BRISTOL SIDDELEY

AERO ENGINE SCHOOL

SECTION 7

CONSTANT SPEED DRIVE UNIT

7.1 DESCRIPTION

7.2 CONSTANT SPEED DRIVE UNIT OIL TANK

7.3 FILLING CONSTANT SPEED DRIVE OIL TANK

7.1. DESCRIPTION.

This device is designed to maintain a constant speed drive to the alternator, to give an output speed of 6,000 R.P.M., at input speeds varying between 3,000 and 8100 R.P.M.

Transmission Unit and Cylinder Block

The transmission unit is driven at .97 of H.P. compressor R.P.M., and comprises two axial cylinder type pumps each with its own angled camplate, one of these pumps which is referred to as the motor, has a fixed camplate, whilst the other has a variable camplate which is connected to a servo mechanism, the movement of which is controlled by a governor.

A ported plate is interposed between the pumps at their inner ends, and an eccentrically located valve plate is positioned at the inlet to each pump, these are sealed between their outside diameters and the cylinder block, and between their faces and the port plate; and operate to connect the pump with the motor on its inlet side (via the port plate) and to connect the motor outlet back to the manifold, through which oil is supplied to the unit.

The gear on the cylinder block which is driven from the engine, is connected to the output gear through the cylinders of the motor. A clutch in the output side of the transmission prevents a reversal of the drive to the unit.

Oil Tank (Capacity = 1½ gallons)

The tank which is of adequate capacity to supply the needs of the system, is equipped with inlet and outlet lines, and a baffle is provided for de-aeration of the return oil, before it is re-circulated.

Pumps

Oil is taken from the tank and delivered to the cylinder block and governors, via the two gear type charge pumps, which are set in parallel; a third pump conveys the return oil from the governors via the relief valve back to the tank.

The two charge pumps...

The two charge pumps are driven separately, one from the drive input, and the other from the output end of the unit, to ensure that when the system is functioning, there is always an adequate oil supply.

The scavenge pump is driven from the output end of the unit.

Valves.

There are three valves in the system, one of these - the charge relief valve - is a spring loaded piston valve which controls the pressure from the charge pumps, and the oil passing this valve is conveyed via a further spring loaded valve to the scavenge pump inlet, this second valve is included to control a low pressure oil supply which is taken via jets to lubricate the races in the transmission unit.

The trip valve is also a spring loaded piston type valve, which is provided to ensure that oil is positively delivered from the basic governor, to the "overdrive" side of the control cylinder on starting, and to open up a drain from the cylinder in the event of an overspeed.

Pressure Switch

The pressure switch is closed when the unit is running normally, but opens under the influence of the overspeed governor, to connect the alternator with the main aircraft electrical system.

Governors

Two governors are provided, one to protect against an overspeed, and the other to maintain a constant speed condition, the latter is connected through a rack and pinion to a pressure frequency control motor.

The governor in each case comprises a valve to which fly weights are connected in such a manner, that centrifugal force acting upon them causes axial movement of the valve in its ported sleeve.

This governor force acts in opposition to that

of a coil ....

of a coil spring, and when operating these forces position the valve, to regulate or stop the flow of oil as required.

Normal Governing

The basic governor receives an oil supply from the charge pumps, which is directed through one of two ports by the valve, if the valve moves towards the governor chamber it will direct oil to the "Underdrive" control cylinder, and at the same time opening a drain (via the valve bore) from the "Overdrive" cylinder. If it moves in the other direction it will connect charge pressure to the "Overdrive" cylinder, and open a drain from the "Underdrive" and by so doing will control the angle of the pump camplate and therefore the output speed.

Overspeed Governing

This governor operates to pre vent an overspeed, which may be caused by malfunctioning of the system, and is set to limit max: output R.P.M. at 7,000, which it does by throwing the transmission unit into an "Underdrive" position if an overspeed occurs.

If the valve moves towards the governor chamber, the first effect is that pump pressure is delivered to the end area of the valve, and since the outlet from this region is restricted, the pressure builds up rapidly, to force the valve to move right againsst its spring. With the valve set in this position it brings about the following sequence of events:-

1. It closes off pump oil from the pressure switch and the end of the trip valve, by closing a diagonal drilling in the valve stem, it also connects these regions to drain via a further diagonal drilling.

1a. It drains oil from the pressure switch, so that the switch breaks the circuit from the alternator to the aircraft electrical system.

1b. It drains pressure from the end of the trip valve, so that the coil spring closes the valve, so shutting off the supply to the "Overdrive" cylinder

and simultaneously....

and simultaneously opens it to drain.

Principle of Drive Operation

Overdrive

This condition is one where the input speed is less than the required output speed (6,000 R.P.M.) and the unit is required to step up the speed, this is done in the following manner. As the pump plungers reciprocate they force oil into the motor, and the hydraulic force so created causes the plungers in the motor when moving from minimum to maximum stroke, to give a push to the camplate, which advances it beyond the speed at which the unit is already rotating, the amount of oil transferred from pump to motor will vary with the angle of the pump camplate, and the greater the amount of transfer the greater the amount of added speed.

Underdrive

In this condition the output speed is required to be less than the input, and due to the governor action the camplate will have swung to the opposite position to that previously described, and the pump will have a negative displacement, so that oil is now pumped from the motor to the pump. The work required to do this causes a drag on the motor camplate so that it becomes retarded in relation to the input drive.

At 6,000 input R.P.M. the camplate will be set in a neutral position, and there will be no transfer of oil in either direction and the input and output R.P.M. will be the same.

7.2 CONSTANT SPEED DRIVE OIL TANK

The oil tank is a welded unit fabricated from stainless steel sheet. At the top rearward end of the oil tank an oil level sight glass is positioned and retained in position by a housing, "O" seals and bolts. Welded to the inside of the oil tank is a baffle tray which is used to de-aerate the oil when it is returned to the tank for recirculation.

At the top of the tank an air pressurizing valve and two interconnected filters are fitted The lower filter contains a ball which seals the air inlet under conditions of negative gravity and prevents the passage of oil into the filters and air system. When the engine is started, pressure air from the intermediate casing is piped to the air inlet banjo connection on the lower filter. This air passes through the filter and ball valve to pressurise the tank. When the pressure reaches four to six lb/in^2 the double valve in the upper filter unit opens and bleeds air to atmosphere via its filter element thus maintaining the desired pressure in the oil system. If a pressure in excess of four to six lb/in^2 builds up in the vent system of the tank or constant speed drive the air/oil fumes pass through the filters via the ball valve and the cleared air is vented to atmosphere via the upper filter and its pressurizing valve.

A housing secured to the base of the tank contains an anti-gravity valve. the oil supply channel to the constant speed drive unit and houses the lower end of the oil tank vent pipe. Two large ports in the upper flange of the housing communicate with the annulus beneath the lower valve seating.

When the oil tank is filled oil is pumped through the Avery coupling at the base of the combined drive unit and through the filter to the tank inlet pipe. The oil is de-aerated as it passes over the de-

aerating baffle ......

aerating baffle at the top of the tank and then flows to the base of the tank where some of the oil passes through the ports of the anti-gravity valve housing. This oil fills the drain valve passage beneath the anti-gravity valve then rises through the open lower valve and flows through the oil supply channel to the constant speed drive unit.

If negative-Gee is applied to the oil system, e.g. inverted flight the oil flows to the top of the tank and the anti-gravity valve will simultaneously move in its housing to close the lower valve and open the upper valve. Oil then flows through the upper valve and through the channel in the housing to the constant speed drive unit.

An oil cooler is fitted in the oil scavenge return line from the constant speed drive unit to the oil tank.

7.3 FILLING THE CONSTANT SPEED DRIVE OIL TANK

The oil levels desired are with the oil at approx. ambient temperature. For hot oil the expansion will be about 1/4 pint of every 20°C rise in temperature. (.200" at sight glass).

The acceptable tolerance on the normal oil level at ambient temperature is ± .200" at the sight glass (1/4 pint).

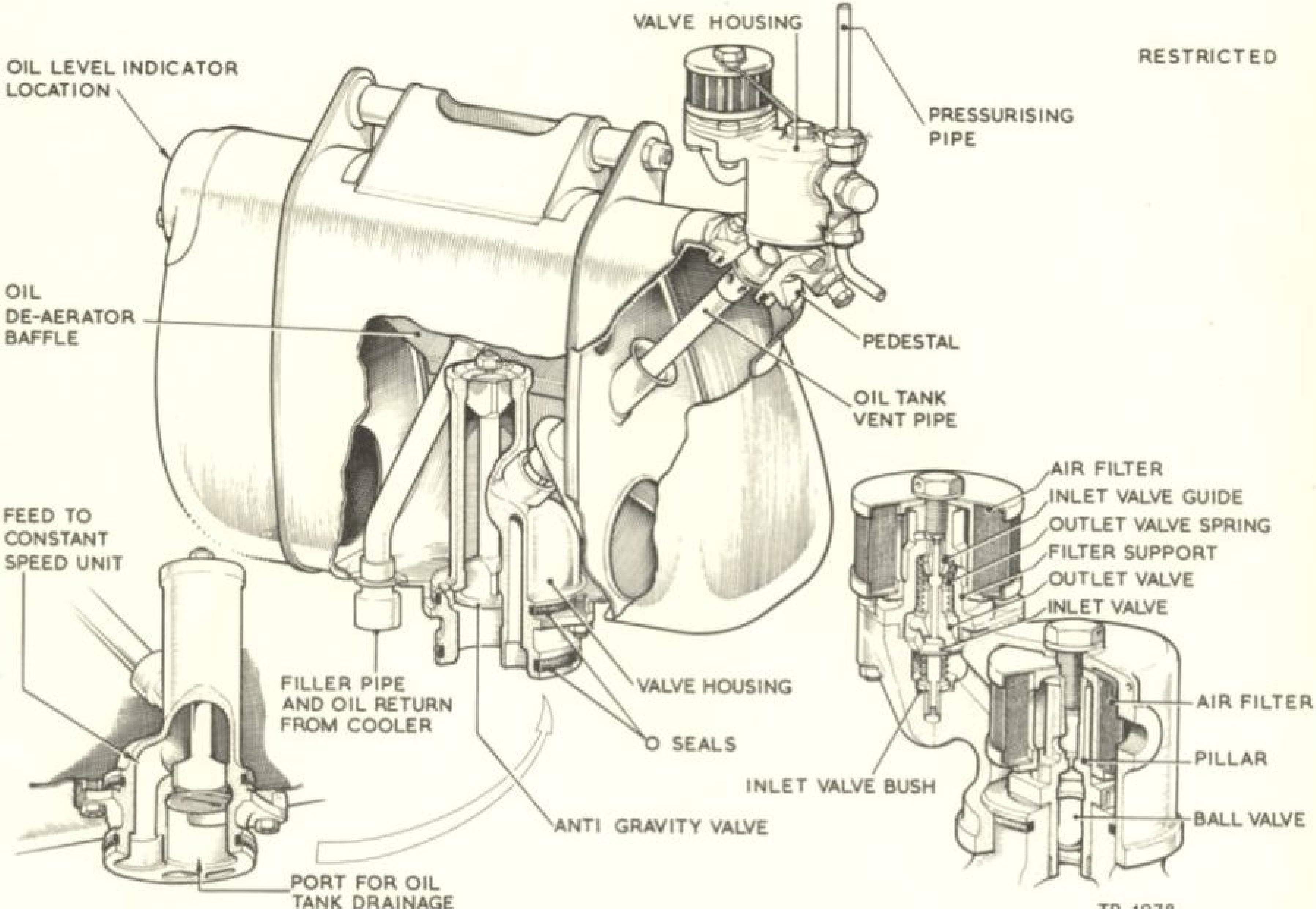
Normal Topping Up

Carry out a motoring cycle.

Adjust oil level to centre of sight glass.

Motor and re-adjust until the oil level is maintained, within ± .200" of the centre of the sight glass.

When filling an empty system or when it is known that a large quantity of oil has been lost from the system the tank should be filled to sight glass level before carrying out the first motoring cycle.



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CONSTANT SPEED UNIT OIL TANK


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