Small Loader Plc Control System Design

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Abstract

An application example of electrical control system for small loader based on PLC components and process of the control system are amply discussed, now the PLC selection the PLC control system is working reliably, and satisfies the design requirement.

Keywords

Small loader, PLC, control system.

1. Introduction

This paper designs the hydraulic system of the small loader with reference to the parameters of a loader. According to the control requirements of the underground small loader hydraulic system, the PLC control system of the device was designed, and the hardware of the control system was selected, the input and output ports were allocated, and the hardware selection and control program were written for the PLC.

1.1 Loader Hydraulic System Design

The small loader is mainly used in the drilling field under the coal mine, and the size is required to adapt to the working environment. The machine works well, is safe and reliable, and can work flexibly in the narrow space of the drilling field, including the design of the boom hydraulic system, the bucket hydraulic system and the walking steering hydraulic system.

The design of coal mine drill field of small loaders hydraulic system should meet the following requirements:

(1)Since the steering ， movable arm and the hydraulic system of the bucket may work at the same time, in order to prevent mutual interference between the oil passages during operation, the steering hydraulic oil passage can be the same as the boom and the bucket hydraulic oil. The roads are separated to make them independent. Because the size of the loader is small, the two hydraulic circuits are separately supplied with oil by a double gear pump.

(2)high reliability. During loading operation, the load changes greatly,accompanied by impact and vibration. Therefore, safety protection devices should be installed in the hydraulic system to prevent the hydraulic system from being damaged. Overflow valves can be installed on each hydraulic return circuit to protect the hydraulic system and hydraulic components from overload or other accidents in the hydraulic system.

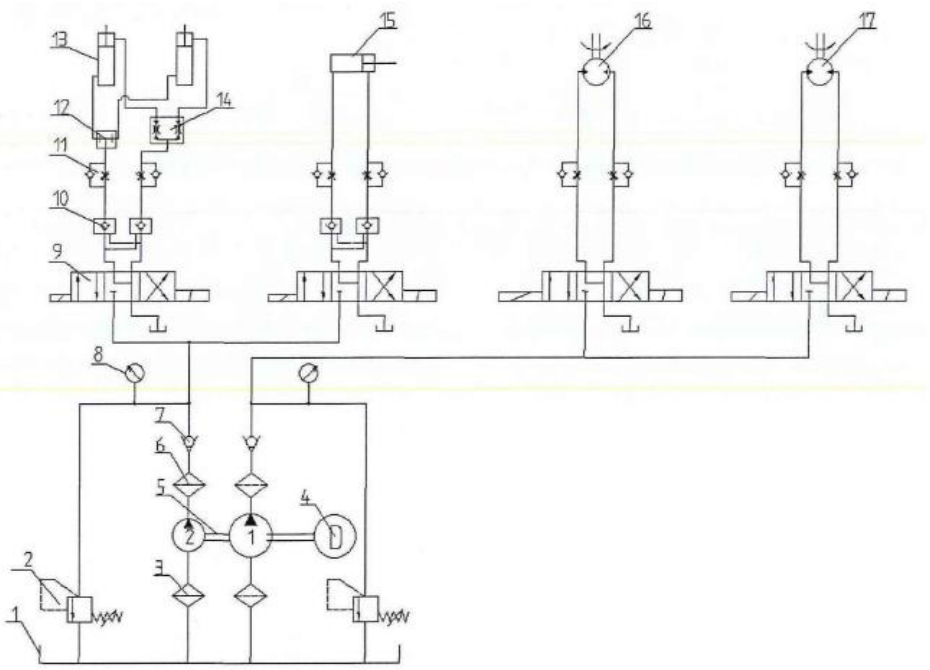
(3) the oil cylinder of the rotary bucket and the moving arm needs to reach out and retract, and the walking motor needs to realize rotation reversal and stop. These actions can be achieved by installing 3d four-way electromagnetic reversing valve.

The rotary bucket , movable arm oil cylinder are also need to lock the seat, no matter how big the load, how to change the situation, or fuel tank to the hydraulic cylinder of the hydraulic pipeline failure cases, require the hydraulic cylinder has the function of locking to prevent the occurrence of safety accidents,

so the movable arm, the rotary bucket of hydraulic circuits are set in the hydraulic lock cylinder for location of the lock.

(4)in order to prevent the hydraulic oil in the hydraulic circuit from flowing back into the hydraulic pump when the small loader in the underground coal mine drilling field stops working, one-way valve should be set in the oil pipeline.

In summary, the hydraulic system principle diagram of the small loader in the underground coal mine drilling field is shown in figure 1:



Oil tank 2.relief valve 3.purolator 4.Electric machinery 5.Bidentate united pump 6.purolator 7.Check valve 8.piezometer 9.Three - position four-way electromagnetic directional valve 10. Hydraulic lock 11 .flow speed control valve 12. joint 13. Movable arm oil cylinder 14.flow-combining valve 15. turn oil cylinder 16. Walking left motor 17.Walking right motor

2. Design of PLC Control System

2.1 Distribution and Determination of Input and Output Points

The control system of the small loader consists of two input terminals for the start of the motor, five input terminals for the rotary bucket oil cylinder and five input terminals for the moving arm oil cylinder, ten input terminals in total, and three input terminals for the forward and backward rotation and stopping of each motor. There are eighteen input terminals. Three contacts are required for starting the motor, that is, three output terminals are required, two output terminals are required for each electromagnetic reversing valve, four electromagnetic reversing valves in total, and eight output terminals are required, so a total of 11 output terminals are required. As shown in table 14, it is the input address distribution table of PLC control system of small loader.

Table 1. Input allocation table

Input	Switching values	*Instructions*
X0	SB1	Motor start button
X1	SB2	Motor stop button
X2	SB3	Turn bucket cylinder extension switch
X3	SB4	Turn bucket cylinder retraction switch
X4	SB5	Moving arm cylinder extension switch
X5	SB6	Moving arm cylinder retraction switch

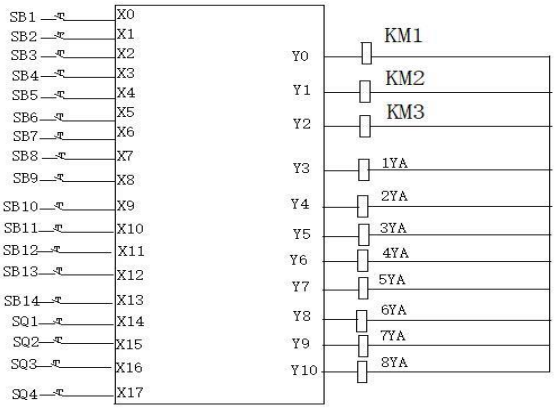
X6	SB7	Left motor forward switch
X7	SB8	Left motor back switch
X8	SB9	Right motor forward switch
X9	SB10	Right motor back switch
X10	SB11	Turn bucket cylinder stop switch
X11	SB12	Moving arm cylinder stop switch
X12	SB13	Left motor stop switch
X13	SB14	Right motor stop switch
X14	SQ1	Turn bucket cylinder upper stroke switch
X15	SQ2	Turn bucket cylinder lower stroke switch
X16	SQ3	Moving arm cylinder left stroke switch
X17	SQ4	Moving arm cylinder right stroke switch

Table 2. Output allocation table

Output	*Code*	*Instructions*
Y0	KM1	Contactor 1
Y1	KM2	Contactor 2
Y2	KM3	Contactor 3
Y3	1YA	Left motor solenoid commutator valve coil 1
Y4	2YA	Left motor solenoid commutator valve coil 2
Y5	3YA	Right motor solenoid commutator valve coil 1
Y6	4YA	Right motor solenoid commutator valve coil 2
Y7	5YA	Moving arm solenoid directional valve coil 1
Y8	6YA	Moving arm solenoid directional valve coil 1
Y9	7YA	Turn bucket solenoid directional valve coil 1
Y10	8YA	Turn bucket solenoid directional valve coil 1

2.2 PLC Type Selection

The S7 series programmable controller has high stability, strong anti-interference ability, and adopts the mode structure, which can be replaced by CPU module, I/O module, interface module and power module as required. This paper adopts s7-200 cpu226 PLC, which has 24 digital input and 16 digital output. For control procedures, using STEP7 programming software programming and debugging, such not only can use ladder diagram and statement table offline form of programming, through the compiled by connecting cable directly downloaded to the PLC memory to carry out, and in the debug run time can monitor the state of each input/output or online point on off status, even online modify a variable in a program, bring great convenience debugging.



3. Conclusion

After applying the PLC and its programming software STEP7 to the equipment control system, the equipment runs stably and reliably, satisfies the requirements of the control system .The control system has a simple structure and convenient maintenance, which satisfies the application requirements well.

References

[1] Jiakang Huang. Design and research of working device for small loader in coal mine drilling field(D): [Master's thesis]. Anhui: Anhui University of Science and Technology, 2015.
[2] Zipeng Guo. Research on hydraulic drive system of loader (D). [Master's thesis]. Shanxi: Chang'an University. 2014.
[3] Yubo Shan, Liu Feng, Liu Delin. Design Concept of Bucket Type Rock Loading Machine. Coal Mine Machinery, 2009, 30 (9): 142-143.
[4] ping Li. Hydraulic Transmission System and Design [M]. Beijing: Chemical Industry Press, 2005.
[5] Jianxing Li. Programmable Control and Its Application [M]. Beijing: Mechanical Industry Press, 1999.
[6] Yonghua Tu. Electrical Appliances-PLC Control Technology and Application [M]. Beijing: Mechanical Industry Press, 2007.