

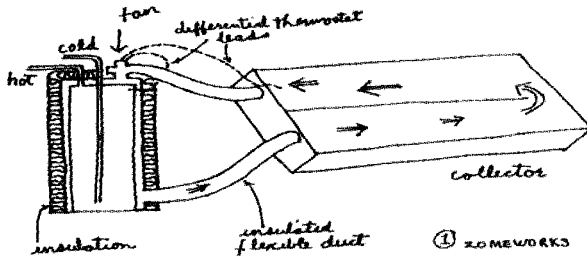


In the early days of the New Mexico Solar Energy Association, the membership of the group contained some of the most innovative and productive pioneers of solar research and designs in the United States. The earliest issues of our newsletter, which at the time was known as "The Sun Bulletin" contained many articles about how to put together solar hot water heaters, how to calculate PV loads, how to design passive solar buildings and much more. Most of these articles are still useful and appropriate for today's world and so we will be reprinting them in this and future Sunpapers.

SUN BULLETIN
VOLUME 2, NUMBER 5 1977
Solar Hot Air Water

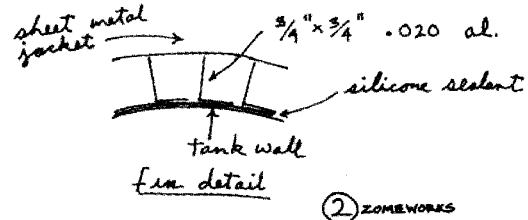
by Steve Baer

You can heat water by blowing hot air from an air collector directly over a hot water tank (fig.#1). An 82-gallon electric hot water heater is a good size to supply ample hot water for three or four people.



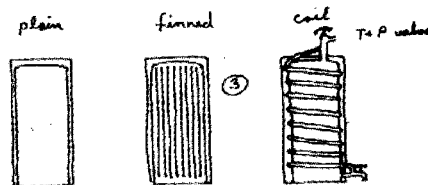
The steel tank is inside a sheet metal jacket with Fiberglass insulation between the tank and the jacket. Take the jacket off the tank and pull the insulation away from the tank. We will put insulation on the outside of the jacket and blow hot air between the jacket and the tank. The fan - a 250 cfm squirrel cage blower, available from Grainger (Dayton shaded pole motor, 120 watt 4C447) -- is attached to the top of the jacket. Cut a hole in this jacket and fasten the fan outlet. A collar must be fastened to the inlet of the fan and a 6" insulated duct run to the collector. The air is circulated in a continuous loop from the collector to the tank and back again to the collector. Since the air is traveling in a loop, it gives exactly as much heat to the tank as it picks up in the collector (neglecting heat loss from the insulated lines and from the tank).

The tank is colder than the air blowing past it; the black mesh inside the collector is hotter than the air flowing through it. The temperature differences between the air and the tank, and the air and the mesh determines how well the water heater works. We'd like the tank to cool the air down close to the temperature of the tank. The air then enters the



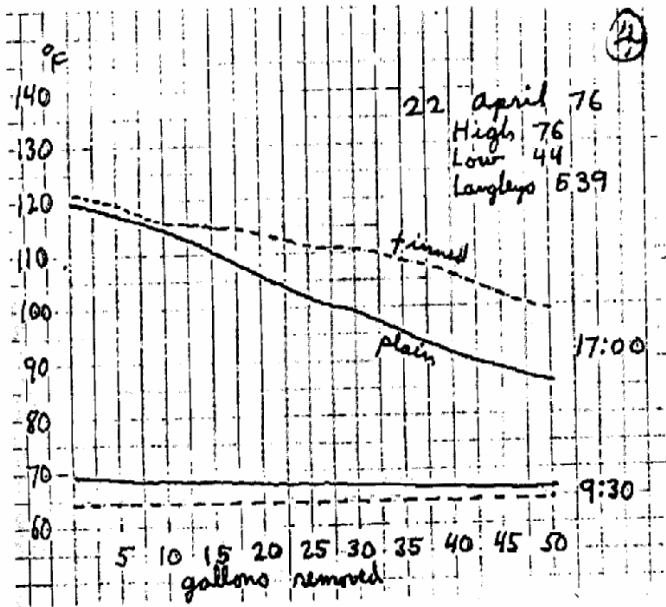
collector relatively cool and keeps the collector cool. A cool collector is an efficient collector. Unfortunately, the water tank doesn't expose very much area to the air flowing past it, and thus it has a hard time absorbing the heat from the air. To increase this area, we glued aluminum fins all over the surface of one 82-gallon tank. The fins must fit in the narrow space between the jacket and the tank. We used a variety of different fin types in covering the tank (figure 2 below).

We then raced two water heaters -- on one the tank had fins and on the other the tank had no fins. Each tank was connected to a 40 ft.2 collector -- all the details of the system were the same except that one had fins and one hadn't. (figure 3)



The results are shown on the graphs for 22 and 23 April (figures 4 and 5 on page 10). The top lines show the temperature at 17:00 (5pm) as the water was actually drained from the tank and measured by the 5 gallon can. The bottom lines show the water temperature in the morning, which were taken from thermocouples attached to the bottom and top of the tank. The tests done on 30 April and 1 May, 1976.

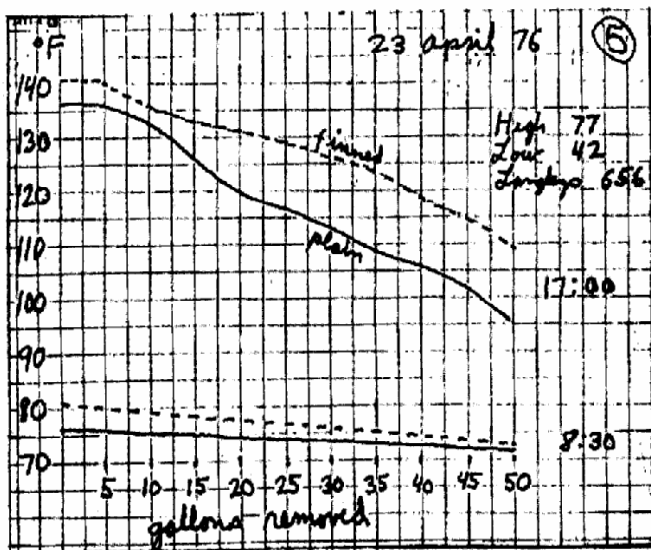
(Continued Page 10)



We used 40 ft.² collectors in our experiments. Larger collectors would provide more hot water, especially in the winter. It would probably be sensible to increase the collector area to 60 ft.² or even 80 ft.². The cross-section of air stream through the collector should be at least 1 ft.² and the collecting surface should be five or six layers of black metal lath or some other material that provides a large transfer area to the air flowing past it (figure 8) Most electric water heaters have a top and bottom electrode. Disconnect the bottom electrode or it will try to heat all the water before the sun has a chance to. You can leave the top electrode to heat the top 15 gallons by electricity if the sun has not been bright enough. If you have a gas heater, it may be possible to blow air past the tank without interfering with the gas flame. We have not tried it.

You can always have the solar hot water pass through a second tank with a gas heater that will come on if the solar water is not hot enough. In this arrangement, a hot water tank made from a gas heater is ideal because the tank has a flue pipe passing through it and the air can blow around and through the tank. Why is an air heater better than a conventional flat plate collector with a pump circulating antifreeze through it? Air is not corrosive. Fans are cheaper and more reliable than pumps. Air collectors are easier and cheaper to build than liquid collectors.

TOP Figure 4 and Bottom Figure 5



Figures 6 and 7 (next page) show the tank wrapped with a 60' coil of soft 3/4" copper tube to be still more efficient than the fins. In order to get the jacket over the coil of copper tube, it was necessary to split the jacket and re-attach it. The hot air should always enter the tank at the top. The coil of 3/4" copper tube has water convecting upwards through it as the warm air heats it. It is necessary that the spiral go uphill along its entire length so that no bubbles are trapped within. The T and P relief valve placed above the top end of the spiral allows one to let off bubbles that collect during installation or later. If the collector is placed above the tank, there should be a gravity damper somewhere in the connecting "ducts to prevent backflow of warm air at night.

(Continued Next Page)

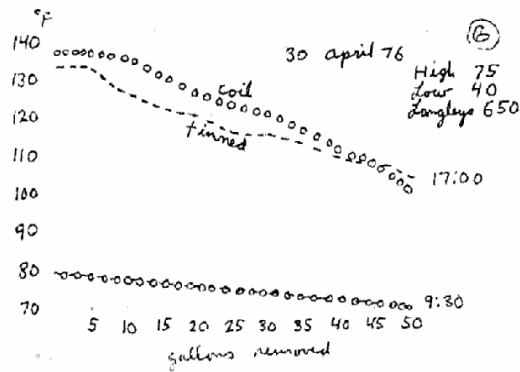
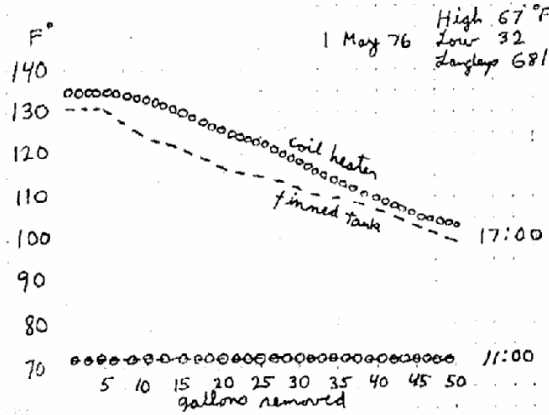


Figure 6 Above and Figure 7 Below



Can you make an air water heater without fans or thermostats? Yes, but the tank must be above the collector. The flow channels should all equal 1/20 of the collector area and the heat transfer area into the tank must be greatly increased. The tank should also be set on top of a rock storage bin that readily absorbs the day's heat and then slowly transfers this to the water tank all day and all night.

Instead of a differential thermostat, you could also use a regular thermostat in an insulated glass box beside the collector. Set this thermostat at 130° F. or 140° F. The fan could also be operated by a hand switch.

Note: This study of hot air water heaters was done by Zomeworks Corporation in preparation for the design and installation of a number of water heaters for the Benedictine Monastery in Pecos, N.M.

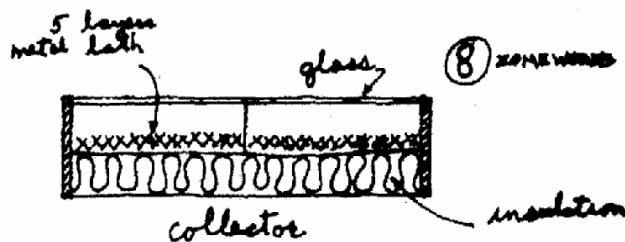


Figure 8