APPROVAL OF SUPERVISOR

"I admit to have read this report and it has followed the scope and quality in Partial Fulfillment Of Requirements For The Degree Of Bachelor of Mechanical Engineering (Thermal Fluid)"

Signature : 

Supervisor Name : Mr.Kothwal Abdul Raheem

Date : 8TH May 2007

DESIGN A SOLAR POWERED WATER PUMPING SYSTEM FOR TYPICAL HOUSEHOLD REQUIREMENT.

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This Report Is Submitted In Partial Fulfillment of Requirements for the Bachelor Degree of Mechanical Engineering (Thermal Fluid)

Faculty of Mechanical Engineering
University Teknikal Malaysia Melaka

May 2007

AGREEMENT

"I agree that this report is my own work except for some summaries and information which I have already stated"

Signature : 

Name : DINESH KUMAR MURUGIAN

Date : 8TH May 2007

DEDICATION

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

ACKNOWLEDGMENTS

To Design and implement a solar powered pumping system for a typical household requirement is quite a big and challenging task for me. Here I would like to take this opportunity to thank the people for their utmost help and guidance given to me during the implementation of my project.

First of all, I would like to thank and appreciate my PSM Supervisor, Mr. Kothwal Bin Abdul Raheem for his full support and guidance in order to build my confidence and ability during my project implementation. Overall he is a very good advisor and from the beginning of my project until the last stage of my project, he keeps on supporting me as well as corrects my mistakes. He had given me much knowledge and supporting ideas throughout the development of my project. And for that, I would like to thank him again for all his utmost support and guidance.

I extend my thanks and appreciation to my uncle, Mr. Anamale, Electrical Engineer, who gave me full support and guidance in order to build my confidence and ability during the implementation of my project especially in the electrical part.

I also extend my thanks and appreciation to my loving parents and my family members who were always by my side giving their undivided time, help and advice.

Last but not least, I also extend my thanks to my Colleagues who were always keeping in touch to guide me during the implementation of my project.

This PSM 2 project report book is especially dedicated to everyone who was involved in contributing directly or indirectly because without his or her help and support I would not have been able to create this report book successfully.

Thank You.

ABSTRACT

My PSM project is regarding the design of a Solar Powered Pumping System. This project enables me to carry out survey and collect the relevant information about the water pumping system which uses solar energy as the power source. The system is concerning a typical design of a pumping system with the appropriate accessories.

Throughout my observation and survey, I understand that solar energy is a suitable and available power source that could produce efficient output to the water pumping system for household use since low maintenance is required. So, I have created and implemented a functioning of the solar powered water pumping system.

This system will help in solving the problem created by the old water pumping system which requires a complex power source as well as high maintenance cost. The first benefit of the system is to produce a desired output where the system is able to function without supervision or maintenance for one or two year's time since the system is fully automatic. The process of operating the pump is also going to be easier and faster.

Besides that, the set up cost for this project is also affordable to all residents who need a sufficient water pumping system for their house. Furthermore, this system is a 100% environment friendly project where there is no wastage produced during the operation of the system. Practically, this system is necessary to a developing nation such as Malaysia.

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LIST OF ABBREVIATION

SHORT FORM	DESCRIPTION
FSR	Float Switch Relay
AC	Alternative Current
DC	Direct Current
AH	Ampere per Hour
PV	Photovoltaic
GPM	Gallon per Minute
NPSHA	Net Positive Suction Head Available
NPSHR	Net Positive Suction Head Required
PSI	Pounds per square inch
n.o	Normally Open
n.c	Normally Close
s.g	Specific Gravity
Hp	Horsepower

Chapter 1 : Introduction

INTRODUCTION

1.1 Project Background

Generally water pumping system is a wonderful use for alternative power technology. Solar technology is very suited to water pumping system especially for typical household requirement. A typical system includes one or more solar panels, an efficient 12 volts DC battery (40AH) with maintenance free, a 1000 watt DC to AC inverter, a control panel with float switch and an AC pump as well as the water tanks with appropriate head. This device trades voltage for extra current to start a pump. Commonly electric current take more power to start up than they take to run. A 12 volts DC battery (40AH) takes care of this problem. It will allow the pump to start and run even on cloudy days. Solar powered water pumping system is one of the easiest solar power systems to install since battery or battery-charging equipment is needed. When the sun is shining, automatically the system is pumping. When the sun is not shining, the pumping system works with aid of battery which can last for 2 to 3 days. Low voltage AC pumps are designed to pump using the absolute minimum of electric power. The appropriate pump that will runs at all in delivering water is the centrifugal pump with pressure relief switch.

First of all, photovoltaic effect produces a flow of electron. Electrons are excited by particles of light and find the attached electrical circuit the easiest path to travel from one side of the solar cell to the other and convert into electric voltage. Envision a piece of metal such as the side panel of the car. As it sits in the sun, the metal warms. The exciting of electrons, bouncing back and forth, creating friction as well as the heat, causes this warming. The solar cells merely take a percentage of these electrons and direct them to flow in a path. This flow of electrons is known as electricity. Photovoltaic or solar electric cells convert sunlight directly into electricity. This electricity is collected by the wiring in the module then supplied to the 12DC battery in order to charge the battery as

well as run the pumping system by converting the DC supply to AC supply for the pump by using an inverter. Inverter plays a vital role in order to complete the pumping system.

When 100% of energy is directly applied to the pump, 20% to 25% of water will get pumped. This kind of system is ideal when the water is being pumped into a large storage tank or is being used immediately for irrigation as well as for the requirement of household domestic uses. In the other hand, this system saves the maintenance cost of the batteries, the maintenance and periodic replacement that require, plus charge controllers and fusing or safety equipment that usually batteries demand.

The solar-powered pumping system is very necessary for people from all walks of life where each house needs this system in order to produce good pumping system for household requirement. By the way, this system is economically affordable and low maintenance. Solar pumping is better suited for the household water supply because of the smaller quantities of water involved and thus lower power demand as well as the comparatively high value of domestic water compare to that irrigation. Solar pumping system is considered as a long-term option since the energy required for the system is available at anytime and with more demand.

Furthermore solar powered pumping system should include a pump controller in order to provides better pump performances and start/stop control as well as for the safety purpose. It is also avoiding the pump to operate when the solar output is too low as a result will damage the system or shorten the pump life cycle. Each residential size solar module will produce a fairly appropriate 18 volts output at almost any level of sunlight. However the current output (amps) will be directly proportional to sun intensity. The pumping generally will have a minimum current draw when stalled and no pumping takes place. As the voltage increases, pump rotation and water-pumping increases as long as current is available. Commonly solar electric system has more advantage than other source of electric system. These solar electric systems are reliable and available at anytime since demand for the electricity increasing with respect to population. The life cycle also increases compare to the others.

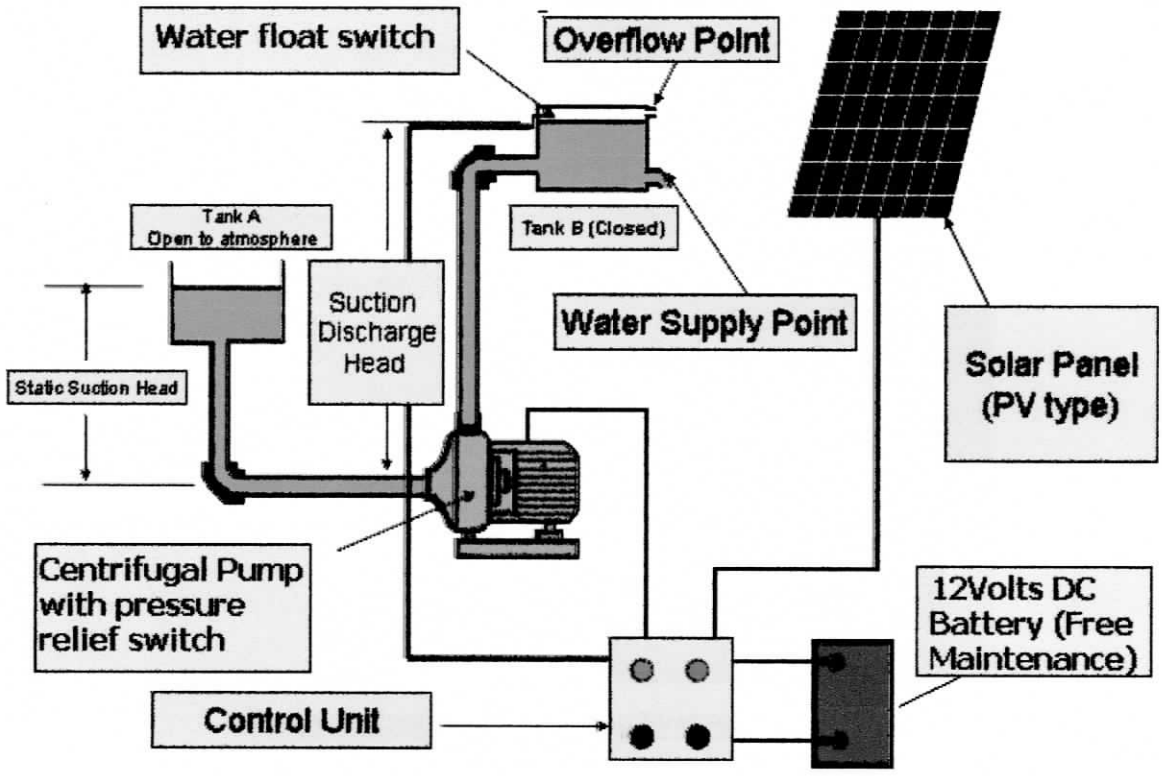


Figure 1: Schematic drawing of my project

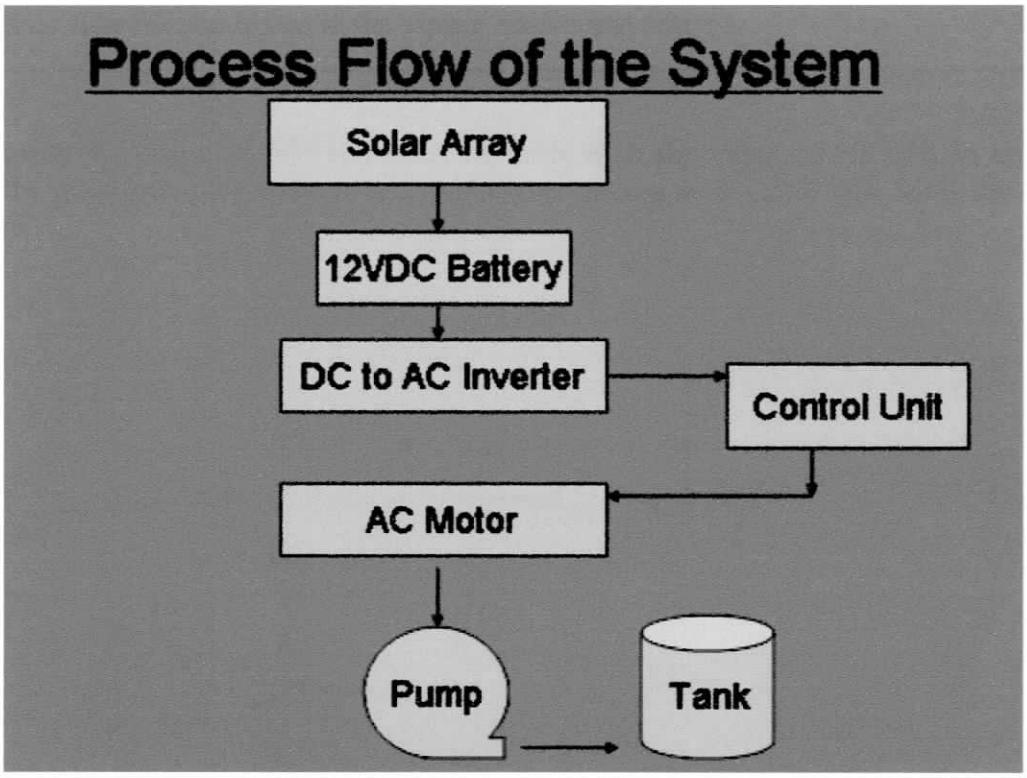


Figure 2: Process Flow of the System

Another important matter that needs to be considered is the pumping basics. Commonly any well or pressure pump is designed to provide a given flow of water (GPM) for a given pressure or lift (head). Pumping head is measured in feet and represents the lift that can a pump raise the water from a low point to a high point. While sizing the pump, determination of Net Positive Suction Head Required (NPSHR) is important in order to select an appropriate pump for a better pumping. The value of NPSHR can be referring to the pump curve diagram. Secondly, determination of Net Positive Suction Head Available (NPSHA) is needed to be carrying out once obtained the NPSHR value that in meter head. The definition of NPSHA is derived as follow:

NPSHA = Static head + surface pressure head – The vapor pressure of your product + The friction losses in the piping, valves and fittings.

Practically the value of NPSHA must be more than the value of NPSHR in order to produce good pumping system and avoid overloading as a result will spoil the entire system.

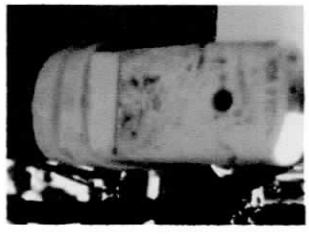
1.2Working Principle of My Project

Manual Selection

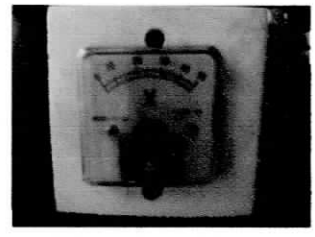
- First of all, place the solar panel at the appropriate place where the solar energy is easily available.

Solar Collector Panel

- Then plug in the solar input source and make sure the voltage reading shows a reading which is appropriately 18V.



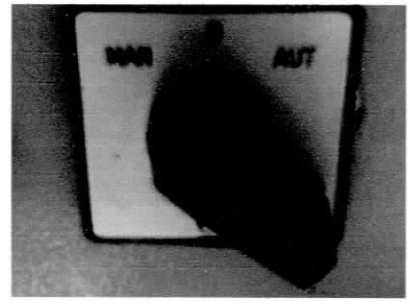
Solar Input Plug



Voltmeter

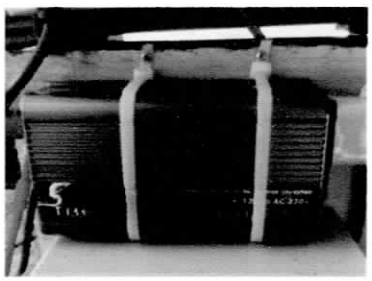
- Then plug in the positive and negative wire to the battery respectively and switch on the selector switch to 'Manual'.

12VDC Battery Compartment



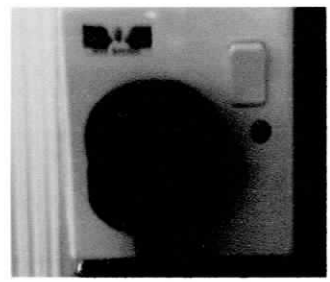
Auto/Manual Selector Switch

- Next, switch on the inverter as well as the pump switch.



Inverter Box

Inverter Power Switch

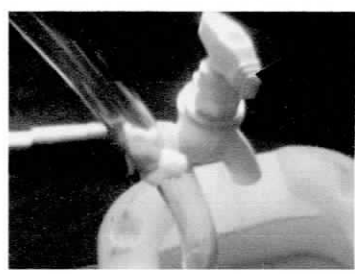


Pump Power Switch

- Make sure the inverter indicator light shows green which indicate no failure.

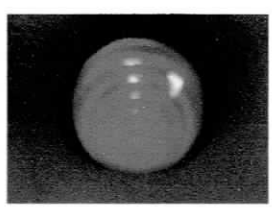
Indicator Lights

- Make sure the drainage pipe is closed before start up the pump.



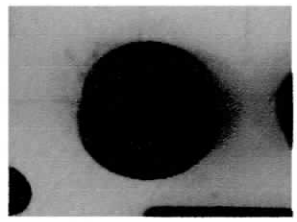
Drainage Pipe

- Make sure the red light indicator is on when you select the manual selector switch.



Stop Indicator Light

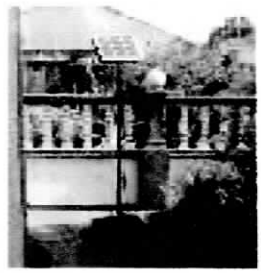
- Then you switch on the green start button and pump in the desired water that you require and stop it manually by pressing the red button.



Start Button

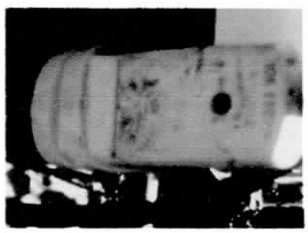
Automatic Selection

- First of all, place the solar collector panel at the appropriate place where the solar energy is easily available.

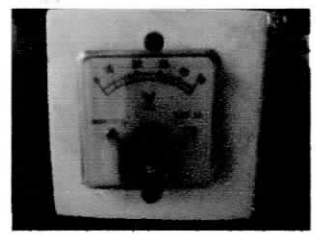


Solar Collector Panel

- Then plug in the solar input source and make sure the voltage reading shows a reading which is appropriately 18V.

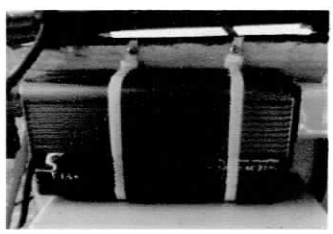


Solar Input Plug



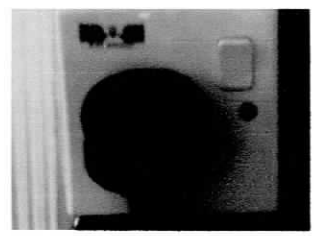
Voltmeter

- Next, switch on the inverter as well as the pump switch.



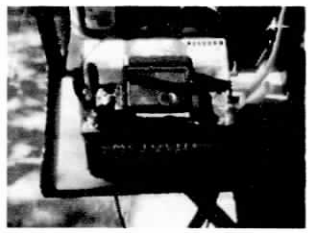
Inverter Box

Inverter Power Switch

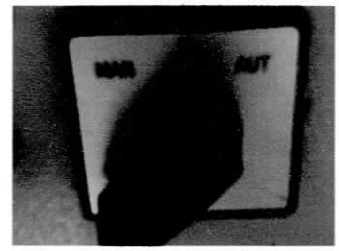


Pump Power Switch

- Then plug in the positive and negative wire to the battery respectively and switch on the selector switch to 'Auto'.



12VDC Battery Compartment

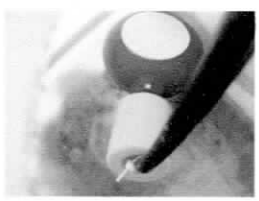


Auto/Manual Selector Switch

- Make sure the tank A is filled with water before pumping to tank B. Do not run the system dry which will spoil the pump.

Tank A (Open to Atmosphere)

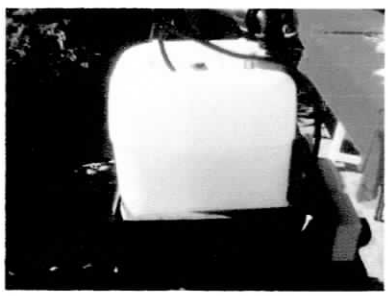
- Once the selector switch is turn to auto, the pump will start pumping since the float switch is in down position which indicates on.



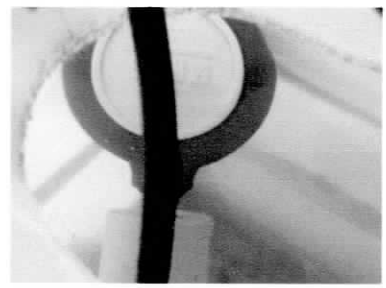
Water Float (Down Position)

Start Indicator Light

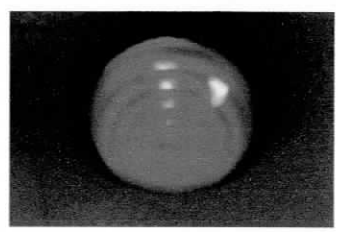
- The water will be pumped to tank B until it reaches the high level where the float switch will be at up position as well as indicate 'off' where it will trigger the red light 'on'. The system will be shut down automatically once the desired water supply reaches the high level point.



Tank B (Closed Tank)



Water Float (Up Position)



Stop Indicator Light

1.3 Overview of My Project

Figure 3: Front View

Figure 4: Side View