

ADVANCED SOLAR WATER HEATER

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Abstract: The said paper contains an advanced solar water heater which is used to heat water by tracking the sun, this tracking is done with the help of specially designed solar tracking circuit. This circuit rotates the whole apparatus with specified degrees of freedom. The thermocouple is inserted inside the water container to detect the temperature of the water. In order to know the water level inside the tank we are using the water level sensor. All the readings from the thermocouple and water level sensor is played on the control panel display. As an advancement we are using electric water heater to bring the temperature of water to a desired level. This level is been determined by the user which is set with the help of numeric keypad, installed inside the control panel.

Index Terms: Electronics Solar heater, solar tracker, electric heater, thermocouple, water level sensor

I. INTRODUCTION

During rainy season or winters, the amount of sun rays reaches the earth is in limited proportion. The conventional solar water heater are having fixed constrains, this could catches the sun rays only for those duration where the solar tube are facing towards the sun. During rest of the time the solar rays are not catch which results into waste of solar energy and also the water does not reached to desired temperature. So with some advancement in technology if we could track the sun's location then we could use the required sun's radiation to heat the water. This could result into proper utilization of the solar energy. During the rainy season there are certain condition's where the sun gets hide behind the clouds at those situation when we need the hot water we uses the water heater at that situation if we could integrate the solar water heater with the electric heater then we don't have to use the electric heater separately and there could be continuous hot water available at any situation. At certain cases we need to pump the water inside the solar tank manually and in this situation if we could pump the water automatically then we could reduce this efforts and also reduce the risk of damage to the heating coil. In this paper we are developing such a kind of technology which satisfy all the needs and efforts of the user.

II. CIRCUIT DIAGRAM:

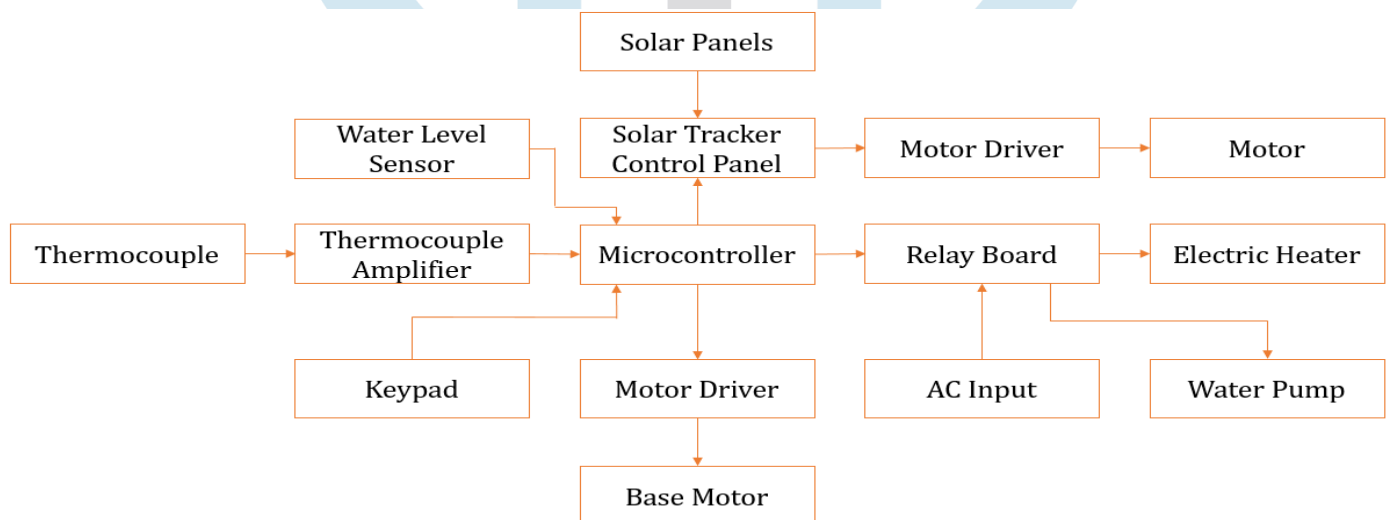


FIGURE 1: ELECTRONICS FLOWCHART (CONTROL PANEL)

In this circuit we are using arduino as a microcontroller, this microcontroller is connected with different kinds of sensors, amplifier, electromechanical devices such as motor & relays, solar tracking circuits, heaters and numeric keypads.

At first, the systems checks for the water level inside the tank, this level is checked with the help of water level sensor. After sensing the water level if there is any need of water inside the tank then microcontroller operates the water pump with the help of electromechanical relays. After operating the pump it continuously tracking the water level as soon as the tank gets full the controller turnoff the pump. In this way the water level sensing and automatic water filling system works.

Second stage is to get input from the user what temperature of water they need, the user uses the keypad to enter the values. This entered values are in degree Celsius. This values are used as a set point and by using the PID (proportional integral derivative) function as follows:

If the temperature of the water is below set point then with the help of solar tracking circuit the system is rotated and allowed to face towards the sun. Another condition if there is no sun appears in the sky, then the system operates the water heater to heat the water. If the temperature of water is greater than or equal to the set point temperature then the system faces in the opposite direction of sun or if there is no sun and heater is operated then the heater is turned off.

In order to check the temperature of water the system uses the thermocouple. This thermocouple senses the temperature and send it to thermocouple amplifier to amplify the signals. This amplified signals are then recorded inside the microcontroller which is used for the further processing.

The system also displays the water level in terms of percentage and temperature of water in degree Celsius on the display for the user to manipulate the system (manually control system during malfunction). The manual control includes to kill power, reset the temperature values and rotate the system.

III. MODEL:

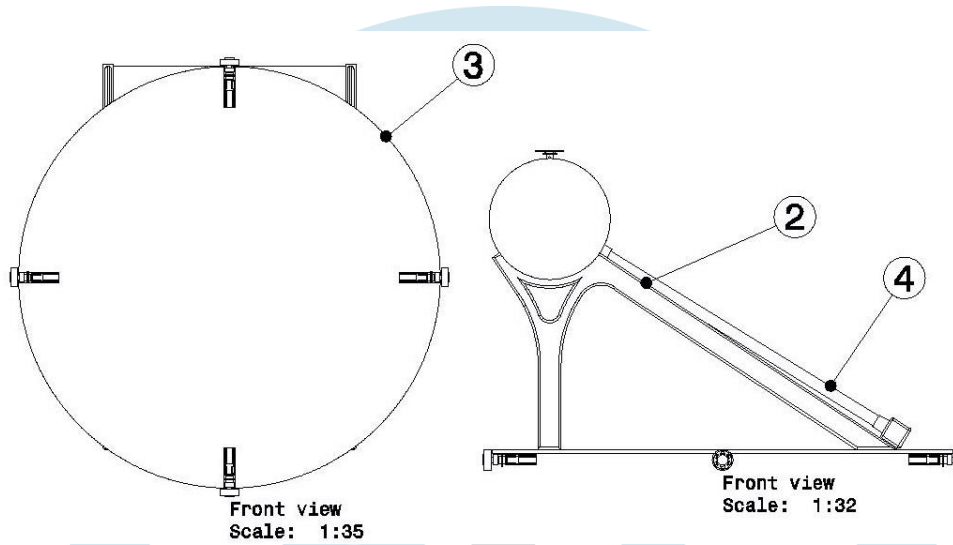


Figure 4: Side & Bottom View

Type	Y Shaped Chassis With Side Support Structure
Material Used	Stainless Steel Channels With 60 X 20 mm With 3 mm Thickness
Material Used	Commercial Grade
Chassis Fabrication Methods and Operation	Welding, Drilling, Bolting, Bending, Grinding and Cutting.
Base Chassis Material	Stainless Steel
Base Chassis Thickness	40 mm

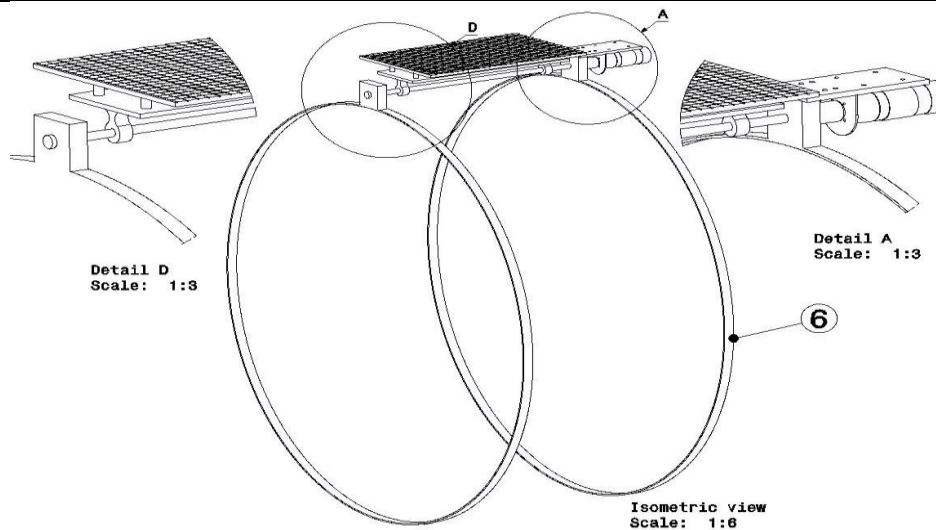


Figure 4: Solar Tracker Mounting & Assembly Drawing

Motor Type	Planetary Geared DC Motor With Encoder
Torque	
Rated Torque:	1200 mN.m
RPM Of Motor	24 RPM
Gear Ratio	264:1
Brand	Cytron
Power Transmission From Base Motor To motor Shaft	Planetary Gear Drive
Power Rating	
Rated Current	<900 mA
Rated Power	7 W
Voltage	12 Volt
Encoder Output	1848 PPR
Solar Tracker Assembly Method	Bolting, Welding, press fitting
Solar Tracker Lower Hinge Material & manufacturing Process	Sheet Metal, Steel Block, Milling, Welding and Rolling.
Solar Tracker Upper Hinge Material and Manufacturing Process	Steel Block, Milling

1. Solar tracker is coupled between the two support hinges as shown in detailed view D and detailed view A. through this hinges there is a shaft on which the whole solar tracking panels are mounted.
2. One of the end of the shaft is coupled with the flexible coupling whereas, the other end of the flexible coupling is attached to the motor shaft which is mounted on the hinges support with the help of motor clamp.
3. Solar panel rotated with the help of the motor and the signal are send to the control panel.
4. The motor is equipped with the encoder which sends all the feedback during rotation with the help of which angle of the panels are maintained.
5. The whole system is mounted on water tank with the help of round clamps made up of sheet metal with diameter equal to diameter of the tank.

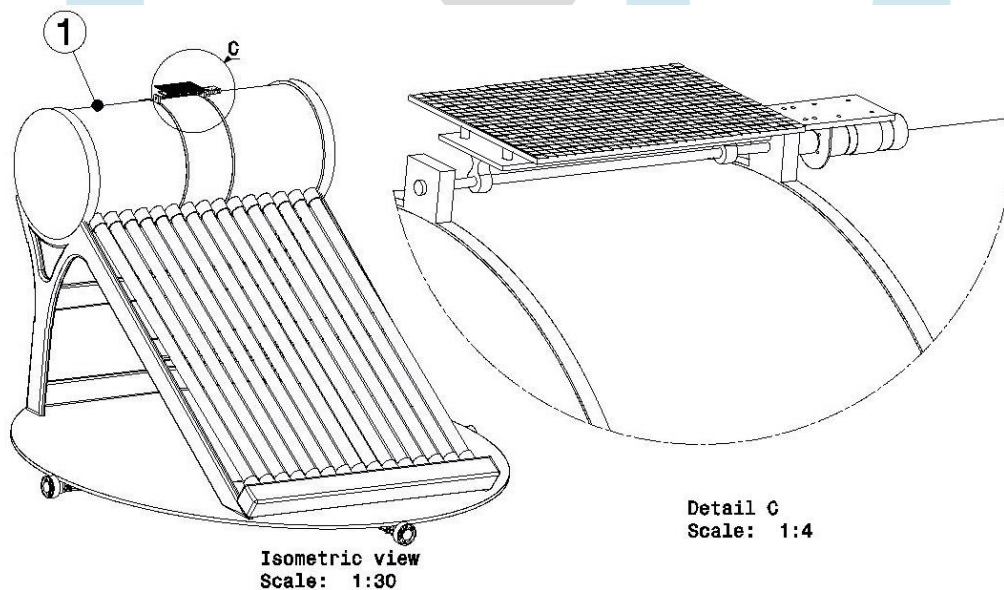


Figure 5: Isometric View & Solar Tracker Detailed View

Wheel Type	Circular Metal Wheel With Optimized Holes
Wheel Diameter	150 mm
Number Of Wheels	4
Shaft Type	N8
Wheel Coupling	Anti-Slip Type Of Flange Coupling
Motor Coupling	Anti-Slip Type of Flexible Coupling Outer Diameter- 50 mm Inner Diameter – 16 mm Length - 64 mm
Motor Type	Ebike MY1016Z DC Geared Motor 250 W
Constant Torque / Stall Torque / RPM	8 N m / 40 N m / 337 RPM
Bearing	24184B Make- NTN Series Spherical Roller Bearing Inner Diameter- 16 mm Outer Diameter- 28 mm
Motor Clamp Shape & Joining Process	L Shape & Bolting
Bearing Block Material	Stainless Steel Commercial Grade
Bearing Block Dimension	50 X 30 X 50 mm
Bearing Block Manufacturing Process and operation	Counter Boring and Milling

1. The base motor assembly was designed to reduce the vertical reaction develops due to weight of the support structure, on to the motor’s shaft.
2. The wheels were coupled with the flange type of anti-slip coupling.
3. The coupling was then coupled from the hub side to the transmission shaft. Which is passing through the bearing house assembly, this bearing house was made with the help of CNC operating. The end of the shaft is connected to flexible coupling.
4. The other end of flexible coupling is connected to motor shaft. The motor is mounted on L shaped clamp which was designed with laser cutting and sheet metal bending operation. Later L clamp was hardened to increase hardness.
5. There was three reaction force developed during motion and two reaction forces during steady condition. The vertical force was neutralized by the bearing house assembly. The force left was horizontal force along the axis of motor, this force is absorbed by the flexible coupling. The rotational force is created by the motor so no need to neutralize it.
6. All these assembly was fixed on the specific plate known as base plate, with the help of bolting. The plate was then join to the chassis with bolting at the places were the holes were drilled at the chassis.

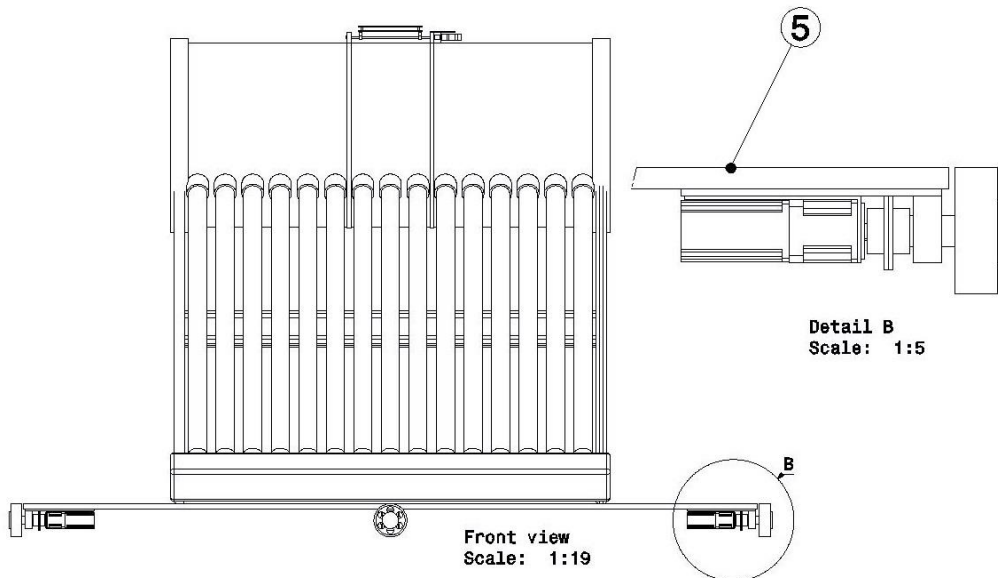


Figure 4: Front View & Motor Detailed View

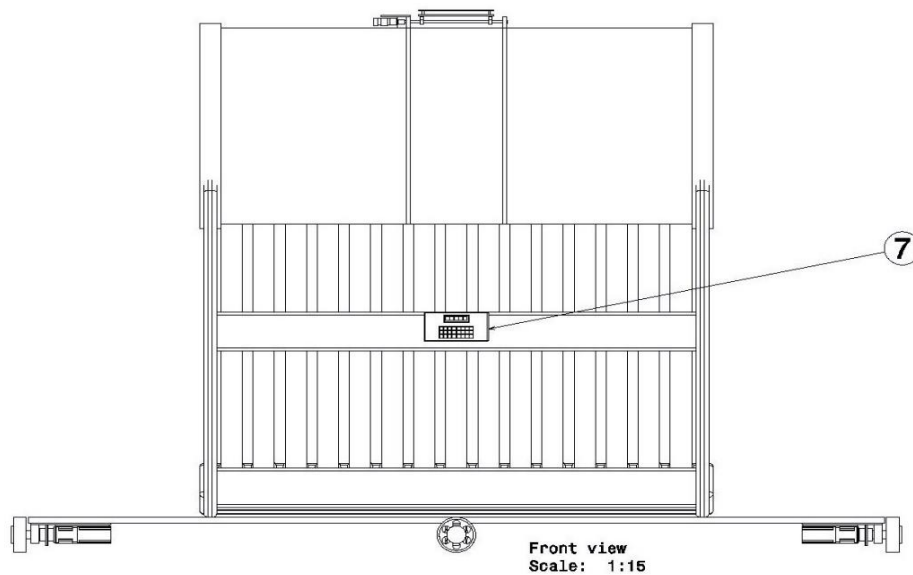


Figure 3: Rear View

IV. PARTS DESCRIPTION:

Part 1 Water Tank:

Water tank is used to store the hot water it is made up of steel. With special foam material included in between the two layers of steel to avoid the heat transfer. The thermocouple and water level sensor is inserted inside tank to measure the temperature and water level inside the tank. The tank part 1 is kept on the support structure part 2 with solar heating tubes part 4 inserted inside the tank.

Part 2 Support Structure:

Support structure is used to support the tank and solar tube part 4.

Part 3 Base Plate:

Base plate is used to support all the structure. Base plate is circular in shape. Coupled with Base motor assembly and fixed with support structure

Part 4 Solar Tubes:

Solar tubes are used to absorb the heat and transfer it to the water. It is coupled in between tank and the support structure

Part 5 Base Motor Assembly:

It is situated at the base of the Structure. Coupled with base plate & used to rotate the whole Structure.

Part 6 Solar Tracker Assembly:

Solar tracking circuit is equipped with planetary dc geared motor with encoder coupled with motor clamp. The motor shaft is coupled with flexible coupling with the

Part 7 Control Panel:

Control panel is used to control the circuit. It is fixed at rear side of the structure

V. DISCUSSION:

1. With the help of solar tracking circuit it is possible to utilize the waste solar energy to heat the water to a desired level.
2. It is also possible to heat the water when ever the Sun is not in the Sky with the help of electric heater.
3. Using PID it is possible to keep temperature in a Set limit.
4. There is no need to fill the tank manually due to installation of water level Sensor.
5. The temperature and water level is displayed on the display for further processing from the user side. This control includes kill power, set temperature limit, manually lift the water through pump, and rotate the whole system.

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