FINAL TECHNICAL REVIEW

"Power Conversion of Energy Fluctuations" OERI 000230

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Reviewed by: A. L. Hedrich (NBS)

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The description of this invention was received in the Office of Energy-Related Inventions on September 18, 1975. The material submitted consists of the specification for a patent application and a reprint of a paper published by the inventor in Physical Review, October 1974.

A first stage evaluation was conducted by myself and Dr. Chester Page of NBS. We both concluded that the concept was theoretically sound and that it should undergo a second stage evaluation to determine the nature and level of support, if any, that would be appropriate. The Innovation Center at the Massachusetts Institute of Technology, Cambridge, Massachusetts performed the second stage evaluation. Extensive discussions were carried on with the inventor during the entire evaluation process. As a result of their evaluation, M.I.T. recommends that additional research be done and that a research prototype of the device be built and tested to better understand what might be achievable.

Description of the Invention:

It is well known that any resistive element exhibits a randomly varying voltage across it and that as the temperature of the resistor is increased, the magnitude of the voltage is increased. If this voltage could be rectified, the resultant direct current would represent a useful available power. The source of thermal energy used to heat the resistive elements is not important although the one that comes most readily to mind is solar energy. Silicon solar cells have been used to convert solar energy to electric energy but at an efficiency of less than 10%. Future developments might increase this efficiency to 15%. If answers can be found to the problems outlined below, this device could increase this efficiency to above 30%. The inventor claims efficiencies up to 80% but this is considered to be overly optimistic.

For such rectification to take place, the rectifying diode must be maintained at a temperature lower than that of the hot resistor. The greater the temperature differential the greater the efficiency of the conversion of thermal to electric energy. This consideration leads to the requirement for an efficient thermal barrier between the two elements. A major goal of the recommended research effort would be to evaluate the available techniques for obtaining such a thermal barrier.

In addition to maintaining the temperature difference discussed above, it is necessary to make the resistive and rectifying elements extremely small. The amount of power available from an individual element is independent of its size; it is solely dependent on its temperature. Therefore, it is necessary to provide a large number of elements if useful amounts of energy are to be converted. If the efficiency is to be acceptable, it is necessary that these elements be formed in a very densely packed array. The second major goal of the research will be to evaluate the capability to produce circuits of the very small dimensions required using state-of-the-art techniques.

Conclusions:

1. The concept advanced by Yater is theoretically sound.

2. There is no conclusive evidence that the concept cannot be made to work substantially as claimed by the inventor.

3. If the concept can be made to work as claimed, the direct conversion of thermal energy to electric energy, particularly in the case where the thermal energy is in the form of solar energy, can be done at efficiencies substantially higher than can be done with existing techniques.

4. There are several potential difficulties that must be evaluated, namely:

   a. The achievement and maintenance of a thermal barrier of very small dimensions.

   b. Fabrication of extremely small and densely packed individual resistive and rectifying elements.

   c. Identifying materials that will perform satisfactorily at the high temperatures required for acceptable efficiencies of the device.

Recommendations:

1. An attempt should be made to construct and test a device of the type proposed. The research should be done so as to develop the information needed to evaluate the problems posed in Conclusion 4 above.

2. Because of the difficulties outlined in Conclusion 4 above, the first effort should result in a recommendation for the next step of developing the required components to overcome these difficulties.

3. Because of the tentative nature of the conclusions at the present time, it is recommended that further effort be carefully reviewed at frequent intervals to allow redirection of the work as called for by interim results.