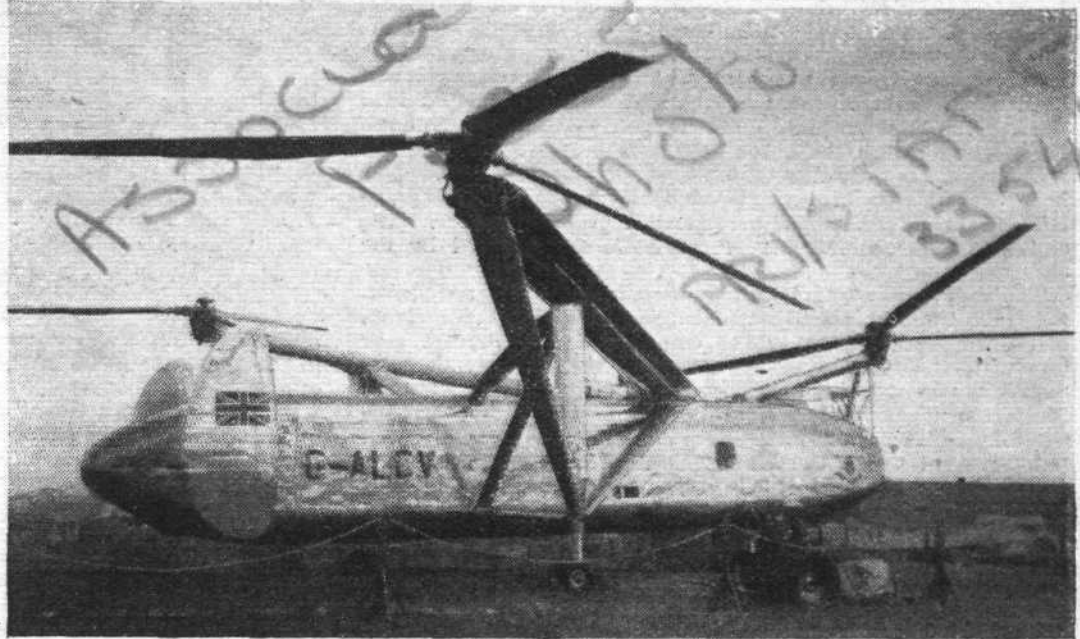


Discussing the Helicopter

*The Cierva W.11
"Air Horse" De-
scribed and
Evaluated : Ad-
vantages and Dis-
advantages of
Three Rotors*



The Cierva W.11 "Air Horse" is powered by a Rolls-Royce Merlin engine. The all-up weight is 17,500 lb.

LAST week we dealt with four of the five papers read at the joint all-day meeting on November 20th of the Royal Aeronautical Society and the Helicopter Association of Great Britain. In the following pages we give a summary of the paper read by Mr. Shapiro, of the Cierva Autogiro Company's technical staff.

Mr. Shapiro recalled early schemes for multi-rotor helicopters, and said that by 1945 the Cierva company became convinced that neither the physical achievement of vertical flight nor the achievement of continuous operation could any longer be considered satisfactory aims. They were searching for a project which would offer economically sound commercial operation on a large scale. Such operation could only be envisaged by increasing the size of the helicopter. The Air Horse design arose primarily as an answer to the demand for large loads. It was realized that difficulties increased in proportion to rotor diameter, and it was thus natural to increase the number of rotors.

Three rotors were chosen because a body in space is determined by the position of three of its points, provided they are not in line. In the Air Horse the rotors have freely flapping blades, and the three rotors turn in the same direction, torque reaction being counteracted by horizontal thrust components, obtained by built-in tilt of the rotors. The rotors are arranged with the single rotor in front and two side by side at the back.

Control in pitch and roll is by lift couples obtained through differential application of collective pitch to the three rotors. For control in yaw, cyclic pitch variation in the fore-and-aft phase is applied differentially to the side-by-side rotors. The machine is fitted with an undercarriage having a stroke of five feet and capable of absorbing the shock of high rates of descent.

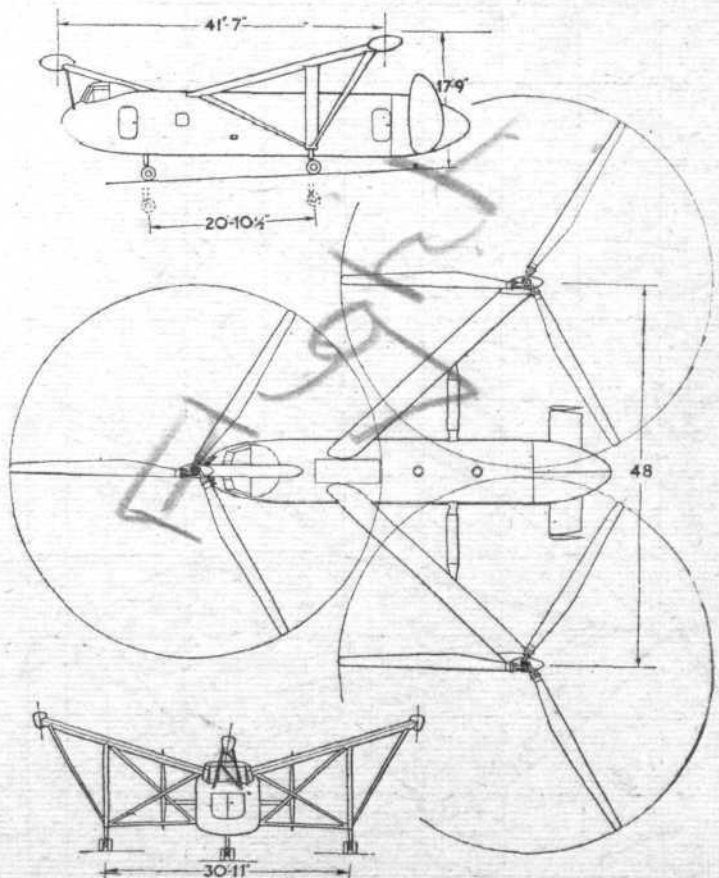
The airframe of the Air Horse is a semi-monocoque structure with outriggers carrying the rotors and undercarriage. The canopy-covered cockpit is in front, equipped with fully duplicated controls and all necessary instruments. Behind the cockpit is a small luggage compartment through which the crew enter the cockpit. The front undercarriage leg is attached to the fuselage frame at the rear of this compartment. Then comes the engine room, which contains, in addition to the engine and its accessories, the distribution gear box, the "control exchange" mechanism and its ancillary hydraulic equipment, and the fan and radiator unit. A fire-proof bulkhead separates this section from the main load compartment, at present fitted for freight-carrying only. A tail section completes the streamlining of the fuselage. It is in hinged halves to give unobstructed access to the compartment. There is a fixed tailplane with adjustable fins at its ends.

Streamlined outrigger booms to carry the rotors and undercarriage are of semi-monocoque construction and streamline section to reduce drag at forward speed. The undercarriage legs, supplied by Lockheeds, comprise telescopic tubes, the

outer of which carry the loads while the inner constitute the oleo-pneumatic shock absorber. Palmer wheels and tyres are fitted.

Power is supplied by a Rolls-Royce Merlin 24 with single-stage, two-speed supercharger. The cooling system layout is of shunt type and includes a light-alloy Marston radiator. The exhaust system is a specially developed "cross-over" manifold surrounded by a jacket through which cooling air is drawn by the ejector action of the exhaust gas. The coolant radiator and the oil coolers (including transmission oil coolers) receive a flow of air from a horizontally mounted variable-pitch fan drawing air from above and ejecting it downwards through the radiators.

The engine drives the distribution gears through its standard spur gear reduction and a clutch unit consisting of



General arrangement of Cierva W.11 "Air Horse."