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CHIP-PART CONVEYING AND HOLDING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a chip-part conveying and holding apparatus in which a chip part is conveyed while the chip part is positioned and held in a housing portion formed in a conveying table by a vacuum suction force. Since the conveying and holding apparatus of the present invention is appropriate for a characteristic inspection apparatus in which conforming articles are selected by measuring the electrical characteristics of rectangular parallelepipedic chip-type electronic parts, hereinafter, a case in which the conveying and holding apparatus is applied to the characteristic inspection apparatus is described as an example.

2. Description of the Related Art

Up to now, among such characteristic inspection apparatuses, there is an apparatus described in Japanese Unexamined Patent Application Publication No. 9-304464, for example. In this apparatus, a chip part is conveyed such that a carrier portion for housing the chip part is formed in the outer peripheral portion of an indexed table, a vacuum-suction passage for positioning and holding the chip part is formed in the carrier portion, and the chip part is sucked and held in the carrier portion. In the construction, the chip part conveyed to a measuring portion is pushed up by a push-up pin disposed on the lower side of the measuring portion, the chip part is made to contact a measuring terminal disposed on the upper side of the measuring portion, and the electrical characteristics of the chip part are measured.

However, in the characteristic inspection apparatus according to the above publication, when a chip part is pushed up and placed in contact with the measuring terminal, there are cases in which the chip part falls out of the vacuum-suction passage, the chip part falls, and the chip part is displaced, and, as a result, there is a chance that a measurement error may occur. Furthermore, there is also a chance that the chip part may not return to its original position after the chip part has been pushed



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up, and there is a risk that the chip part may be caught by irregularities on the ceiling while the chip part is conveyed to the next step.

SUMMARY OF THE INVENTION

The present invention was made in consideration of the above described circumstances, and it is an object of the present invention to provide a chip-part conveying and holding apparatus in which falling of chip parts, measurement errors due to displacement, and the chip parts being caught by irregularities on the ceiling during conveyance can be prevented.

In an aspect of the present invention, a chip-part conveying and holding apparatus comprises a conveying table; a housing portion for housing a chip part, the housing portion being formed in the conveying table; and a suction passage for sucking and holding the chip part, the suction passage being formed in the conveying table. In the chip-part conveying and holding apparatus, the chip part is conveyed while being sucked and held in the housing portion, and the suction passage contains a first suction passage for primarily positioning and holding the chip part at a conveying position while the chip part is conveyed and a second suction passage for primarily positioning and holding the chip part at a measuring position when the chip part is moved from the conveying position.

Since the suction passage linked to the housing portion contains the first suction passage for primarily positioning and holding the chip part at the conveying position and the second suction passage for primarily positioning and holding the chip part at the measuring position when the chip part is moved, the chip part can be positioned and held at the measuring position by the suction force of the second suction passage to prevent the chip part from being displaced and falling down when the chip part is moved. In this way, when the conveying and holding apparatus is applied to a characteristic inspection apparatus, for example, displacement and falling down of the chip part when the electrical characteristics are measured by pushing up the chip part are prevented, and measurement errors can thus be prevented. Furthermore, since the chip part can be returned to its original conveying position by

the suction force of the first suction passage when the measurement is finished, the chip part is prevented from being caught by irregularities on the ceiling during conveyance, and accordingly, scratches and damage to the chip part can be prevented.

In the present invention, the second suction passage height is set to be larger than the first suction passage height in the moving direction of the chip part.

Since the second suction passage height is made larger than the first suction passage height in the moving direction, when the chip part is moved, the chip part can be more reliably positioned and held by the suction force of the second suction passage at the measuring position.

In the present invention, the first suction passage width is set to be larger than the second suction passage width in the direction perpendicular to the moving direction of the chip part.

Since the first suction passage width is larger than the second suction passage width, when the chip part is returned to its original conveying position from the measuring position, the chip part can be more reliably returned by the suction force of the first suction passage and can be reliably positioned at the conveying position.

In the present invention, a plurality of the housing portions are formed in the radial direction at predetermined angular intervals in the circumferential direction of the conveying table.

Since a plurality of lines of housing portions are formed in the radial direction of the conveying table, many chip parts can be simultaneously and continuously conveyed, and accordingly, the processing capacity can be enhanced.

In the present invention, the first and second suction passages of each of the housing portions extend in the radial direction of the conveying table and are linked to a common ring passage formed in the conveying table.

Since the first and second suction passages of each housing portion are linked to a common ring passage, many suction passages can be simultaneously vacuum-sucked by connecting a vacuum source to the ring passage.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic top view of a characteristic inspection apparatus according to an embodiment of the present invention;

Fig. 2 is a top view of a chip-part housing portion in the characteristic inspection apparatus;

Fig. 3 is a top view in section of a suction passage of the chip-part housing portion;

Fig. 4 is a sectional view of the suction passage of the chip-part housing portion, that is, a sectional view taken on line IV - IV of Fig. 2;

Fig. 5 is a sectional view showing how the chip part is sucked and held;

Fig. 6 is a sectional view showing how the chip part is sucked and held;

Fig. 7 is a sectional view of the measuring portion of the characteristic inspection apparatus, that is, a sectional view taken on line VII - VII of Fig. 1;

Fig. 8 is a sectional view of the measuring portion of the characteristic inspection apparatus, that is, a sectional view taken on line VIII - VIII of Fig. 1;

Fig. 9 is a top view of the suction passage;

Fig. 10 is a sectional view of the suction passage, that is, a sectional view taken on line X - X of Fig. 9;

Fig. 11 is a sectional view of the suction passage, that is, a sectional view taken on line XI - XI of Fig. 9;

Fig. 12 is a perspective view of the suction passage, viewed in the direction of an arrow XII of Fig. 9;

Fig. 13 is a perspective view of the suction passage, viewed in the direction of an arrow XIII of Fig. 9;

Fig. 14A is an exploded perspective view of a turntable of the characteristic inspection apparatus;

Fig. 14B is an exploded perspective view of a fixed table of the characteristic inspection apparatus; and

Fig. 15 is a modified example of the suction passage.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, embodiments of the present invention will be described in accordance with the accompanying drawings.

Figs. 1 to 8 are for describing a characteristic inspection apparatus (conveying and holding apparatus) for chip parts according to one embodiment of the present invention. Fig. 1 is a schematic top view of the characteristic inspection apparatus, Figs. 2 and 3 are top views showing chip-part housing holes in the characteristic inspection apparatus, Fig. 4 is a sectional view of a chip-part housing hole (sectional view taken on line IV - IV of Fig. 2), and Figs. 5 and 6 are sectional views showing how a chip part is sucked and held. Figs. 7 and 8 are sectional views of a measuring portion of the characteristic inspection apparatus (sectional views taken on line VII - VII and line VIII - VIII of Fig. 1), Fig. 9 is a top view of a suction passage, Fig. 10 is a sectional view of the suction passage (sectional view taken on line X - X of Fig. 9), Fig. 11 is a sectional view of the suction passage (sectional view taken on line XI - XI of Fig. 9), Figs. 12 and 13 are perspective views of the suction passage (views in the direction of arrows XII and XIII in Fig. 9), and Figs. 14A and 14B are exploded perspective views of a turntable and fixed table.

In the drawings, a characteristic inspection apparatus 1, which is constructed to measure electrical characteristics of four electronic chip parts (hereinafter simply called chip parts) simultaneously, is shown. In this characteristic inspection apparatus 1, a disk-shaped turntable 2 is intermittently rotated so that the disk-shaped turntable 2 may pass through a part supply portion 3, a measuring portion 4, and a part unloading portion 5 in order. Each chip part W housed and disposed in the above turntable 2 is placed in contact with an upper measuring terminal (the other measuring terminal) 6 of an upper measuring portion 4a disposed on the upper side of the measuring portion 4 and a lower measuring terminal (one measuring terminal) 7 of a lower measuring portion 4b; and the electrical characteristics of the above chip part W are measured by a measuring device 8 connected to each of the measuring terminals 6 and 7 to select conforming articles.

In the present embodiment, for the sake of convenience, although the upper measuring terminal and the lower measuring terminal are mentioned, the description

using the words upper and lower only shows the relative positional relation when constructed so that the rotational axis of the turntable is vertical and does not show any absolute positional relation of each component (when the apparatus is constructed in different ways, the upper and lower relation are not necessarily realized). For example, the rotational axis of the turntable may be made inclined or horizontal. When the rotational axis of the turntable is horizontal, the measuring terminals will be described as a right measuring terminal and a left measuring terminal.

The above turntable 2 is mounted on a fixed table 10 so as to be rotatable and is intermittently rotated by a driving motor (not illustrated). In the turntable 2, four housing holes 2a are formed in the radial direction at predetermined angular intervals so as to pass through the turntable 2, and each chip part W is housed inside a housing space formed by the housing hole 2a and a conveying surface 10a on the fixed table 10. In the chip part W, external connection electrodes 12a and 12b are formed on both end faces of a rectangular parallelepipedic element 11, and the chip part W is vertically disposed so that the electrodes 12a and 12b may face upward and downward, respectively.

Each of the above housing holes 2a is rectangular when viewed from above, and a suction passage 15 is linked to the left corner portion positioned on the upstream in the conveying direction of each of the housing holes 2a and on the central side of the table.

Each of the above suction passages 15 extends in the radial direction of the turntable 2 and is linked to a common ring passage 16 formed in the fixed table 10. This ring passage 16 is formed such that the housing holes 2a disposed in the circumferential direction make concentric circles and a vacuum generating source (not illustrated) is connected to each ring passage 16.

The suction passages 15 are provided as depressions on the bottom surface of the turntable 2 and are each composed of a first suction passage 15a which mainly positions and holds the chip part W at a conveying position X and a second suction passage 15b, formed so as to be next to the first suction passage 15a, which mainly

positions and holds the chip part W at a measuring position (a moving position) Y where electrical characteristics are measured after the chip part W has been pushed up.

The passage height B2 of the second suction passage 15b in the push-up direction (moving direction) is set to be larger than the passage height A2 of the first suction passage 15a, and also the passage width A1 of the first suction passage 15a in the direction perpendicular to the push-up direction is set to be larger than the passage width B1 of the second suction passage 15b. Thus, the suction passage is formed so as to be convex when viewed from the side.

The lower measuring portion 4b of the measuring portion 4 is provided below the fixed table 10, a holder 21, to which the mentioned above lower measuring terminal 7 is attached, is supported by a common supporting member 22, and a rising-and-falling cylinder mechanism 23 is connected and fixed to the supporting member 22. The rising-and-falling cylinder mechanism 23 is constructed such that four sets of lower measuring terminals 7 are simultaneously raised and lowered by using high-pressure air between a measuring position and a waiting position.

A fixed base 24 made of an insulating material is disposed and fixed at a portion of the fixed table 10 facing each of the lower measuring terminals 7, and the upper surface 24a of the fixed base 24 is flush with the conveying surface 10a. A pair of inspection and measurement holes 24b and 24b are formed in the fixed base 24 so as to pass through the fixed base 24 in the vertical direction. Moreover, the fixed base 24 may be integrally formed together with the fixed table 10.

Each of the lower measuring terminals 7 is composed of a pair of pin terminals 7a and 7b, and each of the pin terminals 7a and 7b is supported by the holder 21 so as to have elasticity by means of springs 25a and 25b which are separately provided. The top portion of each of the pin terminals 7a and 7b is inserted inside the inspection and measurement hole 24b of the fixed base 24, and, while no measurement is performed, the tip portion is positioned at a waiting position where the tip portion is lowered from the upper surface 24a of the fixed base 24. The diameter of the pin terminals 7a and 7b is very small when compared with the size of the chip part W, and accordingly, the

inspection and measurement hole 24b is also very small in diameter. Therefore, this inspection and measurement hole 24b does not hinder the conveyance of chip parts W.

When the rising-and-falling cylinder mechanism 23 makes each holder 21 rise, the pin terminals 7a and 7b move to a measuring position protruded from the upper surface 24a of the fixed base 24 and are placed in contact with the electrode 12b of the chip part W to push up the chip part W upward.

On the other hand, the upper measuring portion 4a is provided above the turntable 2, and fixed holders 27 where the upper measuring terminals 6 are attached are fixed to the measuring portion 4.

A cylindrical concave portion 27a whose bottom extends in the axial direction is formed on the lower surface of the fixed holder 27. A disk-shaped member 28 is provided inside each of the concave portions 27a so as to move upward and downward (in the measurement direction), and a pair of pin holes 28a and 28a is formed in the moving member 28 so as to pass through the moving member 28.

The moving member 28 is suspended by a spring 29 provided between the moving member 28 and the bottom wall of the concave portion 27a to apply a force to the chip part W.

The measuring terminal 6 is composed of a pair of pin terminals 6a and 6b, and each of the pin terminals 6a and 6b is supported by the fixed holder 27 so as to have elasticity by means of springs 30a and 30b, which are separately provided. The tip portion of each of the pin terminals 6a and 6b is inserted inside the pin hole 28a of the moving member 28, and, while no measurement is performed, the tip portion is positioned so as to be above the lower surface 28b of the moving member 28.

The spring constant of the springs 25a, 25b, 30a, and 30b of the pin terminals 6a, 6b, 7a, and 7b is set to a value at which, when the chip part W is pushed upward, the chip part W maintaining balance can stop at a measuring position. Furthermore, the spring constant of the spring 29 of the moving member 28 is set to a value which is smaller than that of the spring constant of the springs 25a, 25b, 30a, and 30b. Concretely, the spring constant of the springs 25a and 25b is 0.25 N/m, the spring constant of the springs 30a and 30b is 0.20 N/m, and the spring constant of the spring

29 is 0.10 N/m. The reason why the spring constant of the springs 25a, 25b, 30a, and 30b is larger than the spring constant of the spring 29 in this way is that, because of the construction of the inspection apparatus 1, the chip part W is assured to be in contact with the pin terminals 6a, 6b, 7a, and 7b and is required to stop while the chip part W is balanced. Moreover, it is a matter of course that the optimal spring constant varies based on the terminal shape and the chip part.

In the characteristic inspection apparatus 1 of the present embodiment, chip parts W are supplied and disposed inside the housing holes 2a in the turntable 2 at the part supply portion 3. Then, each of the chip parts W is positioned and held at the conveying position X at the left corner portion of the housing hole 2a by the vacuum suction force of the first suction passage 15a, and the turntable 2 is intermittently rotated in the direction of arrows a in that state to convey the chip parts W to the measuring portion 4.

When the chip parts W are positioned at the measuring portion 4 by indexing, the rising-and-falling cylinder mechanism 23 pushes up each of the lower pin terminals 7a and 7b, makes the pin terminals 7a and 7b protruded from the fixed base 24, places the pin terminals 7a and 7b in contact with the electrode 12b, and thus pushes the chip parts W upward. Accompanying that, the moving member 28 is pushed up and the electrode 12a of the chip part W is placed in contact with the pin terminals 6a and 6b. Thus, the chip part W is maintained by sandwiching the chip part W between the lower pin terminals 7a and 7b and the upper pin terminals 6a and 6b such that the chip part W is balanced at the measuring position Y. In this state, the electrical characteristics of the chip part W are measured by the measuring device 8, and, after conforming articles have been selected, the articles are conveyed to the part unloading portion 5 and unloaded.

When the chip part W is pushed up by the pin terminals 7a and 7b in the measuring portion 4, the chip part W is positioned and maintained at the measuring position by the suction force of the second suction passage 15b. When the pin terminals 7a and 7b go down, accordingly, the chip part W goes down and is

positioned and maintained at the original conveying position X by the first suction passage 15a.

In this way, according to the present embodiment, while no measurement is performed, the lower measuring terminal 7 is deeply inserted inside the inspection and measurement hole 24b of the fixed base 24, and, since the upper measuring terminal 6 has been deeply inserted so as to become invisible inside the pin hole 28a of the moving member 28 provided so as to be able to move in the upward and downward direction, the measuring terminals 6 and 7 are hidden inside the moving member 28 and the fixed base 24 and are not exposed. Accordingly, the chip part W does not collide with the measuring terminals 6 and 7 during conveyance and can thus be prevented from being broken and damaged.

Furthermore, the lower measuring terminal 7 protrudes from the fixed base 24 by pushing up the lower measuring terminal 7 to place the measuring terminal 7 in contact with the chip part W, and simultaneously, the chip part W is pushed up, the moving member 28 is pushed up by the chip part W, and thus the chip part W is placed in contact with the upper measuring terminal 6. Therefore, the electrical contact between the measuring terminals 6 and 7 and the chip part W can be reliably made and stable measurement can be performed.

In the present embodiment, since a force is given to the measuring terminals 6 and 7 by using the springs 30a, 30b, 25a, and 25b so that the chip part W may be balanced and stopped at the measuring position, when compared with the case in which a related chip part is pressed on a fixed member and measured, the occurrence of damage (scratches, cracks, etc.) to the chip part W can be prevented.

Furthermore, since the moving member 28 is suspended by the spring 29 and a force is applied to the chip part W, an impact at the time of contacting the chip part W against the moving member 28 can be absorbed and the occurrence of damage to the measuring terminal 6 and the chip part W can be prevented.

In the present embodiment, since the measuring terminals 6 and 7 are composed of pairs of terminals 6a, 6b, 7a, and 7b which are supported so as to have elasticity by means of the springs 30a, 30b, 25a, and 25b which are independently

provided, it becomes possible to detect contact and Kelvin measurements by using a four-terminal measurement technique.

According to the measurement and inspection apparatus of the present embodiment, since the suction passage 15 linked to the housing hole 2a is composed of the first suction passage 15a, which positions and maintains the chip part W at the conveying position X, and the second suction passage 15b, which positions and maintains the chip part W at the measuring position Y when the chip part W is pushed up, the chip part W can be positioned and maintained at the measuring position Y and, when the chip part W is pushed up from the conveying position and electrical characteristics are measured, displacement and falling down of the chip part W can be prevented, and accordingly measurement errors can be prevented.

Furthermore, since the chip part W can be returned to its original conveying position X while the orientation of the chip part W is maintained, the chip part W can be prevented from being caught by projections and depressions on the ceiling during conveyance, and accordingly damage to the chip part W can be prevented.

Also, in the present embodiment, since the passage height B2 of the second suction passage 15b in the pushing up direction is made larger than the passage height A2 of the first suction passage 15a, when the chip part W is pushed up so as to reach the upper measuring position Y, the suction force of the second suction passage 15b having a larger passage height more reliably sucks the upper portion of the chip part W, and accordingly, the chip part W can be positioned and maintained at the measuring position Y without fail.

Furthermore, since the passage width A1 of the first suction passage 15a is made larger than the passage width B1 of the second suction passage 15b, when the chip part W is returned to the original conveying position X from the measuring position Y, the downward suction force acting on the chip part W is large, and accordingly, when the lower measuring terminal 7 goes down, the chip part W also immediately descends. Therefore, the chip part W is safely returned to its original conveying position X where it can be surely positioned and maintained.

In the present embodiment, since the housing portions 2a stand in four lines in the radial direction of the turntable 2 and are formed at predetermined angular intervals in the circumferential direction, many chip parts W can be conveyed at the same time and in succession, and accordingly, the characteristic inspection capacity can be enhanced.

Since the first and second suction passages 15a and 15b of each housing portion 2a are linked to the common ring passage 16, many suction passages 15 can be simultaneously vacuum-sucked by connecting a vacuum generating source to the ring passage 16.

Moreover, in the above embodiment, although the suction passage 15 is composed of first and second suction passages 15a and 15b having a convex shape in cross-section, the suction passages of the present invention are not limited to this shape, and, for example, as shown in Fig. 15, a suction passage 17 may be composed of first and second suction passages 17a and 17b which are tapered and, in this case, the same effect as in the above embodiment can be obtained.

Furthermore, in the above embodiment, although the conveying and holding apparatus of the present invention was applied to a measurement and inspection apparatus for measuring electrical characteristics of chip parts, the conveying and holding apparatus of the present invention can be also applied to, for example, a part mounting apparatus in which chip parts are conveyed and mounted on a printed-circuit board; that is, the conveying and holding apparatus of the present invention can be applied to anything in which chip parts are conveyed while being sucked and held.

WHAT IS CLAIMED IS:

1. A chip-part conveying and holding apparatus comprising:
a conveying table;
a housing portion for housing a chip part, the housing portion being formed in the conveying table; and
a suction passage for sucking and holding the chip part, the suction passage being formed in the conveying table,
wherein the chip part is conveyed while the chip part is sucked and held in the housing portion, and
the suction passage contains a first suction passage for primarily positioning and holding the chip part at a conveying position while the chip part is conveyed and a second suction passage for primarily positioning and holding the chip part at a measuring position when the chip part is moved from the conveying position.
2. A chip-part conveying and holding apparatus as claimed in claim 1, wherein the height of the second suction passage is set to be larger than the height of the first suction passage in the moving direction of the chip part from the conveying position.
3. A chip-part conveying and holding apparatus as claimed in claim 1 or 2, wherein the width of the first suction passage is set to be larger than the width of the second suction passage in the direction perpendicular to the moving direction of the chip part from the conveying position to the measuring position.
4. A chip-part conveying and holding apparatus as claimed in claim 1 or 2, wherein a plurality of the housing portions are formed in the radial direction at predetermined angular intervals in the circumferential direction of the conveying table.
5. A chip-part conveying and holding apparatus as claimed in claim 4, wherein the first and second suction passages of each of the housing portions extend in

the radial direction of the conveying table and are linked to a common ring passage formed in the conveying table.