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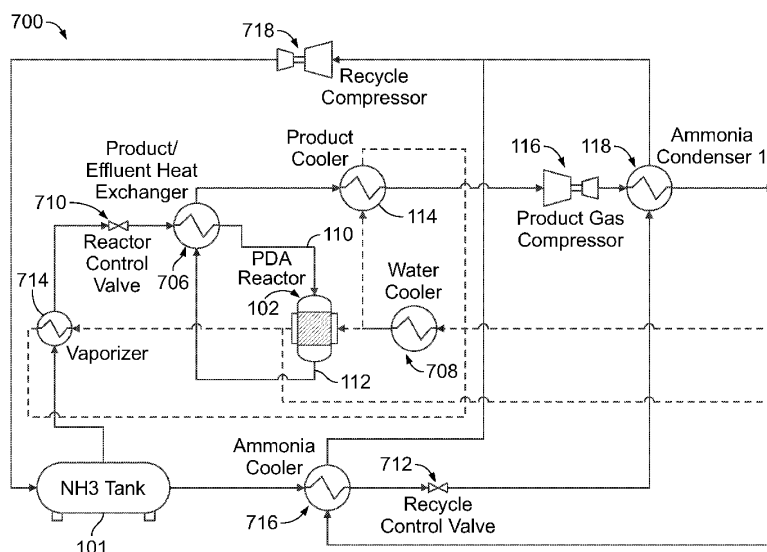


FIG. 7

(57) Abstract: Ammonia-based photocatalytic reactor systems and methods are provided. Example features include coolant-circulation systems utilizing water and/or ammonia as a coolant for removing heat generated by LEDs comprising part of a photocatalytic reactor, a single compressor before the photoreactor inlet compressing ammonia gas anywhere from 1 - 113.4 Bar at Room temperature to 132.4 C, eliminating the need for second compressor and a choice for optimized reactor conversion, with temperature and pressure chosen to maintain the gas phase while appropriate for downstream separation, storing ammonia either from - 33C to room temperature and from atmospheric pressure to 113.4 bar, in order to eliminate either a need for one or both downstream compressors and-or a need for storing liquid ammonia at negative temperatures, thereby allowing room temperature storage, elimination of a compressor, condenser and two-phase separator, so that a product stream is provided substantially directly to an ammonia scrubber, thus producing ammonium

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hydroxide as by product to be use either in house or as a product to consumer, replacing a PSA system with a membrane H2 and N2 separator, eliminating a reactor downstream compressor, condenser, two-phase separator, and scrubber and replacing with two PSA systems, including a first one to separate ammonia as backflush and a second one to separate H2 and N2, including, in one example, a compressor between the first PSA system and the second PSA system, and a PDA reactor with combined membrane separation and substantially only a gas cooler and PSA system downstream from the PDA reactor, thereby eliminating a plurality of downstream components such as one or more compressors, condensers, separators, scrubbers, and/or dryers, for example.