Develop Clamping and Drilling System Using PLC

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Abstract

Many industrial applications require that a hydraulic systems working automatically after an operator presses a START pushbutton. Such as cutting, bending, drilling, clamping and forming metals, that needs more force. Clamping and drilling system one of them, that need control for ability to clamp and drilling the workpiece with required force without damage or deforming the work piece. In this study, clamping and drilling system was developed and improvement by using PLC control system. The PLC is programed for control requirements to the hydraulic system of workpiece clamp and drilling. The Programming Software for GLOFA series GMWIN is selected and programming (LAD) software was used to program the system control process of the system. Using PLC control hydraulic system, can be easy to improve power the productivity greatly and increase the system stability, reliability, also security for factory workers.

Keywords: clamping and drilling system - hydraulic system- PLC control system- workpiece.

1. Introduction

Recently, the increasing use of electrically controlled hydraulic systems in industry comes from the need for fast, low-cost means of production with better quality, less waste, and more energy. Electrically controlled hydraulic systems offer many other advantages. A few of these are decrease fatigue, micro control and small size [1, 2]. Before the technical progress in the industrial field, all drilling operations are carried out related to the vibration which results in the noise environment as well as more fatigue of the workers [3].

The improved performance of the clamping and drilling machine must be developed to meet the demands of the times. In order to meet Manufacturing requirements for complex and precise products, by using PLC control the clamping and drilling machine is developed into Precision machine for clamping drilling machine.

Fixtures can be enhancing the production quality if they are properly designed. Fixture serves both purposes Fixtures can be enhance the production quality if they are properly designed. Fixture serves both purposes. Work clamping and drilling system consists of work piece detection, clamping and unclamping, drilling and undrilling. Work piece detection is achieved by using proximity sensors. Many industrial processes involve some type of system or process of automation. Milling, folding, tensioning and grinding are just a few of these processes. Operations are often controlled by some type of sequential circuit so that the operation of the machines occurs at a specific moment during the work cycle. The clamp cylinder should always be turned on first [4,5].

The drilling process is a common automated machining process. Many machining functions are accomplished with a drill connected to a hydraulic cylinder. Drilling the hole, tapping and threading the hole,

and countersinking the top edge of the hole are all mechanical jobs that call for drilling [6].

2. Clamping and Drilling System

Clamping and drilling system consist of hydraulic part and electric control part, as shown in figure1.

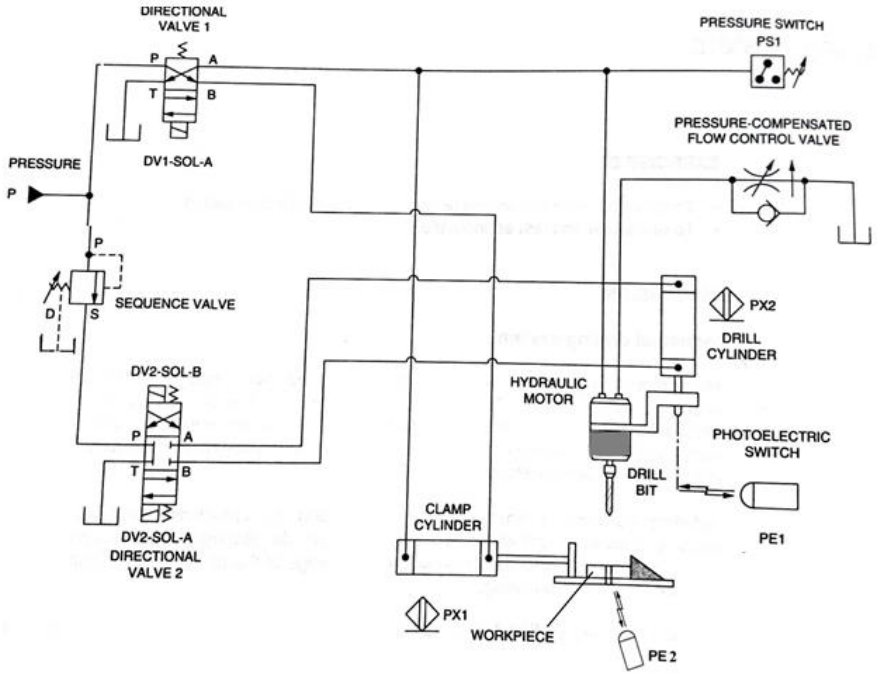

Figure 1: Clamping and Drilling System

Figure 1 shows a typical drilling system that includes a clamp cylinder and a drilling cylinder that lowers and raises a hydraulic drill. The sequence of operation is as follows: directional valve 1 is shifted first to extend the clamp cylinder. When the workpiece is held in place, the hydraulic motor of the drilling unit begins to rotate. Then the gear valve 2 is shifted to extend the drilling cylinder, reducing the drilling unit. When the workpiece is drilled, the directional valve 2 is shifted

to retract the drilling cylinder, which raises the drilling unit. When the drilling cylinder is retracted, the valve is returned, directional valve1 is returned to its normal condition to retract the clamp cylinder and stop the hydraulic motor of the drill unit.

The pressure- compensated flow control valve connected downstream of the hydraulic motor provides a constant motor speed by compensating for pressure changes upstream and downstream.

Electro control part that includes magnetic proximity sensors, pushbutton switches for start and reset, and Relays as actuators for solenoid valves as shown in the figure2.The magnetic proximity switches and diffuse Reflective Photoelectric Switch require a 24-V DC voltage to operate. Therefore, make sure to connect the plus and the negative terminals of these sensors or switches to the 24-V DC power supply. Magnetic proximity sensors so that it is activated when the bore cylinder rod is fully retracted. Leave the cylinder rod in the fully retracted position.

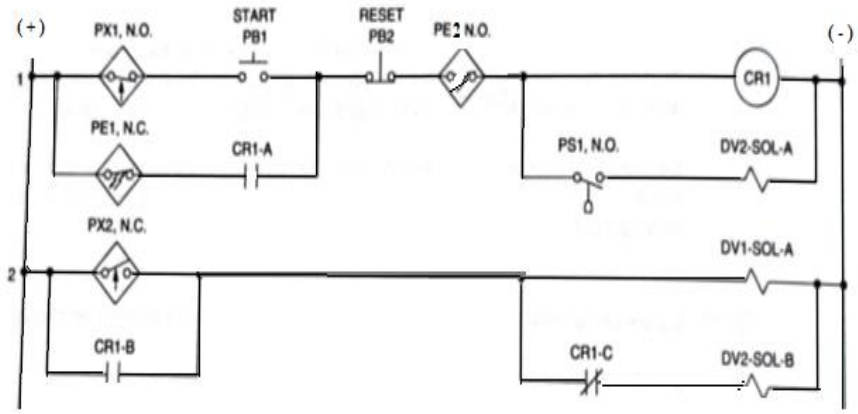

Figure 2: Electro control part

3. Programmable Logic Controller (PLC)

It is a digital logic device used to control for typical industrial processes, such as control of machinery on factory assembly lines, electro hydraulic [7, 8]. It is used in many industries applications. The interlocking between the limit switch or

a proximity sensors is given for continuous motion of the machine. PLC can be programing by many method such as LAD, STL, FBD, etc. The PLC hardware consists of input and output units, where the sensors and switches connected with PLC inputs, and the actuators connected with PLC outputs [9]. The microprocessor-based CPU is the one that controls the operations inside the PLC. The read input is read and its state is stored in the data memory, the data is transferred to the application program and processed, the updated data memory is updated and finally the executed of the output [10].

In this system the PLC is working as brain to control of this system, where the PLC is received the signal from a proximity sensors or limit switches, then send a signal or command to actuators or loads which connected by output units. By using ladder diagram (LAD), the electrical diagram as shown in figure 2 can be rewritten as ladder diagram. The (LAD) is one of methods of GLOFA series GMWIN PLC programming. Figure 3 shows the ladder diagram that control clamping and drilling system or machine. Table.1 shows the symbols used in the electrical diagram and scalar diagram.

Figure 3: ladder diagram (LAD)

Table-1: the symbols used in the electrical diagram and scalar diagram

Section	Indirect Variable	I/O Assignment	comment
Input	START	%IX1.0. 0	Push Switch-1
	RESET	%IX1.0.2	PushSwitch-2
	PX1.N.O	%IX1.0.5	Proximity Switch
	PE1.N.O	%IX1.0.4	Photoelectric Sensor-1
	PE2.N.O	%IX1.0.3	Photoelectric Sensor-2
	PS1.N.O	%IX1.0.6	Pressure Switch
Output	SV11	%Qx0.0.0	Solenoid Valve-A Extend Cy1
	SV21	%Qx0.0.2	Solenoid Valve-B Extend Cy2
	SV22	%Qx0.0.3	Solenoid Valve-B Retract Cy2
	MOTOR S	%Qx0.0.5	Motor Operation
	SV12	%Qx0.0.1	Solenoid Valve-A Retract Cy1

4. Clamping and drilling system operation and control

- Firstly, The workpiece to drill is positioned by hand in the drill place. When the operator presses a START pushbutton, solenoid A of directional valve 1 is activated, but if there is no the workpiece on drill place the system not operate. This shifts the valve to the straight-arrows condition to extend the clamp cylinder. Since the extending clamp cylinder requires a pressure, the hydraulic motor of the drill unit does not rotate now.

- When the clamp cylinder stress the workpiece, the pressure rises quickly behind its piston, the hydraulic motor of the drill unit starts rotating. Also, pressure switch PS1 is activated, indicating that the workpiece is correctly clamped. This activates solenoid A of directional valve 2 and shifts the valve to the straight-arrows condition to extend the drill cylinder. The sequence valve stays partially closed so that most of the pumped oil goes to the motor, while a small amount of oil goes through the sequence valve to extend the drill cylinder. The drill cylinder, will extends at slow speed, which is beneficial because the drill bit will not be damaged by impacting the workpiece.

- The drill cylinder extends and lowers the drill unit to drill a hole in the workpiece, When this cylinder becomes fully extended, it activates a photoelectric sensor or switch, PE1 This activates solenoid B of directional valve 2, shifting the valve to the crossed - arrows condition to retract the drill cylinder and raise the drill unit, During retraction of the drill cylinder, solenoid A of directional valve 1 is kept energized so the drill motor continues to turn and the clamp remains constant.

-When the drill cylinder becomes fully retracted, it will activates magnetic proximity switch PX2, which de-energizes solenoid B of directional valve 2 and returns the valve to the center condition.

This also de-energizes solenoid A of directional valve 1, that will causing the clamp cylinder to retract and the drill motor to stop rotating.

- When the clamping cylinder becomes fully retracted, it activates magnetic proximity switch PX1, which stops the cycle. The drilled workpiece can then be removed. Several refinements can be added to the drilling system to provide special control functions by reprograming PLC. They may include, for example, a reset pushbutton as a safety feature to permit the operator to stop the system at any sequential step and reset it back to the initial state where both cylinders are fully retracted and the hydraulic motor is stopped.

5. Conclusion

In this study, clamping and drilling system was developed and improvement by using PLC control system. The PLC is programed for control requirements to the hydraulic system of workpiece clamp and drilling. The Programming Software for GLOFA series GMWIN is selected and programming (LAD) software was used to program the system control process of the system. Using PLC control hydraulic system can be easy to improve power the productivity greatly and increase the system stability, reliability, also security for factory workers.

The PLC program can be modified to increase the speed of work and thus increase the production capacity easily without any problem.by using PLC in drilling machine leads to Optimization process and drilling is smooth and reduce noise when compared to other system or machine.

References

[1] Guanghuai Wang. Application of Hydraulic technology. Harbin Institute of technology Press; 2005

[2] Dey, A. (1995), “Drilling machine”, Latest development of heavyearth moving

[3] Machinery, Annapurna Publishers,pp.120-228. Charbulova, M., Matusova and M., Caganova, D., “Intelligent Production Systems and Clamping Systems for Intelligent Production Systems”, Journal.

[4] J. W. Luo, Hydraulic Drive and Control [M].Chongqing: Chongqing University Press. (2006. 7.)

[5] Minke, G, “Building with earth: design and technology of a sustainable architecture”, Walter de Gruyter, (2013).

[6] Bassily, Hany, et al. "A Mechatronics Educational Laboratory – Programmable Logic Controllers and Material Handling Experiments." Mechatronics 17.9 (2007): 480-8.

[7] S. Ilango and V. Soundararajan, “Introduction to Hydraulics and pneumatics”, PHI Learning Private Limited, New Delhi,2nd Edition, 2009.

[8] Zuperl, U., Cus, F., Vukelic, D., “Variable Clamping Force Control for an Intelligent Fixturing”, Journal of Production Engineering, Vol. 14, 2009, pp. 19-22.

[9] Wong, Kiing Ing, and Teck Ung Siaw. "PLC and SCADA Laboratory Experiments for a Final Year Instrumentation Course." International Journal of Information and Education Technology, vol. 5.11 (2015)

[10] Charbulova, M., Matusova and M., Caganova, D.,"Intelligent Production Systems and Clamping Systems for Intelligent Production Systems", Journal of Production Engineering, Vol. 14, 2009, pp. 63-66.