SOLAR COLLECTORS

Stationary collectors

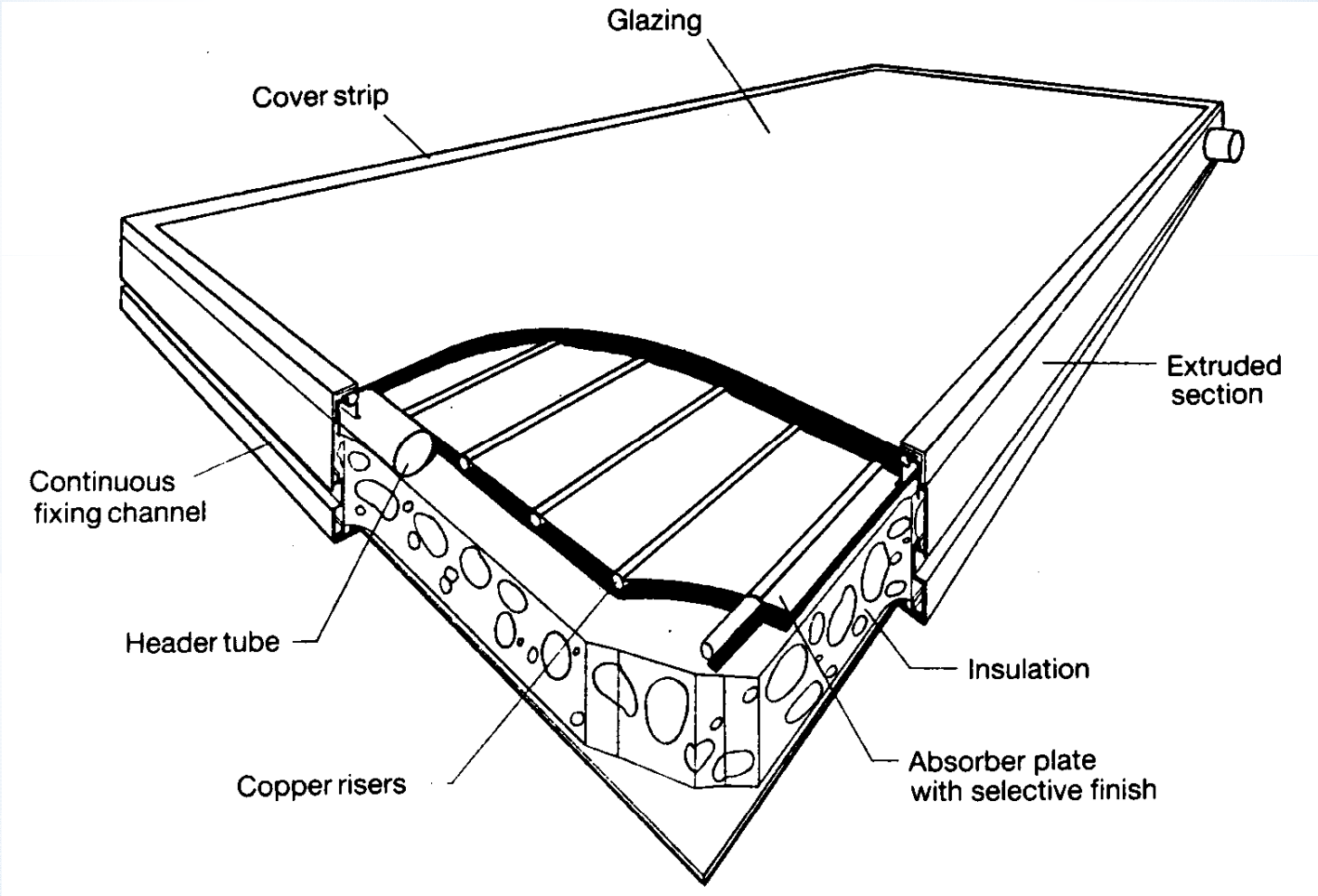
Flat-plate collector

No concentration

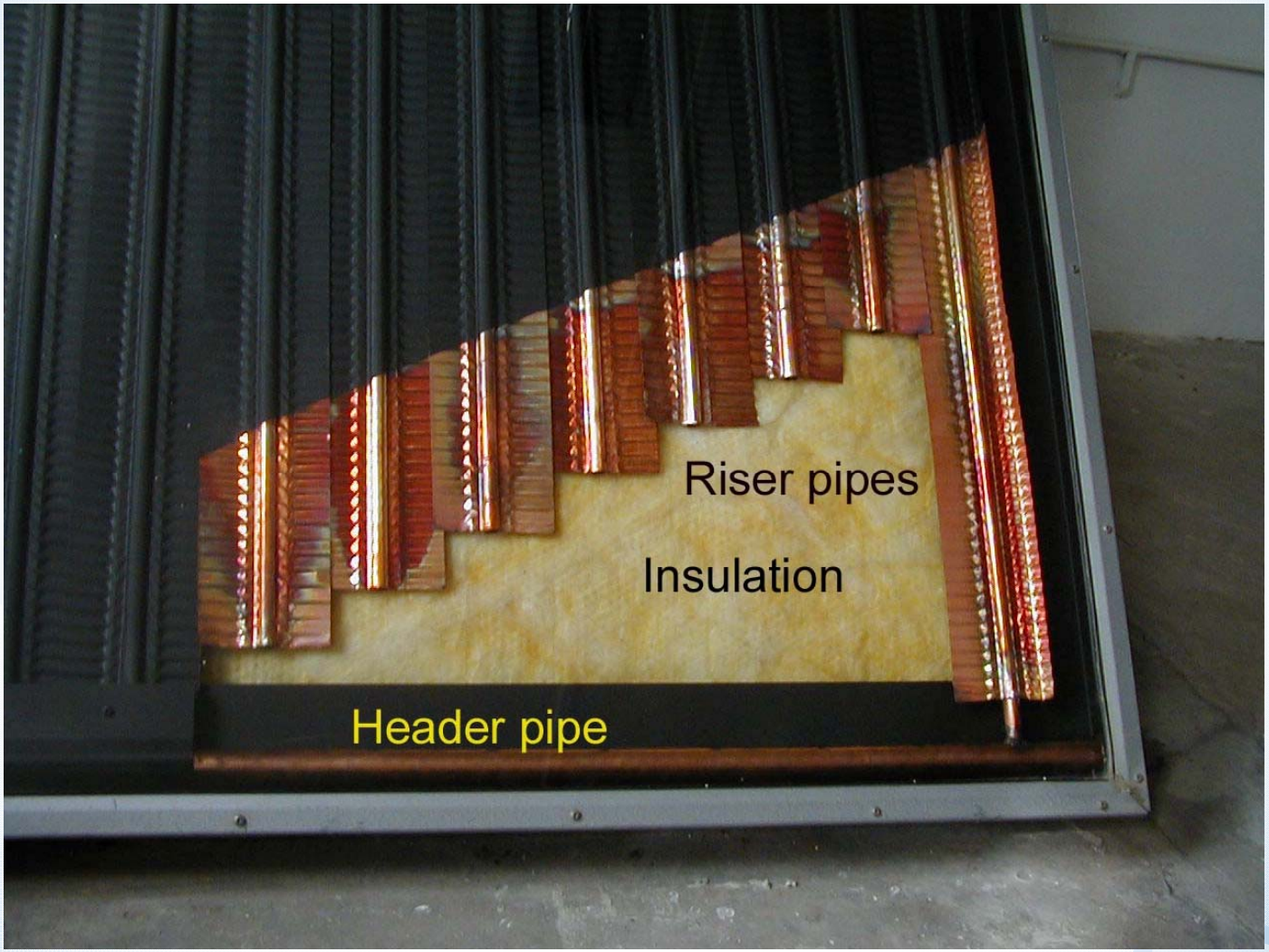
Flat Plate collector

The Flat Plate Collector is basically a heat exchanger which transfers the radiant energy of the incident sunlight to the sensible heat of a working fluid-liquid or air.

Flat-plate collector

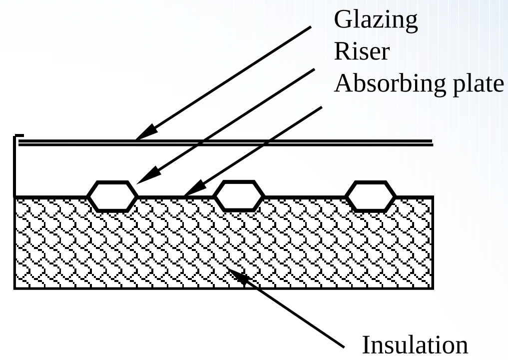


Flat-plate collector

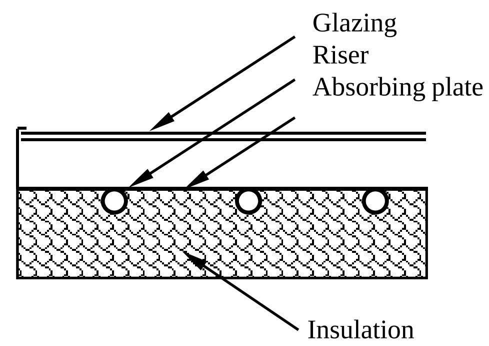


Types of flat-plate collectors Water systems

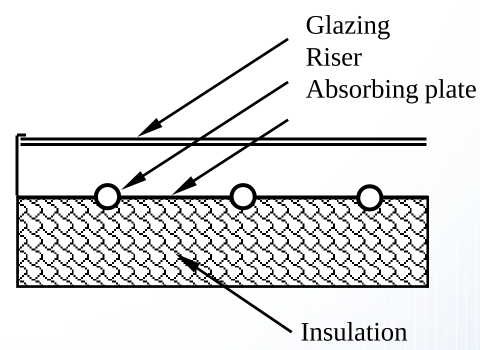
A

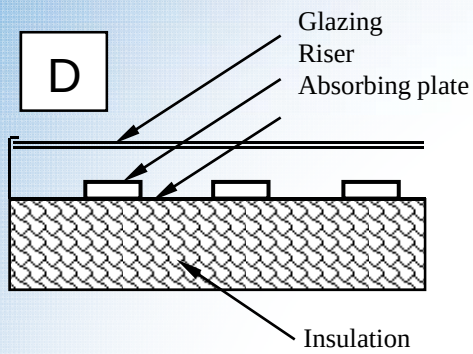


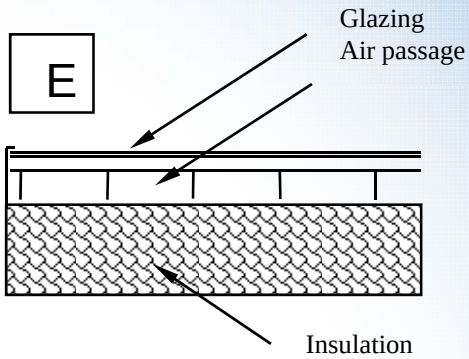
B

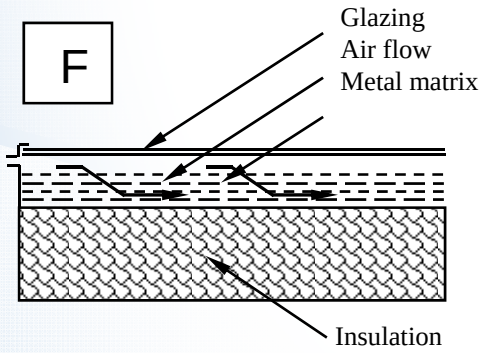


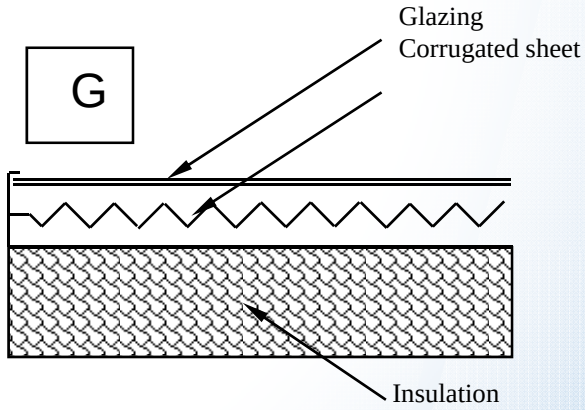
C



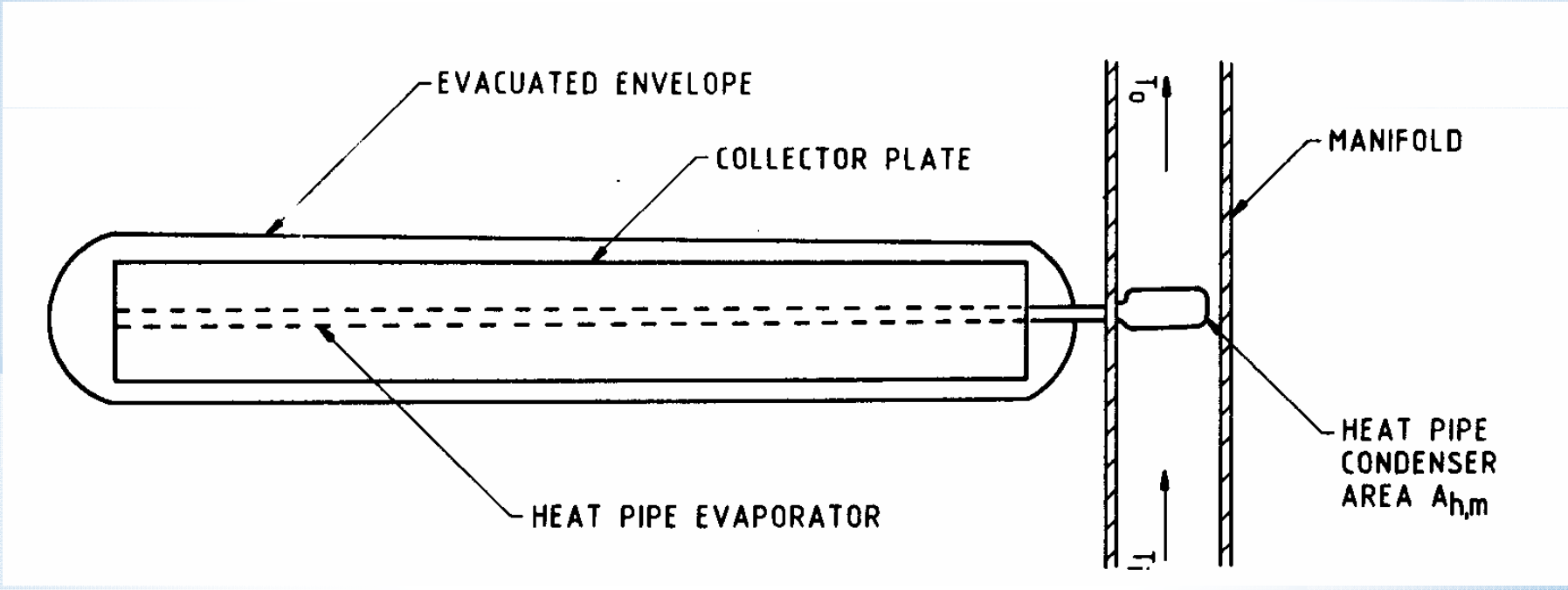

D
Glazing
Riser
Absorbing plate
Insulation


E
Glazing
Air passage
Insulation

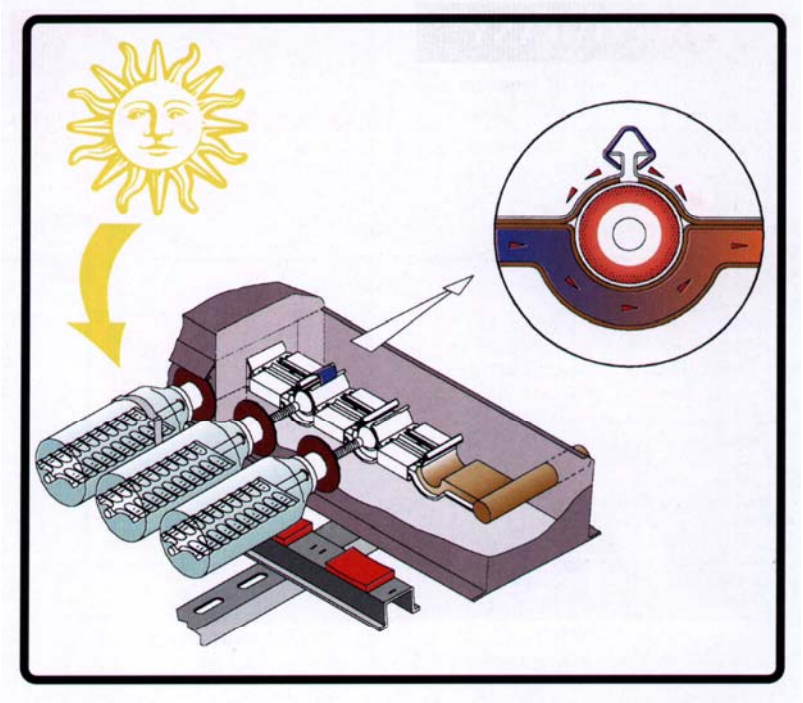

F
Glazing
Air flow
Metal matrix
Insulation


G
Glazing
Corrugated sheet
Insulation

Schematic diagram of an evacuated tube collector



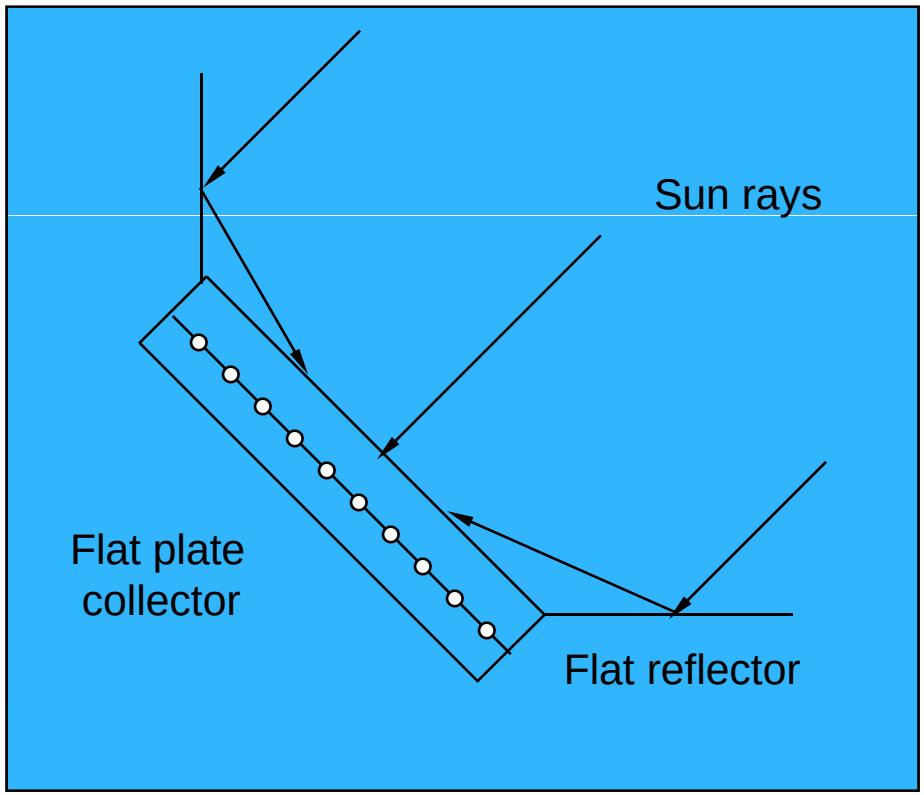
Evacuated tube collectors



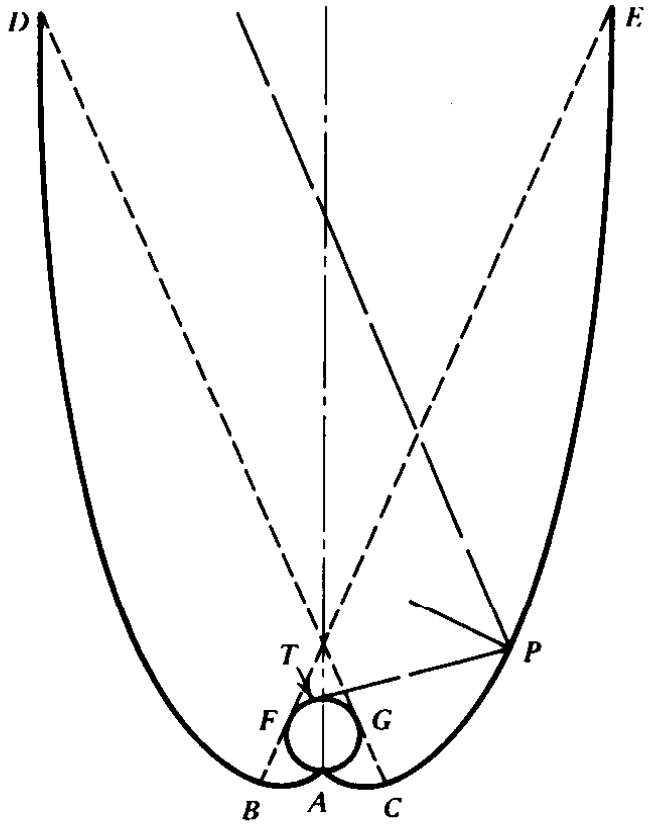
Stationary collectors

Concentrating

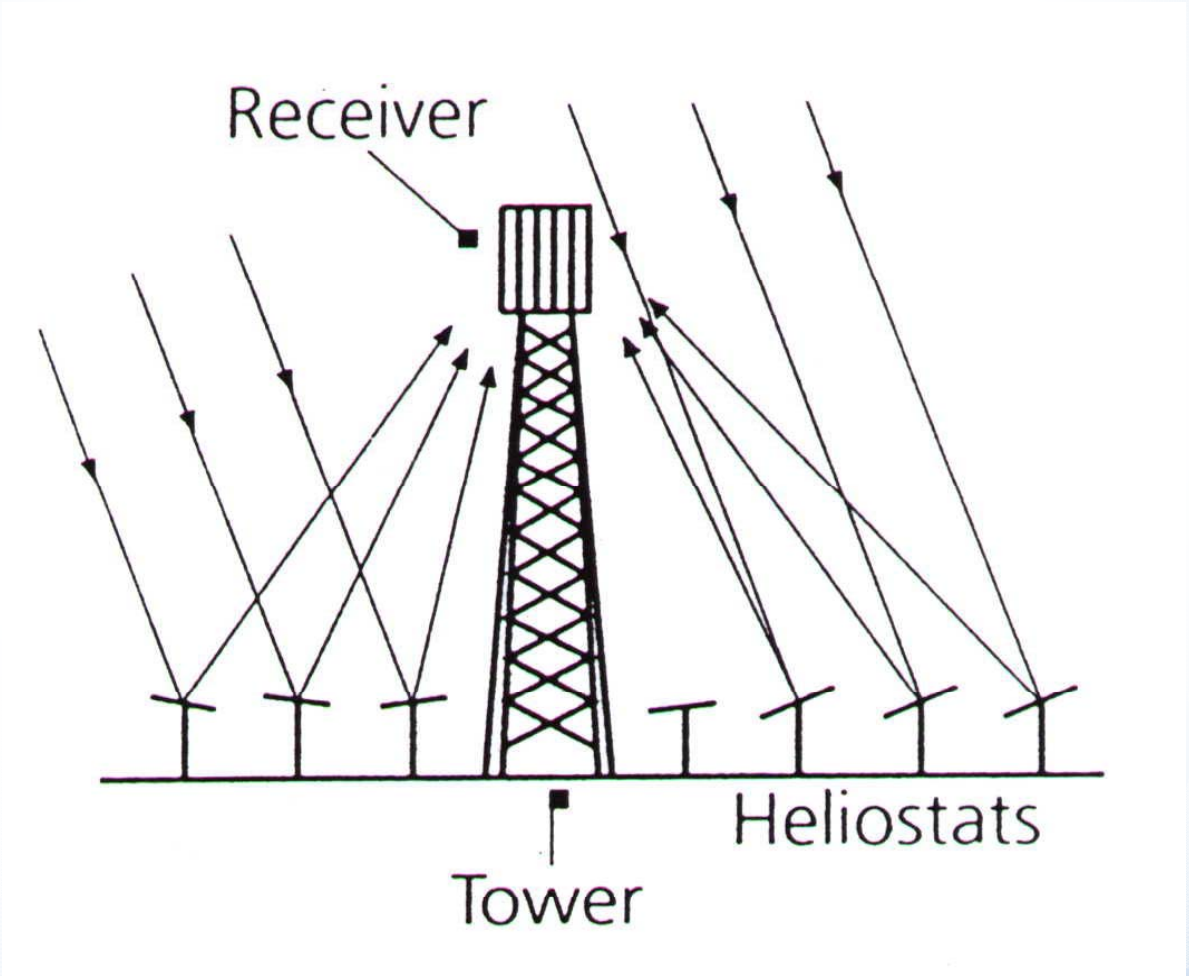
Flat plate collector with flat reflectors



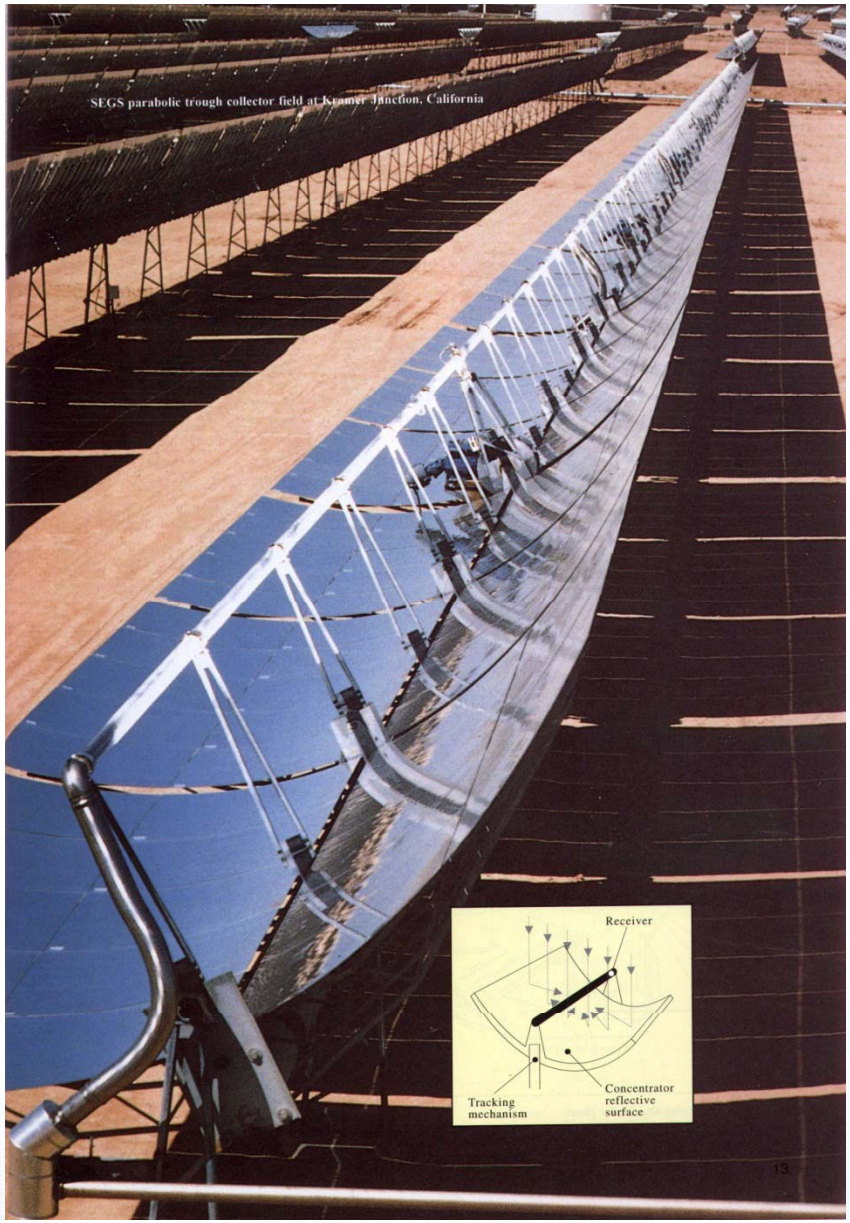
Schematic diagram of a CPC collector



Schematic of central receiver system



Parabolic trough collectors



Useful energy collected from a collector

General formula:

$$q_u = A_c\left[G_t\tau\alpha - U_L\left(T_p - T_a\right)\right] = mc_p\left[T_o - T_i\right]$$

by substituting inlet fluid temperature (Ti) for the average plate temperature (Tp):

$$q_u = A_c F_R\left[G_t(\tau\alpha) - U_L\left(T_i - T_a\right)\right]$$

Where F_R is the heat removal factor

Collector efficiency

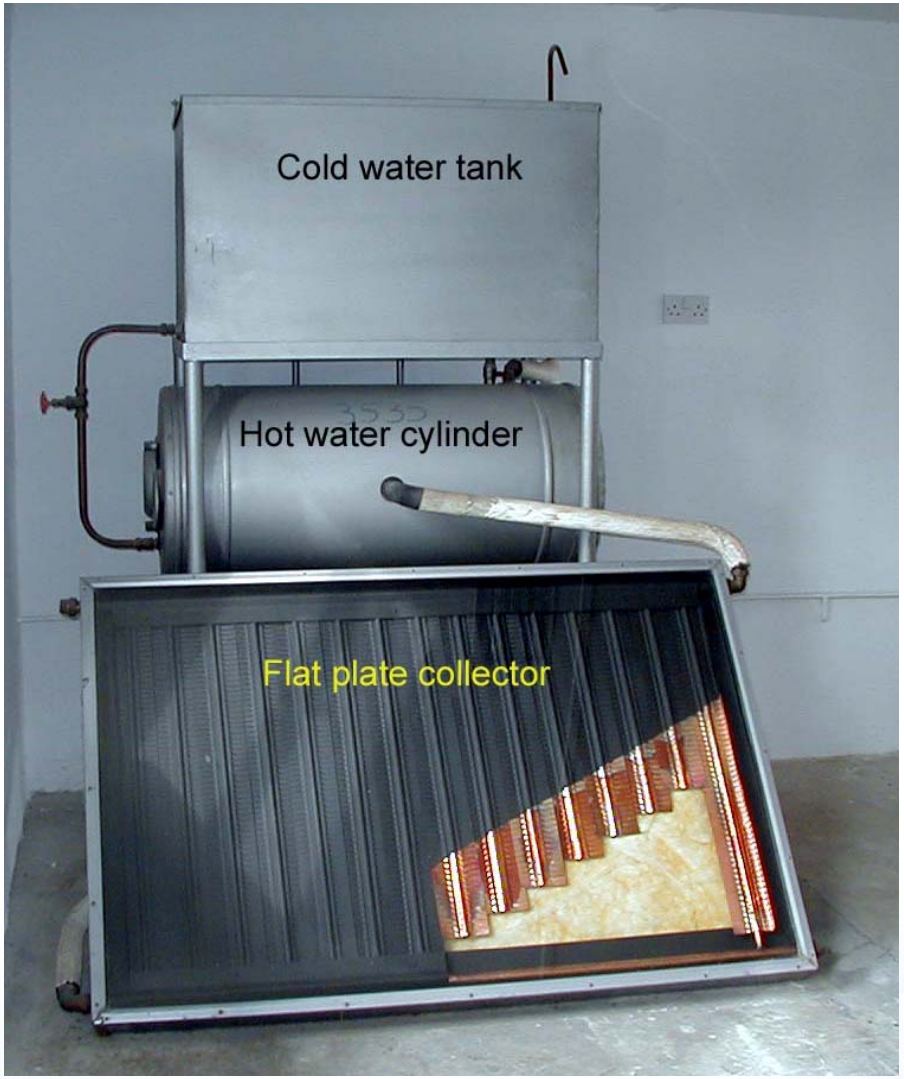
Finally, the collector efficiency can be obtained by dividing q_u by $(G_t A_c)$. Therefore:

$$n = F_R \left[\tau\alpha - \frac{U_L (T_i - T_a)}{G_t} \right]$$

Overall heat loss coefficient

- The overall heat loss coefficient is a complicated function of the collector construction and its operating conditions and it is given by the following expression:
- $U_L = U_t + U_b + U_e$ *(for flat plate collector)*
- i.e., it is the heat transfer resistance from the absorber plate to the ambient air.

Laboratory model



Application on inclined roof

Multi-residential application

Swimming pool heating

Heliostat detail