PCM Passive Cooling System Containing Active Subsystems

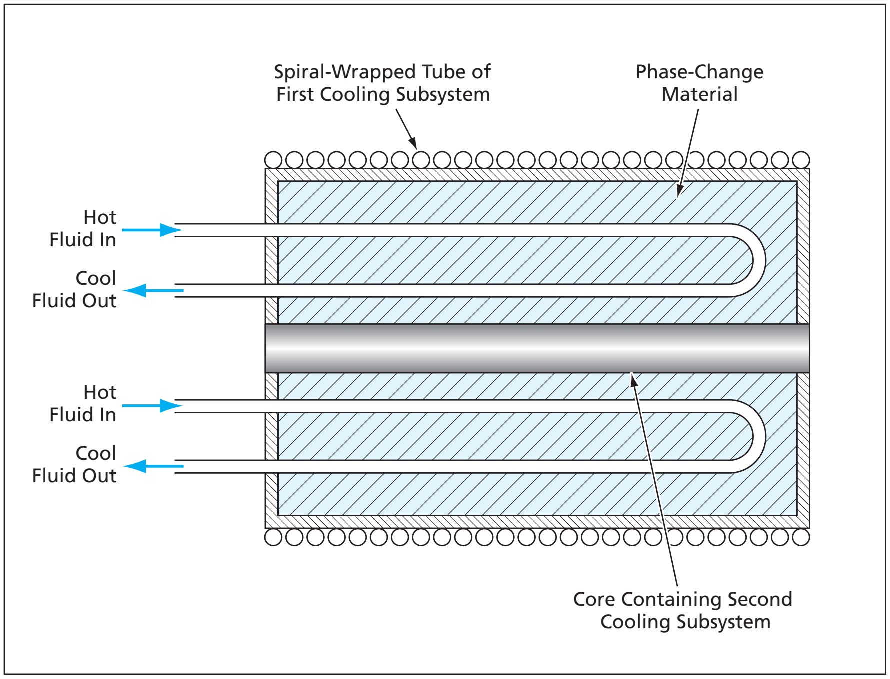
A PCM would absorb intense heat bursts and would be regenerated between them.

Lyndon B. Johnson Space Center, Houston, Texas

A multistage system has been proposed for cooling a circulating fluid that is subject to intermittent intense heating. The system would be both flexible and redundant in that it could operate in a basic passive mode, either sequentially or simultaneously with operation of a first, active cooling subsystem, and either sequentially or simultaneously with a second cooling subsystem that could be active, passive, or a combination of both. This flexibility and redundancy, in combination with the passive nature of at least one of the modes of operation, would make the system more reliable, relative to a conventional cooling system.

The system would include a tube-in-shell heat exchanger, within which the space between the tubes would be filled with a phase-change material (PCM). The circulating hot fluid would flow along the tubes in the heat exchanger. In the basic passive mode of operation, heat would be conducted from the hot fluid into the PCM, wherein the heat would be stored temporarily by virtue of the phase change.

Of course, it would become necessary to remove heat from the PCM to maintain or restore its heat-absorption capacity. This would be accomplished by means of the first, active cooling subsystem, which would circulate a cooling fluid through one or more tube(s) in thermal contact with the PCM. For example, such a cooling tube could be wrapped in a spiral around the heat-exchanger shell as shown in the figure.



This **Cross Section Is Greatly Simplified** to show only selected major features of a heat exchanger according to the proposal.

The heat exchanger would include an inner core that would accommodate the second cooling subsystem. As mentioned above, the second cooling subsystem could be active, passive, or both. This subsystem would remove heat from the core by means of heat pipes, a water membrane evaporator, and/or one or more active refrigeration devices. In the case of a water membrane evaporator, heat would be dissipated in the environment by releasing the steam generated at the membrane.

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Automated Electrostatics Environmental Chamber

Atmospheric temperature and pressure can be varied between the extremes of Mars and Earth.

John F. Kennedy Space Center, Florida

The Mars Electrostatics Chamber (MEC) is an environmental chamber designed primarily to create atmospheric conditions like those at the surface of Mars to support experiments on electrostatic effects in the Martian environment. The chamber is equipped with a vacuum system, a cryogenic cooling system, an atmospheric-gas replenishing and analysis system, and a computerized control system that can be programmed by the user and that provides both automation and options for manual control. The control system can be set to maintain steady Mars-like conditions or to impose temperature and pressure variations of a Mars diurnal cycle at any given season and latitude. In addition, the MEC can be used in other areas of research because it can create steady or varying atmospheric conditions anywhere within the wide temperature, pressure, and composition ranges between the extremes of Mars-like and Earth-like conditions.

The MEC (see figure) includes access ports for installation and removal of experimental devices, and vacuum-feed-through ports for connecting to the devices from the outside. Also included are feed-through ports for pressure sensors, thermocouples, and gas-supply tubes that are permanent parts of the apparatus. There also are access ports for visual monitoring of experimental devices.

The temperature in the chamber can