Service Instruction Note

DIESEL

SEP 2002

Based on UK DT319 (EN)

SIN 508

DPG PUMPS (DPA)

EQUIPMENT: Pumps 3230F560T, 3349F250T, 3340F260T, 3260F530T and 3340F280T fitted to gen set and constant speed applications. First customer Wilsons
gen sets equipped with Perkins engines.

SUBJECT: Introduction of fuel injection pumps with tight governor control.

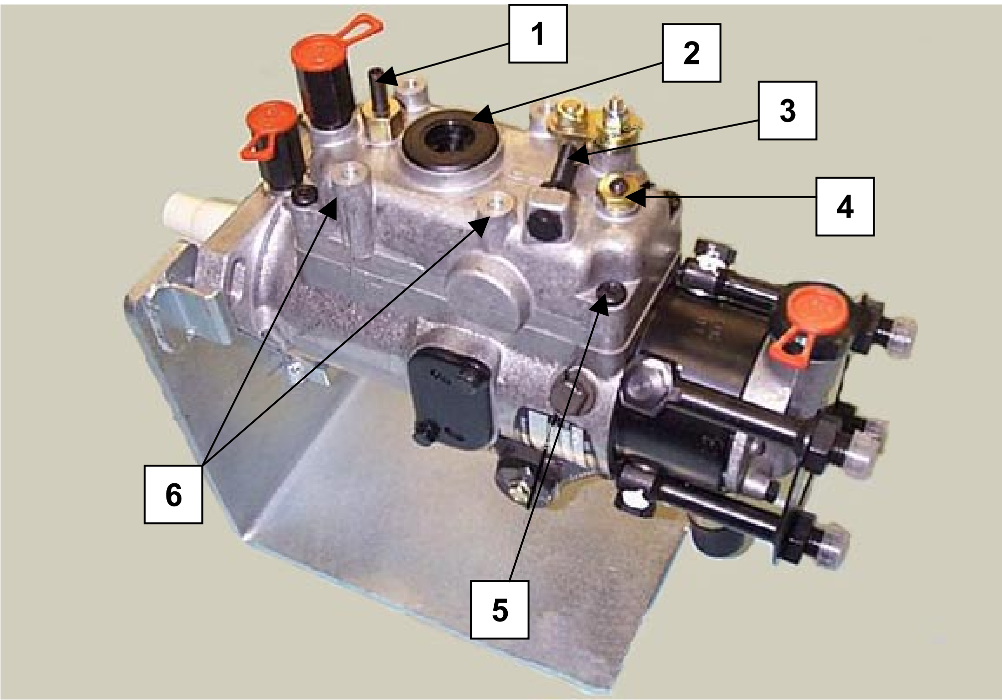

Fig 1

1. INTRODUCTION

The DPG fuel injection pump (Fig 1) is a variant of the DPA pump and has been designed specifically for generator sets and constant speed applications that require tight governor control. This note describes the principles of operation.

The pump is designed to maintain 'class A' governing for a much longer period of running than conventional DPA pumps. Furthermore, if after some time in service the performance moves outside limits, the pump can be adjusted externally on the engine to restore class 'A' governing requirements, hence extending service life.

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The pump has three external setting screws (Fig 1):

- Speed set screw (3)
- Droop control screw (4)
- Overspeed protection screw (1)

The pump has the following special features:

- Reduced wear mechanical governor
- Governing stabiliser
- Reduced governor hysteresis
- Droop control and adjustment (metering valve height)
- Over speed protection
- Provision to convert for use with an Electronic Governor (EG) using a Woodward LCS integral actuator/controllerfitted by the customer.
- Four-screw fixing governor cover (5) (including a trapped seal) with screw mountings (6) for the EG device.

NOTE: *These features may not appear on all pump variants.*

Pumps are supplied to the customer with a plug in the actuator hole (2).

The DPG pump will allow the customer to perform the following tasks on the engine:

- external adjustment of the governor rate (droop).
- external adjustment to compensate for wear to the governor components.
- external adjustment to convert from 50 Hz @ 1500 rpm to 60 Hz @ 1800 (or vice versa).

2. SPECIAL FEATURES

2.1 Reduced wear package (fig 2)

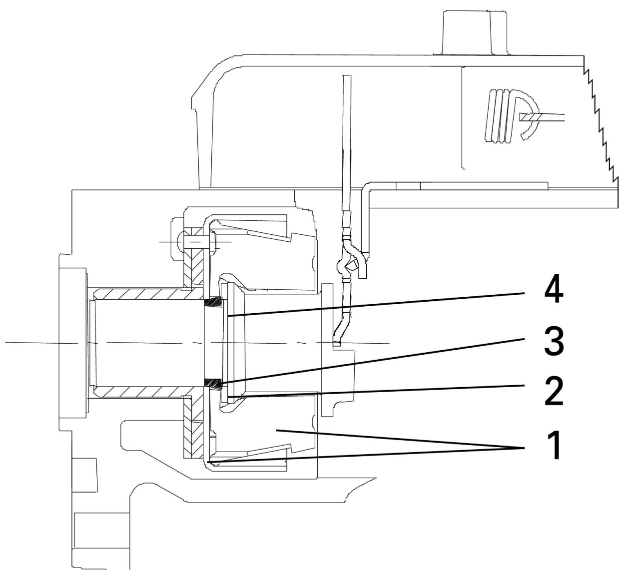


Fig. 2

Design and quality improvements have been made to the governor weights and cage (1). The standard thrust washer (2) is driven by the driveshaft at engine start up via a drive rubber (3) (elastomer ring clutch) located between the weight cage and the thrust washer. The thrust sleeve has also been modified to include hydrodynamic thrust bearing pads (4) to keep the thrust washer rotating. The thrust washer disengages from the drive rubber on run up. As a result of these additions, wear to the toes of the weights is reduced.

2.2 Governor stabiliser (fig 3)

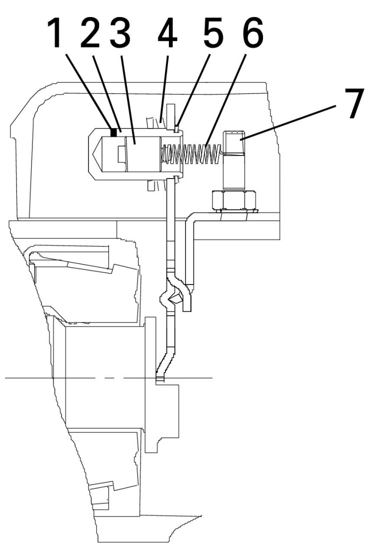


Fig. 3

The governor stabiliser is an hydraulic damper fitted to the governor arm and minimises system oscillations (i.e. designed to tune out the instability of engine/alternator systems) and allows the setting of steeper governor pull-off without instability (i.e. smaller droops). It comprises a stabiliser body (2) and an antibacklash spring (4), attached to the governor arm by a circlip (5), into which is fitted a stabiliser piston (3) and a stabilising spring (6). One end of the spring is attached to a stud (7). This spring is in parallel to the main governor spring. A small orifice (1) in the body controls the damping effect.

2.3 Hysteresis (fig 4)

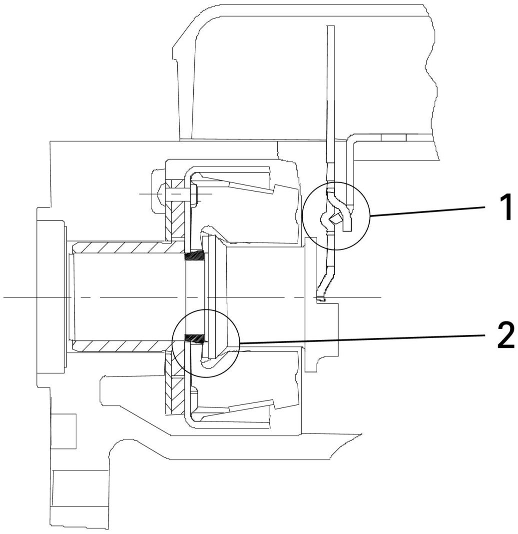


Fig.4

Hysteresis between governor pull-off and pull-on has been reduced by introducing an improved knife edged governor arm and control bracket assembly giving zero lift (1) at the pivot point and knife-edges. In addition there is the improved design of governor weights/cage and thrust sleeve arrangement (2) as described previously in 2.1.

2.4 Droop control and adjustment (fig 5)

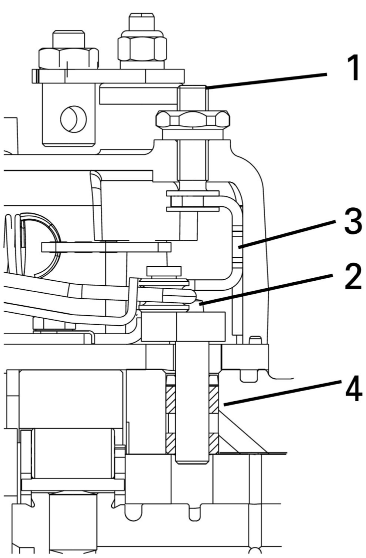


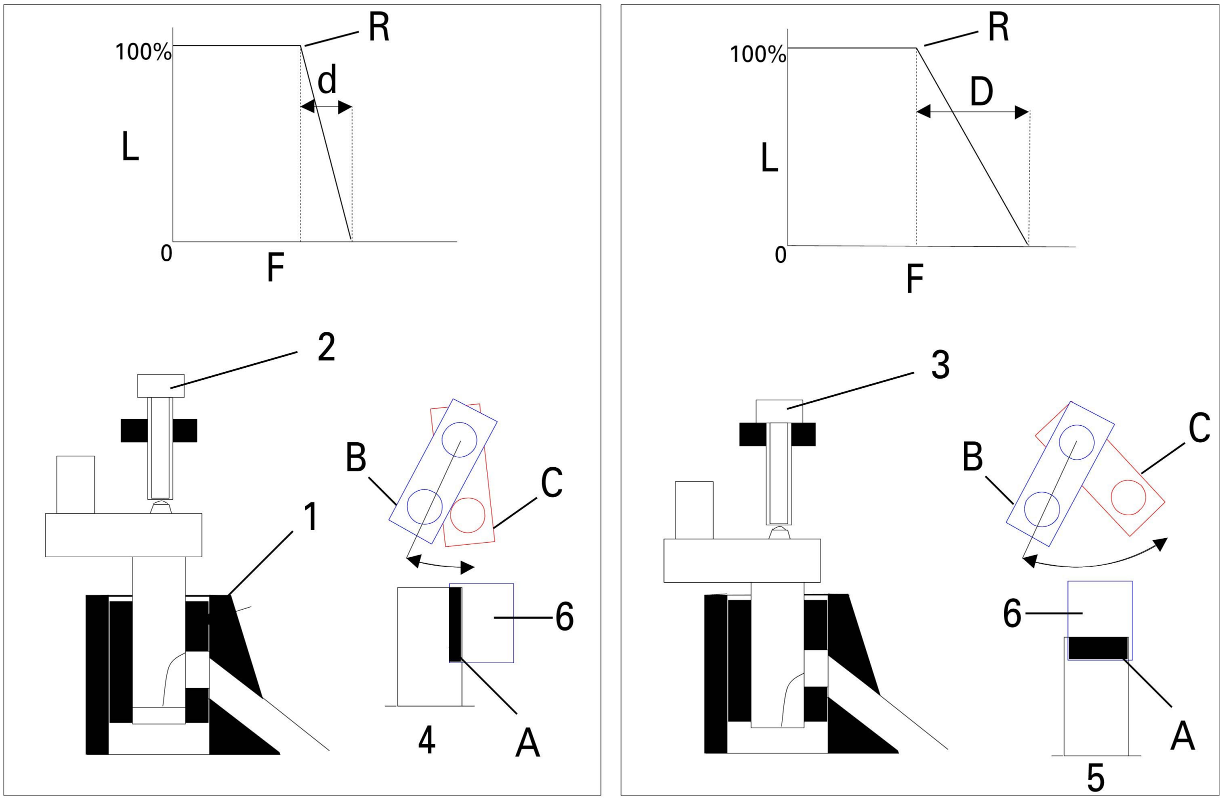
Fig.5

The rate of governor pull-off, or the percentage speed difference between full load and no load is known as droop.

An external adjustment arrangement sets the droop to the desired governor rate. It also allows adjustment to compensate for the effect of manufacturing tolerances on governor performance. In addition it provides a means for governor rate adjustment to compensate for any wear in the field.

It comprises an external screw adjuster (1) that controls the height of the metering valve via a stop guide (3). The stop guide acts on the top of the metering valve (2) and enables fuel delivery adjustment. The fuel feed hole to the metering valve is square. To facilitate this feature, a sleeve (4) with a square filling port is fitted into the hydraulic head.

Figures 5A and 5B explain the principle of setting the droop control characteristic.



L	=	Load
F	=	Frequency
R	=	Rated Frequency
A	=	Flow area for 100 % load delivery
B	=	Metering valve arm no load position
C	=	Metering valve arm 100 % load position
1	=	Fixed Metering valve sleeve with square fill port for maximum sensitivity
2	=	Droop adjuster up
3	=	Droop adjuster down
4	=	Metering valve slot up
5	=	Metering valve slot down
6	=	Square filling port (side view)
d	=	Short droop
D	=	Long droop

Referring to Fig 5A

With the droop adjuster up (2) (screwed out) a small change in governor spring load and thus a small rotation of the metering valve creates a large change in flow area (A), thus giving a short governor pull-off.

Referring to Fig 5B

With the droop adjuster (3) in the down position (screwed in) a larger metering valve rotation is required to produce the same change in flow area (A). This requires a larger load change on the governor spring, producing a longer governor pull-off.

Setting the droop on the engine

This is a brief description of the procedure the customer would follow for setting the droop on the engine.

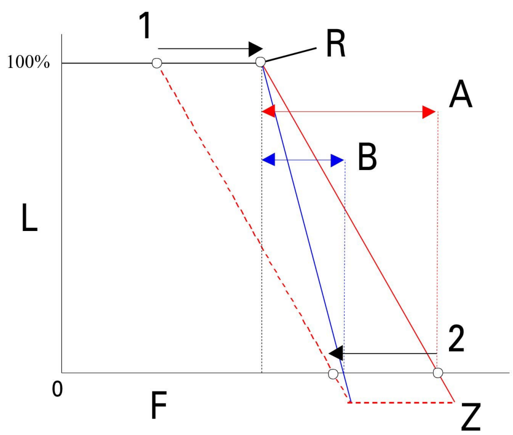


Fig 5C

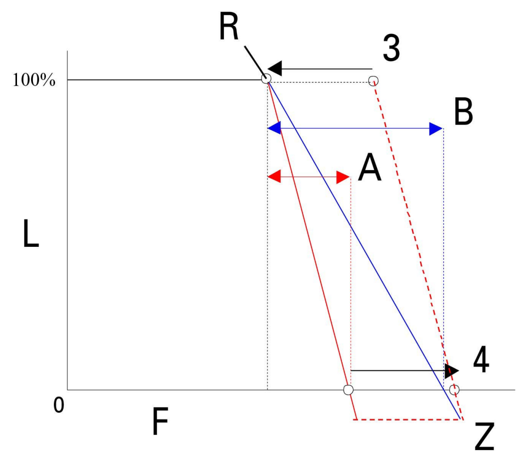


Fig 5D

L	=	Load	F	=	Frequency
R	=	Rated Frequency	Z	=	Zero Fuel
A	=	Initial Droop	B	=	Final Droop
1	=	Droop screw out	2	=	Throttle screw out
3	=	Droop screw in	4	=	Throttle screw in

Setting less droop (Fig 5C)
1) Under no load, loosen the trunnion nut slightly and the throttle lever setting screw locknut, then turn the throttle lever setting screw (2) anticlockwise to give slightly less than the new droop frequency/speed. Lock the adjusting screw and trunnion nut.

2) Under full load, slacken the droop screw locknut, and then screw out the droop adjuster (1) to give the rated frequency/speed. Lock the adjuster.

If fitted, set the over speed protection screw by winding it in until it just interferes with the full load frequency/speed (engine speed begins to drop), then back it off one flat and lock.

Setting more droop (Fig 5D)
Back off the over speed protection screw.

1) Under no load, loosen the trunnion nut slightly and the throttle lever setting screw locknut, then turn the throttle lever setting screw (4) clockwise to give slightly more than the new droop frequency/speed. Lock the adjusting screw and trunnion nut.

2) Under full load, slacken the droop screw locknut, and then screw in the droop adjuster to give the rated frequency/speed. Lock the adjuster.

If fitted, set the over speed protection screw by winding it in until it just interferes with the full load speed, then back it off one flat and lock.

2.5 Over speed protection (Fig. 6 and 6A)

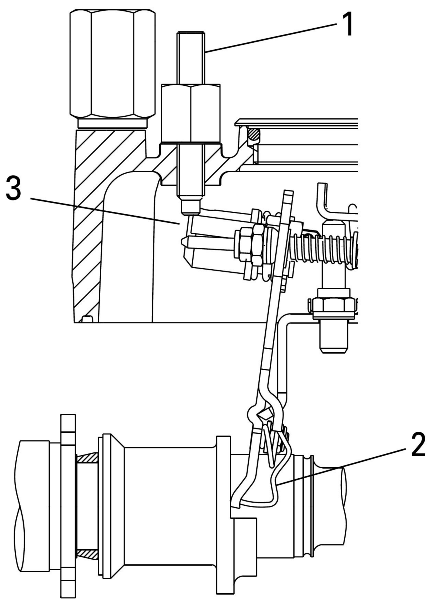


Fig 6

Some customer's alternators are fitted with an over speed trip device, and when fitted these are normally set to trip between 9% and 11% above rated speed. At engine start up a correctly set pump can cause up to 20% over speed and hence this could cause the over speed trip device to shut down the engine immediately after starting.

The governor stabiliser operates over all of the travel of the governor arm, for dead travel as well as the travel that changes fuel delivery. This introduces a time delay before the governor responds to the over speed at start up that is not present under normal running. Limiting the dead travel by means of a stop screw reduces the over speed to below 10%.

It comprises an external screw adjuster (1) that abuts a pin (3) attached to the governor arm.

NOTE: *The introduction of this screw affected the wear package, as there was no loading on the governor weights. An over speed spring (2) was added to the governor arm to apply a load to the thrust sleeve in order to hold the weights in on start-up.*

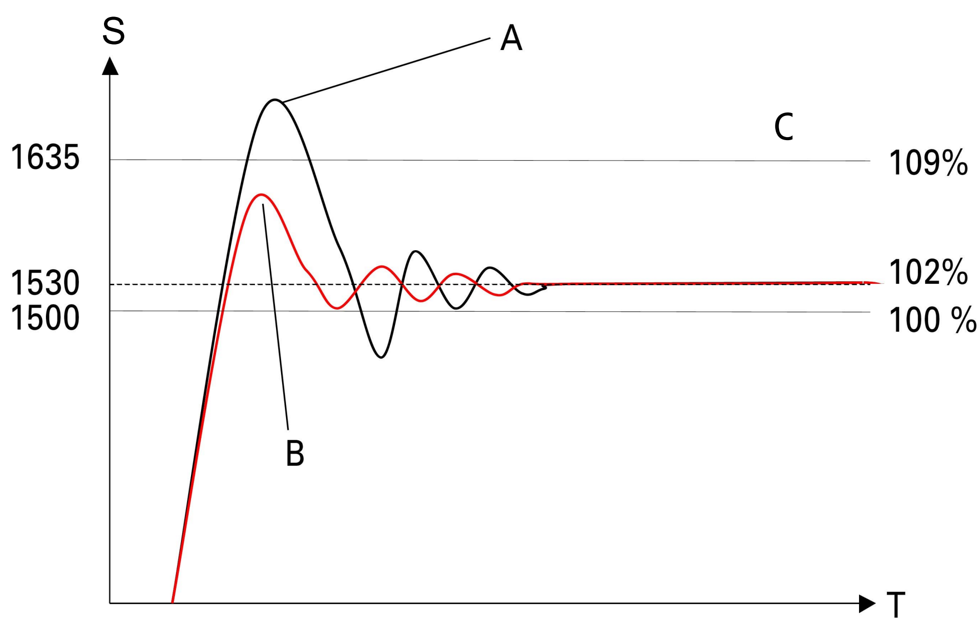


Fig 6A

A	=	Over speed on start up
B	=	Over speed protection device limits over speed on start-up
S	=	Engine speed (rpm)
T	=	Time
C	=	Over speed trip device bottom limit

2.6 Electronic conversion

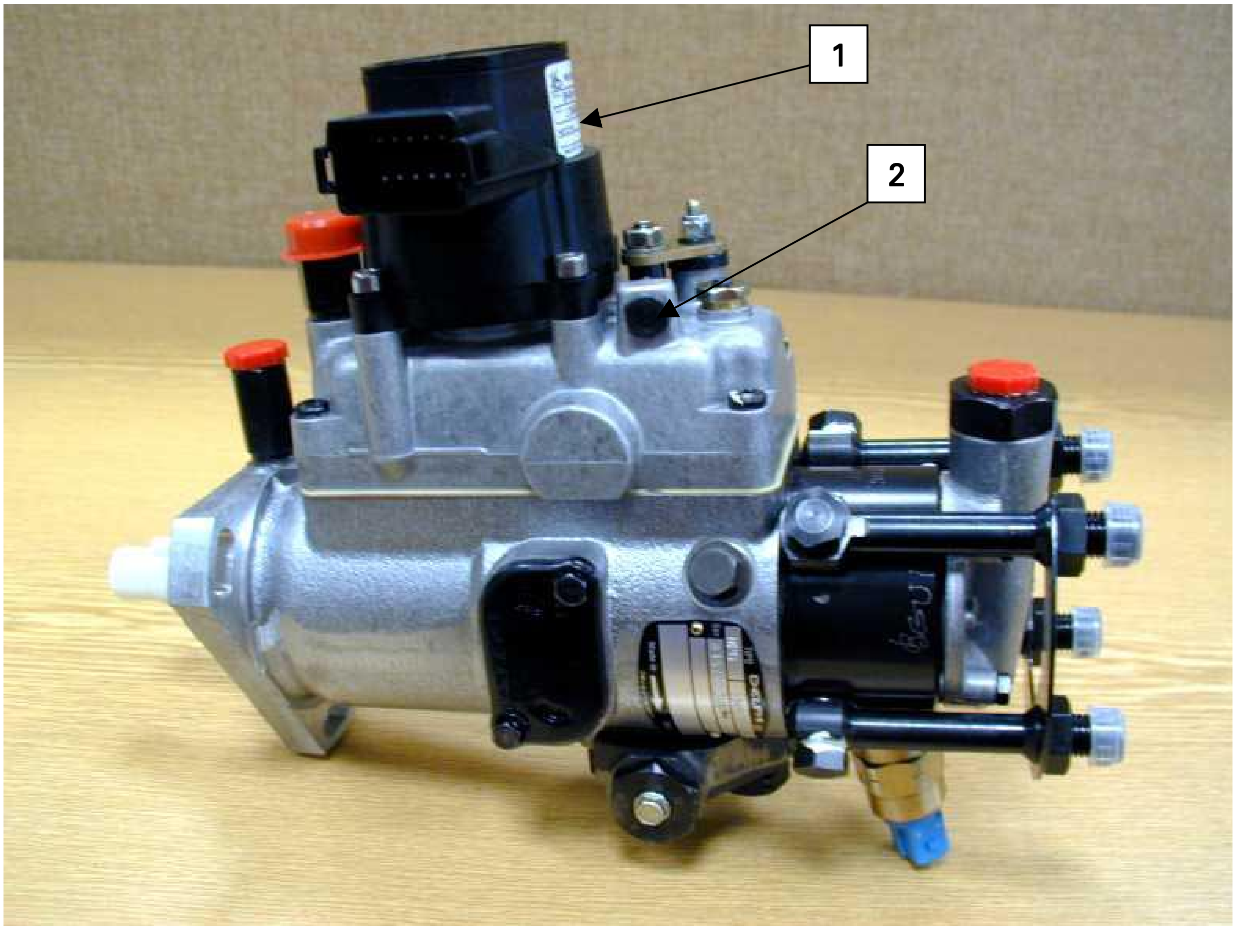


Fig 7

The pump can be simply converted to electronic governing with the fitment of a Woodward LCS integral actuator/controller (Fig 7 Item 1) fitted by the customer. The integral design of the LCS means that no separate controller is required which reduces wiring harness complexity to a minimum. The LCS digital control ensures precise governing with multiple governing strategies e.g. isochronous load sharing, 50/60 Hz switching, auxiliary load sharing etc. The actuator is supplied with a speed signal (normally from a variable reluctance magnetic pickup monitoring flywheel teeth) which is monitored within the LCS control. If the speed signal from the engine does not match the pre-programmed speed, the LCS actuator moves the pump metering valve (via the linkage spring, which has been modified to accept the actuator lever) to increase or decrease fuel until the speed signal and the pre-programmed speed are equal. This process is repeated many times a second. For pumps equipped with the Woodward LCS integral actuator the mechanical governor is used as an over speed protection device in the event of an electronic governor failure.

NOTE: *The over speed protection screw (Fig 1 Item 1) is removed and the hole is plugged. The speed setting screw (Fig 7 Item 2) then functions as a backup overspeed setting.*

For Dismantling/Re-assembly and test procedures of DPG pumps refer to Service Instruction Note 509 (UK Note DT320)