

NEW FIXTURE FOR ELECTROMAGNETIC VALVE AND STEERING MECHANISM DESIGN

Rongqiang DONG

Chongqing Jiaotong University, Chongqing, 400074, CHINA

Abstract: Electromagnetic valve is used to control the direction of flow automation components. Because of its irregular with more holes, using traditional fixture on the ordinary lathe or CNC lathe processing, production efficiency is low and difficult to ensure machining quality. Through the analysis of the structure characteristics of the parts and machining requirements, it has designed a set of more reasonable fixture, which is an economical and practical equipment for improving the production efficiency and processing precision. Finally the new fixture could has a certain amount of practical value.

Keywords: Fixture; Electromagnetic Valve; NC Machining

1. Introduction

With the progress of science and technology, and the development of production, all kinds of perforated mechanical products emerge in endlessly, have various shapes, among them, the solenoid valve is a kind of typical Hole Parts. In the process of Hole Parts manufacturing, productivity and processing quality are core issues of concern[1]. In the production and processing of the solenoid valve, the hole is more on its six surface, and the shape is irregular, if using traditional fixture on general CNC lathe machining, there are some problems, for example, a low efficiency, identity of Hole depth is poor, workers need high technical level, it is difficult to ensure machining quality. In order to solve these problems, we design a relatively reasonable and feasible special fixture which made process the perforated parts such as solenoid valve on the CNC machine tools can process smoothly, to ensure the quality of machining at the same time, to some extent, it can improve production efficiency.

2. Structure Characteristics and Processing Technology of Solenoid Valve Parts

2.1. The Structure of Solenoid Valve

Solenoid valve is automated basic element which is used to control the direction of fluid, belongs to the actuator, is used for mechanical control and Industrial valves normally, to control the direction of the medium, so as to achieve control of the valve switch. Today, in modern industrial processes, Solenoid valve play an irreplaceable role which is in improving the degree of equipment automation, so if we produce the Solenoid valve that conforms to the technical requirements efficiently and Low

cost, It will greatly promote the development of productivity.

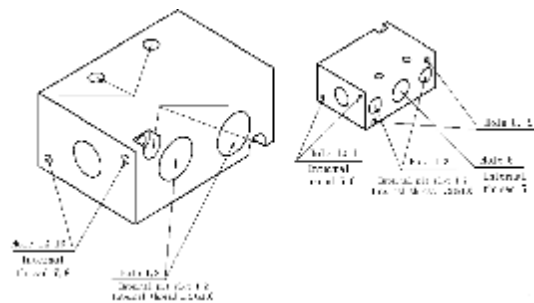


Figure 1. Electromagnetic valve body

As shown in Figure 1, the electromagnetic valve for processing parts as follows:

- (1) on the surface before and after 3 x $f11.9$ hole and tapping screw thread M14 bore hole (3, 4, 5);
- (2) the front 3 x $f8.5$ hole and tapping screw thread M10 bore (1, 2);
- (3) on the surface before and after 3 x $f11.9$ hole width is 2 tank (tank 3, 4, 5);
- (4) the front 3 x $f18.5$ hole width 1.5 tank (tank 1, 2);
- (5) 3 x $f3.2$ in front of the hole (hole 8, 9 hole);
- (6) behind the steps of the 3 x $f6$ slots (step 1 and step 2);
- (7) the top 3 x $f4.2$ hole bore (6, 7);
- (8) lateral 3 x $f2.5$ hole and tapping screw M3 bore hole (10, 11, 12, 13) hole.

2.2. Processing Technology Design

Using a dedicated vertical combination machine tools[2, 3], Blank can complete the above step 8 work content after a process[4]. The machine has a turntable of 15 Split stations, were installed on both sides of the turntable is drilling, tapping machine. Among them, after drilling machine is modified, used with a hydraulic lifting device to complete the processing of Solenoid valve on the tank. Fixture used in this paper, a new type of special fixture design, Can achieve rapid positioning and clamping of the work piece, and can index automatically, complete the side 4 x f 2.5 holes, processing of screw thread M3. In addition, that can completed the loading and unloading of work, greatly shorten the production cycle, improve production efficiency, while reducing the labor intensity by incorporating robots and transport equipment..

3. Fixture Design

Machine tool fixture is the technological equipment which is used for clamping work piece, when processing parts on machine tool, its role is to correct the relative position between work piece and cutlery, and clamp work piece firmly. Fixture is generally composed by positioning device, clamping devices, knife guiding device, as well as other elements.

In order to improve the production efficiency, the fixture should use cylinder to driven and clamping, in addition, to process holes and threads easily in the side of electromagnetic valve, need to add slewing mechanism, thus, the work piece can turn 90° Angle. Generally speaking, the fixture should meet the following requirements: ensuring clamping safely, reliably, that is to say, the clamping force is big enough, and it is easy to position; ensuring the accuracy of the parts size and the shape and position of parts; shorting the auxiliary time of demolition, installation, finding the right piece; it can revolve indexing automatically; maintaining and replacing damaged parts are convenient.

Considering that the fixtures meet the above requirements, we designed the special fixture of the electromagnetic valve as shown in Figure 2.

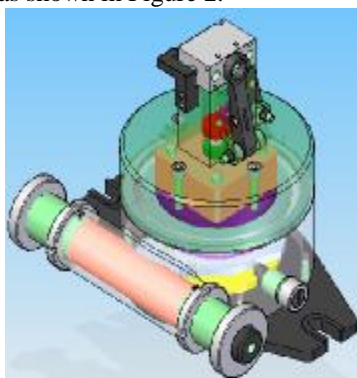


Figure 2. Jig 3D assembly drawing

4. Working Principle and Steering Mechanism of the Fixture

4.1. Clamping Principle

The fixture which used a single-acting hydraulic cylinder driven that two plate clamp the work piece at the same time by hydraulic cylinder, so that we can achieve the purpose of rapid clamping, positioning is accurate and reliable. The clamping mechanism mounted on the bottom of the work piece, It can vacate the left and right, front and back, and the top space, thus the power head does not interfere with the fixture in the process of processing. The entire fixture can realize the functions of turning 90° angle by the steering mechanism at the bottom.

3.2. Determination of the Clamping Force

in the process of clamping, the working stroke of hydraulic cylinder is 10 mm, maximum working pressure is 8Mpa, according to the transfer mechanism of clamp platen[6], clamp force model is simplified as shown in figure 13.

(1) The hydraulic cylinder force Q is:

$$Q = P A = P(pR^2 - pr^2) \quad (1)$$

In the above formula: P is the maximum working pressure of the hydraulic cylinder, A is the effective active area of the cylinder, R is the piston radius, r is the radius of the piston rod.

(2) Blank suffered by clamping force W is:

$$W = \frac{QhL_1}{2L_2 \cos 58^\circ} \quad (2)$$

In the above formula: L₁ is the vertical distance from the fulcrum to the point of action W, L₂ is the vertical distance from the fulcrum to the force action points of the Hydraulic cylinder Rally Q in the direction of rod, η is the efficiency of the hydraulic cylinder.

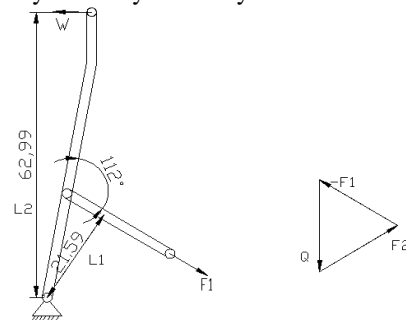


Figure 3. Force diagram

4.3. Steering Mechanism Design

Steering mechanism is mainly composed of Rack and pinion hydraulic cylinders, Cam with the gear, the lock pin, Indexing plate, stopper device and other components.

When it is working, Rack and pinion hydraulic cylinders drives Cam with the gear rotating, at first, Indexing plate cannot rotate freely because of the effect for the lock pin. After Cam with the gear rotated 35°, the lock pin is driven out from indexing hole by the cam, at this time, in the role of stopper device, indexing disk drive spindle rotating (shaft and fixture as a single entity), the lock pin slides on the cam. When Indexing plate rotated 90°, the lock pin return to the indexing holes again, and then it completes a division, Work piece rotate 90°. After the work piece is completed, the indexing device is reset according to the same principle.

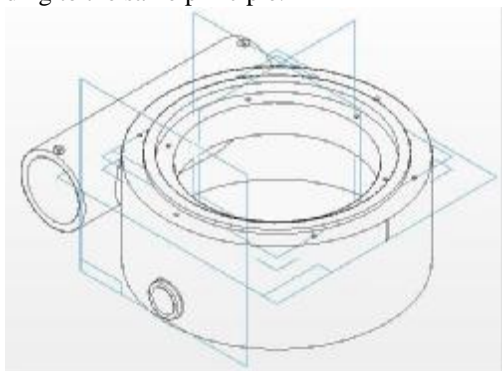


Figure 4. Degrees body stereogram

(1) In situ

The above parts assembly relationship is as follows: shaft connected by screws and the fixture; it can rotate freely that cam gear sleeve on the shaft; Indexing plate sleeve on the shaft, and is connected by screws and shafts, cannot rotate freely; stopper device is fixed on cam gear by screw thread, Its internal compression spring ensures that the Locking nail on the stopper device keep close to the indexing plate which is In bottom of the Locking nail tightly; set device is mounted on the Indexing body, Its interior has a compression spring, can guarantee the lock pin close to the indexing plate or driving cam gear sliding. At the initial position, the positional relationship of the components shown in Figure 5, the lock pin in the Indexing groove, at this time, the fixture cannot rotate freely.

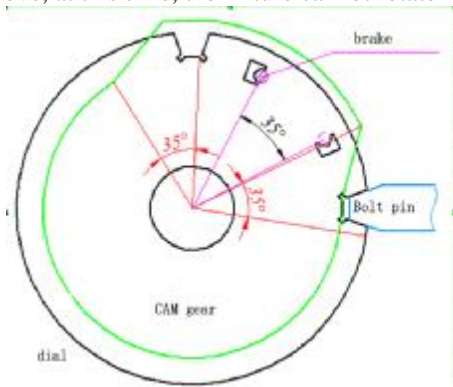


Figure 5. Initial sketch map

(2) Cam gear rotate 35°

After the cam gear driven by the rack hydraulic cylinder and rotate 35°, the lock pin is driven out from Indexing groove by the cam, at the same time, the stopper device exactly touched the stopper groove on the surface of the indexing plate. At this time, in the role of stopper device, indexing plate rotate together with the cam gear, then it can complete the indexing movement.

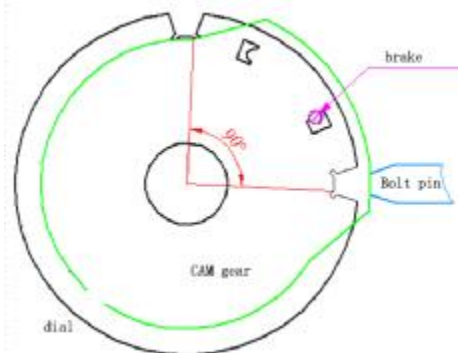


Figure 6. After 35° rotation

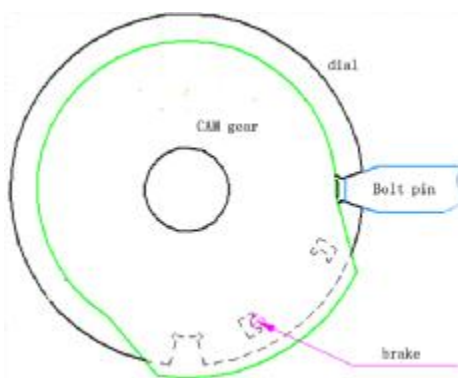


Figure 7. After 125° rotation

(3) Cam gear rotate 125°

When the cam gear rotate 125° together with indexing plate CAM gear and dial rotated 125°, the lock pin re-enter to the indexing groove, and then it completes a division, work piece rotate 90°.

4. Conclusion

(1) The design of electromagnetic valve fixture in this paper, adopts hydraulic drive, has many characteristics, such as clamping reliable, accurate positioning, as well as auto-rotation 90°, and so on. The clamping and steering mechanism mounted on the bottom of the work piece, It can vacate the left and right, front and back, and the top space, thus the processing tool does not interfere with the fixture in the process of processing.

(2) Using this fixture that coordinates with the appropriate combination machine tools, it not only takes up less space, the blank also can complete the processing step in

text by clamping and locating once, it not only assures the Processing quality, but also improve the processing efficiency of the solenoid valve.

References

- [1] Min W J, Hang Y Y, Lu D W, et al. Design of pressure control system for numerical control fixture based on PLC and high-speed switch electromagnetic valve. *Machine Tool and Hydraulics*, 2013,1(22):136-138.
- [2] Cong F T, Chi J S. Design of modular machine tool. Shanghai: Shanghai Science and Technology Press, 1994.
- [3] Qiu Y T, Combination Machine Tools. Beijing: Mechanical Industry Press, 1995.
- [4] Li H. Machining Process Manual. Beijing: Bei Jing Press.
- [5] Liu H W, Lin J X, Cao M L. Material Mechanics. Beijing: Higher Education Press, 2010:159 161.