HJD Type Single lever Crane PLC transformation in control circuit

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HJD winch is a commonly used type of winch for domestic ships, The motor is AC three-speed squirrel cage motor with three independent sets of the stator windings. The respective number of the poles is 4/8/28. The asynchronous speed is 1500/750/215 r/min. The 4-pole and 8-pole are designed based on constant power. The 4-pole is high-speed while 8-pole is rated pole. The 28-pole is low speed pole with low starting current, large starting torque, in order to meet the requirements of frequent starting and landing goods with low-speed. Traditional HJD winch control circuit adopts relays and contactors for secondary circuit control, the coils and contacts are easily burned after long-term use, frequently causing accident. The chief aim of the present work is provide a available way shifting to PLC control reducing the use of coils and contacts. In this paper, The PLC reconstruction, including basic protection control process, rose and drop process, brake process, low/medium/high-speed process, has been supplied. There are no failures after long-term use. PLC used in this paper is Siemens S7-200.

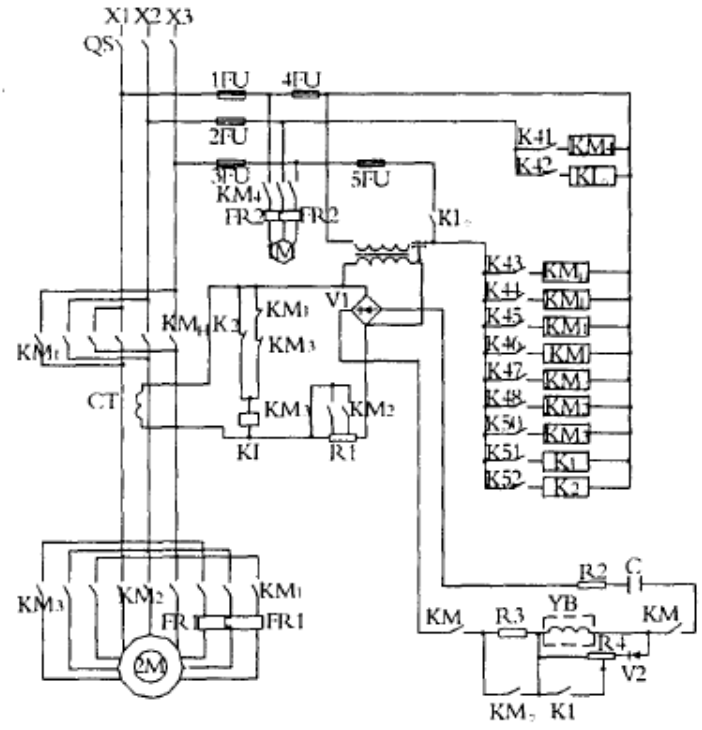


Figure 1: Control Circuit

1. Reconstruction of Basic Protection Control Process
   Close the main circuit power and master controller power switch, open the throttle switch and control circuit power switch. In normal circumstances when the protection equipment releases, the energy flow circulates, winch functions correctly. The pictures below realize the reconstruction of fan motor overload protection, the motor windings overheating protection, power supply missing phase protection, emergency forced running and so on. Power Switch I0.1 can also be used as emergency-off switch. Switch I1.4 is zero-voltage relay, The master controller must be put back to

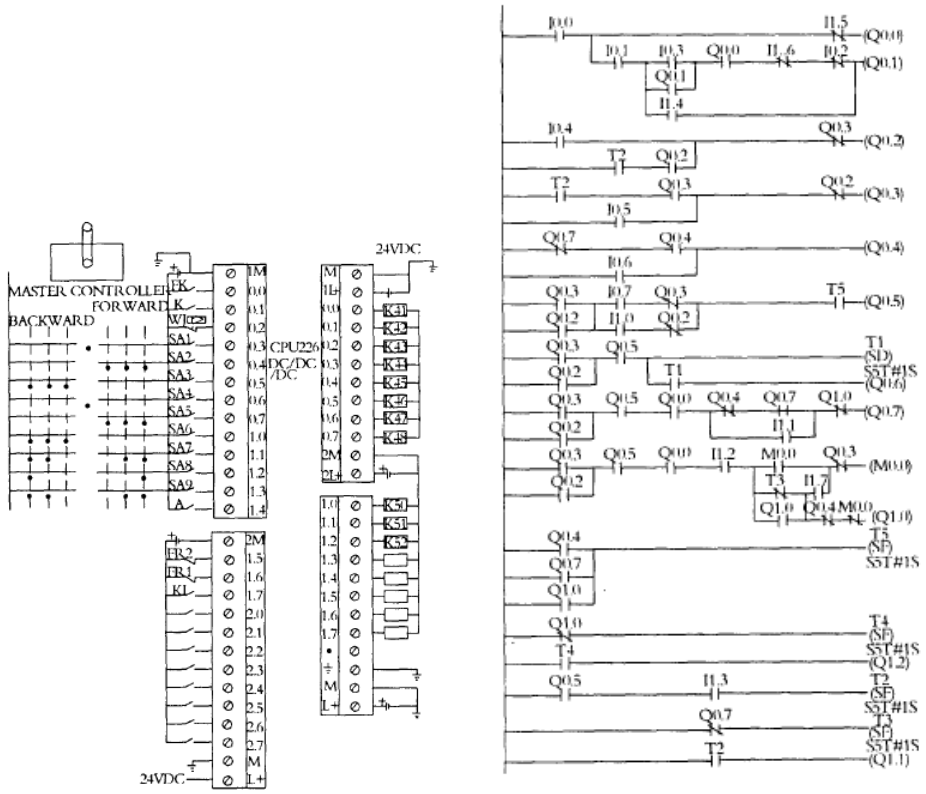
zero position when power failure occurred.

2. Reconstruction of Rose and Fall Process
   The process realizes the function of rise and fall, at the same time achieve reverse torque control. Torque control functions are based on "automatic parking process" and "automatic delay start process". Steering control contacts Q0.2, Q0.3 interlock, to avoid short circuit.

3. Reconstruction of Brake Process
   The process implements the parking brake as well as automatic grade braking at high speed. In normal rise or fall state, parking brake coil pulls in, while main switch placed on an empty file, brake coil pulls out after delay, mechanical parking brake operates. When the motor parks in medium/high gear, DC master switch disconnect, low speed winding connected, producing rotating magnetic field in the stator, while the rotor still runs at a high speed, so that the motor runs on electrical braking mode.

4. Reconstruction of Low/Medium/High-Speed Process
   Motor runs at low speed after control circuit power closes, so the essence of low-speed process is to close rise or fall contactor, let the crane go in the running state. The medium speed switch locks with low speed switch and interlocking with high speed switch. Compared with medium-speed process, high speed process additionally need to consider the delay from medium-speed to high-speed and heavy load. Heavy load is detected by load relay, when load relay coil pulls in, high speed link cut, so crane still operates in medium-speed. Taking into account the mandatory run, the medium/high-speed link joins the fan contactor and braking contactor.

5. Wiring Diagram and Control Logic Diagrams



(a) Wiring Diagram (b) Logic Diagram

Figure 2: The Notification System

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