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5P61 - Meat Grinder with ACC Circuit

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Inductive pulse power supplies play an important role in electromagnetic launch. Among various power supply topologies, the meat grinder with SECT circuit (as shown in Fig. 1) attracted researchers'attention with its advantages of high energy density, good output waveform and low main switch voltage. C1 is the current turning-off source and the leakage inductive energy absorber simultaneously. In real application, the self-recovery ratio of C1 voltage is too low, so users need to pre-charge C1 before the charge of inductors. This requires each power module in the system to keep a pre-charging port for C1, and adds the complexity of integration. In addition, the pre-charged voltage of C1 is different from the voltage of the primary supply US. Therefore, an extremely large current will appear and destroy the device when primary supply and C1 are accidentally short-circuited.

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To solve these problems, the meat grinder with auto-charged commutating capacitor (ACC) circuit is proposed, as shown in Fig.2. At the beginning of operation, T1 is triggered. While charging inductors L1 and L2, US primary supply charges can also charges C1 through D and L2 until its voltage is higher than US. After the current through L1 reaches the designated value, T2 can be triggered. C1 uses its energy to turn off T1 through C1-T2-T1-US-LS-L2. L1 and L2 constitute a meat grinder circuit and achieves pulsed high current output. So ACC circuit inherit almost all the properties of SECT circuit but call off the pre-charged procedure.

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In simulation, the meat grinder with ACC circuit can generate a pulse current with amplitude of 23.8kA and half-wave time of 7.8ms. The voltage of C1 drops to zero after discharging, i.e. the repetitive operation can be realized without any adjustment. The experiment results support the above conclusions.

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