Attachment B

ADVANCEMENTS IN SOLAR THERMAL TECHNOLOGY

A brief synopsis for HB-1126

Flat plate thermal collectors have been the tried and true collection technology for the last 30 years, but a slew of new: collector types, storage plans, and controls is quickly changing the face of solar heating while increasing the number of applications it is feasible for.

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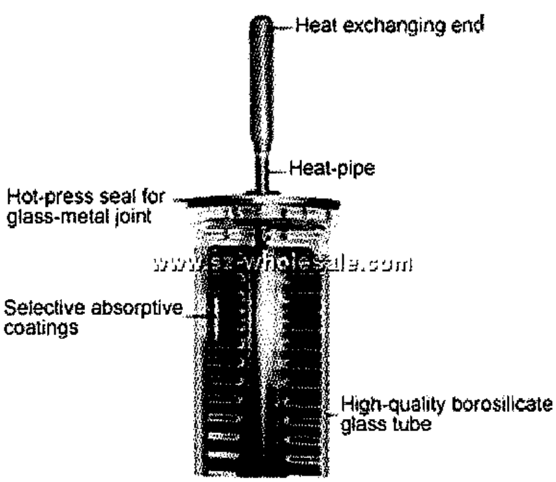
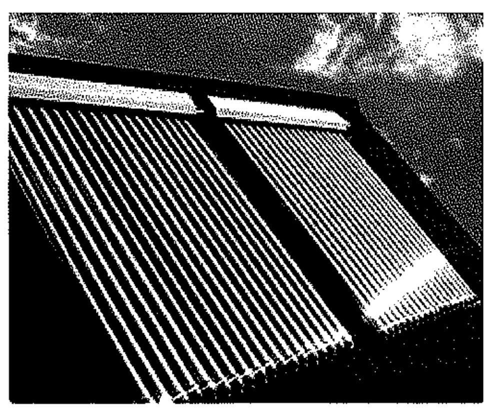
A brief synopsis for HB-1126

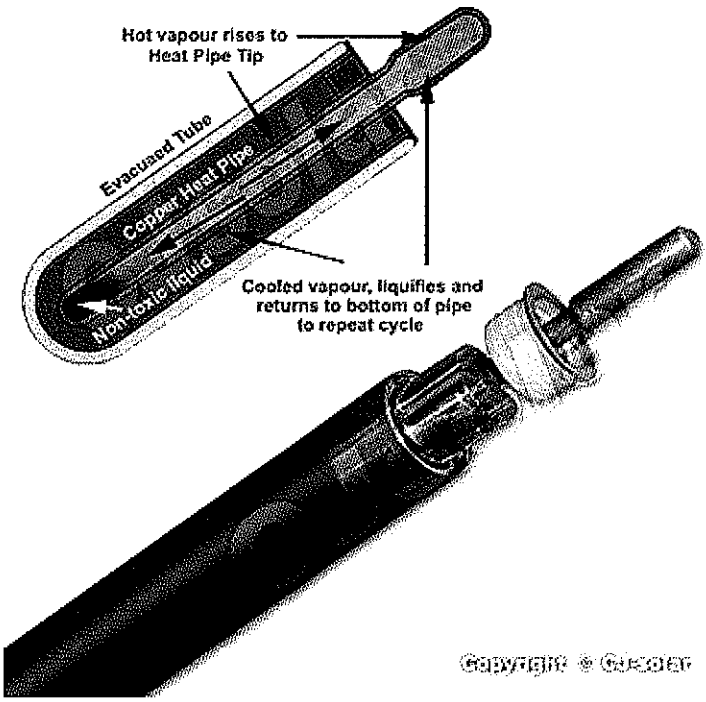
I. COLLECTORS

a. Evacuate tube collectors differ from traditional flat plate collectors in that they do away with the typical methods of heat retention in the solar collector's box. While all collectors use some sort of black absorptive surface surrounded by insulation and/or glass, the evacuated tube does away with traditional fiberglass/polyisocyanurate materials to decrease thermal losses to the atmosphere. Instead the absorptive surface is encased in a glass tube that has all of the internal air removed in a vacuum process. The removal of all atmosphere in the tube essentially serves as the ultimate in insulation, and enables the collector to absorb and effectively transfer higher temperature energy to the water. In short, where a traditional collector starts to fall off its performance curve at around 150F as more and more energy is immediately lost back through the glass and insulation; an evacuated tube does not start to lose enough energy to fall off its performance curve until internal temperatures reach the 200F-240F, or higher, range depending on brand and quality.

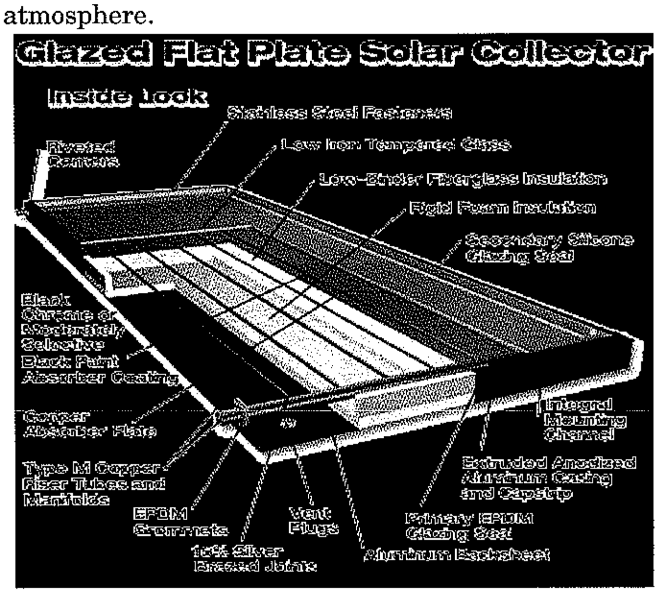




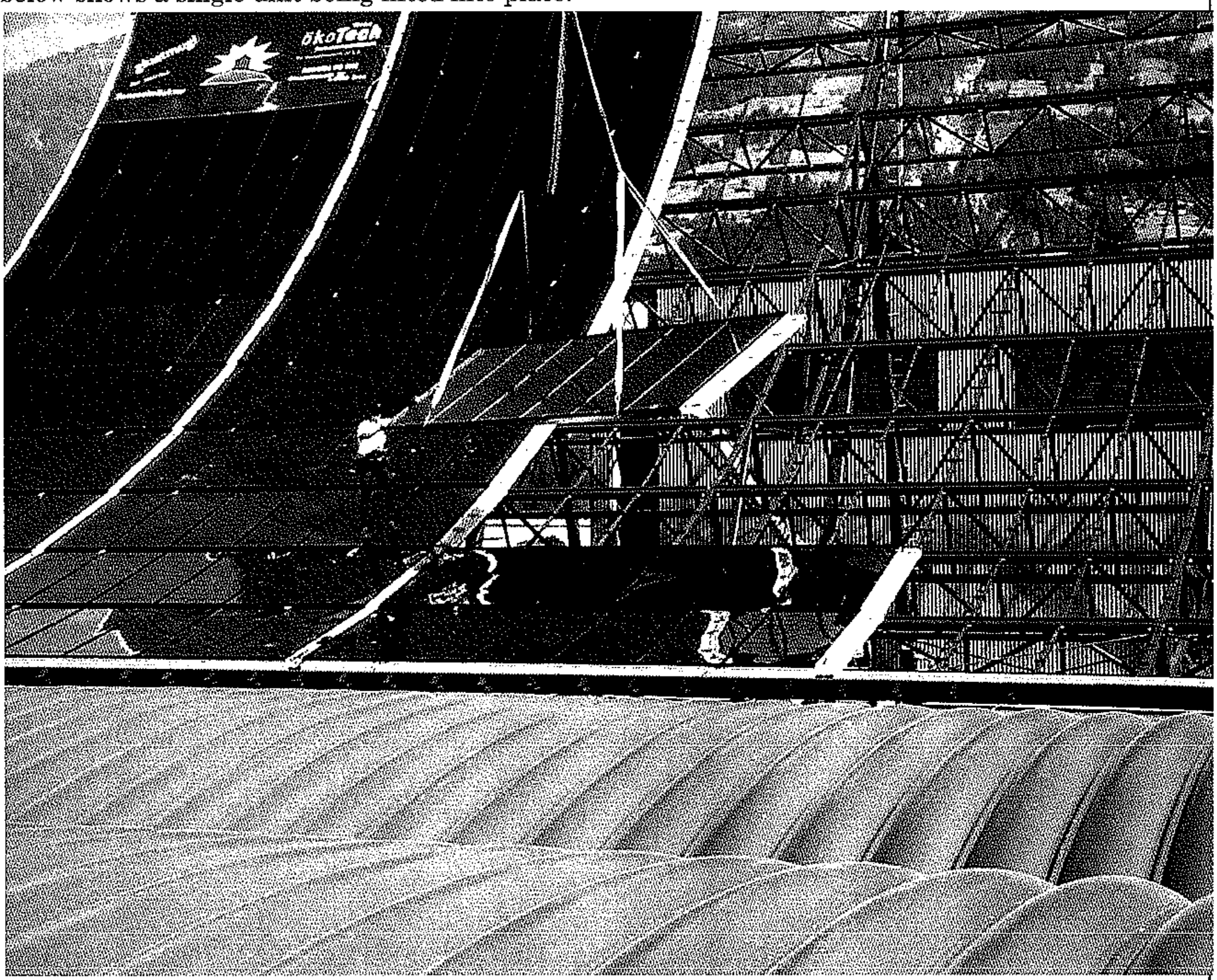
In addition to an evacuation of the atmosphere, many tube type collectors also use heat pipe technology. Instead of simply having some fluid flow through a collector to absorb and transfer the energy, a heat pipe is a small closed loop system found within the individual tubes. A heat pipe is typically filled with alcohol or water/alcohol mixture. The tubes are installed with a slope, and as energy enters the tube, and is transferred to the heat pipe the liquid inside is vaporized. The vapor rises to the bulb at the end of the pipe which is encased in a heat exchanger manifold. A more traditional fluid is typically flowing around the outside of the bulb pulling heat from the alcohol. As the alcohol cools it goes through a phase change, turning back to liquid, and falls to the bottom of the tube beginning the process over again. When used properly there are many benefits to heat pipes including quicker startup at lower temperatures, and "amplification" of energy transfer seen when phase changes occur.



b. Flat plate collectors are also going through numerous advancements. The traditional flat plate collector has water or glycol flowing through a large absorber pulling heat off of it and transferring the energy into the building. The box is not airtight, but has traditional insulation technologies in place to reduce energy loss back out to the atmosphere.

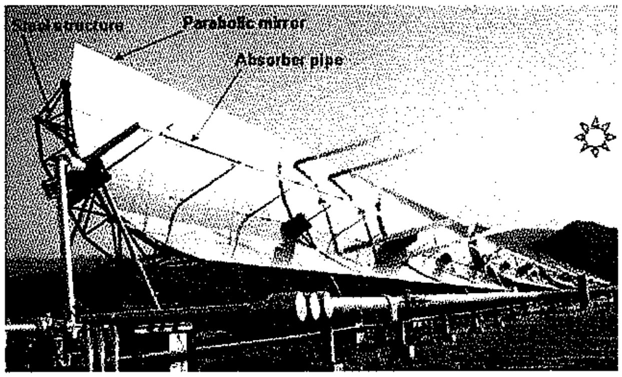


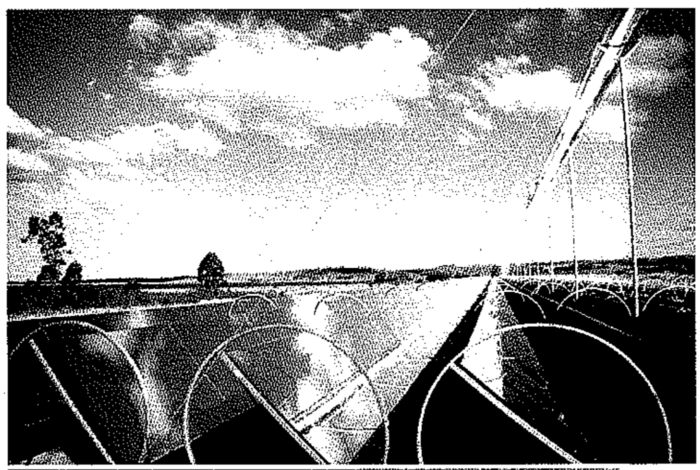
There are many things being done to increase the efficiency and temperatures seen in flat plates. Heat pipe technology is finding its way into flat collectors as a way to increase efficiency, but also simply altering the speed and way traditional fluids flow the absorber as in the new Enerworks collector. The Enerworks collector uses patented low-flow technology (which also leads to smaller pumps requiring less electricity), and what is called a serpentine flow pattern to increase the efficiency and temperatures achieved in what appears to be an otherwise "traditional" collector. There are also companies striving to increase performance through better insulation. Buderus makes a flat plate collector that is hermetically sealed, and is filled with argon gas. Instead of pulling a vacuum, the argon is a very inert gas which behaves in the same way as a vacuum substantially reducing the amount of energy that is transferred through the "air" present in flat plate collectors. These argon filled collectors are often capable of the same temperatures of evacuated tubes. Lastly there are flat plate manufacturers that are increasing the size of the collector from what is typically considered a large collector at40 ft^2, to the new large at 140 ft^2. The picture below shows a single unit being lifted into place.

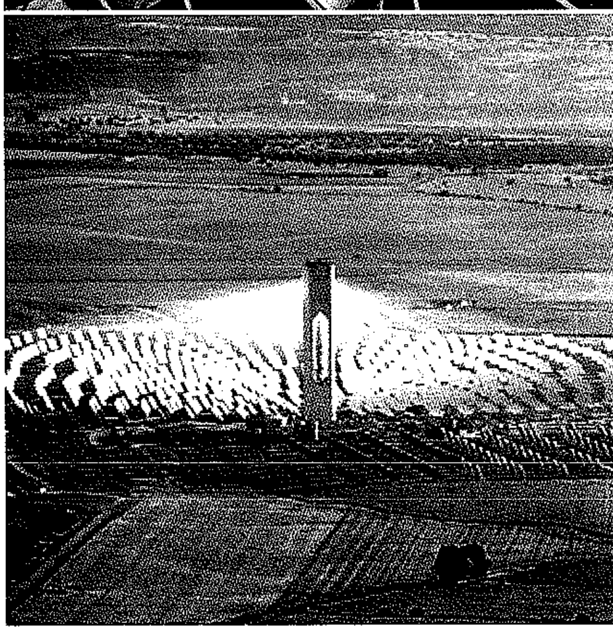


This reduces installation costs, and when coupled with greater insulation thickness as found in S.O.L.I.D. collectors these large collectors are also able to achieve temperatures in excess of 230F.

c. Concentrating collectors are the last style of thermal collectors, and are likely seeing the most investment dollars of any thermal technology. Essentially there is some sort of mirrored surface used to reflect a large amount of area back to a smaller absorptive surface. This technology can be used for traditional low temperatures on a large scale, or can be setup to produce temperature as high as 1000F. The technology can either exist as parabolic troughs (top), linear Fresnel lenses (mid), or what is called power towers (bottom).

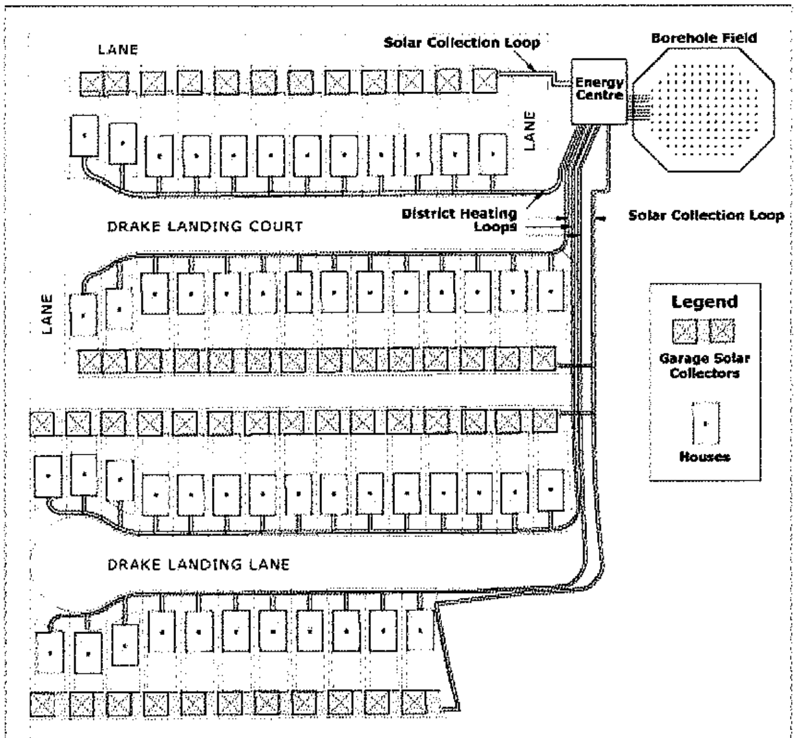


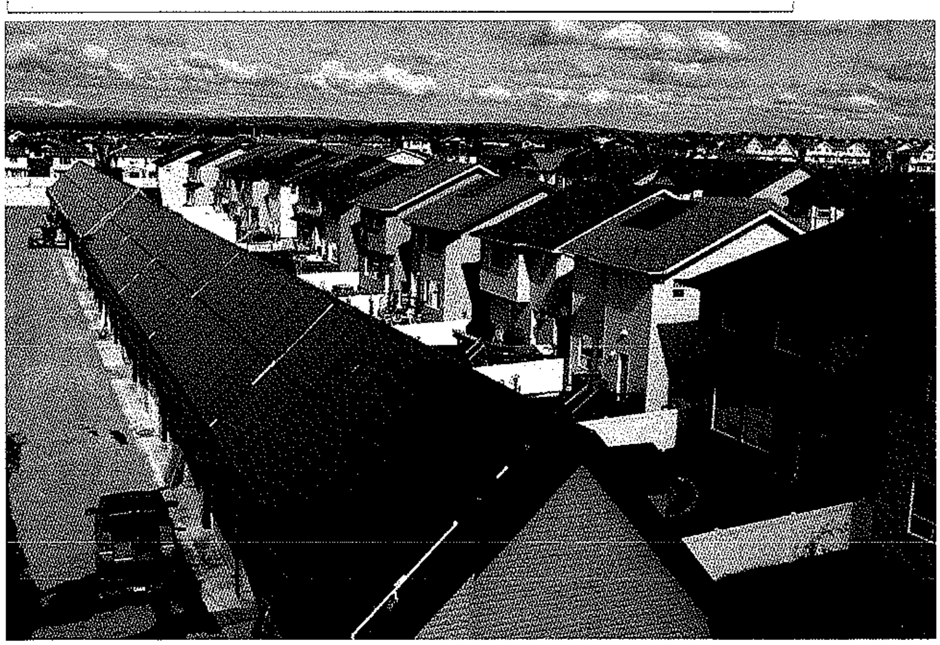




II. STORAGE

a. New concepts in storage include earth storage for long term district heating storage, molten salt for high temperature storage, and phase change materials for increased capacity within the same confined space. The two pictures below show a 52 home development in Canada that uses a district solar heating system to charge the earth to 180F all summer so that the heat can be drawn back out when needed for wintertime heating.





b. Molten salt storage is often used in high temperature storage applications, and only found in conjunction with concentrating solar thermal. Molten salt is able to store extremely high grade heat for dispatchable use on demand around the clock. The picture below shows two large salt storage tanks coupled with a concentrating array.

III. Controls

a. Building automation technology is now found in commercial solar controls giving the ability to have complete remote/automated control of all facets of the system. Residential customers are able to take advantage of variable speed pumps which lower the electrical demand of the system while maximizing energy capture. In addition to process control, these systems are able to accurately and verifiably measure and record the energy that is being transferred into the building system. Gone are the days when a user had to trust that a solar thermal system was indeed saving the owner money, as today's technology allows them to log into their system remotely and see real time performance.

In addition to typical water/space heating, process heating and solar air conditioning are becoming more prevalent applications as the technology continues to evolve. Solar thermal technology is seeing continuous advancements, but as with all renewable technologies, proper incentives will accelerate these developments while building an industry that can compete with subsidized low cost fossil fuels. For more info or questions please contact CoSEIA , www.coseia.org

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