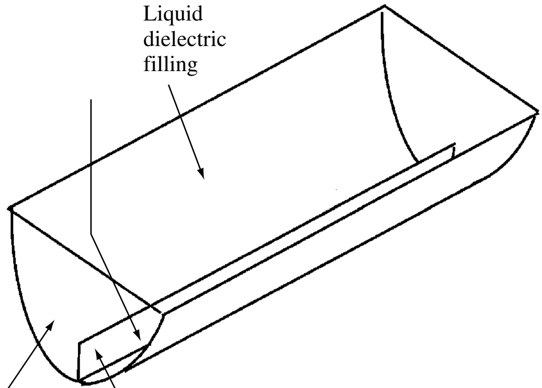

Figure 11.5 One of many static concentrator configurations. In this case a bifacial cell, which is sensitive to light from both surfaces, is mounted in a reflective CPC-like trough that is filled with liquid dielectric. The dielectric forms the dual role of cooling the cell and providing additional concentration

The allure of static concentrators is indeed great because of the elimination of the tracking requirement and, hence, the opening of the general PV marketplace to their use. Unfortunately, no static concentrator design has yet been found where the decrease in cell cost through concentration is sufficiently more than the added cost of the concentrator to warrant widespread commercialization. The discovery and development of a practical, cost-effective static concentrator would be a significant contribution to photovoltaics.

11.3 HISTORICAL OVERVIEW

This section reviews the early efforts to develop concentrators in order to put into context the issues facing current development efforts. The concept and practice of concentrators were well known to early workers in photovoltaics because many of the early solar thermal electric systems used concentrators to generate the high temperatures needed for efficient conversion. These systems generally relied on reflective concentrators that could benefit from the relatively mature technology of glass mirrors. Shuman's oft-mentioned solar electric system built in Egypt in 1913 used reflective troughs, and reportedly attained a conversion efficiency of 3 to 4% from sunlight to electricity [5]. It would be another 40 years before solar cells attained such performance.[4]

Bell Laboratories demonstrated the silicon solar cell in 1952 and developed it into a practical device of 10% conversion efficiency by 1955 [6]. The high cost of the cell precluded its use as a primary source of terrestrial energy, except in small, remote applications. Work on concentrating PV systems as a means to reduce cost began shortly

[4] Indeed, as discussed later, photovoltaic concentrators based on reflective troughs were able to achieve only 5% conversion efficiency in 1980.