WORK SHOP MANUAL

6LD260
6LD260/C
6LD325
6LD325/C
6LD360
6LD360/V
6LD400
6LD400/V
6LD401/B1
6LD435
6LD435/V
6LD435/B1

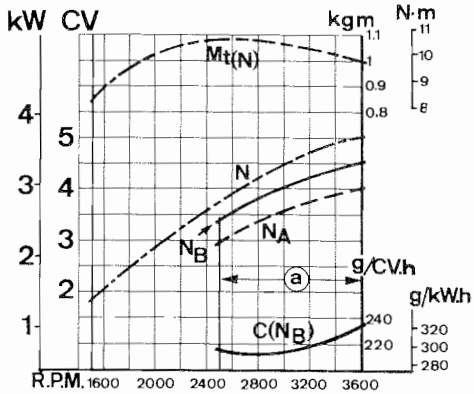
LOMBARDINI

This manual contains the most important information for the repair of LOMBARDINI air-cooled, direct injection Diesel engines type 6LD260, 6LD260/C, 6LD325, 6LD325/C, 6LD435/V, 6LD435/B1. This information is current as of October 1, 1990, and is subject to change without notice.

INDEX

CHARACTERISTIC POWER, TORQUE AND SPECIFIC FUEL CONSUMPTION CURVES

6LD260



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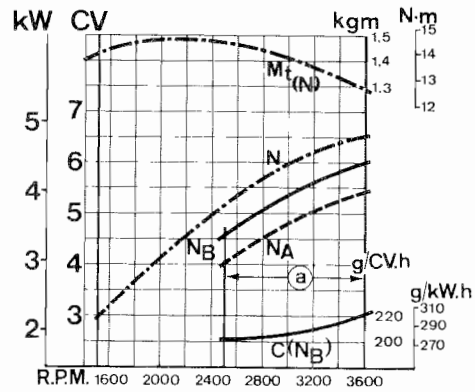

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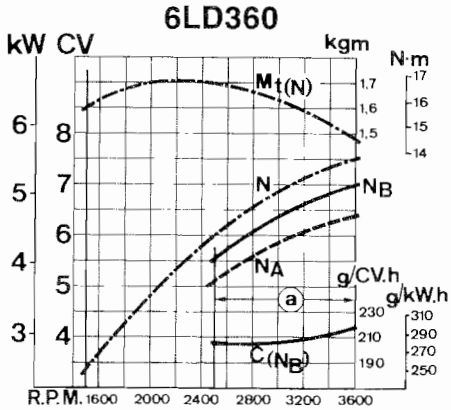

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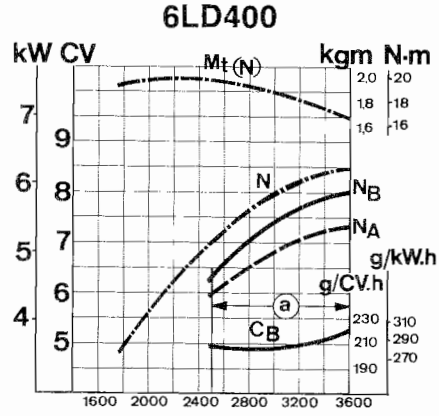
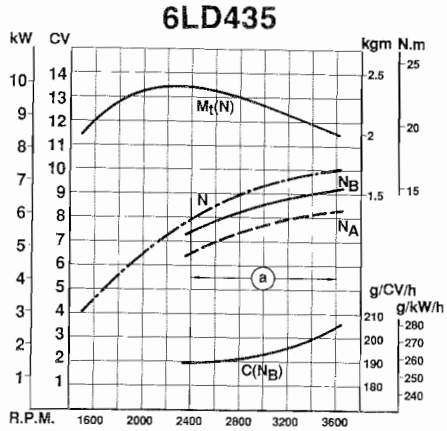


6LD435



N (DIN 70020 - 80/1269/CEE - ISO 1585) AUTOMOTIVE RATING: Intermittent operation with variable speed and variable load.
N_B (DIN 6270) RATING WITH NO OVERLOAD CAPABILITY: Continuous light duty **N_A (DIN 6270) CONTINUOUS RATING WITH OVERLOAD CAPABILITY:** Continuous heavy duty with constant speed and constant load.

The above power values refer to an engine fitted with air cleaner and standard muffler, after run-in and at the environmental conditions of 20°C and 1 bar.
Max. power tolerance is 5%. Power decreases by approximately 1% every 100 m altitude and by 2% every 5°C above 20°C.

$C(N_B)$: Specific fuel consumption at N_B power
Mt : Torque at N power
ⓐ : Speed for continuous operation. In case of application outside this range please contact LOMBARDINI.

MAINTENANCE

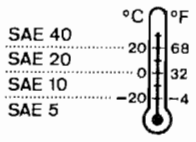
OPERATION	COMPONENT		INTERVAL (HOURS)								
				10	50	125	250	500	1000	2500	5000
CLEANING	OIL-BATH AIR CLEANER (*)			●							
	FEED PUMP FILTER						●				
	HEAD AND CYLINDER FINS (*)						●				
	FUEL TANK								●		
	INJECTORS							●			
CHECK	LEVEL	AIR CLEANER OIL		●							
		CRANKCASE OIL		●							
		BATTERY FLUID			●						
	VALVE/ROCKER ARM CLEARANCE						●				
	INJECTOR SETTING							●			
REPLACEMENT	OIL	AIR CLEANER (**) (***)		●							
		CRANKCASE (***)			△		●				
	OIL FILTER CARTRIDGE				△		●				
	FUEL FILTER CARTRIDGE						●				
OVERHAUL INSPECTION	PARTIAL (****)									●	
	COMPLETE										●

△ First replacement
(*) Under severe working conditions, clean daily
(**) Under extremely dusty conditions, change every 4-5 hours.
(***) See recommended oil type
(****) Includes checking cylinders, piston rings, guides, springs, grinding valve seats, de-carboning heads and cylinders as well as checking injection pump and injectors.

RECOMMENDED OIL TYPE

AGIP DIESEL SIGMA S SAE 30-40 specification MIL-L-2104 C
ESSOLUBE D3, specification MIL-L-2104 D and UNIFARM specification MIL-L-2104 C.
In countries where AGIP and ESSO products are not available use diesel engine oil API SERVICE CD or a similar type complying with the military specification MIL-L-2104 C and MIL-L-2104 D.

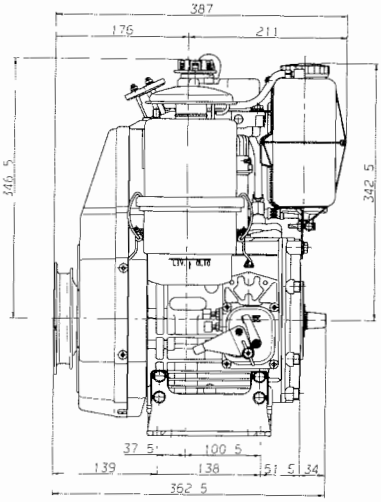
SUGGESTED OIL GRADES

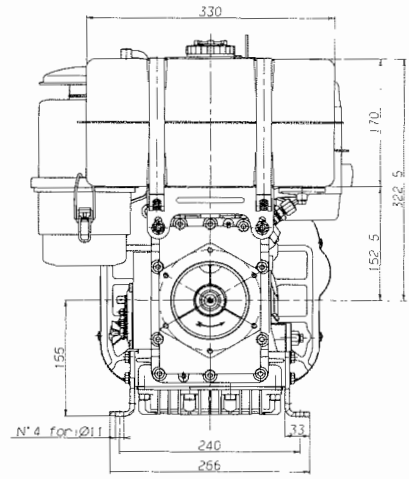


CAPACITIES (LITERS)

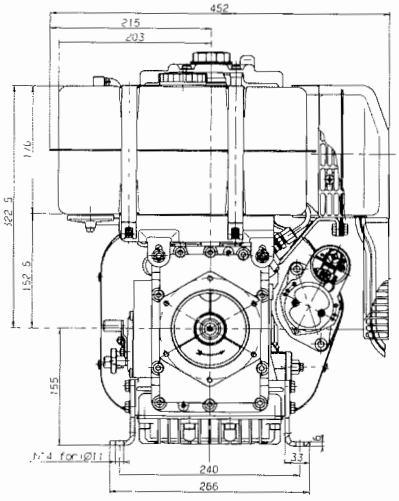
Standard fuel tank	4.3
Air cleaner oil tank	0.3
Standard oil sump:	
6LD260, 6LD260/C, 6LD325, 6LD325/C, 6LD360	1.0
6LD400, 6LD 401/B1, 6LD435, 6LD435/B1	1.2
6LD360/V, 6LD400/V, 6LD435/V	1.1

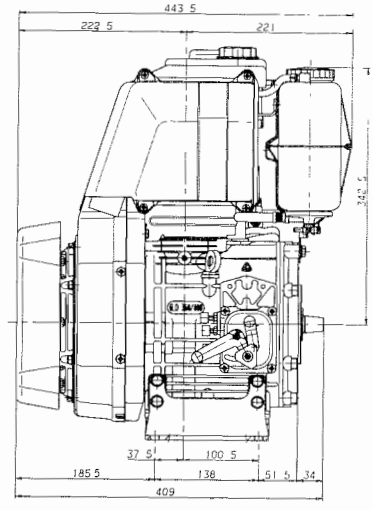
OVERALL DIMENSIONS 6LD435





OVERALL DIMENSIONS 6LD401/B1 and 6LD435/B1





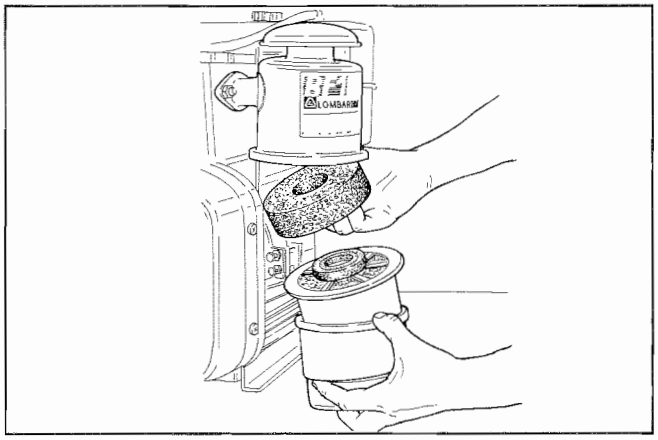
MAIN TORQUE SPECIFICATIONS		
POSITION	Diameter x Pitch mm	Torque Nm
Injection pump delivery valve union	18x1,5	35 ÷ 40
Oil sump	8x1,25	23
Engine flanging bell	8x1,25	35
Rocker arm cover	8x1,25	20
Air cleaner	8x1,25	26
Oil filter	33x2	30
Oil pick-up	12x1,5	35
Clutch flange	8x1,25	40
Injector	6x1	9
Oil pump/speed governor gear	10x1,5	25
Injection pump delivery control lever (steel)	6x1	10
Injection pump delivery control lever (aluminium)	6x1	9
Muffler	8x1,25	25
Starter motor	8x1,25	23
Rocker arm control lever fulcrum pin	12x1,25	50
Engine foot	8x1,25	23
Injection pump	8x1,25	23
Oil pump	6x1	10
Gear cover, timing side	8x1,25	23
Pressure switch	12x1,5	40
Rope pulley	7x1	25 ÷ 27
High pressure injection line	12x1,5	20 ÷ 25
Main bearing support, flywheel side	8x1,25	23
Fuel tank mounting	8x1,25	25
Oil drain plug	12x1,5	50
Oil drain plug for 6LD435, 6LD435/B1 and 6LD401/B1	14x1,5	50
Connecting rod big end	8x1,25	35
Engine cylinder head	9x1,25	35
Engine (integral cylinder)	8x1,25	32
Oil pressure relief valve	18x1,5	25
Flywheel	14x1,5	167

USE OF SEALANTS	
POSITION	Type of sealant
Air baffle/ (electric starting)	Loctite 270
Rocker arm shaft	Selon 334
Injection pump control lever pin (integral cylinder)	Loctite 270
Gear cover, timing side	Selon 334
Oil pick-up	Loctite 270
Alternator/stator retaining screws	Loctite 270
Alternator retaining screws	Loctite 270
(Studs in blind holes)	Selon 334
(Studs in through holes)	Loctite 270
(Bearing support)	Loctite 648 8.V.

STANDARD BOLT TORQUE SPECIFICATIONS						
DESCRIPTION						
Diameter and Pitch (mm)	High-carbon steel		Alloy steel		Special alloy steel	
	Nm	Kgm	Nm	Kgm	Nm	Kgm
4x0,70	3,6	0,37	5,1	0,52	6	0,62
5x0,80	7	0,72	9,9	1,01	11,9	1,22
6x1,00	12	1,23	17	1,73	20,4	2,08
7x1,00	19,8	2,02	27,8	2,84	33	3,40
8x1,25	29,6	3,02	41,6	4,25	50	5,10
9x1,25	38	3,88	53,4	5,45	64,2	6,55
10x1,50	52,5	5,36	73,8	7,54	88,7	9,05
12x1,75	89	9,09	125	12,80	150	15,30
14x2,00	135	13,80	190	19,40	228	23,30
16x2,00	205	21,00	289	29,50	347	35,40
18x2,50	257	26,30	362	37,00	435	44,40
20x2,50	358	36,60	504	51,50	605	61,80
22x2,50	435	44,40	611	62,40	734	74,90
24x3,00	557	56,90	784	80,00	940	96,00

DISASSEMBLY AND REASSEMBLY

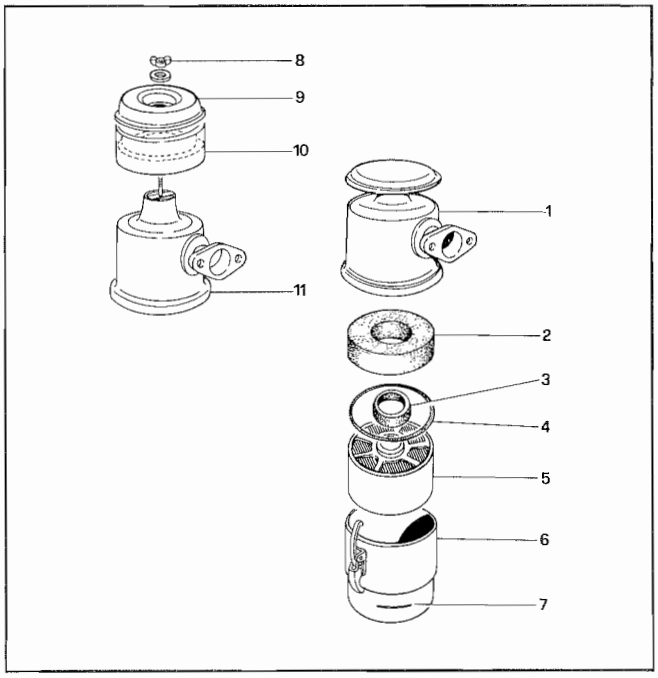
Besides disassembly and reassembly operations this chapter also includes checking and setting specifications, dimensions, repair and operating instructions.
Always use genuine LOMBARDINI spare parts for proper repair operations.



1

Oil-bath air cleaner (standard)

Oil-bath air cleaner with two filtering elements. The lower filtering element is made of metal while the upper is made of polyurethane.
Check gaskets and replace as necessary.
Check that flange welds are free of defects and porosity.
Carefully clean bowl and filtering elements with Diesel fuel and blow through the lower element with compressed air and dry the upper element with a cloth.
Fill with engine oil to the mark.
When refitting tighten nuts to 26 Nm.
See Page 9 for periodic maintenance details and oil replacement.



2

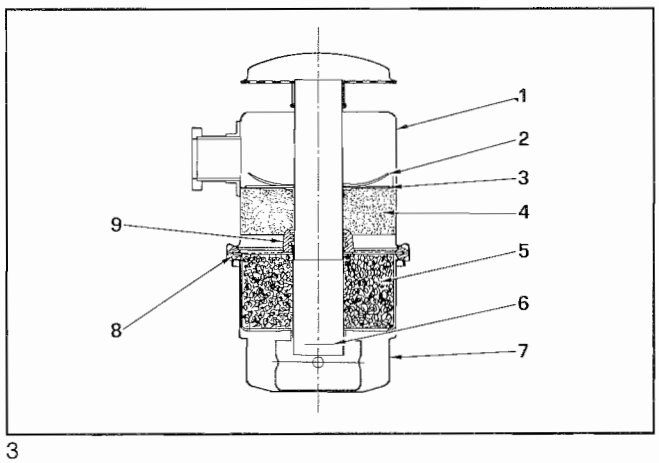
Oil-bath air cleaner components

1 Upper body
2 Upper filtering element (polyurethane)
3 Internal seal ring
4 External seal ring
5 Lower filtering element (steel mesh)
6 Lower body
7 Oil level mark

Centrifugal pre-filter components

8 Wing nut
9 Cover
10 Centrifugal pre-filter
11 Centrifugal pre-filter upper body

Daily check ematy pre-filter cup 10 as necessary.

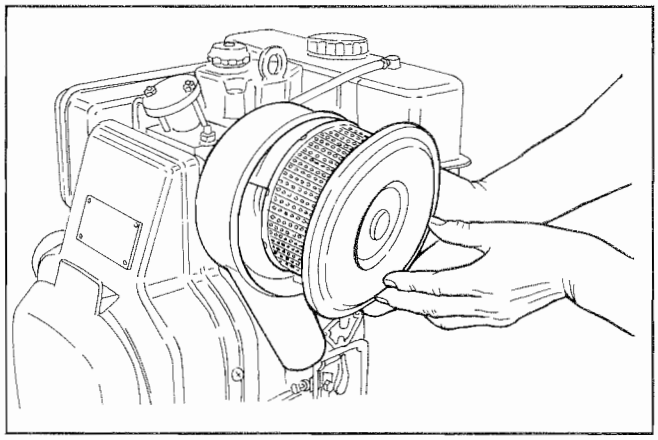


3

Oil-bath air cleaner for de-noised engines

1 Cover
2 Diaphragm stop
3 Diaphragm
4 Upper filtering element (polyurethane)
5 Lower filtering element (steel mesh)
6 Oil level mark
7 Bowl
8 External seal ring
9 Internal seal ring

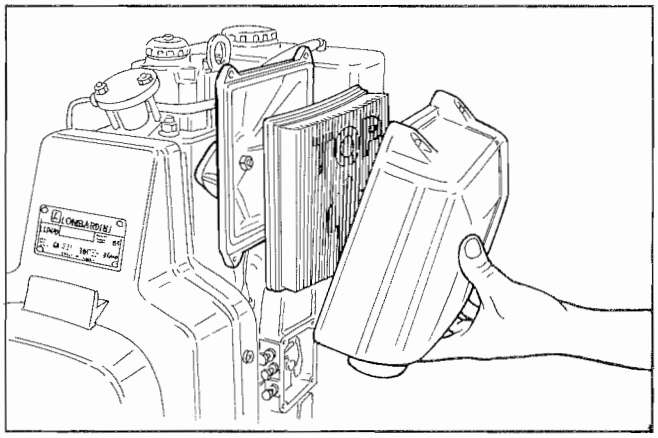
When refitting tighten nuts to 26 Nm.
See Page 9 for periodic maintenance details and oil replacement.



4

Dry air cleaner (optional)

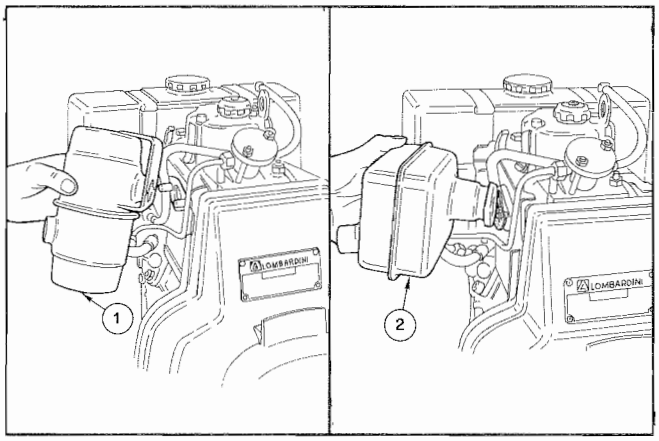
Circular shape with air inlet facing upwards or downwards.
Cartridge characteristics:
Filtering area = 2150 cm²
Degree of filtration = 12 μ



5

Dry air cleaner (optional)

Features an aluminum mounting and a Moplen cover.
The cartridge should always be fitted with the arrow facing upwards (TOP).
Cartridge characteristics:
Filtering area = 3650 cm²
Type of paper = Bosso 20/66 PNCS, yellow
Degree of filtration = 12 μ

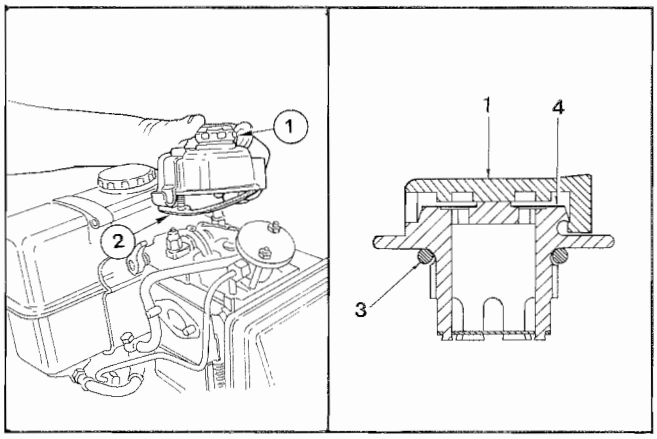


6 7

Muffler

1 Standard muffler
2 Optional muffler

Note: The optional muffler **2** is also available in the de-noised version.
When refitting replace the gasket and tighten nuts to 25 Nm.

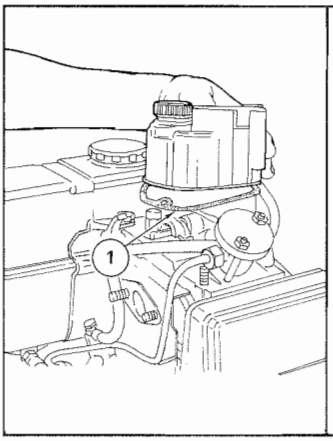


8 9

Rocker arm cover

Components:
1 Breather and oil refill cap
2 Gasket
3 O-ring
4 Diaphragm

The rocker arm cover houses the crankcase breather.
The breathing system efficiency often depends upon diaphragm **5**: regularly check for clinliness.
When refitting replace gasket **2**. Tighten screws to 20 Nm.



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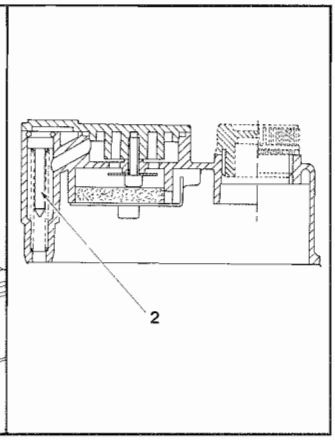
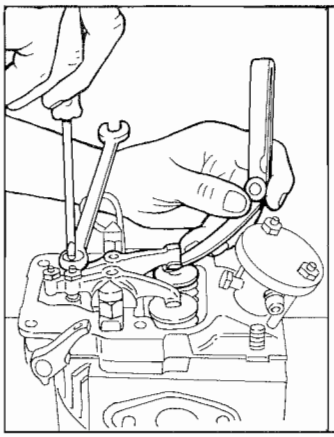


11

Rocker arm cover with internal crankcase vapor recirculation system

Can be fitted with both in case of oil-bath and dry air cleaner.
The crankcase vapors are induced through the intake port.
As the air filter clogs, valve **2** prevents excess oil vapors/condensate from entering the intake port.
When refitting replace gasket **1** and tighten screws to 20 Nm.



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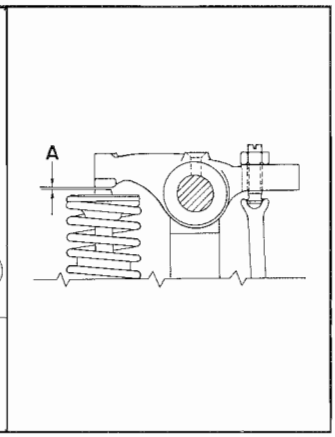
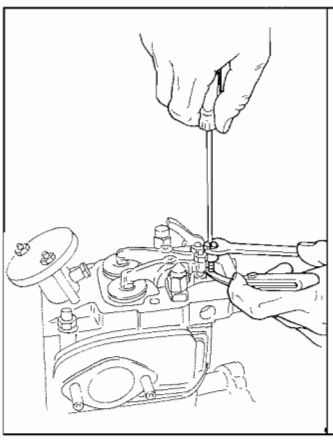


13

Valve/rocker arm clearance

Remove rocker arm cover and check gaskets for damage. Setting should be performed when the engine is cold: bring piston to top dead center on the compression stroke and set clearance **A** at 0,10 ÷ 0,15 mm using a thickness gauge.



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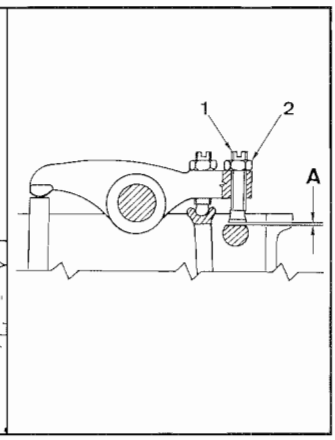

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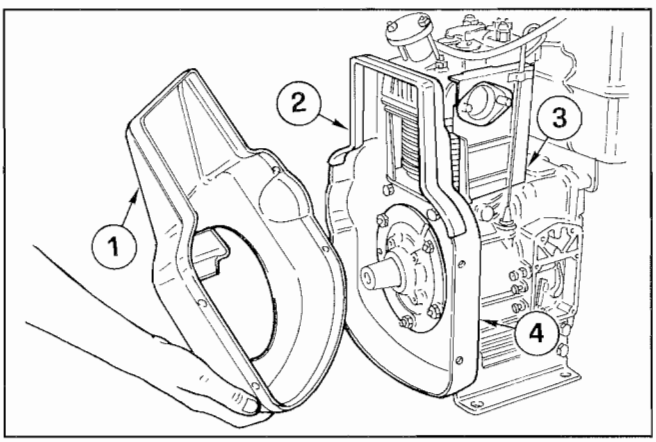
Clearance between compression release cam and adjusting screw

Bring piston to the top dead center on the compression stroke and loosen nut **2**.
By means of screw **1** set clearance **A** at 0,4 ÷ 0,5 mm using a thickness gauge. Tighten nut **2**.



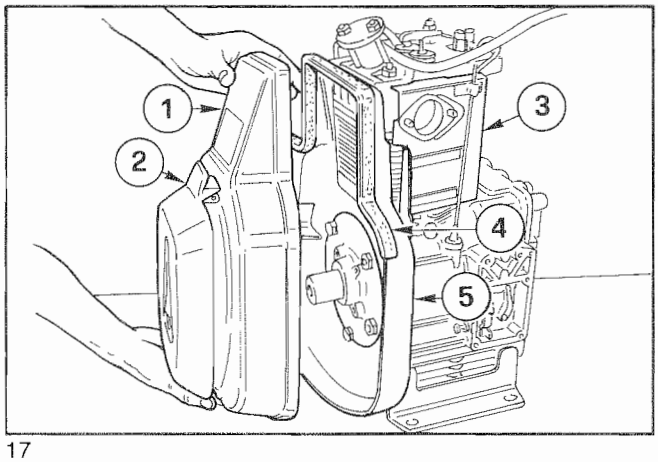
16

Standard shroud and side plates

Components:

1 Shroud
2 Gasket
3 Side plate
4 Shroud plate

Together with plate **4** and both side plates **3** the shroud directs the air flow generated by flywheel rotation towards the head and cylinder.
Gasket **2** seals the shroud to the plate and reduces vibration.
When refitting tighten the screws which fix it to the plate to 10 Nm.

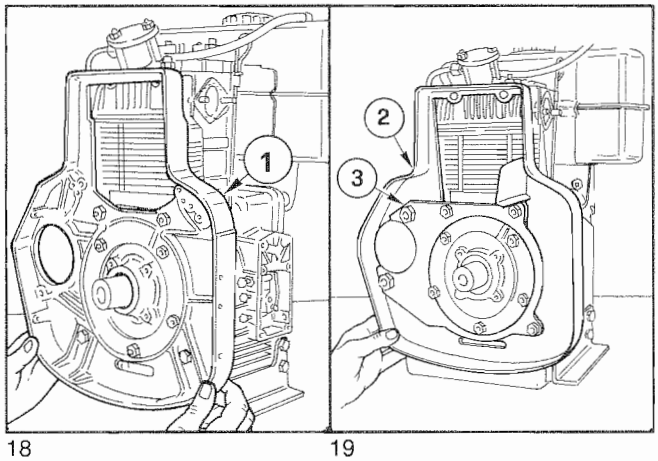


17

Sound-insulating shroud with shroud plate and side plates

1 Shroud
2 Pulley guard
3 Side plate
4 Gasket
5 Shroud plate

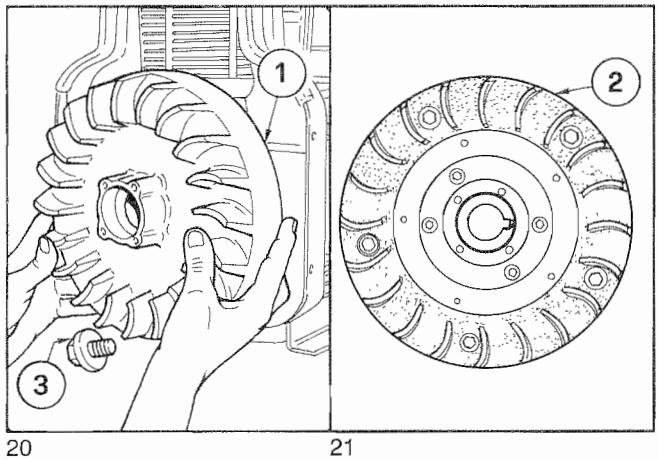
Similar to plate **5** and side plates **3** the sound-insulating shroud **1** is made of special material (ANTIPHON) which absorbs the noise generated by plate vibrations.
Pulley guard **2** is made of deadening material which reduces the noise the cooling fins produce.
When refitting tighten screws to 10 Nm.



18 19

Shroud/starter plate

Three types of conveyor plates for electric starting are available: made of aluminium **1**, of standard sheet metal **2** or ANTIPHON. Plates made of sheet metal and ANTIPHON require a mounting plate **3** to support the starting motor.
When refitting tighten screws to 23 Nm.

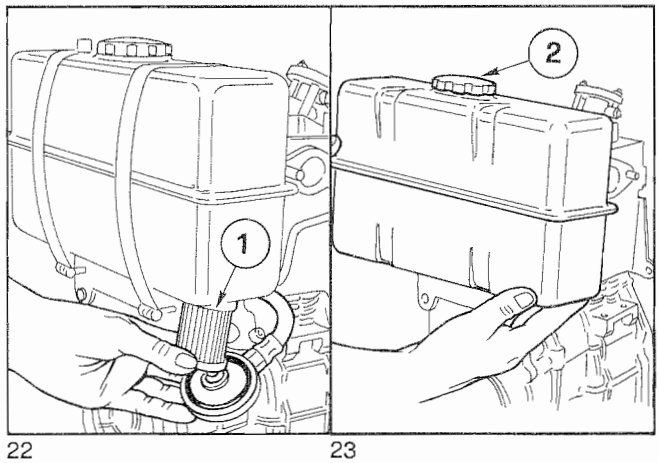


20 21

Flywheel

1 Standard flywheel
2 Flywheel with plastic blades for small vehicles.

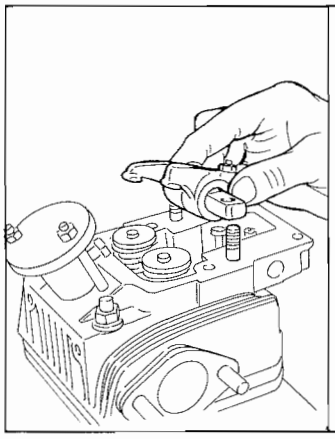
Turn bolt **3** clockwise (in the case of models 6LD260/C and 6LD325/C turn the bolt counterclockwise) to loosen. When refitting tighten the bolt to 167 Nm.



22 23

Tank

After removing fuel filter **1** remove tank and tank support.
Completely emtpy the tank and check that no impurities are present within the tank.
Check that cap breather **2** is not clogged.
When refitting tighten support screws to 25 Nm.
See Fig. 131 for refitting fuel filter components.



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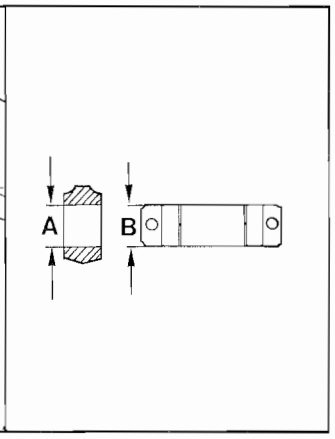
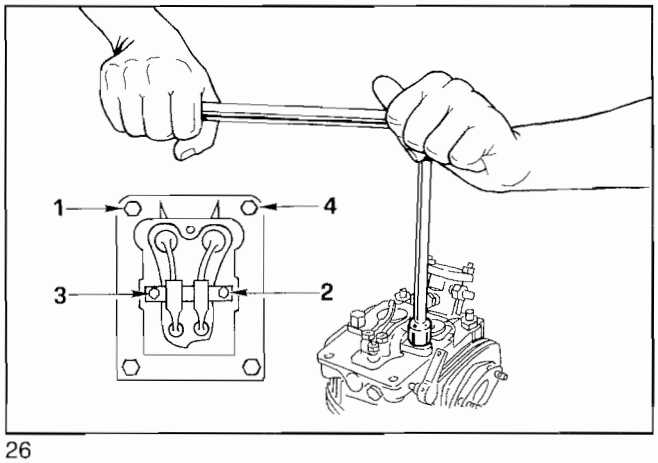


25

Rocker arm assembly

Dimensions (mm):
A = 15,032 ÷ 15,050
B = 14,989 ÷ 15,000

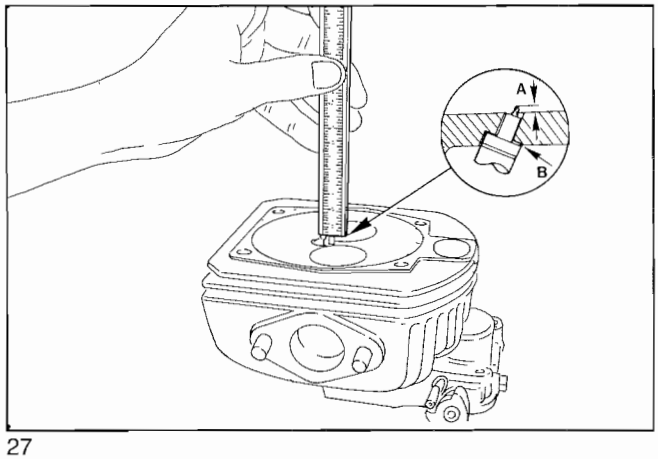
Clearance (mm):
(A-B) = 0,032 ÷ 0,061 **(A-B)** limit value = 0,120



26

CYLINDER HEAD

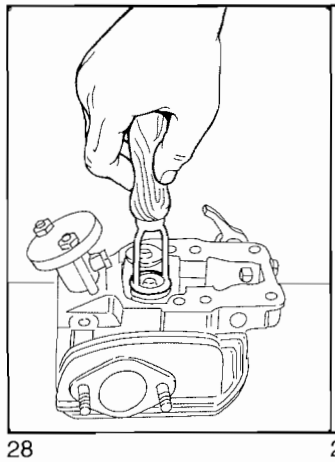
Do not remove when hot to avoid warpage.
If cylinder head is warped, machine a maximum of 0.3 mm.
Always replace copper head gaskets; see Fig. 58 for choosing the right thickness.
Progressively tighten nuts to 35 Nm in the **1**, **2**, **3**, **4** sequence.



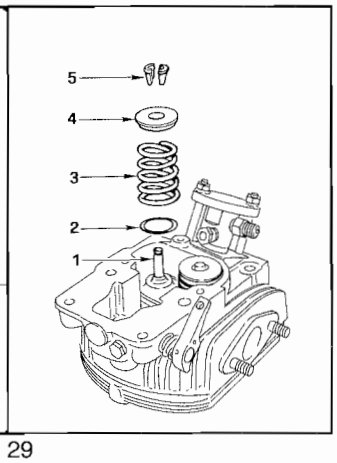
27

Injector projection

The end of nozzle **A** should project 2,35 ÷ 3,30 mm from the cylinder head plane.
For 6LD401/B1 and 6LD435/B1 this value should be 2.85 ÷ 3.75 mm.
Adjust with copper gaskets **B** with thickness 0.5, 1.0 and 1.5 mm.



28

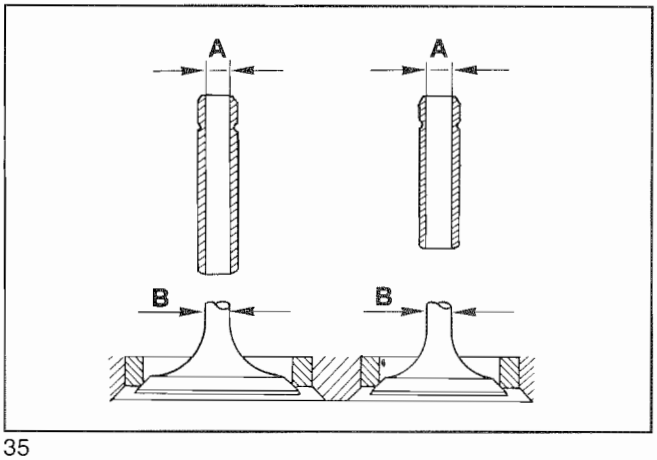


29

Valves

1 Valve stem
2 Spring disk/seat
3 Spring
4 Retainer
5 Half collets

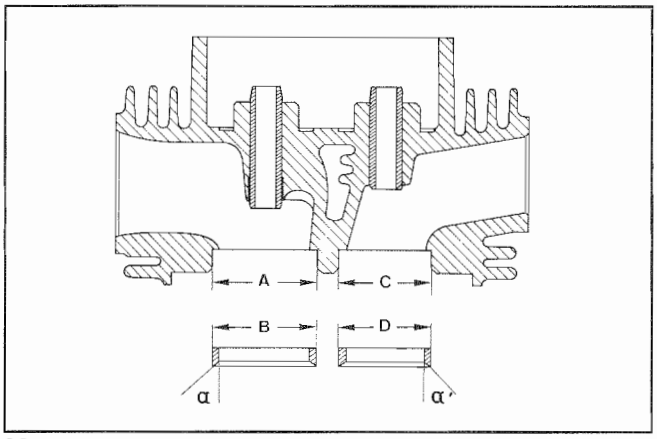
Note: To remove half collets place a suitable spacer under the valve head and press down firmly as shown in the figure.



35

Dimensions and clearance between guides and valve stems (mm)

A = 7,030 ÷ 7,060
B = 6,985 ÷ 7,000
(A-B) = 0,030 ÷ 0,075 **(A-B)** limit value = 0,13



36

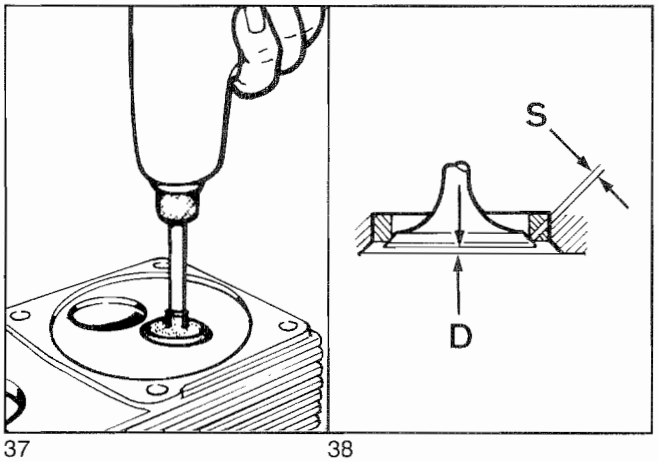
Valve seats and valve seat bores

Dimensions (mm):
A = 35.000 ÷ 35.010
B = 35.100 ÷ 35.120
C = 31.000 ÷ 31.010
D = 31.100 ÷ 31.120

For 6LD 401/B1 and 6LD435/B1
A = 37.000 ÷ 37.010
B = 37.100 ÷ 37.120
C = 33.000 ÷ 33.010
D = 33.100 ÷ 33.120

For 6LD260 and 6LD 260/C
A = 31.000 ÷ 31.016
B = 31.100 ÷ 31.120
C = 27.000 ÷ 27.013
D = 27.085 ÷ 27.100

Press valve seats into the bores and cut α to 45°.



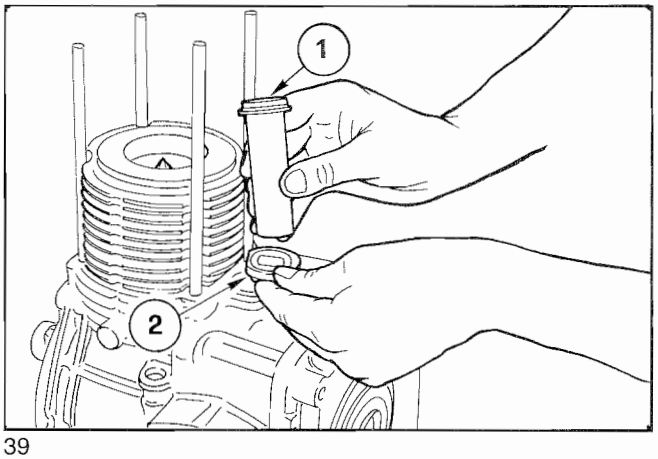
37

38

Valve seat lapping

After cutting lap valve seats with fine lapping compound.
The sealing surface **S** should not exceed 2 mm.
Valve recess **D** after grinding = 0.25 ÷ 0.55 mm; maximum worn limit 1.10; for 6LD260 = 0.25 ÷ 0.75 mm; worn limit 1.20.

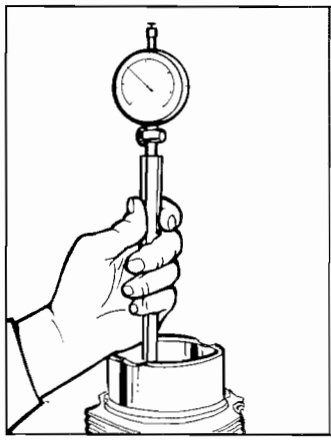
Note: In the case of heads with compression release the exhaust valve recess **D** should be 0.55 ÷ 0.85 mm; in case of models 6LD260 and 6LD260/C = 0.55 ÷ 0.95 mm.



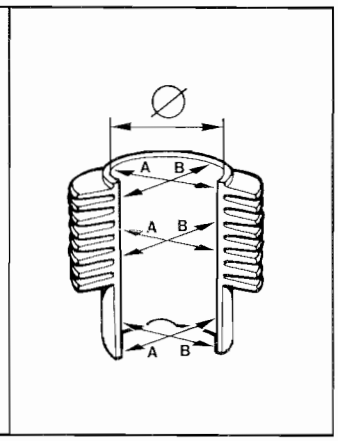
39

Pushrod tube

When refitting the head check before tightening that the upper **(1)** and lower **(2)** gaskets fit well onto the pushrod tube and their seats in the head and crankcase.



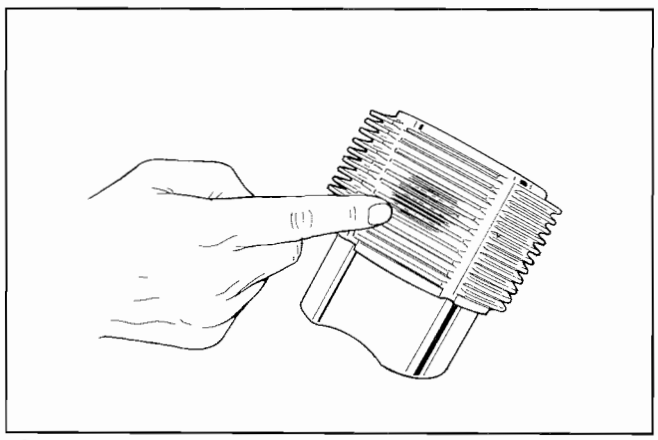
40



41

CYLINDER

Set the dial gauge to zero with a calibrated ring.
Check diameter ∅ at **A** and **B** at three different heights as shown in the figure.
If wear exceeds the max. given value by 0.06 mm bore the cylinder and fit oversize piston and rings.
See Page 23 for diameter values.

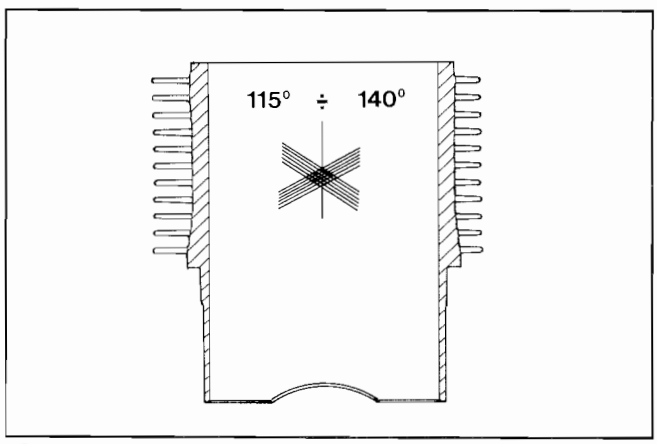


42

Cylinder classes

According to diameter, cylinders are divided into class **A**, **B** and **C** which feature corresponding piston sizes (See Page 23).
Each class is identified by a specific color: white for class **A**, red for class **B** and green for class **C**.
These colors are visible on the cylinder outer surface as shown in the figure.

Note: No consideration is given to the above classes for cylinders supplied as spares.

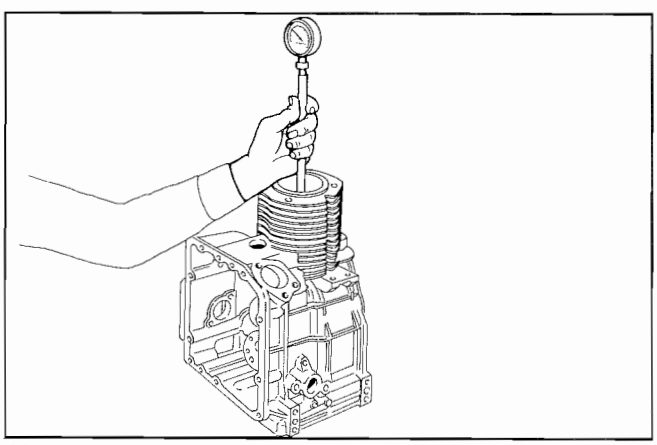


43

Cylinder roughness

The cross-hatch pattern should be at an angle of 115° ÷ 140°; lines should be uniform and clear in both directions.
Average roughness must range between 0.5 and 1 μm.
The cylinder surface which comes into contact with piston rings should be machined with the plateau method.

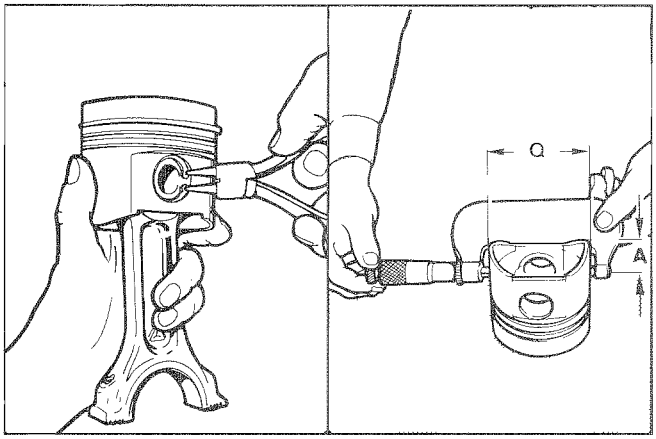
Warning: Do not manually hone the cylinder bore surfaces with emery cloth.



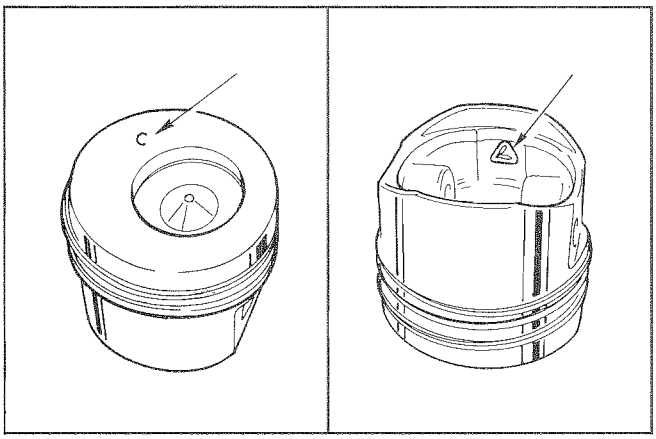
44

Cylinder characteristics in models 6LD260 and 6LD260/C

In models 6LD260 and 6LD260/C the cylinder forms an integral part of the crankcase.
In this case cylinders and pistons are not divided into classes.
Check as shown in Fig. 40 and 41.



45 46



47 48

PISTON

Being of low expancion type, the piston allows small clearances between piston and cylinder and, thus, oil consumption is reduced.
Low expacion pistons are fitted to all engines of this series except for 6LD260 and 6LD260/C.
Remove circlips and remove piston pin.
Remove piston rings and clean grooves.
Measure diameter **Q** at the **A** distance from the bottom of skirt (**A** = 12 mm). In case of 6LD360 **A** should measure = 9,5 mm.
In case of diameter wear exceeding the minimum given value by 0.05 mm replace piston and rings.

Note: Oversize pistons of 0.5 and 1.0 mm are available.

Piston classes and logo

Depending on diameter, pistons are divided into class **A**, **B** or **C**; the class reference is stamped on the piston crown (Fig. 47) while the logo is stamped inside (Fig. 48).

Piston and cylinder dimensions (mm)

Engine	Class	Cylinder ∅	Piston ∅	Clearance
6LD325 **6LD325/C**	A B C	78.00 ÷ 78.01 78.01 ÷ 78.02 78.02 ÷ 78.03	77.95 ÷ 77.96 77.96 ÷ 77.97 77.97 ÷ 77.98	0.04 ÷ 0.06
6LD360 **6LD360/V** **6LD401/B1**	A B C	82.00 ÷ 82.01 82.01 ÷ 82.02 82.02 ÷ 82.03	81.95 ÷ 81.96 81.96 ÷ 81.97 81.97 ÷ 81.98	
6LD400 **6LD400/V** **6LD435** **6LD435/V** **6LD435/B1**	A B C	86.00 ÷ 86.01 86.01 ÷ 86.02 86.02 ÷ 86.03	85.95 ÷ 85.96 85.96 ÷ 85.97 85.97 ÷ 85.98	
6LD260 **6LD260/C**	—	70.00 ÷ 70.02	69.91 ÷ 69.93	0.05 ÷ 0.11

Notes: In models 6LD360 and 6LD360/V, the piston has the same diameter as the 6LD401/B1 but a different combustion chamber. For the same reason the piston fitted to models 6LD400 and 6LD400/V differs from the one fitted to 6LD435, 6LD435/V and 6LD435/B1.

The 6LD360 and 6LD360/V cylinder has the same bore as the 6LD 401/B1 but a different length. For the same reason the cylinder fitted to models 6LD400 and 6LD400/V differs from the one fitted to 6LD435, 6LD35/V and 6LD435/B1.

Piston availability:
Pistons with rated diameter are supplied only in class **A**.
Oversize pistons of 0.50 and 1.00 mm are supplied with oversize reference stamped on the crown.

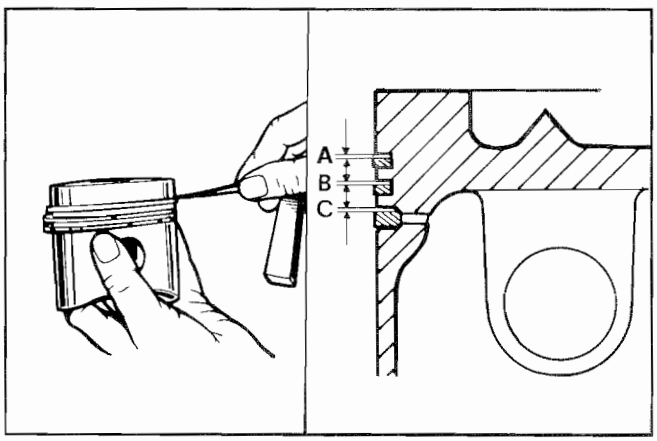
49

Piston rings - End gaps (mm)

Introduce piston rings into the lower part of cylinder and measure the end gap.

1st chromium-plated ring	**A** = 0.30 ÷ 0.45
2nd torsional ring	**A** = 0.30 ÷ 0.45
3rd oil control ring	**A** = 0.25 ÷ 0.40

Note: In models 6LD260 and 6LD260/C the piston features four rings (See Fig. 53).



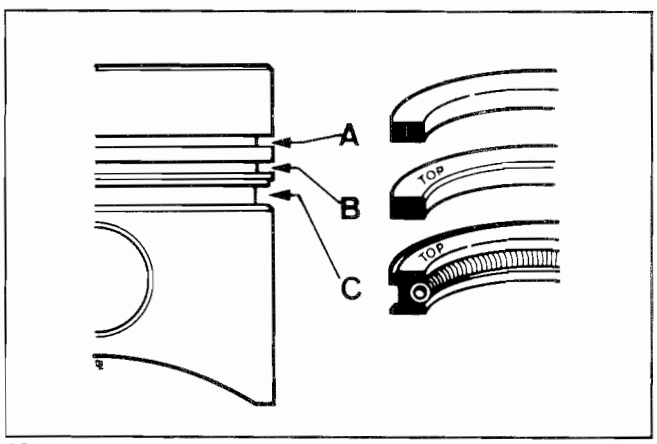
50 51

Piston rings - Clearance between grooves (mm)

For 6LD400, 6LD400/V, 6LD435, 6LD435/B1, 6LD435/V
A = 0.09 ÷ 0.12; limit value = 0.20
B = 0.05 ÷ 0.08; limit value = 0.14
C = 0.04 ÷ 0.08; limit value = 0.14

For 6LD325, 6LD325/C, 6LD360, 6LD360/V, 6LD401/B1
A = 0.08 ÷ 0.10; limit value = 0.17
B = 0.05 ÷ 0.08; limit value = 0.14
C = 0.04 ÷ 0.07; limit value = 0.13

For 6LD260 and 6LD260/C also see fig. 53)
A = 0.11 ÷ 0.15; limit value = 0.25
B = 0.06 ÷ 0.10; limit value = 0.18
C = 0.06 ÷ 0.10; limit value = 0.18
D = 0.05 ÷ 0.09; limit value = 0.16

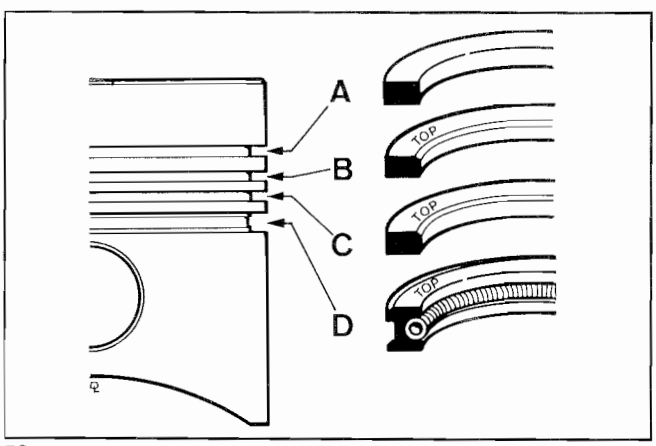


46

Piston rings - Fitting sequence

A = 1st chromium-plated ring
B = 2nd torsional ring
C = 3rd oil control ring

Note: Before fitting the piston into the cylinder turn the rings so that the ring gaps are staggered.

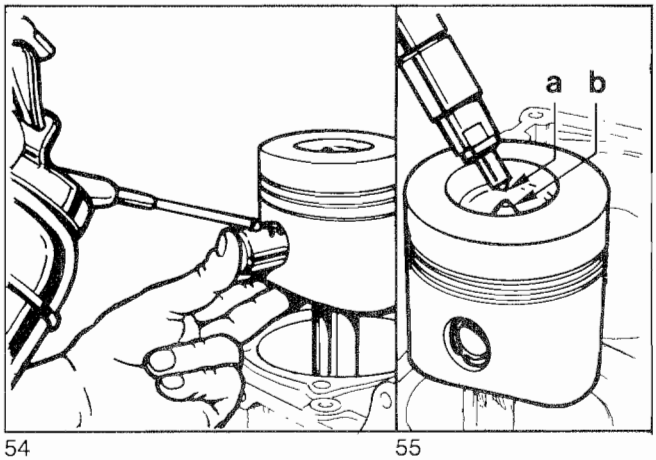


53

Piston rings - Fitting sequence for models 6LD260 and 6LD260/C

A = 1st chromium-plated ring
B = 2nd torsional ring
C = 3rd torsional ring
D = 4th oil control ring

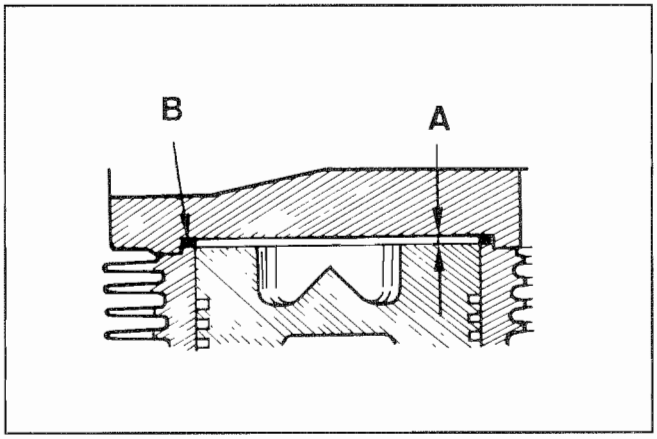
Note: Install piston rings with inscription facing upwards. Piston rings without inscription may be installed in either direction.



54 55

Piston - Refitting

Connect piston to connecting rod such that the combustion chamber center **b** is under nozzle tip **a**.
Lubricate piston pin and introduce into the piston by exerting pressure with your thumb.
Check that both circlips are well inside their seats.

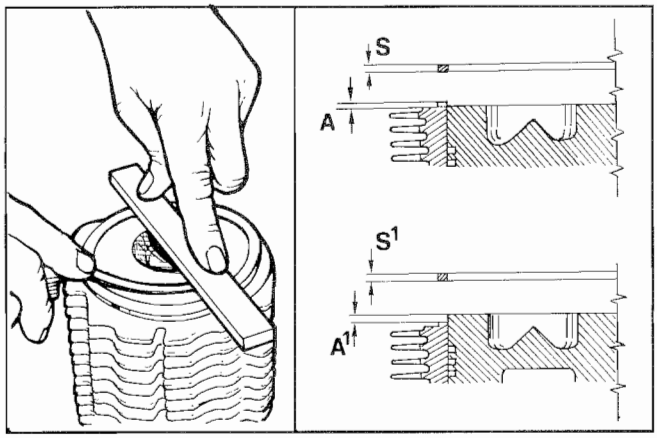


56

Piston clearance

A = Piston clearance
B = Head gasket

The thickness of head gasket **B** determines piston clearance **A** which should be 0.70 ÷ 0.75 mm; it should be 0.60 ÷ 0.65 mm in 6LD260 and 6LD260/C and 0.65 ÷ 0.70 mm in 6LD401/B1 and 6LD435/B1.
Gaskets are available in the following thicknesses: 0.50; 0.55; 0.60; 0.65; 0.70; 0.75; 0.80; 0.85; 0.90; 0.95 mm. For 6LD260 and 6LD260/C = 0.45; 0.50; 0.55; 0.60; 0.65; 0.70; 0.75; 0.80 mm.



57 58

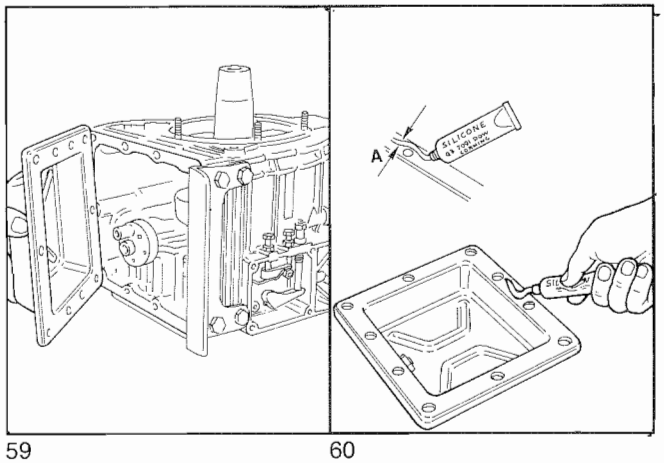
Choosing the head gasket thickness with piston clearance of 0.70 ÷ 0.75 mm

A Distance between piston and cylinder plane (piston under cylinder plane)
S Gasket thickness referred to **A**.

A (mm) =	0.25	0.20	0.15	0.10	0.05	0
S (mm) =	0.50	0.55	0.60	0.65	0.70	

A_1 Distance between cylinder plane and piston (piston on cylinder plane)
S_1 Gasket thickness referred to **A_1**.

A_1 (mm) =	0	0.05	0.10	0.15	0.20	0.25
S_1 (mm) =	0.75	0.80	0.85	0.90	0.95	

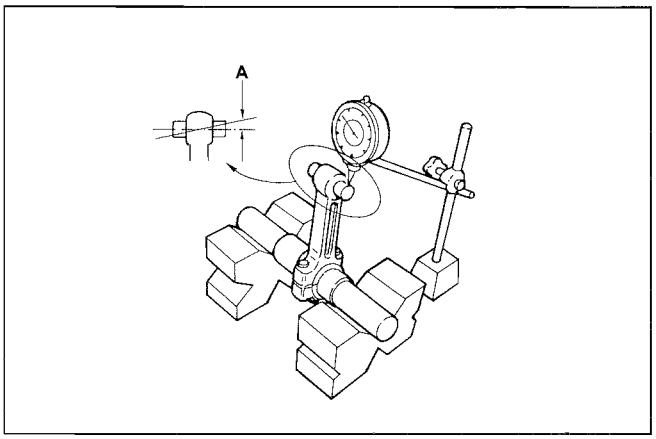


59 60

Standard oil sump (sheet metal)

Sealing between oil sump and crankcase is obtained by silicone paste sealant.
Carefully clean all parts and apply a double continuous strip of silicone type "Q37091 Dow Corning" in thickness **A** (2 ÷ 4 mm). Wait three minutes before installing on the crankcase.
Tighten screws to 23 Nm. Wait two hours before starting the engine.

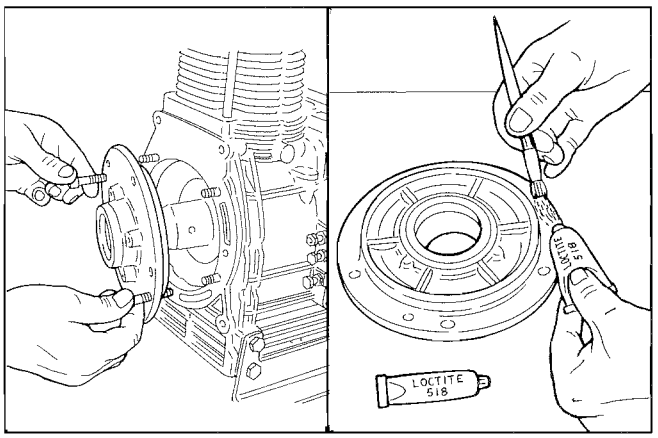
Note: Aluminium oil sumps, including those fitted to engines 6LD401/B1 and 6LD435/B1 feature a gasket made of G3820.



65

Connecting rod alignment

Use a gauge as shown in the figure.
Check that axes are aligned using the piston pin; axial mis-alignment **A** = 0.015; max. limit 0.03 mm.
Moderate warpage may be corrected by gradually working with a press.

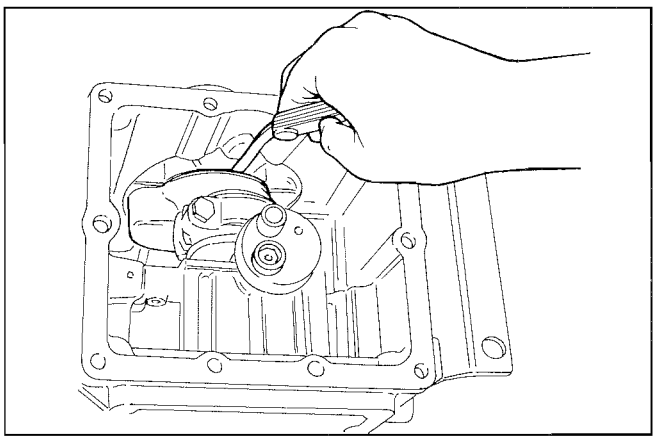


66 67

Main bearing support, flywheel side

Remove main bearing support using two M8x1.25 screws.
Sealing bertween main bearing support and crankcase is ensured by a layer of fluid sealant type "Loctite 518"; carefully clean both sealing surfaces and spread the sealant in a uniform fashion.
Tighten nuts to 23 Nm.

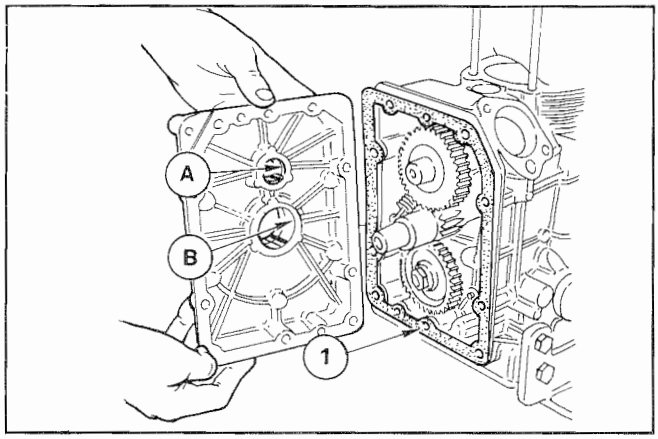
In case Loctite 518 is not available a 0.20 mm gasket can be used if allowed by the crankshaft end play (max. 0.17 mm). If not replace the support.



68

Crankshaft end play

Check crankshaft end play after tightening the main bearing support on the flywheel side to 23 Nm; the value should be 0.12÷0.37 mm.
Since a sealant is used there is no adjustment.
If end play is outside values given, the support must be replaced.

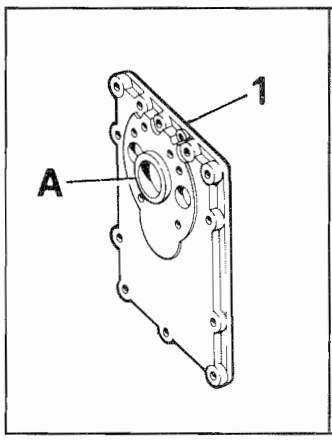


69

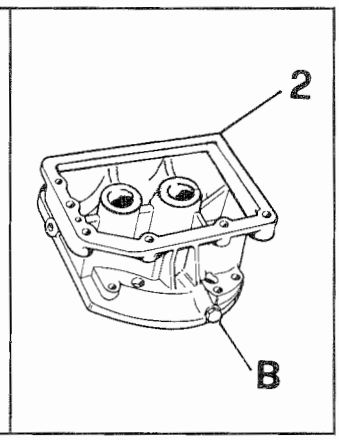
Gear cover, timing side

Gasket **1** is made of Betaflex with 0.2 mm thickness. Replace when refitting.
At **B**: oil seal bore outside and crankshaft roller bearing inside.
At **A**: camshaft journal bore with lubrication hole.

Note: The roller bearing is not fitted to engines meant for agricultural use identified by "K AGR" on the nameplate.
When refitting tighten screws to 23 Nm.



70



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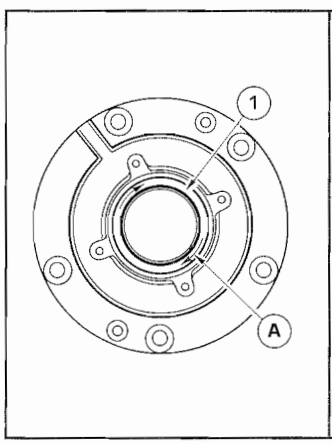
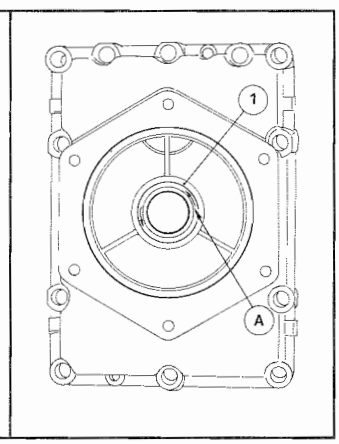
Gear cover, timing side, for 6LD260/C, 6LD325/C and 6LD360/V, 6LD400/V and 6LD435/V

Gear cover **1** is fitted to engines with camshaft p.t.o.
When replacing the oil seal check that knurls at **A** follow the same direction as the camshaft direction of rotation (counterclockwise).
Gear cover **2** fitted to engines with vertical crankshaft and also acts as an oil sump; plug **B** is used to drain oil.



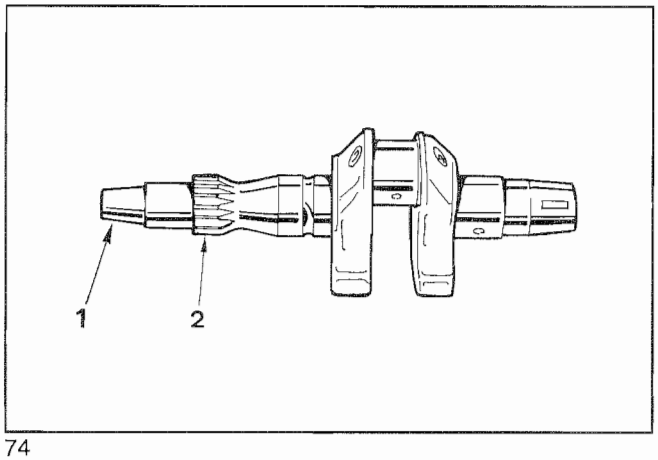
72



73

Oil seal

Oil seal **1** is located in the support on the flywheel side while oil seal **2** is located in the gear cover on the timing side.
Arrows **A** point to the crankshaft direction of rotation which is clockwise if the engine is viewed from the flywheel side and counterclockwise if the engine is viewed from the timing side.
Press them into their seats exerting uniform pressure throughout their front surface.



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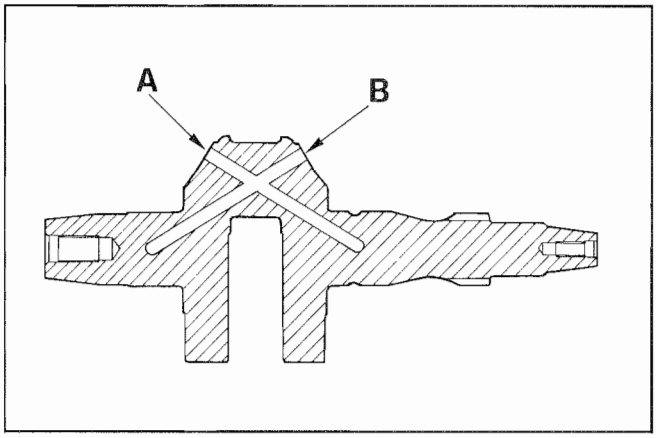
CRANKSHAFT

Without considering p.t.o. types **1** essentially there are two types of crankshaft: with 68 mm stroke (6LD260, 6LD260/C, 6LD325, 6LD325/C, 6LD360, 6LD360/V, 6LD400, 6LD400/V) and 75 mm stroke (6LD401/B1, 6LD435, 6LD435/V, 6LD435/B1).

Toothing **2** of the timing control gear is straight in all engines except for 6LD401/B1 and 6LD435/B1 which are helical.

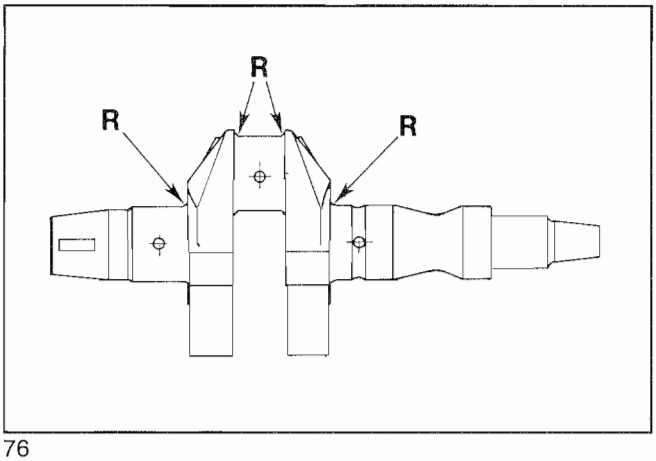


75

Crankshaft lubrication ducts

Remove plugs, clean ducts **A** and **B** with a pointed tool and compressed air.

After cleaning screw plugs back in place and check for sealing.



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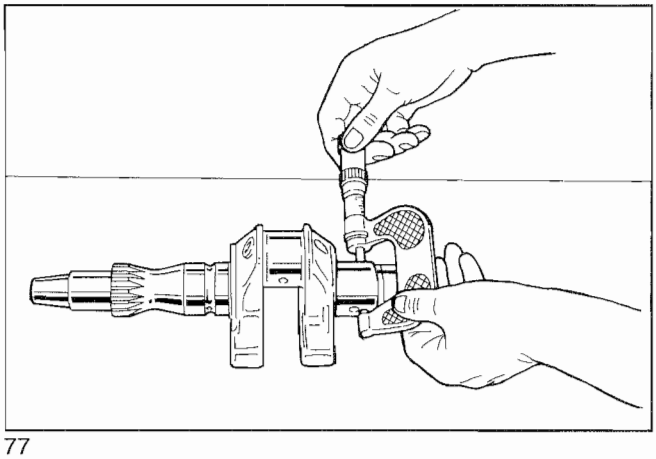
Crankshaft journal radius

The radius **R** connecting journals to shoulders is 2.8÷3.2 mm.

Note: When grinding main or rod journals restore the **R** value to original specification to avoid crankshaft breakage.



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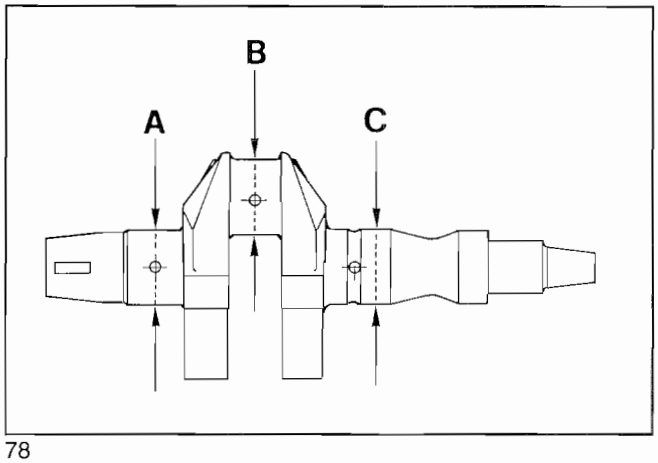
Checking main journal diameter

Use an outside micrometer.



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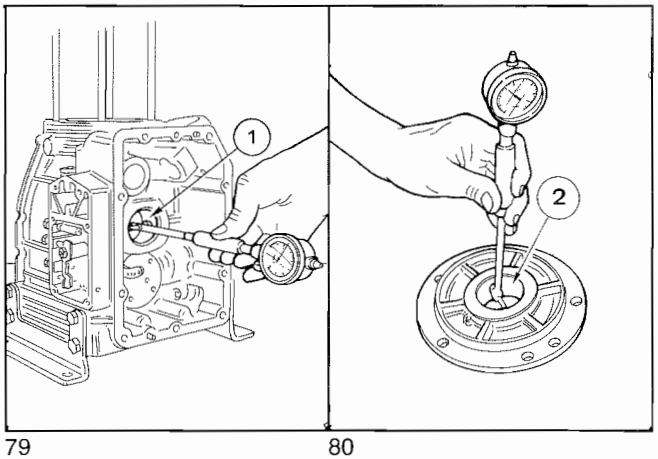
Main journal and rod journal diameter (mm)

A = **C** = 39.990 ÷ 40.000
B = 39.984 ÷ 40.000

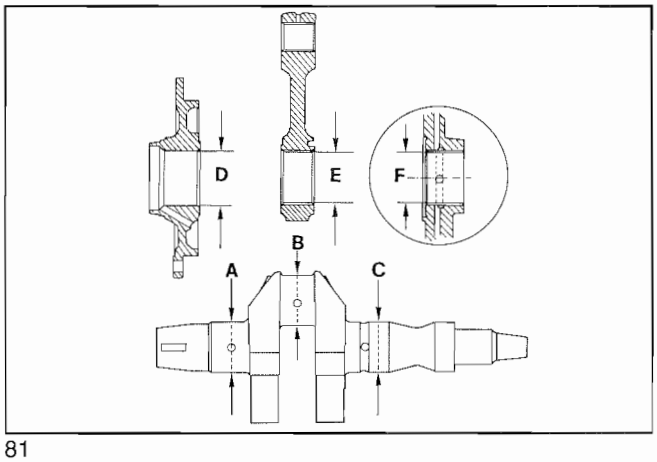


79 80

Main bearing inside diameter

1 Main bearing in crankcase
2 Main bearing in the support on the flywheel side

Use inside micrometer or bore gauge to measure the diameter of main bearings **1** and **2**.

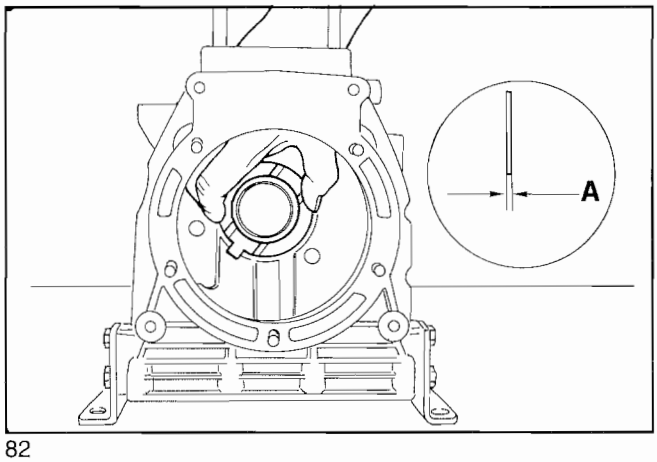


81

Main bearing and connecting rod big end bearing inside diameter and clearance between the corresponding journals (mm)

D = **F** = 40.040 ÷ 40.060
E = 40.020 ÷ 40.065
See Fig. 78 for **A**, **B** and **C**.

(D-A) = 0.050 ÷ 0.070 **(D-A)** limit value = 0.13
(E-B) = 0.020 ÷ 0.081 **(E-B)** limit value = 0.14
(F-C) = 0.050 ÷ 0.070 **(F-C)** limit value = 0.13

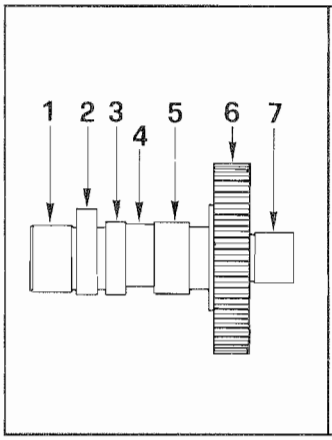


82

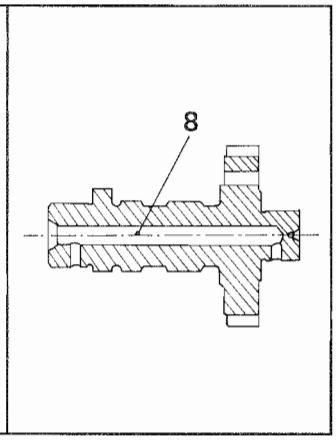
Thrust washer

Apply grease to the steel side of the thrust washer to aid in limiting washer movement during assembly of the crankshaft position thrust washer as shown.

Dimensions (mm):
A = 2.310 ÷ 2.360 limit value = 2.200



83



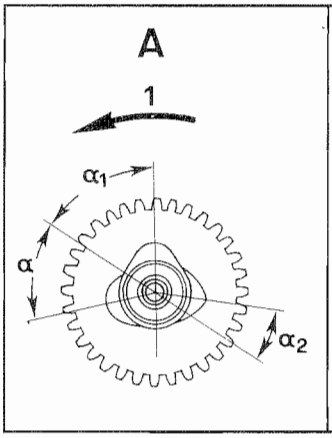
84

CAMSHAFT

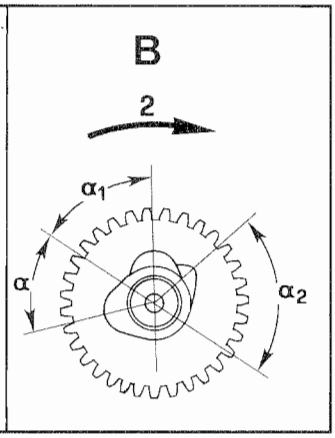
Components:

1 Journal, crankcase side
2 Intake lobe
3 Exhaust lobe
4 Fuel pump eccentric
5 Injection lobe
6 Gear
7 Journal, gear cover side
8 Lubrication hole (only for 6LD360/V, 6LD400/V, 6LD435/V).

Gear **6** features a straight toothing except for engines type 6LD401/B1 and 6LD435/B1 where it is helical-toothed.



85

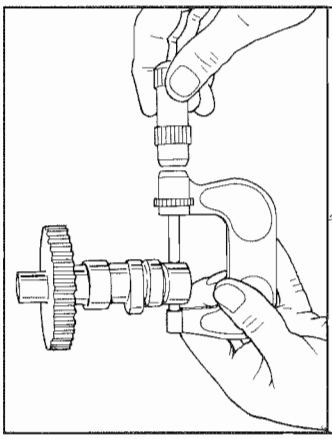


86

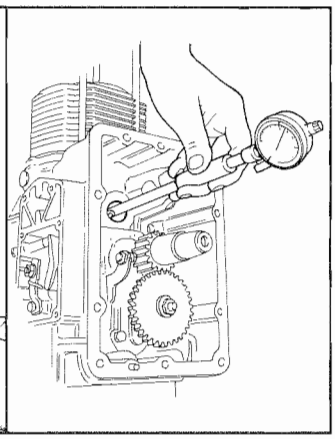
Cam timing with straight-toothed gear

1 Counterclockwise rotation
2 Clockwise rotation only for 6LD260/C and 6LD325/C

A	B
α = 51°	α = 53°15'
α_1 = 53°15'	α_1 = 51°
α_2 = 25°30'	α_2 = 84°39'



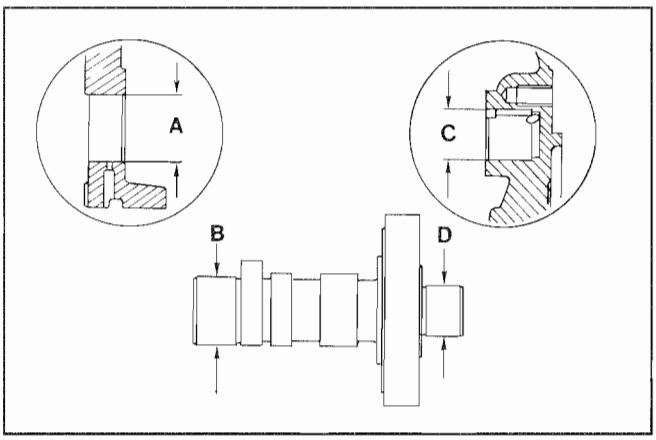
87



88

Camshaft journals and bore

Measure with an outside micrometer gauge and an inside bore gauge.



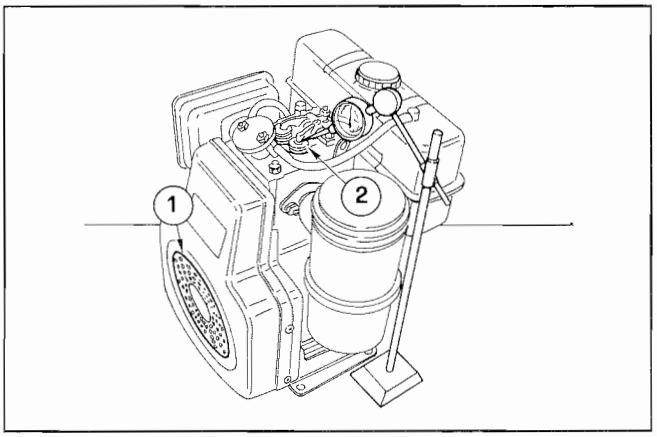
89

Dimensions of camshaft journal and bore (mm)

A = 25.976 ÷ 25.989 (crankcase housing)

B = 25.937 ÷ 25.950
C = 20.000 ÷ 20.021 (gear cover housing)
D = 19.957 ÷ 19.970

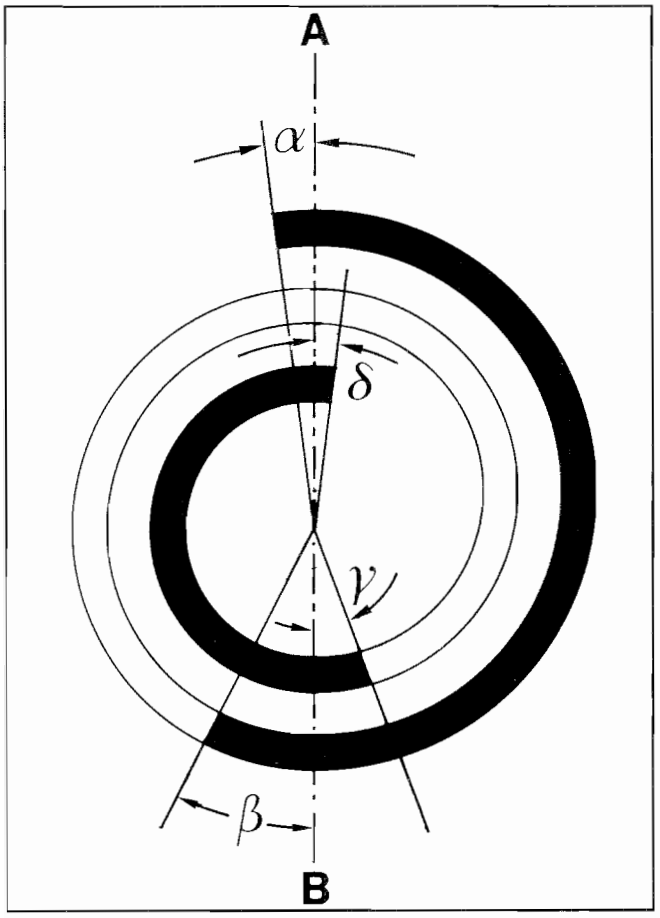
(A-B) = 0.026 ÷ 0.052	**(A-B)** limit value = 0.095
(C-D) = 0.030 ÷ 0.064	**(A-B)** limit value = 0.110



94

Valve timing check

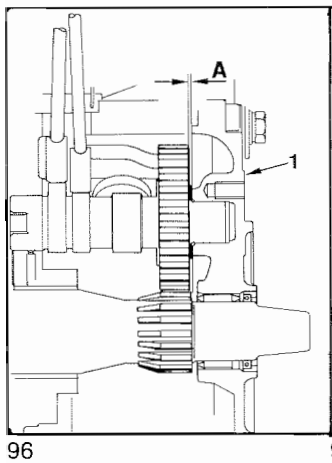
Check valve timing at the crankshaft. The values shown are checked at the circumference of disk guard **1** with 168 mm diameter.
Set valve clearance at 0.65 ÷ 0.70 mm (after checking restore the value at 0.10 ÷ 0.15 mm).
Set dial gauge on intake valve **2** to a zero value; by rotating the driving shaft according to its direction of rotation you can measure α (intake valve opening before top dead center **A**) and β (intake valve closing after top dead center **B**), see Fig. 95.
Follow the same procedure for exhaust valve checking γ (exhaust valve opening) and δ (exhaust valve closing).



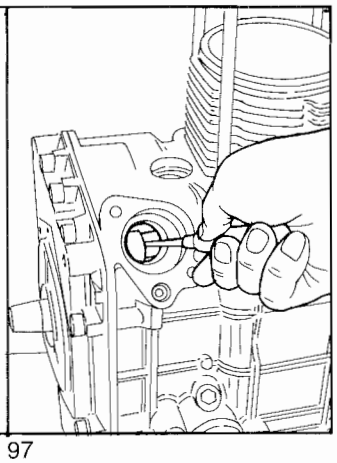
95

Timing angles for checking purposes

α = 7.5° before top dead center corresponding to 11 mm on disk guard **1**, Fig. 94.
β = 25.5° after bottom dead center corresponding to 37 mm on disk guard **1**.
γ = 21° before bottom dead center corresponding to 30.5 mm in disk guard **1**.
δ = 3° after top dead center corresponding to 4.5 mm on disk guard **1**.



96

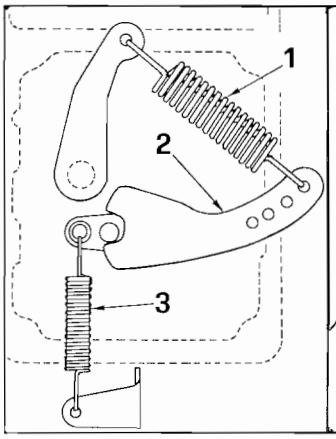


97

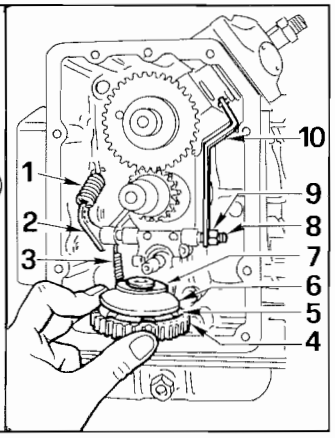
Camshaft end play

Check end play **A** (0.20 ÷ 0.60 mm) after tightening gear cover **1** on the timing side.
Perform this check before fitting cylinder head and injection pump.
Remove injection pump tappets and axially move camshaft backwards and forwards with a small bar (See Fig. 97).

Note: Care should be taken not to damage tappet bore.



102



103

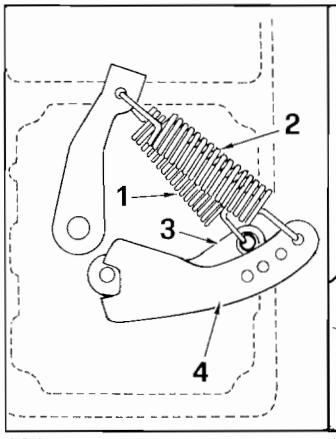
Speed governor for engines meant for agricultural purposes

This type of governor is fitted to those engines characterized by the letters K AGR on the nameplate (agricultural use).
Governor gear **5** and bell **7** are made of plastic material.
Nut **9** is of the self-locking type.
The injection pump control lever **10** is made of sheet metal.

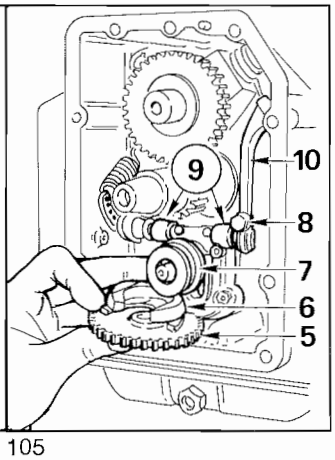
Components:

1 Governor spring
2 Lever
3 Extra fuel spring
4 Gear
5 Ball
6 Mobile bell
7 Washer
8 Journal
9 Adjusting nut
10 Inj. pump control lever

When refitting tighten nut **9** to 10 Nm. Also see Fig. 99. 100 and 101 for spring placement.



104



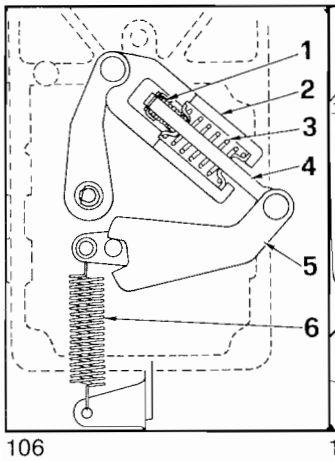
105

Speed governor and leverage for generating sets

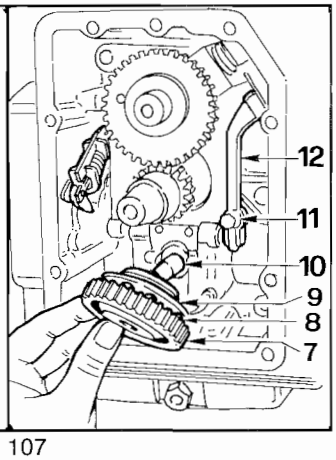
The bearings inside oil pump mountings **9**, the double roller bearing inside mobile bell **7** and weights **6** ensure that the performance is suitable for generating sets.

Components:

1 Extra fuel spring
2 Governor spring
3 Extra fuel spring lever
4 Governor spring lever
5 Governor gear
6 Weight
7 Mobile bell
8 Screw
9 Oil pump mountings
10 Injection pump control lever (in aluminium)



106



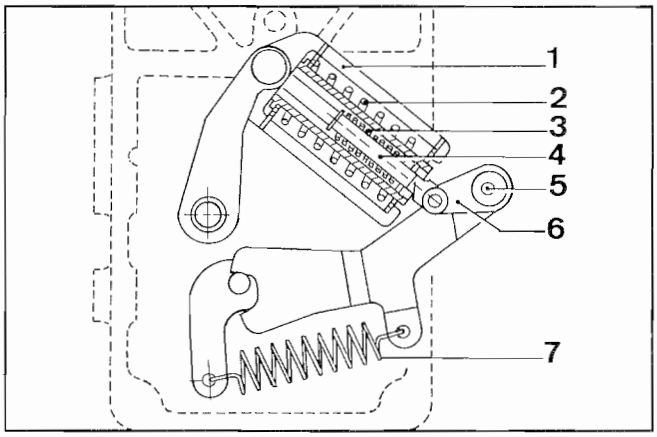
107

Governor spring and leverage for small-size vehicles

The system made up of two co-axial springs featuring different diameter making it possible to obtain a limited speed change with respect to throttle movement especially at low speeds.

Components:

1 Low speed spring
2 Frame
3 High speed spring
4 Link
5 Lever
6 Extra fuel spring
7 Governor gear
8 Ball
9 Mobile bell
10 Oil pump shaft
11 Adjusting screw
12 Injection pump control lever (in aluminum)



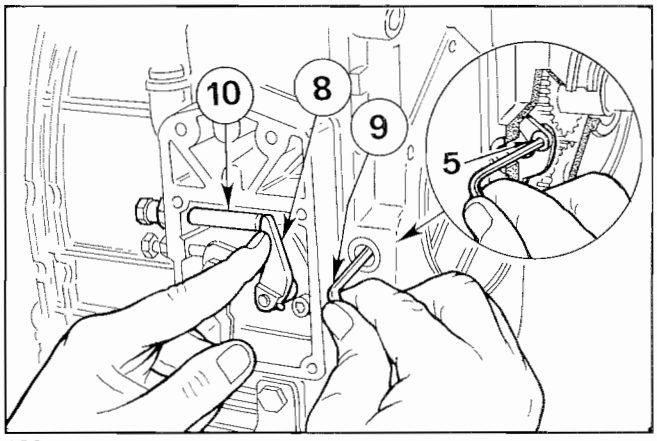
108

Speed governor with provision for external droop adjustment

The governor is of the ball type. The operating features are similar to those shown in Fig. 106 and 107.
The main feature of this speed governor is the possibility to modify droop externally.

Components:

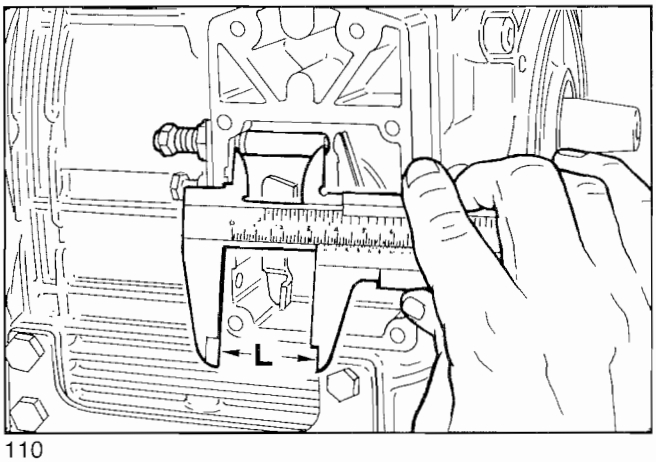
1 Frame
2 Full speed spring
3 Idling speed spring
4 Journal
5 Hole for Allen wrench
6 Connecting rod
7 Extra fuel spring
8 Fuel lever
9 3 mm Allen wrench
10 Fuel delivery limiter



109

Manual droop adjustment

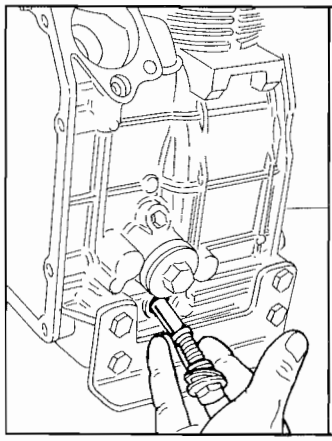
Introduce Allen wrench **9** into hex **5**. To center the wrench inside hex **5** move lever **8** to the left or the right as required.
Slowly turn the wrench: decreases when turning the wrench counterclockwise and increases when turning it clockwise.
There is no direct link between the degrees of rotation and the droop. On average, 20° of rotation cause a droop of 15 ÷ 20 r.p.m.



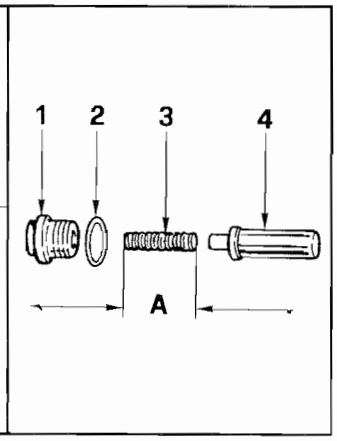
110

Bringing fuel delivery limiter to its original position after droop adjustment

If this operation is unavoidable (See Fig. 109) it is recommended, before loosening the fuel delivery limiter, to carefully measure distance **L** in order to re-position it exactly as before once the operation is completed.



124



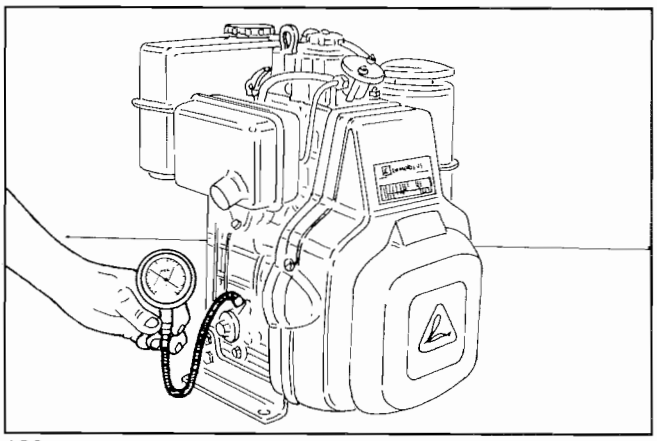
125

Oil pressure relief valve

1 Plug
2 Gasket
3 Spring
4 Valve

Dimensions (mm):
A = 37

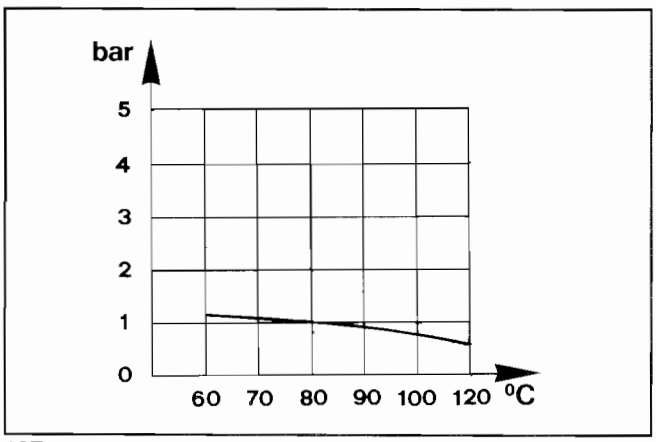
Carefully clean all components and check spring **A** length.



126

Oil pressure check

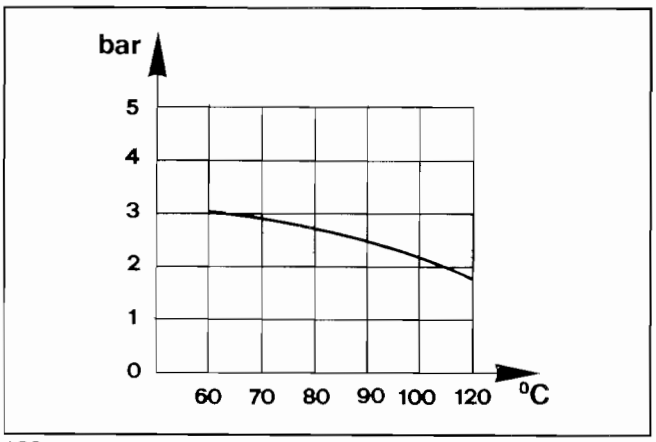
Fill engine with oil and fuel.
Connect a 10 bar pressure gauge to the oil filter fitting as shown.
Start the engine and check pressure as a function of the oil temperature.



127

Oil pressure curve at idle speed

The curve is obtained at the oil filter port with constant engine speed of 1200 r.p.m. in no-load conditions; pressure is given in bar and temperature in centigrades.

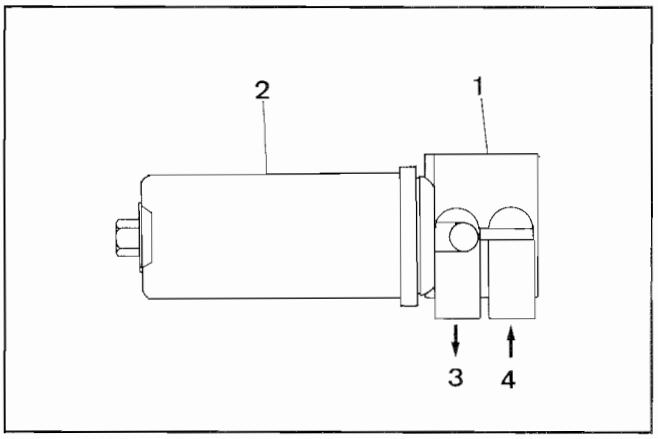


128

Oil pressure curve at full speed

The curve is obtained at the oil filter port with engine working at 3000 r.p.m. at the **N** power; pressure is given in bar and temperature in centigrades.

Note: After the running-in period the lube max. temperature should be less than the room temperature plus 95°C.

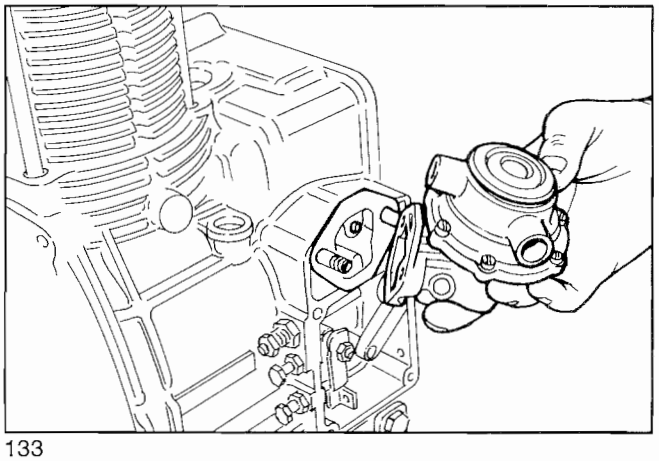


132

Fuel filter separate from the tank (optional)

1 Mounting
2 Cartridge
3 Fuel outlet from the filter
4 Fuel inlet into the filetr

Cartridge characteristics:
Filtering area = 720 cm²
Degree of filtration: 5 ÷ 8 µm
Max. working pressure: 7 bar
Working temperature: —25° ÷ 150°C
See Page 9 for maintenance details.

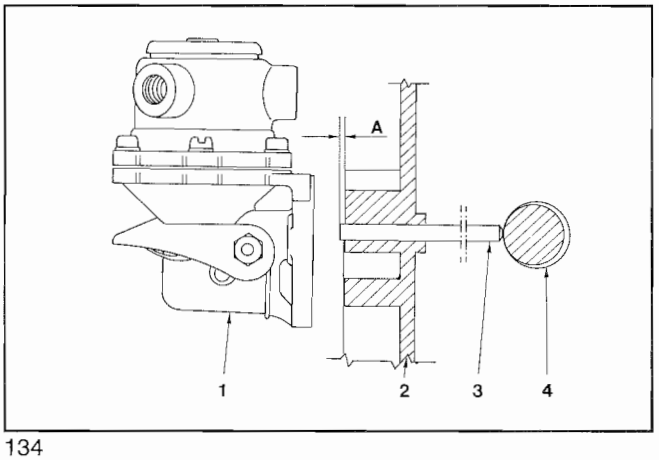


133

Fuel transfer pump (optional)

When the tank is supplied separate from the engine it usually requires also the shipment of the fuel feeding pump and the camshaft suitable for driving the pump. The pump is of the diaphragm type and is operated by a camshaft eccentric via a drive rod.

Characteristics: when the control eccentric rotates at 1500 r.p.m. minimum delivery is 60 l/h and self-regulation pressure is 4 ÷ 5 mm water column.

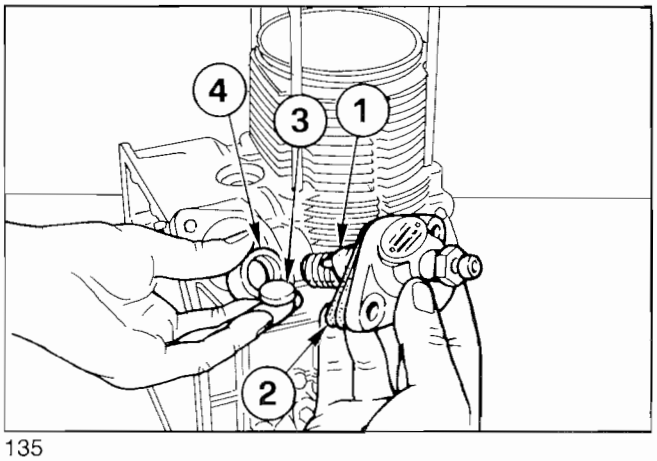


134

Fuel feeding pump drive rod protrusion

Components:
1 Fuel transfer pump
2 Crankcase
3 Drive rod
4 Camshaft eccentric

This check should be performed when eccentric **4** is at rest (rod at lowest level).
Protrusion **A** of drive rod **3** is 0.8 ÷ 1.2 mm; protrusion can be adjusted by means of gaskets available in the following thicknesses: 0.50; 0.80 and 1.0 mm.
Drive rod length = 93.0 ÷ 93.2 mm.



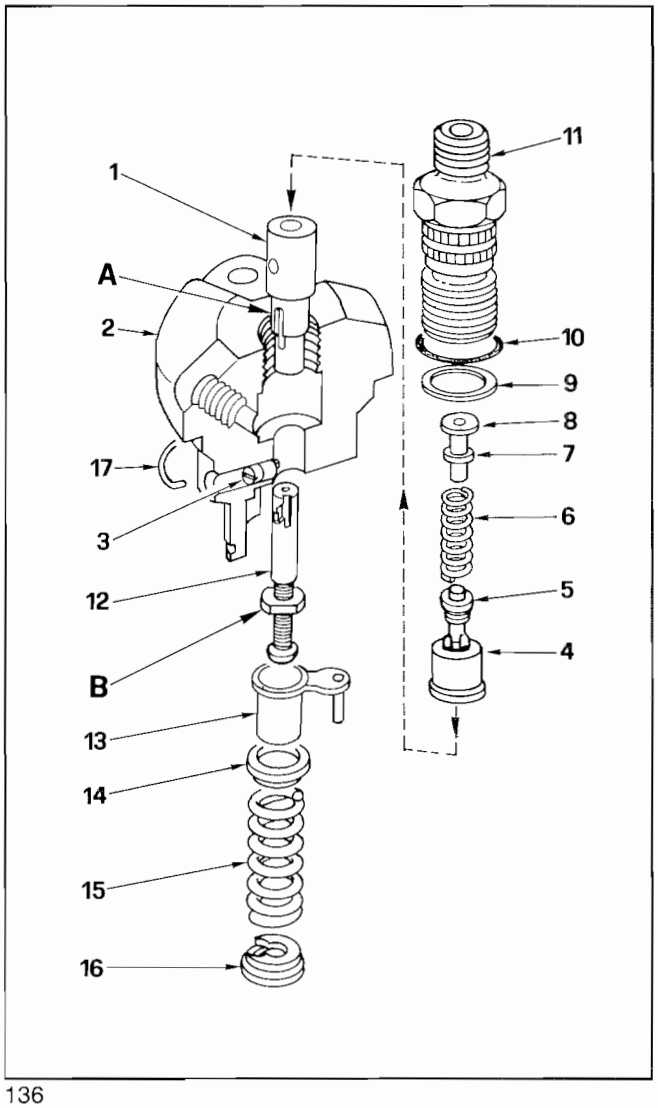
135

Injection pump

Components:
1 Delivery control
2 Shims for injection advance
3 Spacer
4 Tappet

The injection pump is mounted on the crankcase and is operated by the camshaft via tappet **4**.

Note: When removing the injection pump from its seat make sure that spacer **3** is not dropped into the oil sump; injection pump operation will be impaired if the spacer is not installed.



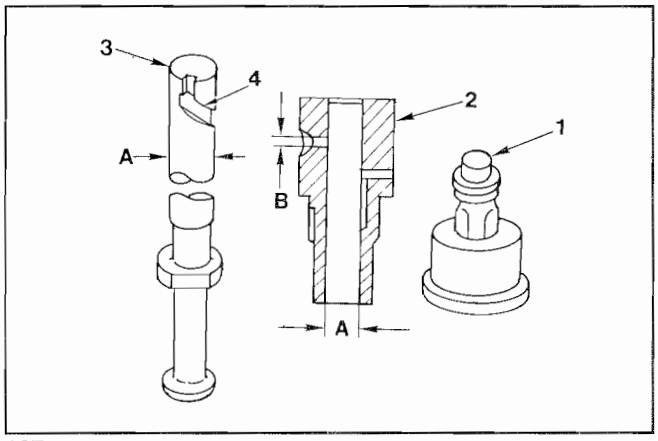
136

Injection pump refitting

Components:

1 Barrel	**9** Washer
2 Pump body	**10** O-ring
3 Pin	**11** Delivery union
4 Delivery valve seat	**12** Plunger
5 Delivery valve	**13** Rack
6 Spring	**14** Spring plate
7 Shim	**15** Spring
8 Filler	**16** Spring retainer

Fit barrel **1** into pump body **2** making sure that groove **A** matches with pin **3**.
Follow the above fitting sequence remembering that plunger **12** should be introduced into cylinder **1** with mark **B** (can be any mark or writing) on the same side as pin **3**.
Tighten union **11** to 35 ÷ 40 Nm.



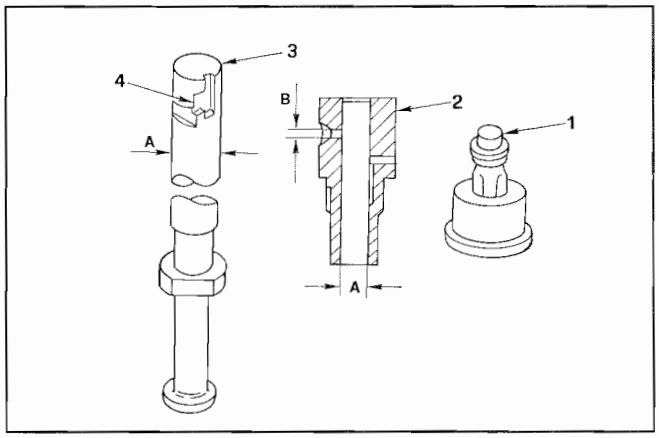
137

Plunger and delivery valve for injection pump type 6LD260 and 6LD260/C

1 Delivery valve
2 Barrel
3 Plunger
4 LH helix

A = 5.5 mm (nominal diameter)
B = 2.5 mm

The volume displaced by delivery valve **1** is 25 mm³.



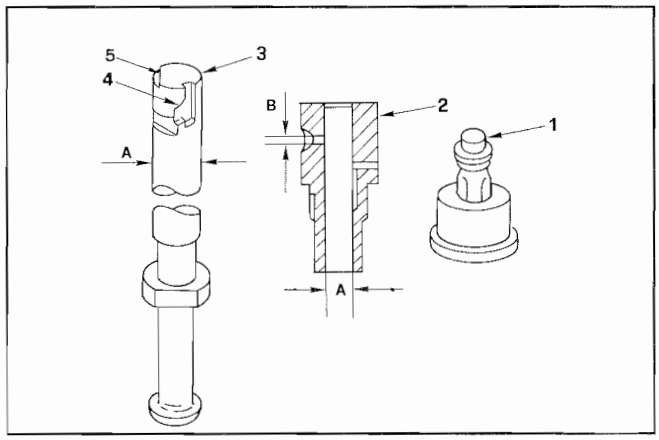
138

Plunger and delivery valve for injection pump type 6LD325 and 6LD325/C

1 Delivery valve
2 Barrel
3 Plunger
4 RH helix

A = 5.5 mm (nominal diameter)
B = 2 mm

The volume displaced by delivery valve **1** is 15 mm³.



139

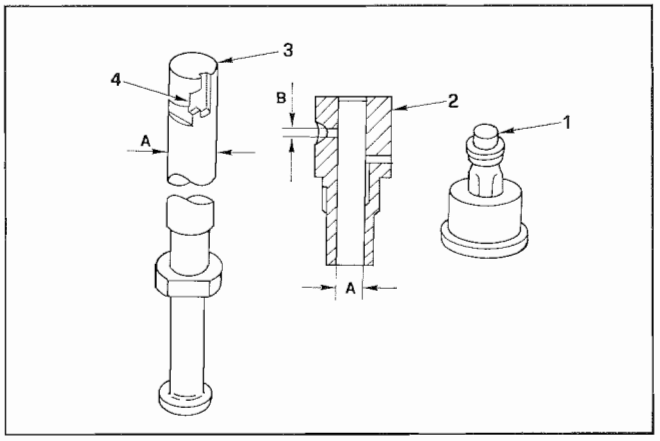
Plunger and delivery valve for injection pump type 6LD360, K AGR and 6LD400, K AGR

1 Delivery valve
2 Barrel
3 Plunger
4 RH helix
5 Retardation notch

A = 6 mm (nominal diameter)
B = 2 mm

The volume displaced by delivery valve **1** is 25 mm³.

Note: In engines for agricultural use pump type QLC (See Fig. 143) can be fitted as an alternative to this pump.



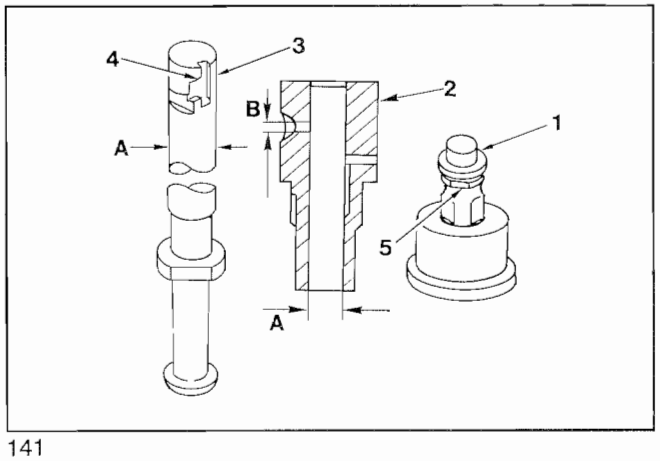
140

Plunger and delivery valve for injection pump type 6LD360, 6LD360/V, 6LD400 and 6LD400/V

1 Delivery valve
2 Barrel
3 Plugger
4 RH helix

A = 6 mm (nominal diameter)
B = 2 mm

The volume displaced by delivery valve **1** is 15 mm³.



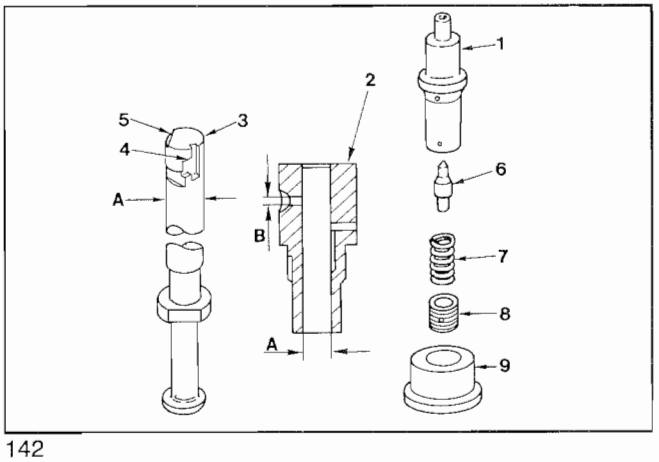
141

Plunger and delivery valve for injection pump type 6LD435 and 6LD435/V

1 Delivery valve
2 Barrel
3 Plunger
4 RH helix
5 Wrench flat

A = 7 mm (nominal diameter)
B = 2 mm

This valve differs from the others because of the flat **5**; the volume displaced is 15 mm³.



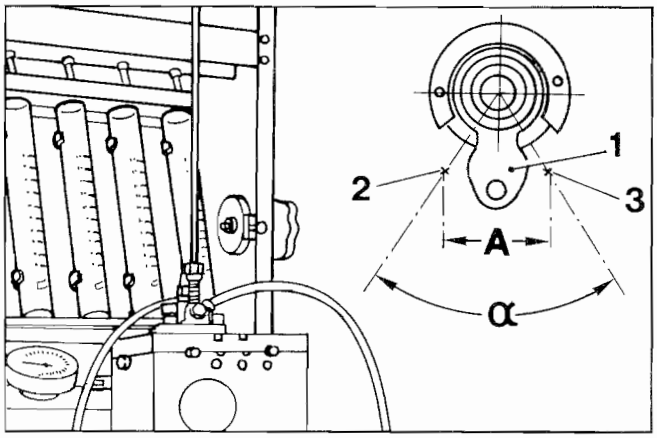
142

Plunger and delivery valve GDV for injection pump type 6LD401/B1, 6LD435/B1

1 Main delivery valve
2 Barrel
3 Plunger
4 RH helix
5 Retardation notch
6 By-pass
7 Spring
8 Ring nut
9 Valve seat

A = 7 mm (nominal diameter)
B = 2 mm

The injection pump features a valve type GDV whose task is to keep a constant pressure of 65 ÷ 70 bar inside the delivery tube between injections.



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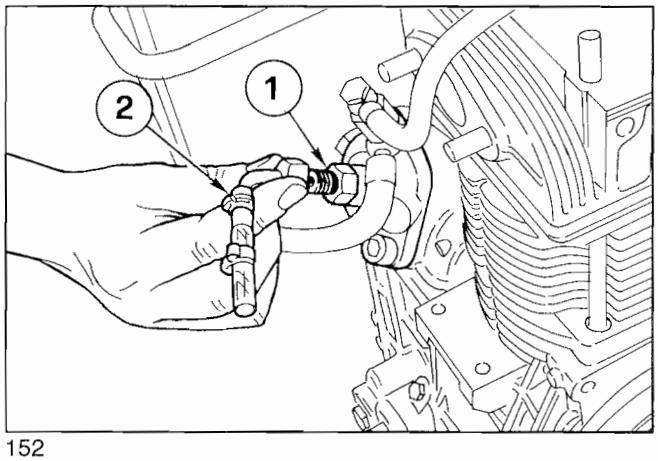
Injection pump delivery check on test bench

1 Delivery control rack
2 Rack **1** in stop position (corresponding to max. delivery in models 6LD260, 6LD260/C)
3 Rack 1 in max. delivery position (corresponding to stop position models 6LD260, 6LD260/C)
A = 18.5 ÷ 19.5 mm (max. rack rod stroke in injection pump type QLC)
α = 66°

Test data

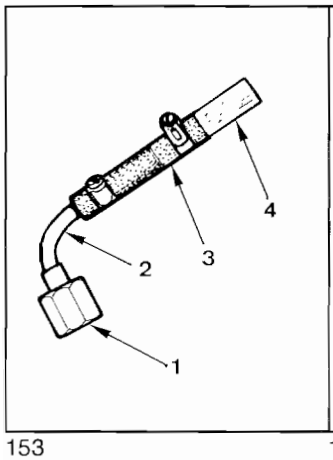
Injection pump for engine type	Control rod max. force	Rod stroke during max. delivery	Camshaft r.p.m.	Delivery
	Newtons	mm	R.P.M	mm³/stroke
6LD260 **6LD260/C**	0,35	9	1800	15 ÷ 25
		0	150	32 ÷ 45
6LD325 **6LD325/C**	0,35	9	1800	30 ÷ 40
		0	150	49 ÷ 61
6LD360 AGR **6LD400 AGR**	0,35	9	1800	18 ÷ 32
		0	150	48 ÷ 60
6LD360 **6LD360/V** **6LD400** **6LD400/V**	0,35	9	1800	18 ÷ 32
		0	150	58 ÷ 68
6LD435 **6LD435/V**	0,35	9	1800	38 ÷ 44
		0	150	53 ÷ 63
6LD401/B1 **6LD435/B1**	0,35	9	1800	18 ÷ 32
		0	150	50 ÷ 60
6LD325 for small-size vehicles **6LD360** for small-size vehicles	0,35	12	1500	16 ÷ 24
		12	500	6 ÷ 14
		0	150	52 ÷ 62



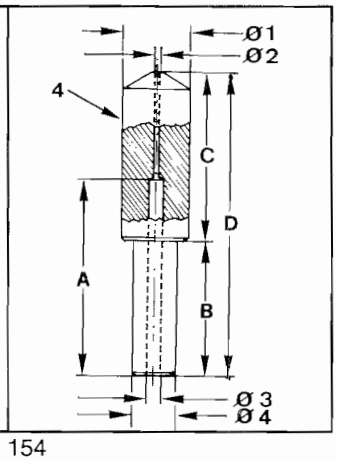
152

(STATIC) INJECTION TIMING

Disconnect high pressure line making sure that during this operation the delivery union of pump **1** is not loosened. Install injection timing tool **2**.



153



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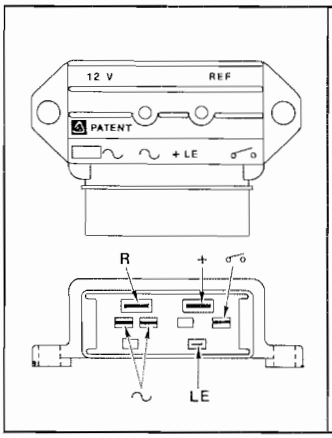
Injection timing checking device Ser. No. 7271-1460-024

Components:
1 Union
2 Tube
3 Sleeve
4 Transparent body

Device allows for immediate monitoring of the fuel flow through the small transparent hole.

Dimensions (mm):
$\varnothing_1$ = 10.00; $\varnothing_2$ = 0.60; $\varnothing_3$ = 2.00; $\varnothing_4$ = 6.50.
A = 29.00; **B** = 20.00; **C** = 25.00; **D** = 45.00.



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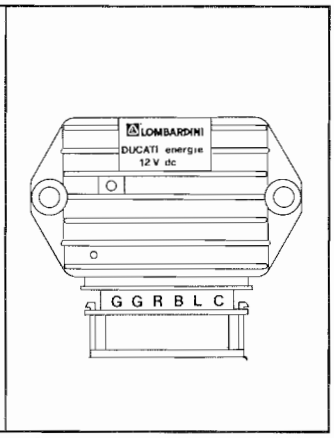

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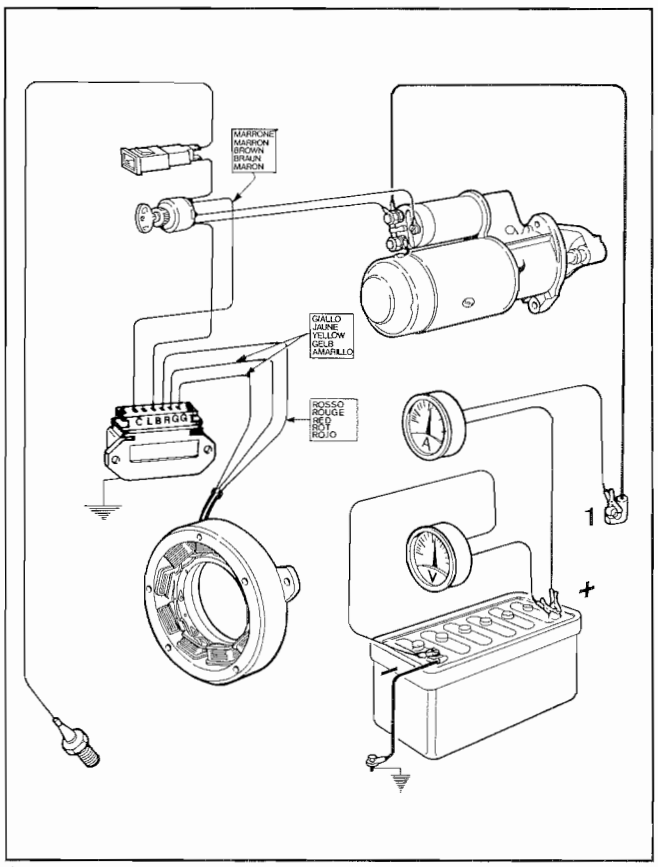
Voltage regulator

Type LOMBARDINI, supplied by AETSA SAPRISA, NICSA and DUCATI: voltage 12V, max. current 26 A.
To avoid wrong connections 3 different tab sizes are provided.

AETSA, SAPRISA NICSA	DUCATI	TAB DIMENSIONS mm	
		WIDTH	THICKNESS
~	G	6,35	0,8
R	R	9,50	1.2
+	B	9,50	1,2
LE	L	4,75	0,5
	C	6,35	0,8



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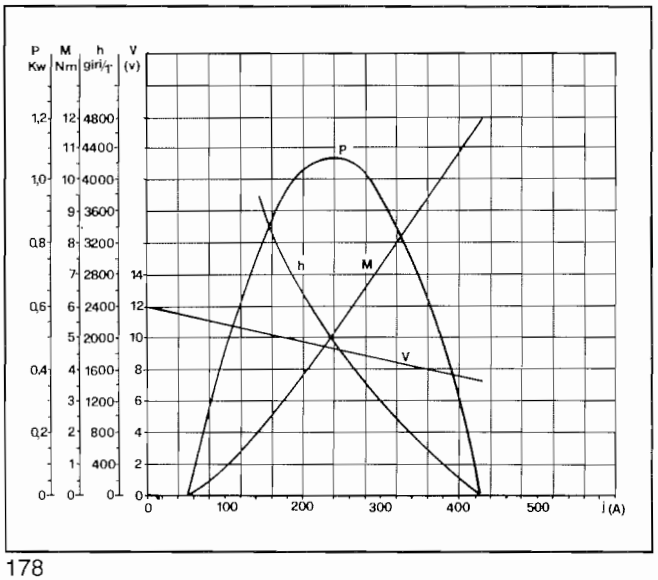
Testing voltage regulator for proper operation

Check that connections correspond to the schematic.
Disconnect the terminal from the battery positive pole.
Connect a d.c. voltmeter between the two battery poles.
Fit an ammeter between the positive pole and the corresponding cable **1** terminal.
The ammeter should be suitable for reading the required value (14A) and for withstanding the starting motor peak absorption (400 ÷ 450A).
Start and stop the engine a several times until battery voltage drops below 13V.
When battery voltage reaches 14.5V the ammeter current should suddenly drop down to almost zero.
Replace regulator if recharge current is zero with voltage below 14V.

Warning: When the engine is running do not disconnect battery cables or switch key to "off" position.
Keep regulator away from heat sources above 75°C.
Do no electric weld on engine or application.



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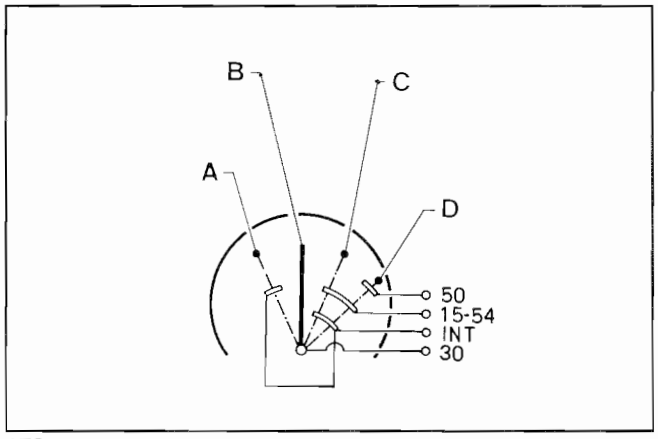
Characteristic curves for starting motor type Bosch EF (L) - 12V, Class 1

Curves were obtained at a temperature of +20°C with 56Ah battery at half charge.

V = Motor terminal voltage in Volts
n = Motor speed in r.p.m.

M = Torque in Nm
P = Power in kW
J (A) = Absorbed current in Ampere.



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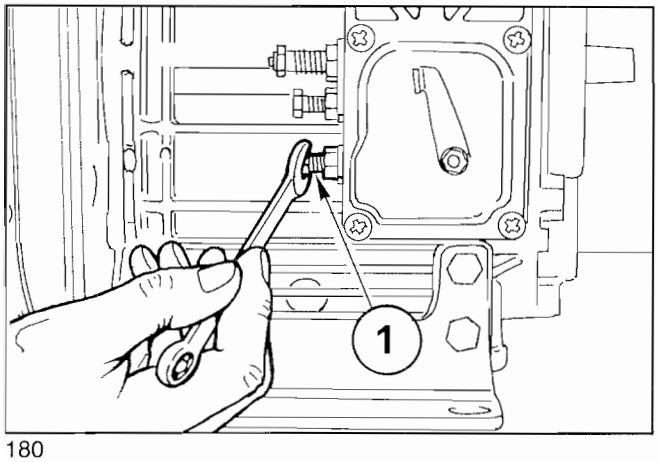
Key switch positions

A = Accessory
B = Off
C = On
D = Start



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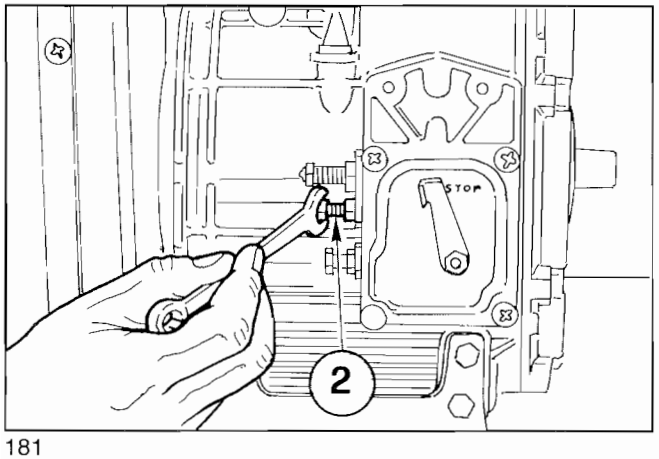
1) Idle speed setting in no-load conditions (standard)

After filling with oil and fuel, start the engine and warm up for 10 minutes. Adjust idling speed at 1000 ÷ 1200 r.p.m. by turning setscrew **1**; then tighten lock nut.

Note: Idling speed setting in no-load conditions for engines type 6LD401/B1 and 6LD435/B1 is 2200 r.p.m.
Idling speed setting for engines fitted to small-size vehicles is 950 ÷ 1000 r.p.m.



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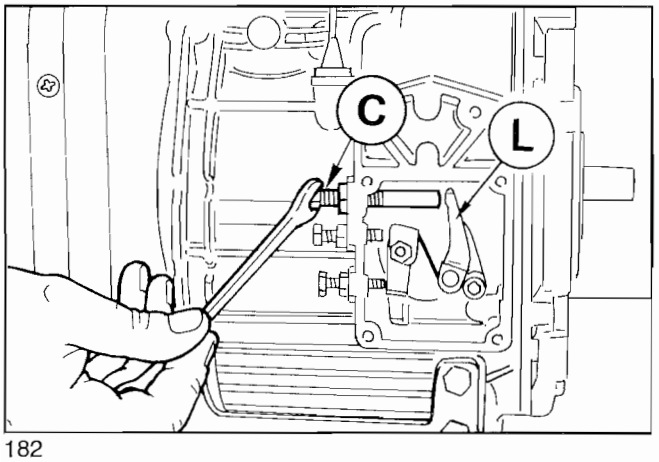
Full speed setting in no-load conditions (standard)

After setting idle speed turn screw **2** and set full speed in no load conditions at 3800 r.p.m.; then tighten lock nut.

Note: Full speed setting for engines type 6LD400/B1 and 6LD435/B1 is 3150 r.p.m.



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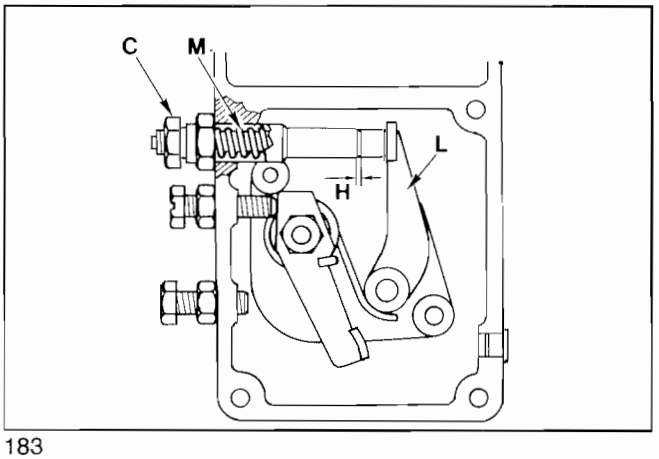
Injection pump delivery setting

Setting should be performed with engine on a torque dynamometer. If not, setting is only approximate.
The following steps are required:
Loosen delivery limiting device **C** by 5 turns.
Bring engine to full speed in no-load conditions, i.e. 3800 r.p.m.
Tighten delivery limiting device **C** until it touches lever **L**.
Unscrew delivery limiting device **C** by 1 1/2 turns.
Tighten lock nut.

Note: If the engine, under full load, generates too much smoke tighten **C**; if no smoke is observed at the exhaust and the engine cannot reach full power unscrew **C**.



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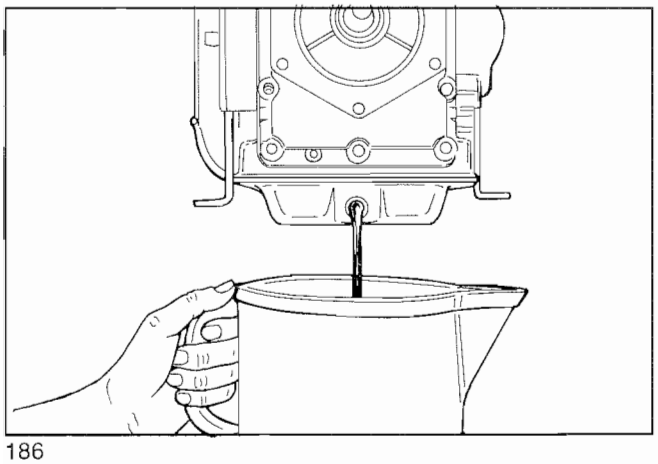
Injection pump delivery limiting and torque device (standard)

Delivery limiting device **C** has the function of limiting the injection pump max. delivery.
The same device also acts as torque device. The speed governor spring (Pos. **9** fig. 98) acts on lever **L** withstanding the resistance opposed by spring **M** inside the cylinder.
The stroke **H** allowed by the torque device to lever **L** is 0,3 ÷ 0,4 mm. As a result of this pump delivery increases and torque reaches its peak value.



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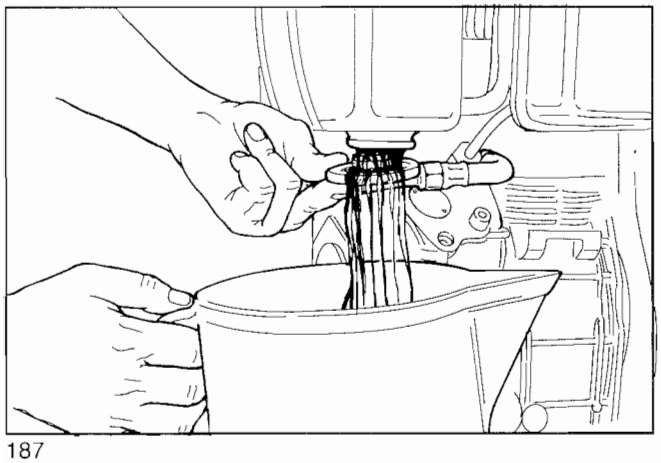
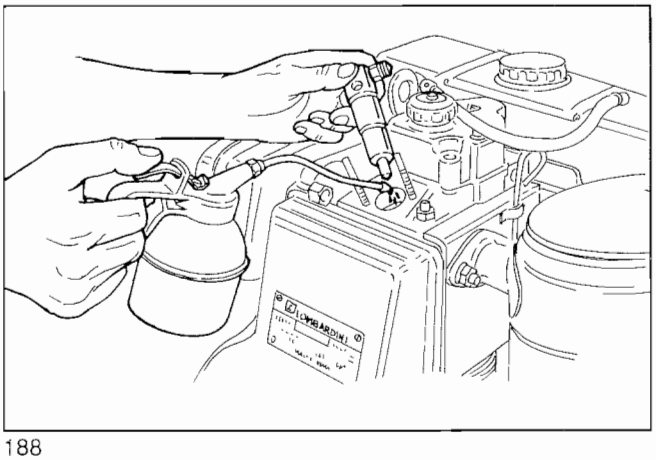


187



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STORAGE

Prepare engines as follows for storage over 30 days.

Temporary protection (1 ÷ 6 months)

- Let engine run at low idle speed in no-load conditions for 15 minutes.
- Fill crankcase with protection oil MIL-1-644-P9 and let engine run at 3/4 speed for 5 ÷ 10 minutes.
- When engine is warm empty oil sump and fill with standard new oil.
- Remove fuel filter cover and empty the tank.
- Remove fuel filter, replace cartridge.
- Carefully clean cylinder fins, cylinder and head.
- Seal all openings with tape.
- Remove the injector, pour a spoonful of oil type SAE 30 into the cylinder and rotate manually to distribute the oil. Refit the injector.
- Spray oil type SAE 10W into exhaust and intake manifolds, rocker arms, valves, tappet, etc., Grease all unpainted parts.
- Wrap the engine in a plastic film.
- Store in a dry place, if possible not directly on the soil and far from high voltage electric lines.

Permanent protection (over 6 months)

The following is recommended apart from the above instructions:

- For the lubrication and injection system as well as for moving parts use rustproof oil type MIL-L-21260 P10 grade 2, SAE 30 (Ex.: ESSO RUST - BAN 623 - AGIP, RUSTIA C. SAE 30). Let the engine run with rustproof oil and drain any excess.
- Coat external unpainted surfaces with antirust type MIL-C-16173D - grade 3 (ex.: ESSO RUST BAN 398 - AGIP, RUSTIA 100/F).

How to prepare the engine for operation

- Clean engine outside.
- Remove protections and covers.
- Remove antirust by an appropriate solvent or degreaser.
- Remove injector, fill with standard oil, turn crankshaft by a few revolutions, remove oil pan plug and drain the protective oil.
- Check injector setting, valve clearance, head tightening, oil filter and air cleaner. If the engine is stored over a long period of time (over 6 months) check one of the crankshaft bearings for corrosion.