

Design and Fabrication of Automatic Pneumatic Water Pumping System

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Abstract: The aim of the project is pneumatic operated water pumping system, hand operated pneumatic water pumping system is provided for the pumping action. The piston is reciprocated with the help of a pneumatic cylinder solenoid valve. There are two systems used in this project, one is the pneumatic cylinder and another one is the hand operated water pump. The output quantity of the water is varied by a small knob provided in the pneumatic hose. This pumping system also used in pumping of petroleum-based products, water supply in agriculture lands, Industrial pumping and also in domestic applications.

Keywords: Hand Operated Pneumatic Pump, Pneumatics, Pneumatic Cylinder and Solenoid Valve

I. Introduction

This project runs on compressed air, pneumatic operated water pumping system. Hand operated Water pump system in which the piston is provided for the pumping action. The piston is reciprocated with the help of a pneumatic cylinder and solenoid valve. The output quantity of the water is varied by the knob. A pump is a Mechanical device which converts mechanical energy into hydraulic energy. As an introduction to pneumatic pumps, it's important to understand that pneumatics is a branch of technology that uses the force of compressed gases to create mechanical effects.

Pneumatics pumps use these mechanical forces to manipulate the movement of fluids within microfluidic channels. Pneumatic pumps basically use air in the same method, that a hydraulic pump would employ fluids. Both these pumps are capable of producing amplified levels of mechanical force which translates into a high source of power. The basic principle of a pneumatic pump is focused on the use of pressurized gas or air to move media. When pneumatic pumps are utilized for industrial applications, it involves the use of compressed inert gases or compressed air. They have airtight chamber filled with compressed gas. The compressed gas applies an external pressure on the pneumatic piston, which then applies pressure on the pump which is connected to the pneumatic pistons. They are capable of utilizing many pressurized gases as drivers.

II. Literature Survey

M Khaja Gulam Hussain et.al [1], This paper presents the technology of pneumatics has gained tremendous importance in the field of automation from old fashioned timber works, machine shops and space robots. Certain characteristics of air have made this medium quite suitable for use in modern manufacturing and production industries. It is therefore important that technicians and engineers should have knowledge on pneumatic systems air operated valves accessories. Pneumatic system consists of a compressor plant, pipe lines control valves and drive members. The air is compressed in an air compressor and from the compressor plant the flow media is transmitted to the pneumatic cylinder through a well laid pipe line system.

So, keeping in mind about the importance of pneumatic system are introducing a project called Automatic pneumatic water pumping system. Here all need is a compressor pneumatic cylinder, connecting links and a control system. The aim of the project is pneumatic operated water pumping system, radial plunger pneumatic water pumping system are reciprocating pump is provided for the pumping action. The piston is reciprocated with the help of a pneumatic cylinder solenoid valve. There are two cylinders are used in this project, one for pneumatic cylinder and another one for hydraulic cylinder. The output quantity of the water is varied by the timing control unit. This pumping system also used in pumping of petroleum-based products, water supply in agriculture lands, Industrial pumping and also in domestic applications.

N S M Hussin et.al [2], This paper presents the current pumping system (DC water pump) for agriculture is powered by household electricity, therefore, the cost of electricity will be increased due to the higher electricity consumption. In addition, the water needs to be supplied at different height of trees and different places that are far from the water source. The existing DC water pump can pump the water to 1.5 m height but it cost money for electrical source.

The hydraulic ram is a mechanical water pump that suitable used for agriculture purpose. It can be a good substitute for DC water pump in agriculture use. The hydraulic ram water pumping system has ability to pump water using gravitational energy or the kinetic energy through flowing source of water. This project aims to analyse and develop the water ram pump in order to meet the desired delivery head up to 3-meter height with less operation cost. The hydraulic ram is designed using CATIA software. Simulation work has been done using ANSYS CFX software to validate the working concept. There are three designs were tested in the experiment study. The best design reached target head of 3 m with 15% efficiency and flow rate of 11.82l/min. The results from this study show that the less diameter of pressure chamber and higher supply head will create higher pressure.

Karan Dutt et.al [3], This paper presents about pneumatics working and components. The main emphasis is given on its various components' functioning and working. Pneumatics is a section of technology that deals with the study and application of pressurized gas to produce mechanical motion. Pneumatic systems are used extensively in industry, and factories are commonly plumbed with compressed air or compressed inert gases. This is because a centrally located and electrically powered compressor that powers cylinders and other pneumatic devices through solenoid valves can often provide motive power in a cheaper, safer, more flexible, and more reliable way than a large number of electric motors and actuators.

O. A. Adeodu et.al [4], This paper presents development of a pneumatic pumping system that operates using pneumatic cylinders as the actuator. The pump is self-priming and supplies fluids at high pressure and constant flow rates compared to normal centrifugal pumps. In this work, a 3D model is developed using SolidWorks software and the pneumatic circuit used is simulated using FESTO fluid simulator.

The modelling and design of the Pneumatic fluid pumping system were done using existing design parameters of a reciprocating pump as the basis and in fabricating the system. The performance evaluation of the pumping system was carried out by conducting integrity test on the joints and valves by introducing compressed air at a constant pressure of 10 bar into the cylinders to ascertain any leakages through the joints and valves. Also, experimental plots of discharge head against flow rates in the range of 800 to 7890 mm give flowrate between $3.87 \times 10^{-3} \text{ m}^3/\text{sec}$ to $1.48 \times 10^{-3} \text{ m}^3/\text{sec}$, respectively were obtained. The wear and tear in the system have been reduced due to reduction in moving parts and the elimination of prime movers. The design will find useful application in oil and gas industries and where flows through high suction and head are need. Based on the results are presented, recommendations to improve the system for better performance were also suggested.

Aakash M. Bodh et.al [5], This paper presents transmitting power from one point to another. Mechanical transmission is through shafts, gears, chains, belts, etc. Electrical transmission is through wires, transformers, etc. Fluid power is through liquids or gas in a confined space. It shall discuss a structure of hydraulic systems and pneumatic systems. We will also discuss the advantages and disadvantages and compare hydraulic, pneumatic, and mechanical systems. Fluid power is the technology that deals with the generation, control and transmission of forces and movement of mechanical element or system with the use of pressurized fluids in a confined system.

Both liquids and gases are considered fluids. In this article the energy analysis of the pneumatic system is implemented in the simulation model. Previous research has shown the comparison of methods for the investigation on the energetic behavior of pneumatic drives and its practical application. Concerning the analysis of the methods for determination the energy efficiency, the presented model is based on exergy analysis.

III. Objectives and Methodology

3.1 objectives

The main objective of our project is to design and fabricate an Automatic Pneumatic Water Pumping System model. Besides the main objective, following are our secondary objectives

- To understand project planning and execution.
- To understand the fabrication techniques in a mechanical workshop.
- To understand the usage of various mechanical machine tools and also measuring tools
- To make day to day human life easier by proper use of technology, our design overcomes the previous
- Simple in construction
- Less space required

- Low energy consumption
- No need of skilled persons

3.1 Methodology

To fabricate the model, it all begins with a systematic plan where the fabrication is of five steps of solving process. The steps are as follows:

- **Analyzing Research Papers**

Collect all the relevant data about the problems and the research programs which are happening around and the outcomes of them and evaluate them by comparing with the other research programs where to sort out the demerits of the conventional types of braking systems in a more effective.

- **Selection of the Pneumatic cylinder**

To Overcome the Problems, selection of the Pneumatic cylinder is to minimize the problems which normally occur in the conventional type water pumps. To study and analyze about the system where by focusing on to the working principle and the fabrication materials and design required for the model to be done and even a study towards the functioning of the braking system according to the design planned.

- **Preparation of Design**

In this step it is more concentrated on to the design part where looking on to several alternatives of designs according to the installation specifications as planned in the previous steps.

- **Fabrication**

In this step the process consists of working on to the chosen design and approach into the reality. The model is then fabricated as per the specifications given and check if all the mechanisms work perfectly

- **Testing**

The model is tested to check if it meets all the objectives, and the model is again made to test whether there has to be done any improvement or any modifications to it. After the test is done completely the model is then made to implement.

IV. Working Principle

Initially starting with air compresses, its function is to compress air from a low inlet pressure (usually atmospheric) to a higher-pressure level. This is accomplished by reducing the volume of the air. Air compressors are generally positive displacement units and are either of the reciprocating piston type or the rotary screw or rotary vane types. The air compressor used here is a typically small sized, two-stage compressor unit. It also consists of a compressed air tank, electric rotor pressure controls and instruments for quick hook up and use. Fig. 1 shows the draft of the automatic pneumatic water pumping system.

The compressor is driver by a motor where air is compressed and from the compressor plant the flow media is transmitted to the pneumatic cylinder through a well laid pipe line system as shown in Fig. 3. Through a variety of direction control value are available, hand operated solenoid Valve is used. The solenoid valve used here is 5 ports, 3 positions. There are two exhaust ports, two outlet ports and one inlet port. The limiting switches are provided to limit the stroke of the cylinder rod. The cylinder rod is connected to hand operated pump which using this action from the pump to pumpwater. The cylinder output is coupled to further purpose. The piston end has an air honing effect to prevent sudden thrust at extreme ends. Fig. 2 shows the CAD model of the Automatic pneumatic water pump system designed using Catia V5 software.

V. Figures

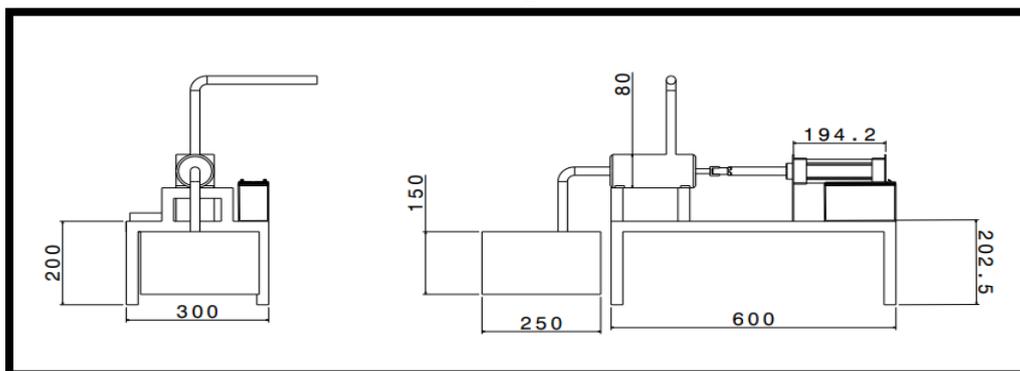


Fig.1 Front and Side View Automatic Pneumatic Water Pumping System

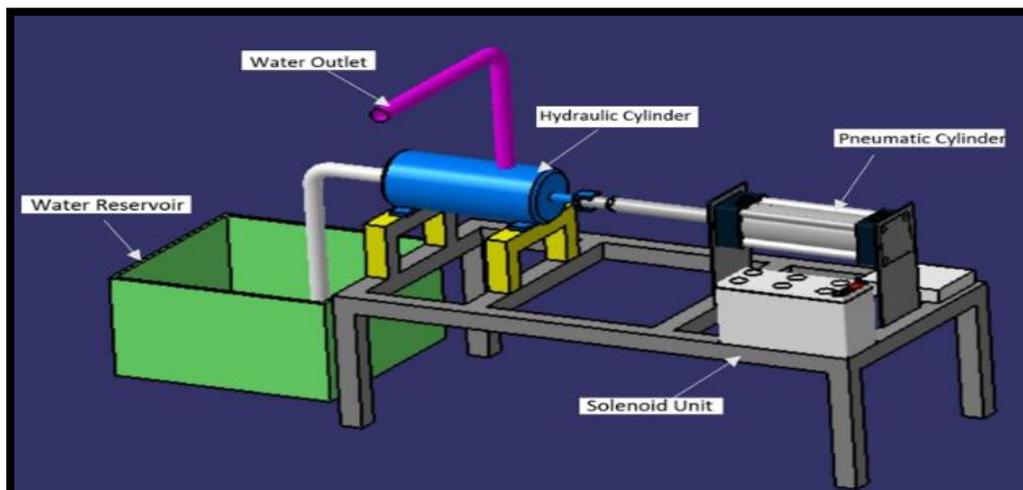


Fig.2 CAD model of Automatic Pneumatic Water Pumping System



Fig.3 Completed Project Model

VI. Conclusion and Future Scope of Work

6.1 Conclusion

It is concluded that, this system is very useful in the area where electricity is not available throughout the day. By using less amount of electricity, we can suck the water from the ground by this system using the compressed air. This system is also useful in petrol industries to suck petrol from ground to the required height by using less amount of electricity than the motors. By increasing the pressure can able to raise the head of water with less amount of electricity than the motors which use for sucking of water from ground. In this system the discharge of water increases with increase in pressure but takes less amount of electricity as compared to electric motors which depends upon electricity for increase in discharge of water i.e., discharge of water increases by increasing of electricity consumed. But only things take care in this system is about the leakages.

6.2 Future Scope of Work

Though the machine has some innovative concepts, there is still a lot of scope for development like

- The pump does not have a built-in compressor it needs an external compressor.
- The pump should be in large scale to able to use in large scale industries

References

- [1]. M Khaja Gulam Hussain, T. John babu, Dr. Syed Altaf Hussain, Fabrication of Pneumatic Water Pumping System, International Research Journal of Engineering and Technology, Volume 03, Issue 7, 2016, PP: 2395-0072.
- [2]. N S M Hussin, S A Gamil, N A M Amin, M J A Safar, M S A Majid, M N F M Kazim and N F M Nasir, Design and analysis of hydraulic ram water pumping system, Journal of Physics: Conference Series, Volume 10, Issue 02, 2017, PP: 9081-2052.
- [3]. Karan Dutt, Analytical Description of Pneumatic System, International Journal for Research in Applied Science & Engineering Technology, Volume 4, Issue 09, 2017, PP: 2229-5518.
- [4]. O. A. Adeodu, I. A. Daniyan, I. K. Usoro, A. I. Asuquo K. A Bello, O. R. Oloyede, Development and Performance Evaluation of a Pneumatic Fluid Pumping System, International Conference on Engineering for Sustainable World, Volume 3, Issue 08, 2020, PP: 012-112.
- [5]. Aakash M. Bodh, G. H. Waghmare, Study, Design and Improvement of Pumping System Efficiency of Hydraulic Pneumatic Reciprocating Pump, International Journal of Mechanical Engineering and Technology, Volume 7, Issue 3, 2016, PP:0976-6340.