A symmetry result in a free boundary problem

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We study a shape optimization problem involving a solid $K \subseteq R^n$ which has constant temperature and it is surrounded by a layer of insulating material Ω which obeys a generalized boundary heat transfer law. We minimize the energy of such configurations among all (K, Ω) with prescribed measure for K and Ω, and without topological or geometrical constraints. In the convection case (corresponding to Robin boundary conditions on $\partial\Omega$) we obtain a full description of minimizers. In the general case, we prove the existence and regularity of solutions and we give a partial description of minimizers.

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