Preface

The analysis of the dynamic properties of fluid-flow machines has been for many years the subject of numerous studies conducted in many centres around the world, both academic and industrial. The results of these studies contribute to the development of theory, but also have direct application use and often end in implementation. In recent times, works on the improvement of rotating machines and a better understanding of the phenomena taking place in them, are growing in importance. Dynamic problems have escalated, as global competition forces manufacturers to continuously improve the operating conditions of new products, while maintaining a light, and more and more frequently even miniature design. In addition, raising the commercial characteristics and miniaturization is occurring along with the growing requirements in terms of efficiency, reliability and precision of operation. Due to the fact that fluid-flow machines are used in many sectors of the economy (among others: energy, transport, aviation) and very often constitute a key element in larger installations, the growing expectations also apply to such machines.

The study of the dynamic properties of various types of fluid-flow machines has been conducted for many years, also at the Institute of Fluid-Flow Machinery PASci in Gdansk. In previous years, the works were focused mainly on large machines such as turbine sets used in the power industry. Although microturbines are machines that are much smaller than thermal turbines used in the commercial power industry, very complex dynamic problems also occur in them. Due to the smaller size and greater rigidity of rotor blades, most problems associated with vibrations of these elements can be avoided, however, other difficulties appear, which do not occur in large turbine sets, for instance, high rotation speeds, aggressive working mediums and technological difficulties in making very small elements. As a result of the fact that microturbines are widely used in distributed generation, specialized diagnosticians rarely keep watch over their proper functioning, which is standard in the case of professional power turbines. Therefore, microturbines should also be reliable and work safely. It is additionally very important to use appropriate numerical models of microturbines, enabling their analysis and optimisation already at an early stage of design works.

In the era of constant development of computer technology and measurement methods, this is taking on a particular importance. By using the calculation tools available, the modern engineer is able to model and do simulations of even very complex mechanical systems. Simulation tests of a well-identified machine model can provide a lot of valuable information. A properly developed and used model can contribute to obtaining the desired effects much more quickly and cutting down the scope of more expensive experimental studies of prototype designs to a minimum. The described problems justify the need to carry out research for a better understanding of the phenomena occurring in different types of fluid-flow machines, including steam microturbines. This monograph has been devoted precisely to those issues.

The following chapters discuss simulation testing and experimental dynamic properties of microturbines, as well as their subassemblies. Chapter 1 provides the introduction to renewable energy and distributed generation, indicating the possibilities of using microturbines in the economy. Chapter 2 characterises the microturbines and discusses the key problems concerning the properties of dynamic mechanical systems, in particular rotating systems. It also provides information on the research tools used. Chapter 3 presents the results of studies of unconventional bearing systems used, among others, in steam microturbines. Foil bearings were focused on especially. Then, in Chap. 4, methods of modelling and simulation tests of microturbines are discussed, on the example of two alternative structural solutions—radial and axial microturbines. Experimental tests of the properties of dynamic elements of microturbines are discussed in the last, fifth chapter.

The published monograph should in particular interest the group of people who work in designing, modelling as well as operation and diagnostics of various types of fluid-flow machines, especially steam microturbines. The authors of the work are hoping that this position will contribute at least a little to a wider application of modern research tools in the design, operation and diagnostics of such machines, which in turn will also contribute to introducing more elaborate and reliable constructions on the market.

The results presented in this monograph are the output of several years' study on the development of simulation models as well as structural and dynamic analysis of the microturbines. The research was conducted within the project POIG.01.01.02-00-016/08 "Model agroenergy complexes as an example of distributed cogeneration based on local renewable energy sources" co-financed by the European Union, and also within the project "Advanced Power Generation Technologies—Task 4. Development of integrated technologies for the production of fuel and energy from biomass, agricultural waste and other", from the National Centre for Research and Development. The most important effect of the realization of these projects is, inter alia, the creation of prototype small power plants with ORC (owned by IMP PAN), with different power outputs as well as several construction solutions of steam microturbines.

The book was written by two authors, but its content was influenced by the work of many people. At this point the authors would like to thank their immediate colleagues from the Department of Turbine Dynamics and Diagnostics

IMP PAN, in particular M. Bogulicz, M.Sc. for the involvement in the creation of computer programs, P. Baginski, M.Sc. Eng. for cooperation in the conduct of experimental research and B. Czoska, M.Sc. for his assistance in preparing the translation. During the realization of the research also participated employees of the Aeroelasticity Department IMP PAN in persons professor R. Rządkowski, Ph.D., D.Sc. and M. Drewczyński, Ph.D. and staff from other research centers with which the authors have been cooperating with for many years, including a team of professor Z. Kozanecki, Ph.D., D.Sc. from the Lodz University of Technology and also the team from the Faculty of Technical Sciences, University of Warmia and Mazury in Olsztyn, directed by W. Miaskowski, Ph.D. The authors express their thanks to all members of the teams involved.

http://www.springer.com/978-3-319-12017-1

Steam Microturbines in Distributed Cogeneration

Kiciński, J.; Żywica, G.

2014, XI, 219 p. 284 illus., Hardcover
ISBN: 978-3-319-12017-1