Rotor cooling using integrated heat pipes and oil spray cooling

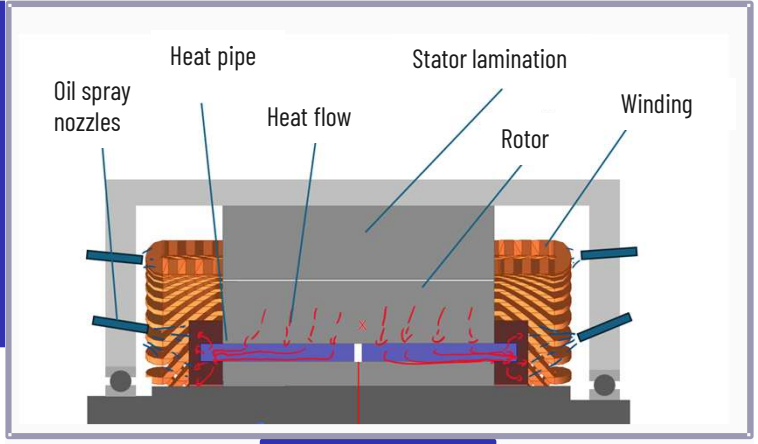
Lower rotor temperature due to improved axial heat dissipation.

STATUS QUO

Permanent magnet synchronous motors (PMSM) are used as standard traction motors for electric vehicles. The temperature of the magnets in the rotor determines the demand for heavy rare earths (HRE) material. In order to reduce this share, considerable effort is made to cool the motor, e.g. by oil spray, shaft cooling or circulating oil through the rotor lamination.

OUR TECHNOLOGY

Heat pipes are integrated into the rotor to efficiently transport heat from inside the rotor to its axial ends combined with a non-rotating oil spray cooling. As heat pipes require a hot end and a cold end, two heat pipes are arranged along the motor's axis. In circumferential direction, 4 to 8 heat pipe arrangements a reasonable. To enable effective heat dissipation from the heat pipes to the oil, the rotor end plates are made of a thermally conductive material (such as aluminium) to distribute the heat over a large area and facilitate spraying.



BENEFITS

- ► Improved rotor cooling, HRE free magnets
- ► Comparatively simple rotor design
- ► Use of inexpensive standard components

APPLICATION POSSIBILITIES

The cooling concept is particularly suitable for PMSM with high torque or power density. Typical areas of application are:

- Motors for electric vehicles
- Motors for electric aircraft
- Traction motors in railway applications

COMMERCIALIZATION OPPORTUNITIES

There are various possibilities for cooperation between the industrial partner and TU Darmstadt: from an exchange with the know-how carriers of the technology up to a close cooperation in case of further development needs. The technology is protected by intellectual property rights and can be used by the industry partner after a sale or licensing agreement.

CURRENT STAGE OF DEVELOPMENT TECHNOLOGY READINESS LEVEL (TRL)

9	Product ready to launch
8	
7	Prototype
6	
5	
4	
3	Proof of Concept
2	
1	Idea

The technology development is at Level #3:

Such a cooling system has been investigated using simulations. A demonstrator for the 'proof of concept' is currently under construction and will be tested by Q3 2026.

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