

Design of the abrasive flow polishing split fixture quick-change for gear

Weina Liu¹

1. College of Mechanical and Electric Engineering, Changchun University Of Science and Technology, Changchun 130022, China

Yinchen Wang¹ and Yingzhi Zhang²

1. College of Mechanical and Electric Engineering, Changchun University Of Science and Technology, Changchun 130022, China
2. College of Mechanical Science and Engineering, Jilin University, Changchun 130025, China

Abstract— In view of the large quality of the monolithic fixture of the abrasive flow machining machine, and it easily happens accidents during the clamping process, the changing of the gear speed in mass production, the low degree of automation and the clamping process need a larger space, and the improvement of the fixture after changing the different batch thickness gears is necessary. The paper presents a design scheme of the split-type quick-change fixture for the grinding particle flow polishing of vertical and horizontal abrasive flow machine tools.

Index Terms— Split Clamp; Quick change; Scheme design

I. INTRODUCTION

Abrasive flow machining, also known as Squeeze honing, is a kind of micro-processing technology which contains abrasive liquid phase carrier to polish and deburring parts under pressure. At home and abroad, the research of abrasive flow processing mainly concentrates on the structure and machining principle of the processing device, the simulation of machining process and the processing technology.[3-8]

In the field of gear processing, the traditional means can not achieve uniform machining of gear surface. Because the abrasive wear is uneven, the machining result of the gear surface is different. The abrasive flow is able to flow in the process because the abrasive grains are carried by the liquid carrier and can directly ensure the machining uniformity of the gear surface. The traditional integral fixture occupies a large proportion, but its application process is often more complicated. Moreover, due to the small processing space, the process of gear removal may collide with fixture and affect the surface quality of gears; these disadvantages make the manipulator a kind of equipment that can promote the automation production cannot apply to the production line. Integral fixture machining gear installation, clamping, disassembly by manual completion of waste of human and material resources, and overall fixture generally larger quality, installation and clamping process prone to accidents.[11-12]

Therefore, In this paper, a design scheme of the polishing fixture for the split type rapid- change gear

abrasive flow for the abrasive flow machine tool is proposed to solve the problem of changing the gear speed, low automation degree, the installation clamping process needs larger space, and the fixture needs to be improved after different batch thickness gears are replaced, vertical abrasive flow machine tool and horizontal abrasive flow machine tool fixture is not universal, separate design and use cause a lot of waste problems.

II. OVERALL PROJECT DESIGN

The process of the fixture to the gear polishing process is: move up the top roof → take out base and upper cover → open the upper cover and change the gear → close the upper cover → ensure the positioning of base and upper cover between bottom backplane and top roof → move down top roof for clamping → start polishing → finish polishing.

The fixture adopts split-type design in order to realize the rapid replacement of gears and to meet the machining requirements of different gears. Due to the abrasive flow processing is reciprocating cycle processing, abrasives have impact on the fixture itself, in order to ensure the clamping effect, the fixture which parts can be adjusted to be fixed and sealed.

The overall structure of a split-style fast-changing gear abrasive flow polishing fixture is shown as fig 1.1 and fig 1.2

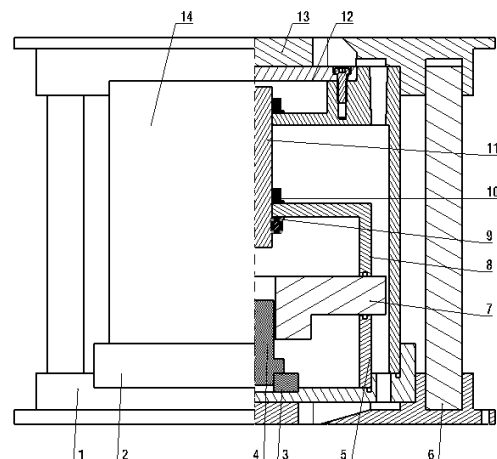


Figure 1: fig 1.1 Split quick change gear abrasive flow polishing fixture main cross-sectional view

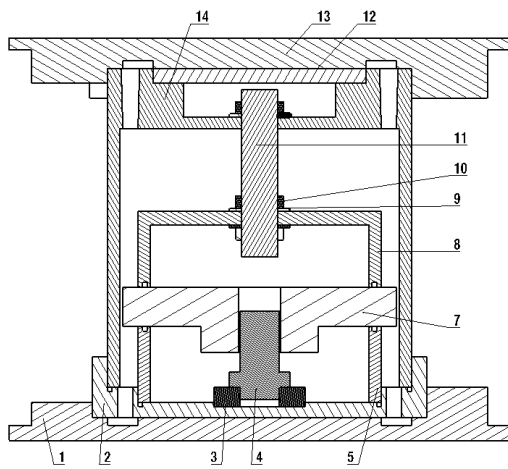


Figure 1: fig 1.2 Split quick change gear abrasive flow polishing fixture right cross-sectional view

Split quick-change gear abrasive flow polishing fixture Parts serial number, name and function is shown as table 1-1

Part serial number	Part name	Part features	Connection between parts
1	Bottom Backplane	Support_Fixture, connecting machine	Bolt Connection
2	Base	Mounting support	Coaxial mounted in bottom bottom groove
3	Positioning seat	Install changable positioning column	Coaxial mounted on the positioning seat
4	Positioning column	Positioning gears , Suitable to be replaced with different inner diameter gears	Coaxial mounted on the positioning seat
5	Lower Support ring	Supporting function	Coaxial mounted on the positioning seat
6	Support Column	Supporting and Constrained Upper Roof	Mounted on supports holes of top roof, and bottom floor
7	Gear		
8	Upper Plate	Limit gear to move up; clamp	Fixed by the nut on the adjustment columnar
9	SPRING Gasket	Prevent the nut from loosening	Prevent loosening
10	Nut	Adjust Spacing; fixed	Used to connect
11	Tune Columnar	Adapting to different thickness gears	through threaded holes of upper lid, Use nut to fix
12	Upper Cover Plate of Tune Columnar	Prevent abrasive impact adjustment columnar	Fixed on upper case lid with Hexagon Socket Screws
13	Top roof	Position upper lid and clamp	Bolt Connecting Machine
14	Upper Cover	composed of processing cavity with base; clamping gears	Mounted on the Backplane

TABLE 1-1 SPLIT QUICK CHANGE GEAR ABRASIVE FLOW POLISHING FIXTURE PARTS FUNCTION

III.SPECIFIC PROJECT DESIGN

A. Design and positioning of gear support

The gear support is completed by the bottom backplane 1, the base 2 and the lower support ring 5 three parts. Mainly limit the downward displacement in the direction of the gear Z axis. Wherein the base 2 coaxial is mounted on the inner part of the bottom backplane 1, and the lower support ring 5 is arranged inside the base 2, and fixed with the groove of the base 2. These three components are assembled to support the lower surface of the gears, which is shown as fig 2.1.

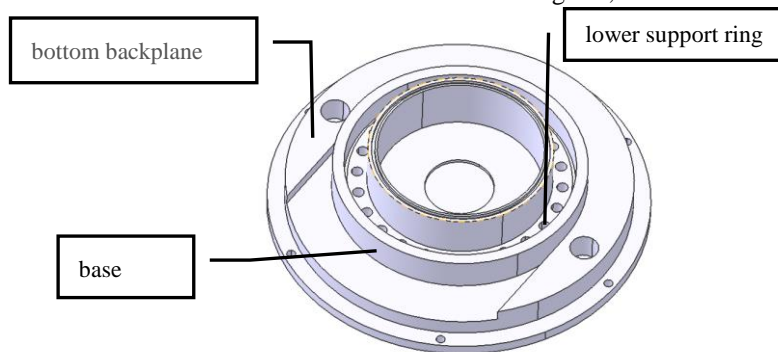


Figure 2: fig 2.1 Assembly of Lower bottom plate, base and lower support ring

The positioning of the gears is done through the positioning column, and the bottom diameter of the locating column is the same as that of the locating cylinder; in order to facilitate the removal of gears, and in the processing of gear does not produce shaking, the top diameter of the positioning column is slightly smaller than the hole diameter of the gear. The rotational degrees of freedom of the gears along the x and Y axes, the

movement degrees of freedom along the X and Y axes are limited by the support ring 5 and the positioning column 4. At this point, only the rotational degrees of freedom along the z-axis and the upward movement along the z axis are not limited to the gear 7. As fig 2.2 shows.

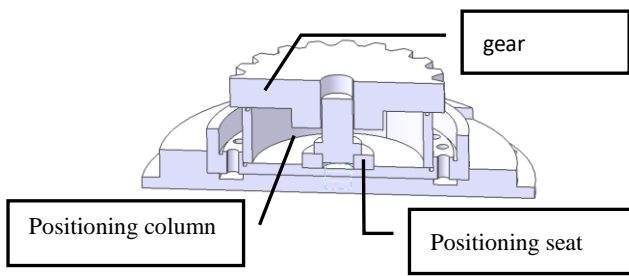


Figure 2: fig 2.2 Gear support and positioning

The work of restricting gears moving upward along the z axis is mainly done by upper Lid 14, columnar 11, Upper Platen 8. In order to adapt to the processing of different thickness of gears, the upper lid 14 Center has threaded holes, its thread specifications and columnar thread specifications are the same; the upper Plate 8 center has through hole. First, through the spring gasket 9 and Nut 10, installed on the both side of upper plate 8, and adjust it to tune columnar r 11 of the appropriate position, complete the gear z-axis freedom limit, at this time in the upper end of the columnar installed Spring Gasket 9 and Nut 8, fixed columnar position, depending on the situation choose the type of gasket and nut, to prevent the emergence of loose in the processing. The upper cover plate of tune column 12 is installed on the upper cover 14 through the inner hex bolts to prevent the grinding of the abrasive from the columnar to produce the shock causing the nut to loosen. At this point, the tune columnar 11 and upper plate 8 and upper cover 14 and the upper cover plate of tune columnar 12 become a whole, as picture 2.3 shows, no split is required in the process except maintenance.

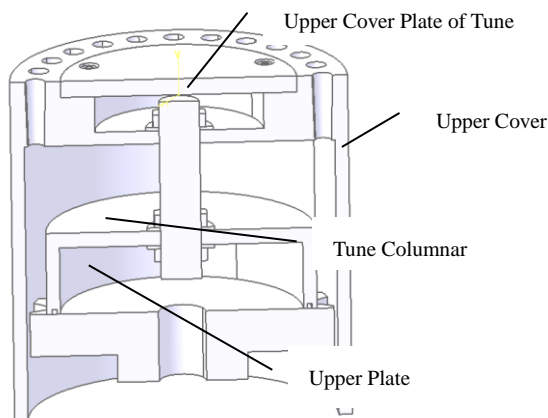


Figure 2: fig 2.3 Restrictions on the upper part of the gears

B. Gears clamping

The clamping of gears is done mainly by the bottom plate 1 and top roof 13.

Base 2 is installed on the lower floor 1, upper cover 14 and support ring 5 install on base 2. At this point, the gears are only fixed in the machining cavity composed of the upper cover 14 and the base 2. Bottom of top roof 13 with inner diameter and upper cover 14 has the same

groove; top roof 13 moving downward along support column 6, then top of upper lid into groove at bottom of top roof. Continue to move down the top 13, press the upper lid 14 to complete the clamping of the gear 7. The whole process is shown as fig 2.4.

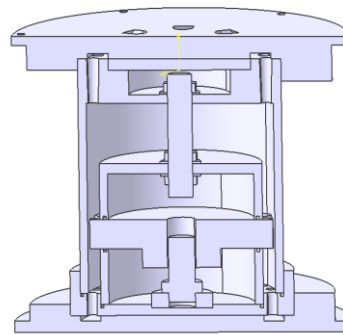


Figure 2: fig 2.4 Clamp tightening gear state profile

C. Quick change

The first prerequisite for fast replacement is to adjust the columnar 11 and upper Platen 8 to fit in a suitable position. In this position, through the upper box cover 14 to install the bottom 2 of the interior, so that the upper lid just and the base contact, upper plate 8 lower surface and to be machined gear 7 surface Contact; by clamping so that the parts are tightly connected; seal the processing cavity through the standard parts seal ring to prevent the abrasive from leaking out.

The second condition for rapid replacement is the guide groove above the upper top 13 below the guide groove and the lower Backplane 1. The structural schematic diagram of upper roof 13 is fig. 2.5 and the schematic diagram of the bottom floor 1 is fig. 2.6. Both guides are parallel and open in the same direction. In the process of changing gears, only 13 upward displacement of the top roof is required to fit the distance, do not have to completely open, then can be along the upper and lower two guide slots, take out the base 2 and upper box cover 14. Due to the different sizes of two parts, the fixture orientation installation error will not occur in the horizontal machine tool machining. Separating the removed base 2 from the upper lid 14 to remove the gears from the positioning column. This process does not involve fastener disassembly, relying on the structure of each component to complete.

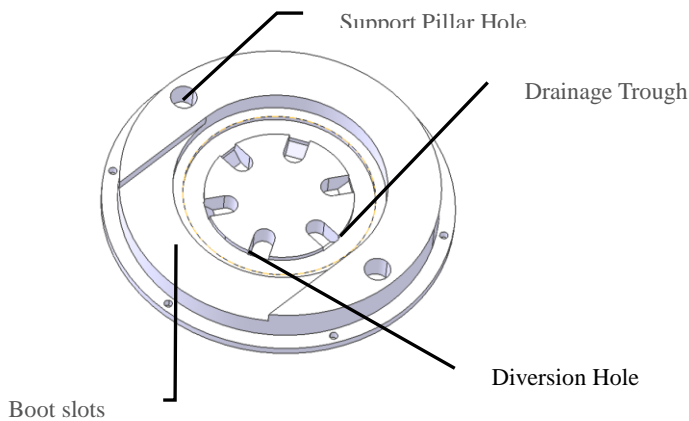


Figure 2: fig 2.5 Schematic diagram of top roof structure

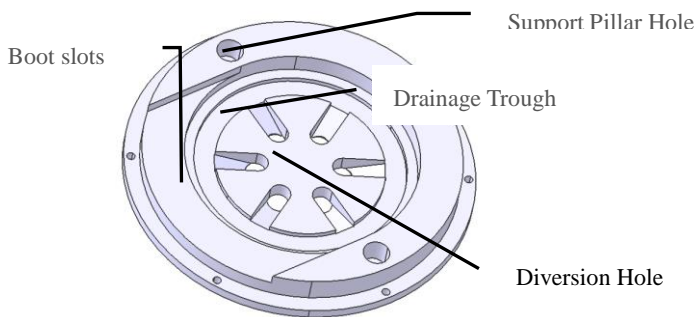


Figure 2: fig 2.6 Schematic diagram of bottom floor structure

IV. WORKING PROCESS

Move the top roof up to a certain distance, so that we can remove the base 2 and upper cover 14 with the guide groove of the lower bottom plate 1 and top roof 13. Move up the upper cover 14 and gears can be seen, then use tools which without contacting the gear tooth surface to remove gears. With a help of high degree of automation, the above steps can be accomplished using a robotic arm. Classify the removed gears and take the gears to be machined, the gear with a convex side downward, the inner hole of the gear is inserted into the locating column and the lower surface of the gear is contacted with the lower support ring 5. The upper cover 14 is mounted to the base 2, and the upper plate is contacted with the surface of the gear. Push the installed base 2, upper cover 14 along the bottom backplane 1, the top roof 13 of the boot slot into the lower floor of the base constraint concave. At this time the upper cover 14 and top roof 13 of the upper lid-constrained concave platform, the top roof along the support column downward movement, upper roof contact and pressure on the lid. At this time the bottom plate is completed to the base of the compression, the base through the lower support ring, the upper lid through the upper plate to complete the gear pressure. A cycle after the machine starts: abrasive starting position in the lower cylinder: Vertical machine Tool Processing example: the abrasive into the lower bottom of the drainage hole, through the drainage hole

and the lower floor annular drainage trough into the base of the feeding hole, in the base and upper box cover formed in the cavity of the gear processing, because the gear is the smallest section, The abrasive can be polished to the gears. Because the base and the upper cover have the same number of feed mouth as well as the same size, in the polishing process, the abrasive movement of uniform stability, processing gear surface has the same roughness. The abrasive material enters the upper roof drainage trough through the feeding hole of the upper lid, and enters the upper cylinder through the upper roof drainage groove and the upper surface diversion hole on top roof. The abrasive from the upper cylinder to the downward cylinder is on the contrary to the above.

V. CONCLUSION

In the condition of not changing the traditional machining method and guaranteeing the machining precision of the traditional integral fixture in mass production, the process of installing clamping and disassembling is improved. Remove the gear by removing the top and upper lid of the bottom plate through the guide groove and moving up the lid. The whole process only needs to move the upper roof up the appropriate distance, this link is not limited by the upper and lower space, reducing the fixture quality as well. Because the bottom floor and the upper roof are all through holes, it can be connected machine tools with the nut screws. The use of vertical machine tools can also be used in horizontal machine tools. In the processing of the same diameter, different thickness of the gears, only need to adjust the tune columnar and the position of the upper plate, so as to adapt to the processing gear thickness, no need to change the fixture again.

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