Design of Hydraulic System for Mobile Rail Vehicle

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Abstract

In this paper, the hydraulic system of mobile rail car is designed. First, the mobile rail car is introduced briefly. Then the balance loop and the pressure retaining loop are designed. On this basis, the general hydraulic principle of the mobile rail car is drawn.In the design of the hydraulic system, under the limited system pressure and installation size, the pressure of the hydraulic cylinder is enhanced by using the pressurized loop to get a greater clamping force.The structure of the hydraulic system is perfect, it can successfully complete the action of clamping, pushing and so on. It has good popularization and application value, and provides a theoretical reference for the future research.

Keywords

Movable type, welding, balance loop, pressure retaining loop.

1. Introduction

With the continuous rise and development of high speed railway, trains have higher requirements for railway lines. The high speed track structure requires the characteristics of a seamless structure with good comprehensive elasticity, smooth, rail bar and turnout.Continuous welded rail is an important part of railway modernization. It has the advantages of reducing driving resistance and reducing vibration and noise. And the economic benefit is remarkable, according to the statistics of the relevant departments, compared with the ordinary line, the seamless line can save at least 15% of the regular maintenance cost and extend the service life of the rigid rail by 25%.The main methods of rail welding are gas pressure welding, thermit welding, arc welding and contact welding.In all kinds of welding technology, the development of aluminum thermal technology in Germany is early, as early as in 1970s, its aluminum thermal welding technology is extremely applicable, welding materials (flux) and welding machinery have been developed greatly. France has found fast rail welding technology in high speed railway. Advanced contact welding method is adopted in base welding, and mobile contact welding and QPCJ aluminum heat welding are used in field welding.

The mobile rail car can weld a number of rail joints in a blockade point to realize the mechanized operation of the rail welding in the field, improve the working environment, improve the safety labor protection of the construction personnel, control the welding process automatically, have the function of pressing and pushing and pushing, and the tensile force is great, and the high quality of the welding joint is effectively guaranteed. The amount and high stability greatly improve the automation and welding quality of rail welding. The design of mobile rail car mainly includes the design of welding machine control part and the design of hydraulic system. The main purpose of this paper is to design the hydraulic system.

2. Hydraulic System of Rail Car

The hydraulic system of mobile rail welding vehicle includes pump station, lifting device hydraulic subsystem and welding machine head hydraulic subsystem. The pumping station provides high pressure oil for the entire hydraulic system, and the motor drives the hydraulic pump. When the pump station is selected, it should meet the power demand and have proper power reserve.

The hydraulic subsystem of hoisting device includes the following aspects[1].

The rotary table hydraulic motor is used to rotate the worktable so that the welder can rotate to an appropriate angle.

There are two variable amplitude hydraulic cylinders are used to change the pitching angle of telescopic arms.

There are two telescopic hydraulic cylinders are used to expand the inner arms of telescopic telescopic arms and change the distance of the welders.

The three sets of hydraulic components can work at the same time, so that the position of the welder's head can be adjusted efficiently to the welds[2].

The hydraulic subsystem of the welding machine head consists of a clamping cylinder, which makes the head double arm clamp to clamp the two segment of the rail to be welded, so that the top forging hydraulic cylinder can lift the top forging rail, so it needs a larger clamping force. Due to the pressure limitation of hydraulic system and the size of hydraulic cylinder section, it is impossible to achieve unlimited size. It is necessary to design special hydraulic cylinders or increase pressurization circuits[3].

2.1 Balance Loop.

The function of the balance circuit in the hydraulic transmission is to prevent the vertical moving parts of the hydraulic transmission from falling down, and the balance valves are usually used to control them.The balance valve is divided into internal control according to the control mode (the inlet pressure of the valve is used as the control pressure to control the valve opening and closing) and the external control (opening and closing the valve through the external pressure into the control port). The balance valve is divided into internal leakage according to the unloading mode (the unloading port is connected to the sequential valve outlet) and the outlet (the unloading port is individually taken back to the fuel tank)[4].The correct use conditions of the balancing valve or the hydraulic check valve are shown in Table 1.

Table 1 Correct use conditions of balance valve or liquid controlled one-way valve

The name of the valve	Control mode	Unloading mode	Conditions of use
Balance valve	External control	Inward leakage	The throttle valve is connected in series before the valve, and the adjusting opening pressure is slightly larger than 0.
		Outward leakage	The throttle valve is connected in series before or after the valve, and the adjusting opening pressure is slightly larger than 0.
	Internal control	Inward leakage	No series throttle valve is needed, adjusting the opening pressure is slightly larger than 0.
		Outward leakage	There is no need to let out
Liquid controlled one-way valve	External control	Inward leakage	The throttle valve is connected in series before the valve, and the adjusting opening pressure is slightly larger than 0.
		Outward leakage	The throttle valve is connected in series before or after the valve, and the adjusting opening pressure is slightly larger than 0.

2.2 Pressure Retaining Loop.

In this system, the hydraulic cylinder is clamped by clamping the rail, and the top forging hydraulic cylinder is sent to the rail flash welding. In this process, a certain clamping force is needed. After the welding is completed, it needs to hold the clamping and keep the head forging force to push the tumor. Therefore, it is necessary to design a loop to guarantee the pressure of the clamping hydraulic

cylinder and the top forging hydraulic cylinder. The force is maintained. Since the whole process lasted for a short period of time, about 60 to 80s (welding time was 60 to 80s), the pressure retaining circuit of the hydraulic check valve was adopted to meet the requirement[5-7].The hydraulic control check valve is simple in principle and mainly uses cone valve sealing to keep pressure. The pressure protection loop is shown in Fig. 1.

The whole process is divided into three working conditions: first, the hydraulic cylinder moves upward. At this time, the reversing valve is required to work in the left position, the hydraulic cylinder is injected into the lower chamber, and the fluid on the hydraulic cylinder is returned to the oil tank through a one-way valve, that is, the electromagnet 1YA is electrified at this time; the second is the supercharging condition, at this time the right position of the valve is needed and the pressure of the upper chamber of the hydraulic cylinder is raised. The pressure relay adjusted to the pressure value, that is, the electromagnet 2YA electrified at this time; finally, when the pressure reaches the set value, the reversing valve is in the middle, the pump is unloading, the hydraulic cylinder is guaranteed by the one-way valve, that is, the electromagnet 2YA is out of power.

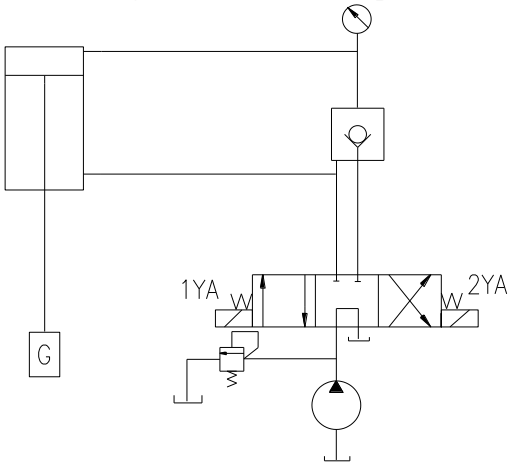

Fig. 1 Hydraulic control loop of one way valve

3. Hydraulic System of Mobile Rail Car

Fig. 2 shows the hydraulic principle diagram of the rail car. The hydraulic system completes the position adjustment of the welding machine head, the rail clamping, the rail top forging, and the push and convex. These four kinds of operations can not be carried out at the same time.The connection mode of the distributor valve shown in Fig. 2 can ensure that there are no other operations when adjusting the position of the welder.When clamping the rail, the top forging hydraulic cylinder cannot move; when the clamping action is finished, the oil pressure of the pipe of the clamping hydraulic cylinder rises. The pressure change passes through the sensor to the electrical signal to be input into the control computer. When the set value is reached, the action of the solenoid valve is switched to the middle, and the liquid controlled one-way valve of the large cavity loop of the clamping liquid pressure cylinder starts to rise. The holding effect ensures the gripping of rails during the forging process.At the same time, the computer sends out program setting instructions to the proportional speed control valve and the solenoid valve, both of which are combined with the action control top forging hydraulic cylinder to be forged or backward in accordance with the predetermined process curve. During the forging process, the computer continuously collects the real-time value and technological requirements of the welding current and compares it to determine the forging speed of the upsetting hydraulic cylinder. The computer is controlled by weak current, and the valve is controlled by strong electricity. Relay connection is used as the intermediate drive between the two[8-10].

In order to prevent overload, a safety relief valve 2 is set up. Overload valve is installed on the pipeline of the turntable hydraulic motor 11, the telescopic hydraulic cylinder 8 and the luffing hydraulic cylinder 9, so as to prevent overload damage of the components.

Hydraulic control one-way valve is installed for clamping hydraulic cylinder 20 and upsetting hydraulic cylinder 16 respectively for the purpose of holding pressure holding upsetting and pressure bumping. Depending on the tightness of the hydraulic check valve, the pressure can be maintained for a long time to meet the need.

The valves of each distribution valve are provided with one-way valves. When acting together, they will not interfere with each other due to the self weight of the working devices.

The action sequence of each solenoid valve is shown in Table 2.

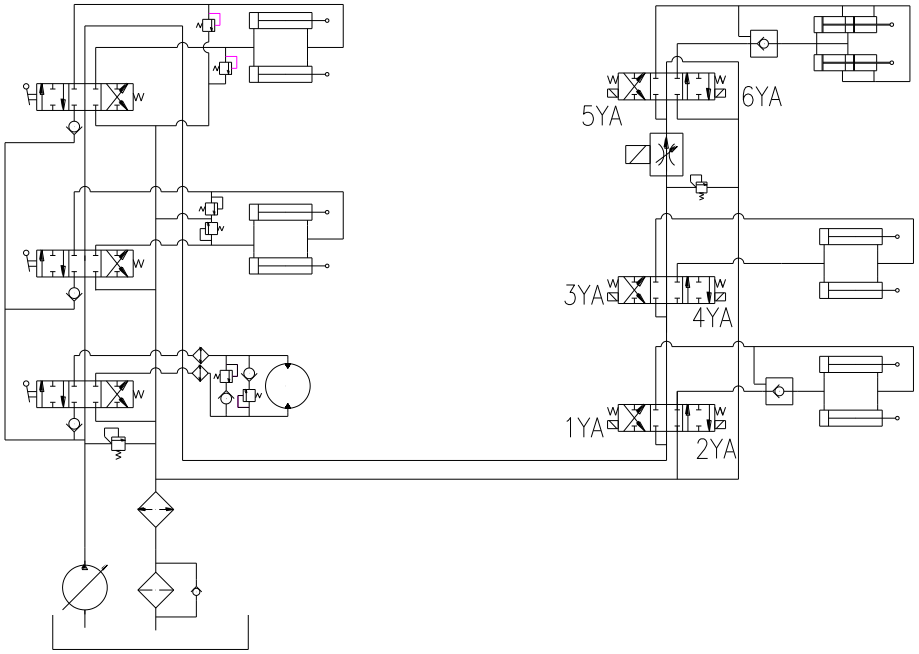

Fig.2 Hydraulic principle diagram of mobile rail car

Table 2 Action sequence table of each solenoid valve

	1YA	2YA	3YA
Clamp	+	—	—
Top forging	—	—	—
Protruding	—	—	+

4. Conclusion

Rail welding is an important part of laying CWR, and its smooth and internal quality is the key to ensure the normal operation of jointless track. Practice has proved that if the quality of rail welding is not good, it will bring great trouble to the maintenance of the line, and it will also endanger driving safety seriously. The mobile rail car has solved the transportation problems of the supporting equipment, provided the power source for the site, and also provided a good working environment for the field operation. It greatly alleviated the labor intensity of the field work, made the rail welding quality reach or close to the level of the welded rail, and ensured the welding quality, and met the increasingly prominent quality. High speed and heavy load on rail are high standards and high requirements for rail welds. The structure of the hydraulic system designed in this paper is perfect, the selection of hydraulic components is correct, and the mobile rail car can realize the functions of clamping, top forging, pushing and so on. It has good application value and has good prospects for development.

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