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# Chapter 1

## Introduction

In nature, hydraulic energy is a type of usable energy which can be directly converted into mechanical energy. It has since more than one hundred years mainly been utilized for the production of electricity. As a most important type of the renewable energy, hydraulic energy shows its very broad perspective in the future. More and more hydropower plants will be built or refurbished worldwide. In many countries, hydraulic energy will be the main source for producing electrical energy. In Norway, for example, almost the entire production of electricity is from the hydropower. According to the Swiss Federal Office of Energy (BFE 2004), the hydropower provides about 60 % of the total electricity production in Switzerland.

The hydraulic energy in our nature exists in two main forms: the flowing water in rivers and the stored water in reservoirs. Accordingly, different types of hydraulic turbines are used for generating electricity.

Among various types of hydraulic turbines, the Pelton turbine (Fig. 1.1), which is also called the constant-pressure turbine, represents an important and probably also the most widely applied turbine type. The first Pelton turbine was invented by Lester Allan Pelton in 1879 and tested successfully. The turbine is mainly used in mountainous areas where the available water, for example, is stored in a lake or reservoir which lies a few hundred to 1800 m above the turbine machines. The turbine power ranges from several kilowatts to 400 MW (Angehrn 2000). In Switzerland and Austria, Pelton turbines are predominantly installed in the Alpine regions, most of them since more than 80 years ago.

A Pelton turbine essentially consists of a Pelton wheel with blades of the bucket form and one or more injectors that generate the high-speed jets when leaving the nozzle. The energy transfer from the high-speed jet onto the Pelton wheel is performed through the interaction between the jet and the rotating buckets. Based on this kind of hydraulic and mechanical interactions, the Pelton turbine technology is divided into hydromechanics and structural mechanics. Both categories represent a broad spectrum of state-of-the-art technologies and comprise the entire technical and engineering aspects like the efficiency, reliability, and lifetime. Thus, on the one hand, maximum hydraulic efficiency should be achieved in the design of the

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