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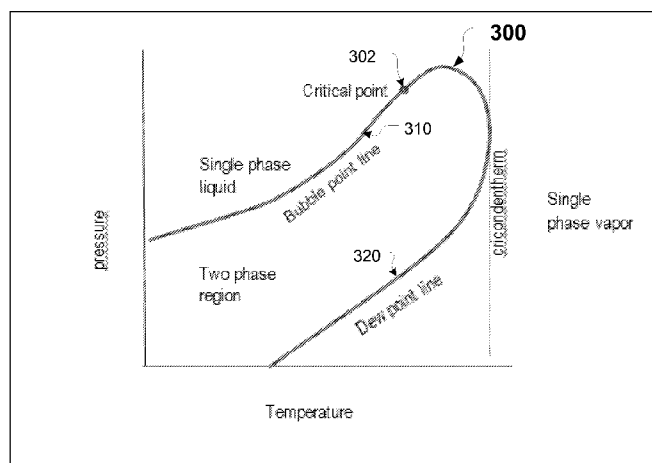
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(54) Title: EFFICIENT AND ROBUST COMPOSITIONAL RESERVOIR SIMULATION USING A FAST PHASE ENVELOPE

**FIG. 3**

(57) Abstract: System and methods of simulating different phase states of fluids in a reservoir are presented. A phase envelope is approximated in response to a non-successful calculation of the saturation pressure. If a given temperature is above a maximum temperature of the approximate phase envelope, a phase of the grid-block is set as a single phase vapor with a composition equal to the overall composition. A saturation pressure is interpolated from the approximate phase envelope in response to a determination that the given temperature is not above the maximum temperature of the approximate phase envelope. If the interpolated saturation pressure is within an accuracy tolerance range, the phase state of the grid-block is determined based on the interpolated saturation pressure.