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РАЗРАБОТКА ПРОГРАММНОГО МОДУЛЯ ДЛЯ ДИАГНОСТИКИ АВИАЦИОННЫХ ДВИГАТЕЛЕЙ ПО ТЕРМОГАЗОДИНАМИЧЕСКИМ ПАРАМЕТРАМ
DEVELOPMENT OF A SOFTWARE MODULE FOR DIAGNOSTICS OF AIRCRAFT ENGINES USING THERMOGASDYNAMIC PARAMETERS

Аннотация: статья затрагивает проблему повышения эффективности методов диагностики авиационных двигателей. Более подробно рассматриваются методы диагностики по термогазодинамическим параметрам. В качестве примера авторы представляют диагностическую систему сравнения эталонных значений параметров состояния газотурбинного двигателя (ГТД) с текущими параметрами.

Abstract: the article addresses the problem of improving the efficiency of methods for diagnosing aircraft engines. Methods of diagnostics by thermogasdynamic parameters are considered in more detail. As an example, the authors present a diagnostic system for comparing reference values of state parameters of a gas turbine engine (GTE) with current parameters.

Ключевые слова: авиационный газотурбинный двигатель, техническая диагностика, термодинамический параметр, математическая модель.

Keywords: aviation gas turbine engine, technical diagnostics, thermodynamic parameter, mathematical model.

The increasing complexity of the design of aircraft engines today causes not only an increase in their cost, but also a significant increase in labor costs for the search for design and manufacturing defects. High losses from poor-quality product diagnostics, lack of methodological materials on the organization of aircraft engines diagnostic support make it necessary to develop effective methods and means of automated control for the aircraft engines diagnosis.

The experience of using the means of early detection of engine malfunctions shows that in the operative diagnostics of defects the main thing is the constant monitoring of thermogasdynamic parameters (TPDP). Therefore, important and urgent tasks are the research and development of methods for automated aircraft engines diagnostic according to the TPDP as well as for the composition of the complex of automation equipment that implements these methods [1].

In accordance with generally accepted concepts, thermogasdynamic parameters include: pressure, temperature, ratio of pressures and temperatures, flow rate, fuel and oil consumption, flow areas of the flow part sections, thrust, and rotor speed. Therefore, diagnostic methods according to thermogasdynamic parameters should be attributed to parametric methods [2].

Thermogasdynamic parameters are monitored and diagnosed by comparing the values of the parameters with the maximum allowable values, by determining the deviations of the throttle characteristics in the form of deviations of individual parameters, and also by analyzing the deviations of the complexes of parameters using the mathematical models of GTE. The construction of mathematical models is the most crucial stage in the thermogasdynamic diagnostics of GTE and is mainly determined by the correctness of the formulation of the equations included in the model [3].

In this article we consider the diagnostic system based on the principle of comparing reference values of state parameters of a gas turbine engine (GTE) with current parameters, obtained as a result of their measurements during its operation. This is achieved by mathematical modeling of gas turbine engines in a specially developed software environment of AS GCAE and EI (Automated System of Gas-Dynamic Calculations of Aviation Engines and Energy Installations).

In the GTE it is impossible to directly measure the parameters of the state; they can only be determined indirectly, through measured thermodynamic parameters [4].

Based on the comparison, the the technical condition coefficients are calculated for various parameters (a comprehensive diagnostic indicator). (See table 1)

For correct estimation of the state parameters, it is necessary to obtain an adequate mathematical model of the GTE based on the results of measured thermodynamic parameters and to localize the node according to the developed algorithm, which is most likely responsible for the deviation from the operative condition.

The collection of information in the course of GTE operation is carried out by the Automated Remote Measurement System (ARMS), which is designed to measure, collect and transmit information about the parameters of the GTE to computer media.

As an example in fig. 1it is shown a block diagram of such a system for monitoring the parameters of a TJ 100 turbojet engine.

Table №1

Calculated parameters			Calculated parameters for AS GCAE and EI	Measured Parameters	Absolute error
1) rotation frequency	n	rev / min	56339	56339	0
2) Total hourly fuel consumption	S_TSum	Kg/h	108,176	108,11	-0,066
3) Specific fuel consumption	SFC	kg / h · kN	99,2116	99,183	-0,0286
4) The total engine thrust	R_Sum	kN	1,09036	1,09054	0,00018

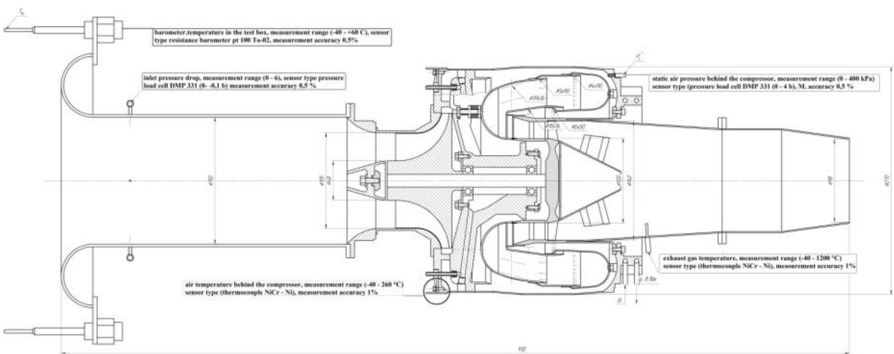

Fig.1. Block diagram for monitoring the parameters of GTE TJ-100

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