4. Inner Structure of the Head of Axisymmetric Gravity Currents

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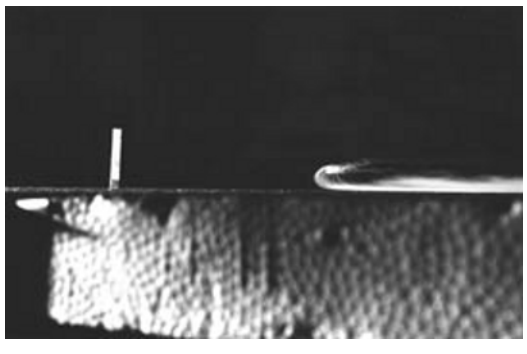

Fig. 1

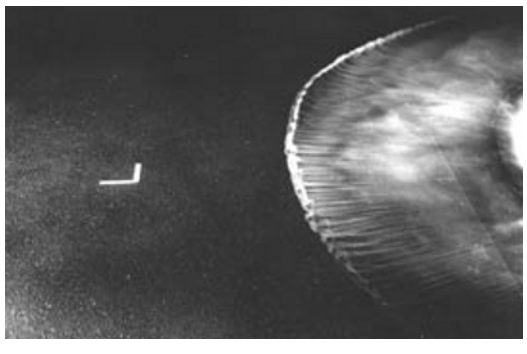

Fig. 2

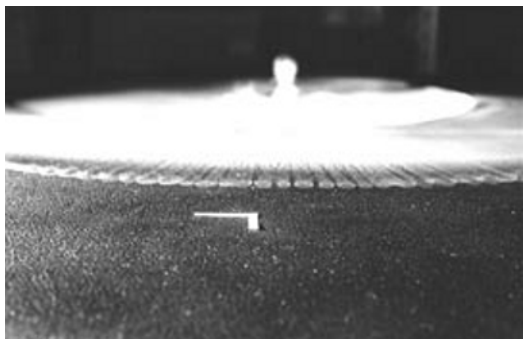

Fig. 3

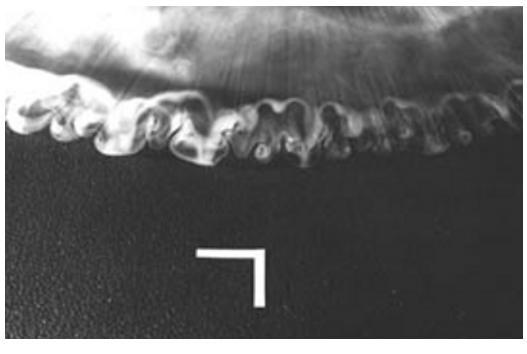

Fig. 4

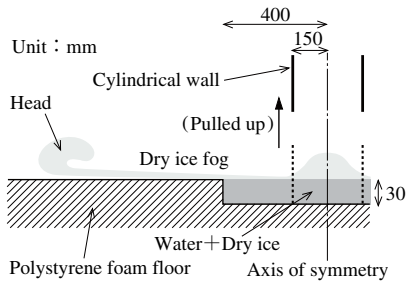

Fig. 5

When a layer of cold air with fog is released from a cylindrical reservoir on a horizontal floor, it spreads nearly axisymmetrically as a gravity current. At the head of the gravity current, the fog layer is rolled up (see Fig.1) and forms a rim when it is looked down from above (Fig.2). Behind the rim, the fog layer is divided into a number of spoke-like structures. Figure 3 shows that each spoke has an elliptical cross section of the nearly equal size. At the head of the gravity current, a thin vortex tube seems to connect two adjacent spokes. A close-up view from above (Fig.4) reveals that each spoke consists of a pair of roll-like convection cells. Fog looks thinner (denser) in the updraft (downdraft) region. Pieces of dry ice are immersed into water to generate dense air with fog. The fog layer accumulates in the cylindrical reservoir and is released by removing the sidewall upward (Fig.5). Figures 1-4 were taken in separate runs.

Fig.1 A side-view of the gravity current. The head advances from right to left at a speed of about 30 cm s^{-1}. The height of the white vertical bar to the left of the head of the gravity current is 5 cm.
Fig.2 The rim-like structure in the fog layer. Each side of the L-shaped scale is 5 cm in length (also in Figs.3 and 4).
Fig.3 A front view of the head. The L-shaped scale is the same as shown in figure 2.
Fig.4 The structure of the head. The L-shaped scale is the same as shown in figure 2.
Fig.5 A vertical cross section of the experimental apparatus.