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NASA TECH BRIEF

Goddard Space Flight Center

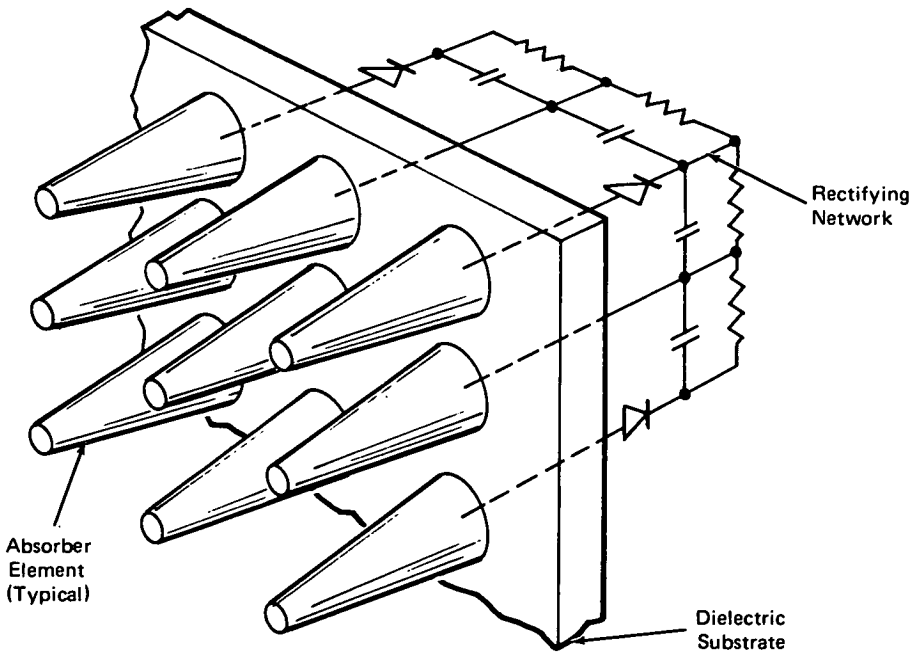
Proposed Electromagnetic Wave Energy Converter

The problem:

Electric power can, theoretically, be transmitted in several ways. But the only method that is currently practical on a large scale is through metallic conductors. As evidenced by the "universal" distribution and use of electricity, this method has worked well enough in the past. However, expanding demands for power are requiring the development of power sources that are new, and perhaps more "universal" in the literal sense of the word. Currently under consideration, for instance, are orbiting power stations which would beam power down to the earth from miles out in space. Such a system would require development of an efficient power converter for transforming electromagnetic radiation to useful electrical power. In addition, such a converter in a more advanced form could potentially be used to convert energy from the largest available power supply, the sun, permitting widespread terrestrial application of solar-electric converters. Such converters for centralized or dispersed use, as on homes, would capitalize on our only inexhaustible nonpolluting energy source, the sun.

The solution:

A proposed device converts incident electromagnetic wave energy into electric power through an array of insulated absorber elements responsive to the electric field of impinging electromagnetic radiation. This device could also serve as a solar energy converter that is potentially less expensive and fragile than solar cells, yet substantially more efficient.



Electromagnetic wave energy converter for vertical, horizontal, or randomly polarized waves

(continued overleaf)

How it's done:

The proposed device is shown in the illustration. Wide band electromagnetic wave energy impinges on the array of tapered, metallic or dielectric, absorber elements that are mutually insulated. For maximum energy conversion, each element is several wavelengths long in the direction of propagation and spaced relatively close to its neighbors to enhance absorption of the wave. Thus, the converter surface appears microscopically "rough".

A voltage replica of the electric field variations absorbed by each element pair is derived at its output. These voltage variations are supplied to a rectifier for conversion to useful dc power.

The device, in principle, may convert wave energy from the microwave region through visible light and is ideally suited for solar-to-electric energy conversion. If it is used to absorb plane polarized waves (e.g., a laser beam), the converter elements in the plane of polarization are aligned in pairs. For random or circularly polarized radiation (e.g., from the sun), a two-dimensional array would be used as shown.

Because the conversion process is based on the wave, rather than the quantum properties of radiation, it is expected that conversion efficiencies will be substantially greater than existing solar cells. Further, because the absorption and conversion means are separate, each can be individually optimized to more nearly match the incident electromagnetic power spectrum, thus maximizing conversion efficiency.

It is interesting to observe that morphologically similar converters exist in nature in insects and mammals, but have not previously been duplicated by man for useful power converters.

Note:

Requests for further information may be directed to:

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Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

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