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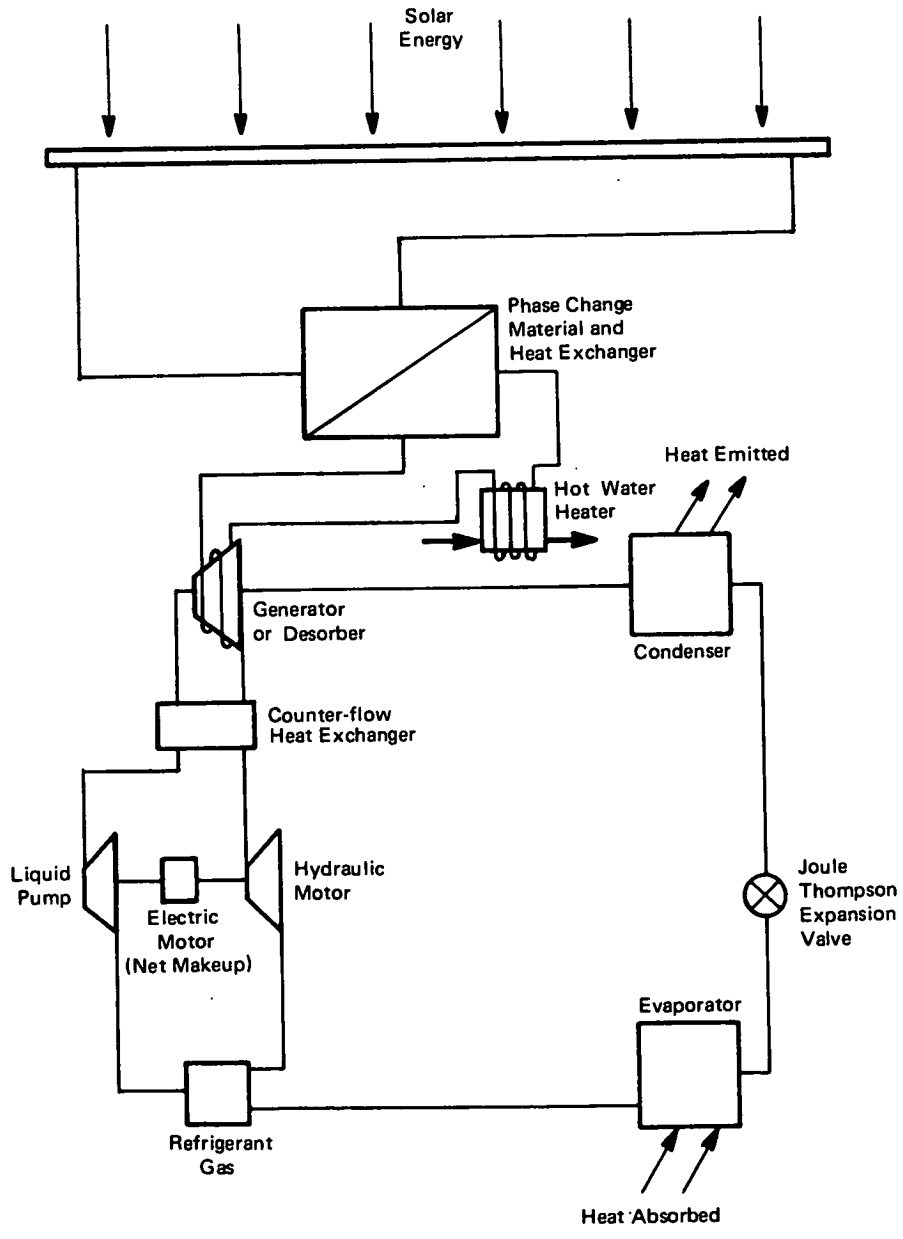
NASA TECH BRIEF

Marshall Space Flight Center

Solar Powered Absorption Cycle Heat Pump Using Phase Change Materials for Energy Storage



(continued overleaf)

Current methods of heating and cooling have not only created a polluted environment, but are steadily draining the supply of fossil fuels. This solar powered system has been designed to provide heating and cooling as required in several applications, including residential homes. The heating and cooling cycle is provided independently of the environmental temperature.

The primary source of energy for the system is solar energy that is accumulated in a solar collector. The system is diagrammed in the accompanying illustration. The energy is stored in the phase change material as available heat for use in the absorption cycle heat pump during periods when direct solar energy is inadequate or not available (night and cloudy days). The heat from the phase change material is used to drive off refrigerant gas from the absorbent liquid in the generator or desorber. The high-pressure refrigerant gas gives off heat as it is condensed (in the condenser). The condensed liquid refrigerant is then expanded through a Joule-Thompson expansion valve and boils in the evaporator with the absorption of heat. The evaporator and condenser are identical and can be switched by valves to provide either heat or cold in the habitat.

The refrigerant gas leaves the evaporator and is exposed to the absorbent liquid returning from the desorber after being cooled in a counter-flow heat exchanger and is reduced in pressure by either a hydraulic motor or an expansion valve. Cooling is also provided in the absorber to enhance the solution of the refrigerant gas in the absorbent liquid. The resulting liquid is then pumped to a high pressure with a pump powered by a hydraulic motor and supplemented by an electric motor. The fluid is heated in a counter-flow heat exchanger, and additional heat is supplied in the desorber to separate the refrigerant gas from the absorbent liquid. If the solar input energy is not adequate over periods longer than the storage capacity of the phase change materials, supplementary heat must be provided by the appropriate conventional means.

Notes:

1. In addition to the heating and cooling of residential homes, this system may be used for heating swimming pools, hydroponic gardens, and hot houses.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Marshall Space Flight Center
   Code A&PS-TU
   Marshall Space Flight Center, Alabama 35812
   Reference: B72-10615

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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