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(54) **Title:** SYSTEM AND METHOD TO BALANCE CHARGE FOR MULTI TANK SYSTEM VANADIUM REDOX FLOW BATTERY AND OPERATION TOGETHER WITH LITHIUM BATTERY IN HYBRID INTEGRATION

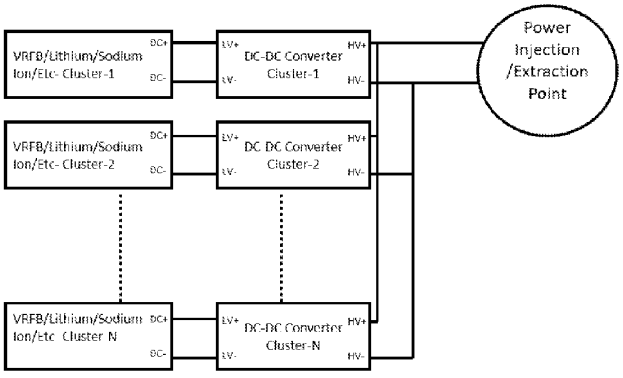



FIG. 4

(57) **Abstract:** A system and method for balancing the state of charge (SOC) in a multi-tank Vanadium Redox Flow Battery (VRFB) system, particularly in hybrid integration with Lithium Batteries (LiB), is disclosed It addresses SOC imbalance issues in VRFB systems utilizing multiple hydraulically disconnected electrolyte tanks, thereby improving round-trip efficiency by eliminating the need for intermediate DC-DC converters. A small-scale DC-DC converter operating in droop control mode facilitates charge balancing between VRFB clusters during both charging and discharging. the invention provides a droop control method for hybrid energy storage systems (ESS) consisting of VRFB and LiB in both DC and AC coupled configurations. This method dynamically adjusts droop coefficients and voltage/frequency reference levels based on real-time charging and discharging requirements, ensuring optimal power distribution and SOC balance across multiple battery clusters. The system enhances overall efficiency, reliability, and cost-effectiveness of hybrid energy storage solutions by leveraging the complementary strengths of VRFB and LiB technologies.

*[Continued on next page]*

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