Build a Solar-Thermal Direct-Air Heater

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The town I live in is located near the Alberta-BC border, about 100 miles north of the US Canada border. Winters here are long and cold, but many days are crystal clear and sunny.

Our tool shed has a south-facing wall which was ideal to mount a solar thermal direct-air collector panel. The collector panel exterior dimensions are 48” high x 49.5” wide’

The siding on the shed is made out of cement-fiber composite, (same as our house) which was chosen because of it’s durability and fire-proof qualities. The Vertical orientation suits our northern latitude, and stays clean and frost-free under the roof overhang.

Construction :

1) Plan measure and layout.
The collector I would build would Make maximum use of a 8’ x 26” sheet of “SUNTUF” clear polycarbonate, cut exactly in half. My collector box would measure 48” high x 49.5” wide. This allows for 1 complete overlap of the 26” wide polycarbonate panel corrugation middle seam.

2) Cut two 4-1/4” circular holes, line with 4” tin duct, and seal with putty (duct-seal) *Diagram 3*

3) Fasten the collector box wood-frame to the siding with long & heavy wood-screws. Seal all spaces behind the box frame with putty and caulk all of the joins, both inside and out. *Diagram 2*

Diagram 1 : Completed Direct-Air Solar Collector

Diagram 2 : Simple Construction

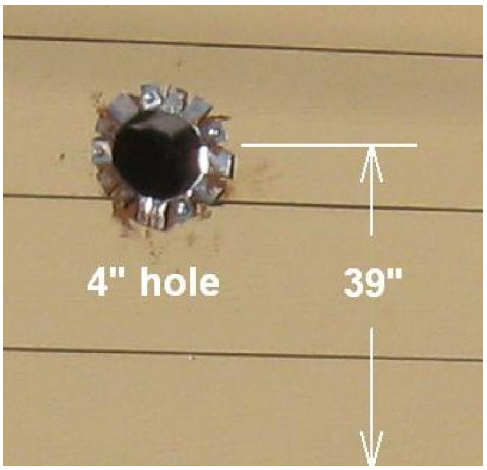

Diagram 3 : Cut two 4” holes, insert tin duct and seal

4) Paint the box interior flat-black. Fasten foam gasket. *Diagram 4*

5) Sandwich the corrugated polycarbonate panel between 2 layers of the matching foam gasket. Overlap the polycarbonate by one corrugation, and seal the center seam with clear silicon. Screw wood trim overtop the outer gaskets, and the collector is complete. *(Diagram 1)*

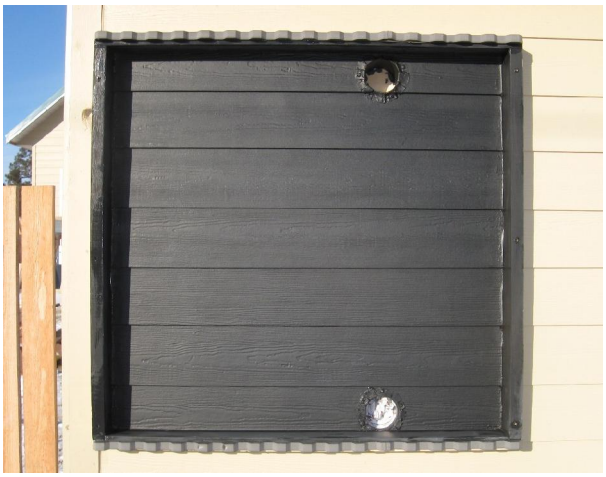

Diagram 4: Black paint and foam gasket.

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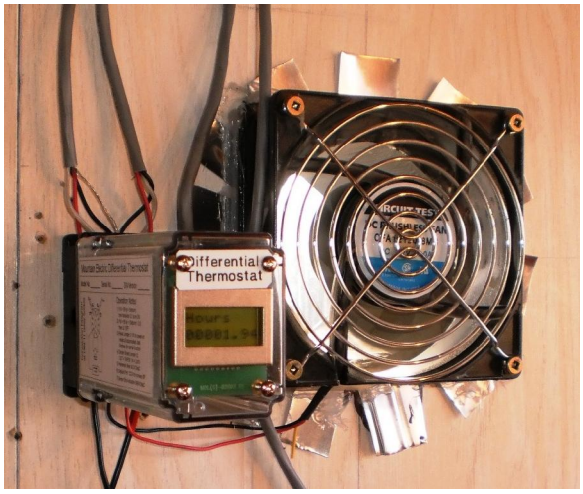

Diagram 5 : Top vent (inside)

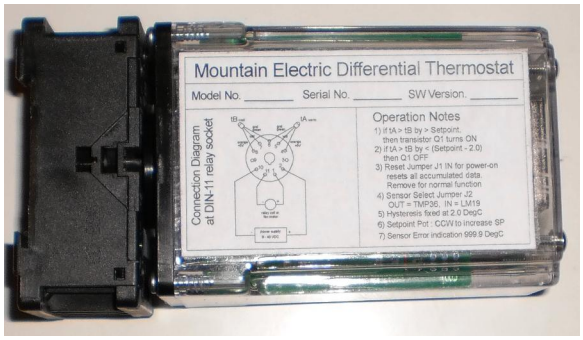

Diagram 6 : Differential thermostat

<u>Operation</u>

As the sun heats up the air inside the collector panel, heat rises to the level of the top vent. A single 4" 12VDC electric fan blows the hot air into the tool-shed. Cooler air enters the collector panel in through the bottom 4" vent, which has a plastic dryer flapper to prevent reverse siphoning of cold air out the bottom at night. *(diagram 8)* The fan is controlled by a differential thermostat. The fan has an air-flow capacity of 121 CFM.
Don't forget the essential finger-guard!

<u>Electronic Controls</u>

The 4" fan is controlled by a differential thermostat. (diagram 6) Sensor-1 is located in the air-stream of the upper 4" duct (warm-vent). Sensor-2 is located inside the room immediately beside the lower 4" duct (cool-vent)

When the temperature of the warm-vent is greater than 4 DegC warmer than the cool vent, the fan turns on. When the warm-vent is less than 2 DegC warmer than the cool-vent, the fan turns off.

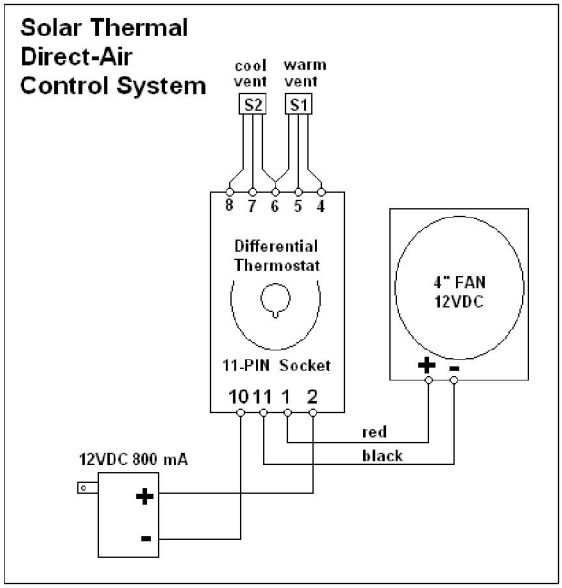

Diagram 7 : Control system

Energy Conversion

This differential thermostat records and displays the Degree-Hours of the warm air that is transferred into the building while the fan is turned on. Knowing the thermal capacity of air, as well as the flow-volume of the fan (121 CFM), it is possible to convert accumulated degree-hours of temperature rise into energy harvested (in WH or kWh).

In this case :

WH ~= Degree-Hours x 55

kWh = WH/1000

Diagram 8 : Cool-Vent duct-flap

Bill of Materials

1) 1 ea 8’ long x 26” wide clear SUNTUF clear polycarbonate
2) 24 ft SUNTUF foam gasket
3) 2 ea 8’ long 2x4
4) 24 ea 5” long heavy wood screw
5) 1 pound duct-seal putty
6) 1 tube acrylic exterior caulking
7) 1 tube clear silicon
8) 2 ft 4” tin duct
9) Flat black enamel paint (2 coats)
10) 1 ea 4” plastic duct-flap
11) Misc nails, screws
12) 1 ea 4” 12VDC 121 CFM box fan : RPElectronics p/n CFA1212038MB
13) 1 ea 4” finger-guard RPElectronics p/n CFG-120M
14) 1 ea 12VDC, 800 mA AC adapter RPElectronics p/n RP-1280
15) 1 ea Differential Thermostat : Mountain Electric SDT-1
16) 1 ea 11-pin DIN socket for above : Mountain Electric ES11

Sources

RP Electronics : www.rpelectronics.com

Mountain Electric : www.mountainelectric.ca