USING STORED HEAT 10

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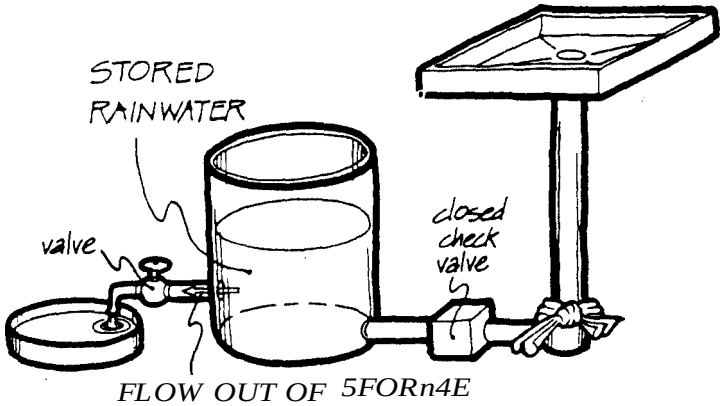
Solar heat has been collected and stored in order to be used. In a swimming-pool heater it's easy to use the stored heat. Instead of pumping the solar-heated water to a heat storage tank, the pool itself stores the sun's heat. But if we're trying to heat a house or water, we need some way to get the heat out of storage. By analogy, If we want to get the rainwater from the rainwater collector, one way would be to tap into the side of the storage tank. We can tap off some stored rainwater whether we're simultaneously collecting rainwater or whether the rain has stopped and we're only tapping off the stored rainwater.

Using Stored Rainwater



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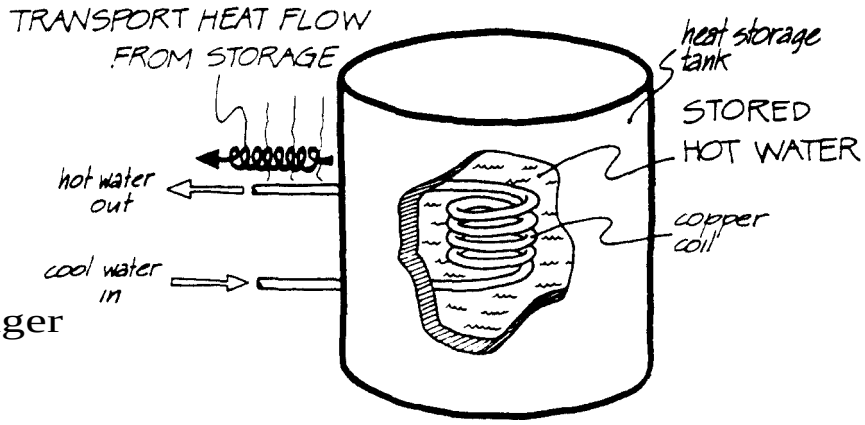
WIZEN NEEDED

Similarly, a heat storage tank can be "tapped" to yield its stored heat. However, instead of actually removing the hot water from the storage tank, a *heat exchanger is* usually used to extract the heat-but not hot water. A heat exchanger consists

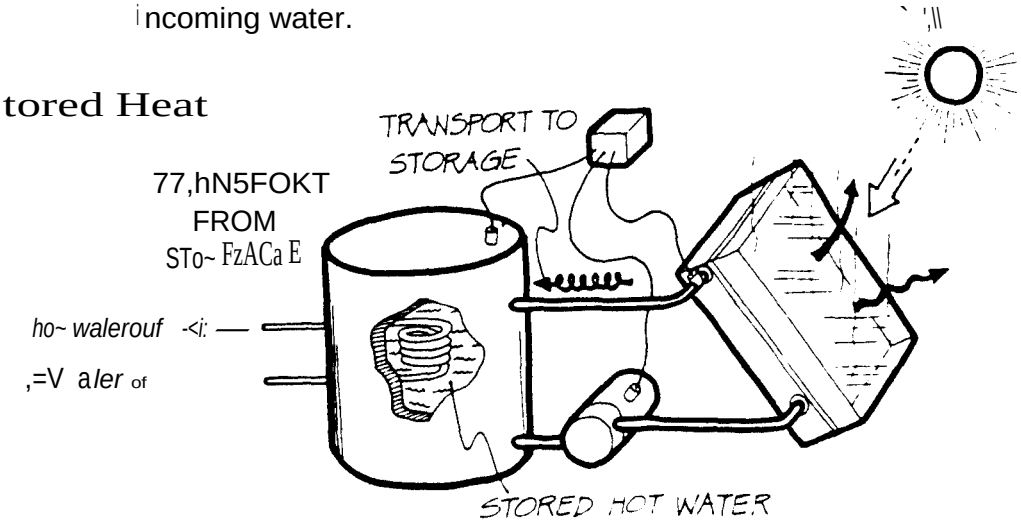
of a coil of copper tubing which sits Inside the heat storage tank; cool water is pumped into one end of the coil and hot water flows out the other end. The stored hot water heats the outer surface of the copper coil by natural convection; the heat flows easily through the copper by conduction. The water flowing through the coil is then heated by convection from the hot copper surfaces that the water flows past. This kind of heat exchanger is called a *liquid-to-liquid* heat exchanger, since heat is transferred from one liquid (the hot storage water) to another (the water pumped through the coil).



A Heat Exchanger Extracts Stored Heat

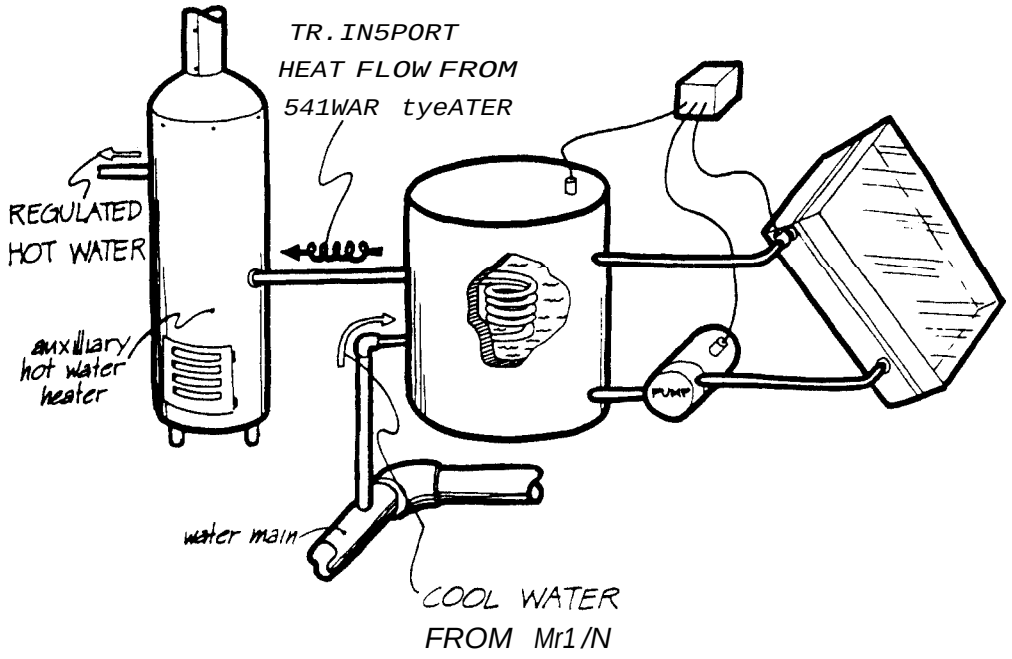
Cool water can be pumped into the heat exchanger whether or not the solar energy system is also collecting heat. It is possible to withdraw heat from storage while simultaneously adding solar heat to storage. The only requirement for the heat exchanger is that the stored water must be hotter than the cool incoming water.

Using Stored Heat



Let's consider the case of heating water. Usually a solar heating system is used as a preheater for a conventional gas, oil, or electrical hot-water heater. Cold water from a well or water main flows through the heat exchanger before going to the conventional auxiliary unit, as it is sometimes called.

Solar Water Heating: Preheater Arrangement



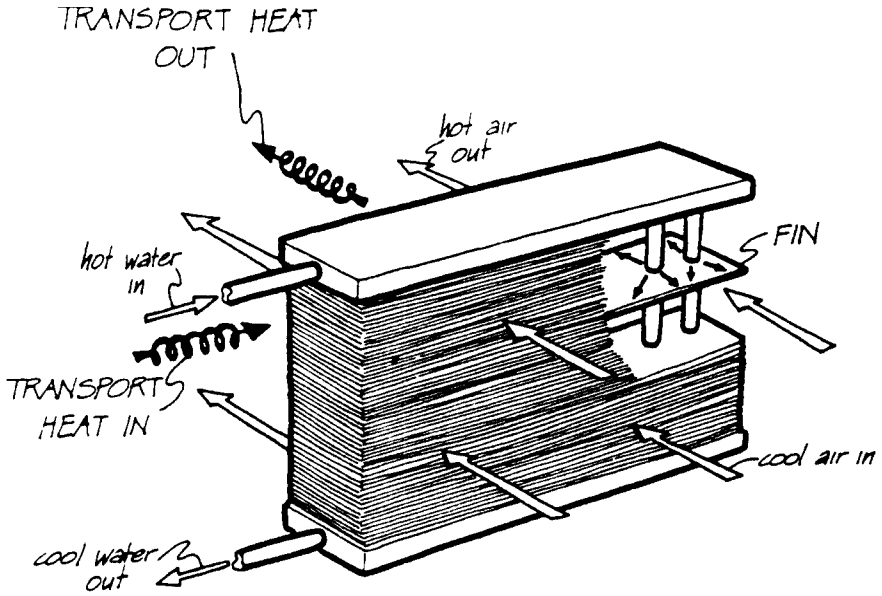
The preheater arrangement has several advantages. First, the stored solar-heated water only has to be hotter than the water main temperature to extract stored heat. Usually, the water main temperature is about the same as the ground temperature, so even a little sunlight can heat the water from the main. Second, if the solar heater cannot get the water hot enough, the auxiliary hot-water heater can top it *off.* In the winter, for example, the water main temperature could be 50° F. The solar heater might only be able to heat it to 100° F. The auxiliary heater needs only to heat it another 30° for its temperature to reach the desired 130° F. Most of the heat was added by the solar heater, but some was added by the auxiliary heater. Since most people are accustomed to regulated hot water, having a conventional auxiliary unit in addition to the solar preheater is almost a necessity.

Similarly, in house heating, a solar heating system can be used as a preheater for a conventional furnace. Let's suppose we're solar heating a house that is heated by *forced air* (forcing heated air through air ducts). We can extract solar heat from our storage tank with a *liquid-to-air* heat exchanger.

Recall that we've already used a liquid-to-liquid heat exchanger to extract heat from our storage for hot-water heating. The two types of heat exchangers look distinctly different. This is because It is so much easier to transfer heat to water than to air, and much more surface must be exposed to the air than to the water.

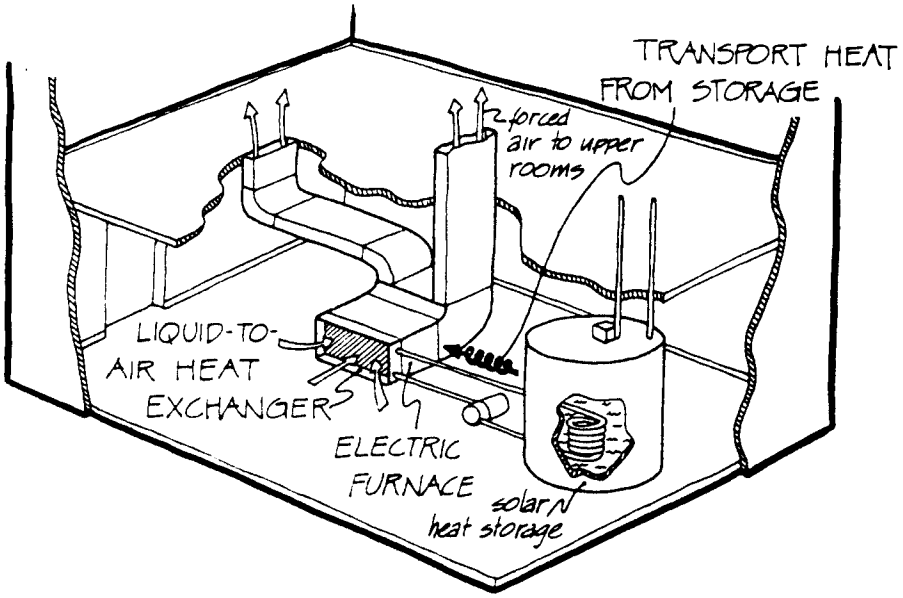
In a liquid-to-air heat exchanger (a car radiator is one type), hot water pumped through many parallel tubes transfers heat to the air by way of hundreds of thin metal fins attached to the tubes. Heat flows easily into the metal tubes from the flowing hot water. Then it's conducted easily along the fins, insuring that lots of hot fin surface is exposed to the air blowing by. Because heat doesn't flow easily by convection from a surface into air, a lot of fin surface is needed and the air must blow fast over the fins.

A Liquid-to-Air Heat Exchanger



In heating a house with a solar preheater, a liquid-to-liquid heat exchanger draws heat from the solar heat storage and feeds it into a liquid-to-air heat exchanger. The latter transfers heat to the air flowing into a furnace-often an electric furnace. If the air is sufficiently hot, the furnace's coils never come on. But if the solar heat storage is too cool, the coil of the furnace will add additional heat to the air.

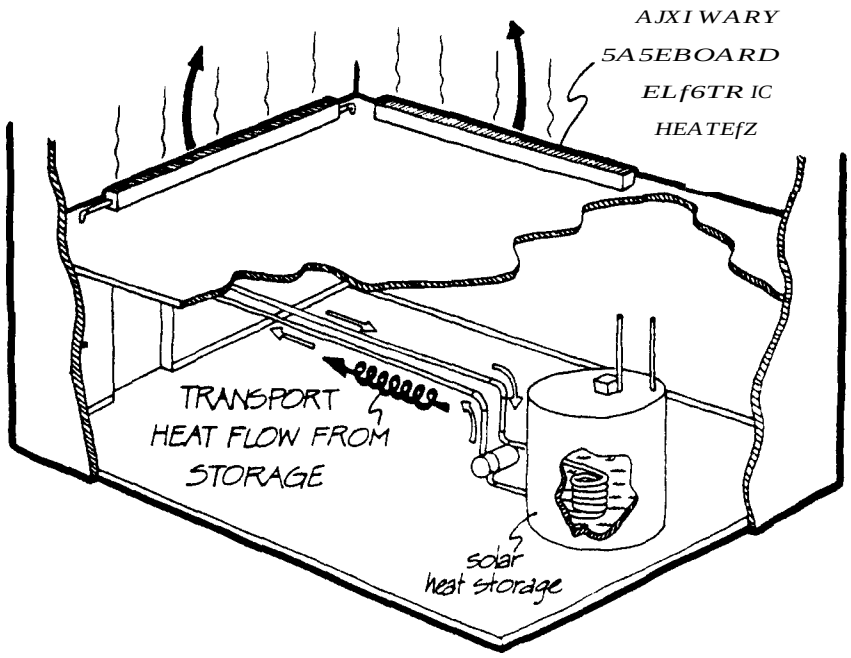
Solar House Heating: Preheater Arrangement



Solar heat is also used as a preheater for a conventional heating system. Note that even though electricity is a very expensive fuel, it is used only a fraction of the time: the house is primarily solar heated, and electricity is used as a back-up.

So far we've talked about preheater, or series arrangements of solar and auxiliary heating systems. Series, In electrical terms, means flowing first into one and then into the other; the auxiliary adds its heat only after the solar heat is added. Another arrangement Is a parallel one where both the solar heating system and the auxiliary unit directly heat the house. An example of a parallel arrangement is a house that is simultaneously heated by electric baseboard heating and hot-water baseboard heating. Both systems add heat to the house, but the electric auxiliary system comes on only when the temperature of the solar storage is insufficient to heat the house.

Solar House Heating: Parallel Arrangement



There are many other ways that solar energy can be coupled with an auxiliary unit for house and hot-water heating. The ones shown here are just a few of the possibilities.

But why have an auxiliary unit at all? Without one you couldn't count on having your hot water or house heated after several days of cloudy weather. Then why not store a week's supply of heat? From an economic viewpoint, storing much more than a day or two's heat supply becomes expensive. A storage tank that holds a week's supply of heat costs much more than one that holds a day's supply. Although some solar energy heating systems have been, built to store heat for months at a ti me, the majority of residential systems store only a day's heat supply.