A TYPICAL DAY: MORNING 16

10

Now that we've examined all the elements of a solar heating system, let's see how It operates during a typical winter day. Right now we'll consider only collecting and storing heat; later we'll see how we use the stored heat. We'll also follow the operation of our rainwater collecting apparatus so comparisons can be made between the two at various stages.

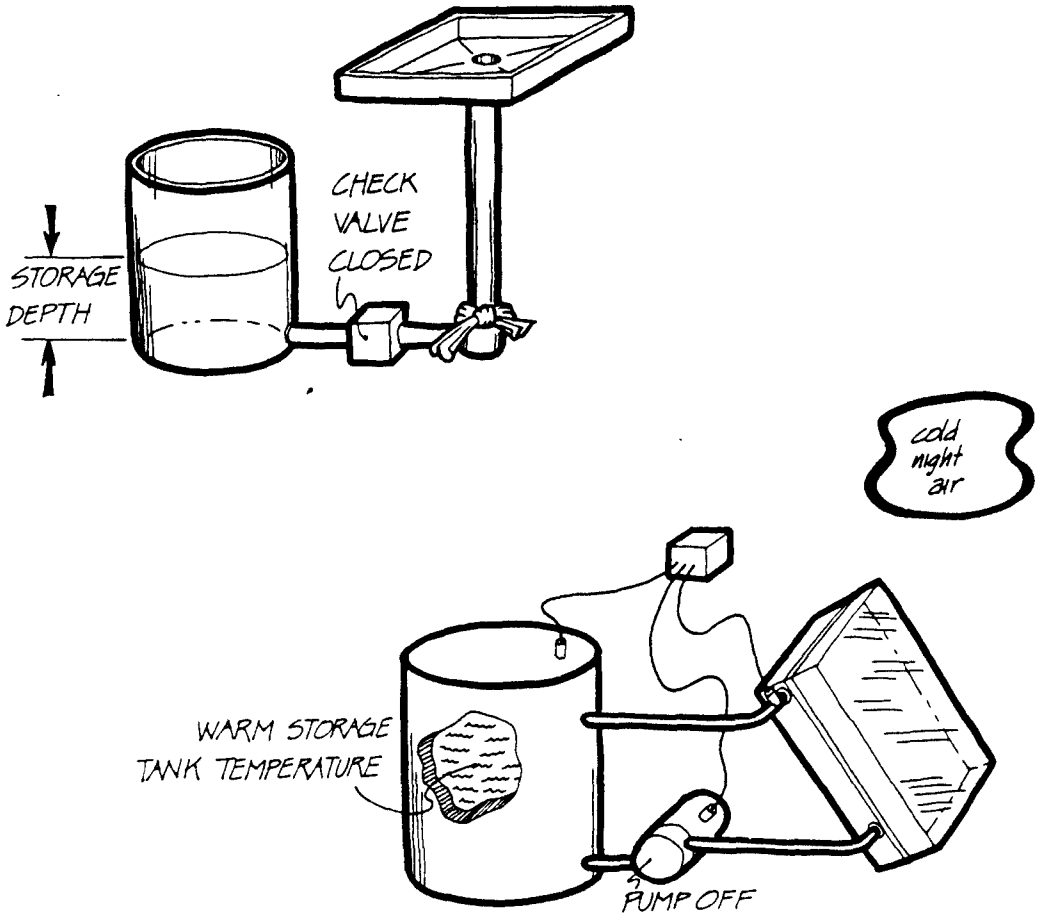
Let's assume that both collecting systems begin the day partly full. For example, in the rainwater collector, there might have been some rainwater left from previous rain. In the solar collecting system, we'll assume the heat storage tank is still warm from the previous day's collection.

In the rainwater apparatus, the check valve has closed to keep the stored water from leaking out. No rain Is falling, and any water in the pipe has long since leaked out. As for the solar heater, the sun has not yet risen. The collector, which has been exposed to the cold night air, is much colder than the heat storage tank. The heat storage is warmer than the outdoors because it still contains heat. The controller had sensed that the collector was colder than the heat storage tank and shut off the pump, preventing the storage tank from cooling.

As the sun rises, the collector starts to get a little warmer. But since a south-oriented collector doesn't face the sun early in the morning, not much solar radiation is absorbed. The collector will get warmer, but not as warm as the heat storage. Since the collector Is still colder than the storage tank, the controller won't turn on the pump. Of course, the collector is a little warmer than the outdoors, so It loses heat through Its glazing. In fact, it loses all the heat absorbed by the collector: since none Is saved, all of the incoming heat is lost.

For the rainwater apparatus to be analogous to our solar collector, let's suppose that it starts to drizzle on the rainwater

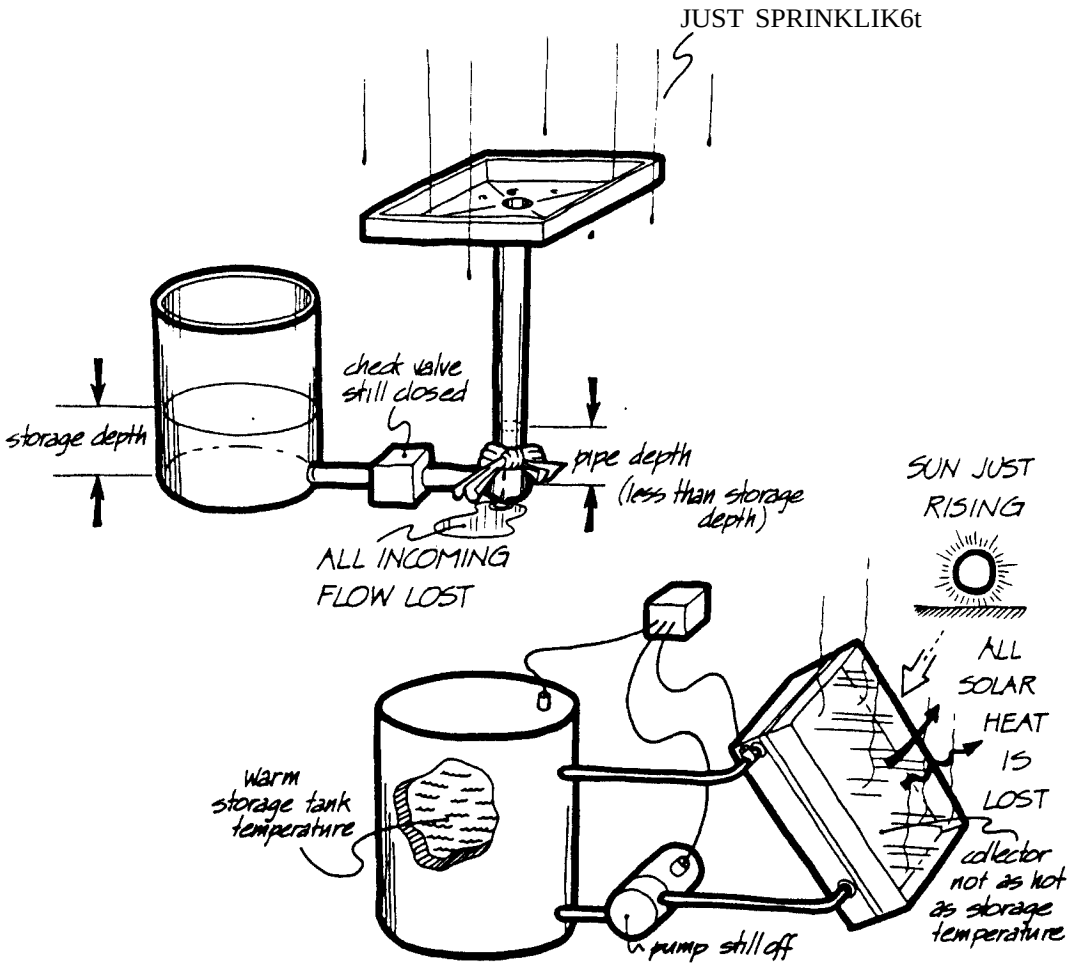
Before the Sun Rises



collecting tray. Since little rainwater is being collected, the water in the collection pipe dosn't get as deep as the storage depth. No rainwater flows into storage, and efficiency is zero- all the rain captured by the tray leaks away.

Until the temperature of a collector gets hotter than the storage tank, no heat is collected. Often on cloudy days, a solar collector doesn't collect any heat whatsoever, just as when the sun first rises in the morning not enough solar radiation falls on the collector to make its stagnation temperature hotter than the storage tank's. The heat leaks away from the collector as fast as it is absorbed. The cold temperature outdoors aggravates the situation, since the incoming solar radiation must further raise the collector's temperature so that it equals the storage temperature.

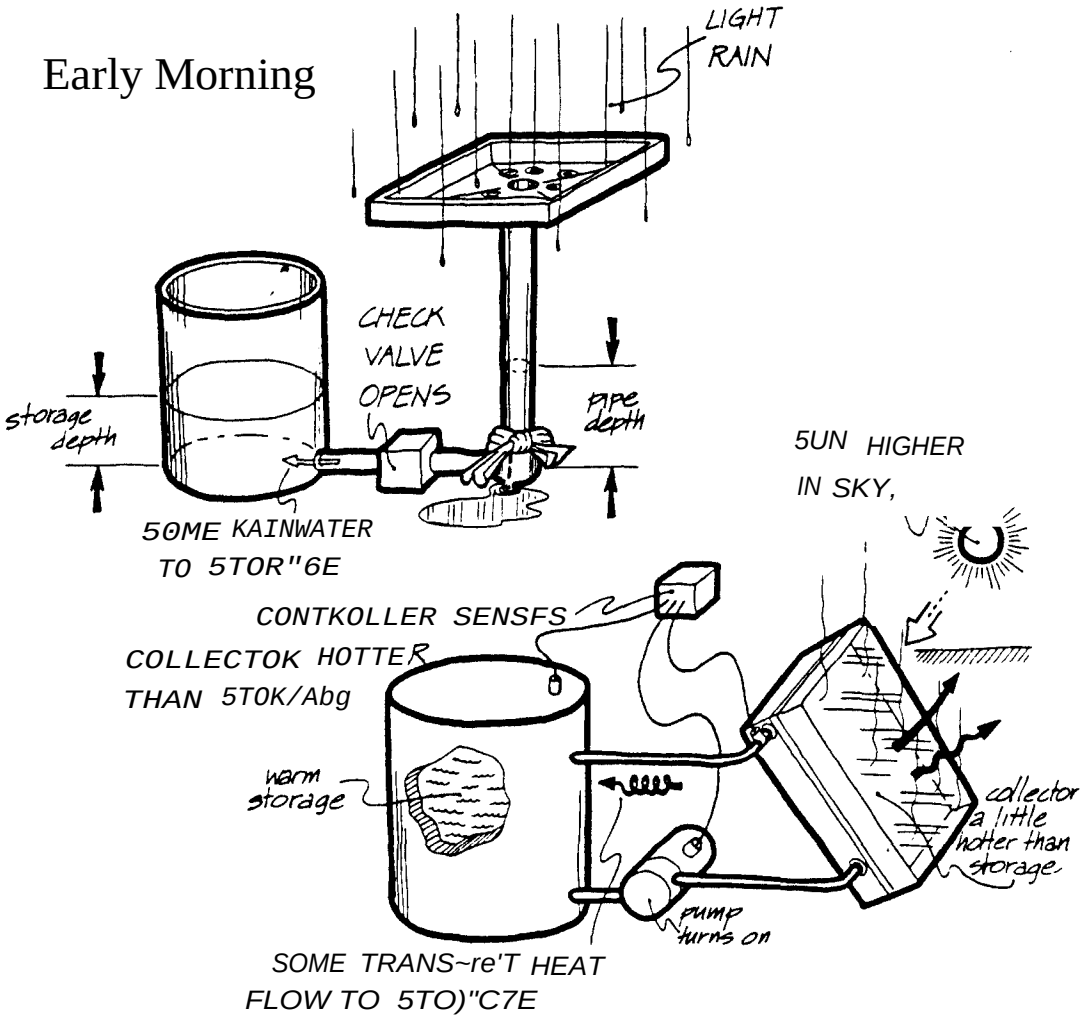
Just After Sunrise



As the sun gets higher in the sky, its radiation strikes the collector more and more head-on, and more solar radiation is absorbed by the collector plate. Eventually the collector plate gets hotter than the storage tank. When it does get hotter, the pump controller senses the temperature difference between the collector and the storage tank and turns on the pump. With pump water flowing, some of the heat absorbed by the collector is moved Into storage: water flowing from storage is heated as It passes through the collector. Warm water from the collector further heats up the storage tank. Now not all the collector's heat Is lost, since some of It is going into storage.

In the rainwater collection system, let's suppose the rain increases from a drizzle to a light rain; this Is analogous to more sunshine being absorbed by the solar collector. With more rain-

water collected and flowing down the pipe, the pipe's water depth gets higher than the storage water depth. The check valve opens and not all the rainwater is lost through the leak, since some Is flowing into storage.



In the late morning the sun faces the collector nearly head-on; and much more solar radiation is absorbed by the collector plate. With the pump on, warm water from storage is pumped through the collector, where it is further heated. It returns to the storage tank hotter and continues to heat the tank. The collector always stays a little hotter than the storage tank, so the controller always keeps the pump on. Efficiency is high in the late morning. The collector receives water from storage, and

before noon storage isn't very hot yet. When the collector isn't hot, heat losses are low, resulting in high efficiency.

The rainwater equivalent to the sun hitting the collector nearly head-on Is a heavy rain. The incoming water fills up the pipe and flows through the check valve into the storage tank. Since the pipe's water depth Isn't too high yet, not much rainwater is lost and efficiency is high.