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Thermal instability in a liquid layer with permeable boundaries under the influence of variable gravity. (English) Zbl 07463916

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Summary: In this paper, we study the thermal instability of a horizontal layer of liquid heated from below and confined between thermally conducting permeable boundaries under the action of a variable gravitational field across the layer. It is established that the principle of the exchange of stabilities holds good in the more general framework of hydrodynamical boundary conditions when the parameter representing the gravity variation increasing vertically upward is less than equal to unity. The underlying eigenvalue problem is solved using the Chandrasekhar's technique which is then computed numerically. The numerical results for a wide range of the parameters are presented and discussed. It is found that the gravity variation increasing vertically upward has a destabilizing effect and that the permeability of a boundary has a stabilizing effect on the onset of convection. Influence of the gravity variation increasing vertically upward for various particular cases of the boundary conditions is obtained as limiting cases of the permeability parameters of the boundaries and illustrated graphically.

MSC:

76E06 Convection in hydrodynamic stability
76E20 Stability and instability of geophysical and astrophysical flows
47A55 Perturbation theory of linear operators
76-XX Fluid mechanics

Keywords:

buoyancy; convection; variable gravity; permeable; conducting

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