Introduction to Fluid Machinery

Fluidmachinery refers to any device designed to modify, utilize or control a fluid flow. There seems little doubt that the first fluid machines were devised in order to raise water from a river or well either for drinking or for irrigation. Among the first records of such devices were the Egyptian "shadoof" depicted in 4000-year-old rock carvings from the banks of the Nile (see Figure 1). Many variants of this weighted lever device designed to help raise a container of water must have existed wherever primitive agriculture began to develop. Much later, the invention of crude one-way valves allowed the development of reciprocating

Figure 1: Depiction of an Egyptian "shadoof" from about 2000BC.

devices that increased the efficiency of water movement. Moreover, in another development about 2000 years ago, Archimedes described the use of the Archimedean screw (see Figure 2) to raise water and thus presaged the evolution of modern turbomachines.

With the advent of grain crops, inventive farmers devised ways to use the power of flowing water or of wind to aid in the milling of their grain and thus began the evolution of turbines. Where flowing streams or rivers were available the most obvious way to harness their power was to dip an "undershot" water wheel (see Figure 3, left) into the flowing water. Even better was to divert water from further upstream into a "race" or "penstock" through which the water could be fed to a more powerful "overshot" water wheel (see Figure 3, right). In farmlands that were flatter or devoid of flowing streams it was better to use the wind as the source of power and there windmills began.

Thus began the evolution of pumps to move water (or air) and turbines to harness the power of flowing water or wind. These fluid machines then began to take the specialized forms described in the following sections.

There are, of course, a wide variety of other flow control devices that should be included under the heading of fluid machinery. These include some very simple flow control devices that were part of ancient irrigation systems such as sluice gates, the ancestor of the modern hydraulic valve. The Romans equipped their cities

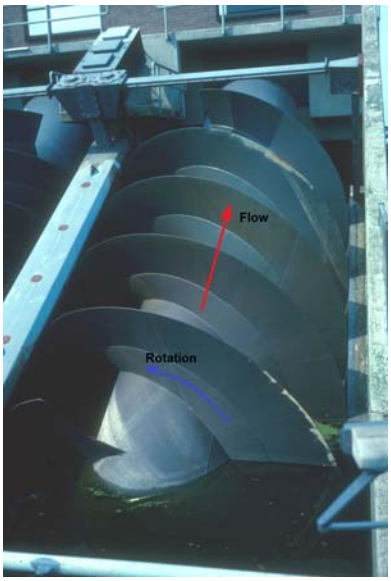

Figure 2: An Archimedes screw.

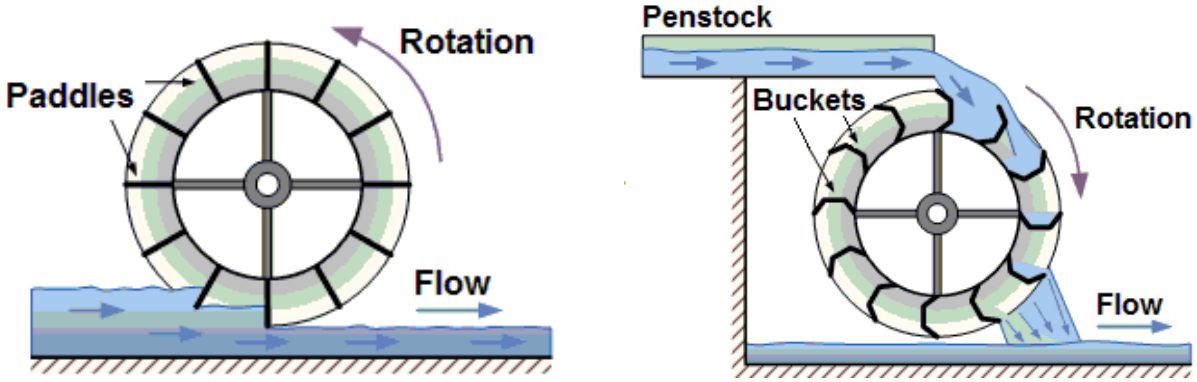

Figure 3: Undershot (left) and overshot (right) water wheels.

with quite sophisticated water supply systems with reservoirs and valves. Figure 4 shows two modern-looking ball valves recovered from the ruins of Pompeii.

Other, more complex fluid machines include fluid couplings and fluidic control and measuring devices,

Figure 4: Roman ball valves for water supply systems (from the ruins of Pompeii).