Spiky **C**entral **R**eceiver **A**ir **P**re-heater (SCRAP)

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Introduction

In a concentrating solar power (CSP) plant, solar radiation is directed onto a central receiver or heat exchanger by means of a field of mirrors or heliostats. A novel heat exchanger concept is proposed in which heat from concentrated solar radiation is effectively transferred to an air stream at a high temperature.

The proposed concept may be integrated into a Brayton cycle, where pressurized air leaving the compressor flows through the heat exchanger to be heated, before entering the turbine.

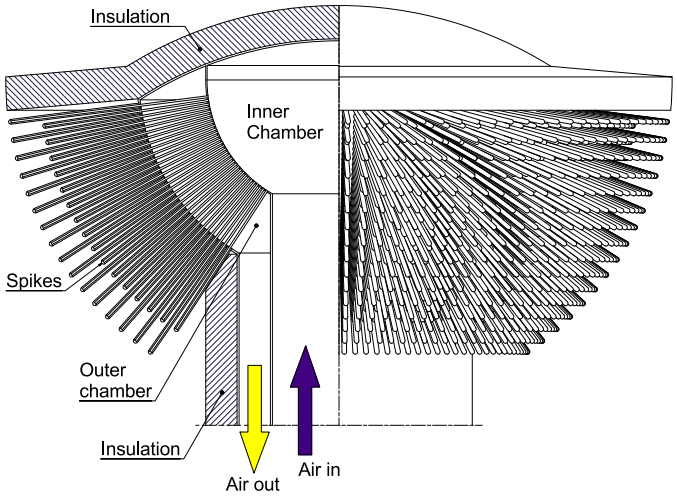

Figure 1: Concentric spherical surface chamber spiky air pre-heater (left half in section)

An example of such a heat exchanger is shown in figure 1. It may consist of two concentric spherical surfaces forming chambers (inner and outer) or headers that are connected via radial concentric tube assemblies or spikes emanating from these surfaces. Air entering the inner chamber flows radially outwards inside a multitude of tubes before it is re-directed through 180° to flow to the outer chamber via rectangular passages that are formed by internally finned outer tubes as shown in figure 2. The inner tubes are free to move inside outer tubes thus minimizing thermal stresses.

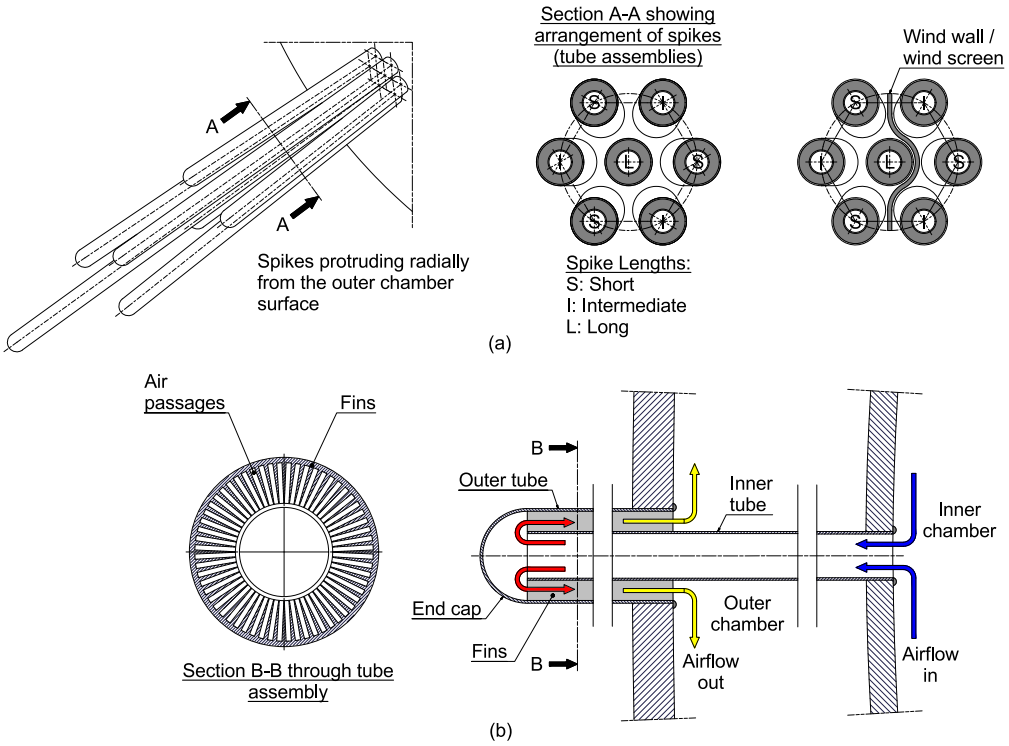

Figure 2: SCRAP tube assembly (spike) details: (a) tube arrangement, (b) tube geometry

Spikes may have different lengths to achieve a surface or body that absorbs radiation most effectively. Furthermore, tube diameters, fin heights of 5 mm to 20 mm and passage dimensions will be different for each tube length in order to ensure an optimum air flow rate through individual tubes, resulting in a heat exchanger that has a maximum effectiveness. Tube materials must be strong enough to withstand high pressures and temperatures and should have a relatively high thermal conductivity. In certain applications the flow direction in the tubes may be reversed and the internal tubes may also be finned or have spiral tape inserts. Heat transfer fluids other than air may be considered.

This central receiver concept can absorb radiation from a 360° heliostat field.

To reduce the negative effect of winds on the heat exchanger, vertical wind screens or wind walls can be inserted between spikes (see figure 2) at different circumferential locations.

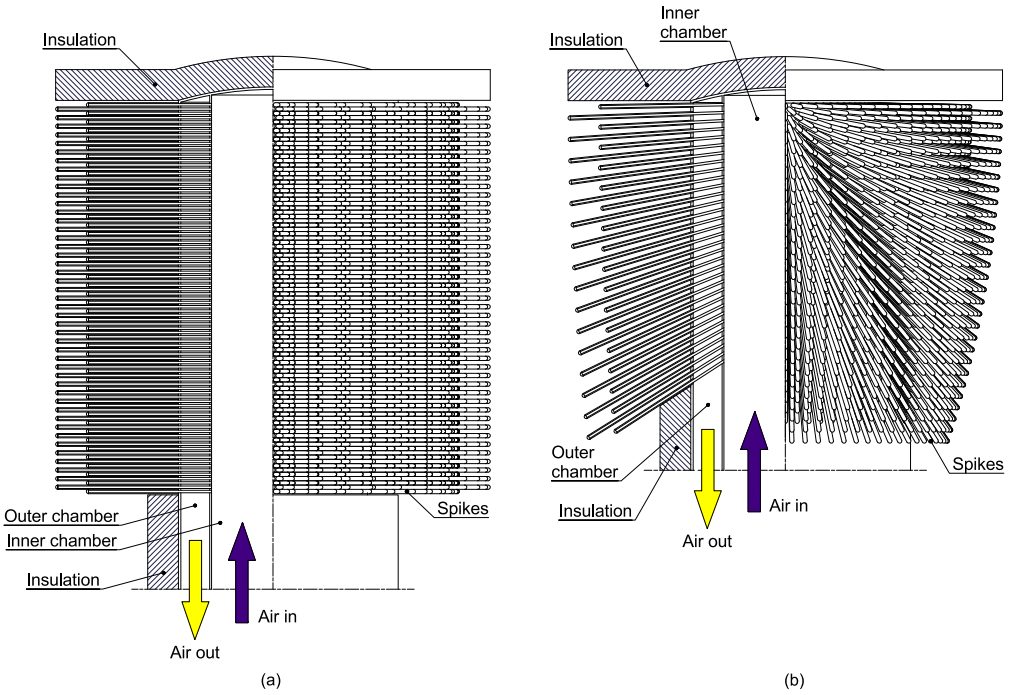

Figure 3: Concentric cylindrical surface spiky air pre-heater (left half in section): (a) radial spikes, (b) inclined spikes

For larger central receiver power plants, concentric cylindrical configurations with radial or inclined radial tube arrangements as shown respectively in figure 3(a) and figure 3(b) are more appropriate.

Claims (novelty)

A novel central receiver heat exchanger concept is proposed. The heat exchanger consists of concentric spherical or cylindrical surfaces that form chambers or headers connected by a multitude of radial concentric tube assemblies of different lengths to form a body that absorbs solar radiation most effectively while heating an air stream flowing inside the tubes. The inside tubes are free to move in the internally finned outer tubes, thereby minimizing thermal stresses.