AVIAN GYROPLANE PROGRESS

VTOL AND 150 m.p.h. FOR PRIVATE PILOTS

In an effort to produce a simple, cheap and effective means of air transport, a group of former Avro Aircraft engineers has designed and built an autogyro with vertical take-off and landing capability. The engineers formed a company called Avian Industries Ltd., at Georgetown, Ontario, and have designed and built a prototype of the 2/180 Gyroplane in seven months. It is a tandem two-seater based on a steel keel and rotor pylon forming the entire primary structure and supporting seats, controls, undercarriage and a rear-mounted Lycoming 180-h.p. flat-four engine. The three spring-steel undercarriage legs are each held to the keel by a single bolt. Propulsion in autorotative flight at cruising speeds of 150 m.p.h. is by a ducted fan propeller at the tail with a small aerodynamic rudder mounted in the ring. Additional kinetic energy required for vertical take-off and landing to and from 200ft is provided by cold tip-jets supplied from a compressed-air container continuously charged by an engine-driven pump. The three-bladed rotor is controlled by aerodynamic tabs at the trailing-edge near the tip, although it is not made clear whether cyclic- and collective-pitch changes are made in conventional helicopter fashion or not. Power-off approaches without tip-jets can be made at 20-25 m.p.h. With touch-down at 15 m.p.h. Very little has yet been said about the actual method of control, particularly during landing and take-off.

It is claimed that the Gyroplane can be flown by relatively inexperienced fixed-wing pilots and that the machine should cost less to operate than a car. Target price of production versions is $10,000 and Gyroplanes should be available next April. The company envisages a sales potential of 5,000 aircraft per year and the planned initial production of 20 per month is thought to be capable of satisfying only the local-demand in Ontario.

The first prototype, designated 2/180B, was to have flown on September 30, but a change of premises, a decision to dispense with subcontracting and negotiations with the Government have caused some delay. Moreover, the first prototype, which has now completed taxying tests and some tethered running, has a belt-drive from the rear of the engine to the rotor for early trial work.

According to Avian, the autogyro concept represents a major step in the direction of low cost and improved performance in itself, but the use of kinetic energy by over-speeding the rotor on the ground was too unsafe for jump take-off and landing in an aircraft for relatively inexperienced pilots. Particularly in the landing case, the kinetic energy in a practical rotor is barely sufficient for a perfect landing. To obtain sufficient stored energy for simple landings and overshoots, the compressed-air system was developed, so that the pilot not only has rotor kinetic energy for landing but a compressed air reservoir containing an additional five times this energy. This also allows a jump take-off to a height of about 200ft.

The main feature of a conventional rotor system is dynamically unstable at low forward speeds, and relatively difficult to control, but Avian have developed a servo tab-controlled rotor offering inherent true dynamic stability even in the hover. With high off-set flapping hinges, the servo tab-control gives very high initial angular acceleration, and ample damping in pitch and roll so that, although the initial acceleration exceeds the minimum Mil. Spec. requirements, the maximum rate of pitch and roll is very low, being less than 10 deg/sec at low speeds. This means that the pilot's stick is a rate control device, rather than an acceleration control, an improvement which has long been sought by human engineers. In low forward characteristics the Avian 2/180 conforms to the Mil. Spec. helicopter requirements in hovering, and to conventional fixed-wing practice in forward flight.

The blades have no drag hinges but are relatively heavy and have exceptionally high in-plane stiffness. Their structure is steel, with glass plastics skins stabilized by hardwood forward of the main spar, and by balsa in the trailing-edge section. Use of steel and the fact that the blade angle of attack is determined almost entirely by the tab angle leads Avian to believe blade tracking will not be necessary in service unless for some reason a tab control circuit is changed. The tabs give very light stick forces. Aluminium alloys have been avoided where fluctuating stresses are more than 1,000 lb/sq in so that the rotor system and the main fuselage structure are of steel. With a design fatigue reserve factor of three infinite fatigue life should be obtained for all components. The blade retention straps have a reserve factor of six because they are designed on a stiffness requirement, and each strap is composed of 25 individual laminations. Extensive damage to the floor structure or the exterior skin has no effect upon the safety of the aircraft, which can in fact be operated without any of these items attached. A crash landing will often result in no more than bent undercarriage legs which can be replaced by the removal of three bolts.

The 150 m.p.h. cruising speed of the Avian at 75 per cent power is due primarily to its small size and clean aerodynamic form and also to the use of a ducted fan. Moreover, the fan duct replaces the fuel tank and also to the use of a ducted fan. Moreover, the fan duct replaces the fuel tank and enables the rudder or yaw vane to be mounted immediately behind the propeller where it is most effective. A fixed-pitch propeller can be used without performance sacrifice, propeller noise is reduced and the duct constitutes a valuable safety feature. Because the autogyro rotor is always in rotation, the familiar "dead man's curve" of a helicopter is absent. The most dangerous flight condition would occur if the engine failed in the first second after take-off, but with the air bottle system a normal landing could be made from any height below 100ft. Thus the Avian 2/180, although a single-engined aircraft, has a very high degree of safety with respect to engine failure even in the event of a failure in normal flight before the air bottle had been recharged by the engine-driven compressor.

Avian 2/180 Gyroplane (Lycoming O-360); Rotor diameter, 26ft; overall length, 14ft; height, 7ft 11in; cockpit width, 35in; empty weight, 1,000lb; gross weight, 1,600lb; internal fuel, 26 Imp gal; maximum cruising speed, 150 m.p.h.; minimum speed, 0 m.p.h.; maximum rate of climb, 1,500fpm; normal still-air range, 450 miles.