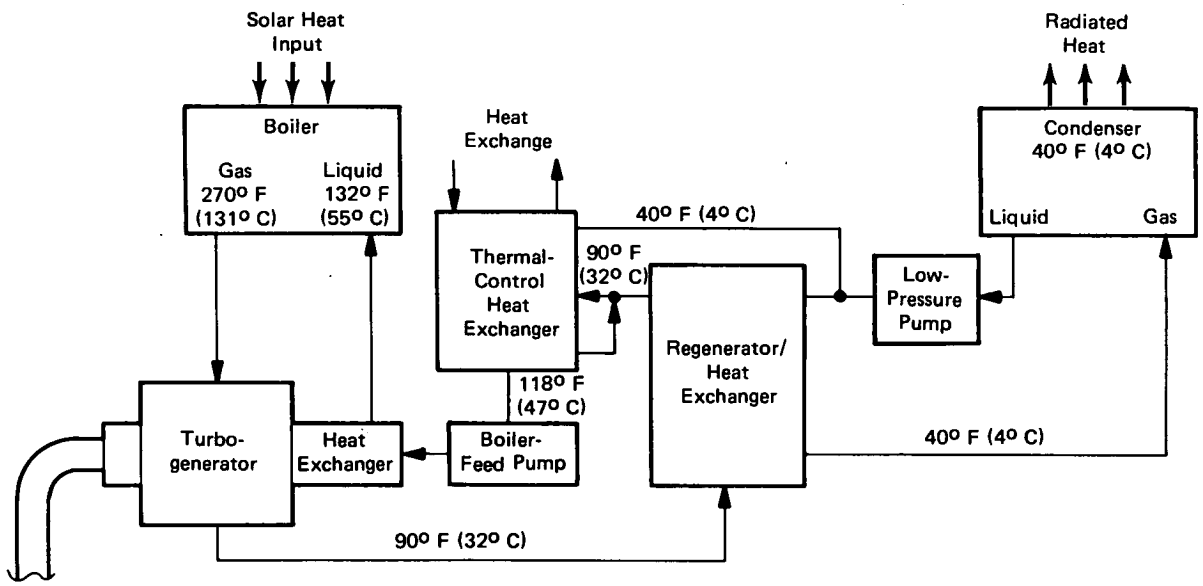
NASA TECH BRIEF

Marshall Space Flight Center

Solar-Energy Conversion System Provides Electrical Power and Thermal Control for Life-Support Systems



Solar-Energy Conversion System

A new solar-energy conversion system has been proposed to generate electrical power and to provide temperature control for life-support systems. The system utilizes a Freon cycle and includes a boiler, a turbo-generator with heat exchanger, regenerator and thermal-control heat exchangers, low-pressure and boiler-feed pumps, and a condenser.

As shown in the illustration, solar energy heats the liquid Freon to 270° F (131° C) and to a pressure of 375 psia (2.6×10^6 N/m^2). The resulting expanded hot gas feeds into a turbogenerator where it releases approximately 19.5 Btu/lb (10.9 kcal/kg). The cooled gas at 90° F (32° C) enters the regenerator/heat-exchanger, releasing approximately 7.8 Btu/lb (4.4 kcal/kg), which is used to heat the condenser discharge liquid. This gas also is fed to the thermal-control heat exchanger and is fed back to the regenerator to provide heat to the surrounding environment. From the regenerator/heat exchanger, the gas cooled to 40° F (4° C), enters the condenser in a saturated state at 15.2 psia (10.5×10^4 N/m^2) where it condenses to liquid. Heat generated during condensation is also radiated into the surrounding environment.

On the return cycle to the boiler, the Freon, in liquid phase, is pressurized to a 375-psia boiler pressure by low-pressure and boiler-feed pumps, respectively. It picks up heat from the thermal-control heat exchanger, removing 11.2 Btu/lb (6.2 kcal/kg), which raises its temperature to 118° F (47° C). Additional heat is picked up in the turbogenerator heat exchanger, which releases 2.9 Btu/lb (1.6 kcal/kg). While in this heat exchanger, the liquid maintains the generator operating temperature by removing heat resulting from electrical power losses. From the generator, the liquid then enters the boiler at 132° F (55° C), and the cycle is repeated.

(continued overleaf)

Notes:

1. The power cycle described is for a 270° F/40° F (131° C/4° C) heat exchange. Two other power cycles have been developed for 215° F/20° F (101° C/–7° C) and 180° F/20° F (81° C/–7° C) heat exchanges which produce different operating values within the same system.
2. The exchanger described may be of interest to engineers and scientists investigating new energy sources.
3. 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: B73-10524

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:

Patent Counsel
Marshall Space Flight Center
Code A&PS-PAT
Marshall Space Flight Center, Alabama 35812

Source: B. K. Davis
Marshall Space Flight Center
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