7.6 - POWERPLANT

TURBOPROP ENGINE OPERATION (Figure 7.6.1)

The PRATT & WHITNEY CANADA turboprop engine (PT6A-66D model) is a free turbine engine rated at 850 SHP and developing a thermodynamic power of 1825 ESHP. An electrically driven device limits the power of the engine to 770 SHP (110 % TRQ - 2000 RPM) at sea level, when the flap control lever is not on "850" position (UP/TO/LDG).

Intake air enters engine through an annular casing and is then ducted toward compressor. The latter consists of four axial stages and one single centrifugal stage assembly to form a whole assembly. Compressed air and fuel are mixed and sprayed into combustion chamber by fuel nozzles. The mixture is first ignited by two spark igniter plugs, then combustion continues as a result of air-fuel mixture flow. Gases resulting from combustion expand through a series of turbines. The first one (gas generator turbine) drives compressor assembly and accessories, the two other ones (power turbines), independant from the first one, drive propeller shaft through a reduction gear box. Hot gases are evacuated through two exhaust stubs located laterally on both sides forward of engine cowling.

All engine driven accessories, except power turbine tachometer and propeller governor, are installed on accessory gearbox located rearward of engine.

1) Propeller governor
2) Exhaust stub
3) Axial compressors
4) Accessory gearbox
5) FCU Fuel control unit
6) Oil to fuel heater
7) Input coupling shaft
8) Air intake
9) Centrifugal impeller
10) Combustion chamber
11) Compressor turbine
12) Power turbine 1st stage
13) Power turbine 2nd stage
14) Power turbine shaft

Figure 7.6.1 (1/2) - POWERPLANT

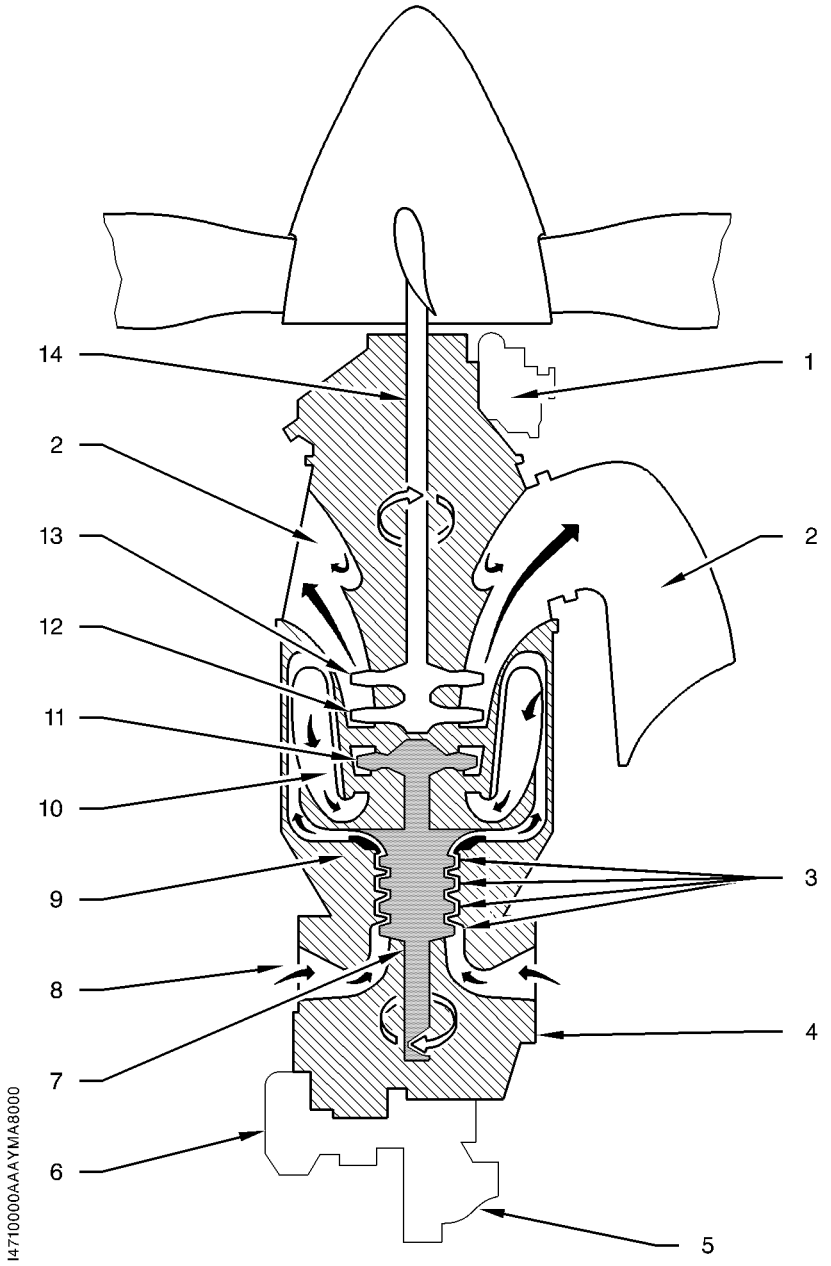

Figure 7.6.1 (2/2) - POWERPLANT

ENGINE CONTROLS (LEVERS) (Figure 7.6.2)

Engine operation requires use of four levers located on pedestal console in cabin :

- power lever (Item 2), and its detent for reverse (Item 6)
- propeller governor lever (Item 1),
- condition lever (Item 3),
- "MAN OVRD" emergency fuel regulation lever (Item 5).

NOTE :
Thumbwheel for lever friction (Item 4)

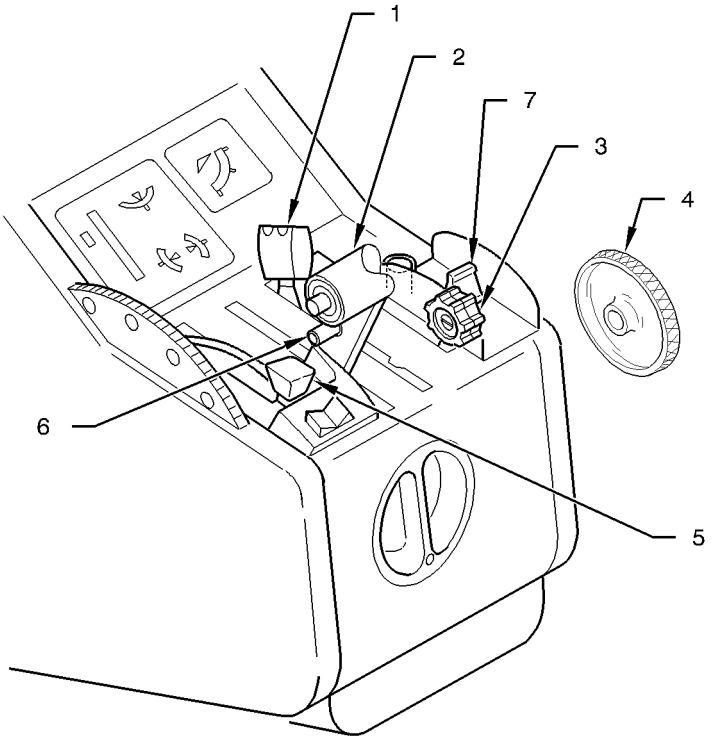

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Figure 7.6.2 - ENGINE CONTROLS (LEVERS)

Power control lever

The power control lever is linked to fuel control unit. It modulates engine power from full reverse to takeoff.

Engine running, the power control lever rearward displacement, past the lock using the detent, allows to control :

- the engine power in the Beta range from idle to maximum reverse,
- the Beta valve to select the propeller pitch in reverse.

Return to idle position is accomplished by pushing the power control lever forward.

CAUTION

DO NOT MOVE THE COCKPIT POWER CONTROL LEVER INTO THE PROPELLER REVERSE POSITION OR DAMAGE TO THE LINKAGE WILL RESULT.

REVERSE MAY ONLY BE SELECTED WITH ENGINE RUNNING AND PROPELLER TURNING

When engine is shutdown, there is no oil pressure in the propeller and the feathering spring locks the Beta ring and the propeller reversing interconnect linkage on the engine.

All rearward effort on the power control lever, past the idle stop, may damage or break the flexible control cable.

Propeller governor lever

The propeller governor lever activates the propeller governor located forward of the engine to select and maintain any propeller speed between 1600 and 2000 RPM. This lever allows propeller feather. Changing from normal range to feather position requires "FEATH" stop by moving lever toward left side and back. The lever being locked in feather position, unlocking requires moving the lever toward left side and forward.

Condition lever

The fuel condition lever is linked to FCU. It can be positioned to cutoff, idle LO / IDLE or idle HI / IDLE. Change from idle LO / IDLE to cutoff position is only possible after having overridden the idle gate. To override idle gate, raise lever and move it rearwards. If the lever is locked in cutoff position, unlocking is performed by raising lever and moving it forward.

"MAN OVRD" emergency fuel regulation lever

Emergency fuel regulation lever is normally in locked position. In case of FCU or power lever failure, it allows setting engine power manually. Unlocking and locking are performed by pulling lever knob up.

NOTE :
The power available if the power lever fails will be limited by the position of the lever.

Lever friction (Figure 7.6.2)

A thumbwheel (Item 4) located on right side of pedestal console increases friction to avoid control slip after setting.

Maximum power mode (Figure 7.6.2)

850 SHP maximum power is selected by the pilot for climb and cruise, only with retracted flaps, by moving flap control lever (Item 7) past the lock to the 850 position.

Unlocking is performed by raising the lever and moving it forward.

ENGINE INSTRUMENTS (Figure 7.6.3)

Engine indicating panel consists of the following instruments :
a torquemeter, a propeller speed indicator, an ITT indicator, a gas generator speed indicator, an oil pressure and temperature indicator and a fuel flow totalizer/computer.

Torquemeter (TRQ) indicates engine torque expressed in percent (%).

NOTE :
Engine torque is also checked by a red warning light labelled "TRQ" located on advisory panel.

Propeller speed indicator (PROP) indicates propeller speed in RPM.

ITT indicator indicates gas temperature between generator turbine and power turbine by a dual display (pointer and digital indication). Gages are graduated in "°C".

NOTE :
Interturbine temperature check is also assured by the "ITT" red warning light that illuminates on advisory panel when interturbine temperature exceeds 850°C.

Gas generator speed indicator (Ng) indicates generator rotation speed expressed in percent (%).

Oil pressure and temperature indicator (ENG OIL) is a dual indicator graduated in "°C" and in PSI.

NOTE :
Each instrument is provided with marks indicating utilization limits. Lubrication system monitoring is ensured by "OIL PRESS" warning light, which illuminates on advisory panel when engine oil pressure is too low.

Fuel flow totalizer/computer (FLOW) is a digital display instrument which indicates :

- quantity of fuel consumed since beginning of flight,
- instantaneous consumption,
- remaining flight time depending on fuel quantity.

"PROP O' SPEED TEST" push-button allows checking the overspeed valve for correct operation.

"ITT TEST" button allows checking the ITT indicator for correct operation :

- digital display "**I888**"
- the pointer abuts against maximum limit
- the "ITT" indicator light illuminates on the advisory panel.

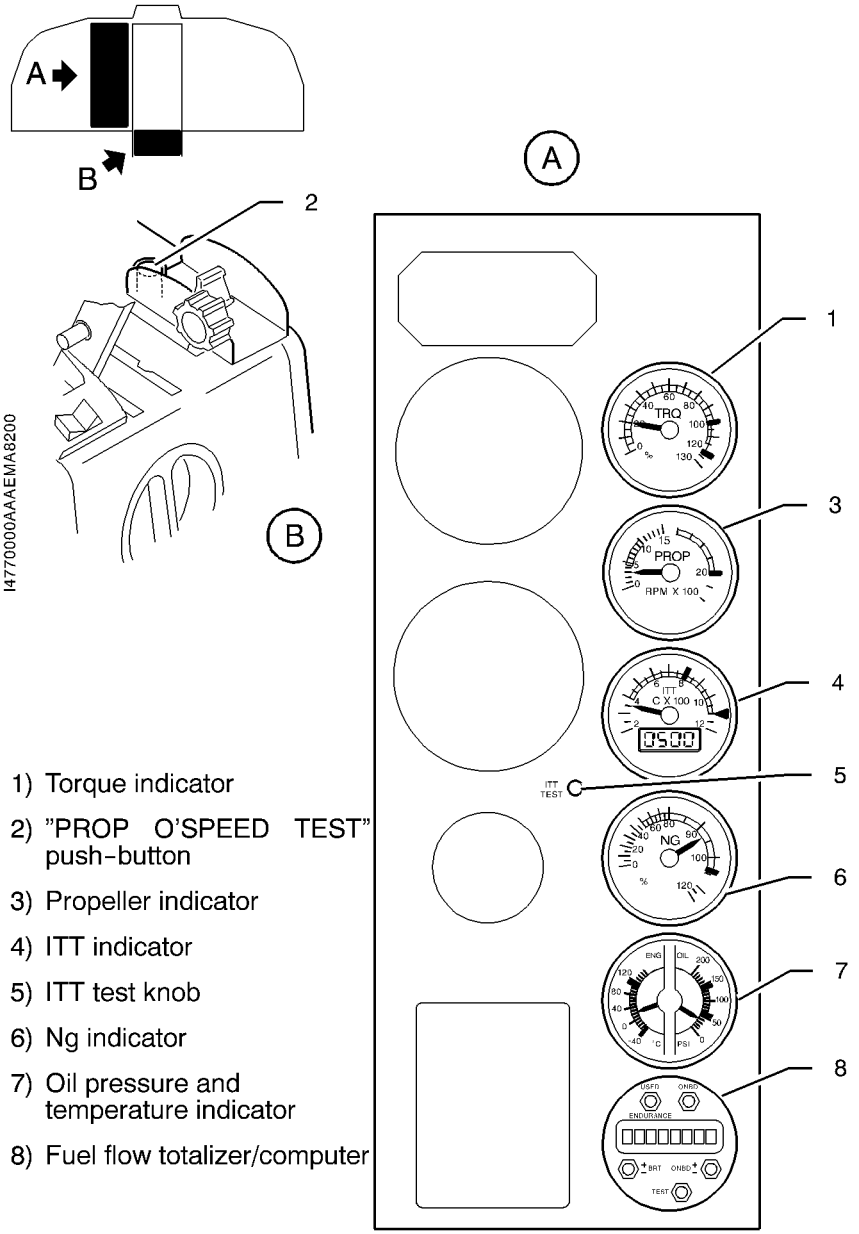


Figure 7.6.3 - ENGINE INSTRUMENTS

ENGINE LUBRICATION

Engine oil is in a tank incorporated into the powerplant. It ensures lubrication and engine cooling. A cooler located on left side in engine compartment maintains oil temperature within limits. Oil flow into the cooler is metered by a thermostatic valve. Engine oil also supplies propeller governor and engine torquemeter.

Lubrication system content, cooler included, is 12.7 quarts (12 litres). A graduated dipstick allows checking oil quantity in system. A visual oil sight glass, located on engine left side, allows a rapid checking of oil level.

NOTE :
For checking and oil filling-up, refer to Section 8.

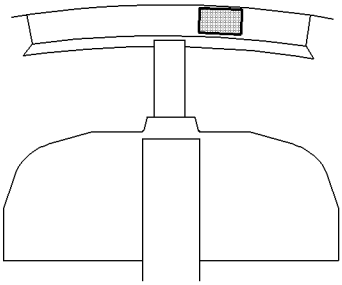
ENGINE STARTING (Figure 7.6.4)

Ignition function

Ignition system consists of an ignition unit and two spark igniter plugs in powerplant, a three-position "IGNITION" switch "OFF - AUTO - ON" located on "ENGINE START" panel at upper panel and "IGNITION" warning light located on advisory panel.

Ignition unit supplies, from 28-Volt source, high voltage current necessary to spark igniter plugs. When "IGNITION" switch is positioned to "AUTO", ignition unit supply is ensured as long as "STARTER" switch located on left side of "IGNITION" switch is maintained "ON" : this is normal procedure for ground starting or flight air start with starter.

"ON" position for "IGNITION" switch is used in case of flight air start without starter. In this configuration, ignition unit is supplied permanently. In any case, "IGNITION" warning light illuminates as long as ignition unit is supplied.



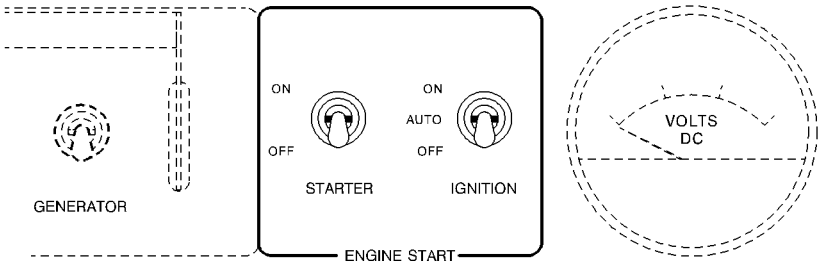


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Figure 7.6.4 - ENGINE STARTING

Starter function

Starting system consists of "STARTER" switch located on "ENGINE START" panel, starter generator, "STARTER" warning light in advisory panel and ignition circuit (Refer to Paragraph "Ignition function").

Starting procedure is manual. Setting "STARTER" switch to "ON" connects the starter generator which drives powerplant. "STARTER" warning light illuminates indicating that the starter generator is operating.

WARNING

POWERPLANT STARTING MUST BE PERFORMED BY QUALIFIED PERSONNEL AND BY FOLLOWING PROCEDURES AND PARAMETERS DESCRIBED IN SECTION 4 "NORMAL PROCEDURES"

ENGINE AIR INLET

Engine air inlet is located at front lower section of engine cowling. Air inlet port is protected against icing by a hot air flux provided by engine. Air is driven throughout a duct in engine casing before entering engine through a protective screen. An inertial separator system inside the air duct protects the engine from ingesting dense particles (water, ice, fine gravels, sand).

Separator consists of two movable vanes. During normal operation, air is conducted directly towards engine air inlet. To separate particles suspended in the air, vanes are positioned to force engine induction air to execute a sharp turn : under the effect of centrifugal force denser particles separate from the air and are discharged overboard through two apertures located under engine cowling.

Operation of inertial separator vanes is electrically controlled by "INERT SEP" inverter located on "DE-ICE SYSTEM" panel. When inverter is set to ON, an electric actuator activates vanes ; "INERT SEP" warning light on advisory panel illuminates when vanes have reached their maximum deflection and remains illuminated as long as switch remains ON. Full deflection takes about 30 seconds.

EXHAUST SYSTEM

Exhaust gases are evacuated through exhaust stubs located on sides of engine cowlings.

ENGINE ACCESSORIES

All engine driven accessories [except power turbine tacho-generator (Np) and propeller governor] are installed on accessory gearbox located rearwards of engine.

Oil pump

Oil pump is a self-controlled gear pump located at the bottom of oil casing.

Fuel high pressure pump (HP)

Fuel high pressure pump is installed on accessory gearbox. It supplies fuel nozzles, flow being controlled by fuel regulator (FCU). Fuel provided by engine driven main pump (mechanical) enters high pressure pump through a filter, then it is discharged under pressure into fuel regulator (FCU) through a second filter. In case of contamination of this second filter, a by-pass valve allows fuel to go directly from high pressure pump to the regulator.

Compressor turbine tacho-generator (Ng)

Compressor turbine tacho-generator (Ng) is attached on accessory gearbox. It supplies a voltage which feeds gas generator speed indicator.

Power turbine tacho-generator (Np)

Power turbine tacho-generator is attached on the right side of the reduction gearbox. It supplies a voltage which feeds propeller speed indicator.

Torque transmitter

Torque transmitter is attached on the torque limiter, it measures torque produced by the power turbine by comparing oil pressures (reduction gear and power turbine) and converts pressure difference into a voltage which is applied to torquemeter.

Propeller overspeed limiter

Propeller overspeed limiter is installed on left side of the reduction gear box. It prevents a propeller overspeed in case of main propeller governor failure.

Propeller overspeed limiter is equipped with a test solenoïd which allows performing ground tests by arming limiter under normal overspeed power.

"PROP O'SPEED TEST" propeller test push-button (Figure 7.6.3) of overspeed limiter is located near flap control lever on the pedestal console.

Torque limiter

Torque limiter is located on right side of the reduction gear box. It is rated to limit engine torque to 110 % at sea level. The torque limiter is deactivated when the flap control lever is on "850" position.

PROPELLER

Airplane is equipped with an all-metal, four-bladed, constant-speed and full-feathering propeller.

Regulation

Propeller governor located on engine maintains rotation speed selected by pilot with propeller governor lever. Regulation is obtained through propeller blade pitch variation : counterweights drive propeller blades toward high pitch (low RPM) whereas oil pressure delivered by governor drives back blades toward low pitch (high RPM).

Propeller governor allows feathering either by voluntary pilot action via the propeller governor lever or automatically in case of engine failure or shutdown.

Propeller reverse pitch allows reduced taxiing speed or landing roll. Change from idle to reverse position is performed with power lever (Refer to Paragraph "ENGINE CONTROLS").

Propeller overspeed regulator tests (Figure 7.6.3)

"PROP O'SPEED TEST" push-button located on pedestal console near flap control lever is used on ground to check proper operation of propeller overspeed regulator. This push-button activates a solenoïd, attached on propeller overspeed regulator, which limits propeller rotation speed when power lever is positioned forwards.

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