



Camshaft

Removal

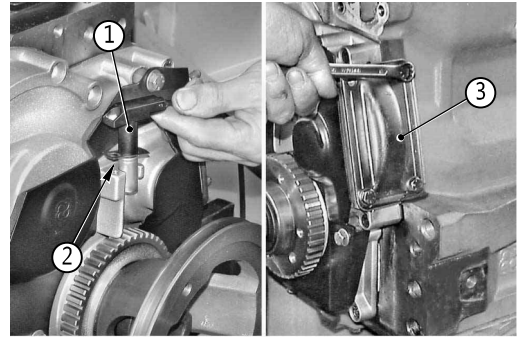
Only if fitted: remove the screw and remove engine speed sensor (1) and spacer (2), if present.

Remove cover (3).



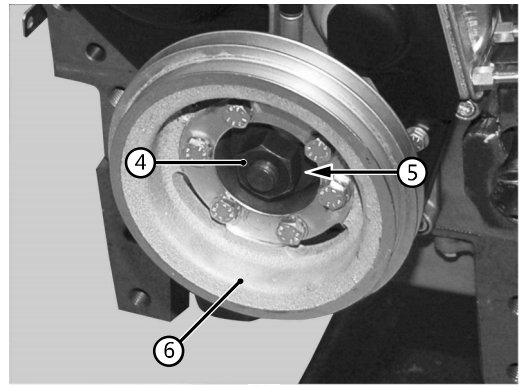
NOTE

This operation should not be done if the engine is equipped with the trailer air braking compressor or auxiliary PTO.



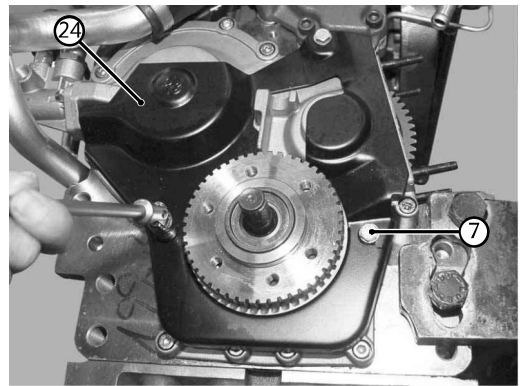
1.

Undo retaining nut (4), remove washer (5) and remove crankshaft pulley (6).



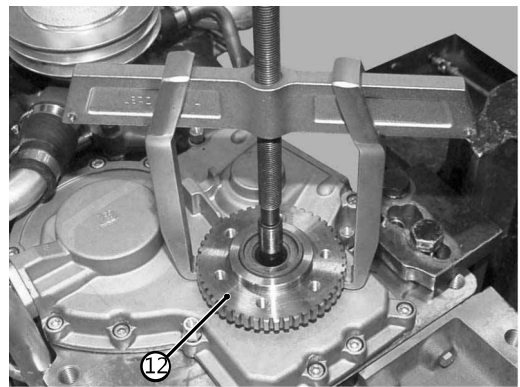
2.

Remove screws (7) and remove cover (24).



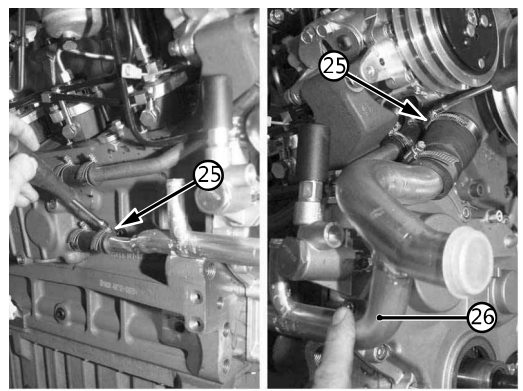
3.

Using a puller, remove pulse wheel (12).



4.

Loosen clamps (25) and remove cooling line (26) from pump to heat exchanger.



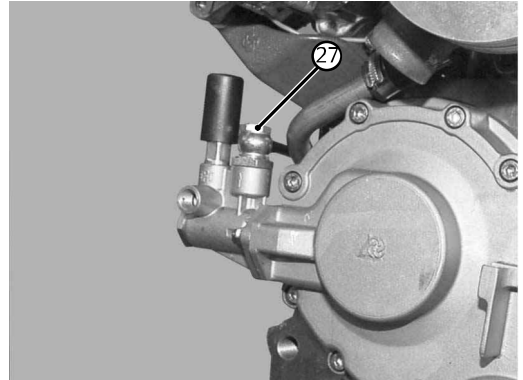
5.

Undo union (27) and disconnect diesel fuel pipeline.



NOTE

Always renew the copper gaskets.



6.

Undo the screws and spacers and remove timing cover (13).



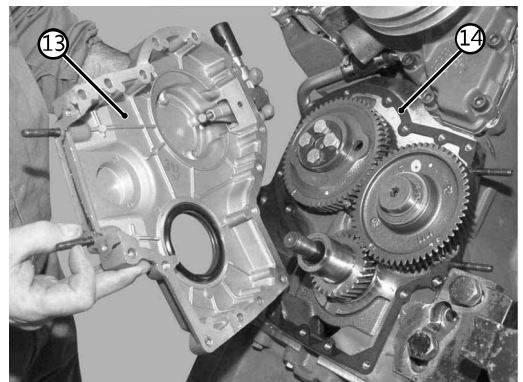
NOTE

Gasket (14) remains in place, but must be renewed on reassembly.



NOTE

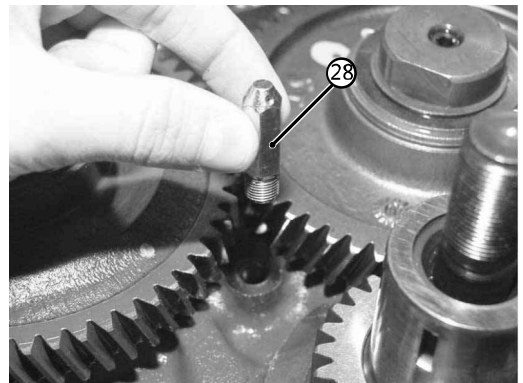
If the crankshaft oil seal is to be renewed, see "Renewal of crankshaft rear oil seal".



7.

Unscrew and remove washer jet (28), check that it is not clogged, and then refit.

Washer jet: Loctite 243



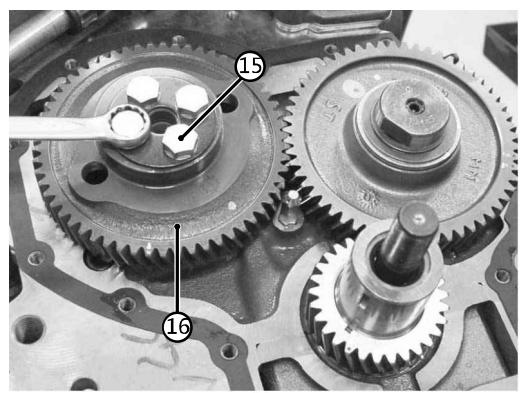
8.

Remove self-locking screws (15) and remove timing gear (16).



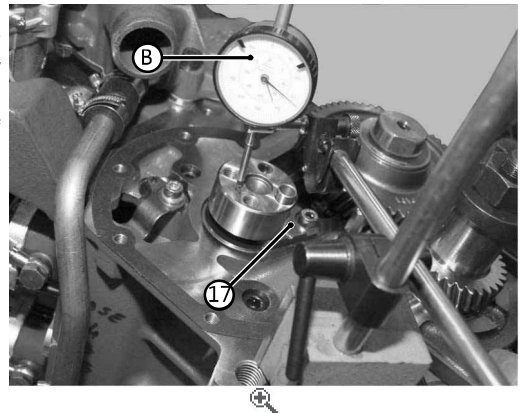
NOTE

Renew screws (15) on reassembly.



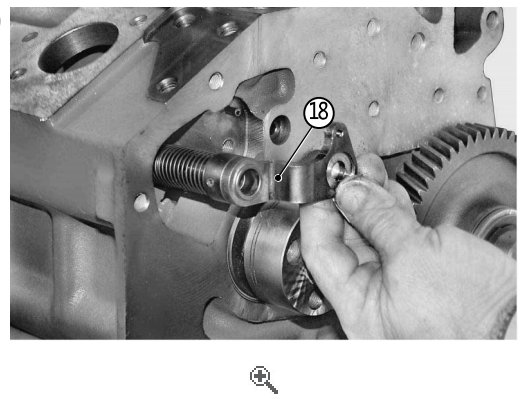
9.

Position a dial gauge on a magnetic stand "B" and preload the gauge by about 3 mm (0.118 in.) on the head of the camshaft. Pry the camshaft axially in one of the two directions; set the dial gauge to zero and move the camshaft in the opposite direction to check if end float is within the permissible range of values (see "Checks and technical data"). If end float is outside the specified limits, replace clearance yoke (17).



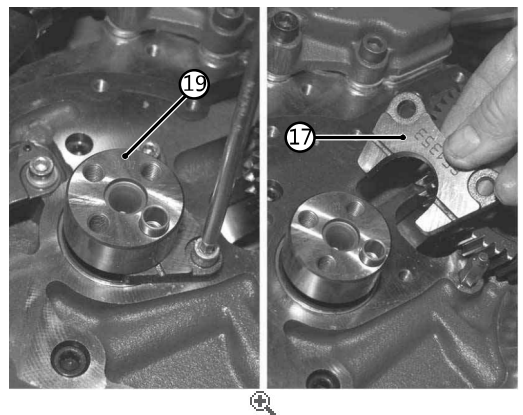
10.

Loosen and remove the retaining screw and remove spring assembly (18) contrasting the injection pump control rod.



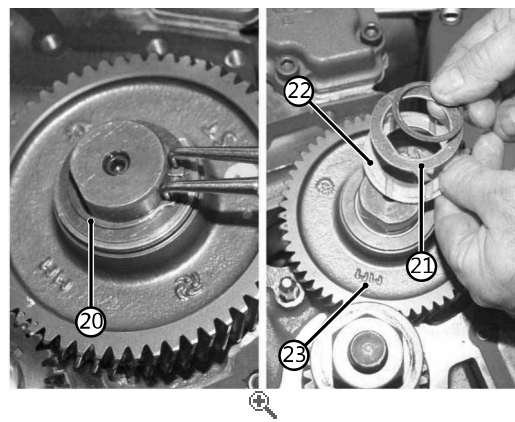
11.

Remove the screws and washers and clearance yoke (17) of camshaft (19).



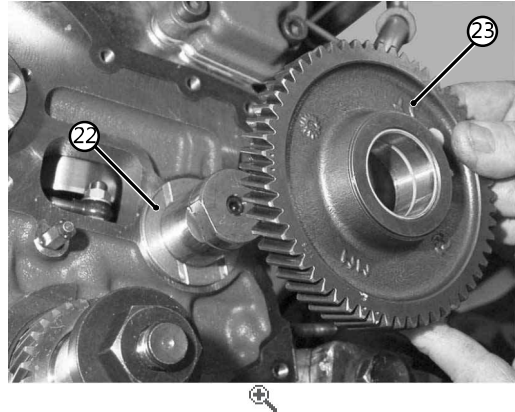
12.

Remove circlip (20) and remove clearance washer (21) and the bronze thrust washer (22) of intermediate gear (23).



13.

Remove intermediate gear (23) and thrust washer (22).



14.

Overturn the engine and remove camshaft (19).



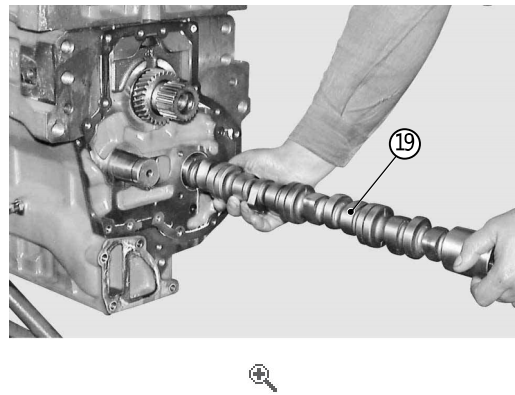
NOTE

Exert constant axial traction and rotate the camshaft to and fro to facilitate removal.



NOTE

Take care not to damage the main bearings with the crest of the cams.

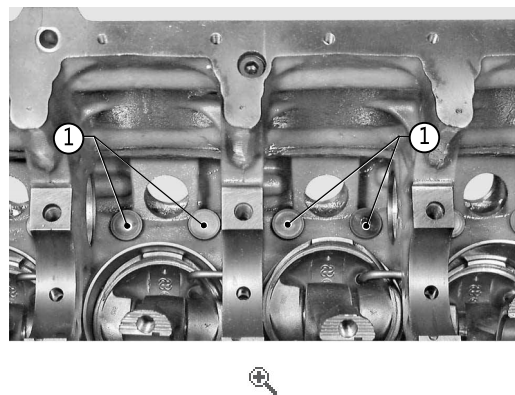


15.

Installation

Lubricate the seats and fit tappets (1).

Tappet seats: Engine oil



1.

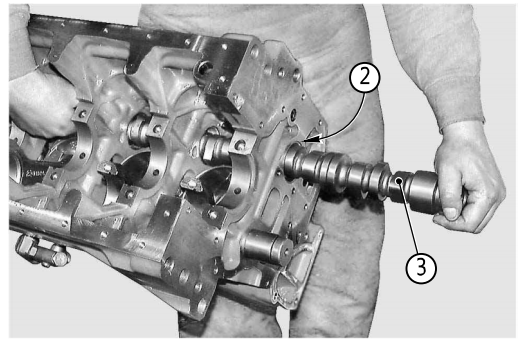
Lubricate bushes (2) and fit camshaft (3).

Bushes: Engine oil

NOTE



Take care not to damage the bearings with the cam lobes.



2.

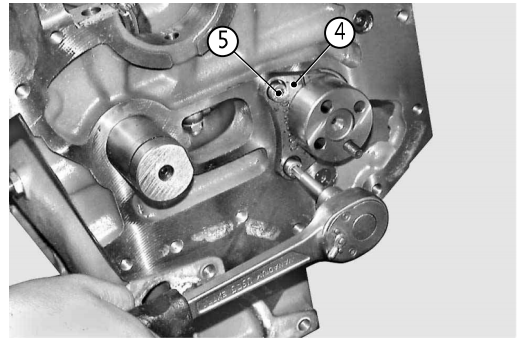
Fit clearance yoke (4) and secure it with screws (5) and washers.

Lubricate the camshaft in the groove engaged with the yoke and try turning it. rotation should be free with no signs of sticking.



NOTE

Check also that end float is within the tolerance limits indicated in "Technical data and dimensions".



3.



Valve timing

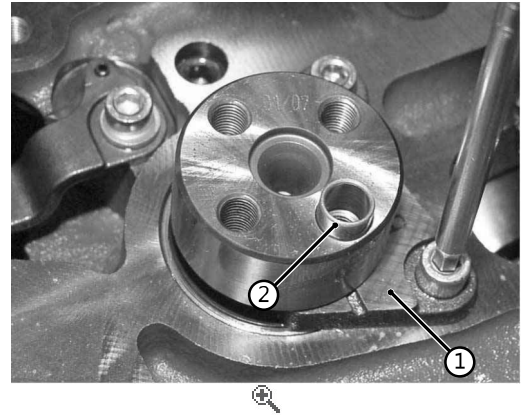
Timing operations must be carried out on cylinder N° 1.

If removed, refit the crankshaft, tappets and camshaft.

Fit the timing drive gear on the crankshaft.

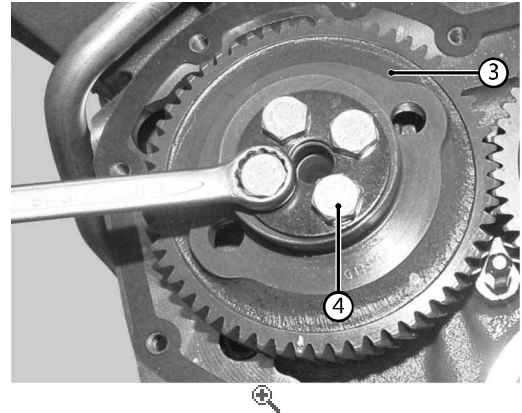
Secure camshaft end float control plate (1).

If removed, fit centring bush (2) on the camshaft.



1.

Fit timing gear (3) and fasten fixing screws (4).



2.

Position a dial gauge on a magnetic stand on the block.

Bring the first piston to top dead centre (T.D.C.).

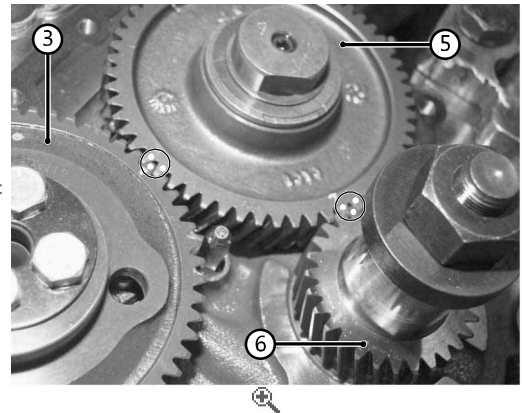
Preload the dial gauge by 20 mm (0.788 in.) on the piston.

Turn the crankshaft clockwise by 40°; the piston stroke must be of 17.273 ± 0.04 mm (0.6806 ± 0.0016 in.).

DANGER



The prescribed stroke must be obtained exclusively with clockwise rotation. If the descent value is surpassed, return to T.D.C. and repeat the procedure.



Install intermediate gear (5) matching the timing punch marks of timing gear (3) and crankshaft gear (6).

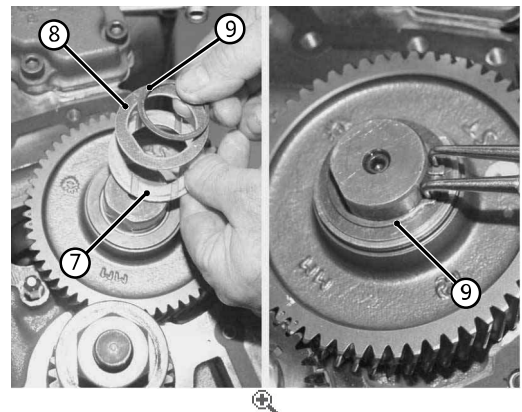
3.

Fit bronze thrust washer (7), clearance ring (8) and circlip (9).

NOTE



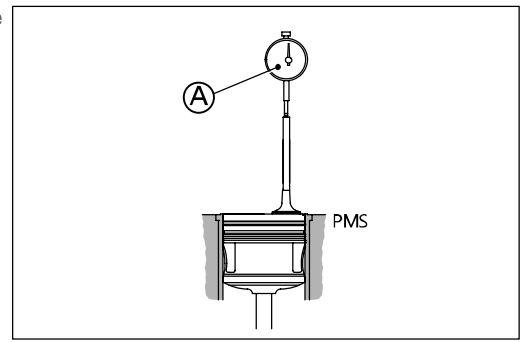
Ensure the thrust washer oil grooves (4) are facing the intermediate gear.



4.

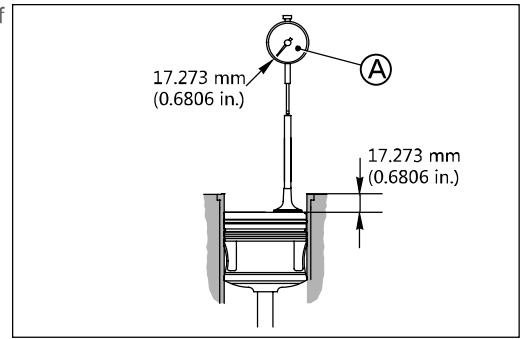
Check

The following check can be performed for verification purposes. Bring the first piston to top dead centre (T.D.C.) and set dial gauge (A) to zero.



1.

Turn the crankshaft clockwise by 40°; the first piston stroke must be of 17.273 ± 0.04 mm (0.6806 ± 0.0016 in.).



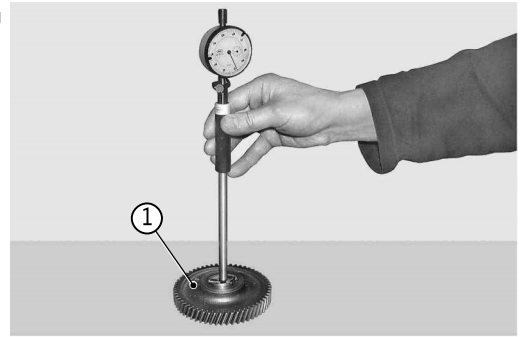
2.



Timing gear checks

Use a dial bore gauge to check the diameter of the intermediate gear bush (1).

Renew the bush if its wear exceeds the limit permitted by "Technical data and dimensions".



1.

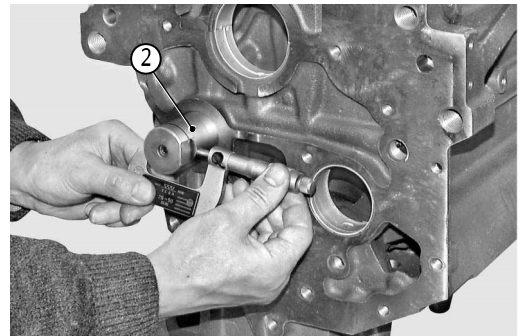
Use a dial gauge to check the diameter of intermediate gear shaft (2).

If the measurement is less than the permissible value given in "Technical data and dimensions", renew the shaft.



NOTE

The shaft must always be renewed if it presents signs of seizure.



2.

3. Before timing the camshaft, check the backlash between the timing gears to reduce noise levels.

Permitted backlash:

0.05 ... 0.1 mm (0.0019 ... 0.0039 in.)

The correct backlash is obtained by fitting the intermediate gear chosen from among the three available sizes, each identified by a coloured dot:

Unit of measure: mm (in.)

Measured backlash	Gear to be installed	NOTES
0.05...0.10 (0.0019 -- 0.0039)	Red dot	Standard gear
0.11...0.13 (0.0043 – 0.0051)	Yellow dot	1st oversize gear *
above 0.13 (above 0.0051)	Green dot	2nd oversize gear *

* The oversize concerns the tooth width on the reference diameter.

Removing the shaft

To remove the shaft fit a bolt with a long nut and force between the shaft and internal wall.

Before fitting the new shaft, clean the lubrication hole carefully; after installing the shaft in the engine block, close the oilway with the plug coated with sealant.

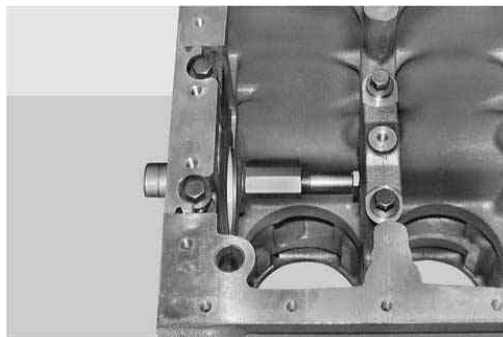
Plug: Loctite 242

The gear shaft must be fitted in the engine block exclusively using the method of prior cooling in liquid nitrogen.



NOTE

DO NOT use hammers, mallets or hydraulic jacks



1.



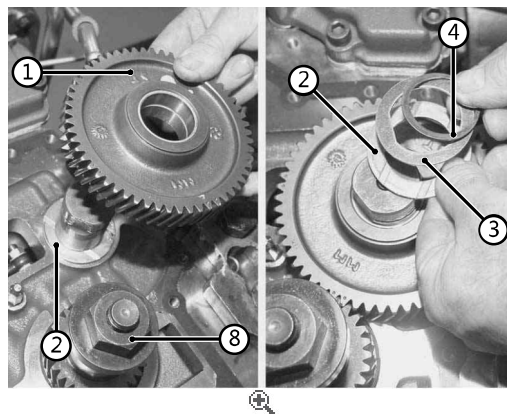
Adjusting timing gears backlash



NOTE

Timing operations must be carried out on cylinder N° 1.

Temporarily install intermediate gear (1) complete with thrust bushes (2), thrust washer (3) and circlip (4).



1.

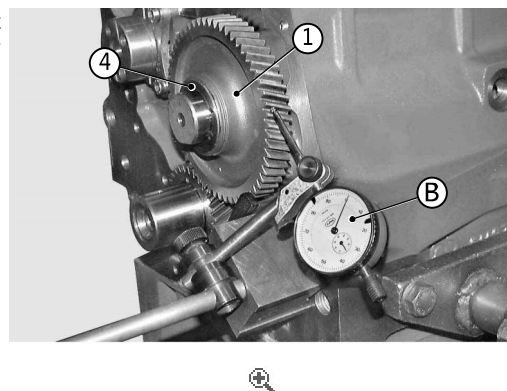
Position a dial gauge "B" on a magnetic stand with the contact point perpendicular to a tooth of the intermediate gear; preload the dial gauge by about 2 mm. (0.079 in.).

Turn intermediate gear (1) two and fro to check backlash between teeth.



NOTE

Make a note of the backlash value before proceeding with the following check.



2.

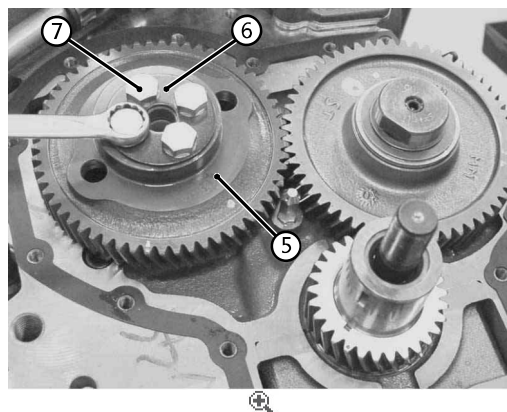
Fit camshaft gear (5), flange (6) and new screws (7).



NOTE

Tighten the screws to a minimum torque of 10 Nm (7.4 lb.ft.) to ensure that the gear is pressed fully home onto the camshaft.

Tighten pulse wheel retaining screw (8) on the crankshaft.



3.

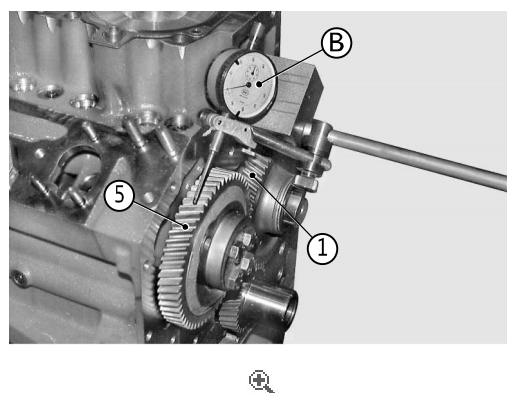
Position dial gauge "B" with the contact point perpendicular to a tooth of the camshaft gear.

Drive intermediate gear (1) fully home and move camshaft timing gear (5) to and fro to check the backlash between the teeth.



NOTE

Make a note of the backlash.



4.

5. Check the two backlash values measured against the permissible values given in "TECHNICAL DATA AND DIMENSIONS" and, if the measured values are not within the permissible limits, renew the intermediate gear with a replacement part that is capable of producing the optimal backlash values.

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