

Technical Communication

Development of High-speed & High-accuracy roll & Pitch Angle Adjustment Machine for HDD Suspension

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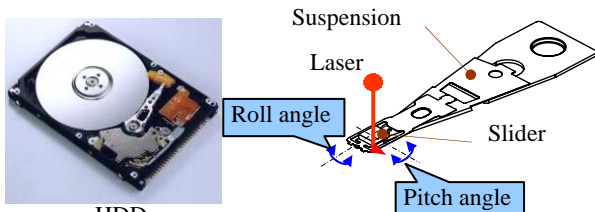
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Our company develops and sells the roll and pitch angle adjustment machine of the magnetic head suspension that applies the laser forming technology for mass production manufacturing of the hard disk drive (HDD). It reports on the details this time, we developed a high-speed, high accuracy machine corresponding to the output expansion, the miniaturization, and a large capacity of HDD.

Keywords: roll and pitch angle, laser forming, suspension adjustment, magnetic head suspension,

1. Necessity of suspension adjustment

HDD is consisted with slider and disk which maintain the space of about 10 nm to read and write magnetic data. Therefore, the magnetic head suspension requires highly accurate shape to maintain the slider. The accuracy of the roll and pitch angle of the suspension are the most important. To satisfy this demand, we developed the mass production manufacturing machine of the suspension that applied the laser forming technology in 2002.



HDD
Fig. 1 Structure of suspension in HDD

2. Necessity of new machine

As the storage capacity of HDD has increased in recent years, the roll and pitch angle of suspension requires high accuracy. The performance of the initial type machine developed in 2002 is shown in the following. It might be difficult to satisfy the demand with the performance of this machine. Therefore, more highly accurate and high-speed machine has been needed.

- *Measurement accuracy 0.02deg
- *Adjustment resolution 0.10deg
- *Adjustment accuracy 0.07deg
- *Adjustment time 2sec/piece



Fig. 2 Initial type machine

3. New machine development

We developed aiming at three technological concepts for the new machine.

- (1) Improvement of adjustment resolution and accuracy
- (2) Shortening of adjustment time
- (3) Improvement of angle measurement accuracy

3.1 Improvement of adjustment resolution and accuracy

We developed a new laser scanning unit to satisfy these concepts. The laser is irradiated directly to the suspension for a new unit though the laser propagated in the fiber before. As a result, the control of the laser irradiation spot diameter became possible by installing the defocus adjustment mechanism. We achieved a minute adjustment and the accuracy improvement by using the irradiation parameter of the best laser irradiation energy.

- *Adjustment resolution 0.10deg >>> 0.05deg
- *Adjustment accuracy 0.07deg >>> 0.03deg

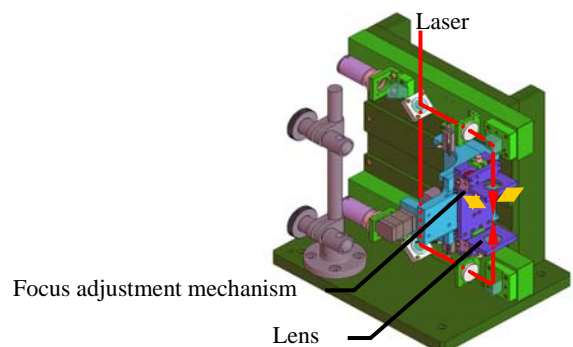


Fig. 3 Laser scanning unit

3.2 Shortening of adjustment time

The feature of this laser scanning unit is high-speed scanning of the lens of the laser. High-speed laser scanning and laser irradiation positioning became possible because it moved a light lens in a vertical side to a laser optical axis. As a result, the adjustment time was improved greatly.

- *Adjustment time 2sec/piece >>> 0.8sec/piece

3.3 Improvement of angle measurement accuracy

The conventional measuring method scanned the suspension in the XY stage, and calculated the angle from the measurement data of the laser displacement sensor. In our new concept, we adopted the direct measurement by an auto collimator for the improvement of the angle measurement accuracy. As a result, we achieved the improvement of four times the measurement accuracy.

*Angle measurement accuracy 0.02deg >>> 0.005deg

4. Machine of new mass product type

We developed the machine of high speed and high accuracy that combined new technological concepts. This machine have two functions of angle measurement and adjustment. The angle measurement verifies the result of adjustment in the standard value. We achieved the adjustment processing performance of 1800pieces/hour by using suspension jig that is able to set a lot of suspensions. When the next jig is prepared in the jig set stage, the jig is exchanged by the automatic operation for the jig that has been adjusted. As a result, the continuous automatic operation driving becomes possible. The suspension jig has the advantage to install user's suspension palette, to excel in work, and to correspond easily to the product change. In addition, the design that reduced the size to 60% of the conventional machine is effective to application to the mass production factory.



Fig. 4 New type machine



Fig. 5 Suspension jig

5. Adjustment performance

The amount of the adjustment is controlled by the position, the direction, the speed, and the number of lines of laser scanning, and the product is adjusted to the standard angle. The laser irradiation position by the difference of the position where the suspension is installed can be corrected by the image processing function. The laser irradiation to a minute part becomes possible by making the irradiation spot diameter minute and the adjustment performance has improved. The following graph is adjustment accuracy in actual operation.

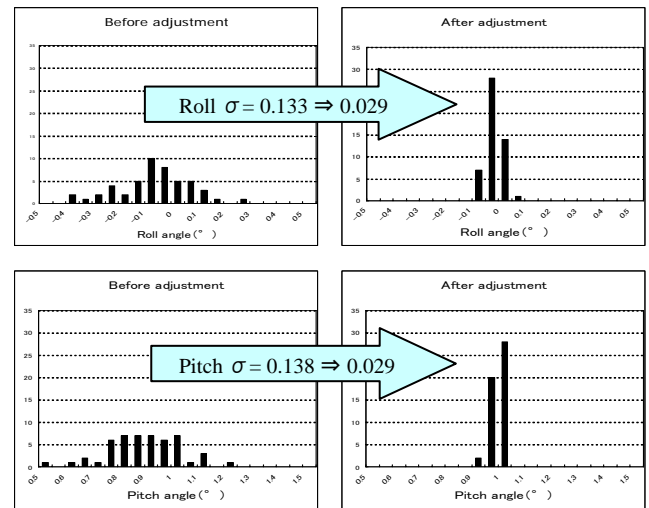


Fig. 6 Sample data before and after adjust



Fig. 7 Laser irradiation part

6. Machine maintenance

This machine has the following function for maintenance, and contributes to steady operation.

(1)The angle measuring instrument can confirm whether to operate normally by mastering jig with the measurement parts of each angle. After jig is transported to the measuring instrument, measurement data are compared with the standard value to judge.

(2)The laser power can calibrate with the power meter automatically. After transporting the power meter to the laser scanning unit, the laser is calibrated so that measurements of the power meter may become the instruction outputs.

(3)The adjustment data of each lot can be totaled. The total of data can contribute to the management of operation.



Fig. 8 Mastering jig

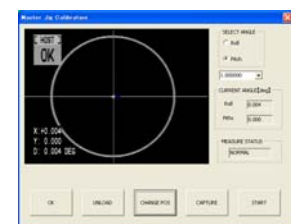


Fig. 9 Measurement confirmation screen



Fig. 10 Laser calibration screen



Fig. 11 Lot data total screen

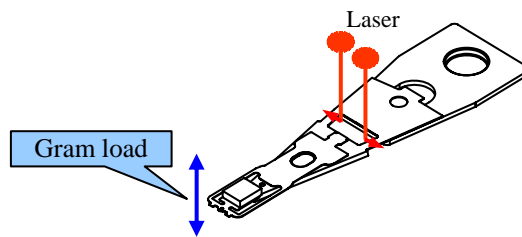


Fig. 12 Gram load adjustment of suspension

- *Adjustment accuracy 0.03gf
- *Adjustment time 1sec/pieces

At the end, the machine of high accuracy and the high quality that uses the laser forming technology will be offered excluding the HDD field in the future.

7. Development of gram load adjustment

In addition to the roll and pitch angle, there is a gram load in the shape accuracy demand of the suspension. This gram load has the standard demand of about $\pm 0.1\text{gf}$. We are planning the function addition to adjust this. The gram load adjustment irradiates the laser to the hinge part of the suspension. A recent experiment result is shown in the following.

References

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