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Inductive-Capacitive Hybrid Pulsed Power Supply for Energy Recovery

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As a relatively new kind of the pulsed power supplies for electromagnetic launchers, the IPPS (inductive pulsed power supply) attracts researchers'attentions with the major advantage of high energy storage density. However, it possesses one major disadvantage: too much energy remained in the energy storage inductors and then wasted in the muzzle resistor after the projectile (or armature) leaves the muzzle. And when high energy level and low energy loss are major considerations during the inductors'design, this problem will get worse. The reason is simple. Under this circumstance, the inductors will have relatively large inductance L, small resistance R, and high ratio of inductance and resistance L/R, and the discharging time will be relatively long, which leads to relatively high remaining energy.

This paper proposes a solution to this problem, namely hybridizing the IPPS and the CPPS (capacitive pulsed power supply). To be more specific, during the projectile acceleration process, the IPPS and the CPPS supply the load together; after the projectile leaves the muzzle, the remaining energy in the IPPS turns to charge the CPPS. It should be noted that, since all IPPS modules and CPPS modules are connected in parallel and relatively independent, one CPPS modules can recapture several IPPS modules'remaining energy, which brings possibility to the energy self-recovery of the CPPS modules. In this paper, the working process of this hybrid power supply is analyzed stage by stage. And then the practical feasibility is verified through experiments, in which the load is a small railgun with 0.3-m length, 10-mm×10-mm caliber, 2.7-g armature. Results show that most of the remaining energy in the IPPS module is recaptured, which leads to the energy self-recovery of the CPPS module.

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