from combustion. However, velocity cooling was erratic around the cylinders, especially on the aft side where little airflow reached the fins.

As engine power increased over the years, so too did the compression ratios, operating speeds, and therefore operating temperatures. Similarly, there was a demand for cooling drag reduction to help increase aircraft speed. Initially, enclosing the engine inside a cowling greatly decreased its drag, but ever-increasing demands led to smaller, tighter engine cowlings and reduced frontal areas. As engine cowlings became more aerodynamically efficient, they also diminished the volume of cooling airflow. Thus, a need for increased cooling efficiency was created, and pressure cooling was the logical solution.

Before we launch into the intricacies of pressure cooling, let's take a brief look at liquid cooling and the reason it is only rarely used in aircraft. By surrounding the cylinders with liquid, heat can be transferred by conduction to the water (or glycol, an ethylene compound used as an antifreeze), which is then pumped through a radiator. The radiator's job is to transfer the heat to the air, much in the same way as the cooling fins on air-cooled engine cylinders. As far as I know, all automobiles produced, except the original Volkswagen Beetle, use this system.

If you want to realize quickly why liquid cooling is not used in aircraft, open up the hood on your car and take a look. Note the maze of plumbing, pump, and radiator—all points of potential failure in the high-vibration environment of the aircraft. Weight is another factor; liquid-cooled engines tend to be heavier than their air-cooled counterparts. Add to the basic engine the weight of coolant (8+ pounds per gallon), hoses, radiator, and pump.

Pressure Cooling Systems

The basic principles of air cooling remain the same in the pressure-cooling system. Cylinders typically are made of chrome-molybdenum steel and cylinder heads of aluminum alloy. Very thin fins, cast or machined around the outside of both, provide increased cooling surface area for the heat to radiate out into the air. It works the same way a steam-heat radiator works in a house.

The big advantage of a pressure-cooling system is that it carefully directs the airflow within the cowling over cylinders via strategically located baffles. These baffles build up and direct the airflow so all cylinders are cooled equally from all sides. To prevent air from leaking around the baffles and taking a route less conducive to uniform cooling, rubber seals are attached to the baffles, and these press against the cowling to form an airtight enclosure.

If we imagine ourselves to be a molecule of air on a cooling journey around the engine, we must first enter the air inlet of the engine cowling. Older aircraft will probably have a high drag inlet, while newer aircraft benefit from a lower drag configuration as illustrated in Figure 4-5. In either case, the propeller is the prime mover that will push us back into the inlet when the aircraft is on the ground. In flight, ram air accomplishes the same task. From the inlet, we travel over the front-top of the engine, where very carefully positioned baffles will direct us down, around, and through the cylinder fins. In addition to assuring engine cooling, these baffles also direct other molecules to cool the oil radiator and engine-driven accessories. Now a hot little molecule, we exit through the opening in the underside of the cowling, rejoining the free airstream.