OLYMPUS 202/301 SERIES

SECTION II

AIR STARTING

General

Engine starting is achieved by using compressed air, either from a ground source or the rapid starting system. The latter will be dealt with later.

The starting medium is low pressure air at 35 psi, the supply of which is controlled by an electrical circuit.

The starting circuit is designed so that the following requirements are fulfilled:

a. All engines may be started independently and in any order from an outside source.

b. One engine started as in a above and from this engine the others may be started either independently or simultaneously.

c. Wet and dry motoring cycles may be carried out.

System Installation

The ground starting connection is in the starboard mainplane, just outboard of No 4 engine. Air from this source passes through a non return valve and enters the aircraft main supply duct between No 2 and 4 engines.

Operation

NB ensure type of start selector switch is at NORMAL. When the starter master switch is put ON the bypass valve in the bomb bay opens. Air from the ground source is now available at the engine isolation cock on each engine. To start an engine, open the appropriate engine isolation cock and press the engine starter button. The starter air valve opens and allows air pressure to pass to the turbine of the starter motor thus rotating the engine. A pressure switch in the starter air valve closes and a light comes on in the starter button. When the engine reaches self sustaining speed, the starter button overspeed cut out switch operates and closes the starter air valve. The pressure switch opens and the light in the starter button goes out.

The remaining engines can be started independently either from the ground source or by using air supplied from the running engine selected to 70%

A simultaneous start of the remaining engines can be achieved by opening the running engine to 90% and with all engine isolation cocks open pressing the remaining starter buttons.

During a wet or dry cycle the engine not reach self sustaining speed and the engine will motor over until the start is cancelled by switching off the Start Master Switch.

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SECTION 11

THE RAPID STARTING SYSTEM

Introduction

1. Modification 1320 provides for the rapid starting of the Olympus engines of the Vulcan B2.

2. The system, using stored high pressure dry air and a turbine starter, is capable of starting the four engines in 19/20 seconds. If an engine fails to start, one re-start is available for each of the port or starboard pair.

3. During a rapid start, the PFC's are automatically started and (if modified Gyros have been fitted) the MFS and flight instruments are boost started, to be available by the time the engines have completed their start cycle. NB If modified gyros have not been fitted, the flight instruments will be started automatically but a minimum of 60 seconds must be allowed from the time the rapid start is initiated to the time the instruments are required for flight.

4. In addition, to facilitate the scramble start, provision is made for the rapid disconnection of all external connections including the external power supply, pitot head covers and air conditioning trolley.

5. By use of the individual start buttons, any selected engine may be started using the rapid start system, however in this case the PFC's would not be energised automatically and would have to be brought on line in the normal way.

(a) Simultaneously using rapid start facility — (Giving automatic PFC starting and, if fitted, rapid flight instrument availability).

(b) Singly using:

(i) Rapid starting facility — (Normal starting of PFC's and artificial feel)

(ii) Normal 'Palouste' method

(c) Starting Nos 1 & 4 engines by [illegible]

The remaining engines from
Air supplied from the engine.

System Components

7. Engine Starter Panel. The panel consists of four individual start buttons, incorporating red lamps, a single rapid start button, a NORMAL/RAPID switch a GYRO HOLD OFF button, an ignition switch, engine master switch and an air cross feed indicator.

/8. Air Storage System

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RAPID STARTING SYSTEM

8. Air Storage System. Ten HP air storage cylinders are mounted in pairs above the fire proof skinning at each engine bay rear bulkhead position in the aircraft. The five cylinders on the port side supply air via a manifold unit, to the rapid starting systems for No 1 and 2 engines. The layout on the starboard side is similar to the port and supplies air for the rapid starting of No 3 and 4 engines. The bottles are charged with dry air from an air charging trolley and when fully charged contain air at 3,300 psi. A Charging point and pressure gauge is located each side between the jet pipe tunnels. Sufficient air is available for three engine starts per side, ie one simultaneous start of two engines plus a further single start. From the manifold unit the air is fed to the individual engine air solenoid valve.

9. Air Bottle Solenoid Valve. A solenoid operated valve which, when energised on the pressing of the start button, opens and allows HP air from the storage cylinders to pass to the reducing valve.

10. Reducing Valve. Reduces the HP Air to 300 psi for delivery to the combuster, A safety disc, which burst at 550 psi is incorporated in the valve to protect the combustor from excessive pressures in the event of failure of the valve.

WARNING: This air exhausts into the same ducting as the normal exhaust from the starter. The outlet ducting is directly beneath the engine.

11. Combustor A simple air heater burning a mixture of main engine fuel and stored air. The combustor has a combined fuel metering nozzle and atomiser, together with a fuel flask. The fuel flask has an integral non-return valve in the fuel inlet line and a sliding piston assembly. This piston is normally forced to the bottom of the flask by fuel pressure. The fuel flask is automatically primed with fuel at aircraft booster pump pressure via the engine LP fuel system. Air from the reducing valve enters the combustor and the pressure is felt on the sliding piston in the fuel flask. The piston is forced towards the top of the flask and in doing so forces fuel through a "non-drip" valve and then through the atomiser. The fuel mixes with air passing round the atomiser and the mixture is ignited by an igniter plug. The remaining air passes between two walls of the combustor chamber and cools the outer wall before mixing with the heated gases to reduce the temperature to a level suitable for the starter. A pressure switch, is fitted to the combustor to terminate the cycle if the air fuel mixture does not ignite.

12. Combustor - HE ignition unit. Supplies high energy electrical current to the combustor ignitor plug. Operation of start button with RAPID START selected automatically brings HE ignition into operation. The ignition system operates for a period of two seconds, when the two second timer in the Time delay unit operates and breaks the circuit.

13. Starter. A small axial flow turbine motor designed to suit the system gas pressure and temperature. Turbine torque is transmitted to the engine via an epicyclic reduction gear and a clutch. A speed sensitive cut off switch fitted to the starter terminates the starting cycle when the engine reached a predetermined speed.

/14. Air Regulating.

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14. Air Regulating Control Valves. Controls normal L.P. air starting by "Palouste" ground trolley or engine air bleed.

15. Non-Return Valve. Fitted between the air regulating control valve and the starter, to prevent combuster gases entering engine air duct.

16. Fuel Dipping Valve. During the starting cycle (11-12 seconds), more fuel is delivered by the fuel metering unit than is required by the engine. This excess fuel is automatically bled from the pressure to the suction side of the fuel metering unit by the fuel dipping valve. Operation of the valve is initiated by the start button and is automatically cancelled at the end of the starting cycle.

17. Time Delay Units. Contain two electronic timers, one of 2 seconds and the other 12 seconds. The two second timer operates two seconds after the start button is pressed, breaking the circuit to the combuster H.E. ignition unit, making the circuit to the start light and breaking a pair of contacts in parallel with those of the pressure switch. Thus if the combustor is not ignited and the pressure switch made, the start is cancelled and the timer resets.

18. The twelve second timer controls the maximum duration of the starting cycle and twelve seconds after pressing the starter button the timer breaks the circuit to the air bottle solenoid valve, fuel dipping valve and the start relay. The time delay unit then resets.

Servicing

19. Prior to installation and at specified servicing periods, the starter motor lubricating oil should be drained and 150 cc of new oil injected into the starter.

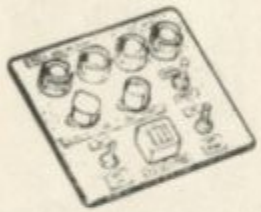
20. The life of a starter motor is based on the number of starts carried out and so each start must be recorded in the F.700.

GENERAL ARRANGEMENT

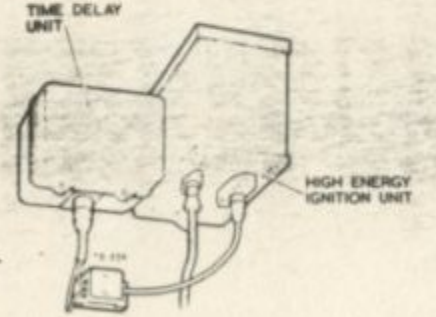
RAPID ENGINE STARTING SYSTEM

COLOUR KEY
STORAGE PRESSURE AIR
REDUCED PRESSURE AIR
FUEL SUPPLY

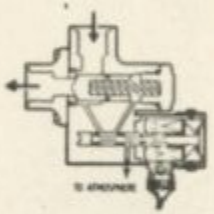
ENGINE CONTROLS



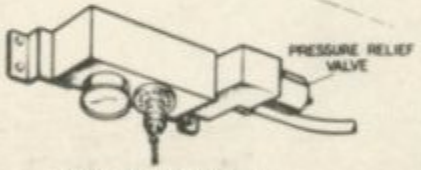
ENGINE START CONTROL PANEL
(PORT CONSOLE)



ENGINE BAY EQUIPMENT



ON/OFF VALVE 'A'



CHARGING POINT 'B'