Effects of induced magnetic field and two-dimensionality of imposed magnetic field in MHD induction generator

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Inertia dominant laminar flow of liquid metal between two parallel insulator walls is investigated in the coordinate system moving with a traveling sine wave magnetic field. Flow and magnetic fields are represented in the form of asymptotic expansions for small parameters \( H^{-1} \), \( N^{1/2} \), \( Rm \), and \( \Lambda^{-1} \) (\( Ha \) is the averaged Hartmann number, \( N \) is the interaction parameter, \( Rm \) is the magnetic Reynolds number, \( \Lambda \) is the dimensionless wavelength). Non-periodic corrections to the flow velocity due to the effects of the induced magnetic field and the two-dimensionality of the imposed magnetic field have a biquadratic profile of \( O(R^2m) \) and a quadratic profile of \( O(\Lambda^{-2}) \), respectively. The multi-structure of the boundary layer is not affected by these effects. For the same pressure drop, the input power fractions due to these effects are proportional to \( R^2m \) and \( \Lambda^{-2} \), respectively. These fractions are wasted and expressed as part of the Ohmic power loss.

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