

ARTICLE

FEATURES OF THE APPLICATION SOFTWARE COMPLEX AUTODESK INVENTOR TO BUILD 3D MODELS ROTOR GTE-16M

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ABSTRACT

This article discusses the features of using Autodesk Inventor software for modelling equipment, the advantages and effectiveness of this program. Graphics in the form of 3D (three-dimensional) looks much more realistic than the traditional two-dimensional graphics, in addition, it allows you to represent the object in the form in which it can be in reality, to consider it from all sides. Characteristics Autodesk Inventor allows you to create digital models of technological products, includes convenient mechanisms for finding components, forms design documentation. The primary means of intensification of production consist in the accuracy of automated design, the installation of technological management, to improve the quality of products and the efficiency of its production. The main thing in the development of modern equipment is the introduction and improvement of technical products, improving the quality of the system. The complexity of the technological processes that must ensure the lowest costs at the highest productivity, the need to select the optimal process, the multivariate available capabilities and the responsibility of the decisions made presupposes the rational application of CAD methods and tools (computer-aided design). Currently, CAD should provide the solution of the following tasks: to perform 3-dimensional modelling, geometric constructions, applying standard product dimensions; To work with the library of standard objects, as well as text technical documentation. Without the automation of design, the system cannot work in full efficiency, the modelling of the elements allows us to evaluate the prospect of introducing any equipment and improve the quality of the system as a whole.

INTRODUCTION

To solve the task, the computer-aided design (CAD) system was chosen, namely Autodesk Inventor.

KEY WORDS

CAD, Autodesk Inventor,
graphic editor,

The Autodesk Inventor component library includes a large number of standard components for fastening and finished product models, partitions for design features, which is very convenient for the user. Including the GOST standard and all common world standards (ANSI, ISO, DIM, JIS, etc.). Currently, the number of standard parts in the library is approaching one million.

In addition to the library of finished parts, Autodesk Inventor also has a library of their individual elements that performs various forms of die cuts, holes, punches, selections, etc. [2]

Autodesk presents various versions of the Inventor product. Student's license Inventor is presented to students and teachers as a free version in an educational form, such version has a special mark on the created or edited files.

METHODS

Among modern balancing machines, two main groups can be distinguished: pre-resonance machines with rigid supports and resonant ones, with elastically suspended supports of rotation. The most widespread are the resonant machines due to less stringent requirements to the foundations for which they are installed. However, the balancing performed in the pre-resonance frequency range makes it possible to obtain the greatest accuracy.

Features of the pre-resonance type of balancing machine:

- high accuracy of balancing in the pre-resonance mode;
- possibility of balancing without calibration starts;
- balancing of any types of rotors;
- cardan drive for rotors with large aerodynamic resistance and rotors of complex configuration;
- special saddle-shaped inserts for balancing aviation turbines and compressors in their own bearings;
- Manual drive belt;
- Constant (for long term) calibration factors.

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Analyzing the characteristics of existing balancing machines presented in the Russian market, a large-scale horizontal pre-resonance balancing machine was developed from such large manufacturers as: DIAMEX, CIMAT, SCHENCK, and Techno balance.

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[Fig. 2.1] shows the assembly 3D model of the developed balancing machine.

The pre-resonance balancing machine consists of a bed 1 and two support units 2, which are adjustable in height. The support units can be displaced along a rail mounted on the frame relative to each other and equipped with a piezoelectric force sensor.

The cast base [Fig. 2.2] is made of a vibration-resistant polymer (20% more absorbs vibration than a cast-iron bed), mounted on special vibration-armor, covered with a vibration-absorbing layer, does not require a foundation. The total length of the bed is 1500 mm.

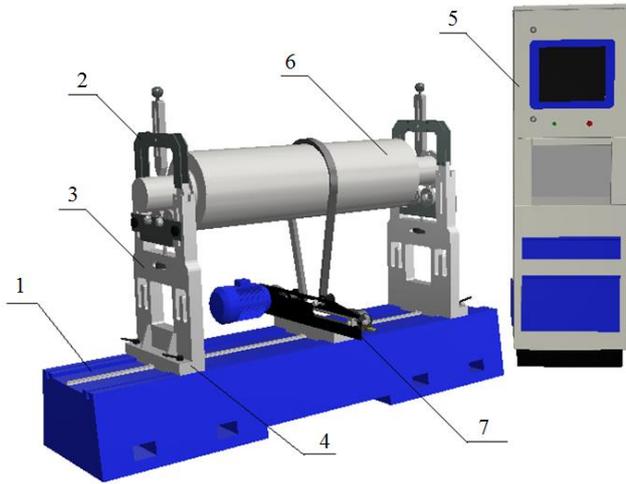


Fig. 2.1: 3D model of the balancing machine. 1 - bed; 2 - reference node; 3 - support base; 4 - support plate; 5 - control unit; 6 - the investigated rotor; 7 - middle support with electric motor.



Fig. 2.2: Stand of the pre-resonance machine together with the installed rail.

The support assembly [Fig. 2.3] includes the support base and the support plate. Piezoelectric force sensor, built into the support base. On each support cylindrical reinforced rollers are installed on which a balancing rotor is installed. The height of the support rollers is adjustable in height, thus this design feature allows covering a wide range of balancing rotors along the diameter of the support necks.

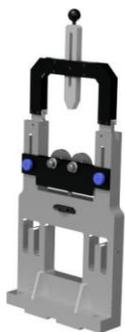


Fig. 2.3: Supporting assembly.

The operation of the machine in question is controlled by the control unit 5 (operator's rack), to which the force sensors mounted on each support and the driving motor are connected. Preconfigured frequency-controlled asynchronous electric drive allows controlling the rotor speed, acceleration and deceleration with the help of a belt drive and a number of guide rollers.

As a phase angle sensor for the belt drive, a laser tachometer is used [Fig. 2.4].



Fig. 2.4: Digital laser tachometer DT2234C +.

The operator's rack [Fig. 2.5] is equipped with a laser printer to output the balancing results on paper.

RESULTS AND DISCUSSION

Rotor GTD-16M

As the object of balancing, the rotor of the turbocharger of the gas turbine engine GTD-16M is considered. [Fig. 3.1] shows the turbo-generator unit TG-16M is an autonomous unit used to create the conditions for launching gas turbine engines of aircraft. GTE-16 serves for driving through the reducer of the generator and for all components of the maintenance of the TG-16 [14].



Fig. 3.1: General view of the turbo-generator unit TG-16M.

The rotor of the turbocharger [Fig. 3.2] is a shaft at one end of which is a turbine disk, on the other is a compressor impeller [Fig. 3.3] [14].

The rotor rotates on the rolling bearings installed in the compressor casing.



Fig. 3.2: Rotor shaft of the turbocharger with a disk: 1 - shaft; 2 - blade with blades.



Fig. 3.3: The impeller of the compressor.

The turbine is a single-stage, axial, designed to convert the thermal energy of hot gases into mechanical work and includes three main units: a nozzle apparatus, a turbine disk with blades and a turbine case. The disk of the turbine [Fig. 3.4] is made of steel EI437BU, along the edge of the disk 36 Christmas tree grooves are made, into which turbine blades are inserted. The disc hub is tightened to the shaft with interference and is fixed with 6 radial pins made of 18X2H4BA steel. The rotor shaft is solid, made of steel 38XMUA. The blades of the turbine are made of the alloy ZhS6-K. On the disc, the turbines are fixed with a plate lock, the protrusions of which are bent to the disc of the turbine. [3,9,10]



Fig. 3.4: Turbine disc GTE-16M.

For further calculations, a 3D model of the turbocharger rotor in the Autodesk Inventor CAD was simulated [Fig. 3.5]. According to the operating and maintenance manual for the turbo-generator unit TG-16M, the 3D model is designed in a scale of 1: 1 and takes into account all the geometric features of these parts of the unit.

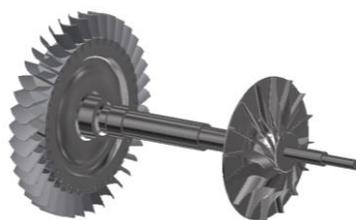


Fig. 3.5: Modelled turbocharger rotor 3D model.

CONCLUSION

The software package Autodesk Inventor allows you to automate, simplify the design of the installation, significantly reduces costs. In this article, the turbo-generator unit TG-16M, the gas turbine engine, and its components are considered: a reducer, a GS-24A-3C direct current generator and systems. For normal operation of the installation in accordance with the specifications, the gas turbine engine GTD-16, turbocharger rotor, turbine, turbine disk are their main characteristics and components of the material. All parts of the system, with the correct modelled view, ensure a balanced and efficient operation of the installation.

Modelled model allows you to analyze it in the process of assembly, if necessary, make changes without losing the quality of the model.

In this paper, using the Autodesk Inventor program, calculations were made, the materials of the parts and their physical and chemical properties were assigned and an assembly unit was created that includes 3 components: a shaft, a disk with blades and a compressor impeller.

Model of turbo-generator unit TG-16M 3D-model is designed in scale 1: 1 and takes into account all the geometric features of these parts of the unit.

CONFLICT OF INTEREST

There is no conflict of interest.

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None

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