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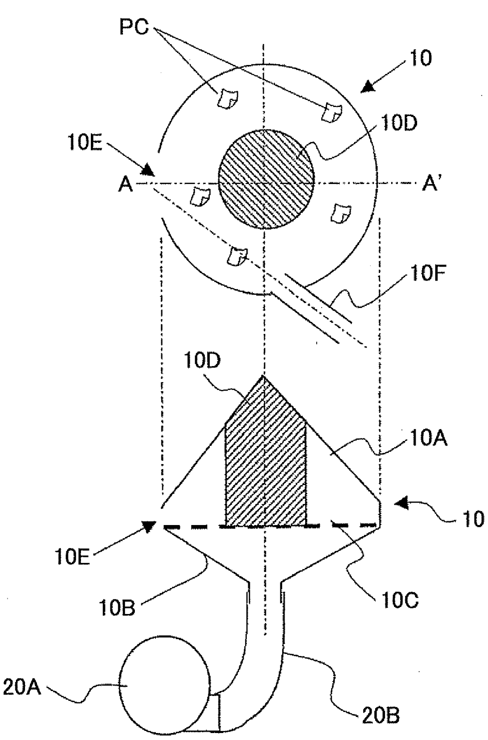
(54) Cleaning media, method of manufacturing cleaning media, and dry-type cleaning device

(57) Cleaning media (PC) having a thin shape and used in a dry-type cleaning device for cleaning a cleaning target by being blown by an air flow and collided with the cleaning target includes a fracture induction part (LY) inducing fracture and being formed so that, upon being fractured along the fracture induction part into pieces, at least one acute-angle part is formed in at least one of the pieces.

FIG.1



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Description

[0001] The present invention relates to cleaning media, a method of manufacturing the cleaning media, and a dry-type cleaning device, the cleaning media being used in a dry-type cleaning to clean a cleaning target by flying (blowing) the cleaning media having a thin (slice) shape by an air flow so that the cleaning media collide with the cleaning target.

[0002] In manufacturing a product, in a process of cleaning a fixture (jig) used for manufacturing the product, a cleaning method using cleaning liquid or solvent has been generally used. However, as a dry-type cleaning method in which neither a drying process nor waste liquid treatment is necessary, there has been proposed a technique in which a cleaning target is cleaned by flying cleaning media having a thin (slice) shape such as film chips and colliding the cleaning media with the cleaning target.

[0003] To remove stains firmly adhered like a film, it is known that a method of cutting into the cleaning target with the film chips having acute edges is effective. For example, Japanese Laid-open Patent Publication No. 2010-279850 (hereinafter "Patent Document 1") discloses material characteristics of a material that is properly broken during cleaning to generate new edges and a structure of cleaning media having grooves.

[0004] In Patent Document 1, FIGS. 9 through 13 illustrate a configuration where grooves are formed on one or both surfaces of the cleaning media having a rectangular shape in a manner such that the grooves are parallel to one side of the cleaning media, so that new edges may be formed on the rectangular chips separated at grooves of the cleaning media. Further, the angle of the cleaning media before and after the separation is substantially a right angel.

[0005] Further, in Patent Document 1, FIGS. 14, 15, 18, and 19 illustrate modified examples of the cross-sections of the grooves, and FIGS. 16 and 17 illustrates examples where there are formed plural types of rectangular cross-sections of the grooves which are illustrated in FIGS. 12 and 13.

[0006] Further, in FIG. 20 of Patent Document 1, it may be thought that the grooves are used as air flow paths so as to peel off the cleaning media adhered to the wall surfaces by electrostatic force.

[0007] Further, paragraph [0032] of Patent Document 1 describes the cleaning media may have any of various shapes including a circular shape, a triangle shape, a rectangular shape, and a star shape, or any combination thereof.

[0008] The dry-type cleaning method as described above is used in a process of cleaning a fixture (jig) that is used in a recycle process of products or an automatic soldering process for electronic boards.

[0009] According to an aspect of the present invention, cleaning media having a thin shape and used in a dry-type cleaning device for cleaning a cleaning target by being blown by an air flow and collided with the cleaning target includes a fracture induction part inducing fracture and being formed so that, upon being fractured along the fracture induction part into pieces, at least one acute-angle part is formed in at least one of the pieces.

[0010] According to another aspect of the present invention, a method of manufacturing the cleaning media includes forming a plurality of the fracture induction parts on a belt-like material and along a longitudinal direction of the belt-like material; and cutting the belt-like material in a direction inclined relative to the longitudinal direction to acquire the cleaning media.

[0011] Other objects, features, and advantages of the present invention will become more apparent from the following description when read in conjunction with the accompanying drawings, in which:

FIG. 1 is a drawing illustrating a main part of a dry-type cleaning device according to an embodiment of the present invention;
FIGS. 2A and 2B are drawings schematically illustrating a cleaning operation in the dry-type cleaning device of FIG. 1;
FIG. 3 is a drawing illustrating an example cleaning process using the dry-type cleaning device;
FIG. 4 is a picture image of a cleaning target before cleaning using cleaning media according to an embodiment;
FIG. 5 is a picture image of the cleaning target after cleaning using the cleaning media;
FIGS. 6A through 6D are drawings illustrating collision patterns of the cleaning media in Patent Document 1;
FIGS. 7A through 7C are top views of cleaning media according to an embodiment;
FIGS. 8A through 8C illustrate cases where new acute-angle parts are generated when the cleaning media are separated at corresponding fragile parts;
FIGS. 9A through 9C illustrate a status of used-up acute-angle parts after the cleaning media are used for a certain period of time in case no fragile parts are formed on the cleaning media;
FIG. 10 is a picture image of the cleaning media on which fracture induction parts are formed;
FIG. 11 is a picture image of fractured cleaning media;
FIGS. 12A through 12C are drawings illustrating the relationship between the angles of the acute-angle parts of the cleaning media and the ease of entering into fine pores of the acute-angle parts;
FIG. 13 is a graph illustrating the relationship between the angles of the acute-angle parts and entering probabilities into the fine pores based on experiments;
FIGS. 14A through 14C illustrate examples of cross-sections of the fragile parts as illustrated in FIGS. 7A through 7C;
FIGS. 15A and 15B illustrate examples where the cleaning media are fractured at different fragile parts;

FIGS. 16A through 16C illustrate modified examples of the fragile parts;
FIGS. 17A and 17B illustrate another modified example of the fracture induction part (fragile part) before and after, respectively, the fracture induction part is fractured;
FIGS. 18A through 18D collectively illustrate an example of a fracturing procedure of the cleaning media having the fracture induction parts formed in a zig-zag manner in another modified example;
FIGS. 19A and 19B illustrate another example of fracturing the cleaning media having the fracture induction parts formed in discontinuous lines;
FIG. 20 is a drawing illustrating a process of manufacturing the cleaning media having a parallelogram shape; and
FIG. 21 a drawing illustrating a process of manufacturing the cleaning media having a trapezoid shape.

[0012] The cleaning media of related art may be suitable for effectively cleaning a wide (flat) area. However, such cleaning media may not sufficiently clean the fine pores or the inside of a concave part. Namely, when the cleaning target has a fine or complicated surface, the cleaning target may not be uniformly cleaned (i.e., some parts of the cleaning target may not be sufficiently cleaned).
[0013] More specifically, there may be many cleaning targets having fine pores (holes) and concave parts. In this case, for example, if the size of the cleaning media is greater than that of the fine pores and the concave parts, only the acute-angle parts (or corners) of the cleaning media may enter into the fine pores and the concave parts.
[0014] Further, when the cleaning media are repeatedly used, the acute-angle parts may be gradually rounded (crash, dulled, broken-up). As a result, it may become more difficult for the cleaning media to enter into the fine pores and the concave parts when the cleaning media are repeatedly used over time.
[0015] For example, the diameter of the holes formed on a metal mask used in a mounting process of a print board is approximately 0.2 mm.
[0016] On the other hand, if the size of the cleaning media is reduced so that such fine holes and the like may be cleaned, the flying energy or the kinetic energy (i.e., the collision energy applied to the cleaning target in collision) depending on the mass may be accordingly reduced. Therefore, basic cleaning performance may be inevitably reduced.
[0017] Further, an additional cost may become necessary to manufacture such tiny cleaning media by reducing the size of film chips or the like so as to clean the fine pores and the concave parts.
[0018] Further, even when the cleaning media are formed (manufactured) simply by forming grooves as described in Patent Document 1 so that the cleaning media may be easily fractured at the grooves, the shape of the new edges generated in the fracture may be randomly generated under limited control. As a result, the possibility of generating corner parts (of the cleaning media) having acute angles suitable to clean the fine pores and the concave parts may become extremely low.
[0019] The present invention is made in consideration of the current status described above, and may provide cleaning media that accurately prevent the occurrence of uneven cleaning of a cleaning target even when the cleaning target includes fine pores and concave parts and contribute to improvement of cleaning performance in dry-type cleaning.
[0020] Further, the present invention may provide a method of manufacturing (processing) such cleaning media at lower cost.
[0021] To that end, in an embodiment of the present application, the nature that thin-shaped cleaning media are randomly fractured (separated) under little control is rectified (improved) so that the cleaning media may be more desirably fractured (separated) under regular conditions (control) and the acute-angle parts to be entered into the fine pores and concave parts may be more reliably formed.
[0022] In other words, according to an embodiment, the fracture of the cleaning media may be intentionally controlled.
[0023] In the following, an embodiment of the present invention is described with reference to the accompanying drawings.
[0024] First, before details of the features of the cleaning media according to the embodiments are described, a cleaning mechanism of the dry-type cleaning device is described.
[0025] FIG. 1 illustrates a main part of a dry-type cleaning device (chassis) according to an embodiment. As illustrated in FIG. 1, the dry-type cleaning chassis (hereinafter may be simplified as "chassis") 10 includes an upper chassis 10A and a lower chassis 10B which are made of hollow bodies having a conical shape.
[0026] Further, the dry-type cleaning chassis 10 is integrated (formed) by the upper chassis 10A and the lower chassis 10B by connecting the bottom surface side of the upper chassis 10A with the bottom surface side of the lower chassis 10B.
[0027] Further, between the upper chassis 10A and the lower chassis 10B, a plate-like separation plate 10C is provided as a porous unit at the position corresponding to the bottom surfaces of the conical shapes of the chasses.
[0028] In the upper chassis 10A, there is provided an inner tube member 10D having a cylindrical shape as a part of the chassis 10, so that the cylindrical axis of the inner tube member 10D is common to the conical axis of the upper chassis 10A. Further, in FIG. 1, the lower part of the inner tube member 10D is in contact with the separation plate 10C.
[0029] The apex side (i.e., the lower side in FIG. 1) of the lower chassis 10B is open like a tube to form an air suction port so as to be connected to a suction device 20A via a suction duct 20B. The suction device 20A and the suction duct

20B constitute a suction unit. As the suction device 20A, for example, a vacuum motor, a vacuum pump, or a low pressure generator using an air flow or a water flow may be adequately used.

[0030] A part near the bottom surface of the upper chassis 10A has a cylindrical shape (cylindrical part). Further, an opening part 10E is formed on a part of the cylindrical part. The opening part 10E is formed by cutting the cylindrical part along a cross section parallel to the cylindrical axis of the cylindrical part and has a rectangular shape.

[0031] Further, there is a hollow cylinder 10F penetrating the cylindrical part, and the hollow cylinder 10F is integrally formed with the upper chassis 10A. In the following, the hollow cylinder 10F is called an "inlet 10F".

[0032] The inlet 10F extends in the direction substantially parallel to the separation plate 10C, and the longitudinal direction of the inlet 10F is inclined relative to the radius direction of the cylindrical part of the upper chassis 10A and is substantially in parallel to the tangent line of the circumferential surface of the inner tube member 10D. Further, in the inlet 10F, the outlet side opened inside the upper chassis 10A is positioned so as to face the opening part 10E. Inside of the inlet 10F, an air flow path is formed.

[0033] The separation plate 10C is a discoid member having punched holes like a punching metal, and is provided between a part of the boundary between the lower chassis 10B and the upper chassis 10A as illustrated in the lower side of FIG. 1. In the upper side of FIG. 1, the symbol "PC" denotes a "thin (slice)-shaped cleaning chip". The aggregation of the thin (slice)-shaped cleaning chip PC constitute the cleaning media. Therefore, in the following, the symbol "PC" further denotes the cleaning media.

[0034] Next, a cleaning operation of cleaning the cleaning target with the dry-type cleaning device as configured described above is described with reference to FIGS. 2A and 2B.

[0035] FIGS. 2A and 2B are drawings schematically illustrating a cleaning operation in the dry-type cleaning device of FIG. 1;

[0036] The upper sides and the lower sides of FIGS. 2A and 2B are illustrated similar to those of FIG. 1. More specifically, FIG. 2B illustrates a case where air is suctioned by the suction unit while the opening part 10E is opened (released). On the other hand, FIG. 2A illustrates a case where air is suctioned by the suction unit while the opening part 10E is closed (sealed) by a surface of a cleaning target CO.

[0037] Before the cleaning operation, the cleaning media PC are contained (stored) in the upper chassis 10A of the dry-type cleaning chassis 10. To that end, an appropriate amount of the thin-shaped cleaning media PC are introduced into the upper chassis 10A through the opening part 10E formed on the upper chassis 10A by using an appropriate method.

[0038] For example, as illustrated in FIG. 2B, the suction device 20A may be driven to suction air contained in the chassis 10 from the lower chassis 10B side through the suction duct 20B. By doing this, a negative pressure is generated in the upper chassis 10A.

[0039] Due to the negative pressure, an air flow AF (see upper side of FIG. 2B) is generated. Then, by using the air flow AF, a desired amount of the cleaning chips PC may be suctioned into the upper chassis 10A through the opening part 10E, thereby introducing the "cleaning media" into the upper chassis 10A.

[0040] The cleaning media introduced as described above are stuck on (adhered to) the separation plate 10C which is the porous unit, and stored (contained) in the upper chassis 10A as illustrated in the upper part of FIG. 2B. The air in the upper chassis 10A is suctioned by the suction unit, so that a negative pressure is generated in the upper chassis 10A.

[0041] Further, external air is introduced into the upper chassis 10A through the inlet 10F. However, the flow speed and the flow amount (flow rate) of the air introduced into the upper chassis 10A through the inlet 10F are small due to the air flow AF.

[0042] Therefore, there may be generated a circulating air flow RF may be generated but the generated circulating air flow RF may not have sufficient strength (energy) to fly (blow up) the cleaning media.

[0043] The cleaning chips PC introduced into the upper chassis 10A are stuck (adsorbed) on the separation plate 10C as described above. As a result, the cleaning chips PC functionally close the corresponding holes of the separation plate 10C.

[0044] Accordingly, as the amount of the cleaning chips PC sticking to the separation plate 10C are increased, the total area of the separation plate 10C where the holes capable of passing the cleaning chips PC through the separation plate 10C becomes smaller and the suction force of suctioning air in the upper chassis 10A becomes weaker accordingly.

[0045] Therefore, when a certain amount of the cleaning chips PC are introduced into the upper chassis 10A, further suctioning of the cleaning chips PC is practically stopped.

[0046] By doing this, it may become possible to introduce and store an appropriate amount of the cleaning chips PC in the upper chassis 10A as the cleaning media, the appropriate amount corresponding to the suction performance of the suction unit.

[0047] After the cleaning media are contained (stored) in the upper chassis 10A as described above, the opening part 10E of the upper chassis 10A is in close contact with the surface of the cleaning target CO (where "stains" to be cleaned (removed) are adhered to) as illustrated in FIG. 2A.

[0048] When the opening part 10E is in close contact with (sealed by) the surface of the cleaning target CO, air suction through the opening part 10E is stopped. As a result, the negative pressure in the opening part 10E is suddenly increased, and both the air amount and the air flow speed (flow rate) of the air suctioned through the inlet 10F are increased. The air is rectified in the inlet 10F, and the air is blown into the opening part 10E from the exit of the inlet 10F as a strong air flow.

[0049] The blown air flow blows out the cleaning chips PC retained on the separation plate 10C toward the "surface of the cleaning target CO which is in close contact with (sealing) the opening part 10E".

[0050] The air flow becomes the circulating air flow RF flowing along the inner wall of the upper chassis 10A in a circular ring manner, and a part of the air flow is suctioned by the suction unit through the holes of the separation plate 10C.

[0051] When the circulating air flow RF flowing in the upper chassis 10A in a circular ring manner as described above is returned to the exit of the inlet 10F, the circulating air flow RF joins the air flow introduced through the inlet 10F and blown from the exist of the inlet 10F joins the circulating air flow RF and is accelerated. By doing this, it may become possible to form (generate, maintain) a stable circulating air flow RF in the upper chassis 10A.

[0052] The cleaning chips PC circulate (fly) in the upper chassis 10A by the circulating air flow RF, and repeatedly collide with (stains of the) surface of the cleaning target CO. Due to the impact of the collisions, the stains may be broken into fine particles or powder and separated from the surface of the cleaning target CO.

[0053] The separated stains are discharged to the outside of the dry-type cleaning chassis 10 through the holes of the separation plate 10C by the suction unit.

[0054] The circulating air flow RF formed (generated) in the upper chassis 10A has the circulation axis orthogonal to the surface of the separation plate 10C (the surface of the upper chassis 10A side), so that the circulating air flow RF flows in parallel to the surface of the separation plate 10C.

[0055] Therefore, the circulating air flow RF blows the cleaning chips PC suctioned onto the separation plate 10C in the lateral direction, and flows (enters) between the cleaning chips PC and the separation plate 10C to peel (separate) the cleaning chips PC from the separation plate 10C and blow up the cleaning chips PC again.

[0056] Further, as described above, the opening part 10E is closed (sealed) and the negative pressure in the upper chassis 10A is increased to be substantially equal to the negative pressure in the lower chassis 10B. As a result, the force to stick the cleaning chips PC to the separation plate 10C is weakened. Therefore, the cleaning chips PC are blown up (flown) more easily.

[0057] Further, the circulating air flow RF is accelerated in a constant direction. Therefore, the circulating air flow RF is more likely to be generated as a fast air flow, which further facilitates fast motion of the cleaning chips PC. Further, according to air flow simulations, the circulating air flow RF circulates several times in the upper chassis 10A before being suctioned through the porous unit (separation plate 10C); therefore the flow rate of the circulating air flow RF becomes five to six times as much as that of the air flown through the air flow path (inlet 10F).

[0058] Due to a greater flow rate, much more cleaning media may be blown up (flown). Further, the cleaning chips PC fastly circulating are unlikely to stick to the separation plate 10C, and the stain sticking to the cleaning chips PC are likely to be separated from the cleaning chips PC by a centrifugal force.

[0059] FIG. 3 illustrates an example of a cleaning operation (process) using the dry-type cleaning device. In the example of the cleaning process, the cleaning target is a metal mask 100 used in a solder paste application process. The metal mask 100 includes plural mask opening parts 101 as openings, and solder pastes SP adhere (stick) to the periphery of the mask opening parts 101. The adhered solder pastes SP are the cleaning targets to be removed.

[0060] To that end, a cleaning operator holds a connecting part between the lower chassis 10B of the dry-type cleaning chassis 10 and the suction duct 20B by a hand HD, and presses the opening part 10E of the upper chassis 10A down to a part of the cleaning target ("part to be cleaned") while the air in the upper chassis 10A is suctioned by the suction unit.

[0061] Before the opening part 10E is pressed down to the part to be cleaned, due the suction of the air in the upper chassis 10A, the cleaning chips PC of the cleaning media are adsorbed to the separation plate 10C. Due to the adsorption of the cleaning chips PC to the separation plate 10C, even when the opening part 10E faces downward as illustrated in FIG. 3, the cleaning chips PC may not be discharged from the opening part 10E.

[0062] Obviously, after the opening part 10E is pressed down to the part to be cleaned, the chassis (the opening part 10E) is practically sealed. Therefore, no cleaning chips PC of the cleaning media are discharged.

[0063] When the opening part 10E is pressed down to the part to be cleaned, the amount and the speed of the air introduced through the inlet 10F are suddenly increased, which generate the strong circulating air flow RF. Due to the strong circulating air flow RF, the cleaning chips PC adsorbed to the separation plate 10C are blown up to collide with the solder paste (stains) adhered to the part to be cleaned and remove the solder paste (stains) from the part to be cleaned.

[0064] The cleaning operator holds the chassis 10 by hand, and moves the chassis 10 relative to the metal mask 100 so that the part to be cleaned is sequentially moved so as to remove the entire solder paste.

[0065] FIGS. 4 and 5 illustrates states before and after the actual cleaning is performed using the cleaning media according to an embodiment described below, respectively. When the states of FIGS. 4 and 5 are compared, it appears that the soldering paste adhered to the periphery of the mask opening parts 101 has been cleanly removed.

[0066] Further, while the opening part 10E is moved relative to the part to be cleaned, if the opening part 10E is separated from the part to be cleaned, the cleaning chips PC may not be discharged (leaked) from the inside of the chassis 10 due to the adsorption and flying of the cleaning chips PC.

[0067] Therefore, the number of the cleaning chips PC of the cleaning media may be maintained, and the degradation of the cleaning performance due to the decreased number of the cleaning media may not occur.

[0068] FIGS. 6A through 6D illustrate fructuring patterns and collision patterns of the cleaning media with reference to Patent Document 1.

[0069] In the following, the term "pencil hardness" refers to the data measured based on the method defined in Japanese Industrial Standards (JIS) K-5600-5-4. The data correspond to the tip number of the hardest pencil that does not damage and bend the tested (evaluated) cleaning medium PC having the thin shape.

[0070] Further, the term "folding strength" refers to the data measured based on the method defined in JIS P8115. The data correspond to the number of folding times back and force of the evaluated cleaning media having the thin shape at the angle of 135 degrees and with R=0.38 mm.

[0071] Further, when the cleaning media formed of the brittle material have the folding strength less than 10, the cleaning media are likely to be fractured at the center of the cleaning media before burring is generated as illustrated in FIG. 6A.

[0072] Therefore, the edge (corner) portions of the cleaning media may be maintained. Due to the maintained edge portions of the cleaning media, the amount of cutting into the cleaning target by the cleaning media may not be remarkably reduced.

[0073] Therefore, the cleaning performance (removing capability) of the cleaning media with respect to a film-like object adhered to the cleaning target may not be remarkably degraded over time.

[0074] When the cleaning media formed of the brittle material have the folding strength less than or equal to 52, the burrs generated by the repeated collisions of the cleaning media may not remain on the cleaning media but the cleaning media may be broken and separated as illustrated in FIG. 6B. In this case, since the burrs may not remain on the cleaning media, the edge portions of the cleaning media may be maintained.

[0075] When the cleaning media is likely to be plastic-deformed (plastically deformed), the edge portion of the cleaning media may be greatly deformed as illustrated in FIG. 6C to increase the contacting area and reduce the impact force. As a result, the contacting force at the edge portion of the cleaning media upon the collisions may be dispersed, thereby degrading the cleaning performance.

[0076] Therefore, the amount of cutting into the cleaning target by the cleaning media may be reduced. Therefore, the cleaning performance (removing capability) of the cleaning media with respect to a film-like object adhered to the cleaning target may be degraded.

[0077] When the cleaning media are likely to be ductile fractured, the plastic deformation of the fractured surface of the cleaning medium may progress to increase the contacting area and reduce the impact force as illustrated in FIG. 6D. As a result, the contacting force at the edge portion of the cleaning media upon the collisions may be dispersed, thereby degrading the cleaning performance.

[0078] Therefore, the cleaning performance (removing capability) of the cleaning media with respect to a film-like object adhered to the cleaning target may be degraded.

[0079] In Patent Document 1, a material optimizing the pencil hardness and the folding strength of the cleaning media is selected so as to appropriately generate the new edges without degrading the cleaning performance.

[0080] In the following, details of the configuration of the cleaning chips PC according to this embodiment are described.

[0081] FIGS. 7A through 7C illustrate examples of surface shapes of the cleaning chips PC according to this embodiment. FIG. 7A illustrates a cleaning chip PC-1 having a parallelogram shape. FIG. 7B illustrates a cleaning chip PC-2 having a trapezoidal shape. FIG. 7C illustrates a cleaning chip PC-3 having a triangular shape. Here, the term "surface shape" refers to a shape of a surface facing a direction orthogonal to a thickness direction of the cleaning chips (cleaning media).

[0082] In the cleaning chip PC-1 having a parallelogram shape, plural fracture induction parts LY are linearly formed so that the fracture induction parts LY are substantially parallel to the short side el of the parallelogram. Further, the distances between the adjacent fracture induction parts LY in the longitudinal direction of the parallelogram are substantially the same.

[0083] Similarly, in the cleaning chip PC-2 having the trapezoidal shape, plural fracture induction parts LY are linearly formed so that the fracture induction parts LY are substantially parallel to the upper side or the lower side of the trapezoid. Further, the distances between the adjacent fracture induction parts LY in the height direction of the trapezoid are substantially the same.

[0084] Similarly, in the cleaning chip PC-3 having the triangular shape, plural fracture induction parts LY are linearly formed so that the fracture induction parts LY are substantially parallel to the side of the triangle. Further, the distances between the adjacent fracture induction parts LY in the height direction of the trapezoid are substantially the same.

[0085] Herein, the term the "fracture induction part" refers to a part (concept) where the fraction of the cleaning media is induced when a stress due to the collision or the like is applied to the cleaning media. For example, the concept of the "fracture induction part" includes a concept of a "fragile part".

[0086] In other words, the "fracture induction part" refers to a factor for controlling a fracturing manner to intentionally generate an acute-angle corner part by excluding the case where the acute-angle corner part is generated by chance.

[0087] The strength of the fracture induction part is determined so that the fracture induction part is (reliably) fractured when a stress is repeatedly applied to the cleaning media having the fracture induction part. Details of the setting of the stress are described below.

[0088] Those cleaning media have the respective polygonal surface shapes where plural (two in those cases of the cleaning media) acute-angle parts.

[0089] As described above, due to the stress repeatedly applied to the cleaning media (cleaning chip) PC, the cleaning media PC is fractured along the fracture induction parts LY. The cleaning media PC in this embodiment has plural acute-angle corner parts (hereinafter may be simplified as "acute-angle parts") SC that may enter into the fine hole or a concave part of the cleaning target CO even before the cleaning media is fractured (i.e., even before the cleaning media are initially used).

[0090] Therefore, even in the initial condition where cleaning is just started and there are only a limited number of fractured fracture induction parts, it may become possible to provide cleaning performance to clean the fine holes and concave parts (i.e., the capability of entering in the fine holes and concave parts for cleaning).

[0091] FIGS. 8A through 8C illustrate cases where new acute-angle parts are generated when the cleaning media are fractured (separated) at the corresponding fracture induction parts (fragile parts).

[0092] FIG. 8A illustrates a case where the cleaning chip PC-1 having the parallelogram shape is fractured into three pieces. FIG. 8B illustrates a case where the cleaning chip PC-2 having the trapezoidal shape is fractured into two pieces. FIG. 8C illustrates a case where the cleaning chip PC-3 having the triangular shape is fractured into two pieces.

[0093] In those cleaning media, after being fractured during the cleaning process, new acute-angle parts NSC are generated.

[0094] Therefore, even when the acute-angle parts SC are (gradually) rounded (crash, dulled, broken-up) before the fracture of the cleaning media occurs, new acute-angle parts NSC may be generated after the fracture of the cleaning media occurs. Therefore, it may become possible to maintain the cleaning performance to clean the fine holes and concave parts during the cleaning process.

[0095] On the other hand, in a case where there is no fracture induction parts LY formed on the cleaning media PC as illustrated in FIGS. 9A through 9C, when the cleaning media PC having polygonal shape includes the acute-angle parts SC, the acute-angle parts SC are likely to be rounded as the cleaning media PC repeats the collision with the cleaning target.

[0096] Therefore, in order to maintain the cleaning performance to clean the fine holes and concave parts, it may be necessary to (continuously) introduce the new cleaning media. As a result, a large amount of cleaning media may have to be consumed.

[0097] On the other hand, in the cleaning media in this embodiment, many acute-angle parts SC may be sequentially generated in a step-by-step manner from a single (each) cleaning media PC. Therefore, it may become possible to remarkably reduce the consumption amount of the cleaning media PC.

[0098] To make it possible to use more acute-angle parts SC, it is preferable that the pitch (distance) between the adjacent fracture induction parts LY is in a range from approximately 1 mm to approximately 3 mm.

[0099] FIGS. 10 and 11 are picture images of the cleaning medium having the fracture induction parts LY before and after the cleaning media is fractured into many pieces, respectively.

[0100] The resin film (i.e., the cleaning medium) on which threadlike or linear fracture induction parts LY are formed as illustrated in FIG. 10 is gradually fractured at the fracture induction parts LY as being used into many pieces as illustrated in FIG. 11. Namely, due to the behavior of the "fracture induction parts LY", the cleaning media are fractured and new acute-angle parts SC are generated.

[0101] Therefore, by forming the fracture induction parts LY on the cleaning media as described above, it may become possible to use the resin film (cleaning media) for a long time period without being changed.

[0102] FIGS. 12A through 12C illustrate the relationship between the angles of the acute-angle parts of the cleaning media and the ease of entering into fine pores of the acute-angle parts depending on the angles of the fracture induction parts LY.

[0103] As illustrated in FIG. 12A, when the angle of the acute-angle parts SC of the cleaning media (hereinafter may be referred to as an "apex angle") is greater than or equal to 60 degrees, it may become difficult for the acute-angle parts SC to enter into the hole h1 having a diameter greater than the thickness t of the cleaning target CO.

[0104] As illustrated in FIG. 12B, when the angle of the acute-angle parts SC of the cleaning media PC is 45 degrees, it may become possible for the acute-angle parts SC to enter into the hole h2 having a diameter substantially equal to the thickness t of the cleaning target CO.

[0105] As illustrated in FIG. 12C, when the angle of the acute-angle parts SC of the cleaning media is less than or equal to 20 degrees, it may become possible for the acute-angle parts SC to enter into the hole h3 having a diameter less than the thickness t of the cleaning target CO.

[0106] However, the strength of the acute-angle parts SC may be inevitably reduced. Therefore, it may become difficult to maintain the acute-angle shape for a long time period.

[0107] Therefore, to enter into the fine holes and the concave parts, it is preferable that the apex angle of the acute-angle parts SC is greater than or equal to 20 degrees and less than or equal to 45 degrees.

[0108] As an example, FIG. 13 illustrates experimental results of the relationship between the angle of the acute-angle parts SC of the resin film piece (i.e., cleaning media) having the thickness of 100 μm and the entering probability of the acute-angle parts SC entering into the fine holes having a diameter of (Φd=0.3 mm formed on a stainless plate having a thickness of t=0.15 mm.

[0109] The entering probability of the acute-angle parts SC entering into the fine holes is measured by measuring the percent (%) of the fine holes to which the acute-angle parts SC are entered by using a pressure-sensitive paper placed on the rear side of the stainless plate under a condition that the cleaning chassis is moved at a speed of 2 mm/s relative to the stainless plate.

[0110] FIG. 13 illustrates that when the angle of the acute-angle parts SC is 30 degrees, the acute-angle parts SC are entered into the fine holes with higher probabilities, on the other hand when the angle of the acute-angle parts SC is 60 degrees, the entering probability of the acute-angle parts SC entering into the fine holes is extremely low.

[0111] Further, when the thin (slice)-shaped cleaning media having the acute-angle parts SC are repeatedly used (i.e., used for a long time period), due to the repeated collisions, the acute-angle parts SC may be rounded (crash, dulled, broken-up), thereby reducing the entering probability of the acute-angle parts SC entering into the fine holes. However, when the thin (slice)-shaped cleaning media having the fracture induction parts LY to be fractured to generate new acute-angle parts SC, the reduction of the entering probability of the acute-angle parts SC entering into the fine holes is reduced. As a result, a higher entering probability of the acute-angle parts SC entering into the fine holes may be maintained for a long time period.

[0112] The reduction of the entering probability of the acute-angle parts SC entering into the fine holes means the reduction of the removing (cleaning) capability of removing the soldering paste adhered to the metal mask described above.

[0113] According to the results described above, it is preferable that the angle of the acute-angle parts SC of the cleaning media used for cleaning the fine holes and concave parts is less than or equal to 45 degrees, more preferably, less than or equal to 30 degrees and that the fracture induction parts LY to be fractured to generate new acute-angle parts SC are formed. By doing this, the service lifetime of the cleaning media may be extended.

[0114] Next, details of the configurations of the fracture induction parts LY are describe with reference to FIGS. 14A through 14C.

[0115] The fracture induction parts LY illustrated in FIGS. 14A through 14C are formed as linear grooves or transformed parts. Here, unlike Patent Document 1, the size of the "grooves" of the fracture induction parts LY in this embodiment is not determined so as to be used as a path through which an air flow is passed to blow up the cleaning media attached to the wall surface.

[0116] Namely, the size of the "grooves" is not determined so as to have a sufficient width so that the fractures may be randomly generated. Specifically, the size of the "grooves" of the fracture induction parts LY in this embodiment refers to an extremely thin and streaky size so that the fracture line is uniformly "linearly" formed.

[0117] However, in a case where the shape of the cross-section of the grooves or the transformed parts is "V" (inverted triangle) shape, the fracture generally occurs at the apex part of the V shape. Therefore, the size of the width of the grooves is not related to the size of the grooves.

[0118] Here, the concept of the term "linearly" includes not only the concept of a strictly straight line but also a slightly changed (curved) wave line and a zig-zag line, and not only a continuous line but also a discontinuous line.

[0119] However, to easily manufacture the cleaning media, it may be advantageous when the line is a straight and continuous line.

[0120] The fracture induction parts LY-1 of FIG. 14A are formed as grooves having a V (notch) shaped cross-section using a blade or a tool.

[0121] The fracture induction parts LY-2 of FIG. 14B are formed as grooves having a rectangular shaped cross-section using a blade or a tool.

[0122] The fracture induction parts LY-3 of FIG. 14BC are formed by transforming (weakening) the characteristics of (the material of) the fracture induction parts LY-3 by a physical treatment using heat, ultraviolet light, laser light or the like or a chemical treatment to form a streaky transformed (fragile) part. The description of the size of the transformed parts is similar to that of the size of the grooves.

[0123] On the parts where the transforming (weakening) process is performed, stress may be concentrated and the strength may be reduced. Therefore, when stress is repeatedly applied to the cleaning media, fatigue breakdown (fracture) is more likely to occur at the transformed parts.

[0124] FIGS. 15A and 15B schematically illustrate examples where the cleaning media having the fracture induction parts LY-1 are fractured at different fracture induction parts LY-1.

[0125] Due to the repeated collisions with the cleaning target, the stress is repeatedly applied to the fracture induction parts LY-1 (i.e., grooves), so that the cleaning media are finally fractured along the fracture induction parts LY-1. The cleaning media PC may be fractured at the center part as illustrated in FIG. 15A, or may be fractured at an edge part as illustrated in FIG. 15B.

[0126] It is preferable that the material of the cleaning media is a resin film having the folding strength greater than or equal to 0 and less than 65. However, due to the effect of the fracture induction parts (grooves or transformed parts), a material having the folding strength greater than 65 may also be used.

[0127] Namely, due to the fracture induction parts in this embodiment, the fracturing manner of the cleaning media may be controlled. Therefore, unlike Patent Document 1, it may become possible to generate new edges and acute-angle parts SC without strictly setting (determining) the "pencil hardness" and the "folding strength". Therefore, it may become possible to increase the degree of freedom in choosing the material of the cleaning media.

[0128] Next, modified examples of the fracture induction parts (fragile parts) are described with reference to FIGS. 16A through 16C.

[0129] In the pattern of the fracture induction parts LY-1 of FIG 16A, a group including three types of grooves g1, g2, and g3 having V shaped cross-sections is repeatedly formed. The depths and the widths of the grooves g1, g2, and g3 in the thickness direction of the cleaning media PC are different from each other.

[0130] In the pattern of the fracture induction parts LY-2 of FIG 16B, a group including three types of grooves g4, g5, and g6 having rectangular (trapezoidal) shaped cross-sections is repeatedly formed. The depths and the widths of the grooves g4, g5, and g6 in the thickness direction of the cleaning media PC are different from each other.

[0131] In the pattern of the fracture induction parts LY-3 of FIG 16B, a group including three types of transformed parts v1, v2, and v3 is repeatedly formed. The depths and the widths of the transformed parts v1, v2, and v3 in the thickness direction of the cleaning media PC are different from each other. However, for example, a pattern may be used in which the width of the transformed parts v1, v2, and v3 are set as the same value and only the depths of the transformed parts v1, v2, and v3 are set to be different from each other.

[0132] Further, in the above description, a case is described where the grooves or the transformed parts have shapes similar to each other. However, the grooves or the transformed parts may have the shapes different from each other and the fracture strength values different from each other as well.

[0133] FIGS. 17A and 17B illustrate another modified example of the fracture induction parts (fragile parts) before and after, respectively, the fracture induction part is fractured;

[0134] In the embodiment described above, it is assumed that the fracture induction parts (fragile parts) are linearly formed. However, in this example (embodiment), the fracture induction parts LY of the cleaning media PC-1 are formed in a curved manner.

[0135] When the fracture induction parts LY are curved, the angle of the acute-angle parts SC may become more acute when compared with the case where the fracture induction parts LY are linearly formed.

[0136] FIGS. 18A through 18D collectively illustrates an example where the fracture induction parts are formed in a zig-zag manner.

[0137] In this cases, the fracture induction parts may be sequentially fractured in the order of FIGS. 18A to 18D. Therefore, it may become possible to generate a larger number of the new acute-angle parts NSC when compared with the case where the fracture induction parts are linearly formed and arranged with substantially the same distances as illustrated in FIG. 7A.

[0138] FIGS. 19A and 19B illustrate another example of fracture of the cleaning media having the fracture induction parts formed as discontinuous lines (perforation lines).

[0139] Further, in this case, it may not always be necessary that the depths in the thickness direction are controlled or the lines are formed in a half-cut manner. Namely, the lines are formed by being fully cut in the thickness direction of the cleaning media. Further, it may become possible to adjust the ease of fracture by adjusting a ratio of a cut length "a" to a non-cut length "b" (see FIG. 19A).

[0140] Namely, by forming the fracture induction parts having different ratios of the cut length "a" to the non-cut length "b", it may become possible for the cleaning media to be sequentially fractured at different fracture induction parts at different timings.

[0141] As described above, by forming the fracture induction parts in a manner that the depths and/or widths of the fracture induction parts are different from each other, when the cleaning media are repeatedly used (for a long time period), the cleaning media are likely to be fractured at the fracture induction parts having a greater depth and/or width first.

[0142] Then, when the cleaning media are used, the cleaning media are likely to be gradually fractured at the fracture induction parts in the decreasing order of the depth and/or width of the fracture induction parts. As a result, it may become possible to gradually generate new edges and the acute-angle parts.

[0143] In a case where the fracture induction parts are uniformly formed by, for example, forming the groves having the same size, plural fracture induction parts are likely to be fractured in the same timing range. Namely, the timings when new edges are generated may be concentrated in a particular timing period.

[0144] On the other hand, in a case where the fracture induction parts are formed as described in this embodiment, even when the cleaning media are used for a longer time period, new edges may be continuously (gradually, sequentially) generated. As a result, it may become possible to stabilize the cleaning performance.

[0145] Namely, it may become possible to control the fracturing order of fracture induction parts over time in the cleaning process and alleviate the concentration of the timings when the fracture induction parts fracture and the new edges and the acute-angle parts are generated.

[0146] For example, in a case where the fracture induction parts as illustrated in FIG. 14A are formed in a resin film (cleaning medium) having a thickness of 100 μm, the following results as illustrated in Table 1 are obtained. Namely, by changing depth of the fracture induction parts, it may become possible to control (change) the time period until the resin film is fractured at the fracture induction parts.

Table 1

Depth of fracture induction parts	Results
0-20 μm	not fractured or fractured in direction different from direction of fracture induction parts
20-80μm	Fractured after 1 to 10 minutes
80μm or more	Fractured quickly

[0147] Next, a method of manufacturing the cleaning media described above is described with reference to FIGS. 20 and 21.

[0148] FIG. 20 schematically illustrates a process of manufacturing the cleaning media PC-1 having the parallelogram shape as illustrated in FIG. 7A.

[0149] First, in a fracture induction (fragile) part forming process, while a belt-like film TL as a base material is moved in the moving direction, the streaky fracture induction parts are formed in the direction parallel to the moving direction. In this process, preferably, the fracture induction parts are formed so that the depths and/or the widths of the formed fracture induction parts are different from each other.

[0150] Next, in a cutting process, while being moved in the moving direction, the belt-like film TL is cut in the direction inclined relative to the moving direction. By cutting in the inclined direction, it may become possible to form (generate) the acute-angle parts SC used for removing (cleaning) the stains in the fine holes or the concave parts of the cleaning target.

[0151] FIG. 21 schematically illustrates a process of manufacturing the cleaning media PC-3 having the trapezoid shape as illustrated in FIG. 7C.

[0152] First, in a fracture induction (fragile) part forming process, while a belt-like film (material) TL as a base material is moved in the moving direction, the streaky fracture induction parts are formed in the direction parallel to the moving direction.

[0153] In this process, preferably, the fracture induction parts are formed so that the depths and/or the widths of the formed fracture induction parts are different from each other.

[0154] Next, in a cutting process, while being moved in the moving direction, the belt-like film TL is cut in the direction inclined relative to the moving direction.

[0155] Further, the cutting direction in a cutting process (1) is opposite to the cutting direction in a cutting process (2) relative to the direction orthogonal to the moving direction as illustrated in FIG. 21.

[0156] Further, the cutting process (1) and the cutting process (2) are alternately performed so that the cut cleaning media PC-3 have the trapezoid shape.

[0157] By cutting in the direction inclined relative to the moving direction, it may become possible to form (generate) the acute-angle parts SC used for removing (cleaning) the stains in the fine holes or the concave parts of the cleaning target.

[0158] According to an embodiment, it may become possible to clean the inside of the fine holes and the concave parts formed on the cleaning target and maintain the cleaning performance in the entire cleaning process.

[0159] Therefore, it may become possible to effectively and uniformly perform high-quality dry-type cleaning without any remaining uncleaned parts.

Claims

1. Cleaning media having a thin shape and used in a dry-type cleaning for cleaning a cleaning target by being blown by an air flow and collided with the cleaning target, the cleaning media comprising:

a fracture induction part configured to induce fracture and being formed so that, upon being fractured along the fracture induction part into pieces, at least one acute-angle part is formed in at least one of the pieces.

2. Cleaning media according to claim 1,
wherein the fracture induction part is formed as a groove.

3. Cleaning media according to claim 1,
wherein the fracture induction part is formed by transforming characteristics of a material of the fracture induction part.

4. Cleaning media according to claim 2 or 3,
wherein the fracture induction part is formed in a continuous or discoutinuous line.

5. Cleaning media according to claim 4,
wherein a surface shape of the cleaning media is any one of a parallelogram shape, a trapezoidal shape, and a triangular shape.

6. Cleaning media according to claim 5,
wherein the fracture induction part is formed in a direction substantially parallel to one side of the surface shape.

7. Cleaning media according to any one of claims 1 through 6,
wherein the cleaning media includes plural fracture induction parts, and wherein fracture strength values of at least two of the plural fracture induction parts are different from each other so as to determine a fracturing order.

8. Cleaning media according to claim 7,
wherein the fracture strength values different from each other are set based on a difference of depths of the fracture induction parts in a thickness direction of the cleaning media.

9. A method of manufacturing the cleaning media according any one of claims 1 through 8, the method comprising:

forming a plurality of the fracture induction parts on a belt-like material and along a longitudinal direction of the belt-like material; and
cutting the belt-like material in a direction inclined relative to the longitudinal direction to acquire the cleaning media.

10. The method of manufacturing the cleaning media according claim 9, wherein, in the cutting, the belt-like material is cut in a constant direction relative to the longitudinal direction to acquire the cleaning media having a parallelogram shape.

11. The method of manufacturing the cleaning media according claim 9, wherein, in the cutting, the belt-like material is cut in first and second directions alternately, the first direction being opposite to the second direction relative the direction orthogonal to the longitudinal direction, to acquire the cleaning media having a triangular shape.

12. A dry-type cleaning device for cleaning a cleaning target by blowing cleaning chips having a thin shape and colliding the cleaning chips with the cleaning target, the dry-type cleaning device comprising:

the cleaning media according any one of claims 1 to 8 as the cleaning chips.

13. A method of cleaning by blowing cleaning chips having a thin shape so that they collide with a cleaning target, wherein the cleaning chips comprise cleaning media according to any one of claims 1 to 8.

FIG.1

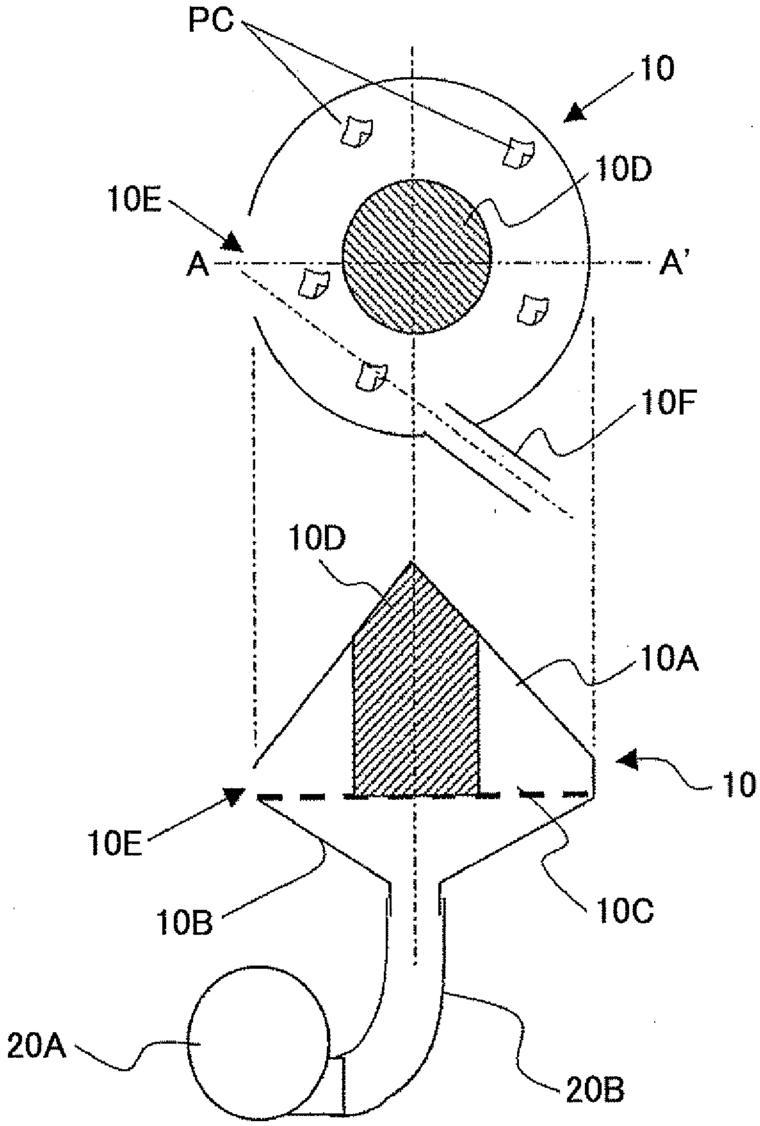


FIG.2A

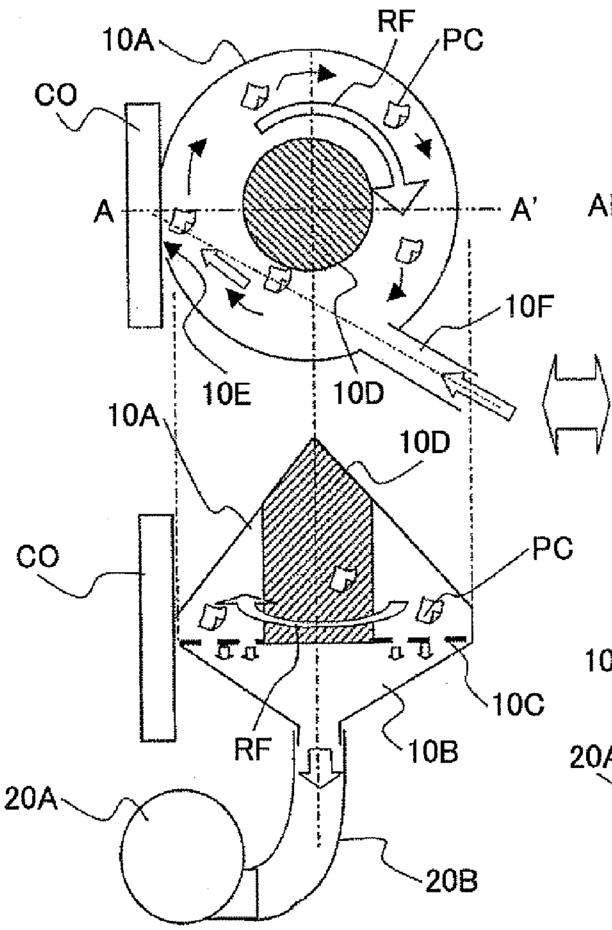

RF
PC
10A
CO
A
A'
10F
10E
10D
10A
10D
CO
PC
10C
RF
10B
20A
20B

FIG.2B

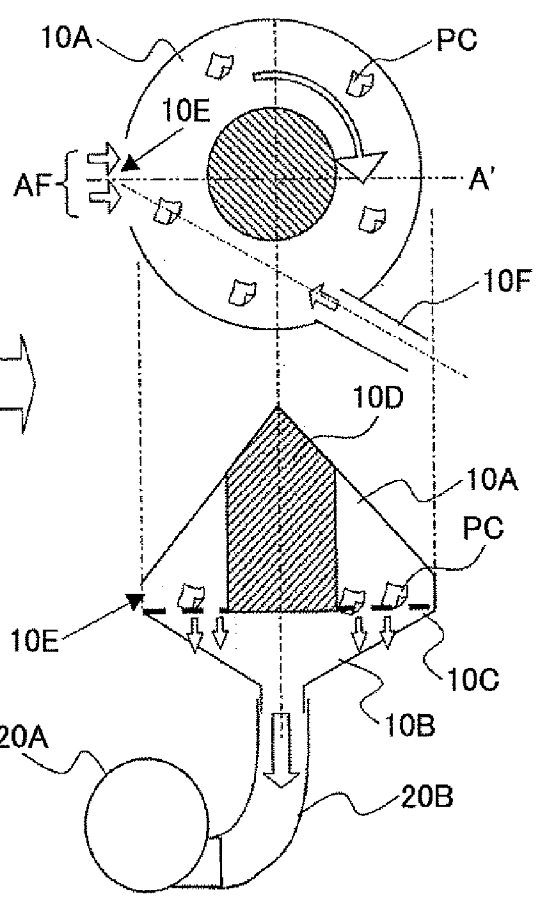
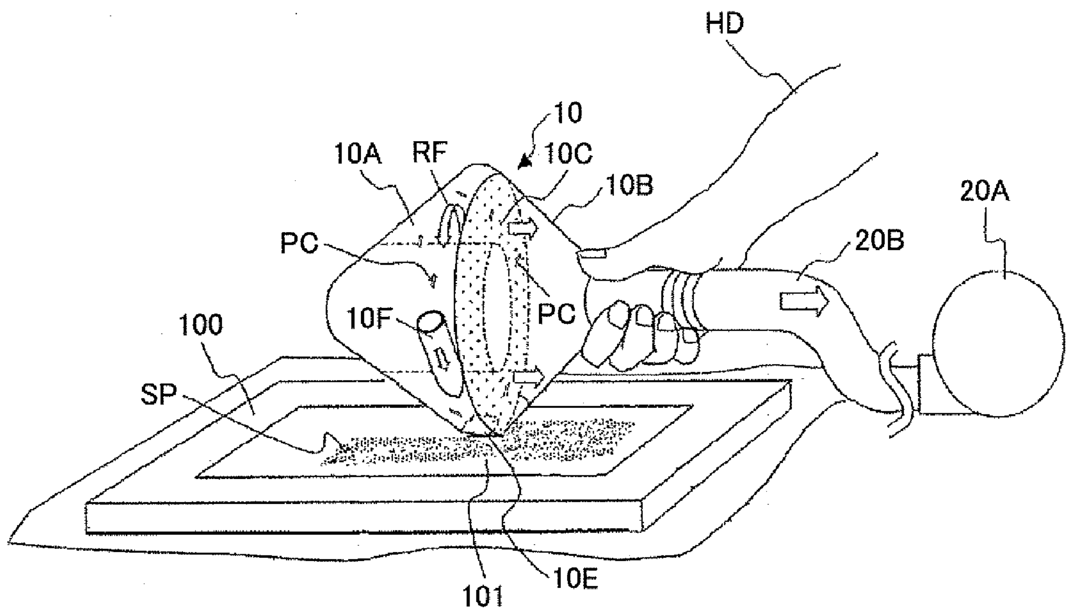

10A
PC
10E
AF
A'
10F
10D
10A
PC
10E
10C
10B
20A
20B

FIG.3



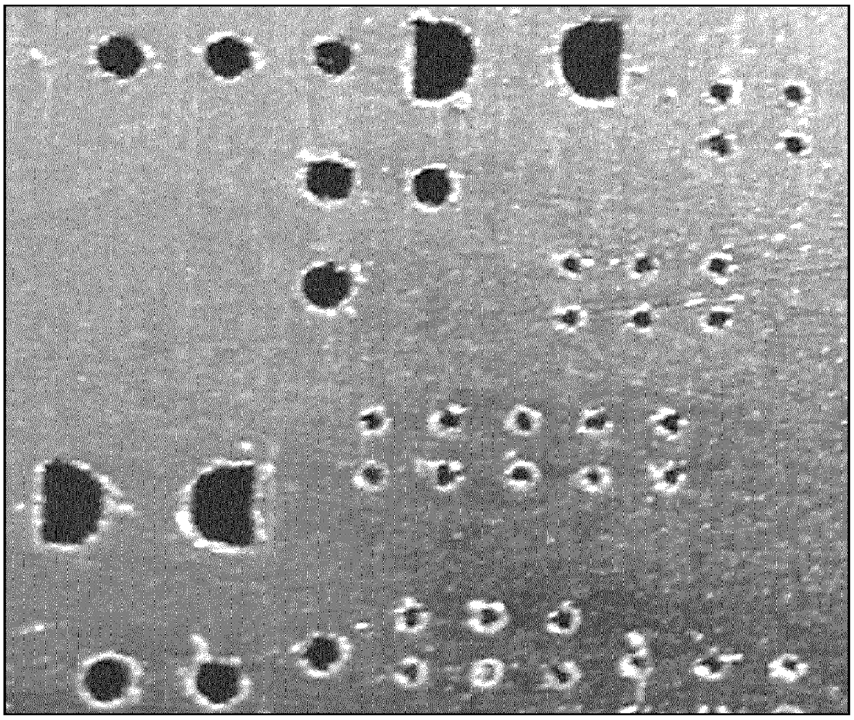


FIG. 4

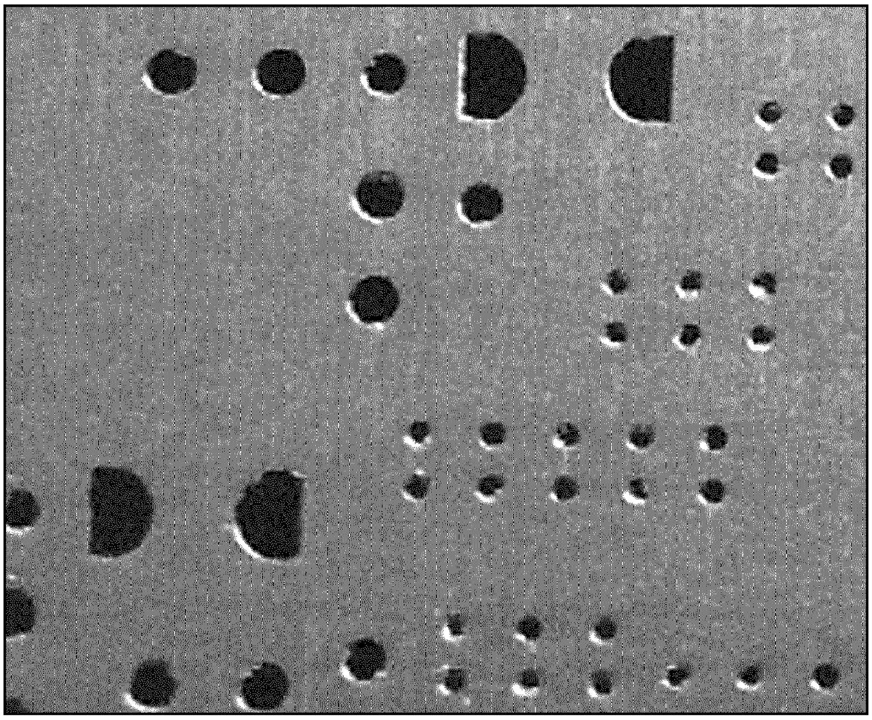


FIG. 5

FIG.6A

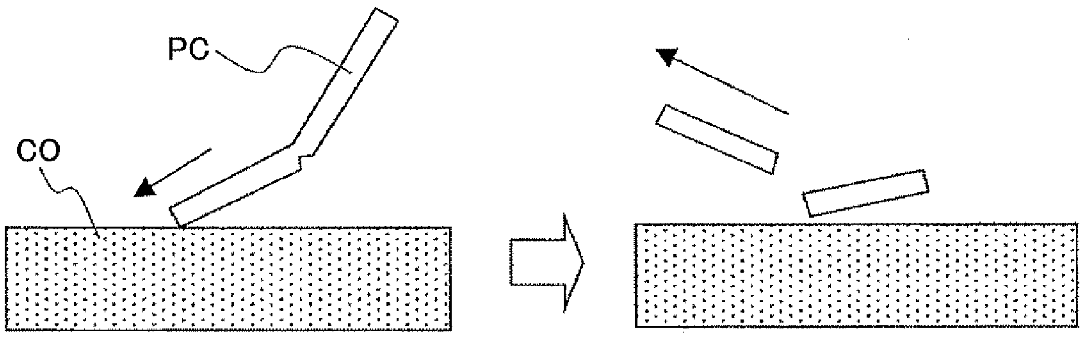


FIG.6B

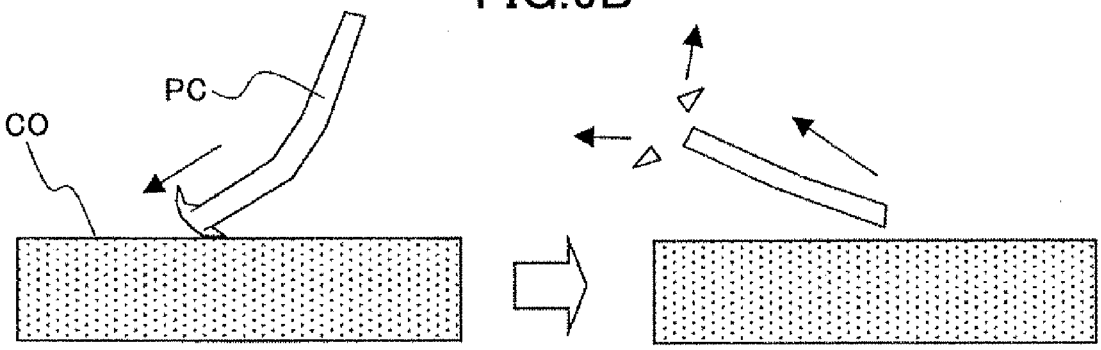


FIG.6C

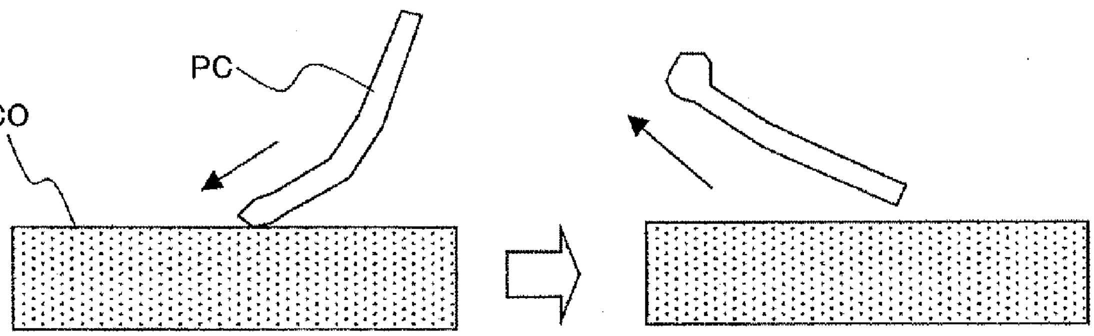


FIG.6D

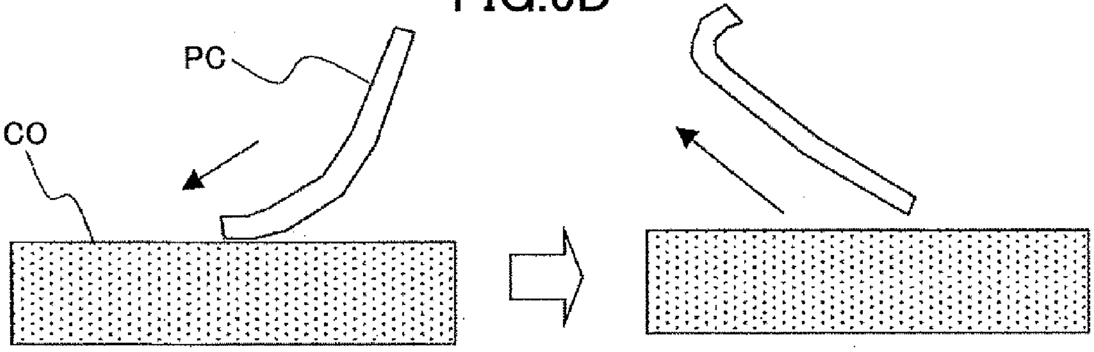


FIG.7A

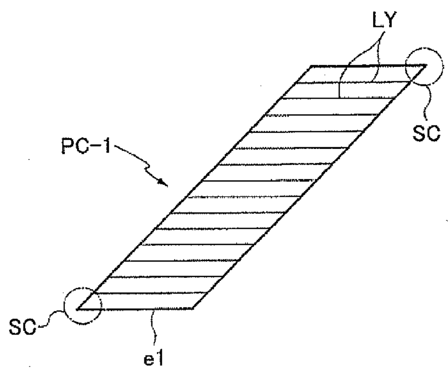


FIG.7B

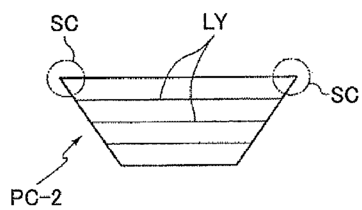


FIG.7C

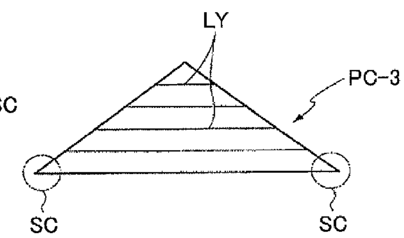


FIG.8A

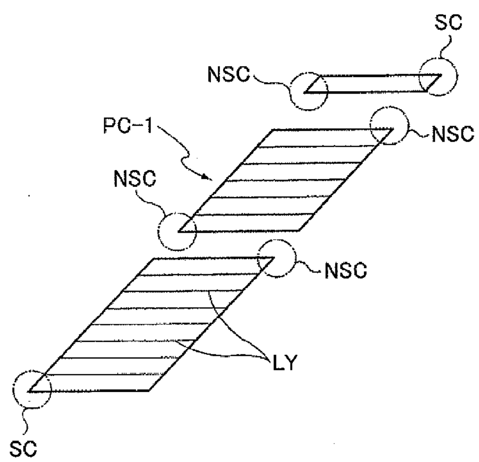


FIG.8B

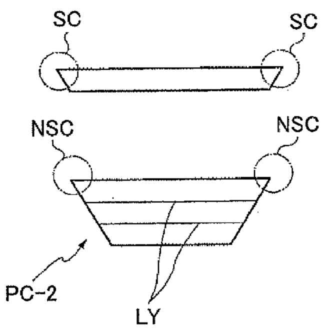


FIG.8C

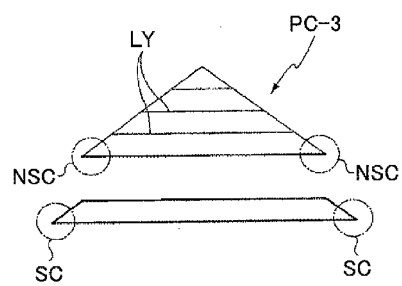


FIG.9A

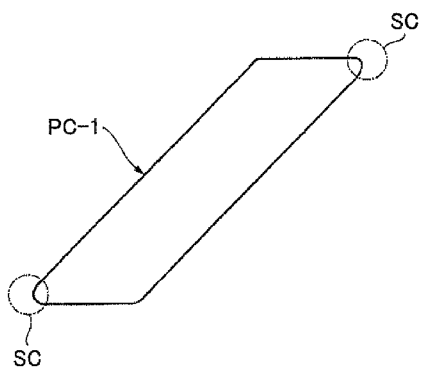


FIG.9B

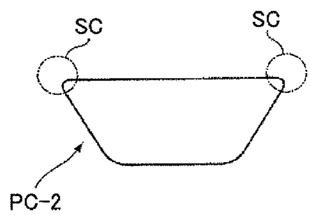
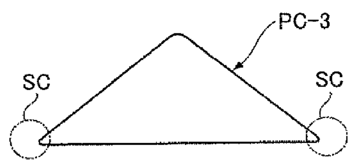


FIG.9C



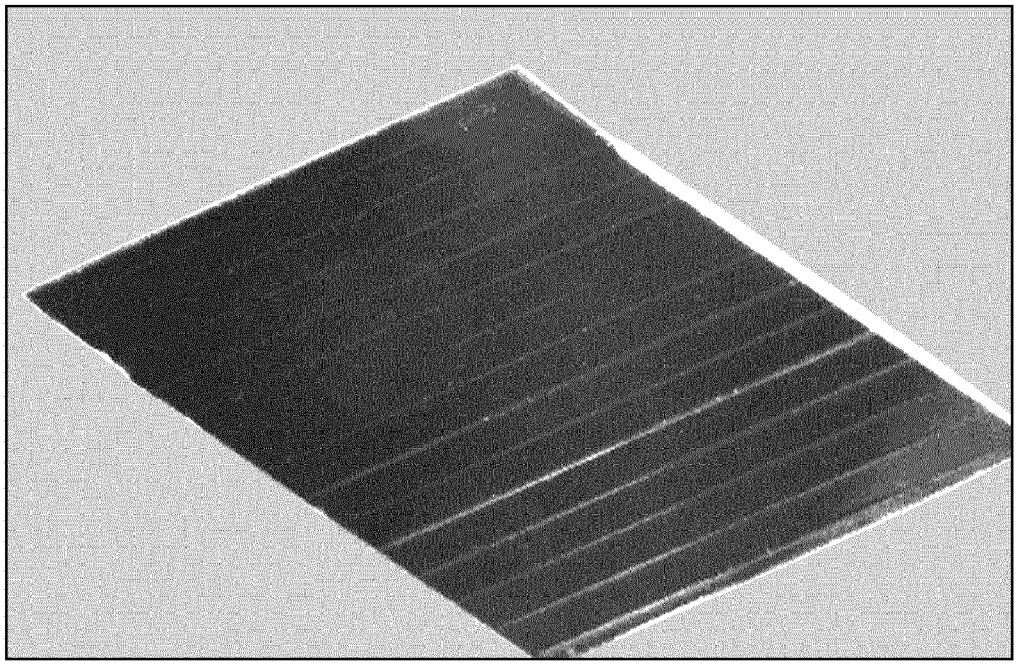


FIG. 10

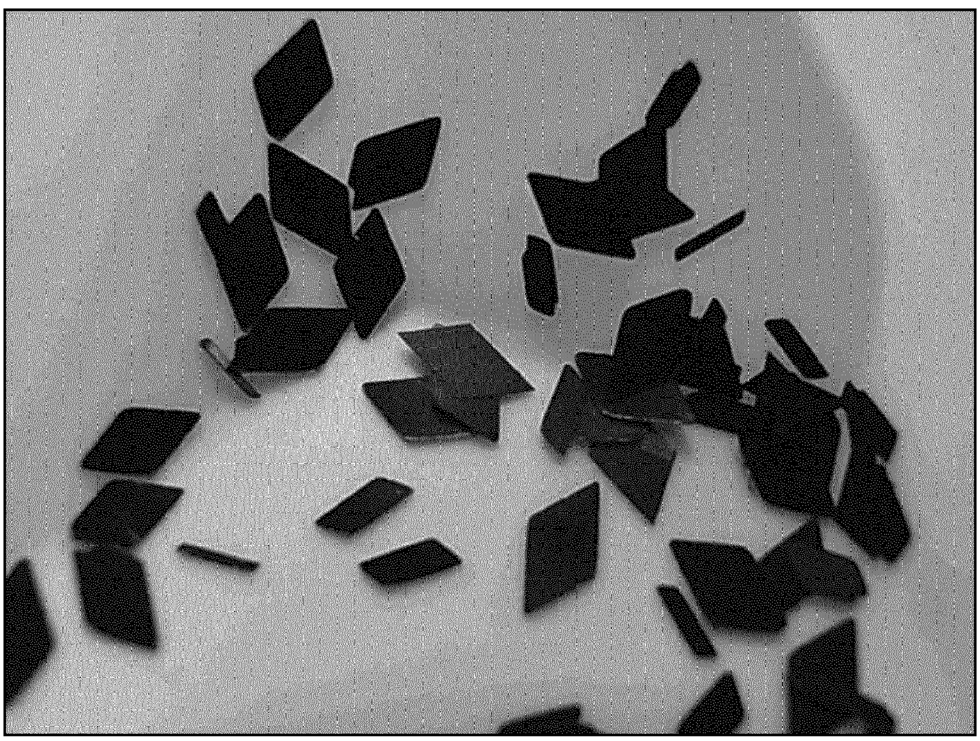


FIG. 11

FIG.12A

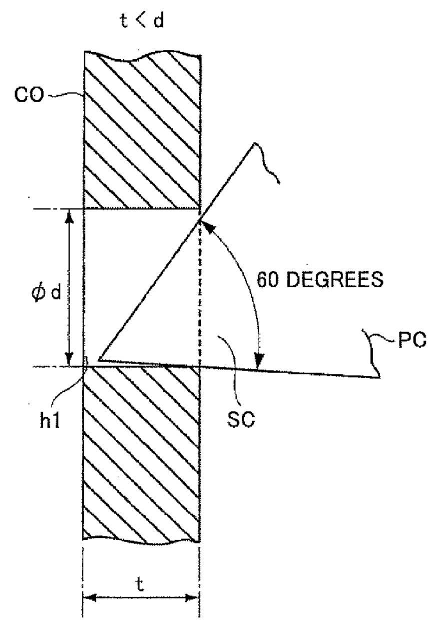


FIG.12B

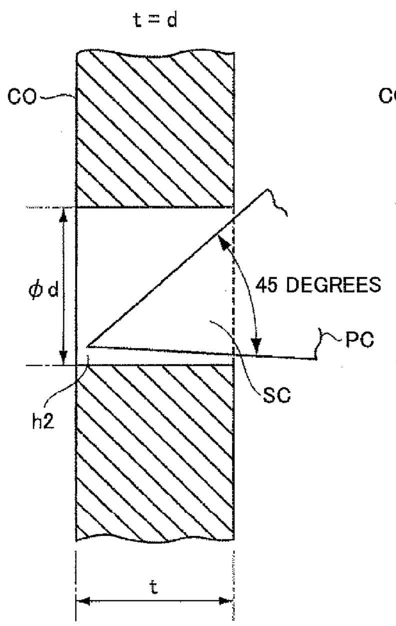


FIG.12C

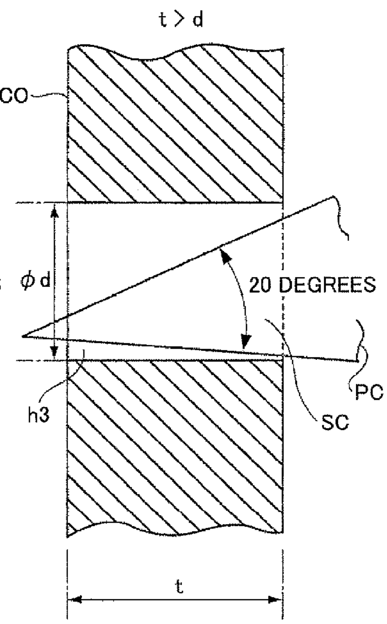


FIG.13

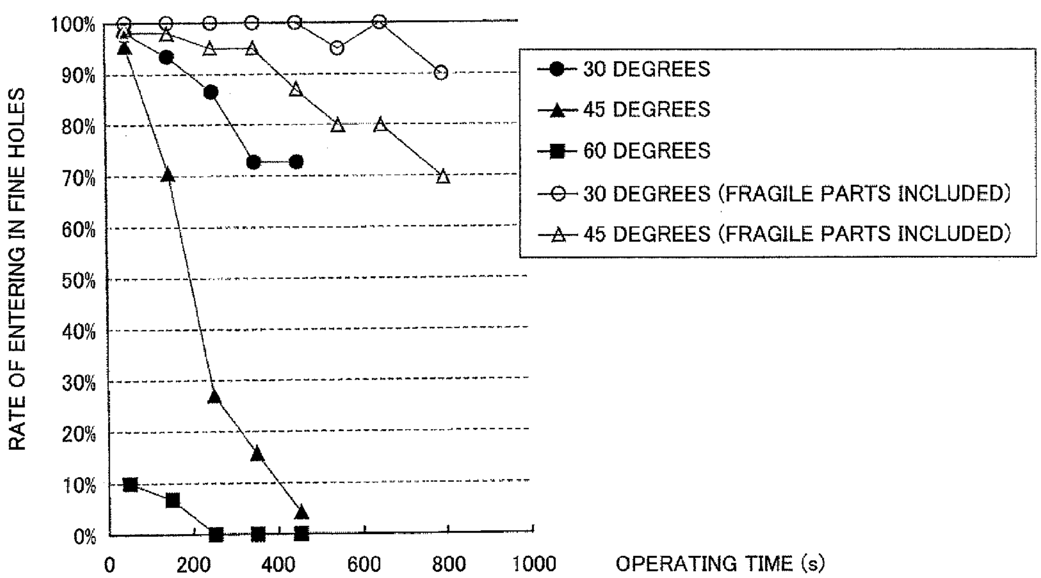

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
RATE OF ENTERING IN FINE HOLES
0
200
400
600
800
1000
OPERATING TIME (s)
30 DEGREES
45 DEGREES
60 DEGREES
30 DEGREES (FRAGILE PARTS INCLUDED)
45 DEGREES (FRAGILE PARTS INCLUDED)

FIG.14A

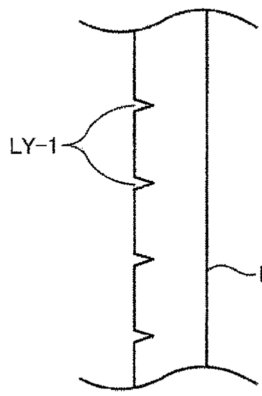


FIG.14B

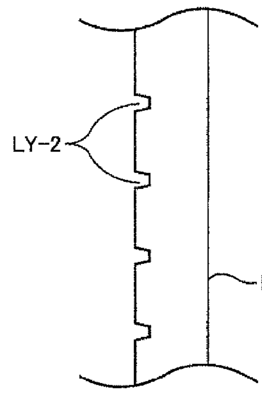


FIG.14C

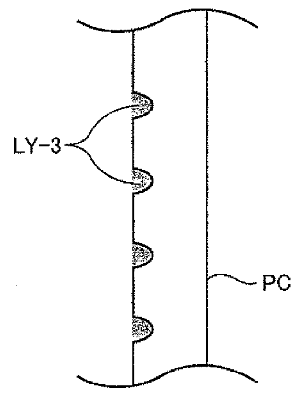


FIG.15A

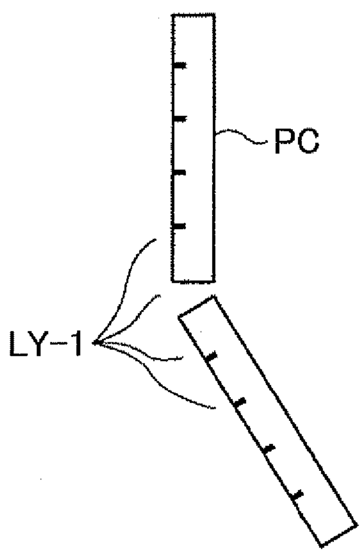


FIG.15B

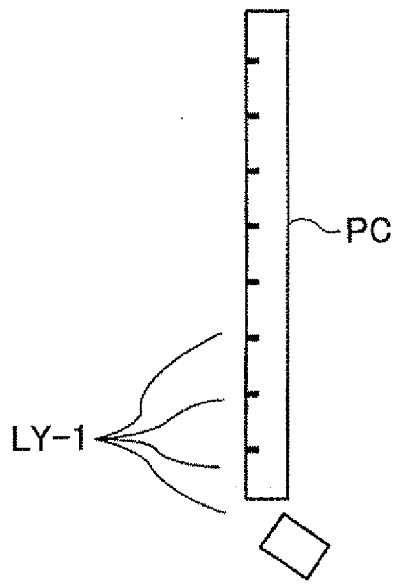


FIG.16A

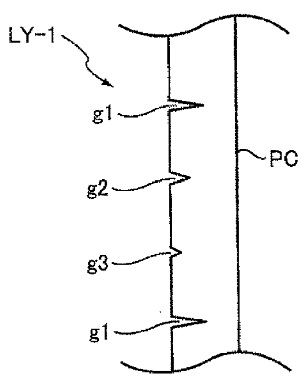


FIG.16B

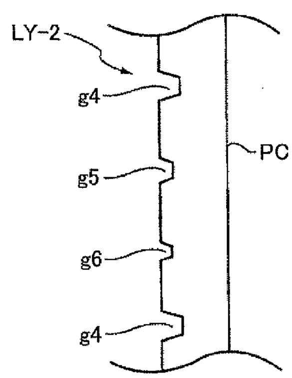


FIG.16C

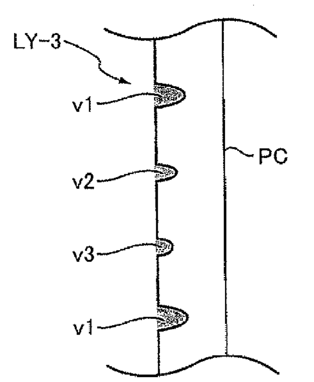


FIG.17A

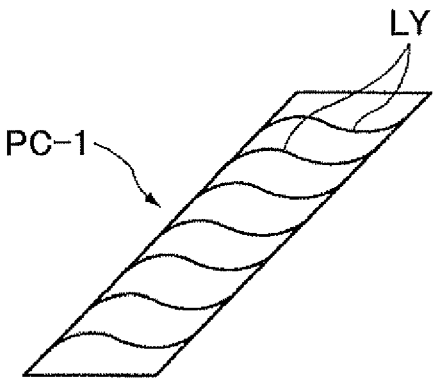


FIG.17B

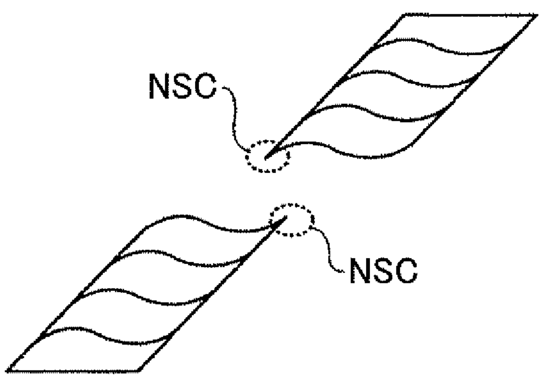


FIG.18A FIG.18B FIG.18C FIG.18D

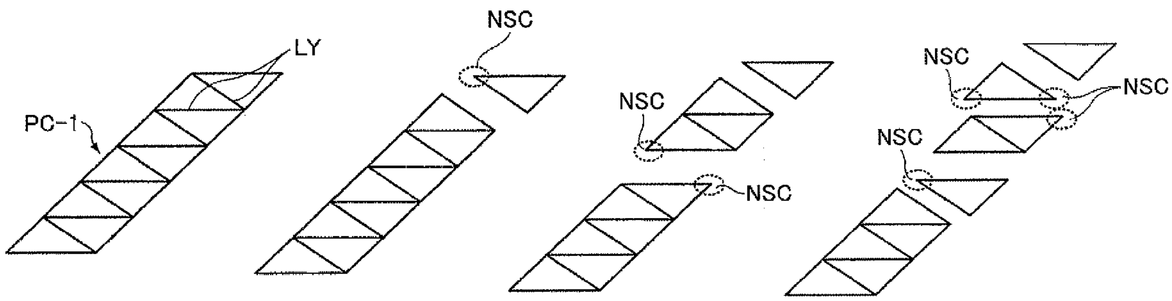


FIG.19A

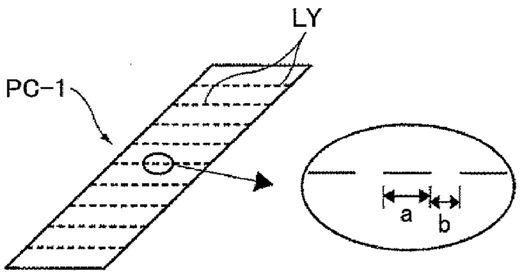


FIG.19B

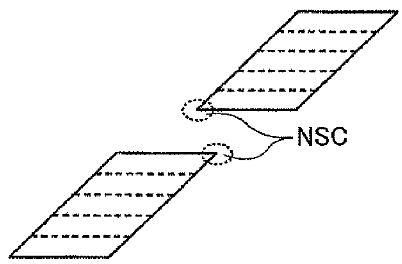


FIG.20

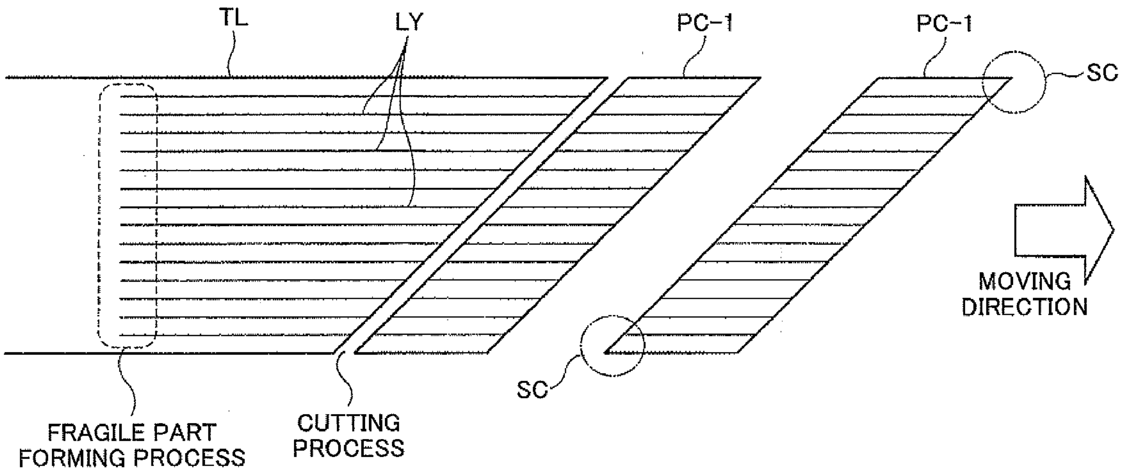
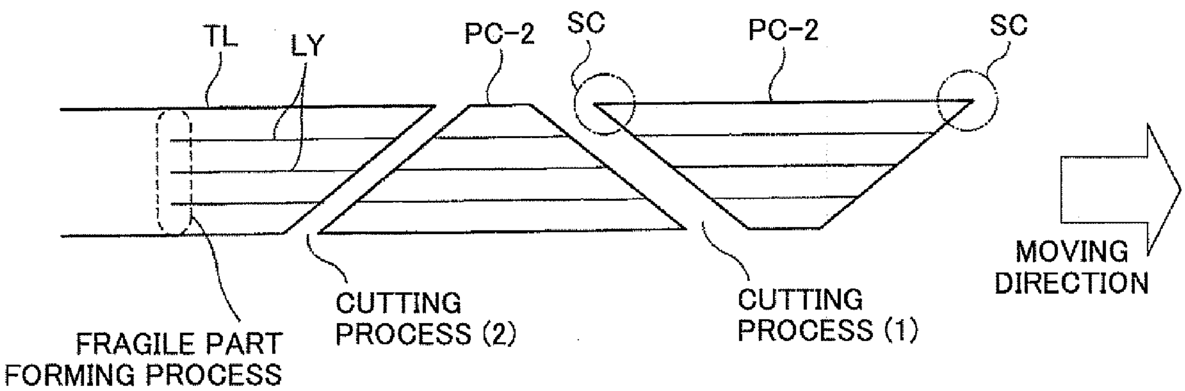

TL
LY
PC-1
PC-1
SC
SC
MOVING DIRECTION
FRAGILE PART FORMING PROCESS
CUTTING PROCESS

FIG.21


TL
LY
PC-2
SC
PC-2
SC
MOVING
DIRECTION
CUTTING
PROCESS (2)
CUTTING
PROCESS (1)
FRAGILE PART
FORMING PROCESS

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010279850 A **[0003]**