Olympus 201 Series
Section 14
Rapid Starting System

Introduction

1. Modification 1320 provides for the rapid starting of the Olympus engines of the Vulcan B.2.

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 P.F.C.'s are automatically started and (if modified Gyros have been fitted) the M.F.S. and flight instruments are boost started, to be available by the time the engines have completed their start cycle. N.B. 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 P.F.C.'s would not be energised automatically and would have to be brought on line in the normal way.

6. Because of the increased size of the Turbine Air Starter the A.A.P.P. is no longer able to supply the air required and so this engine starting facility has been deleted. Thus the engines may be started:-

(a) Simultaneously using rapid start facility. (Giving automatic P.F.C. starting and, if fitted, rapid flight instrument availability.)

(b) Singly using:-

(i) Rapid starting facility. (Normal starting of P.F.C.'s and artificial feel.)

(ii) Normal "Palouste" method.

(c) Starting Nos. 1 or 4 engines by (b) and 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. The A.A.P.P. Bleed for Cabin Conditioning Switch.

/8. Air Storage System.

8. Air Storage System. Eight H.P. air storage cylinders are mounted in pairs above the fire proof skinning at each engine bay rear bulkhead position in the aircraft. The four 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. There is provision for a fifth bottle each side adjacent to the two above the outboard engines. The bottles are charged with dry air from an air charging trolley and when fully charged contain air at 3,300 p.s.i. 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, i.e. 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 H.P. air from the storage cylinders to pass to the reducing valve.

10. Reducing Valve. Reduces the H.P. air to 300 p.s.i. for delivery to the combustor. A safety disc, which burst at 550 p.s.i., 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 L.P. 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, (set to 105±5 p.s.i.) is fitted to the combustor to terminate the cycle if the air/fuel mixture does not ignite.

12. Combustor - H.E. Ignition Unit. Supplies high energy electrical current to the combustor igniter plug. Operation of start button with RAPID START selected automatically brings H.E. 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 reaches a predetermined speed.

/14. Air Regulating.....

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Section 14

Rapid Starting System

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 combustor 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.

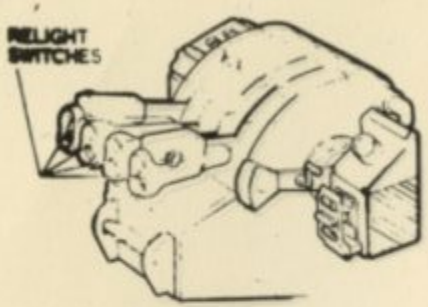
17. Time Delay Units. Contain two electronic timers, one of 2 seconds and the other 12 seconds. The two second timer operates two seconds after the start button is pressed, breaking the circuit to the combustor H.E. ignition unit, making the circuit to the start light and breaking a pair of contacts 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.

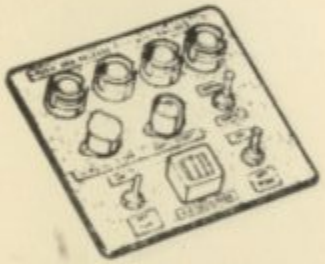
GENERAL ARRANGEM

RAPID ENGINE STARTING SYSTEM

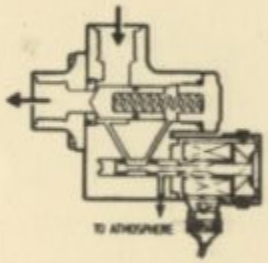
COLOUR KEY
STORAGE PRESSURE AIR
REDUCED PRESSURE AIR
FUEL SUPPLY



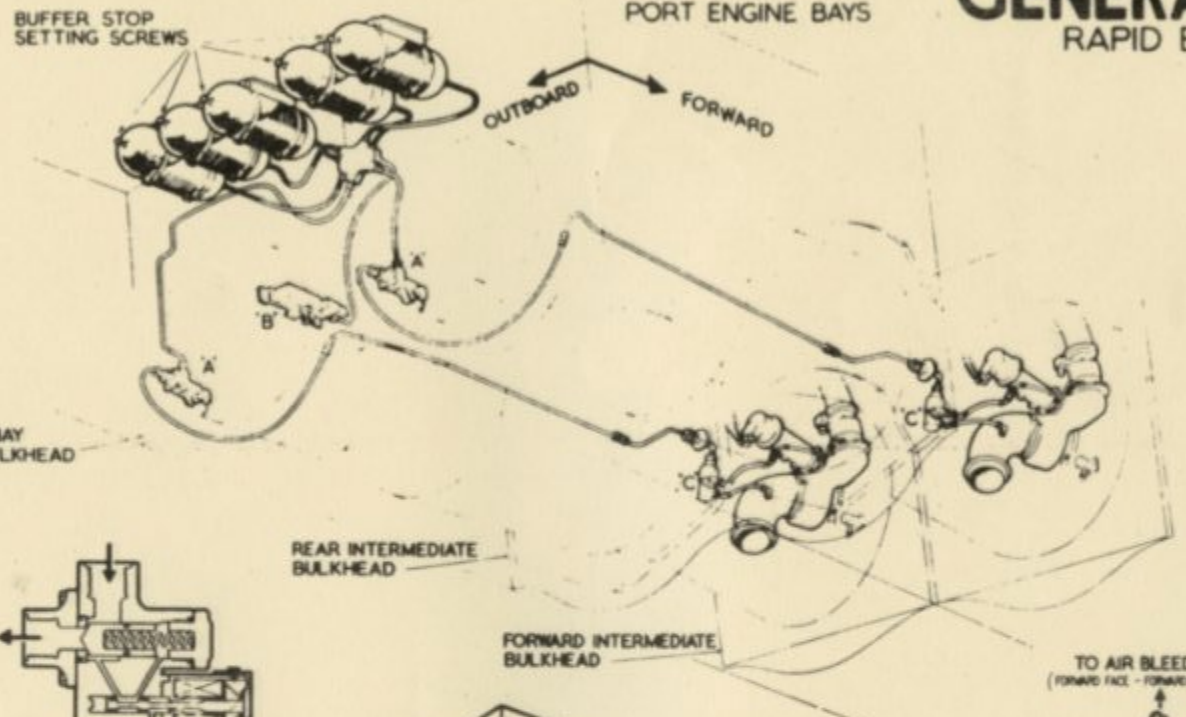
ENGINE CONTROLS

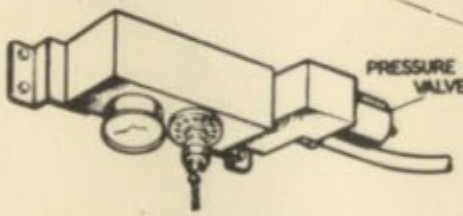


ENGINE START CONTROL PANEL
(PORT CONSOLE)



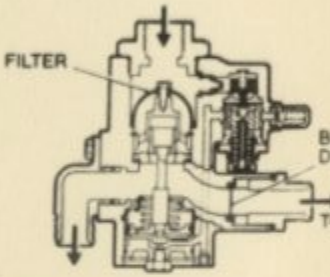
ON/OFF VALVE 'A'

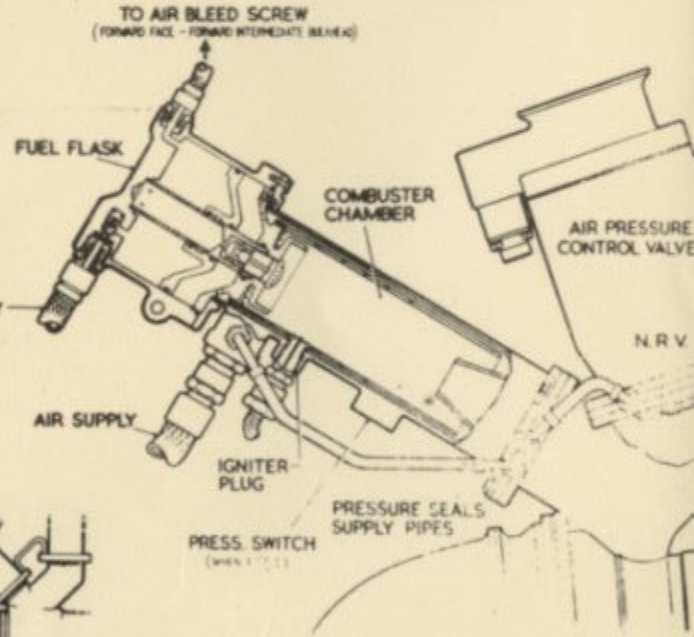


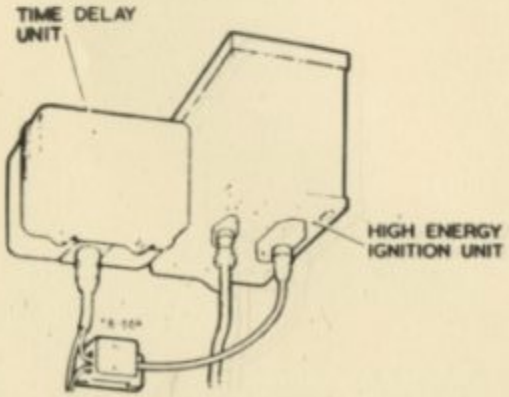


CHARGING POINT 'B'

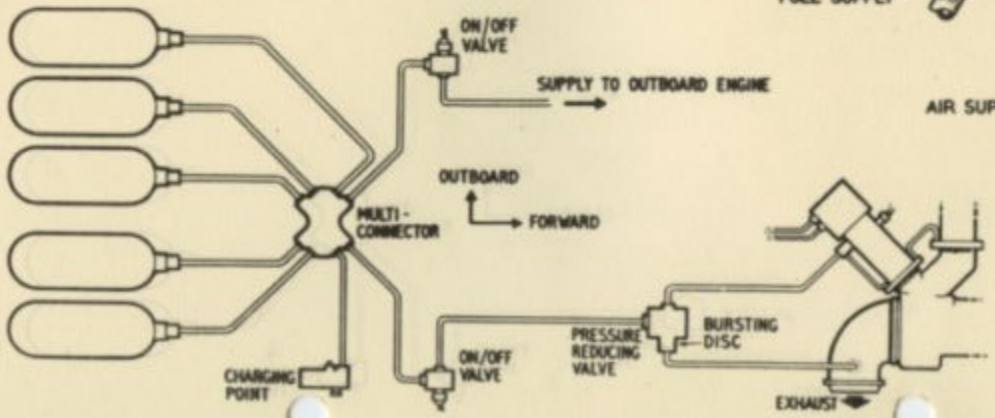
PRESSURE REDUCING VALVE 'C'







ENGINE BAY EQUIPMENT



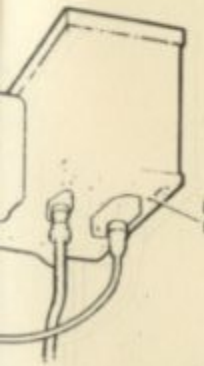
GENERAL ARRANGEMENT

RAPID ENGINE STARTING SYSTEM

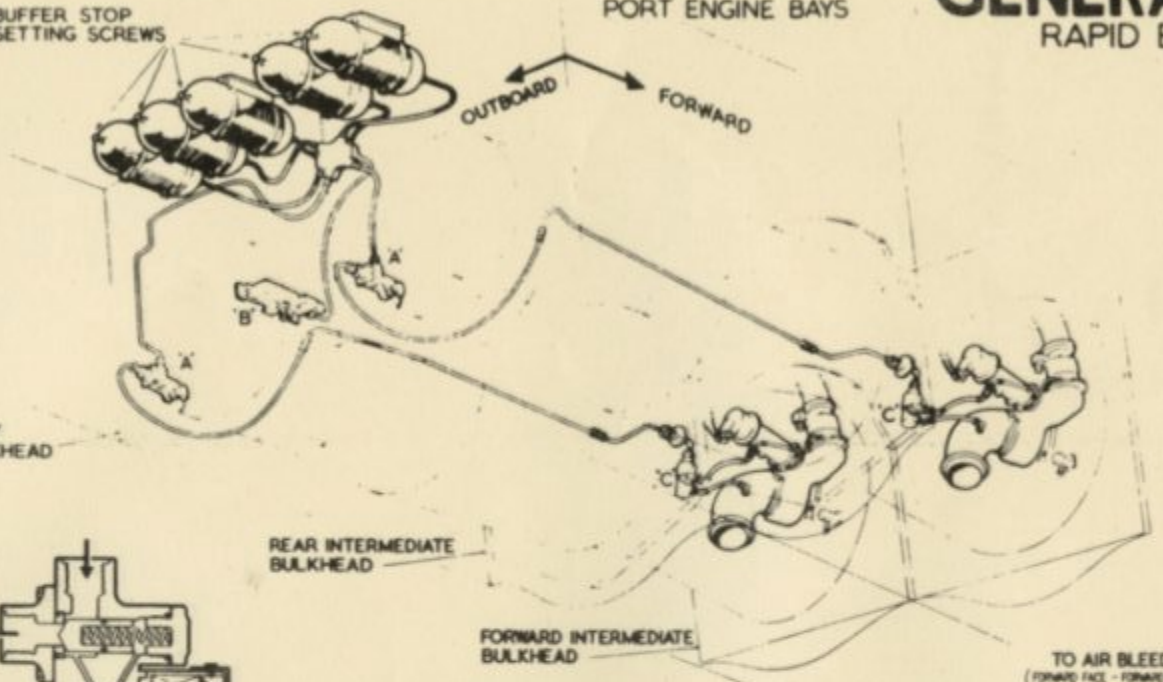
COLOUR KEY
STORAGE PRESSURE AIR
REDUCED PRESSURE AIR
FUEL SUPPLY

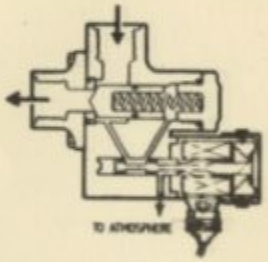
NE CONTROLS

ART CONTROL PANEL
RT CONSOLE)

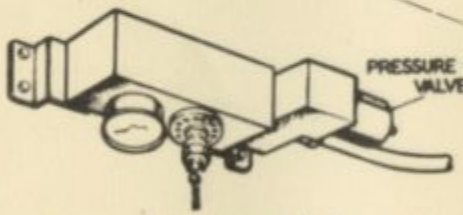


BAY EQUIPMENT





ON/OFF VALVE 'A'



CHARGING POINT 'B'

PRESSURE REDUCING VALVE 'C'