Research and Design of a New Type of Quick-loading Flat-nose Pliers

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Abstract. Fixtures often were used in milling operation to ensure the accuracy and efficiency of machining work pieces. Flat clamp is a universal fixture used for mounting small workpieces. At present, there are mechanical and hydraulic flatnose pliers on the market, but the cost is high. The working principle of the above pliers is to use a wrench to turn the lead screw, and the lead screw nut drives the movable pliers to move, forming tightening and loosening of the workpiece. During the clamping process, the workpiece may be damaged due to the problem of excessive clamping force, and the phenomenon of jamming may also occur, which seriously affects the processing quality of the workpiece and reduces the processing efficiency. In order to solve the above problems and meet the needs of the milling machine, a conical inclined block and clamping bolts were designed to clamp the workpiece, which solves the problem of damage to the workpiece due to excessive clamping force. In addition, the installation and removal of workpieces also become simpler, which greatly reduces the situation of jamming, improves the processing efficiency, and meets the processing needs of different workpieces.

Keywords: milling machine; Fixtures; pliers; Conical inclined block

1 INTRODUCTION

A kind of flat-nose pliers that are often used by fitters in their work now, which are very widely used and are often used to clamp various workpieces on machine tools. For example, on planers, milling machines, and drilling machines, flat-nose pliers, as a general fixture, are fixed on the machine table to clamp the workpiece for cutting, which is an indispensable auxiliary tool in the operation of fitter training. At present, there are mechanical and hydraulic pliers on the market, but the cost is high. The principle is to use the lead screw to drive the movable pliers to move to tighten and loosen the workpiece [1-5]. During the clamping process, the workpiece will be damaged due to excessive clamping force, and the ball screw will be blocked by iron chips, which will seriously affect the processing quality of the workpiece and reduce the processing efficiency [6-9].

In order to overcome the disadvantages of traditional flat-nose pliers in operation and make it more convenient and faster to process parts, we designed a new type of fast-clamping pliers that can quickly clamp and replace jaws. The use of this flat-nose pliers improves work efficiency.

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2 THE STRUCTURE OF THE NEW FLAT-NOSE PLIERS

In order to meet the needs of fitters, the device utilizes the cooperation of conical inclined blocks and clamping bolts to clamp the workpiece [10-13]. This kind of quick-action vise is specifically composed of conical oblique blocks, locking bolts, rubber pads, etc. The three-dimensional modeling using SOLIDWORKS is shown in Figure 1, and its basic structure is shown in Figure 2.

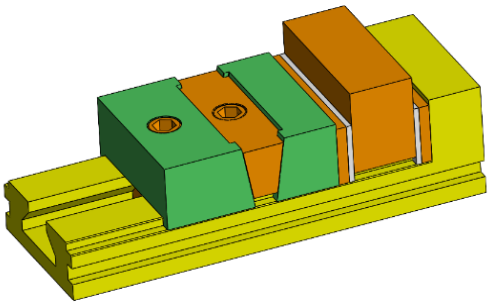
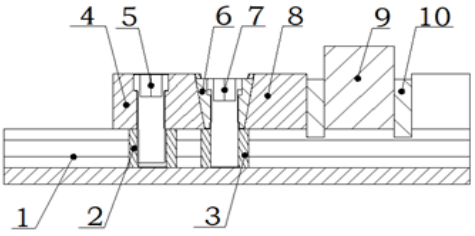


Figure 1. Three-dimensional view of flat-nose pliers



1- Fixed clamp body (with permanent magnet chuck); 2- second slider; 3- second slider; 4- third inclined block; 5- Second tightening bolt; 6- first inclined block; 7- first tightening bolt; 8- second inclined block; 9- workpiece to be processed; 10- Rubber mat;

Figure 2. Basic structure of flat-nose pliers

2.1 Fixed clamp body adopts permanent magnet suction cup structure Author affiliations

The fixing of traditional flat-nose pliers is accomplished by bolts or pressing plates in the T-slot between the pliers chassis and the drilling machine table. The general operating procedure is to align and clamp the workpiece with a vise for trial drilling. After the test drill is aligned with the hole position, tighten the bolt to fix the clamp body for drilling. This way each hole must be tightened and aligned once with the bolt. Especially when machining some

workpieces with small hole diameter and large number of holes, it is time-consuming, laborious and low in work efficiency. At present, the masters of factories and enterprises generally operate directly with pliers. However, for newcomers in vocational schools who have just come into contact with drilling operations, if the flat pliers are not fixed, there will be great personal safety hazards, which are prone to occur. Accidents such as clamp movement, drilling deviation and workpiece scratching. In order to avoid the above situation, we draw lessons from the permanent magnet suction cup technology, and design and install the permanent magnet suction cup mechanism on the base of the clamp body. After the test drill is aligned, turn the electromagnetic switch to fix the clamp body, and after drilling the hole, turn the magnet suction cup. The design adopts a permanent magnet suction cup mechanism, the flat jaws are fast to fix, easy to disassemble and use, and improve work efficiency.

2.2 The clamping movement of the movable jaw adopts the chute guide mechanism

At present, most of the flat-nose pliers attached to the lathe use a rotating worm to clamp the workpiece. When changing the clamping workpiece, if the size of the workpiece changes greatly, the screw needs to be rotated many times to rotate in place, and the clamping work efficiency is low. In order to To achieve flexible and fast positioning and clamping of workpieces, we designed the original screw mechanism into a slider and guide rail mechanism. Two chute guide rails are used in this device to realize the function of quick workpiece change:

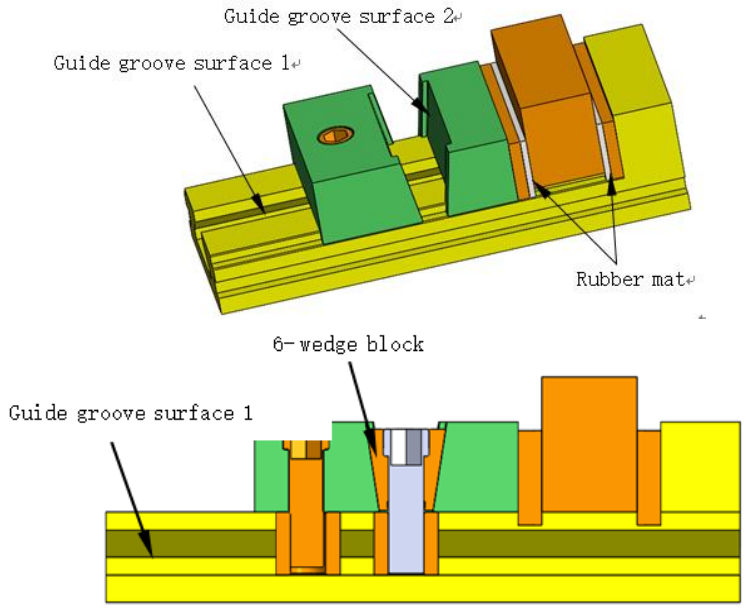


Figure 3. Chute guide

1) When the size of the clamped part changes, simply push and pull the 4-slider to complete the positioning and clamping of the clamped part, and fix the slider with bolts;

2) After the positioning of the clamped part is completed, the 7-first tightening bolt is tightening the 6-wedge block, and the 6-wedge block moves down to clamp the clamped part. The surface of the guide groove is shown in Figure 3.

2.3 Design of movable jaw clamping rubber pad

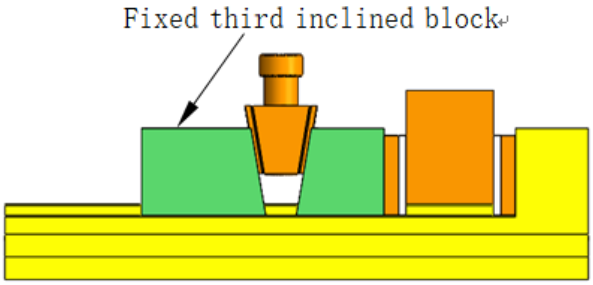
The movable jaws in daily use, often clamping different materials for processing, so there will be a problem, if the hardness of the machined parts is too low will cause damage to the surface of the clamped workpiece, on the contrary, if the hardness of the machined parts is too high will cause damage to the surface of the jaws, so that in the process of processing will not clamp the workpiece, resulting in reduced processing accuracy. Although the traditional method, outside the clamping workpiece with copper sheet for protection, but still can not solve the fundamental problems, in order to solve these problems, both sides of the jaws are equipped with rubber pads, as shown in Figure 3, not only to protect the workpiece to prevent workpiece pinch, but also to increase the clamping force, while the rubber pads are easy to replace, so that the economic applicability of flat jaws more.

In order to verify the feasibility of the technology, in the case of ensuring the workpiece clamping force and the strength of the parts mechanism durable reliability, we refer to the mechanical parts design manual for the overall strength of the mechanism calibration calculations, to meet the design requirements.

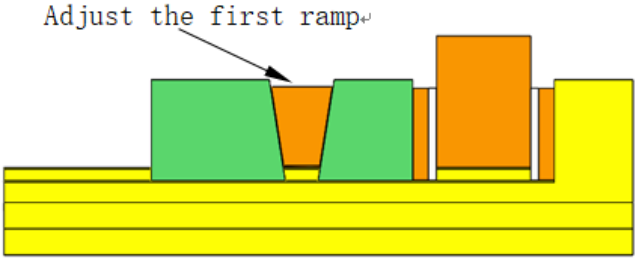
3 THE WORKING PRINCIPLE OF THE NEW FLAT-NOSE PLIERS

When the device is in use: 1) Place the 9-workpiece in the live jaw, firstly, according to the size of the 9-workpiece, push and pull the 4-slider to complete the positioning and clamping of the clamped piece, as shown in Figure 4 (1) ;2) Then tighten the 5-second tightening screw to lock the position of the 4-third inclined block, as shown in Figure 4(2); 3) Then adjust the 7-first tightening screw to make the 6-first inclined block The block moves down, at this time, the 8-second inclined block will move to the right to squeeze the workpiece, and tighten the 7-first tightening screw to complete the clamping of the workpiece, as shown in Figure 4 (3).

To take off the workpiece, loosen the 7-first fastening screw and take down the 6-first inclined block, and the workpiece can be easily removed. The new flat-nose pliers have a simple structure, are easy to operate and use, and at the same time avoid the phenomenon of iron filings being stuck in the process of machining workpieces, thereby increasing work efficiency. Figure 4 is a sequence diagram of the device clamping a workpiece.



(1) Fixed workpiece (2) Fixed third inclined block



(3) Adjust the first ramp

Figure 4. Flow chart of the principle of flat-nose pliers

4 USE EFFECT AND FUNCTION EVALUATION

The purpose of product innovation and improvement is to be easy to use, durable, safe and efficient [7]. Based on this design concept, in the design and manufacture of flat pliers, we refer to some traditional mature mechanisms and processing and manufacturing technologies, and optimize them together, which has the effect of multiplying the advantages and multiplying the benefits. The structure design of this new type of fast flat-nose pliers is relatively simple and reasonable, and it is easy to realize in the process of processing and manufacturing. The time-saving and labor-saving effect can ensure the reliability of the flat-nose pliers at work. Therefore, this new type of fast flat-nose pliers has very high practical application value in production practice, especially, it can greatly shorten the time for clamping the workpiece and improve the workpiece quality. Production efficiency can reduce costs, and after popularization and use, it can be widely used in fitter workbenches and various machine tools in the mechanical field to process workpieces.

5 CONCLUSION

(1) Improve work efficiency. The newly designed flat-nose pliers for machine tools are easier to operate, and a permanent magnet suction cup mechanism is designed and installed on the base of the pliers body, which is easy to disassemble and use. At the same time, two chute

guide rails are designed to realize the function of quick workpiece change and improve work efficiency.

(2) The positioning accuracy is improved. The workpiece reference surface to be processed can be a side surface, or a point, line, or surface in the middle of the workpiece, which can realize rapid positioning and clamping.

Through the innovative design of the flat-nose pliers for machine tools, the manpower and material resources are reduced, the work production efficiency is improved, and the machining accuracy of the parts is guaranteed at the same time. The new flat-nose pliers have application and promotion value.

6 ADVANTAGES AND PROSPECTS OF NEW TYPE FLAT-NOSE PLIERS

The designed and manufactured quick-action vise device for milling machine has been used in actual processing, achieved good results, played an important practical application value, and laid a foundation for further optimization:

(1) The device realizes the clamping of the workpiece by using the conical inclined block and the clamping bolt, which is convenient for clamping and solves the problem that the flat-nose pliers are stuck by iron filings;

(2) The fixed clamp body adopts the structure of permanent magnet suction cup. When in use, the jaw can be moved freely according to the requirements of the working conditions, and the fixing bolts can be tightened with a hexagonal wrench when locking;

(3) The clamping movement of the movable jaw adopts the chute guide mechanism. When replacing the clamping workpiece, the positioning and clamping can be completed by easily pushing and pulling the slider, which greatly improves the work efficiency;

Although the designed quick-action vise device for milling machine solves the existing problems, there is still room for improvement and improvement. With the rapid development of intelligent and digital mechanical transmission, the device will be gradually improved and perfected in practice in the future to make it more suitable for the needs of milling machines [14-16].

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