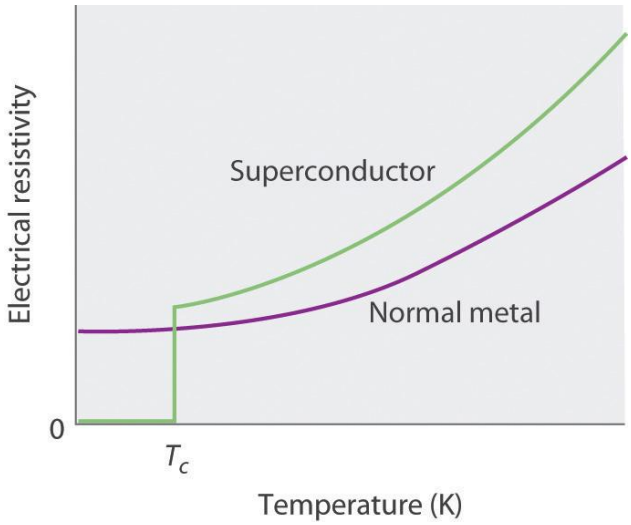
SPACE PROPULSION - Unit III

Superconductivity

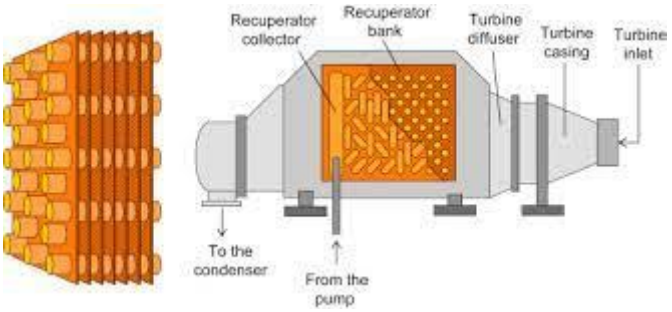
Complete disappearance of electrical resistance in various solids when they are cooled below a characteristic temperature. This temperature, called the transition temperature, varies for different materials but generally is below 20 K (−253 °C).

The use of superconductors in magnets is limited by the fact that strong magnetic fields above a certain critical value, depending upon the material, cause a superconductor to revert to its normal, or non superconducting, state, even though the material is kept well below the transition temperature.



Recuperation

A recuperator is a special purpose counter-flow energy recovery heat exchanger positioned within the supply and exhaust air streams of an air handling system, or in the exhaust gases of an industrial process, in order to recover the waste heat. Generally, they are used to extract heat from the exhaust and use it to preheat air entering the combustion system. In this way they use waste energy to heat the air, offsetting some of the fuel, and thereby improve the energy efficiency of the system as a whole.



Cutaway of a recuperated microturbine

Recuperators can be used to increase the efficiency of gas turbines for power generation, provided the exhaust gas is hotter than the compressor outlet temperature. The exhaust heat from the turbine is used to pre-heat the air from the compressor before further heating in the combustor, reducing the fuel input required.

The larger the temperature differences between turbine out and compressor out, the greater the benefit from the recuperator.

Therefore, microturbines (<1 MW), which typically have low pressure ratios, have the most to gain from the use of a recuperator. In practice, a doubling of efficiency is possible through the use of a recuperator.

The major practical challenge for a recuperator in microturbine applications is coping with the exhaust gas temperature, which can exceed 750 °C (1,380 °F).