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DEVICE AND PROCESS FOR APPLYING SOLDER TO PRINTED
CIRCUIT BOARDS

The present invention relates to a device and process for applying solder to printed circuit boards.

In a known device of this type, the guide system consists of two vertical guide rails, each of which has a U-shaped guide channel (German Offenlegungsschrift 2,411,854). The printed circuit boards are guided and also held in these guide channels on two narrow sides lying opposite one another. The guide rails extend from the soldering bath upwards past blast nozzles, out of which flows a jet of hot air directed against the faces of the printed circuit boards drawn out of the soldering bath. By means of these air jets, excess solder is removed from the passing printed circuit board and, in addition, solder is also cleared from the through-holes in this printed circuit board. To enable the printed circuit boards to be held and guided perfectly, above all during the time when they are subjected to the jets of hot air, the width of the guide channels is selected so that it corresponds approximately to the thickness of the printed circuit boards.

This necessitates a very precise and, consequently, expensive positioning of the printed circuit boards for the purpose of introduction into the guide channels. Moreover, printed circuit boards which are slightly curved can be introduced only with difficulty or even not at all. Furthermore, it is necessary to change over or replace the guide rails every time for processing printed circuit boards of different widths or thicknesses. Since the printed circuit boards experience softening in the hot

soldering bath, there is also the danger, due to the close-fitting lateral guidance, that the printed circuit boards leaving the soldering bath and not yet resistant to mechanical stress will be damaged.

5 The present invention intends to avoid the disadvantages mentioned above. Its object is therefore to provide a device or a process of the type mentioned in the introduction, in which printed circuit boards of different widths and thicknesses and also printed
10 circuit boards which are not exactly flat can be introduced into the soldering bath without the need for very precise positioning and, consequently, at a high working speed, the printed circuit boards nevertheless being guided and held perfectly during their movement
15 and not being exposed to the danger of damage.

 The present invention provides a device for applying solder to printed circuit boards, the device comprising a solder-bath vessel having an open upper end for receiving a printed circuit board moved
20 downwardly into the vessel, and guide means for guiding the printed circuit board into the vessel, the guide means comprising downwardly extending rods arranged in two generally parallel spaced rows within the vessel, the rods being spaced within the rows, whereby a
25 printed circuit board can be closely, but loosely received over its entire width between the rows with each row guiding a respective face of the printed circuit board, the guide means being mounted in the vessel so as not to impede contact of solder in the
30 vessel with the edges of the printed circuit board.

 Because of the resulting multiplicity of guide points, good guidance is ensured, without continuous

mechanical contact between the printed circuit boards and the guide means being necessary. In addition, there is no longer any need for very precise positioning of the printed circuit boards, as was required for introduction into guide rails. Even somewhat curved printed circuit boards can be introduced and guided without difficulty. The danger of damaging the printed circuit boards is thereby largely avoided. Moreover, there is no longer any need to adapt the guide means to different plate widths or thicknesses.

The invention also resides in a process for applying solder to a printed circuit board, said process comprising: vertically downwardly introducing a printed circuit board into the solder bath vessel containing a solder bath in a device as defined above, thereby applying solder to said printed circuit board, and then vertically upwardly withdrawing said printed circuit board from said solder bath through said open upper end of said solder bath container; the board being inserted between the two rows of rods and withdrawn from between said rods said vertically downward and upward movements being guided by said rods by loose contact with only opposite sides of said printed circuit board and without contact with lateral edges thereof.

The device according to the invention provides a technically advantageous solution to the particularly critical phase of removing the particular printed circuit board from the soldering bath vessel. This phase is critical for two reasons. First, because of the relatively high temperature of the soldering bath, the base material of the printed circuit boards softens, so that the printed circuit boards, on being

drawn out of the device, are particularly prone to suffer damage, for example by bending or the like. Secondly, the warm air jets which, when the particular printed circuit board is being drawn out, act on both the broad faces of the board, can cause the printed circuit board to vibrate and this can cause the board to strike against parts of the devices involved and thereby to suffer damage. The reason why the warm air jets can cause the particular printed circuit board to vibrate is because the blast nozzles are arranged, staggered relative to one another in a vertical direction, on either side of the transport path of the printed circuit boards. This staggering is necessary because, if the blast nozzles were arranged precisely opposite one another, their jets would substantially cancel out on blowing through side-to-side holes in the particular printed circuit board and accordingly such holes in the printed circuit board would only be freed unsatisfactorily from excess solder.

The process according to the invention, and the device designed for it, now ensure that on removing the particular printed circuit board, the latter is stabilised in relation to the air jets which act, in a vertically staggered manner, on the two broad faces of the printed circuit board.

Reference is now made to the accompanying diagrammatic drawing in which:

Figure 1 shows, in a cross-section, a device for tinning printed circuit boards; and

Figure 2 shows a longitudinal section through the tinning device along the line II-II of Figure 1.

The design and mode of operation of the tinning device for printed circuit boards will now be described

with reference to the Figures. "Tinning" signifies below not only the application of a lead/tin alloy, but also that of any suitable solder of another type.

5 The tinning device has a housing designated by 1, which is closed at the top by a cover 2. In this cover 2. there is a slit-like orifice 3 for the printed circuit boards. A soldering-bath vessel 4 which is open towards the orifice 3 and closed at the bottom by a sieve plate 5 is located in the lower part 1a of the housing 1. The interior of the soldering-bath vessel 4 is connected via this sieve plate 5 to a distributing chamber 6 provided on the bottom of the lower part 1a of the housing. The actual soldering bath 7 is located in the soldering-bath vessel 4. A collecting space 8 for the solder is formed between the walls 4a of the soldering-bath vessel 4 and the walls 1b of the lower part 1a of the housing. By means of a pump (not shown), the solder is conveyed from the distributing chamber 6 upwards through the soldering-bath vessel 4. The solder subsequently flows over the upper edge of the vessel walls 4a into the collecting space 8, from which it then passes again into the distributing chamber 6. The heating system of a design known per se, which is required for heating the solder, is not illustrated. When the pump is at a standstill, the level S of the soldering bath lies underneath the upper margin of

the walls 4a of the soldering-bath vessel 4, as illustrated in the Figures.

Guides 9, distributed at a distance from one another over the width of the soldering-bath vessel 4, are located in the interior of the soldering-bath vessel 4, as emerges from Figure 2 in which a part of the housing is not illustrated at the bottom and on the right-hand side. Each of these guides 9 is formed by two rod-shaped guide elements 10 and 11 which are located opposite one another at a distance and which are connected to one another at their lower end, as is evident especially from Figure 1. The thus clip-shaped guides 9 extend into the region of the sieve plate 5 of the soldering-bath vessel 4 and project above the level S of the soldering bath. The rod-shaped guide elements 10, 11 are each provided with a bent-out portion 12 and 13 respectively at the end of their upper end section 10a and 11a respectively. As Figure 1 shows, the bent-out portion 12, 13 of each guide element 10, 11 projects towards the opposite guide element 10 and 11 respectively, so that a narrowing 14 of the gap 15 between these two guide elements 10, 11 is established by these bent-out portions 12, 13 of the guide elements 10, 11 located opposite one another.

The upper end sections 10a, 11a, projecting upwards out of the soldering bath 7, of the guide elements 10 and 11 respectively can be spread apart from one another resiliently and, for this purpose, are each supported on a fixedly held supporting spring 16 or 17 respectively. In the region of the level S of the soldering bath, mountings 18 and 19 respectively, in which the guides 9, that is to say the guide elements 10 and 11, are held, are attached to the inner side of the opposite walls 4a of the soldering-bath vessel 4. Instead of a single mounting 18 or 19 respectively for the guide elements 10 and 11 respectively, it is also possible to provide for each guide element 10 and 11 respectively a special mounting which is fastened to the vessel wall 4a. The mountings 18, 19 are attached

to the walls 4a at such a height that, when the pump is at a standstill, they project a little above the solder level S, so that the seating of the guides 9 in these mountings 18, 19 can be checked at any time.

Located above the guides 9 are two blast nozzles 20 and 21 which extend over the entire width of the soldering-bath vessel 4 and which establish between them a gap 22 aligned with the narrowing 14. As is described in more detail, for example, in German Offenlegungsschrift 2,411,854, these blast nozzles 20, 21 are connected to a hot-air source.

Arranged parallel to the two blast nozzles 20, 21 are two semi-circular troughs 32, 33 which extend preferably over the entire width of the soldering-bath vessel 4 and in which the excess solder removed by the jet of hot air is captured. Located in each of the troughs 32, 33 is a worm gear (not shown) by means of which the excess solder is discharged laterally from the installation, preferably continuously, before it solidifies.

Above the two blast nozzles 20, 21 there are two guide members 23 and 24 which run parallel to one another and which also extend over the width of the soldering-bath vessel 4 and parallel to the blast nozzles 20, 21. Each of these guide members 23, 24 has a support bar 25 and 26 respectively, on which sit guide discs 27 and 28 respectively at a distance from one another (see especially Figure 2). The guide discs 27, 28 can be bent out resiliently. The guide members 23, 24 establish between them a through-orifice 29 which is aligned with the orifice 3 in the housing cover 2 and with the gap 22 between the blast nozzles 20, 21.

A printed circuit board 30 which is held by a gripper 31 indicated only diagrammatically is represented by dot-and-dash lines.

The mode of operation of the tinning device described is as follows:

The printed circuit board 30 grasped at the outset in a known way by the gripper 31 is introduced

into the device through the orifice 3 in the housing cover 2 and passes through between the two guide members 23 and 24. The function of these guide members 23, 24 is to guide curved printed circuit boards 30, without damage to these, between the blast nozzles 20, 21 to the guides 9. Subsequently, the printed circuit board 30 passes through the narrowing 14 between the opposing guide elements 10, 11 into the gap 15 between these guide elements 10, 11. The width of this narrowing 14 is somewhat greater than the thickness of the printed circuit board 30, so that, if the latter is completely flat, it can be guided without contact between the bent-out portions 12, 13 of the guide elements 10 and 11. The upper end sections 10a, 11a of the guide elements 10 and 11 are pressed apart from one another by the gripper 31 and subsequently, as a result of their natural elasticity and/or under the action of the supporting springs 16, 17, spring back again into their original position. When curved boards are introduced, the end sections 10a, 11a can also spread open, thus permitting the introduction of even curved boards, without these boards being damaged by the guide elements 10, 11.

After it has passed through the narrowing 14, the printed circuit board 30 passes into the gap 15 between the guide elements 10, 11, which is considerably larger than the thickness of the printed circuit board 30. In the soldering bath 7 solder is applied to the printed circuit board 30 in a known way.

Since, as already mentioned, the guides 9 extend into the region of the sieve plate 5, even curved boards are held by these guides 9 essentially in the centre of the soldering-bath vessel 4. These guides 9 therefore prevent the possibility of the printed circuit board 30 coming in contact with the wall 4a of the soldering-bath vessel 4. As Figure 1 shows, the guide elements 10 and 11 converge towards the bottom, as a result of which the gap 15 between these guide elements 10, 11 becomes correspondingly narrower. This measure contributes additionally to perfect positioning of even curved

printed circuit boards 30 in the middle of the soldering-bath vessel 4.

After the tinning process has ended, the printed circuit board 30 is drawn out again from the soldering bath 7 in a known way. During this time, it is moved through the narrowing 14 and between the blast nozzles 20 and 21. During this movement, the printed circuit board 30 is subjected on both sides to jets of hot air flowing out of the blast nozzles 20 and 21. By means of these jets of hot air, excess solder is removed, and solder is cleared from the through-holes in the printed circuit board 30, as is described in detail, for example, in German Offenlegungsschrift 2,411,854 already mentioned. After this removal of excess solder, the printed circuit board 30 is taken out of the device via the through-orifice 29 and the housing orifice 3.

As a result of the guide elements 10, 11 which are present on both sides of the printed circuit board 30 and which are distributed respectively at a distance from one another over the width of the printed circuit board 30 to form a row in each case, several guide points are formed, and these guarantee sufficient guidance and positioning, without continuous mechanical contact between the printed circuit board 30 and the guide elements 10, 11 being necessary. As already mentioned, the width of the narrowing 14 is somewhat greater than the thickness of the printed circuit board 30, so that, as a rule, the guide elements 10, 11, that is to say their bent-out portions 12, 13, do not rest on the printed circuit board 30. Since the upper end sections 10a, 11a of the guide elements 10, 11 can be bent out resiliently, these end sections 10a, 11a can be deflected elastically, if the printed circuit board 30 strikes against these bent-out portions 12, 13. The printed circuit board 30 is guided exactly on the one hand, and, on the other hand, damage caused by the guides 9 is prevented, since these guides 9 offer no firm mechanical resistance to the printed circuit board 30.

Underneath the narrowing 14, the distance between

the opposing guide elements 10, 11 becomes greater. This means that underneath this narrowing 14 there is normally no contact between the printed circuit board 30 and the guide elements 10, 11. The printed circuit board 30 is therefore freely accessible on all sides in the soldering bath 7 and is nowhere covered by the guides 9.

On removing the particular printed circuit board from the soldering-bath vessel 4 the upper end sections 10a, 11a of the guide elements 10, 11 act, in a particularly advantageous manner, as stabilising elements which prevent the printed circuit board from being caused to vibrate by the warm air jets from the vertically staggered blast nozzles 20 and 21, which vibrations would otherwise cause the printed circuit board, which in this phase in particular is especially sensitive, to strike against parts of the device involved and thereby to suffer damage. To achieve the desired stabilisation of the particular printed circuit board when it is being removed, the upper end sections 10a, 11a of the guide elements 10, 11 extend as far as possible into the inter-space 22 between the two blast nozzles 20 and 21 which are somewhat staggered relative to one another in the vertical direction. Furthermore, the upper end sections 10a, 11a of the guide elements 10, 11 are constructed so as to be resilient in the direction at right angles to the broad faces of the printed circuit boards being passed through, so that whilst each printed circuit board is stabilised by these means, damage because of the printed circuit board striking the upper end sections 10a, 11a of the guide elements 10, 11 is avoided. Finally, in order to achieve the desired stabilisation of the particular printed circuit board to be removed from the soldering bath, the width of the gap 14 between the upper end sections 10a, 11a of the guide elements 10, 11 or the bent-out portions 12, 13 provided there is appropriately chosen and set.

Since the guides 9 act on the front and rear sides of the printed circuit board 30 and since the

printed circuit board 30 consequently does not need to be guided at its margins, there is no longer any need for precise lateral positioning, and printed circuit boards 30 of different widths can be processed without an adjustment of the guides 9 being necessary.

It goes without saying that the tinning device described can, in various parts, have a different design from that shown. Of the possible alternative forms, only a few are mentioned below.

The width of the gap between the bent-out portions 12, 13, that is to say the width of the narrowing 14, can be changed by varying the force which is exerted by the supporting springs 16, 17 on the upper end sections 10a, 11a. This can be achieved, for example, by the use of supporting springs 16, 17 with different spring characteristics. If the upper end sections 10a, 11a of the guide elements 10, 11 have the necessary resilient properties, it is possible to do without the supporting springs 16, 17 under certain circumstances.

Because the guide elements 10, 11 are located opposite one another in pairs and connected to one another, an especially advantageous design is obtained both in terms of manufacture and in terms of operation and maintenance. It is also possible, however, not to connect the opposing guide elements 10, 11 to one another at their lower end. Furthermore, the guide elements 10 can be offset laterally in relation to the guide elements 11, so that these guide elements 10, 11 no longer lie directly opposite one another in respect of the printed circuit board 30.

CLAIMS

1. Device for applying solder to printed circuit boards, the device comprising a solder-bath vessel having an open upper end for receiving a printed circuit board moved downwardly into the vessel, and
5 guide means for guiding the printed circuit board into the vessel, the guide means comprising downwardly extending rods arranged in two generally parallel spaced rows within the vessel, the rods being spaced within the rows, whereby a printed circuit board can be
10 closely, but loosely received over its entire width between the rows with each row guiding a respective face of the printed circuit board, the guide means being mounted in the vessel so as not to impede contact of solder in the vessel with the edges of the printed
15 circuit board.
2. Device according to Claim 1, wherein the distance between the rows of rods diminishes downwardly.
3. Device according to Claim 1 or 2, wherein each rod in each row is located directly opposite a
20 corresponding rod in the other row, to form a pair of rods.
4. Device according to Claim 3, wherein each rod is connected at its lower end to said corresponding rod in the respective pair.
- 25 5. Device according to Claim 3 or 4, wherein each rod has an upper end portion which is resiliently biased towards the upper end portion of said corresponding rod in the respective pair.
6. Device according to Claim 5, wherein the upper end
30 section of each rod is biased by spring means.



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7. Device according to any preceding claim, wherein the upper end portions of the rods in each pair define a narrowing of the distance between the two rows of rods.

5 8. Device according to Claim 7, wherein the narrowing is formed by the upper end portions in each pair of rods being bent towards each other.

9. Device according to any preceding claim, wherein the rods are supported by mountings located in the
10 region of the solder bath level.

10. Device according to any preceding claim comprising two opposing guide members located above said rods and forming a gap therebetween for passage of the printed circuit boards.

15 11. Device according to Claim 10, in which each guide member has a number of disc-shaped guides mounted on a rod-shaped carrier and axially spaced from one another, each carrier extending parallel to the rows of rods.

20 12. Device according to Claim 10 or 11, having two spaced blast-nozzle arrangements for removing excess solder from the printed circuit boards, the guide members being located above the blast-nozzle arrangements, and the gap between the guide members being aligned with the space between the blast-nozzle
25 arrangements.

30 13. Device according to Claim 12, or any one of Claims 1 to 11, in which two opposing blast-nozzle arrangements are provided for removing excess solder from the printed circuit boards, comprising semi-circular troughs for receiving the excess solder and work gears for removing the solder in its molten state.

35 14. Device for applying solder to printed circuit boards, substantially as herein described with



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reference to the accompanying drawings.

15. A process for applying solder to a printed circuit board, said process comprising: vertically downwardly introducing a printed circuit board into the solder bath vessel containing a solder bath in a device according to any one of Claims 1 to 14, thereby applying solder to said printed circuit board, and then vertically upwardly withdrawing said printed circuit board from said solder bath through said open upper end of said solder bath container; the board being inserted between the two rows of rods and withdrawn from between said rods, said vertically downward and upward movements being guided by said rods by loose contact with only opposite sides of said printed circuit board and without contact with lateral edges thereof.

16. A process according to Claim 15, substantially as herein described with reference to the accompanying drawings.

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