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Electrical machine converter systems for the on-board AC system of a modern aircraft

The article deals with the overview of the aircraft power supply system, which has improved technical and functional characteristics in terms of the generation, distribution and control of electrical energy on the aircraft.

The concept of electricity supply does not include distribution and feeder networks, their protection and management, and aircraft consumers of electricity.

The main power supply system that provides power supply in normal flight conditions.

Auxiliary power supply system that provides power supply under normal conditions on the ground when the main system is not working. An example of such a system is an auxiliary power plant with an additional generator, which is turned on only at airfields to provide power to the aircraft when the aircraft engines are not working.

Auxiliary-emergency power supply system that performs the following functions:

in addition to the functions of the auxiliary system, the functions of emergency power supply in flight, in case of complete or partial loss of power supply from the main system. Such a system, unlike a simple auxiliary system, works in flight simultaneously with the main system or with part of the main system. An example of such a system is the same APU with a generator. It differs in that the auxiliary generator is used not only on the ground, but also in flight, instead of one or more generators that have failed.

An emergency power supply system that provides power in flight when there is a complete loss of power from the main or auxiliary emergency system (if the latter is available on the aircraft).

Recent years have been marked by the transfer of most consumers to AC power, which is associated with the need to reduce the weight of the entire complex of electrical equipment of aircraft, as well as the growth of power consumption.

The main structural scheme of the power supply of modern aircraft is a stable frequency alternating current system, the structural scheme of which is shown in Fig. 1.

According to the principle of operation, aircraft generators do not differ from similar ground-based generators, but they have a number of features: low weight and dimensions, high armature current density, forced air, evaporative or liquid cooling, high rotor speed, and the use of high-quality structural materials. As direct current sources, contactless synchronous alternators and collector DC generators are usually used. Generators are installed on engines and auxiliary power plants, while the speed of turboprop engines of airplanes and helicopters is stabilized by adjusting the engine load by changing the pitch of the screw, but on

turbojet engines, the rotor speed can vary widely and with a rigid mechanical drive to the alternator, the frequency also changes significantly, which is often unacceptable for consumers.

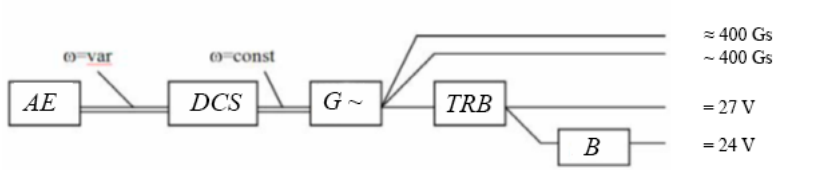

Fig. 1. Structural circuit of power supply by alternating current.
Stable frequency: AE - Aviation Engine; G - alternator of variable three-phase current; TRB - transformer rectifier block; DCS - drive constant speed; B - rechargeable battery.

Therefore, the electrical networks are built according to different schemes. The construction of the network depends on the appointment of an aircraft, its design features and equipment used. On most aircraft, an AC generators are installed, outstanding a stable frequency current, either due to the constant speed of the engine, or due to the drive of constant revolutions (DCR, are also called the drives of the constant rotation frequency - the DCRF).

There are also aircraft where unstable frequency generators are installed on the engines, from which consumers who are undemanding to the frequency are fed-fluorescent lighting, an anti-icing system, rectifiers, and converters that produce an alternating current of a stable frequency are fed from the rectifiers.

Generators always work complete with protection and control equipment. For example, alternating current generators GT40PCH6, GT40PH8, GT60PC8 and some others work with BZU-376SB protection and control unit and a BRN-208MA voltage control unit or with one block of control, protection and control of BRZU-115. BZU protects the generator from exceeding current and frequency (disconnects the generator drive at a frequency of more than 480 Hz), the load (turning off the contactor, connecting the generator to the network) - from increasing and stroke and frequency drops. BRN Adjusts the output voltage of the generator. BRZU combines all these functions, as well as it is the easiest set BZU + BRN by weight - 4.62 kg against 5.3 and 4.4, respectively.

On aircraft, electric machine converters and static semiconductor converters (inverters) are used as secondary current sources. An electric machine converter is an assembly consisting of a direct current electric motor and an alternating current generator (sometimes two), mechanically fixed to a single shaft. The principle of operation of such a converter is based on the double conversion of electrical energy in electric machines - the engine and the generator. Electric machine converters require regular maintenance (usually every 100 hours of flight or operating time) and monitoring of the condition of the brush-collector units, with the replacement of the current collector brushes as they wear out.

Static converters convert direct current to alternating current using controlled semiconductor devices-transistors or thyristors. Their noise and vibration are significantly lower than those of rotating converters (only the cooling fan is made of movable elements, and there is no cooling fan at all in low - power converters), and the efficiency can reach 85 %, which is especially important when the aircraft is powered by emergency batteries.

The aircraft power supply system is a modern system that has improved technical and functional characteristics in terms of generating, distributing and controlling electrical energy on the aircraft.

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