HEAT

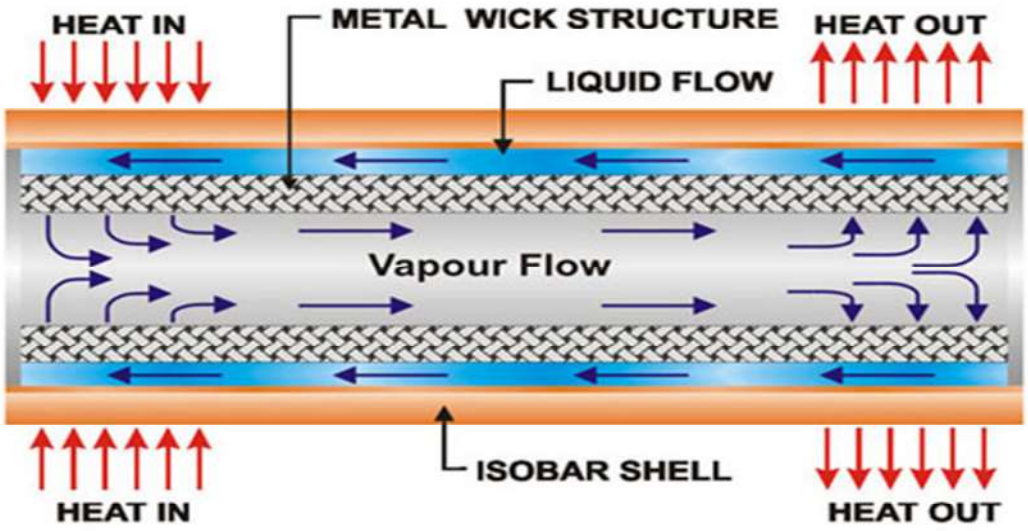
PIPE

Heat Pipe

The idea of heat pipes was first suggested by R.S. Gaugler in 1944. However, it was not until 1962, when G.M. Grover invented it, that its remarkable properties were appreciated and serious development began. Since the heat pipe was first patented by Grover in 1963, elementary theories have been advanced, and developments in aerospace and terrestrial applications have progressed to the point where the heat pipe is now used commercially. While heat pipe technology has reached a rather high level, its market has not yet met expectations. More recently, increasing environmental problems have attracted a great deal of attention.

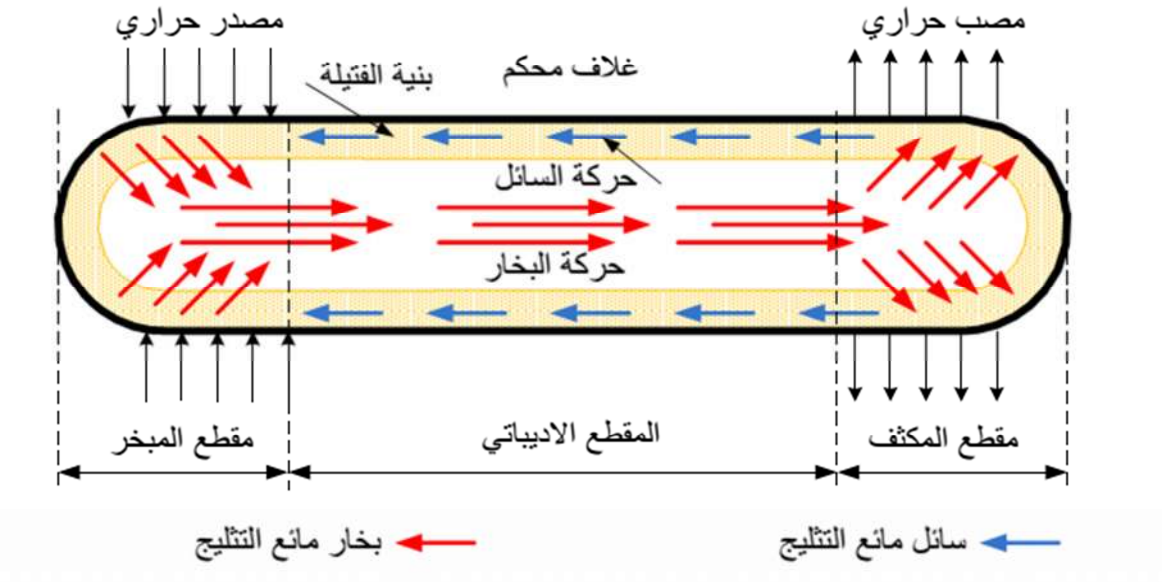
A heat pipe heat exchanger is a simple device which is made use of to transfer heat from one location to another, using an evaporation-condensation cycle.

The heat input region of the heat pipe is called evaporator. The cooling region is called condenser. In between the evaporator and condenser regions, there may be an adiabatic region.



Component of heat pipe

1- Container: Metal Tubing, usually copper or aluminum.
2- Working Fluid: Pure liquids such as helium, water and liquid silver
3- The wicking structure: Transports working fluid from the Condenser to the Evaporator and Provides liquid flow even against gravity



Heat pipe working principles:

A heat pipe is a container tube filled with the working fluid. One end of this tube (called evaporator section) is brought in thermal contact with a hot point to be cooled. The other end (called condenser section) is connected to the cold point where the heat can be dissipated. A portion of the tube between evaporator and condenser is called adiabatic section. The working fluid and its pressure are chosen in such a way that the saturation temperature is between the evaporator temperature *Te* and condenser temperature *Tc*. The fluid is thus vaporized in the evaporator section. The created vapor is transported to the condenser section and condenses there. The liquid is transported back to the evaporator section. The heat is transferred mainly due to the latent heat absorption in the evaporator and

its release in the condenser. Since the latent heat is large, the heat pipes are quite efficient. They are capable of evacuating up to 100-200 W/cm2. There are different kinds of heat pipes. They differ by their geometry and a mechanism of fluid transport inside the heat pipe.

Heat Pipe Applications:

1. cooling of electronic devices and computers.
2. cooling of high-heat-load optical components
3. cooling of milling machine spindles,
4. cooling of injection molds,
5. cryogenic systems,
6. aircraft thermal control systems,
7. cooling of engine components in conventional aircraft,
8. space craft systems,
9. heat exchangers,
10. waste heat recovery systems,

Types of Heat Pipes:

1- Capillary Pumped Loop Heat Pipe
2- Two-Phase Closed Thermo-syphon
3- Capillary-Driven Heat Pipe
4- Annular Heat Pipe
5- Vapor Chamber Heat pipe
6- Rotating Heat Pipe
7- Loop Heat Pipe
8- Pulsating Heat Pipe
9- Mono-groove Heat Pipe
10- Inverted Meniscus Heat Pipe
11- Nonconventional Heat Pipes

Advantage of heat pipe

- Very long time.
- Noiseless.
- Requires no mechanical or electrical input.
- Provide lower operating costs.
- Maintenance free.
- Environmentally safe.

Disadvantage of heat pipe

- High cost.
- Requires that the air streams must be relatively clean and may require filtration.
- Requires that the two air streams be adjacent to each other,
- Viscosity limit the work of the heat pipe
- Chock flow