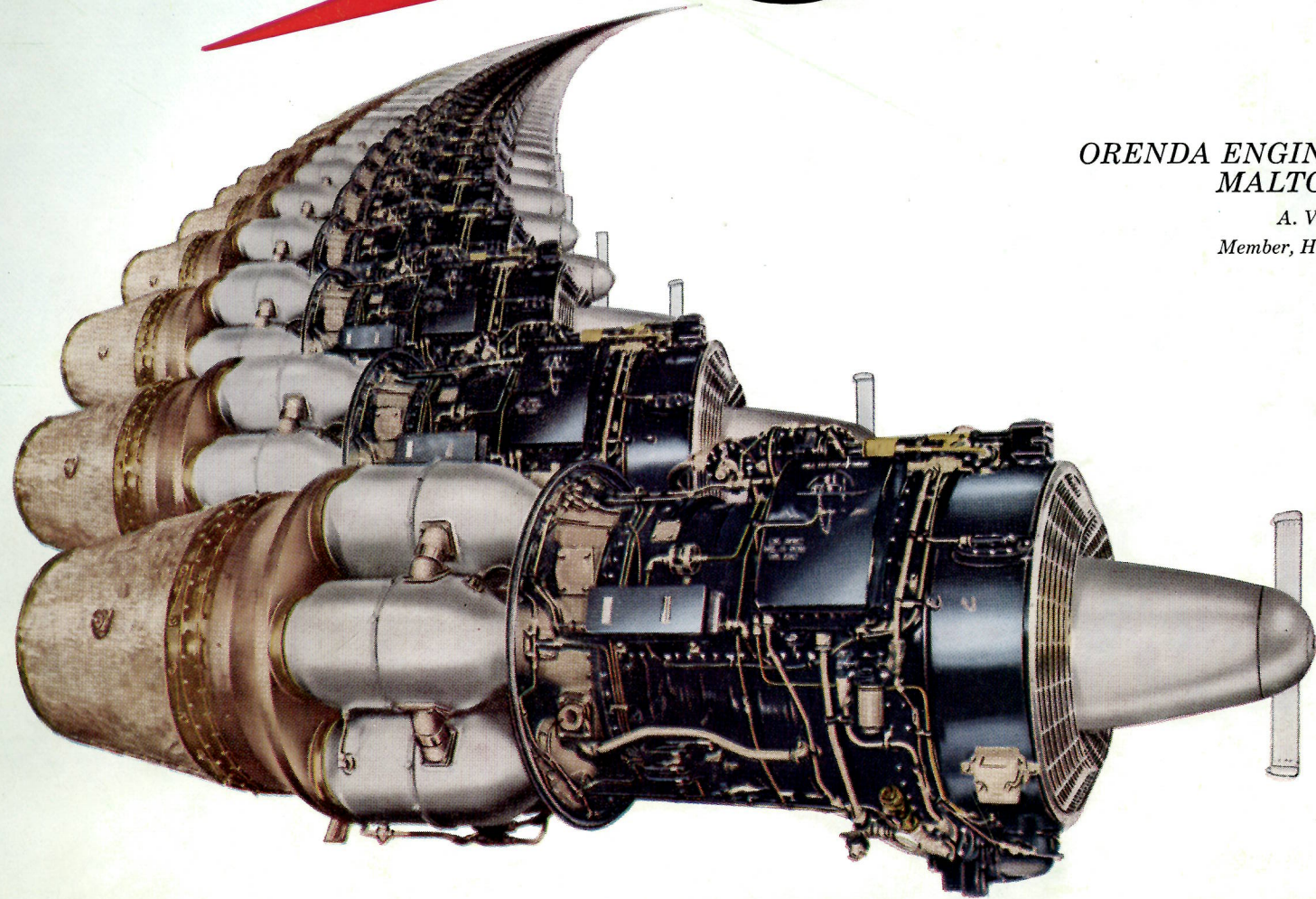




ORENDA ENGINES LIMITED
MALTON, ONTARIO

A. V. Roe Canada Limited
Member, Hawker Siddeley Group



172

THIS, above all, is a story of people . . . of the 6,000 people who make up the team which is known as Orenda Engines Limited. Without them none of the story which follows could have been written—for the Orenda achievement is the sum total of their skills, their ingenuity, their planning, their effort and, above all, teamwork.

To the people of Orenda, then, this salute.

W. R. McLACHLAN,
Vice-President & General Manager.

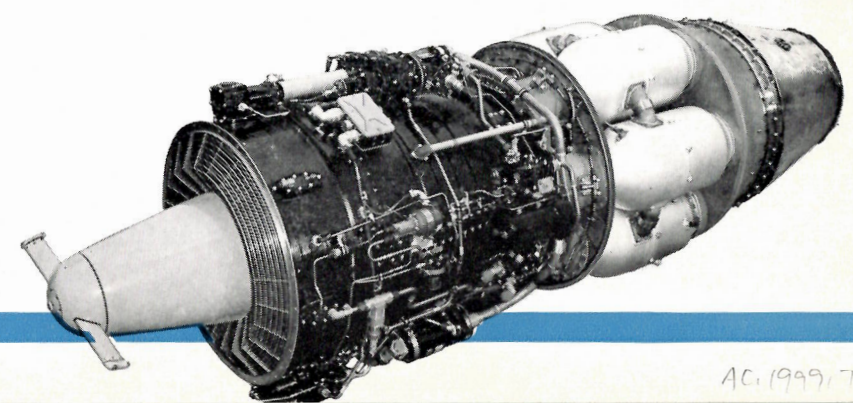


Presenting the **O**REND **A** story

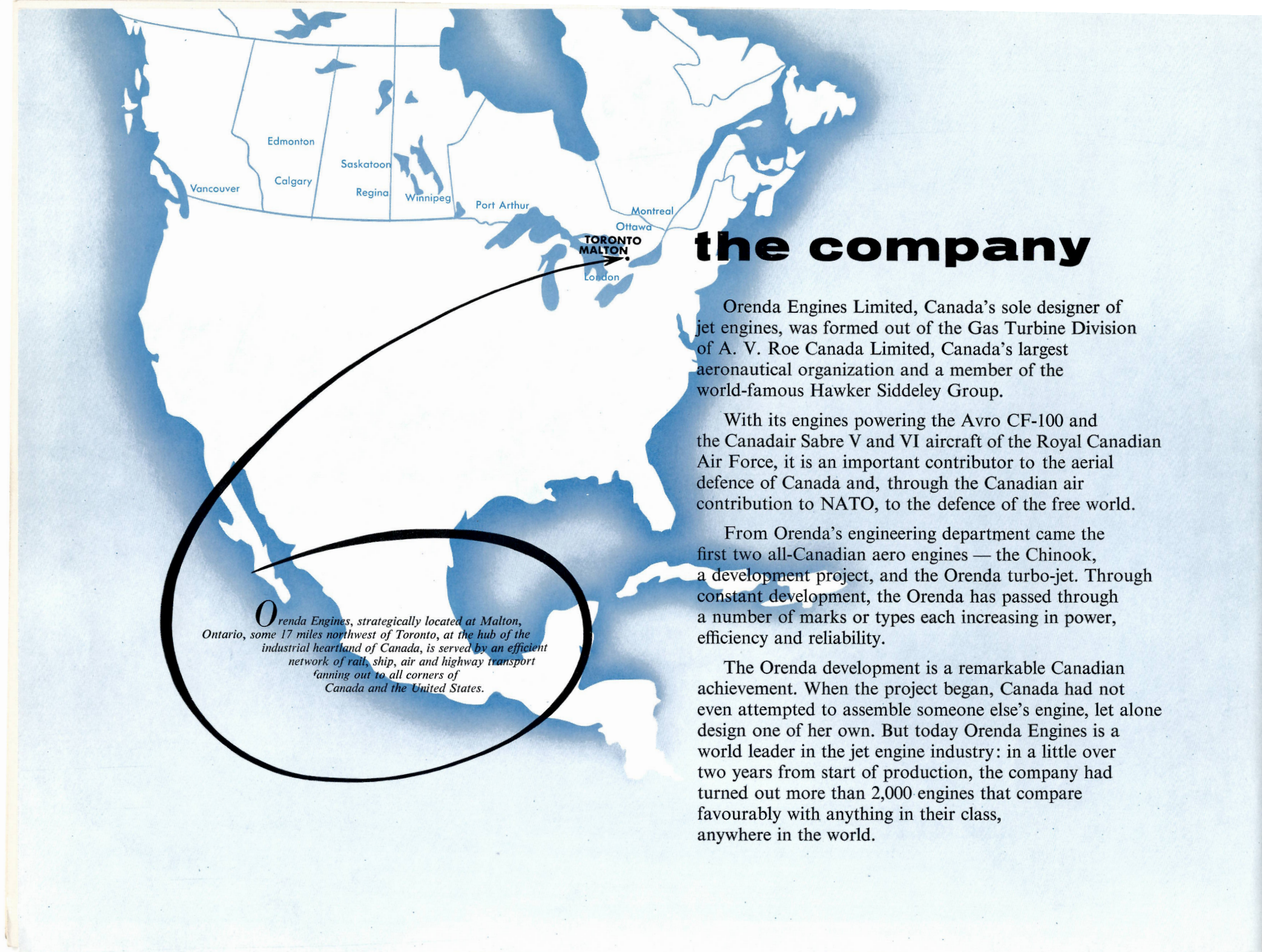
OREND **A** today is a famous name wherever jet planes fly... and throughout the aircraft industry. This booklet tells why. It tells the story of the product, of the plant and its facilities; of the company and its potential, of its significant contribution to the defence of Canada and of the free world...

*Detailed technical data is available to authorized organizations. Please write: Vice-President, Sales and Service, Orend **A** Engines Limited, Box 4015, Terminal **A**, Toronto, Ontario, Canada. Phone: Toronto CHerry 1-2681.*

*Orend **A**'s Public Relations Department is at the service of all media of public information.*



AC 1999/7, 12



the company

Orenda Engines Limited, Canada's sole designer of jet engines, was formed out of the Gas Turbine Division of A. V. Roe Canada Limited, Canada's largest aeronautical organization and a member of the world-famous Hawker Siddeley Group.

With its engines powering the Avro CF-100 and the Canadair Sabre V and VI aircraft of the Royal Canadian Air Force, it is an important contributor to the aerial defence of Canada and, through the Canadian air contribution to NATO, to the defence of the free world.

From Orenda's engineering department came the first two all-Canadian aero engines — the Chinook, a development project, and the Orenda turbo-jet. Through constant development, the Orenda has passed through a number of marks or types each increasing in power, efficiency and reliability.

The Orenda development is a remarkable Canadian achievement. When the project began, Canada had not even attempted to assemble someone else's engine, let alone design one of her own. But today Orenda Engines is a world leader in the jet engine industry: in a little over two years from start of production, the company had turned out more than 2,000 engines that compare favourably with anything in their class, anywhere in the world.

Orenda Engines, strategically located at Malton, Ontario, some 17 miles northwest of Toronto, at the hub of the industrial heartland of Canada, is served by an efficient network of rail, ship, air and highway transport fanning out to all corners of Canada and the United States.

the nation

Orenda Engines is a young and aggressive enterprise reflecting the spirit of Canadian industry and of the Canadian people: imbued with the pioneering spirit, ever looking beyond present horizons and quickly reaching maturity.

Orenda operates in a keen and progressive atmosphere generated by the surging industrial growth of Canada. No nation can call on a richer heritage of natural resources — especially hydro power and minerals, the two prime foundations of industrial development. No nation has a greater store of the new, light, super-tough metals demanded by the jet age, especially titanium.

And Canada has the people of skill and imagination required to speed her destiny as a great world industrial power: people of Canadian birth . . . and New

Canadians who enthusiastically embrace Canada as their new home and who are thus contributing significantly to her vibrant industrial growth.

Our engineers and skilled technicians come from Canada's fine universities and technical schools — and from many other universities throughout the world. These graduates have played a very considerable part in the dramatic growth of Canada's aircraft industry which, in 10 short postwar years, leaped from a pre-war position of insignificance to fourth place among world air powers.

And around the Orenda program has been built a whole new network of manufacturing industries for Canada, bringing new skills, new materials, new capital, new jobs to what is, industrially, the world's fastest-growing nation.





the product

The Orenda* is an axial flow turbojet engine, deriving its power from the reaction due to the change in momentum of the gases passing through the engine.

Essentially, the current production engines consist of a ten-stage compressor, six combustion chambers and a two-stage turbine. The construction is conventional and utilizes a number of well-tried features developed in earlier models.

Dry sump lubrication is provided and the oil system is equipped with a temperature regulator and positive displacement scavenge and pressure pumps of special design.

The fuel system is provided with automatic scheduling to maintain correct air/fuel ratio under all operating conditions. The fuel shut-off and delivery is controlled by a single lever. The ignition is by two low-voltage surface-gap type plugs which directly ignite the primary flow during starting.

Ample provision is made for driving aircraft accessories. Air for cabin pressurization and

other services is made available through tapings from the compressor. The current models are "unhanded" and installation in single or multi-engined aircraft is facilitated by the use of a convenient three-point suspension system.

The Orenda 11 and 14 turbojets are the more recent production models of this well-known series of engines. Through the valuable experience obtained from earlier models, which resulted in the incorporation of many new features, it has been possible substantially to increase the power rating.

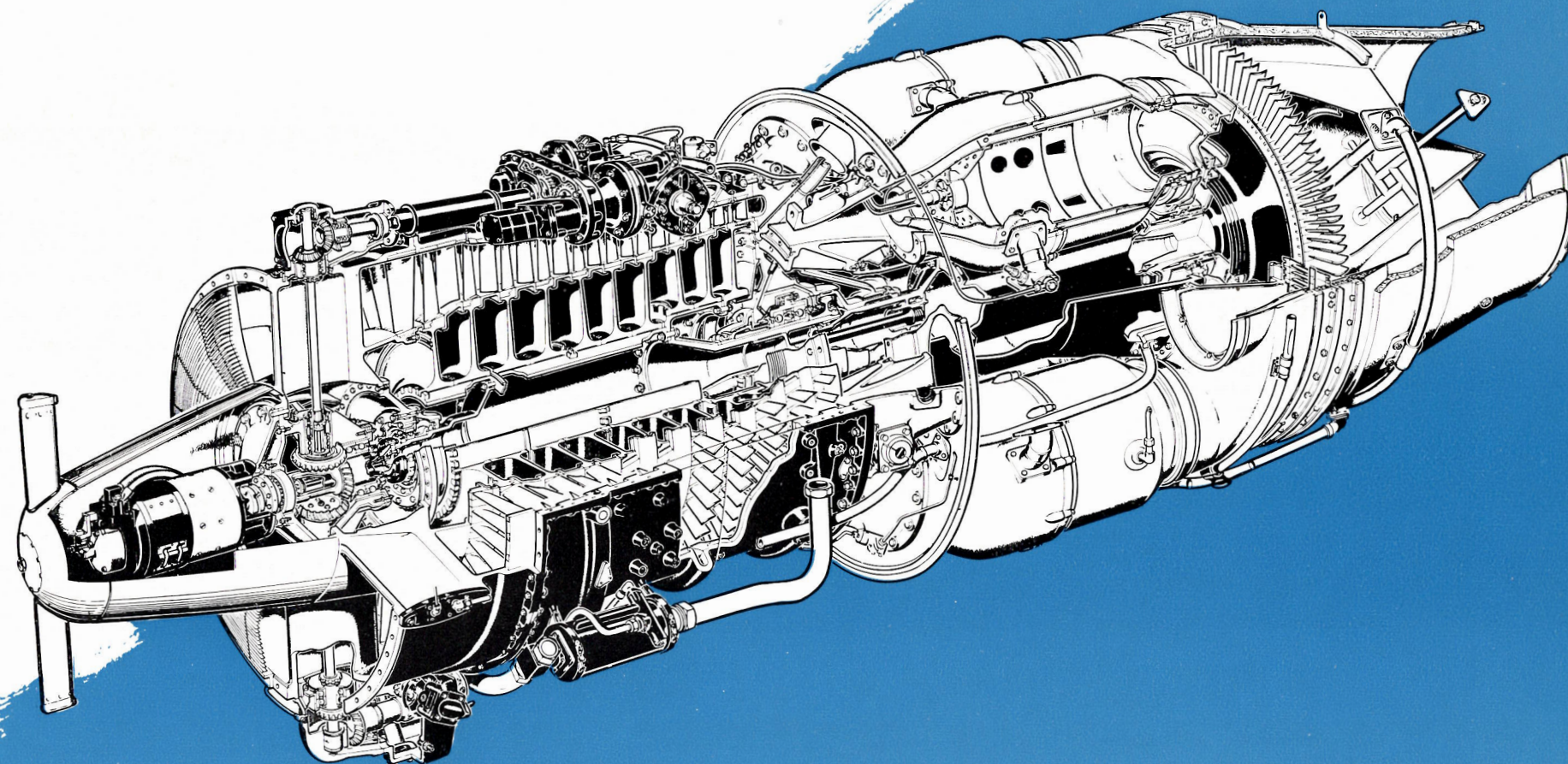
With a lower overall weight, the maximum static thrust at sea level has been considerably increased, while the specific fuel consumption has been improved. The performance of these two models is basically the same, giving a thrust rating in excess of 7,000 lbs.

The structural differences between the two models have been introduced to extend the adaptability of the engines. Both engines are unhanded and either model can be fitted to single or multi-engined aircraft.

*Iroquois for "source of all power"

1,700 blades in each engine—
this is a turbine blade

section view of orenda





yesterday...

First steel for Orenda's modern production plant went into position in May, 1951.

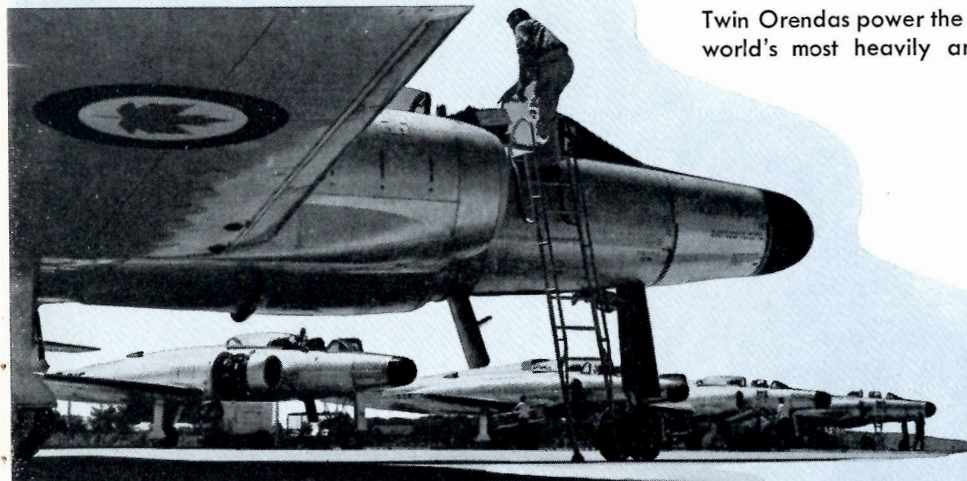
Jet engine development in Canada had its beginnings in 1943. That year a Canadian Government technical mission went to Britain to study gas turbine progress there.

The findings of this mission led to establishment of a cold weather test station at Winnipeg, Manitoba in 1944 by the National Research Council of Canada. A Crown company, Turbo Research Limited, was formed to direct the initial program of design and development. Out of this came the first Canadian turbojet, later to be called the Chinook.

In the spring of 1946, Turbo Research was absorbed into the then newly-formed A. V. Roe Canada Limited.

The design of the Chinook was completed and an experimental number manufactured for the purpose of establishing shop facilities, developing engineering skills and creating sub-contract sources capable of producing the high quality of workmanship demanded by this new type of engine.

The Chinook was first run on March 17, 1948. In the succeeding 20 months, over 1,000 hours of development running were logged with the thrust increased from the original design value of 2,600 lbs. to well over 3,000 lbs.



Twin Orendas power the Avro CF-100, the world's most heavily armed interceptor

... and today

The Orenda came into being when the Royal Canadian Air Force ordered the design and development of an engine with thrust equal to that of the largest engines then known to be on the drawing boards in the U. K. and U. S.

Here is the calendar of that accomplishment and subsequent development:

September, 1946: Design started.

February, 1949: First engine completed and initial testing begun.

July, 1950: Flight testing started in a converted Lancaster flying test bed.

October, 1950: A prototype Orenda used to power a North American F86A Sabre.

February, 1952: First production model type-tested with first deliveries to the RCAF starting shortly afterwards.

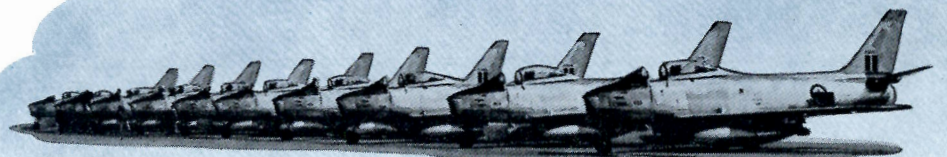
January, 1953: The Orenda 8 and 10 models passed the required type-tests and went into quantity production for installation in the CF-100 and the Sabre V.

April, 1953: First production of the Orenda 9, an unhandled version of the 8.

January, 1954: A major milestone — the Orenda 11, incorporating a two-stage turbine type-tested at an improved thrust rating and put into production immediately.

September, 1954: The Orenda 14, a further development of the 11, went onto the production line.

As of April 30, 1955, some 2,300 Orendas had been delivered to service.



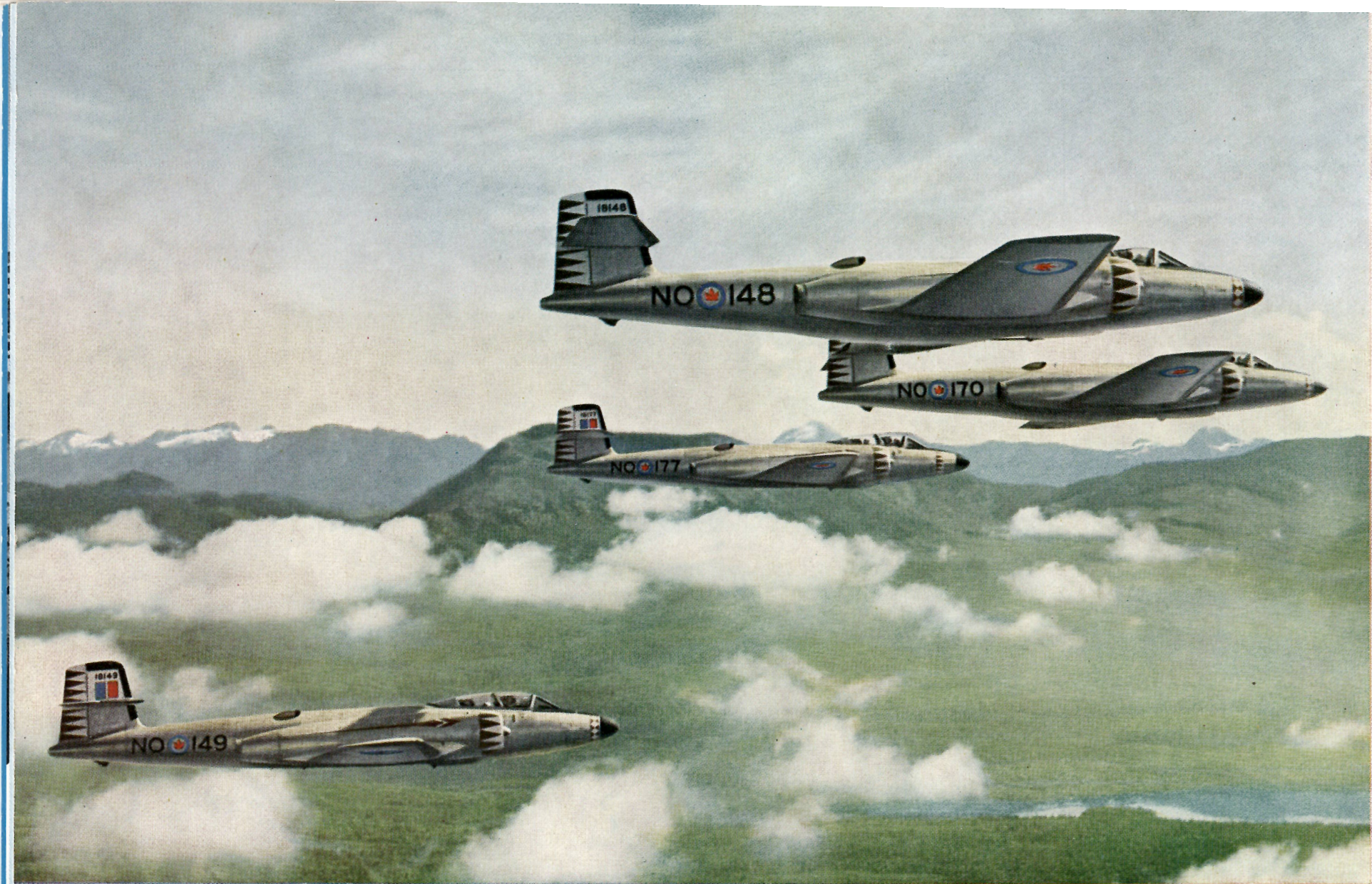
The Orenda has made the Canadian Sabre V and VI the worlds best day fighters



major assemblies

The above illustration shows an engine broken down into major assemblies. Starting at the left is the nose group which incorporates the alcohol anti-icing unit. The starter and power take-off fit to the front of the intake casting, the latter incorporating the intake screen, intake guide vanes, and front bearing.

The compressor is the largest single assembly of the engine. The centre bearing, centre casting, and engine firewall form the centre section. The backbone casting lies between these and the nozzle box and is surrounded by the combustion chambers. The turbine rotor shaft passes through the backbone casting to couple up with the compressor rotor. The shroud ring is attached to the rear of the nozzle box and to this is secured the exhaust cone assembly.



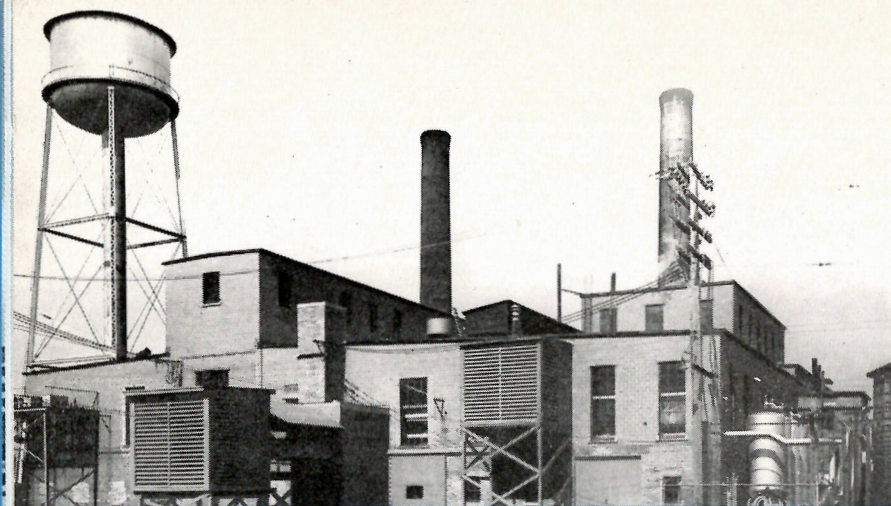
defence ... of the north

The Avro CF-100, all-weather, long-range interceptor, and the most heavily armed aircraft of its type in production in the world, is ready to defend Canada and the North American continent from air attack from any direction. The long range of the CF-100, its intricate equipment, designed and installed particularly for fighter interceptor duties, make it a formidable and versatile air weapon . . . the outstanding aircraft of its type in service.

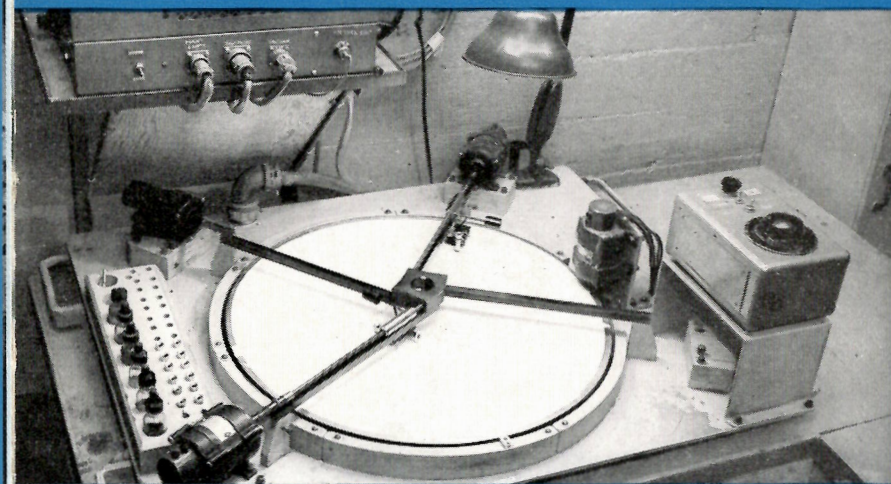


... and of europe

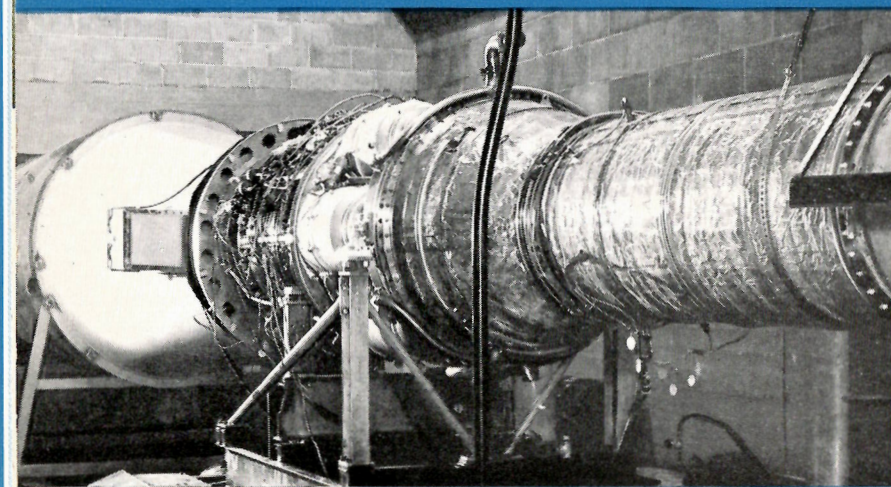
Canada's contribution to NATO, on a per capita basis, has surpassed that of all other nations. Orenda Engines is as proud of that accomplishment as any Canadian industry or organization, for Orendas power many of the Canadian front-line aircraft now on guard for NATO in Europe: the Canadair Sabre V's and VI's of the Royal Canadian Air Force. Orenda engines have made these aircraft the most powerful operational fighters in Europe today.



Part of test establishment at Nobel



Recording rig automatically plots test data



Orenda on test at National Research Council Laboratory

research

The Orenda organization is backed by extensive research facilities — at Malton and elsewhere.

The five research units — mechanical, materials, instruments, aerodynamics and fuel systems — of the Sir Thomas Sopwith Research Laboratory at Malton, go hand in hand with Orenda's constant production-testing. Here, also, the dreams of the research scientist are translated into daily practicality.

The extensive facilities of the National Research Council, located a few miles east of Ottawa, Ontario, are available to the Canadian aircraft industry.

The photograph on the left shows one of the early Orenda engines undergoing a series of special tests in one of their many laboratories.

At Nobel, some 170 miles north of the Malton plant, full scale facilities are in operation for conducting aerodynamic and thermodynamic tests on engine main components. Multi-stage and single-stage compressors, turbines, combustion chambers and other assemblies can be tested to provide information necessary in the development of the complete engine and to continually extend the available knowledge of the behaviour of such units. A remote-controlled variable-incidence cascade rig for determining the characteristics of blade sections in a fixed pack is equipped with specially developed semi-automatic traversing and data-recording instrumentation. This latter equipment, also used on some of the other rigs will automatically plot and integrate up to four variables.

The establishment is essentially self-contained with its own shop services and supporting laboratories, and is in constant teletype communication with the parent plant.

production

Orenda's modern production plant was specifically designed for jet engine manufacture. Officially opened late in 1952, it has earned industry-wide recognition as one of the finest facilities of its kind anywhere and is manned by a production team with a reputation for contributing many "firsts" to jet engine production practice.

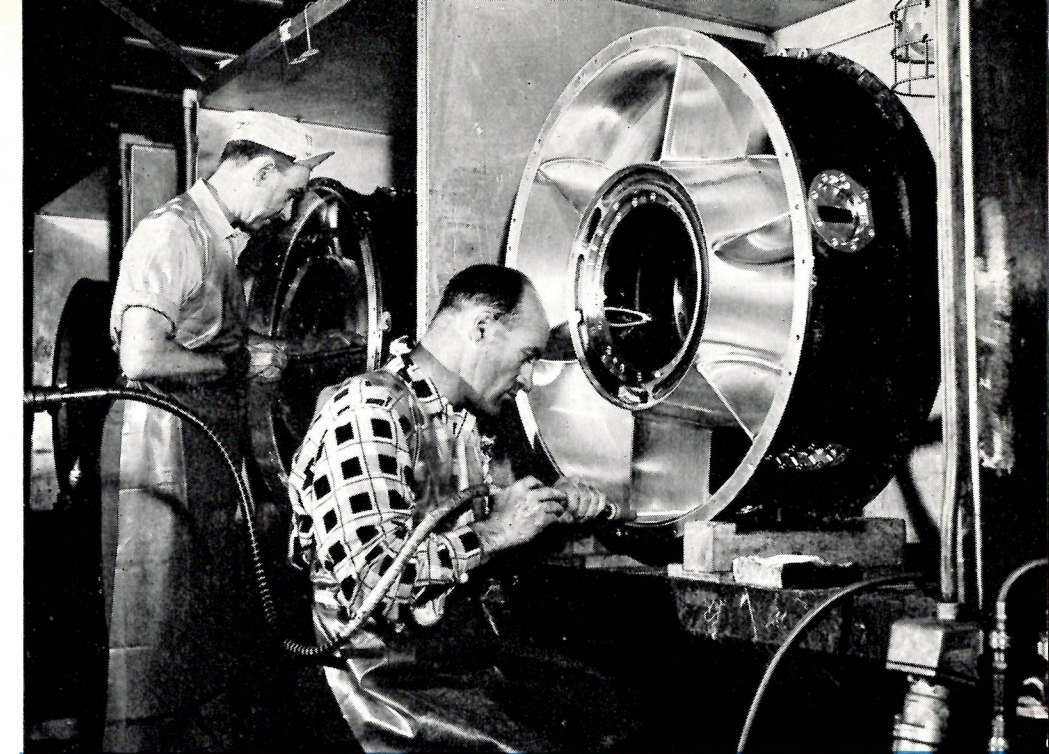
The plant covers an area of 750,000 sq. ft. and is geared for sudden expansion in case of national emergency.

Flexibility of production is the keynote. Layout and equipment are planned to permit rapid change from one engine model to another — or the manufacture of two or more models concurrently.

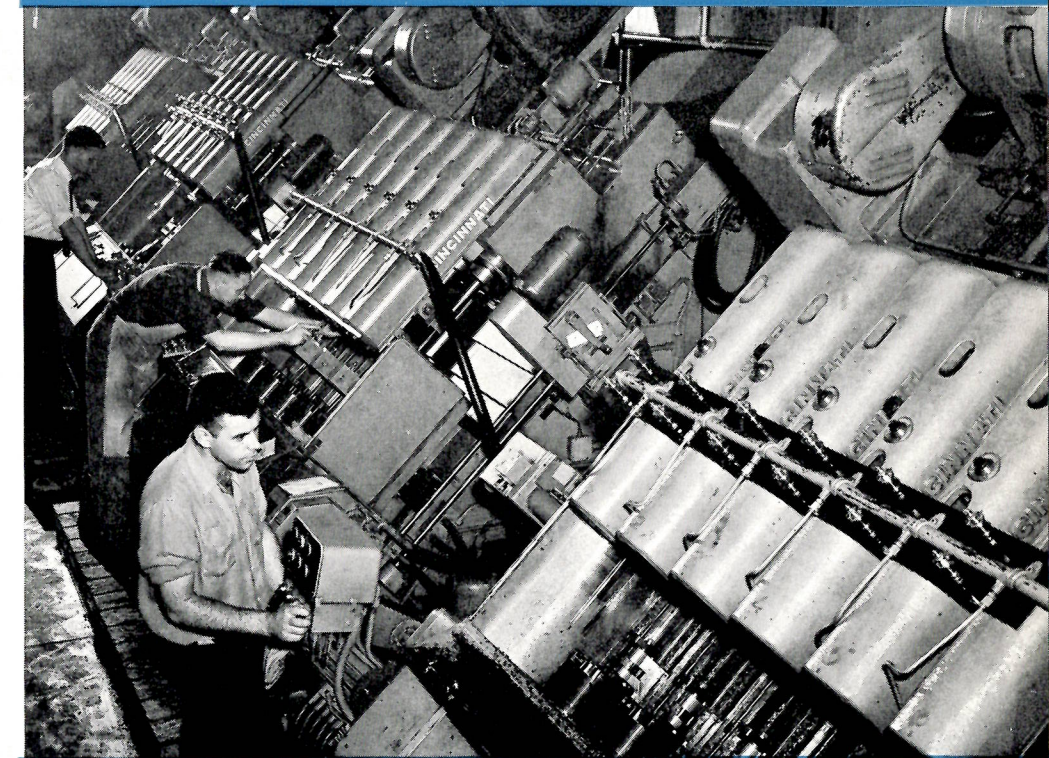
Fully air-conditioned and temperature-controlled to provide the precise constancy of atmospheric conditions necessary for working to the fine tolerances demanded in jet engine manufacture, the plant is kept at a constant 73 degrees winter and summer. In each of the building's eight zones, 81,000 cubic feet of air is changed every minute.

The plant has one of the finest machine shops and tool rooms on the North American continent, and contains the largest collection of vertical turret lathes and broaching machines in Canada.

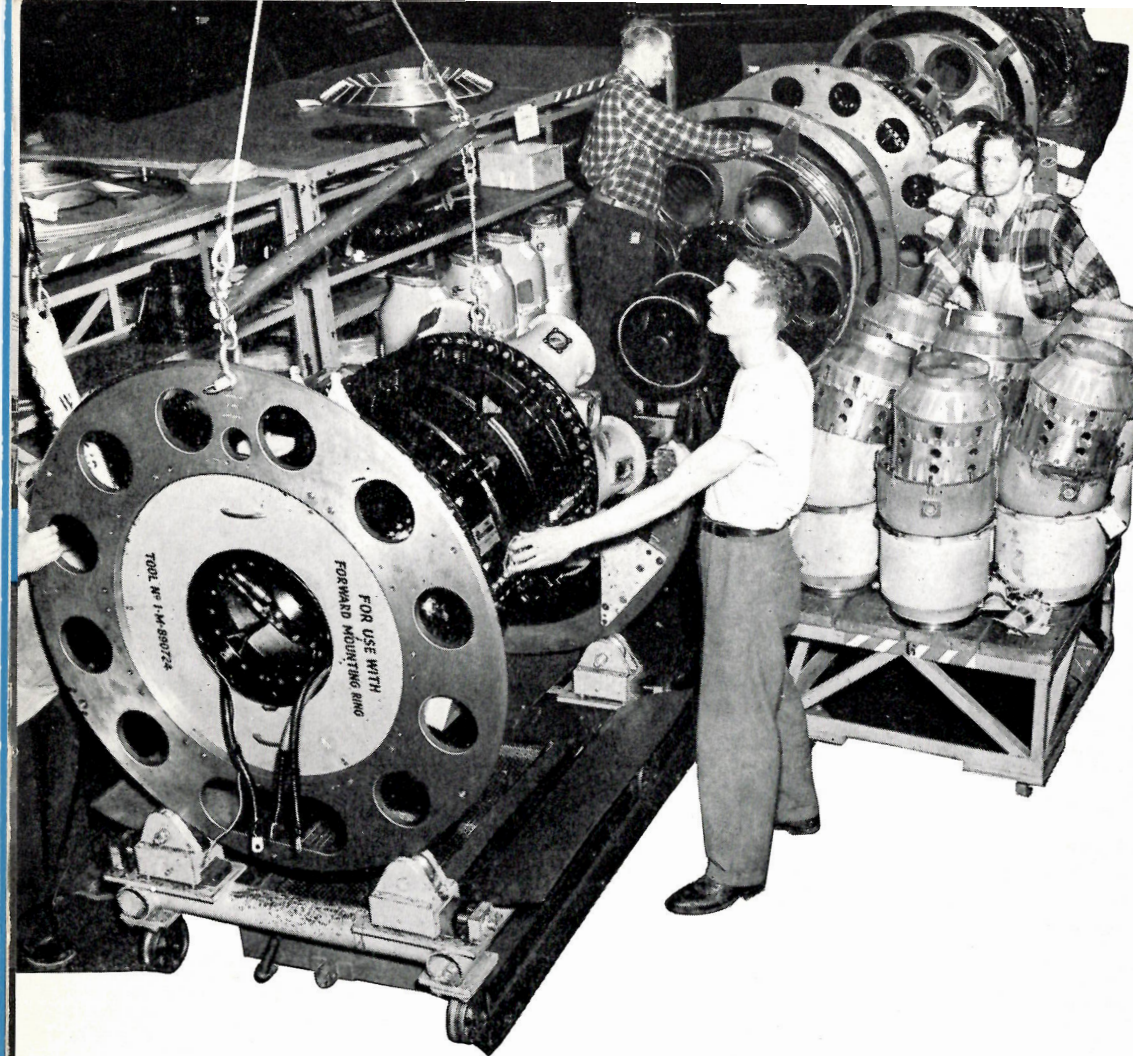
(Continued on next page)



Intake castings are hand finished



Automatic milling machines form blade contours



Each Engine is built twice

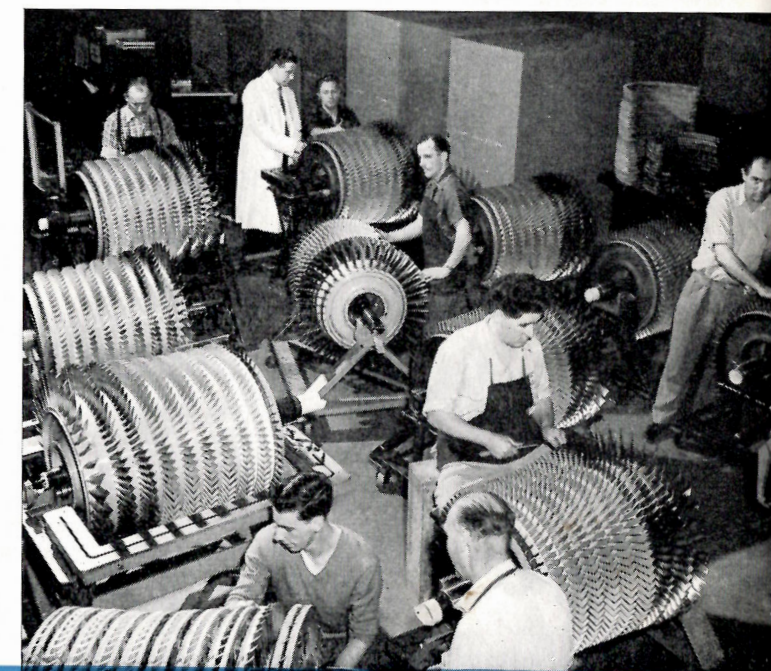
The Assembly Area is laid out for progressive assembly on rail-guided fixtures. It follows normal aero-engine practice and in effect builds each engine twice. After the first build, the engine is run on one of the test cells located nearby and is then returned to the Assembly Area for stripping and inspection. The engine is then re-assembled, given a final test and packed for delivery.

The test cells, which are of the very latest design provide a remarkable degree of silencing to the Orenda's characteristic "roar". Each pair of cells shares a common control room having individual test and control panels. Most of the equipment used is of Canadian manufacture.

(Continued from preceding page)

Layout and choice of equipment in the huge machine shop make an immediate and striking impression on the visitor. To each pair of machines there is a 1,000-lb. hoist crane to speed the loading and unloading of machines.

Within the Machine Shop and Tool Room are many interesting machines, some of which are capable of machining to two ten-thousandths of an inch. Some of the measuring instruments can measure dimensions with an accuracy of one millionth of an inch.



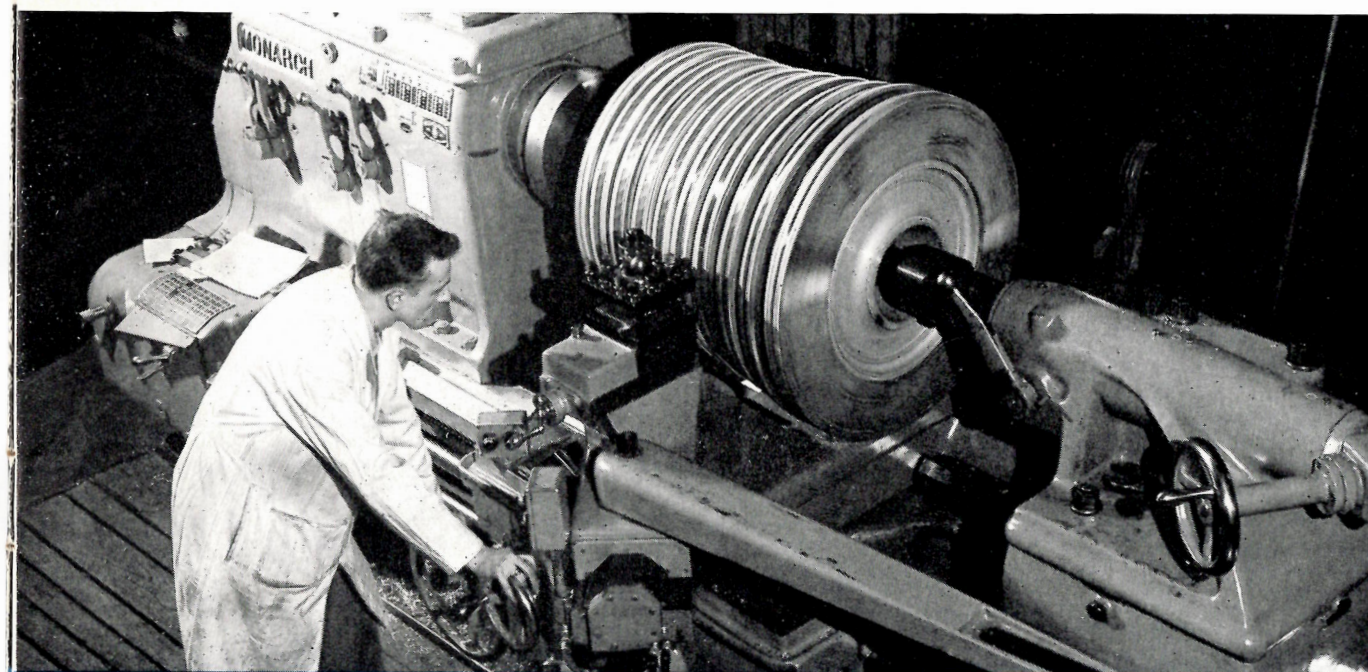
Inspecting compressor rotor assemblies

inspection and quality control

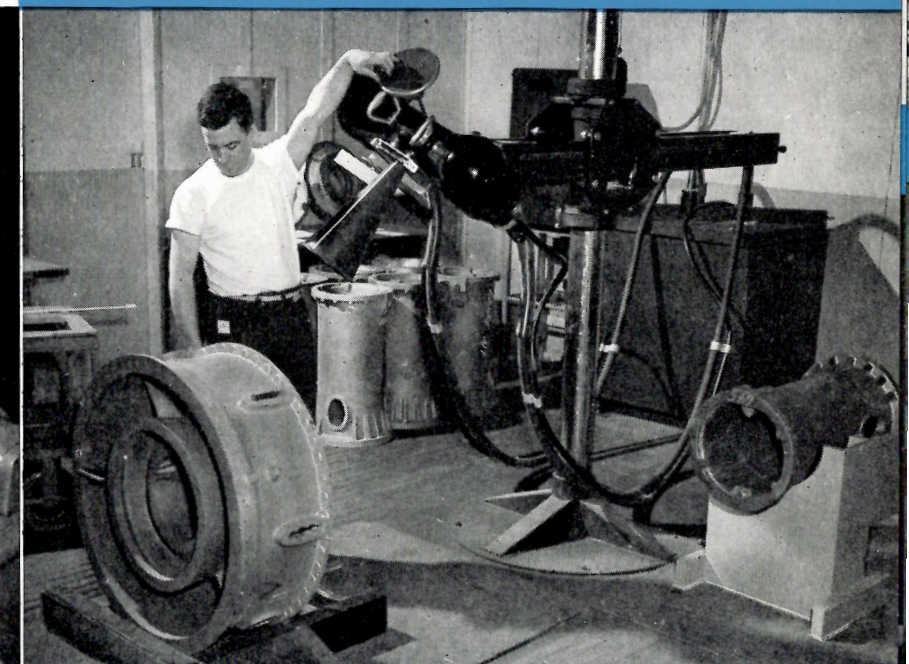
Rigid adherence to precise engineering and material specifications is essential in all aspects of Orenda manufacture. The company has developed an excellent system of precise and detailed inspection and quality control over materials, mechanical tolerances and operational standards of its products, in both development and production phases, using the most modern equipment.



X-ray is among Inspection methods



Machining tips of compressor rotor blades



Castings are x-rayed

service in the field

There cannot be too much emphasis on Service . . . in any engine operation.

Orenda Engines offers complete service in the field.

And every Orenda operator is assured of on-the-spot service, as required, anywhere in the world.

A staff of experienced service specialists is maintained both in Canada and in Europe. Provided with the latest technical information and recalled periodically to Headquarters for refresher courses, their function is to assist in maintaining engine serviceability.

Representatives stationed overseas are under the direct control of Area Supervisors who are responsible for local administration and the maintenance of complete liaison between the operator and the Company.

Working parties of experienced mechanics are available to operators for the incorporation of modifications or for any special work to be done in the field.



Service Engineers, supported by a group of Analysts, form the core of the Headquarters Staff. Field Service reports and engine modifications are prepared and action is taken as and when required. When it is necessary to incorporate a modification, the work can be carried out either by the operator's personnel (when all the necessary technical information and assistance will be supplied) or, by one of the Orenda Service Department's working parties.

Modification and Service Bulletins are issued by the Headquarters Staff, as necessary, thus keeping the operator and the Field Service Staff supplied with up-to-the-minute technical information and recommendations.

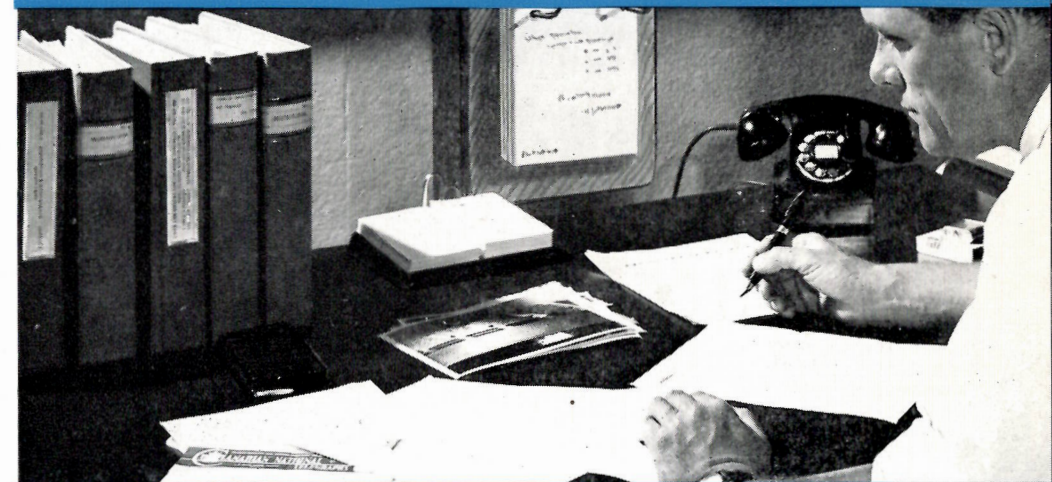
Instructors, specially trained to deal with Orenda engines, are available at short notice to give lectures on operation and handling, and to explain the details of the Orenda oil, fuel, air, anti-icing and electrical systems. Instruction courses can be arranged at the operator's plant or at the Company's Headquarters.

Engine technical publications perform an important function of Orenda engine service. Within the Service organization is an efficient publications group producing all the required publications. These publications cover every aspect of servicing, maintenance, repair, overhaul, spare parts and all proprietary units used on Orenda engines.

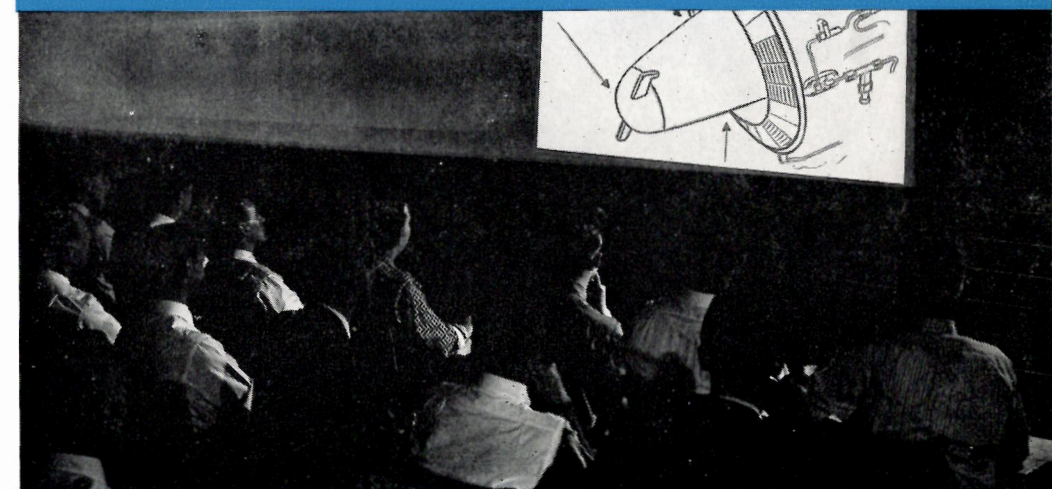
An additional Sales and Service function is a training school for service personnel — pilots, ground crews, maintenance staffs — where they receive comprehensive instruction in all phases of operation and maintenance of Orenda engines.



Part of Service Headquarters office



Field Service Reports come under scrutiny



Visual Aid Instruction is part of service offered

overhaul

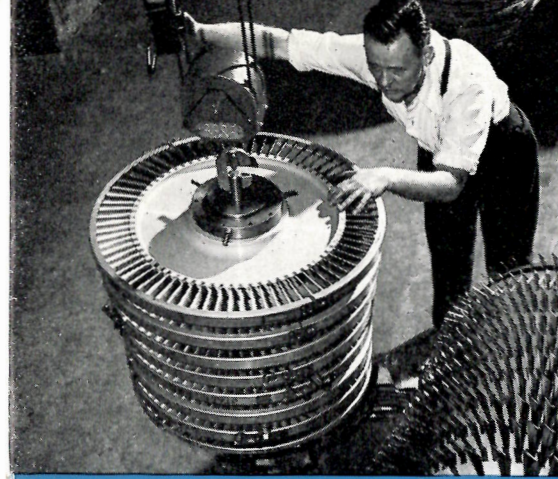
A complete overhaul service is maintained both in Canada and in Europe for speedy and economic reconditioning of major assemblies and time-expired engines. A section of the new engine plant at Orenda's Malton headquarters has been laid out in the most modern way to ensure quick and efficient engine turnover. The Company is prepared at any time to organize for the Orenda operator an overhaul base wherever required.

repair

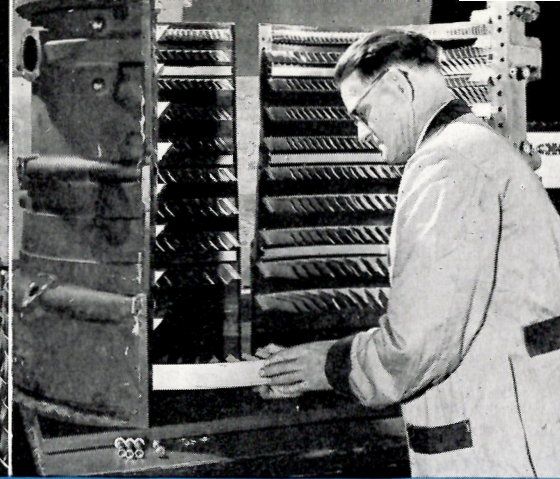
Service engineers make a constant study of experience gained in the field with the object of reducing overhaul costs and at the same time maintaining a high standard of reliability. This information is available to the operator in the form of Orenda Repair Schemes, and every assistance is given should the operator wish to incorporate the schemes at his own base. Repair Representatives are also available to investigate on the spot any special technical problems which may arise during overhaul procedure at the operator's base.

spares

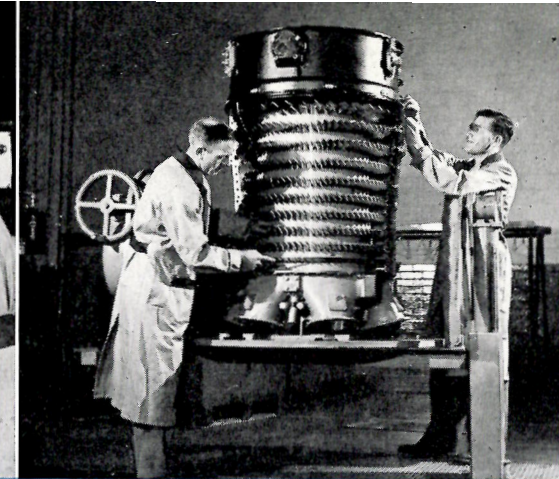
Orenda Engines maintains an efficient engine spares organization consisting of specially trained personnel and the most modern packaging equipment. Spares can be shipped at short notice — and scientifically packaged to withstand the rigors of climatic extremities and the abuse of rough handling in shipment to any part of the world where Orenda engines are in use. Detailed lists are available giving the recommended spares requirements to service or to overhaul any number of engines. These lists are constantly under review to ensure that the operator is kept adequately supplied with the proper spares.



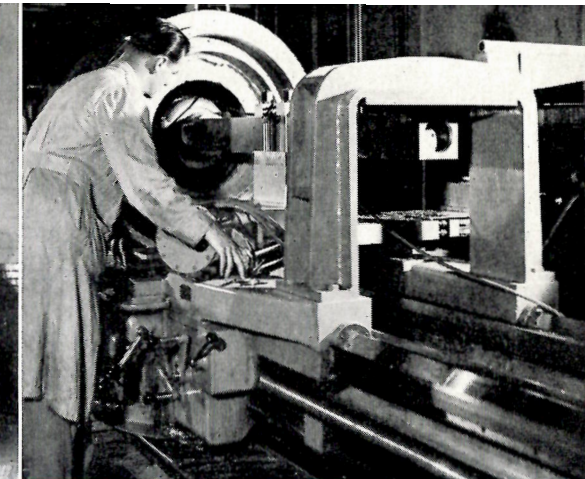
Compressor Rotor in Transit



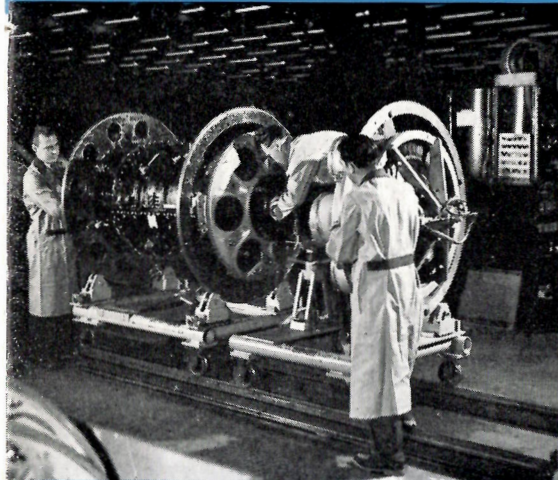
Fitting Stator Blades



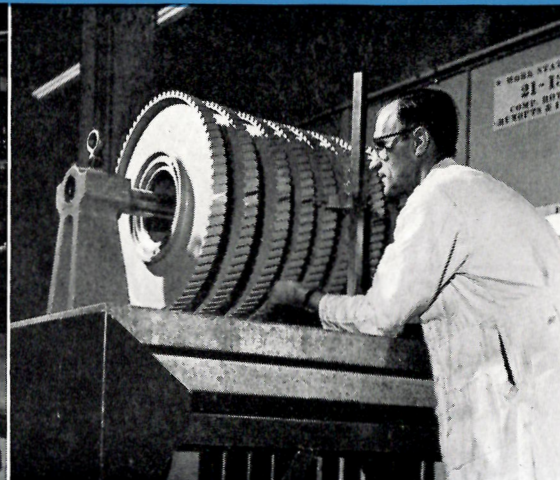
Assembling Compressor



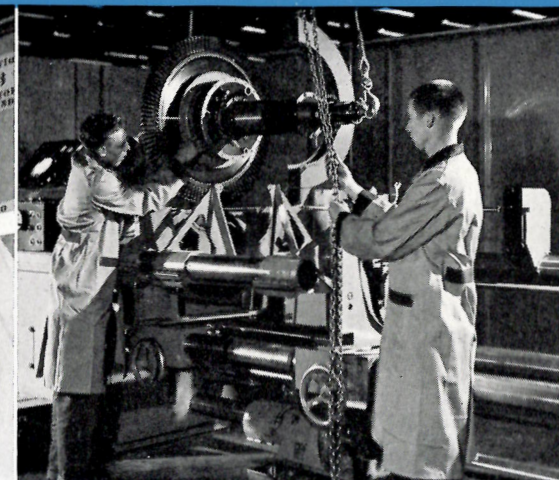
Machining Stator Blade Tips



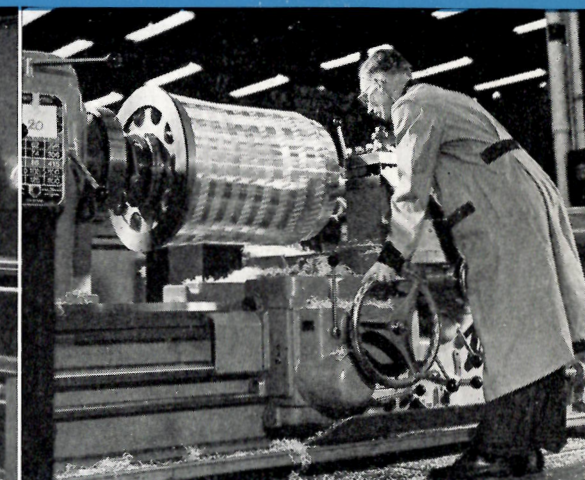
Connecting Centre Coupling



Indexing Rotor Discs



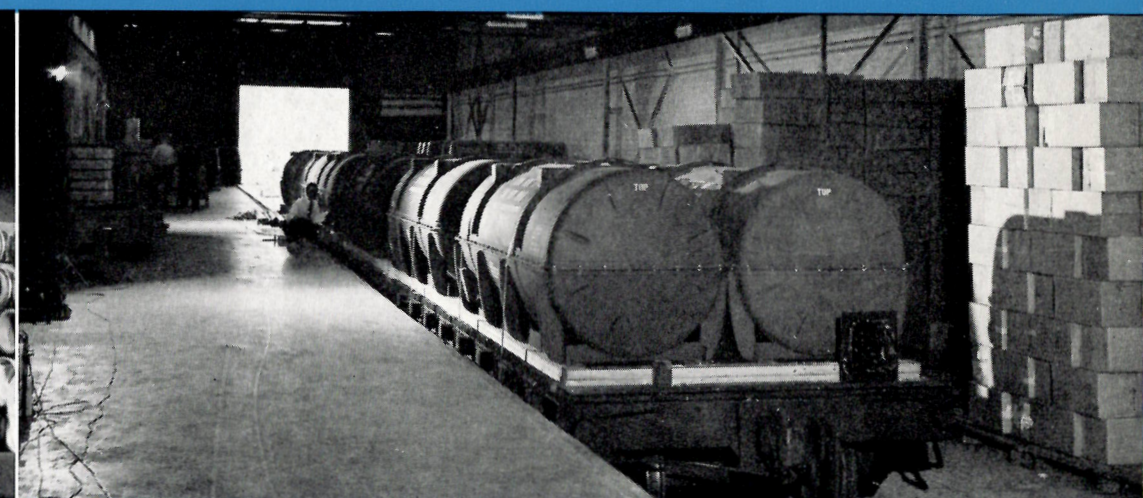
Balancing Turbine Assembly



Machining Compressor Rotor Discs



Section of Spares Department



Engines outward bound by rail



tomorrow

To open up new fields of jet power . . . to supply the increasingly complex requirements of the supersonic era . . .

To design, develop, manufacture and service whatever types of aero engines that may be required now, or in the future, for the defence of Canada and the free world . . .

These are the goals to which Orenda people are working - with design improvements to the current series of Orenda engines and with development work on new projects.

ORENDA ENGINES LIMITED

DIRECTORS AND SENIOR OFFICIALS

<i>Chairman and President</i>	- - - - -	CRAWFORD GORDON, JR.
<i>Vice-President and General Manager</i>	- - - - -	W. R. McLACHLAN
<i>Vice-President Engineering</i>	- - - - -	C. A. GRINYER
<i>Vice-President Manufacturing</i>	- - - - -	E. K. BROWNRIDGE
<i>Vice-President Sales and Service</i>	- - - - -	F. L. TRETHEWEY
<i>Sales Manager</i>	- - - - -	P. Y. DAVOUD
<i>Director</i>	- - - - -	A. A. BAILIE
<i>Secretary and Treasurer</i>	- - - - -	K. R. CHURCH
<i>Chief Inspector and Quality Control Manager</i>	- - - - -	L. E. MARCHANT
<i>Personnel and Industrial Relations Manager</i>	- - - - -	J. E. NESBITT

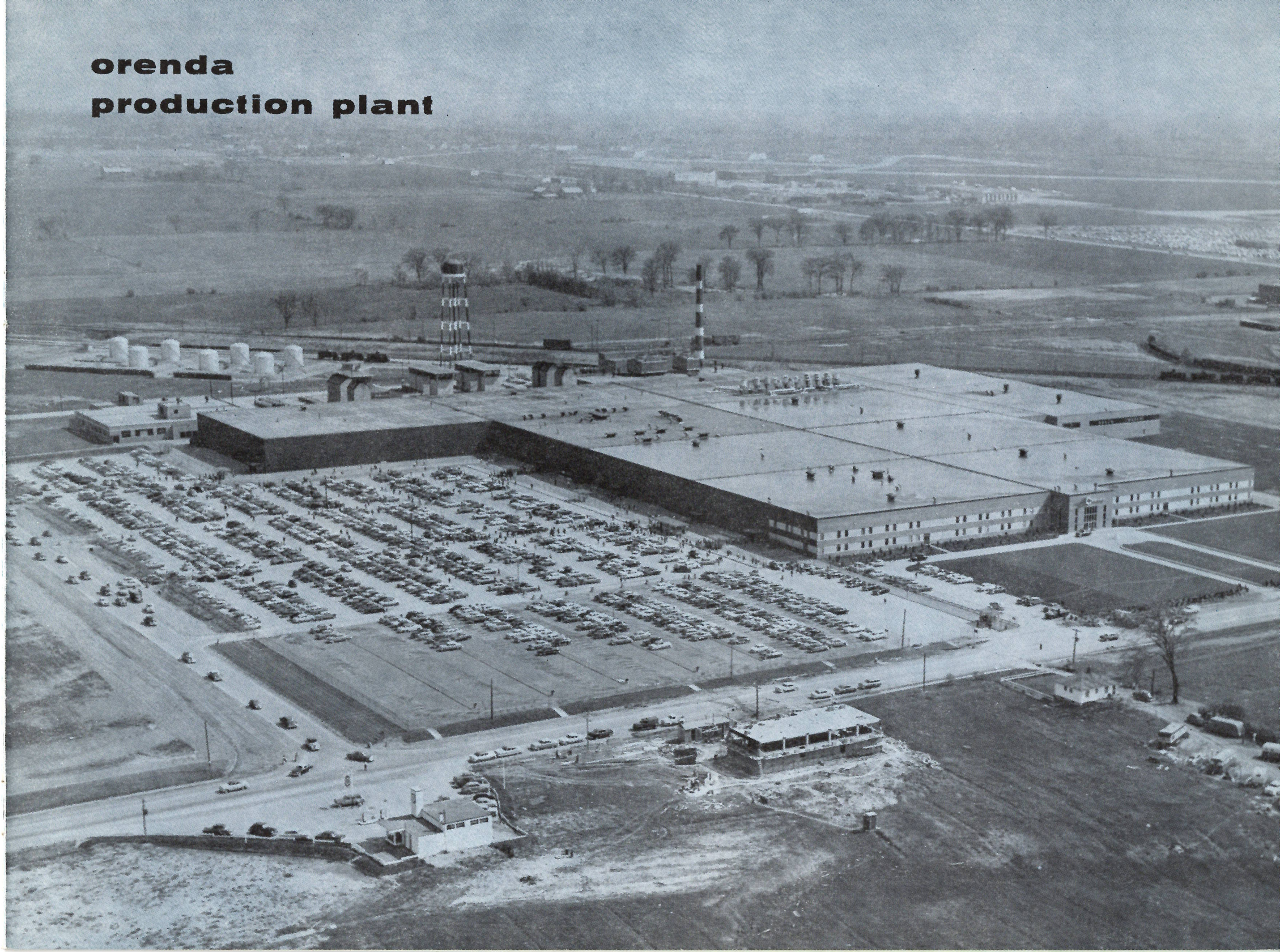
A. V. ROE CANADA LIMITED • MEMBER, HAWKER SIDDELEY GROUP

A. V. ROE CANADA LIMITED

BOARD OF DIRECTORS

<i>Chairman</i>	- - - -	SIR ROY H. DOBSON, C.B.E., F.R.Ae.S., J.P.
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<i>Director</i>	- - - -	J. S. D. TORY, O.B.E., Q.C., S.J.D.

**orenda
production plant**



*ORENDA
ENGINES
LIMITED*

MALTON, ONTARIO

Postal Address: Box 4015, Terminal A,
Toronto, Ontario, Canada



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Engravings by Superior Engravers Limited