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Design of pulsed power system for permitting to utilize attractive force of multi-stages synchronous induction coilgun

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The capacitor bank topology with a load side crowbar diode is well known as a pulsed power system for the electromagnetic launcher such as coilgun and railgun because of its controllability, reliability, technical maturity. In general case of multi-stages synchronous induction coilgun accelerates a projectile using the electromagnetic force that converts electrical energy to kinetic energy; the pulsed power system is storing slowly and supplying rapidly electrical energy to a stator coil. The current of a stator coil induces the current on the armature coil; these current directions are opposite and it generates repulsive force. The crowbar diode, which is placed at load side, not only prevents the capacitor from the damage of voltage reversal caused by inductive load during pulsed power supplying period but also blocks induced current caused by the previous stator coil.

This paper presents new capacitor bank topology of pulsed power system for multi-stages synchronous induction coilgun to improve the efficiency.

Proposed method is inserting a switch such as GTO(Gate Turn-Off thyristor) parallel to the crowbar diode and load in order to permit generating Attractive force between next stator and armature. The switch is controlling induced current of the stator caused by the previous stator which is being supplied with pulsed power from a capacitor. The current directions of stator and armature coils are the same. Then cause generating attractive force between each other. A mathematical model and FEM simulation in Magnet/Comsol were developed to verify the suggested topology.

The result indicates usefulness in an aspect improving the energy efficiency and launching velocity with same control method, structure and supplied energy. The energy efficiency increase over 1% is confirmed with simulation results of three stages synchronous induction coilgun.

Primary author: Mr SONG, Myung-Geun (Hanwha Defense Systems)

Co-authors: GO, Byeong-Soo (Changwon National University); LE, Dinh-Vuong (Changwon National University); PARK, Minwon (Changwon National University); Prof. YU, In-Keun (Changwon National University)

Presenter: Mr SONG, Myung-Geun (Hanwha Defense Systems)

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