An Introduction TO SOARING

by Robert M. Stanley

PART II

The following is the second installment of an article on soaring written by Robert M. Stanley for the National Aeronautics Council. It is reprinted with their permission.—Editor.

Soaring, in its modern, more technical sense, is that ability of a motorless aircraft to utilize those movements present in our atmosphere to sustain and increase its altitude above the ground. The term gliding is loosely applied in a generic sense to include all forms of motorless flight, including soaring, but in its strictest interpretation denotes a toboggan-like slide along an invisible airpath from a higher to a lower elevation. Likewise, the term glider is frequently used to include all forms of heavier-than-air craft not equipped with engines, although those gliders capable of prolonged soaring flight are properly termed sailplanes.

The sailplane can best be recognized by its smooth shapely contoured form, by its great wing span and by the careful attention which has been paid to the achievement of pleasing symmetry and streamlining. A mere glider generally has the very angular ungainly appearance so common to early aviation photographs, and possesses none of the sleek refinements which are the sailplane's prime requisites.

Perhaps the most surprising feature of the modern sailplane is its phenomenal strength. Built to soar aloft inside storms which send mere airplanes scurrying for shelter, the sailplane must possess great strength to withstand the turbulent buffeting and savage gusts which lurk within the storm cloud. Common is it now for sailplanes to be designed to withstand ten times their normal loaded weights. When we consider that this is the limit of human capacity and that the average transport or bomber can stand only about half this load, we must hold a high opinion of the structural integrity of these soaring craft.

Aerodynamically, the sailplane is the most highly refined of all aircrafts. In order to achieve the phenomenally flat glide so essential to cross country soaring, all forms of drag must be decreased to their irreducible minima. Cockpits are carefully enclosed, but a single wheel, the landing gear is carefully housed, and meticulous detail is paid to possible sources of resistance. Wing surfaces are waxed and polished, and airfoil contours are exactly preserved by closely spaced, light ribs. The really efficient sailplanes will fly as much as 30 miles horizontally for each mile they descend at cruising speed. (The average airplane can only go six or eight.)

One of the largest sources of drag encountered at slow speed is that drag upon which lift itself depends, called induced drag. Since this decreases with span, it is customary for sailplanes to have very great wing spans, from 45′ to 65′. Such large wings, naturally, present something of a problem in weight and structural design, and can prove very awkward to maneuver rapidly, but are the inevitable price we must pay for performance.

The problem of weight is not so serious as one might think, however, and never becomes so critical that safety need be jeopordized due to mere structural weight. A pound is well spent if it increases safety or aerodynamic efficiency. From mathematical considerations, and by actual flight verifications, it has been proven that added weight does not adversely affect gliding angle, that a heavy plane can glide as far from a given elevation as a lightly loaded one, and generally can go farther and faster. For this reason, really high performance, championship sailplanes frequently are very small and very heavy, thereby achieving speed to go farther during daylight hours.

While gliding ratio is the prime consideration which governs design, another very important quality is sinking speed. Unlike gliding ratio, sinking speed is not influenced extensively by drag, but is closely linked with weight. While, as we have seen, weight is no handicap to distance, it can seriously handicap rate of climb, and if a soaring current is very weak, only by employing a very low sinking speed can one remain aloft. Usually, for planes built to wing loadings of 3 to 4 lbs. per sq. ft., as is now customary, upward moving air currents possess sufficient vigor to make sinking speed unimportant, but on poor soaring days, it is not unusual to see old, lightly built sailplanes surpassing the more modern and heavy ships in climb and duration.

A third factor, closely linked with sinking speed, is diameter of turn. If the sailplane is to be capable of successfully employing updrafts having very narrow confines, it is necessary that the pilot be able to make continued spirals which will keep him within this small area. Only by using low wing loading and efficient airfoils can this desirable condition be achieved. Stalling speed is kept at a low figure as a result, and is a contributing factor to soaring's amazing safety record. Maneuvers and steep turns must be, and can be made with safety at slow speed and low altitudes as a result of these design criteria.

The phenomenal structural strength of the sailplane has been mentioned. This is not due, however, to mere extravagance, but to the fact that the sailplane's low wing loading and stalling speed render it hypersensitive to momentary shocks due to gusts and turbulence. Its structure must be sufficiently resilient to absorb such shock loads without acquiring a permanent deformation. The wing must retain its torsional rigidity even though the tips may deflect as much as three feet. It must be of stable design such that turbulent atmospheric bumpiness will not set up destructive flutter in the wing or control surfaces. Ailerons must be well supported so that they do not bind or chafe regardless of the deflected position of the wing. Control cables must be so located that their length does not vary with the wing deflection, tightening or slacking in bumpy air.

The most common material used in the construction of soaring planes is plywood, assembled with glue and nails. Recent American designs show, however, a rather persistent trend toward all metal construction, using either steel tube with fabric covering or all metal duralumin monococque structure. Though the latter is undeniably expensive in initial cost, the ruggedness and freedom from maintenance problems effects quite measurable savings in