

Virtual Design of the Hydraulic Manifold Block

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Abstract—The hydraulic manifold block is designed by using virtual design method to provide the designer with a complete, image geometric model. Design process is simulated by using the method of physical modeling. Designers can directly see the results of design, the relationship between the observation holes and the assembly result on the virtual model. It reduces the labor of designers and increases the reliability of the calibration process. The programming method is carried out. Taking Visual Basic as the integrated development environment, the database as well as the macro recording and decompilation technology is used for the secondary development of Solid Works, in order to realize three-dimensional parametric design of the hydraulic manifold block.

Keywords—hydraulic manifold block; virtual design; programming method; solid works.

I. INTRODUCTION

Hydraulic manifold block is made of solid metal processing block. The mounting surface of board type valve, the cavity of the cartridge valve and oil outlet of pipe joint and flange are on the surface of the hydraulic manifold block. It has the hole connecting valve mouth, which can realize complex function of oil duct connected between components [1] [2]. As the number of holes on a hydraulic manifold blocks generally can reach dozens, hundreds, for design staff, the design of the channel is not only a lot of work, also checking the channel connecting relation correctly or not, has become more difficult. The traditional check method is based on lines complex integrated block six views and the numerous zigzag sections, using space imagination of the designer to analyze the internal relationship between the holes. It requires a lot of time and manpower. It is difficult for human alone to find out mutual interference between complex holes. Based on the computer aided design, virtual Design (VD) is a new design method by using virtual reality technology developed. The hydraulic manifold block is designed by using virtual design method to provide the designer with a complete, image geometric model. Design process is simulated by using the method of physical modeling. Designers can directly see the results of design, the relationship between the observation holes and the assembly result on the virtual model [3]. It reduces the labor of designers and increases the reliability of the calibration process [4]. Characteristics of virtual design of hydraulic manifold block:

(1) Friendly and intuitive software interface, more meet

the requirements of modern common interface.

(2) Practicality and convenience of the design process.

(3) Strong function of construct and parameterized local modification in three-dimensional space to bring great convenience for designers to optimize the design of valve block.

(4) Open database system structure to bring great convenience for the user to maintain, modify, and add the data of all kinds of valve.

(5) Involves wide channel types, including thread cartridge valve, two-way cartridge valve, all kinds of plate valves, screw hole, bore pipe, overflow valve hole, light and user-defined hole, and allowing the appropriate hole design.

II. PREPARATION FOR VIRTUAL DESIGN OF THE HYDRAULIC MANIFOLD BLOCK

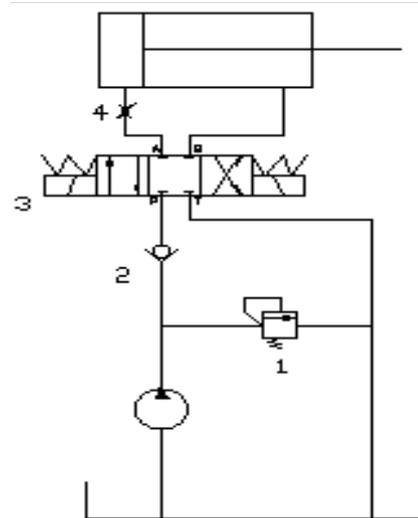


Figure 1. Hydraulic principle diagram

According to the hydraulic principle diagram shown in figure 1, it is regarded as the hydraulic manifold block. 1, overflow valve, 2, one-way valve, 3, electromagnetic directional valve and 4, throttle valve in the hydraulic principle diagram. DBD for overflow valve selection model is put in the front of the hydraulic manifold block; RVP for one-way valve is put at the left of the hydraulic manifold block; 4 W E for electromagnetic directional valve is put at the top of the hydraulic manifold block; FP3 for throttle valve is put on the back of the hydraulic manifold block.

The various channel serial number is shown in figure 2.

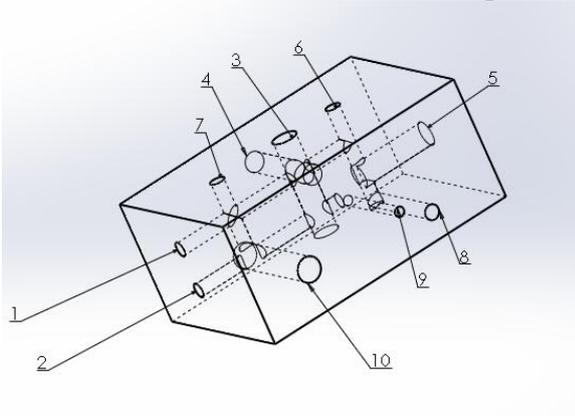


Figure 2. The holes serial number

III. THE THREE-DIMENSIONAL ENTITY REALIZATION OF THE HYDRAULIC MANIFOLD BLOCK

The programming method is carried out. The code is extracted from the first Macro recording [5]. As the direct admission code does not be run directly, it needs to be programmed again. Its part of the VB program code is as follows:

```
Private Sub UserForm_Click()
End Sub
Private Sub set_up_Click()
Dim swApp As Object
Dim Part As Object
Dim boolstatus As Boolean
Dim l As Double
Set swApp = Application.SldWorks
Set Part = swApp.ActiveDoc
boolstatus = Part.Extension.SelectByID2("Front Plane",
"PLANE", 0, 0, 0, False, 0, Nothing, 0)
Part.ClearSelection2 True
Dim vSkLines As Variant
vSkLines = Part.SketchManager.CreateCenterRectangle(0, 0, 1 / 2, -d / 2, 0)
Part.ClearSelection2 True
boolstatus = Part.Extension.SelectByID2("Line5",
"SKETCHSEGMENT", 0, 0, 0, False, 0, Nothing, 0)
boolstatus = Part.Extension.SelectByID2("Line6",
"SKETCHSEGMENT", 0, 0, 0, True, 0, Nothing, 0)
```

IV. VIRTUAL DESIGN

Those who repeatedly were designed and checked did not meet the requirement of the holes connecting [6] [7]. Virtual design is used to modify it. Click 'clear view show' to put the 3 d graphics newly generated block in a transparent view shown in figure 3. The connecting situation for internal channel of the hydraulic manifold block is observed to conveniently and accurately design the process hole.

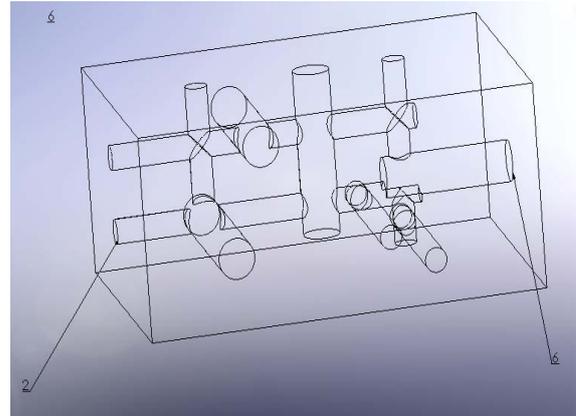
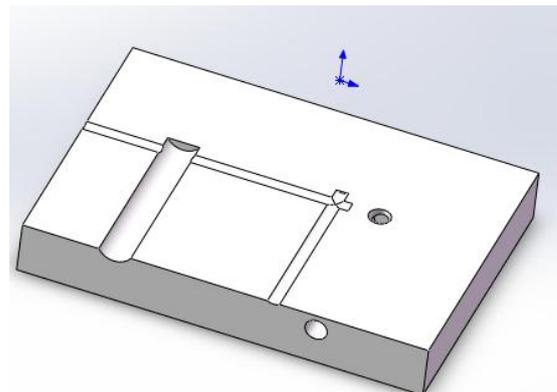


Figure 3. The channel serial number

Holes 2 and 6 connecting error is found in figure 3. Modify the wrong hole connected on the virtual design. Click on the macro toolbar "recording \ macro pause" , then began to bore with wizard drawing process, and after operation click the "stop the macro" icon to stop recording. At this time there will be a "save as" dialog box, enter the name of the macro, and click the "save" commands. (SWP) is automatically added to the file name extension [8]. Then the process of connect error hole redesign has been recorded in the macro and preserved. Open "macro recording file" to extract the macro file hole in the x, y, z coordinates and aperture, hole depth, and redraw the process hole data information added to the hole in the table, which will automatically change the channel connecting table. The new holes data resulting from the virtual design is checked, verify whether meet the design requirements. Those who are connected incorrect holes are iterative designed and checked, until the holes all meet the design requirements. The last generation entities were shown in figure 4.



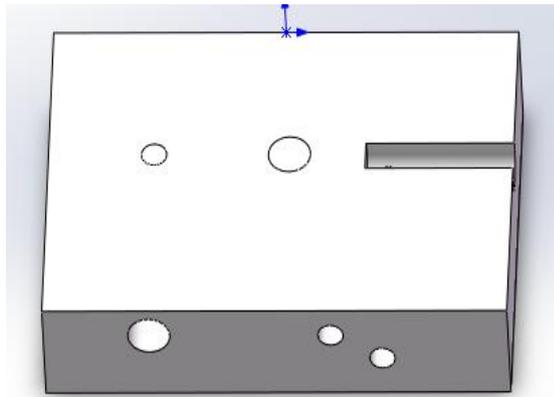


Figure 4. The last generation entities

V. SUMMARY

The hydraulic manifold block as a common component in the hydraulic system, which has the advantages of small volume, light weight, less leakage, easy installation and disassembly, has been widely used. The programming method is carried out. Taking Visual Basic as the integrated development environment, the database as well as the macro recording and decompilation technology is used for the secondary development of Solid Works. The hydraulic manifold block is designed by using virtual design method to meet the design requirements.

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REFERENCES

- [1] Wei-Min L I, Xie L Y. On the SolidWorks-Based Virtual Design Integrated Hydraulic Manifold Blocks[J]. Journal of Northeastern University, 2006, 27(6):681-684.
- [2] Feng X U. Study on the Design of Hydraulic Manifold Block Based on Pro/E[J]. Journal of Nanjing Institute of Industry Technology, 2004.
- [3] Xin Y S, Wang Y X, Yao P X. Application of Pro /E Advanced Development in Hydraulic Manifold Block Design[J]. Modular Machine Tool & Automatic Manufacturing Technique, 2014.
- [4] Wang J, Zhang J J. Optimal Design of Network in Hydraulic Manifold Block[J]. Mechanical Engineering & Automation, 2008.
- [5] Zhou H Y, Zhong T X. Path Optimization Design of Hydraulic Manifold Block[J]. Journal of Shanghai Jiaotong University, 2001.
- [6] Zhang Y L, Gao Y M, Dai B J, et al. Establishment of Hydraulic Components Database and Graphics Library for Hydraulic Manifold Block Design[J]. Machine Tool & Hydraulics, 2004.
- [7] FENG Yi, Zhang H, et al. Design of hydraulic manifold blocks based on intelligent virtual design method[J]. Computer Integrated Manufacturing Systems, 2006, 12(3):339-345.
- [8] Guan H, Yu J H. The Design of Virtual Instruments Control Plate for Hydraulic Testing System Based on VB[J]. Chinese Hydraulics & Pneumatics, 2004.