Iowa Science Teachers Journal

Volume 14 | Number 1 Article 6

1977

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Recommended Citation

Bridgenell, John (1977) "A Solar Water Heater," *Iowa Science Teachers Journal*: Vol. 14: No. 1, Article 6.
Available at: https://scholarworks.uni.edu/istj/vol14/iss1/6

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A SOLAR WATER HEATER

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The sketch (Fig. 1) and photograph (Fig. 2) show a very simple solar water heater made from readily available parts. The heater was constructed by myself, with a little help from Dad, for my science fair project. Incidentally, it won first prize in the seventh grade physics division.

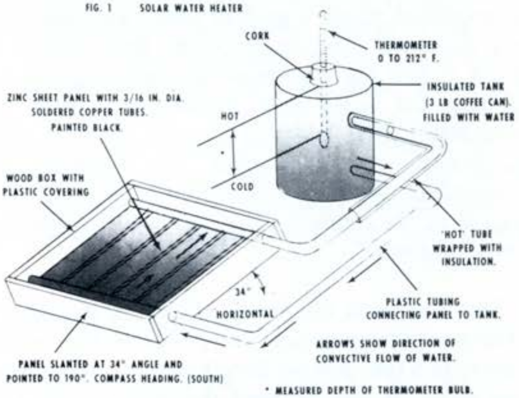

Fig. 1.
A solar water heater.

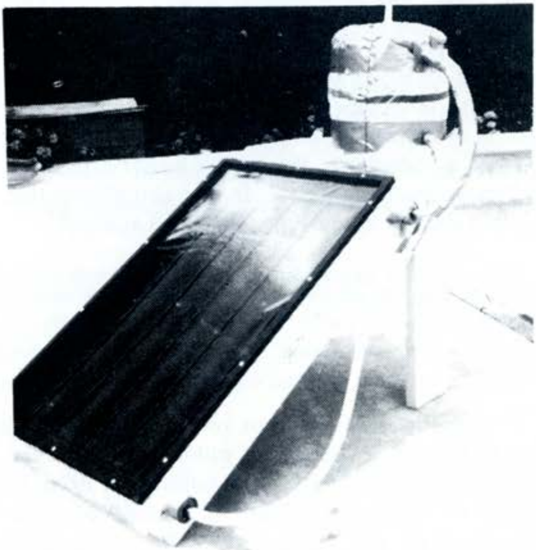

Fig. 2.
A solar water heater.

The heater uses the thermosyphon principle to accumulate hot water in the tank and to return the cooler water to the solar collector panel. For this reason, the water tank (a 3-lb. coffee can) is located above the solar panel. The panel is made of 3/16-inch diameter copper tubing soldered to a 12½ by 20-inch zinc sheet at about 2½ inch intervals. The 3/16-inch tubes are manifolded into ½-inch diameter copper tubing at the top and bottom of the panel. The panel is enclosed in a wooden tray with a plastic sheet lid. The water pipes are connected to the tank by transparent plastic tubing.

The panel was positioned at about a 34-degree angle to the horizontal (our latitude is about 34 degrees) and pointed about 10 degrees west of south. The temperature rise of water in the tank was plotted versus the time of day with an unpainted panel, a painted panel, and with a double layer of plastic sheet over the panel. The depth of the thermometer in the water tank could be varied so that the maximum and mean water temperature could be measured. Painting the panel with a flat black paint raised the maximum water temperature by about 25%, while using a double layer of plastic sheet increased the temperature an additional 2%. The maximum water temperature obtained was 178 degrees F with the water starting out at 65 degrees in the morning. The maximum ambient air temperature on this day was 66 degrees F.

The maximum efficiency of the heater was calculated by measuring the mean water temperature rise per hour and comparing the heat required to achieve this (in Btu per hour) to the incident heat from the sun reaching the solar panel. It was assumed that 50% of the 420 Btu/hr/ft^2 incident solar radiation outside the atmosphere reached the panel. On this basis the highest efficiency was obtained with the panel painted flat black and with a double layer of plastic. The maximum efficiency was calculated to be 45% and occurred at 10:45 AM when the mean water temperature was 105 degrees F. As the water temperature got higher, the efficiency fell off due to heat loss and re-radiation from the panel. At 3 PM, when the water temperature reached a maximum, the overall heater efficiency was zero. After this time, the water started to cool. It was also shown that the cooling rate could be delayed slightly by covering the panel at night.

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Energy

If energy was delivered to your door like milk--today, you would have had 19 half gallons of oil, 14 half gallons of natural gas, and 46 pounds of coal on your doorstep. By 1985, your family will need 30 half gallons of oil, 24 half gallons of natural gas and 70 pounds of coal. The demand for energy throughout the world is rising fast. We must not waste.....but use it wisely.

Environmental Vistas 8(3):2