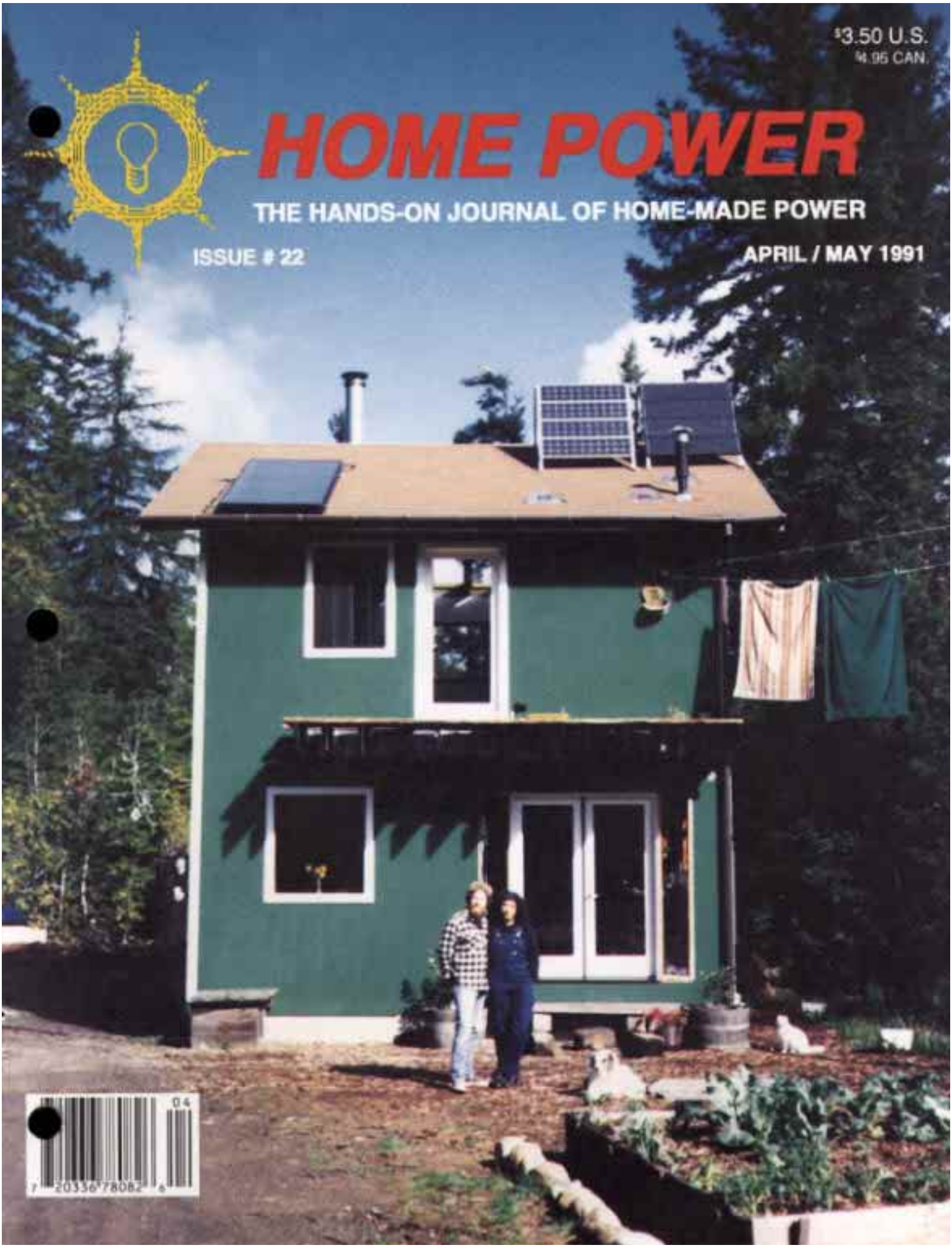
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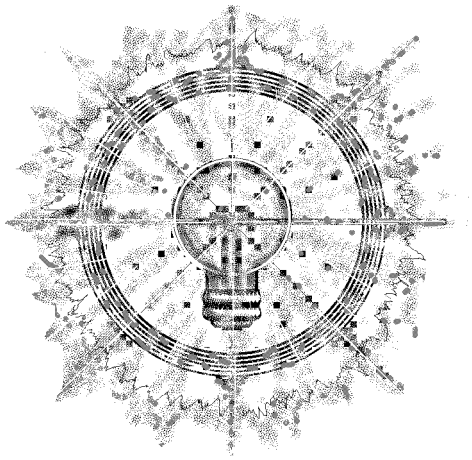

HOME POWER

THE HANDS-ON JOURNAL OF HOME-MADE POWER

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Home Power Magazine
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Think About It

"Never doubt that a small group of thoughtful committed citizens can change the world: indeed, it's the only thing that ever has."

Margaret Mead.

Cover

Walt and RaQuel Stillman on their Huckleberry Homestead. Sunshine makes their electricity and heats their water Story on page 6.

Photo by Rebecca Golly.

Gettin' into Hot Water

Bill Battagin

There's been a lot of talk about hot water lately. Generally, to our gang, that means doing it with something other than gas or electricity (e.g. sunshine). For those who thought they've seen it all, here's another wild, yet simple, idea that may get you into hot water.

Closed–loop Thermosyphon

I call this system a closed-loop thermosyphon. Thermosyphon systems are not the highest in overall efficiency. They do offer many advantages to the home builder. They are simple to make and don't require electric pumps. Home builders can use tricks to gain an edge in efficiency.

A thermosyphon system is as follows: the solar hot water panel(s) is located on a lower story, porch, or shed roof so that the TOP of the panel is at least 18 inches below the bottom of the storage tank. Tank location is usually in a second story, an attic, sometimes a cupola - somewhere that ensures an 18 inches vertical height difference between panel and the tank. Systems where the top of the panel is above the bottom of the tank will work if installed properly, but is generally not recommended.

A Heat Exchanger

The key to this system is the heat exchanger, the only element in the system which must be "homegrown". Why use a heat exchanger? Mainly use it because it provides freeze protection. Even if the possibility of freezing seems remote, you need to take this precaution! It only takes one frozen night to ruin an unprotected collector. The heat exchanger also increases the efficiency of heat transfer. Finally, antifreeze is not as corrosive as water. The heat exchanger in my systems have been: 4 inch steel pipe inserted length-wise through a non-glass lined standard electric hot water heater tank (older variety); or capping and welding couplings to the ends of what is now the flue of a gas hot water heater.

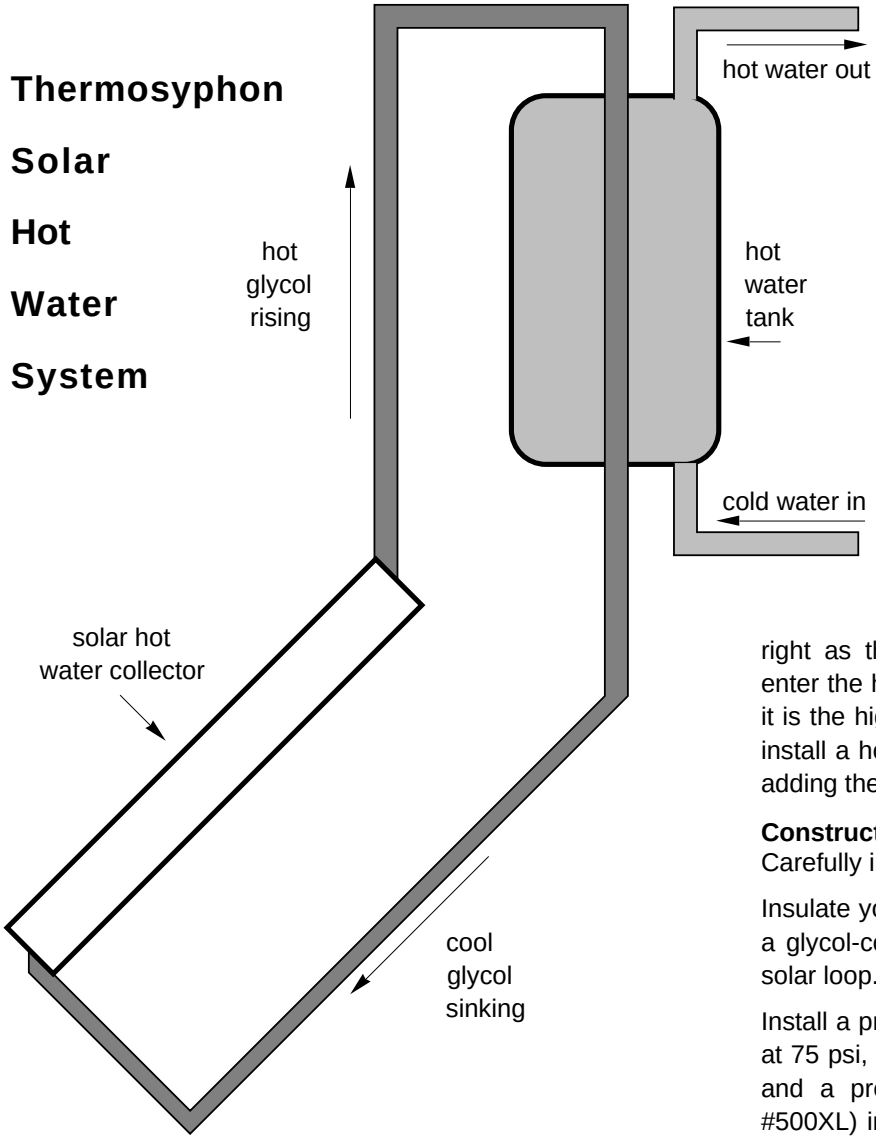
The tank should have a minimum of 40 gallons storage because solar heaters don't "kick-on" when the demand is high. Of course, the more people using the hot water, the larger the storage should be. I build 85 gallon tanks for a family of 4 careful users. Most of the systems I've installed were with a tank/heat exchanger that I've built from scratch, then had hot dip galvanized. So, the simplest scenario of this system is solar heated antifreeze from your panel rises (thermosyphon) to the heat exchanger in your tank. Losing its heat and thus becoming more dense, the antifreeze sinks back to the panel to be reheated.

Heat Exchanger Details

I feel like apologizing for the system being so simple, but thermosyphon systems are simple. Some of the details are critical, however, and need discussion and careful attention. This heat exchanger does not employ a double wall between the heat exchange fluid and your potable water. Technically, this is unacceptable, due to the possibility that a leak could occur in this one wall and a toxic fluid could mix with your hot water.

In the real world, (1) Don't use a toxic fluid. Propylene Glycol is non-toxic to humans. (2) How many of us drink water from the water heater? (3) Install a pressure gauge in your solar loop and charge the loop to 25 psi. or lower than your domestic water pressure. Most water supplies will be considerably higher than 25 psi, so if a leak occurs rather than your glycol and water mixture flowing into your potable water, water flows into the glycol and water mix. At this time, your pressure gauge tells you that there is trouble, and repairs can be made. The likelihood of a leak is slight if (a) schedule 40 galvanized steel pipe or, (b) an exterior glass-lined flue in a gas heater are used as the heat exchanger. In one case we have zinc, in the other case glass, protecting the steel from corrosion. The zinc coating on the INside of your galvanized pipe will have to be removed before you're finished. Zinc is not compatible with propylene glycol.

Zinc removal can be accomplished with one gallon of "pool acid" (20% hydrochloric or Muriatic acid) diluted with two gallons of water. Pour this solution carefully into your completed heat exchanger with the bottom coupling plugged. Take your time, have a hose nearby, wear appropriate safety clothing as the zinc/acid reaction is pretty exciting at first. It might take an hour of small,



intermittent additions of acid to get the heat exchanger full due to the bubbly reaction. Once full, let the reaction continue for about 30 minutes, then drain, neutralize (use baking soda) and dispose of the acid properly - FLUSH THOROUGHLY. If the heat exchanger is not yet welded into the tank, do so now. Check for leaks, and the hard part is over.

Panel Discussion

I favor factory built panels because of durability. Homegrown panels are great because you can scrounge parts. However, you must take the time to do a meticulous job if you want the panel to stay effective over time. Mounting the panel with either the long side or the narrow side parallel to the roof's edge is acceptable. I'm not going to discuss panel tilt here - there's plenty of info out there on it. There can be an advantage to mounting the panel with the long edge parallel to the roof's edge (horizontally), which is that this will get the "top" of the panel lower with respect to the bottom of the tank. If you can mount the panel with the short edge parallel to the roof's edge and still have good vertical height difference, do it. The panel must be of the header/riser type so any air in the panel can get out, which leads to...

Airpockets

In any thermosyphon system, great care must be taken to insure that all components and pipes are installed so that air anywhere in the system can get out. Air heads grasp this concept quicker than the average tofu-eater, but all systems must inevitably live by this law. Install a vent right as the heated glycol and water mix are about to enter the heat exchanger. This is the best place because it is the highest point in the loop. This is a good place to install a hose bib for cleaning and rinsing the loop before adding the glycol and water mix.

Construction Details

Carefully insulate your solar loop pipes - Yes, it matters.

Insulate your tank with AT LEAST R-19 fiberglass. Install a glycol-compatible expansion tank below the top of the solar loop.

Install a pressure only relief valve (Watts model #530) set at 75 psi, in the solar loop towards the top of the hot run; and a pressure/temperature relief valve (Watts model #500XL) in the top of your hot water tank. These valves and a pipe from the drip tray under your hot water tank should all be run to a visible outside location - label them where you see them terminate.

When you connect the copper pipes from the panel to the heat exchanger you will have to use a few galvanized parts and a dielectric union. This little bit of zinc exposure to the glycol and water mix is not enough to cause problems. If you've used an electric water heater tank, connect the juice (if available) for back-up to the solar (its proper place, in a world of sunshine!). Heck, don't be shy, hook-up the wood stove first - forget the grid!

Install a hose bib to a point just below the lower connection to the panel and don't forget an easy to read pressure gauge somewhere in your solar loop.

The Final Stretch

Lastly, we need to clean and Charge! the solar loop.

You'll need another recycled 30-40 gallon hot water heater tank (the Charging! tank). In your own creative way, thoroughly clean and rinse this tank. Then connect a hose bib to the lowest opening, install an air stem in any top location (to add compressed air), and install a 0 to 100 psi pressure gauge. Plug all other openings except one. With a funnel, add approximately 6-7 gallons of a solution of trisodium phosphate and water, then plug this hole and pressurize the tank to 70-80 psi. Connect the hose bib on this tank to the hose bib on the low side of your panel with hose and appropriate adapters. Allow the trisodium phosphate solution into the solar loop with the aid of the pressure in your Charging! tank - 30 psi into the loop is plenty. Check the solar loop thoroughly for leaks and for its ability to thermosyphon.

There should be hot water in your hot water tank for this step so you can feel a dramatic (20°F- 50°F) temperature difference between the pipes entering and leaving the heat exchanger. Allow to thermosyphon for 1-2 hours, drain, then flush with gobs (technical term for "lots") of water. Drain and flush the Charging! tank also. When draining the solar loop, catch the solution in a bucket so that the amount of glycol and water mix necessary can be determined. Take this amount and add a gallon for the total mix you'll need. OK, we know the system thermosyphons, it doesn't leak and it's clean. Pour the glycol and water mixture (mixed based on your calculations for your area - discuss this with the source from which you obtained the glycol) into your clean Charging! tank. Pressuring the tank to 70 to 80 psi, connect to the lower hose bib on solar loop, again and Charge! to 25 psi. Check for leaks and enjoy the next 50 years of solar hot water.

Maintenance

(1) Watch the pressure gauge on your solar loop. Under normal conditions, it will slightly rise and fall with the system's temperature. If it rises and falls with the pressure of your water supply, there's a leak in your heat exchanger.

(2) In five years, you'll need to test the inhibitors and freeze protection of your propylene glycol. Addition of inhibitors or replacement of glycol may be necessary - again, your supplier can help.

(3) Clean the covering on your panel (not when it's hot) occasionally if the rain hasn't been doing it for you.

P.S. This article puts me/my ideas on the chopping block for discussion and criticism, which I welcome. My intentions in writing this article were to help heal this planet that has given so much. No hot water system is environmentally benign, but to my knowledge, this system is comparatively low in impact and is durable.

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