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SQUEEGEE FOR SCREEN PRINTING

BACKGROUND OF THE INVENTION

5 The present invention relates to a squeegee for screen printing used for applying solder paste on printed circuit boards, for example.

Compact electronic devices have demanded large-scale component integration on printed circuit boards. The larger the scale of component integration
10 in compact devices, the more increase in demand for reliable solder paste.

Application of the proper amount of solder paste on circuit components requires high reliability of squeegees as a tool used for solder paste application
15 in screen printing in addition to reliable solder paste.

Squeegees used for screen printing are classified into urethane squeegees made of hard rubber, complex squeegees made of urethane and metal, and so on.

Problems in application of solder paste on printed
20 circuit boards by a well known squeegee is discussed with reference to FIGS. 1A and 1B.

As shown in FIG. 1A, a hard rubber-squeegee 10 moves in the direction of the arrow to pour solder paste 13 onto a circuit board 12 through a window 11a of a
25 metallic mask 11. The more the amount of the solder paste 13 for large-scale integrated circuits, the larger the window 11a inevitably formed on the metallic mask 11.

The solder paste application process for electric
30 devices with large-scale integrated circuits requires sophisticated skills. This is because some of the solder paste 13 already applied is easily scraped off with the edge of the squeegee 10 through such a large window as shown in FIG. 1B. This results in
35 unsatisfactory amount of solder paste applied on the circuit board. Such unsatisfactory solder amount will cause decrease in quality of circuit boards and also

the manufacturing yield.

On the other hand, if the pressure of the squeegee 10 to the solder paste 13 is low to overcome such problems, this also results in unsatisfactory amount of solder paste applied on the circuit board, particularly, for electric components arranged thereon with fine pitches.

SUMMARY OF THE INVENTION

10 A purpose of the present invention is to provide a squeegee for screen printing that offers reliable solder paste application for circuit boards with any scale of component integration.

The present invention provides a squeegee for screen printing having a metallic blade formed with depressions thereon for applying solder paste on a circuit board.

BRIEF DESCRIPTION OF DRAWINGS

15 FIGS. 1A and 1B illustrate a solder paste application process using a conventional squeegee;

FIG. 2 is a perspective view of a squeegee according to the present invention;

20 FIG. 3 is an enlarged plain view of a metallic blade of the squeegee shown in FIG. 2;

FIG. 4 is an enlarged plain view illustrating one step of a solder paste application process according to the present invention; and

25 FIGS. 5A, 5B and 5C further illustrate the solder paste application according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Preferred embodiments according to the present invention will be described with reference to the attached drawings.

30 As shown in FIG. 2, a squeegee 15 according to the present invention is provided with a metallic blade 20

that is attached to a holder 30 with a plate 40 by screws 50. The metallic blade 20 is made of an elastic plate, such as, 0.25 mm-thick SUS304.

The metallic blade 20 is formed with fine depressions 21 on a blade surface 20a by a chemical process, such as, photo-etching, as shown in FIGS. 3 and 4. The diameter and depth of the depressions 21 are preferably 150 μm , and 5 μm to 10 μm , respectively. The depressions 21 are systematically arranged with the pitch P of, for example, 250 μm in FIG. 3.

A solder paste 60 used in this invention is preferably composed of metallic particles 70 mixed with 10 wt% of flux 80. The metallic particles 70 are preferably eutectic alloys Sn-Pb of 15 μm to 50 μm in diameter or alloys of Sn-Pb-Bi8 or Sn-Pb-Bi13 of 25 μm to 45 μm in diameter. The viscosity of the solder paste 60 is preferably 200 $\pm$ 50 Pa. C., or 220 $\pm$ 30 Pa. C., obtained by experiment under the JIS-Z3284 standards.

The depth of each depression 21 is preferably smaller than the diameter of each metallic particle 70.

Illustrated in FIG. 4 and also FIGS. 5A to 5C is a process of application of the solder paste 60 composed of the metallic particles 70, that is, the eutectic alloys Sn-Pb of 15 μm to 50 μm mixed with 10 wt%-flux 80 having the viscosity of 200 $\pm$ 50 Pa. C., by using the squeegee 15.

The metallic blade 20 moves to apply the solder paste 60 provided over the blade surface 20a to the window 11a of the metallic mask 11 to fill it with the solder paste 60.

In detail, as shown in FIG. 5A, the metallic blade 20 moves in the direction of the arrow F to make the metallic particles 70 roll over the blade surface 20a and the depressions 21 formed thereon. During the movement of the metallic blade 20, some of the metallic particles 70 are embedded in the depressions 21, while the other particles 70 roll over the blade surface 20a

to confine the former in the depressions 21. This results in imbalance of velocity between the metallic particles 70 while moving.

5 The imbalance, that is, the relative difference in velocity between the metallic particles 70 due to the existence of the depressions 21 promotes thixotropy, that is, promotes softness of the flux 80 of the solder paste 60.

10 The solder paste 60 that is the mixture of the metal and the flux 80 is changed from an insoluble state (a gel) to a soluble state to soften the flux 80, which promotes the liquidity of the solder paste 60 over the blade surface 20a.

15 The metallic particles 70 thus smoothly roll over the blade surface 20a as the squeegee 15 moves. The window 11a of the metallic mask 11 is then filled enough with the solder paste 60 as shown in FIG. 5B.

20 When the solder paste application process is completed, as shown in FIG. 5C, the circuit board 12 is transferred downwardly with the solder paste 60 having the shape the same as the window 11a.

25 Resin of ethylene tetrafluoride coated over the blade surface 20a will increase the liquidity of the solder paste 60 over the surface 20a and the workability of the squeegee 15. The resin is preferably polytetrafluoroethylene (PTFE).

30 As disclosed above, the squeegee 15 having the fine depressions 21 formed on the blade surface 20a offers the solder paste 60 with the thickness the same as the metallic mask 11 without being scraped off even on a circuit board on which electric components are arranged with fine pitches.

35 The dimension of the depressions 21 and also the shape of the metallic particles 70 of the solder paste 60 are not limited to those described above but are decided according to the circumstance's demands.

As disclosed above, the squeegee having the fine

depressions formed on the entire blade surface according to the present invention, achieves smooth rolling of the metallic particles of the solder paste over the blade surface. This high workability of the
5 squeegee will provide circuit boards with high quality.



WHAT IS CLAIMED IS:

1. A squeegee for screen printing having a metallic blade formed with depressions thereon for applying solder paste on a circuit board.
2. The squeegee according to claim 1, wherein the metallic blade is made of an elastic plate.
3. The squeegee according to claim 1, wherein the metallic blade is coated with resin of ethylene tetrafluoride.
4. The squeegee according to claim 1, wherein the metallic blade is coated with polytetrafluoroethylene.
5. The squeegee according to claim 1, wherein the depressions are formed by etching.
6. The squeegee according to claim 1, wherein the depth of the depressions is smaller than the diameter of metallic particles included in the solder paste.

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