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Research of a new DC breaker based on the electromagnetic forming technology for Battery power supply of long pulsed magnet

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In Wuhan National High Magnetic Field Center, a new explosive DC breaker switch based on the pulsed electromagnetic forming (EMF) technology is developed to shut down the Battery Bank power supply for protecting the long pulsed magnetic field system when terrible fault happens. The switch is reformed from the aluminum wire electrical explosive switch of the Laboratoire National des Champs Magnétiques Intenses in France. The new DC breaker switch consists of pulsed magnet (EMF coil), aluminum tube (the main contact of DC breaker) and its supporters. The switch uses pulsed magnetic field to apply repulsion produced by induced eddy current to expand the aluminum tube, which can be broken at the weaknesses of V-shaped slots in a very short time. The concept of repulsion is based upon inducing currents flowing in the contrary directions in the pulsed magnet (EMF coil) and in the aluminum tube, which, according to Ampere law, results in repulsion forces between the pulsed magnet and the tube. By combining the advantages of the aluminum wire electric explosive DC breaker and the electromagnetic forming (EMF) technology, the analytical model based upon the solution of Maxwell is built by the software COMSOL Multiphysics to simulate the distribution of magnetic flux, magnetic force, tube deformation and their interactions. Both simulation and primary experimental results show that the design of the new DC breaker with compact volume and easy maintenance is feasible. In addition to the pulsed high magnetic field facility, the breaker can also be applied to numerical potential industrial fields.

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