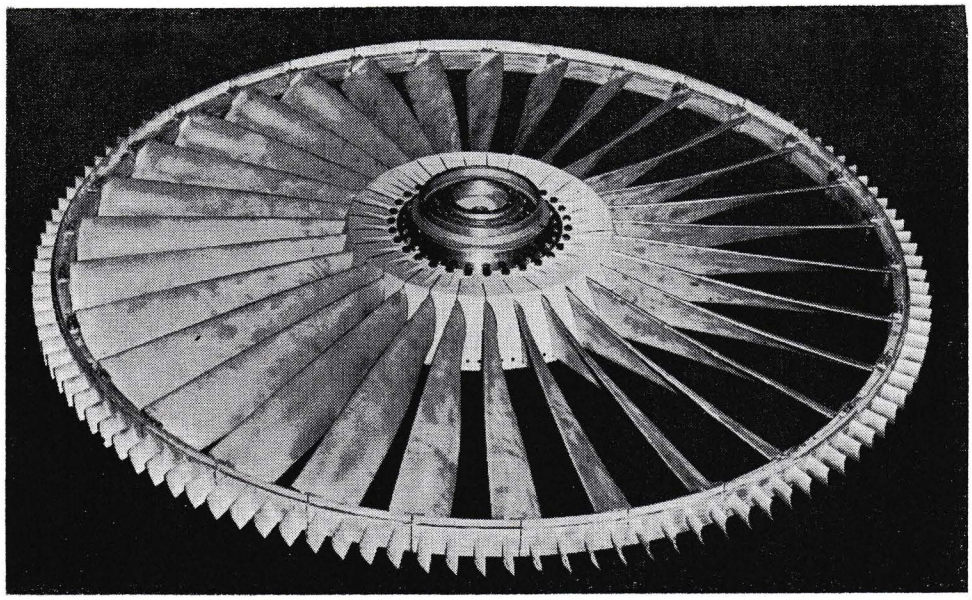


Complete tip turbine-driven rotor of Orenda lifting fan, ready for assembly into casing.

Straight Up from Malton

TURBO LIFTING FAN WORK PUTS ORENDA ON TOP OF VTOL FIELD

AN ACTIVE program of design studies and practical development work on aircraft lifting fans has put Orenda Engines Ltd. in the forefront of the VTOL field. Lifting fans can be used in STOL applications also.

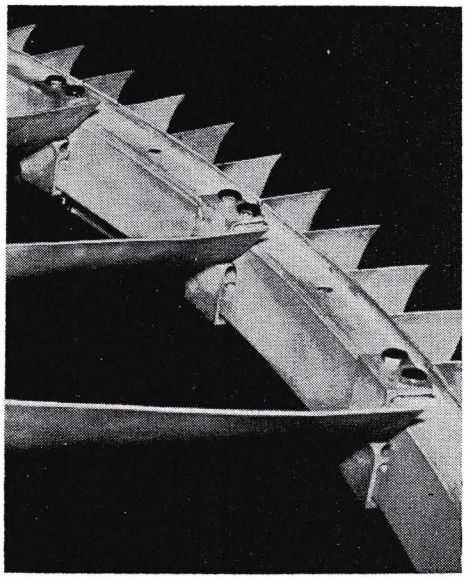
At the present time, turbo lifting fans developed by the Malton, Ont., engine firm have logged more running time and flight hours than any other comparable unit in the western world. One type of tip turbine-driven axial flow VTOL fan which was designed and successfully developed by Orenda has been under development testing since early in 1959.

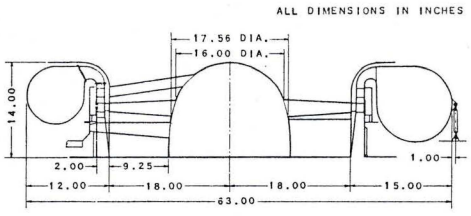
Whether or not the company's experience and leading position in the lifting fan field can be turned to profit now depends on factors largely outside its control. Current design and development work in the U.S. and the U.K. aimed at evolving a vehicle in which a VTOL component is wedded to the horizontal flight characteristics of a fixed wing aircraft, centres around four broad concepts:

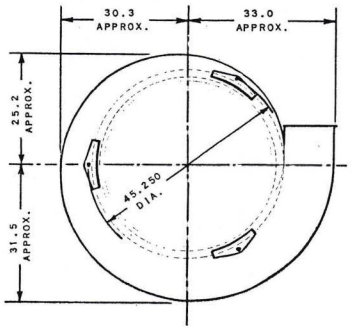
- Lifting fans for vertical flight combined with more-or-less conventional methods of forward propulsion.
- Tilting engines, sometimes in conjunction with tilting wings.
- Combination of fixed installation vertical lift engines and separate fixed installation turbojet for horizontal flight.
- Fixed installation turbojet with thrust diverting devices.

It is only if the lifting fan concept predominates, as there is an excellent chance of its doing, that Orenda will be in a position to capitalize on its extensive experience.

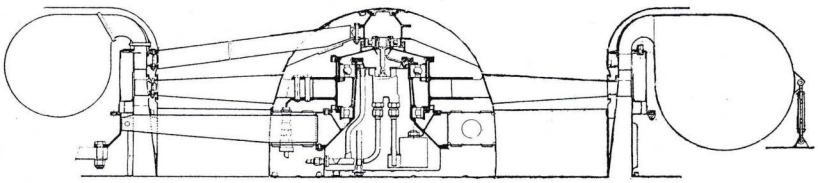
(Continued on page 56)







Left, detail of rotor and tip turbine blades. Above, general arrangement of TLF-2 fan. Below, cross-section cutaway shows interior detail.



fications of existing water supplies for cell cooling during afterburner operation.

With the completion of tooling and the acquisition of raw materials and accessories from various suppliers, part manufacture has proceeded at an ever increasing rate. No undue problems were encountered in engine assembly and our testing results have been very satisfactory. Some of the assembly operations are shown in the accompanying photographs.

ORENDA VTOL

(Continued from page 31)

Work at Orenda to date has involved five rotor designs to different aircraft requirements. These include partial entry turbine, shaft driven, and very large units.

Mechanical and aerodynamic design of both a tip turbine driven fan and a shaft driven fan of 3000 lb. lift and about 34 inches in diameter have been carried out for the National Research Council. No hardware has been made for either of these designs.

Design studies have also been done on a large fan, 140 inches in diameter and capable of delivering approximately 60,000 lb. of lift.

The 3000 lb. tip turbine fan designed under NRC sponsorship — designated the TLF-2 — is described as a rugged and reliable unit suitable for mounting in both commercial and military aircraft. Design criteria chosen were aimed at achieving minimum unit diameter and thickness consistent with the requisite aerodynamic performance and weight.

Simplicity, and therefore low total cost, is featured, especially so in the case where a single gas turbine engine is used for both aircraft forward thrust and the generation of gas power for lifting purposes.

Design performance of the Orenda TLF-2 is as follows:

Fan:

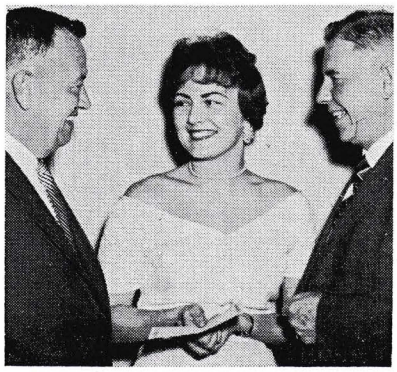
Air weight flow	164 lb./sec.
Pressure ratio	1:5
Speed	5250 rpm

Turbine:

Gas weight flow	23 lb./sec.
Inlet temp.	900°K (1160°F)
Inlet pressure	30.4 psia

Entire Unit:

Output thrust	3000 lb. (SL, std. day)
Total weight	250 lb.
Thrust/weight ratio	12:1



TOPS AT ONTARIO COUNTY: The recent annual dinner of the Ontario County Flying Club was the occasion for a number of presentations. Winners were, top, L to R: Michael Clulow, Air Cadet Trophy; Alex Ingram, Bombing Contest Trophy; Larry McLean, Outstanding Pilot 1960 Trophy; Douglas Brownlee, Top Graduate Pilot 1960 Trophy; OCFC Pres. W. B. McCullough, Spot Landing Contest Trophy. At right, guests at the annual dinner included George Hurren (L), RCFCA past pres., shown explaining Zen Buddhism to club member Miss Laurel Gates and Toronto Reg. Director of Air Services David Glen.

The Orenda TLF-2 turbo lifting fan consists of a single-stage axial flow fan driven by a single-stage axial flow turbine fixed in segments to the tips of the fan rotor blades. A large mass of air is drawn downward into the fan rotor, compressed to a low pressure ratio and passed out at increased velocity, with the turbine effluent gases, through an exhaust annulus where lifting thrust is obtained.

The fan and turbine gas streams are effectively separated by means of three peripheral gas sealing rings. Hot gas is supplied from an externally mounted gas generator to the turbine via a single entry scroll.

The rotor is supported by two sets of bearings, the upper ball bearing carrying radial and thrust loads, and the lower roller bearing radial loads only. The lubricating pump and oil tank are integral.

A row of stator blades reduces the rotor outlet whirl and carries structural loads from the hub to the casing.

The assembled units forms a rigid structure designed to ensure minimum turbine tip clearances and low gas leakage. Basic loads are taken on three equispaced mounting brackets, and stabilizing links are provided for attaching the scroll to the aircraft structure.

The sole external connections are the oil level warning and tachometer signals.

Orenda points out that the TLF-2 is based on a proven rotor configuration. Development, endurance and flight tests have been carried out on similar designs which verify the mechanical and aerodynamic concepts used in the design of the TLF-2. Specific improvements resulting from this development program have been incorporated into the new design, the company says. The original design was supported by considerable development experience with highly loaded rotors having low hub-tip ratios and relatively long blades.

FLYING CLUBS MEET

(Continued from page 35)

1st vice pres.; Alec Davidson, Sidney, B.C., 2nd vice pres., Roy Graves, Calgary, 3rd vice. pres.; Dr. H. A. Yates, Ottawa, treas.; G. F. Henderson, Q.C., Ottawa, hon. solicitor; M. A. Seymour, Q.C., St. Catharines, Ont., hon. counsel; Denis Barclay, To-