講演番号	289

Development of New Generation Hybrid Transaxle for Mid-size SUV

Hirokazu Arai[1)] Shinichiro Suenaga[1)] Kohei Shimayabu[1)] Junichiro Yasui[1)]
Yuji Yamaya[1)] Keisuke Yuki[1)] Hiroki Kato[1)]
1) Toyota Motor Corporation
1 Toyota-cho, Toyota City, Aichi 471-8572, Japan (E-mail: hirokazu_arai@mail.toyota.co.jp)

KEY WORDS: **Power transmission, New type transmission, Mechanism(A2)**

A new PHEV system was developed for mid-size SUV. This paper presents the technologies for downsizing, weight reduction, and loss reduction applied to the newly developed transaxle PE10.

By eliminating the PCU mounting bracket and integrating the PCU into the transaxle case, the PE10 achieved a 15% reduction in overall height and an 18% reduction in mass compared with the previous-generation vehicle equipped with the P810 transaxle. This integration also enabled installation of the AC charger in the engine compartment (Fig. 1).

To secure installation space for the PCU, model-based development (MBD) was employed in the PE10. By controlling gear tooth contact, the gear face width was reduced while maintaining reliability equivalent to that of the conventional unit. As a result, the overall width of the transaxle was reduced, allowing the left-hand (LH) mount position to be lowered within the same engine room width and thereby securing sufficient space for PCU installation.

Furthermore, through downsizing of the output gear module, modification of the bearing support structure, and elimination of the mechanical oil pump, the PE10 achieved a 44.8% reduction in mechanical losses compared with the P810 under WLTP (EU) conditions.

In addition, a 30% reduction in gear module compared with the P810 resulted in a 29% reduction in gear meshing losses. Potential strength degradation associated with module reduction was mitigated through the use of MBD tools. By designing the gears to maintain tooth contact at the center of the gear regardless of torque load, while accounting for misalignment, increases in tooth surface contact pressure and tooth root stress under high load were suppressed. Consequently, reduced-module gearing was achieved while maintaining reliability equivalent to that of the P810.

Moreover, the motor counter drive gear was reconfigured to be supported by the MG2(Motor) rotor shaft, allowing elimination of the motor counter drive LH bearing and contributing further to loss reduction (Fig. 2).

In the P810, a mechanical oil pump was used during engine-driving operation, while an electric oil pump was used during EV driving to supply lubrication oil and cool the motor. In contrast, the PE10 integrates the oil passages and shortens their total length, thereby reducing pressure losses. The required oil flow rate for each component is appropriately distributed, enabling a reduction in overall flow rate. As a result, the required oil supply can be provided solely by an electric oil pump with the same output as that used in the P810. The elimination of the mechanical oil pump consequently contributes to additional loss reduction.

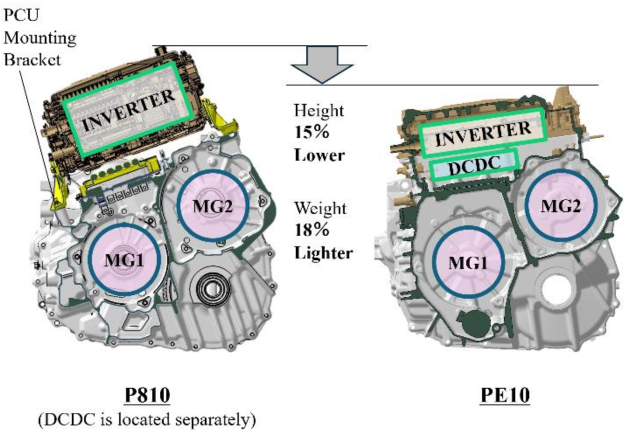

Fig.1 Comparison of Unit Specifications for P810 and PE10

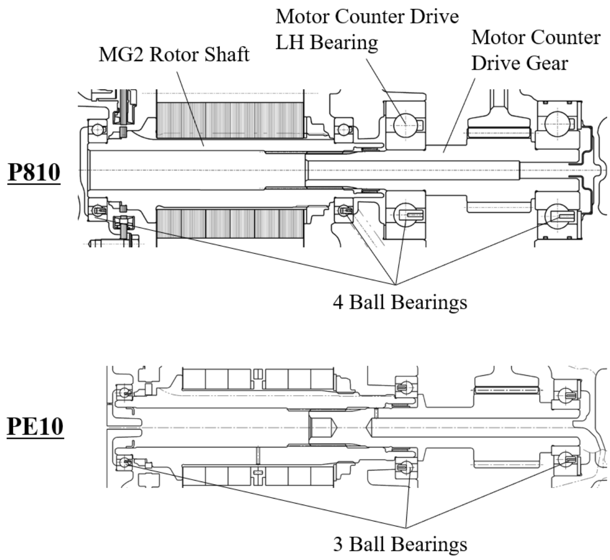

Fig.2 Support Structure Change of MG2 Axis