

MOUNTING METHOD, MOUNTING HEAD AND MOUNTING APPARATUS

FIELD OF TECHNOLOGY

The present invention relates to a mounting technology.

BACKGROUND TECHNOLOGY

Japanese Patent No. 5507775 (Patent Document 1) discloses a bonding apparatus which is an example of a mounting apparatus.

PRIOR ART DOCUMENT

PATENT DOCUMENT

Patent Document 1: Japanese Patent No. 5507775

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

In a mounting apparatus (e.g., a pick and place type apparatus), components on a sheet are upwardly moved, at a pick-up position, by eject pins and sucked by suction collets, then the components are transferred to a mounting position in the sucked state (e.g., the bonding apparatus disclosed in the Patent Document 1). In the apparatus disclosed in Patent Document 1, number of the suction collets are increased so as to improve mounting efficiency (e.g., number of mounting components per a unit time), which affects productivity (production tact).

However, even in case that the number of suction collets is increased, if the components cannot be stably sucked (cannot

secure a reliability), the mounting efficiency must be lowered. Further, if a distance of transferring the components, by the suction collets, between the pick-up position and the mounting position is long, the mounting efficiency must be lowered.

An object of the present invention is to provide a technology capable of improving the mounting efficiency. The object and other objects of the present invention and new features thereof will be explained with reference to the descriptions of the specification and the attached drawings.

MEANS FOR SOLVING THE PROBLEMS

Typical inventions disclosed in the present application will be briefly explained as follows.

An example of the mounting method of the present invention comprises the steps of: (a) preparing a substrate onto which a component will be mounted, a sheet which has one surface and the other surface and in which the component is stuck on the one surface, a pin, and a mounting head having a plunger in which the pin is inserted; (b) holding the sheet in a state where the one surface is located on the substrate side with forming a space between the sheet and the substrate; (c) warping the sheet and bringing the component into contact with the substrate by pressing the component, via the sheet, by means of the plunger from the other surface side; and (d) relatively protruding the pin from the plunger by moving the plunger to an inner side of the mounting head.

In the preferable mounting method, the component is pressed by the pin which has pierced the sheet and the component is separated from the sheet when the warped sheet

is restored by moving the plunger in the step (d). With this structure, the component can be easily separated from the sheet.

In the preferable mounting method, the plunger presses the component in a direction perpendicular to the substrate in the step (c). With this structure, causing displacement of the components, with respect to the substrate, can be prevented.

In the preferable mounting method, the plunger presses the component in a state where a front end of the plunger and a front end of the pin are located in a same plane in the step (c). With this structure, the pin can be protruded when the plunger begins to move to the inner side of the mounting head. Further, in the preferable mounting method, the plunger presses the component in a state where the front end of the pin protrudes from the front end of the plunger by an amount equal to or less than a thickness of the sheet. With this structure, the pin can bite the sheet when the plunger presses the component via the sheet, so that the pin can easily pierce through the sheet when the plunger is moved to the inner side of the mounting head.

In the preferable mounting method, the mounting head is moved away from the substrate after performing the step (d). With this structure, the piercing pin can be pulled out.

In the preferable mounting method, the plunger is moved toward the substrate after performing the step (d). With this structure, the pin can be evacuated in the plunger by relatively moving the pin with respect to the plunger.

In the preferable mounting method, a plurality of the sheets on each of which the component is stuck is prepared in the step (a), and the mounting head is relatively moved in a

plane area of the sheet according to a position of another component to be brought into contact with the substrate after performing the step (d). With this structure, a plurality of the components can be mounted by moving the mounting head between the components only, so that the mounting efficiency can be improved.

An example of the mounting head of the present invention comprises: a head section; a plunger protruding from the head section; and a pin being inserted, in a reciprocating direction of the plunger, in the plunger and the pin relatively protrudes from the plunger in a state where the plunger is moved and located on the head section side.

The preferable mounting head further comprises a solenoid having the plunger which acts as a movable iron core. In comparison with a mounting head in which a plunger is moved by air suction, the plunger can be moved at a higher speed.

The preferable mounting head further comprises a spring which is provided in the head section and which biases the plunger in a direction to protrude the plunger from the head section. With this structure, the plunger can be held in the protruding state.

In the preferable mounting head, the pin is fixed to the head section in a state where the pin pierces through the plunger. With this structure, the protruding pin can be held stably.

In the more preferable mounting head, a front end of the plunger and a front end of the pin are located in a same plane in a state where the plunger protrudes most from the head section.

With this structure, the pin can simultaneously relatively protrude from the plunger when the plunger begins to move to the inner side of the mounting head.

The mounting apparatus of the present invention comprises the above described mounting head.

EFFECTS OF THE INVENTION

Effects obtained by the typical invention of the present application will be briefly explained. Namely, the solving means of the present invention is capable of improving the mounting efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic configuration diagram of an embodiment of a mounting apparatus relating to the present invention.

Fig. 2 is a schematic front view of an embodiment of a mounting head relating to the present invention.

Fig. 3 is a schematic side view of the embodiment of the mounting head relating to the present invention.

Fig. 4 is a schematic view of the embodiment of the mounting head relating to the present invention in which a part of the mounting head is seen through.

Fig. 5 is a schematic view of the mounting head shown in Fig. 4 in which a part of the mounting head is enlarged.

Fig. 6 is a schematic sectional view of the embodiment of the mounting head relating to the present invention.

Fig. 7 is a schematic explanation view of an embodiment of a mounting method relating to the present invention.

Fig. 8 is a schematic explanation view of the mounting method which shows a step following the step shown in Fig. 7.

Fig. 9 is a schematic explanation view of the mounting method which shows a step following the step shown in Fig. 8.

Fig. 10 is a schematic explanation view of the mounting method which shows a step following the step shown in Fig. 9.

EMBODIMENTS OF THE INVENTION

In the following embodiments of the present invention, the description will be divided into a plurality of sections if required, but they are basically not independent of each other, one section relates to modified examples, details, etc. of a part or all of another section. Thus, a same symbol is applied to structural members having the same function, and explanation will not be repeated. Further, numbers of structural members (including numbers of pieces, numeric values, quantities, ranges, etc.) are not limited to the described numbers except in case that the number is especially specified and that the number is theoretically clearly limited, so the numbers may be smaller or greater than the described ones. Further, as to shapes of structural members, the shapes include substantially similar shapes except in case that the shape is especially specified and that the shape is theoretically clearly excluded.

In the present embodiment, a mounting technology relating to the present invention can be applied to a mounting step (bonding step) included in a method for producing semiconductor devices (electronic devices). For example, in the method for producing semiconductor devices, an adhesive sheet (dicing sheet) is stuck onto a semiconductor wafer (the

semiconductor wafer is transferred onto the adhesive sheet), then the semiconductor wafer is diced (cut) to produce components (e.g., semiconductor chips such as IC chips, LED chips, etc.) in a form of piece (they are merely called chips or dies). In the mounting step, the components are mounted (e.g., flip-chip mounting) onto a substrate, e.g., ceramic substrate, printed substrate, lead frame, by a mounting apparatus.

The mounting technology of the present embodiment will be explained with reference to Figs. 1-10. Fig. 1 is a schematic configuration diagram of a mounting apparatus 100. Figs. 2 and 3 are a schematic front view and a schematic side view of a mounting head 10, in each of which the mounting head 10 is a main part of the mounting apparatus 100. Fig. 4 is a schematic view of the mounting head 10 in which a part is seen through. Fig. 5 is a schematic view of the mounting head 10 shown in Fig. 4 in which a part is enlarged. Fig. 6 is a schematic sectional view of the mounting head 10 taken along a line VI-VI of Fig. 3. Figs. 7-10 are schematic explanation views explaining a mounting method.

(Mounting Apparatus)

As shown in Fig. 1, the mounting apparatus 100 has the mounting head 10. The mounting head 10 is capable of pushing (pressing) components 21 onto a substrate 20 when the components 21 are mounted onto the substrate 20.

The mounting apparatus 100 has a head driving section 11. The head driving section 11 is used to move the mounting head 10. The head driving section 11 is constituted by a known driving mechanism, e.g., linear motor, ball bearing screw. By the head driving section 11, the mounting head 10 is capable of

moving in the vertical direction (i.e., a Z-direction of a 3-dimensional coordinate, an up-and-down direction in the drawing) and the horizontal direction (i.e., X- and Y-directions). The head driving section 11 has a vertical driving unit 23 for moving (reciprocally moving) the mounting head in the vertical direction, and the mounting head 10 is attached to a slider 23a of the vertical driving unit 23 (see Figs. 2 and 3).

The mounting apparatus 100 has a substrate stage 12. The substrate 20 can be set (disposed) on the substrate stage 12 when the components 21 are mounted. The substrate stage 12 has a surface 12a on which the substrate 20 will be set parallel to the horizontal plane. With this structure, the mounting head 10 can be vertically (perpendicularly) moved with respect to the substrate stage 12 (the surface 12a). The substrate stage 12 may have a sucking mechanism (not shown) for sucking the substrate 20 and stably holding (fixing) the same thereon.

The mounting apparatus 100 has a stage driving section 13. The stage driving section 13 is used to move the substrate stage 12. The stage driving section 13 is constituted by a known driving mechanism, e.g., linear motor, ball bearing screw. By the stage driving section 13, the substrate stage 12 is capable of moving in the horizontal direction (i.e., X- and Y-directions).

The mounting apparatus 100 has a sheet holding section 14. The sheet holding section 14 is capable of holding a sheet 22 on which the components 21 have been stuck. The sheet 22 is held by the sheet holding section 14 in a tensed state. For example, a ring unit (e.g., grip ring unit including an inner ring

and an outer ring for pinching the sheet 22) may be employed as the sheet holding section 14 for holding the sheet 22 in the tensed state.

A transparent (translucent) and elastic adhesive sheet, e.g., dicing sheet, may be used as the sheet 22. The sheet 22 has one surface 22a and the other surface 22b (see Fig. 7), and one or a plurality of the components 21 are stuck on the one surface 22a (a plurality of the components are stuck in the present embodiment). The sheet holding section 14 holds the sheet 22 between the mounting head 10 and the substrate stage 12.

The mounting apparatus 100 has a control section 15. The control section 15 controls each section and unit to operate the mounting apparatus 100. The control section 15 includes a central processing unit (CPU) and a storage unit (ROM, RAM). In the control section 15, the central processing unit reads control programs from the storage unit to execute them, so that each of the sections (e.g., the head driving section 11, the stage driving section 13) of the mounting apparatus 100 can be controlled. For example, alignment of the components 21 with respect to the substrate 20 is performed, by the control section 15, when the mounting step is performed.

The mounting apparatus 100 has a camera 16 and light units 17, which are controlled by the control section 15. The camera 16 is located close to the mounting head 10 so as to detect positions of the components 21 stuck on the sheet 22. The light units 17 are provided around the substrate 20 (the substrate stage 12) so as to irradiate the components 21 stuck on the sheet 22 with lights. In the present embodiment, the

sheet 22 is transparent or translucent, so that the camera 16 can detect the components 21 which are located at the positions where the no lights pass through. The detection data of the camera 16 is image-processed by the control section 15 and used as control data for mounting the components 21 onto the substrate 20.

(Mounting Head)

As shown in Figs. 4-6, the mounting head 10 comprises a head section 30, a plunger 31 and a pin 32. The head section 30, the plunger 30 and the pin 32 are coaxially arranged in the vertical direction (the up-and-down direction). The plunger 31 protrudes from the head section 30. The pin 32 is inserted, in a reciprocating direction of the plunger 31 (up-and-down direction in the drawing), in the plunger 31 (a through-hole 31e of the plunger).

In the mounting head 10, the pin 32 relatively protrudes from the plunger 31 when the plunger 31 is moved toward the head section 30 (see Fig. 5). With this structure, the mounting head can press the components 21 to mount them onto the substrate 20. In comparison with the conventional pick and place type mounting apparatus, the structure can be simplified (e.g., no sucking mechanism, a short transferring distance), reliability can be secured, and mounting efficiency can be improved.

A concrete structure of the mounting head 10 will be explained. The head section 30 is constituted by a plurality of assembled parts (i.e., a front part 30a, an intermediate part 30b and a rear part 30c). In the head section 30, the intermediate part 30b is formed into a hollow cylindrical shape. The front

part 30a is attached to one side of the intermediate part 30b and the rear part 30c is attached to the other side thereof so as to close the hollow. Note that, in the mounting head 10, the rear part 30c of the head section 30 is attached to the slider 23a of the head driving section 11 (see Figs. 2 and 3).

The plunger 31 has a front end part 31a and a shaft part 31b. The front end part 31a is extended from the shaft part 31b and its width is gradually reduced toward a front end (e.g., truncated cone shape). As described later, the components 21 are pressed, by means of the plunger 31 (the front end part 31a), via the sheet 22, and the front end part 31a is formed into the truncated cone shape so the mounting head can suitably mount such the small components 21. Further, in the present embodiment, a nipple part 31c whose diameter is further reduced is formed as a tip end of the front end part 31a of the plunger 31 (see Fig. 5). With this structure, an area of a front end surface 31d of the plunger 31 can be further reduced, so that the plunger 31 (the nipple part 31c) is capable of biting the sheet 22 and pressing the components 21. Note that, in the mounting method shown in Figs. 7-10, the nipple part 31c is not shown.

The pin 32 has a front end part 32a, a shaft part 32b and a rear end part 32c. The pin 32 is pierced through the plunger 31 and fixed to the head section 30. Concretely, the pin 32 is retained in the head section 30 by the rear end part 32c whose diameter is greater than that of the shaft part 32b, so that the pin is fixed by a fixing member 40 (see Fig. 4). By moving the plunger 31, the pin 32 relatively protrudes from the plunger 31, even in that state the pin 32 can be stably held by fixing the pin

32.

The front end part 32a of the pin 32 is extended from the shaft part 32b and formed into such a funnel shape (e.g., needle shape). As described later, the pin 32 (the front end part 32a) pierces through (breaks through) the sheet 22 and presses (holds) the components 21, and the sharp front end part 32a can easily pierce through the sheet 22.

In the present embodiment, the front end of the plunger 31 (the front end surface 31d) and the front end of the pin 32 (a front end surface 32d) are located in a same plane (flush with each other) in a state where the plunger 31 protrudes most from the head section 30 (see Fig. 7). Since the front end of the plunger 31 and the front end of the pin 32 are located in the same plane, the pin 32 can simultaneously protrude from the plunger 31 when the plunger 31 begins to move to the inner side of the mounting head 10.

The mounting head 10 has a solenoid 34 for moving the plunger 31. The solenoid 34 includes the plunger 31, which acts as a movable iron core, and a coil 33 provided around the plunger 31. A main body of the solenoid 34 (accommodating the coil 33) is fixed (screwed) in the head section 30 (the intermediate part 30b). Turn-on/off of the solenoid 34 is controlled by the control section 15 (see Fig. 1).

A pull solenoid may be used as the solenoid 34. When the solenoid 34 is turned on (a current is flowing through the coil 33), the plunger 31 is moved (pulled) toward the inner side (an upper side in the drawing) of the mounting head 10 (the head section 30), and the movement is limited by a plunger retainer section 35. When the solenoid (pull solenoid) 34 is turned off,

the upward movement of the plunger 31 is stopped, and the plunger 31 is released (moves downward by its own weight).

Note that, the plunger 31 may be moved upward by, for example, air suction. In comparison with the manner of moving the plunger 31 by air suction, the solenoid 34 can stably move the plunger 31 at a higher speed.

The mounting head 10 has a spring 37 for moving the plunger 31 downward. The spring 37 is a return spring, which is provided in the head section 30 and pushes (biases) the plunger 31 to protrude the plunger 31 from the head section 30. The spring 37, which surrounds the plunger 31, is provided between a flange 36 formed in the front end part of the plunger 31 (the inside of the head section 30) and the main body (the coil 33) of the solenoid 34. With this structure, by means of the spring 37 is capable of pressing the plunger 31 through the flange 36.

When the solenoid 34 is turned off, the flange 36 contacts the inner part of the head section 30 (see Figs. 4 and 6), so that the plunger 31 protrudes from the head section 30 and the protruding state can be held. On the other hand, when the solenoid 34 is turned on, the plunger 31, which acts as the movable iron core, is drawn or moved to the inner side of the mounting head 10 (the head section 30), then the spring 37 is compressed and the flange 36 is moved away from the head section 30 (see Fig. 5).

(Mounting Method)

The mounting method (actions of the mounting apparatus 100 having the mounting head 10) will be explained. As shown in Fig. 7, the substrate 20 onto which the components 21 will

be mounted, the sheet 22 on which one or a plurality of the components 21 have been stuck (a plurality of the components 21 are stuck in the present embodiment), and the mounting head 10 (the mounting apparatus 100) are prepared as a preparation step.

In this step, electrode patterns 41, which will be electrically connected to the components 21, have been formed on the substrate 20. The components 21 will be connected to the electrode patterns 41 by a bonding material, e.g., solder paste, electrically conductive paste. For example, the bonding material is previously applied to connection terminals of the components 21. The sheet 22 has the one surface 22a and the other surface 22b, and the components 21 are stuck on the one surface 22a. The mounting head 10 has the pin 32 and the plunger 31 in which the pin 32 has been inserted. In the mounting head 10, the front end of the plunger 31 (the front end surface 31d) and the front end of the pin 32 (the front end surface 32d) are located in the same plane (a normal state).

Successively, as shown in Fig. 7, the sheet 22 is held in a state where a space is formed between the sheet 22 and the substrate 20 and the one surface 22a faces the substrate 20. Concretely, the substrate 20 is set on the substrate stage 12. Further, the sheet holding section 14 (see Fig. 1) holds the sheet 22, in the tensed state, parallel to the substrate 20 with the space. The positions of the prescribed electrode patterns 41 of the substrate 20 and the positions of the components 21 to be mounted are aligned with each other by the stage driving section 13 (see Fig. 1). The mounting head 10 is held in a state where a space is formed between the sheet 22 and the mounting

head 10. Aligning the components 21 to be mounted and the mounting head 10 is performed by the head driving section 11 (see Fig. 1).

Successively, as shown in Fig. 8, the plunger 31 presses (pushes) the component 21, via the sheet 22, from the other surface 22b side, so that the sheet 22 is warped and the component 21 is brought into contact with (bonded to) the substrate 20. Concretely, the mounting head 10 is moved downward by the vertical driving unit 23 (see Figs. 2 and 3) of the head driving section 11. At this time, the plunger 31 perpendicularly presses the component 21 with respect to the substrate 20. With this action, the component 21 can be mounted onto the substrate 20 without causing positional displacement. The plunger 31 presses the component 21 in the state where the front end of the plunger 31 and the front end of the pin 32 are located in the same plane.

Successively, as shown in Fig. 9, the pin 32 relatively protrudes from the plunger 31 by moving the plunger 31 to the inner side of the mounting head 10. Concretely, the solenoid 34 is actuated to draw the plunger 31 (the iron movable core) into the inner side of the head section 30. Since the pin 32 inserted in the plunger 31 is fixed to the head section 30, the pin 32 relatively protrudes from the plunger 31. Further, the plunger 31 is moved from the state where the front end of the plunger 31 and the front end of the pin 32 are located in the same plane, so that the pin 32 can simultaneously protrude when the plunger 31 begins to move to the inner side of the mounting head 10.

When the warp of the sheet 22 is restored by returning

the plunger 31, the component 21 is pressed (held) by the pin 32 which has pierced through the sheet 22, and the component 21 is separated from the sheet 22. At this time, as described above, the component 21 is brought into contact with (bonded to) the substrate 20.

By locating the pattern 41 to be connected immediately under the selected component 21 of the components 21 which will be separated from the sheet 22, the selected component 21 can be transferred downward from the sheet 22. The component 21 can be easily separated from the sheet 22. Since the component 21 can be mounted or transferred from the sheet 22 to the component 21, so that reliability can be improved.

Successively, as shown in Fig. 10, the mounting head 10 is moved away from the substrate 20. Concretely, the mounting head 10 is moved upward and returned by the vertical driving unit 23 (see Fig. 2 and 3) of the head driving section 11 until reaching the position shown in Fig. 7. By this action, the pin 32 can be pulled out from the sheet 22.

Further, as shown in Fig. 10, the plunger 31 is moved toward the substrate 20. Concretely, the solenoid 34 is turned off, then the plunger 31 is moved in the direction of protruding from the head section 30 (toward the outside of the head section 30) by the spring 37. Finally, the plunger 31 protrudes most from the head section 30. By this action, the pin 32 can be evacuated in the plunger 31 by relatively moving the pin 32 with respect to the plunger 31. Further, the pin 32 can be pulled out from the sheet 22.

Successively, the mounting head 10 is relatively moved in a plane area of the sheet 22 so as to align with another

component 21 (e.g., adjacent component 21a) which will be bonded to the substrate 20. Concretely, the mounting head 10 is moved parallel to the sheet 22, by the head driving section 11, until the plunger 31 and the pin 32 of the mounting head 10 locate above the component 21a. Further, the substrate 20 is moved parallel to the sheet 22, by the stage driving section 13, until the corresponding pattern 41 of the substrate 20 locates under the component 21a. Then, the component 21a is mounted onto the substrate 20 by the steps explained with reference to Figs. 7-10.

To mount a plurality of the components 21, the mounting head 10 is moved to the components 21 accordingly. While mounting a plurality of the components 21, the mounting head 10 is moved in the plane area of the sheet 22, on which a plurality of the components 21 have been stuck. On the other hand, in the conventional pick and place type apparatus, the component is sucked and conveyed to a mounting position, which is located outside of a plane area of the sheet, by the suction collets. In the present embodiment, even in case that all of the components 21 are mounted, the transferring distance is shorter than that of the conventional apparatus, so that the mounting efficiency can be improved.

The embodiment of the present invention has been explained in detail, but the present invention is not limited to the above described embodiment, and modifications thereof can be allowed without deviating the scope of the present invention.

In the above described embodiment, the components are semiconductor chips. The present invention can be applied to

other electronic components which can be stuck on the sheet, e.g., semiconductor chips, resistor chips, capacitor chips, inductor chips.

In the above described embodiment, the front end of the plunger and the front end of the pin are located in the same plane in the state where the plunger protrudes most from the head section. Further, the front end of the pin may protrude from the front end of the plunger by an amount equal to or less than (not thicker than) a thickness of the sheet in the state where the plunger protrudes most from the head section. In this case, the pin can bite the sheet when the plunger presses the component via the sheet, so that the pin can easily pierce through the sheet when the plunger is moved to the inner side of the mounting head. Further, the front end of the pin may evacuate in the plunger in the state where the plunger protrudes most from the head section. In this case, the pin can protrude (uncover) only when the plunger is moved to the inner side of the mounting head, so that the pin can be protected.

In the above described embodiment, the mounting head and the substrate (the substrate stage) are moved with respect to the fixed sheet (the sheet holding section). Further, the mounting head may be fixed and the sheet and the substrate may be moved, and the substrate may be fixed and the mounting head and the sheet may be moved. Namely, any constitutions in which the mounting head, the substrate and the sheet are relatively moved may be employed.

CLAIMS

Claim 1

A mounting apparatus having a mounting head, and a head driving section adapted to move the mounting head, the mounting head comprising:

a head section;

a solenoid;

a plunger which acts as a movable iron core of the solenoid, and protruding downward from the head driving section in the normal attitude of operation of the mounting apparatus; and

a pin coaxial with and inserted into the plunger, the pin being capable of reciprocating motion relative to the plunger,

the plunger has a front end part and a shaft part,

the front end part of the plunger tapering towards a nipple part formed as a tip end of the front end part of the plunger,

the front end part and the nipple part protruding downward from the head section,

wherein the plunger protrudes downward most from the head section when the solenoid is not actuated, and;

wherein the pin protrudes downward relative to the plunger in a state where the plunger moves upward upon actuation of the solenoid.

Claim 2

The mounting apparatus according to claim 1, in which the mounting head further comprises a spring provided in the head section to bias the plunger into protruding downward most when the solenoid is not actuated, and when in this state;

the front end of the pin is located in the same plane as the front end of the plunger.

Claim 3

The mounting apparatus according to claim 1 or claim 2, wherein the pin has a pin-front end part, a pin-shaft part, and a pin-rear end part, wherein a; diameter of the pin-rear end part is greater than a diameter of the pin-shaft part, and the pin-rear end part is fixed to the head section.

Claim 4

The mounting apparatus according to claim 3,

wherein the pin-front end part is extended from the pin-shaft part, and is formed into a funnel shape, and;

wherein the pin-front end part is adapted to pierce through a sheet in a state when the solenoid is actuated.

Claim 5

The mounting apparatus according to claim 1 or claim 2,
wherein the mounting head is attached to a slider of a vertical driving unit of the head driving section.