

MOLD CLEANING SHEET

FIELD OF THE INVENTION

[0001]

5 The present invention relates to a mold cleaning sheet to be used at the time when a mold surface of a mold is cleaned.

BACKGROUND OF THE INVENTION

[0002]

10 In a process of encapsulating semiconductor devices with a resin through transfer molding, resin molding work using a mold is usually performed over and over again. With increasing in number of repetitions of the resin molding work (number of shots), contaminants such as components having oozed out from the resin, burrs and dust accumulate on mold surfaces of a mold, notably a surface of a cavity. Such
15 contaminants give rise to reduction in the ability of molded articles to be released at the time of their removal from the mold, roughening of the surfaces of the molded articles and so on. Thus the mold surfaces (including the surface of the cavity) come to require cleaning every given number of repetitions (number of shots) of molding work.

[0003]

20 As a method for cleaning mold surfaces, the method of using a mold cleaning sheet has been proposed (e.g. see Patent Document 1 or 2). Such a mold cleaning sheet is, as shown in Fig. 14, a sheet including a sheet-like base material 1 and a plurality of belt-shaped mold cleaning members 20 formed on one side or both sides (one side in Fig. 14) of the sheet-like base material 1 and aligned in parallel with
25 clearance between neighboring members. At the time of cleaning of a mold, the mold cleaning sheet is sandwiched between upper and lower sections of the mold, and in this

state, the mold is clamped. Thereby, the mold cleaning members 20 of the mold cleaning sheet are charged into cavity. At this time, the air in the cavity gets out of the clearance between neighboring belt-shaped mold cleaning members 20, and the mold cleaning members 20 come to fill up throughout the interior of the cavity. And heat
5 molding is performed in such a situation, whereby the contaminants on the surface of the cavity are made to adhere to the mold cleaning members 20. Thereafter, the mold cleaning sheet is removed from the mold, and the contaminants, together with the mold cleaning members 20, are eliminated from the mold surfaces (the surface of the cavity).

[0004]

10 Patent Document 1: JP-A-2007-196586
Patent Document 2: JP-A-2008-132759

SUMMARY OF THE INVENTION

[0005]

15 Although those mold cleaning sheets have ensured satisfactory removal of air from the interior of cavity through the clearance formed for air removal as mentioned above and thereby have gained superiority in property of charging mold cleaning members 20 into cavity (cleaning property), they have suffered wrinkling and warping in some cases. When a mold was cleaned with such a mold cleaning sheet, there were
20 cases where the dimensions of the mold cleaning sheet came to fall short of the mold dimensions or the mold cleaning sheet suffered bending. In such cases, there occurred degradation in the property of charging the mold cleaning members 20 into cavity, resulting in insufficient cleaning.

[0006]

25 Under these circumstances, the present inventors have been trying to find a cause for the wrinkling and the warping. As a result, the present inventors have found

that the cause consists in shrinkage of the belt-shaped mold cleaning members 20 along their length and the shrinkage depends e.g. on the size, the shape and the constituents of the mold cleaning members 20. More specifically, the present inventors' finding is that, although the making of the mold cleaning sheet is carried out by molding an
5 unvulcanized rubber composition or a thermosetting resin composition into belt-shaped mold cleaning members 20 on one side or both sides of the sheet-like base material 1, thermal stress remaining in the resultant mold cleaning members 20 after removal of the mold cleaning sheet from the mold gives rise to shrinkage of the belt-shaped mold cleaning members 20 along their length; as a result, wrinkling and warping occurs in the
10 mold cleaning sheet.

[0007]

The invention has been made in view of these circumstances, and an object of the invention is therefore to provide a mold cleaning sheet which suffers neither wrinkling nor warping and has a high cleaning property.

15 [0008]

In order to attain the object above, the present invention relates to the following items (1) to (5).

(1) A mold cleaning sheet for cleaning a mold having a cavity which has an opening in a shape of an oval or a quadrangle,

20 in which the mold cleaning sheet includes:

 a sheet-like base material; and

 a plurality of belt-shaped mold cleaning members formed on at least one side of the sheet-like base material, formed from an unvulcanized rubber composition or a thermosetting resin composition, and disposed in a pattern that the plurality of belt-
25 shaped mold cleaning members are aligned in parallel with a clearance on the base material,

each of the mold cleaning members is cut into a plurality of blocks in a longitudinal direction of the mold cleaning members at predetermined intervals to form a column including the plurality of blocks,

each of the blocks has a length of from 3 mm to 50mm,

5 a clearance between neighboring blocks in the column including the plurality of blocks is 0.1 mm or more and is not larger than a width of the mold cleaning members,

a clearance between neighboring mold cleaning members in a direction of the width of the mold cleaning members is not smaller than 1/2 of the width of the mold
10 cleaning members and not larger than the width of the mold cleaning members, and

the width of the mold cleaning members is 1 mm or more and not larger than 4/5 of a breadth of the opening of the cavity.

(2) The mold cleaning sheet according to (1), in which the sheet-like base material is a cloth.

15 (3) The mold cleaning sheet according to (2), in which the cloth is a fabric including long fibers, or a nonwoven fabric.

(4) The mold cleaning sheet according to (3), in which the nonwoven fabric is a spunbond nonwoven fabric.

(5) The mold cleaning sheet according to any one of (1) to (4), in which
20 the sheet-like base material is subjected to an embossing treatment.

[0009]

The present inventors have repeated a study of how to prevent the above-mentioned mold cleaning sheets, each of which has a plurality of belt-shaped mold cleaning members aligned in parallel with clearance between neighboring members,
25 from becoming wrinkled and warped while making use of their high cleaning capabilities. As a result, the present inventors have discovered that, when each of the

belt-shaped mold cleaning members is cut at predetermined intervals in a longitudinal direction thereof to form a column including a plurality of blocks, shrinkage caused by the thermal stresses remaining in the mold cleaning member is not borne by the belt-shaped one in its entirety, but shared among the blocks, whereby reduction in shrinkage is achieved. Further, we have repeated a study on the appropriate-and-correct size and others of the block-shaped mold cleaning members. As a result, the inventors have found that, when adjusting the length of each block to fall within a range of 3 to 50 mm, and besides, adjusting clearance between neighboring blocks in a column including the plurality of blocks to have a dimension of 0.1 mm or more and not larger than the width of the mold cleaning member, further adjusting clearance between neighboring ones of mold cleaning members aligned in their width direction to have a dimension not smaller than 1/2 of a width of each mold cleaning member and not larger than a width of each mold cleaning member, and furthermore adjusting the width of each mold cleaning member to have a dimension of 1 mm or more and not larger than 4/5 of the breadth of the opening of the cavity in the shape of an oval or a quadrangle (rectangle or regular square), the shrinkage is made appropriate and correct, neither wrinkling nor warping occurs in the mold cleaning sheet and the cleaning property is also improved, thereby attaining the invention.

[0010]

In the present mold cleaning sheet, a plurality of belt-shaped mold cleaning members are formed on at least one side of a sheet-like base material and cut at predetermined intervals in a longitudinal direction thereof to form a column including a plurality of blocks, and the length of each of blocks is adjusted to fall within the range of 3 to 50 mm. As a result, shrinkage occurring in each of the belt-shaped mold cleaning members can be distributed among the blocks and lessened, whereby it becomes possible to prevent the present mold cleaning sheet from becoming wrinkled

and warped. And besides, in each column of the mold cleaning members, clearance is formed between neighboring block-shaped mold cleaning members in the column. Thus, such clearance, together with clearance between neighboring ones of mold cleaning members aligned in the direction of the width (previously known clearance),
5 can be used as clearance for removing air at the time of cleaning of a mold, and contributes an increase in amount of clearance for removing air. Moreover, the clearance between neighboring blocks in each column including the plurality of blocks is adjusted to have a dimension of 0.1 mm or more and not larger than the width of each mold cleaning member, and besides, the clearance between neighboring ones of mold
10 cleaning members aligned in their width direction is adjusted to have a dimension not smaller than 1/2 of the width of each mold cleaning member and not larger than the width of each mold cleaning member; as a result, the air removal is performed appropriately, and this appropriate air removal, coupled with no occurrence of wrinkling and warping, brings about improvement in the property of charging the mold cleaning
15 members into cavity, and further contributes to improvement in cleaning property. Further, the width of each mold cleaning member is adjusted to have a dimension 1 mm or more and not larger than 4/5 of the breadth of the opening of the cavity, having a shape of an oval or a quadrangle, and hence the opening of the cavity, even small in size, is filled only in part with the mold cleaning member; as a result, the present mold
20 cleaning sheet can show excellent ability at removing air from the interior of cavity, and comes to excel in property of charging mold cleaning members into cavity (cleaning property) accordingly.

[0011]

When the sheet-like base material is a cloth, its surface is rough, and therefore
25 can improve effect of anchoring the mold cleaning members. Thus, adhesion force

between the sheet-like base material and the mold cleaning members can be strengthened.

[0012]

When the cloth is a fabric including long fibers, or a nonwoven fabric in particular, surface roughness of the sheet-like base material (cloth) becomes appropriate and correct, and it becomes possible to make the effect of anchoring the mold cleaning members appropriate and correct,

[0013]

Moreover, when the nonwoven fabric is a spunbond nonwoven fabric, such a nonwoven fabric is relatively lacking in directional property of tensile strength and easily absorbs and relieves the stress imposed at the time of heat molding; as a result, the fabric resists sheet rupture at the time of heat molding. And besides, the fabric causes no sheet rupture at the time of peeling from a mold (demolding), and makes peeling (demolding) work simple and easy.

[0014]

Additionally, when the sheet-like base material is subjected to an embossing treatment, since the sheet-like base material can also have a rough surface, it shows an increase in effect of anchoring the mold cleaning members and can strengthen adhesion of the sheet-like base material to the mold cleaning members.

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BRIEF DESCRIPTION OF THE DRAWING

[0015]

Fig. 1 is an oblique perspective view showing schematically a first embodiment of the present mold cleaning sheet.

Fig. 2 is an oblique perspective view showing schematically a second embodiment of the present mold cleaning sheet.

Fig. 3 is an oblique perspective view showing schematically a third embodiment of the present mold cleaning sheet.

Figs. 4a to 4e are drawings showing schematically various examples of a shape of one profile of a mold cleaning member, which profile is seen in a plane perpendicular to the longitudinal direction of the mold cleaning member.

Figs. 5a to 5c are drawings showing schematically various examples of a shape of the other profile of a mold cleaning member, which profile is seen in a plane along the longitudinal direction of the mold cleaning member.

Fig. 6 is a plan view showing schematically one example of a disposition pattern of mold cleaning members.

Figs. 7a and 7b are plan views showing schematically other examples of a disposition pattern of mold cleaning members.

Figs. 8a and 8b are plan views showing schematically other examples of a disposition pattern of mold cleaning members.

Fig. 9 is a plan view showing schematically a further example of a disposition pattern of mold cleaning members.

Figs. 10a and 10b are plan views showing schematically still further examples of a disposition pattern of mold cleaning members.

Figs. 11a and 11b are plan views showing schematically other examples of a disposition pattern of mold cleaning members.

Figs. 12a to 12e are drawings showing schematically various other examples of a shape of one profile of a mold cleaning member, which profile is seen in a plane perpendicular to the longitudinal direction of the mold cleaning member.

Figs. 13a to 13c are drawings showing schematically various other examples of a shape of the other profile of a mold cleaning member, which profile is seen in a plane along the longitudinal direction of the mold cleaning member.

Fig. 14 is an oblique perspective view showing schematically a previously known mold cleaning sheet.

DETAILED DESCRIPTION OF THE INVENTION

5 [0016]

Next, embodiments of the invention are described in detail on the basis of the drawings.

[0017]

Fig. 1 shows a first embodiment of the present mold cleaning sheet. The mold cleaning sheet according to this embodiment is a sheet for use in cleaning a mold in which cavity each having an opening in the shape of an oval or a quadrangle (a rectangle or a regular square) are formed, and it has on one side of a sheet-like base material 1 a plurality of block-shaped mold cleaning members 2 which are made from an unvulcanized rubber composition or a thermosetting resin composition and disposed regularly in rows and columns with clearance a and clearance b. More specifically, in the mold cleaning sheet according to this embodiment, each of the belt-shaped mold cleaning members 20 of a previously-known mold cleaning sheet (see Fig. 14) is divided along the longitudinal direction of the mold cleaning member into a plurality of blocks with predetermined clearance a between neighboring blocks, and a column including these blocks is formed. Moreover, the length Y of each block-shaped mold cleaning member 2 (a dimension of each block in the longitudinal direction) is adjusted to fall within the range of from 3 to 50 mm, the clearance a between neighboring blocks in each column including the plurality of block-shaped mold cleaning members 2 is adjusted to 0.1 mm or more and not larger than the width X of each mold cleaning member 2, the clearance b between neighboring mold cleaning members 2 in their width direction is adjusted to be not smaller than 1/2 of the width X of each mold cleaning

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member and not larger than the width X of each mold cleaning member, and the width X of each mold cleaning member 2 is adjusted to 1 mm or more and not larger than 4/5 of the breadth of the opening of the cavity, in the shape of an oval or a quadrangle (smaller one of the oval's or quadrangle's dimensions from side to side). The
5 disposition of the mold cleaning members 2 in a pattern with such dimensions is a major feature of the invention. Additionally, in this embodiment, each block is formed overall so as to have a profile shape like a dome in a plane perpendicular to the longitudinal direction.

[0018]

10 More specifically, in the mold cleaning sheet according to this embodiment, as mention above, by dividing each belt-shaped mold cleaning member 20 along the longitudinal direction of the mold cleaning member into a plurality of blocks with clearance a between neighboring blocks, shrinkage the longitudinal direction of the mold cleaning member 2 (the column direction of the blocks) is distributed among the
15 blocks, which leads to control of shrinkage in the overall mold cleaning sheet. This control becomes more effective when upsizing of the mold cleaning sheet is carried out for the purpose of increasing productivity. Further, by adjusting the length Y of each block to fall within the range of from 3 to 50 mm, occurrence of wrinkling and warping in the mold cleaning sheet is prevented. Additionally, from the viewpoint of more
20 effective wrinkle-and-warp prevention, it is appropriate that the length Y of each block be within the range of from 10 to 40 mm. And besides, the height H of the block is adjusted to fall within the range of from 1 to 5 mm in ordinary cases.

[0019]

Further, the mold cleaning sheet according to this embodiment has, as
25 mentioned above, the clearance a formed between neighboring blocks in the longitudinal direction of each mold cleaning member 20 in addition to the clearance b

between neighboring mold cleaning members 20 in the direction of the width of the mold cleaning members 2 as in the previously-known mold cleaning sheet (see Fig. 14). Furthermore, the clearance a and the clearance b are adjusted to fall within the foregoing ranges, respectively, whereby appropriate-and-correct removal of air is attained at the time of cleaning of a mold. And the appropriate-and-correct removal of air coupled with the wrinkle-and-warp prevention makes it easy to bring the mold cleaning sheet into close contact with the mold surfaces of a mold, enhances the property of charging the mold cleaning members 2 into cavity, and provides improvement in cleaning property.

[0020]

Furthermore, in the mold cleaning sheet according to this embodiment, the width of each mold cleaning member 2 is adjusted to have a dimension of 1 mm or more and not larger than $\frac{4}{5}$ of the breadth of the opening of the cavity, in the shape of an oval or a quadrangle, whereby the opening of the cavity, even small in size, is filled only in part with the mold cleaning member 2; as a result, the present mold cleaning sheet can show excellent ability at removing air from the interior of cavity, and comes to excel in property of charging mold cleaning members into cavity (cleaning property) accordingly. Incidentally, the preferable range of the width X of the block is from $\frac{2}{5}$ to $\frac{4}{5}$ of the breadth of the opening of the cavity, in the shape of an oval or a quadrangle, from the viewpoint of the charging property. Additionally, the width X of each mold cleaning member 2 is adjusted not to exceed 50 mm from the viewpoint of reduction in shrinkage of the mold cleaning member 2.

[0021]

Moreover, in the mold cleaning sheet according to this embodiment, the clearances a and b between neighboring mold cleaning members 2 are formed in a grid pattern, which makes it easy to cut the mold cleaning sheet lengthwise and widthwise

and allows use of the mold cleaning sheet cut to an appropriate-and-correct size in response to the dimensions of a mold to be cleaned.

[0022]

More detailed explanations are given below. Examples of a substance forming the sheet-like base material 1 include paper (handmade Japanese paper, paper made in the Western way, synthetic paper, etc.), cloth (fabric, nonwoven fabric, cloth produced by knitting, etc.) and plastic (polyethylene terephthalate, polyimide, polyethylene naphthalate, polyamide, polypropylene, etc.). As to the thickness of the sheet-like base material 1, a sheet having a thickness of from 0.05 mm to 1 mm is used.

Among those substances, nonwoven fabrics, substances subjecting to an embossing treatment, substances treated so as to have rough surface, substances processed by perforation, porous substances and the like are preferable from the viewpoint of producing an effect of anchoring the mold cleaning members 2 and strengthening their adhesion to the mold cleaning members 2. Of nonwoven fabrics, a spunbond nonwoven fabric is preferred over the others from the viewpoint of its excellence in breaking strength.

[0023]

On the other hand, the unvulcanized rubber composition or the thermosetting resin composition for forming the mold cleaning members 2 is prepared by mixing an inorganic filler, such as silica powder or titanium oxide, into unvulcanized rubber or thermosetting resin. The content of silica powder is about 40 to about 50 parts by weight, and the content of titanium oxide is about 5 parts by weight based on 100 parts by weight of unvulcanized rubber or thermosetting resin. Additionally, other ingredients may be also mixed appropriately into such a composition according to the necessity.

[0024]

Examples of the unvulcanized rubber include natural rubber (NR), chloroprene rubber (CR), butadiene rubber (BR), nitrile-butadiene rubber (NBR), ethylene-propylene-diene rubber (EPDM), ethylene-propylene rubber (EPM), styrene-butadiene rubber (SBR), polyisoprene rubber (IR), isoprene-isobutylene rubber (IIR), silicone rubber (e.g. Q) and fluoroelastomers (e.g. FKM).

[0025]

Examples of the thermosetting resin includes melamine resin.

[0026]

The mold cleaning members 2 have not particular restriction on its color, but it is preferable that they have a light color, such as white or gray. This is because contaminants to be eliminated from the cavity of a mold have a dark color such as black, and therefore the light color of mold cleaning members 2 makes it easy to check by the naked eye whether or not the contaminants have adhered to the mold cleaning members 2. In order to impart a light color to the mold cleaning members, white pigment or the like is added to the unvulcanized composition or the thermosetting resin composition.

[0027]

The mold cleaning sheet can be made e.g. in the following manner. First the unvulcanized rubber composition or the thermosetting resin composition is kneaded with a continuous-type kneader or batch-type kneader, and then laid on one side of the sheet-like base material 1. Subsequently, the composition laid on the base material is pressurized with a mold having depressions corresponding to a disposition pattern of the mold cleaning members 2. Thereby, on one side of the sheet-like base material 1, the mold cleaning members 2 according to the disposition pattern are formed in an integrated manner. After demolding, the integrated material is reeled up or cut to an appropriate size.

[0028]

Incidentally, although the mold cleaning members 2 are formed on only one side of the sheet-like base material 1 in the foregoing embodiment, they may be formed on both sides of the sheet-like base material 1 as shown in Fig. 2. On the other hand, as shown in Fig. 3, the block-shaped mold cleaning members 2 on the front surface may be disposed so as to differ from those on the rear surface in the direction of the length (by 90° in Fig. 3).

[0029]

In addition, although each mold cleaning member 2 overall is formed so as to have a profile shape like a dome in a plane perpendicular to the longitudinal direction of the mold cleaning material 2, it may have any other profile shape. For example, the profile may be shaped like a dome in the top part and a trapezoid in the lower part as shown in Fig. 4a, or it may be shaped like a dome in the top part and a rectangle in the lower part as shown in Fig. 4b. In addition, the profile may be in triangle form as shown in Fig. 4c, or in trapezoid form as shown in Fig. 4d, or in semicircle form as shown in Fig. 4e.

[0030]

Of these mold cleaning members, those shown in Figs. 4a to 4c and Fig. 4e are formed so as to be non-flat on the top, and therefore, even when an opening of a cavity is small, the non-flat top of the mold cleaning members 2 makes it easy to fill up in part the opening of the cavity, and removal of the air in the interior of cavity becomes easier. As a result, the property of charging a mold cleaning material is more improved, and the property of cleaning the interior of cavity is also enhanced.

[0031]

In the case where each mold cleaning member 2 is further concerned, the profile shape thereof in a plane along the longitudinal direction of the mold cleaning

material 2 may be a rectangle as shown in Fig. 5a (a form such that both end faces in the longitudinal direction are perpendicular to the sheet-like base material 1 and the perimeters thereof are shaped into a square), or may be a trapezoid as shown in Fig. 5b (a form such that both end faces in the longitudinal direction are angled, and the perimeters thereof are shaped to be angular), or may be a form such that both end faces in the longitudinal direction are shaped into curved faces as shown in Fig. 5c (a form such that the perimeters of the end faces are also rounded off). Incidentally, in the foregoing embodiments shown in Fig. 1 to Fig. 3, the shape of the profile in a plane along the longitudinal direction of each mold cleaning member 2 is shown in Fig. 5a.

[0032]

As to the mold cleaning sheets having mold cleaning members whose lateral faces and end faces are not square to the surface of the sheet-like base material 1 as in cases shown in Fig. 4a, Fig. 4c to Fig. 4e, Fig. 5b and Fig. 5c, measurements of the width X and length Y of mold cleaning members 2 and the clearances a and b are carried out at the roots (on the undersides) of the mold cleaning members.

[0033]

As to the disposition pattern of the mold cleaning members 2, examples thereof include the disposition patterns whose plan views are shown in Figs. 6 to 11. Incidentally, the roots (undersides) of the mold cleaning members 2 are represented pictorially in these Figs. 6 to 11. More specifically, the disposition pattern may be the pattern made up of squares disposed regularly in rows and columns as shown in Fig. 6, or the pattern made up of ovals (width X : length Y = 1 : 10) disposed regularly in rows and columns, with the direction of their length oriented vertically as shown in Fig. 7a or horizontally as shown in Fig. 7b, or the pattern made up of rectangles (width X : length Y = 1 : 10) disposed regularly in rows and columns, with the direction of their length oriented vertically as shown in Fig. 8a or horizontally as shown in Fig. 8b, or the pattern

shown in Fig. 9 wherein each of rectangles in outermost rows as shown in Fig. 8a is placed so that one end thereof is in line with the edge of the sheet-like base material. Additionally, the ratio between the width X and the length Y of rectangles shown in Figs. 8a and 8b may be changed to 1 : 5.5 as shown in Figs. 10a and 10b or 1 : 4 as shown in Figs. 11a and 11b. Incidentally, the disposition pattern of the roots (undersides) of the mold cleaning members 2 in each of the embodiments shown in Figs. 1 to 3 is equivalent to the disposition pattern shown in Fig. 9.

[0034]

Further, though the sheet-like mold cleaning sheet 1 is bare in the clearances a and b between neighboring mold cleaning members 2 in each of the foregoing embodiments, the portion of the sheet-like base material 1 corresponding to the clearances a and b may be covered with a thin film of forming material for the mold cleaning members 2 (a thin film 2a of unvulcanized rubber composition or thermosetting resin composition) as shown in Figs. 12a to 12e (section views corresponding to those in Figs. 4a to 4e) and in Figs. 13a to 13c (section views corresponding to those in Figs. 5a to 5c). In these cases, it is appropriate that the thin film 2a and the sheet-like base material 1 be adjusted to have the same thickness. By such adjustment, even when it is formed between mold cleaning members 2 placed side by side in a state of protruding from the surface of the base material 1, the thin film 2a has no adverse effect on shrinkage of the mold cleaning sheet and causes neither wrinkling nor warping in the mold cleaning sheet.

EXAMPLES

[0035]

Next, examples according to the invention, together with comparative examples, are illustrated below. However, the invention should not be construed as being limited to these examples.

[0036]

5 <Sheet of Cloth>

A spunbond nonwoven fabric made up of long polyester fibers (Eltas E01070, manufactured by Asahi Kasei Corporation) was prepared for a sheet-like base material. This nonwoven fabric had a tear strength of 8.5 N, a thickness of 0.35 mm and a basis weight of 70 g/m².

10 [0037]

<Mold Cleaning Material>

A mold cleaning material was prepared by kneading, in a kneader, 100 parts by weight of ethylene propylene rubber, 50 parts by weight of silica powder, 5 parts by weight of titanium oxide, 2 parts by weight of organic peroxide [n-butyl-4,4-bis(t-butylperoxy)valerate], 10 parts by weight of imidazole [2,4-diamino-6-(2'-methylimidazolyl-(1'))ethyl-s-triazine] and 5 parts by weight of montan wax.

[0038]

<Examples 1 to 5 and Comparative Examples 1 to 6>

On both sides of the sheet-like base material, the mold cleaning material
20 prepared in the foregoing manner was formed into a pattern that blocks were disposed regularly in rows and columns, with clearances being left between neighboring blocks, whereby a mold cleaning sheet (see Fig. 2) was made. Each block was formed so as to have the shape shown in Fig. 1. And dimensions of each block and the clearances are shown in the following Tables 1 and 2.

25 [0039]

<Shrinkage Ratio of Mold Cleaning Sheet>

Before and after the mold cleaning sheets were made in Examples 1 to 5 and Comparative Examples 1 to 6, respectively, dimension measurements of the sheet-like base material were made along the direction corresponding to the longitudinal direction of mold cleaning members, and from the thus obtained measurement values, shrinkage ratios of the sheet-like base material in those mold cleaning sheets were calculated. On the basis of these calculation results, mold cleaning sheets having shrinkage ratios below 1% were rated as "A", those having shrinkage ratios from 1% to 3% were rated as "B", and those having shrinkage ratios beyond 3% were rated as "C". The rating results thus obtained are shown in the following Tables 1 and 2. Incidentally, mold cleaning sheets were difficult to make in Comparative Examples 2 and 4, and no rating was therefore given thereto.

[0040]

[Charging Property]

Mold cleaning was carried out with each of the mold cleaning sheets made in Examples 1 to 5 and Comparative Examples 1 to 6. The mold to be cleaned is a mold for transfer molding used in encapsulating semiconductor devices in resin, and it is composed of an upper section and a lower section. Each of the mold surfaces (opposite faces) of the upper section and the lower section is in the shape of a rectangle measuring 24 mm by 91 mm. And the shape of each cavity under clamping is almost a rectangular solid (the shape of each opening of the cavity is an oval), and the dimensions thereof are 5 mm by 5 mm by 2 mm (height) (the breadth of each opening of the cavity is 5 mm). In addition, the number of cavities formed in the mold is 16, and these cavities are disposed in two parallel rows in each of which 8 cavities are included. The clearance between these two rows is 10 mm, and the clearance between neighboring cavity in each row is 1 mm. As to the cleaning conditions, the clamping gap of the mold was set at 0.5 mm, the molding temperature was set at 175°C, and the

molding time was set at 5 minutes. Conditions after cleaning under these settings were checked by visual observations. On the basis of observation results obtained, mold cleaning sheets having allowed cleaning in every corner of each cavity were regarded as superior in charging property and rated as "A", and those having left uncleaned portions in corners of cavity were regarded as inferior in charging property and rated as "B". The rating results thus obtained are shown in the following Tables 1 and 2. Incidentally, mold cleaning sheets were difficult to make in Comparative Examples 2 and 4, and no rating was therefore given thereto.

[0041]

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Table 1

		Example				
		1	2	3	4	5
Mold cleaning member (mm)	Width: X	4	4	3	3	3
	Length: Y	50	3	40	40	40
	Height: H	3				
Clearance (mm)	a	1	0.5	1	3	0.1
	b	4	2	3	3	1.5
Shrinkage ratio		B	A	A	A	A
Charging property		A	A	A	A	A

[0042]

Table 2

		Comparative Example					
		1	2	3	4	5	6
Mold cleaning member (mm)	Width: X	5	1	3	3	3	3
	Length: Y	40	40	40	40	60	40
	Height: H	3					
Clearance (mm)	a	3	3	5	0.05	3	3
	b	3	1	3	3	3	5
Shrinkage ratio		B	-	A	-	C	A
Charging property		B	-	B	-	B	B

[0043]

As can be seen from the results shown in Tables 1 and 2, the mold cleaning sheets made in Examples 1 to 5 are superior in charging property and cleaning property to the mold cleaning sheets made in Comparative Examples 1 to 6.

[0044]

5 While the invention has been described in detail with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof.

Incidentally, the present application is based on Japanese Patent Application
10 No. 2011-254241 filed on November 21, 2011, and the contents are incorporated herein by reference.

All references cited herein are incorporated by reference herein in their entirety.

[0045]

15 The mold cleaning sheets according to the invention are usable for cleaning of the mold surfaces of a mold.

Description of Reference Numerals and Signs

[0046]

20 1 Sheet-like base material
2 Mold cleaning member
X Width
Y Length
a and b Clearance

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WHAT IS CLAIMED IS:

1. A mold cleaning sheet for cleaning a mold having a cavity which has an opening in a shape of an oval or a quadrangle,

wherein the mold cleaning sheet comprises:

a sheet-like base material; and

a plurality of belt-shaped mold cleaning members formed on at least one side of the sheet-like base material, formed from an unvulcanized rubber composition or a thermosetting resin composition, and disposed in a pattern that the plurality of belt-shaped mold cleaning members are aligned in parallel with a clearance on the base material,

each of the mold cleaning members is cut into a plurality of blocks in a longitudinal direction of the mold cleaning members at predetermined intervals to form a column including the plurality of blocks,

each of the blocks has a length of from 3 mm to 50mm,

a clearance between neighboring blocks in the column including the plurality of blocks is 0.1 mm or more and is not larger than a width of the mold cleaning members,

a clearance between neighboring mold cleaning members in a direction of the width of the mold cleaning members is not smaller than 1/2 of the width of the mold cleaning members and not larger than the width of the mold cleaning members, and

the width of the mold cleaning members is 1 mm or more and not larger than 4/5 of a breadth of the opening of the cavity.

2. The mold cleaning sheet according to claim 1, wherein the sheet-like base material is a cloth.

3. The mold cleaning sheet according to claim 2, wherein the cloth is a fabric including long fibers, or a nonwoven fabric.

4. The mold cleaning sheet according to claim 3, wherein the nonwoven fabric is a spunbond nonwoven fabric.

5. The mold cleaning sheet according to any one of claims 1 to 4, wherein the sheet-like base material is subjected to an embossing treatment.