Journal of Indian Research (ISSN: 2321-4155)
Vol.2, No.4, October-December, 2014, 81-84

Engineering

AUTOMATION OF DRILLING PROCESS USING ELECTRO-HYDRAULICS

Pulkit Barala*

ABSTRACT

Automation is today a need of every industry and is extensively used for each and every process. Drilling process requires clamping initially and thus require at least three kinds of operations, clamping the work piece, drilling and then unclamping. In that respect a case study is used to automate this process with the help of electro-hydraulics. Automation of any process leads us to optimized output for each factor such as time, cost, feasibility of operation, reliability, and elimination of human error.

Keywords: Electro-Hydraulics, Direction Control Valves (DCV), Double Acting Cylinder, Pump unit, Relay/ Contactor, Valve Solenoid, Limit switch

INTRODUCTION

From last few decades, numerous technologies have been developed in the field of manufacturing. Among all these technologies, Fluid Power is unique. Fluid power has played very crucial role in the rapid growth of several industries. Electro-Hydraulics is very important branch of fluid power. Basically, it is a combination of Hydraulics and electrical components.

Hydraulics is based on the principal that fluid power can be used to transmit energy from one form to another. In hydraulics, "oil" is used as working medium to transmit energy at different required pressures. The word, Hydraulics, is derived from a Greek word "*Hudour*" which means water. Hydraulics can be used at high pressure as compared to pneumatics. It is generally used in manufacturing industries for mass production of goods.

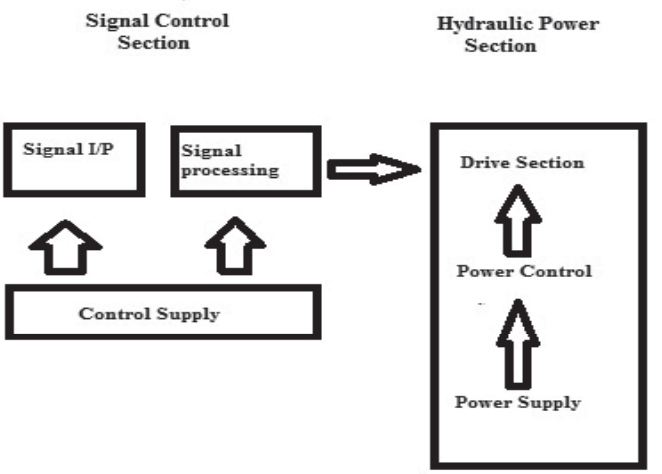


Figure 1: Structure of Hydraulics

***Pulkit Barala** is pursuing M.Tech at the Department Of Mechanical Engineering, Mewar University, Gangrar, Chittorgarh, Rajasthan-312901. E-mail: pulkit.barala@gmail.com.

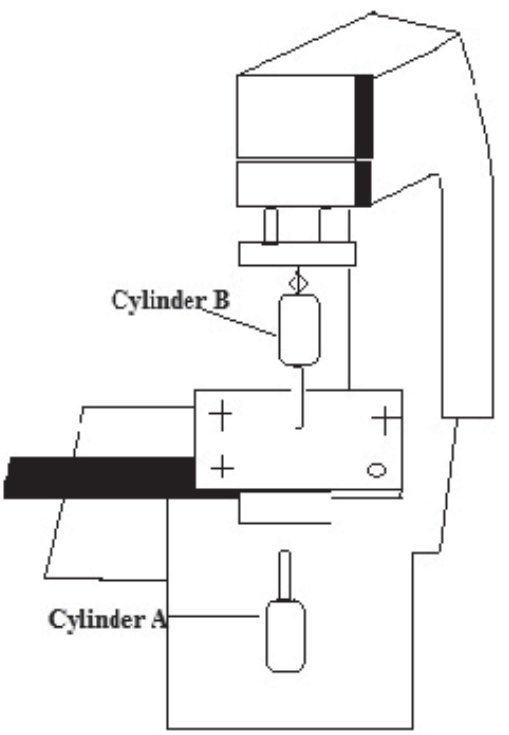
Figure 1 is the simplified block diagram depicting the division of hydraulic system into a signal control section and a hydraulic power section. The signal control section is responsible to activate valves in the power section.

The Hydraulic power unit (power source) provides the energy required for the hydraulic installation. It's most important components are the reservoir, drive (motor), hydraulic pump, pressure relief valve, filter and cooler. It may act as a carrier for devices like direction control valve.

The field of automation using Electro-Hydraulics is studied by many scholars till date. Michael *et. al*[1] used *Electro-Hydraulic Servo Actuator* (EHA) to determine the direction of motion. System Identification technique was used for system modeling using parameter estimation technique. Fraiser[2]in his paper mechanized the existing drill and blast-method using hydro-powered drill jigs in the regions of South African narrow reefs. Vaida *et. al.*(2012)[3] carried out engineering studies by using features, the convenience and dependence on control and power section. This paper deals with the automation of pump unit and also developed a system that enhanced the flow control, pressure and hydraulic power. Vijay[4] has researched on Position Control Electro-hydraulic Linear Actuator for controlling the motion of helicopter. Based on mathematical modeling, models of the actuator and its components are made using Matlab/Simulink.

CASE STUDY

A work piece is to be drilled and it is to be clamped by two position. Continuous system is to be developed.



A+ B Clamping by cylinder A
A+ B+ Drilling by cylinder B
A+ B- Retracting cylinder B
A- B- Unclamping by cylinder A

Cycle is continuously operating.

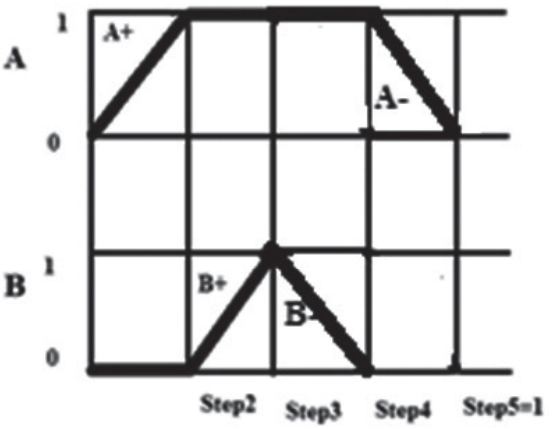


Figure 3: Functional Diagram

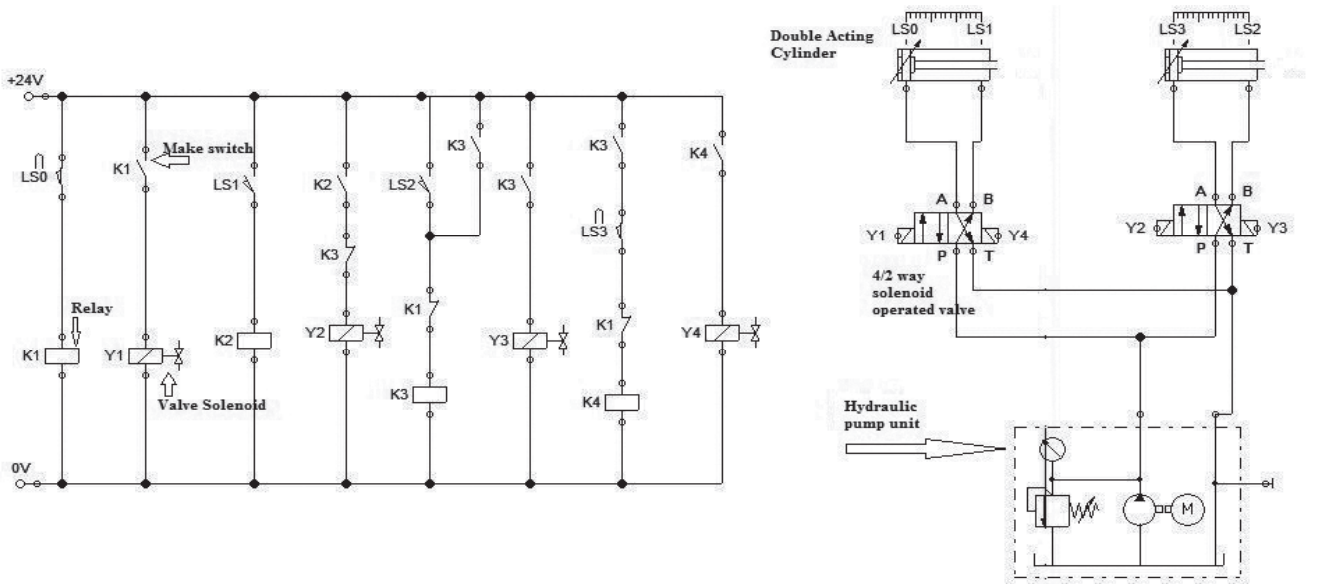


Figure 4: Electro-Hydraulic Circuit

In the above Electo-Hydraulic circuit, different fluid tools like relay (K1, K2…,K4), valve solenoids(Y1,Y2…. Y4),make switch(K1,….k4) are used. When power is supplied through power section , K1 will actuate, resulting in the actuation of Y1 solenoid and thus cylinder A will execute forward motion. Cylinder A will clamp the work piece. Then as piston of A reaches Limit switch LS1, K2 (refer to **Figure 4**) and similarly Y2 will actuate and cylinder B will execute forward motion through LS3 (drilling operation). When piston reaches LS2, it will ignite K3 and Y3 will force the cylinder B to move back (after drilling). Finally, LS3 will actuate K4 and unclamping of work piece takes place through Y4.

SCOPE OF STUDY

Conventional drilling employs man-power. In this paper, we have used Electro-Hydraulics, which is the combination of electrical and hydraulic components to automate the process of drilling very easily. It is very advantageous in respect of each and every factor such as minimizing human error, reduction of time consumption, reliability, and cheeper. The main goal of this study is to automate the operations of drilling and achieve a better

overall efficiency. Today, automation is the need of real world and is useful in almost all manufacturing industries. Hydraulics offer great advantages like we can even use it at the field where large forces of 4000-5000 tonnes and pressure more than 500 bar are required. Hydraulic application has proliferated into vast areas like automotive industries, machine tool manufacturers, power transmission, chemical industries, oil and petrochemical industries, gas industries, even in defense systems, marine and mining plants, etc. So the list of application never ends and on their basis, we can easily predict its future.

RESULTS AND DISCUSSION

- All the operations required in the given case study are successfully automated through simulation;
- Enhances the efficiency of overall operation greatly;
- Time of operation is reduced to great extent as compared to the conventional process;
- Operation is very economical for mass production;
- Functional diagram helps in defining the required operation.

CONCLUSION

- Use of sensors may further improve the efficiency;
- Human error is completely eliminated thus diminishes the risk factor;
- FluidSIM is used for simulation;
- Any logic can be developed using following approach.

REFERENCES

1. Michael, J.; M.F. Rahmat, N.Abdul Wahab and W.K. Lai.2013. "Design for an Industrial Electro-hydraulic actuator system with servo valve", *International Journal on Smart Sensing and Intelligent Systems*, Vol.6, No.1.
2. Fraiser, P. 2012. "The use of High Pressure, Water-Hydraulics (Hydropower) Technology in South African Narrow Reef Hard-Rock Mines", *The Southern African Institute of Mining and Metallurgy*.
3. L. Vaida, D. Banyai, P.A. Oadegbuyi, J.O. Uhomoibhi.2012. "Engineering studies of the control structure of Electro-Hydraulic Pumps and variable Axial pistons", *International Journal of Scientific and Technology Research*, Vol. **1**, Issue 8.
4. Tenali, Vijay Sagar.2007. *Simulation of Electro-Hydraulic Servo Actuator*, M.Tech Thesis, IT Rourkela
5. Stein, Benno; Daniel Curatolo, Marcus Hoffman.1998. "Enriching Engineering Education in Fluidics", *The Society for Computer Simulation International*, pp. 274-279.
6. Vossoughi, R. and M. Donath.1995. "Dynamic feedback linearization for Electrohydraulically actuated control systems", *ASME Journal of Dynamic Systems,Measurement and Control*,**117,**4:468-477.
7. Yao, B.; F. Bu, J Reedy. 2000. "Adaptive Robust Control of Single-Rod Hydraulic Actuators:Theory and Experiments ",*IEEE Transactions on Mechatronics*, **5**,1:79-91.
8. Nagaraj, Shanmukha and Ramesh, S. 2013. "Automated Sequential Controlling Of Modular Workstations", *International Journal Of Research In Engineering And Technology (IJRET),* **1**, 2: 111-116.
9. Koppar, Vyasraj; Ravindra M.Lathe and Patil Siddharam.2014. "Automation of a Planer Using Electro-Pneumatics Devices and PLCs", *International Journal of Innovative Science, Engineering & Technology*, **7**, 11:18-25.
10. Mahendrakar, Akshay R.2014. "Automation Of Drilling Process Using Electropneumatics System", *International Journal of Science and Research*, Vol.3, Issue 10.