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Aero-Engine Air Intake and Its Location Design

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Abstract***: The air source used for air conditioning in modern aircraft comes from the bleed air from the high-pressure compressor of the engine. As long as the engine is running, it can provide air supply and also provide cabin pressurization. The source of engine bleed air is drawn from the compressor of the turbofan engine. There are low-pressure stage bleed air and high-pressure stage bleed air at the bleed air part. In order to reduce the loss of engine power, modern airliners use two-stage bleed air. When the low-pressure stage bleed air is insufficient. It can be supplemented with high-pressure stage bleed air. At this time, the low-pressure stage has a one-way valve to prevent backflow. Aeroengine Air Inlet: An opening of an air duct or similar structure that uses the forward motion of the aircraft to collect air and direct it to the engine or ventilator. In flight, the intake port should realize the deceleration and boosting of the high-speed airflow, and convert the kinetic energy of the airflow into pressure energy. With the increase of flight speed, the pressurization effect of the intake port becomes larger and larger, and the pressurization effect of supersonic flight can greatly exceed that of the compressor. Therefore, the supersonic aircraft intake port plays an important role in improving flight performance. By analyzing the air intakes and their positions of common aero-engines, it is found that in order to enable the engine to generate greater thrust, the current air intakes and their position designs must minimize the flow rate and angle of attack of the intake air. Changing the position of the air inlet is an important method to reduce the flow rate and angle of attack. Based on the fact that there has not been a perfect solution for the air intake and its location of the aero-engine, the design of the air intake and its location has been carried out. Finally, the optimal design of the air inlet and its position is realized by SolidWorks 3D modeling software. The design results show that, in order to make the engine generate more thrust, the design of the air intake and its position is not necessarily the same as the design of the air intake and the angle of attack.***

Keywords: aero-engine; air intake and its location; optimization

1 Introduction

The aero-engine is the heart of the aircraft. Whether the air intake system can smoothly inhale air through the air inlet has an important influence on the performance of the whole engine and the thrust generated by the engine [1-3]. The intake system mainly includes an intake port and an intake port. Common air intake locations are generally in the front of the nose, the rear of the fuselage, the abdomen or the back of the aircraft [4,5]. So why do jet engine air intakes vary in location? This is because the design arrangement of the position of the air intake is mainly to adapt to the overall design of the aircraft, the performance of the engine and the needs of flight purposes, so that the speed distribution is uniform and the additional resistance is small [6-8]. At the same time, the air intake should not be easy to inhale debris so as to avoid damage to the internal parts of the engine. Today's aero-engines are generally designed to reduce wind resistance, and racing cars require a certain amount of wind resistance to be retained. By understanding and comparing the two, a design similar to a racing car can be adopted, and then the wind resistance can be used for its own use.

Compressor technology follows the endogenous development logic, but at the same time it must serve the overall needs of aero-engines, otherwise, no matter how high its performance index is, it cannot be integrated into an advanced complete machine. The design of the air inlet and its location is an important method to improve the performance of the compressor [9]. Therefore, it is very meaningful to carry out technical research on the air intake and its location under the overall traction. However, the forward-looking foundation and key technology research in the domestic compressor design field is relatively heavy. According to its technical endogenous logic development, the unilateral pursuit of high pressure ratio and high efficiency does not improve the overall performance of aero-engines [10]. It is mainly reflected in the lack of domestic ability to put forward basic and innovative technologies according to the overall development needs. In this regard, developed countries have done a good job and can rely on the overall concept of pre-research to drive technological innovation of fans/compressors, such as lift fans, core engine drives (multi-channel drive) Technological innovations such as exhaust) fans and intercooling compressors all appear in this situation [11-12]. Basic research is not systematic, comprehensive, and in-depth For a long time, the field of compressor design is also difficult to measure and imitate. Insufficient sex and depth. It is of great significance to the technical research and breakthrough in the field of compressors to design a new type of design scheme.

2 air intake design method

2.1 Ideas

First, from the perspective of design methods and theories that still exist, the international development trend is sorted out; then, in terms of basic research, innovation capabilities, etc., the current development status and existing problems at home and abroad are discussed; The direction, thinking and focus of the subsequent development of the air intake and its location. Inspired by the design of the racing car, I found out that the reason why the racing car can convert the wind resistance into the downward force for its own use is because the "ground effect" is used in the design of the chassis structure of the racing car. The reason for the downward force is to use the low-pressure area at the rear of the car, so that the air flowing through the chassis can be compensated to the low-pressure area more quickly. The effect of lift due to excessively fast air velocity on the surface. The car uses a specially designed underbody to create a "ground effect" that generates a downward force to increase its contact with the ground, which increases the friction of the wheels and makes the car more efficient. After thinking and discussion, we have come up with a design plan to make the air inlet into an opposite structure to convert the downward force into the upward force, resulting in a hydrodynamic effect similar to "ground effect". In this way, the wind resistance can be converted into upward force for its own use.

2.2 Scheme

We combine the air inlet and the wing to form a similar incompletely closed nozzle structure. The air velocity in the nozzle structure is accelerated through the exhaust port, so that the pressure in the nozzle structure is reduced, and the aircraft The pressure under the wing is greater than the pressure inside the nozzle, causing it to exert a lift on the wing and fuselage.

3 Design Results and Discussion

3.1 Results

The design based on the air intake of the aerospace engine adopts the combination of the air intake and the wing. The combined structure of the air inlet and the wing designed in this paper can be applied to many types of aircraft, and can solve the problems such as the difficulty of flying due to the influence of resistance during flight, and the need for more materials and more power due to the large power required for the aircraft to overcome the resistance. The design results are shown in Figure 1-3.

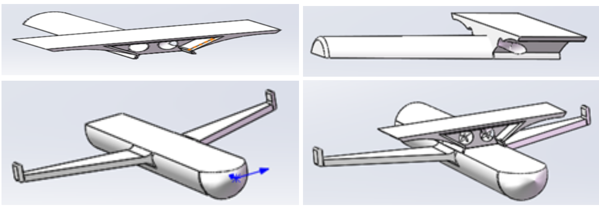

Fig.1 An isotropic view of the results of the design of an air intake for an aerospace engine

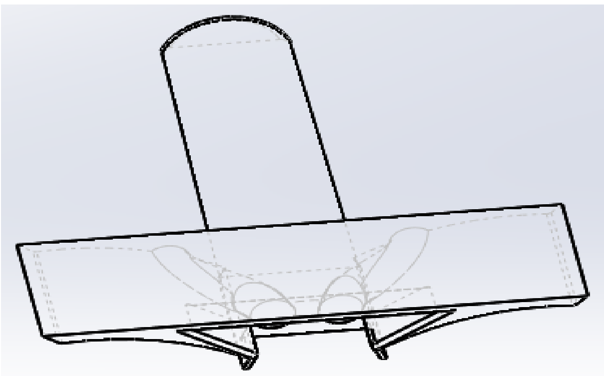

Fig. 2 Air intake perspective

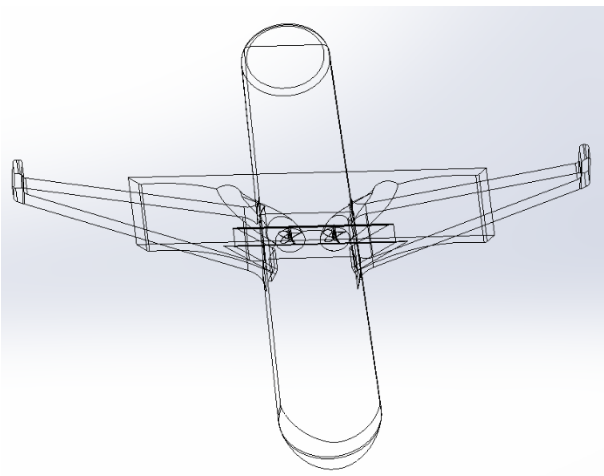

Fig. 3 General assembly drawing of air intake

3.2 Discussion

We have analyzed in detail that the air intakes are generally divided into two types: frontal air intake and non-frontal air intake according to their different positions on the aircraft. Front air intake: The air intake is located at the head of the fuselage or the engine nacelle, and the flow field in front of the air intake is not disturbed. The advantage is that the structure is simple. The biggest disadvantage of the front air intake on the fuselage head is that it is not convenient to place radar and antenna on the fuselage head, and the air intake pipe is too long and the wind resistance problem; non-frontal air intake: including air intake on both sides, wing root air intake, ventral intake and underwing intake. They overcome the disadvantage of the frontal air intake of the nose to varying degrees. In the non-frontal air intake scheme, a layer of uneven airflow (boundary layer) in front of the air intake close to the fuselage or wing surface must be prevented from entering the air intake. Because the design scheme we adopted can perfectly solve the problem of wind resistance, and in order to make the structure simple enough, there is no need to consider a layer of uneven airflow (boundary layer) in front of the air intake close to the surface of the fuselage or wing into the air intake problem, we ended up opting for a frontal intake. Since the intake duct we designed is not linear, we were worried that it would affect its wind resistance conversion efficiency. By querying the data and performing a certain degree of calculation, we concluded that its influence on the wind resistance conversion efficiency can be ignored. record the result. Therefore, there is no need to design a special fan blade to match it, just use a standard fan blade.

3.3 Recommendations for the next step

We believe that this design is very good and has many advantages, but there is still room for improvement. For example, the incompletely closed nozzle mechanism between the wings is completely closed. This design has not been completed due to some shortcomings in capacity. If you can design a reasonable structure, you can continue to work hard and improve it next time.

4 Conclusion

The design structure is very good, and the combined structure of the air inlet and the wing has the advantages of fast take-off speed, high space utilization, reducing the influence of the aircraft by resistance, and saving fuel. This design can be promoted to the aircraft on the market, so that the aircraft on the market can use the design.

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