

This Sheet Has Been Replaced



9900022-6  
IPOS copy

THIS SHEET HAS BEEN  
REPLACED

1

### Dispensing nozzle for a die bonder

The invention relates to a device for a die bonder for metering and applying a pre-determined quantity of a viscous adhesive medium, with a dispensing nozzle which is  
5 provided with a feed channel surrounded by a wall surface, through which feed channel the adhesive medium can be conveyed to a nozzle plate in which there is at least one outlet aperture, wherein the feed channel discharges into the at least one outlet aperture, and in the discharging area a cross-sectional area of the feed channel is larger than a cross-sectional area of the at least one outlet aperture. The invention furthermore relates to a specific use  
10 for the device.

In this technology, it is often necessary to supply a specific quantity of liquid, for example a viscous adhesive medium, in a metered manner, and optionally to apply it in a specific pattern onto a surface. An example of such an application is, for example, the so-called "die  
15 bonding", in which electronic components (chips) are glued to a substrate. For this, a pre-determined quantity of adhesive medium is applied to the substrate with the aid of a metering device of a so-called die bonder. A manipulating tool of the die bonder then places the electronic component on the adhesive surface, provided with the adhesive medium, of the substrate. In high speed die bonding, this procedure takes less than 600 ms.

20

For the metering of the viscous die bonding adhesive medium, said medium is conveyed from a storage container into a more or less cylindrical receiving area of a so-called dispensing nozzle. On a dispensing side of the nozzle there is at least one outlet aperture through which the adhesive medium is dispensed in a metered manner. It is also often  
25 provided that there are several outlet apertures arranged in a specific pattern so that a pre-determined pattern of adhesive medium can be applied. In order to meter a specific quantity of the adhesive medium, a specific pressure pulse is applied to the adhesive medium, for example in the storage container. As there is an interdependency between the magnitude and length of the pressure pulse and also the viscosity of the liquid, the cross-sectional area  
30 of the outlet aperture, and other parameters, the pressure pulse required can be substantially

This Sheet Has Been Replaced



pre-determined. In this connection, attention is drawn to the publication "Dispensing Technology, The Key to High Quality / High Speed Die Bonding, ESEC Process Information", reference to the contents of which is hereby made.

- 5 It has now been shown that time and again there are discrepancies between the pressure pulse determined theoretically and that actually necessary. As a result, either the quantities of liquid metered do not correspond to the quantities required, or the quantities of liquid cannot be applied quickly enough. The latter can be critical with respect to time for the entire die bonding process and therefore limit the production rate.

10

- In addition, previously known nozzles often drip, even though the pressure pulse has long been removed from the liquid and the liquid has a flow limit which means the liquid should not be flowing by itself. As at this time the nozzle of the die bonder is no longer located over the substrate, the quantity of liquid expelled due to the dripping cannot be used for  
15 gluing. On the contrary, the working environment is soiled by the dripping liquid which regularly leads to stopping of the machinery.

20

The object of the invention is therefore to further develop a dispensing nozzle such that the dripping behaviour of the nozzles and the ability to pre-determine the parameters of the pressure pulse required is improved.

25

This object is solved with a device described in the introduction, in that in the feed channel there is provided a means for positive guiding of the viscous adhesive medium, by means of which, during filling of the nozzle, a front of the adhesive medium maintains a pre-determined direction of flow, so that the adhesive medium guides substantially all of the air located in the feed channel in the direction of the at least one outlet aperture. In connection with the present invention, a "viscous" liquid is to be understood as a liquid, the viscosity of which is at least 1 Pas at room temperature.



Within the framework of the invention, it has been shown that gas and/or air pockets are frequently responsible for the disadvantages previously described. These air pockets are normally created during the (initial) filling of the nozzle, as the flow front flowing into the nozzle from the storage container can only partially evacuate the nozzle. In particular on  
5 the outer peripheral area of the nozzle plate, in which the outlet apertures are made, "dead" cavities (dead flow zones) often form in which the liquid encapsulates air. When pressure pulses are applied, these air pockets act like a shock absorber. On the one hand, because of the compression of the air, the pockets store a part of the energy, whereby not all of the energy applied can be used for expelling the liquid. On the other hand, at the end of and/or  
10 respectively termination of the pulse, the air gives up the stored energy into the liquid again in the form of kinetic energy. It has been shown that this in particular is a cause of the disadvantageous dripping of the nozzle.

With dispensing nozzles according to the invention, such air pockets are prevented in a  
15 manner which is inexpensive from a constructional point of view, namely in that the adhesive medium front itself conveys the gas located in the nozzle to the outlet apertures. In connection with the invention, "adhesive medium front" is to be understood as the surface of the liquid which forms when the nozzle is filled and flows in the direction of the nozzle plate of the nozzle and respectively the outlet apertures. Advantageously, the adhesive  
20 medium front evacuates the nozzle according to the invention substantially completely because of the positive guiding. Naturally, it is however not absolutely necessary that the gas content remaining in the nozzle is actually zero. In order to obtain advantages over the previously known nozzles, it is sufficient if the remaining air pockets are reduced to an extent wherein the disadvantages relevant in practice can be avoided.

25

The positive guiding can be differently organised, depending on the total number of outlet apertures, and/or the distribution of the outlet apertures on the nozzle plate. It has, however, proved advantageous when the positive guiding has a chicane arranged in the feed channel opposite the nozzle plate. "Chicane" is to be understood as a flow guiding element with  
30 which the cross-sectional area of the feed channel useable for the through-flow of the



adhesive medium is reduced. Using the chicane, the adhesive medium can maintain, at least in sections, a direction of flow when positively guided which differs from the direction of flow which the adhesive medium would have with positive guiding without a chicane.

- 5 For many applications, it has proved advantageous when, as a result of the positive guiding, the liquid front firstly makes contact with the areas of the nozzle plate which are at the greatest distance from a longitudinal axis of the nozzle plate. Subsequently, positive guiding conducts the adhesive medium towards a central longitudinal axis, that is to say the centre of the nozzle plate. In this way it is possible to encapsulate all the air still present in  
10 the feed channel when the adhesive medium makes contact with the nozzle plate with the adhesive medium and to convey it towards at least one of the outlet apertures. The adhesive medium can in this way maintain a direction of flow which has an orthogonal component with respect to the longitudinal axis of the nozzle plate.
- 15 Further preferred configurations of the invention will be evident from the dependent claims.

The invention will be described in more detail with reference to the embodiments shown schematically in the drawings; in these is shown, in

- 20 Fig. 1 a perspective part view of a die bonder;
- Fig. 2 a sectional representation of a part of a previously known dispensing nozzle;
- Fig. 3 a device according to the invention, shown partly cut-away;
- 25 Fig. 4 a sectional representation of a part of the device according to the invention of Fig. 3;
- Fig. 5 a sectional representation along the line V - V of Fig. 4;

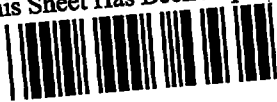


Figs. 6, 7 further devices according to the invention.

In Fig. 1 a section of a die bonder 1 is shown, on which dispensing nozzles according to the invention can be affixed. The dispensing nozzle 2" shown on the die bonder is a nozzle previously known per se, with a single outlet aperture. An adhesive medium is introduced from a storage container 3 into the dispensing nozzle 2". A pressure necessary for this is exerted by means of a transitory compressed air blast of pre-determined amplitude in the storage container 3 upon the adhesive medium. The quantity of air necessary for this is supplied via a line 4.

For better understanding of the present invention, a dispensing nozzle 2' shown in more detail in Fig. 2 will firstly be explained, into which an adhesive medium 5' is introduced from a storage container which is not shown. The dispensing nozzle is provided with a feed channel 7' circular in cross-section and widening out towards a nozzle plate 6', which is formed by a substantially conical wall surface 8' of an insert 9' of the dispensing nozzle 2'. The feed channel 7' terminates on its dispensing side at the nozzle plate 6'. In the nozzle plate 6' a total of seventeen outlet apertures 10' are made within a circular surface, seven of which can be seen in the representation of Fig. 2. In each of the outlet apertures 10' there is arranged a dispensing tube 11'.

As can be seen in this representation, the front 12' of the adhesive medium has already made contact with the centre of the nozzle plate 6', that is to say the circular surface of the nozzle plate 6' provided with outlet apertures 10'. As, however, the part of the front 12' which is located between the outlet aperture 10' and the wall surface 8', has not completely been made contact with, the front 12' has already encapsulated air 15' between the outlet apertures 10' and the wall surface 8'. Even when the front 12' continues to flow, this air 15' can no longer escape and remains in the area between the corner 16' formed by the nozzle plate 6' and the wall surface 8', and the outlet apertures 10'. As can clearly be seen, these air pockets become larger as the distance of the outlet apertures 10' to the corner 16' increases.

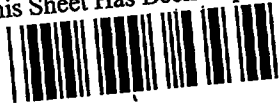


In the embodiment of a device according to the invention shown in Figs. 3 and 4, an insert 9 is arranged in a substantially cylindrical housing 17 of a dispensing nozzle 2, in which a feed channel 7 is configured. Above the feed channel 7 there is located a storage container 3 filled with an adhesive medium 5. In said storage container is arranged a pressure piston 18 which is actuated by means of a drive means, not shown in more detail, and by means of a corresponding mechanism of the die bonder 1. With this, it is possible to perform a specific stroke with the piston 18 within a specific time, whereby a pre-determined quantity of the adhesive medium 5 can be conveyed in the direction of the dispensing nozzle 2.

10 Figs. 3 and 4 also show that the feed channel 7 of the dispensing nozzle 2 is provided with a substantially circular cross-section. In the nozzle plate, also circular, arranged at the end of the feed channel 7 - with respect to the direction of flow of the adhesive medium 5 - several outlet apertures 10 are made which are arranged in an approximately symmetrical pattern with respect to one another (see also Fig. 5). In each of the outlet apertures 10 there is  
15 located a cylindrical dispensing tube 11. In particular Fig. 4 and Fig. 5 show that the feed channel has a cross-sectional area directly in front of the outlet apertures 10 which is much larger than a cross-sectional area of, respectively, an outlet aperture.

A chicane 21 is arranged in the feed channel 7 along its longitudinal and symmetrical axis  
20 20. In the embodiment presently described, the chicane 21 is substantially configured as a cone arranged concentrically in the feed channel 7, which gets wider towards the nozzle plate 6. As is evident in particular in Fig. 5, the chicane is fixed with three struts 22 to the nozzle plate 6.

25 Consequently, a positive guide is formed for the adhesive medium between the chicane 21 and the wall surface 8 of the feed channel 7 on the one hand and the chicane 21 and the nozzle plate 6 on the other hand. This positive guide for the dispensing nozzle 2 has a substantially annular self-contained first section 23, which is produced by the space between the wall surfaces 8 of the feed channel 7 and the casing surface of the chicane 21. A second  
30 section 24 of the positive guide results from the distance of the nozzle plate 6 from the base



surface 25 of the chicane 21. In the embodiment shown, a width B of the first and of the second sections 23, 24 of the positive guide is substantially constant and of the same size.

In order to fill the initially empty dispensing nozzle 2 with adhesive medium, said medium is introduced into the feed channel 7 by actuation of the pressure piston 18. As soon as the adhesive medium makes contact with the chicane 21, the adhesive medium 5 arrives at the positive guide, whereby the geometric shape of the flow front 12 changes. The adhesive medium 5 now flows into the first section 23 of the positive guide - mainly in direct proximity with the conically inclined wall surface 8 of the dispensing nozzle 2 - towards the nozzle plate 6. At the end of the first section 23 the adhesive medium 5, mainly in direct proximity with the wall surface 8 of the positive guide in the area of the outer periphery, firstly makes contact with the nozzle plate 6, whereby an air pocket between the wall surface 8 and the adhesive medium 5 can at least be avoided as far as possible. As is evident from Fig. 4, the transition from the wall surface 8 to the die plate 6 is substantially continuous because of a radius 14. This contributes to preventing the formation of a "dead flow zone", as in this way the adhesive medium is conveyed into the second section 24.

After sufficient further adhesive medium has flowed through, in the second section 24 of the positive guide an annular, enclosed flow front forms, which lies on both the nozzle plate 6 and the base surface 25 of the chicane. This front flows at all places, substantially uniformly from the outside to the inside, towards the longitudinal axis 20 of the nozzle plate 6. In other words, the flow direction of the front 12 is orthogonal, that is to say radial with respect to the longitudinal axes of the outlet apertures 10. With this, the front 12 pushes the remaining air 15 still in the nozzle 2 towards the outlet apertures 10.

25

In order that a complete evacuation of the nozzle can take place by outflowing of the air 15, the positive guide should be shaped such that the annular front 12 closes directly over, at least in the area of, one of the outlet apertures 10. In the present embodiment, the front closes over the outlet aperture 10a, which runs along the longitudinal axis 20 of the nozzle 2. In this connection, "close" should be understood as that both an upper side of the nozzle

30



plate 6 and the base surface 25 are substantially completely wetted. As soon as the adhesive medium is located in all the dispensing tubes 11, the die bonder is ready for use.

5 Naturally, the configuration of the chicane can differ from the embodiment previously described, for example, because of a different distribution of the outlet apertures on the nozzle plate or for obtaining specific flow behaviours. Thus, in Fig. 6 a further possible variation according to the invention is shown. A substantial difference from the embodiment previously described is in that in this case the chicane 21 is configured in the shape of a disc. As here, all the outlet apertures 10 are located outside the centre of the  
10 nozzle plate 6, the positive guiding in the chicane 21 along the longitudinal axis 20 also has an additional central, third section 26. This is configured in the shape of a continuous recess, by means of which the adhesive medium also reaches the nozzle plate.

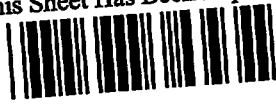
Consequently, when this dispensing nozzle is filled, two flow fronts 12 form as soon as the adhesive medium makes contact with the chicane 21.

15

One flow front goes through the first section 23, also present in this case, between the wall surface 8 of the feed channel and the chicane 21 into the second section 24, in which it flows in an annular, closed manner towards the direction of the centre of the nozzle plate 6. The second flow front goes through the third section 26 on the nozzle plate 6 and then flows  
20 into the second section 24, going from the centre of the nozzle plate radially outwards in the opposite direction to the other flow front.

A particularly simple construction of the dispensing nozzle 2 is shown in Fig. 7. The housing 17 is composed of an upper housing part 17a and the nozzle plate 6. The housing  
25 part 17a includes the shape-determining function of the insert 9. The housing part 17a is provided with four indentations 30 in which toes 31 of the chicane 21 engage. The position of the chicane 21 with respect to the housing part 17a, and thereby also the width of the positive guide in the section 23 is thus clearly defined.

This Sheet Has Been Replaced



THIS SHEET HAS BEEN  
REPLACED

In order to obtain sufficient sealing between the housing part 17a and the nozzle plate 6, a sealing ring 32 with a concave surface 33 corresponding to the radius 14 (Fig. 4) is provided. The sealing ring 32 is, for example, made from rubber. A locking piece 34 with a bayonet lock is preferably provided for fixing the nozzle plate 6 onto the housing part 17a so that after the insertion of the chicane 21, the sealing ring 32 and the nozzle plate 6 in the housing part 17a, the locking part 34 can be affixed by means of a rotation on the housing part 17a. In order that the width of the positive guide is also clearly defined in the section 24, the chicane 21 is provided with four pins 35 against which the nozzle plate presses in the assembled state.



10

This Sheet Has Been Replaced



## Claims

1. Dispensing nozzle (2) for applying a viscous adhesive medium onto a substrate, with a feed channel (7), through which the adhesive medium can be conveyed to a nozzle plate (6) provided with at least one outlet aperture (10; 10a), characterised in that the feed channel (7) is configured such that the adhesive medium front (12) forming during filling of the dispensing nozzle (2) conveys the air present in the dispensing nozzle (2) to the at least one outlet aperture (10; 10a).
2. Dispensing nozzle according to claim 1, characterised in that a chicane (21) affecting the direction of the adhesive medium front is present in the feed channel (7).
3. Dispensing nozzle according to claim 1 or 2, characterised in that during filling of the dispensing nozzle (2), the adhesive medium front (12) firstly makes contact with the area of the edge of the nozzle plate (6) on the nozzle plate (6), and then flows in the direction of the centre of the nozzle plate (6).
4. Dispensing nozzle according to claim 1 or 2, with at least two outlet apertures (10), characterised in that during filling of the dispensing nozzle (2), the adhesive medium front (12) firstly makes contact with the nozzle plate (6) both in the area of the edge of the nozzle plate (6) and in the centre of the nozzle plate (6), and then flows in the direction of the outlet apertures (10).
5. Dispensing nozzle according to one of claims 1 to 4, characterised in that the feed channel (7) is configured in a concave manner in the area of the edge of the nozzle plate (6).