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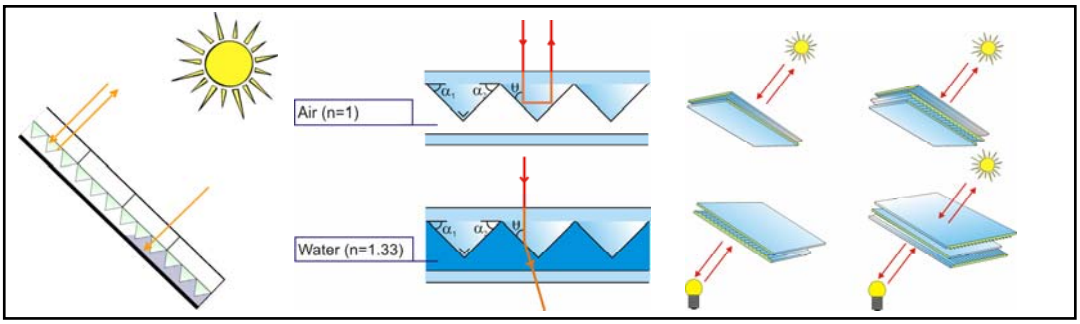
OPPORTUNITY

Market Sector:
Greenhouses, solar collectors, sustainable energy, building materials

Solar switch for greenhouse applications

A cheap but efficient (self- limiting) temperature control system



Summary of invention

A fluid-containing (polycarbonate) greenhouse roof plate with a prismatic optical layer that is transparent under normal operation but totally reflective when the switching fluid is removed from the plate. The temperature and amount of sunlight inside the greenhouse can be regulated by switching the optical transmittance of the roof plate via the fluid. In this way the plants inside the greenhouse can be protected from damage through overheating. When the prismatic structure is used in the opposite direction the roof plate prevents artificial light from escaping from the greenhouse, resulting in less light pollution. The fluid in the optical switch might also be used to cool the roof or to extract heat for thermal energy conversion as in a solar collector device.

Applications

The main application of the switching prismatic layer is in cheap mass produced polycarbonate plates for warm water production. It can be produced by standard extrusion as an integral part of the plates.
The invention can regulate the amount of light entering a greenhouse and can transport the excess heat to a storage system via the switching fluid. The fluid can also be used to cool the roof of the greenhouse. The fluid in combination with the prismatic structure acts as an optical switch and can also be used for the reduction of “light pollution” of greenhouses during the night.

The invention prevents degradation of the (polycarbonate) roof material due to overheating since evaporation of the switching fluid brings the roof plate into a reflected state which lowers the temperature of the roof material; in other words, the temperature of the roof is self-limiting.

KEYWORDS
Solar collector; greenhouses overheat protection; optical switch; temperature limitation; light-pollution

KEY BENEFITS
High solar collector performance

Standard (cheap) plastic can be used since overheating is impossible

Tunable light input in greenhouses

Reduced nightly light-pollution of greenhouses

Standard extrusion can be used for large scale production

PATENT / IP STATUS
Patent application filed, R. Griessen and M. Slaman

PATENT APPLICATION NUMBER
P6017675NL1

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Another important use of the invention is to protect thermal solar collectors from overheating that occurs when the collectors are not used for long periods or when the solar collector is accidentally emptied.

Commercialization

Proof of principle has been demonstrated and several configurations of prismatic structures have been tested. The invention does not need extensive research or development before implementation in applications. The technology should be directly relevant for greenhouse manufacturers, the building material sector and sustainable energy applications. It is available under licence.

Principle of operation

Efficient solar collectors and greenhouses? Suffer from the problem that high stagnation temperatures are reached if too little cooling water is used. Two strategies are used to cope with this problem: high-temperature-resistant materials or dumping excess hot water from cooling. The first option requires expensive materials while the second is environmentally unfriendly. Our invention limits automatically the solar heat input whenever the temperature of the heat transport medium exceeds its boiling point. This is simply achieved by using a transparent prismatic layer in front of the solar heat absorber or greenhouse. Under normal operation this layer is immersed in the heat transport fluid. As the index of refraction of the prismatic structure and the fluid are similar solar light is hardly deflected and can pass through. Above the boiling point of the fluid the prismatic layer is no longer immersed in the liquid and it reflects the incoming solar light. The choice of fluid can easily be adapted to local situations. The great advantage of our invention is that cheap and easily extruded plastic solar collectors can be used. This opens a promising path to mass production. The principle applies equally to solar collector or greenhouse applications.

Remarks

Higher oil and gas prices are fuelling demand for solar heating systems even more than for photovoltaics. Heavy energy dependence is influencing governments to support solar thermal applications. Market developments are highly promising. The heat generation costs of solar thermal plants are competitive with oil and gas heating systems. However, commercially available solar collectors are more expensive to buy than conventional heating systems. Our safe plastic solar collector system reduces the price of solar heating considerably, and the use of the same prismatic structures in greenhouses roofs improves their energy efficiency significantly.

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