講演番号	327

文献番号	20225327

Energy Loss Comparison of Traction Motor Winding Changeover Methods for Electric Vehicle

Keisuke Takeuchi [1)] **Akeshi Takahashi** [1)] **Kazuo Nishihama** [1)]

Katsuhiro Hoshino [2)] **Noriyuki Maekawa** [2)]

1) Hitachi, Ltd., Research & Development Group
7-1-1, Omika-cho, Hitachi-shi, Ibaraki, 319-1292, Japan (E-mail: keisuke.takeuchi.od@hitachi.com)
2) Hitachi Astemo, Ltd.
2520 Takaba, Hitachinaka-shi, Ibaraki, 312-8503, Japan

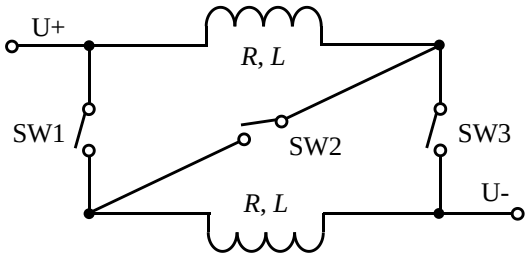
KEY WORDS: **EV and HV systems, motor, motor characteristics**, Energy loss, Winding changeover [A3]

Winding changeover systems for electric vehicles have been proposed to reduce the energy loss by switching the traction motor windings. In this report, we calculated and compared the energy loss improvement at JC08 and WLTC modes by applying three winding changeover methods: a proposed series and parallel switching method with mechanical switches, the one with electronic switches, and neutral point switching from a previous study. As a result, the proposed method was the most efficient, and the energy loss was reduced by 5% compared to 4% of the conventional switching method at JC08 mode.

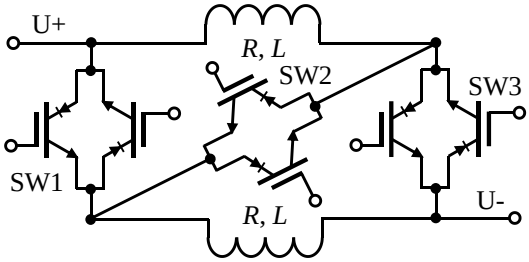
Fig. 1 shows the comparative electrical circuit diagrams for winding changeover. The proposed circuit shown in Fig. 1(a) involves three mechanical switches for one phase which connects two windings in series or parallel. Connecting in series at low speed, the inverter current becomes a half of that in parallel, and the inverter conduction loss decreases. The circuit shown in Fig. 1(b) involve six electronic switches for one phase instead of the mechanical switches in Fig. 1(a). The conventional circuit shown in Fig. 1(c) includes twelve diodes and two electronic switches for three phases. This method changes the neutral point and uses only one coil at high speed, and it causes the doubled copper loss at high speed.

Fig. 2 shows calculated results of no winding change and three methods shown in Fig. 1 at JC08 and WLTC modes. This evaluation considered the inverter, motor, winding changeover, and driving losses. As a result, the energy loss of the proposed method was reduced by 5% compared to 4% of the conventional method at JC08 mode. On the other hand, the improvement quantity at WLTC mode was 2% by the proposed method and 0% by the conventional method. The system efficiency enhancement was smaller than that at JC08 mode.

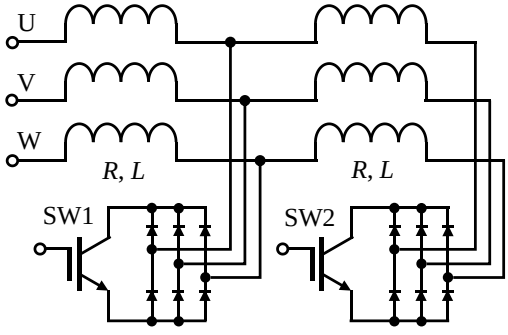
Therefore, we concluded that the proposed method with mechanical switches is the most efficient of the three methods and simpler than the one with electronic switches.



(a) Proposed with mechanical switches



(b) Proposed with electronic switches



(c) Conventional

Fig. 1. Electrical circuit diagrams for winding changeover.

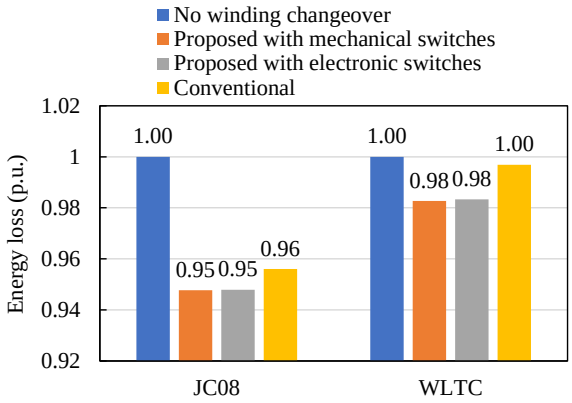


Fig.2. Energy loss comparison.