

Intelligent Power Unit for 2022 Model Year Hybrid Electric Vehicle

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Global warming and air pollution are regarded as serious issues on a global scale, and not just the automobile industry but all industries are working to establish carbon-free and sustainable industrial formats in order to reduce greenhouse gas emissions.

As one countermeasure, the automobile industry is promoting the development of various electric vehicles such as HEVs (hybrid electric vehicles), PHEVs (plug-in hybrid vehicles), BEVs (battery electric vehicles), and FCVs (fuel cell vehicles). Among these, Honda has mounted the 2-motor hybrid system e:HEV, in service since 2020, in its HEV lineup. This electric power train for cars consists of an E-CVT (electric coupled continuously variable transmission) with two built-in motors, a PCU (power control unit), and an IPU (intelligent power unit) in addition to the engine. In the Hybrid Electric Vehicle announced in 2018, technologies were introduced to enhance the efficiency and reduce the size of each IPU component and the IPU was located under the 2nd seat to provide cargo space and usability equivalent to a gasoline vehicle. This paper introduces the development of the 2022 model year IPU, which uses a new IPU internal component layout to achieve a low-noise structure, reduced number of components, smaller size, and lighter weight while providing the necessary and sufficient strength.

The IPU of the 2022 model year e:HEV system forms a space with the case and cover, and its interior consists of high-voltage Li-ion battery modules, a high-voltage power distribution component with a power shut-off function, components with battery cooling functions, and a battery ECU that monitors the battery voltage and capacity and controls charging and discharging. Size and weight reduction, a low-noise structure, and reduction of the number of components were investigated by optimizing the IPU internal component layout while satisfying the space constraints for mounting such an IPU under the rear seat. Specific methods included use of low-height cells, optimal placement of air-cooled devices, and optimization of the IPU cover shape.

First, with regard to use of low-height cells, the 2022 model year e:HEV system uses cells with a low height of 65 mm while keeping the same numbers of series and modules. Adoption of low-height cells reduced the battery mounting height compared with the previous MOD upper/lower double stack layout by making use of the reduced cell height to adopt a parallel, transverse structure while securing clearance between the IPU case and the MOD. Regarding the optimal placement of air-cooled devices, a parallel, transverse MOD structure is used and the cooling fan is placed in the most efficient position for reducing noise. The Li-ion battery to be cooled requires thin cooling air passages between the cells, and the battery cells are cooled by flowing air through those passages. The cooling air passages between the battery cells have a structure with a small cross-sectional area to increase the cooling air speed, which produces pressure loss. Focusing on this, the cooling fan that is a source of noise was set on the downstream side of the Li-ion battery to achieve a structure that prevents the transmission of noise to the cabin side by reducing and shielding noise with a Li-ion battery that produces pressure loss. Figure 1 shows the IPU internal device layout of this structure.

The IPU cover shape was also modified. A reinforcing member was previously added near the fastening point, but in this model a rib shape is set that transverses the IPU cover near the fastening point. This increases the overall stiffness of the IPU cover, enabling removal of the reinforcing member and weight reduction.

As described above, the packaging efficiency was enhanced by reviewing the IPU internal component layout, including the cooling fan. As a result, the IPU achieved weight reduction of 12% and volume reduction of 9% compared with the previous model.

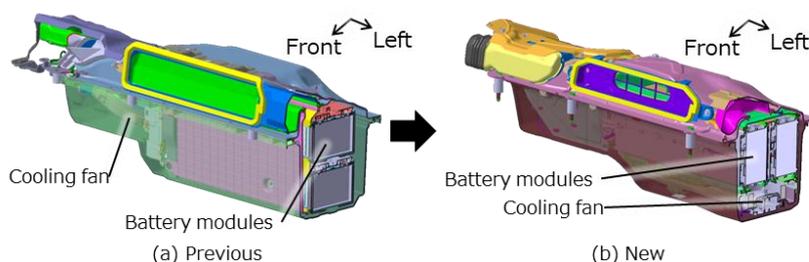


Fig.1 Placement of air-cooled devices in IPU