RAS M-200

Boundary Layer Theory

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BY

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a common maximum at $h/d \approx -0{\cdot}5$. Further small local maxima occur at $-h/d \approx 0{\cdot}1$ and $1{\cdot}0$. The minima between them occur at $-h/d \approx 0{\cdot}2$, $0{\cdot}8$, and $1{\cdot}35$. Depending on the depth of the cavity it may sometimes happen that regular vortex patterns are formed in it, leading to the different values of drag. As seen from the symmetry of the curves about $h/d = 0$ shallow cavities of up to $-d/h = 0{\cdot}1$ give the same increase in drag as corresponding small protuberances.

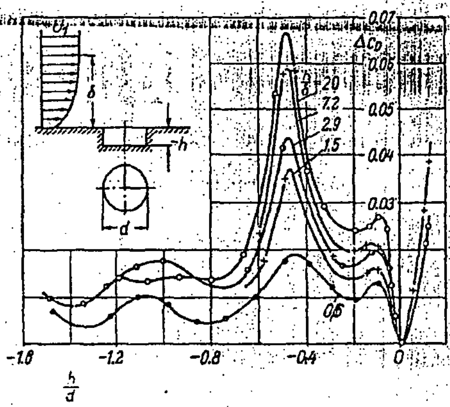

Fig. 21.14. Resistance coefficient of circular cavities of varying depth in a flat wall, as measured by Wieghardt [54]

The flow pattern which exists behind an obstacle placed in the boundary layer near a wall differs markedly from that behind an obstacle placed in the free stream. This circumstance emerges clearly from an experiment performed by H. Schlichting [38] and illustrated in Fig. 21.15. The experiment consisted in the measurement of the velocity field behind a row of spheres placed on a smooth flat surface. The pattern of curves of constant velocity clearly shows a kind of *negative wake effect*. The smallest velocities have been measured in the free gaps in which no spheres are present over the whole length of the plate; on the other hand, the largest velocities have been measured behind the rows of spheres where precisely the smaller velocities

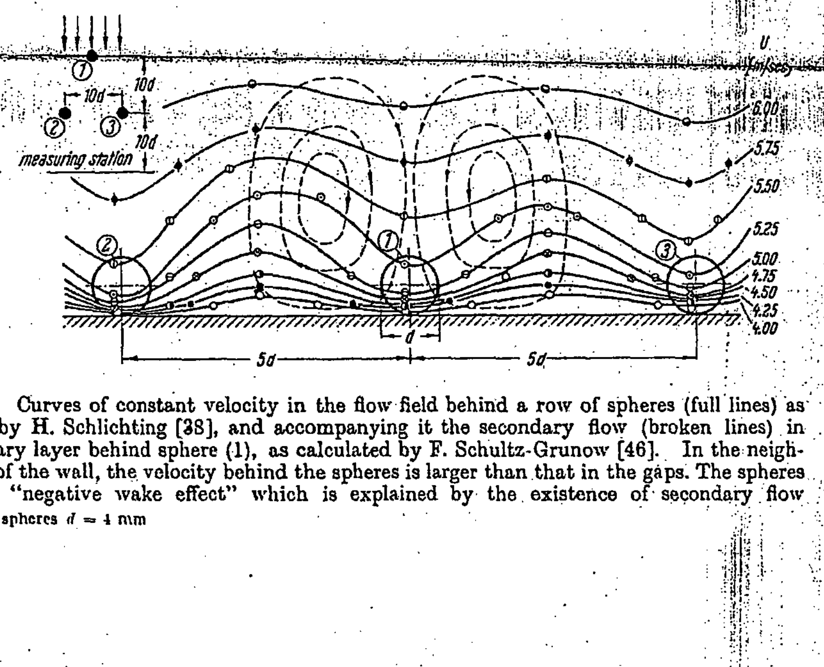

Fig. 21.15. Curves of constant velocity in the flow field behind a row of spheres (full lines) as measured by H. Schlichting [38], and accompanying it the secondary flow (broken lines) in the boundary layer behind sphere (1), as calculated by F. Schultz-Grunow [46]. In the neighbourhood of the wall, the velocity behind the spheres is larger than that in the gaps. The spheres produce a "negative wake effect" which is explained by the existence of secondary flow
Diameter of spheres $d = 4$ mm