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Group-Phase Velocity Demonstrator

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THE speed with which the concepts of group velocity, phase velocity, and beats are grasped, integrated, and retained can be materially aided with the following simple demonstration apparatus.

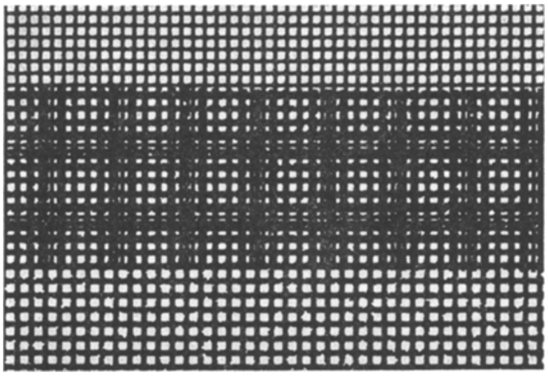

FIG. 1. Fifteen-mesh overlay pattern obtained by overlapping pieces of 65- and 80-mesh screening (magnification approximately 5 times).

Two pieces of Lectromesh screen (an electrolytically deposited screen made by the C. O. Jelliff Manufacturing Corporation, Southport, Connecticut) of dimensions 2 in. × 10 in. and of 65 and 80 mesh, respectively, are cut along the mesh and are separately mounted between pieces of cleared 2 in. × 10 in. spectrographic plates. The screening should be mounted parallel to one long edge of the glass plate, and each sandwich should be bound like a lantern slide with care taken so that the binding is parallel to the screen. Finally fiducial marks may be scribed or ruled in corresponding locations on each of the two sandwiches.

When the completed sandwiches are overlapped so that, say, an inch of 65-mesh screening, an inch of overlay, and an inch of 80-mesh screening are visible, the overlay displays a 15 mesh pattern (Fig. 1). Holding the 80-mesh screen stationary, a displacement of the 65-mesh screen to the right causes the 15-mesh pattern to move to the left. Holding the 65-mesh screen stationary, a displacement of the 80-mesh screen to the right causes the 15-mesh pattern to move to the right with greater speed than that of the 80-mesh screen. By superimposing a uniform velocity for the assembly as a whole upon the relative motions of the two screens, the difference between group and phase velocity can be made clear. The overlay 15-mesh pattern may be identified as the group wave while the 65- and 80-mesh screens may be considered as the separate phases. Thus the group velocity is distinctly different from the velocity of either phase, and the concept of group velocity is meaningful only when the two phases move with different velocities, hence in a dispersive medium.

The same apparatus may be used to illustrate beats by moving the two screens at the same speed. Here the

"group velocity" of the beat is the same as the separate phase velocities, corresponding to audible beats in air, an essentially nondispersive medium.