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Design and Fabrication of Solar Air Heater with Air Purification System

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Abstract: ***The aim of this textual work is to represent the review on solar air heater with air purification system. The review highlights the domain of solar air heater technology.***
It shows the different types and innovations of the solar air heater in the course of time. It thoroughly discusses the key points of various papers by former authors. Along with this, it also discusses about the nature and purpose of the paper and the developments done in this field. Together with this, a brief content of experimental set up has been given which gives an over view of design and fabrication of solar air heater with air purification system. There are stripes of pipes inside the wooden box which have gaps in between them. The gaps are filled with Aluminum foil painted black in color. fins with different design and surface roughness are provided to increase the rate of heat transfer inside the setup.
The Aluminum foil is there to compensate the heating errors due to leakage in stripes of pipe. There are many techniques have been used to enhance the characteristics performance of the solar air heater such as surface geometry and different kinds of materials at inlet of the duct fan.
Additionally, the paper shows objective, working principle, methodology, components, results and applications of the solar air heater. Thus, design and fabrication of solar air heater with air purification system gives the compendium of this technology.
Keyword: Solar Air Heater(SAH), Air purification, Black Aluminum foil, Eco-friendly Air Heating.

I. INTRODUCTION

Solar air heater as a thermo-mechanical device works on energy derived from solar radiation. It absorbs solar energy to change the thermal state of the air. The energy derived from the sun is used to heat air and pass out from exit pipe and filtered by the air purification system. It absorbs the solar radiation through radiation collector to warm up the air and further circulating this air in different location. It uses the warmed air to provide heat in buildings especially in industrial areas.
It is based on the principle of rise and down setting of air at its different level of temperature. Solar collector is used to draw the quanta of radiation which is a flat and black body.
SAH utilizes abundant, renewable and inexhaustible solar energy. It is pollution free and thus eco-friendly. It gives us cost effective air heating. It confines the electricity need at a certain level which is very useful in our lives.

II. LITERATURE REVIEW

1) Chabane et al. analyzed a single pass solar air collector with and without baffle fin.Through the study, they investigated the effect of roughness and operating parameters on heat transfer.
2) Akpinar and kocyigit have done an experimental investigation with flat plate solar air heater with several obstacles and without obstacles. They presented the data obtained in the experiment with the correlations by the linear regression.
3) Gedion Habtay with others, investigated with an indirect active type of solar dryer and two different solar air collectors. They have found the drying efficiency of the apple.
4) Amr Elbrashy and others, in their works with the solar air heater, tried to enhance the heater with the evacuated tube solar collectors. They have used nanoparticles as enhancers.

III. METHODOLOGY

We considered that, a practical observation of solar air heater should be done in order to understand the fundamentals of it. So, we constructed one, in which the inflow of air is from the lower end of SAH and after the air is warmed through the middle section, the air is out flow from the uppermost end through a cylindrical pipe.

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The system has following items as its components: -

• Wooden box with absorber plate
• Solar panel
• Air purifier
• Duct fan
• Temperature measurement device
• Battery

A. Diagram of the Experimental Model

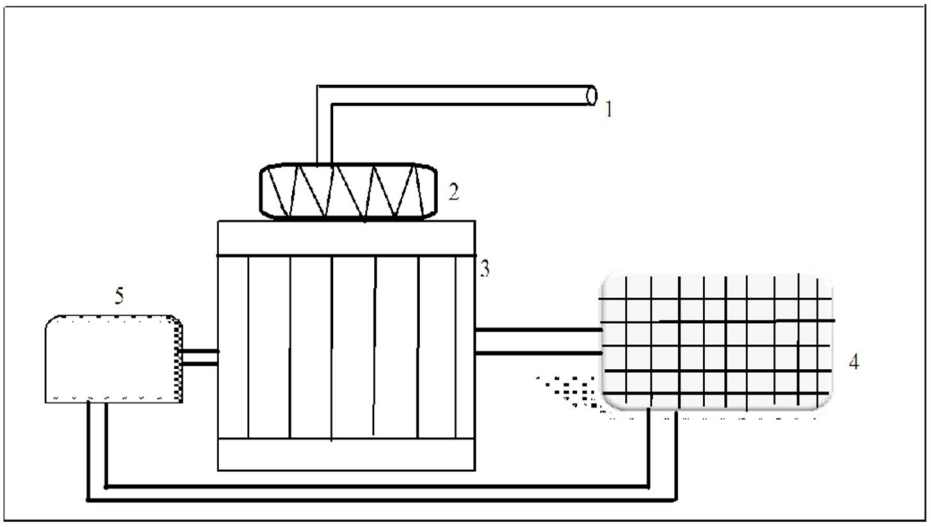


FIG. 1 - Schematic diagram of model

B. Fig Numerology

1) Warm air flow
2) Air purification system
3) Wooden box
4) Solar panel
5) Battery

C. Wooden box with Absorber Plate

The occupants of the box are an absorber plate, pipes, and duct fan. The box has stripes of square pipes. Together with this, we have also infrastructure sheets of aluminum foil to deal with the compensation of energy due to error leakage.

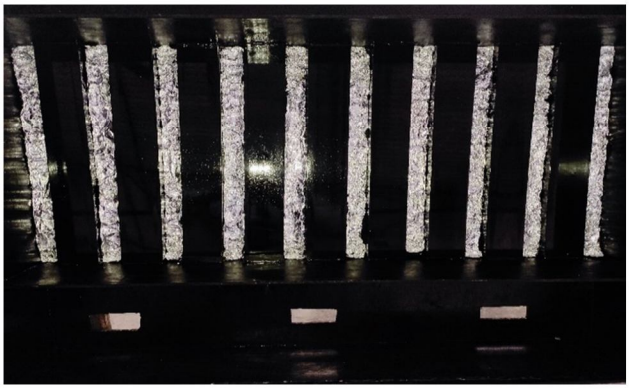


FIG. 2 – Absorber plate

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D. Solar Panel

The solar panel draws solar radiation and convert it into electricity which can be used to charge the battery. The electricity generated by the solar panel is of DC type. The solar panel we have used in the model was of 12 Watt. It was of polycrystalline type.

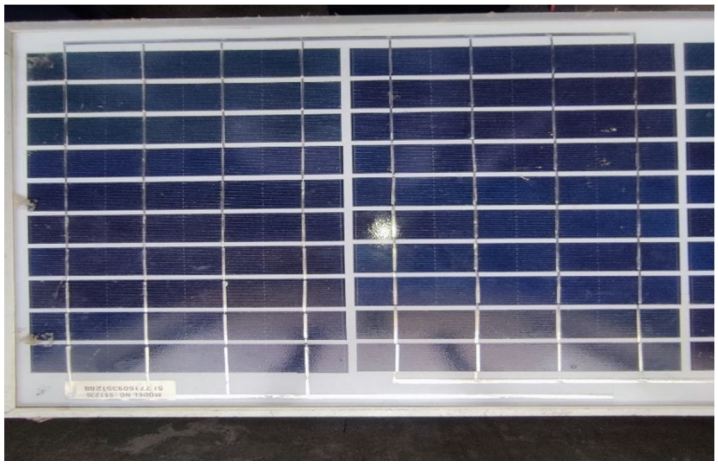


FIG. 3 – Solar panel

E. Air Purifier

For air purification, we have used air filter in our model to remove the impurities comes along with air. The air filter removes the dust particles which comes with air and allows only clean air to pass through its porous surface.

F. Duct Fan

We also used the duct fan for the steady speed of airflow. It is a DC brushless fan. It is of 12v. The airflow of the duct fan is directed towards the outlet pipe.

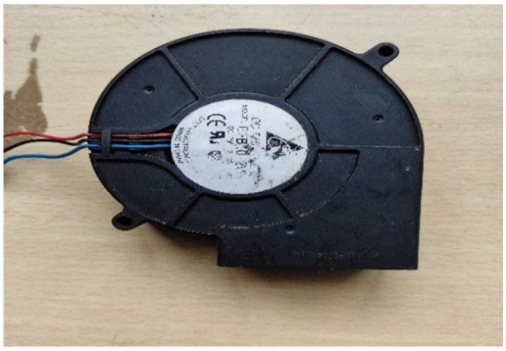


FIG. 4 - Duct fan

G. Temperature Measurement Device

A temperature measurement device speculates the temperature in a wide range. It shows the temperature value at its display. We have used this for measurement of the temperature in **℃.**



FIG. 5 - Temperature measurement device

H. Battery

We used a 12v battery which is charged by the solar panel. It is of Lithium-ion type.



FIG. 6 - Battery

I. Working Principle

It works on the principle that warm air rises up and cold air sinks down. It absorbs irradiance and converts it into thermal energy of the absorbing surface and then transfers this energy to a fluid flowing through the collector. It is typically based on the conservation of energy and is used to warm up the air for many purposes.

The cool air enters into the pipe and passes through the sunlight absorbing media which are heated by the sunlight. And as a result, the temperature of air rises up. The temperature can be measured through the temperature measurement device. With the help of duct fan the air can be spread inside the room through the distribution pipe. Also, the air is totally filtered with the air purification system.

IV. RESULTS & DISCUSSION

The review model has been constructed in the study of solar air heater(SAH) which gives sufficient performance. This is illustrated by getting the temperature range which is sufficient for warming up the air.

The data is taken two times a day in IST and on two concordant summer days which is given below: -

Sr. No	Time	Temperature (°C)
1	1:00 PM	58.4
	3:00 PM	60.7
2	1:00 PM	58.9
	3:00 PM	61.6

In the result, we found that temperature of the air outflow section is 55-62°C.
(In summer season)

V. CONCLUSION

Solar air heater is sustainable and reliable device which uses eco-friendly energy in order to provide warm air for various purposes. The design, geometry and flow conditions in the pipes can be modified for better heat transfer rate.

It brings us a sustainable use of solar power which encourages for the development in the eco-friendly air heating. It also enables us with an approach in further development in the field of this technology.

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Thus, the SAH can be used with different variations in order to provide specific temperature at different areas.

A. *Advantages*

1) Eco-friendly and Renewable energy source.
2) The simple and cost-effective design.
3) Way better than solar water heater due to less corrosiveness.
4) Reduces the electricity needs.
5) Low maintenance required like cleaning.

B. *Application*

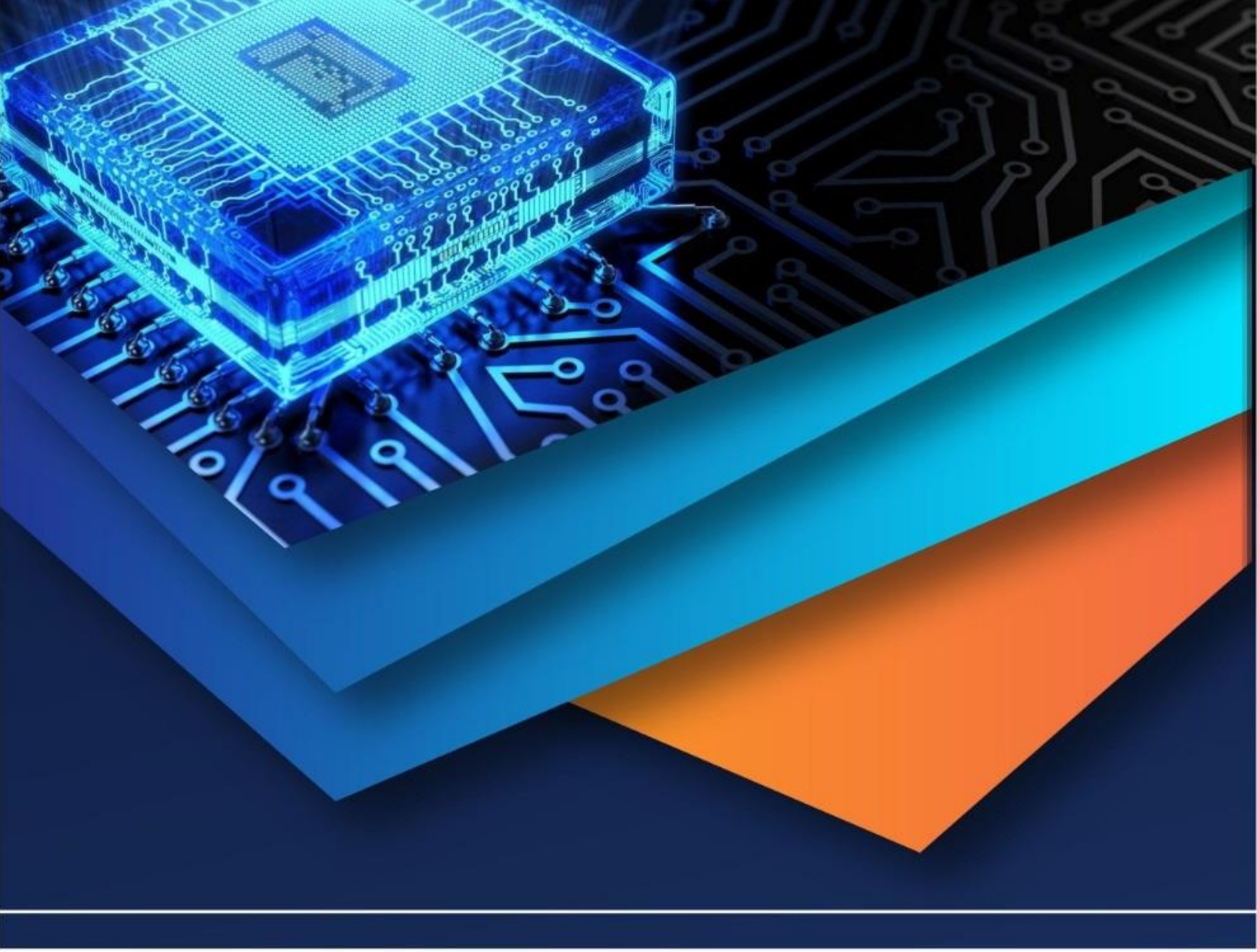
1) It can be used in drying up of clothes, food and crop items.
2) It can be used for space heating in industrial and household compartments.
3) It can also be used to soak up the moisture present in papers and wood.
4) It can used for providing impurity free fresh air in at cold places.
5) It can provide an alternative in cost effective conditions in rural areas.

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