Efficient Circuit Triggers High-Current, High-Voltage Pulses

The problem: To design an efficient parallel-charging, high-voltage pulse modulator where low-voltage rating of components is an advantage. Conventional circuits for producing high-voltage output pulses dissipate a portion of their theoretical output power across the charging resistors.

The solution: A modified circuit employing diodes that effectively disconnect the charging resistors from the circuit during the discharge cycle.

How it's done: The diagrams of a conventional circuit and the improved circuit show three parallel stages for charging and a single stage for discharging the capacitors C₁, C₂, and C₃ in series through the load. Either of the circuits can theoretically employ as many stages as required to produce an output voltage of the desired magnitude.

In the conventional circuit illustrated, the capacitors C₁, C₂, and C₃ are charged to the B+ voltage through charging resistors R₁, R₂, and R₃. A trigger pulse applied to C₁ biases the four-layer diode D₁ to a low-impedance state, opening a series conductive path from C₁ through D₃ to impress the sum of the voltages across the three capacitors onto the load. The output pulse, however, also appears across the charging resistors, where I²R losses occur. Since the maximum

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voltage drop occurs in $R_1$, this resistor cannot be a low-voltage component, and the effect of voltage gradients must be considered. Currents larger than the diode holding current will flow through the charging resistor, making it difficult to turn the circuit off before the capacitors are completely discharged.

In the improved circuit, the diodes $D_4$, $D_5$, $D_6$, and $D_7$ effectively disconnect the charging resistors from the circuit during the discharge cycle. This circuit thus allows the use of low-voltage charging resistors and eliminates power loss through these resistors, as well as the problems of voltage gradients and power turnoff associated with the conventional circuit.

**Note:**

For further information about this innovation inquiries may be directed to:

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**Patent status:** NASA encourages commercial use of this innovation. No patent action is contemplated.

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