

APPARATUS FOR AUTOMATICALLY TAPING
OR HANDLING ELECTRONIC COMPONENTS

The present invention relates to an apparatus for automatically taping or handling electronic components, and is suitable for automatically taping electronic components by which electronic components transferred from a preceding process are moved onto a base tape and fixed thereto with an adhesive tape.

Conventionally there was disclosed an apparatus for automatically taping radial lead type electronic components having wire type lead terminals in U.S. Patent No. 4,954,207. This apparatus is designed to tape electronic components whose terminals are previously fitted into nicks of a ground paper tape, and has three rotary drums. The electronic components arranged at an equal pitch by the paper tape are received on the outer peripheral surface of a first drum, wherein the lead terminals are extracted from the paper tape. The extracted electronic components are then moved onto a second drum, where the pitch of arrangement is changed. The electronic components are further moved onto a third drum, where the lead terminals are fixed between the base tape and the adhesive tape, thus completing the taping processes.

Since the above-described apparatus involves the process of extracting electronic components from the paper tape on the first drum, the construction of the

first drum has become complicated. Moreover, the electronic components may drop off or the lead terminals may be deformed when the extraction process is carried out at high speed, thus making obstacles to further enhancement in the speed of the apparatus as well as to the reliability.

Also, since the paper tape cannot be used again after extraction, there was a need for providing a fruitless process of abandoning the paper tape.

Furthermore, in the case of electronic components with plate-type lead terminals formed from sheet materials, since the electronic components are introduced into the taping apparatus in the form of discrete ones without being supported by the paper tape, the above automatic taping apparatus that depends on use of a paper tape may not be suitable.

Therefore the present invention aims to provide an apparatus capable of automatically taping electronic components without using paper tapes. The present invention also aims to provide an apparatus capable of handling or taping electronic components at high speed and high reliability. Furthermore, it is desired that the present invention provide an automatic taping apparatus capable of taping electronic components having plate-type lead terminals.

According to one aspect of the present invention there is provided an apparatus for automatically

handling electronic components, said apparatus comprising: a toothed timing belt having retainer grooves for retaining lead terminals of the electronic components; a rotary drum having a toothed pulley rotatably engaging the teeth of said timing belt; and means rotatable with the drum and including formations arranged such that as the drum and the timing belt move into engagement the lead terminals are lifted from the retainer grooves in the belt so as to be easily transferable to the drum.

According to another aspect of the present invention, there is provided an apparatus for automatically taping electronic components to fixedly hold their lead terminals between a base tape and an adhesive tape, said apparatus comprising: an endless timing belt for conveying said electronic components in an approximately horizontal direction, which has a plurality of retainer grooves formed on its outer peripheral surface in its widthwise direction for retaining said lead terminals and has internal teeth formed on its inner peripheral surface; a first rotary drum for receiving said electronic components from said timing belt, said drum having a toothed pulley to be engaged with said internal teeth of said timing belt and to rotate the belt with rotation of said drum, a pair of flanges provided on both sides of said toothed pulley said flanges being larger in diameter than said toothed pulley for guiding said belt

therebetween and retainer teeth formed on outer peripheral edges of said flanges for retaining said lead terminals, said retainer teeth defining a dedendum circle; a second rotary drum for receiving said electronic components from said first rotary drum, said second rotary drum being positioned adjacent said first rotary drum and having retainer teeth formed on its outer peripheral edge for retaining said lead terminals; a third rotary drum for receiving said electronic components from said second rotary drum, said third rotary drum being positioned adjacent said second rotary drum and having retainer teeth formed on its outer peripheral edge for retaining said lead terminals and having a base tape feed section adjoining said retainer teeth, said base tape feed section having an outer peripheral surface on which a base tape is fed; an adhesive tape feed drum being kept in pressure contact with said base tape feed section for applying an adhesive tape to said base tape with said lead terminals held therebetween; wherein the first rotary drum is arranged with the top of the dedendum circle being positioned above bottoms of said retainer grooves of said timing belt engaged with said toothed pulley, thereby lifting said lead terminals to be transferred from said retainer grooves onto said retainer teeth.

Whereas the electronic components are conveyed approximately in the horizontal direction as retained

on the retainer grooves of the timing belt, the components can be taken off upwardly from the retainer grooves. The timing belt is guided into between the flanges of the first rotary drum, where it is engaged with the toothed pulley provided inside of the drum, and rotates integrally therewith. Along the peripheral edges of the flanges the retainer teeth are formed at a pitch corresponding to the retainer grooves of the timing belt and the first rotary drum is arranged with the top of the dedendum circle of its retainer teeth being positioned above the bottoms of the retainer grooves of the timing belt engaged with the toothed pulley. Thus, in synchronization with the engagement of the timing belt with the toothed pulley, the electronic components retained by the timing belt are transferred onto the retainer teeth of the first rotary drum in such a manner that they are lifted by the retainer teeth. At this time, the lead terminals of the electronic components will not be deformed since they are subjected to little stress. Upon transferring the components from the timing belt onto the first rotary drum, feed pitch may be allowed to change to one for the taping at the following stage.

Next, the electronic components are transferred from the retainer teeth of the first rotary drum onto those of the second rotary drum. The second rotary drum serves to relay the electronic components from the first drum to the third drum.

Finally, the electronic components are transferred from the retainer teeth of the second drum onto those of the third drum. The base tape feed section is integrally provided on an outer peripheral portion adjoining the retainer teeth of the third rotary drum, for bringing the end portions of the lead terminals retained by the retainer teeth thereof into contact with or proximity to the base tape. This base tape feed section is pressure-contacted with the adhesive tape feed drum, which feeds the adhesive tape successively. Therefore, the end portions of the lead terminals are fixed between the base tape and the adhesive tape, thus completing the taping process.

According to an embodiment of the present invention, the process of extracting the lead terminals from paper tape on the first rotary drum has been eliminated, and so the construction of the first rotary drum can be simplified while the taping can be processed at higher speeds with greater reliability. In particular, since the electronic components are moved from the timing belt onto the first rotary drum only by being lifted, the lead terminals will not be subjected to any additional force, thus free from such defects as deformation.

Also, since a timing belt that allows itself to be used again many times is employed instead of ground paper tapes, it is possible to implement reduction in resources and to eliminate the disposal processing of

ground paper tapes.

The above and further features of the present invention are set forth with particularity in the appended claims and should become clearer from
5 consideration of the following detailed description of an exemplary embodiment of the invention given with reference to the accompanying drawings.

In the drawings:

FIG. 1 is an overall perspective view of the
10 automatic taping apparatus embodying the present invention;

FIG. 2 is a front view of the automatic taping apparatus of FIG. 1;

FIG. 3 is a perspective view of electronic
15 components retained by a timing belt of the automatic taping apparatus;

FIG. 4 is a sectional view taken along the line IV-IV of FIG. 2;

FIG. 5 is an enlarged view of the part where the
20 electronic components are moved from the timing belt onto a first drum of the automatic taping apparatus;

FIG. 6 is an enlarged view of the part where the
electronic components are moved from the first rotary drum onto a second rotary drum of the automatic taping
25 apparatus;

FIG. 7 is a sectional view taken along the line VII-VII of FIG. 2;

FIG. 8 is a sectional view taken along the line

VIII-VIII of FIG. 2; and

FIG. 9 is a sectional view taken along the line IX-IX of FIG. 2.

The automatic taping apparatus according to an embodiment of the present invention comprises a first rotary drum 10, a second rotary drum 20, and a third rotary drum 30, each of which rotates in the direction indicated by the arrows as shown in FIGS. 1 and 2, i.e. the first and the third drums 10 and 30 rotate in a same direction and the second drum 20 rotates in a direction opposite to that of the first and the third drums 10 and 30. The first drum 10 and the third

drum 30 are arranged so as to be approximately flush with each other, and the second drum 20 is arranged at an intermediate portion of the first and third drums 10 and 30 and slightly above the two drums. Radial-lead type electronic components 5 conveyed by a timing belt 1 are delivered through the first, the second and the third drums 10, 20 and 30, so that they are formed into a final taped product T. The timing belt 1 is formed endless, and on its inner circumferential surface there are provided internal teeth 2 at an equal pitch as shown in FIG. 3, while on its outer circumferential surface there are provided retainer grooves 3, each one set comprising three, in the widthwise direction. Three plate-type lead terminals 6 of each electronic component 5 are retained in the retainer grooves 3 in a horizontal state.

The timing belt 1 is driven in an approximately horizontal state while it is retaining the electronic components 5, leading to the first drum 10. The first drum 10, as shown in FIG. 4, has a toothed pulley 11 to engage with the internal teeth 2 of the timing belt 1 and a pair of flanges 12 and 13 being larger than the pulley 11 in diameter and fixed on the front and rear surfaces of the pulley 11. On the peripheral edges of the flanges 12 and 13 there are provided retainer teeth 12a and 13a, as shown in FIG. 5, at pitch P, approximately equal to pitch P, of

the retainer grooves 3 of the timing belt 1. Practically, the pitch P_1 of the retainer grooves 3 is set to one of lead terminals worked out from sheet materials (e.g. 12 mm), while the pitch P_2 of the retainer teeth 12a and 13a is set to another for taping treatment (e.g. 12.7 mm). The dedendum circle R_1 of the retainer teeth 12a and 13a is set so as to pass above the bottom level R_2 of the retainer grooves 3 of the timing belt 1, so that when the timing belt 1 is introduced between the flanges 12 and 13 of the first drum 10, the lead terminals of the electronic components 5 retained by the timing belt 1 are moved onto the retainer teeth 12a and 13a in such a manner that they are lifted. Simultaneously the pitch is changed from P_1 to P_2 .

The timing belt 1, after transferring the electronic component 5 onto the first drum 10, is steered to return to a portion, which is not shown, through a guide pulley 14.

The peripheral edge portion of the second drum 20, which is shaped like a disc, is fitted between the flanges 12 and 13, though the edge portion will not make contact with the timing belt 1. As shown in FIG. 6, retainer teeth 21 which are equal in pitch to the retainer teeth 12a and 13a of the first drum 10 are formed on the periphery of the second drum 20. The dedendum circle of the retainer teeth 12a and 13a and that of the teeth 21 are

arranged so as to be in proximity to each other, thus allowing the lead terminals 6 to be delivered in the tangential direction of the two dedendum circles. Since the retainer teeth 12a, 13a, and 21 are shaped in the form of involute curves, the lead terminals 6 may also be moved over in some directions other than the tangential direction.

The pitches of the retainer teeth 12a, 13a, and 21 are set so as to be equal to each other, that is, the pitch of arrangement of the electronic components 5 is not changed when they are moved from the first drum 10 onto the second drum 20. Therefore the clearance of engaging portions of the retainer teeth 12a, 13a, and 21 to which the lead terminals 6 are to be fitted can be reduced, while the backlash of the lead terminals 6 can be diminished, so that the retaining reliability can be enhanced.

In addition, just above the first drum 10 there is provided a sensor 22, which detects the presence of an electronic component 5 that has been transferred from the timing belt 1 onto the first drum 10. As a result of detection, when an electronic component 5 is retained by the retainer teeth of the first drum 10, the second drum 20 and the third drum 30 are made to rotate synchronously with the first drum 10, while when it is not, the second drum 20 and the third drum 30 are stopped. This arrangement allows the final taped product T₁ to be prevented from missing the

electronic component 5.

The second drum 20 rotates downward after having received the electronic component 5. Therefore, underneath the second drum 20 there are provided a front-and-rear pair of guide plates 24 to prevent the electronic component 5 from dropping down. On the top of guide plates 24 there are formed circular-arc guide surfaces 25 adjoining the dedendum circle of the retainer teeth 21 of the second drum 20, so that the lead terminals 6 are transferred toward the third drum 30 by the second drum 20 in such a manner that they slide over the guide surfaces 25 of the guide plates 24, as shown in FIG. 7.

The electronic component 5, moved by the second drum 20, is then transferred onto the third drum 30. This transference is carried out in the same manner as in the case between the first drum 10 and the second drum 20, which is illustrated in FIG. 6. More specifically, as shown in FIG. 8, the third drum 30 is provided with a front-and-rear pair of flanges 31 and 32, both of which are provided at their peripheral edges with retainer grooves 31a and 32a being equal in both shape and pitch to the retainer teeth 12a and 13a of the first drum 10. The peripheral portion of the second drum 20 is fitted between the flanges 31 and 32, thereby allowing the electronic component 5 retained by the retainer teeth 21 of the second drum 20 to be

transferred onto the retainer grooves 31a and 32a of the third drum 30. The third drum 30 is provided with a base tape feed section 33 behind the rear-side flange 32 so as to be integrated with the flange 32. A base tape T_1 fed from below is wound around the peripheral surface of the feed section 33. The gap between the dedendum circle of the retainer grooves 31a and 32a and the peripheral surface of feed section 33 is set so as to be equal or slightly smaller than the thickness of the base tape T_1 , such that the end portions of the lead terminals 6 retained by the retainer grooves 31a and 32a are set onto the surface of the base tape T_1 .

On the front side of the third drum 30, a circular-arc head presser plate 35 is held so as to be shiftable in the front-to-rear direction, in such a way that the plate 35 serves to push the top of the electronic component 5 toward the third drum 30 by a spring 36, as shown in FIG. 8. By this arrangement, the electronic component 5 is pushed until root portions 6a of the lead terminals 6 (see FIG. 3) make contact with the front-side flange 31 of the third drum 30, so that protruding length L of the lead terminals 6 that protrude from the rear-side flange 32 toward the rear side is set to a specified value.

An adhesive tape feed drum 40 is press-contacted with the feed section 33. The drum 40 is a drum that feeds

an adhesive tape T_1 from a tape feed means, not shown, with its adhesive face outward. This drum serves to make the adhesive tape T_1 adhere to the base tape T_2 , thereby fixing the lead terminals 6 between the two tapes T_1 and T_2 . The taped product T_3 in which the electronic component 5 has been fixed is transferred to the subsequent process via a press roller 42. In addition, a gear wheel 41 is fixed to the rear side of the drum 40 as shown in FIG. 9. Since the gear wheel 41 is engaged with a gear wheel 34 fixed to the rear side of the third drum 30, the feed section 33 and the drum 40 synchronously rotate at an equal circumferential speed, thus preventing any wrinkles between the base tape T_2 and the adhesive tape T_1 .

Moreover, the insertion width of the lead terminals 6 into the taped product T_3 (i.e. protruding length of the lead terminals 6) may be changed by causing the front-side flange 31 of the third drum 30 to move in the forward direction. More specifically, the front-side flange 31 of the third drum 30 is divided into five portions 31b in the circumferential direction, each part being held by two axes 50 and 51 so as to be movable in the rear-to-front direction and also being urged toward the rear side by springs 52 and 53 set around the axes 50 and 51, respectively. The ends of the axes 50 and 51 are coupled by a coupler member 54, to which a cam follower 54a is

mounted in a rotatable manner. This cam follower 54a is kept in press-contact with a cam surface 55 provided at a fixed portion by the urging force of the springs 52 and 53.

Since the cam follower 54a rolls on the cam surface 55 as the third drum 30 rotates, each portion 31a of the front-side flange 31 moves in the rear-to-front direction independently. The cam surface 55 is low in the height of its protrusion at a portion corresponding to the second drum 20 and increasingly higher at a portion corresponding to the drum 40. This causes the divided portions 31a of the front-side flange 31 to be moved toward the front side increasingly from the second drum 20 side to the drum 40 side. Accordingly, the electronic component 5, having been received by the third drum 30, is moved to the front side while it is kept between the front-side flange 31 and the head presser plate 35 (as illustrated by two-dot chain line in FIG. 8), until it is fixed with the adhesive tape T, at a insertion width regulated by the height of the cam surface 55. It should be noted that the insertion width of the lead terminals 6 into the taped product T, may be changed optionally by changing the height of the cam surface 55. The top of the cam surface 55 keeps its height from a portion corresponding to the drum 40 to a portion corresponding to a press roller 42, thereby preventing the electronic component 5 from moving immediately after having

been fixed by the taped product T_1 .

In addition, the present invention is not limited to the above-described embodiment and, for example, may be applied to electronic components having wire
5 type lead terminals. Also, the number of the terminals may well be 2 or 4 or more without being limited to only 3.

Although an embodiment of the present invention has been fully described by way of example with
10 reference to the accompanying drawings, it is to be noted here that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention as defined by
15 the appended claims, they should be construed as included herein.

CLAIMS:

1. An apparatus for automatically taping electronic components to fixedly hold their lead terminals between a base tape and an adhesive tape, said apparatus comprising:

an endless timing belt for conveying said electronic components in an approximately horizontal direction, which has a plurality of retainer grooves formed on its outer peripheral surface in its widthwise direction for retaining said lead terminals and has internal teeth formed on its inner peripheral surface;

a first rotary drum for receiving said electronic components from said timing belt, said drum having a toothed pulley to be engaged with said internal teeth of said timing belt and to rotate the belt with rotation of said drum, a pair of flanges provided on both sides of said toothed pulley said flanges being larger in diameter than said toothed pulley for guiding said belt therebetween and retainer teeth formed on outer peripheral edges of said flanges for retaining said lead terminals, said retainer teeth defining a dedendum circle;

a second rotary drum for receiving said electronic components from said first rotary drum, said second rotary drum being positioned adjacent said first rotary drum and having retainer teeth formed on its outer peripheral edge for retaining said lead terminals;

a third rotary drum for receiving said electronic



components from said second rotary drum, said third rotary drum being positioned adjacent said second rotary drum and having retainer teeth formed on its outer peripheral edge for retaining said lead terminals and having a base tape feed section adjoining said retainer teeth, said base tape feed section having an outer peripheral surface on which a base tape is fed;

an adhesive tape feed drum being kept in pressure-contact with said base tape feed section for applying an adhesive tape to said base tape with said lead terminals held therebetween;

wherein the first rotary drum is arranged with the top of the dedendum circle being positioned above bottoms of said retainer grooves of said timing belt engaged with said toothed pulley, thereby lifting said lead terminals to be transferred from said retainer grooves onto said retainer teeth.

2. An apparatus for automatically taping electronic components in accordance with claim 1, wherein

a guide plate having circular-arc guide surfaces is arranged adjoining said second rotary drum, which surface slidably supports said lead terminals retained by said retainer teeth of said second drum.

3. An apparatus for automatically taping electronic components in accordance with claim 1 or 2, wherein said third rotary drum comprises:



a pair of flanges having said retainer teeth on their outer peripheral edges, one of said flanges being movable in its axial direction as it rotates integrally with said third rotary drum;

5 an urging means for urging said movable flange toward said third rotary drum; and

a cam means for moving said movable flange in such a direction that it leaves said third rotary drum.

4. An apparatus for automatically taping electronic
10 components in accordance with claim 3, wherein

a head presser plate for pushing the tops of said electronic components toward said movable flange is provided in vicinity of said third rotary drum..

5. An apparatus for automatically taping electronic
15 components in accordance with any preceding claim, wherein

said first rotary drum and said third rotary drum are arranged so as to be approximately flush with each other, and said second rotary drum is arranged at an
20 intermediate portion of said first and third rotary drums and somewhat upward of them.

6. An apparatus for automatically taping electronic
components in accordance with any preceding claim,
further comprising a sensor for detecting presence of
25 said electronic components that have been transferred



from said timing belt onto said first rotary drum, wherein said second and third rotary drums are stopped when said sensor detects no presence of said electronic components.

5 7. An apparatus for automatically taping electronic components in accordance with any preceding claim, wherein said apparatus is arranged to automatically tape radial lead components having a plurality of plate type lead terminals.

10 8. An apparatus for automatically handling electronic components, said apparatus comprising:

 a toothed timing belt having retainer grooves for retaining lead terminals of the electronic components;

 a rotary drum having a toothed pulley rotatably
15 engaging the teeth of said timing belt; and

 means rotatable with the drum and including formations arranged such that as the drum and the timing belt move into engagement the lead terminals are lifted from the retainer grooves in the belt so as to be easily
20 transferable to the drum.

9. An apparatus for handling or taping electronic components substantially as herein described with reference to the accompanying drawings.

