UDC 520.6.02

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The power supply system of a promising aircraft with an increased level of electrification

The article deals with the overview of the power supply system of electricity sources and the consideration of the possibilities of using high-voltage DC power supply systems on modern aircraft.

Despite significant progress in the aviation industry, the level of electrification of modern aircraft is still not very high and unmanned aerial vehicles are more electrified.

Analysis of the composition of electricity consumers of future aircraft allows us to conclude that the power supply system should provide the following types of voltage:

- 270 V DC power supply for electric drive devices and power plant start-up system;
- AC 200/115 V with a frequency of 400 Hz to power most of the aviation and electronic equipment;
- direct current of 27 V for the power supply of traditional consumers, which it is advisable to switch to alternating current or high-voltage direct current. At the same time, for some powerful consumers (heating, lighting, de-icing systems, etc.), it is advisable to use a floating-frequency AC voltage.

The 270 V system is most fully used for electromechanical drives and electronic control systems.

All electrical equipment of aircraft, depending on the purpose of each of its elements can be divided into three main groups:

1) electric power sources and converters, their protective and regulating devices;
- power transmission and distribution system;
- consumers of electric energy.

The first group includes:

- electric generators of direct and alternating current;
- chemical current sources;
- electric energy converters, including electric machine converters of all types;
- rectifiers, transformers, voltage multipliers and other devices;
- regulating and protective equipment, including voltage and frequency regulators;
- devices for protecting generators from reverse currents and reverse power, protection against overvoltage and overload;
- devices that provide automatic distribution of active and reactive power between parallel generators, etc.

Elements of the second group:

- electrical (on-board) network, including various wires and harnesses;
- switching control and protection equipment;
- switchgear equipment;
- control and measuring devices for monitoring the operating mode of the electrical system of the aircraft;
- installation and installation equipment (connectors, switchgear, remote controls, etc.).

The third group includes:

- control and measuring equipment and devices based on the use of electrical energy, thermometers, tachometers, fuel meters, compasses, etc.;
- automatic control systems, computers;
- means of communication and radio equipment (navigation and location);
- aerial photography equipment;
- electric motors, electromagnets and other devices used to actuate and control actuators;
- lighting and car alarm devices (external, internal, signal and control devices);
- de-icing and heating devices, as well as refrigeration units;
- electric ignition system.
- starting devices (electric starters for starting aircraft engines, etc.);
- electrified weapons, including turret installations, electromagnetic descents, locks, electric bomb throwers, photokinopulemets, etc.

The technical possibilities that have emerged recently (DC generators with contactless switching, contactless motors and switching equipment) require consideration of the possibilities of using high-voltage DC power supply systems on modern aircraft. Taking into account the simplicity of DC systems and their main advantage (the absence of PPCHV and related disadvantages and difficulties), it is necessary to consider the use of high-voltage DC power supply systems. Getting all the advantages of DC systems, you can eliminate the main drawback of the systems under consideration - poor performance in high-altitude conditions.

The difficulties associated with the unreliable operation of the brush-collector unit and switching equipment can be successfully overcome by using brushless and contactless generators and DC motors. Electromagnetic relays and contactors that do not work reliably in high-altitude conditions can be replaced by static switches and switches made on the basis of semiconductor devices. The existing and currently being developed semiconductor devices with high electrical parameters are able to solve the problems of replacing electromagnetic relays and contactors. So, for transistors, the operating voltage reaches 400-1400 V, and the current, respectively, I00-300 A. In the future, the voltage of transistors can reach 2000 V, and thyristors 1500-2000 V.

The use of contactless elements in the power system will allow you to safely supply voltage to the DC power supply system and make it high-voltage, thereby providing the advantages of AC systems, while reducing the main currents of the distribution network.

With equal system voltages, a DC system will allow you to save 40-50% in the mass of wires, since such a system can be made as a single-wire one. At the same time, by reducing the number of wires and eliminating the need for reactive power transmission, the losses in the wires will be reduced by 50%. Taking into account the experience of operating AC power supply systems, the conditions for the introduction of high-voltage switching equipment and safety requirements, we can say that the voltage of DC power systems will not exceed 200-250 V.

Analysis of the trend in the development of SES of domestic and foreign aircraft and helicopters shows that the main types of SES on aircraft, except for light-engine aircraft, in the near future will still remain three-phase alternating current systems 200/115 V, 400 Hz. The sources of electrical energy in such systems will be contactless synchronous generators combined in one design with hydro-mechanical drives of constant speed.

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