WAFER SHEET STRETCHING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a wafer sheet stretching apparatus for stretching a wafer sheet retained on a wafer ring.

Description of the Related Art

As a machine for sequentially picking up a semiconductor pellet from a wafer sheet having pasted thereon a wafer divided in units of a semiconductor pellet and retained by a wafer ring and for bonding the picked-up semiconductor pellet onto a substrate such as a lead frame or carrier tape, there are known a pellet bonding machine, inner lead bonding machine, etc. In order to pick up the semiconductor pellet excellently from the wafer sheet, each of these bonding machines removes the slack of the wafer sheet or forms very small gaps between the semiconductor pellets by stretching the wafer sheet retained on the wafer ring by the use of a wafer sheet stretching apparatus in advance of the pickup operation of the semiconductor pellets. Conventionally, as such a wafer sheet stretching apparatus, there is that which is described in, for example, Japanese Patent Application Laid-Open No. 9-82783.

This wafer sheet stretching apparatus comprises a stretching mechanism for stretching a wafer sheet, a rotating mechanism for rotating this stretching mechanism about an axis that orthogonally intersects a sheet surface of the wafer sheet to be stretched, and an XY table for moving the stretching mechanism in the X and Y directions. Each of the stretching mechanism, rotating mechanism and XY table has drive means such as a

motor or air cylinder. And, when the wafer ring is supplied to the wafer sheet stretching apparatus, first, the stretching mechanism stretches the wafer sheet. Next, a detecting camera detects the amount of positional displacement in the rotation direction of the wafer (pellet) on the stretched wafer sheet. In a case where the positional displacement in the rotation direction of the wafer has been detected by the detecting camera, the rotating mechanism makes its rotation in the direction of correcting this displacement. Also, in a case where dividing the wafer into a plurality of equal areas and picking up the semiconductor pellet for each area, the rotating mechanism rotates the stretching mechanism so that the area from which the pellet is to be picked up this time may be located at the pickup position where the pellet is to be picked up by a suction nozzle such as a pellet transfer. Thereafter, each semiconductor pellet on the wafer ring is positioned at the pickup position and is picked up by the suction nozzle and bonded to a lead frame or the like.

Meanwhile, in the above-described stretching apparatus, single purpose drive means is used for each of the stretching mechanism and rotating mechanism. This raises the problem that the stretching apparatus becomes large in size and in weight because of the necessity of ensuring the space for disposing the respective drive means with respect to the apparatus. In addition, the drive means for the stretching mechanism and that for the rotating mechanism are very low in the operation rate compared to the drive means for the XY table. Namely, during the pickup operation (pellet bonding operation) of the semiconductor pellet, the drive means for the XY table operates for each pickup of the semiconductor pellet in order to position the semiconductor pellet sequentially at the pickup position while, on the other hand, the drive means for the stretching mechanism operates only at the time of stretching the wafer sheet and at the time of releasing the stretched state of

the wafer sheet. Also, the drive means for the rotating mechanism operates only at the time of correcting the rotational displacement of the wafer or at the time of changing the pickup area of the semiconductor pellet. Providing the drive means whose operation rate is low individually is not preferable in terms of the construction of the apparatus.

SUMMARY OF THE INVENTION

The present invention is intended to provide a wafer sheet stretching apparatus which is small in size, light in weight and makes it possible to increase the operation rate of the drive means.

The present invention is equipped with a stretching mechanism that includes a support ring having a hole at a central part thereof and supporting a wafer sheet retained on a wafer ring by a circular annulus portion formed projectively on an outer-peripheral portion of the hole, a stretching ring that is disposed in such a way as to oppose the support ring and that has an annular portion that is loosely fitted over the circular annulus portion so as to stretch the wafer sheet in cooperation with the circular annulus portion and an approaching/separating mechanism for causing relative movement of the support ring and stretching ring in the direction of their being approached to or separated from each other, and a rotating mechanism for supporting the stretching mechanism so that this mechanism may be freely rotatable about an axis that orthogonally intersects a sheet surface of the wafer sheet supported on the circular annulus portion, and is characterized in that the approaching/separating mechanism and the rotating mechanism are connected to single drive means through power-switching means.

According to the present invention, when stretching the wafer sheet retained on the wafer ring or releasing the stretched state of the stretched

wafer sheet, the drive means is connected to the approaching/separating mechanism through the power-switching means to thereby approach or separate the support ring and the stretching ring with or from each other. When adjusting the rotation position of the wafer ring stretched by the stretching mechanism, the drive means is connected to the rotating mechanism through the power-switching mechanism to thereby rotate the stretching mechanism. As a result of this, single drive means is used concurrently both as drive means for driving the stretching mechanism and as drive means for driving the rotating mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front sectional view illustrating the construction of a wafer sheet stretching apparatus according to the present invention;

Fig. 2 is a sectional view taken along a line A-A of Fig. 1;

Fig. 3 is a front sectional view illustrating an operational state of Fig. 1; and

Fig. 4 is a front sectional view illustrating another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first embodiment of the present invention will now be explained with reference to the drawings. Fig. 1 is a front sectional view illustrating the construction of a wafer sheet stretching apparatus according to the present invention; Fig. 2 is a sectional view taken along a line A-A of Fig. 1; and Fig. 3 is a front sectional view illustrating an operational state of Fig. 1.

A wafer sheet stretching apparatus 1 is comprised of a stretching mechanism 2, rotating mechanism 3, motor 4 serving as drive means, power-

switching means 5 and CPU 6 serving as control means.

The stretching mechanism 2 has a support ring 7, stretching ring 8, and screw mechanism 9 serving as an approaching/separating mechanism. The support ring 7 has a hole 7e at a central part thereof and, by a circular annulus portion 7d formed projectively on an outer-peripheral portion of the hole 7e, supports a wafer sheet 12 retained on a wafer ring 13 and having pasted thereon a wafer 11 divided for each semiconductor pellet 10. The stretching ring 8 has an annular portion 8c that is disposed in such a way as to oppose the support ring 7 at a position above the support ring 7 and that is loosely fitted over the circular annulus portion 7d so as to stretch the wafer sheet 12 in cooperation with the circular annulus portion 7d and an engaging recessed portion 8a that is engaged with the wafer ring 13. The screw mechanism 9 is disposed at the positions that are symmetrical about the center of the support ring 7 (see Fig. 2) to thereby cause upward/downward movement (approach/separation movement) of the stretching ring 8 relative to the support ring 7. And, the screw mechanism 9 has screw shafts 14 and pulleys 15 fixed to lower end portions 14a (input shafts) of the screw shafts 14. The screw shaft 14 is rotatably supported by a bearing 16 formed in a flange portion 7a of the support ring 7. Also, on the end of the screw shaft 14 on a side opposite to that of the pulley 15 there is formed a male screw portion 14b which is screwed with respect to a female screw portion 8b formed in the stretching ring 8.

The rotating mechanism 3 has a support base 17 that is placed on an XY table not illustrated and an annular pulley 18 serving as a rotating ring. A lower half portion of the annular pulley 18 is rotatably connected through a bearing 19 to a boss portion 17a formed on an upper portion of the support base 17 and an upper half portion thereof is rotatably connected through a

bearing 20 to a boss portion 7b formed on a lower portion of the support ring 7. Also, in an outer-peripheral portion of the annular pulley 18 there is formed a groove portion 18a for having wound thereover a first drive belt 22 and a second drive belt 23 as later described.

The motor 4 is fixed to the underside of the flange portion 17b of the support base 17 and an output shaft 4a thereof is protruded upwardly from the flange portion 17b. To a forward end of the output shaft 4a there is fixed a pulley 21.

The power-switching means 5 has the first drive belt 22, the second drive belt 23 and the electromagnetic solenoid 24 serving as stopper means. The first drive belt 22 is wound over the pulley 21 of the motor 4 and the annular pulley 18. The second drive belt 23 is wound over the respective pulleys 15 of the screw mechanism 9 and the annular pulley 18. Also, the first and second drive belts 22 and 23 have tensions imparted thereto by tension imparting mechanisms 25 (Fig. 2). It is to be noted that since the tension imparting mechanisms 25 provided on the respective drive belts 22 and 23 are of the same structure, an explanation will be given of only the tension imparting mechanism 25 provided on the second drive belt 23 and an explanation of the tension imparting mechanism 25 of the first drive belt 22 is omitted. As illustrated in Fig. 2, the tension imparting mechanisms 25 are disposed in correspondence with the respective pulleys 15 and each have a pair of rotating rollers 26 and support shafts 28 that are supported this rotating rollers 26 at freely rotation and are fixed so that the positions thereof may be freely adjustable in the longitudinal directions of long slots 27 provided in the flange portion 7a. Namely, the tension imparting mechanism 25 makes it possible to adjust the tension that is imparted to the second drive belt 23 by loosening the nuts of fixing means composed of bolts and nuts not

illustrated that are provided on the support shafts 28 and moving these support shafts 28 in the longitudinal directions of the long slots 27. The electromagnetic solenoid 24 has a base portion 24a and a rod 24b that protrudes from and retracts into this base portion 24a, the base portion 24a being fixed to a notched portion 17c of the support base 17. Also, as indicated by a two-dot chain line in Fig. 1, in its protruded state, the rod 24b of the electromagnetic solenoid 24 is engaged with a recessed portion 7c of the support ring 7 that is situated at the initial set position in the rotation direction of the support ring 7. It is to be noted that in this embodiment the power-switching means 5 in the construction thereof commonly uses the annular pulley 18 of the rotating mechanism 3.

The CPU 6 is electrically connected to the motor 4 and electromagnetic solenoid 24 and makes a suitable control thereof.

Next, the operation of the wafer sheet stretching apparatus will be explained.

As illustrated in Fig. 3, in advance of the supply of the wafer ring 13, the support ring 7 is positioned at the initial set position thereof and the recessed portion 7c thereof is engaged with the protruded rod 24b. Also, the stretching ring 8 is positioned at the release position where the wafer ring 13 is released.

When the wafer ring 13 is supplied to the interior of the engaging recess portion 8a of the stretching ring 8, the stretching operation of the wafer sheet 12 is started.

In the stretching operation, first, the motor 4 is rotated in an arrow A direction. At this time, due to the engagement of the rod 24b with the recessed portion 7c, the rotation of the support ring 7 relative to the support base 17 is checked and therefore the annular pulley 18 rotated by the motor 4

through the first drive belt 22 is rotated around the boss portion 7b of the support ring 7 and the boss portion 17a of the support base 17 and rotates the pulley 15, i.e., the screw shaft 14 through the second drive belt 23. The stretching ring 8 is lowered through the rotation of the screw shaft 14. In the process in which the stretching ring 8 is lowered, the wafer sheet 12 is supported by an upper end of the circular annulus 7d and, due to a further fall of the stretching ring 8, as illustrated in Fig. 1, the wafer sheet 12 is stretched. Next, the value of positional displacement in the rotating direction caused between the direction where the semiconductor pellets 10 are arranged and the standard direction on the wafer sheet 12 is detected by an image processor not illustrated that uses a detecting camera. The CPU 6 corrects the positional displacement in the rotation direction of the wafer 11 through the following operation according to the detection value that has been obtained by the image processor.

When performing the correction operation for correcting the positional displacement in the rotation direction of the wafer 11, as indicated by a solid line in Fig. 1, first, the rod 24b is lowered, whereby the rotation of the support ring 7 relative to the support base 17 is permitted. Next, the motor 4 is rotated with a prescribed rotations number in a prescribed direction according to the detection value that has been obtained by the image processor, whereby the positional displacement in the rotation direction of the wafer 11 is corrected. Namely, upon rotation of the motor 4, this rotation is transmitted through the first drive belt 22 to the annular pulley 18. And, since the relative rotation between the support ring 7 and the support base 17 is permitted as mentioned above, the support ring 7 is rotated jointly with the annular pulley 18 and as a result the wafer 11 is rotated by the extent which corresponds to the positional displacement thereof. It is to be noted that the

retention effect is acted on between the support ring 7 and the annular pulley 18 by the tension imparted to the second drive belt 23 wound over the pulley 15 and the annular pulley 18, no relative rotation occurs therebetween.

Upon completion of the correction of the positional displacement in the rotation direction of the wafer 11, the semiconductor pellet 10 on the wafer ring 13 is sequentially positioned to the pickup position thereof at which the semiconductor pellet 10 is to be picked up by a suction nozzle such as a pellet transfer and then is picked up. It is to be noted that in a case where the wafer 11 is divided into two or four equal parts and the semiconductor pellet 10 is picked up for each divided area, the wafer 11 is rotated so that the area which is to be picked up this time may be moved to the pickup position simultaneously with the correction operation of the positional displacement in the above-described rotation direction.

Upon completion of the pickup operation for picking up the semiconductor pellet 10 by the suction nozzle, the motor 4 is rotated in a prescribed direction, thereby positioning the support ring 7 to the initial set position. Thereafter, the electromagnetic solenoid 24 is driven, whereby the rod 24b is engaged with the recessed portion 7c. Next, the motor 4 is rotated in a direction (the arrow B direction) reverse to that at the time when performing the wafer sheet 12 stretching operation, whereby the stretching ring 8 is positioned at the release position, whereby the wafer sheet 12 releasing operation is performed. Then, the wafer ring 13 is conveyed out from over the wafer sheet stretching apparatus 1 by a conveying mechanism not illustrated and a new wafer ring 13 is supplied instead. Thereafter, similar operations are repeated. And when a final wafer ring 13 has been discharged out, the stretching apparatus 1 is stopped.

According to the above-described embodiment, the single motor 4 is

used concurrently both as the drive means for the stretching mechanism 2 and the drive means for the rotating mechanism 3 and this makes it possible to decrease the disposition space necessary for the disposition of the drive means for the both mechanisms 2 and 3 to approximately a half of the conventional one. This makes it possible to make the stretching apparatus 1 small in size and light in weight.

Also, since the single motor 4 is used concurrently both as the drive means for the stretching mechanism 2 and the drive means for the rotating mechanism 3, it is possible to greatly increase the operation rate of the motor 4 compared to a case where the drive means have been provided individually with respect to the mechanisms 2 and 3.

Also, through the concurrent use of the single motor 4 both as the drive means for the stretching mechanism 2 and the drive means for the rotating mechanism 3, it is possible to decrease the load applied onto the XY table for moving the support base 17 thereon in the XY directions and therefore to make the inertial mass of the XY table small. As a result, it is possible to increase the stop precision and movement speed of the XY table. As a result, it is possible to increase the productivity of the bonding machine to which this stretching apparatus 1 is applied and the reliability of the products produced by this bonding machine. Also, since a small drive output for driving the XY table is only needed, the drive source for driving the XY table can be made small in size and hence the XY table itself can be made small in size. Therefore, the stretching apparatus 1 as a whole can be made small in size and light in weight.

Incidentally, although in the above-described embodiment an example wherein the power-switching means 5 is constructed using the belts 22 and 23, the pulley 18 and the electromagnetic solenoid 24 has been

explained, the invention is not limited thereto. Namely, it will be sufficient if the power-switching means 5 is of a structure wherein the drive force of the drive means is selectively switchable to one of the stretching mechanism 2 and rotating mechanism 3 according to the necessity. For example, as illustrated in Fig. 4, a gear mechanism 30 may be used.

In Fig. 4, the gear mechanism 30 has driven gears 31 and 32 and a drive gear 33. The driven gear 31 is fixed to the lower end portion 14a (input shaft) of the screw shaft 14 and is meshed with an annular gear 35 that has been mounted on the outer-periphery of the boss portion 7b of the support ring 7 through a bearing 34. The driven gear 32 is rotatably supported by a support shaft 36 provided projectively on the flange portion 17b of the support base 17 and is meshed with an annular gear 37 fixed to the underside of the boss portion 7b of the support ring 7. Here, the both gears 31 and 33 are disposed on the same axis and are formed in such a way that the teeth numbers thereof are the same. Also, the both annular gear 35 and 37 are disposed on the same axis and are formed in such a way that the teeth numbers thereof are the same. The drive gear 33 is provided on a spline shaft 39 connected to the output shaft of a motor 38 so that the gear 33 may be slidable in the axial direction thereof and, on the other hand, is engaged with an engaging pawl 41 of an electromagnetic solenoid 40. This electromagnetic solenoid 40 is connected to the CPU 6 and, according to the instruction of the CPU 6, is switched to an upper position indicated by a two-dot chain line in Fig. 4 or a lower position indicated by a solid line, whereby the position in the heightwise direction of the drive gear 33 is switched to the position of its being meshed with the driven gear 31 or the position of its being meshed with the driven gear 32. Also, the support ring 7 is supported on the support base 17 through a bearing 42. And, when performing the operation of stretching or

releasing the wafer sheet 12, first, the electromagnetic solenoid 40 is switched to the upper position to thereby mesh the drive gear 33 with the driven gear 31. Next, the motor 38 is forwardly or reversely driven to thereby rotate the respective screw shafts 14 through the drive gears 33, the driven gears 31 and the annular gear 35. The stretching ring 8 is thereby moved vertically. It is to be noted that at this operation time the rod 24b of the electromagnetic solenoid 24 is engaged beforehand with a recessed portion 37a of an annular gear 37 as in the case of the first embodiment. Also, when performing the correction operation in the rotation direction of the wafer 11, the rod 24b of the electromagnetic solenoid 24 is lowered and, on the other hand, the electromagnetic solenoid 40 is switched to the lower position to thereby mesh the drive gear 33 with the driven gear 32. Next, the motor 38 is rotated in a prescribed direction to thereby rotate the annular gear 37 through the drive gear 33 and the driven gear 32. As a result of this, the support ring 7 is rotated in a prescribed direction. By constructing in this way, there is obtained the same effect as attainable with the above-described embodiment.

Also, although in the above-described embodiments the power-switching means 5 has been explained by way of an example of its being controlled through the operation of the CPU 6, the power-switching means may be of a type wherein the power switching is manually performed by an operator according to the necessity.

Also, in the present invention, the stretching of the wafer sheet 12 means not only stretching it to such an extent that gaps are formed between the semiconductor pellets 10 pasted onto the wafer sheet 12 but also stretching it to such an extent as to zero the slack of the wafer sheet 12 kept retained by the wafer ring 13.

As described above, according to the present invention, it is possible to

achieve the size and weight reductions and in addition to achieve the increase in the operation rate of the drive means.

WHAT IS CLAIMED IS:

1. A wafer sheet stretching apparatus equipped with:

a stretching mechanism that includes a support ring having a hole at a central part thereof and supporting a wafer sheet retained on a wafer ring by a circular annulus portion formed projectively on an outer-peripheral portion of the hole, a stretching ring that is disposed in such a way as to oppose the support ring and that has an annular portion that is loosely fitted over the circular annulus portion so as to stretch the wafer sheet in cooperation with the circular annulus portion and an approaching/separating mechanism for causing relative movement of the support ring and stretching ring in the direction of their being approached to or separated from each other;

a rotating mechanism for supporting the stretching mechanism so that this mechanism may be freely rotatable about an axis that orthogonally intersects a sheet surface of the wafer sheet supported on the circular annulus portion; and

wherein that the approaching/separating mechanism and the rotating mechanism are connected to single drive means through power-switching means.

2. A wafer sheet stretching apparatus according to claim 1, characterized by comprising control means for controlling the power-switching means so as to supply the drive force of the drive means selectively to the stretching mechanism or rotating mechanism.

3. A wafer sheet stretching apparatus equipped with:

a stretching mechanism that includes a support ring having a hole at a central part thereof and supporting a wafer sheet retained on a wafer ring by

a circular annulus portion formed projectively on an outer-peripheral portion of the hole, a stretching ring that is disposed in such a way as to oppose the support ring and that has an annular portion that is loosely fitted over the circular annulus portion so as to stretch the wafer sheet in cooperation with the circular annulus portion and a screw mechanism for causing relative movement of the support ring and stretching ring in the direction of their being approached to or separated from each other;

a rotating mechanism that has a support base and a rotating ring that is interposed between the support base and the support ring and that is connected to the support base and the support ring so that the rotating ring may be freely rotatable about an axis orthogonally intersecting a sheet surface of the wafer sheet supported by the circular annulus portion; and

whereby further comprising a drive motor supported by the support base, a first drive belt that connects an output shaft of the drive motor and the rotating ring, a second drive belt that connects the rotating ring and an input shaft of the screw mechanism, stopper means that stops selectively the relative rotation between the support base and the support ring and control means that switches the stopper means to a state of stopping the relative rotation between the support base and the support ring or a state of permitting this relative rotation.

4. A wafer sheet stretching apparatus according to claim 3, characterized in that the screw mechanism has a plurality of screw shafts each having formed thereon a male screw portion screwed into a female screw portion formed in the stretching ring, whereby a plurality of the screw shafts are disposed so that they may be located around the circular annulus portion of the support ring at equal intervals and be freely rotatable relative to the

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