APPARATUS EMBODIMENT OF SOLAR POWER PUMP

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This dissertation is submitted as partial fulfillment of the requirement for the degree of Bachelor of Mechanical Engineering (Thermal Fluid)

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APRIL 2009

APPROVAL OF SUPERVISOR

"I admit to have read this report and it has followed the scope and quality in Partial Fulfilment of Requirements for the Degree of Mechanical Engineering (Thermal Fluid)"

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Date :..

Dedication

This book is especially dedicated to my loving parents, my supervisor, all respective UTeM staffs and friends for their undivided help and guidance in enabling me to gain experience and knowledge in making my final year project a success.

ACKNOWLEDGEMENTS

Alhamdulillah, praise to Allah s.w.t. the most gracious, the most merciful. Thank you for giving me the strength and spirit for me to complete this research on solar powered positive displacement pump. I would have never completed this final year project if not for the help by some people.

Throughout time given in completion this project, I am very grateful with the co-operation from lecturer, technicians and friends. I have learned so many things such as instrumentation, job skills, interaction between individuals and the most precious is how to produce a technical report. My highly appreciation to Mr. Kothwal Abdul Raheem who supervised my progress for this technical report writing, for shared his knowledge and concerned towards my project. Without his guidance, assistance, encouragement and patience, I don't think I can manage to complete this project on time. Thank you so much sir.

I also want to express the highest gratitude to my parents and family for giving me the moral support when I really need one. Thank you very much and I will always love you. Last but not least, I would like to thank to all my friends for their encouragement and support when we face any difficulty in completing this academic exercise. Words just cannot illustrate how much I thank all of you.

ABSTRACT

Nowadays, the world is having energy crisis. A lot of alternative energy has been introduced to reduce the cost in a daily life such as solar power in pumping water. The use of solar pumps to provide water to communities living in remote areas has undergone a consistent increase in recent years. This report presents the complete fabrication of the solar power pump. The objectives of this research are not only to fabricate but to assemble and to test a working model of the pump for satisfactory performance. This research meant to discover the advantages and the applications of the solar power pump. The operation of solar power pump is obtained through two experiments. So, the results are explained regarding the effect of Current (amps) and DC voltage of the pump-motor upon the solar radiation which measured in volts. The second experiment is to compare the theoretical and experimental volume flow rate. The importance of this report is to point out as well as the technical information, the basic operation and its common uses in real life application.

ABSTRAK

Pada masa kini, dunia sedang hebat dilanda krisis sumber tenaga. Banyak sumber tenaga alternatif baru diperkenalkan untuk mengurangkan kos kehidupan seharian seperti tenaga solar yang digunakan untuk mengepam air untuk kegunaan seharian. Penggunaan pam solar untuk membekalkan air semakin bertambah dari hari ke hari terutamanya kepada masyarakat yang dikawasan pedalaman dalam beberapa tahun kebelakangan ini. Laporan ini mewakili fabrikasi lengkap pam yang menggunaka tenaga solar. Tujuan kajian ini dibuat bukan sahaja untuk fabrikasi malah untuk memasang dan menguji model yang berfungsi supaya memenuhi kehendak dan prestasi yang memuaskan. Kajian ini juga bertujuan untuk mengetahui kelebihan dan aplikasi pam yang menggunakan tenaga solar. Operasi pam yang menggunakan tenaga solar ini akan diketahui melalui dua eksperimen yang akan dijalankan. Keputusannya akan diketahui melalui kesan arus dan voltan arus terus oleh motor pam melaui radiasi solar yang diukur dalam volt. Tujuan eksperimen kedua dijalankan adalah untuk membandingkan kadar isipadu aliran air. Laporan ini penting dalam mengenalpasti spesifikasi teknikal, asas operasi dan aplikasinya dalam kehidupan seharian.

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LIST OF ABBREVIATIONS AND SYMBOLS

A	=	Ampere
A	=	Cross sectional area of pipe
AC	=	Alternative current
AH	=	Ampere per hour
BC	=	Before century
D	=	Diameter of pipe
DC	=	Direct current
F	=	Darcy friction factor
g	=	Gravity acceleration
GPM	=	Gallons per minute
HDPE	=	High density polyethylene
Hp	=	Horsepower
ICE	=	Internal combustion engine
J	=	Joule
K_L	=	Loss coefficient
kWh	=	kilowatt hour
l/min	=	liter per min
MAWP	=	Maximum allowable working pressure
MPPT	=	Maximum power point trackers
m^3	=	Meter cubes
n.c	=	Normally closed
n.o	=	Normally open
NiCd	=	Nickel cadmium
NPSHA	=	Net positive suction head available
NPSHR	=	Net positive suction head required
P_{atm}	=	Atmospheric pressure

P_V	=	Vapor pressure
PD	=	Positive displacement
PSI	=	Pound per square inch
PV	=	Photovoltaic
PVC	=	Polivinylchloride
ΔP	=	Pressure drop
Q	=	Volume flow rate
Re	=	Reynolds Number
STC	=	Standard test condition
s.g	=	Specific gravity
V	=	Volt
V	=	Velocity of water
W	=	Watt
$\mathcal{E}$	=	Electromotive force
μ	=	Dynamic viscosity
υ	=	Kinematics viscosity

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CHAPTER I

INTRODUCTION

1.1 Background of the Research

The use of solar pumps to provide water to communities living in remote areas has undergone a consistent increase in recent years (Hamza and Azmi, 1995). One of the first tasks in designing a PV-driven water supply system is the choice of the pump, which depends on the well depth and diameter, the flow rate of water, the presence of abrasive suspended solid particles entrained by the flow and the daily radiation peak power.

The earliest pump was used by Sennacherib, King of Assyria, for the water systems at the Hanging Gardens of Babylon and Nineveh in the 7th century BC. The pump was known as Archimedes screw. The pump was powered by windmill or manually using human power. Lately, the world is having energy crisis. The crude oil price especially is increasing highly give big impact to develop and small country such as our Malaysia. So, a lot of alternative energy has been introduced to reduce the cost in a daily life. Solar power is one of alternative energy that became popular nowadays. Solar technology is very well suited to pumping water, even more so than the traditional windmill. A solar powered pump is a pump running on the power of the sun. It has the same function, namely to provide the pressure necessary to move a liquid at the desired rate from point A to point B of the process.

This research investigated solar power pump to lift sufficient water for various application such as water irrigation, rural water supplies and livestock watering. A solar powered pump can be more environmentally friendly and economical in its operation compared to pumps powered by an ICE or internal combustion engine. There are more than 10,000 solar powered water pumps in use in the world today. In developing countries they are used extensively to pump water from wells and rivers to villages for domestic consumption and irrigation of crops. This research also included field test on a prototype pump assembly for satisfactory performance and testing.

1.2 Problem Statement

Nowadays, there is still a lot of equipment at house depend on the electricity that generates from natural gas. One of the best examples is pump to lift water. As a result the electricity bill is high that burden many people. Besides that, at inner state people used water from well and pump it manually using their own energy. But, this method is not efficiently, waste time and it is not user friendly. In addition, there is also pumping that powered by solar energy. The problem is Malaysia known as wet and hot weather. During raining day, solar system cannot function without sunlight and automatically the pump cannot function as usual. On the other hand, the objective of this project is to complete apparatus embodiment of solar power pump.

1.3 Significance of the Research

Solar energy is the prime source of energy of the earth where solar water pumping was introduced into the field in the late nineteen-seventies. A typical solar pumping system for a household requirement is consists with following components such as:

- Solar collectors
- A controller
- Solar bank
- Pump

The starting point for any assessment of solar water pumping is to determine the energy requirement for a typical pumping system. The greater the energy demand, the more PV modules will be needed as well as the cost.

In this research, it can enhance student knowledge in alternative energy especially in solar technology whereas student can research, assemble and fabricate a solar power pump. Furthermore, student can gain a new knowledge on how the principle solar energy works and in choosing the right solar panel for the system. Besides that, this research can help society decreasing electricity usage that supply by the government. Automatically, it can help reduce electricity bill and generates economy.

1.4 Objective of the Research

This research has been confined to two relatively simple aspects:

a. To complete apparatus embodiment of solar power pump.

b. To test a prototype pump assembly for satisfactory performance and testing.

1.5 Scope of the research

The scope of this research involved on literature review on current solar power pump technology. It is also to identify current problem in pumping process. The design of this model is not included.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Solar power pump can be used for a range of operations. There are more than 10,000 solar powered water pumps in use in the world today. Solar PV water pumping systems are used for irrigation and drinking water in India. The majority of the pumps are fitted with a 200 watt - 3,000 watt motor is powered with 1,800 Wp photovoltaic arrays which can deliver about 140,000 liters of water/day from a total head of 10 meters. By 30th September, 2006, a total of 7,068 solar PV water pumping systems have been installed (Wikipedia, 2008). In developing countries they are used extensively to pump water from wells and rivers to villages for domestic consumption and irrigation of crops.

For locations beyond the reach of power lines and with little wind, solar pumps offer a clean and simple alternative to fuel-burning generators. Using the principle of thermodynamics they require no batteries, no high-voltage electricity, no engine consuming gasoline or diesel fuel. There are two basic types of solar-powered water pumping systems, battery-coupled and direct-coupled.

A typical solar powered pumping system consists of a photovoltaic array that powers an electric motor, which drives a pump. The water is often pumped from the ground or stream into a storage tank that provides a gravity feed. No energy storage is needed for these systems. Solar powered pumping systems are a cost-effective alternative to agricultural wind turbines for remote area water supply.

Solar power pump have the potential to provide significant changes to rural communities. It is not only throughthe direct of provision of water but also through the possibilities of sociological and economic development. The impact of solar power pump can go beyond the availability of fresh water but can hae both positive and negative consequences. Without knowledge of these consequences it is difficult to see the solar power pump designers, manufacturers and project implementers can hope to provide a sustainable solution to the problem of water provision. In fact, solar pumps are becoming one of the favored means for pumping water.

2.2 Solar Energy

Solar Energy is being used around the world for powering numerous applications. It converts energy from the sun into electricity. The sunlight is collected either by photovoltaics and concentrating solar thermal devices, or by one of several experimental technologies such as thermoelectric converters, solar chimneys and solar ponds. Solar energy can be classified into two categories which are:

2.2.1 Thermal energy

Thermal Energy is everywhere and lights up days. It heats the earth, human bodies and homes and so on. It is used to heat water for domestic use or even pools. There are two ways in which water can be heated which are actively and passively. Actively means when a conventional heating element within the solar hot water system heats water on hot days. While, passively is when water is preheated before it is delivered to the cold inlet of a conventional gas or electric water heater.

2.2.2 Electric Energy

Electric Energy uses the power of the sun to produce electricity through solar cells, otherwise known as photovoltaics (PV). It can be applied in three ways:

a) Stand-alone

A system not connected to the grid. More often than not, these systems are installed in remote areas where there is no utility-supplied power, like remote holiday cottages. It is often cheaper to install a solar energy system than lay electricity cables to the site. Excess energy can be stored in a battery for use during times where there is no sunshine.

b) Grid-connected

A system where utility supplied electricity is connected to the property, but the owners wish to harvest clean, free energy from the sun. Usually in a quest to live a more sustainable, environmentally friendly existence. Electricity is supplied firstly from the solar energy system, then the connected battery if one has been installed and finally from the grid if there is still a need.

c) Back-up

A system connected to an unreliable grid or one of poor quality. These types are usually installed in areas where a lot of power blackouts occur. A small system will service the most important electrical appliances and lights, but a bigger system will be required to keep the fridge running during a blackout.

2.3 Photovoltaic cells

Solar or photovoltaic (PV) cells are made of semiconducting materials that can convertsunlight directly into electricity. When sunlight strikes the cells, it dislodges and liberates electrons within the material which then move to produce a direct electrical current (DC). This is done without any moving parts.

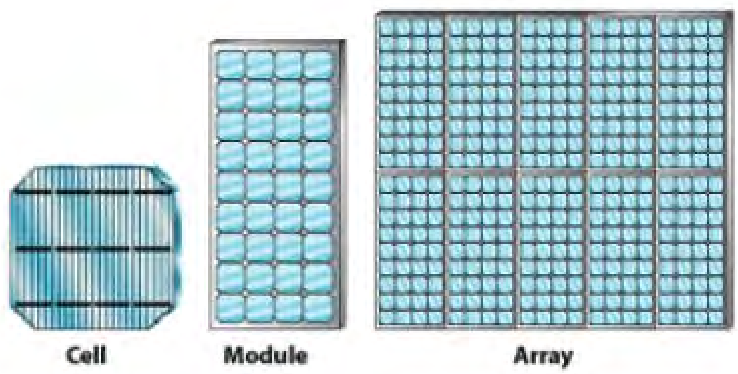

Figure 2.1: Diagram that shows how individual cells make up a module. An array consists of sets of modules (National Renewable Energy Laboratory, 2001).

PV cells are combined to make modules that are encased in glass or clear plastic. Modules can be aggregated together to make an array that is sized to the specificapplication. Most commercial PV cells are made from silicon and come in three general types which are monocrystalline, multicrystalline, and amorphous.

2.3.1 Monocrystalline

Single crystal or monocrystalline cells are made using silicon wafers cut from a single, cylindrical crystal of silicon. This type of PV cell is the most efficient, with around 15% efficiency which means the fraction of the sun's energy that is converted to electrical power. However, it is also one of the most expensive to produce. They are identifiable as having individual cells shaped like circles or rectangles.

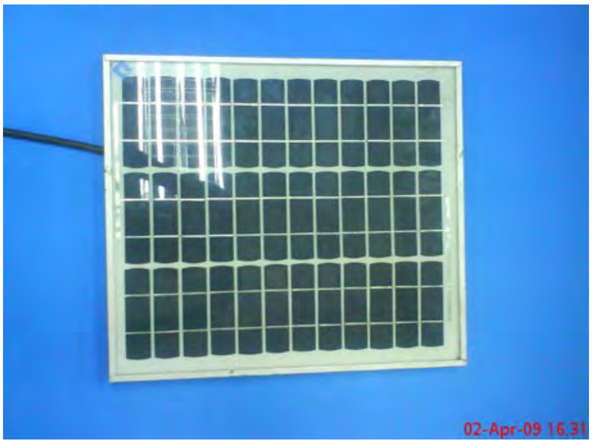

Figure 2.2: Monocrystalline

2.3.2 Multicrystalline

Multicrystalline or polycrystalline silicon cells are made by casting molten silicon into ingots, which crystallize into a solid block of intergrown crystals. The size of the crystals is determined mostly by the rate at which the ingot is cooled, with larger grains made by slower cooling. Cells are then cut from the ingot. Multicrystalline cells are less expensive to produce than monocrystalline ones, due to the simpler manufacturing process and lower purity requirements for the starting material. But, they are slightly less efficient, with average efficiencies of around 12%.