

power output lead 15. The power output to the leads 15 and 16 along with the power output from the other rectifying modules of the layer 3 are conducted to the electrical load using the leads 4 and 5 (see FIG. 1a).

In FIG. 3b a schematic view is given to show one embodiment of a circuit to combine the output power from all the modules using a series-parallel circuit to produce a convenient final output voltage to leads 4 and 5. In this schematic, the module output powers of the rectifying modules 8 carried by the leads 19 and 21 in the vertical column are connected in parallel so that the total current of all modules in the vertical columns are added at a constant output voltage. Also, as shown in FIG. 3b the total output of each column is added in series so that the resultant output voltage to the load is the sum of the output voltages of each column.

In FIG. 3c the sectional view shows an embodiment of a construction of the vacuum thermal barrier and the condenser plates 22, 10, 23, and 18 by which the electric voltage fluctuations are transmitted from the higher temperature module 7 to the lower temperature module 8. The condenser plates 22, 10, 23, and 18 are constructed on the substrates 34 and 35 which form the opposite walls of the enclosed vacuum. These two adjacent walls of the substrates 34 and 35 are also plated as shown with a metallic coating 33 having a low net effective emissivity such as gold. The plated area of the walls covers all the area of both adjacent walls with the exception of the areas containing condenser plates 22, 23, 10 and 18 and a small separation area between the metallic coating 33 and the condenser plates. This separation area as shown in FIG. 3c electrically insulates the condenser plates 22, 23, 10 and 18 from the metallic coating 33 on the walls. This metallic coating enables the vacuum thermal barrier to minimize the amount of the heat loss by radiation across the walls of the vacuum. An embodiment of the thermal barrier shown as layer 2 in FIGS. 1a, 1b and 2 is comprised of an assembly of condenser plates 22, 23, 10 and 18 and the metallic coating layer 33 shown in FIG. 3c and the spacing support walls shown in FIG. 1a.

FIG. 4 is a schematic view of module 7 wherein a resistor or resistance film 26 is used as the source of the electric energy fluctuations.

FIG. 5 is a schematic view of the rectifying module 8 in which a diode 24 is connected to lead 17 with opposite polarity to that of diode 12. The other terminal of diode 24 is connected to lead 19 to provide a path for the rectified current in the module. FIG. 6 shows module 8 wherein the low impedance capacitor 25 is added to isolate the rectified output voltage from module 7.

Referring now to FIG. 7, there is shown a sectional view of layer 42 which is added adjacent to thermal conducting film 37 for the efficient conversion of radiation energy to thermal energy. This is another embodiment of the invention for converting solar radiation or other radiation to useful electric power. The incoming solar radiation is normally incident on plane 44 of layer 42. Plane 44 is divided into contiguous square cells 44a, 44b, 44c, etc., in both dimensions of plane 44 by walls 46a, 46b, 46c, 46d, etc., in horizontal planes normal to the plane of the drawing and by walls 39a, 39b, 39c, etc., in vertical planes parallel to the plane of the drawing. On the back surface of each cell of the parabolic surface 38 is typically coated with an aluminum, silver, or other reflecting surface layer 52 so as to reflect all the incoming normally incident solar radiation into the round hole 40 in the surface of the reflecting

paraboloid. This round hole is placed in the plane normal to the axis of the paraboloid at the focus of the paraboloid. The reflecting surface is supported by thermal insulating material 41. The sides of the cylindrical hole 40 as well as the flat back side of the insulating material 41 are coated with a reflecting layer 52 so as to direct all incoming solar radiation against the thermal conducting layer 37 to be absorbed and converted to thermal energy. On the left side the thermal conducting layer 37 is spaced from the collecting layer 42 by the spacing supports 54 made of thermal insulating material such as glass. On the right side the thermal conducting layer 37 is in thermal contact with layer 1 of the invention. (See FIGS. 1a, 1b and 2). This radiation collection layer 42 may be made of some thin and flexible material such as quartz with the dimensions of each round hole 40 in each small cell typically being as small as 1 micron in diameter and the thickness of layer 42 being as small as 10 microns.

The linewidth of the conductors for the module circuits using electron beam microfabrication may typically be of the order of 10^{-4} to 10^{-6} cm. Micro circuit manufacturing techniques may be used in the fabrication of the modules which can range in size according to the power output requirements. The maximum power requirements can be achieved using module size larger than the physical limit on circuit miniaturization given in a paper by R. W. Keyes in the May 1975 issue of the Proceedings of the IEEE (pp. 740-767). In this paper, the applicable limit on circuit miniaturization is the electromigration damage to conductors and this limit allows conductors carrying the maximum current requirements of this device to be smaller than 10^{-6} cm in diameter. Using larger conductors and increasing the area of modules 7 and 8 in the plane of layers 1 and 3 of FIGS. 1a and 2 up to 10^{-6} square centimeters gives a power output capability of the layers 1 and 3 of the order of 10 KW per square meter in the plane of layers 1 and 3 in FIGS. 1a and 2.

A review of microcircuit manufacturing techniques is given in a paper by H. I. Smith in the October 1974 issue of the Proceedings of the IEEE (pp. 1361-1388), and also in a paper by A. N. Broers and R. H. Dennard in Semiconductor Silicon 1973 (pp. 830-841). Other techniques in addition to electron beam microfabrication are feasible for the microfabrication of the circuits of this invention. Among these techniques, X-ray lithography using sensitive polymers as electron resist material may be utilized for simplicity and low cost. The manufacture of micro circuit components for the instant invention can be accomplished using the micro circuit technology described by H. Sobel in the August 1971 issue of the Proceedings of the IEEE (pp. 1200-1211) and by M. Coulton in the October 1971 issue of the Proceedings of the IEEE. Diodes 9, 12, and 24 may typically be classical Schottky barrier diodes or quantum or tunnel diodes. The Schottky diodes may be of the type described by Fetterman et al in Applied Physics Letters, Jan. 15, 1974, page 70. The tunnel diodes may be of the type described by Twu et al in Applied Physics Letters, Nov. 15, 1974 or by Javan in the IEEE Spectrum, October, 1971, page 91. For the rectifying diodes 12 and 24, increasing the nonlinearity increases the efficiency of the device. As shown in the paper by J. C. Yater in the October 1974 issue of the Physical Review A (pp. 1361-1369), the non-linearity obtainable from classical diodes enables the Carnot cycle efficiencies to be obtained. For quantum effect or