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REV 4T

2007 WORKSHOP MANUAL



four 4 stroke

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2007 WORKSHOP MANUAL

INTRODUCTION 1

CHAPTER 1
LUBRICATION CIRCUIT

1 LUBRICATION CIRCUIT 6
1.1 ENGINE OIL 6
1.2 CHECKING THE ENGINE OIL LEVEL 7
1.3 CHANGING THE ENGINE OIL 7

CHAPTER 2
ENGINE REMOVAL AND REFITTING

2 ENGINE REMOVAL AND REFITTING 10
2.1 ENGINE REMOVAL 10
2.2 REFITTING THE ENGINE 17

CHAPTER 3
DISMANTLING

3 DISMANTLING 18
3.1 DRAINING THE OIL 18
3.2 IGNITION 19
3.3 CYLINDER HEAD 19
3.4 CYLINDER 22
3.5 FLYWHEEL 22
3.6 OIL PUMP (LEFT-HAND CRANKCASE) 23
3.7 CLUTCH 24
3.8 PRIMARY TRANSMISSION 26
3.9 KICKSTART 27
3.10 SHIFTING MECHANISM 27
3.11 OIL PUMP (RIGHT-HAND CRANKCASE) 28
3.12 TIMING SPROCKET 29
3.13 SPLITTING THE CRANKCASE 29
3.14 GEARBOX AND SHIFTING MECHANISM 30
3.15 CRANKSHAFT 31

CHAPTER 4
ASSEMBLY

4.1 RIGHT-HAND CRANKCASE 32
4.2 LEFT-HAND CRANKCASE 34
4.3 CLUTCH CASING 35
4.4 GEARBOX AND SHIFTING MECHANISM 37
4.4.1 Mainshaft 37
4.4.2 Layshaft 38

4.5 CRANK ASSEMBLY 40
4.6 CLOSING THE CRANKCASE 41
4.7 SHIFTING MECHANISM 42
4.8 TIMING SPROCKET 44
4.9 OIL PUMPS 45
4.10 KICKSTART 48
4.10.1 Preassembly of kickstart shaft 48
4.10.2 Assembling the kickstart 49

4.11 PRIMARY TRANSMISSION GEAR 49
4.12 CLUTCH 50
4.13 FLYWHEEL 53
4.14 PISTON AND CYLINDER 54
4.14.1 Measurements and checks 54
4.14.1.1 Cylinder 54
4.14.1.2 Piston 54
4.14.2 Fitting 56
4.14.2.1 Studs 56
4.14.2.2 Piston 56
4.14.2.3 Cylinder 57

4.15 CYLINDER HEAD COVER 58
4.16 CYLINDER HEAD 59
4.16.1 Checks 59
4.16.2 Fitting 61

4.17 VALVEGEAR 62
4.17.1 Pre-assembly of camshaft 62
4.17.2 Fitting the valvegear 63

4.18 CLUTCH CASING 66
4.19 IGNITION 68
4.20 FINAL DETAILS 69

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FOREWORD

This publication is addressed to the user of the motorcycle and to technical assistance staff. It has been written with the objective of making known, and comprehensible, the operations involved in the inspection, maintenance and repair of the motorcycle it deals with.

N.B. Read this manual carefully and from start to finish before carrying out any work on the engine. A good knowledge of all the components that make up the engine, and of all the procedures to be followed during the various inspection and maintenance jobs, will help to prolong the life of the engine.
The manual has been made as comprehensive as possible through the addition of diagrammatic illustrations that help clarify the subject at hand.

Note for information

Betamotor S.p.A. is committed to a policy of continuous improvement of its products. For this reason it is possible that you will encounter slight differences between what is stated in this manual and the vehicle on which you are about to carry out repair and/or maintenance. **Betamotor** models are exported to numerous countries, where different rules apply with respect to highway law and homologation procedures. Trusting that you will understand, **Betamotor** S.p.A. therefore believes that it must reserve the right to make alterations to its products and technical documentation at any time and without prior notice.

We respect and defend the environment.

Everything we do has repercussions for the the entire planet and its resources. In the interests of the community, Betamotor wants its customers and technical assistance staff to be aware of the need to adopt procedures for the use of the vehicle and for disposal of its parts which fully comply with the applicable regulations in terms of environmental pollution and the disposal and recycling of waste.

SAFETY

Carbon monoxide

- Exhaust gases contain carbon monoxide (CO), which is a poisonous gas. Carbon monoxide can cause loss of consciousness and lead to death.
- If the engine has to be started, make sure that the area is well ventilated. Never start the engine in an enclosed space.
- Starting the engine in an enclosed space is permissible only if appropriate devices are used for extracting the exhaust gases.

Petrol

- Petrol is highly flammable and in certain conditions can cause explosions.
- Keep heat sources, sparks and flames well away from the work area.
- Always work in a well-ventilated area.
- Never use petrol as a cleaning solvent. In general, avoid handling it if not strictly necessary.
- Do not use petrol for cleaning components by means of compressed air.
- Keep it well out of the reach of children.

Engine oil

- Engine oil can cause skin diseases if it repeatedly comes into contact with the skin for prolonged periods.
- If you come into contact with engine oil, wash the affected parts as soon as possible with soap and water.
- If it comes into contact with the eyes, rinse with plenty of water and consult a doctor.
- If ingested, do not provoke vomiting, in order to avoid inhalation of the product. Consult a doctor immediately. If it is thought that inhalation of the product has taken place, take the person concerned urgently to hospital.
- Waste oil contains dangerous substances which are harmful to the environment. When changing the oil, it is necessary to be equipped for disposing of the waste oil in accordance with the relevant law.
- Do not dispose of waste oil into the environment.
- Keep it well out of the reach of children.

Coolant

- In certain circumstances the ethylene glycol in coolant is flammable, and its flame is invisible. If ethylene glycol catches fire, the flame, although invisible, can cause serious burns.
- Avoid bringing coolant into contact with hot components. Such components could be sufficiently hot to cause it to ignite.
- Coolant (ethylene glycol) can cause skin irritation and is poisonous if ingested.
- If coolant comes into contact with the skin, remove any contaminated clothing or footwear immediately and wash promptly with soap and water. If it comes into contact with the eyes, rinse with plenty of clean water and consult a doctor immediately. If ingested, do not provoke vomiting, in order to avoid inhalation of the product. Give the affected person clean water to drink, take them to hospital urgently and show the product to the medical staff.

- In case of exposure to high concentrations of fumes, take the affected person into an unpolluted environment and if necessary call a doctor.
- Do not remove the radiator filler cap when the engine is still hot. The coolant, being under pressure, can spurt out violently and cause burns.
- Coolant contains dangerous substances which are harmful to the environment. When changing the coolant, it is necessary to be equipped for disposing of waste oil/coolant in accordance with the applicable law.
- Do not dispose of coolant into the environment.
- Keep it well out of the reach of children.

Hot parts

- The engine and exhaust system become very hot and retain heat for a considerable time, even after the engine has been switched off. Wait for them to cool down before handling these parts or working in areas adjacent to them. In addition, use insulating gloves.

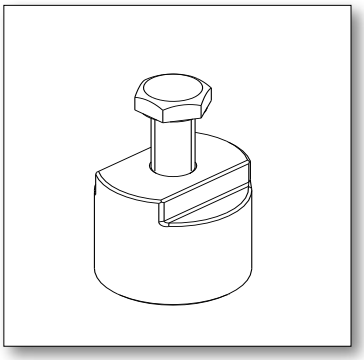
WARNINGS

The information in this paragraph is important in order for the operations carried out on the motorcycle to be performed without damaging the motorcycle itself.

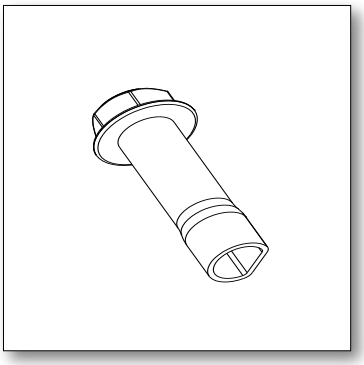
- Before dismantling, clean the vehicle thoroughly.
- During dismantling, clean all parts and put them away in containers, following exactly the order of dismantling.
- Always use special tools where necessary and whenever their use is specified.
- Always use adhesives, sealants and lubricants where specified. Follow the recommendations regarding their technical characteristics.
- Always replace parts such as gaskets, O-rings and safety washers with brand new parts.
- When loosening or tightening nuts or bolts, always start with the largest or from the centre. Always follow the recommended torque settings.
- Use only original Betamotor spare parts.

Assembly	Component	Qty	Thread lock	Torque (Nm)
Valvegear group				
Valve adjuster covers	Bolt M6x16	4		10
Camshaft sprocket	Screw M6x10	2		10
Water pump cover	Screw M6x20	3		10
Carburettor flange	Bolt M6x16	2		10
Exhaust flange	Screw M6x15	4		10
Bush, movable guide	Screw M6x25	1	X	10
Camchain tensioner	Bolt M6x16	2		8
Water circuit bleed screw	Screw M6x12	1		8
Water circuit drain screw	Screw M6x12	1		8
Rocker spindle plug	M16x1	2		10
Valve adjuster locknut	Nut M6x0.75	4		11
Cylinder head cover	Bolt M6x35	4		10
	Bolt M6x25	2		10
	Bolt M6x55	4		10
Head – Cylinder	Bolt M6x25	1		10
Crankshaft group				
Crankshaft half, clutch side	Nut M18x1.5	1		150
Crankshaft half, flywheel side	Nut M14x1.5	1		120
TDC locking bolt	Special bolt M8	1		25
Crankcase group				
RH crankcase – LH crankcase	Bolt M6x45	2		10
	Bolt M6x60	9		10
RH crankcase – Clutch casing	Bolt M6x25	8		10
	Bolt M6x40	1		10
	Bolt M6x30	1		10
Selector drum bearing retaining bolt	Bolt M6x10	2	X	10
Flywheel cover	Bolt M6x30	5		10
	Bolt M6x35	2		10
Clutch cover	Screw M6x20	4		10
Head – Cylinder – Crankcase	Stud M10x1.25	4	X	30
	Nut M10x1.25	4		30
Oil drainplug	M16x1.25	1		20
Oil filler plug	M16x1.25	1		10
Oil level plug	M16x1.5	1		10
Retaining plate Corteco	Special screw M4x8	2	X	3
Oil circuit jet	M5x0.75	2		6
Ignition/Starting group				
Pickup retaining bolt	Bolt M6x12	2		8
Stator retaining screw	Screw M5x25	3		6
Ramp	Bolt M6x20	2	X	8
Kickstart pivot retaining bolt	Bolt M8x20	1		25
Sparkplug	M10x1	1		10-12
Gearchange group				
Detent cam	Bolt M6x35	1	X	10
Oil pump group				
Cover, oil pump LH	Screw M6x14	2		10
Cover, oil pump RH	Screw M6x20	1		10
	Screw M6x15	1		10

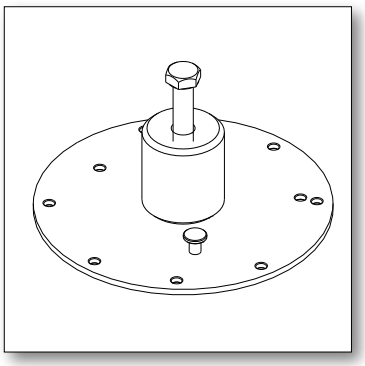
Assembly	Component	Qty	Thread lock	Torque (Nm)
Pivot, oil pump idler gear	Screw, shallow, M6x25	1	X	10
Intake filter cover, output oil pump	M20x1.5	1		15
Intake filter cover, scavenge oil pump	M20x1.5	1		15
Filter cover, output oil pump	Screw M6x20	3		10
Oil pressure relief valve	Special bolt M12x1.25	1		20
Clutch group				
Pressure plate	Bolt M6x16	6		10
Clutch centre	Special nut M14x1.25	1		90
Clutch actuator body.	Bolt M6x16	3		10
Frame – Engine				
Swing-arm bolt	Nut M16	1		90
Stay RH	Bolt M8	2		25
Stay LH	Bolt M8	2		25
Engine mounting bolt, front	Bolt M10	1		25
Engine mounting bolt, lower	Nut M10	1		25
Mounting bolt, cylinder head	Nut M8	1		30



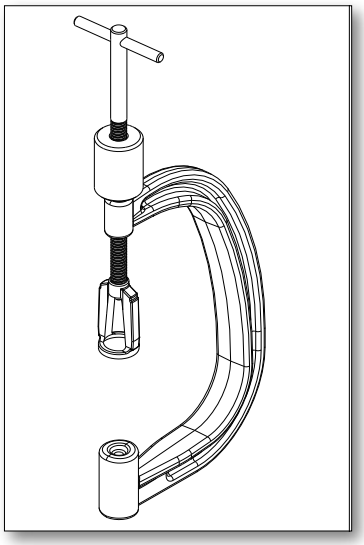
01.00040.000
Flywheel extractor



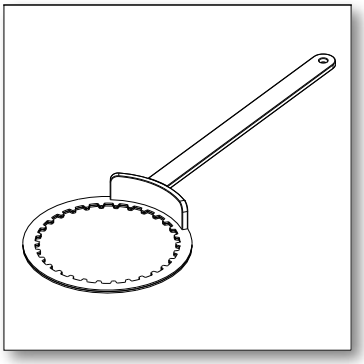
01.00041.000
Key for water pump shaft



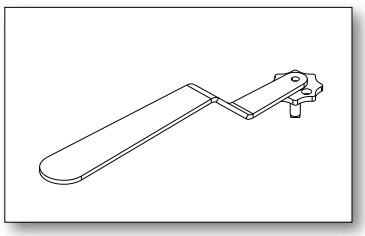
01.00042.000
Crankcase splitter



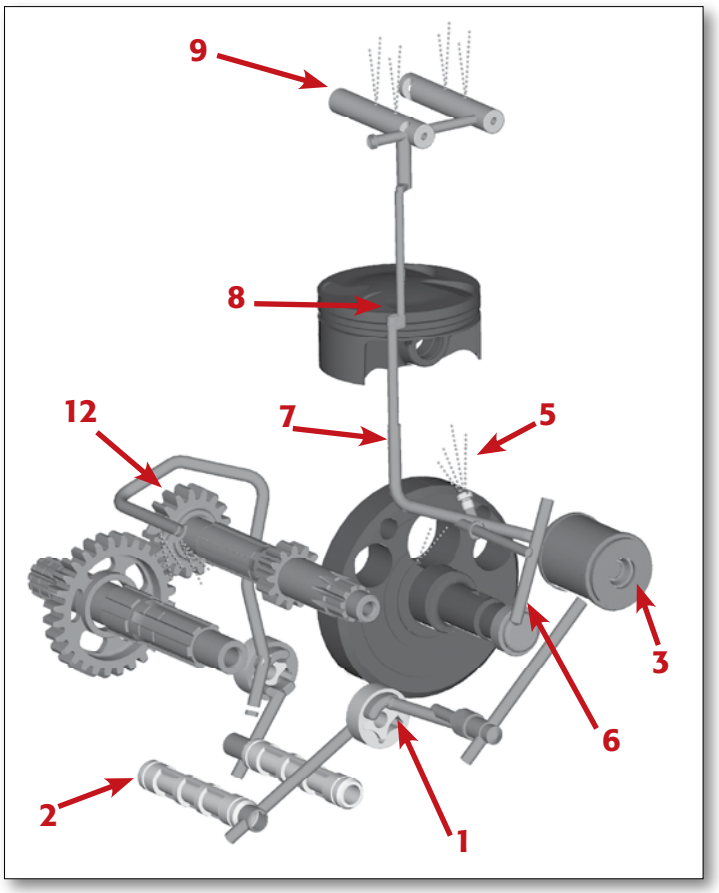
01.00043.000
Valve spring fitting tool



01.00044.000
Inner clutch hub locking tool

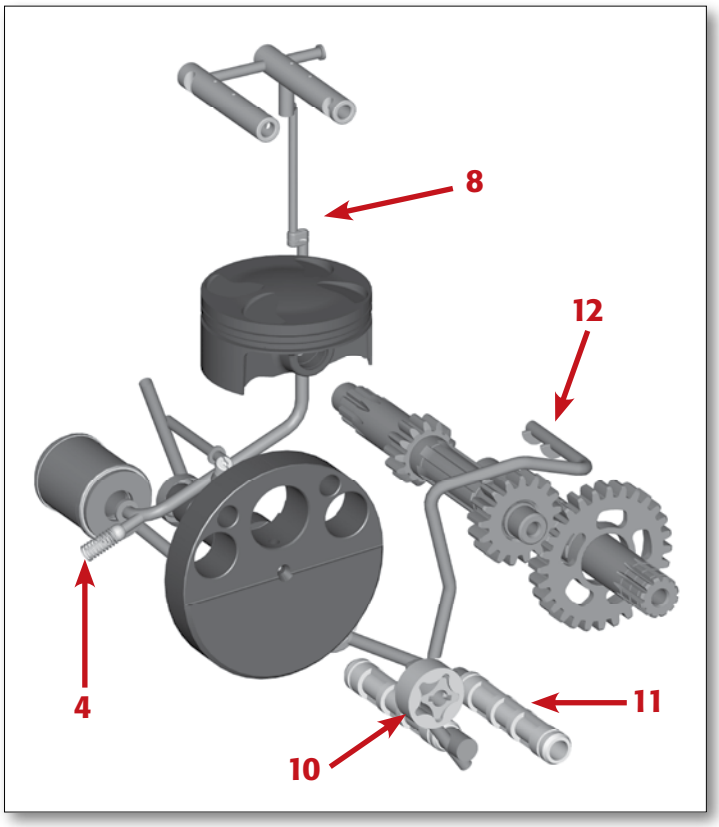


01.00045.000
Carburettor adjusting spanner



1 LUBRICATION CIRCUIT

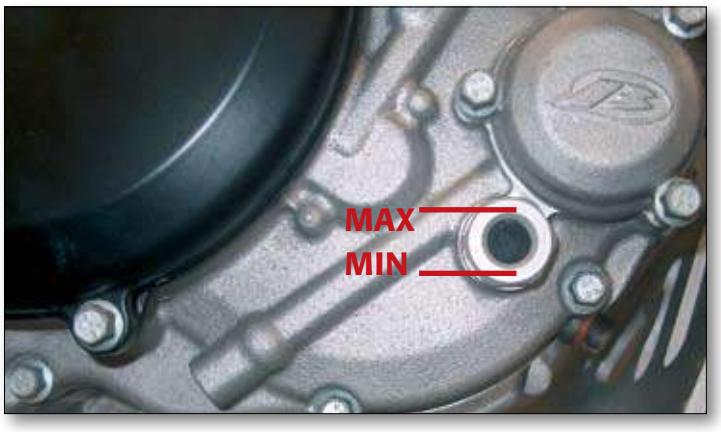
The output oil pump (1) draws in oil from the area at the base of the gearbox through its own mesh oil filter (2) and then sends it to the paper oil filter (3). From here the oil, starting from the bypass valve (4), is directed in three different directions: by means of a jet (5) it lubricates the piston pin and takes heat from the crown of the piston; and it passes through two pipes, one of which (6) takes it to the crankshaft to lubricate the roller bearing on the crankpin; the other (7), whose flow is regulated by a jet (8), feeds the valvegear (9). The oil then returns to the base of the crank chamber from the piston, the conrod assembly and the cylinder walls, and is drawn in by the scavenge pump (10) through the mesh filter (11). It is pumped through special jets (12) and lubricates the transmission gears. The oil in the cylinder head, however, returns to the base of the gearbox passing through the timing case and the inner clutch casing.



1.1 ENGINE OIL

Use only fully synthetic oils of a reputable brand (BARDAHL XTC60 15W50).

1.2 CHECKING THE ENGINE OIL LEVEL



The engine oil level must be checked when the engine is warm. Run the engine for several minutes and then switch it off. Place the bike on a flat surface in such a way that it is perfectly vertical.

Wait a few minutes and then check the oil level in the sightglass located in the clutch casing (right-hand side of the engine). The level must be between the limits indicated in the picture.

If necessary, remove the oil filler plug and top up the level.

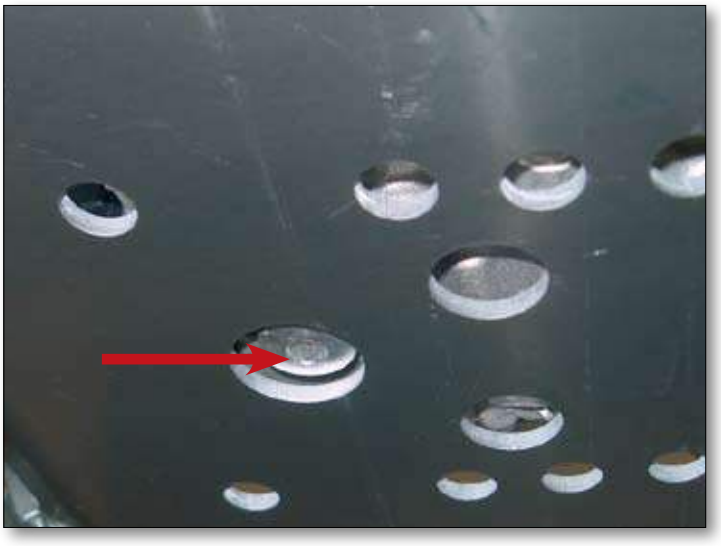
N.B. Running the engine with too little oil causes excessive wear to the engine components.



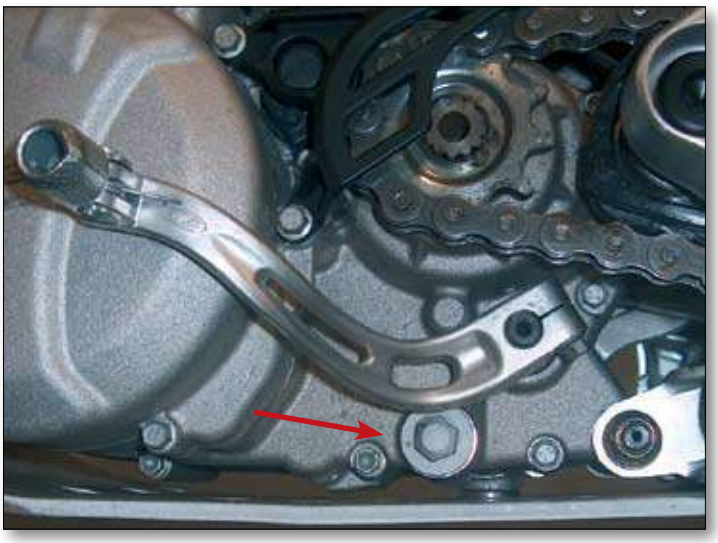
1.3 CHANGING THE ENGINE OIL

N.B. At each oil change, the mesh filters must be cleaned and the paper filter replaced.
N.B. The oil change must be carried out when the engine is at working temperature. Be careful not to scald yourself with the hot oil.

After the engine has reached operating temperature, switch the bike off and stand it upright.

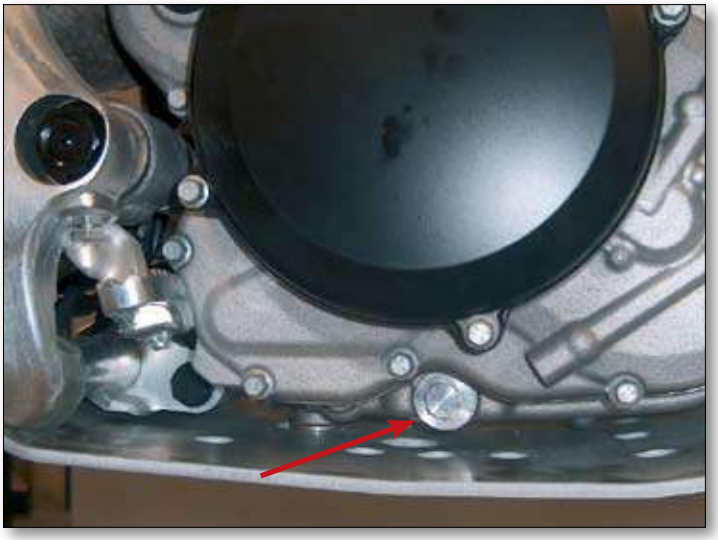


Unscrew the oil drainplug and let all the oil flow out into a drain pan. Thoroughly clean the magnet on the drainplug to get rid of the metallic impurities that it has collected.



Unscrew the plug in the left-hand casing and use pliers to extract the filter. Clean it carefully and blow it through with compressed air. Check for damage to the O-rings, and replace them if necessary. Refit all the parts and tighten the plug to 15 Nm.

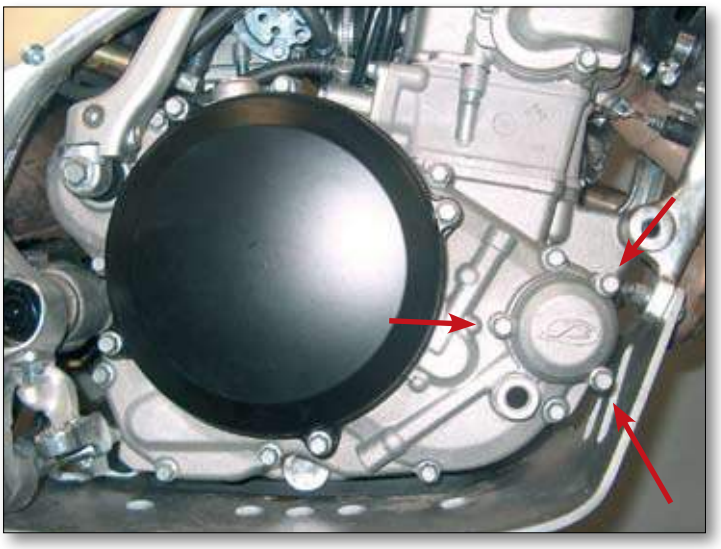




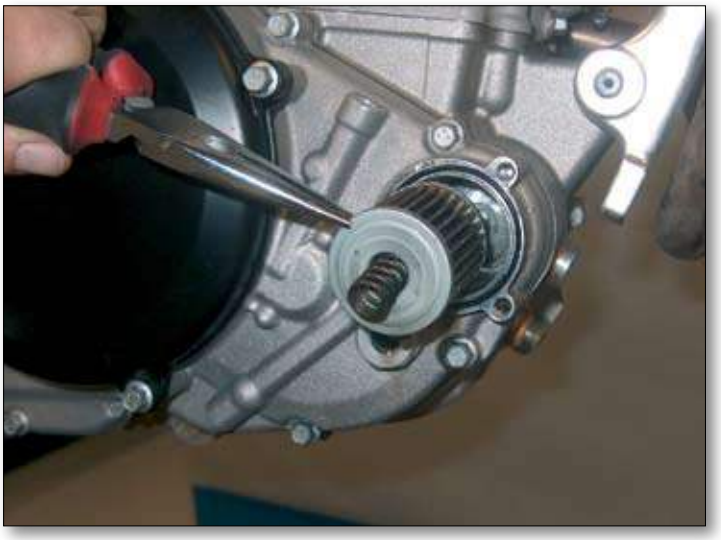
Carry out the same procedure for the output mesh filter, for which the access is via the right-hand engine casing.



Position a container under the bike, near the cover for the paper filter, and unscrew the bolts on the filter cover.

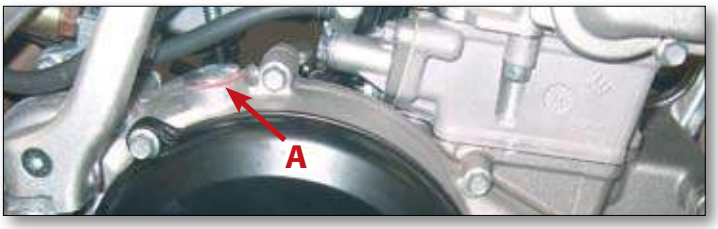


Then extract the paper filter using pliers. Check the condition of the O-ring too, and replace it if necessary.
Change the filter and refit the cover, tightening the three M6x20 bolts to 10 Nm.



Refit the oil drainplug, tightening it to 20 Nm, and refill with 0.81 of engine oil (BARDHAL XTC60 15W50).

N.B. If the engine has been opened up for an internal inspection, the quantity of oil to put in is 0.9 litres.

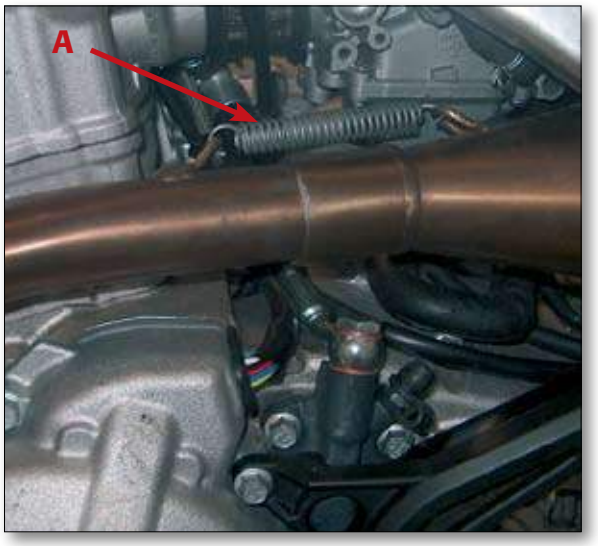


Finally, tighten the oil filler plug (A) to 10 Nm.

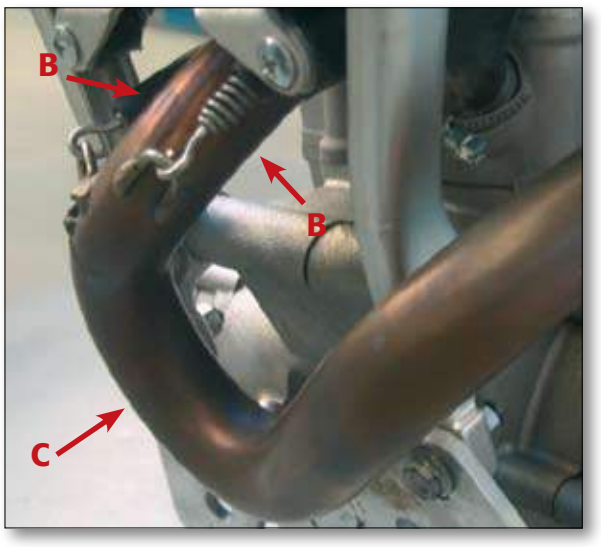
2 ENGINE REMOVAL AND REFITTING

2.1 ENGINE REMOVAL

Thoroughly clean the entire motorcycle and put it on a stable stand.
Remove the rear mudguard.



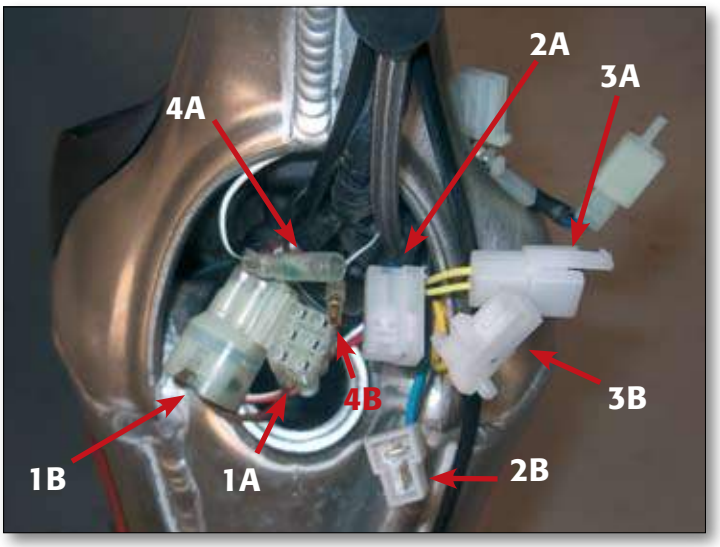
Unhook the tension spring (A) on the side of the exhaust system and the two springs in front of the cylinder head (B).
Next, remove the exhaust manifold(C) by pulling it forwards.



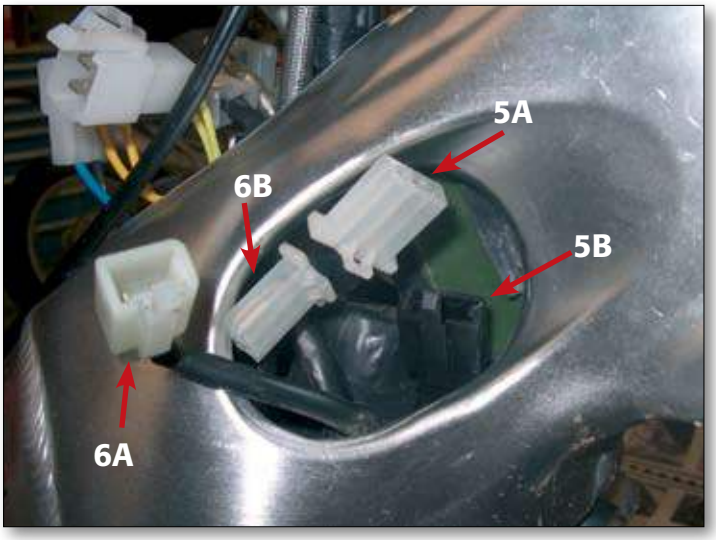
Remove the plate under the engine.

Disconnect all the electrical cables located between the headstock and the fuel tank under the plastic tank cover:

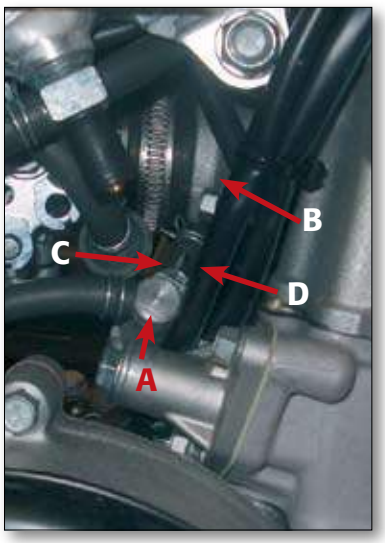
1A connector, control unit to generator cable group
1B control unit connector
2A connector, regulator to wiring harness (regulated voltage)
2B regulator connector (regulated voltage)
3A connector, regulator to flywheel (alternating current)
3B regulator connector (alternating current)
4A connector, killswitch cable to generator
4B connector, killswitch cable to vehicle wiring harness

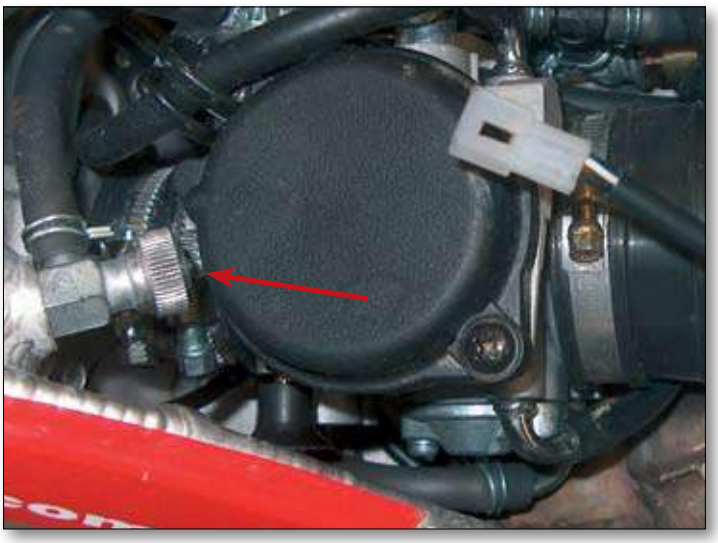


5A connector, electric fan to vehicle wiring harness
5B electric fan connector
6A thermoswitch connector
6B connector, thermoswitch to vehicle wiring harness

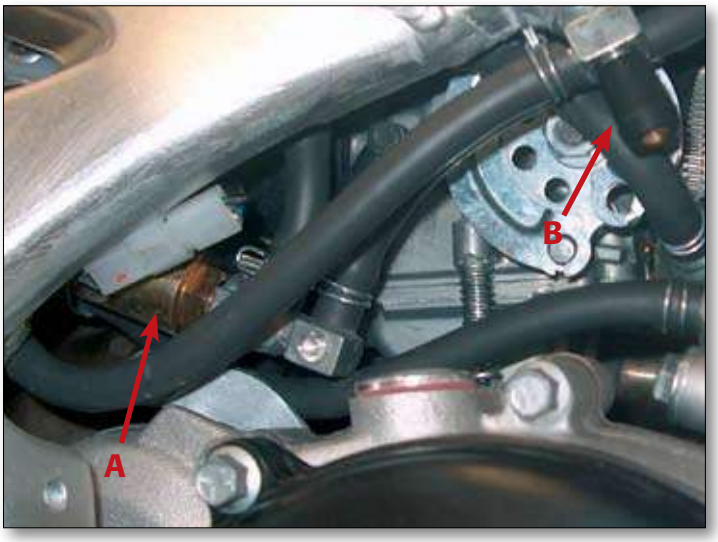


Disconnect the hot start cylinder (A) from the carburettor flange (B) by loosening the clamp (C) and pulling off the pipe (D) which connects it to the carburettor flange.

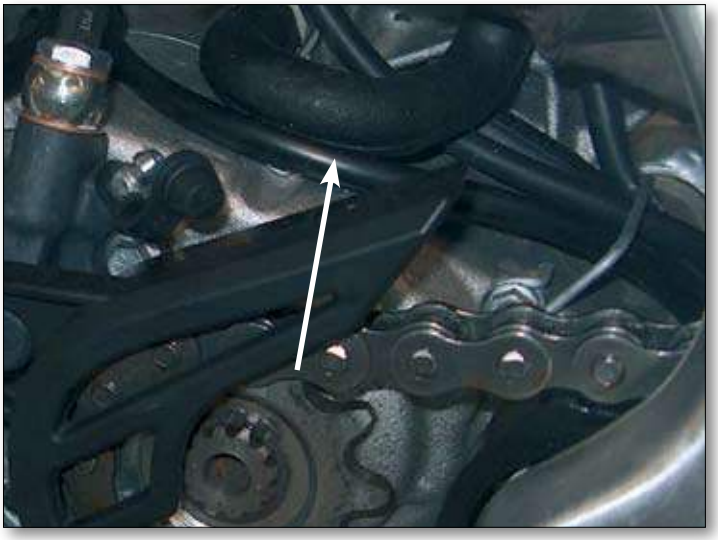




Close the tap on the fuel tank by screwing in the relevant knob.



Disconnect the pipes and the electrical connector from the electric tap (A), after making sure that the supplementary/reserve tap (B) is closed (pull the knob downwards).

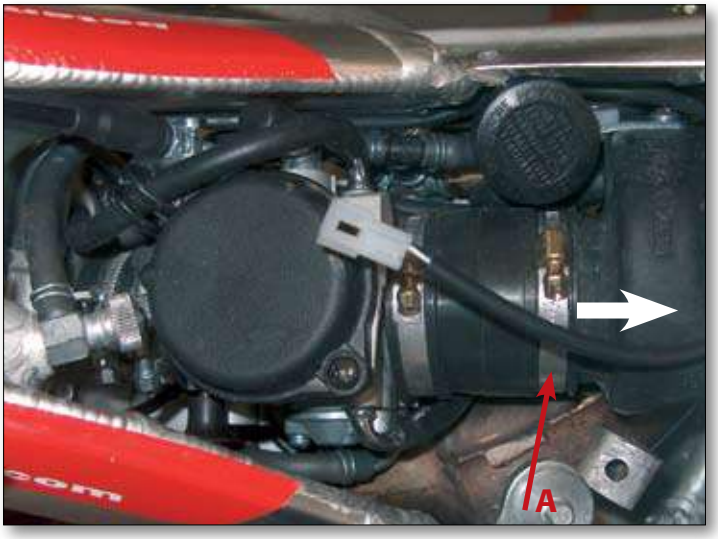


Disconnect the oil vapour breather pipe.

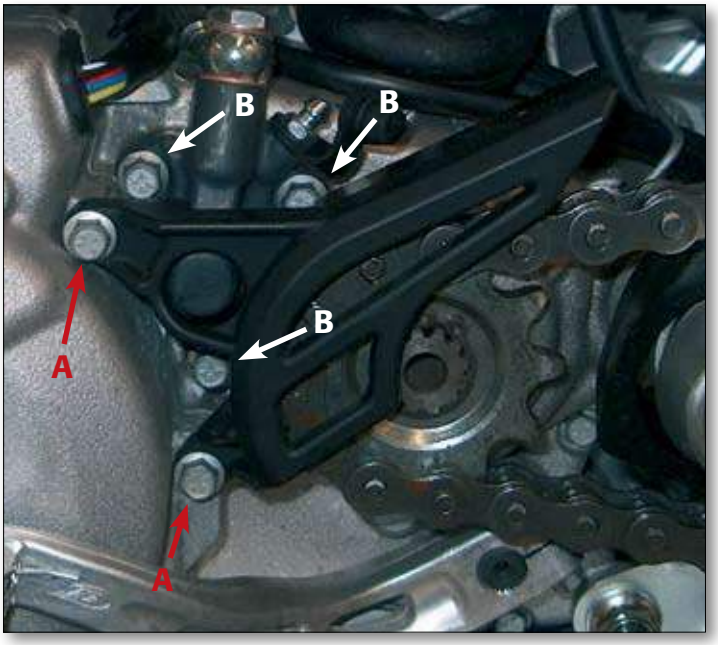
Loosen the clamp which secures the carburettor to the rubber carburettor flange.

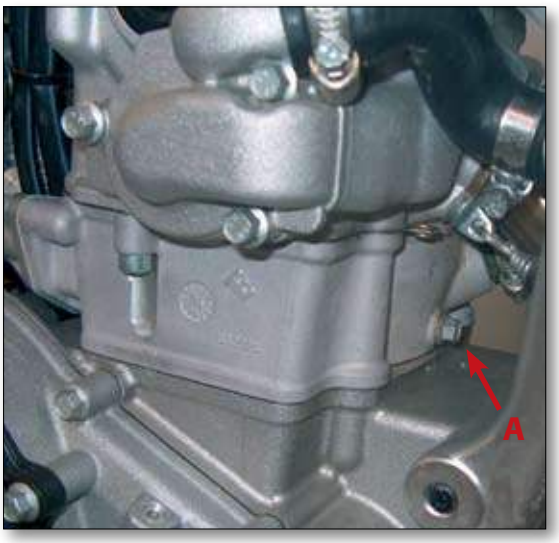


Loosen the clamp (A) which secures the rubber sleeve to the filter box and pull the carburettor backwards (see the arrow in the illustration) until the carburettor is completely disconnected from the rubber flange.



Remove the sprocket cover casing by unscrewing the two retaining bolts (A).
Slip the chain off the sprocket after slacking off the rear wheel spindle.
Remove the clutch actuator by unscrewing the three retaining bolts (B).





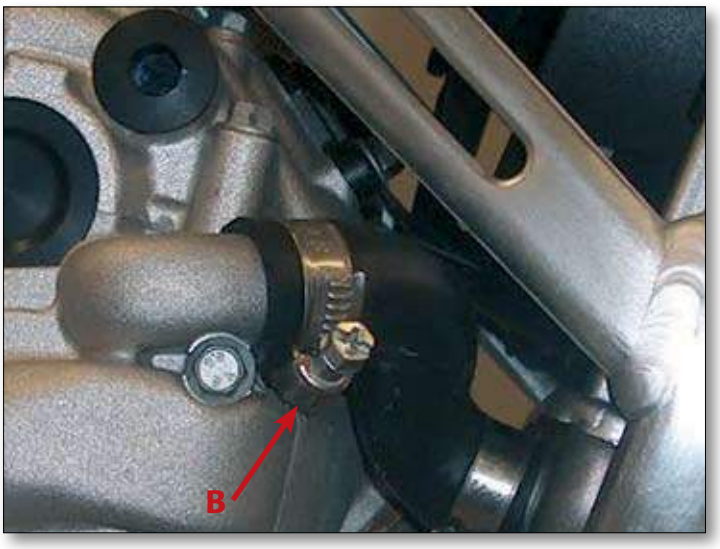
Position a drain pan under the engine and unscrew the drain bolt for the cooling system (A). Then open the radiator cap (B) to allow all the liquid in the system to flow out.



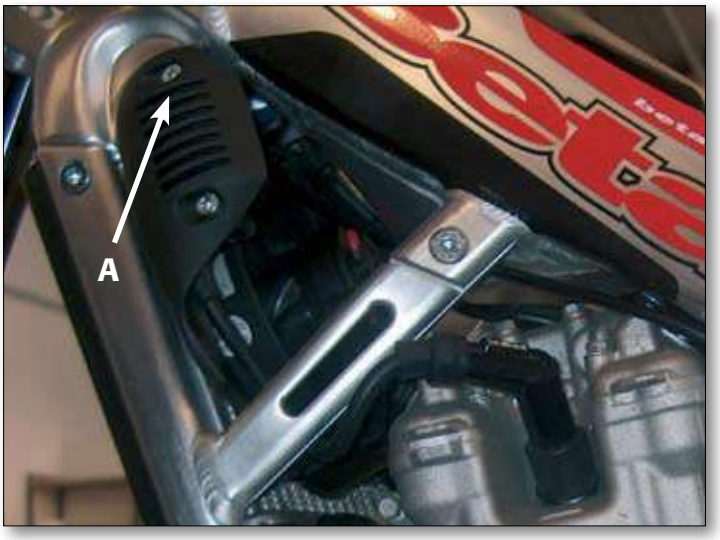
Loosen the clamps that secure the cooling system pipes respectively to the cylinder (A) and the water pump (B).



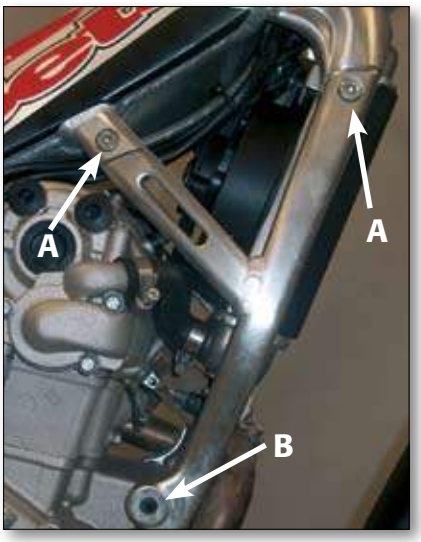
Pull off the sparkplug cap and unscrew the upper bolt (A) securing the coil support.



Loosen the clamps that secure the cooling system pipes respectively to the cylinder (A) and the water pump (B).



Unscrew the bolts that secure the stay to the frame (A) and take out the front engine mounting bolt (B) after unscrewing it.





Unscrew the bolt securing the radiator and then remove the entire radiator/stay assembly after disconnecting the connectors for the electric fan and the radiator sensor.

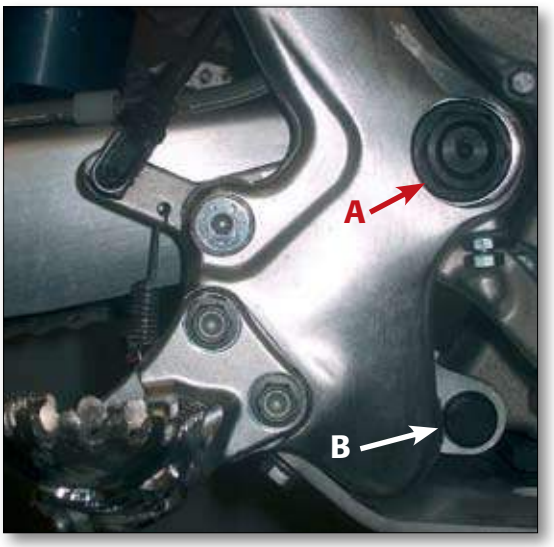


Take out the bolt securing the cylinder head to the frame.



Slack off the nut securing the lower engine/frame mounting bolt.

Remove the swing-arm bolt (A) and pull the swing-arm backwards.
Take out the lower engine mounting bolt (B) and then lift the engine from the frame.

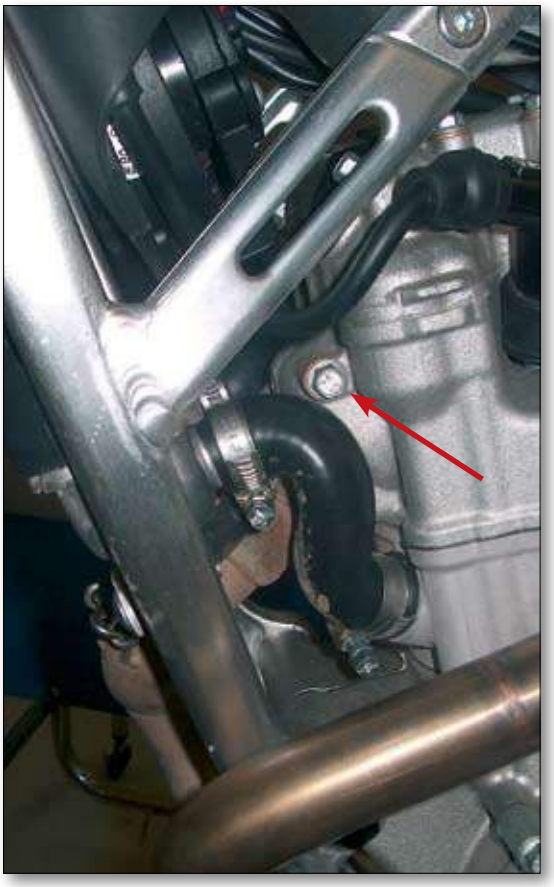


2.2 REFITTING THE ENGINE

To refit the engine, follow the engine removal steps in reverse. For tightening torques, consult the relevant table.

Once refitting is complete, refill the system with coolant through the radiator until the liquid comes out of the bleed hole on the left-hand side of the cylinder head.
Tighten the bleed screw and continue pouring the liquid into the radiator until it reaches the flared section in proximity to the filler cap. The total quantity of liquid to put in is 0.6 litres.

Caution
Do not run the engine with the voltage regulator connected to the electrical generator without also connecting the vehicle wiring harness (central system). Doing so could cause damage to the regulator itself.





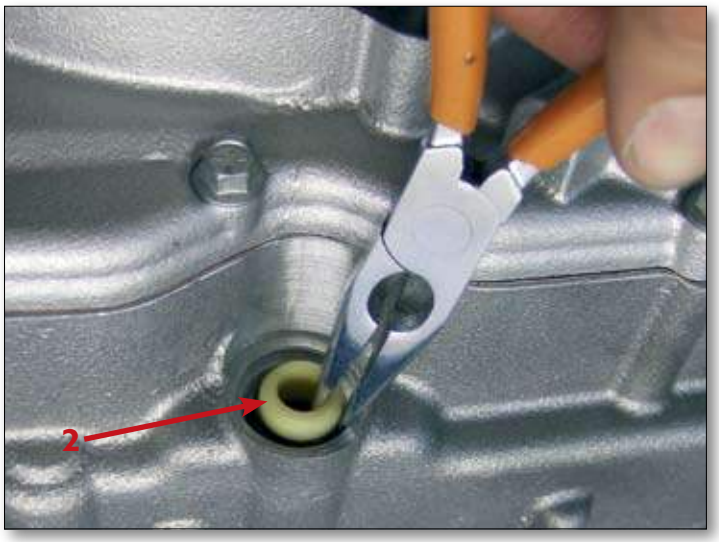
Before you start to dismantle the engine it is essential that you also read the next chapter, which deals with assembly, because it discusses all the checks that need to be carried out on individual components.

3.1 DRAINING THE OIL

Remove the oil drainplug and let the oil flow out into a drain pan.

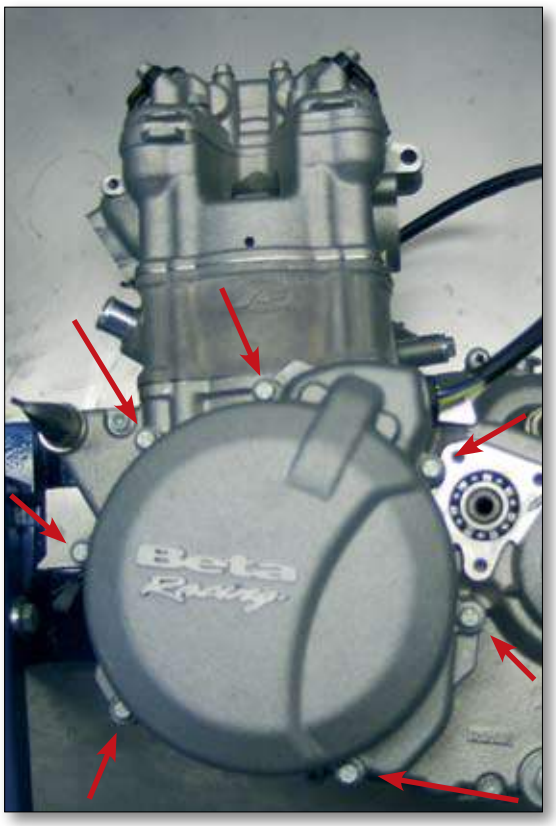


Take out the oil filters from the left-hand (1) and right-hand (2) crankcase halves after first removing the filter covers.



3.2 IGNITION

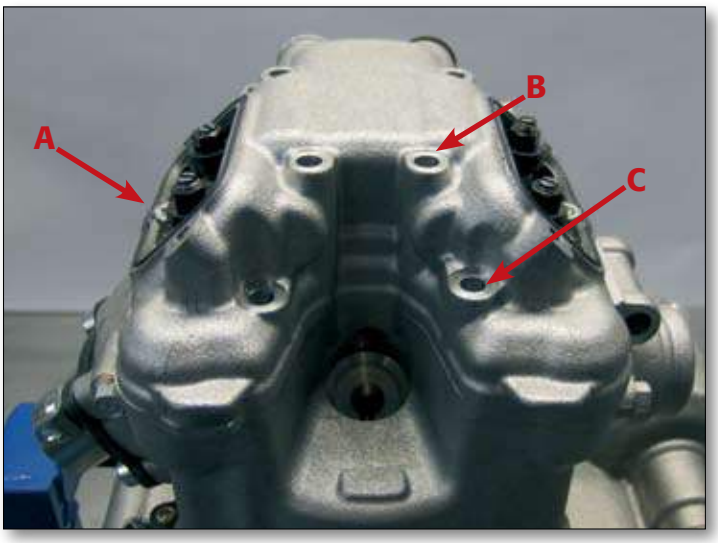
Undo the 7 bolts retaining the flywheel cover and remove it, together with the stator and pickup that are mounted on it.



3.3 CYLINDER HEAD

Remove the washer from the TDC bolt and look for TDC between the compression and combustion strokes. At this point, all the valves are fully closed and the complete timing system is therefore unloaded.
To find TDC, set up a dial gauge with suitable support in the sparkplug hole, and rotate the flywheel by hand until the dial gauge indicates that the piston has reached its highest point.
Then tighten the crankshaft locking bolt without the washer and check that the crank is locked by trying to rotate the flywheel.
Remove the sprocket from the output end of the layshaft after first removing the retaining circlip, and then remove the further circlip located behind the sprocket.





Remove the valve covers and then take out all the bolts securing the cylinder head cover: 2 M6x25 bolts (A), 4 M6x55 bolts (B) and 4 M6x35 bolts (C).



Remove the head cover and then the camshaft end plug. If this operation is difficult, it should be carried out with the aid of a rubber hammer by tapping on the fins on the left-hand side of the engine to help in detaching the cover from the head. If you need to inspect the rockers, unscrew the rocker spindle housing plugs and extract the spindles using an M4 bolt screwed into the spindles from the timing case side. Do this while the cover is still fitted to the head and secured by the bolts. This is because the spindles are restrained from rotating, which helps when screwing in the extracting bolt.

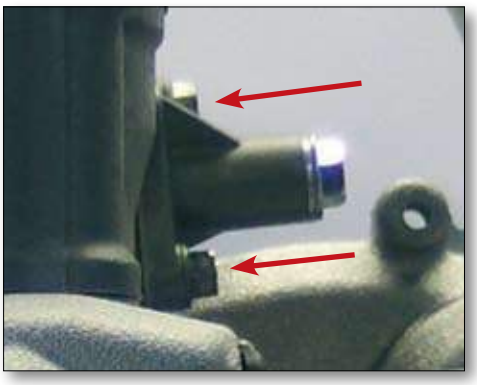
Before you undertake the removal of the camshaft, attend to the water pump. This is because the camchain tends to lock the water pump gear, which helps when removing the water pump shaft.

After you have removed the water pump cover and its retaining bolts, remove the circlip which retains the impeller, and then the impeller itself. Then use the special tool (A) to unscrew the water pump shaft from the gear which takes its drive from the camchain.





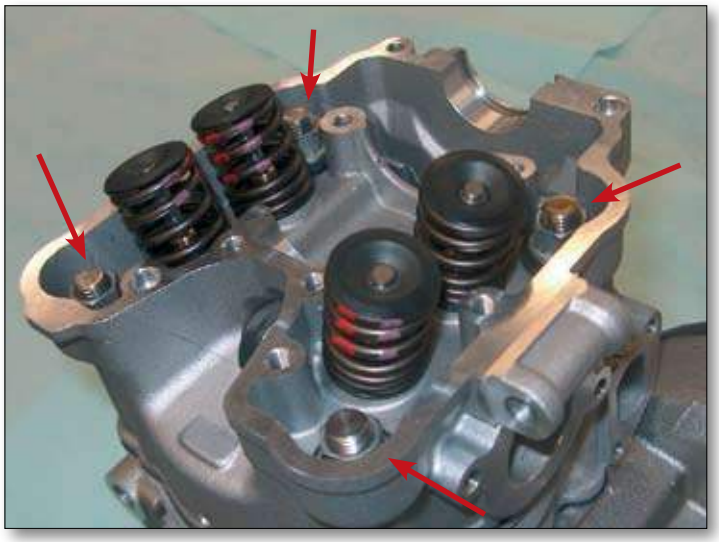
Remove the camchain tensioner by unscrewing the two retaining bolts.
Remove the camshaft and its bearings from the head, taking care not to let the camchain fall into the timing case. For camshaft inspection and dismantling, refer to what is said in the chapter on assembly.

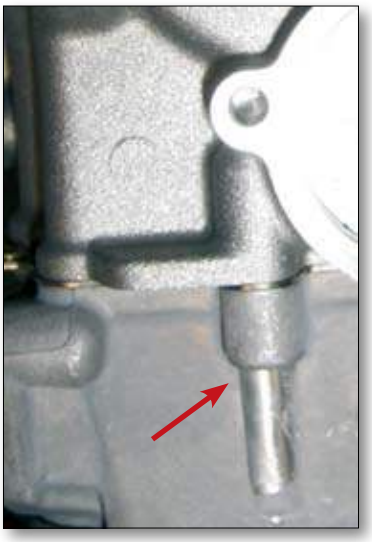


Remove the water pump shaft, taking care that the gear does not fall into the crankcase. Remove the fixed camchain guide.



Unscrew the cylinder head retaining nuts, which are screwed onto the studs, and the bolt on the water pump side. Then remove the head and the head gasket, taking care also to remove the dowels.





If the water pump shaft bearings are to be replaced, extract the one on the outer side by pressing it with a padded drift towards the inside of the timing case until it comes completely free.
For the inner bearing, use a slide hammer with a suitable internal extractor.



3.4 CYLINDER

Slide the cylinder up until the piston pin is visible. Then remove the retaining circlip and extract the piston pin as far as is necessary to release the connecting rod.

In this way, you can take off the cylinder and piston together without having to split them. You only need to split them when performing operations or measurements on the two components individually (see the section devoted to this subject in the chapter on assembly).

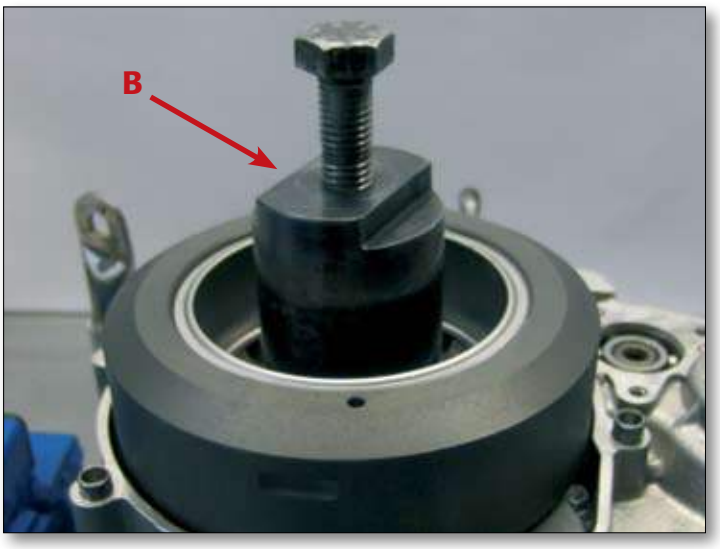






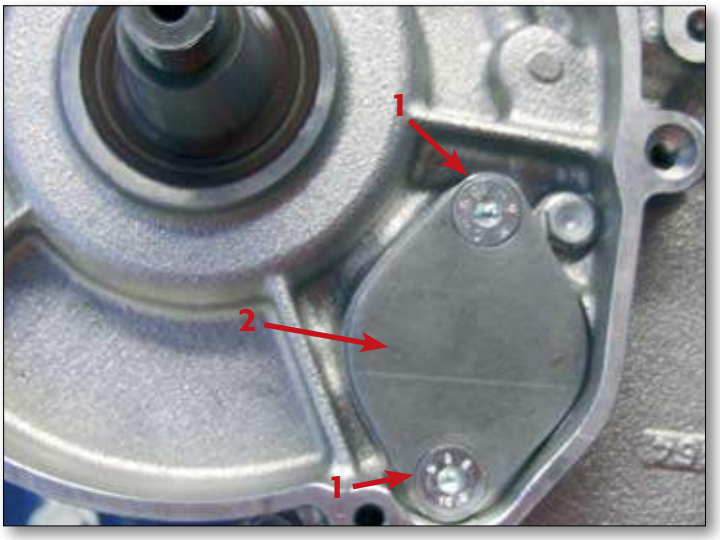
3.5 FLYWHEEL

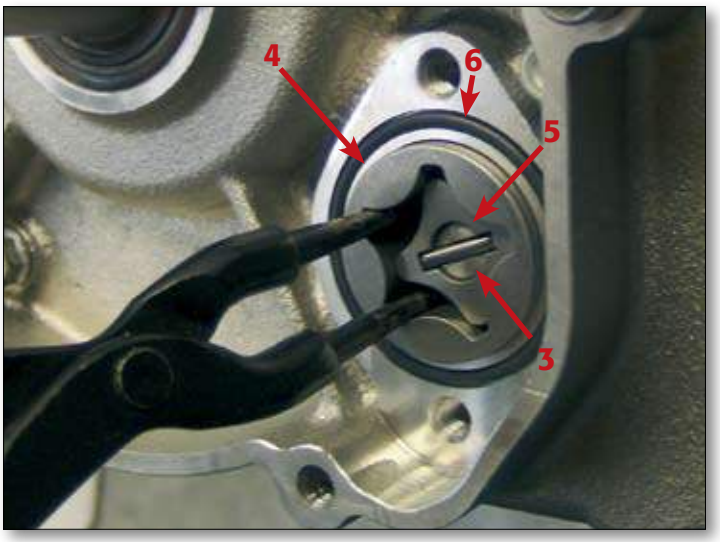
Unscrew the flywheel retaining nut (A) and extract the flywheel using the special extractor (B). Screw the extractor into the threads in the flywheel and extract it by tightening the central bolt which bears on the crankshaft.

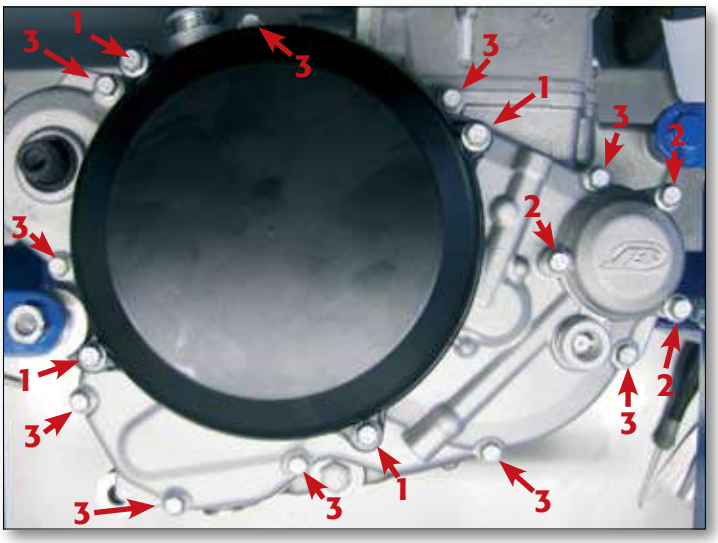


3.6 OIL PUMP (LEFT-HAND CRANKCASE)

Remove the left-hand oil pump cover (2) after first _unscrewing the retaining screws (1). Next, extract the pump outer rotor (4) using a pair of circlip pliers, after you have removed the pin (3). Then remove the inner rotor (5) and the O-ring (6) which seals the cover.



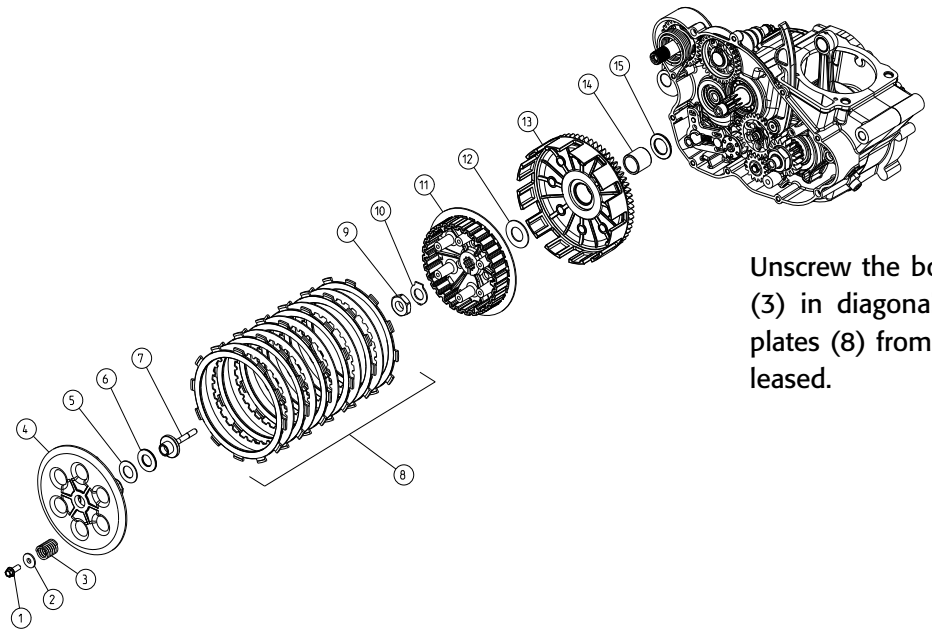




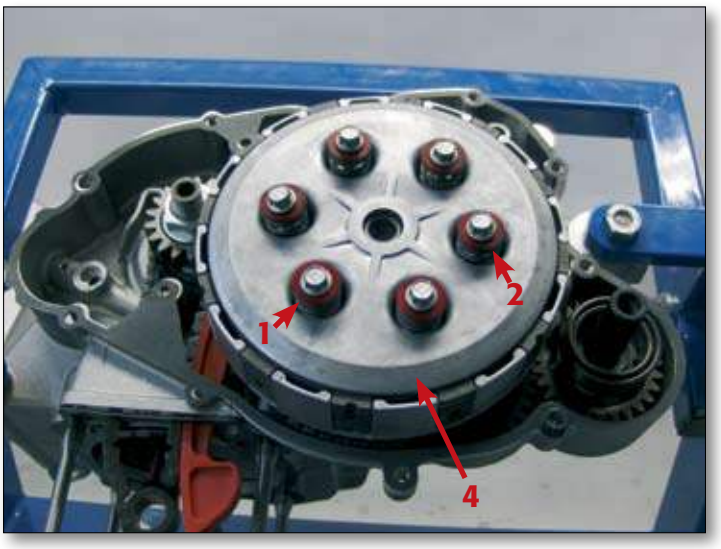
3.7 CLUTCH

Unscrew the bolts retaining the clutch cover (1) and the oil filter cover (2) and remove the two covers and their O-rings. Then unscrew the bolts holding the clutch casing (3) after you have removed the kickstart lever.





Unscrew the bolts (1) retaining the clutch springs (3) in diagonal sequence to prevent the friction plates (8) from jamming when the springs are released.

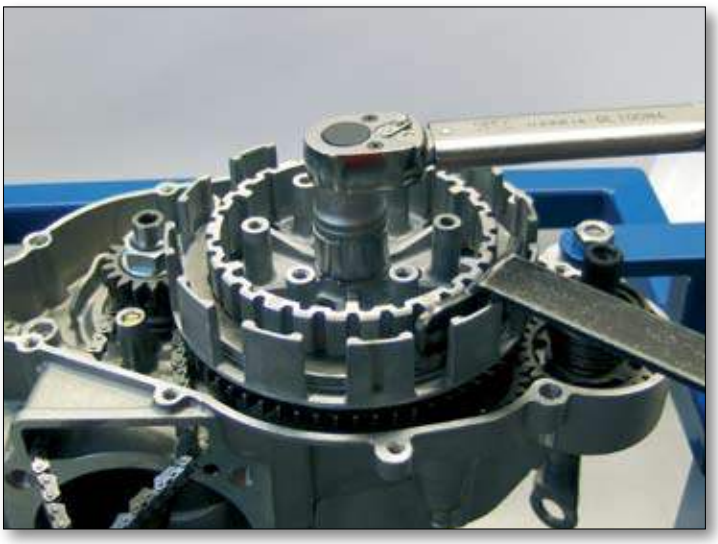


Then extract, in sequence, the special washers (2), the springs (3) and the clutch pressure plate (4). Next, remove the friction plates (8) and then the pressure plate lifter (7), the needle roller bearing (6) and the corresponding washer (5).



Using a screwdriver, release the tabs on the tabwasher (10).



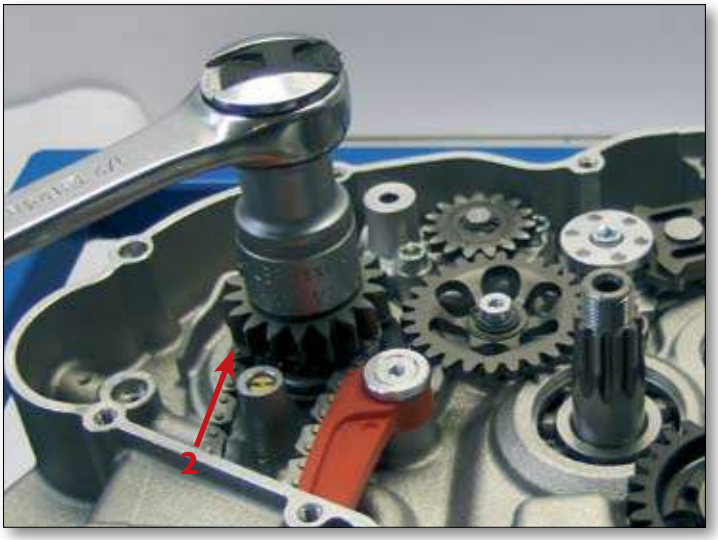


Which locks the retaining nut (9) for the clutch hub (11) and unscrew the nut, using the special tool for locking the clutch centre.
Extract the clutch centre (11), the thrust washer (12), the clutch basket (13), the bush (14) and the thrust washer (15).



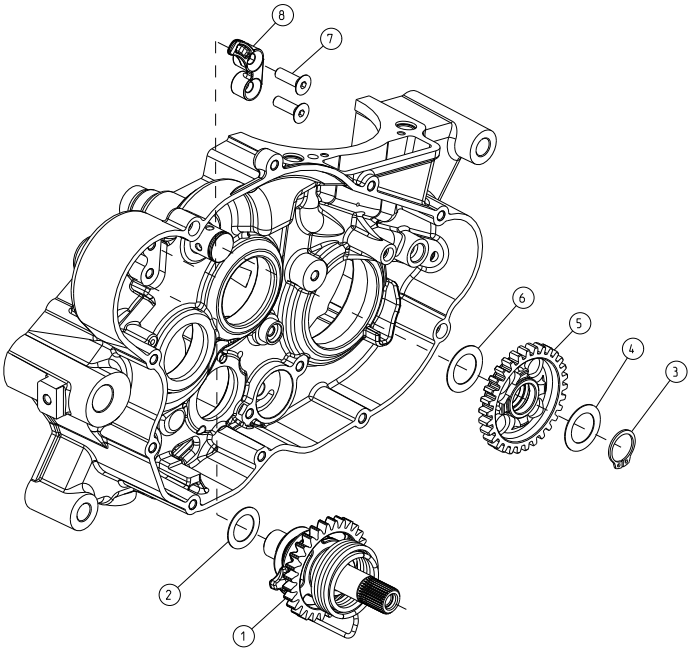
3.8 PRIMARY TRANSMISSION

Unscrew the crankshaft nut (1) and extract the primary transmission gear (2).
Also remove the washer located between these two components.

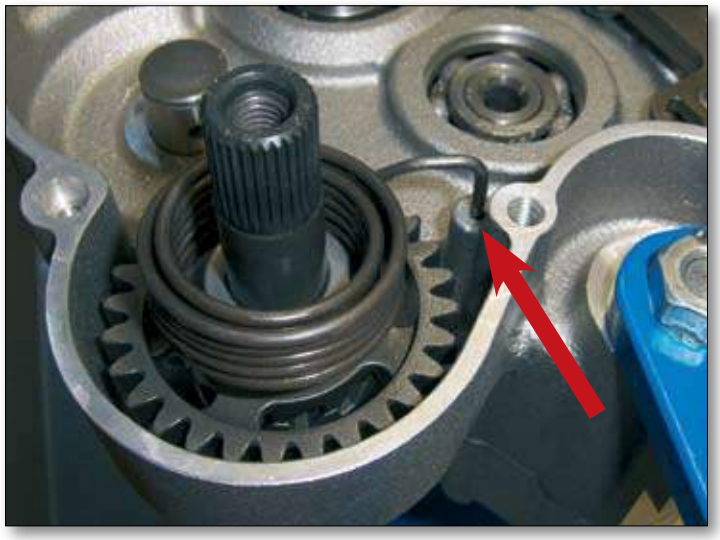


3.9 KICKSTART

Extract the kickstart shaft complete (1) together with the thrust washer (2), ensuring that the assembly does not come apart accidentally.



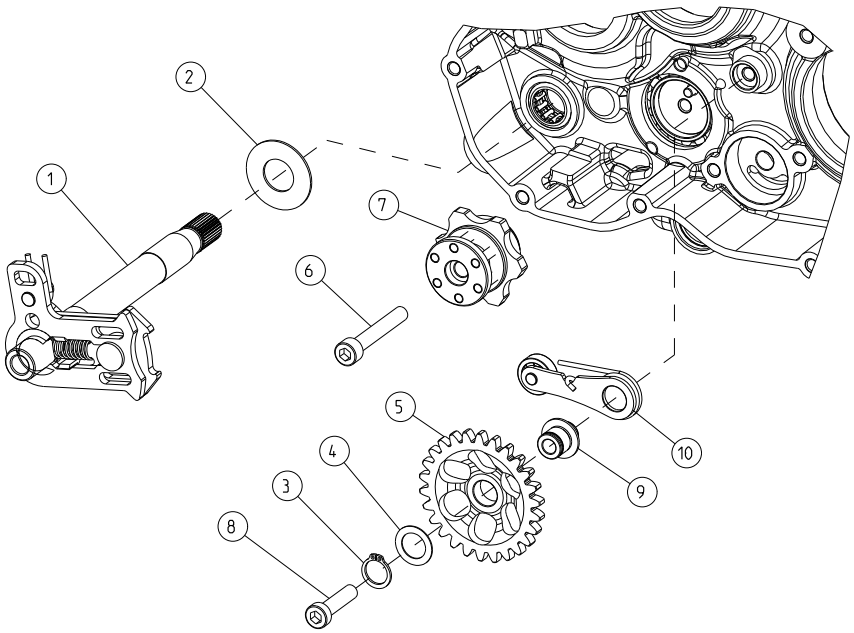
N.B. Take care when extracting the kickstart return spring from its housing. Because it is under preload, it can cause injury as a result of rapidly springing back to its rest position.



Remove the kickstart idler gear (5) after you have first removed the retaining circlip (3). At the same time, remove the two thrust washers (4, 6) located either side of it on the idler shaft.
Remove the kickstart ramp (8) after you have released it by taking out the retaining bolts (7).

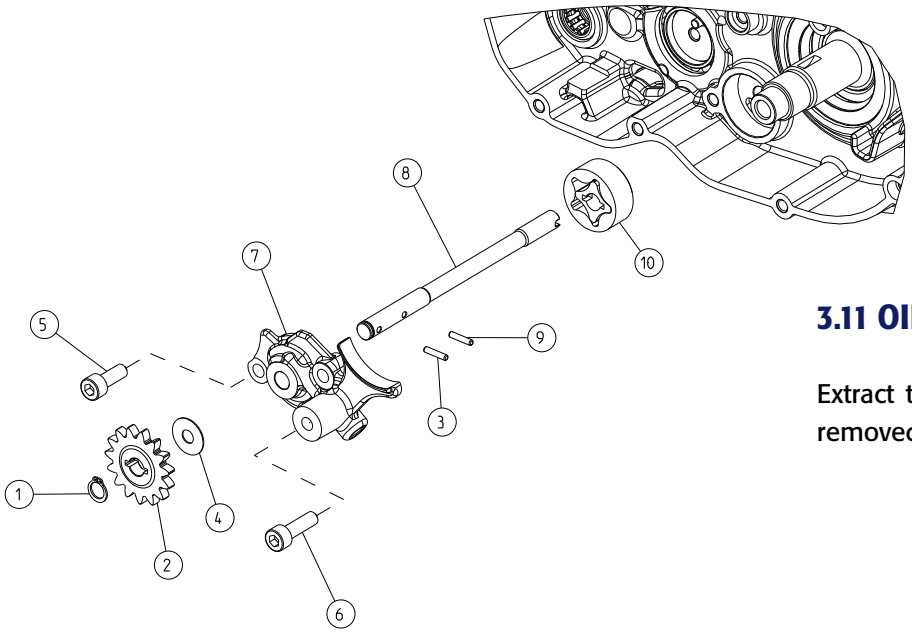
N.B. To facilitate removal of the ramp, heat it to soften the thread lock on the two retaining bolts..

3.10 SHIFTING MECHANISM



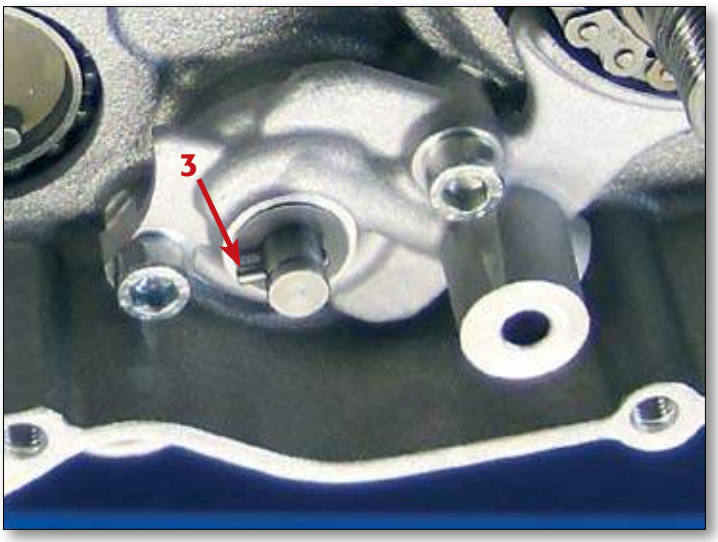


Take out the gearchange shaft (1), pushing back the movable pawl with a screwdriver to prevent it from interfering with the gearchange detent cam.
Pull off the idler gear (5) together with its thrust washer (4), after you have first removed the retaining circlip (3).
Unscrew the bolt (6) securing the detent cam (7) and remove the cam, moving the detent lever aside.
Unscrew the retaining bolt (8) and extract first the idler pivot pin (9) and then the detent lever (10).



3.11 OIL PUMP (RIGHT-HAND CRANKCASE)

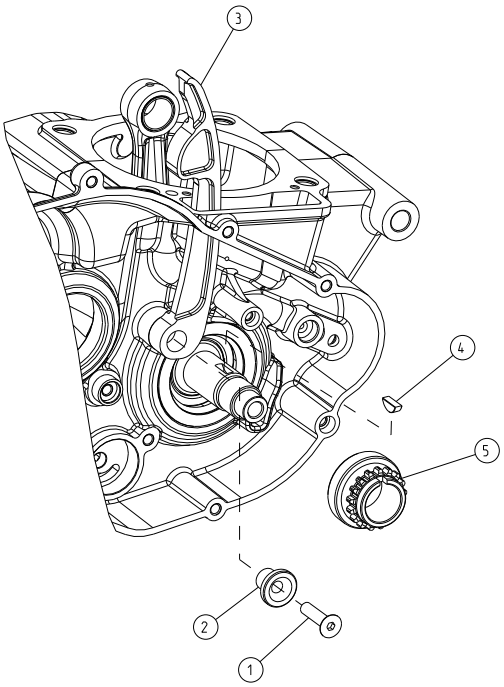
Extract the oil pump gear (2), after you have first removed the retaining circlip (1).



Remove the pin (3) which carries the drive from the gear (2) to the oil pump shaft (8), and then the thrust washer (4). Remove the oil pump cover (7) after first unscrewing the retaining screws (5, 6).
Extract the oil pump shaft (8) together with the pin (9), and then remove the oil pump rotors (10), adopting the same procedure as was used for the oil pump in the left-hand crankcase half.

3.12 TIMING SPROCKET

Once you have removed the camchain, take out the movable guide (3) and the bush (2) by unscrewing the retaining bolt (1).

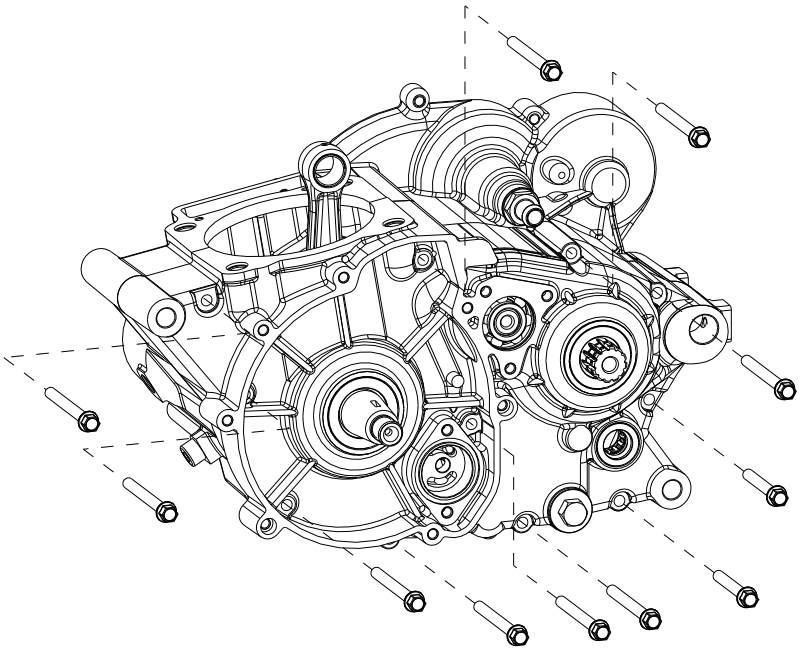


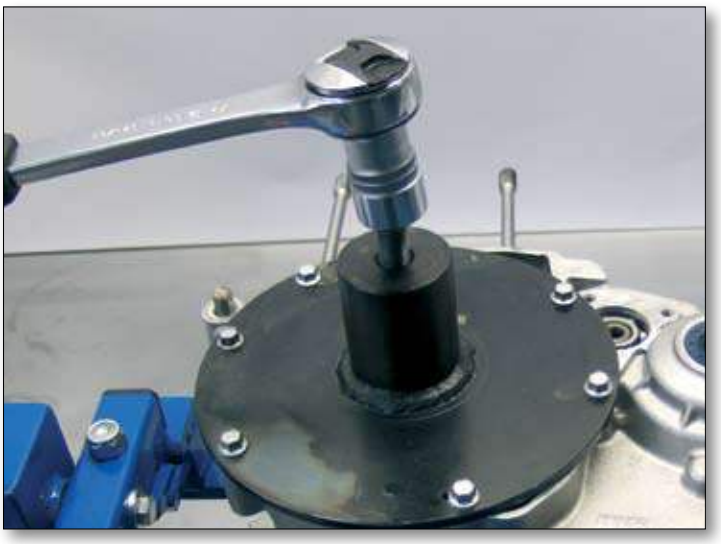
Use an engineering chisel to remove the woodruff key (4) from its housing in the clutch side crankshaft end, and then extract the timing gear (5).



3.13 SPLITTING THE CRANKCASE

Remove the ball and the clutch pushrod. Unscrew all 11 bolts that hold the crankcase together.

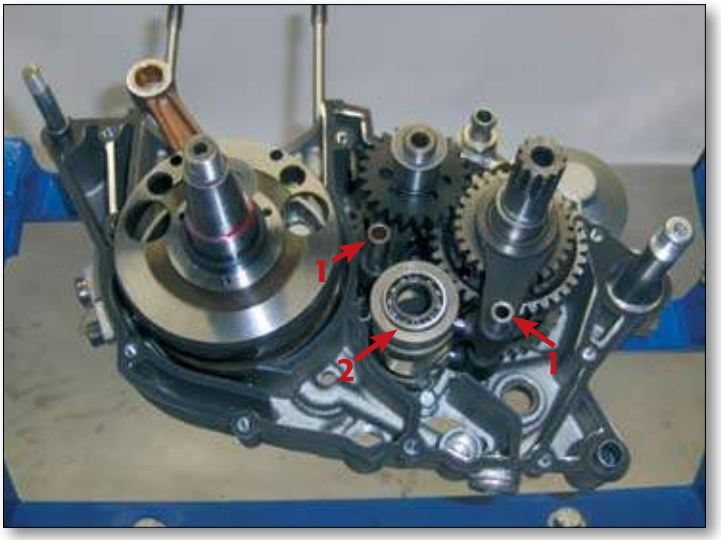




Once you have removed the gasket from the cylinder base, use the special tool for splitting the crankcase, securing it to the left-hand crankcase half using the threads for the flywheel cover retaining bolts. Turn the engine so that the right-hand crankcase half is facing downwards.



Then screw in the bolt at the end of the special tool until the two crankcase halves are separated, and manually take off the left-hand crankcase half.



3.14 GEARBOX AND SHIFTING MECHANISM

Extract the selector fork spindles (1) and the gear-box selector drum (2).

Remove the selector forks (3) and then extract the mainshaft and layshaft as a unit, complete with all the gears.



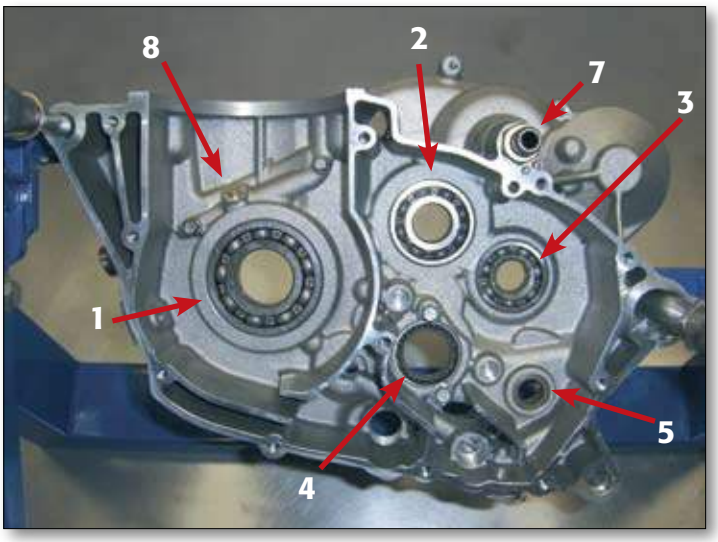
3.15 CRANKSHAFT

Attach the pad (A) (supplied with the crankcase splitter) to the crankshaft end on the clutch side, so that the crankshaft extractor (which is the same tool as the crankcase splitter) has a flat surface to push against.



Fit the splitting tool to the right-hand crankcase half, using the threads for the clutch casing bolts to retain it. Then screw in the bolt at the end of the special tool until the crankshaft is extracted.
If the bearings need to be replaced, heat the crankcase to 150°C. The bearings will be easy to extract at this temperature.

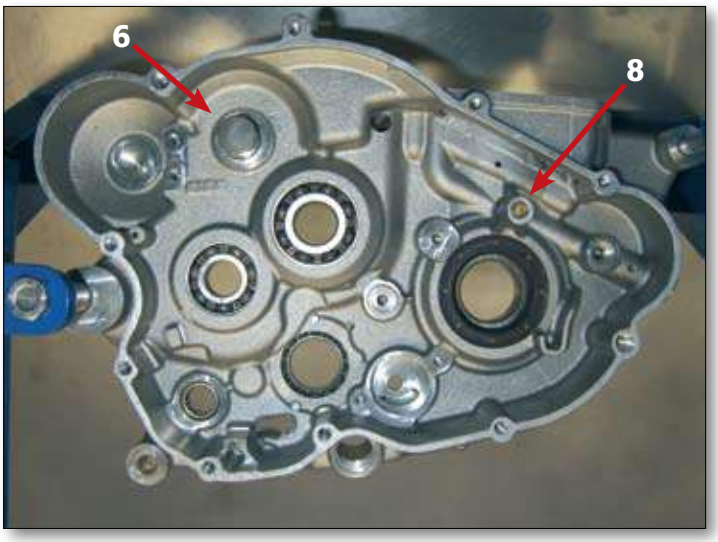




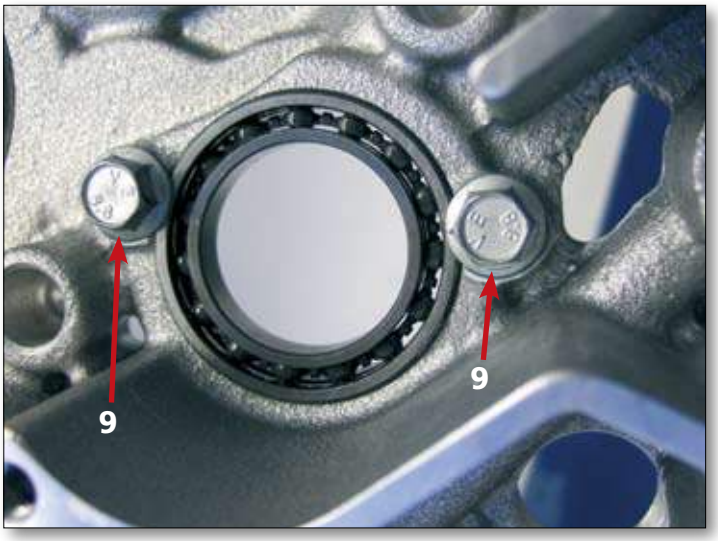
4.1 RIGHT-HAND CRANKCASE

Heat the crankcase in an oven to 150c°. Fit the ball bearings into their housings (main bearing 1, mainshaft bearing 2, layshaft bearing 3, gear selector drum bearing 4), and drive them home with a press and suitable mandrels, taking care that the crankcase is resting on a flat surface throughout. The housing for the needle roller bearing (gearchange shaft 5), does not have a stop: it can be located flush with either surface of the crankcase half.
If after the crankcase has cooled down, the outer race of one of the bearings tends to spin in its housing, the crankcase itself must be replaced.

N.B. Before refitting the bearings, check the state of wear of the revolving parts and make sure that the balls run correctly in their tracks in the bearing.

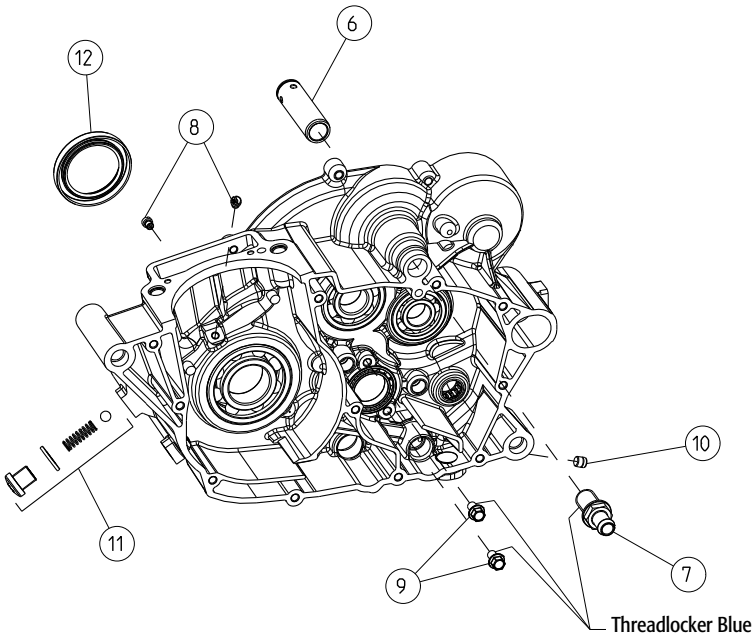


While the crankcase is still hot, use a press to fit the shaft (6) for the kickstart idler gear on the right-hand side.
Fit the breather nozzle (7), applying medium-strength thread lock to the threads.



Fit the oil jets (8) and secure the selector drum bearing (4) with its retaining bolts (9), applying medium-strength thread lock tightening these to 10 Nm.

Fit the oil expansion plug (10), driving it home with a suitable pin punch, after having checked that the oilways are not blocked by blowing them through with compressed air.



Make sure that the oil pump housing is free from scoring and signs of seizure.
Fit the oil pressure relief valve (11).

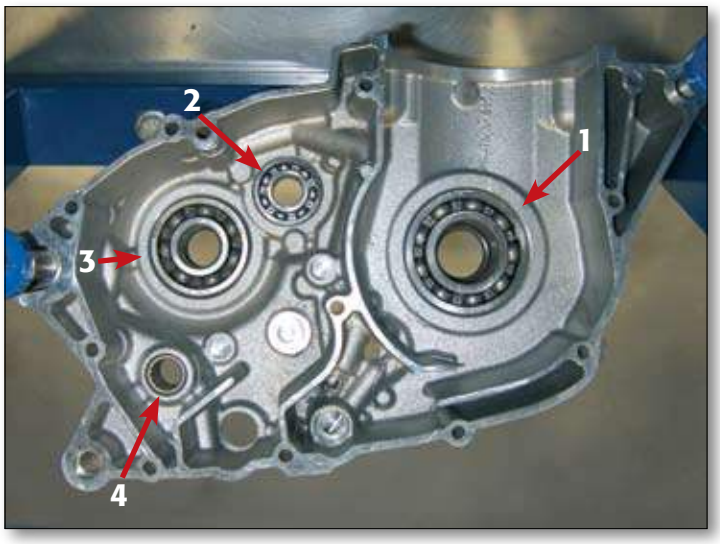
N.B. Make sure that the number and thickness of washers (12x18x1, 12x18x1.5) for the oil pressure relief valve are the same as in the factory setup.



Fit the crankshaft oilseal (12), lubricating its outer surface with grease to make it easier to insert it into its housing. Press it in until it is flush, with the open side facing inwards.

N.B. Remember to always grease the outer surface of oilseals to help seat them properly in their housings.

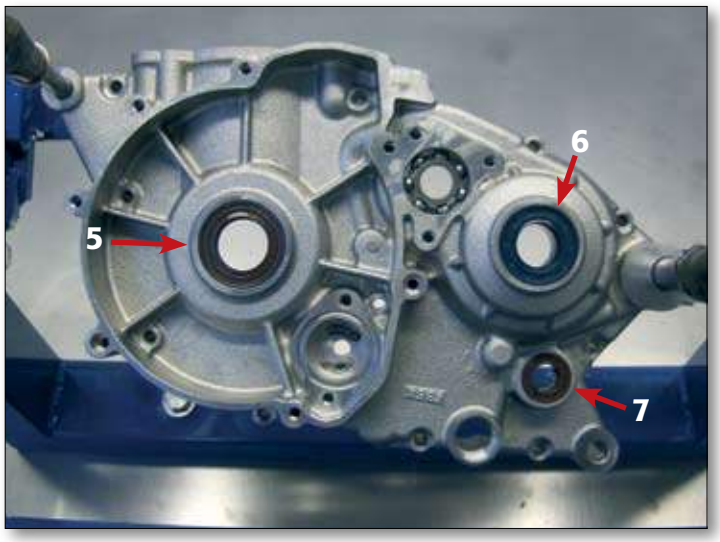




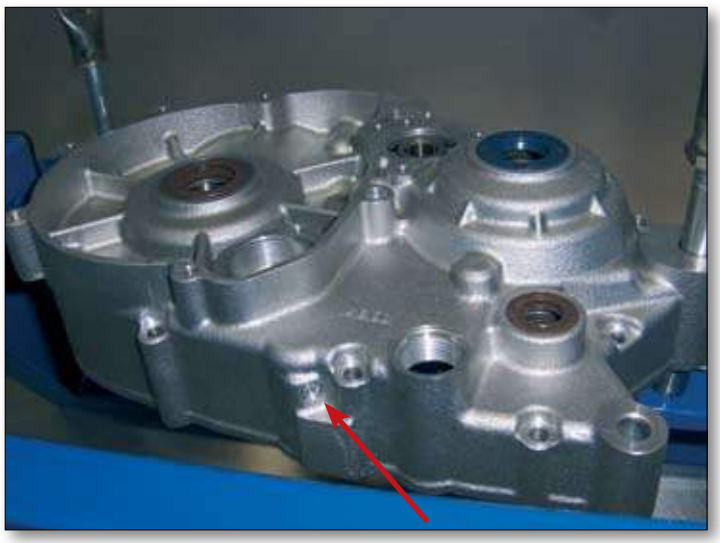
4.2 LEFT-HAND CRANKCASE

Fit the bearings (main bearing 1, mainshaft bearing 2, layshaft bearing 3, gearchange shaft needle roller bearing 4), following the same procedure as for the right-hand crankcase.

N.B. When fitting the main bearing, use a pad on the opposite side to avoid putting excessive stress on the flat surface of the housing under the load from the press.



Fit the oilseals for the crankshaft (5), layshaft (6) and gearchange shaft (7), all with the open side facing inwards. Remember to grease the outer surface to facilitate seating.



Fit the oilway expansion plug, driving it home with a suitable pin punch.

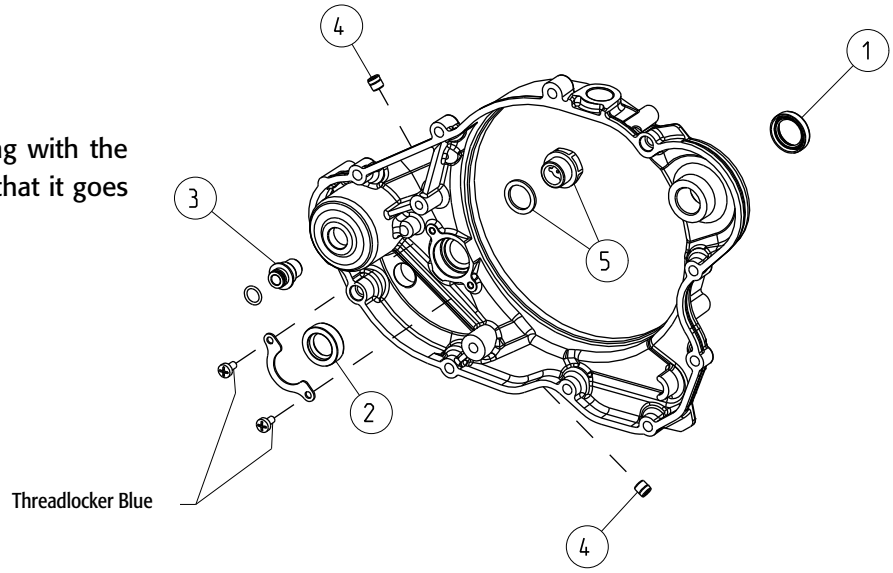
Make sure that the oil pump housing is free from scoring and signs of seizure.
Blow compressed air through all the oilways to clean them, and check that there are no obstructions.

N.B. Before refitting the bearings, check the state of wear of the revolving parts and make sure that the balls run correctly in their tracks in the bearing.

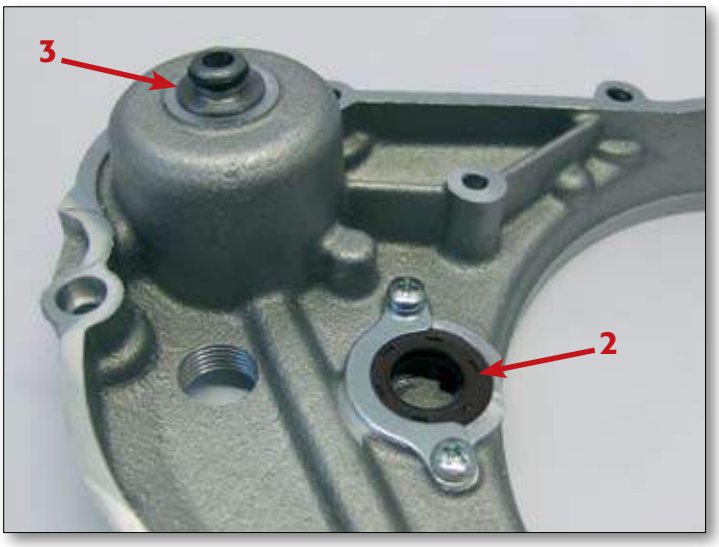


4.3 CLUTCH CASING

Fit the kickstart oilseal (1) in its housing with the open side facing inwards, making sure that it goes fully home.

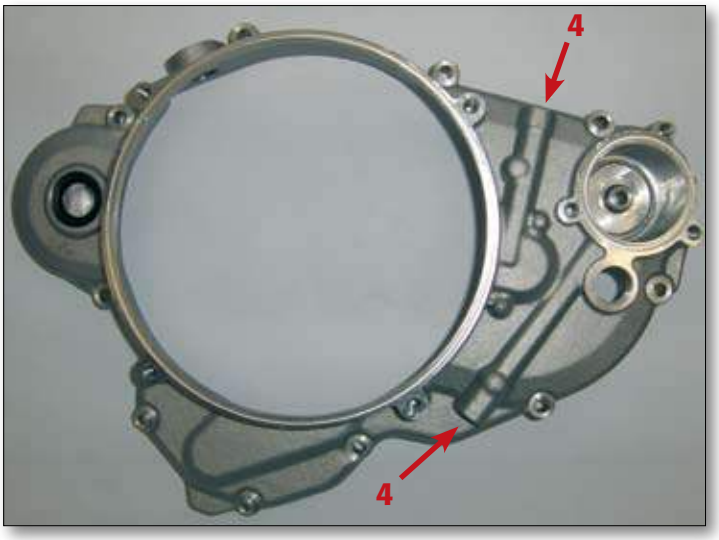






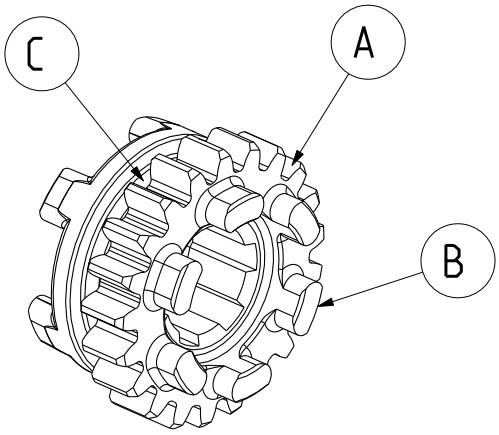
Fit the crankshaft oilseal (2) in its housing, with the open side facing inwards. Remember to grease the outer surface to facilitate seating. Then secure the oilseal with its retaining plate and tighten the screws to a torque of 3 Nm, after applying medium-strength thread lock.
Fit the oil filter spigot (3) with its O-ring.

N.B. The spigot is an interference fit in its housing.



Close the oilways with the special oilway expansion plugs (4), using a pin punch.
Make sure that the oilway is clear by blowing it through with compressed air.
Fit the oil level plug (5), tightening it to 10 Nm.

4.4 GEARBOX AND SHIFTING MECHANISM

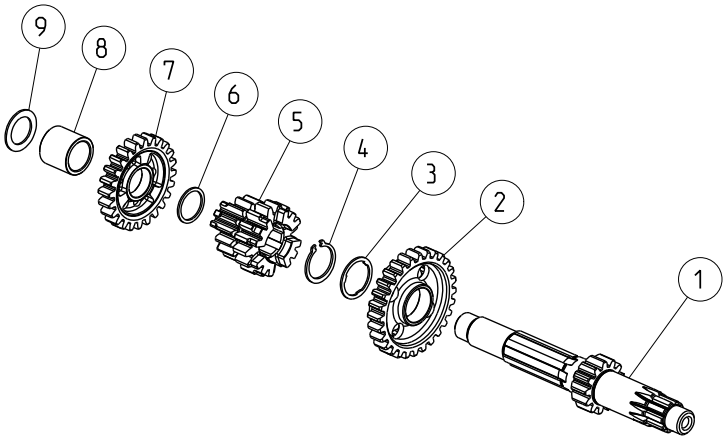


Before proceeding to the reassembly of the gearbox mainshaft and layshaft, carry out the following inspections:

- Check the wear on the sliding surfaces of the mainshaft and layshaft.
- Check that the teeth of the gears do not show signs of pitting or particular wear (A).
- Check that the dogs on the gears are not rounded off (B).
- Check for wear on the grooves for the selector forks (C).
- Check that all the parts slide correctly.

N.B. During the process of reassembly, clean and oil all the parts with suitable engine oil.
N.B. It is good practice to fit new circlips each time the gearbox is assembled.

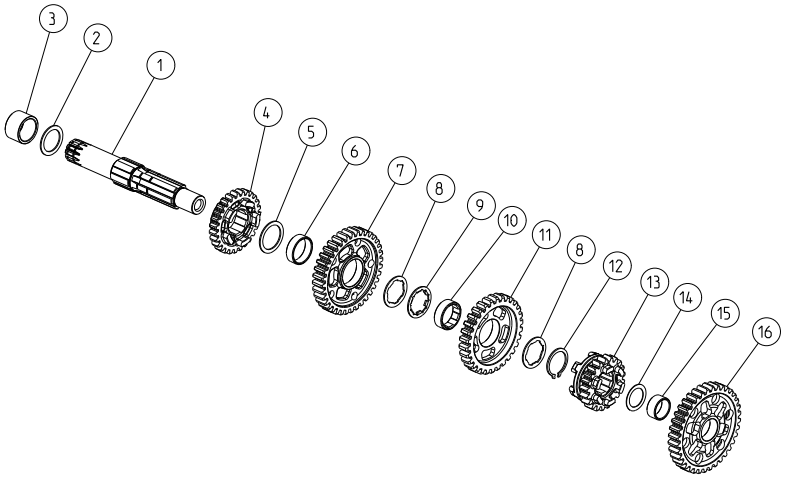
4.4.1 Mainshaft



Position the shaft (1) with the splined end facing downwards and fit the following parts onto it from above, in the following order:

- 5th idler gear (2), with the dogs facing upwards, followed by the relative splined washer (3). Secure with the circlip (4). The latter must be fitted such that the side which does not have the corner radius faces upwards.
- Double sliding 2nd/3rd gear (5) with the larger gear facing downwards, and thrust washer 17x20.5x1 (6).
- 4th idler gear (7) with housings for the dogs facing downwards, spacer (8) and 15x25x1 thrust washer (9).

N.B. Check that the gears slide correctly.
N.B. Apply molycote grease between shaft and gears.

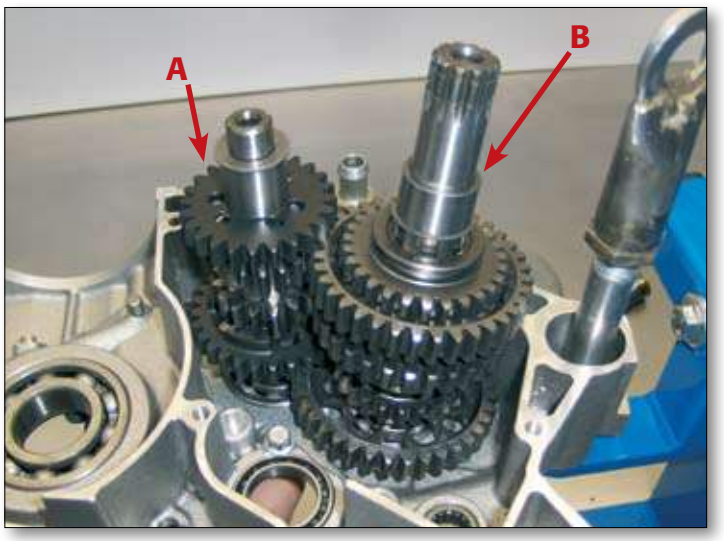


4.4.2 layshaft

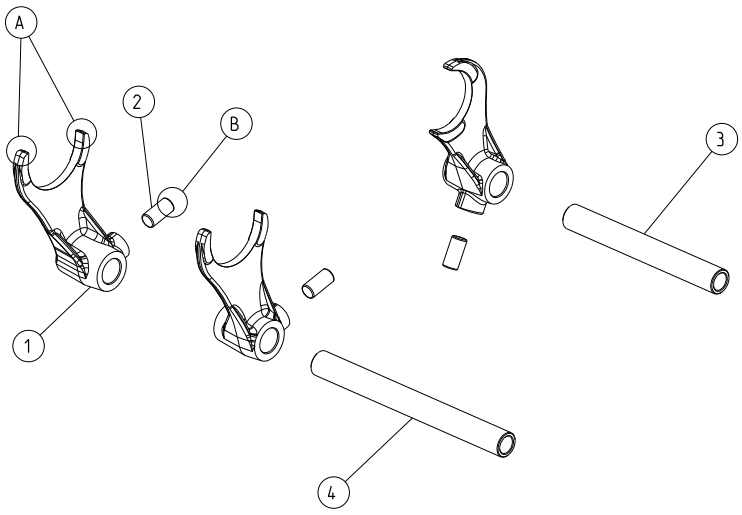
Position the shaft (1) with the splined end facing downwards after fitting the 20x27x1 washer (2) and the spacer (3), securing them so that they cannot fall off while the other parts are being fitted.
Then fit the parts from above in the following order:

- Sliding 4th gear (4), with the dogs facing upwards, and 22.2x29x1 thrust washer (5).
- Bush (6), 2nd idler gear (7) with the flat side facing downwards, splined washer (8) and stop washer (9) with the tangs facing downwards.
- Splined bush (10), 3rd idler gear (11) with the flat side facing upwards, splined washer (8), circlip (12).
- Sliding 5th gear (13), with the groove for the selector fork facing downwards, 17x24x0.5 thrust washer (14).
- Bush (15), 1st idler gear (16), with the more concave side facing downwards.

N.B. Check that the gears slide correctly.
N.B. Apply molycote grease between shaft and gears.



Fit mainshaft (A) and layshaft (B) as a pair into their respective bearings in the right-hand crankcase.



Check the state of wear of the contact areas between the selector forks and the grooves in which they run in the gears (A), and between the pegs and the grooves in the selector drum (B).
Fit the pegs (2) to the selector forks (1), using grease.

Fit the complete selector forks into the gearbox, positioning them in their guides in the gears.

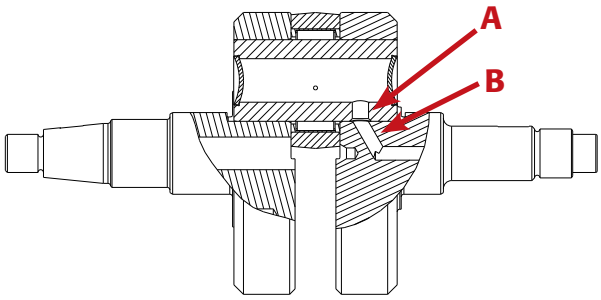


Check the wear on the guides in the selector drum. Locate the drum in its bearing and locate the pegs in the guides. Push the two pins through the forks, taking care to use the longer one for the forks on the secondary shaft.

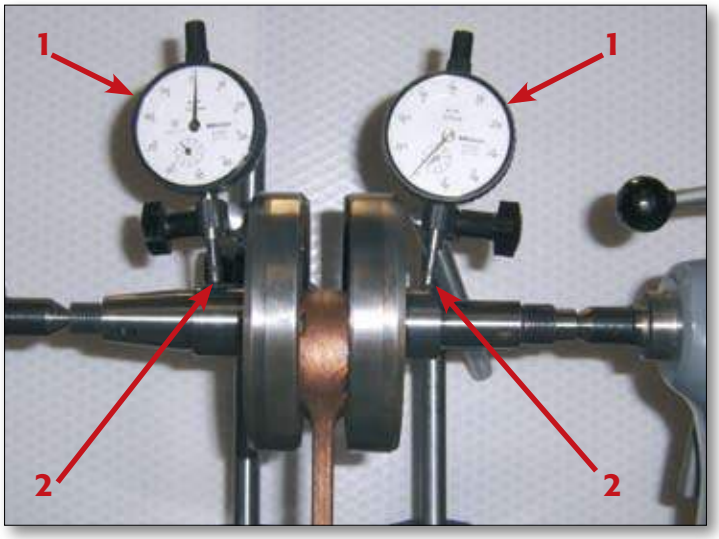
N.B. Before fitting the fork spindles, make sure that the forks slide freely on them and check the spindles for wear.
N.B. Always remember to oil the various parts in contact with each other (pegs/selector drum grooves, selector forks/gears, etc.).
N.B. Turn the two gearshafts over by hand to make sure that everything moves correctly.



4.5 CRANK ASSEMBLY



If the crankshaft has been dismantled for the purpose of replacing the connecting rod or inspecting the state of wear of the roller cage and the crankpin, be careful during subsequent reassembly that the oilway holes in the crankpin (A) and in the clutch side crankshaft half (B) are properly lined up. Faulty assembly could lead to lack of proper lubrication in the area of the conrod big-end, with consequent damage to the roller bearing.



Check for misalignment of the shafts in the crankshaft halves by setting up the crankshaft between centres, or in a similar instrument, and using a pair of dial gauges (1) positioned on the contact surfaces for the main bearings (2) to measure the maximum variation during a complete revolution of the crank.

The limit value is 0.08mm.

If a variable difference is found between the point measurements of the two crankshaft halves, this may be due a twist in the crankshaft itself.

The limit value for this difference is 0.03mm.

You also need to check the side-float at the conrod big-end, whose value must be within the following range:

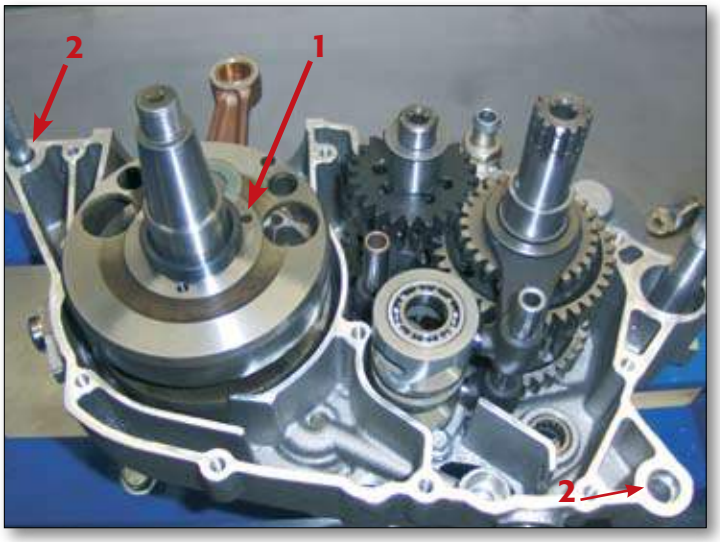
Recommended clearance: 0.15-0.35mm
Maximum clearance: 0.50mm

4.6 CLOSING THE CRANKCASE

Heat the main bearing in the right-hand crankcase half so as to facilitate insertion of the crankshaft.

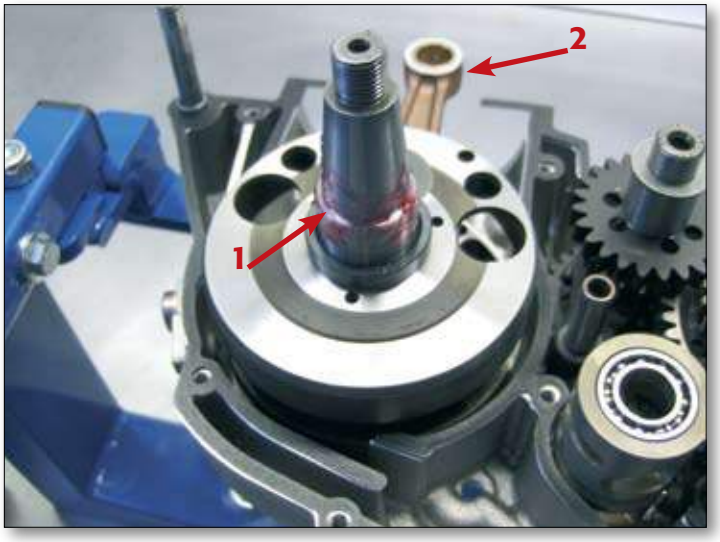


Fit the spacer (1) onto the crankshaft and the dowels into their housings (2).

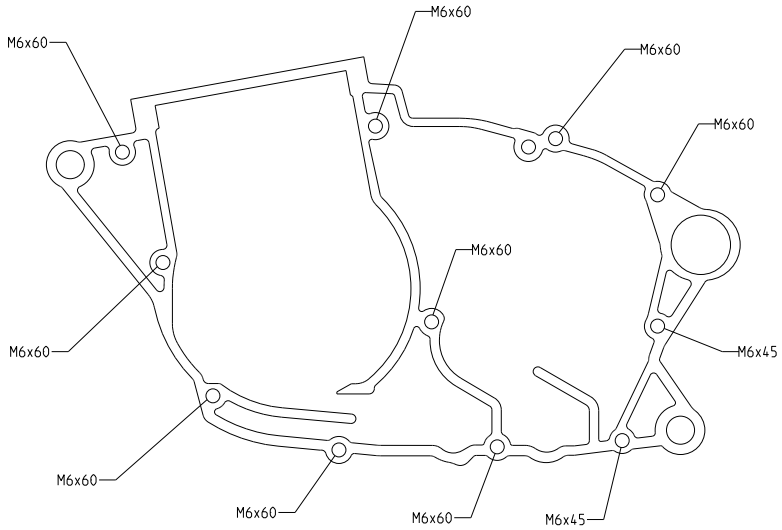


Grease the area of the crankshaft which needs to slide into the oilseal in the left-hand crankcase (1), and fit the crankcase centre gasket, cutting it in the cylinder area (2) to avoid interference with the connecting rod during assembly.

N.B. Put a little grease on the gasket face of the right-hand crankcase in order to help the gasket to adhere.
N.B. It is good practice to change the gaskets each time the crankcase is opened.



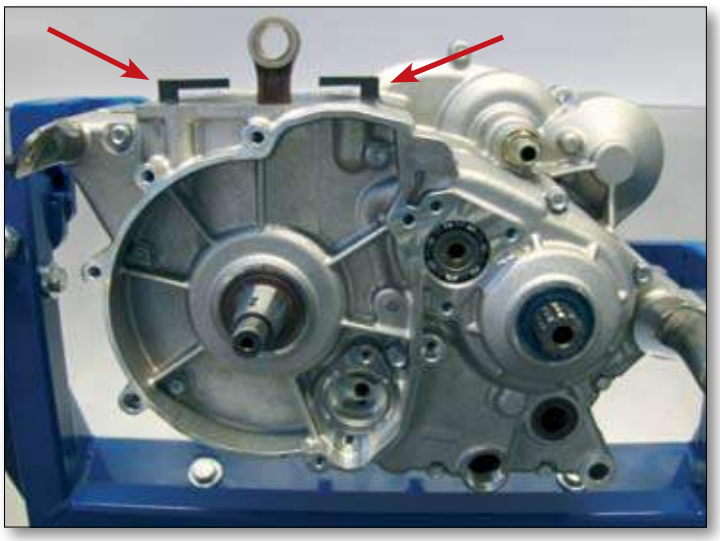
After heating the left-hand main bearing, place the left crankcase half over the right half, and use a plastic hammer to close up the two halves until they are positioned correctly.



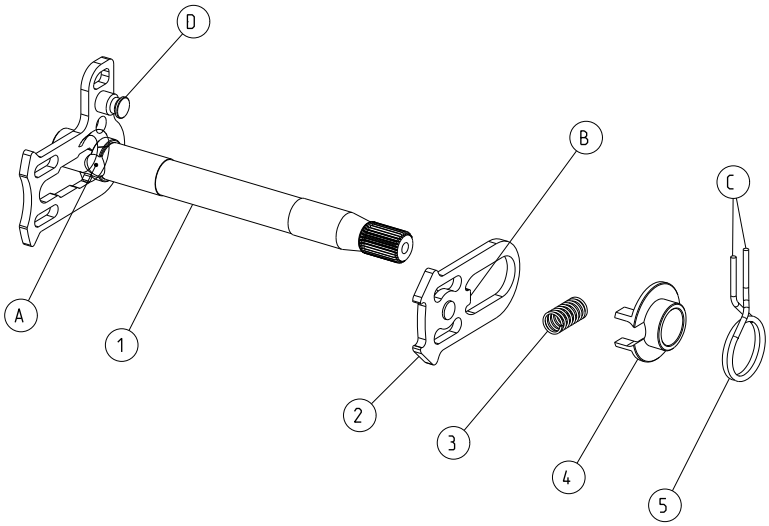
Rotate the mainshaft and the layshaft by hand to verify that the gearbox moves correctly and that all the gearbox components slide freely.

N.B. Check that the gearbox layshaft oilseal is correctly positioned after the crankcase is closed up.

Insert the bolts in the positions shown in the drawing and tighten them to 10 Nm.



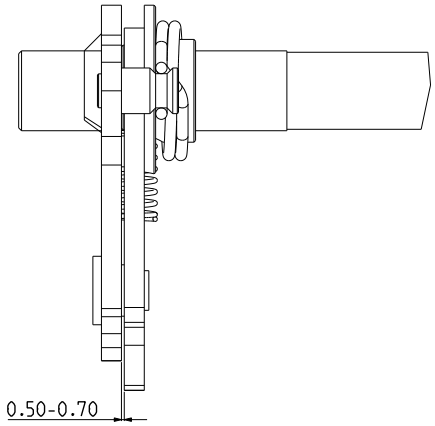
Accurately cut the protruding part of the cylinder base gasket, taking care not to damage the surface on which the cylinder will rest.
Tap the two ends of the crankshaft several times in an axial direction with a rubber hammer in order to release it from residual stresses induced in the crankcase by heating it.



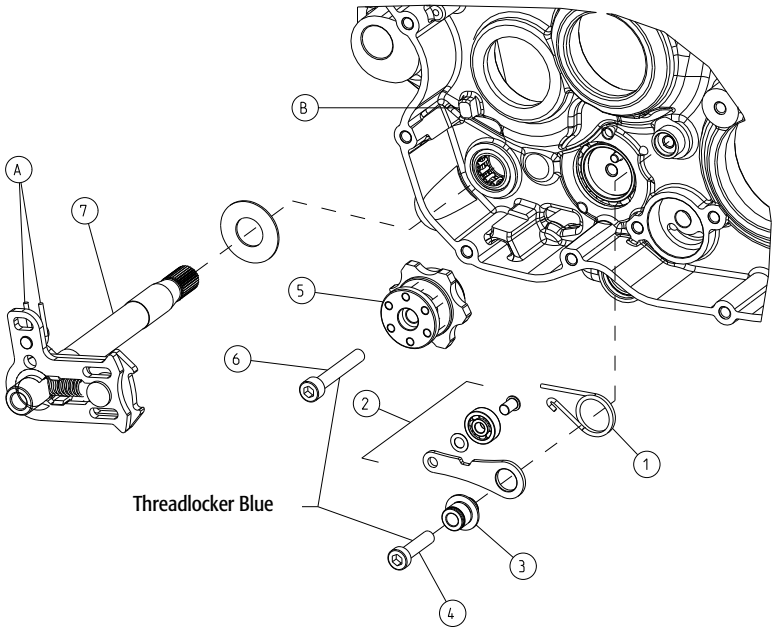
4.7 SHIFTING MECHANISM

To assemble the shifting shaft, follow these steps:
- Clamp the shaft (1) with the serrated end facing upwards.
- Fit the movable pawl (2) with the pin facing downwards, and insert the pin into the corresponding slot in the fixed pawl.
- Position the spring (3) with one end in the housing in the shaft (A) and the other on the tang (B) on the movable pawl.
- Fit the spring guide (4) and the return spring (5), hooking it onto the pin on the fixed pawl (D) by means of its two ends (C).

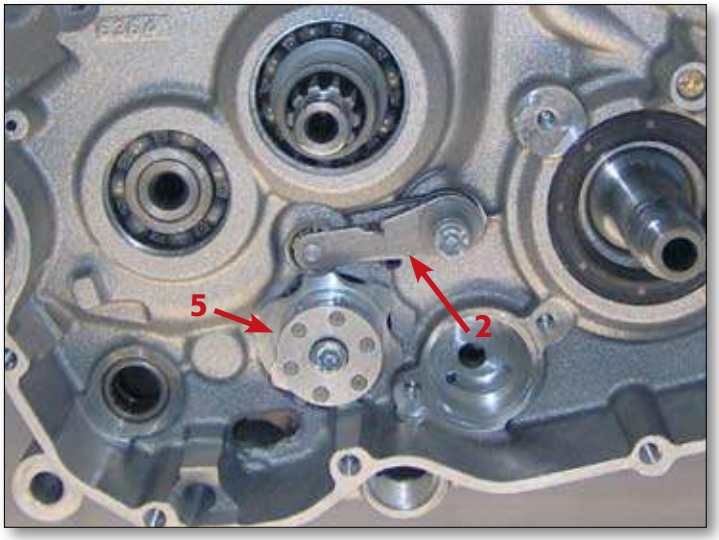
After you have fitted the gearchange shaft, check the axial play between the two pawls, which must be between 0.50mm and 0.70mm. If this clearance is exceeded, replace the movable pawl.



Position the spring (1) and the detent lever (2) in their housing and hold them in place with the idler pivot pin (3). Secure with the M6x25 bolt (4) tightened to 10 Nm after applying medium-strength thread lock.

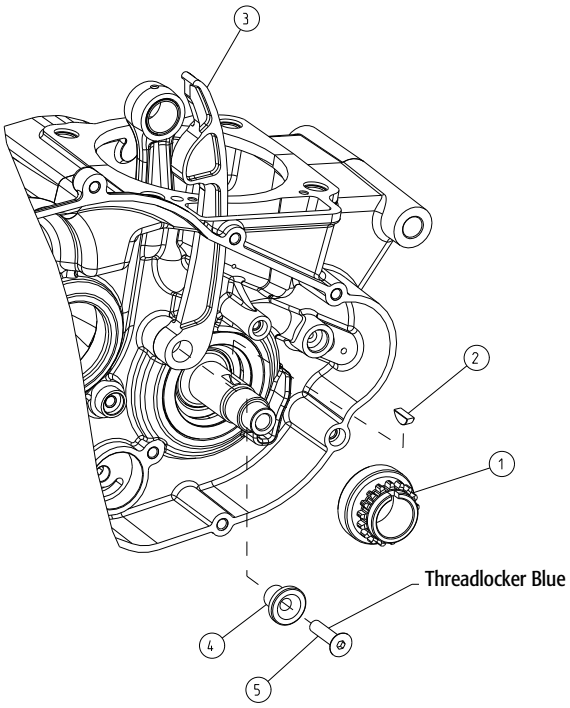


Move the detent lever out of the way and fit the detent cam (5). Secure with the M6x35 bolt (6) tightened to 10 Nm after applying medium-strength thread lock.





Fit the shifting shaft into its roller bearings after oiling it well, and push back the movable pawl so that it can take up its correct position against the detent cam, and so that the gearchange shaft goes fully home. Before assembling these parts, fit the 14x30x1 thrust washer onto the shaft. Locate the shaft in such a way that the ends of the spring (A) sit either side of the lug (B) on the crankcase.
Fit the shifting lever and test the gearbox operation by rotating the mainshaft by hand and changing from one gear to another.



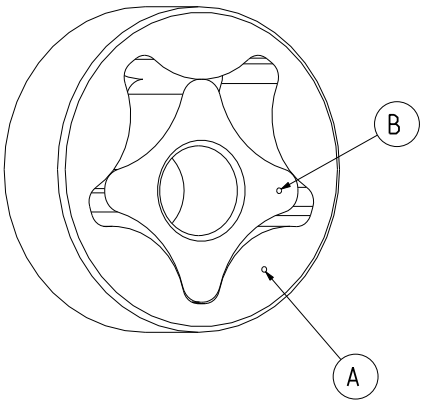
4.8 TIMING SPROCKET

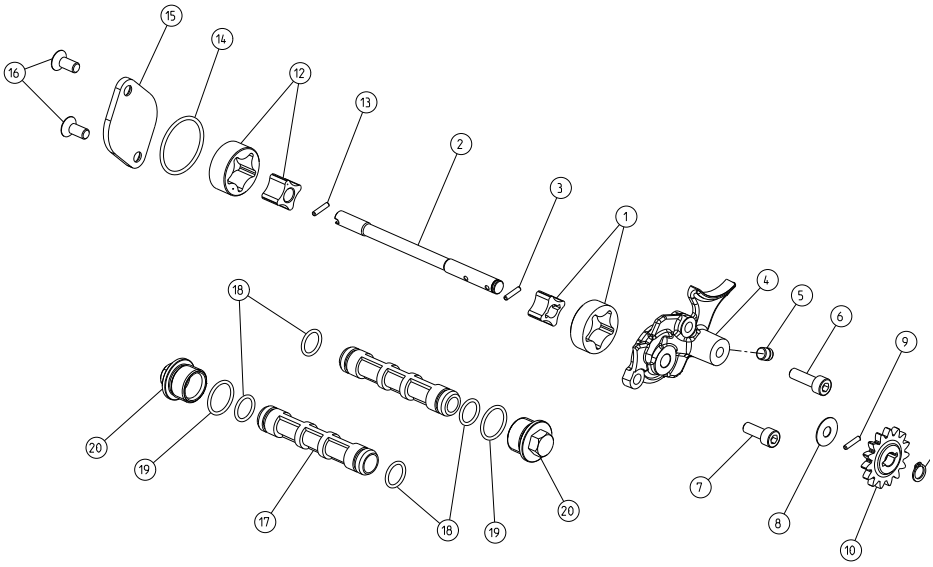
Fit the timing sprocket (1) after you have applied a sufficient amount of grease to the outer surface that comes into contact with the oilseal. Lock the sprocket with the Woodruff key (2), tapping it several times if necessary with a rubber hammer to help it to seat properly.
Fit the movable camchain guide (3) with its bush (4) and secure with the M6x25 screw (5), after applying medium-strength thread lock. Tighten to 10 Nm.
Fit the camchain, running it round the sprocket and passing it through the slot in the timing case.



4.9 OIL PUMPS

N.B. The pumps have reference marks both on the outer rotor (A) and on the inner rotor (B). During assembly these two marks must remain on the same side of the pump and must always face towards the inside of the pump housing.





Position the engine bottom end with the outer side of the right-hand crankcase half facing upwards. Locate the pump (1) in its housing in the right half of the crankcase, after oiling it well, with the reference marks facing towards the inside, so that they are not visible once the pump is fitted.
Insert the shaft (2) with the part with the two holes facing upwards, fitting the pin (3) into the second hole from the top.

Use a feeler gauge to check the clearance between inner rotor and outer rotor. If you find that there is play beyond the permitted limits, replace the pump.

Maximum clearance 0.20mm.



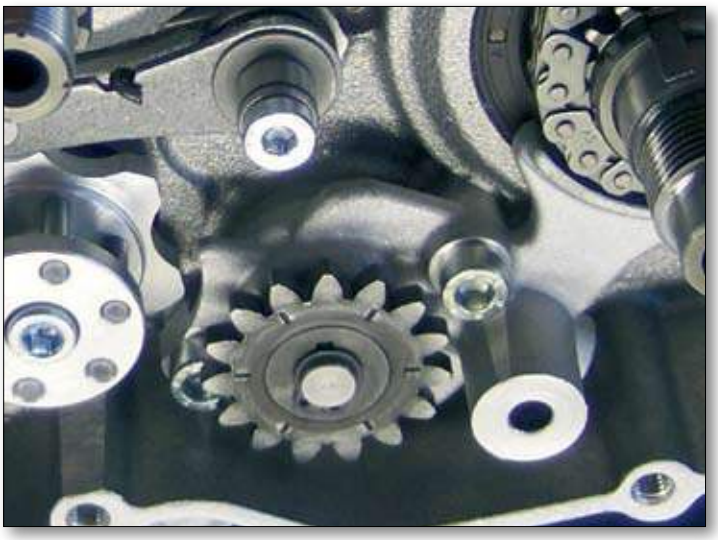


Measure the clearance between the outer rotor and the pump housing, using a feeler gauge for this too.

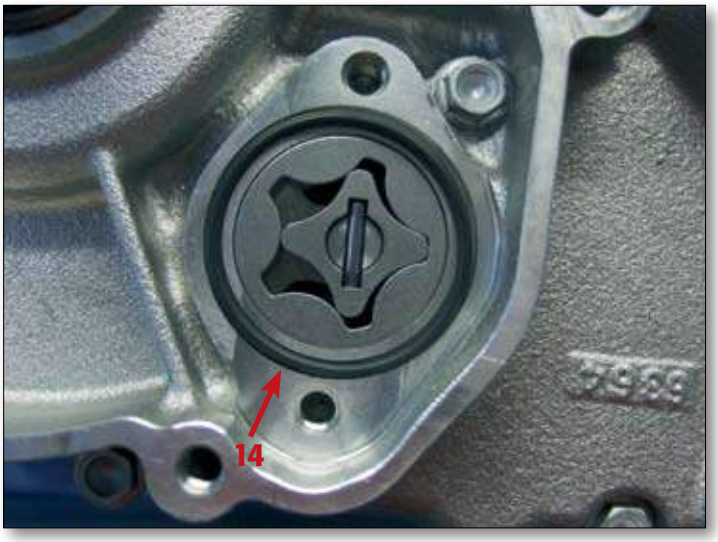
Standard clearance 0.09-0.23mm.

Measure the axial clearance, defined as the difference between the depth of the pump housing in the crankcase and the thickness of the outer rotor.

Standard clearance 0.05-0.10mm.



Refit the cover (4), after you have blocked the hole with the oilway expansion plug (5), and tighten the M6x20 screws (6) and M6x15 screws (7) to 10 Nm.
After you have fitted the washer (8) and the pin (9) into the top hole in the shaft (2), secure the drive gear (10) with the circlip (11). Ensure that the gear is positioned correctly: the side with the larger raised part must face downwards.
Rotate the gear (10) by hand and check that the pump moves without being forced.
Position the engine bottom end with the left half of the crankcase facing upwards, and fit the pump (12) after oiling it well.
Insert the pin (13) and perform a clearance check as for the pump in the left-hand half.



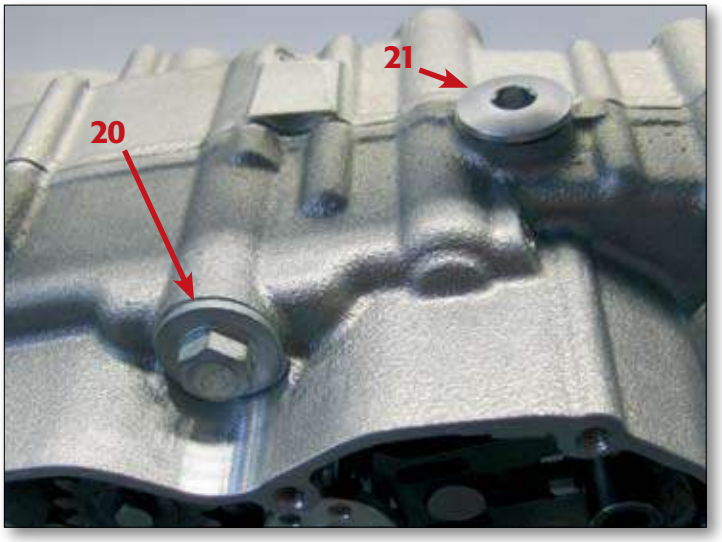
Fit the O-ring (14) into its seat and refit the cover (15) to the pump.
Tighten the M6x14 screws (16) to 10 Nm.
Rotate the gear (10) by hand and check again that it moves properly.

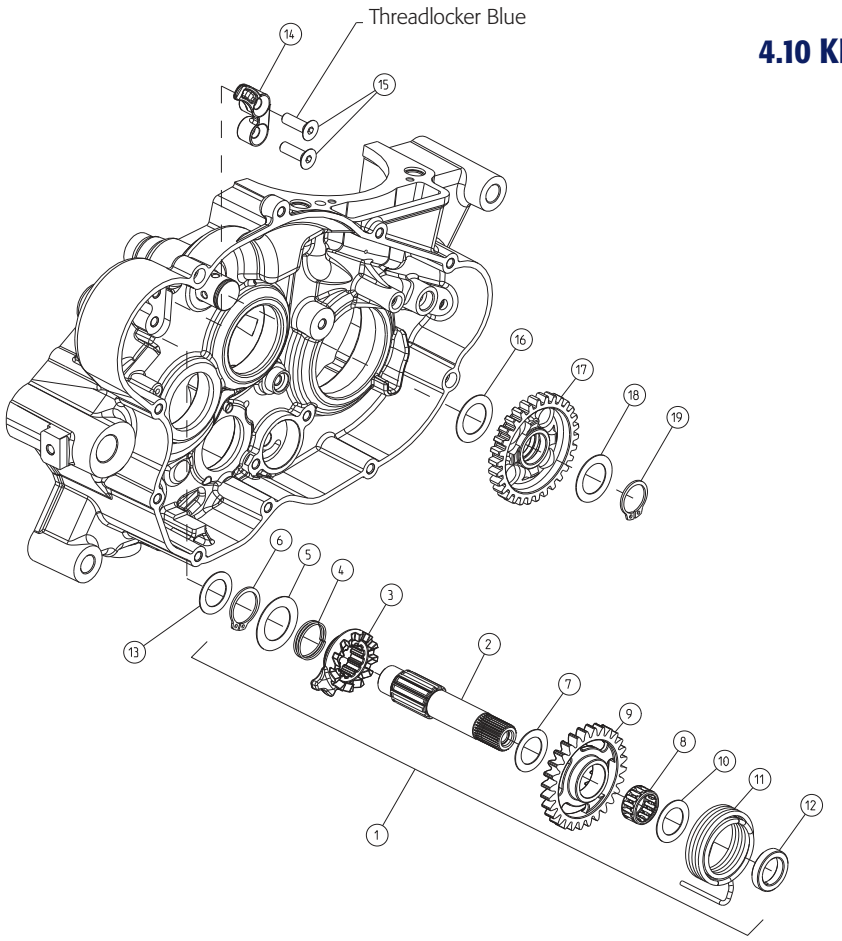
Insert the two filters (17) into their holes, after first lubricating them with oil and fitting the O-rings (18).

N.B. The two filters have a tapering internal cavity. Use a pin punch with a taper point to facilitate fitting.



Refit the filter covers (20), tightened to a torque of 10 Nm, after fitting the O-rings (19). Also close the oil drain hole with the drainplug (21) and 16x22.5x1 gasket, tightening it to 20 Nm.





4.10 KICKSTART



4.10.1 Preassembly of kickstart shaft

Clamp the kickstart shaft (2) with the serrated end facing downwards and fit the kickstart sleeve (3) from above, applying molycote grease to the splined section.

Fit the spring (4) and the 20x30x0.5 thrust washer (5), securing them with the circlip (6).

N.B. Take care that the sleeve is fitted in such a way that the relative position of the hole (A) for securing the return spring (11) is as shown in the drawing.

Position the kickstart shaft (2) with the serrated end facing upwards, and fit the thrust washer 16x25x0.5 (7), the caged roller bearing (8), the gear (9) with the side ratchet side facing downwards, and the 16x25x0.5 thrust washer (10).

Fit the return spring (11), securing the end in the hole provided (A), and fit the spacer with the recess for the spring facing downwards.

Fit the ramp (14) with two M6x20 bolts. Tighten the bolts to 8 Nm after first applying thread lock to the threads.

4.10.2 assembling the kickstart

Insert the kickstart shaft (1) into its housing after first oiling it well and fitting the 16x25x0.5 thrust washer (13) onto it, taking care that the spring is secured in the hole provided for it (B).

N.B. Apply some molycote grease to the contact surfaces between the ramp and the kickstart sleeve.

Fit the kickstart lever to check that the parts move freely.

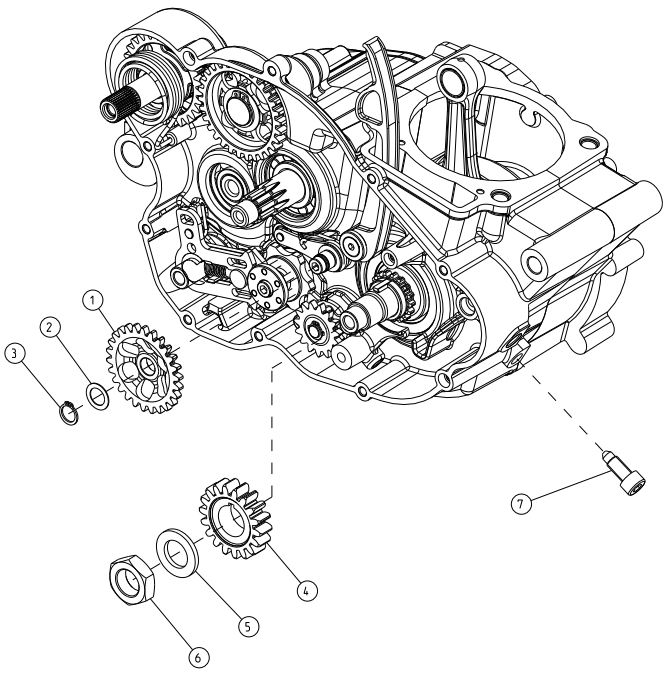


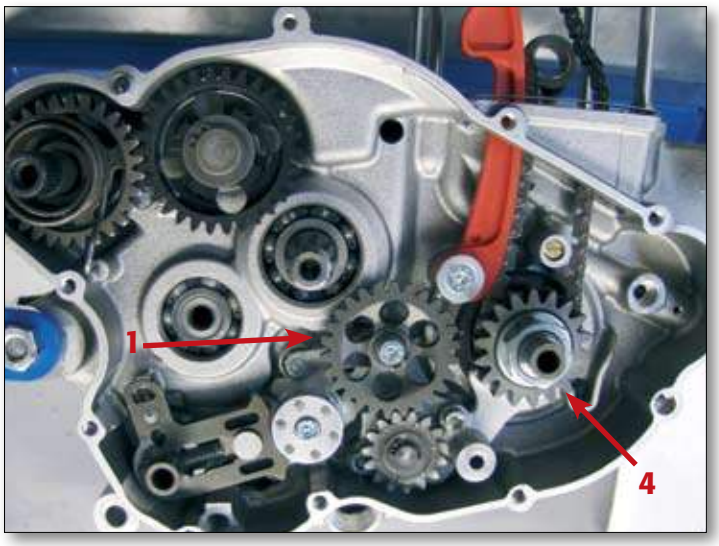
Fit the kickstart idler gear (17) on its shaft, together with the two 18x27x0.5 thrust washers (16, 18), after you have lubricated the parts in contact with each other, and secure it with the circlip (19). Ensure that the convex side of the gear is facing towards the crankcase.
Check that the parts move correctly with respect to each other.

N.B. Before you assemble the various parts, check the wear on the gear teeth and on the contact surfaces between the ramp (14) and the kickstart sleeve (3). In the event of excessive wear, replace the damaged components.



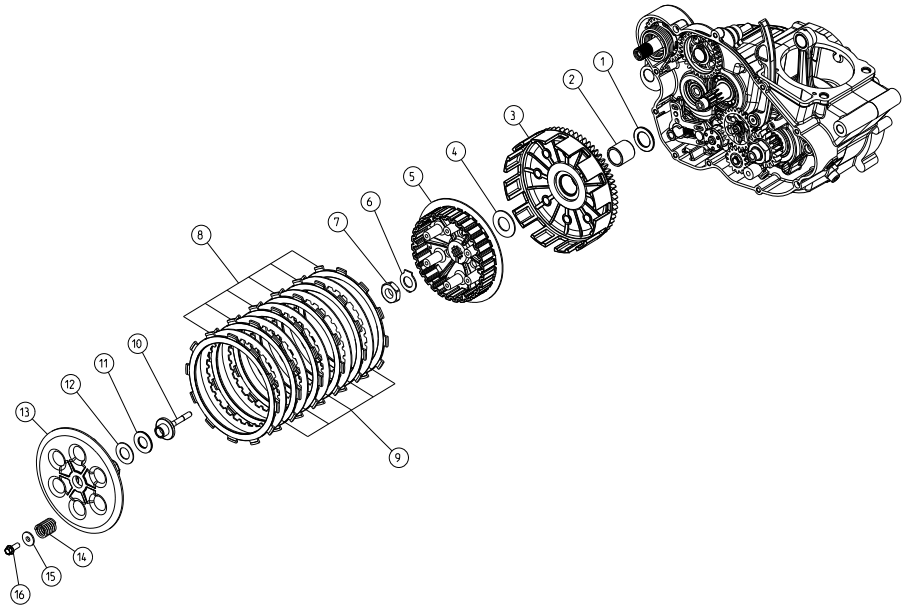
4.11 PRIMARY TRANSMISSION GEAR





Fit the idler gear (1) on its pivot pin with the concave side facing outwards, fit the special 11x17x0.5 washer (2), and secure with the circlip (3).
Fit the primary transmission gear (4) with the convex side facing inwards, taking care to align the keyway with the woodruff key itself. Position the 18x30x3 washer (5).
Lock the crankshaft at TDC using the appropriate bolt (7), then tighten the nut (6) to 150 Nm.

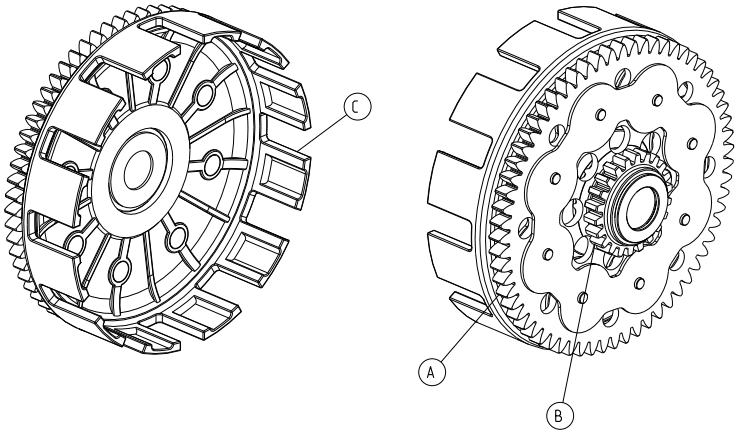
N.B. Check the wear on the gear teeth before carrying on with assembly, and oil well all the parts that are in contact with each other.



4.12 CLUTCH

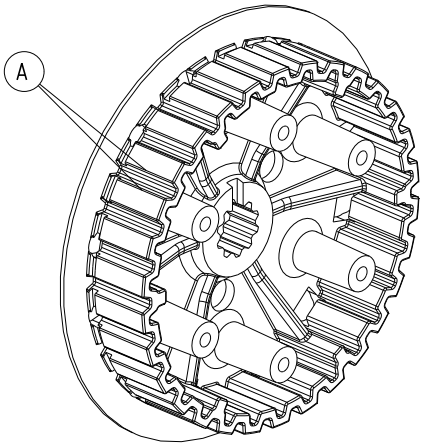
Fit the 20x32x2 washer (1) and the bush (2) onto the gearbox mainshaft after first oiling the two components and the shaft itself. Check the bush for signs of seizure or excessive wear. If these are found, replace the bush. Also measure the clearance between the steel bush (2) and the bush in the clutch basket (3).

Standard clearance 0.010-0.112mm

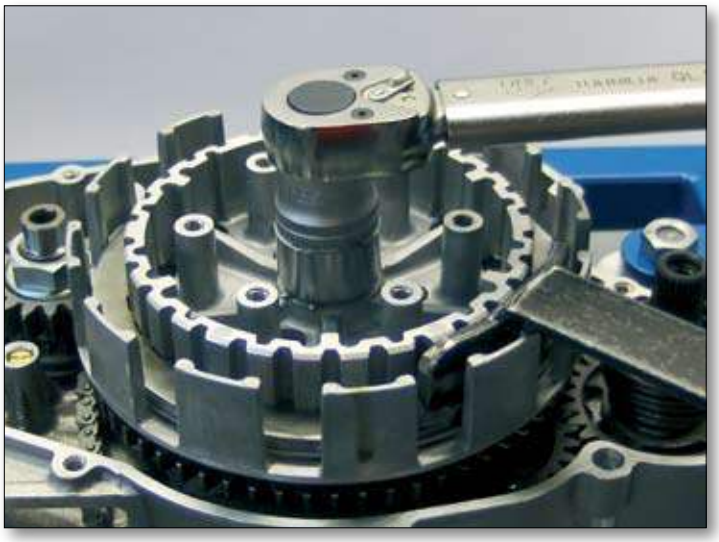


Before you fit the clutch basket, check the wear on the teeth of the primary transmission gear (A) and on the gear (B) which carries the drive to the oil pumps. Check too the condition of the teeth (C) on the clutch basket which engage with the drive plates (8). Manually check that there is not excessive tangential play in the relative rotational movement between the clutch basket and the primary gear which is fitted to it via the silent-block. Unscrew the TDC locking bolt to facilitate assembly of the clutch.
Fit the 18.3x35x1.5 washer (4) after first oiling its housing in the clutch basket assembly (3).

Check the wear on the teeth (A) of the clutch centre which engage with the driven plates.
Fit the clutch hub (5) and secure it with the nut (7) after you have fitted the tabwasher (6).



Lock the clutch hub with the special tool and tighten the nut to 90 Nm.



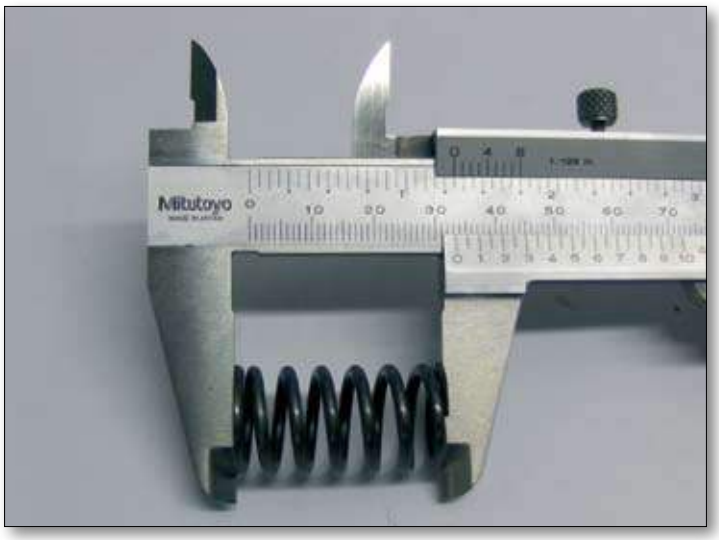
Lock the nut (7) by pulling up the tabs on the tabwasher (A).
Check the thickness of the clutch drive plates (8) which must be not less than 2.8mm (thickness when new: 3mm). Also check both the drive plates (8) and the driven plates (9) for flatness: the discs must not undulate excessively, as this could lead to low friction when the two are in engagement.
Fit a drive plate first into the clutch basket, and then the others, taking care that no two plates of the same type are in contact with each other.

N.B. Remember to oil the plates during the assembly process. Recommended procedure is to keep the drive plates in an oil-bath for 10-12 hours before assembly.





After you have fitted all the friction plates, fit the pressure plate lifter (10) in the central hole in the clutch basket, together with the lifter needle roller bearing (11) and the corresponding washer (12). Check the wear on the needle roller bearing and the contact surfaces. Replace the components if they show excess wear.



Check the length of the springs (14):

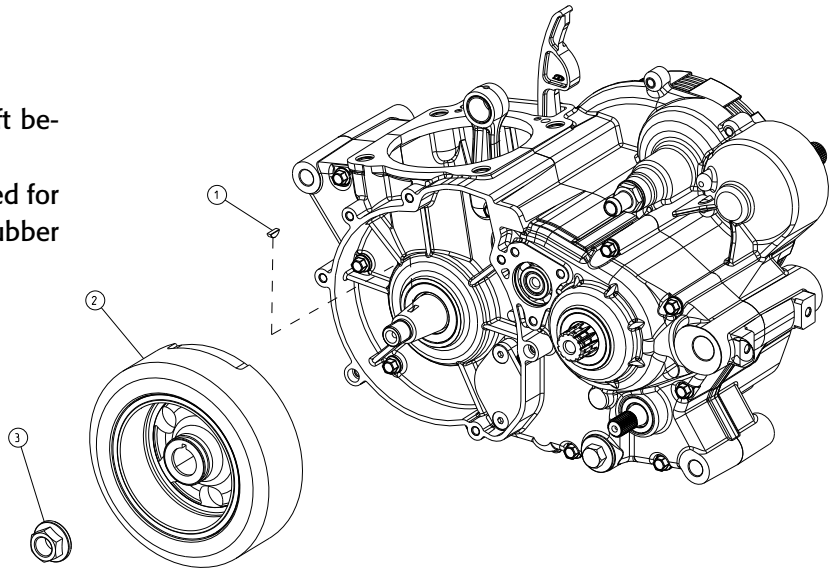
Minimum value 33.3mm (33.8mm when new).



Fit the clutch pressure plate (13), the clutch springs (14), the special washers (15) and the M6x16 bolts (16). Tighten the bolts (16) in diagonal sequence to 10 Nm. Tighten the TDC locking bolt once more.

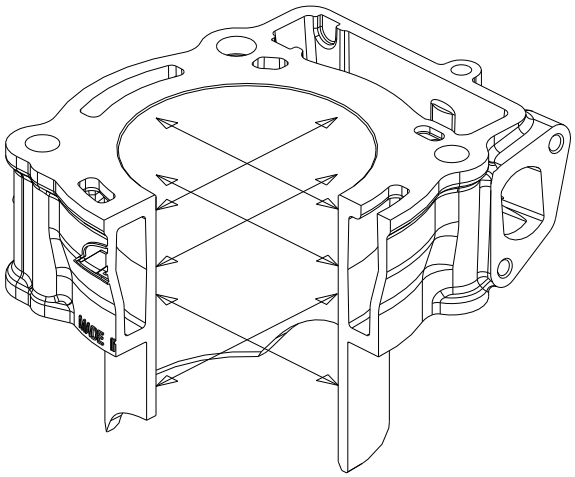
4.13 FLYWHEEL

Carefully degrease the taper on the crankshaft before proceeding to fit the flywheel.
Insert the drive key (1) in the keyway machined for it in the left-hand crankshaft journal, using a rubber hammer if necessary.

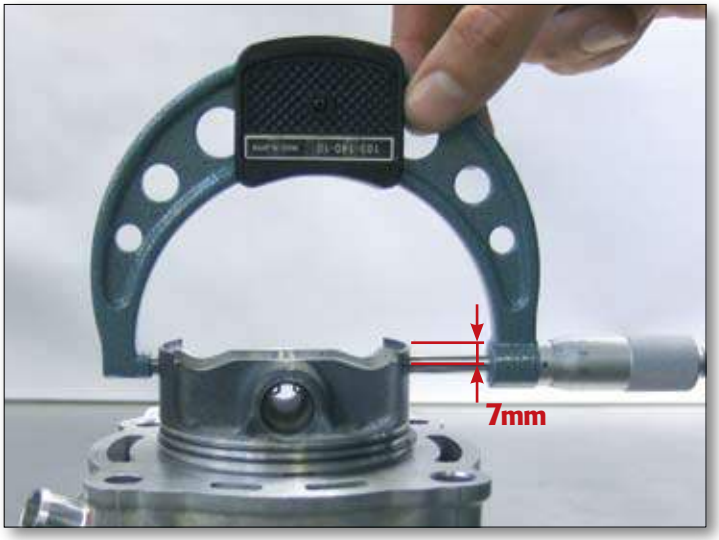


Fit the flywheel (2) and secure it with the flanged nut (3), tightening to a torque of 120 Nm.









4.14 PISTON AND CYLINDER

4.14.1 measurements and checks
4.14.1.1 Cylinder

Check whether the lower and upper surfaces of the cylinder show deformation. Use a surface plate and a dial gauge to measure for flatness.

The limit value for deformation is 0.05mm.

Recondition the cylinder in the event of out-of-limits values.
Check whether the inner surface of the cylinder shows signs of seizure or excessive wear. If it does, recondition the surface.

Measure the internal diameter of the cylinder on two axes at right angles to each other, X (parallel to the crankshaft) and Y (perpendicular to the crankshaft) and at three different levels. Use the largest value measured for subsequently determining the maximum piston-cylinder clearance.

N.B. The front side of the cylinder (exhaust side) is marked with the letter for the selection grade. This is needed for correct matching with the piston, as both must be of the same grade (the piston is marked on the crown with its diameter measurement).

SELECTION GRADE	
A	76,960±0,005mm
B	76,970±0,005mm
C	76,980±0,005mm

4.14.1.2 Piston

Check the sliding surfaces for wear and scoring, and look for dark areas below the oil scraper ring groove. Replace the piston if these are found.
Use a micrometer to measure the diameter of the piston in a direction perpendicular to the piston pin, at a distance of 7mm from the base of the skirt.
Once the measurement of the diameters of the cylinder and piston has been carried out, the clearance between the two can be determined:

Limit of play 0.1mm

Measure the thickness of the two compression rings.

Minimum thickness of upper ring: 0.87 mm
Minimum thickness of lower ring: 0,77 mm

Change the compression rings if their thicknesses are lower than these limits.

Fit the piston ring into the cylinder and use a feeler gauge to measure the gap between the two ends of the ring. When inserting the ring into the bore, use the top of the piston to ensure that the ring is sitting parallel to its working plane, and position it approximately 10mm from the top surface of the cylinder.

Maximum gap, compression rings: 0.8mm
Maximum gap, oil scraper ring: 1.0mm

Replace the rings if the values for the gaps exceed those listed.
If the gap exceeds the limit value even when using a new piston ring, the cylinder must be replaced.
Clean the grooves for the compression rings and for the oil scraper ring of carbon residues from combustion.



Use a feeler gauge to measure the play between the compression rings and the ring grooves in the piston. If these values exceed the maximum, with piston ring thicknesses within the prescribed limits, the piston must be replaced.

Maximum play: 0.12mm



Measure the diameter of the piston pin and, if this value is below the limit, replace the piston pin.

Piston pin minimum diameter: 15.995mm

Replace the piston pin also if you detect excessive scoring or discolouration of the surface in contact with the connecting rod small end bush.
Measure the diameter of the hole in the piston for housing the piston pin. If the play between the piston pin and its housing exceeds the limit, with the piston pin diameter within the prescribed limits, change the piston.

Limit of play 0.04mm

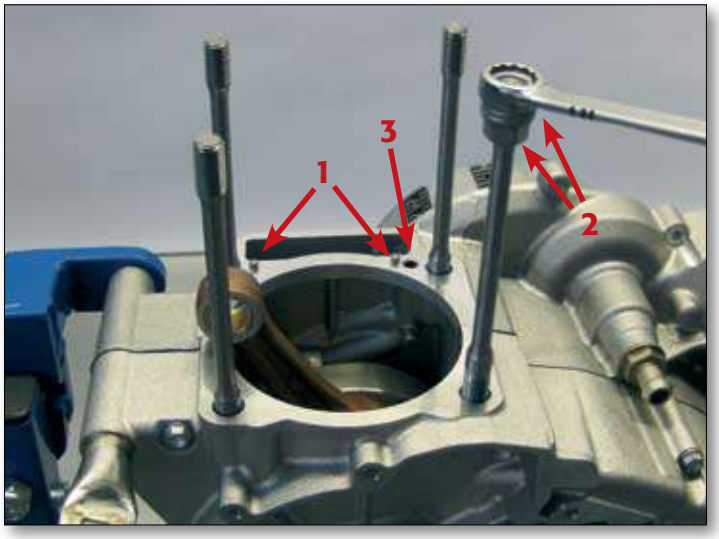






Measure the internal diameter of the conrod small end and then determine the play with the piston pin. If this value exceeds the limit, with the diameter of the piston pin within limits, replace the connecting rod.

Limit of play 0.07mm



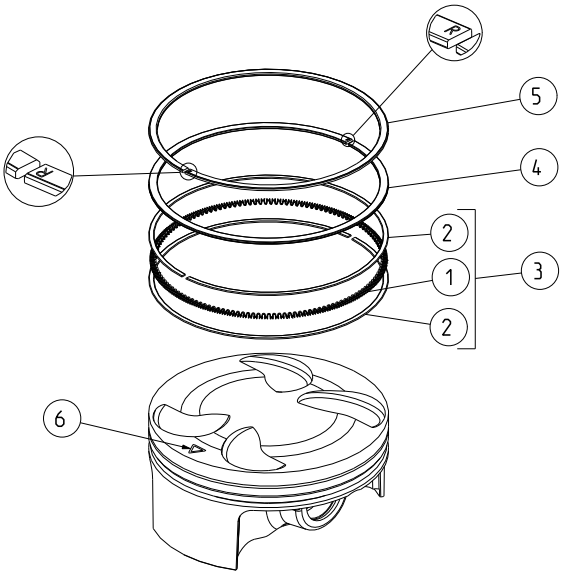
4.14.2 fitting

4.14.2.1 Studs

Insert the two dowel pins (1) into the right-hand crankcase, using a hammer to ensure that they go fully home in their housings.

Insert the studs into their housings by the longer threaded section, after you have first applied a thread lock. Use a nut and locknut (2) for screwing in the studs. Tighten to 30 Nm.

Fit the cylinder base gasket, taking care that it does not obstruct the oilway (3).



4.14.2.2 Piston

Fit the oil scraper ring (3) in the lower ring groove in the piston, inserting the spring (1) first, followed by the two flat sections (2) with their gaps facing in opposite directions.

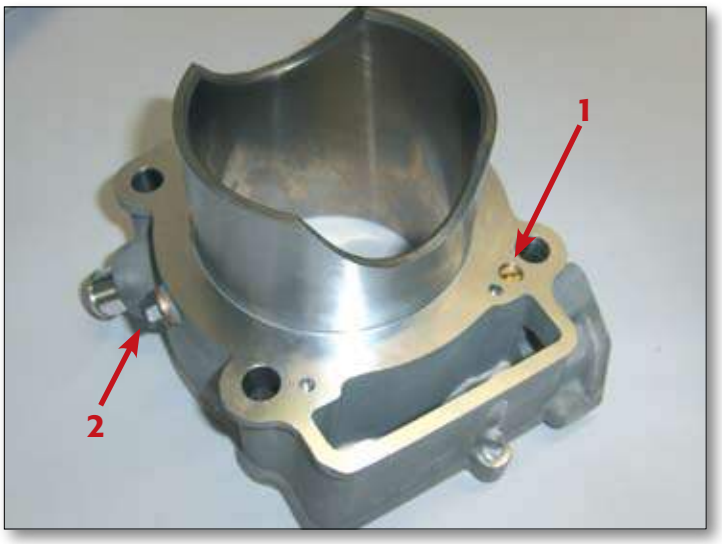
Fit the two compression rings (4, 5) into their grooves with the letter marking facing upwards and with the ring gaps facing in opposite directions.

Check after fitting that the rings can rotate in their grooves without excessive impediment.

N.B. When fitted, the piston must be have the arrow (6) facing towards the front of the engine (exhaust side).

4.14.2.3 Cylinder

Fit the oil jet (1) and the M6x12 bolt (2) for draining the cooling water with the appropriate washer. Tighten the bolt to 8 Nm.



Insert the piston into the cylinder from below, positioning it in the correct direction (with the arrow pointing in the bike's direction of travel). Lubricate the contact surfaces well, and take care not to damage the piston rings. Next, insert the circlip for retaining the piston pin, on one side only. Make sure that the open part of the circlip is facing either upwards or downwards.

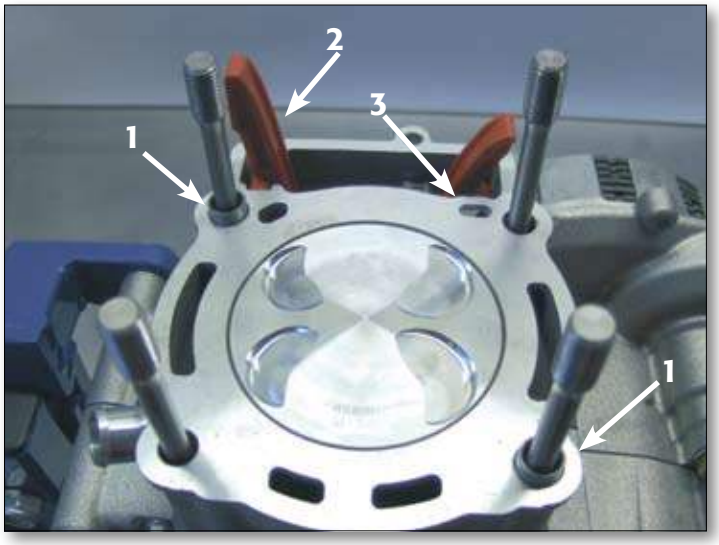


Slide the cylinder down between the studs until the small end of the conrod is aligned with the piston pin housing. Then insert the piston pin from the side which is still open, and lock it with its circlip, having previously lubricated the surfaces of the piston pin itself and of its housing.

N.B. Ensure that the cylinder base gasket is in position before fitting the cylinder.
N.B. Ensure that both circlips are fitted with the opening facing either upwards or downwards.

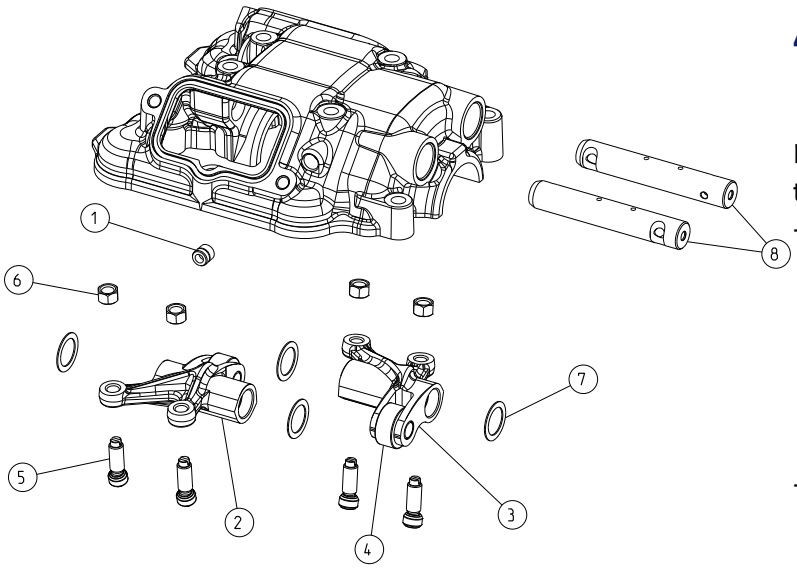
Bring the cylinder down until it makes contact with the crankcase, if necessary with the help of a rubber hammer to settle it in position. Ensure that the





camchain passes freely through the timing case on the right-hand side of the engine.

Insert the two dowels (1) and the movable camchain guide (2). Fit the cylinder head gasket, taking care that it does not obstruct the oilway (3).



4.15 CYLINDER HEAD COVER

Before proceeding to fit the head cover, carry out the following checks:

- Check the condition of the surfaces of the rocker spindles (8). Replace them if you detect excessive wear or scoring. Measure their external diameter and, if this is below the limit, replace the rocker spindle.

Limit value 11.93mm

- Check that the rollers (4) in the rocker arms run freely. If you detect excessive radial clearance, replace the rocker arms.
- Check the adjuster nuts (6) to ensure that the surfaces that bear on the rocker arms are flat.
- Measure the diameter of the spindle hole in the rocker arm. If the play of the spindle in the hole is outside the limit value, replace the rocker arm.

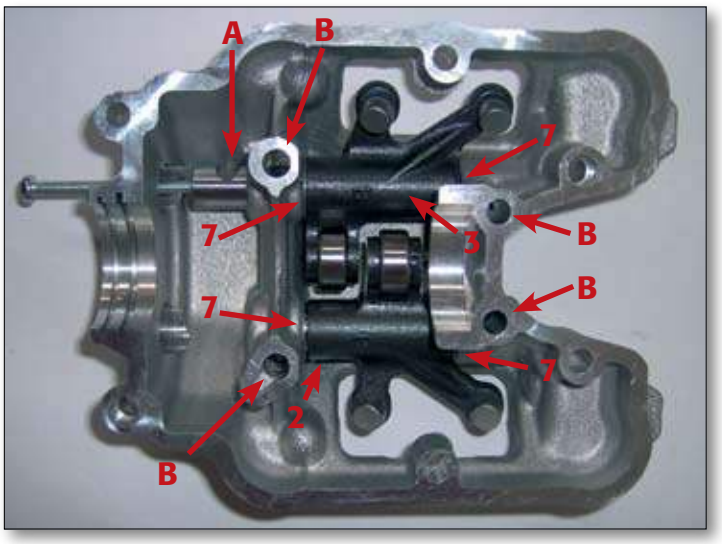
Limit of play 0.10mm

Insert the oil plug (1) in its housing using a pin punch.

Fit the adjuster screws (5) and the adjuster nuts on both rockers.



Fit the inlet rocker (2) and the exhaust rocker (3) as indicated in the photo, inserting the 12x17x0.5 thrust washers (7) between the rockers and the head cover, after you have lubricated them well with engine oil.
Insert the rocker spindles (8) with the cutouts (A) adjacent to the straight-through holes (B) for the cylinder-head hold-down bolts, and with the end containing a threaded hole facing outwards. This hole is used for locating the rocker spindles in the correct position using an M4 bolt.



4.16 CYLINDER HEAD

4.16.1 checks

Check the valve guides with a ø5H7 go/no-go gauge. If the gauge is easily introduced into the guide, then the guide must be replaced.
Check whether the valve stems show signs of wear, scoring or damage. Then measure their diameter and, if this value is below the limit, replace the valve.

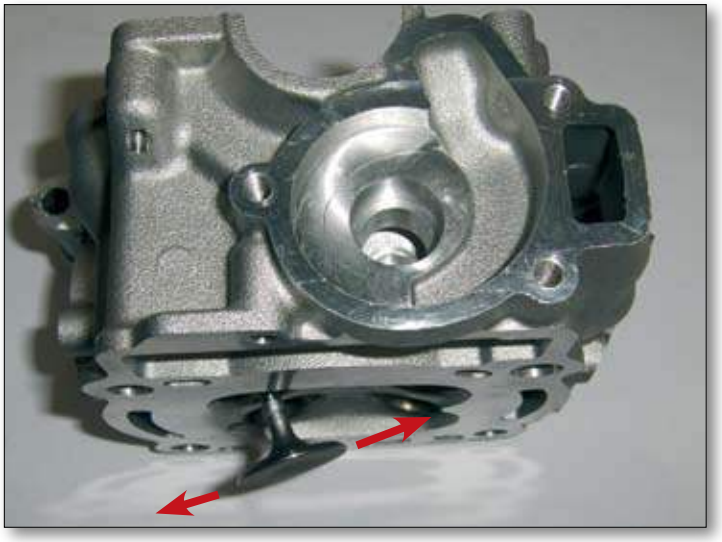
Minimum diameter 4.978mm



Check the valve stem/valve guide play. To do this, locate the valve in its guide with the top surface of the valve stem flush with the guide, and measure the maximum radial oscillation of the valve head.

Play when new 0.08mm
Limit of play 0.25mm

If the play exceeds this limit and the diameter of the valve stem is within the prescribed limits, replace the guide. Otherwise, replace both parts, unless the diameter of the guide is in tolerance, in which case only the valve is to be replaced.
Check the wear and the sealing surface of the valve seats. To do this, apply a thin layer of engineer's Prussian blue to the contact area of the valve with

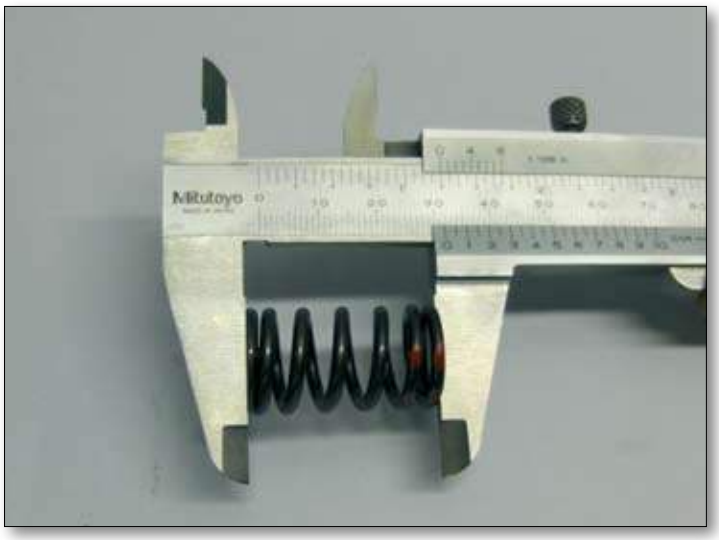




the seat. Then insert the valve into the guide until it is pressing against the seat, and rotate it on its axis. When the valve is removed, the dye will be missing on the contact area. The width of this contact area must fall within certain limits:

Standard 1.15-1.40mm
Service limit 1.80mm

If the sealing area is outside the service limit, the seat must be recut.
Recut the seat also if excessive roughness is visible, or if there is damage due to impact.



Check the free length L0 of the inner and outer valve springs. Change the springs if their free length is below the minimum value:

Minimum L0 outer spring 38.6mm
(39mm when new)
Minimum L0 inner spring 31.5mm
(31.8mm when new)

Measure the compression strength of the valve springs with a pressure dynamometer at length L1:

Outer spring: F=200±9N at L1=30mm
Inner spring: F=110±6N at L1=26.5mm



Using a suitable tester, check how well the valves seal once the head is assembled.

4.16.2 fitting

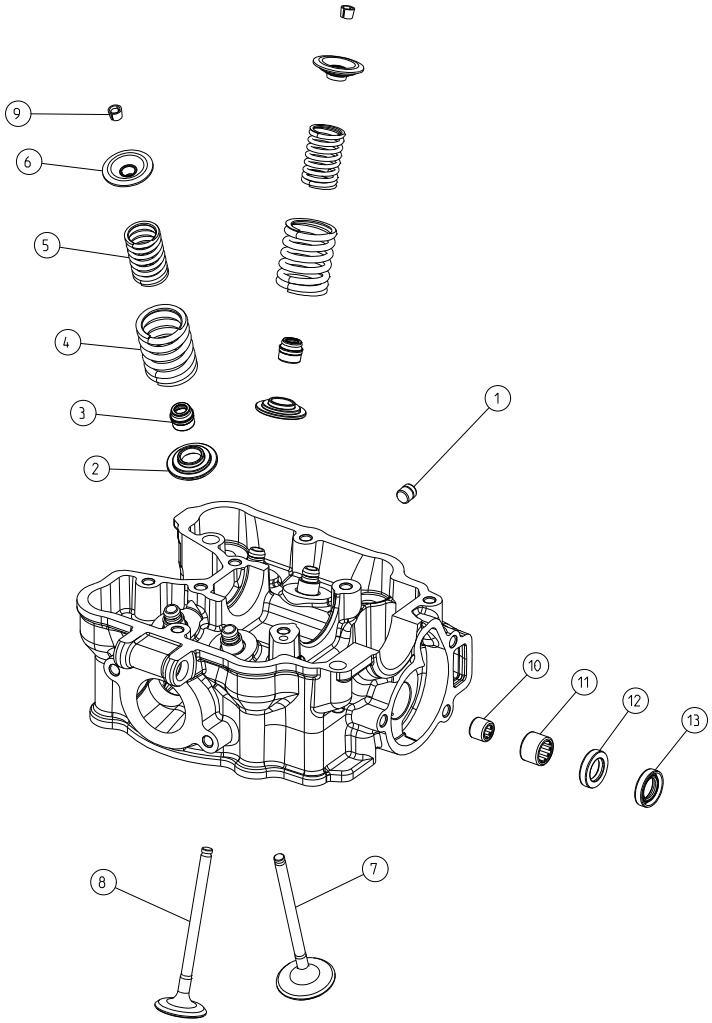
Insert the oil plug (1) using a pin punch.

Fit the lower spring caps (2) and then the valve guide oilseals (3). Take care not to confuse the lower spring caps with the upper ones. The upper caps differ from the lower ones in that they have a more marked bevel on the opposite side to the spring.

N.B. Change the valve guide oilseals each time an inspection of the head is carried out and the valves are removed.

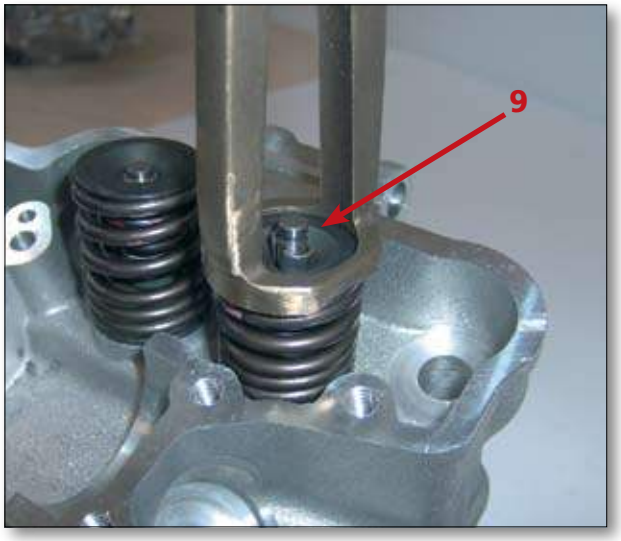
Fit the outer springs (4) and the inner springs (5), and then the spring caps.

N.B springs have a coloured paintmark. Fit them with this mark facing upwards.



After you have greased the valves and fitted them into their guides (inlet 7, exhaust 8), secure them with the split collets (9) using the special tool (A). The operation must be carried out individually for each valve.

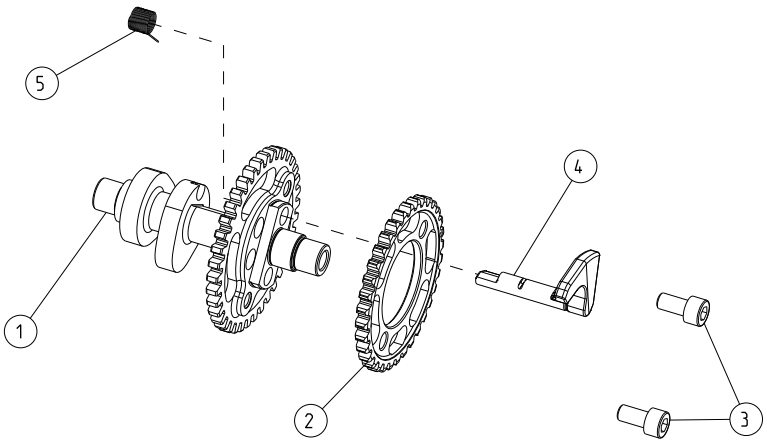
N.B. Used valves must always be refitted in the same guide as they were in before dismantling.







Apply a few taps to the upper spring caps with a double rubber hammer to help the split collets to settle.
Fit the two roller bearings (10, 11) for the water pump shaft into their housings in the head. The smaller-diameter bearing (10) should be driven fully home in its housing. The other bearing (11) does not have a stop, therefore you must ensure that it is located flush with the inner surface of the timing case.
Fit the first oilseal (12) with the open side facing towards the head to ensure an oiltight seal, and the second (13) with the open side facing outwards so as to avoid water leaks from the pump into the timing case. Remember to apply grease to the outer surfaces of the oilseal.



4.17 VALVEGEAR

4.17.1 Pre-assembly of camshaft

Check the wear on the contact surfaces of the cams with the rockers and, if you detect excessive wear or damage, replace the camshaft (1).





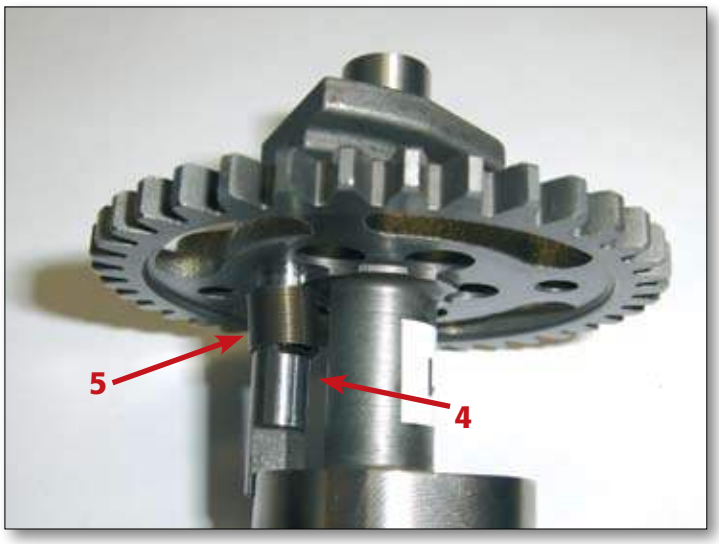
Measure the maximum length of the cams (A) and the diameter of the base circle (B).

Standard length of cam 33.258±0.030mm
Diameter of cam base circle 28±0.015mm

Fit the camshaft sprocket (2) onto the camshaft (1) with the flat face towards the cams, securing it with the M6x10 screws and tightening to 10 Nm after applying medium-strength thread lock.

Fit the decompressor weight (4) and the relative spring (5). The spring must be preloaded by half a turn when fitted. Then check that the decompressor mass returns automatically to its initial position after being displaced. If this does not happen, replace the spring.

N.B. Oil the contact areas between the decompressor mass and the other parts in the camshaft assembly.

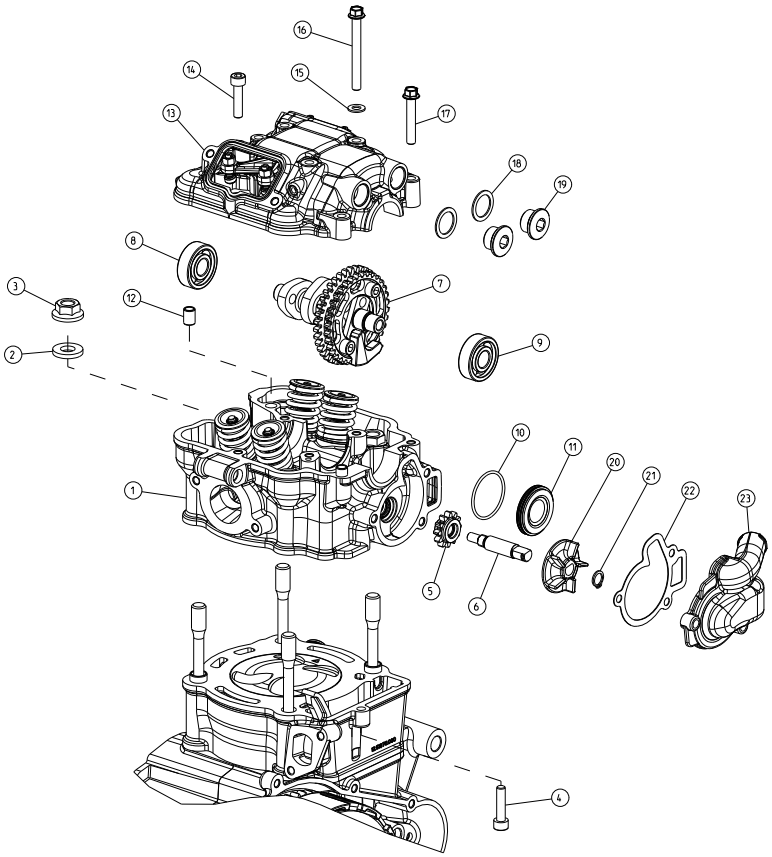


4.17.2 Fitting the valvegear

Fit the head (1) onto the cylinder, tapping it several times in the area of the dowels in order to facilitate seating.

Fit the washers (2) and screw the nuts (3) onto the studs, tightening them in diagonal sequence, starting with the studs in proximity to the dowels. Tighten to a torque of 30 Nm.

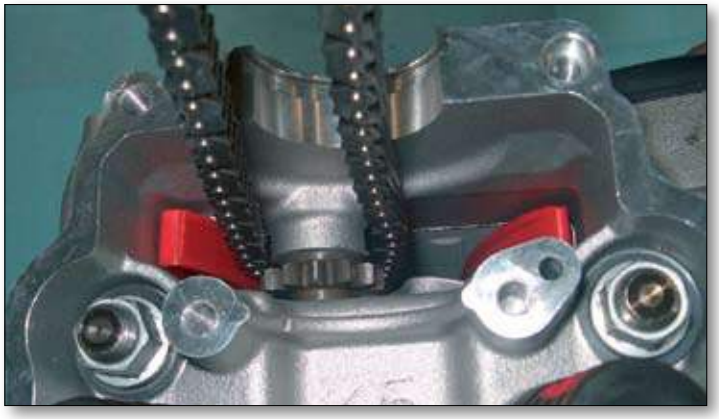
Tighten the M6x25 bolt (4) to 10 Nm.

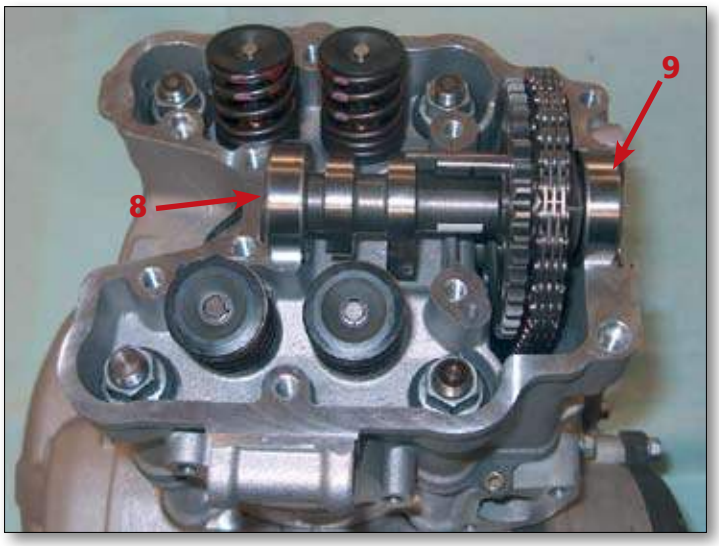


Fit the water pump drive sprocket (5) into its housing in the timing case, with the smaller-diameter face towards the inside, and then the water pump shaft (6) after you have lubricated it with oil.

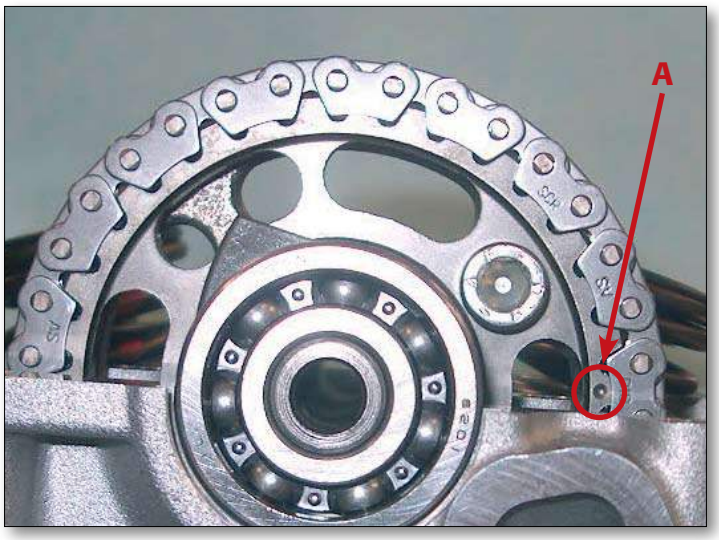
Check the diameter of the water pump shaft in the area where it makes contact with the seals. Signs of wear may be visible in this area. If the diameter is less than the limit value, replace the shaft to avoid sealing problems.

Minimum diameter 9.7mm





Pass the camchain around the camshaft sprocket, and fit onto the camshaft first the sealed bearing (8) and then the bearing on the chain side (9).



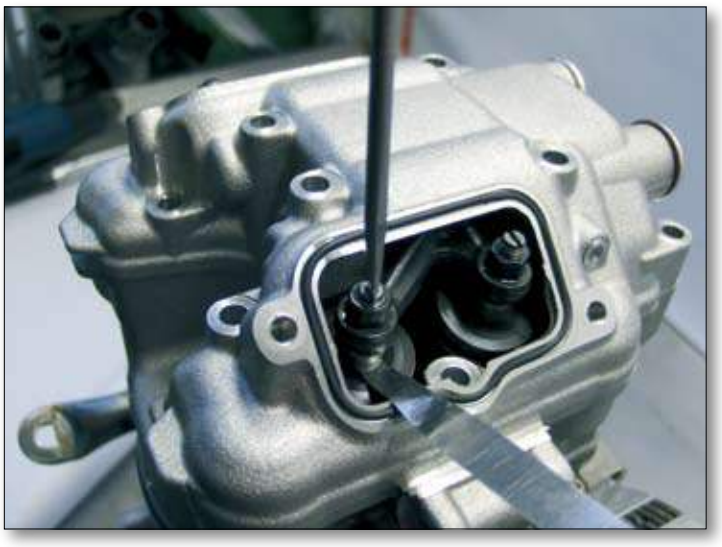
Take care to time up the camshaft properly. The crankshaft is locked at TDC by the special bolt which was fitted earlier (see 4.11). Position the camshaft so that the timing mark (A) is horizontal on the exhaust valve side. In this way, the entire assembly is positioned at TDC between the compression stroke and the combustion stroke, i.e. when the valves are at rest and there is clearance in the rockers which will later need to be adjusted, as is explained further on in this manual. This facilitates the fitting of the head cover and, consequently, the rockers.

N.B. The correct way to check the timing is to tension the camchain by pressing on the movable chain guide with a screwdriver.



Screw the water pump shaft (6) into the gear (5) (which is locked by the camchain) using the appropriate special tool.
Locate the dowels (12) in the head and fit the camshaft end plug (11) with its O-ring (10) into place in its groove.
Put some silicone sealant on the contact surface with the head cover and refit the cover (13) to the cylinder head, ensuring that the rocker spindles are positioned correctly, i.e. so as to allow the subsequent fitting of the cover bolts.
Fit the head cover bolts: two M6x25 (14), four M6x55 (16) with the corresponding washers (15), and four M6x35 (17), tightening them to 10 Nm.

Seal the holes in the head cover for the rocker spindles with the appropriate gaskets (18) and plugs (19).



Adjust the valve clearances, inserting a feeler gauge between the adjuster and the top of the valve, and using the adjuster screw to regulate the play.

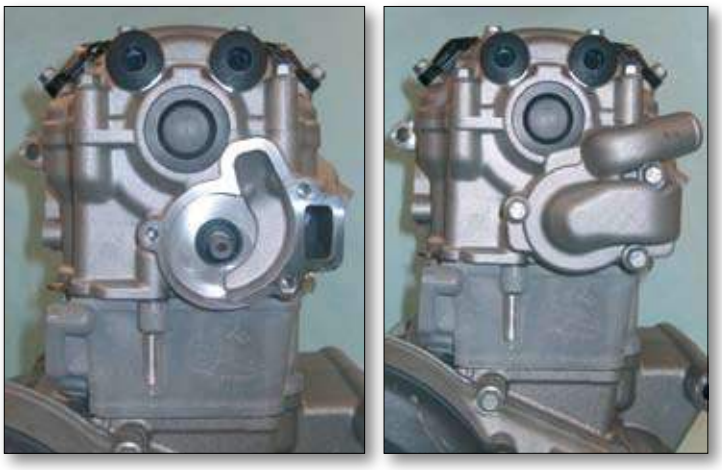
Inlet clearance 0.10mm.
Exhaust clearance 0.15mm.

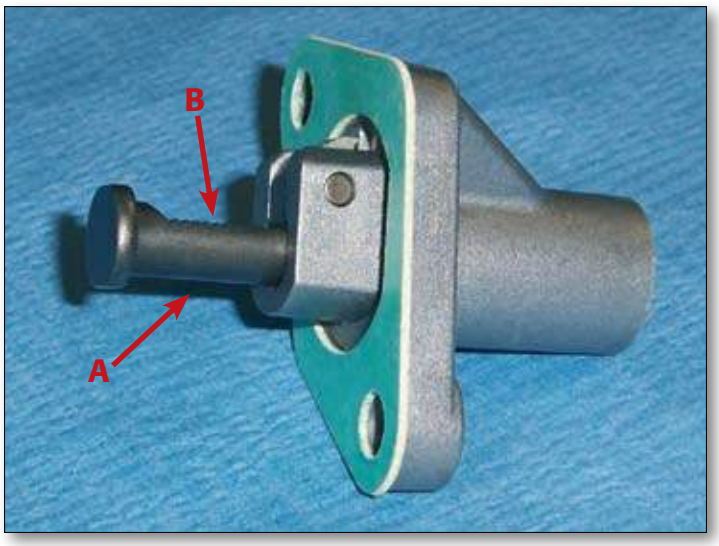
When the clearance is correct, tighten the locknuts to 11 Nm and seat the O-rings for sealing the valve covers in the grooves machined in the head cover. Use silicone sealant to help the O-ring adhere in its groove, and to prevent it from moving when the valve cover is removed.

Fit the valve covers using M6x16 bolts and tighten them to 8 Nm.



Fit the water pump impeller (20), securing it with the circlip (21). Apply some grease in the area of the threads in order to help the gasket (22) to adhere, and fit the cover (23) to the pump, tightening the three M6x20 bolts to 10 Nm.





Check that the tensioner plunger (A) moves freely, and check the teeth (B) on the plunger for wear. Before fitting, push the plunger all the way into the tensioner body.



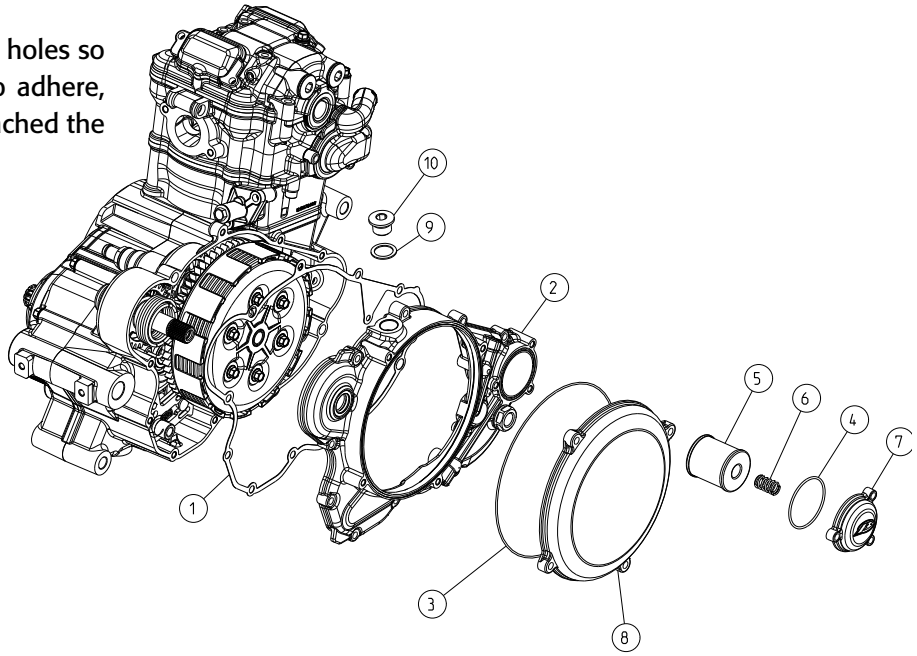
Fit the tensioner body and its gasket, retaining it with M6x16 bolts tightened to 8 Nm. Use a screwdriver to push the plunger so as to put the camchain under tension. Then insert the spring and washer and, finally, screw in the bolt.



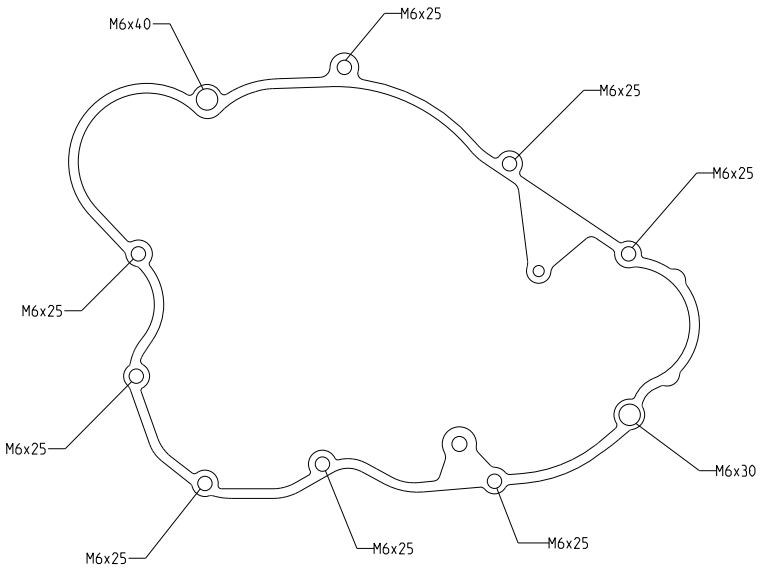
4.18 CLUTCH CASING

Before you proceed to fit the clutch casing, oil all the moving parts well, and also the areas which that have oil passing through them, such as the crankshaft and the oil jet. Then locate the dowels (A).

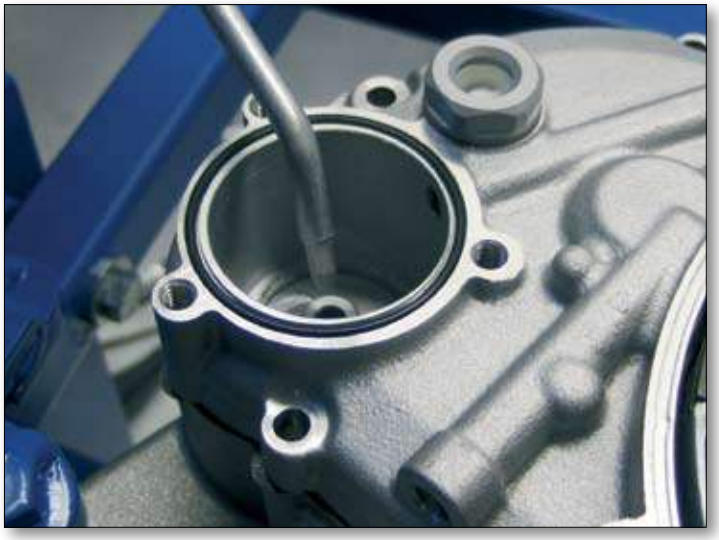
Grease the areas adjacent to the threaded holes so as to help the clutch casing gasket (1) to adhere, and thus to prevent it from becoming detached the next time the cover is opened.

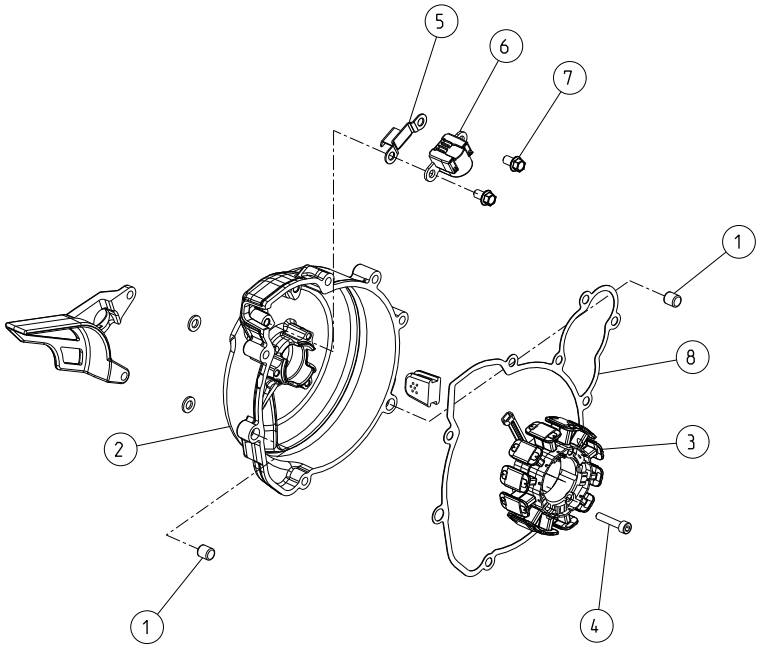


Fit the clutch casing (2) with its retaining bolts, tightening them to 10 Nm.
Insert the O-rings for the clutch cover (3) and the oil filter cover (4) into the grooves formed in the clutch casing, applying some grease to make sure they adhere to their housings.



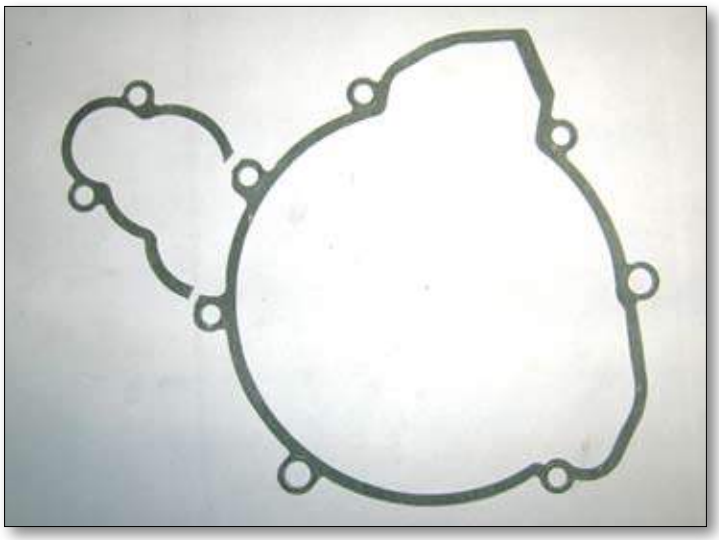
Fit the output oil filter (5) and the spring (6) after you have oiled the filter seat.
Fit the clutch cover (8) and the oil filter cover (7), retaining them with M6x20 bolts (four for the clutch cover and three for the oil filter cover). Tighten the bolts to 10 Nm. Refit the oil filler plug (10), tightening it to 10 Nm, after first applying the 16x22.5x1 gasket (9).





4.19 IGNITION

Insert the two dowels (1) into the left-hand crankcase and apply some grease in the area of the threaded holes in order to help the flywheel cover gasket (8) to adhere.



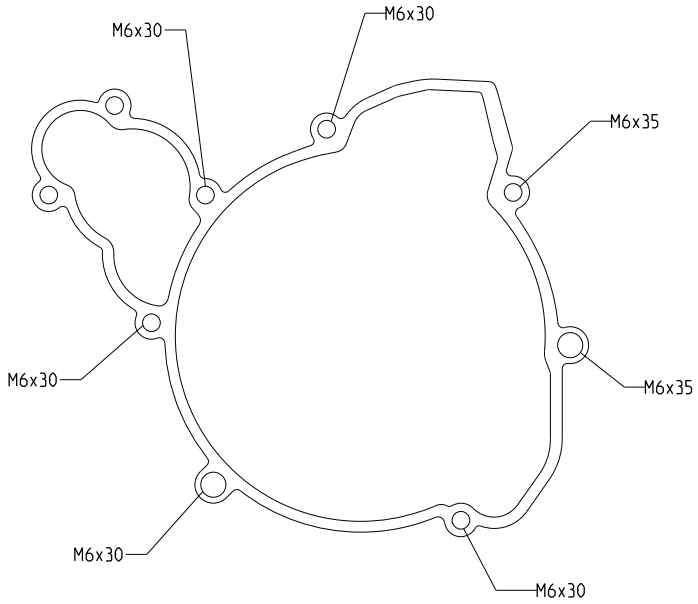
N.B. Before you apply the gasket, cut off the excess section as shown in the picture above.



Fit the stator (3) to the flywheel cover (2), retaining it with three M5x25 screws (4). Tighten the screws to 6 Nm. Take care that the stator cable guide plate is facing towards the inside of the cover.
Fit the cable retaining plate (5) and the pickup (6), tightening the two M6x12 retaining bolts to 8 Nm.

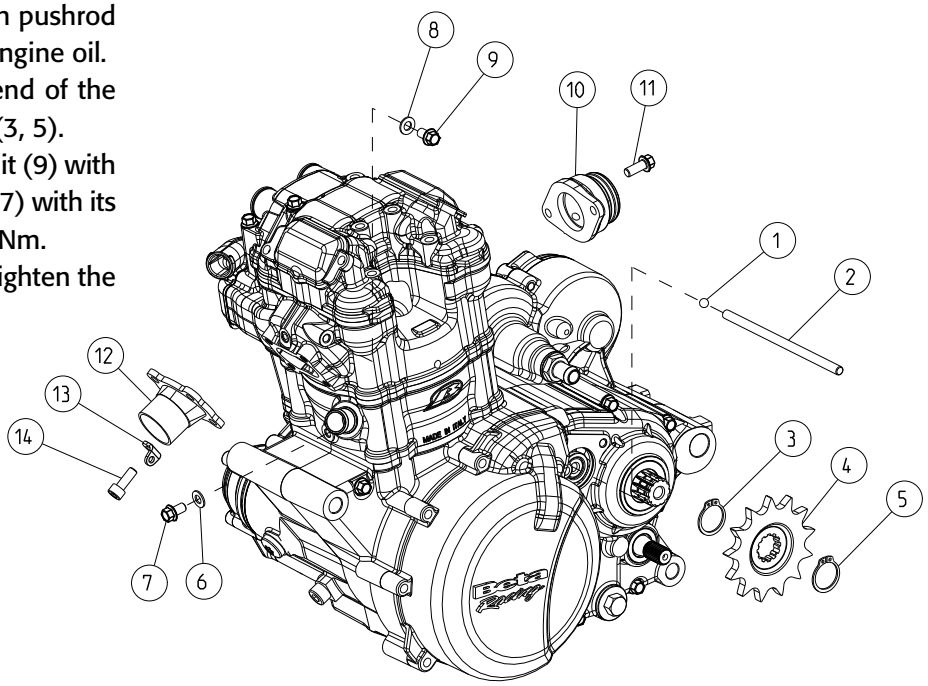
Fit the flywheel cover to the left-hand crankcase half and retain it with the bolts indicated in the picture above. Tighten the bolts to 10 Nm.

N.B. Do not tighten the two M6x35 screws at this stage, as they will also be used to retain the sprocket cover which will be fitted only after the chain has been passed around the sprocket, once the motorcycle is assembled.



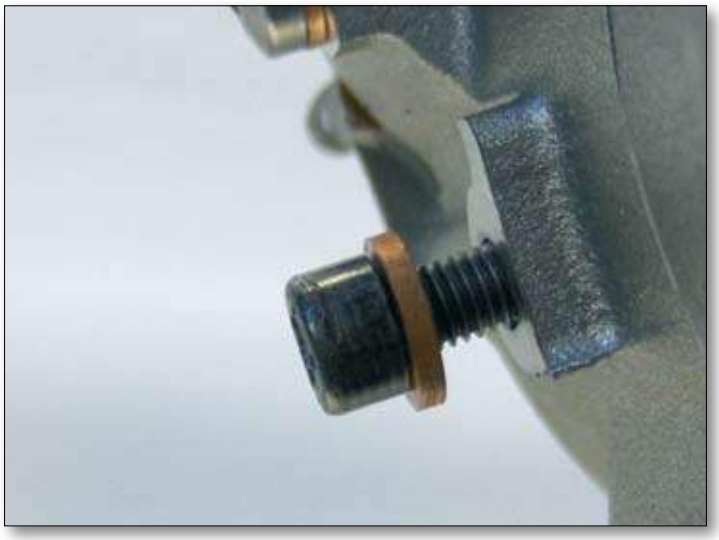
4.20 FINAL DETAILS

Insert first the ball (1) and then the clutch pushrod (2) after you have lubricated them with engine oil.
Fit the front sprocket (4) to the output end of the layshaft, retaining it with the two circlips (3, 5).
Fit the air bleed screw for the cooling circuit (9) with its washer (8) and the water drain screw (7) with its washer (6), tightening both of them to 8 Nm.
Connect the carburettor flange (10) and tighten the two M6x16 bolts (11) to 10 Nm.





Fit the exhaust flange (12) with four M6x15 screws (14) tightened to 10 Nm. Under the heads of the screws fit the two plates (13) for anchoring the exhaust collector support springs. These plates are fitted to the top right and bottom left bolts, looking at the engine from the front (exhaust side).



Fit the special washer between the TDC bolt and its housing on the crankcase. As a result, the crankshaft is no longer locked.
Fit the kickstart lever and check that the whole kickstart system moves correctly.

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