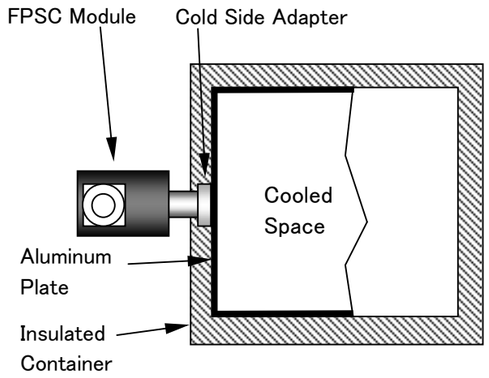
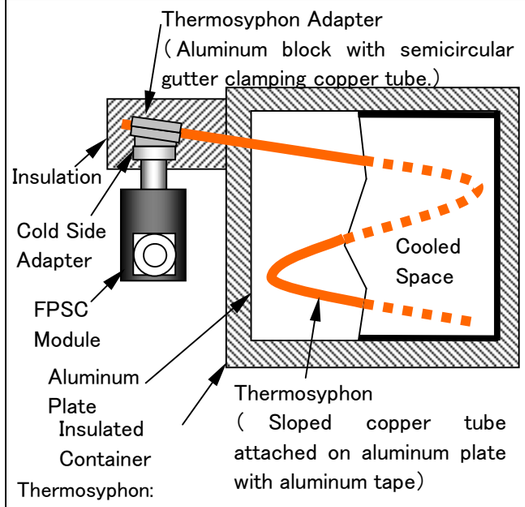
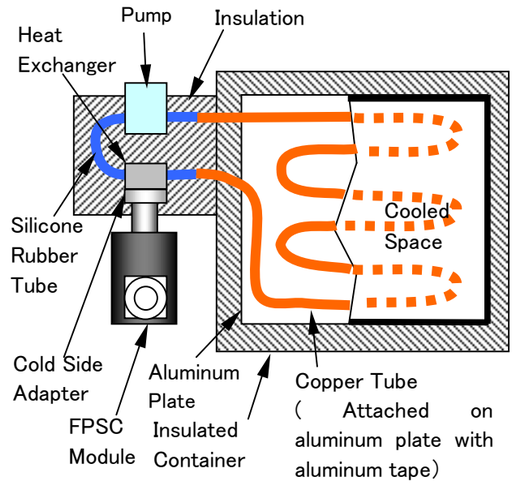
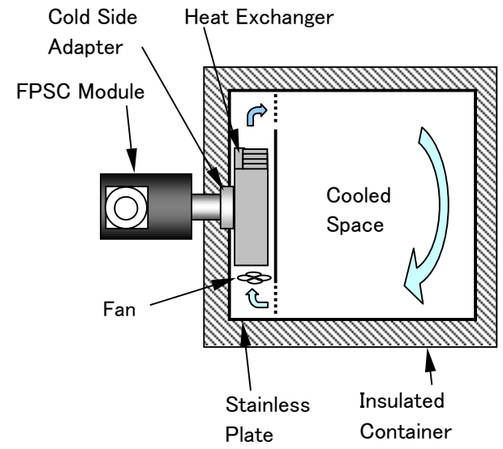
Dec. 15, 2007
TWINBIRD CORPORATION
SC Business Operations

FPSC Application Examples

(to cool air in closed area)

Item	A. Direct Cooling with Conductive Connection	B. Direct Cooling with Thermosyphon	C. Direct Cooling with Brine	D. Indirect Cooling
Structure	 Direct Cooling: Inside air is cooled by natural convection.	 Thermosyphon: A kind of heat pipes that is gravity dependant. Working fluid (CO2, CFC, etc.). Continuous two-phase heat transport.	 Brine: Single-phase liquid, which is circulated to transport heat.	 Indirect Cooling: Inside air is cooled with forced convection.
Cooling Performance / Temperature Distribution	**Least** Aluminum plate is not cooled uniformly and the thermal resistance between the aluminum plate and inside air is relatively large. Limited effective volume.	**Better** Aluminum plate is cooled more uniformly than "A". Two-phase heat transport allows for the lowest thermal resistance between the aluminum plate and FPSC. Most effective form of secondary heat transport.	**Better** Copper tube is attached on aluminum plate with more freedom than "B". Aluminum plate is cooled more uniformly than "B" but results in a higher overall thermal resistance between the cooled space and the FPSC.	**Best** The thermal resistance between Cold Side of FPSC and heat exchanger is relatively small. The thermal resistance between heat exchanger and inside air is relatively small.
Influence of Frost on Cooling Performance	**Little** The surface area of the aluminum plate exposed to the inside air doesn't become smaller when the aluminum plate surface is covered with frost.	**Little** (Same as left.)	**Little** (Same as left.)	**Very Large** When the space between fins of heat exchanger is filled with frost, air cannot flow there, The surface area of finned plate exposed to the inside air becomes smaller and the cooling performance is reduced. It is necessary to defrost and defrosting causes the overall cooling performance to be reduced.
Noise	**Larger** The vibration of the FPSC is conducted to the insulated container and aluminum plate directly and they can become a source of noise.	**Larger** The vibration of the FPSC can be conducted to the insulated container and aluminum plate through the copper tube.	**Smaller** The vibration conduction from FPSC to the insulated container and aluminum plate through the silicone rubber tube is relatively small.	**Smaller** The vibration conduction from FPSC to the insulated container is relatively small when using soft insulation to isolate them.
Others	(1) The structure is simple.	(1) It is necessary to define and prepare a suitable working fluid for desired operating/storage temperature. (2) It is necessary to prepare charging equipment for working fluid.	(1) It is necessary to define and prepare suitable brine and pump for desired working/storage temperature. (2) The heat from the pump motor adds an additional heat load and reduces the overall cooling performance. (3) It is necessary to take precautions against potential brine leakage.	(1) It is necessary to specify a fan motor suitable for operation at the desired working temperature. (2) The heat from the fan motor adds an additional heat load and reduces the overall cooling performance.