a sandwiched between the plurality of common electrodes 27 and plurality of individual electrodes 29 independently from each other, so printing of any image becomes possible.

[0044] The common electrode 27 is for example given a predetermined potential from the connector 9. The plurality of individual electrodes 29 are given driving signals (potentials) from driving ICs 45 (FIG. 2) which will be explained later. More specifically, for example, the plurality of individual electrodes 29 (plurality of heat generating parts 23a) are classified into a plurality of groups, and a driving signal is input to the individual electrodes 29 in each group from the driving IC 45 which is provided corresponding to each group.

[0045] The plurality of wirings 31 act to connect the driving ICs 45 with the connector 9 or connect the plurality of driving ICs 45 to each other. They contribute to input of signals in accordance with contents of the image to the driving ICs 45. The ground electrode 33 for example connects the driving ICs 45 and the connector 9 and contributes to giving the reference potential to the driving ICs 45.

[0046] The conductive layer 25 is for example comprised of aluminum (Al) or aluminum alloy or another suitable metal. The thickness thereof may be suitably set. For example, it is 0.5 μm to 2. 0 μm. The conductive layer 25 is for example formed by forming a thin film by a sputtering process or another thin film forming technique, then working the thin film to a predetermined pattern by using photo-etching or the like. Note that, the etching may be carried out in two stages of a process of etching the heat generator layer 23 and the conductive layer 25 together and a process of etching the conductive layer 25 immediately above the heat generating parts 23 after that.

(Common Electrode)

[0047] The common electrode 27, as indicated by notations attached in FIG. 2, has a main wiring part 27a which is positioned on the side (+D2) opposite to the terminal side of the head base body 3 relative to the plurality of heat generating parts 23a (first glaze 17), sub-wiring parts 27b extending from the main wiring part 27a to the terminal side of the head base body 3, and a plurality of lead parts 27c which extend from the main wiring part 27a and are individually connected to the plurality of heat generating parts 23a.

[0048] The main wiring part 27a, for example, linearly extends along (for example in parallel with) the first glaze 17 with a constant width at a position where it does not overlap the first glaze 17.

[0049] The sub-wiring parts 27b for example extend out of the end parts of the main wiring part 27a, pass the outer sides of the end parts of the first glaze 17 (outside of the D1 direction), and extend up to the positions which are adjacent to the edge part of the substrate 11 on the -D2 side. Parts of the end parts on the -D2 side of the sub-wiring parts 27b configure the terminals 3d to which the pins 9a of the connector 9 are connected. Note that, the common electrode 27 may be configured so that the potential is given from the driving ICs 45 in place of the connector 9 as well.

[0050] The plurality of lead parts 27c are for example provided one-to-one with respect to the plurality of heat generating parts 23a, linearly extend from the main wiring part 27a along (for example in parallel with) the D2 direction with constant widths, and are connected to the +D2 side of the heat generating parts 23a. Note that, the lead parts 27c may be positioned above the first glaze 17 as a whole, or parts on the tip end sides may be positioned above the first glaze 17.

[0051] (Individual Electrodes)

[0052] The plurality of individual electrodes 29 are for example provided one-to-one with respect to the plurality of heat generating parts 23a. Further, the plurality of individual electrodes 29 for example extend from the center side of the substrate 11 to the first glaze 17 side while gradually expanding their widths and pitch. After that, the plurality of individual electrodes 29 (the connection parts 29a in those) for example linearly extend along (for example in parallel with) the D2 direction with the constant widths and are connected to the -D2 side of the plurality of heat generating parts 23a. The connection parts 29a may be all positioned above the first glaze 17 or parts on the tip end sides may be positioned above the first glaze 17. Note that, unlike the shown example, two or more heat generating parts 23a which are adjacent to each other may be connected with respect to one individual electrode 29 as well. The end parts of the plurality of individual electrodes 29 which are on the opposite sides to the plurality of heat generating parts 23a configure pads 3e (FIG. 2) for surface-mounting of the driving ICs 45.

(Wiring and Ground Electrode)

[0053] The plurality of wirings 31 connecting the driving ICs 45 and the connector 9 configure at first ends the pads 3e on which the driving ICs 45 are surface-mounted and configure at the other ends the terminals 3d to which the connector 9 is connected. The plurality of wirings 31 connecting the driving ICs 45 to each other configure at first ends the pads 3e on which the driving ICs 45 are surface-mounted and configure at the other ends the pads 3e on which the other driving ICs 45 are surface-mounted. Note that, the head base body 3 may be given a circuit configuration provided with no wiring 31 connecting the driving ICs 45 to each other as well.

[0054] The ground electrode 33 is for example formed solid pattern state in a region which is surrounded by the individual electrodes 29, common electrode 27, and plurality of wirings 31. A part of the ground electrode 33 configures the pads 3e on which the driving ICs 45 are surface-mounted, and another one part configures the terminals 3d to which the connector 9 is connected.

(Protective Layer)

[0055] On the conductive layer 25, the protective layer 35 (FIG. 3) is provided. Note that, in FIG. 2, illustration of the protective layer 35 is omitted. The protective layer 35 for example contributes to suppression of wear of the heat generator layer 23 and conductive layer 25 due to contact with the recording medium and oxidation and/or corrosion of these layers.

[0056] The protective layer 35 is formed so as to cover over at least the plurality of heat generating parts 23a. Specifically, for example, the protective layer 35 has a breadth large enough to cover the entire first glaze 17. Further, in the shown example, the protective layer 35 extends up to the further outer side of the first glaze 17. The protective layer 35 for example linearly extends along (for example in parallel with) the first glaze 17 with a constant width.

[0057] The protective layer 35 can be formed by using SiN, SiO, SiON, SiC, SiCN, or diamond-like carbon or the like. The protective layer 35 may be configured by a single layer as in the present embodiment or may be configured by stacking a plurality of layers. The protective layer 35 can be prepared by using a sputtering process or another thin film forming technique or screen printing or another thick film forming technique. The thickness of the protective layer 35 may be suitably set. For example, it is thicker than the sum of thicknesses of the heat generator layer 23 and conductive layer 25 and is 3 μm to 20 μm.

(Coating Layer)

[0058] In a region where the protective layer 35 is not arranged, a coating layer 37 (FIG. 3) is provided. Note that, in FIG. 2, illustration of the coating layer 37 is omitted. Further, the coating layer 37 may be superimposed on a part of the protective layer 35 as well. The coating layer 37 for example contributes to insulation between the conductive layer 25 and the external part of the head base body 3 and suppression of oxidation/corrosion of the conductive layer 25.

[0059] The coating layer 37 is for example provided over substantially the entire surface of the substrate 11 while exposing the heating line 3b, plurality of pads 3e, and plurality of terminals 3d. The thickness of the coating layer 37 is for example 5 μm to 30 μm. The material of the coating layer 37 is for example an epoxy-based resin, polyimide-based resin, or silicone-based resin or other resin material. The coating layer 37 is for example formed by screen printing or photolithography.

(Driving ICs)

[0060] The driving ICs 45 have the function of controlling the energization state of the heat generating parts 23a. As the driving ICs 45, for example, use may be made of a switching member having a plurality of switching elements in the internal part. The driving ICs 45 are surface-mounted on the plurality of pads 3e through not shown bumps and are sealed by a hard coat 47 (see FIG. 7) . The hard coat 47 is made of for example an epoxy resin or silicone resin or another resin.

(Surface Shape of Protective Layer)

[0061] FIG. 4A and FIG. 4B are perspective views showing a part of the head base body 3 in an enlarged state. FIG. 4A omits illustration of the protective layer 35 compared to FIG. 4B.

[0062] As already explained, the plurality of heat generating parts 23a are aligned in the D1 direction. To the +D2 side of the heat generating parts 23a, the plurality of lead parts 27c of the common electrode 27 are connected. To the -D2 side of the heat generating parts 23a, the connection parts 29a of the individual electrodes 29 are connected.

[0063] The three of the lead parts 27c, heat generating parts 23a, and connection parts 29a, for example, substantially configure projected rims (notation omitted) as a whole which linearly extend along (for example in parallel with) the D2 direction with constant widths. From another viewpoint, a plurality of lower grooves 51 (FIG. 4A) extending in the D2 direction are formed.

[0064] As already explained, the planar shape (pattern) of the heat generator layer 23 is the same as the pattern of the conductive layer 25 (common electrode 27 and individual electrodes 29) excluding the heat generating parts 23a. Accordingly, at the positions between the plurality of lead parts 27c and between the plurality of connection parts 29, the lower grooves 51 have depths corresponding to the sum of the thickness of the heat generator layer 23 and the thickness of the conductive layer 25.

[0065] In the protective layer 35 which is superimposed on that, first recessed parts 53, second recessed parts 55, and third recessed parts 57 are formed at the positions substantially overlapping the lower grooves 51. The first recessed parts 53 are recessed parts where at least parts are positioned between lead parts 27c which are adjacent to each other when viewed on a plane. The second recessed parts 55 are recessed parts where at least parts are positioned between the connection parts 29a which are adjacent to each other when viewed on a plane. The third recessed parts 57 are recessed parts where at least parts are positioned between the heat generating parts 23a which are adjacent to each other when viewed on a plane.

[0066] Note that, although not particularly shown, the protective layer 35 may have recessed parts substantially superimposed on the heat generating parts 23a as well. The recessed parts may be connected with the third recessed parts 57 in the D1 direction or may not be connected. Further, the depths of the recessed parts may be shallower than, the same as, or deeper than the depth of the third recessed parts 57.

[0067] FIG. 5 is a plan view showing the upper surface of the protective layer 35 in an enlarged state. In this diagram, the lead parts 27c, heat generating parts 23a, and connection parts 29a are indicated by dotted lines. Further, hatching is attached to the heat generating parts 23a. FIG. 6A to FIG. 6C are schematic cross-sectional views of the upper surface part of the protective layer 35, in which FIG. 6A corresponds to the VIa-VIa line in FIG. 5, FIG. 6B corresponds to the VIb-VIb line in FIG. 5, and FIG. 6C corresponds to the VIc-VIc line in FIG. 5.

(First Recessed Parts and Second Recessed Parts)

[0068] The first recessed parts 53 and second recessed parts 55, when viewed on a plane, are for example substantially recessed grooves which linearly extend in parallel with the D2 direction with constant widths. In the recessed grooves, the end parts on the side opposite to the heat generating parts 23a may be positioned on the first glaze 17, may be positioned on a long side (edge part) of the first glaze 17, or may be positioned on an outer side than the first glaze 17 (shown example) . Further, in the recessed grooves, the end parts on the heat generating part 23a side, predicated on being positioned closer to the heat generating part 23a side than the end part on the side opposite to the heat generating part 23a described above, may be positioned on the first glaze 17 (shown example), may be positioned on an edge part (long side) in the D2 direction of the first glaze 17, or may be positioned on the outside of the first glaze 17. Further, the end parts of the heat generating parts 23a, in the D2 direction, may reach the positions of the heat generating parts 23a or may be positioned on the sides outside from the heat generating parts 23a (shown example).

[0069] The cross-sectional shapes of the first recessed parts 53 and second recessed parts 55 (shapes of the cross-sections perpendicular to the D2 axis, same below) may be made suitable shapes . For example, they may be substantially rectangular. Otherwise, for example, the cross-sectional shapes may be shapes which become narrower in widths toward the bottom sides over the entire depths or in ranges from suitable depths to the bottom sides. In the first recessed parts 53 and second recessed parts 55, either of the widths or depths may be larger than the others as well.

[0070] When the first recessed parts 53 or second recessed parts 55 have parts which are positioned outside the first glaze 17, the cross-sectional shapes of those parts are for example constant without regard as to the positions in the D2 direction. When the first recessed parts 53 or second recessed parts 55 have parts which are positioned on the first glaze 17, the cross-sectional shapes of those parts may become for example shallower toward the heat generating part 23a sides as if the upper parts of the grooves were removed (for example the protective layer 35 may become shallower) . Note that, in FIG. 4B and FIG. 5, the edge parts of the first recessed parts 53 and second recessed parts 55 on the peak side of the first glaze 17 are clearly shown. However, these recessed parts may gradually become shallower as they approach the peak of the first glaze 17, and the edge parts on the peak side may become unclear.

[0071] The widths w1 (FIG. 6A) of the first recessed parts 53, although according to the state of formation of the protective layer 35, are for example substantially equal to the distances between the lead parts 27c. In the same way, the widths w2 (FIG. 6C) of the second recessed parts 55, although according to the state of formation of the protective layer 35, are for example substantially equal to the distances between the connection parts 29a. The widths w1 and w2 are for example equal sizes with each other. Note that, the widths of the recessed parts (53, 55, 57, etc.) may be specified at for example middle positions between the upper openings of the recessed parts (upper surface of the protective layer 35) and the deepest positions of the recessed parts. The widths w1 and w2 are for example 1 μm to 150 μm.

[0072] The depths d1 (FIG. 6A) of the first recessed parts 53 and the depths d2 (FIG. 6C) of the second recessed parts 55, although according to the state of formation of the protective layer 35, are for example not more than the total thicknesses of the heat generator layer 23 and the conductive layer 25. The depths d1 and d2 are for example equal sizes to each other. Note that, the depths of the recessed parts (53, 55, or 57 etc.) may be specified at for example the deepest positions of the recessed parts or at positions which become the centers of the widths of the upper openings of the recessed parts. Further, the depths may be specified in the normal line direction in the case where the protective layer 35 has the state of a curved surface as in the present embodiment or may be specified in the D3 direction in a case where the curvature is relatively small. The depths d1 and d2 are for example 0.5 μm to 2 μm.

(Third Recessed Parts)

[0073] The third recessed parts 57, for example, when viewed on a plane, are recessed grooves which substantially linearly extend in a direction inclined to the D2 direction with constant widths. In the recessed grooves, the end parts on the second recessed part 55 sides are for example connected to the end parts of the second recessed parts 55 in the D2 direction. Further, in the recessed grooves, the end parts on the first recessed part 53 sides are for example adjacent to the first recessed parts 53 in the D1 direction.

[0074] Note that, when the second recessed parts 55 and the third recessed parts 57 are connected in the D2 direction, for example, the amounts of overlap of the two in the D1 direction at the connection positions may be not less than 70% of the lengths of the parts of the second recessed parts 55 in the D1 direction located immediately before the connection with the third recessed parts 57 and/or not less than 70% of the lengths of the parts of the third recessed parts 57 in the D1 direction located immediately before the connection with the second recessed parts 55.

[0075] Further, when the first recessed parts 53 and the third recessed parts 57 are adjacent to each other in the D1 direction, for example, predicated on parts of the ranges of arrangement of the two in the D2 direction overlapping with each other, the two may be separated from each other. Further, when the two are connected (shown example), the amounts of overlap in the D1 direction at the connection positions may be less than 30% of the lengths of the parts of the first recessed parts 53 in the D1 direction located immediately before overlapping with the third recessed part 57 and less than 30% of the lengths of the parts of the third recessed parts 57 in the D1 direction positioned immediately before overlapping with the second recessed parts 55.

[0076] The end parts of the third recessed parts 57 on the second recessed part 55 sides (-D2 sides) are connected with the end parts of the second recessed parts 55 on the third recessed part 57 sides, therefore the explanation for the positions of the end parts of the second recessed parts 55 on the heat generating part 23a sides which was explained above may be construed as the explanation for the positions of the end parts of the third recessed parts 57 on the second recessed part 55 sides. That is, the end parts of the third recessed parts 57 on the second recessed part 55 sides may be positioned above the first glaze 17 (shown example), may be positioned in the edge part (long side) of the first glaze 17 on the -D2 side, or may be positioned on the side outside from than the first glaze 17 (-D2 side). Further, the end parts of the third recessed parts 57 on the second recessed part 55 sides, in the D2 direction, may fall in the range of the heat generating parts 23a or may be positioned on the sides outside from the heat generating parts 23a (-D2 side) (shown example).

[0077] The end parts of the third recessed parts 57 on the first recessed part 53 sides (+D2 sides) may be positioned above the first glaze 17 (shown example), may be positioned on the edge part (long side) of the first glaze 17 on the +D2 side, or may be positioned on the side outside from the first glaze 17 (+D2 side). Further, the end parts of the third recessed parts 57 on the first recessed part 53 sides, in the D2 direction, may fall in the range of the heat generating parts 23a or may be positioned on the sides outside from than the heat generating parts 23a (+D2 side) (shown example) .

[0078] In the third recessed parts 57, due to the inclination when viewed on a plane, for example, parts are positioned between the heat generating parts 23a, but other parts overlap with the heat generating parts 23a. In more detail, the third recessed parts 57 are positioned on the edge parts of the heat generating parts 23a on the -D2 side (at least a part thereof). In the third recessed parts 57, the area ratio of the parts positioned between the heat generating parts 23a and the parts positioned on the heat generating parts 23a or the ratios of the areas in the third recessed parts 57 overlapping with the heat generating parts 23a which are occupied in the areas of the heat generating parts 23a may be suitably set. For example, the ratios of the areas in the third recessed parts 57 overlapping with the heat generating parts 23a which are occupied in the areas of the heat generating parts 23a is 10% or less or 5% or less. Note that, although not particularly shown, the third recessed parts 57 need not overlap the heat generating parts 23a.

[0079] The cross-sectional shapes of the third recessed parts 57 (shapes of the cross-section perpendicular to the D2 axis, same below) may be made suitable shapes. For example, they may be substantially rectangular. Otherwise, for example, the cross-sectional shapes may be shapes which become narrower in widths toward the bottom sides over the entire depths or in ranges from suitable depths to the bottom sides. In the third recessed parts 57, either of the widths or depths may be larger than the others as well. In the example shown in FIG. 6B, the depths d3 are smaller than the widths w3. In the third recessed parts 57, at least parts (all in the shown example) are positioned above the first glaze 17. The cross-sectional shapes of the parts above the first glaze 17 may become shallower toward the heat generating part 23a sides as if the upper parts of the grooves were removed (for example, the protective layer 35 may become thinner as well).

[0080] The widths w3 of the third recessed parts 57 (FIG. 6B, here, made the lengths in the D1 direction) are for example substantially equal to the widths w1 of the first recessed parts 53 and/or the widths w2 of the second recessed parts 55. For example, the differences between the widths w3 and the widths w1 or w2 are less than 20% of the latter.

[0081] The depths d3 of the third recessed parts 57 (FIG. 6B) are for example shallower than the depths d1 of the first recessed parts 53 and the depths d2 of the second recessed parts 55. For example, each of the depths d3 is 1/5 or less, 1/10 or less, or 1/20 or less of each of the depths d1 and the depths d2. Note that, in the above, if the values of the depths d1, d2, or d3 change according to the position in the D2 direction, for example, the largest values may be used for comparisons or the values at the positions where the parts are connected to each other or adjacent to each other may be used for comparisons.

[0082] In regions where the ranges in the D2 direction of the first recessed parts 53 and the third recessed parts 57 overlap with each other, the relatively deeper parts (parts having the depths d1) are parts of the first recessed parts 53 and the relatively shallower parts (parts having the depths d3) are parts of the third recessed parts 57. Accordingly, as shown in FIG. 6A, in the case where the parts in the third recessed parts 57 adjacent to the first recessed parts 53 are connected to the first recessed parts 53 in the D1 direction, the widths w4 of the connected parts (here, made the lengths in the D1 direction) become narrower than the widths w3 of the other parts of the third recessed parts 57. Consequently, for example, the widths w4 becomes narrower than the widths w1 and/or widths w2.

[0083] The head base body 3 may be fabricated according to the same method as various known methods except for the formation of the third recessed parts 57. Further, the method of formation of the various layers on the substrate 11 is as already explained. The first recessed parts 53 and the second recessed parts 55 are for example formed by formation of parts of the protective layer 35 in the lower grooves 51 at the time of formation of the protective layer 35 in a manner with the parts appearing to sink down due the lower grooves 51.

[0084] The third recessed parts 57 may be formed according to a suitable method. For example, although not particularly shown, after preparing the head base body 3 according to the known method described above, the head base body 3 is conveyed to the -D1 side while polishing it by fixed abrasive grains from the second recessed parts 55 to the +D2 side by the widths of the second recessed parts 55. Due to this, the third recessed parts 57 which are relatively shallower and have widths equal to the second recessed part 55 and which extend to the +D2 side while inclining to the +D1 side are formed.

(Thermal Printer)

[0085] FIG. 7 is a schematic diagram showing the configuration of a thermal printer 101 having the thermal head 1.

[0086] The thermal printer 101 is provided with a thermal head 1, a conveying mechanism 103 for conveying a recording medium P (heat-sensitive paper taken as an example), a platen roller 105 which presses the recording medium P against a heating line 3b, a power supply device 107 supplying electrical power to them, and a control device 109 which controls operations of them.

[0087] The thermal head 1 is attached to an attachment surface 111a of an attachment member 111 provided in a housing (not shown) of the thermal printer 101. The thermal head 1 is attached to the attachment member 111 so as to run along a main scanning direction (D1 axis direction) perpendicular to the conveyance direction S of the recording medium P.

[0088] The conveying mechanism 103 has a driving part (not shown) and conveying rollers 113, 115, 117, and 119. The conveying mechanism 103 conveys the recording medium P in the direction indicated by the arrow S to convey the same onto the protective layer 35 which is positioned above the plurality of heat generating parts 23a in the thermal head 1. The driving part has a function of driving the conveying rollers 113, 115, 117, and 119. For example, use can be made of motors. The conveying rollers 113, 115, 117, and 119 can be configured by for example covering columnar shaft bodies 113a, 115a, 117a, and 119a made of stainless steel or another metal by elastic members 113b, 115b, 117b, and 119b made of butadiene rubber or the like.

[0089] Note that, although not shown, when the recording medium P is image receiving paper to which ink is transferred, the ink film is conveyed together with the recording medium P to a space between the recording medium P and the heat generating parts 23a in the thermal head 1.

[0090] The platen roller 105 is arranged so as to extend along the direction perpendicular to the conveyance direction S of the recording medium P. Its two end parts are supported so that rotation becomes possible in a state pressing the recording medium P against the tops of the heat generating parts 23a. The platen roller 105 for example can be configured by covering a columnar shaft body 105a made of stainless steel or another metal by an elastic member 105b made of butadiene rubber or the like.

[0091] The power supply device 107 has a function of supplying current for making the heat generating parts 23a in the thermal head 1 generate heat as described above and current for operating the driving ICs 45. The control device 109, in order to selectively make the heat generating parts 23a in the thermal head 1 generate heat, supplies a control signal controlling the operation of the driving ICs 45 to the driving ICs 45.

[0092] The thermal printer 101 presses the recording medium P against the tops of the heat generating parts 23a in the thermal head 1 by the platen roller 105 while conveying the recording medium P above the heat generating parts 23a by the conveying mechanism 103 and selectively makes the heat generating parts 23a generate heat by the power supply device 107 and control device 109 to thereby perform predetermined printing on the recording medium P. Note that, where the recording medium P is image receiving paper, the thermal printer 101 thermally transfers the ink of the ink film (not shown) conveyed together with the recording medium P to the recording medium P to thereby print on the recording medium P.

[0093] As described above, in the present embodiment, the thermal head 1 has a plurality of heat generating parts 23a, a plurality of first electrode parts (lead parts 27c), a plurality of second electrode parts (connection parts 29a), and a protective layer 35. The plurality of heat generating parts 23a are aligned on a predetermined surface (for example the foundation layer 21 or the major surface of the substrate 11) in the first direction (D1 direction) along the major surface of the substrate 11. The plurality of lead parts 27c, when viewed on a plane, are connected with respect to the plurality of heat generating parts 23a on one side (+D2 side) of the second direction (D2 direction) crossing the D1 direction. The plurality of connection parts 29a, when viewed on a plane, are connected with respect to the plurality of heat generating parts 23a on the other side (-D2 side) of the D2 direction. The protective layer 35 covers the plurality of heat generating parts 23a, plurality of lead parts 27c, and plurality of connection parts 29a. Further, the protective layer 35 has a plurality of first recessed parts 53, a plurality of second recessed parts 55, and a plurality of third recessed parts 57. The plurality of first recessed parts 53, when viewed on a plane, are positioned among the plurality of lead parts 27c. The plurality of second recessed parts 55, when viewed on a plane, are positioned among the plurality of connection parts 29a. The plurality of third recessed parts 55, when viewed on a plane, are positioned among the plurality of heat generation parts 23a and are shallower than the plurality of first recessed parts 53 and plurality of second recessed parts 55.

[0094] Accordingly, for example, since the third recessed parts 57 are positioned among the heat generating parts 23a, the liability of adhesion (occurrence of sticking) of the recording medium or ink film to the region in the protective layer 35 above the heat generating parts 23a is reduced. On the other hand, the third recessed parts 57 are made relatively shallower. Therefore, for example, waste such as paper waste (paper powder) generated due to the sliding movement is easily discharged from the third recessed parts 57. As a result, for example, the liability of the characteristics concerned with heating ending up changing due to the waste deposited in the third recessed parts 57 is reduced, and consequently the image quality is maintained.

[0095] Further, in the present embodiment, the third recessed parts 57 extend in the direction inclined relative to the D2 direction when viewed on a plane.

[0096] Accordingly, for example, when focusing on a linear region in the recording medium parallel to the D1 direction, at the time when this region is sliding in the D2 direction relative to the head base body 3, the contact position against the protective layer 35 (conversely speaking, the position just above the third recessed parts 57) changes in the D1 direction accompanied with the sliding movement. That is, the state of contact changes. As a result, for example, it becomes easier to peel off the recording medium from the protective layer 35. That is, the apprehension of sticking is reduced.

[0097] Further, in the present embodiment, parts of the third recessed parts 57 are positioned on the edge parts in the D1 direction (-D1 direction) of the heat generating parts 23a.

[0098] Accordingly, for example, the effect of suppressing sticking can be obtained in the edge parts of the heat generating parts 23a. As a result, for example, the sliding movement of the recording medium with respect to the heating line 3b is carried out smoothly particularly above the heat generating parts 23a, and consequently intervals of dots in the D1 direction on the recording medium become stable. That is, the image quality improves.

[0099] Further, in the present embodiment, the third recessed parts 57 are connected in the parts on the -D2 side with the second recessed parts 55 in the D2 direction.

[0100] Accordingly, for example, waste such as paper waste entering into the second recessed parts 55 can be discharged to the third recessed parts 57. As explained above, the third recessed parts 57 are relatively shallow, therefore they easily discharge the waste. As a result, in comparison with the case where the waste is directly discharged from the second recessed parts 55 to the outside, discharging of waste is facilitated. This effect is further improved at the time when the second recessed parts 55, relative to the third recessed parts 57, are positioned on the upstream side of the relative movement of the recording medium relative to the head base body 3.

[0101] Further, in the present embodiment, the third recessed parts 57 are adjacent to the first recessed parts 53 in the D1 direction at the parts on the +D2 side.

[0102] Accordingly, for example, the contact area of the recording medium and the protective layer 35 can be reduced more. As a result, for example, the effect of suppressing sticking is improved.

[0103] Further, in the present embodiment, the sum of the widths (w1+w4) of the mutually adjoining parts in the D1 direction of the first recessed parts 53 and the third recessed parts 57 is larger than the widths w2 in the D1 direction of the second recessed parts 55.

[0104] Accordingly, both of the action of reducing the contact area of the recording medium and the protective layer 35 more and the action that the contact state changes along with the sliding movement of the recording medium are exerted, therefore the effect of suppressing sticking becomes higher.

[0105] Further, in the present embodiment, the protective layer 35 has parts of the third recessed parts 57 in which the widths in the D1 direction are smaller than the widths w1 or w2 of the first recessed parts 53 or second recessed parts 55 in the D1 direction (for example parts having the widths w4).

[0106] Accordingly, the third recessed parts 57 themselves are made thin while reducing the contact area of the recording medium and the protective layer 35 by the third recessed parts 57. Due to this, for example, it becomes easy to arrange the third recessed parts 57 at suitable positions with necessary and sufficient areas.

[0107] The present embodiment can be construed from another viewpoint than the viewpoint that the third recessed parts 57 are positioned among the heat generating parts 23a when viewed on a plane and are shallower than the first recessed parts 53 and second recessed parts 55. For example, the third recessed parts 57 may be adjacent to the first recessed parts 53 in the D1 direction when viewed on a plane and be shallower than the first recessed parts 53 and second recessed parts 55.

[0108] In this viewpoint, for example, by the third recessed parts 57, substantially the first recessed parts 53 are expanded to the D1 direction and the apprehension of sticking can be reduced. On the other hand, the third recessed parts 57 are made relatively shallower. Therefore, for example, paper water or other waste is easily discharged.

(Modification)

[0109] FIG. 8 is a perspective view showing a part of a thermal head according to a modification in an enlarged state and corresponds to FIG. 4B.

[0110] In this modification, the third recessed parts 57 in the embodiment are divided into first divided recessed parts 57a and second divided recessed parts 57b. For example, the first divided recessed parts 57a and second divided recessed parts 57b become shallower toward the heat generating part 23a sides (for example the protective layer 35 becomes thinner). As a result, they are interrupted on the heat generating part 23a sides . The first divided recessed parts 57a and second divided recessed parts 57b may have or may not have parts which are positioned between the adjoining heat generating parts 23a when viewed on a plane.

[0111] In this modification as well, for example, the third recessed parts 57 (strictly speaking, the first divided recessed parts 57a thereof), in the same way as the third recessed parts 57 in the embodiment, are adjacent to the first recessed parts 53 in the D1 direction when viewed on a plane and are shallower than the first recessed parts 53 and second recessed parts 55, therefore the same effects as those by the embodiment are exerted. For example, the first recessed parts 53 are substantially expanded to the D1 direction by the third recessed parts 57, so the liability of sticking can be reduced. On the other hand, the third recessed parts 57 are made relatively shallower. Therefore, for example, paper waste or other waste is easily discharged.

[0112] Note that, in the above embodiment and modification, the foundation layer 21 or the major surface of the substrate 11 is one example of the predetermined surface. The D1 direction is one example of the first direction. The D2 direction is one example of the second direction. The lead part 27c is one example of the first electrode part. The connection part 29a is one example of the second electrode part. Each of the third recessed part 57 and first divided recessed part 57a is one example of the third recessed part.

[0113] The technique according to the present disclosure is not limited to the embodiment and modification explained above and may be executed in various ways.

[0114] For example, in the present embodiment, provision of the heating line 3b on the major surface of the substrate 11 was exemplified. However, the heating line may be formed on a side surface (end face) of the substrate 11 or the heating line may be formed on a chamfered surface formed by chamfering a corner part formed by the major surface and the side surface. Note that, as understood from this, the predetermined surface above which the heat generating parts and electrode parts are provided is not limited to the major surface of the substrate.

[0115] In the embodiment, the first recessed parts were positioned on the common electrode (lead part) side relative to the heat generating parts, and the second recessed parts were positioned on the individual electrode (connection part) side relative to the heat generating parts. However, these arrangements may be vice versa. From another viewpoint, the first recessed parts were positioned downstream of the direction of conveyance of the recording medium (downstream of the relative movement of the recording medium relative to the heat generating parts) relative to the heat generating parts, and the second recessed parts were positioned upstream relative to the heat generating parts . However, these arrangements may be vice versa.

Reference Signs List

[0116] 1... thermal head, 23a... heat generating part, 27c... lead part (first electrode part), 29a... connection part (second electrode part), 35... protective layer, 53... first recessed part, 55... second recessed part, and 57... third recessed part.

Claims

1. A thermal head (1) comprising:

a plurality of heat generating parts (23a) which are aligned on a predetermined surface in a first direction (D1) along the predetermined surface,
a plurality of first electrode parts (27c) which are connected with respect to the plurality of heat generating parts (23a) on one side of a second direction (D2) crossing the first direction (D1) in a plan view of the predetermined surface,
a plurality of second electrode parts (29a) which are connected with respect to the plurality of heat generating parts (23a) on the other side of the second direction (D2) in a plan view of the predetermined surface, and
a protective layer (35) covering the plurality of heat generating parts (23a), the plurality of first electrode parts (27c), and the plurality of second electrode parts (29a), wherein
the protective layer (35) comprises

a plurality of first recessed parts (53) located among the plurality of first electrode parts (27c) in a plan view of the predetermined surface,
a plurality of second recessed parts (55) located among the plurality of second electrode parts (29a) in a plan view of the predetermined surface, and
a plurality of third recessed parts (57, 57a, 57b) located among the plurality of heat generating parts (23a) in a plan view of the predetermined surface and being shallower than the plurality of first recessed parts (53) and the plurality of second recessed parts (55).

2. The thermal head according to claim 1, wherein the second direction (D2) is a second direction perpendicular to the first direction (D1), and the third recessed parts (57, 57a, 57b) extend in a direction inclined relative to the perpendicular second direction (D2) in a plan view of the predetermined surface.

3. The thermal head according to claim 1 or 2, wherein, in the third recessed parts (57, 57a), parts are located on edge parts of the heat generating parts (23a) in the first direction (D1).

4. The thermal head according to any one of claims 1 to 3, wherein, in the third recessed parts (57, 57b), parts on the other side of the second direction (D2) are connected with the second recessed parts (55) in the second direction (D2).

5. The thermal head according to any one of claims 1 to 4, wherein, in the third recessed parts (57, 57a), the parts on the one side of the second direction (D2) are adjacent to the first recessed parts (53) in the first direction (D1).

6. The thermal head according to any one of claims 1 to 5, wherein each sum of widths (w1+w4) of the mutually adjoining parts of the first recessed parts (53) and the third recessed parts (57, 57a) in the first direction is larger than each width (w2) of the second recessed parts (55) in the first direction (D1).

7. The thermal head according to any one of claims 1 to 6, wherein the third recessed parts (57, 57a) comprises parts with widths (w4) in the first direction (D1) each smaller than each of the widths (w1, w2) of the first recessed parts (53) and the second recessed parts (55) in the first direction (D1).

8. A thermal head (1) comprising:

a plurality of heat generating parts (23a) which are aligned on a predetermined surface in a first direction (D1) along the predetermined surface,
a plurality of first electrode parts (27c) which are connected with respect to the plurality of heat generating parts (23a) on one side of a second direction (D2) crossing the first direction (D1) in a plan view of the predetermined surface,
a plurality of second electrode parts (29a) which are connected with respect to the plurality of heat generating parts (23a) on the other side of the second direction (D2) in a plan view of the predetermined surface, and
a protective layer (35) covering the plurality of heat generating parts (23a), the plurality of first electrode parts (27c), and the plurality of second electrode parts (29), wherein
the protective layer (35) comprises

a plurality of first recessed parts (53) located among the plurality of first electrode parts (27c) in a plan view of the predetermined surface,
a plurality of second recessed parts (55) located among the plurality of second electrode parts (29a) in a plan view of the predetermined surface, and
third recessed parts (57, 57a) comprising portions which are adjacent to the plurality of first recessed parts (53) in the first direction (D1) in a plan view of the predetermined surface, the portions being shallower than the plurality of first recessed parts (53) and the plurality of second recessed parts (55).

9. A thermal printer (101) comprising:

a thermal head (1) according to any of claims 1 to 8,
a conveying mechanism (103) conveying a recording medium (P) onto the thermal head (1), and
a platen roller (105) which presses the recording medium (P) against the top of the thermal head (1).

FIG.1

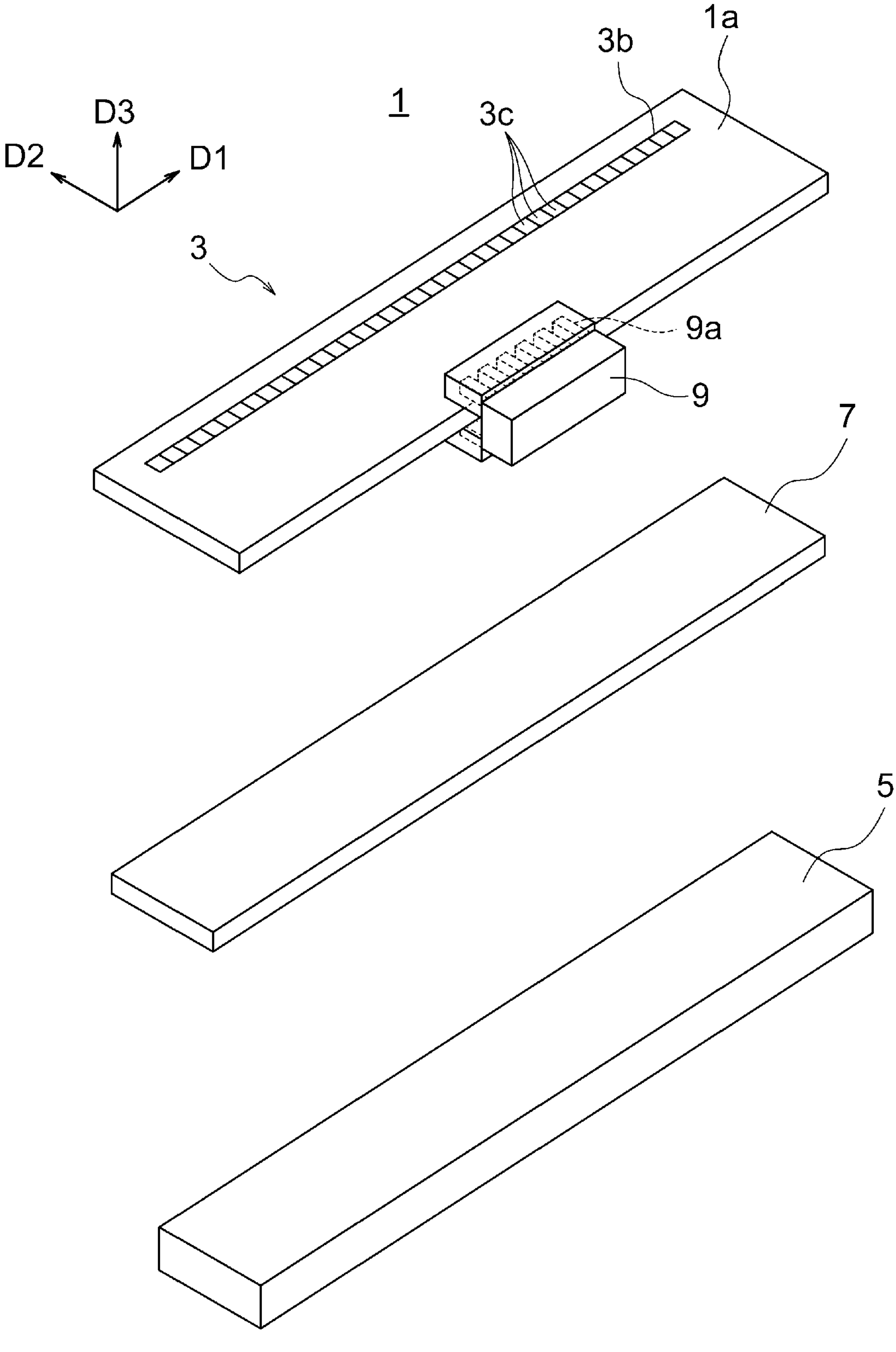


FIG.2

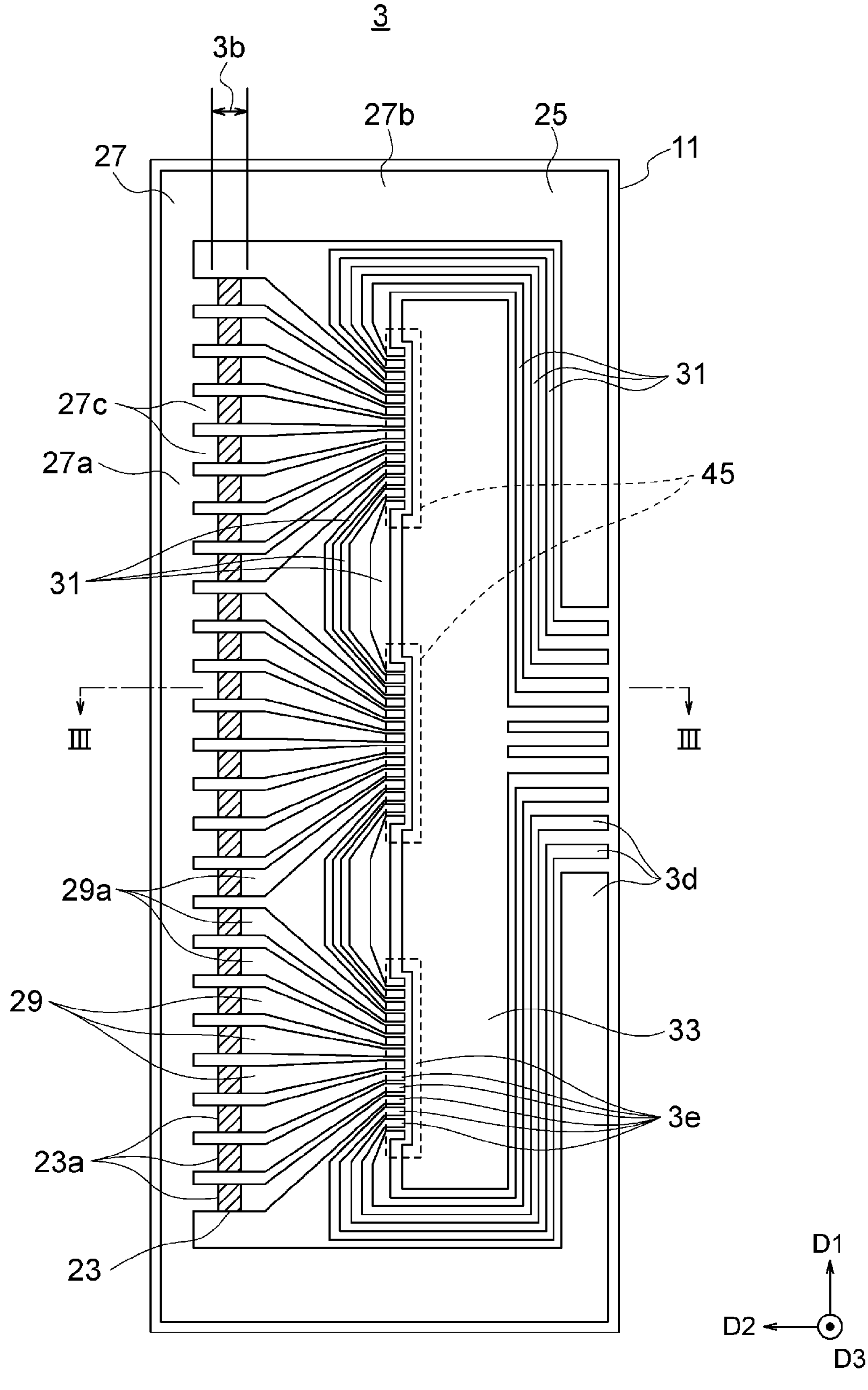

3
3b
27b
25
11
27
31
27c
27a
45
31
III
III
3d
29a
29
33
3e
23a
23
D1
D2
D3

FIG.3

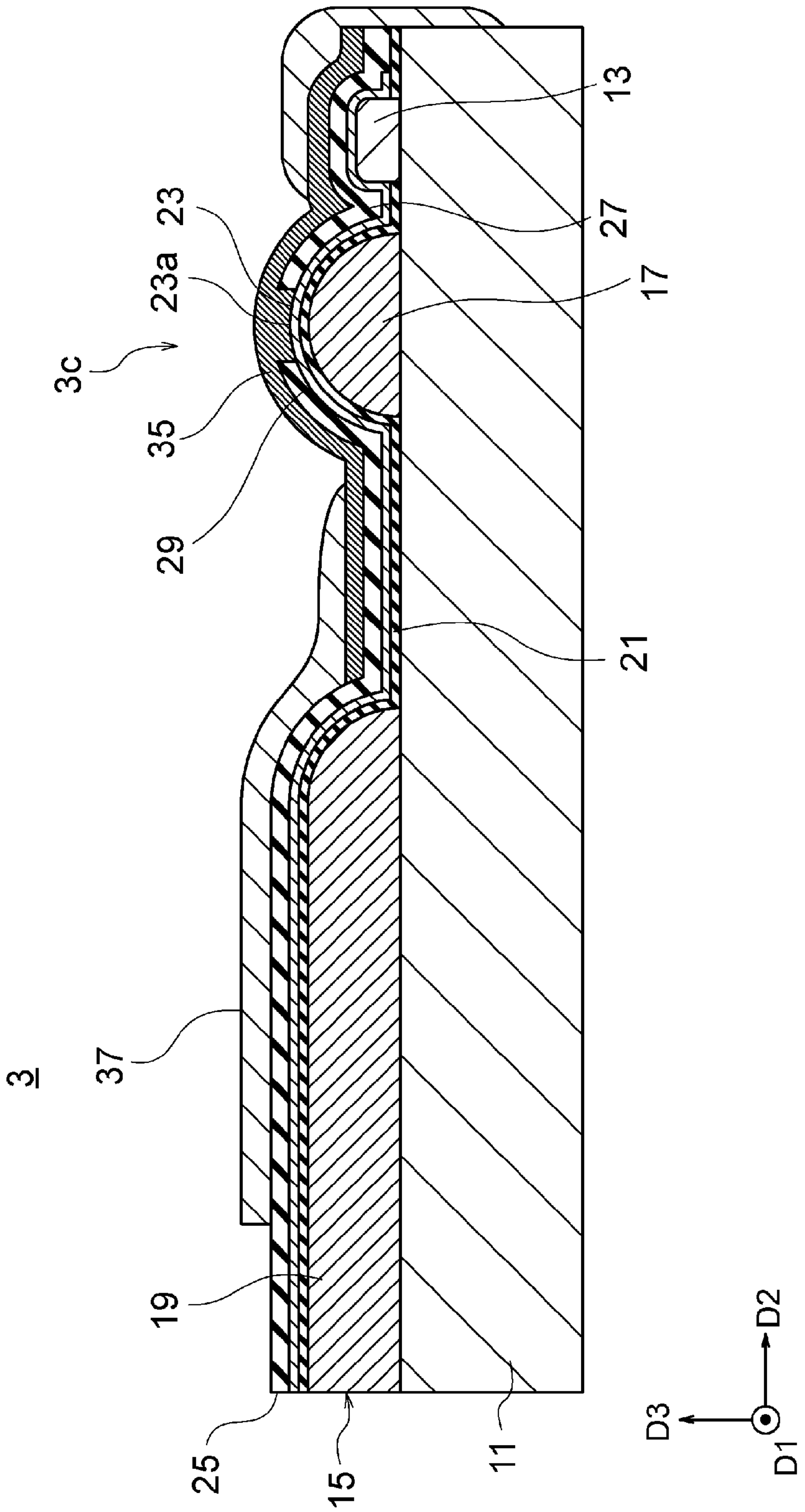


FIG.4A

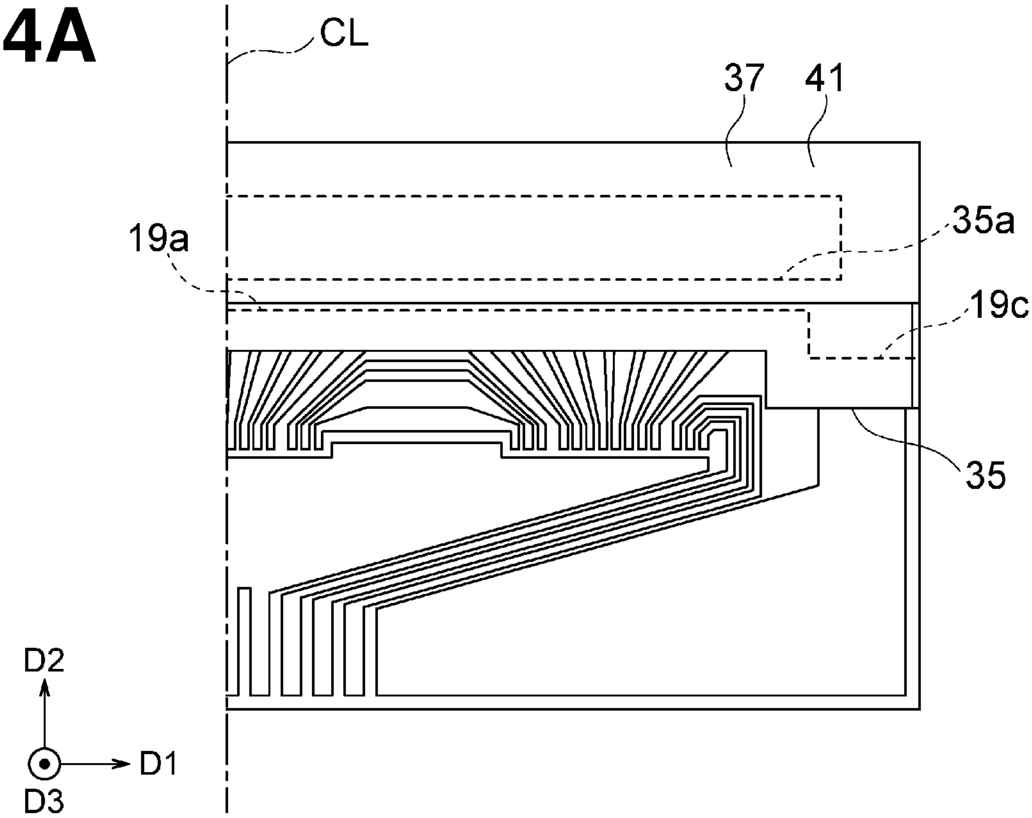

CL
37
41
19a
35a
19c
35
D2
D1
D3

FIG.4B

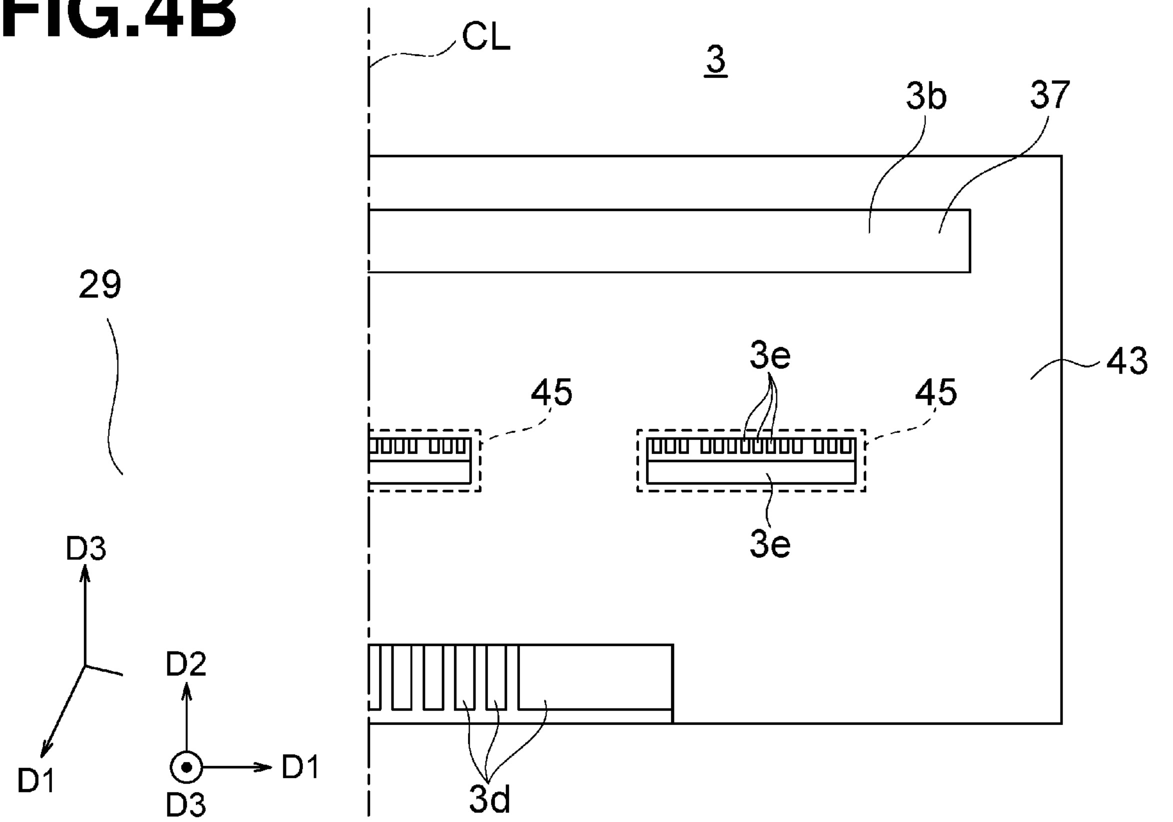

CL
3
3b
37
29
3e
45
45
43
3e
D3
D2
D1
D1
D3
3d

FIG.5

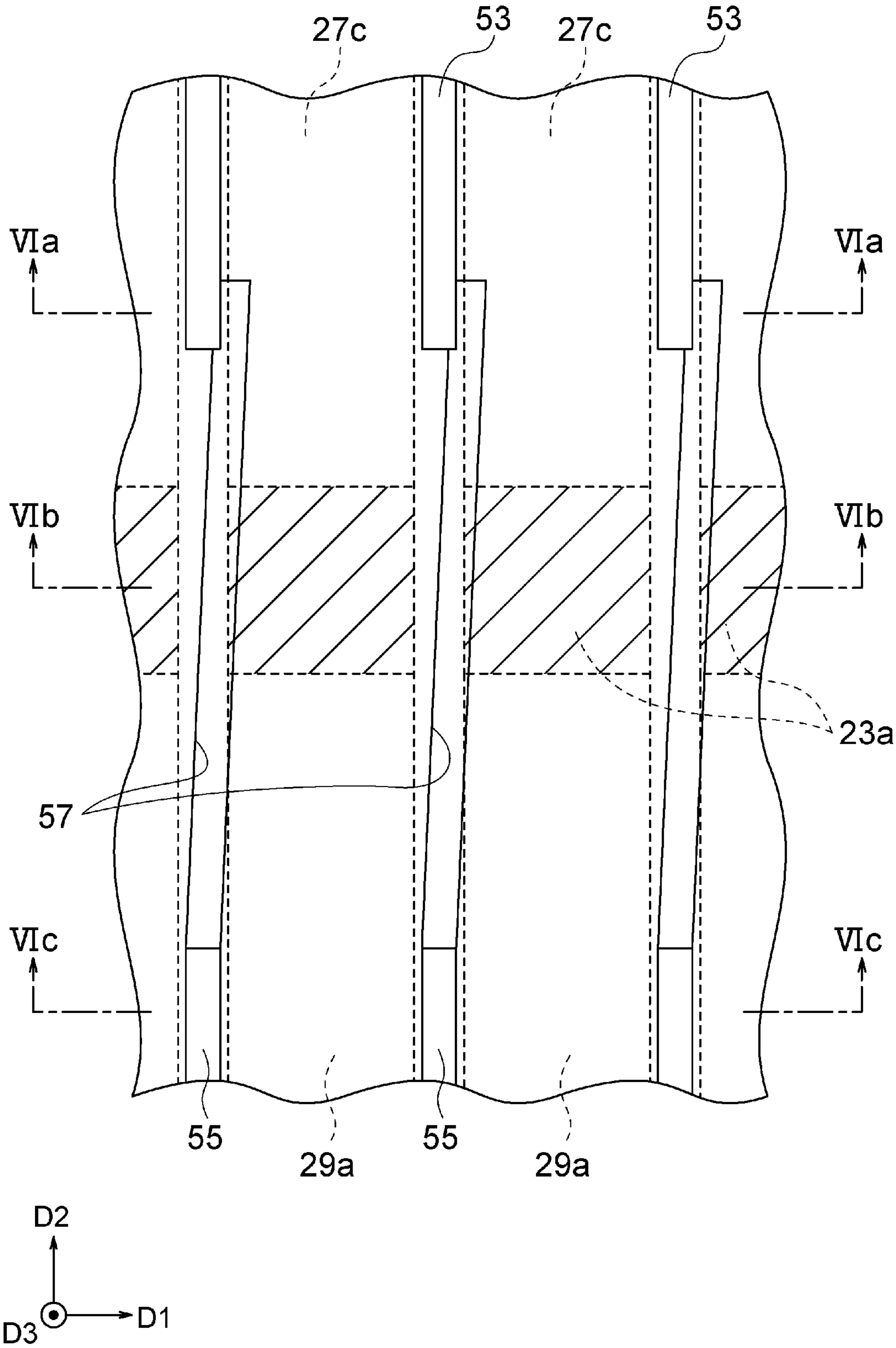


FIG.6A

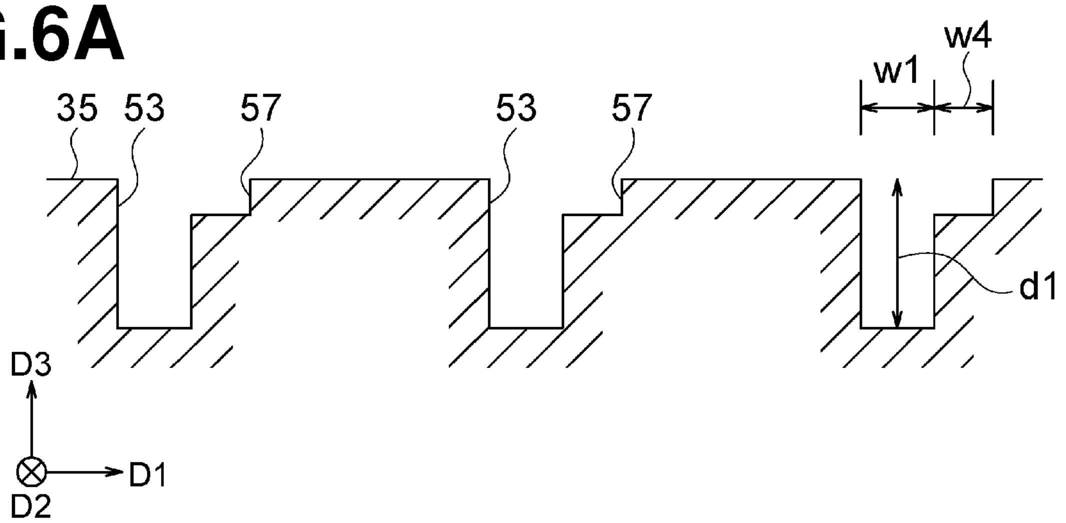


FIG.6B

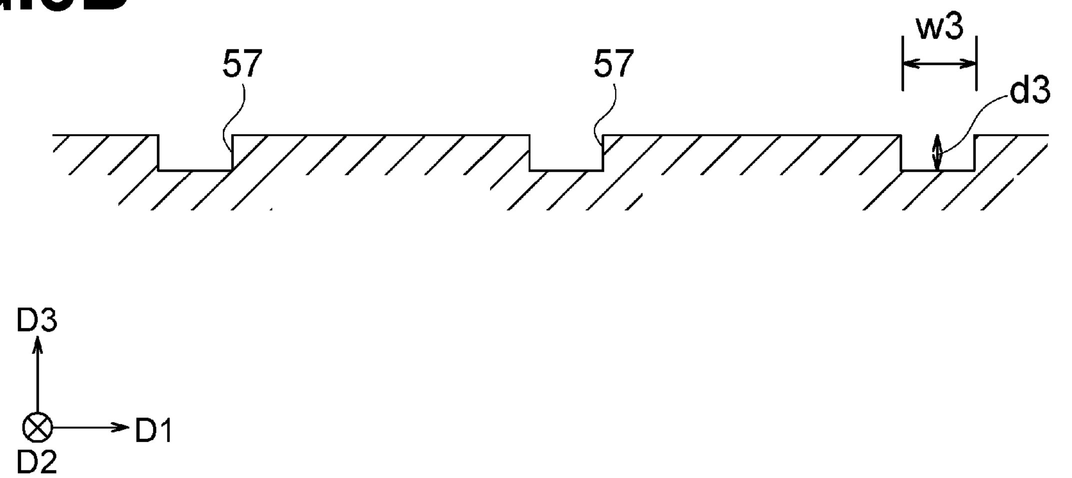


FIG.6C

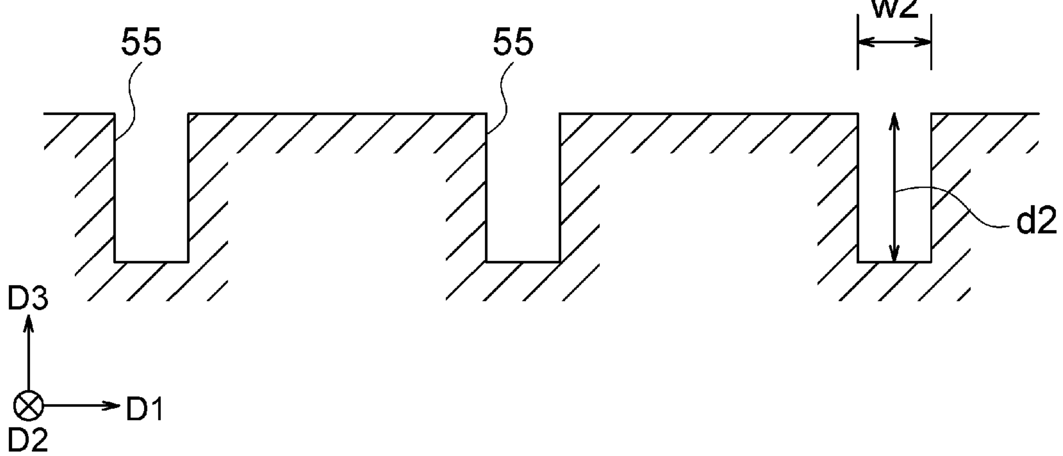
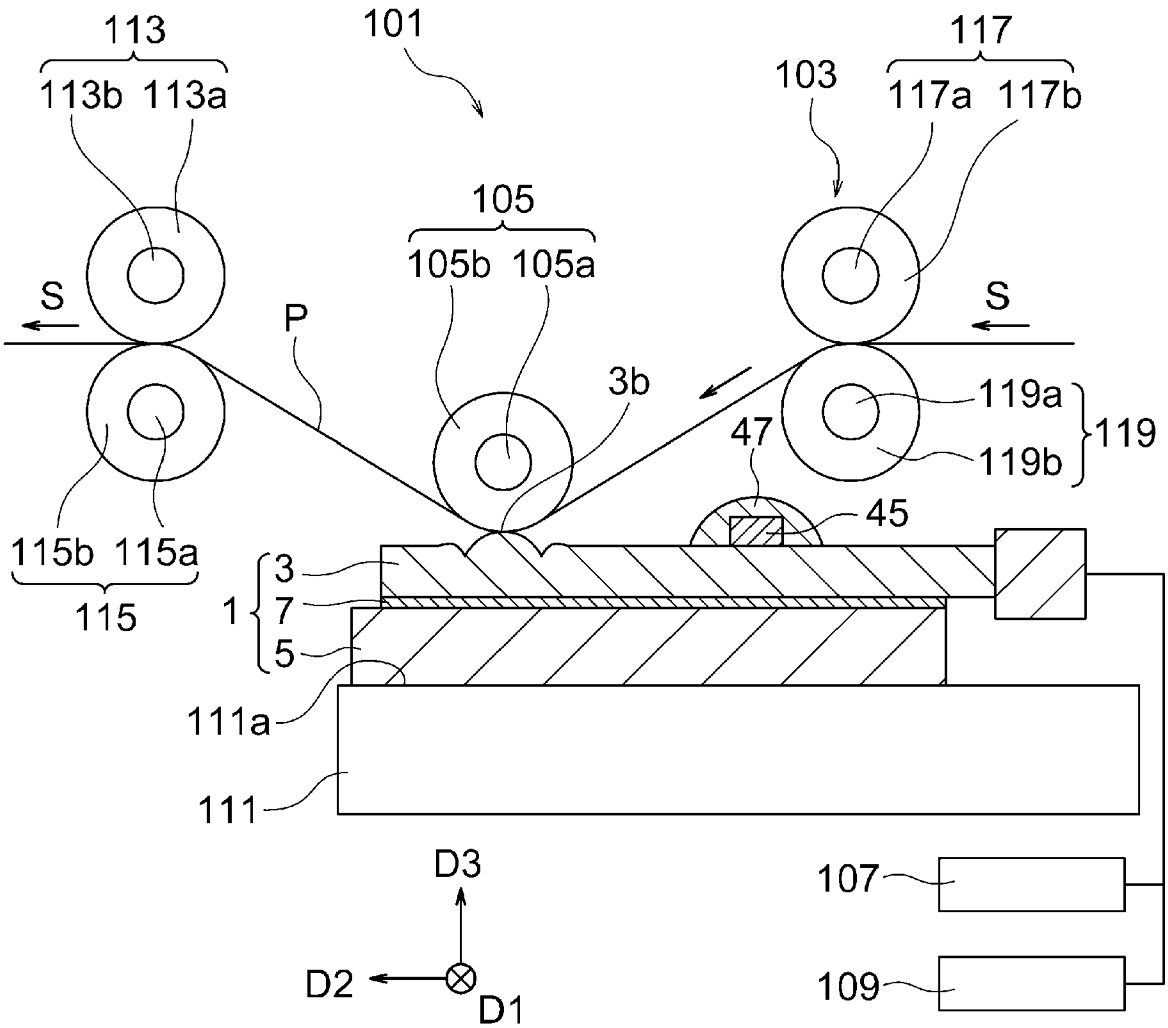


FIG.7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117
103
117a 117b
105
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S
S
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3b
119a
119
119b
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45
115b 115a
115
3
1
7
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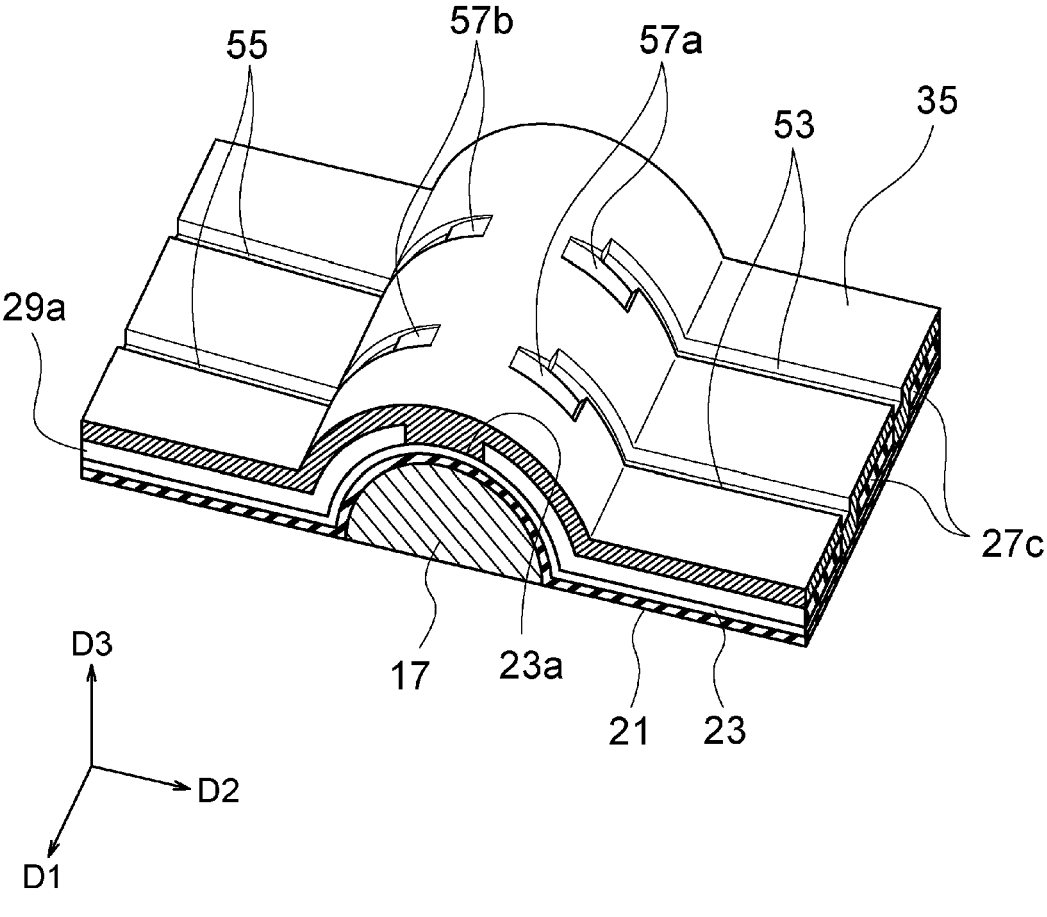
111a
111
D3
D2
D1
107
109

FIG.8



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EUROPEAN SEARCH REPORT

Application Number
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B41J

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	22 January 2019	Didenot, Benjamin

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