

ALIGNMENT STAGE



159159

Technical Field



G00002

[0001]

5 The present invention relates to an alignment stage and, in particular, to an alignment stage which has three degrees of freedom of X, Y, and θ , and is used for performing alignment of a work piece which receives a moving load.

 This application claims the right of priority based on Japanese Patent Application No. 2009-126034 filed with the Japan Patent Office on May 26, 2009, the
10 entire contents of which are incorporated herein by reference.

Background Art

[0002]

 In recent years, as a method of forming an electrode pattern (conductive pattern) for a liquid crystal display on a required substrate, in place of microfabrication by etching
15 or the like of a metal vapor-deposited film, a method of printing and forming the electrode pattern on the substrate by using a printing technology, for example, intaglio offset printing technology, using electrically conductive paste as the printing ink has been proposed (refer to Patent Documents 1 and 2, for example).

[0003]

20 In the case of offset-printing a fine print pattern, such as the above electrode pattern on a flat plate-like printing target such as the above substrate, high print precision is required. For this reason, a flat plate printing apparatus of the type using the same flat plate-like printing plate as a printing target is advantageous as an offset printing apparatus in the case of performing offset printing of high print precision.

25 [0004]

Generally, in the case of carrying out offset printing by using the flat plate-like printing plate and the printing target, a rotated blanket roll is relatively moved with respect to the printing plate subjected to inking in advance, while being pressed against the printing plate at a required contact pressure. In this way, ink is transferred

5 (delivered) from the printing plate to the surface of the blanket roll. Subsequently, the blanket roll is relatively moved with respect to the printing target while being pressed against the printing target at a required contact pressure in a state where the blanket roll is rotated. As a result, ink is re-transferred (printed) from the blanket roll to the surface of the printing target, whereby the print pattern of the printing plate is reproduced on the
10 surface of the printing target.

[0005]

Incidentally, when performing a printing job while sequentially replacing the printing target with new printing targets, if a position discrepancy in the installation position occurs with each printing target, a problem arises in that the reproducibility of a
15 printing position is deteriorated.

[0006]

Also, the printing plate is gradually worn away (consumed) by being used in printing. For this reason, it is necessary to replace it every time after a specified number of printing cycles or a printing period. Also, when performing overprinting, a
20 replacement of the printing plate is required. If the position discrepancy in which installation position of the printing plate after the replacement is deviated from the installation position of the printing plate before the replacement occurs in accordance with the replacement of the printing plate, the reproducibility of a printing position is deteriorated.

25 [0007]

If the lowering of reproducibility of a printing position caused by position discrepancy in an installation position of the printing target or the printing plate as described above occurs, there is a possibility that the high printing precision required in the case of offset-printing a fine print pattern, such as the electrode pattern, cannot be
5 satisfied.

[0008]

In order to avoid the above problems, holding the printing plate and the printing target, which are used in offset printing, on an alignment stage, thereby performing alignment for every printing plate and every printing target before the start of a printing
10 job is considered. Position discrepancies in installation positions of the printing plate and the printing target are corrected by the alignment, thereby increasing reproducibility of a position in which the contact position of the printing plate or the printing target with respect to the blanket roll is kept identical each time. In this way, it is considered to be possible to increase the reproducibility of the position of a print pattern which is printed
15 from the printing plate to the printing target through the blanket roll.

[0009]

In order to avoid the above problems, further, performing position correction of the printing plate or the printing target by using an alignment stage is considered. If the alignment stage is used, in a case where a phenomenon due to a design error or the like,
20 for example, tilt or displacement occurs in the movement direction (a direction perpendicular to the shaft center of the blanket roll) of the outer circumferential surface of the rotating blanket roll and the relative movement direction when relatively moving the blanket roll while pressing it against the printing plate or the printing target, or a case where eccentricity exists in the blanket roll, so that a fluctuation occurs in the peripheral
25 velocity of the blanket roll which is rotated at a given constant rotating velocity, it is

possible to move the printing plate or the printing target to follow the movement of the contact portion of the outer circumferential surface of the blanket roll while bringing the blanket roll into contact with the printing plate or the printing target held on the alignment stage.

5 [0010]

Incidentally, in a manufacturing process of a liquid crystal display or a semiconductor, it is necessary to secure the superposition precision of members or layers which are laminated. For this reason, as an alignment stage for performing disposition of a work piece in the XY orthogonal coordinate plane and alignment of a rotation angle θ , for example, an alignment stage as shown in FIGS. 8 and 9 is used.

[0011]

In the alignment stage shown in FIGS. 8 and 9, one supporting unit 2 and three driving units 3A, 3B, and 3C are respectively provided at four corner portions of a base 1 which is a fixed side. Also, the four corner portions of a top table 4 which is a moving side are placed and mounted on the upper sides of the supporting unit 2 and the respective driving units 3A, 3B, and 3C.

[0012]

At the supporting unit 2, two linear motion guides 5a and 5b, which are composed of linear guide rails 6a and 6b and guide blocks 7a and 7b slidably mounted on the guide rails 6a and 6b, are disposed to be stacked in two upper and lower stages in orthogonal positions to each other. The guide rail 6b of the linear motion guide 5b of an upper stage is mounted above the guide block 7a of the linear motion guide 5a of a lower stage. Also, a turning bearing 8 capable of turning in the horizontal plane is mounted above the guide block 7b of the linear motion guide 5b of the upper stage. In this way, it is possible to obtain three degrees of freedom of X, Y, and θ at the top of the turning

bearing 8, which becomes an upper end portion of the supporting unit 2, with the guide rail 6a of the lower-stage linear motion guide 5a, which becomes a lower end portion of the supporting unit 2, as a reference.

[0013]

5 In the supporting unit 2, the guide rail 6a of the lower-stage linear motion guide 5a is installed at a corresponding location of the base 1. Also, a corresponding location of the top table 4 is mounted above the turning bearing 8.

[0014]

In each of the driving units 3A, 3B, and 3C, a ball screw linear motion
 10 mechanism 9, which is composed of a servomotor 10, a screw shaft 11 connected to an output shaft of the servomotor 10, and a nut member 12 thread-engaged with the screw shaft 11, is disposed parallel to the guide rail 6a of the lower-stage linear motion guide 5a in the same configuration as that of the supporting unit 2. The nut member 12 of the ball screw linear motion mechanism 9 is connected to the guide block 7a of the
 15 lower-stage linear motion guide 5a. In this way, it is possible to move the guide block 7a of the lower-stage linear motion guide 5a integrally with the nut member 12 along the longitudinal direction of the guide rail 6a by moving the nut member 12 along the shaft center direction of the screw shaft 11 by the forward and reverse driving of the screw shaft 11 by the servomotor 10 of the ball screw linear motion mechanism 9.

20 [0015]

In each of the driving units 3A, 3B, and 3C, the guide rail 6a of the lower-stage linear motion guide 5a and the ball screw linear motion mechanism 9 are respectively disposed at corresponding locations of the base 1. Also, a corresponding location of the top table 4 is mounted above the turning bearing 8. At this time, the direction (the
 25 driving direction) of each of the ball screw linear motion mechanisms 9 of two driving

units 3A and 3B among the respective driving units 3A, 3B, and 3C is an X-axis direction, the direction (the driving direction) of the ball screw linear motion mechanism 9 of the remaining one driving unit 3C is a Y-axis direction, and the respective driving directions are disposed to be at right angles to each other.

5 [0016]

According to the above alignment stage, by appropriately adjusting position keeping and movement of the guide block 7a of the lower-stage linear motion guide 5a and a movement direction and the amount of movement of the guide block 7a by the ball screw linear motion mechanism 9, with which each of the driving units 3A, 3B, and 3C is provided, it is possible to perform the horizontal displacement in an X-Y plane and the rotational displacement of a rotation angle θ of the top table 4 in combination with each other. As a result, it is possible to perform alignment in three axial directions of X, Y, and θ with respect to a work piece (not shown) that is an alignment target held on the top table 4 (refer to Non Patent Document 1, for example).

15 Citation List

Patent Document

[0017]

[Patent Document 1] Japanese Patent No. 2797567

[Patent Document 2] Japanese Patent No. 3904433

20 Non Patent Document

[0018]

[Non Patent Document 1] THK Co., Ltd., catalog "Alignment Stage CMX", catalog number 238-4, August 3, 2007

25 Summary of Invention

Technical Problem

[0019]

The existing alignment stage shown in FIGS. 8 and 9 assumes that alignment of a work piece is performed in a light process in the manufacturing process of a liquid crystal display or a semiconductor. For this reason, loading of a load has barely been considered.

[0020]

That is, in offset printing using the flat plate-like printing plate or the printing target, alignment of the printing plate or the printing target is performed with it held on the alignment stage shown in FIGS. 8 and 9, whereby position correction of the printing plate or the printing target to a desired position is performed. Subsequently, the rotated blanket roll is relatively moved with respect to the printing plate or the printing target held on the alignment stage, while being pressed against the printing plate or the printing target at a required contact pressure. Then, in the alignment stage holding the printing plate or the printing target, a load acts on an elongated band-like region which corresponds to a contact portion of the printing plate or the printing target and the outer circumferential surface of the blanket roll and extends in the shaft center direction of the blanket roll. The elongated band-like region on which the load acts moves along a relative movement direction of the blanket roll with respect to the printing plate or the printing target with the passage of time. For this reason, a moving load acts on the alignment stage.

[0021]

In the alignment stage shown in FIGS. 8 and 9, the top table 4 is supported at four corners thereof by the supporting unit 2 and the driving units 3A, 3B, and 3C. For this reason, for example, in a case where a load acting on the elongated region which

extends along the Y-axis direction acts as a moving load which moves in the X-axis direction, if the moving load acts on an intermediate portion in the X-axis direction of the top table 4, that is, an intermediate portion in the X-axis direction of the top table 4, which is not supported by any of the supporting unit 2 and the driving units 3A, 3B, and 3C, there is a possibility that the top table 4 may be deformed to be bent due to the lowering of supporting stiffness in the vertical direction of the top table 4. Due to this deformation, there is a possibility that a position discrepancy may occur in a work piece (not shown) such as the printing plate or the printing target which is held on the top table 4.

[0022]

In the alignment stage shown in FIGS. 8 and 9, alignment of three axes of X, Y, and θ is performed on the top table 4 by combination of horizontal displacement in the X-Y plane and rotation of a rotation angle θ by the three driving units 3A, 3B, and 3C each having the ball screw linear motion mechanism 9. Here, the number of ball screw linear motion mechanisms 9 of the driving units 3A and 3B for performing driving in the X-axis direction and the number of ball screw linear motion mechanisms 9 of the driving unit 3C for performing driving in the Y-axis direction are different from each other. For this reason, a difference occurs between horizontal direction stiffness in the X-axis direction and horizontal direction stiffness in the Y-axis direction. For this reason, for example, if position correction of the printing plate or the printing target is performed by the alignment stage in a state where a moving load acts on the printing plate or the printing target by bringing the blanket roll into contact with it in offset printing, a difference occurs between the ease of movement in the X-axis direction and the ease of movement in the Y-axis direction due to a difference between the horizontal direction stiffness in the X-axis direction and the horizontal direction stiffness in the Y-axis

direction of the alignment stage. Accordingly, there is a possibility that it may become difficult to perform the desired position correction on the printing plate or the printing target.

[0023]

5 In the alignment stage shown in FIGS. 8 and 9, position control of the top table 4 is performed by controlling the driving amount of each ball screw linear motion mechanism 9 using an encoder built in each servomotor 10 of each ball screw linear motion mechanism 9 of the respective driving units 3A, 3B, and 3C. Here, in the following each case, for example, a case where a moving load acts on the top table 4, or a
10 case where the top table 4 is horizontally displaced or rotationally displaced in a state where a moving load acts, when bending, rattling, or the like occurs in a thrust transmission portion such as the screw shaft 11 or the nut member 12 of each ball screw linear motion mechanism 9, on which the load acts as an external force, it is not possible to exclude the error element. Moreover, it is not possible to detect existence itself of the
15 error element. For this reason, there is a possibility that high-precision position control of the top table 4 may become difficult.

[0024]

Also, in the alignment stage shown in FIGS. 8 and 9, each servomotor 10 which is a driving source of each ball screw linear motion mechanism 9 of the respective
20 driving units 3A, 3B, and 3C is disposed at a position which is covered by the top table 4 on the base 1. For this reason, thermal deformation occurs in the top table 4 or the base 1 due to the influence of heat generation of each servomotor 10 and there is a possibility that position discrepancy may occur in a work piece (not shown), which is held on the top table 4, in accordance with the thermal deformation of the top table 4 or the base 1.

25 [0025]

In this manner, in the existing alignment stage shown in FIGS. 8 and 9, it is difficult to hold a work piece, on which a moving load acts, in a state where high-precision positioning is performed in three axial directions of X, Y, and θ or perform high-precision position correction of the work piece in three axial directions of X, Y, and θ in a state where the moving load acts.

[0026]

The present invention provides an alignment stage which can hold a work piece, on which a moving load acts, in a state where high-precision positioning is performed in three axial directions of X, Y, and θ , and can displace the work piece in three axial directions of X, Y, and θ with high precision even in a state where a load acts.

Solution to Problem

[0027]

According to a first aspect of the present invention, an alignment stage according to the present invention includes: a base; a top table which is disposed at a position above the base and holds a work piece on which a moving load acts; a required number of supporting units which are each composed of guides slidable in two directions orthogonal to each other and a turning bearing provided over the guide and each have three degrees of freedom of X, Y, and θ ; and at least three driving units which are composed by providing the supporting unit with a one-axis direction linear motion mechanism, wherein the supporting units and the driving units are provided disposed in a zigzag fashion along a movement direction of the moving load between the base and the top table, and driving directions by the linear motion mechanisms of two driving units among the respective driving units and a driving direction by the linear motion mechanism of the remaining driving unit are at right angles to each other in the X-Y

plane.

[0028]

According to a second aspect of the present invention, the disposition in a zigzag fashion is made by locations corresponding to the four corner portions and the center of the top table.

[0029]

According to a third aspect of the present invention, the disposition in a zigzag fashion is made by locations corresponding to the four corner portions and the center of the top table, the respective driving units are provided at the locations corresponding to the four corner portions of the top table, and the supporting unit is provided at the location corresponding to the center of the top table.

[0030]

According to a fourth aspect of the present invention, an alignment stage according to the present invention includes a base; a top table which is disposed at a position above the base and holds a work piece on which a moving load acts; and driving units which are each composed of guides slidable in two directions orthogonal to each other and a turning bearing provided over the guide, each have three degrees of freedom of X, Y, and θ , and each includes a one-axis direction linear motion mechanism, wherein the driving units are provided disposed in a zigzag fashion along a movement direction of the moving load between the base and the top table, and driving directions by the linear motion mechanisms of two driving units among the respective driving units and driving directions by the linear motion mechanisms of the remaining two driving units are at right angles to each other in an X-Y plane.

[0031]

According to a fifth aspect of the present invention, the disposition in a zigzag

fashion is made by locations corresponding to positions on lines each connecting the intermediate position of each side of the top table to the center of the top table.

[0032]

According to a sixth aspect of the present invention, the linear motion
5 mechanism is constituted by a ball screw linear motion mechanism which includes a motor, a screw shaft connected to an output shaft of the motor, and a nut member thread-engaged with the screw shaft, and the motor is disposed to protrude to the outside of the base.

[0033]

10 According to a seventh aspect of the present invention, a linear scale for detecting a driving amount by the one-axis direction linear motion mechanism of each of the driving units is provided on the base adjacent to each of the driving units.

Advantageous Effects of Invention

[0034]

15 The alignment stage according to the present invention exhibits the following excellent effects.

[0035]

(1) A top table for holding a work piece on which a moving load acts is disposed at a position above a base. A required number of supporting units, which are
20 each composed of guides slidable in two directions orthogonal to each other and a turning bearing provided over the guide and each have three degrees of freedom of X, Y, and θ , and three or more driving units which are composed by providing the supporting unit with a one-axis direction linear motion mechanism are, provided between the base and the top table. The supporting units and the driving units are disposed in a zigzag
25 fashion along a movement direction of the moving load. Driving directions by the

linear motion mechanisms of two driving units among the respective driving units and driving directions by the linear motion mechanisms of the remaining driving units are at right angles to each other in an X-Y plane. The alignment stage of the present invention having such a configuration can perform combined movement of horizontal movement in the X-Y plane and rotation of a rotation angle θ of the top table by combining the driving of the three or more driving units provided. For this reason, with respect to the work piece which is held on the top table, it is possible to perform position correction in three axial directions of X, Y, and θ .

[0036]

(2) According to the alignment stage according to the present invention, even if a moving load acts on the work piece which is held on the top table, the moving load acting on the top table through the work piece can be continuously received by the respective driving units and the supporting units, which are disposed in a zigzag fashion along a movement direction of the moving load. For this reason, it is possible to increase the stiffness in the vertical direction of the top table, so that a potential for deformation of the top table by the moving load can be prevented before it happens. Accordingly, position discrepancy in the work piece due to deformation of the top table can be prevented before it happens.

[0037]

(3) In the alignment stage according to the present invention, disposition in a zigzag fashion along a movement direction of the moving load is made by locations corresponding to the four corner portions and the center of the top table. In this way, it is possible to easily perform disposition in a zigzag fashion of the respective driving units and the supporting units along a movement direction of the moving load. Further, the top table can be supported in a balanced manner in front-back and right-left directions by

the respective driving units and the supporting units.

[0038]

(4) In the alignment stage according to the present invention, disposition in a zigzag fashion along a movement direction of the moving load is set by locations corresponding to the four corner portions and the center of the top table. Also, the respective driving units are provided at the locations corresponding to the four corner portions of the top table. Further, the supporting unit is provided at the location corresponding to the center of the top table. In the alignment stage of the present invention having such a configuration, the same effect as that of the above (3) can be obtained. In addition, the driving units each provided with the linear motion mechanism can be disposed in twos in each of the directions orthogonal to each other, so that it is possible to equalize the horizontal direction stiffness along the X-axis direction and the horizontal direction stiffness along the Y-axis direction of the top table. Accordingly, in a state where a moving load acts on a work piece held on the top table, when position correction of the work piece is performed by moving the top table, a possibility that a bias may occur in the movement in the X-axis direction and the movement in the Y-axis direction can be lowered, so that it becomes possible to perform desired position correction on the work piece.

[0039]

(5) In the alignment stage according to the present invention, a top table for holding a work piece on which a moving load acts is disposed at a position above the base. Driving units which each have a configuration composed of guides slidable in two directions orthogonal to each other and a turning bearing provided over the guide and each having three degrees of freedom of X, Y, and θ and also a one-axis direction linear motion mechanism are provided between the base and the top table. The driving

units are disposed in a zigzag fashion along a movement direction of the moving load.

Driving directions by the linear motion mechanisms of two driving units among the respective driving units and driving directions by the linear motion mechanisms of the remaining two driving units are at right angles to each other in an X-Y plane. In the

5 alignment stage of the present invention having such a configuration, the same effects as those of the above (1), (2), (3), and (4) can be obtained.

[0040]

(6) In the alignment stage according to the present invention, disposition in a zigzag fashion along a movement direction of the moving load is made by locations
10 corresponding to positions on lines each connecting an intermediate position of each side of the top table to the center of the top table. In this way, it is possible to dispose the respective units to be closer to each other. For this reason, it is advantageous in a case where the present invention is applied to an alignment stage of a size in which a planar shape is smaller.

15 [0041]

(7) A one-axis direction linear motion mechanism of each driving unit, with which the alignment stage according to the present invention is provided, is constituted by a ball screw linear motion mechanism which includes a motor, a screw shaft
20 connected to an output shaft of the motor, and a nut member thread-engaged with the screw shaft. The motor of each ball screw linear motion mechanism is disposed to protrude to the outside of the base. In the alignment stage of the present invention having such a configuration, heat which is generated from each servomotor of each ball screw linear motion mechanism, which becomes a driving source of each driving unit, can be efficiently emitted into the atmosphere. Accordingly, thermal deformation of the
25 base or the top table due to heat generation of each servomotor can be suppressed. For

this reason, it is possible to reduce a possibility that position discrepancy may occur in a work piece, which is held on the top table, by the influence of thermal deformation of the base or the top table.

[0042]

5 (8) In the alignment stage according to the present invention, a linear scale for detecting the driving amount by the one-axis direction linear motion mechanism of each of the driving units is provided on the base adjacent to each of the driving units. In this way, it is possible to perform scale feedback control of the one-axis direction linear motion mechanism of each driving unit by using the linear scale provided at the outside
10 of each driving unit. Accordingly, even if a moving load acting on a work piece held on the top table acts on the one-axis direction linear motion mechanism of each driving unit as an external force so that mechanical strain or the like occurs in the linear motion mechanism, the driving unit is not affected thereby. Therefore, it is possible to perform high-precision position control of each driving unit. As a result, it is possible to
15 perform high-precision position control of a work piece which is held on the top table.

[0043]

 (9) As described above, according to the alignment stage according to the present invention, it is possible to hold a work piece, on which a moving load acts, in a state where high-precision positioning is performed in three axial directions of X, Y, and
20 θ . Also, it becomes possible to perform high-precision position correction of the work piece in three axial directions of X, Y, and θ in a state where the moving load acts.

Brief Description of Drawings

[0044]

25 FIG. 1 is a schematic plan view, in a partial cut away, showing one embodiment

of an alignment stage according to the present invention.

FIG. 2 is a schematic side view of the alignment stage of FIG. 1.

FIG. 3A is a plan view, in a cut away, of a supporting unit in the alignment stage of FIG. 1.

5 FIG. 3B is a view in the direction of the arrow A-A in FIG. 3A.

FIG. 3C is a view in the direction of the arrow B-B in FIG. 3A.

FIG. 4A is a plan view, in a cut away, of a driving unit in the alignment stage of FIG. 1.

FIG. 4B is a view in the direction of the arrow C-C in FIG. 4A.

10 FIG. 4C is a view in the direction of the arrow D-D in FIG. 4A.

FIG. 5 is a schematic view showing disposition of the supporting unit and the respective driving units in relation to a load movement direction in the alignment stage of FIG. 1.

15 FIG. 6 is a schematic plan view showing another embodiment of the present invention.

FIG. 7 is a schematic plan view showing of an application of the embodiment of FIG. 6.

FIG. 8 is a perspective view, in a partial cut away, showing an outline of one example of an existing alignment stage.

20 FIG. 9 is an enlarged perspective view showing a driving unit in the alignment stage of FIG. 8.

Description of Embodiments

[0045]

25 Hereinafter, an embodiment of the present invention will be described with

reference to the drawings.

[0046]

In FIGS. 1 to 5, one embodiment of an alignment stage according to the present invention is shown.

5 A top table 4a is disposed on the upper side spaced a required dimension from a base 1 which is a fixing side. The top table 4a holds a work piece (not shown) on which a moving load acts, for example, a printing plate, a printing target, or the like, on which the moving load acts by relatively moving it while pressing a blanket roll rotating at the time of offset printing. Between the base 1 and the top table 4a, a supporting unit 13
10 and four driving units 14A, 14B, 14C, and 14D are respectively disposed at required locations which are disposed in a zigzag fashion in a movement direction (hereinafter simply referred to as a load movement direction and shown by an arrow L in the drawings, the same is also true in FIGS. 6 and 7) of the moving load acting on the work piece (not shown) for example, at five locations respectively corresponding to the center
15 and four corner portions of the top table 4a, which are disposed in the zigzag disposition of two location, one location, and two locations in the direction orthogonal to the load movement direction L and in order from the upstream side in the load movement direction L. The supporting unit 13 is constituted by guides slidable in two directions orthogonal to each other and a turning bearing 8 on the side above the guide and has
20 three degrees of freedom of X, Y, and θ at an upper end portion with respect to a lower end portion. The four driving units 14A, 14B, 14C, and 14D are each provided with a one-axis direction linear motion mechanism, for example, a ball screw linear motion mechanism 9 which is the same as that shown in FIGS. 8 and 9, in addition to the same configuration as that of the supporting unit 13. The directions of the ball screw linear
25 motion mechanisms 9 of two driving units 14A and 14B among the four driving units 14

and the directions of the ball screw linear motion mechanisms 9 of the remaining two driving units 14C and 14D are disposed so as to be at right angles to each other in a horizontal plane. In this state, the lower end portions and the upper end portions of the supporting unit 13 and each driving unit 14 are respectively mounted on corresponding locations of the base 1 and the top table 4a, so that the alignment stage according to the present invention is constituted.

[0047]

In the supporting unit 13, as shown in FIGS. 3A, 3B, and 3C, a lower-stage guide block 16a of a guide block 16 of a configuration made by integrating the

lower-stage guide block 16a and an upper-stage guide block 16b with back sides brought to face each other in an orthogonal disposition state is slidably mounted on a lower-stage guide rail 15 extending by a required dimension in a horizontal direction. On the upper side of the upper-stage guide block 16b of the guide block 16, an upper-stage guide rail 17 extending by a required dimension in the horizontal direction orthogonal to the lower-stage guide rail 15 is held so as to be able to slide in the longitudinal direction. In this manner, two upper-stage and lower-stage linear motion guides are connected with back sides brought to face each other, thereby forming guides slidable in two directions orthogonal to each other. Also, the turning bearing 8 is mounted on the upper side of the upper-stage guide rail 17. In this way, by sliding of the lower-stage guide block 16a of the guide block 16 along the lower-stage guide rail 15, sliding in the longitudinal direction of the upper-stage guide rail 17 with respect to the upper-stage guide block 16b of the guide block 16, and turning of the turning bearing 8, it is possible to obtain three degrees of freedom of X, Y, and θ at the top of the turning bearing 8, which becomes the upper end portion of the supporting unit 13, with the lower-stage guide rail 15, which becomes the lower end portion of the supporting unit 13, as a standard.

[0048]

As shown in FIGS. 4A, 4B, and 4C, each of the driving units 14A, 14B, 14C, and 14D includes the ball screw linear motion mechanism 9 disposed parallel to the lower-stage guide rail 15, in addition to a configuration which is composed of the lower-stage guide rail 15, the guide block 16, the upper-stage guide rail 17 and the turning bearing 8, which are the same as those of the supporting unit 13 shown in FIGS. 3A, 3B, and 3C. Further, a nut member 12 of the ball screw linear motion mechanism 9 is connected to the lower-stage guide block 16a of the guide block 16 through a connection member 18. In this way, it is possible to move the guide block 16 along the longitudinal direction of the lower-stage guide rail 15 integrally with the nut member 12 by the ball screw linear motion mechanism 9.

[0049]

As shown in FIG. 1, at the location corresponding to the center of the top table 4a on the base 1, the supporting unit 13 is disposed in a position in which the lower-stage guide rail 15 follows either the X-axis direction or the Y-axis direction (in the drawing, a position following the X-axis direction is shown). The lower-stage guide rail 15 is mounted on a corresponding location of the base 1.

[0050]

As shown in FIGS. 1 and 2, among four locations corresponding to four corner portions of the top table 4a on the base 1, at two locations corresponding to diagonal positions on one side of the top table 4a, the driving units 14A and 14B are disposed in a position in which their ball screw linear motion mechanisms 9 follow the Y-axis direction. At two locations corresponding to diagonal positions on the other side of the top table 4a, the driving units 14C and 14D are disposed in a position in which their ball screw linear motion mechanisms 9 follow the X-axis direction. In each of the driving units 14A,

14B, 14C, and 14D, the lower-stage guide rails 15 and the ball screw linear motion mechanisms 9 are mounted on corresponding locations of the base 1 such that all of the servomotors 10, with which the respective ball screw linear motion mechanisms 9 are provided, are in states where they protrude further outward than the outer peripheral edges of the base 1.

[0051]

As shown in FIG. 5, two driving units 14A and 14C on the upstream side in the above-mentioned load movement direction L, the supporting unit 13, and two driving units 14D and 14B on the downstream side in the load movement direction L, which are disposed in sequence such that a zigzag disposition is made along the load movement direction L, are disposed such that regions M occupying the load movement direction L of the respective turning bearings 8 somewhat overlap with each other. In addition, although it is not shown in the drawing, a gap of a dimension in a range narrower than the width of a moving load acting on a work piece (not shown) which is held on the top table 4a may be formed between the regions M occupying the load movement direction L of the respective turning bearings 8 of the driving units 14A and 14C, the supporting unit 13, and the driving units 14D and 14B, which are disposed in a zigzag disposition in sequence along the load movement direction L. As a result, when a moving load acts along the load movement direction L with respect to a work piece (not shown) which is held on the top table 4a mounted over the turning bearings 8 of the supporting unit 13 and the respective driving units 14A, 14B, 14C, and 14D, it is possible to receive the moving load in a continuous fashion from two driving units 14A and 14C on the upstream side in the load movement direction L to two driving units 14D and 14B on the downstream side in the load movement direction L through the supporting unit 13, which are disposed in a zigzag disposition in sequence along the load movement direction L.

In this way, the possibility can be reduced that support stiffness in a vertical direction is lowered while the moving load acts on the top table 4a.

[0052]

A linear scale 19 disposed along a movement locus of the guide block 16 along
 5 the lower-stage guide rail 15 is provided along the lower-stage guide rail 15 of each
 driving unit 14 on the base 1 and at a location adjacent to the guide block 16 moving
 through the lower-stage guide block 16a. In this way, it is possible to detect the amount
 of displacement of the guide block 16 with a required location in the longitudinal
 direction of the lower-stage guide rail 15, for example, the center in the longitudinal
 10 direction as a point of origin. On the basis of a detection signal of the linear scale 19, a
 command is provided to the ball screw linear motion mechanism 9 of the corresponding
 driving unit 14 by a controller (not shown). In this way, scale feedback control of a
 position of the guide block 16 which moves along the longitudinal direction of the
 lower-stage guide rail 15 can be performed.

15 [0053]

In addition, like symbols are applied to the same constituent element as those
 shown in FIGS. 8 and 9.

In the case of using the alignment stage of the present invention having the
 above configuration, in a state where movement along the X-axis direction of each guide
 20 block 16 of the respective driving units 14C and 14D each provided with the ball screw
 linear motion mechanism 9 along the X-axis direction is stopped, the respective guide
 blocks 16 are moved in synchronization with each other in the same direction along the
 Y-axis direction by the driving of the respective ball screw linear motion mechanisms 9
 of the respective driving units 14A and 14B each provided with the ball screw linear
 25 motion mechanism 9 along the Y-axis direction. As a result, the top table 4a moves in

the Y-axis direction in a movement direction and the amount of movement according to the movement direction and the amount of movement of each guide block 16.

[0054]

Also, in a state where movement along the Y-axis direction of each guide block 16 of the respective driving units 14A and 14B is stopped, the respective guide blocks 16 are moved in synchronization with each other in the same direction along the X-axis direction by the driving of the respective ball screw linear motion mechanisms 9 at the respective driving units 14C and 14D. Then, the top table 4a moves in the X-axis direction in a movement direction and an amount of movement according to the movement direction and the amount of movement of each guide block.

[0055]

Therefore, if the respective guide blocks 16 of the respective driving units 14C and 14D are moved in synchronization with each other in the same direction along the X-axis direction simultaneously with the movement of the respective guide blocks 16 of the respective driving units 14A and 14B in synchronization with each other in the same direction along the Y-axis direction, the top table 4a obliquely moves in the X-Y plane at a vector in which the movement direction and the amount of movement in the Y-axis direction of each guide block 16 of the respective driving units 14A and 14B and the movement direction and the amount of movement in the X-axis direction of each guide block 16 of the respective driving units 14C and 14D are composited.

[0056]

Further, if the respective guide blocks 16 of the respective driving units 14A, 14B, 14C, and 14D are moved in synchronization in directions coming close to the servomotors 10 or directions receding from the servomotors 10 by the respective ball screw linear motion mechanisms 9, the top table 4a rotates in the counterclockwise

direction in a plan view or the clockwise direction in a plan view with the center of the top table 4a as the rotational center.

[0057]

Also, by combining (compositing) the movement of the respective guide blocks 16 of the respective driving units 14A, 14B, 14C, and 14D in the case of moving the top table 4a in the X-Y plane, that is, the case of moving it in the X-axis direction, the case of moving it in the Y-axis direction, or the case of obliquely moving it in the X-Y plane, and the movement of the respective guide blocks 16 of the respective driving units 14A, 14B, 14C, and 14D in the case of rotating the top table 4a, it is possible to rotate the top table 4a while horizontally moving it in the X-Y plane.

[0058]

In this manner, according to the alignment stage of the present invention, by moving a printing plate, a printing target, or other work pieces (not shown), which is held on the top table 4a, by combination of the horizontal movement in the X-Y plane and the rotation of a rotation angle θ of the top table 4a, it is possible to perform position correction in three axial directions of X, Y, and θ with respect to the work piece.

[0059]

Further, even in a case where a moving load acts on a work piece (not shown), which is held on the top table 4a, along the load movement direction L, the moving load acting on the top table 4a can be continuously received at the respective driving units 14A and 14C, the supporting unit 13, and the respective driving units 14D and 14B, which are disposed in a zigzag disposition in sequence along the load movement direction L. As a result, stiffness in the vertical direction can be increased, so that the deformation amount by which the top table 4a is deformed to be bent by the moving load can be reduced. Accordingly, the possibility of position discrepancy in the work piece

(not shown) caused by deformation of the top table 4a occurring can be reduced.

[0060]

Further, the alignment stage according to the present invention is made so as to move the top table 4a by two driving units 14A and 14B each provided with the ball screw linear motion mechanism 9 following the Y-axis direction and two driving units 14C and 14D each provided with the ball screw linear motion mechanism 9 following the X-axis direction. Therefore, it is possible to equalize the horizontal direction stiffness along the X-axis direction and the horizontal direction stiffness along the Y-axis direction.

[0061]

Therefore, when performing position correction of the work piece (not shown) by moving the top table 4a in a state where a moving load acts on the work piece (not shown) held on the top table 4a, a possibility that a bias may occur in the movement in the X-axis direction and the movement in the Y-axis direction can be prevented. Then, it is possible to perform a desired position correction on the work piece (not shown).

[0062]

Further, in the alignment stage according to the present invention, scale feedback control of the respective driving units 14A, 14B, 14C, and 14D is performed by using the linear scales 19 provided outside the respective driving units 14A, 14B, 14C, and 14D. Therefore, even if a moving load acting on the work piece (not shown) held on the top table 4a acts on the respective ball screw linear motion mechanisms 9 of the respective driving units 14A, 14B, 14C, and 14D as an external force, so that bending, rattling, or the like occurs in a thrust transmission portion such as a screw shaft 11 or the nut member 12 of each of the ball screw linear motion mechanisms 9, without being affected thereby, it is possible to move the guide blocks 16 of the respective driving units

14A, 14B, 14C, and 14D to desired positions which are detected by the linear scales 19.
As a result, it is possible to perform high-precision position control of the top table 4a.

[0063]

Also, in the alignment stage according to the present invention, all of the
5 servomotors 10 which are driving sources of the respective ball screw linear motion
mechanisms 9 of the respective driving units 14A, 14B, 14C, and 14D are disposed to
protrude to the outer periphery side of the base 1. For this reason, heat which is
generated from the respective servomotors 10 can be efficiently diffused into the
atmosphere. Accordingly, it is possible to suppress thermal deformation of the base 1 or
10 the top table 4a due to heat generation of the respective servomotors 10. As a result, a
possibility can be reduced of position discrepancy occurring in a work piece (not shown),
which is held on the top table 4a, due to the influence of thermal deformation of the base
1 or the top table 4a.

[0064]

15 As described above, according to the alignment stage of the present invention, it
is possible to hold a work piece (not shown), on which a moving load acts, in a state
where high-precision positioning is performed in three axial directions of X, Y, and θ .
Further, it becomes possible to perform high-precision position correction of the work
piece (not shown) in three axial directions of X, Y, and θ in a state where a moving load
20 acts.

[0065]

Next, another embodiment of the present invention is shown in FIG. 6. This
embodiment is an example in which disposition of the units between the base 1 and the
top table 4a in the embodiment shown in FIGS. 1 to 5 is changed. That is, in the
25 embodiment shown in FIGS. 1 to 5, between the base 1 and the top table 4a, the driving

units 14A, 14B, 14C, and 14D and the supporting unit 13 are respectively disposed at positions corresponding to the four corner portions and the center of the top table 4a such that a zigzag disposition is made in which the number of units which are arranged in the direction orthogonal to the load movement direction L is two, one, and two in sequence
 5 from the upstream side in the load movement direction L. In the embodiment shown in FIG. 6, in place of the above disposition, four driving units 14A, 14B, 14C, and 14D are respectively disposed on each of four lines each connecting the intermediate position of each side of the top table 4a and the center of the top table 4a such that a zigzag disposition is made in which the number of units which are arranged in the direction
 10 orthogonal to the load movement direction L is one, two, and one in sequence from the upstream side in the load movement direction L.

[0066]

One driving unit 14A on the upstream side in the load movement direction L, two driving units 14C and 14D of an intermediate portion in the load movement direction
 15 L, and one driving unit 14B on the downstream side in the load movement direction L, which are disposed such that a zigzag disposition is made along the load movement direction L, are disposed such that the regions M occupying the load movement direction L of the respective turning bearings 8 somewhat overlap with each other. Also, although it is not shown in the drawing, a gap of a dimension in a range narrower than
 20 the width of a moving load acting on a work piece (not shown) which is held on the top table 4a may be formed between the regions M occupying the load movement direction L of the respective turning bearings 8 of the driving unit 14A, the driving units 14C and 14D, and the driving unit 14B, which are disposed in a zigzag disposition in sequence along the load movement direction L.

25 [0067]

In addition, like symbols are applied to the same constituent elements as those shown in FIGS. 1 to 5.

Also by this embodiment, the same effects as those of the embodiment shown in FIGS. 1 to 5 can be obtained. Further, since it is possible to dispose the four driving units 14A, 14B, 14C, and 14D to be closer to each other, a favorable configuration can be made for a case of applying them to an alignment stage of a size in which the planar shape is smaller.

[0068]

In addition, the present invention is not to be limited only to the above embodiments and appropriate changes are possible within the scope of the gist of the present invention. For example, in the embodiment shown in FIGS. 1 to 5, the top table 4a is made into a square shape and one supporting unit 13 and four driving units 14A, 14B, 14C, and 14D are disposed at positions in which four-times rotation symmetry with the middle of the top table 4a as the center is made. However, a planar shape of the top table 4a may be enlarged corresponding to a planar shape of a work piece (not shown) which is a support target, or be made into a rectangle. In this case, the number of supporting units 13 which are disposed between the respective driving units 14A, 14B, 14C, and 14D of four corner portions of the top table 4a may be increased. That is, for example, in a case where the size of the top table 4a is large, the zigzag disposition may be made in which the number of units of the respective driving units 14A, 14B, 14C, and 14D and the respective supporting units 13 which are arranged in the direction orthogonal to the load movement direction L is three, two, three, two, three, and the like in sequence from the upstream side in the load movement direction L. Also, in a case where the top table 4a is of a rectangle which is long along the load movement direction L, the zigzag disposition may be made in which the number of units of the respective

driving units 14A, 14B, 14C, and 14D and the respective supporting units 13 which are arranged in the direction orthogonal to the load movement direction L is two, one, two, one, two, and the like in sequence from the upstream side in the load movement direction L. Also, in a case where the top table 4a is of a rectangle which is long in the direction orthogonal to the load movement direction L, a zigzag disposition may be made in which the number of units of the respective driving units 14A, 14B, 14C, and 14D and the respective supporting units 13 which are arranged in the direction orthogonal to the load movement direction L is three, two, and three, four, three, and four, or the like in sequence from the upstream side in the load movement direction L.

[0069]

Further, as shown in FIG. 7, four driving units 14A, 14B, 14C, and 14D which are interposed between the base 1 and the top table 4a may be disposed such that a quadrangle which is formed by connecting the turning bearings 8 of the respective driving units 14A, 14B, 14C, and 14D is tilted by a required angle of less than 45 degrees with respect to the load movement direction L. By such disposition, the respective driving units 14A, 14B, 14C, and 14D may be disposed in a zigzag disposition which is asymmetric with respect to the load movement direction L. In addition, in the case of disposition as shown in FIG. 7, it is preferable if disposition is made such that the regions M occupying the load movement direction L of the respective turning bearings 8 of the driving units 14C and 14D, which are located secondly and thirdly along the load movement direction L, among the respective driving units 14A, 14B, 14C, and 14D somewhat overlap with each other. Alternatively, it is preferable if a disposition is made in which a gap of a dimension narrower than the width of a moving load acting on a work piece (not shown) which is held on the top table 4a is formed between the regions M occupying the load movement direction L of the respective turning bearings 8 of the

driving units 14C and 14D.

[0070]

The guides slidable in two directions orthogonal to each other in the supporting unit 13 and the driving units 14A, 14B, 14C, and 14D may have a configuration in which
5 the guide rail 6b of the upper-stage linear motion guide 5b is mounted on the guide block 7a of the lower-stage linear motion guide 5a, as in the supporting unit 2 and the driving units 3A, 3B, and 3C shown in FIGS. 8 and 9.

[0071]

In a case where the main purpose is to increase stiffness in the vertical direction
10 of the top table 4a when a moving load acts on a work piece (not shown) which is held on the top table 4a and there is no need to perform position correction of the work piece (not shown) which is held on the top table 4a, in a state where a moving load acts, so that a problem does not arise even if there is a difference between the horizontal direction stiffness in the X-axis direction and the horizontal direction stiffness in the Y-axis
15 direction with respect to the top table 4a, any one of the respective driving units 14A, 14B, 14C, and 14D in each embodiment described above may be replaced by the supporting unit 13.

[0072]

It is preferable to mount the external linear scale 19 on each of the driving units
20 14A, 14B, 14C, and 14D so as to be able to perform scale feedback control of the movement of the guide block 16 along the lower-stage guide rail 15. However, if the mechanical stiffness of each ball screw linear motion mechanism 9, such as stiffness of the screw shaft 11 of each ball screw linear motion mechanism 9 of the respective driving units 14A, 14B, 14C, and 14D, is sufficiently high, so that bending or rattling does not
25 easily occur in the thrust transmission portion of each ball screw linear motion

mechanism 9 even if a moving load acting on a work piece (not shown) which is held on the top table 4a acts on each ball screw linear motion mechanism 9 as an external force, a configuration is also acceptable in which the movement of the guide block 16 along the lower-stage guide rail 15 of each of the driving units 14A, 14B, 14C, and 14D is controlled on the basis of a signal of an encoder built in the servomotor 10 of each ball screw linear motion mechanism 9.

[0073]

From the viewpoint of heat release, it is preferable that the servomotor 10 which serves as a driving source of each ball screw linear motion mechanism 9 of the respective driving units 14A, 14B, 14C, and 14D is disposed so as to protrude to the outside of the base 1. However, in a case where the amount of heat generation of each servomotor 10 is sufficiently small compared to heat capacity of the base 1, the top table 4a, or other constituent members, or a case where due to a heat release mechanism for releasing heat to the outside of the alignment stage, which is separately provided at each servomotor, or the like, there is no concern that position discrepancy in a work piece, which is held on the top table 4a, due to thermal deformation of the base 1, the top table 4a, or other constituent members will occur by the influence of heat generation of the respective servomotors 10 of each ball screw linear motion mechanism 9, the servomotor 10 of each ball screw linear motion mechanism 9 may be disposed between the base 1 and the top table 4a.

[0074]

The linear motion mechanism for moving each guide block 16 of the respective driving units 14A, 14B, 14C, and 14D along the longitudinal direction of the lower-stage guide rail 15 through the lower-stage guide block 16a may adopt any type of linear motion mechanism besides the ball screw linear motion mechanism 9 if it satisfies the

following conditions. That is, it is possible to keep the position of a corresponding guide block 16 even if a moving load acting on the top table 4a acts on the linear motion mechanism as an external force. Further, as necessary, it is possible to drive a corresponding guide block 16 in a state where a moving load acting on the top table 4a acts as an external force.

[0075]

The alignment stage according to the present invention may be applied as an alignment stage of any machine or apparatus besides an alignment stage for holding a printing plate or a printing target in an offset printing apparatus, if it is an alignment stage in which holding a work piece on which a moving load acts is needed, thereby performing alignment thereof.

[0076]

In addition, of course, various changes can be made within the scope that does not depart from the gist of the present invention.

Industrial Applicability

[0077]

According to the alignment stage according to the present invention, it is possible to hold a work piece, on which a moving load acts, in a state where high-precision positioning is performed in three axial directions of X, Y, and θ . Also, it becomes possible to perform high-precision position correction of the work piece in three axial directions of X, Y, and θ in a state where a moving load acts. Accordingly, the alignment stage according to the present invention can be used for an alignment stage which is used for performing alignment of a work piece which receives a moving load.

Reference Signs List

[0078]

1: base

4a: top table

5 8: turning bearing

9: ball screw linear motion mechanism (linear motion mechanism)

10: servomotor (motor)

11: screw shaft

12: nut member

10 13: supporting unit

14: driving unit

15: lower-stage guide rail (guide)

16: guide block (guide)

17: upper-stage guide rail (guide)

15 19: linear scale

CLAIMS

1. An alignment stage comprising:

a base;

5 a top table which is disposed at a position above the base and holds a work piece on which a moving load acts;

a required number of supporting units which are each composed of guides slidable in two directions orthogonal to each other and a turning bearing provided over the guide and each have three degrees of freedom of X, Y, and θ ; and

10 at least three driving units which are composed by providing the supporting unit with a one-axis direction linear motion mechanism,

wherein the supporting units and the driving units are provided disposed in a zigzag fashion along a movement direction of the moving load between the base and the top table, and

15 driving directions by the linear motion mechanisms of two driving units among the respective driving units and a driving directions by the linear motion mechanisms of the remaining driving unit are at right angles to each other in the X-Y plane.

2. The alignment stage according to Claim 1, wherein the disposition in a
20 zigzag fashion is made by locations corresponding to the four corner portions and the center of the top table.

3. The alignment stage according to Claim 1, wherein the disposition in a zigzag fashion is made by locations corresponding to the four corner portions and the
25 center of the top table, the respective driving units are provided at the locations

corresponding to the four corner portions of the top table, and the supporting unit is provided at the location corresponding to the center of the top table.

4. An alignment stage comprising:

5 a base;

a top table which is disposed at a position above the base and holds a work piece on which a moving load acts; and

driving units which are each composed of guides slidable in two directions orthogonal to each other and a turning bearing provided over the guide, each have three
10 degrees of freedom of X, Y, and θ , and each include a one-axis direction linear motion mechanism,

wherein the driving units are provided disposed in a zigzag fashion along a movement direction of the moving load between the base and the top table, and

driving directions by the linear motion mechanisms of two driving units among
15 the respective driving units and driving directions by the linear motion mechanisms of the remaining two driving units are at right angles to each other in the X-Y plane.

5. The alignment stage according to Claim 1 or 4, wherein the disposition in a zigzag fashion is made by locations corresponding to positions on lines each connecting
20 an intermediate position of each side of the top table to the center of the top table.

6. The alignment stage according to any one of Claims 1 to 4, wherein the linear motion mechanism is constituted by a ball screw linear motion mechanism which includes a motor, a screw shaft connected to an output shaft of the motor, and a nut
25 member thread-engaged with the screw shaft, and the motor is disposed to protrude to the

outside of the base.

7. The alignment stage according to Claim 5, wherein the linear motion mechanism is constituted by a ball screw linear motion mechanism which includes a motor, a screw shaft connected to an output shaft of the motor, and a nut member thread-engaged with the screw shaft, and the motor is disposed to protrude to the outside of the base.

8. The alignment stage according to any one of Claims 1 to 4, wherein a linear scale for detecting a driving amount by the one-axis direction linear motion mechanism of each of the driving units is provided on the base adjacent to each of the driving units.

9. The alignment stage according to Claim 5, wherein a linear scale for detecting a driving amount by the one-axis direction linear motion mechanism of each of the driving units is provided on the base adjacent to each of the driving units.

10. The alignment stage according to Claim 6, wherein a linear scale for detecting a driving amount by the one-axis direction linear motion mechanism of each of the driving units is provided on the base adjacent to each of the driving units.

20

11. The alignment stage according to Claim 7, wherein a linear scale for detecting a driving amount by the one-axis direction linear motion mechanism of each of the driving units is provided on the base adjacent to each of the driving units.