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PLC Based Automatic Control of HydraulicPress Machine Using LVDT

Dr. D. Raja[*1], V. Deepika[#2], R. Nivethitha[#2], A. Hemalatha[#2], A. Arthi[#2]
[*1]Professor, [#2]UG Scholar
Department of Electrical and Electronics Engineering, Sri Manakula Vinayagar Engineering College, Puducherry, India.

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ABSTRACT

Now a days most of the industries are moving towards automation which reduces the manpower and processing time. The automation technique which carries out the automatic process of hydraulic pressing machine using PLC is implemented in this project. The existing Pressing machine is manually operated by the operator and the cycle time of this machine is 6sec and the output is 600 products per hour. The Limit switch is used to control the upward and downward movement of the solenoid in the hydraulic machine. In this project, cylinder and press table are designed by the designing procedure. They are analyzed to improve their performance and quality of working operation. Using PLC, it can be very easy to meet the process requirements, such as to improve the system stability, reliability, security, and automation level. The outcome of this machine is to reduce the cycle time from 6sec to 4 sec and the output is increased from 600 to 900 products per hour. By designing this machine, better joint strength is provided and it improves the quality and productivity by minimizing the cycle time.

Keywords : Pressing, Cycle time, Press machine, Automation.

I. INTRODUCTION

Automation is a term for technology applications where human input is minimized. It can be done in the industries where more number of labours are involved in the protection field. These origins demand for labours and also some manufacture loss. In order to achieve problems, PLC were introduced in multiple inputs can be managed with the single outputs. In earlier days the PLC was used to control the machineries by using limit switch but today HMI is used to reduce the number of ports. It can be able to activate on several devices by programming the ladder logics based on time limit. In this method of study, the existing method was discussed and how to overcome the disadvantage was examined. The proposed method overcomes the drawback of existing method. Hydraulic machine is used to assemble and de-assemble the motor parts. So, the pressure level is also similar. The motor is in progress by pressing the switch.

After that the downward button has to press down the solenoid. For upward movement the upward button has to press. The speed of the solenoid is controlled by speed of the motor. This is the operation of the Hydraulic machine. The interlocking between the up and down button is done by performance of one cycle. The limit switch is used to control upward and downward motion of the solenoid of the hydraulic machine and wait for the time period. It is commonly applicable and user friendly to all application.

II. HYDRAULIC PRESS MACHINE

In Hydraulic machine, hydraulic fluid is fed throughout the hydraulic cylinders and becomes pressurized according to the resistance present. The fluid is controlled automatically by control valves and distributed through hoses and tubes. The advantage of hydraulic machinery is due to the very large amount of power that can be shifted through small tubes and flexible hoses, and the high-power density and wide array of Limit switches that can make use of this control. Pascal's Law states that the "Pressure applied to any part of a confined fluid transmits to every other part with no loss. The pressure acts with equal force on all equal areas of the confining walls and perpendicular to the walls". This is the basic principle for any hydraulic system. The figure 1 shows the hydraulic press machine.

Figure 1 Hydraulic Press Machine

Since the hydraulic press works on the basis of Pascal's Law, its working is similar to the one of the hydraulic systems. A hydraulic press contains of basic components used in a hydraulic system that contains the Cylinder, pistons, the hydraulic pipes, etc. The working of this press is very humble. The system comprises of two cylinders, the oil is poured in the cylinder having a minor diameter. This cylinder is known as the slave cylinder. The piston in this cylinder is pushed so that it compresses the oil in it that flows through a pipe into the larger cylinder. The larger cylinder is known as the master cylinder. The pressure is applied on the larger cylinder and the piston in the master cylinder pushes the oil back to the original cylinder. The force applied on the oil by the smaller cylinder results in a larger force when hard up in the master cylinder. The hydraulic press is mostly used for industrial purposes where a large pressure is required for squeezing metals into thin sheets. An industrial hydraulic press uses the material to be worked upon along with the help of the press plates to crush or hit the material into a thin sheet. This is the process of the hydraulic machine. Next the pressing time or work stroke is strongminded. If a dwell is used that time is also added. Finally, the return stroke time is added to control the total cycle time the hydraulic valve reaction delay time is also a factor that should be involved for an accurate total time calculation. These factors are planned in order to control academic production rates when evaluating a new process. In the case of jobs that are in process, measuring the cycle rate with a stopwatch is sufficient Most hydraulic presses are not measured high speed machines. In the automatic mode, however, hydraulic presses function in the 20 to 100 stroke per minute range or higher. These speeds normally are sufficient for hand fed work. The resulting production rate speeds are comparable to that of mechanical OBI and OBS presses used single stroking applications. Here, there is no additional clutch and brake wear to consider in the case of the hydraulic machine. The figure 2 shows the model of hydraulic press machine.

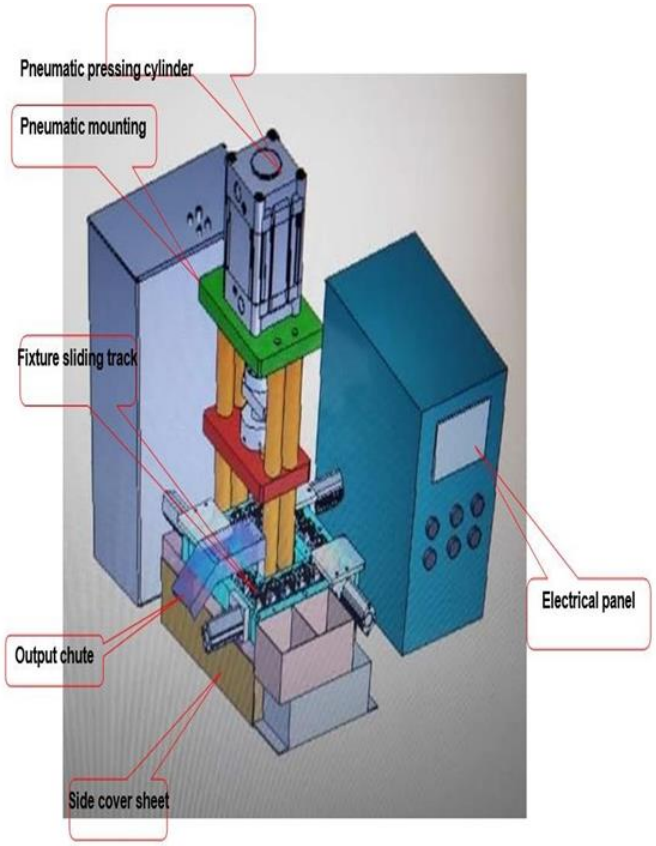

Figure 2 Model of hydraulic press machine

The figure 3 is shown as the block diagram for the proposed system. To maintain the pressure of cylinder as constant which helps for the smooth flow of pressure in a hydraulic cylinder for proper and efficient working of the pressing done by the system. This action can be achieved with the help of PLC . The automatic control of hydraulic machine is done through PLC by control panel. The limit switch which is connected from hydraulic press machine is used to control up and down movement of the solenoid in the hydraulic press machine and wait for the period of time. For the manual operation the push button is turned ON and remains same till the operation ends. HMI is used to monitor and configure set points, control algorithms, send commands, and adjust and establish parameters in the PLC. The HMI also displays process status information and historical information. In the hydraulic machine the motor runs till it reaches stop or emergency condition

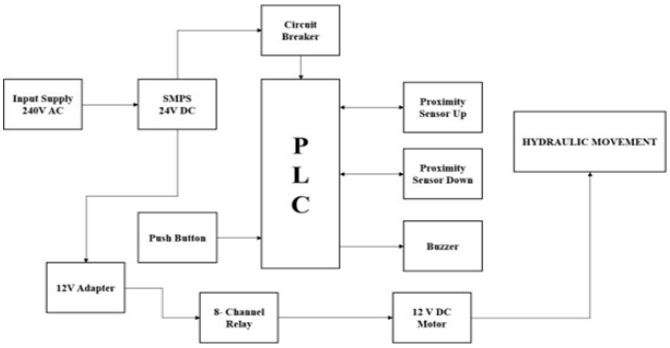

Figure 3 Block diagram of hydraulic press machine

III. PROGRAMMIC LOGIC CONTROLLER

PLC is called as Programmable Logic Controller. It is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides. It is used in many industries. Eight input and four output are used for proposed system. The interlocking between the limit switch is given for continuous motion of the machine. In this automatic control process, the motor is started by pressing the start button. The solenoid is always in up position while starting the motor. By using the controller action, the solenoid starts to move downward direction. The movement of the solenoid valve is controlled by the limit switches, which is connected with the control unit of the PLC, open and close the contacts. After completing the process of assemble or de-assemble process the motor is turned off. This is the operation of the system. When the solenoid reaches the particular position, the limit switch opens the contact. After remove the bearing of the motor from the shaft, the limit switch closed the contact. Now the solenoid moves in upward. This is the continuous process which is automatically happened. The limit switch controls the movement of the solenoid by open and closing

IV. HARDWARE RESULTS

This automation system will reduce the manpower and time but, the production rate and the profit of the materials are increasing.

A pressing machine is used for an operation of automatically set (squeeze) rivets in order to join materials together. Now a days manufacturing industries are equally aware about the importance of semi- and fully automatic pressing machines to build the quality of the products and optimization of production rate . But our pressing machine will offer the time consistency, productivity, and lower cost when compared to manual pressing machines. And also, we assure that there will be no damage to the component as once the pressing is done automatically therefore, the rejection pieces are turns to zero . By designing this machine, we provide a better joining strength and it improves quality and productivity by minimizing the cycle time. Also, it can be easily operated by Semiskilled operator . The time consumption and man power is reduced. The time delay can be done according to the load condition. This process can be used effectively in any automation industry.

This below table shows the comparative analysis of proposed model with existing model

Table 1 comparative analysis of proposed model with existing model

	EXISTING MODEL	PROPOSED MODEL
1 Shift	28,800 secs	28,800 sec
Planned Shutdown	27,000 sec	27,000 sec
Available Time	26,100 sec	26,100 sec
1 Component cycle	60 sec (26,100/60)	54 sec (26,100/54)
1 Shift output	435 pieces	474 pieces
3 Shift output	1305 pieces	1422 pieces

V. CONCLUSION

In conclusion, the PLC-based automatic control of a hydraulic press machine using LVDT provides an efficient and reliable solution for high precision and repeatability in the pressing process. The LVDT is used to measure the position of the press head, and the PLC uses this information to control the press stroke and force. The system is designed to be highly customizable, allowing it to be adapted to various industrial applications. The prototype demonstrates the capabilities of the system and provides a promising solution for enhancing productivity and reducing waste in the manufacturing industry. Overall, this technology has the potential to revolutionize the way hydraulic press machines are controlled and operated, improving efficiency and performance.

VI. FUTURE SCOPE OF THE PROJECT

The PLC-based automatic control of hydraulic press machines using LVDT technology has a promising future scope for further development and application. Some potential areas for future improvement include:

1. Integration with Industry 4.0: The technology can be integrated with Industry 4.0 concepts to enable real- time data acquisition and analysis, remote monitoring, and predictive maintenance. This can lead to enhanced productivity, reduced downtime, and improved quality control.
2. Advanced Control Algorithms: The control algorithms can be further developed to improve the precision and accuracy of the press stroke and force control. This can enable the technology to be used in more complex manufacturing processes, resulting in higher quality products.
3. Implementation in other industries: The technology can be implemented in other industries such as aerospace, automotive, and medical devices, where high precision and repeatability are critical.
4. Miniaturization: The technology can be miniaturized to create smaller, more portable

hydraulic press machines, enabling their use in remote locations or where space is limited.

5. Enhanced safety features: The safety features of the technology can be enhanced to prevent accidents and injuries in the workplace.

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