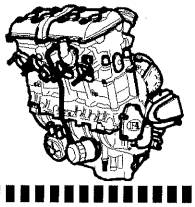
Workshop Manual

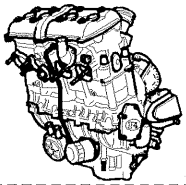
F4 serie oro

Engine

Part Number: 8A0092871

MV Agusta





Engine disassembly, overhaul and assembly

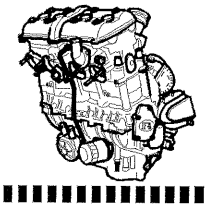
WARNING
During this operations, flammable vapours can occur and metallic parts can be ejected at high speed
For this reason you have to:
- Operate far from flames and sparks
- Wear protective clothes and glasses

ATTENTION
If a cylinder part replacement for wear is needed, we strongly recommend to verify and replace if necessary the same part in the whole cylinders group.
The contemporary substitution of these parts is recommended:
- Pistons with their rings and pins
- Valves with their springs, cotters, plates and shim adjustment
- Valve guides with their valves, springs, cotters, plates and shim adjustment
- Main bearings
- Every part subjected to uniform wear independently from the position number of its cylinder

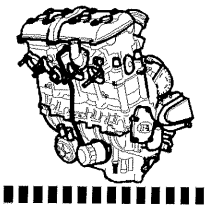
ATTENTION
To let the engine work at his best, every coupling must be in the clearance limits
A tight coupling may cause seizures when moving parts heat
A slack coupling causes vibrations with faster wear of the moving parts.

NOTE
Every legend (right, left, upper, lower, front rear) is referred to the running direction of the motorcycle

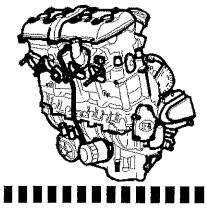
NOTE
The numeration of cylinders, of the main bearings and of their parts is increasing from left to right referred to the running direction of the motorcycle



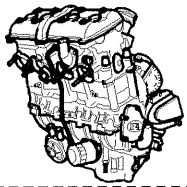
ITEM	STANDARD	WEAR LIMIT
CYLINDER COMPRESSION	min.: 7.5 max.: 13.5 bar at 280 rpm	
Minimum loadless voltage of the battery	12,5 Volt	
CO ADJUSTMENT		
Throttle angle	1.5° ~ 1.7°	
CO value	4.5% ± 0.5% at 1100 ± 50 rpm	
VALVES		
Sealing external diameter		
Exhaust	$24.6_{0}^{+0.3}$ mm	
Inlet	$28.6_{0}^{+0.3}$ mm	
Sealing face thickness	$1_{-0.3}^{0}$ mm	
Stem-guide clearance		
Exhaust	0.02 ÷ 0.04 mm	Coupling: 0.10 mm
Inlet	0.01 ÷ 0.03 mm	0.08 mm
Guide internal diameter	$4.5_{+0.012}^{+0}$ mm	4.55 mm
Valve stem		
Exhaust	4.475 ± 0.005 mm	4.455 mm
Inlet	4.485 ± 0.005 mm	4.465 mm
Valve spring		
Exhaust	30.5 mm	30 mm
Inlet	32.6 mm	32.1 mm
Valve-cam clearance		
Exhaust	0.20 ÷ 0.25	
Inlet	0.15 ÷ 0.20	



ITEM	STANDARD	WEAR LIMIT
CYLINDERS - PISTONS		
Piston ovalization	.....	0.015 mm
Piston - cylinder clearance	0.025 ÷ 0.045 mm	0.10 mm
Piston - piston pin clearance	0.004 ÷ 0.012 mm	0.03 mm
Piston pin-rod small end clearance	0.015 ÷ 0.032 mm	0.04 mm
Rings thickness		
1°	$0.8^{-0.01}_{-0.03}$ mm	0.75 mm
2°	$1^{-0.01}_{-0.025}$ mm	0.96 mm
Scraper ring	$2^{0}_{-0.1}$ mm	1.88 mm
Rings-cylinder maximum clearance		
1°	0.2 ÷ 0.4 mm	0.6 mm
2°	0.2 ÷ 0.4 mm	0.6 mm
Scraper ring	0.2 ÷ 0.7 mm	1 mm
CLUTCH		
Plates thickness	3 mm	2.8 mm
Springs	.....	38.8 mm



ITEM	STANDARD	WEAR LIMIT
GEAR		
Fork pin-groove clearance	0.35 ÷ 0.15 mm	0.65 mm
Drum slot width	7.05 ÷ 7.15 mm	7.35 mm
Fork pin diameter	6.8 ÷ 6.9 mm	6.7 mm
Idle gears minimum axial clearance	0.10 mm	
Fork-gear maximum clearance		0.7 mm
Gear limit		
Drive		5.6 mm
Output		4.6 mm
Gear selection forks limit		
Drive (5ª - 6ª)		4.65 mm
Output (1ª - 2ª, 3ª - 4ª).		3.65 mm
Slot - fork clearance	0.2 ÷ 0.3 mm	0.7
CRANKCASE - CRANKSHAFT		
Main bearings working clearance	0.012 ÷ 0.038 mm	0.06 mm
Big end bearings working clearance	0.036 ÷ 0.061 mm	0.08 mm
Crankshaft axial clearance	0.2 mm	



Parts cleaning

Always clean parts with biodegradable solvents and dry with compressed air
Always clean the assy before disassembly and then the single parts.
Clean everything before installation

Coupling

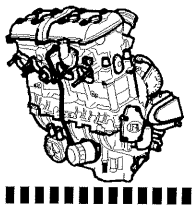
To let the engine work at his best, every coupling must be in the clearance limits
A tight coupling may cause seizures when moving parts heat
A slack coupling causes vibrations with faster wear of the moving parts.

General rules for parts installation

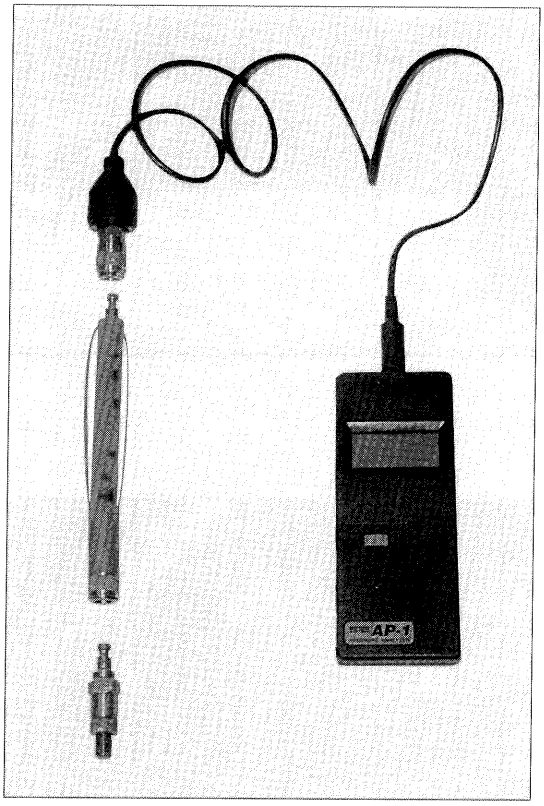
To reassembly the various parts you'll have to execute the procedures in opposite sense of the assembly, paying attention to the particular operations, if specified.
Always replace gaskets oil seals, metallic stoppers, washers in straining material and self-locking nuts.
Bearings wear is done for a certain number of working hours so we recommend their replacement, as the wear check is difficult.
These notes are an addition to the dimensional checks described in the various chapters.
Parts cleaning is basic; bearings and all the other wearing parts need lubrication with engine oil before installation.
Tighten screws and nuts to the prescribed torque setting.

In the next pages disassembly, overhaul and assembly operations of the various parts of the engine are described in sequence to get to the complete engine disassembly.

Remove the engine from the frame;
drain oil from the oil sump;
remove the spark plugs and close their seats with clean clothes, to avoid any little objects (washers, etc....) falling into the engine



Cylinder compression measurement



To execute this operation you need the following special tool:
Spark plug tool: n° 89013
Compression gauge.
Compression gauge adapter.

A) Warm the engine to the working temperature;
B) Turn off the engine, remove fairing, tank airbox and spark plugs;
C) Measure the cylinder compression
Run the engine in the W.O.T. position with the starting motor since the compression gauge indicator doesn't rise anymore; the indicated compression value is at the maximum.

NOTE
The battery must be completely charged.

Cylinder compression
Range: **min.: 7.5** **max.: 13.5 bar**

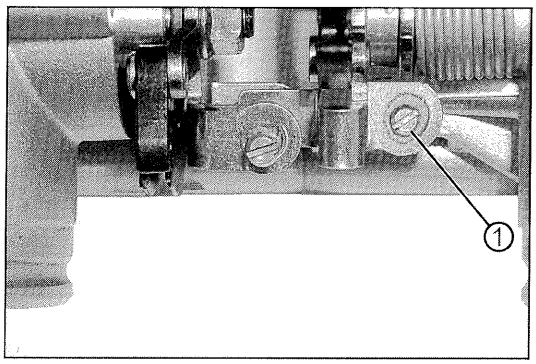
at 280 rpm

- Repeat the same procedure for the other cylinders

⇨ If the compression value is higher then the maximum, check the following points
A) Combustion chamber and piston crown coke
B) The head gasket thickness is not correct
C) The valve stem seal and or the piston rings are damaged

⇨ If the compression value is then the maximum, check the following points
A) One or more valves seat are damaged and the valves don't withstand the pressure (leaking)
B) One or more valves have a zero working clearance
C) The piston - cylinder clearance is too wide
D) The cylinder head and or the head gasket are damaged
E) The piston ring - slot clearance is too wide.

NOTE
Check the battery voltage before executing the compression check as the value is strongly influenced by the revolution speed of the engine , that is, from the battery voltage.

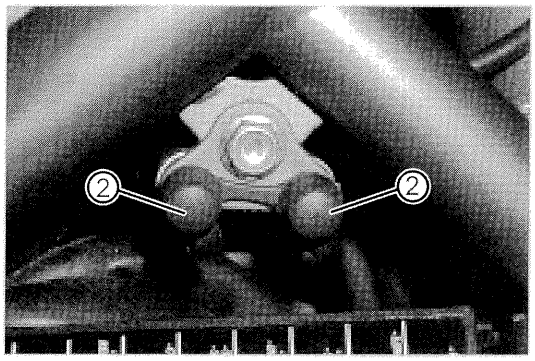


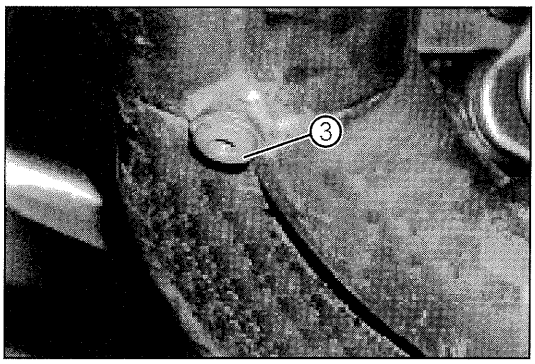
CO ADJUSMENT

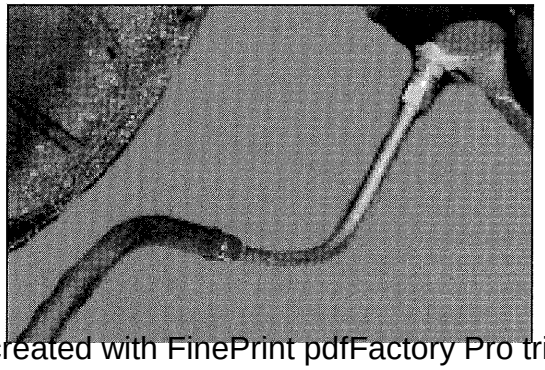
A) Verify and regulate if necessary the throttle idle opening with the Marelli DST software. The throttle angle must be 1.5°; hunting between 1.5° and 1.7° is admitted; hunting between 1.5° and 1.3° is not admitted. Correct if necessary by acting on the screw (1) on the opening pulley of the throttle. Apply Loctite 242 after the adjustment.

NOTE
Act on the right screw only (the smaller one).

B) Verify the correct working of the temperature and pressure sensors, the atmospheric pressure and the battery voltage
C) Wait for the cooling fan start with engine idle
D) Connect the vacuometer to the connections (2) and the CO tester to the connection (3) unscrewing the cap with a 5 mm allen key.



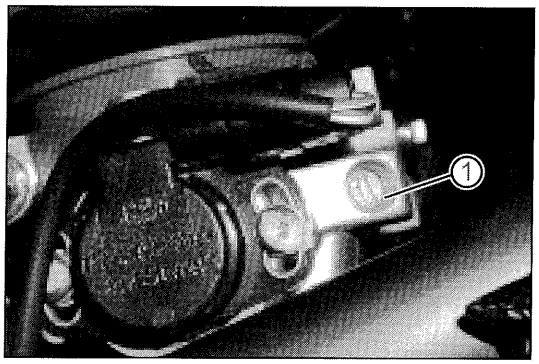




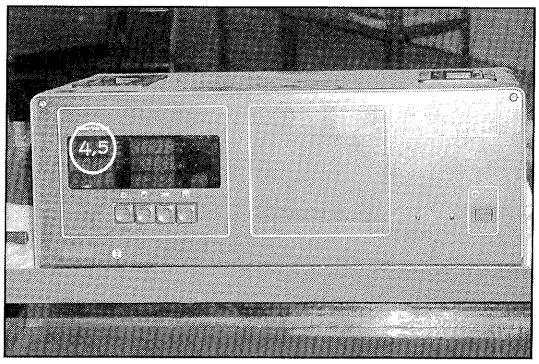
E) Regulate the cylinders vacuum by acting on the by-pass screw of the throttles holder (1), verifying the CO value (with the fan cooler working) is in a range of 4% and 5% (4.5 ± 0.5%).
The revolution speed of the engine must be 1100 ± 50 rpm (with the fan cooler working).

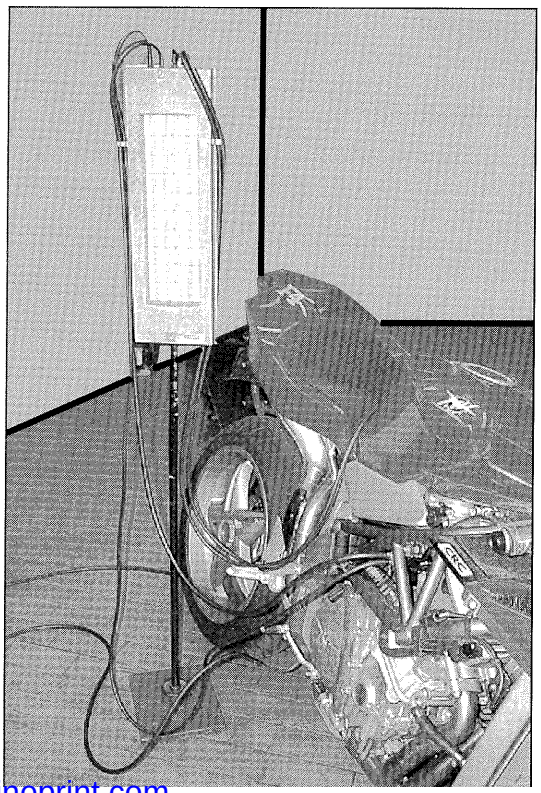
F) Disconnect the vacuometer, speed up the engine and verify the throttle gets back to the value previously defined, wait for the CO value stabilisation and verify CO and rpm values are in the given clearance.

G) If the values are out of range check the vacuometer line for air infiltration, reconnect the vacuometer and repeat the operation starting from the E) point.

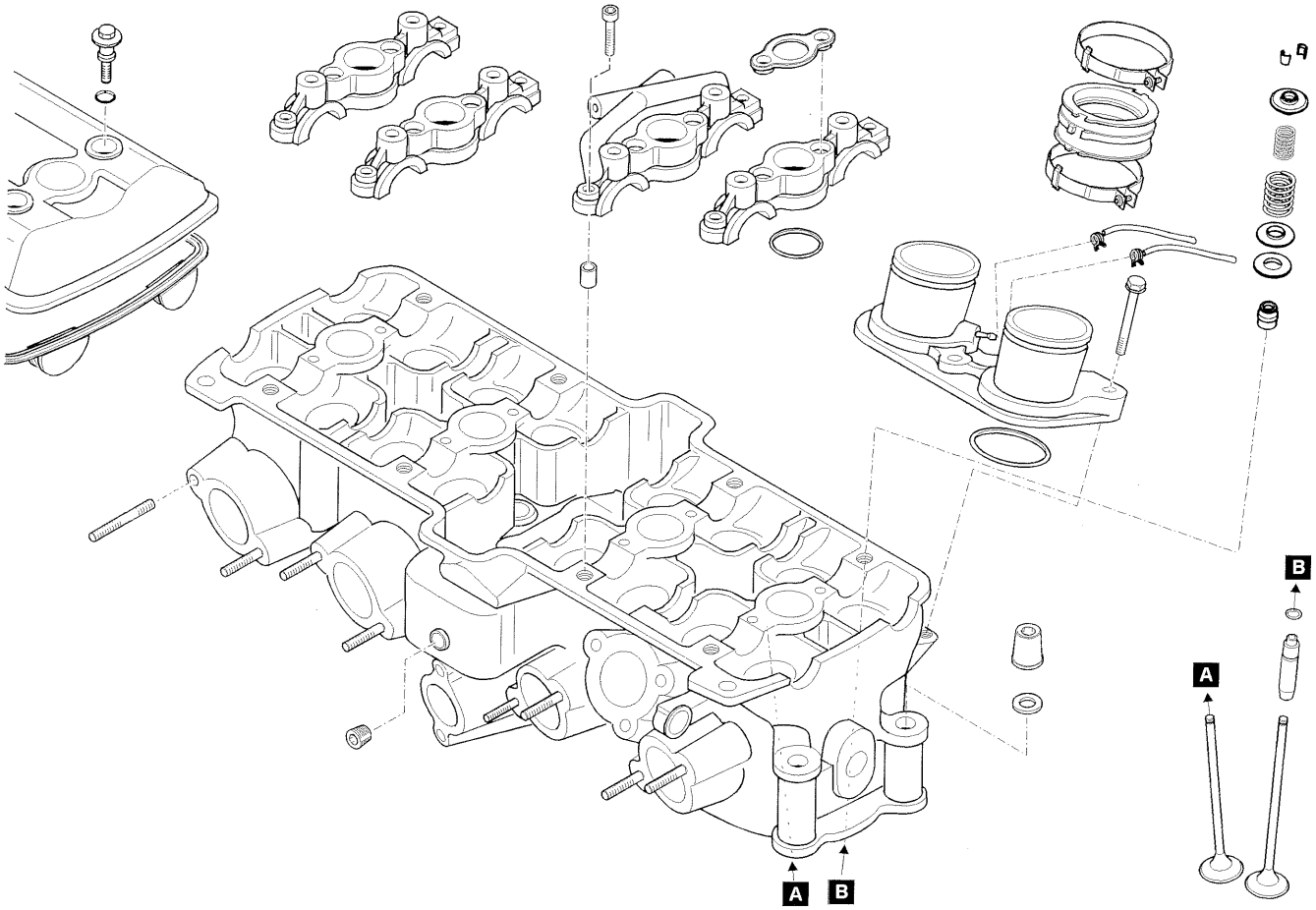


NOTE
Neither operate on the coupling screw of the throttle shafts and on the control unit trimmer.

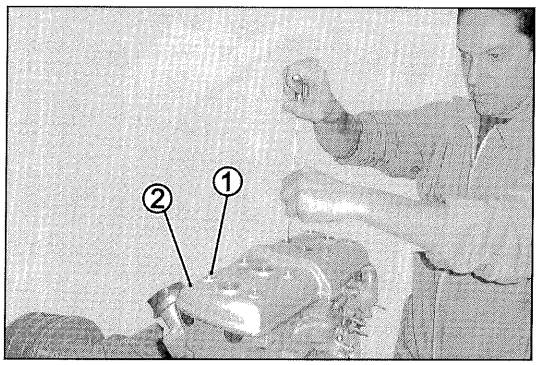




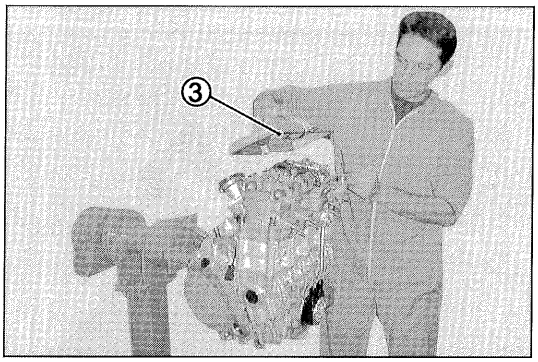
HEAD



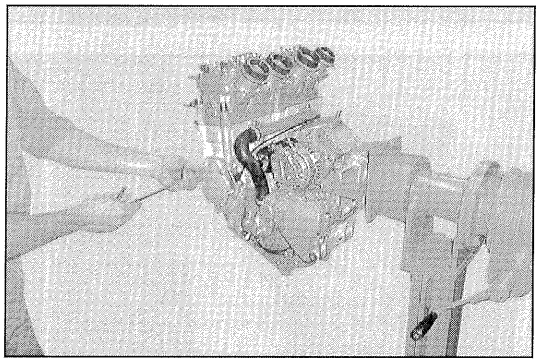
Head assy removal



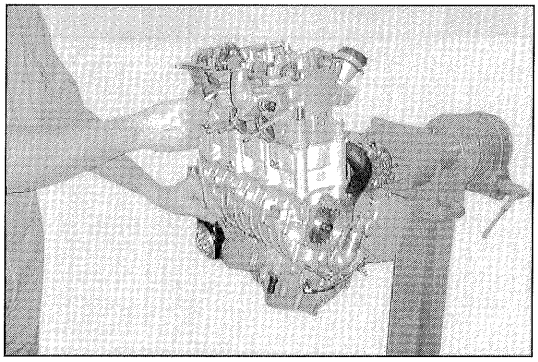
Remove carefully the 8 fixing nuts (1) and the valve cover(2) to avoid any damage to the gasket (3).

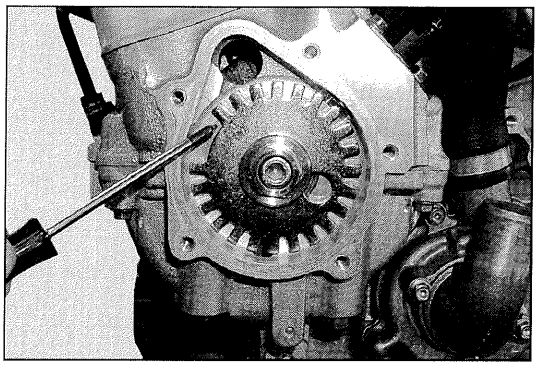


Working on the L.H. side of the engine remove the phonic wheel cover and its gasket by acting on the 5 bolts.

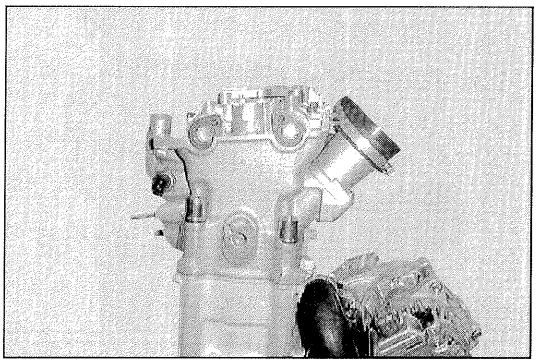


Remove the head oil pipe on the front side, by acting on the fixing screws with a 8 T-wrench.
Rotate the camshaft until the n°1 piston reaches the TDC using a 19 socket wrench on the phonic wheel nut.

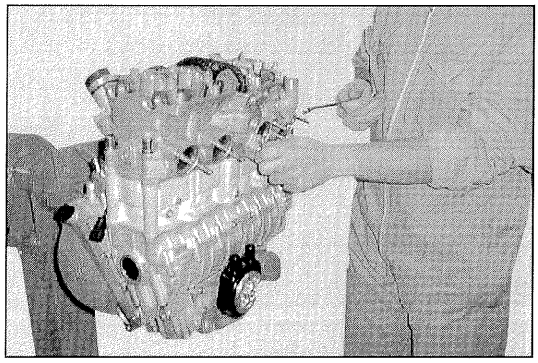




In this position the "T" notch on the phonic wheel is aligned with the notch on the crankcase.

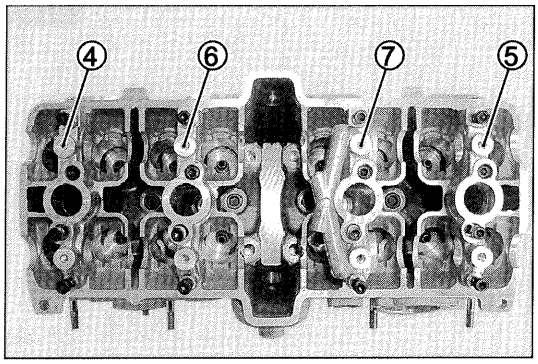


The N°1 cylinder cams converge to the top symmetrically as shown in picture. The notches on the camshafts control gears are horizontal and face outwards.

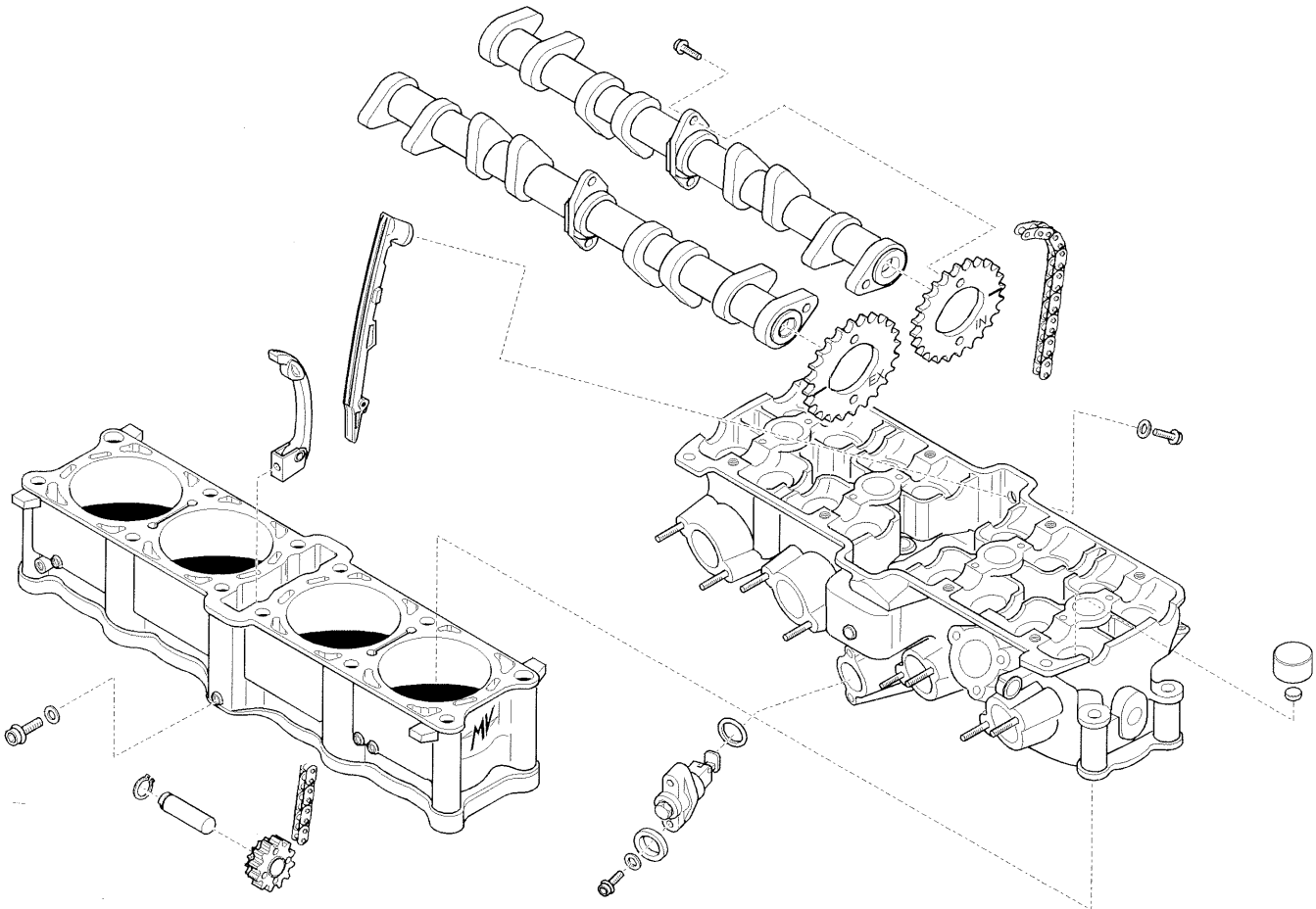


Withdraw the central screw of the timing system chain tensioner. Remove the chain tensioner by acting on the 2 fixing screws.

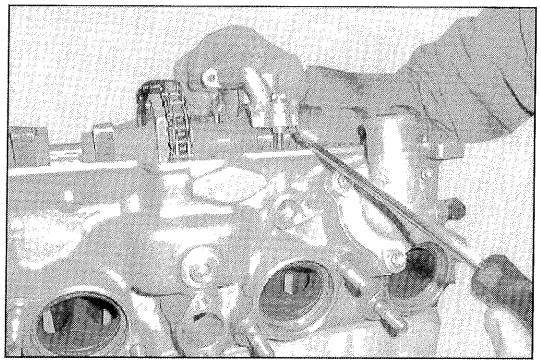
First remove the external camshafts U-bolts (4 - 5) by acting on the 4 socket head screws of each one.
Then remove the internal ones taking care to the valve springs thrust.



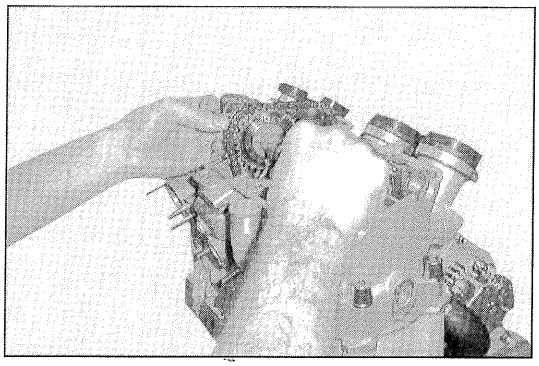
TIMING SYSTEM DRIVING PARTS



Help if necessary the U-bolt removal using a mallet or carefully the end of a flat screwdriver

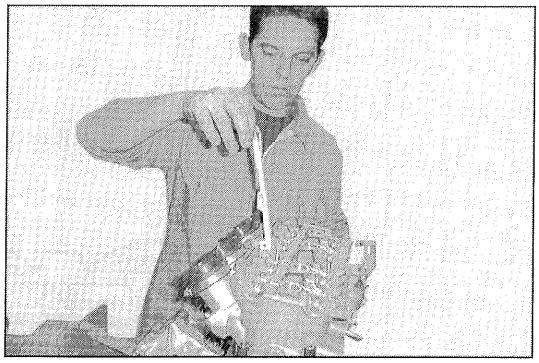


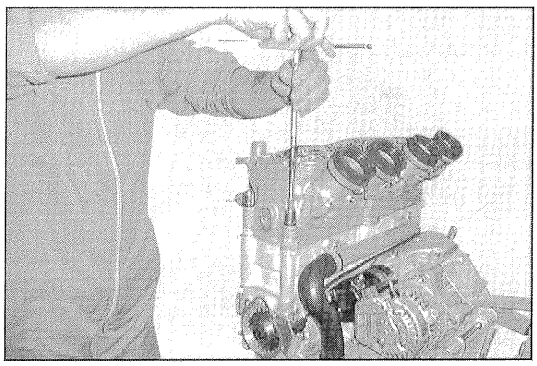
Rotate without effort the exhaust side camshaft removing it from its seat, in this way the timing system chain has a lower tension.
Disentangle the chain from the gear. First remove the exhaust side camshaft and fasten the timing chain with a copper wire to recover it in the next operations.



Remove the intake side camshaft.

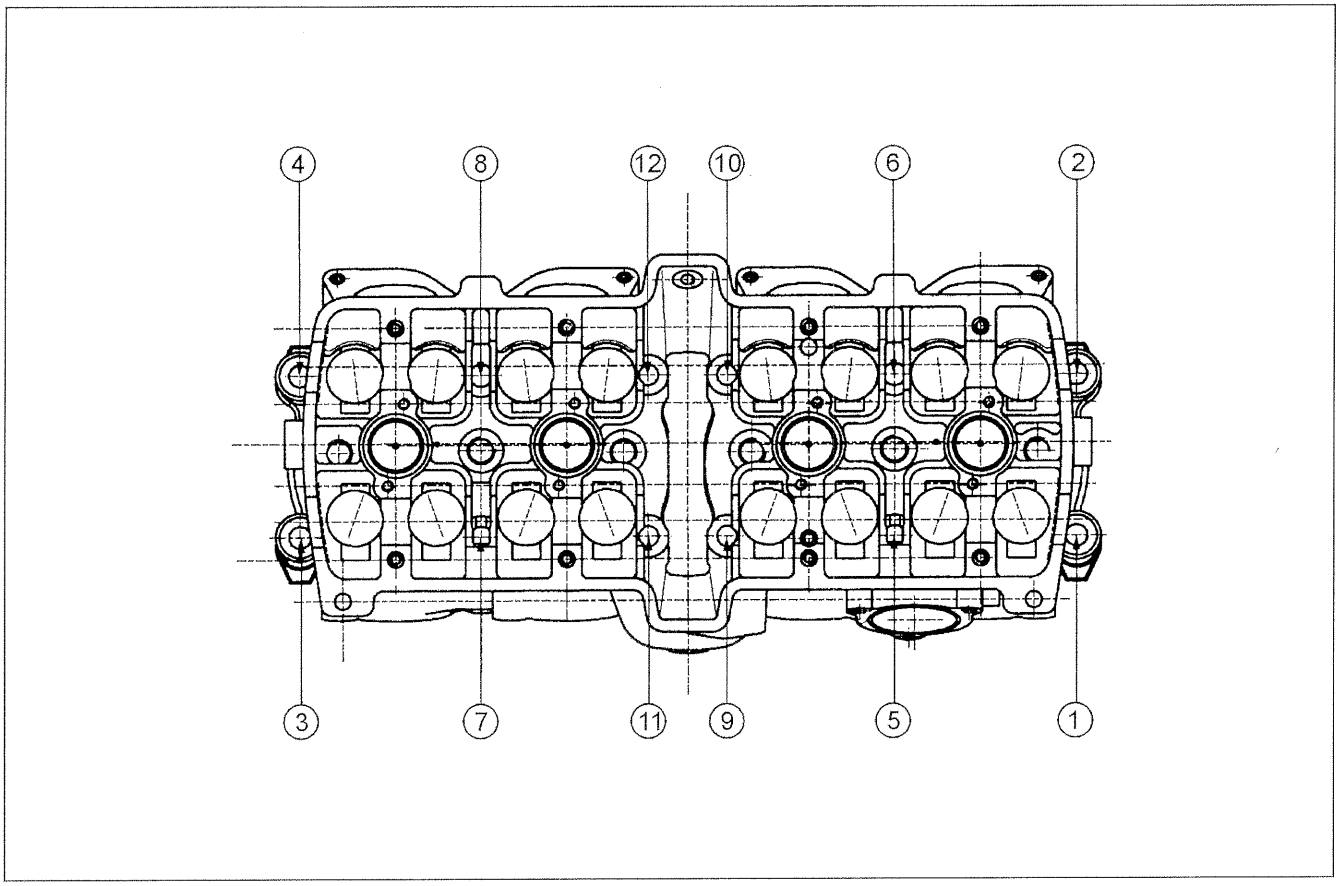
Remove the timing chain guide by acting on the fixing screw.



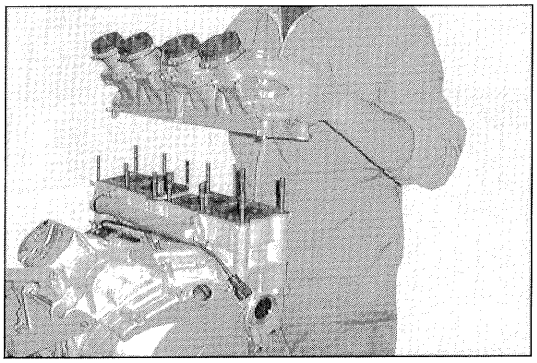


Remove the 12 head fixing nuts starting from the external ones: just follow the order shown in picture

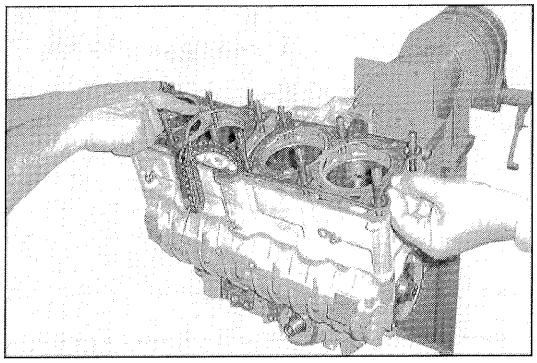
ATTENTION
There is a washer on each stud bolt: avoid its fall in the engine; to be sure stop the holes with clean clothes.



Remove the head and carefully put it on a clean table.

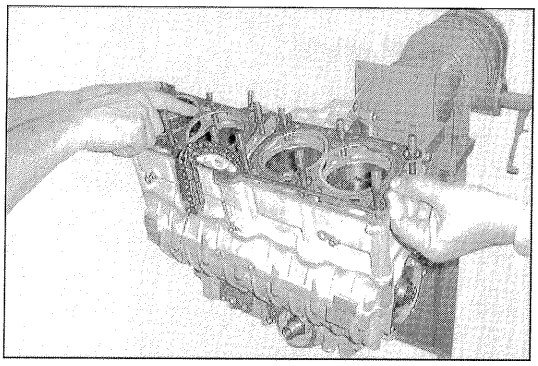


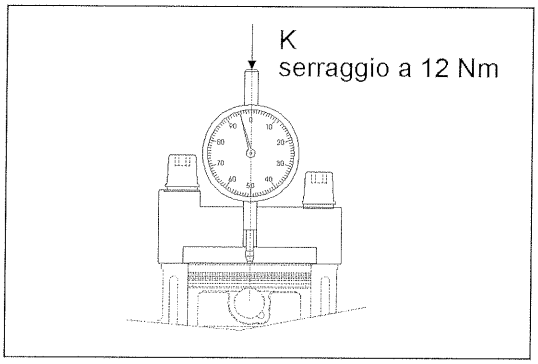
Don't turn it upside-down.
Remove the gasket which is going to be replaced at reassembly.



Head assy inspection

Remove any carbon deposit from the combustion chamber.
Clean any fouling of the cooling ducts.
Check any surface for cracks and the seal surfaces for grooves, steps or any other damage.
Check the mating surfaces for flatness and the spark plug thread condition.





Head assy assembly

To execute this operation you need the following special tool:
A) n° 94793 piston / cylinder plane distance measuring tool

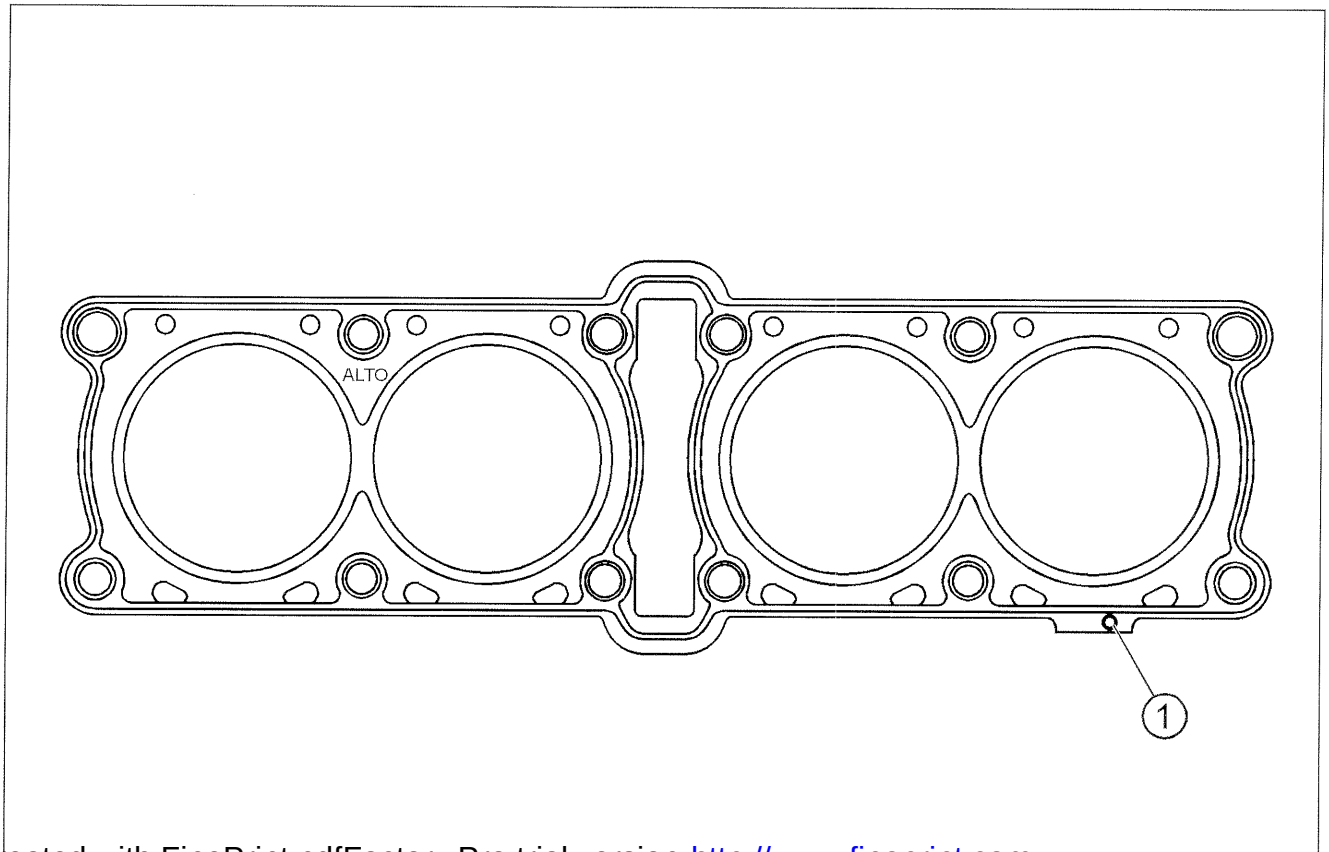
Place the new gasket on the cylinder plane.
The gasket is of the same thickness of the one installed before if no parts replacement occurred.

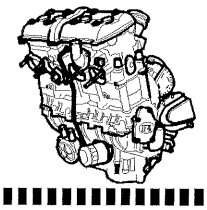
If replacement is necessary you'll need to measure the piston / cylinder plane distance with the n° 94793 tool, tightening the head nuts at 12 Nm.
The choice is made following the downside table:

Piston / cylinder plane distance	Gasket type
0,37 - 0,57 mm	Thick => 1,45 mm
0,17 - 0,37 mm	Thin => 1,30 mm

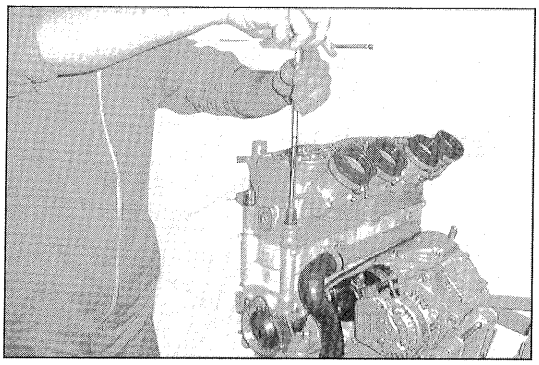
You can distinguish gaskets from the hole (1) as shown in picture
The one with the hole is the thick gasket as in the downside table

HOLES NUMBER	THICKNESS	PART N°
NONE	1.30 ± 0.05 mm	8A0087757
1	1.45 ± 0.05 mm	800087757

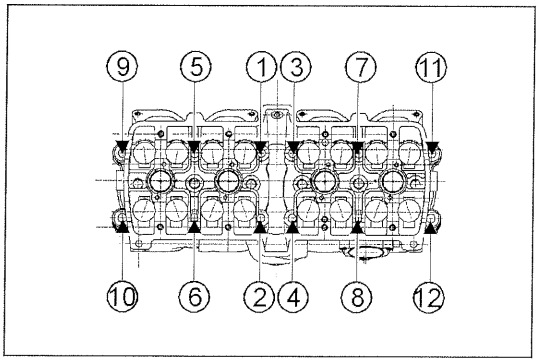




Install the gasket with the ALTO writing on the upper side and the projection in the running direction
Install the centering bush between head and cylinder.
Insert the washers in the stud bolts, using a screwdriver to guide them on the inner stud bolts if necessary
Apply MOLKOTE HSC antiscuff grease on the nuts thread.
Don't apply any grease on the stud bolts thread: they have to be clean and degreased.

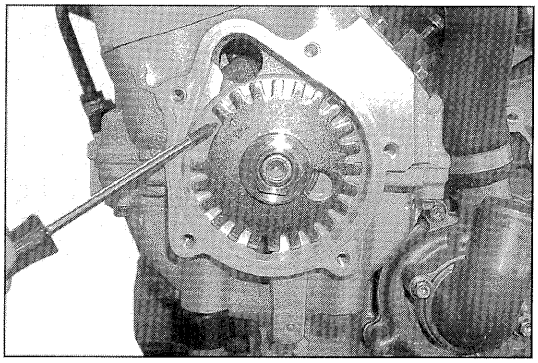


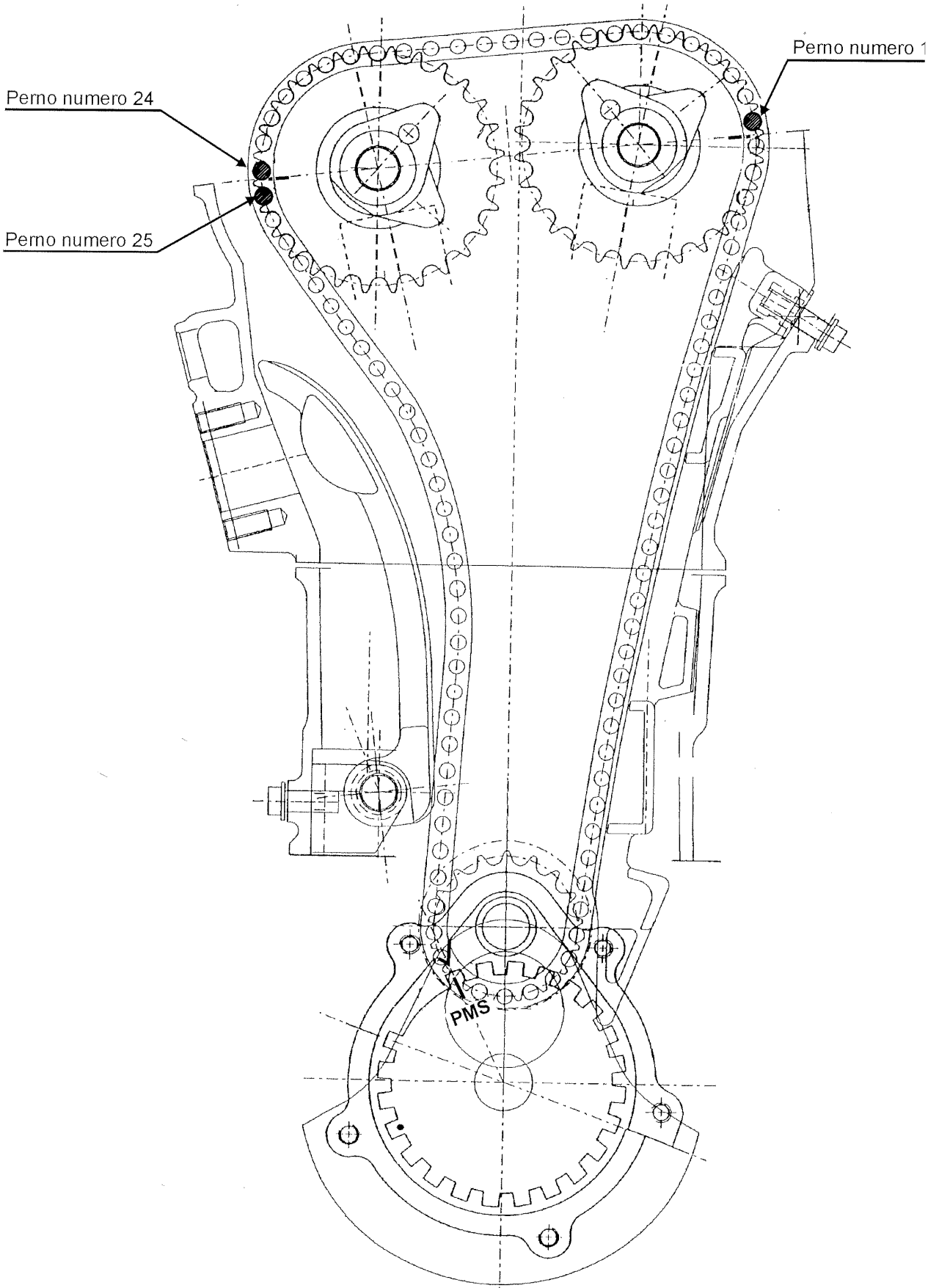
Tighten the bolts with a setscrew wrench and pre-lock them at a 35 Nm torque.
Tighten the bolts following the order as shown in picture at a 45 Nm torque.



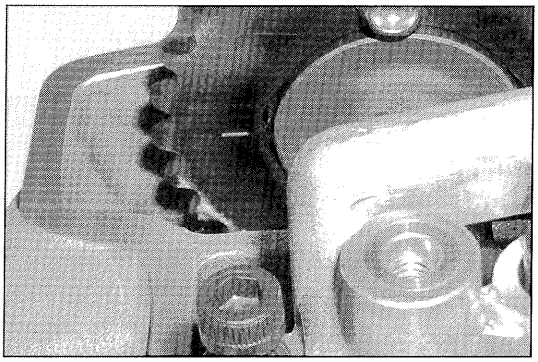
Pick up the timing chain.
Insert the timing chain guide with its screw and lock with LOCTITE 242 at a 8 Nm torque after a perfect degreasing.

To obtain a proper timing operate this way:
Let the n°1 piston reach the TDC: in this position the "T" notch on the phonic wheel is aligned with the notch on the crankcase.
Remove the copper wire of the timing chain.
Tighten the timing chain.





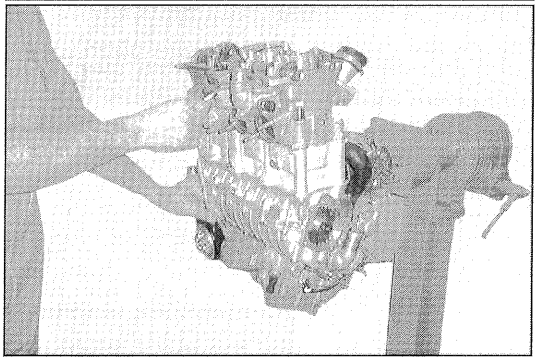
Install the intake camshaft with the timing notch of the drive gear parallel to the head table, facing outside (see picture).
Install the exhaust camshaft with the notch between the 24° and 25° pin of the timing chain.
Start the from the pin after the intake camshaft notch.
Check the proper O-Ring installation under the head U-bolts.



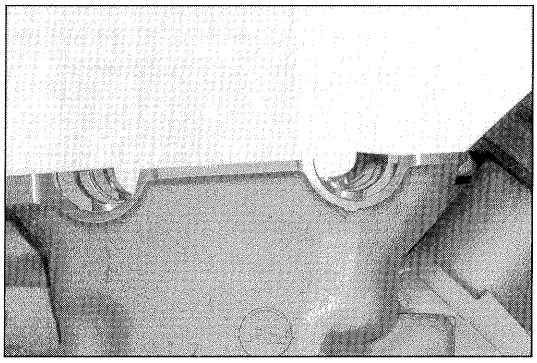
Install the n°2 and n°3 U-bolts, referring to the numbers on the intake side.
Install the n°1 and n°4 U-bolts.
Tighten the socket head screws by hand.

ATTENTION
Check the proper installation of the chain tensioner before the U-bolts screws locking.

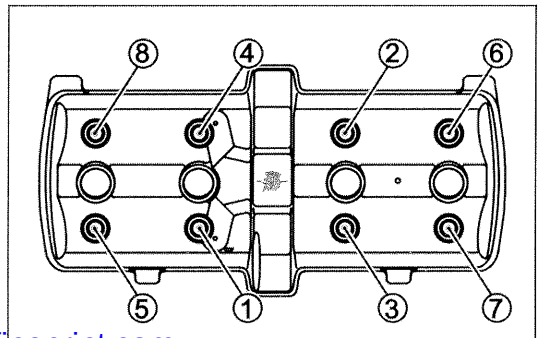
ATTENTION
Don't lock the U-bolts screws if their springs are charged. Rotate properly the crankshaft to have the springs of the U-bolt you are acting on are released and the cams are on the basic radius.



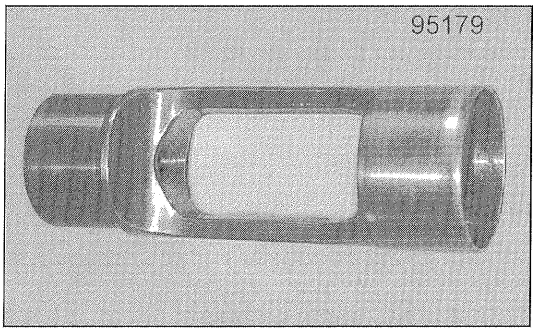
Tighten the Allen screws gradually.
Tighten at a 12 Nm torque, starting from the n° 2 and n°3 U-bolts.
Check the valve cover gasket condition.
Apply 5552 silicone gasket on the semicircles of the head (see picture)



Install the valve cover.
Install the screws by hand, then lock them at a 8 Nm torque.
Install the head oil delivery pipe and grease the O-Rings.



Head parts disassembly

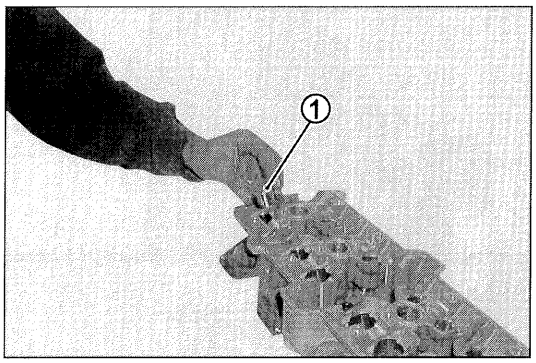


To execute this operation you need the following special tools:

n°94796 tool for valve removal
n°95719 tool for cotters removal
n°94798 tool for stem rubber seal removal tool.

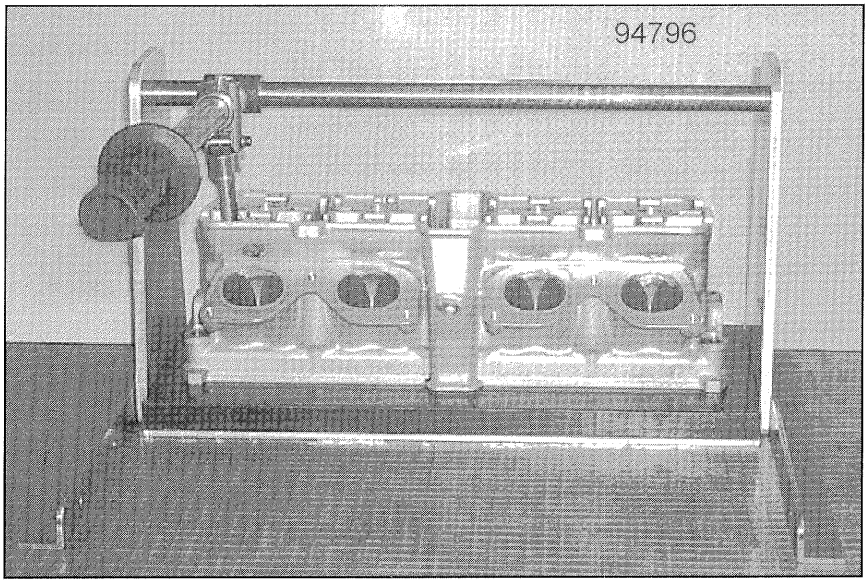
ATTENTION
Each part of a valve (collets ,springs, etc.) must be reinstalled on the same valve

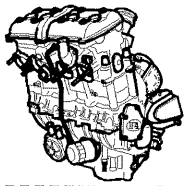
Remove the head following the procedures described in the chapter " Head assy removal"



Valve removal

A) Remove the buckets (1) using a magnet and number them with a pen to install them in the same position.
B) Remove the clearance adjusment shim pads (2) with a magnet and put them in their bell to install them in the same position.
Use only the n°95179 tool to remove collets to avoid valve bending.
C) Install the head on the n°94796 tool.
D) Use a mallet on the upper cap to unlock the collets.
E) Compress the springs on the upper cap
F) Remove the collets with a magnet
G) Carefully release the cap pusher.





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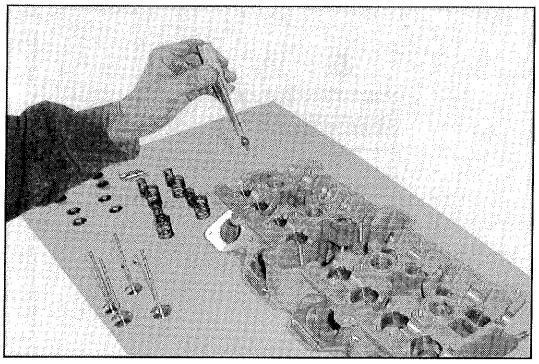
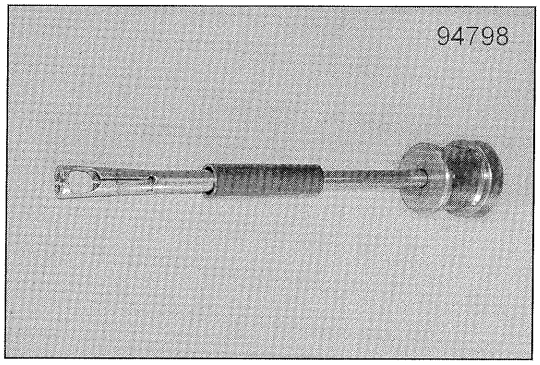
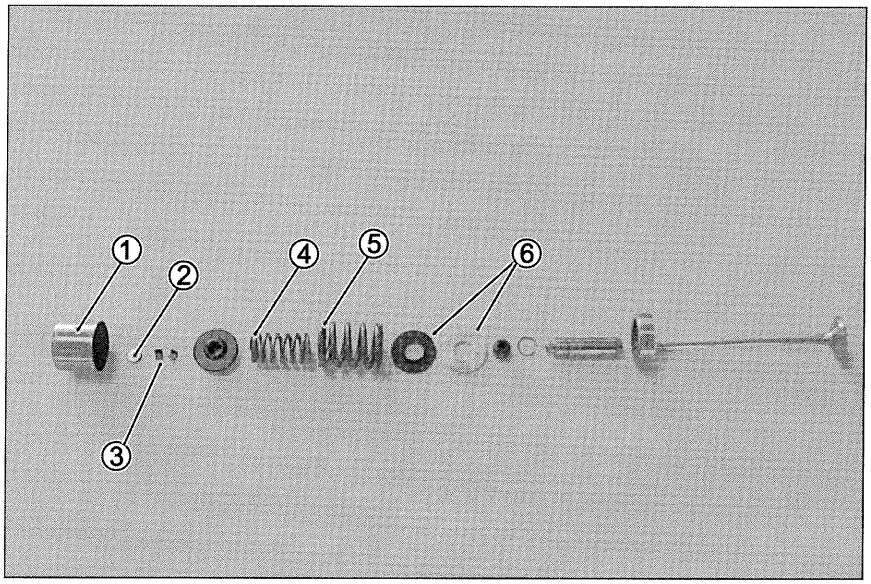
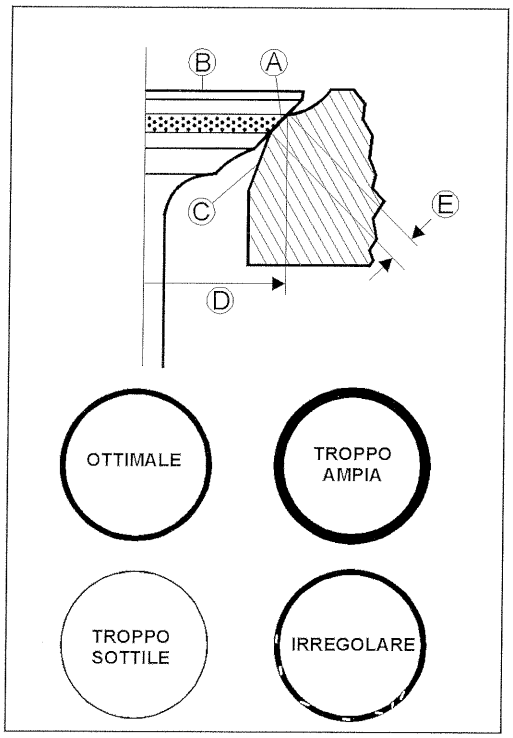
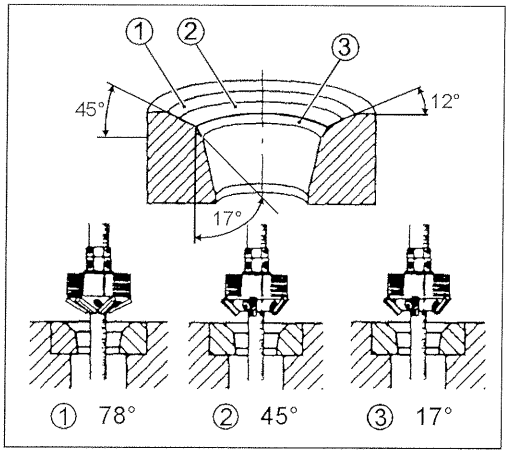
Now you can remove in sequence:
A) Collets
B) The 2 coaxial springs (4 and 5)
C) Remove if necessary the rubber stem seals using the n°94798 tool
D) Remove the lower cap and the shim adjustment
E) Remove the valve from the combustion chamber.











Valve seat maintenance

To execute this operation you need the following special tool:

n° 95321 tool: valve seat cotting tools kit

Check the sealing surface [A] between the valve [B] and the seat [C] for cracks or pitting.
Measure the external diameter [D] of the sealing surface on the valve seat.
If the value is too wide a repair is needed.

External diameter of the valve seat sealing surface

Standard: exhaust: $24.6\ ^{+0,3}_{+0}$ mm

intake: $28.6\ ^{+0,3}_{+0}$ mm

Measure the sealing width using a painted gauge or Prussian blue.
If it is too wide, too thin or uneven, proceed with repair.

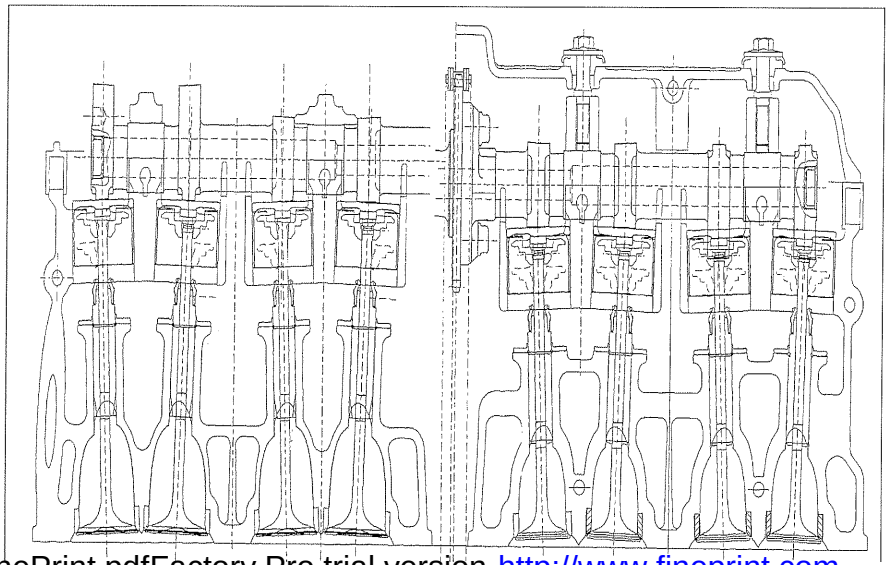
Width of the valve seat sealing surface

Standard: exhaust, intake $1\ ^{0}_{-0.3}$ mm

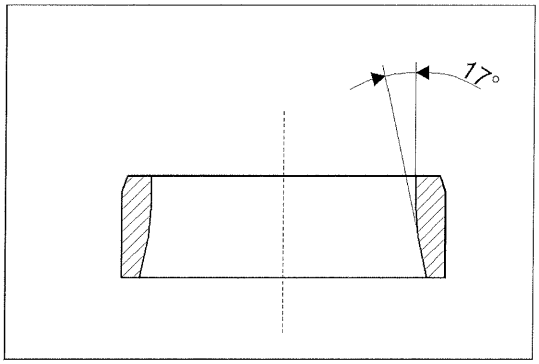
Repair by milling the seats with the mills kit: 78° (1), 45° (2), 17° (3)
Grind the valves and check the seal.

ATTENTION
Remove as less as possible material from the seat:
Intake max 0.6 (vertical)
Exhaust max 0.4 (vertical)

Check intake and exhaust ducts for leaking by filling them with fuel.
If leaking occurs check the repair quality with Prussian blue.



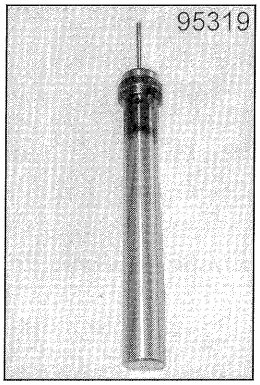
Valve seat replacement

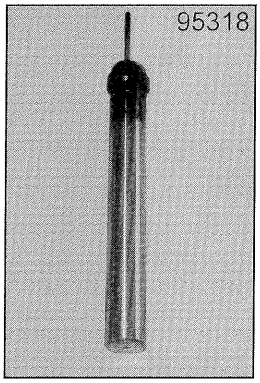


To execute this operation you need the following special tools:

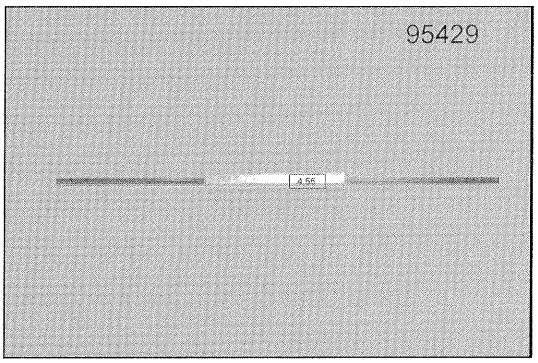
n°95318 punch removal valve seat intake
n°95319 punch removal valve seat exhaust

Operate like this:
A) Remove the old seats by milling them carefully to avoid any damage to the seat housing on the head.
B) Check the housing diameter to choose the new oversize seat with an installation interference of .....
C) Valve seat are supplied as spare parts with a 0.03 mm oversize of the external diameter.
D) Slowly and uniformly heat the head at 180° and cool the new seats with dry ice.
E) Drive the seats in their housing with the punches n°95318 (exhaust) and n°95319 (intake).
F) Let the head cool, then mill the seats and grind the valves relating to the dimensions below:





Ø A	$28.60^{+0.3}_{-0}$
Ø S	$24.6^{+0.3}_{-0}$
[E]	$1^{+0}_{-0.3}$



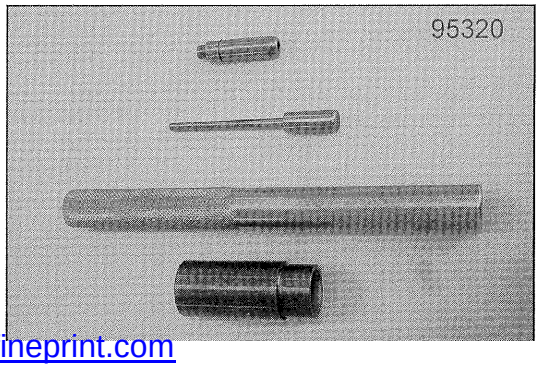
VALVE GUIDE CONTROL AND MAINTENANCE

To execute this operation you need the following special tools:
n°95429 installing valve guides intake
n°95320 installing valve guides exhaust

valve stem - valve guide clearance: **mm 0.01-0.03 intake**
0.02÷0.04 exhaust

coupling limits **mm 0.10 intake - 0.12 exhaust**

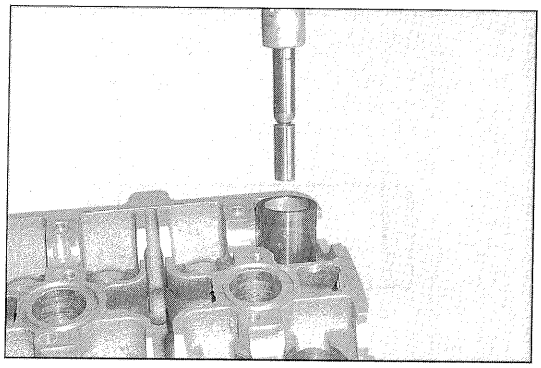
Guide internal Ø limit: **mm 4,55**

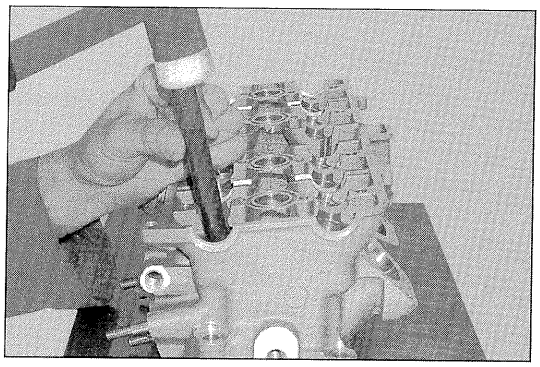


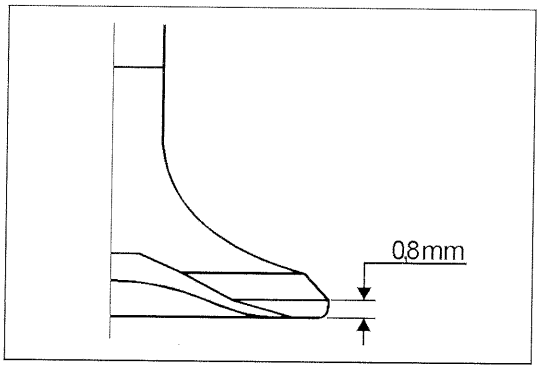
Perform an accurate visual check of the valve guide
Measure valve stem - valve guide clearance using the check punch and a micrometer to determine the wear

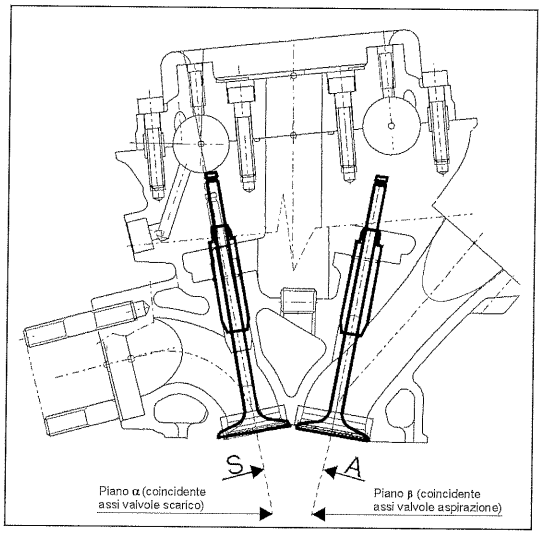
NOTE
The check punch (Ø 4.55mm)can't go through the guide hole.

NOTE
If guide replacement occurs you have to check and replace









Valve guide removal

Remove the valves and the rubber seals as shown before, then proceed like this:
Slowly and uniformly heat the head at 100°.
Withdraw the valve guide with the n°95320 punch
Perform an accurate visual check of the valve guide

Valve guide installation

Install an oversize valve guide proceeding like this:

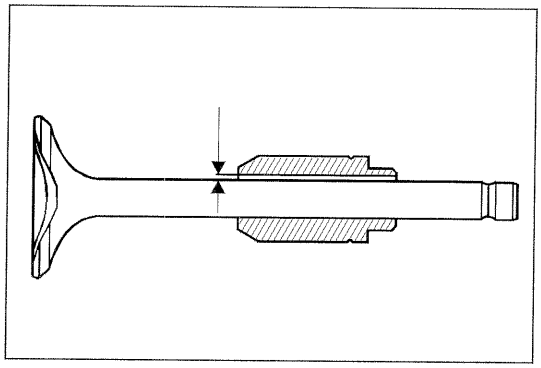
Oil the valve guide external surface
Slowly and uniformly heat the head at 180°÷200°.
Cool the valve guides with dry ice or liquid nitrogen (N2)
Insert the valve guide up to the sealing using the n°95320 punch and let it rest till the temperature is stabilised.
Check the valve sliding in the guide and perform one cut with a 4.5 H7 reamer if necessary

Valve

The valve stem diameter can't be lower than :
4.485$^{-2/100}$ mm intake
4.475$^{-2/100}$ mm exhaust
The minimum distance from the seal position at 45° to the valve table can't be lower than 0.8 mm (see picture)
Check the stem and the sealing surface for their good conditions. No sign of pitting, cracks, strain or wear are allowed.
Verify the stem straightness is perfect.

Valve - Valve guide coupling

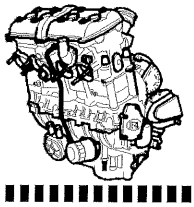
The **coupling clearance** at installation is:
0.01 ÷ 0.03 intake
0.02 ÷ 0.04 exhaust
The maximum coupling clearance is
0.10 intake
0.12 exhaust
If the clearance is too wide, replace valve and guide.



Springs

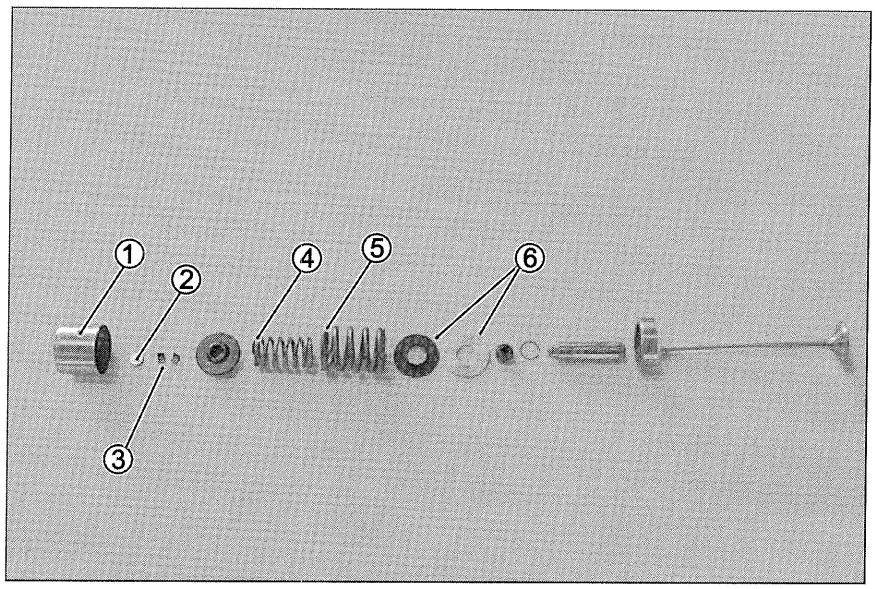
Check the free length is not lower than the limit allowed, replace the springs if necessary:

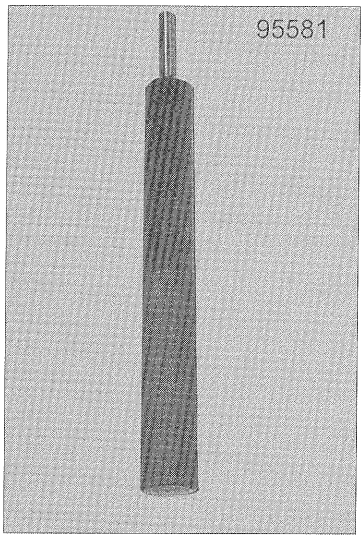
Inner spring l = 30,5 mm	Service limit: 30 mm
External spring l = 32,6 mm	Service limit: 32,1



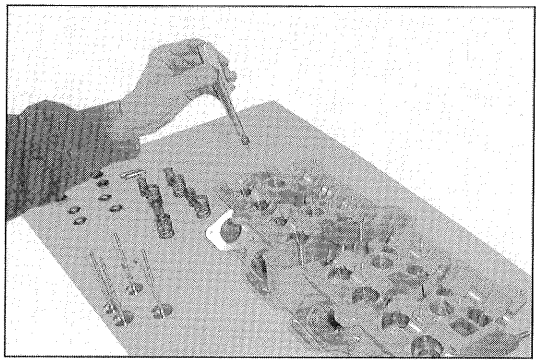
Valve assembly

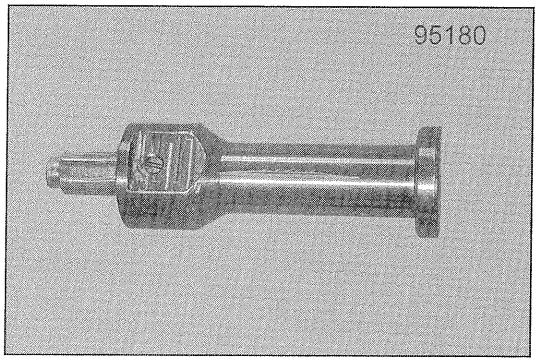
A) Accurately degrease the guide
B) Install the shim adjustment and the lower cap (6) check for the tolerance.
C) Install the rubber wear, always new, on the valve guide with the 95581 tool
D) Oil the valve stem





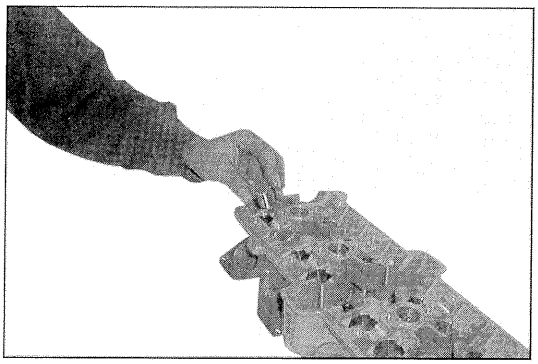
Install the valve.





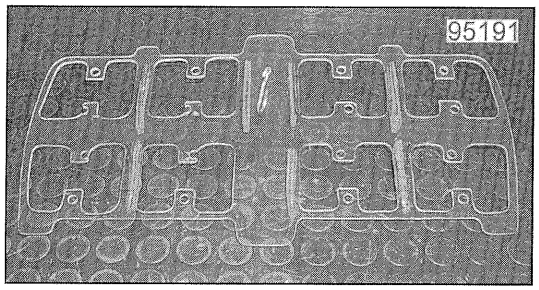
Install following the order:
A) The 2 coaxial springs
B) The collets in the upper cap housing, the fit of the cap on the springs.
C) Install the head no the n°94796 tool and compress the springs till the cotters installation with the n° 95180 tool.
D) Carefully use a mallet to set the collets

NOTE
Before collets setting ensure the head is not leaning on a table to avoid any damage to the valve there is no problem if the head is mounted on the n° 94796 tool.



E) Insert a shim with the right thickness and lubricate its surface
F) Check for the free revolution of the shim in its seat.
G) Insert the bucket after the lubrication of its the seat

Install the head following the procedure described in the chapter " Head assy assembly "

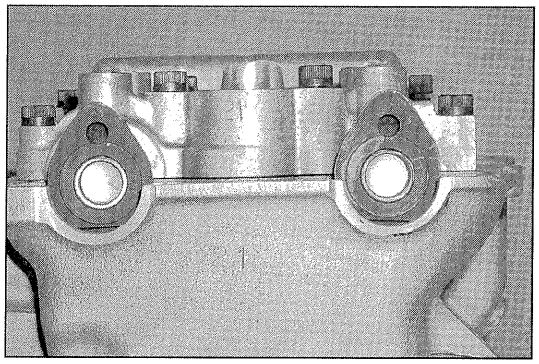


Valve clearance adjustment

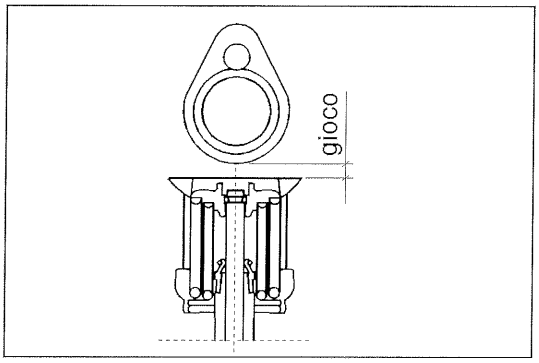
Ensure the spark plugs are not installed

ATTENTION
If the head is installed on the engine, close the spark plugs housing with clean clothes and install the n°95191 grid to avoid any fall of objects in the timing chain housing

A) With a crankshaft revolution, fully release the springs of the valve you are acting on (TDC in compression stroke)

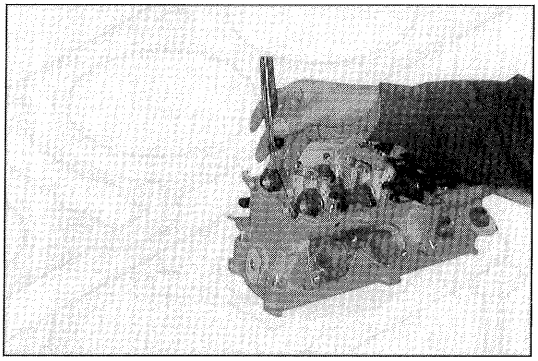


B) Measure the valve clearance with a thickness gauge



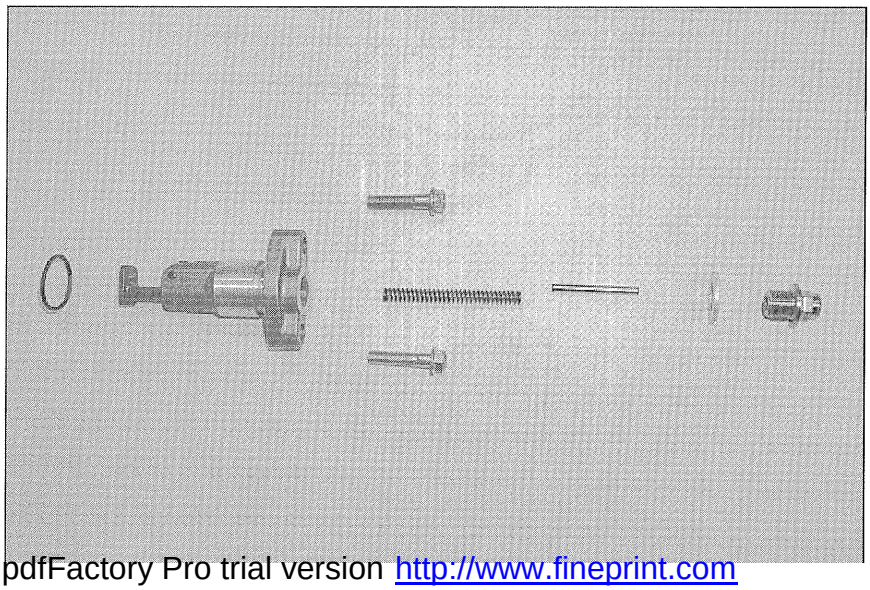
Intake valve clearance	Exhaust valve clearance
0,15 ÷ 0,20 mm	0,20 ÷ 0,25 mm

C) Calculate the difference between the obtained clearance "D" and the standard value of the table
D) Read on the shim the thickness value "S"
E) Choose a new shim with a "S+D" thickness value

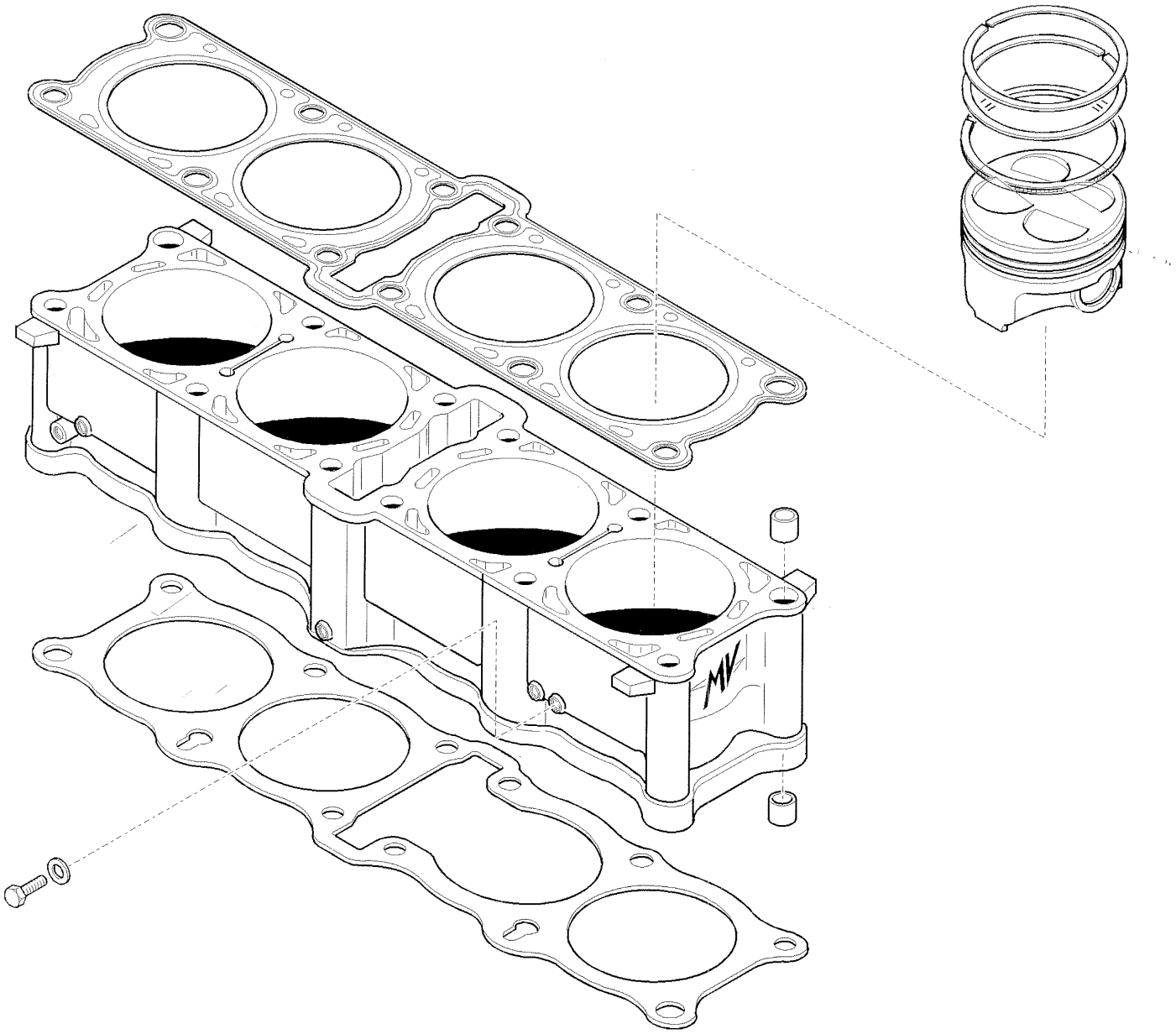


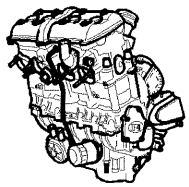
Chain tensioner

Remove the central screw-cap and withdraw the spring and the pin.
Remove the screws fixing the chain tensioner to the head.
Remove the chain tensioner.
Disassembly the chain tensioner and check the correct working of each part.
The internal pin must run clearly and the inner spring must give a quick response.
Replace the assembly in case of malfunction.
If everything works properly lubricate the parts and install the assembly with the chain tensioner in the minimum extension position (all in the main body)
Install the chain tensioner body locking the 2 socket head screws using a T wrench with a 8 Nm torque
Install in this order: the pin in the spring, the spacer and the screw cap.
Lock the screw cap by hand till you feel the tensioner extend, then lock it with a 8 Nm torque
Acting this way the chain tensioner is adjusted.



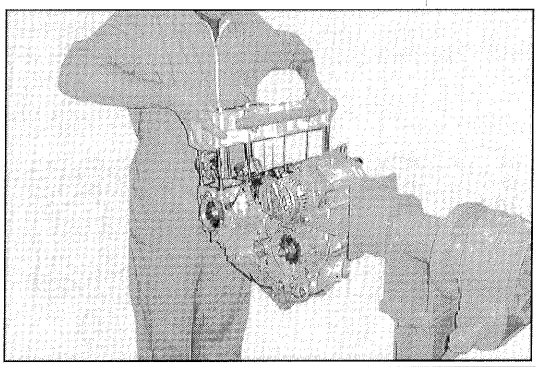
CYLINDERS AND PISTONS GROUP

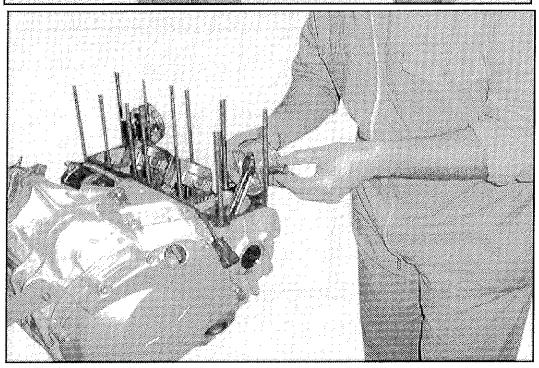




Cylinder and piston removal

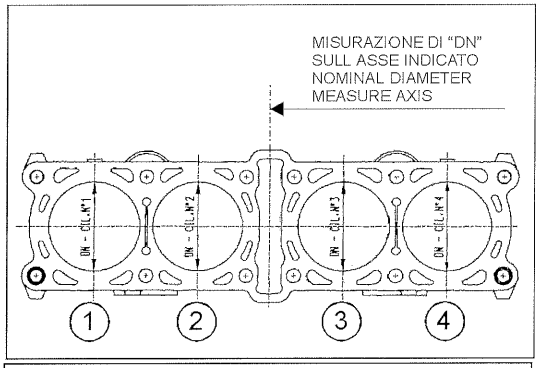
Remove the head and the rubber pipe connecting cylinder and water pump as described in the specific chapters.
Remove carefully the cylinders block, taking care to avoid any damage to the piston rings.
Operate on a piston at a time during the removal procedure.
First remove the 2 pistons at TDC, then rotate the crankshaft 180° and remove the 2 others.
Remove the piston circlip fixing the pin to the piston.
Withdraw the pin.
Sign the piston crown to remember its position, then remove it
Remove the crankcase - cylinder group gasket.



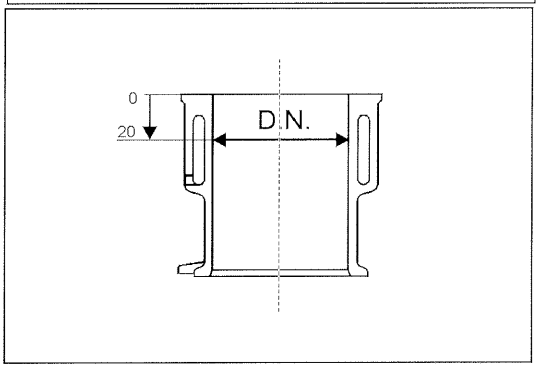


Cylinder overhauling

Check the cylinder walls for evidence of seizure.
Check the cylinder ovality proceeding like this:
A) Measure the **nominal diameter for each cylinder at a 20 mm distance from the upper edge** as shown in picture
B) Repeat the measurement for the other cylinders perpendicularly.
C) **Ovality** must be **lower than 0.015 mm** (wear limit).

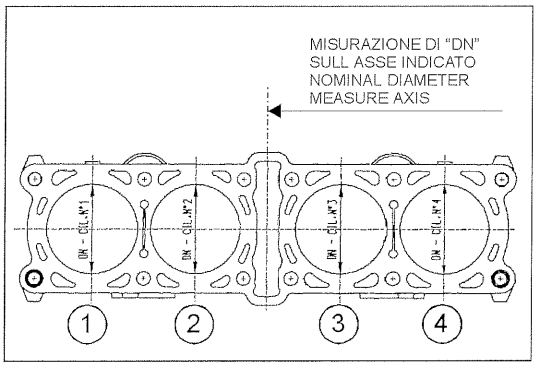


Replace the entire group if just one cylinder is out of range
Replace if necessary pistons and rings too.
There is an identification letter for each cylinder giving the dimension group: you must have , for example, an "A" cylinder coupling with a "A" piston, and so on.



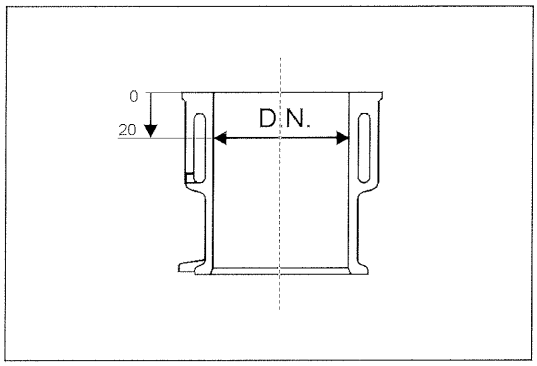
Piston overhauling

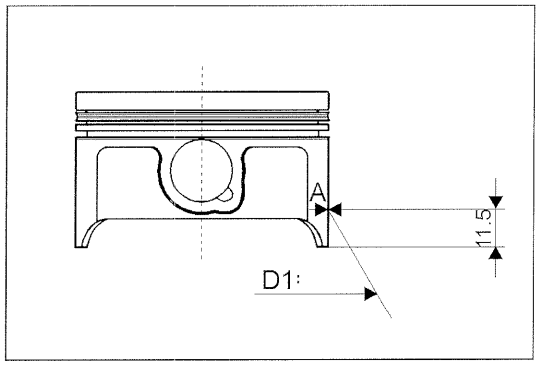
Clean the piston crown from carbon deposit.
Perform an accurate visual check of the piston; no signs of pitting, cracks, strain or wear are allowed.
Measure the piston diameter perpendicularly to the pin axis at the dimension shown in picture.
Replace the piston in case of wear
The piston dimension group must be the same of the cylinder

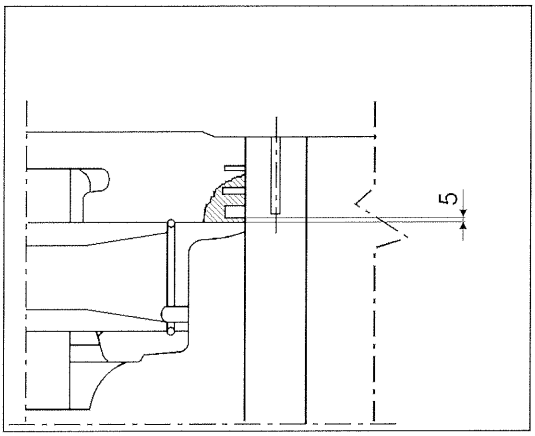


Cylinder - piston coupling

The piston - cylinder group is supplied matched; if an exchange of piston occurs, verify the coupling clearance.
Measure the barrel diameter at a 20 mm distance from the upper edge as shown in picture
Measure the piston diameter at a 11,5 mm distance from the skirt base, perpendicularly to the pin axis
Measure at 20°C.
The piston - cylinder clearance must be in the range **0.025÷0.045mm**.
Wear limit : **0.1 mm**





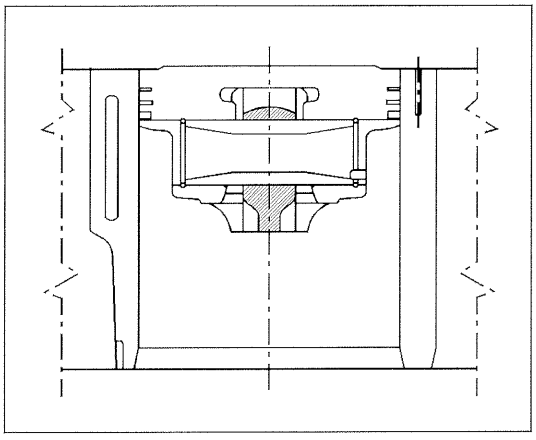


Piston pin overhauling

Check the piston pin for scoring or blue signs caused by overheating.

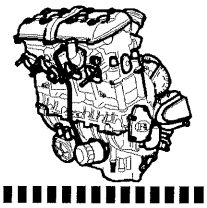
Piston pin - piston coupling

The clearance (S) must be in the range **0.004 ÷ 0.012 mm**.
Wear limit: **0.03 mm**
Replace piston and pin if the coupling exceeds the limit.

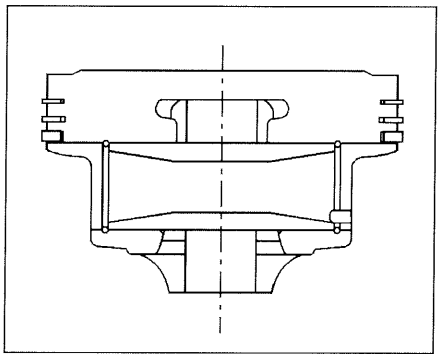


Piston pin - rod small end coupling

The clearance must be in the range **0.015 ÷ 0.032 mm**.
Wear limit: **0.04 mm**



Rings



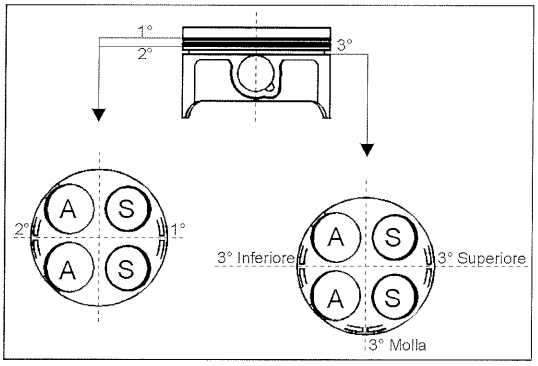
Check the rings for scoring or signs of swell.
The ring must have a sharp edge and free in its housing.
The spare part piston are supplied with pin and rings
In case of rings wear, we recommend to replace the piston too.

RING	Standar	WEAR LIMIT
1°	THK $0.8^{-0.01}_{-0.03}$	0.75
2°	THK $1^{-0.01}_{-0.025}$	0.96
SCRAPER	THK $2^{-0}_{-0.1}$	1.88

Rings - cylinder coupling

Place the ring perfectly plane at 5 mm from the head table in the cylinder and measure the distance between the ends.
The maximum clearance for each ring is:
N°1 RING: **0.2 ÷ 0.4 mm**
Wear limit: **0.6 mm**
N°2 RING: **0.2 ÷ 0.4 mm**
Wear limit: **0.6 mm**
SCRAPER: **0.2 ÷ 0.7 mm**
Wear limit: **1.0 mm**

Cylinder and piston installation

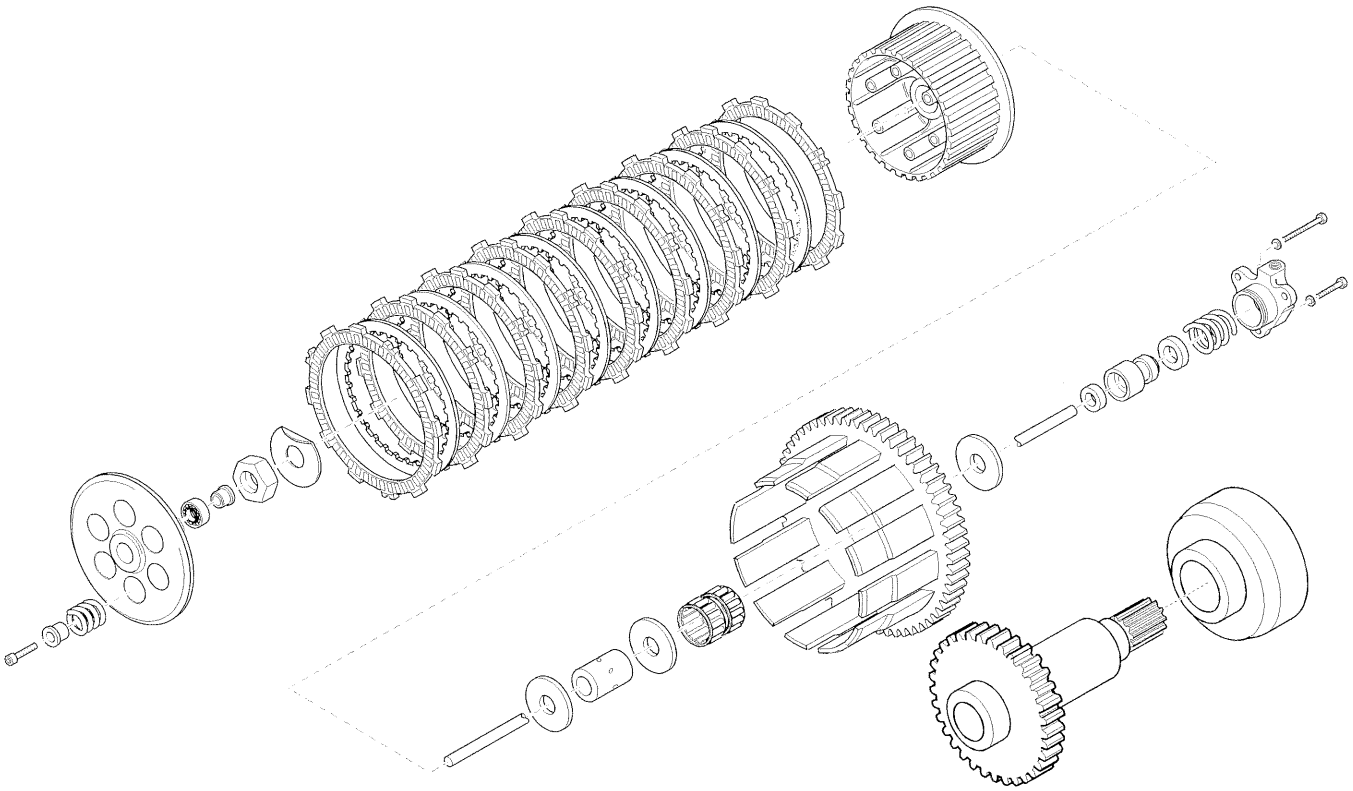


Install the rings in the piston with the "Ne Top" writing towards the top, following the order shown in picture.
Oil the rod small end and the gudgeon pin.
Install the inner ring on the piston.
Install the piston with the rings on the rod: the arrow must be on the exhaust side.
Insert the pin up to the beat.
Install the external ring

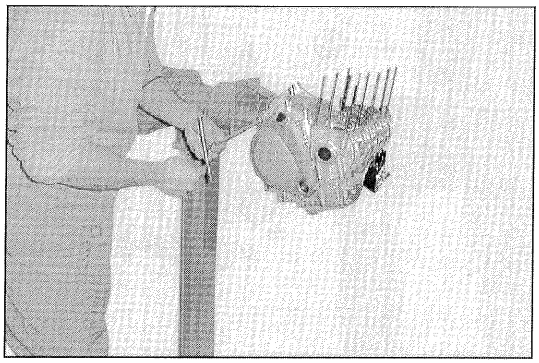
ATTENTION
Cover the crankcase openings with a clean cloth before the stopper ring installation, to avoid its fall in the oil sump

Install a new gasket between the crankcase and the cylinder group.
Install the rings on the piston as shown before.
Oil cylinder and rings
Place the pistons n°1 and 4 at TDC then, with a crankshaft rotation, the 2 others always at the TDC.
Install the pistons pushing the rings by hand.
Take maximum care during this operation, due to the rings brittleness.
Let the crankshaft rotate few turns, to check the pistons for their free

CLUTCH



The clutch disengagement is obtained with a transmission group made of a thrust piston an the engine left side, with hydraulic drive.
This piston pushes a rod controlling the clutch spring plate

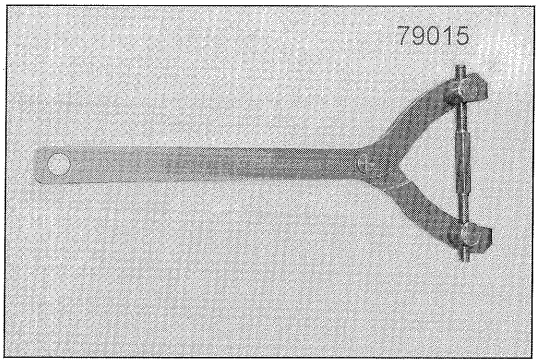


Clutch removal

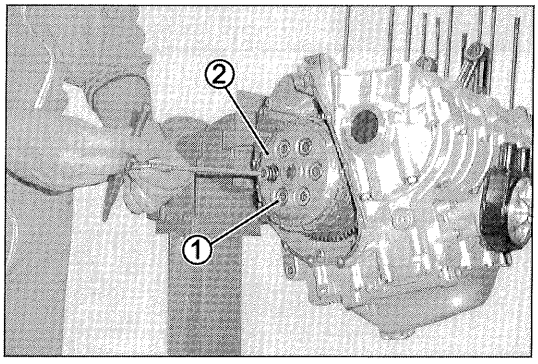
To execute this operation you need the following special tools:

n° 79015 clutch tool

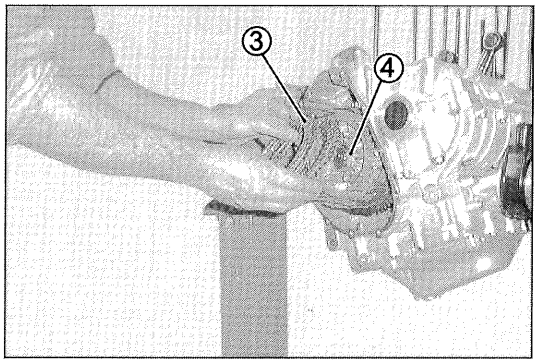
Remove the 11 screws fixing the clutch cover to the crankcase.
Remove the clutch cover and the gasket that is going to be replaced at reassembly.

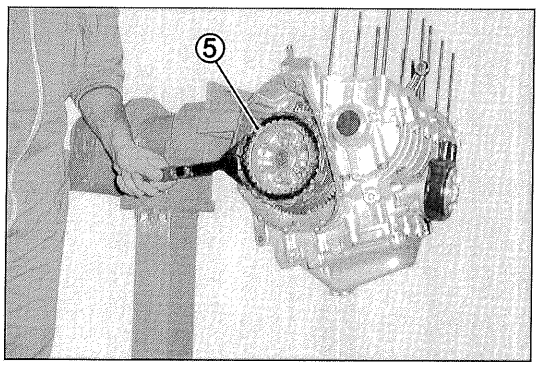


Remove the 6 screws(1) of the clutch spring plate (2) with its springs

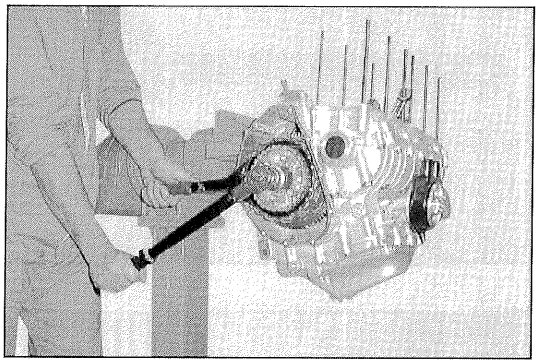


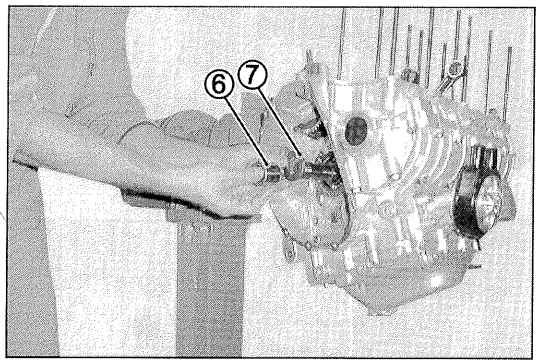
Remove the clutch spring plate.
Withdraw by hand all the plates (3) you can.
Straighten the nut (4) tab washer





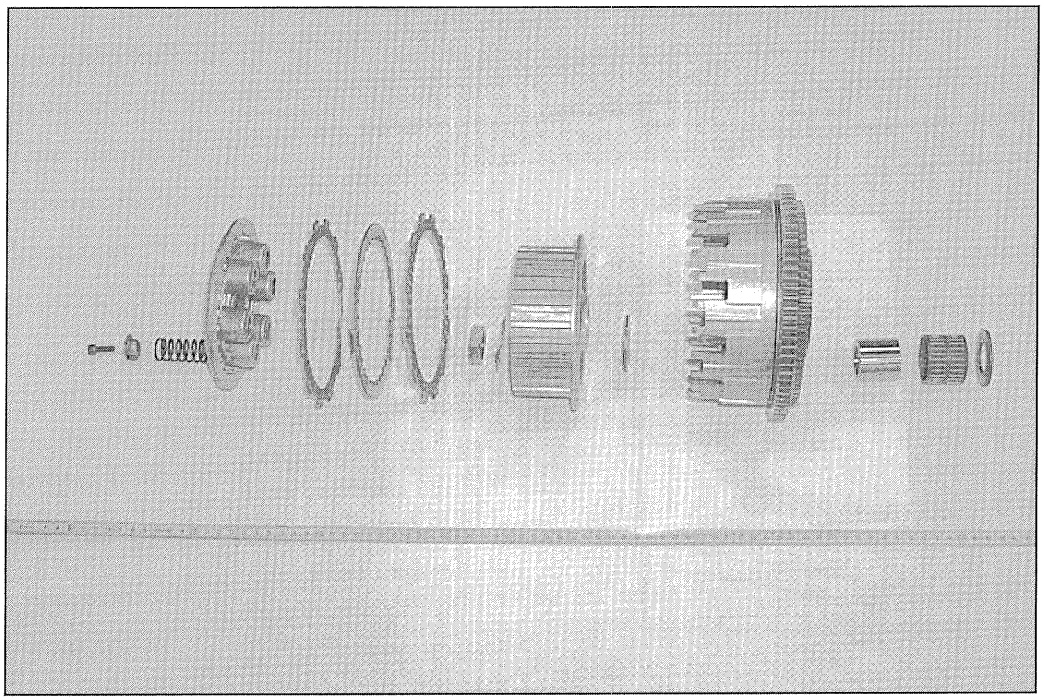
Remove the nut using the n° 79015 tool to stop the clutch hub (5).
Remove the clutch hub.

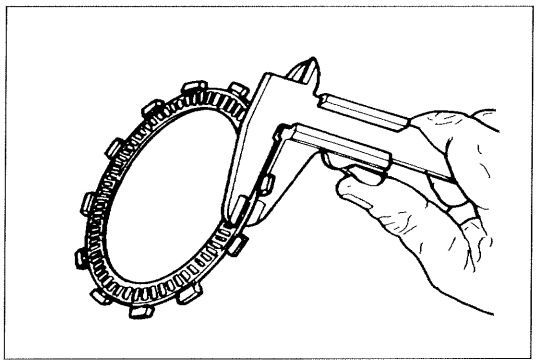




Remove the clutch group, the spacer (6) and the shim adjustment washer (7)

Strip the clutch group in the order shown in picture



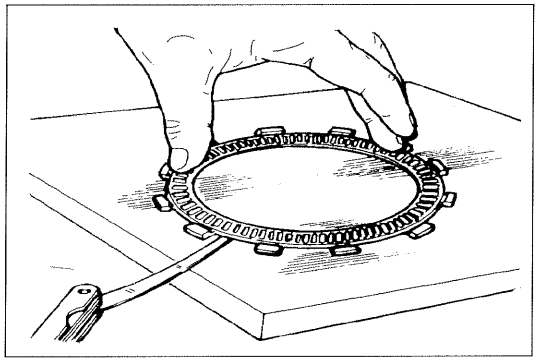


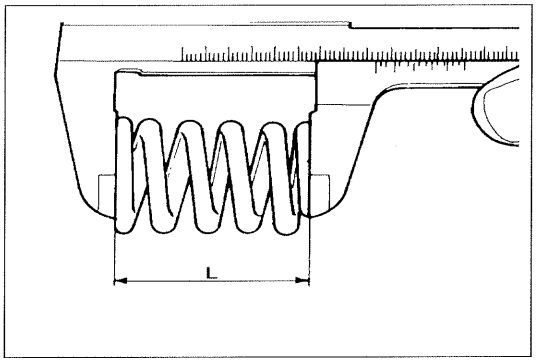
Clutch overhauling

Check the rod for straightness and wear

Check the friction plates for wear. T**he standard thickness is.3 mm**
Wear limit : **2.8 mm**.
No signs of burning, grooves or other damages are allowed.
Replace the whole plates group even if only one is damaged.

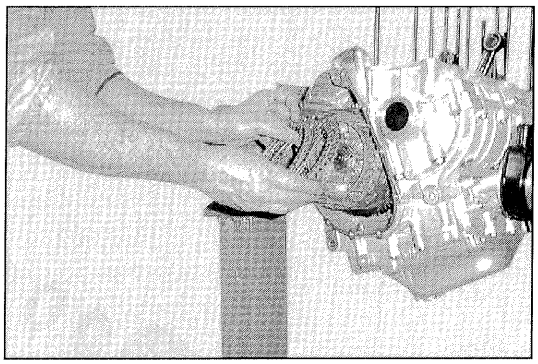
Put the plate on a table and check the deformation.





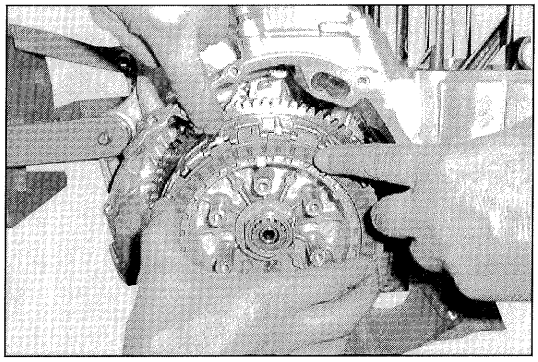
Measure the length "L" of the springs with a gauge.
Service limit: **38.8 mm**
Replace the springs exceeding the service limit.

Clutch installation

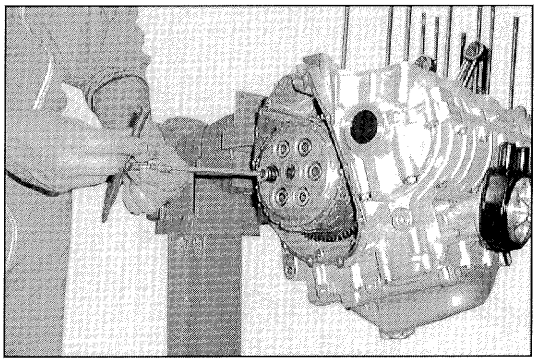


Assembly the clutch group
Install the 9 friction plates and the 8 steel plates alternated, starting with a friction plate
Insert the group following the 3 meshes taking care of the crankshaft one.
Insert the shim adjustment washer and the spacer.
We strongly recommend to use a new tab washer at reassembly.
Lock the nut at a 95 Nm torque and bend the tab washer

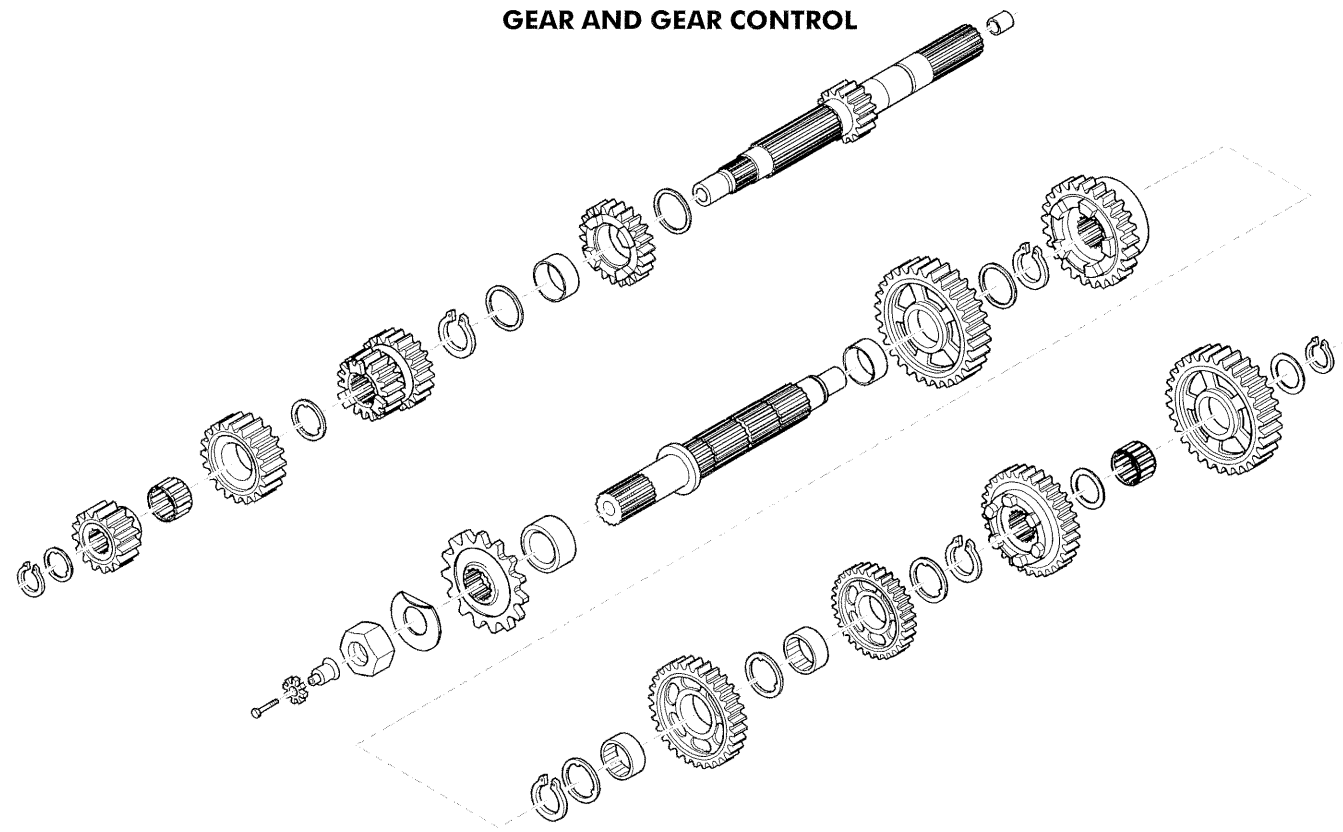
ATTENTION
The first 16 plates have a given assembly position but the last one needs a one step rotation.

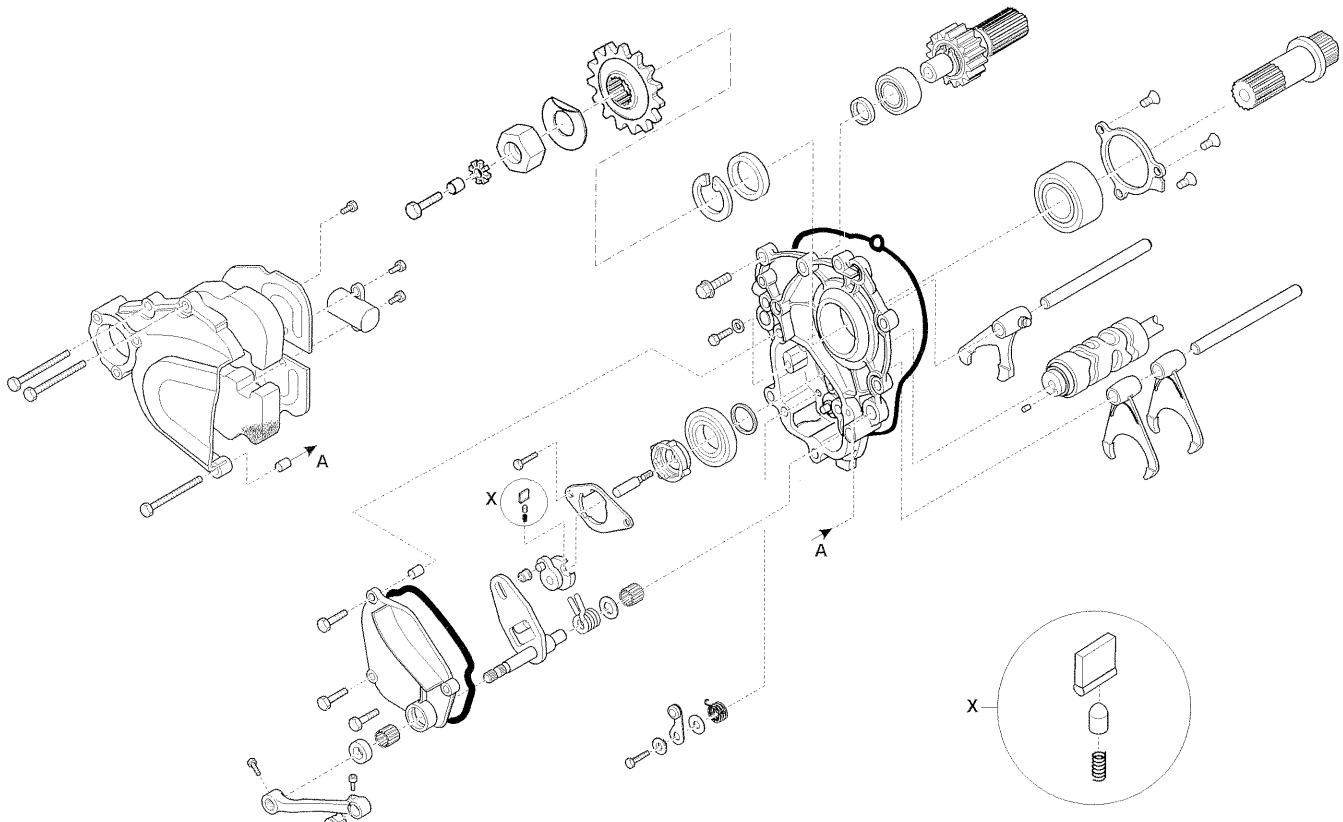


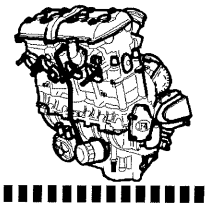
Install the clutch spring plate, locking the screws with springs at a 10 Nm torque.
Replace the cover gasket.
Align the dowel pins.
Install the cover and tighten the screws by hand.
Lock them at a 10 Nm torque.



GEAR AND GEAR CONTROL







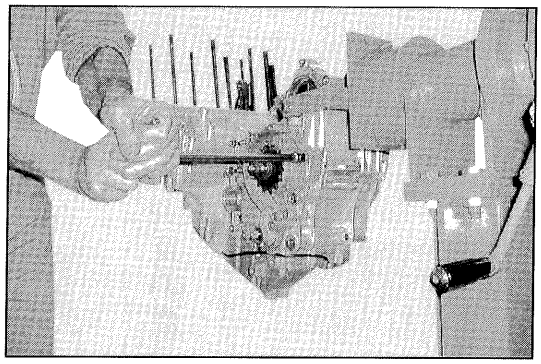
Gear group removal

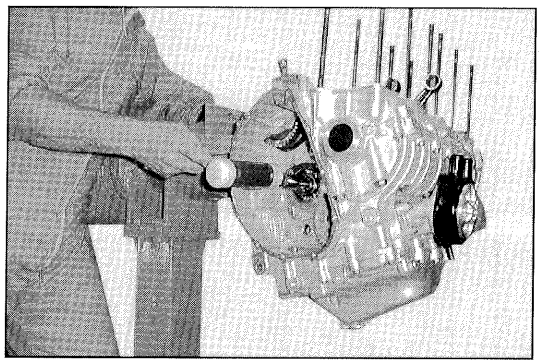
Remove the clutch following the procedures described in the chapter " Clutch removal"
Remove the clutch rod acting on the clutch side

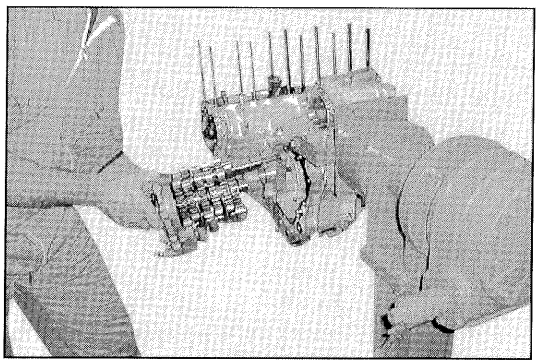
NOTE
Only remove push rod from sprocket side

Remove the 6 screws of the gear cover
Carefully use a mallet on the drive shaft acting on the clutch side, with a hand on the gear cover till it is shoved off the crankcase.

Remove the gear group

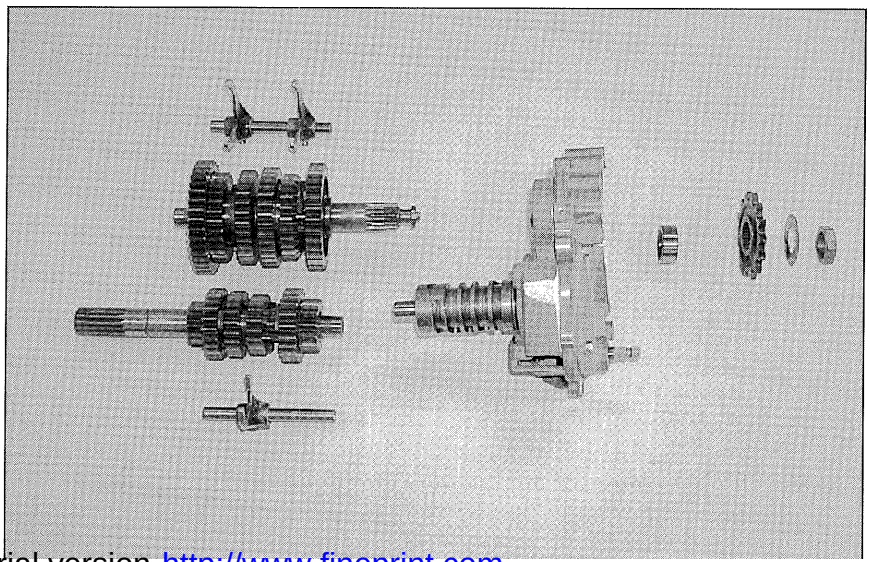


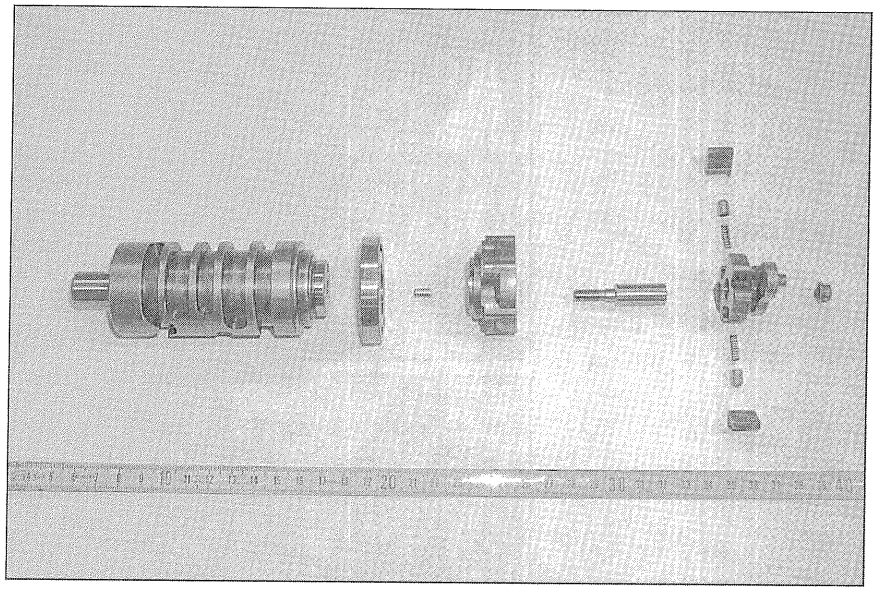


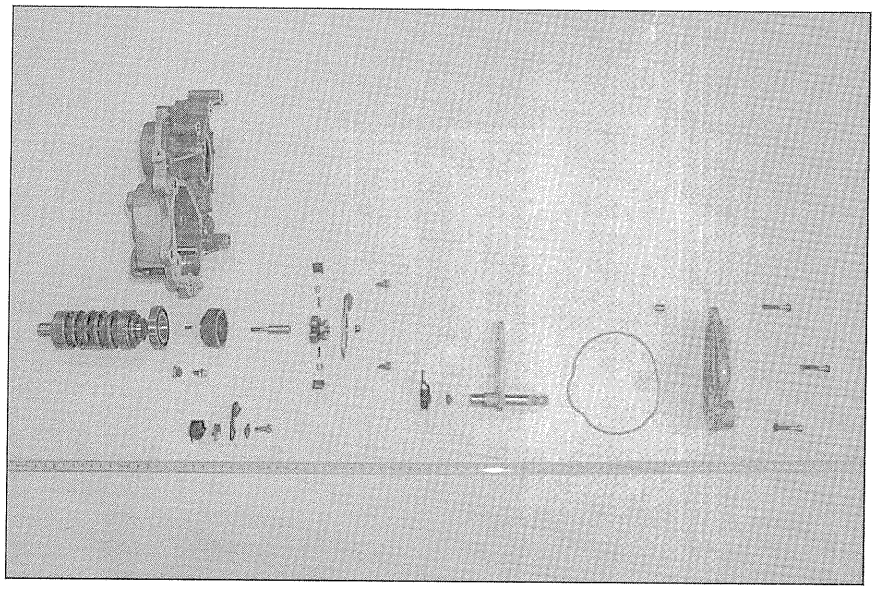


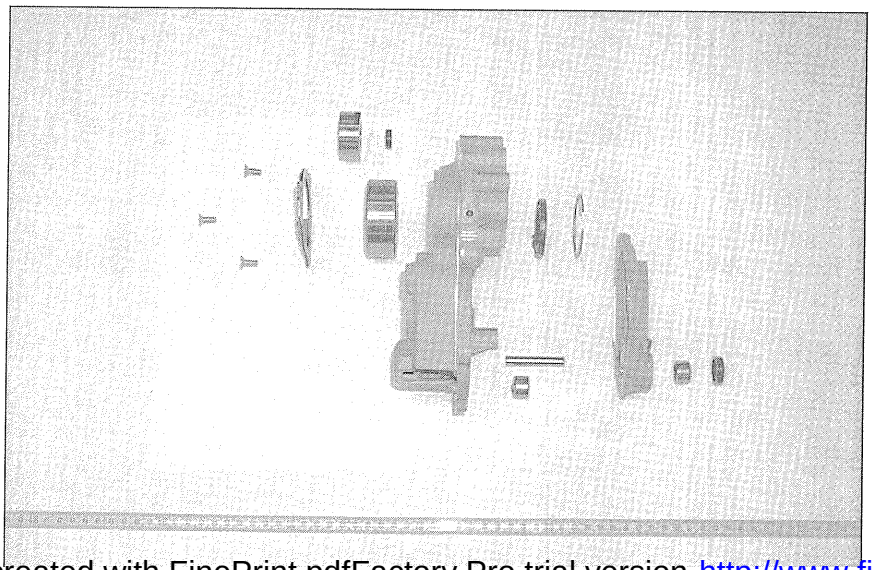
Gear control

Strip the gear group in the order shown in picture.
Methodically arrange the various parts to make the reassembly easier.
Check every part for damage or wear.
Particularly check the following parts:
- Shift drum
- Drive and output shafts





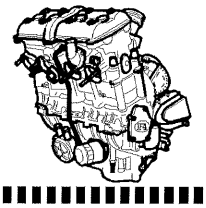




Shift drum

Check the shift drum: no signs of wear on the grooves are allowed.
Fork pin - groove clearance for new parts: **0,15 ÷ 0,35 mm**
Wear limit: **0,65 mm**
Groove width of a new drum: 7,05 ÷ 7,15
Wear limit: 7,35
Verify the working clearance between the fork pin and the shift drum groove, measuring the dimensions with a gauge.
If the value exceeds the service limits, compare the standard value to choose the parts to be replaced.

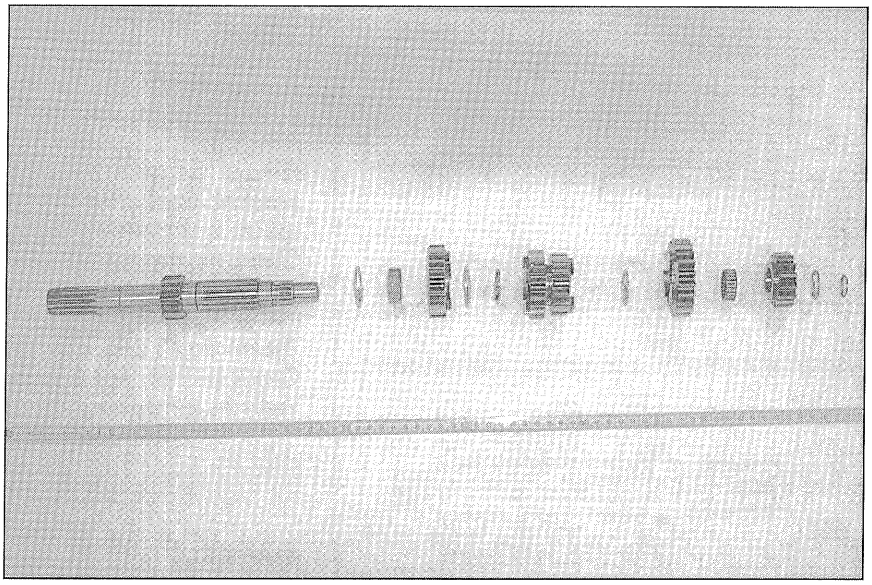
Verify the gear locker pawl free movement.
Reassemble the various parts by acting in the opposite way.

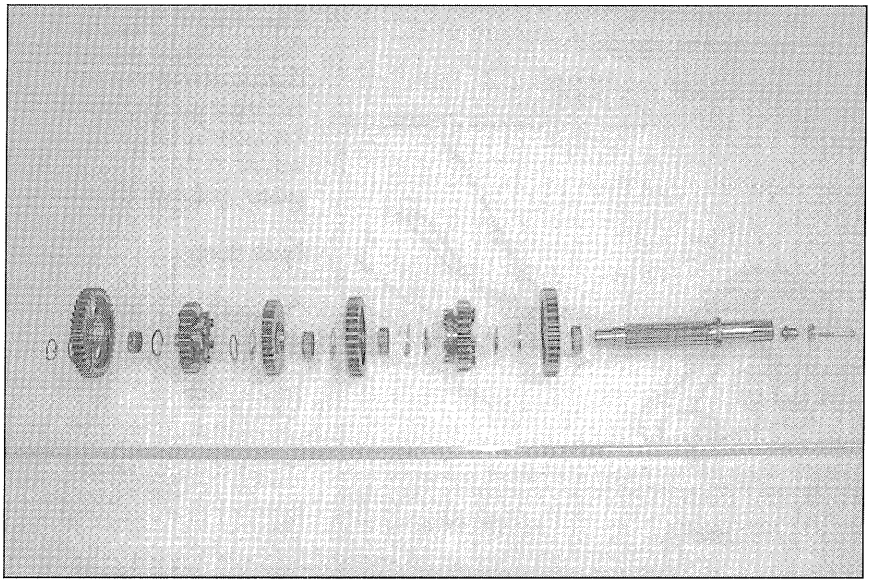


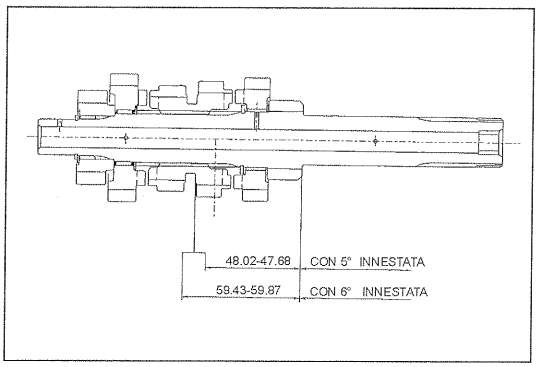
Drive and output shafts

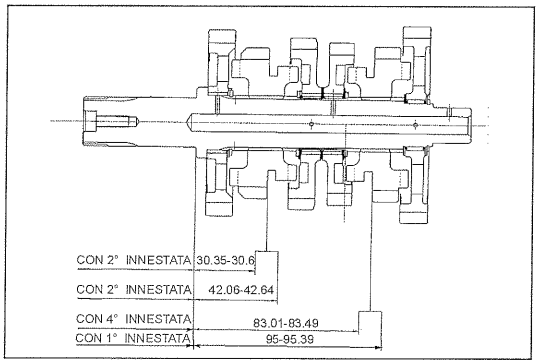
ATTENTION
Overhaul the shaft separately to avoid any confusion of similar parts

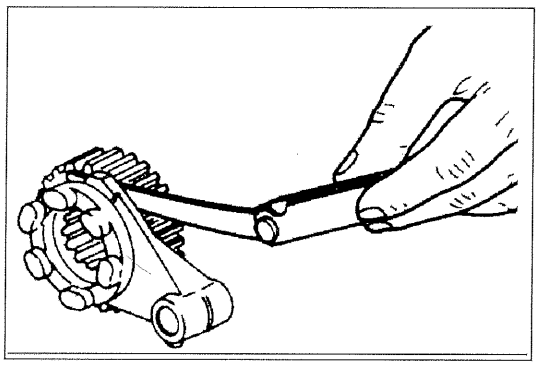
Methodically arrange the various parts to make the reassembly easier.

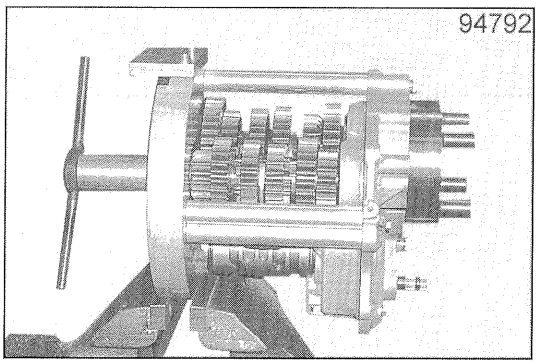












Gear group overhaul

To execute this operation you need the following special tools:
n° 94792 gearbox tool

remove the gear group from the engine and install it on the engine simulation tool n° 94792, tightening the pinion locking nut and the nut with spacer simulating the clutch hub.
Check the gears teeth for their perfect condition: they must have sharp edges.
Idle gear must rotate on their shafts easily.
The minimum axial clearance of the idle gears is 0,10 mm
Check the bearings in the gearbox for wear.
Verify the dimensions shown in the picture

Shift forks

Check the shift forks for evidence of bending and other damages.
Replace the curved shift forks due to the danger of malfunction of the gear shifting and of the disengagement of the gear under charge. Check with a thickness gauge the fork clearance in the groove of its gear.
Replace the fork or the gear if the clearance is too wide, relating to the given values:

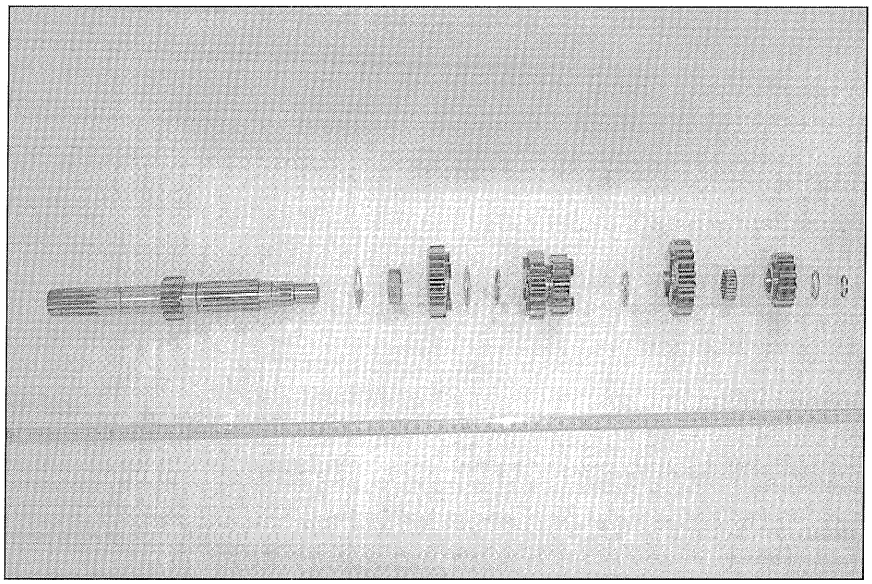
gear groove limit	**5.6 mm**	**drive**	
	4.6 mm	**output**	
fork limit	**4.65 mm**	**drive**	**5th-6th speed**
	3.65 mm	**output**	**1st-2nd., 3rd-4th speed**

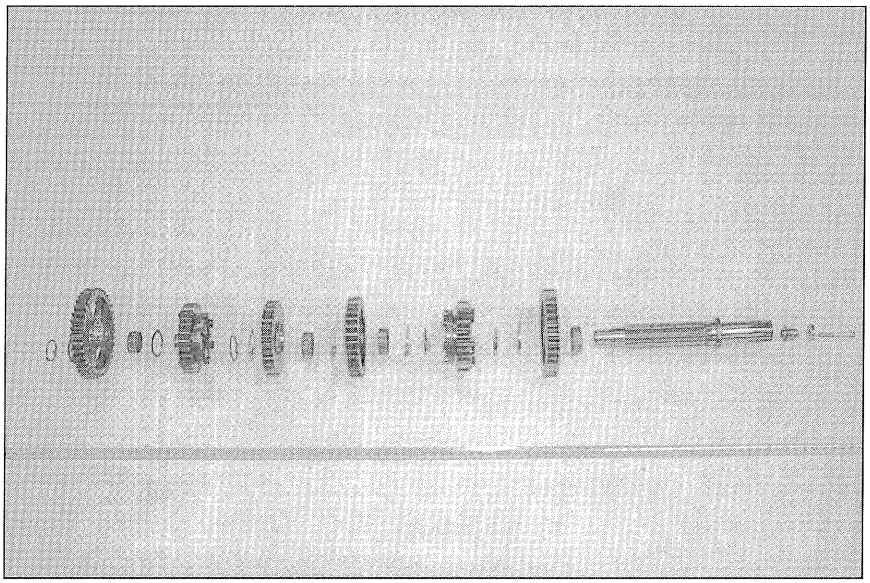
The forks must slide without stress.
The speed gears must slide without obstacles and without friction

Installation

To execute this operation you need the following special tools:

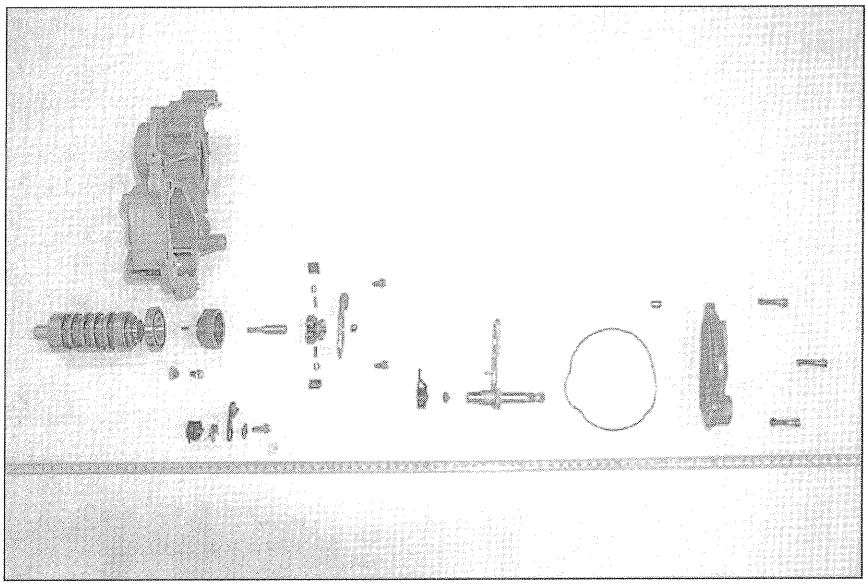
n° 94792 gearbox tool



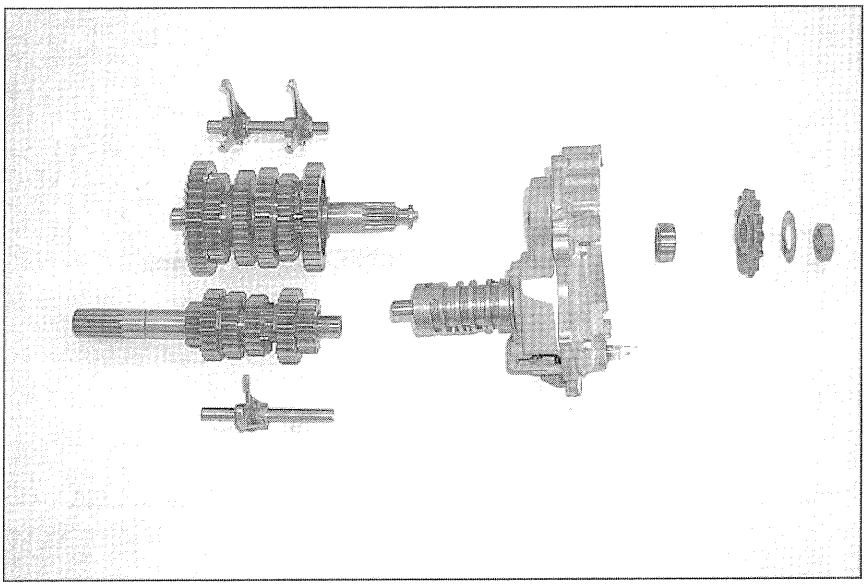


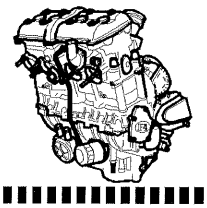
Reassembly the various parts by acting in the opposite way.
Install the 2 shafts on the n° 94792 engine simulation tool
Install a shift pedal and check the gear box is correctly working

ATTENTION
Always install a new washer under the pinion at reassembly.

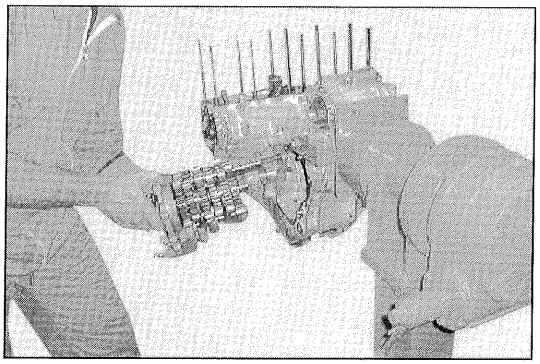


The gear engagement and disengagement needs to take place without resistance.
It you find any resistance , verify the axial clearance is correct.
Check with a thickness gauge for the **groove - fork clearance** of every engaged gear: **0.2 ÷ 0.3 mm** on both sides of the coupling.
The fork must be free in its movement .
Install the gasket on the internal side.



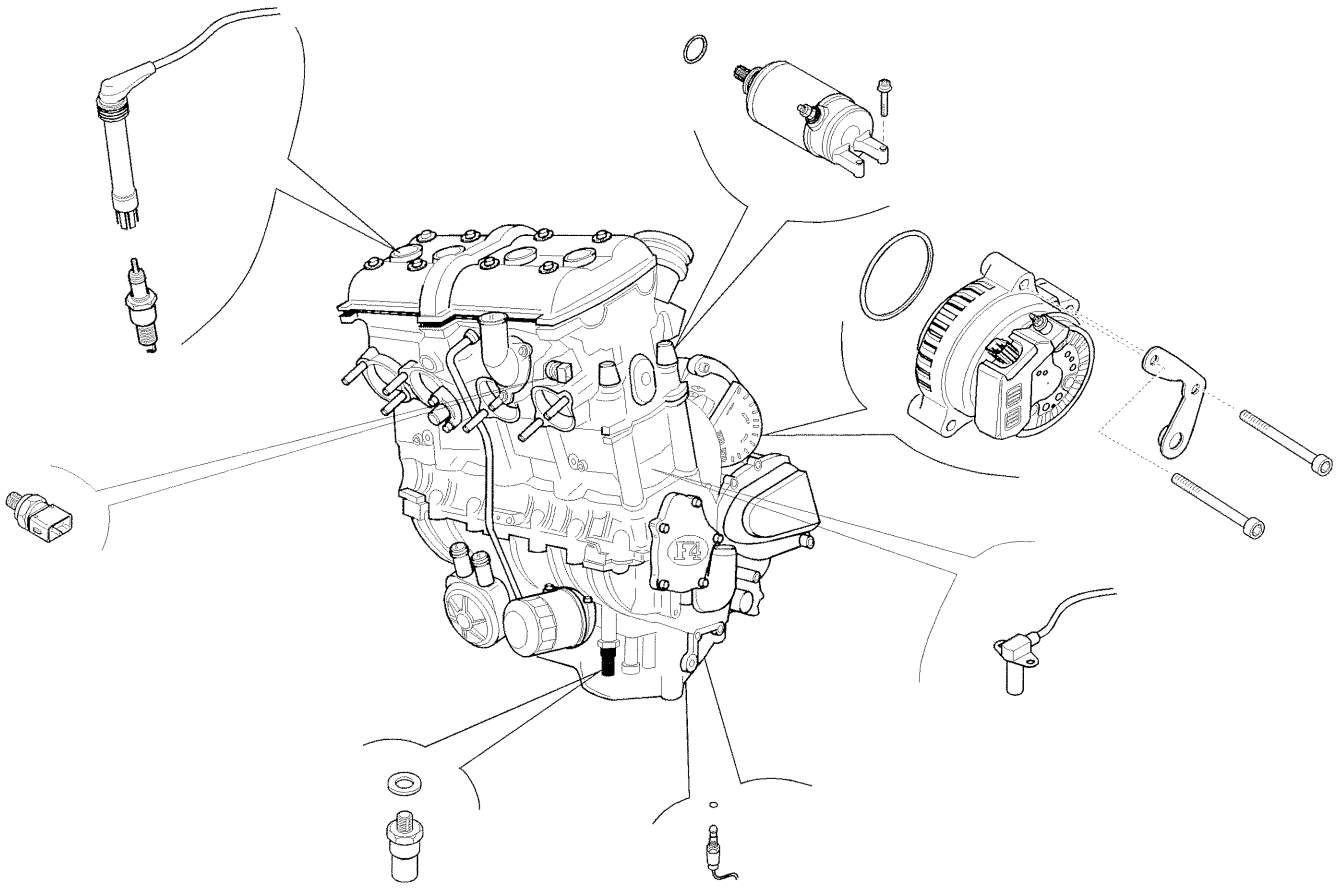


Install the gear group in gear in the crankcase to avoid any damage to the neutral switch light.

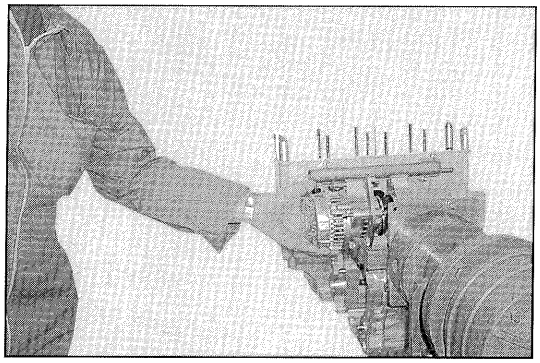


ATTENTION
Do not install the gear group in the neutral position
Install the clutch rod

CRANKCASE ACCESSORIES



Remove the phonic wheel pick-up



Alternator

- Removal:

Acting on the left side of the engine, remove the 3 locking bolts of the alternator and of the stiffening brace
Withdraw the alternator: avoid any fall of the flexible couplings.

- Installation:

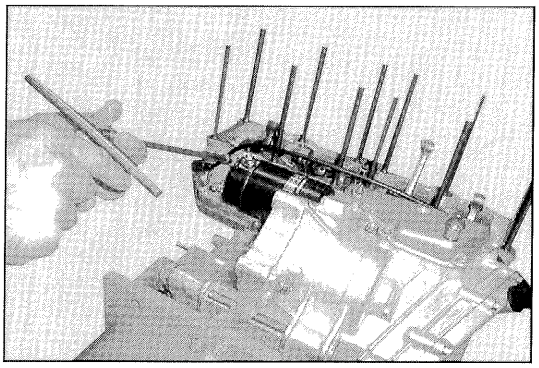
Grease the flexible couplings and the O-Ring.
Insert the blades in the flexible coupling assy.
Approach the screws by hand, then lock at a 25 Nm torque.

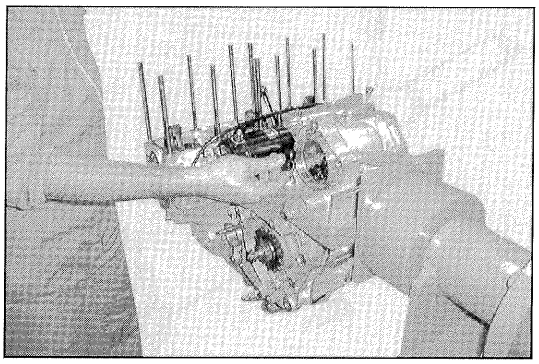
Starting motor

- Removal

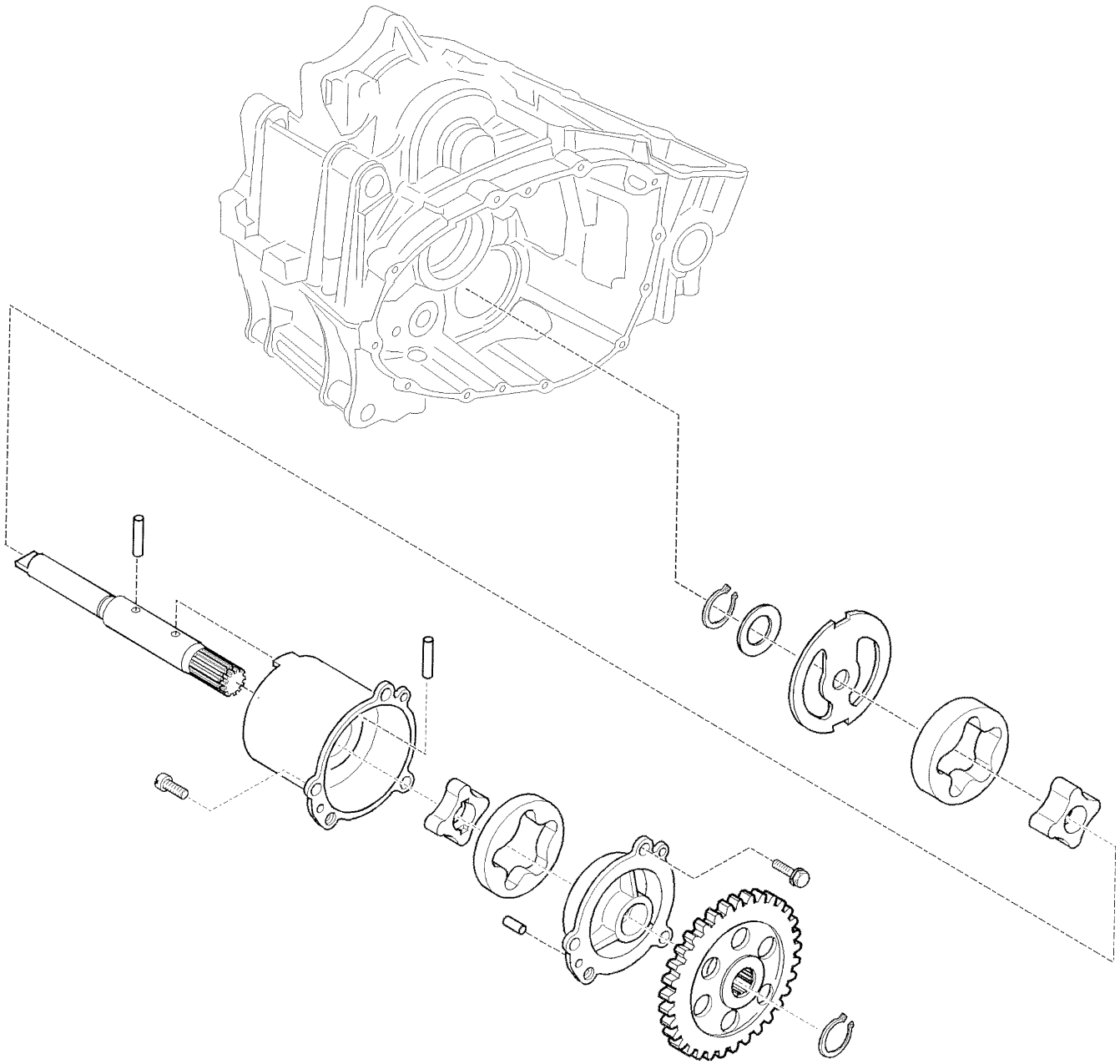
Remove the 2 locking screws.
Withdraw the starting motor, paying attention to avoid any damage to the
- O-Ring on the shaft.

Installation:
install the motor on the crankcase
Approach the screws by hand, then lock at the prescribed torque.

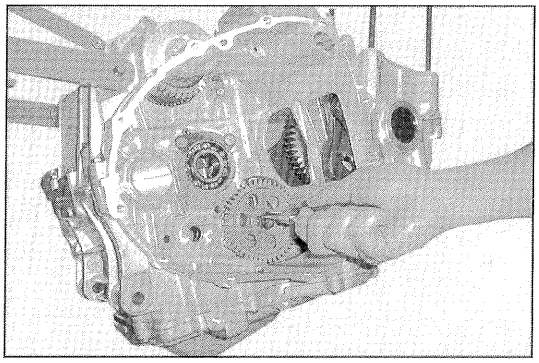




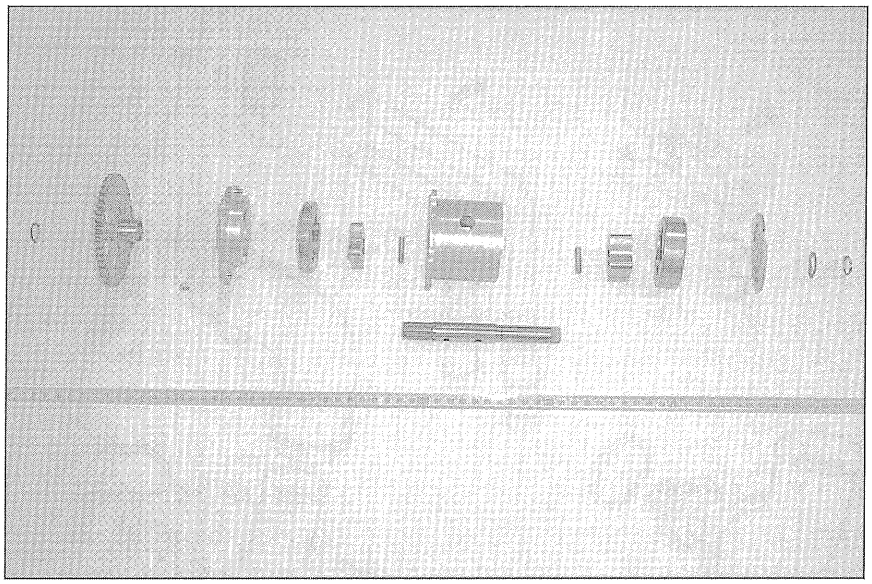
OIL PUMP

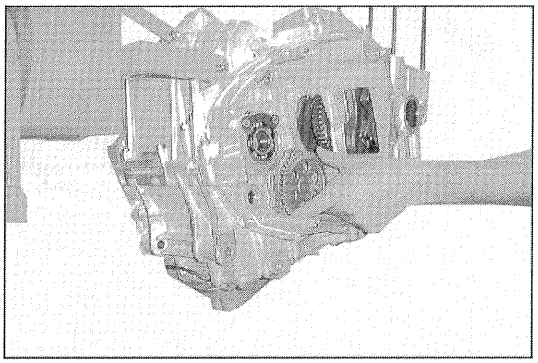


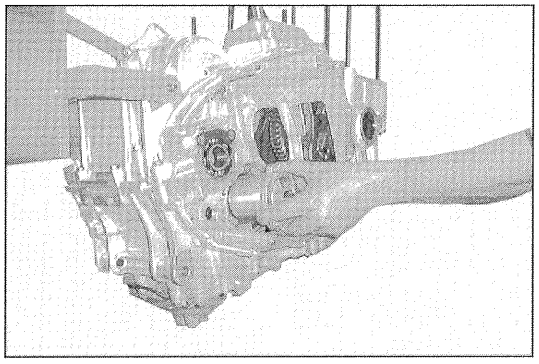
Remove the clutch and the gear as described in the specific chapters.
Remove the seeger ring and the oil pump gear
Remove the 3 locking screws.
Push the oil pump shaft on the transmission side and withdraw the oil pump body by the clutch side.
Remove the external screws to strip the pump.
Separate the various parts as shown in picture



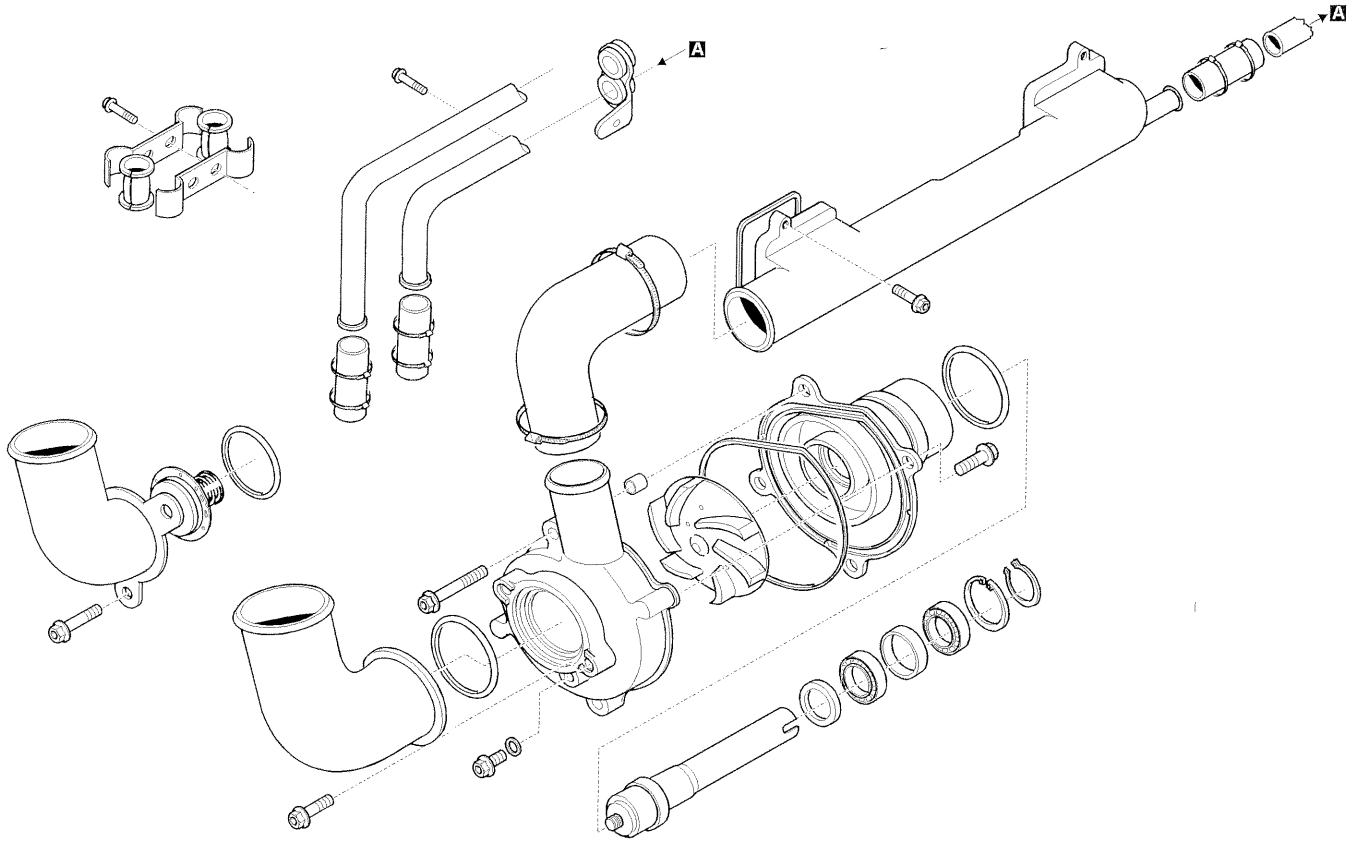
Perform an accurate visual check of the parts to find signs of scoring or deformation
Replace the damaged parts.
Reassembly the various parts by acting in the opposite way.
Install the oil pump on the engine.
Accurately degrease the 3 screws, then lock them at a 10 Nm torque with LOCTITE 242

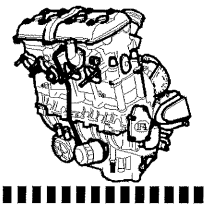






WATER PUMP

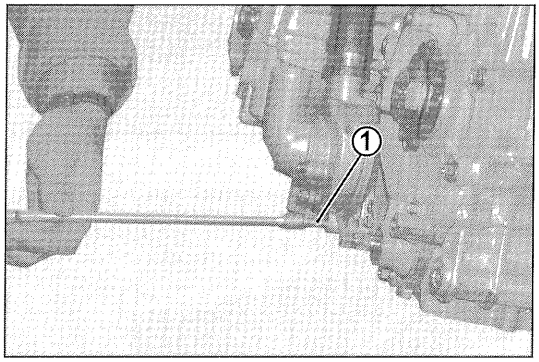




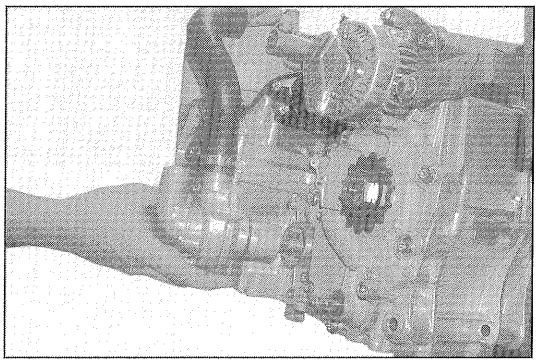
Water pump removal.

ATTENTION
Operate with cool engine

A) Loose the clamp and remove with care the pipe coupling, to avoid any damage.
B) Remove the screws (1) locking the pump to the crankcase.



C) Remove the pump from the crankcase

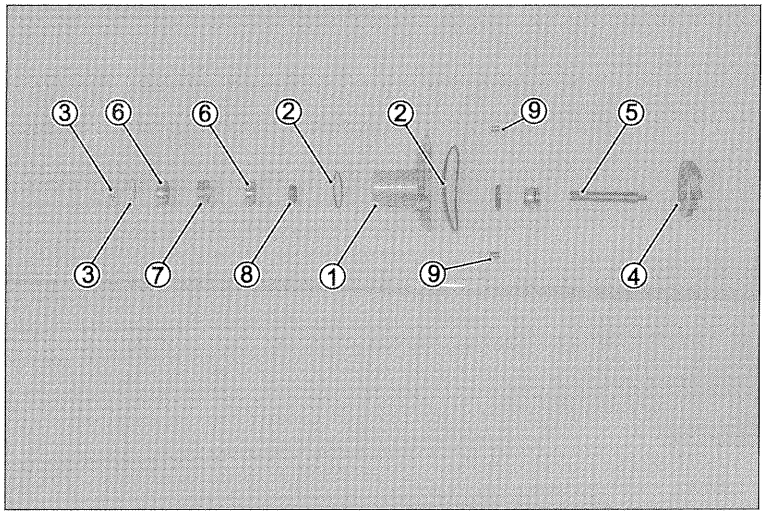


Water pump parts disassembly

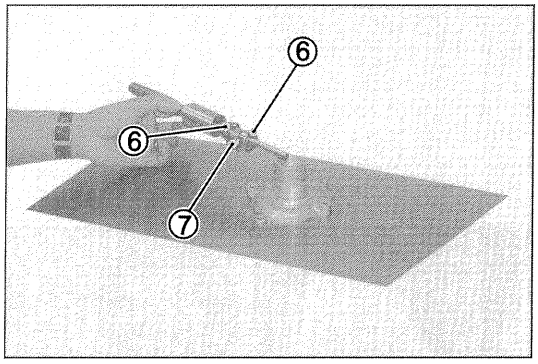
Operate this way:
A) Remove the screws locking the pump body(1) and separate this one from the cover

ATTENTION
Do not let the 2 dowl centering bushes (9) fall.

B) Remove the 2 O-Rings (2)
C) Remove the 2 seeger rings (3).
D) Extract the rotor(4)with the shaft (5).
E) Separate the rotor(4) and the shaft (5) by unscrewing it.

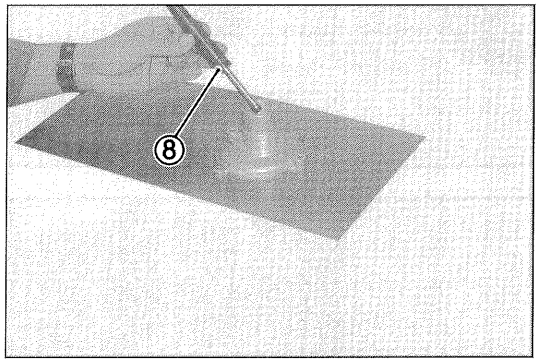


ATTENTION
Use proper precaution during the next operation to avoid scalds



A) Heat the pump body (1) at 120°C
B) Extract the 2 bearings (6) and the spacer (7)

C) Heat at 120°C another time
D) Withdraw the ring (8)



Water pump parts overhauling

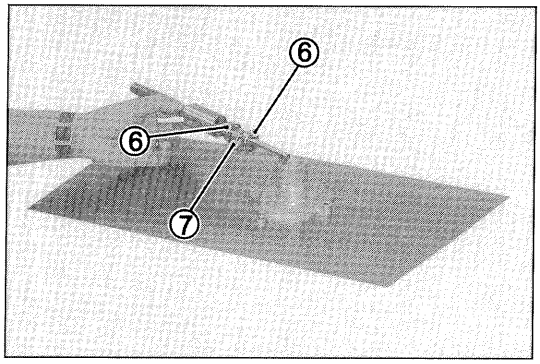
Check every part for signs of wear
Take a particular care about the bearings smoothness and the O-Ring condition.
Check the rotor for signs of flaws and settling.
The clearance between the rotor shaft and the bearings can't be too wide
Replace the parts with signs of wear

Water pump parts assembly

ATTENTION
Use proper precaution during the next operation to avoid scalds

A) Heat the pump body (1) at 120°C
B) Withdraw the ring (8)

C) Withdraw the 2 bearings (6) and the spacer (7)
D) Let the body(1) cool, then withdraw the rotor (4) with its shaft(5)
E) Withdraw the 2 seeger rings (3).
F) Withdraw the 2 O-Rings(2)

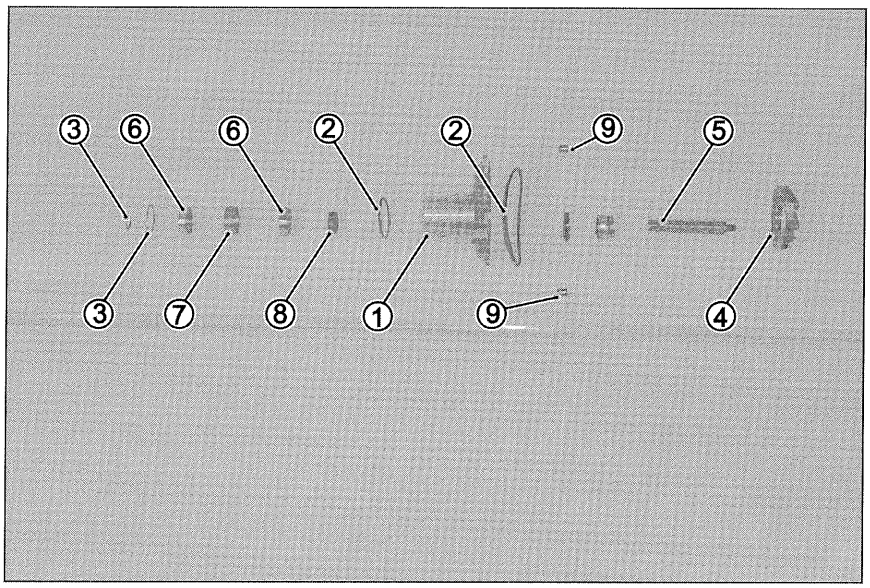


ATTENTION
Do not let the 2 centering bushes (9) fall.

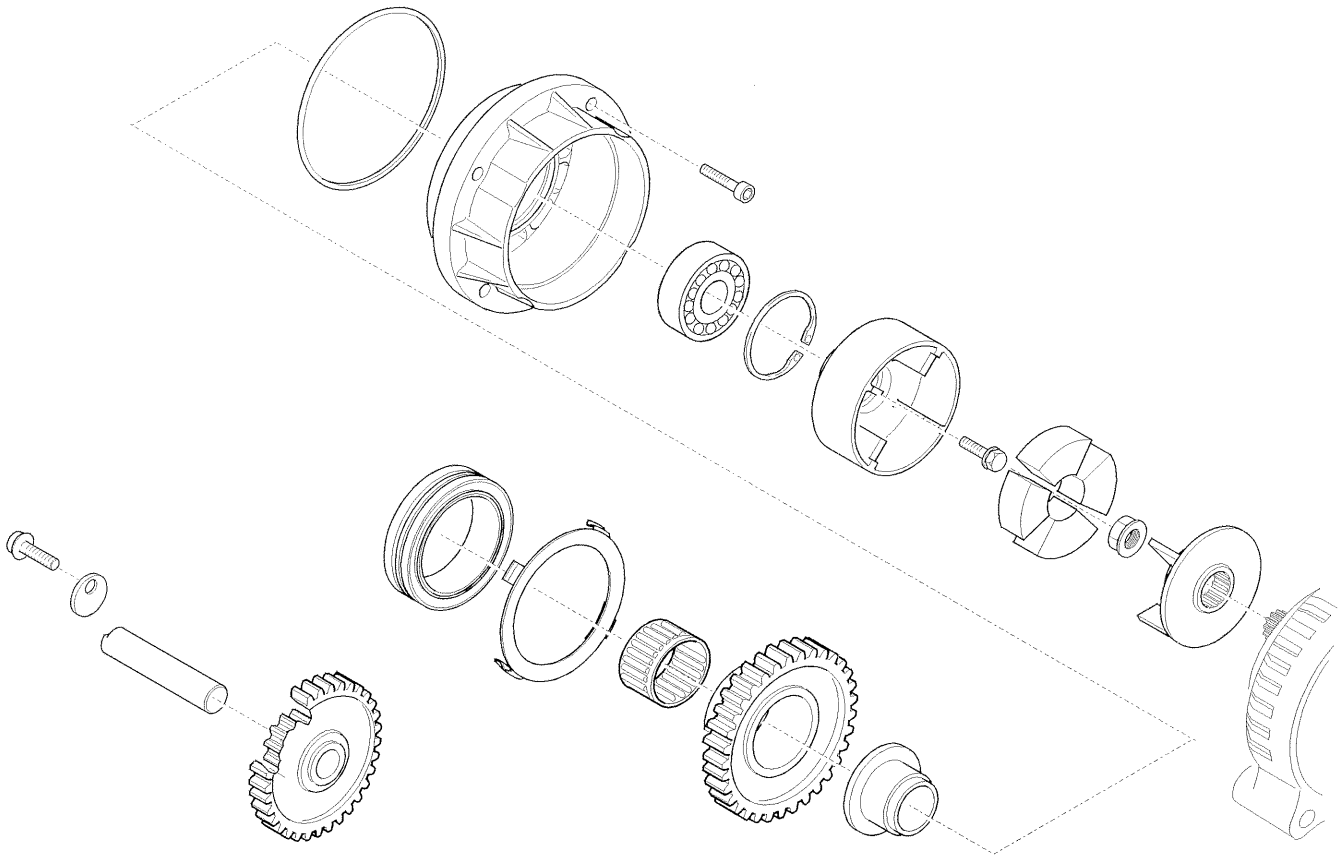
G) Tighten the screws locking the pump body(1) and join this one to the cover

Water pump installation

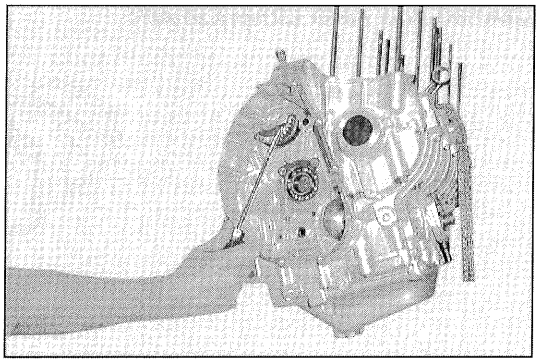
A) Install the pump on the crankcase, taking care to avoid damaging the O-Ring of the body
B) Tighten the screws (1) locking the pump to the crankcase
C) Install on the crankcase with care the pipe coupling and the clamp.



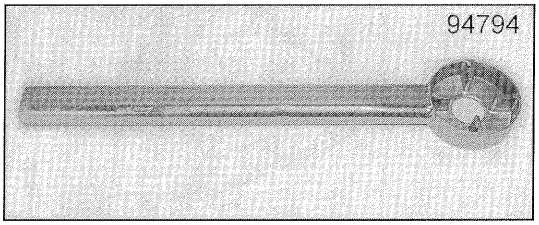
START

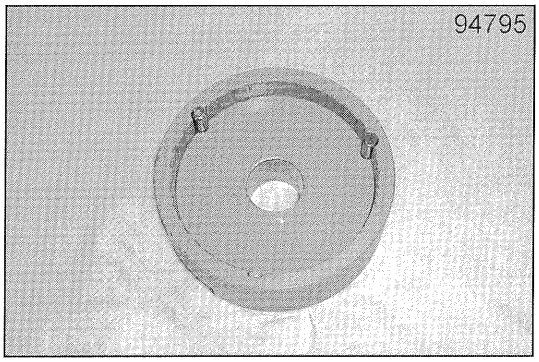


Start free wheel



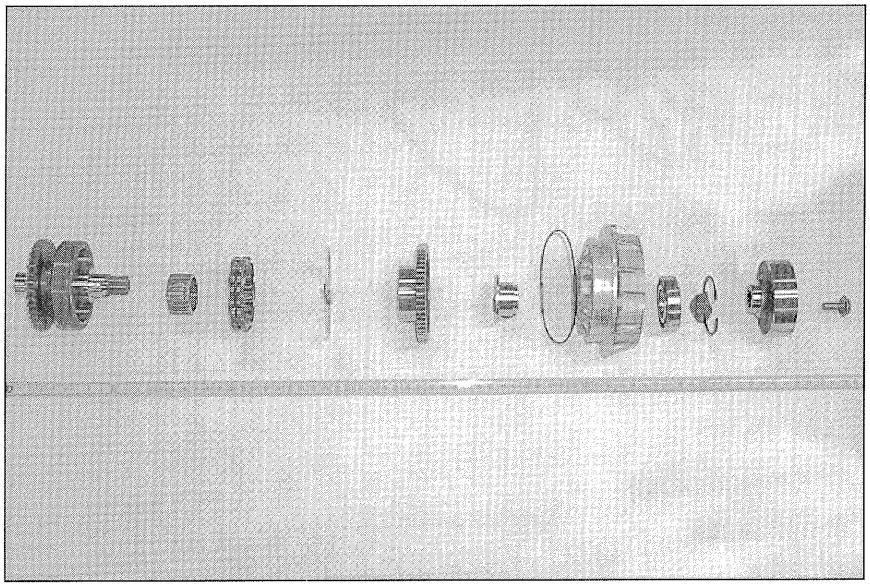
Remove the clutch and the gear as described in the specific chapters.
Withdraw the pin of the intermediate starting gear, removing the pin stopper plate before.
Withdraw the intermediate starting gear
Withdraw the alternator stiffening bracket and the generator shaft.
Remove if necessary the male spring drive from the generator with the n°94794 sprag locking nut tools to unlock the nut
Remove the screw with the n°94795 sprag locking nut tools tool and disassembly the generator shaft
Remove and check the free wheel
Install the free wheel with the seeger ring facing the inner side; install the opened part of the seeger ring at last to make the job easier
The free wheel can **rotate clockwise only**
Install the n°94795 tool on the group and lock the screw at a 25 Nm torque with LOCTITE 242
Install the male spring drive on the generator and lock the nut at a 25 Nm torque with LOCTITE 242
Rotate the oil draining hole of the flange till it faces down.
Lock the screws at a 8 Nm torque with LOCTITE 242.
Install the start gear with the smaller teeth on the speed gear side facing inwards.
Install the pin on the clutch side.
Install the pin stopper plate locking the screw with LOCTITE 242.



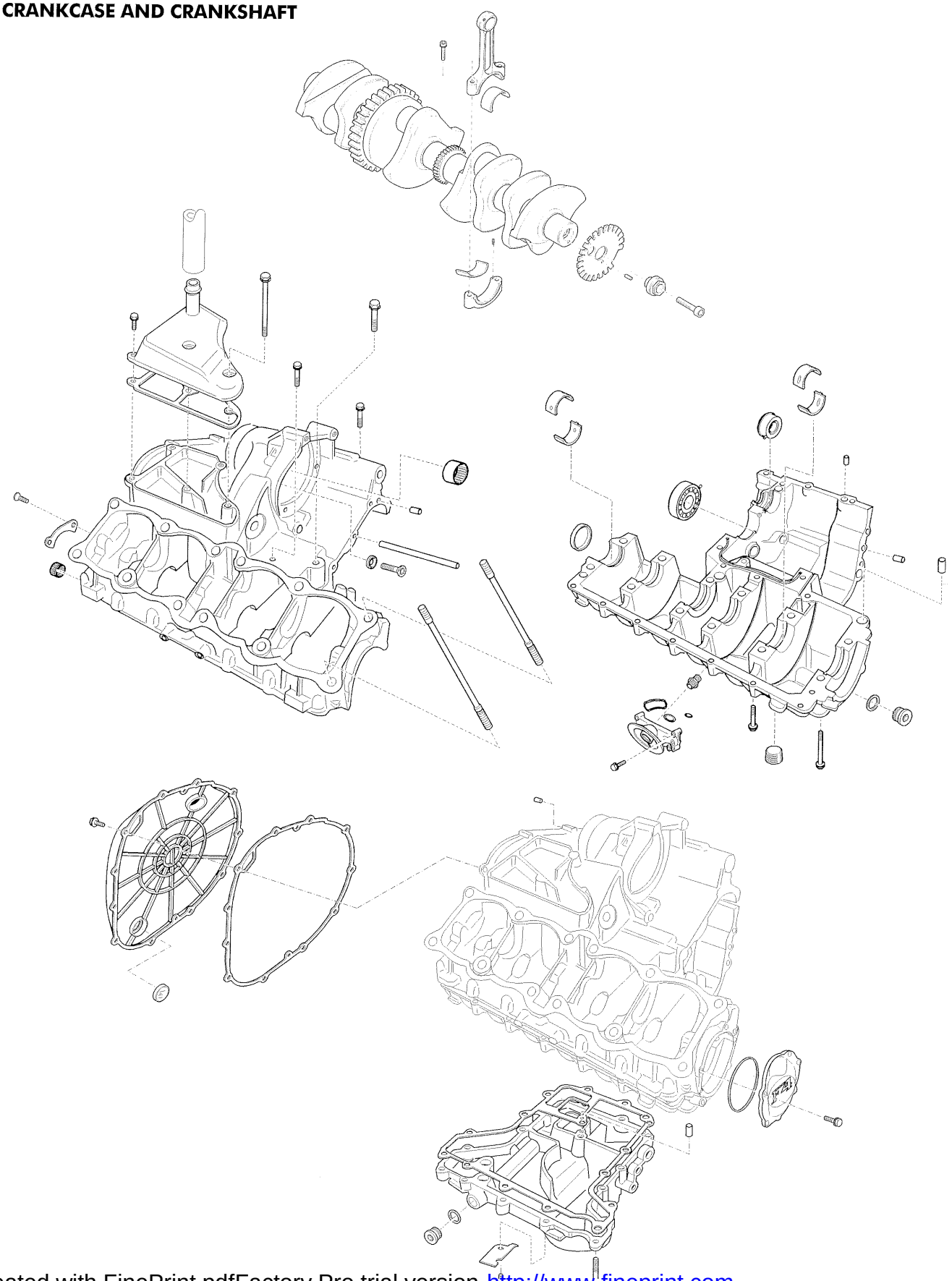


Neutral switch

No maintenance is required.
Replace the switch in case of malfunction
Use a socket spanner, locking at a 10 Nm torque, to install the switch.

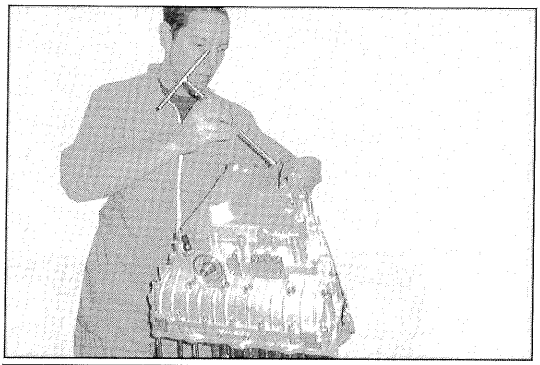


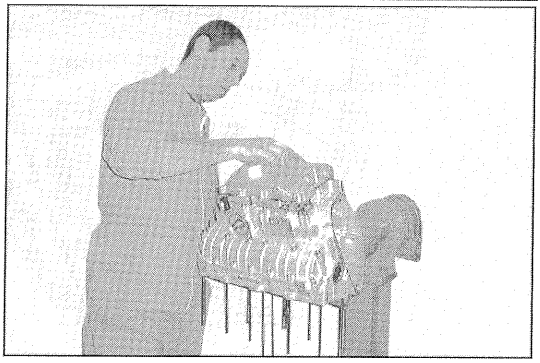
CRANKCASE AND CRANKSHAFT

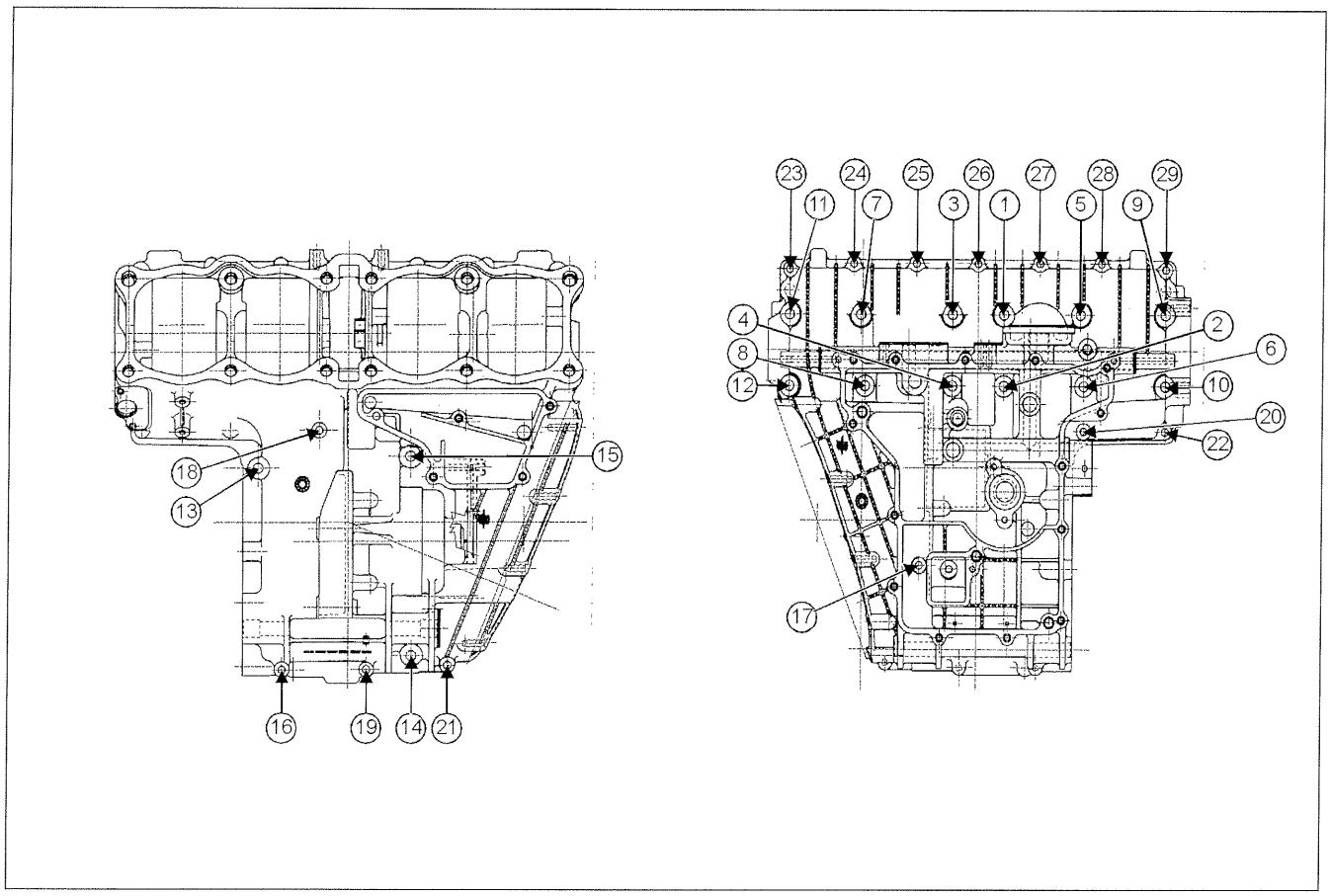


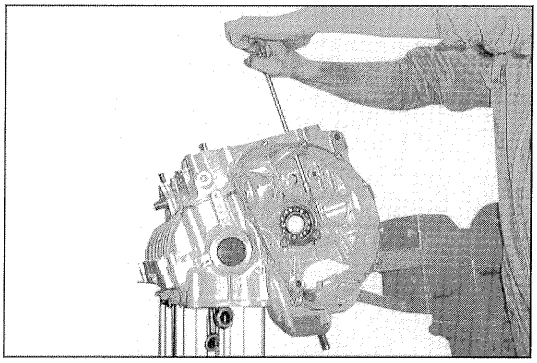
Oil sump

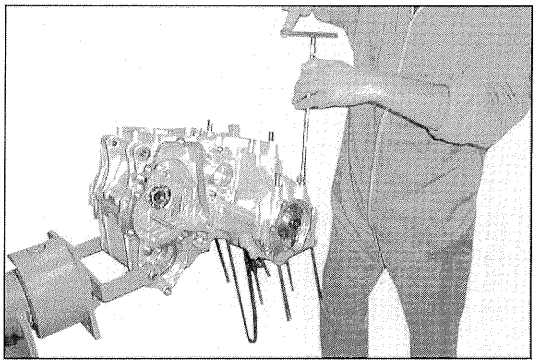
Remove the oil sump by acting on the 6 mm screws
Always replace the gasket at reassembly.
Check the oil filter to find cracks or clefts; clean with low pressure compressed air from inside to outside
To remove the oil filter withdraw the locking screw
Degrease the 2 screws and lock them at a 8 Nm with LOCTITE 242 at reassembly.
Install the gasket and approach the screws by hand.
Lock the screws at a 10 Nm torque.











Crankshaft removal

Remove the oil filter and the heat exchanger with its support.
Remove the following parts as described in the specific chapters:

A) Head
B) Cylinders group
C) Pistons
D) Clutch
E) Speed gear

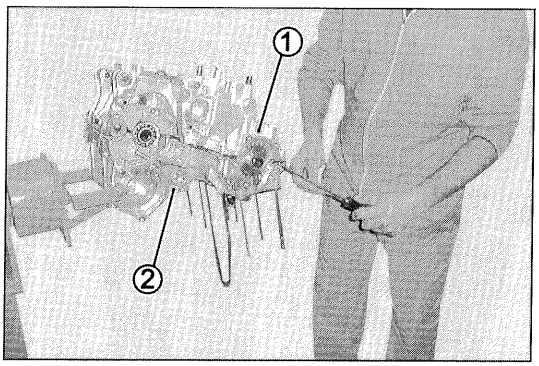
Remove:
F) The 6 screws, blow-by cover included

NOTE
Do not forget the screw inside the sump

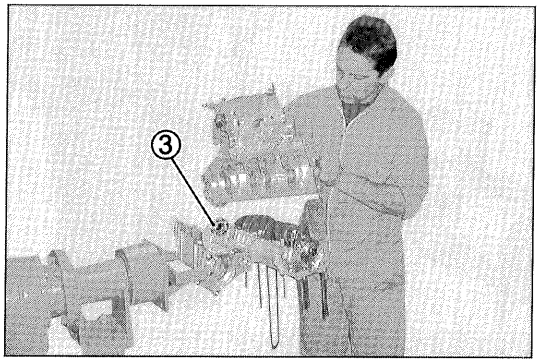
G) The 8 mm screws

NOTE
The screws have the same or much different length, thus, is impossible make a mistake at reassembly.

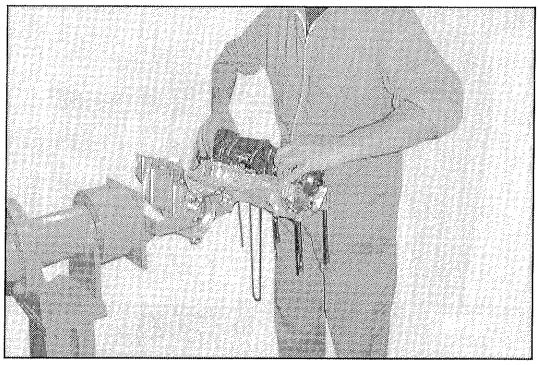
H) Separate the 2 sumps(1 and 2) levering on the 2 relieves



I) Remove the bearings(3)



J) Withdraw the crankshaft



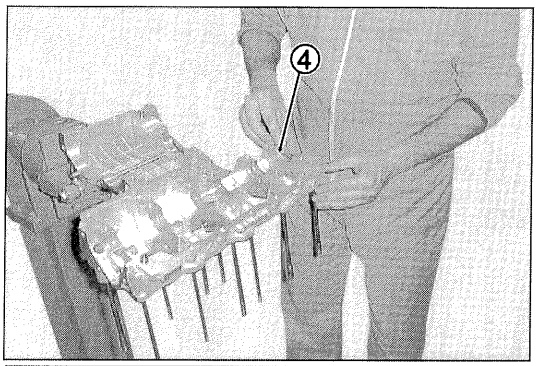
If a temporary half shell bearing brass (4) removal is needed, write on the support and the sump number with a pen
Example:
the half shell bearing brass of the support n°1 (starting from the left) of the upper sump will be written L1
For the couplings, refer to the classes shown downside:
main bearings selection table

MAIN BEARING SELECTION TABLE						
			CRANKSHAFT SEAT DIAMETER			
			A	38.103 38.111	B	38.112 38.119
MAIN JOURNAL DIAMETER	A	34.981 34.988	1.546 / 1551 BLUE		1.550 / 1.555 YELLOW	
	B	34.989 34.997	1.542 / 1.547 RED		1.546 / 1.551 BLUE	
WORKING CLEARANCE 0.012 / 0.038						

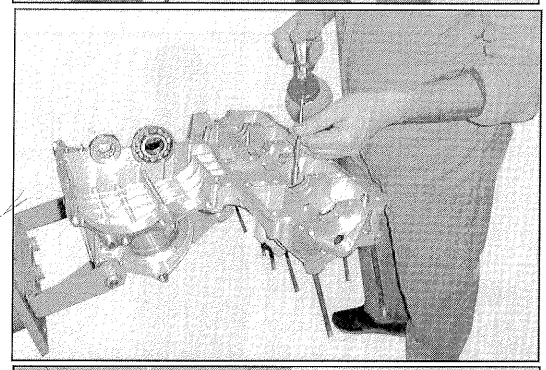
Crankshaft overhaul

Remove the crankshaft and replace the main bearings and the big end bearings in case of doubt about their efficiency.
Check the crankshaft working clearance
Main bearings working clearance:0.012÷0.038
Wear limit:**0.06 mm**
Big end bearings working clearance:0.036÷0.061
Wear limit:**0.08 mm**

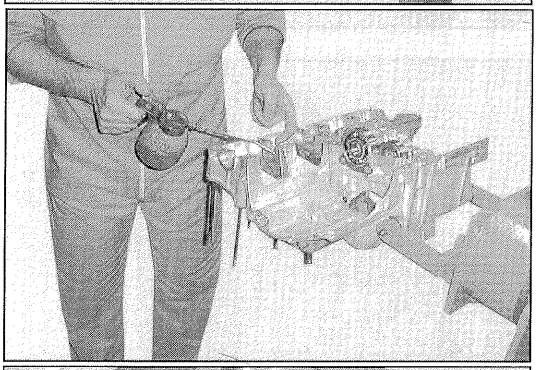
Crankshaft installation



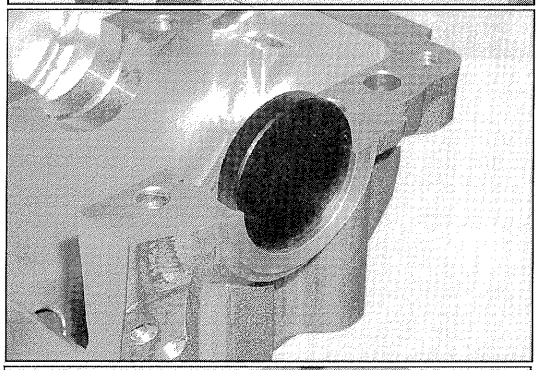
Degrease and clean all the paste residuals
Install the bearings in the crankcase without lubrication



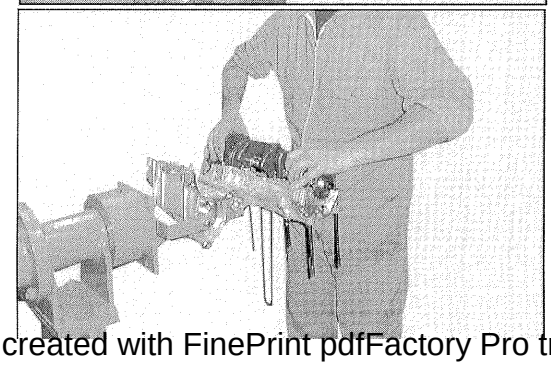
Lubricate the bearings on site



Lubricate the n°5 support side as it is works for the camshaft centering

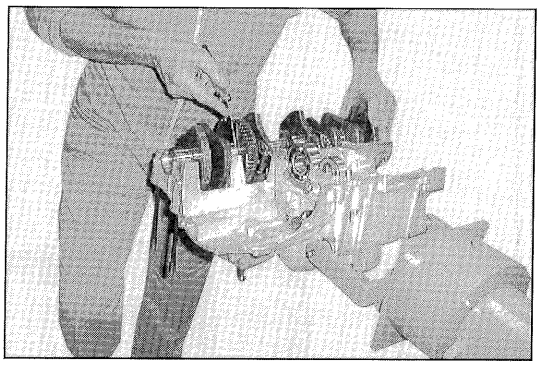


Install a new cap on the right side with silicone paste on its surface, between the cap and the crankcase

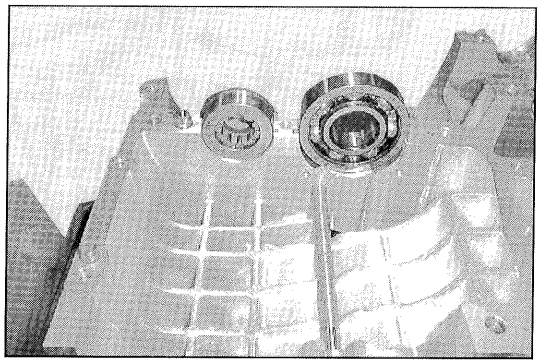


Install the crankshaft

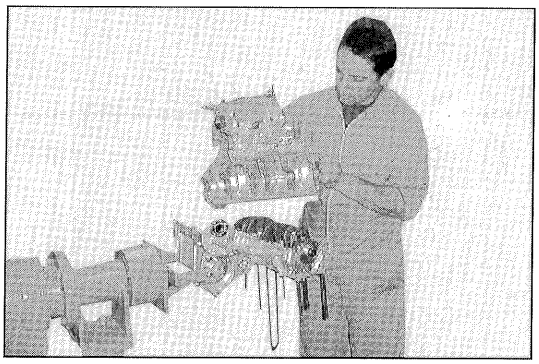
Check with a thickness gauge the **axial clearance** of the crankshaft with the main bearing: the right value is **0.2 mm**.
If you find a different value please contact MvAgusta motor S.p.A.

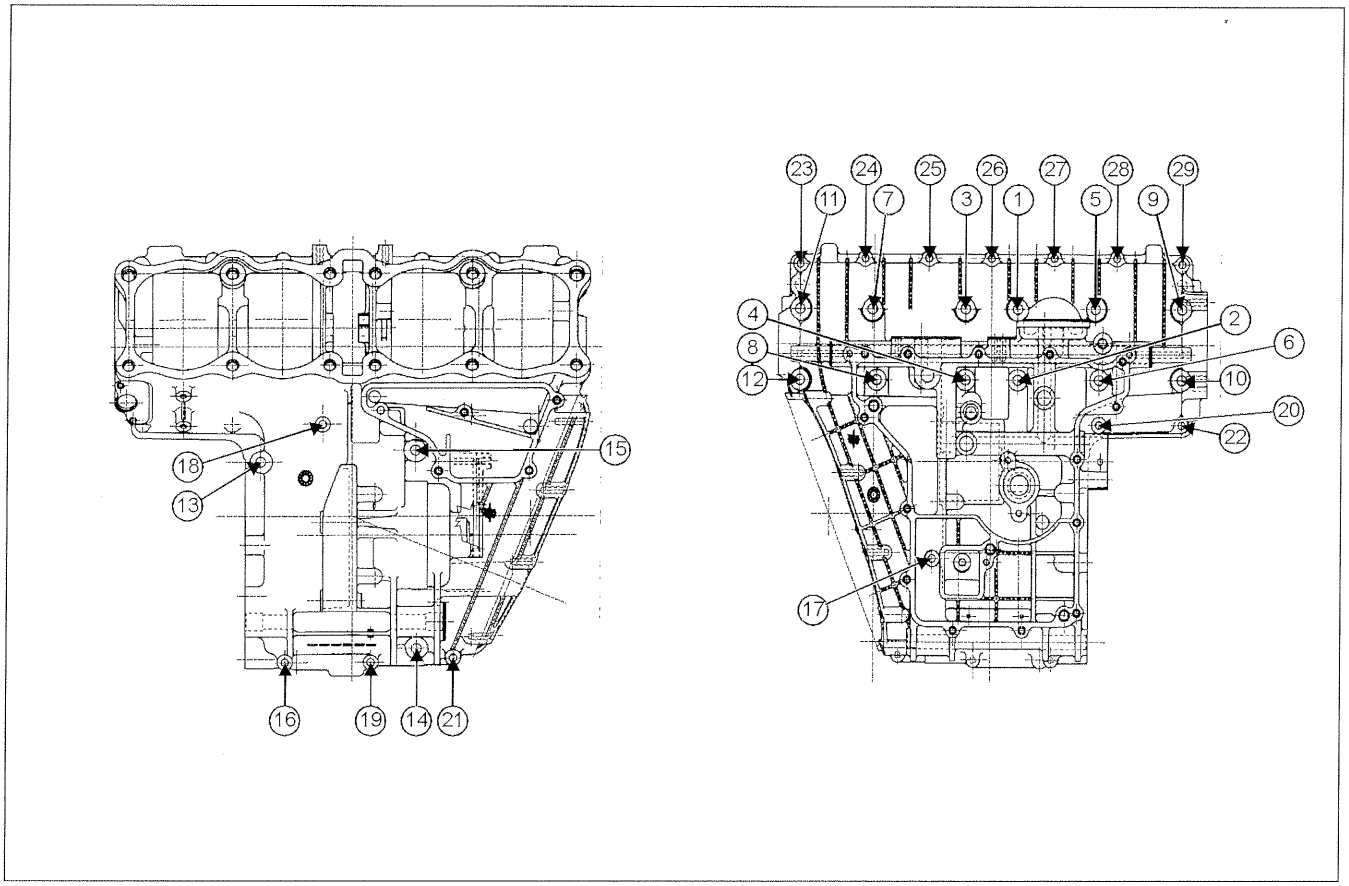


Install the bearings on the lower crankcase with the stoppers facing each other and inside the crankcase.



Install the centering bushes on the lower crankcase.
A layer off a THREEBOND 1215 gasket on the mating surfaces of the upper and lower crankcases
Proceed to the assembling of the crankcases, carefully using a mallet up to the complete closing.



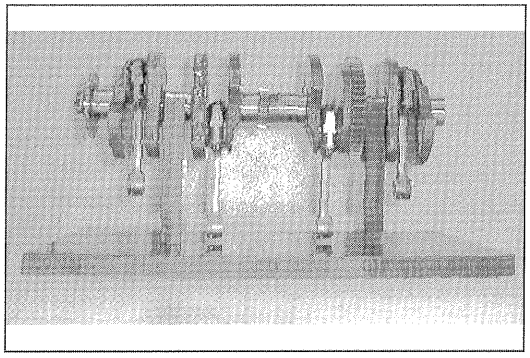


Install the 12 8 mm screws by hand, then lock them at the prescribed torque.
Install the remaining 6 mm screws by hand, then lock them at the prescribed torque.

ATTENTION
Lock the screws inverting the removing order

Install the heat exchanger with the O-Ring and lock the support screws at a 10 Nm torque, the exchanger aluminium screw at a 14 Nm torque.
Always replace the aluminium seal washer at reassembly
Install the oil filter lubricating the gasket with engine oil and locking by hand

Rod disassembly



Remove the crankshaft, following the described procedure
Place the crankshaft with the rods facing down
Operate separately on every rod
Remove the 2 screws locking the small end and the big end, supporting the rod

NOTE
Reassembly every rod before acting on the next.

Shell removal

Disassembly the rod and remove the bearings from the big end and the small end

Crank pin - brasses coupling

If replacement occurs check the dimension of the rod and of the pin, referring to the table below, choose the bearings by colour
Measure on the primary axis, with the screws locked at a 35 Nm torque.
If replacement is needed, simply follow the indicated letter the class of the rod and of the bearing.

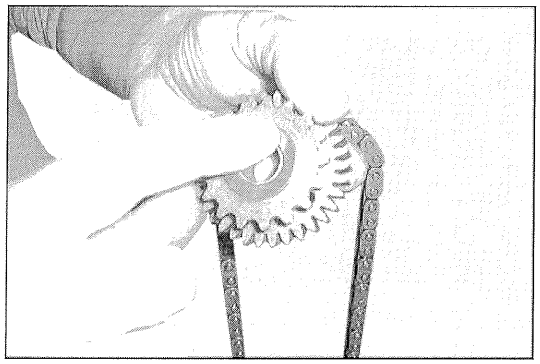
Bearings installation

Install the bearing half shells on the big end and the small end
Lock at a 25 Nm + 25° torque

Always use new screws even if the rod is not.

BIG END BEARING SELECTION TABLE

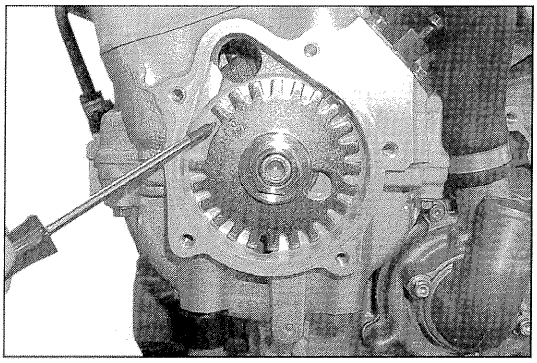
			BIG END DIAMETER			
			A	38.114 38.122	B	38.123 38.130
ROD JOURNAL DIAMETER	A	34.981 34.988	1.450 / 1.545 BLUE		1.544 / 1.549 YELLOW	
	B	34.989 34.997	1.536 / 1.541 RED		1.540 / 1.545 BLUE	
WORKING CLEARANCE 0.036 / 0.061						



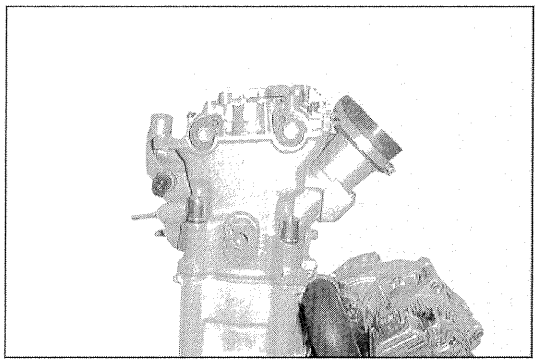
Timing chain inspection and installation

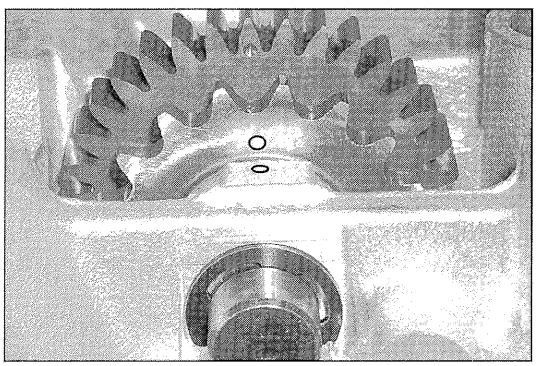
Check the wear of every part of the timing drive system (gears and chain)at engine overhaul.
If the gear teeth are worn out replace all the parts.
Replace the timing chain at the prescribed mile-age.

ATTENTION
If the wear of a timing part exceeds the prescribed limit, check the entire group and replace the parts if necessary.



Rotate the camshaft until the n°1 piston reaches the TDC, using a 19 socket wrench on the phonic wheel nut.
In this position the "T" notch on the phonic wheel is aligned with the notch on the crankcase.
The N°1 cylinder cams converge to the top symmetrically as shown in picture. The notches on the camshafts control gears are horizontal and face outside.





Place the round sign on the intermediate timing gear aligned with the notch on the head.
Install the timing chain but fasten it with a copper wire to recover it if necessary.
Check the sign position on the gear(aligned with the notch on the head)
Install the pin and lock it with the seeger ring.