TECHNICAL AEROMODELING-IV

Henry R. Jex is a 25 year old design aerodynamicist with a fervor for understanding physically the mysteries of flight at all speeds. Born and raised in Maryland, where his family still resides, he has adopted Southern California as a permanent home.

An intense curiosity towards aerodynamic phenomena and the flight characteristics of birds, models and machines existed since his early teens, so there was no doubt about his future course. Four years at the Massachusetts Institute of Technology, during which studies did not interfere too strenously with extracurricular activities, resulted in a B.S. in Aeronautical Engineering in 1951. After a year at the Southern California Cooperative Wind Tunnel in Pasadena, he returned to school, this time to the California Institute of Technology for an M.S. in Aeronautical Engineering. Until recently he has been working in the Aerodynamics Department of the Cooperative Wind Tunnel in various projects including tunnel wall corrections, future testing requirements and supersonic nozzel design. Some interesting consulting work in general aerodynamics has been performed during this past year. At present he is in the preliminary design group of Radioplane Co. in Van Nuys, California.

Mr. Jex was the founder-president of the Tech Model Aircrafters at M.I.T. and has been a member of the Low Speed Aerodynamisc Research Association (of England) for several years. He is also a member of the Institute of Aeronautical Sciences, Gamma Alpha Rho (an honorary aeronautical society) and Tau Beta Pi. Several of his papers concerning low speed aerodynamics have been published by the L.S.A.R.A. and national magazines of which the most recent is the current series in SOARING. He does his own art work for these articles with the consolation that they may some day be used in a book on the educational uses of technical aeromodeling.

BY HENRY R. JEX

We have learned about the bugaboo of *separation* of flow from a wing, how it is aggravated by the *laminar* condition of the boundary layer common to low speeds, (low Reynolds Numbers, actually) and reduced by making the boundary layer artifically *turbulent* by various means. The general reasoning behind the use of *turbulators* such as cork grains, surface threads, leading-edge wires, and the leading-edge bubble were described in the last article, and this present one will show them as finally combined into specific airfoils of practical design for model sailplanes.

In model sailplanes the main criterion for good performance is low sinking speed rather than a flat glide, as is the measure for full-size sailplanes. It can be shown by mathematics and experiment that low sink demands a very high lift airfoil, even at the expense of some increased drag. The induced-drag, which is the price we pay for high lift, can only be minimized by very high aspect-ratio wings (i.e. wings with large span for a given wing area). High aspect-ratio wings in turn require a moderately thick airfoil to contain the larger spars needed. But conventional thick, high lift airfoils have the very worst low speed separation characteristics possible, so life is difficult for the serious modeler!

Aside from some unwieldy tricks such as vortex-generators (see Sept.-Oct. '54 SOARING) and boundary-layer suction, the only recourse is to promote a turbulent boundary layer over the highly-cambered aft portion of our airfoils. The compromise to be decided on is this: either to use a thin sharp airfoil which has less separation tendencies but a heavy structure, or to use a thicker airfoil with some added features to force transition.

A second consideration arises here for thermal-hunting model aircraft; this is the "gust-sensitivity" of the airfoil. Poor (that is, abrupt and extensive) stall characteristics cause a model to drop right out of a small thermal, while a smooth, gradual stall results in a "buoyant" flight that thrills the aeromodeller (and wins him trophies!) It is well-known that airfoils with sharp leading-edges (particularly those with a leading-edge bubble present) stall suddenly —from the leading edge back. On the other hand, those with blunt leading-edges stall from the trailing edge forward in a gradual manner. The conclusion is that a blunt leading-edge is desirable if a turbulent boundary layer can be forced by some other means.

First, let us look at successful types of thin airfoils. The recommendations