Olympus 22/301 Series

Section 19

AIRCRAFT FUEL SYSTEM

REFERENCES:- AP 4505B Volume 1, AP 4343 Series.

Introduction

1. Fuel is carried in fourteen tanks, five in each wing and four in the fuselage above and aft of the nose wheel bay.

2. On either side of the centre line of the aircraft the tanks are divided into two groups; the No. 1, 4, 5 and 7 tanks provide fuel for the outboard engines and the No. 2, 3 and 6 tanks the inboard engines. Normally the four engines tank groups function independently; electrically operated cross-feed cocks are however provided, by the use of which all engines can be supplied from any selected group. They consist of an engine cross-feedcock between each inboard and outboard engines, and an aircraft cross-feed cock between the port and starboard sides of the aircraft.

Fuel Tanks

3. Light-alloy fuel tank compartments are built into the mainplane and nose fuselage as an integral part of the structure. Bag type fuel tanks, constructed of flexible rubber and fabric sheeting line the compartments. They are secured in position with metal colleted studs, secured to the tank with vulcanised rings, and pressed into holes in the compartment skin plating. The bottom surface of each tank is reinforced to carry a magnesium alloy sump plate which forms a reservoir, housing the fuel pump and refuelling valve. On the strengthened upper surface is a vent valve and emergency level switch. A drain valve mounted together with an inhibitor cartridgeon the sump plate, is used to drain water from the fuel tanks. The cartridge, containing a chromate compound, protects the magnesium sump from corrosion.

4. To prevent excessive quantities of fuel from passing into the vebt pipe lines of the pressurisation system, due to changes in aircraft attitude and consequent fuel swirl, spring loaded inward/outward vent and combined float valves are fitted. The float valves are fitted at the inboard end of each wing tank; they are cylindrical in shape and house an inward relief valve, set at $\frac{1}{4}$ psi and an outward relief valve, set at $\frac{3}{4}$ to 1 psi. A series of holes around the cylindrical body, through which nitrogen or air pressure normally enters the tanks, is sleeved with a cork float. When the fuel level rises above the float valve, due to change in aircraft attitude, the sleeve, being buoyant, floats up the cylindrical body to cover the holes and thus prevents fuel from entering the pressure lines. Should the cork float stick and cause the holes in the valve housing to remain covered, the inward vent valve will be opened by the pressurisation supply of air or nitrogen. Conversely, should the pressure differential in the tanks exceed $\frac{3}{4}$ to 1 psi, the outward relief valve will open to release excess pressur back into the pressurisation lines.

Tank Servicing Cocks

5. Manually operated cocks are interposed in the delivery pipe lines from the tanks to allow for draining during servicing. The cock operating levers are so designed that the cover plates annot be fitted into place unless the cocks are in the open position.

Tank Reservoirs

6. The wing tank main fuel pumps are each housed in a rectangular light alloy reservoir situated within each wing tank. Flap valves, acting as non-return valves, are mounted in each reservoir and are normally in the open position. When the aircraft dives, the flap valves are closed by the head of fuel in the reservoir this Head being maintained by an auxiliary pump.

AAPU Fuel Supply

7. The AAPU fuel tank capacity 10 galls is connected into the aircraft fuel system by a single pipe which branches at a two way union, one connecting into the refuelling pipe, the other into the main fuel feed pipe. This will then ensure that the tank is kept constantly full during flight and will be refuelled during normal refuelling operation.

Fuel Pumps

8. An electrically operated immersed fuel pump is mounted in each tank. The fuselage No. 1 tanks and the mainplane No. 7 tanks have an additional pump for the transfer of fuel. Each wing tank is fitted with an auxiliary pump, which ensures that the main pump is not starved of fuel during nose down conditions; they are running at all times when the main tank fuel pumps are switched on.

Recuperators

9. "ecuperators are fitted in the delivery line to each engine to maintain a supply of fuel to the engines when the aircraft is being flown under negative "G" conditions. A recuperator consists of a double-walled metal cylindrical tank of approximately 6 gallons capacity. It is divided internally into an upper and lower compartment by a synthetic rubber bag.

10. To main connections are provided on the recuperators. The upper end is connected through a diaphragm operated fuel control valve into the fuel delivery line. Air is fed to the lower end from the engine compressor through a non-return valve and a pressure compensating relief valve, relieving at pressures between 6 and 10 psi. Servo air is also taken from this line, between the double walls of the recuperator to the diaphram of the fuel control valve.

11. A secondary connection consists of a bleed line from the fuel control valve through a non-return valve to the No. 4 tanks. This releases the air in the upper compartment when the recuperator is initiallly filled. There is also a bleed line to atmosphere from the fuel control valve to prevent fluid hydraulic locking.

Recuperator Operation

12. When the engines are started, air passes to the lower side of the rubber bag and between the double walls of the recuperator to the diaphram of the fuel control valve, which is normally spring loaded to the closed position. This causes the valve to open and allow fuel into the upper compartment, any air in the recuperator being bled to No. 4 tank.

13. Passing of servo air through the double walls of the recuperator is a safety precaution; should the walls be punctured by enemy action or other causes, the air supply to the diaphram of the fuel control valve exhausts through the puncture to atmosphere. This releases the pressure on the fuel control valve diaphram and the valve closes under the influence of its spring loading, so preventing loss of fuel.

14. Under normal conditions, the air pressure is about half the fuel delivery pressure, and consequently the rubber bag remains in the lower half. When the fuel pressure drops due to negative "g" conditions, the air pressure raises the bag and forces fuel through the fuel control valve into the delivery line. Sufficient fuel is available for approximately 10 seconds of negative "g" flying.

15. Low Pressure Cocks

Similar in coperation to tank servo cocks but electrically operated from cockpit.

16. The cross feed cocks are similar to the low pressure cocks but are controlled by switches on the fuel control panel. Magnetic indicators, adjacent to the switches indicate the position of the cock.

Fuel Pressure Warning Indicators

17. Magnetic indicators are situated on the pilots centre instrument panel just below the jet pipe temperature indicators. They indicate when the fuel pressure falls below 5 spi when de-energised they indicate "White" and when energised indication "Black".

Fuel Contents Gauges

18. A fuel contents gauge panel, containing four fuel gauges, on for each engine tank group, is mounted at the bottom centre of the pilot's instrument panel. Each gauge is calibrated with two scales, arranged concentrically on the dial. Normally the gauge records, on the inner scale, the total fuel contents of one engine tank group. When however a tank contents push button is pressed, the gauge records on the outer scale the individual fuel tank contents. Both scales are calibrated in thousands of pounds.

Note:- Under no circumstances should two tank contents push buttons in any one tank group be operated simultaneously as the instrument would then be damaged by the excess current. Also buttons must <u>not</u> be pressed during refuelling operations as the effect is the same as operating two buttons.

19. Four group conents fuel gauges are also fitted on the navigators panel. these cannot read individual contents.

High Pressure Cocks

20. The high pressure cocks, one to each engine, are an integral part of the engine. They are entirely mechanical in operation and are opened and closed by the initial movement of the throttle levers.

Sequence Timers

21. Due to the configuration of the aircraft, the fuel tanks are dispersed forward and aft of the aircraft centre of gravity. It is therefore important that fuel balance is maintained throughout flight. This is achieved by the incorporation of an electrically operated sequence timer by the use of which a small quantity of fuel is pumped from each tank in turn. The quantity of fuel pumped from each tank during one cycle of the sequence timer is proportional to the tank capacity. Thus the fuel centre of gravity is kept reasonably constant.

22. The maximum quantity of fuel that can be drawn from the tanks furthest from the C.G. position without exceeding C.G. travel limits approximately 50 gallons. If small amounts of about 15-20 gallons are drawn from each tank in turn, the C.G. position is kept within the limits. The C.G. travel is further reduced by feeding from a forward tank in one group and a rear tank in the other group on the same side of the aircraft, i.e.

Period No.	Outboard Engine	Inboard Engine
1	Tank No. 1	Tank No. 6
2	Tank No. 7	Tank No. 2
3	Tank No. 4	Tank No. 3
4	Tank No. 5	Tank No. 2

Note:- No. 2 tank is larger than the others and two periods of feeding are used.

23. To keep the tanks at the same percentage of total capacity each pump feeds for a time proportional to the total tank capacity.

Tank No.	Seconds	Tank No.	Seconds
1	77.5	6	91.5
7	67.5	2	57.5
4	77.5	3	77.5
5	63.5	2	59.5

24. Control of the feeding periods is maintained by the two sequence timers. Each controls the seven pumps of the two tank groups on one side of the aircraft. The sequence timer consists of a three phase AC motor driving a camshaft through a reduction gear 56.316 : 1. The camshaft has seven cams and rotates at 0.2 rpm. This action reduces the speed of the pumps to approximately half, therefore the pumps running at full speed will be delivering, in the sequence already quoted in para 21.

Sequence Timer Control

25. Four switches on the fuel control panel, labelled AUTO/MANUAL control the circuit from the sequence timer cam assembly to the change speed relays.

Fuel Tank Capacities

26. The capacities quoted allow for approximately three per cent space in the tanks. Some difference may be experienced between individual aircraft due to slight variations in the setting of tank cut-off switches.

Fuel Transfer Pumps

27. Tanks No,s 1 and 7 have a transfer pump fitted into their sumps. This enables fuel to be transferred from the forward to the aft tank or vice versa to control the C.G. movement. Since these two tanks feed into the same engine group no cross-feeding need be resorted to. Control of these pumps is by the C.G. transfer switch on the fuel control panel.

Rate of Flow Indicators

28. Situated on the 2nd pilots instrument panel is a rate of flow fuel indicator which records the rate of fuel flow in lbs/hour through the selected engine. Four push button switches mounted on the fuel control panel, one for each engine control the electrical supply to the indicator.

Refuelling System

29. Pressure refuelling of the aircraft is carried out through two refuelling points in each main wheel bay which lead to a refuelling valve in each tank. These valves are each rated at 50 gallons per minute. Even distribution of the fuel load is accomplished by utilising the electrical output from the contents gauge transmitter units. Selection from 0 per cent to 100 per cent of the total tank capacity is possible.

Refuelling

30. WARNING. Do not press individual contents gauge buttons on centre console whilst refuelling is in progress or damage will ensure due to the fact that a reading is already indicated from the tank being refuelled. Also the automatic sequence of the refuelling will be disturbed.

This file was downloaded
from the RTFM Library.

Link: www.scottbouch.com/rtfm

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