Study of the Influence of Electrical Parameters on Launch Performance of Projectile from the Single-stage Reluctance Coil Launcher

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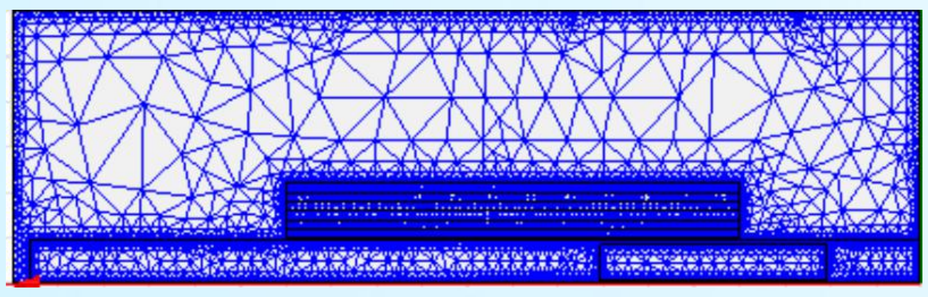
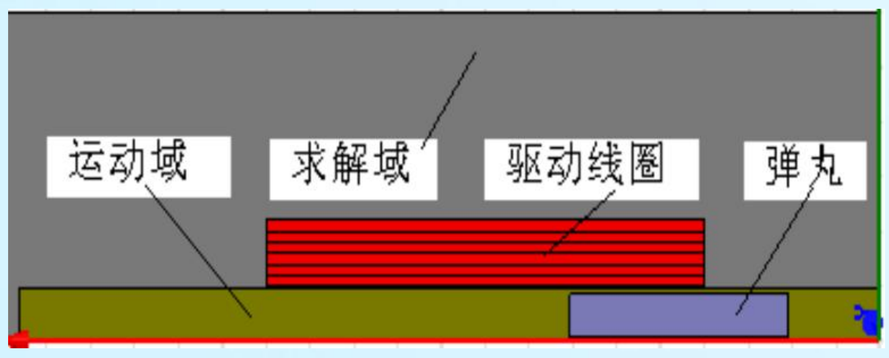
Abstract The influence law of the electrical parameters on the projectile velocity is obtained, by the imitation research about the influence rule of the variation of electrical parameters (including capacitor voltage and capacitance) in a single-stage reluctance coil emitter on the transmitting performance, using the two-dimensional transient field solver in the finite element analysis software of Ansoft. At the same time, the single-stage reluctance coil launcher is also set up to conduct relevant tests, and the correctness of simulation analysis is verified. The results show that increasing the voltage and capacitance of the capacitor is beneficial to increase the exit velocity of the projectile, in the condition that the relative position of the projectile and driving coil is constant, The capacitor voltage is less than 1000V, and the capacitor capacitance is less than 1500F. The simulation and experiment results provide guidance for the related analysis and study of multi-stage reluctance coil launcher.

1. Simulation and Analysis



Mesh Parting Diagram



Simulation Model Diagram

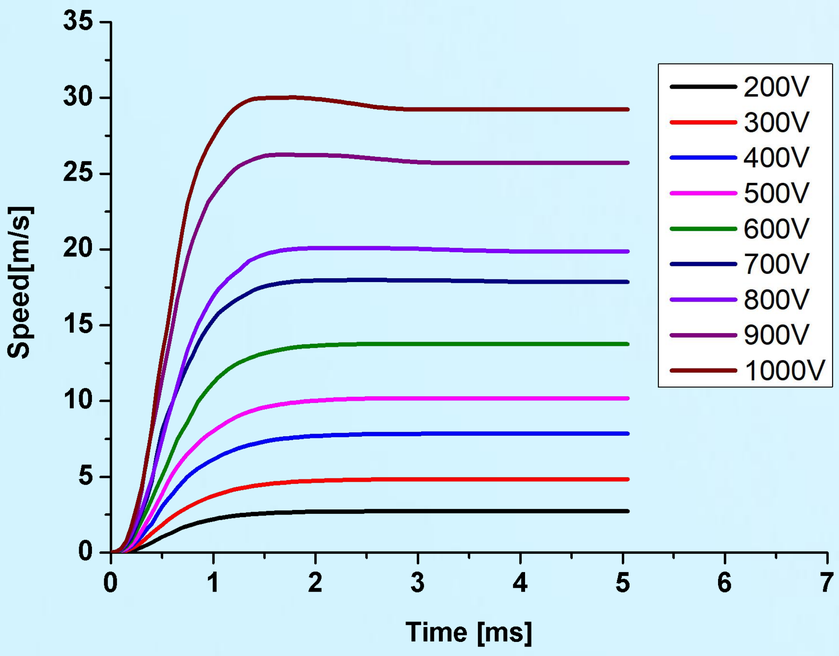


Diagram of the effect of capacitor voltage on projectile velocity

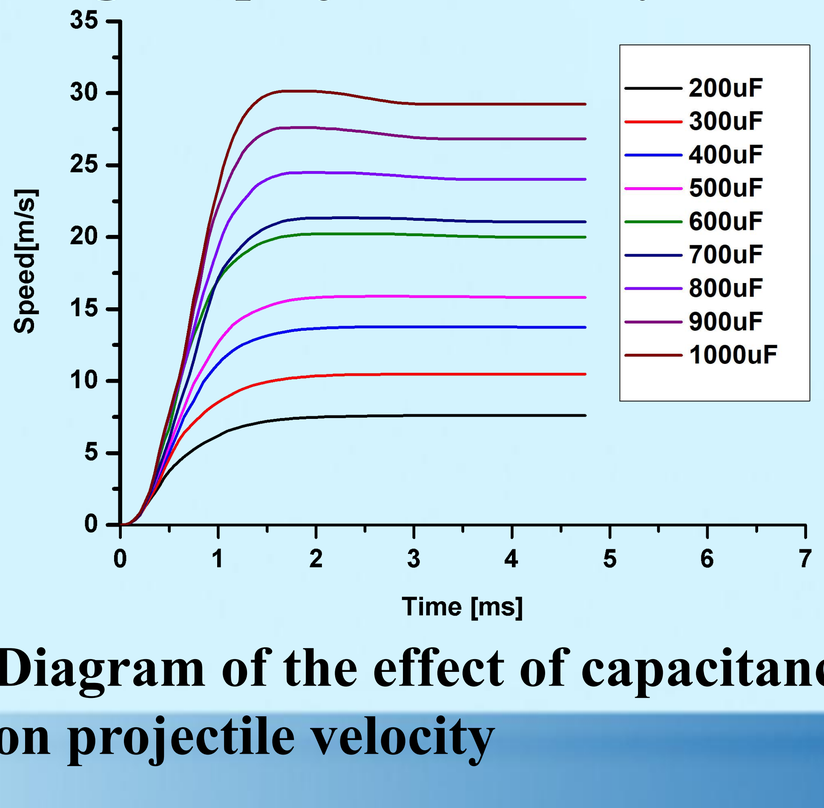


Diagram of the effect of capacitance on projectile velocity

2. Related Tests

Test device diagram of a single-stage reluctance coil launcher

The exit velocity of the projectile from the test and simulation results obtained by fixing the capacitance as 500mf and adjusting the voltage

$U(V)$	590	640	690	740	790	840
Test velocity (m/s)	18.20	19.50	21.00	22.18	24.00	25.50
Simulation velocity (m/s)	15.75	16.14	18.06	18.89	19.98	22.09

The exit velocity of the projectile from the test and simulation results obtained by fixing the voltage as600Vand adjusting the capacitance

$C(\mu F)$	500	750	1000	1250	1500
Test velocity (m/s)	18.34	22.68	27.41	28.96	29.45
Simulation velocity (m/s)	15.80	22.52	29.24	34.95	38.87

3. Conclusions

The simulation and test results show that increasing the voltage and capacitance of the pulse capacitor is beneficial to increase the exit velocity of the projectile. At the same time, fixing the capacitance and increasing the voltage of the capacitor will reduce the efficiency of the single-stage reluctance coil launcher.