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Designing a compartment for a nuclear engine with a parachute system

The work presents a designed compartment for a nuclear power plant with a parachute system, which will be located in an aircraft. In the event of an emergency, the compartment will be disembarked to avoid a local man-made disaster.

Introduction

The energy crisis prompts humanity to look for new or develop forgotten effective types of aircraft. One of these is an aircraft with nuclear power plant. Work on the atomic program began in Antonov's Research and Design Bureau in 1965. The largest soviet aircraft at that time was the heavy transport An-22, which allowed for the installation of a serious crew protection system. On its basis, the project of a long-range low-altitude anti-submarine defense aircraft with a nuclear power plant - An-22 PLO, as well as a variant of an intercontinental air-missile complex equipped with naval ballistic missiles with nuclear warheads - An-22R was developed [1].

In parallel with the work on the An-22 in 1971, the designers of the Antonov Research and Design Bureau were already planning a project for an even larger military transport aircraft - the An-124. One of the variants of this promising machine, which was assigned the label "Completely Secret", was supposed to be the An-124A - a barrage carrier of strategic missiles, with a nuclear reactor as the main source of energy for the engines [1].

However, the work on the development of atomic airplanes was suspended due to a number of problems faced by the developers: a high probability of exposure to the flight crew, a nuclear explosion when the plane falls, and radioactive emissions into the atmosphere. At that time, it was not possible to solve these problems. However, today humanity has achieved great success, we have the latest technologies that provide new opportunities for atoplanes.

References review

At the moment, the question of the energy crisis is very strong, gas turbine engines have almost reached the peak of their capabilities, basically everything comes down to reducing noise and weight. It is necessary to switch to alternative types of engines. One of these is a nuclear power plant. All the disadvantages and advantages of this type of engine are described in source [2]. Despite the significant advantages, the nuclear power plant has a number of problems, one of which is the fall of the aircraft in the event of an emergency, which can lead to a man-made disaster. The way out of this situation can be a system of separation of the compartment with the power plant in case of danger and its subsequent landing. There are several options for the implementation of compartments that are separated during flight. One of them is a catapult capsule that is fired from an aircraft and opens the parachute system. The paper examines the main causes of loss of survivability after a plane crash and ways to eliminate them, as well as means of evacuating the plane, both in the air and after impact [3]. Independent ejection pods are not only used for airplanes. For example, in source [4] a catapult capsule for a submarine was calculated. However, the use of an independent launch capsule is not suitable for a nuclear power plant for several reasons. The main reason is the excessive weight of the power plant together with radiation protection. Shooting an object of such size and weight requires a lot of force. The explosion that will accompany this phenomenon can affect the movement of the aircraft and cause damage. In most cases, the nuclear power plant is located in the tail of the aircraft, therefore, during ejection, the compartment can damage the tail fin. Due to the reasons mentioned above, such a system cannot be used to solve the problem. A more appropriate option is the landing of the compartment, followed by the use of the parachute system. It is this option that will be considered in the work.

The goal of the work

The purpose of this work is design a compartment for a nuclear power plant with a parachute system, which will be located in an aircraft. In the event of an emergency, the compartment will be disembarked to avoid a local man-made disaster.

Research results

First, a three-dimensional model of the compartment was created, which includes the power plant and the parachute system. The designed model of the compartment is presented in Fig. 1.

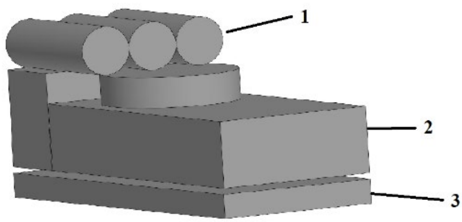

Fig. 1 Three-dimensional model of the compartment:
1 - Parachute system; 2 - Nuclear power plant with radiation protection; 3 - Cell blocks

The proposed nuclear power plant has a mass of 5 tons along with radiation shielding. The parachute system was chosen based on the landing of large and heavy objects from military cargo planes and the results of works [5] and [6]. This system includes: cargo parachutes, suspension system, fixing system and platform with cell blocks. Based on the weight characteristics, the parameters of the parachute were calculated based on the equations presented in source [7]:

The area of the cargo dome is 1.200 m^2;

The number of parachutes is 3;
The dome area of one parachute is 400m²;
The number of slings is 120;
The speed of descent is 10 m/s;
The weight of the system is 200 kg;
The material is nylon.

In the event of an emergency, the landing of the compartment with the nuclear power plant will be carried out, followed by the use of the parachute system. After separating the compartment from the aircraft, the cargo parachutes that form the dome are opened. After that, the compartment lowers at the declared speed. During the descent, the platform with cellular blocks will absorb air, increasing in size to reduce the shock on landing.

It should also be noted that the weight of the system for landing a compartment with a nuclear power plant is rather large — 200 kg. But, if analyzed more deeply, the mass of this system is 4% of the mass of the engine. However, with an increase in engine mass by 4%, all the advantages of a nuclear power plant are preserved — clean and cheap energy on a large scale.

Conclusions

The work presents a designed compartment for a nuclear power plant with a parachute system, which will be located in an aircraft. In the event of an emergency, the compartment will be disembarked to avoid a local man-made disaster.

The calculations show that the weight of the system for disembarking a compartment with a nuclear power plant is quite heavy — 200 kg. The mass of this system is 4% of the mass of the engine. However, with an increase in engine weight by 4%, the main advantage of a nuclear power plant is preserved — cheap energy on a large scale.

In this way, one of the main problems of airplanes is solved, namely the occurrence of a man-made disaster in the event of an emergency. However, there are still several very important problems - radiation exposure of the flight crew, if it is not an unmanned aerial vehicle, and radioactive emissions into the atmosphere.

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