AVON.

GENERAL CONSTRUCTION AND IDENTIFICATION OF COMPONENTS.

Commencing from the front of the engine the units are:-

Intake Casing and Front Bearing Housing.

A magnesium alloy intake casing carries the compressor front bearing in a central hub supported by six webs. These are radially offset to allow flexibility during temperature changes and are designed to carry oil to the bearing, electric cables for the starter and air for anti-icing. The intake casing is surrounded by an anti-icing air manifold.

Rearward of the intake webs are 37 swirl vanes whose angle can be varied progressively from 0° to 40° by the action of a hydraulic ram which is linked to a central control ring via two master blades.

The blades are fabricated in sheet steel with hollow construction to pass the anti-icing air flow.

Compressor.

It is a 12 stage axial flow compressor. The rotor consists of 12 discs, each carying a set of blades, splined to a steel shaft formed in two parts. The discs are separated by spacers, the whole assembly being clamped endwise against the shaft flange by the main retaining nut at the front end. The 12th stage disc is in two halves bolted together and the centre bolts also form the junction of the compressor shaft flanges.

Each blade is attached to its disc by a steel pin. The total number of blades is 1018. The blades and discs of the first 8 stages are in aluminium alloy. The final stages have blades in aluminium bronze, with steel spacers and discs to withstand the higher air temperature. The spacers between stages 3 and 4, and 11 and 12, form vortex reducers for air tapped off for cooling and sealing.

Compressor Casing.

The aluminium alloy case is in two parts carrying a total of 1195 blades in annular grooves. The blades form the stators for the first 11 stages, the 12th stage stators being mounted in the compressor outlet casing. The stator blade material is aluminium alloy for stages 1 to 7 and aluminium bronze for stages 8 to 11. The blades in stages 1, 2, 3 & 4 are in packs to prevent flutter, while those in stages 10 and 11 are similarly dealt with to prevent fretting on their location points.

Outlet Casing.

This aluminium alloy casing forms eight air delivery elbows and houses 80 precision cast 12th stage outlet guide vanes in the forward side. The compressor shaft passes through the hub of the outlet casing and locates in the centre ball thrust bearing carried in an aluminium alloy housing attached to the outlet casing hub. A drive gear for the internal wheelcase is splined onto the shaft behind the thrust bearing, and also serves for engagement of the turbine shaft coupling. This is accessible for disconnecting by removing cover plates in the intermediate casing which is secured to the rear face of the outlet casing.

/continued.

Centre Coupling.

Consists of three main parts (a) a gear on the compressor shaft secured by a nut and lock washer, (b) a sleeve carrying a knurled lockring and internally splined to the turbine shaft and (d) a male and female ball coupling.

Combustion Chambers.

Eight of these assemblies are secured to the compressor outlet elbows by bolts, the joint being sealed by an anodised light alloy spherical ring. The rear of the assembly slides into the nozzle box and is sealed by a piston ring. The combustion chambers are numbered from the top anti-clockwise when viewed from the rear of the engine. Igniters are carried in Nos. 3 and 6 chambers. The main components of each combustion chamber are (a) an aluminium alloy expansion chamber, (b) an aluminised mild steel air casing, (c) a Nimonic flame tube. The expansion chambers form a fireproof bulkhead.

Nozzle Box.

The main units are (a) Spun cast outer casing in H.R. Crown Max. (b) 8 fabricated nozzles in Nimonic alloy (c) 76 H.P. nozzle guide vanes in H.R.C.M. (d) 67 L.P. nozzle guide vanes in H.R.C.M. (e) A cast iron spider on which are mounted the engine trunnions.

H.P. Turbine and L.P. Turbine.

These are mounted on a common shaft. The ferritic turbine discs carry sets of shrouded blades in fir-tree roots, retained endwise by locking tabs. The blades have extended roots to form Nimonic rims to the ferritic discs.

There are 103 Nimonic 90 blades in the H.P. disc and 71 Nimonic 80A blades in the L.P. disc.

To prevent flutter the blades are welded at their tips in pairs and an odd three.

Exhaust Unit.

Bolted to the nozzle box and consisting of an outer skin forming a heat shield and an inner unit known as the "bullet" with its supporting struts and insulator plate.

External Wheelcase.

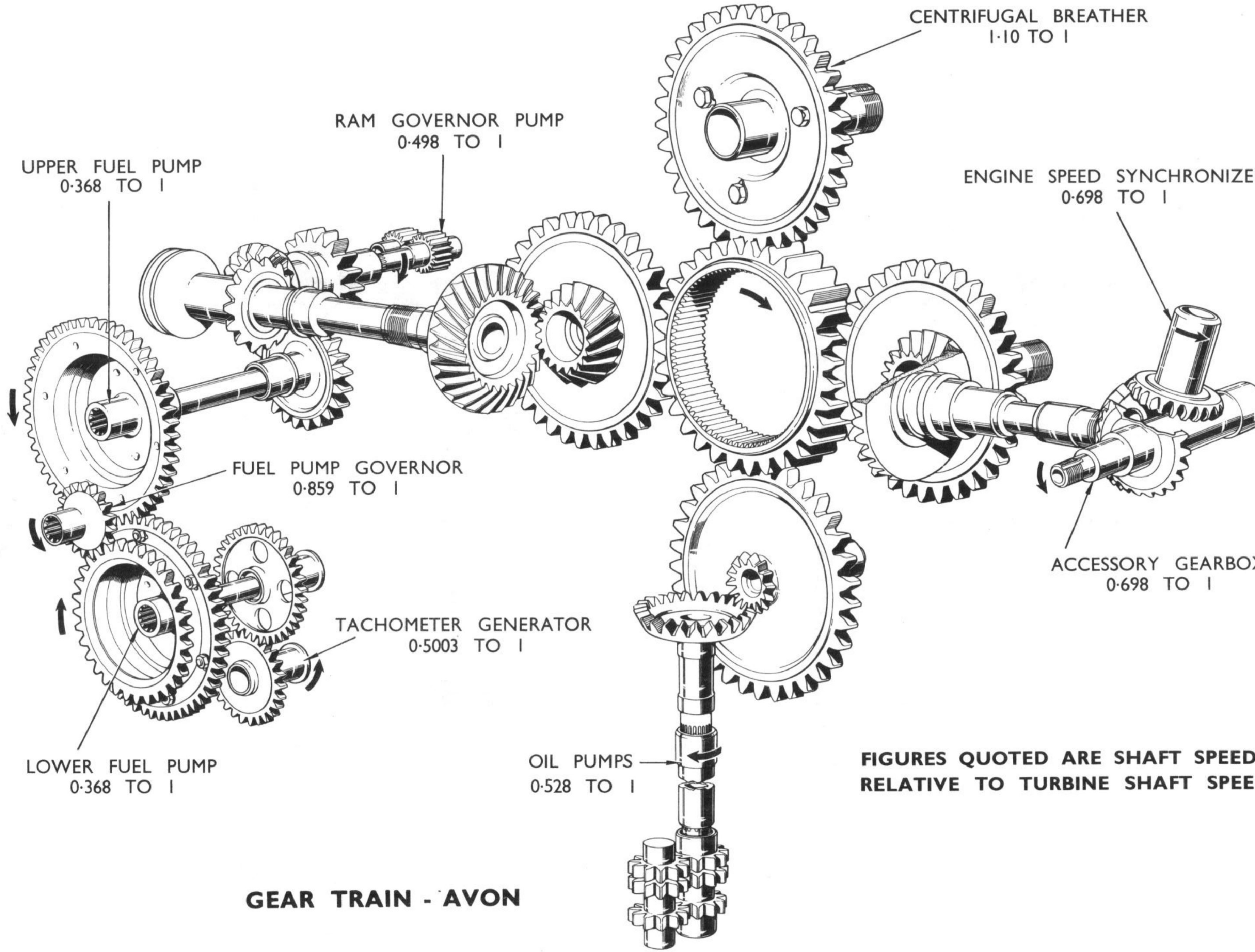
This is a magnesium alloy unit, link mounted on the starboard side of the compressor outlet casing and driven at 0.6398 x engine speed from the internal wheelcase. It carries the engine dual fuel pump on the forward face, driven at .3681 x engine speed, the guide vane ram governor pump on the rear side driven at .5 x engine speed and the tacho-generator also mounted on the rear side and driven at .5 x engine speed.

Oil Sump.

Mounted below the compressor casing. The material is magnesium alloy. If carries internally one pressure and two scavenge pumps, and four filters.

Internal Wheelcase.

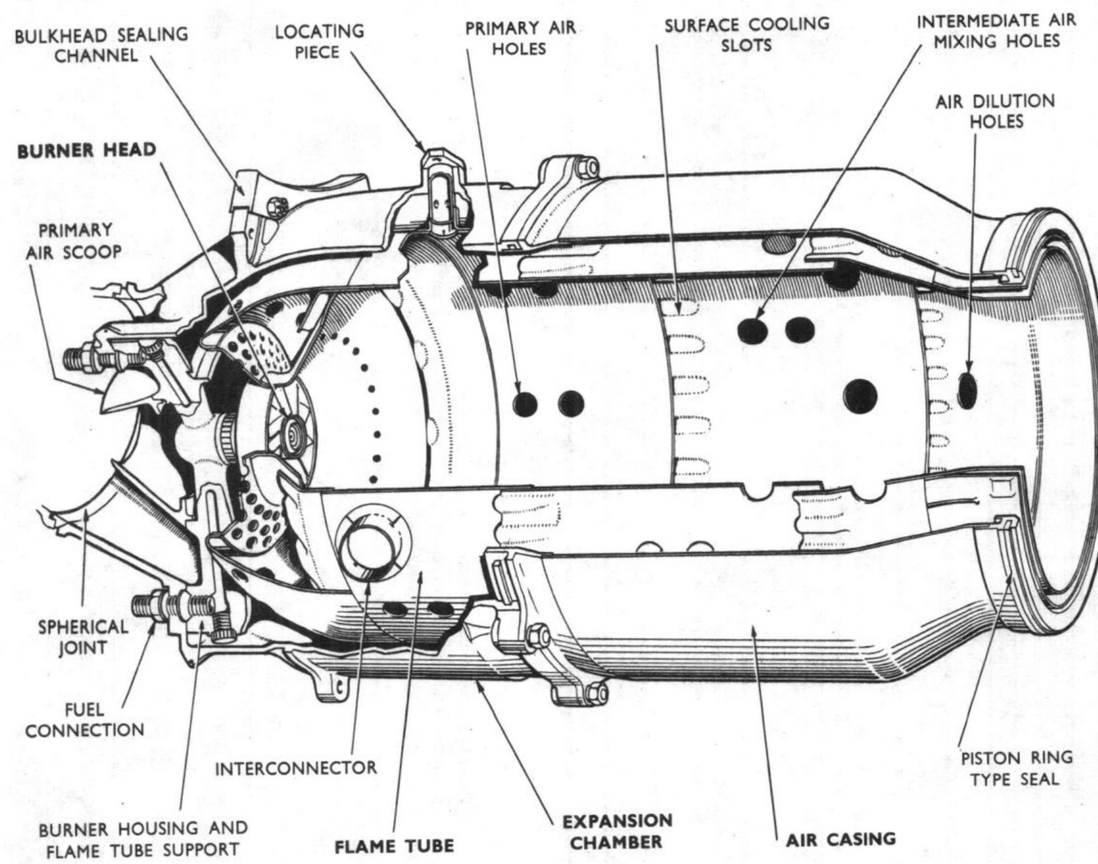
A magnesium alloy casting bolted inside the compressor outlet casing contains four spur gears driven from the centre coupling driving teeth. The drives are:- Top - centrifugal breather; Lower - oil pump; Starboard - external wheelcase; Port - the auxiliary gearbox. The top and port drives can be inter-changed to suit any aircraft installation. Each drive runs at 0.6398 x engine speed.

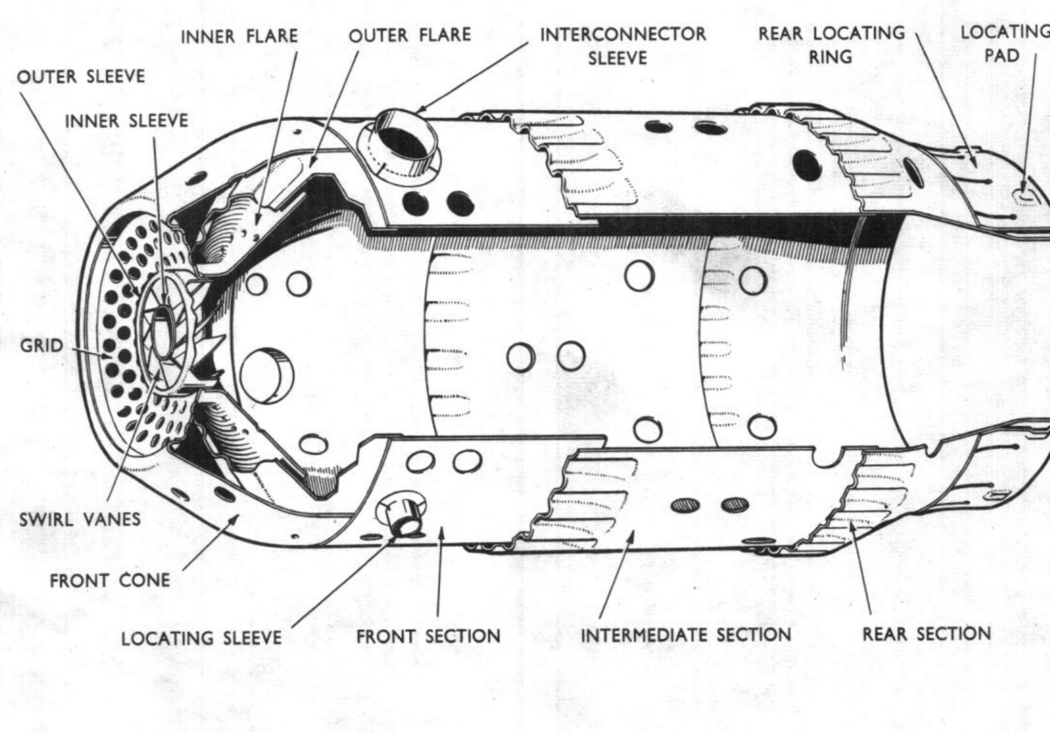


FIGURES QUOTED ARE SHAFT SPEEDS RELATIVE TO TURBINE SHAFT SPEED

GEAR TRAIN - AVON

AERO ENGINE SCHOOL
COURSE NOTE
No TAV.113





COMBUSTION ASSEMBLY - AVON

AVON.

COMBUSTION CHAMBERS.

Construction.

The combustion chambers are mounted between the compressor outlet casing and the nozzle box and are numbered in an anti-clockwise direction viewed from the rear. No.1 is in the top port position.

Each chamber consists of:-

A light alloy expansion chamber.
A mild steel air casing, aluminised to prevent corrosion.
A flame tube in heat resisting Nimonic alloy.
Interconnectors coupling adjacent assemblies.
Nos.3 and 6 chambers carry H.E. igniter plugs for engine starting and relighting. (Avon Mk.1 Pre.Mod. 174 have torch igniters on Nos. 2 and 7).

The chambers are supported so that free radial and longitudinal expansion can take place without distortion.

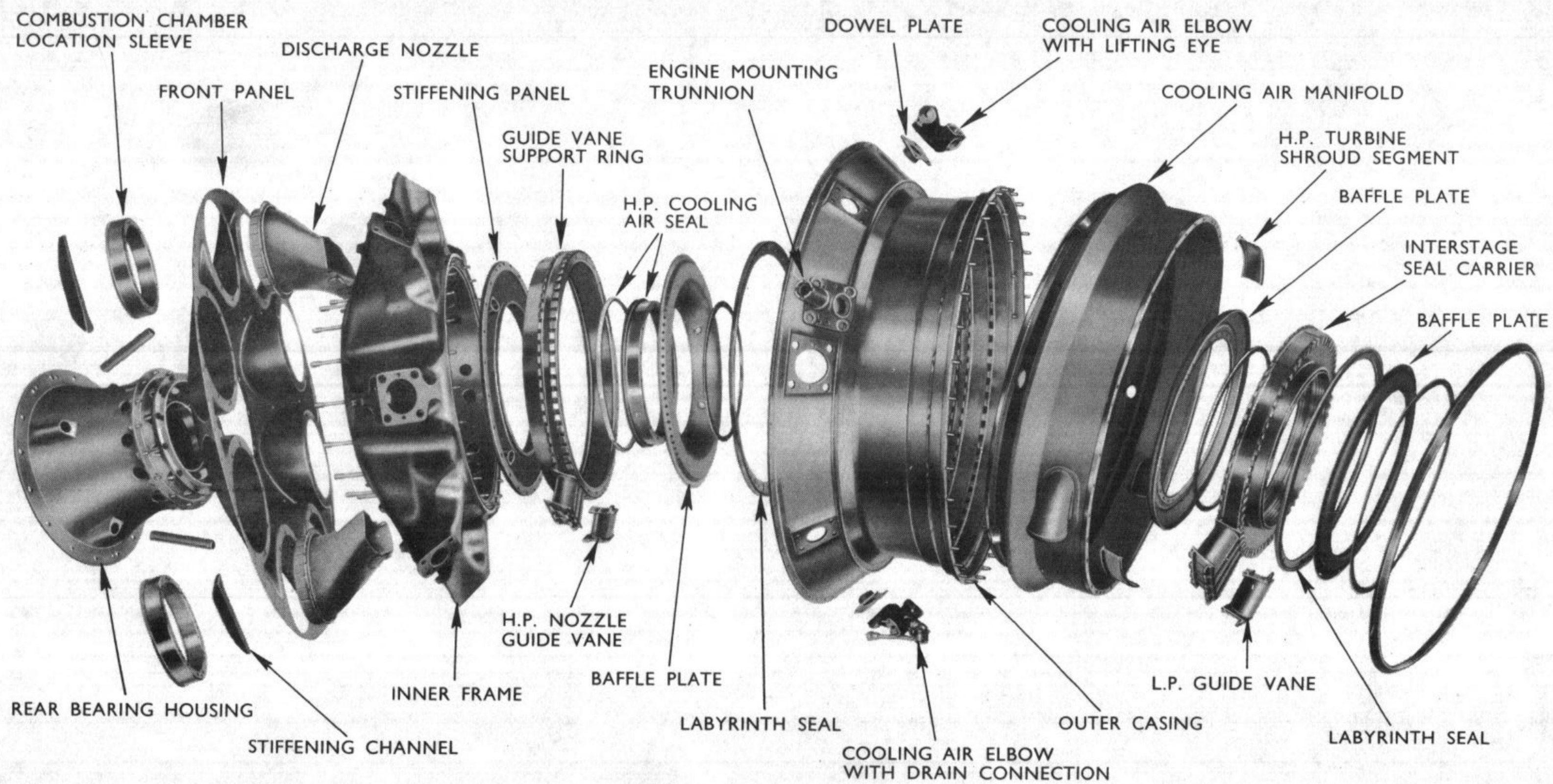
The assemblies are connected to the compressor outlet casing on a spherical joint ring. The rear end of the air casing fits into the nozzle assembly and is sealed by a spring ring to form a sliding joint. Similarly the end of the flame tube is supported in the nozzle box by means of raised pads which permit cooling air to flow between. The forward end of the flame tube is supported on a flange of the burner tripod mounting and is secured by a locating pin. Between each pair of combustion chambers is a sealing channel which forms part of the fire-proof bulkhead.

Operation.

Approx. 15% of the air flowing into each combustion chamber assembly is metered into the front end of the flame tube for mixing with the fuel. Some of this air passes through swirl vanes surrounding the burner head and some through holes in the flare. A vortex flow is thus produced which ensures good mixing of fuel and air, and complete combustion. The remainder of the air passes between the air casing and the flame tube and is progressively fed into the flame tube by the large holes in the centre and rear of the tube. Some of this air helps to complete the combustion process, and approx. 33% of the total engine air consumption is burnt. The unburnt air in the flame tube dilutes the combustion gases and reduces their temperature to a figure which the turbine assembly can accept.

The interconnectors equalise the gas pressure in the combustion assemblies and pass on the flame produced by the igniters during the starting process.

15.2.55.



NOZZLE BOX COMPONENTS -AVON

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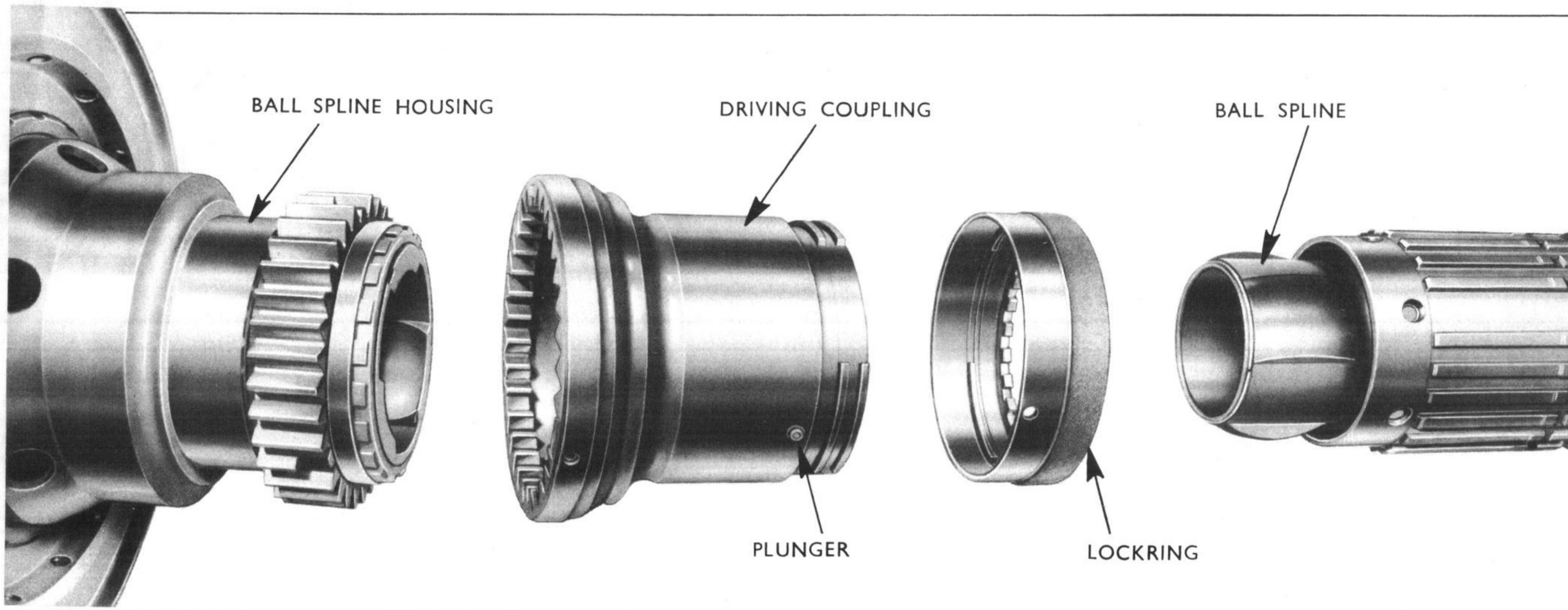

AVON CENTRE COUPLING

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AVON.

CENTRE COUPLING.

The centre coupling is designed to transmit the drive from the turbine shaft to the compressor, so that the turbine may be removed without disturbing the compressor assembly. To accommodate slight variations in alignment the centre coupling incorporates a ball spline and socket.

The assembly consists of a ball spline and housing to provide axial location of turbine to compressor, and a driving coupling which transmits the drive from turbine to compressor.

Ball Spline Housing.

The ball spline housing is formed integral with the rear compressor shaft and carries 3 equidistant internal splines. The housing is splined externally and carries a gear providing a drive for the internal wheelcase. The rear portion of the gear teeth are used as splines for the driving coupling, three master teeth being formed by reducing the tooth length.

Driving Coupling.

The driving coupling is splined at its forward end to engage the rear portion of the ball spline housing gear teeth. It is splined internally at the rear to engage the turbine shaft, a master tooth ensuring correct positioning. A spring loaded plunger is fitted to locate a lockring which is located on external splines at the rear of the coupling.

Lockring.

The lockring carries 3 internal splines engaging with the external splines on the coupling. At the rear it carries internal splines engaging with the turbine shaft. It is knurled for ease of manipulation.

Ball Spline.

The ball spline is fitted to the forward end of the turbine shaft, and forms 3 splines. A light piston ring is fitted at the forward end of the ball to provide an air seal. The turbine shaft is splined to enter the driving coupling.

Coupling Assembly.

Engage the driving coupling with the gear carried on the compressor shaft. Fit the lockring to the coupling and turn until the internal splines coincide with the splines in the coupling. Pass the turbine shaft through the lockring and coupling, until it butts against the ball spline housing. Slide the coupling and lockring rearwards to disengage from the compressor. Turn the turbine shaft 60° to enter the ball splines and turn back 60° to lock the ball splines. Slide the coupling forward onto the master teeth and rotate the lockring until the plunger engages. Reverse this sequence for removal.

21.8.52.