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(54) Title: **METHOD AND SYSTEM FOR SOLVING FINITE ELEMENT MODELS USING MULTI-PHASE PHYSICS**

(57) Abstract: Systems and methods for solving finite element models, wherein the matrix that governs the solution is modified by adjusting the weighting coefficients of the matrix so that the elements which lie on the diagonal of the matrix are non-negative and the elements which are off the diagonal are non-positive. In one embodiment, a system is discretized on a finite element mesh with the contribution of each node to the discretization being weighted based upon the direction of fluid flow across each element. The nodes which are upstream from the other nodes of the respective elements are weighted more heavily to cause the resulting matrix to be substantially diagonal. This matrix is solved using traditional techniques.