

Device for the Metered Delivery of a Viscous Liquid

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The invention concerns a device in accordance with patent claim 1.

5 Such a device is known for example from the Patent Specification US 4 485 387. In this specification a system is described for the application of a thick-film printing ink onto a substrate with which an intake channel and a discharge channel are envisaged with a double cylinder arranged transversely to them. Via a rotary valve, the intake channel is alternately connected to one cylinder while at the same time the other cylinder is connected to the discharge channel and vice versa. Diametrically opposed coupled
10 pistons are arranged in both diametrically opposite cylinders which are constantly moved back and forth by a motor. The valve is simultaneously turned back and forth in time with the piston movement. In this way, a specific amount of printing ink is taken into one cylinder and the previously measured amount of printing ink is simultaneously discharged at the other cylinder. The stroke of the piston is adjustable so that the amount of printing ink taken in and discharged can be adjusted as necessary. In order to
15 guarantee faultless operation of the device presented, it has relatively large dimensions and therefore a large weight. This device is therefore connected via long tubes to a writing head which is movable across the substrate.

In order to apply electrical connections to integrated circuits or ICs, connection fingers interconnected
20 by means of a frame, so-called leadframes, are punched out of a thin metal sheet. By means of a so-called die bonder, the integrated circuit is subsequently applied which then adheres to the connection fingers. For this purpose, a pattern of epoxy adhesive for a specific size of integrated circuit is applied to the respective leadframe which is preferably done by means of a device as described above. Because, depending on their composition, the epoxy adhesives or resins have a short work life, with time remains
25 are left behind in the metering device so that it has to be regularly cleaned. For this purpose, the device has to be dismantled and rinsed with a cleaning paste (tenside) similar to soft soap. Afterwards, the device must be carefully re-assembled which requires a certain amount of skill, especially with the seals. In particular, the stuffing boxes present in the device are to be tightened with a torque wrench. The long tubes to the writing head also have to be cleaned and, if necessary, replaced. It goes without saying that
30 these devices are quite complicated and therefore expensive especially with relation to the piston drive.

For this and other reasons, the object of the presented invention is to improve a device of the above type in such a way that it has less weight, is considerably easier and cheaper to manufacture and that more simplified cleaning is possible.

35 This object is solved by means of a device with the features of patent claim 1.

With the device in accordance with the invention, a particularly small construction is possible so that it can even be assembled together with the movable writing head of a device for the application of adhesive to a substrate.

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Further advantages of the invention follow from the dependent patent claims and from the following description in which the invention is described in more detail based on the embodiments presented in the schematic diagrams. It is shown in:

Fig. 1 a metering device,

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Fig. 2 the metering device in various phases of operation, and

Fig. 3 a device for applying adhesive to a substrate.

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Fig. 1 shows a metering device for the metered delivery of a liquid. The metering device has a first body 30 with three parallel arranged, continuous and horizontally running drill holes 31, 32 and 33 as well as two further bodies 34 and 35 attached to each of which are a guide rod 36 or 37 and a piston 38 or 39 running parallel to it. The bodies 30, 34 and 35 consist preferably of plastic. The drill hole 32 takes up the first guide rod 36, drill hole 33 the second guide rod 37 and drill hole 31 the two pistons 38 and 39, whereby body 34 is located on one side of the drill hole 31 and body 35 on the other side of drill hole 31. The drill hole 31 is widened at both ends to accept one sealing element 40 and one bearing element 41 each for the corresponding piston 38 or 39. The central area of the drill hole 31 connects two chambers 42 and 43 installed in the body 30, whereby in operation the first chamber 42 is connected to a reservoir containing the liquid and the second chamber 43 is connected to the writing nozzle 44. For this purpose, for example, a nipple 45 for attaching a tube or the writing nozzle 44, respectively, are directly inserted into the corresponding chamber 43 or 42.

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The bodies 34 and 35 and with them the guide rods 36 and 37 and the pistons 38 and 39 are movable in the direction of the drill holes 31, 32 and 33. The guide rods 36 and 37 take over the actual support of the two pistons 38 and 39. Drive of the bodies 34 and 35 is carried out by means of two cam discs 46 and 47 arranged on a rotational axis and driven by a common motor. For this purpose, the bodies 34 and 35 have a cam 48 adjacent to the corresponding cam disc 46 or 47. The two bodies 34 and 35 are connected by means of a pre-tensioned spring 49 so that the cams 48 always remain in contact with the corresponding cam disc 46 or 47 and the movements of the pistons 38 and 39 follow the stagger of the assigned cam disc 46 or 47. A single 360° revolution of the motor or the cam discs 46 and 47 leads to one single back and forth movement of the pistons 38 and 39.

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Figs. 2A-F now show schematically the relative position of the pistons 38 and 39 in six different angle

positions during one single revolution of the cam discs 46 and 47. At the start, the faces of the pistons 38 and 39 are located within the first chamber 42, whereby a small slit is formed between the two faces of the pistons 38 and 39 (Fig. 2A). First of all, only the piston 38 moves so that the slit between the two pistons 38 and 39 is enlarged. The enlarged slit immediately fills with liquid (Fig. 2B). Afterwards, both
 5 pistons 38 and 39 move from the first chamber 42 to the second chamber 43 whereby the width of the slit remains constant (Fig. 2C). In this way, a predetermined amount of liquid is transported from chamber 42 to chamber 43. After that, piston 39 remains stationary (Fig. 2D) while piston 38 is moved back until the slit between the faces of the two pistons 38 and 39 again achieves the originally small width (Fig. 2E). During this phase, the amount of liquid which is located in the slit between the pistons
 10 38 and 39 is pressed into chamber 43. Subsequently, both pistons 38 and 39 are moved back whereby the slit between the faces maintains the small width (Fig. 2F) until, after one complete revolution of the motor, they are again located in the initial position (Fig. 2A). Therefore, during one back and forth movement of the pistons 38 and 39, the distance between their faces varies whereby the distance during the forward movement is larger than during the backward movement so that a predetermined volume of
 15 liquid is transported from the first chamber 42 to the second chamber 43.

VespeL, a hard, plastic which can be processed like brass is a suitable material for the body 30. The pistons 38, 39 and the guide rods 36, 37 are preferably formed from conventional clipping punches as are used, for example, as ejector pins in the injection moulding technique. Such clipping punches have an extremely smooth surface. The ends of the pistons 38, 39 are rounded. The sealing elements 40 (Fig.
 20 1) are made of comparably soft plastic, for example Teflon. For a short distance, the inside diameter of the sealing elements 40 is selected slightly smaller than the diameter of the pistons 38, 39 so that the sealing elements 40 tightly surround the corresponding piston 38 or 39, however, without leaving the range of elastic deformation. The seal is therefore created on the short distance located on the side of the sealing element 40 facing towards the chamber 42 or 43. The bearing elements 41 on the other hand are
 25 formed out of a harder plastic than the sealing elements 40 so that the support for the pistons 38, 39, so long as it is not produced by the guide rods 36 or 37, is effected by the bearing elements 41 and not by the sealing elements 40.

Because the spring 49 is tensioned between the two bodies 34 and 35, it's expansion varies only by the amount of the difference between the minimum and maximum width of the slit. Engagement of the
 30 spring 49 in the bodies 34 and 35 takes place as close as possible to the guide rods 36, 37 so that the torques from the guide rods 36 and 37 exerted on the respective drill hole 32 or 33 because of the spring 49 remain as low as possible. These torques could be eliminated completely by means of additional springs.

The diameter of drill hole 31 and the difference between the minimum and maximum width of the slit

between the faces of the pistons 38 and 39 are dimensioned corresponding to the minimum volume of liquid V_{min} , to be delivered. The volume of liquid to be applied with one single dispensing action can be increased to n times the liquid volume V_{min} in that the motor carries out n revolutions. The device is equally suitable for the spot application of liquid portions for which the writing axis remains stationary
5 as well as for the writing of liquid lines and patterns for which the writing axis is moved with a predetermined speed along predetermined lines. The direction of rotation and the speed of the motor are coordinated and controlled with regard to the writing movement so that the predetermined amount of liquid is applied to the substrate at the predetermined location in accordance with the given liquid pattern.

10 A particular advantage of this device can be seen in that it gets along without a valve. A backward run is also possible whereby liquid is then transported from the second chamber 43 to the first chamber 42. The maintaining of a minimum, finite width of the slit between the faces of the two pistons 38 and 39 guarantees wear-free operation.

The metering device can be built very compactly so that it can be directly mounted onto the writing head
15 of an apparatus for the application of adhesive to a substrate as is described, for example, in the European Patent application EP 901 155 and which is explicitly incorporated here as reference. Fig. 3 corresponds to the Fig. 1 of EP 901 155. The liquid is supplied to the dispensing head 50 via a tube 51 in accordance with the teaching of the EP 901 155 whereby a not presented pump is located at the other end of the tube 51 with which the amount of adhesive to be applied is metered. One of the metering
20 devices in accordance with the invention can now be mounted directly onto the cradle 52 instead of the dispensing head 50, so that the pump metering the amount of adhesive is located on the writing head 53 and is moved with it. In this way, a shorter distance results between the metering device exercising the function of the pump and the tip of the writing nozzle 44 with the advantage that the coordination of the writing movement and the pump action, i.e. the control of the direction of rotation and speed of the
25 motor as a function of time with reference to the writing movement, is simplified even with very high writing speeds and a short writing cycle.

The metering device is equally suited for the application of adhesives which mostly have a high viscosity as well as of liquids with lower viscosities which, for example, serve as globtop or as underfill material for a flipchip.

Claims

1. Device for the metered delivery of a viscous liquid, comprising:
a first body with a drill hole, wherein the drill hole connects a first chamber, via which the liquid is supplied, and a second chamber, via which the liquid is delivered,
5 a first piston and a second piston wherein the drill hole takes up the first piston and the second piston, and
drive means for driving the first piston and the second piston back and forth in such a way that the distance between the faces of the two pistons varies.
2. Device according to claim 1, further comprising a second body to which the first piston is attached
10 and a third body to which the second piston is attached, wherein the drive means comprise a first cam disc for driving the second body and a second cam disc for driving the third body and a motor for driving the two cam discs.
3. Device according to claim 2, wherein a spring connects the second body and the third body.
4. Device according to claim 1, wherein each of the two pistons is supported in the first drill hole by
15 means of a bearing element and is sealed against the drill hole by means of a sealing element, whereby the bearing element consists of harder material than the sealing element.
5. Device according to claim 2, wherein each of the two pistons is supported in the first drill hole by means of a bearing element and is sealed against the drill hole by means of a sealing element, whereby the bearing element consists of harder material than the sealing element.
- 20 6. Device according to claim 3, wherein each of the two pistons is supported in the first drill hole by means of a bearing element and is sealed against the drill hole by means of a sealing element, whereby the bearing element consists of harder material than the sealing element.
7. Apparatus for the application of a liquid to a substrate with a movable writing head, wherein a
25 device for the metered delivery of liquid according to one of claims 1 to 6 is mounted on the writing head.