Extraterrestrial solar radiation

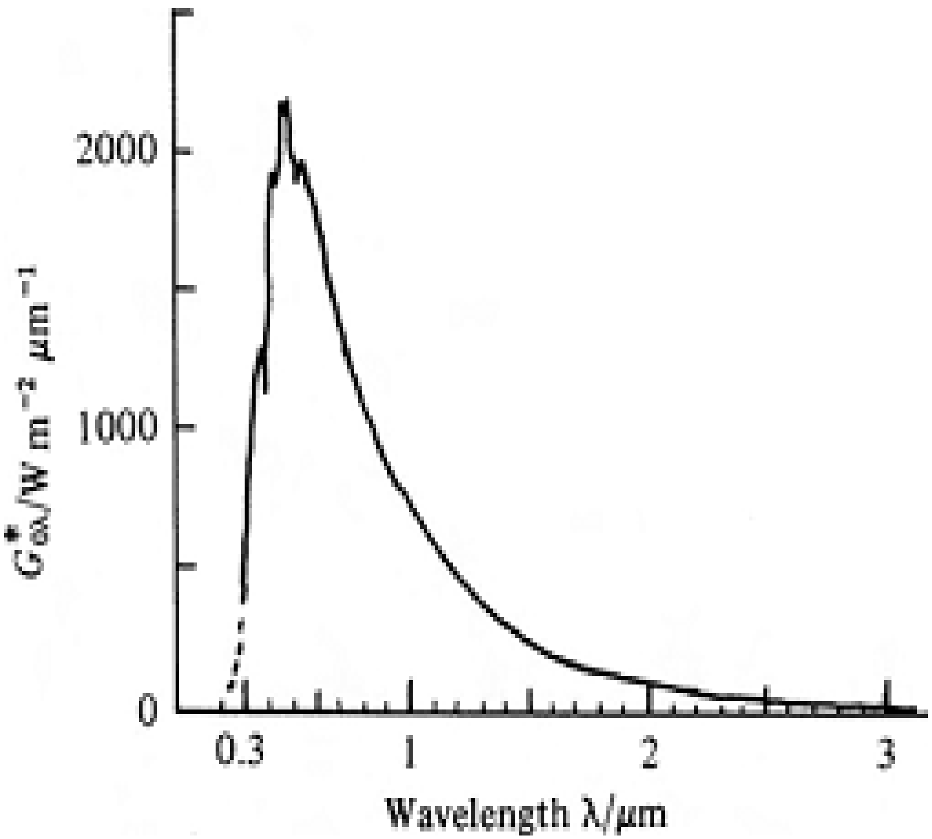

Figure 4.1 Spectral distribution of extraterrestrial solar irradiance, $G^*_{0\lambda}$. Area under curve equals $1367 \pm 2\,W\,m^{-2}$ (data source: Gueymard 2004).

The solar spectrum can be divided into three main regions:

1	Ultraviolet region ($\lambda < 0.4\,\mu m$)	~5% of the irradiance
2	Visible region ($0.4\,\mu m < \lambda < 0.7\,\mu m$)	~43% of the irradiance
3	Infrared region ($\lambda > 0.7\,\mu m$)	~52% of the irradiance.

SOLAR THERMAL ELECTRIC CONVERSION

There are three different types of Thermal electric Conversion Systems:

1. Low temperature systems
2. Medium temperature systems
3. High temperature systems

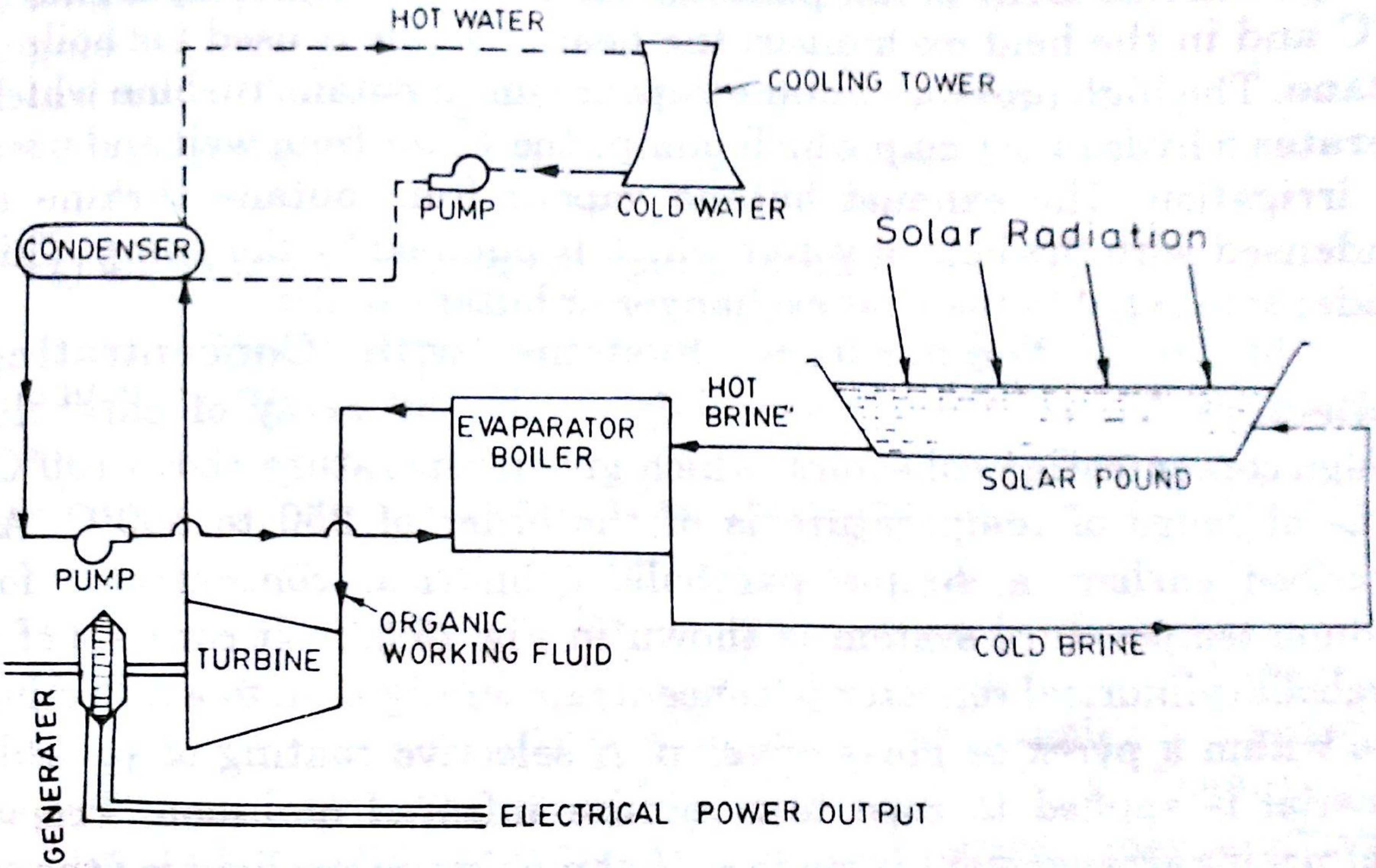

Fig: 5.5.1. Flow diagram of solar pond electric power plant.

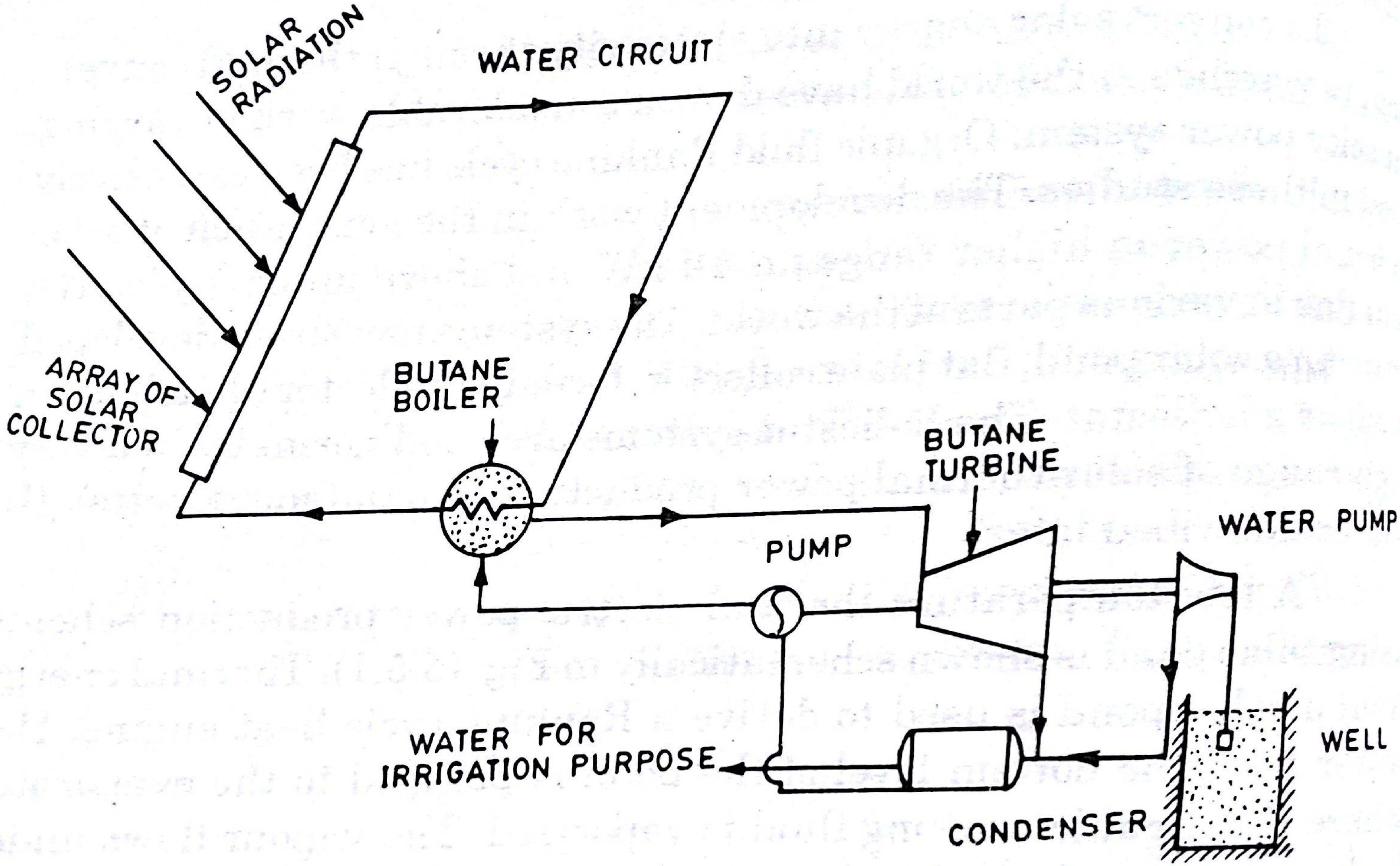

Fig. 5.5.2. Schematic of a low temperature solar power plant.

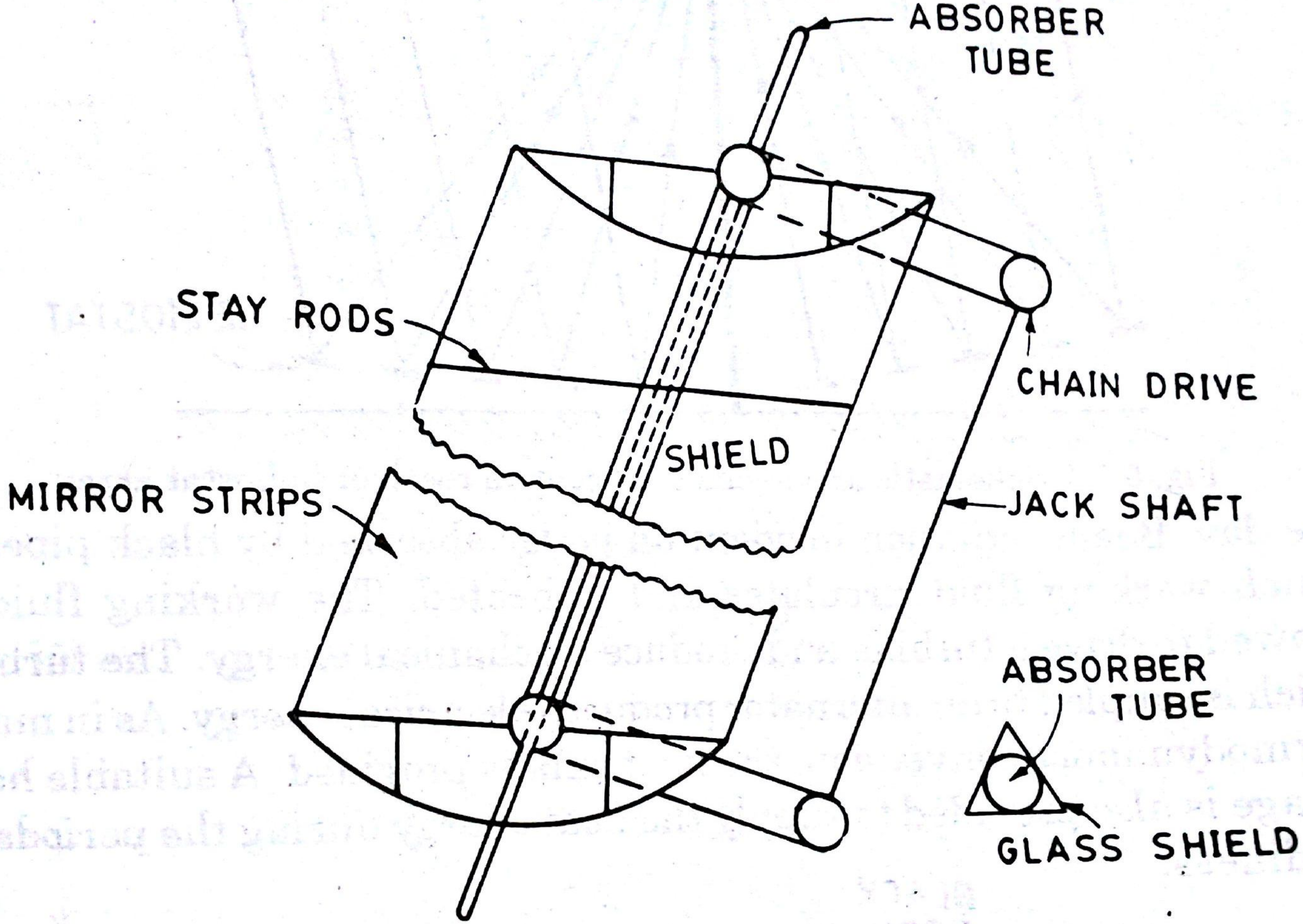

Fig. 5.5.3. A typical parabolic cylindrical concentrator.

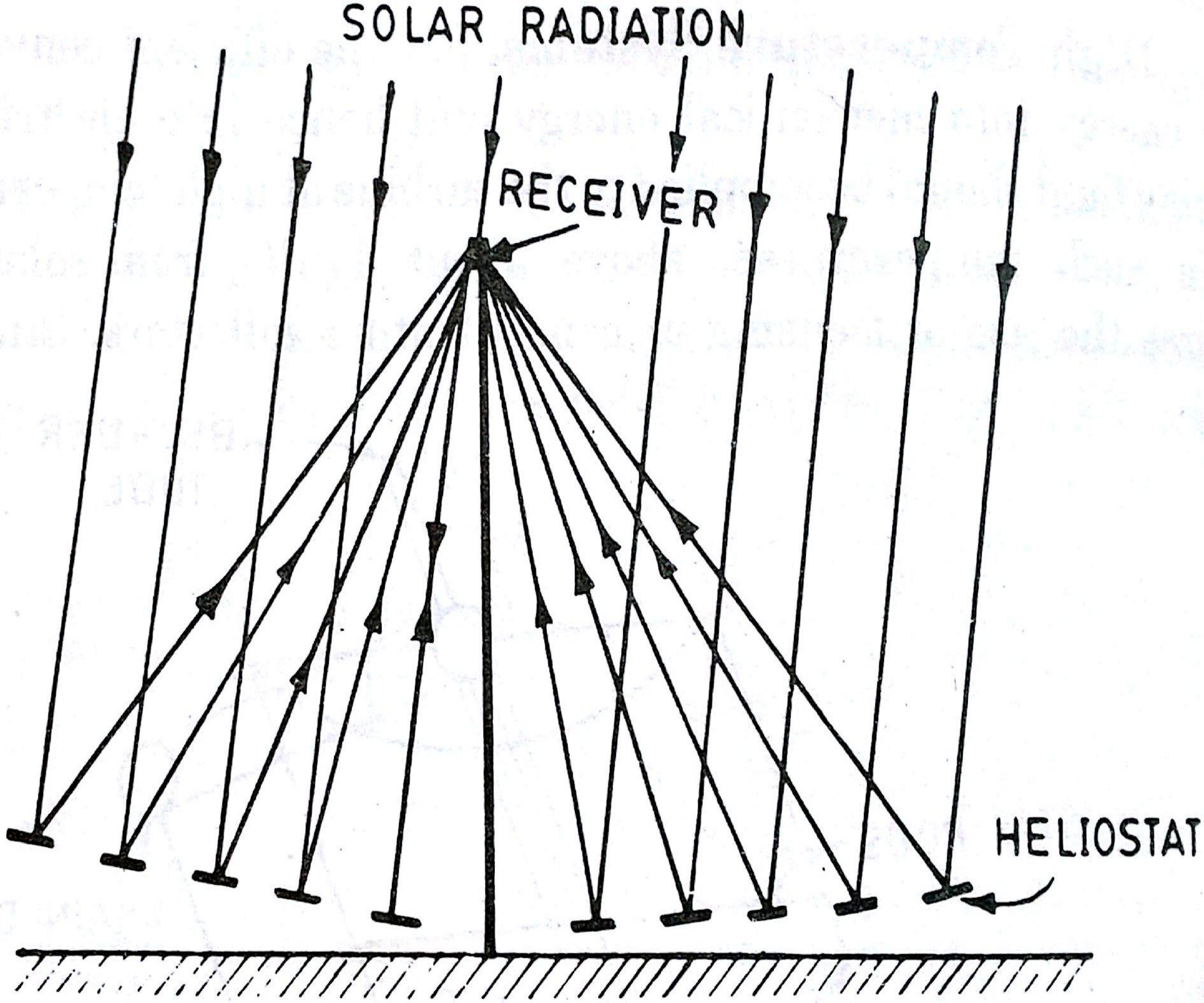

Fig. 5.5.4. Schematic arrangement of central receiver heliostat array.

cloudiness.

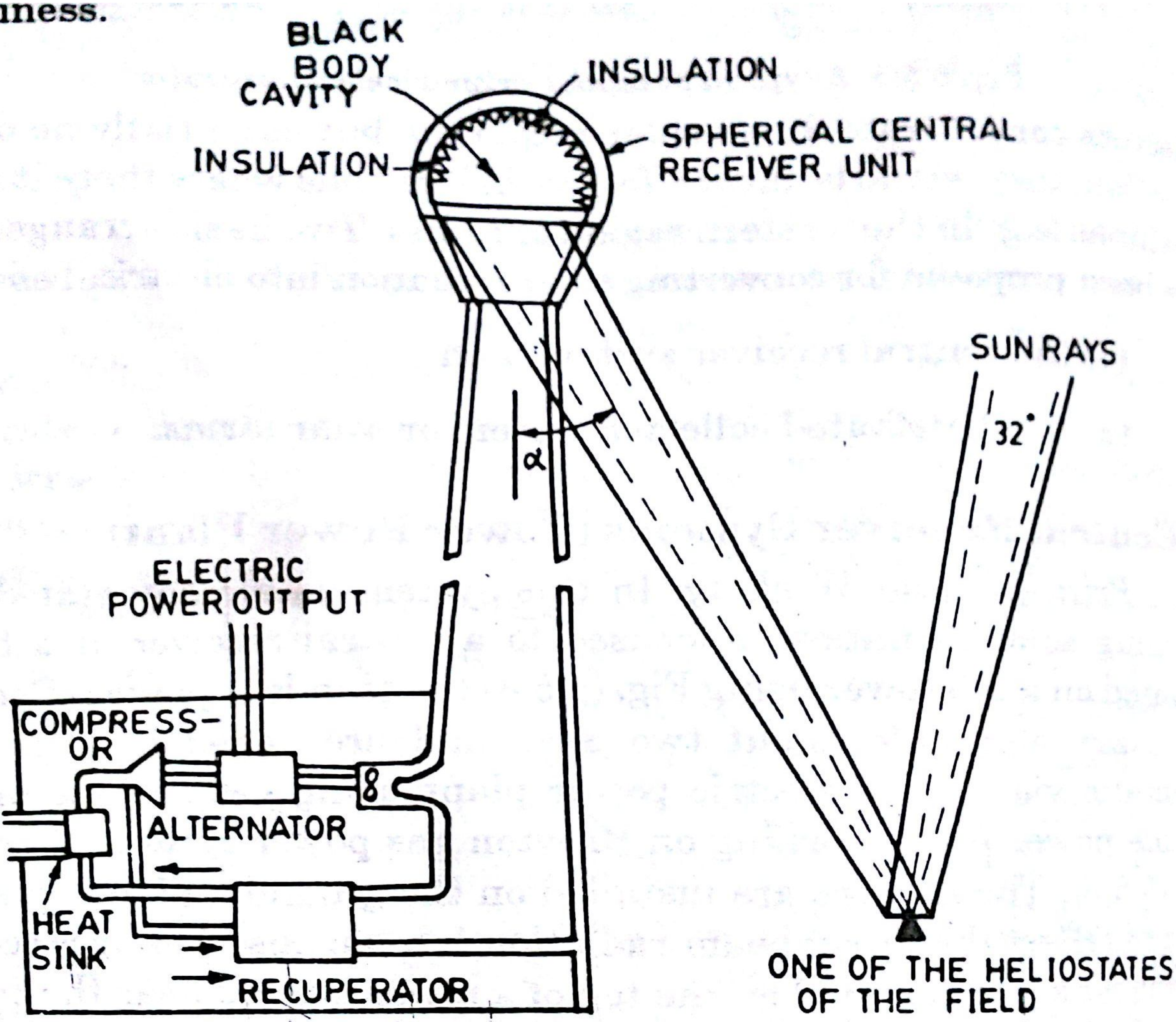

Fig. 5.5.5. Schematic of a Central Tower receiver associated with a field of flat mirrors and a gas turbine.

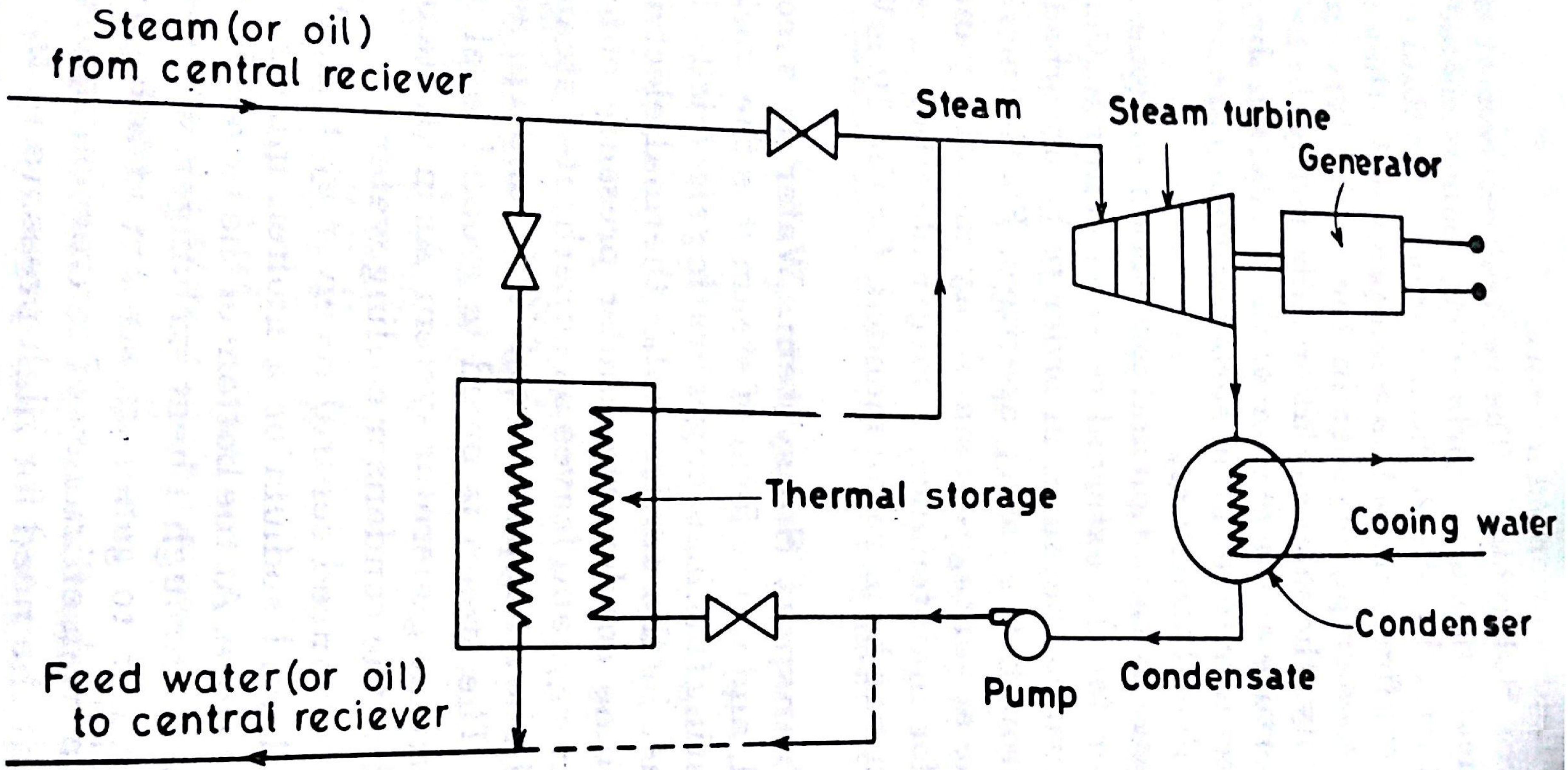

Fig. 5.5.6. Electric power generation using thermal storage.

Solar photo voltaic energy conversion

- The photo voltaic effect can be observed in nature in a variety of materials, but the materials that have shown best performance in sunlight are the semi-conductor materials.
- To obtain useful output from photon interaction in a semi-conductor, three processes are required:

1. The photons have to absorbed in the active part of the material and result in electrons being excited to higher energy potential
2. The electron-hole charge carrier created by the absorption must be physically separated and moved to the edge of the cell.

3. The charge carriers must be removed from the cell and delivered to a useful Load before they loose their extra potential.

- The above three processes can be completed by a SOLAR CELL.

- Energy conversion devices which are used to convert sunlight to electricity by the use of the photovoltaic effects are called **SOLAR CELLS** or **PHOTOVOLTAIC CELLS**

- The combination of such cells designed to increase the electric power output is called a **SOLAR MODULE** or **SOLAR ARRAY**

Solar Cell consists of:

(a) Semi-conductor in which electron hole pairs recreated by absorption of incident solar radiation
(b) Region containing a drift field for charge separation
(c) Charge collecting front and back electrodes.

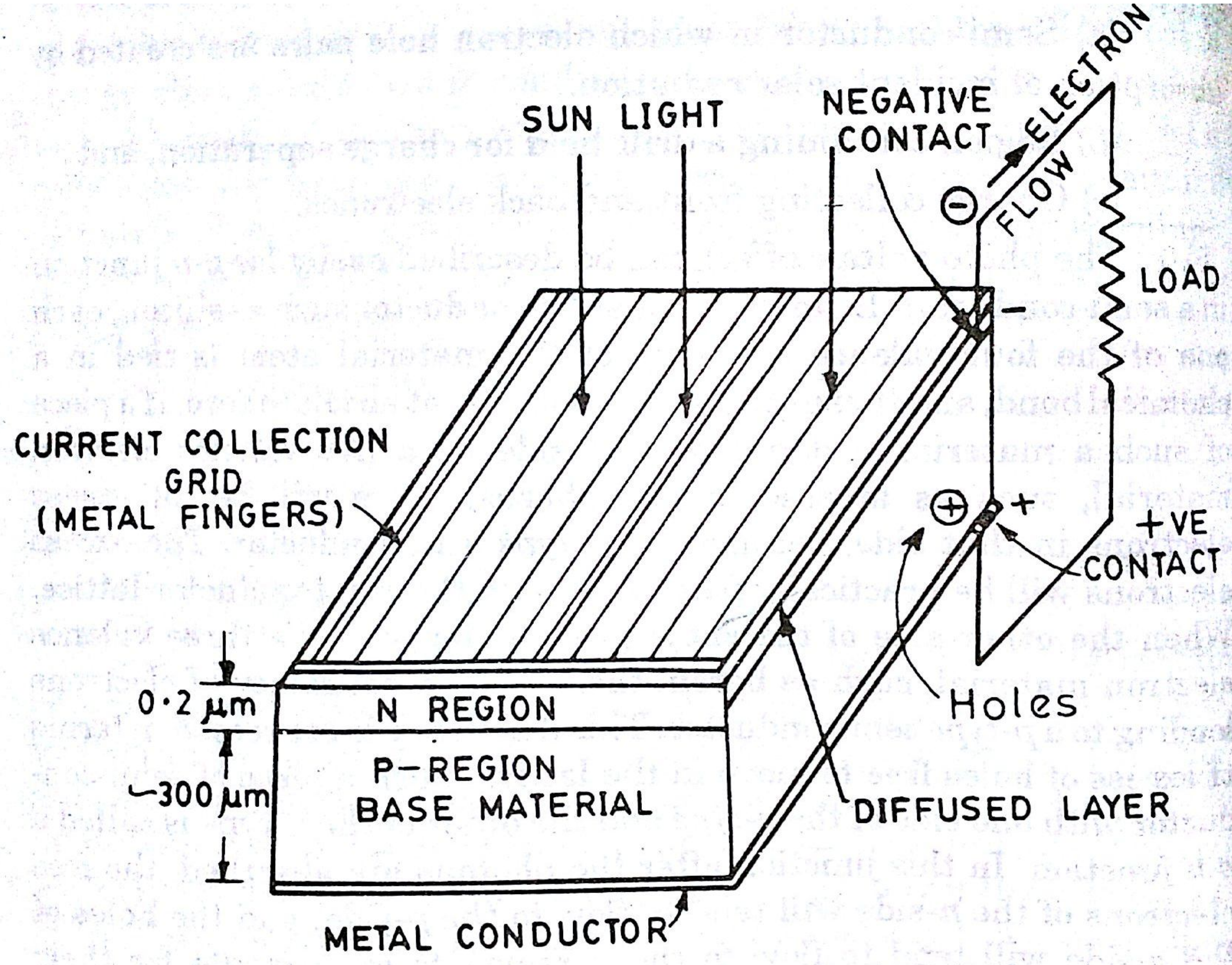

Fig. 5.6.1. Schematic view of a typical solar cell.

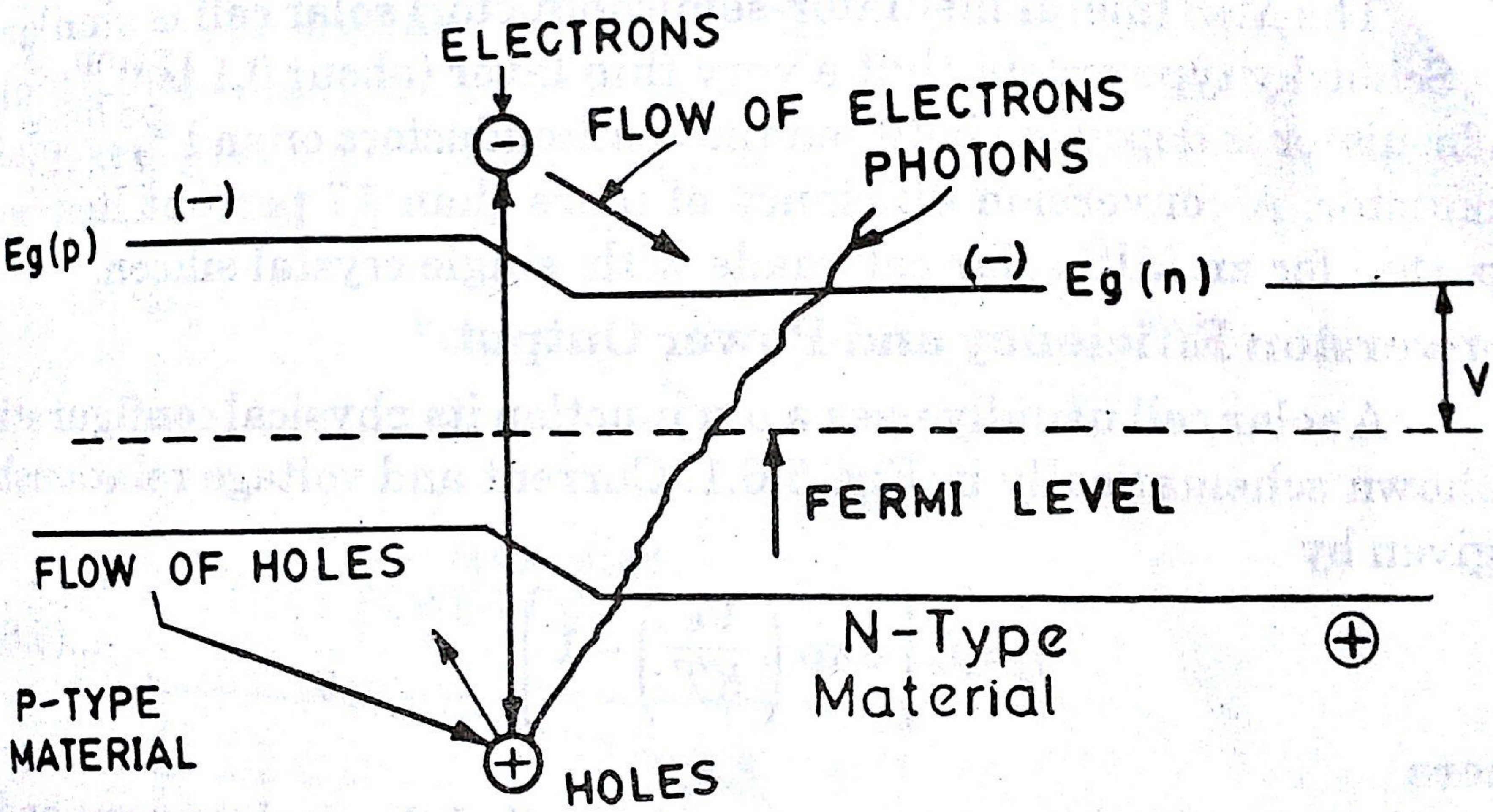

Fig. 5.6.2. *p-n* junction electric fields.

A PV(Photo Voltaic) system consists of:

1. Solar cell array
2. Load leveler
3. Storage system
4. Tracking system(where necessary)

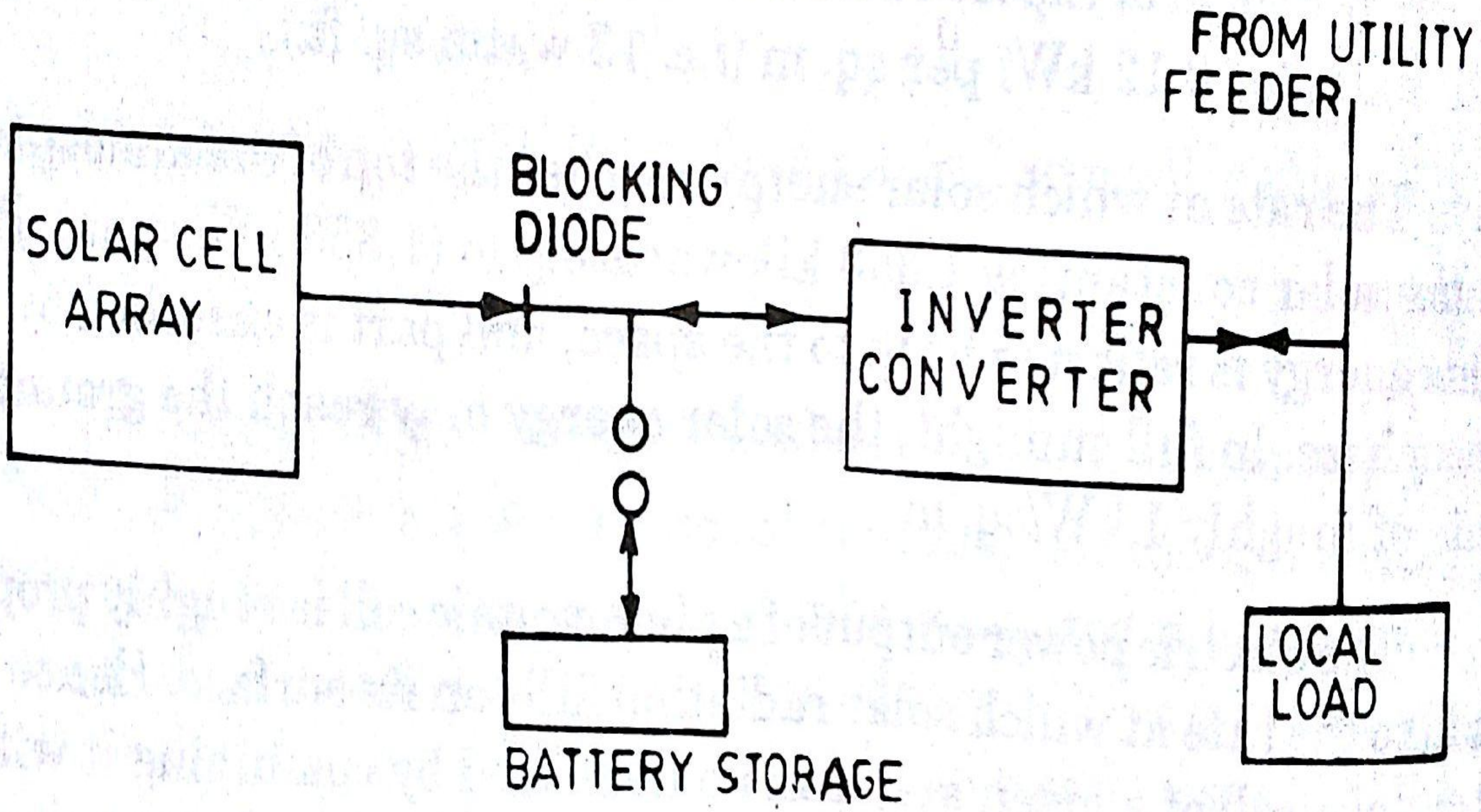

Fig. 5.6.5. Basic photovoltaic system integrated with power grid.

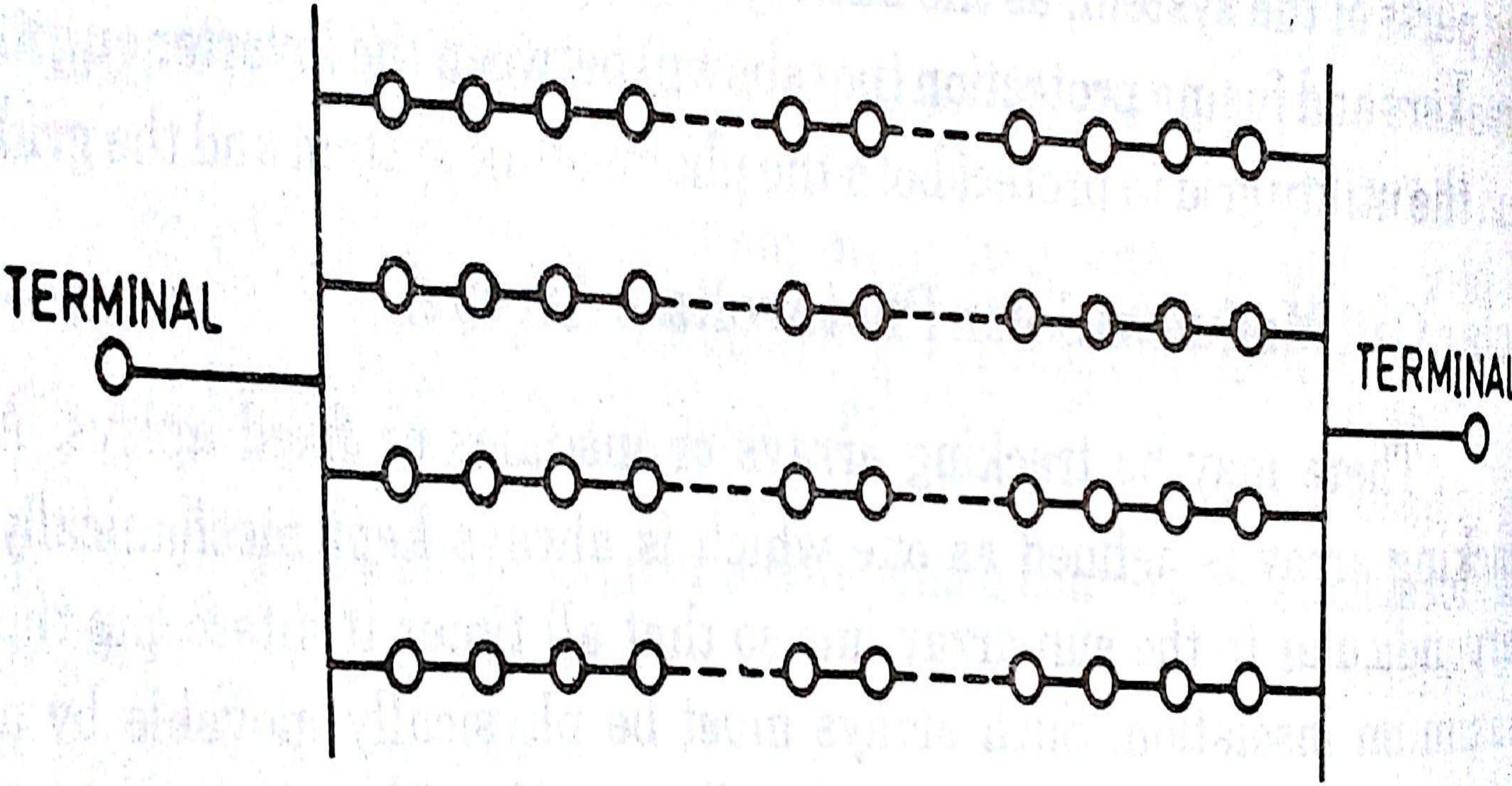

Fig. 5.6.6. Solar cell arrangements in series and parallel.

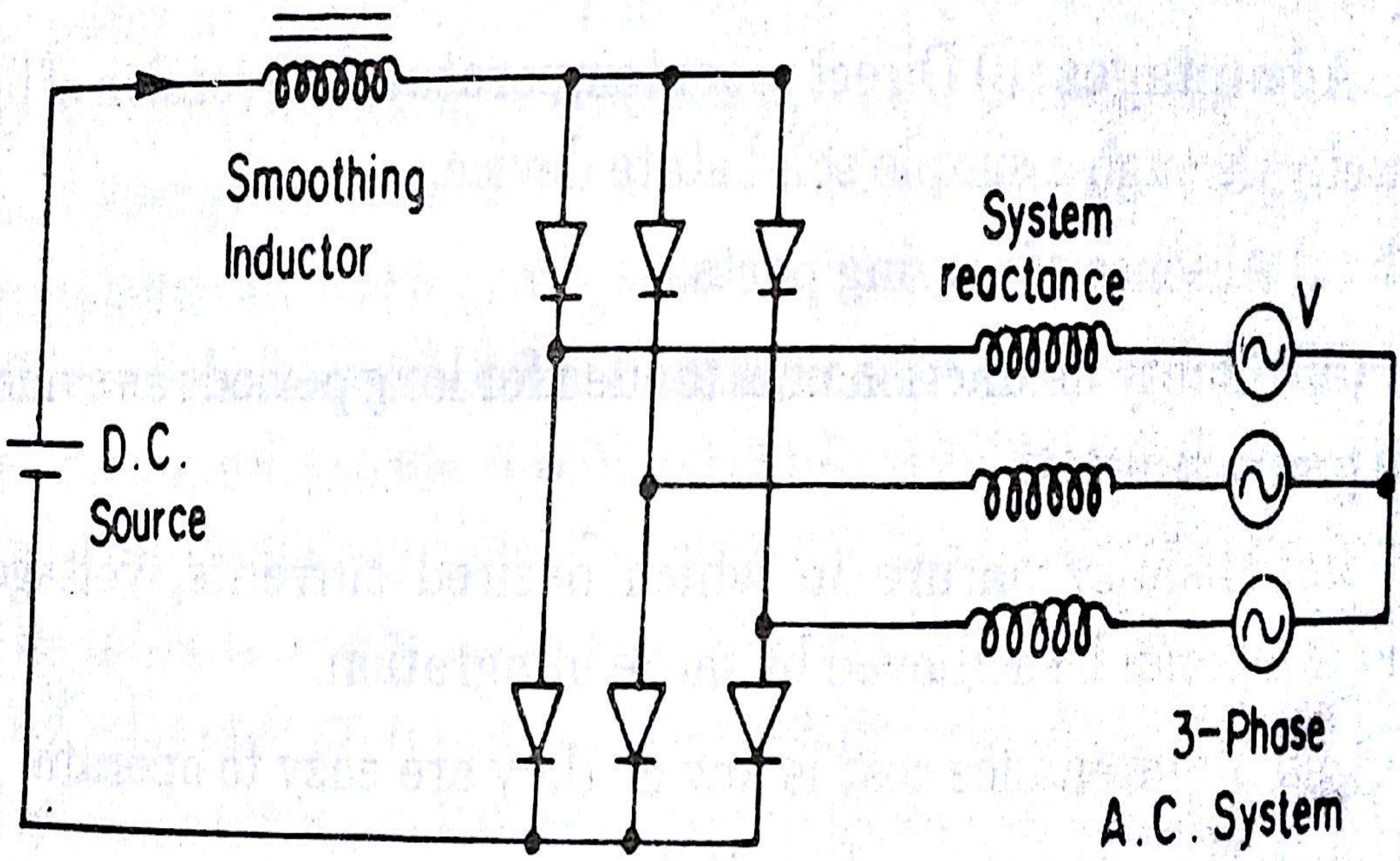

Fig. 5.6.7. Current-fed line commutated inverters.