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Reducing Friction Drag on Flat Plate

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There are in existence several methods of boundary layer control which have been developed for the purpose of reducing friction drag of streamlined body. These include such as acceleration of the boundary layer (blowing), injection of a different gas, cooling of the wall et al. All of them are described in some detail in the scientific literature. In this paper a new method for the reducing friction drag, which remains sufficiently studied. The proposed method is based on the use of a liquid film on the surface of the streamlined body.

A solution to the problem of a flow over a flat semi-infinite plate set at an angle of deflection to the horizon, and having a thin liquid film on its surface by external airflow is presented. The film is formed at the plate made of raindrops. Liquid moves by gravity and friction on the outer surface of the film. Influence on the boundary layer raindrops and thermal effects are ignored. In general, the problem is conjugate, including a problem of a film flow (internal problem) and a problem of the boundary layer of incoming air (external problem). For solution the dual problem a method of successive approximations was used. This method consists in the fact that the external and internal problems can be solved separately, but logically or iteratively. At each new approximation the inner problem is solved with regard to the friction resulting from the external problem, the solution of which, in turn, takes into account speed at boundary surface, obtained in the previous approximation from the interior problem. Thus, the iterative process continues until the speed and, consequently, the friction at the phase interface change little from iteration to iteration. For the interior problem the method of asymptotic expansions in a small parameter was used. This paper gives null and first approximation. External problem was solved the numerical method of finite differences. In the paper presents some results showing the reducing friction drag on the flat plate.

Keywords: flat plate, boundary layer, liquid film, friction drag, conjugate problem