

The Adjustment of the Screw Tightening Machine of Non-Integer Multiple-Axis Bolts

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Abstract: This paper analyzes the problem that the existing tightening machine can not be used to tighten the flywheel bolts in the new diesel engine models of a certain brand, and expounds the scheme of reforming the tightening machine to make it suitable for all models. The transformation of the tightening machine mentioned in this paper can greatly improve the production efficiency and bring more profits to the company.

Keywords: Flywheel Bolts; Tightening Machine; Production Efficiency

1. Introduction

As one of the five main bolts of diesel engine, the importance of flywheel bolt is self-evident. The method of torque + Angle is generally adopted for tightening flywheel bolts. Manual tightening cannot accurately ensure the degree of rotation Angle, so the flywheel bolts of our earliest A-series products are tightened by A tightening machine.

With the continuous increase of diesel engine types, B series products have begun mass production. It was found that the spacing and quantity of flywheel bolts of the two series products were different during the mixed line production. As a result, the flywheel bolts of B series products cannot be assembled by tightening machines. If the mixed line production needs to add two additional flywheel bolt tightening equipment, it will not only increase the production cost but also occupy limited production land and increase the production time.

In this paper, the adjusting method of non-integer multiple wheelbase bolt tightening machine is proposed, which can realize the tightening of flywheel bolts with different spacing and different number in one tightening machine. Compared with the manual tightening of B series flywheel bolts, it not only improves the assembly efficiency, but also ensures the assembly quality more effectively. The structure

of the device is simple and compact, and the number of equipment is reduced while realizing the function, thus reducing the production cost, increasing the production efficiency, saving energy, space and capital[1].

2. Overview of Adjustable Tightening Machine Functions

2.1 Flywheel Bolt Position Diagram

2.1.1 Flywheel Bolt Distribution of A Series Products

Each product is equipped with 10 flywheel bolts, the bolts are distributed uniformly, and the bolt spacing is 130mm[2]. As shown in Figure 1.



Figure 1. Distribution of Series A Flywheel Bolts

2.1.2 B Series 6 Cylinder Product Flywheel Bolt Distribution

Each product is equipped with 9 flywheel bolts, the bolts are evenly distributed, and the bolt spacing is 126mm. As shown in Figure 2.



Figure 2. Bolt Distribution of B-Series 6-Cylinder Flywheel

2.1.3 B Series 12 Cylinder Product Flywheel Bolt Distribution

Each product is equipped with 10 flywheel bolts, the bolts are uniformly distributed, and the bolt spacing is 138mm. As shown in Figure 3.

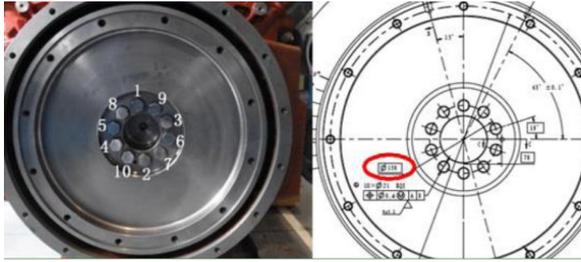


Figure 3. Distribution of Flywheel Bolts of Series B Series 12 Cylinder

2.2 State of the Tightening Machine Before Transformation

Before the transformation, the flywheel bolt tightening machine is tightened with two axes at the same time, and the spacing between the tightening axes cannot be adjusted. As shown in Figure 4.



Figure 4. Status of the Tightening Machine Before Modification

2.3 Solution Description

The initial state of the equipment is Series A fastening type, tool center spacing 130mm, series B 12-cylinder products need to change the pitch after use, tool center spacing 138mm. B series 6 cylinder products have 9 bolts, according to the requirements of the assembly sequence, the spacing between the two bolts is 124mm each time they are tightened. Tighten 1-6, 5-7,9-3,2-4,6-8[3].

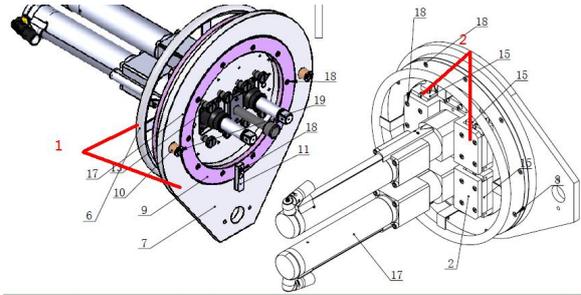
Because of the small difference in bolt spacing between the three products, it is difficult to use cylinder pitch change, so the manual sliding positioning pin form of pitch change is more portable and accurate[4].

The equipment body up and down expansion stroke is 500mm, the main frame adopts aluminum alloy profile structure, lifting mode adopts cylinder expansion to lift, and the body maintains pneumatic balance during tightening. The guide rail system has two fixed

rails and one moving rail structure, and no additional guide rail is required[5].

3. Contents and Working Principle of Transformation

The adjustable tightening machine is mainly composed of a rotating device, a sliding device and other main mechanisms. As shown in Figure 5.



1- Rotating device 2- sliding device

Figure 5. Adjustable Tightening Machine Diagram

3.1 Rotating Device

The original rotating device could not realize the adjustment of the tightening shaft spacing, so the new rotating device was redesigned and made of lightweight aluminum alloy, which not only met the space requirements of the tightening shaft spacing adjustment but also could rotate easily.

The rotating device is mainly composed of cross roller bearing CRBC, cross roller bearing CRBC inner stop ring, cross roller bearing CRBC outer stop ring and cross roller bearing CRBC outer washer. As shown in Figure 6.

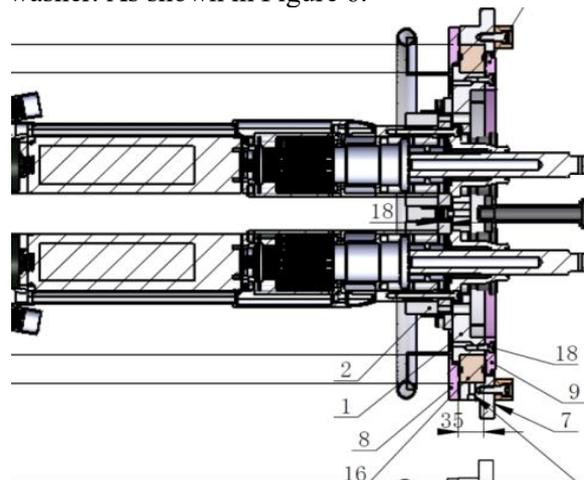


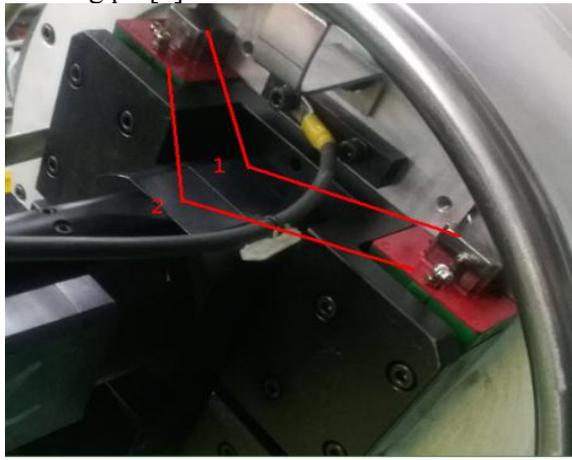
Figure 6. Rotating device diagram

7- Cross roller bearing CRBC outer ring 8- Cross roller bearing CRBC outer stop ring 9- Cross roller bearing CRBC Inner stop ring 16- Cross roller bearing CRBC.

3.2 Sliding Device

The spacing difference between the flywheel bolts of the three products is up to 14mm, so the manual adjustment method with a more compact structure is adopted. Using manual adjustment, the spacing of the tightening shafts can reach 124mm, 130mm and 138mm, respectively, to achieve accurate positioning of the flywheel bolt tightening position of different products. As shown in Figure 7-10.

The sliding device is mainly composed of a straight slide block, a straight slide rail and an indexing pin[6].



1-slide rail 2-slider

Figure 7. Roating Device Diagram

Pull out the indexing pin and move the tightening shaft manually to adjust the spacing of the tightening shaft to three states, and then unscrew the indexing pin to lock the tightening shaft.

Move the two tightening shafts to the innermost, and the tightening shaft spacing is 124mm, which is suitable for B-series 6-cylinder products.



Figure 8. Tightening the Shaft Spacing of 124mm Figure

Move both tightening shafts to the outer side at 138mm spacing for B Series 12 cylinder products.



Figure 9. Tightening the Shaft Spacing of 138mm Figure

Move one tightening shaft to the outermost side, the other side to the innermost side at 130mm for the B series 12 cylinder products.



Figure 10. Tightening the Shaft Spacing of 130mm Figure

4. Conclusion

With the continuous expansion of the product scale, the production rhythm is also constantly improving, the tightening of the main bolts in the technology innovation, the selection of powerful control of electric tightening tools in the assembly, and the development of reasonable tightening process and scientific management methods, in order to ensure stable assembly quality, produce first-class products, reduce the investment in production department equipment, Improve and enhance the manufacturing level of China's engine.

The non-integer multi-wheelbase flywheel bolt tightening function designed in this paper is suitable for tightening three series of flywheel bolts with different spacing. It can meet the quality and efficiency requirements of the production workshop, effectively reduce the production cost of the enterprise, improve the assembly quality and efficiency, and meet the current development trend of assembly line automation.

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