

Automation of Hydraulic Press to Reduce Cycle Time

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Abstract— Hydraulic press machine is used in many manufacturing companies for different purpose. Hydraulic power units are main driving components of driving system, consist mainly a motor, reservoir and a hydraulic pump. The hydraulic press is actuated by various methods like hand lever operation, solenoid operation, push button operation etc. In this paper, we have study the automation of hydraulic press, comparison between hand lever operated hydraulic press and solenoid operated hydraulic press. Study suggests how drawbacks of hand lever operated press machine are overcome by using solenoid operated press machine. Time study is used to measure the time required for doing same operation by these two different press machines. Finally the improvement in productivity by reducing the time for operation has been studied and analyzed. Time reduction of operation is achieved by automation of hydraulic press.

Key words: Hydraulic Press, Hand Lever, Solenoid Valve, Automation, Hydraulic Circuit, Time Study

I. INTRODUCTION

In mechanical industries, hydraulic press is used for various purposes such as for pressing operations or in assembly line. Hydraulic press uses hydraulic circuit for actuation of piston. Hydraulic power units are main driving components of driving system, consist mainly a motor, reservoir and a hydraulic pump. These units can generate a tremendous amount of power that can drive any kind of hydraulic ram [1]. The hydraulic press is actuated by various methods like hand lever operation, solenoid operation, push button operation etc. The lever operated hydraulic press is difficult to operate as more manual force is required and therefore is ergonomically unsuitable. Hence automation of hydraulic press is to be done by replacing hand lever with push buttons. The automation is based on various factors like ergonomics, operator safety, cycle time reduction, increasing productivity.

II. HYDRAULIC CIRCUIT

As stated above, hydraulic press works with the help of hydraulic circuit in which the hydraulic fluid flows through the circuits and actuates the piston which leads in pressing operation. Basic components of hydraulic circuit are reservoir, filter, pressure relief valve, direction control valve, actuator and pump along with motor. Pressure relief valve, direction control valve, flow control valve is used to control the direction and flow of hydraulic fluid in hydraulic circuit and hence control the movement of piston. Piston movement provides the required force for pressing operation.

A. Hand Lever Operation

Fig. 2.1 shows hand lever operated hydraulic circuit. As the hand lever is used, amount of manual force required is large. Also it increase the total time required for pressing operation. Sometime position of hand lever cause difficulty to operator. Another disadvantage of this circuit is that due to vertical

alignment of cylinder, piston comes down due to its self-weight.

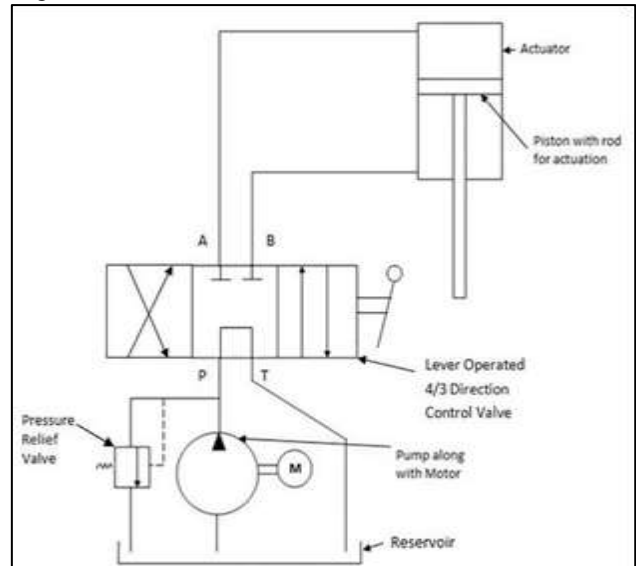


Fig. 2.1: Hydraulic Circuit with Hand Lever Operation

B. Hydraulic Circuit with Solenoid Operation

A solenoid is an electromagnetic device in which a coil of wire surrounds a steel rod and induces a magnetic field that moves the rod into and out of the coil [2]. This phenomenon is used to control the position of DCV and hence to control the movement of piston. The solenoid operated valve is widely used in many applications due to its fast-dynamic response, cost effective, less contamination sensitive characteristics. Fig. 2.2 shows solenoid operated hydraulic circuit. The solenoid valve can be operated by limit switches or by push buttons.

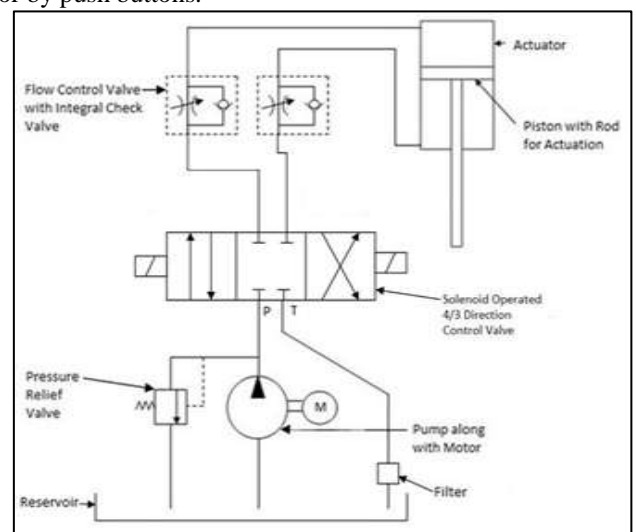


Fig. 2.2: Hydraulic Circuit with Solenoid Operation

The advantage of using solenoid valve is that it requires less manual force (only in case of push buttons. Manual force is not required for limit switches). The flow control valve prevents the piston's downward motion due to its self-weight.

III. AUTOMATION

The purpose of automation is to overcome the following drawbacks:

- To reduce operator efforts
- To reduce cycle time of press operation
- To increase safety of operator
- To make operation ergonomically suitable

A. Methods of Automation

Solenoid valve actuation by using limit switches (complete automation). Solenoid actuation using push buttons (Semi-automatic).

The method of actuation by push buttons is most adopted technique as the operator can stop the operation whenever needed. Push buttons are preferred in couple for two hand actuation as this provides safety to operator. For two hand operation, Push buttons can be operated by two ways: By connecting push buttons in series configuration, by programming with the help of Programmable logic control system (PLC).

PLC is used when sequencing of multiple operations is needed. Advantage of PLC is that it can also operate two circuits simultaneously.

IV. TIME STUDY

Time study is one of the productivity improvement technique used in many manufacturing companies. Time study is a scientific analysis method design to determine the best way to execute the repetitive task [3]. The time recording device (e.g. Stopwatch) is use to record the time taken to accomplish a task. Time study is mainly used in Hydraulic systems due to their repetitive operation.

A. Case Study

Time study for a particular pressing operation by using hand lever operation is given below:

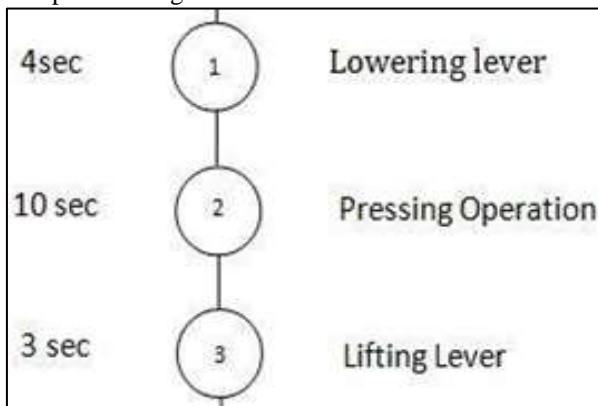


Fig. 4.1: Hand Lever Operation Time Study

Time study for a particular pressing operation by using solenoid operation is given below

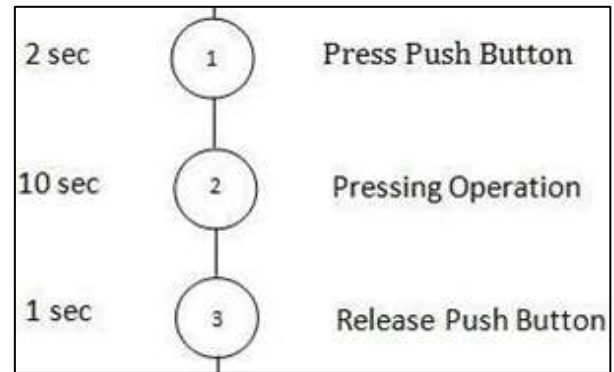


Fig. 4.2: Solenoid Operation Time Study

From above Time Study it is observed that the total time required for pressing operation by using hand lever is 17 sec and that for push button (solenoid operated) is about 13 sec.

That means total time required for operation is less in case of push button as compare to hand lever.

V. CONCLUSIONS

From the study discussed above, we can conclude that the hydraulic press operated with push button (Solenoid Operated) is more efficient than the one operated with hand lever. Also, the manual efforts required for operating the press are reduced by using push button for actuation. Time required for solenoid operated press is less as compare to lever operated press. It is observed that percentage reduction in cycle time for particular pressing operation is near about 24% by using solenoid operated press.

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