ENGINE WORKSHOP MANUAL

DB7

Rev. 1.10

11-2009

MANUAL PURPOSE – WARNINGS

This manual has been written by Bimota SpA primarily intended for use by dealers Bimota and their skilled mechanics. Describes the service procedures for maintenance, repair and replacement of original parts of the motorcycle in question. The technicians, that this manual is intended to, must have the adequate experience and competence: some information has been deliberately omitted, because they have to be part of the indispensable basics that a technician must have. The technicians in the use phase of the manual must comply with the original technical specifications given by the original manufacturer. Bimota assumes no responsibility for errors or omissions of technical nature, produced in the writing of this manual. All the information provided shall be updated at the time of printing, Bimota pursues a policy of continuous research and development, therefore, reserves the right to make changes of its products without prior notice and without obligation to make the same changes to products already sold. The modifications or significant changes made to the specifications or procedures will be reported to all Bimota authorized dealers and, where possible, will be included in subsequent editions of this manual.

SIMBOLS

All indications right or left refer to the direction of travel of motorcycle.

Caution
The non-compliance with the instructions may create a situation of danger and cause serious personal injury and even the death of the pilot, persons in the proximity, or person intent to repair the bike.

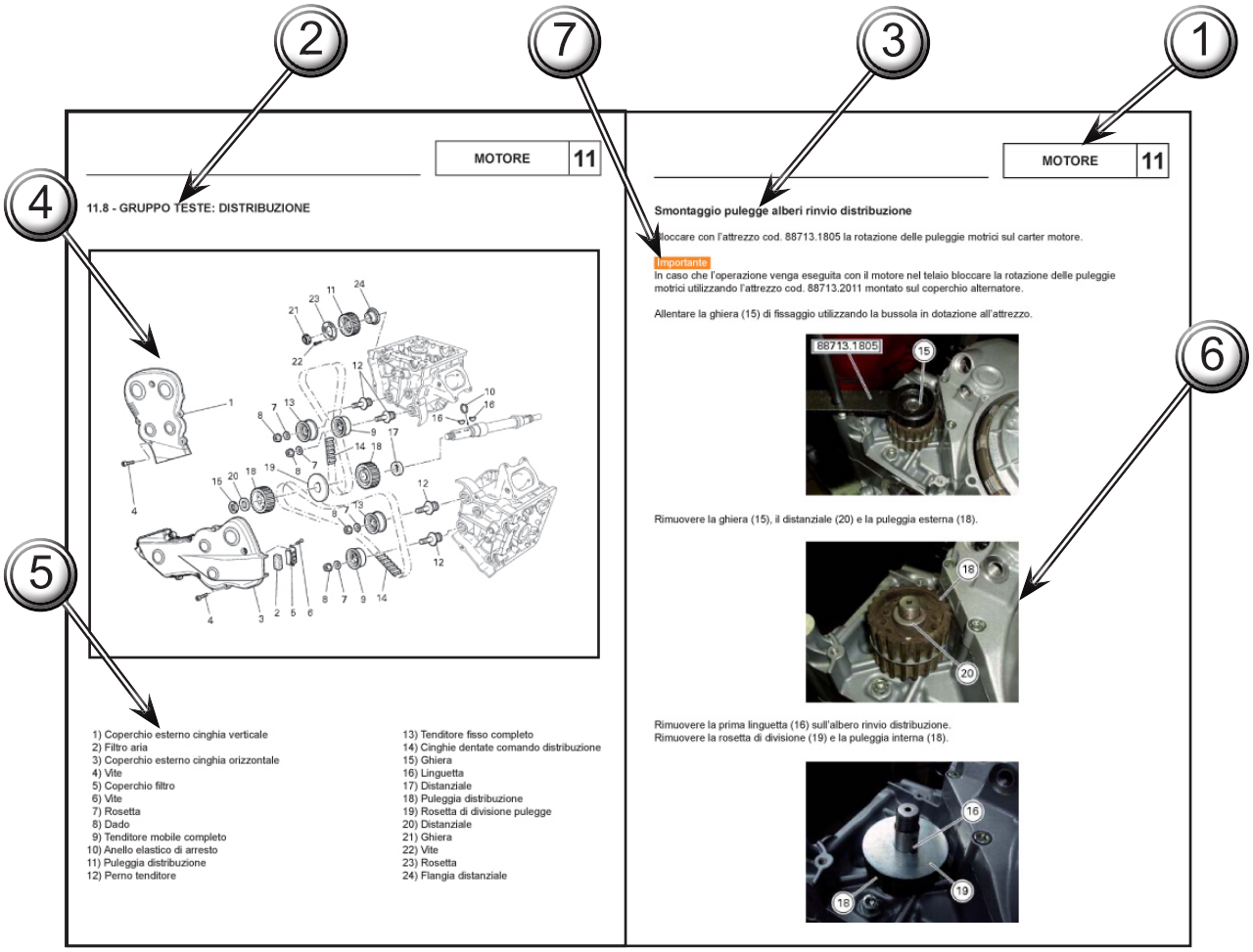
Important
Indicates the possibility of damage to the vehicle and/or its components if the instructions are not performed.

Notes
Provides useful information on the current operation.

USE OF THE MANUAL

This manual is an easy guide for technicians. All the procedures indicated in the manual are illustrated in a detailed way and regards the operations of disassembly, assembly, inspection and repair.

1. The manual is divided in chapters. The name and the relative number, placed in a frame on the right upper corner of each page, indicating the current chapter.
2. Each chapter is divided in sections. In the left upper part of each page is reported the title of the current section, written in capital letters.
3. Paragraph title, written in small letters respect to the section title.
4. At the beginning of some sections, to make the procedures of disassembly more clear and to help the identification of the bike components, are reported the exploded drawings. It is possible to identify by number the related piece.
5. The exploded drawing is accompanied by a list with the piece name and relative characteristics.
6. The instructions for the disassembly/assembly operations are described in sequence.
7. Some operations are accompanied by symbols with the purpose to supply more information and/or possible danger situation for the pilot or motorcycle.



Summary

* Click on the desired item to go to the related section.

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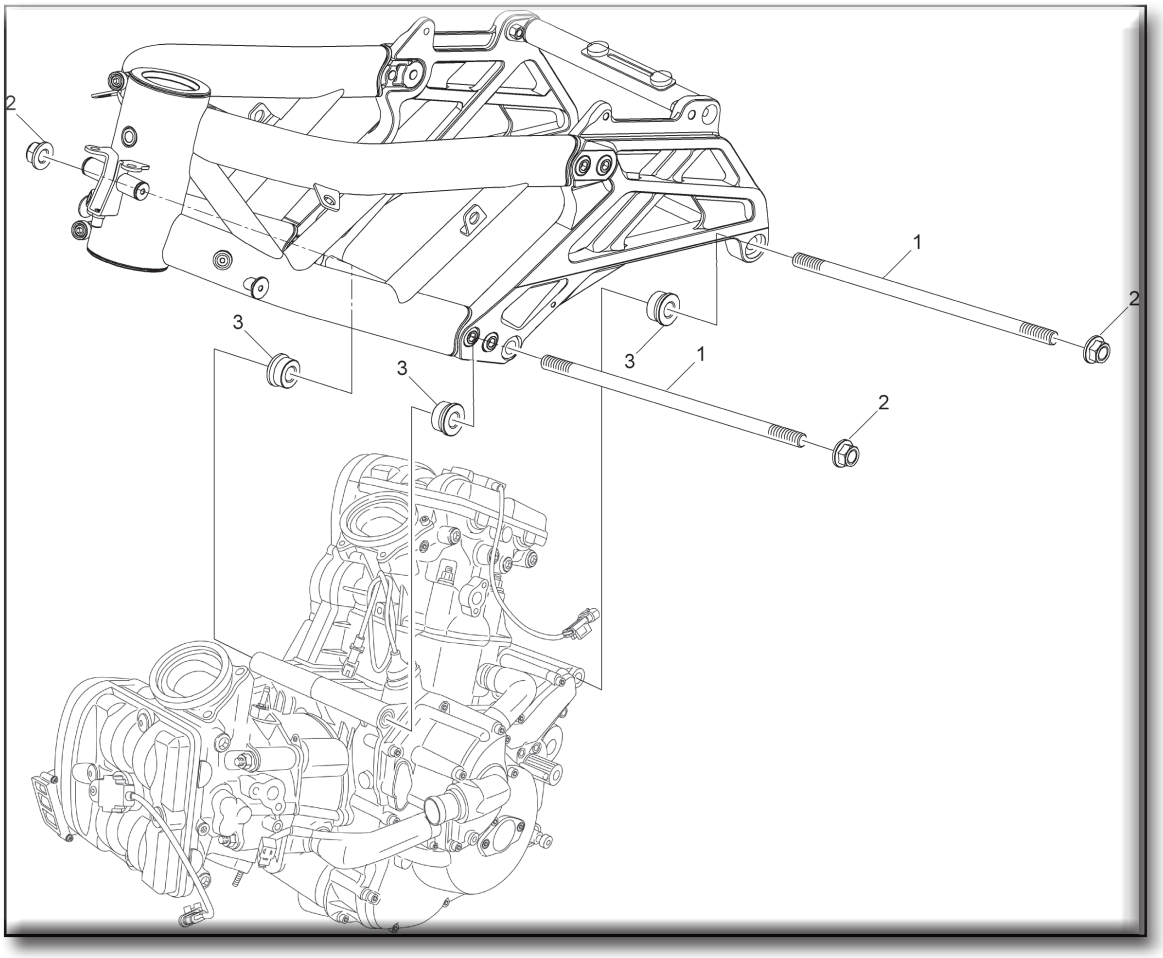
11.1 - REMOVAL – REFITTING OF THE ENGINE ASSEMBLY



1) Engine spindle
2) Nut M12x1,25
3) Spacer

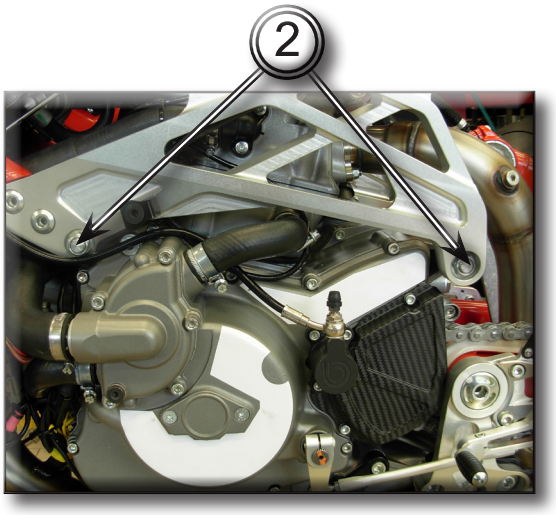
Removal of the engine

In order to remove engine you must first remove a series of other components from the motorcycle.
Most of these removal procedures are described in the relative sections of this manual.
This section describes only the operations to be carried out after having removed all the parts listed belowe:

- Tail, Fuel tank, side fairing, front fairing
- Throttle control, airbox, throttle body, exhaust system
- Foot lever gearshift assembly, rear brake pump, Clutch piston assembly, engine driving pinion
- Engine wiring, battery box mount, oil cooler and pipes, cooling system
- Swingarm, swingarm plate dx-sx, shock absorber rocker

Place a stand beneath the engine to support it during removal from the frame.

Loosen the two spindle nuts (2) on the left or the right side.
Take the spindles (1) off. In this moment the engine unit is detached by the frame.



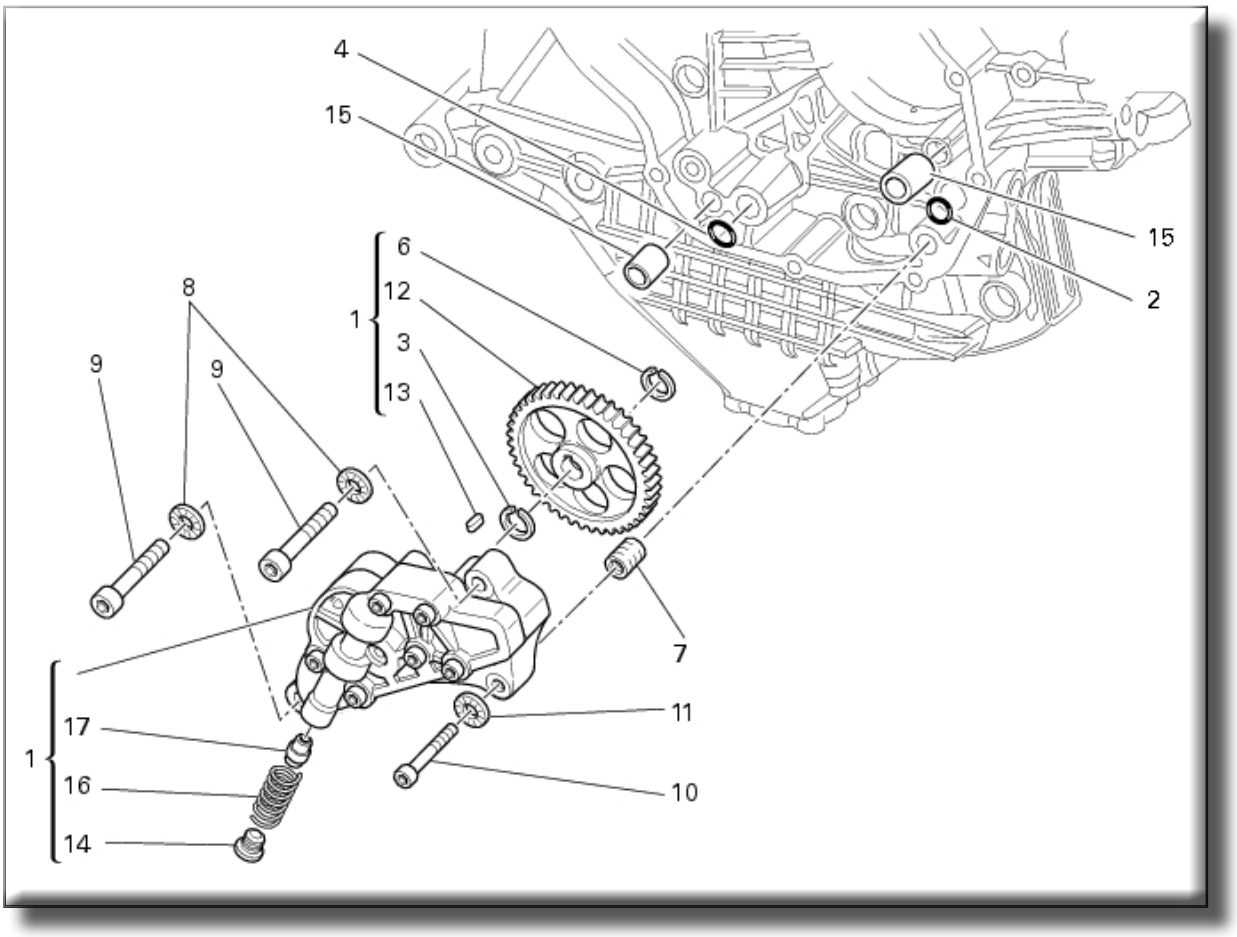
Take the engine off from the frame pulling it down and forward.

Refitting engine

To reassemble repeat the assembling operation in reverse order.

Important
Add grease under the nuts (2) and tighten to specified torque.

11.2 - LUBRICATION SYSTEM: OIL PUMP

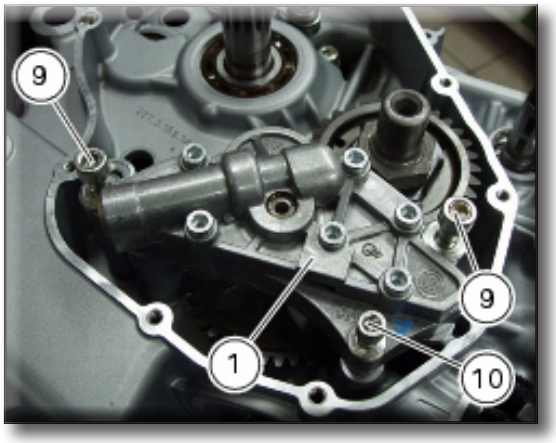


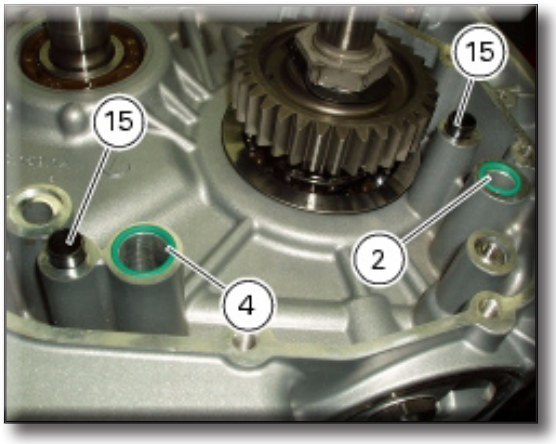
1) Complete oil pump assembly
2) O-ring
3) Circlip
4) O-ring
5) Pump body
6) Circlip
7) Reducer bush
8) Spring washer
9) Bolt
10) Bolt
11) Spring washer
12) Pump drive gear
13) Key
14) By-pass plug
15) Locating dowel
16) By-pass spring
17) By-pass valve

Removal of the oil pump

Drain the oil from the lubrication system
Remove the engine from the frame
Remove the right-hand side crankcase cover

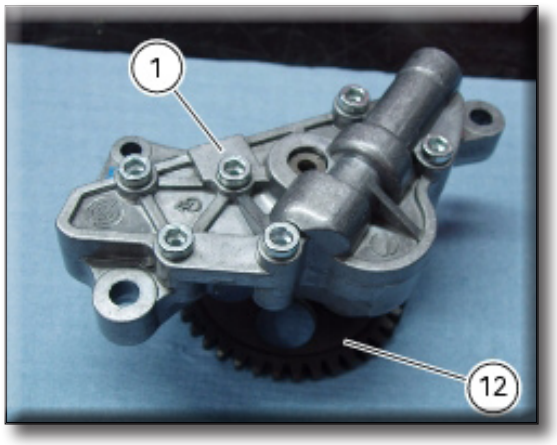
Undo and remove the bolts (9) and (10) securing the pump assembly.
Remove the oil pump assembly (1) and extract O-rings (2) and (4) from the crankcase half together with two centring bushes (15).





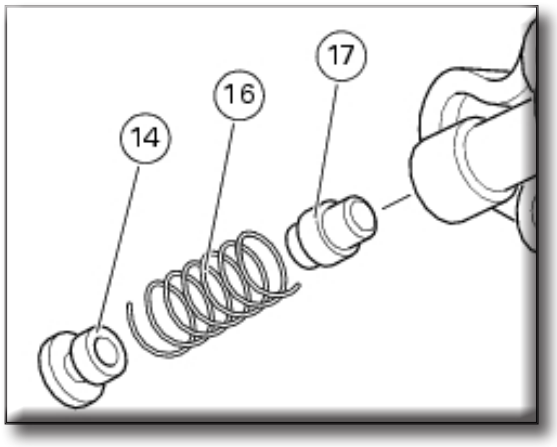
Disassembly of the oil pump

Hold the oil pump (1) in a vice taking care not to damage the drive gear (12).

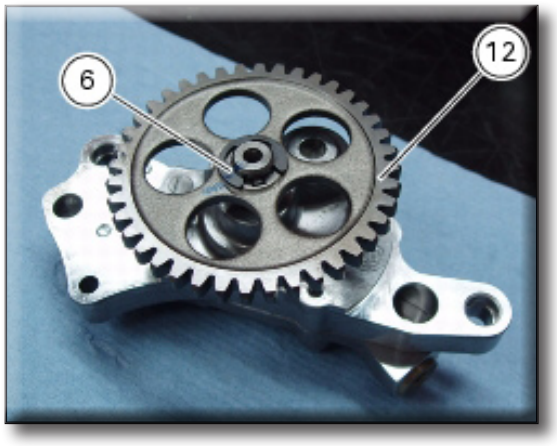


Warning
Make sure that vice jaws are faced with soft material.

Remove the plug (14) and extract the spring (16) and by-pass valve (17).

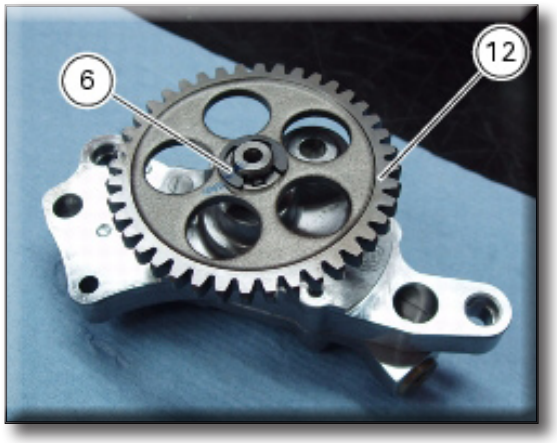


Check the condition of the above components.
Remove the circlip (6) and withdraw the pump drive gear (12).

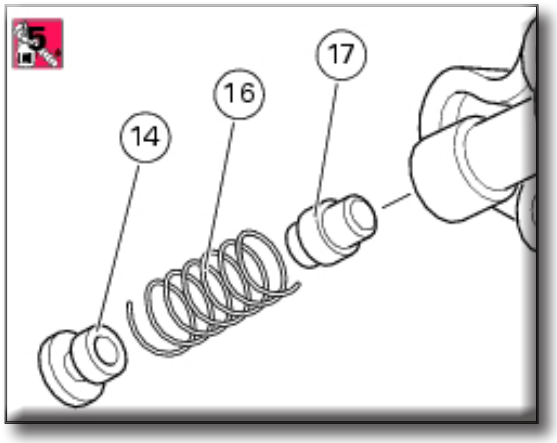


Reassembly of the oil pump

Check that the circlip (3) and Woodruff key (13) are both present on the pump.
Fit the pump drive gear (12) on to the oil pump and secure it by installing the circlip (6) in its groove.

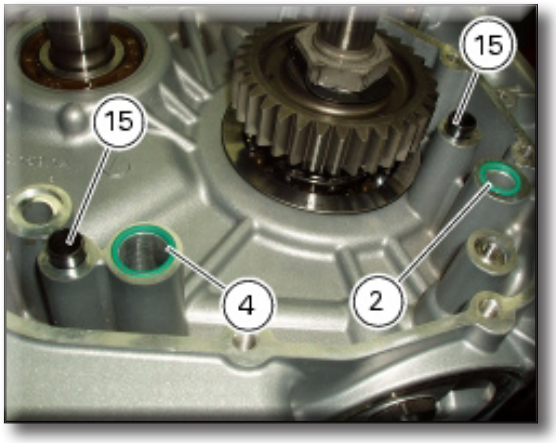


Install in the pump the by-pass valve (17) and the spring (16); screw in the plug (14) and tighten to the specified torque, after applying a medium strength threadlocker.

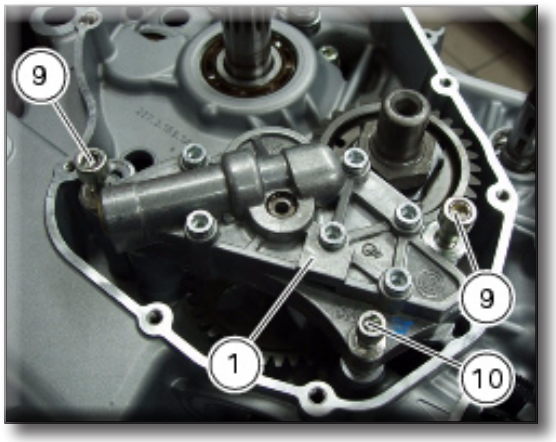


Refitting the oil pump

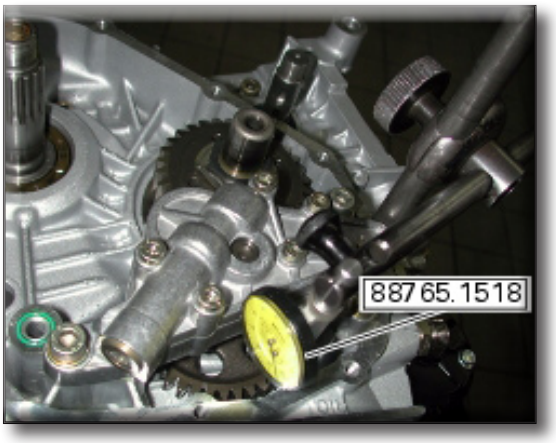
Position the locating dowels (15) and the O-rings (2) and (4) in correspondence with the crankcase lubrication oilways.



Position the oil pump on the crankcase and tighten the bolts (9) and (10) to the specified torque.

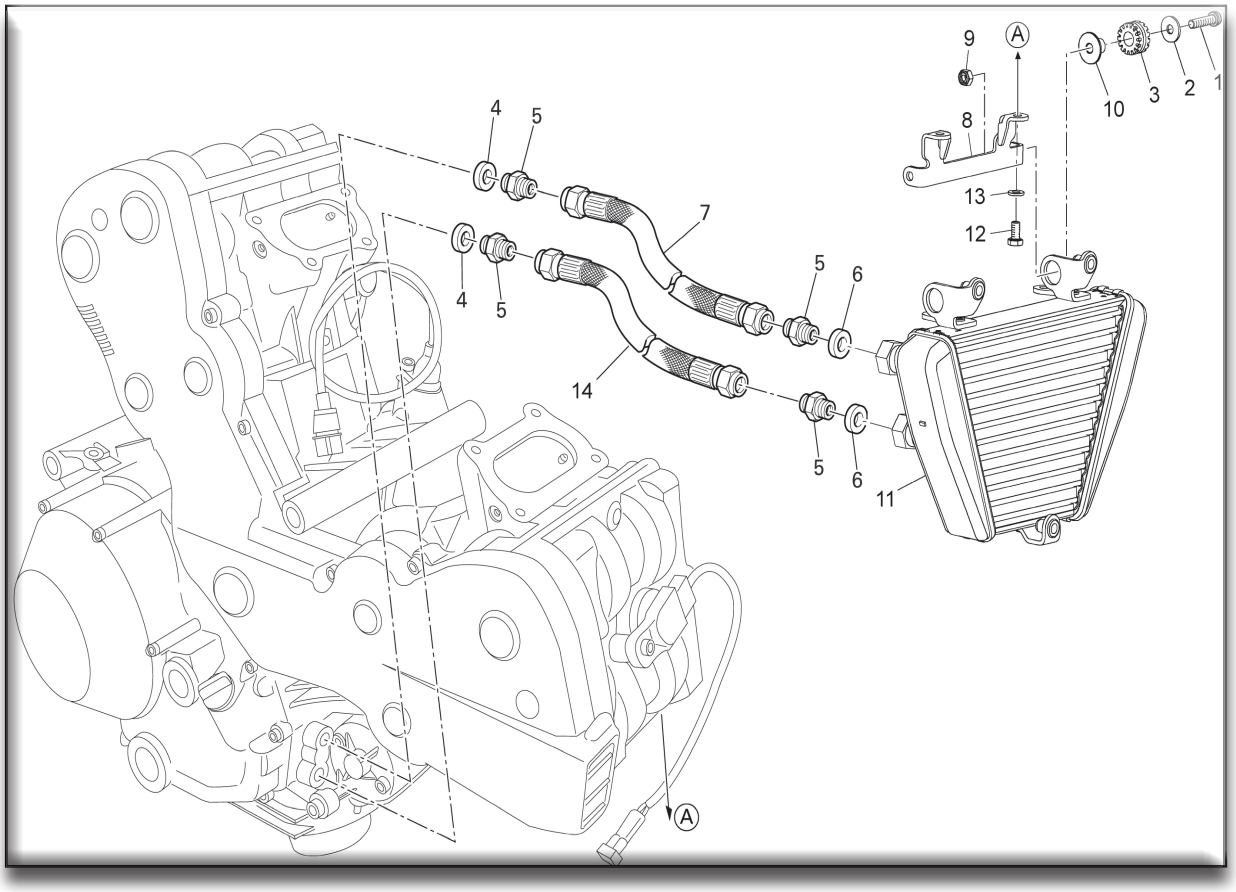


Check the gear backlash with the driving pinion by fixing dial gauge part no. 88765.1518, equipped with the relevant stylus, to the crankcase.
Set dial gauge stylus on one tooth of oil pump gear and zero set instrument in this position.
Move gear slightly to measure play; take four readings in diametrically opposed positions of the gear.
The backlash should be 0.10 mm.



Refit the right-hand crankcase cover
Refit the engine to the frame
Fill the lubrication system with oil

11.3 - LUBRICATION SYSTEM: OIL COOLER

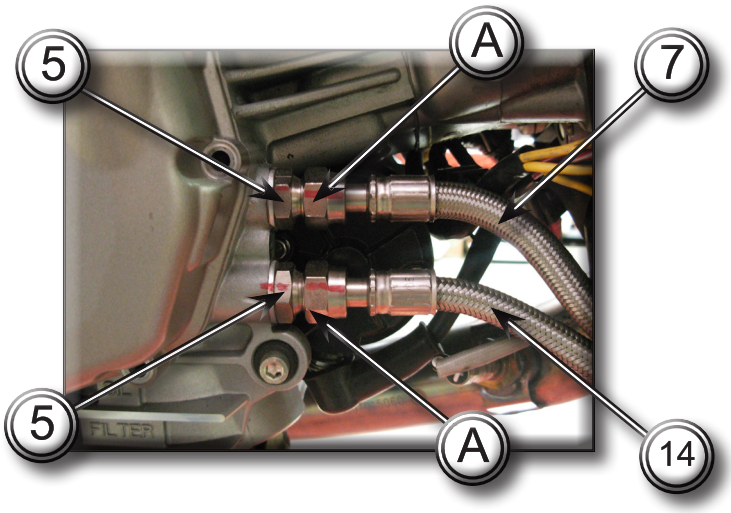


1) Bolt M6x25 TCEI CZ
2) Gasket 6x18x1.6
3) Rubber mounting
4) Aluminium gasket sp.2
5) Nipple
6) Gasket
7) Oil hose
8) Support
9) Nut M6
10) Spacer
11) Oil cooler
12) Bolt M6X12 TE
13) Gasket
14) Oil hose

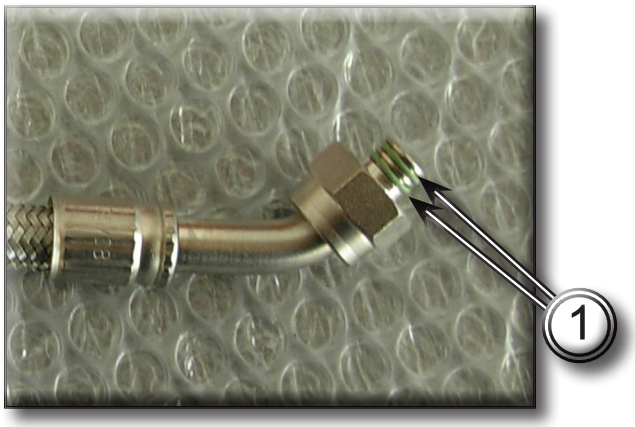
Removal of the lubrication system

Remove the side fairings
Drain the oil from the lubrication system

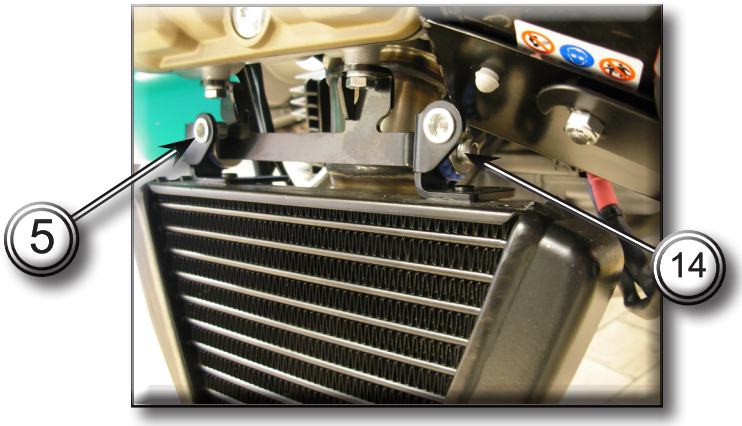
Undo the nuts (A) on the feed and return hoses (7) - (14) and the nipples (5) and disconnect them from the engine.
Unscrew the nipples (5) on the crankcase and recover the gaskets.



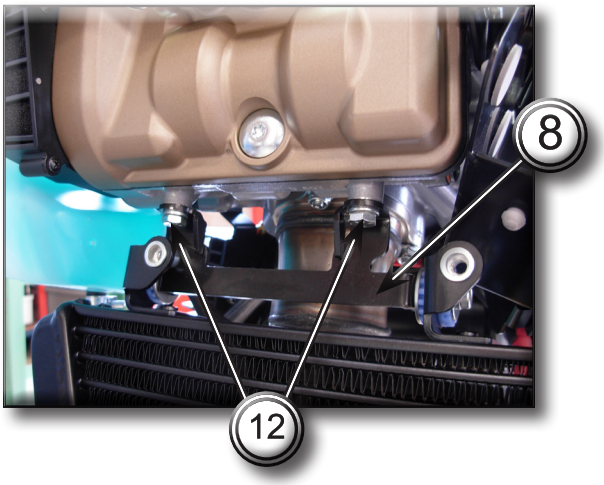
During removal, take care not to lose the O-rings (1) which ensure a tight seal.



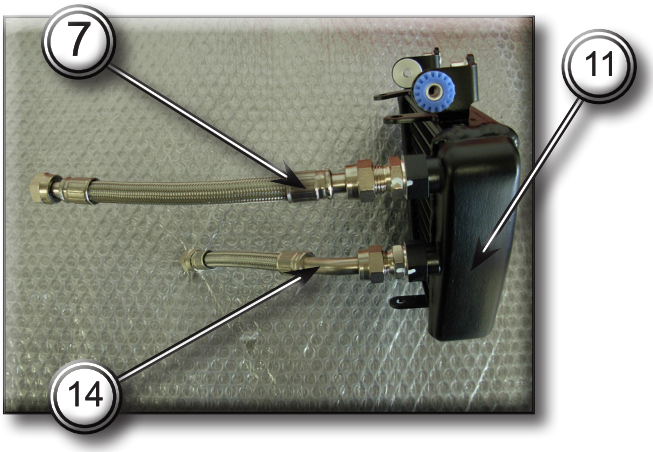
Unscrew and remove the bolt (14) - (5) securing the oil cooler to the support (8).



The support (8) can now be removed by unscrewing the bolts (12).



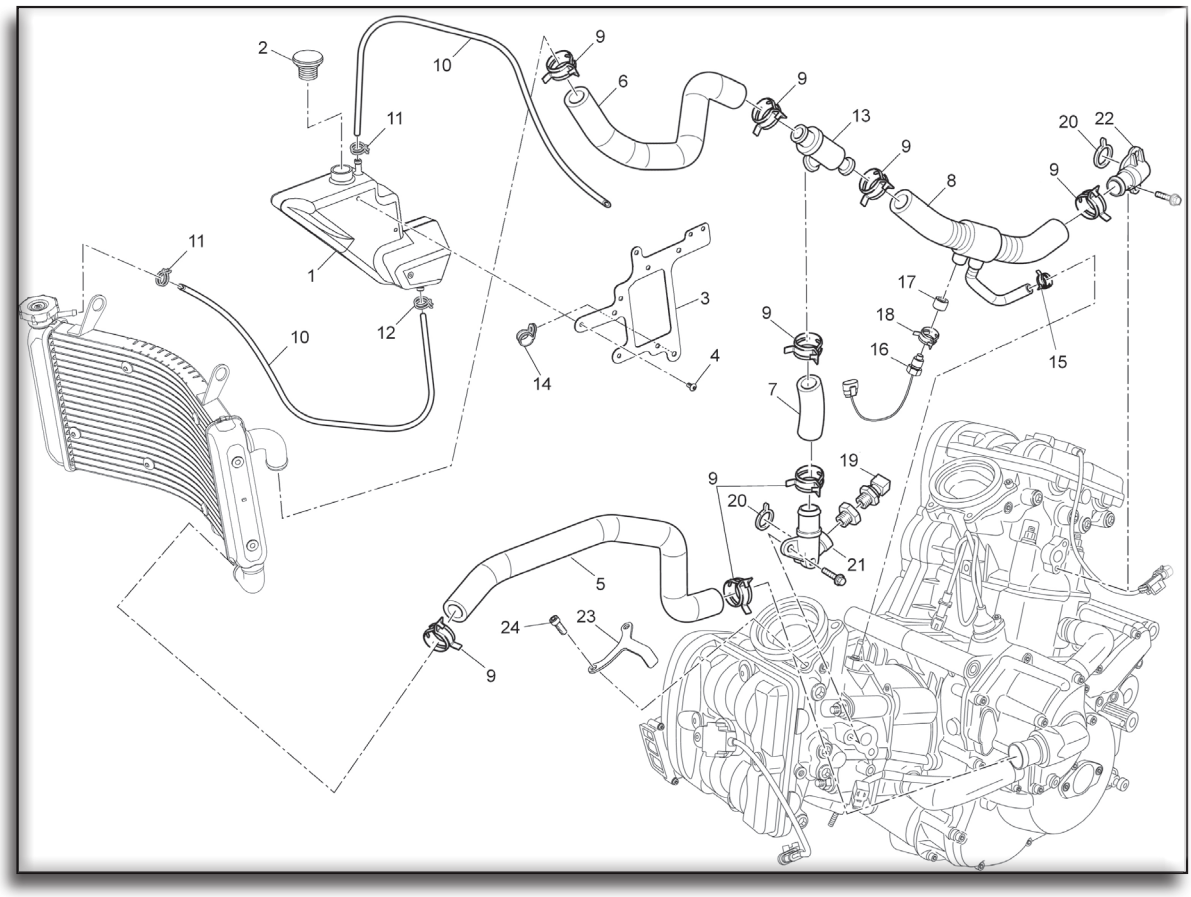
Unscrew the feed and return hoses (7) - (14) from the oil cooler (1).



Oil cooler inspection

Make a visual inspection of the oil cooler. Renew the cooler in the presence of damage or leaks.

11.4 - COOLING SYSTEM: WATER TANK



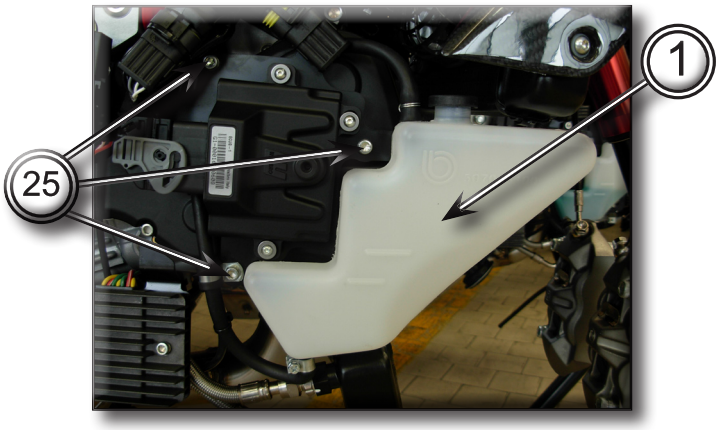
1) Water tank
2) Tank cap
3) ECU mounting plate
4) Screw M5x10 TBEI
5) Water return hose
6) Water delivery hose
7) H. cylinder hose
8) V. cylinder hose
9) Clamp
10) Hose
11) Clamp
12) Clamp
13) Thermostat
14) Hose guide clamp
15) Clamp
16) Water temperature sensor
17) Screwed bush
18) Clamp
19) Sensor
20) O-Ring
21) Water outlet union (horizontal)
22) Water outlet union (vertical)
23) Plate
24) Screw

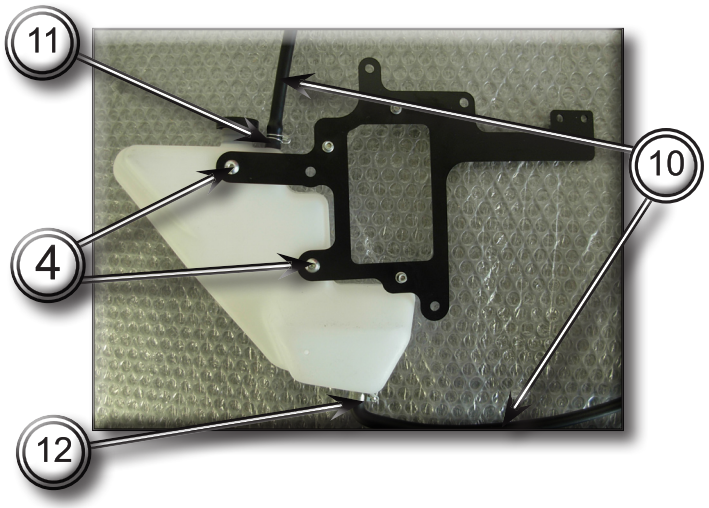
Removal of the water tank

Drain the cooling system.
Remove the air filter box.

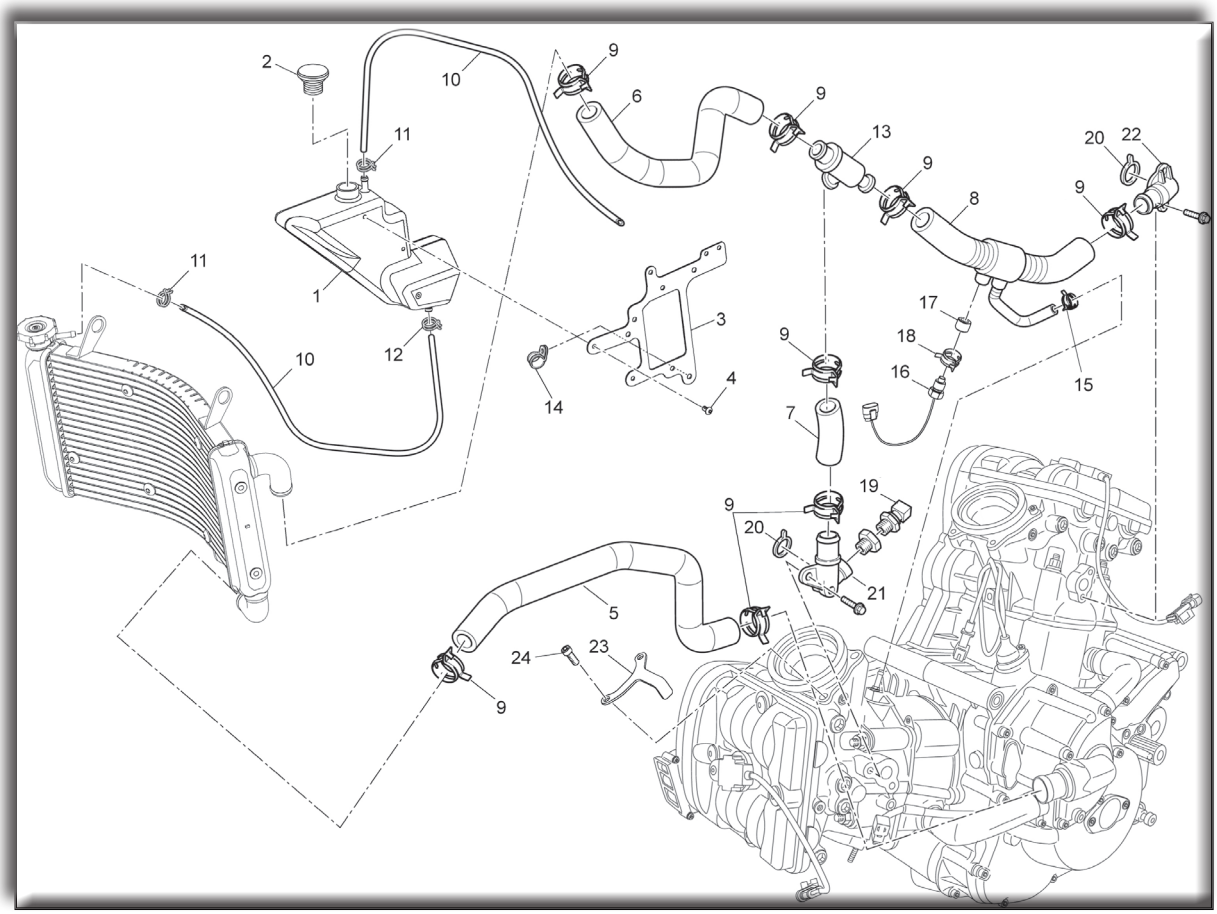
Loosen the clamp (11) and slip the hose (10) off from the water cooler cap.

Unscrew the three screws (25) then remove the expansion tank (1) together with the plate (3) and the hoses (10).
Unscrew the screws (4) to disassembly the expansion tank (1) from the plate (3).
Loosen the clamps (11) and (12) to take away the hoses (10) from the expansion tank.





11.5 - WATER COOLING: WATER COOLER

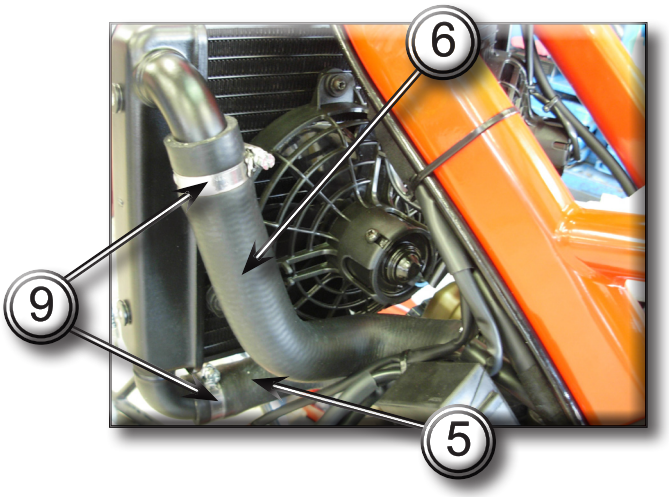


1) Water tank
2) Tank cap
3) ECU mounting plate
4) Screw M5x10 TBEI
5) Water return hose
6) Water delivery hose
7) H. cylinder hose
8) V. cylinder hose
9) Clamp
10) Hose
11) Clamp
12) Clamp
13) Thermostat
14) Hose guide clamp
15) Clamp
16) Water temperature sensor
17) Screwed bush
18) Clamp
19) Sensor
20) O-Ring
21) Water outlet union (horizontal)
22) Water outlet union (vertical)
23) Plate
24) Screw

Disassembly water cooler

Drain the cooling system
Remove the side fairings
Remove the battery support

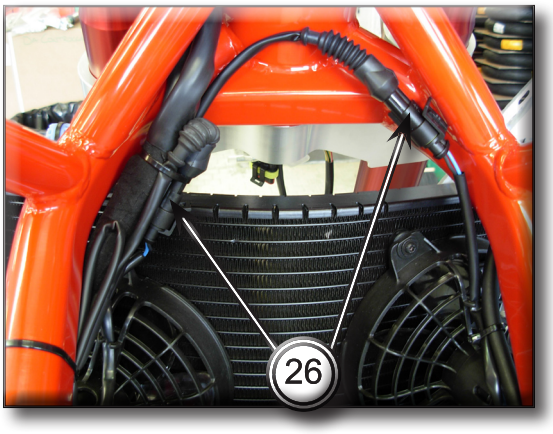
Loosen the clamps le fascette (9) on the coolant hoses (6) e (5) then slip them off from the water cooler manifolds.



Loosen the clamp (11) which joins the water tank to the water cooler then slip off the hose (10).

Unscrew the bolt (25) which fastens the water cooler on the left side of the frame.

Disconnect the connectors (26) of the main wiring from both the cooling fans.

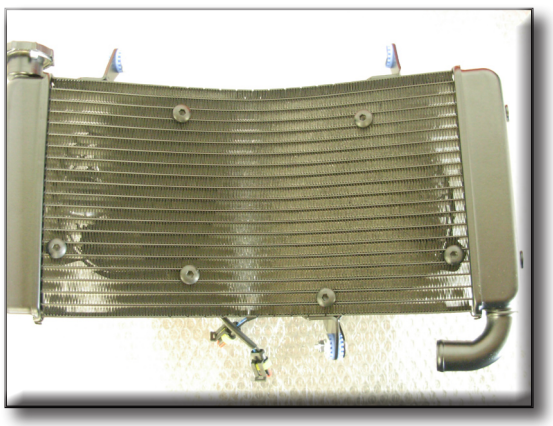


Uncrew the screw (25) on the right side of the frame then take off the water cooler.

Water cooler inspection

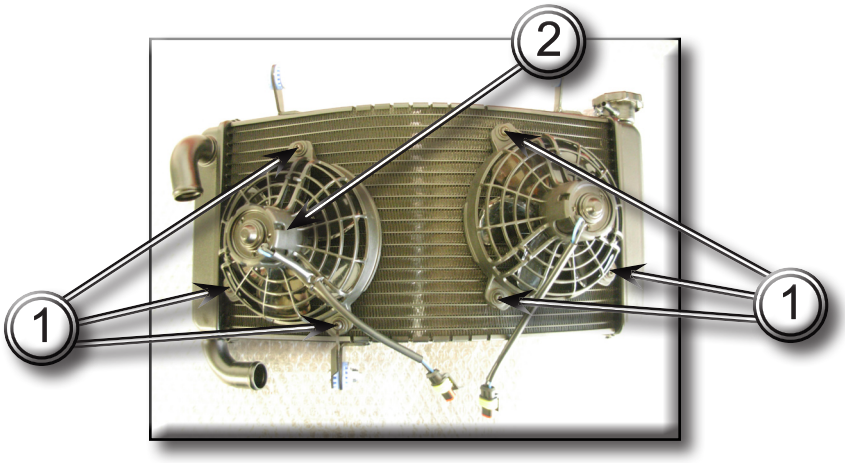
Visually inspect the radiator.
If it shows signs of damage or leaks, the water cooler must be renewed.
Check also that the air flow through the radiator core is not obstructed by leaves, insects, mud etc.
Carefully check the condition of the radiator core.

Important
An excessively high coolant temperature may be caused by partial obstruction of the radiator core.

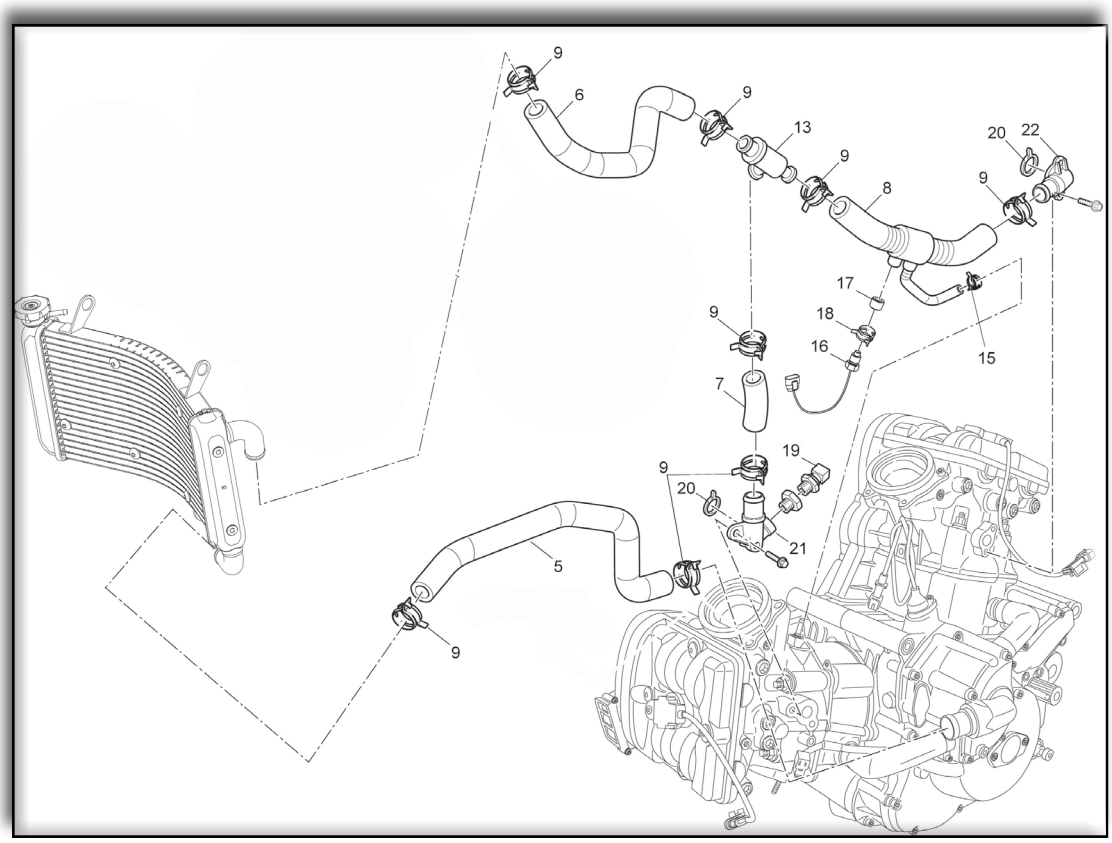


Renewal of the cooling fan

Unscrew the three fan retaining bolts (1) the remove the fan (2) from the water cooler.
Repeat the above operation for the other cooling fan.
When refitting the fan, tighten the bolts (1) to the specified torque.



Removal of the cooling system hoses and unions



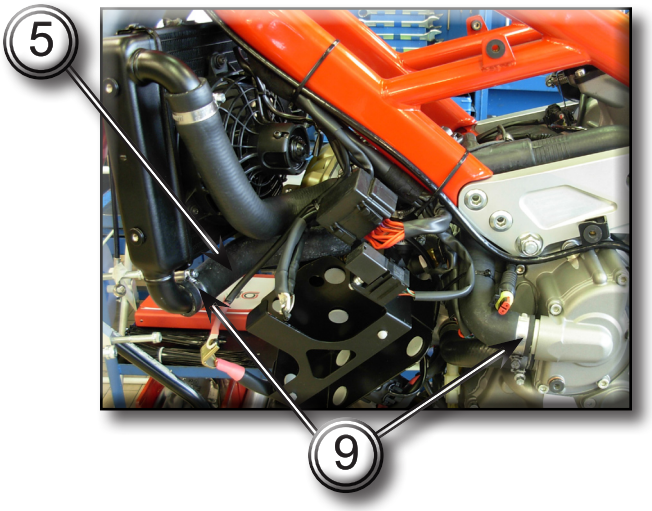
5) Water return hose
6) Water delivery hose
7) H. cylinder hose
8) V. cylinder hose
9) Clamp
13) Thermostat
15) Clamp
16) Water temperature sensor
17) Screwed bush
18) Clamp
19) Sensor
20) O-Ring
21) Water outlet union (horizontal)
22) Water outlet union (vertical)

Important

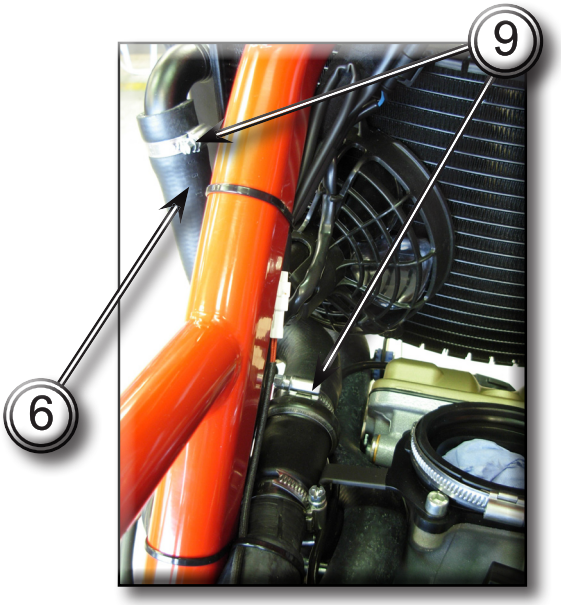
Periodically check the connection hoses for signs of leaks. Hoses that are cracked, swollen, or hardened should be renewed.

Drain the cooling system
Remove the side fairings
Remove the battery box

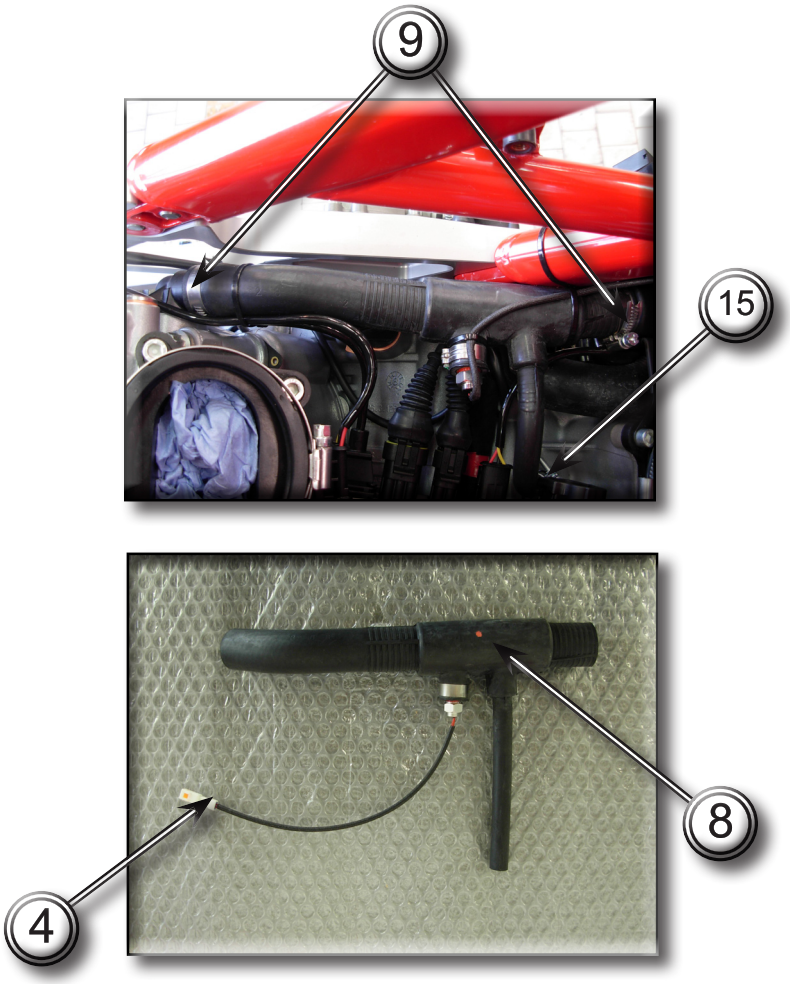
Loosen the fixing clamps (9). Slip off the two ends of the water return hose (5) from the water cooler and from the water pump manifold.



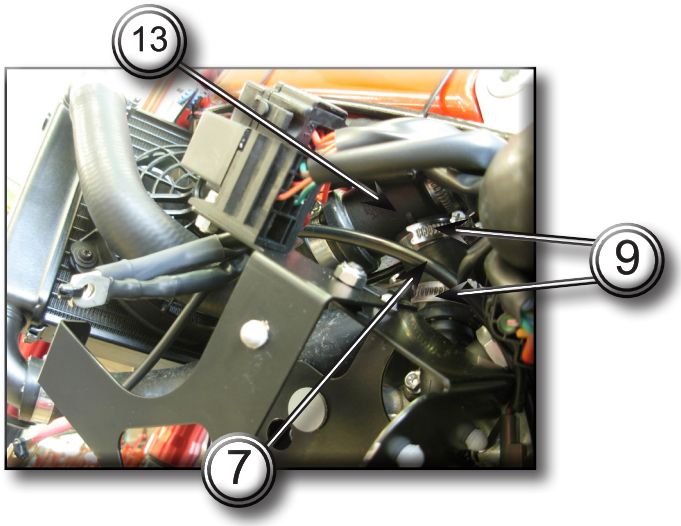
Loosen the clamps (9) then slip off the water delivery hose (6).



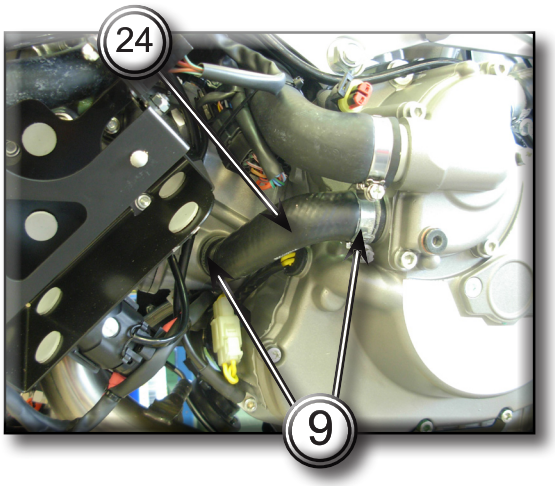
Loosen the clamps (9) and the clamp (15), disconnect the wiring connector (4) of the temperature sensor from the electric wiring then remove the vertical cylinder hose (8) .

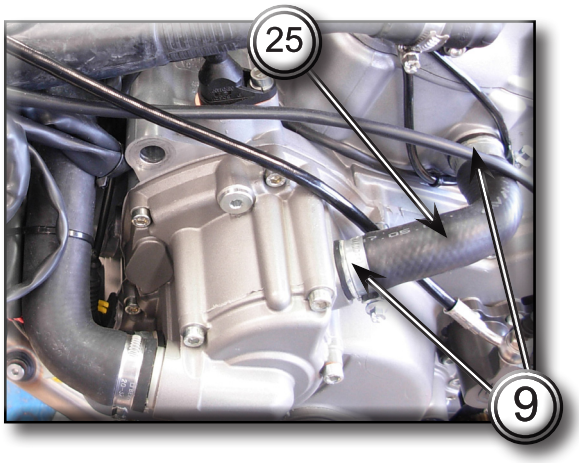


Loosen the clamps (9) to disassemble the thermostat (13) - H. cylinder hose (7) assembly from the union (21).

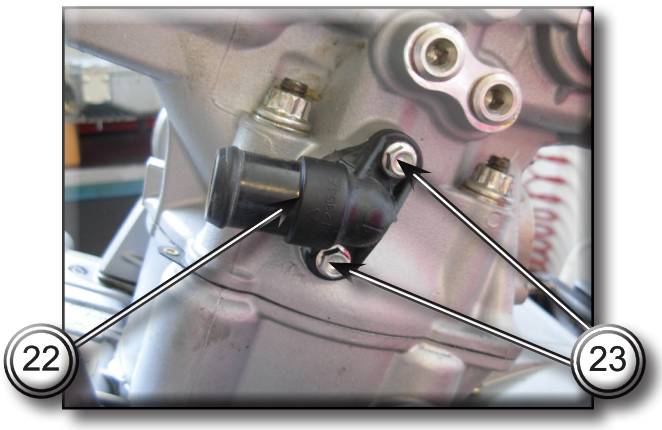


Loosen the clamps (9) and remove the hoses (24) e (25).

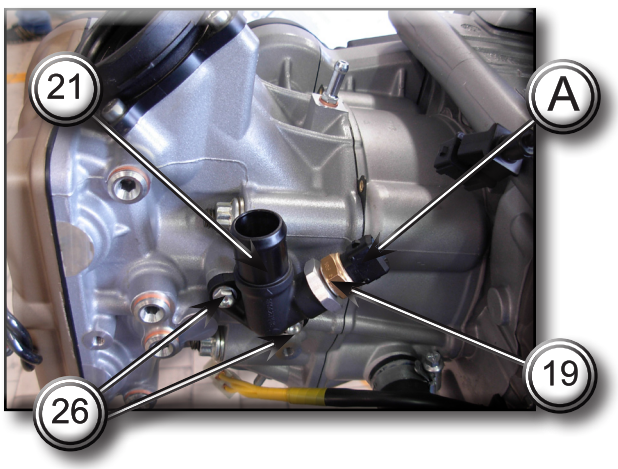




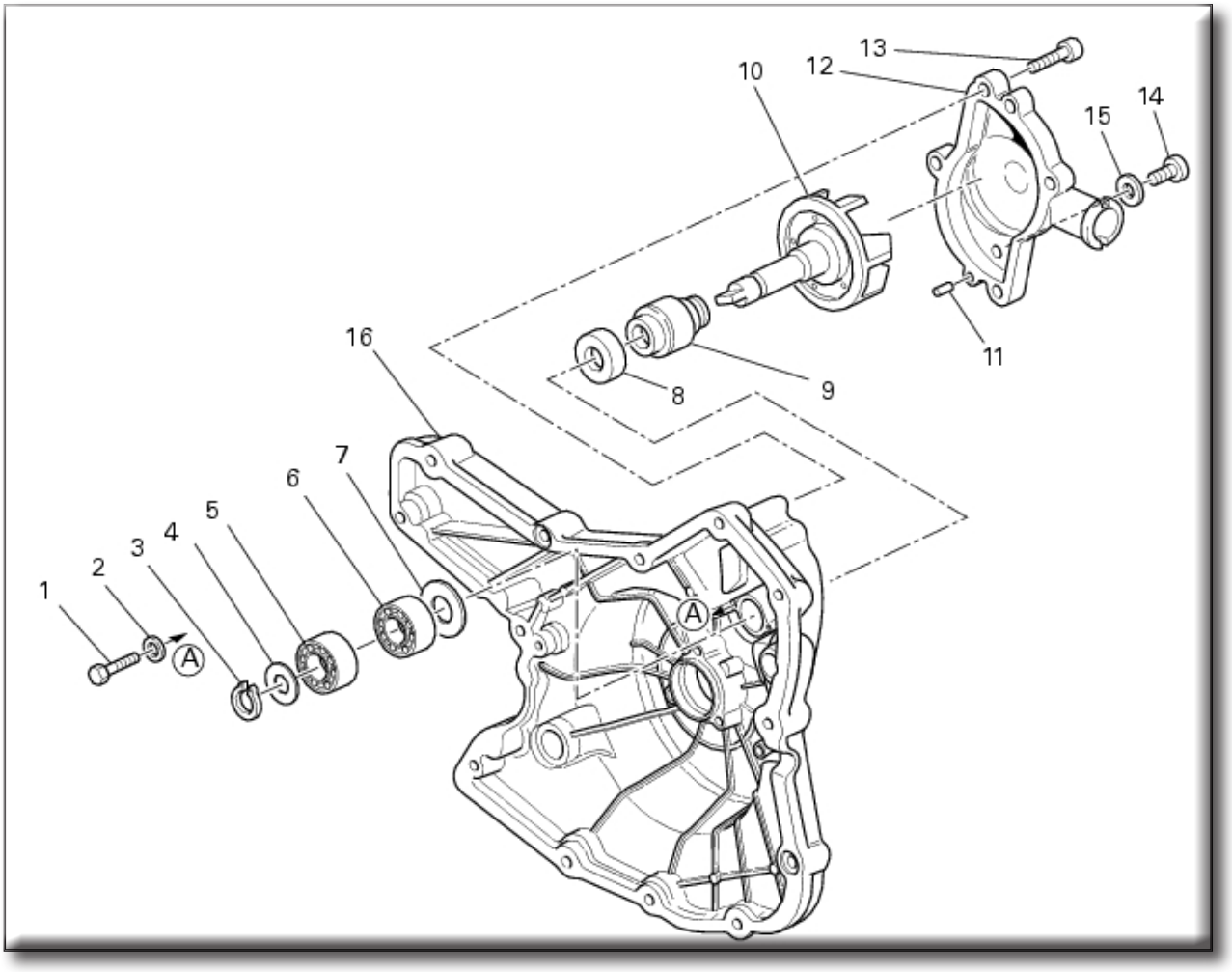
Unscrew the bolts (23) then remove the union (22).
Recover the O-ring (20) located between the union and the vertical cylinder head.



Disconnect the wiring connector (A) of the temperature sensor (19) mounted on the union (21) on the horizontal cylinder head from the main electric wiring.
Unscrew the bolts (26) then remove the union (21) located on the horizontal cylinder head.
Recover the O-ring (20) located between the union and the horizontal cylinder head.



11.6 - COOLING SYSTEM: WATER PUMP

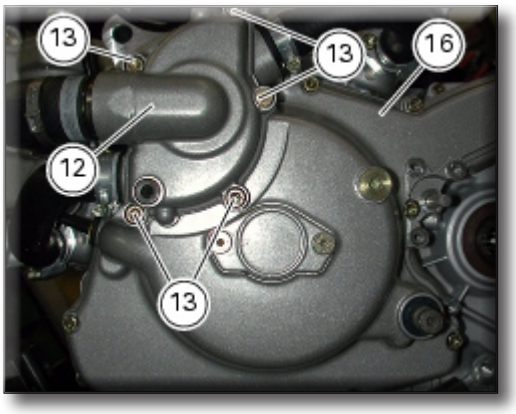


1) Bolt
2) Washer
3) Circlip
4) Washer
5) Outer bearing
6) Inner bearing
7) Spacer
8) Seal seat
9) Mechanical seal
10) Water pump impeller
11) Locating dowel
12) Water pump cover assembly
13) Bolt
14) Plug
15) Seal
16) Left-hand side crankcase cover

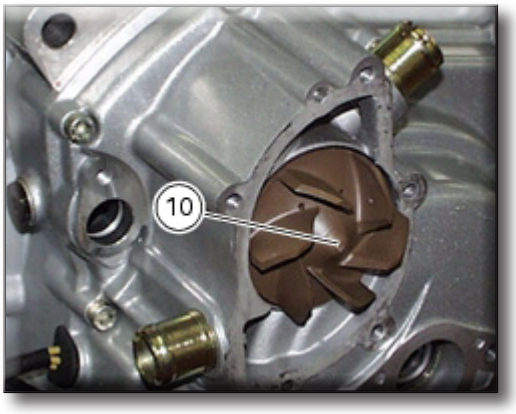
Removal of the water pump

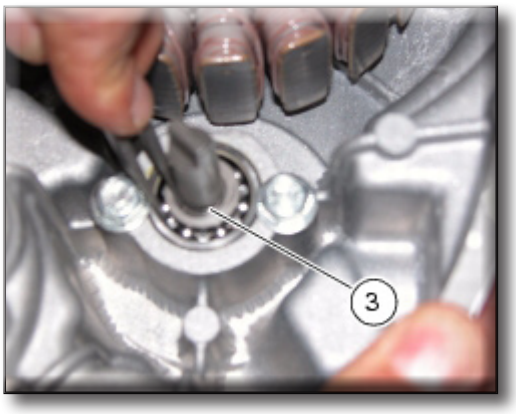
Remove the side fairings
Drain the cooling system
Remove the cooling circuit hoses from the water pump cover
Remove the left-hand side crankcase cover

Undo and remove the five screws (13) securing the water pump cover (12) to the left-hand side crankcase cover (16). Remove the water pump cover (12).

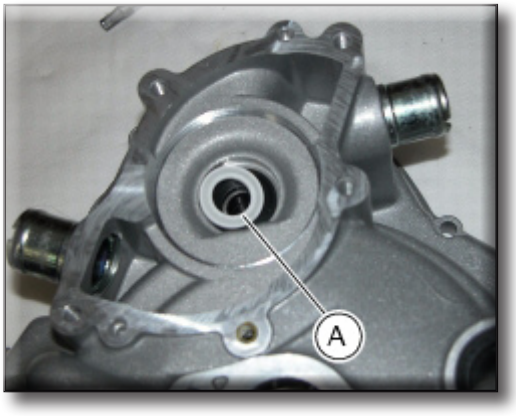


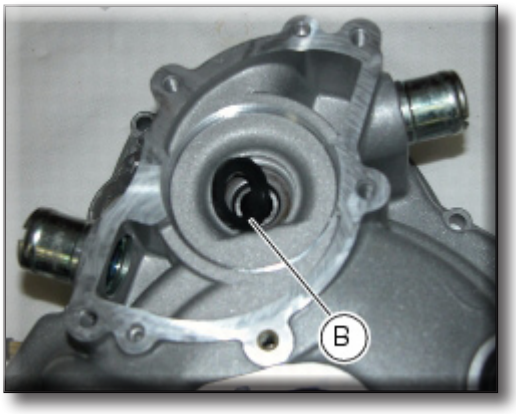
Clean the pump housing of any scale. Rotate the rotor shaft (10) to check the bearings for wear.
If there is excessive play, change the bearings as follows.
Remove the circlip (3) and washer (4) from the impeller shaft.
Withdraw the impeller (10) with the mechanical seal (9) from the outside.



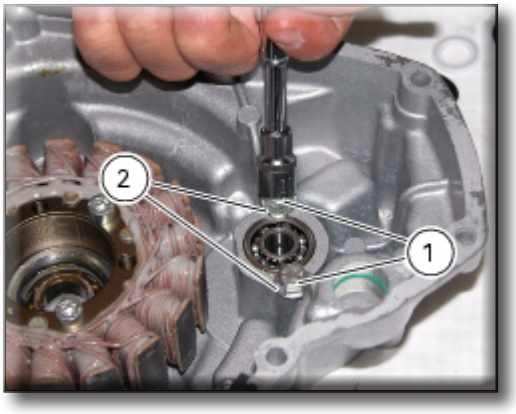


Recover the ceramic washer (A) and seal ring (B) located on the inner side.

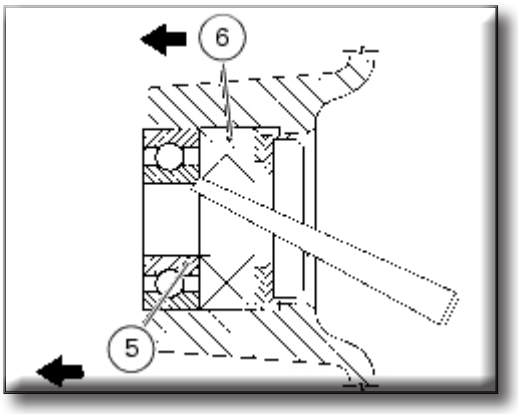




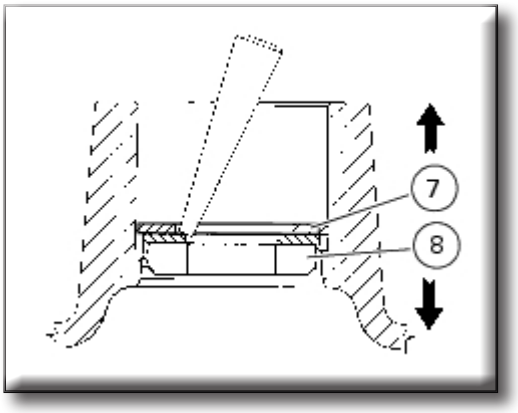
Undo and remove the bolts (1) with washer (2).



Working from the rotor side use a suitable drift to press on the inner race of end bearing (5) until it can be extracted from the cover. Use the same technique to remove the other bearing (6).

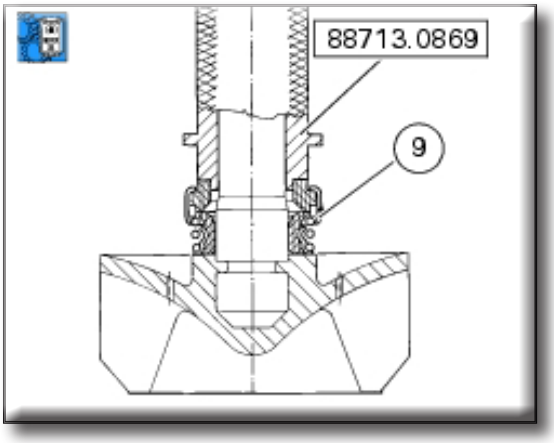


Working from the inside of the cover, remove the seat (8) of the mechanical seal (9).
Remove the inner spacer (7).
Check the condition of the components of the mechanical seal: there should be no signs of deformation, cracking, or excessive wear.
In the case of damage, both components must be renewed.

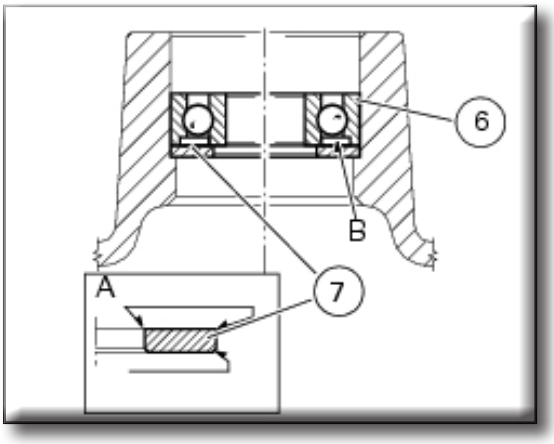


Refitting the water pump

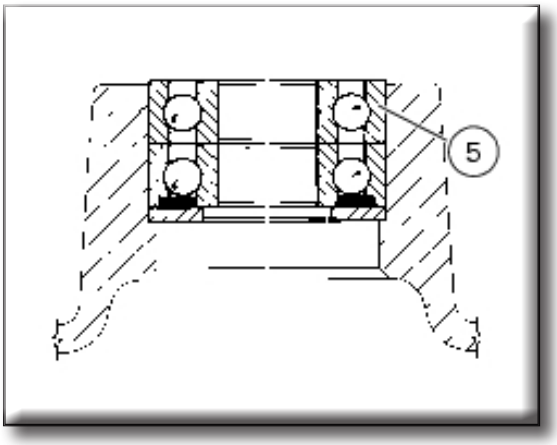
Clean the seat in the cover, any parts you intend to reuse, and the rotor shaft. Lubricate with engine oil and refit as follows. Using drift part no. 88713.0869 fit the new seal (9) on the impeller shaft.



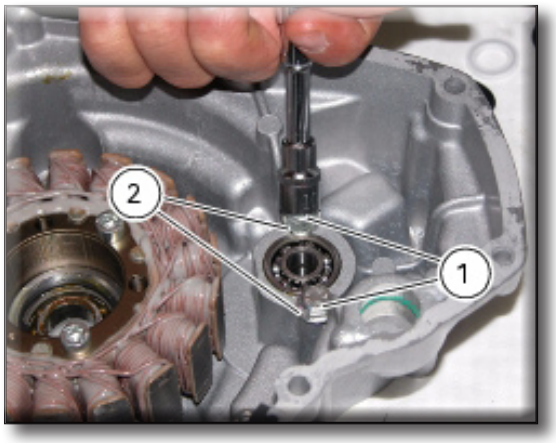
Working from the inside of the cover, fit the inner spacer (7) with its square edge (A) facing outwards.
Using a suitable drift that bears on the outer race, drive home the bearing (6) against the spacer (7) with the shield side facing the cover.



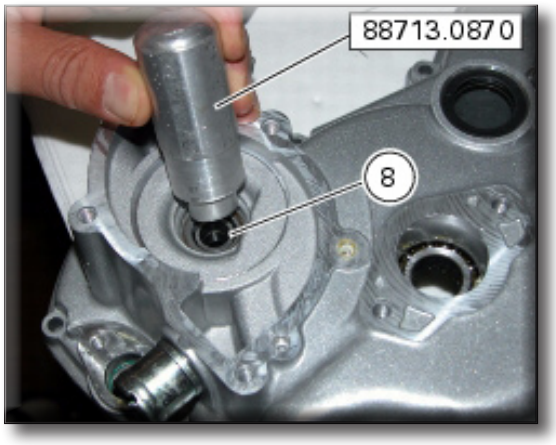
Fit the other bearing (5) and drive it fully home against the previously fitted bearing.

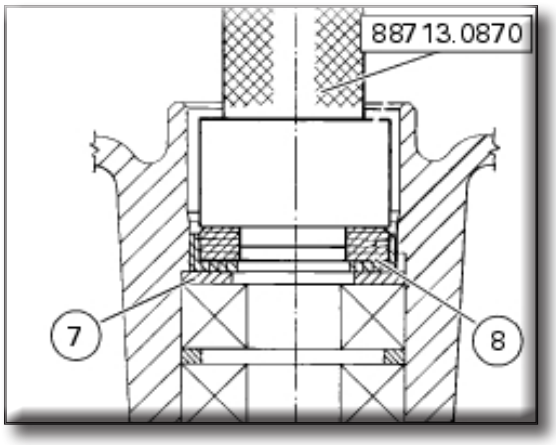


Fit the two bolts (1) with washers (2) and tighten them to the specified torque.

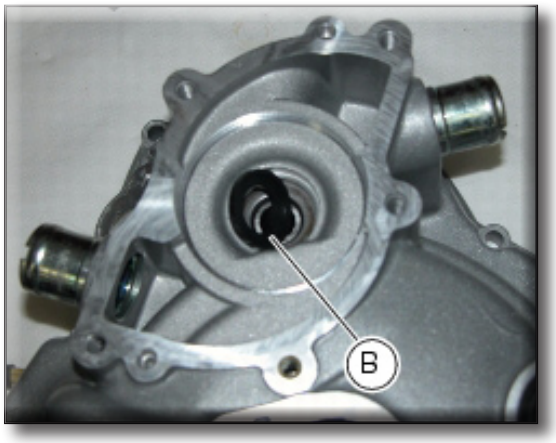


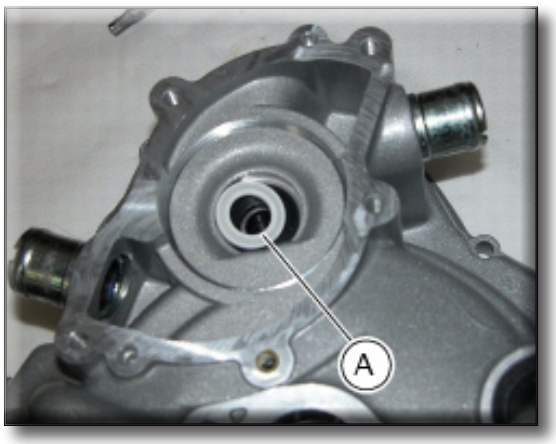
Now turn over the cover and fit the locating ring (8) using drift part no. 88713.0870.
Position the ring as shown in figure and push it until it seats against the spacer (7).



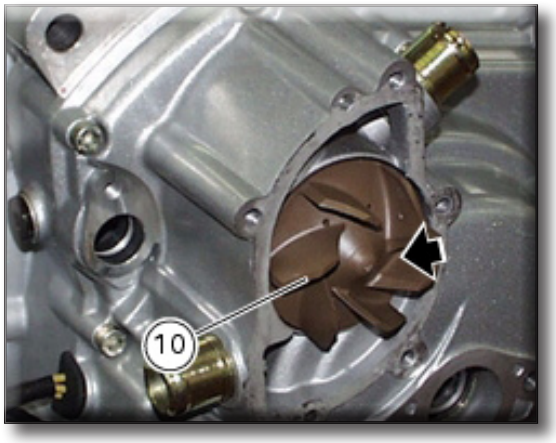


Fit the seal ring (B) and the ceramic washer (A).

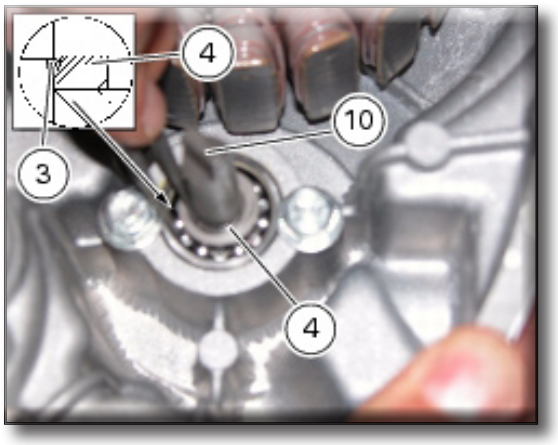


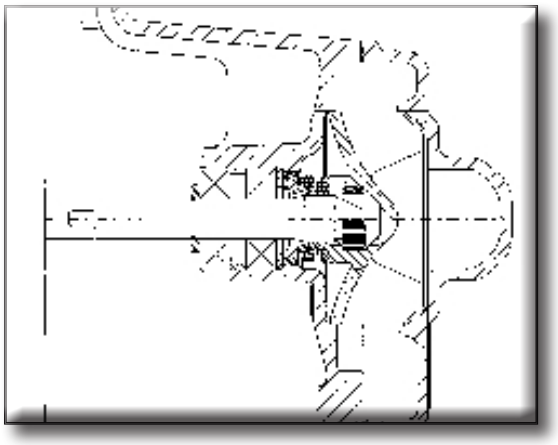


Insert the impeller shaft (10) with the mechanical seal (9). Turn the cover over.

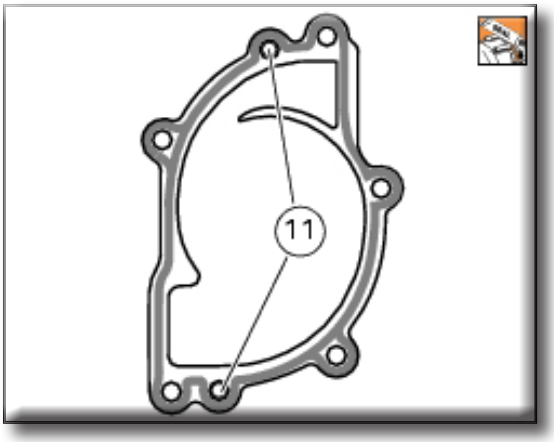


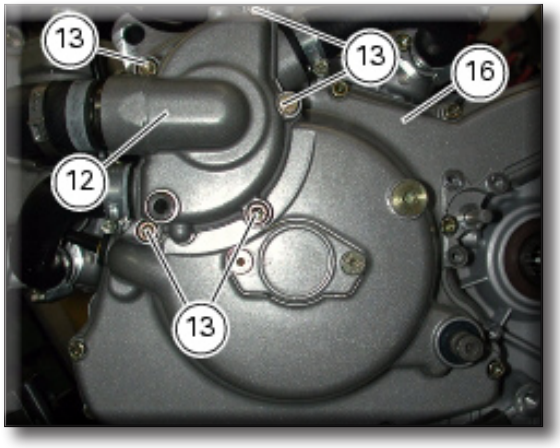
Insert rotor shaft (10) with seal and turn over the cover again.
Fit spacer (4), positioned as shown in the cross-sectional view, and lock the assembly in place with circlip (3).
Rotate the impeller (5) and make sure it turns smoothly without sticking.
Clean the mating surfaces thoroughly on the pump cover and on the left-hand side crankcase cover.





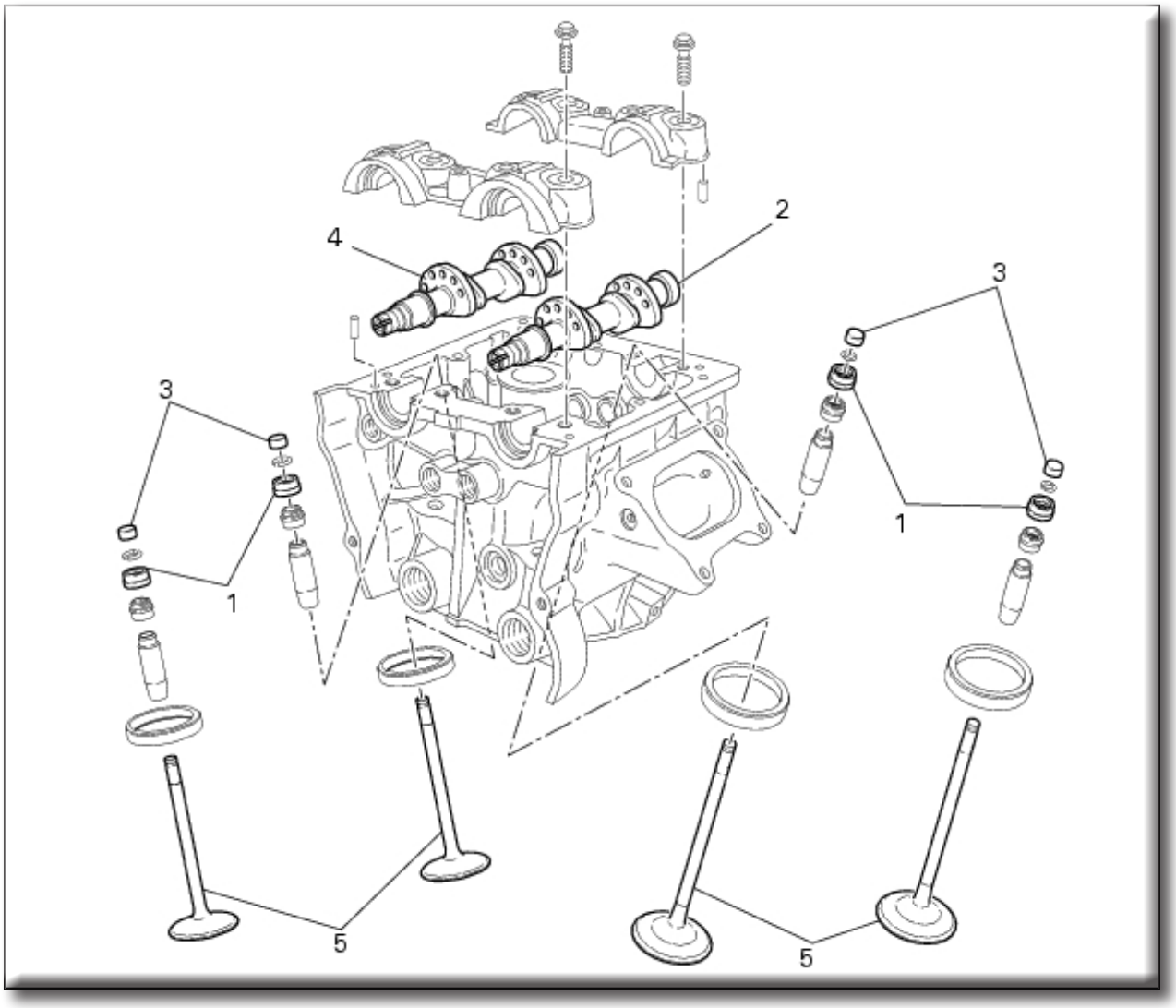
Apply a bead of liquid gasket to the water pump cover (12) as shown in the figure.
Fit the locating dowels (11) and position the pump cover (12) on the left-hand side crankcase cover.
Fit the screws (13) in their threads.
Tighten the screws (13) to the specified torque.
Refit the components removed in the procedure.





Refit the left-hand side crankcase cover and connect the cooling system hoses to the crankcase cover
Refit the cooling system hoses to the water pump cover
Fill the cooling system
Fit the side fairings

11.7 - CYLINDER HEAD ASSEMBLIES: CHECKS AND ADJUSTMENTS



1) Closing shim
2) Intake side camshaft
3) Opening shim
4) Exhaust side camshaft
5) Valve

Checking and adjusting the valve clearances

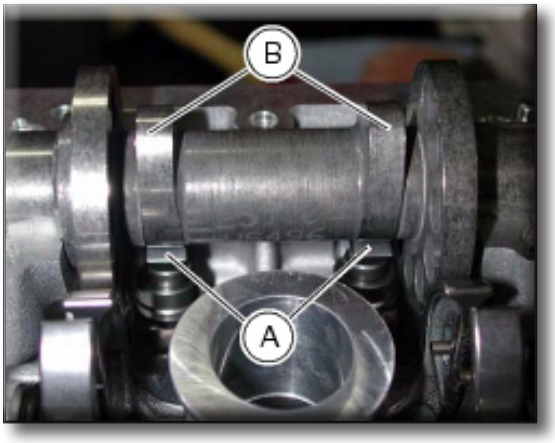
Remove the side fairings
Remove the radiator
Remove the airbox
Remove the timing belts
Remove the rocker cover

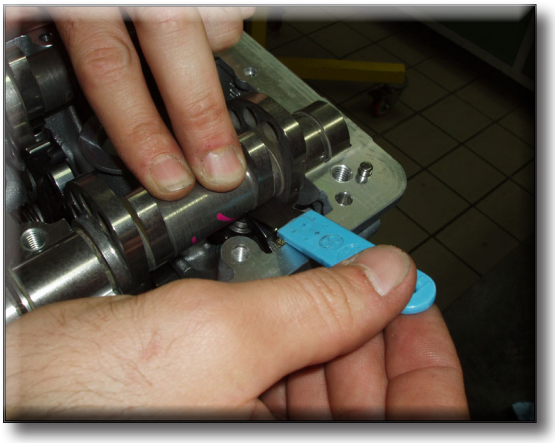
Notes
For clarity, the figures show the engine removed from the frame.

Checking the opening clearance

Move the piston of the cylinder being checked to TDC of the power stroke: in this condition all the valves are closed and the camshafts are in their rest position and thus free to rotate.
Using a feeler gauge, check the clearance between the opening rocker arm (A) and the lower edge of the camshaft cam (B).
The clearance must be within the specified limits “Timing system/valves”.
If they are not, remove the opening shim (3), as described in the paragraph “Removal of the valves”, and replace it with a shim of appropriate thickness to obtain the specified clearance.

Notes
Opening rocker arm shims measuring 2 to 3.45 are available as replacement parts: each shim is marked with its size.



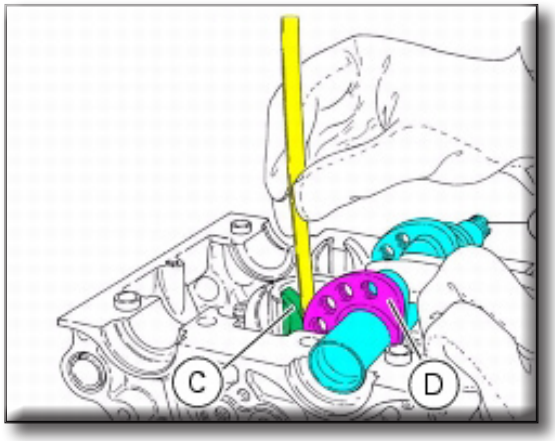


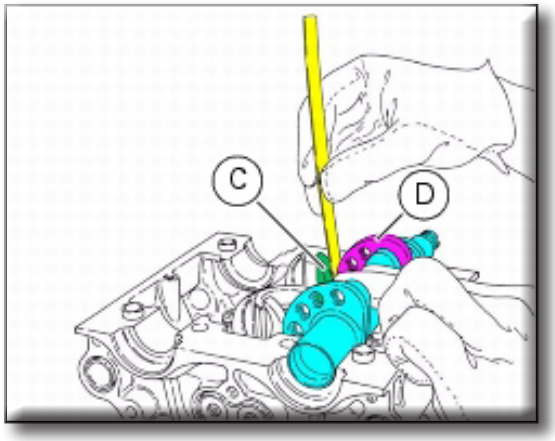
Checking the closing clearance

Using a feeler gauge, check the clearance between the closing rocker arm shoe (C) and the upper edge of the camshaft cam (D), taking care not to compress the rocker arm return spring.
The clearance must be within the specified limits “Timing system/valves”.
If it is not, remove the closing shim, as described in the paragraph “Removal of the valves”, and replace it with a shim of suitable height to obtain the specified clearance.

Notes
Closing rocker arm shims measuring from 2.2 to 4.5 are available as replacement parts: each shim is marked with its size.

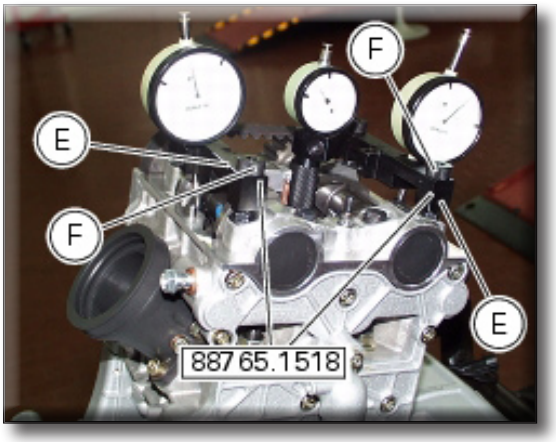
Check and adjust the clearances of all valves.
Refit the opening and closing shims as described in the paragraph “Reassembly of the cylinder head”



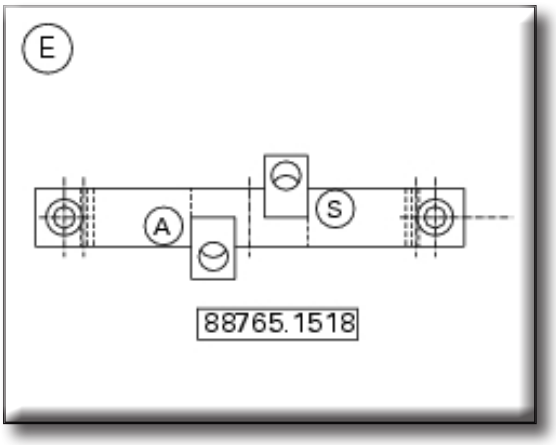


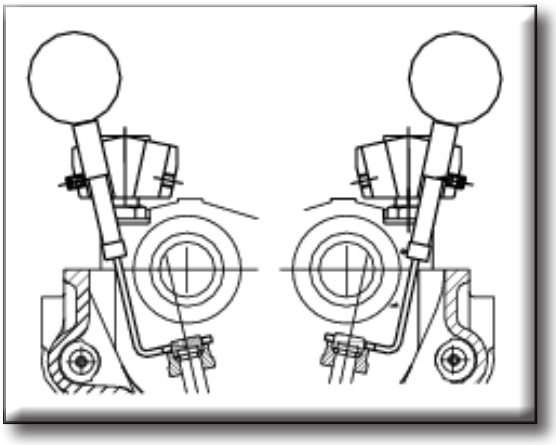
Checking valve lift

Put the engine in the condition described in “Checking and adjusting the valve clearances” above.
Install the dial gauge stand (E) 88765.1518 on the intake side camshaft bearing studs, and secure it with the knobs (F).



Set the opening valve clearance to zero when the camshaft is in its rest position by fitting a feeler gauge between the upper rocker arm and the opening shim.
Lock the dial gauge into the seat of the stand marked “A” and position the fork probe against the face of the closing shim.
Set the dial gauge to zero when the valve is fully closed.
Rotate the intake camshaft so as to allow the intake valves to lift fully.
Check that the reading on the dial gauge corresponds to the specified value “Timing system/valves”.
Repeat the same procedure with the exhaust valves, moving the stand to the opposite studs and fitting the dial gauge into the seat marked “S” on the stand (E).





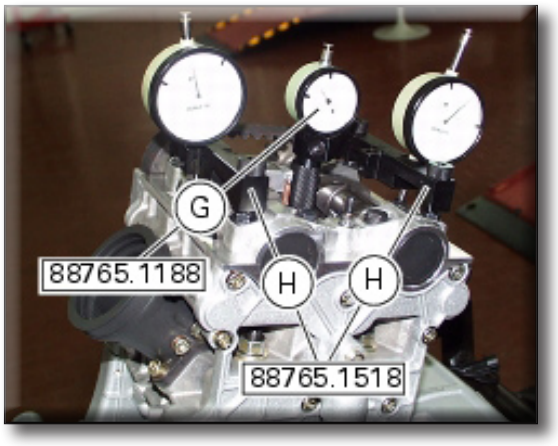
Refit following the procedure indicated in the previous paragraph “Checking and adjusting the valve clearances”.
Refit the components removed.

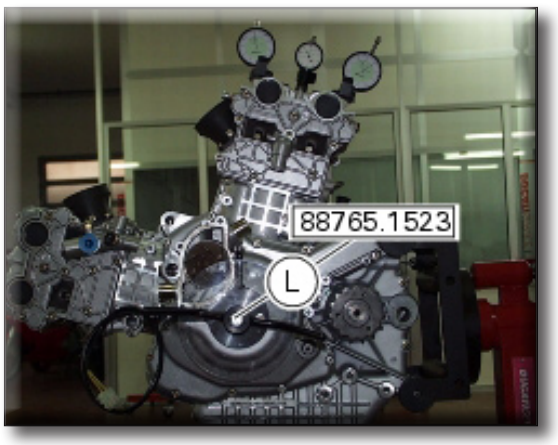
Refit the timing belts
Refit the rocker cover
Refit the airbox
Refit the radiator
Refit the side fairings

Checking the engine timing

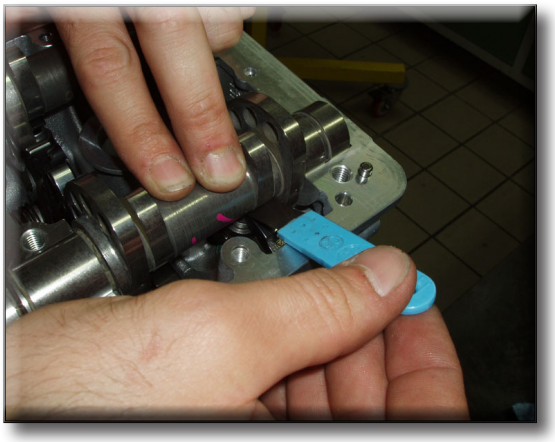
Remove the side fairings
Remove the radiator
Remove the airbox
Remove the timing belts
Remove the rocker cover
Remove the water pump cover

Put the engine the condition described previously for the operation “Checking and adjusting the valve clearances”.
Install service tool (G) no. 88765.1188 in the spark plug bore to determine piston’s TDC, along with gauges (H) 88765.1518 and the timing check tool (L) (timing degree wheel 88765.1523 with graduated disk).

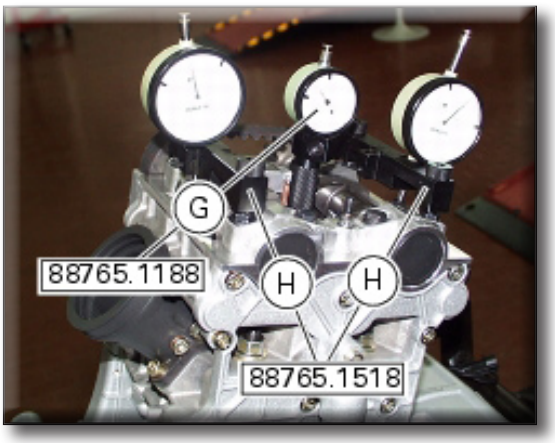


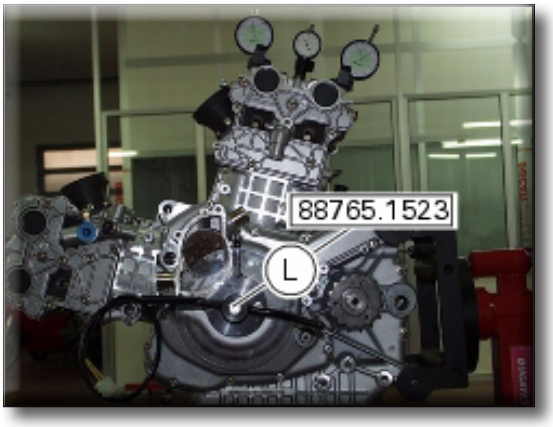


Set the opening valve clearance to zero when the camshaft is in its rest position by fitting a feeler gauge between the upper rocker arm and the opening shim.
Check that, in this condition, the camshaft can rotate.
If it moves stiffly, use a thinner feeler gauge.

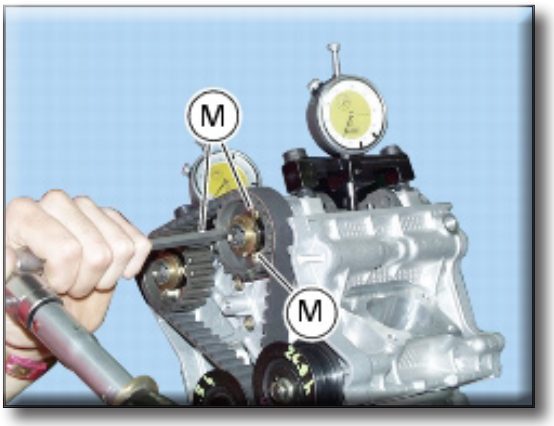


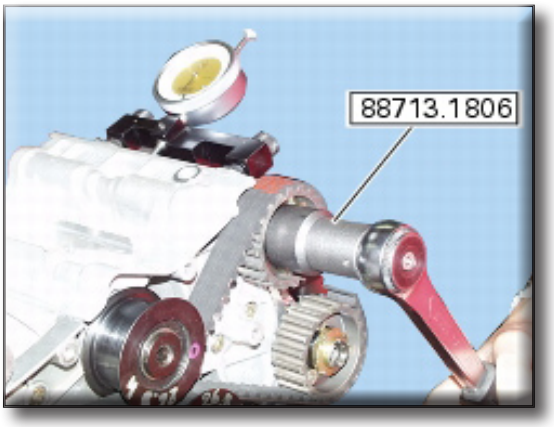
In this condition, with the piston of the horizontal cylinder at TDC with the valves fully closed as confirmed by the reading on gauge (G), set the gauges (H) to zero.
Refit the belts and tension them as described in Sect. “Refitting the timing belts”.
Turn the degree wheel (L) counterclockwise until the dial gauge (H) on the exhaust side reads a lift of 1 mm.
Check that the angular displacement reading in degrees on the degree wheel (L) is as specified.
Continue to rotate in the same direction until you obtain a 1 mm lift on the intake side.
Check the angular value on the degree wheel.
Continue turning the shaft until you reach total closure of the valve on the expansion stroke.
Now reverse the rotation (i.e. clockwise) of the degree wheel (L) until gauge (H) shows a 1 mm lift of the intake valve. Check that the angular value is as specified.
Rotate clockwise again until obtaining 1 mm lift of the exhaust valve.
Check the angular value against the specified value.
Repeat the procedure for the vertical cylinder.
Permissible tolerance for measured values is ±3° with respect to specified values.





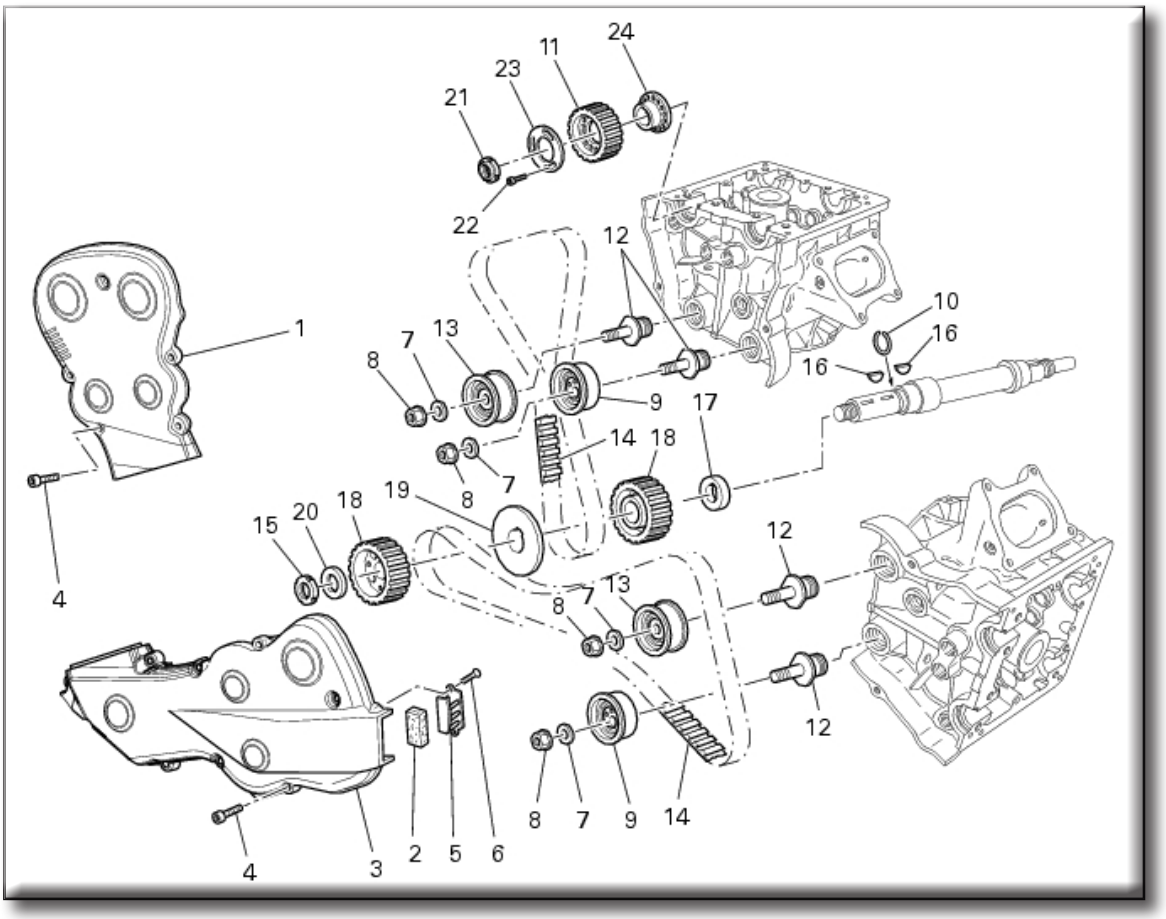
Remove all tools installed for the timing check and tension the belts to their prescribed operating tension, as described in “Measuring timing belt tension”.
If the values obtained are outside the specified ranges, loosen the timing pulley screws (H) and correct the value by turning the camshaft nut with the wrench supplied with service tool no. 88713.1806.
Then tighten the three timing pulley screws (H) to the specified torque and mark the new timing positions on the relative components.





Refit the water pump cover
Refit the timing belts
Refit the rocker cover
Refit the airbox
Refit the radiator
Refit the side fairings

11.8 - CYLINDER HEAD ASSEMBLIES: TIMING



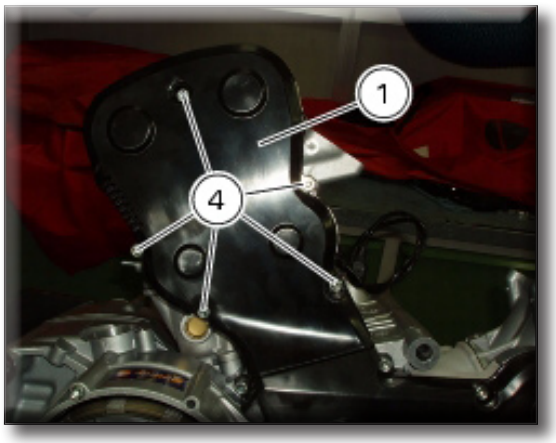
1) Vertical cylinder timing belt cover
2) Air filter
3) Horizontal cylinder timing belt cover
4) Bolt
5) Filter cover
6) Bolt
7) Washer
8) Nut
9) Tensioner pulley assembly
10) Circlip
11) Camshaft pulley
12) Tensioner pulley mounting stud
13) Idler pulley assembly
14) Timing belt
15) Nut
16) Key
17) Spacer
18) Camshaft pulley
19) Driveshaft pulley spacer
20) Spacer
21) Nut
22) Bolt
23) Washer
24) Spacer flange

Removal of the timing belt covers

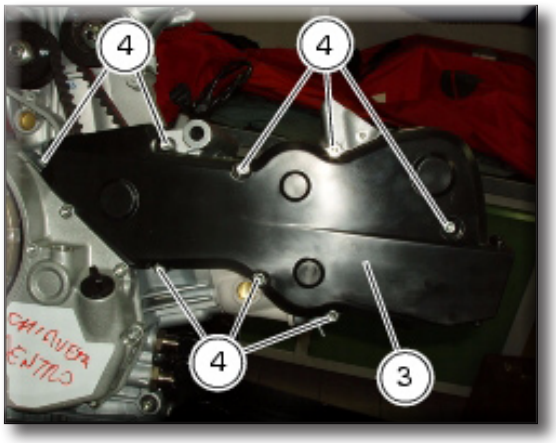
Remove the side fairings
Disconnect the electrical system components on right-hand side of the engine

Notes
Remove also any parts which may impede the procedure in any way.

Undo the bolts (4) securing the timing belt cover (1) and remove it from the vertical cylinder assembly.



Undo the bolts (4) securing the timing belt cover (3) and remove it from the horizontal cylinder unit.



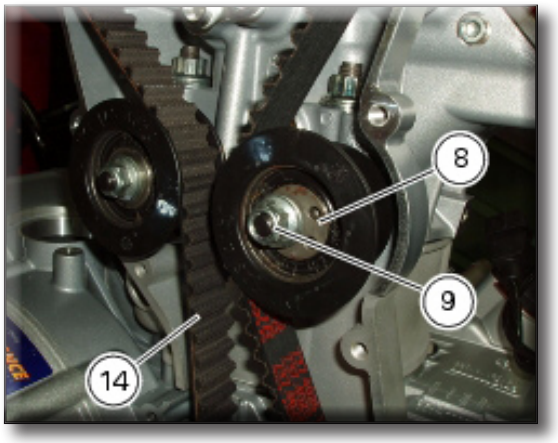
Removal of the tensioner pulley / timing belt

Loosen the nut (8) and remove the tensioner pulley (9) from its mounting stud (12) on the cylinder head. Remove the timing belt (14) from the horizontal cylinder assembly.

Important

If the belts are to be re-used, mark the direction of rotation with an arrow and also mark the cylinder they belong to.

Repeat the procedure for the other cylinder.

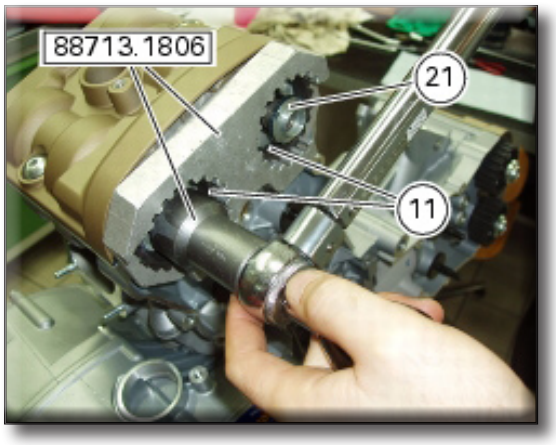


Removal of the camshaft pulleys/idler pulley

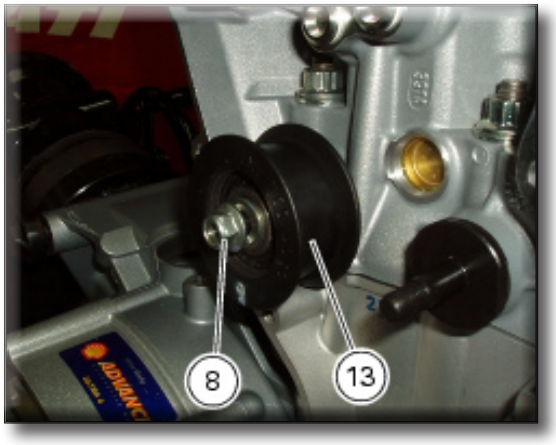
Insert tool part no. 88713.1806 on the pulleys to stop them rotating and use the bush supplied with it to slacken off nuts (21) securing the pulleys.

Important
On reassembly, always use new nuts.

Remove the nuts (21) and the pulleys (11) from the camshafts.

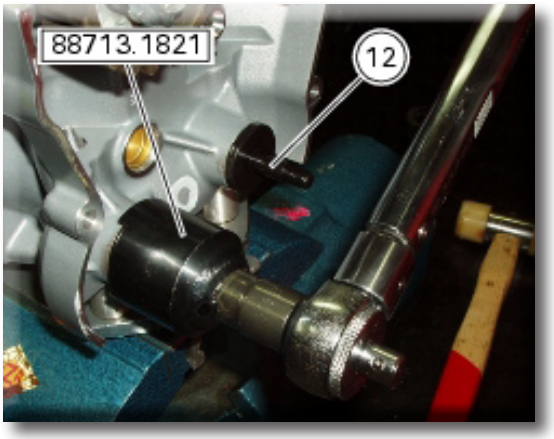


Loosen the nut (8) and remove the idler pulley (13).
Repeat the same procedure to remove the other pulley.



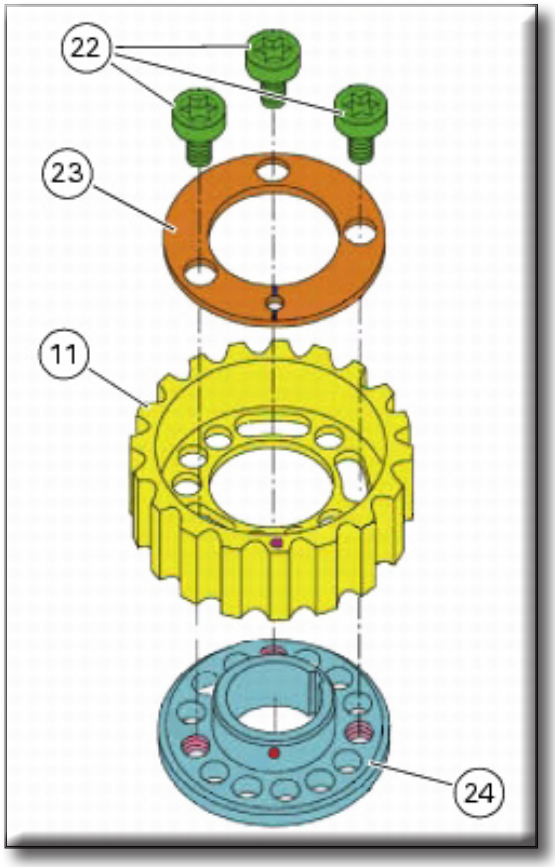
Removal of the tensioner and idler pulley mounting studs

Using service tool no. 88713.1821, remove the tensioner pulley mounting studs (12) from the cylinder heads.



Disassembly of the camshaft pulleys

Undo and remove the bolts (22).
Slide off the washer (23).
Withdraw the camshaft pulley (11) from the spacer flange (24).

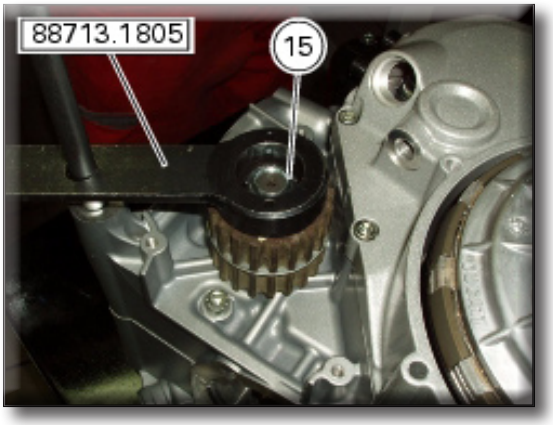


Removal of the timing belt driveshaft pulleys

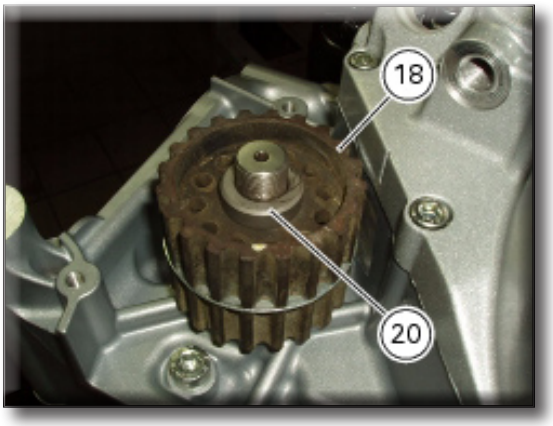
Use the service tool no. 88713.1805 to hold the driving pulley against rotation.

Important
If this operation is carried out with the engine installed in the frame, hold the driveshaft pulleys against rotation by using service tool no 88713.2011 mounted on the alternator cover.

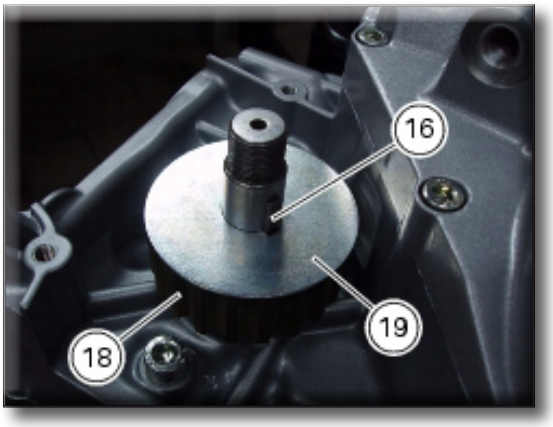
Loosen the nut (15) using the socket supplied with the service tool.



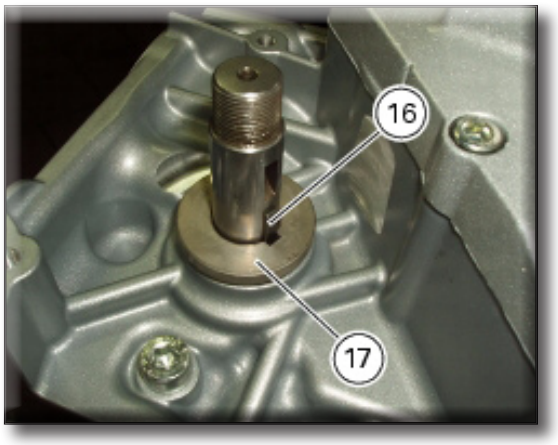
Remove the nut (15), the spacer (20) and the outer pulley (18).



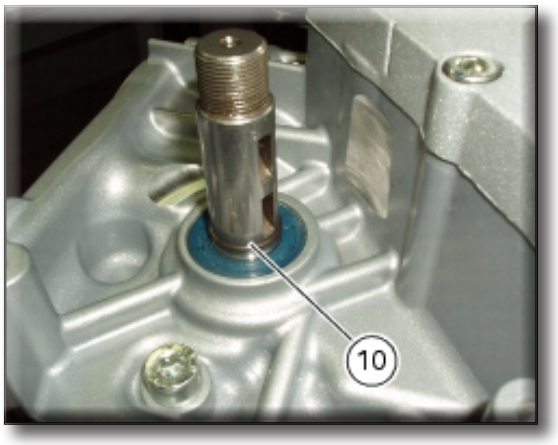
Remove the first Woodruff key (16) from the timing belt driveshaft.
Remove the intermediate spacer (19) and the inner pulley (18).



Remove the inner spacer (17) and second Woodruff key (16) on the timing belt driveshaft.

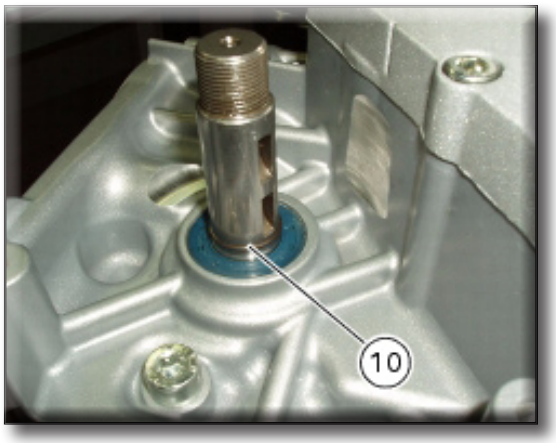


It is now possible to remove the circlip (10) on the driveshaft.

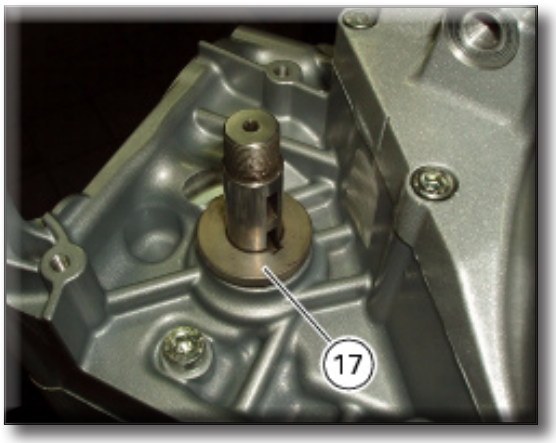


Refitting the timing belt driveshaft rollers

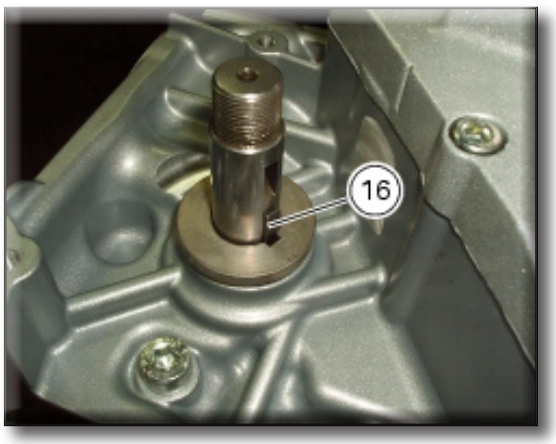
To fit the circlip (10) to the driveshaft, use the protective cap 88713.2834.



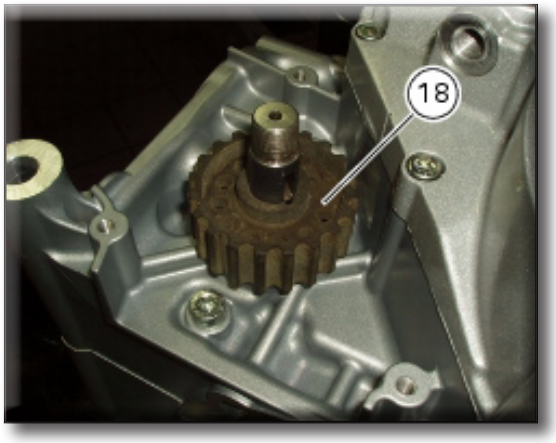
Install the inner spacer (17) on the driveshaft, taking care to align the notch in the spacer with the slot for the Woodruff key.



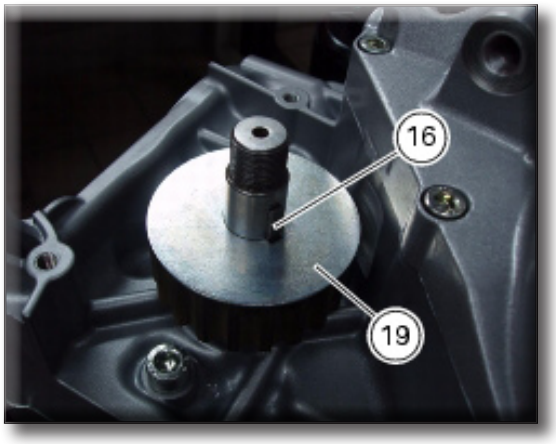
Fit the first Woodruff key (16) on the timing belt driveshaft.



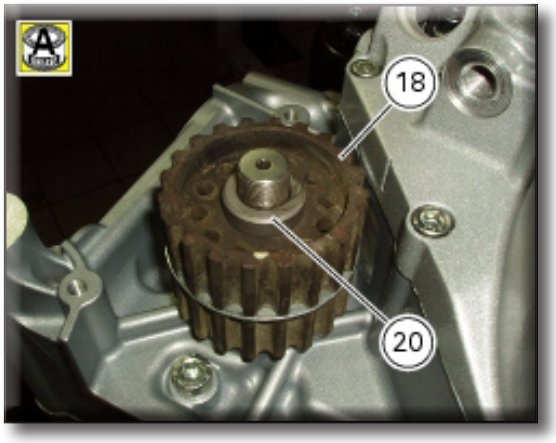
Locate the inner pulley (18).



Refit the second Woodruff key (16) and the washer (19).



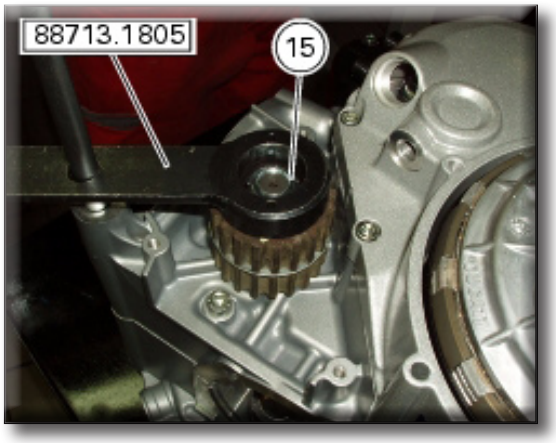
Locate the outer pulley (18) and the spacer (20).
Apply the recommended grease to the threads on the end of the driveshaft.



Fit the nut (15).

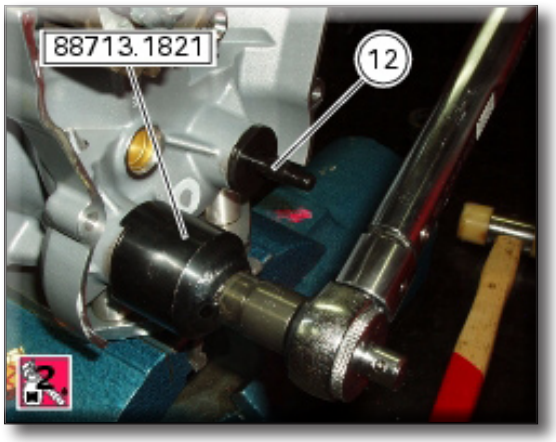
Important
To prevent the nuts working loose and consequent serious engine damage, always use new self-locking nuts on all timing belt pulleys on reassembly.

Lock rotation of the pulleys with service tool no. 88713.1805 and, using the insert supplied with the wrench in conjunction with a torque wrench, tighten the self-locking nut to the specified torque.



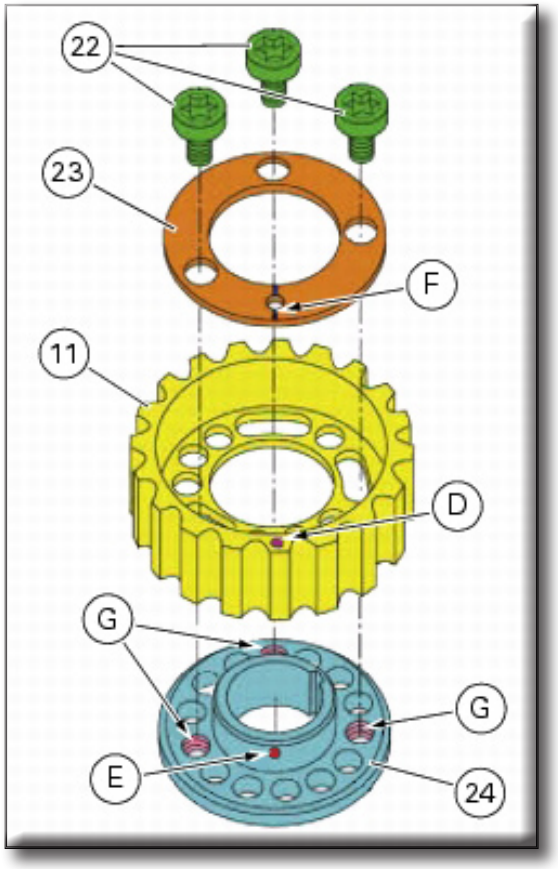
Refitting the idler and tensioner pulley mounting studs

Apply the recommended threadlocker to the threads of the studs
To fit the studs correctly on the cylinder heads, note the references of the parts given in the photographs.
Insert the idler and tensioner pulley mounting studs (12) in the cylinder heads and tighten them using service tool no. 88713.1821.
Tighten the pulley shafts to the specified torque.



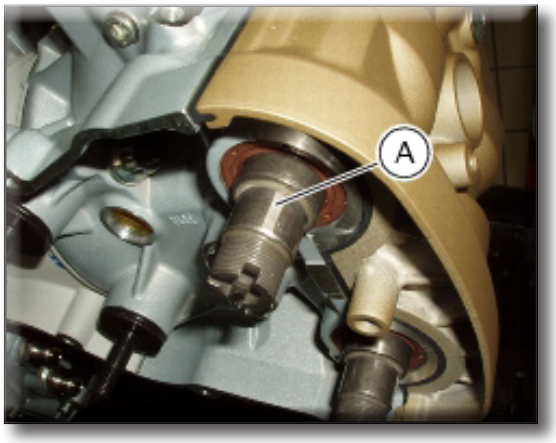
Reassembly of the timing pulleys

Fit the pulley (11) on the hub (24), aligning the timing mark (D) on the pulley with the timing mark on the (E) on the hub.
Fit the washer (23) up against the pulley, aligning the timing notch (F) with the timing marks on the pulley and the hub.
Insert the three bolts (22) in the threaded holes (G) of the hub.
Tighten the bolts (22) to the specified torque.

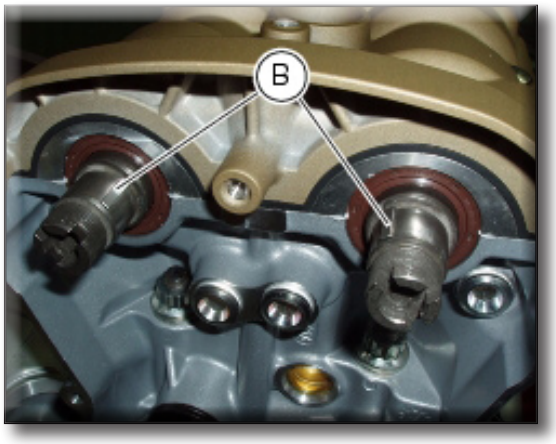


Rimontaggio puleggie testa / tenditori fissi

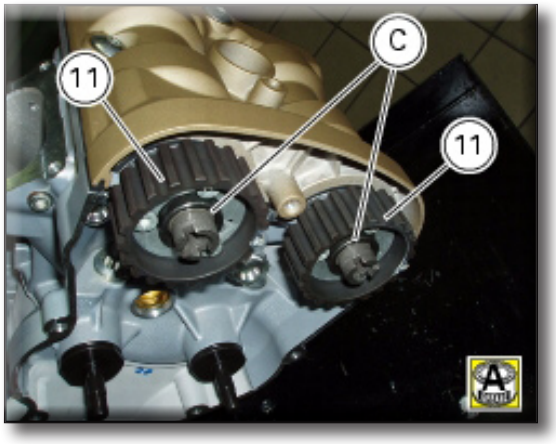
Check that the keyway on the end of the camshaft is in good condition and without burrs.



Fit a Woodruff key (B) in the keyway of each camshaft.

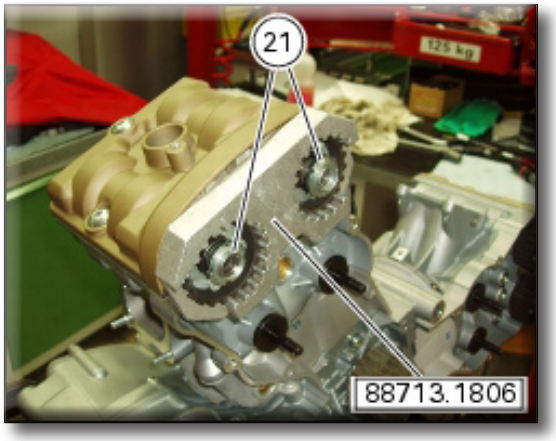


Fit the pulley (11) on the camshaft, inserting the Woodruff key in the in the slot (C) in the pulley.
Apply the recommended grease to the threads on the end of the camshaft.
Repeat the procedure on the other camshaft.

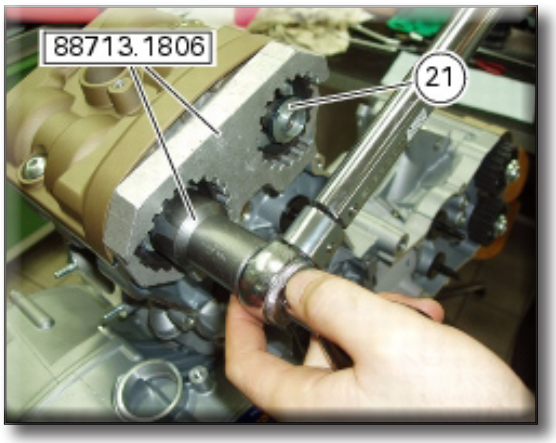


Fit the service tool 88713.1806 on to the pulleys to prevent rotation.
Apply the recommended grease to the mating face of the nut (21).
Fit the nut (21).
Carry out the same operations on the other camshaft.

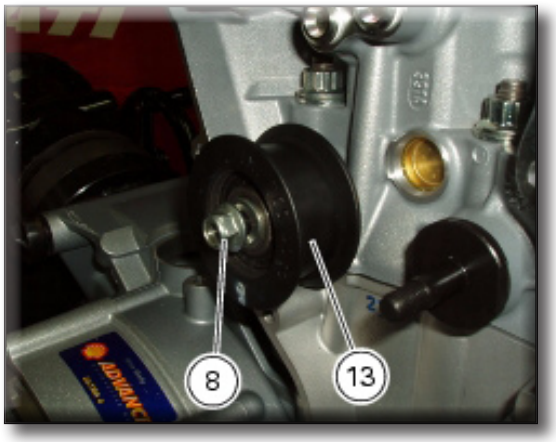
Important
Always fit new nuts on reassembly.



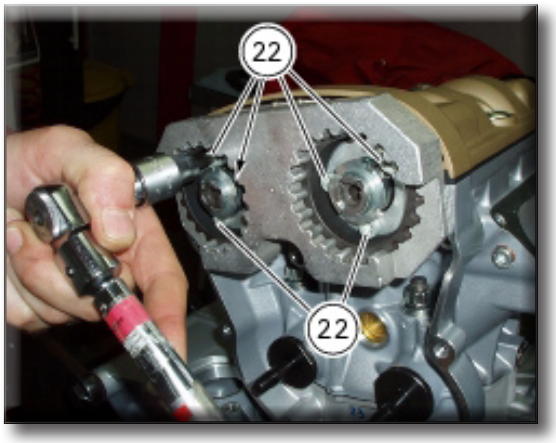
Using the bush supplied with service tool 88713.1806 and a torque wrench, tighten the nuts (21) to their specified torque.



Fit the idler pulleys (13), complete with bearings, on to their mounting studs on the cylinder heads and tighten down the nuts (8) to the specified torque.

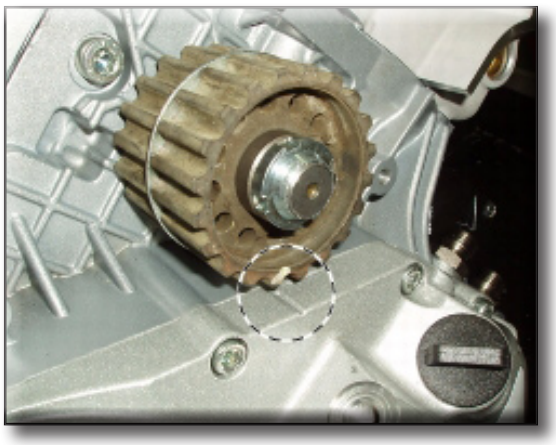


Unscrew the bolts (22) securing the pulleys, turning them anti-clockwise through 90° ± 5°.
Check that the pulleys have no endfloat and can rotate freely at all points along the full length of the slots.



Refitting the timing belts

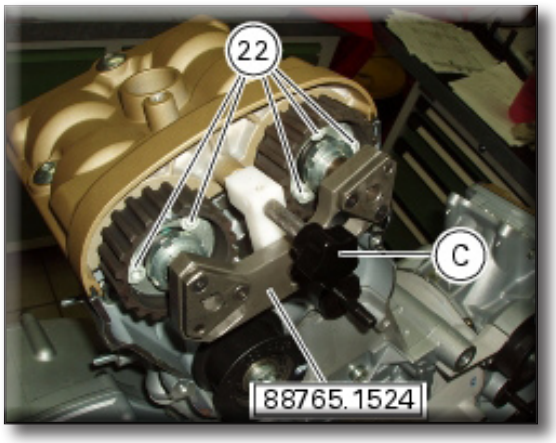
Turn the pulleys on the timing belt driveshaft until the timing mark on the outer roller is aligned with the mark on the right-hand crankcase cover.
In this condition, the horizontal cylinder piston will be at top dead centre.



Install the service tool 88713.2011 in the alternator cover to hold the crankshaft against rotation and secure it the relative pin.

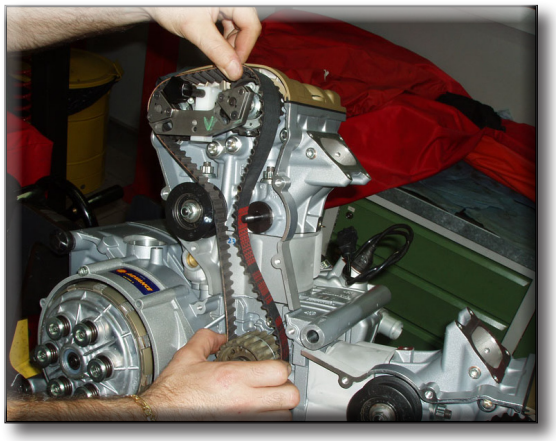
Fit the service tool no. 88765.1524 to prevent rotation of the camshafts: one for the vertical cylinder head and one for the horizontal cylinder head.
Fix the tools to the rocker cover with the pin (C).

Important
To ensure correct timing, the bolts (22) securing the pulleys to the hubs must be loose and positioned in the centres of their slots.

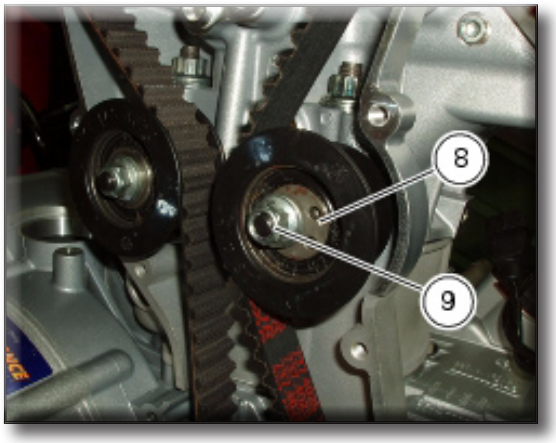


Fit the vertical cylinder timing belt around the camshaft pulleys and pass it behind the idler pulley.
Repeat the operation for the horizontal cylinder belt.

Notes
If the used belts are to be refitted, position them in their original direction of rotation and on their original cylinder.



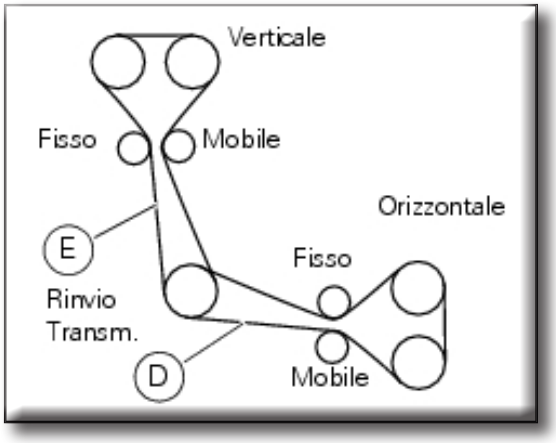
Fit the tensioner pulleys (9) on the mounting studs on the two cylinder heads.
Start the nut (8) on the crankshaft



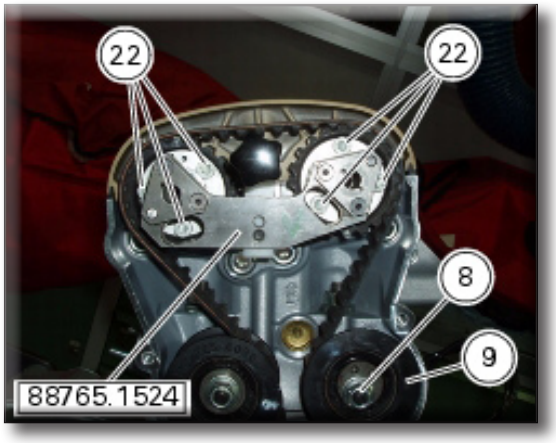
Check the timing belt tension and adjust if necessary as described in the paragraph “Measuring timing belt tension”

Warning

Check the tension on the belt sections (D) and (E) shown in the figure.

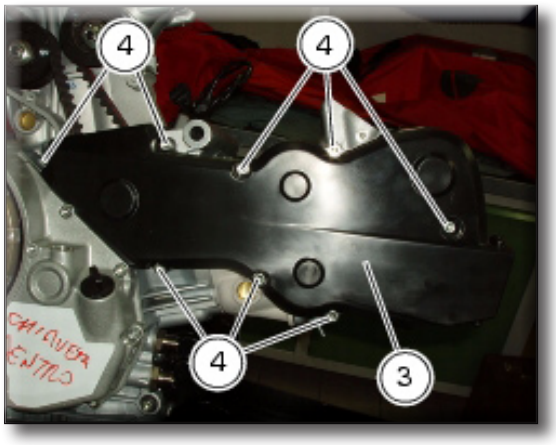


Once the belts are correctly tensioned, ensure that the nuts (8) securing the tensioner pulley (9) and the bolts (22) are tightened to the specified torque.
Remove the camshaft holding tool 88765.1524 and the crankshaft holding tool 88713.2011.

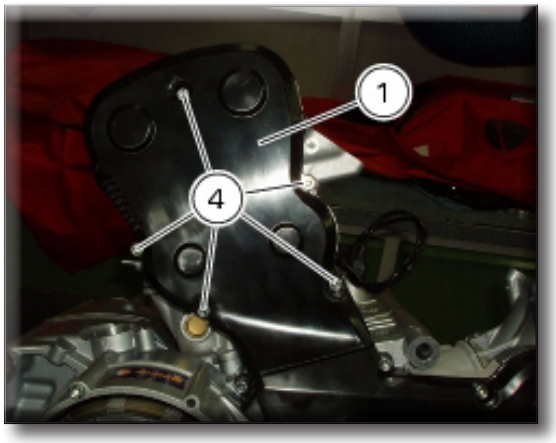


Refitting the timing covers

Locate the horizontal cylinder timing cover (3) and secure it in place with bolts (4).



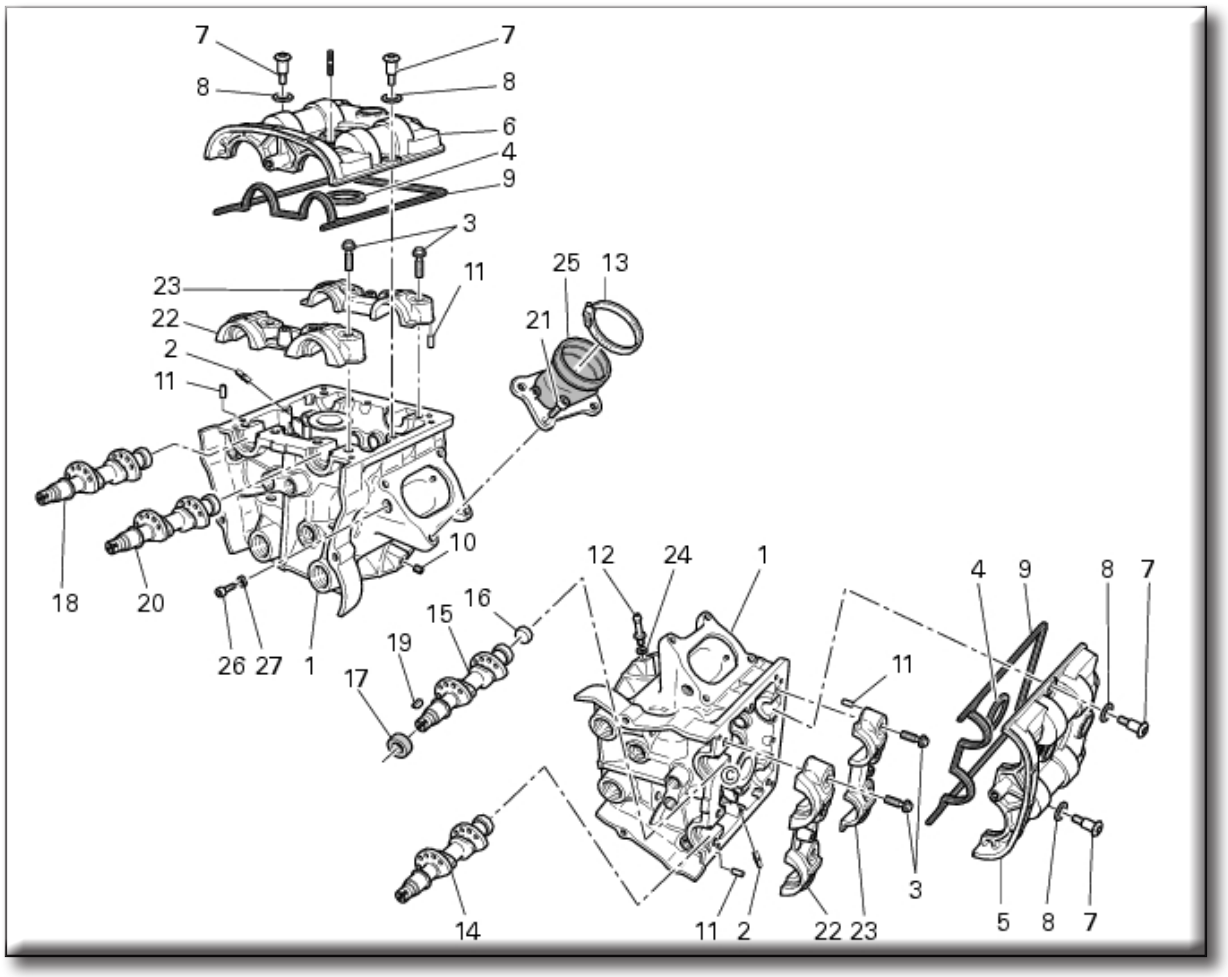
Do the same with the vertical cylinder outer cover (1).
Tighten the bolts (4) progressively in a crosswise pattern to the specified torque.



Notes
If the above operations have been carried out with the engine installed in the frame, refit the previously removed parts.

Reconnect the electrical system components on right-hand side of engine
Refit the side fairings

11.9 - CYLINDER HEAD ASSEMBLIES: CAMSHAFTS

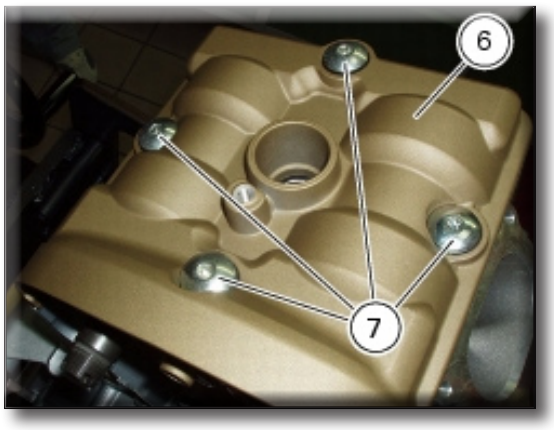


1) Cylinder head
2) Stud bolt
3) Special screw
4) Seal
5) Horizontal cylinder head rocker cover
6) Vertical cylinder head rocker cover
7) Special screw
8) Washer
9) Cylinder head gasket
10) Grub screw
11) Locating dowel
12) Union
13) Clamp
14) Horizontal cylinder exhaust camshaft
15) Horizontal cylinder intake camshaft
16) Plug
17) Oil seal
18) Vertical cylinder exhaust camshaft
19) Key
20) Vertical cylinder intake camshaft
21) Bolt
22) Timing side support
23) Opposite side support
24) Seal
25) Intake manifold
26) Bolt
27) Washer

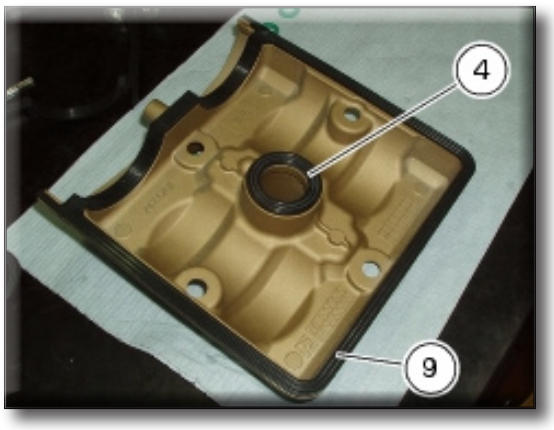
Removal of the camshafts

Remove the coils
Remove the engine from the frame
Remove the timing belt covers, the timing belts and timing belt pulleys
Remove the oil pump from the engine

Unscrew and remove the bolts (7) from the rocker covers.
Remove the rocker cover (6).

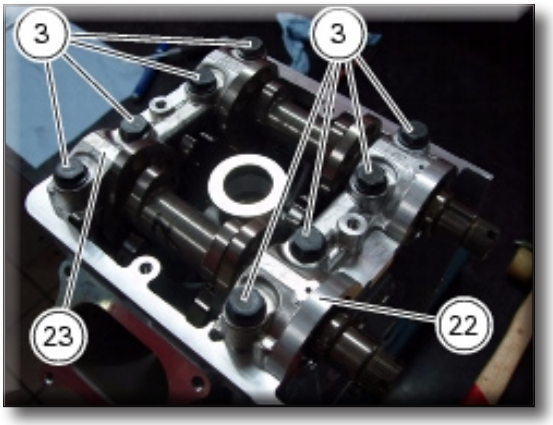


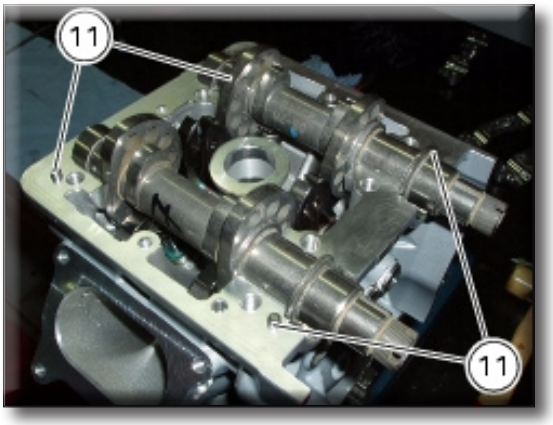
Remove the gaskets (4) and (9).



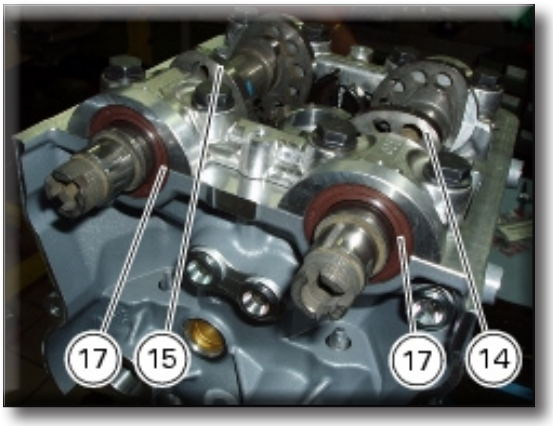
Repeat the same procedure for the other rocker cover.
Remove the seals (8) on the rocker cover.

Unscrew the bolts (3) securing the camshaft supports.
Withdraw the camshaft supports (22) and (23) straight out from the cylinder head, taking care not to damage the machined faces and locating dowels (11).

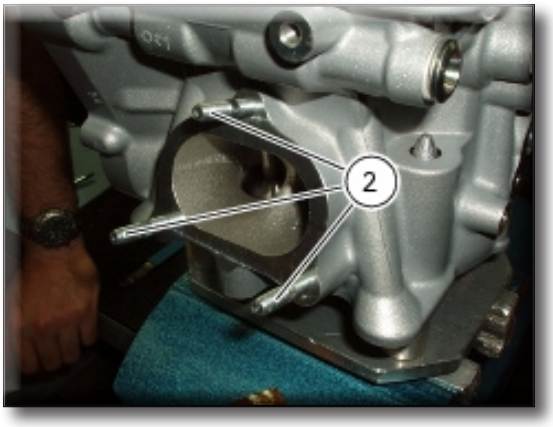




Remove the exhaust camshaft (14) and the intake camshaft (15), and slide off the seal rings (17) on their ends.
Repeat the same procedure for the other cylinder head..

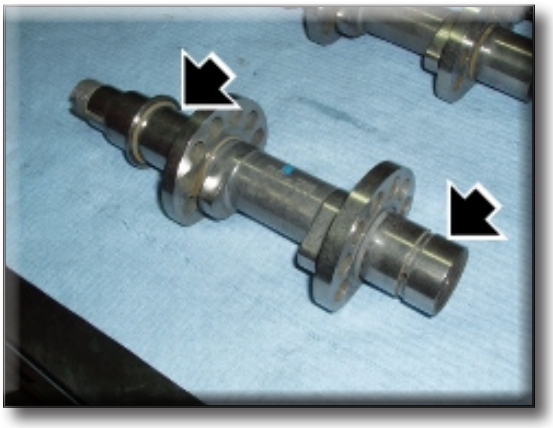


If necessary, unscrew the stud bolts (2) from the cylinder heads.

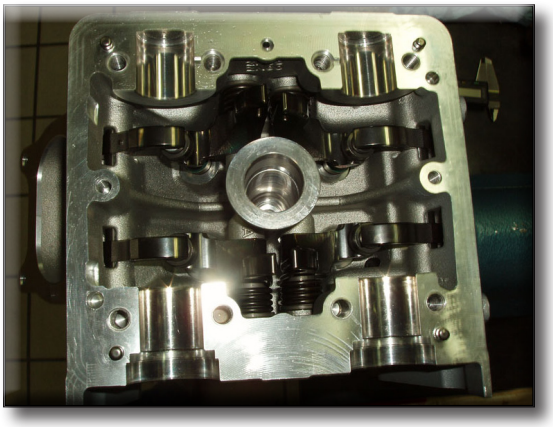


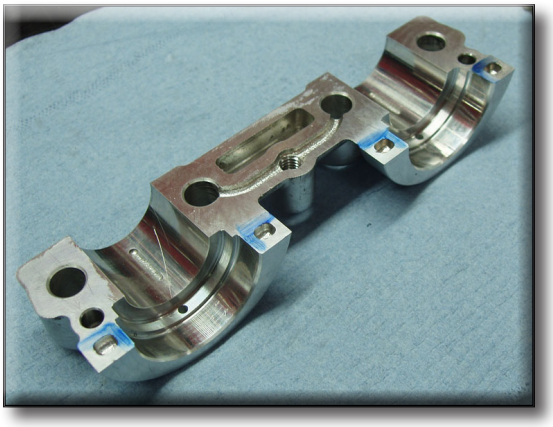
Checking the camshafts and supports

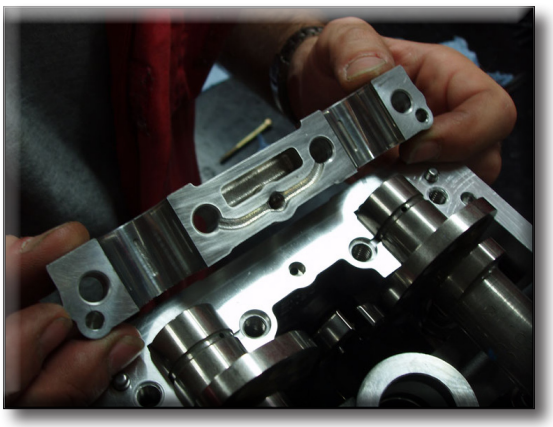
Check the cam contact surfaces for scratches, grooves, steps and waving.
Worn cams are frequently the cause of poor timing, which leads to loss of engine power.
Place the camshaft between two centres and check the runout using two dial gauges.
Service limit: 0.1 mm.



Visually inspect the camshaft tracks for scoring and abnormal wear. If any of the above defects are found, the camshaft should be renewed.
If you find scoring or excessive wear, check the operation of the engine lubrication circuit.

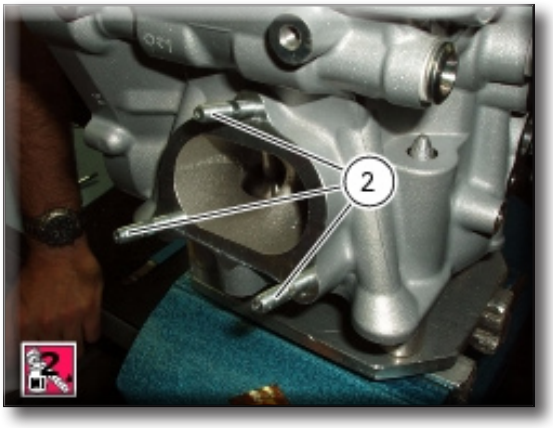




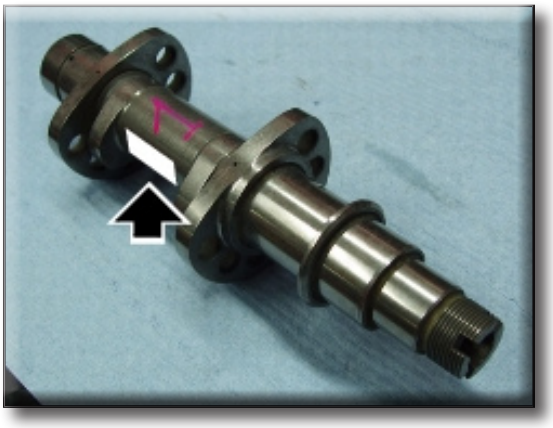


Refitting the camshafts

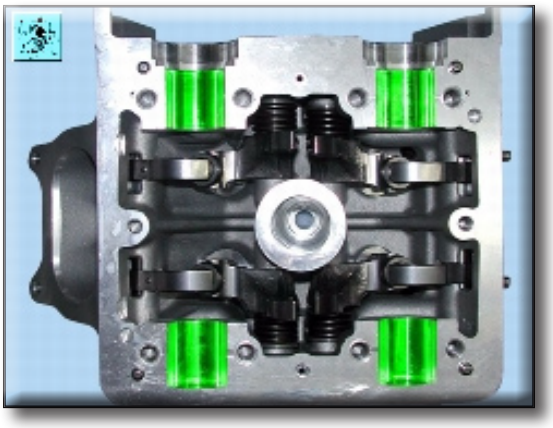
If the stud bolts (2) were removed, apply the recommended threadlocker to the short end of the stud bolts (2), i.e. the end that is to be screwed into the cylinder head.
Tighten the lock nuts (2) to the prescribed torque

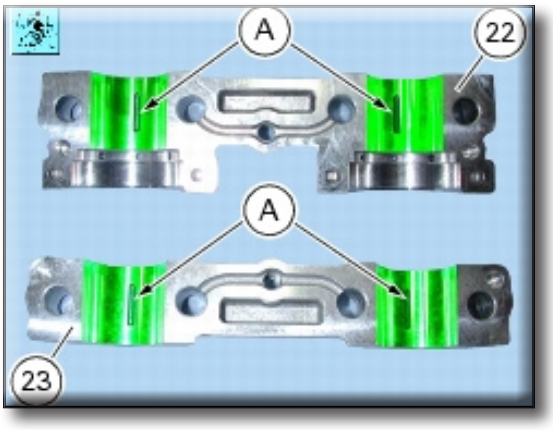


Check that the camshafts (marked “VA” and “VS” for the vertical head and “OS” and “OA” for the horizontal head) are clean and in good condition. If the camshafts are not new, use emery cloth to remove signs of wear on the cam and support surfaces, working on a flat surface.



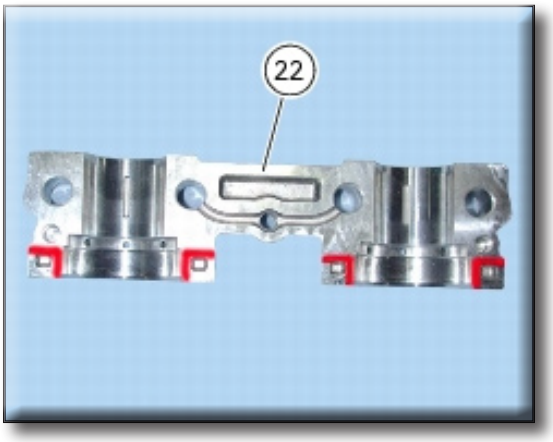
Lubricate with the specified lubricant (Molycote M55 Plus), the camshaft seats on both the cylinder head and the supports (22) and (23) (green zone).
Fill the reservoirs (A) with the recommended lubricant (Molycote M55 Plus).



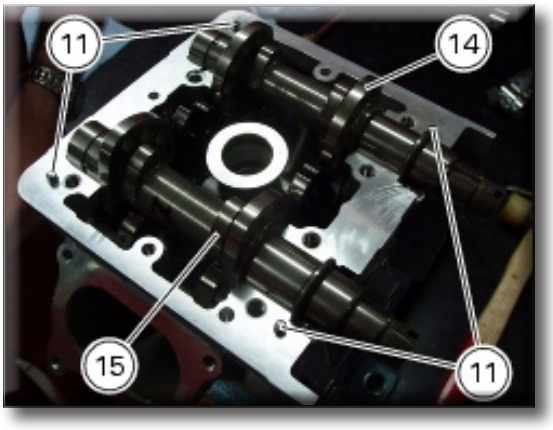


Apply sealant (Three Bond 1215 liquid gasket) at the four points of the support (22) shown in red in the photo. Clean off any excess sealant.

Notes
Only apply sealant to the timing side support (22): do not apply to support (23).



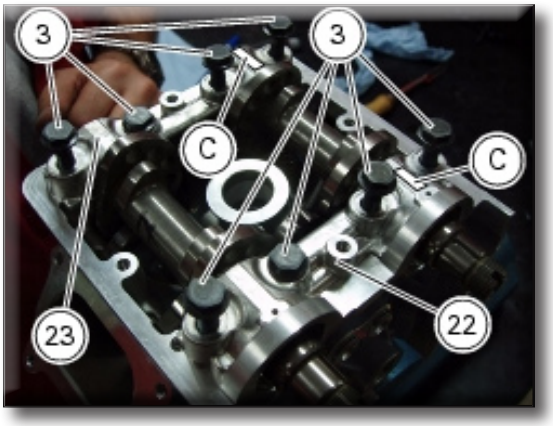
Install the camshafts (14) and (15) in the cylinder head, and rotate them to distribute the lubricant evenly. Check that the locating dowels (11) are present.

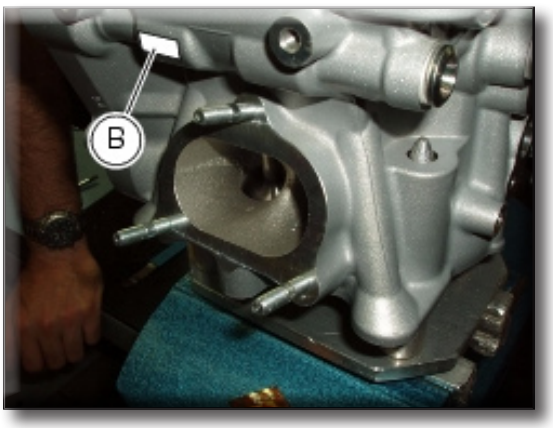


Fit the supports (22) and (23) so they are perfectly seated on the cylinder head, checking that the number stamped in zone (B) of the cylinder head is the same as the number stamped in zone (C) of the support.

Important
The support (22) must be installed on the timing side.

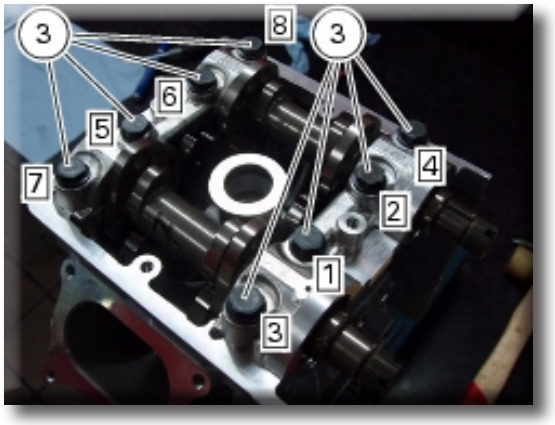
Bed down the supports.
Apply engine oil to the threads and undersides of the heads of the bolts (3).
Insert the bolts (3).





Pre-tighten the bolts (3) to the specified torque.
Pre-tighten one support at a time, working in the sequence 1-2-3-4-5-6-7-8.
Then finally tighten the bolts to the specified torque.
Tighten one support at a time, working in the sequence 1-2-3-4-5-6-7-8.
Remove any excess sealant from between the cylinder head and the support.
Turn the camshafts by hand to check that they rotate freely.

Notes
The bolt (3) in position 1 must always be installed on the intake and timing side.



Important
Check the valve lift

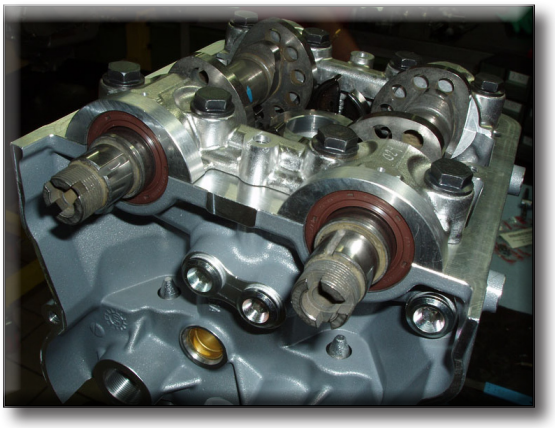
Oil seals

Lubricate the oil seals (17) with denatured alcohol.
Fit the installation tool supplied with service tool 88713.2861 on the camshaft and install the oil seal on the cylinder head with the spring side.

Important
Always fit new oil seals on reassembly.

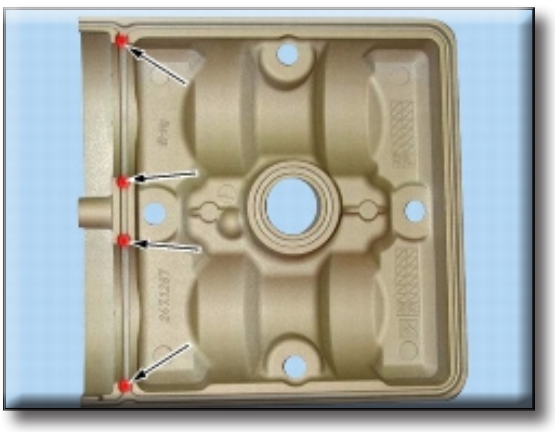
Use the drift provided with the tool and a mallet to seat the oil seals.

When correctly installed, the oil seal should be flush with the bevel of the cylinder head bore.

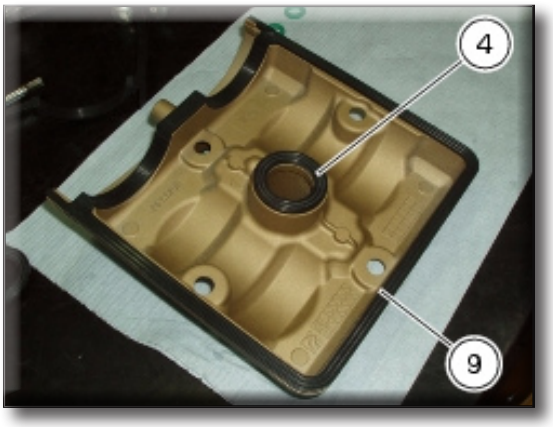


Rocker cover

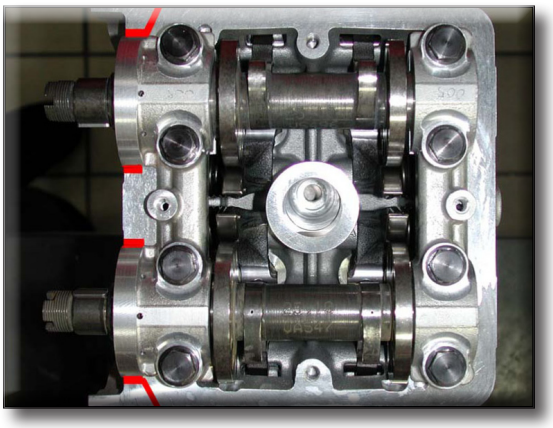
Apply sealant (Three Bond 1215 liquid gasket) at the four points of the rocker cover shown in red in the photo.



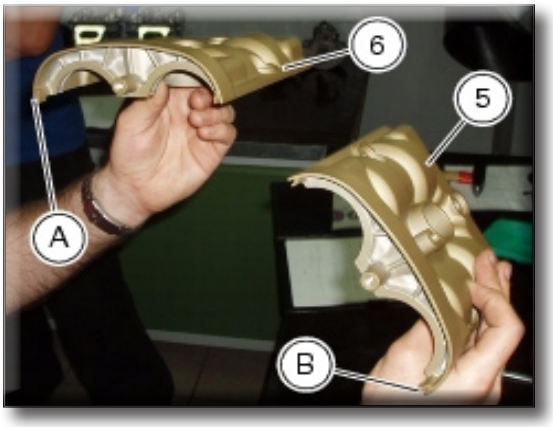
Fit the gaskets (4) and (9) on the rocker cover, as shown in the figure.



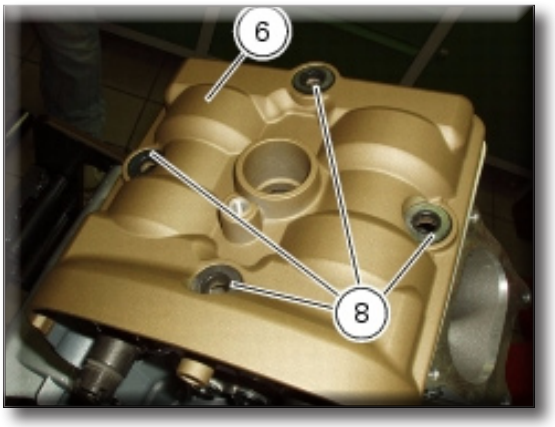
Apply sealant (Three Bond 1215 liquid gasket) at the four points of the cylinder head shown in red in the photo.



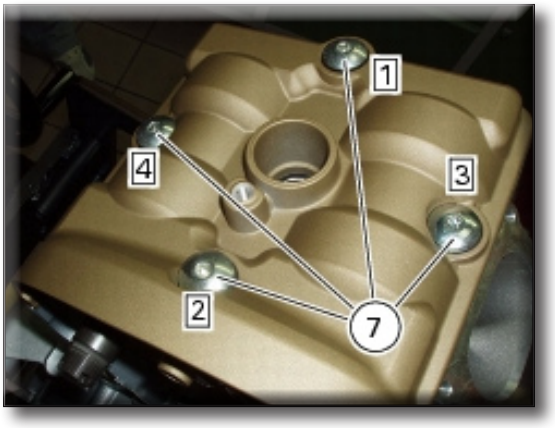
Rocker cover identification: The vertical head rocker cover (6) has a nib (A) on the left-hand side (exhaust side), whereas rocker cover (5) has a nib (B) on the right-hand side (exhaust side).



Locate the cover (6) on the cylinder head, aligning the four fixing holes.
Install the four washers (8) in the cover fixing holes, with the rubber sides facing the cover.



Insert the bolts (7).
Tighten screws (7) to the specified torque



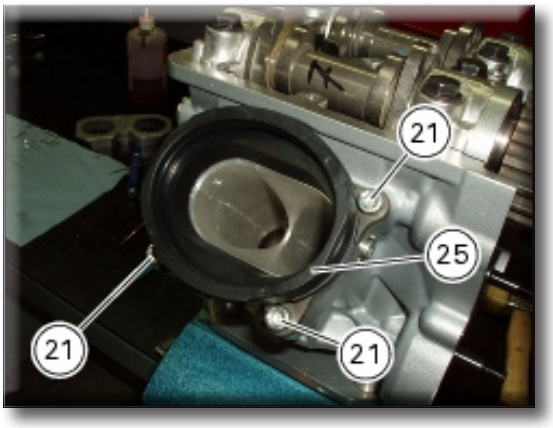
Remove excess sealant from the area of application.
Repeat the same procedure for the other cylinder head.
Refit all the components removed in the procedure.

Refit the oil pump
Refit the timing belt pulleys, timing belts and the timing belt covers
Refit the engine to the frame
Refit the coils

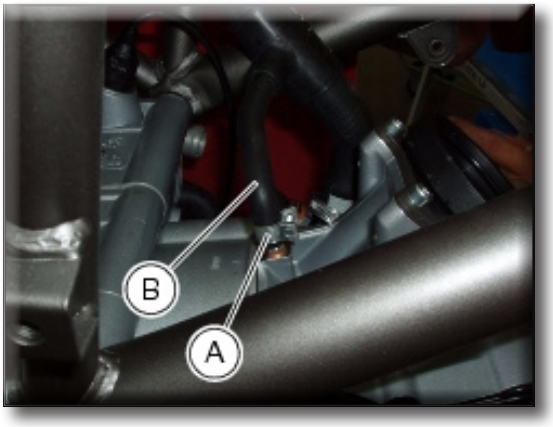
Removal of the intake manifold and coolant union

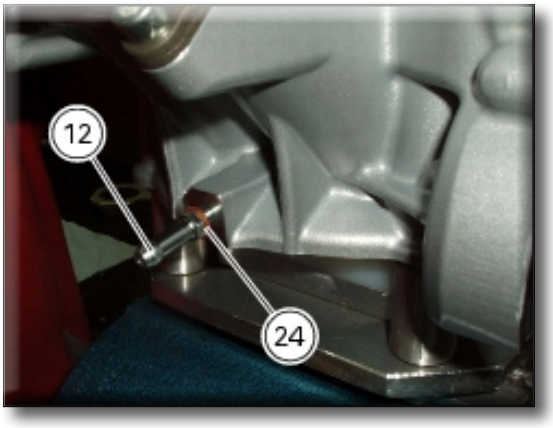
Remove the manifolds (25) by undoing the bolts (21).

Notes
When the lower two bolts (21) of the vertical cylinder head manifold are unscrewed, the expansion tank support will come free.

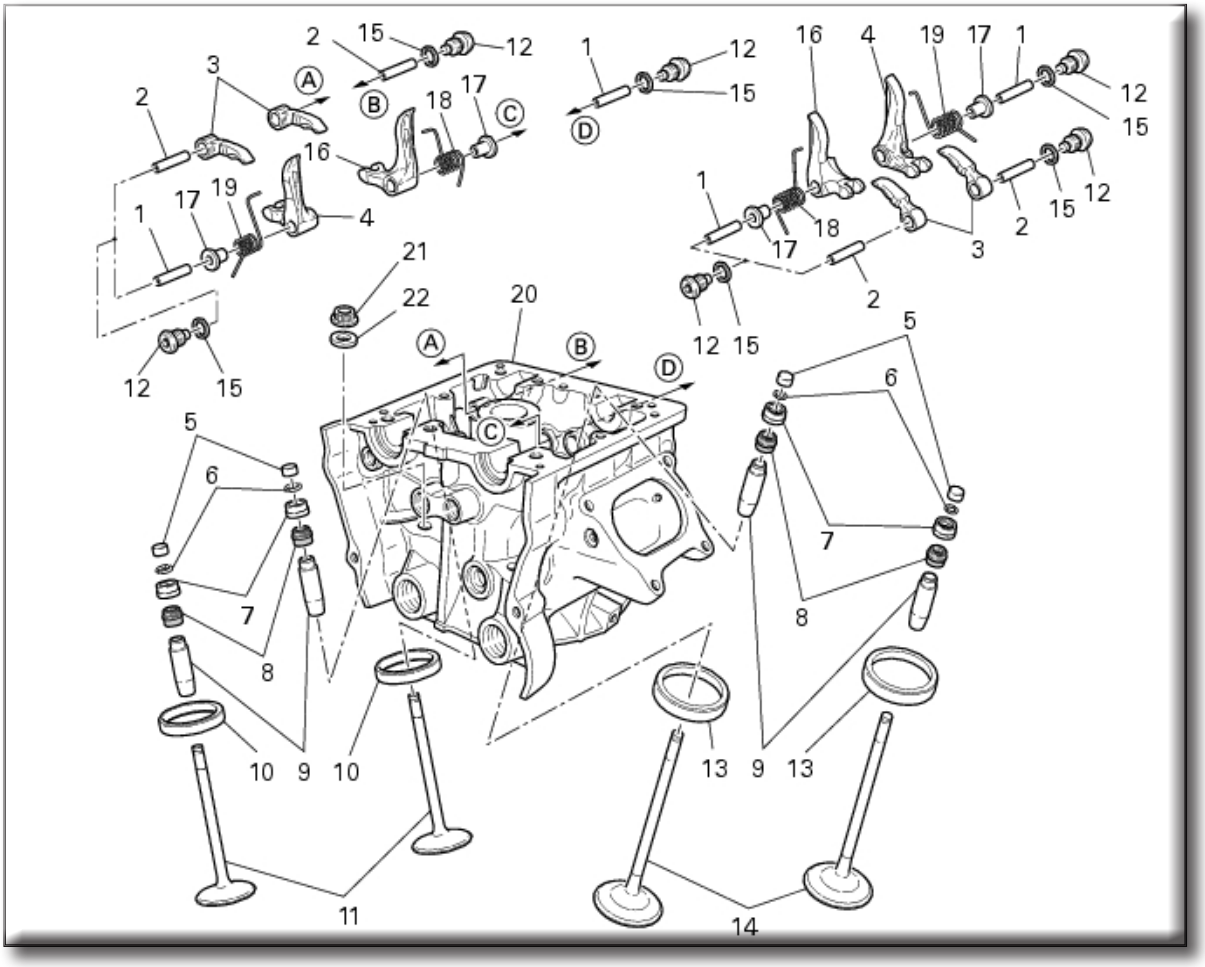


Loosen the clamp (A) and remove the hose (B).
Unscrew the union (12) and recover the seal (24).





11.10 - CYLINDER HEAD ASSEMBLIES: VALVES - ROCKER ARMS



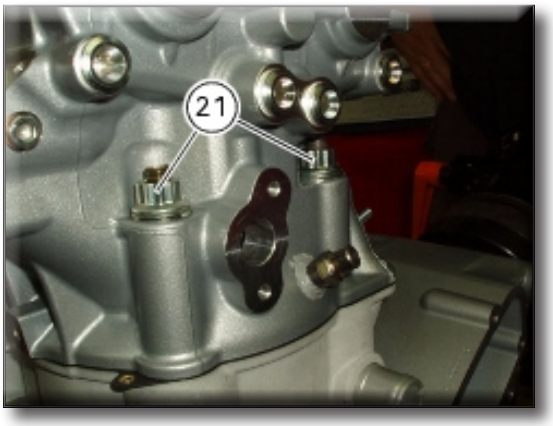
1) Closing rocker arm shaft
2) Opening rocker arm shaft
3) Opening rocker arm
4) Closing rocker arm (left)
5) Valve opening shim
6) Half rings
7) Valve closing shim
8) Oil seal
9) Valve guide
10) Exhaust valve seat
11) Exhaust valve
12) Plug
13) Intake valve seat
14) Intake valve
15) Aluminium gasket
16) Closing rocker arm (right)
17) Spacer
18) Valve return spring (right)
19) Valve return spring (left)
20) Cylinder head
21) Cylinder head nut
22) Washer

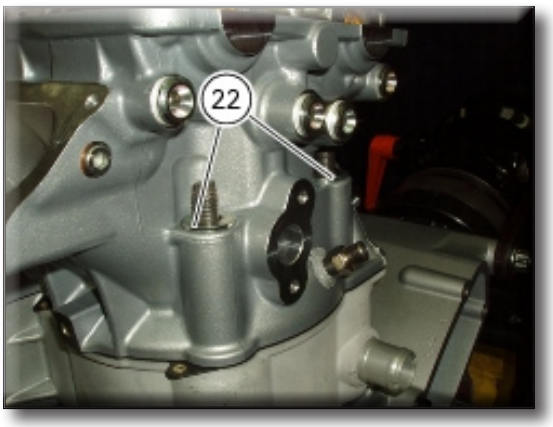
Removal of the cylinder heads

Remove the engine from the frame
Remove the coolant hoses
Remove the timing belt covers and the timing belts
Remove the oil pump

Using the service tool 88713.2676, unscrew the nuts (21) on the cylinder head studs.

Remove the cylinder head nuts (21) and special washers (22).



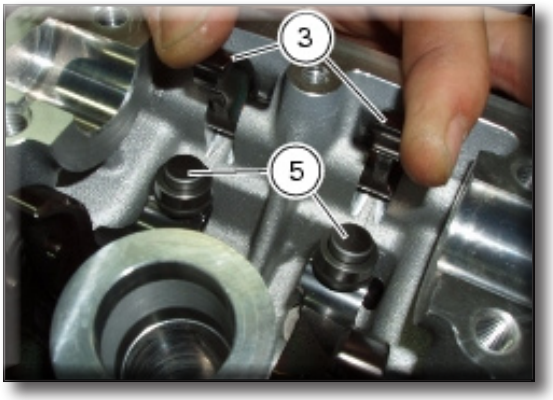


Remove the cylinder head assembly by lifting it off the engine studs.
Repeat the same procedure for the other cylinder head.

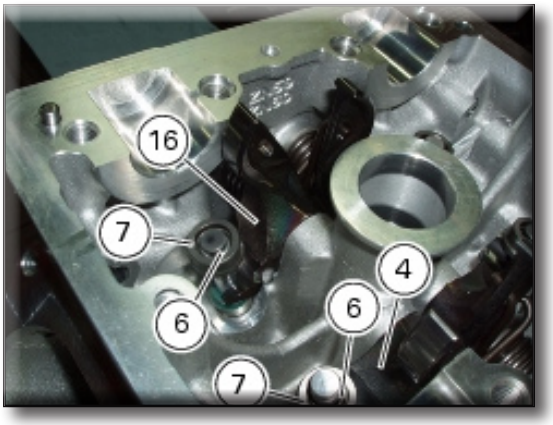
Removal of the valves

Remove the cylinder head assembly from the engine
Remove the timing belt pulleys
Remove the camshafts

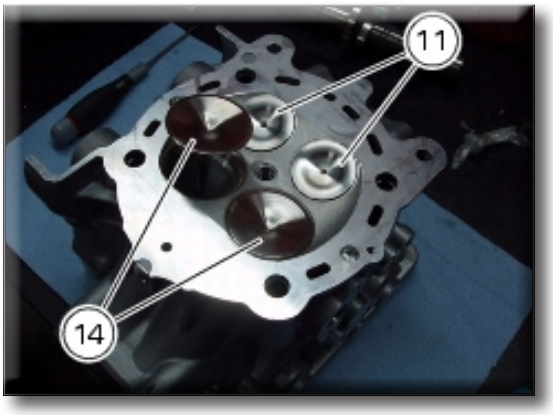
Raise the rocker arm (3) and remove the opening shim (5) from the valves with a pair of pliers.



Push down the closing rocker arms (16) and (4) and the closing shim (7).
Remove the half rings (6) from the valves with a magnetic screwdriver.
Extract the closing shims (7) from the valve using a pair of pliers.



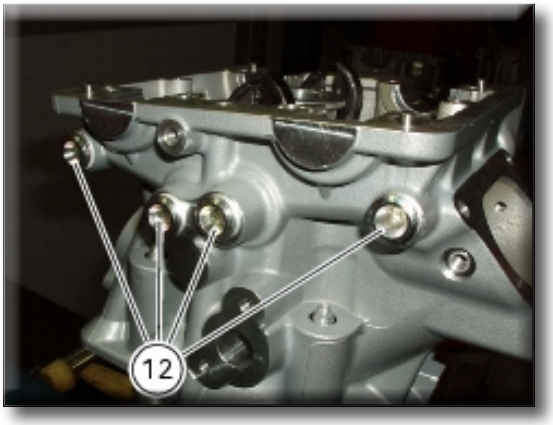
Withdraw the valves (14) and (11) from underside of the cylinder head.

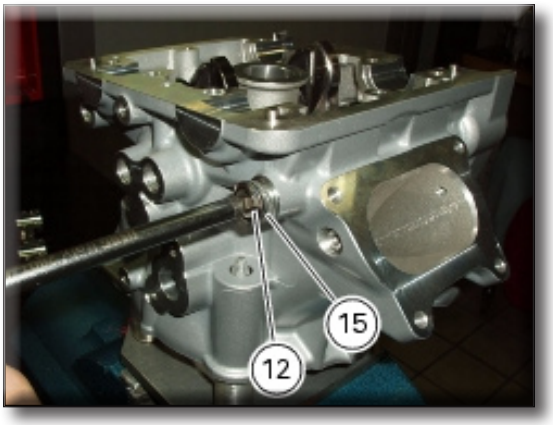


Repeat the same procedure for the other cylinder head.

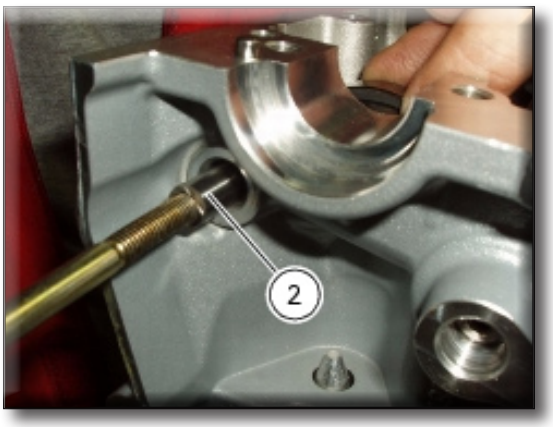
Removing the valve rocker arms

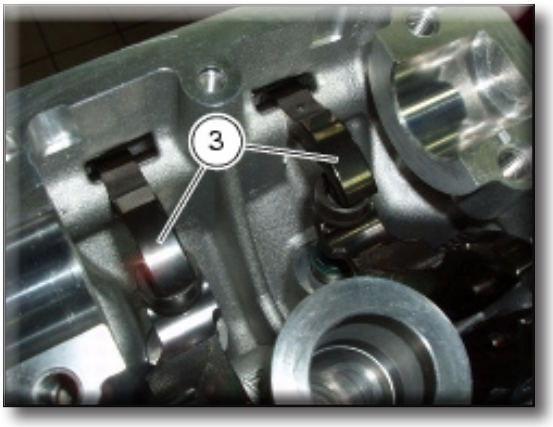
With the cylinder head in the condition described in the previous paragraph, remove the rocker arms. Unscrew the eight plugs (12) and recover the seals (15).



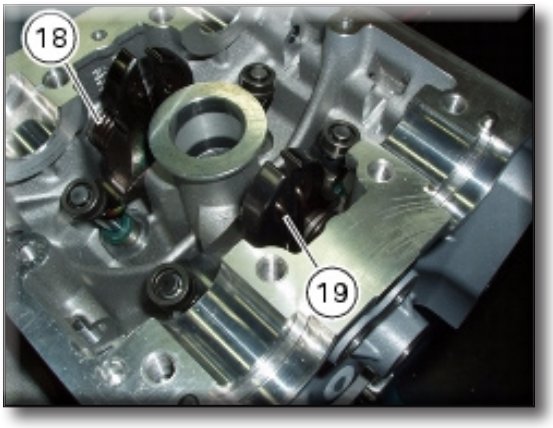


Using an M5 bolt, withdraw the shafts (2) of the opening rocker arms (3) on the exhaust and intake sides. Remove the opening rocker arms (3).

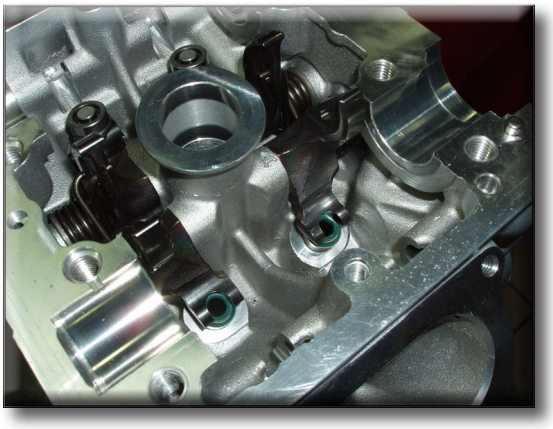




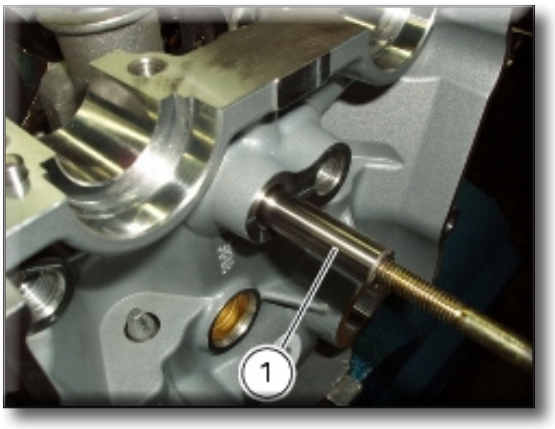
Using accessory (C) of the rocker arm spring tensioning kit 88713.2069 installed between the spring and the inner wall of the cylinder head, move the straight end of the rocker arm return spring (19) and (18) and insert it in the drilled shaft.



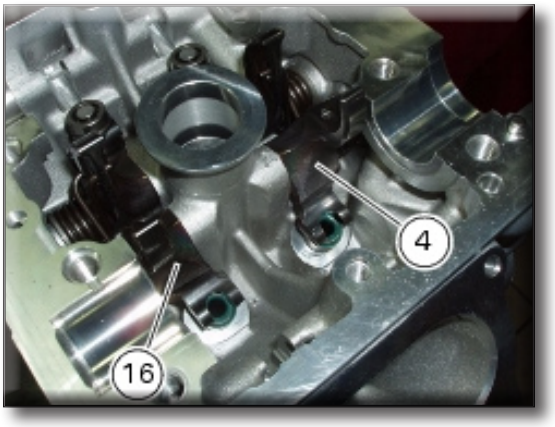
Use the shaft to slide the end of the spring into its final position.

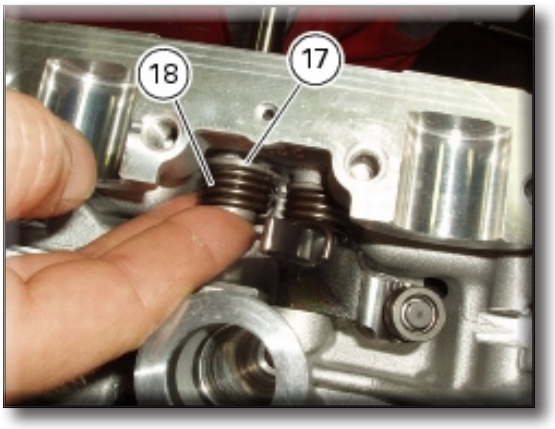


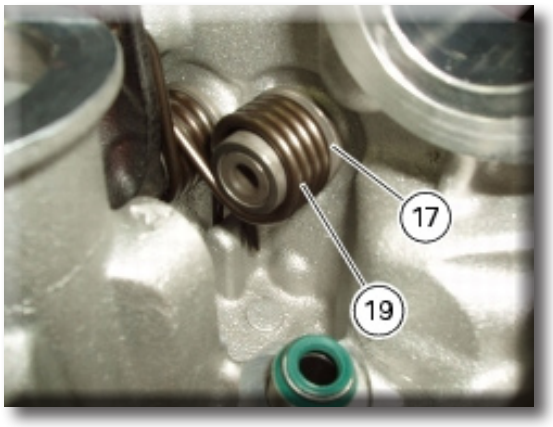
Using an M5 bolt, withdraw the shafts (1) of the closing rocker arms on the exhaust and intake sides.



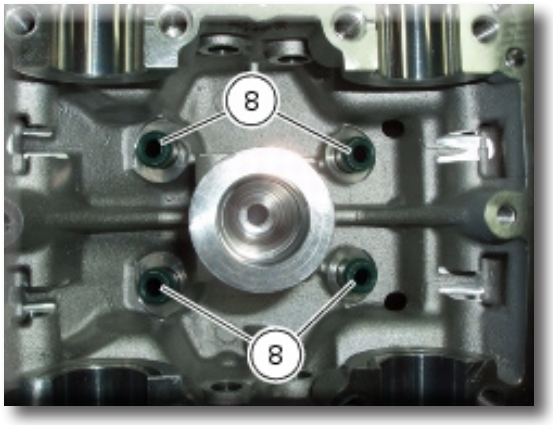
Remove the closing rocker arms (4) and (16), the springs (18) and (19) with the spacers (17).







Remove the seal rings (8) from the ends of the valve guides.

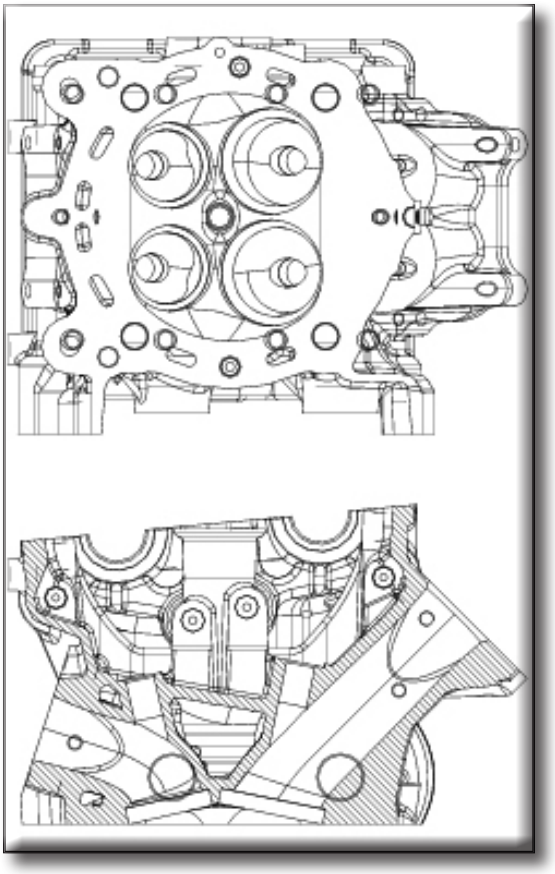


Repeat the same procedure for the other cylinder head.

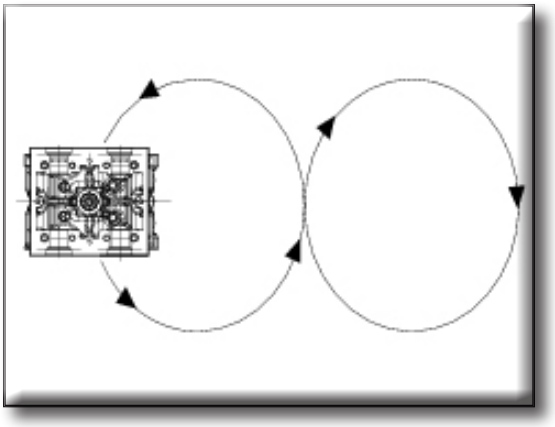
Overhaul of cylinder head components

Cylinder heads

Remove any carbon deposits from the combustion chamber and its ducts.
Remove any scale from the coolant ducts.
Check for cracking and inspect the sealing surfaces for scoring, ridges or other damage.

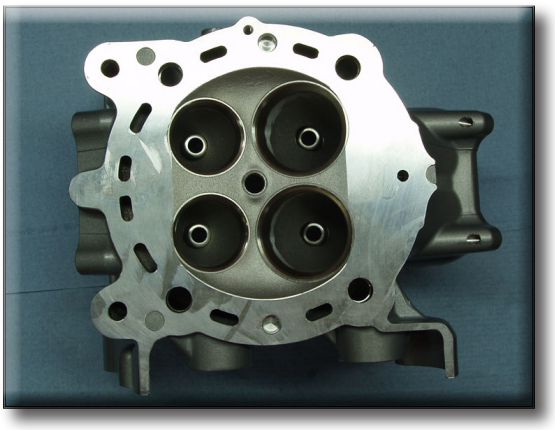


Check that the cylinder barrel mating surfaces of the cylinder head are free of carbon deposits and scale. If this is not the case, spread diamond dressing compound (6 to 12 micron thickness) on a reference surface and slide the cylinder head on the surface as shown in the figure until a flat finish is obtained.

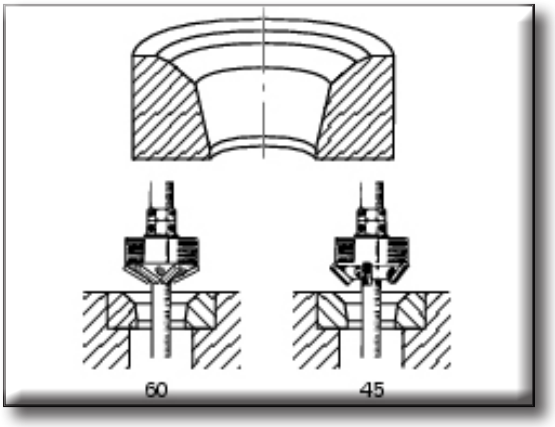


Valve seat

Visually inspect the valve seats: for cracking or pitting.



Minor damage can be repaired by grinding with special 45° and 60° single-blade grinders. Grind the valves and check the seal.

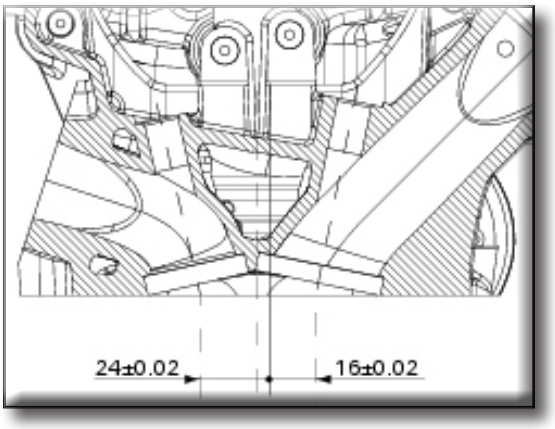


If the valve seats are excessively damaged, fit oversize seats. Replacement seats are available with 0.03 and 0.06 mm oversized outside diameters.

Imporent

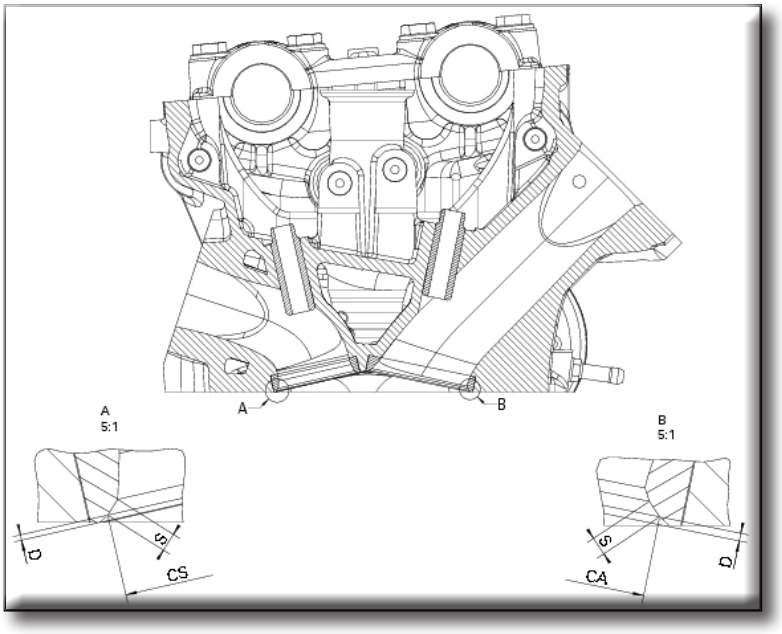
When you change the valve seats, change the valve guides as well.

Proceed as follows:
Remove the worn seats, grinding carefully to avoid any damage to cylinder head bores.
Check the diameter of head bores and choose the oversized valve seat that will give an interference fit of 0.04 to 0.10 mm.

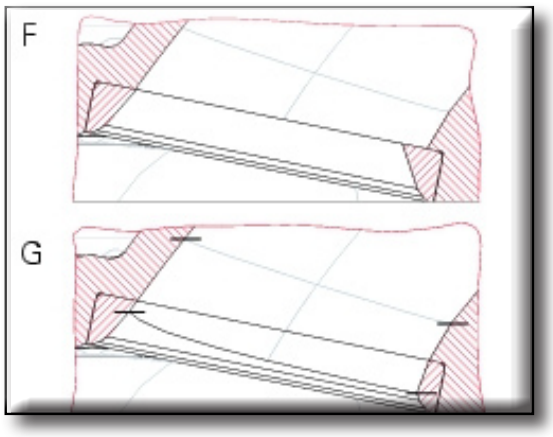


Heat the cylinder head gradually and evenly up to 150° and chill the new valve seats in dry ice.
Drive the seats perfectly square into the head bores using the appropriate valve guide seat installer 88713.2846 and 88713.2847.
Allow the cylinder head to cool down and grind the seats to the following dimensions:
CA = Ø41,6± 0.025 mm.
CS = Ø33.6± 0.025 mm
S = 1.2 mm.
D = 0.2 to 0.4 mm

Important
Do not use any lapping compound after final grinding.

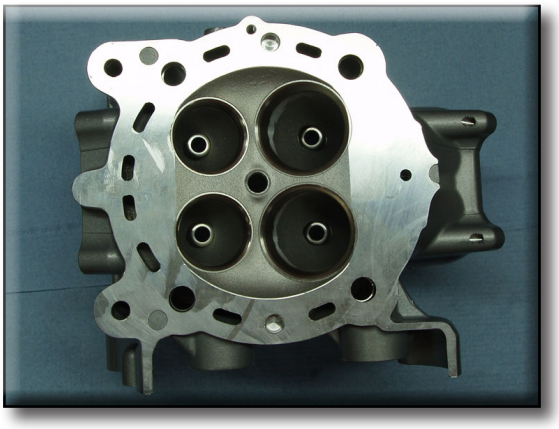


It is advisable to smooth the joint between the intake valves seats and the intake ducts (F = before; G = after).

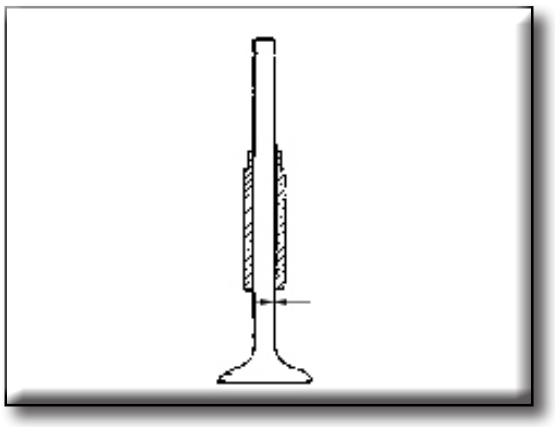


Valve guides

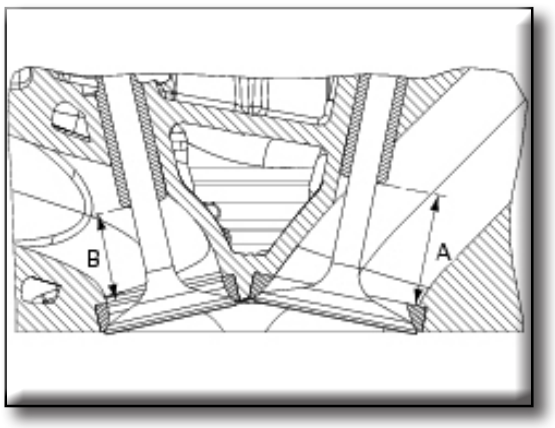
Check the inner surface of the valve guides for cracking or distortion.



Thoroughly check the dimensions of the inner surface of the valve guide. Measure the inside diameter with a bore diameter gauge.
Measure the diameter at different positions of the valve guide.



The assembly clearance must be:
highest measured value – lowest measured value = 0.03 to 0.045 mm.
The maximum permissible wear limit is 0.08 mm.
Change the valve guides when the ovality exceeds permissible limit or the clearance to the valve stem is outside the tolerance range.
When you change the valve guide, you must also change the valve.
Replacement valve guides are available with outside diameter oversizes of 0.03, 0.06 and 0.09 mm.
Change the valve guides as follows:
heat up the cylinder head gradually and evenly up to 150 °C.
remove the original valve guides using service tool no. 88713.2842
allow the cylinder head to cool down and check the condition of the seats.
select the most suitable valve guide so as to obtain an assembly clearance with the cylinder head of 0.022 to 0.051 mm; heat the cylinder head up again and chill the new valve guides with dry ice;
lubricate the seats in the head and install the valve guides using the appropriate service tools and referring to dimension given in the figure;
A= 22.4±0.15 mm.
B= 28.45±0.15 mm.
Hone the mating surface with a reamer.

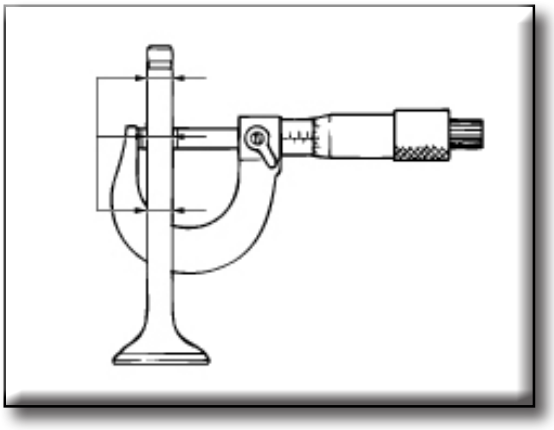


Checking the valve

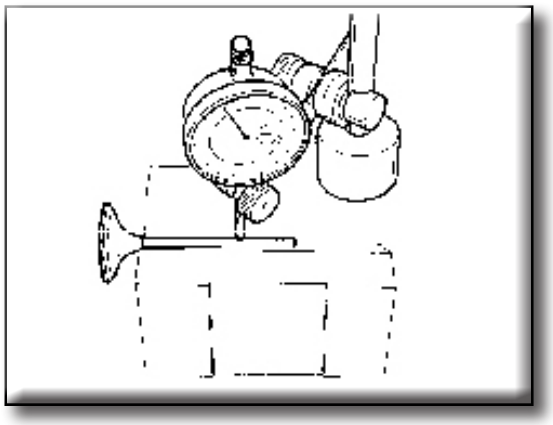
Check that the stem and the surface that contacts the valve seat are in good condition.
There must be no pitting, cracks, deformations or signs of wear.

Warning
The valves cannot be ground.

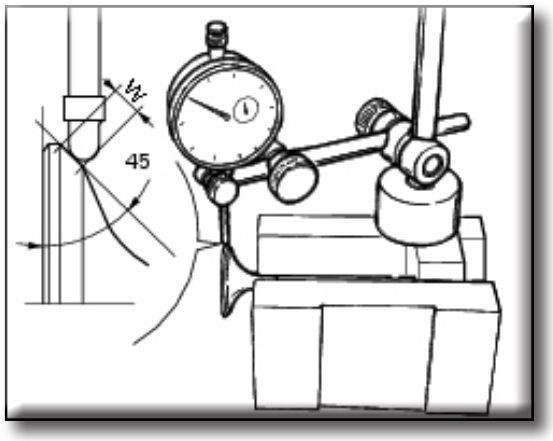
Perform the following checks.
Measure the diameter of the valve stem (B) at various points along the section that runs in the valve guide.

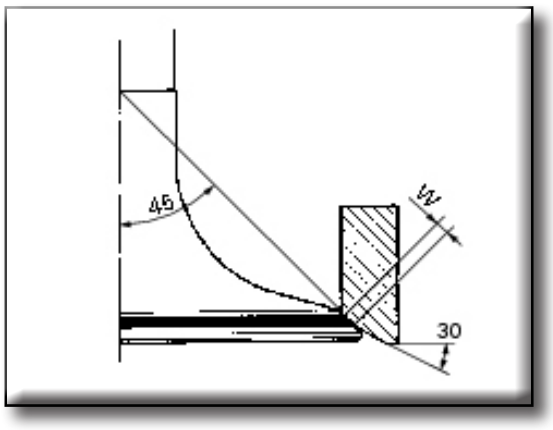


Check the valve stem for buckling. Place it on a “V” block and measure deformation with a dial gauge.
Service limit: 0.053 mm.
Check that valve head band (at 45° to valve head top face) is concentric to the valve stem as follows: place valve on a V block, set a dial gauge at right angles to head and rotate valve.
Nominal concentricity: 0.01 mm.
Service limit: 0.03 mm.



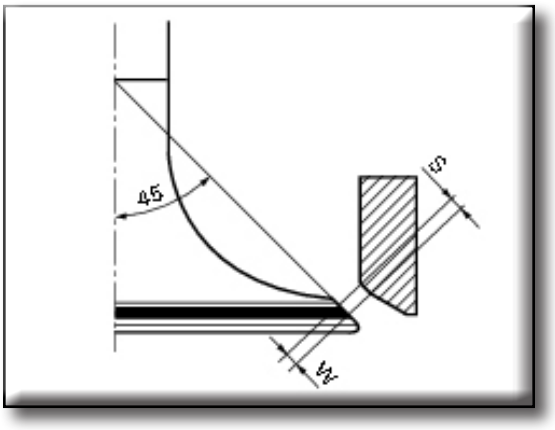
Use Prussian blue or a mixture of minium and oil to check that the contact surface (W) between the valve and seat is 1.4 to 1.6 mm (1.05 to 1.35 mm when new).
Grind the seat if the dimension measured is greater than the above limit.





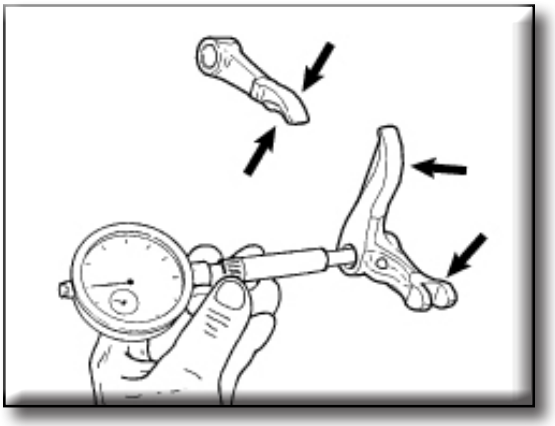
Checking the valve seal

After grinding the seats it is important to check the seal between the valve face and the seat: if the seat contact area (S) on the valve is wider than the 45° band (W) this could lead to poor sealing.



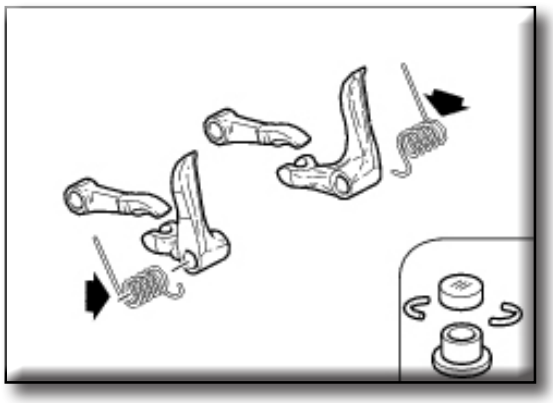
Checking the rocker arms

Check for signs of wear, grooves or chrome flaking off.
Check the condition of rocker arm bore and shaft.
Assembly clearance: 0.025 to 0.049 mm
Wear limit: 0.08 mm.



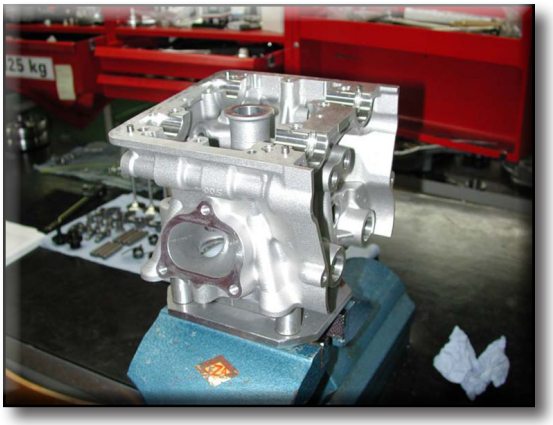
Opening and closing shims - Springs

Check the condition of the contact surfaces of the valve opening and closing shims: there must be no signs of wear. Check the condition of the closing rocker arm return springs:
Check for cracking, distortion, or loss of elasticity.



Reassembly of the cylinder head

Notes
The cylinder heads are identical. Only the definition of the intake and exhaust side determines whether they are to be installed on the vertical or horizontal cylinder.
The exhaust side can be identified by the three threaded holes on the flange.

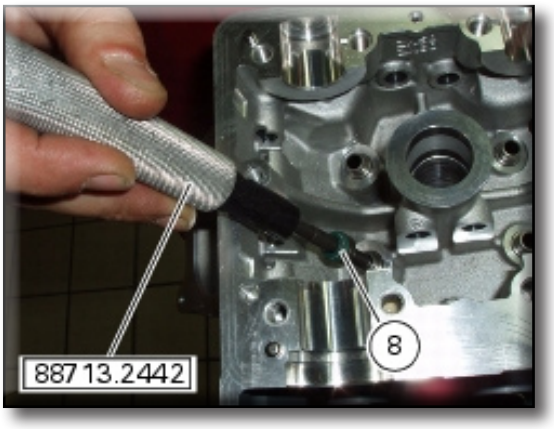


The intake side can be identified by the presence of four threaded holes on the flange.

All the photos in this chapter refer to a vertical cylinder head.

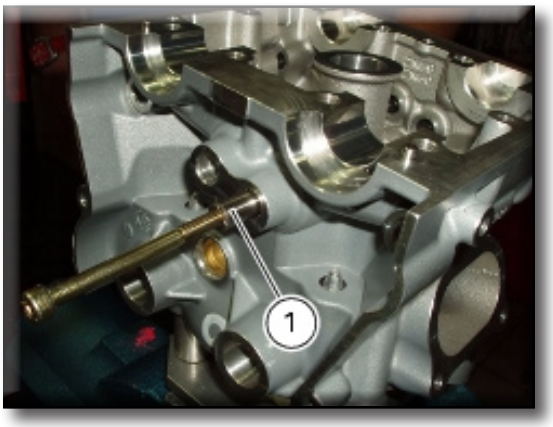
Valve guide seals

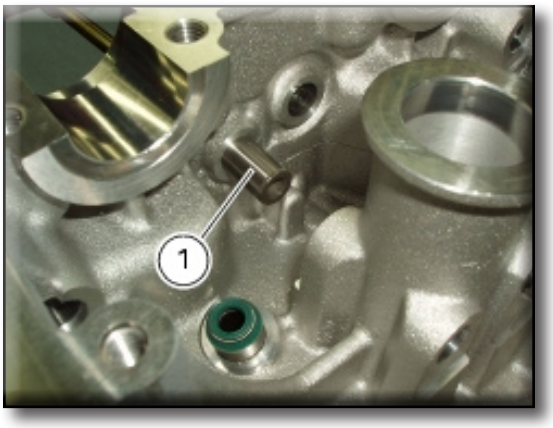
Position the cylinder head on the service stand 88713.2103.
Use alcohol to lubricate the valve guide seals (8) and insert them from the spring side onto tool 88713.2442.
Fit the end of the tool into the valve guide and use a mallet to tap the seals (8) home into the valve guides.



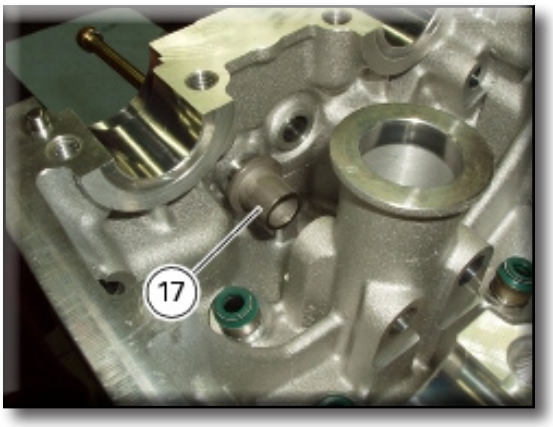
Reassembly of the closing rocker arms.

Check that the rocker arms are not scored or show signs of breakage in the area of contact with the camshaft and shim. The closing rocker arm shafts are 10 mm in diameter, whereas the opeining rocker arm shafts are 9 mm in diameter.
Using an M5 bolt, position the closing rocker shaft (1) towards the exhaust side of the cylinder head.

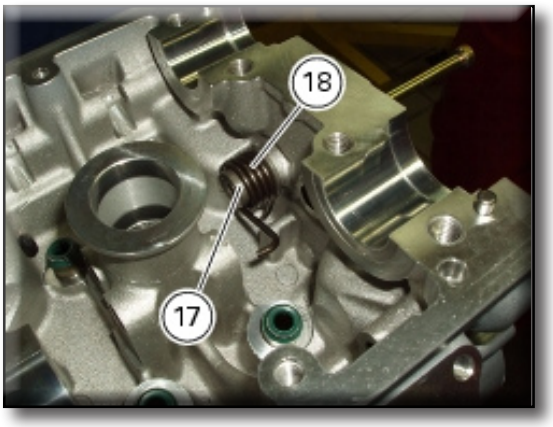




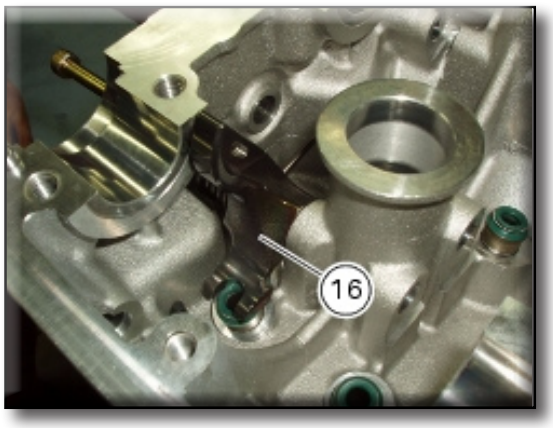
Locate the spacer (17) on the shaft.



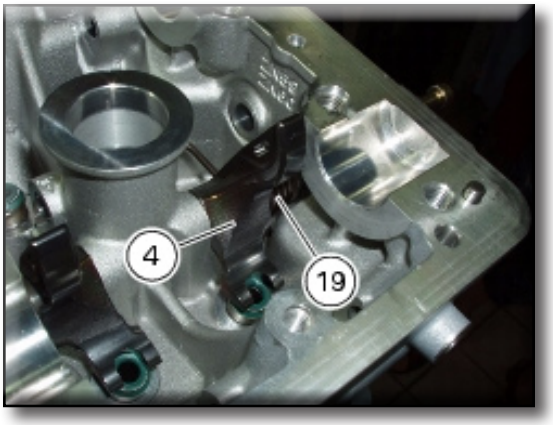
Locate the spring (18) on the spacer (17).



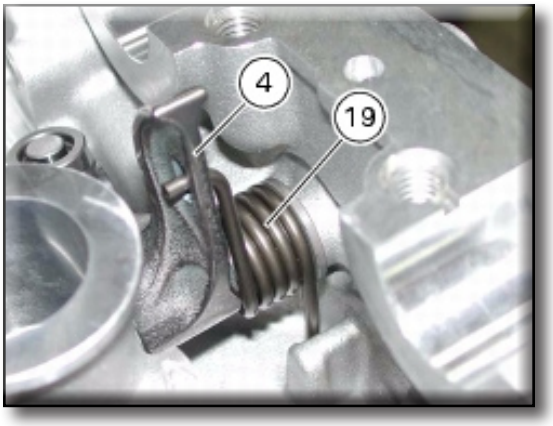
Locate the closing rocker arm (16) and drive the shaft home.



Proceed in a similar manner to install the closing rocker arm (4) with the spring (19) from the exhaust side.



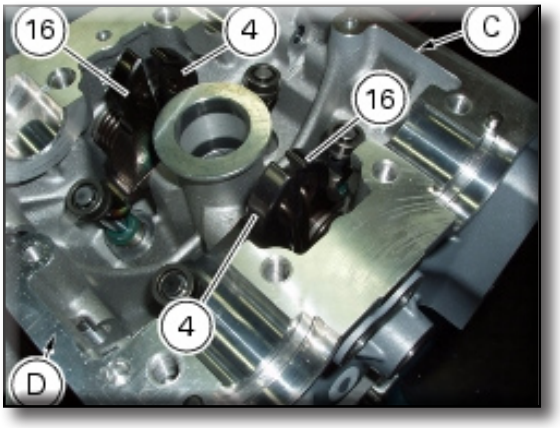
Load the springs (18) and (19) on the closing rocker arms (16) and (4) respectively using service tool no 88713.2069.



Proceed to install the closing rocker arms (4) and (16), the relative springs and shafts on the intake side (C) in the same manner as described for the exhaust side (D).

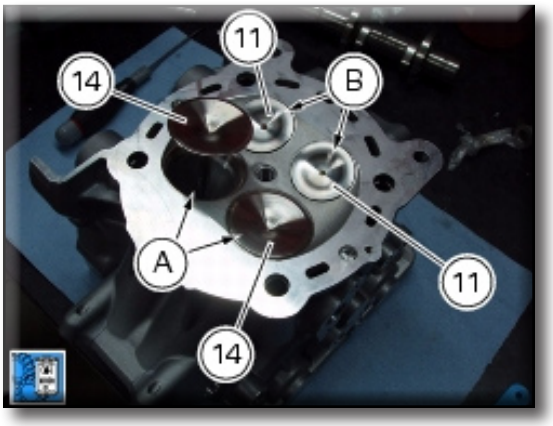
Notes
Always install the closing rocker arms on the exhaust side before those on the intake side.

Warning
Take care not to damage the shoe of the closing rocker arm with the intake spring during assembly.

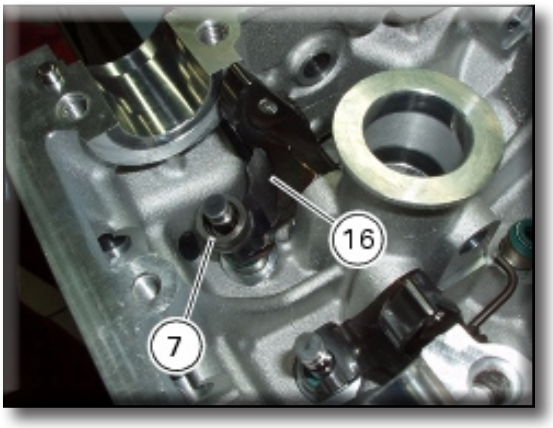


Refitting the valves, closing shims and half rings

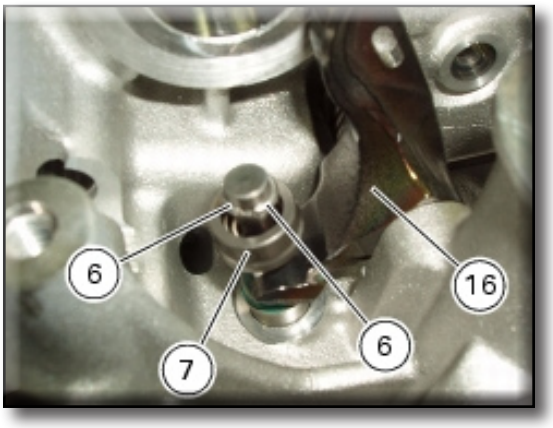
Carefully clean the two intake valve seats (A) and the two exhaust valve seats (B).
Lubricate the stems of the two intake valves (14) and the two exhaust valves (11) with engine oil.
Install the valves in respective seats in the cylinder head.



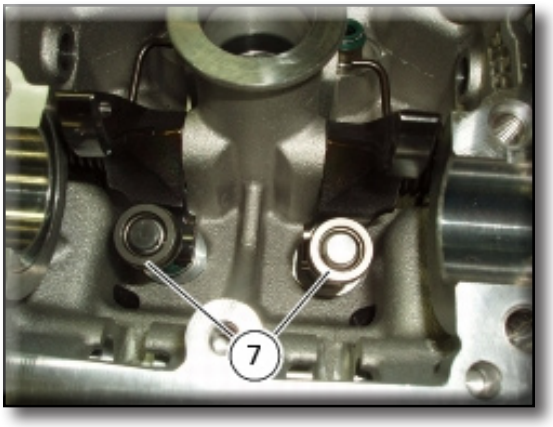
Hold the closing rocker arm (16) pushed downwards and fit the closing shim (7) on the valve stem. If using the old cylinder head, start by fitting the original shim.



Insert the new half rings (6) and release the rocker arm to ensure that they seat inside the shim (7). To ensure the half-rings are seated in the shim, tap the end of the rocker arm (16) with a rubber mallet.



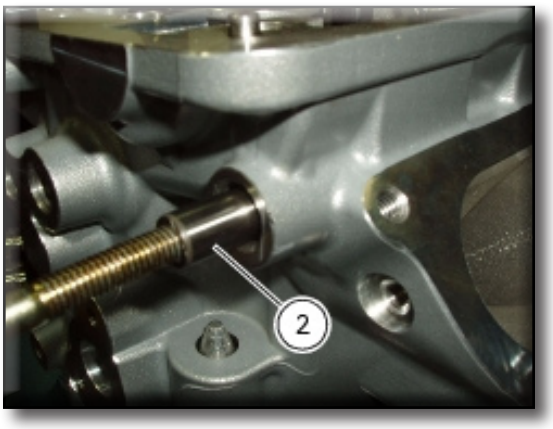
Repeat the procedure with the opposite valve and check that the top of the valve stem is aligned with the surface of the shim (7); if it is not, repeat the half-ring installation procedure.



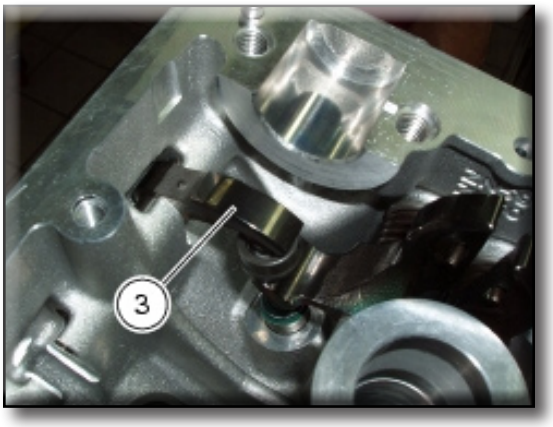
Install the closing shims on the intake valves (14) using the method described above for the exhaust valves. Refit the camshafts to check the valve closing clearances.

Refitting the opening shims and opening rocker arms

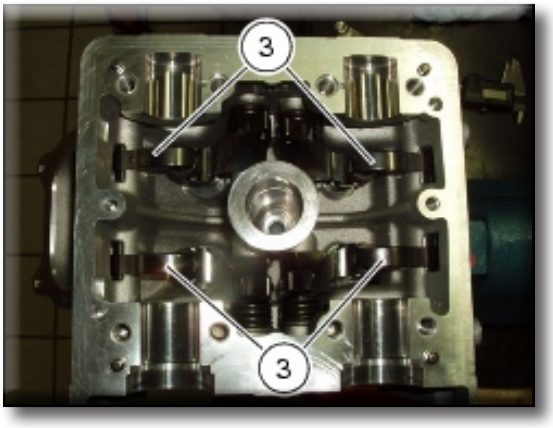
Using an M5 bolt, position the opening rocker arm shaft (2) (diameter 9 mm).



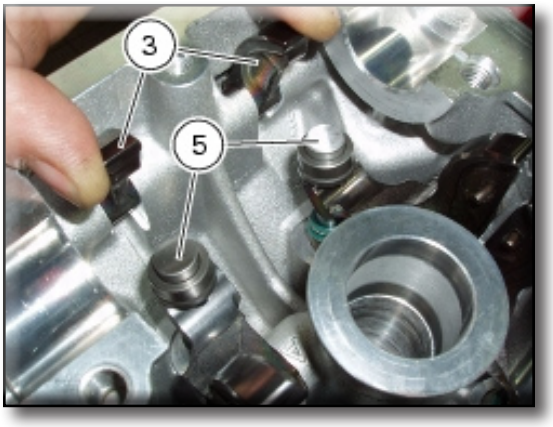
Locate the opening rocker arm (3) and drive the shaft home.



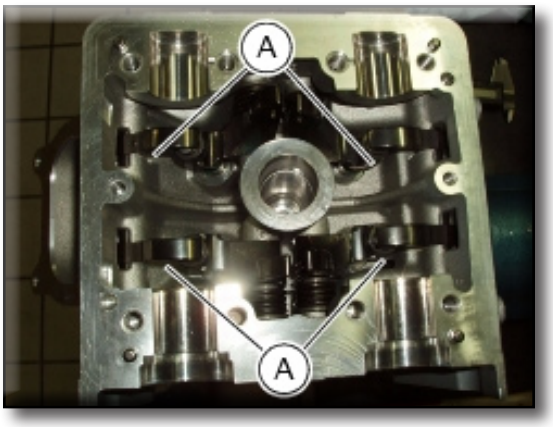
Install the four rocker arms (3) in the manner described above.



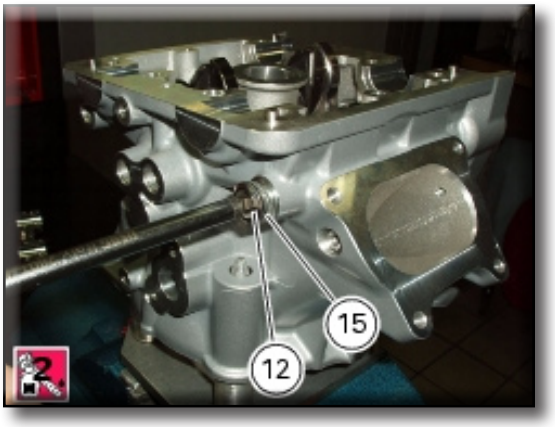
Raise the opening rocker arm (3) and install the opening shim (5) so it seats against the valve stem.



Release the rocker arm so that it rests against the shim.
Ensure the shim is correctly seated by lightly tapping the rocker arm shoe (A) with plastic mallet.
Refit the camshafts to check the valve opening clearances.



Apply the recommended threadlocker to the plugs (12).
Fit the eight plugs (12) with their seals (15): position the seals so that the square edges face the cylinder head.
Tighten the plugs to the specified torque.

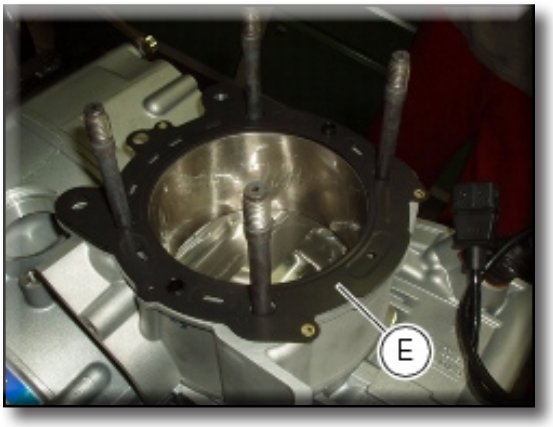


Refit the camshaft supports
Refit the timing belt pulleys
Refit the rocker covers
Refit the cylinder head assembly

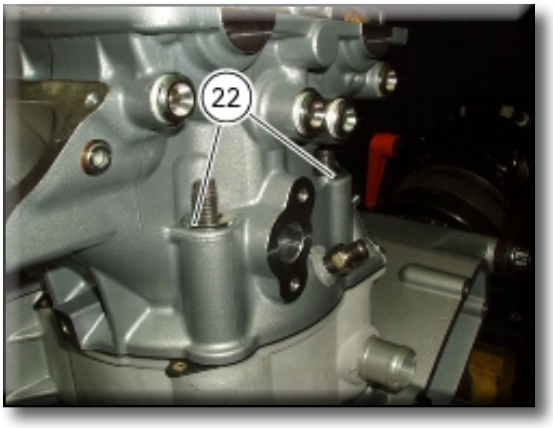
Fitting the cylinder head assemblies

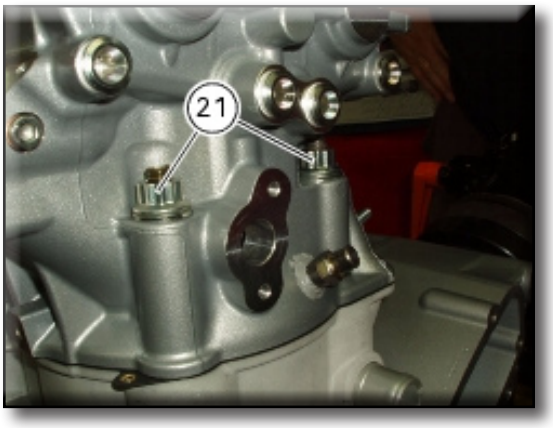
Before fitting the head, check that gasket is installed on the mating surface between head and cylinder

Notes
When fitting the gasket, side (E) with the stamped code must be in contact with the cylinder head.



Lower the cylinder head carefully over the studs. Take care not to damage the threads.
Fit the special washers (22) and nuts (21) onto the cylinder head studs.

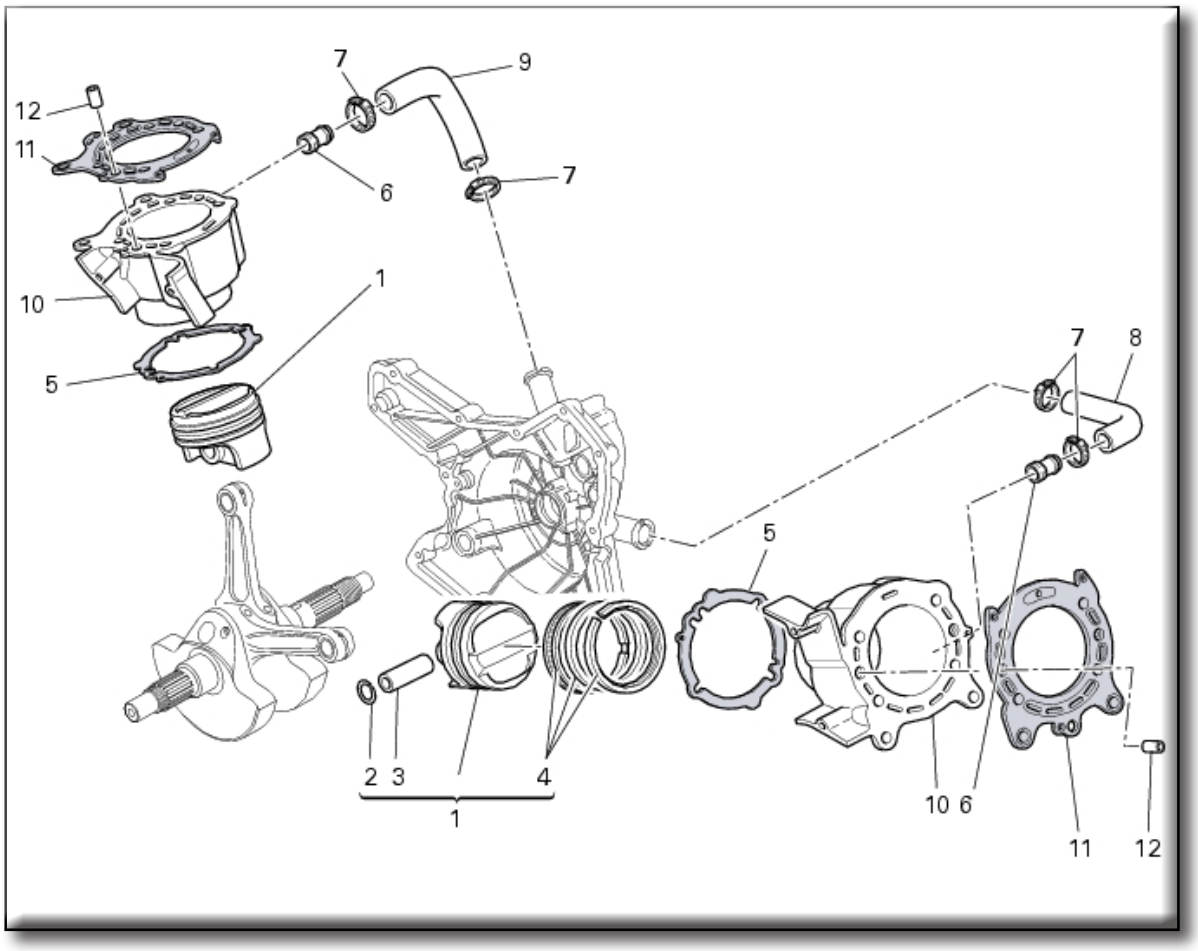




Tighten the nuts (21) on the studs in the sequence 1-3-2-4 using service tool 88713.2676 in conjunction with a torque wrench.
Pre-tighten and tighten the cylinder head nuts (21) to the specified torque.

Refit the coolant hoses
Refit the oil pump
Refit the timing belts and covers
Refit the engine to the frame

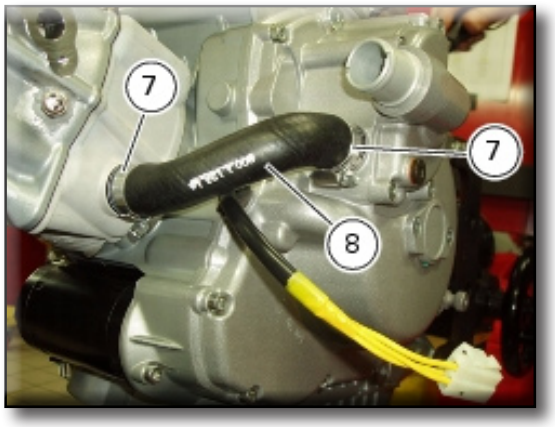
11.11 - CYLINDER / PISTON ASSEMBLIES

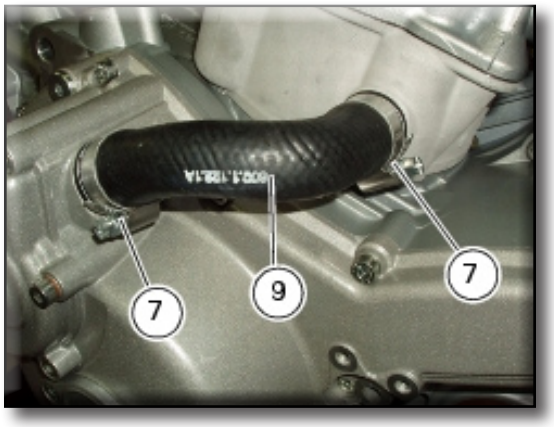


1) Piston
2) Gudgeon pin circlip
3) Gudgeon pin
4) Set of piston rings
5) Cylinder-crankcase gasket
6) Water pump outlet union
7) Hose clip
8) Horizontal cylinder coolant inlet hose
9) Vertical cylinder coolant inlet hose
10) Cylinder barrel
11) Cylinder head gasket
12) Bush

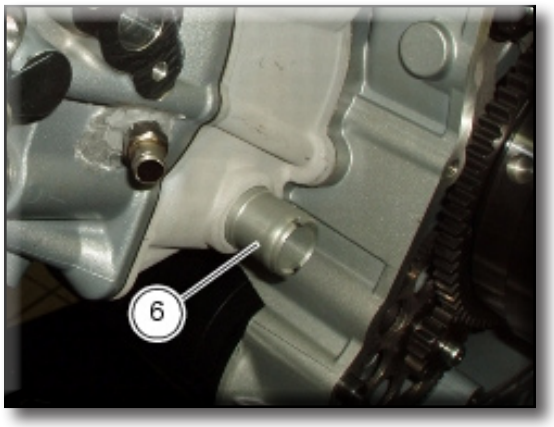
Removal of the cylinder/piston assembly

Loosen the clamps (7) and remove the hoses (8) and (9) from the cylinder barrels (10) and from the left-hand crankcase cover.



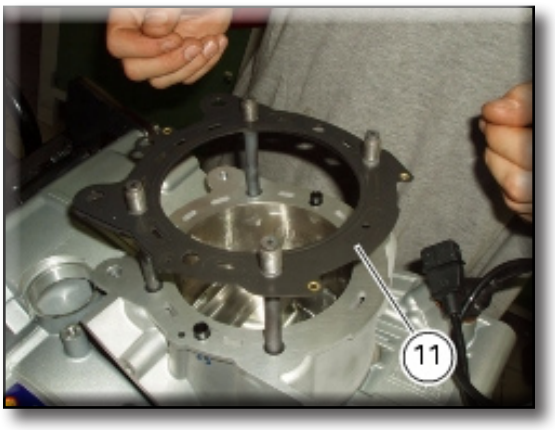


Unscrew the unions (6).

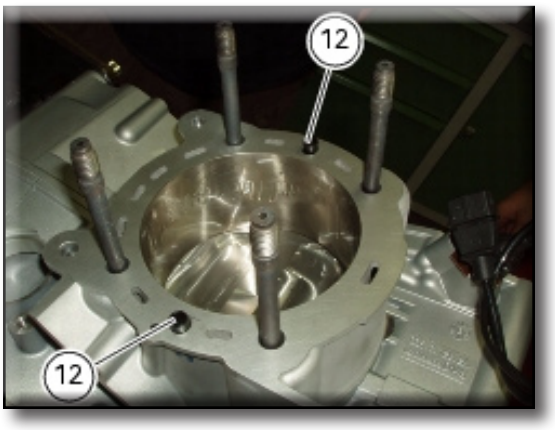


Notes
The following procedure is described with the engine removed from the frame and the cylinder head removed from the engine.

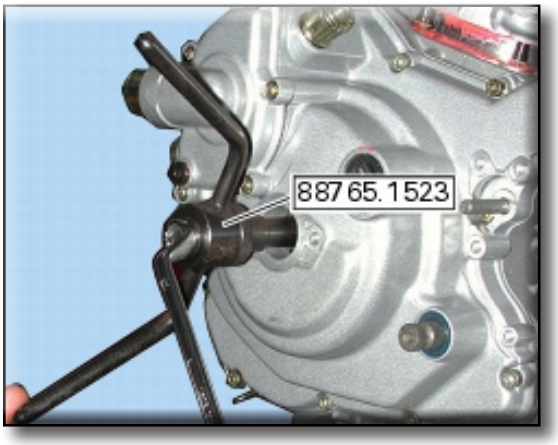
Remove the cylinder head gasket (11) from the cylinder barrel.



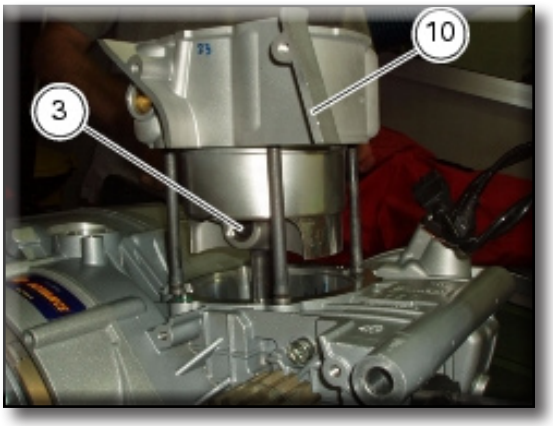
Remove the locating dowels (12).



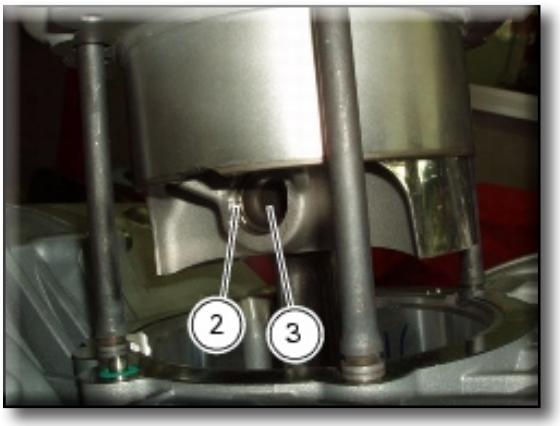
Use service tool no. 88765.1523 to bring the piston of the horizontal cylinder to TDC.



Carefully lift the cylinder barrel (10) off the crankcase, keeping it vertical.
If necessary, rock the cylinder slightly using both hands or tap its base gently with a rubber mallet. Continue to lift the cylinder until you can access the gudgeon pin (3).
Since insertion of piston in the barrel is a difficult operation to perform at the time of reassembly, remove the piston together with the barrel as described below.
Stuff the crankcase opening with a rag or soft paper to prevent foreign material from falling in.

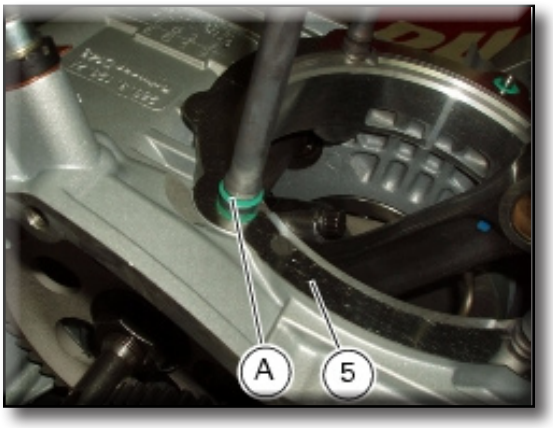


Remove the circlip (2) from the gudgeon pin (3) on the clutch side.



Working from the opposite side, drive out the gudgeon pin sufficiently to release the connecting rod.
Lift the barrel/piston assembly clear of the crankcase studs. If work is to be carried out on the piston, carefully withdraw it from the cylinder.

Remove the four O-rings (A) located on the crankcase studs between the barrel and the base gasket (5).



Important

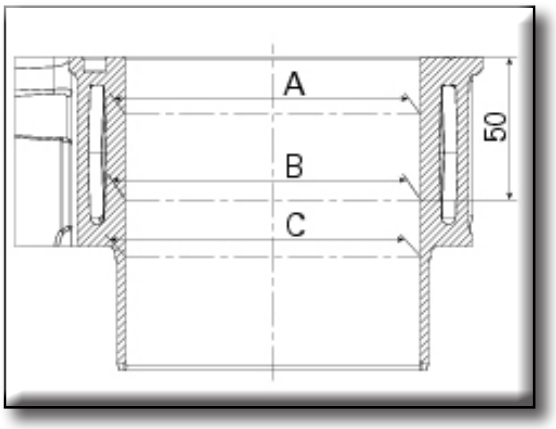
Mark the pistons to show from which cylinder they were removed:
V= Vertical - H= Horizontal

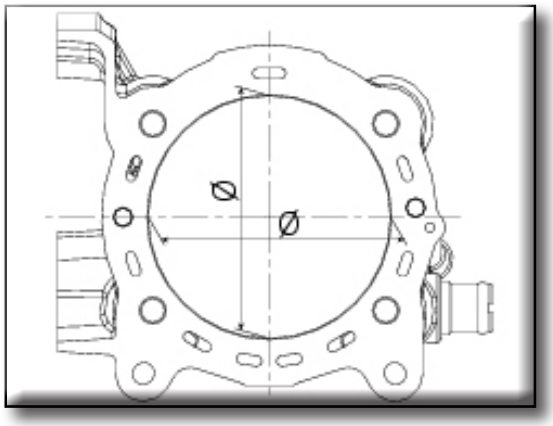
To remove the vertical barrel-piston assembly, bring the vertical piston to TDC and proceed as for removal of the horizontal cylinder barrel.

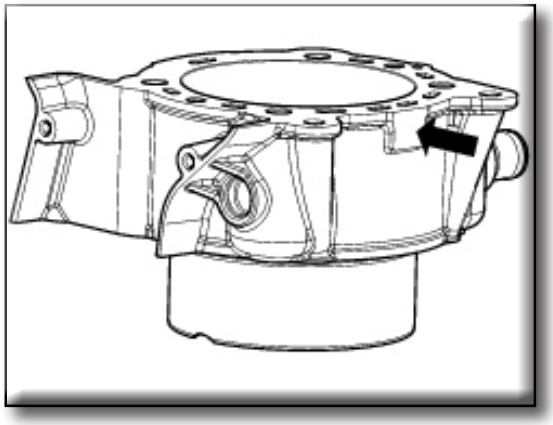
Overhaul of the cylinder barrel/piston components

Overhauling the cylinder

Check that the walls are perfectly smooth. Measure the cylinder bore diameter at 50 mm from the top surface and determine the size class to which it belongs in accordance with the values specified in Sect. Cylinder/ Piston. Measure the bore diameter again at three different heights A, B and C and at positions offset by 90°; check that the measurements of taper and ovality in the bore fall within the range specified in Sect. Cylinder/ Piston.
In the event of damage or excessive wear the barrel must be renewed as it has a silicon carbide coating (which provides the cylinder walls with excellent anti-friction and anti-wear properties) and therefore cannot be rebored.
The cylinder barrels are marked with letters (stamped between two oil return ways) indicating their size class. Always match cylinders with pistons from the same size class.

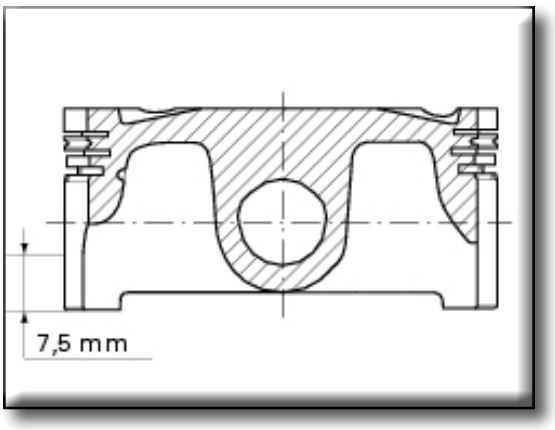






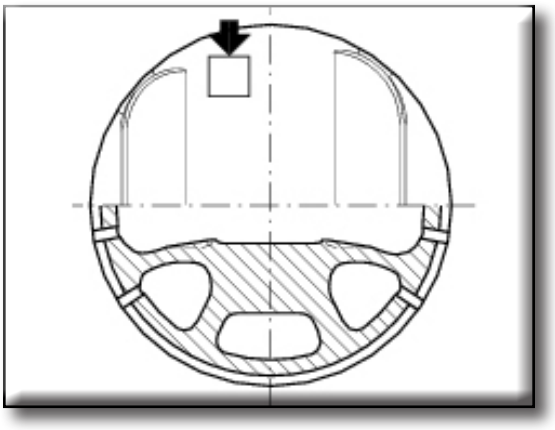
Overhauling the piston

Clean the piston crown and piston ring grooves of any carbon deposits.
Inspect the piston and check its dimensions carefully: there must be no signs of scuffing, scoring, cracks, or other damage.
The piston diameter must be measured at 7.5 mm up from the bottom of the skirt at a 90º angle to the gudgeon pin. The pistons must always be renewed as a pair.



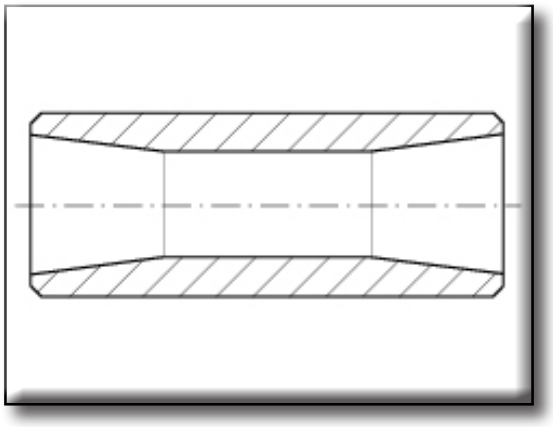
Checking the piston-cylinder clearance

The pistons are marked by a letter (punched into the piston crown) that indicates the size class to which they belong. Always match cylinders with pistons from the same size class.
For the values, refer to Sect. “Cylinder/Piston”.



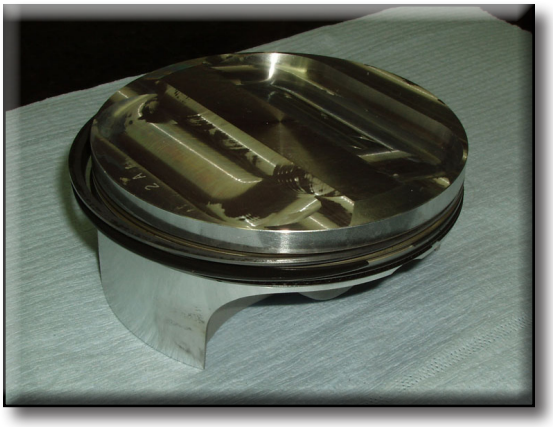
Overhauling the gudgeon pins

Gudgeon pins must be perfectly smooth without signs of scoring, steps, or blueing due to overheating. The well-lubricated gudgeon pin must slide smoothly inside the piston without stiffness.
The assembly clearance with the piston at the time of installation must be 0.002-0.008 mm.
The maximum permissible wear limit is 0.035 mm.
If a new gudgeon pin is fitted, you must also change the connecting rod small end bush.



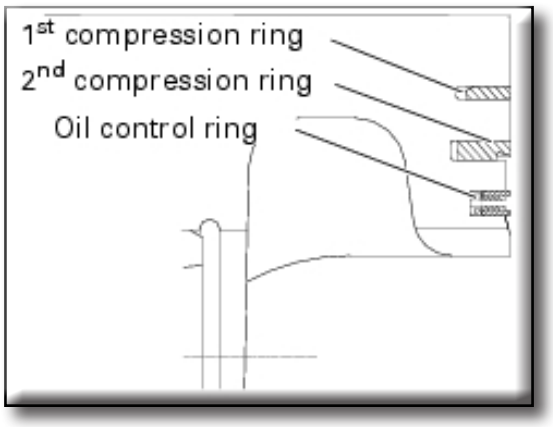
Overhauling the piston rings

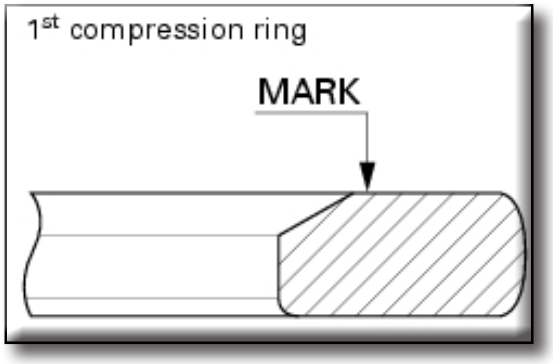
The piston rings must not show any signs of scuffing or scoring. Replacement pistons are supplied complete with piston rings and gudgeon pin.

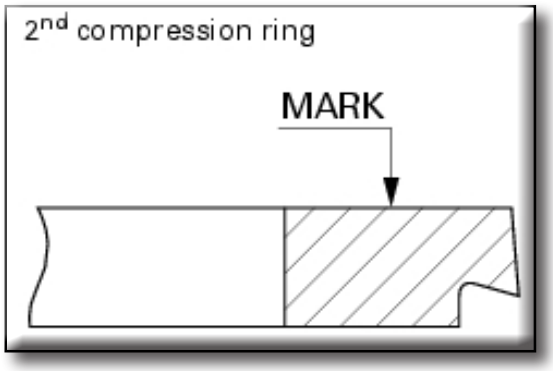


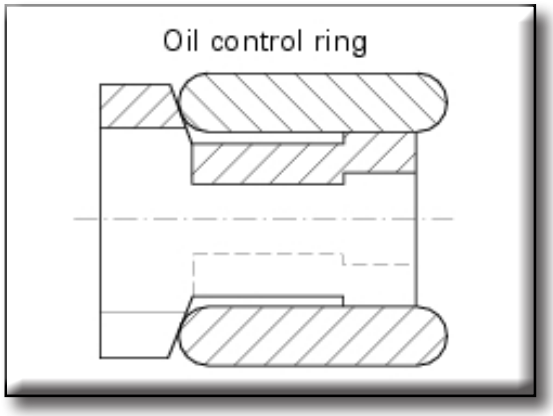
Checking the piston ring-grooves clearance

The maximum permissible wear limit is 0.15 mm for the top compression ring (1st) and 0.10 mm for the others (2nd and oil control ring).
The markings punched on the piston rings must always be facing upwards.





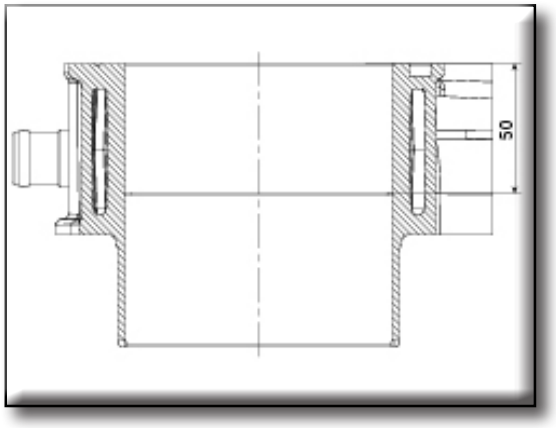


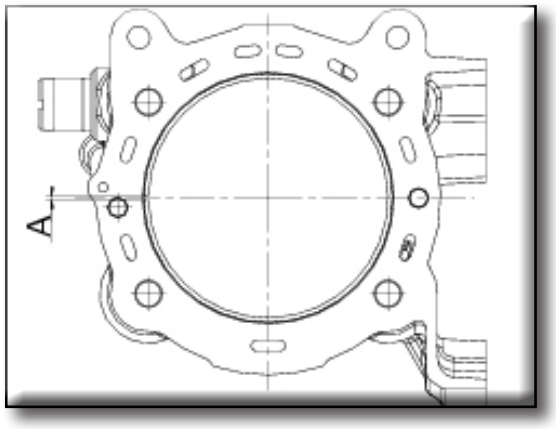


Checking the piston ring/cylinder clearance

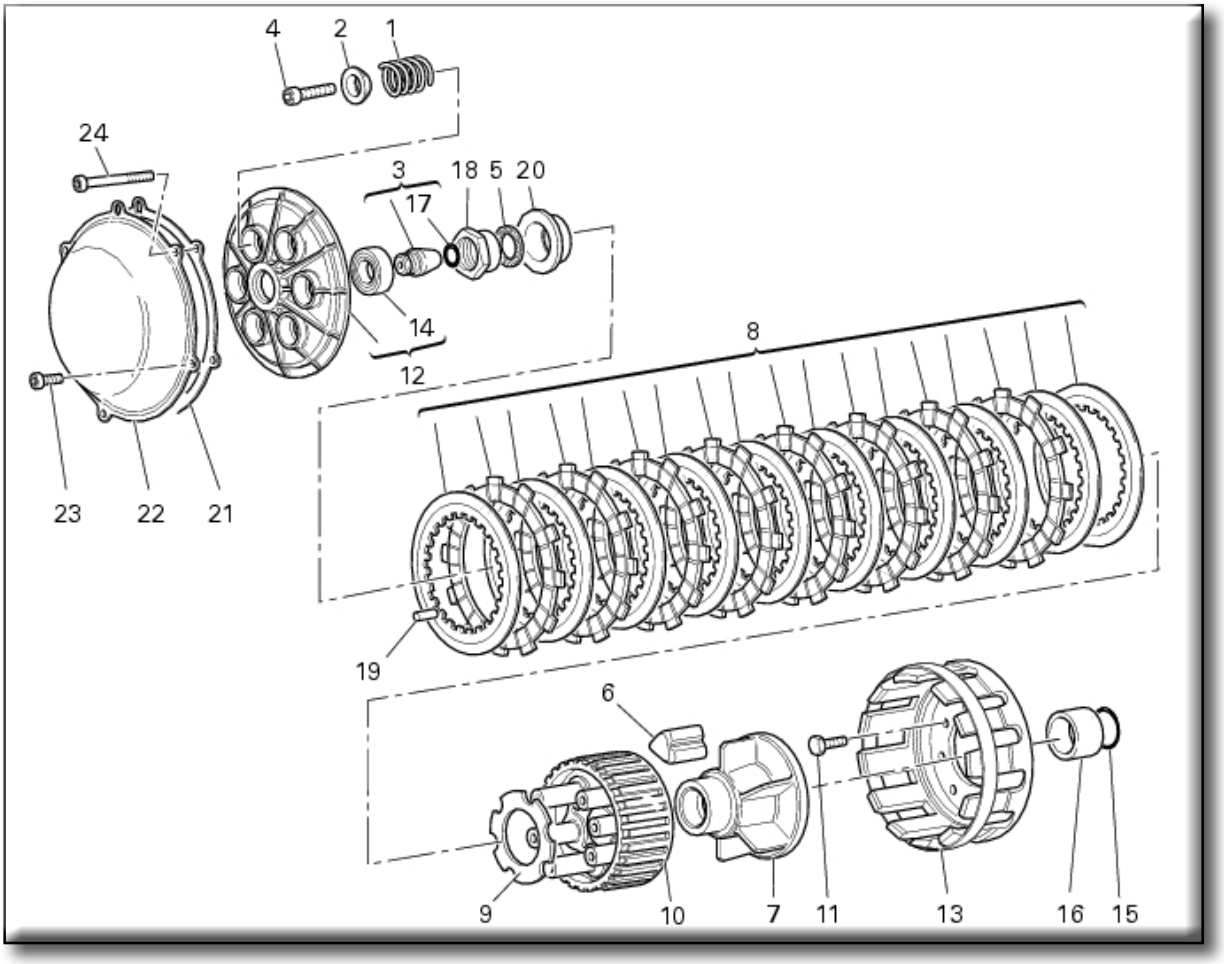
Insert the ring in the cylinder bore so that it is positioned 50 mm from the top face of the cylinder barrel; make sure that the ring is positioned perfectly square to the cylinder walls by checking with a gauge at several points around the ring that the top surface of the ring is exactly 50 mm from the top face of the cylinder barrel. Measure the piston ring gap (A):

	Distance (A) mm	Wear limit
Top compression ring	0,2 ÷ 0,4	0,8
Second compression ring	0,3 ÷ 0,5	0,8
Oil control ring	0,2 ÷ 0,7	1,0





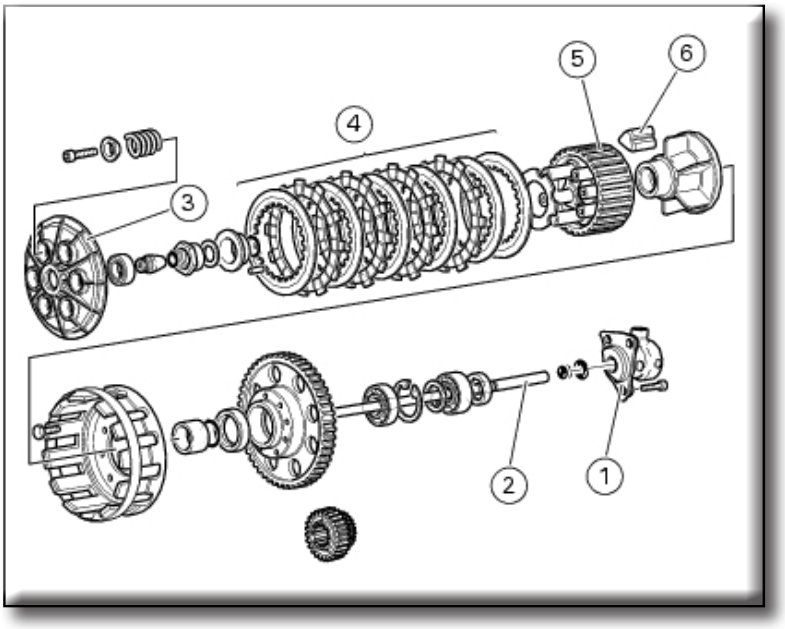
11.12 - CLUTCH ASSEMBLY: CLUTCH



1) Clutch spring
2) Collar
3) Clutch lifter
4) Bolt
5) Lock washer
6) Cush drive rubber
7) Cush drive hub
8) Clutch plates
9) Thrust washer
10) Clutch centre
11) Bolt
12) Pressure plate
13) Clutch drum
14) Bearing
15) O-ring
16) Spacer
17) O-ring
18) Nut
19) Locating dowel
20) Bush
21) Clutch cover gasket
22) Clutch cover
23) Bolt
24) Bolt

Description

The clutch is disengaged by a slave cylinder consisting of a piston (1) housed inside a cylinder mounted to the left-hand crankcase cover.
This piston (1) moves a pushrod (2), which runs through gearbox input shaft and operates the pressure plate (3) located on top of the clutch plate pack (4).
Motion is transmitted from the clutch centre (5) to the primary shaft through special cush drive rubbers (6), which make for smoother clutch engagement and thus prevent damage to transmission parts. Before working on the internal clutch parts, check that the clutch operates correctly.
Then deal with the problem in a systematic manner.



The following is a list of possible causes of clutch malfunctions.

A clutch which does not disengage may be caused by:
- excessive play of the control lever;
- distorted clutch plates;
- incorrect spring tension;
- faulty clutch release mechanism;
- excessive wear of the hub or clutch drum.

A clutch which slips may be caused by:
- insufficient play of the control lever;
- worn clutch plates;
- weakened springs;
- faulty clutch release mechanism;
- excessive wear of the hub or clutch drum.

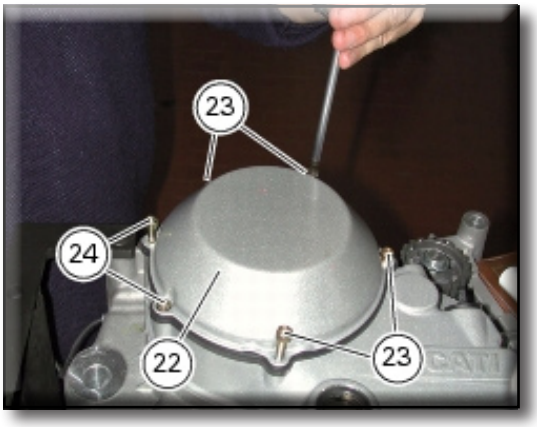
A noisy clutch may be caused by:
- excessive backlash between the primary drive gears;
- damaged primary drive gear teeth;
- excessive play between driving plate tabs and clutch drum;
- worn gear/clutch drum bearings;
- worn cush drive rubbers;
- the presence of metal particles (filings) on the gear teeth.

Removal of the clutch

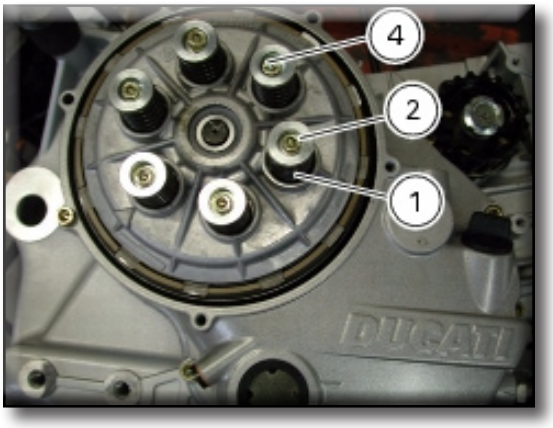
Remove the side fairings

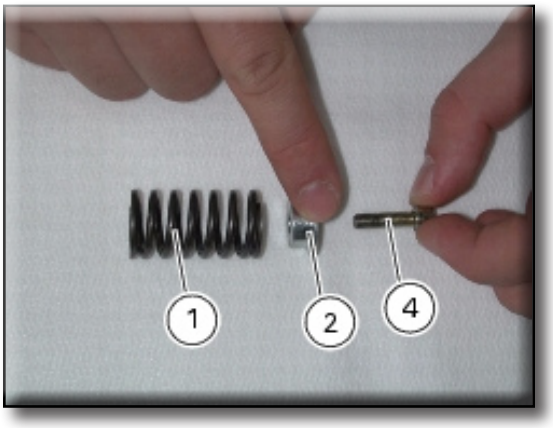
Notes
For clarity, the figures show the engine removed from the frame.

Undo the four retaining bolts (23) and the two retaining bolts (24) from the clutch cover (22).
Remove the cover and the sound deadening gasket (21).

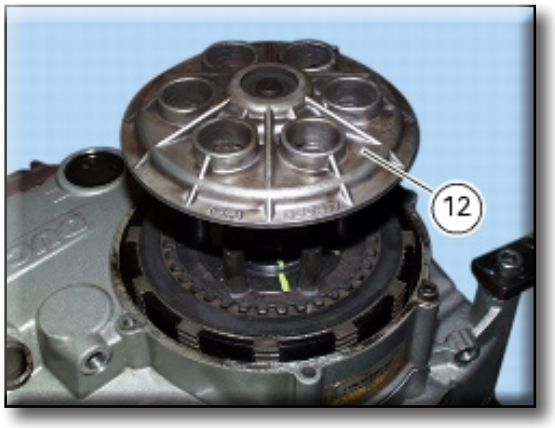


Unscrew the retaining bolts (4) and remove the collars (2) and the clutch springs (1).



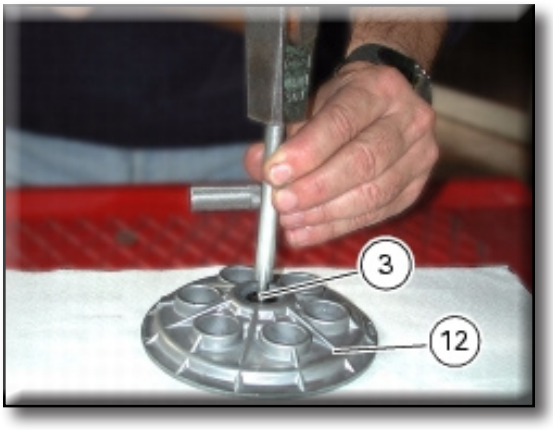


Remove the pressure plate (12).

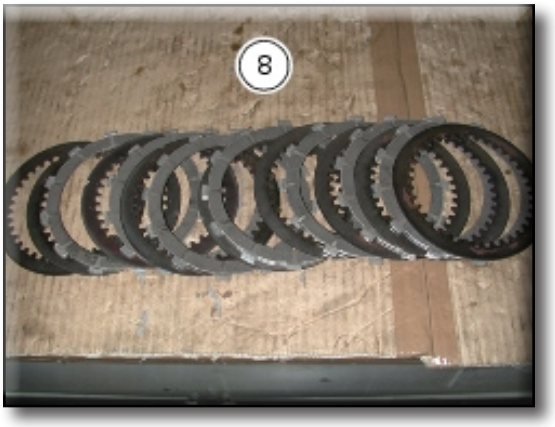


Remove the clutch lifter (3) and its O-ring (17) using a suitable drift and a plastic headed mallet.
Then remove the bearing (14) installed from inner side of the pressure plate (12) using a drift of suitable size.

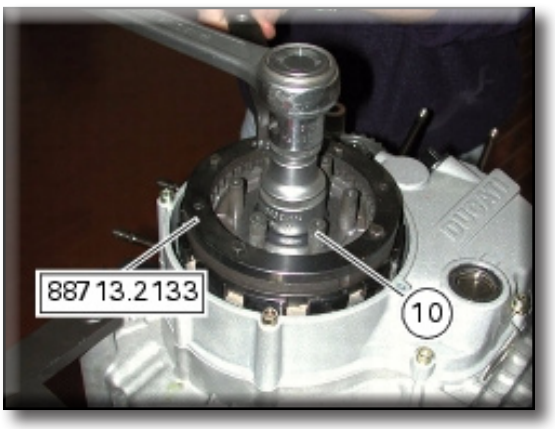
Notes
Once disturbed, the bearing must be renewed.



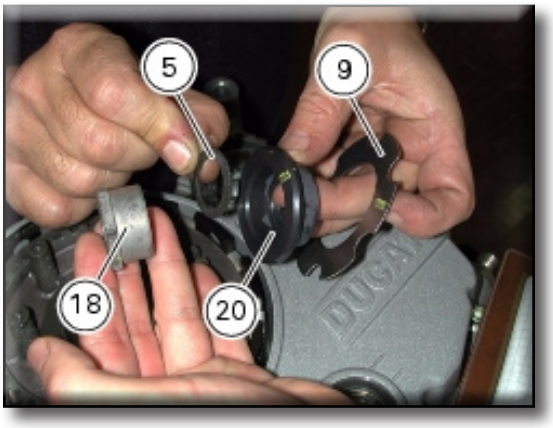
Remove the clutch plates (8).
When removing the clutch plates, keep them together in pairs in the correct order and set them aside, tying them together, if necessary.



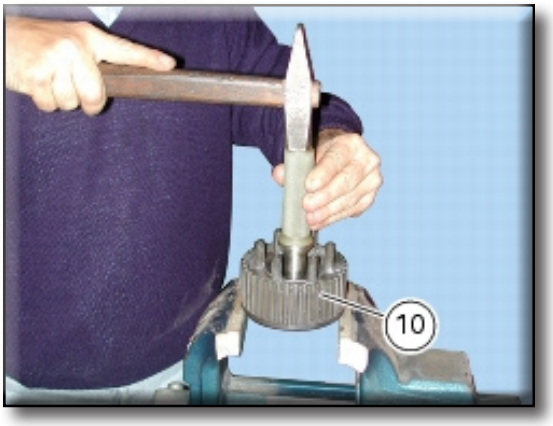
Restrain the clutch centre (10) using service tool 88713.2133 and remove the centre nut (18).



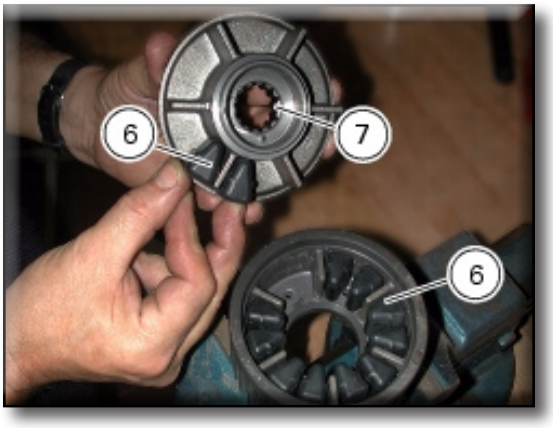
Remove the washer (5), bush (20) and thrust washer (9).



Remove the clutch centre (10) complete with the cush drive rubbers from the shaft.



When renewing the cush drive rubbers (6), use a drift to remove the hub (7) from the clutch centre (10) and overcome the resistance of the rubbers.

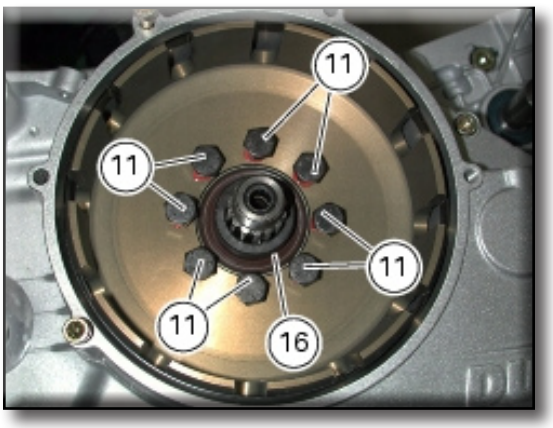


Slide off the spacer (16), taking care not to damage its internal O-ring (15).

Visually check the O-ring for wear and renew it if necessary.
Locate the service tool 88713.1805 to prevent the clutch drum from rotating when loosening the screws (11).

Notes
If no cover parts need to be serviced, leave the clutch drum assembly and the primary drive gear installed on the clutch cover.

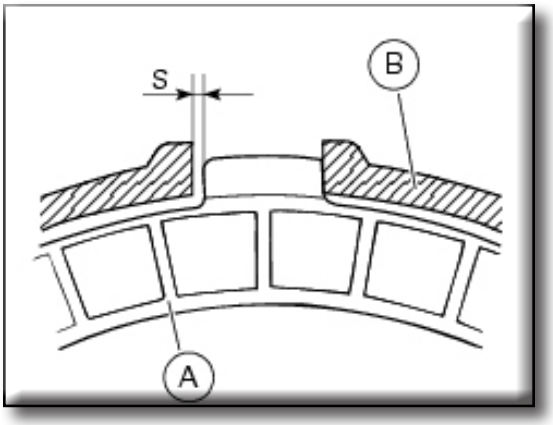
Undo the eight bolts (11) securing the clutch drum to the primary drive gear.
Remove the clutch drum.



Inspection and overhaul of the clutch components

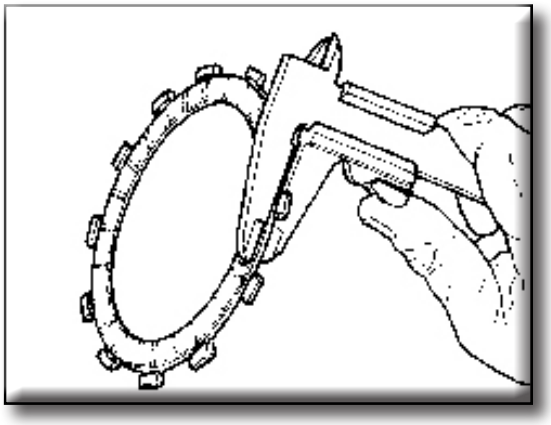
Checking the clearance between the clutch drum and the friction plates

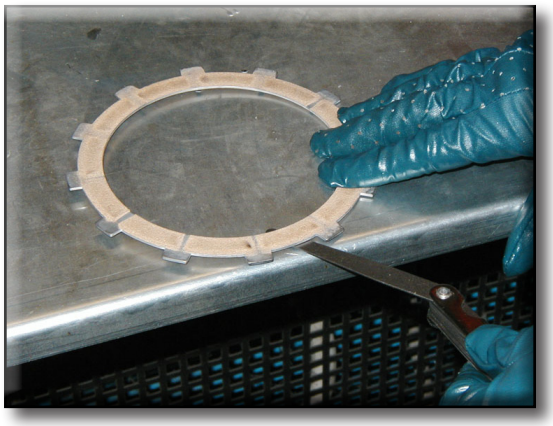
Insert the friction plate (A) in the clutch drum (B) and measure tang-to-slot clearance (S) with a feeler gauge.
The clearance “S” must not exceed 0.6 mm.
If it does, renew the plates and, if necessary, the clutch drum.



Overhaul of the friction plates

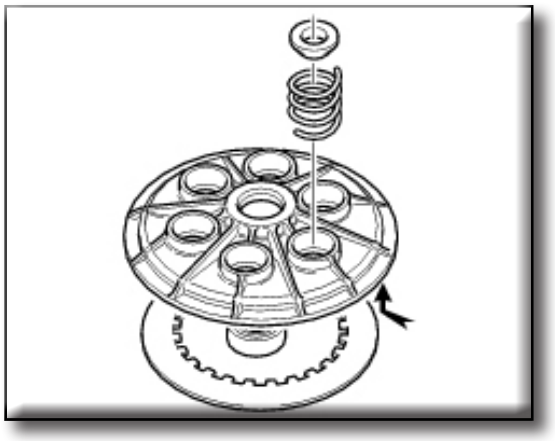
The friction plates must not show any signs of blackening, grooves or deformation.
Measure the thickness of the friction plates. It should not be less than 2.8 mm.
Place the plate on a flat surface and check the amount of deformation with a feeler gauge.
Max flatness error: 0.2 mm.





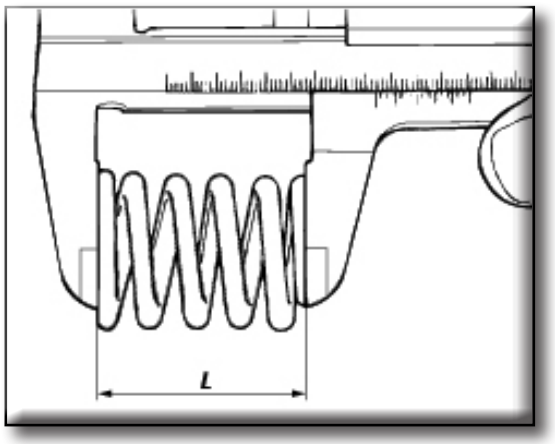
Overhaul of the pressure plate

Check the condition of the bearing: renew the bearing if the play is excessive.
Check the contact surface of last plain steel plate. If extremely scored, polish it in the same manner as described previously for the cylinder head surface.
Check the condition of the spring guide cups and always replace the spring retaining collars.

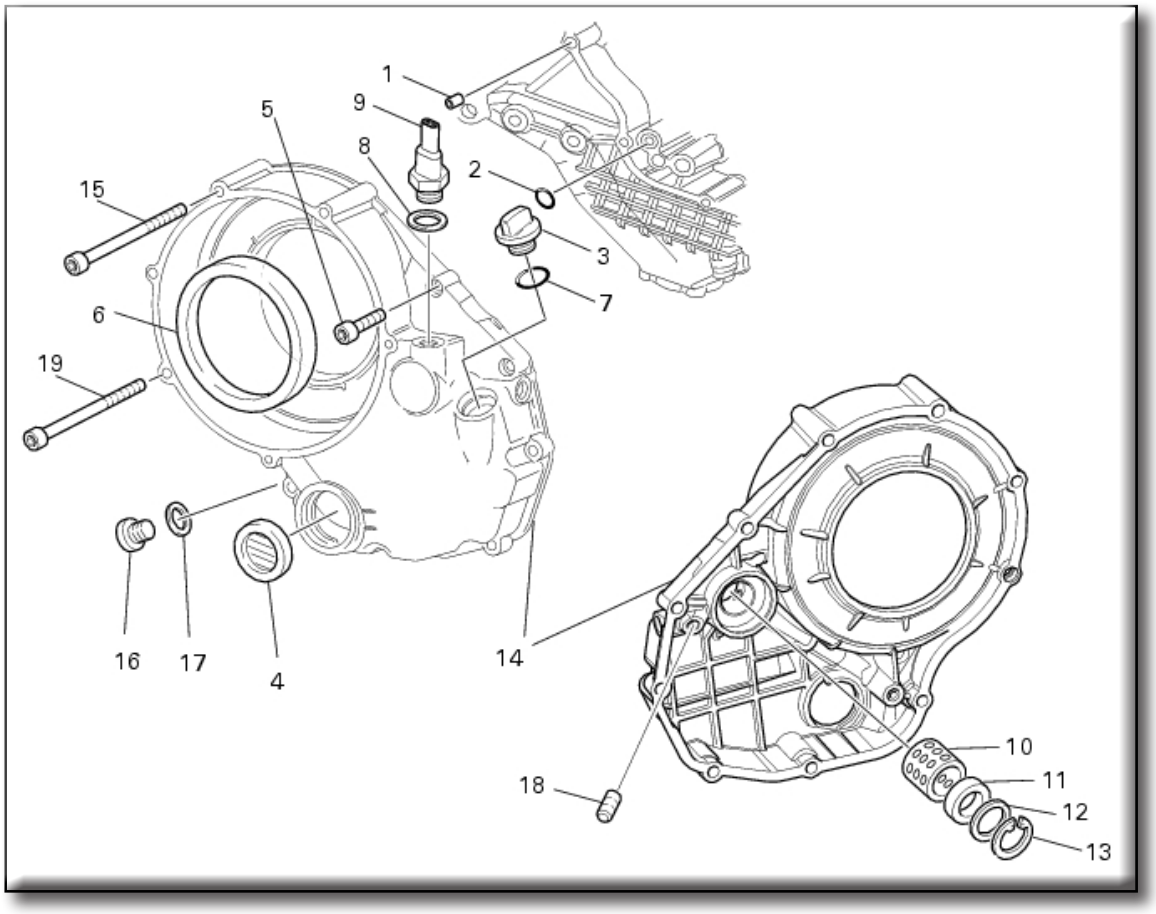


Overhaul of the clutch springs

Measure the length “L” of each spring:
Minimum length: 36,5 mm.
Renew any springs that are shorter than the above limit value.



11.13 - CLUTCH ASSEMBLY: RIGHT-HAND SIDE CRANKCASE COVER



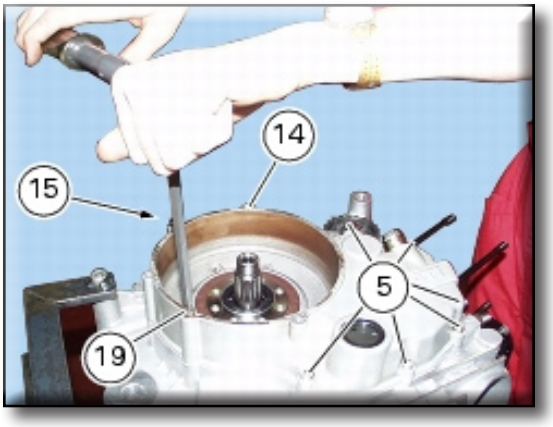
1) Locating dowel
2) O-ring
3) Plug
4) Oil level plug
5) Bolt
6) Ring
7) O-ring
8) Seal
9) Switch
10) Bush
11) Oil seal
12) Shim
13) Circlip
14) Right-hand side crankcase cover
15) Bolt
16) Plug
17) Seal
18) Grub screw
19) Bolt

Removal of the right-hand side crankcase cover

Remove the side fairings
Drain the engine oil
Remove the clutch centre

Notes
For clarity, the figures show the engine removed from the frame.

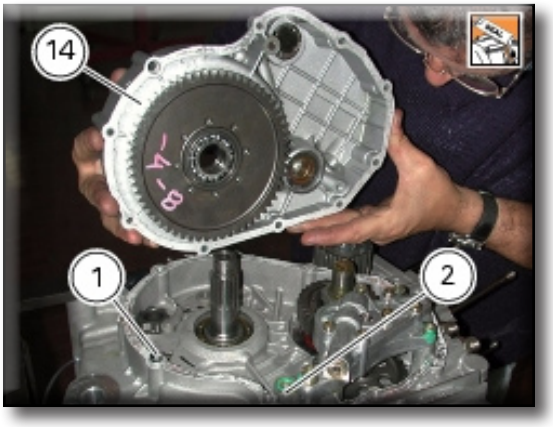
Undo and remove the six short bolts (5) and the long retaining bolts (15) and (19) from the crankcase cover (14).



Tap around the edge of the cover with a plastic mallet to detach it from the crankcase half.
Remove the right-hand side crankcase cover from the crankcase, taking care to recover the locating dowel (1).

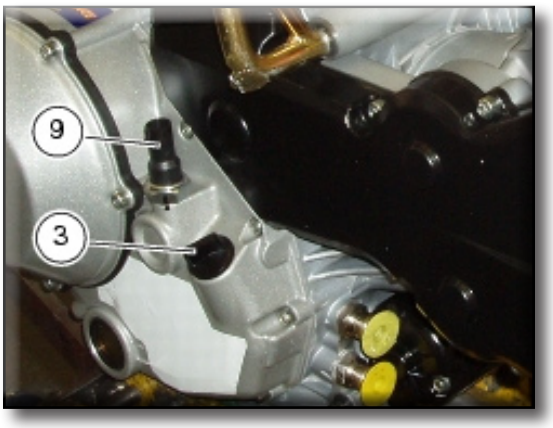
Important
The right-hand crankcase cover (14) can be removed complete with the clutch drum and primary drive gear.

Remove the O-ring (2) located next to the crankcase oil way.

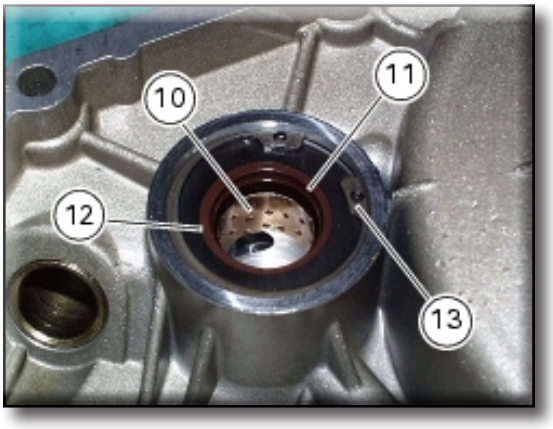


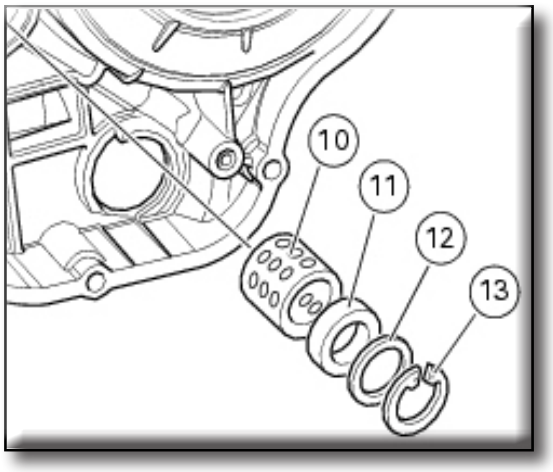
Disassembly of the right-hand side crankcase cover

Remove the plug (3) and the O-ring (7), the engine oil pressure sensor (9) and the seal (8), the plug (16) and the seal (17) from the crankcase cover.

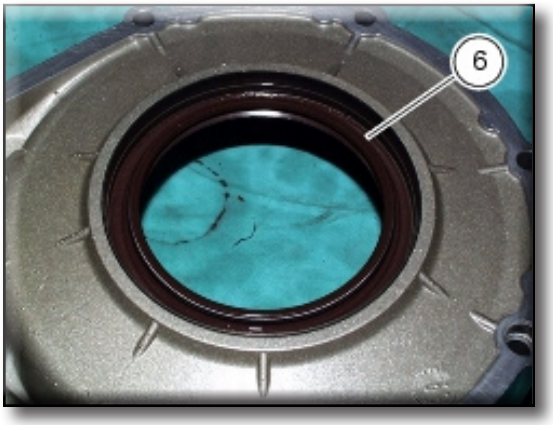


Remove the circlip (13) and withdraw the shim (12) and the oil seal (11).
The drilled bush (10) is mounted to the cover by a forced interference fit. Remove it using a suitable puller.
Inspect the oil seal (11) and renew it if necessary.

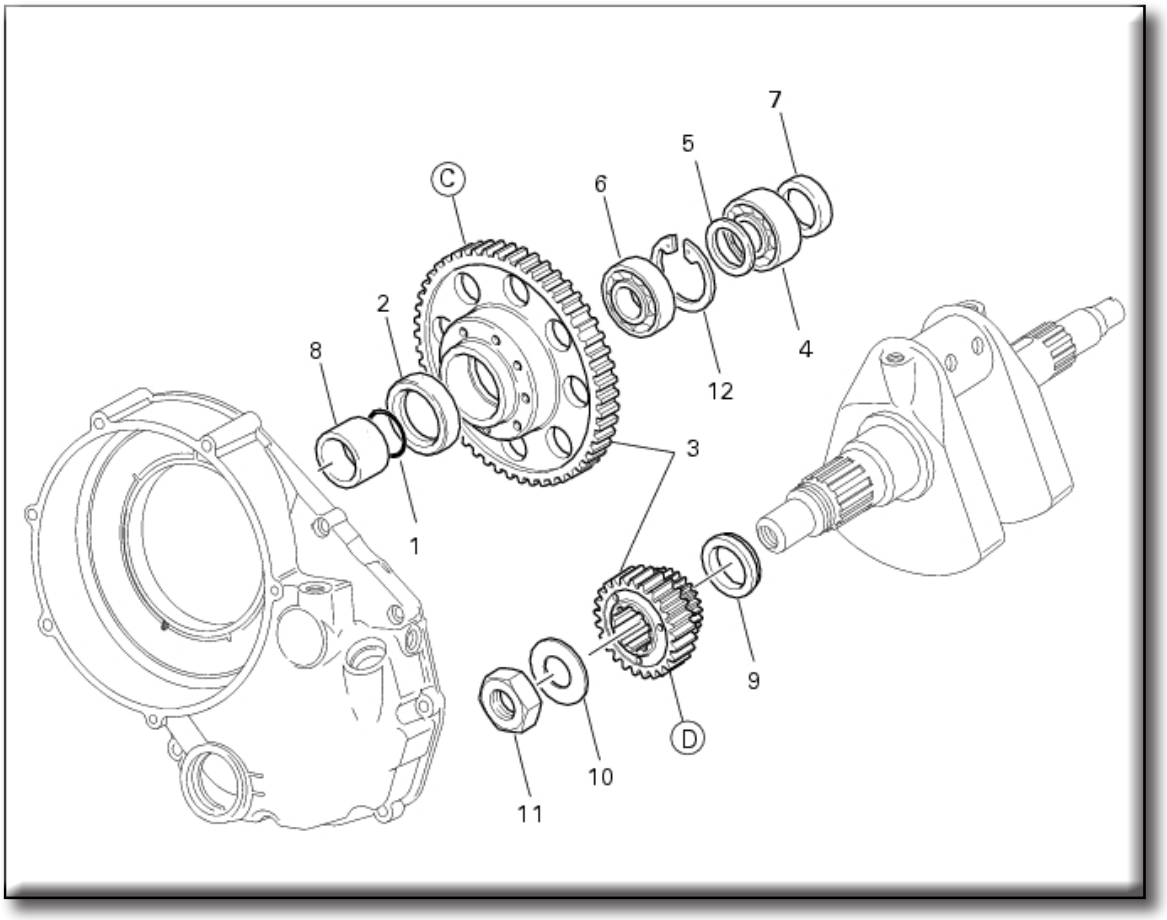




To check the condition of the oil seal (6) installed in the crankcase cover between the clutch drum and the primary drive gear, first remove the latter two components Sect. “Removal of the clutch”.



11.14 - CLUTCH ASSEMBLY: PRIMARY DRIVE GEARS



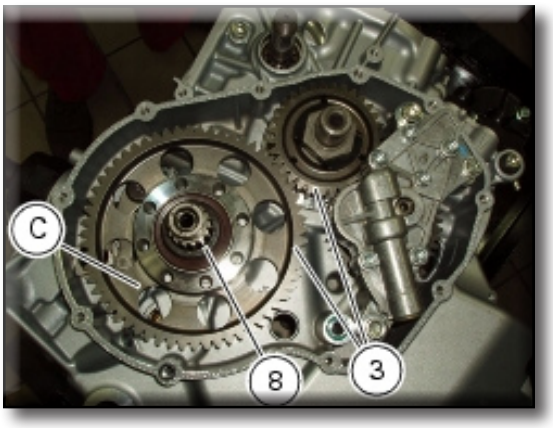
1) O-ring
2) Oil seal
3) Primary drive gears
4) Bearing
5) Circlip
6) Bearing
7) Spacer
8) Spacer
9) Spacer
10) Lock washer
11) Nut
12) Circlip

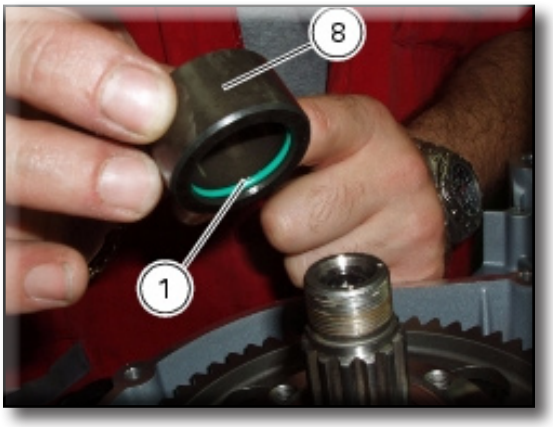
Removal of the primary drive gears

Remove the side fairings
Remove the clutch drum, the clutch centre and the clutch plate pack
Remove the right-hand side crankcase cover

Notes
For clarity, the figures show the engine removed from the frame.

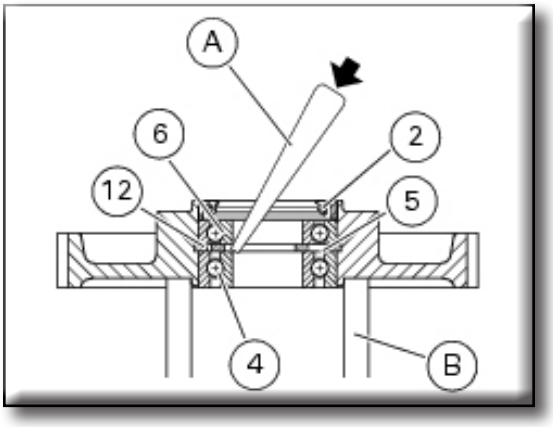
Withdraw from the input shaft the spacer (8) and the O-ring (1) seated against the bearing (6) of the driven gear (C) of the primary drive (3).
Remove the driven gear (C) of the primary drive (3) complete with the bearings and oil seal.



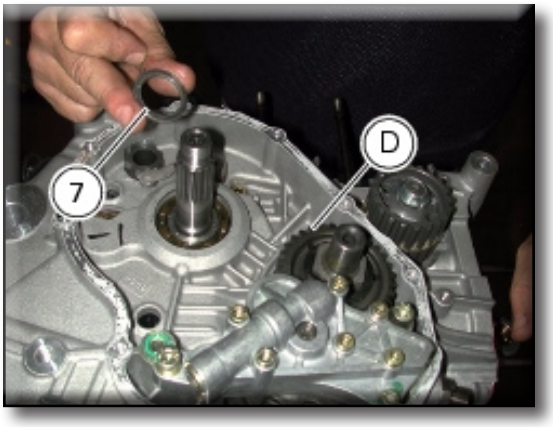


To renew the inner parts of the gear, use a suitable drift (A) and a support (B).
After removing the oil seal (2), tap from the inside towards the exterior using part of the inner race of bearing (4) to be removed, after moving aside spacer (5) located between the two bearings.
Tap on different points to remove the components squarely.
Use the same technique to remove the bearing (6).

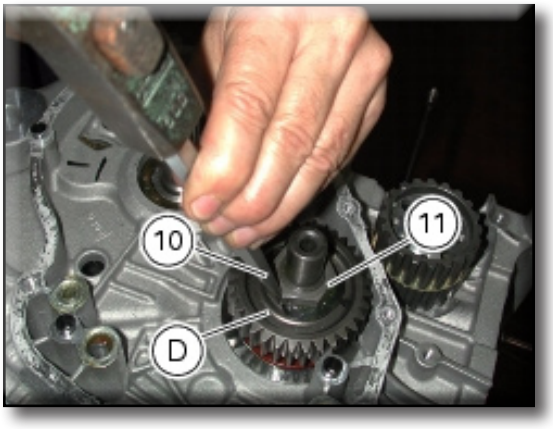
Important
Once disturbed, the oil seal (2), circlip (12) and the spacer (5) must be renewed. The latter two components must always be renewed as a pair.



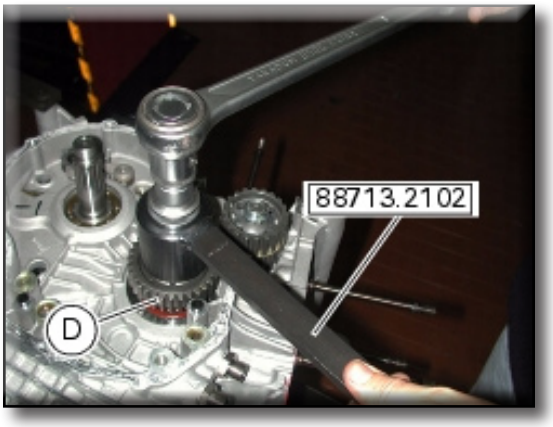
Remove the spacer (7) from the gearbox input shaft.
Remove the oil pump (Sect. N 2.1, Removal of the oil pump) in order to be able to disengage the driving gear (D).



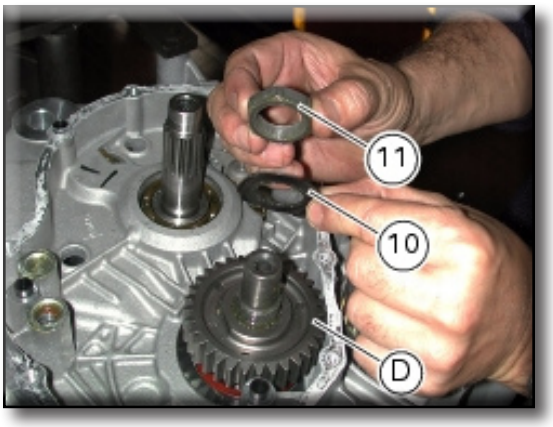
Straighten out the lock washer (10) on the nut (11) securing the driving gear (D) of the primary drive pair.



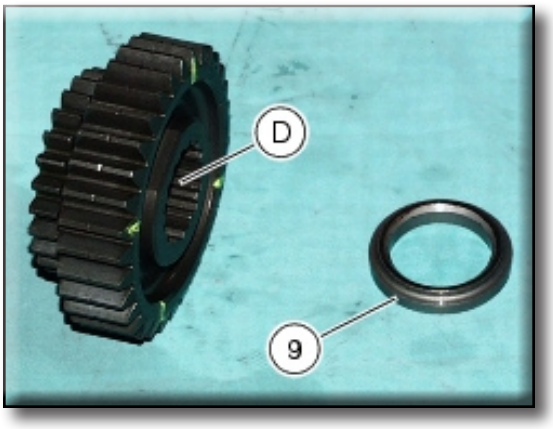
Install the tool 88713.2102 on the gear (D) and hold it against rotation by inserting a pin in one of the engine mounting bolt holes.



Loosen the retaining nut (11) of the driving gear (D) using a socket wrench of suitable length.
Remove the nut (11) and the lock washer (10).

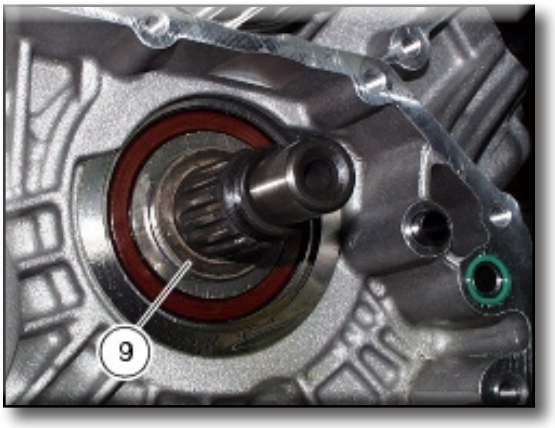


Remove the driving gear (D) of the primary drive and the spacer (9) from the crankshaft.

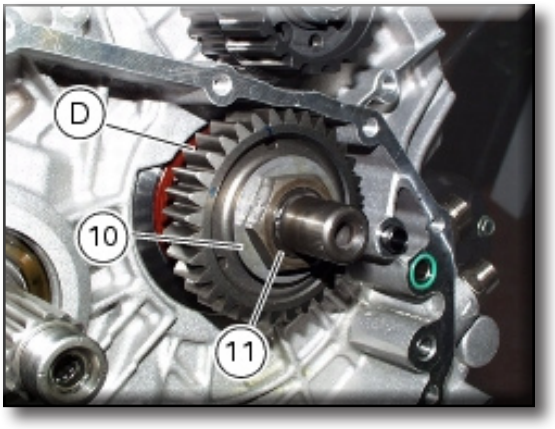


Refitting the primary drive gears and checking backlash

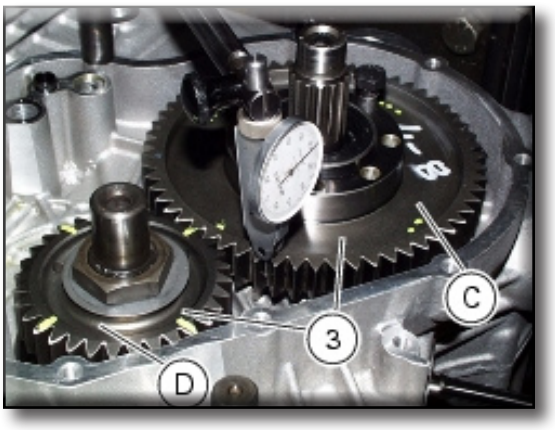
Carefully degrease the splined end of the crankshaft and the corresponding internal splines of the primary gear.
Fit the inner spacer (9) to the shaft with its flat side facing outwards.



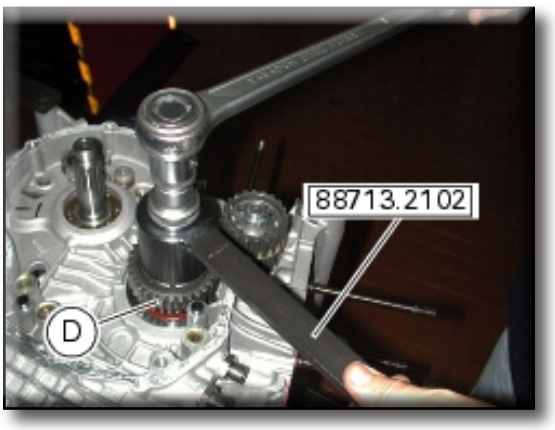
Fit gear (D) onto the crankshaft with oil pump drive sprocket facing the crankcase.
Temporarily secure the gear with washer (10) and nut (11).



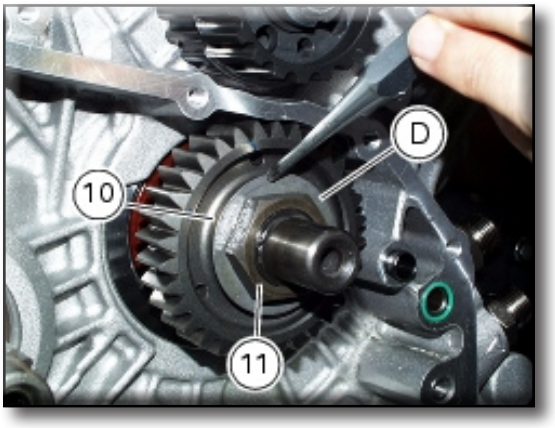
If fitting a new primary drive gear pair (3), check the backlash.
Temporarily fit the gear (C) complete with the bearings and the oil seal onto the gearbox input shaft and fix a dial gauge on the crankcase; position the dial gauge stylus on a gear tooth.
Turn the driven gear (D) to mesh the teeth and check with the dial tool that backlash ranges between 0.05 and 0.07 mm.
Measure the backlash at 16 diametrically opposed points of the gear.



If the measured values are outside the permissible tolerance, change the position of the driven gear (C) on the input shaft leaving crankcase gear (D) untouched. If still outside tolerance values, renew the primary drive gear pair.
When this test is complete, finally tighten the previously installed nut (11).
Install the tool 88713.2102 on the gear (D) and hold it against rotation by inserting a pin in one of the engine mounting bolt holes.
Tighten the nut to the specified torque with a torque wrench, turning clockwise.



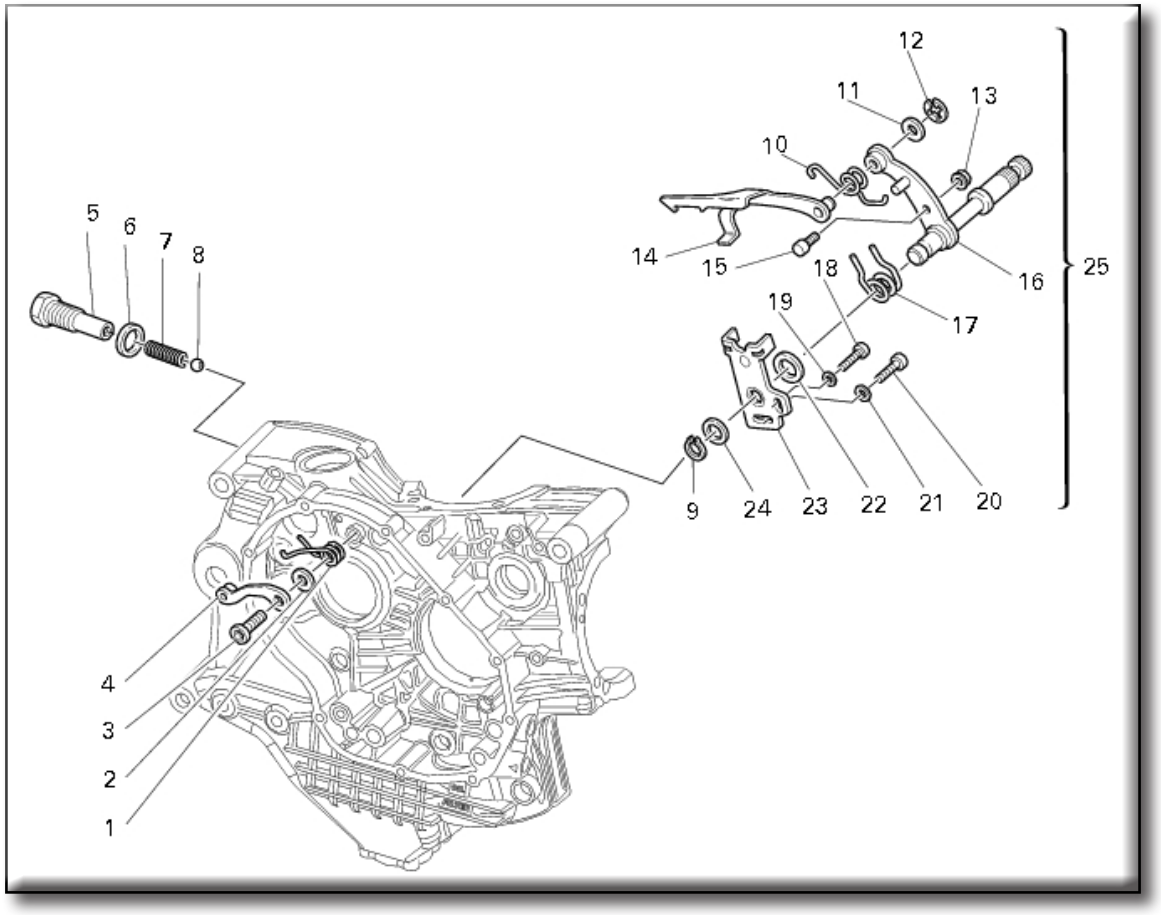
Stake the washer (10) on the gear (D) in correspondence with the milled location and on the nut (11) in a diagonally opposed position.



Refit the oil pump and check the meshing play between the oil pump gear and primary drive gear on the crankshaft

Refit the right-hand crankcase cover
Refit the clutch drum, clutch centre and the clutch plate pack
Refit the side fairings

11.15 - GEARBOX ASSEMBLY: GEARCHANGE MECHANISM

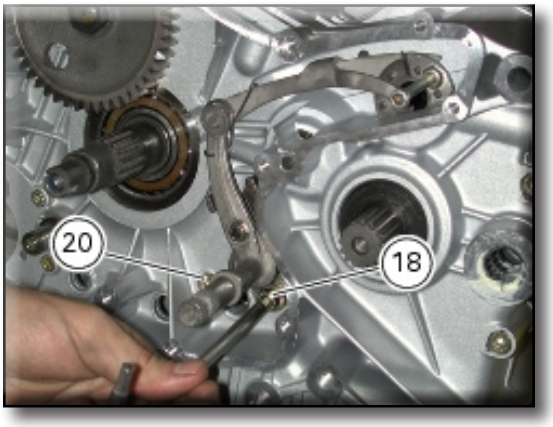


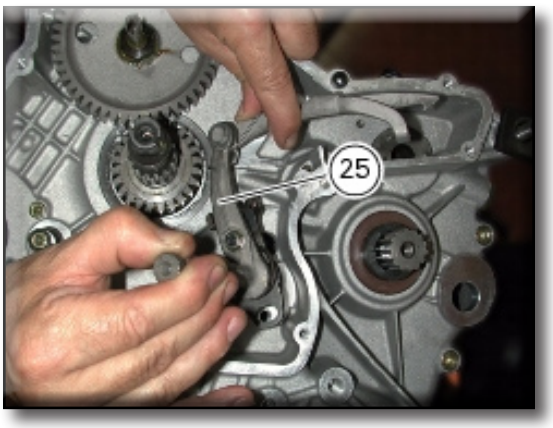
1) Return spring
2) Washer
3) Special screw
4) Gear pawl assembly
5) Interlock plunger holder
6) Seal
7) Detent ball spring
8) Ball
9) Circlip
10) Selector claw return spring
11) Shim, thk. 0.5 mm
12) Shim, thk. 0.2 mm
13) Ring
14) Nut
15) Selector drum control fork
16) Gearchange lever pin
17) Shaft with gearchange lever arm
18) Gearchange lever arm return spring
19) Bolt
20) Washer
21) Bolt
22) Washer
23) Locating ring
24) Stop plate
25) Shim, thk. 0.2 mm
26) Shim, thk. 0.5 mm
27) Gearchange mechanismompleto

Removal of the gearchange mechanism

Remove the left-hand side crankcase cover and flywheel/alternator assembly
Remove the right-hand side crankcase cover complete with clutch drum and primary drive gear

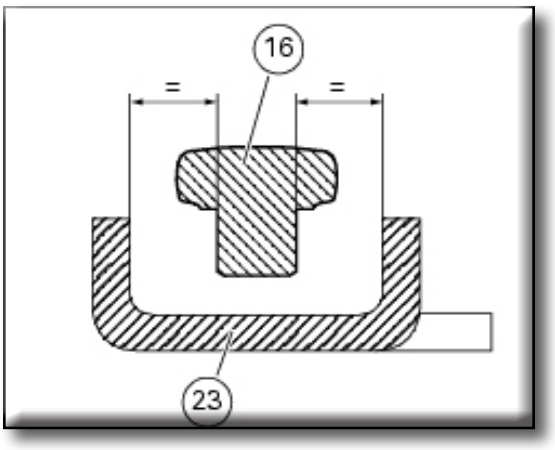
Undo and remove the bolts (18) and (20) securing the gearchange mechanism (25).
Remove the gearchange mechanism complete with the shaft, spring, and stop plate.



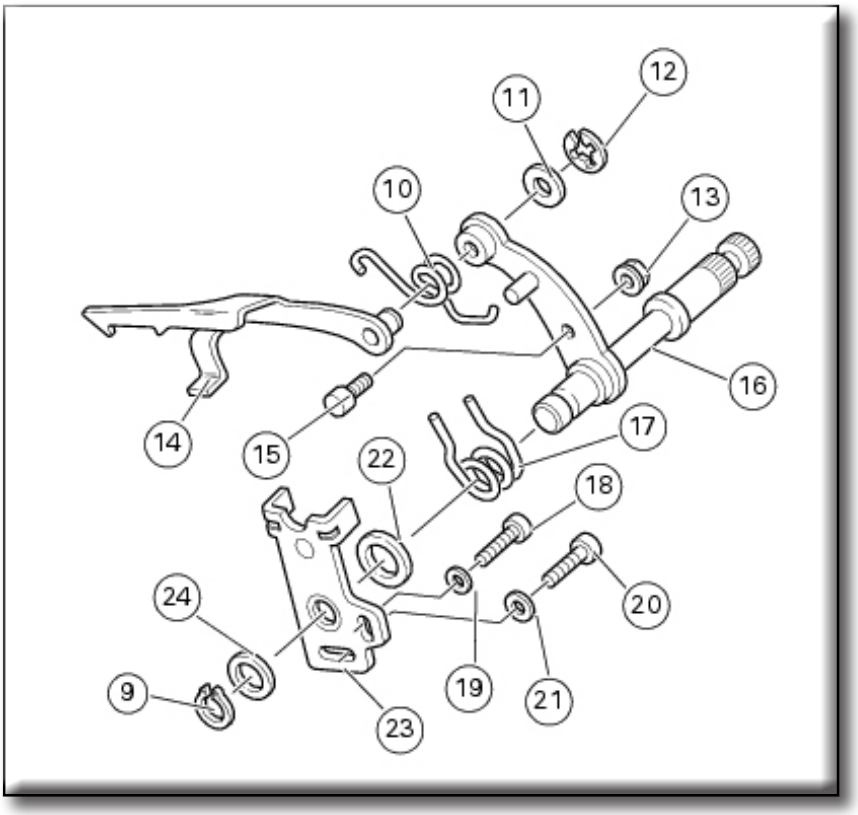


Important
Visually inspect the gear selector claw (14) for wear, particularly around the area where it contacts the selector drum.

If it proves necessary to change components, disassemble the gear selector lever as shown in the exploded view.
Reassemble the gearchange mechanism, orienting the eccentric pin (15) in such a way that the lever arm (16) is positioned centrally with respect to the shoulders of the stop plate (23).

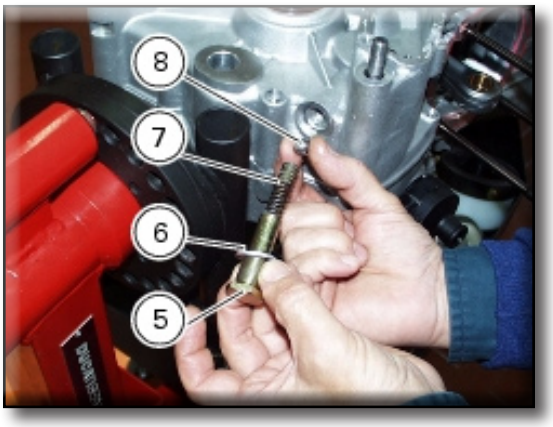


Now tighten the nut (13) to the specified torque

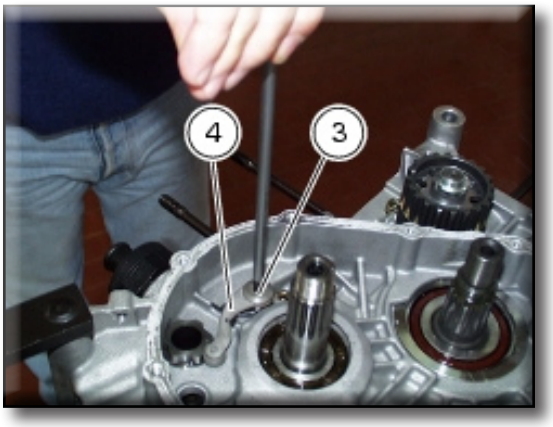


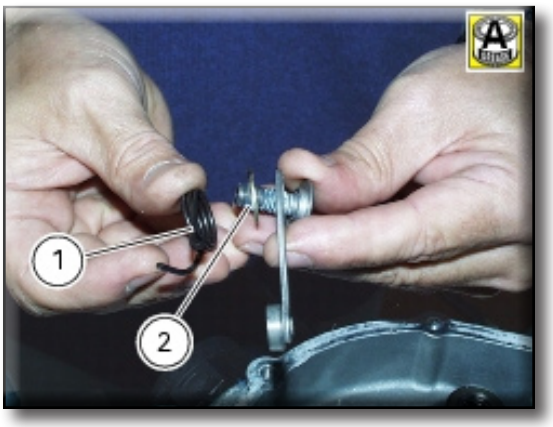
Disassembly of gear interlock plunger and pawl assembly

Unscrew the interlock plunger screw (5) and remove the seal (6), spring (7) and the detent ball (8).

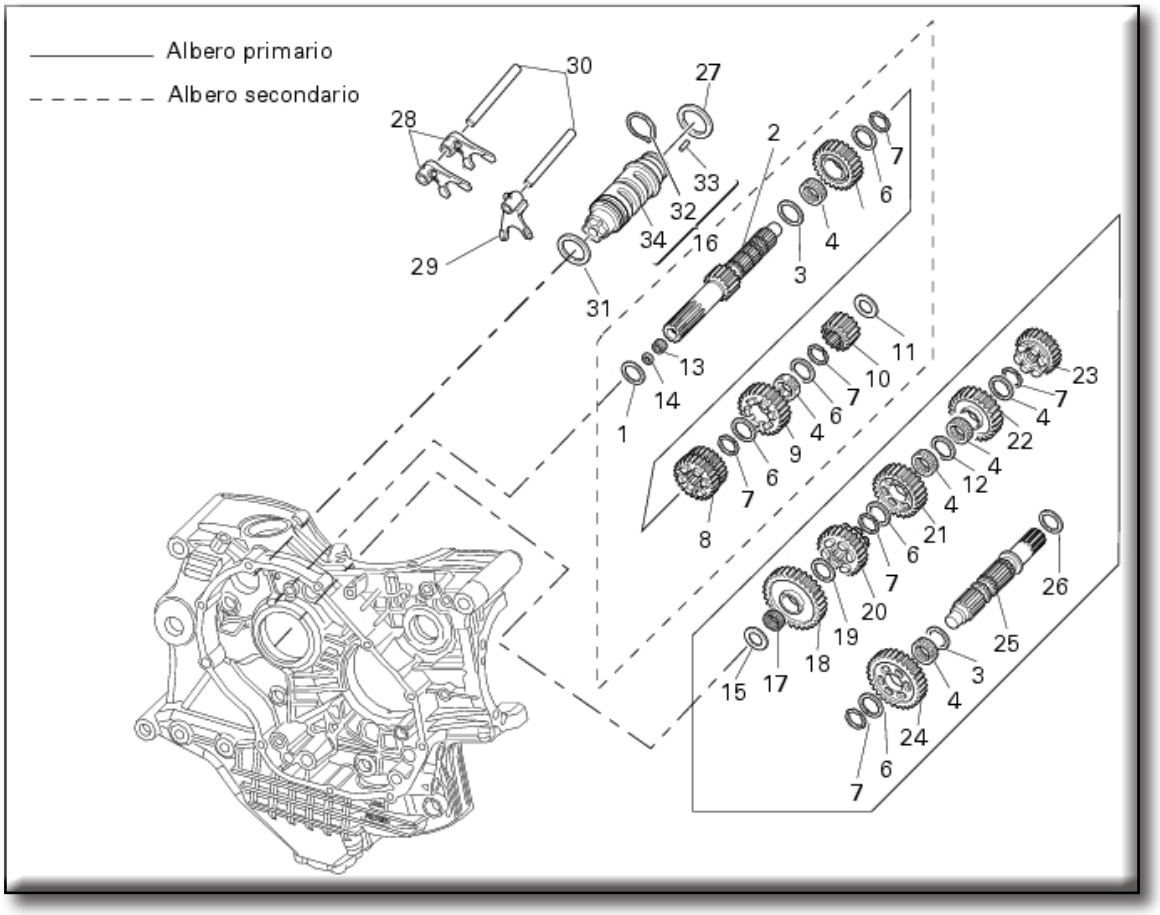


Unscrew the RH crankcase half bolt (3) and remove the pawl (4), washer (2) and spring (1).





11.16 - GEARBOX ASSEMBLY: GEARBOX SHAFTS

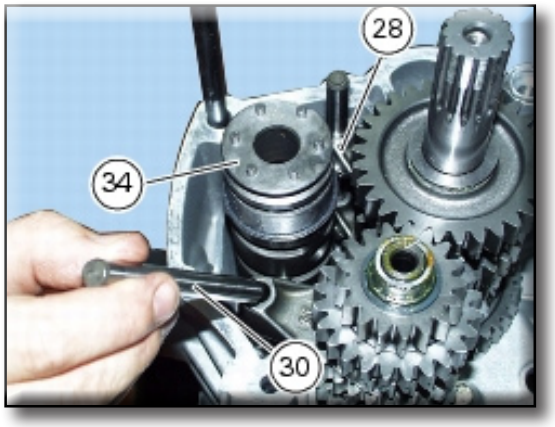


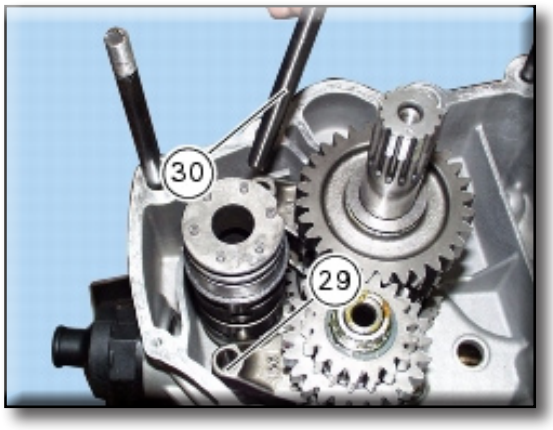
1) Shim, thk. 1 mm
2) Gearbox input shaft
3) Shim, thk. 0.5 mm
4) Needle roller bearing
5) 5th speed driving gear
6) Splined washer, thk. 0.5
7) Circlip
8) 3rd- 4th speed driving gear
9) 6th speed driving gear
10) 2nd speed driving gear
11) Shim, thk. 1.8 mm
12) Splined washer, thk. 0.5
13) Roller bearing
14) Oil seal
15) Shim
16) Selector drum assembly
17) Needle roller bearing
18) 1st speed driven gear
19) Shim, thk. 1 mm
20) 5th speed driven gear
21) 4th speed driven gear
22) 3rd speed driven gear
23) 6th speed driven gear
24) 2nd speed driven gear
25) Gearbox output shaft
26) Shim
27) Shim, thk. 1 mm
28) 1st, 4th- 2nd, 3rd speed selector fork
29) 5th, 6th speed selector fork
30) Selector fork shaft
31) Shim, thk. 1 mm
32) Needle roller retaining circlip (square cross-section)
33) Special needle roller (square cross-section)
34) Selector drum

Removal of the gearbox assembly

Remove the engine from the frame
Separate the crankcase halves

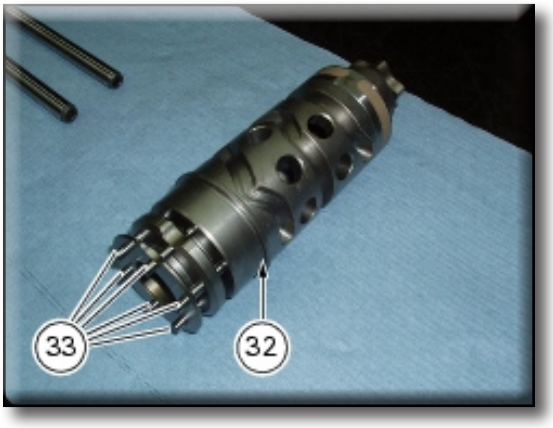
Withdraw the selector fork shafts (30).
Move the forks (28) and (29) to disengage them from the slots in the selector drum (34).



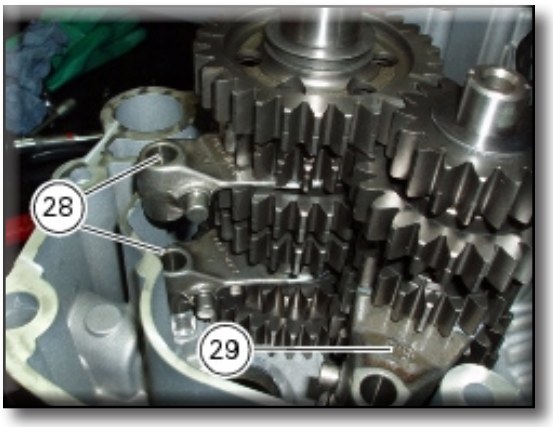


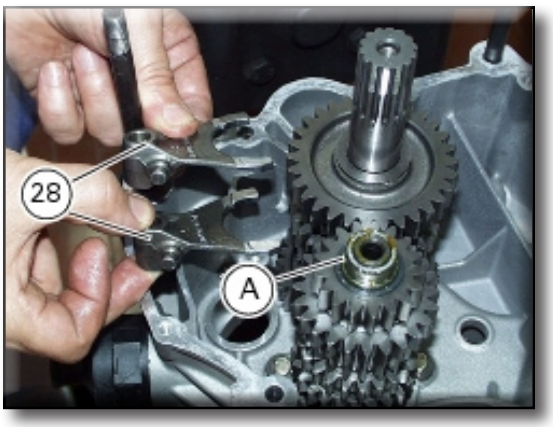
Withdraw the selector drum (16) taking care not to lose shims (31) and (27) mounted on the shaft. Note that the positions of the shims must not be inverted.

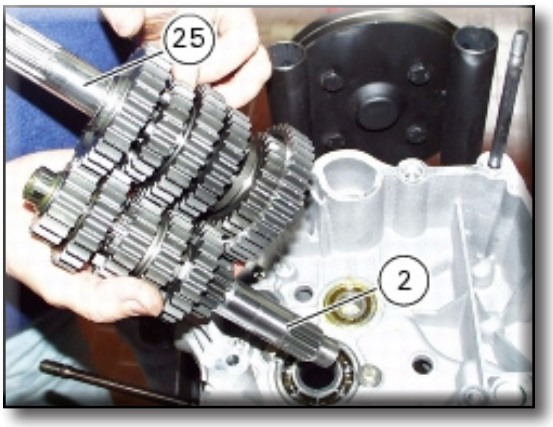
Now you can renew the needle roller retaining ring (32) and the special needle rollers (33).



Remove gear selector forks (29) and (28).
Remove the gearbox input (2) and output (25) shafts complete with gears, taking care to recover the spacers on the ends of the shafts.
If the bearing inner races (A) are left on the shafts, slide them off the ends of the gearbox input (2) and output (25) shafts Sect. “Separation of the crankcase halves”.







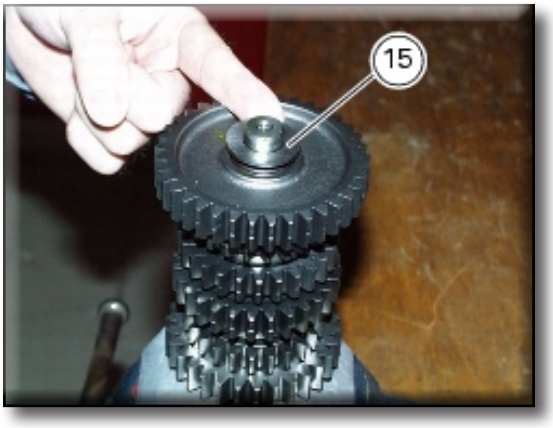
Disassembly of the gearbox shafts

Place the shaft in a vice in such a way as to facilitate the disassembly operations.

Important
Take care not to invert the positions of the shims on reassembly: this would potentially lead to jamming when using the gear selector control, making it necessary to reopen the engine crankcase.

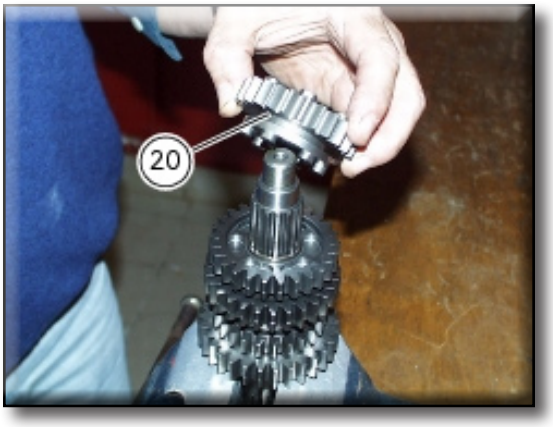
Disassembly of the gearbox output shaft

Remove the chain-side clearance washer (15) and clutch-side clearance washer (26) from the output shaft.

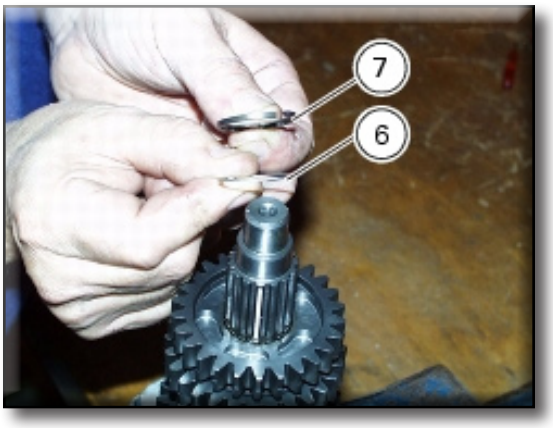


Withdraw the first speed driven gear (18) with the roller cage (17) and the shim (19).

Remove the fifth speed driven gear (20).



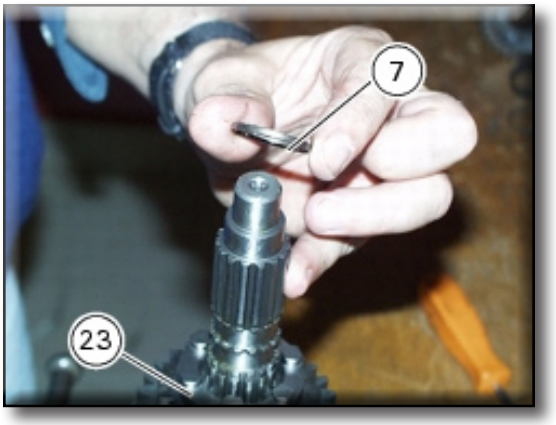
Use two flat screwdrivers to remove the circlip (7) taking care not to damage the shaft surface.
Remove the circlip (7) and the splined washer (6).



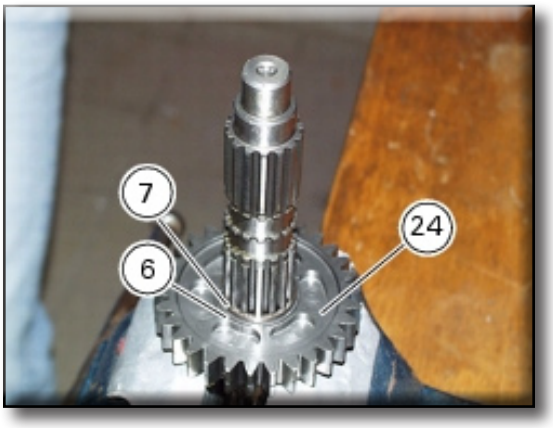
Withdraw the fourth speed driven gear (21) with the roller cage (4) and splined washer (12).

Remove the third speed driven gear (22) with the roller cage (4) and the splined washer (6).

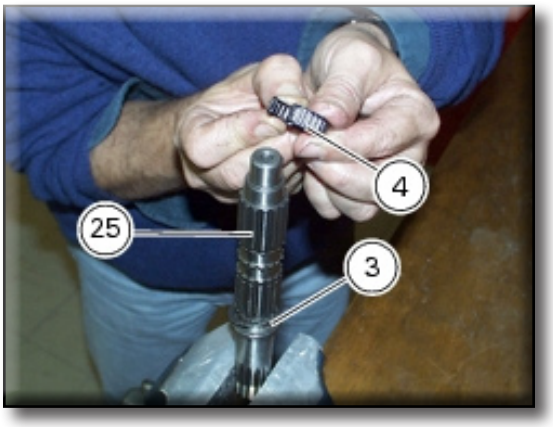
Remove the circlip (7) and remove the sixth speed driven gear (23).



Remove the circlip (7) and withdraw the splined washer (6) and the second speed driven gear (24).



Withdraw the roller cage (4) and the shim (3). All the components have thus been removed from gearbox output shaft (25).



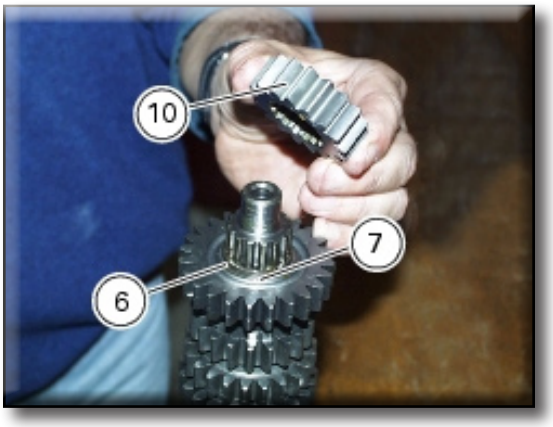
Disassembly of the gearbox input shaft

Remove the chain-side shim (11) and the clutch-side shim (1) from the input shaft.

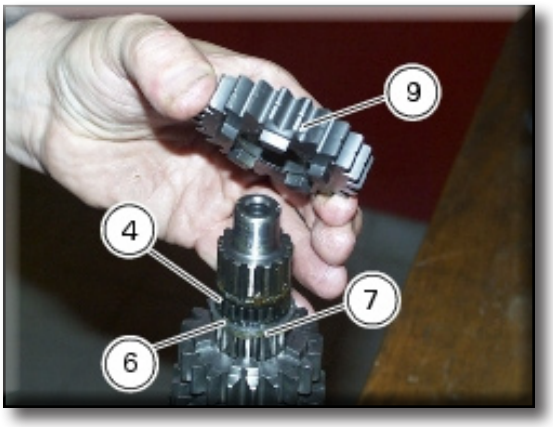
Remove the second speed driving gear (10). Use two screwdrivers to prise out the circlip (7) and the splined washer (6).

Important

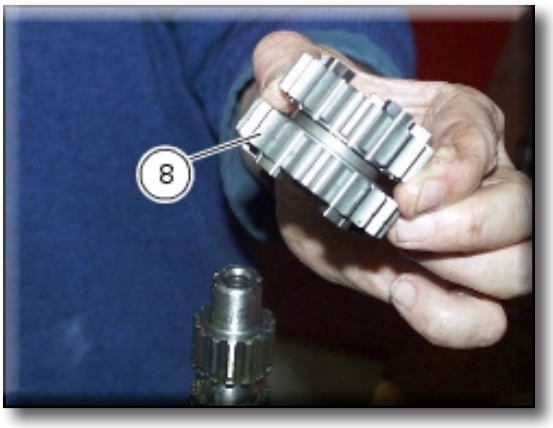
Take care to avoid damaging the surface of the shaft while removing circlip (7).



Remove the sixth speed driving gear (9) with its roller cage (4). Remove the splined washer (6) and the circlip (7).

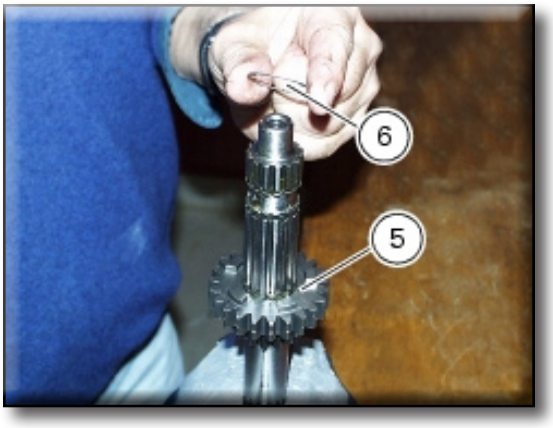


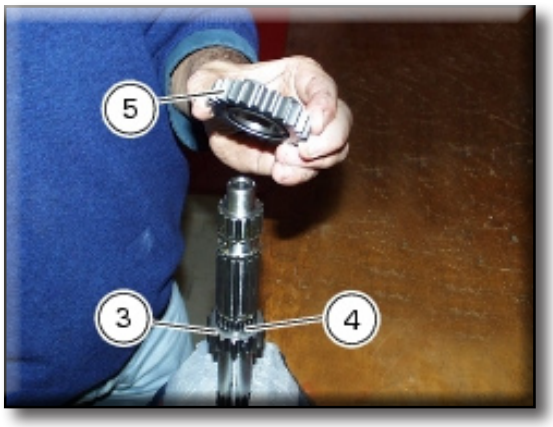
Withdraw the third and fourth speed driving gear (8).



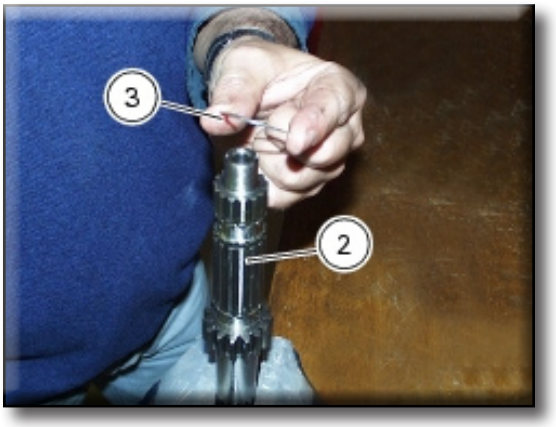
Remove the circlip (7) and the splined washer (6).

Remove the fifth speed driving gear (5) with the roller cage (4).



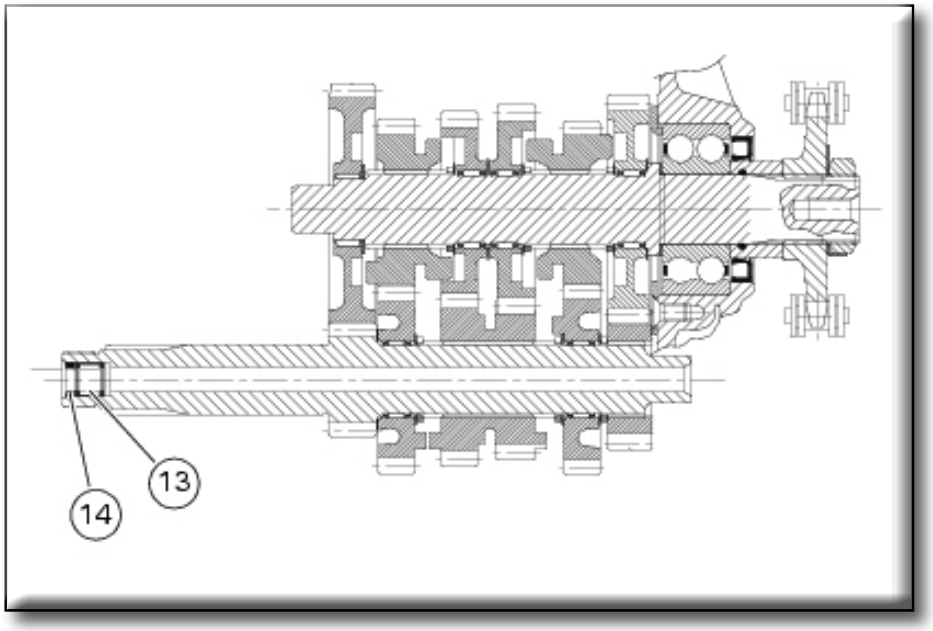


Slide the shim (3) off the input shaft (2).



Overhaul of the gearbox

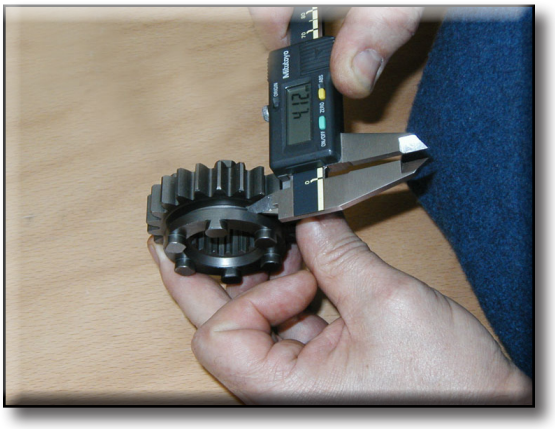
Check the condition of the front coupling dogs of the gears. They must be in perfect condition and with no sign of wear on the edges of the teeth.
The idler gears must rotate freely on their shafts.
When refitting, make sure the circlips are correctly positioned.
Check the needle roller bearings for wear.
The threads and splines of the shafts must be in perfect condition.
At each overhaul, check the condition of the needle roller cage (13) and the oil seal (14) located on the end of the gearbox input shaft: remove them if necessary using a suitable puller and renew them.
Also check that the component parts of the gear selector mechanism are in good condition.



Engage the gears and check that the gearchange mechanism does not stick (selector fork - gear groove, and fork pin - desmodromic drum groove) due to incorrect end float. Restore the correct endfloat by shimming the gearbox shafts and the selector drum with suitable shims.
For the total gearbox shaft and selector drum end float values, refer to Sect. “Gearbox”.

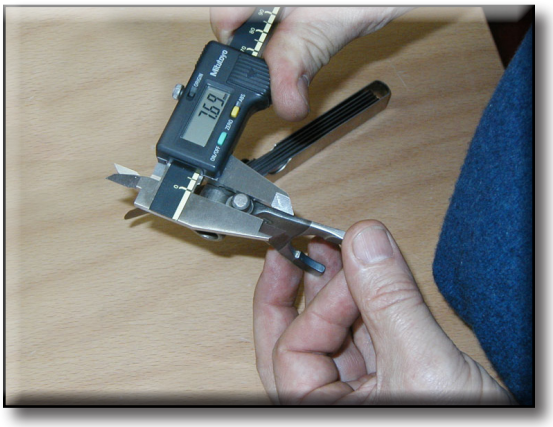
Inspection of the gear selector forks

Visually inspect the gear selector forks. Bent forks must be renewed as they may lead to difficulties in gear changing or may suddenly disengage when under load.
Use a feeler gauge to check the clearance of each fork in its gear groove.
If the service limit has been exceeded, check whether or not it is necessary to renew the gear or the fork by referring to the limits specified for each part Sect. “Gearbox”.

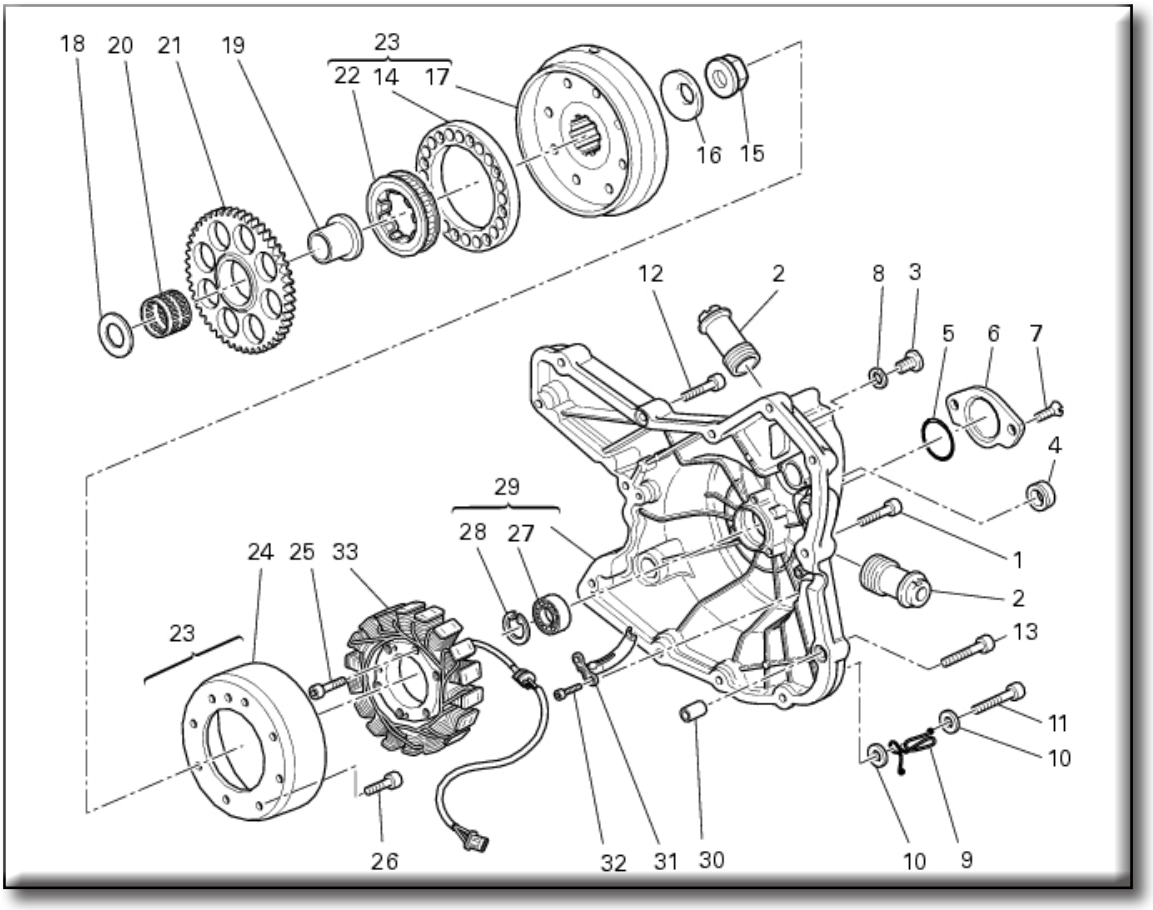


Inspection of the gear selector drum

Use a gauge to measure the clearance between fork pin and the slot on the selector drum.
If the service limit is exceeded, determine which part must be renewed by comparing these dimensions with those of new components Sect. “Gearbox”.
Also check the wear on the drum support pins; these must not show any signs of scoring, burrs, or deformation.
Turn the drum in the crankcase to establish the extent of radial play. If play is excessive, change whichever part is most worn.



11.17 - FLYWHEEL - ALTERNATOR



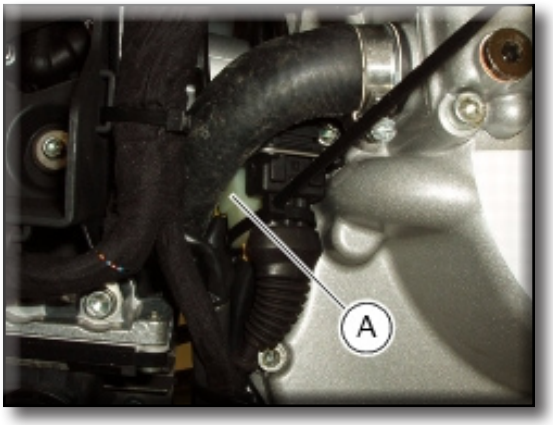
1) Bolt
2) Cylinder coolant inlet union
3) Ignition inspection plug
4) Oil seal
5) O-ring
6) Cover
7) Bolt
8) Aluminium gasket
9) Cable guide
10) Washer
11) Bolt
12) Bolt
13) Bolt
14) Flange
15) Flanged nut
16) Belleville washer
17) Flywheel
18) Washer
19) Inner ring
20) Needle roller bearing
21) Electric starter driven gear
22) Starter clutch
23) Flywheel-starter clutch assembly
24) Alternator rotor
25) Bolt
26) Bolt
27) Bearing
28) Circlip
29) Left-hand side crankcase cover
30) Locating dowel
31) Bracket
32) Bolt
33) Alternator stator

Removal of the left-hand side crankcase cover

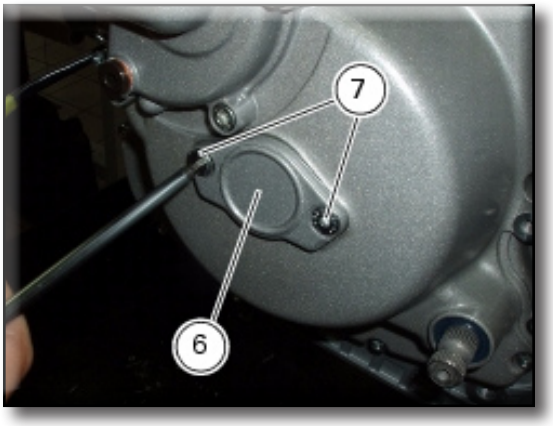
Remove the front sprocket cover
Drain the engine oil
Remove the clutch pushrod
Remove the pump-cylinder hoses
Remove the water pump-radiator hose

Notes
This operation is described for an engine removed from the frame since all reassembly procedures are easier with the engine on the bench.

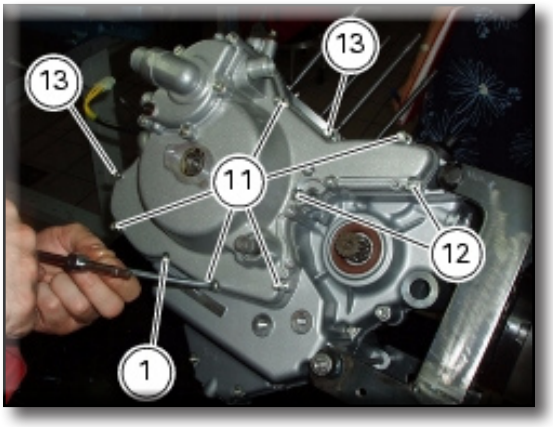
Disconnect the alternator wiring connector from the main wiring loom (A).

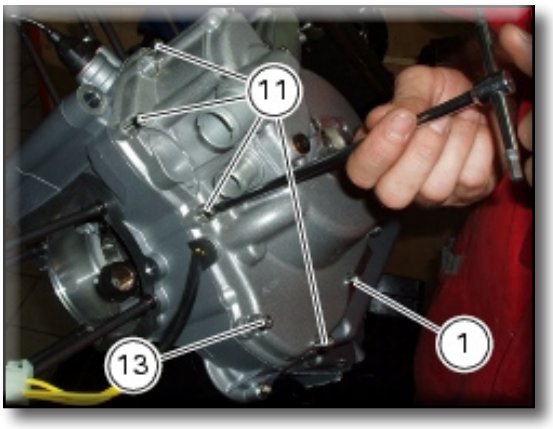


Unscrew the two retaining bolts (7) of the centre cap (6) over the end of the crankshaft.

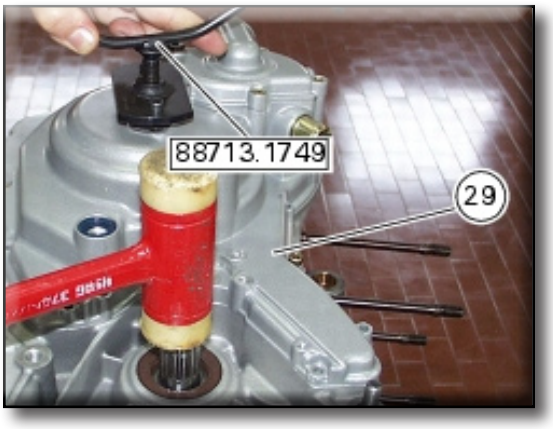


Unscrew the left-hand crankcase cover bolts (1), (11), (12) and (13).

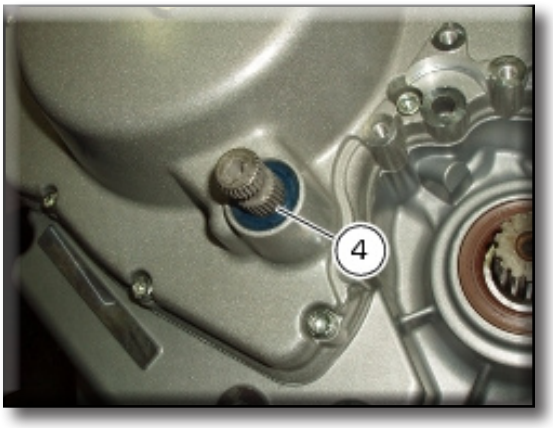




Fix service tool 88713.1749 to the holes of the two bolts (7) you have just removed.
Turn the tool shaft slowly to remove the cover (29) from the LH crankcase half.

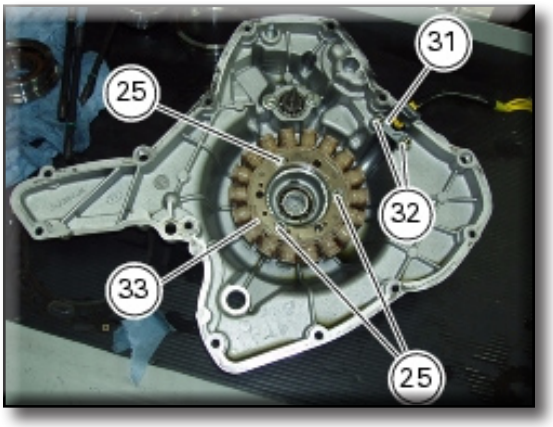


On the cover in correspondence with the gearchange shaft, there is an oil seal (4) that may be damaged when removing the crankcase cover.
Always check the condition of this oil seal and renew it if damaged.

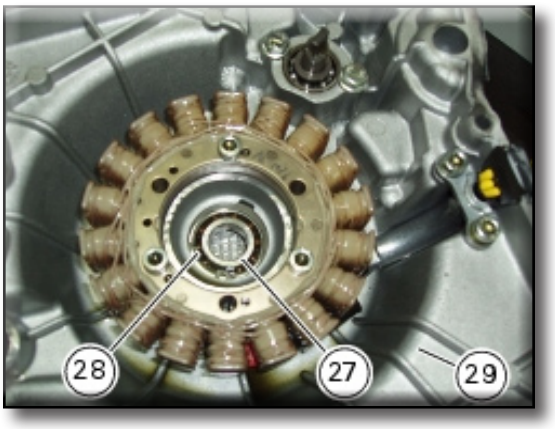


Disassembly of the left-hand crankcase cover

Undo the three stator retaining bolts (25) and the two cable guide bracket (31) retaining bolts (32) from inside the LH crankcase cover.
Remove the stator (33) and the cable guide (31).



The left-hand side crankcase cover is fitted with a bearing (27), held in place by circlip (28), which locates on the end of the crankshaft.
Remove the circlip (28) with circlip pliers.
Remove the bearing (27) using a universal puller.
Be careful when fitting the new bearing (27) to ensure it is positioned with the shielded side facing away from the cover.
Secure the bearing with the circlip (28), ensuring that it is correctly fitted in its seat in the LH crankcase cover (29).

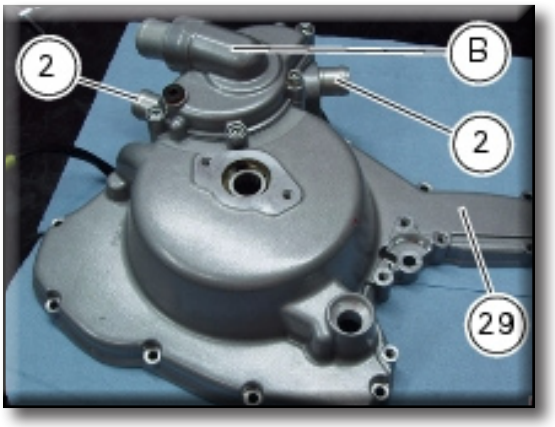


Unscrew the horizontal and vertical cylinder coolant inlet unions (2).
When fitting new components, apply the recommended threadlocker and tighten to the specified torque.

Important

The unions (2) may also be removed without removing the LH crankcase cover (29) from the engine.

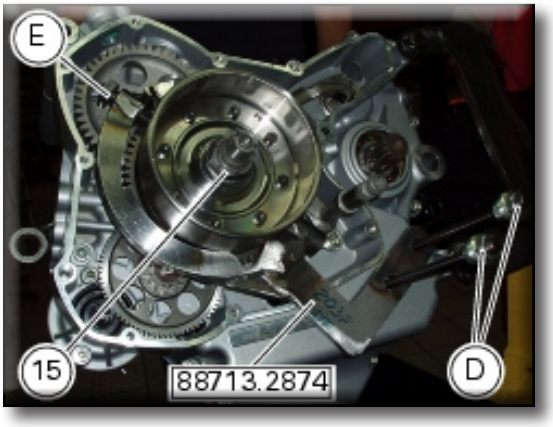
Disassemble the components of the water pump (B) as described in Sect. “Removal of the water pump”.



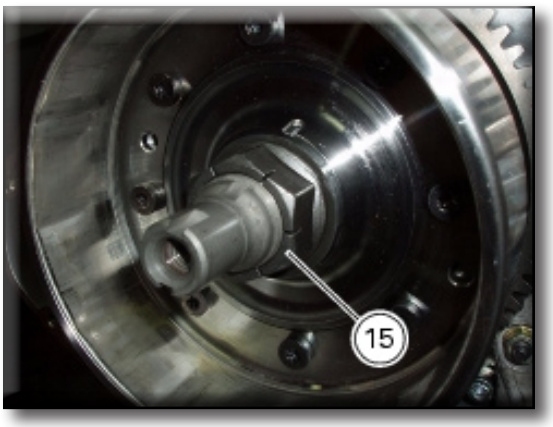
Removal of the flywheel/alternator assembly

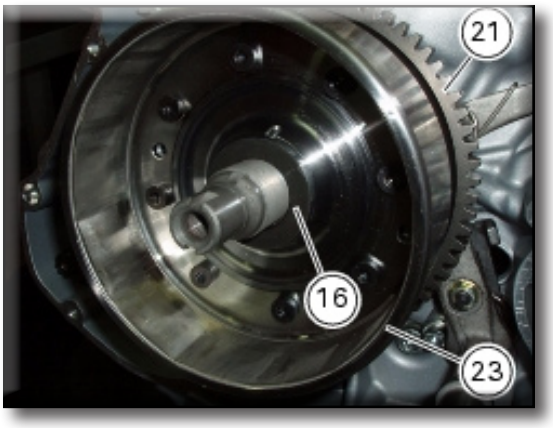
Use service tool no. 88713.2874 fixed to the M10 side stand fixing holes (D).
Lock the tool to the flywheel with screw (E).
Unscrew the alternator/flywheel retaining nut (15).

Warning
While unscrewing the nut, apply axial pressure to the wrench socket to avoid damage or injury in the event of the wrench suddenly slipping off the nut.



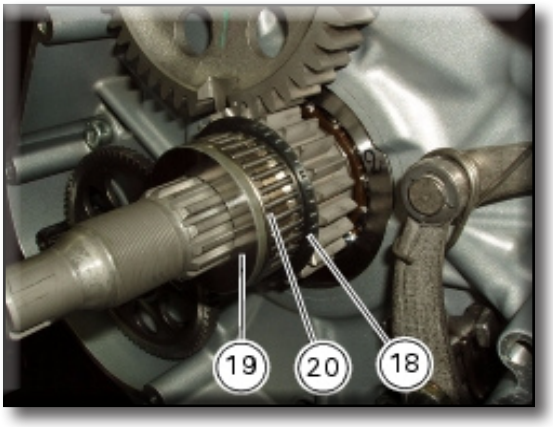
Remove the nut (15), the Belleville washer (16) and the flywheel assembly (23) with the driven gear (21) from the crankshaft.





Remove the inner ring (19), the needle roller bearing (20) and the washer (18).

Important
Check the bush (19), the needle roller bearing (20) and the inner washer (18) for wear. Renew if worn.

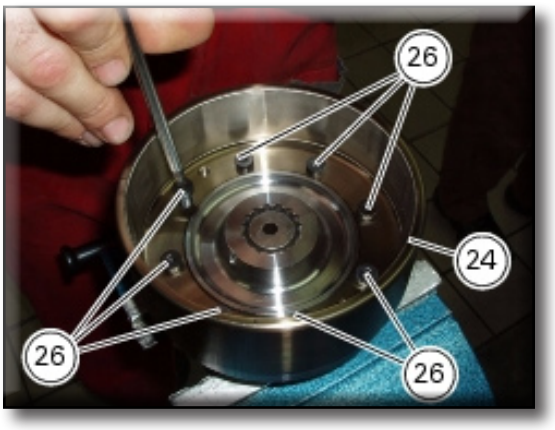


Overhaul of the flywheel/alternator assembly

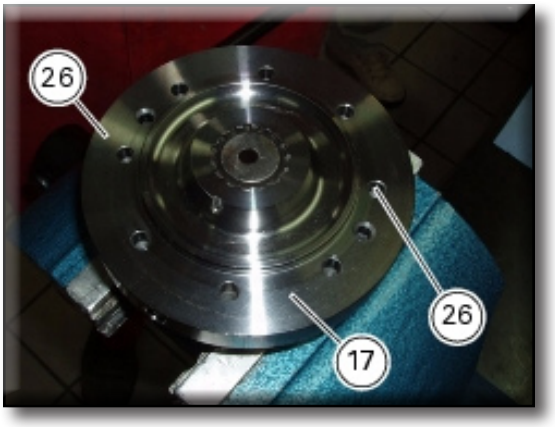
Check that the inner part of alternator rotor (24) shows no signs of damage.
Check that the starter clutch is working properly and that the needle races do not show signs of wear or damage of any kind.
If there is any malfunction, remove the whole assembly.

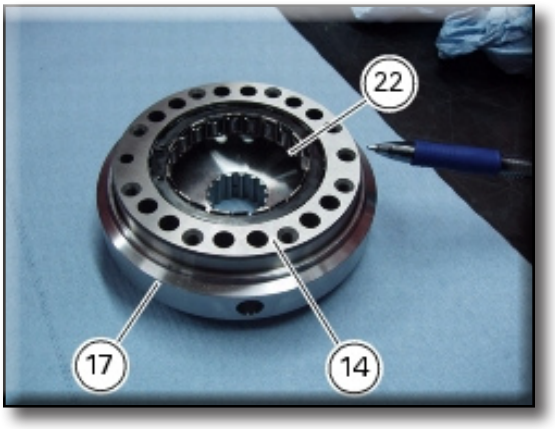
Disassembly of the flywheel/alternator

Undo the eight bolts (26) and remove the rotor (24) from the flywheel.



Insert two of the bolts (26) just removed from the flywheel rotor-side in their holes in order to remove the flange (14) and the starter clutch (22) from the flywheel (17).
The starter clutch is a slight interference fit on the flange. To remove it, use a suitable drift.



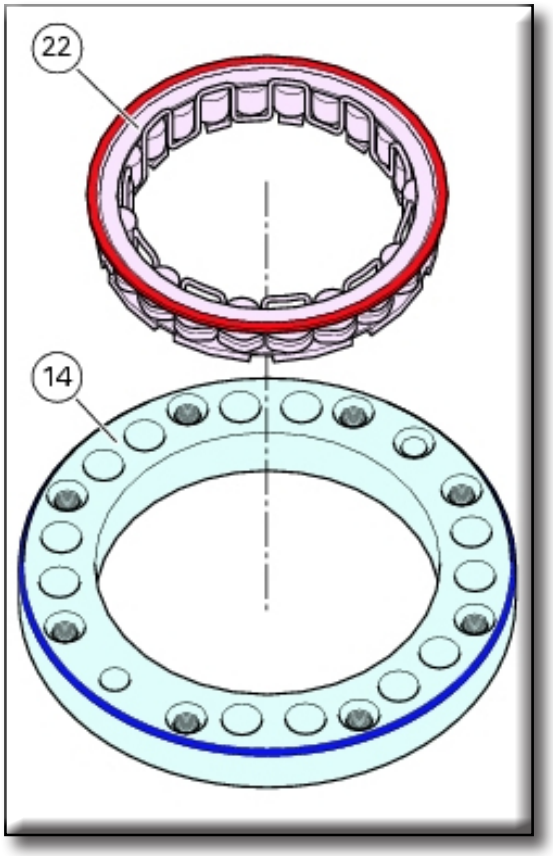


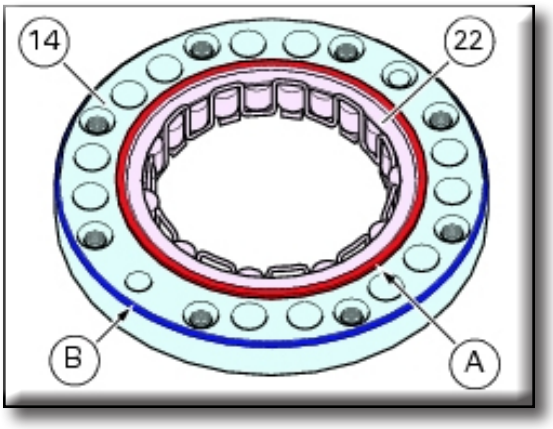
Reassembly of the flywheel-alternator assembly

Install the starter clutch (22) in the flange (14) to bring the edge (A) of the clutch up against the flange.

Important

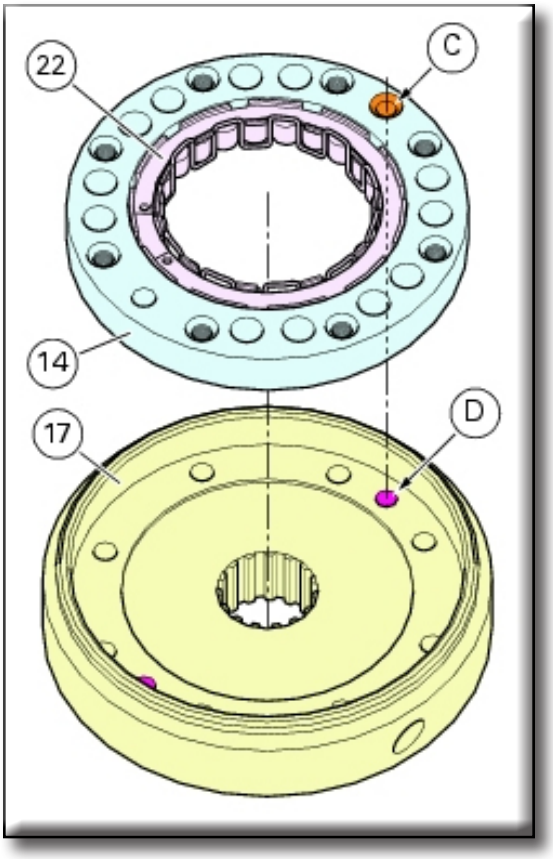
Assemble the components (starter clutch and flange) so that the edge (A) of the starter clutch is positioned on side of the flange with the bevelled edge (B).

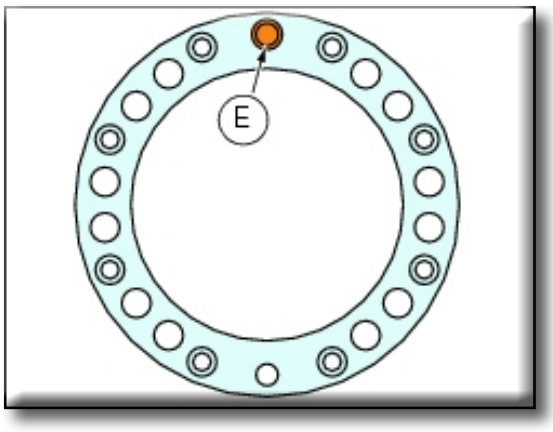


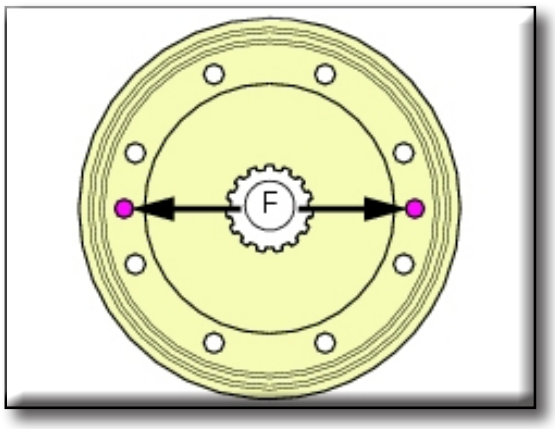


Seat the flange (14) with the starter clutch (22) in the flywheel (17), aligning the flange locating hole (C) with the flywheel locating hole (D).

Notes
The flange locating hole (C) is the hole with the countersunk lead-in (E).
The locating hole (D) of the flywheel can be either one of the two holes (F).
Use suitable tools to align the locating holes.

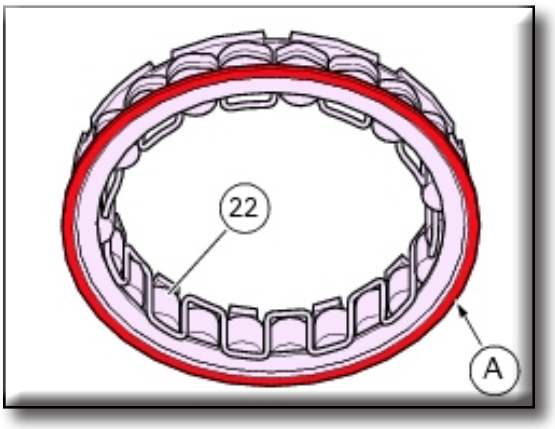






Important

Assemble the components (flange and flywheel) so that edge (A) of the starter clutch (22) is enclosed between the flange and flywheel.

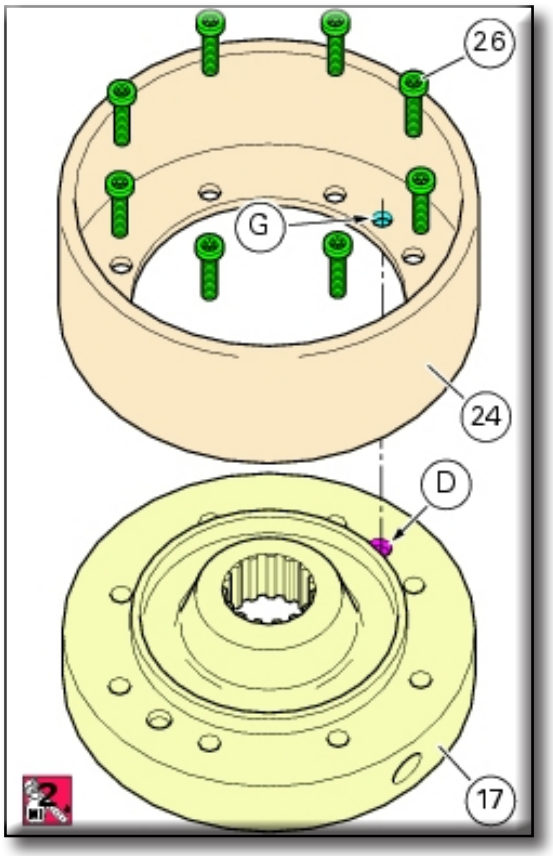


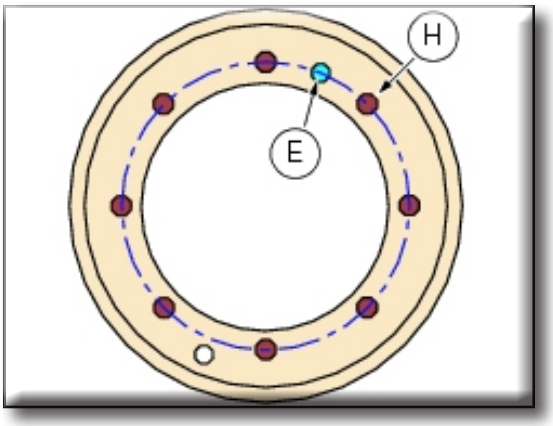
Install the rotor (24) on the flywheel (17), aligning the flywheel locating hole (D) with the rotor locating hole (G).

Notes

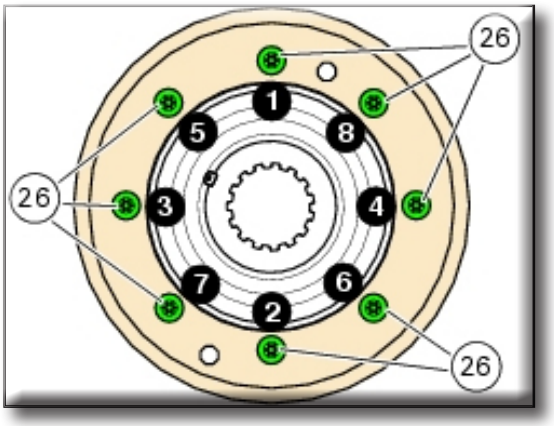
The flywheel locating hole (D) of the flywheel is the hole that was previously aligned with the flange locating hole (C), i.e. the hole with the countersunk lead-in (E).
The rotor locating hole (G) is the hole positioned on the same diameter as the fixing holes (H).
Use suitable tools to align the locating holes.

Apply threadlocker to the rotor/flywheel fixing bolts (26) and start them in their threads.





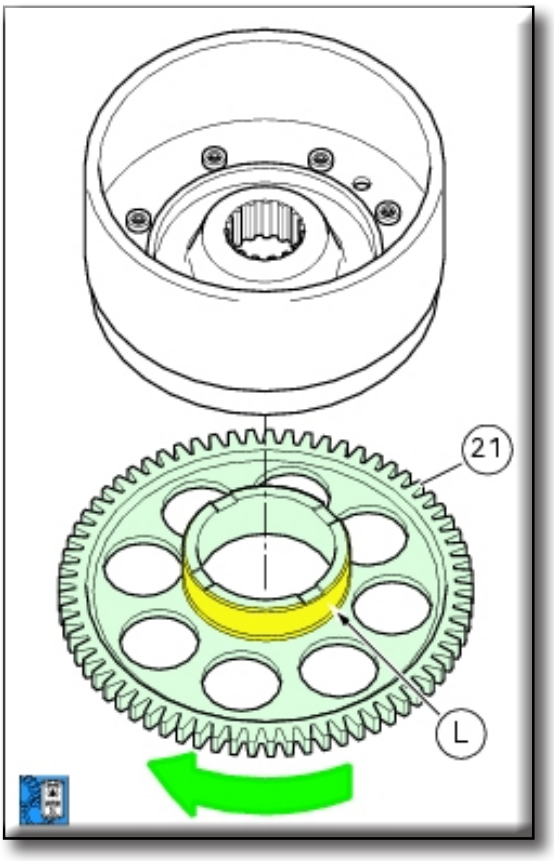
Tighten the bolts (26) to the specified torque, in the indicated sequence.

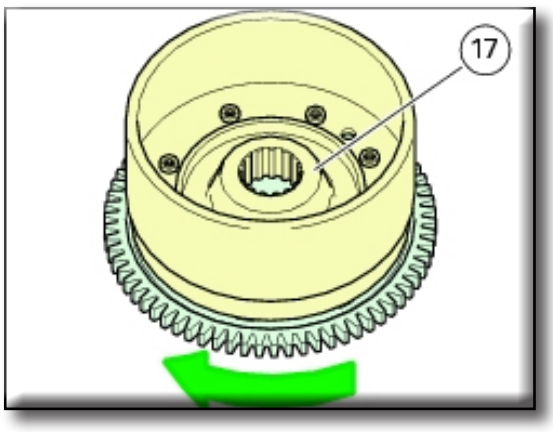


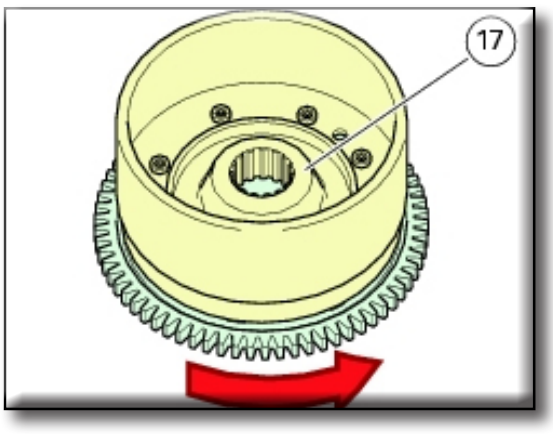
Lubricate the surface (L) of the driven gear (21) with engine oil.
Install the driven gear in the starter clutch, ensuring it is properly seated.

Notes
To facilitate installation, rotate the driven gear in the direction of the green arrow.

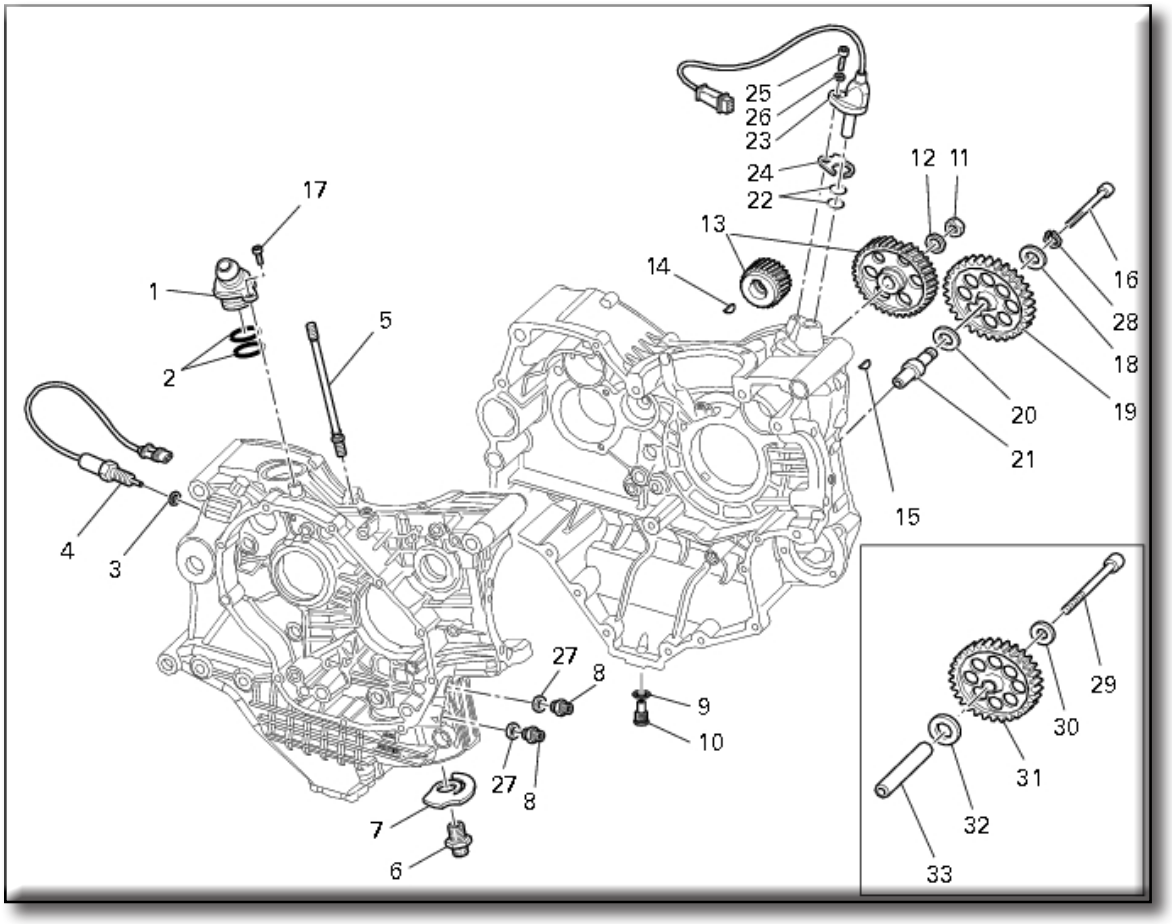
Hold the flywheel (17) with one hand and check that the driven gear can rotate freely in the direction of the green arrow but not in the direction of the red arrow.
If either of these two is not met, this means that the starter clutch has not been installed correctly.







11.18 - CRANKCASE ASSEMBLY: EXTERNAL COMPONENTS

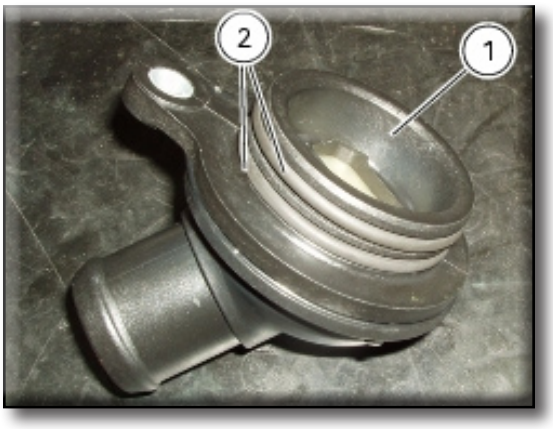


1) Oil breather valve
2) O-ring
3) Seal
4) Neutral switch
5) Cylinder barrel/head stud
6) Nipple
7) By-pass spring
8) Nipple
9) Plug
10) Aluminium gasket
11) Nut
12) Lock washer
13) Timing gear pair
14) Key
15) Key
16) Bolt
17) Bolt
18) Washer
19) Starter idler gear
20) Washer
21) Gear shaft
22) O-ring
23) Engine sensor
24) Shim
25) Bolt
26) Washer
27) Aluminium gasket
28) Circlip
29) Bolt
30) Washer
31) Starter idler gear
32) Washer
33) Gear shaft

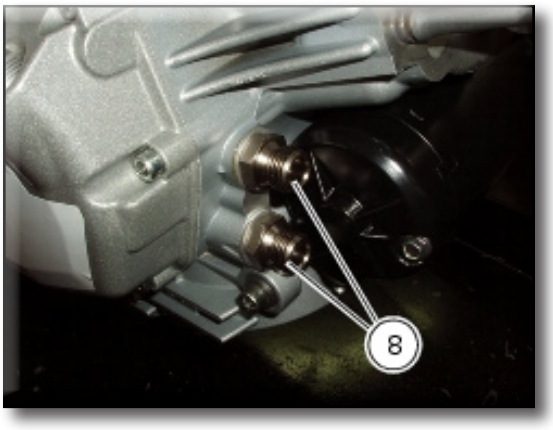
Removal of external components

Remove the engine from the frame
Remove the lubrication system
Remove the oil filter cartridge
Remove the cylinder head assemblies and the timing parts
Remove the cylinder barrel/piston assemblies

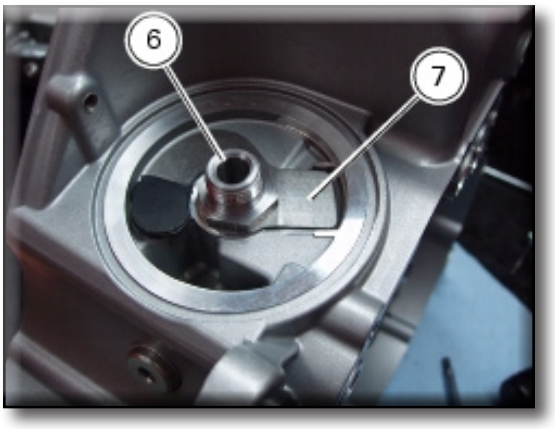
Unscrew the bolt (17) and remove the oil breather valve (1) with the O-rings (2). Check the condition of O-rings (2) and renew them if necessary.



Unscrew and remove the oil inlet and outlet nipples (8) from the right-hand crankcase half and recover the seals (27).

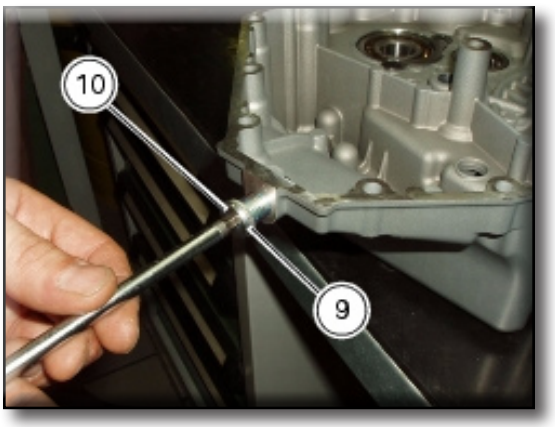


Unscrew and remove the oil filter support nipple (6) and remove also by-pass spring (7).

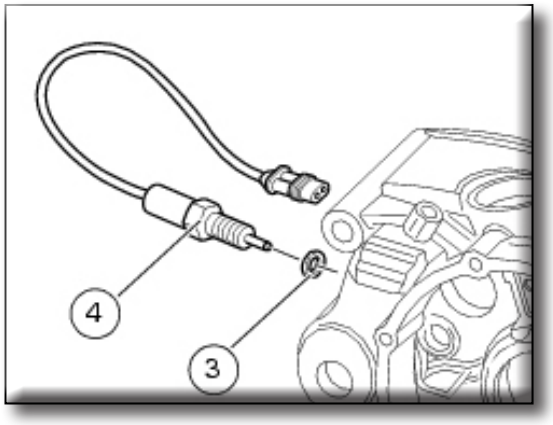


Remove the mesh filter (A) with its seal from the right-hand crankcase half.

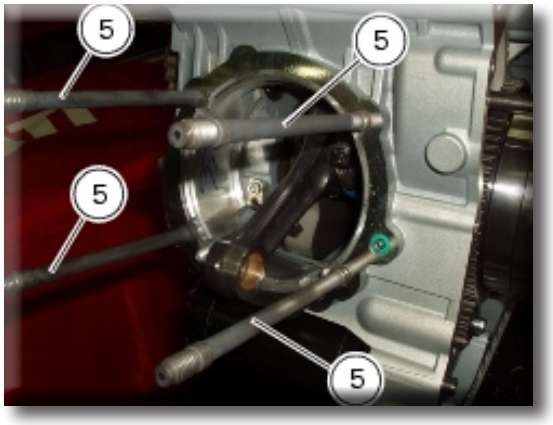
Remove the drain plug (10) with its seal (9).

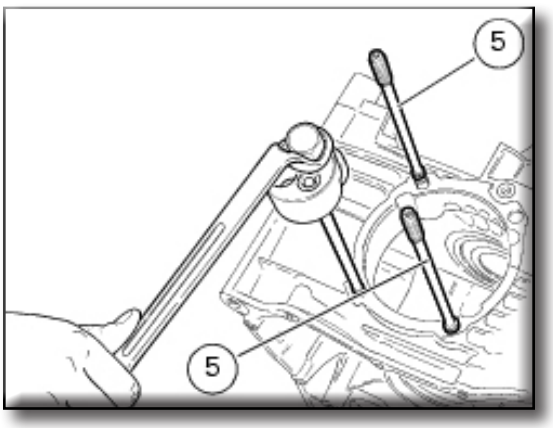


Remove the neutral switch (4) with seal (3).

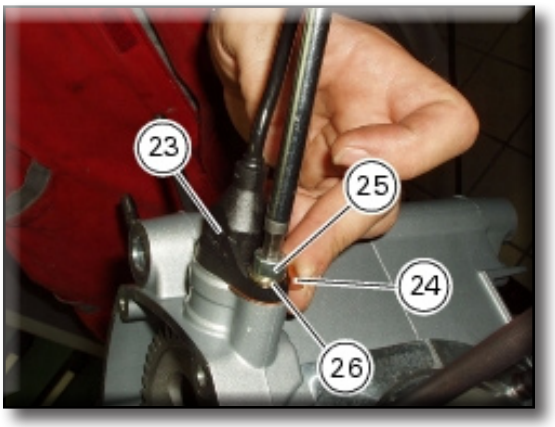


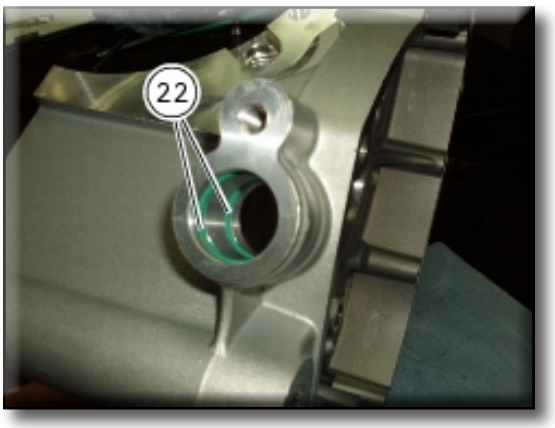
Remove the cylinder head studs (5) with the aid of the appropriate tool.





To remove the engine sensor (23), unscrew the bolt (25) and recover the shim (24) and the washer (26).
Check the condition of O-rings (22) and renew them if necessary.
If the engine sensor is to be renewed, it will be necessary to check the air gap as indicated in the paragraph “Checking the engine sensor air gap”.





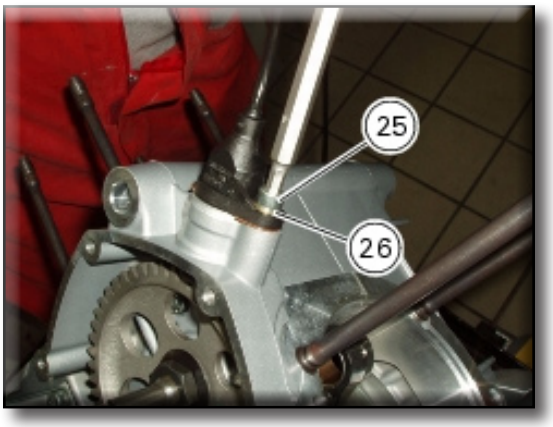
Refitting the external components

Grease the engine sensor (23) in the part indicated.

Fit the engine sensor (23) in its seat in the crankcase.

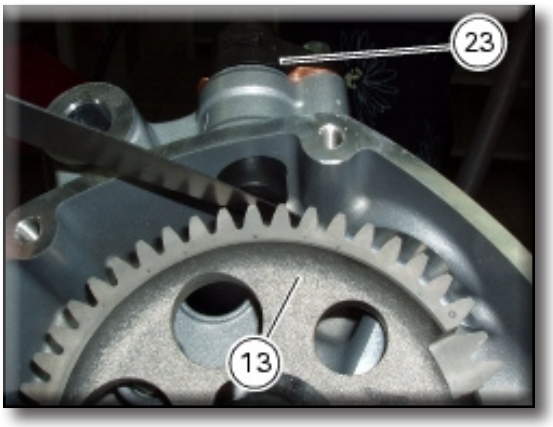
Position the 0.6 mm thick shim (24).

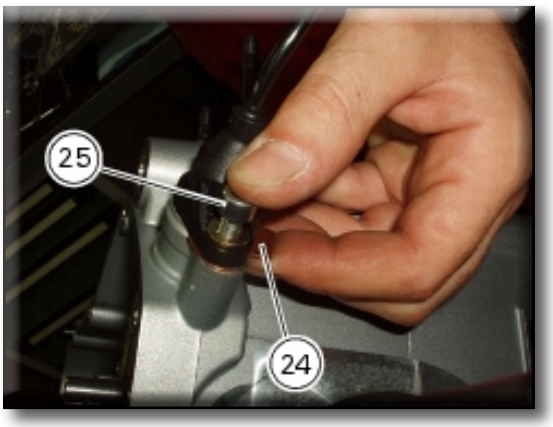
Insert the bolt (25) with the washer (26) and tighten to the specified torque



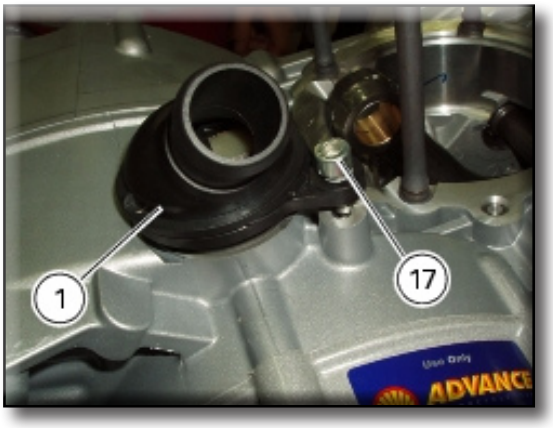
Use a feeler gauge to check the clearance between the engine sensor (23) and the timing gear (13). The value must be between 0.6 and 0.8 mm.

Notes
If the gap is incorrect, loosen the screw (25) of the engine sensor and replace the shim (24) with one of suitable thickness paragraph “Checking the engine sensor air gap”.

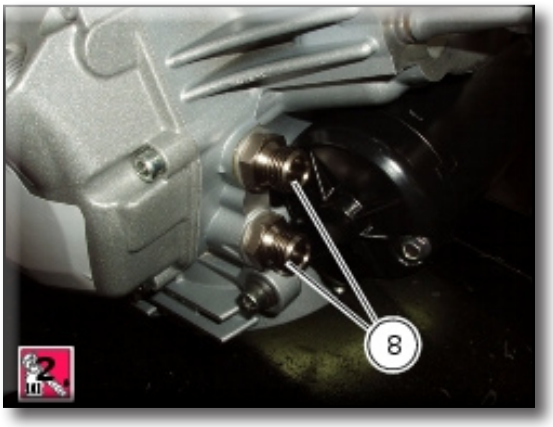




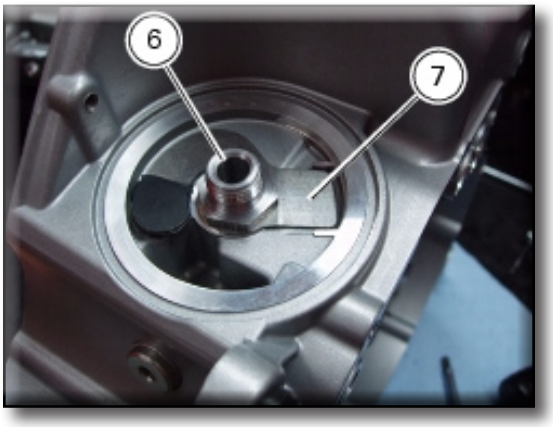
Install the oil vapour breather valve (1) in the crankcase along with O-ring (2).
Tighten the bolt (17) to the specified torque.



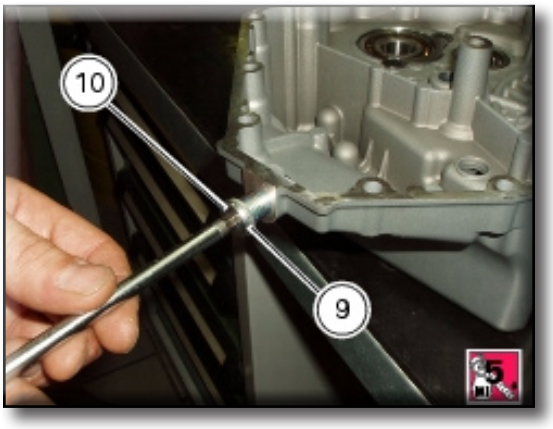
Tighten the two oil hose connection nipples (8) with the seals (27) to the specified torque.



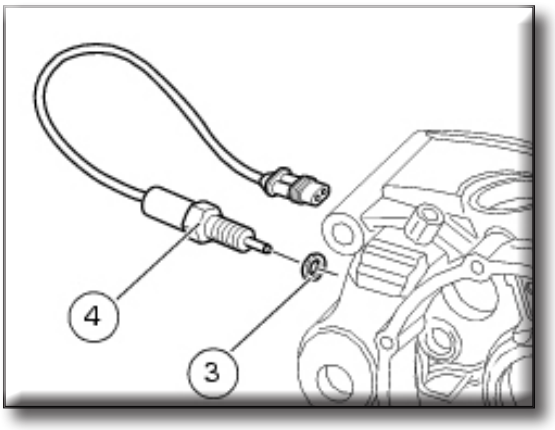
Locate the by-pass spring (7) and screw on the nipple (6) that supports the oil filter cartridge, tightening to the specified torque.



Tighten drain plug (10) and seal (9) to the specified torque (Sect. C 3, Engine torque settings) applying the specified threadlocker.

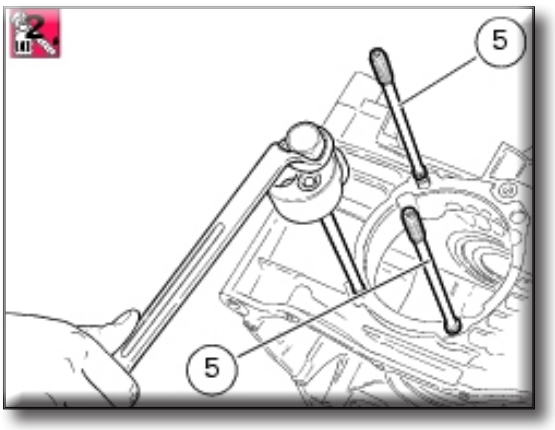


Refit the neutral switch (4) with seal (3).



Refit the mesh filter (A) with seal as described in

Now fit the studs (5) on the crankcase halves, applying thread locker and tightening to the specified torque value. Use the appropriate commercial tool for this operation.

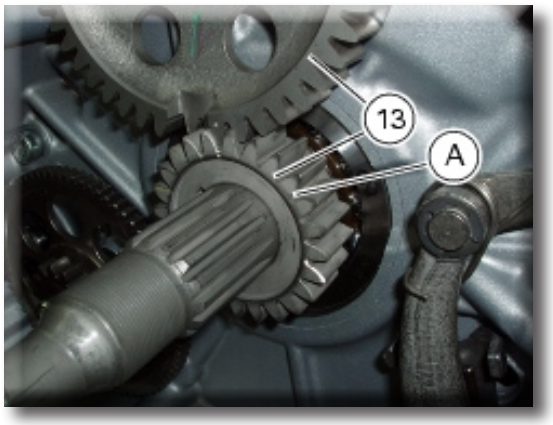


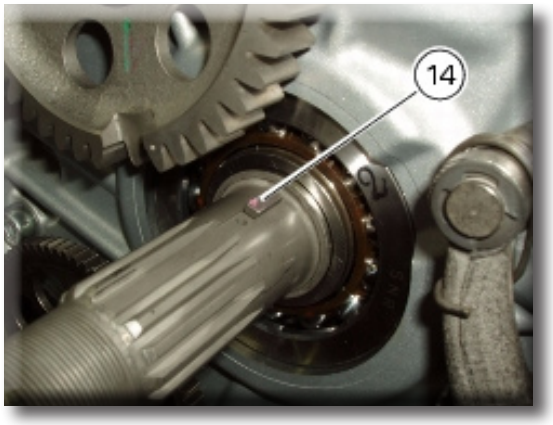
Refit the cylinder barrel/piston assemblies
Refit the cylinder head assemblies and the timing parts
Refit the oil filter cartridge
Refit the lubrication system
Refit the engine to the frame

Removal of the timing gears

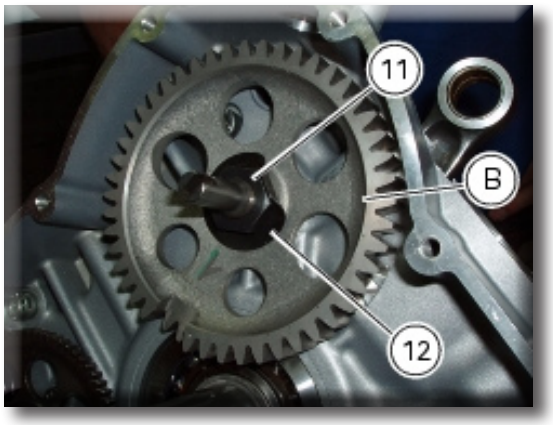
Remove the left-hand crankcase cover and alternator assembly

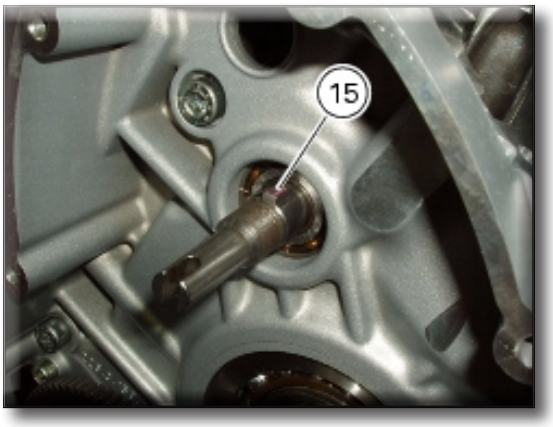
Slide out driving gear (A) of timing gear pair (13) and remove the Woodruff key (14).





Relieve the staking on the lock washer (12) of the nut (11).
Restrain the driven timing gear by inserting a pin (C) in one of the holes, and unscrew the nut (11).
Remove the nut (11), washer (12), driven timing gear (B) and Woodruff key (15) from the timing belt driveshaft shaft.

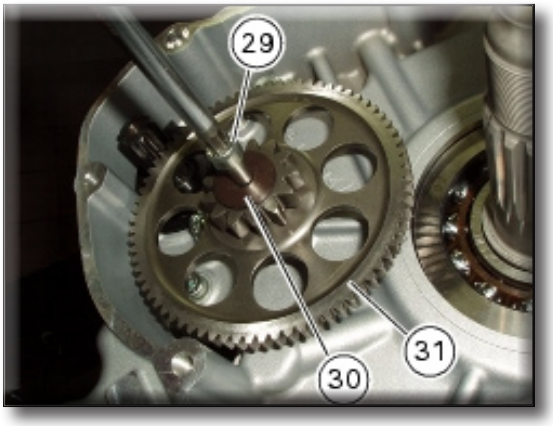


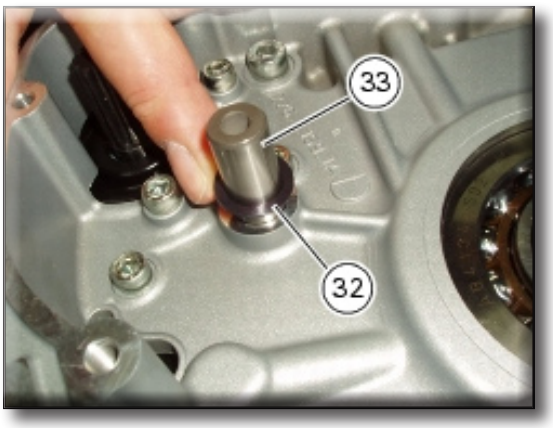


Removal of the starter motor idler gear

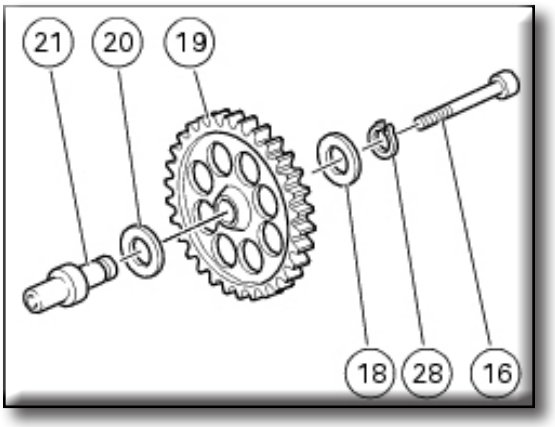
Remove the left-hand crankcase cover and alternator assembly

Unscrew the bolt (29) and remove the idler gear (31) with the washers (30) and (32) and the shaft (33).





For models with starter idler gear (19), remove the circlip (28) and the washer (18). Remove the gear (19) and the washer (20). Unscrew the bolt (16) and remove the shaft (21).

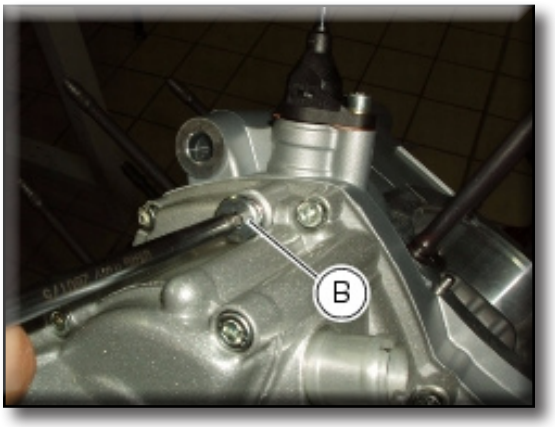


It is now possible to remove the starter motor

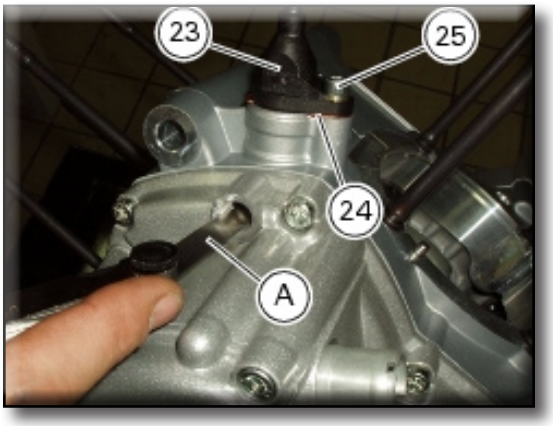
Checking the engine sensor air gap

If either the alternator or the engine sensor has been renewed, the sensor air gap must be checked as described below.

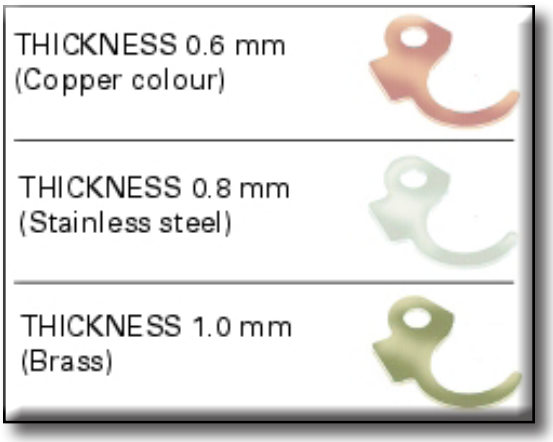
Remove the left-hand fairing
Remove the plug (B) from the inspection hole in the left-hand crankcase cover.



Insert a feeler gauge (A) through the hole, positioning it between the end of sensor (23) and the teeth of timing belt driveshaft gear.
Check that gap is 0.6 to 0.8 mm.
If not, slacken off the screw (25) securing the sensor (23) so as to extract the shim (24) and replace it with one of suitable thickness.



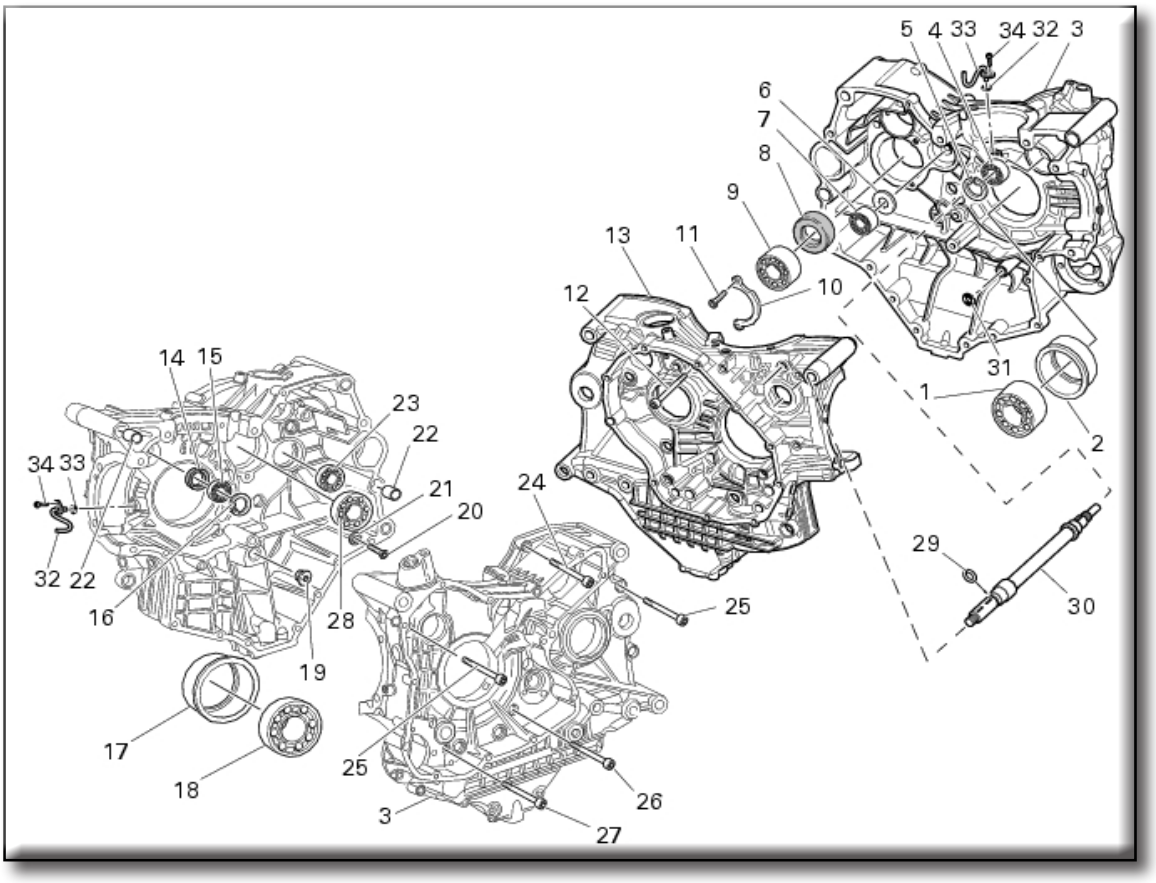
Notes
There are three different shims available, and these can be identified by their colours, as shown in the figure.



Tighten the screw (25) to the specified torque.
Refit the plug (B) with its seal and tighten to the specified torque.

Refit the fairings

11.19 - CRANKCASE ASSEMBLY: CRANKCASE HALVES



1) Bearing
2) Bearing shell
3) Crankcase half - front
4) Bearing
5) Circlip
6) Washer
7) Bearing
8) Oil seal
9) Bearing
10) Retaining plate
11) Bolt
12) Bolt (M8x90)
13) Right-hand side crankcase half
14) Oil seal
15) Bearing
16) Circlip
17) Bearing shell
18) Bearing
19) Bearing
20) Bolt
21) Spacer
22) Bush
23) Bearing
24) Bolt (M6x35)
25) Bolt (M8x75)
26) Bolt (M8x75, drilled)
27) Bolt (M6x75)
28) Bolt (M8x90)
29) Circlip
30) Timing belt driveshaft
31) O-ring
32) O-ring
33) Hose
34) Bolt

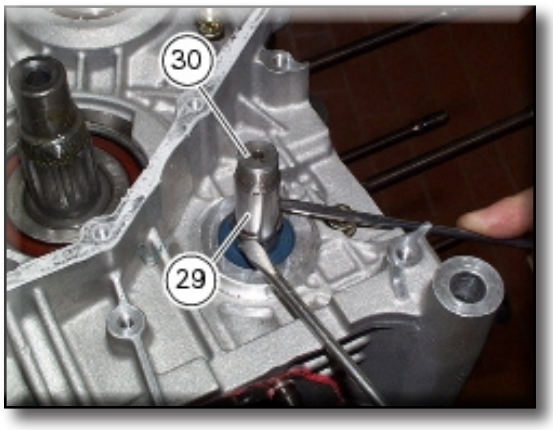
Separation of the crankcase halves

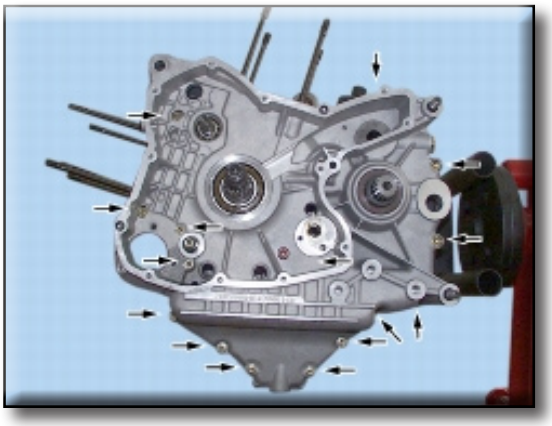
Remove the engine from the frame
Remove the lubrication system
Remove the cooling system
Remove the cylinder head assemblies and the timing parts
Remove the cylinder barrel/piston assemblies
Remove the left-hand crankcase cover and alternator assembly
Remove the engine starting system
Remove the right-hand crankcase cover
Remove the clutch assembly
Remove the gauze pickup filter

Use two screwdrivers to remove the circlip (29) from the timing belt driveshaft shaft (30) on the right-hand crankcase half.

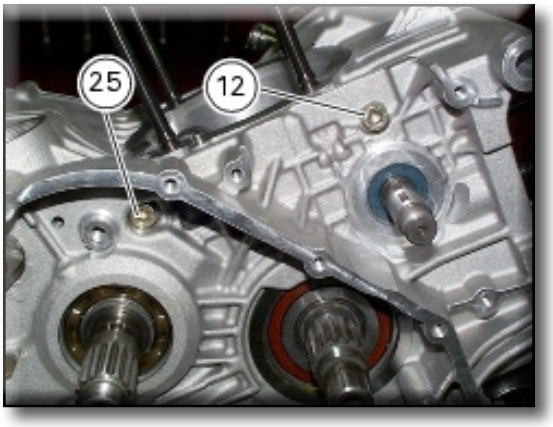
Notes
Take care to avoid scoring the surface of the shaft while removing the circlip.

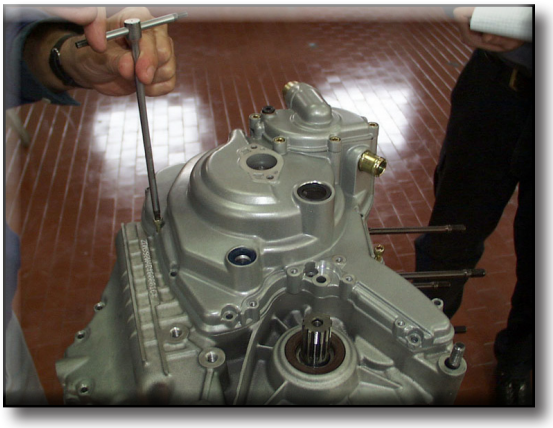
Unscrew the crankcase bolts working from the chain side.





Unscrew the two bolts (12) and (25) on the right-hand side near the vertical cylinder.



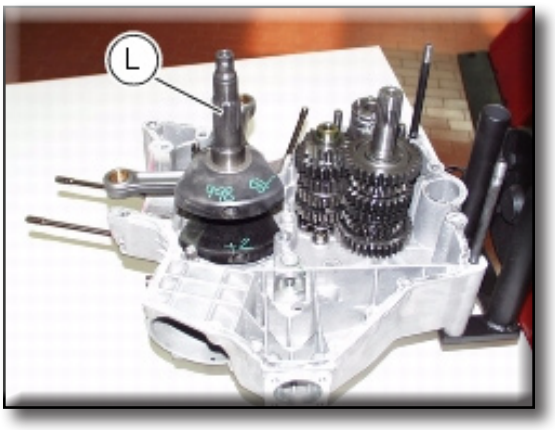


Re-use the left-hand crankcase cover or a service cover with puller 88713.1749. Secure it to the crankcase half using some of the original bolts and begin separating the crankcase halves by turning the central pin of the tool. Tap the end of the gearbox output shaft with a plastic mallet to separate the crankcase halves.

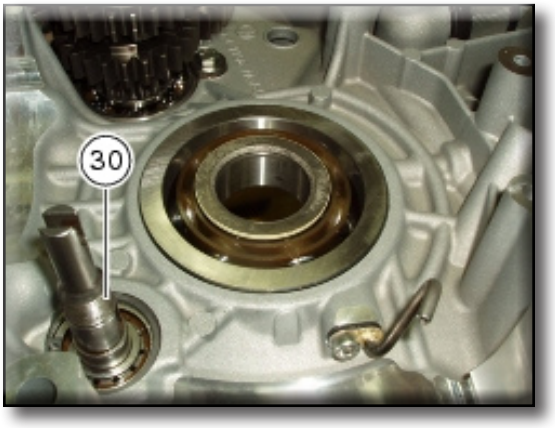
Notes
Take care not to lose the shims on the shafts and on the selector drum.

Remove the gearbox shafts and gear selector drum from the crankcase halves.

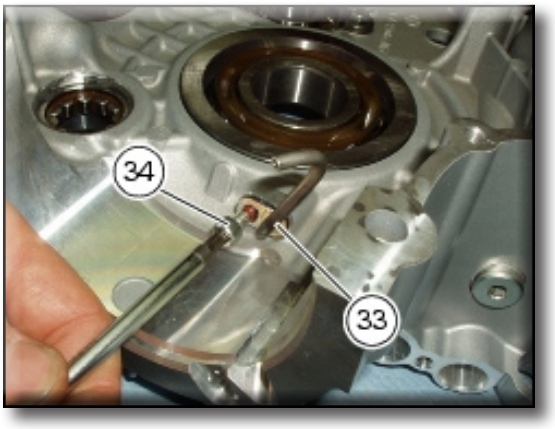
Drive out the crankshaft (L) using a plastic mallet, taking care not to lose the shims.



Remove the timing belt driveshaft (30).

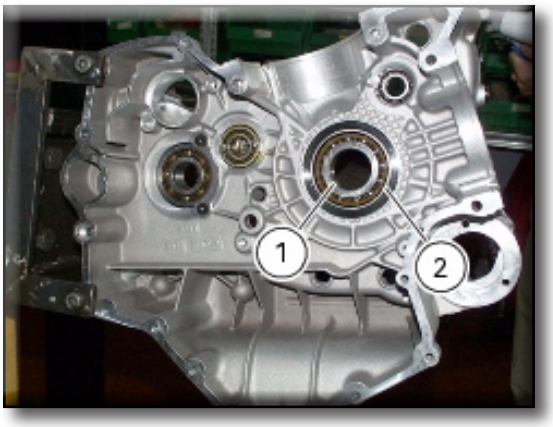


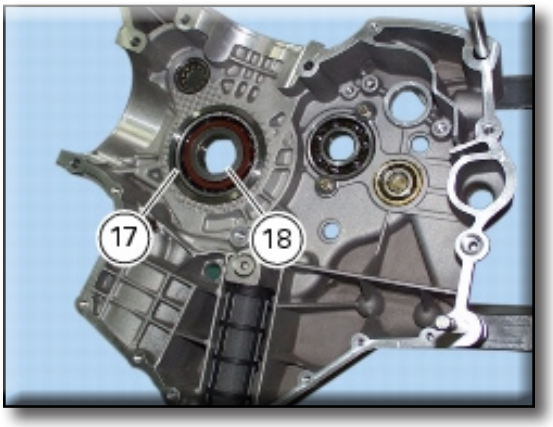
Remove the bolts (34), remove the hoses (33) and recover the O-rings (32).



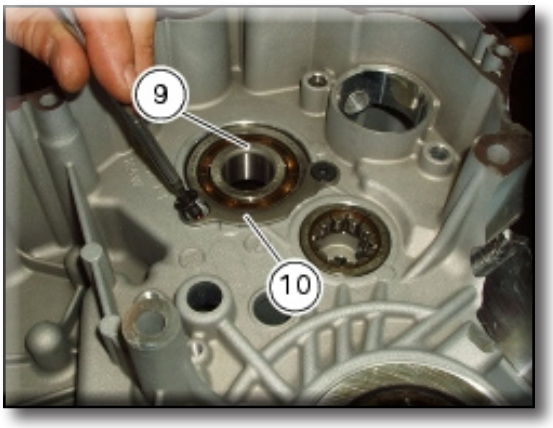
Overhaul of the crankcase halves

Carefully examine the engine crankcase halves.
Check that the surfaces of the crankcases are perfectly flat using a reference surface.
Check that bearings (1) and (18) and bushes (2) and (17) are in perfect condition.
Note that the main bearings must always be changed in pairs



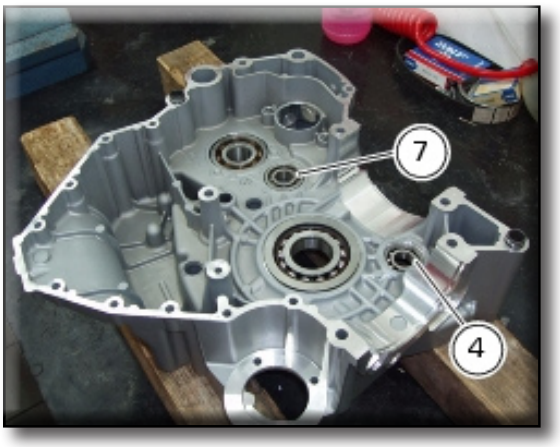


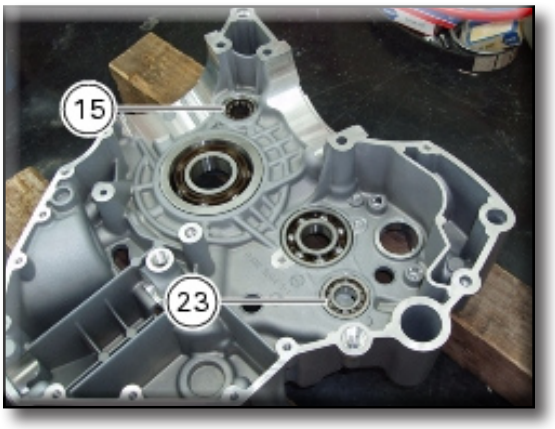
Notes
When overhauling an engine it is good practice to renew all the crankcase bearings.
After having renewed the gearbox shaft bearings (28) and (9), secure them in the crankcase with the spacers (21) and the retaining plate (10).



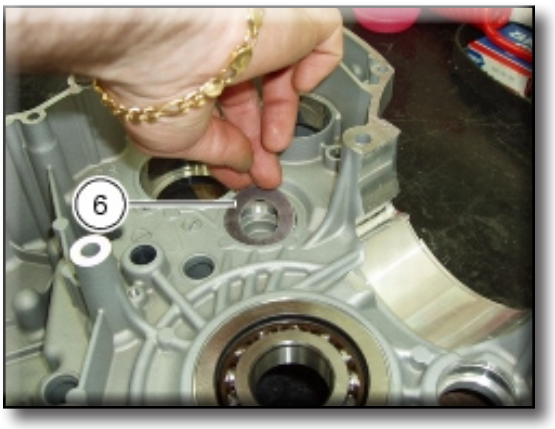
At each overhaul it is recommended to renew also the oil seal (8) on the outside of bearing (9).

Renew the bearings (7) and (23) on the ends of the gearbox shafts and timing belt driveshaft bearings (4) and (15).

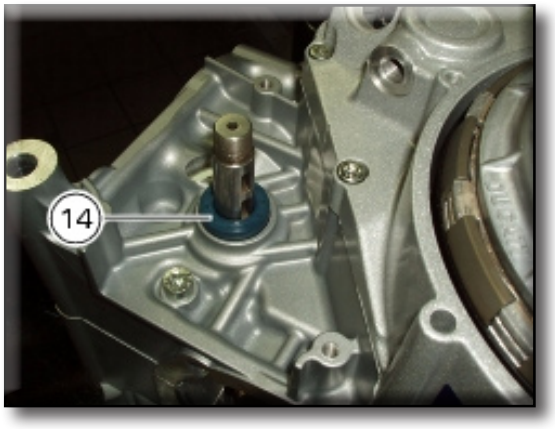




Take care not to lose the shim (6) interposed between the bearing (7) on the end of the gearbox input shaft and the chain side crankcase half.

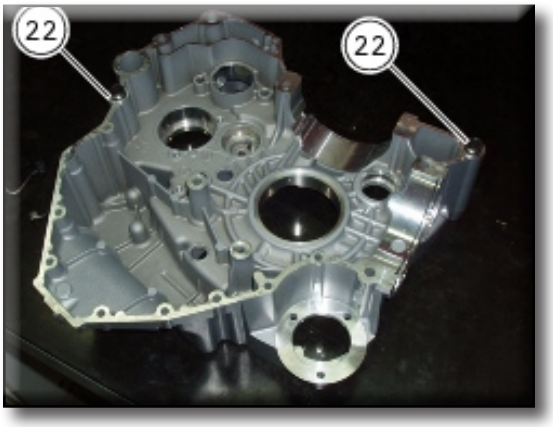


The oil seal (14) on the external side of the roller bearing (15) must be renewed at each engine overhaul.

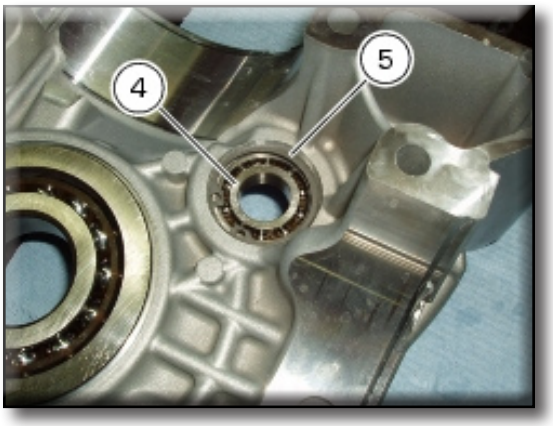


Check that the oilways are free of restrictions or clogging.
Check the condition of locating dowels (22). In the event of signs of distortion or excessive assembly clearance with the corresponding seats, remove the locating dowels using appropriate tools.
If it proves difficult to remove the dowels (22) from the crankcase, use a tap with a left-hand thread to force them out.

Important
The dowels (22) must always be renewed when they have been removed using the above procedure.



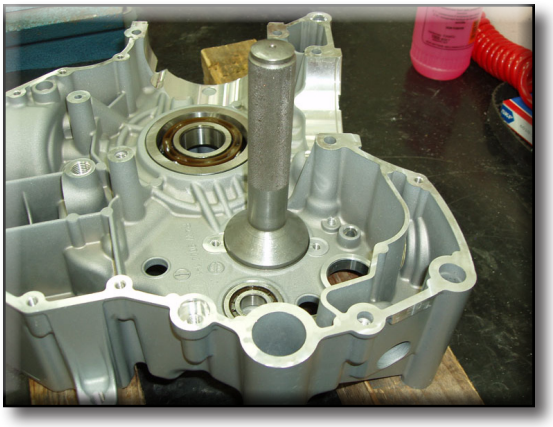
Remove the bearing (23), the circlip (5) and the roller bearing (4).



Main bearings

The main bearings have are of the angular contact type with offset inner races so that the balls transmit loads from one groove to the other along straight lines at an angle to the axis of the bearing. Angular contact thrust bearings are designed to withstand combined loads (radial and axial loads).
Bearings of this type can bear thrust loads in one direction only. In fact, under the action of a radial load inside the bearing, an axial force is created that must be counterbalanced by an axial force acting in the opposite direction; that is why these bearings are generally fitted back to back in pairs.
To renew the bearings proceed as follows:

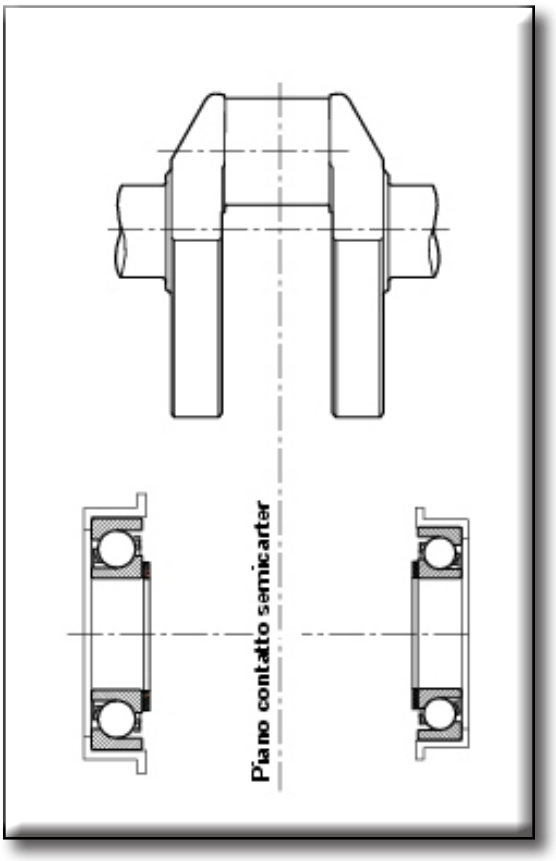
- heat the crankcase half in an oven to 100 °C;
- remove the bearing using a drift and hammer;
- install the new bearing (while the crankcase is still hot) keeping it perfectly square in its seat using a tubular drift that only bears on the outer ring of the bearing;
- allow the parts to cool and check that the bearing is securely seated in the crankcase.



Important
On worn engines, the bearing holder may no longer be a tight fit in the crankcase half.

After having removed the bearing holder, check that the interference fit between the crankcase and the holder with the bearing installed is no less than 0.03 mm, otherwise the crankcase halves must be renewed.

Notes
For shimming the main bearings, see the chapter at the end of this section.

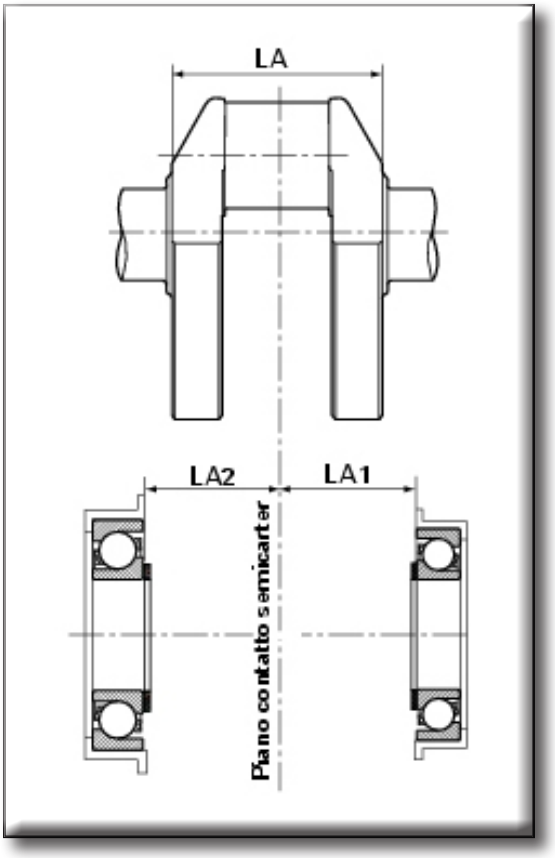


Shimming the shafts

Before assembling the crankcase halves, calculate the shims required to obtain the correct end float of the crankshaft and gearbox shafts.
To determine the correct shim thicknesses proceed as follows.

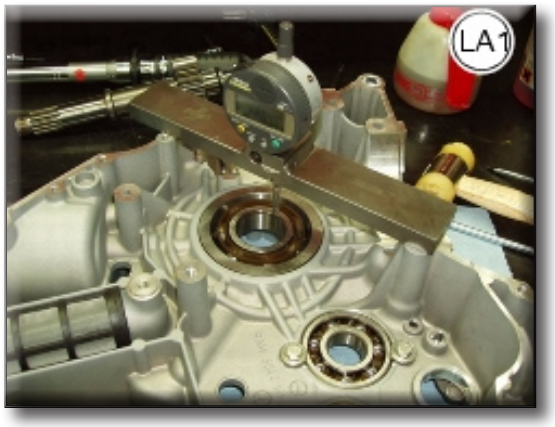
Shimming the crankshaft

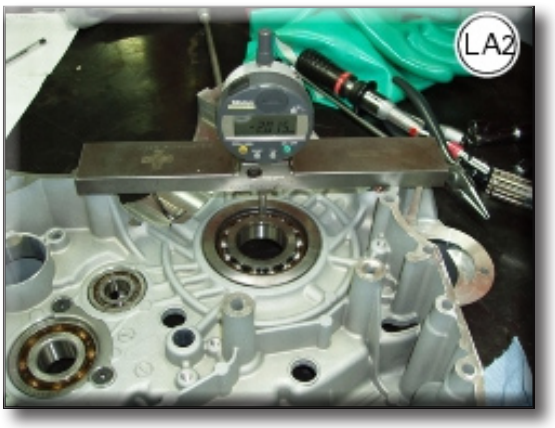
After fitting the new main bearings, proceed as follows to determine the total shim thickness “SA”:
measure the distance “LA” between the bearing contact surfaces on the crankshaft;
measure the depths “LA1” and “LA2” corresponding to the distance between contact surface of the crankcase half and the contact surface of the inner race of the bearings.



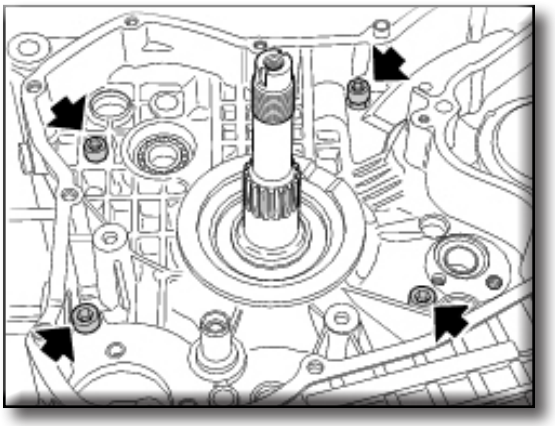
Add a pre-load of 0.30 mm to prevent excessive crankshaft end float when the crankcase halves are at their normal operating temperature.

This gives: SA=LA1+LA2+0.30-LA.
To calculate the each single shim thickness note that: SA=SA1+SA2
where “SA1” and “SA2” represent the shims for the right-hand crankcase half 1 and the left-hand crankcase half 2.
Considering the alignment of the shaft, this gives: SA1=LA1+0.15-LA/2;
and finally, the second shim thickness: SA2=SA-SA1.

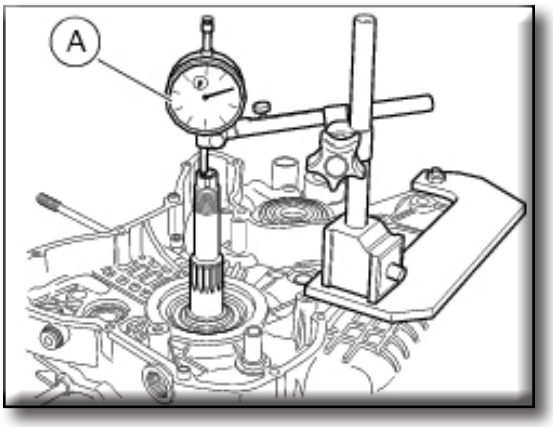




In addition to the above description, the following text illustrates a practical shimming procedure, providing a guide on how to calculate the crankshaft shim thicknesses accurately.
Install a shim of minimum thickness (1.90 mm) on each side of the crankshaft to prevent contact between the crankshaft web and the engine block.
Install the crankshaft and assemble the two crankcase halves.
Fit four M8 screws into the holes shown in the figure and tighten to the specified torque.

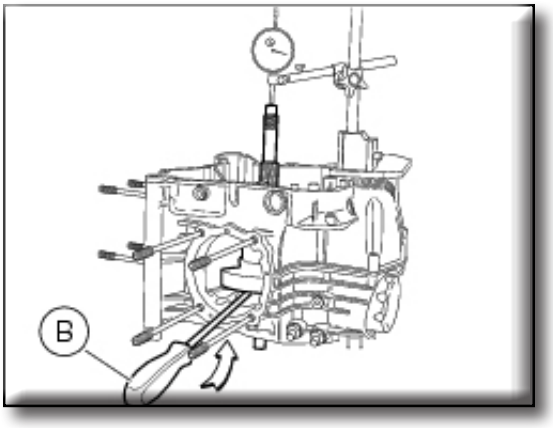


Place a dial gauge (A) with a magnetic base on a support plate fixed to the crankcase.
Bring the stylus into contact with the end of the crankshaft and set the dial gauge to zero in this position.



Insert a lever (B) between the crankcase and the crank web and force the crankshaft towards the dial gauge. Note the dial gauge reading. This is the crankshaft endfloat. Add a preload of (0.30 mm) plus the thickness of the shims used (1.90x2=3.8 mm).
Divide the resulting value by two to obtain the thickness of the shim packs to be installed at either end of the crankshaft.

Notes
After assembling the crankcase, the crankshaft should turn with some interference in the new bearings.



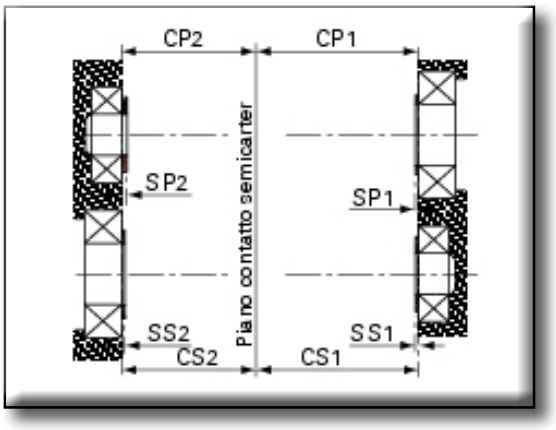
Shimming the gearbox shafts

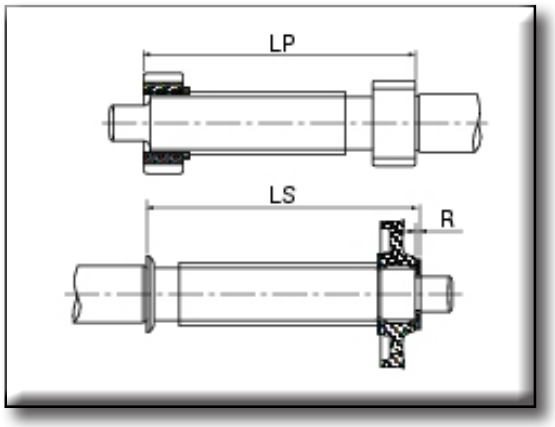
To establish the total shim thicknesses to be installed on the input shaft “SP” and the output shaft “SS”, proceed as follows:

Measure the dimensions “LP” and “LS” on the input and output shafts (for the output shaft add shim thickness “R” of 2.3 mm;
Measure the depth corresponding to the distance between the contact surface of the crankcase half and the contact surface of the inner race of the bearing for the input shaft (“CP1” and “CP2”) and for the output shaft (“CS1” and “CS2”);
Given that end float should be in the range 0 to 0.15 mm, we will take the optimal value of 0.15 mm, which gives: SP=CP1+CP2-LP-0.15 and SS=CS1+CS2-LS-0.15.
To determine the thickness of each single shim pack, note that:
SP=SP1+SP2 and
SS=SS1+SS2

Where “SP1” and “SP2” are the clutch and chain side input shaft shimming values respectively and “SS1” and “SS2” the corresponding values for the output shaft. This gives:
SP1=CP1-64-0.075 and
SS1=CS1-64-0.075, so that
SP2=SP-SP1 and SS2=SS-SS1.

Notes
The method described for the crankshaft can also be used to calculate the shim thicknesses for the gear shafts.





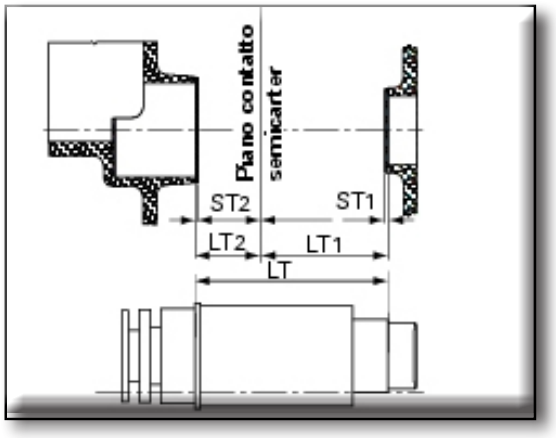
Shimming the gearbox selector drum

A similar procedure is used to establish the total shimming thickness “ST” for the gearbox drum.

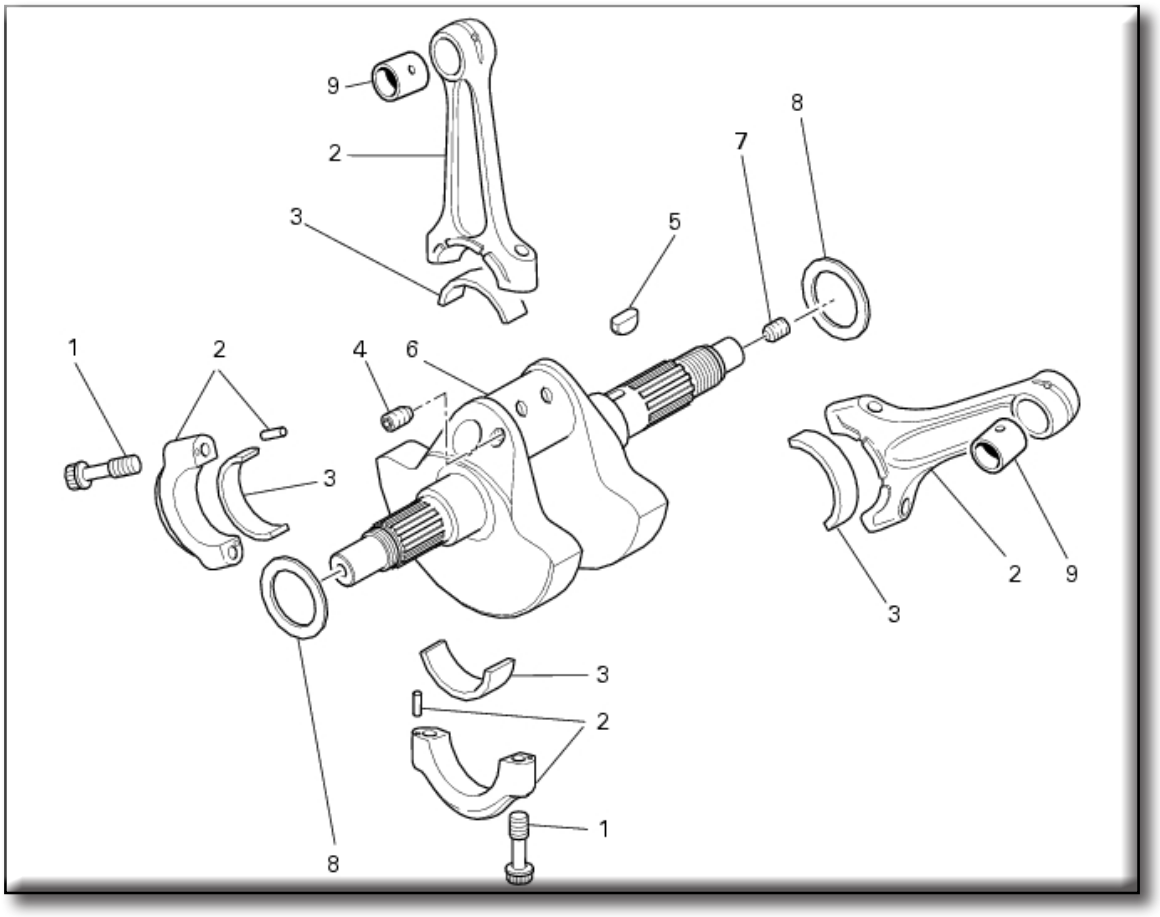
Given that:
LT1 = right-hand side crankcase depth
LT2 = left-hand side crankcase depth
LT = gearbox selector drum shoulder.

Given that end float should be 0 10 to 0.40 mm.
And taking the mean optimal value of 0.25 mm.
This gives: ST=LT1+LT2-LT-0.25.
Given that ST=ST1+ST2.
We obtain ST1=LT1-59-0.125, so that ST2=ST-ST1.

Notes
The method described for the crankshaft can also be used to calculate the shim thicknesses for the gear shafts.



11.20 - CRANKCASE ASSEMBLY: CONNECTING RODS

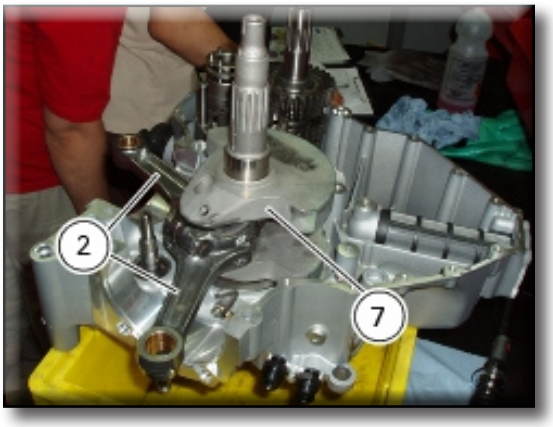


1) Special screw
2) Connecting rod assembly
3) Half bearing
4) Grub screw
5) Key
6) Crankshaft
7) Grub screw
8) Shim
9) Bushes

Removal of the connecting rods assembly

Remove the engine from the frame
Remove the lubrication system
Remove the cooling system
Remove the cylinder head assemblies and the timing parts
Remove the cylinder barrel/piston assemblies
Remove the left-hand crankcase cover and alternator assembly
Remove the engine starting system
Remove the right-hand crankcase cover
Remove the clutch assembly
Remove the clutch assembly

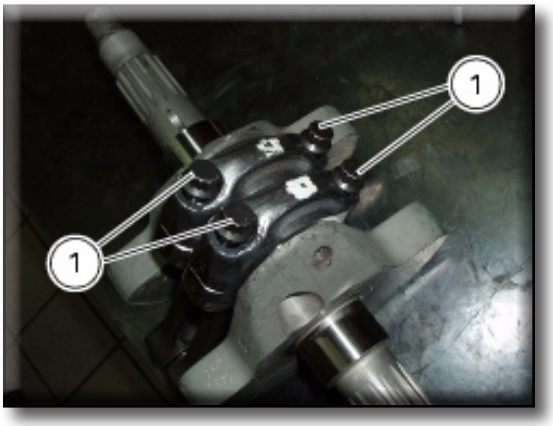
After separating the crankcase halves, withdraw the crankshaft (7) complete with connecting rods (2).



Disassembly of the connecting rods

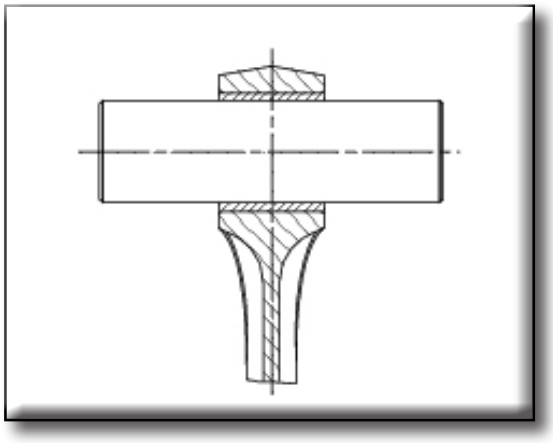
To disassemble the connecting rod, undo the bolts (1) and separate the connecting rod from the crankshaft.

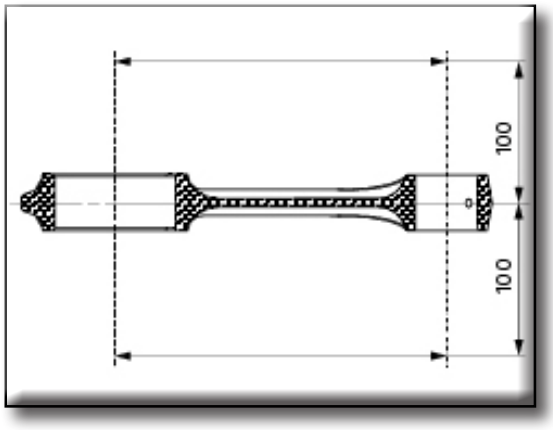
Important
Take care not to mix up components of different connecting rods and maintain the original orientation.



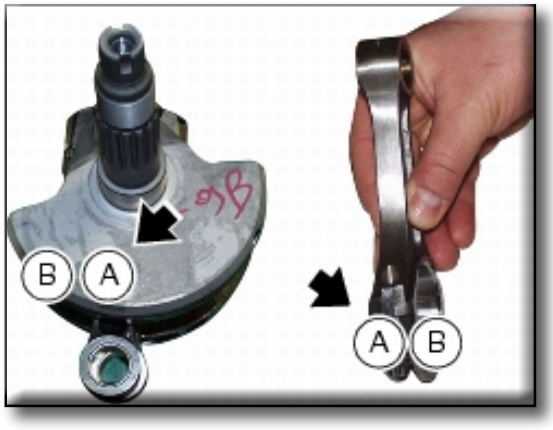
Overhaul of the connecting rods

Make the following dimensional checks on the connecting rods:
- clearance with gudgeon pin on assembly.
In the event of excessive wear, renew the connecting rod.
The small end bushing must be in good condition and firmly driven into its seat.
Check for parallelism error measured at 100 mm from the connecting rod longitudinal axis:
the value must be H - h less than 0.02 mm; otherwise, renew the connecting rod.



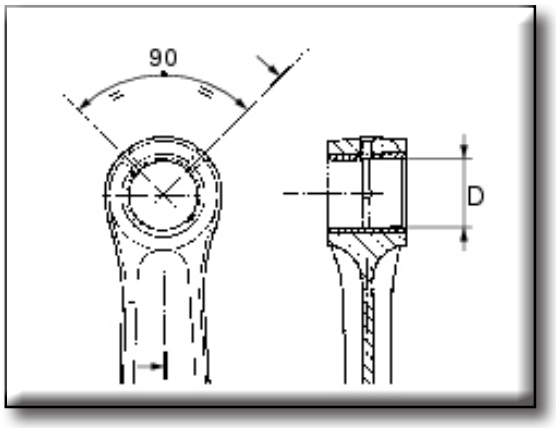


The connecting rod is supplied in two size classes A and B relative to the big end diameter as punch marked on the side of the cap.
It is preferable to use crankshaft and connecting rods of the same size class..



Renewal of the small end bushing

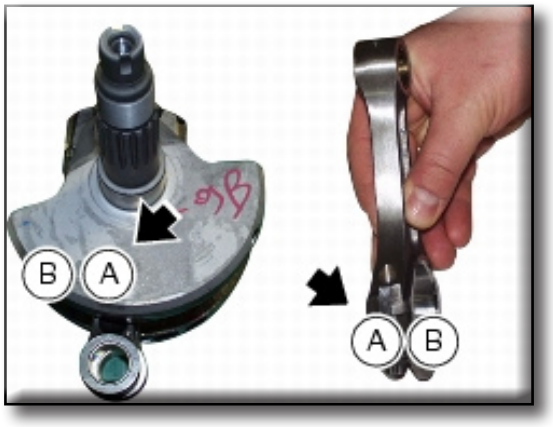
To remove the worn bushing, use a suitable drift and a press.
Drill lubrication holes into the new bushing in correspondence with the existing lubrication holes on the connecting rod small end.
Now ream out the bushing until the inside diameter (D) is 20.035 to 20.045 mm.

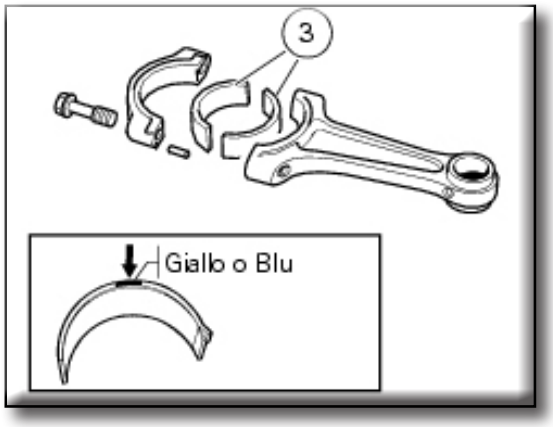


Connecting rod bearings

It is good practice to renew the bearings (3) each time the engine is overhauled.
Replacement bearings are supplied ready for assembly and they must not be reworked with scrapers or emery cloth.
The bearings may belong to two different size classes, each identified by a specific colour (YELLOW and BLUE).
The bearings are composed of an external steel ring, the inner face of which is electro-plated with a lead-based compound.
The table shows the appropriate bearings to be fitted according to the size class of the crankshaft and connecting rod.

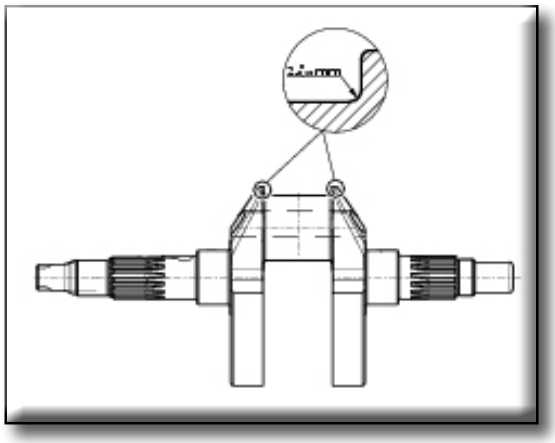
Crankshaft class	Connecting rod class	Bearings colour
B	B	BLUE/YELLOW
B	A	YELLOW/YELLOW
A	B	BLUE/BLUE
A	A	BLUE/YELLOW



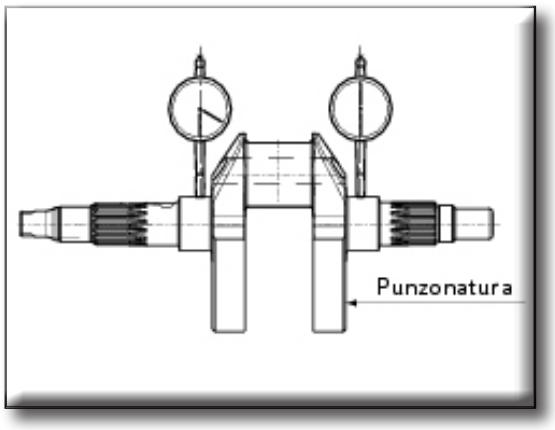


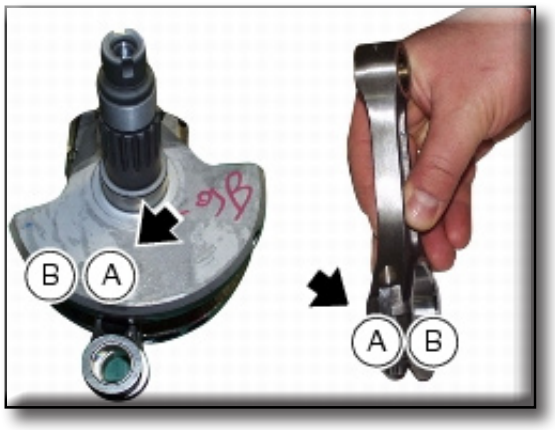
Crankshaft

The main bearing and big-end journals should not be scored or grooved;
the threads, keyways, and slots must be in good condition.
Check for fretting or burrs in the fillet between journal and shoulder.
Fillet radius: 2 mm.

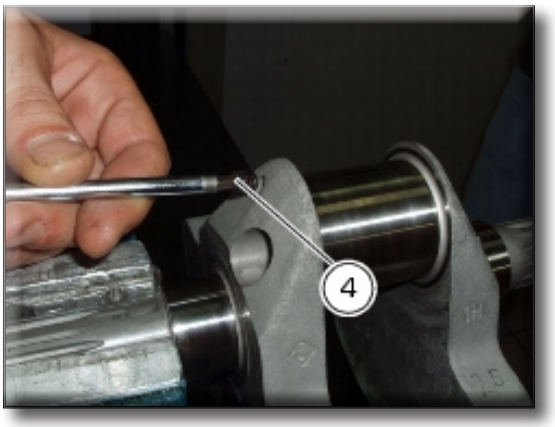


With the aid of a micrometer, measure the ovality and taper of the big-end journals, taking the measurements in various different directions.
Use a dial gauge to measure the alignment of the main journals by setting the crankshaft between two opposing centres.
At each overhaul it is strongly recommended to clean the crankshaft's internal oilways.
The prescribed values are given.
The crankshaft is supplied in two size classes (journals) A and B, as punch marked on the side of the crank web on the pinion side.



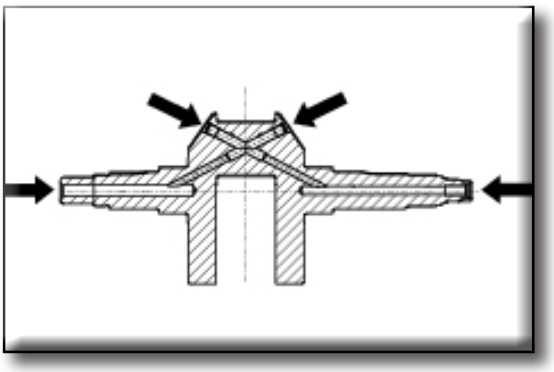


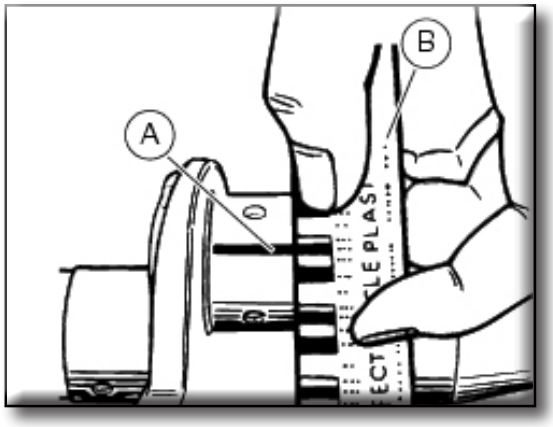
Unscrew all the plugs (4) and (7) from the crankshaft, heating the crankshaft, if necessary, to release the threadlocker applied at the time of assembly.
Clean all the oilways using suitable diameter metal brushes and then blow with compressed air to remove any residues that have accumulated and are restricting the oil flow.
Apply THREE BOND 1375B liquid gasket to the plug threads (4) and (7) and reinstall them.
Tighten all the plugs to the specified torque.



Big-end bearing shell-journal clearance

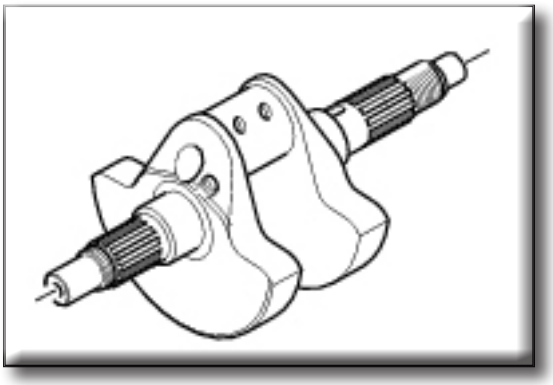
To check the assembly clearance between the bearing shells and crankshaft journals you will lay a strip (A) of GREEN “Plastigage PG-1” on the journal. Fit the connecting rod with the original bearings and tighten the screws to a torque of 50 Nm.
Remove the connecting rod and compare the width of the Plastigage strip to the scale (B).
If the width measured corresponding to the existing clearance is not within the prescribed limit, either the bearings or the crankshaft must be renewed.





Reassembly of the connecting rods

Before starting the work, check that the crankshaft main bearing journals and big-end journals are free of burrs or evident signs of machining: if necessary, clean the surfaces with very fine emery cloth and oil.
Check that the grooves are in perfect condition with no signs of forcing.

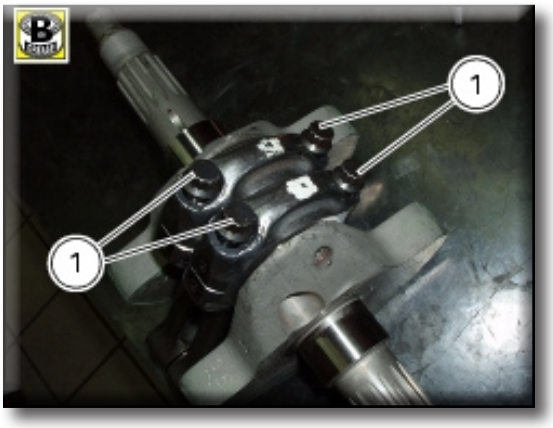


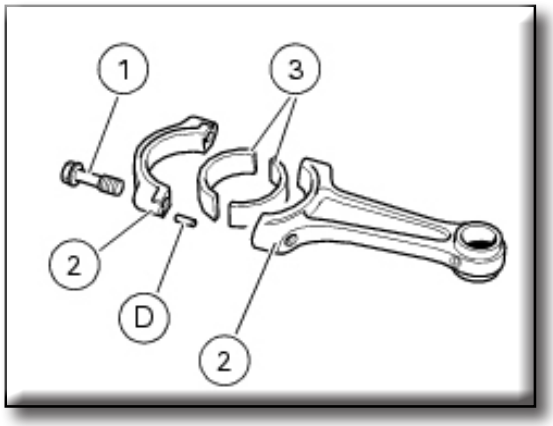
Check that each connecting rod (2) and cap are fitted with their locating pins (D).
Wash the pins and dry them with compressed air.
Clean and lubricate the journals and con-rod bearing shells (3) with engine oil and fit the connecting rods in their original mounting positions.
Use the recommended grease to lubricate the threads and underside of the heads of the new bolts (1) and the threaded hole in the connecting rod, packing in grease from both sides of the hole.

Warning
The grease utilised is an irritant in contact with the skin. Wear protective gloves.

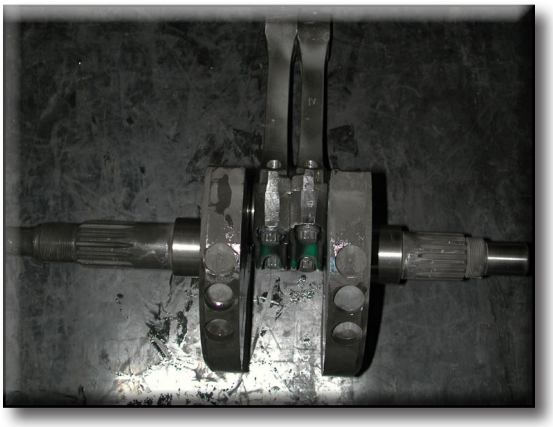
Important
Lubrication of connecting rod cap bolts is essential to obtain the correct coupling and to prevent breakage of the parts.
Use the same connecting rod cap bolts a maximum of three times.

Tighten the bolts (1) by hand.
If this proves difficult or in the case of jamming, undo the bolts and lubricate them again.
Remove excess grease. Tighten the bolt by hand until the head seats against the connecting rod.





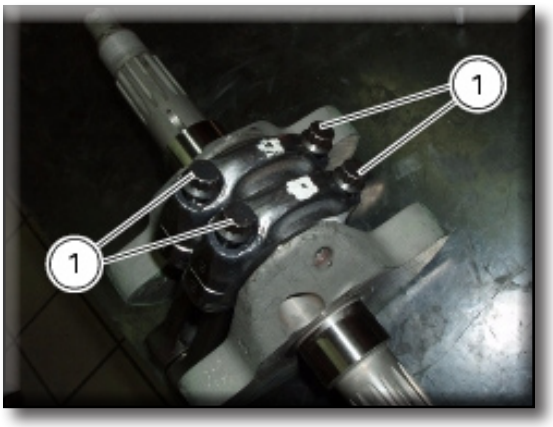
Fit the spacer of the tool 88713.2878 between the connecting rods and take up residual axial play with the fork feeler gauge of the tool 88713.2878 which is available in the following thicknesses:
0.1 mm - 0.2 mm - 0.3 mm.
Temporarily fit the gudgeon pin to align the connecting rods, and then tighten the bolts.



Tighten the bolts (1) with a torque wrench and angle reading (degree wheel) in accordance with the procedure described below (observe the same tightening sequence at each step as that of the previous step):

1) first torque each bolt to a value of 20 Nm;
2) now carry out a second tightening stage applying a torque of 35 Nm on each bolt;
3) now tighten each bolt, reading the angle of rotation, to 85 Nm, checking that the final angle is between 55° and 90°.

Important
If the final angle is less than 55° or greater than 90°, repeat the procedure using two new bolts.

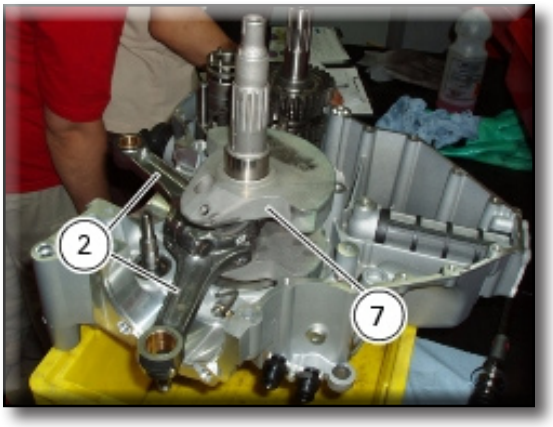


Refitting the connecting rods.

Install the connecting rod assembly (7) and (2) in the crankcase, carry out the shimming and crankcase reassembly procedure as described in Sect. N 9.2, Reassembly of the crankcase halves.

Important

Make sure that the connecting rods (2) are correctly positioned in the respective cylinder seats. Incorrect positioning of the connecting rods at this stage will inevitably lead to the need to re-open the crankcase.



Refit the clutch assembly
Refit the right-hand crankcase cover
Refit the engine starter system
Refit the left-hand crankcase cover and alternator assembly
Refit the cylinder barrel/piston assemblies
Refit the cylinder head assemblies and the timing parts
Refit the cooling system
Refit the lubrication system
Install the engine in the frame