IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

Passive Cooling based Secondary Concentrator for Solar Concentrating Photovoltaic (cpv) System for Uniform Flux Distribution and Effective Cooling

IITM Technology Available for Licensing

PROBLEM STATEMENT

- **Photovoltaic cells** convert solar energy to electrical energy.
- Efficiency increases with increased solar energy input.
- **Cell temperature** rises during conversion, reducing performance.
- **Accurate concentrator** and effective thermal management system are needed for higher efficiencies.
- **Novel passive cooling** based secondary **three-dimensional compound parabolic collector (CPC)** reflector proposed for cost-effective solar power generation.

TECHNOLOGY CATEGORY/ MARKET

Technology: Cooling for Solar CPV System
Category: Energy, Energy Storage & Renewable Energy
Industry: Solar Industry
Application: Solar concentrating photovoltaic power system
Market: The global market size was worth around **USD 234.57 billion in 2023** and is predicted to grow around **USD 425.39 billion by 2032** with a compound annual growth rate **(CAGR) of roughly 6.84% between 2024 and 2032**

INTELLECTUAL PROPERTY

IITM IDF Ref. 980
Patent No: IN 353190

TRL (Technology Readiness Level)

TRL- 3, Experimental Proof of Concept

Research Lab

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TECHNOLOGY

1. •A **solar concentrating photovoltaic** (CPV) system comprising of :
2. •A **111-V triple-junction CPV**,
3. •A **primary concentrator** comprising of Fresnal lens,
4. •A **passive cooling** means comprising of secondary concentrator comprising of a compound parabolic collector,
5. •A **concentrator optic** means comprising of an optical homogenizer and
6. •A plurality **reflector** means comprising of fins associated with secondary concentrator and optic means wherein the said system is characterized
7. •In the **secondary concentrator** being a non-imaging concentrator with **fins reflecting the solar light that does not focus** directly onto the solar cell enhancing the absorption of solar light refracted by **Fresnal lens**,
8. •In the **optical homogenizer** having a **high reflective surface with fins** ensuring uniform distribution of solar irradiance at the surface of solar cell and
9. •In the **fins more specifically adapted to dissipate the heat** generated by non absorbed photons for maintaining the cell temperature.

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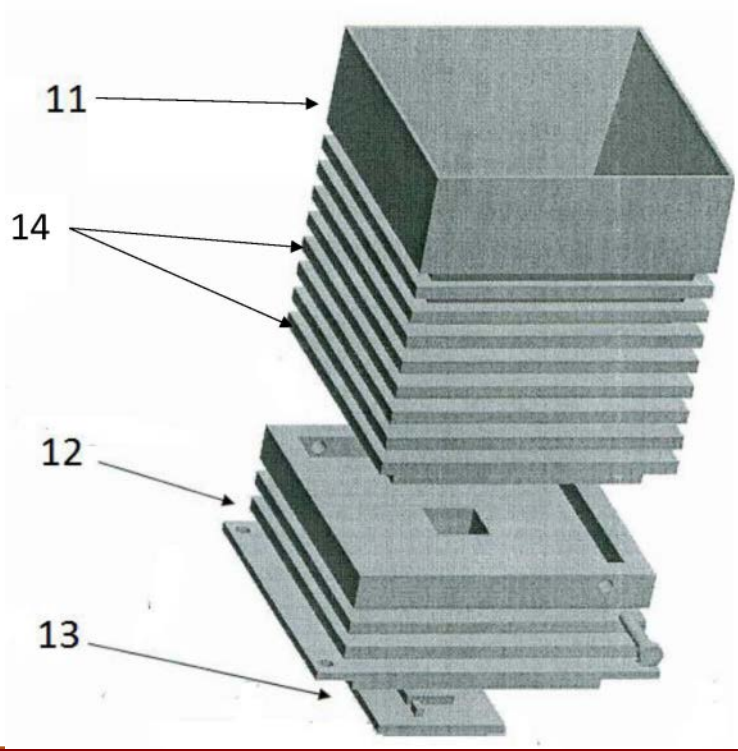
Fig.1illustrates the arrangement of Fresnal lens based solar CPVsystem



Numerals	Definition
11	CPC
12	Homogenizer
13	Solar/ CPV cell
14	Fins

Key Features / Value Proposition

- **CPV Systems Classification**
  - **Active**: Manages thermal energy.
  - **Passive**: Reflects thermal energy.
- **Fresnel Lens-Based CPV System**
  - **Compact**, cost-effective.
  - **Primary** concentrator: **Fresnel lens**.
  - **Secondary** concentrator: **Compound parabolic collector.**
  - Optical homogenizer.
  - **111-V triple-junction CPV cell**.
- **Secondary Reflector and Optical Homogenizer in Solar Cell**
  - **Prevents overheating** and lens deformation.
  - Ensures uniform solar irradiance distribution.
  - **Uses fins for passive cooling** and temperature maintenance.
  - **Allows larger cell** area behind
- **Solar Cell Concentration**
  - Uses **concentration optics** for small-sized solar cells.
  - Employs large, inexpensive plastic Fresnel lens.
- **Solar Irradiance Measurement**
  - **Chromatographic** aberration reduces average irradiance.
  - Secondary optics needed.
  - Optical homogenizer enhances uniformity.
- **Heat Sink and Fins in CPC**
  - Dissipates heat from non-absorbed photons.
  - Provides fins around CPC and homogenizer.
- **CPV Cell Efficiency**
  - **Higher concentration** ratios.
  - Uniform irradiation for reliability.
  - **Less parasitic power** due to passive cooling.
  - Efficient with minimal internal power consumption.
- **System Overview**
  - **Simple, low-cost**
  - **Standalone, modular**

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