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System for processing electrical or  
electronic components

The present invention relates generally to a system for processing electrical or electronic components. In particular, the invention relates to: apparatus for processing generally flat bodies each comprising at least one electrical or electronic component; to a carrier for such components; and to a magazine for such components.

There are now becoming increasingly popular "plastic leadless chip carriers", known as "PLCC's", and "small outline integrated circuits" known as "SOIC's". These are formed from "quad flat packs" which have a relatively flat body, rectangular in plan view, and with leads projecting from all four sides in the same plane as the flat body. The leads, normally of copper, are bent to the required shape so as to form either a PLCC or an SOIC. Such quad flat packs are typically provided in strip form with a continuous metal edge along each longitudinal edge of the strip. The strips may for example be about 15 to 20 cm long and about 1 to 8 cm wide.

It is known to apply solder to the leads of such components after the leads have been bent to the required shape by immersion in a bath of molten solder. Alternatively, an electroplating method can be used to coat the leads of the components before bending of the leads.

The manufacturers of these strips generally put stacks of about 100 strips in suitable magazines for ease of transport and storage. In order to coat the leads of the components, the individual strips are removed from the magazines to allow the strips to be dipped into a suitable bath of solder or plating solution. One known apparatus for this purpose has a

robotic arm which picks up a strip from the top of a magazine, using a pneumatically operated suction device, and conveys the strip to a clip provided on a conveyor belt. The magazine is spring loaded so that a strip is always available at the top of the magazine. The clips on the conveyor belt are arranged to grip the tops of the strips on two opposing faces thereof.

This apparatus suffers a number of disadvantages. One disadvantage is the relatively long cycle time of the robotic arm, ie. the time taken to complete one cycle of picking up a strip, delivering it to the conveyor belt, and returning to pick up the next strip. The cycle time is typically 2-5 seconds. This cycle time is partially the result of using a pneumatically operated device which is inherently slow. The relatively long cycle time means that the apparatus as a whole, taking into account subsequent processing stages, may not operate at its maximum efficiency in that the rate of supply of strips may be less than the maximum processing capacity of later stages of the apparatus.

Additionally, this apparatus is not always reliable as the magazine is relatively complex and prone to problems. The mechanism for ensuring that there is always a strip at the top of the magazine sometimes malfunctions so that the strip is either below or above its correct position. In such circumstances, it is difficult, if not impossible, for the robotic arm to pick up the strip.

According to one aspect of the invention, there is provided an apparatus for processing generally flat bodies each comprising at least one electrical or electronic component, the apparatus comprising means for receiving a stack of component bodies and means for removing a component body from the bottom of said stack.

By removing a strip from the bottom of the stack thereof, gravity ensures that each successive component body drops into the right position to be removed easily

from the stack. The component bodies can thus be removed reliably and quickly. In particular, in one preferred embodiment of the present invention, eight component bodies can be removed from a stack each second, representing a considerable improvement over the 2-5 second cycle time of the known arrangement.

The apparatus of the invention is particularly useful for processing component bodies in the form of strips of components.

Preferably the removing means comprises at least one projection which is arranged to move below the stack to thereby remove a component body. Thus, the at least one projection need only move below the stack in order to remove a component body from the stack, whereby the use of pneumatic suction cups is avoided. The projection may project laterally below the stack, but preferably it projects upwardly. Thus, in a preferred embodiment at least one projection projects upwardly and has a height which is substantially equal to or less than that of each component body so that the component bodies can be removed one by one from the stack. To avoid problems with tolerances, the projection may for example have a height which is 10-20% less than that of a single component body.

The at least one projection may be arranged on conveying means, for example an endless belt or chain conveyer, which is arranged to move below or to one side of the stack. The provision of such conveying means allows the component bodies to be quickly and easily removed from the stack. In the case where the conveying means moves below the stack, the projection will normally project upwardly, whereas if the conveying means moves to one side of the stack, the projection will normally project laterally below the stack. One or more, but preferably two such conveying means can be used, each having at least one projection. In a preferred embodiment, a pair of spaced apart parallel

conveying means are provided. In use, they are driven at the same speed and with their projections in lateral alignment. Preferably a plurality of projections are provided on the conveying means so that component bodies can be successively removed from the bottom of the stack. The spacing between successive projections may be substantially equal to or greater than the dimension of each component body in the conveying direction.

In order to stabilise a stack during removal of the bottom component body, stabilising means may be provided. A preferred embodiment comprises stabilising means in front of the stack and against which the stack engages during removal of the bottom component body, a gap being provided below the stabilising means to allow the bottom component body to pass thereunder. The stabilising means may for example be a plurality of stabilising poles which extend vertically next to the stack. These can stabilise the stack to prevent it from toppling over. For example two such poles may be arranged in front of the stack and two behind it.

As the apparatus may now achieve greater processing speeds as compared with the prior art arrangements, the stack of strips may be used up quickly. Accordingly, it is preferred that the apparatus is arranged to accommodate a plurality of stacks which can be successively used. Thus, the supply of stacks may be replenished without disturbing the operation of the apparatus. Preferably, therefore, the receiving means is arranged to receive a plurality of stacks of component bodies and to advance a stack for component body removal when the component bodies of a previous stack have been removed. In one preferred embodiment, stacks are advanced by the stabilising poles behind the stack, which stabilising poles may be provided on an endless chain conveyor or the like.

A component body carrier is preferably arranged to receive a component body which has been removed from the

bottom of a stack. Once a component body has been removed from the bottom of the stack, it may be deposited directly on the carrier for further processing. It is preferred however that the conveying means on which the at least one projection is arranged also transports the component bodies to the carrier therefor. Thus, advantageously, the conveying means both removes the component bodies and transports them onwards.

The component body carrier preferably comprises first and second supports for engaging at least part of opposite edges of a said component body, at least one of the supports being resiliently urged towards the other for securing the component body. This allows the component body to be firmly held and allows a range of differently sized component bodies to be carried.

The component body carrier is preferably supported on an endless chain. Thus, component bodies held at their edges can be conveniently transported whilst being subjected to desired processing steps, for example electroplating. Such an advantageous carrier could in fact be loaded by arrangements other than that described above and accordingly the carrier is inventive in its own right.

According to a second aspect of the invention, therefore, there is provided a carrier for a generally flat body comprising at least one electrical or electronic component, the carrier comprising a plurality of holders, each holder having an upper support member and a lower support member and biasing means for urging at least one of the support members towards the other, the component body being supported at locations along opposite edges thereof by the upper and lower support members, the holders being supported by link members of an endless chain. One or two individual holders may for example be provided on each chain link.

Where the component bodies are to be treated by an

electroplating process, whilst held by the carrier, it is necessary to supply an electric current to the components. Accordingly it is preferred that at least one of the support members is arranged to conduct current to the strip. The support member may be coupled to a strip of conducting spring metal, which when urged into contact with an electric current supply member, supplies electric current via the support member to the component body. In one preferred embodiment, the spring metal strip may be wrapped around a support member and protrude from a link of the chain so that when the chain passes the current supply member, the spring metal strip is urged into contact therewith. In such circumstances, the chain links should be made of or be coated with a suitable insulating material. Current may be supplied via both the upper and the lower support members, but in practice this is not necessary and it may be convenient for only one set of support members to perform this function.

It will of course be appreciated that the component body carrier can be used to support the component bodies for any desired processing step.

A magazine will normally be used to transport a stack of generally flat component bodies to the processing apparatus. As the size of the component bodies, for example the width of a strip of integrated circuit components, may vary, separate magazines have to be provided for each size of component body which can be inconvenient as a range of differently sized magazines need to be kept in stock.

According to a third aspect of the invention there is provided a magazine for retaining a stack of generally flat bodies comprising at least one electrical or electronic component, said magazine having engaging means for engaging opposite edges of the component bodies in the stack, the engaging means being adjustable to accommodate differently sized component bodies.

Such a magazine can be used to retain a range of differently sized component bodies, thus reducing the number of different sizes of magazines required to one.

Preferably, the magazine has an end via which the component bodies are loadable into the magazine, and blocking means arranged to block said end to retain the component bodies in the magazine. Thus, the magazine may be loaded and unloaded via the end when it is unblocked. The magazine may be held with the end uppermost for loading and subsequently be inverted for unloading.

Preferably, the engaging means comprises a pair of opposed legs movable into engagement with the opposite edges of the component bodies, and the blocking means comprises a pair of opposed feet provided on the respective legs for blocking said end of the magazine. With such an arrangement, the engaging and blocking means are operable simultaneously. When it is desired to unload the magazine, the legs are disengaged from the edges of the component bodies, so as to minimise the risk of damage as the bodies and the magazine undergo relative movement.

The engaging means may be linearly slidable, for example laterally of a stack of strips. Preferably, however, the engaging means is pivotable about an axis perpendicular to the faces of the component bodies. Where the engaging means comprises a pair of opposed legs, such a pivoting movement can conveniently bring each leg into engagement with the opposite edges of the component bodies. Although there may be just one engaging means, preferably two or more are provided. If two pivotable engaging means are provided, they are preferably brought into engagement with the component bodies by being pivoted in opposite directions.

Certain preferred embodiments of the present invention will now be described by way of example and with reference to the accompanying drawings in which:

Figure 1 is a perspective view of an apparatus for processing strips of integrated circuit components;

Figure 2 is a side view of part of the apparatus of Figure 1;

Figure 3 is a perspective view of a strip carrier;

Figure 4 is a cross-sectional view along line IV-IV of Figure 3 illustrating how electric current is supplied to the strip carrier;

Figure 5 is a schematic plan view showing how a strip is moved to and positioned in the strip carrier, showing the strip at positions A, B, C and D;

Figure 6 shows cross-sectional views of the strip at positions A, B, C and D;

Figure 7 is a perspective view of a second embodiment of the strip processing apparatus, provides a continual supply of vertical stacks of strips;

Figure 8 is a plan view of the apparatus of Figure 7;

Figure 9 is a perspective view of a magazine for a stack of strips;

Figure 10a shows a plan view of the magazine of Figure 9;

Figures 10b and 10c show plan views of the magazine of Figure 9, when containing a stack of relatively wide and relatively thin strips respectively; and

Figure 11 is a perspective view of an electroplating tank for electroplating the strips.

Reference will now be made to Figures 1 and 2 of the drawings which show strip processing apparatus 2 for delivering strips 4 of integrated circuits to a strip carrier 6. The strips are arranged in a vertical stack 8 which is located against a pair of stack stabilising poles 10, laterally spaced apart along the front longitudinal edges 12 of the strips. A pair of laterally spaced stabilising poles 10 is also provided behind the stack 8 (not shown in Figure 1), in order to ensure that it does not topple rearwardly. The stack 8

is supported by a pair of laterally spaced tracks 22 which extend forwardly to the strip carrier 6. Thus the stack is received on the tracks 22 between the front pair of poles 10 and the rear pair of poles. The four stabilising poles 10 are positioned by supports 16 such that the bottom ends 18 thereof are spaced upwardly from the tracks 22 so as to form respective front and rear gaps.

The strips 4 are conveyed to the strip carrier 6 by a pair of parallel endless linked chains 25 which are laterally spaced apart by a distance which is a little less than the length 24 of the strips 4. The chains 25 are driven in synchronization by drive sprockets 26 in planes parallel to the end faces 28 of the stack 8. Each chain 25 is provided with a number of projections 30 which are arranged with a spacing 32 which is greater than the width 34 of the strip 4. The projections 30 on each of the chains 25 are arranged to be transversely aligned such as shown in Figure 1. The projections 30 have a height above the tracks 22 which is equal to or slightly less than the height 38 of a strip 4.

In use, a stack 8 of strips is deposited between the stabilising poles 10. The strips 4 are conveyed, one at a time, from the bottom of the vertical stack 8 by the projections 30 on the chains 25 to the strip carrier 6. In particular, the chains 25 are driven in the direction of arrow A. Projections 30 on each of the two chains 25 come into contact, at the same time, with the rear longitudinal edge 14 of the strip 4 at the bottom of the stack 8. As the chains 25 continue to move in the direction of arrow A, the bottom strip 4 is pushed from below the stack by the projections 30, through the front gap below the front poles 10, and is conveyed to the strip carrier 6. The following pair of projections 30 then remove the next strip 4 and so on. Thus each strip is individually delivered to the strip carrier.

The strip carrier 6 will now be described in more detail with particular reference to Figures 1 and 3. The strips 4 are maintained in a vertical plane by a plurality of individual holders 42 which are mounted on the links 44 of an endless chain 46. In this embodiment, there are two holders 42 mounted on each link 44 and each strip is gripped at evenly spaced apart locations. Each holder 42 has an upper support member 48 and a lower support member 50 between which the opposed longitudinal edges 12 and 14 of the strip 4 are gripped.

The upper member 48 is surrounded along part of its length by an expansion spring 52 which biases the upper member 48 down towards the lower member 50. A T-bar 54 is provided on the upper member 48 against which the lower end of the spring 52 rests, the upper end of the spring 52 acting against the underside 56 of the respective link 44. The upper member 48 has an inverted V-shaped portion 58 at its lower end in which the upper longitudinal edge 14 of the strip 4 is accommodated.

The lower member 50 has a portion 59 which extends downwardly from the link 44, this portion 59 being spaced apart but parallel to the upper member 48. At the lower end of this portion 59, there is a generally V-shaped portion 62, which is substantially larger than that provided at the lower end of the upper member 48. The apex of both the V-shaped portion 62 and that of the inverted V-shaped portion 58 of each individual holder 42 lie along a vertical axis of the holder. The lower longitudinal edge 12 of the strip is supported in the base of this V-shaped portion 62, as shown in Figure 1.

A roller 64 is provided at the upper end 65 of the upper member 48 (omitted from Figure 1 but shown in Figure 3). The roller 64 contacts a cam track 66 which causes the upper member 48 to be lifted up and lowered so that a strip can be placed between the upper and lower members 48 and 50 and gripped. This latter

process will be described in more detail hereinafter.

With some embodiments of the invention, the strips 4, while held by the strip carrier 6, will undergo an electroplating process so as to coat the leads of the integrated circuit components. Accordingly the strips 4 will be conveyed by the chain 44 to a bath of plating solution through which the strips pass, while being held by the individual holders 44 (see Figure 11 and the description hereafter). In such situations, it is necessary to supply an electric current to the strips 4. The upper support member 48 is thus made from a conducting material. A spring metal contact 68 is wound around this upper support member 48 and is accommodated within the link 44. Part of this contact 68 is arranged to extend through a suitable slot 69 in the link 44. This contact 68 can be seen in Figures 3 and 4. When the chain 46, which is of a non-conducting material or is coated with an insulating material and which carries the holders 44, is driven past an electric power supply member 70, the contact 68 is urged into contact with this member as shown in Figure 4. Accordingly, an electric potential can thereby be provided via the upper support member 48 to the strips 4. It will be appreciated that an electric current can also be supplied to the lower member 50 if desired, but otherwise this member will be coated with or be made from a non-conductive material.

The method by which the strips 4 are positioned in the individual strip holders 44 will now be described with particular reference to Figures 5 and 6. The strips 4 are delivered to the strip carrier 6 as shown in Figures 1 and 2. The strips follow the downwardly curved front ends of the tracks 22 and in doing so move from a horizontal orientation towards a vertical orientation. The front longitudinal edge 12 of each strip drops into the base of the V-shaped portion 62 of the lower member 50 and the face of the strip nearest

the tracks 22 engages a guide bar 72 which is shown in Figures 5 and 6. As can be seen particularly clearly from Figure 5, the guide bar 72 is so shaped as to gradually bring the strip 4 from an angled orientation at position A to vertical orientation at position B. At position C, a jet of air is applied in the direction of arrow X against the face of the strip furthest from the guide bar 72. The combination of the guide bar 72 and the air jet ensures that the strip 4 remains vertical. The upper member 48 is then moved via the cam track 66 and roller 64 from a position in which it is raised to a position in which it is lowered so that the strip is firmly gripped between the upper and lower support members 48 and 50. Once the strip 4 has been gripped, there is no need to provide a guide bar 72 and the strip is then ready for subsequent processing, for example in an electroplating bath.

Figures 7 and 8 show a second embodiment of the strip processing apparatus, which provides for automatic supply of the stack of strips to the chains 25. In order to reduce the processing time for each strip, a number of stacks 108 are provided which can be used in succession. As before, a pair of front stabilising poles 110 are provided for engagement with the front edges 12 of the strips, to help maintain each stack 108 in a vertical configuration. However, the arrangement behind the stack 108 differs from that of the first embodiment, in that the apparatus further comprises a mechanism for receiving a plurality of stacks, to the rear of the chains 25.

The plural stack receiving means 111, or standby loader, comprises a plurality of longitudinally spaced stack advancing poles 112 mounted on a pair of laterally spaced chains 74. The poles 112 on one chain 74 are transversely aligned with the corresponding poles on the other belt. The chains 74 are driven in synchronization by drive sprockets 76 and move in a horizontal plane.

Again, the chains 74 are arranged to drive the stack 108 in the direction of arrow A. It should be noted that the pair of endless chains 25 having the projections 30 are arranged between the two chains 74.

The operation of the plural stack receiving means 111 will now be described. As before, chains 25 and their projections 30 are arranged so as to remove the bottom strip 4 from the stack 108A. The front stack 108A is arranged so that it is supported by the two locating poles 110 at the front and the two forwardmost stack advancing poles 112 at the rear (see Figure 8). Accordingly, when the projections 30 contact the strip at the bottom of stack 108A, the bottom strip can thereby be removed in the manner described previously. When the last strip of the stack has been removed, the chains 74 are indexed forward so that the next stack 108B is in position and strips can be removed therefrom. Accordingly, the stacks can be replenished without interrupting the operation of the apparatus.

Reference will now be made to Figures 9 and 10a which show a magazine 120 suitable for storing and transporting a stack of strips such as hereinbefore described. The magazine 120 has a horizontally disposed upper rectangular plate 128 formed with a pair of longitudinally spaced vertical holes through which two rods 126 extend vertically. The rods are attached, at the bottom ends thereof, to a stiffening collar 122 which is provided with a pair of inwardly directed stops 138 on each side thereof. To the plate 128, two strip engaging members 130 are pivotally attached so as to be pivotable about vertical axes. The engaging members 130 each have an upper portion 132, the axis of which extends parallel to the plane of the plate 128. The upper portions 132 are longer than the width of the plate 128 and are pivotally connected thereto. From each end of each upper portion 132 two leg portions 134 extend perpendicularly, these leg portions 134 being

parallel to the rods 126. At the end of each leg portion 134 is a foot 136. The feet 136 of each engaging member 130 extend in opposite directions to each other from their respective leg portions 134 and perpendicular to the upper portion 132 thereof.

The magazine can be adapted to hold stacks of differently sized strips 4. For example, Figure 10B shows the magazine adjusted for a stack of relatively wide strips, whilst Figure 10C shows the magazine adjusted for a stack of narrower strips. The magazine is initially in the position shown in Figures 9 and 10a, in which the leg portions 134 abut against their respective stops 138. The strips are then loaded into the magazine in the direction of arrow D. The magazine may be inverted to facilitate loading. The engaging members 130 are then pivoted in opposite directions so that the leg portions 134 thereof come into contact with the opposed edges of the strips 4, i.e. the sides of the stack of strips. The feet 136 of the retaining members 130 rest at least partially under the stack to thereby retain the stack in position.

Figure 10c shows how the magazine can be used with a stack of narrower strips. The retaining members 130 are again pivoted in opposite directions until the feet 136 catch under the bottom of the stack. The feet 136 hold the strips in position so that they can be easily transported.

The magazine is particularly useful for loading a stack 8 of strips between the locating poles 10 shown in Figure 2, or between the stack advancing poles 112 shown in Figures 7 and 8. Once the stack is in position, the engaging members 130 are turned to the release position shown in Figure 10A and the empty magazine is lifted to leave the stack in place.

Figure 11 shows a tank 80 for providing a bath of electroplating solution through which the strips carried by the strip carrier 6 may pass. The tank 80 has an

elongate inner cell 81 defined by longitudinal side walls 82 and end walls 83. The end walls are formed with respective slots 84 through which solution filling the inner cell escapes into outer cells 85. The solution passes to a reservoir from where it is pumped to the bottom of the inner cell 81 to maintain the required level therein. During electroplating, the chain 46 of the strip carrier 6 travels horizontally and the strips enter and leave the bath of solution via the slots 84 in the end walls.

Although the system shown in the drawings and described above is for handling components in the form of elongate strips, it will be appreciated that with appropriate modification the system may be used for processing other generally flat bodies each comprising at least one electrical or electronic component, which bodies may have a variety of shapes in plan view, e.g. square.



CLAIMS:

1. Apparatus for processing generally flat bodies each comprising at least one electrical or electronic component, the apparatus comprising means for receiving a stack of component bodies and means for removing a component body from the bottom of said stack.
2. Apparatus as claimed in claim 1, wherein said removing means comprises at least one projection which is arranged to move below the stack to thereby remove a component body.
3. Apparatus as claimed in claim 2, wherein the at least one projection projects upwardly.
4. Apparatus as claimed in claim 2 or 3, wherein the at least one projection is arranged on conveying means moveable below or to one side of said stack.
5. Apparatus as claimed in any preceding claim, comprising stabilising means in front of the stack and against which the stack engages during removal of the bottom component body, a gap being provided below the stabilising means to allow the bottom component body to pass thereunder.
6. Apparatus as claimed in any preceding claim, wherein the receiving means is arranged to receive a plurality of stacks of component bodies and to advance a stack for component body removal when the component bodies of a previous stack have been removed.
7. Apparatus as claimed in any preceding claim, further comprising a component body carrier arranged to receive a said component body which has been removed from the bottom of a said stack, the component body



carrier comprising first and second supports for engaging at least part of opposite edges of a said component body, at least one of the supports being resiliently urged towards the other for securing the component body.

8. Apparatus as claimed in claim 7, wherein said component body carrier is supported by an endless chain.

9. Apparatus as claimed in claim 7 or 8, comprising a guide member for engaging one face of a component body to guide it into position between the first and second supports, and means for directing pressurised gas against the opposite face of the component body to urge it towards the guide member.

10. A carrier for a generally flat body comprising at least one electrical or electronic component, the carrier comprising a plurality of holders, each holder having an upper support member and a lower support member and biasing means for urging at least one of the support members towards the other, the component body being supported at locations along opposite edges thereof by the upper and lower support members, the holders being supported by link members of an endless chain.

11. A carrier as claimed in claim 10, comprising camming means for urging one of the support members of each holder away from the other support member thereof, counter to the biasing means, as the said holder is advanced by the endless chain.

12. A magazine for retaining a stack of generally flat bodies each comprising at least one electrical or electronic component, said magazine having engaging means for engaging opposite edges of the component



bodies in the stack, the engaging means being adjustable to accommodate differently sized component bodies.

13. A magazine as claimed in claim 12, having an end via which the component bodies are loadable into the magazine, and blocking means arranged to block said end to retain the component bodies in the magazine.

14. A magazine as claimed in claim 13, wherein the engaging means comprises a pair of opposed legs movable into engagement with the opposite edges of the component bodies, and the blocking means comprises a pair of opposed feet provided on the respective legs for blocking said end of the magazine.

15. A magazine as claimed in claim 12, 13 or 14, wherein the engaging means is pivotable about an axis perpendicular to the faces of the component bodies.

16. A magazine as claimed in any of claims 12 to 15, comprising a pair of engaging means.

17. Apparatus for processing generally flat bodies each comprising at least one electrical or electronic component, substantially as hereinbefore described with reference to the accompanying drawings.

18. A carrier for a generally flat body comprising at least one electrical or electronic component, substantially as hereinbefore described with reference to the accompanying drawings.

19. A magazine for retaining a stack of generally flat bodies each comprising at least one electrical or electronic component, substantially as hereinbefore described with reference to the accompanying drawings.