THE AVIAN GYROPLANE

A Progress Report

By HARRY McDOUGALL

THE AVIAN GYROPLANE is essentially an up-dated version of the pre-war autogyro. In the 1930's the autogyro, using a rotor which revolved freely in the airstream instead of being driven by the engine, had reached an advanced state of development but research into this mode of flight was suspended when the helicopter was perfected as a practical flying machine.

The dispersal of the various design teams which had become familiar with the problems of auto-rotating flight caused a hiatus in development which has made the task of the present-day gyroplane designer particularly difficult. He must, in effect, rediscover all the basic principles and then apply them in the context of advanced aerodynamics and modern industrial technology.

Background: The development of the Avian Gyroplane can be traced back to a project which started at Avro Aircraft Ltd. when the fate of the Arrow was hanging in the balance and the company was casting about for ways to diversify. A survey carried out by the company's sales department revealed the existence of a substantial market for a 3-5 seat autogyro and design of this project, designated the P.15, was commenced.

The P.15 became an incidental casualty when the Arrow was cancelled but the project had by then generated considerable enthusiasm among the design engineers concerned and it was they who set up the Avian company to construct a similar but smaller aircraft.

The Avian Gyroplane has suffered its share of mishaps and the company makes no attempt to minimize the problems that have been involved in perfecting the plane. The first prototype was destroyed when a non-company pilot inadvertently operated the collective pitch lever while taxiing. On another occasion the disintegration of a propeller caused severe structural damage. A canopy which came adrift in flight also resulted in damage to one aircraft when the pilot was compelled to land the plane with inadequate directional control because of the increased drag at one side.

Sound Design: However, it is notable that, although the fourth and fifth prototypes are now flying, no major changes in the overall design have been or are being contemplated. The general configuration of the aircraft with its stubby fuselage and pusher propeller enclosed in a duct which substantially increases the thrust, is considered sound and the present engineering effort is concentrated solely on improving the performance.

The basic structure of the Avian is essentially a single steel beam to which a steel tube forming the basis of the rotor is attached. The fuselage is of light Fiberglas stressed to withstand air loads only.

Since the rotor is not driven in flight but derives lift solely from the air passing over the rotor blades as the plane moves forward, the hinging of the blades to the rotor head must be arranged to permit an automatic cyclic pitch adjustment as the rotor revolves. This is essential to create a balanced condition and prevent the craft from rolling and the hinges now used were developed by Avian only after a long process of experimentation.

Provision is made for a jump start, this being accomplished by using the engine to drive the rotor through a system of belt drives. While the plane is still on the ground the blades remain at neutral pitch. The engine drives the rotor until it reaches a predetermined rpm and operation of a pitch lever then changes the pitch of the blades from neutral to coarse and simultaneously declutches the engine. The kinetic energy stored in the whirling blades is sufficient to lift the plane well clear of the ground after which it goes into a normal forward climb.

Gradual Improvement: The aerodynamic and structural problems encountered have been systematically solved and each of the five prototypes has been an improvement on its predecessor.

When it was discovered that the duct blanked off too much of the rudder resulting in a lack of adequate directional control, a larger rudder was fitted. The design of the duct itself

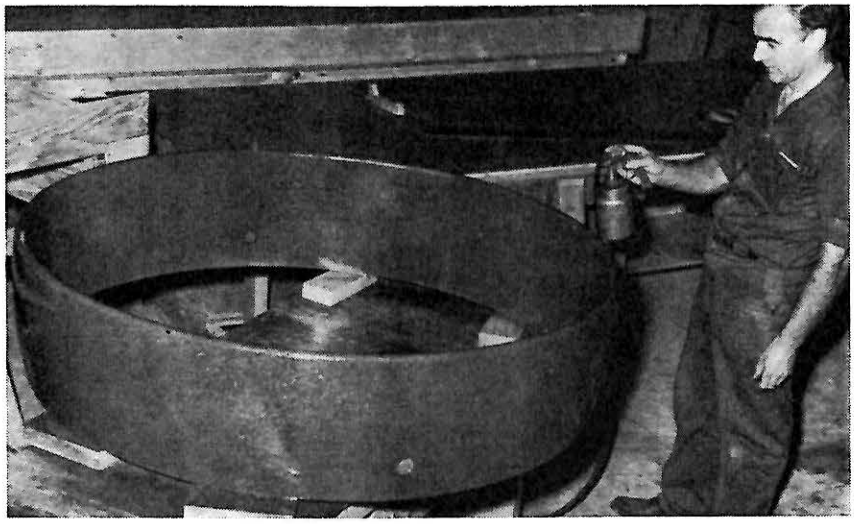
5609


CF-NWS-X

has undergone a constant process of refinement. A crucial factor in the design is the distance between the tip of the propeller and the inner face of the duct, which for maximum efficiency must be kept as small as possible.

More than 300 hours flying time have been accumulated on the prototype aircraft and all the various phenomena encountered are now thoroughly understood.

Since the prime requirement to improve the performance is more power, this is the area now receiving most attention. A change which is expected to have a major effect is the substitution of a constant speed Hartzell propeller of the type used by the Republic Seabee, for the wooden propeller presently used. A prime result of this change is that a much higher proportion of the available power will be delivered to the rotor for the jump takeoff, which it is hoped will ultimately be increased to 50 feet.



Much development work has gone into duct, which substantially boosts thrust.

Bigger Disc: To improve the general performance, longer rotor blades are being substituted for those presently used. These will have the effect of increasing the lifting capacity and the general performance by decreasing the disc loading which is defined as the area swept by the rotor blades divided by the load. One effect will be to improve the rate of climb which with the present short rotor blades is a rather modest 400 fpm. Avian expects ultimately to double this.

To permit the extra power to be transmitted to the rotor blades it will be necessary to strengthen the rotor drive mechanism which at present consists of two belt drives. The lower belt will be retained but the upper belt may be substituted by a geared drive which, in addition to being more rugged, will probably be lighter in weight.

Since the efficiency of any ducted propeller depends almost entirely on the manner in which duct and propeller are matched, substitution of the new propeller will inevitably involve some further redesign of the duct to provide maximum efficiency. However, as the ducts used to date have been built from balsa wood covered with Fiberglas this does not pose particular constructional problems. When the design of the new duct is complete it can be fabricated with relative ease.

Handling Technique: The best flying techniques for the aircraft have now been established fairly clearly. In its present configuration, using the wooden propeller, it is customary to idle the engine at about 1,000 rpm then engage the rotor drive mechanism by depressing the pitch lever to full down. This is done gradually and has the effect of simultaneously moving the rotor blades to neutral pitch.

The rpm are increased by means of the twist grip throttle mounted at the top of the control column and when rotor speed reaches 300 rpm, the brakes are released and the pitch lever is pulled to the full up position. This simultaneously declutches the engine and changes the pitch of the rotor blades to coarse. The aircraft ascends vertically for a few feet and then goes into its normal climb.

Although there is no danger involved in leaving the rotor blades in coarse pitch, a better performance is achieved by moving the pitch lever to the central position; this gives cruising pitch. The lever has infinite movement and some measure of control over the performance under particular circumstances can be achieved by selecting various intermediate positions.

For cruise, the rotor normally turns at 240 rpm. Minimum cruising speed for the aircraft is about 30 mph but it is hoped eventually to reduce this to 25 mph.

No Rotor Torque: Since the rotor revolves freely and is not driven in flight there is no torque, but bearing drag has a very slight tendency to put the aircraft into a left turn. This could be counteracted by the installation of a simple trimming device in the duct but the effect is so minor that this modification has not been considered necessary. Directional control by use of the rudder is excellent. Steep turns at low speeds and low altitudes can be made with safety.

The normal landing approach speed is about 30 mph with a fairly steep nosedown attitude, the rate of descent being about 700-800 fpm at gross load. The aircraft is flared out in the normal manner and the landing roll, using brakes but not the pitch control is about 75 feet.

No-roll landings are made using a slightly different technique. On the approach, the pitch control is used to reduce the pitch of the rotor blades. This has the effect of increasing the rate of descent to about 1,800 fpm but it also builds up the rotor speed. At approximately 50 feet altitude the nose is raised and at the same time the pitch control is moved to coarse which results in a sudden increase in lift permitting the aircraft to touch down very easily and stop immediately, with no roll even in still air conditions.

Money Matters: Avian's efforts have, to some extent, been hampered by lack of capital. Initially, the company was financed by Georgetown Industrial Developments Ltd., an organization formed by a group of Georgetown, Ont., businessmen to encourage any company which had a potential for providing employment in the area after the Arrow was cancelled.

(Continued on page 30)

the new facilities. Three main runways have been reinforced with asphalt and the north-south runway has been extended to 11,000 feet. A $1,167,000 aircraft parking apron has been completed in front of the terminal.

Attractive Facilities: "The new facilities should attract more business," said William Fenn, regional air service director for DoT. Four or five of the old terminals would fit into the waiting room of the new one.

For years, Winnipeg has watched airliners on international flights fly over the city without stopping because they had no right to take on or discharge passengers and freight here. There is now the possibility as a result of pending air route talks with the U.S. that some of this may be changed and Winnipeg may have the chance to enjoy some of the advantages that its geographical position astride international and domestic air routes.

CONTINUATION

(from page 14)

GYROPLANE

Subsequent to the demise of the first prototype, new capital was introduced by Thermo Electric (Canada) Ltd., whose Fred S. Walter is now Avian's president. The money invested by Thermo Electric is in the form of an interest-bearing loan which may be taken back, at the discretion of the lender, as Avian stock.

Recently, Avian has been reorganized as a public limited company but at the time of writing had not completed its prospectus for the Toronto Securities Exchange Commission.

Although the nearly $1M in funds invested to date has been adequate to support the research and development program, it has not been sufficient to permit all problems to be tackled simultaneously. In particular, the time required to analyze test results has delayed development.

The engineering manpower available, while permitting thorough investigations of each specific area in sequence, has been inadequate to enable all the various problem areas to be investigated simultaneously. If more engineering manpower had been available the test program, by this time, might have been completed and the plane would possibly have entered the production stages. This shortage of engineering manpower rather than any insuperable technical problem, has been the main reason for the length of the present development program.

No Predictions: Avian officials are confident that the plane will ultimately receive a Certificate of Airworthiness although they are not making over-optimistic predictions of the date when that aim will be achieved. Present indications are that the test program will be completed in early 1965.

Surveys to establish the potential market for the aircraft have been conducted and tentative plans have been made for production. The plans call for 30 aircraft to be produced during the first year. These will be part of the first 100 aircraft which Avian proposes to sell direct to users. The philosophy behind this arrangement is that the company will be able to maintain a close liaison with users and incorporate any minor changes that are requested.

The second year's production is estimated at 150; third year, 300; fourth year, 500; and subsequently 700 per year.

Avian does not anticipate any difficulty in raising the necessary funds to finance production. However, since the company has at present no product to offer for sale the research and development program must be financed entirely out of capital and this may cause some financial problems.

Many enquiries from dealers who hope eventually to handle the Gyroplane have been received, some with offers of substantial deposits, but Avian has made no firm commitments. It

is fairly obvious that there is intense interest in the aircraft, which will market, according to present estimates, in the $17,000 - $20,000 range.

Letters to the Editor

Hangar Rash

Sir:

Congratulations to R. L. Jerry for the very fine article, "Hangar Rash — Its Prevention and Cure", in the December 1963 issue of AIRCRAFT.

Too many of these basic fundamentals of flying and those things associated with it are being either forgotten or ignored by the majority of "after 5" and weekend pilots.

An article such as this, with illustrations, has much more impact than the general "check-off" list.

I for one would like to see more of this type of article as I have felt for some time now that AIRCRAFT Magazine, while interesting, goes over the heads of most weekend flyers. After all, how many can afford a 180, Apache, or Tri Pacer on the average working man's salary? Let's get back to the J3's, Aeroncas, Taylorcrafts, and Ercoupes.

There's a good article in "Air Progress" . . . on how to buy a used plane. It goes into such things as what to look for, what to expect and basic costs of buying, owning, and operating . . . all of which is American. Can not something like this be done for us with the Canadian viewpoint, for the sake of an argument, the six of seven basic light aircraft—J3, Aeronca, Luscombe, Taylorcraft, Ercoupe, 140, and Stinson?

It is my hope in the near future, as is it that of many pilots I suppose, to purchase a used plane, but being a fairly new member of the society I am not familiar with the general owning and operating costs and would be very pleased to receive any information I could get on this subject.

ORMAND RICHES

Willowdale, Ont.

Fuel at Frobisher

Sir:

In the December issue of AIRCRAFT, we noticed an item containing information in regard to the availability of fuel at Frobisher Bay [see "Twilight at Frobisher" p. 35]. It would appear this information was obtained from a DoT Notam. Part of the information contained in the Notam was correct at the time it was issued, however, in respect to the availability of fuel, it was not quite accurate.

Esso Aviation 115/145 gasoline has always been available at Frobisher Bay. In regard to turbine fuel JP1, it became necessary for us to ship a refueler unit in from Montreal in order to provide this service. The refueler was delayed due to space availability aboard vessels going to Frobisher Bay, however, in the meantime we had provided turbo fuel for a number of aircraft passing through Frobisher Bay using an existing refueler in another service. The vehicle which now distributes JP1 at Frobisher is capable of delivering high and low pressure fueling as well as under-wing and over-wing fueling.

Subsequent to the Notam which you published in your magazine, a second Notam was issued in January correcting the information previously distributed.

IMPERIAL OIL LTD.
J. A. Meagher
Aviation Sales

Montreal.