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THE DEVELOPMENT OF A HYDRAULIC GEAR PUMP

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ADMISSION

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Date : 29 MAY 2006

This work is dedicated to my beloved family and all of my family. Your love are forever………………..

To all classmates, do remember our friendships. It was a happy moment to be with you guys in these past few years…………..

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Last but not least, I would like to express my gratitude to my parent, friends, and all those that have been very supportive to me in finishing this research.

Thank you.

ABSTRACT

From the PSM Research, I have learned the design of efficient hydraulic gear pump component that provides adequate levels of strength, stiffness and durability is a major consideration in the development of hydraulic gear pump. A good understanding of classical theory based on the performance in hydraulic gear pump components is essential for any work in the durability area. The ability to apply advanced solid mechanic software and analysis techniques is another requirement of the hydraulic gear pump development. In additional, there is a wide range of test procedures that must be followed to ensure the through life performance of a component.

This research involves computer software for engineering design, the use of laboratory experimentation and consideration of fatigue and theories of failure. Due to constrain in with standing high hydraulic pressure, they only 'safe' experiment that had been done is the efficiency of the hydraulic gear pump it. In this research, the theoretical and actual flow rate was determined and the volumetric efficiency of the pump was studied.

ABSTRAK

Berdasarkan kepada kajian PSM ini, saya telah dapat mempelajari tentang teknik merekacipta gear pam hidraulik berserta komponennya dan melengkapi kekuatan, kekakuan dan ketahanan adalah perkara utama yang perlu diambil kira dalam merekacipta dan fabrikasi sebuah gear pam hidraulik. Pemahaman yang mendalam tentang teori berdasarkan kepada perkembangan komponen hidraulik gear pam dalam bidang kejuruteraan. Bagi menjayakan projek merekacipta dan fabrikasi gear pam hidraulik penggunaan perisian komputer `Solid Work' dan analisis terhadap gear pam hydraulic diperlukan.

Research ini mengandungi perisian rekabentuk berpandukan komputer bagi jurutera, penggunaan makmal dan juga sebarang kegagalan semasa eksperimen. Oleh itu, keselamatan semasa eksperimen dijalankan adalah penting.

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CHAPTER 1

INTRODUCTION

1.1 Project Arrangement

Overall the project activities can be illustrated as below:

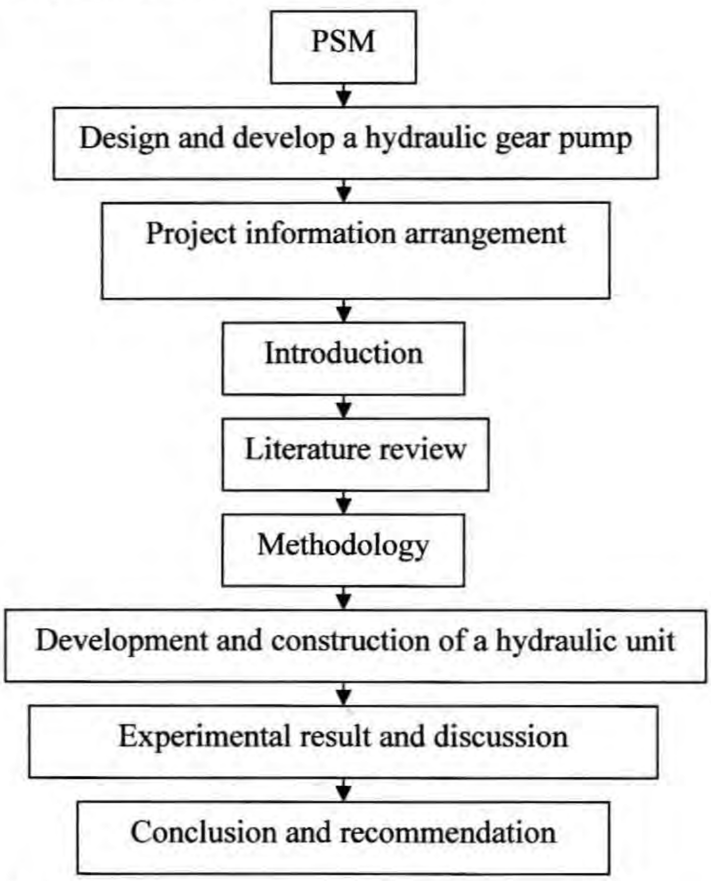

Figure 1.1 Diagram show flow to produce reports

1.2 Objective

Objective of this project

i. design and develop a hydraulic gear pump for educational and research purpose on lubricant

ii. include on how to design shaft, gear and some equation on gear hydraulic pump

iii. to develop an appreciation of engineering through the application of design, fluid mechanics and thermodynamic

iv. to promote study in practical applications of engineering and scientific principles

1.3 Project scope

i. To design and built a hydraulic gear pump

ii. To determine the performance of hydraulic gear pump

iii. To analyse the volumetric efficiency of the pump

1.4 Problem statement

As mentioned before the main purpose of this thesis is to design and develop the hydraulic gear pump. The types of hydraulic gear pump that are going to be use during the development are external gear pump. Which the gear contains two gears, a driven shaft, a dive shaft and bearing. Therefore in the development also need seal to avoid leakage. We must know number of teeth at gear pump. The force acting on the shaft either by twisting or moment. The other way is use the moment and twisting force on the shaft. The other is the force acting on the bearing. Then we need to know the pressure produce by pump.

1.5 Problem analysis

Some of the approach that has to be considers overcoming the problem statement mentioned above:-

i. Identify all the problem statement and try to overcome it.
ii. Design and develop a hydraulic gear pump based on the problem
iii. Study on the gear and characteristics
iv. Familiarized with all the equations, concept and theory related to the problem
v. Collecting data from the development of the gear hydraulic pump to overcome the data

CHAPTER 2

LITERATURE REVIEW

2.1 A hydraulic gear pump

Hydraulic gear pumps are used in a wide variety of machines, for example agricultural and construction vehicles, and aeroplanes, to provide flexible power from the engine to lifting gear or ancillary equipment. The pump under investigation here forms part of the power steering mechanism of an agricultural tractor. As shown in figure 2.1, it consists of a drive gear and a driven gear which sit in two bearing blocks, floating within housing, with a flange plate on one side and a cover on the other to press the blocks onto the gears.

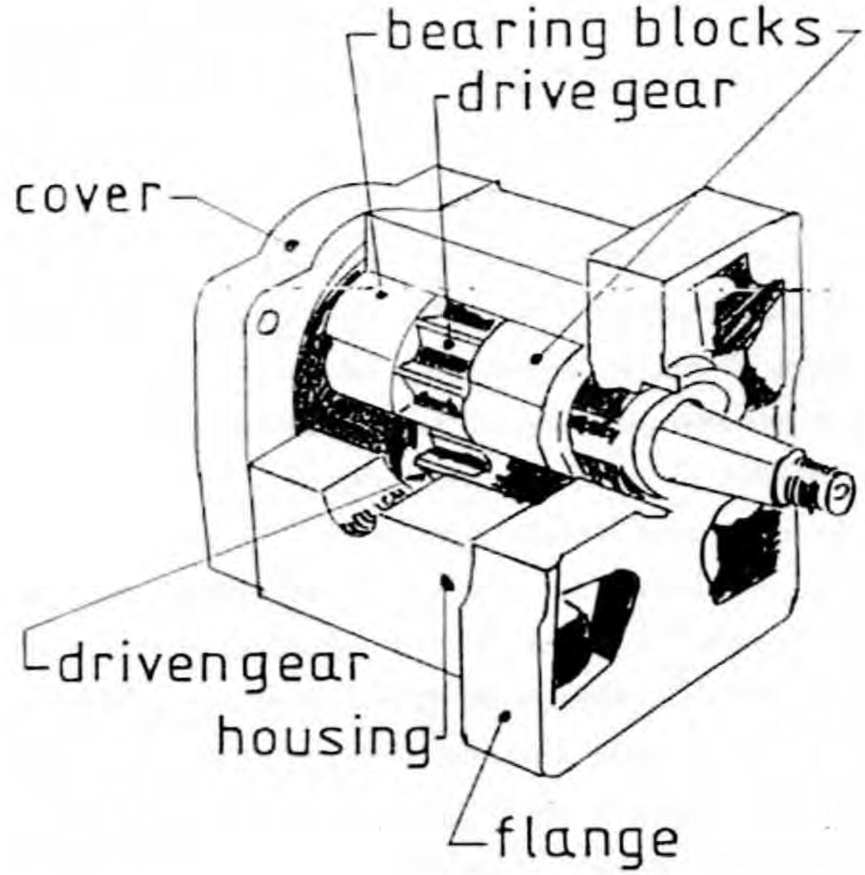

Figure 2.1: A hydraulic gear pump

To improve the engineering design, the manufacturer wished to investigate how the many geometrical aspects of the components and their relative positions influence leakage of the hydraulic fluid around the internal components. The physical phenomenon underlying the leakage process is very complicated, primarily because of the flexing of components under high pressure, and the dynamical motion of the gears in oil. Thus no mathematical model is available to predict leakage accurately, and consequently experiments on a software model (for example, Aslett *et al.*, 1998) are not an option for this type of study. Real prototypes must be used which incur costs of manufacture, measurement and testing, and lead to restrictions on experiment size. The final part of the manufacturing process involves running the pump so that the gears cut into the bearing blocks, creating a seal against oil leakage. This bedding-in process creates an additional restriction as it changes features of the components of a completed pump so that its components cannot be re-used in another prototype.

As a first attempt to experiment on the pump, a small pilot study was planned to establish laboratory testing procedures, and to gain some insights into how the leakage might arise. In this study only features related to the drive gear, the driven gear and the two bearing blocks (known collectively as the gear pack) were varied, and all other features were held constant. A sample of used gear pump was available. The relevant dimensions of these components were carefully measured, and a design was then needed to specify which components should be selected and assembled to make each of the twelve pumps. Although the specific reasons for leakage occurring are not known, the engineers identified three possible leakage paths through the pump. For each path a derived factor such as side gap, clearance and gear form was defined giving the size of the path as an explicit formula in terms of the geometrical dimensions of the components. The clearance is based on the difference between the diameter of the drive shaft and that of the journal bearing into which it fits. The gear form is a function of the profile of the gears while and the side gap corresponds to the size of the gaps between the gears and bearing blocks. An aim of the pilot study was to obtain information on which of these derived factors might be important for leakage so that more detailed follow-up experiments could be focused on the appropriate leakage paths.

2.2 Pump classification

Basically pumps can be classified as positive and non-positive pumps as shown below.

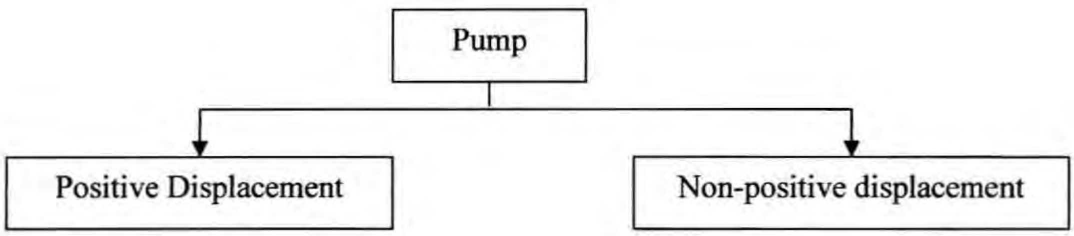

Figure2.2: Diagram Classified of pump

2.3 Positive displacement pump (PD)

Positive displacement pumps are those who are pumping volume changes from maximum to minimum during each pumping cycle. That is, the pumping element expands from a small to a large volume and is then contracted to a small volume again.

Positive displacement pumps are used where pressure is the primary consideration. In these pumps the high and low pressure areas are separated so that the fluid cannot leak back and return to the low pressure source. The pumping action is caused by varying the physical size of the sealed pumping chamber in which the fluid is moved. As fluid moves through the pumping chamber, volume increases and is finally reduced causing it to be expelled alternately increases and then decrease the volume. Since the volume per cycle is fixed by the positive displacement characteristics of the pumping chamber, the volume of fluid pumped for a given pump size is dependent only on the number of cycles made by the pump per unit time. Gear, vane, piston, screw pumps are some examples of such pumps.

In such pumps the flow enters and leaves the unit at the same velocity, therefore, practically no change in kinetic energy takes place. These pumps provide the pressure with which a column of oil acts against the load and are hence classified as hydrostatic power generators.

2.3.1 Advantages of Positive Displacement Pumps

i. PD pumps are widely used in hydraulic system
ii. They can generate high pressure
iii. They are relatively small and enjoy very high power to weight ratio
iv. They have relatively high volumetric efficiency
v. There is relatively small change of efficiency throughout the pressure range
vi. They have greater flexibility of performance under varying speed and pressure requirements

2.4 Non-Positive Displacement Pumps (NPD)

Pumps where the fluid can be displaced and transferred using the inertia of the fluid in motion are called non-positive displacement pumps. Some examples of such pumps are centrifugal pumps, propeller pumps, etc.