HJD Type Crane PLC transformation in control circuit

HJD型克令吊控制电路的PLC改造

船海 闫鹏 201430110059

Abstract

Background. HJD type crane is widely used in domestic ships. Traditional HJD type crane adopts relays and contactors for secondary circuit control. The coils and contacts are easily burned after long-term use, frequently causing accidents.

Aims and Approach. The chief aim of the present work is provide an available way shifting to PLC control and reducing the use of coils and contacts. PLC, namely, programmable logic controller, is a digital computer used for automation and control. PLCs support multiple analogue and digital inputs and outputs arrangements, with extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. PLC used in this paper is Siemens S7-200.

Conclusion. In this paper, The PLC transformation, including basic protection control process, rose and fall process, brake process, low/medium/high-speed process, has been supplied after analyzing the principle of control circuits. There are no failures in experiment after long-term usage.

Keywords: HJD, PLC, crane, S7-200, simens.

Outline

Thesis Sentence: The PLC transformations and the method of implementation, including basic protection control process, rose and fall process, brake process, low/medium/high-speed process, list below. Details can be found in the article.

I. Basic protection control process is transformed considering overload, overheat, etc.

   A. Overload protection of fan motor and crane motor

      1. Fan motor overload protection is achieved by fan thermal relay FR2.

      2. Crane motor overload protection is achieved by crane motor thermal relay FR1.

   B. Motor windings overheating protection is achieved by motor temperature controller ST.

   C. Power supply missing phase and circuit break protection are achieved by zero-voltage relay KA1.

   D. Emergency forced running is achieved by the contactor SB.

II. Rose and fall process is transformed into rose process and fall process.

   A. Rose process is achieved by steering control contactor Q0.2.

   B. Fall process is achieved by steering control contactor Q0.3.

   C. DC delay time relay is required in reversing at high speed.

III. Brake process is different depending on the conditions of motor.

   A. In normal rise or fall state, parking brake coil pulls in,mechanical parking brake operates.

   B. In medium/high gear, DC master switch disconnect, low speed winding connects realizing automatic grade braking.

IV. Reconstruction of low/medium/high-speed process list below.

   A. Low-speed process

      1. The crane will run in operational status by releasing rise or fall contactor and the braking contactor.

      2. The shift from low-speed to medium-speed is achieved by energize medium-speed winding power.

   B. Medium-speed process

      1. Medium speed contactor is self-locking and interlocking with low/high speed contactor.

      2. Braking contactor and fan contactor make sure the Motor does not run at medium speed.

   C. High-speed process

      1. Motor should not run in high speed when heavy loaded.

         a. The detection of load is achieved by load relay.

         b. The protection of overload is achieved by load contactors.

      2. The diagram of wiring and control logic has been uploaded to PLC

References

Smoczek, J., and J. Szpytko. 2014. "Evolutionary algorithm-based design of a fuzzy TBF predictive model and TSK fuzzy anti-sway crane control system." *Engineering Applications of Artificial Intelligence* 28:190-200.

Kłosiński, Jacek. 2005. "Swing-free stop control of the slewing motion of a mobile crane." *Control Engineering Practice* 13:451-460.

Kim, Dooroo, and William Singhose. 2010. "Performance studies of human operators driving double-pendulum bridge cranes." *Control Engineering Practice* 18:567-576.

Armstrong, N.A., and P.R. 1994. “MooreA distributed control architecture for intelligent crane automation.” *Automation in Construction* 3:45-53.

Das, S.K., S. Utku, and B.K. Wada. 1990. “Use of reduced basis technique in the inverse dynamics of large space cranes.” *Computing Systems in Engineering* 1:577-589.

Chang, Chengyuan, and Kuo-Hung Chiang. 2008. “Fuzzy projection control law and its application to the overhead crane.” *Mechatronics* 18:607-615.

Armstrong, N.A., and P.R. Moore. “A distributed control architecture for intelligent crane automation.” *Automation in Construction* 3:45-53.

Rusinski, Eugeniusz, Zaklina Stamboliska, and Przemysław Moczko. 2013. “Proactive control system of condition of low-speed cement machinery.” *Automation in Construction* 31:313-324.

Gelen, Gökhan, Murat Uzam. 2014. “The synthesis and PLC implementation of hybrid modular supervisors for real time control of an experimental manufacturing system.” *Journal of Manufacturing Systems* 535-550.

Peng, Xiaohua, Zhilei Cui, Wen Gu, Weiguo Xu, Xuejun Guo. 2014. “Low level of LAT–PLC-γ1 interaction is associated with Th2 polarized differentiation: A contributing factor to the etiology of asthma.” *Cellular Immunology* 131-137.

Javier Matanza, Sadot Alexandres, Carlos Rodriguez-Morcillo. 2013. “Performance evaluation of two narrowband PLC systems: PRIME and G3.” *Computer Standards & Interfaces* 198-208.

Acknowledgments

The author acknowledge the support of the Shanghai Maritime University and the college of Merchant Marine. The author appreciate the valuable help from instructor Mr. Ling, and express his gratitude to all those who helped him during the writing of this thesis. The content is solely the responsibility of the author and does not necessarily represent the official views of the Shanghai Maritime University and Merchant Marine College.