Abstract to the dissertation of
Katranova Gaziza on the topic: «Development and research of highly efficient front devices of the combustion chambers of gas turbine installations», submitted for the degree of Doctor of Philosophy (PhD) on the specialty 6D071700 –«Heat Power Engineering»

Relevance of the research topic

The dissertation of Katranova G. S. is written on an actual topic, since in modern conditions gas turbine installations are widely used as a drive for superchargers of compressor stations for pumping oil and gas. Due to the branching and length of gas pipelines and their passage both in sparsely populated and densely populated places, the reduction of harmful emissions of gas turbine installations into the environment is of particular relevance. In addition, in recent years, gas turbines have been used as engines for driving generators in the energy sector, and as gas turbines in the composition of combined-cycle plants, the number of which is growing from year to year.

The object of the dissertation research is. The object of the study is the front-end devices of the combustion chambers of the gas turbine engine.

The subject of the research is the development of streamlined microfibre devices in the form of turbine profiles, as well as devices based on them.

The purpose and objectives of the study. The purpose of the dissertation work is to research, develop and improve microfakel devices based on water-repellent bodies that provide low toxicity of gas turbine installations and minimize hydraulic losses in the combustion chamber of gas turbine engines.

Scientific and information base of the research. The scientific developments are based on modern methods of mathematical modeling, identification methods and computational algorithms. The results of real and numerical experiments using COMSOL and Ansys fluent programs are presented.

The reliability of the work. The results of experimental and numerical experiments have a sufficient degree of confidence for the following reasons:

- when planning, preparing and conducting experiments, calculations of the errors of the obtained data were carried out;
- when conducting experiments, modern high-precision instruments and equipment were used, which were verified and certified;
- the results of the experiments were compared with the nearest analogues and the results obtained by foreign authors;
- the results of the numerical simulation were compared with the experimental data obtained.

The reliability of the work is also supported by an integrated approach to conducting experiments, a high degree of accuracy of measurement systems.

Scientific novelty. On the basis of theoretical and experimental studies, streamlined microfibre devices in the form of turbine profiles, as well as devices based on them, have been developed. At the same time:

- the optimal forms of turbine profiles that provide optimal flame stabilization and low emissions of harmful substances are identified;

- the optimal angle between the turbine profile and the cover plate is revealed, as well as the fuel supply method that provides the lowest hydraulic losses, with relatively low nitrogen oxide emissions, high stabilization indicators and high fuel combustion efficiency;

- new technical devices have been developed based on the microfakel principle of fuel combustion – a two-zone combustion chamber, a burner.

The scientific novelty of the work is also confirmed by three patents of the Republic of Kazakhstan and one Eurasian patent.

Scientific and practical significance of the study.

The scientific and practical value of the work consists in the development and receipt of:

- the principle of using easy-to-clean microfibre devices in the form of turbine profiles, providing high stabilization of the flare, relatively low hydraulic losses and low emissions of toxic substances;

- a two-zone combustion chamber with turbine profiles, providing high technical and environmental performance in the entire load range, protected by the copyright certificate for the invention;

- dual-zone combustion chamber, with corner stabilizers, protected by copyright certificate.

The obtained experimental data on microfakel devices allow us to create a new class of combustion chambers with high environmental and technical and economic indicators.

Approbation of the research results. The main provisions of the work are presented in 20 publications, including

- in the journal «Thermal Science», which is a database of Web of science, in the «Espacios» journal and «IOP Conference Series: Earth and Environmental Science», which is included in the Scopus database – 3;

- in journals recommended by CCES of the MES – 3;

in foreign scientific journals, including international conferences – 7;

- patents of the Republic of Kazakhstan for the invention – 2;

- patents of the Republic of Kazakhstan for a utility model-1;

- Eurasian patent for invention– 1;

- collective monograph – 3.

The content of the dissertation. Volume and structure. The dissertation contains an introduction, 4 sections, a conclusion, a list of references, and appendices.

In the introduction, the relevance of the scientific work is revealed, the problem under study is specified. The main idea, scientific novelty, reliability of the work, personal contribution of the author, as well as approbation of the results and publications are presented.

In the first section of the thesis presents an analysis of the main directions of development of the gas turbine construction, the role of gas turbines in the

energy sector in the world and Kazakhstan, an overview of the main directions of improving the environmental performance of gas turbines and GTU, the analysis of the front of the devices of the combustion chamber and burner devices, providing MFS, theoretical and experimental studies MFPs, including a well-streamlined bodies. The statement of the purpose and objectives of the study is presented.

The second section of the dissertation presents the results of mathematical modeling of the flow around the blade profile, the study of the flow failure point, the process of microfakel combustion behind streamlined bodies and the calculation of emissions for MFPs in the form of streamlined profiles. The dependences of the concentrations of nitrogen oxides, hydraulic losses, and temperatures at the outlet from the simulated area on the type of microfibre elements used are presented.

The third section describes the experimental setup and physical models, the method of conducting experiments and measuring the main parameters, and estimates the measurement errors.

The fourth section presents the results of an experimental study of easy-to-flow and low-flow bodies – turbine profiles and angle stabilizers, respectively. The results of measurements of temperatures and concentrations of nitrogen oxides at the outlet of the experimental installation are presented. The results of the analysis are presented. Based on the results of experimental studies, formulas for the dependence of the "poor" breakdown, the concentrations of nitrogen oxides and the temperature level, as well as hydraulic losses, depending on the microfibre elements used, are presented.

The conclusion reflects the main results and conclusions of the dissertation work.