Chapter 3-A

HEAT EXCHANGERS

OF A NEW BOOK BEING CREATED ON THE PAGES OF THE TRIBAL MESSENGER BY STEVE BAER...

Heat exchangers are among the last things that a curious person ponders of all the objects that you find in junkyards. Discarded heat exchangers seem more useless than axles or gear wheels and their performance more remote. Heat exchangers along with axles, pulleys and gears make up a surprisingly large portion of the metal you find in junkyards. Most of the pictures in this section were taken at the ACME metal junkyard on North Second Street. There is no better place to educate yourself in the matter of heat exchangers than a junkyard - it would take several days to visit all the equipment where it is installed at work or displayed in a salesroom that you can see, pick up and closely examine in a few minutes at a large junk yard. The one danger in visiting junkyards is that it encourages only a limited part of one's design instincts. The piles of junk suggest uses for themselves rather than the needs suggesting the design of the equipment. It is a kind of backwards design.

Axles transfer energy by torque. The rigid shaft, turned at one end, commands the other end to do the same. In heat exchangers it is again a motion transferred through metal. But in this case it is by molecular trembling, heat, passing through the walls and along the fins of the exchanger. It is simple to pass energy by a shaft. Great beauty is found in many designs of the more sophisticated heat exchanger.

Metals vary greatly in their ability to conduct heat. Below are listed various materials with the quantity of heat (in BTUs) that will flow through a 1 ft. sq., 1" thick sheet in one hour if the temperature on one side is one degree F higher than the other side.

Copper	- 2700 BTU
Lead	- 250 BTU
Gold	- 2060 BTU
Silver	- 2900 BTU
Zinc	- 750 BTU
Aluminum	- 1500 BTU
Iron	- 400 BTU
Air (still)	- 0.163 BTU
Water "	- 3.85 BTU
Oil "	- 1.2 BTU
Glass	- 5.8 BTU
Styrofoam	- 0.25 BTU
Glass Wool	- 0.25 BTU

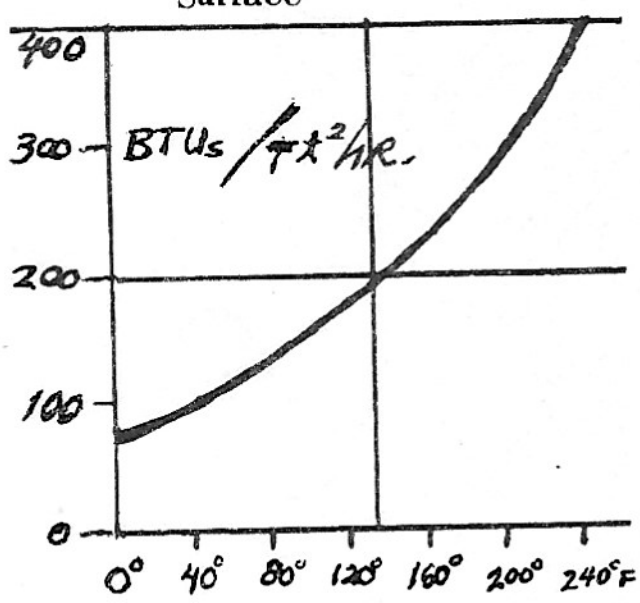
As an example of what these rates of heat flow mean in terms of the strength of sunlight, we can see that a 1" thick piece of lead, to pass the heat of the direct sun through itself would have to be slightly more than one degree F hotter on the sunny side than the cold side - for the sun gives about 300 BTUs/sq. ft./hr. Lead is a relatively good conductor. For this same quantity of heat to pass through a good insulator such as styrofoam the temperature would have to be more than 1000 degrees F hotter on one side than the other (long before which the styrofoam would have burned up). You'll notice in the headings under the pictures of the heat exchangers such titles as liquid to air, liquid to liquid - but a glance at our list of conductivity of materials shows that air, water and oil are all very poor --so what sense is there in building a heat exchanger to pass heat to these substances when they can't pass it through themselves once they are given it? The trick is that these substances, gasses and liquids, must flow past or through the heat exchanger to make the exchanger function. Radiators on automobiles rely on the radiator fan and the motion of the car to push the air past the cooling fins and then there is a water pump to circulate the water within the radiator. The radiators in a building rely on the convection currents of the heated air to keep taking the heat away.

This is usually the difficult part of the heat's journey - into and out of the exchanger, not through it. To accomplish this pumps, agitators and fans are used to keep presenting the surfaces of the exchanger with fresh matter to be heated or cooled.

It is quickly apparent after a glance at a liquid to gas heat exchanger that the transfer to gas is more difficult than to liquid, for much more surface is exposed to the outside air than to the inner circulating liquid. All in all, the progress of heat through a heat exchanger is like that of a jet traveller who must fight his way through traffic jams arriving at and departing from the rapid leg of his trip.

Heat transfer is generally broken into three categories; conduction, convection and radiation. We have listed values of conductive transfer and mentioned the function of convection in moving matter past hot or cold surfaces. Radiation is another powerful transfer mechanism wherever there are marked differences in temperature between two surfaces. All of our energy from the sun arrives by radiation. There is no material between us and the sun to carry heat by conduction or convection.

Radiant Energy From a Black Surface



1. LIQUID - AIR

An aluminum box with aluminum tubes bonded to the box. The tubing appears to be soldered to the flat sides. This is part of a refrigerator or freezer. Chilled liquid is pumped through the tubes. The liquid takes away the heat which has traveled through the sides of the box, the bond between box and tubing and finally the walls of the aluminum tube itself. Many of the elements of heat exchangers exist in series and thus, as with a chain, the performance is no better than the poorest component.