Mould part, mould and method for encapsulating electronic components mounted on a carrier

The invention relates to a mould part and mould for encapsulating electronic components mounted on a carrier, comprising at least one mould cavity provided in said mould part and at least one runner for moulding material connecting to said mould cavity. The invention also relates to a method for encapsulating electronic components mounted on a carrier comprising the successive steps of:

a) placing one electronic component mounted on a carrier into a mould provided with at least one mould cavity,

b) feeding liquid moulding material into the mould cavity,

c) at least partially curing the moulding material, and

d) removing the electronic component mounted on the carrier from the mould.

Such a mould and method form prior art whereby using for instance epoxy resin a package of moulding material can be applied around an electronic component mounted on a carrier such as a lead frame or BGA. One particular application of this technique is encapsulating semi-conductor products, such as chips.

One of the market trends is the mounting on a carrier of encapsulating packages of an ever-increasing area. These packages can be subdivided by sawing during further processing. The drawback of the current gate to a mould cavity is that the filling of larger-area mould cavities calls for higher encapsulating material flow velocities. This in turn may result in the formation of gas inclusions or stresses in an encapsulating material package after curing

The present invention has for its object to upgrade both the mould and the method of encapsulating electronic components mounted on a carrier whereby high-speed and well-controled production of larger-area packages of encalsulating material is possible.

To this end the invention provides a mould part of the type stated in the preamble, wherein the gate from the runner to the mould cavity has an oblong shape. The gate of oblong shape from the runner to the mould cavity herein preferably runs parallel to the contact face of the associated mould part. An advantage of an oblong supply opening is

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that encapsulating material can be fed simultaneously into the mould cavity over the entire supply opening length. This enables a large mould cavitity to be filled with encapsulating material in a relatively short period of time without the flow velocities of the encapsulating material having to be as high as they currently are. The present invention thus enables a package of high-grade encapsulating material of a fairly large area to be manufactured in a brief period of time. Another advantage of the mould part according to the invention is its high flexibility in use. If, for example, a plurality of runners for moulding material open onto a specific mould cavity, they should, for homogenous filling of the mould cavity, debouch into the mould cavity at positions where they are located close to the electronic components to be encapsulated. This means the positions where the runners open onto the mould cavity depend on the locations of the electronic components to be encapsulated. This is why the prior art causes the mould structure to depend on the orientation of the mounting of the components on the carrier. With gating through an oblong connection in accordance with the invention a mould cavity may be wholly filled irrespective of the orientation of the mounting of the electronic components for encapsulating on the carrier. This enables a wide variety of products to be encapsulated using one single mould. It is only the shape of the carrier and the location at which the packages of encapsulating material have to be arranged which are determined by the mould. A mould part and a mould according the invention are therefore flexible in use.

The oblong gate from runner to mould cavity may have different shapes. It may be straight for opening onto a straight mould cavity face, angular for opening onto a mould cavity angle or for instance curved for opening onto a curved mould cavity face. Although mould cavities are generally substantially rectangular, the present invention can be used irrespective of the mould cavity shape. Partly subject to mould cavity dimensions and the encapsulating material to be used, it is for instance possible to choose a gating via one long side of a mould cavity or a mould cavity angle. An alternative is to fit a mould cavity with a plurality of oblong gates.

In a preferred embodiment at least one runner debouches into a distribution chamber for encapsulating material, which distribution chamber transposes into the mould cavity by

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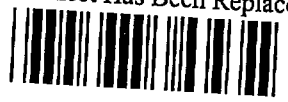
means of the gate of oblong shape. This encapsulating material distribution chamber is preferably recessed further into said mould part than the gate of oblong shape. A threshold-like elevation is thus positioned between distribution chamber and mould cavity. On initiation of an encapsulating operation the encapsulating material will first of all fill the distribution chamber before entering the mould cavity. In the distribution chamber the pressure is evenly distributed, whereby the encapsulating material will then flow uniformly into the mould cavity along the entire length of the gate. An additional advantage is that it is possible to manufacture comparatively thin packages of encapsulating material, since the encapsulating material enters the mould cavity as a thin layer.

While the mould cavity is being filled with encapsulating material, the gas present in the mould cavity should be able to escape from the mould cavity. To this end the mould cavity is provided with a gas discharge opening, which is also oblong in shape. A preferred embodiment of the mould cavity is provided with a plurality of gas discharge openings which run substantially parallel to the supply opening. The encapsulating material flows through the mould cavity across a wide front and, in order to prevent the formation of gas inclusions, the gas should be able to escape from the mould cavity at various positions. This is found to be a particularly advantageous option when the discharge opening is oblong-shaped and runs substantially parallel to the front of the flowing encapsulating material in the mould cavity.

The invention also provides a mould for encapsulating electronic components mounted on a carrier, which mould comprises at least one mould part as specified above. The above described mould part functions only in co-action with a counter mould part.

The invention also provides a method for encapsulating an electronic component mounted on a carrier as described in the preamble, wherein the liquid encapsulating material is fed into the mould cavity through a wide supply opening, causing the moulding material to flow into the mould cavity in a wide elongate front. The moulding material is herein preferably fed into the mould cavity as a thin layer with a substantially constant front. The wide front of encapsulating material will be forced over

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the electronic components to be encapsulated in more or less constant manner, which is why the orientation of the electronic components on the carrier is irrelevant to the choice of a specific mould. The other advantages of this method have already been described with reference to the mould part according the invention.

Finally, the invention comprises a moulded electronic component mounted on a carrier, wherein the gate of the moulding material package is elongate. An encapsulation of this type is manufactured by the above disclosed method and provides the associated advantages as stated above.

The present invention will now be further elucidated with reference to the non-limitative embodiments shown in the following figures. Herein:

figure 1 shows a bottom view of a mould part according the invention,

figure 2 is a perspective view of an encapsulated electronic component mounted on a carrier according the invention,

figure 3 is a top view of the encapsulated electronic component shown in figure 2, and

figure 4 shows a cross-sectional view of the encapsulated electronic component as shown in figure 2.

Figure 1 shows a view of an upper mould part 1, in which what is called a "cull strip" 2 is located centrally, on both sides of which are arranged mould cavities 3. Cull strip 2 is provided with recessed collecting chambers 4, into which a plunger, not shown in this figure, forces liquid encapsulating material. The liquid encapsulating material then flows through runners 5 to distribution chambers 6. In mould part 1 shown in this figure sets of two collecting chambers 4 are mutually connected by a coupling channel 7. In addition, each collecting chamber 4 is connected on two opposite faces to three runners 5, which debouch into two distribution chambers 6. Each distribution chamber 6 is connected to two collecting chambers 4.

The liquid encapsulating material that is forced into a distribution chamber 6 will be distributed uniformly over distribution chamber 6 until this latter is completely filled

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with encapsulating material. To this end the side of distribution chamber 6 directed toward mould cavity 3 is provided with a threshold 8. The space between contact face 9 of mould part 1 and threshold 8 forms an elongate supply opening through which encapsulating material from distribution chamber 6 can be forced into a mould cavity 3. The uniform distribution of pressure exerted on the encapsulating material located in distribution chamber 6 will simultaneously force the liquid encapsulating material into a mould cavity 3 more or less uniformly over the entire length of a threshold 8.

The side of a mould cavity 3 remote from a distribution chamber 6 is provided with gas discharge openings 10. The encapsulating material forced into a mould cavity 3 reduces the volume available for gas in a mould cavity 3, which gas will hereby escape from the mould cavity through gas openings 10. Four discharge openings 10, all elongate in shape, connect onto each mould cavity 3. Gas discharge openings 10 run parallel to threshold 8 of a distribution chamber 6, which defines the supply opening of a mould cavity 3. When the encapsulating material flows into a mould cavity 3, the front of the encapsulating material will move through mould cavity 3 in such a way that it remains more or less parallel to threshold 8. As a result the front will reach gas discharge openings 10 more or less simultaneously. The advantage of a plurality of elongate gas discharge openings 10 is that the gas can escape simultaneously at various points and the gas inclusion hazard can be minimized.

Mould part 1 is also provided with centering pins 11, which allows an accurate fit of upper mould part 1 onto a lower mould part not shown in this figure.

Figure 2 shows a perspective view of a carrier 12, on which a number of packages of encapsulating material 13 are arranged. These encapsulating material packages 13 encapsulate non-visible electronic components. On one gate end 14 of a package of encapsulating material can be seen a residue of encapsulating material 15 which represents the shape of distribution chamber 6 and a supply opening. This will be further illustrated by figures 3 and 4. Encapsulating material package 13 and carrier 12 can then optionally be further machined, for example by sawing the whole into smaller portions, in each of which one or more encapsulated electronic components are located.

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Figure 3 shows a top view of encapsulating material package 13 and carrier 12, in which can be seen that the residual encapsulating material 15 consists of two parts, i.e a first section 16 having a shape corresponding with that of distribution chamber 6 as represented in figure 1, and a second section 17. The encapsulating material located in distribution chamber 6 during curing will, after removal of carrier 12 from the mould, form first section 16 of the residual encapsulating material 15. This first section 16 thus has a shape corresponding with that of distribution chamber 6, as shown in figure 1. The encapsulating material located during curing in the oblong supply opening situated above threshold 8, as shown in figure 1, forms a second section 17 of residual encapsulating material 15. This second section 17 of residual encapsulating material 15 consequently has a shape corresponding with that of the oblong-shaped connection.

Finally, figure 4 shows a cross-sectional view through encapsulating material package 13 and carrier 12 as shown in figure 2, in which five encapsulated electronic components 18 are also visible. Residual encapsulating material 15 is also visible, which clearly shows that first section 16 is higher than second section 17. This is the result of distribution chamber 6 being mounted recessed in a mould part 1 in relation to threshold 8.

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Claims

1. Mould part of a mould for encapsulating electronic components mounted on a carrier, comprising at least one mould cavity provided in said mould part and at least one runner for moulding material connecting to said mould cavity, wherein the gate from said runner to said mould cavity has an oblong shape.

2. Mould part as claimed in claim 1, wherein the gate of oblong shape from the runner to the mould cavity runs parallel to the contact face of the associated mould part.

3. Mould part as claimed in claim 1 or 2, wherein the gate of oblong shape from the runner to the mould cavity is a straight gate which opens onto a straight side of said mould cavity.

4. Mould part as claimed in claim 1 or 2, wherein the gate of oblong shape to the mould cavity has an angular shape which opens onto an angle of said mould cavity.

5. Mould part as claimed in claim 1 or 2, wherein the gate of oblong shape from the runner to the mould cavity has a curved shape which opens onto the curved side of said mould cavity.

6. Mould part as claimed in any of the foregoing claims, wherein the mould cavity is provided with a plurality of oblong gates.

7. Mould part as claimed in any of the foregoing claims, wherein at least one runner debouches into a distribution chamber for encapsulating material, which distribution chamber transposes into the mould cavity by means of the gate of oblong shape.

8. Mould part as claimed in claim 7, wherein the moulding material distribution chamber is recessed further into said mould part than the gate of oblong shape.

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9. Mould part as claimed in claim 8, wherein a threshold-like elevation is positioned between the distribution chamber and the mould cavity.

10. Mould part as claimed in any of the foregoing claims, wherein on the side remote from the gate of the runner the mould cavity connects onto at least one gas discharge opening which has an oblong shape.

11. Mould part as claimed in claim 10, wherein a plurality of gas discharge opening run substantially parallel to the supply opening.

12. Mould for encapsulating electronic components mounted on a carrier, comprising at least one mould part as claimed in any of the claims 1-11.

13. Method for encapsulating electronic components mounted on a carrier comprising the successive steps of:

a) placing one electronic component mounted on a carrier into a mould provided with at least one mould cavity,

b) feeding liquid moulding material into the mould cavity,

c) at least partially curing the moulding material, and

d) removing the electronic component mounted on the carrier from the mould, wherein the liquid moulding material is fed into the mould cavity through a wide supply opening, causing the moulding material to flow into the mould cavity in a wide elongate front.

14. Method as claimed in claim 13, wherein the moulding material is fed into the mould cavity as a thin layer with a substantially constant front.

15. Moulded electronic component mounted on a carrier, wherein the gate of the moulding material package is elongate.

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