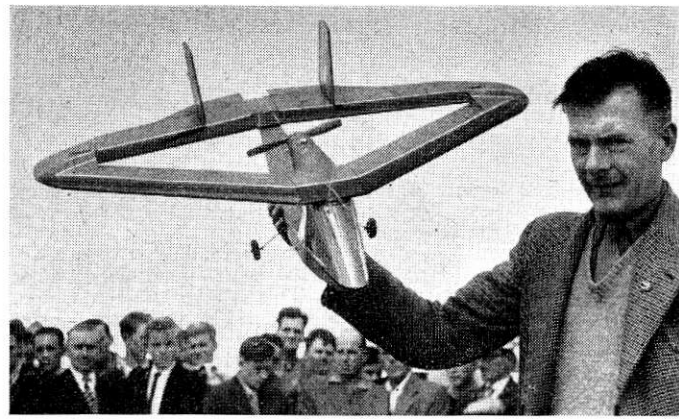
AERO MODELLER

Remarkable semi-scale 36 inch model proves the stability values of a full-size project

by G. WOOLLS



The Warren-Young Wing

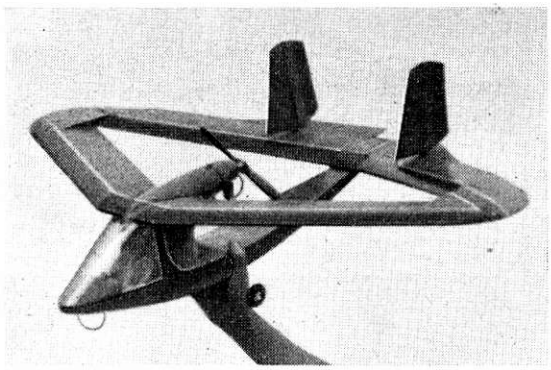
POSSIBLY MANY READERS will look at "Ace of Diamonds"—smile tolerantly, and mutter something about odd looking aircraft without other purpose than to look unusual.

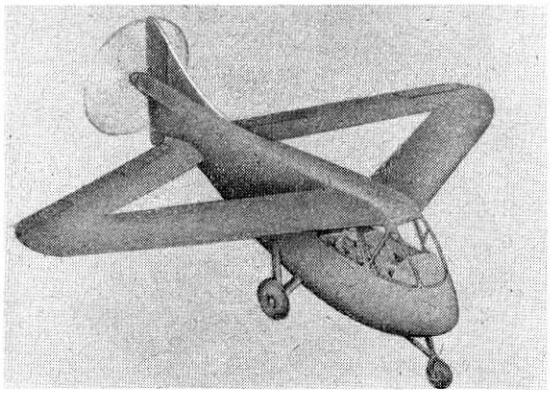
In order to straighten the record, let it be stated that the model is based on a full size project and appears to bear out the advantages claimed for the original aircraft.

It was back in 1926 that Mr. Norman Hall-Warren, A.R.Ae.S. created a wing design which would be stall and spin-proof and have a very large speed range.

Ex-R.F.C. pilot and well-known sailplane enthusiast, Rex Young later joined forces with Hall-Warren and in December, 1937, a patent (No. 508022) was granted. A private backer for the building of a prototype was found, but the international situation at that time (just prior to the war) prevented fruition of the project.

Since the war, rising production costs and official obstructions (Warren states) have prevented the production of a full size aircraft.





The theory behind the Warren-Young is largely concerned with the Boundary Layer flow over the wing. One of the features of swept wings is that the Boundary Layer moves in a spanwise direction, towards the tips in the case of sweepback, and towards the root when the wing is swept forward. This outward movement normally causes tip stalling, and fences are often used in an attempt to cure this.

A study of the diagram opposite, will show how the combination of sweepback and sweepforward causes the Boundary Layer to move from the front plane centre section, around the tip and thence back to the rear plane centre section. This continuous removal of the boundary air prevents stagnation of the airflow and stops the lift from decreasing at angles of attack greater than that of maximum lift, *i.e.*, both front and rear planes will have a flat lift curve.

There is also a slot effect between the front and rear plane near the point of juncture. This has the effect of speeding up the flow over the trailing edge of the front plane, preventing early separation, which might otherwise occur at this position.

In addition, the relatively large chord of the wing tip spreads the tip vorticity, preventing an early local stall and as with all low aspect ratio aerofoils, the Warren-Young tip surface will continue to develop lift up to an exceptionally high angle of attack. In fact the stalling angle of the tip is beyond that attainable in flight and is probably well over 40°.

Another anti-stall characteristic of the Warren-Young wing derives from the fact that the rear plane is always operating at a lower angle of attack than the front plane, due to the decalage indicated by stability considerations, and also to a smaller degree due to the downwash, and the rear plane is therefore still lifting strongly when eventually the lift of the front plane starts to fall.

The stability of the Warren-Young aeroplane is exceptional, due to the large area of wing surface located with an effective arm about the centre of gravity. There is no onset of instability or upset of balance at very high angles of attack, corresponding to very low forward speeds. In fact it is impossible to spin the Warren-Young, nor in the accepted sense, is it possible to stall it.

All this means that the Warren-Young aeroplane will take-off after an exceptional short run and can be climbed very steeply in complete safety. Also it can approach a landing in an almost vertical path, with no risk of loss of balance or sudden loss of lift. The calculated figures for the Warren-Young Skycar, a two-seater, 100 h.p., light plane version, are still-air minimum level flying speed 28 m.p.h. and approach and touch-down speed of about 20 m.p.h.

Comparison of George Woolls' model with Skycar project below shows main difference in engine and prop position, a long extension shaft being too complicated for the flying model.

Coupled with the aerodynamic advantages, the Warren-Young wing is an exceptionally stiff structure, due to the triangulation in both the horizontal and vertical planes, and is thus proof against any distortion. Moreover, it is a proven fact that the Warren-Young aeroplane will tolerate relatively large changes in locus of centre of gravity, without reducing stability.

It is interesting to note that the Russian aircraft designer, Mikoyan, has stated that the Rhomboid type aircraft (*i.e.*, Warren-Young type) is the shape of things to come in supersonic flight (*see R.A.F. Flying Review*, June, 1955).

Readers who require detailed technical descriptions of the Warren-Young wing may refer to the following publications:

—*Flight*, November 18th, 1943
May 18th, 1944
August 10th, 1950

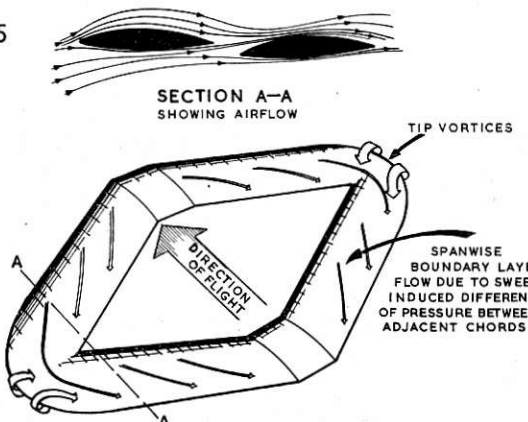
The Aeroplane, March 5th, 1948
June 25th, 1948

Aeronautics, March, 1948

Brit. Pat. Spec. No. 508022 of December, 1937

"Ace of Diamonds" may be described as a semi-scale model of the projected Warren-Young "Sky-Car". That aeroplane has its propeller at the extreme rear of the fuselage, but as the necessary extension shaft would add complication to the model, the prop. was moved to a position between the wings.

The first powered version went O.O.S. on its third flight, being recovered some 2½ months later from a cornfield! A second powered version (seen above) won the Unorthodox Concours at the 1957 All Britain Rally and made several excellent demonstration flights. The model is not an absolute beginners project, but this does not mean that it is so complicated to be beyond the



AIRFLOW OVER "WARREN-YOUNG" WING

powers of anyone who has already built a couple or more orthodox power jobs. Although the model will bear out the stability claims made for the Warren-Young Wing, it must, in common with any other aircraft, be rigged correctly in order to give it a proper chance to fly properly.

Check that C.G. lies where indicated, and that there is no side thrust, as, due to the proximity of the prop. to the fins, this has a very powerful effect. There should be approx. 6° of wash-in on the rear wing, and with this, the elevators should be shimmed up until their back edges are about $\frac{3}{32}$ in. above their front edges. Ensure that the rudder trim tabs are not offset.

Trimming, if any, follows the usual pattern, remembering that the model is a scale type, *i.e.*, tight spiral climbs should not be attempted—at first anyway!