Development of compressor for multi air conditioning system using CO2 refrigerant

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EXTENDED ABSTRACT

In the situation that F-gas regulations and the reduction of the amount of high-GWP refrigerants are being strengthened in Europe, the adoption of natural refrigerants is required.[1] CO2 refrigerants are expected to be used in commercial air conditioning equipment that requires a large amount of refrigerant filling because they have a low GWP of 1 and are non-flammable. On the other hand, CO2 refrigerant has performance degradation issues due to its high operating pressure, which leads to refrigerant leakage from axial and radial gaps.

The swing compressor(Fig.1) features an integrated blade and piston design that separates the compression chambers, which leads to reduce radial refrigerant leakage between the chambers.(Fig.2) Additionally, this structure ensures high reliability under high-speed operation, as there are no sliding parts on the outer circumference of the piston. As for the axial gap, the oscillation of the piston caused by the crankshaft's rotation is a structural feature that tends to cause thermal expansion from sliding and discharge gases at consistent positions. Utilizing this characteristic, the axial gap is minimized by analytically determining the deformation amount of components joined by bolts (Fig. 3), and then intentionally making deformation in areas less affected by thermal expansion (Fig. 4). In these efforts, an efficiency of compressor achieved 69% under cooling partial load conditions required for air conditioning performance. The VRV products equipped with the swing compressor shown in Table 1 met the MEPS performance regulation values specified in European standards. Furthermore, the structural characteristic of having fewer components and enabling high-speed operation allowed for a balance between performance and reduced material usage (Table 1).

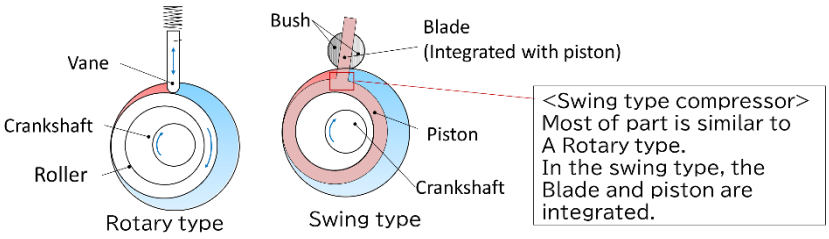

Fig.1 Comparison of structures of Rotary and Swing

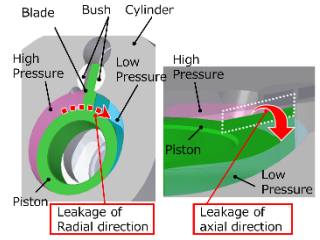

Fig.2 Leakage pass of swing compressor

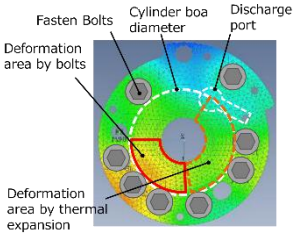

Fig.3 Analytically deformation of bolts

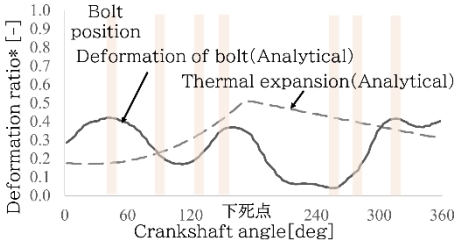

Fig.4 Deformation of bolt and thermal expansion

Table 1 Comparison of comp. weight

	Installed product HP	Comp. Wight
Scroll	10 HP	64 kg
Rotary	5 HP	40 kg
Swing	7.5 HP (For Refrigerator)	35 kg

REFERENCES

[1] Daikin Europe N.V.. "*An outlook from Daikin on refrigerant alternatives in Europe – addressing Applications, Affordability, Safety and Future-Readiness*", (Reference 2025-01-09)<https://www.daikin.eu/en_us/press-releases/an-outlook-from-daikin-on-refrigerant-alternatives-in-europe.html>