Air at standard conditions enters a compressor at 75 m/s and leaves at an absolute pressure and temperature of 200 kPa and 345 K, respectively and speed $V = 125$ m/s. The flow rate is 1 kg/s. The cooling water circulating around the compressor casing removes 18 kJ/kg of air. Determine the power required by the compressor.
#2. Air is drawn from the atmosphere into a turbomachine. At the exit, conditions are 500kPa (gage) and 130°C. The exit speed is 100 m/s and the mass flow rate is 0.8 kg/s. Flow is steady and there is no heat transfer. Compute the shaft work interaction with the surrounding.
#3.
The *pump-turbine* system in the figure draws water from the upper reservoir in the daytime to produce power for a city. At night, it pumps water from lower to upper reservoirs to restore the situation. For a design flow rate of 15,000 gal/min in either direction, the friction head loss is 17 ft. Estimate the power in kW *(a)* extracted by the turbine and *(b)* delivered by the pump.
#4.
The fireboat draws seawater (SG = 1.025) from a submerged pipe and discharges it through a nozzle, as in the figure. The total head loss is 6.5 ft. If the pump efficiency is 75 percent, what horsepower motor is required to drive it?
#5.
Kerosene at 20°C flows through the pump in the figure at 2.3 ft³/s. Head losses between 1 and 2 are 8 ft, and the pump delivers 8 hp to the flow. What should the mercury manometer reading \( h \) ft be?
In a hydroelectric power plant, 100 m$^3$/s of water flows from an elevation of 120 m to a turbine, where electric power is generated. The total irreversible head loss in the piping system from point 1 to point 2 (excluding the turbine unit) is determined to be 35 m. If the overall efficiency of the turbine generator is 80%, estimate the electric power output.
A fireboat is to fight fires at coastal areas by drawing seawater with a density of 1030 kg/m$^3$ through a 20 cm-diameter pipe at a rate of 0.1 m$^3$/s and discharging it through a hose nozzle with an exit diameter of 5 cm. The total irreversible head loss of the system is 3 m, and the position of the nozzle is 4 m above sea level. For a pump efficiency of 70%, determine the required shaft power input into the pump and the water discharge velocity.