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Letters

A new low-cost tracking ridge concentrator

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Abstract

A new tracking ridge concentrator uses proven tracker hardware. Unlike V-trough concentrators no additional mirror supporting structures are needed. It could double solar energy gain of PV panels in comparison with fixed ones.

Keywords: Solar tracker; Photvoltaics; Tracking concentrator; Mirrors

A new tracking soft ($C = 1.6$–1.7) concentrator (Fig. 1) which can double PV energy harvest (in comparison with fixed panels) and substantially reduce price of PV energy is presented.

The new system combines simple low-cost tracker [1] with flat booster mirrors but unlike V-trough concentrator [2,3] by the new ridge concentrator the "outer" mirror has been eliminated (Figs. 1 and 2). On single axis trackers, both horizontal and polar, the mirrors have to be extended beyond PV panels to ensure uniform illumination of panels at seasonaly variable elevation of the sun. A triangular extension of the mirror is shown in Fig. 3. On polar axis trackers with seasonaly adjustable slope [1] of the axle the extended mirror is not needed (Fig. 2).

It is advantageous that soft concentrators for photovoltaics do not need highly specular expensive mirrors. Weather resistant (at least 10 yr) mirrors with high total reflectance are needed.

The mirror can be made of

(a) rolled stainless-steel sheet with special surface finish [4],

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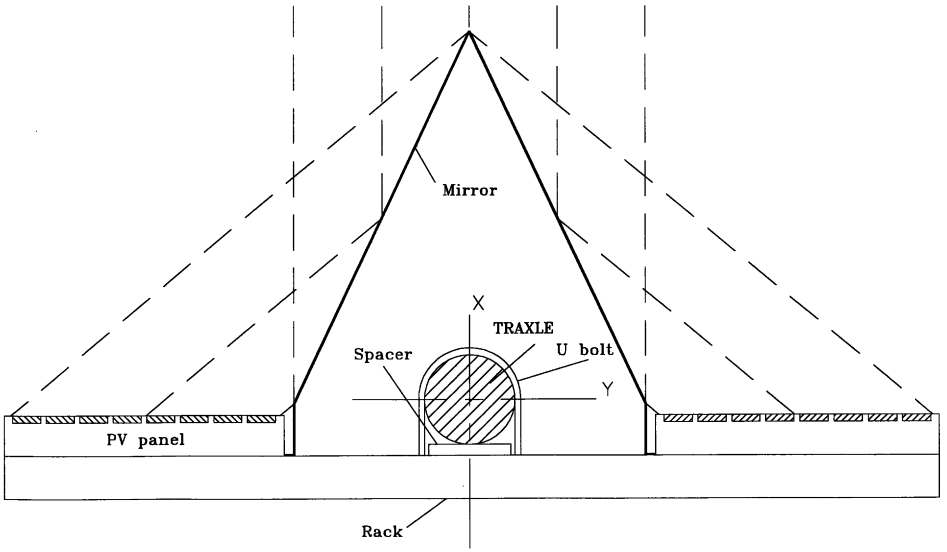

Fig. 1. Scheme of crossection of the tracking ridge concentrator.

(b) rolled aluminium alloy sheet (plated with pure aluminium) protected by a weather resistant polymer (PVF) film [4,5],
(c) silver coated polymer (acrylic) film [6] or sheet,
(d) aluminium coated polymer (acrylic) film [4] or sheet, and
(e) silver coated hardened glass

Choice (b) could be the best trade off between reflectance and price. Instead PVF lacquer [4] the aluminium mirror of the ridge concentrator is protected by adhesive laminated transparent PVF film. Manufacturing of one self-supporting "bended" sheet mirror is very simple.

The new tracking soft concentrator is very compact and simple (reliability). Proven existing tracker hardware is used. Unlike V-trough concentrators no additional mirror supporting structures are needed and wind induced torque is strongly reduced.

The ridge concentrator is easily scalable. The standard version of the tracking ridge concentrator can accomodate from two small PV panels (50 Wp) up to 10 PV panels with 120 Wp output power (in arid climate eqvivalent to 20×120 Wp PV panel fixed system). Application of the ridge concentrator on different tracking systems is also very easy. It can be used on polar or horizontal single axis trackers, two axis trackers as well as on 360° trackers for space and terrestrial applications [7].

Concentration ratio 1.6–1.7 reduces the temperature of PV panels (higher efficiency) and avoids degradation of the encapsulant. The new design also improves (against V-trough) air flow around PV panels (improved cooling).

Concentration ratio 2–2.4 of standard V-trough concentrators frequently caused browning of the EVA encapsulant while elevated temperature reduces the efficiency of PV panels.

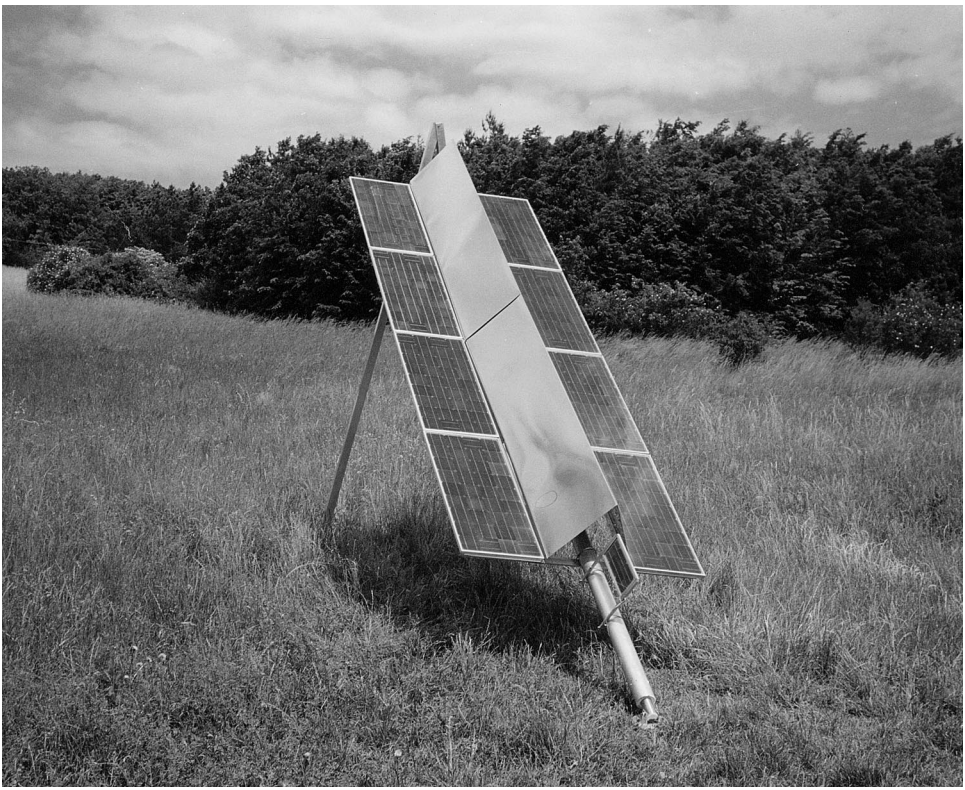

Fig. 2. Photograph of the polar axis tracking ridge concentrator with 8×55 Wp PV panels.

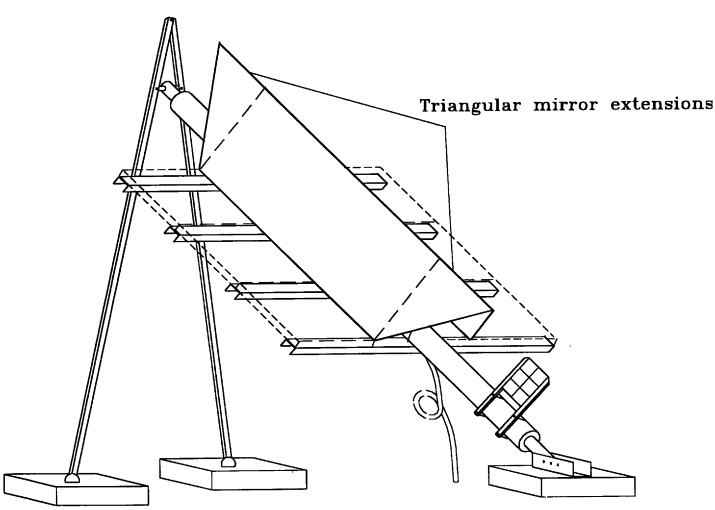

Fig. 3. Scheme of triangular extension of the ridge concentrator mirror.

The new tracking ridge concentrator can double the annual energy harvest (100% energy surplus in arid climates like e.g. northern Africa, Arabia, Arizona or western Australia, 70% in central Europe) in comparison with fixed panels and pumping capacity, the surplus can be as high as 150% [2].

One year comparison of energy production between fixed tilt PV panels and PV panels mounted on polar axis tracking ridge concentrator was started in May 1999 (Prague region, 50° N). The very first results show that e.g. on a clear (6.8 kW h/m^2) day in June 99 an energy surplus of 107% was observed.

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