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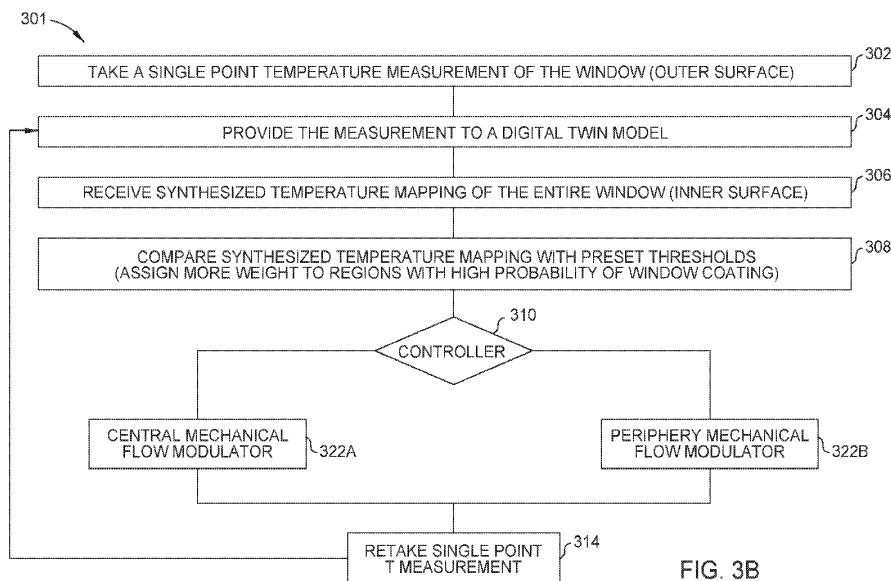


FIG. 3B

(57) Abstract: Embodiments of the disclosure relate to a substrate processing system with improved thermal management. The substrate processing system utilizes a pyrometer for temperature measurement on the outer surface of a chamber body, and a controller to adjust operations based on estimated temperatures at various locations on the inner surface of a chamber body. The system employs a digital twin model, potentially physics-based, data-based, or a hybrid, to simulate process runs and generate temperature mappings inside the chamber body. The chamber structure features a chamber body made from high IR transmission materials and includes a chamber conditioning assembly with variable speed blowers and mechanical flow modulators. The associated method manipulates the system with the digital twin model and the chamber conditioning assembly for enhanced temperature control. Furthermore, an apparatus is presented, equipped with mechanical flow modulators directing air flows for effective thermal regulation, migrating unwanted window

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