Hydraulic Test System Design of Hydraulic Valve

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Abstract

In the high-voltage, high-speed, high-power manufacturing industry, the integration of machine, electricity and liquid equipment accounts for a larger proportion of the entire machinery and equipment. The performance of the hydraulic valve and its parameter matching directly affect the reliability of the hydraulic system. The pros and cons of its performance and the appropriateness of parameter matching have a direct impact on the rationality of a hydraulic system design, operational reliability, and ease of installation and maintenance. As a necessary equipment for detecting hydraulic components, the hydraulic test bench can measure various hydraulic components such as hydraulic pumps, hydraulic motors, and hydraulic valves. This paper designs a comprehensive test bed system to test the performance of hydraulic valves, including the main items of type test and factory test, and arrange the test system on site, and use Pro/E for 3D modeling.

Keywords

Hydraulic test system; hydraulic valve; performance test.

1. Introduction

As a main component of the hydraulic system, the hydraulic valve directly affects the performance of the entire hydraulic system. Therefore, accurate testing of hydraulic valve performance is of great significance. The performance test of hydraulic valve is an important means to distinguish the advantages and disadvantages of the product, improve the structural design, improve the process level, ensure the system performance and promote the product upgrade. However, the corresponding performance tests involve many parameters and high precision requirements, and some parameters need to be indirectly processed. In addition, there are many related conditions to be guaranteed during the test process. Traditional test methods have been difficult to meet the increasingly high requirements of performance testing.

Due to the relatively complex composition and function of the hydraulic system, the possibility of failure increases. The failure of the hydraulic system has the characteristics of concealment, transformation and diversity of induced factors. Therefore, in the diagnosis and elimination of faults, not only skilled technicians but also perfect testing equipment are needed. At present, the test equipment for testing the performance parameters of hydraulic components is mostly a hydraulic test bench with a single performance, and in the test, the test records are generally recorded by the experimenter, and the test data is inaccurate. From the point of view of use, once the hydraulic system fails, it is often necessary to test the technical specifications of various hydraulic components to diagnose the location of the fault and the source of the fault. This requires multiple sets of hydraulic test stands with a single performance, which will inevitably increase the cost of testing. To this end, we have designed a hydraulic comprehensive test bench, which can test the performance parameters of the hydraulic valve separately, and the test is convenient, the cost is low, and the data is accurate.

2. Test Requirements for Hydraulic Valve Performance Testing

According to JB/T10347-2002 "Hydraulic Relief Valve", JB/T10370-2002 "Hydraulic Sequence Valve", JB/T10367-2002 "Hydraulic Pressure Reducing Valve", JB/T10364-2002 "Hydraulic Check Valve", JB/ T10366-2002 "hydraulic speed control valve", JB/T10368-2002 "hydraulic throttle valve", JB/T10372-2002 "hydraulic pressure relay" mechanical industry standard requirements[1],

[2] . The new hydraulic valve test bench designed in this paper is completed under the conditions of the test indicators required in the standard. The main indicators of the standard are described below:

(1) The test items of the hydraulic valve test bench are: factory test and type test;

(2) The test accuracy requirements of the hydraulic valve test bench: the type test is not lower than the B grade, and the factory test is not lower than the C grade;

(3) When the specified rated flow rate of the tested valve is less than or equal to 200L/min, the test flow rate is the rated flow rate;

(4) When the specified rated flow rate of the tested valve is greater than 200L/min, the test flow rate is allowed to be 200L/min. However, it must be assessed by the working conditions, and the performance indicators of the tested valves are based on the requirements;

(5) The operation time of the hydraulic control check valve in the system shall not exceed 10% of the response time of the tested valve, and the maximum shall not exceed 10 ms;

(6) During the factory test, the working voltage of the electromagnet of the tested valve shall be 85% of its rated voltage;

(7) The system oil supply pressure is 31.5 MPa, the system oil supply flow rate is 200 L/min, and the maximum diameter of the tested valve is Ø32.

3. Determination of the Loading Plan

Compared with several existing loading schemes [3], the system selects hydraulic loading. The loading scheme as shown in Figure 1 is employed.

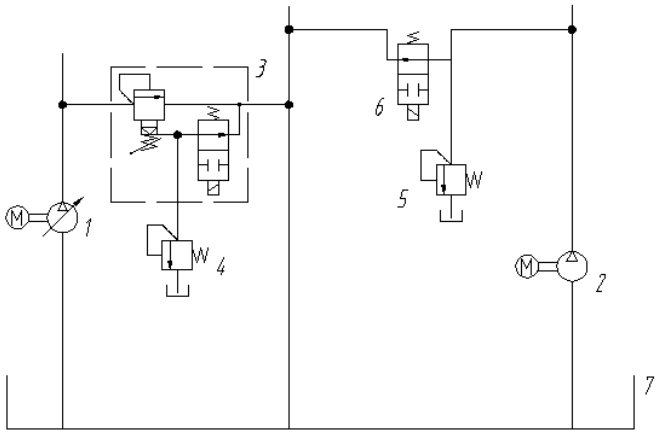

Figure 1. Hydraulic valve performance test partial loading scheme

The variable pump 1 is a main oil supply pump, the outlet is connected in series with an electromagnetic relief valve 3, and the valve 3 is provided with a two-position two-way electromagnetic reversing valve. When the reversing valve is in the conducting state, the oil pressure at the outlet of the pump 1 is determined by the relief valve 3. When the reversing valve is in an open circuit, the oil pressure at the outlet of the hydraulic pump 1 is set by the remote relief valve 4, thereby achieving multi-stage pressure regulation.

The hydraulic pump 2 is a control oil supply pump, and its outlet is connected to the direct-acting relief valve 5 in series. When the two-position two-way selector valve 6 is in the on state, the outlet of the pump 2 is turned on to the fuel tank, and the outlet oil pressure is zero. When the switching valve

6 is in the open state, the outlet oil pressure of the hydraulic pump 2 is determined by the set pressure of the relief valve 5 [4].

4. Determination of Hydraulic Valve Test System

Since the test bench is a comprehensive test bench for testing hydraulic valves, including pressure control valves, flow control valves, and directional control valves, the test system is divided into a main test oil circuit and a control oil circuit. At the same time, it is considered that the operator can easily understand the working state of the system, and can transmit the signal line to the control room by the computer data automatic acquisition and processing system display. Two sets of test systems are used: one is to display the signal with the mechanical meter on the console, and the other is to collect the signal through the sensor and display it on the instrument cabinet through computer processing [5] [6] .

Taking into account the above, the hydraulic system that was finally established is shown in Figure 2.

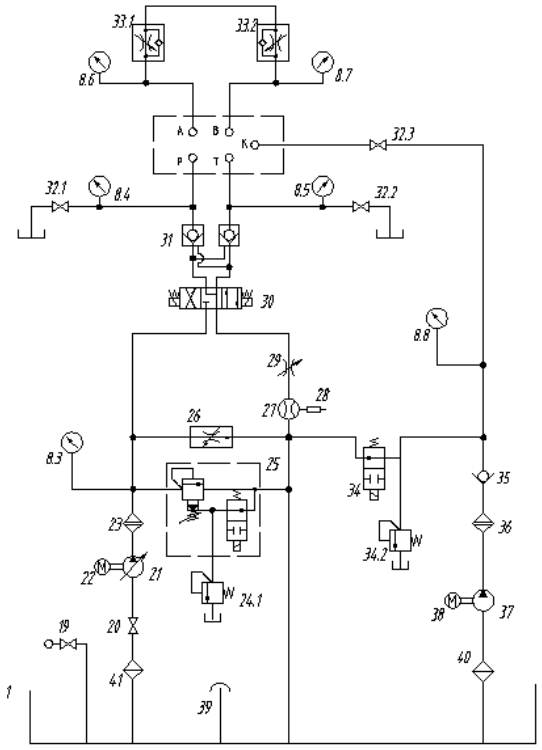

Figure 2. Schematic diagram of hydraulic valve test system

In order to expand the test range and improve the flexibility of the test system, the main oil circuit hydraulic pump 21 uses a constant power variable oblique axis piston pump. The pilot type electromagnetic spill valve 25 regulates the outlet oil pressure of the pump at the main pump outlet. The electromagnetic spill valve 25 is provided with a two-position two-way electromagnetic reversing valve [7]. When the reversing valve is turned on, it is equivalent to the set pressure of the electromagnetic spill valve is zero. When the valve is closed, the outlet pressure of the pump can be set by the electromagnetic spill valve 25 and the direct acting relief valve 24.1. The speed regulating valve 26 regulates the flow rate by means of bypass throttling. The electromagnetic reversing valve 30 can switch the flow direction of the oil. The pilot operated check valve 31 ensures one-way flow of the oil, thereby improving the accuracy of the test results. The oil passage of the control oil passage hydraulic pump 37 is connected with a direct-acting relief valve 24.2 to adjust the oil pressure at the pump outlet. The electromagnetic reversing valve 34 is used to adjust the presence or absence of the control oil pressure. There are five ports A, B, P, T and K in the system. When testing a certain type of hydraulic valve, the test valve port can be tested by connecting it to the corresponding port [8] [9].

5. 3D Modeling and Site Layout

After completing the design and selection of the above hydraulic system, we need to arrange the construction of the field test bench. After considering multiple factors, determine the layout of the test bench and model the test bench using Pro/E. As shown in Figure 3.

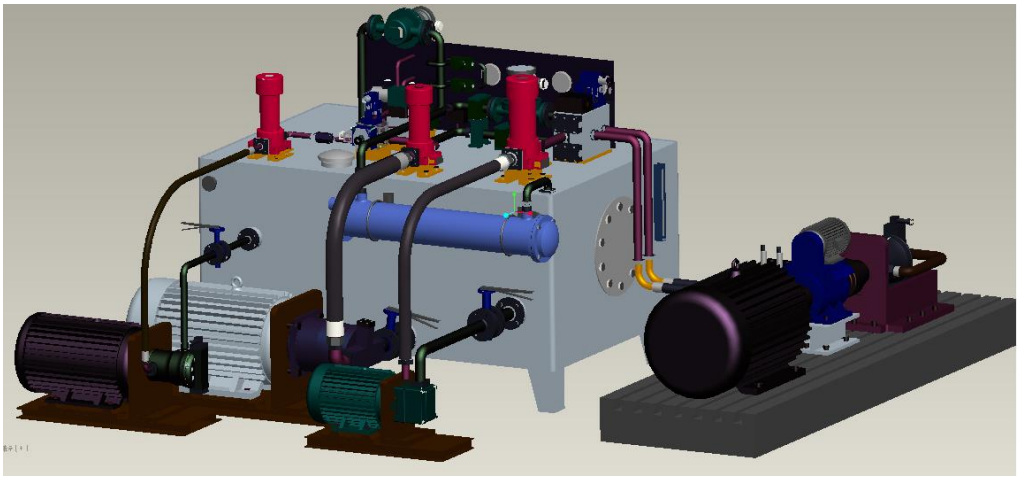

Figure 3. 3D view of the hydraulic station

As can be seen from the figure, the test bench includes various components such as a power source device, a fuel tank, a filter, a cooler, an operation panel, and a pipe fitting. It can be seen that the test bench can meet the above requirements and can more conveniently and accurately test the performance of the hydraulic valve.

6. Conclusion

Due to the performance of the hydraulic components and the matching of parameters, it directly affects the rationality of the design of a hydraulic system, the convenience of installation and maintenance, and whether it can operate normally and reliably according to the established requirements. Therefore, a fully functional hydraulic test rig can test all kinds of hydraulic components that will be put into use, and the test results are directly related to the stability and rationality of the system in the future. This test bench was developed to meet the above requirements.

This paper mainly designs the schematic diagram of the hydraulic valve integrated test system, and designs the layout, sealing and installation of the hydraulic components in the test system, and carries on the three-dimensional modeling of the test system.

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