Large Capacity Electric Compressor for Air Conditioning System of Hybrid Electric Vehicles

Mitsubishi Heavy Industries Thermal Systems, Ltd.

Mitsubishi Heavy Industries Thermal Systems, Ltd. has marketed electric compressors for air conditioning systems of hybrid electric vehicles since 2007, and achieved the industry's top class of small, light, and more efficient compressors featuring its unique scroll technology, inverter control system and optimized internal structure[*1]. We have developed a new series of large-capacity electric compressors to meet the needs of electric vehicles such as the promotion of battery cooling during rapid charging and the expansion of heating capacity for application to heat pumps. The developed product has achieved a significant increase in cooling capacity while minimizing the increase in body size by optimizing the internal specifications in comparison with the current product.

1. Product characteristics

As shown in **Figure 1**, the layout of the inverter, motor and scroll of the developed product follows the design of the current product. The compression mechanism uses an improved 3D scroll profile[*2] which was redesigned for the developed product. By enlarging the motor size and redesigning the inverter, the electric load capacity was also expanded, and the effect of increasing the cooling capacity can be sufficiently leveraged.

In addition, by designing the drive system components such as bearings in the same size as the current product in order to maintain the same body diameter as the current product and minimize the increase in overall length, we aimed to achieve packaging that does not restrict vehicle mounting.

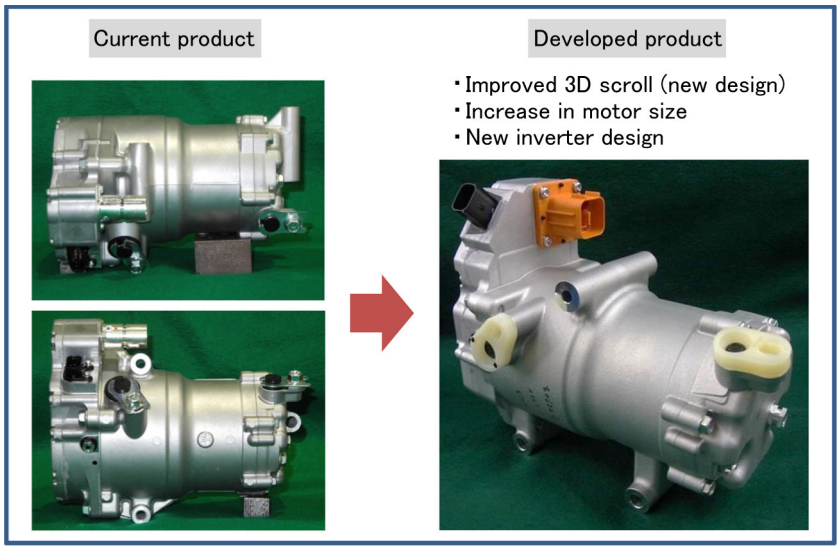

Figure 1 Appearance comparison between current and developed products

2. Increasing capacity

To respond to the needs of the market in detail, we have developed two types of products with different displacement volumes[*3].

Figure 2 gives a comparison of the cooling capacity between the current and the developed product. The horizontal axis shows the ratio of overall compressor length and the vertical axis shows the ratio of cooling capacity using the current product as a base of 100%.

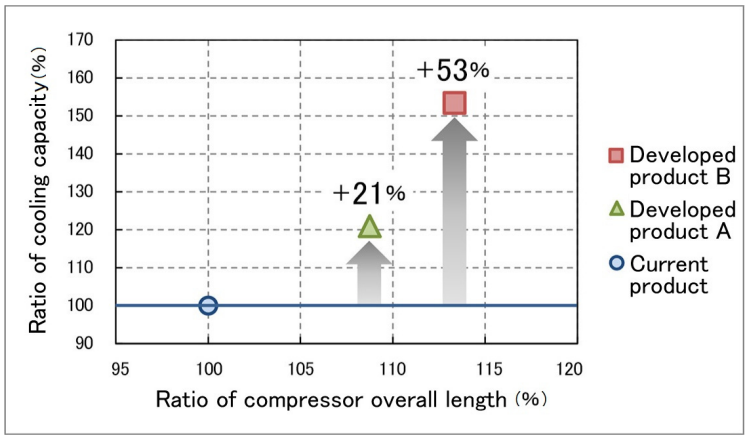

Figure 2 Comparison of cooling capacity between the current product and the developed products

In the case of developed product A, the compressor overall length ratio increases by 9% and the cooling capacity ratio decreases by 21%. In the case of developed product B, the compressor overall length ratio increases by 13% and the cooling capacity ratio decreases by 53%.

Both models have achieved a significant increase in cooling capacity as the total length of the compressor increases.

Figure 3 gives a comparison of the noise level between the current product and developed product B. The horizontal axis shows the ratio of cooling capacity by percentage with using the current product's maximum speed as a base of 100% and the vertical axis shows the noise level by decibel.

Developed product B achieved the same noise level as the current product with the same cooling capacity.

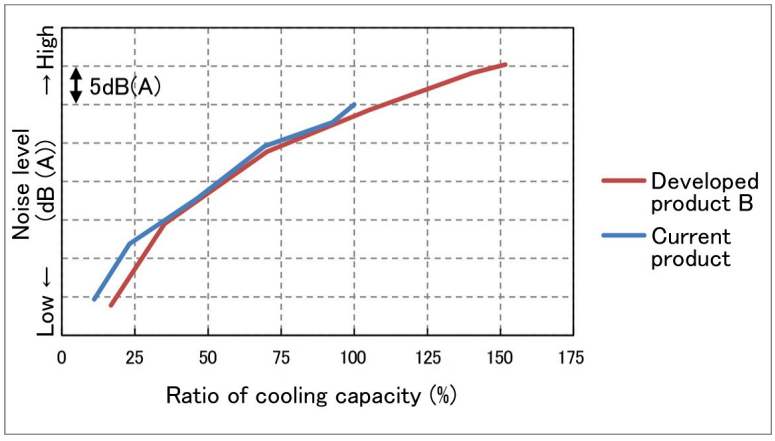

Figure 3 Comparison of noise between the current and developed products

3. Future Development

Figure 4 shows the development history and future development of our electric compressors. The developed product introduced here is being further developed with the aim of launching it on the market in 2023. In addition to increasing the cooling capacity, simplified structural and noise reduction technologies are also being developed.

Our company will continue to contribute to the spread of electric vehicles and the improvement of the global environment by developing products that meet market needs.

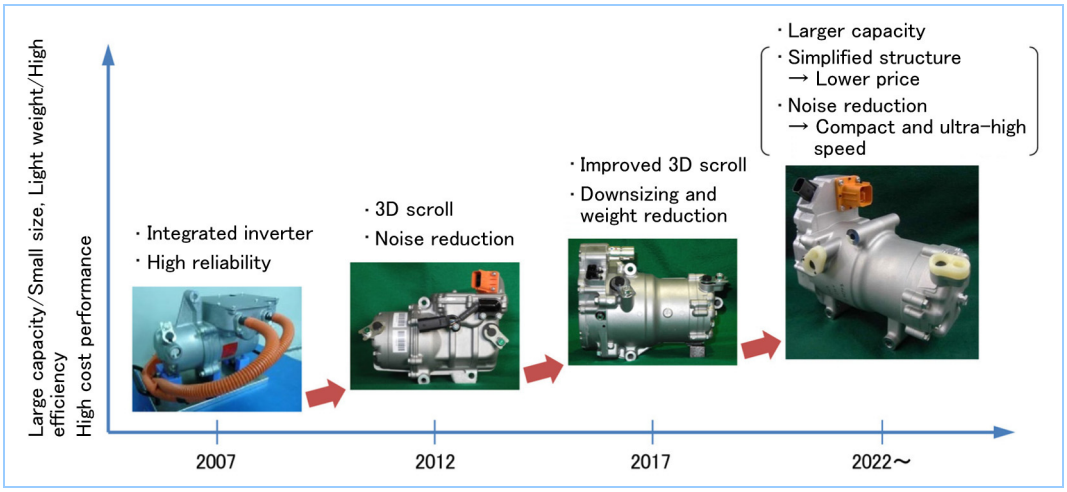

Figure 4 Development flow of our company's electric compressor

*1 See Mitsubishi Heavy Industries Technical Review 54-2 (2017) "Development of Electric Compressors for Air Conditioning Systems of Hybrid Electric Vehicles."

*2 Highly-efficient 3D scroll with reduced leakage during compression process.
"3D Scroll" is a registered trademark of Mitsubishi Heavy Industries Thermal Systems, Ltd. in Japan.

*3 The suction volume of a scroll per one shaft rotation.