Inspection units are Designed and Manufactured Based ON Engine Cross-Through Hole Paths

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Abstract: The cross-hole penetration quality is critical in engine overall performance. In view of the large visual inspection error and the complexity of the oil pressure flow test procedure, the study designed a new quality inspection device for cross-cutting holes. The weight ball is pulled by the hand-held traction so that it slides down to the cross-section of the orifice, and the mass inspection of the cross-section of the orifice is completed by drawing the telescopic traction mechanism from the other end of the orifice, thereby effectively reducing the impact of human error, The purpose of increasing productivity.

Keywords: Cross-Through Hole Path, Quality Inspection, Telescopic Traction

1. Introduction

In the engine area, there are often more cross-hole structures, both in the block and in the cylinder head[1, 2]The quality of these cross-holes can directly affect the cooling or lubrication of the components concerned, which in turn affects the engine overall performance[3-5]On the system. To ensure stable engine operation, the cross-hole penetration quality needs to be tested, and the existing cross-hole penetration quality test relies on visual and complex oil pressure flow tests to verify the cross-hole penetration quality. However, the visual inspection error is large, and can easily lead to misjudgment, and cannot see the deep holes or cross-holes in tight spaces, while the oil pressure flow test is complex and costly. The inspection time is long, so there is an urgent need to design a quality inspection device suitable for cross-cutting holes to meet the production needs of enterprises and improve productivity.

2. Design of Quality Inspection Devices

2.1 Design Purpose

In order to be suitable for cross-cutting inspection of the hole, the design requirements of the new inspection device should be satisfied: Convenient to operate, debilitating factors of misjudgment, accurate results, and the tool must not scratch the inner wall of the hole channel during inspection. The goal is to ensure the integrity of the cross-bore channel and increase the efficiency of inspection.

2.2 Design Content

2.2.1 Overall design of the quality control unit

The cross-through hole quality in the engine block or cylinder head is vital to the stability of the engine's entire operation, however, the long hole or cross-hole in the tight space cannot be clearly seen by visual inspection, which can easily lead to misjudgment, the oil pressure flow test takes a long time, and the inspection process is complex and cumbersome. To solve the technical problems described above, a new type of quality inspection device is provided, with the internal workpieces consisting mainly of the counterweight sphere, the telescopic traction mechanism, and the traction sphere. The structure is shown in Figure 1.

The concept of this new inspection device is as follows: Slowly drop the weight ball from the cross-through hole port into the cross-through hole channel, causing the weight ball to slip under its own gravity to the cross-through hole channel crossing position, extending through the cross-through hole channel through the other end of the cross-through hole channel through the telescopic traction mechanism. Pull out the weight sphere at the intersection. Complete a quality check that crosses through the hole path.

During inspection, the cross-through hole bore size is not acceptable if the weight sphere is stuck in the inner wall limit of the cross-through hole, or if the weight sphere can eventually be pulled out of the telescopic hitch, the cross-through hole bore size is acceptable. The unit is simple in structure, easy to make, low cost, simple inspection method, easy to operate, The examination was highly efficient, and the examination process weakened the factors for misjudgment, and the results of the examination were accurate.

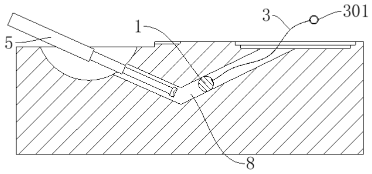

Figure 1. Structure Diagram of the Quality Control Unit

Of which 1, the counterweight sphere; 3, the towing rope; 5, the telescopic rod; 8, the cross-hole channel; 301, Towing the ball.

2.2.2 Design of the counterweight sphere

The design of the counterweight sphere consists of three parts, the counterweight sphere, the towing section, and the fixed section, and the weight sphere is constructed as shown in Figure 2.

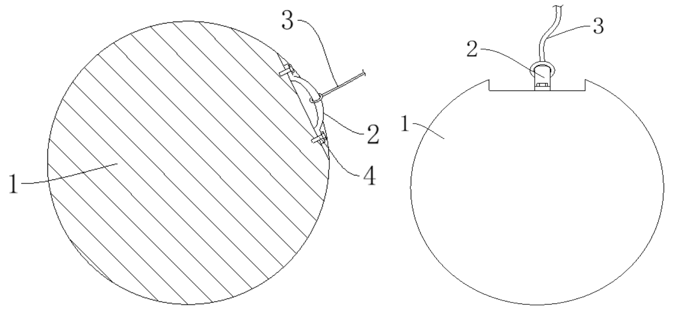

Figure 2. Structure Diagram of the Counterweight Sphere

Where 1, the counterweight sphere; 2, the fixing section; 3, the towing rope; 4, the bolt.

For quality inspection of cross-through holes, To prevent wear of the weight sphere or scoring on the inner surface of the orifice, the surface of the weight sphere is polished to a surface finish of not more than 0.8 RA to reduce friction between the weight sphere and the measured cross-through hole wall, while the weight sphere is consistent with the cross-through hole inner diameter to be detected. The maximum distance from the center of the counterweight to the fixed part on the sidewall is greater than the radius of the counterweight sphere to avoid the ballasted over during cross-through-hole slide, and to ensure that the fixed face of the mount rotates parallel to the cross-through hole for accurate cross-through hole detection.

The mounting is bolted and attached to the side wall of the counterweight sphere, attaching a wear-resistant tow rope to the upper end of the fixation, and attaching the trailing ball to the end of the rope. The towing rope is set up to facilitate the placement of the weight ball in the cross-through hole path to be inspected, especially in confined spaces where the weight ball cannot be picked up by hand, and to prevent the weight ball from sticking through the hole channel if the cross-through hole penetration quality check is not satisfactory. In the event that the telescoping hitch does not pull out the weight ball properly, the ballasting can be pulled out with a drawcord to protect the cross-through hole from friction wear.

2.2.3 Design of the telescopic towing mechanism

The cross-through passages are found in the engine block or inside the cylinder head, and their processing equipment and processes vary greatly, so two different types of telescopic traction mechanisms are designed to suit different working environments.

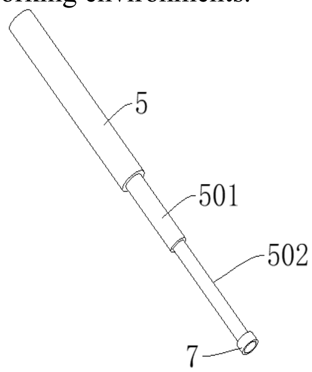

Figure 3. Structure Diagram of the Telescopic Traction Mechanism

Of which 5, telescopic rod; 501, outer sleeve; 502, inner sleeve; 7, magnet block.

The telescopic hitch one is structured as shown in Figure 3 and consists mainly of the telescopic rod and magnet block. The telescopic rod can be either air driven or electrically driven telescopic end lengthening, extending the magnet block through the cross of the bore by extending the telescopic end, the magnet block is magnetically adsorbed to the surface of the counterweight sphere, and the worker can then pull the weight ball out by controlling the telescopic end zoom. You can also pull the telescopic rod directly to pull the weight ball out.

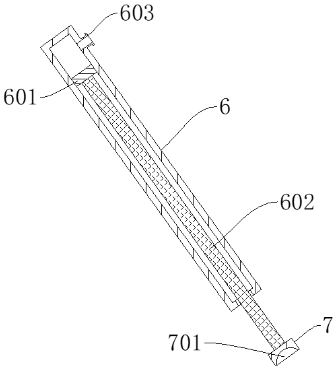

Figure 4. Structure Diagram of the Telescopic Traction Mechanism Two

Of which 6, sealing pipe; 601, piston; 602, elastomer; 603, connecting port; 7, Magnet block; 701, sink.

The telescopic hitch two is constructed as shown in Figure 4 and consists mainly of sealing pipes and magnet blocks, where the piston is slipped in the sealing tube, where one side of the piston is secured with a spring piece through the sealing tube, and the end of the spring piece is equipped with an adsorption groove and magnet block. The sealing pipe sidewall has a connection port to the pneumatic unit.

The output end of the hydraulic drive assembly or the telescopic end of the pneumatic drive assembly is attached to the connection port. The piston slides in the seal tube via the output of the hydraulic drive assembly or the pneumatic drive assembly to push the elastomer out of the seal tube, which can flex according to the cross-through hole bend, making it ideal for cross-through hole channels where multiple curved holes exist. Interference occurs between the cross-through inner wall of the orifice and the telescopic end of the telescopic traction assembly, causing the telescopic end to not reach into the cross-through hole to contact the counterweight sphere to adsorb.

To facilitate the mating of the magnet block suction surface with the counterweight sphere, the ball articulation between the magnet block and the telescopic end of the telescopic traction mechanism allows the magnet block to rotate at an angle to form a fit with the counterweight sphere. In addition, the magnet block, located on the side away from the telescopic end of the telescopic rod, has an adsorption tank that mates with the spherical surface of the counterweight ball, which allows the magnet block to increase contact area with the counterweight sphere, increases the absorbability of the magnet block to the counterweight sphere, and prevents the counterweight sphere from falling off during the sliding process.

The elastomer is a rubber rod that adapts to the cross-through hole bend and supports the magnet block with a mating clearance between the seal tube and the rubber rod to reduce friction interference between the seal tube and the rubber rod.

3. Quality inspection unit comparison and advantages

In order to compare the advantages of the new quality inspection device, different methods of cross-hole quality inspection were examined, inspection time, inspection complexity, inspection error, The results of the five-aspect comparison, such as testing costs, are shown in Table 1.

Table 1. Comparison of Different Inspection Methods

Inspection methods	How to check	Inspection time	Verify complexity	Check for errors	Inspection costs
Visual inspection	Manual	Short	Easy	Large	Small
Oil pressure flow test	Workpiece	Long	Complex	Small	Large
Counterweight sphere inspection	Workpiece	Short	Easy	Small	Small

Table 1 shows that the accuracy of the workpiece inspection is higher than that of the manual inspection and that the error of the inspection is less than that of the visual inspection method; the inspection time of the ballast sphere inspection method is much smaller than that of the oil pressure flow test method. The inspection process is also relatively easy, so the inspection cost is less. By contrast, the new quality inspection device with the ballasted sphere as the main body has greatly shortened the time for cross-hole quality inspection, improved the accuracy of the inspection and the productivity of the enterprise, and significantly reduced the inspection cost.

4. Conclusion

(1) In response to the technical problems of the current two methods of cross-through hole quality, design a new quality inspection device with the counterweight sphere as its core, and complete the quality inspection of cross-through

holes through the interaction of the telescopic traction mechanism and the traction.

(2) In order to accommodate the different working environments of inspection devices, two different types of telescopic traction mechanism have been designed, which are convenient, efficient, and durable. Increased efficiency of cross-hole inspection;

(3) Comparing the advantages and disadvantages of different inspection methods with five aspects, such as inspection method, inspection time, inspection complexity, inspection error, inspection cost, etc. A new quality inspection device with the ballasted sphere as the main body can greatly reduce the time required for cross-hole quality inspection and increase the productivity of the enterprise.

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