

Design of special fixture for dividing head

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Abstract

In the general machinery factory, the machine is responsible for the processing of the workload of 40% to 60%, the technical performance of the machine can directly affect the processing of the final quality of mechanical products and related economic benefits, thus affecting the level of national economic development. The graduation design of the content for the fine boring head of the box on the diameter of 80mm and 90mm holes were combined machine, requiring a surface roughness of 0.2. Dividing the head of the box fixture for the special fixture, through the fixture positioning and clamping, must be limited to six degrees of freedom, so that it can meet the processing requirements. Another design of the clamping program can also improve the processing efficiency, simplify the clamping steps, reduce the labor intensity of workers, improve efficiency.

Keywords

Combination machine, Combination boring machine configuration, Fixture.

1. Introduction

Tools are the hallmark of the progress of human civilization, since the late 20th century, modern manufacturing technology and machinery manufacturing process automation has developed by leaps and bounds. But the tools (including fixtures, knives, measuring tools and accessories, etc.) in constant innovation, its function is still very significant. Machine tool fixtures have a direct impact on the quality of parts processing, productivity and product costs. Therefore, both in traditional manufacturing and modern manufacturing systems, fixtures are important process equipment.

The role of machine fixture, (1) to ensure the accuracy of processing with the machine fixture clamping parts, can accurately determine the workpiece and the tool, the relative position between the machine, can guarantee the processing accuracy. (2) to improve production efficiency Machine tool fixture can quickly locate and clamp the workpiece, can reduce the auxiliary time, improve production efficiency. (3) to reduce the labor intensity Machine tool fixture using mechanical, pneumatic, hydraulic clamping device, can reduce the labor intensity of workers. (4) to expand the scope of the machine tool machine tool fixture can expand the scope of processing, for example, in the lathe or drilling machine using boring die can replace the boring machine boring, the lathe, drilling machine with boring machine function.

2. Fixture concrete structure design

2.1 Workpiece analysis

Process requirements boring $\phi 90H7$, $\phi 80H7$ coaxial hole system, the two groups coaxial coaxial degree of not more than 0.002, surface roughness value of 6.3 μ m. Two cylindrical degree and roundness are not greater than 0.002, $\phi 80$, $\phi 90$ two holes on the bottom of the vertical degree of not more than 0.003.

As shown in Figure 1, the first step can be used as the positioning standard for the process, that is, the yangwei tail for the positioning of the base to support the surface, the design of a one-time processing of the workpiece, the top of the clamping.

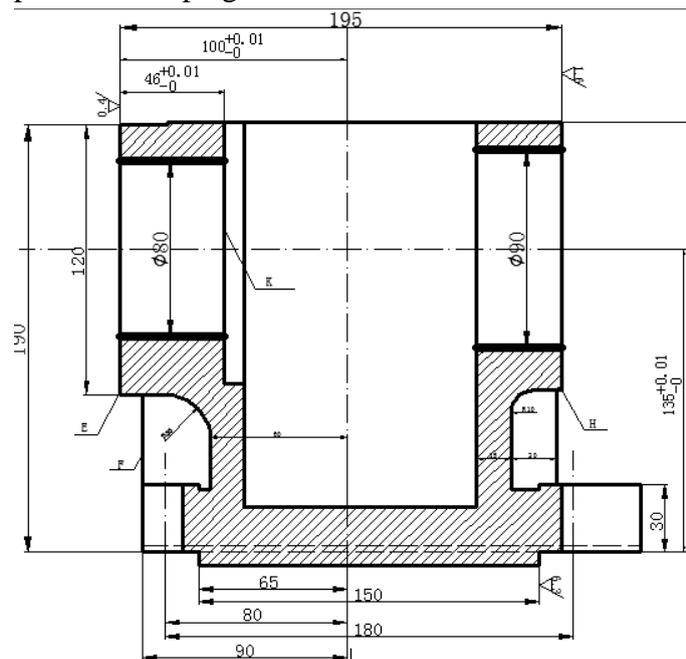


Fig. 1 The box boring process diagram

2.2 The design of the positioning scheme of the workpiece

According to the structure of the box, process size, shape and position accuracy requirements, the workpiece positioning to be limited to six degrees of freedom. The positioning and clamping position of the workpiece has been specified in the process diagram, but in the formulation of positioning, clamping program, it should still be analyzed and studied, to determine the positioning of the benchmark is to meet the requirements of the workpiece position accuracy, fixture structure Can be achieved. And finally determine the fixture positioning in accordance with the bottom of the Yangwei tail.

2.3 The design of the clamping program for the workpiece

The basic requirements of the clamping device, mechanical processing, in order to maintain the correct positioning of the workpiece to determine the location, to prevent the workpiece in the cutting force, inertia force, centrifugal force and gravity under the action of displacement and vibration, machine fixture should be set Tighten the device, the workpiece clamped firmly. Whether the clamping device is reasonable, reliable and safe, has a significant impact on the accuracy of the workpiece, the productivity and the working conditions of the workers.

Comprehensive analysis, using the following clamping program.

The clamping device is an important and non-missing component of the clamping of the fixture, unless the various forces received by the workpiece during the machining process do not leave it in the desired position Clamping device. The advantages and disadvantages of the clamping device design, to

improve the accuracy of clamping and processing efficiency, reduce labor intensity has a great impact. The basic functional requirements of the various types of fixtures can be summarized into two categories: the first is the performance requirements, the main designation uniqueness, positioning stability, clamping stability and overall constraints; the second type of requirements is fixture Structural rigidity, cost and ease of operation, easy maintenance and other requirements.

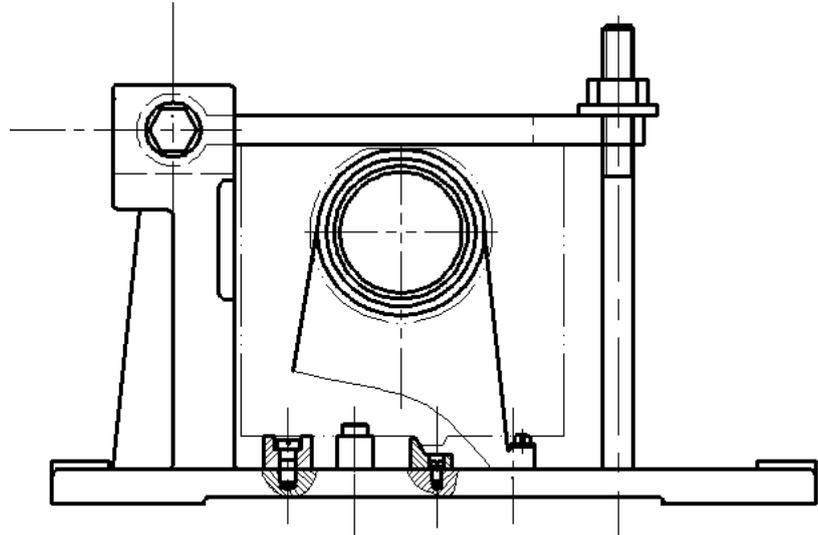


Fig. 1 The Clamping program

3. The relevant calculation and precision check of fixture

There are two types of fixture installation on the machine, one is installed in the machine table (such as milling machine, boring machine, drilling, etc.); the other is installed in the machine tool on the spindle (such as lathes, grinding machines, etc.) The fixture is mounted on the machine table and clamped with the T-slot of the machine table by screws.

Boring machine fixture and the connection part of the table called the ear base, because the connection should be firmly stable, so the fixture on both sides of the surface of the ear to be flat, The stability of the installation on the machine, in addition to the requirements of the clip with sufficient strength and stiffness, but also to be processed surface as close as possible to the table to reduce the center of gravity of the fixture. Therefore, the aspect ratio of the clamp body is limited to 1-1.25.

The clip is a base piece that connects the various devices and components on the fixture into a unitary body. It is usually the largest and most complex part of the fixture. Design folder should be noted that the following points:

- (1) Should have good processing accuracy and dimensional stability

An important plane on the clamp body, such as the surface on which the positioning element is mounted, the surface of the mounting tool or positioning element, and the mounting base (the surface to which the machine is connected) of the clamp body, etc., should have a high size, shape and mutual position Accuracy, and its accuracy to maintain good stability. To this end, the clamp body rough should be in response to the aging or annealing treatment, if necessary, after roughing, should also be the second aging treatment.

- (2) Should have sufficient strength and stiffness

During the processing, the clamping body to bear a greater cutting force and clamping force, for the package by the folder does not produce an unacceptable deformation and vibration, clip body should have sufficient strength and stiffness. So the need to choose the right material, the appropriate wall thickness. Welding and casting clamps are often provided with stiffeners. In the case of not affecting the workpiece loading and unloading, the use of box-shaped structure of the clamping body has a high strength and stiffness.

(3) Have a good manufacturing process and usability

In accordance with the characteristics of a single production process, the structure of the clip should be simple, easy manufacturing process.

For clip-on bodies that produce large amounts of chips during processing, the chip removal structure should be considered on the clamp body, and sufficient chip space should be considered in the fixture structure in order to remove a small amount of chips falling on the positioning element, reliable.

When the weight of the fixture is large, it should be provided on the clamp body for lifting devices (such as ring screws, etc.).

(4) Should ensure that the fixture installed on the machine is stable and reliable

The installation of the fixture on the machine tool is generally achieved by the contact or cooperation of the mounting surface on the clamp body with the corresponding surface on the machine tool. When using the machine table installation fixture, the fixture center of gravity should be as low as possible, the higher the center of gravity is the greater the bearing surface. The middle of the bottom of the clip body should generally be hollowed out, surrounded by contact with the machine table to ensure stable and reliable installation, in order to find the fixture in the machine on the side of the folder often set a narrow gauge

When calculating the clamping force, it is usually regarded as a rigid system for the clamp and the workpiece. According to the working force of the workpiece, the clamping force (large workpiece should consider the workpiece gravity, inertial force) of the role of the situation, to find the most detrimental state of the clamping, according to static balance principle to calculate the theoretical clamping force, Multiplied by the safety factor as the actual clamping force. which is:

$$F_K = FK$$

The actual required clamping force (N), F theoretical clamping force (N), K safety factor, in the finishing, K take 1.5.

In the plane positioning, the theoretical clamping force is calculated as:

$$F = \frac{(P - P_0)}{\mu}$$

Where P is the cutting force of the machine tool, P₀ is the part of the cutting force of the cylindrical pin, and μ is the friction between the workpiece and the limit base. From Table 1, we make μ to 0.15.

Table 1. Selection of friction coefficient

Numble	Friction conditions	Scheme 2
1	Processed plane	0.15
2	Spherical	0.2-0.25
3	Mirror	0.7

4. Conclusion

Modern production in order to have good economic benefits, we must improve labor productivity and affect the productivity of many factors, metal processing is an important factor in the fixture on the fixture. Fixture design based on the principle is simple, practical, fast and reliable. Here the "fast" refers to the quick clamping. According to the type of workpiece, structural characteristics of different, can be used in different forms. Reasonable clamping form can not only achieve fast and efficient purpose and can reduce the labor intensity of workers, the general fixture designed to become a product, the formation of a clamping mode.

References

- [1] H. Wang, W.C. Jiao, Z.Y. Zhao, H.B. Li and J.J. Zhou Shen Yang University of Technology, Liaoyang Campus, Liaoyang, China School of Mechanical Engineering, Dalian University of Technology, Dalian, China College of Mechanical Engineering and Automation, Huaqiao University, Quanzhou, China Shen Yang No.1 Machine Tool Works of Shen Yang Machine Tool Co., Ltd, Shen Yang, China. The Finishing of Rolling Bearing Raceway by Electrochemical Mechanical Finishing (ECMF) Technology [A].Current Development in Abrasive Technology---Proceedings of the 9th International Symposium on Advances in Abrasive Technology [C].2006:6.
- [2] Zhan WANG. The I-beam steel temperature field analysis in cooling control process after hot rolling[A]. Proceedings of 2016 5th International Conference on Environment, Materials, Chemistry and Power Electronics(EMCPE 2016)[C].2016:6.
- [3] Feng Pengfei. Study on the Reliability Evaluation Method of Equipment based on the Cloud-Logistic model[A]. Proceedings of 2016 13th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI)[C],2016:4.
- [4] Min ZHAO. The Parameters Optimization of Laser Sculpture of Barcode Tape[A]. Science and Engineering Research Center.Proceedings of 2016 International Conference on Applied Mechanics,Electronics and Mechatronics Engineering (AMEME 2016) [C].Science and Engineering Research Center.,2016:5.
- [5] YANG Cheng. Dynamic and Static Characteristics Analysis and Research for Key Components of The NC Lathe CK61125[A]. Materials Science Forum.Proceedings of 2016 International Symposium on Advances in Materials Science (IAMS 2016)[C]. Materials Science Forum, 2016:7.