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DESIGN OF A LAYERED HIGH PRECISION MAGNET GIRDER

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Abstract

In order to adjust the collimation of the light source magnet, a layered magnet girder is developed, which can adjust the six degrees of freedom accurately and reduce the mutual influence of the adjustment process between the various layers of the girder. The precision of the collimation is up to 5 microns.

INTRODUCTION

The HEPS is a high energy synchrotron source with the electronic energy of 5GeV and the emittance of 0.5nmrad in 13th Five-Year Plan. The synchrotron radiation source consists of two types of accelerators, the intensifier and the storage ring [1]. The synchrotron radiation source consists of two types of accelerators, the booster and the storage ring. The main equipment of the accelerator is all kinds of magnets (including: dipole magnet, quadrupole magnet, sextupole magnet, correction magnet).The magnet girder is a device used to support, adjust and locate the magnet. Its adjusting precision directly affects the collimating accuracy of the magnet [2]. This electric magnet girder is applied to support and position precision adjustment of the dipole magnet in the booster.

THE STRUCTURE OF GIRDER

In order to save the manpower and adjusting time of the magnet collimation adjustment, the girder adopts all electric control, which can realize three directions movement of X, Y, Z direction and Rotational motion around the axis of X, Y and Z. The girder realizes the precise collimation of magnets in a small area, and the adjustment range of the horizontal X, Y and Z directions is + 15mm. The structure of the electric adjusting girder is shown in Figure 1 below.

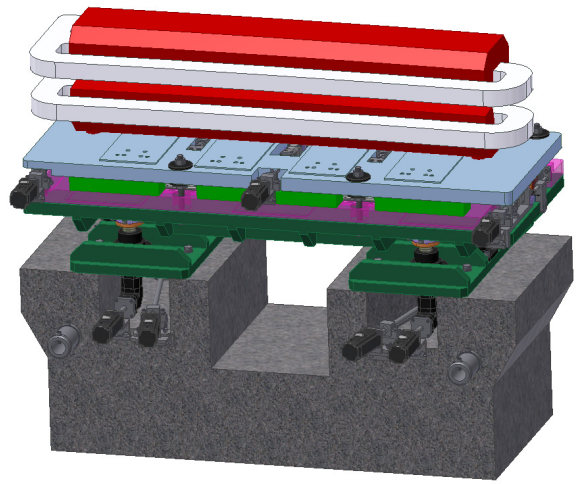

Figure 1: The structure of magnet girder.

The structure of the magnet girder is divided into two parts, namely the horizontal adjustment mechanism (shown in Figure 2) and the height adjustment mechanism (as shown in Figure 3). The horizontal adjustment assembly adopts a layering adjustment mode, and each layer realizes one direction adjustment independently. Height adjustment assembly realizes elevation adjustment by 4 adjusting mechanisms.

After the magnet collimating adjustment is completed, the girder is fixed by the height locking mechanism and the horizontal locking mechanism. The base of the magnet girder is made of marble, providing high stability support. The hoisting rod is used for lifting the whole magnet girder.

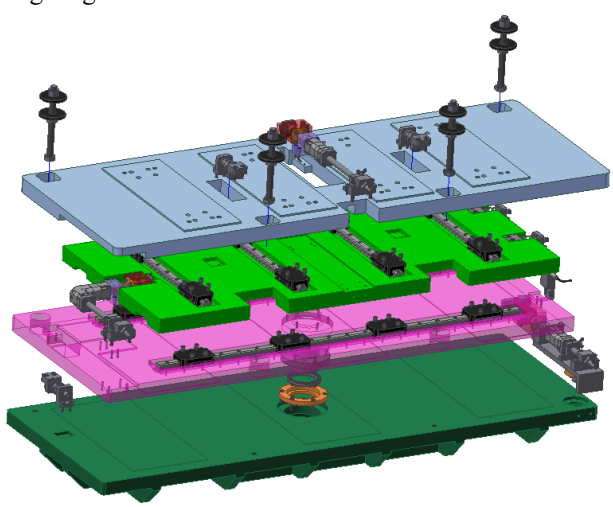

Figure 2: The horizontal adjusting mechanism.

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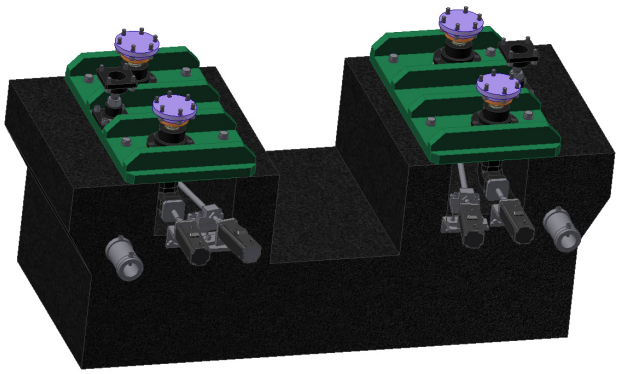

Figure 3: The height adjustment mechanism.

STRUCTURE OF THE HORIZONTAL ADJUSTING MECHANISM

The structure of the horizontal adjusting mechanism is shown in Figure 4 and Figure 5 below, which is divided into horizontal transverse moving plate, horizontal longitudinal moving plate, rotary adjusting plate and lifting plate. Each plate is regulated by an independent mechanism. A spring pre-tightening device is installed on each plate, and the pre tightening force is applied to the adjusting mechanism to reduce the screw thread clearance of the adjusting screw.

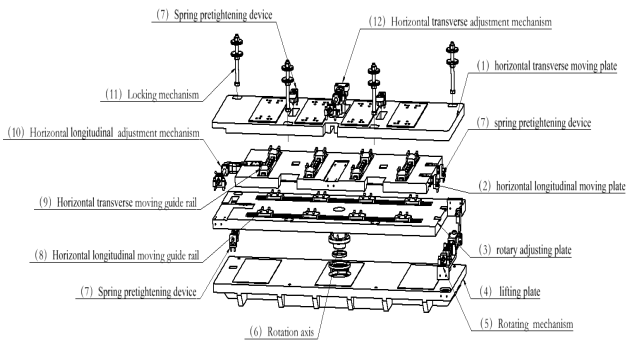

Figure 4: The structure of the horizontal adjusting mechanism.

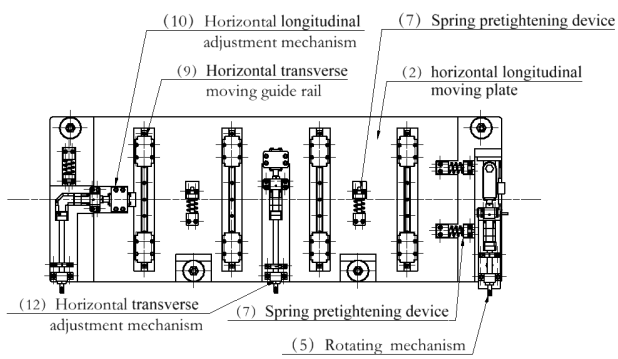

Figure 5: Second layer view of the horizontal adjusting mechanism.

THE STRUCTURAL OF HORIZONTAL ADJUSTMENT MECHANISM

Each adjustment organization takes the same structural form, shown in Figure 6. The reducer and the trapezoidal screw are connected by coupling. The adjusting nut is installed on the moving plate after being installed on the connecting seat. The push and pull of each laminate is realized by trapezoidal screw. In order to facilitate the operation and maintenance of the motor, all motors are connected with the reducer by the extending shaft. All 7 motors are elicited to the operator side. The pre tightening spring device is connected with the upper and lower plate respectively, as shown in Figure 7. Pre tightening force is applied to reduce the internal clearance of the adjusting mechanism.

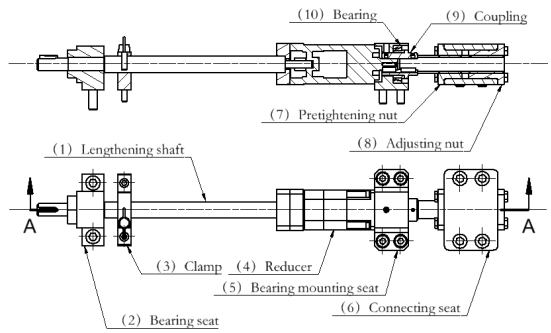

Figure 6: The structural of horizontal adjustment mechanism.

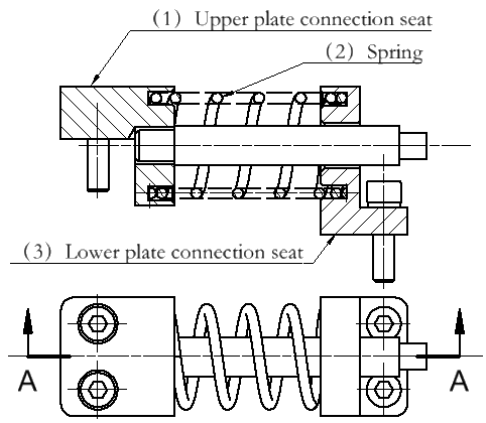

Figure 7: The structure of spring pre-tightening device.

THE STRUCTURAL OF VERTICAL ADJUSTMENT MECHANISM

The vertical adjustment mechanism connects the vertical plate and the marble base to realize the different position state of the vertical plate welding plate. Four height adjustment mechanism lift together to realize the lifting of the whole girder; Two adjusting mechanism in the same side is marked as one group. The two group of mechanism adjusted in reverse direction to realize the

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rotary motion of the girder. The structure of the vertical adjustment mechanism was shown in Figure 8. The ball connection structure enables the height adjustment mechanism to have a certain rotation angle. During the adjustment process, the motor rotates the adjusting nut. Because of the positioning key, the screw rod does not rotate, and only rises and goes up and down. Thus the purpose of vertical direction lifting is achieved.

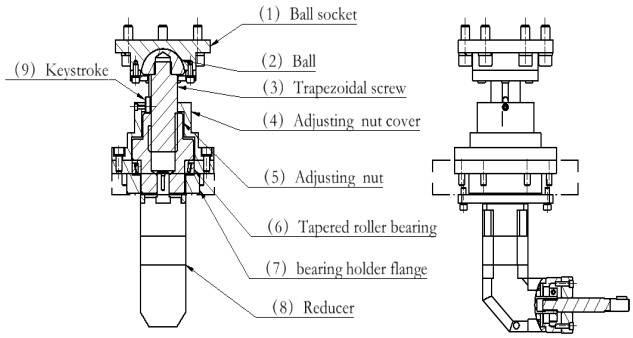

Figure 8: The structural form of vertical adjustment mechanism.

PRECISION FEEDBACK

The clearance of the adjusting mechanism will affect the adjusting accuracy of the girder. Therefore, the displacement sensor, shown in Figure 9,was installed to compensate for the movement amount, so as to ensure the adjustment accuracy of the 5μm.

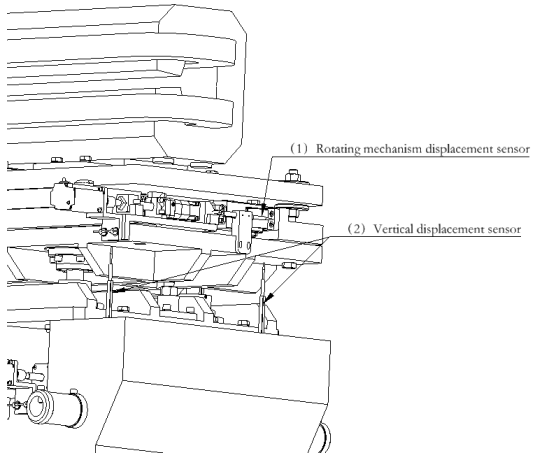

Figure 9: The displacement sensor of the each adjustment mechanism.

CONCLUSION

Layered high precision magnet girder provides a high-precision alignment scheme for the magnet. Its highest accuracy is 5um, providing stable and high precision support for the magnet of the light source.

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