

# Research on a new type boring process based on horizontal lathe

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## Abstract

Based on the widely used ordinary horizontal lathes, the paper researched and developed a new type boring device to solve the problem of enhancing boring precision and improving boring process without other special machine tools. The paper explained the design scheme and the detailed process, researched the boring process of real parts. Finally, we can provide a hole processing scheme of low cost, high utilization rate of equipment for small and medium enterprises.

## Keywords

Horizontal lathes; new type; boring processing; research.

## 1. Introduction

In the machining and manufacturing of mechanical parts, hole processing is very common. For the general requirements of parts hole processing, drilling, reaming and other processes can be used to achieve, from the cost point of view, it is often suitable to arrange in the ordinary machining equipment, such as ordinary lathe, drilling machine and so on. If the accuracy is required to be higher, the boring machine or special machine tool is often used for hole processing, and the cost will rise accordingly. Based on the optimization of equipment selection and processing, we study how to improve the accuracy of hole machining and expand the processing range on the ordinary horizontal lathe, so as to improve the manufacturing efficiency, reduce the single function of enterprise processing equipment, and highlight the complexity.

## 2. Problems and analysis

Process the holes at both ends of the seat part as shown in Figure 1.

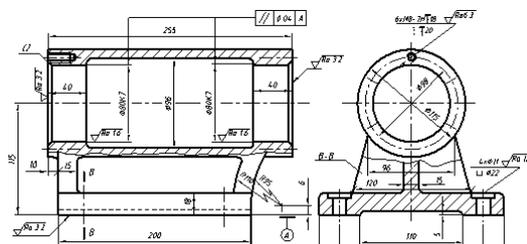


Fig.1 Part drawing of seat body

As shown in the figure, the diameter of the two holes is not very large, but there is a certain span in the position. If the ordinary boring process is used on the ordinary horizontal lathe to meet the requirements of parts, it is difficult to achieve. The first is the clamping problem; the second is the very high requirements for the cutter bar, mainly because the length diameter ratio of the whole cutter bar is large, and it is very difficult to ensure the stiffness, which affects the size and shape accuracy of the hole. If it is processed on the boring machine, the situation will be improved obviously, and the processing process and accuracy can be guaranteed. However, for enterprises, especially in the case of single piece or small batch processing, the

input of special equipment is increased, the equipment configuration is discrete and the operation and maintenance costs are increased.

### 3. Proposal of a new type boring processing scheme

Based on the above problems, this paper studies the defects existing in the boring process of the ordinary horizontal lathe. From the perspective of improving and integrating the functions of the ordinary machining equipment, we propose to develop a new boring equipment and process method based on the ordinary horizontal lathe, focusing on the realization of the more optimized and expanded boring processing functions in the horizontal lathe.

#### 3.1. Research on a new boring equipment scheme

Based on the basic structure and function of the horizontal lathe, a new scheme to change the processing characteristics of the existing lathe is put forward. The boring tool bar is set on the ordinary horizontal lathe. One end of the boring tool bar is clamped in the three jaw chuck of the lathe, and the other end is inserted into a specially designed movable support seat. The relative rotation of the boring cutter bar in the movable support seat is not limited, analyzed. The boring tool is installed in the middle part of the boring cutter bar, so that the spindle rotation drives the cutter bar to rotate, so as to realize the turning function of the cutter; the original horizontal lathe tool clamping device is innovatively designed as the workpiece clamping device, the workpiece clamping device is installed on the slide box of the lathe and can realize feed movement in the length direction parallel to the boring cutter bar. For the workpiece that needs to finish boring, the bottom hole should be processed first, and then it should be connected to the boring cutter bar through the bottom hole and installed and fixed in the workpiece clamping device. In this new type of boring machine, the boring cutter and boring blade can be flexibly installed and replaced, so that the boring blade can be adjusted and changed along the radial direction of the cutter bar according to the needs; at the same time, the tailstock of the horizontal lathe itself can be adjusted, which is convenient to be fixed tightly with the movable support seat in the equipment at any time.

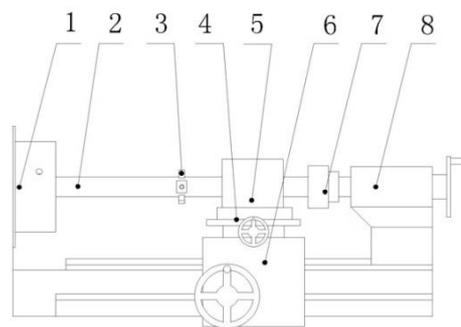
The new boring equipment with the above scheme has been used for many times through boring and cutting with different hole diameter and hole depth. We find that the scheme can change the main function of the lathe without changing the main structure of the lathe, and complete the processing of the holes which are difficult to be completed on the lathe. The function of the ordinary horizontal lathe is optimized, the utilization rate of the equipment is greatly improved, the equipment investment is reduced, the processing cost is saved, and the enterprise benefit is improved.

#### 3.2. Processing of a new boring machine

According to the research scheme of the new boring machine mentioned above, the structure of the new boring machine based on horizontal lathe is shown in Figure 2.

As shown in Figure 2, the basic structure of the new boring equipment is the ordinary horizontal lathe. According to the needs of boring, a boring cutter bar with a diameter smaller than the diameter to be processed is set in the lathe. One end of the boring tool bar is clamped in the three jaw chuck of the lathe, and the other end is inserted into a specially designed and manufactured movable support seat. The relative rotation of the boring cutter bar in the movable support seat is not limited. However, the runout in the radial direction is constrained by the movable support seat, which determines that the boring cutter bar can rotate accurately around its own axis to ensure the rigidity of the tool bar and improve the machining stability, and the movable support seat is firmly supported and fixed in the tailstock of the lathe. During machining, the boring tool is installed in the middle of the boring tool bar. The tool bar drives the boring tool to rotate with the spindle, and the workpiece to be bored is installed in the

workpiece clamping device. The clamping device is changed from the tool clamping device of the original lathe, and the main body motion changes from the original workpiece rotation to the tool rotation. The workpiece clamping device is installed on the slide box of the lathe and feeds freely in the direction parallel to the axis of the boring cutter bar; the workpiece to be bored is connected to the boring cutter bar through the pre processed bottom hole and installed on the workpiece clamping device. The boring blade installed on the boring cutter can be flexibly adjusted in radial direction to meet the different requirements of machining hole diameter. In addition, the movable support seat, to a large extent, becomes the balance limiting part of the boring cutter bar. It can be pressed by the lathe tailstock at its right end, or it can be directly fixed on the lathe tailstock in the form of integration.



1 chuck 2 boring tool bar 3 boring cutter 4 workpiece clamping device  
5 workpiece 6 slide box 7 movable support seat 8 tailstock

Fig.2 Structure diagram of a new boring machine based on horizontal lathe

Further analysis on the working principle shows that in the new boring equipment based on horizontal lathe shown in Fig. 2, the cutter bar is clamped on the lathe through a three jaw chuck, at this time, one end of the cutter bar is fixed and one end is free, which is in cantilever support state. If the lathe is started in this way, the circular runout of boring cutter bar with large length diameter ratio will be more prominent, and the accuracy of size and shape cannot be guaranteed. Based on this problem, the design of the movable support seat is very necessary. The boring cutter bar can rotate freely in the movable support seat, and the radial position of the end of the boring tool bar is limited by the movable support seat, so the possibility of jumping during working is eliminated. The right end of the movable support seat is jacked and fixed with the lathe tailstock, so that the boring cutter bar can be reliably fixed on the lathe. When designing the boring tool, we consider to install it directly on the cutter bar. The boring blade installed on the boring tool can be adjusted along the radial direction of the boring tool bar. The diameter of the boring hole can be changed according to the needs. During processing, it is adjusted to the appropriate extension length and fixed by the set screw. The workpiece to be bored is fixed on the workpiece clamping device through thread connection or fastener, and the workpiece clamping device itself is fixed on the slide box of the lathe, so that the workpiece to be bored can realize feed movement with the slide box. When boring, the workpiece is clamped reliably at the required processing height in advance. The lathe is started and the boring cutter rotates with the cutter bar at a high speed due to the rotation of the main shaft. The position of the slide plate is adjusted to make the workpiece reach the accurate machining point. The slide box of the lathe is manually controlled to feed to the left or right on the guide rail until the boring process is completed. The axial positioning of boring tool on the boring tool bar should be appropriate and fixed at the required position. Generally, it should be selected in the middle part of the boring tool bar. It should be noted that the boring tool can pass through the workpiece normally, and there is no interference between the slide box of the lathe and the boring tool to ensure that the whole boring operation can be completed.

## 4. Application of new boring process

The research results based on the new boring process of the common horizontal lathe are applied to process the two end holes of the seat parts shown in Fig. 1. First of all, the boring tool bar uses the movable support seat to realize the fixation of both ends, which effectively improves the rigidity and stability and ensures the machining accuracy; secondly, the new boring method adopts the tool rotation, and the workpiece is relatively fixed, so the clamping is easy to realize. It is also shown that there are requirements for the size and shape and position tolerance accuracy of the seat body parts. The processing process arrangement should include complete rough boring, semi precision boring and fine boring. Using new boring equipment, the processing can be completed only by clamping once and changing or adjusting different boring tools (pieces). The method is simple and easy to operate, the processing efficiency is improved, the error link is reduced, the accuracy is improved, and the processing quality and cost control can be well guaranteed.

## 5. Conclusion

In this paper, the research of a new boring process based on ordinary horizontal lathe is discussed. Starting from the development of new boring processing equipment, the main motion mode of lathe is changed under the premise of keeping the basic structure of lathe unchanged. The problems of improving the boring accuracy, improving the boring processing technology and expanding the processing field without the aid of other special machine tools are solved. The application of the actual parts shows that the research has realized the boring of the workpiece with large hole depth and long span, reduces the investment of special equipment, improves the processing efficiency and precision, and the equipment structure is simple, easy to be realized on the lathe, and has strong popularization. At the same time, the research itself has made a bold attempt on how to expand the functions of ordinary machine tools, and provided ideas and reference direction for small and medium-sized enterprises in terms of equipment configuration and improvement and optimization of general equipment.

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