EXPERIMENTAL STUDIES OF SUPERSONIC FLOWS IN SOAP FILMS

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ABSTRACT

The nature of the compressible flows in soap films was investigated experimentally. The shock waves were generated by the burst of the vertical soap films using a perforating spark. Two cases were studied. In the first case of one-dimensional (1-D) moving shock waves, the images of propagating shock waves and small disturbances were recorded using a fast line scan CCD camera. In the vertical film its thickness generally varies with height and the velocities of the rim and shock wave depend on the thickness of the film. Hence, the line scan CCD camera scanned the central horizontal line of the film in the current experiments, along which the thickness was constant, to avoid the complication caused by the thickness stratification. An aureole and a “ shock wave ” preceding the rim of the expanding hole were clearly observed. These images are similar to the x-t diagrams in gas-dynamics and give the velocities of shock and sound waves. Except in the regions near bursting points, the velocities of the rim and shock wave were virtually constant. The moving shock waves will cause thickness jumps and induce supersonic flows. The relations of induced Mach number, , and ratio of thickness across the shock, , vs. shock Mach number, , are presented. Both results suggest soap films are analogous to compressible gases of specific heat ratio . In the second case, two-dimensional (2-D) oblique shock waves in vertical soap films were generated with induced supersonic flows passing wedges of various angles. The traditional high-speed flash photography was used to observe the oblique shock angles, b , at different free-stream Mach numbers, M. The experimental q -b - M relations are presented.

Keywords : Shock waves ; Line scan CCD camera ; Aureole ; Supersonic flows,Oblique shock

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