CONTENT OF SECTIONS

PREFACE TO USER'S GUIDELINE MANUAL

Section 1 describes the engine illustrating its features and working in general.

Section 2 describes the type of fuel feed.

Section 3 relates to the specific duty and is divided in four separate parts:

1. Mechanical part, related to the engine overhaul, limited to those components with different characteristics based on the relating specific duty.
2. Electrical part, concerning wiring harness, electrical and electronic equipment with different characteristics based on the relating specific duty.
3. Maintenance planning and specific overhaul.
4. Troubleshooting part dedicated to the operators who, being entitled to provide technical assistance, shall have simple and direct instructions to identify the cause of the major inconveniences.

Sections 4 and 5 illustrate the overhaul operations of the engine overhaul on stand and the necessary equipment to execute such operations.

Installation general prescriptions are reported within the appendix.

Such prescriptions shall be strictly followed by the operators in–charge of installation to avoid incorrect working as well as serious failures which may reduce performance and life of the engine.

Furthermore, the appendix reports general safety prescriptions to be followed by all operators whether being in–charge of installation or maintenance, in order to avoid serious injury.

Graph and symbols

	Removal Disconnection
	Refitting Connection
	Removal Disassembly
	Fitting in place Assembly
	Tighten to torque
	Tighten to torque + angle value
	Press or caulk
	Regulation Adjustment
	Warning Note
	Visual inspection Fitting position check
	Measurement Value to find Check
	Equipment
	Surface for machining Machine finish
	Interference Strained assembly
	Thickness Clearance
	Lubrication Damp Grease
	Sealant Adhesive
	Air bleeding

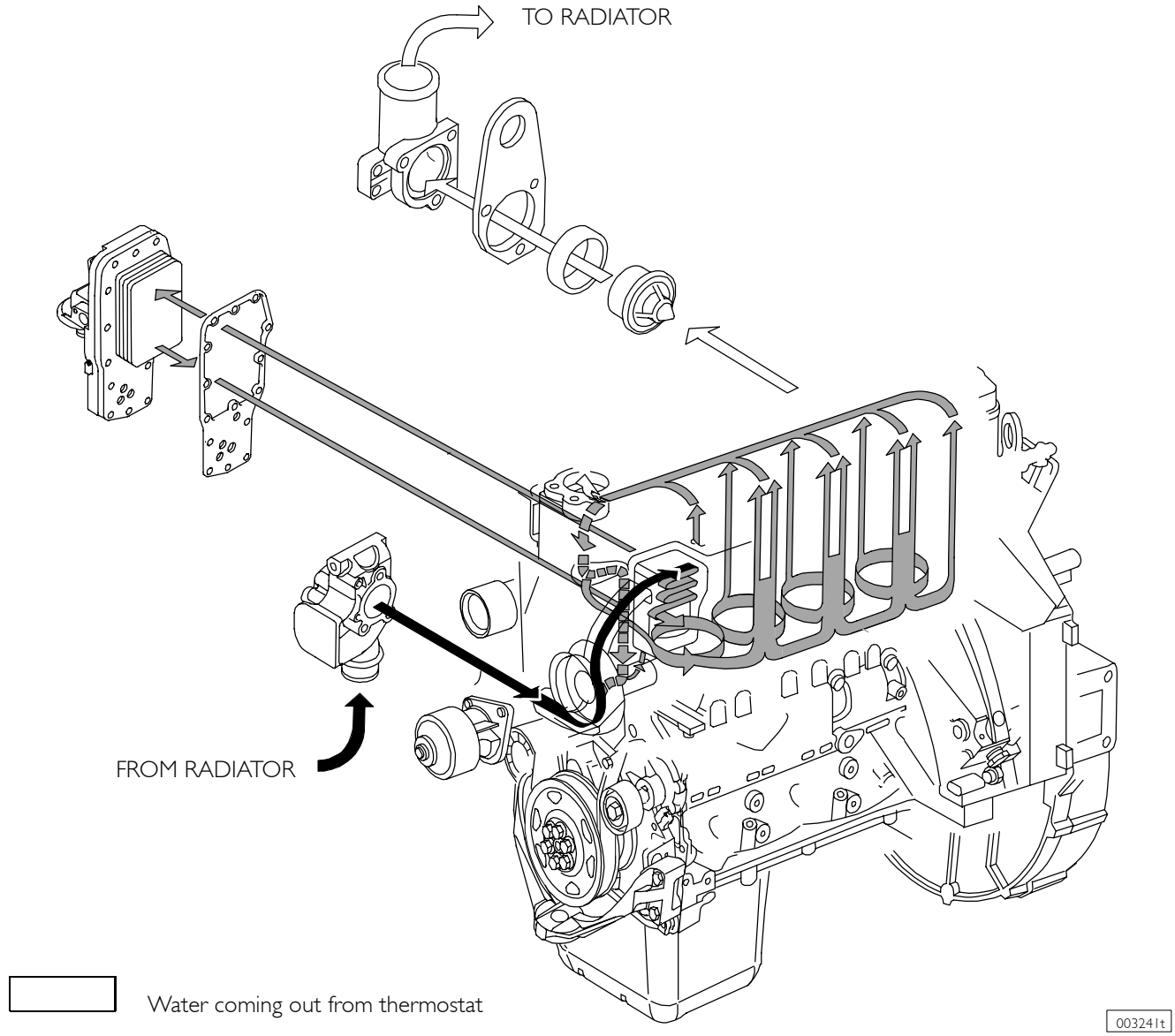
	Intake
	Exhaust
	Operation
ϱ	Compression ratio
	Tolerance Weight difference
	Rolling torque
	Rotation
	Angle Angular value
	Preload
	Number of revolutions
	Temperature
	Pressure
>	Oversized Higher than…. Maximum, peak
<	Undersized Less than…. Minimum
	Selection Classes Oversizing
	Temperature < 0 °C Cold Winter
	Temperature > 0 °C Hot Summer

COOLING SYSTEM

The engine cooling system, closed circuit forced circulation type, generally incorporates the following components:

- ❑ Expansion tank; placement, shape and dimensions are subject to change according to the engine's equipment.
- ❑ Radiator, which has the duty to dissipate the heat subtracted to the engine by the cooling liquid. Also this component will have specific peculiarities based on the equipment developed, both for what concerns the placement and the dimensions.
- ❑ Visc pusher fan, having the duty to increase the heat dissipating power of the radiator. This component as well will be specifically equipped based on the engine's development.
- ❑ Heat exchanger to cool the lubrication oil: even this component is part of the engine's specific equipment.
- ❑ Centrifugal water pump, placed in the front part of the engine block.
- ❑ Thermostat regulating the circulation of the cooling liquid.
- ❑ The circuit may eventually be extended to the compressor, if this is included in the equipment.

Figure 4



COOLING SYSTEM LAYOUT (4 cyl. engines)

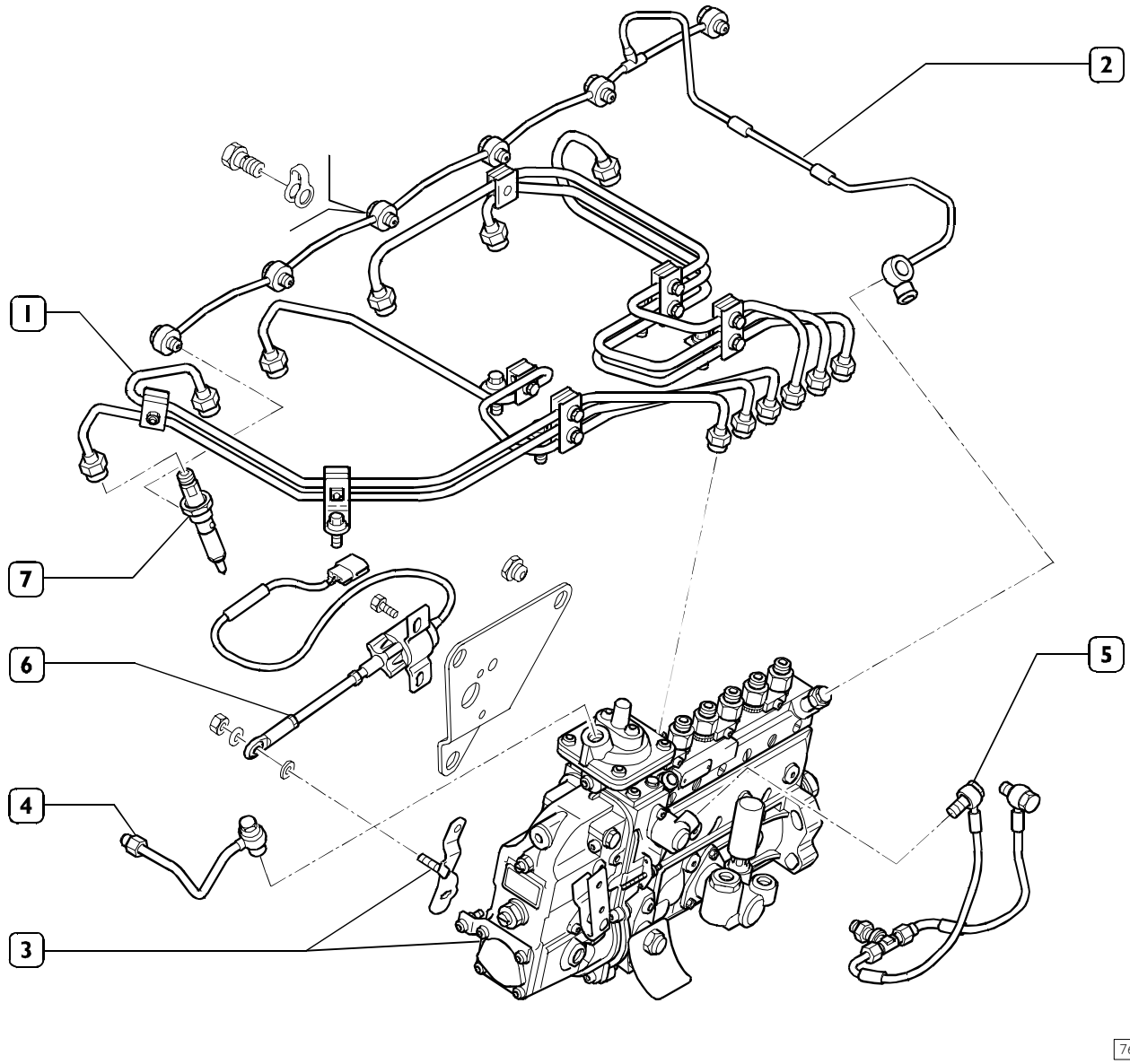
INJECTION FEED SYSTEM BY MECHANICAL PUMP UNIT

General information

Fuel feed system is composed by:

- ❑ Fuel tank (placed on the machine)
- ❑ Fuel delivery and back–flow to tank
- ❑ Fuel pre–filter (if available, it is usually placed close to the engine on the machine frame)
- ❑ Priming pump, assembled to the pump body
- ❑ Fuel filter (assembled to the engine in different positions according to equipment application and duty)
- ❑ Injector feed pipeline (from fuel feed pump to injectors)
- ❑ Injectors

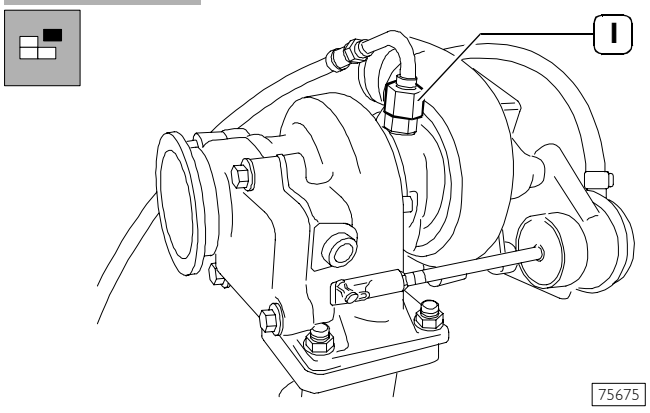
Figura 6



1. Injector feed pipes – 2. Fuel exhaust pipes from injectors – 3. Fuel feed pump – 4. Connector for LDA pressure gauge pipe within suction collector – 5. Lubrication pipes – 6. Engine stop – 7. Injector

Disassembly of application components

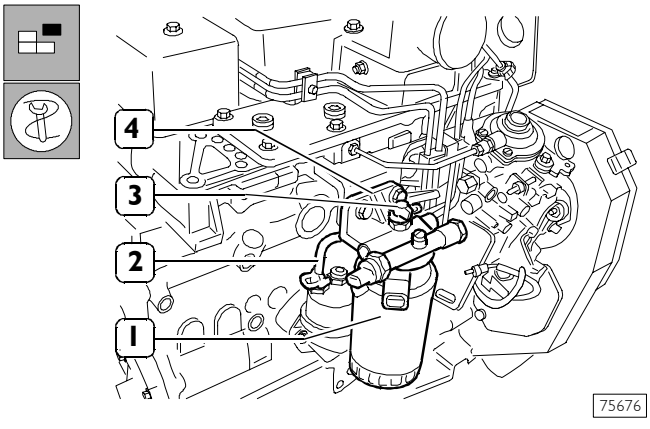
Figure 7



Proceed disassembling the supercharger:

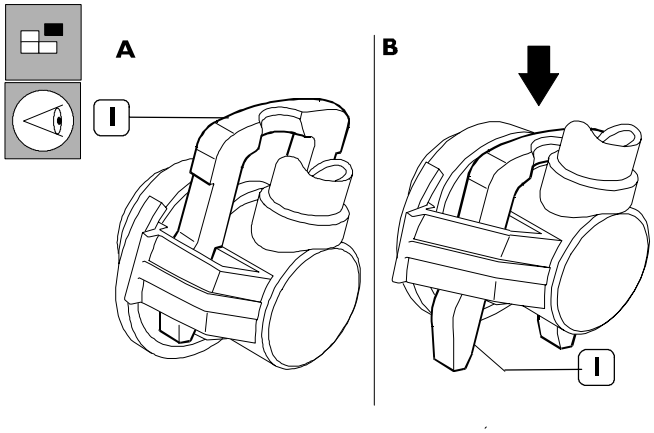
- ❑ loosen the fixing nut (1) and remove the lubrication pipe from the supercharger. Analogously carry out the same operation on the other end of the pipe and remove it from the upper part of the heat exchanger.
- ❑ Loosen the screw nuts fixing the supercharger on the exhaust manifold.
- ❑ Hold up the supercharger and after lifting it remove the gasket.

Figure 8



- ❑ Place a container under the fuel filter and screw out the condense drain faucet underneath said filter. Carry out complete drainage of the fuel contained therein.
- ❑ Screw out completely the faucet and, using acceptable tools, remove the oil filter (1).
- ❑ Disconnect fuel pipelines (2 and 3) respectively from priming pump to filter bearing and from this last one to the feed pump.
- ❑ Remove the fuel filter bearing (4) from the bracket fixed to the engine head.

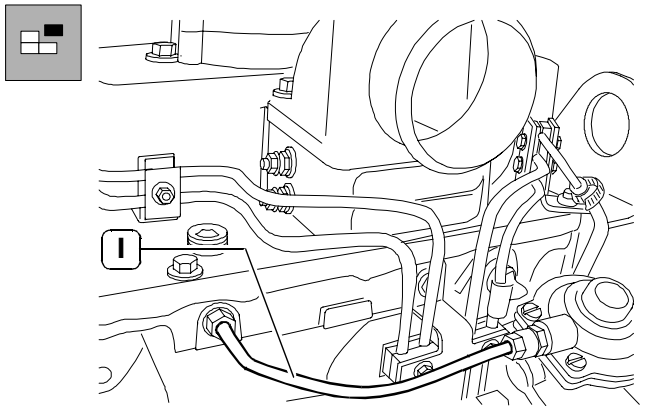
Figure 9



To disconnect fuel pipelines (2 and 3, picture 8), in low pressure from the relating pipe fittings, it is **Necessary to press the locking fastener (1) as shown in picture B.**

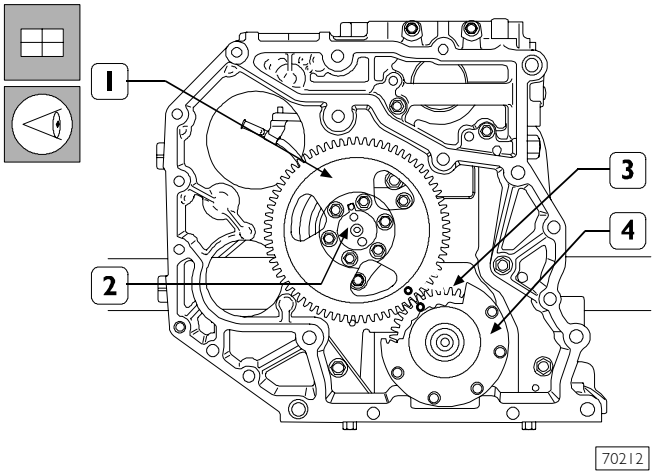
After having disconnected the pipeline, reset the locking fastener (1) in lock position as shown in. Picture A, to avoid any possible deformation of the fastener itself.

Figure 10



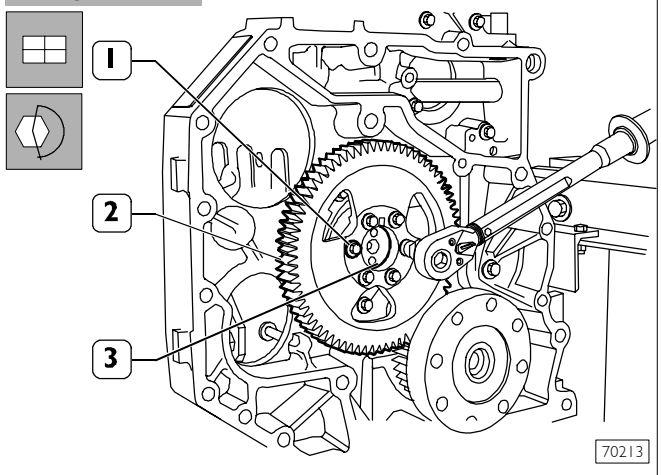
- ❑ Disconnect the LDA pipe (1) from the head and from the feed pump. Pipe the ends of the pipelines as well as the feed pump and the engine head.

Figure 41



❑ Orient engine drive shaft (4) and camshaft (2) taking care that in phase of assembly of the driving gear (2) to the camshaft, the notches marked on the gears (1 and 3) shall match.

Figure 42



❑ Tighten the screws (1) fixing the gear to the camshaft (3) and lock them to the prescribed couple.

Figure 43

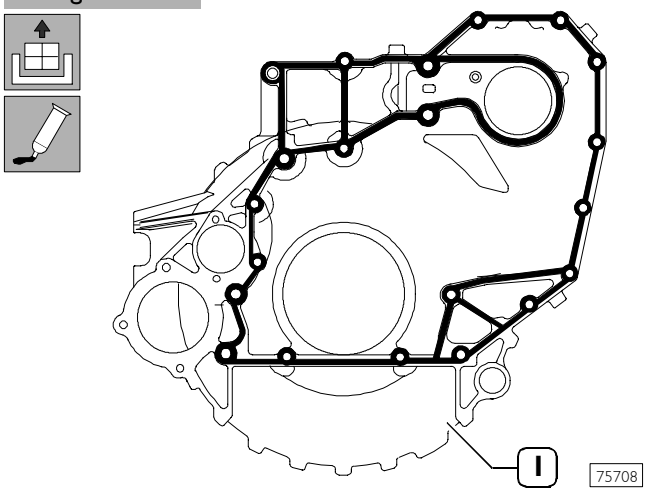


DIAGRAM SHOWING SEALING LOCTITE 5205 APPLICATION.

It is necessary and essential to clean the surface to be sealed in order to achieve excellent tight seal.

Apply sealing LOCTITE 5205 on the box in order to form a kerbstone of a few mm. Diameter. It must be uniform (no crumbs), with no air blisters, thinner or irregular zones.

Any eventual imperfection shall be correct as soon as possible.

Avoid using material in excess to seal the joint. Too much sealing material would drop out on both sides of the joint and obstruct lubricant passages.

After having completed seal application, the joints must be immediately assembled (10–20 minutes time).

Figure 44

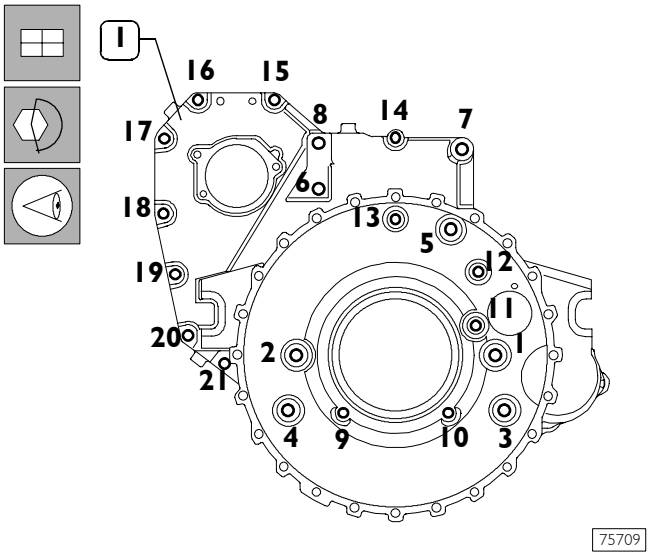


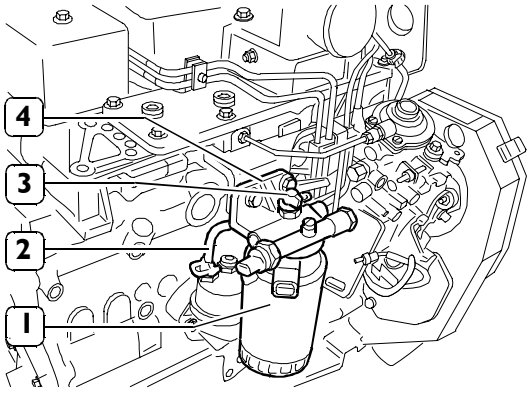
DIAGRAM SHOWING SCREW TIGHTENING TO FIX FLYWHEEL COVER BOX.

❑ Reassemble the box (1) to the engine block, tighten the fixing screws in the same position as found out during disassembly and fix the screws to the locking couples listed here below, following the order as shown in the picture.

Screws M12	75 ÷ 95 Nm
Screws M10	44 ÷ 53 Nm

Before assembly, always check that the threads of the ports and of the screws have no evidence of tear and wear nor dirt.

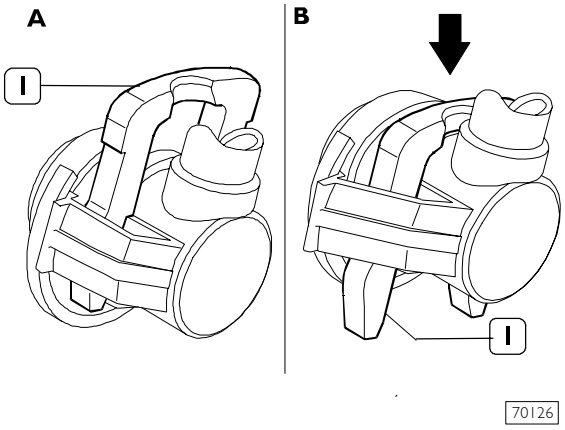
Figure 87



- ❑ Assemble the fuel filter bearing (4) to the bracket fixed to the engine head.
- ❑ Connect the fuel pipelines (2 and 3) respectively from priming pump to filter bearing and from this last one to feed pump.
- ❑ Using acceptable tools assemble fuel filter (1).

The filter shall be priory filled with fuel to facilitate feed system bleed operations.

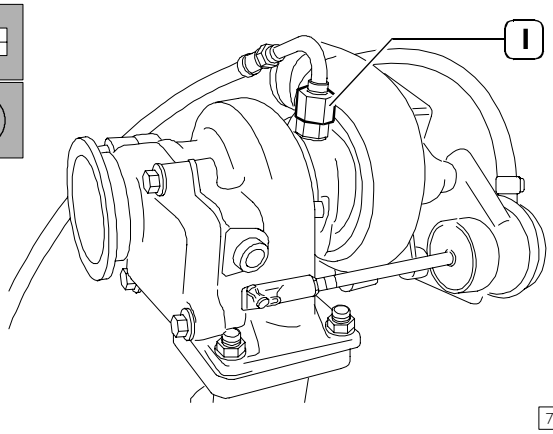
Figure 88



To connect fuel pipelines (2 and 3, Figure 87) in low pressure from the relating connection unions it is necessary to press the locking fastener (1) as shown in picture B.

After having connected the pipeline, reset the fastener (1) into block position as shown in picture A.

Figure 89



Proceed assembling the turbocharger:

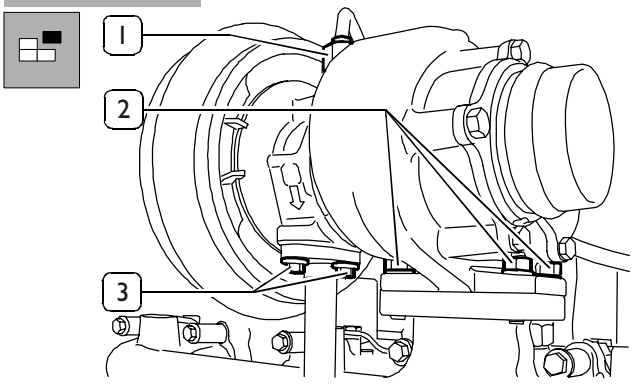
- ❑ Hold the turbocharger and place it on the exhaust manifold after having interposed the gasket.
- ❑ Screw up the fixing nuts of the turbocharger to the exhaust manifold tightening them to the prescribed couple.
- ❑ Tighten the lubrication pipe fixing ring. Operate in the same way on the other end of the pipe. Connect it to the upper part of the heat exchanger.

To complete engine assembly it is necessary to remove it from the turning stand.

- ❑ Using acceptable tools, hold the engine and loosen the screws fixing the brackets to the turning stand.
- ❑ Disassemble the brackets from the engine after having properly put it on a wooden bearing.

Disassembly of application components

Figure 111

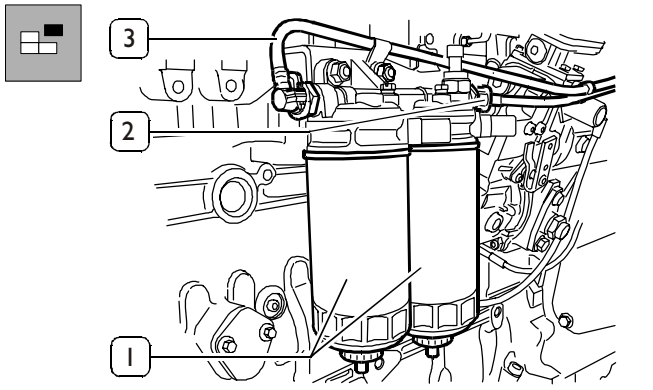


76143

Proceed disassembling the supercharger:

- ❑ loosen the fixing nut (1) and remove the lubrication pipe from the supercharger. Analogously carry out the same operation on the other end of the pipe and remove it from the upper part of the heat exchanger.
- ❑ Loosen the fixing screw (3) and remove the exaust lubrication pipe from the supercharger.
- ❑ Loosen the screw nuts fixing the supercharger on the exhaust manifold.
- ❑ Hold up the supercharger and after lifting it remove the gasket.

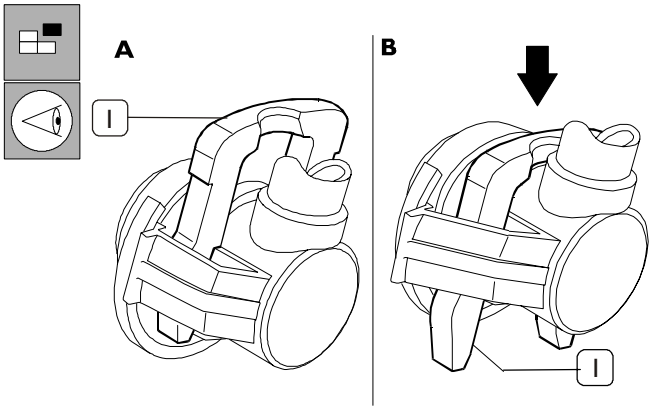
Figure 112



76141

- ❑ Place a container under the fuel filter and screw out the condense drain faucet underneath said filter. Carry out complete drainage of the fuel contained therein.
- ❑ Screw out completely the faucet and use acceptable tools to disassemble oil filters (I).
- ❑ Disconnect fuel pipelines (2 and 3) respectively from priming pump to filter bearing and from this last one to the feed pump.
- ❑ Remove the fuel filter bearing from the bracket fixed to the engine head.

Figure 113

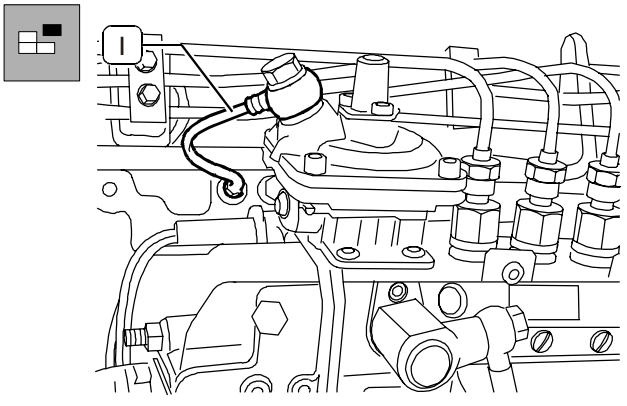


70126

To disconnect fuel pipelines (2 and 3, picture 8), in low pressure from the relating pipe fittings, it is **Necessary to press the locking fastener (1) as shown in picture B.**

After having disconnected the pipeline, reset the locking fastener (1) in lock position as shown in. Picture A, to avoid any possible deformation of the fastener itself.

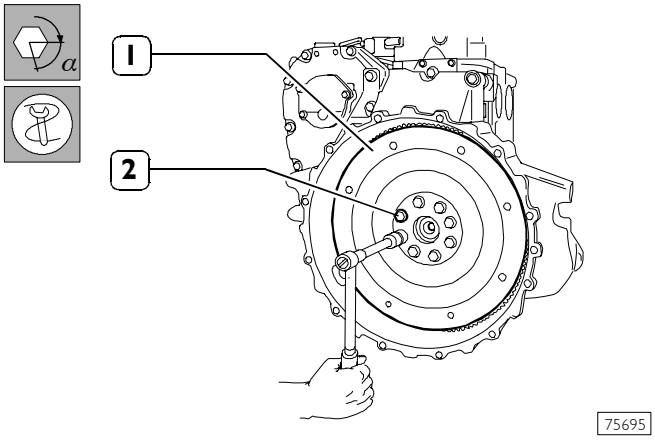
Figure 114



76139

- ❑ Disconnect the LDA pipe (1) from the head and from the feed pump. Pipe the ends of the pipelines as well as the feed pump and the engine head.

Figure 154

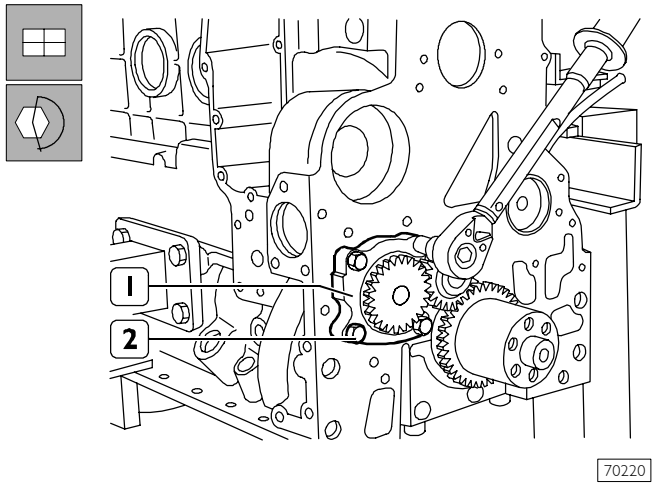


Tighten the engine flywheel (1) fixing screws (2) in two phases:

- ❑ 1st phase; tightening by means of dynamometric wrench to couple 30 ÷ 40 Nm;
- ❑ 2nd phase, 60° ± 5° angle dwell.

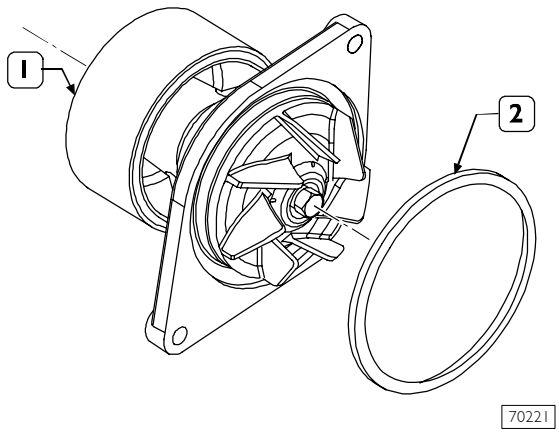
Angle dwell shall always be performed using acceptable tools.
Before assembly, always check that the threads of the ports and of the screws have no evidence of tear and wear nor dirt.

Figure 155



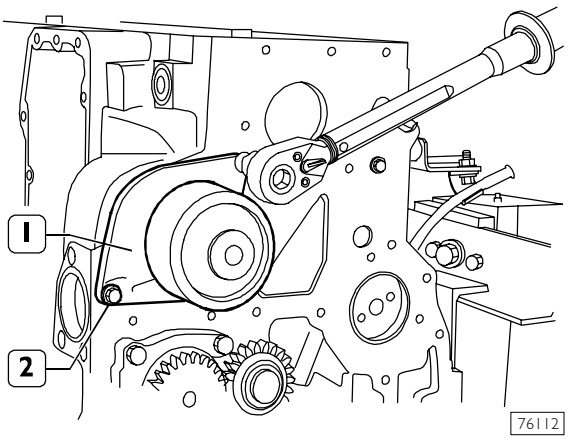
- ❑ Assemble oil pump (1).
- ❑ Tighten fixing screws (2) and lock them to the prescribed couple.

Figure 156



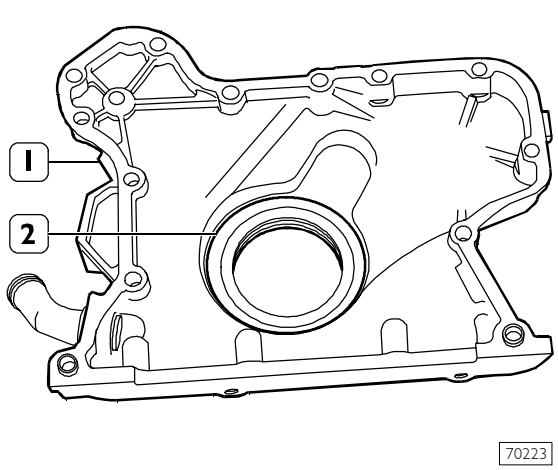
- ❑ Apply to the water pump (1) a new fixing ring (2).

Figure 157



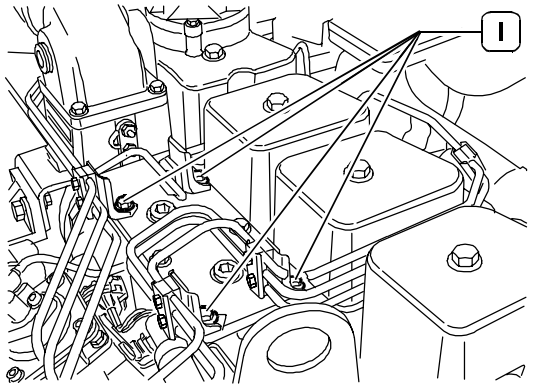
- ❑ Assemble the water pump (1).
- ❑ Tighten the screws (2) and lock them to the prescribed couple.

Figure 158



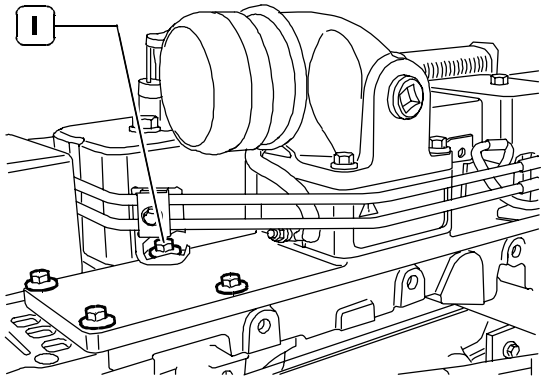
- ❑ Remove the fixing ring (2) from the front cover (1), accurately clean the plug surface.

Figure 190



76148

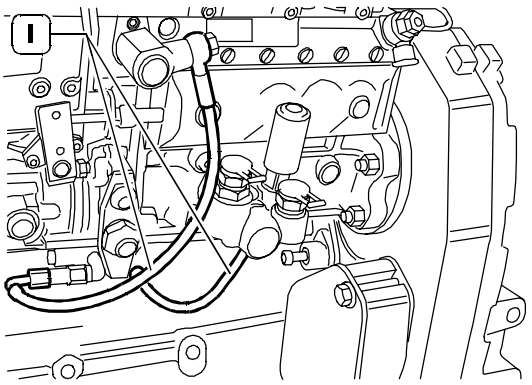
Figure 191



76150

❑ Fix the pipes to the injectors throughout the brackets previously assembled (fixing screw 1, Figure 190 and 2, Figure 191).

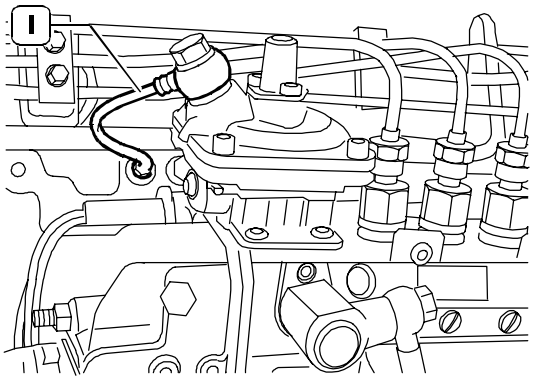
Figure 192



76132

❑ Assemble lubrication pipes to feed pump.

Figure 193

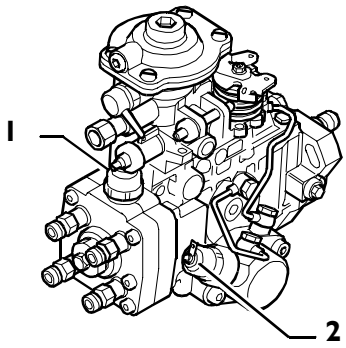


76139

❑ Fix the LDA pipeline (1) to the engine head and to the feed pump.

Electromagnets assembled to feed pump

Figure 219

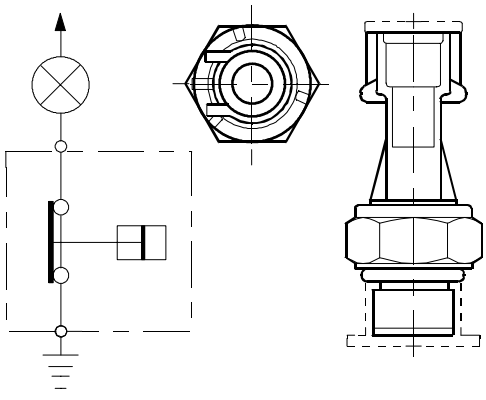


75724a

1 – Hydraulic head Electro–magnet; 2 – KKSB Electro–magnet

Oil pressure switch

Figure 220



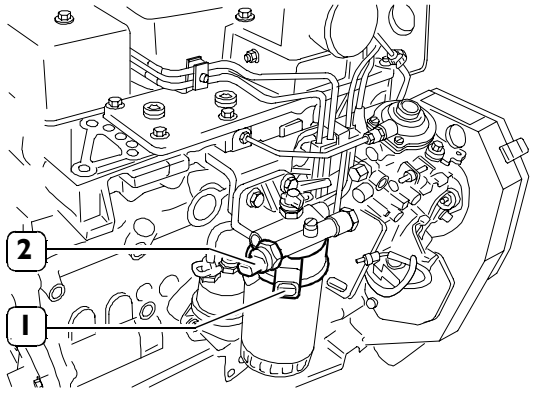
75722

It is assembled to the block on the engine's left hand side.Specifications:

Working tensions:	12 ÷ 24 V
Contact closure upon lower pressure:	0.2 bar
Contact opening upon higher pressure:	0.9 bar

Fuel filter

Figure 221



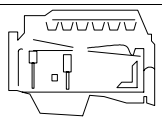
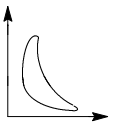
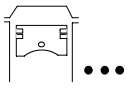
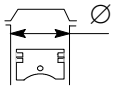
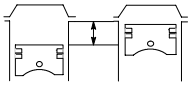
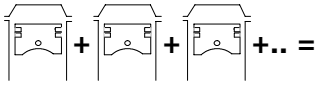
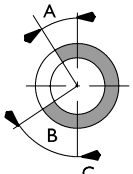
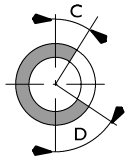
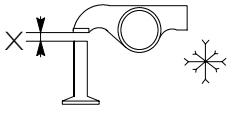
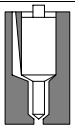
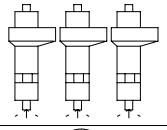
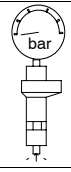
75716

1 – Fuel temperature sensor; 2 – Resistor for filter heating;

On the fuel filter bearing there is the temperature sensor and the fuel filter heating resistor connection.

ANOMALY	POSSIBLE CAUSE	REMEDY	NOTE
Engine running with abnormal knocking	Knocking of crankshaft causing excessive play on one or more main or rod bearings or excessive play on shoulders.	Rectify the pins of the crankshaft and install smaller bearings. Replace the thrust half–rings.	
	Crankshaft unbalanced.	Check alignment of crankshaft.	
	Loosening of screws securing flywheel.	Replace the loosened screws and tighten all the screws to the specified torque.	
	Misalignment of rods.	Replace the rods.	
	Noise from piston journals due to excessive play of piston hubs and in the rod bushing. Loose bushings in the rod seatings.	Replace the piston journal and/or the piston and rod bushing. Replace with new bushings.	
	Noisy timing.	Adjust the play between camshaft cams and tappets and check that there are no broken springs, that there is no excessive play between the valve stems and the valve guides, tappets and seatings.	
The engine smokes abnormally. Black or dark grey smoke.	Excessive maximum pump output.	Disconnect the pump and adjust delivery in accordance with the data given in the calibration table.	See your dealer.
	K.K.S.B. device out of calibration or malfunctioning.	Check operation by a tester and adjust correctly as described in the manual.	
	There is an excessive delay on the injection pump.	Correct the set–up.	

GENERAL SPECIFICATIONS

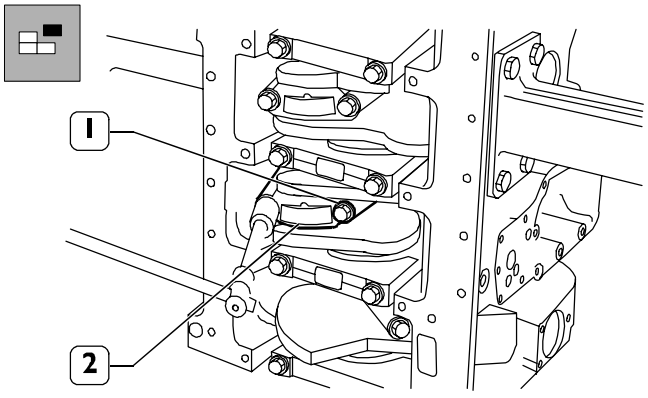
	Type		4 CYLINDERS	6 CYLINDERS
	Cycle		Four–stroke diesel engine	
	Power		Supercharged with intercooler	
	Injection		Direct	
	Number of cylinders		4 in–line	6 in–line
	Bore	mm	104	
	Stroke	mm	132	
	Total displacement	cm^3	4485	6728
	**TIMING**			
	start before T.D.C.	A	–	
	end after B.D.C.	B	–	
	start before B.D.C.	D	–	
	end after T.D.C.	C	–	
	Checking timing			
	X	mm	–	
	X	mm	–	
	Checking operation			
	X	mm	0.152 to 0.381	
	X	mm	0.318 to 0.762	
	FUEL FEED			
	Injection Type:	Bosch	VE 4/12F 1150LV	
	Nozzle type		Injectors DSLA 145P	
	Injection sequence		1 – 3 – 4 – 2	1 – 5 – 3 – 6 – 2 – 4
	Injection pressure	bar	245 for F4GE0404A*D6 260 for others	

The following instructions are prescribed on the understanding that the engine has previously been placed on the rotating bench and that removal of all specific components of the equipment have been already removed as well. (See Section 3 of the manual herein).

The section illustrates therefore all the most important engine overhaul procedures.

The following operations are relating to the 4 cylinders engine but are analogously applicable for the 6 cylinders.

Figure 1



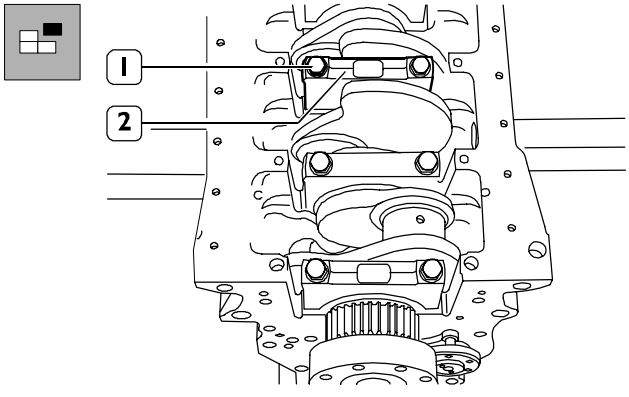
70158

Remove the screws (1) fastening the connecting rod caps (2) and remove them.

Withdraw the pistons including the connecting rods from the top of the engine block.

Keep the half–bearings into their housings since in case of use they shall be fitted in the same position found at removal.

Figure 2



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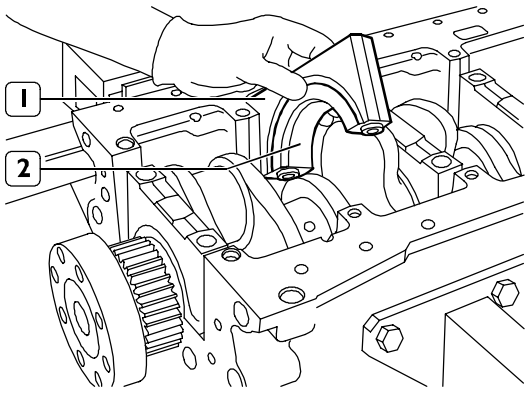
Remove the screws (1) and the main bearing caps (2).

Figure 3



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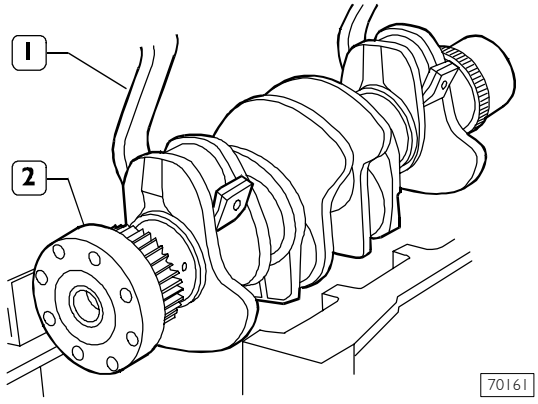
The second last main bearing cap (1) and the relevant support are fitted with shoulder half–bearing (2).

Take note of lower and upper half–bearing assembling positions since in case of reuse they shall be fitted in the same position found at removal.

Figure 4



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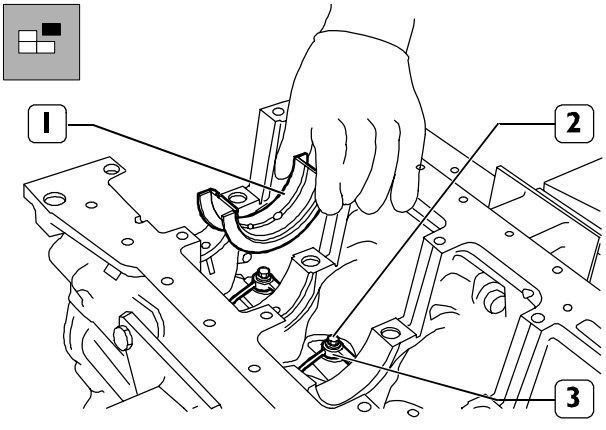
Use acceptable tools (1) and hoist to remove the output shaft (2) from the block.

Figure 5



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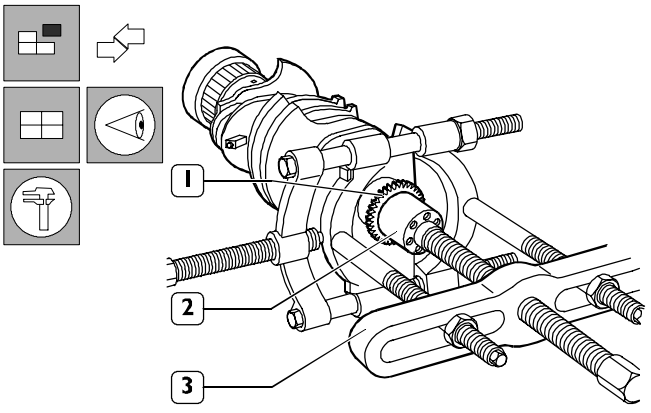
Remove the main half–bearings (1).
Remove the screws (2) and remove the oil nozzles (3).

Replacing oil pump control gear

Figure 31

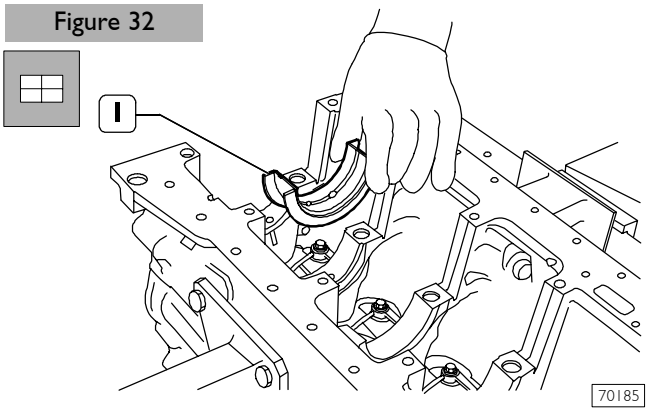


Check that gear toothing (1) is not damaged or worn, otherwise remove it using the proper puller (3).

When fitting the new gear, heat it to 180°C for 10 minutes in an oven and then key it to the output shaft.

Fitting main bearings

Figure 32



Refit the main bearings that have not been replaced, in the same position found at removal.

Main bearings (1) are supplied spare with 0.250 – 0.500 mm undersize on the internal diameter.

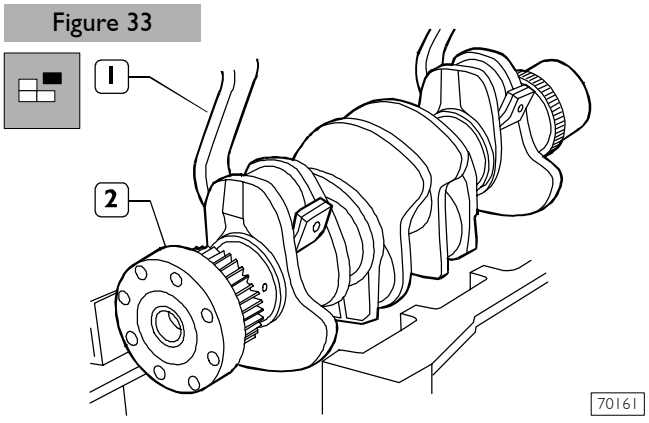
Do not try to adapt the bearings.

Clean accurately the main half bearings (1) having the lubricating hole and fit them into their housings.

The second last main half bearing (1) is fitted with shoulder half rings.

Finding journal clearance

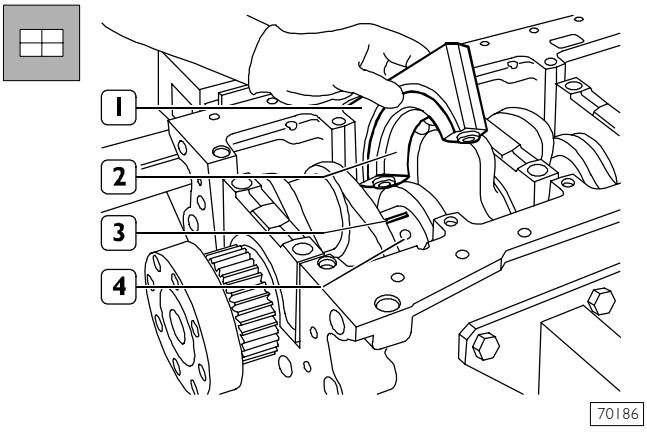
Figure 33



Refit the output shaft (2).

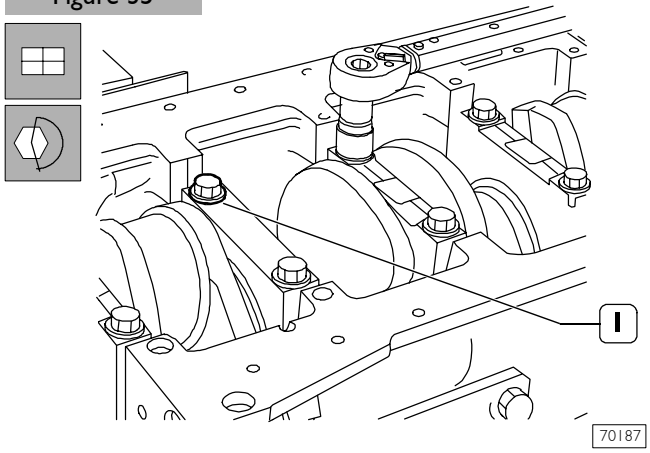
Check the backlash between output shaft main journals and the relevant bearings as follows:

Figure 34



- ❑ clean accurately the parts and remove any trace of oil;
- ❑ position a piece of calibrated wire (3) on the output shaft pins (4) so that it is parallel to the longitudinal axis;
- ❑ fit caps (1), including the half bearings (2) on the relevant supports.

Figure 35



Tighten the pre-lubricated screws (1) in the following three successive stages:

- ❑ 1st stage, with dynamometric wrench to 50 ± 6 Nm.
- ❑ 2nd stage, with dynamometric wrench to 80 ± 6 Nm.