

Device for cleaning an encapsulating device for electronic components

The invention relates to an assembly for cleaning an encapsulating device for electronic components provided with a displaceable brush with brush elements and to an
5 encapsulating device provided with such a cleaning assembly. The invention also relates to a method for cleaning with a brush a contact side of a mould part of an encapsulating device for electronic components.

In the manufacture of electronic components, more particularly the manufacture of
10 semiconductors, these are usually wholly or partially encapsulated with an encapsulating material. The encapsulating material normally consists here of a thermocuring epoxy or resin incorporating a filler. During encapsulation semiconductors mounted on a carrier (for instance a lead frame or board) can be clamped between mould parts such that, following clamping, mould cavities are defined
15 around the components for encapsulating. Liquid encapsulating material is then introduced into these mould cavities, after at least partial curing of which the mould parts are moved apart and the carrier with encapsulated electronic components removed. At the start of a new production cycle it is important that the mould parts be cleaned of residual encapsulating material particles, since these may disrupt the controlled
20 encapsulation of the electronic components. According to the prior art the mould parts are cleaned for this purpose with a brush in the opened and unloaded state.

The present invention has for its object to provide means and a method for improved
25 cleaning of an encapsulating device for electronic components.

The invention provides for this purpose an assembly for cleaning an encapsulating device for electronic components, comprising: a brush provided with a number of brush elements, a drive for displacing the brush relative to the encapsulating device for electronic components, a protruding contact element coupled to the encapsulating
30 device, and a suction device provided with at least one suction opening placed close to the protruding contact element, wherein the drive is adapted to move the brush along the protruding contact element such that the protruding brush elements are displaced relative to each other by the protruding contact element. In a specific embodiment variant the brush elements are formed here by bristles. The use of a brush element to

clean residue from mould parts is per se known. Loose (dust) particles can be removed with a brush element and it is also possible to remove adhered residual material from the mould parts. Because the present invention now provides a contact element along which the brush can be moved, whereby the protruding brush elements move relative to each other, particles nestling between the brush elements (bristles) will be released more easily. During their relative movement the brush elements will be spread locally, whereby the space between the brush elements increases locally. This release of (dust) particles from the brush will particularly take place close to the contact element. It is precisely at this location that a suction opening is now provided through which the released (dust) particles will be suctioned away. The (dust) particles are displaced/discharged to a known location by the suction device. It is thus possible to remove from the brush (dust) particles which will consist particularly of residue of the (cured) encapsulating material but which possibly also comprise material from other sources (such as for instance the carrier). Cleaning of the brush will result in an increased brushing efficiency in a subsequent cleaning operation; the cleaner brush results in an improved cleaning action of the brush, and consequently to cleaner contact sides of the mould parts, and in an increased level of quality of the encapsulated electronic components.

In order to limit wear and enable a good cleaning action to be realized without damaging the contact sides of the mould parts, it is possible to manufacture the bristles from plastic. It is moreover desirable here to manufacture the bristles from a material which is heat-resistant up to a minimum of 200 °C, preferably up to 250 °C or up to 300 °C. An example of a suitable material is the plastic PEEK.

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In yet another embodiment variant the protruding contact element takes an elongate form and/or suction openings are arranged on opposite sides of the protruding contact element. Such an embodiment makes it possible to displace the brush along the contact element in simple manner (for instance with a linear movement). The advantage of arranging suction openings on opposite sides of the protruding contact element is that (dust) particles released on both sides are hereby suctioned away, so preventing the danger of contamination from the brush spreading in an undesired direction. The protruding contact element can also take a multiple form such that it comprises a plurality of adjacent edges. Yet another option is to provide the protruding contact

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element with a profiled profile edge, such as for instance a profile edge taking a corrugated form. The protruding contact element can also be manufactured from plate material provided with openings (for instance perforated plate material) in order to thus enable an improved suctioning of released material.

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In a particular embodiment variant the brush has an elongate form so that it can thereby clean a relatively large surface area of a contact side of a mould part with only a limited number of movements. Such an elongate brush is moreover advantageously movable in longitudinal direction relative to the protruding contact element, which can thereby have

10 a limited size and wherein the suction opening(s) can also have a limited length. The brush is desirably displaced mechanically or automatically, and the drive can be formed here by an electric motor. Alternatively, it is also possible for the brush to be displaceable in transverse direction relative to the protruding contact element.

- 15 In yet another embodiment variant the brush is provided with at least one supply opening for gas. Blowing a gas out of the brush during displacement of the brush along the contact element can realize a further improved cleaning of the brush and further makes possible an improved control of the gas flow with which the released (dust) particles are discharged. This results in a further improvement in the cleaning result. Yet
- 20 another option consists of arranging one or more air knives in a manner such that (dust) particles released from the brush cannot disperse freely but are guided to the suction opening. It is particularly advantageous here for the air knives to partially or wholly bound a space which connects to the suction opening and in which the brush can be moved along the contact element. The released particles are thus wholly (or
- 25 substantially wholly) discharged through the suction opening.

- In order to further simplify the release of (dust) particles from the brush in a controlled manner the assembly can also be provided with ionizing means. The ionizing means will usually add an equal number of negative and positive charges to the brush, whereby
- 30 insulators such as PVC, teflon and the like will discharge rapidly. The undesired and uncontrolled electrostatic charging of the brush can be prevented or at least reduced by means of ionization.

The present invention also provides an encapsulating device provided with a cleaning assembly as described above, wherein the encapsulating device is provided with: at least two mould parts displaceable relative to each other and adapted to engage electronic components for encapsulating, and feed means for encapsulating material which
5 connect to mould cavities defined by the mould parts and enclosing the electronic components for encapsulating. The cleaning assembly according to the present invention is integrated into such an encapsulating device. In order to limit the movement of the brush necessary for cleaning thereof it is possible to arrange the protruding contact element in the encapsulating device such that the contact element
10 protrudes outside a contact surface of one of the mould parts. The encapsulating device can also be provided with a plurality of protruding contact elements in order to thus shorten or otherwise simplify the path a brush needs to travel to a contact element. It is also possible here to opt for a plurality of elongate, protruding contact elements with differing orientation.

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In addition, the present invention also provides a method for cleaning an encapsulating device for electronic components, comprising the processing steps of: A) cleaning a contact side of a mould part of the encapsulating device by relative displacement of a brush, B) bringing the brush into contact with a protruding contact element and moving
20 the brush relative to the protruding contact element such that the brush elements of the brush are touched by the contact element and the brush elements displace relative to each other, and C) suctioning off ambient air, at least while performing processing step B), such that air is discharged at the position of the mutually displacing brush elements.

25 By having the process take place repeatedly the brush will generally be cleaned better than if it were carried only once along the protruding contact element. It is therefore possible to opt to carry the brush intermittently along the protruding contact element during processing step B). So as not to lengthen the overall cycle time of an encapsulating process it is desirable for processing steps B) and C) to be performed
30 while the brush is approaching the contact side to be cleaned of a mould part of the encapsulating device and/or while the brush is being removed from the cleaned contact side of a mould part of the encapsulating device. It thus becomes possible to integrate the cleaning step of the brush into the production cycle of encapsulation of electronic components such that the overall cycle time of an encapsulating operation is not

influenced (or hardly so) by the additional cleaning process. This can be realized by having the cleaning of the brush take place outside the critical path or at least ensuring that cleaning of the brush does not extend the critical path defining the length of a production cycle.

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The invention will be further elucidated on the basis of the non-limitative exemplary embodiments shown in the following figures. Herein:

figure 1 is a perspective view of a part of an encapsulating device for electronic components according to the present invention;

10 figure 2 is a top view of an alternative embodiment variant of a part of an encapsulating device for electronic components according to the present invention;

figure 3 is a perspective view of a cleaning assembly according to the present invention during cleaning of the brush;

figure 4 shows a cross-section through an alternative embodiment variant of a cleaning
15 assembly according to the present invention during cleaning of the brush, and

figure 5 is a perspective view of a protruding contact element with suction openings which takes a multiple form.

Figure 1 shows a part of an encapsulating device 1 for electronic components provided
20 with a cleaning assembly 2. The shown part of encapsulating device 1 is provided with a lower mould part 3 assembled from an exchangeable mould segment 4 and a permanent mould segment 5 holding the exchangeable mould segment 4. Also shown are parts of columns 6 along which an upper mould part (not shown here) can be guided to the lower mould part 3. Further shown is that mould cavities 7, runners 8 and plunger
25 housings 9 are recessed into the exchangeable mould segment 4. Liquid encapsulating material can be carried from plunger housings 9 through runners 8 (together also referred to as the feed means for encapsulating material) to mould cavity 7. On the upper side (the side facing toward the upper mould part) of the lower permanent mould segment 5 two protruding contact elements 10 protrude above contact surface 11. The
30 protruding contact elements 10 are surrounded by suction openings 12 through which released dirt can be suctioned away.

Shown in figure 1 on the rear side of lower mould part 3 is a double brush unit 13 which likewise forms part of encapsulating device 1. Brush unit 13 is provided with two

brushes 14 with bristles 15. A spindle 17 can be driven by means of an electric motor 16, whereby (in an opened position of encapsulating device 1) brushes 14 of brush unit 13 can brush clean the mould cavities 7, runners 8 and/or plunger housings 9. When brushes 15 are then retracted to the rear side of lower mould part 3, brushes 14 pass
5 over the protruding contact elements 10 at least once, whereby bristles 15 are moved apart locally with the result that at least some of the particles nestling between bristles 15 will be released and subsequently suctioned away through suction openings 12. It is otherwise also possible to carry brushes 14 intermittently along the protruding contact elements 10 so as to thus enable even better cleaning of brushes 14. Brushes 14 can for
10 instance be cleaned just after they are retracted after cleaning of mould part 3, although it is also possible to opt for one or more other cleaning sequences.

Figure 2 is a top view of a lower mould part 20 which is assembled, similarly to the lower mould part 3 shown in figure 1, from an exchangeable mould segment 21 and a
15 permanent mould segment 22 holding the exchangeable mould segment 21. Columns 23 are again also visible. The mould cavities 7, runners 8 and plunger housings 9 recessed into the exchangeable mould segment 21 are designated with the same reference numerals as in figure 1. In contrast to the embodiment variant shown in figure 1, lower mould part 20 is now provided with two elongate, protruding contact elements 24, 25,
20 both surrounded by suction openings 26, 27 with differing orientation. This creates more options for cleaning of the brush, whereby the cleaning result and the time required therefore can be better optimized.

Figure 3 is a perspective view of a brush 30 provided with bristles 31, precisely in the situation where it is being carried in longitudinal direction as according to arrow P_1
25 along a protruding contact element 32. Clearly shown is that bristles 31 are moved apart at the position of contact with the protruding contact element 32. Situated on either side of the protruding contact element 32 are discharge openings 33 through which ambient air is suctioned away together with the released contamination. Also arranged in brush
30 30 is a channel system 34, shown here in broken lines, with an opening 35 on the upper side into which a gas can be blown as according to arrow P_2 . The gas thus blown in will flow out between bristles 31 so as to thus further support the cleaning of brush 30. It is possible to envisage further refining this blowing system such that gas is blown out only at the position of protruding contact element 32. Situated on the upper side of the brush

is a drive 36, shown schematically here, for displacing brush 30. Other than shown here, it is of course also possible to displace the protruding contact element 32 relative to brush 30 in order to thereby obtain the same effect (this is after all a relative mutual displacement of brush 30 and the protruding contact element 32).

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The cross-section shown in figure 4 through a part of a cleaning assembly shows a protruding contact element 41 with suction openings 42 on either side through which gas is suctioned away as according to arrows P_3 . Further situated on either side of the protruding contact element 41 (at a greater distance than suction openings 42) are two

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blow nozzles 43 with which air knives can be generated as according to arrows P_4 .

Contamination released as a result of contact with the protruding contact element 41 is thus prevented from dispersing in an undesired direction.

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Figure 5 shows a protruding contact element 50 which takes a multiple form and is defined by three plate parts 52, 53, 54 in parallel arrangement and protruding relative to a surface 51. Surface 51 preferably lies in line here with the contact surface of a mould part for cleaning or is situated at an at least more or less similar height as the contact side of this mould part for cleaning. Provided between plate parts 52, 53, 54 are two suction slits 55, 56 through which (dust) particles can be suctioned away.

Claims

1. Assembly for cleaning an encapsulating device for electronic components, comprising:
- 5 - a brush provided with a number of brush elements,
- a drive for displacing the brush relative to the encapsulating device for electronic components,
- a protruding contact element coupled to the encapsulating device, and
- a suction device provided with at least one suction opening placed close to the
- 10 protruding contact element,
wherein the drive is adapted to move the brush along the protruding contact element such that the protruding brush elements are displaced relative to each other by the protruding contact element.
- 15 2. Cleaning assembly as claimed in claim 1, **characterized in that** the brush elements are bristles.
3. Cleaning assembly as claimed in claim 2, **characterized in that** the bristles are manufactured from plastic.
- 20 4. Cleaning assembly as claimed in any of the foregoing claims, **characterized in that** the protruding contact element is elongate.
5. Cleaning assembly as claimed in any of the foregoing claims, **characterized in**
- 25 **that** the protruding contact element takes a multiple form.
6. Cleaning assembly as claimed in any of the foregoing claims, **characterized in that** suction openings are arranged on opposite sides of the protruding contact element.
- 30 7. Cleaning assembly as claimed in any of the foregoing claims, **characterized in that** the brush has an elongate form which is movable in longitudinal direction relative to the protruding contact element.

8. Cleaning assembly as claimed in any of the foregoing claims, **characterized in that** the drive comprises at least one electric motor.
9. Cleaning assembly as claimed in any of the foregoing claims, **characterized in that** the brush is provided with at least one supply opening for gas.
10. Cleaning assembly as claimed in any of the foregoing claims, **characterized in that** the assembly is also provided with ionizing means.
- 10 11. Encapsulating device for electronic components provided with a cleaning assembly as claimed in any of the foregoing claims, wherein the encapsulating device is provided with:
- at least two mould parts displaceable relative to each other and adapted to engage electronic components for encapsulating, and
 - 15 - feed means for encapsulating material which connect to mould cavities defined by the mould parts and enclosing the electronic components for encapsulating.
12. Encapsulating device as claimed in claim 11, **characterized in that** the protruding contact element protrudes outside a contact surface of one of the mould parts.
- 20 13. Encapsulating device as claimed in claim 11 or 12, **characterized in that** the encapsulating device comprises a plurality of protruding contact elements.
- 25 14. Method for cleaning an encapsulating device for electronic components, comprising the processing steps of:
- A) cleaning a contact side of a mould part of the encapsulating device by relative displacement of a brush,
 - B) bringing the brush into contact with a protruding contact element and moving the brush relative to the protruding contact element such that the brush elements of the brush are touched by the contact element and the brush elements displace relative to each other, and
 - 30 C) suctioning off ambient air, at least while performing processing step B), such that air is discharged at the position of the mutually displacing brush elements.

15. Method as claimed in claim 14, **characterized in that** the brush is carried intermittently along the protruding contact element during processing step B).
- 5 16. Method as claimed in claim 14 or 15, **characterized in that** the processing steps B) and C) are performed while the brush is approaching the contact side to be cleaned of a mould part of the encapsulating device.
- 10 17. Method as claimed in claim 14 or 15, **characterized in that** the processing steps B) and C) are performed while the brush is being removed from the cleaned contact side of a mould part of the encapsulating device.