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Thermal transpiration of a slightly rarefied gas through a horizontal straight pipe in the presence of weak gravitation TOSHIYUKI DOI, Tottori University — Thermal transpiration of a slightly rarefied gas in the presence of weak gravitation is studied based on kinetic theory. We consider the situation where the Knudsen number (the mean free path divided by the characteristic length of the cross section) is small and the dimensionless gravity (the characteristic length divided by the ascent height of the molecules against gravity) is of the order of the square of the Knudsen number. The behavior of the gas is studied analytically based on the the fluid-dynamic-type equation derived from the Boltzmann equation. When the temperature gradient is imposed along the pipe, the pressure gradient is produced not only in the vertical direction but also in the horizontal direction due to the effect of gravity. This horizontal pressure gradient, which is of the higher order of the Knudsen number, induces a flow of the order of the Knudsen number, and produces a relatively finite effect on thermal transpiration. The velocity profile is considerably different from that of the conventional thermal transpiration due to the effect of weak gravitation. A direct numerical analysis of a flow through a long channel is conducted based on the model Boltzmann equation, and the mechanism of this phenomenon is demonstrated.

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