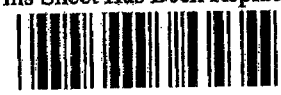
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SPECIFICATION

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☑ Description : paged 1 to paged 11
☑ Claim(s) : paged 12 to paged 13
☑ Drawing(s) : paged 14 to paged 15
☑ Abstract : paged 19 to paged —
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TITLE OF THE INVENTION

CUTTING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a cutting system for detecting the size, shape, and position of a workpiece and suitably cutting the workpiece according to the detected information, particularly, a cutting system is including a dicing system for holding indeterminate-shape or disorderly semiconductor wafers with a specified frame, suitably aligning the wafers according to the detected information, and suitably cutting them with a specified blade installed .

2. Description of the Prior Art

An aligning system for dicing (cutting) a workpiece such as a semiconductor wafer consisting of the structure disclosed in the official gazette of for example, Japanese Patent Laid-open Publication No. 60-244803 is generally known as an embodiment according to the prior art.

For the above invention according to the prior art, semiconductor wafers with regular size and shape such as those with the diameter of 5" or 6" are properly held by a frame respectively and provided with pattern matching and alignment at the pixel density of the X-Y-axis matrix caught by a camera according to the optimum alignment stroke previously set to said wafer with regular size.

For dicing, alignment is necessary to accurately align the cutting line (street) of a semiconductor wafer with the blade

for cutting the wafer. To improve the alignment accuracy, it is necessary to execute pattern matching at two separate places (alignment stroke) on a wafer. In a conventional method, for an indeterminate-shape wafer such as a broken wafer, pattern matching may not be executed within the alignment stroke. In this case, it is necessary to change the alignment stroke manually. When a plurality of wafers are present on a frame, it is necessary to set the alignment stroke every wafer.

Therefore, for the above embodiment according to the prior art, alignment can automatically be executed only when wafers have regular size and shape, and one wafer is properly held by one frame. However, if workpieces of the same type with different sizes (e.g. 5" and 6") are supplied to a production line, it is necessary to manually select the condition meeting each workpiece. In this case, selection of condition greatly decreases the efficiency of continuous automatic operation.

In addition, in order to prevent expensive wafers from wasting, partially broken wafers are formed into chips by separating usable portions from unusable ones. In this case, however, automatic cutting is impossible. Therefore, manual alignment is executed before cutting. Especially when a plurality of indeterminate-shape and disorderly wafers are held by one frame, it is impossible to automatically align and cut individual wafer.

Therefore, the embodiment according to the prior art has the problem to be solved in automatically dicing disorderly wafers of different shapes in order to improve operability.

SUMMARY OF THE INVENTION

In order to solve the problem of the embodiment according

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to the prior art, the present invention provides a cutting system for detecting the size, shape, and position of a workpiece and suitably cutting the workpiece according to the detected information. Particularly, the present invention provides a dicing system comprising a frame for holding workpieces (wafers), first detecting means for detecting the size, shape and position of the workpieces (wafers) held by the frame, second detecting means for aligning the workpieces (wafers) according to the information detected by the first detecting means, and cutting means for cutting the workpieces (wafers) according to the information detected by the second detecting means, wherein the first detecting means detects the size, shape and position of the workpieces (wafers) on the X-Y-axis matrix, the cutting stroke is controlled according to the information detected by the first detecting means, the second detecting means and the cutting means are installed in the same unit, it is possible to install the first detecting means independently or in other unit, or install the first detecting means, second detecting means, and cutting means in the same unit. It is also possible to make the first and second detecting means common. And, two or more workpieces (wafers) are held by the above-mentioned frame.

The size, shape, quantity, and position of the wafers mounted on a frame are detected by the first detecting means on an X-Y-axis matrix (e.g. X-Y-axis matrix consisting of 256x256 pixels of a CCD camera), the detected information is stored as data on a memory, each wafer is accurately aligned by the second detecting means according to the data, the cutting stroke is specified at the same time, therefore wafers with different sizes and shapes, for which it is impossible to

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be aligned by the conventional pattern matching, are automatically and suitably cut (diced).

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an explanatory drawing schematically showing the first embodiment of the dicing system of the present invention;

Fig. 2 is a top view of the frame having a plurality of indeterminate-shape and disorderly wafers;

Fig. 3 is an explanatory drawing showing the X-directional cutting stroke for a wafer;

Fig. 4 is an explanatory drawing showing the Y-directional cutting stroke for a wafer;

Fig. 5 is an explanatory drawing schematically showing the second embodiment of the dicing system of the present invention;

Fig. 6 is a flow chart showing the dicing step of the dicing system of the present invention;

Fig. 7 is an explanatory drawing showing another embodiment of the workpiece detecting means applicable to the cutting and dicing system of the present invention;

Fig. 8 is an explanatory drawing for detection according to level difference detected by the detecting means of another embodiment shown in Fig. 7; and

Fig. 9 is a graph for explaining plotting of positions by the level difference detected by the detecting means of another embodiment shown in Fig. 7.

DESCRIPTION OF SYMBOLS

1 : Control section

2 : First detecting means

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3 : Second detecting means

4 : First position

5 : Second position

6, 6a, 6b, 6c: Wafer

6d: Workpiece

7 : Base or table

8 : Cutting means

9 : Frame

10 : Film

10a: Holding means

11 : Detecting means

A : Cutting area

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the first embodiment shown in Fig. 1, numeral 1 is a control section including a storage section. The control section 1 controls the first detecting means 2, second detecting means 3, and cutting means 8. The first detecting means 1 is installed at the first detecting position 4 and the second detecting means 3 is installed at the second detecting position 5. At the first detecting position, the size, shape, position, and quantity of wafers 6 which are workpieces. At the second detecting position, wafers are accurately aligned to be cut. For example, a CCD camera consisting of 256x256 pixels is used as these detecting means. The wafer 6 is held on the specified holding means such as a base or table 7 and cut by the specified cutting means, i.e. the blade 8 in the cutting area A according to the data consisting of the information by the detecting means.

For the wafer 6, as shown in Fig. 2, for example, three

wafers of 6a, 6b, and 6c and mounted on a frame 9. These wafers are partially chipped and their shapes and sizes are disorderly and indeterminate, which are mounted on the frame by visually arranging the cutting streets "a" and "b" of each wafer. Numeral 10 is a film for mounting wafers.

The frame 9 having the wafers 6a, 6b and 6c is entirely picked up by the first detecting means 2 at the first detecting position 4 to detect the wafer state. In this case, the size, shape, and quantity of wafers mounted on the frame 9 are detected on the X-Y-axis matrix. In addition, approximate tilt angle "Θ" of the cutting street is detected by the known means as shown in the official gazette of Japanese Patent Laid-open Publication No. 60-54454 according to necessity and further the position of the wafers 6a, 6b and 6c on the X-Y-axis matrix are detected. Then, the information for the alignment stroke and cutting stroke according to the above-mentioned are stored in the control section 1.

At the second detecting position 5, the wafers 6a, 6b and 6c are accurately aligned at their positions by the known pattern-matching means as shown in the above-mentioned prior art according to the information obtained at the first detecting position 4, and alignment information is detected.

That is, such steps are comprising, for example, detecting accurately how the displacement and tilt angle on the X-Y-axis of the cutting streets "a" and "b" of the wafer 6a on the frame 9 are, storing such data as information, also detecting the cutting strokes of the cutting means 8 in the X-axis direction as shown in Fig. 3 and the Y-axis direction as shown in Fig. 4 according to the size and shape of the wafer 6a based on the information obtained at the first detecting means, and storing

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the both detected informations in the control section 1. Similarly, the displacement, tilt angle and cutting stroke of other wafers 6b and 6c are detected and stored in the control section 1.

The first detecting means 2 may be formed as an independent unit or installed in other unit. For example, the first detecting means may be installed in a unit for mounting the wafers on the frame 9, so-called wafer mounting unit, or installed in the dicing unit together with or separately from the second detecting means 3.

The above example is shown in Fig. 5 as a second embodiment. That is, the first and second detecting means are integrated as a detecting means 11. A CCD camera similarly to the above-mentioned may be used as the detecting means 11. Then, the size and shape of the wafers mounted on the frame 9 and the position of each wafer on the X-Y-axis matrix (e.g. matrix consisting of 256x256 pixels of a CCD camera) are detected and are stored in the control section 1 as information.

At the same time, the tilt angle of the cutting street of each wafer on the X-Y-axis matrix is detected and the cutting stroke is also detected corresponding to the size and shape of each wafer. These pieces of information are stored in the control section 1. The frame 9 is mounted on a base or table 7 and wafers are suitably cut by the cutting means 8 in the cutting area A, similarly to the procedure for the above embodiment.

For the above embodiments, the size, shape, position, quantity and cutting street of one or more wafers mounted on the frame 9 are detected on the X-Y-axis matrix, and, at the

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same time, the cutting stroke is also detected corresponding to the size and shape of the wafers. Accordingly, cutting (dicing) is accurately and securely executed according to these pieces of information.

The following is the description of dicing for the system of the present invention according to the flow chart in Fig. 6. In the first step a, one or more wafers mounted on the frame 9 are supplied to the first position 4 of the first detecting means 2. In the second step b, the state of the wafer is detected by the first detecting means 2 at the first position 4. That is, the size, shape, position, and tilt angle of the cutting street of the wafers corresponding to the X-Y-axis matrix are detected as information.

In the third step c, the optimum alignment stroke and cutting stroke of the waters are calculated according to the detected information for the size, shape, position and tilt angle of cutting street corresponding to the X-Y-axis matrix. In the fourth step d, the data detected in the second step b and calculated in the third step c is transferred to and stored in the control section 1 as information.

In the fifth step e, each wafer on the frame is accurately aligned by the second detecting means 3, e.g. pattern matching means with the optimum alignment stroke according to the information in the first detecting means 2 and the alignment information is stored in the control section 1. In the sixth step f, the wafers are cut at the cutting area A according to the cutting-stroke information obtained by the first detecting means 2 and stored in the control section 1 and the alignment information obtained by the second detecting means 3 and stored in the control section 1. And in the seventh step g, the cut

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wafers are cleaned after the end of the dicing process and the frames having the cleaned wafers are delivered to the next process.

For the second embodiment, the second step b through the fifth step e are executed by one detecting means 11 made by integrating the first and second detecting means and the sixth f and seventh g steps are executed in order according to the data detected by the detecting means 11. The above steps are repeated every supplied frame. Therefore, suitable dicing can continuously be executed even if the size, shape, and quantity (one or more) of wafers mounted on each frame are different. For the above embodiment, a semiconductor wafer is used as the workpiece, however, the workpieces is not limited, e.g. workpiece made of ferrite or noble metal may be used for the same process.

In the above embodiment, a CCD camera is used as detecting means, however, the detecting means is not limited, e.g. various types of detecting means including ultrasonic detecting means, laser beam detecting means and so on may be used.

In this case, the size, shape, and position of a workpiece are detected by the ultrasonic or laser-beam detecting means as shown in Figs. 7 through 9.

The following is the description of the above detection. The size, shape and position of the workpiece 6d are detected by detecting the level difference "h" between the workpiece 6d and the holding means 10a for holding the workpiece according to scanning them by the detecting means or detecting the difference of reflected luminous energy (Figs. 7 and 8) and plotting the boundary points (e1, e2,..., and en) between the workpiece 6d and the holding means 10a on the X-Y

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coordinate axis (X-Y-axis matrix) (Fig. 9). Then, cutting is executed by the means same as that of the first or second embodiment.

In addition, combination of different types of detecting means such as combination of the CCD camera and the ultrasonic or laser-beam detecting means is included in the technical idea of the present invention unless the combination contradicts the gist of the present invention.

ADVANTAGES OF THE INVENTION

First, the cutting and dicing system of the present invention comprises a frame for holding wafers, first detecting means for detecting the size, shape and position of the wafer held by the frame on an X-Y-axis matrix, second detecting means for aligning the wafers according to the information detected by the first detecting means, and cutting means for cutting the wafers according to the information detected by the second detecting means, wherein the size, shape and position of indeterminate-shape and disorderly wafers are detected by the first detecting means on an X-Y-axis matrix, the wafers are accurately aligned by the second detecting means according to the detected information, and one or more indeterminate-shape wafers are automatically and accurately diced though they are only manually diced conventionally.

Secondly, the first detecting means detects the size, shape and position of a wafer on an X-Y-axis matrix and the cutting stroke is controlled according to the information detected by the first detecting means. Accordingly, it is confirmed that the cutting efficiency is improved and the throughput is increased up to 1.5 times compared with the conventional throughput. Even if a plurality of wafers are

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mounted on one frame, each wafer can be cut (diced) without moving unnecessarily and being affected by other wafers.

Thirdly, it is possible to install the second detecting means and cutting means in the same unit, the first detecting means, independently or in other unit, or the first detecting means, second detecting means and cutting means in the same unit. It is also possible to make the first and second detecting means common. Accordingly, it is possible to simply upgrade the conventional dicing systems.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

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* C L M S *

WHAT IS CLAIMED IS:

1. A cutting system for cutting a workpiece comprising the steps of;

detecting the size, shape, and position of a workpiece(6d), and

suitably cutting the workpiece(6d) according to the detected information.

2. A cutting system according to claim 1, comprising a first detecting means(2) for detecting the size, shape and position of the workpiece(6d) held by a frame(9), a second detecting means(3) for aligning the workpiece(6d) according to the information detected by the first detecting means(2), and a cutting means(8) for cutting the workpiece(6d) according to the information detected by the first and second detecting means(2,3).

3. A cutting system according to claim 2, wherein the first detecting means(2) detects the size, shape and position of the workpiece(6d) on an X-Y-axis matrix.

4. A cutting system according to claim 2 or 3, wherein a cutting stroke is controlled according to the information detected by the first detecting means(2).

5. A cutting system according to claim 2, 3 or 4, wherein the frame(9) holds two or more workpieces(6d).

6. A cutting system according to claim 2, 3, 4 or 5, wherein the second detecting means(3) and the cutting means(8) are installed in the same unit and the first detecting means(2) is installed in the unit independently or in other unit.

7. A cutting system according to claim 2, 3, 4 or 5, wherein the first detecting means(2), second detecting means(3), and cutting means(8) are installed in the same unit.

8. A cutting system according to claim 7, wherein the

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* C L M S *

first detecting means(2)/ and the second detecting means(3)/ are common(11)/

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ABSTRACT

A cutting system for cutting a workpiece comprising the steps of detecting the size, shape, quantity, position and cutting stroke of the workpieces having different size and shape mounted on a frame by first detecting means (2) on an X-Y-axis matrix, storing the detected information on a memory, aligning said workpieces accurately by second detecting means (3) according to the detected information, and cutting said workpieces automatically and suitably.

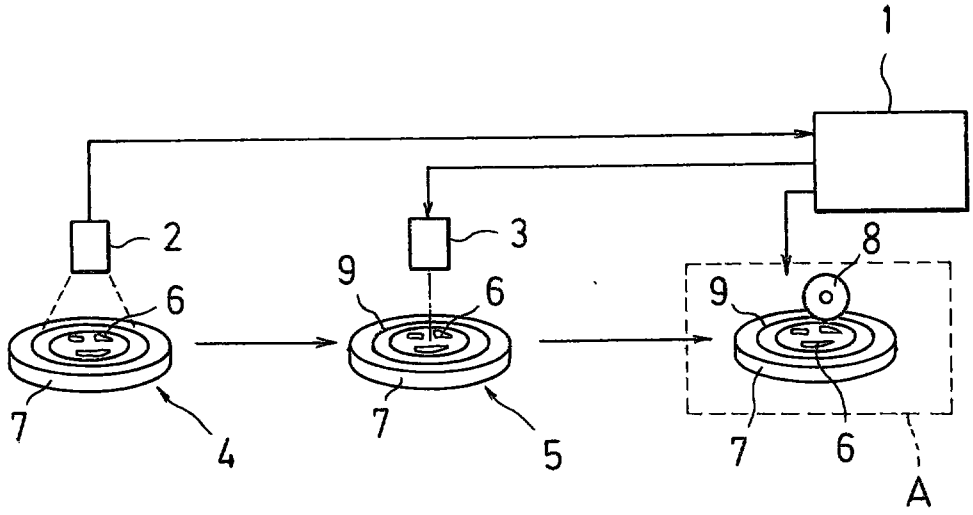
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FIG.1



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FIG.2

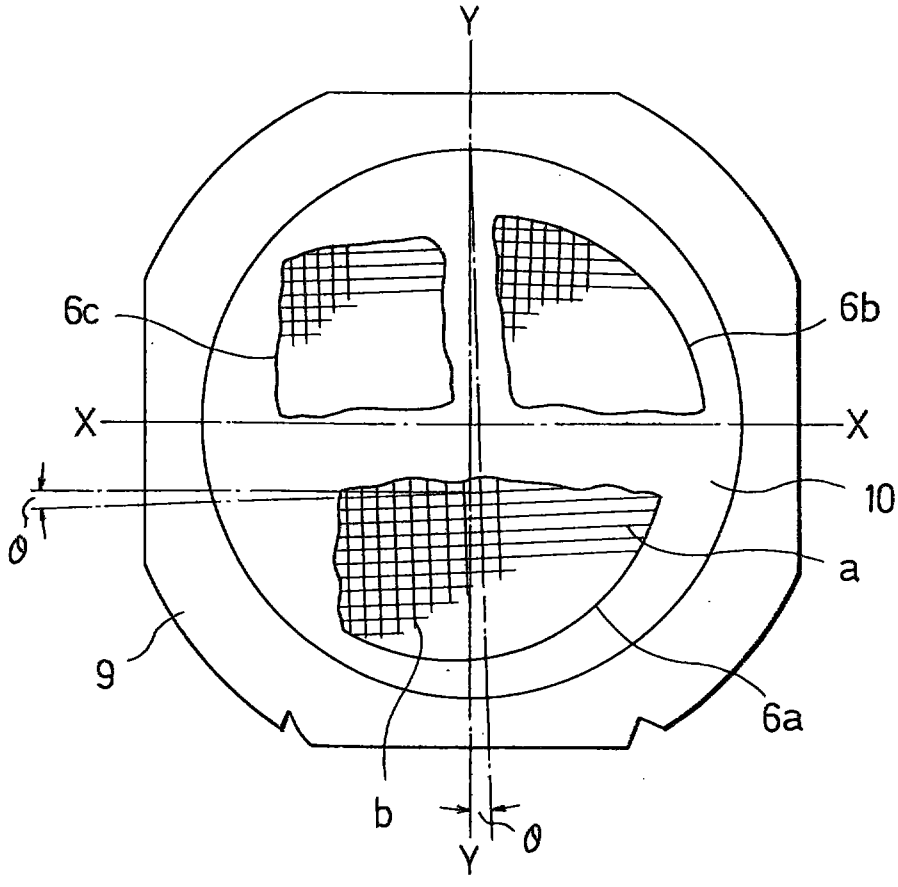
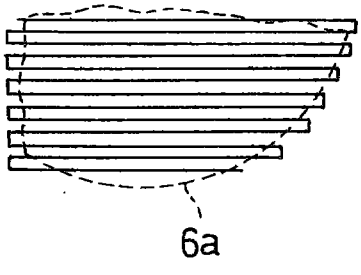


FIG.3



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FIG.4

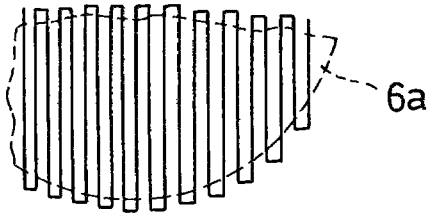
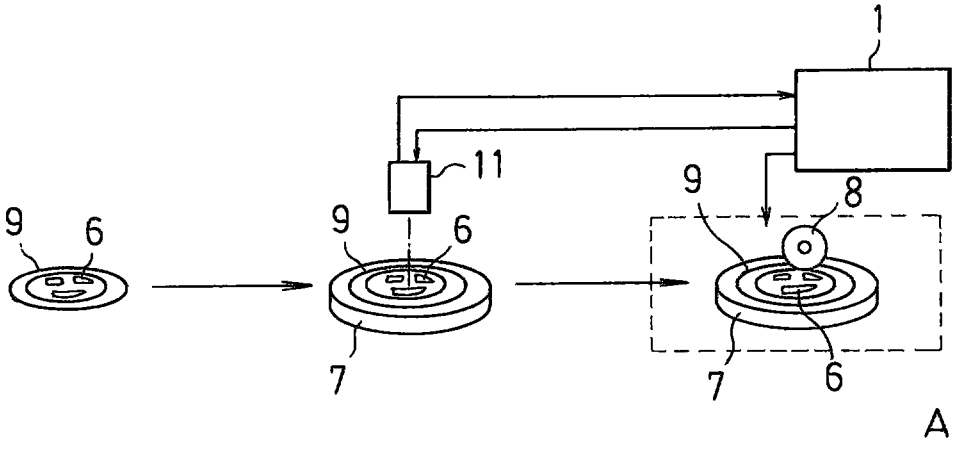
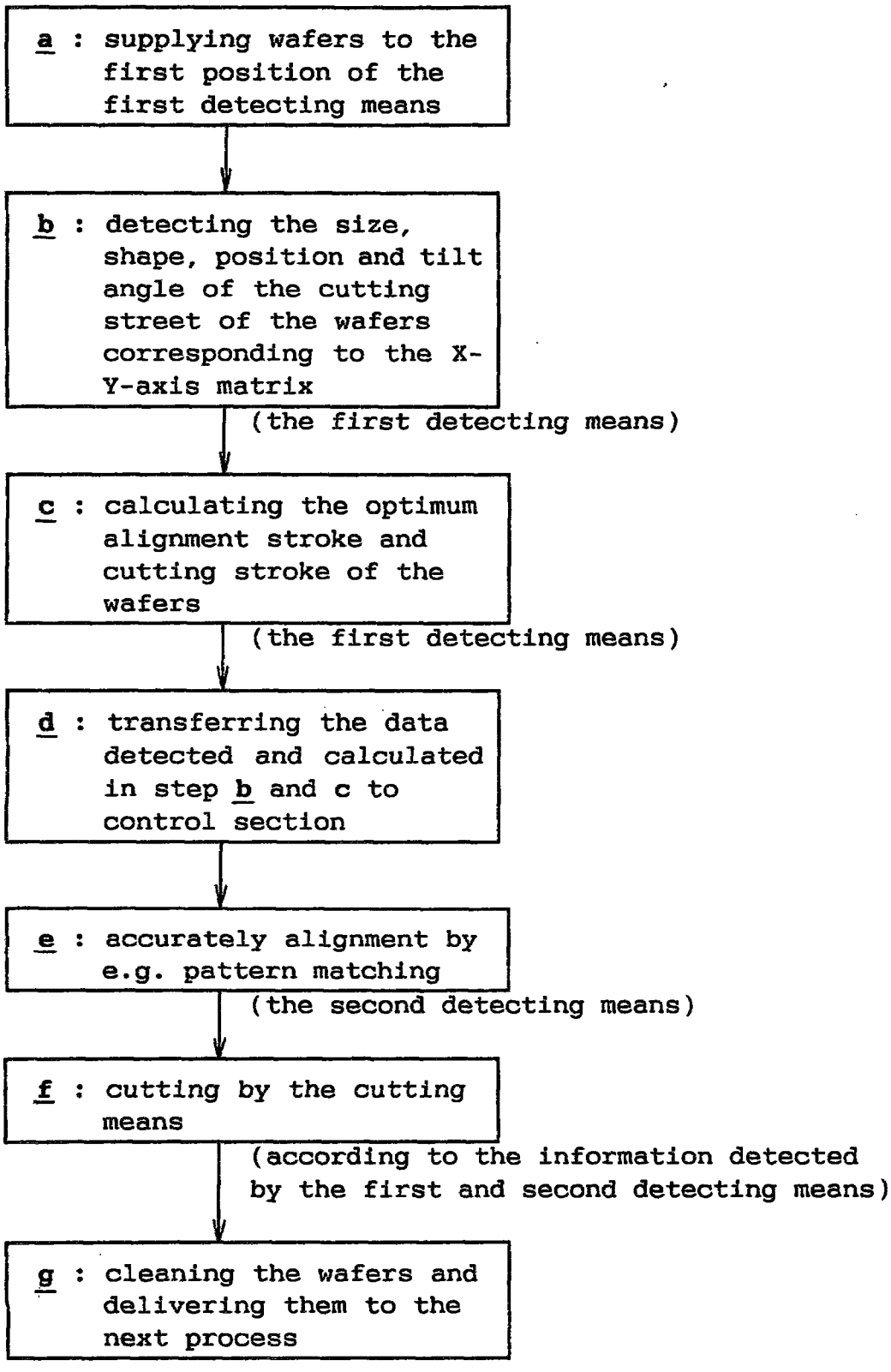


FIG.5



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FIG.6



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FIG.7

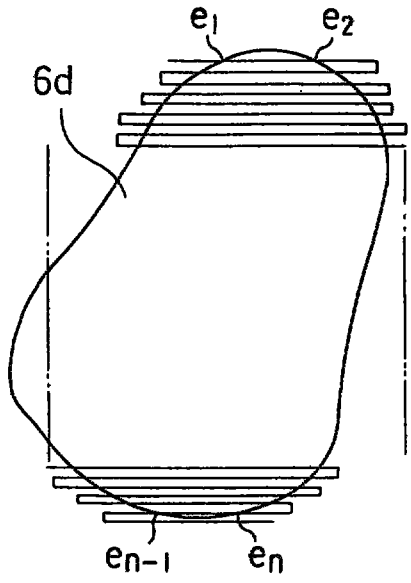


FIG.8

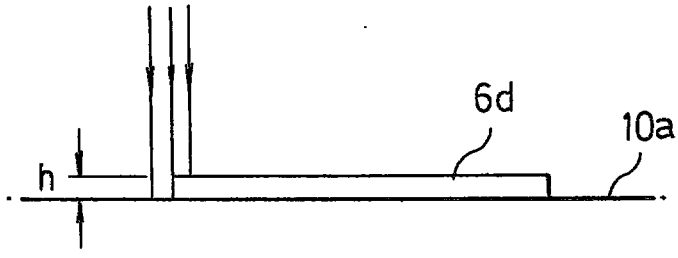
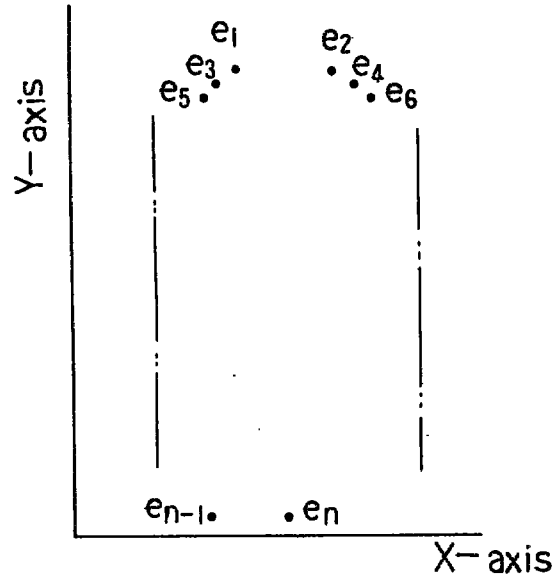


FIG.9



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SPECIFICATION

TITLE OF THE INVENTION

CUTTING SYSTEM

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a cutting system for detecting the size, shape, and position of a workpiece and suitably cutting the workpiece according to the detected information, particularly, a cutting system is including a dicing system for holding indeterminate-shape or disorderly semiconductor wafers with a specified frame, suitably aligning the wafers according to the detected information, and suitably cutting them with a specified blade installed .

2. Description of the Prior Art

An aligning system for dicing (cutting) a workpiece such as a semiconductor wafer consisting of the structure disclosed in the official gazette of for example, Japanese Patent Laid-open Publication No. 60-244803 is generally known as an embodiment according to the prior art.

For the above invention according to the prior art, semiconductor wafers with regular size and shape such as those with the diameter of 5" or 6" are properly held by a frame respectively and provided with pattern matching and alignment at the pixel density of the X-Y-axis matrix caught by a camera according to the optimum alignment stroke previously set to said wafer with regular size.

For dicing, alignment is necessary to accurately align the cutting line (street) of a semiconductor wafer with the blade

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for cutting the wafer. To improve the alignment accuracy, it is necessary to execute pattern matching at two separate places (alignment stroke) on a wafer. In a conventional method, for an indeterminate-shape wafer such as a broken wafer, pattern matching may not be executed within the alignment stroke. In this case, it is necessary to change the alignment stroke manually. When a plurality of wafers are present on a frame, it is necessary to set the alignment stroke every wafer.

Therefore, for the above embodiment according to the prior art, alignment can automatically be executed only when wafers have regular size and shape, and one wafer is properly held by one frame. However, if workpieces of the same type with different sizes (e.g. 5" and 6") are supplied to a production line, it is necessary to manually select the condition meeting each workpiece. In this case, selection of condition greatly decreases the efficiency of continuous automatic operation.

In addition, in order to prevent expensive wafers from wasting, partially broken wafers are formed into chips by separating usable portions from unusable ones. In this case, however, automatic cutting is impossible. Therefore, manual alignment is executed before cutting. Especially when a plurality of indeterminate-shape and disorderly wafers are held by one frame, it is impossible to automatically align and cut individual wafer.

Therefore, the embodiment according to the prior art has the problem to be solved in automatically dicing disorderly wafers of different shapes in order to improve operability.

SUMMARY OF THE INVENTION

In order to solve the problem of the embodiment according

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to the prior art, the present invention provides a cutting system for detecting the size, shape, and position of a workpiece and suitably cutting the workpiece according to the detected information. Particularly, the present invention provides a dicing system comprising a frame for holding workpieces (wafers), first detecting means for detecting the size, shape and position of the workpieces (wafers) held by the frame, second detecting means for aligning the workpieces (wafers) according to the information detected by the first detecting means, and cutting means for cutting the workpieces (wafers) according to the information detected by the second detecting means, wherein the first detecting means detects the size, shape and position of the workpieces (wafers) on the X-Y-axis matrix, the cutting stroke is controlled according to the information detected by the first detecting means, the second detecting means and the cutting means are installed in the same unit, it is possible to install the first detecting means independently or in other unit, or install the first detecting means, second detecting means, and cutting means in the same unit. It is also possible to make the first and second detecting means common. And, two or more workpieces (wafers) are held by the above-mentioned frame.

The size, shape, quantity, and position of the wafers mounted on a frame are detected by the first detecting means on an X-Y-axis matrix (e.g. X-Y-axis matrix consisting of 256x256 pixels of a CCD camera), the detected information is stored as data on a memory, each wafer is accurately aligned by the second detecting means according to the data, the cutting stroke is specified at the same time, therefore wafers with different sizes and shapes, for which it is impossible to

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be aligned by the conventional pattern matching, are automatically and suitably cut (diced).

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an explanatory drawing schematically showing the first embodiment of the dicing system of the present invention;

Fig. 2 is a top view of the frame having a plurality of indeterminate-shape and disorderly wafers;

Fig. 3 is an explanatory drawing showing the X-directional cutting stroke for a wafer;

Fig. 4 is an explanatory drawing showing the Y-directional cutting stroke for a wafer;

Fig. 5 is an explanatory drawing schematically showing the second embodiment of the dicing system of the present invention;

Fig. 6 is a flow chart showing the dicing step of the dicing system of the present invention;

Fig. 7 is an explanatory drawing showing another embodiment of the workpiece detecting means applicable to the cutting and dicing system of the present invention;

Fig. 8 is an explanatory drawing for detection according to level difference detected by the detecting means of another embodiment shown in Fig. 7; and

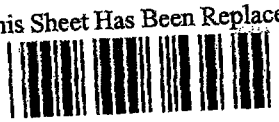
Fig. 9 is a graph for explaining plotting of positions by the level difference detected by the detecting means of another embodiment shown in Fig. 7.

DESCRIPTION OF SYMBOLS

1 : Control section

2 : First detecting means

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3 : Second detecting means

4 : First position

5 : Second position

6, 6a, 6b, 6c: Wafer

6d: Workpiece

7 : Base or table

8 : Cutting means

9 : Frame

10 : Film

10a: Holding means

11 : Detecting means

A : Cutting area

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the first embodiment shown in Fig. 1, numeral 1 is a control section including a storage section. The control section 1 controls the first detecting means 2, second detecting means 3, and cutting means 8. The first detecting means 1 is installed at the first detecting position 4 and the second detecting means 3 is installed at the second detecting position 5. At the first detecting position, the size, shape, position, and quantity of wafers 6 which are workpieces. At the second detecting position, wafers are accurately aligned to be cut. For example, a CCD camera consisting of 256x256 pixels is used as these detecting means. The wafer 6 is held on the specified holding means such as a base or table 7 and cut by the specified cutting means, i.e. the blade 8 in the cutting area A according to the data consisting of the information by the detecting means.

For the wafer 6, as shown in Fig. 2, for example, three

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wafers of 6a, 6b, and 6c and mounted on a frame 9. These wafers are partially chipped and their shapes and sizes are disorderly and indeterminate, which are mounted on the frame by visually arranging the cutting streets "a" and "b" of each wafer. Numeral 10 is a film for mounting wafers.

The frame 9 having the wafers 6a, 6b and 6c is entirely picked up by the first detecting means 2 at the first detecting position 4 to detect the wafer state. In this case, the size, shape, and quantity of wafers mounted on the frame 9 are detected on the X-Y-axis matrix. In addition, approximate tilt angle "Θ" of the cutting street is detected by the known means as shown in the official gazette of Japanese Patent Laid-open Publication No. 60-54454 according to necessity and further the position of the wafers 6a, 6b and 6c on the X-Y-axis matrix are detected. Then, the information for the alignment stroke and cutting stroke according to the above-mentioned are stored in the control section 1.

At the second detecting position 5, the wafers 6a, 6b and 6c are accurately aligned at their positions by the known pattern-matching means as shown in the above-mentioned prior art according to the information obtained at the first detecting position 4, and alignment information is detected.

That is, such steps are comprising, for example, detecting accurately how the displacement and tilt angle on the X-Y-axis of the cutting streets "a" and "b" of the wafer 6a on the frame 9 are, storing such data as information, also detecting the cutting strokes of the cutting means 8 in the X-axis direction as shown in Fig. 3 and the Y-axis direction as shown in Fig. 4 according to the size and shape of the wafer 6a based on the information obtained at the first detecting means, and storing

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the both detected informations in the control section 1. Similarly, the displacement, tilt angle and cutting stroke of other wafers 6b and 6c are detected and stored in the control section 1.

The first detecting means 2 may be formed as an independent unit or installed in other unit. For example, the first detecting means may be installed in a unit for mounting the wafers on the frame 9, so-called wafer mounting unit, or installed in the dicing unit together with or separately from the second detecting means 3.

The above example is shown in Fig. 5 as a second embodiment. That is, the first and second detecting means are integrated as a detecting means 11. A CCD camera similarly to the above-mentioned may be used as the detecting means 11. Then, the size and shape of the wafers mounted on the frame 9 and the position of each wafer on the X-Y-axis matrix (e.g. matrix consisting of 256x256 pixels of a CCD camera) are detected and are stored in the control section 1 as information.

At the same time, the tilt angle of the cutting street of each wafer on the X-Y-axis matrix is detected and the cutting stroke is also detected corresponding to the size and shape of each wafer. These pieces of information are stored in the control section 1. The frame 9 is mounted on a base or table 7 and wafers are suitably cut by the cutting means 8 in the cutting area A, similarly to the procedure for the above embodiment.

For the above embodiments, the size, shape, position, quantity and cutting street of one or more wafers mounted on the frame 9 are detected on the X-Y-axis matrix, and, at the

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same time, the cutting stroke is also detected corresponding to the size and shape of the wafers. Accordingly, cutting (dicing) is accurately and securely executed according to these pieces of information.

The following is the description of dicing for the system of the present invention according to the flow chart in Fig. 6. In the first step a, one or more wafers mounted on the frame 9 are supplied to the first position 4 of the first detecting means 2. In the second step b, the state of the wafer is detected by the first detecting means 2 at the first position 4. That is, the size, shape, position, and tilt angle of the cutting street of the wafers corresponding to the X-Y-axis matrix are detected as information.

In the third step c, the optimum alignment stroke and cutting stroke of the waters are calculated according to the detected information for the size, shape, position and tilt angle of cutting street corresponding to the X-Y-axis matrix. In the fourth step d, the data detected in the second step b and calculated in the third step c is transferred to and stored in the control section 1 as information.

In the fifth step e, each wafer on the frame is accurately aligned by the second detecting means 3, e.g. pattern matching means with the optimum alignment stroke according to the information in the first detecting means 2 and the alignment information is stored in the control section 1. In the sixth step f, the wafers are cut at the cutting area A according to the cutting-stroke information obtained by the first detecting means 2 and stored in the control section 1 and the alignment information obtained by the second detecting means 3 and stored in the control section 1. And in the seventh step g, the cut

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wafers are cleaned after the end of the dicing process and the frames having the cleaned wafers are delivered to the next process.

For the second embodiment, the second step b through the fifth step e are executed by one detecting means 11 made by integrating the first and second detecting means and the sixth f and seventh g steps are executed in order according to the data detected by the detecting means 11. The above steps are repeated every supplied frame. Therefore, suitable dicing can continuously be executed even if the size, shape, and quantity (one or more) of wafers mounted on each frame are different. For the above embodiment, a semiconductor wafer is used as the workpiece, however, the workpieces is not limited, e.g. workpiece made of ferrite or noble metal may be used for the same process.

In the above embodiment, a CCD camera is used as detecting means, however, the detecting means is not limited, e.g. various types of detecting means including ultrasonic detecting means, laser beam detecting means and so on may be used.

In this case, the size, shape, and position of a workpiece are detected by the ultrasonic or laser-beam detecting means as shown in Figs. 7 through 9.

The following is the description of the above detection. The size, shape and position of the workpiece 6d are detected by detecting the level difference "h" between the workpiece 6d and the holding means 10a for holding the workpiece according to scanning them by the detecting means or detecting the difference of reflected luminous energy (Figs. 7 and 8) and plotting the boundary points (e1, e2,..., and en) between the workpiece 6d and the holding means 10a on the X-Y

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coordinate axis (X-Y-axis matrix) (Fig. 9). Then, cutting is executed by the means same as that of the first or second embodiment.

In addition, combination of different types of detecting means such as combination of the CCD camera and the ultrasonic or laser-beam detecting means is included in the technical idea of the present invention unless the combination contradicts the gist of the present invention.

ADVANTAGES OF THE INVENTION

First, the cutting and dicing system of the present invention comprises a frame for holding wafers, first detecting means for detecting the size, shape and position of the wafer held by the frame on an X-Y-axis matrix, second detecting means for aligning the wafers according to the information detected by the first detecting means, and cutting means for cutting the wafers according to the information detected by the second detecting means, wherein the size, shape and position of indeterminate-shape and disorderly wafers are detected by the first detecting means on an X-Y-axis matrix, the wafers are accurately aligned by the second detecting means according to the detected information, and one or more indeterminate-shape wafers are automatically and accurately diced though they are only manually diced conventionally.

Secondly, the first detecting means detects the size, shape and position of a wafer on an X-Y-axis matrix and the cutting stroke is controlled according to the information detected by the first detecting means. Accordingly, it is confirmed that the cutting efficiency is improved and the throughput is increased up to 1.5 times compared with the conventional throughput. Even if a plurality of wafers are

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mounted on one frame, each wafer can be cut (diced) without moving unnecessarily and being affected by other wafers.

Thirdly, it is possible to install the second detecting means and cutting means in the same unit, the first detecting means, independently or in other unit, or the first detecting means, second detecting means and cutting means in the same unit. It is also possible to make the first and second detecting means common. Accordingly, it is possible to simply upgrade the conventional dicing systems.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

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WHAT IS CLAIMED IS:

1. A cutting system for cutting a workpiece comprising the steps of;

detecting the size, shape, and position of a workpiece(6d), and

suitably cutting the workpiece(6d)/according to the detected information.

2. A cutting system according to claim 1, comprising a first detecting means(2) for detecting the size, shape and position of the workpiece(6d) held by a frame(9), a second detecting means(3) for aligning the workpiece(6d) according to the information detected by the first detecting means(2), and a cutting means(8) for cutting the workpiece(6d) according to the information detected by the first and second detecting means(2,3).

3. A cutting system according to claim 2, wherein the first detecting means(2) detects the size, shape and position of the workpiece(6d) on an X-Y-axis matrix.

4. A cutting system according to claim 2 or 3, wherein a cutting stroke is controlled according to the information detected by the first detecting means(2).

5. A cutting system according to claim 2, 3 or 4, wherein the frame(9) holds two or more workpieces(6d).

6. A cutting system according to claim 2, 3, 4 or 5, wherein the second detecting means(3) and the cutting means(8) are installed in the same unit and the first detecting means(2) is installed in the unit independently or in other unit.

7. A cutting system according to claim 2, 3, 4 or 5, wherein the first detecting means(2), second detecting means(3), and cutting means(8) are installed in the same unit.

8. A cutting system according to claim 7, wherein the

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first detecting means(2) and the second detecting means(3) are common(11)

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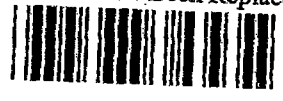
CUTTING SYSTEM

ABSTRACT

A cutting system for cutting a workpiece comprising the steps of detecting the size, shape, quantity, position and cutting stroke of the workpieces having different size and shape mounted on a frame by first detecting means (2) on an X-Y-axis matrix, storing the detected information on a memory, aligning said workpieces accurately by second detecting means (3) according to the detected information, and cutting said workpieces automatically and suitably.

Fig. 1

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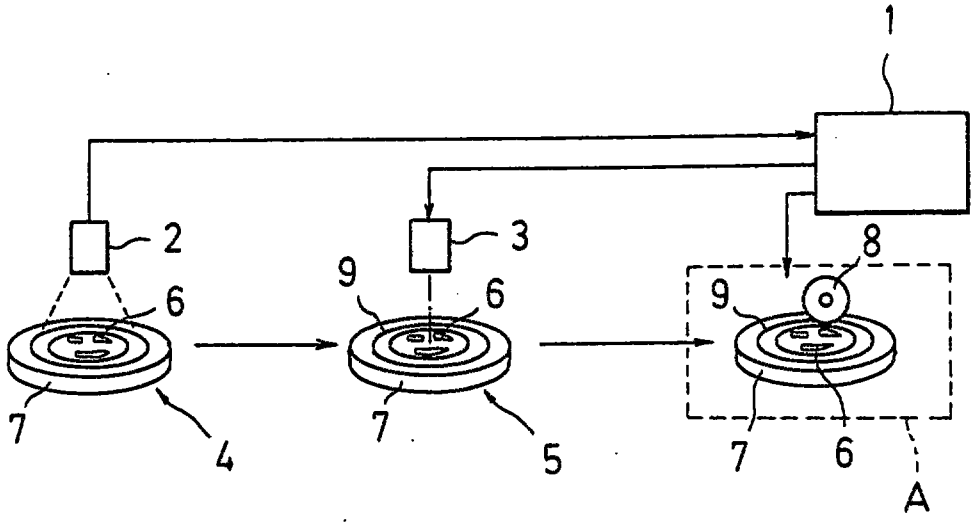
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FIG.1



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FIG.2

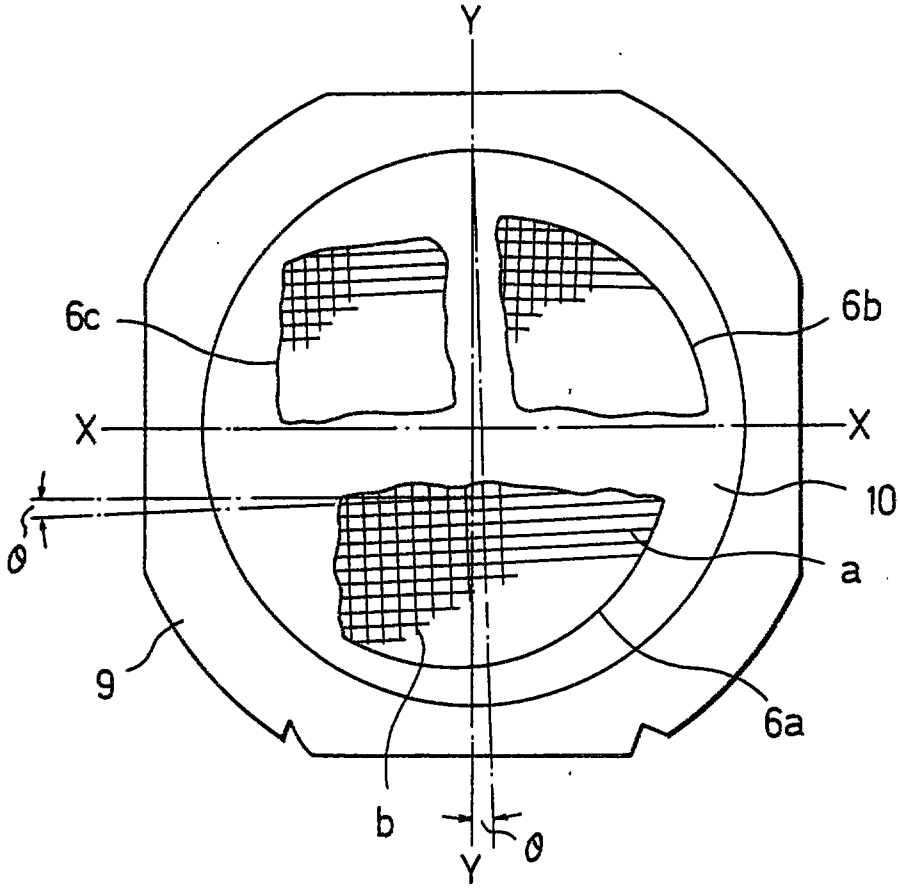
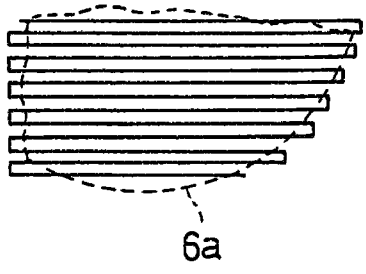


FIG.3



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FIG.4

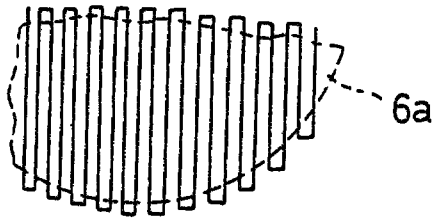
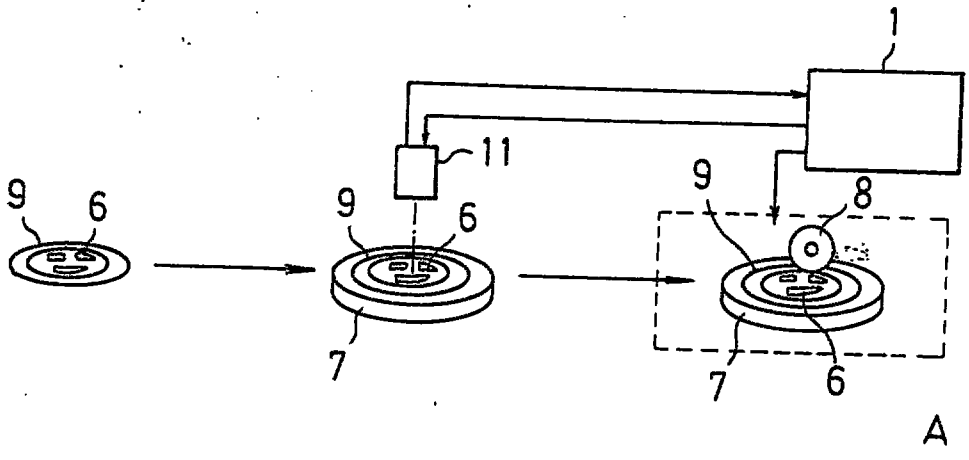
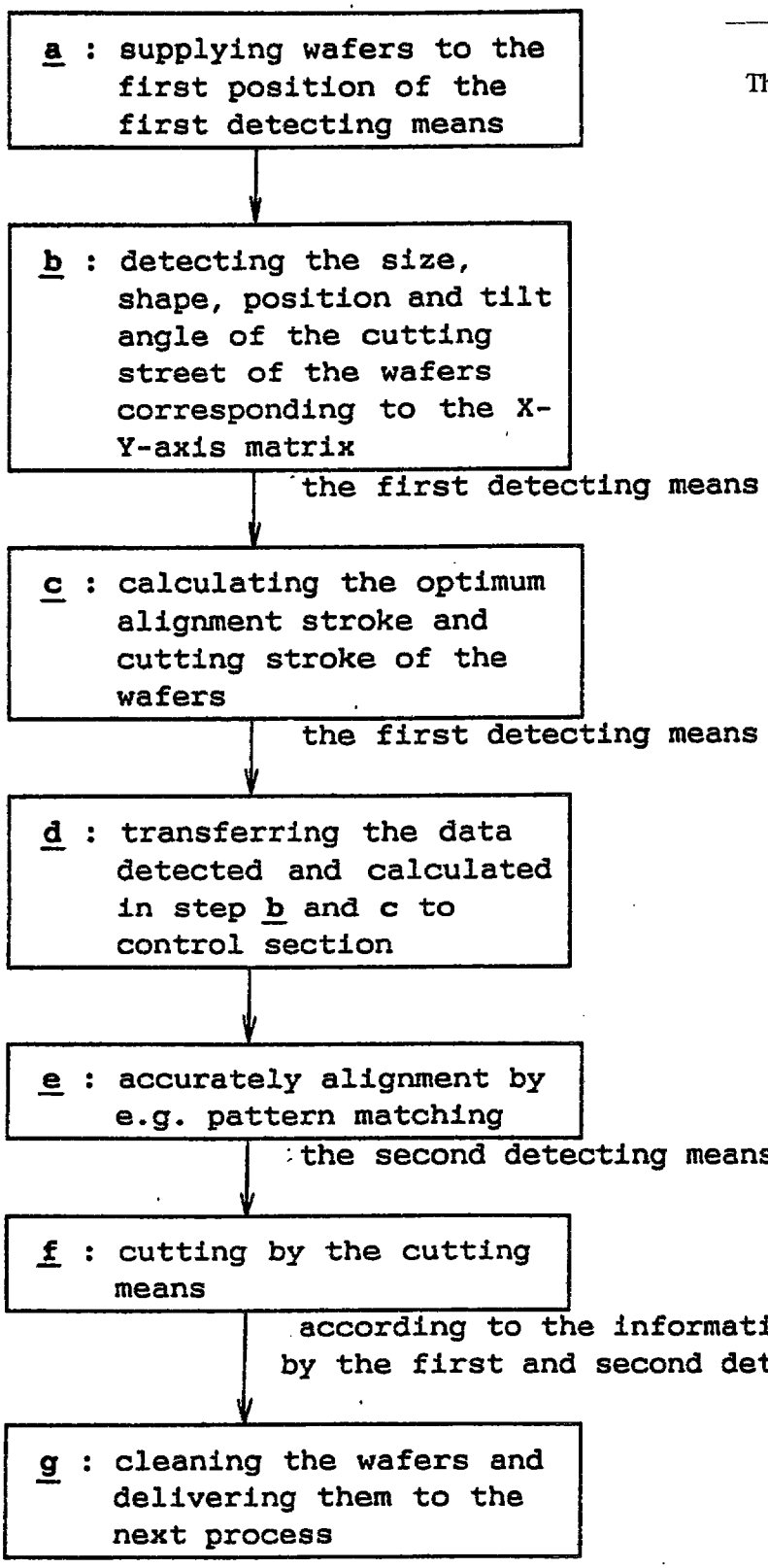


FIG.5



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FIG.6



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FIG.7

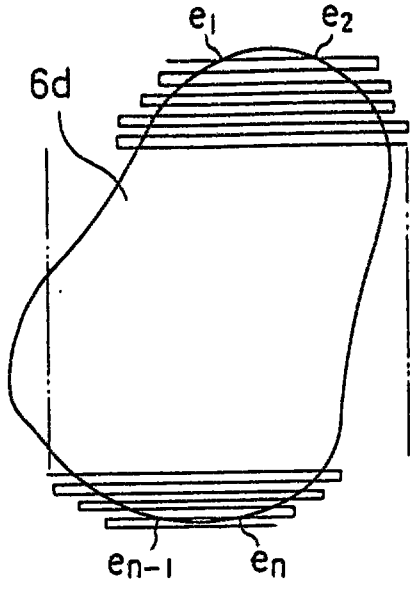


FIG.8

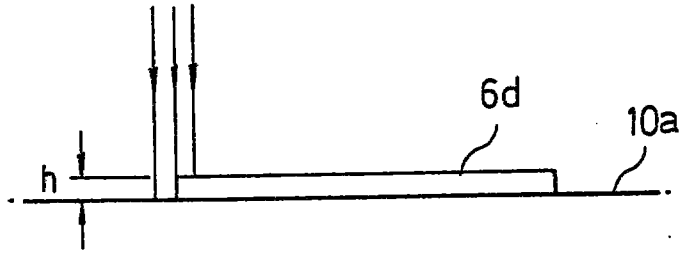
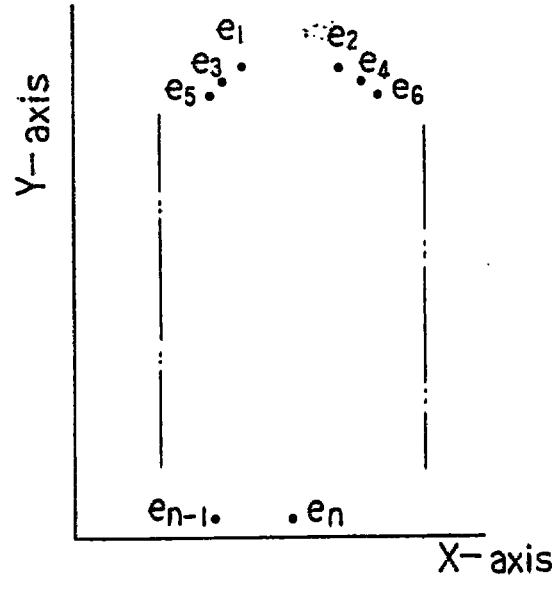


FIG.9



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Drawing(s) : paged ... to paged ...
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CUTTING SYSTEM

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a cutting system for detecting the size, shape, and position of a workpiece and suitably cutting the workpiece according to the detected information, particularly, a cutting system is including a dicing system for holding indeterminate-shape or disorderly semiconductor wafers with a specified frame, suitably aligning the wafers according to the detected information, and suitably cutting them with a specified blade installed .

2. Description of the Prior Art

An aligning system for dicing (cutting) a workpiece such as a semiconductor wafer consisting of the structure disclosed in the official gazette of for example, Japanese Patent Laid-open Publication No. 60-244803 is generally known as an embodiment according to the prior art.

For the above invention according to the prior art, semiconductor wafers with regular size and shape such as those with the diameter of 125 mm (5") or 150 mm (6") are properly held by a frame respectively and provided with pattern matching and alignment at the pixel density of the X-Y-axis matrix caught by a camera according to the optimum alignment stroke previously set to said wafer with regular size.

For dicing, alignment is necessary to accurately align the cutting line (street) of a semiconductor wafer with the blade for cutting the wafer. To improve the align-

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ment accuracy, it is necessary to execute pattern matching at two separate places (alignment stroke) on a wafer. In a conventional method, for an indeterminate-shape wafer such as a broken wafer, pattern matching may not be executed within the alignment stroke. In this case, it is necessary to change the alignment stroke manually. When a plurality of wafers are present on a frame, it is necessary to set the alignment stroke every wafer.

Therefore, for the above embodiment according to the prior art, alignment can automatically be executed only when wafers have regular size and shape, and one wafer is properly held by one frame. However, if workpieces of the same type with different sizes (e.g. 5" and 6") are supplied to a production line, it is necessary to manually select the condition meeting each workpiece. In this case, selection of condition greatly decreases the efficiency of continuous automatic operation.

In addition, in order to prevent expensive wafers from wasting, partially broken wafers are formed into chips by separating usable portions from unusable ones. In this case, however, automatic cutting is impossible. Therefore, manual alignment is executed before cutting. Especially when a plurality of indeterminate-shape and disorderly wafers are held by one frame, it is impossible to automatically align and cut individual wafer.

Therefore, the embodiment according to the prior art has the problem to be solved in automatically dicing disorderly wafers of different shapes in order to improve operability.

SUMMARY OF THE INVENTION

In order to solve the problem of the embodiment according to the prior art, the present invention provides a cutting cutting method and cutting apparatus as outlined in the claims.

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The size, shape, quantity, and position of the wafers mounted on a frame are detected by the first detecting means on an X-Y-axis matrix (e.g. X-Y-axis matrix consisting of 256x256 pixels of a CCD camera), the detected information is stored as data on a memory, each wafer is accurately aligned by the second detecting means according to the data, the cutting stroke is specified at the same time, therefore wafers with different sizes and shapes, for which it is impossible to be aligned by the conventional pattern matching, are automatically and suitably cut (diced).

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an explanatory drawing schematically showing the first embodiment of the dicing system of the present invention;
Fig. 2 is a top view of the frame having a plurality of indeterminate-shape and disorderly wafers;
Fig. 3 is an explanatory drawing showing the X-directional cutting stroke for a wafer;
Fig. 4 is an explanatory drawing showing the Y-directional cutting stroke for a wafer;
Fig. 5 is an explanatory drawing schematically showing the second embodiment of the dicing system of the present invention;
Fig. 6 is a flow chart showing the dicing step of the dicing system of the present invention:
Fig. 7 is an explanatory drawing showing another embodiment of the workpiece detecting means applicable to the cutting and dicing system of the present invention;
Fig. 8 is an explanatory drawing for detection according to level difference detected by the detecting means of another embodiment shown in Fig. 7; and
Fig. 9 is a graph for explaining plotting of positions

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by the level difference detected by the detecting means of another embodiment shown in Fig. 7.

DESCRIPTION OF SYMBOLS

1 :	Control section
2 :	First detecting means
3 :	Second detecting means including an alignment means
4 :	First position
5 :	Second position
6, 6a, 6b, 6c:	Wafer
6d:	Workpiece
7 :	Base or table
8 :	Cutting means
9 :	Frame
10 :	Film
10a:	Holding means
11 :	Detecting means
A :	Cutting area

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the embodiment shown in Fig. 1, numeral 1 is a control section including a storage section. The control section 1 controls the first detecting means 2, second detecting means 3, and cutting means 8. The first detecting means 1 is installed at the first detecting position 4 and the second detecting means 3 is installed at the second detecting position 5. At the first detecting position, the size, shape, position, and quantity of wafers 6 are detected. At the second detecting position, wafers are accurately aligned to be cut. For example, a CCD camera consisting of 256x256 pixels is used as these detecting means. The wafer 6 is held on the specified holding means such as a base or table 7 and cut by the

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specified cutting means, i.e. the blade 8 in the cutting area A according to the data consisting of the information by the detecting means.

For the wafer 6, as shown in Fig. 2, for example, three wafers of 6a, 6b, and 6c are mounted on a frame 9. These wafers are partially chipped and their shapes and sizes are disorderly and indeterminate, which are mounted on the frame by visually arranging the cutting streets "a" and "b" of each wafer. Numeral 10 is a film for mounting wafers.

The frame 9 having the wafers 6a, 6b and 6c is entirely picked up by the first detecting means 2 at the first detecting position 4 to detect the wafer state. In this case, the size, shape, and quantity of wafers mounted on the frame 9 are detected on the X-Y-axis matrix. In addition, approximate tilt angle "Θ" of the cutting street is detected by the known means as shown in the official gazette of Japanese Patent Laid-open Publication No. 60-54454 according to necessity and further the position of the wafers 6a, 6b and 6c on the X-Y-axis matrix are detected. Then, the information for the alignment stroke and cutting stroke according to the above-mentioned are stored in the control section 1.

At the second detecting position 5, the wafers 6a, 6b and 6c are accurately aligned at their positions by the known pattern-matching means as shown in the above-mentioned prior art according to the information obtained at the first detecting position 4, and alignment information is detected.

That is, such steps are comprising, for example, detecting accurately how the displacement and tilt angle on the X-Y-axis of the cutting streets "a" and "b" of the wafer 6a on the frame 9 are, storing such data as information, also detecting the cutting strokes of the cutting means 8 in the X-axis direction as shown in Fig. 3 and the Y-axis direction as shown in Fig. 4 according to the size and shape of the wafer 6a based on the information

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obtained at the first detecting means, and storing the both detected informations in the control section 1. Similarly, the displacement, tilt angle and cutting stroke of other wafers 6b and 6c are detected and stored in the control section 1.

The first detecting means 2 may be formed as an independent unit or installed in other unit. For example, the first detecting means may be installed in a unit for mounting the wafers on the frame 9, so-called wafer mounting unit, or installed in the dicing unit together with or separately from the second detecting means 3.

The above example is shown in Fig. 5. That is, the first and second detecting means are integrated as a detecting means 11. A CCD camera similarly to the above-mentioned may be used as the detecting means 11. Then, the size and shape of the wafers mounted on the frame 9 and the position of each wafer on the X-Y-axis matrix (e.g. matrix consisting of 256x256 pixels of a CCD camera) are detected and are stored in the control section 1 as information.

At the same time, the tilt angle of the cutting street of each wafer on the X-Y-axis matrix is detected and the cutting stroke is also detected corresponding to the size and shape of each wafer. These pieces of information are stored in the control section 1. The frame 9 is mounted on a base or table 7 and wafers are suitably cut by the cutting means 8 in the cutting area A, similarly to the procedure for the above embodiment.

For the above embodiment, the size, shape, position, quantity and cutting street of one or more wafers mounted on the frame 9 are detected on the X-Y-axis matrix, and, at the same time, the cutting stroke is also detected corresponding to the size and shape of the wafers. Accordingly, cutting (dicing) is accurately and securely executed according to these pieces of information.

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The following is the description of dicing for the system of the present invention according to the flow chart in Fig. 6. In the first step a, one or more wafers mounted on the frame 9 are supplied to the first position 4 of the first detecting means 2. In the second step b, the state of the wafer is detected by the first detecting means 2 at the first position 4. That is, the size, shape, position, and tilt angle of the cutting street of the wafers corresponding to the X-Y-axis matrix are detected as information.

In the third step c, the optimum alignment stroke and cutting stroke of the wafers are calculated according to the detected information for the size, shape, position and tilt angle of cutting street corresponding to the X-Y-axis matrix. In the fourth step d, the data detected in the second step b and calculated in the third step c is transferred to and stored in the control section 1 as information.

In the fifth step e, each wafer on the frame is accurately aligned by the second detecting means 3, e.g. pattern matching means with the optimum alignment stroke according to the information in the first detecting means 2 and the alignment information is stored in the control section 1. In the sixth step f, the wafers are cut at the cutting area A according to the cutting-stroke information obtained by the first detecting means 2 and stored in the control section 1 and the alignment information obtained by the second detecting means 3 and stored in the control section 1. And in the seventh step g, the cut wafers are cleaned after the end of the dicing process and the frames having the cleaned wafers are delivered to the next process.

The second step b through the fifth step e are executed by one detecting means 11 made by integrating the first and second detecting means and the sixth f and seventh g steps are executed in order according to the data detected by the detecting means 11. The above

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steps are repeated every supplied frame. Therefore, suitable dicing can continuously be executed even if the size, shape, and quantity (one or more) of wafers mounted on each frame are different.

In the above embodiment, a CCD camera is used as detecting means, however, the detecting means is not limited, e.g. various types of detecting means including ultrasonic detecting means, laser beam detecting means and so on may be used.

In this case, the size, shape, and position of a workpiece are detected by the ultrasonic or laser-beam detecting means as shown in Figs. 7 through 9.

The following is the description of the above detection. The size, shape and position of the wafer 6d are detected by detecting the level difference "h" between the wafer 6d and the holding means 10a for holding the wafer according to scanning them by the detecting means or detecting the difference of reflected luminous energy (Figs. 7 and 8) and plotting the boundary points (e1, e2,..., and en) between the wafer 6d and the holding means 10a on the X-Y coordinate axis (X-Y-axis matrix) (Fig. 9). Then, cutting is executed.

In addition, combination of different types of detecting means such as combination of the CCD camera and the ultrasonic or laser-beam detecting means is included in the technical idea of the present invention unless the combination contradicts the gist of the present invention.

ADVANTAGES OF THE INVENTION

First, the cutting and dicing system of the present invention comprises a frame for holding wafers, first detecting means for detecting the size, shape and position of the wafer held by the frame on an X-Y-axis matrix,

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second detecting means for aligning the wafers according to the information detected by the first detecting means, and cutting means for cutting the wafers according to the information detected by the second detecting means, wherein the size, shape and position of indeterminate-shape and disorderly wafers are detected by the first detecting means on an X-Y-axis matrix, the wafers are accurately aligned by the second detecting means according to the detected information, and one or more indeterminate-shape wafers are automatically and accurately diced though they are only manually diced conventionally.

Secondly, the first detecting means detects the size, shape and position of a wafer on an X-Y-axis matrix and the cutting stroke is controlled according to the information detected by the first detecting means. Accordingly, it is confirmed that the cutting efficiency is improved and the throughput is increased up to 1.5 times compared with the conventional throughput. Even if a plurality of wafers are mounted on one frame, each wafer can be cut (diced) without moving unnecessarily and being affected by other wafers.

Thirdly, it is possible to install the second detecting means and cutting means in the same unit, the first detecting means, independently or in other unit, or the first detecting means, second detecting means and cutting means in the same unit. It is also possible to make the first and second detecting means common. Accordingly, it is possible to simply upgrade the conventional dicing systems.

Claims

1. A method for continuously cutting a possible plurality of possibly irregular-shaped semiconductor wafers each having cutting streets thereon, comprising the steps of:

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(a) mounting one or more semiconductor wafers (6, 6a, 6b, 6c) on a frame (9);
(b) detecting size, shape, and position of each semiconductor wafer (6, 6a, 6b, 6c) and the quantity of the semiconductor wafers on the frame (9) with a first detecting means (2) along an X-Y axis matrix;
(c) calculating the optimum alignment stroke and cutting stroke of each semiconductor wafer (6, 6a, 6b, 6c) on the basis of the information detected by the first detecting means (2) as cutting-stroke information;
(d) transferring and storing the cutting-stroke information calculated in step (c) to a control section (1);
(e) aligning each semiconductor wafer (6, 6a, 6b, 6c) according to the information detected by the first detecting means (2) and detecting alignment information with a second detecting means (3) including an alignment means;
(f) transferring and storing the alignment information detected in step (e) in the control section (1);
(g) cutting each semiconductor wafer (6, 6a, 6b, 6c) by a cutting means (8) according to the cutting-stroke and alignment information stored in steps (d) and (f); and
(h) repeating the above steps for every supplied frame (9).

2. A cutting apparatus for performing the method of claim 1, comprising:

at least one frame (9) for holding two or more semiconductor wafers (6, 6a, 6b, 6c);
first detecting means (2) for detecting size, shape and position of each semiconductor wa-

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fer (6, 6a, 6b, 6c) and a quantity of the semiconductor wafers held by the frame (9) as cutting-stroke information;
second detecting means including an alignment means (3) for accurately aligning the position of each semiconductor wafer (6, 6a, 6b, 6c) according to the cutting-stroke information detected by the first detecting means (2) and for detecting alignment information of each semiconductor wafer (6, 6a, 6b, 6c);
control section (1) for storing the quantity, size, shape and position of the semiconductor wafers (6, 6a, 6b, 6c) detected by the first detecting means (2) and the alignment information detected by the second detecting means (3);
cutting means (8) for cutting each semiconductor wafer (6, 6a, 6b, 6c) according to the cutting-stroke information detected by the first detecting means (2) and the alignment information detected by the second detecting means (3).

3. A cutting apparatus according to claim 2, wherein the second detecting means (3) and the cutting means (8) are installed together in a first unit and the first detecting means (2) is installed in a second unit.

4. A cutting apparatus according to claim 2, wherein the first detecting means (2), the second detecting means (3) and the cutting means (8) are installed in a single unit.

5. A cutting apparatus according to claim 2, wherein the first detecting means and the second detecting means are common as a single detecting means (11).

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CUTTING SYSTEM

ABSTRACT

A cutting system for cutting a workpiece comprising the steps of detecting the size, shape, quantity, position and cutting stroke of the workpieces having different size and shape mounted on a frame by first detecting means (2) on an X-Y-axis matrix, storing the detected information on a memory, aligning said workpieces accurately by second detecting means (3) according to the detected information, and cutting said workpieces automatically and suitably.

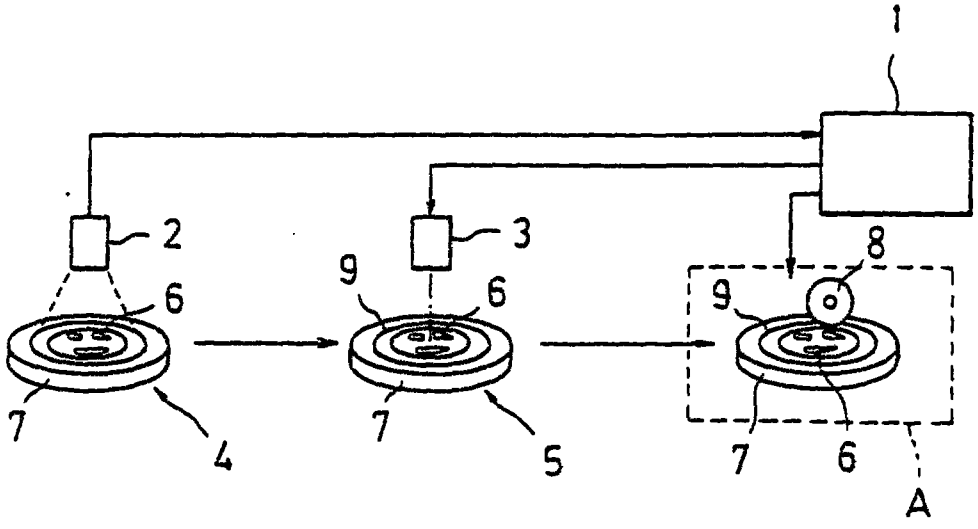
Fig. 1

This Sheet Has Been Replaced

THIS SHEET HAS BEEN REPLACED

REPLACEMENT SHEET
31 JUL 1997

FIG.1



REPLACEMENT SHEET
31 JUL 1997

FIG.2

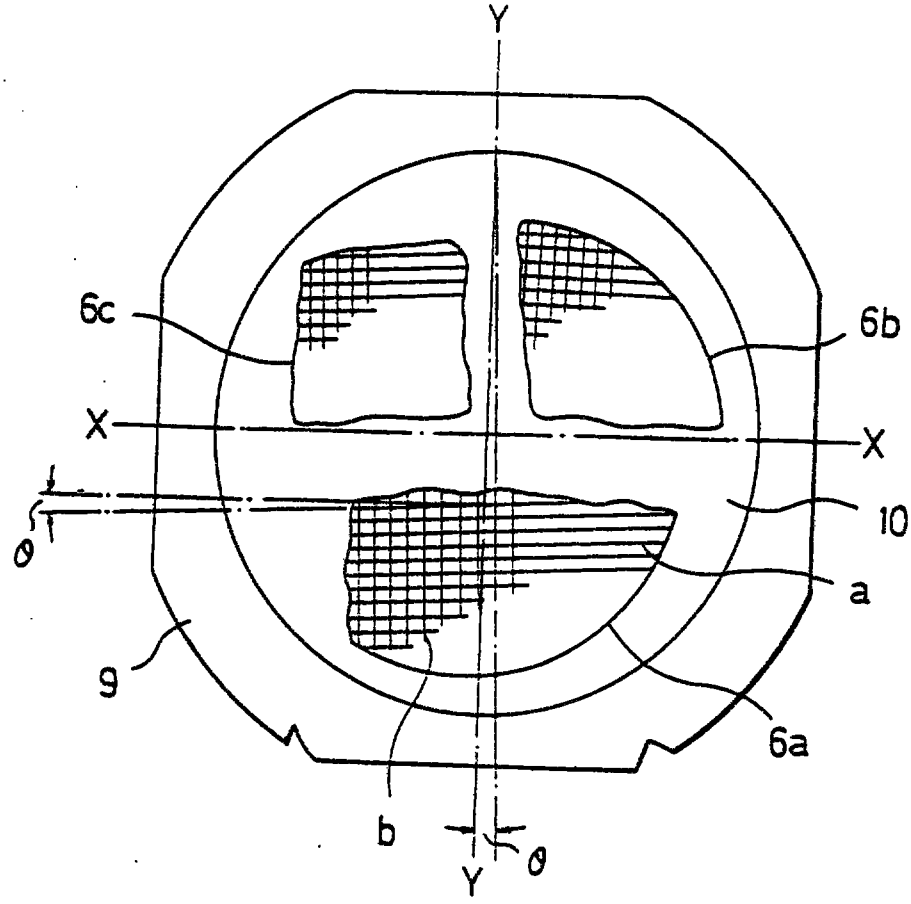
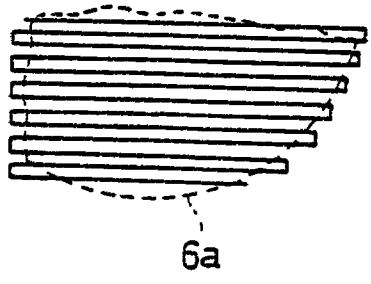


FIG.3



REPLACEMENT SHEET
31 JUL 1997

FIG.4

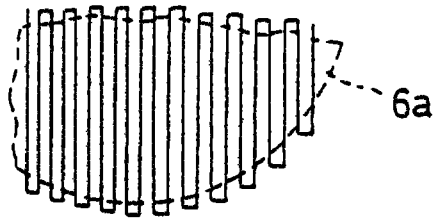
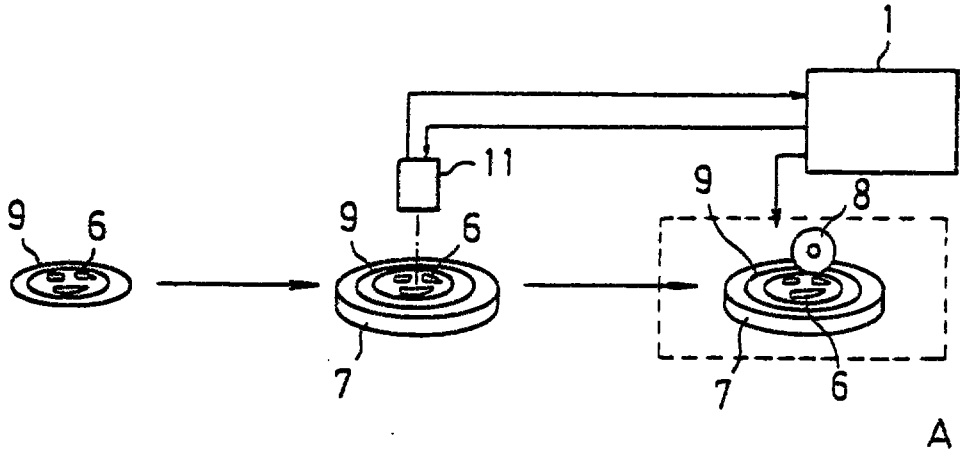
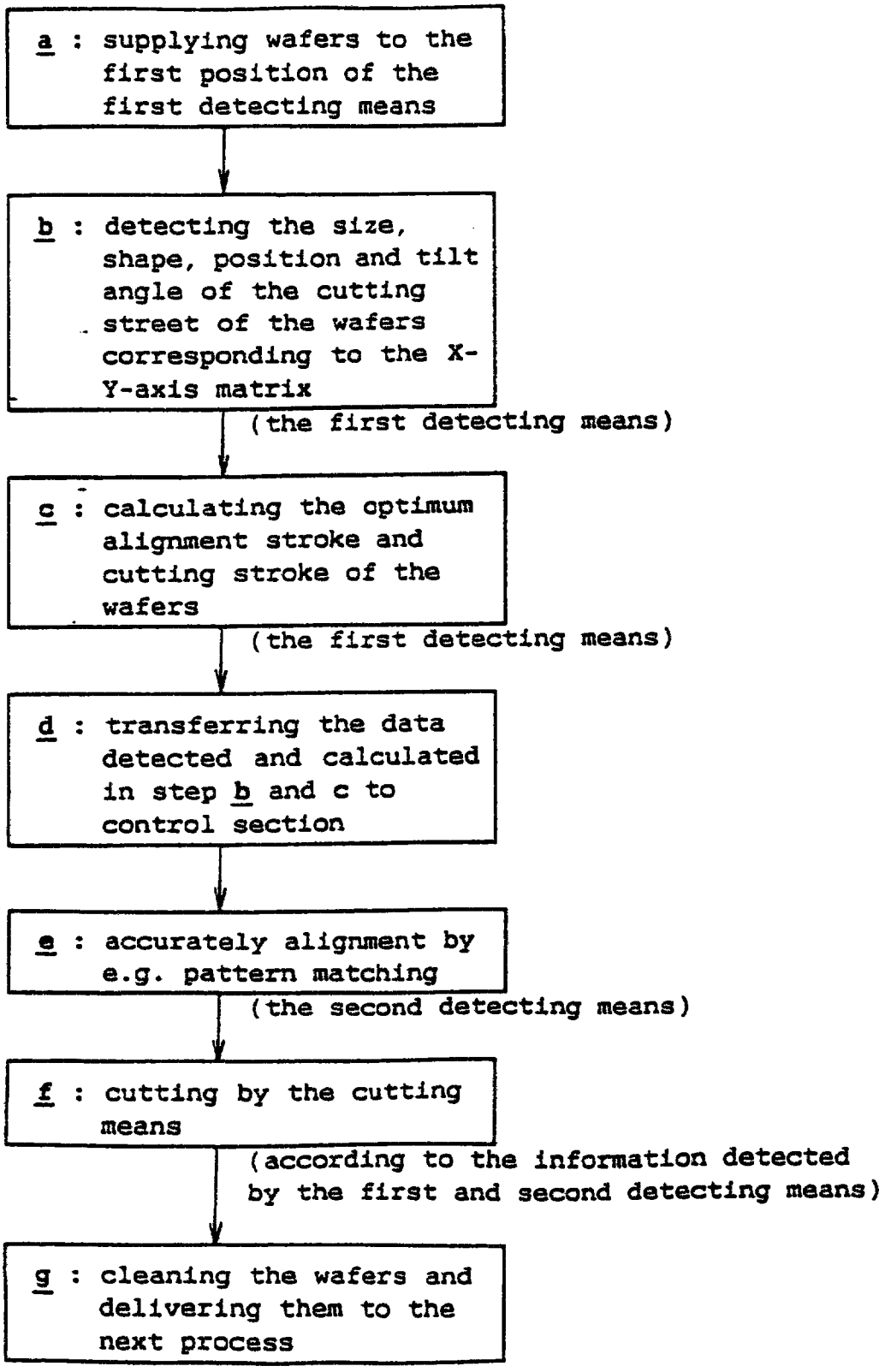


FIG.5



REPLACEMENT SHEET
31 JUL 1997

FIG.6



REPLACEMENT SHEET
31 JUL 1997

FIG.7

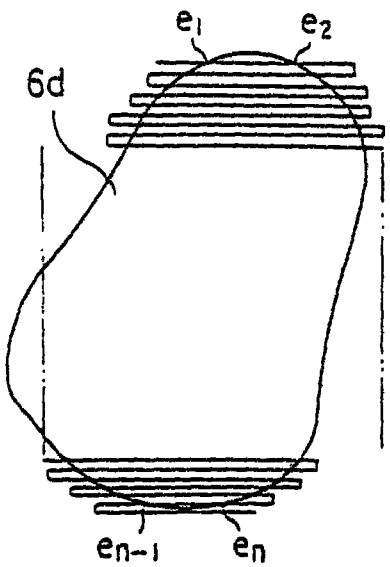


FIG.8

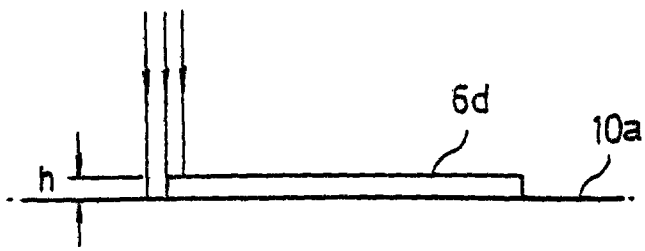


FIG.9

