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Marx Generators for Electroporation Devices

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Many industrial-scale electroporation devices are driven by Marx generators. Thereby, the pulse circuit comprising the Marx generator and the electroporation reactor needs to be tailored specifically to the requirements of the application. Biological material for electroporation-assisted extraction processes is treated at pulse lengths on the order of several microseconds. For large-scale electroporation devices Marx generators equipped with spark gap switches are in use which are connected to ground either symmetrically or unsymmetrically, depending on the electrode arrangement inside the electroporation reactor. The pulse shape is adjusted near to the critically damped case of the circuit. Forced cooling of the spark gap at each spark gap switch by means of a gas flow enables a reliable operation at a pulse repetition rate of around 40 Hz. In the publication measurement results of a Marx generator for an electroporation device for crushed grapes are presented. Marx generators for small-scale devices comprise semiconductor switches, e.g. IGBTs. Adapting the circuit topology of large-scale devices results in a Marx generator with one switch per stage only which is operated efficiently as closing switch under soft-switching conditions. In order to lower costs bypass-diodes at each stage have been omitted. Instead, when interrupting the current in case of a flash-over at the load the voltage across the IGBTs is clamped to a safe level by means of an active clamping circuit. In the publication, both types of Marx generators are described and compared to each other based on measurement results with respect to the intended application.

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