

SECTION 9
STARTING SYSTEM

9.1 DESCRIPTION

9.2 STARTER SERVICING

AERO ENGINE SCHOOL

9.1 DESCRIPTION

A junction in the delivery casing - Teddington Control valve line for aircraft hot air services, will allow ground starting rig or aircraft auxiliary power plant starting air to be felt on the inlet side of the Air Regulating Control Valve when the Teddington valve is selected open. A non-return valve at the delivery casing elbow prevents starting air flowing into the casing.

When the starter button is pressed, the solenoid of the Control Valve will be energised, allowing starting air pressure to flow through the valve to the air starter. An outlet air pressure of 35 p.s.i. is sufficient to close the valve against inlet pressure, so regulating, to 35 p.s.i. the operating pressure of the starter. When the starter is running at its limiting r.p.m. its overspeed switch will operate, de-energise the solenoid and shut off starting air to the starter.

Air Starter

The engine air starter is a single stage turbine unit

with an integral limiting R.P.M. switch and is fitted to the starboard lower side of the engine.

Inlet air, from the air regulating control valve, is admitted to the top of the starter, expands through the starter turbine and is exhausted to the rear through the bulkhead into Zone 2B of the engine installation.

The drive from the starter turbine is transmitted to the engine through gearing 5.5 : 1, and is arranged to engage or disengage automatically. The limiting R.P.M. switch operates when adequate engine R.P.M., allowing the engine to accelerate, has been reached.

The other engines may then be started separately or simultaneously by compressed air supplied from the engine which has been started and running at 70% R.P.M., and 90% R.P.M. respectively.

AERO ENGINE SCHOOL

9.2 STARTER SERVICING

The overhaul life of the starter is 500 starts.

To refill the starter with approved oil proceed

as follows:-

- (1) Remove the starter from the engine.
- (2) Remove the filter plug and allow at least five minutes for draining.
- (3) Fill the starter with 150cc of oil to specification OX30. Refit and secure the filter plug.
- (4) Refit the starter.

NOTE: Rotax Mod. S.6011 includes a number of modifications, one of which is a none return type filter and drain nipple. When this modification is incorporated, it will no longer be necessary to remove the starter for oil refilling.

AERO ENGINE SCHOOL

RAPID START SYSTEM

Introduction

The rapid start system is an adaptation of the L.P. air starting system, and is designed to give six individual engine starts - three for Nos: 1 or 2, and three for Nos: 3 or 4 engines.

The requirement is for the system to be capable of starting all four engines in 15 seconds simultaneously, and in the event of an abortive first attempt, to permit an immediate further attempt to start with the engine running at any speed up to starter cut-out speed.

The air supply for rapid starting is stored in the H.P. cylinders in the aircraft, and a mixture of this stored air and main engine fuel is burned in a combustor to provide a high energy supply to the starter.

Normal L.P. air starting can be carried out by using a ground air starting unit.

Description

The system consists of the following :-

- Air storage cylinders,
- Air ON/OFF valve,
- Pressure reducing valve,
- Non-return valve,
- Combustor combustor,
- H.E. ignition unit,
- Time delay unit,
- Air regulating valve,
- Starter

The air storage cylinders, air ON/OFF valve

Air Storage Cylinders

Eight H.P. air storage cylinders are mounted in pairs above the fireproof skinning at each engine bay rear bulkhead position. The four cylinders on the port side supply air, via a manifold unit, to the rapid starting systems for Nos: 1 and 2 engines. A

Similar

similar lay-out is located on the starboard side of the aircraft.

The cylinders, when charged, contain air at 3,300 p.s.i.

Air ON/OFF Valve

A solenoid operated air ON/OFF valve, when energised, allows H.P. air from the storage cylinders to pass to the reducing valve.

Reducing Valve

Reduces the H.P. air to 300 p.s.i. for delivery to the combustor. A safety disc which bursts 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.

Non-Return Valve

Fitted between the air regulating valve and starter, to prevent combustor gases entering the engine air duct.

Combustor

This is a simple air heater, burning a mixture of main engine fuel and stored air. The combustor has a combined fuel metering nozzle and atomizer, 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 held at 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 passes into the fuel flask ejecting the fuel under pressure through the non-drip valve and atomiser.

This fuel mixes with air passing around the atomiser and is ignited by an igniter plug. The remaining air passes between the two walls of the combustor chamber to cool them. It then mixes with the heated gases to reduce the temperature to a level acceptable to the starter.

A pressure

AERO ENGINE SCHOOL

A pressure switch is incorporated to terminate the cycle if the air/fuel mixture fails to ignite.

Combustor - H.E. Ignition Unit

Supplies high energy electric current to the combustor igniter plug. operation of the starter button with RAPID START selected automatically brings H.E. Ignition into operation. The ignition system operates for a period of two seconds, the two second relay in the Time Delay unit breaks the circuit.

Time Delay Unit

The unit has an electric timing mechanism controlling two relays.

One relay operates 2 seconds after the starter button is pressed and breaks the circuits to the starter overspeed switch and combustor H.E. ignition, and makes the circuit to the start button lamp. The other relay controls the maximum duration of the starting cycle, and twelve seconds after pressing the start button

it cancels the supply to the air ON/OFF valve solenoid, the fuel dipping valve solenoid, and the starter relay. The time delay unit automatically resets.

Air Regulating Valve

Controls normal L.P. air starting by "Palouste" ground starting unit or engine air bleed.

Starter

The starter is 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 pre-determined speed.

Fuel Dipping Valve

This unit is incorporated in the main engine

fuel system

fuel system to limit the amount of fuel metered to the engine during a rapid start. The valve is solenoid operated, and is initiated by the start button. Cancelling is automatic at the end of the starting cycle.

Operation

The system allows the engines to be started separately or simultaneously.

When the appropriate engine start button is pressed, the starter relay, ignition relay, and time delay unit are energised. This action also energises the air ON/OFF valve solenoid, the fuel dipping valve solenoid, the combustor and engine igniters.

Compressed air from the air storage system passes through the air ON/OFF valve and the reducing valve to the combustor. Fuel is fed via the fuel flask to the combustor atomiser where it mixes with some of the air. The resultant gas stream is ignited and ejected

together with the remaining air, into the starter turbine. When the combustor ignites, the combustor pressure switch operates, provides a hold-in circuit for the starter relay and, through the time delay unit, illuminates the start button lamp.

When the engine reaches a self-sustaining speed the starter overspeed switch operates and breaks the circuit to the starter relay, this cancels the supply to the time delay unit, allowing it to re-set. The starter button lamp is extinguished, the air ON/OFF valve and fuel dipping valve solenoids, and the combustor igniters are all de-energised.

If the combustor fails to ignite then the combustor pressure switch does not operate, preventing the hold-in electrical circuit from operating. This action, after approximately two seconds, breaks the electrical supplies to the time delay unit, the air

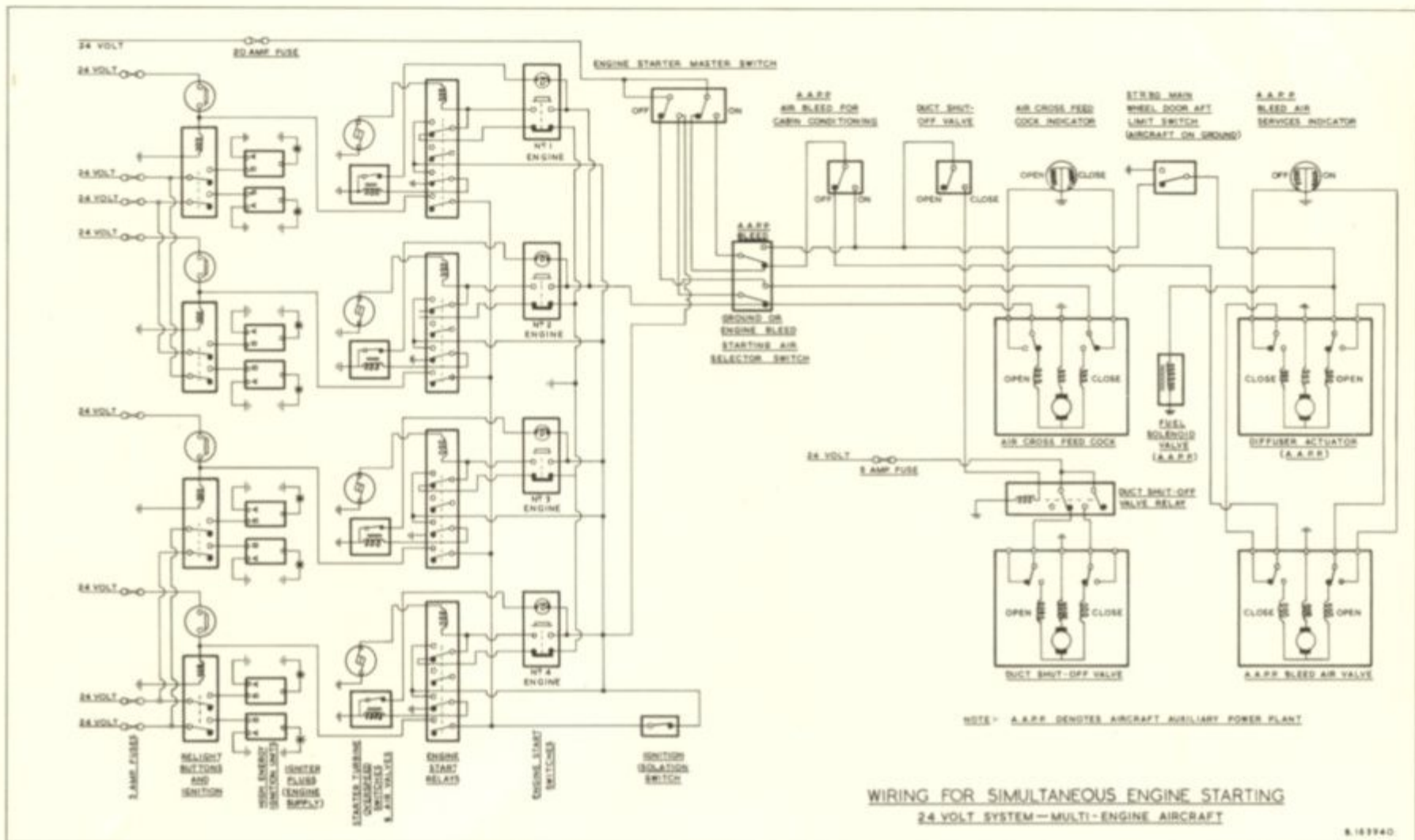
ON/OFF valve

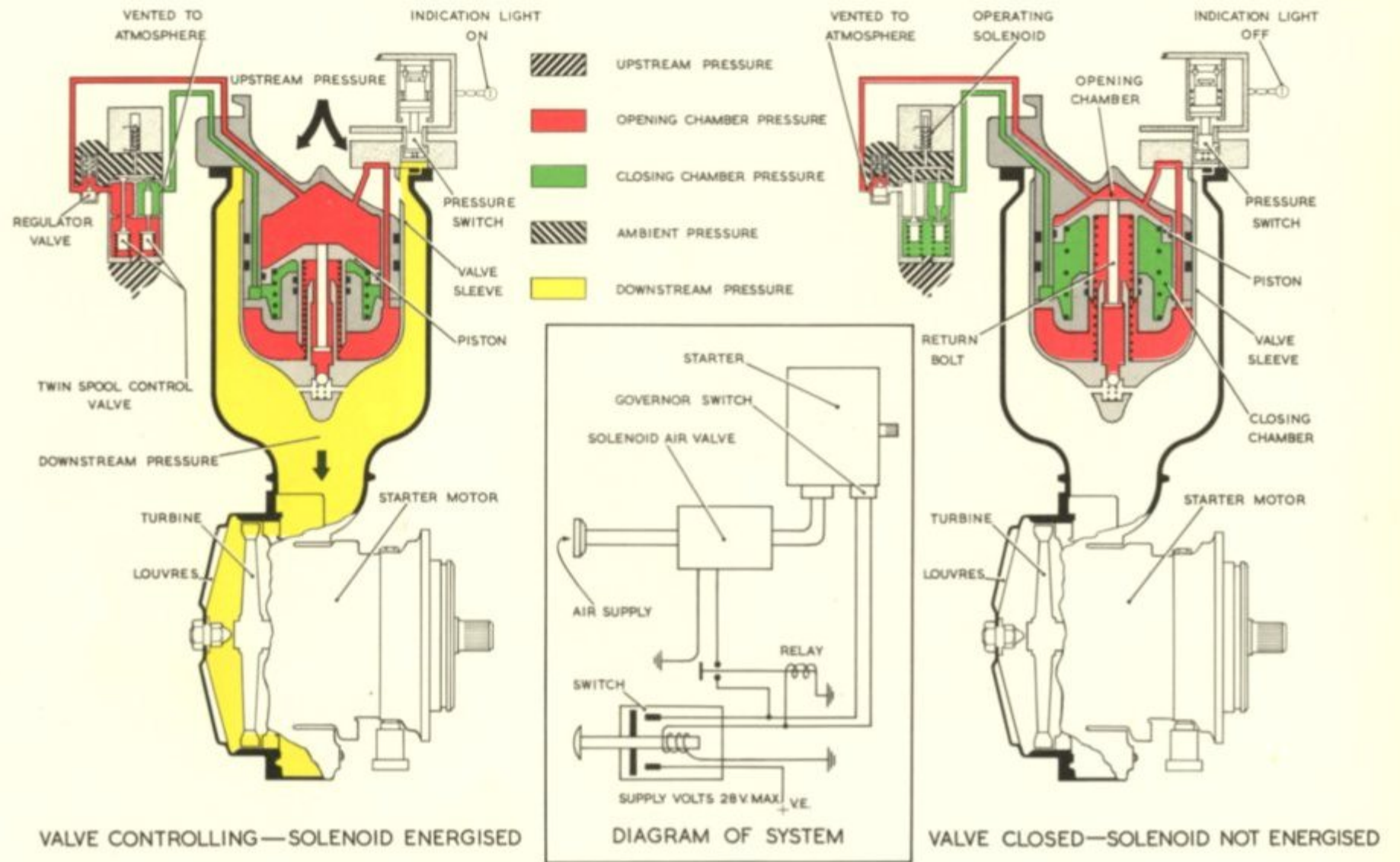
AERO ENGINE SCHOOL

ON/OFF valve and the fuel dipping valve solenoids. The time delay unit automatically re-sets.

If the combustor ignites but the engine does not start, then the time switch will allow the starting sequence to run for the full time (11 - 12 Secs:), when it will break the electrical supplies and cancel the starting cycle. The time delay unit will automatically re-set.

To start all engines simultaneously by the rapid start system, the mass-rapid start button should be pressed instead of the individual starter button. This operates all time delay units, starter relays, air ON/OFF valve fuel dipping valve solenoids.

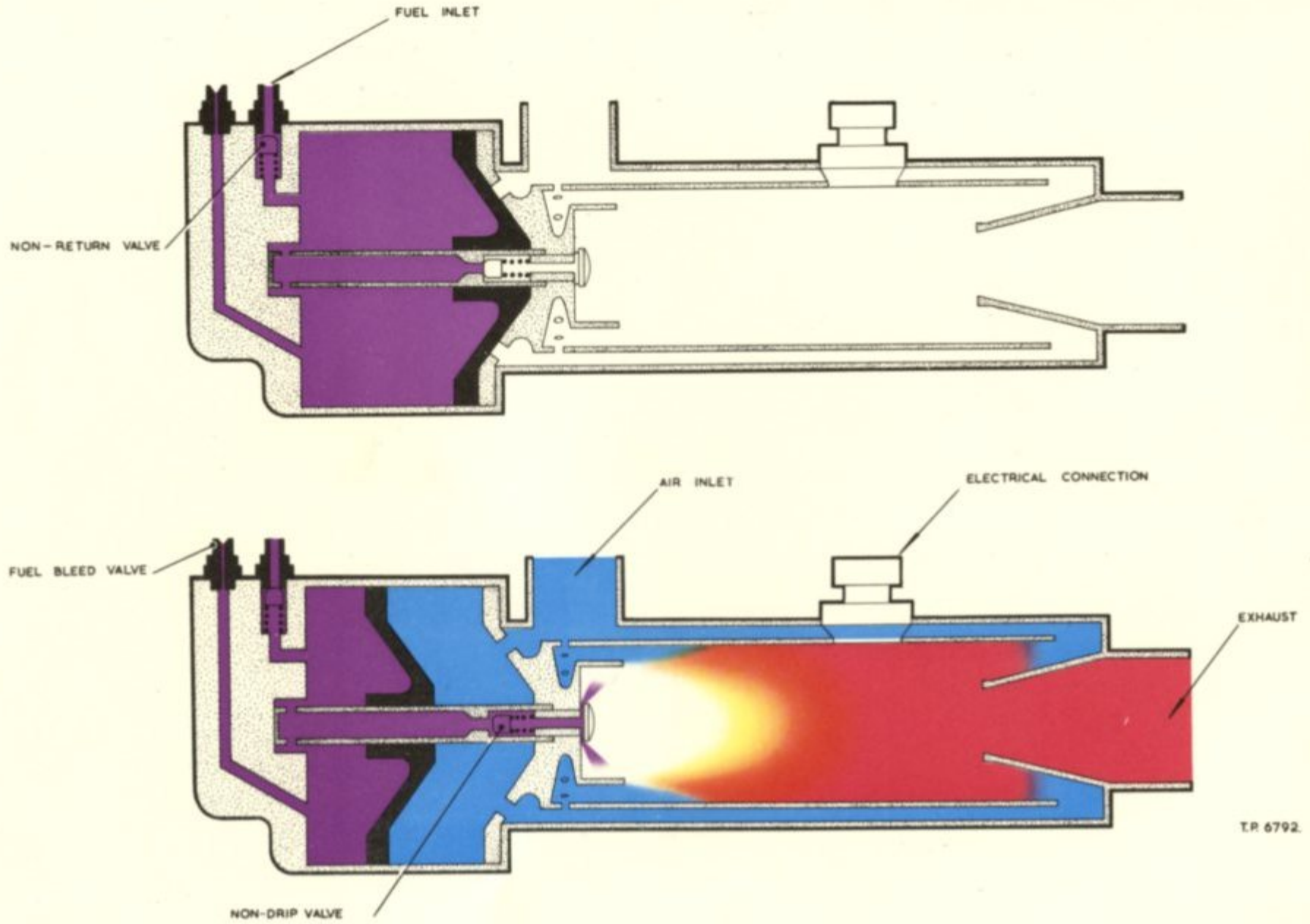




ROTAX AIR PRESSURE CONTROL VALVE DIAGRAM

TP5839.

RESTRICTED



T.P. 6792.

OPERATIONAL DIAGRAM OF COMBUSTOR.

This file was downloaded
from the RTFM Library.

Link: www.scottbouch.com/rtfm

Please see site for usage terms,
and more aircraft documents.



TELEBRIEF
CONNECTIONS

E