DEVELOPMENT OF LOW PRESSURE WATER HYDRAULIC SYSTEM

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"I/We* hereby declared that I/We* have read this thesis and in my/our* opinion this thesis is sufficient in terms of scope and quality for the award of Degree of Bachelor Mechanical Engineering (Thermal-Fluids)"

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"I hereby declared that this is my own work except the ideas and summaries which I have clarified their sources"

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Special dedication to my family, supervisor, my friends and all that help me to finish my thesis.

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ABSTRAK

Tesis ini menerangkan kajian tentang pembangunan sistem hidraulik air tekanan rendah. Kajian ini tertumpu kepada pembinaan unit kuasa hidraulik, mereka system hidraulik air, memasang sistem pengujian dan unit kuasa hidraulik dan menjalankan ujian-ujian tertentu kepada sistem hidraulik air tersebut. Kajian ini juga tertumpu kepada prestasi hydraulic air apabila tekanan rendah diaplikasikan terhadap sistem tersebut. Selain itu, kajian ini juga tertumpu kepada penggunaan *"Programmable Logic Controller (OMRON)"* sebagai sistem kawalan untuk sistem hidraulik air tekanan rendah. Penggunaan sistem hidraulik air ini telah digunakan dalam sektor industri sejak beberapa tahun dahulu, tetapi kemudian telah digantikan kepada minyak sebagai pengerak sistem disebabkan oleh masalah-masalah yang dihadapi dengan menggunakan air sebagai penggerak sistem. Kajian ini dijalankan untuk mengetahui had sistem hidraulik air dan penyelesaian unutk mengatasi masalah yang berlaku. Sistem pengujian telah direka bentuk dan simulasi telah dilakukan dengan menggunakan *"Programmable Logic Controller (OMRON)"* yang digunakan dalam sektor industri masa kini. Melalui simulasi, ia dapat mengurangkan masa pemasangan dan membantu dalam pemasangan sistem pengujian dengan betul. Beberapa ujian telah dijalankan dengan bantuan system pengujian tersebut. Ujian yang sama telah dilakukan terhadap sistem pneumatic dan sistem hidraulik untuk perbandingan terhadap sistem hidraulik air tekanan rendah. Prestasi ujian yang diuji adalah seperti tekanan lolos, kebocoran dalaman, kelajuan lejang dan daya keluaran. Keputusan telah dicatat dan dianalisis untuk menentukan kebolehan sistem hidraulik air tekanan rendah dan membuat perbandingan diantara sistem pneumatik dan sistem hidraulik. Sebagai keputusan, sistem hidraulik air tekanan rendah adalah praktikal. Akan tetapi, beberapa pembaikan diperlukan supaya sistem tersebut lebih bersesuian dan efisien.

ABSTRACT

This thesis presents a study on development of low pressure water hydraulic system. This study mainly focuses on building a hydraulic power unit, design of control system, fabricate water hydraulic power unit and system and run testing procedures on the testing system. The purpose of this study is to test the performance of water hydraulic when low pressure is applied. Besides that other purpose of this study is to use *Programmable Logic Controller (OMRON)* as the control system for this low pressure water hydraulic system. Water hydraulic system is commonly used in industries years ago, but then water hydraulic is replaced with oil as pressure medium because of disadvantages of using water as pressure medium. This study is done to explore the limitations of using water hydraulic system and the solution to solve the occurred problems. A testing system was designed and simulated by using *Programmable Logic Controller (OMRON)* which is widely used in industries nowadays. From the simulation, the motion of cylinder is shown. This simulation can help reduces time in designing and assembling the testing system correctly. Several tests were done with the aid of the testing system for low pressure water hydraulic system. The same tests were also done on pneumatic system and hydraulic system for comparison in terms of performance. The performance of system was tested in terms of breakaway pressure, internal leakages, speed of stroke and output force. The results were recorded and analysed to verify the ability of low pressure water hydraulic system and to make comparison between pneumatic system and hydraulic system. As a result, low pressure water hydraulic system is applicable. However, improvements are needed to make sure the system is more suitable and efficient.

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PLC	=	Programmable Logic Controller
F	=	Force, N
A	=	Area, m^2
P	=	Pressure, Bar
Q	=	Flow rate, m^2/s
v	=	Velocity, m/s
P	=	Power, J/s
N	=	Angular Speed, rad/s
T	=	Torque, Nm
η	=	efficiency
CFD	=	Computational Fluid Dynamics
L	=	Length
t	=	Time

CHAPTER 1

INTRODUCTION

1.3 Background

Fluid power is a technology that uses pressurized fluids for transmission of power. Fluid power is called hydraulics when the fluid is liquid and pneumatics when the fluid is a gas. The first fluid that is used in fluid power applications was water. However water was overtaken by oil hydraulics due to the cause of deficiencies shown by water as pressurized medium. Due to the growing concern of environmental issues has led to the interest of using water hydraulics again. Because water is non toxic, environmental friendly, and readily available is the main factors that many industries are turning to water hydraulic system.

Usually hydraulic system is design for high pressure, but because of water can only work with low pressure, therefore a study is carried out to develop a system for low pressure water hydraulic. In this study, the pressure that will be loaded on to the system for testing is below 10 bars. The control system that will be used in controlling the actuator is by using PLC control system where it is more suitable to used compare to electrical control system.

1.2 Objective

The objectives of this study are:

i. To learn and understand the concept of low pressure water hydraulic system
ii. To re-design the existing low pressure water hydraulic system using PLC control system
iii. To fabricate the new water hydraulic system
iv. To conduct an experiment to test the system
v. To compare between water hydraulic system, pneumatic system and hydraulic system in terms of cylinder speed and output force of cylinder

1.3 Scope

The scopes of the project are:

i. Re-design the existing system by using PLC control system and new pump
ii. Validate the system control
iii. Fabricate the new design of low pressure water hydraulic system
iv. Test the system control design of low pressure water hydraulic system
v. Uses RO water as operating medium
vi. Uses pneumatic cylinder as actuator system
vii. Compare water hydraulic system with pneumatic system and hydraulic system