The Stability of Flow between Arbitrarily Spaced Concentric Cylinders with an Inner Cylinder Rotating and Moving with a Constant Axial Velocity

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Abstract

Instability of viscous incompressible flow between two concentric cylinders with arbitrary gap spacing between them is studied. The outer cylinder is stationary and the inner one is rotating and also moving with a constant axial velocity. The stability equations based on three dimensional disturbances are derived and solved numerically using shooting technique. For various values of the Reynolds number $R$, based on the axial velocity of the inner cylinder, the critical values of the parameters characterizing the onset of the instability of the flow are determined. It is found that for any gap spacing between the cylinders, the constant axial movement of the inner cylinder stabilizes the flow. It is also found that the most critical mode of the disturbances are the axisymmetric mode. However this axisymmetric mode is stationary for $R = 0$ and changes to oscillatory for $R \neq 0$. 