THE THERMIC DIODE 23

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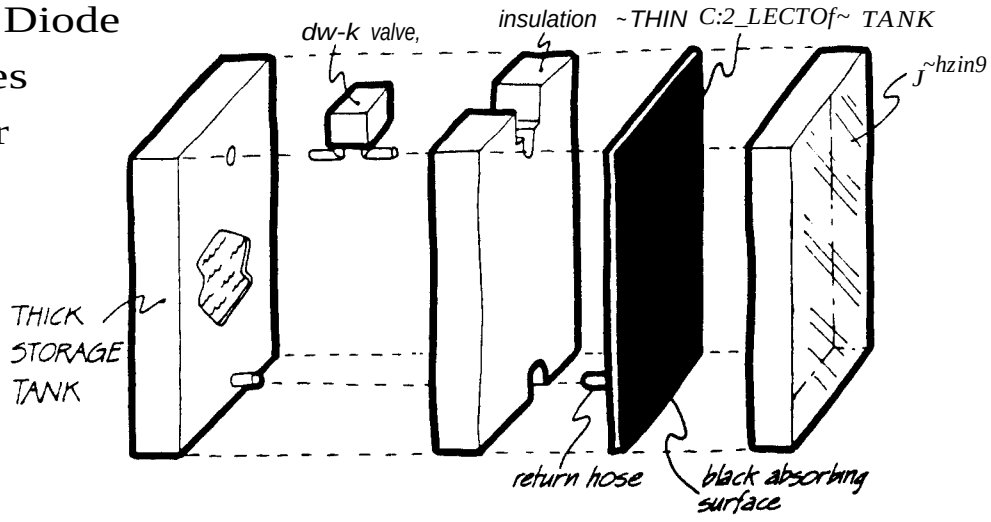
The biggest advantage of passive solar heating systems is their simplicity and reliability. Since they don't depend on fans or pumps which wear out or controllers which malfunction, there's less chance of something going wrong. Considering how easy it is for homeowners to forget to change the filters in their furnaces, the simplicity of a passive system is appealing. But passive solar homes must usually be built from the ground up. It is expensive to add, say, a Trombe wall to your house after it has been built. However, some passive systems are suitable for retrofitting-for adding to a home that has already been built. One such system is called the Thermic *Diode*. The term Thermic Diode comes from its inherent diode function: it stores heat when the sun shines on it but doesn't lose heat at night.

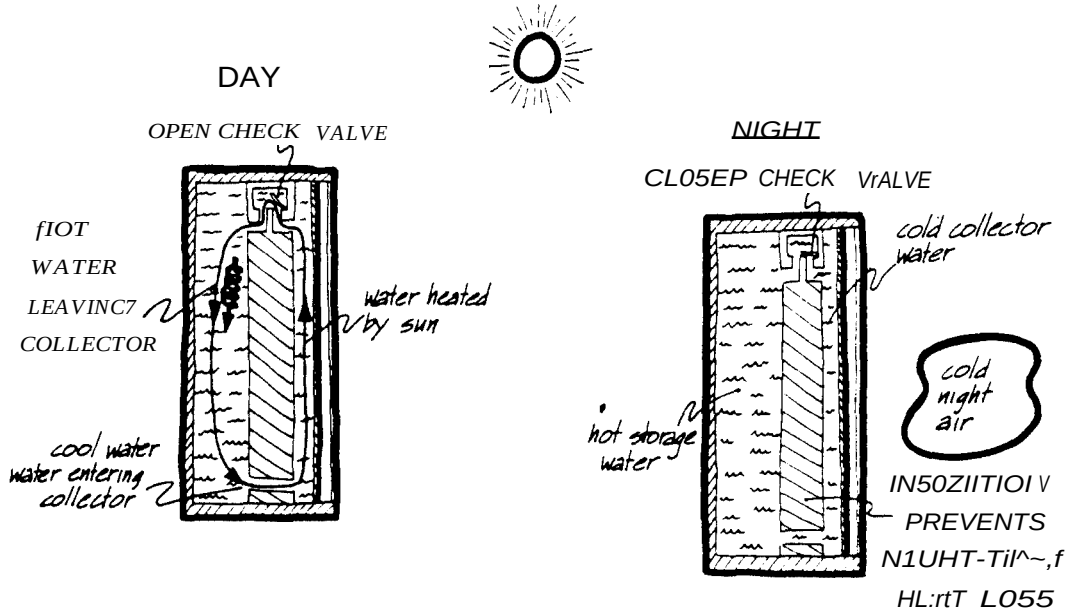
The Thermic Diode is a modular passive heating unit. Modular means that it comes in individual units, or modules,

Thermic Diode Combines Collector and Storage



which can be mass-produced in a factory as the collectors of active solar heating systems are. But it is also passive; it has no fans or pumps and requires no electricity to operate. Each module contains a complete solar heating system: a solar collector, a controller, a heat storage unit, and even a heat exchanger. Yet the Thermic Diode is simple, rugged, and reliable. It doesn't even have any moving parts that could blind or corrode.

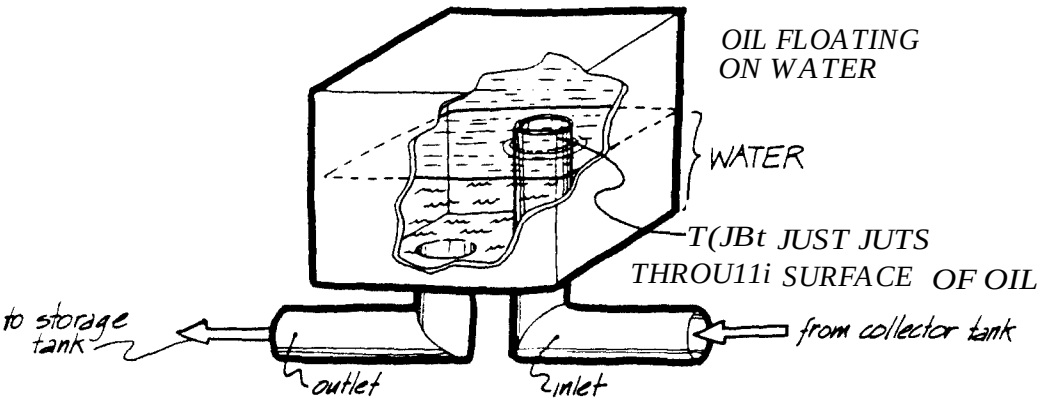
Functionally, the Thermic Diode consists of two flat tanks separated by insulation. The tanks are filled with water and are connected at the top by a check valve and at the bottom by a return hose. During the day, solar radiation passes through the glazing and is absorbed by the black outer surface of the thin collector tank. Heat is conducted through the tank's wall, heating the water inside. The heated water is less dense, so it rises and flows out through the check valve and into the storage tank. Cool water from the storage tank flows into the bottom of the collector by way of the return hose. As in a Trombe wall, the water circulates from the solar collector to the storage tank by the thermosyphon principle. At night, the collector cools and the water tries to thermosyphon in the opposite direction; but the check valve blocks this reverse circulation. The thick insulation prevents heat loss from storage when the valve is closed.



Check Valve Prevents Nighttime Heat Loss

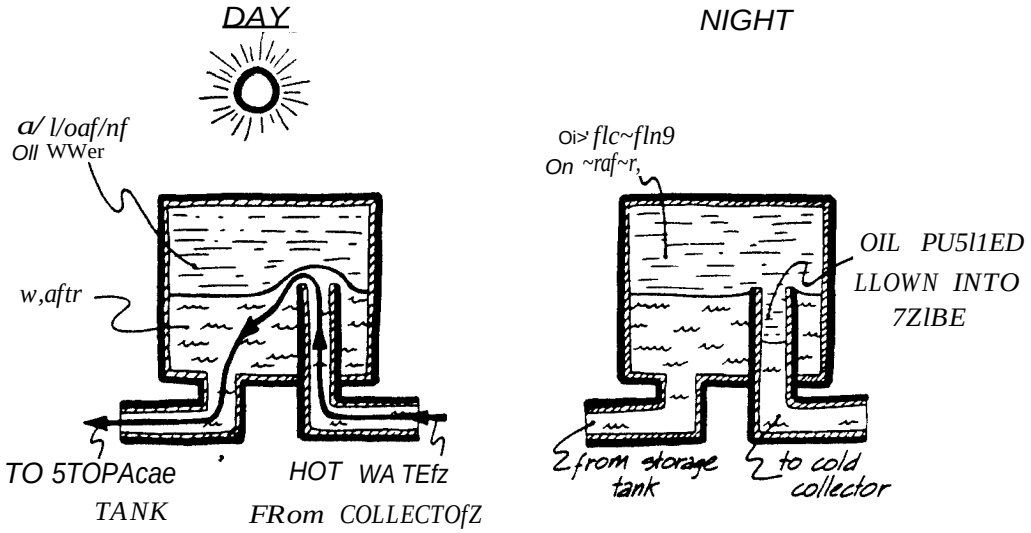
The check valve can't be a simple flap valve like the one that we learned about in our rainwater analogy. The forces that circulate the water are too minute to open and close a flap valve, especially if the same valve has to work reliably for twenty or thirty years. The Thermic Diode uses a specially designed check valve that has no moving parts. The valve is simply a chamber filled with water with a layer of oil floating on the water's surface. The oil layer is thick enough so that it covers the top of a short tube coming from the collector. When the solar collector is hotter than the storage tank, the water in the collector tries to rise. It pushes up over the top of the tube through the oil; then it flows down through the outlet to the storage tank. But when the storage tank is hotter than the collector, hot storage water tries to rise and pushes oil down into the tube. Since oil is lighter than water, it resists being pushed down into the water-the way it is hard to push a beach ball underwater when you're playing at the beach. Oil is pushed only a short way down the tube; then it blocks the hot water trying to circulate from storage to the cold collector.

Floating Oil Acts as Check Valve



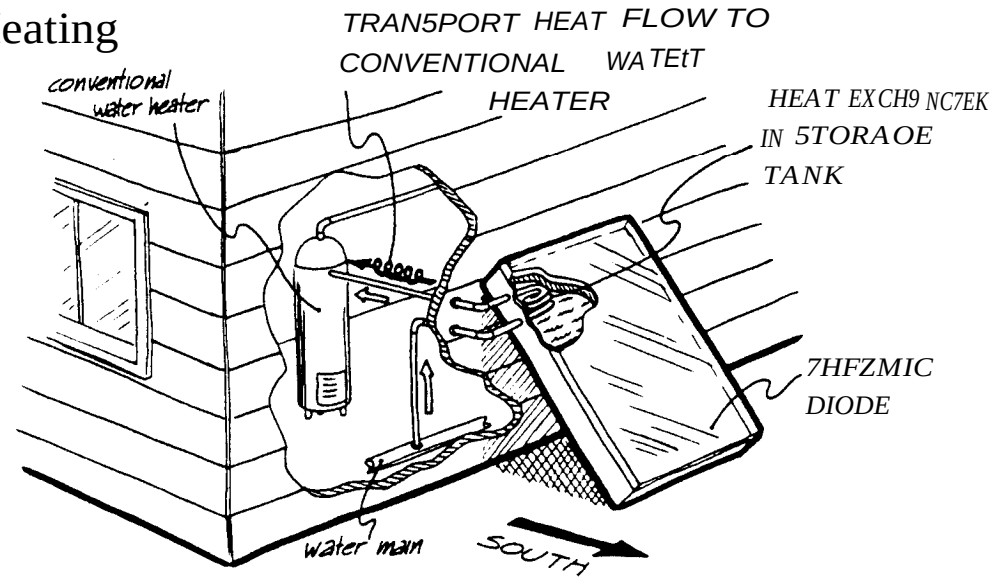
Functionally, the oil valve acts just like a check valve. It lets the hot water flow through in one direction but not in the reverse direction. Coupled with the thermosyphon circulation between the collector tank and the storage tank, the oil valve lets heat flow one way, but not the other. Thermosyphon circulation and the oil valve provide the same diode function that the controller and pump does in the active system.

Water Flows One Way Through Oil Valve



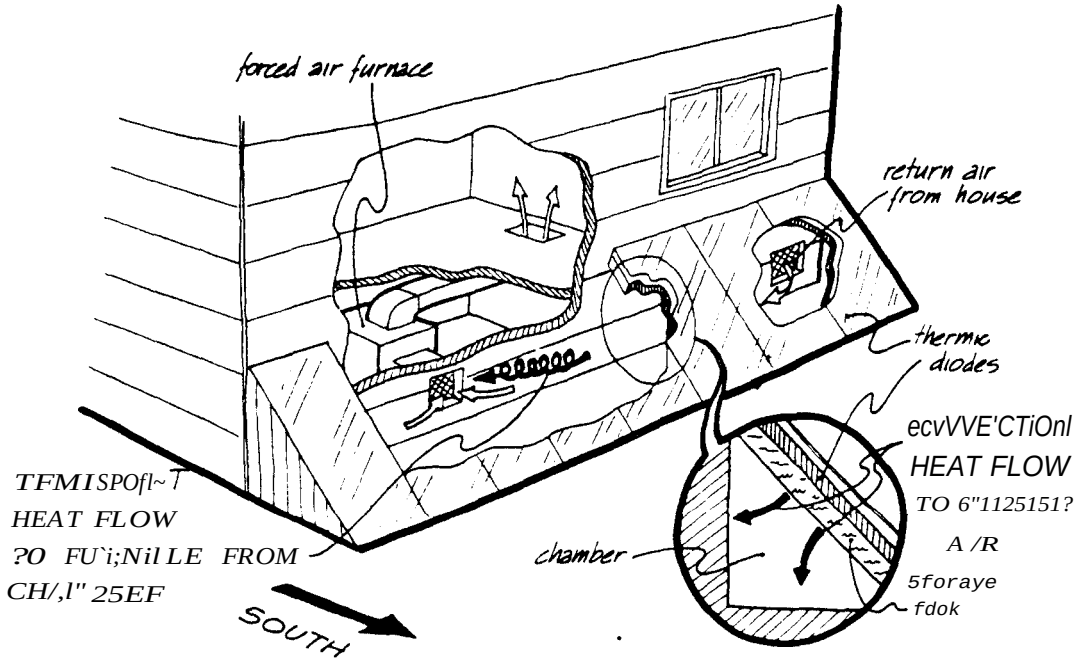
Heat stored in the storage tank can be used for hot-water heating or for house heating. In hot-water heating, a Thermic Diode has a heat exchanger built into the storage tank to extract heat. As we saw earlier for an active system, it can be used as a preheater for a conventional water heater. Only two pipes need be connected: one from the watermain, and one going to the conventional water heater.

Thermic Diode Water Heating



To heat a house by means of baseboard hot water, the heat-exchanger tubes of several Thermic Diodes can be strung together so that the output of one serves as the input to the next. The last tube goes to the auxiliary furnace. For house heating by forced air, the back wall of the storage tank itself can be used as a liquid-to-air heat exchanger. The back walls of several Thermic Diodes are exposed to a chamber formed between the Diodes and the house's wall. Heat flows by convection from the hot storage water through the storage tank's walls, and then by radiation and convection into the chamber. Since the storage tank is flat, lots of surface area is exposed to the chamber, letting the heat flow easily from the stored hot water. The heated chamber air is drawn into a conventional forced-air furnace for additional heating (if needed) before distribution to the living space.

Thermic Diode House Heating



In either hot-water heating or house heating, this passive system separates storage from both the collector (reducing nighttime heat loss) and the living space (allowing heat to be delivered only when it's needed). It performs both the diode and the control functions.