LOW COST ONE AXIS SOLAR TRACKING OPERATED BY WATER PRESSURE

K. A. Manjula Jayampathy

This thesis was submitted to the Department of Mechanical Engineering of the University of Moratuwa in partial fulfillment of the requirements for the Degree of Master of Engineering in Manufacturing Systems Engineering

Department of Mechanical Engineering
University of Moratuwa
Sri Lanka

July 2007

DECLARATION

This Dissertation paper contains no material which has been accepted for the award of any other degree or diploma in any University or equivalent institution in Sri Lanka or abroad, and that to the best of my knowledge and belief, contains no material previously published or written by any other person, except where due reference is made in the text of this Dissertation.

I carried out the work described in this Dissertation under the supervision of (Dr. G. K .Watugala)

Signature : *UOM Verified Signature* Date : 05/06/2007

Name of Student : K. A. Manjula Jayampathy

Registration No : 02 / 9645

(Supervisor's comments to be written here)

Signature *UOM Verified Signature* Date : 06/06/2007

Name of Supervisor : Dr. G. K .Watugala

Abstract

The scope of this study is to design a simple & low cost solar tracking system, which make uses downward movement of a piston cause by controlled discharge of water from water filled cylinder. The solar panels are mounted on the lever and when the lever rotates, the panels also rotate by the same angle, which is required. Rotation is done by connecting two pistons to the frame of panel via two links.

In the method describe here, PV panel is mounted on a frame that pivot on an axis running from South to north with a slight inclination towards the north. As the sun moves from the morning to afternoon, the PV panel is rotated around the axis to make it normal to the Sun's rays as far as possible. The rotation is not done continuously since it will drain some of the solar energy collected with great difficulty. Instead, the rotation is done intermittently.

The tracking is activated by the controlled discharge of water from water filled cylinder. When water is discharged by a controlled rate, the piston on top of water column moves down. The downward motion of piston is then converted to a rotary motion of the frame around the pivot axis by means of two links. The discharge of water is controlled by an electronic circuit, which gets signals from two sensors mounted on the lever. There is an opaque screen normal to the PV panel and between the light sensors. When the incident solar rays are normal to the lever, the two sensor readings are equal. When it is not so, the difference of the two signals from the sensors is fed to an electronic circuit which opens the discharge valve of the water cylinder causing the piston to go down and rotate the frame with solar panel. When the solar panel is rotated in the correct direction by the required amount, the sensors generate the same readings and the electronic circuit stops the water discharge.

Test on this tracking system shows that the total power output of the solar panel can be increase by about 25 % on a sunny day. On a cloudy day, because of the diffused radiation the tracking is not that much advantage, and this is true for other tracking systems as well. It is expected that this low cost one axis tracking system would pave the way for future research to increase of solar energy output in a sunny day by employing reflectors fixed to the frame and rotating together.

Acknowledgements

I would like to take this opportunity to give my hart full thanks to all, those who given all the support in many ways to achieve the success of this project on " Design & Construction of Low Cost Solar Tracking System" that is intended to considerably fulfill the need gap available in domestic solar energy sector.

My sincere gratitude goes to my project supervisor Dr. G. .K .Watugala for proposing me to do this research and his guidance, advices and encouragements throughout past year. Also I would like to thank Dr. .Udaya Kahangamage, former Course coordinator M.Eng in Manufacturing Systems Engineering, all the staff members of Department of Mechanical Engineering, University of Moratuwa, and to my colleagues for their support towards me in different manner.

K. A. M. Jayampathy **29th May 2007**

Table of Contents

List of Figures

List of Tables

Notation Used:

Θ	- Angle of incident of sunrays
β	- Back Tracking angle
m	- Mass of counter weight (Kg)
g	- Gravity of Acceleration
F	- Force (N)
P	- Pressure (N/m^2)
Q	- Water discharge rate (l/sec)
v	- Discharge volume of water (m^3)
Cv	- Volumetric discharge coefficient
R	- Resistance (KΩ)
V	- Voltage
A	- Amperage
I	- Irradiation
ω	- Hour Angle
T	- Time period
PV	- Photo voltaic
ADC	- Analog to digital converter
AC	-Alternating Current
DC	- Direct Current
D	- Outer diameter
d	- Inner diameter
T	- Thickness
F	- Tensile strength
PVC	- Polyvinyl Chloride