Designing THE ROSS-STEPHENS Sailplane

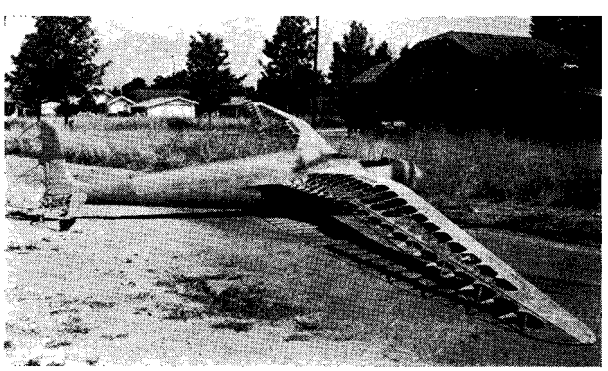
By HARLAND C. ROSS

The RS-1 is the outcome of several years' study on sailplane design. In designing sailplanes it is necessary to employ a different technique from that used in building airplanes, and for the past four years I have devoted most of my spare time along this line. Since the number of high performance sailplanes in America were limited I looked to Germany for some of their best proven ideas. Incidentally, I am a great believer in the saying, "Experience is the best teacher". Since the "Sao Paulo" was considered their most advanced design, I incorporated most of its best features in the RS-1.

I have always had the idea that a small ship was the most practical from a good many standpoints, namely, cost, maneuverability in the air, ease of handling on the ground, smaller and lighter trailers, etc. So with this in mind, I began work on the RS-1. Since some of the German ships appeared ungainly in the air, I spent almost as much time trying to make each part well proportioned in order to have a pleasing appearance to the eye, as I did in the actual aerodynamic design. From the comments the ship received at the National Contest, I feel that my purpose was accomplished.

The RS-1 was designed mainly for one purpose, cross-country flying, so, in order to get high cruising speed, the N.A.C.A. 24 series wing curve was incorporated. I investigated the 230 series but discarded them, due to bad discontinuity in the lift curve and poor characteristics at low Reynolds number. By using a 2.66 to 1 taper ratio, only $3\frac{1}{2}°$ twist was required for lateral control at the stall. With a root chord of four feet it gave an aspect ratio of seventeen.

One of the outstanding differences from most sailplanes is the small wing area of 124.4 square feet, including the part covered by the fuselage. This was made possible only by very careful design and strict check on the weights as the ship progressed. Some figures, which may be of interest and which partly explain the performance of the RS-1, are as follows:



Cy La Tour Photo

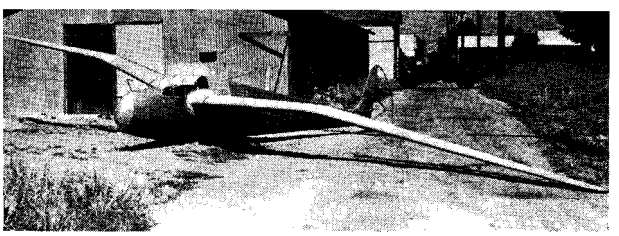
The Ross-Stephens before covering, showing wing construction.

Ship	Wing Loading	Span Loading	AR
Minimoa	3.2 lbs./sq. ft.	11.7 lbs./sq. ft.	15.2
Rhönsperber	3.35 lbs./sq. ft.	11.0 lbs./sq. ft.	15.6
RS-1	3.78 lbs./sq. ft.	10.2 lbs./sq. ft.	17.0

As you will notice, the RS-1 wing loading is considerably heavier than the other ships but at the same time it has a lower span loading, which is one of the main criterions of the design for minimum sinking velocity. In order to improve further the sinking velocity at high angles of attack, the wing was very carefully filleted into the fuselage so that the lift distribution would not be affected at slow speeds.

Spoilers were installed to increase the sinking velocity for landing in small fields. From tests made, the gliding angle changes from 28-1 to 20-1 with the spoilers full open at 38 m.p.h.

The ship flown at the Contest had pendulum elevators but a fixed stabilizer has been designed to replace them



Cy La Tour Photo

Ross-Stephens

so that it can be flown hands off. The stabilizer will also be placed on top of the fuselage.

The fuselage is made up of laminated bulkheads with four light longerons covered with plywood. The cockpit is roomy and inclosed with plastacelle. The seat has a well for a back pack parachute.

The wing is of the single spar type with a plywood leading edge. The ailerons are differentially operated and hinged to a light auxiliary spar.

SPECIFICATIONS

Minimum sinking velocity—2.5 ft./sec. at 38 m.p.h.
Maximum gliding angle—Approx. 28-1 at 48 m.p.h.
Stalling speed—30 miles per hour.
Sinking velocity—6.5 ft./sec. at 70 m.p.h.

AR - 16.75

Theodore Bellak

Span—46 ft.
Length—20.5 ft.
Wing Area—125 sq. ft.
Weight empty—280 lbs
Gross weight—470 lbs.
Aspect ratio—1:17