PART 1

Chapter 2 — ENGINE CONTROLS AND INSTRUMENTS

Contents

DESCRIPTION

1 Avon 122 engine

(*a*) *General*

The engine is a 12-stage axial-flow gas turbine. The Avon 122 develops 7575 lb static thrust at sea level. The main engine systems include:

Variable incidence guide vanes (see para 2)

A cartridge starting system (see para 3)

Relighting facilities (see para 8)

An anti-icing system (see para 13)

A high-pressure fuel system controlled by a flow control unit

A self-contained oil system

(*b*) *High-pressure fuel pumps*

The twin engine-driven HP pumps share a common housing. A servo-control system controls the total pump output and a governor prevents over-speeding of the engine.

(*c*) *Flow control unit*

The servo-control system is operated by the barometric pressure control (BPC) and acceleration control unit (ACU), and varies fuel flow to the engine according to throttle position, altitude, forward speed and RPM.

(*d*) *Oil system*

Oil is carried in the engine sump, the capacity of which is 17 pints. One pressure and two scavenge pumps maintain a continuous circulation through a cooler and filter to the engine bearings and gears.

2 Variable incidence guide vanes and air bleed valves

(*a*) The first row of stator blades in the engine consists of variable incidence guide vanes which impart swirl to the incoming air. At low RPM the first stages of the compressor deliver more air than is acceptable to the later stages. To prevent surge, the surplus air is bled off from stages 4 to 7 through air bleed valves and the guide vanes are held in the maximum swirl position. The air bleed valves are controlled by compressor delivery air pressure and the swirl vanes ram by HP pump delivery fuel pressure.

(*b*) The guide vanes start to move from the maximum swirl position at about 6400 RPM and reach the minimum swirl position at about 7550 RPM. The bleed valves close at about 6500 RPM.

(*c*) The positions of the guide vanes and bleed valves have no noticeable effect of RPM, but until the guide vanes are in the minimum swirl position and the bleed valves are closed the engine is not operating at maximum efficiency; thrust is reduced and fuel consumption is increased.

3 Starting system

(*a*) Starting is by means of a triple breech cartridge starter system, which accelerates the engine until it becomes self sustaining.

(b) When the starting cycle is initiated, a cartridge is indexed and fired and burns for about 3 seconds to turn the engine. At the same time, the high energy igniter units operate to ignite the fuel spray in the engine combustion chambers. After about 30 seconds, the engine becomes self-sustaining and a switch operates to shut down the starting system and to release the starter button.

4 Engine Fire Extinguisher

(a) A fire extinguisher bottle, mounted between the air intakes just forward of the engine, is connected to two spray rings in the engine bay. The system is operated by pressing the fire extinguisher button (which incorporates a fire warning light) on the centre upper instrument panel. In the event of a crash landing, the operation of two series-connected inertia switches activates the fire extinguisher system and isolates the batteries; the generators are isolated by two additional inertia switches (one for each generator).

(b) Twelve resetting flame detector switches are situated around the engine and forward part of the jet pipe. If any of the switches operates, the warning light in the fire extinguisher button comes on provided that electrical power is available. When the button is pressed, the extinguisher discharges its contents through the two spray rings, one around the engine compressor and one around the turbine nozzle box. If the fire is extinguished, the warning light goes out when the flame switches cool.

(c) The fire warning light can be tested by pressing the FIRE TEST PUSH button adjacent to the fire extinguisher button.

(d) When the battery master switch is off, the fire extinguisher can only be operated by the inertia switches. The battery master switch must be on, or an external DC supply connected, to test the warning light or to operate the system using the fire extinguisher button.

CONTROLS AND INDICATORS

5 HP Fuel Cock

The HP fuel cock control is in a quadrant on the port

shelf, and is moved forward from OFF to ON. A safety gate is provided to ensure that the HP cock cannot be moved unless it is first pressed downwards.

6 Throttle Controls

Two throttle control levers are provided, one in a quadrant on the port shelf, and the other on the centre pedestal; the throttles are interconnected. The handle of each lever incorporates a twist-grip for GGS manual ranging, a press-to-transmit switch and an airbrake control. A throttle damper is aft of the lever.

7 Starting Controls

The main control switches below the port instrument panel are:

(a) The battery master switch.

(b) The ignition switch which controls the power supplies to the igniter units. The switch is normally locked in the on position.

(c) The engine master switch and the starter circuit breaker which provide the power supplies to the starting system through the starter button and, provided that the relight button is out, the ignition switch. The engine master switch also controls the power supplies to the booster pump circuit breakers, the fuel pressure warning circuit, the HP pump isolating switch, the standby inverters and the anti-collision lights. The engine master switch should be on and the starter circuit breaker made when the engine is running.

(d) The starter button which initiates the starting sequence.

8 Relighting Control

A spring-loaded relight button is in the top of the HP cock control lever. When pressed and held, the igniter units operate provided that the starter circuit breaker is made and the ignition switch is on.

9 HP Pump Isolating Valve and Warning Light

(a) The HP pump isolating valve provides a means of restoring power in flight following failure of the HP pumps servo system. The failure is indicated by a rapid sustained drop in RPM and a corresponding drop in JPT.

(b) The valve is controlled by an ENGINE FUEL PUMPS — NORMAL / ISOLATE switch on the port shelf. When the switch is set to ISOLATE, one HP pump is isolated from the servo system which continues to control only the other HP pump. The isolated pump moves to full stroke and is controlled only by its over-speed governor.

(c) The BPC and ACU are ineffective with ISOLATE selected; all throttle movements must be made with care to avoid the possibility of engine surge or excessive JPT.

(d) A red warning light adjacent to the switch comes on when ISOLATE is selected.

WARNING: To avoid overfuelling, the throttle must be closed before selecting ISOLATE.

10 Top Temperature Control

(a) The top temperature control (TTC) system prevents the maximum permissible JPT of 690°C being exceeded by reducing the fuel flow to the engine as necessary. The system requires both AC and DC power supplies. The AC supply is provided whenever the No 1 (main) or No 4 (standby) inverter is functioning. The DC supply is controlled by the TOP TEMP — ON/OFF switch on the port shelf provided that the nosewheel door is locked up.

(b) When the nosewheel door is locked up, a microswitch closes and, after a 30 second delay, DC power is supplied to the TOP TEMP switch and the system becomes operative provided that ON is selected; the switch should normally be on at all times.

(c) Malfunctioning of the system is indicated by a JPT reading above 690°C or by a sustained drop in RPM of up

to 1000. In either case the switch should be set to OFF and the JPT and RPM controlled by throttle movement.

Note: Above 40,000 feet, the top temperature control may not prevent the JPT exceeding 690°C when climbing at full throttle; in this case, the top temperature control should be left on and the JPT maintained within the limitations by use of the throttle.

11 Engine Instruments

The JPT gauge and RPM indicator are on the port instrument panel; the oil pressure gauge is below the port instrument panel.

12 Engine Fuel and Air Dipping System

Note: T Mk 8C and T Mk 8B aircraft are not normally fitted with guns and the fuel and air dipping system is rendered inoperative.

(a) An engine fuel and air dipping system automatically decreases RPM to minimise the risk of surge during gun-firing.

(b) When either gun-firing trigger is pressed, solenoid-operated fuel and air dip valves operate to restrict fuel flow to the engine and to bleed air from the compressor, thus causing a drop in RPM.

(c) The amount of fuel bled in a given time is constant and independent of throttle position. At part throttle settings this can result in RPM dropping below flight idling; throttle response is then uncertain, particularly at low altitude and low airspeed. The fuel and air bleeds operate for as long as the gun-firing trigger is pressed and the RPM drop may be aggravated if the trigger is pressed for long periods, particularly if the system is not accurately set up; at low RPM, the trigger should not be pressed for more than 2 to 3 seconds. The camera button and not the gun-firing trigger should be used for cine gun practice.

(d) If, during gun-firing, the RPM drop below flight idling, release the trigger to stop the fuel bleed; if the RPM do not recover:

(i) Close the throttle and select the HP pumps isolating switch to ISOLATE.

(ii) Open the throttle slowly (to avoid the possibility of surge or excessive JPT); when the RPM have recovered, return the isolating switch to NORMAL.

(iii) If the RPM fall again when NORMAL is selected, a servo system fault is indicated; close the throttle, reselect ISOLATE and remain in ISOLATE for the remainder of the sortie. All throttle movements must be made with care to avoid the possibility of engine surge or excessive JPT.

Note 1: The foregoing assumes that the RPM drop is caused by prolonged fuel dipping and not by engine surge. In the latter case, the reducing RPM are accompanied by rapidly increasing JPT; after releasing the trigger, the normal surge recovery actions should be taken, ie close the throttle and increase speed.

Note 2: If the throttle is opened when firing in buffet conditions, the throttle opening time must not be less than 2 seconds.

13 Engine Anti-Icing

An engine anti-icing OPEN/SHUT switch and indicator are forward on the centre pedestal. The indicator shows red when open and green when shut. When the valve is motoring between open and shut or if the system is de-energised the indicator shows amber. Hot air is tapped from the engine compressor and, with the switch OPEN, is ducted to the inlet guide vanes. The system is *not* intended for de-icing, but to prevent ice formation.

14 Management of the Engine Anti-Icing System

(a) With the system in use, all throttle movements must be made smoothly. There is a loss of thrust (about 7%), increased fuel consumption and JPT usually rises about 20°C. At full throttle, RPM may then fall if the top temperature control comes into operation.

(b) Ground Running. In fog or mist conditions below +5°C OAT, select OPEN immediately after starting. Taxy and, if runway length permits, take off with OPEN selected; otherwise run the engine at 7000 RPM for 1 minute immediately before take-off and then select SHUT. Reselect OPEN as soon as possible after take-off and maintain until 2 minutes after clearing the icing conditions.

WARNING: Do not carry out any engine acceleration checks with the system in use.

(c) Level Flight. If icing conditions are met in level flight, climb or descend out of the icing level (see *(d)* and *(e)* below).

(d) Climbing. Open up to not less than 7200 RPM and select OPEN. Climb at the maximum practicable rate. When clear of icing conditions, select SHUT and wait for about 10 seconds before making any rapid throttle movements.

(e) Descending.

(i) Throttle back to not less than 5500 RPM and select OPEN. Descend at the maximum practicable rate; maximum anti-icing protection is obtained at the highest practicable RPM.

(ii) When clear of icing conditions, select SHUT and wait for about 10 seconds before making any rapid throttle movement. If icing conditions persist down to ground level, leave the switch at OPEN and maintain engine speed above 5500 RPM until finally committed to a landing.

(f) Engine Surge. If an engine surges in icing conditions with anti-icing selected OPEN, throttle back briefly to clear the surge and then climb or descend out of icing conditions as quickly as possible. The throttle should be re-opened smoothly, ensuring that the RPM respond progressively to throttle movement with the JPT remaining normal. Leave the anti-icing selected OPEN until clear of icing conditions.