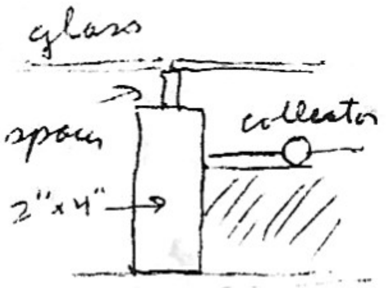
The glasing for the collector should, whenever possible be lifted slightly off of its supports by spacers so that the area taken up by the supports is largely used as a collector rather than "becoming" a dead spot.



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Convection

SOLAR ENERGY

CONVECTION ENGINES

Gravity is a container which continually ranks its contents, light substances rise to the top, heavy substances sink to the bottom. All liquids change density with temperature (see Fig. 1). Each volume of liquid in a gravitational field is thus an engine whether it is as tiny as a drop of water or as immense as the atmosphere. It is an almost universal property of fluids that they expand upon being heated- the very instrument which tells us temperature, the thermometer, is merely a guage for reading the expansion of the contained liquid.

Thus it is almost universal that if a fluid is heated it rises and if it is cooled it sinks. Our planet with all the liquids captured in its gravitational field (except for the anomalies water and heavy water) is continually moving heat outwards.

The flame burns at the bottom of the tea kettle, the heating element is at the bottom of the hot water tank. The entire contents warm. If one wishes to contain cool fluids, a pool is enough - thus in super markets the freezers are open on the top - a pool of cold air rests within. Citrus growers fight this property of air with fans set within groves that lie in valleys.

If we wish to cool a house we can place a loop of tubing through the house and then onto the roof and fill the loop with liquid (throughout this discussion I am omitting any mention of heat transport by radiation or conduction - heat is an enormous subject- radiation or conduction are equally as important as convection.) During the day the sun shines on the portion of the loop that rests on the roof, the liquid within grows hot - where does the heat go? It stays on the roof since the hot liquid is lighter than the cool liquid within the shaded portion of the loop. During the night heat radiates into space. Sometime after the earth spins the house into its shadow the roof will be cooler than the inside of the house - now convection starts. The house gives heat to the loop and its fluid. The fluid rises to the roof, loses its heat to the night sky, grows denser by shrinking and circulates back down within where it again picks up more heat. A combination engine-refrigerator. Perhaps it is difficult for us to think of convection as an engine since it doesn't break down or wear out. Doesn't wear out? We are brought up with the idea that everything wears out. But the very framework within which such questions are posed has permanence, and among its constituents are gravity and the expansion of liquids on being heated. The two together coupled to a heat source which is blinked on and off provide innumerable engines which function endlessly and tirelessly. Then we have readily available engines which can cool buildings, (provided there are low enough night time temperatures) but what of the reverse; can we exploit one of these convection engines to heat our building? We can if our heat source is below the building. This is generally inconvenient; our source of heat (unless we have built on top of a warm springs) is sunlight and it falls on the walls and the roof of the structure rather than the floor. Then if we wish to convert heat downwards we need a liquid that convects backwards, a reverse juice.

Is there such a juice? Water below the temperature of 39 degrees F and deuterium oxide below 52 degrees F are reverse juices. I know of no others. Rubber contracts on being heated but it is a solid rather than a liquid. The reverse juice can hide heat - this quality of water, instead of convecting heat to the stars, to hide heat below 39 degrees F, protects pond life every winter.

Could we use water's property as a reverse juice to prevent freezing of collectors at night?

In the construction of water heaters I have mentioned several times the necessity in cold climates such as Albuquerque to have a two liquid system where an anti-freeze mixture circulates through the collectors instead of water. If water freezes in a pipe it can burst the pipe because the ice is 8% larger than the water it is formed from. Water is at its most dense at 39 deg. F - a quick examination of the diagram of a typical water heater (Fig. 2) shows that there should be no problem of freezing in the collector even without the two liquid system for water before it gets to 32 deg. F, expands slightly and would thus rise to be replaced by heavier water at 39 degrees F. Water really does act this way if it has enough space to move in. Ponds freeze at their tops. I have measured the temperature of water at the bottom of a number of frozen ponds near Taos and found it to be between 39 and 42 degrees F. Then it would seem we could rely on this property to keep our heat collector which is below a supply of warm water above 32 degrees F. Every time water got close to this freezing temperature it would swell slightly and escape upwards toward the storage tank where it would be warmed and shrink and sink to replace colder water again. The problem with utilizing this property is that the expansion and contraction between 39 degrees F and 32 degrees F is very slight and the convective forces are thus weak. To supply enough heat to a collector by this reverse convection on a cold night would require large flow channels. In normal collectors