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Special Fixture Design for Automobile air Intake Manifold

XIE Yi-rong[1], CAO Yun-dong[2], ZHANG Cheng-bing[3]
[1,2]*(College Of Mechanical Engineering, Shanghai University Of Engineering Science, China)*

Abstract: In view of the typical automobile engine intake manifold parts, the machining accuracy is low, the efficiency is low and the cost is high, which is caused by the complicated multi-curved surface during machining. According to the structural characteristics of the intake manifold, the shape analysis, fixture positioning analysis, clamping process analysis and clamping force analysis, through the computer-aided fixture design (CAFD) to establish an effective fixture 3D model, complete fixture design. The fixture has fast clamping, positioning and other functions, improve production efficiency and reduce processing cost.
Keywords: intake manifold, fixture design.

I. INTRODUCTION

The intake manifold is an intake line before the carburetor or throttle body of an automobile engine and before the intake port of the cylinder head, and functions to distribute the air and fuel mixture from the carburetor or the throttle body to each cylinder intake port . Because of its complex shape, the processing technology directly affects the engine efficiency. However, its fixture design is related to the quality of the workpiece processing quality, cost, and affect the assembly of these parts out of the equipment performance and quality. And the accuracy of fixture positioning error on the workpiece also has a great impact. In particular, it is an irregular multi- surface complexity of the work piece, so in the clamping process prone to large positioning error of the situation, resulting in low machining accuracy, low efficiency, time-consuming Labor costs, increase the cost of the problem, and the work of the engine cylinder has a direct impact on efficiency. So it is very important to study the design of the intake manifold fixture for overcoming the above problems.

In this paper, CATIA software is used to design the fixture's positioning elements to locate the x, y and z axis degrees of freedom of the intake manifolds by using the computer aided fixture design and the three-dimensional model of the intake manifold. Using the cylinder as the clamping element of the fixture, try to choose the plane as the clamping surface, by calculating the effective clamping force clamping to find the appropriate clamping program. Finally, the design of the fixture table is completed.

II. SET POSITIONING SCHEME

According to the analysis of the special structure of the intake manifold, the intake manifold is a curved tubular structure, according to its structural design positioning support base as shown below, the groove structure and intake manifold reasonable fit to achieve a fixed role, design 6 is positioned on the table. The support base limits the three degrees of freedom of the workpiece, namely the degree of freedom of rotation around the X axis, the y axis, and the freedom of movement in the Z axis direction. With the diagram after

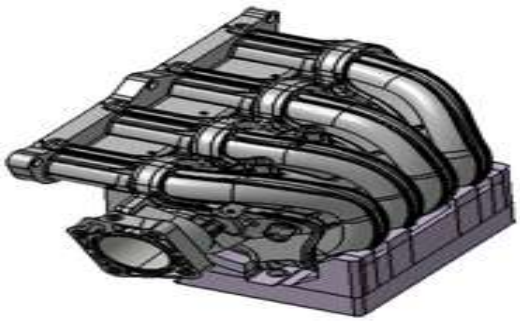

FIG 1 Fixture base with schematic

III. DESIGN OF FIXTURE CLAMPING COMPONENT

3.1 Fixture Clamping Principle

When the processing parts is correctly positioned. It is necessary to obtain a good clamping state. So that the processing parts to obtain a good clamping state of the measures, called the correct clamping. The correct clamping principle between the workstations is as follows:

1. In the clamping process, how to overcome the impact of gravity, the processing parts back to the correct position, is one of the correct clamping principle. Therefore, in considering the positioning scheme and positioning support should be as much as possible to support the reaction force and gravity does not constitute dual, so that the processing center of gravity in the bearing range.

2. In the clamping process, how to get the correct positioning of the processing parts is not from the correct position, is the correct clamping principle of the two. Therefore, in the development of clamping program, as far as possible to avoid the clamping force and supporting force constitute dual force.

3. In the clamping process, how to make the work piece does not produce more than the allowable range of deformation is the correct clamping principle of the three. Therefore, in the development of clamping program, for the poor rigidity of the work piece, should be avoided or should be minimized by the clamping force generated by the bending moment.

4. In the cutting process, how to avoid the work piece can not allow the vibration is the correct clamping principle of the four.Therefore, in the development of clamping program, for the poor rigidity of the work piece, should try to avoid or should be generated by the cutting force generated by the bending moment on the work piece.

5. How to make the minimum clamping force required to balance the cutting force is the fifth principle of correct clamping. Therefore, in the development of clamping program, the cutting force is best balanced by the support reaction force, and as much as possible to avoid the clamping force and clamping force generated by the friction balance.

3.2 Clamping Mechanism Design

In the machining process, the workpiece on the fixture will be a variety of forces. To ensure that the workpiece in the fixture to occupy the correct and determined position in the fixture system must be able to reliably clamping the workpiece clamping device to prevent the workpiece during processing due to the role of the displacement and vibration and other issues And affect the accuracy of the workpiece or clamping effect.

The clamping mechanism is mainly composed of three parts:

(1) power source

Power source is the clamping force clamping device, according to the source of power can be divided into manual clamping and motor clamping. Manual clamping is mainly used for small batch production of the occasion, the source of its force is manpower, time-consuming and laborious use, the need for manual operation; motor clamping is mainly used for large quantities and not suitable for manual operation of the occasion, such as automatic clamping of the occasion , The source of many of its forces, such as air pressure, hydraulic, electromagnetic and vacuum.

(2) power transmission mechanism

The force transmission mechanism mainly transmits the power between the power source and the clamping element. It can change the direction and size of the force as needed. It should be noted that the force transmission mechanism should have a certain self-locking in order to disappear after the clamping force is still able to ensure that the workpiece firmly installed in the fixture body, to avoid accidental fall of the workpiece. This is particularly important in manual clamping.

(3) clamping elements

The clamping element is an actuator that contacts the workpiece and performs a clamping action.

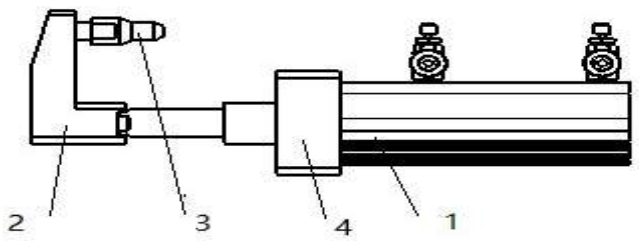

Fig 2 Clamping mechanism

1. cylinder (power source)
2. positioning head (clamping component)

3. Positioning pin (positioning component)
4. Cylinder bracket (positioning component)

The above three parts are the main part of clamping mechanism. In practice, according to different parts, different processing requirements and different clamping methods for the corresponding changes, but no matter how change fixture should meet the following requirements:
1) clamping can not damage the correct position of the workpiece;
2) the size of the clamping force should be appropriate to ensure that the workpiece in the processing process does not vibrate, do not rotate, it will not produce deformation and surface damage;
3) action to be fast, convenient and reliable;
4) easy to manufacture.

3.3 Clamping Scheme

The intake manifold clamp system is used for clamping the intake manifold. As the intake manifold quality is not, in the clamping, the intake manifold clamping force to be clamped on the table. The clamping mechanism in the gearbox system requires a clamping force to overcome the forces generated by bending moments and to ensure that the transmission is firmly fixed to the mounting panel during testing without vibration. Taking into account the limited clamping force manual fixture does not apply to the larger vibration occasions, and the test bed to achieve fully automated clamping, it can only use the motor clamping. So here the use of pneumatic fixture.

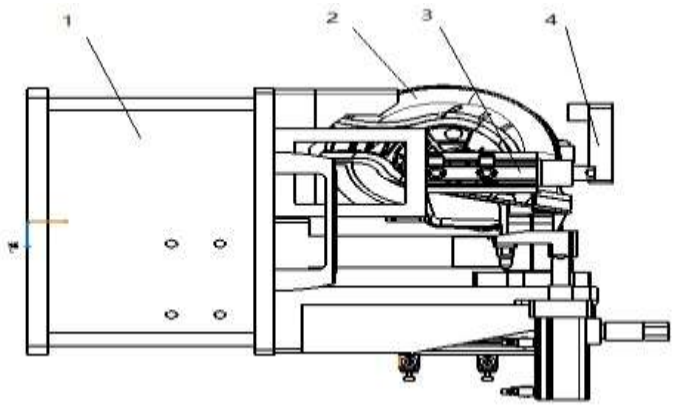

Fig 3 intake manifold clamping mechanism diagram

1. Jig body 2. Intake manifold 3. Cylinder 4. Positioning head

The fixture system is clamped using a pneumatic valve with four cylinder cylinders, and the layout on the fixture system is as follows:

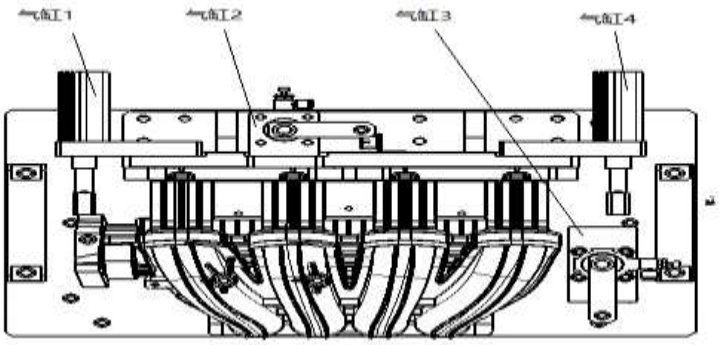

Fig 4 Cylinder in the fixture system layout

In the above figure, the cylinder 1 and the cylinder 4 define the intake manifold two holes through the positioning pin, which has reached the limit of the movement of the intake manifold x-axis and y-axis degrees of freedom, and the cylinder 2 and the cylinder 3 are positioned on the cylinder Compression block from the upper part of the intake manifold restrict the intake manifold x-axis, y-axis freedom of movement.

IV. CLIP BODY STRUCTURE DESIGN

Fixture body is the basis of the fixture system, bearing the positioning mechanism, clamping mechanism, the workpiece and other accessories skeleton. In the course of work, the fixture body to withstand the cutting force from the tool, the workpiece itself, as well as the gravity of a variety of other forces, while the clip body also bear the vibration generated during processing and the impact of force. Although the fixture body does not have to be as complex as the positioning element, it plays a very important role in the fixture system. It is good or bad, the design of the rational or not related to the quality of the workpiece processing and fixture system performance.

Comprehensive various processing environment, the fixture body design has the following three requirements:

1) reasonable structure shape and size
2) sufficient strength and rigidity
3) good structure of the process

The fixture body is the support base of the fixture system. Its technology directly affects the quality of the fixture manufacturing costs. Fixture body of the process is divided into three parts: the structure of technology, measurement technology and assembly process. Considering the overall size of the test bench and the installation environment of the fixture system, the preliminary design of the fixture body dimensions is 500 × 300 × 180mm.

The overall diagram of the fixture is shown below

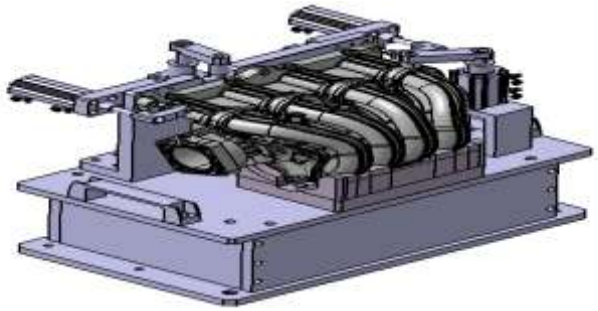

Fig 5 Intake manifold fixture

V. SUMMARIZE

This paper presents the fixture system needs to achieve the function. Then, the fixture system is designed from the three aspects of positioning scheme, clamping scheme and structure design. In the design of the positioning system, the positioning error analysis and the concrete design calculation work are completed by discussing the positioning principle and the current common fixture positioning method in the actual production. In the clamping scheme, the basic structure of the fixture mechanism is made simple Clamping force calculation and selection of hydraulic components. The fixture design is completed and the air intake manifold can be clamped reasonably, so that the machining process can be completed effectively in the working process.

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