DEVELOP LANGUAGE TO FIT JETS

(Continued from page 35)

there being 70 to 80 with fir tree section BLADE ROOTS made to fit the grooves in the wheel.

The shaft is secured to the front of the disc and the drive is taken up through toothed flanges on the rear of the shaft and the disc stub shaft which is a machined extension from the disc. The function of the turbine wheel is to drive the compressor rotor.

The SHROUD RING is a steel ring which is bolted to the nozzle box and fits around the turbine wheel. It is an important part since its function is to restrict the flow of hot gases to the diameter of the turbine wheel.

The TURBINE WHEEL TIP CLEARANCE is checked between the tips of the blades and the bore of the shroud ring.

The TAIL CONE, sometimes called the EXHAUST UNIT, is the rearmost part of the engine proper. Although for convenience it is often listed as a part of the aircraft, it definitely belongs to the engine. It is a fabricated steel cylindrical component which is bolted onto the shroud ring and its function is to direct the flow of hot gases into a straight jet as it leaves the turbine.

The main outer piece is called the OUTER CONE and inside this, supported by airfoil FAIRINGS is the INNER CONE. The base (front face) of the inner cone is about the same diameter as the turbine disc, behind which it is closely mounted. The unit is surrounded by an INSULATING BLANKET made of metal foil covered with gauze.

The JET PIPE, as the name depicts, is simply a pipe. In appearance and construction it is similar to the tail cone except that it is longer and has no inner cone. Its length will be dependent on the type of aircraft to which the engine is fitted. As a rule the unit is classed as an aircraft part although it is supplied by the engine manufacturer. The unit is bolted to the rear end of the tail cone and its function is to direct the hot gases safely from the tail cone to the rear of the aircraft.

While these names and terms are given as being authentic and popularly used in the jet engine workshops of Canada and Britain it may happen that in some cases other names have been applied. The origin of these is often traced to the drawing board where the name is sometimes given without too much thought as to whether or not the particular part in question is already known in the industry as something else. This kind of thing can cause confusion and it is hoped that in the near future jet engine terminology for Canada will be standardized.

The importance of correct terminology cannot be over-emphasized. It is recalled for instance, that during the last war the RAF were definitely instructed to call an airscrew a propeller after someone ordered airscrews and received air crews!

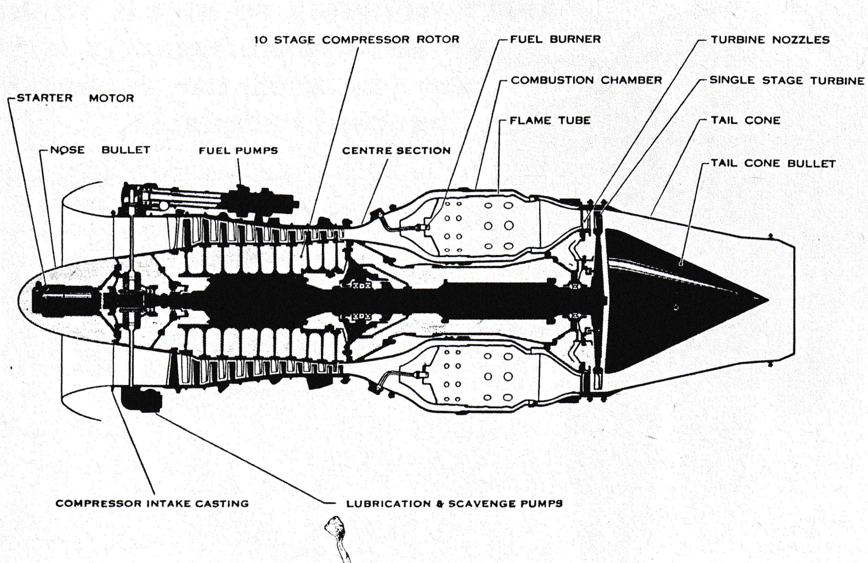

FIG. 1 DIAGRAMATIC SECTION OF ORENDA ENGINE

THIS IS THE ORENDA

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THE Orenda is an axial-flow jet engine having 10 compressor stages, six combustion chambers, a single-stage turbine and an exhaust cone. Under sea-level static conditions the version now in production has a thrust in excess of 6,000 lb., and a specific fuel consumption of 1.00 lb. per hour per pound of thrust. The dry weight is about 2,500 lb. The nominal diameter is 42 inches and the over-all length is very close to 10 ft.

Two mounting arrangements are possible. The first is a four-point suspension with two trunnions on the turbine nozzle box and two mounting pads on the centre casting. The second is a three-point pick-up having two trunnions on the centre casting and an adjustable strut on the backbone casting.

Compressor — The compressor intake is a magnesium alloy casting having an annular air entry around a housing which contains the drive gear box for the engine auxiliaries and the compressor front bearing. The housing is supported by six struts which contain the auxiliary drive shafts, lubrication lines, thermocouple leads, and starter cables. The electric starting motor is mounted on the housing and is covered by the entry bullet.

The rotor is composed of discs mounted on an internal drum. The first nine stages have aluminum discs while the 10th disc is steel. A stepped sealing ring projects from the rear of the 10th stage disc into a gland mounted on the centre casting. A small flow of air is permitted to escape past this seal and is used for cooling the rear face of the turbine disc. The blades are retained in the discs by a form of "fir tree" fixing for the first three stages and dovetails for the remaining ones. The first, second, third, and 10th rotor blades are steel. The rest are an aluminum alloy. Rotor and stator blades are unshrouded. The rotor is supported on a bearing in the intake casting and on the centre bearing in the centre casting.

The compressor stator casings are of magnesium alloy. The stationary blades are mounted by dovetails in rings which are retained in place by lips on interstage spacers which in turn are bolted to the stator casing. Provision is made for bleeding air for engine and aircraft purposes at the second, fifth, and eighth stages.

Centre Section and Backbone — The centre section is an aluminum alloy casting containing the diffusing ducts leading from the compressor to the combustion chambers. The centre bearing assembly is mounted inside the centre section. The rotor is retained axially and the rotor thrust absorbed at this point. The centre bearing assembly consists of two bearings with accurately ground spacer rings between them which permit the bearings to share the thrust load.

The bearing housing is spherically ground on its outer diameter to allow the bearing to accommodate angular misalignment of the main shaft due to aircraft manoeuvres. The bearing housing is spring loaded against a composite rubber thrust ring which deforms slightly with angular misalignment but maintains the axial location of the rotor assembly.

The backbone is a casting of light alloy joining the centre section and the turbine nozzle box. The turbine bearing is mounted on an internal flange at the rear of the backbone.

Combustion Chambers — The six combustion chambers are bolted to the centre casting at the front and are a sliding fit in the nozzle box at the rear. They are arranged around the backbone. Interconnector tubes are provided between chambers to allow crossfiring on light-up. Torch igniters are mounted on two interconnectors for ignition purposes. These consist of a small fuel atomizing nozzle and a spark plug. The combustion chamber consists of a cast aluminum expansion section and a mild steel outer casing with a high temperature alloy flame tube mounted within. The atomizing burners are mounted on pads on the diffuser ducts and project into the combustion chamber.

Nozzle Box—This assembly consists of a welded structure of steel castings and pressings. The turbine nozzle blades are mounted into it as well as the transition ducts which lead the products of combustion from each chamber to the nozzle annulus. The shroud ring which surrounds the turbine rotor blades is attached to the nozzle box.

Turbine and Drive Shaft—The turbine consists of an austenitic steel disc with an integral stub shaft. The blades of nickel-chromium alloy are mounted on its periphery by "fir tree" fixings. The turbine bearing is mounted on a sleeve on the stub shaft section. The stub shaft is attached to the main shaft which drives the compressor through a splined coupling near the centre bearing. The front face and rear faces of the turbine disc are cooled by fifth stage air and tenth stage air respectively. The turbine bearing is cooled by second stage air.

Tail Cone—This assembly is fabricated largely from stainless steel sheet. It consists of an outer cone and an inner bullet supported front and rear by four tubular struts covered by a fairing. Tenth-stage air is conducted through the front struts and forward to the front of the bullet. From here it flows outward between the face of the bullet and the turbine disc escaping into the gas stream at the disc periphery. The outer surface of the tail cone is insulated by a fibre glass and foil blanket protected by aluminum covers.

Fuel System—The fuel system is the means of controlling engine output. The pilot's throttle is connected to an altitude-sensitive scheduling-type flow control unit which varies the delivery of two engine-driven pumps through a servo-system to maintain engine speed constant for any throttle setting irrespective of altitude. The pumps have integral overspeed governors. The remaining fuel system components are: One solenoid-operated reducing valve to supply fuel to the torch igniters; one flow distributor to meter the flow to the burners; six double-orifice burners arranged to allow good atomization over a wide flow range; one dump valve.

A high pressure shut-off cock for the pilot and a low-pressure filter are incorporated in the flow control unit.

Lubricating System — The lubricant is supplied by the oil pump to the rotor bearings, gearboxes, front bearing seal and drive shaft flexible coupling through a ring main. Pressure is kept constant in the main by a pressure control valve which returns excess oil to the reservoir. Separate scavenge pump elements are used to pump lubricant from the following sumps: 1. Rear bearing; 2. Centre bearing; 3. Front oil drains; 4. Flexible coupling.

These discharge into the oil reservoir which is a tank of 13 Imperial pints capacity. The lubricant returned from the rear and centre bearings is cooled by a heat exchanger which uses incoming fuel as a coolant. The ring main system operates at 15-18 psi. The engine oil consumption is about 1 pint per hour.

Cooling Air System—Air is bled from the compressor at the second, fifth and 10th stages and used for cooling as follows:

1. Second Stage Air (a) backbone cavity; (b) turbine bearing; (c) nozzle box.
2. Fifth Stage Air (a) centre bearing; (b) front face of turbine disc.
3. Tenth Stage Air—rear face of turbine disc.

Starting—Starting is effected by a 32-volt electric motor housed in the nose bullet. An over-riding clutch disengages the starter motor when the engine reaches self sustaining speed. The rest of the starting system consists of the booster coils for the torch igniter spark plugs and the control circuit for the torch igniter reducing valve. An external sequence control is necessary to ensure that starting current, fuel for the torch igniters, and power for the torch igniter spark plug are provided at the correct times to permit clean starts.

NENE JET ENGINE TO POWER TRAINERS

(Continued from page 38)

ture on three bearings, a roller bearing at each end and a deep grooved thrust bearing in the centre.

Both units are jointed together just aft of the centre bearing by a ball coupling which allows some flexibility of alignment, and the drive from turbine to impeller is transmitted through the meshing teeth of two flanges which form part of the coupling.

The drive to the wheelcase is taken from the front end of the rotating assembly through a splined shaft which meshes with a spur gear on the wheelcase, driving two layshaft pinions. Ball and roller bearings are used throughout the wheelcase, except on the more lightly loaded driving shafts which are supported in plain bearings.

The combustion chambers are secured between the compressor outlet elbows and nozzle box, and are flexibly mounted to allow for uneven expansion while the engine is running. The nozzle box forms part of the main structure and carries the discharge nozzles, nozzle guide