There's something in the air

With the electrification of the automotive industry, the ambition quickly arose to transfer this to aviation to the same extent. Hydraulic systems give way to electric ones. The system's supply voltage increases to allow for greater ranges thanks to reduced mass.

Electrically powered small aircraft and air taxis will conquer the skies in the coming decades. (Source: iStockphoto)

In the early days of commercial aviation, all control commands were carried out with the help of wires ropes or push rods. This had advantages: forces could be transmitted without delay and without losses. Since the aircraft of the time were small, pilots could operate everything with mere muscle power. However, flying a modern wide-bodied aircraft with muscle power alone would be completely impossible.

Hydraulics

To apply such forces, the technology of hydraulics is used. As early as 1795, an Englishman named Joseph Bramah developed a hydromechanical machine powered by pressurised water. This machine used the power of water to increase the existing muscle power by a factor of 2000. In principle, any fluid is suitable for this purpose. Hydraulic oils have prevailed due to their chemical and thermal properties.

This is how it works

Hydraulics enable forces to be transmitted over almost any distance. With a purely mechanical power transmission, you always need a drive shaft or push rods and cables to provide propulsion. In an aircraft, however, space is at a premium. That's why the use of hydraulics quickly gained acceptance. Since the entire system must be under pressure, pumps are needed on board to provide it permanently or for a specific purpose (e.g. landing gear). For the sake of safety, hydraulic systems in such applications are always designed redundantly.

Pros and cons of hydraulic drives

Hydraulic systems generate very high pressures and thus large forces in a small space. Once the pressure has been built up, a hydraulic drive can hold the desired position for any length of time without requiring additional energy.
However, this is also a weak point of hydraulic systems: Where high pressures are generated, the loss of energy in the event of leakage is high. In addition to leaks, contamination can also occur in the used pipes. The viscosity of the hydraulic oil is also dependent on the outside temperature, and further pressure losses occur due to the compressibility of the oil. The main argument against hydraulics in future aircraft, however, is their high mass. For safety reasons, they must be

equipped with a lot of margin and have a redundant design. This makes them very heavy. In short: hydraulic drives are more vulnerable and require more maintenance than their electric counterparts.

Pros and cons of electric drives

Electric drives are considered easy to control. During movement, they consume less energy than hydraulic drives. They operate largely without jerks. New possibilities for integration into the aircraft structure and into the control system significantly expand the range of applications. Compared to hydraulic systems, an electric drive system is easier to install. It requires less space in the vast majority of applications, as there are no hoses and pumps that need regular maintenance. An electric drive has a long service life and requires little or no maintenance. Although the initial investment costs are higher, they are quickly amortised by the more favourable operation.

Close to series: the "Alice" from Eviation (Source: Eviation)

Disadvantages of electric drives are said to be the linear movement in connection with a high expenditure of force. And as already mentioned: A hydraulic drive can remain in a loaded position without any further energy supply, whereas an electric motor must maintain this position throughout the entire process in order to the necessary force.

Voltage up – current down

Analogue to automotive technology, the developers of electric aircraft are taking the path of high system voltage. Power is the product of voltage times current. If the system voltage for actuators and control units as well as drive systems such as propellers is increased, only low currents

CityAirbus: VTOL Aircraft from Airbus Industries and Siemens

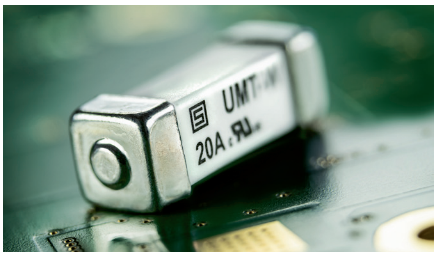
flow. This allows the use of thinner and thus lighter cables. In this way, mass can be saved. With the vast amount of cables that are installed in an aircraft, this adds up to a lot. Less mass leads to lower energy consumption, the aircraft allows greater ranges.

Reliability and safety

It goes without saying that future electric aircraft will have to meet the same safety requirements as before. But it's not all that easy: you have to provide quite a bit of power for an aircraft. System voltages of around 1000 V and outputs of several hundred kW are required here. The use of redundant systems is a given. A wide variety of concepts are being pursued here. A drone (quadcopter) equipped with four propellers, for example, must also be able to land safely if one systems fails.

Requirements

These figures mean that extreme demands are placed on the electrical fuse protection, on a fail-safe concept. Such fuses are designed for continuous currents of several hundred amperes, must be able to interrupt very reliably, precisely and quickly in the event of a malfunction and have a breaking capacity of several kA at 1 kV. In addition, they must be small, light and absolutely reliable.



SCHURTER UMT-W: technological forerunner of future aviation high-voltage fuses

Experience from space technology

SCHURTER, the only qualified supplier of fuses to the European Space Agency (MGA-S and HCSF) since 2008, is aware of the problems that such requirements pose for a fuse in terms of development and process quality. Based on the already available UMT-W, an ultra-compact, pulse-proof SMD fuse with a breaking capacity of up to 1000 A, research is being conducted into even more powerful versions.
The SCHURTER UMT-W is ideally suited for applications with particularly long cables, such as are common in aviation, which are protected on the primary side by an electronic fuse. If this monitoring fails or does not perform its task correctly, the UMT-W takes over as a fail-safe device and transfers the system to a safe de-energised state.

About SCHURTER

The SCHURTER Group is a globally successful Swiss family business. With our components ensuring the clean and safe supply of power, input systems for ease of use and sophisticated overall solutions, we impress our customers with agility and excellent product and service quality.

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