Development of Quiet Under-Floor Equipment

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Recently, there has been a growing demand for quiet train operation from passengers, as well as residents in areas near a railway line. Accordingly, advances are being made in reducing noise and vibration regarding not only the body structure, but also the under-floor equipment.

Efforts for energy saving have resulted in the development of various driving methods, among which is the VVVF inverter that drives an induction generator. This inverter was developed as a measure to save energy and labor for maintenance, by applying technology for industrial equipment. An early VVVF inverter used GTO as switching element, which makes it impossible to use at higher switching frequencies. This feature caused such problems as electromagnetic motor noise due to low-order harmonics. Subsequent technical progress has led to the development of IGBT elements with capacities suitable for train cars. These elements have permitted the reduction of low-order harmonics through the use of higher switching frequencies, and significantly solved problems with electromagnetic motor noise.

As for auxiliary power-supply unit, train cars conventionally used motor generators which, as rotating equipment, caused much noise and vibration, and required periodical maintenance. The ease of maintenance was partly achieved by the development of brushless motor generators. Subsequently, static power-supply units (SIV) were developed to facilitate maintenance even further, while reducing noise. At present, all but a small part of new train cars use SIVs.

Pressurized air has long been used as the source of power for train car brakes, air springs, whistles and doors. Air compressors are mounted to provide pressurized air. Originally, DC motors were used to drive reciprocating compressors. In the early 1980s, brushless AC induction generators were introduced to facilitate maintenance. In the 1990s, rotary compressors, designed to reduce noise and vibration, came to be widely used. Rotary compressors are of screw or scroll type. Either type permits continuous operation, because of a design that prevents the pulsation of supplied air. Also, the no-contact rotor helps to facilitate maintenance significantly.

Recently, there has been a growing trend toward designing under-floor equipment as a module incorporating the dehumidifier and other peripheral systems. Another noteworthy development is to design a vehicle system as an airless one, thereby eliminating air compressors that cause noise and vibration.

As we have explained, many advances have been made in improving equipment technology to reduce noise and vibration. However, it is easy to imagine that affected individuals will demand an even higher level of noise and vibration control.

Accordingly, our company has been making efforts to meet this demand, by optimizing equipment arrangement and the strength of body and equipment suspension. To improve performance in this regard, we see the need to promote such efforts as noise reduction through the use of soundproof covers based on new materials, and the development of new methods to reduce vibration through analysis and simulation.