Rapid Modeling of an Excavator Working Device Based on the Secondary Development of Pro/E

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Abstract: In order to shorten the design cycle of the excavator working device, we have proposed a rapid modeling method for the excavator working device which uses parameters. Based on the Pro/toolkit, which is secondary development tool of Pro/E4.0 and combined with Vs C + +2005 programming software. It developed a flexible set of MFC visualizationfriendly interfaces. Users can enter data in the visual interface according to their needs and it will generate a new part model quickly. So it improves the design quality, shortens the design cycle, and makes the cost lower significantly. Key words: excavator working device; rapid modeling; parameters; Pro/toolkit; secondary development; Pro/ engineer

1 Introduction

An excavator is widely used in the soil, rock mechanical engineering , construction , mining , agriculture , water conservancy, forestry and national defense construction^[1]. So a shortened product development cvcle can be faster to meet the market demand. An excavator working device is constituted by a number of parts. When we use the Pro/E software to design, we model successively the similar parts. If we do it like this, no doubt it can make the design process cumbersome, and waste the designer a lot of working time. At the same time, if we have to modify them, it will waste us more time and effort. Due to the similarities in the component parts of various types of excavators working device, there are certain functional relationships between these similar structures and size. In this paper, we use parameters and combine the Pro/toolkit to achieve the rapid modeling of an excavator working device, so it reduces the design costs and improves the design efficiency.

2 Parametric design

Parametric design is a kind of important geometric pa-

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rameter's fast construction and the geometric model's modification method. The so-called parametric design refers to the design of graphic topological relation as changeless , and its size and shape are constrained; there are certain relationships in the control dimension of parameters and graphic. Parametric design compared with the traditional design , the biggest feature is that it stores the entire design process. The engineering and technical personnel can quickly access the different parts by changing some of the constraint parameter's value.

Through the establishment of an initial model and using the dimension driving method , we can achieve the 3D solid model. The dimension driving is to establish the topological relation according to the designer's requirements , principles and methods. When the user chooses the size that he wants to change and change its value , the related entities and size will be affected. At the same time , they will change. But the topological relation doesn't have any changes and generates a new model. This paper uses a parametric tool to finish the parametric design of an excavator working device model; the tools contain parameters , relations and a family table. The specific procedure is as fol-



Figure 1 Schematic of before improving



Figure 2 Improved schematic

When touching operation buttons, the control units accept the command signal; normally closed solenoid valve V-1 open, normally open solenoid valve V-2 shut down, for a duration of two seconds. During the two seconds, high-pressure nitrogen goes along the arrow (solid line) into the brake, pushes the piston to gradually achieve the maximum stroke , with leak detection continuously. After two seconds the solenoid valve V-1 restore the normally closed state and electromagnetic valve V-2 restores the normal open state; then close the high-pressure gas source , the brake within the remnants of Asian high-pressure gas discharge along the arrow (dotted line) at the end of a cycle. This action is repeated three times , and end after three cycles , increasing the action times to improve the reliability of detection^[2 3].

This schematic takes 2 s for a cycle explanation , of course according to actual production plan requirements , the control units programming can properly adjust production beats , at the same time , the number of cycle can be appropriately set. The more the circulation is the higher the leak detecting reliability

is , but as will reduce the production beat.

3 Tooling design

Tooling's position in the brake calipers is shown in Figure 3, whose role is to restrictively limited relative displacement between the piston and caliper body , to ensure that the relative displacement in the testing process as much as possible to restore the actual braking process.



Figure 3 The position of the tooling in the body components of the brake calipers



Figure 4 Three-dimensional model diagram of tooling

Leak Detection System tooling's dimensional model shown in Figure 4: the upper and lower splint, three bolts, four nuts, two rubber spring compositions. The adjustment of the nut and the height of the rubber height are calculated by actual working condition. Calculated as follows:

$$F = \Delta H \times K \tag{1}$$

$$F = P \times S \tag{2}$$

$$S = R^2 \tag{3}$$

$$H'' = \Delta H + H' \tag{4}$$

Where:

F = high-pressure gas pressure;

P =high-pressure gas pressure;

S = piston area;

R = piston bottom radius;

H'' = rubber spring design height;

K =rubber spring stiffness;

H' = deformation height.

Working mechanism is as follows: the caliper body

and piston form a sealed cavity , high-pressure gas goes through the filling hole into the closed cavity , and promote the piston pressed on plywood; under plywood positions close to the caliper body hook claw; the distance between the upper and lower plates (H) driven by piston become smaller and smaller , the effective stroke of this type brake piston is of 3 mm , obviously the change H is 3 mm; after 0.5 seconds the high-pressure gas stop to inject into the packing stage; after two seconds the release of gas starts; with the action of the rubber spring , the distance between the upper and lower plate reinstated. Then the second cycle is started; repeating three cycles , it lasts for 6 seconds.

4 Control system

The control system is consisted of a PLC , three relays , two solenoid valves , alarm lights , two switches. The circuit schematic is shown in Figure 5.



Figure 5 Circuit schematic

When the switch named SB_2 is closed, the relay KM_1 and KM_2 get electric. Normally closed solenoid value is open. The normally open electromagnetic value is closed. The process lasts for two seconds. Then two solenoid-values reset, namely a loop. A new cycle starts at 4 second, 6 second in the third cycle. The relay the KM_3 get electricity at eight second and the alarm LED blinking until once again set switch named $SB_2^{[4 \sim 6]}$.

5 Field-proven and Prospects

The experiment results show the system is reliable and effective and can meet the requirement of system. It reduces the labor intensity, and effectively implement the national people-centered policy. This article provide an airtight design which has a certain reference value in this industry.

The main brake chamber tightness testing is a problem in the industry; the industry requires that each set of brakes must be 100% leak detected, even though this will not guarantee a defect rate below 10PPM. Therefore, research on reliable, intuitive and efficient leak detection systems is still the subject of future industry.

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