Development of Drilling Fixture for Surface mounted with leaf spring seat of Front Axle

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Abstract. In order to meet the requirement of large-scale production of front axle, ensure the accuracy requirement of drilling holes on the surface mounted with leaf spring seat of front axle, and improve the production efficiency of front axle, the machining center fixture for drilling holes on the surface mounted with leaf spring seat of front axle was developed. The technological requirements of drilling holes on the surface mounted with leaf spring seat of front axle are introduced. The working principle of the machining center fixture for drilling holes on the surface mounted with leaf spring seat of front axle are introduced. The structure and characteristics of the key parts of the fixture are highlighted. Successful development of the fixture improves the production efficiency of front axle, greatly reduces the labor intensity of operators, and improves the automation degree of the production line.

1. Introduction

The front axle is one of the important components in the automobile chassis. Automobile front axle is an important part of automobile, which needs to bear large and complex load and stress [1, 2]. However, the shape of automobile front axle is complex, and the position of hole and surface is required to be high.

The front axle of automobile belongs to long axis symmetrical forging with complicated geometry. The front axle of automobile is one of the most important parts of automobile with complicated load [3, 4]. In order to meet the requirements of large-scale production of front axle, ensure the accuracy requirements of drilling holes on the surface mounted with leaf spring seat of front axle, and improve the production efficiency of front axle, the machining center fixture for drilling holes on the surface mounted with leaf spring seat of front axle is developed.

2. Process requirements of the drilling holes

The front axle is tempered with 45 steel, which has high rigidity, tensile and compressive strength and good vibration resistance [5].

The surface accuracy of underside of leaf spring seat is low, but its flatness is high.

The positioning hole of leaf spring seat is mainly used for machining the main pin hole. Bolt hole is used to connect and fix with leaf spring.
The processing diagram of front axle leaf spring seat face is shown in Figure 1. Bolt holes of leaf spring seat are mainly drilled, its location is hard to guarantee. The face of the leaf spring seat of the front axle is machined to drill two locating holes and eight leaf spring holes on the plane of the leaf spring seat, and countersink the bolt holes plane on the back of the leaf spring seat, etc.

![Figure 1. Processing diagram of front axle leaf spring seat face.](image1)

Two φ D × 1 positioning holes, eight φ e leaf spring holes and four D2 through holes in the plane of two leaf spring seats are drilling, and the machining center is used for machining.

The positioning datum is selected as the shape of the two bottom planes of the plate spring seat and the outer walls of the two main pin holes of the front axle.

The front axle is thin and heavy, so it is difficult to install. In order to facilitate the accurate positioning of the front axle, the direction of the clamping force makes the front axle deformation minimum, and the clamping direction is perpendicular to the machining surface direction of the front axle. The clamping point shall fall within the corresponding range of the supporting element, and the rigidity shall be better within the corresponding range of the supporting element; as the supporting closes as possible to the machined surface, but not the machined surface. The other two clamping points are the outer walls of the two main pin holes, which are also non machined surfaces.

In order to meet the requirements of mass production and improve productivity, hydraulic pressure is used for front axle clamping, automatic clamping and convenient process can be realized.

3. Working principle of the fixture
Hydraulic technology is characterized by compact structure, flexible use, safety and reliability [6], the assembly drawing of the fixture with hydraulic clamping is shown in Figure 2.

![Figure 2. Fixture assembly.](image2)

The working principle of the fixture is: the position of the fixture in the worktable is checked; The hydraulic motor is starting reverses, the two horizontally installed positioning clamping V-shaped blocks are in the released state, and the distance between them is the best; The two vertically mounted clamping cylinders 3 retract downward, while the two vertically rotatable clamping blocks retract downward for the installation of the front axle; One vertically mounted oil cylinder 2 retracts downward, and at the same time, four horizontally mounted rotatable floating supporting wheels retract downward, so as to facilitate the installation of the front axle; The 4 horizontally mounted positioning cylinders 1 retract backward, and the 4 horizontally positioned blocks retract at the same time, so as to facilitate the installation of the front axle; Place the two bottom planes of the plate spring seat of the front axle upward,
and place the front axle on the wheels of four horizontally mounted rotatable floating supporting with the swing arm crane. The 4 horizontally mounted positioning cylinders 1 extend forward, and at the same time, the 4 horizontally positioned blocks extend forward to facilitate the positioning of the front axle; The vertically mounted cylinder 2 extends upward, while the four horizontally mounted rotatable floating supporting wheels move upward under the action of two springs, make the two bottom planes of the plate spring seat of the front axle close to the four horizontal positioning blocks to complete the positioning of the two bottom planes of the plate spring seat; The starting hydraulic motor rotates forward, and the two positioning clamping V-shaped blocks are in the clamping state, with the closest distance between them, position and clamp the outer wall of the two main pin holes of the front axle; Two vertically mounted clamping cylinders 3 extend upward, and at the same time, two vertically rotatable clamping blocks extend upward to clamp the front axle; At this time, the fixture is positioned and clamped to the front axle. Operate the vertical machining center to finish the machining of the hole system on the two bottom planes of the plate spring seat of the front axle, After machining, the starting hydraulic motor reverses, and the two horizontally installed positioning clamping V-blocks are in the released state, with the most distance between them; The two vertically mounted clamping cylinders 3 retract downward, while the two vertically rotatable clamping blocks retract downward, facilitating the loading and unloading of the front axle; One vertically mounted cylinder 2 retracts downward while the four horizontally mounted rotatable floating supporting wheels retract downward and the front axle moves downward; The 4 horizontally mounted positioning cylinders 1 retract backward, and the 4 horizontally positioned blocks retract at the same time, so as to facilitate the loading and unloading of the front axle; Lift the front axle away from the four horizontally mounted and rotatable floating supporting wheels of the floating support with a rotary arm crane. So far, the installation, positioning, clamping, processing, loosening and lifting of the first front axle have been completed; The rear front axle can be installed, positioned, clamped, processed, loosened and lifted as mentioned above.

4. Characteristics of main structure of fixture

4.1. Plane positioning and vertical clamping

Plane positioning and vertical clamping are shown in Figure 3. The four horizontal positioning blocks are respectively controlled by four horizontally installed positioning cylinders 1. To ensure the parallelism of the plane composed of the bottom plane of four horizontal positioning blocks to the workbench, so as to ensure the positioning accuracy; Two vertical rotatable clamping blocks are respectively controlled by two vertically mounted clamping cylinders 3 to move up and down, Since the clamped outer surface is not machined, the single piece linkage clamping mechanism is adopted, The utility model can clamp a front axle uniformly from two directions at the same time, so as to ensure that the clamping force of each clamping point is balanced.

4.2. Shape positioning and horizontal clamping

As shown in Figure 2, the centering and clamping mechanism based on the principle of constant velocity displacement is adopted for shape positioning and horizontal clamping, namely, the screw equidistant moving centering clamping mechanism, the mechanism uses the screw movement between the screw.
and the nut to realize the simultaneous movement and clamping action of the clamping element. The mechanism has the advantages of simple structure, large working stroke and precise transmission connection. The feature of the mechanism is that the left and right two screws drive the left and right V-shaped blocks for positioning and clamping, and the two screws are connected together to form a driving screw whose left end is the right thread and the right end is the left thread. When the driving screw is rotated forward, the left and right positioning clamping V-blocks move to the middle at the same time through the left and right screw sleeves installed on the left and right jaws, at the same time, position and clamp the front axle. When the driving screw is rotated reversely, the left and right positioning clamping V-blocks will move in the opposite direction at the same time, making the front axle in a relaxed state, the front axle can be removed. The two positioning clamping V-blocks move in opposite direction, so as to center and clamp the front axle. When loosening, they move in opposite direction. Two horizontally installed positioning and clamping V-shaped blocks locate and clamp the front axle. In the process of positioning and clamping, the dimensional errors of two positioning surfaces of the front axle are equally divided according to the principle of constant velocity displacement to realize centering or centering. To eliminate the adverse effect of manufacturing error of positioning surface or positioning dimension deviation. So that these errors can be evenly and symmetrically distributed on the positioning reference plane of the front axle with respect to the position of the determined center. As shown in Figure 4, the hydraulic motor drives the gear to rotate, so as to drive the screw rod to rotate, so as to realize rapid shape positioning and horizontal clamping.

![Figure 4. Shape positioning and horizontal clamping driving device.](image)

4.3. Floating auxiliary support
The floating auxiliary support is shown in Figure 5. When the vertically mounted cylinder 2 is retracted downward, make the 4 horizontally mounted rotatable floating supporting wheels retract downward, so as to facilitate the installation of the front axle; After the front shaft is installed on four horizontally mounted rotatable floating supporting wheels, the vertically mounted cylinder 2 extends upward. At the same time, four horizontally mounted rotatable floating supporting wheels move upward under the action of two springs, Make the two bottom planes of the plate spring seat of the front axle close to the lower locating surfaces of the four horizontal locating blocks to complete the positioning of the two bottom planes of the plate spring seat; Before shape positioning and horizontal clamping, the front axle is at the top under the action of spring force. Because the front axle only has the function of spring force and supports the weight of the front axle, the pressure on the two bottom planes of the plate spring seat is small; When the shape is positioned and clamped horizontally, the rotatable floating supporting wheel can rotate freely, and the resistance to be overcome is small, so that the shape is positioned and clamped horizontally smoothly. Due to the large weight of the front axle, the front axle is supported by the spring force, and the pressure requirements on the two bottom planes of the plate spring seat are small. That is, the spring force is only slightly greater than the weight of the front axle. The floating auxiliary support can reduce a lot of clamping time, realize the high speed of front axle clamping, and significantly improve the work efficiency. The floating auxiliary support supports the front axle on the opposite side of the machined surface, and also reduces the downward deformation caused by the cutting force during the machining process of the front axle.
5. Conclusion

According to the requirements of mass production and the characteristics of front axle machining, the fixture of front axle drilling steel plate spring seat face machining center is developed; it has been successfully applied in production practice and fully meets the requirements of front axle processing, and it has reliable machining performance and stable machining accuracy. At the same time, the machining efficiency is improved, the auxiliary machining time is shortened, and the labor intensity is reduced.

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