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Design and Experimental Analysis of a New Flexible Honing Tool

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Abstract: A new type of flexible honing tool is studied in this paper. Its technical parameters and application points are discussed. The tool can remove flash and burr on the inner hole surface of mechanical parts. It has the characteristics of convenient operation, reliable processing and economy. It is especially suitable for automatic line use.

1. Introduction

For mechanical parts, especially cast iron parts, flash and burr will appear in the inner hole of the workpiece when the inner hole is drilled, tapped or sunk radially after finishing. The height of burr is generally 0.05-0.35mm, which will bring two deficiencies to the assembly process: first, scratch the rotating shaft matched with the hole during assembly to reduce the accuracy level; Second, due to large flash and burr, it cannot be installed into the rotating shaft. Therefore, flash and burr must be removed. However, this generally increases the costs of special equipment, materials, energy consumption and man hours for deburring. The author puts forward a simple, reliable and economical flexible honing tool processing method to clean the flash and burr of inner hole without reducing the original machining accuracy and surface quality.

2. Introduction to Honing

Honing or honing, its processing method is: the main shaft of the machine tool drives the honing tool (honing head) to rotate and move up and down in a straight line. Under a certain outward expansion pressure, the oilstone (grinding strip) on the honing head will remove the wear debris on the workpiece surface and grind out the spiral cross reticulated grinding marks. It is mainly used for the processing of precision holes, such as engine cylinder hole Compressor cylinder hole, connecting rod, pump body and control block, etc[1].

3. Honing Principle and Characteristics

3.1 The Principle That Honing Can Finish Machining

The honing oilstone and workpiece are regarded as two mutually grinded surfaces. In order to achieve high machining quality, the motion trajectory of each abrasive particle on the oilstone on the hole wall should not be repeated in the relative reciprocating motion. During processing, the oilstone and the workpiece can reliably grind off the small machining allowance of the workpiece

(generally 0.01 ~ 0.08mm, which shall be determined according to different processing materials, processing batches and processing requirements) at a low cutting speed and pressure. Honing can significantly improve the dimensional accuracy of workpiece (small hole up to 1 ~ 2) μ m. Medium hole up to 10 μ m[2]. They are even smaller) and shape accuracy (small hole roundness up to 0.5 μ m. Cylindricity up to 1 μ m. Medium hole roundness up to 3 μ M or less; when the hole length is 300 ~ 500mm, the cylindricity reaches 5 μ Below m, the dispersion range of machining error is small, only 1 ~ 3 μ m. The machined surface has high quality, and its surface roughness Ra is only about 0.4 ~ 0.04 μ m. Even smaller), generally, because the average pressure P of the oilstone on the workpiece is small (about 0.4 ~ 0.8MPa), the calorific value is small, and there are few metamorphic layers on the machined surface. Because the honing head is in surface contact with the workpiece and there are many abrasive particles involved in cutting, it is also an efficient machining method.

3.2 Characteristics of Honing

In addition to the high roundness, cylindricity and surface quality of machining accuracy and shape accuracy, the cross lines on the workpiece surface are conducive to the formation and maintenance of oil film. Therefore, the service life of the workpiece processed is often more than twice that of the workpiece processed by other processing methods, which is especially suitable for the processing of precision coupling parts with high relative motion requirements. The honing range can be wider. In addition to through holes, discontinuous holes, blind holes, multi-step holes, residual cycloid holes, planes, spherical surfaces and tooth surfaces can be processed, which can adapt to the processing of many kinds of metal materials.

4. Tool Structure and Application

The flexible honing tool uses the iron wire 1 as the rotating shaft. Several nylon wires 2 with a diameter of 0.5-1.5mm are placed side by side between two iron wires with a diameter of 2-2.5mm, and then the two iron wires are screwed together to form the matrix of the flexible honing tool. According to the shape of the inner hole of the machined parts, The outer end of nylon wire is processed into a shape suitable for the processed inner hole (such as cylinder, cone, cone, etc.). The abrasive is then bonded to the outer end of the nylon wire. When in use, the flexible honing tool can be clamped on the bench drill, lathe, milling machine or electric hand drill with appropriate stroke for processing[3]. When the spindle of the machine tool is not concentric with the inner hole of the workpiece, the honing tool can automatically adjust the rotation center depending on the flexibility of the rotating shaft, so as to make the inner hole size change evenly after grinding.

The part material is HT20 ~ 40, the flexible honing tool used is cylindrical, the overall dimension is 29ram, the diameter of the machined inner hole is 25mm, the diameter of nylon wire is 0.6mm, and the abrasive is 180. Green silicon carbide, the diameter of abrasive sphere is 3mm; Ordinary drilling machine is adopted. The rotating speed is 1400 rpm; The honing brush goes back and forth in and out of the hole once. The grinding time is l0-15s without coolant; T-piece inner hole detection measuring tool: 25d4 plug gauge. 960 holes can be machined with the above conditional honing tools, and all of them are qualified through plug gauge inspection. The test results show that the average expansion of the inner hole is o.0075mm. It can be seen that it has little impact on the dimensional accuracy of the hole. After machining, the roughness Ra value of the hole is significantly reduced. At the same time, a small fillet is poured out at the end face of the orifice. The average fillet radius is r0.10-0.20mm, which brings convenience to assembly.

5. Process Parameters

The outer contour dimension of the flexible honing tool is larger than the inner contour dimension of the machined hole. The difference ad between these two dimensions is generally between 5-10 ram. The size difference (ZM) depends on the diameter of nylon wire, the abrasive particle size of abrasive ball and the roughness of machined hole. When nylon wire with larger diameter is selected, a smaller size difference ad can be used. At this time, due to the increased elasticity of nylon wire, the abrasive ball still has the required grinding force on the machined inner hole; When the abrasive with smaller particle size is selected, the smaller size difference ad can be selected[4]. At this time, the effective grinding effect can still be guaranteed. The choice of abrasive particle size also depends on the original roughness of the machined hole and the required surface quality of the inner hole. When the inner hole roughness Ra is required to be low, the abrasive particle with larger particle size number shall be selected. The enlargement of hole diameter depends on abrasive particle size, grinding speed and grinding time. Without changing the grinding time: when higher grinding speed is selected, finer abrasive particle size can be selected. At this time, the roughness Ra value of hole surface can also be reduced. Without changing the abrasive particle size: when higher grinding speed is selected, shorter grinding time can be selected.

The grinding time shall be determined according to the machining conditions. In the initial stage of using flexible honing tools, the grinding time shall be short. At this time, the nylon wire has good resilience, that is, the tool has sufficient grinding force. With the increase of the number of machining holes, the resilience of nylon wire gradually decreases. Therefore, the machining time shall be extended appropriately[5].

6. Improvement of Tools

Through the test, it is found that during the processing process, the nylon wire is gradually tired after bending for several times until it loses its due elasticity. Because it can not be reused after agglomeration of abrasive particles again, the whole tool is scrapped, which affects the popularization and use of the tool to a certain extent. The improved rubber flexible honing tool has more reliable and economic processing characteristics, and its service life is more than ten times longer than that of nylon honing tool[6]. The rubber flexible honing tool uses rubber to replace nylon wire, that is, vulcanize the rubber matrix on the rotating shaft, extend the rubber rod L, and the outer end of the rubber rod is bonded with an abrasive ball 2 with a certain diameter. The main technical parameters of the rubber flexible honing tool are as follows: when the inner hole diameter of the machined part is 40mm, the section diameter of the rubber rod can be 4.5 Mn, the length of the rubber rod is l0mm, and the diameter of the abrasive ball is l0mm[7]. The application and technical parameters of rubber flexible honing tool are basically the same as those of nylon flexible honing tool.

7. Comparison of Nylon and Rubber Tools

The comparison and main differences between nylon honing tools and rubber honing tools are as follows: (1) after machining nearly 500 600 holes, the grinding force decreases with the gradual loss of nylon wire elasticity. At this time, if the grinding speed is not increased, the grinding time must be increased, which affects the production efficiency. Because rubber has superior resilience and deflection resistance than nylon, that is, its elasticity will not be reduced in a limited number of bending times, so the rubber honing tool can always maintain a uniform processing time without adjusting process parameters. Therefore, it is more suitable for use on the automatic line. (2) The service life of nylon flexible honing tool is to process nearly 1000 holes. The rubber flexible honing

tool can process nearly 9000 holes by bonding the abrasive ball at one time, and when the abrasive ball is worn, it can be re bonded after degumming, so it has high durability and service life. (3) Using rubber flexible honing tool can further reduce the hole processing cost than nylon tool, and its processing cost is only one tenth of that of the original nylon flexible honing tool[8].

8. Conclusion

From the above analysis and comparison, it can be seen that the rubber flexible honing tool is more reliable and economical than the nylon flexible honing tool. It can effectively remove the flash and burr of the inner hole, reduce the roughness r value of the hole surface at the same time, that is, improve the surface finish of the hole, and pour out the fillet at the sharp edge of the hole end surface or sink groove in the hole, It brings convenience to assembly, especially in automatic line, and can obtain high technical and economic benefits.

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