UNIQUENESS OF A CLASS OF STEADY PLANE GRAVITY FLOWS

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1. **Introduction.** In a previous communication [2] we established the existence of a class of free boundary flows of an incompressible inviscid fluid in a uniform gravitational field, having plane projections as illustrated in Figure 1. The flow domain is bounded on the right
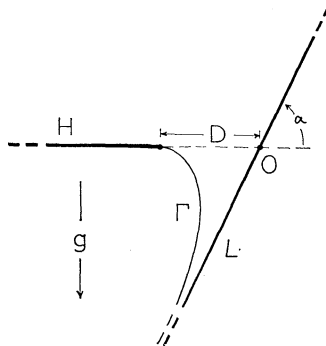

Fig. 1

by an infinite line L inclined at an angle α with the horizontal, and below and on the left by a semi-infinite horizontal line H and a free boundary arc Γ joined to H. The flow is downward through the slot between H and L into a jet bounded by L and Γ. The physical parameters include the boundary inclination α, the acceleration of gravity g, the solt width D, the area flow rate (flux) A, and the flow speed at the slot edge, q. It is shown in [2] that there exists a similarity class of such flows for each choice of the dimensionless pair α, gA/q^3 such that $0 < \alpha < \pi$, $0 < gA/q^3 < \infty$. The flows established there have convex free boundaries in the sense that their inclinations decrease monotonically from zero at the slot edge to $-\pi + \alpha$ at infinity, where they are asymptotic to the fixed boundaries L.

In this paper we shall establish the uniqueness of these similarity classes, find the ranges of the dimensionless products

(1.1) $\qquad \kappa = qD/A , \quad \lambda = gA/q^3 , \quad \mu = gD/q^2 , \quad \nu = gD^3/A^2$

and determine the continuity and monotonicity relations between these products and other similarity invariants. (The products κ, λ, μ, ν are singled out since each involves only three of the four quantities g, D,