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(19) **United States**(12) **Patent Application Publication****Reinartz et al.**(10) **Pub. No.: US 2023/0231231 A1**(43) **Pub. Date: Jul. 20, 2023**(54) **A HEAT-RESISTANT BATTERY SEPARATORS AND RELATED BATTERIES AND METHODS**(71) Applicant: **Ceigard, LLC**, Charlotte, NC (US)(72) Inventors: **Stefan Reinartz**, Waxhaw, NC (US);
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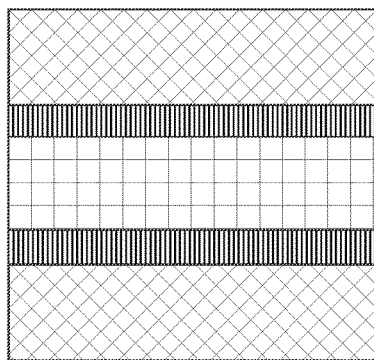
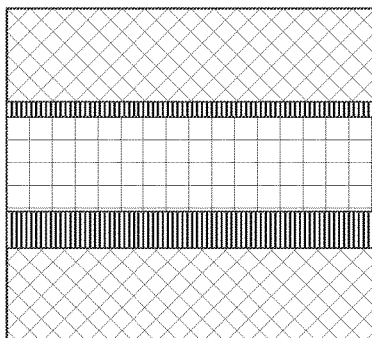
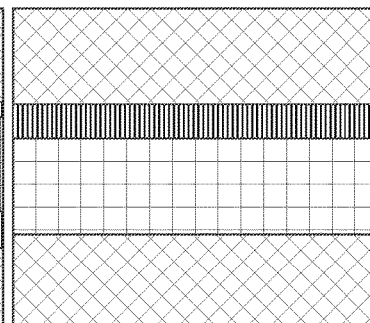
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(57)

ABSTRACT

Disclosed herein is a battery separator comprising two porous or microporous layers and a heat-resistant layer between the two porous or microporous layers. The heat-resistant layer may be a ceramic layer or a layer containing a high melt integrity polymer. In some embodiments, the battery separator may further comprise one or more adhesive layers between the two porous or microporous layers. The resulting battery separator may be safer, have more integrity, and/or have shutdown function.

Symmetric**Asymmetric****Asymmetric**

Heat resistant layer

Porous or
microporous layer

Adhesive layer