Development of control system of hydraulic press based on zelio logic controller

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S u m m a r y Modernization of control system of hydraulic press of model 2240D with the usage of programmable logical controller, namely intellectual relay Zelio Logic is considered. The consequence of technological operations fulfillment such as pressing, non-formal control algorithm, choice motivation of PLC model SR3B261B, control program fragment in the FBD language is given.

K e y   w o r d s : Press, input, output, algorithm, the controller program, logical controller, software, language

INTRODUCTION

The development and mass industrial usage of microprocessor control units (MCU) and microprocessor control systems (MCS) is one of the most important directions of scientific-technological progress in the sphere of automation of stationary and mobile objects in industrial production, transport and communication.

Functionally finished MCU on the base of which the majority of information and control systems are built today are the most interesting ones among a lot of other means of MP technique for the specialists dealing with the automation of industrial objects. MCU can be directly built up into the technological units, assembly complexes, stationary and mobile objects. Thus, control quality of a technological process is essentially, greatly increased, the consumption of energy, raw materials is saved, and the industrial production and product quality is greatly increased.

By nowadays the majority of up-to-date systems of industrial automation are built on the basis of highly-reliable and easily-arranged programmable logic controllers (Programmable logic controllers) PLC and industrial computers (Industrial Computers) IC. Both of them are adapted to work under hard production conditions and they differ from others that PLC are aimed only at direct control of industrial equipment (that is to solve the tasks only in the mode of "tough real time"), but IC along with the control tasks solve the tasks of processing and visualizing of a great amount of information at high levels of complex integrated systems of automation of industrial production [12], [Korop 2011].

The diversity of PLC and IC models, functional possibilities and technological characteristics allows us to consider them as multi-purpose means with the help of which practically all tasks of industrial automation can be solved [11].

The development of control system of hydraulic press 2240D [19] on the basis of programmable controller- intellectual relay Zelio Logic is investigated in this work. Developing control systems the intellectual relay Zelio Logic model SR 3B261B and programmable software Zelio Soft have been used. The program is written in FBD language.

The aim of work is to develop and adjust control system of hydraulic press 2240D.

OBJECTS AND PROBLEMS

The press is designed for pressing of large-sized manufactured goods made of plastics. The size of a product depends on the main mould. Pressing force is 1000 tons. Maximum height of pressed products is 650 mm. Press is a vertical

column structure with an upper hydraulic drive. It has a movable cross-piece, a central pusher adjusted for a products blasting in a mould, regulating its motion that is the pusher's motion can be done at definite height (100 mm, 150mm 200mm, 250mm). The photo of the upper part of the hydraulic press is given on figure 1.

Fig. 1. Hydraulic press

The weight of the products is till 30kg. Hydraulic drive consists of a filling and reserved tanks, two pumping plants, two hydro-panels. The press bed is a frame consisting of a basis with the place for a sliding table and an upper cross-piece tightened by 4 columns taking press force. For comparison we see that thermo-plastic automate KYASE 1000 creates locking force of 1000 tons and a maximum weight of product shot is only 6 kg.

Mould preheating is done with the help of two regulators Micra 602 which control the mould heating. The temperature is controlled by thermocouples of TXK type. Load current is visually controlled by the ammeter readings. Short-circuit protection is performed by high speed switches with nominal current of 50A.

Developing the control system all necessary modes of press working and blocking are realized. The analysis of designed circuit interaction showed that it is necessary to have a controller with 16 discrete inputs (a Cross –piece down, a Cross-piece up, a Pusher down, a Pusher up, EKM maxim., a Cross-piece at the bottom, a Cross-piece at the top, a Pusher at the bottom, a Pusher at the top, Switching on the hydro-power station, Switching off the hydro-power station, EKM minim., Pressure relay, Pusher position).

To give the commands the controller must have 9 discrete outputs (a Cross –piece down, a Cross – piece up, a Pusher up, a Pusher down, Electro-

magnets YM 5, 6, Pressure release, Electro-magnet YM 4, High pressure of M1, Control of M3.

In accordance with necessary number of input and output signals the model of Intellectual relay Zelio Logic SR3B261B [20] is chosen. Input signals are connected to the ports of microcontroller I1 – IG, and output signals are connected to out ports Q1 –Q9. The location of electrical equipment in the control cabinet is shown on fig.2.

Fig.2. The location of electrical equipment in the control cabinet.

ALGORITHM OF PRESS CONTROL

Initial position: a cross piece is at the top (transducer SQ1); a pusher is at the bottom (transducer SQ2). A worker lays down weighted hot polymeric mass PP or PE (after extruder) into a mould of a press. Then he presses button SA1 (a cross piece is going down). YM1 is switched on, the controller Q1 is out. The cross piece is moving down till the transducer SQ3 operation (a cross piece is at the bottom). As a result, outputs Q5, Q6 of a micro controller are activated switching on the electro magnets YM5, YM6 and creating high pressure. Press influences the melted down mass into a mould with the force given by an electro-contacted manometer.

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A cross piece is hosted till the transducer operation of a cross piece upper position SQ1 – input I7. Q2 –YM2 is switched off, a cross piece stops.

The operator presses SA4 buttons (input I4), switches output Q3 –YM3, a pusher is moving upward during the given time, by this the hosting height is determined which is given by using four buttons. The operator extracts the product from a mould and then lowers a pusher down. The cycle may be repeated. The protection of press working area is realized using photo-electric transducers.

CONTROL PROGRAM

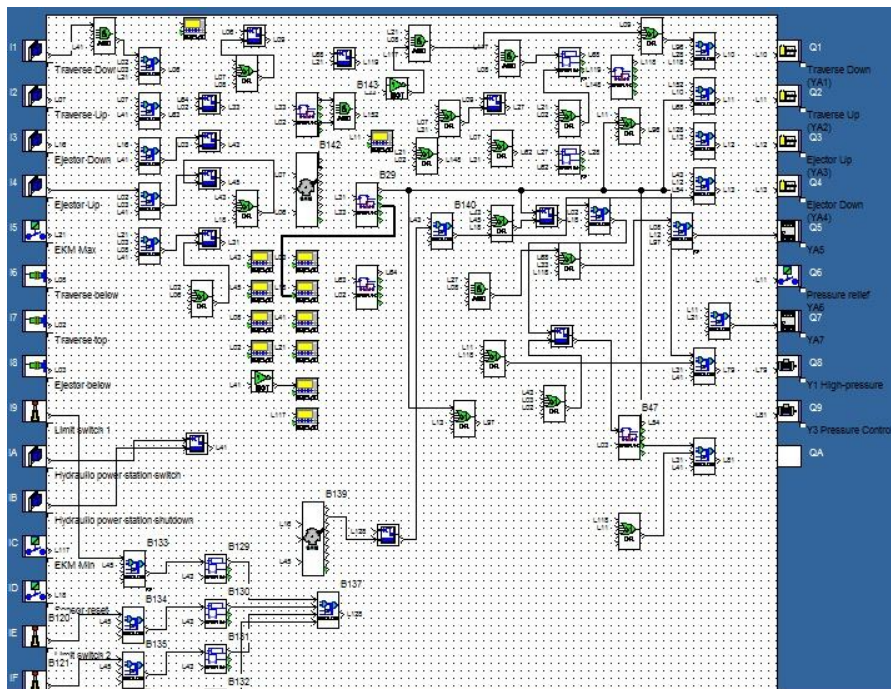The program fragment is written in FBD language, and it is given on fig.3.

Fig. 3. The control program fragment in FBD language

Developing the control system program software Zelio Soft [21] has been used. Programming has been done in the language of functional blocks (FBD) providing the flexibility of programming and high productivity. Zelio Soft performs the checking of coordination, makes syntaxes checking and checks the correctness of data introducing; all this helps correct all errors immediately. The program is tested in real time, and in this case the module can be either connected to the PC or not. Control window shows the input or output conditions of a module in the sphere of applied program.

LCD display on a chosen controller model and usage of DISPLAY function allowed us to show constantly the condition of operated mechanisms what makes the adjusting of control system considerably easier.

CONCLUSIONS

On the basis of considered principles to fulfill technological operations of plastic products pressing, studying the principle hydraulic circuit design of 2240D press, the circuit which has existed earlier on the relay-contact elements, designing the cyclorama of its work, defining necessary quantity of input and output signals we can come to the conclusion that it is possible to use a programmable controller, namely intellectual relay Zelio Logic.

The fixing of input and output signals to the corresponding ports of intellectual relays is done; the control program in FBD language is developed. The principle circuit of control system is designed and the adjusting of its work is performed.

The usage of intellectual relay Zelio Logic allowed us to reduce the sizes of the control system cabinet and the usage of software Zelio Soft and

programmable software in FBD language allowed us to develop and adjust the control system quickly.

REFERENCES

1. **Verhovodov A.V. 2009.:** Using the programme package WinPLC V4 at development managerial system. Praci Lugansk Branch of IIA №2 (20). Part 2, p.10-13.
2. **Verhovodov A.V. 2010.:** Study of the use pulsed sensor at development managerial system pipecarved tool. Praci Lugansk Branch of IIA №2 (22), p.18-22.
3. **Verhovodov A.V., Oleinik R.G. 2009.:** Study of the using the block PI regulator of the programme package WinPLC at regulation temperature processes. Visnik SNU №3, p.32-35.
4. **Verhovodov A.V., Sereda A.A. 2009.:** Use the language and programming facilities SFC standard IEC 61131 at syntheses managerial system on base PLC Zelio Logic. Visnik SNU №3, p. 32-35.
5. **Verhovodov A.V., Malahov O.V., Kalikhevich N.V. 2007.:** Syntheses managerial system horizontally-closed transport system with use the programming language FBD. System technologies. – № 2(31). – Dnepropetrovsk, p.104 -112.
6. **Verhovodov A.V., Malahov O.V., Oleinik R.G. 2008.:** Studies of the possibility of the using PLC VIPA-100 for industrial robot governing MP-9. Praci Lugansk Branch of IIA №1, p.22-25.
7. **Verhovodov A.V., Oleinik R.G. 2008.:** Study of the possibilities of the module of the analog entering-conclusion and text panel at regulation of the temperature. Praci Lugansk Branch of IIA №2, p.14-17.
8. **Verhovodov A.V., Strelbytskyy A.A., Dyubakova V.M. 2010.:** Sintesing of control system of the packaging machine with use eventing operated logic. Visnik SNU №2, p.28-34.
9. **Verkhovodov O, Kovalenko M. 2011.:** Studies of WinPLC7 V4 programming environment in developing robotic workcell control system. TEKA Kom. Mot. i Energ. Roin. – OL PAN, 11B, p. 206-212.
10. **Korop G., Parkhomenko V, Stepanchenko S., Morgachev D, Sosnov N. 2011.:** Greating a softvare system for construction of the daily schedule for rail way industrial enterprise. TEKA Kom. Mot. i Energ. Roin. – OL PAN, 11B, p. 48-53.
11. AKM-Engineering production / www.akmeng.ru
12. Components of industrial electricity saving and automation systems/ http://svaltera.prom.ua
13. Design of automatic process control system / http://energopolis.co.ua
14. Industrial controllers / http://electroalyans.com.ua
15. Manual WinPLC7 V4. / www.vipa.de.
16. PLC Vipa / http://electromatica.ru
17. Programmable logic controller Vipa / http://interexpo.com.ua
18. VIPA art of automation/ www.vipa.de / www.speed7.com.
19. Passport of Hydraulic press model 2240D.
20. Smart relays Zelio Logic. http://www. sneider electric.ru.
21. Zelio Logic. Smart relays. Users Manual. A brand of Sneider Electric, January 2004, 151p.

РАЗРАБОТКА СИСТЕМЫ УПРАВЛЕНИЯ ГИДРАВЛИЧЕСКИМ ПРЕССОМ НА ОСНОВЕ КОНТРОЛЛЕРА ZELIO LOGIC

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Аннотация. Рассмотрена модернизация системы управления гидравлического пресса модели 2240D с использованием программируемого логического контроллера – интеллектуального реле Zelio Logic. Приведены последовательность выполнения технологической операции прессования, неформальный алгоритм управления, мотивация выбора модели ПЛК Zelio Logic модели SR3B261B, фрагмент программы управления на языке FBD.
Ключевые слова: пресс, вход, выход, алгоритм, программа управления, логический контроллер, программное обеспечение, язык.