Heat Pump Encyclopedia Article

Heat Pump

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One of the most basic laws of thermodynamics, referred to as the second law, is that heat will spontaneously travel from a warm body to a cooler body, but not the reverse. Consequently, it is impossible for a system to indefinitely transfer heat from a cooler object to a warmer object unless energy is added to the system. Such a device is called a heat pump, and is designed to make warm bodies warmer and cool bodies cooler by "pumping" heat from one place to another. Over the past decade, heat pumps have replaced traditional air conditioning as an affordable way to keep homes cool in the summer and warm in the winter.

The main ingredient in a heat pump is a cold fluid, such as freon or ammonia, called a refrigerant. The refrigerant travels between the cooler area (the inside of a house, for example, in the case of air conditioning) and the warmer area (the outside air). While inside the house, the refrigerant absorbs heat via an evaporator, reducing the inside temperature. The warmed refrigerant is pumped outside where it passes through a condenser; here, the heat collected inside is released. Before re-entering the house, the refrigerant passes through a valve that lowers its pressure and, subsequently, its temperature, and the process is repeated. (Here, the energy required to operate the valve and lower the refrigerant's pressure is the energy added to the system, in accordance with the second law of thermodynamics.) During the winter, the flow of refrigerant is reversed; the valve increases the fluid's pressure, thus warming the system and heating the house.

Heat-pump technology is used frequently in industrial applications, usually to make hot things hotter without burning fuel. They are often used in the evaporation, condensation, and distillation of liquids. Back in the home, a variation on the heat pump is the common refrigerator, used to keep cold things cold or to make them colder.

The tremendously gifted Irish scientist William Thomson (Lord Kelvin) is usually credited with the concept of the heat pump, though he did not have the resources to construct one. The first patent for this device was awarded in 1927 to T. G. N. Haldane, an English inventor.