



## Motorcycle Art

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**BRUTALE**  
**675**

**BRUTALE**  
**800**

**RIVALE**  
**800cc**



**MV AGUSTA BRUTALE 675 - BRUTALE 800 - RIVALE 800**

**Engine workshop manual**

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# Engine workshop manual

MV AGUSTA BRUTALE 675 - BRUTALE 800 - RIVALE 800

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**MV AGUSTA**



## Statement

This manual, to be used by the MV Agusta authorised workshops, has been realised with the purpose of assisting authorised personnel in maintenance and repairs operations of the motorcycle. The knowledge of technical data herein noted, determines the complete professional training of the technician. With purpose of making the reading of this manual immediately comprehensible, the paragraphs have been aligned with detailed illustrations that highlight the argument dealt with.

## Useful advice

To prevent any problems and to reach an excellent final result, MV Agusta recommend skeeping to the following guidelines:

- In the case of an eventual repair, evaluate the client's impressions who states that there is an abnormal functioning of the motorcycle and to formulate the right questions to clarify the symptoms of the problem.
- Clearly diagnose the cause of the abnormality. The basic fundamental theories can be absorbed by reading this manual that must necessarily be integrated to the personal experience and the participation of training courses that are periodically organised by MV Agusta.
- Rationally plan the repair to avoid slack periods, e.g. the collection of spare parts, the preparation of tools and equipment, etc.
- To reach the part to be repaired limiting the work to the essential operations. With regards to this, a valid help would be to consult this manual with regards to the sequences of removal demonstrated in this manual.

## Informative note

MV Agusta S.p.A. is committed to a policy of continuous improvement of their products. For this reason, there could be slight differences between that which is written here and the motorcycle on which repairs and/or maintenance are about to be carried out. MV Agusta models are exported to many countries where different norms in relation to the highway code and homologation procedures are valid. Hoping that you will comprehend these problems, MV Agusta S.p.A. reserves the right to make modifications to its products and technical documentation at any moment and without prior announcement.



## Respect and defend the environment

Everything that we do has repercussions on the entire planet and its resources. MV Agusta, wanting to protect the interest of the people, would like to make the client and the technicians

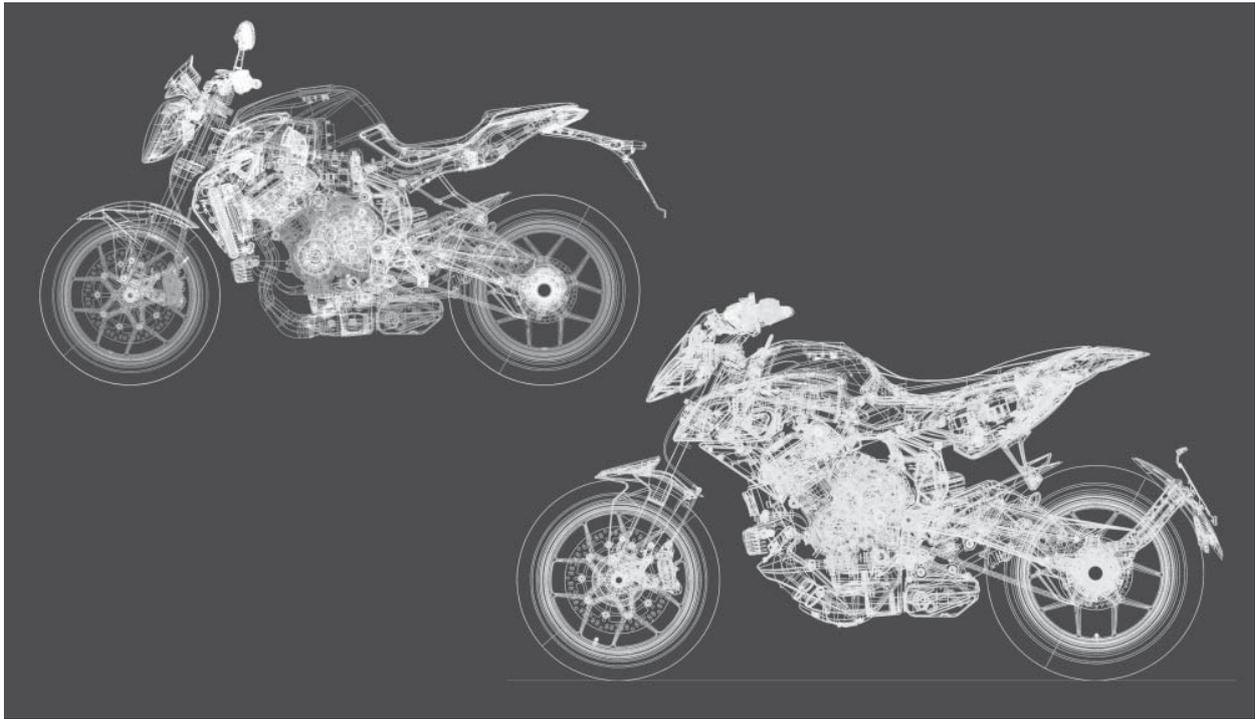
of the technical assistance centres aware and to adopt modalities of use of the motorcycle and the disposal of its parts in full respect of the norms in force in terms of environmental pollution, disposal and the recycling of waste.



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# SECTION A

REVISION 0



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## HOW TO CONSULT THIS MANUAL

### Order of the subjects

This manual is divided into chapters that deal with the sub-groups of the motorcycle. To quickly find the chapter required, the pages of each chapter are marked with a reference mark aligned to the relative item in the general index.

### Display of the operations

The operations of disassembly, assembly, removal and control are presented with the help of illustrations (designs and photographs). The illustrations contain symbols that indicate the procedure, special tools and other information. See the symbols lists for their significance. The procedures are described step after step.

### EXAMPLE

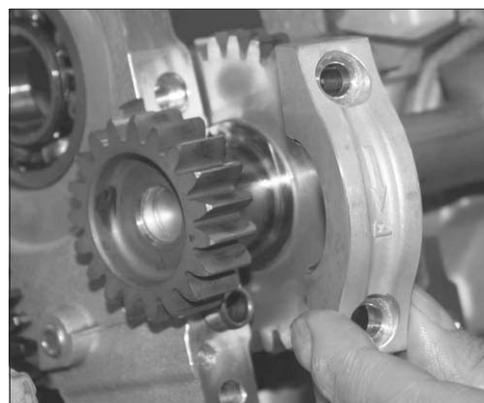
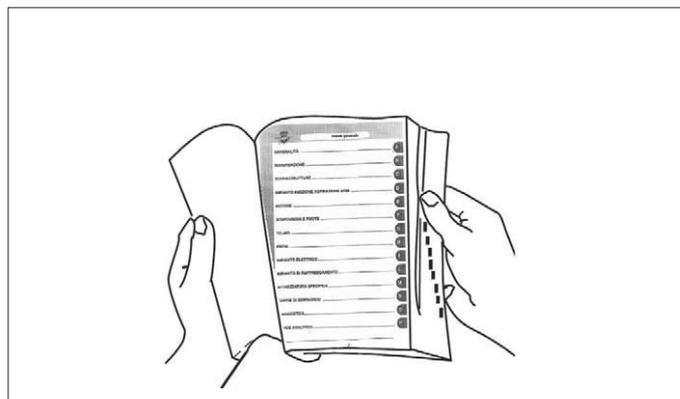
Fitting countershaft head.

Fit the half-bearing on the countershaft head without lubricating .

After placement, lubricate the half-bearing with engine oil.

Check for the presence of the 2 countershaft head blocking rings on the lower block.

Fit the countershaft head with the arrow stamped on the back pointing in the direction of travel.



## PURPOSE OF THE MANUAL

Principally, this manual has been written for MV Agusta dealers and qualified mechanics. It is not possible to document all the knowledge necessary for a mechanic in a manual. Those who utilise it must have a basic knowledge of mechanical concepts and the inherent procedures in the techniques of repairing motorcycles. Without this knowledge, the maintenance and repair operations can render the motorcycle unsafe for use.

### Updates

MV Agusta S.p.A. is committed to a policy of continuous updating of the models produced. The modifications and significant changes to the specifications and the procedures will be communicated to the official dealers and will appear in future editions of this manual. All information, instructions and technical data included in this manual are based upon information on the product updated at the moment of going to print. MV Agusta S.p.A. reserves the right to carry out changes at any moment without prior notice and without incurring any obligation.



## General description

### A GLOSSARY AND SYMBOLS



#### ATTENTION

- ▶ This signifies that the lack or the incomplete observance of this advice can be gravely dangerous for your safety and for the safety of other persons.
- ▶ During this kind of procedure inflammable vapours might develop and metallic parts might be expelled at high velocity.  
Thus, it is necessary to:
  - work far from exposed flames and sparks;
  - wear protective clothing;
  - wear protective eye-glasses.



#### WARNING

- ▶ This signifies that the lack of observance of these instructions can bring the risk of damage to the motorcycle and the equipment.
- ▶ In case it should be necessary, due to wear, to substitute a particular, relative to a cylinder, we strongly suggest that you check and if necessary, substitute the same particular in all of the cylinders for more satisfying results. In particular, we recommend that at the same time you substitute:
  - pistons with relative elastic bands and piston pins;
  - valves with relative springs, semi-cones, disks and grazings;
  - Valve guides with relative valves, springs, semi-cones and grazings;
  - bed bearing;
  - whatever else under goes uniform wear, a side from the position of the relative cylinder.
- ▶ In order to allow the motor to function under the best conditions, it is necessary that all of the couplings are within the accepted tolerances established. A tight coupling, is in fact, cause for seizure as soon as the organs in motion begin to heat, while a loose coupling is cause for vibrations which accelerates wear on the particulars in motion.

**NOTE**

- ▶ Supplies key information for the best fulfilment of the operation.
- ▶ All of the countersigns indicating right, left, superior, inferior, front and back, refer to the motor-bike in the normal direction of march.
- ▶ The motor supports numbering of the cylinders and of the attached components, increases moving from left towards right in regards to the direction of march.



- ▶ This symbol indicates "the procedures to be carried out with an empty cooling circuit".



- ▶ Utilise a specific tool or equipment for the correct carrying out of the operation described.



- ▶ Tighten to the specified torque.



- ▶ Tolerance or limit of use.



- ▶ Utilise the tester.



- ▶ Use the recommended oil.



- ▶ Use the recommended grease.



- ▶ Use the recommended coolant.



- ▶ Use the recommended thread-locking fluid.



- ▶ Use the recommended sealant.



- ▶ Use the recommended adhesive.



- ▶ Carry out accurate cleaning.



- ▶ Use new components.



- ▶ Substitute the component.



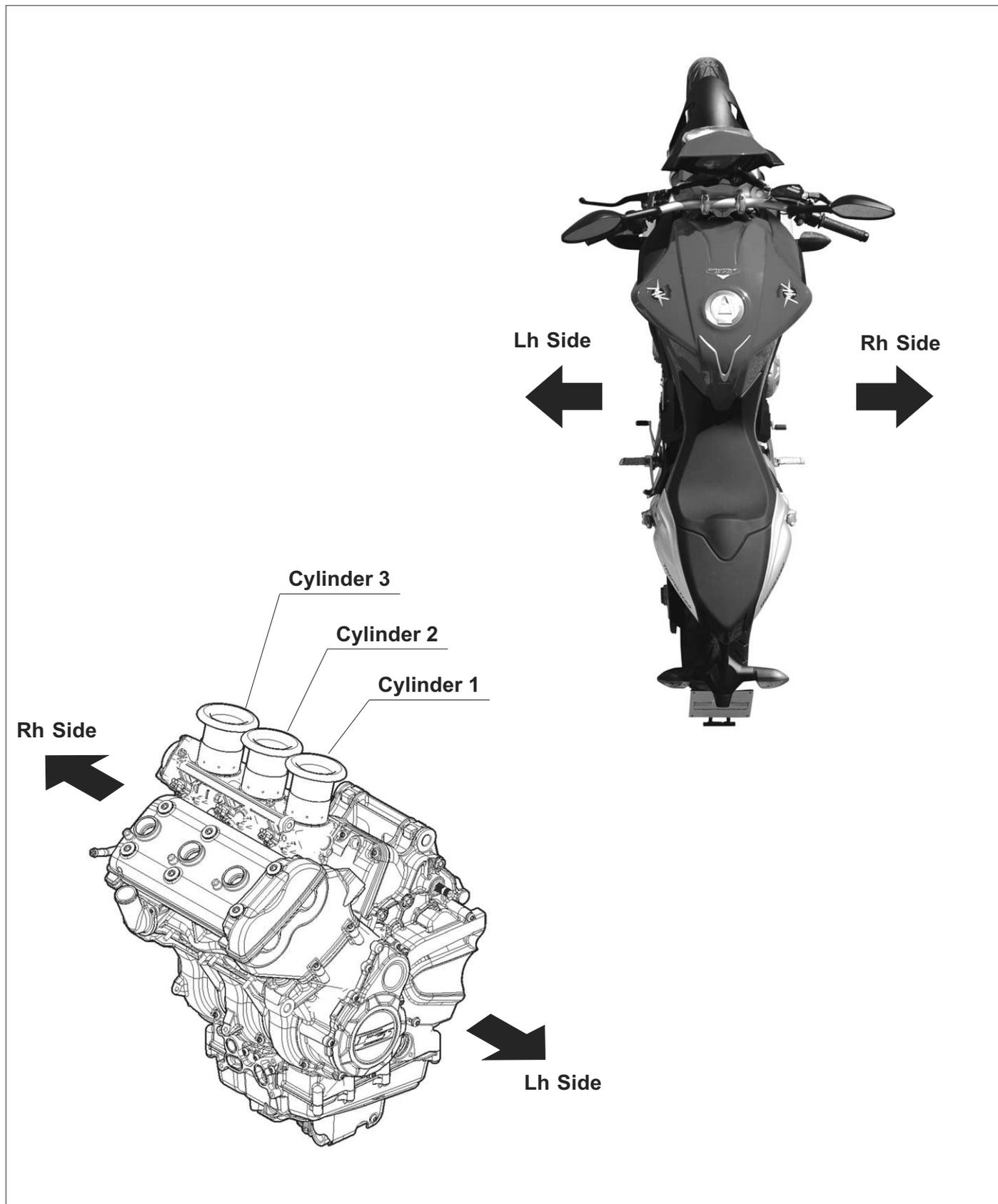
- ▶ Do not leave litter about.



## General description

### A RIGHT HAND AND LEFT HAND STANDARD

To clarify the right hand and left hand standard that is used in this manual, herewith below is a diagram of the motorcycle and the engine against which are indicated the right and left sides.



### **SAFETY**



#### **ATTENTION**

The information contained in this paragraph is fundamental so that the operations carried out on the motorcycle can be conducted with minimum risk to the mechanic.

### **Carbon Monoxide**

- Exhaust gases contain carbon monoxide (CO) that is poisonous. Carbon monoxide can cause the loss of consciousness and death.
- If it is necessary to switch on the engine, check that the environment is well ventilated. Never switch on the engine in an enclosed environment.
- Switching on the engine can only be carried out in an enclosed environment when there are the appropriate devices for the evacuation of exhaust gases.

### **Petrol**

- Petrol is extremely inflammable and under certain conditions can be explosive.
- Keep sources of heat, sparks and flames away from the work area.
- Always work in a well-ventilated area.
- Never use petrol as a cleaning solvent. Generally, avoid handling it unless it is absolutely necessary.
- Do not use petrol for cleaning components by using compressed air.
- Keep petrol out of reach of children.

### **Engine oil**

- Engine oil can cause skin illnesses if in constant and long contact with the skin.
- If the skin comes into contact with engine oil, wash the parts affected as soon as possible with soap and water.
- If engine oil comes into contact with the eyes, rinse abundantly with water and seek medical attention.
- If engine oil is swallowed, do not provoke vomiting to avoid the aspiration of the product into the lungs. Transport the injured person immediately to hospital.
- Used oil contains dangerous substances and poisonous for the environment. To substitute oil, it is necessary to be equipped to deal with the collection of used oil in respect of the norms in force.
- Do not dispose of used oil in the environment.
- Keep used oil out of the reach of children.

### **Engine coolant**

- Under certain situations, the ethylene glycol contained in the engine coolant is inflammable and its flame is invisible. Ethylene glycol would cause serious burns if ignited because it is invisible.
- Avoid bringing the engine coolant into contact with hot parts. Such parts could be sufficiently hot to ignite the coolant.
- The engine coolant (ethylene glycol) can cause irritation of the skin and is poisonous if swallowed.
- If the engine coolant comes into contact with the skin, immediately remove any contaminated clothing and wash with soap and water. If it comes into contact with the eyes, abundantly rinse with clean water and immediately consult a doctor. If swallowed, do not provoke vomiting to avoid the aspiration of the product into the lungs. Administer clean water and transport the injured person immediately to hospital and show the product to a doctor.
- If exposed to high concentrations of vapour, transport the injured person to a non-poisonous atmosphere and if necessary call a doctor.
- Do not remove the radiator cap when the engine is still hot. Being under pressure, the engine coolant can be violently ejected and therefore provoke burns.
- The engine coolant contains dangerous and poisonous substances and is therefore dangerous for the environment. To substitute used engine coolant, it is necessary to be equipped to deal with the collection of used oil/of used engine coolant in respect of the norms in force.
- Do not dispose of engine coolant in the environment.
- Keep engine coolant out of reach of children.



## General description

### A Brake fluid

- Brake fluid is extremely corrosive.
- Avoid any contacts with the eyes, skin and the mucous membrane.
- If brake liquid comes into contact with the skin, remove all contaminated clothing and wash immediately with soap and water.
- If brake fluid comes into contact with the eyes, abundantly rinse with water and call a doctor.
- If swallowed, do not provoke vomiting to avoid aspiration of the product into the lungs. Immediately call a doctor.
- Take the injured person immediately to hospital, if he has breathed brake fluid into the lungs.
- In the case of exposure to high concentrations of vapour, move the injured person to a non-poisonous atmosphere and if necessary call a doctor.
- In the case of accidental contact, rinse abundantly with water and call a doctor.
- Keep brake fluid out of reach of children.

### Thread-locking fluid

- As it is not classified as dangerous, the prolonged contact with the skin, particularly with regards to abrasions can provoke sensitiveness and dermatitis. In the case of contact with the skin, rinse abundantly with running water.
- Move the injured person into the open air and call a doctor if the injured person feels ill after having breathed in the product.
- In the case of contact with the eyes, rinse abundantly with water for at least 15 minutes.
- If the thread-locking fluid has been swallowed, drink an abundant quantity of water or milk. Do not provoke vomiting to avoid the aspiration of the product into the lungs. Immediately call a doctor.
- Keep out of reach of children.

### Nitrogen - rear shock absorber

- The rear shock absorber contains nitrogen under pressure.
- Before disposing of used shock absorbers, discharge the nitrogen via the depressurising valve.
- Utilise only nitrogen to pressurise the shock absorber. The use of unstable gases can cause explosions that could cause burns.
- Do not place the shock absorber near to flames or sources of heat as this could cause explosions with consequent burns.
- Keep out of reach of children.

### Battery

- The battery produces explosive gases. Keep it away from sparks, flames or cigarettes. During recharging, adequately ventilate the environment.
- The battery contains a solution of sulphuric acid (electrolyte).
- Sulphuric acid is corrosive and it destroys many materials and clothing. On contact with small quantities of water it generates a violent reaction that manifests itself by creating large quantity of heat and spurts of hot acid. Sulphuric acid attacks many metals thereby liberating hydrogen: an inflammable gas that forms an explosive mixture when mixed with air.
- Contact with sulphuric acid can cause burns. In the case of contact, remove immediately all contaminated clothing and wash the skin with abundant quantities of water. Take the injured person to hospital if necessary.
- In the case of contact with the eyes, rinse immediately with abundant water. Call a doctor and continue with the treatment until the doctor arrives.
- If the electrolyte is swallowed, rinse the mouth with water without swallowing. Take the injured person immediately to hospital and explain to the doctor there what the injured person has swallowed.
- The battery contains dangerous substances that are poisonous for the environment. It is necessary to be equipped to dispose of this product in respect of the norms in force.
- Do not dispose of used batteries in the environment.
- Keep out of reach of children.

### Hot parts

- The engine and the exhaust system become very hot and maintain this temperature for some time after the engine has been switched off. Wait for these parts to cool down before handling them or working on the motorcycle near to them. Use protective gloves.

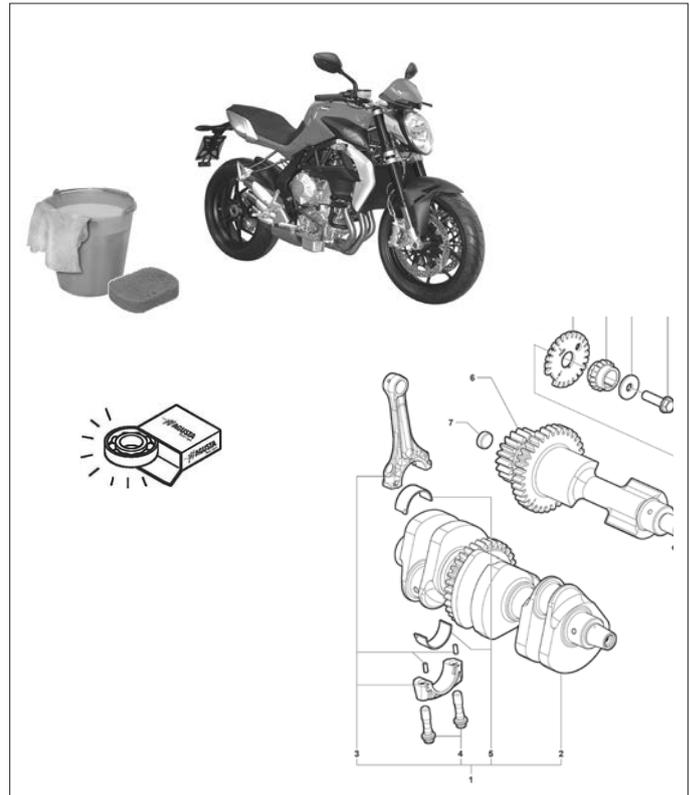


A

## WARNING

The information contained in this paragraph is important so that the operations carried out on the motorcycle can be conducted without damaging the motorcycle.

- Thoroughly clean the motorcycle before disassembling it.
- During disassembly, clean all parts and place them in containers respecting exactly the order of disassembly.
- Always use the special utensils where necessary and each time where prescribed.
- Always use adhesives, sealants and lubricants where prescribed. Respect the instructions about their technical characteristics.
- Always substitute parts such as gaskets, O-rings, security washers with new parts.
- Slackening or tightening nuts or screws, always start with those of a greater dimension or from the centre. Always respect the torque values indicated.
- Utilise only MV Agusta spare parts.



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## General description

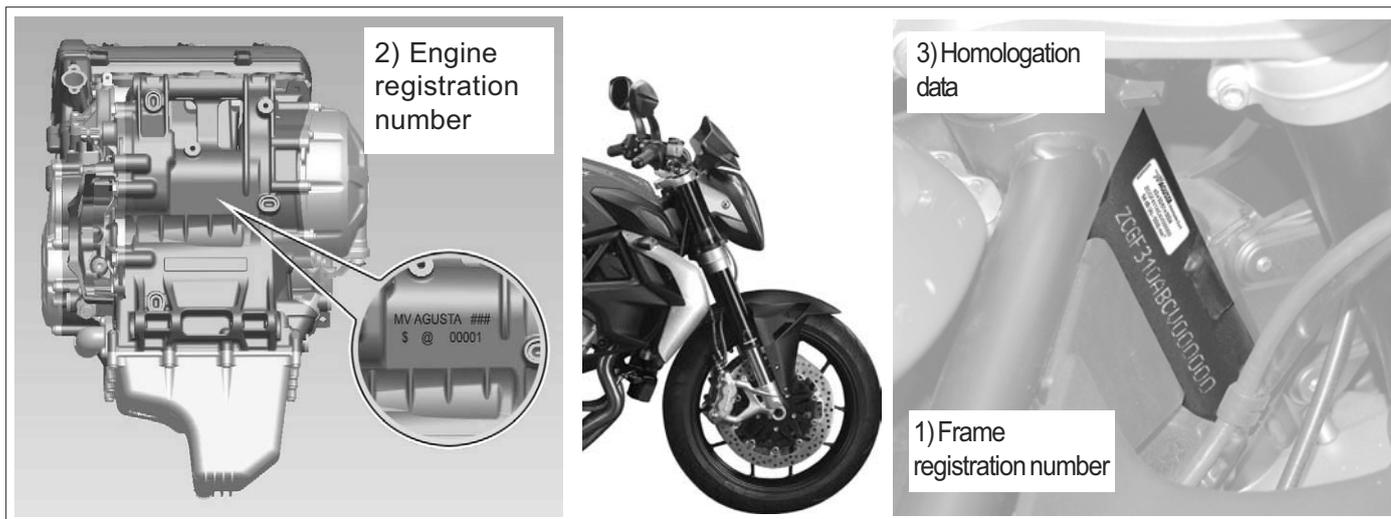
A

### OPERATIVE TECHNICAL SPECIFICATIONS

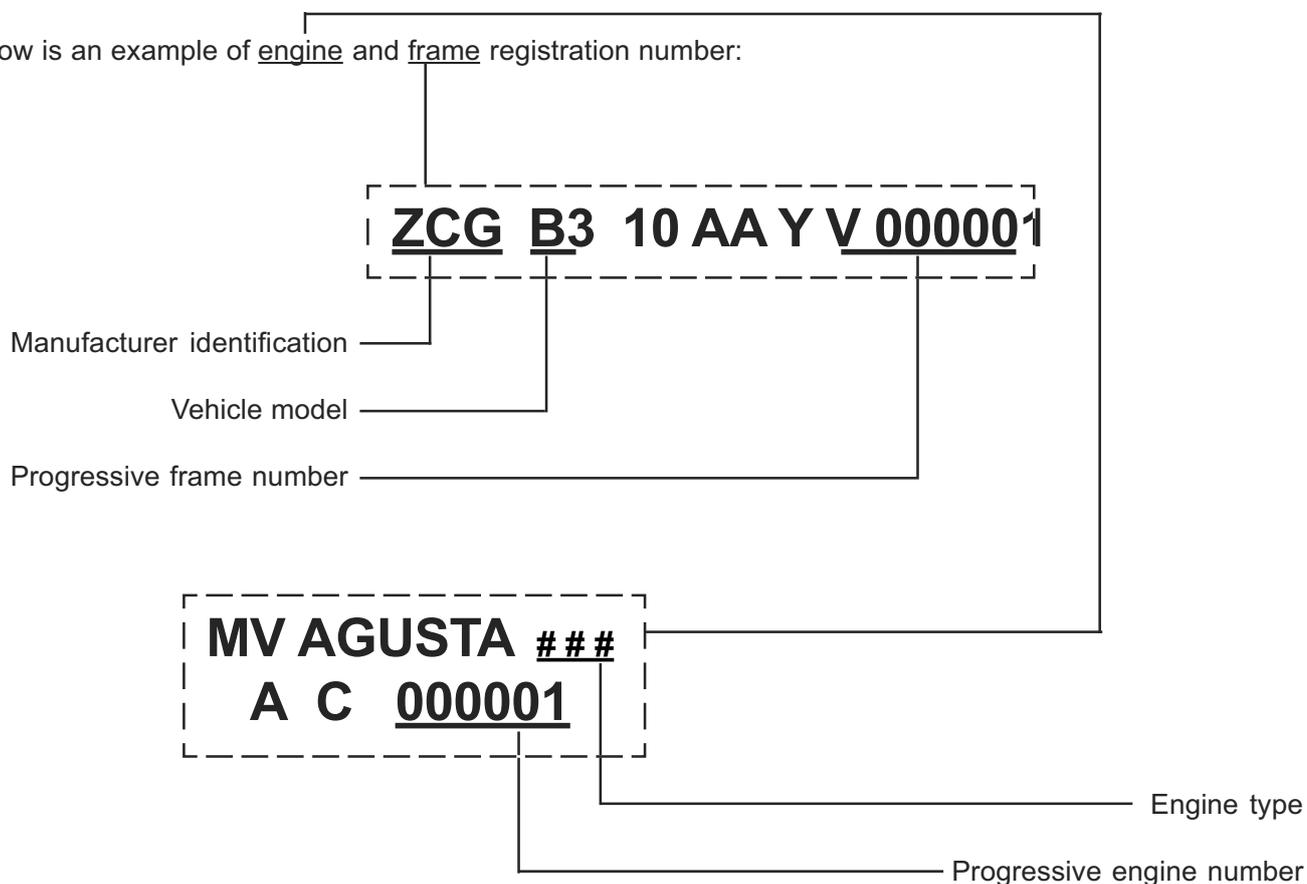
#### MOTORCYCLE IDENTIFICATION

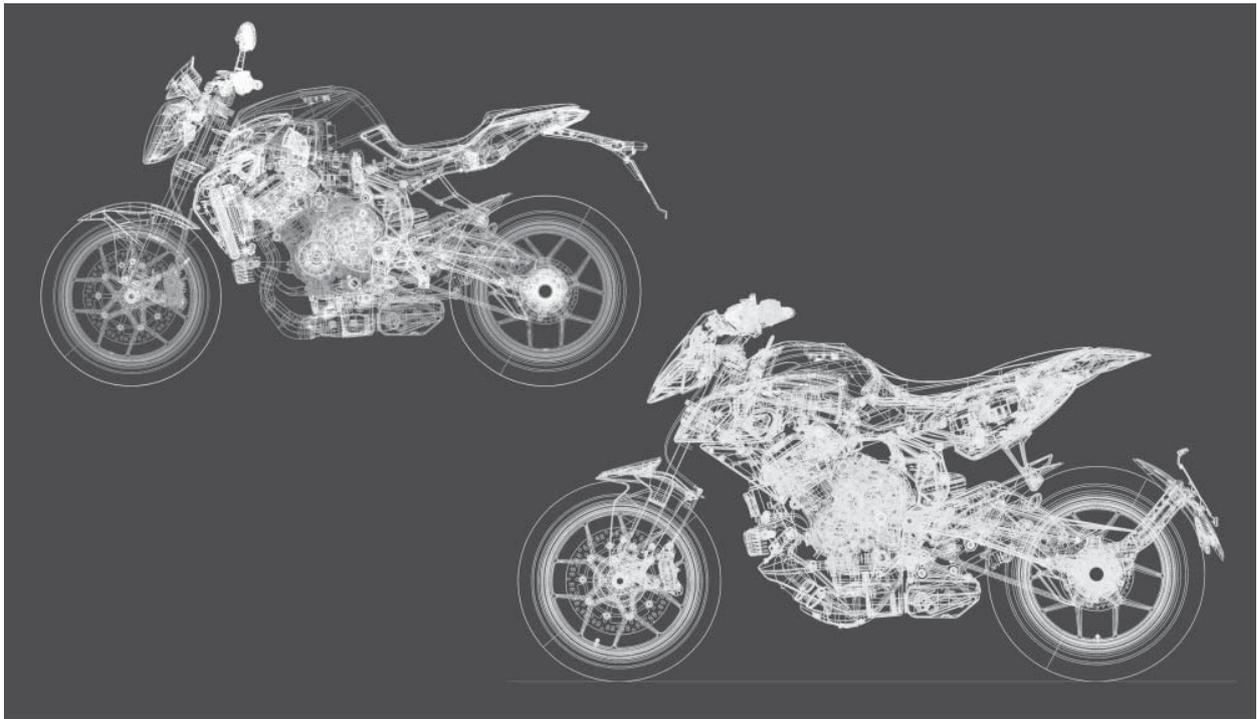
The registration number of the motorcycle is stamped on the right side of the steering head.

The engine registration number is stamped on the upper engine casing, near the forks.



Below is an example of engine and frame registration number:





B

## SECTION B

REVISION 1



## SUMMARY

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## PLANNED MAINTENANCE SCHEDULE

The following diagram shows the recommended planned maintenance intervals. Periodic maintenance is essential to keep the vehicle in perfect running order and to ensure optimum cost efficiency. Intervals are expressed in Kilometers.



**WARNING**

Use shorter maintenance intervals if the vehicle is used in particularly harsh conditions.



### Let us help protect the environment

Everything we do affects the entire planet and its resources.

To protect the common interest, MV Agusta urges its customers and service operators to use the vehicles and dispose of their components in compliance with applicable regulations on environmental pollution control, waste disposal and recycling.

## Programmed maintenance schedule

Km (ml) covered		0	1000 (600)	6000 (3800)	12000 (7500)	18000 (11200)	24000 (14900)	30000 (18600)	36000 (22400)
Service		pre-delivery	A	B	C	D	E	F	G
Description	Operation								
Engine oil	Substitution		●	●	●	●	●	●	●
		At least once a year							
Engine oil filter	Substitution (utilize only MV Agusta original oil filter)		●	●	●	●	●	●	●
		At every substitution of engine oil							
Engine coolant	Check level / Top up	●	●	●	●	●	●	●	●
	Substitution	every 2 years							
Cooling	Check for leakages	●	●	●	●	●	●	●	●
Electric fan	Check functioning	●	●	●	●	●	●	●	●
Valves	Check / adjustment				●		●		●
Timing chain	Check				●		●		●
	Substitution								●
Timing movable pad	Check / Substitution				●		●		●
	Substitution	At least every substitution of the timing chain							
Timing chain tensioner	Check / Substitution				●		●		●
Spark plugs	Check / Substitution			●		●		●	
	Substitution				●		●		●
Fuel filter	Check / Substitution				●		●		●
Throttle body	Check and adjustment		●	●	●	●	●	●	●
Air filter	Check / Substitution			●	●	●	●	●	●
Brake and clutch fluid	Check level	●	●	●	●	●	●	●	●
	Substitution	every 2 years							
Brake / Clutch	Check Functioning and Circuit	●	●	●	●	●	●	●	●
	Cleaning of contact lever and pump piston area	●	●	●	●	●	●	●	●
Brake pads (front and rear)	Check / Substitution		●	●	●	●	●	●	●
Fuel tubes	Check for defects and leakages			●		●		●	
	Substitution	every 3 years							
Accelerator control	Check functioning	●	●	●	●	●	●	●	●
	Verify / adjust play	●	●	●	●	●	●	●	●
Starter control	Check functioning	●	●	●	●	●	●	●	●
Transmission / flexible controls	Check / Adjustment	●	●	●	●	●	●	●	●
Transmission chain	Check / Adjustment	●	●	●	●	●	●	●	●
	Lubricate		●	●		●		●	
	Substitution				●		●		●



# Maintenance

## Programmed maintenance schedule

Km (ml) covered		0	1000 (600)	6000 (3800)	12000 (7500)	18000 (11200)	24000 (14900)	30000 (18600)	36000 (22400)
Service		pre-delivery	A	B	C	D	E	F	G
Pinion wheel / Stop washer	Check		●	●		●		●	
	Substitution				●		●		●
At least at each substitution of the transmission chain									
Crown wheel	Check		●	●		●		●	
	Substitution				●		●		●
At least at each substitution of the transmission chain									
Crown wheel tension regulator	Check / Substitution				●		●		●
Steering head flange ring	Check / Adjustment		●		●		●		●
Steering bearings	Check / Adjustment		●		●		●		●
	Lubrication						●		
Tyres	Check for pressure	●	●	●	●	●	●	●	●
	Check for wear		●	●	●	●	●	●	●
Wheel rims	Visual check	●	●	●	●	●	●	●	●
		Every tyre substitution							
Front wheel bearings	Check			●	●	●	●	●	
	Substitution								●
Every tyre substitution									
Side stand	Check functioning	●	●	●	●	●	●	●	●
Side stand switch	Check functioning	●	●	●	●	●	●	●	●
	Substitution	●	●	●	●	●	●	●	●
Rear wheel hub	Check / Lubricate roller bearings and guide				●		●		
	Substitution / Lubricate roller bearings and guide								●
Rear fork bearings	Check / Lubrication								●
Chain guide frame plate	Check / Adjustment		●	●	●	●	●	●	●
Rear shock absorber	Check / Adjustment		●		●		●		●
Front fork oil	Substitution						●		
Battery connections	Check and clean		●	●	●	●	●	●	●
Electrical system	Check functioning	●	●	●	●	●	●	●	●
Instruments	Check functioning	●	●	●	●	●	●	●	●
Lights / Visual signals	Check functioning bulb replacement	●	●	●	●	●	●	●	●
Horn	Check functioning	●	●	●	●	●	●	●	●
Front headlight	Check functioning bulb replacement	●	●	●	●	●	●	●	●
	Adjust	at every variation of riding set-up of the motorcycles							
Ignition switch	Check functioning	●	●	●	●	●	●	●	●
Locks	Check functioning	●	●	●	●	●	●	●	●
Torque settings - nuts and bolt	Check / Tightness	●	●	●	●	●	●	●	●
Tube band fasteners	Check / Tightness	●	●	●	●	●	●	●	●
General lubrication		●	●	●	●	●	●	●	●
General check		●	●	●	●	●	●	●	●



## Table of lubricants and fluids

Description	Recommended product	Specification
Engine lubrication oil	ENI I-RIDE MOTO2 5W/40 (*)	SAE 5W40 - API SL
Engine coolant	AGIP ECO PERMANENT	Ethylene - Glycol Diluted with 50 % of Distilled Water
Clutch and brake fluid	AGIP BRAKE FLUID DOT 4	DOT 4
Chain lubrication oil	D.I.D. CHAIN LUBE	-

\* To find the recommended product, MV Agusta suggests going directly to the authorised MV Agusta dealers. Eni I-Ride moto2 50W/40 has been manufactured for the Brutale and Rivale engine. If the described oil is not available, MV Agusta suggests using completely synthetic oils with characteristics that conform or exceed the following norms:

- Conforming to API SL
- Conforming to ACEA A3
- Conforming to JASO MA, MA2
- Grade SAE 5 W-40

**NOTE** The above specifications indicated are marked either on their own or together with others on the container of the lubricating oil.





## Maintenance

Table of wear limits

ITEM	STANDARD	WEAR LIMIT
<b>VALVES</b>		
Ø Sealing external diameter		
Exhaust.....	$26,7^{+0,05}_{-0,05}$ mm	
Inlet.....	$31,8^{+0,05}_{-0,05}$ mm	
Sealing face thickness		
Exhaust.....	$1,27^{+0,1}_{-0}$ mm	
Inlet.....	$1,0^{+0,1}_{-0}$ mm	
Stem - Guide clearance		
Exhaust.....	0,02 ÷ 0,04 mm.....	Coupling: 0,10 mm
Inlet.....	0,01 ÷ 0,03 mm.....	Coupling: 0,08 mm
Ø inner guide.....	$4,5^{+0}_{+0,012}$ mm.....	4,55 mm
Valve stem		
Exhaust.....	$4,4725 \pm 0,0075$ mm.....	4,4425 mm
Inlet.....	$4,4825 \pm 0,0075$ mm.....	4,4525 mm
Valve Spring :		
Single		
- Exhaust/Inlet.....	42 mm.....	41,5 mm
Twin		
- External (Exhaust/Inlet).....	37,9 mm.....	37,4 mm
- Internal (Exhaust/Inlet).....	33,8 mm.....	33,3 mm
Valve - Cam clearance		
Exhaust.....	0,20 ÷ 0,29 mm	
Inlet.....	0,15 ÷ 0,24 mm	



ITEM	STANDARD	WEAR LIMIT
<b>CYLINDER AND PISTONS</b>		
Piston ovalization.....	.....	0,015 mm
Piston-Cylinder play.....	0,016 ÷ 0,042 mm.....	0,10 mm
Piston-Pin play.....	0,002 ÷ 0,010 mm.....	0,03 mm
Wrist pin-Connecting rod clearance.	0,015 ÷ 0,029 mm.....	0,06 mm
<b>Piston ring width</b>		
1° segment .....	$0,8_{-0,03}^{-0,01}$ mm.....	0,75 mm
2° segment. ....	$0,8_{-0,02}^0$ mm.....	0,75 mm
Oil scraper .....	$1,5_{-0,08}^{-0,03}$ mm.....	1,38 mm
<b>Maximum piston ring-cylinder clearance</b>		
1° segment .....	0,2 ÷ 0,4 mm.....	0,6 mm
2° segment .....	0,2 ÷ 0,4 mm.....	0,6 mm
Oil scraper .....	0,2 ÷ 0,7 mm.....	1 mm
<b>CLUTCH</b>		
Friction drive plate thickness .....	3 mm.....	2,8 mm
Springs.....	51,7 mm.....	49,5 mm



## Maintenance

B

ITEM	STANDARD	WEAR LIMIT
<b>GEAR SHIFT</b>		
Gear fork - Groove pivot play.....	0,35 ÷ 0,15 mm.....	0,65 mm
Shift drum groove width.....	7,05 ÷ 7,15 mm.....	7,35 mm
Ø Fork pivot.....	6,8 ÷ 6,9 mm.....	6,7 mm
Minimum idle gear axial play .....	0,10 mm	
Maximum gear fork play .....	.....	0,70 mm
Primary gear limit.....	.....	5,60 mm
Secondary gear limit.....	.....	4,60 mm
Fork selection gear limit		
Primary (5a - 6a).....	.....	4,65 mm
Secondary (1a - 2a, 3a - 4a).....	.....	3,65 mm
Fork - Pit play.....	0,2 ÷ 0,3 mm.....	0,7 mm
<b>CRANKCASE - DRIVE SHAFT</b>		
Crankshaft - crankcase plain bearing clearance .....	0,014 ÷ 0,044 mm.....	0,06 mm
Connecting rod - crankshaft plain bearing clearance .....	0,029 ÷ 0,057 mm.....	0,08 mm
Crankshaft axial clearance .....	0,2 mm	



## **Cleaning the parts**

All of the parts must be cleaned with special biodegradable solvents and dried with compressed air. Proceed with the cleaning process of all the parts before disassembling them as well as after the particular parts have been disassembled. Clean each part even before reassembling.

## **Connections**

In order to allow the motor to function in the best conditions it is absolutely necessary that all of the connections meet the standards established by the manufacturer. A connection with reduced standards could cause seizing, while a connection with excessive toleration causes vibrations which accelerate the wear of the components.

## **General norms for assembling the parts**

For reassembling invert the disassembling procedure, paying careful attention to the specified procedures. Gaskets, oil spill protector, metallic locks.

Tightening rings in deformable material and self blocking nuts must always be substituted.

The bearings are dimensioned for a determined number of working hours. Substitution is therefore recommended in consideration of the difficulty in checking wear.

The above mentioned is in addition suggested for dimensional controls of the single components mentioned in the relative paragraphs.

It is absolutely necessary to carefully clean all of the components; the bearings and all of the other parts subject to wear must be lubricated with motor oil before reassembling.

Nuts and screws must be locked to the pre established torques.

Following are the descriptions of the disassembling, revision and reassembling procedures of the various parts and sub parts constituting the motor, in the finalized sequence of a completely disassembled motor.

Disassemble the motor from its frame as described in the relative paragraph;

Drain the oil from the oil cup;

Remove the spark plugs covering the openings with clean rags to avoid small objects (rings, etc.) from falling into the motor.



### Measuring compression in the cylinder

The following tools are necessary in order to carry out this procedure:

Spark plug key: n°800089013

Compression measurer

Adapter for the compression measurer.

- A) Heat the motor to the usual functioning temperature (of regime);
- B) Switch off the engine, remove the tank, air box and spark plugs;
- C) Measure cylinder compression.

Drag the motor into rotation by means of the starting motor with the butterfly valve completely open until the compression measurer indicator (compression meter) no longer rises; the compression measurement obtained is the maximum.

Be sure the battery is completely charged.

Cylinder compression control (280 rpm-min.)		
Engine Type	Min Press. (bars)	Max Press. (bars)
B3	7,5	14

- Repeat the procedure for the other cylinders.

N.B.: If the compression in the cylinder is lower than the minimum value of the reported range, check the following points:

- A) carbon deposits on the walls of the combustion chamber and on the piston ceiling;
- B) the head gasket is not of the correct measurements;

N.B.: If the compression in the cylinder is lower than the minimum value of the reported range, check the following points:

- A) The seat of one or more valves is damaged and the valves do not maintain the compression pressure;
- B) One or more valves have null functioning play;
- C) The piston, cylinder play is excessive;
- D) The cylinder head is twisted and/or the head gasket is damaged;
- E) Excessive play between ring and cable.

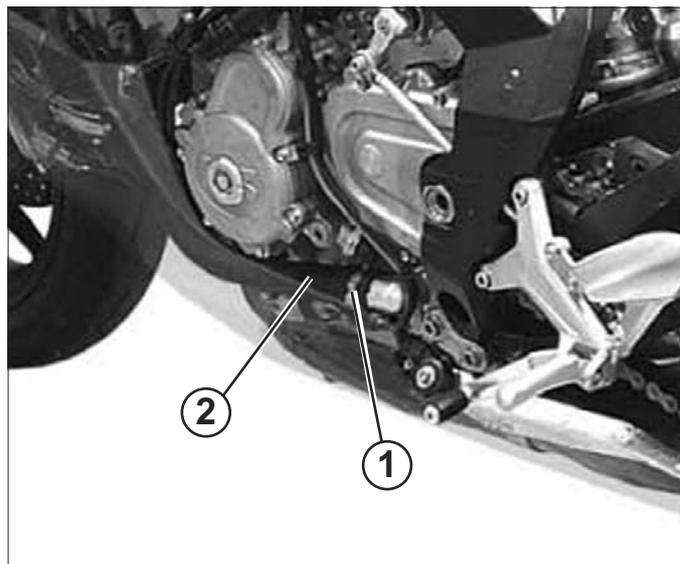
**NOTE** Before carrying out the compression trial, accurately check the battery tension since the compression value which appears is quite influenced by the rotation velocity of the motor, and consequently by the battery tension.



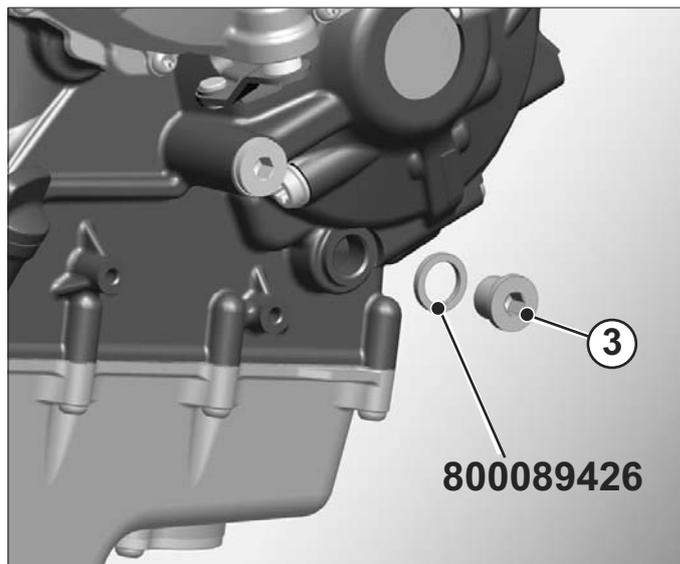
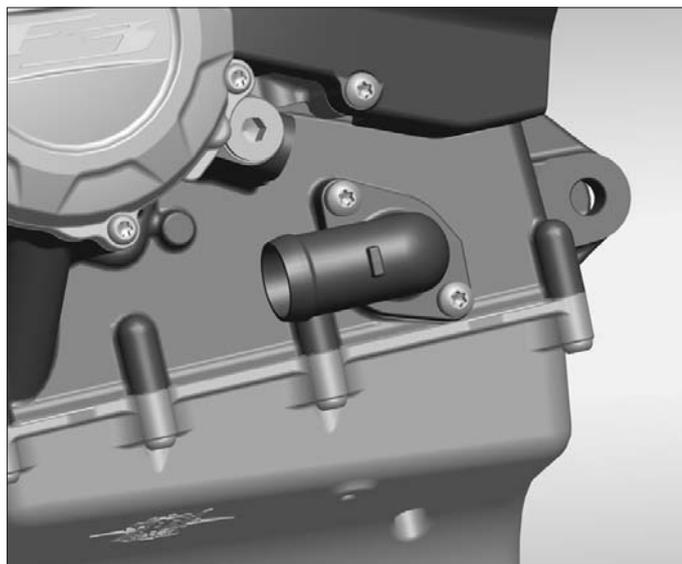
## Draining the coolant circuit

If this operation is performed with the engine fitted on the vehicle, it will be necessary to loosen the strap (1) and disconnect the coolant delivery tube (2) from the radiator to the pump as described in the frame workshop manual.

Place a container under the engine and unscrew the coolant drain cap (3), tilting the engine to aid the drainage. Replace the aluminium washer when refitting (cod. 800089426) and tighten the cap to a torque of 25 Nm with medium-strength thread lock.



B





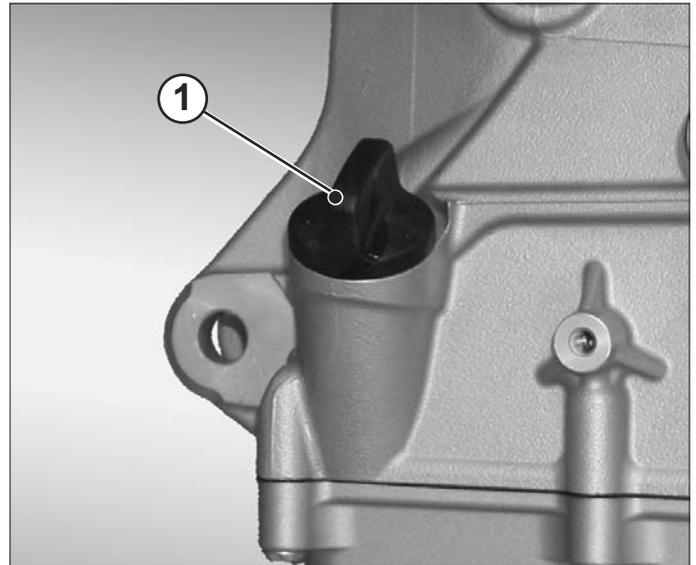
## Changing the engine oil

For replacing the oil, refer to the data in the table.

B

Lubricating system component	Q.ty Litre
crankcase and oil sump	2.75
radiator and hoses	0.25
residual	0.2

Unscrew the oil filler cap (1),

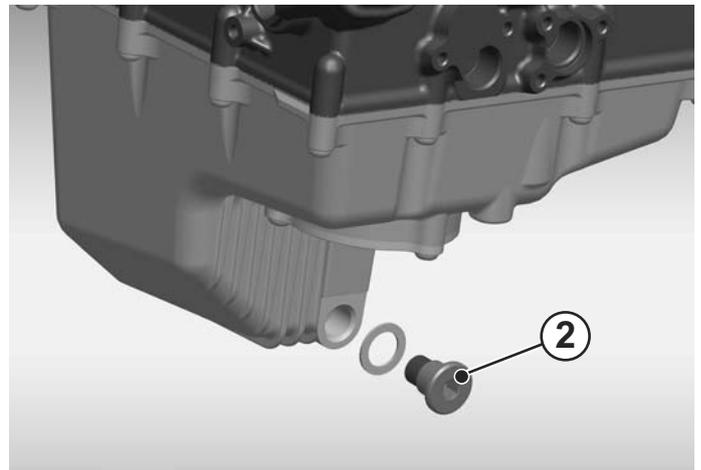


place a container under the engine to catch the used oil and unscrew the oil drain cap (2).

**NOTE** The quantity of oil which drains off from the sump should be about 2.75 L.

**!** To complete the procedure properly it is also recommended to replace the oil contained in the oil radiator.

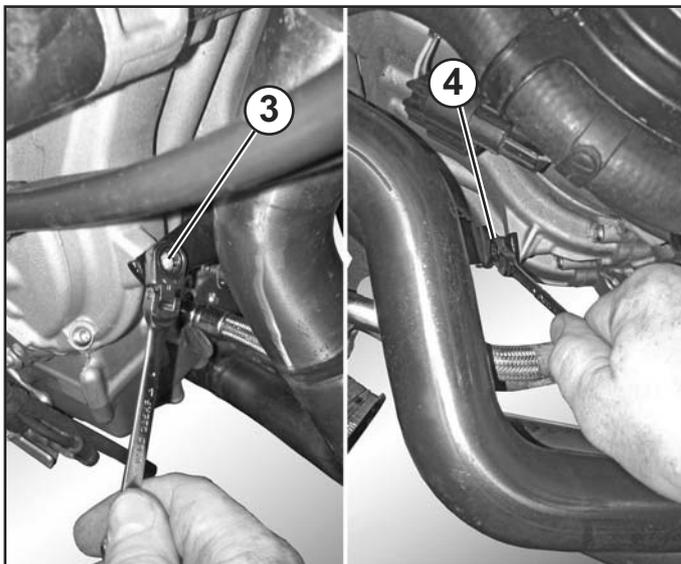
If the engine is installed on the vehicle, it may be necessary to remove the oil radiator.



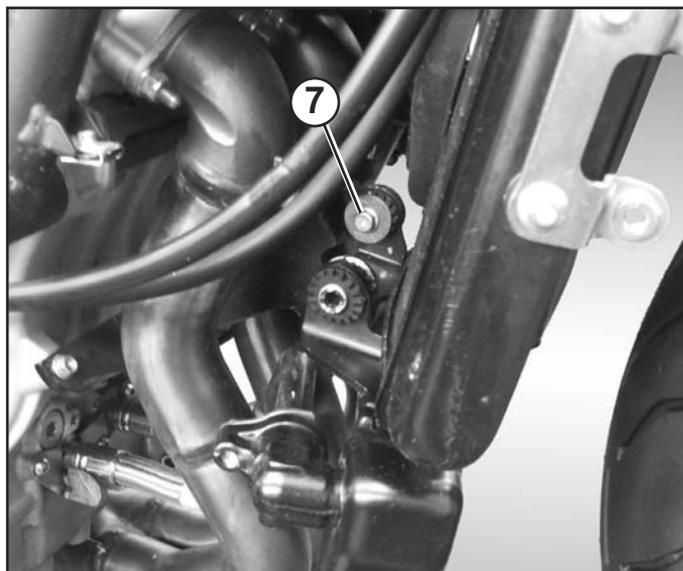
## Removing the oil radiator

Loosen the two screws (3) and (4) that fix the radiators plate.

Remove the screws (5) and (6) that fix the oil radiator to plate and to radiator (coolant).

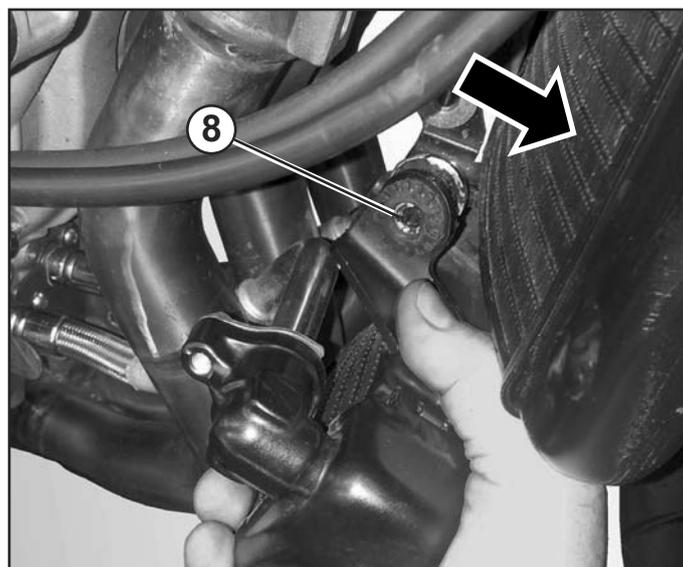


Remove the radiators fixing screw (7).

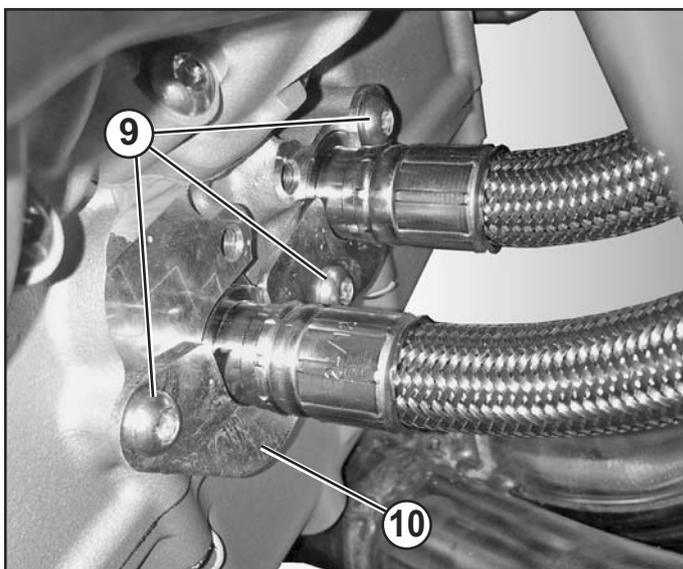


B

Move the radiator slightly towards the front of the motorcycle, then slide the oil radiator from the peg (8) pulling it rightwards.



Unscrew the three screws (8) and remove the retaining plate (9); then, maintaining the oil radiator in lower position than the engine, extract the hoses with the seal rings that will be replaced on refitting.





## Maintenance

Keep the radiator in the indicated position to help it to drain.

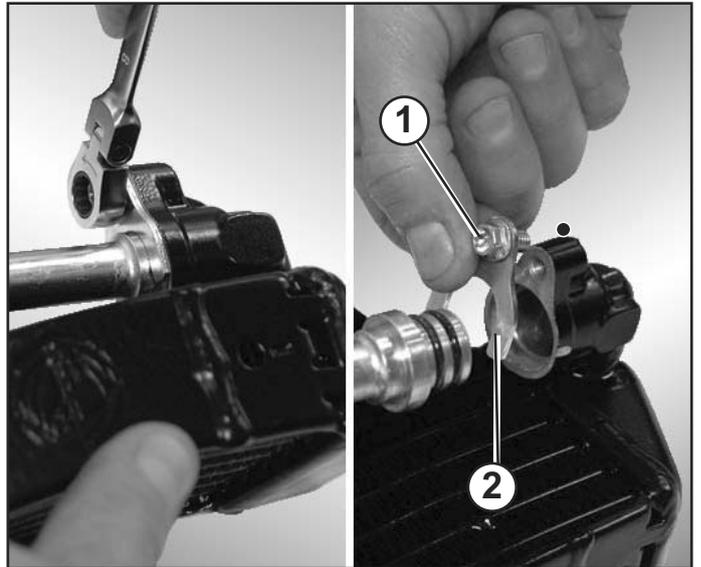
B

**NOTA** The quantity of oil contained in the radiator and hoses is around 0.5 L.



### Oil hoses removal

Remove the 2 screws (1) fastening the retaining plates (2) and extract the hoses from the radiator.



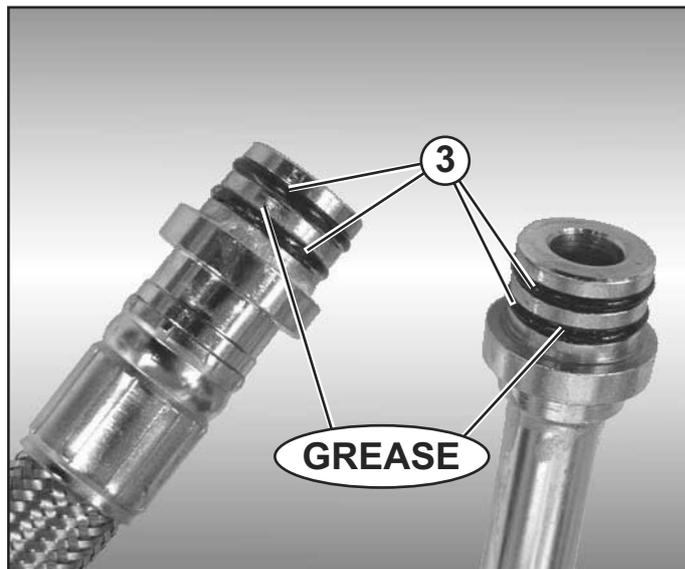
### Radiator check and clean

The dirt and extraneous material embedded in the radiators must be removed. It is recommended to use compressed air for the cleaning of the radiator. Bent fins can be straightened by utilising a small screwdriver



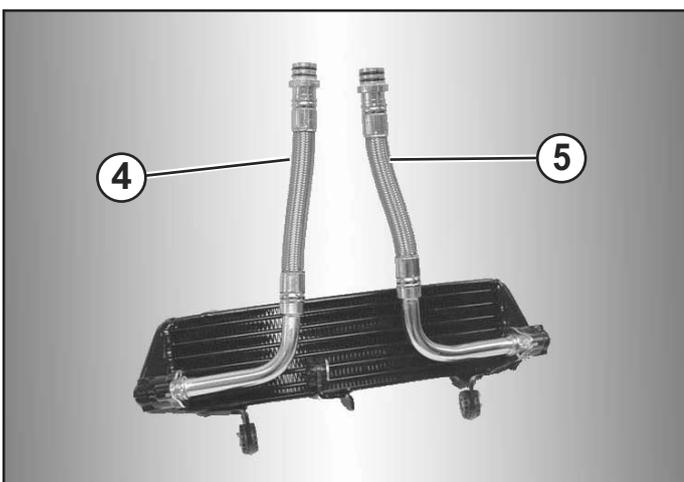
## Refitting

The surfaces should be clean and degreased.  
Always fit new seal rings (3) on the ends of the hoses; these must be greased before refitting.

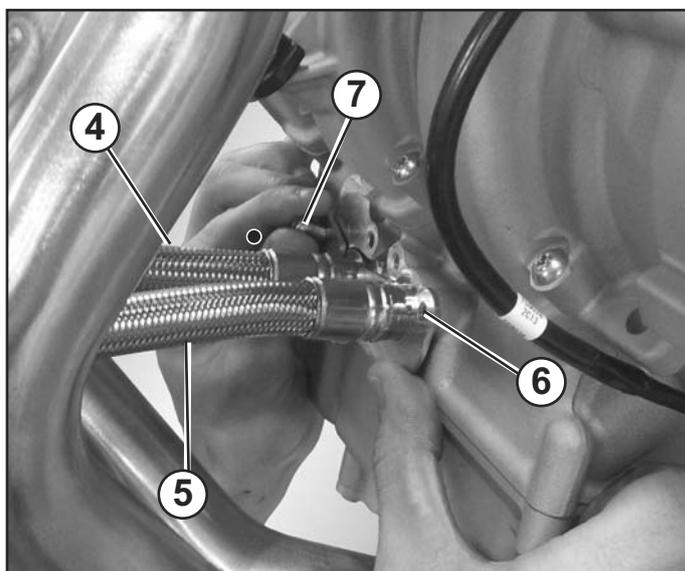


B

Refit the hoses (4) and (5) in the oil radiator with the retaining plates and approach the screws in by hand without tightening them.



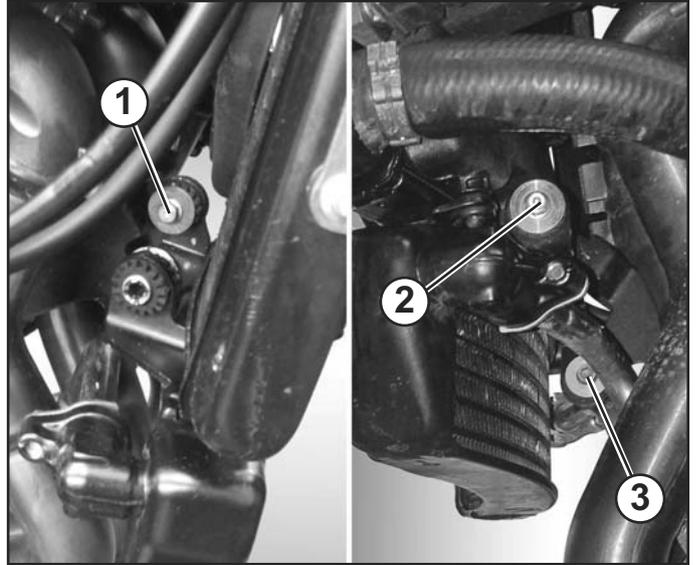
Insert the hoses (1) and (2) with the new greased seal rings in their respective locations in the case.  
Fit the retaining plate (6), screw in the three screws (7) by hand without tightening them.





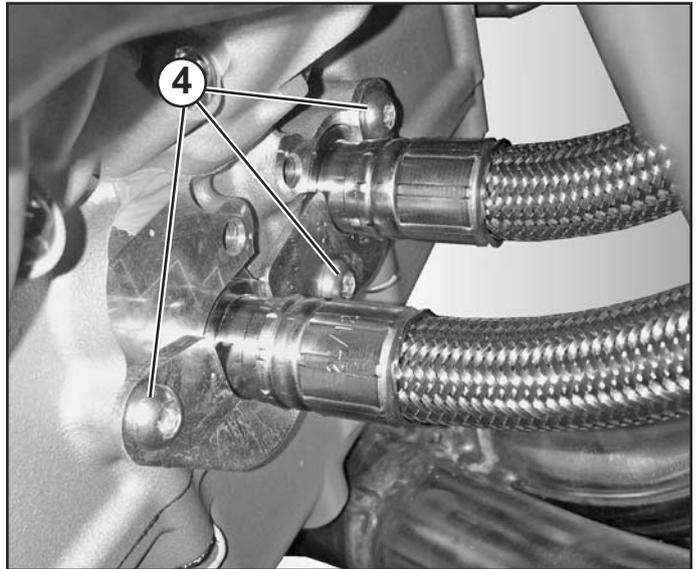
## Maintenance

B in the opposite order it was removed, refit the oil radiator making attention to the correct positioning of the oil hoses and tighten the screws (1, 2 and 3) to the couple of 10 Nm.

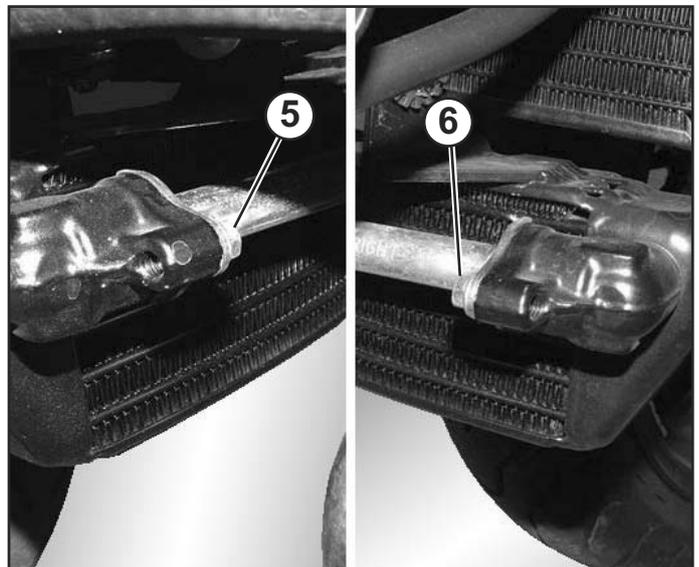


Tighten the screws (4) that fix the retaining hoses to the engine (couple 10 Nm)

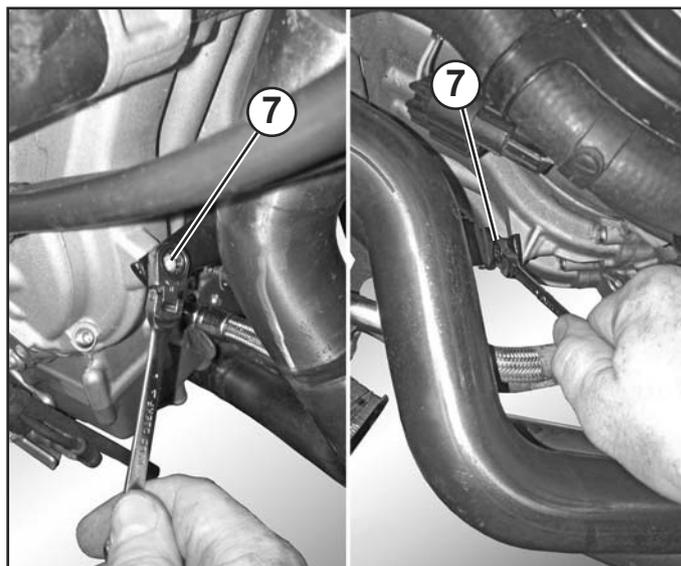
**NOTE** **WARNING:** Do not turn the pipes once the screws have been tightened



Tighten the screws (5) and (6) that fix the oil hoses retaining plates on to the oil radiator to a couple of 10 Nm.



Tighten the two screws (7) that fix the radiators plate on engine to a couple of 10 Nm.



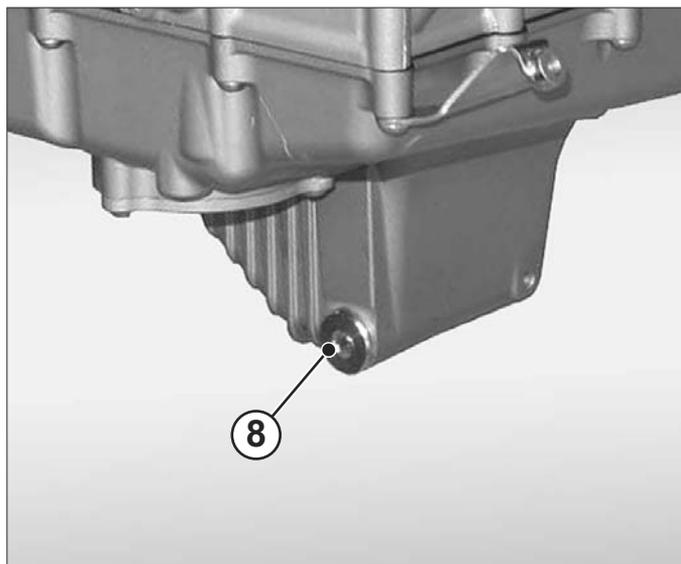
B

### Filling the oil circuit

Refit the drain plug (8) with a new washer and tighten to a couple of 25 Nm.

Fill with eni i-Ride moto2 5W-40 engine oil, referring to the quantities given in the table below the operation performed.

Lubricating system component	Q.ty Litre
crankcase and oil sump	2.75
radiator and hoses	0.25
residual	0.2

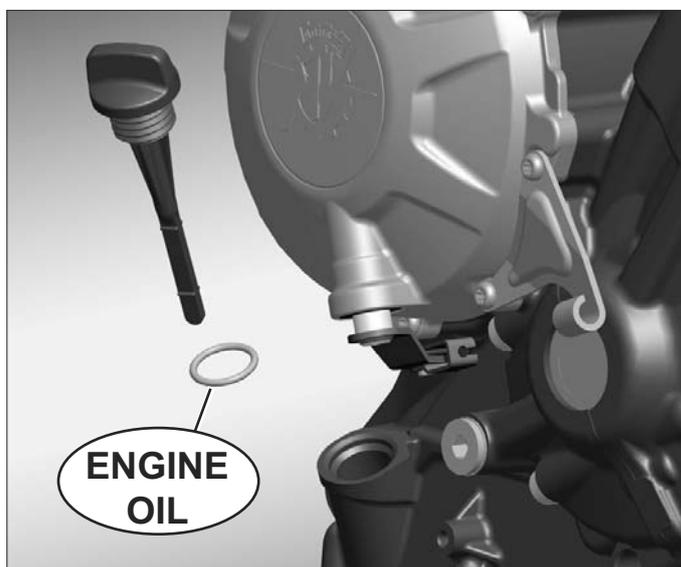


Close the cap with its seal ring.



**Do NOT start the engine after filling. It is necessary to turn the engine over for a few seconds so that the oil passing through the pump reaches all the points requiring lubrication.**

Follow the instructions given on the following page to perform this operation.



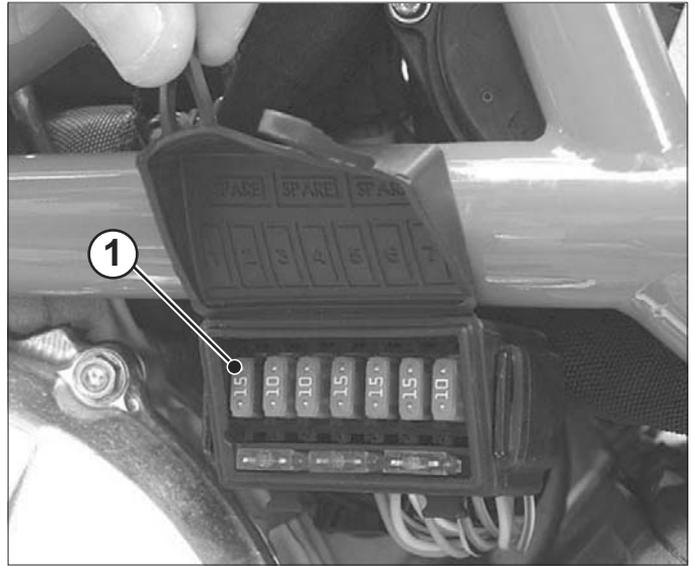


## Maintenance

Remove fuse no. 1 for the fuel pump and coils.

Turn the key to the RUN position and,

**B**



keeping the clutch lever in, press the start button twice for approx 4 seconds each time.

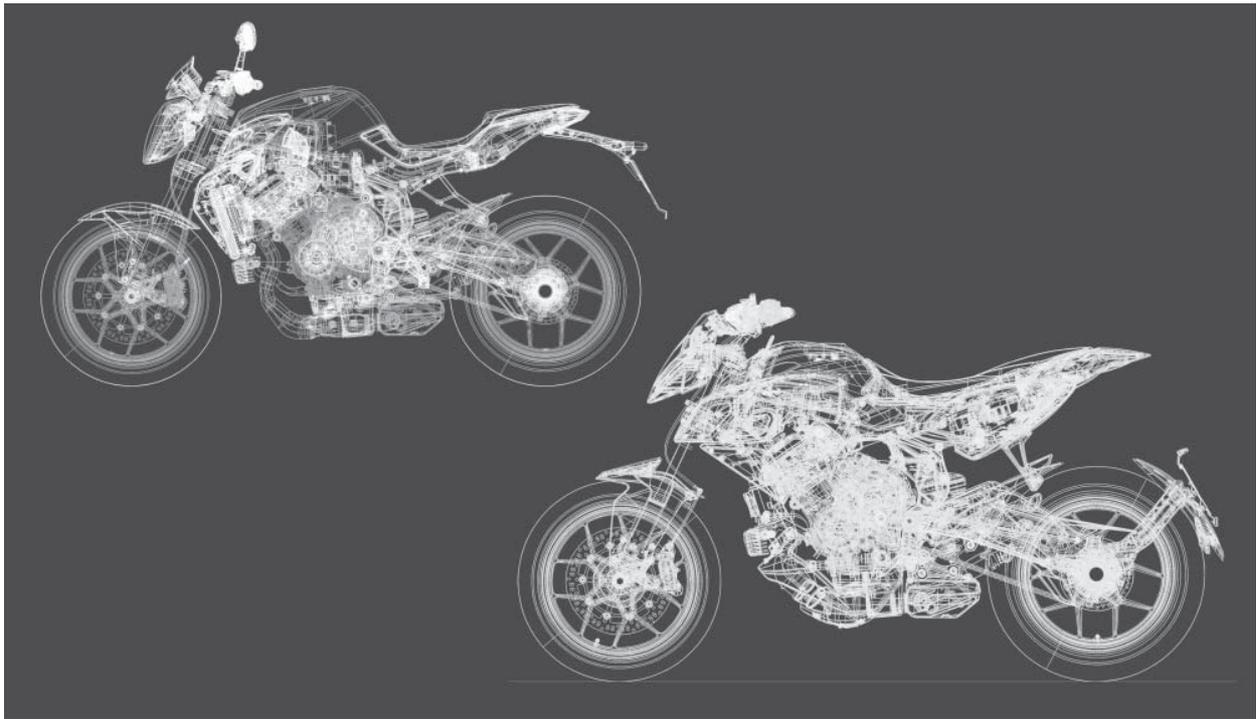
Turn the key to the OFF position and refit fuse no. 1 in its holder.



Unscrew the oil filler cap and check that the level is between the min and max marks.

Top up if necessary.





C

## SECTION C

REVISION 0



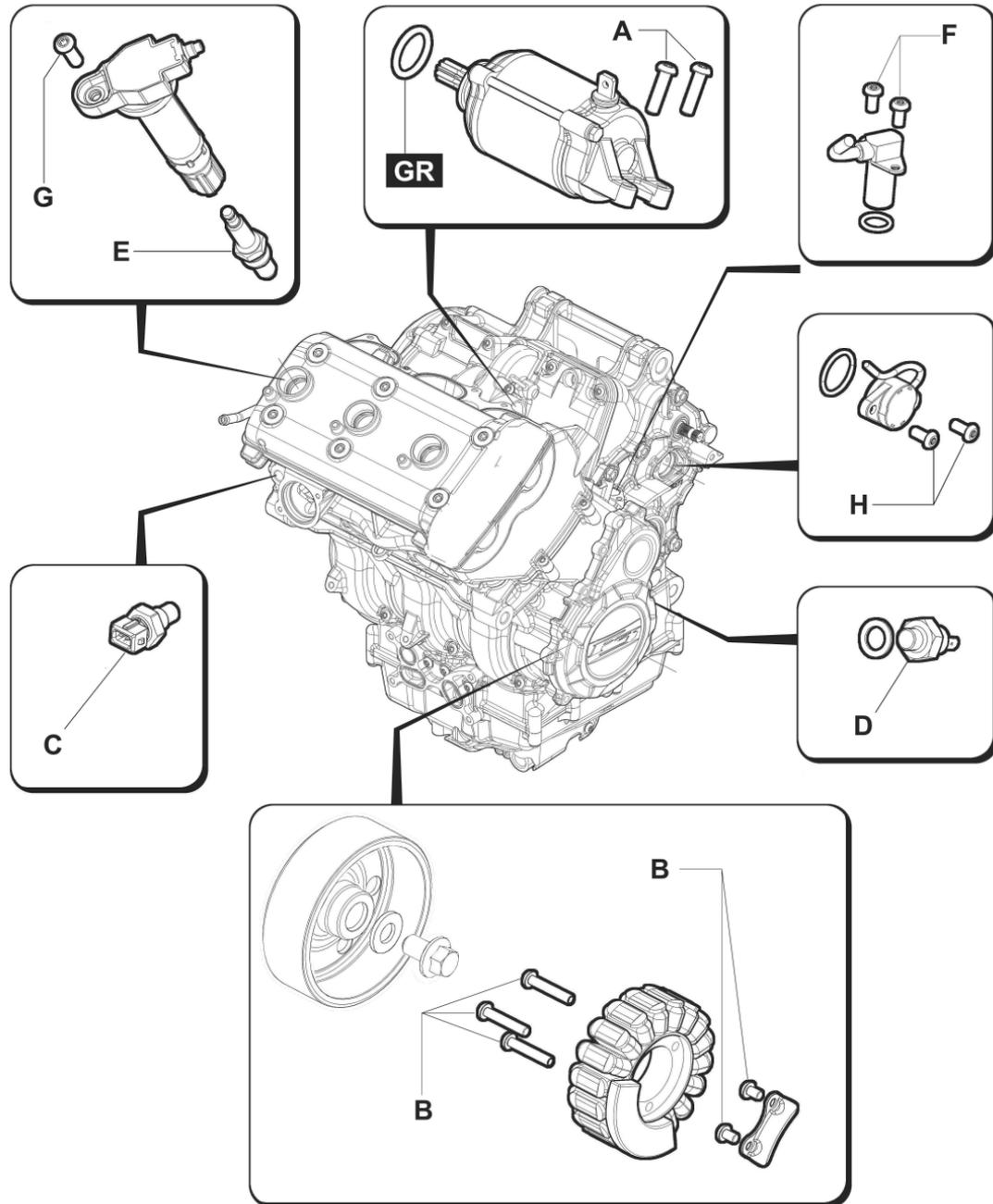
# Electrical components

## SUMMARY

C

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Alternator .....	Page	4
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<b>COILS</b> .....	<b>Page</b>	<b>6</b>
Coolant temperature sensor .....	Page	8
Gear sensor .....	Page	8

## ELECTRICAL COMPONENTS



Tightening torques	Nm	A	B	C	D	E	F	G	H	I	L
		10	10	22	22	12	6	8	6		
Thread blockers		medium	medium	medium	medium		medium				

<b>OIL</b>	Apply motor oil	<b>SS</b>	Apply silicone sealing
<b>NO OIL</b>	Do not apply neither oil nor other types of substances	<b>HSC</b>	Apply HSC Molikote
<b>GR</b>	Apply grease	<b>M</b>	Apply mastic for gaskets



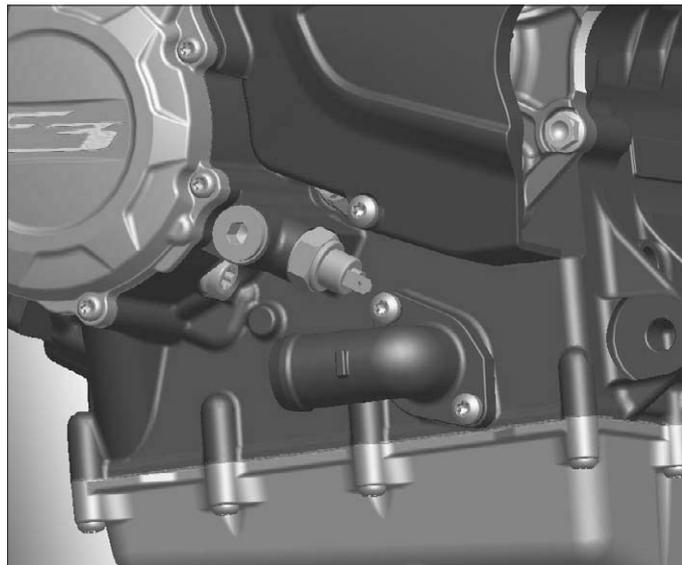
## Electrical components

### Engine oil pressure sensor

Remove the connector and check (with a cold engine) that there is no continuity between the pole of the sensor (1) and the engine mass.

Otherwise, replace the sensor.

Apply a medium strength thread-locking compound on the thread of the sensor and tighten to a torque of 22 Nm.



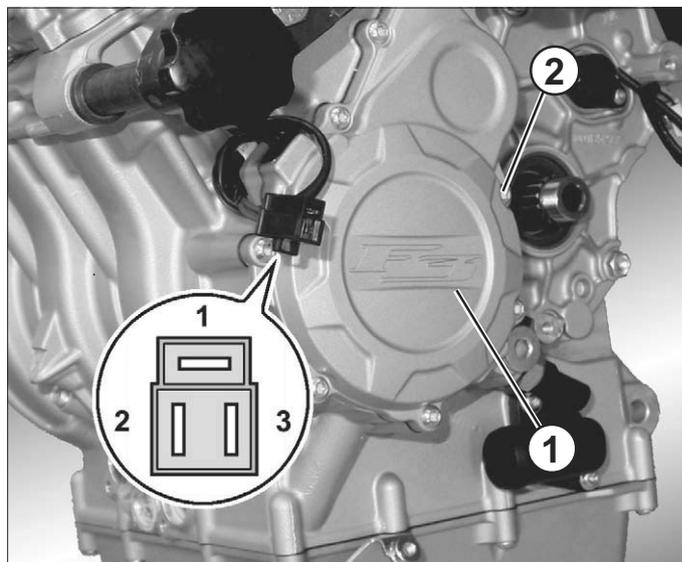
### Alternator

Check:

For this operation it is sufficient to disconnect the connector of the alternator from the system.

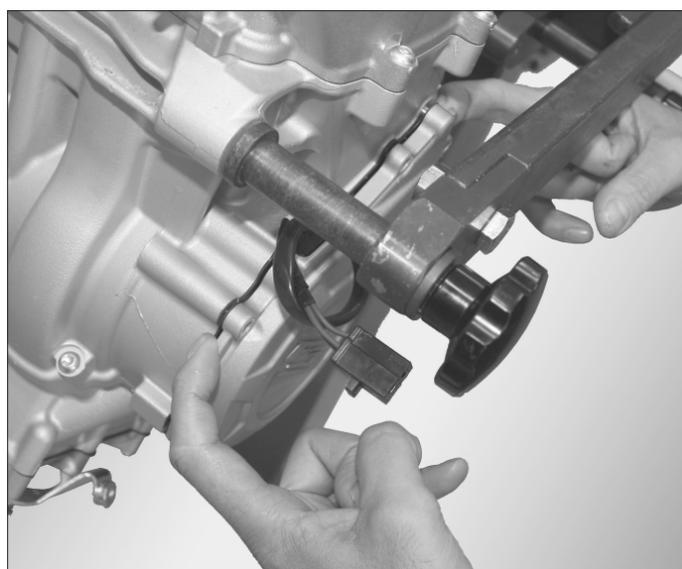
Switch the tester to Ohm and check that when the poles are connected two by two, there is an impedance of 0.2 Ohm

Switch the tester to continuity and check that there is no continuity between each pole and the engine mass.

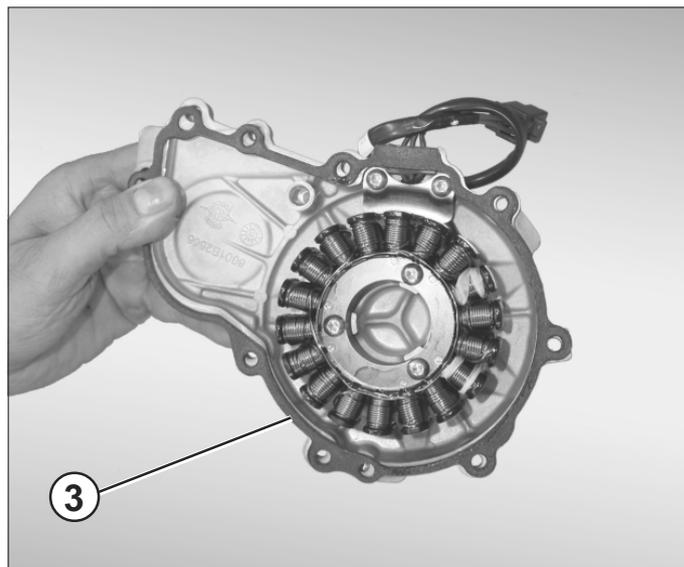


Removal and Assembly:

remove the cover (1) of the phonic wheel (and the alternator) by undoing the 8 screws (2), together with the gasket.



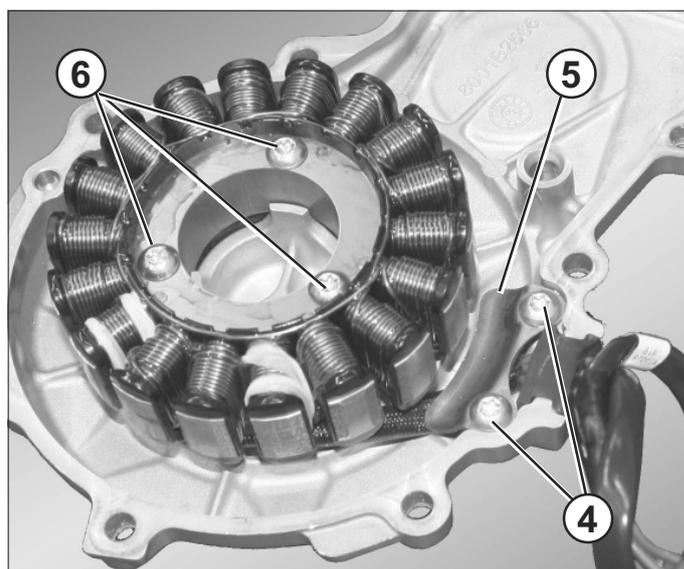
Remove the gasket (3), taking care not to damage it.



Remove the two screws (4) and the cable retaining plate (5).

Remove the stator from the cover by unscrewing the three screws (6).

Refit, paying attention that the cable is correctly positioned and tightening the screws to the required torque with medium-strength threadlocker.



## Starter motor

- Check:

Using the tester, check that there is continuity between the positive pole (7) and the engine mass. Otherwise replace the starter.

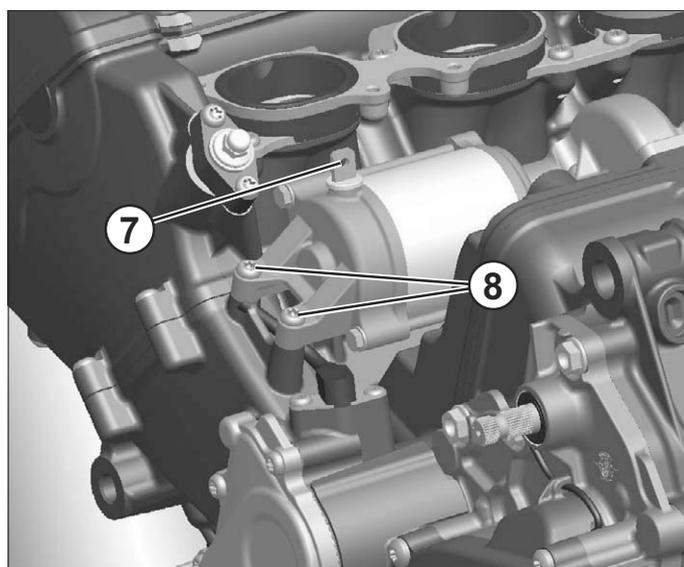
- Removal:

Remove the two fixing screws (8). Pull out the starter motor, taking care not to damage the O-Ring on the shaft.

- Assembly:

Evenly grease the O-ring and re-assemble to the shaft.

Re-assemble the starter motor on the engine block. Insert the two screws (8) by hand, then tighten to the prescribed torque.





## Electrical components

### PICK-UP

Use a tester to check that the impedance value between the negative and positive poles of the pick-up connector is that given in the table.

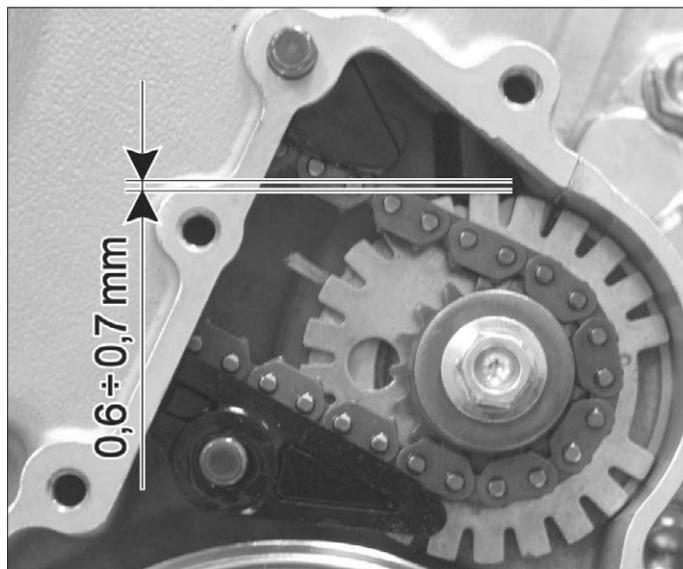


### PHONIC WHEEL GAP

To ensure correct operation of the pick-up it is necessary to measure the gap between it and the phonic wheel using a feeler gauge as shown in the figure.

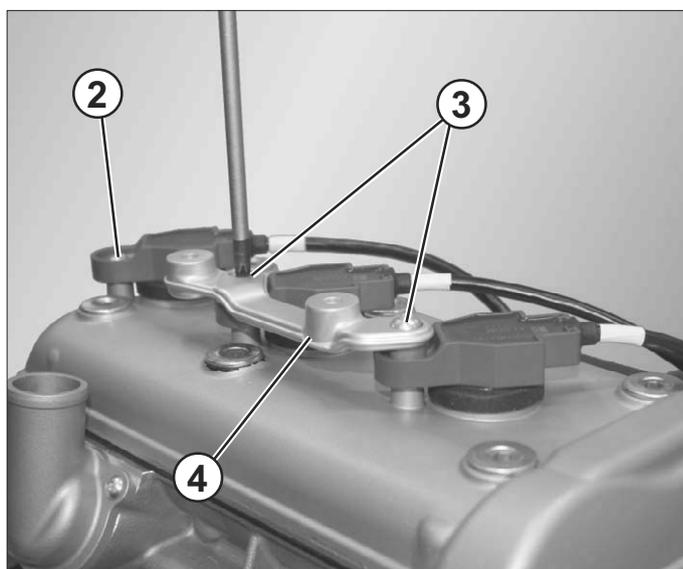
Gap value: 0.6 - 0.7 mm.

The cover on the phonic wheel must be removed (Sec.D pag.6) to perform this procedure.



### COILS

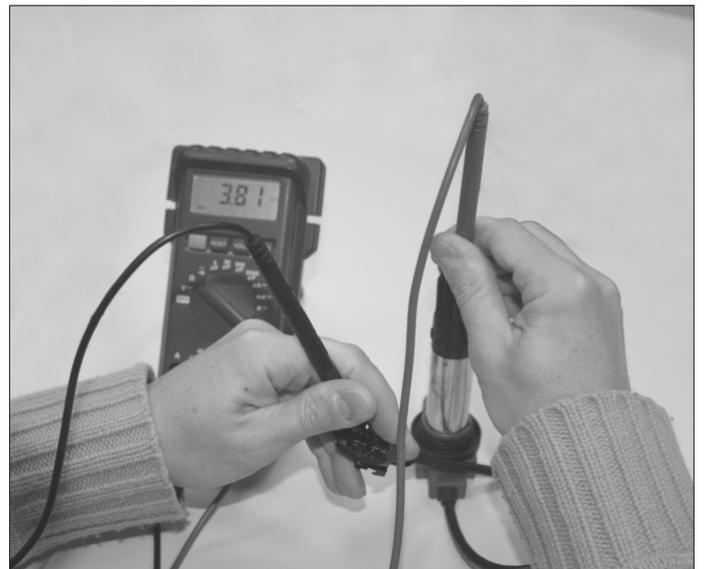
Remove the coil fastening screw (2) and the two screws (3) fastening the coils and the filter case support plate (4).



Detach the coils.



Use a tester to check that there is an impedance value of  $3.8 \text{ K}\Omega \pm 10\%$  between pole no. 2 of the connector and the high-voltage positive of each coil.



Place the terminals of the tester between poles no. 1 and 2 of the coil connector and check that the impedance value is  $1 \Omega \pm 10\%$ .



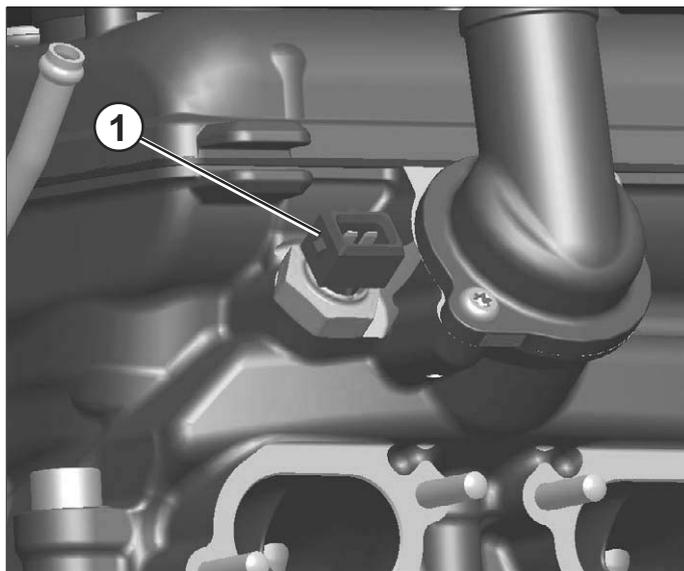


## Electrical components

### Coolant temperature sensor

Remove the sensor (1) and check the impedance values between its poles with reference to the table.

TEMP. °C	RESIST. Ω	TEMP. °C	RESIST. Ω
- 40	100,950	+ 40	1,598
- 30	53,100	+ 50	1,150
- 20	29,121	+ 60	0,746
- 10	16,599	+ 70	0,565
0	9,750	+ 80	0,377
+ 10	5,970	+ 90	0,275
+ 20	3,747	+ 100	0,204
+ 25	3,000	+ 110	0,153
+ 30	2,547	+ 125	0,102



Refit the sensor, tightening it to a torque of 22 Nm using medium-strength thread-locker.

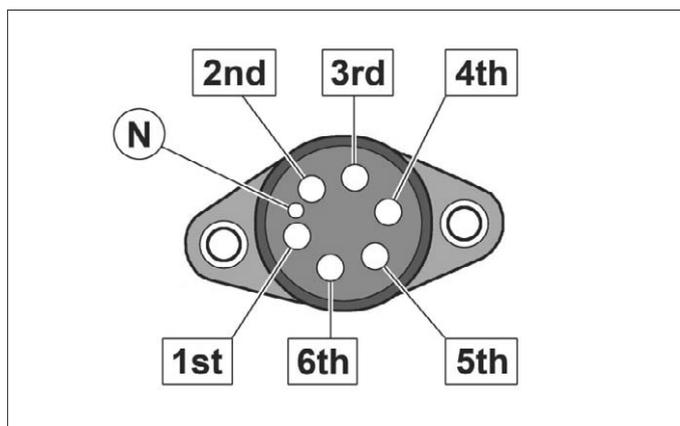
### Gear sensor

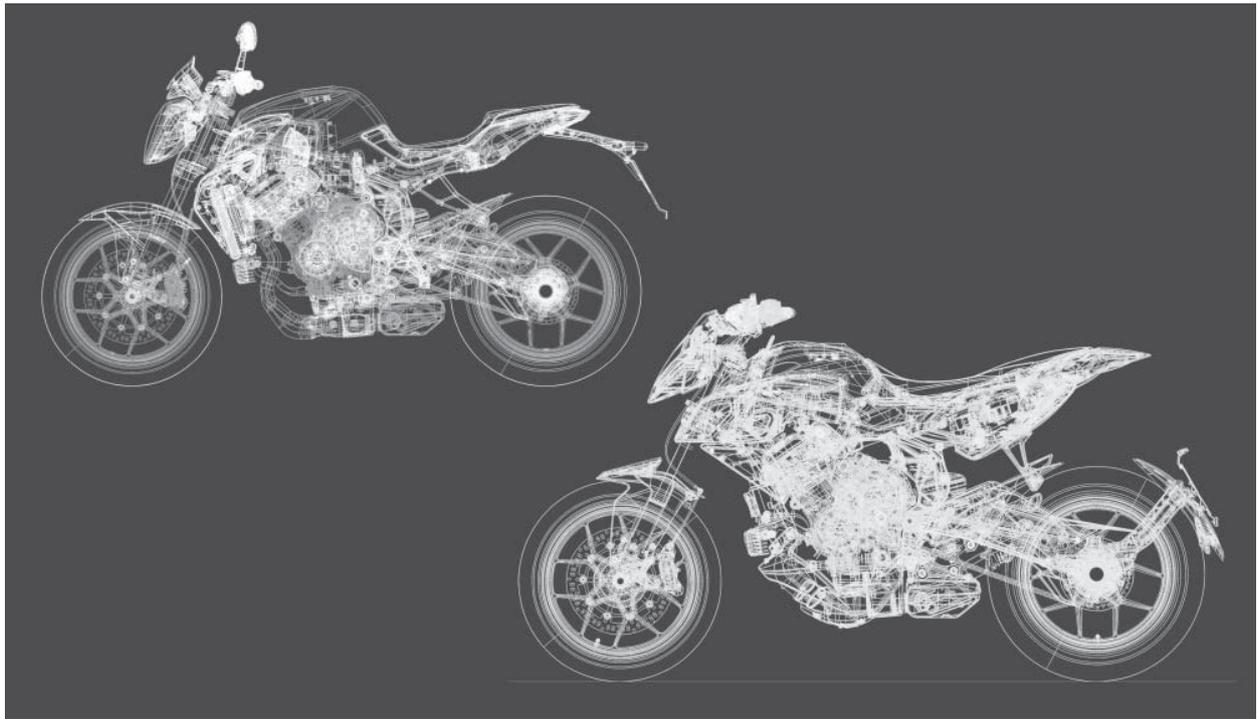
- Check:

Remove the sensor and use a tester to check that the impedance values between the pole of the connector (OUT) and the sensor contacts are as listed in the table.



POLES		Impedance
OUT	N	15400 ± 150,4 Ω
	1st	6650 ± 66,5 Ω
	2nd	3650 ± 36,5 Ω
	3rd	2210 ± 22,1 Ω
	4th	1330 ± 13,3 Ω
	5th	732 ± 7,3 Ω
	6th	316 ± 3,2 Ω





D

# SECTION D

REVISION 1



# Head

## SUMMARY

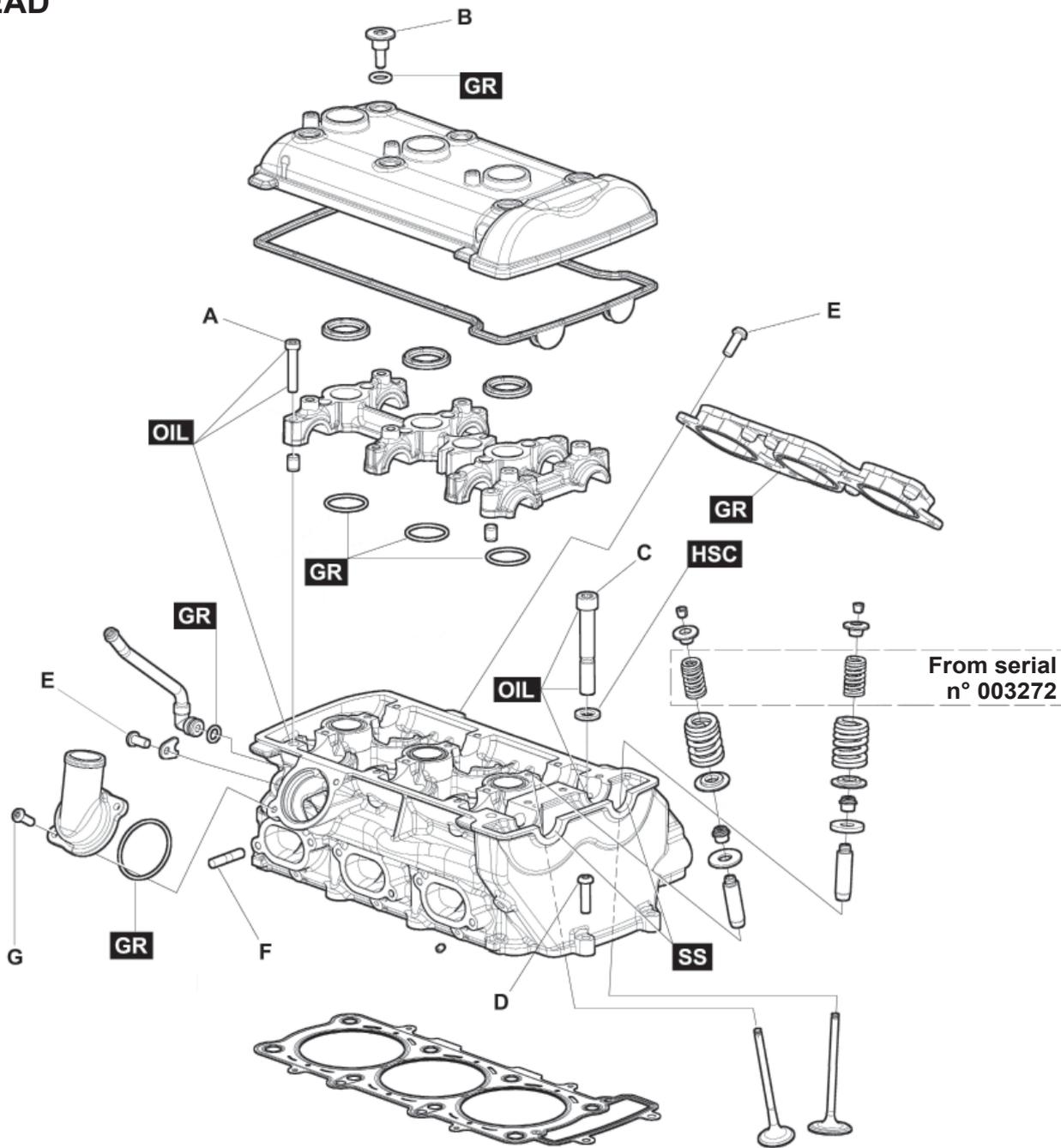
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Removing alternator cover .....	Page	6
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D

## HEAD



Tightening torques		A	B	C	D	E	F	G	H	I	L
	Nm	12	8+10	10+85°	10	10	10	10	6-8		
Thread blockers						medium	sealant	medium			

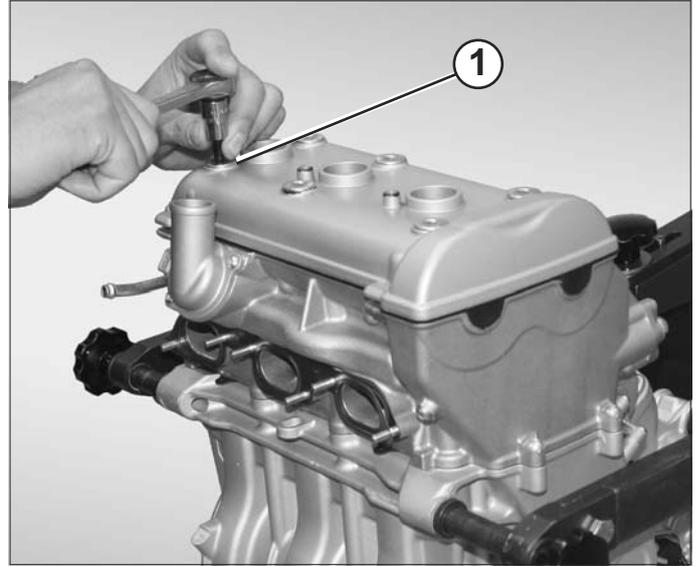
<b>OIL</b>	Apply motor oil	<b>SS</b>	Apply silicone sealing
<b>NO OIL</b>	Do not apply neither oil nor other types of substances	<b>HSC</b>	Apply HSC Molikote
<b>GR</b>	Apply grease	<b>M</b>	Apply mastic for gaskets



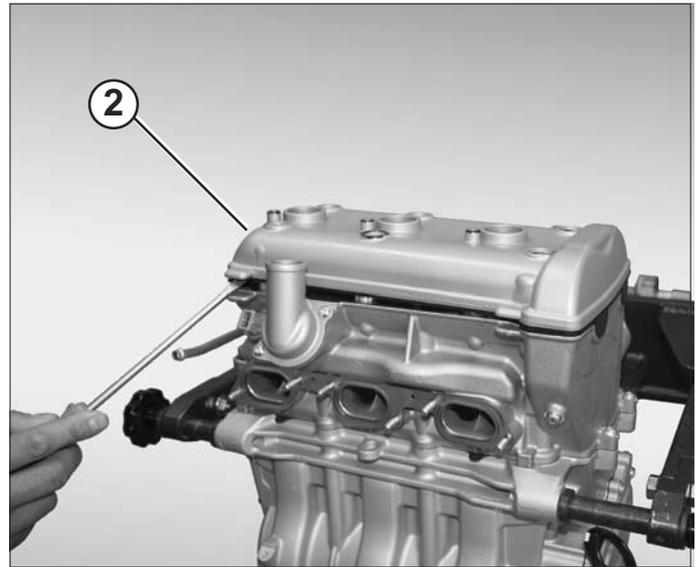
## Head

### Removing head cover

Remove the 6 fastening nuts (1)



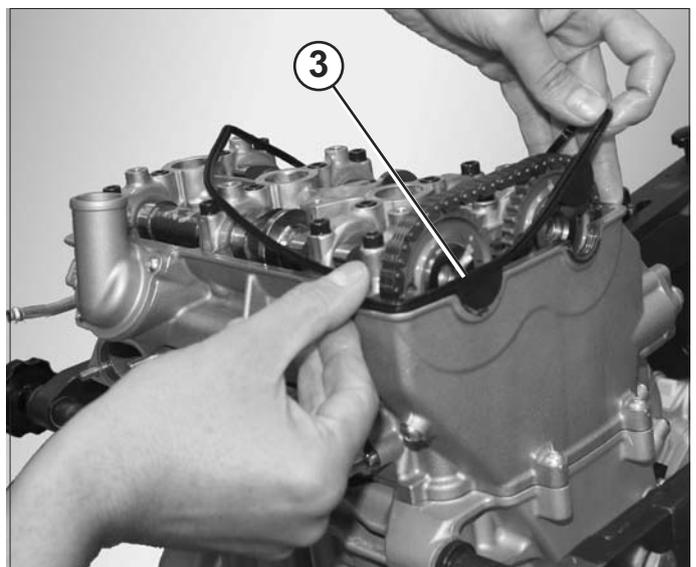
and remove the head cover (2), being careful not to damage the gasket .



Remove the seal (3).



**When refitting, it is essential to apply silicon sealant as shown in the figure at the beginning of the chapter.**

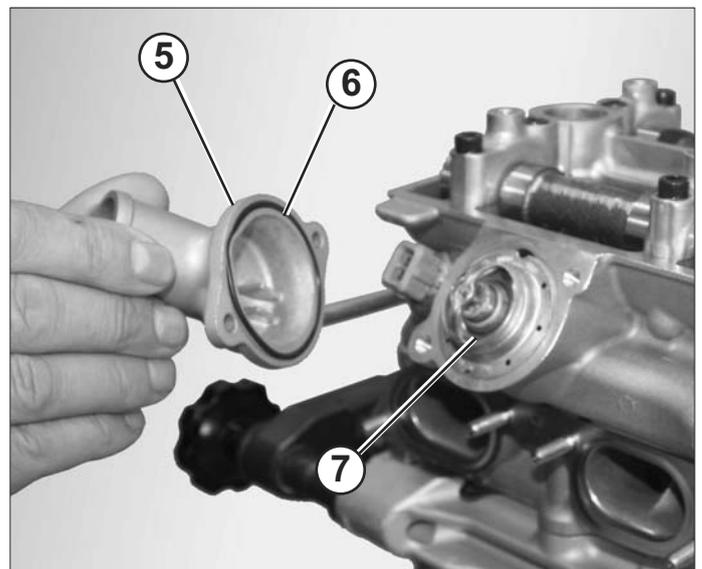


## Removing thermostat cover

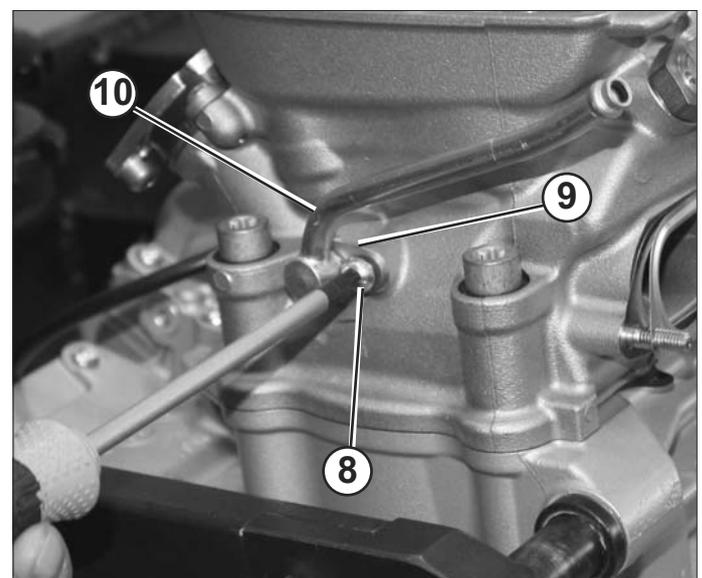
Remove the two screws (4) fixing the thermostat cover.



Remove the cover (5), the gasket (6) and the thermostat (7).



Remove the screws (8) with the retaining plate (9) and extract the degassing tube (10).



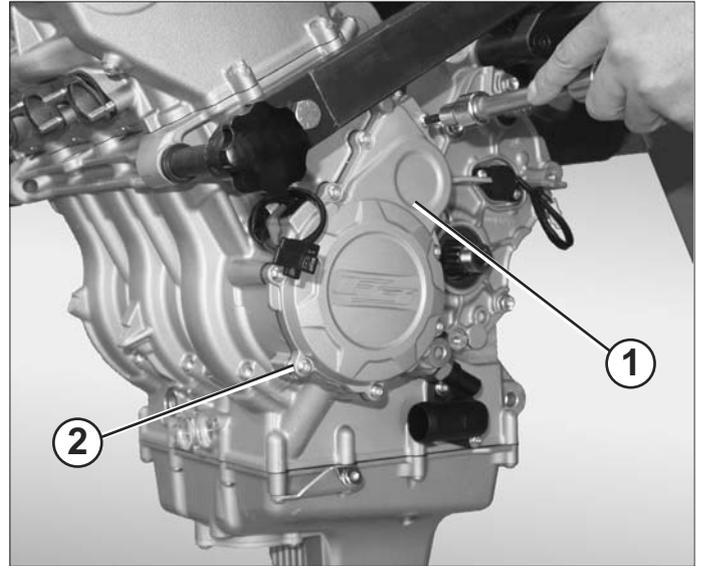


## Head

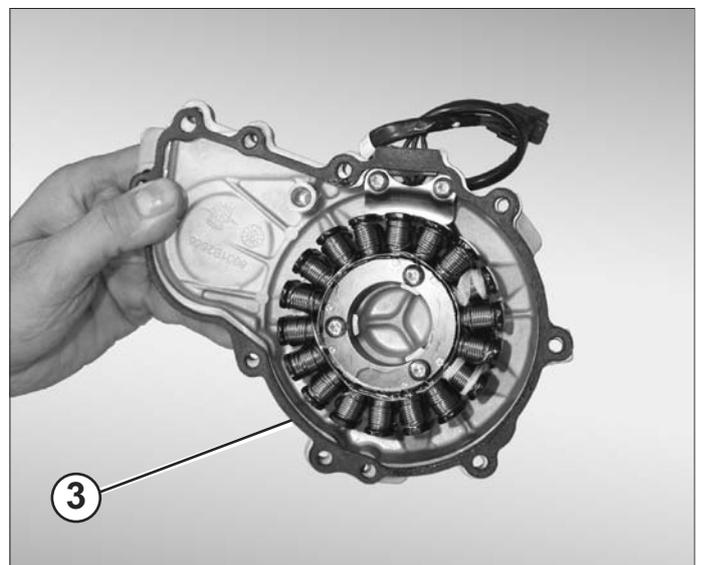
### Removing alternator cover

From the left-hand side of the engine, remove the cover (1) of the phonic wheel (and the alternator) by undoing the 8 screws (2), together with the gasket (3).

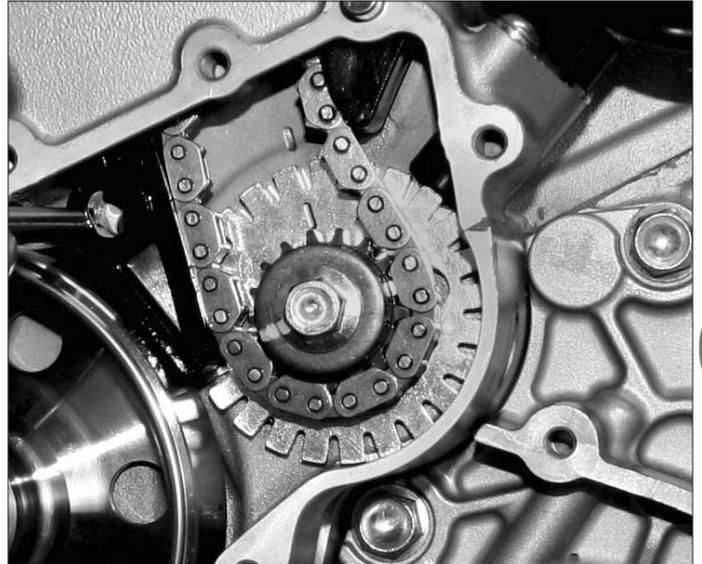
D



Put the cover away in a location away from moisture and dust.

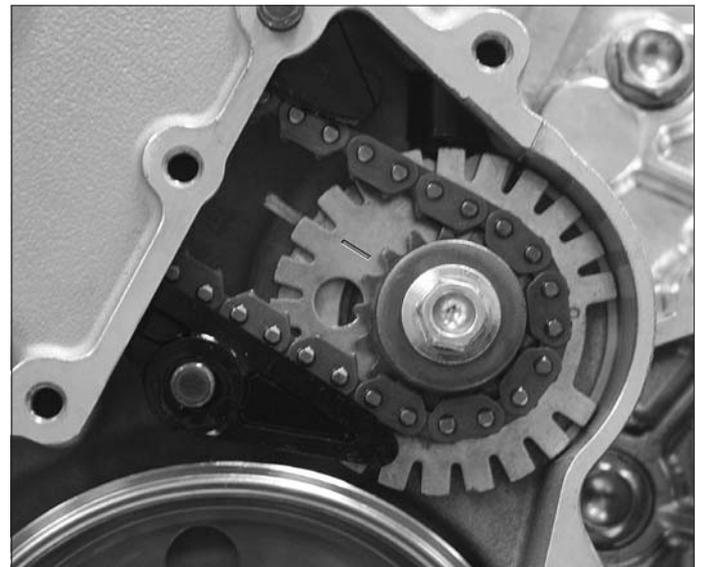


Turn the crankshaft by turning the alternator nut with a 19 mm socket wrench until piston no. 3 reaches TDC in the exhaust-intake phase.



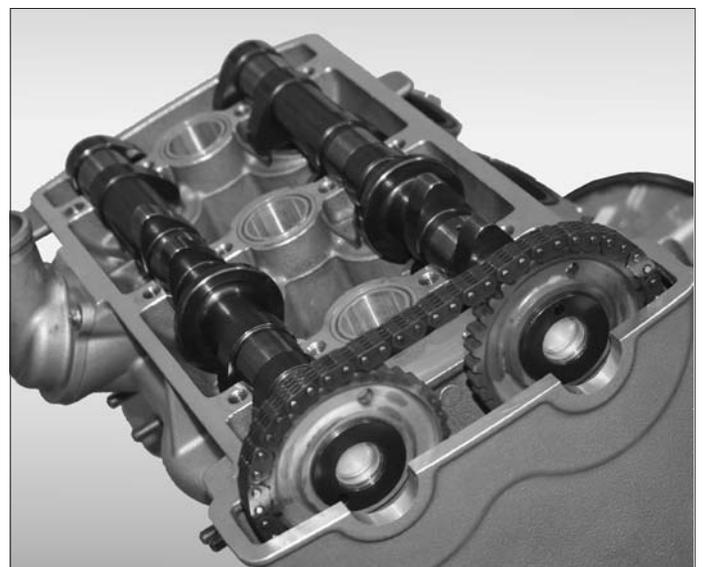
D

In this position the “M” notch on the phonic wheel is lined up with the reference notch on the crankcase.

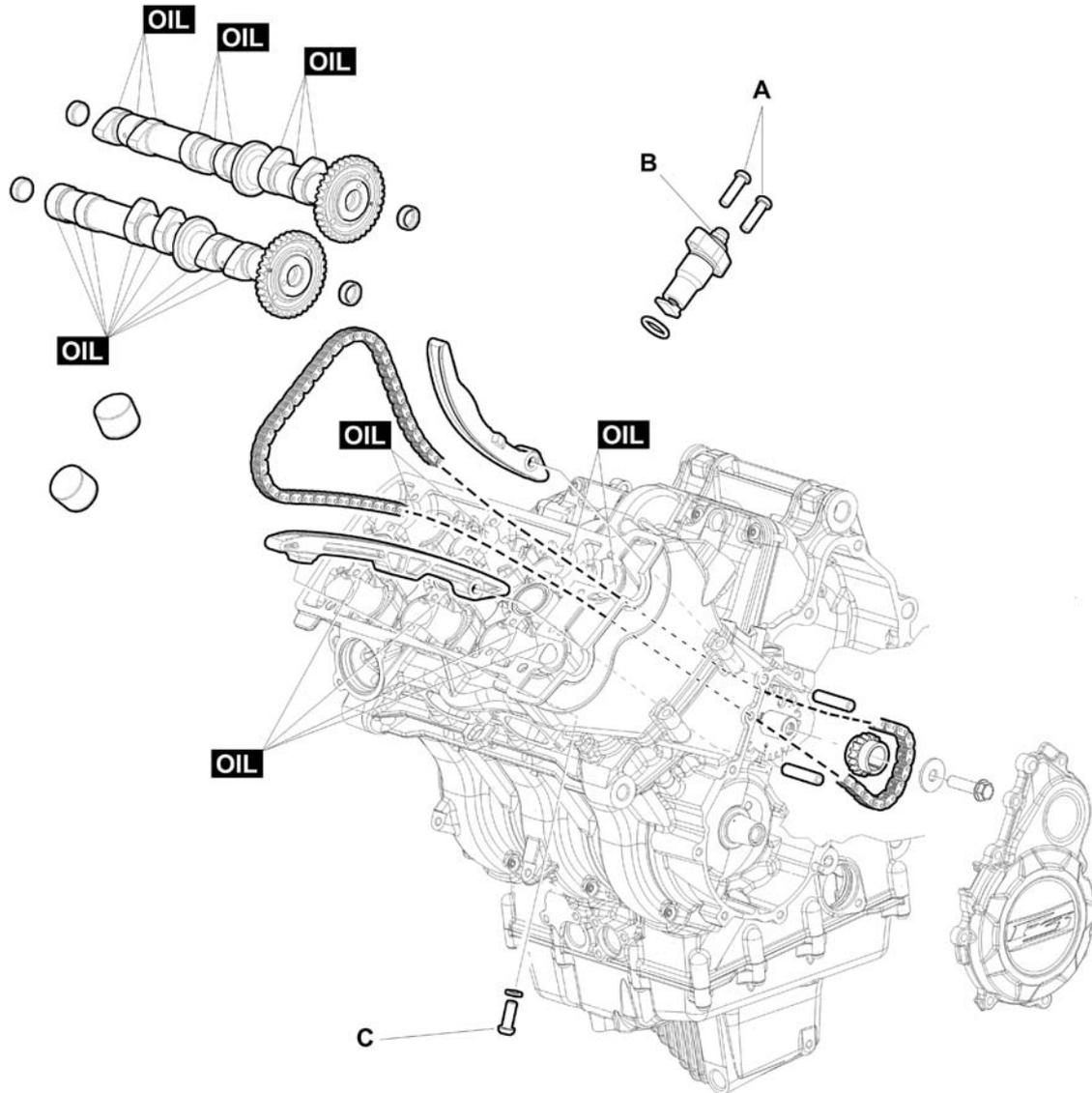


The reference notches on the control wheels of the cam shafts are in horizontal position and positioned externally.

**NOTE** In this position the minimum pressure is obtained from the valve springs on the camshafts, serving to facilitate removal and refitting operations.



## DISTRIBUTION CONTROL UNIT



Tightening torques		A	B	C	D	E	F	G	H	I	L
	Nm	8	12	8							
Thread blockers			medium								

<b>OIL</b>	Apply motor oil	<b>SS</b>	Apply silicone sealing
<b>NO OIL</b>	Do not apply neither oil nor other types of substances	<b>HSC</b>	Apply HSC Molikote
<b>GR</b>	Apply grease	<b>M</b>	Apply mastic for gaskets

## 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.

Remove the pad's screw.



D



Disassembly the chain tensioner and check the correct working of each part.

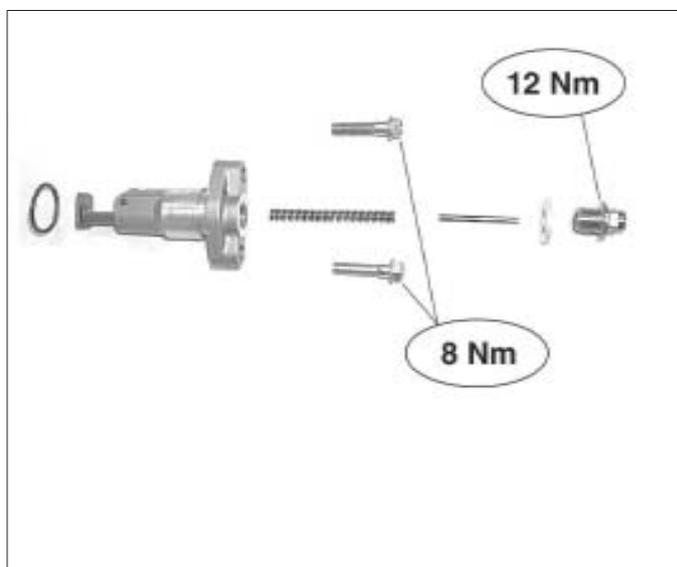
The internal pin must run clearly and the inner spring must give a quick response.

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 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 12 Nm torque.

Acting this way the chain tensioner is adjusted.

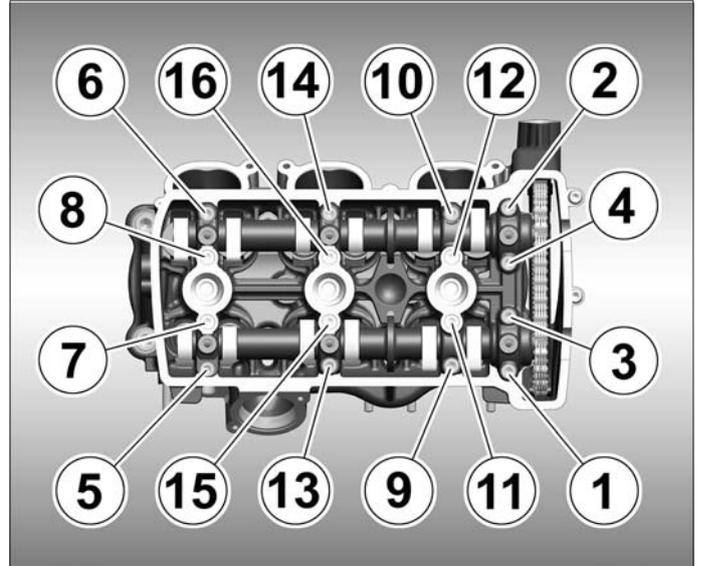




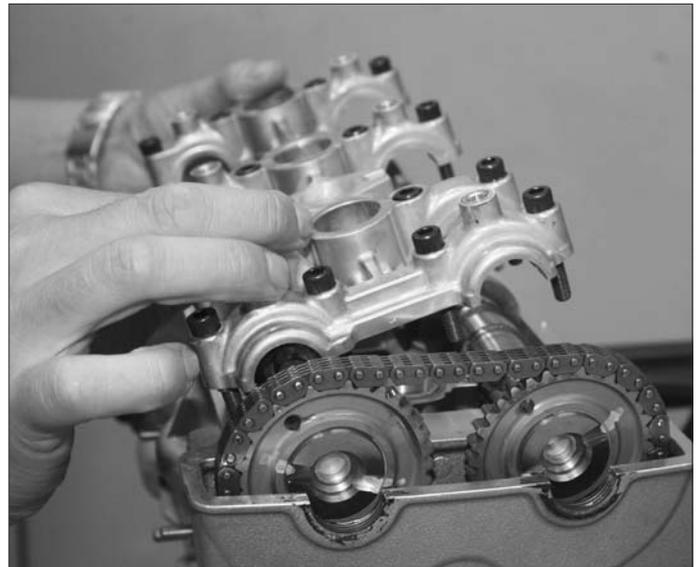
## Head

### Removing the valve gear components

Firstly remove the outermost screws of the camshaft head following the indicated scheme in order to balance the pressure exerted by the valve springs.



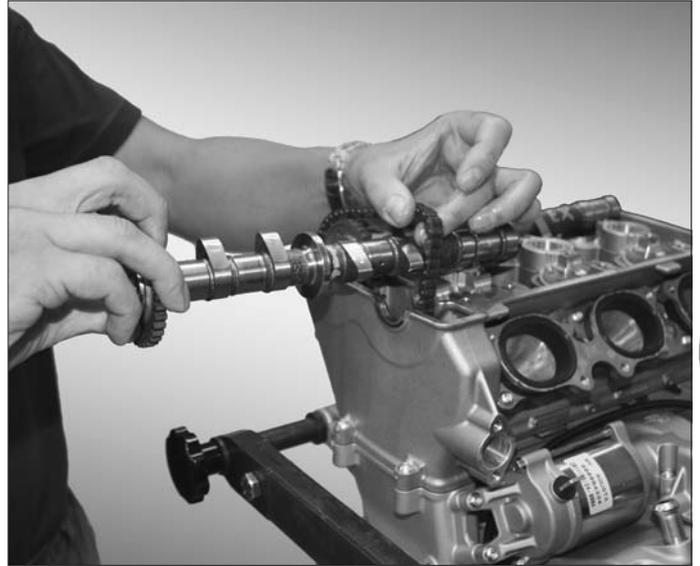
Removing the shaft head.



Release the distribution chain.



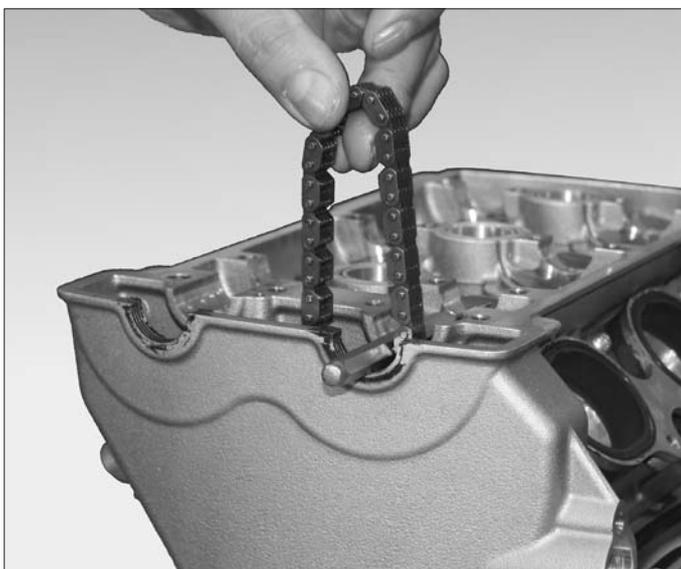
First remove the intake side camshaft.



Sustain the distribution chain and remove the exhaust-side camshaft.

Support the distribution chain with a metallic bar in order to get it back in the following operations.

Extract the two spacers by using a screw M8 as shown in the figure.





## Head

Remove the seal rings, taking care not to damage them.



### D

#### Dismantling the head

Unscrew the 10 fastening screws of the head, starting with the external ones and working inwards, working in diagonal pairs.



Remove the head and place it onto a clear place.

Avoid placing the head upside down.

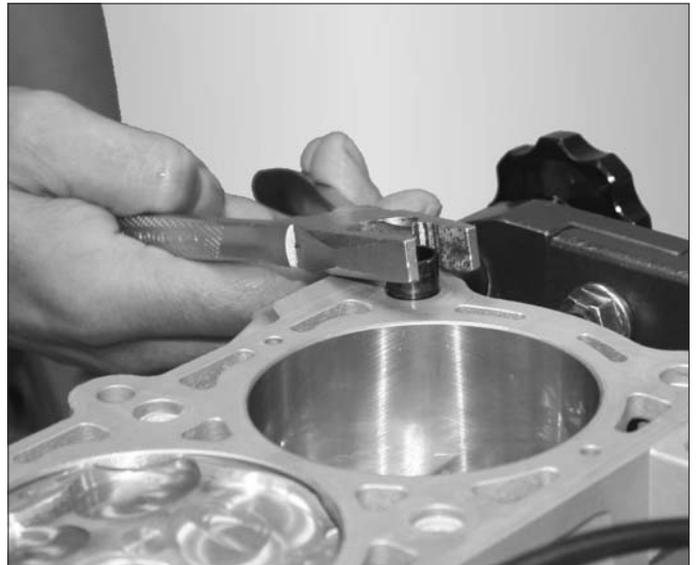


Remove the gasket which will be replaced on refitting if necessary.

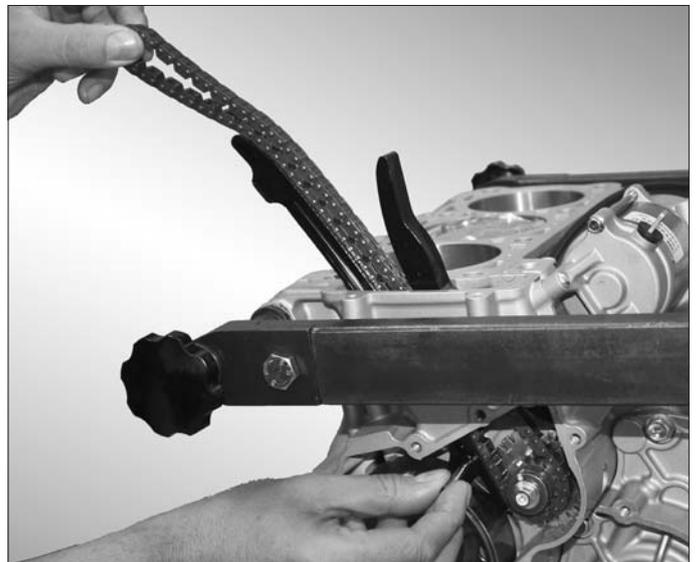


D

Remove the two blocking rings.



Remove the first link block for the distribution chain by undoing the fastening pin. If it should be necessary to replace the distribution chain at the expected mileage (see the scheduled maintenance table), it is advisable to also replace the camshafts. When refitting, thoroughly clean all surfaces.



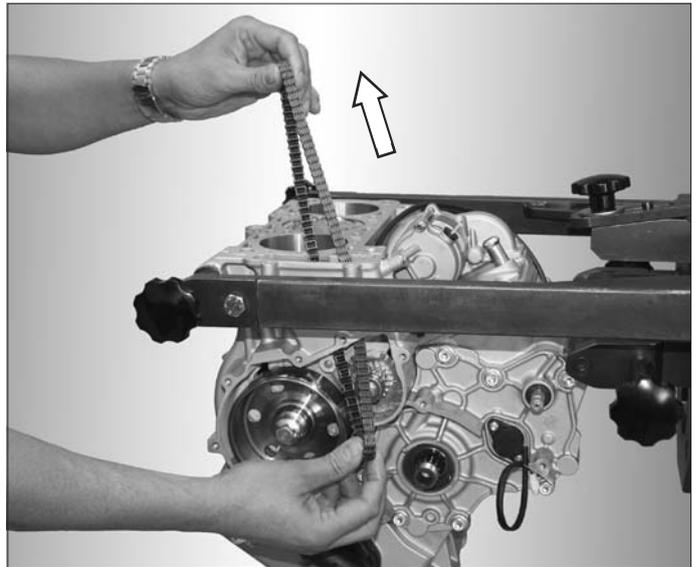


## Head

Remove the sliding block by extracting the fastening pin.



Extract the distribution chain.



### Inspection of the head group

Remove carbon deposits from the combustion chambers. Clean away eventual encrustments from the canalizations of the cooling liquid. Check to be sure that there are no cracks and that the holding surfaces are free of crevices, runs or any other kind of damage. Verify the planarity of the stroke surfaces. Verify the perfect state of the spark plug threads.

## Dismounting cylinder head pieces

In order to carry out this procedure the following tools are necessary:

tool no. 800094796 for valve removal

tool no. **8000B7254** for valve removal

tool no. **8000B7255** to remove semi cones

tool no. 800094798 to take out rubber holdings

 **Each piece relative to the same valve (cup, spring, semi-cone, etc.) must be reassembled onto the same valve from which it came off.**

Remove the cylinder head as indicated the paragraph "Removal of head group".

## Valve removal

A) Take out the cups (1) with the help of a magnet and number them with a marker so as to reassemble them in the same position.

B) Remove the tablets (2) of play adjustment with a magnet and place them inside the relative cup so as to reassemble them in the same position.

To remove the semi cones (3) exclusively use tool n° **8000B7255** so as to avoid bending the valves:

C) Fit the head on tool no. 800094796 with base plate **8000B7254**

D) Hammer on the superior disk with a rubber hammer to unblock the semi cones

E) Press the springs on the superior disk

F) Take out the semi cones with a magnet

G) Slowly release the disk pusher.

**800094798**

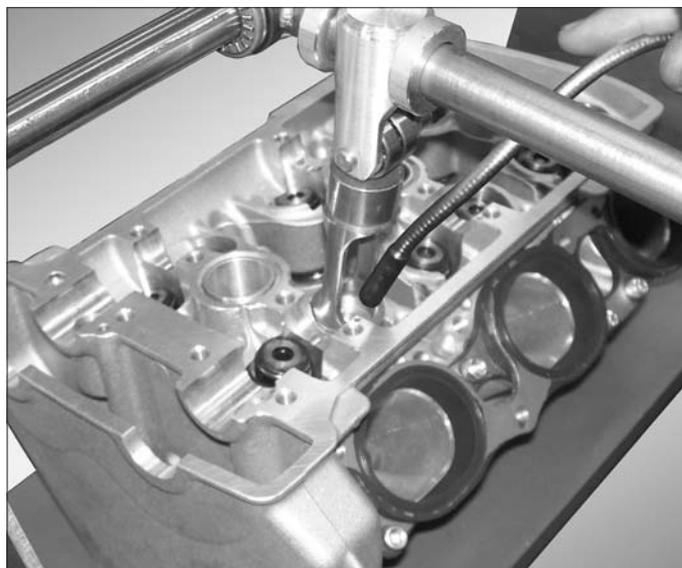


**8000B7255**



**800094796**

**8000B7254**





## Head

Then remove in the following order:

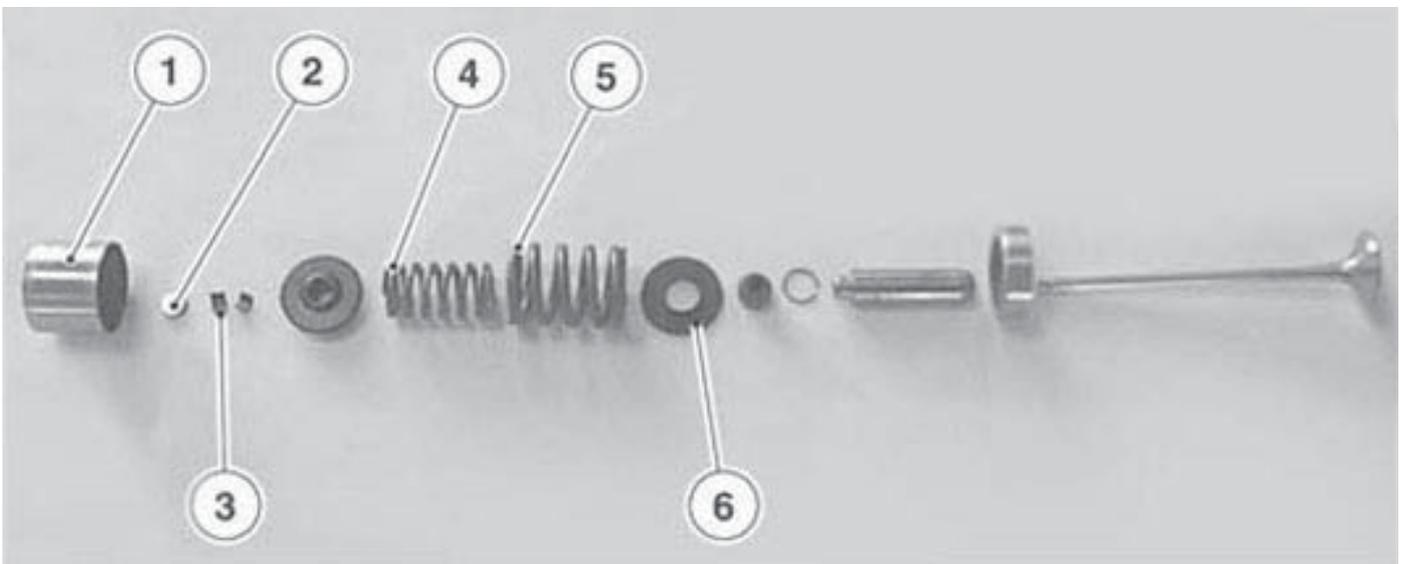
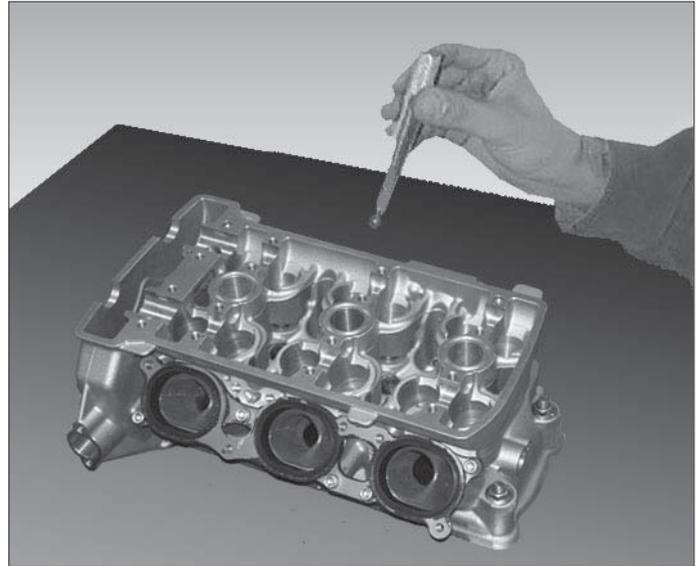
- B) The springs (**5**) and (**4**, from serial number **003272**)
- C) If necessary remove the rubber holdings using tool n° 800094798
- D) Remove the lower valve spring washers (**6**).



**Before of slide out the titanium valves, in order to avoid the damaging of the valve guides, remove the burrs caused by by half-cones carefully using an oil stone.**

**D**

- E) Slide the valve out of the combustion chamber.



## Maintenance of the valve slot

Check the stroke surface [A] between the valve [B] and the slot [C] : no traces of pitting or cracks must appear. Measure the external diameter [D] of the stroke surface on the valve slot.

If this should appear to be too elevated it is possible to repair the slot.

## External diameter of the stroke surface of the valve slot

standard : exhaust  $26,7^{+0,5}_{-0,5}$  mm

standard : inlet  $31,8^{+0,5}_{-0,5}$  mm

Measure the width of the stroke [E] with a varnished gauge or with Prussian blue.

If it should turn out to be too wide, too thin or irregular it will be necessary to repair it.

## Thickness of the stroke surface of the slot

standard : exhaust  $1,27^{+0,1}_0$  mm [E]

standard : inlet  $1,0^{+0,1}_0$  mm [E]

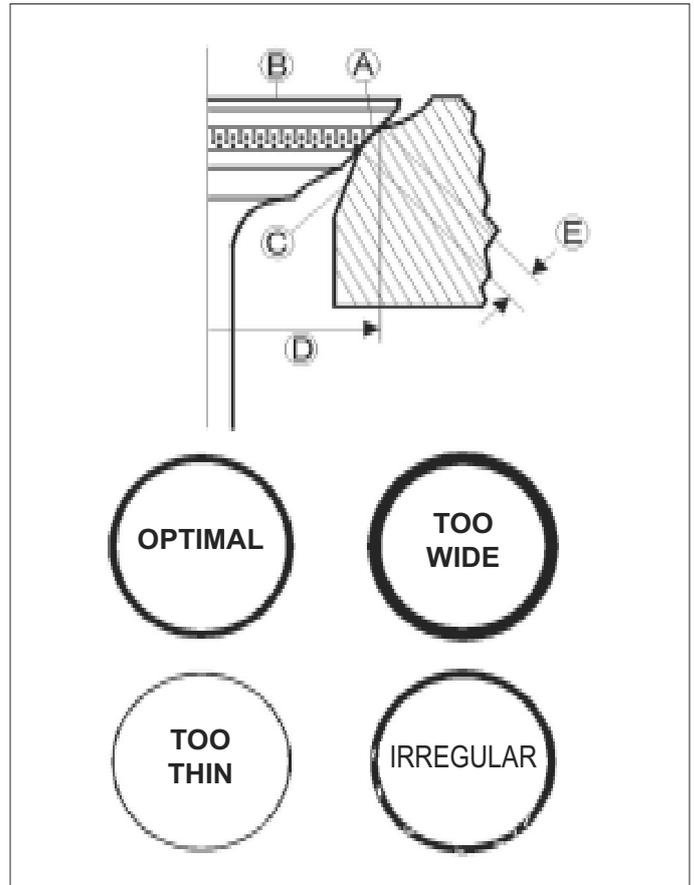
The repair must be carried out by milling the slots using the appropriate monocutting milling machines at  $\alpha^\circ$  (1) and  $\beta^\circ$  (2). Then proceed with the grinding of the valves and verification of the holding.

## Remove the minimum quantity of material from the slot.

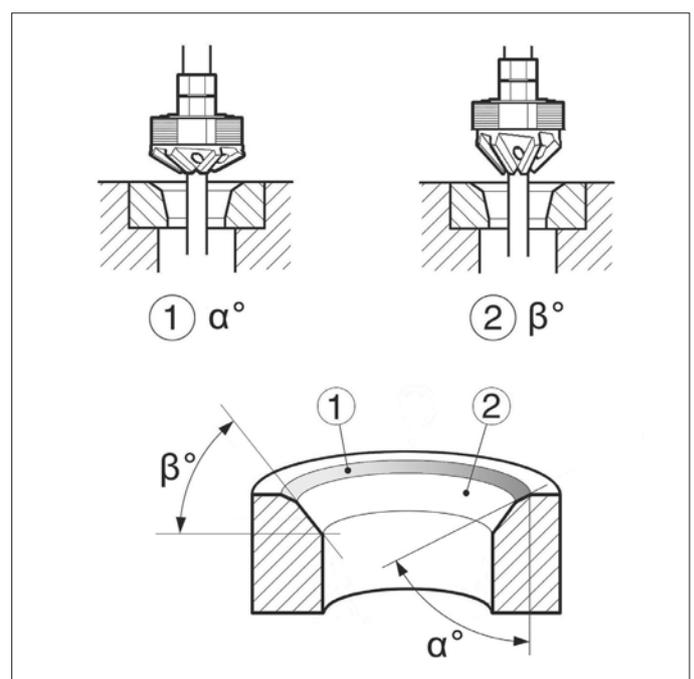
max 0,3 mm (vertical)

**Verify that there is no leakage filling the inlet and exhaust of the gas canalization. If so, check the quality of repair with Prussianblue.**

**When reassembling never use calibrated tablets of a thickness inferior to 1,6 mm.**

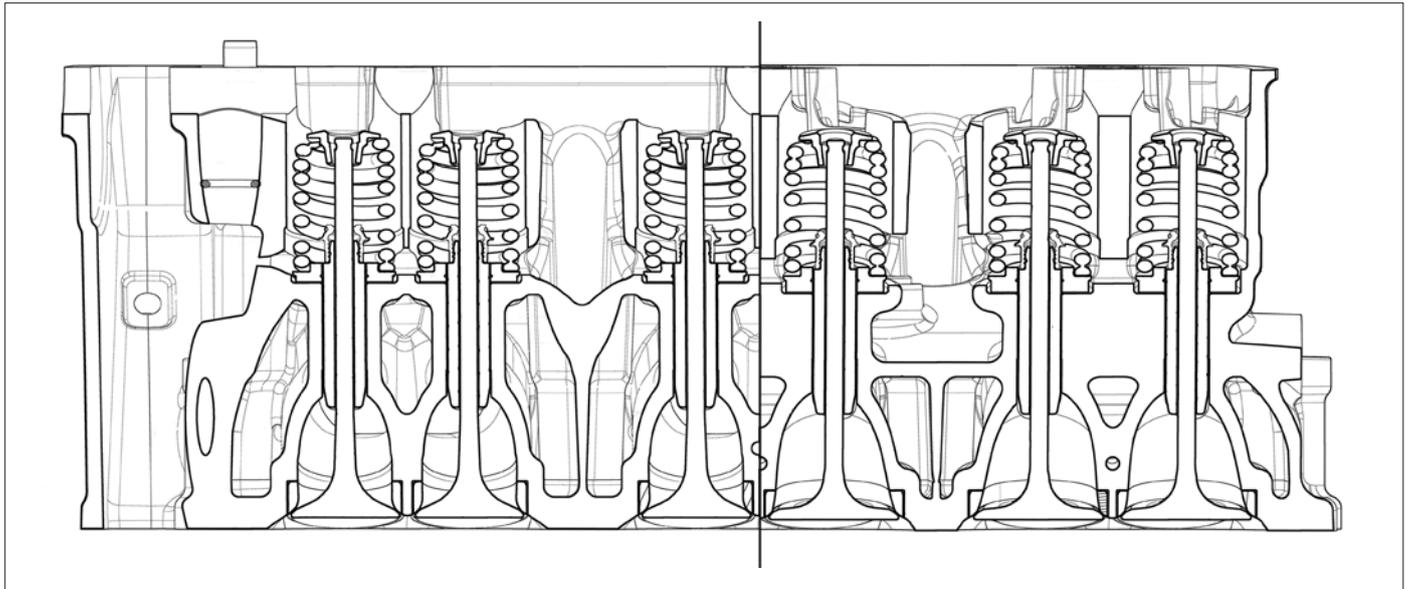


Valve	Monocutting milling	
	$\alpha$	$\beta$
Inlet	60°	45°
Exhaust	60°	45°





## Head



### Substitution of the valve slot

The following tools are necessary for this procedure:  
 prick-puncher n°800095319 for inlet slot; prick-puncher  
 n°800095318 for exhaust slot

Proceed as follows:

- Remove the worn slots carefully milling them so as not to damage the head lodging
- Check the lodging diameter on the head and choose the oversized valve slot considering that the assembling interference should be  $0,10 \div 0,15$  mm.
- Valve slots are furnished with an increased replacement part of  $0,03$  mm on the external diameter.
- Slowly and evenly heat the head at a max temperature of  $180^{\circ}\text{C}$  and cool the new slots with dry ice.
- Place the slots perfectly in frame into its lodging, using the special n°800095319 prick-puncher (INLET) and n°800095318 (EXHAUST)
- Let cool and proceed with the milling of the slots and grinding the valves referring to the following quotients:

Valve	
Ø Inlet	$31,8 \begin{matrix} +0,5 \\ -0,5 \end{matrix}$ mm
Ø Exh.	$26,7 \begin{matrix} +0,5 \\ -0,5 \end{matrix}$ mm
[E] Inlet	$1,0 \begin{matrix} +0,1 \\ 0 \end{matrix}$ mm
[E] Exh.	$1,27 \begin{matrix} +0,1 \\ 0 \end{matrix}$ mm



## Valve guide check and maintenance

In order to carry out this procedure the following tools are necessary:

Control tampon n° 800095429

Punch n° 8000A2385

valve stem-valve guide play: **0,01÷0,03 mm inlet**

**0,02÷0,04 mm exhaust**

coupling limit : **0,08 mm inlet**

**0,1 mm exhaust**

internal guide Ø limit: **4,55 mm**

**800095429**



Proceed with an accurate visual check of the valve guide. In order to determine the coupling wear between guide and valve stem it is necessary to measure the play using a control tampon and micrometer.

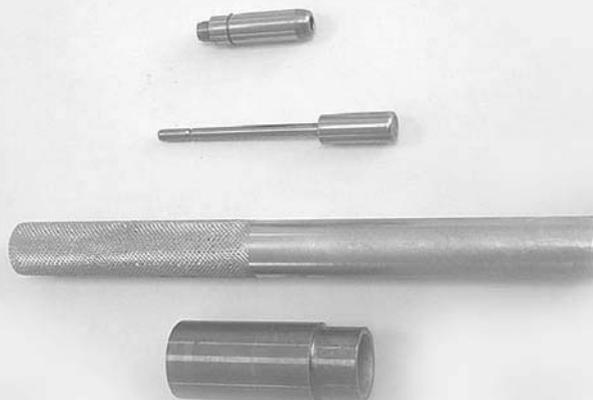


**The control tampon 800095429 (Ø 4,55) must not pass.**



**In the case of substituting the guide valve it is necessary to check and if necessary also substitute the valve.**

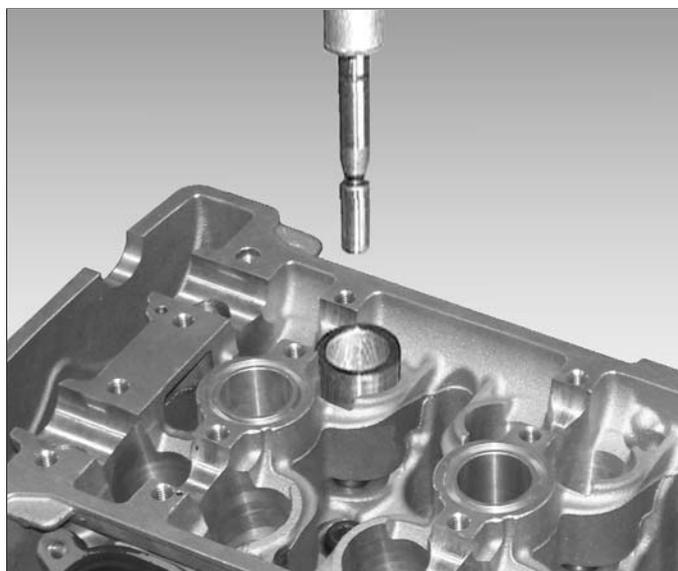
**8000A2385**



## Removal of the valve guide

After having removed the valves and rubber holdings as described in the relative paragraph, continue as follows: Slowly and evenly heat the cylinder head up to 100°.

Using the punch n°8000A2385 remove the valve guide. Continue with a visual check of the slot to verify its State.





## Head

### Guide valve installation

Assemble an oversized valve guide as follows:

Oil the external valve guide surface.

Slowly and evenly heat the cylinder head up to 150°.

If necessary cool the valve guides with (N<sub>2</sub>) nitrogen liquid; or dry ice.

Insert the valve guide using the special n°8000A2385 tampon up to the stroke and let rest until the temperature has stabilized.

Check to be sure the valve slides freely in the valve guide otherwise coat it with a 4,5 H7 reamer or broach N°8000A2625.



### Valve

The stem diameters must not fall below:

**4,4825<sup>-0,03</sup> mm inlet**

**4,4725<sup>-0,03</sup> mm exhaust**

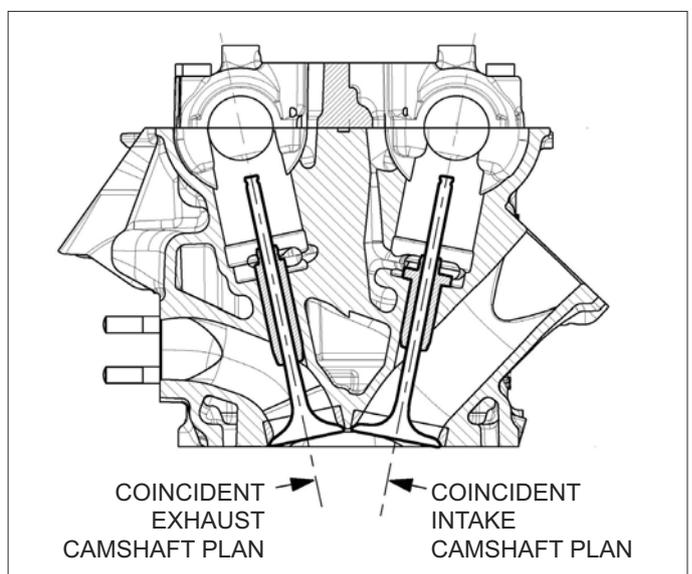
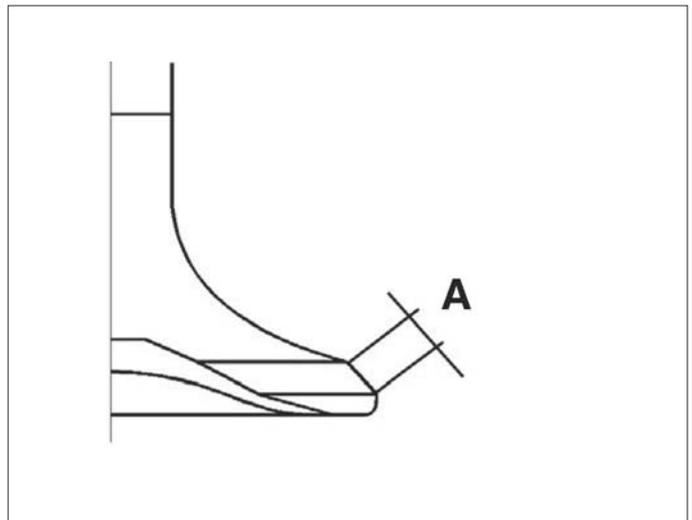
The width "A" of the sealing surfaces should fall in the range :

**0,9 ÷ 1,3 mm inlet**

**1,7 ÷ 2,2 mm exhaust**

Check to be sure that the stem and the surface in contact with the valve slots are in good condition.

No traces of pitting, cracking, deformations or traces of wear should appear. Verify that the stem is perfectly rectilinear.



## Valve-guide valve coupling

Coupling play at assembly must be:

**0,01 ÷ 0,03 mm inlet**

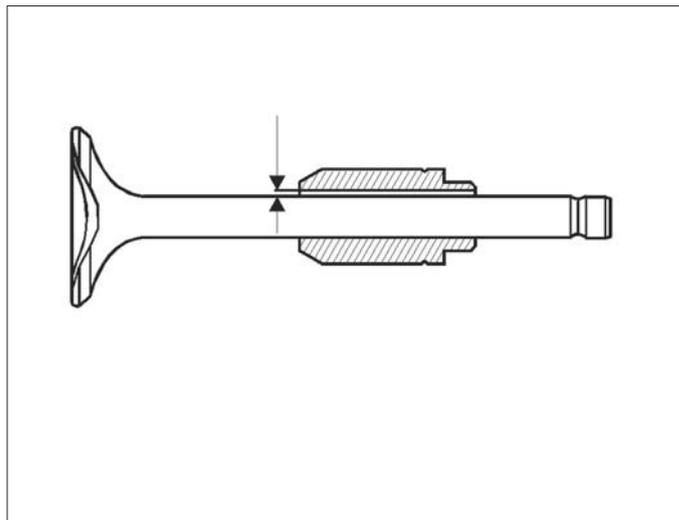
**0,02 ÷ 0,04 mm exhaust**

The maximum coupling limit permitted is even to

**0,08 mm inlet**

**0,10 mm exhaust**

If a major play should result, substitute valve and valveguide.



## Springs

Check to be sure that the free value of length is not inferior to the suggested limit and in such case substitute the springs:

Until serial number 003271:

**L= 42 mm**

Limite de service: **41,5 mm**

From serial number 003272:

**- External**

**L= 37,9 mm**

Limite de service: **37,4 mm**

**- Internal**

**L= 33,8 mm**

Limite de service: **33,3 mm**

### Until serial number 003271



### From serial number 003272



**800095581**



## Valve reassembly

- Carefully degrease the guide
- Insert the lower washer (6) and make sure that they are properly seated.
- Assembly new rubber valve seals onto the guide using tool n°800095581;
- Apply oil to the valve stem before inserting into the guide.



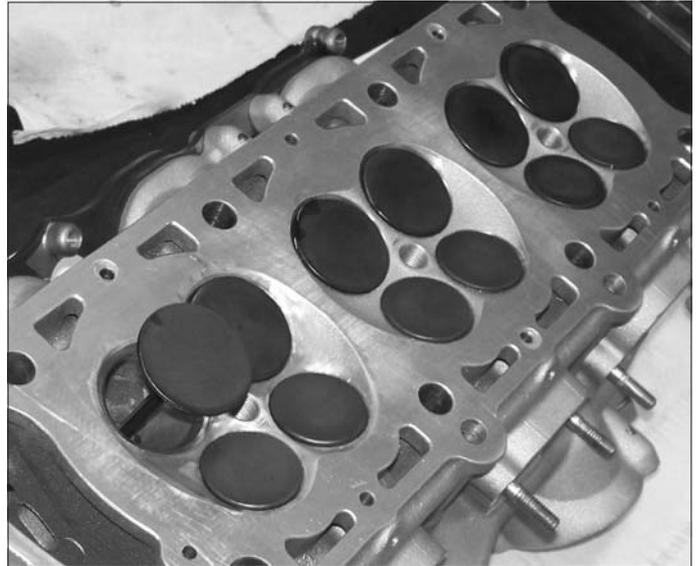
## Head

Assembling the valve.

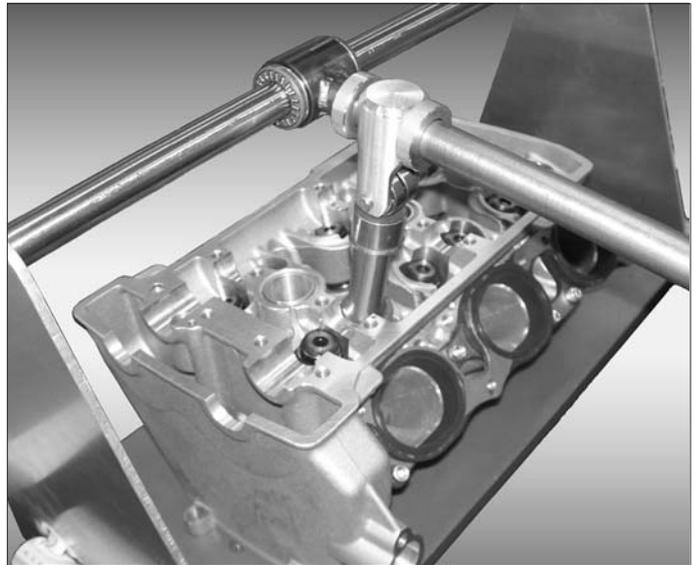
Insert in the order of:

- A) Insert the spring.
- B) Slide the semi cones into the superior disk slot and thus place the disk on the springs.
- C) Fit the head on the valve removal tool no. 800094796 with base plate no. 8000B7254 and compress the spring with tool 800095179 up to insertion of the half cones.
- D**) Using a rubber hammer strike a slight blow on the valve so as to place the semi cones.

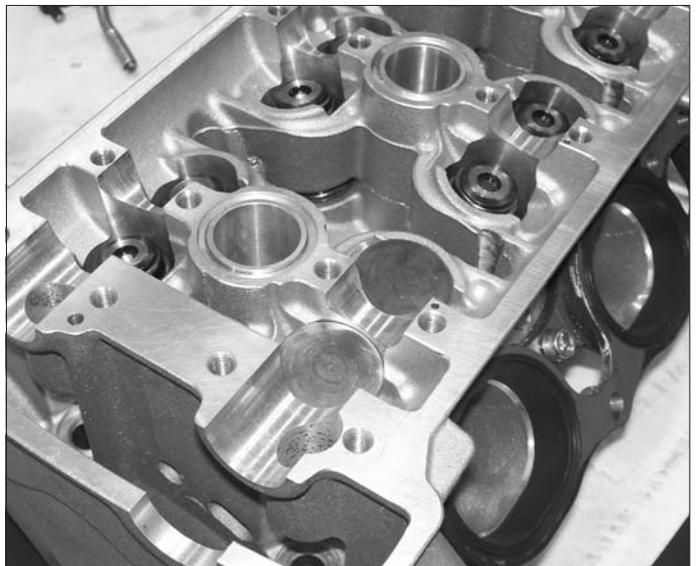
**NOTE** Before placing the valve retainers be sure that the head is not resting on a plane in order to avoid distorting the valve. Place it onto two bases which allow the valve to move.



**800095179**

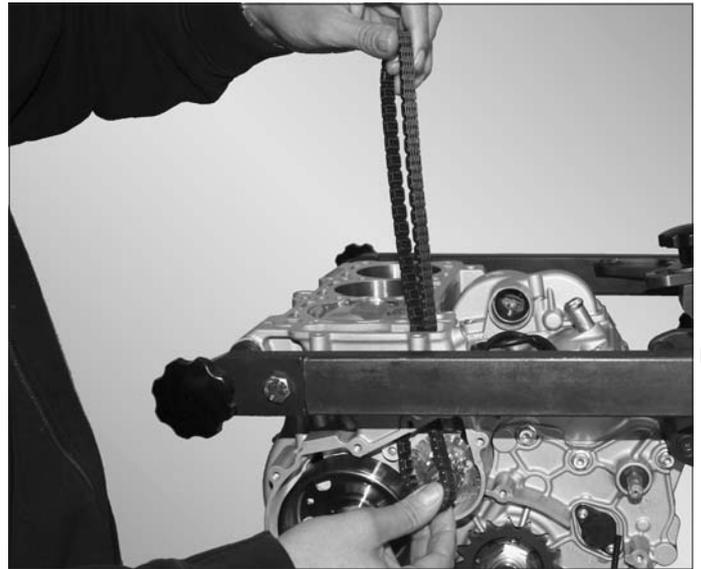


- E) Insert the tablet of the correct thickness and lubricate its surface.
- F) Make sure it easily turns in its slot.
- G) Insert the cup after lubricating the slot.



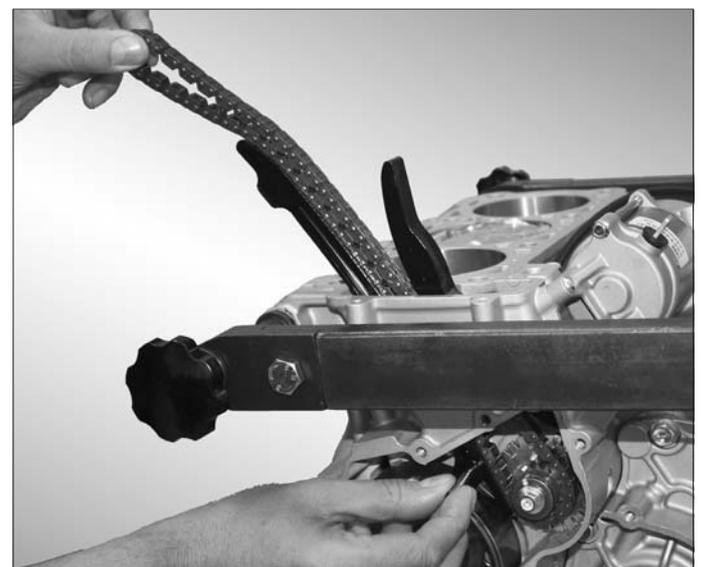
## Head assy assembly

Insert the distribution chain from above onto the phonic wheel gear.



Insert the centering bushes between the head and the cylinder.

Insert the fixed and sliding blocks after carefully degreasing them and their pins.



D



## Head

Fit the gasket on the cylinder head.



**Attention:** the contact surfaces between the cylinders and the head must be scrupulously clean and free of scratches.

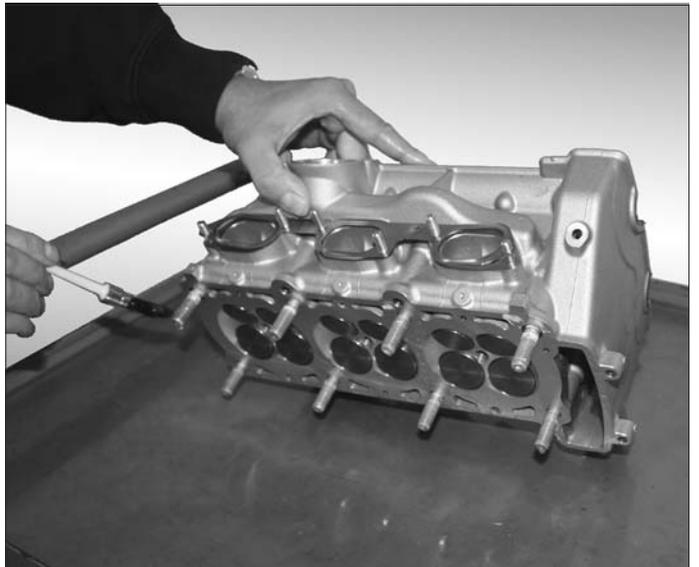


**Attention:** the head gasket must be replaced if it is bent or shows changes in colour.

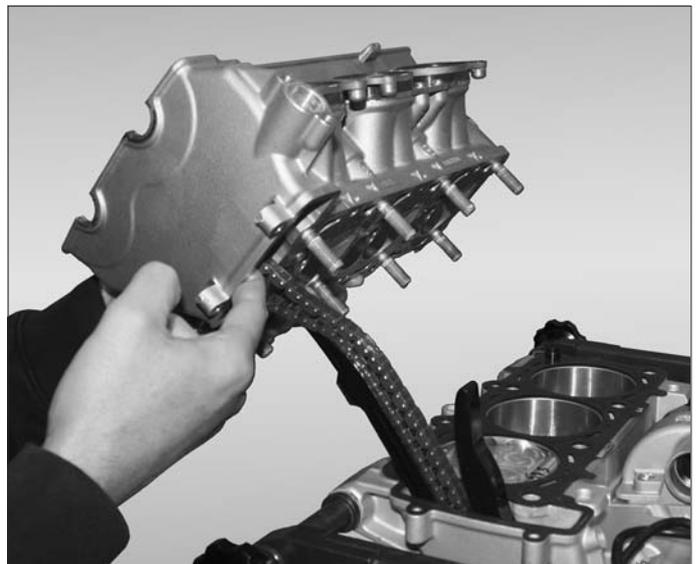
D



Before placing the head in position, lubricate the female threads (on the engine block), screw threads and under the screw heads as indicated.



Place the head in position, keeping the distribution chain raised to avoid having to recover it later.



Pay attention that the screws are properly engaged.

**NOTE** The positioning of the head with the screws is given as a rough guide. The screws may be inserted after the head has been positioned.



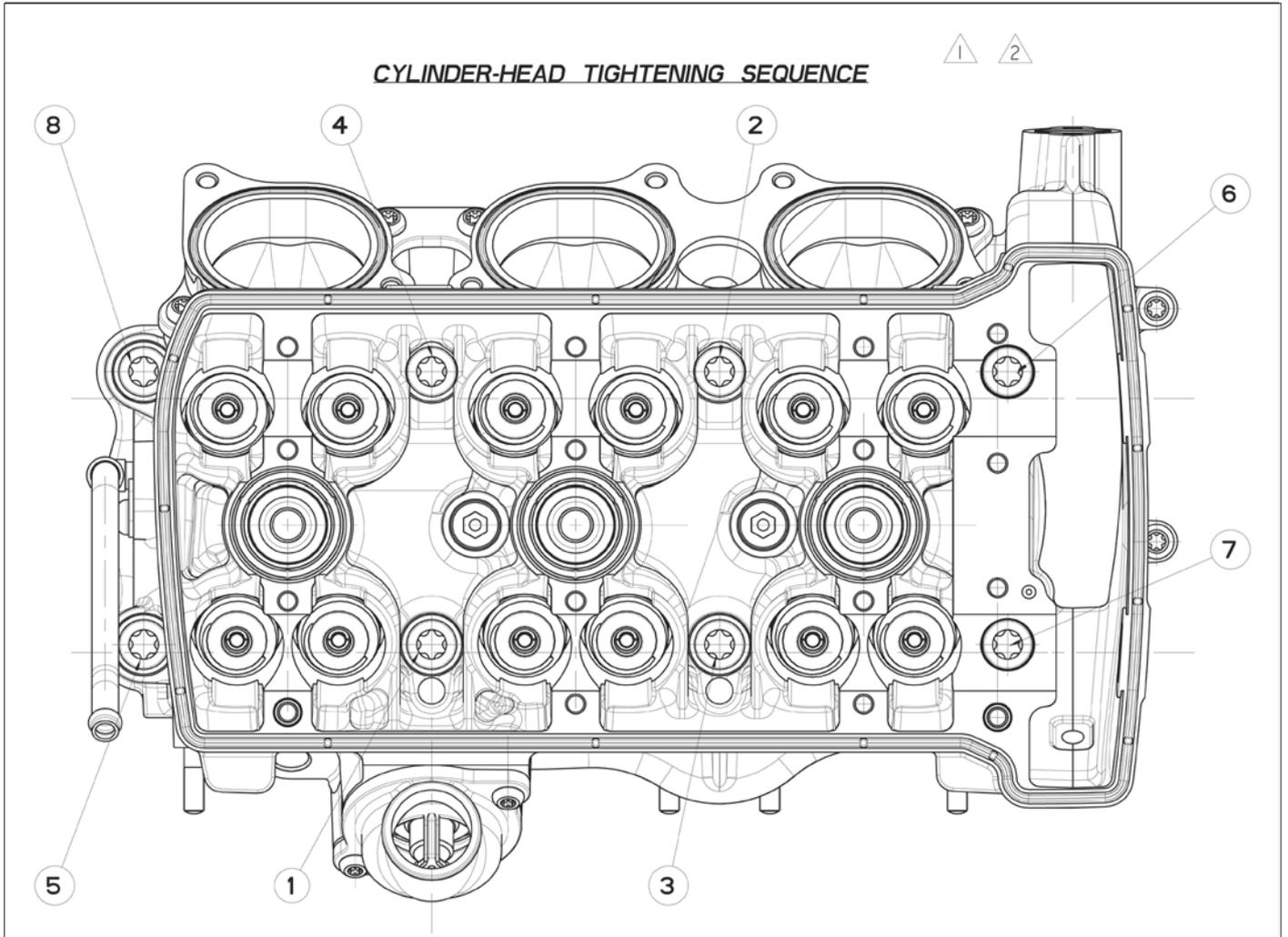
Once the head has been positioned, screw the screws in by hand **without tightening them**.

Support the distribution chain with a metallic bar.



If previously removed, reassembly the fixed pad screw and tighten it to a couple of 8 Nm.





Tighten the 8 screws initially to 10 Nm in opposing pairs.

Screw Nr.	Operation	Value
1-8	Pre-tightening	10 Nm
8-1	Loosening	-
1-8	Intermediate tightening	10 Nm
1-8	Final angle tightening	$85 \pm 1^\circ$
9-10	Tightening	10 Nm



Loosen the 8 screws.



Retighten them to 10 Nm.



Tighten them finally to  $85^\circ \pm 1^\circ$  using an angle tightening wrench, ensuring that the corresponding torque is between 53.5 and 61.5 Nm.



**If the final angle tightening of  $85^\circ \pm 1^\circ$  does not correspond to a torque of 53.5 - 61.5 Nm it will be necessary to replace the screw with a new one and repeat the whole head tightening sequence from the start.**





## Head

Reinsert the two spacers with the previously greased seal rings.



**The seal rings must always be replaced on refitting.**

D

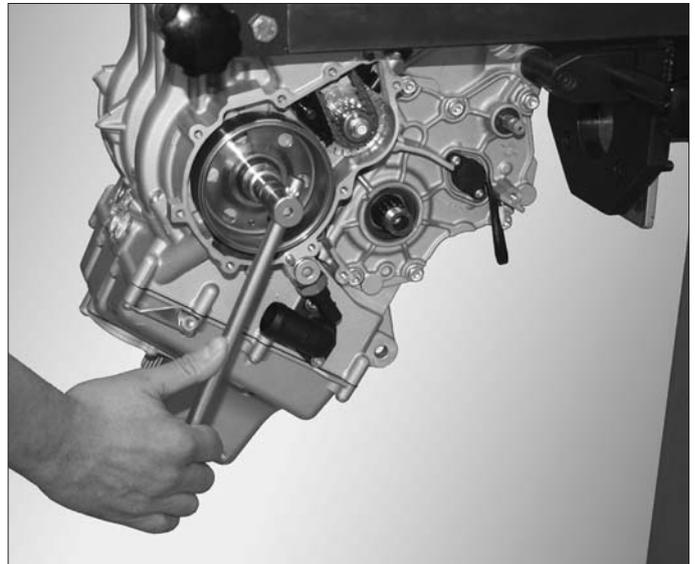


### CAMSHAFT AND DRIVING SHAFT TIMING

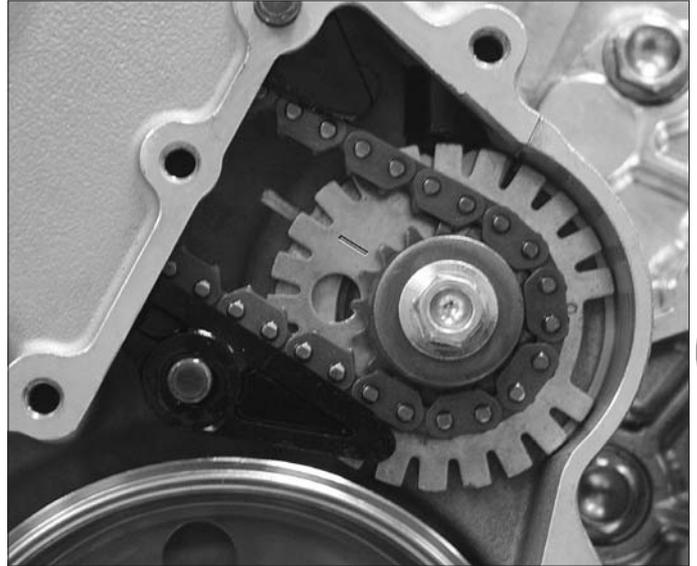
Keep the chain tightened.



Turn the crankshaft clockwise so as to line up the “” notch on the phonic wheel with the reference mark on the engine block.

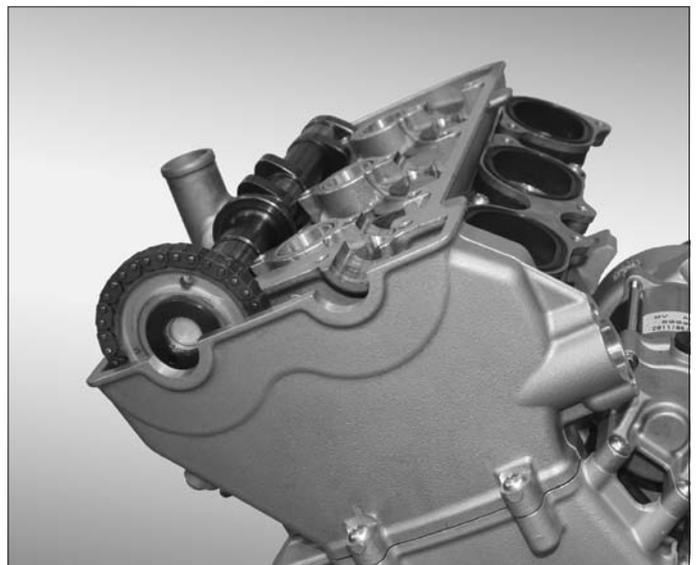
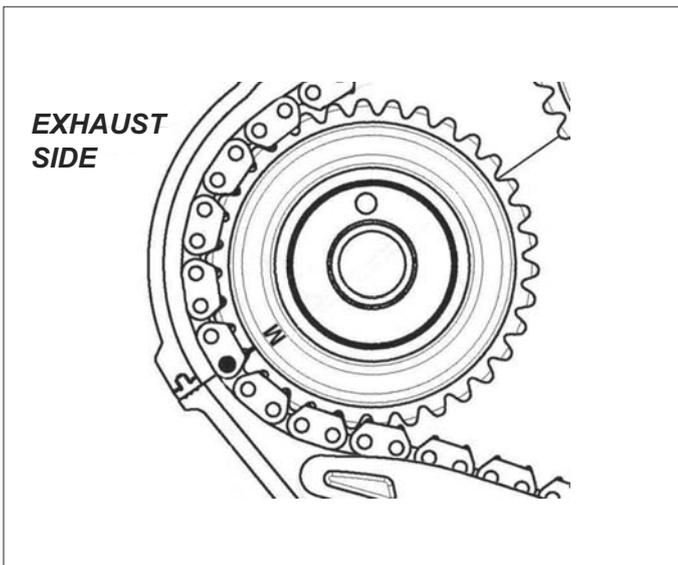
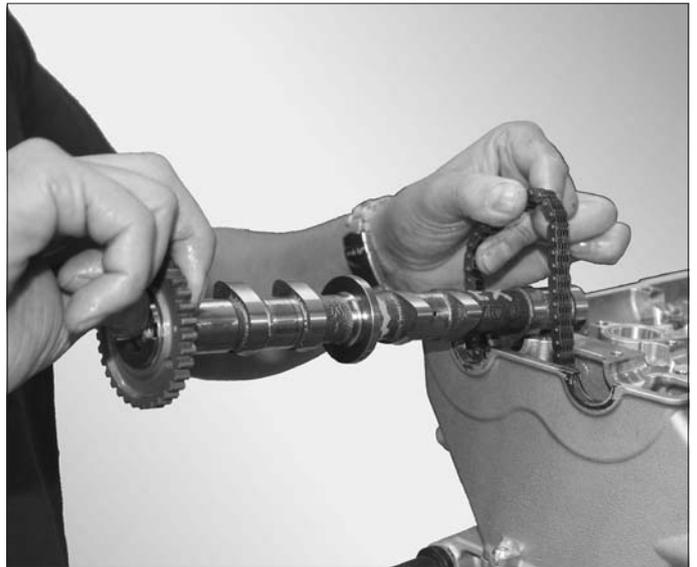


In this position piston no. 3 is at TDC.



D

Keeping the chain tight, insert the exhaust camshaft so that the phase notch "M" on the conveyor wheel is parallel to the head plane and facing outwards.

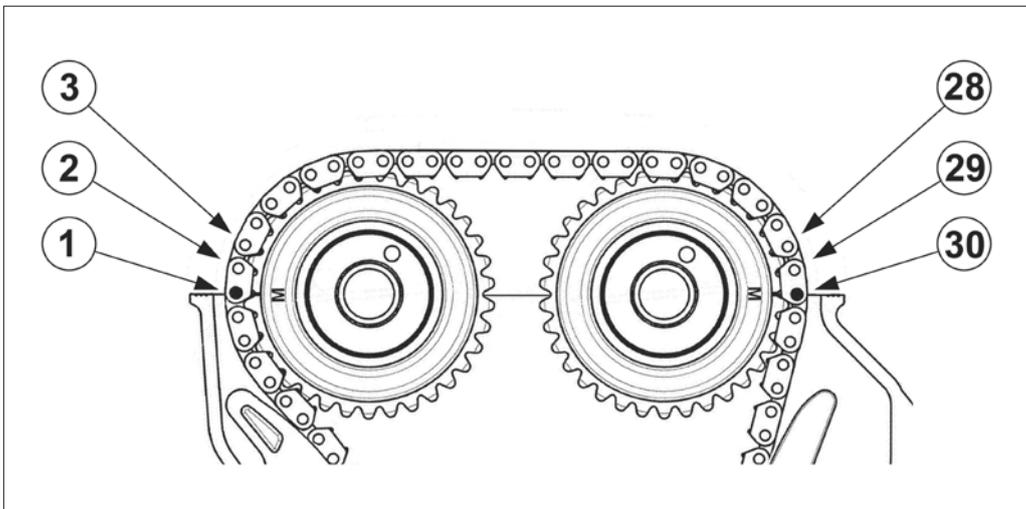
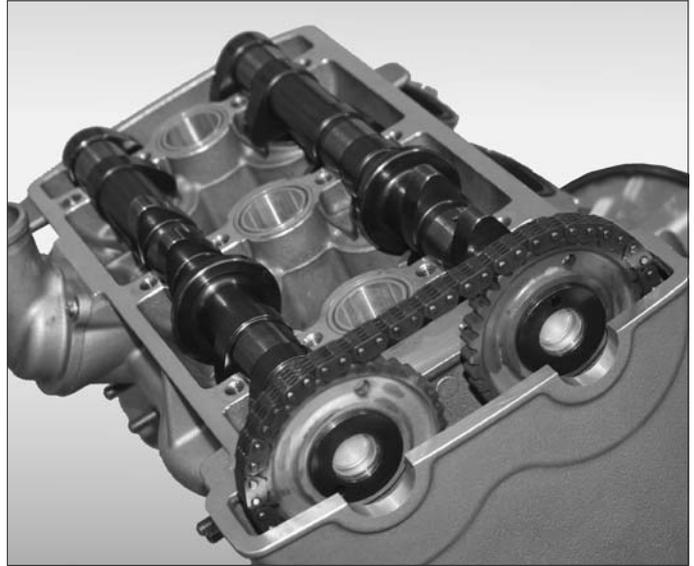




## Head

Insert the intake camshaft with the “M” mark on the 30th pin of the distribution chain, starting to count from the mark “M” of the exhaust camshaft.

**NOTE** In this position the minimum pressure is obtained from the valve springs on the camshafts, serving to facilitate removal and refitting operations.

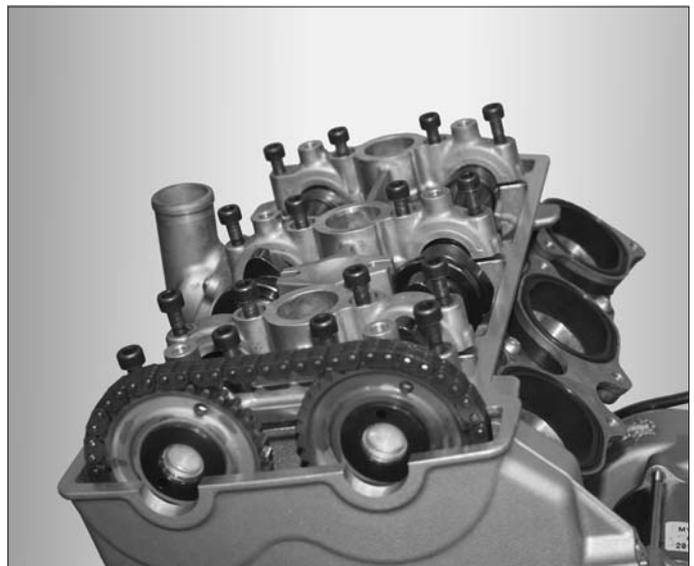


Check the correct position of all the O Rings under the head stands.

Place the stand in position.  
Gradually approach the screws.



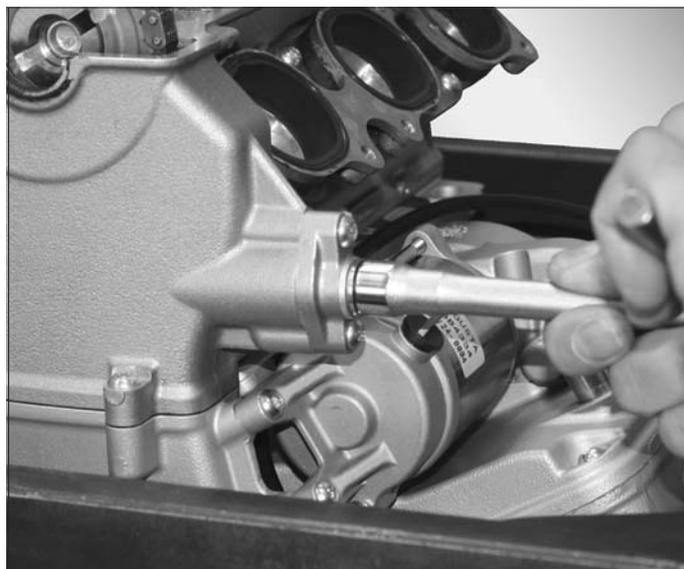
**Attention: do not tighten the screws of the stand before fitting the chain tensioner.**



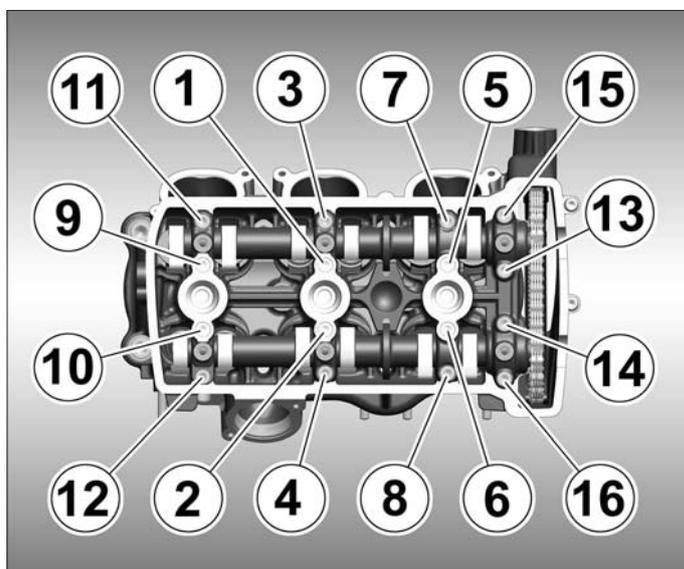
Lubricate the parts of the chain tensioner and install the assembly with the chain tensioner in the minimum extension position (all in the main body).  
Lock the screw cap by hand till you feel the tensioner extend.



Lock it with to 12 Nm torque. Acting this way the chain tensioner is adjusted.  
Tighten the two screws at a torque of 8 Nm.



When this is done, tighten the stand following the indicated tightening sequence.  
Tightening torque 12 Nm.



D



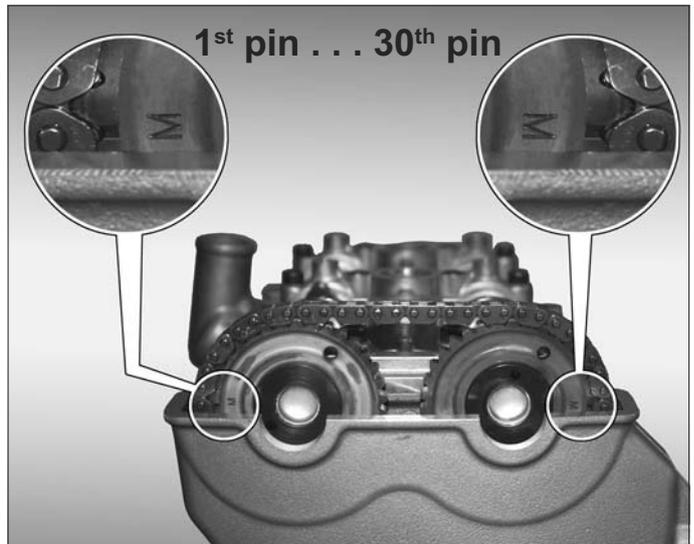
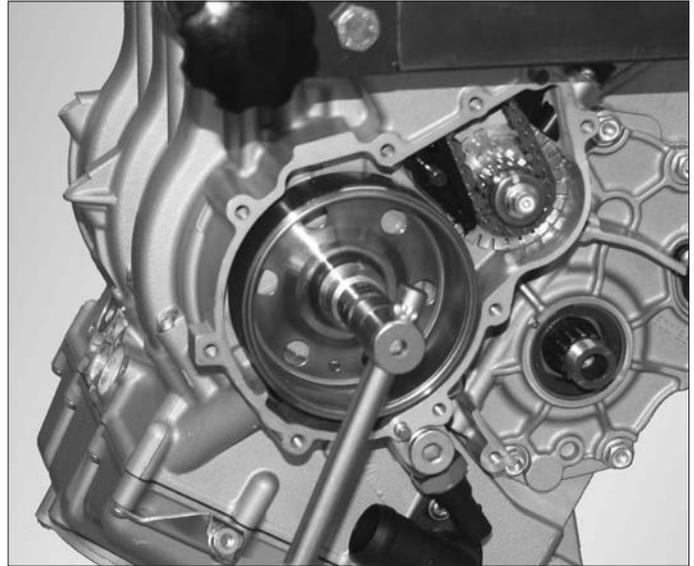
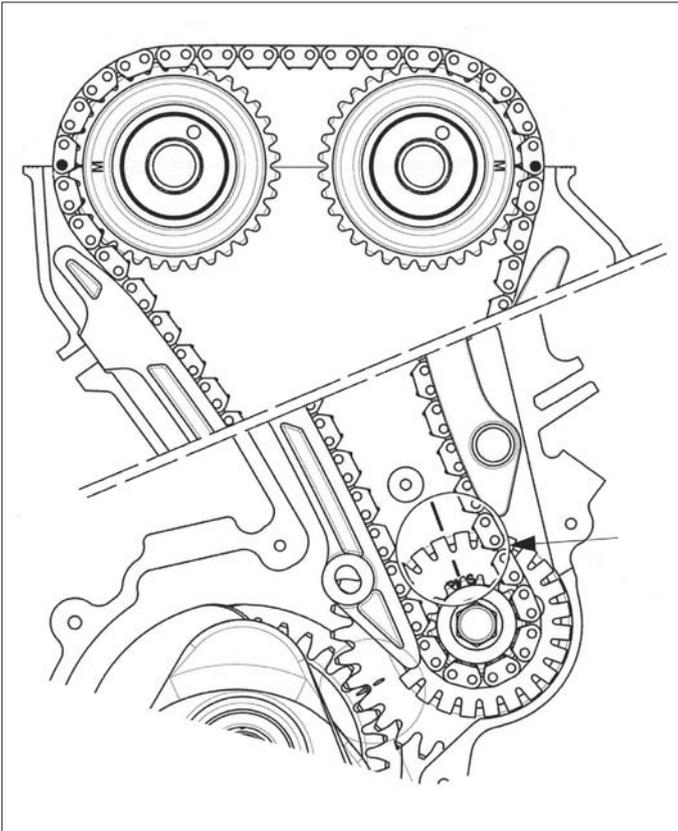
## Head



Once you have tightened the screws on the stand and fitted the chain tensioner, make some turns of the unloaded crankshaft to verify that the timing is correct.

Lining up the notch on the phonic wheel with that on the case (3rd cylinder at TDC), the two "M" marks on the camshafts should be opposite and horizontal to the head plane.

D



### Regulating valve play

Verify that the spark plugs have been disassembled.



Should this procedure be carried out with the head assembled on the motor, block the spark plug holes with clean rags.

A) Rotate the drive shaft until completely unwinding the springs relative to the valves on which intervening (TDC).

B) Measure valve play with a thickometer.

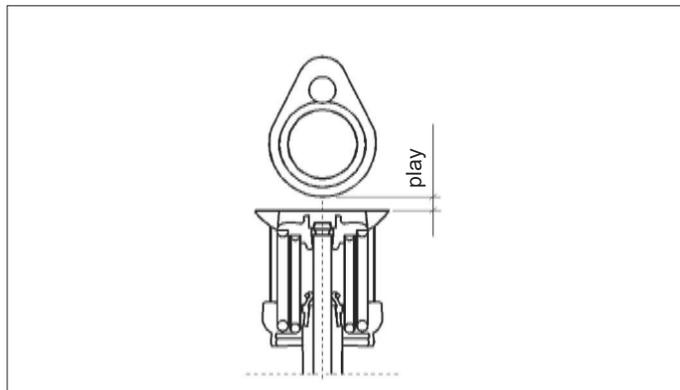


inlet valve play	exhaust valve play
0,15 $\pm$ 0,24 mm	0,20 $\pm$ 0,29 mm

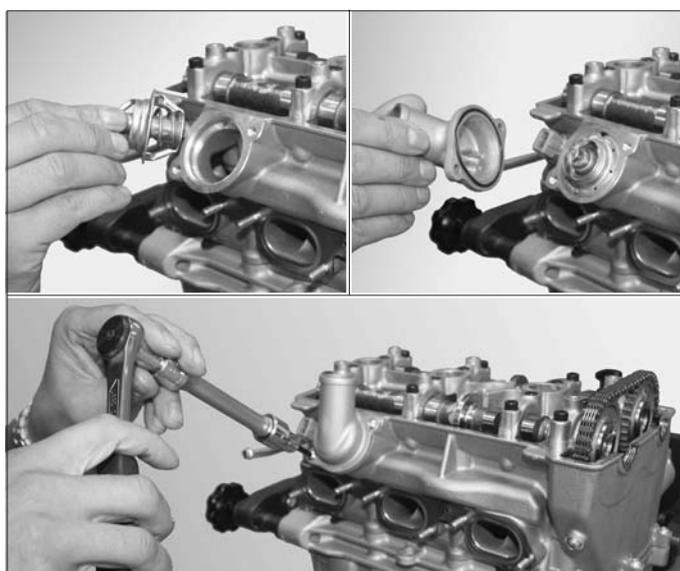
- C) Calculate the D difference between the compared play and optimal play shown on the chart
- D) Read the value of S thickness on the tablet;
- E) Choose a new tablet with an S+D thickness.

**During reassembly never use a valve shim with a thickness less than 1,6 mm.**

Insert the thermostat and assembly the cover with the previously greased seal ring. Insert the two screws and tighten them to a couple of 8 Nm.

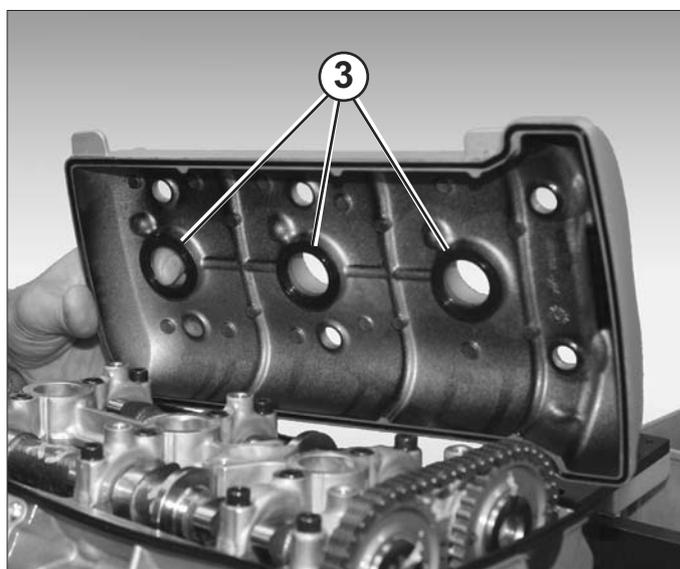
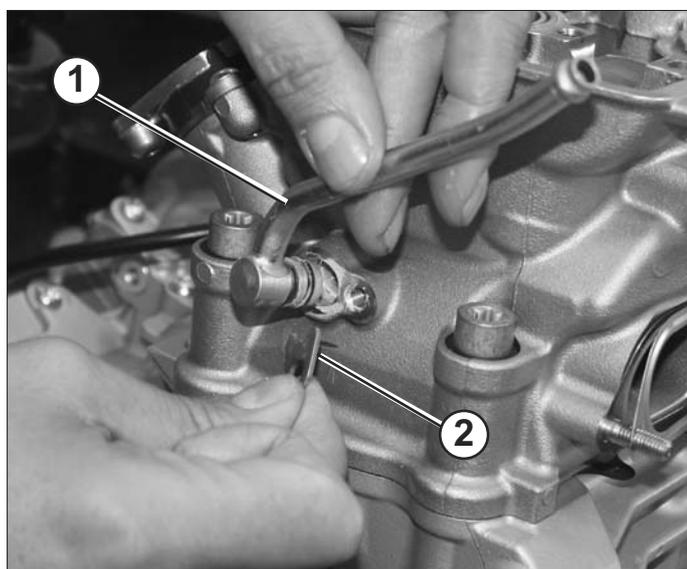


D



Insert the head degassing pipe (1) with the previously greased o-ring. Assembly the fixing plate (2) and tighten the screw to a couple of 10 Nm.

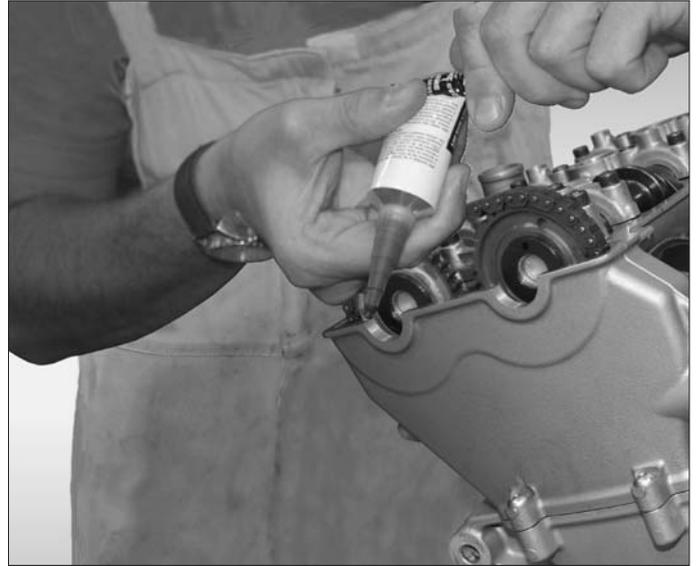
Make sure that the valve cover seals are in good conditions.  
Assembly the ignition coil gasket (3).





## Head

Apply a layer of gasket silicone on the semi moons on the head in correspondence with the camshaft.



D



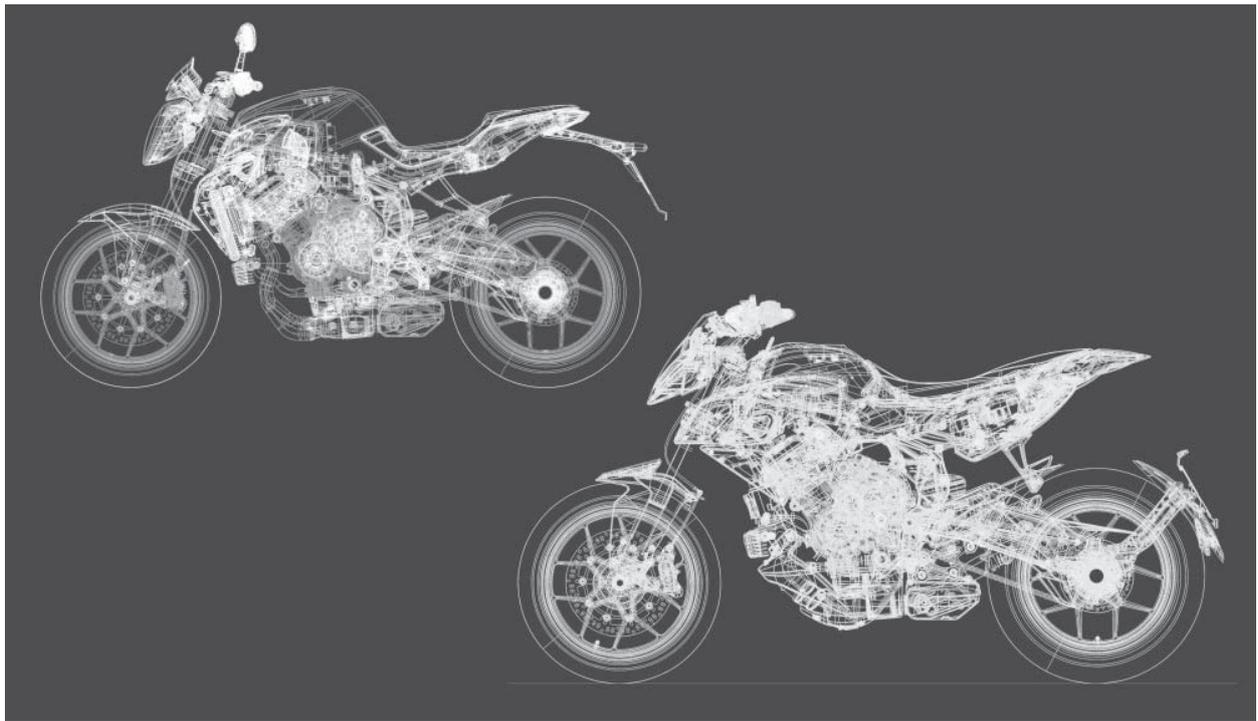
Place the gasket in position and fit the valve cover.

Manually position the screws, thus tighten at 8 Nm.



Refit the sparkplugs, the coils and the filter case support plate, tightening the screws to a torque of 8 Nm.





E

**SECTION E**

REVISION 1

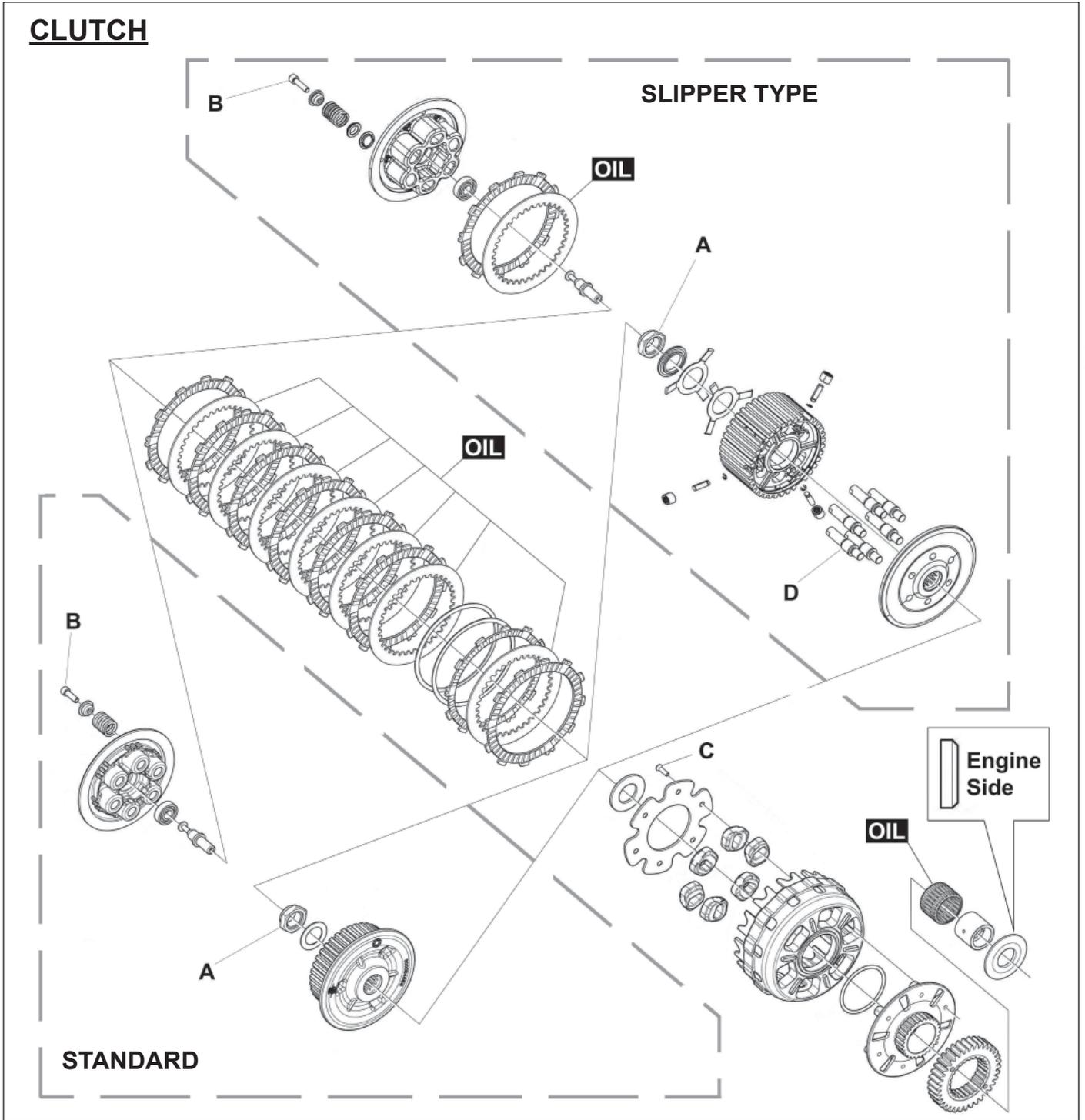


# Clutch

## SUMMARY

<b>CLUTCH</b> .....	<b>Page</b>	<b>3</b>
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Clutch overhauling .....	Page	8
Clutch reassembly .....	Page	9

E



Tightening torques		A	B	C	D	E	F	G	H	I	L
	Nm	120	10	10	4,5						
Thread blockers		medium	medium	medium							

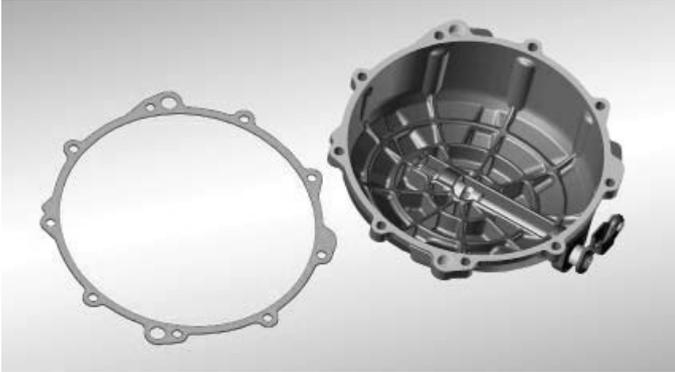
<b>OIL</b>	Apply motor oil	<b>SS</b>	Apply silicone sealing
<b>NO OIL</b>	Do not apply neither oil nor other types of substances	<b>HSC</b>	Apply HSC Molikote
<b>GR</b>	Apply grease	<b>M</b>	Apply mastic for gaskets



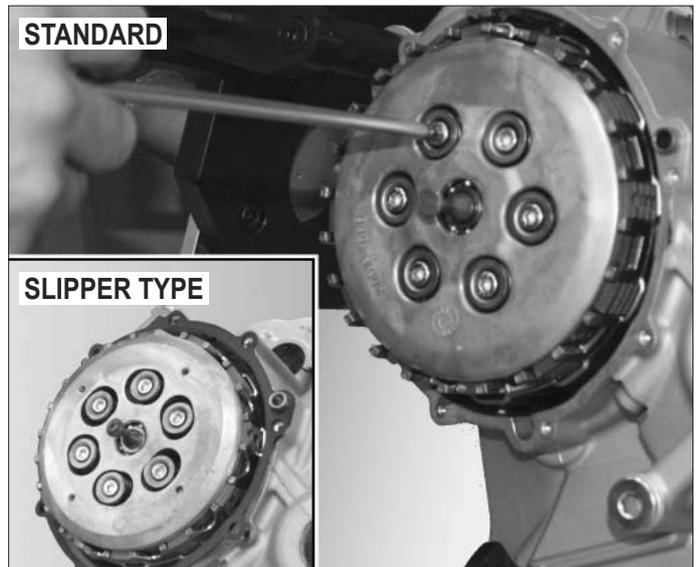
## Clutch

### Clutch disassembly

Remove the 8 screws which fasten the clutch cap to the Crankcase.  
Remove the clutch cap together with the gasket.



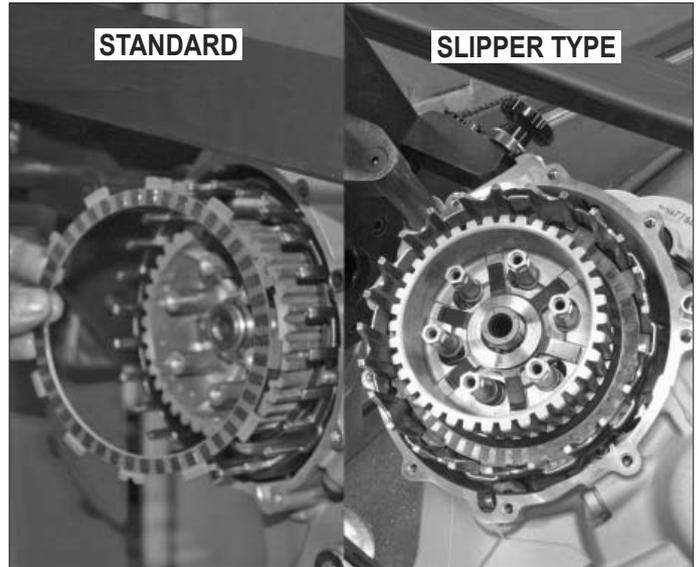
Remove the 6 disk pusher plate tightening screws together with the springs and the relative holders.



Remove the disk pusher plate.



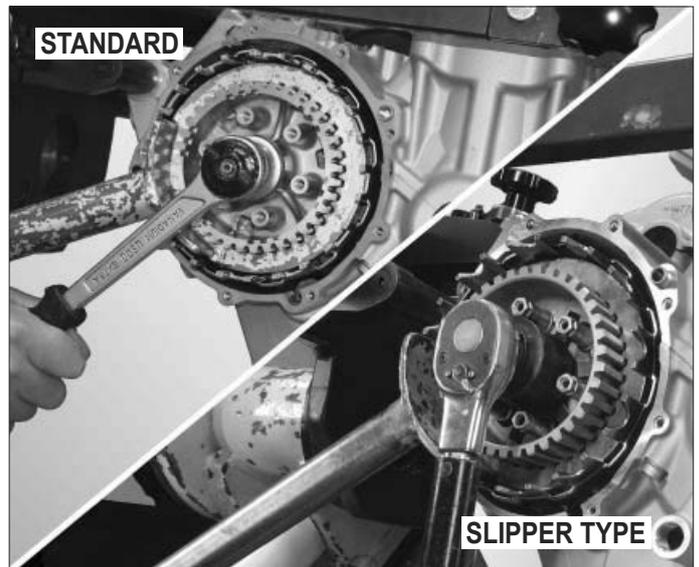
Manually remove all of the attrition disks that you can.



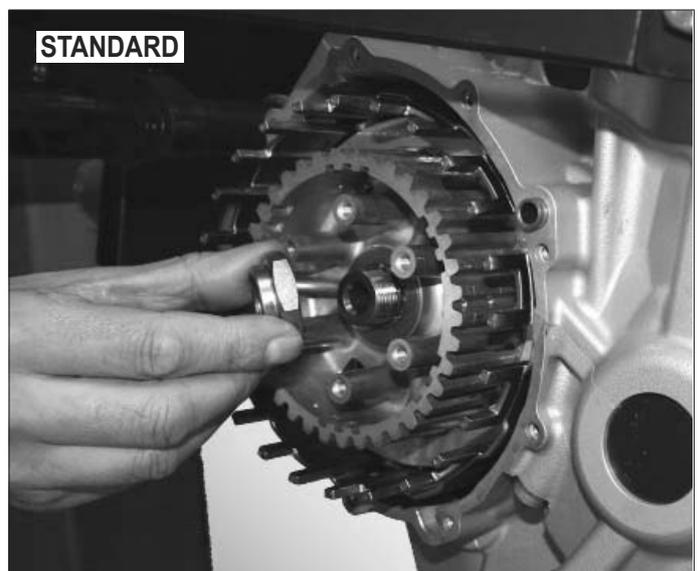
Unscrew the nut using tool n°800079015 to hold the clutch hub still and remove it.

To execute this operation the following tool is necessary:

Tool n° 800079015



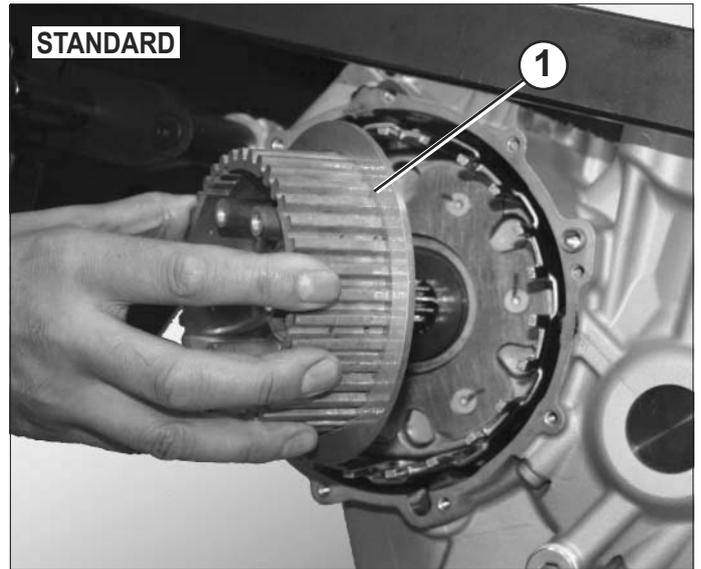
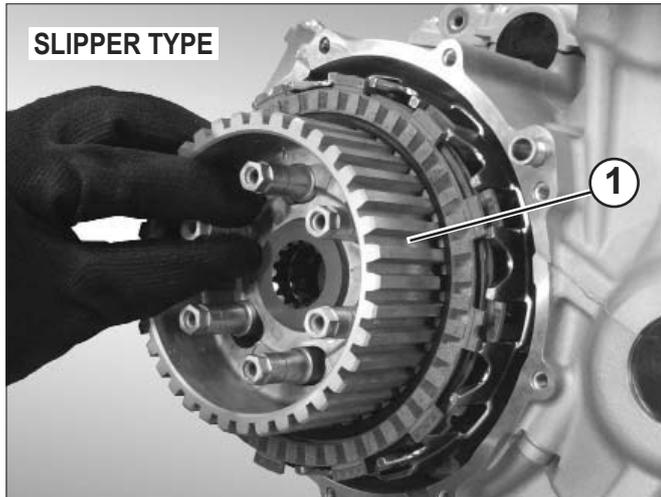
(Standard clutch) remove the nut and the washer.  
(Slipper clutch). Remove the nut, the spacer and the spring



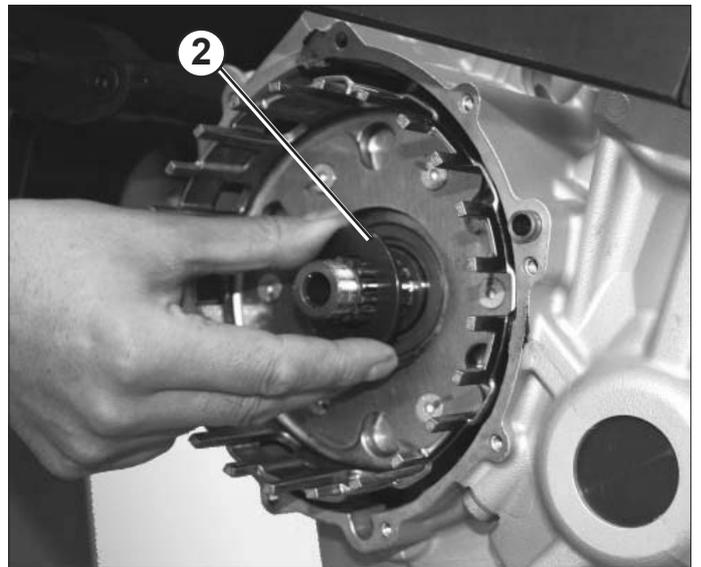


## Clutch

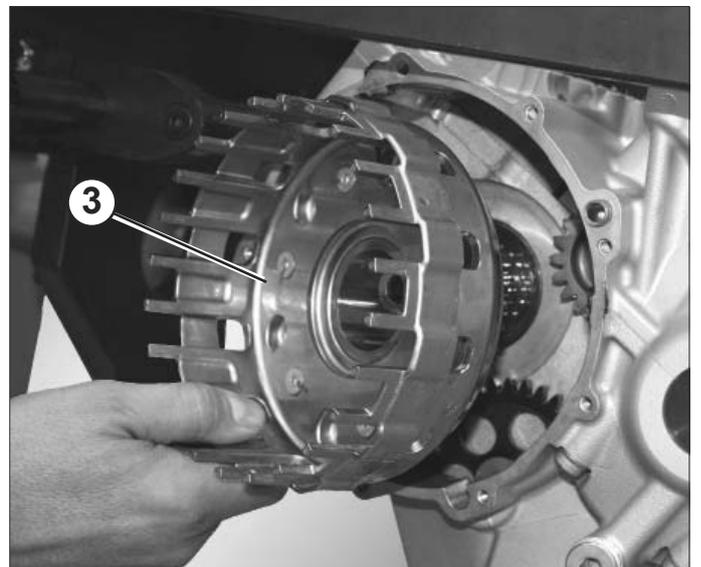
Extract the clutch hub (1).



Remove the washer (2)



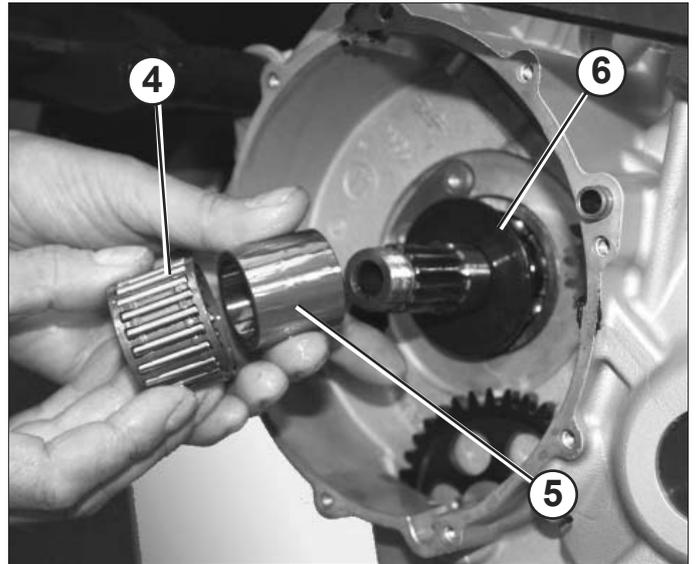
and the clutch housing (3).



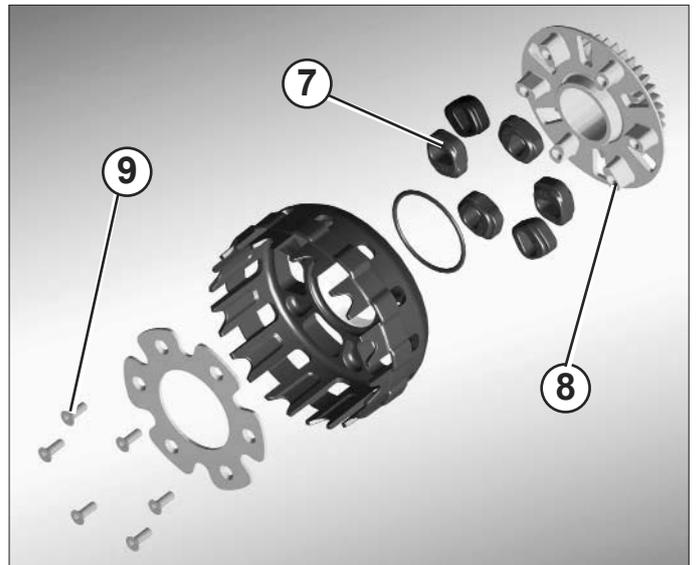
## Clutch



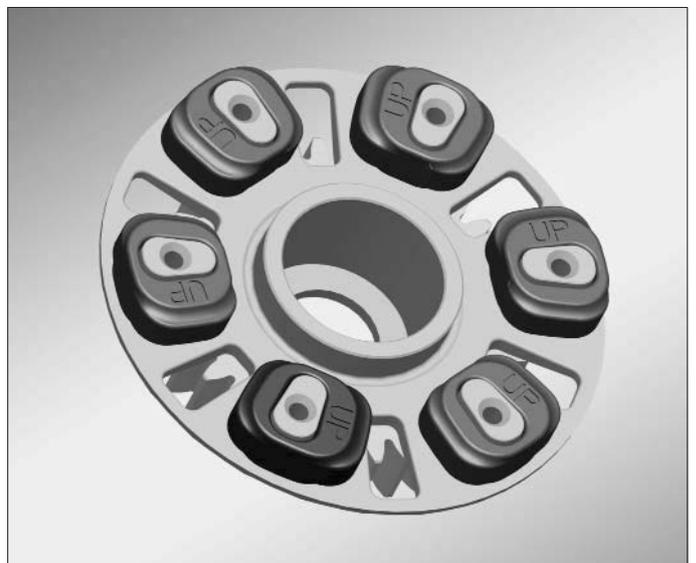
Remove the roller cage (4), the spacer (5) and the shim washer (6).



If it is necessary to remove the clutch housing, check that the rubber stoppers (7) are not scratched or cracked.



Reinstall, paying attention to the correct orientation of the rubbers on the housing (8). Tighten the 6 screws (9) to a torque of 10 Nm with medium-strength thread lock.





## Clutch

### Clutch overhauling

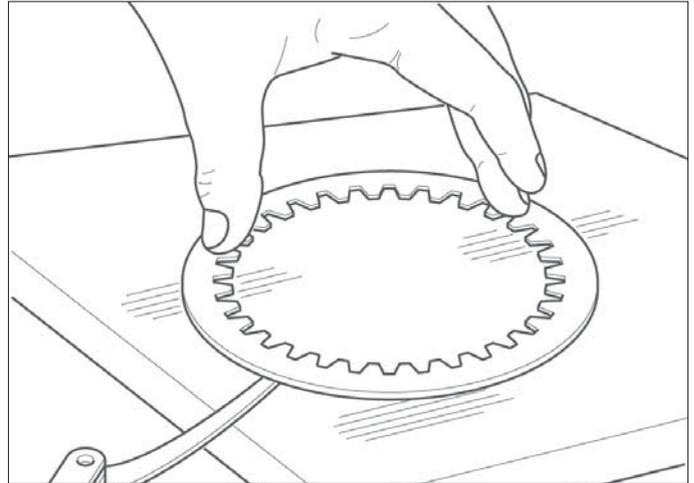
Check the rod for straightness and wear.

Check the friction plates for wear.

The **standard thickness** is **3 mm**.

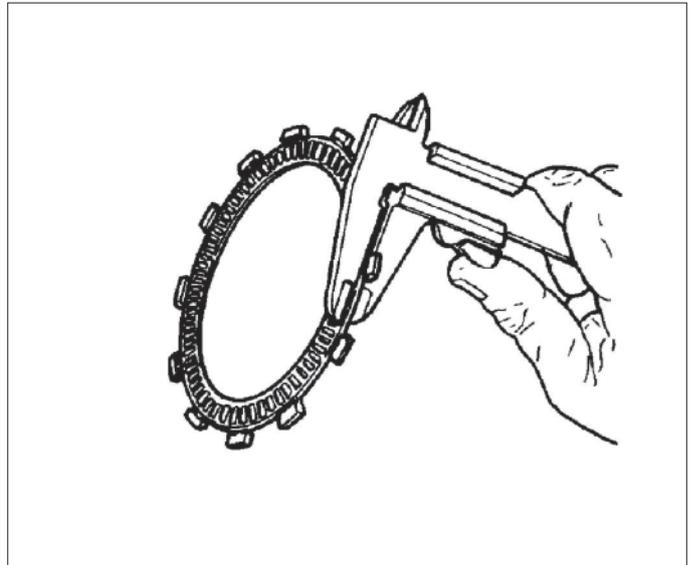
Maximum allowed wear limit : **2,8 mm**.

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.

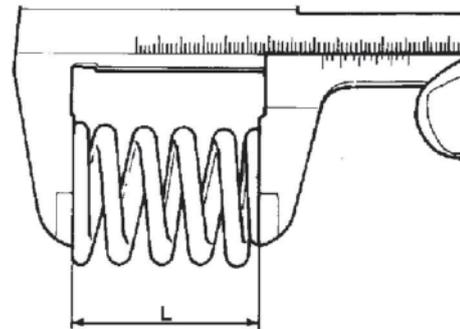
The maximum limit of deformation is **0,1 mm**.



Measure the length "L" of the springs with a gauge.

Service limit: **39 mm**

Replace the springs exceeding the service limit.

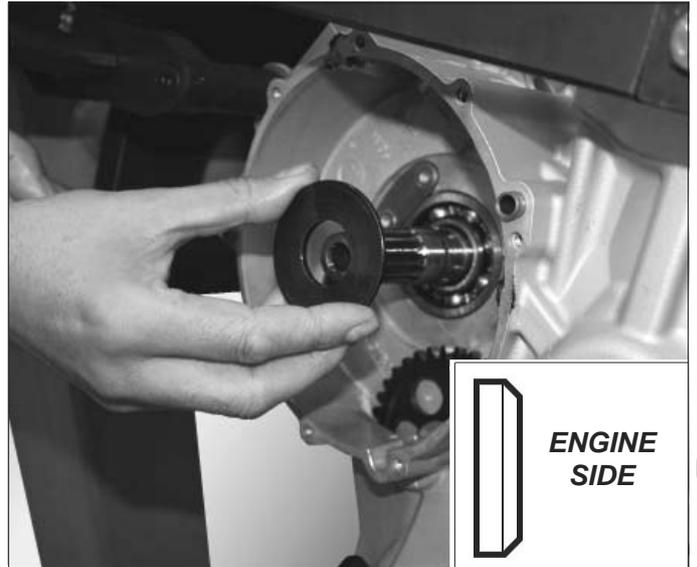


## Clutch reassembly

Reposition the shim washer with the smallest diameter facing towards the engine.



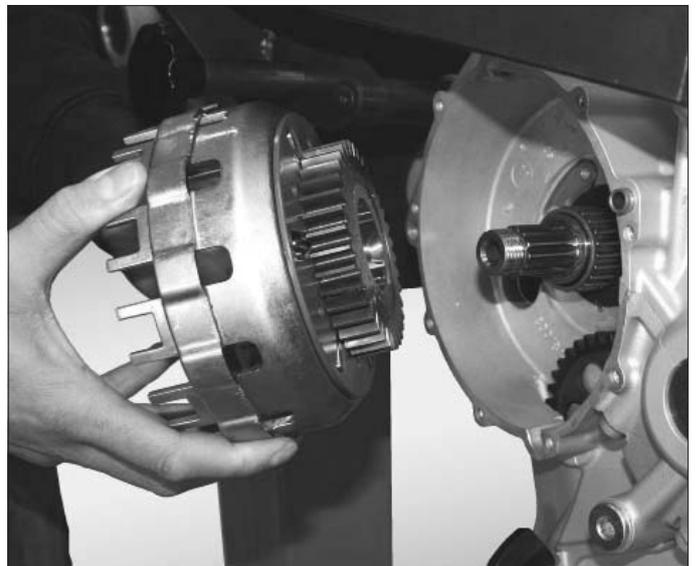
**Make attention to the correct positioning of the washer.**



Position the spacer, the roller cage



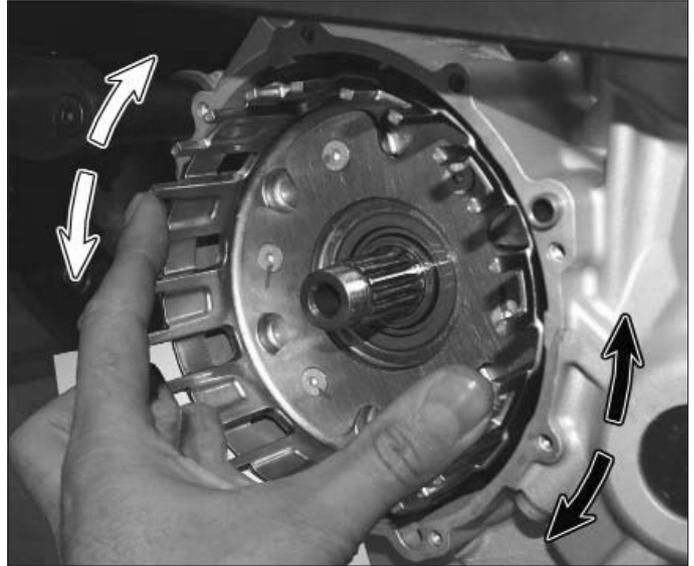
and the clutch housing.





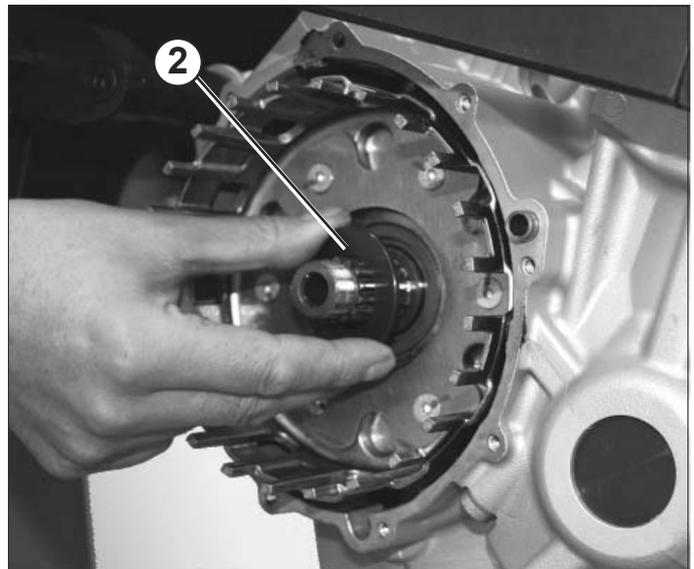
## Clutch

Alternate pushing the clutch case in and rotating it in order to help it mesh with the pump transfer and countershaft gears and avoid them grinding.

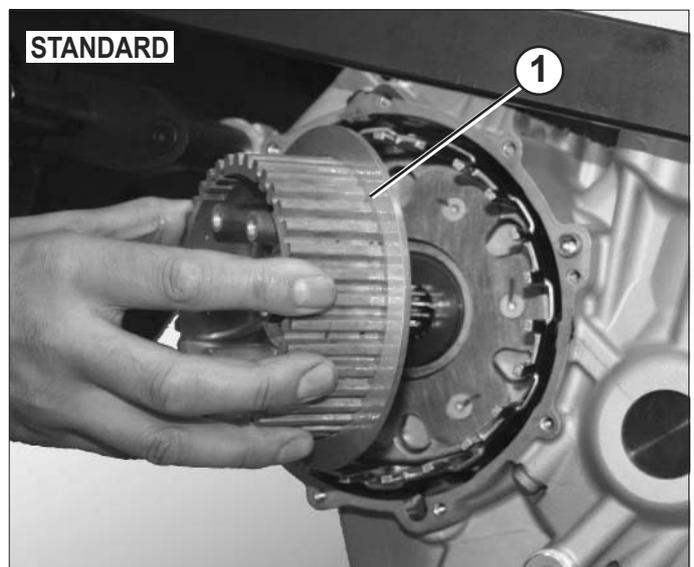
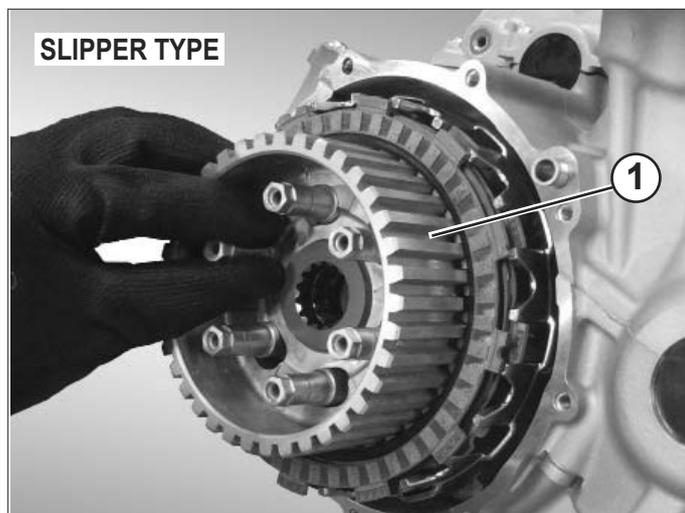


E

Fit the washer.  
Make sure the washer is positioned in front of the friction drum, since it was sheared and therefore has a sharp corner and a rounded corner. Position the rounded corner on the engine side.



Assembly the clutch hub.



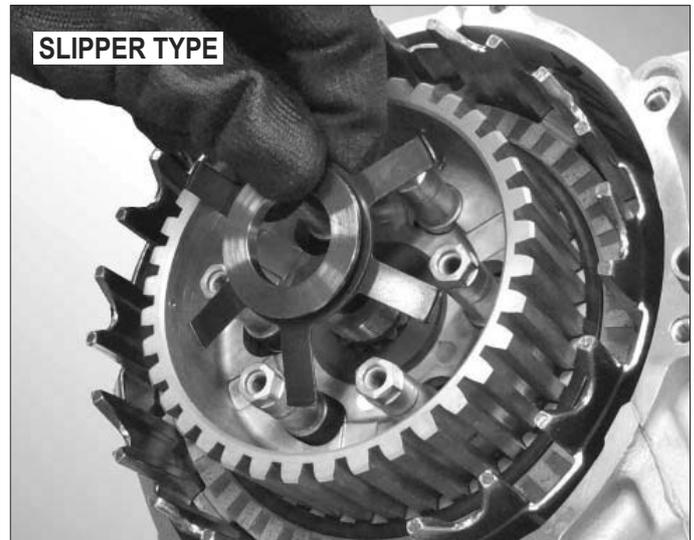
## (Standard clutch)

Grease the side of the washer in contact with the hub.

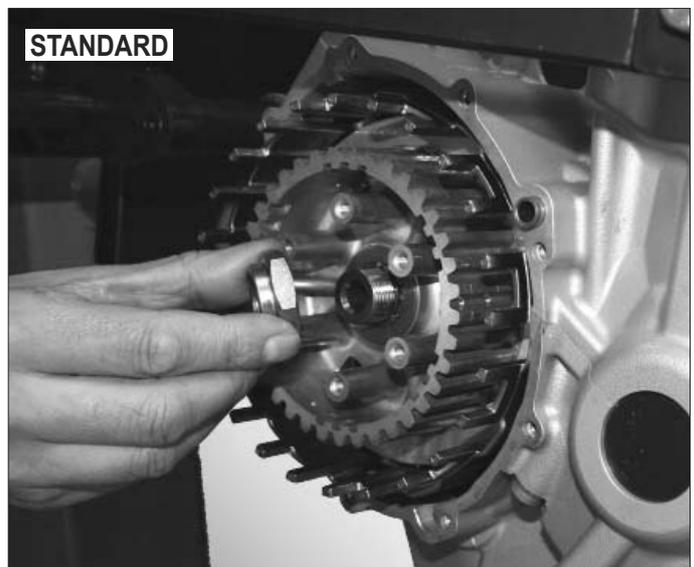
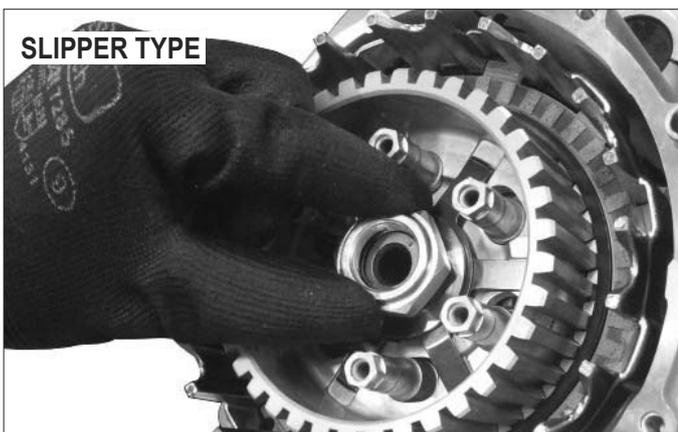


## (Slipper clutch)

Install the two springs and the washer on the hub.



Insert the nut, screwing it down manually until it makes contact with the washer.

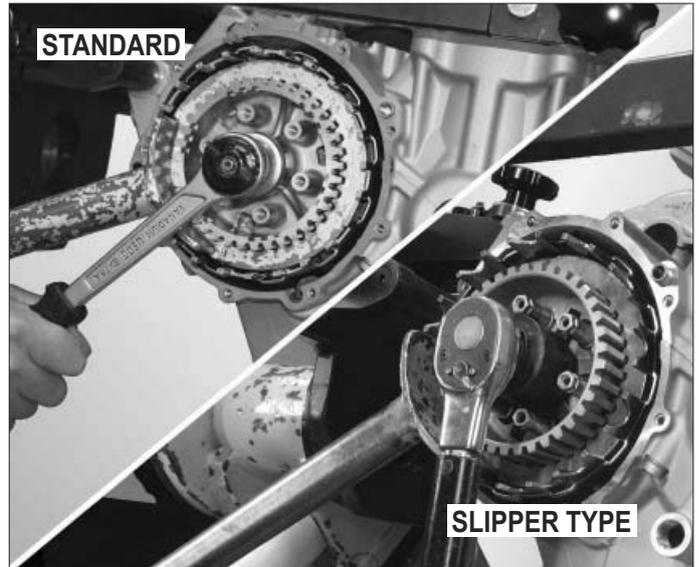


E



## Clutch

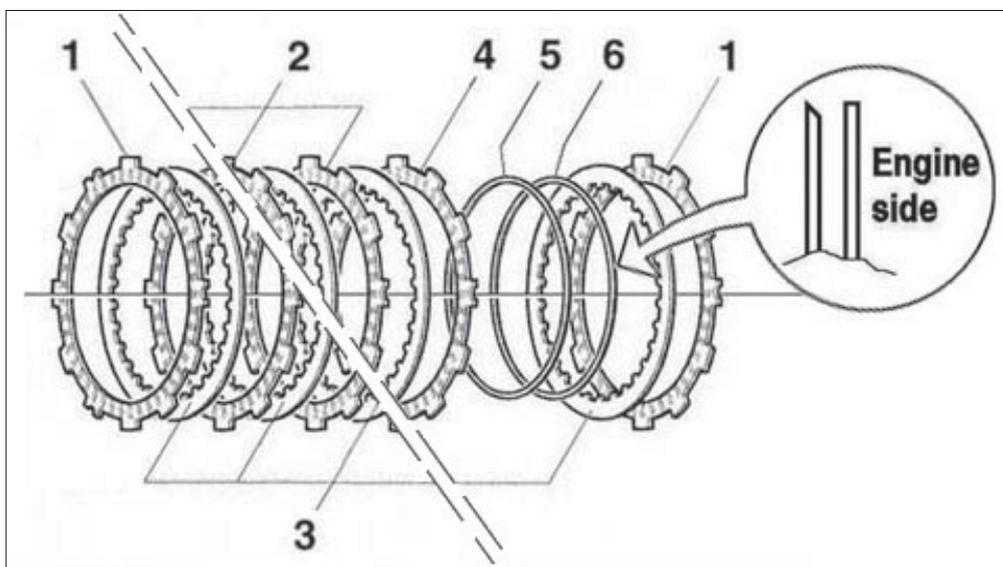
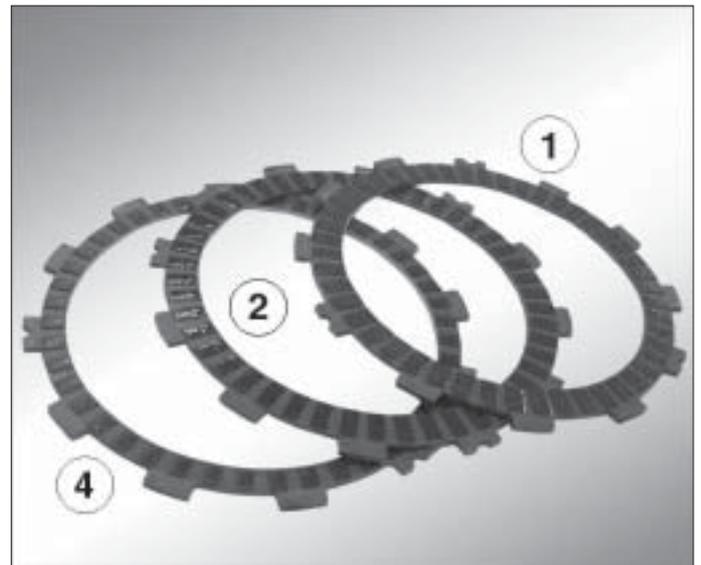
Use the tool no. 800079015 to lock the clutch housing, then tighten the nut to 120 Nm with medium threadblocker.



 **Notice:** three types of packed disks are used; to assemble them, see the diagram.

 **Attention:** before installation, lubricate the friction discs with engine oil.

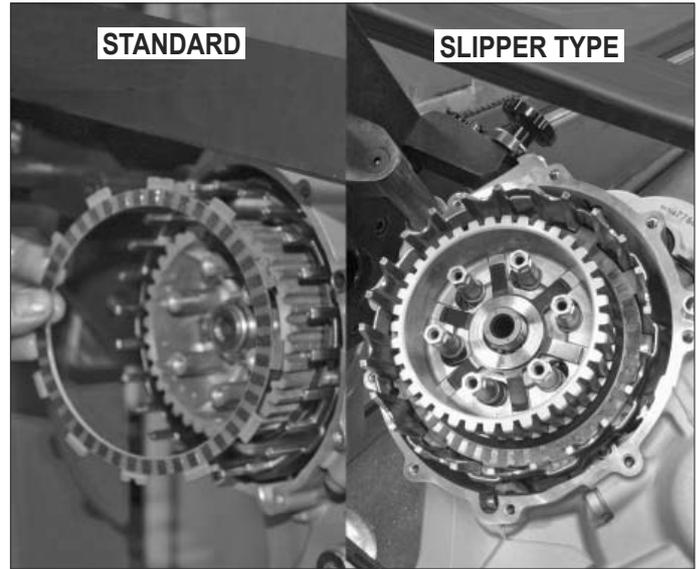
First fit in one of the two disks (1) with the larger friction cells and a plain disk (3). Fit in the spring holder (5), the spring (6) with the narrower diameter facing the engine and the packed disk with the larger inner diameter (4); then, fit in the other two packed disks (2), alternating them with the plain disks (3), and lastly fit in the last outer disk (1); then, alternating with the smooth discs (3), fit the other friction discs (2) and finally the remaining external disc (1).



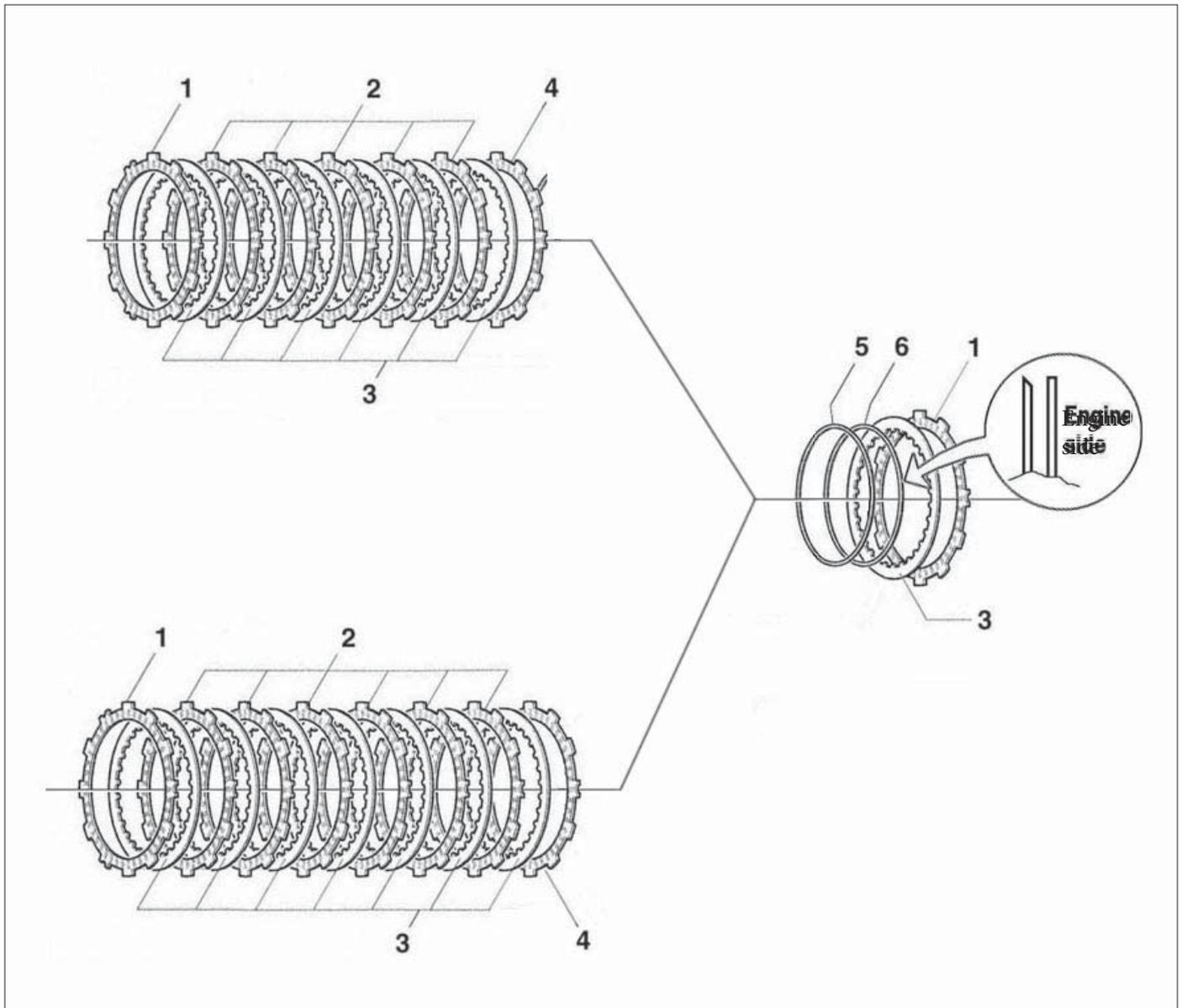
# Clutch



Part	Quantity	
	Standard Clutch	Slipping Clutch
1	2	2
2	5	6
3	7	8
4	1	1
5	1	1
6	1	1



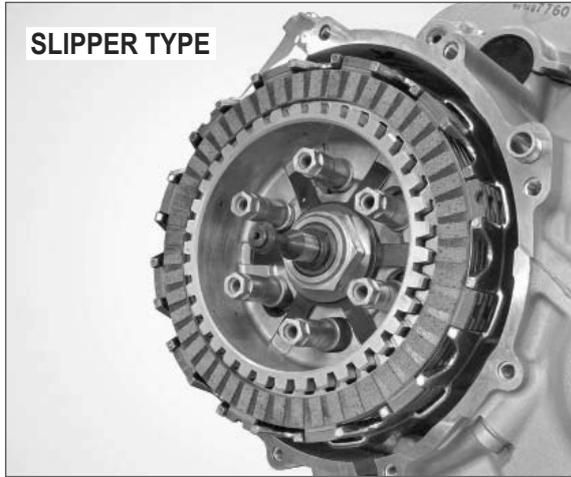
E





## Clutch

Once the discs have been fitted, insert the clutch control rod



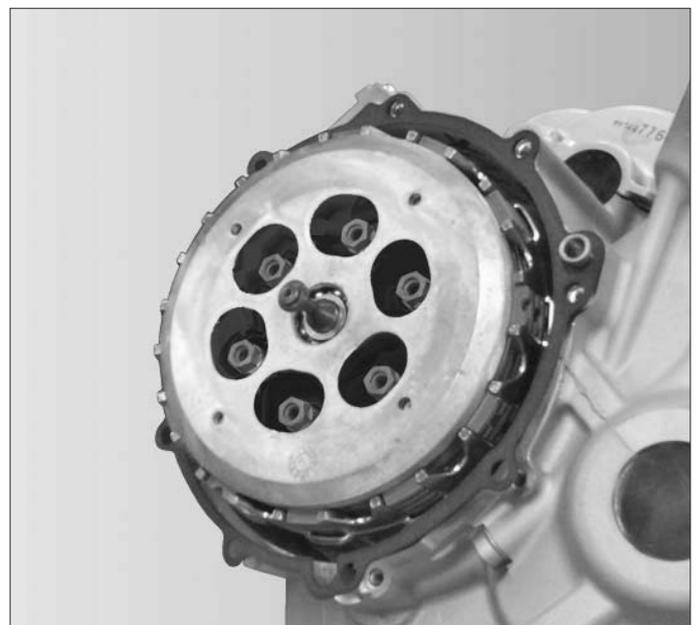
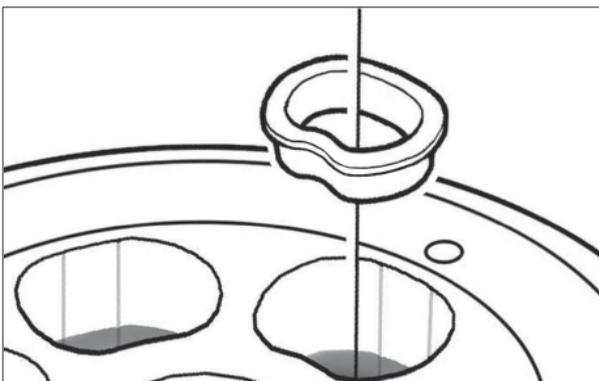
**(Only for standard clutch)**  
Fit in the clutch disc pusher,



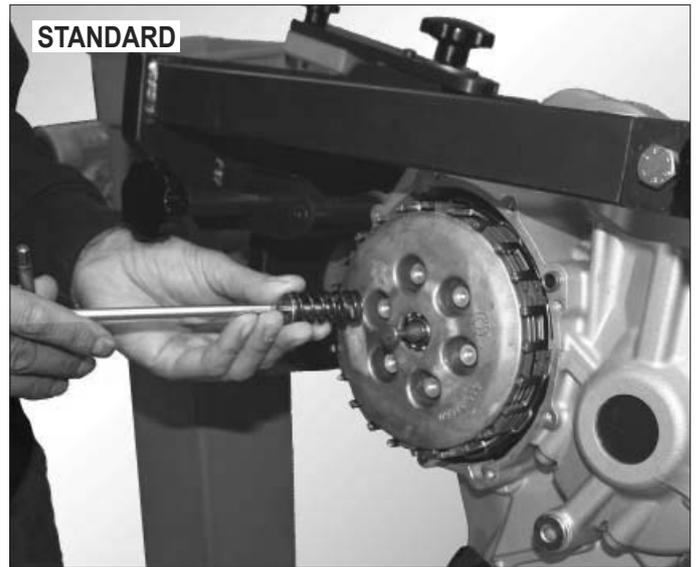
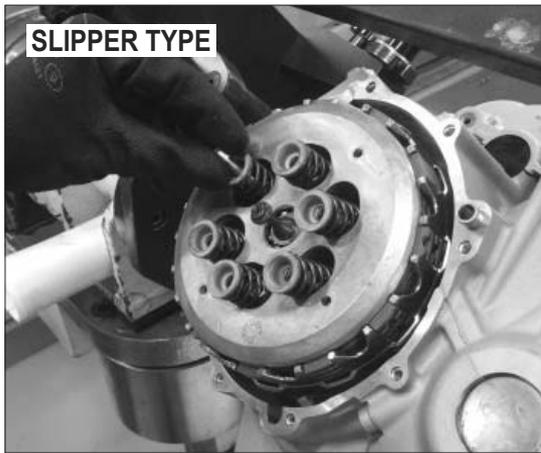
**(Only for standard clutch)**  
Fit in the clutch disc pusher, the six spring holders,



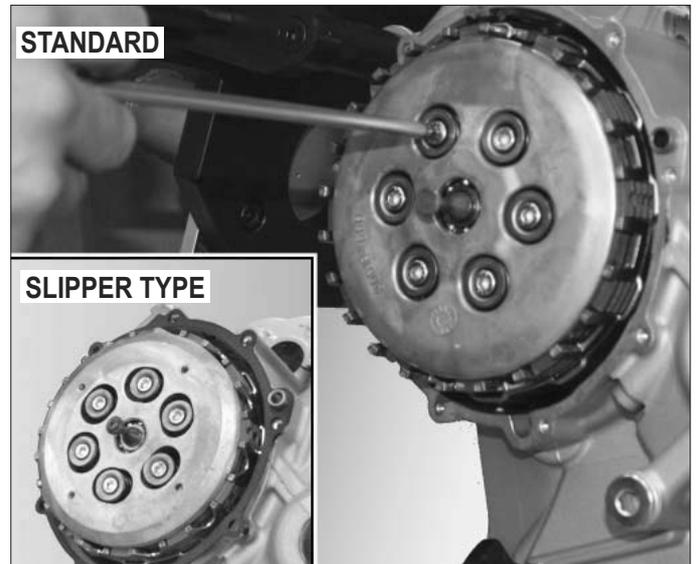
The spring supports have an edge with a concave segment which must be oriented towards the center of the clutch plate pusher; for correct assembly refer to the scheme below.



the plates, the springs, the self-centring washers and the screws



tighten the screws to the prescribed torque following a crossed run.



If necessary, replace the cover gasket, lining it up with the centring pins.

 **The contact surfaces must always be clean and degreased.**

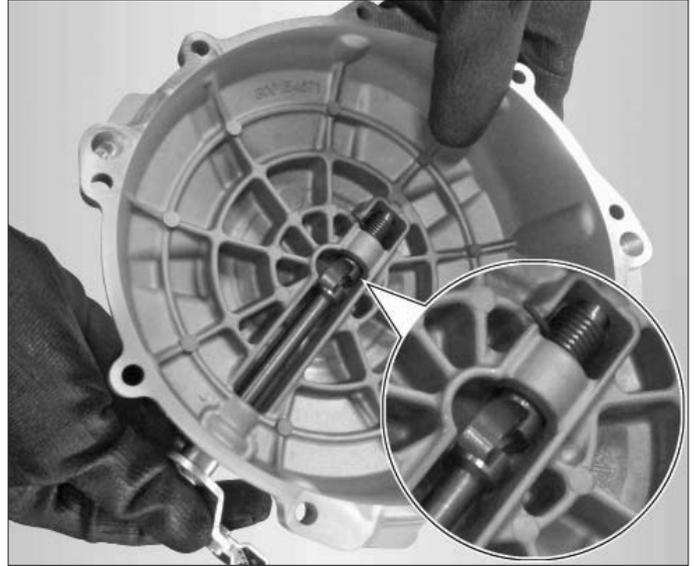




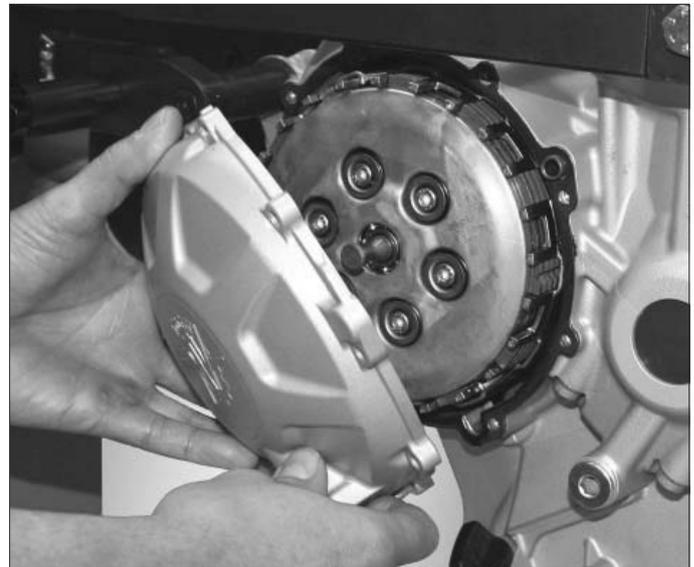
## Clutch

Orient the clutch control shaft on its seat as indicated.

Position the clutch cover,

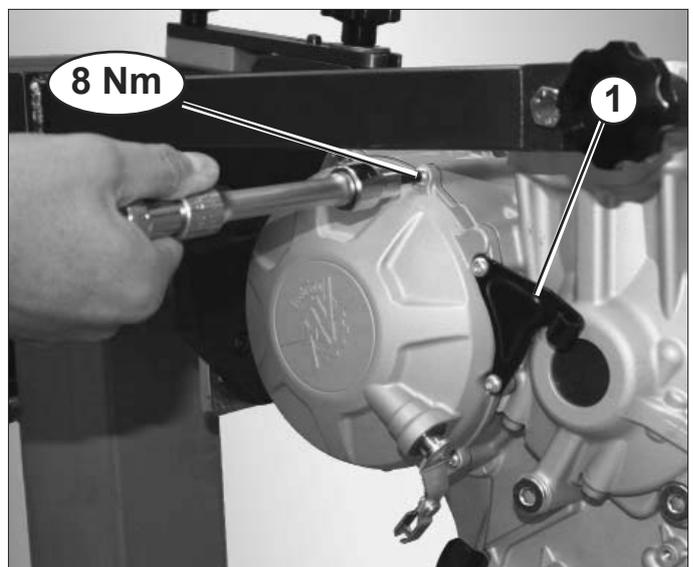


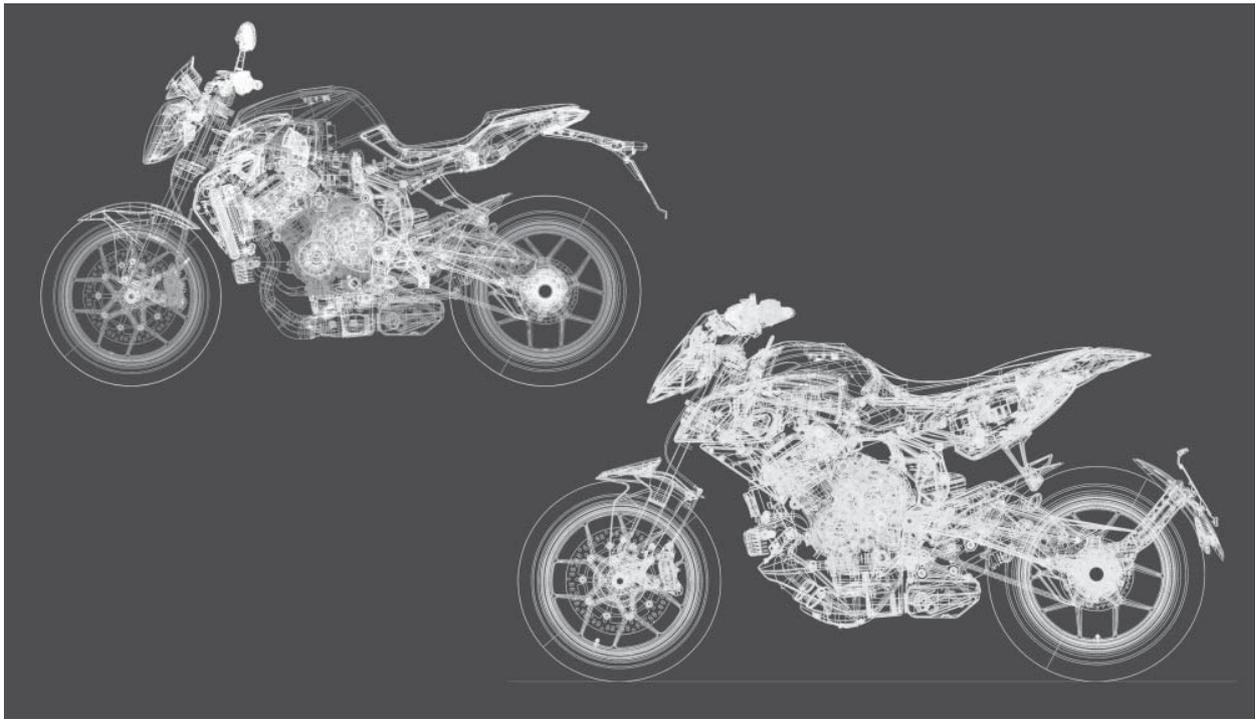
put the plate in position (1) and tighten the screws



by hand.

Tighten the screws to 8 Nm.





F

**SECTION F**

REVISION 0



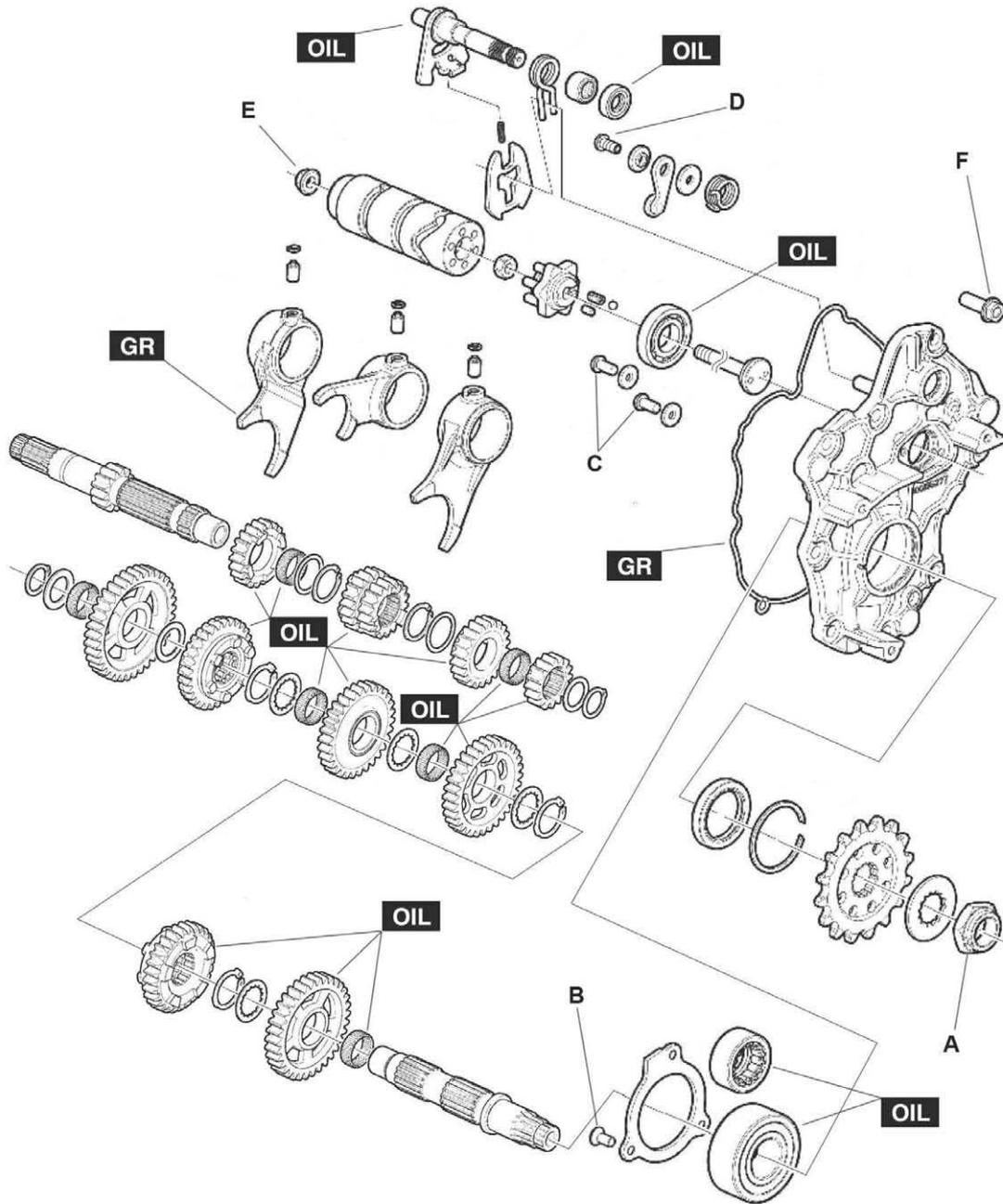
# Transmission

## SUMMARY

<b>TRANSMISSION .....</b>	<b>Page</b>	<b>3</b>
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Overhauling the transmission .....	Page	5
Transmission breakdown .....	Page	8
Main shaft .....	Page	11
Lay shaft .....	Page	12
Gear selector drum (Desmo) .....	Page	14
Gear shift .....	Page	15
Transmission assembly .....	Page	18

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## TRANSMISISON



F

Tightening torque	A	B	C	D	E	F	G	H	I	L
	Nm	140	8	8	6	25 (M8)	25			
Threadlocker type	medium/strength				medium/strength					

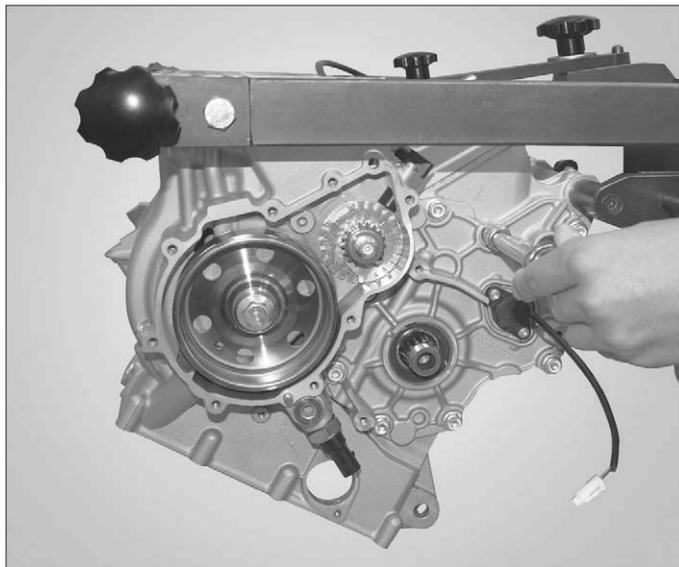
<b>OIL</b>	Apply engine oil	<b>SS</b>	Apply silicone sealant
<b>NO OIL</b>	Do not apply oil or other substances	<b>HSC</b>	Apply Molikote HSC
<b>GR</b>	Apply grease	<b>M</b>	Apply gasket sealant



## Transmission

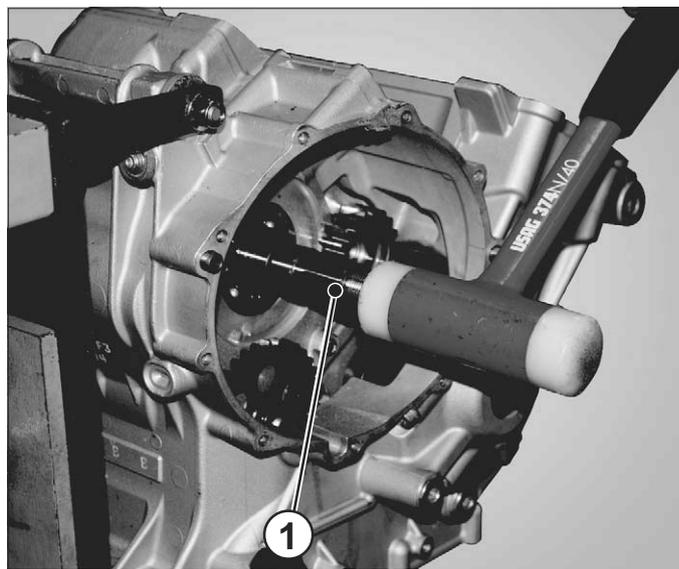
### Removing the transmission

Remove the clutch following the instructions in the relative paragraph. Remove the clutch rod. Remove the 8 fastening screws from the transmission cover.

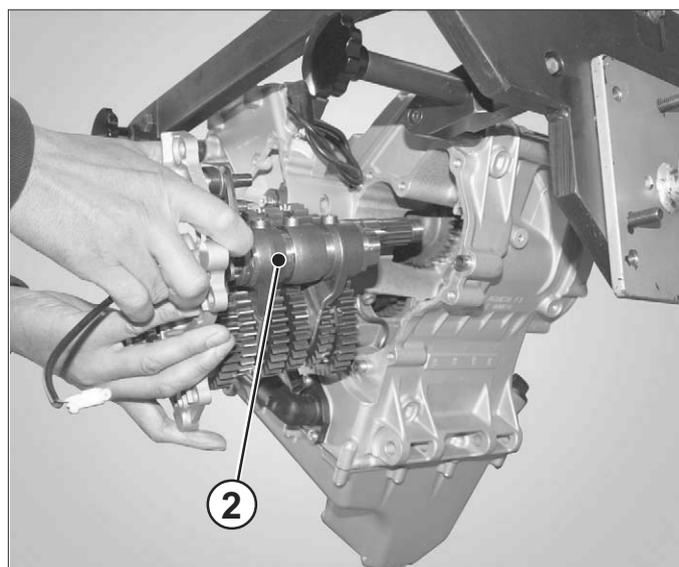


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Using a rubber mallet, delicately strike the main shaft (1) from the clutch end holding a hand on the transmission cover until it moves from the crankcase.

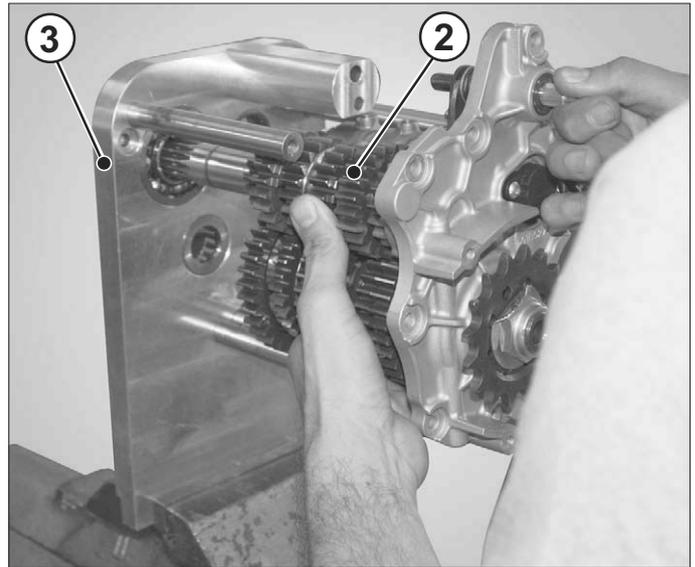


Extract the transmission assembly (2) from the engine block.

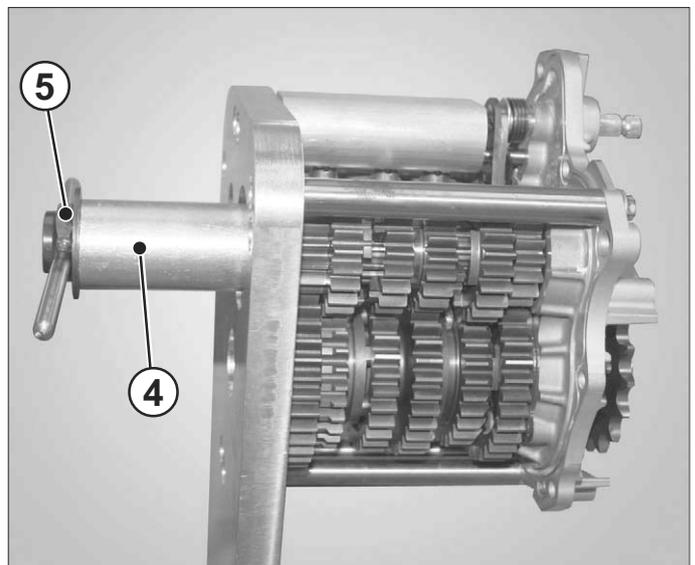
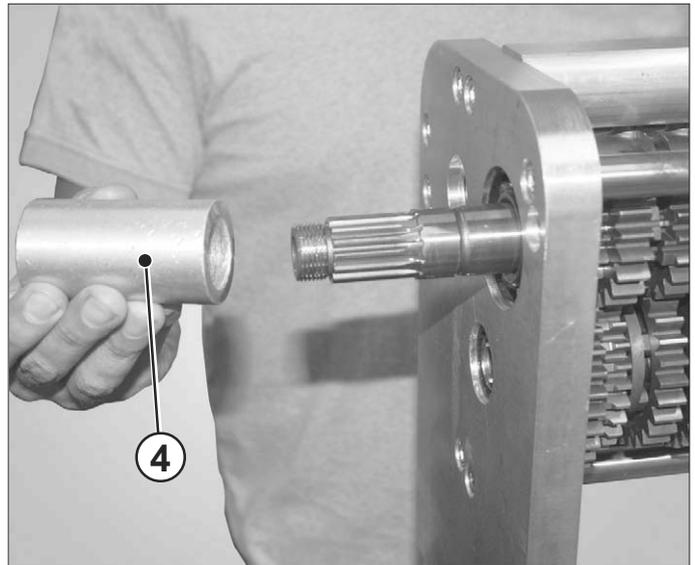


## Overhauling the transmission

- Place the transmission assembly (2) on the transmission overhaul device (3) (Cod. 8000B7177).



- On the rear part insert the spacer (4) on the main shaft and lock it by manually screwing down the flywheel (5).

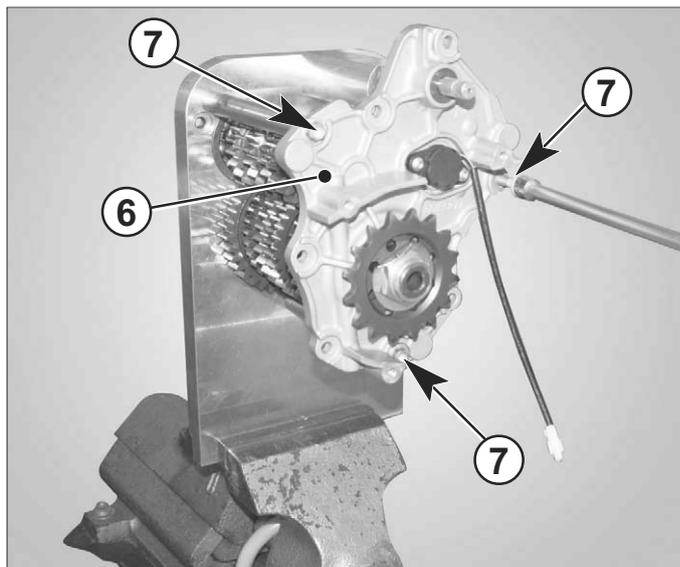


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## Transmission

- Fix the front of the transmission assembly to the device, fastening the flange (6) with the three screws (7).

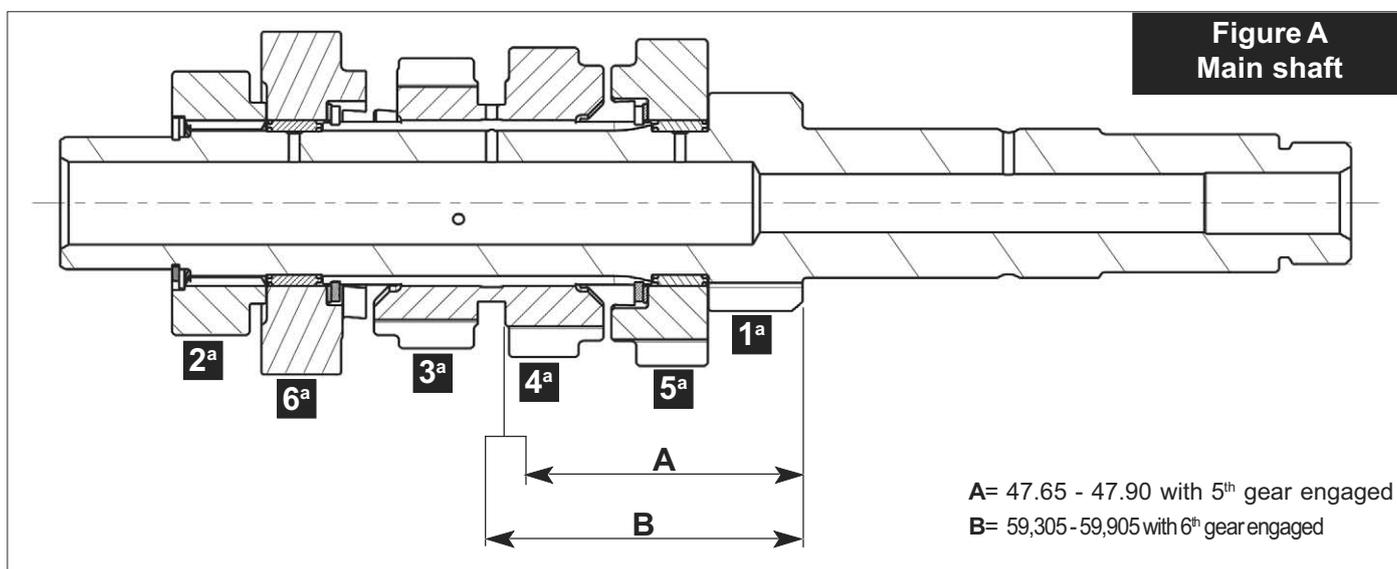
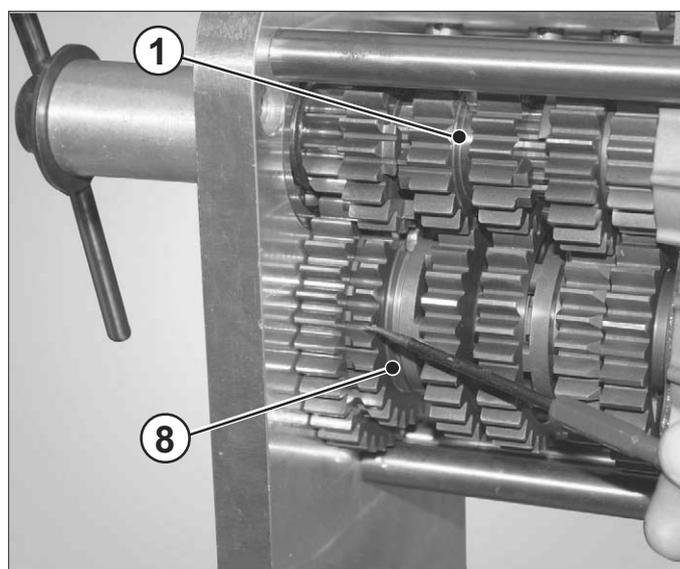


- Check the condition of the front clutching teeth of the gears which must be in perfect shape and sharp edged.

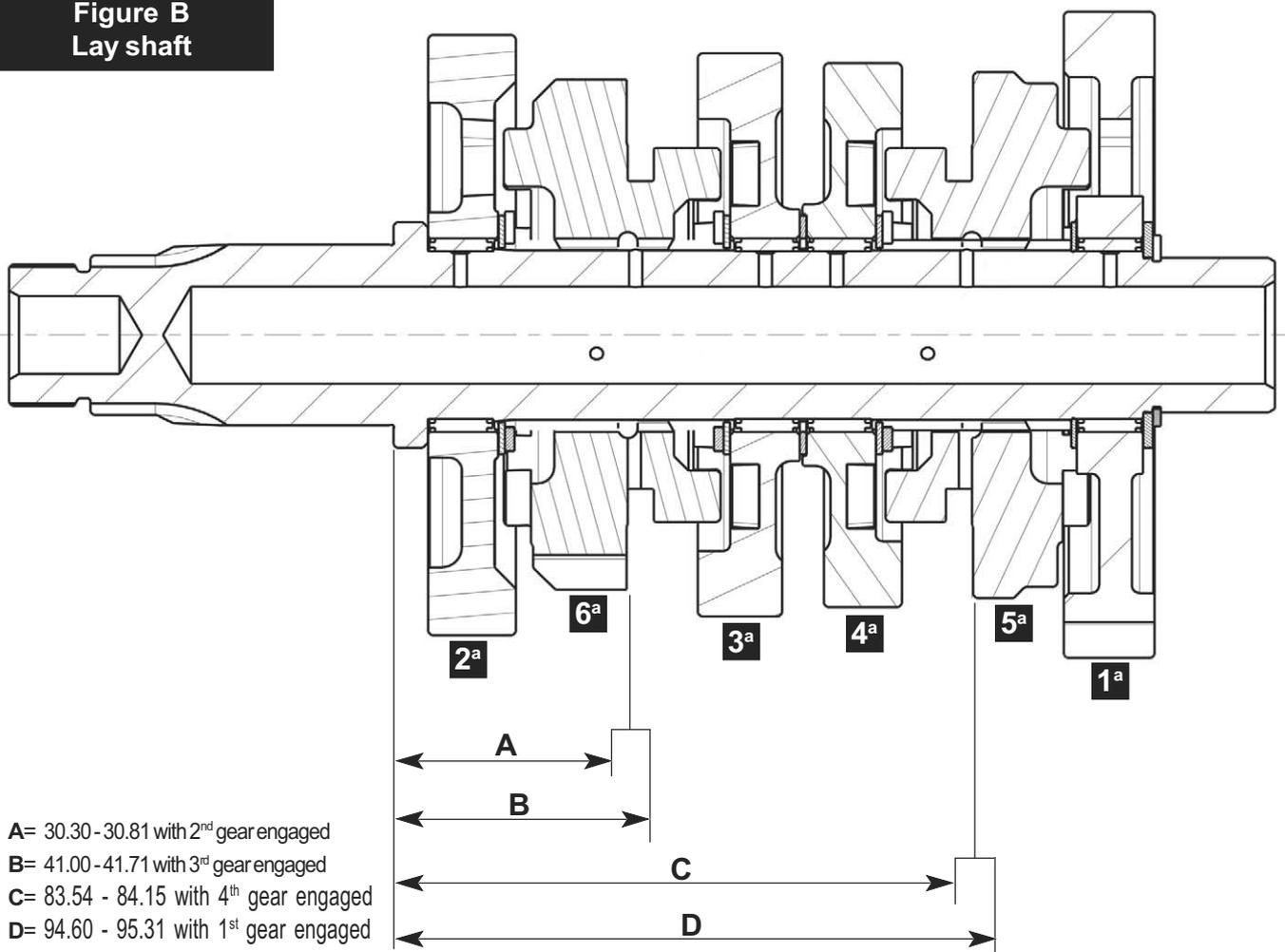
The neutral gears must rotate freely on their shafts. All of the neutral gears must present a minimum axial play of 0.10 mm.

Ensure that the shafts rotate freely without impediments, checking the state of the bearings.

- Check the measurements of the main shaft (1) and lay shaft (8), comparing them with the figures "A" e "B" respectively.



**Figure B**  
**Lay shaft**

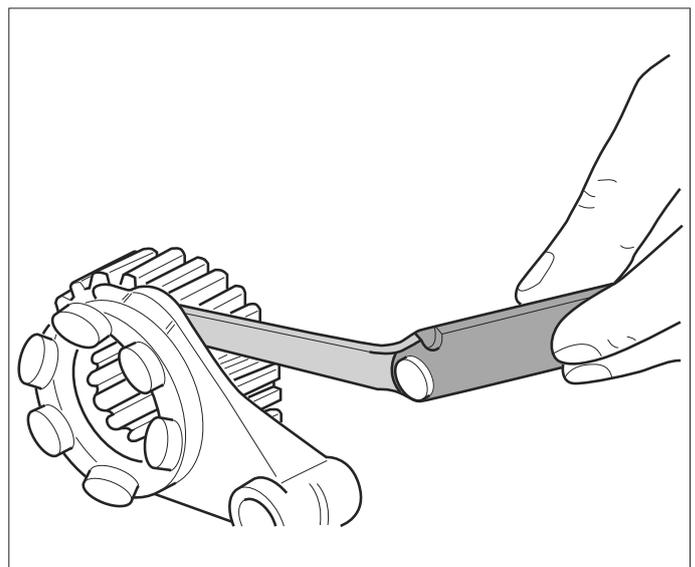


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- Visually inspect the gear selection forks to look for bending or other damage. Every fork that appears damaged must be substituted because it can cause difficulty when engaging a gear and cause sudden disengagement under load. Check the play of each fork using a feeler gauge in the groove of its gear. If play is above 0.7 mm replace the gear or fork in relation to the service limits of each part.

Gear groove limit: ..... **5,6 mm** Primary  
**4,6 mm** Secondary

Fork limit: ..... **4,65 mm** Primary 5<sup>th</sup>-6<sup>th</sup> gear  
**3,65 mm** Secondary 1<sup>st</sup>-2<sup>nd</sup>, 3<sup>rd</sup>-4<sup>th</sup> gear



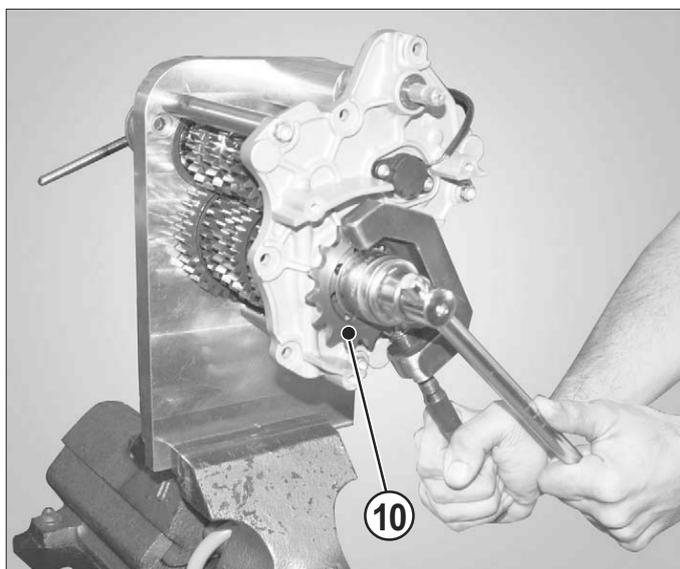
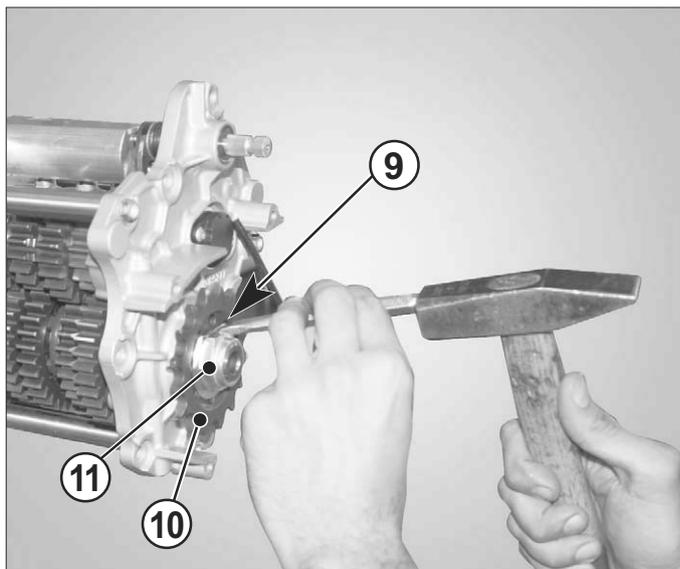
The forks must slide effortlessly.  
 The gears must slide effortlessly and without excessive friction.



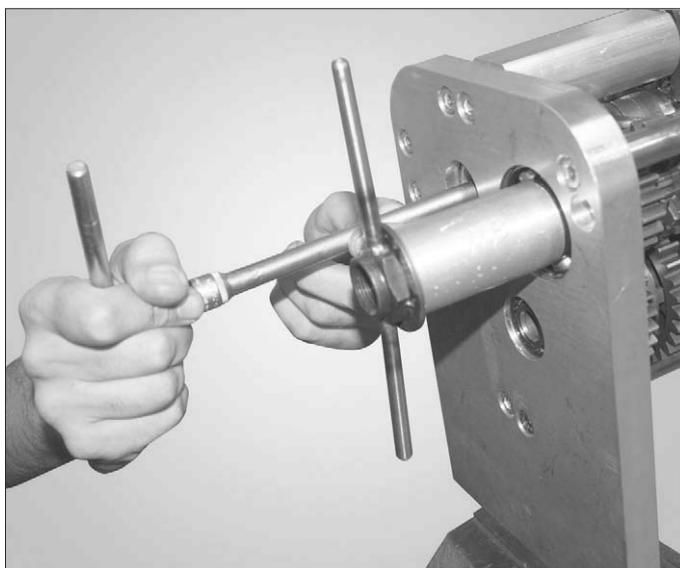
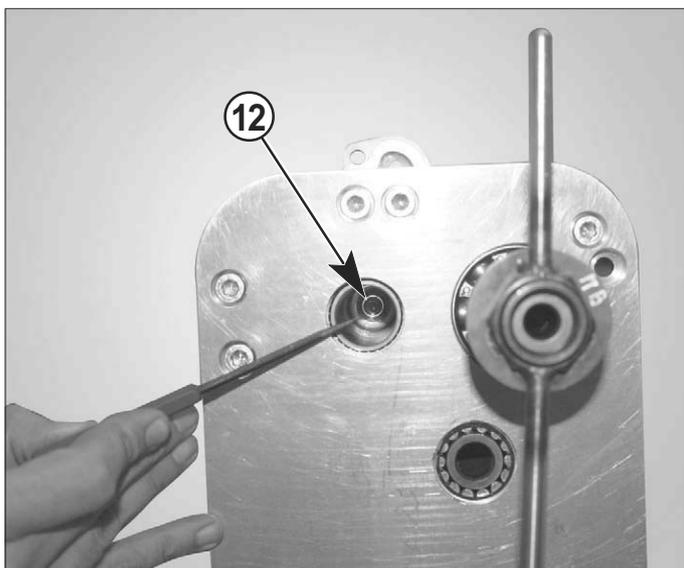
## Transmission

### Transmission breakdown

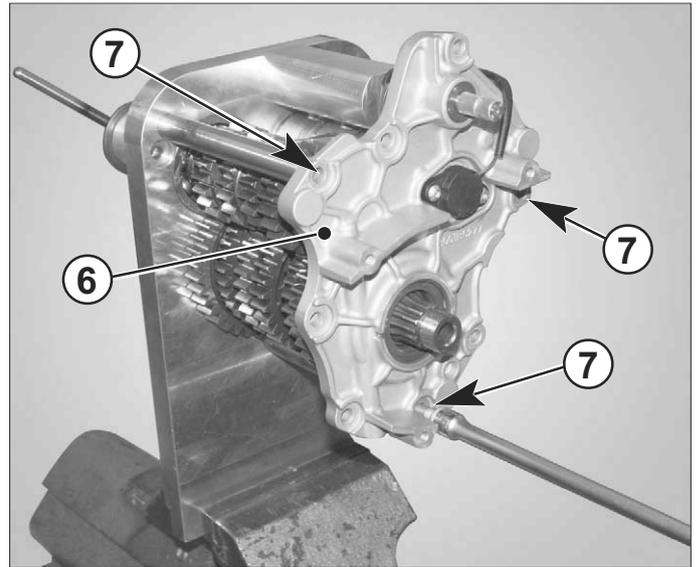
- Straighten the safety washer (9) and, blocking the pinion (10), unscrew the nut (11) then remove the pinion and washer.



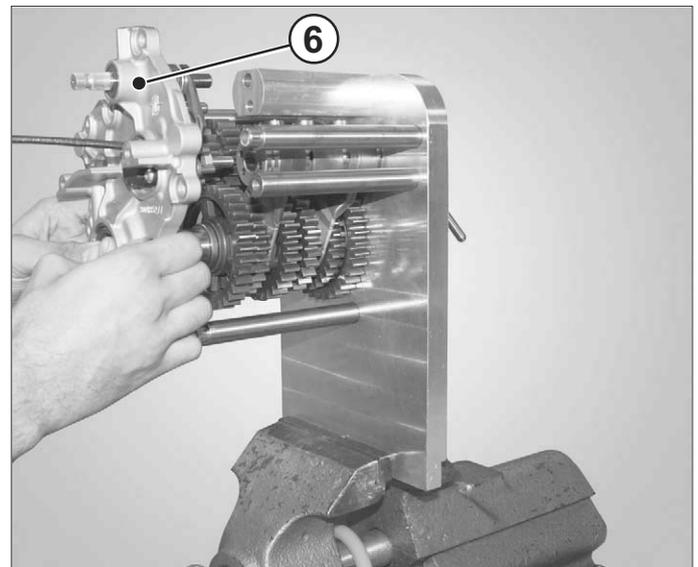
- It is necessary to manually engage 6th gear in order to separate the main and lay shaft, then unscrew the nut (12) fastening the selector drum (desmo) to the gearshift.



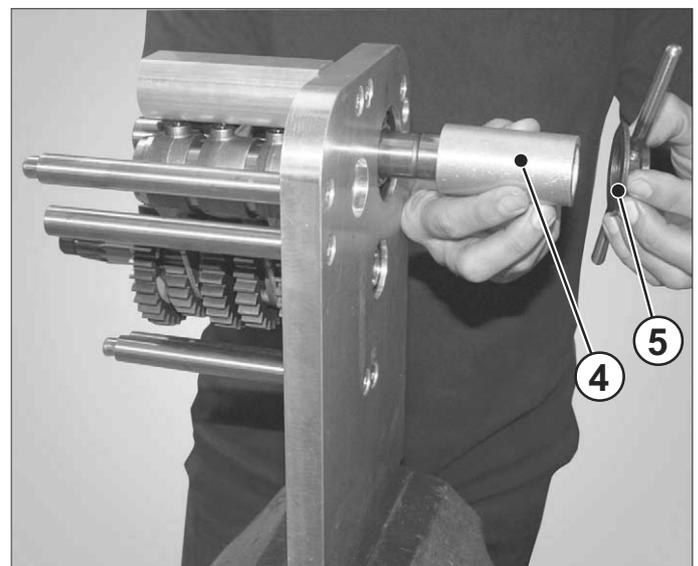
- Unscrew the three screws (7) and remove the flange (6).



F



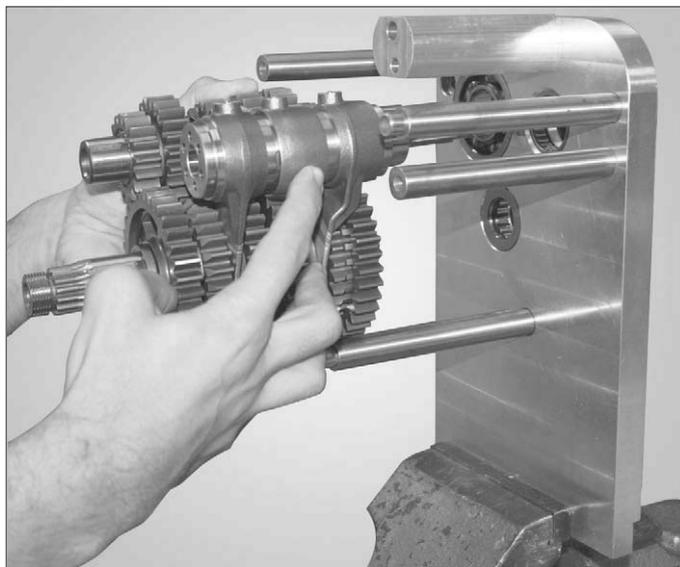
- Unscrew the flywheel (5) and remove the spacer (4), freeing the main shaft.



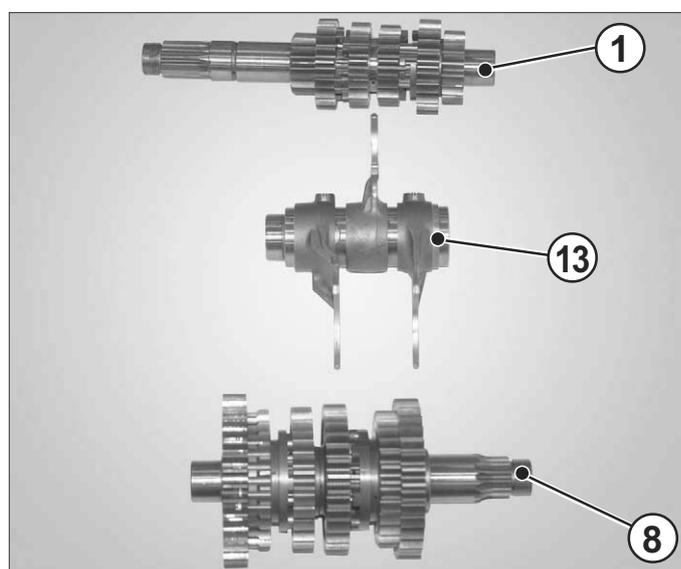
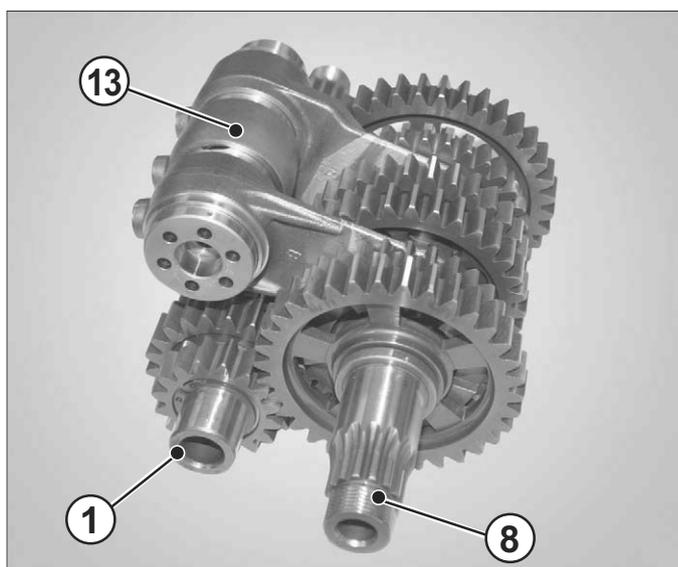


## Transmission

- Extract the transmission shafts from the plate and place them on the bench.



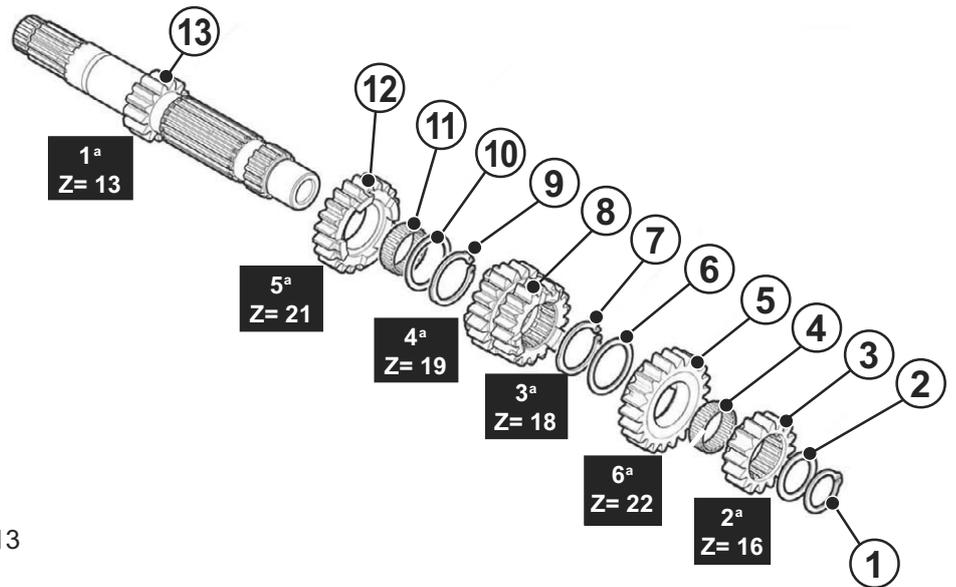
- Remove the selector drum (desmo) (13) and detach the main shaft (1) from the lay shaft (8).



## Main shaft

### Key

- 1) Stop ring
- 2) Shim washer
- 3) 2<sup>nd</sup> gear gears; Z= 16
- 4) Roller cage
- 5) 6<sup>th</sup> gear gears; Z= 22
- 6) Shim washer
- 7) Stop ring
- 8) 3<sup>rd</sup> gear gears; Z= 18
- 4<sup>th</sup> gear gears; Z= 19
- 9) Stop ring
- 10) Shim washer
- 11) Roller cage
- 12) 5<sup>th</sup> gear gears; Z= 21
- 13) Shaft with 1<sup>st</sup> gear gears; Z= 13

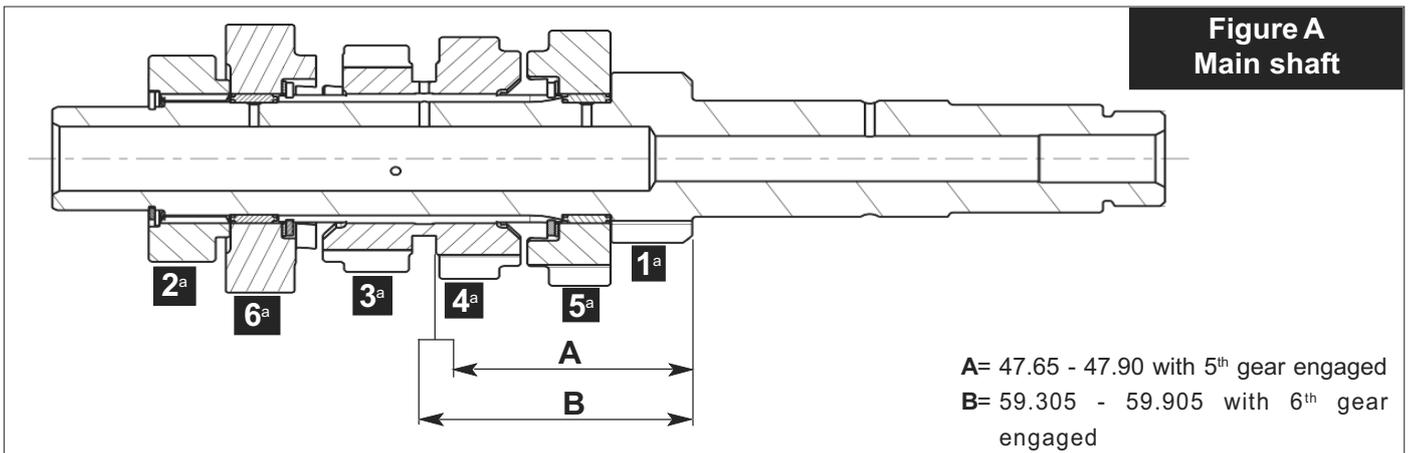
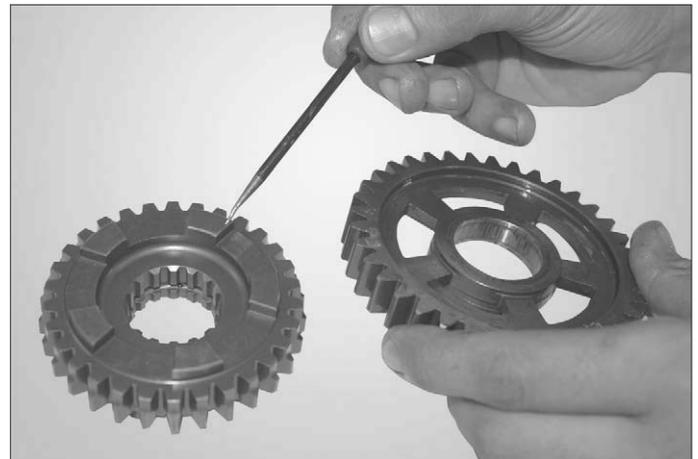


- Disassemble the main shaft starting with the removal of the stop ring (1), removing all the components as in the figure.
- Check that the gear teeth are intact and the threads and grooves of the shafts and gears are in perfect condition.
- Check the state of the front dog clutches.
- Check the state of the roller cages, if they are worn replace them.

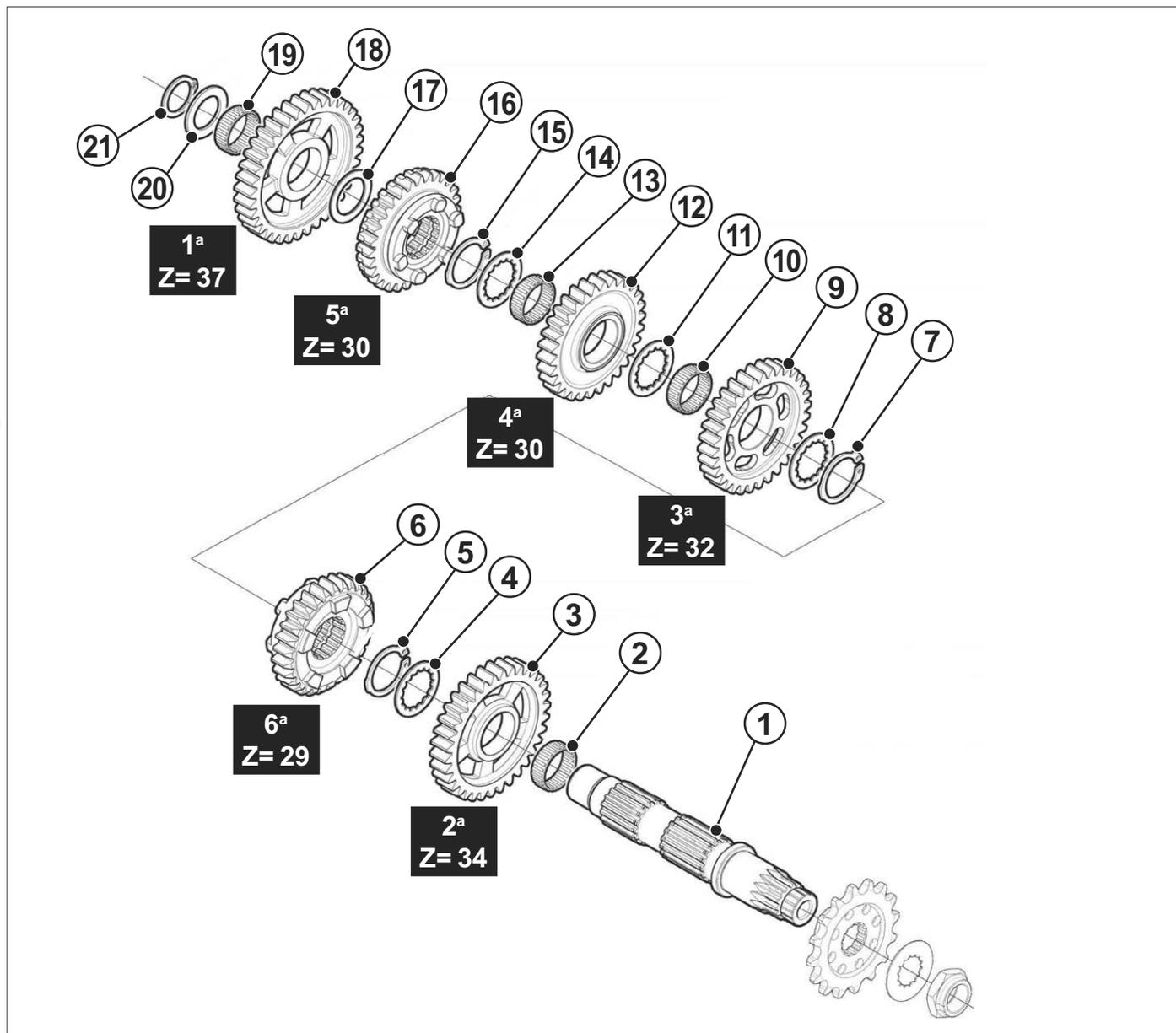


**If it is necessary to replace one or more gears, replace also the corresponding gears on the lay shaft – gears must be replaced in pairs.**

- Refit the gears onto the shaft, proceeding in the reverse order of removal and checking the measurements in figure A.



## Lay shaft

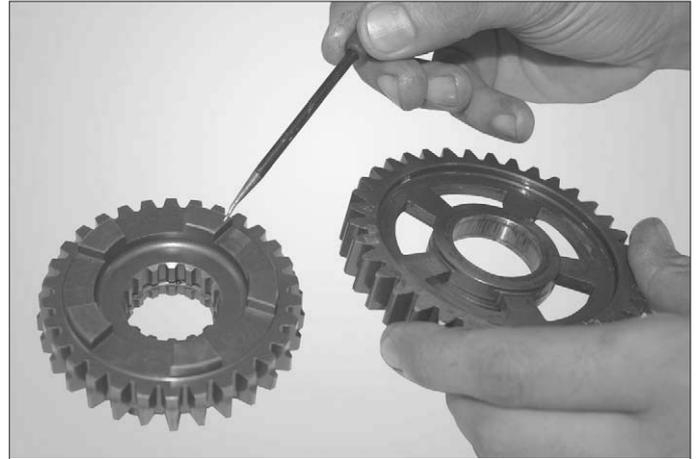


### Key

- 1) Lay shaft
- 2) Roller cage
- 3) 2<sup>nd</sup> gear gears; Z= 34
- 4) Grooved washer
- 5) Stop ring
- 6) 6<sup>th</sup> gear gears; Z= 29
- 7) Stop ring
- 8) Grooved washer
- 9) 3<sup>rd</sup> gear gears; Z= 32
- 10) Roller cage

- 11) Grooved washer
- 12) 4<sup>th</sup> gear gears; Z= 30
- 13) Roller cage
- 14) Grooved washer
- 15) Stop ring
- 16) 5<sup>th</sup> gear gears; Z= 30
- 17) Shim washer
- 18) 1<sup>st</sup> gear gears; Z= 37
- 19) Roller cage
- 20) Shim washer
- 21) Stop ring

- Disassemble the lay shaft starting with the removal of the stop ring (21), removing all the components as in the figure.
- Check that the gear teeth are intact and the threads and grooves of the shafts and gears are in perfect condition.
- Check the state of the front dog clutches.
- Check the state of the roller cages, if they are worn replace them.

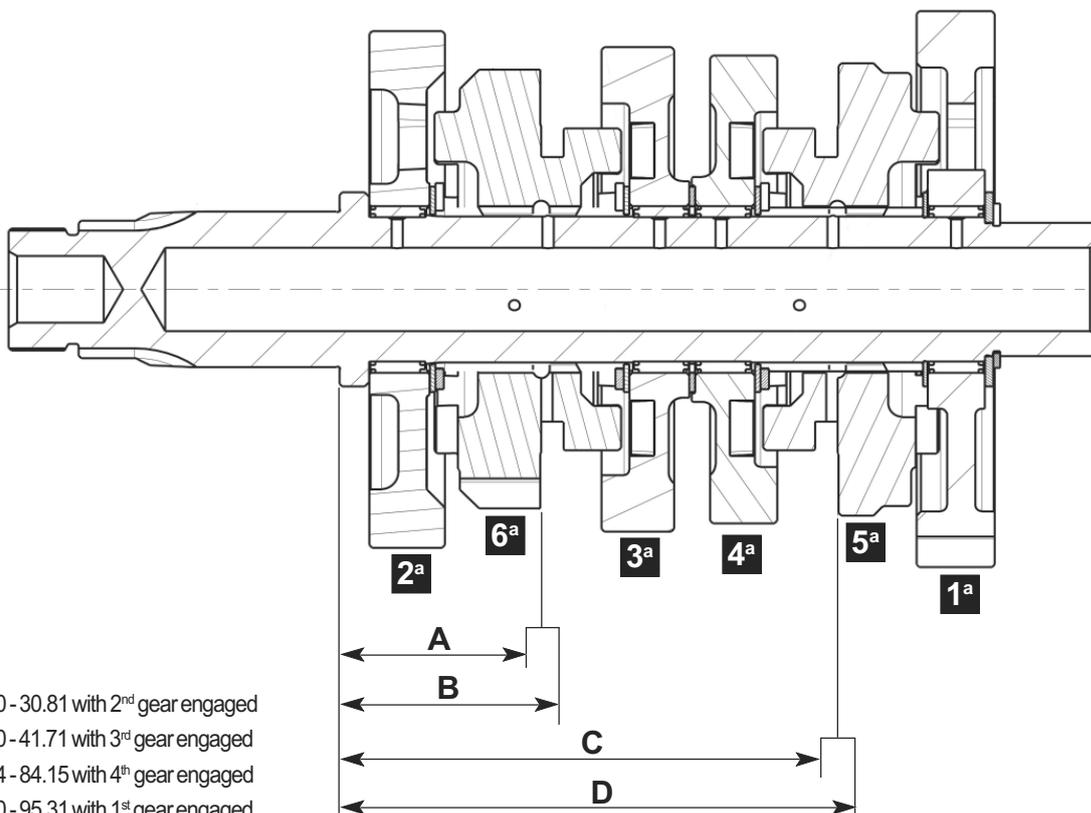


**If it is necessary to replace one or more gears, replace also the corresponding gears on the other shaft – gears must be replaced in pairs.**

- Refit the gears onto the shaft, proceeding in the reverse order of removal and checking the measurements in figure B.

F

**Figure B**  
**Lay shaft**



- A= 30.30 -30.81 with 2<sup>nd</sup> gear engaged
- B= 41.00 -41.71 with 3<sup>rd</sup> gear engaged
- C= 83.54 -84.15 with 4<sup>th</sup> gear engaged
- D= 94.60 -95.31 with 1<sup>st</sup> gear engaged



## Transmission

### Gear selector drum (Desmo)

- Remove the stop ring (1), remove the fork pin (2) and then the fork (3), then repeat the same operations for fork (4) and fork (5).

Examine the selector drum (6) ("Desmo"), whose grooves (7) must not be smoothed from wear.

The play between the fork pin (2) and grooves (7) with new components is **0.05 - 0.15 mm**.

Wear limit: **0.45 mm**.

The width of the grooves (7) for new drums is **7.05 - 7.15 mm**.

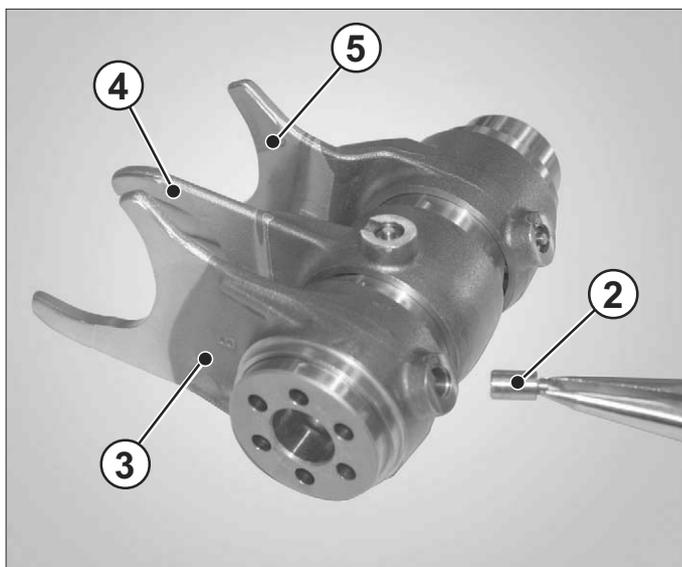
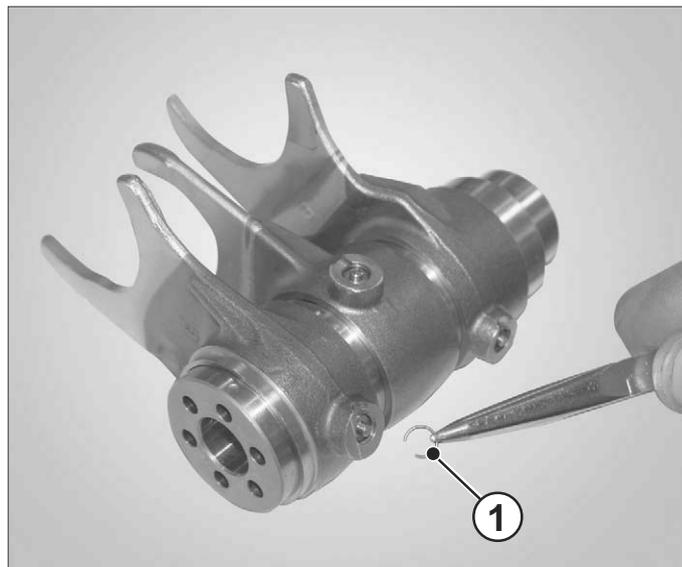
Wear limit: **7.25 mm**.

The diameter of the new fork pin (2) is **7 mm**.

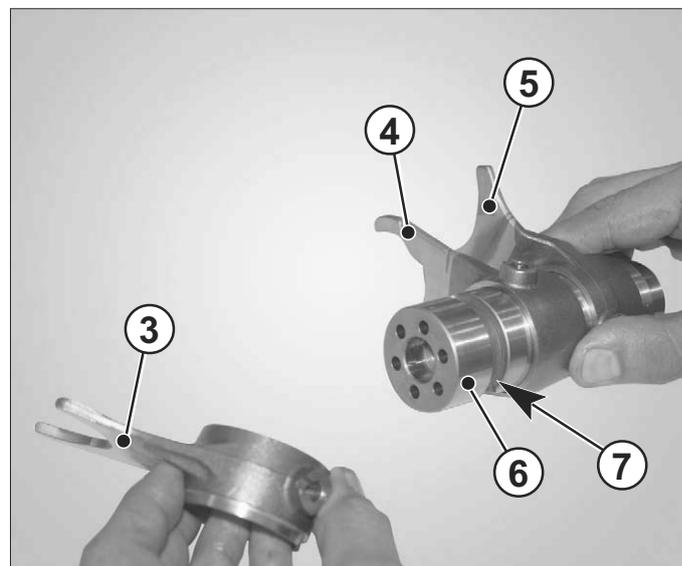
Wear limit: **6.8 mm**.

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 to the new component value to choose the parts to be replaced.



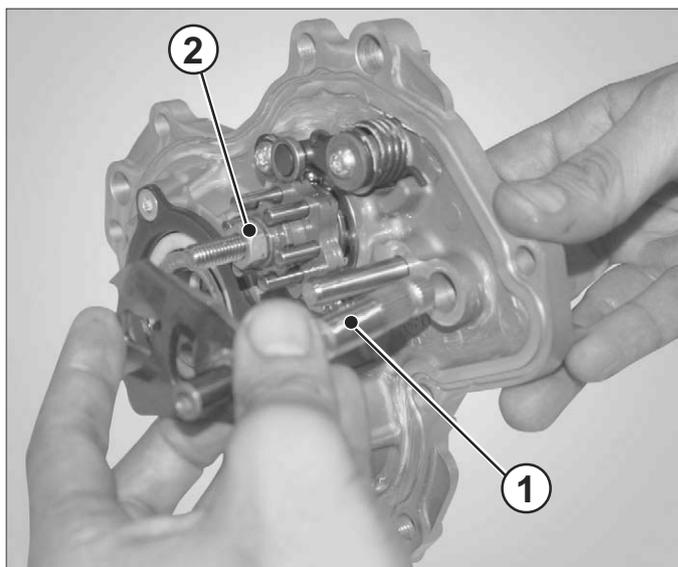
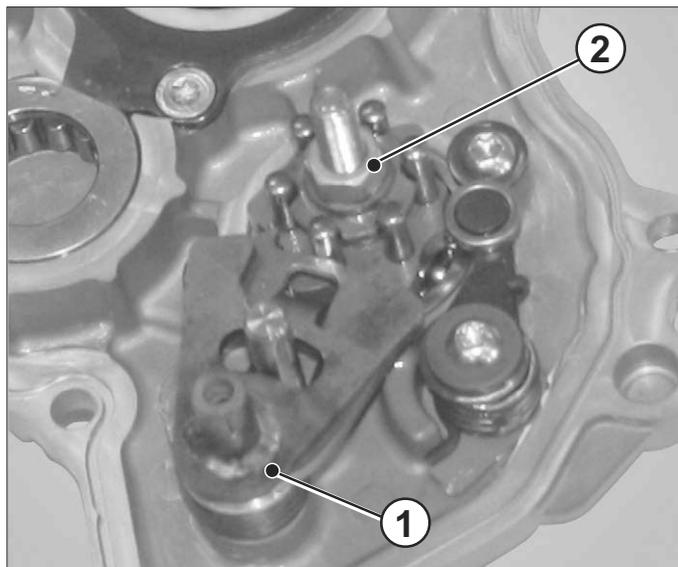
Reassemble the various parts by acting in the opposite way.



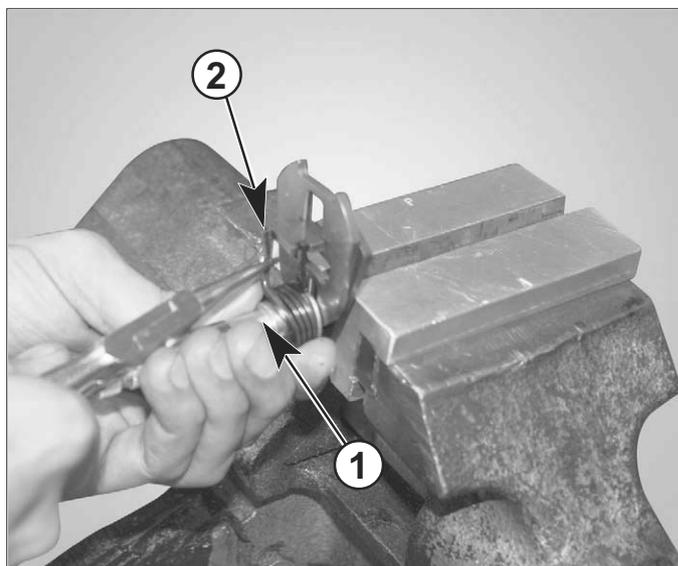
## Gear shift

If necessary, disassemble the gear shift assembly as follows:

- Remove the shift control rod (1), unhooking it from the gear selector (2).

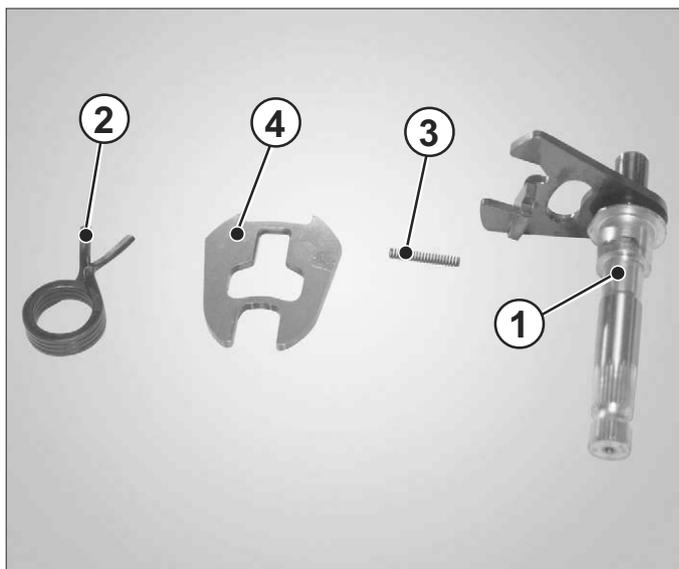


- Position the rod (1) in a vice, using aluminium plates so as not to damage it, unhook the spring and separate it.



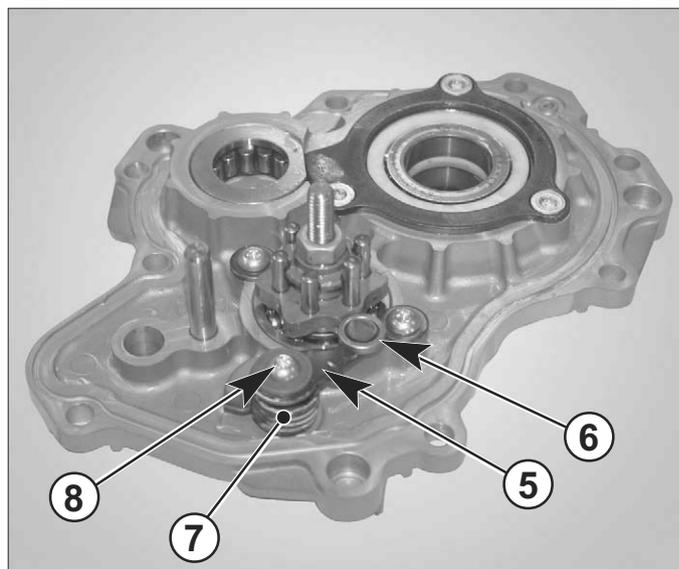
F

- Check spring (2), spring (3), the shaft (1) and the plate (4) for wear; if any component is found to be damaged it should be replaced.

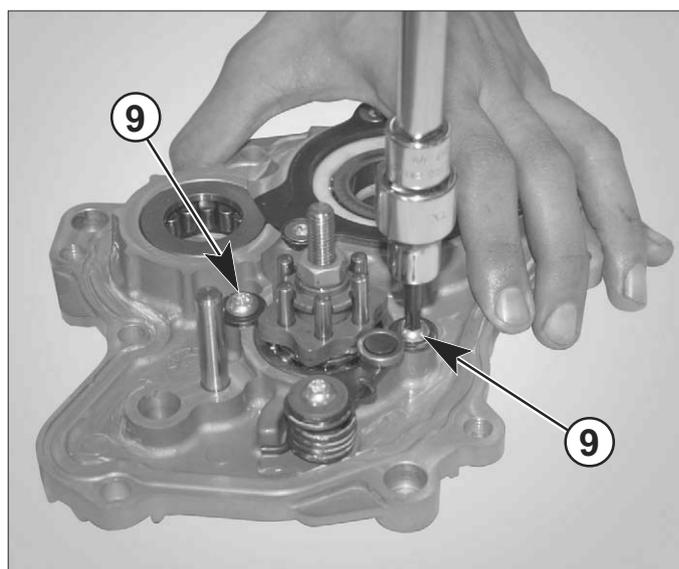


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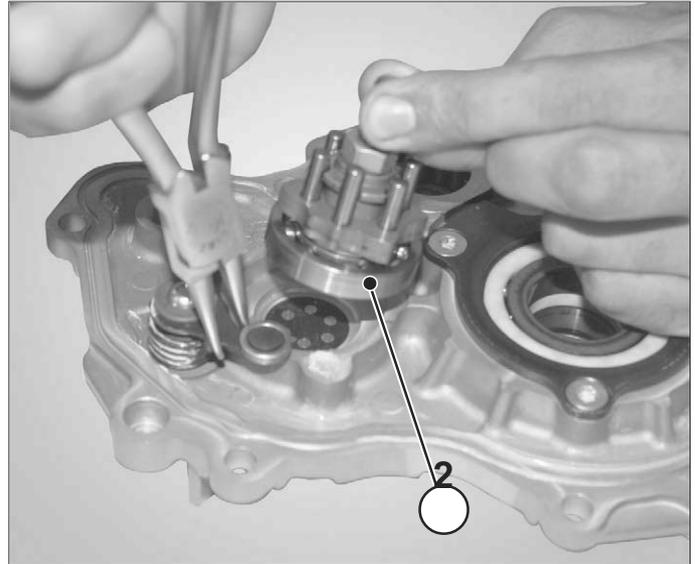
- Refit the rod, following the removal procedure in reverse, without fitting it to the shift flange.
- Check that the gear locker pawl (5) moves freely without obstruction and the thumbwheel (6) turns freely without excessive play; if the spring (7) or the pawl (5) must be replaced, unscrew the screw (8) to remove the assembly. On reassembly, lock the screw (8) with Loctite 243 to 10 Nm.



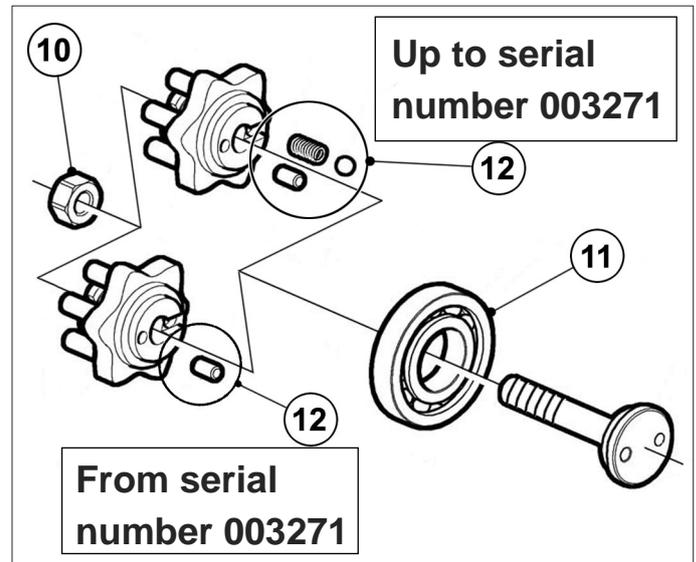
- Unscrew the two screws (9) holding the shift bearing and remove them with their washers.



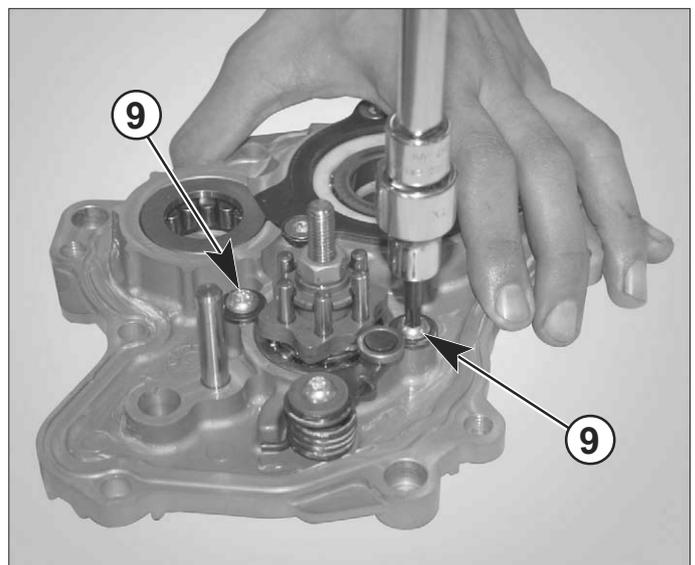
- Move the pawl and remove the shift selector (2).



- Unscrew the nut (10) to disassemble the selector; check the state of the shift selector, the cams must not be worn and be free of impediments. Check that the bearing (11) turns freely and that there are no worn parts in the assembly (12).
- Refit the shift selector, following the removal procedure in reverse, tightening the nut (10) to 25 Nm.



- Tighten the screws (9), appropriately greased with their washers to 10 Nm with Loctite 243.



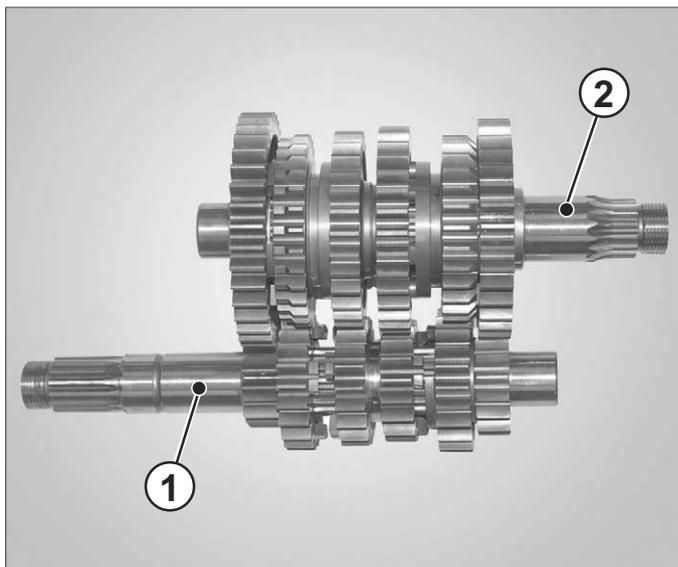
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## Transmission

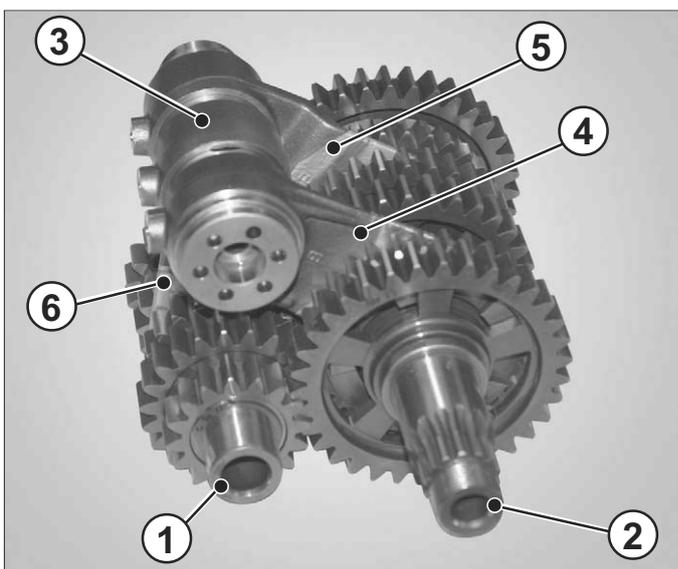
### Transmission assembly

- Position the main (1) and lay shaft (2) gears in neutral.

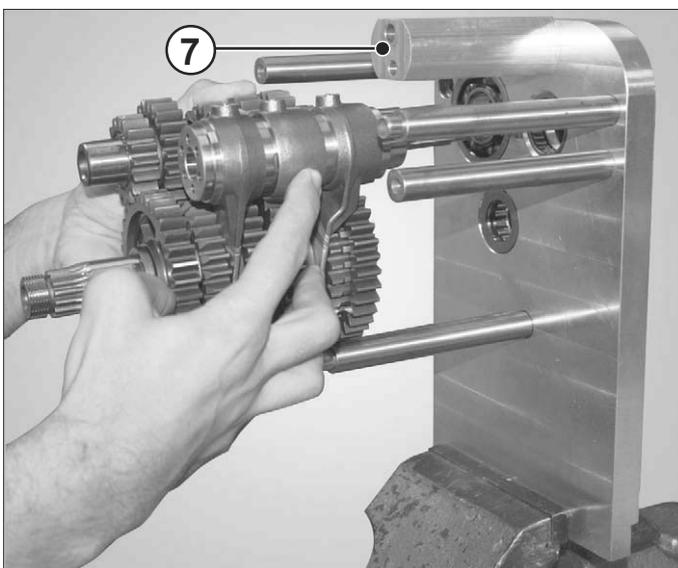


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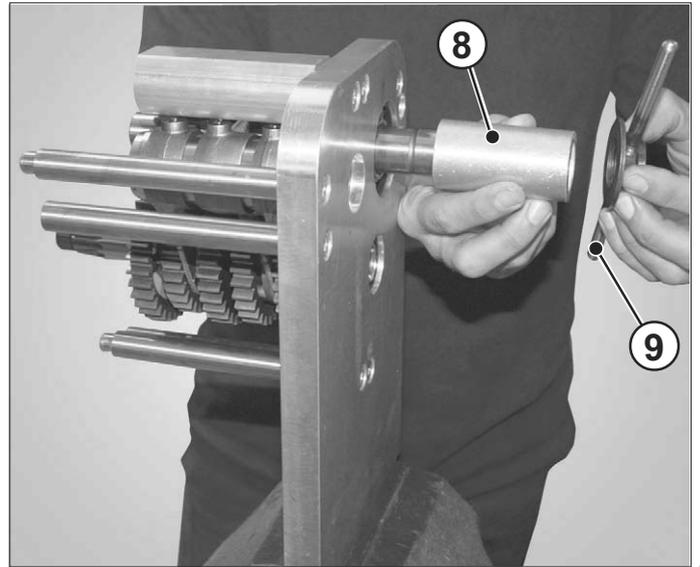
- Bring the two shafts together and position the selector drum (3) inserting fork (4) between the gears of 2<sup>nd</sup> and 6<sup>th</sup> gear, fork (5) between the gears of 4<sup>th</sup> and 5<sup>th</sup> gear of the lay shaft (2) and fork (6) in the groove on the gears of 3<sup>rd</sup> and 4<sup>th</sup> gear.



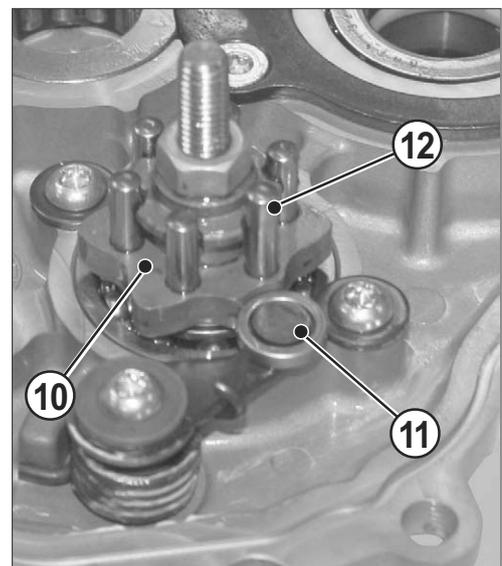
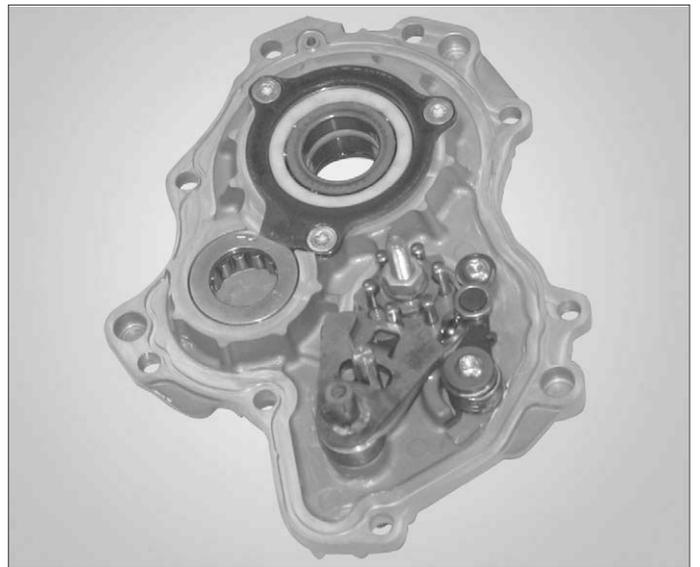
- Place the transmission shafts (2) on the transmission overhaul tool (7) (Cod. 8000B7177).



- Fasten the main shaft, positioning the spacer (8) and screwing on the flywheel by hand (9).



- Place the gear selector (10) in neutral, aligning the pawl wheel (11) with the longest pin (12) of the selector.

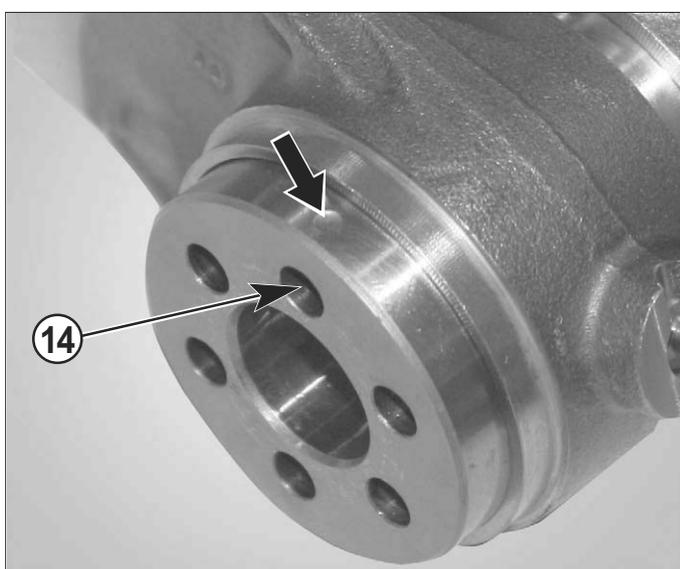
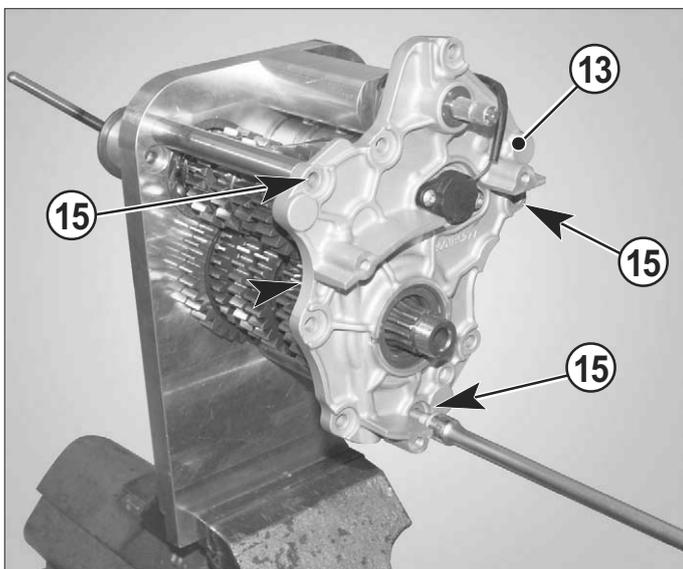
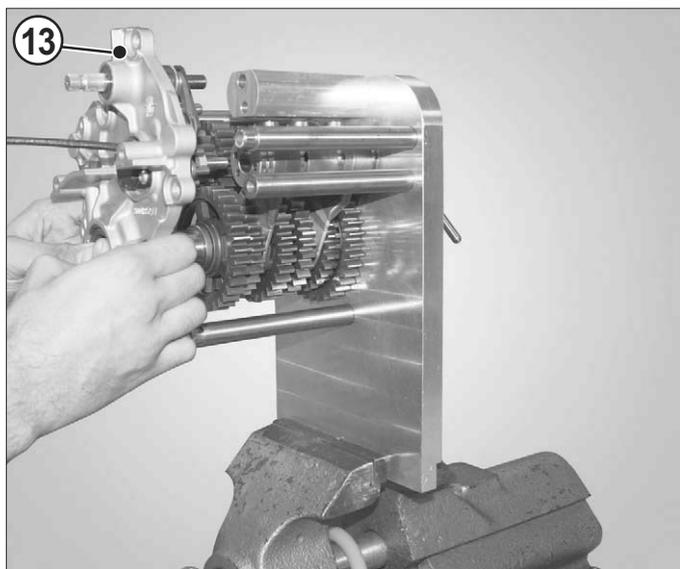
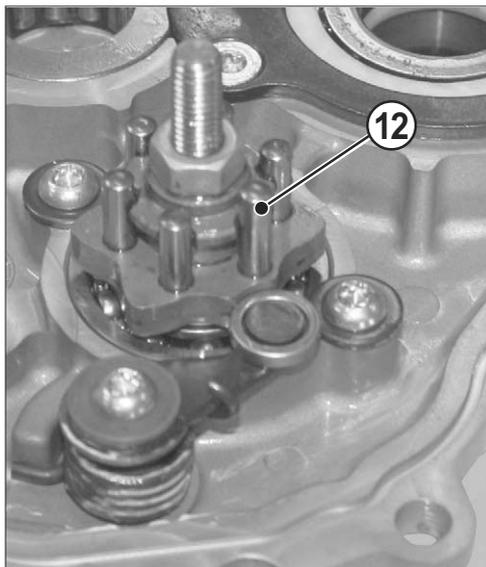


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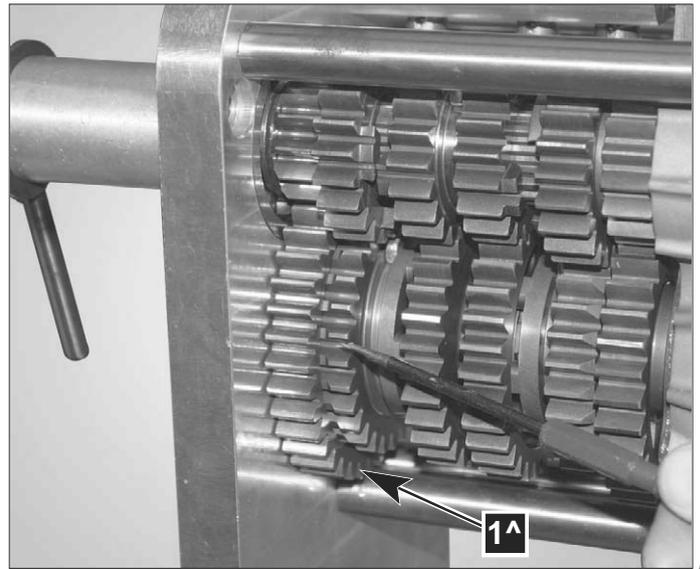
## Transmission

- Fit the flange (13) introducing the pin (12) of the selector in the marked hole (14) of the selector drum.
- Fasten the flange (13) with the three screws (15).

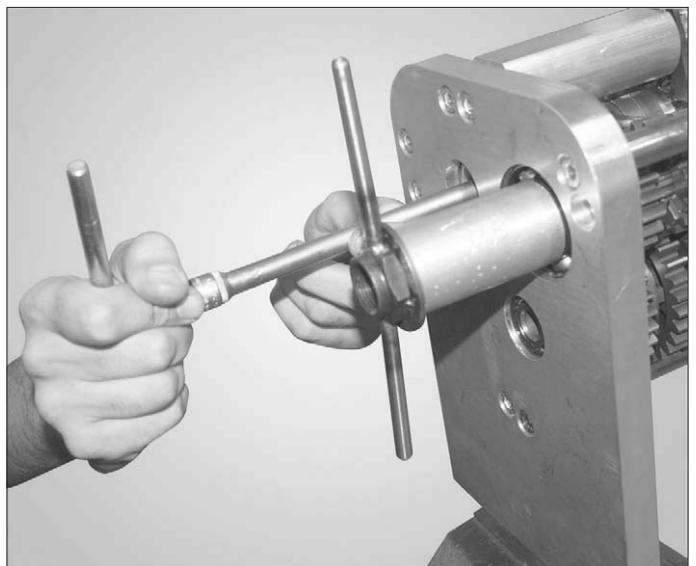
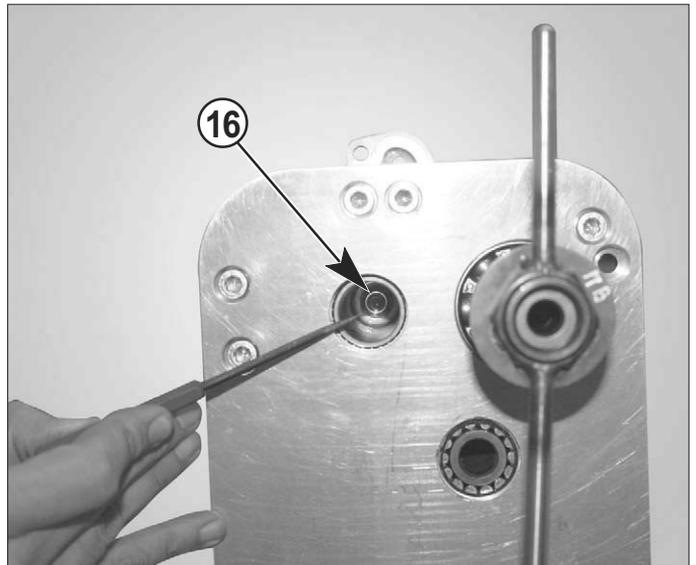


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- Place the gear selector in 1<sup>st</sup> gear.



- Screw the nut (16) down to a torque of 25 Nm + Loctite 243.



F

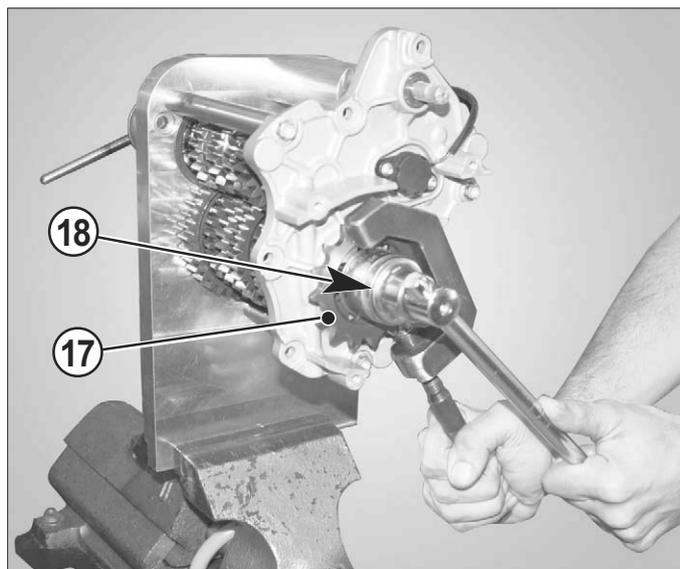


## Transmission



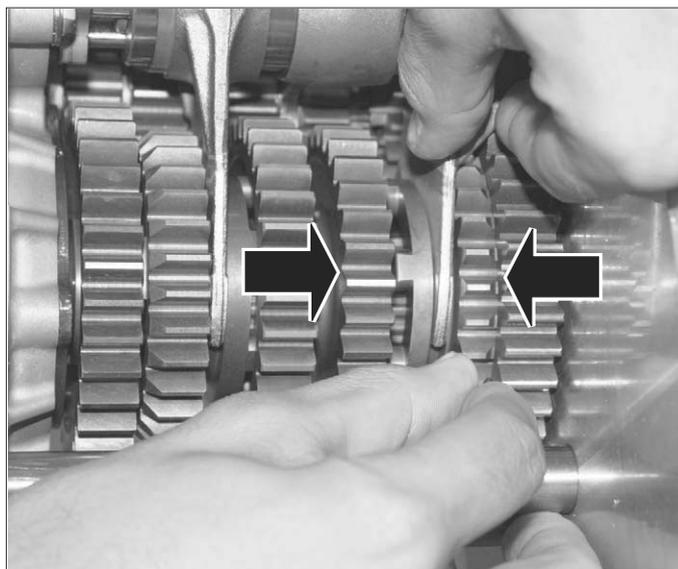
**Place the transmission in neutral before screwing on the pinion nut.**

- After placing the transmission in neutral, refit the pinion (17) on the lay shaft, replacing the safety washer, then screw on the nut (18) to 12 - 13 Nm + Loctite 243 then fold down the safety washer.
- Check that the transmission is operating correctly by manually engaging the gears, checking that they do not stick and that there is play in the forks in the grooves of the sliding gears.

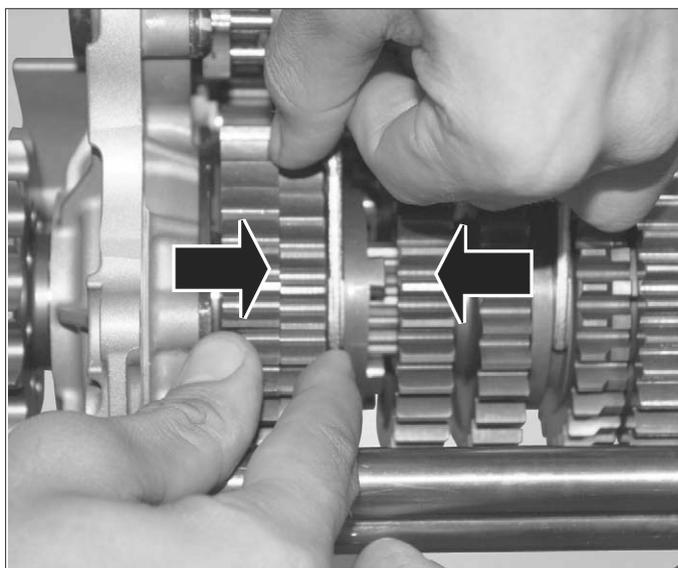


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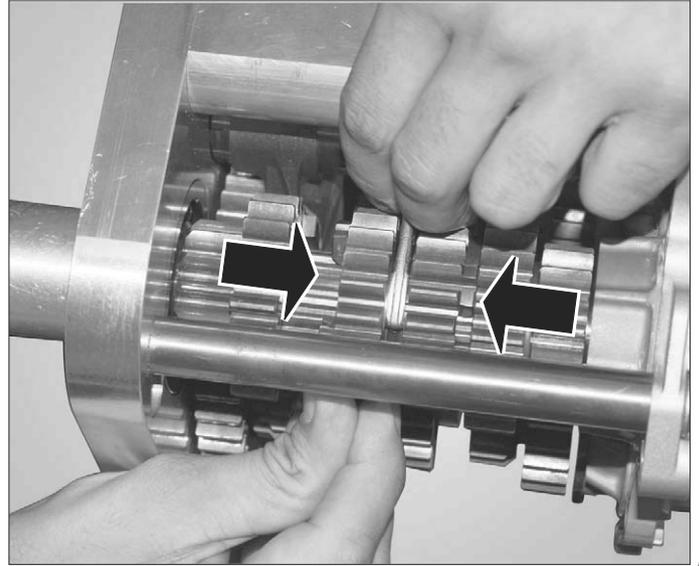
**1<sup>st</sup> and 4<sup>th</sup> GEAR >>>**



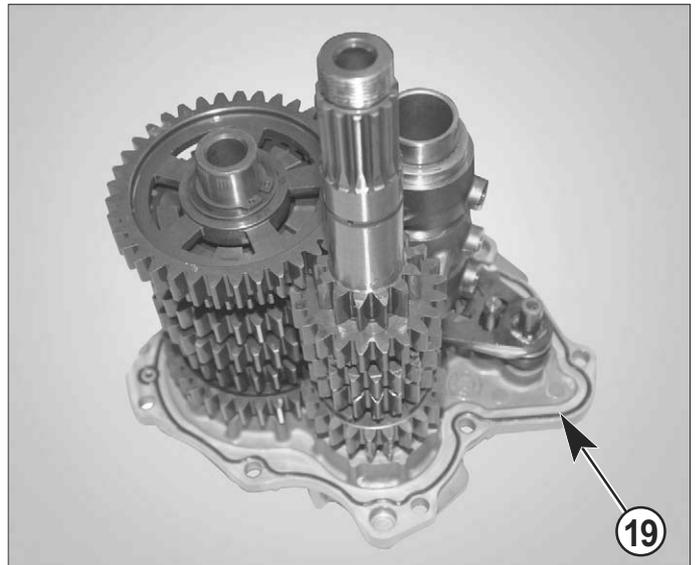
**2<sup>nd</sup> and 3<sup>rd</sup> GEAR >>>**



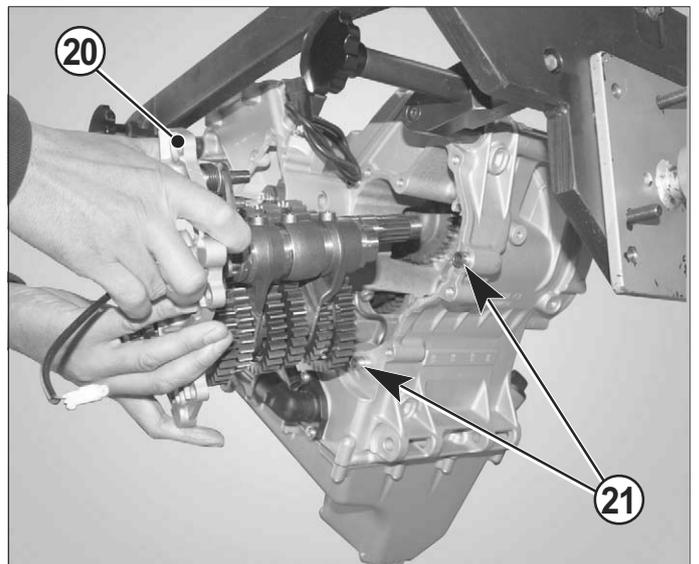
## 5<sup>th</sup> and 6<sup>th</sup> GEAR >>>



- Once you have ensured the transmission is operating correctly, remove it from the device, following the assembly operations in reverse.
- Place the gasket (19) on the flange, lightly greasing it so that it does not come out of its seat when reinstalling the transmission



- Refit the transmission assembly (20) on the engine, ensuring that the blocking rings are present (21),

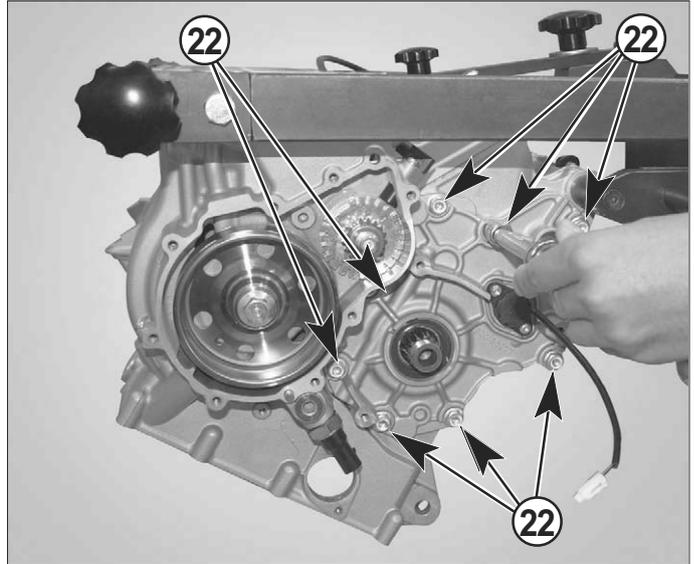


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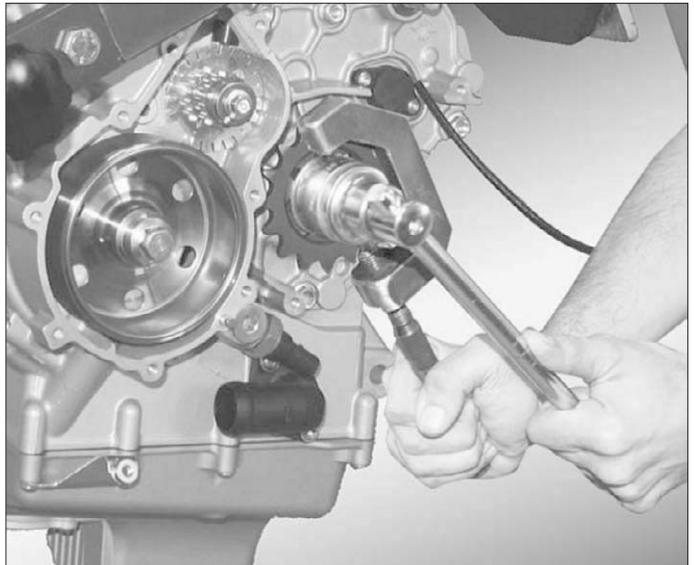
## Transmission

then tighten the eight screws (22) to a torque of 25 Nm.

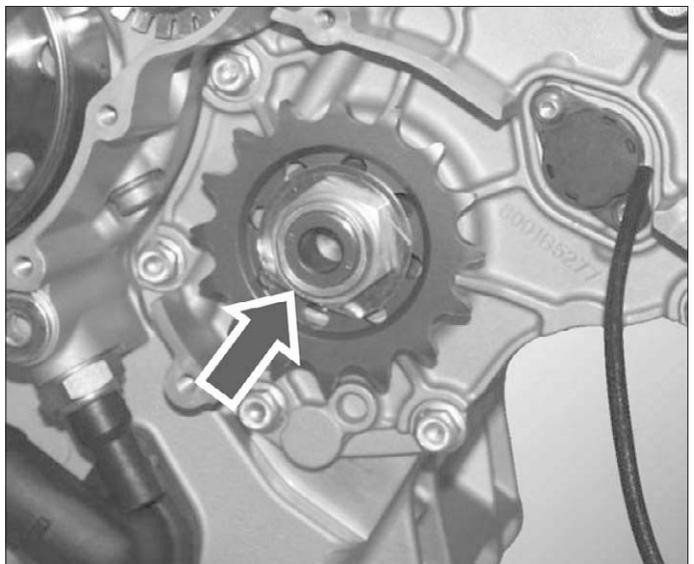


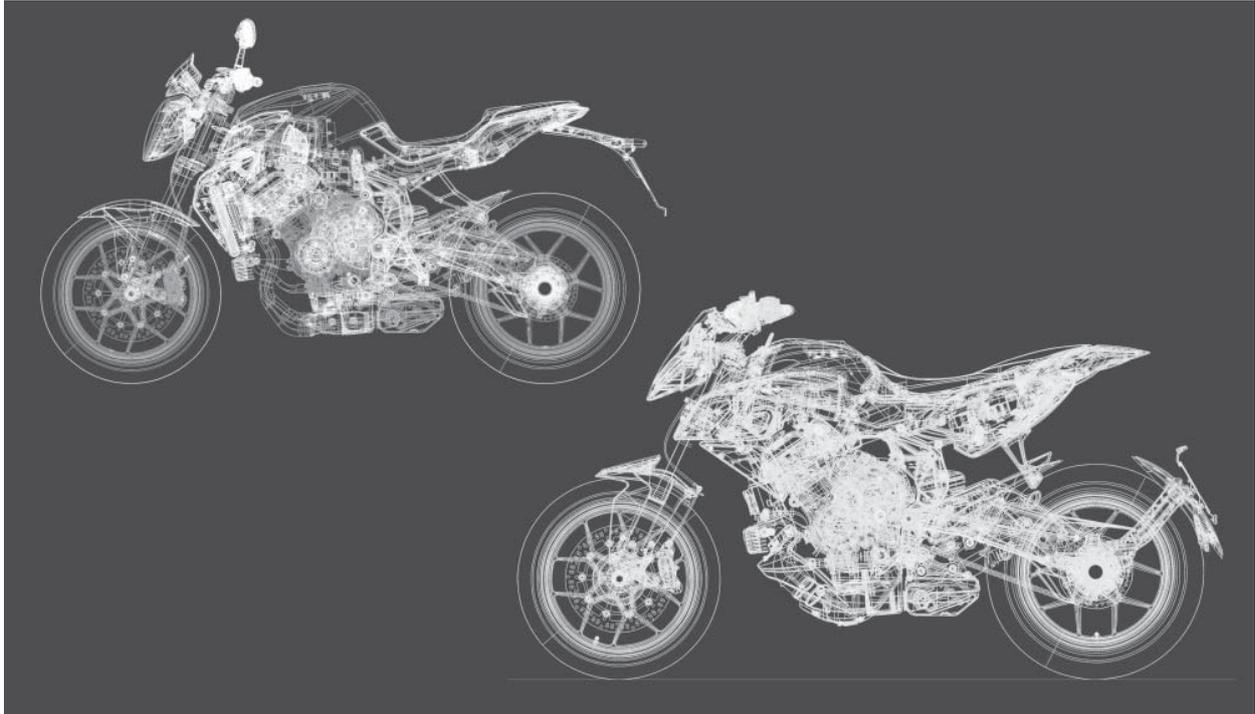
F

- Assembly the pinion, the safety washer and the nut. By blocking the pinion, tighten to a couple of 140 Nm with medium threadblockers.



- Hammer the new washer down onto the two opposite faces of the hexagon as indicated.





G

# SECTION G

REVISION 0

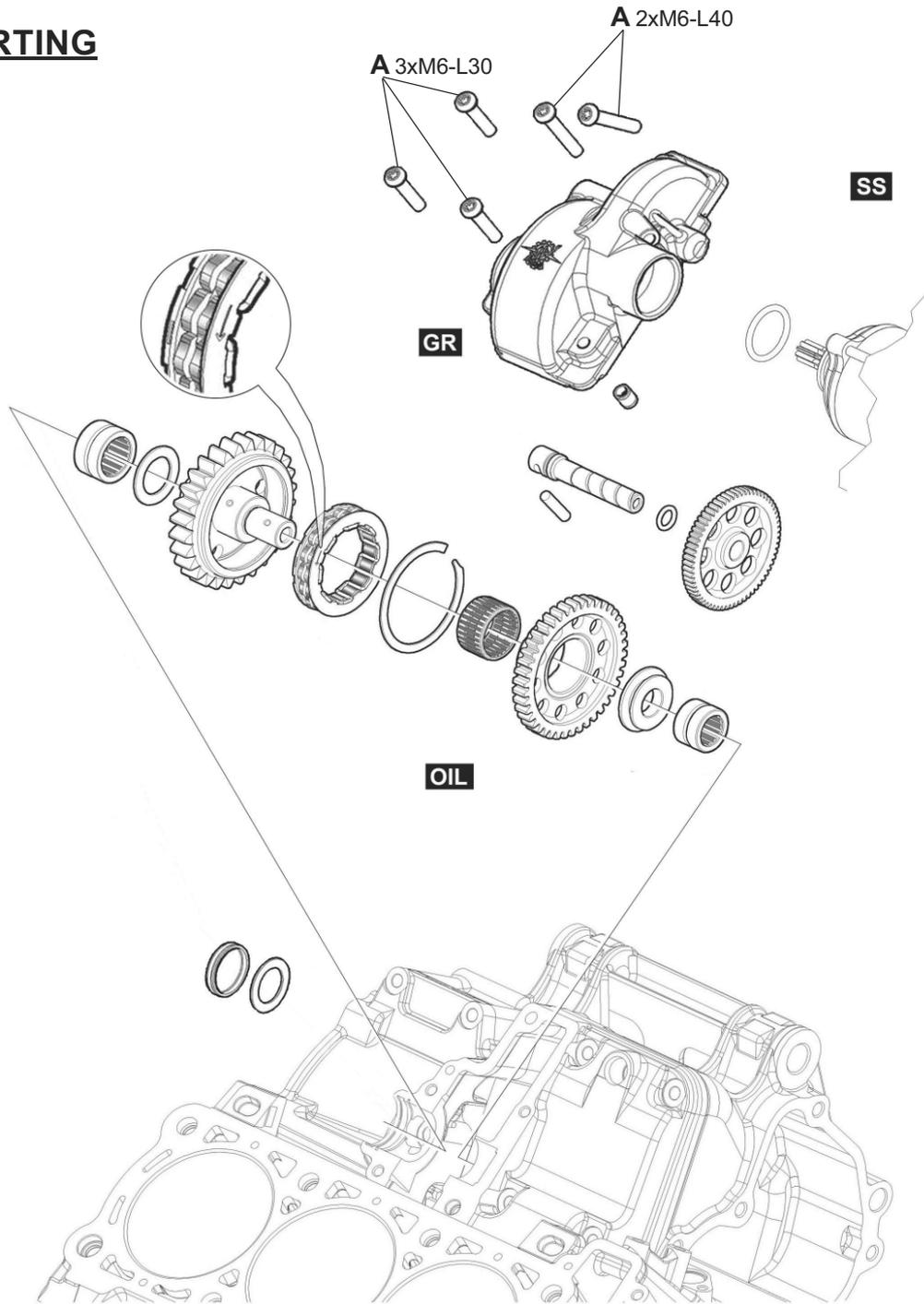


SUMMARY

<b>STARTING</b> .....	<b>Page</b>	<b>3</b>
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Starter free wheel .....	Page	5
Refitting the starter assembly .....	Page	7
Refitting the starter transfer gear cover .....	Page	7



## STARTING



G

Tightening torques	Nm	A	B	C	D	E	F	G	H	I	L
		10									
Thread blockers											

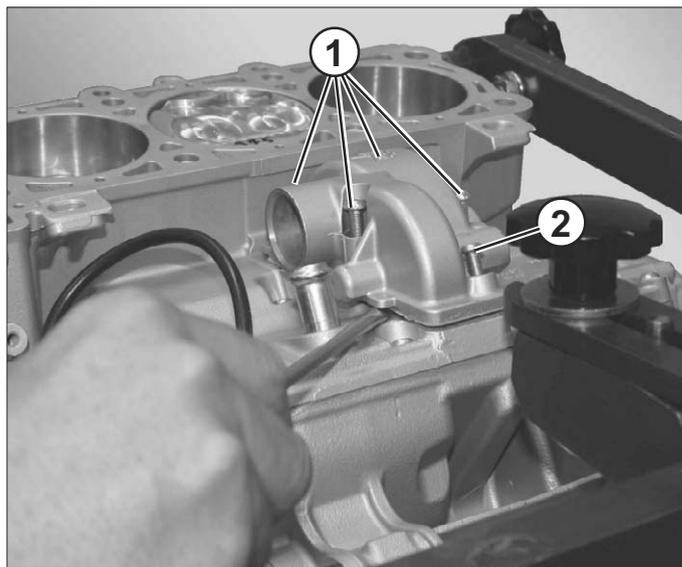
<b>OIL</b>	Apply motor oil	<b>SS</b>	Apply silicone sealing
<b>NO OIL</b>	Do not apply neither oil nor other types of substances	<b>HSC</b>	Apply HSC Molikote
<b>GR</b>	Apply grease	<b>M</b>	Apply mastic for gaskets



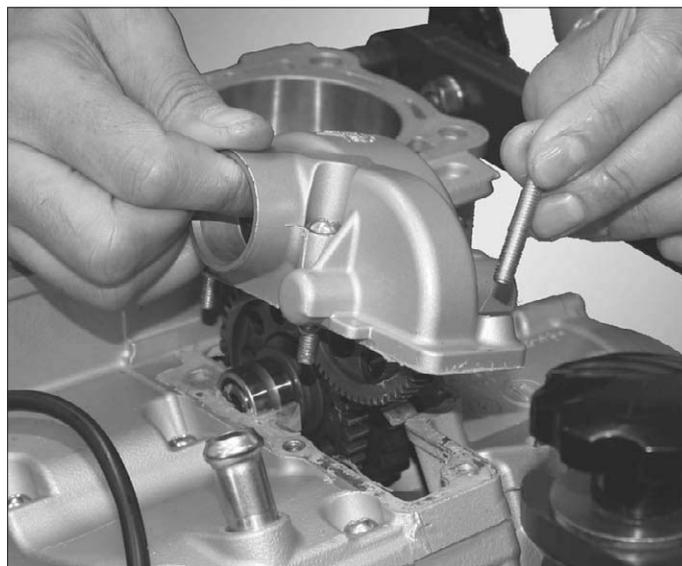
## Starting

### Starter transfer gear

After removing the starter motor as described in Sec. C, unscrew the 4 screws (1) and screws (2). Delicately use a screwdriver on the tip of the lever to separate the starter cover from the upper half-case.

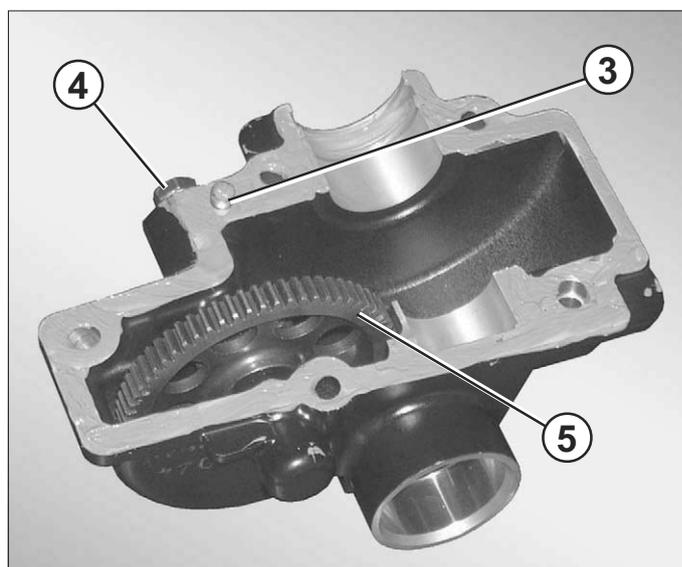


**G** To remove the cover it is necessary to remove the screws (2) as they are not perpendicular to the support plane.



Check that the gear turns freely and the teeth are not damaged.

If removal is necessary, remove the pin (3) and extract the shaft (4) to free the transfer gear (5).



Refitting the transfer components requires the tool:

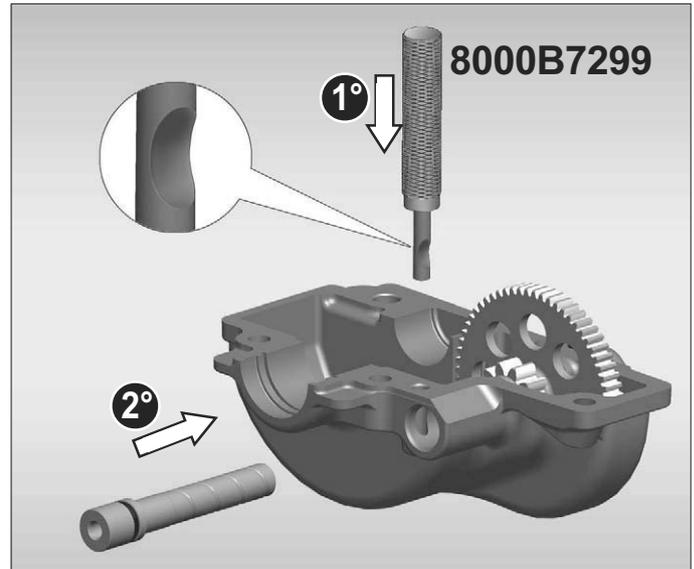
 **Starter transfer gear assembly tool : cod.8000B7299**

Insert the tool into the seat of the pin, oriented as shown in the figure.

Oil the shaft (4) and fit the O-ring.

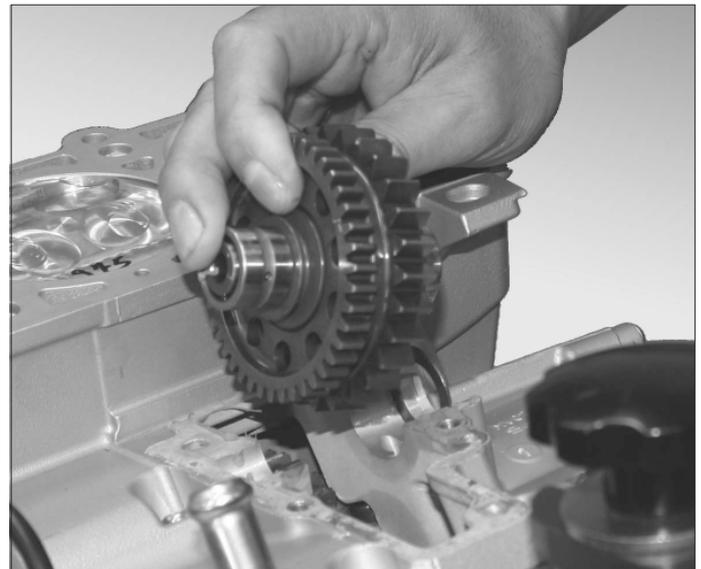
 **Always use a new O-ring to perform this operation.**

Keeping the gear in position, insert the shaft, remove the tool cod. 8000B7299 and refit the pin.



## Starter free wheel

Extract the starter assembly (6).



G

Check that the gears are intact and no components show signs of scoring or anomalous wear. If they do they should be replaced.

 **The gears must always be replaced in pairs.**

 **Attention: all parts must be cleaned and lubricated with engine oil when refitting.**





## Starting

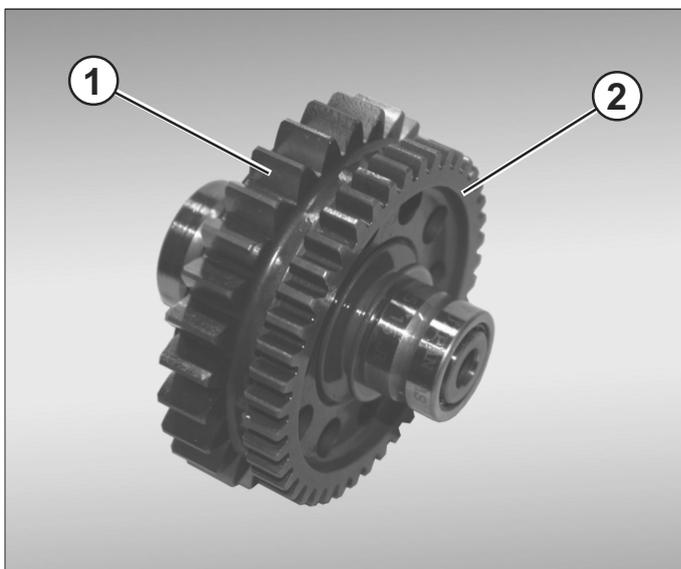
Refit the free wheel on the shaft with the arrow pointing outwards.



**G** Fit the safety ring.



Refit the roller cage and the free wheel gear.  
Check that by blocking the shaft (1), the free wheel gear (2) turns only in the direction indicated by the arrow.

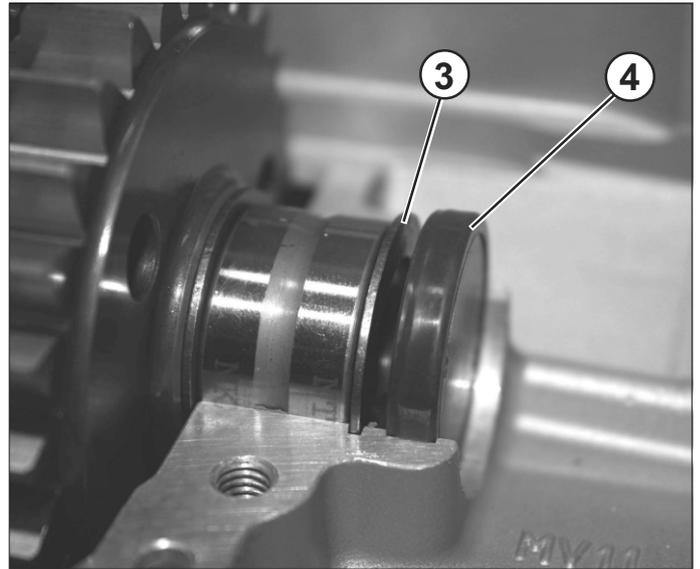


## Refitting the starter assembly

Ensure all surfaces are clean and degreased when refitting.

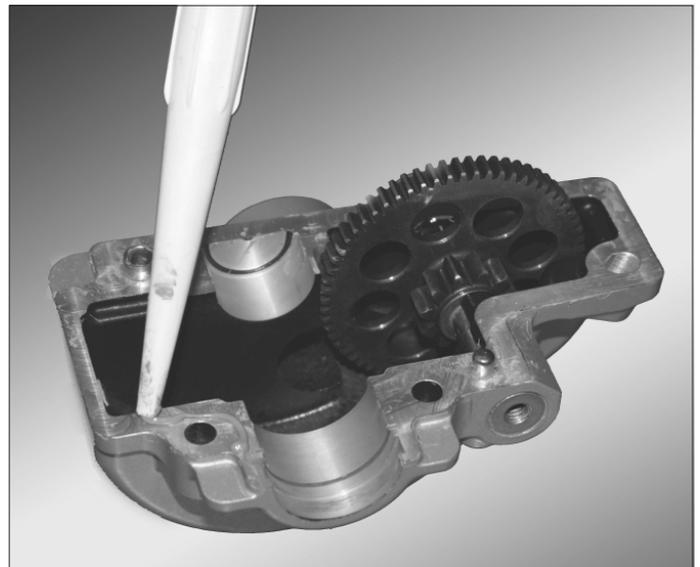
Fit the starter assembly and place the shim washer (3) and the cap (4).

Check that the assembly has a little play along the shaft axis.



## Refitting the starter transfer gear cover

Spread a little gasket sealant on the previously cleaned and degreased contact surfaces of the starter cover.



G

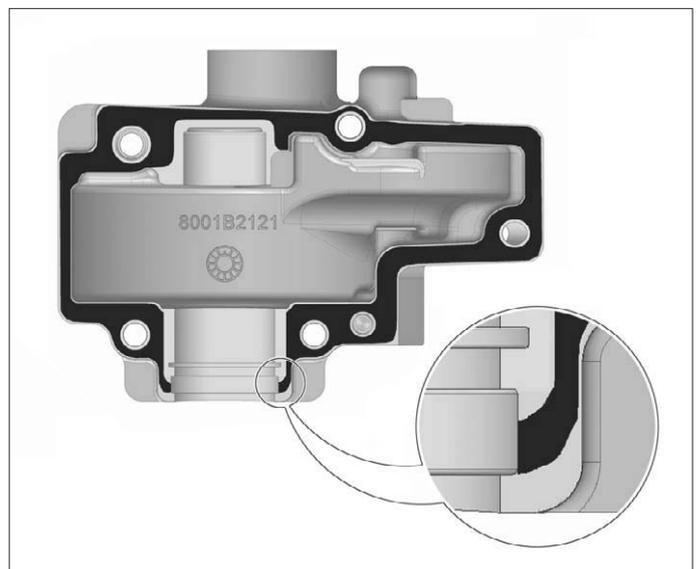
Refer to the figure for this operation.



**In order to avoid oil leaks, the sealant must go up to the internal edge of the two areas to the side of the cap.**



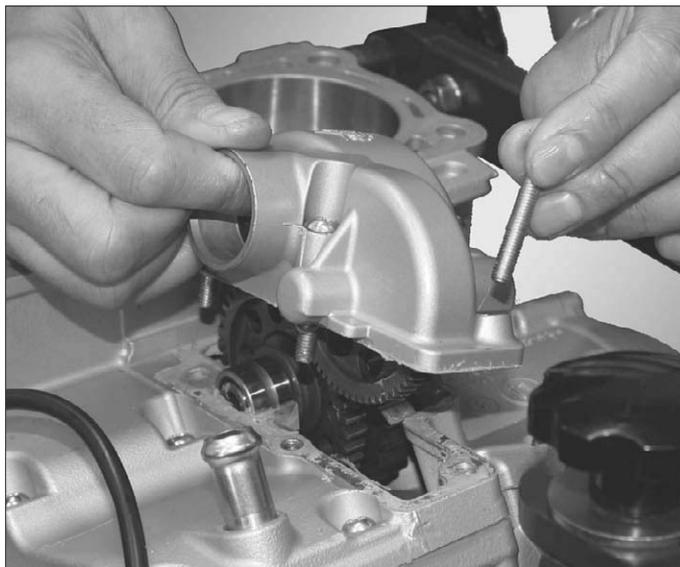
**Ensure that the sealant does not come into contact with the shaft seats.**



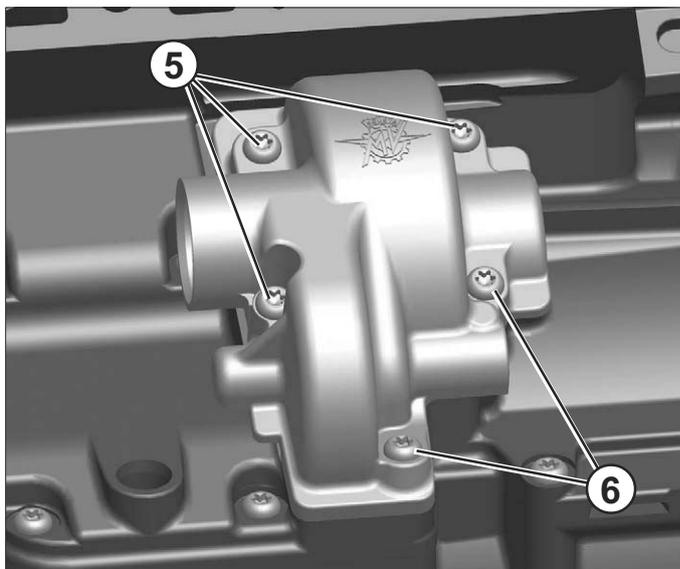


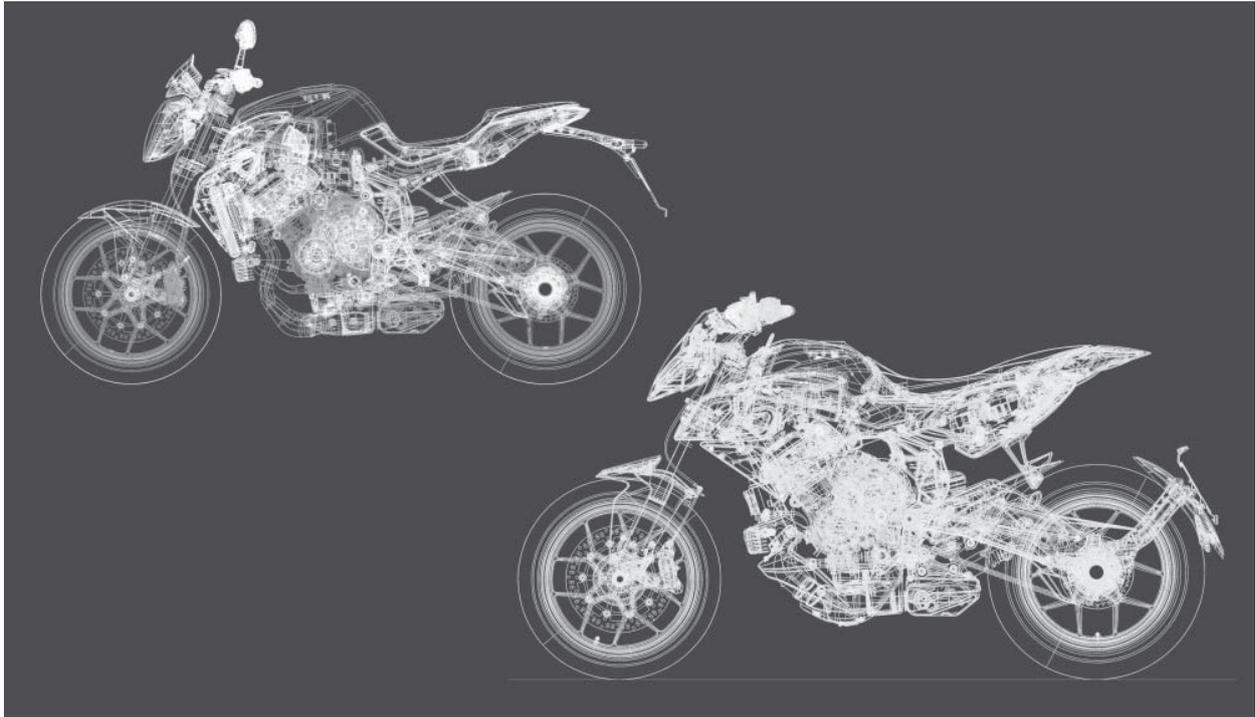
## Starting

Refit the cover in place on the half-case, taking care that the sealant does not come into contact with the gears.



**G** Insert the 3 screws (5) and the two screws (6), tightening them to the specified torque.





H

# SECTION H

REVISION 0

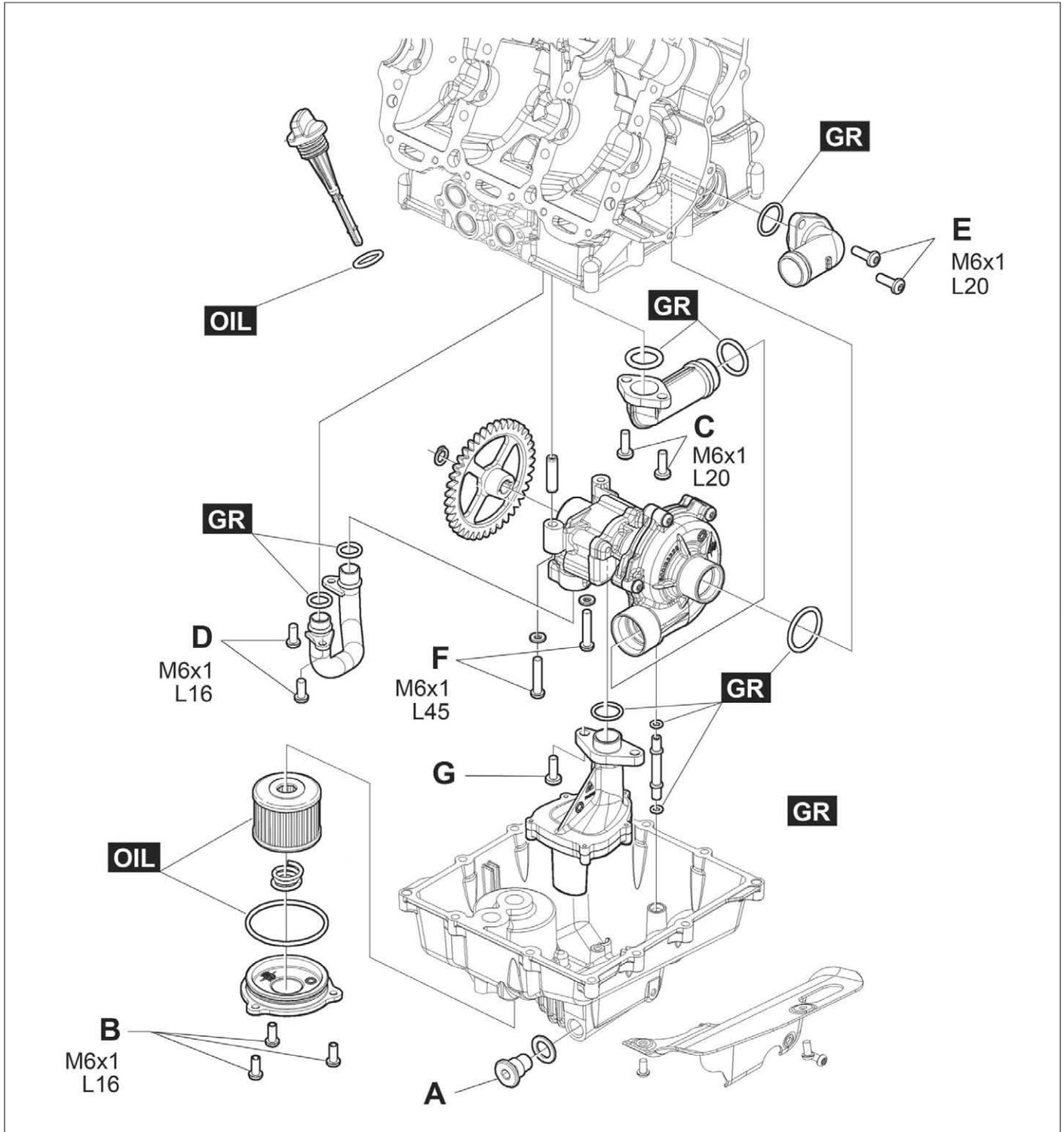


## SUMMARY

Lubrication .....	Page	4
Removing the oil filter .....	Page	4
Removing the lubrication system .....	Page	5
Refitting the lubrication system .....	Page	9
Refitting the oil filter .....	Page	14

H

# Cooling - Lubrication



H

Tightening torque		A	B	C	D	E	F	G	H	I	L
	Nm	25	10	10	10	10	10	10			
Threadlocker type											

<b>OIL</b>	Apply motor oil	<b>SS</b>	Apply silicone sealing
<b>NO OIL</b>	Do not apply neither oil nor other types of substances	<b>HSC</b>	Apply HSC Molikote
<b>GR</b>	Apply grease	<b>M</b>	Apply mastic for gaskets



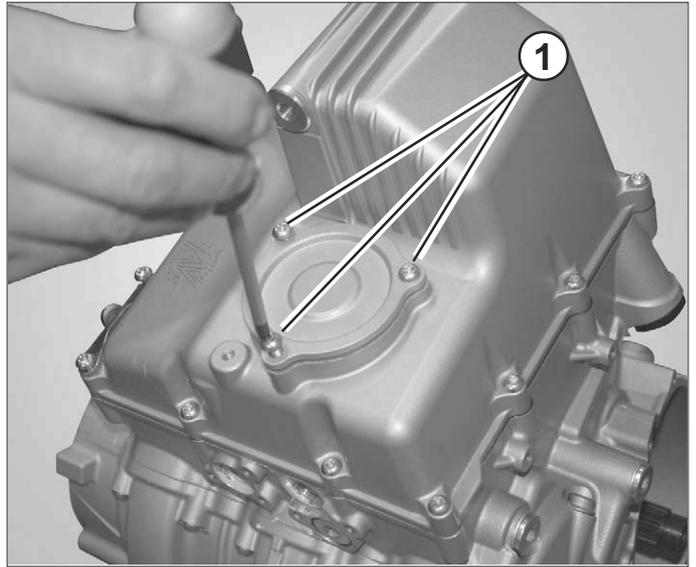
## Cooling - Lubrication

### Lubrication:

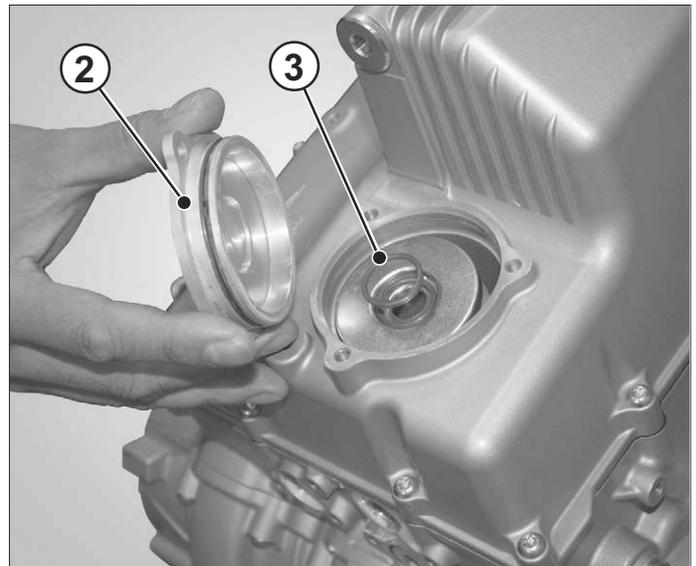
The oil and coolant must be drained from their respective circuits as described in the maintenance section before performing this operation.

### Removing the oil filter

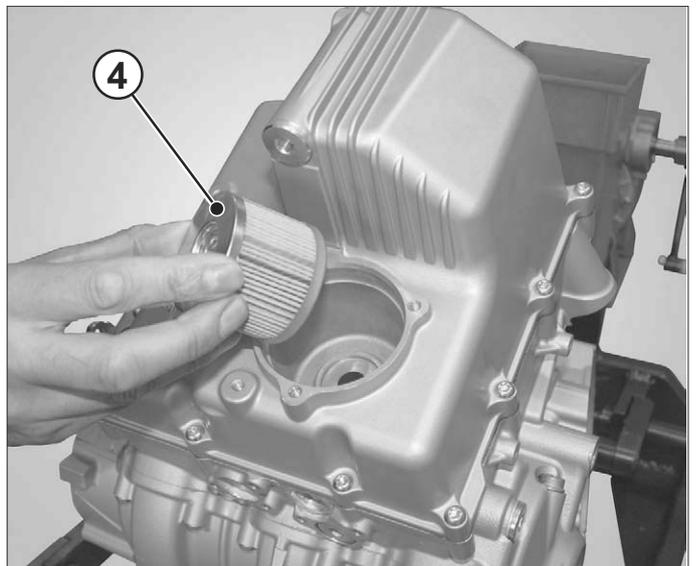
Unscrew the screws (1).



Remove the oil filter cover (2) and the spring (3).

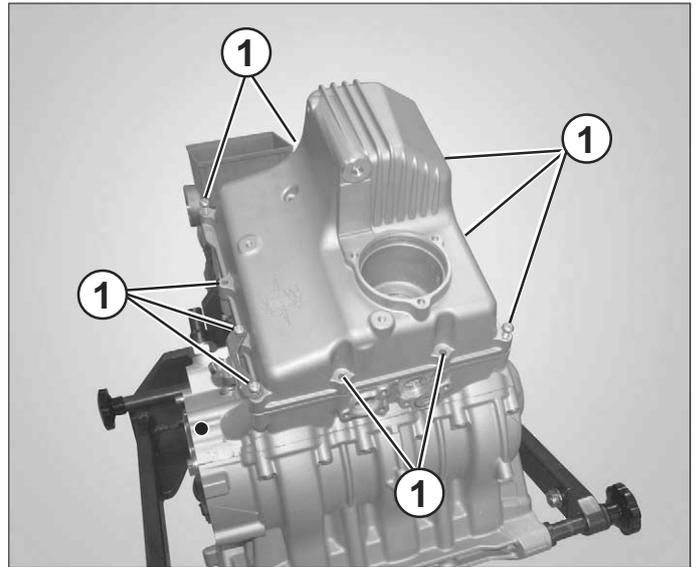


Remove the oil filter (4).

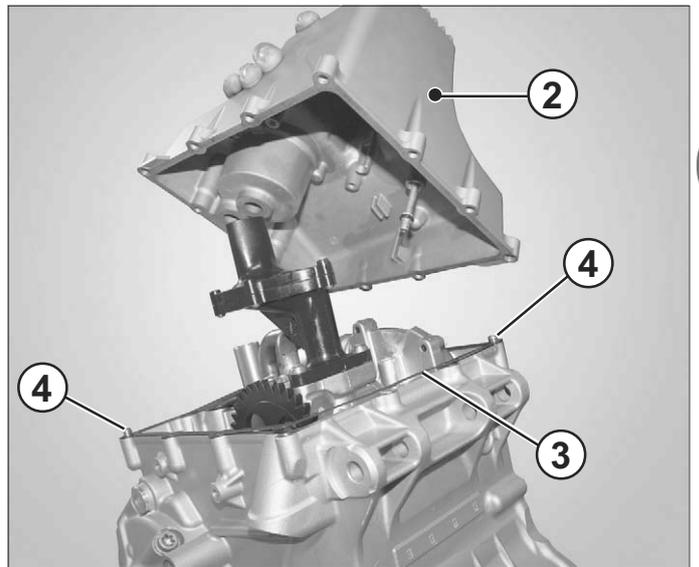


## Removing the lubrication system

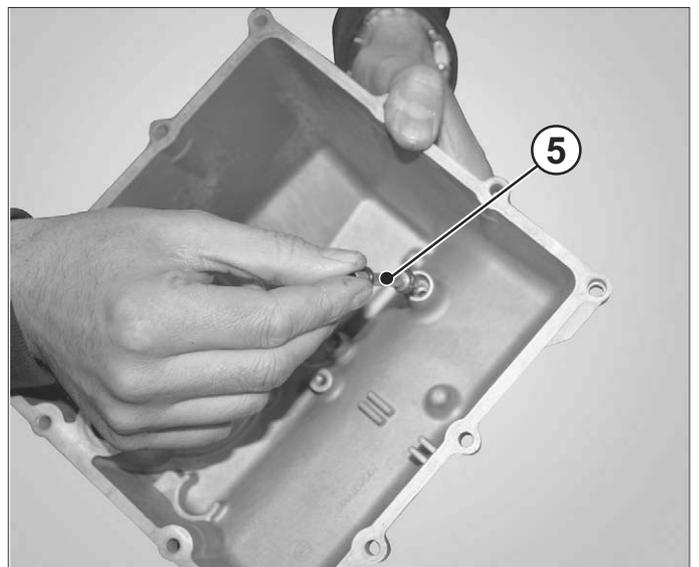
Unscrew the screws (1).



Remove the oil sump (2), keeping the gasket (3) and bushings (4).



Remove the coolant pump discharge tube (5).

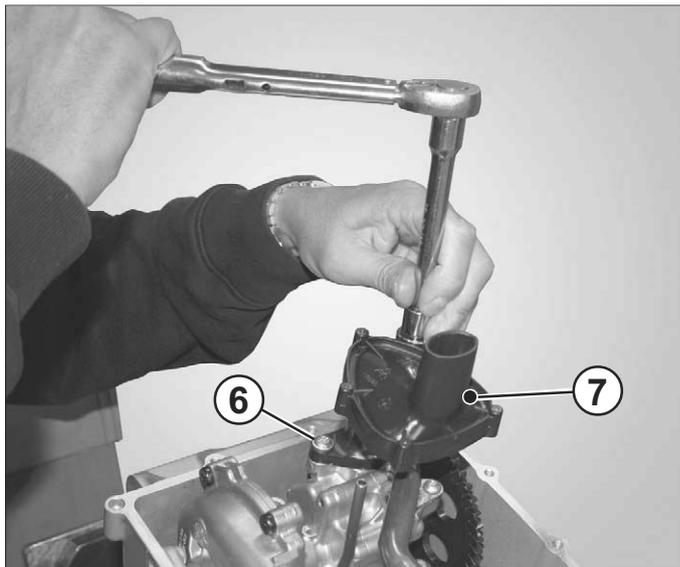


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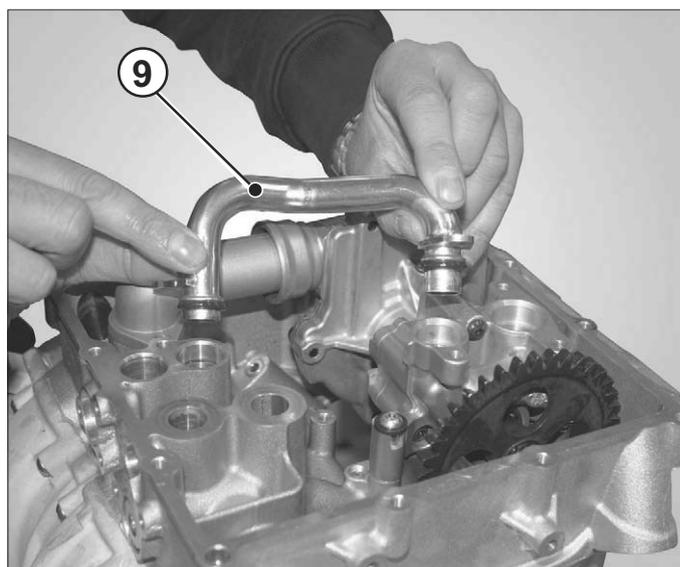
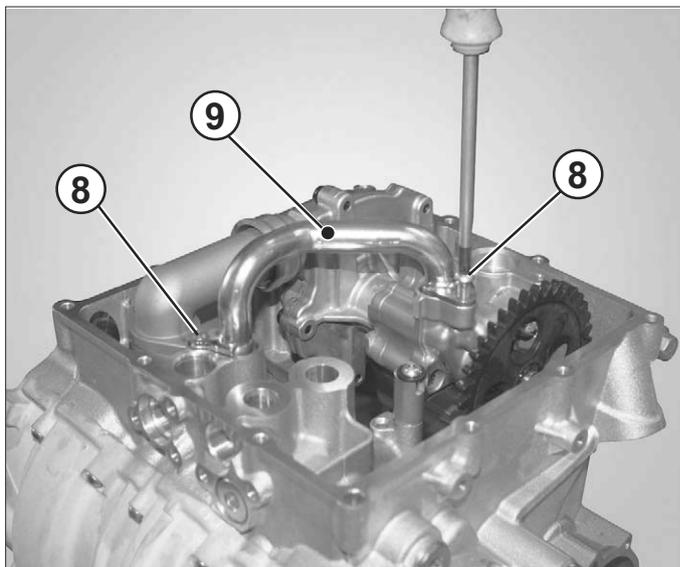


## Cooling - Lubrication

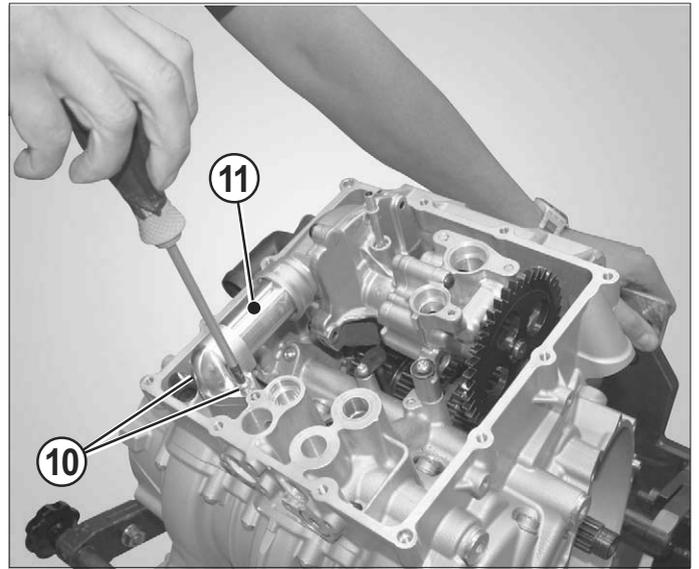
Unscrew the two screws (6) and remove the submerged intake (7).



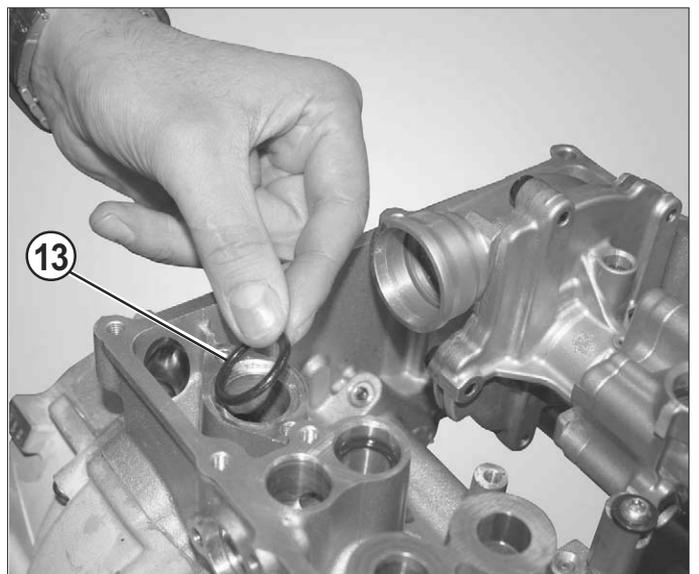
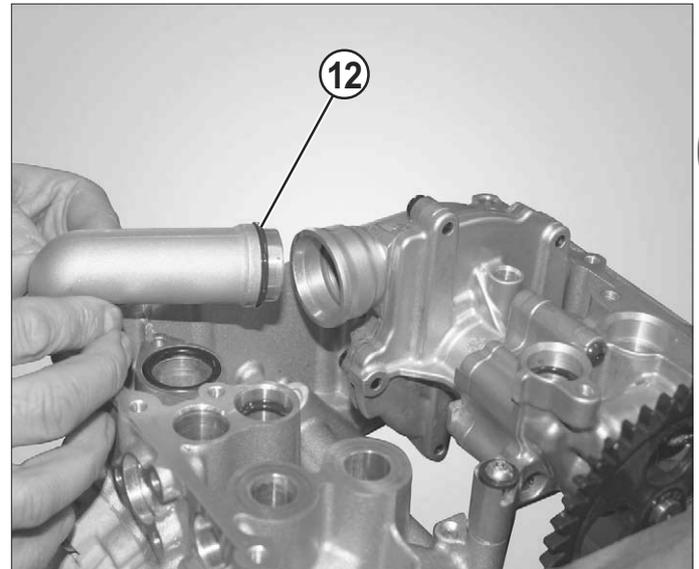
Unscrew the two screws (8) and remove the oil delivery tube (9) from the pump to the heater exchanger with its O-rings.



Unscrew the two screws (10) and remove the coolant delivery tube (11).



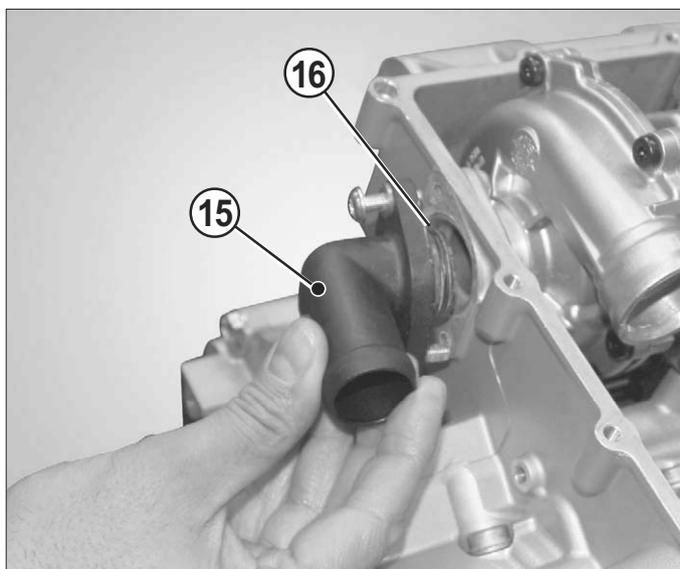
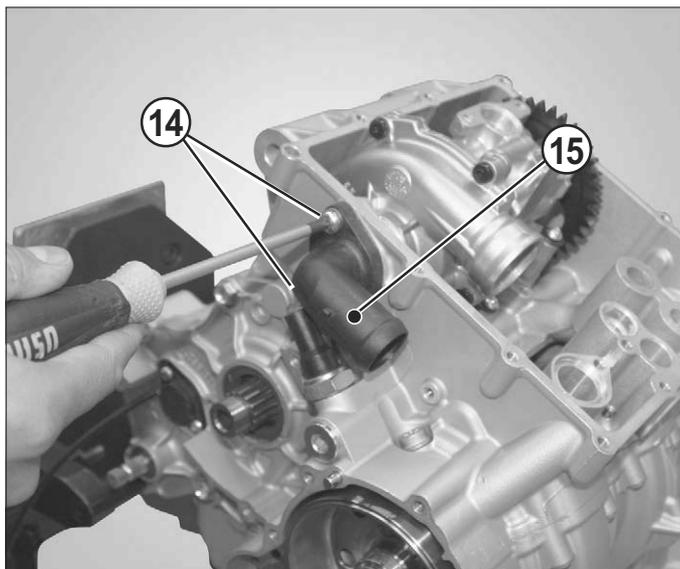
Recover the O-rings (12) and (13).





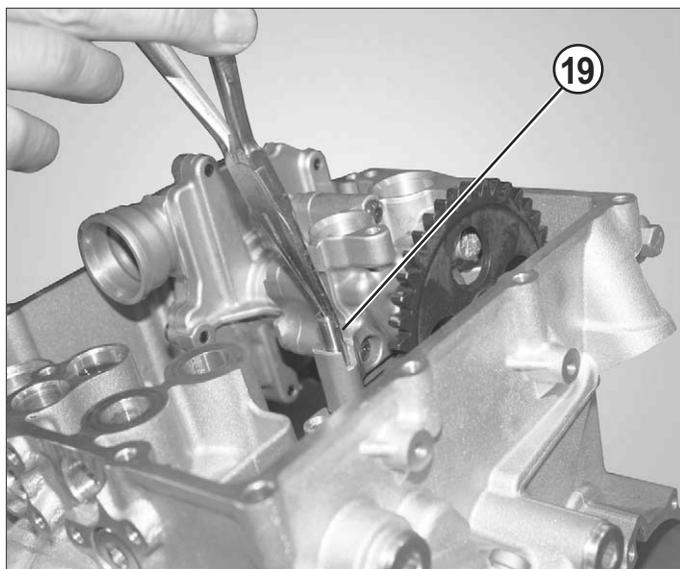
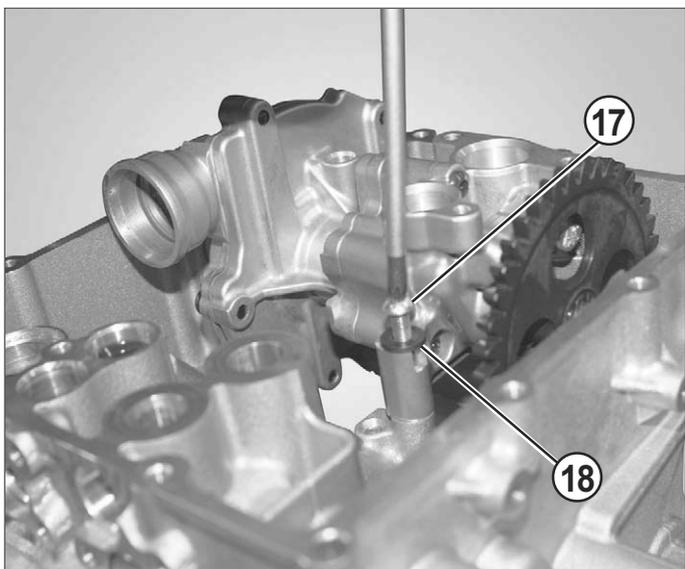
## Cooling - Lubrication

Unscrew the two screws (14) and remove the coolant intake manifold (15), recovering the relative O-rings.

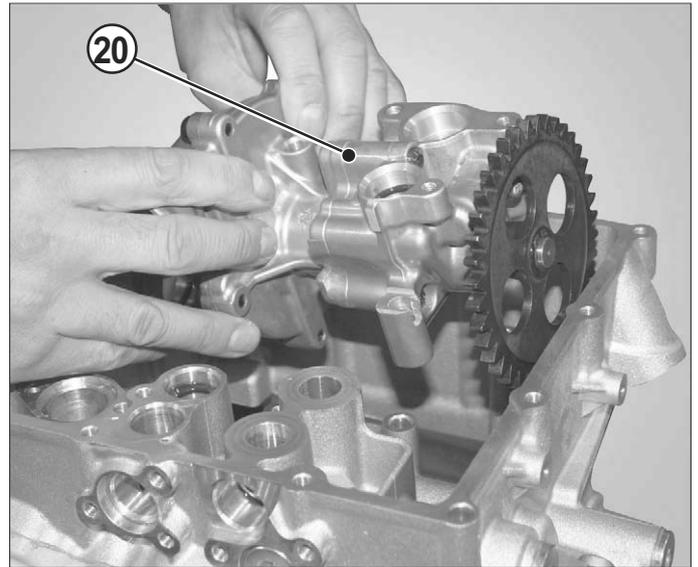


Unscrew the screw (17) and, if present, the washer (18).

Remove the blocking ring (19) with needle-nose pliers.

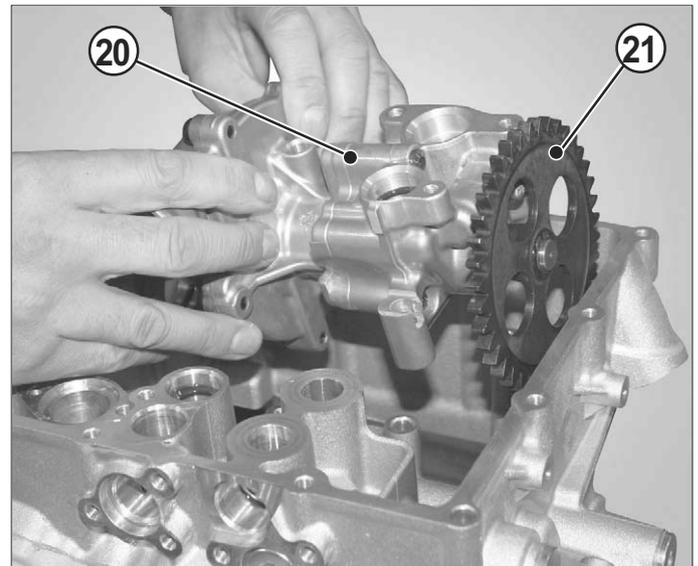


Raise the pump assembly from the gears and remove it from the engine.

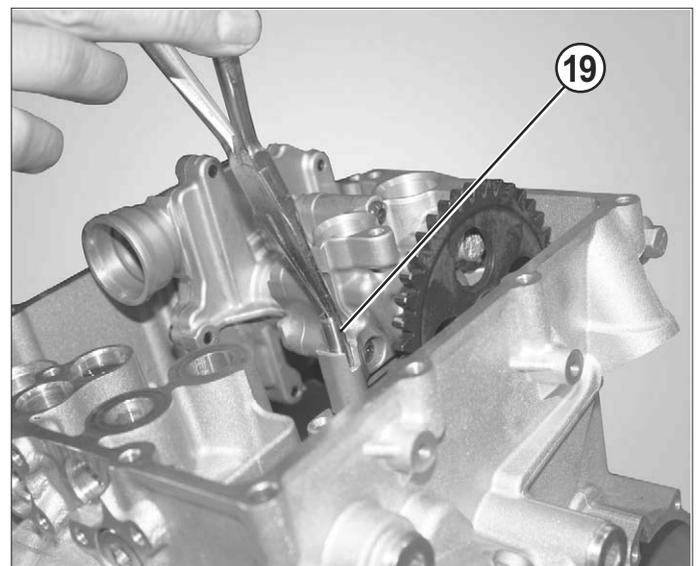


### Refitting the lubrication system

Insert the pump assembly (20), inserting the part of the pump body in its seat in the engine block, then mesh the gears (21) with the crankshaft transfer gear.



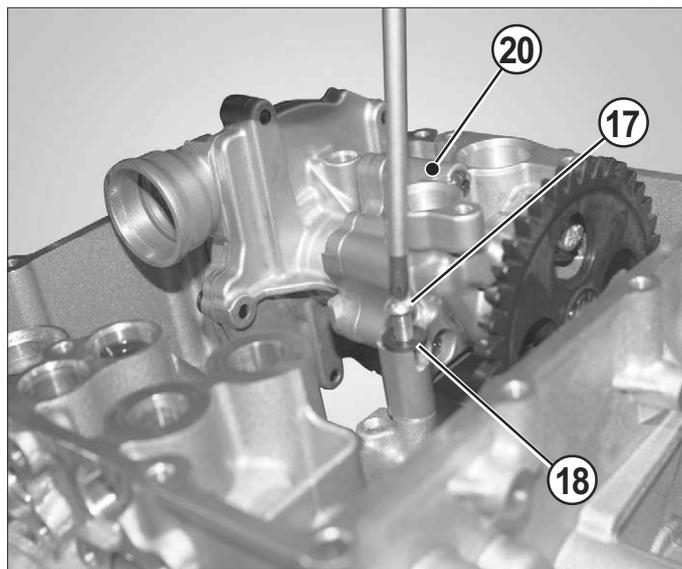
Insert the blocking ring (19) with needle-nose pliers.



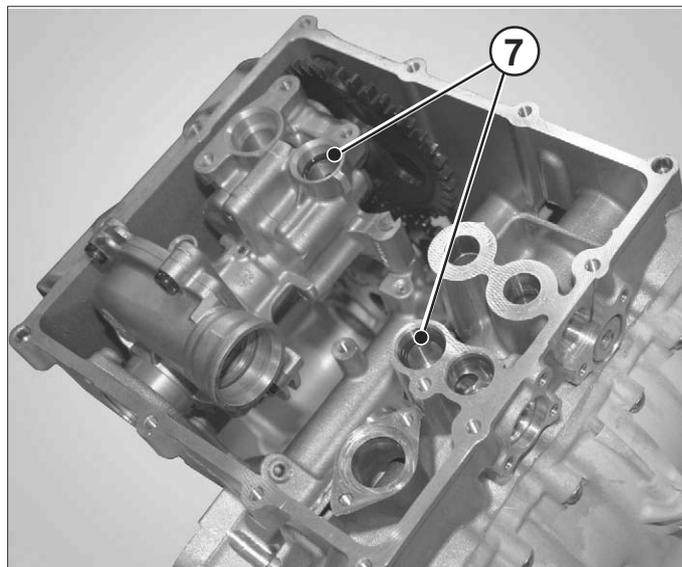


## Cooling - Lubrication

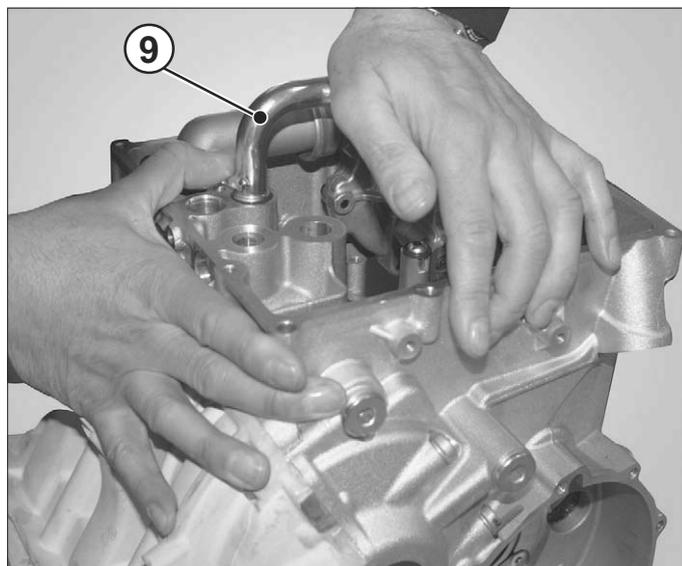
Screw on the screw (17) and, if present, the washer (18) to fasten the pump assembly (20).



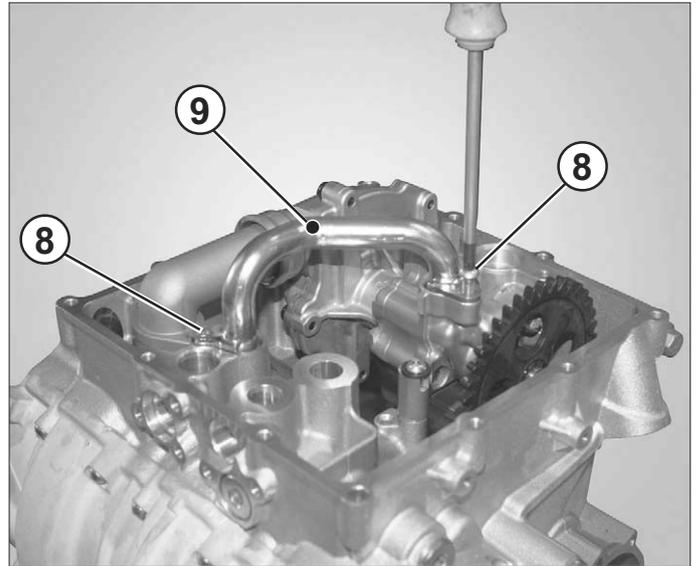
Grease the seats of the oil delivery tube (7) gaskets.



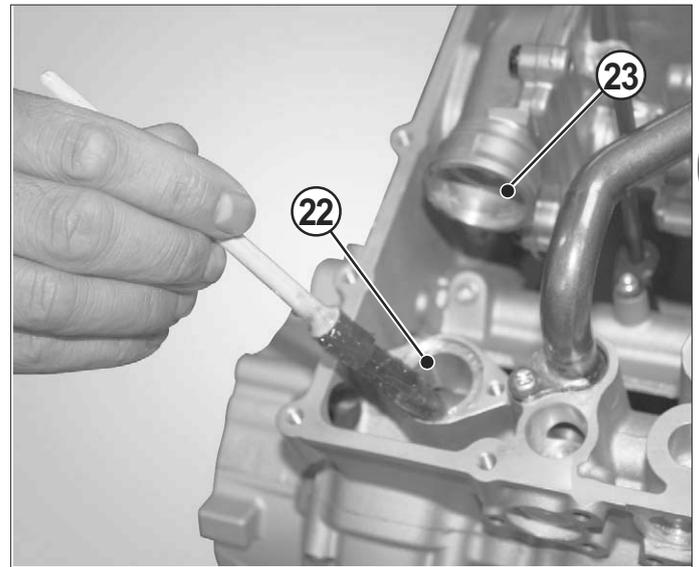
Check that the O-ring gaskets are not damaged; if they are replace them. Then refit the tube (9), applying light pressure so that the gaskets and the tube insert themselves correctly into the seat.



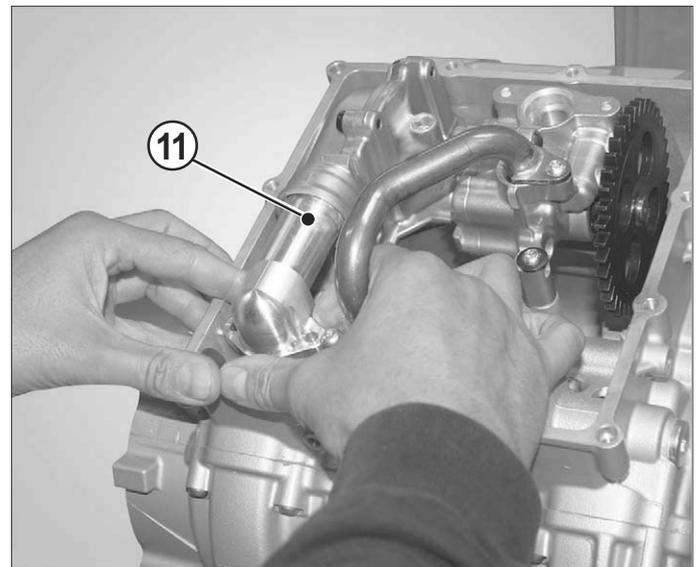
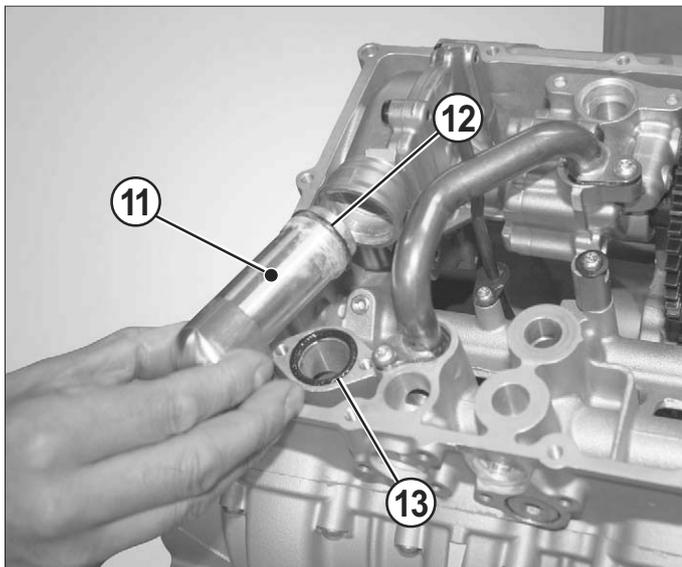
Screw down the tube's (9) two screws (8).



Grease the seats (22) and (23) of the coolant delivery tube.



Check that the O-ring gaskets are not damaged; if they are replace them. Then insert gasket (13) on the engine block and gasket (12) on the tube (11). Grease the seats again and refit the tube.

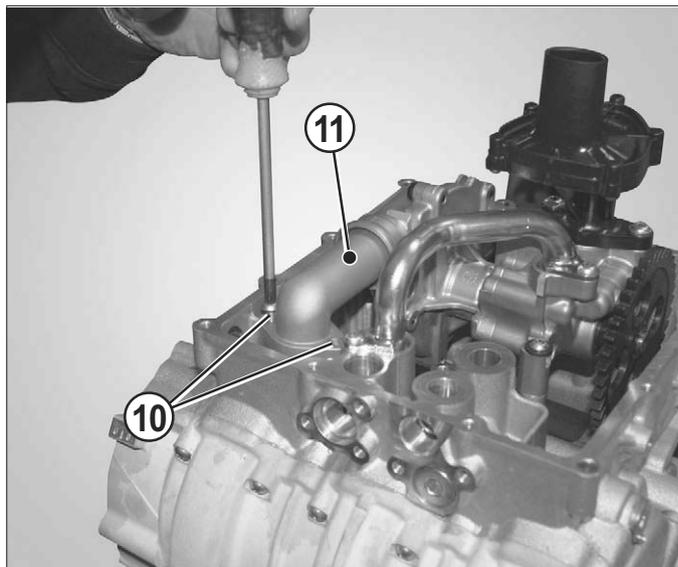


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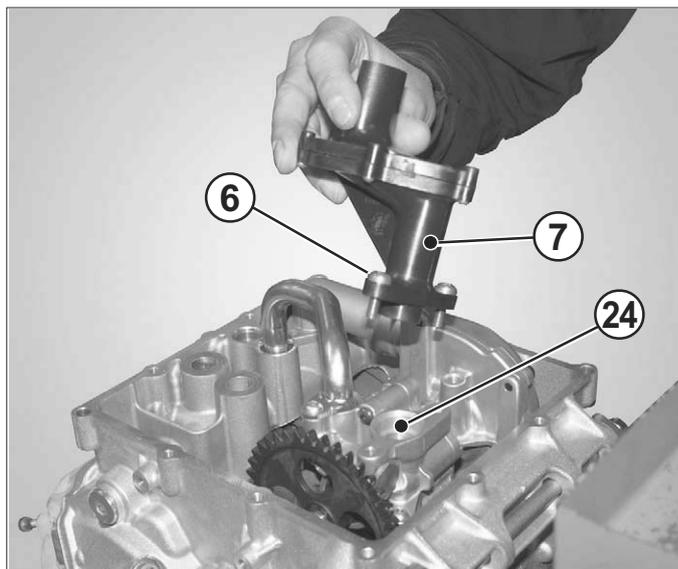


## Cooling - Lubrication

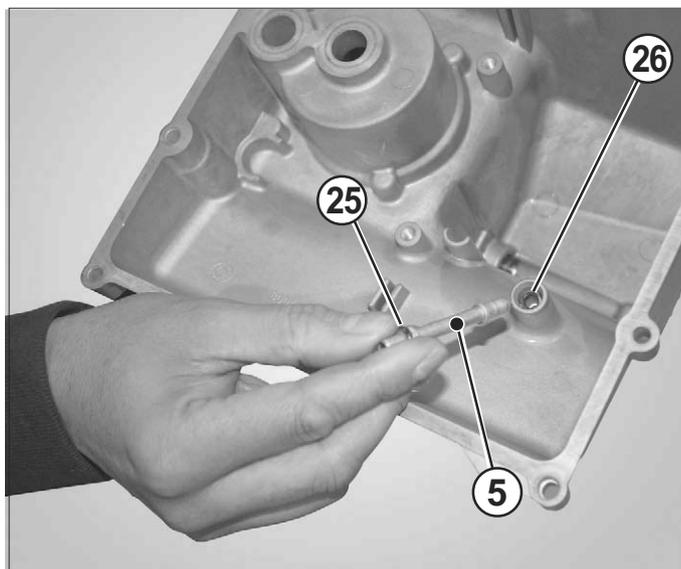
Screw down the tube's (11) two screws (10).



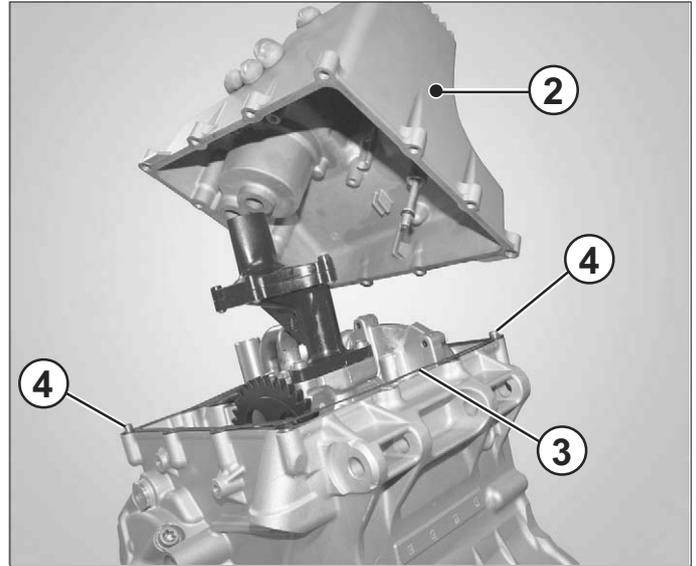
Grease the seat (24) of the submerged intake (7) and fasten it in position by screwing down the screws (6).



Check that the O-ring gaskets (25) and (26) of the coolant drain tube (5) are not damaged; if they are replace them. Then grease the tube (5) and install it in its seat on the oil sump.

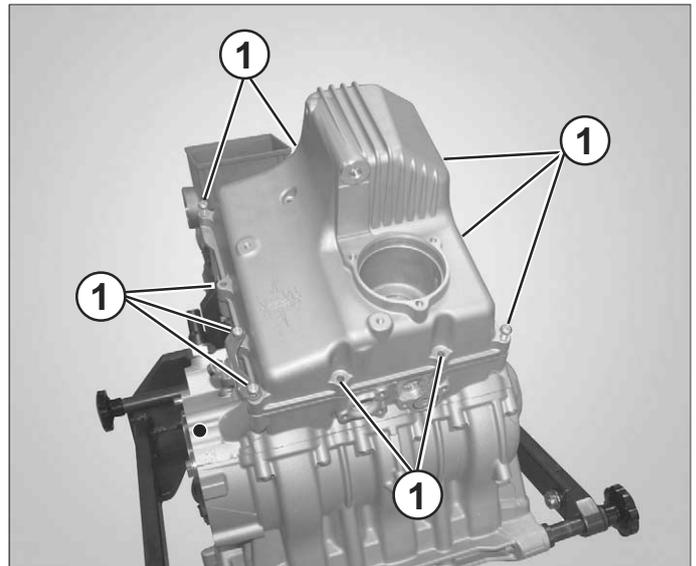


Position the blocking rings (4) in their seats, then fit the gasket (3) and the oil sump (2).  
Screw down the screws (1), those corresponding with

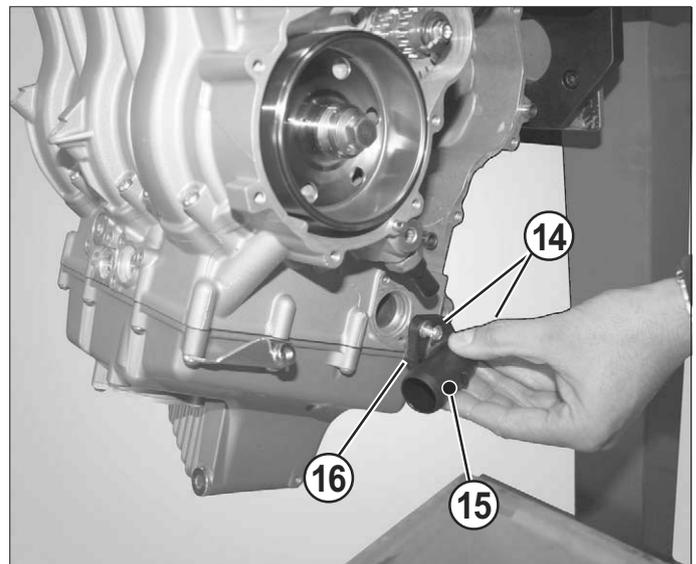


the blocking rings first and then the others. Tightening torque 10 Nm.

**NOTE** It is preferable to fit the oil filter before refitting the oil sump to the engine.



Check that the O-ring gaskets (16) are not damaged; if they are replace them. Then grease the gasket and refit the coolant intake manifold (15), screwing down the screws (14) to a torque of 10 Nm.

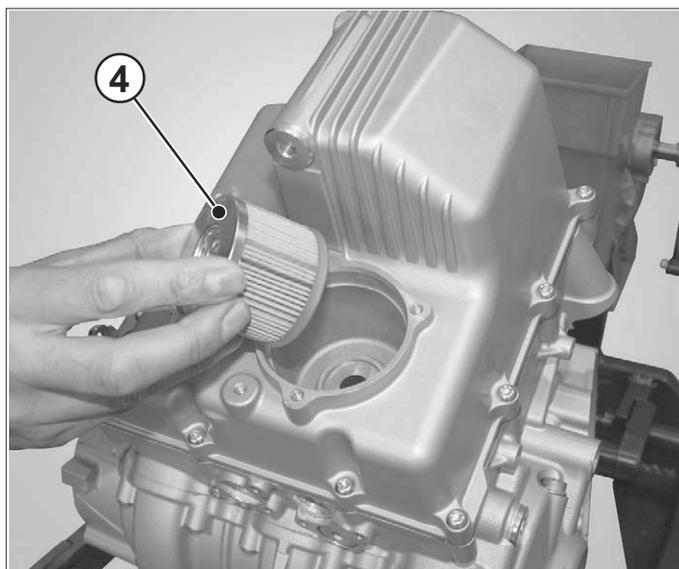




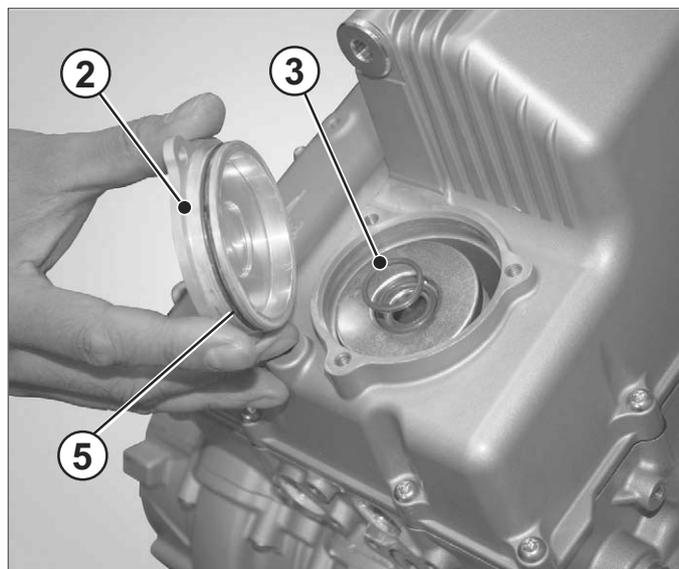
## Cooling - Lubrication

### Refitting the oil filter

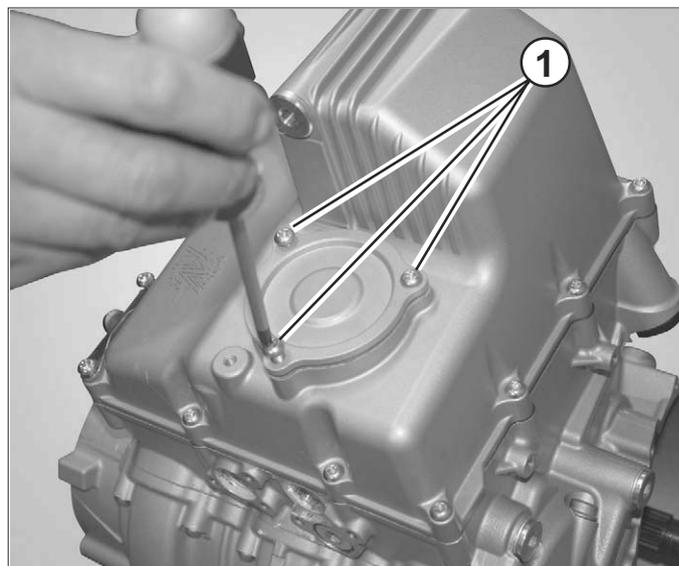
Introduce the oil filter (4) into the sump.

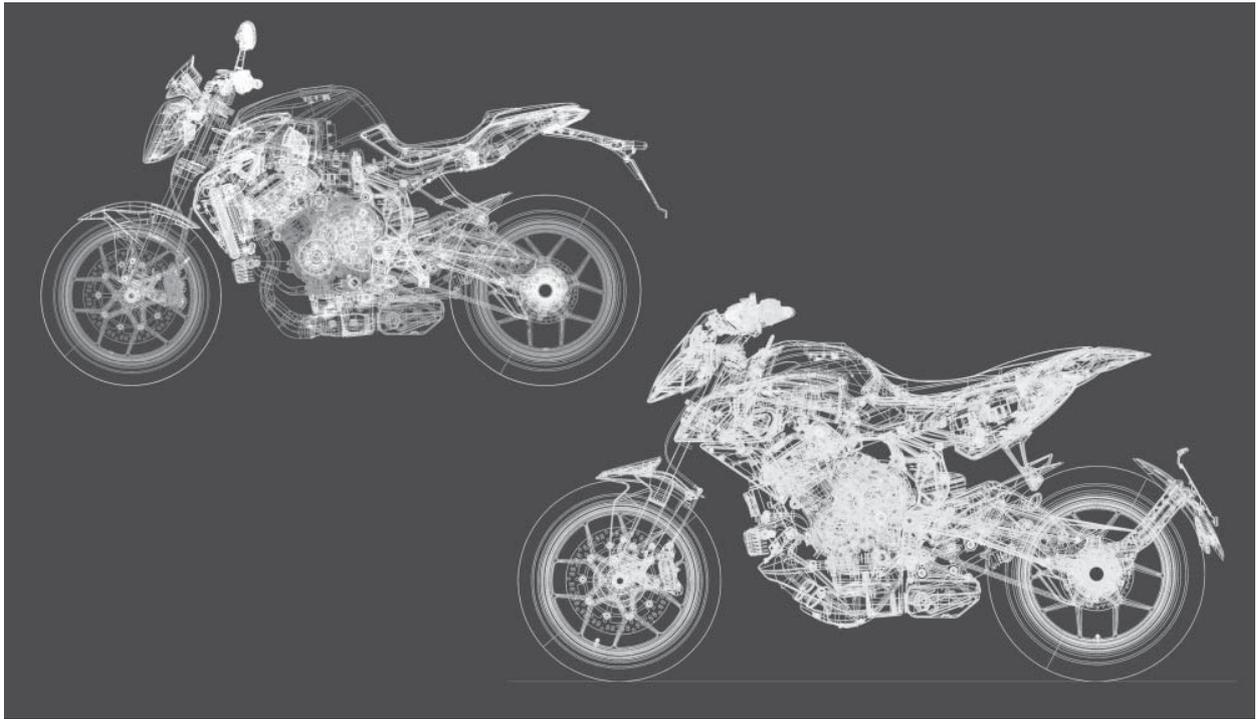


Insert the spring (3) in the filter seat, then lubricate the gasket (5) and fit the cover (2).



Screw down the screws (1).





**SECTION I**

REVISION 1

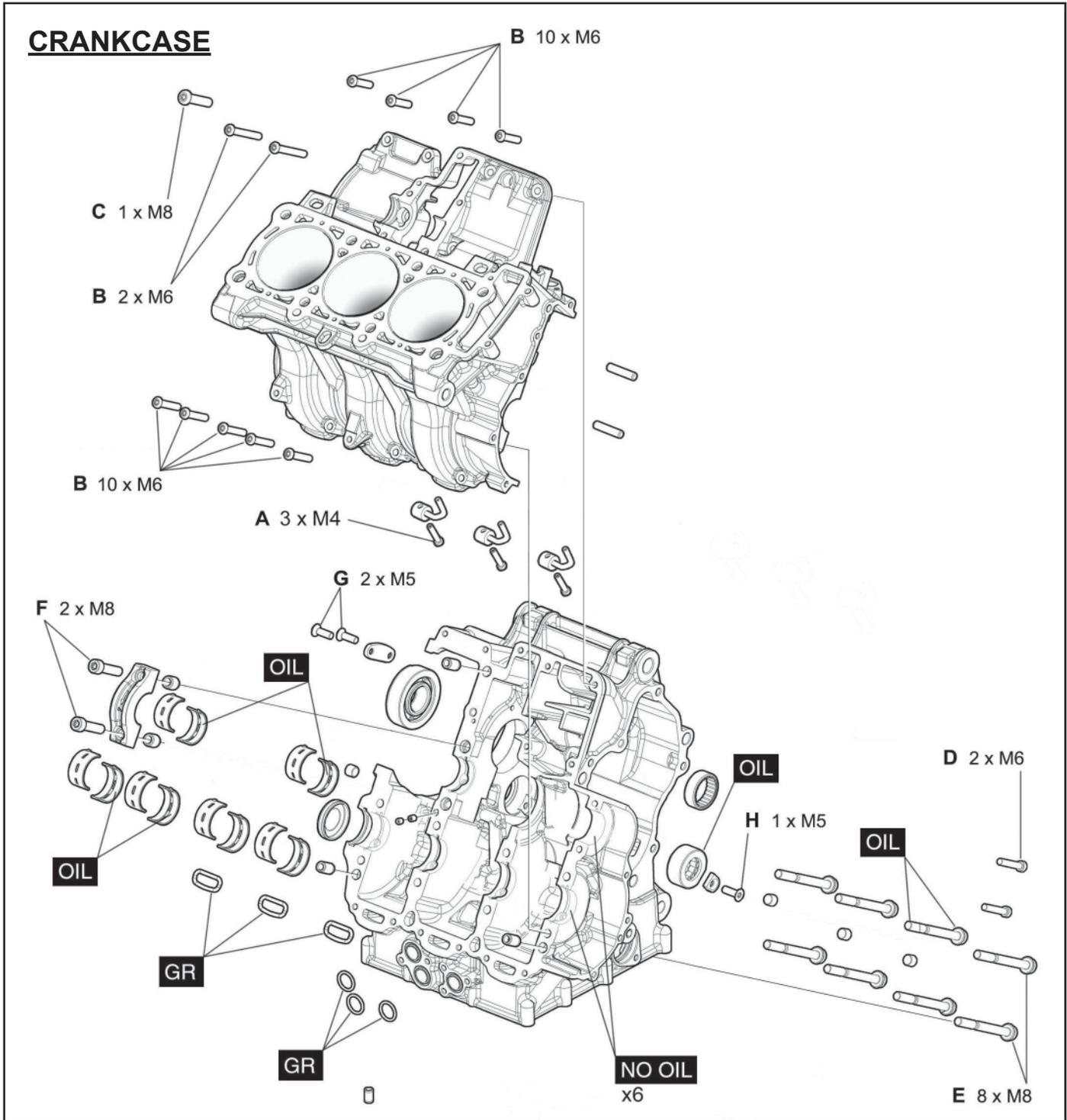


# Crankcase

## SUMMARY

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# Crankcase



Tightening torques		A	B	C	D	E	F	G	H	I	L
	Nm		8	10	25	12	10+60°	25	10	10	12
Thread blockers									strong	medium	strong

<b>OIL</b>	Apply motor oil	<b>SS</b>	Apply silicone sealing
<b>NO OIL</b>	Do not apply neither oil nor other types of substances	<b>HSC</b>	Apply HSC Molikote
<b>GR</b>	Apply grease	<b>M</b>	Apply mastic for gaskets



## Crankcase

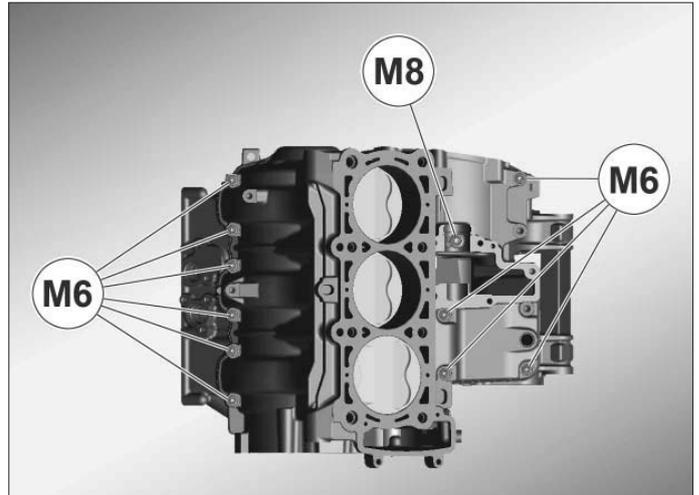
### Crankcase disassembly

Remove as follows as indicated in the relative paragraphs:

- A) The head
- B) The clutch
- C) The gear
- D) Starter
- E) Lubrication and cooling system.

Remove:

- F) Working on the upper part of the engine, remove the 12 6mm screws starting with the outermost ones and the central 8mm screw.

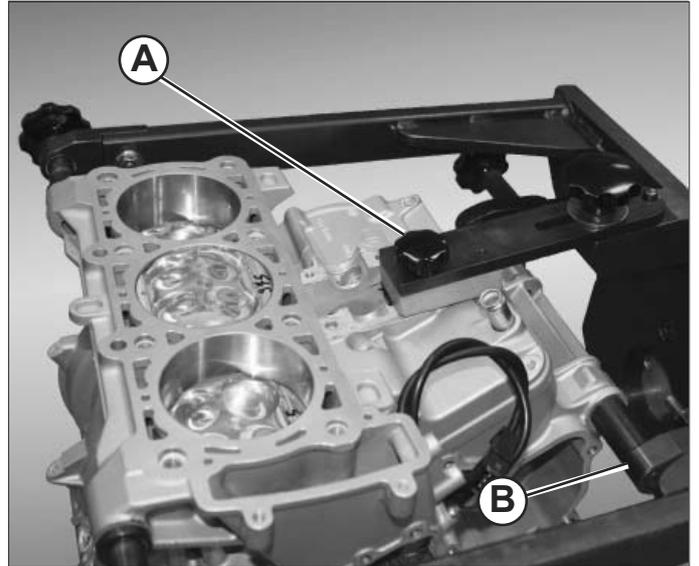


## Crankcase

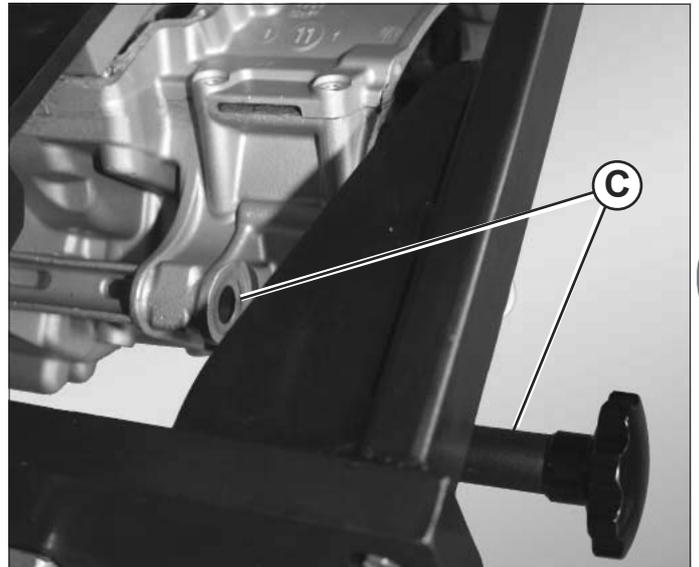


At this point it will be necessary to ensure the upper half-case is fully fastened to the engine support and eliminate the lower fastenings to make it possible to separate the half-cases.

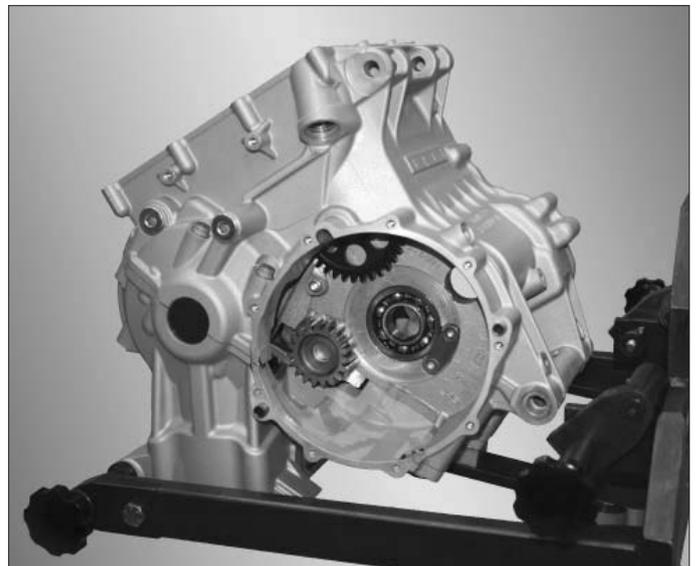
Add a fastening point (A) to the upper half-case using the hole of the central M6 screw. Free the lower half-case from the engine support fastening (B).



And from the engine support fastening (C).



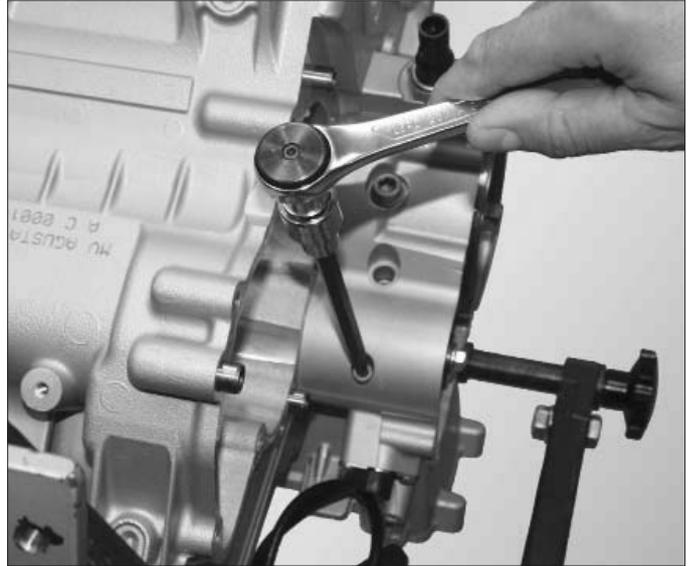
Rotate the engine 180°.



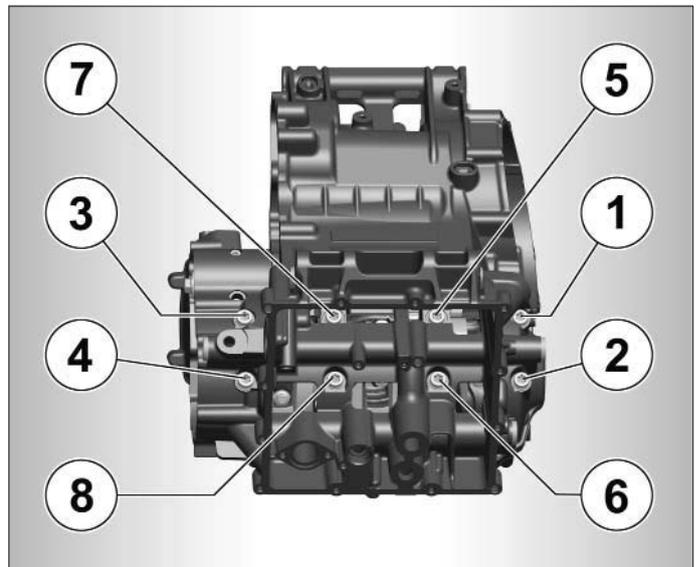


## Crankcase

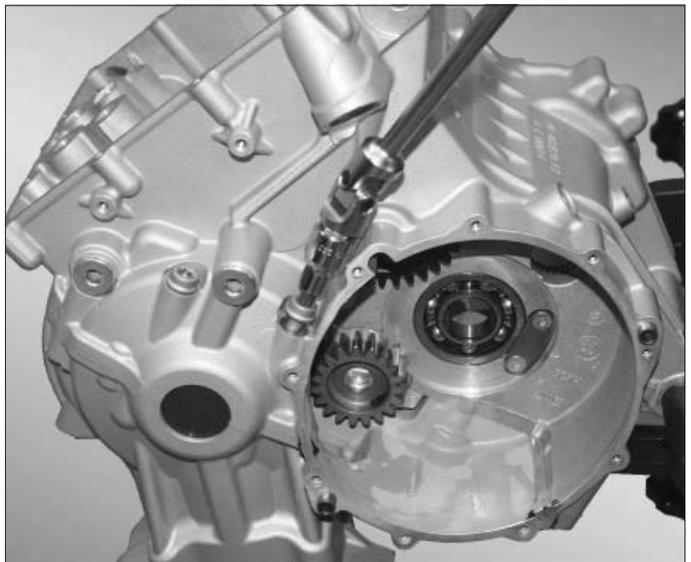
G) Remove the 2 M6 screws.



H) Remove the 8 M8 screws, following the order shown in the figure.



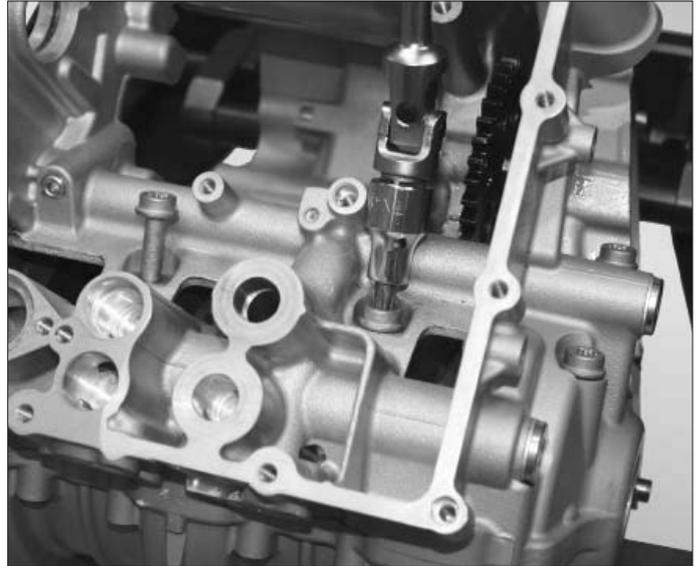
**NOTE** It is recommended you use an articulated driver to remove the screws inside the engine block.



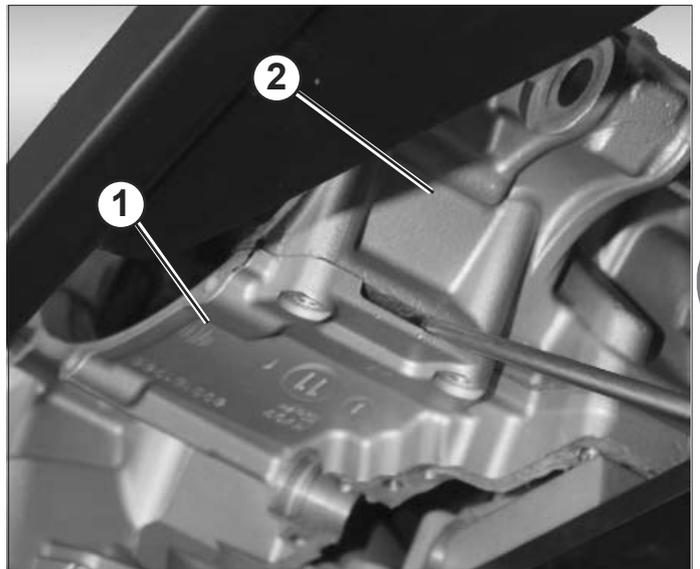
## Crankcase



Remove the screws using a flathead screwdriver.



I) Separate the two cases (1 and 2) by applying leverage on the protrusion.

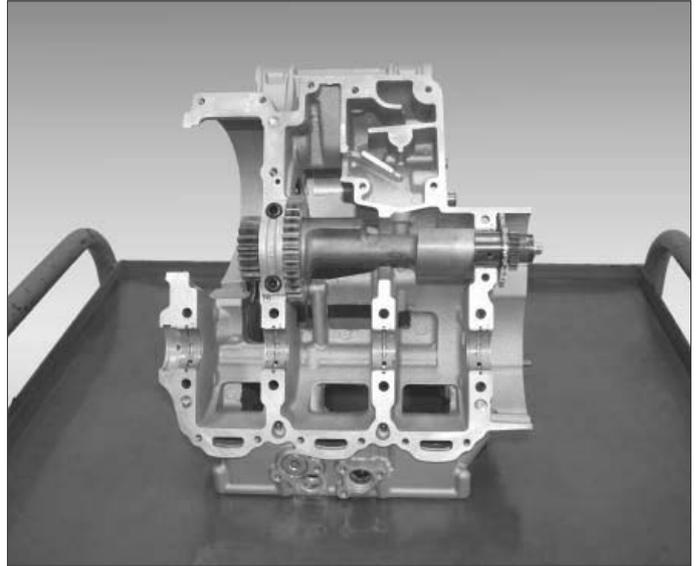


L) Remove the lower half-case and rest it on a flat, clean surface.



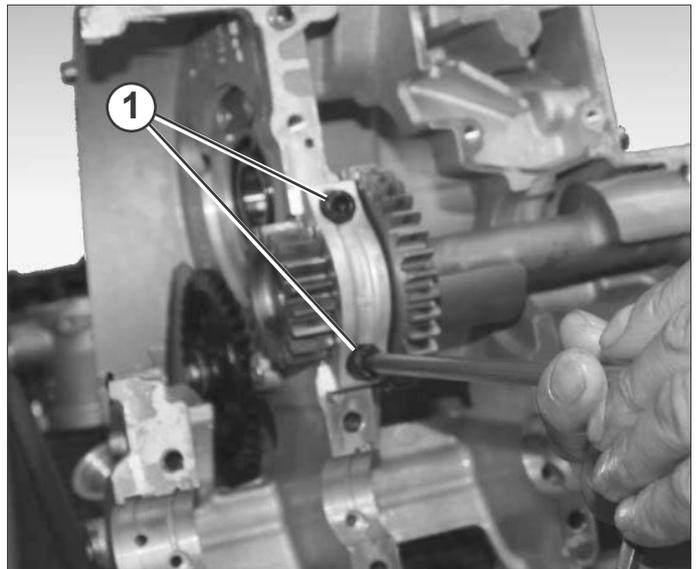


## Crankcase

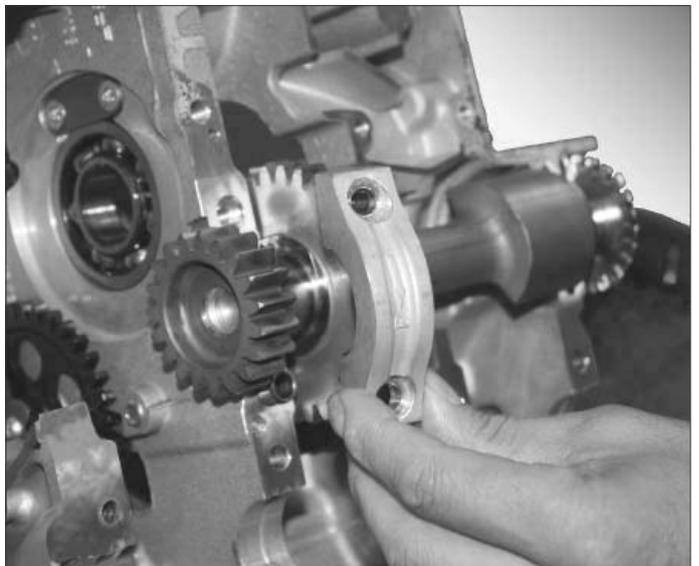


### Removing the countershaft

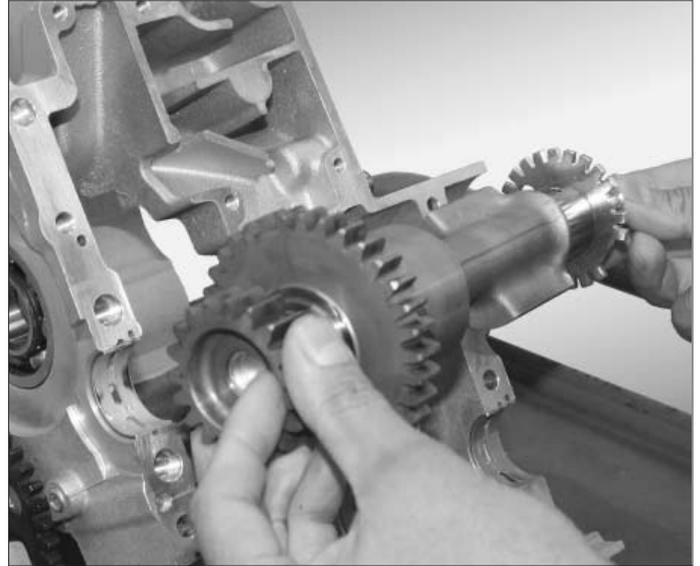
Loosen the 2 screws (1).



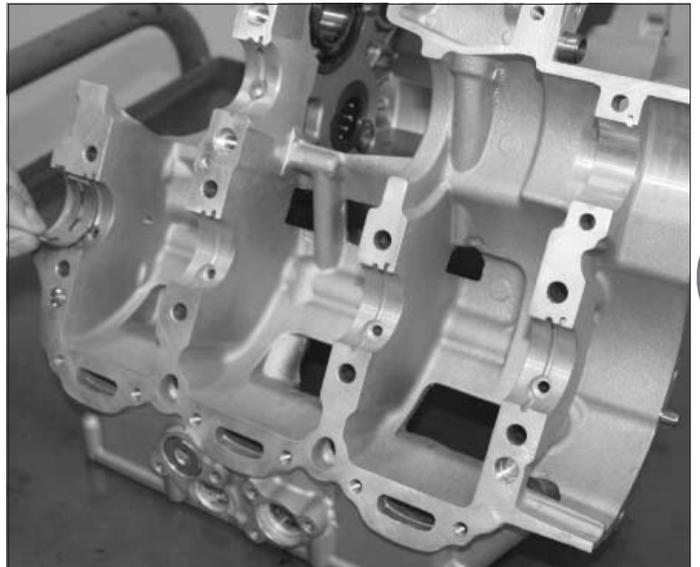
Remove the countershaft head with the two rings and the half-bearing.



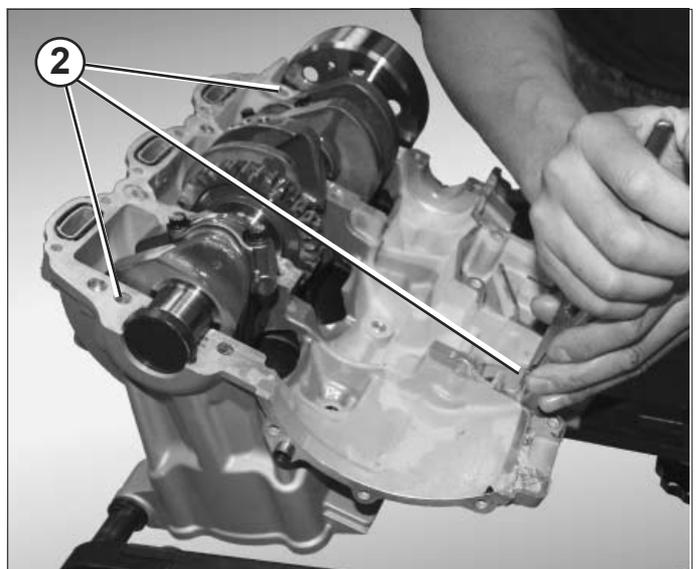
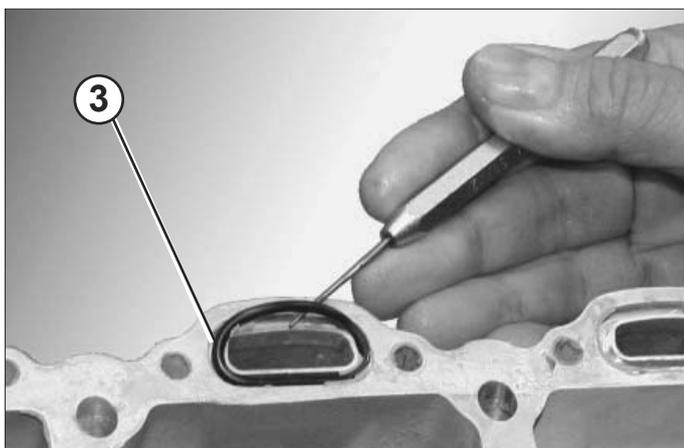
Remove the countershaft.



**NOTE** In the case of temporary removal of the bearings (1) it is recommended you mark the shaft, the support number and the case they belong to with a marker pen. For example the bearing removed from the countershaft of the no. 1 support of the upper case (starting from the left) will be identified by the mark S1 CS1.



Remove the 3 half-case blocking rings (2) and the seal ring (3) of the relative conduits.





## Crankcase

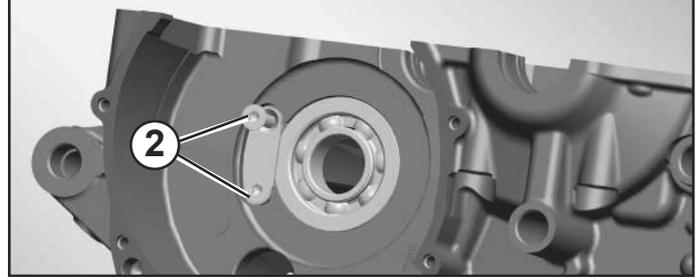
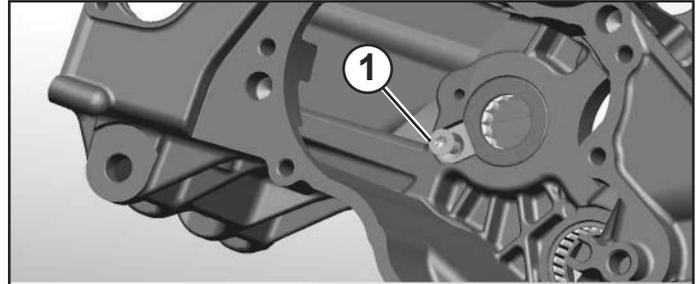
### Removing the gearbox bearings

This operation must be conducted when the engine is warm.

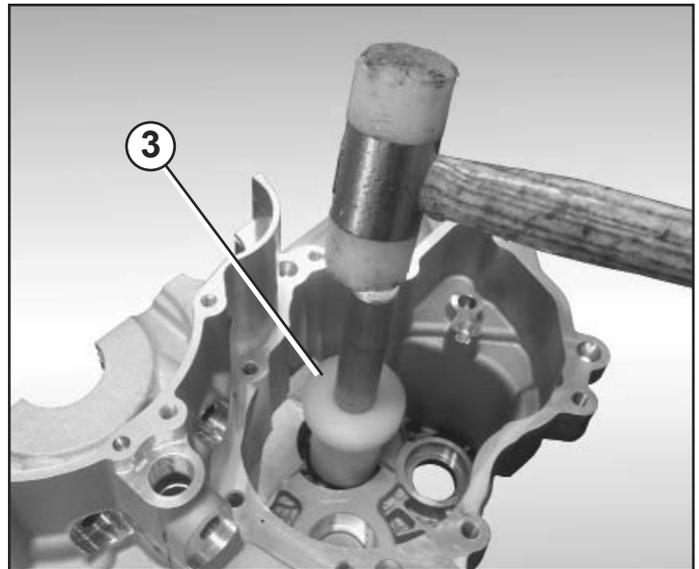
Remove the secondary shaft bearing clamping screw (1) and take out the respective retaining plate.

Remove the primary bearing clamping screws (2) and take out the respective retaining plate.

Use a heat gun to bring the temperature of the bearings' area of the bottom crankcase half to about 125°C.

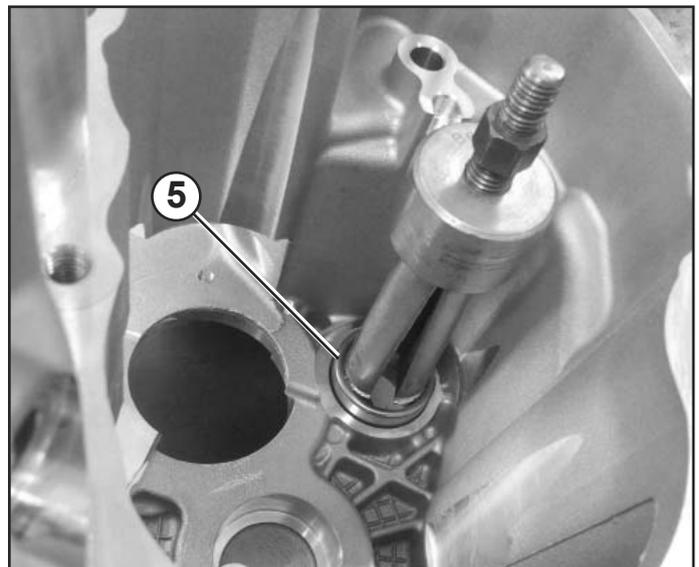


Use a Te on spacer (3) to push the primary bearing by tapping it slightly with a hammer.



Take out the bearing (4) of the secondary shaft using an extractor.

Carry out the same operation to take out the needle cage (5) of the desmodromic shaft.



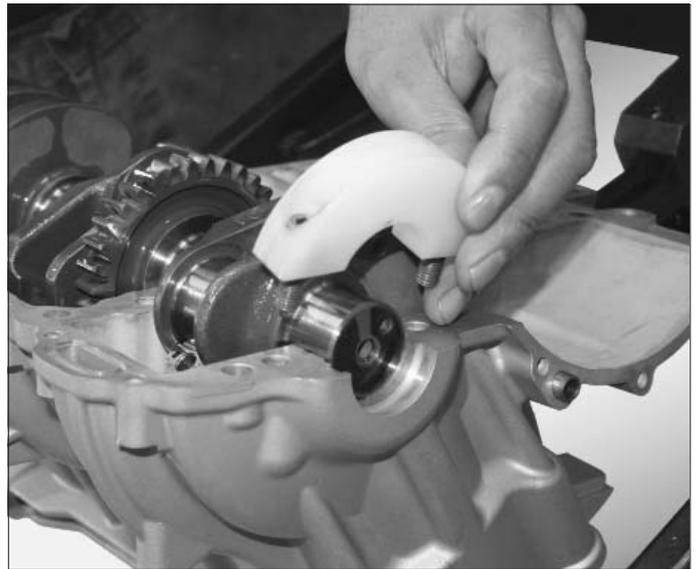
## Removing the crankshaft

Disengage the crankshaft from the piston-connecting rods assembly by removing the big ends.

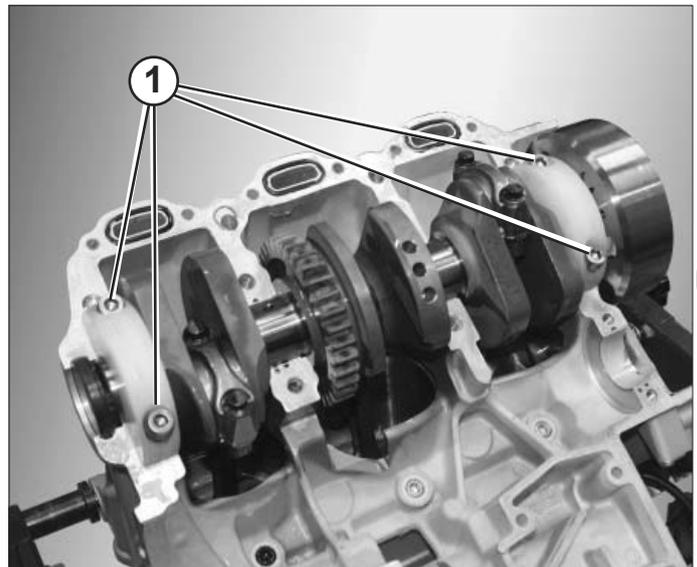


**Tool no. 8000B7214 is required to perform this operation.**

Fit the tool on main journals no. 1 and no.4.

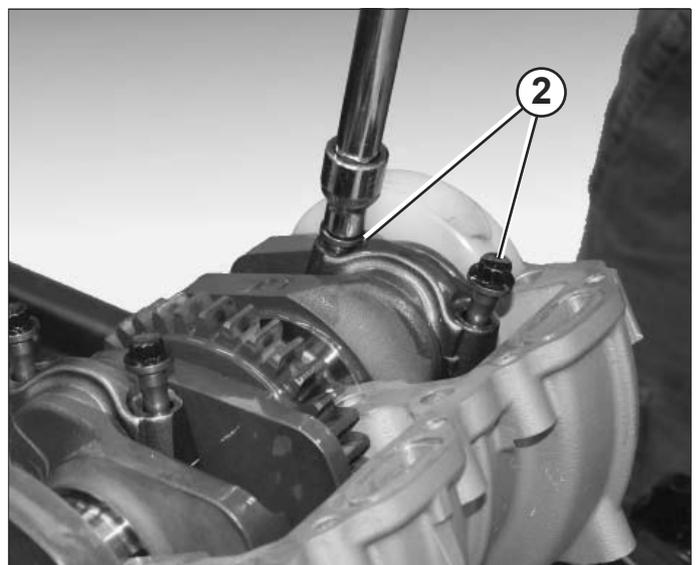


Hand tighten the screws (1) of the tool to lock the crankshaft in place.



## Removing the big ends

Loosen the big end retaining screws (2).

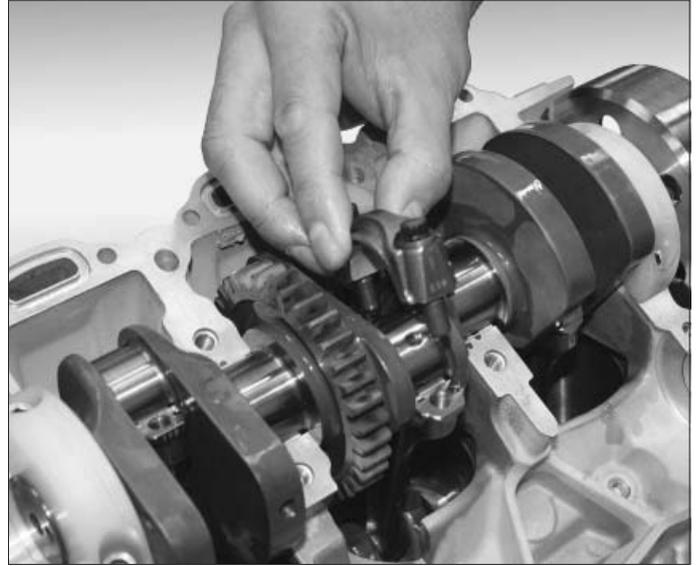




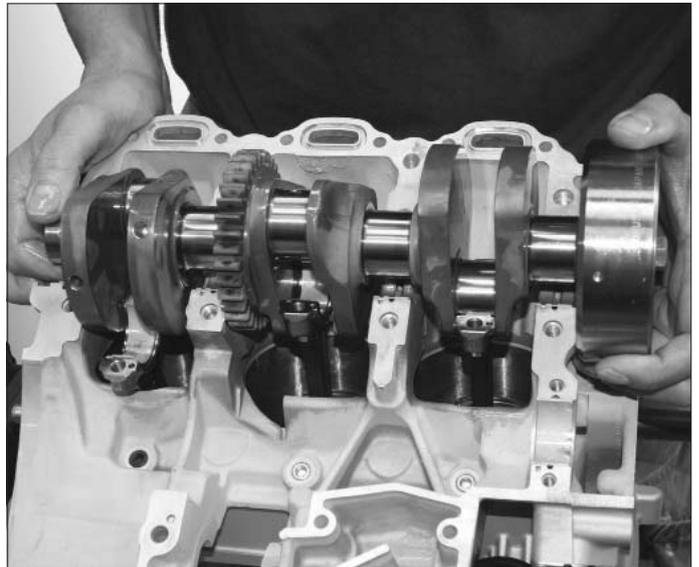
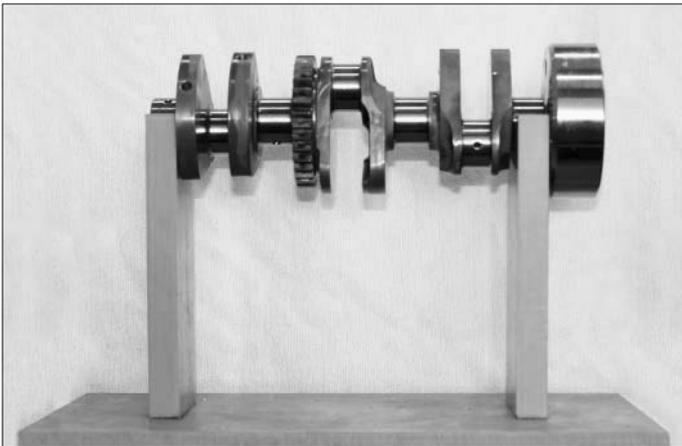
## Crankcase

Remove each big end from its connecting rod, marking it to avoid confusion on re fitting.

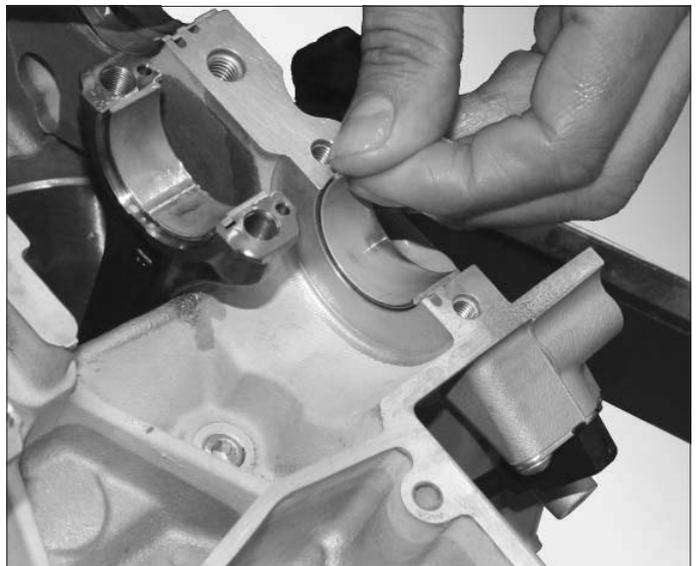
Remove tool no. 8000B7214.



Remove the crankshaft and place it on a support of the type shown in the figure.



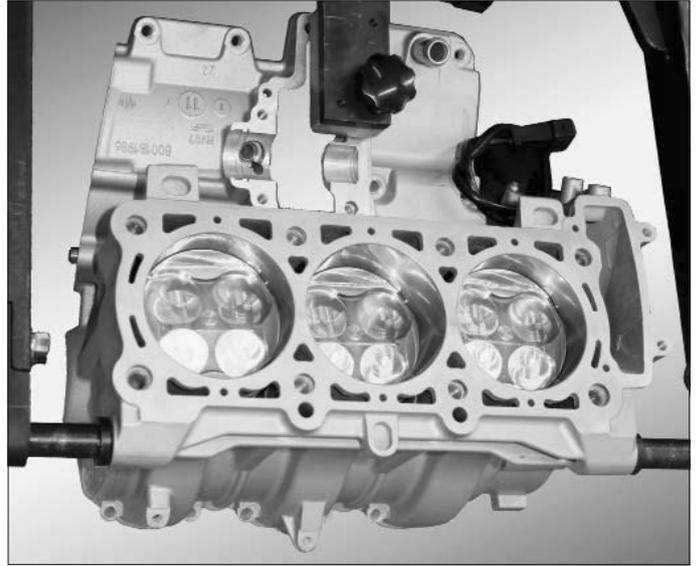
**NOTE** In the case of temporary removal of the bearings (1) it is recommended you mark the shaft, the support number and the case they belong to with a marker pen. For example the bearing removed from the crankshaft of the no. 1 support of the upper case (starting from the left) will be identified by the mark S1 AS1.



## Removing the pistons

Turn the upper half-case.

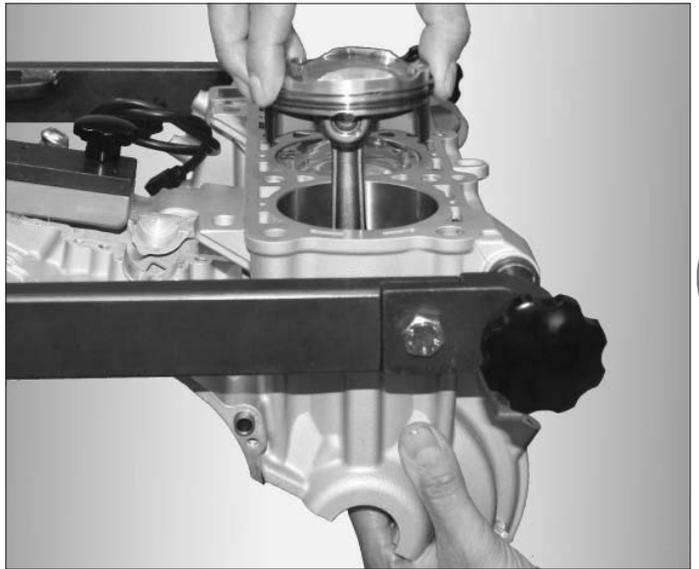
**NOTE** Mark the top of every piston with a marker pen in order to ensure the correct position is respected on reassembly.



Extract the pistons moving the connecting rods up from bottom as indicated, and make attention not to damage the elastic bands.



**Work on one piston at a time to continue the removal.**



Remove the circlips which blocks the pin to the piston. Slide the pin off.

**NOTE** Mark each part according to the cylinder no. it belongs to so they can be reassembled in their original positions.

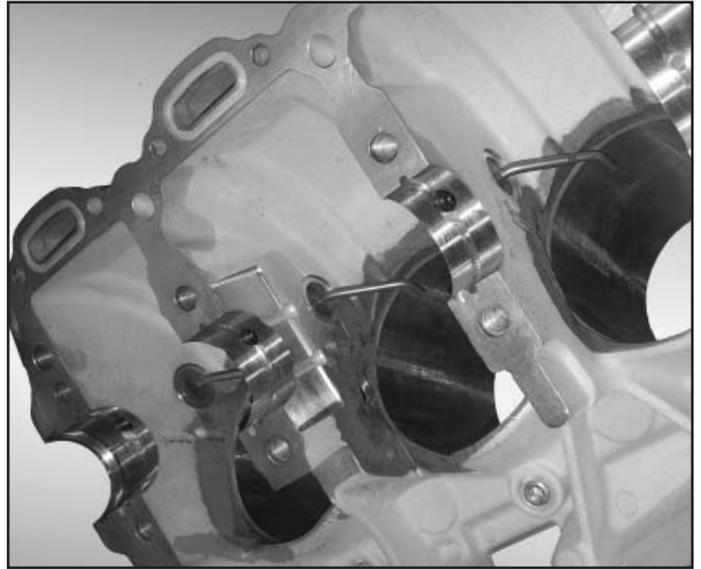




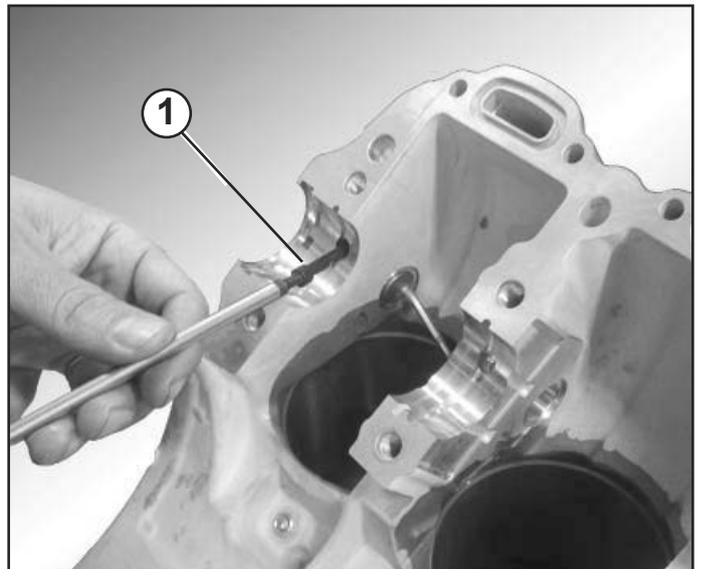
## Crankcase

### Removing the piston oil jets

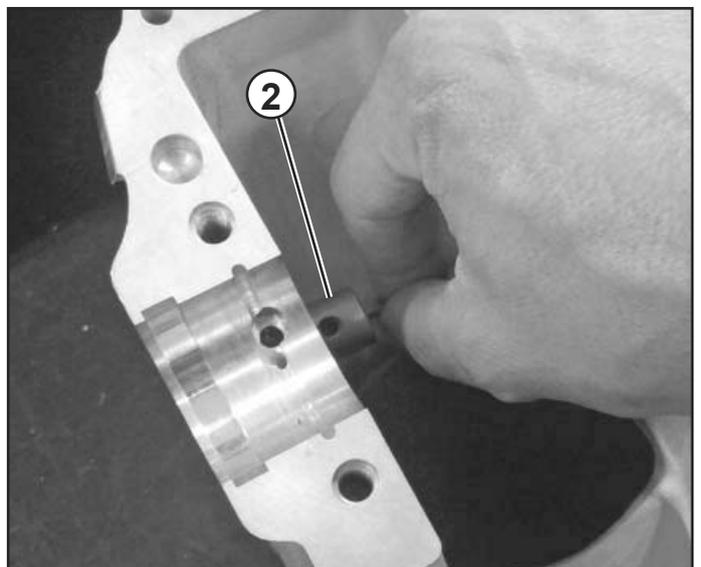
To carry out this operation, it is necessary to remove the main bearings as described on page 12.



Unscrew the three hollow bolts (1).



Take out the three oil jets (2), make sure you do not damage the nozzles.

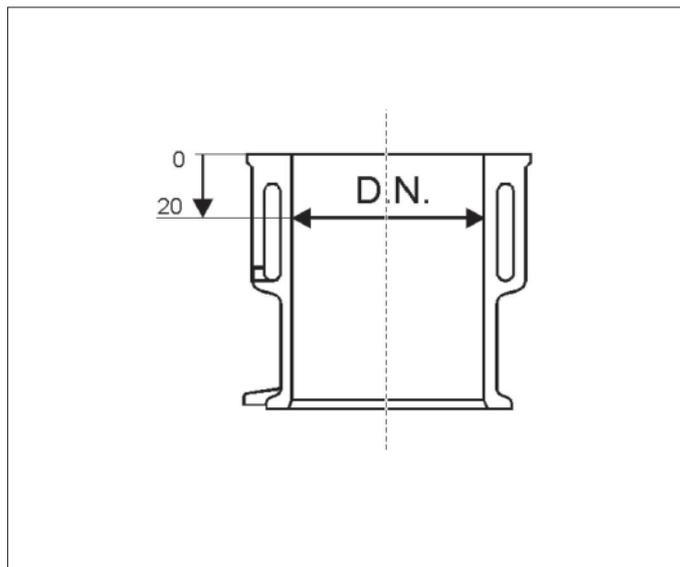


## Cylinder revision

Check to be sure that enclosures show no sign of seizures with the pistons.

Check piston ovalization in the following way:

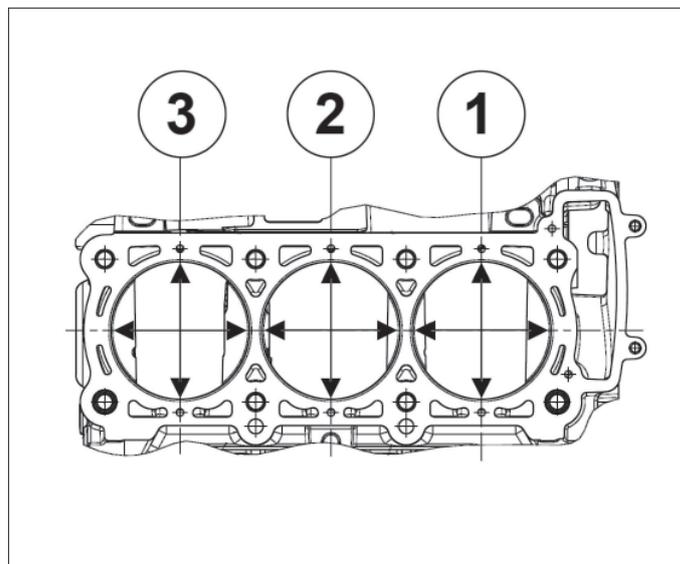
- A) Measure the **nominal diameter of each cylinder at a distance of 20 mm from the superior edge** as indicated in the figure.



- B) Perpendicularly repeat the measurements to the preceding ones.  
 C) Verify that the **ovalization is inferior to 0,015 mm** (wear limits).

In the case that not even one cylinder should pass this verification, substitute the entire block.

If the block should be substituted and if necessary also substitute the pistons and elastic strips.



## Piston revision

Carefully clean the piston ceiling from carbon residues. Continue with a careful visual check of the piston; no signs of lines or other damage must appear. Measure the diameter of the piston at the portion indicated in the direction perpendicular to the piston pin axle.

In the case of excessive wear of one of the pistons, substitute it.

The piston should belong to the same class of the cylinder selection.





## Crankcase

### Piston-cylinder coupling

The cylinder-piston groups are furnished already coupled; if there should be an exchange of cylinders and pistons between them it would be necessary to proceed surveying coupling plays.

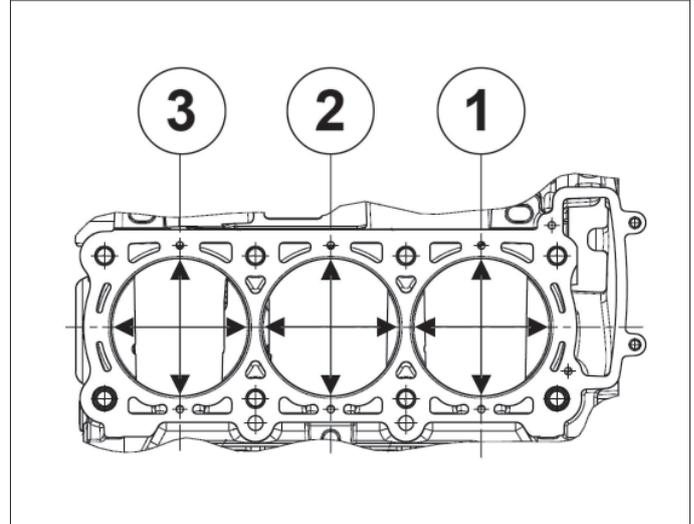
**Measure the diameter of the (ND) pipe at 20 mm from the superior plane**, as indicated on the sketch.

**The piston diameter must be measured at 8 mm from the shell base**, in a perpendicular position to the piston pin axle.

These measurements must be carried out at a stabilized temperature of 20°.

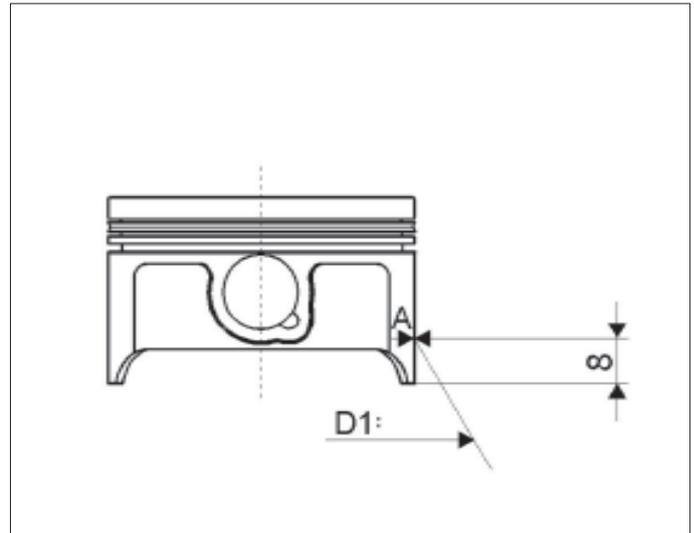
**The play between piston and cylinder must fall between 0,038 e 0,067 mm.**

**Maximum wear limit permitted 0,10 mm.**



### Piston pin revision

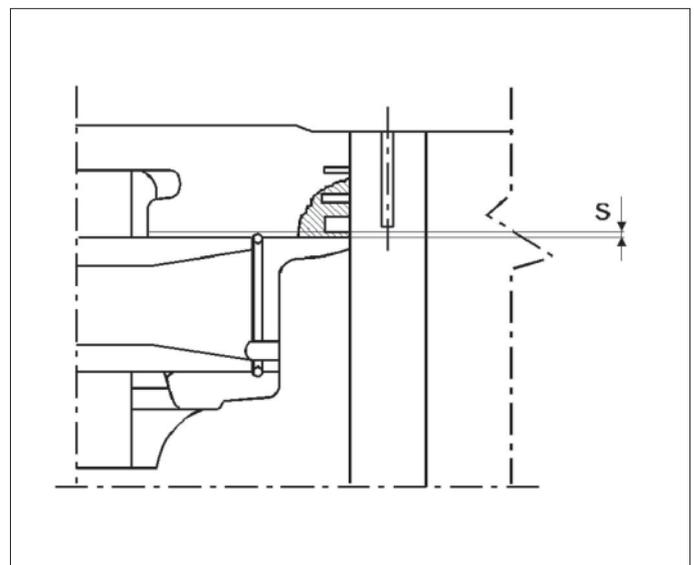
Verify that the piston pins show no lines or bluish colours which indicate over heating.



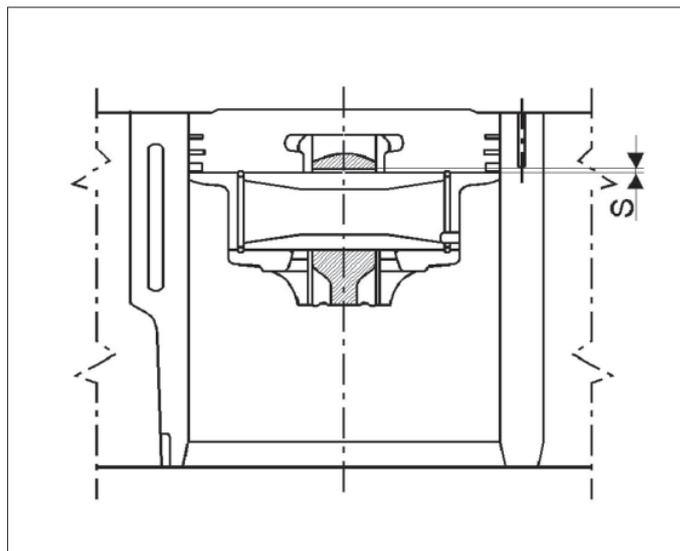
### Piston-pin coupling

**The (S) play between piston pins and piston must be of 0,004÷0,012 mm** in case the limit is exceeded it is necessary to substitute the piston pin and piston.

**The limited wear permitted is 0,03 mm.**

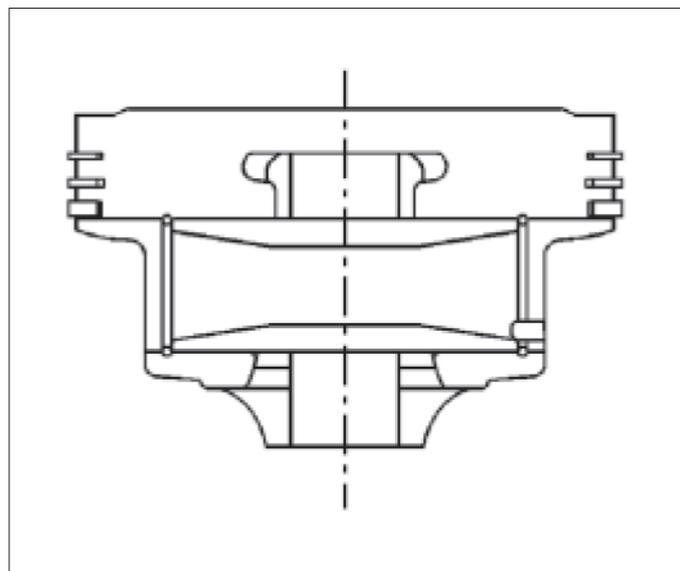


**Piston pin - connecting rod coupling**  
**Play between piston pin and connecting rod** must be of **0,015÷0,032 mm**.  
 Maximum **wear limit** allowed **0,06 mm**.



## Piston rings

Verify the absence of lines and traces of shrinkage on each piston ring. Verify that the edge of the segment is well defined and free in the piston rings.  
 The spare pistons are furnished complete with rings and piston pins. Whenever segment wear is noticeable it is recommended to change the pistons as well.



PISTON RING	Standard	Wear limit
1°	SP 0,8 <sup>-0,01</sup> <sub>-0,03</sub>	0,75
2°	SP 0,8 <sup>0</sup> <sub>-0,02</sub>	0,75
Oil scraper	SP 1,5 <sup>-0,03</sup> <sub>-0,08</sub>	1,38

## Piston ring-cylinder coupling

Introduce the 5 mm segment under the head plane being careful to position it well in "square" and to measure the distance between the two ends of the piston ring.

The maximum play allowed between the ends of the ring is the following for each segment:

PISTON RING N°1: **0,2 ÷0,4 mm**;

Maximum wear limit allowed: **0,6 mm**

INTERMEDIATE PISTON RING: **0,2 ÷0,4 mm**

Maximum wear limit allowed: **0,6 mm**

OIL SCRAPER: **0,2 ÷0,7 mm**

Maximum wear limit allowed: **1,0 mm**



## Coupling of piston pin-small end bush

Check that the bearing is under good condition and that there are not wear marks.

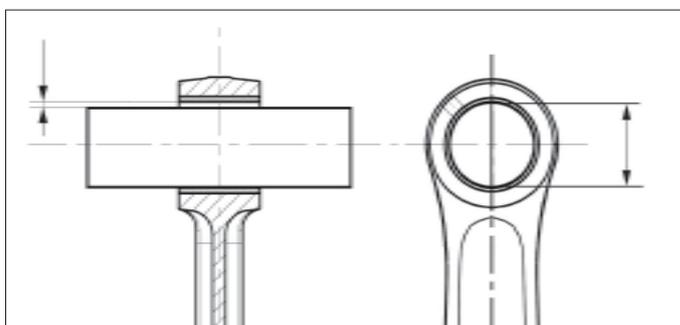


Verify that the internal diameter of the small end bush is between  $16,015 \pm 16,025$  mm.

The play between the small end bush and the piston pin must be between 0,015 and 0,032 mm.



**If the connecting rod does not conform to these parameters it will be necessary to replace it.**



## Coupling half-bearings - crank pin

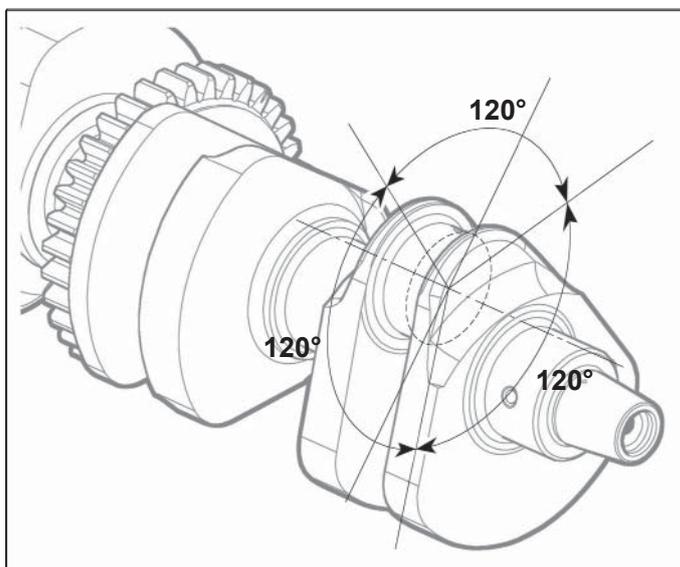
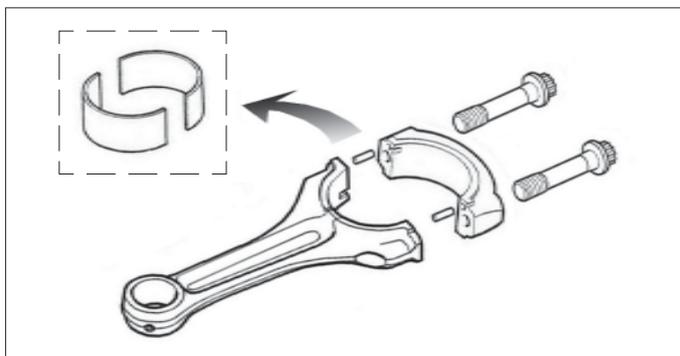
Verify the measure of the connecting rod and pin diameters.

### - Connecting rod pin

The measure of the roundness of the crank pin must be performed along the center surface of the crank pin with three measurements at  $120^\circ$  intervals.

The max. nominal value of roundness is **0,005 mm**.

The obtained average value must be comprised in the values foreseen by the 2 classes of selection of the crankshaft.





# Crankcase

## - Connecting rod

The measure of the connecting rod must be effected after having tightened the connecting rod without half-bearings to the prescribed torque.



**Its recommended to execute the measurement re-using the original used bolts.**

Degrease bolts and connecting rod.  
Lubricate with oil the internal thread, thread and under head.  
Pre-load the bolts to the torque of 5 Nm.  
Intermediate tightening to the torque of 20 Nm.  
Final tightening by turning clockwise of 90° (1/4 of turn).  
Once performed the tightening, effect a measurement on the principal axle of the stem and two to 45° from it as suitable in figure. The internal diameter of the connecting rod is given by the average of the three values.

$$D.i. = (d1 + d2 + d3)/3$$

Check that the torsional and flexion deformation of the connecting rods does not exceed the following values:

**Flexion: Max 0,1/100 mm**  
**Torsion: Max 0,05/100 mm**

If it is necessary to replace one or more parts, refer to the class and the weight of the connecting rod and to the color of the bearing, printed on the same.

(L=109,3mm)		(L=105,1mm)	
Class	Weight (g)	Class	Weight (g)
X	255 ÷ 258	X	250 ÷ 253
Y	258,1 ÷ 261	Y	253,1 ÷ 256
Z	261,1 ÷ 264	Z	256,1 ÷ 259

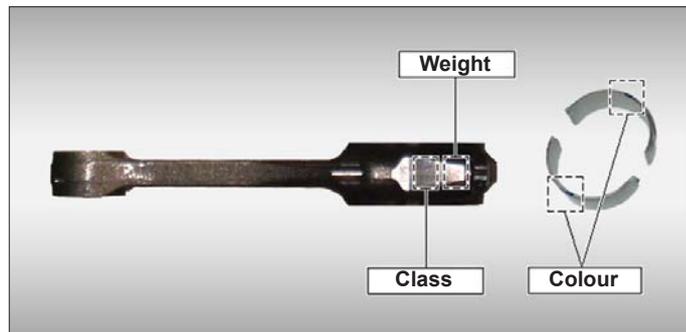
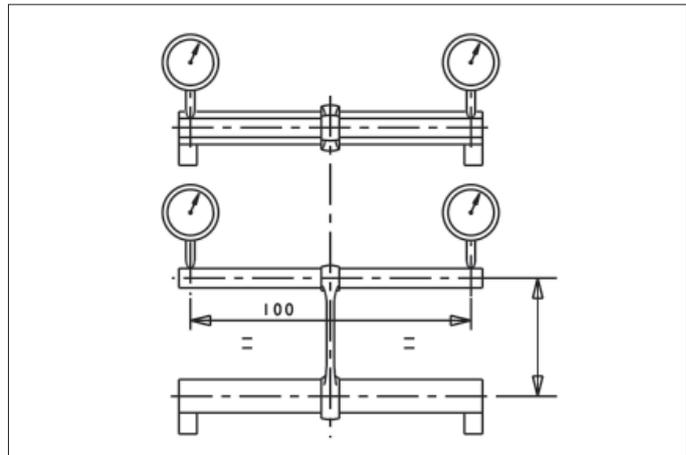


**The replacement connecting rods must pertain to the same weight class. Do not use connecting rods with different weight classes.**

To identify the weight class of the connecting rod, refer to the table herewith.  
Select the half-bearings in base to the color according to the attached chart.

**NOTE** On re tting, the screws and connecting rods must be thoroughly cleaned and degreased.

CONNECTING ROD SCREW TIGHTENING	
TORQUE	
Operation	Value
Pre-load	5 Nm
Intermediate tightening	20 Nm

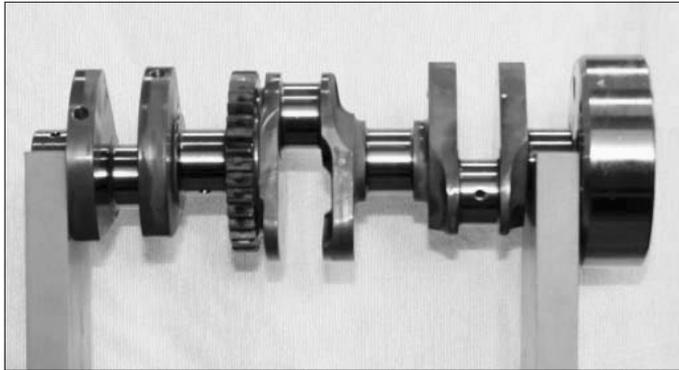
  


SELECTION TABLE FOR F3 CONNECTING ROD				
		CONNECTING ROD HEAD DIAMETER		
		A	B	
		36,000 36,008	36,009 36,016	
CONNECTING ROD	33,016	1.484/1,486		1,486/1,491
PIN DIAMETER	33,024	RED		BLUE
FUNCTIONING PLAY 0,029/0,057				

## Overhauling the crankshaft and countershaft

Clean and check that the teeth of the gears of the two shafts are intact and have sharp edges.

Check that there are no signs of anomalous wear and the surfaces are smooth.



## Overhauling the half-cases

Replace the main bearings if there is any doubt as to their condition. Check wear tolerances of the crankshaft.

For couplings, refer to the classes given in the table.

The **functional clearance** of the crankshaft main bearings must be between

**0,019÷0,046 mm.**

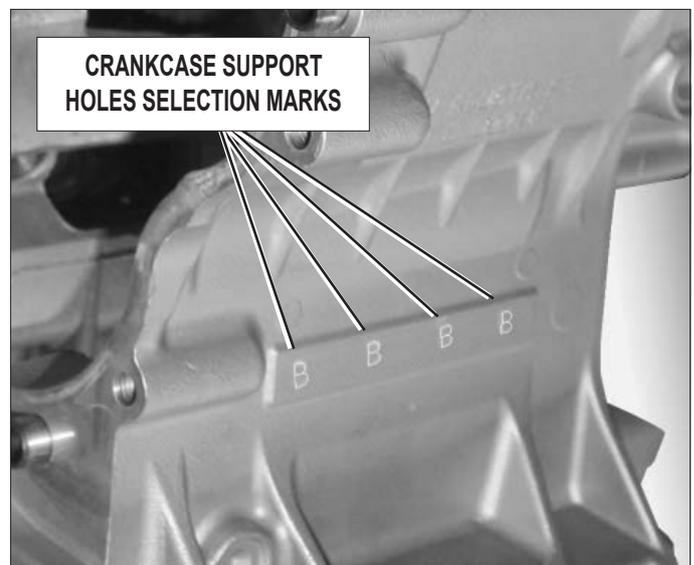
The service limit is **0.06 mm.**

SELECTION TABLE FOR F3 BEARINGS				
BENCH PIN DIAMETER	CARTER SLOT DIAMETER			
	A	36,000 36,008	B	36,009 36,016
33,014 ÷ 33,022	1,484 ÷ 1,489 RED		1,489 ÷ 1,494 BLUE	
FUNCTIONING PLAY 0,019/0,046				

**NOTE** The countershaft has one main bearing selection only.



Insert the blocking rings and lubricate the cylinder liners with engine oil.





## Crankcase

### REASSEMBLY

Make sure the crankcase halves have been thoroughly cleaned and degreased. There shouldn't be any obstructions in the areas where the oil passes. The contact surfaces of the crankcase halves must be perfectly smooth and clean.

### Reassembling the piston oil jets

Make sure there are no obstructions in the conduits of the jets, which must be perfectly clean.

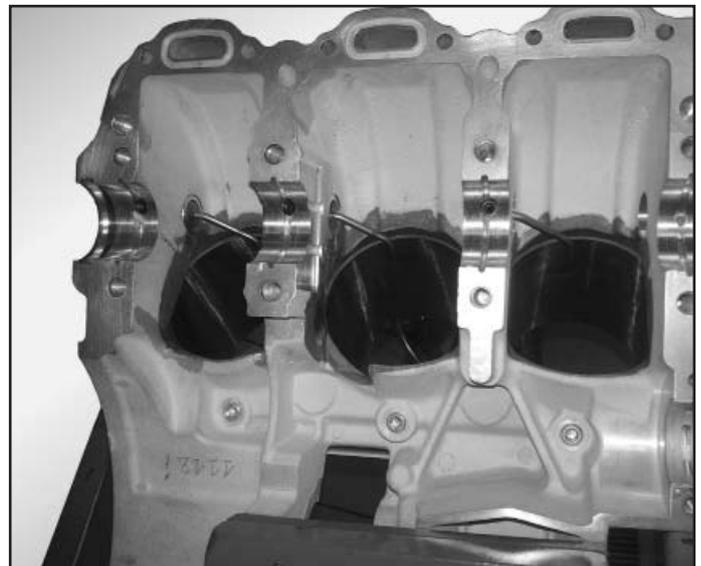
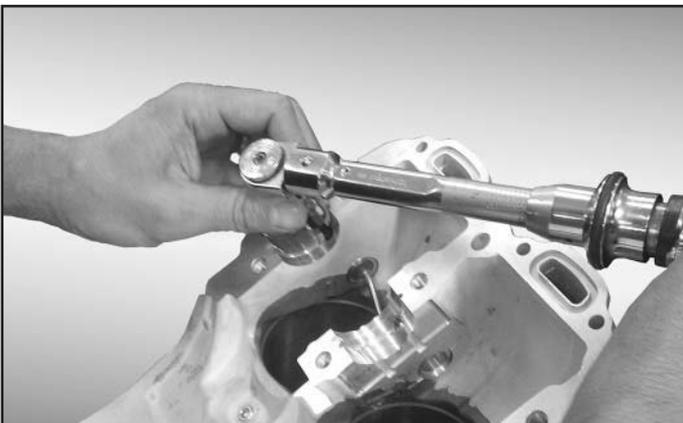
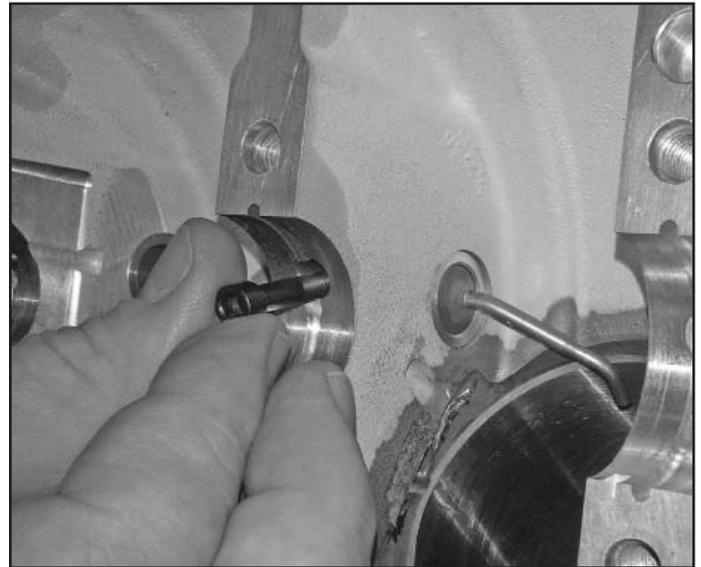
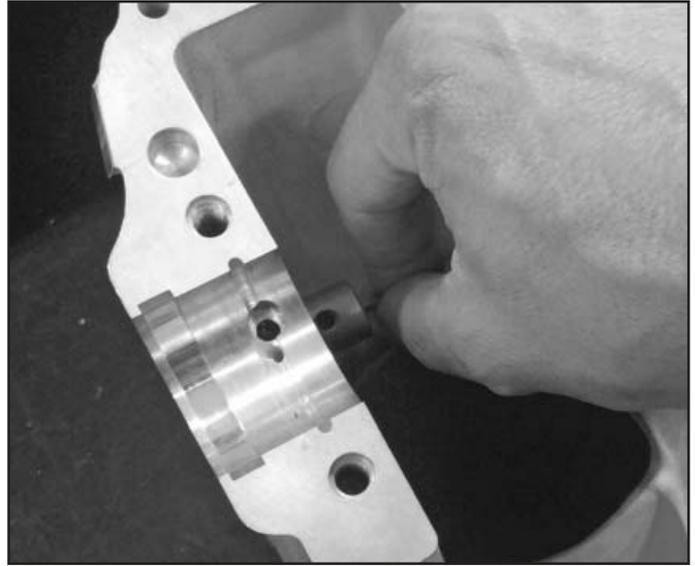


**Do not install damaged or deformed jets. Jets with features that differ from the original ones can cause serious damage to the engine.**

Insert the jets by pushing them all the way into place on the top crankcase half.

Make sure the hollow bolts are clean and have been degreased.

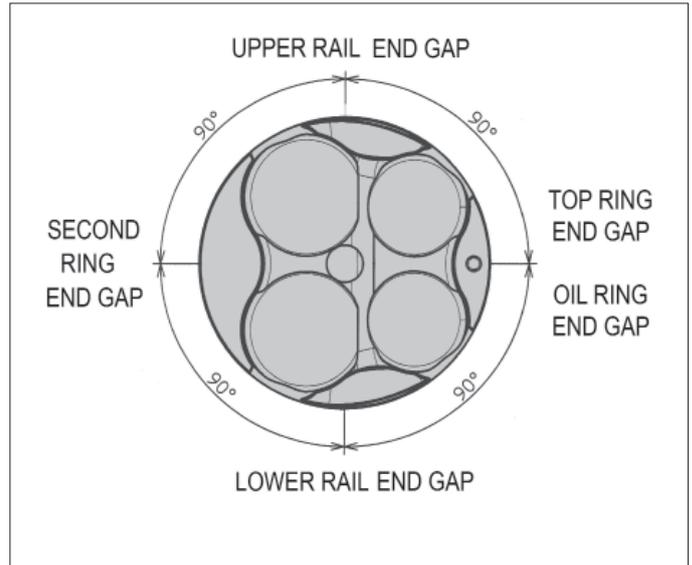
Manually bring the hollow bolts closer and tighten to a torque of 8 Nm.



## Cylinder and piston assembly

The rings must be assembled on the piston with the writing "R" "RN" turned upwards and by following the outline in the figure.

Assemble the internal ring on the piston.  
Assemble the internal ring on the piston.  
Assemble the pistons complete with the previously degreased and cleaned connecting rod.



Insert the piston pins into the piston until beat.



Assemble the external rings.





## Crankcase

Insert the centering bush and lubricate the cylinder barrels with engine oil.



The following tool is required to perform this operation:



**Piston installation device**  
cod. 8000B7207



Position the device on the half-case as indicated, centering the blocking rings and lubricating the liners with engine oil.



## Crankcase



Push the pistons with connecting rods down into their respective cylinders.



Insert the pistons compressing the segments manually to avoid damage.



Pull the connecting rods downward until complete inserting of the pistons into the cylinder.

Once inserted all the pistons, dismantle the tool and turn the half-crankcase.





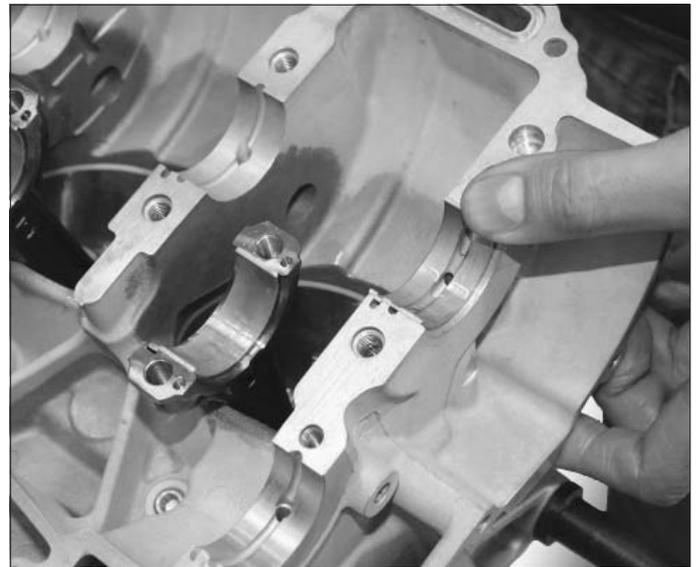
## Crankcase

### Re fitting the half-cases

Carefully degrease and clean from any paste residues.



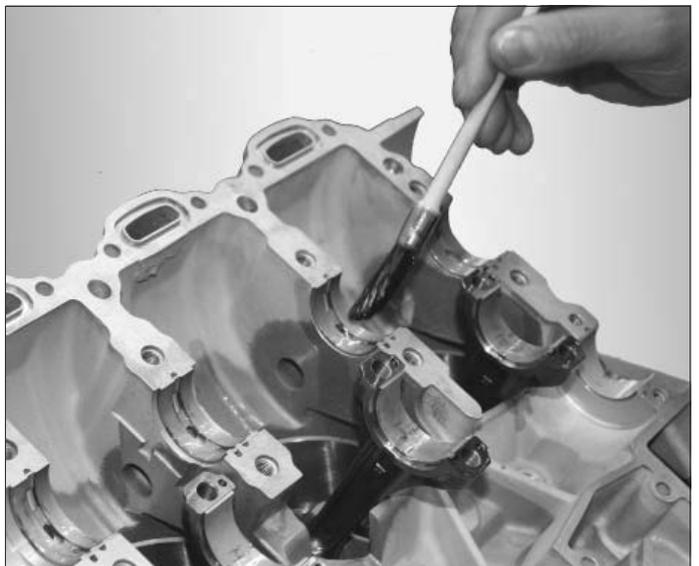
Fit the bearings in their respective seats (previously marked during disassembly) in the case without lubricating them.



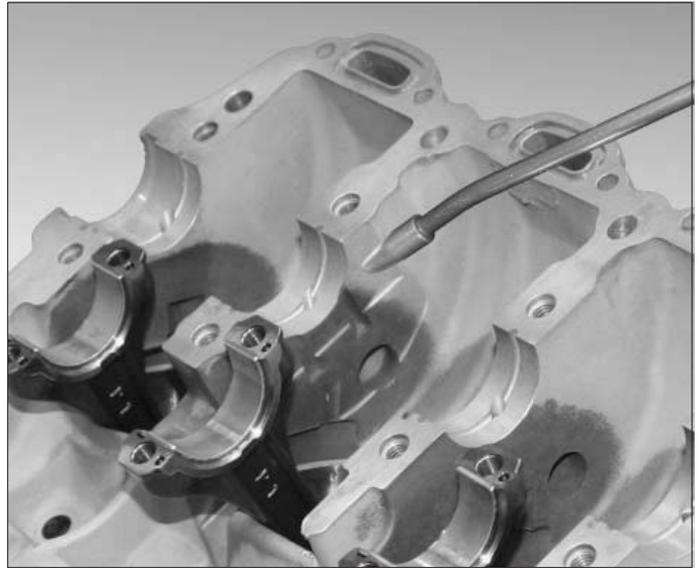
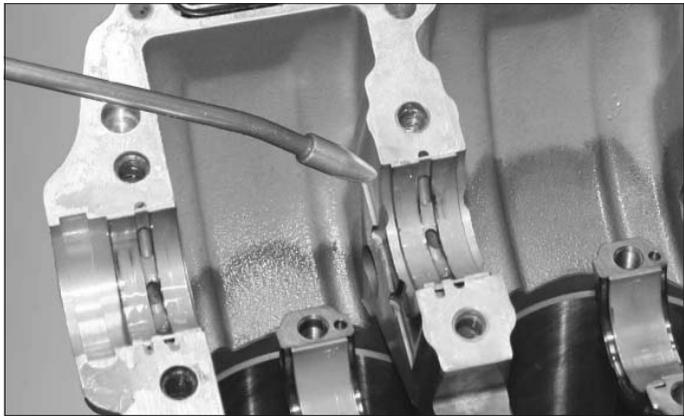
After having positioned them put oil on each bush.



**Oil the main, rod and countershaft bearings with engine oil.**

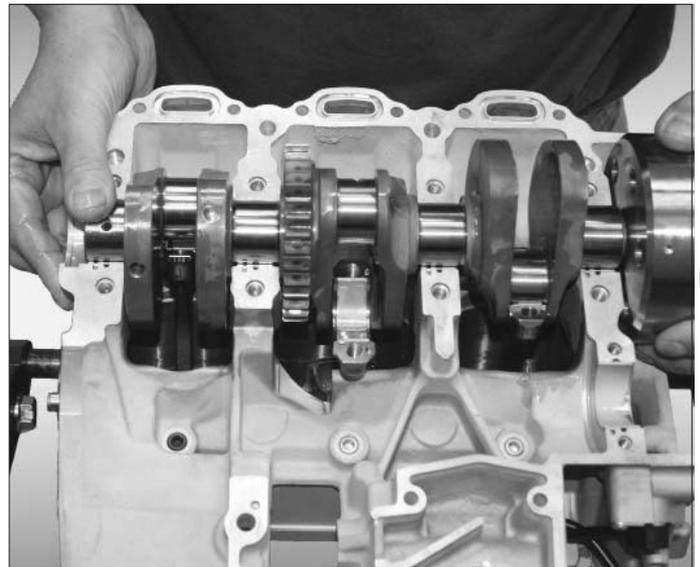


Lubricate journal no. 2 from both sides as it performs the function of centring the crankshaft.

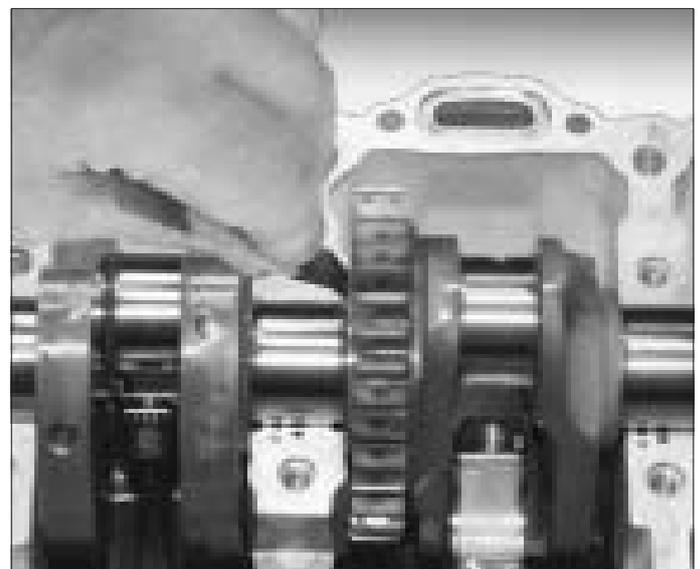


## Fitting the crankshaft

Place the crankshaft in place, bringing the connecting rods into contact.



Use a feeler gauge to check that the crankshaft has end play of between 0.1 and 0.25 mm from the main journals. In case there should be different values contact the manufacturer.



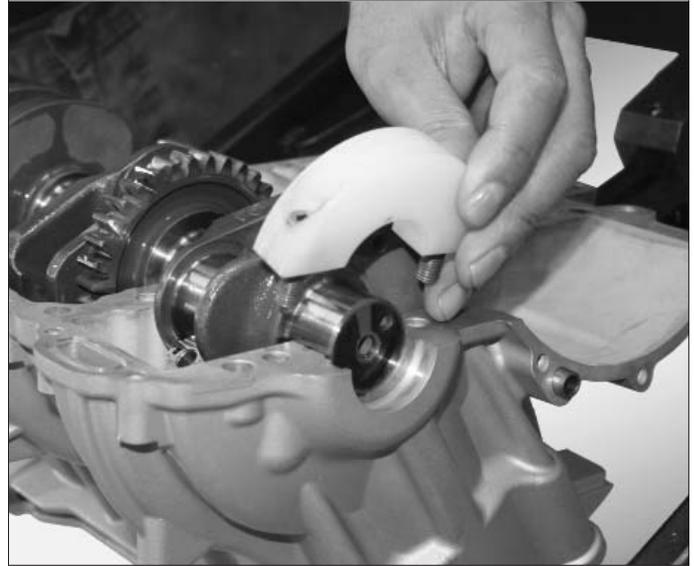


## Crankcase

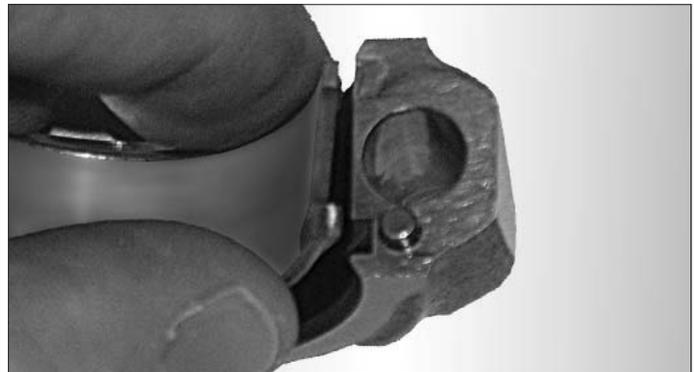
### Fitting the connecting rods

 Tool no. 8000B7214 is required to perform this operation.

Fit the tool on main journals no. 1 and no.4. Hand tighten the screws (1) of the tool to lock the crankshaft in place.

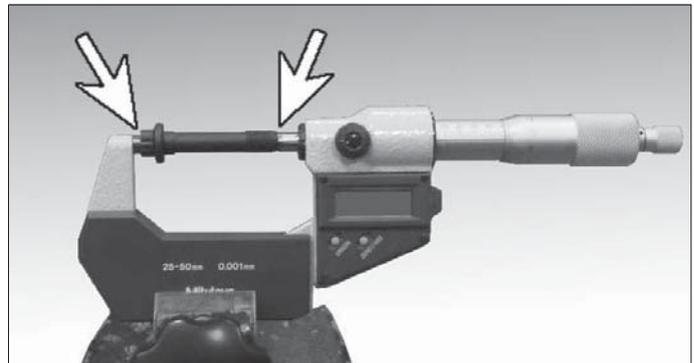


Fit the bearings to the previously cleaned and degreased big ends, lubricating them with engine oil.



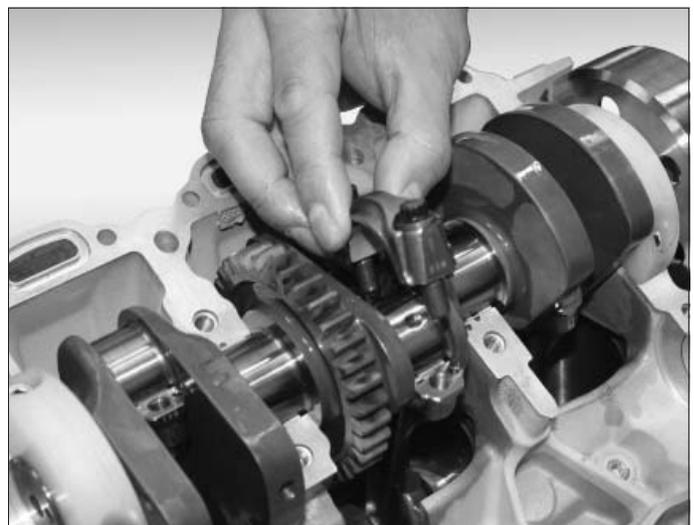
**NOTE** Measure and note down the length of each screw before fitting.

 Always use new bolts, even with used connecting rods.



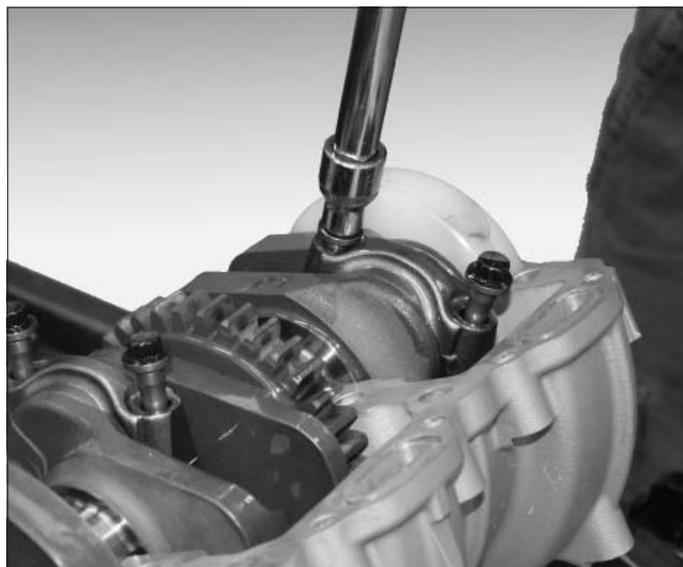
- Lubricate the female threads, screw threads and under the screw heads with oil.

**NOTE** Before fitting the big ends, bring the corresponding connecting rod into contact with the connecting rod pin by manually turning the crankshaft.

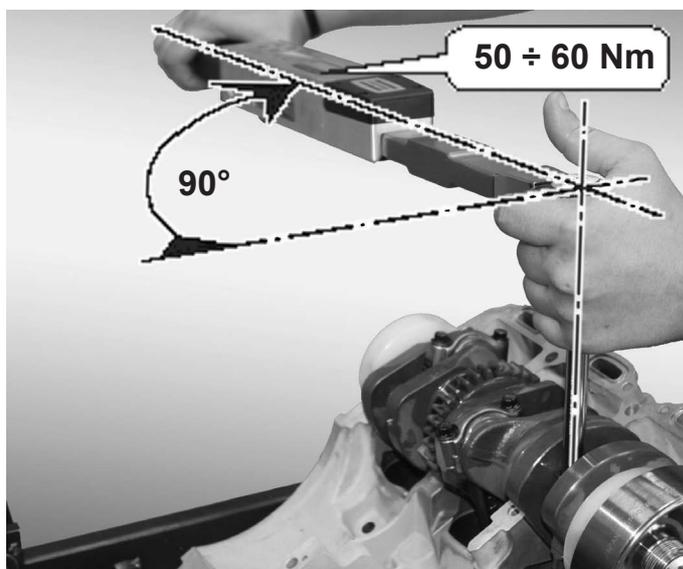


- Reassemble the connecting rods on the crankshaft, by hand tightening the bolts.
- Manually tighten the screws to a torque of 5 Nm.
- Intermediate tightening to the torque of 20 Nm.
- Fully tighten them by turning the screws  $90^{\circ} \pm 5^{\circ}$  clockwise (1/4 turn), using an angle tightening wrench, checking that the torque value is  $50 \div 60$  Nm.

CONNECTING ROD SCREW TIGHTENING TORQUE	
Operation	Value
Pre-load	5 Nm
Intermediate tightening	20 Nm
Final angle tightening	$90^{\circ} \pm 5^{\circ}$



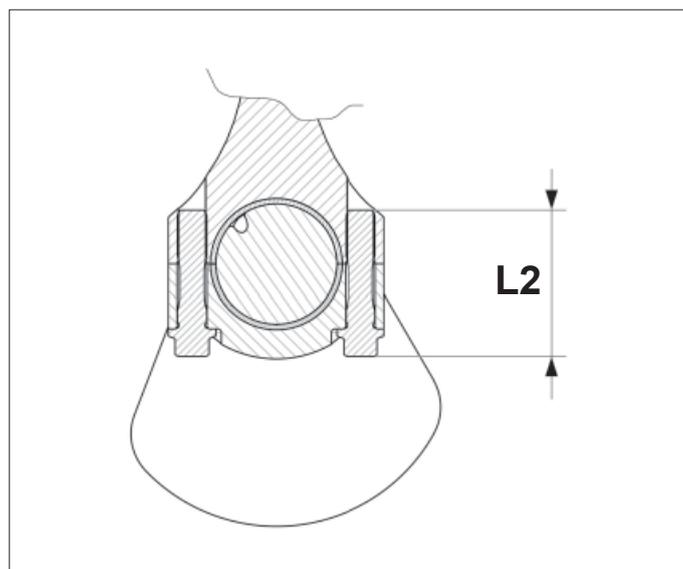
Each screw on angle tightening should present a torque value of between 50 and 60 Nm and a lengthening of no more than 0.235 mm; if either of these conditions is not met it will be necessary to replace the screw with a new one.



- Measure the length of each screw after final tightening and compare it with the value measured before assembly.  
The difference must not exceed the following value:

$$L2 - L1 \leq 0,235 \text{ mm}$$

When the screws have been tightened, remove the tool cod. 8000B7214.





## Crankcase

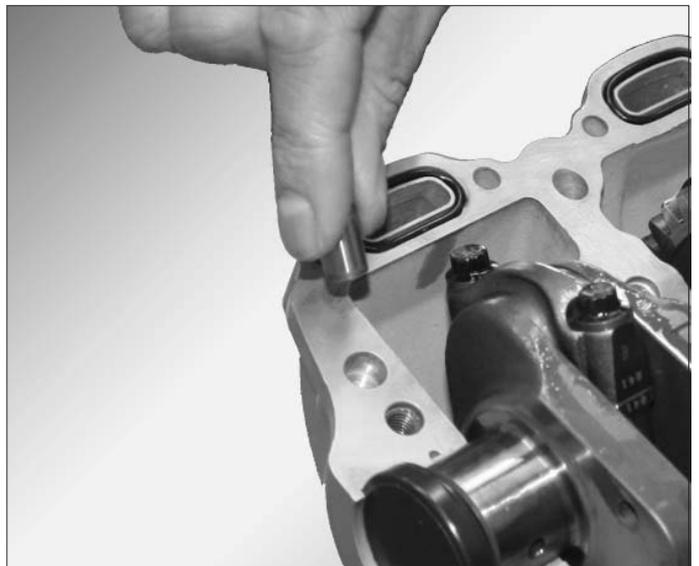
Lubricate the seal rings and insert them in their respective seats, previously cleaned of coolant.



Fitting the crankshaft cap.



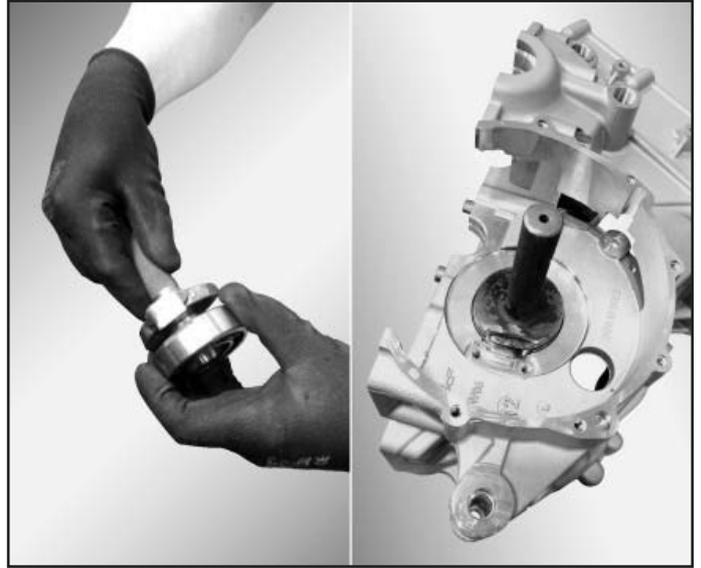
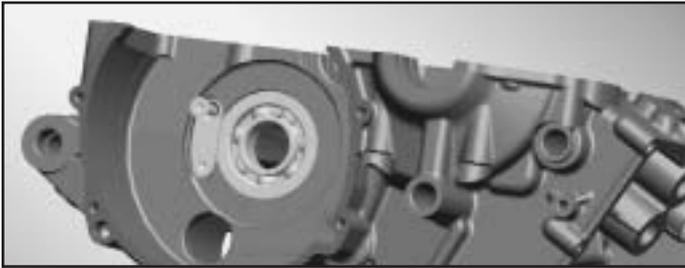
Assembly the centering bushes.



## Reassembling the gearbox bearings

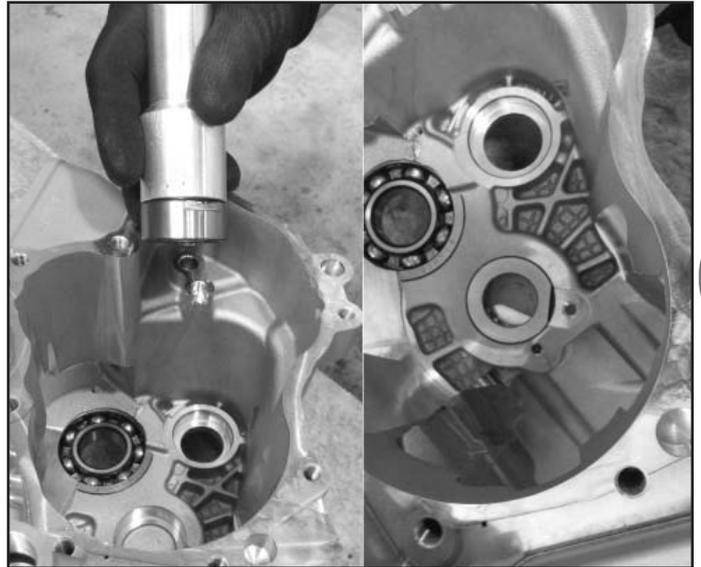
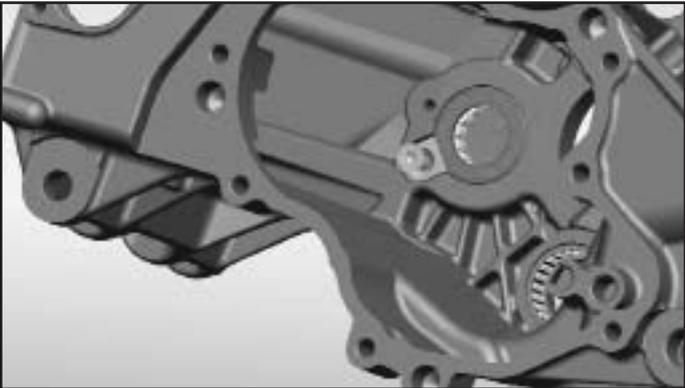
After cleaning and degreasing the bearings' seats, warm up the crankcase half until it reaches a temperature of 125°C.

Mount the primary bearing on a designated tool and adjust it so that the grooved area is near the plate seat. Slide it into place inside the guard. Mount the retaining plate and tighten the two screws to the required torque.



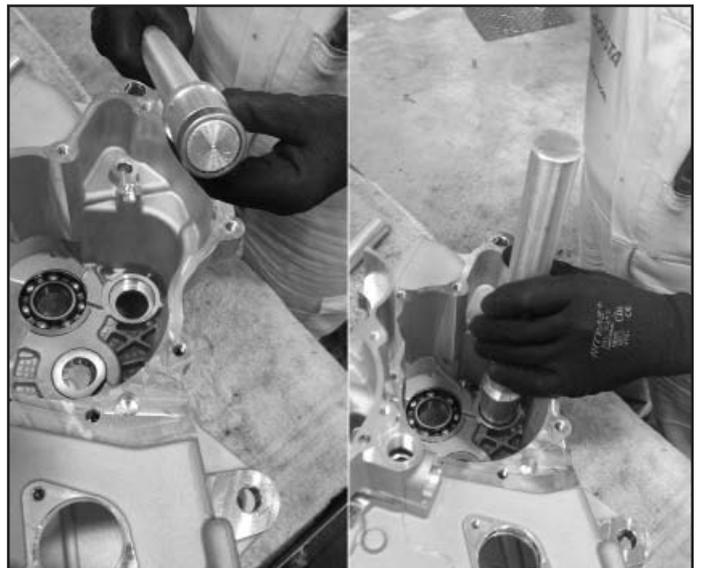
Turn the crankcase half and carry out the same operation for the secondary bearing.

Mount the retaining plate and tighten the screw to the required torque with a high-strength threadlocker.



Mount the needle cage of the desmodromic shaft on the tool with a wider edge on the outside.

Place it in its seat and push it all the way in by tapping it slightly with a hammer.



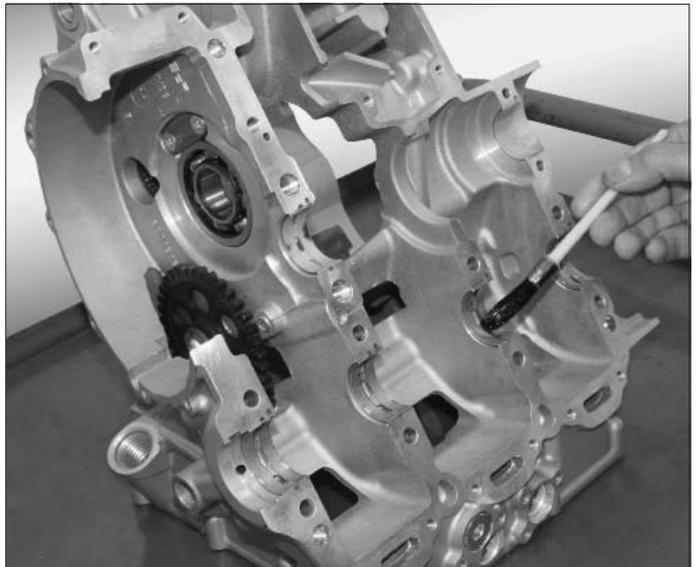


## Crankcase

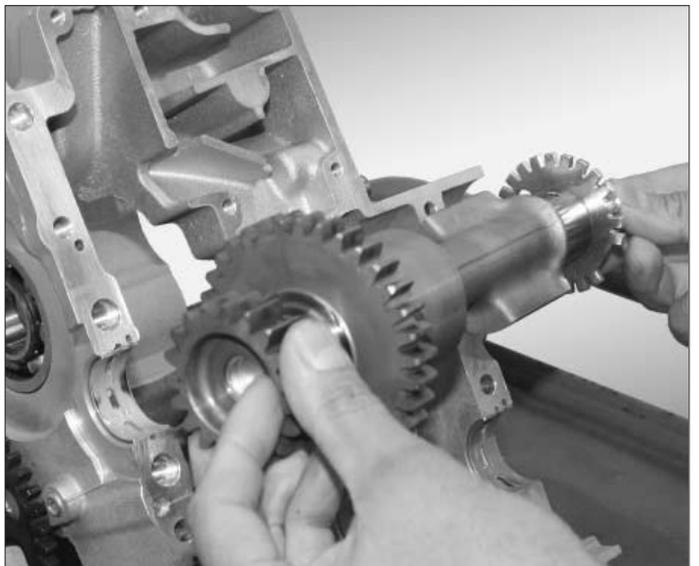
Insert the half-bearings in the respective seats on the previously degreased and cleaned lower crankcase.



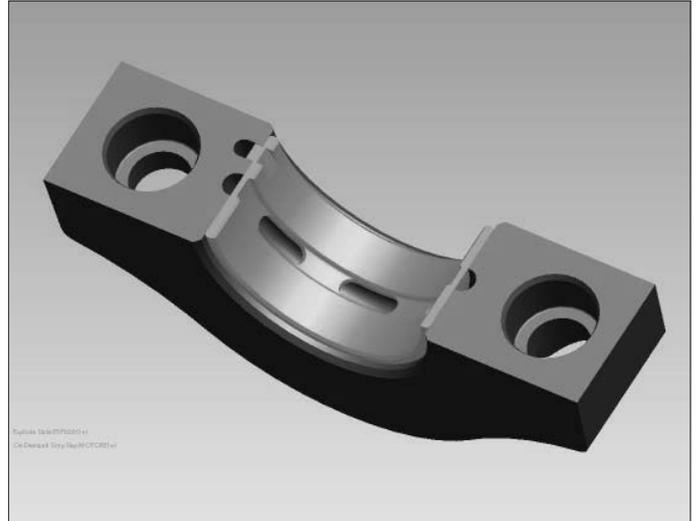
Lubricate the bearings with engine oil.



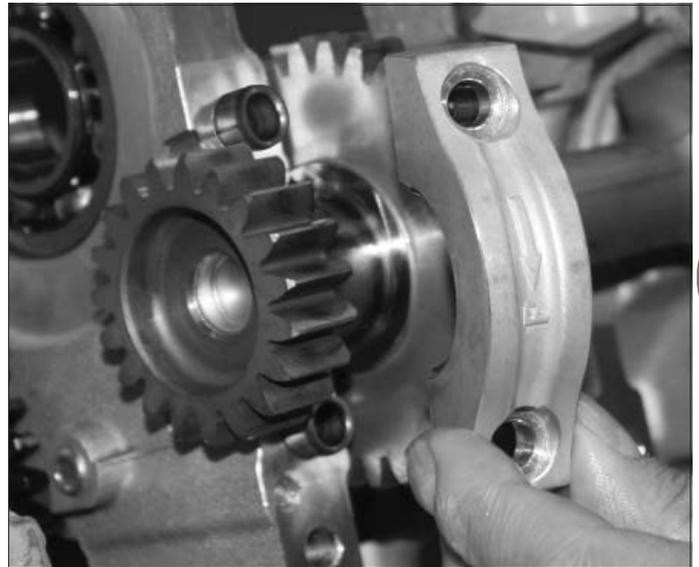
**Re fitting the countershaft**  
Fit the counterbalance shaft.



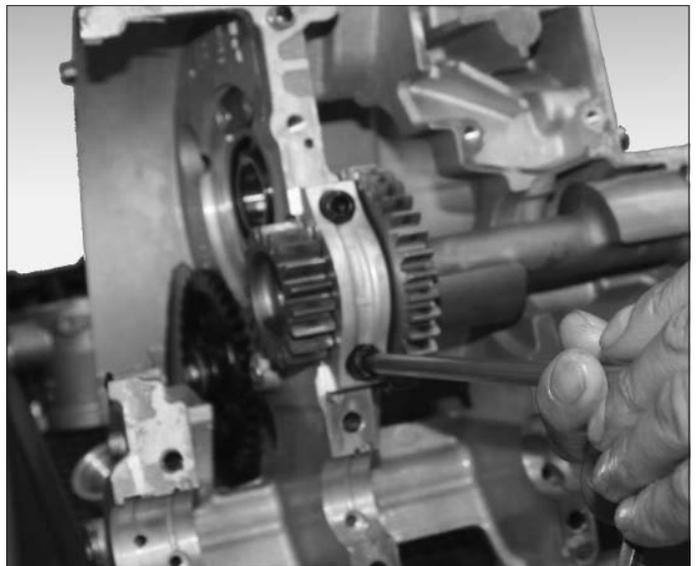
Insert the grooved bearing on the cleaned and degreased countershaft cap.



Insert the two blocking rings (1) and t the cap with the arrow pointing in the direction of travel.



Tighten the two screws (2) to a torque of 25 Nm.

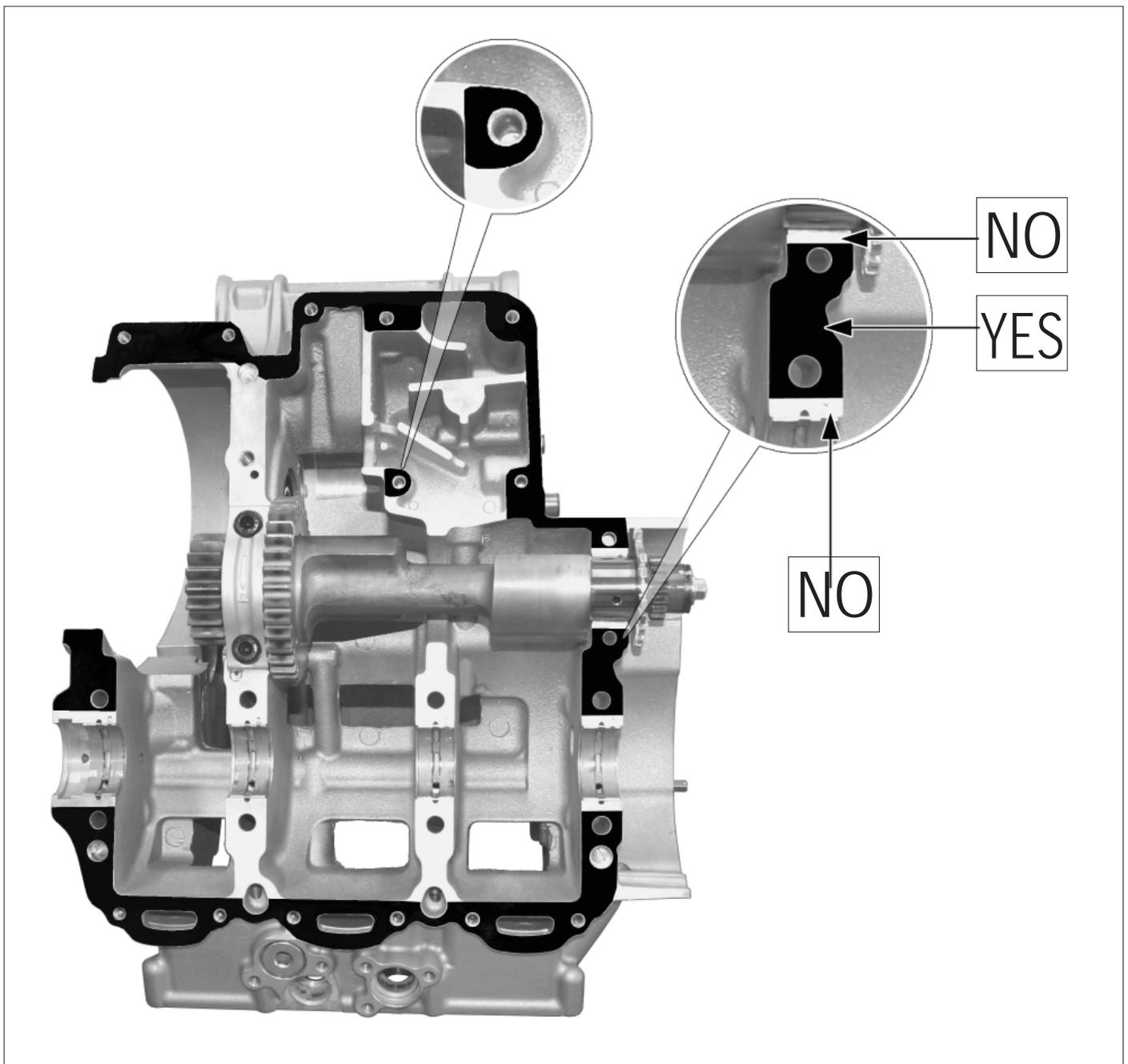




## Crankcase

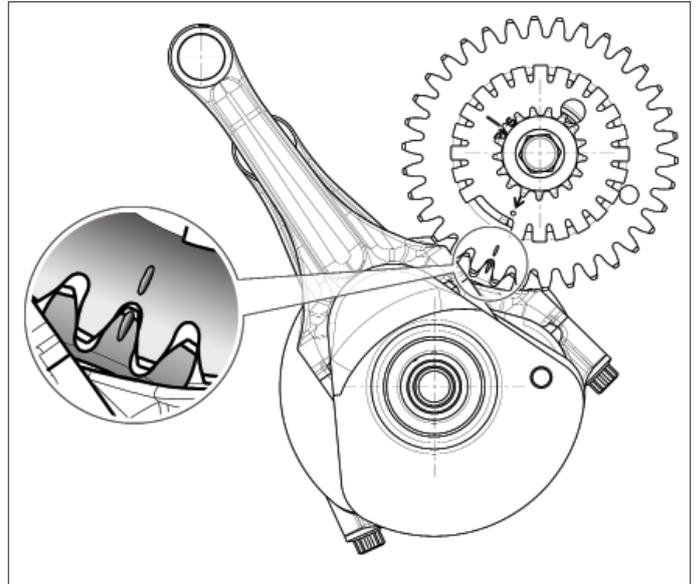
Ensure that the blocking rings are installed on the upper half-case.

Spread a layer of "THREEBOND" type garnish on the stroke points of the two half crankcases paying attention to prevent the paste from coming into contact with the bushings.



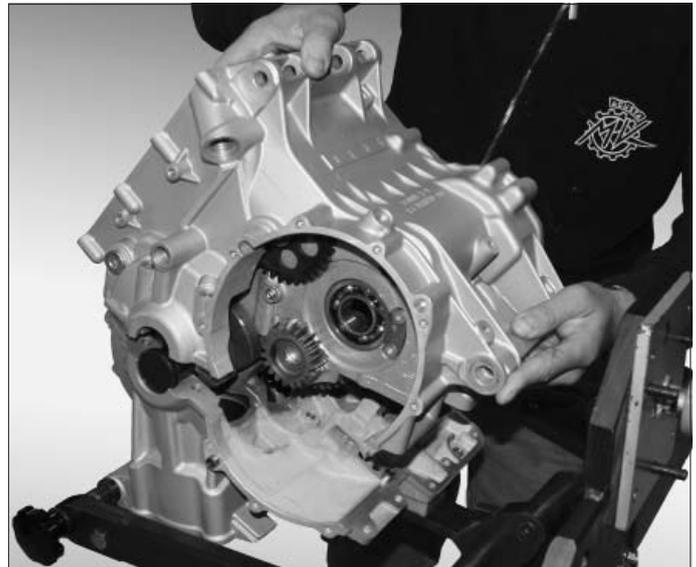
## Crankshaft timing

Orient the gears of the main shaft and countershaft on their respective half-cases so that the timing notches on them can be easily lined up during assembly.

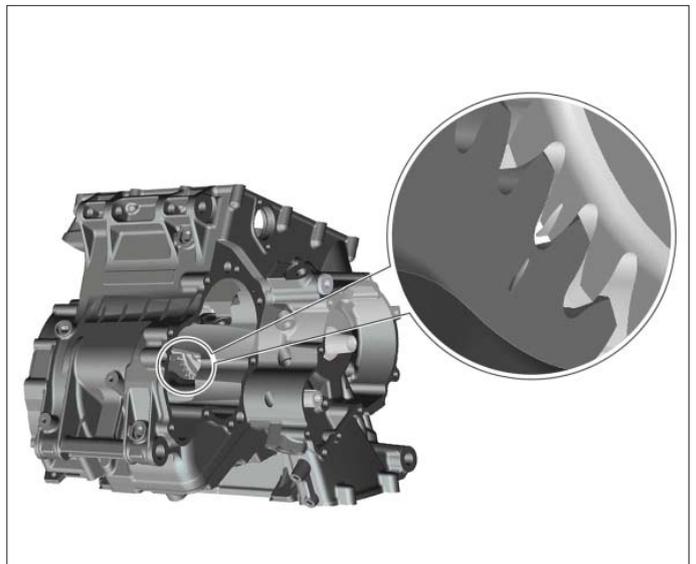


Bring the half-cases together, paying attention to line up the two notches on the gears in order to achieve correct timing.

Couple the two half crankcases carefully beating them with a plastic hammer until completely closed.



Check that the timing has been maintained.



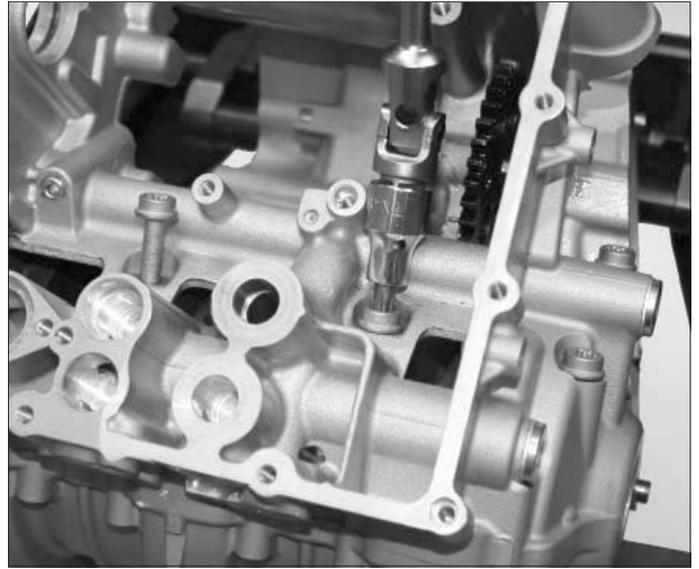


## Crankcase

Manually drive the M8 and M6 screw without tightening.

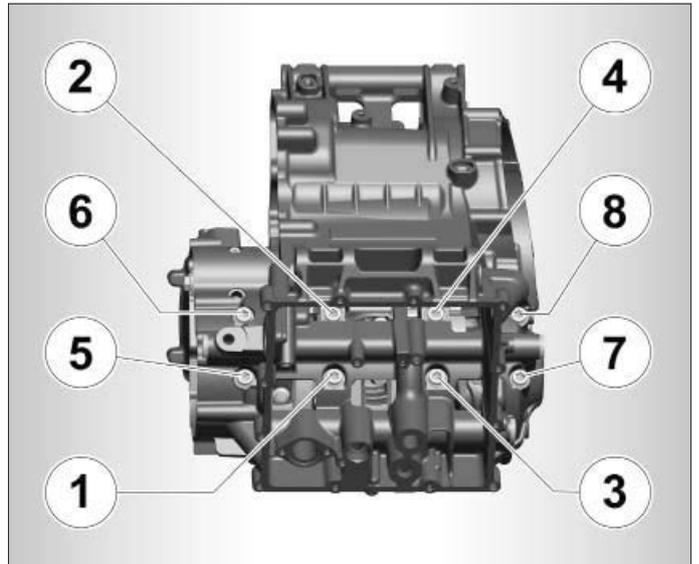
**NOTE**

All screws have either an equal or visibly different length; it is therefore impossible to mix them up during reassembly.

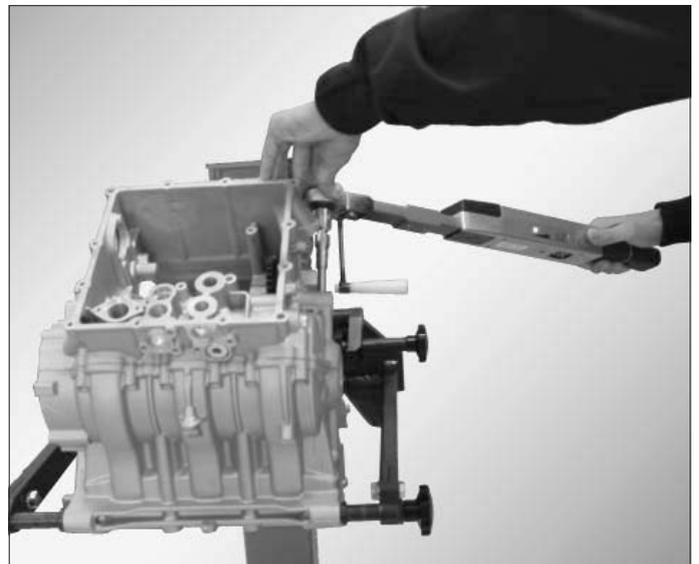


Tighten the 8 screws of the cylinder bank, following the order indicated,

Screw Nr.	Operation	Value
----	Approaching	----
1-8	Intermediate tightening	10 Nm
1-8	Final angle tightening	$60^{\circ} \begin{smallmatrix} +2^{\circ} \\ +0^{\circ} \end{smallmatrix}$



pre-tighten the screws 1 to 8 to a torque of 10 Nm, then tighten fully, turning them a further 60°.



## Crankcase

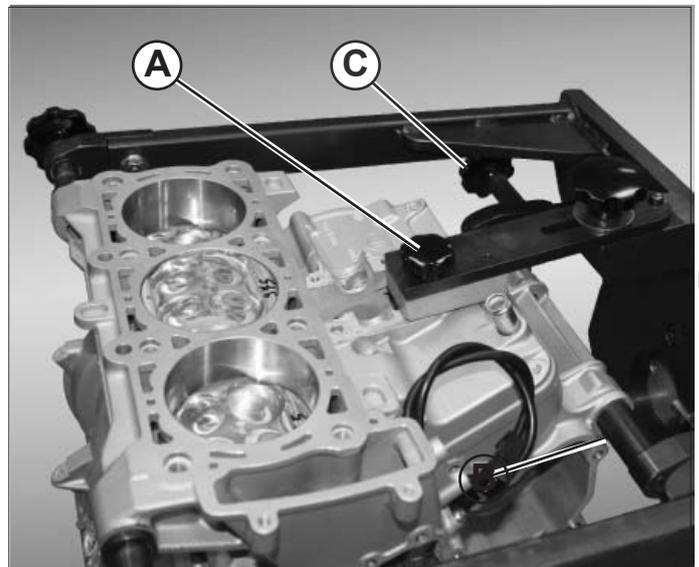


Tighten the two M6 screws of the countershaft to a torque of 12 Nm.



Rotate the engine 180°.

Restore engine support fastenings **(B)** and **(C)** and eliminate the upper half-case xing point **(A)** which uses the M6 screw hole.



Insert the M8 central screw and the other 12 M6 screws.





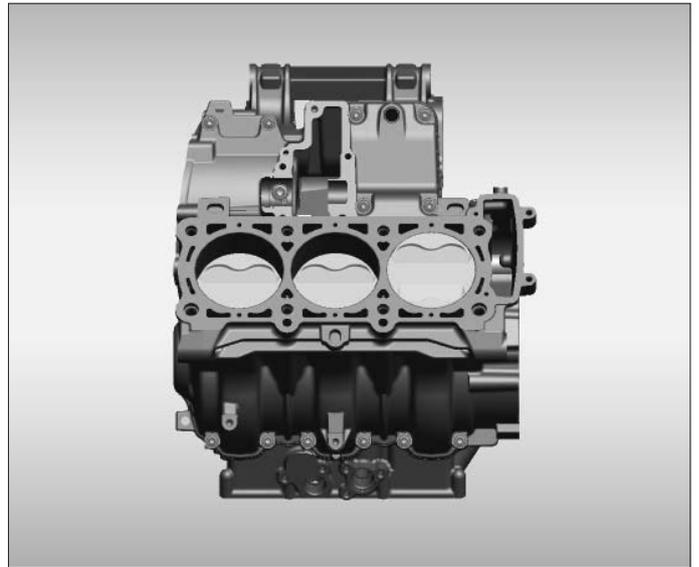
## Crankcase

Tighten first the central screw M8 to a couple of 25 Nm.

Tighten the other 12 screws at a couple of 10

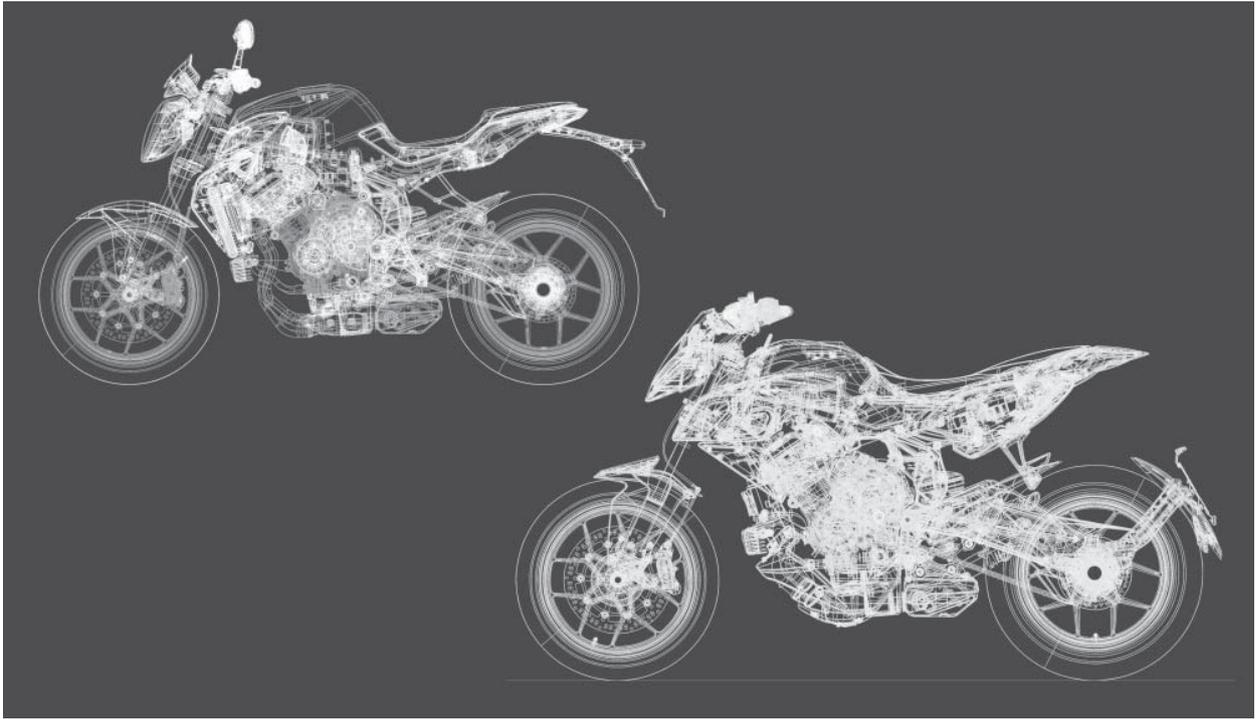


Nm proceeding outwards from center.





## Tightening torques



L

## SECTION L

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# Tightening torques

TIGHTENING TORQUES.....PAGE 3

L



## Tightening torques

**TIGHTENING TORQUES TABLE**

DESCRIPTION	Nm	Thread blockers
<b>HEAD</b>		
Stand screws	12	
Head tightening screws (M10x1,5-L70)	10 Nm + 85°	
Chain tightening cap	12	
Chain tightening screws	10	medium
Sliding block distribution screws	8	
Valve cap screws	10	
Spark plug coil screws	8	
Exhaust pipes stud bolts	10	medium
<b>CLUTCH</b>		
Clutch nut	120	medium
Disk thrust plate screws	10	medium
Clutch housing flange screws	10	medium
<b>GEAR SHIFT</b>		
Pinion nut	140	strong
Gear selection drum tightening screws	25	medium
M6 gear control screws	8	medium
<b>CRANKCASE ACCESSORIES</b>		
Alternator tightening screws	10	medium
Motor starter tightening screws	10	
Water pump collector tightening screws	8	
Thermostat cover fixing screws (M5x1-L16)	6÷8	
Gear sensor cover screws	10	
<b>ALTERNATOR</b>		
Alternator fixing screws	6÷8	medium
Rotor fixing nut	65	
<b>STARTING</b>		
Starting cap screws M6x1	10	
<b>SUMP</b>		
Sump tightening screws	10	

### TIGHTENING TORQUES: CONVERSION FACTOR

To convert a tightening torque, refer to the following table.

	Nm	Kgm	ftlbs
<b>Nm</b>	-----	0,10197	0,7375
<b>Kgm</b>	9,807	-----	7,233
<b>ftlbs</b>	1,3559	0,13826	-----



## Tightening torques

### TIGHTENING TORQUES TABLE

DESCRIPTION	Nm	Thread blockers
CRANKCASE		
2nd bearing plate screw M6x1-L20	10	
Main bearing plate screw M6x1-L20	10	
Cylinder bank screws M8x1,25-L85mm	10+ 60°	
Countershaft cap screws M8x1,25-L35	25	
Countershaft screws M6x1-L35	10	
Central upper crankcase screw M8x35mm	25	
Fixing screws M6	10	
M6 clutch cover screws	10	
COOLING LUBRICATION		
Oil drain plug	25	
Cooling drain plug	25	medium
Inlet/outlet connectors for radiator oil	21	medium
Piston oil jet screw	8	
CONNECTING ROD		
Cap screws	(*)	

(\*) See assembling notes

### STANDARD TORQUES

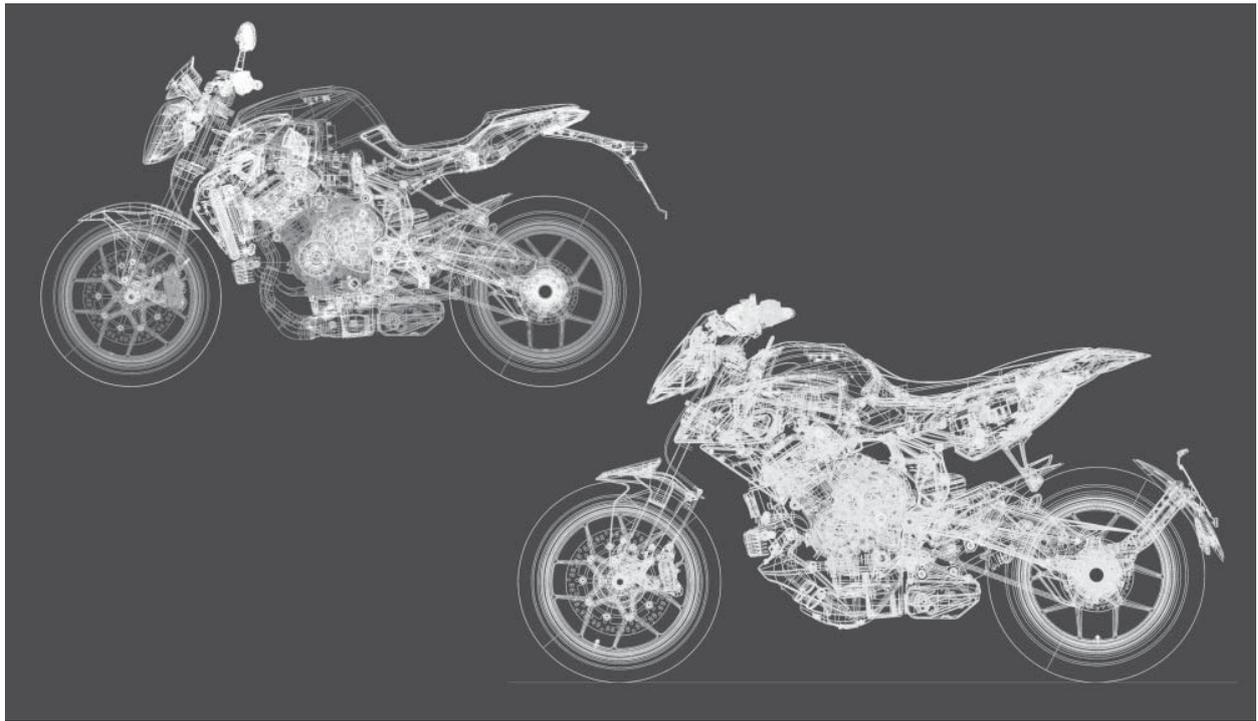
If not otherwise specified, for tighten refer to the torque values indicated in the table below.

Thread Diameter	Tightening torque		
	Kgm	Nm	ftlbs
<b>M5</b>	<b>0,6 ÷ 0,8</b>	<b>6 ÷ 8</b>	<b>4,34 ÷ 5,79</b>
<b>M6</b>	<b>0,8 ÷ 1,0</b>	<b>8 ÷ 10</b>	<b>5,79 ÷ 7,23</b>
<b>M8</b>	<b>2,4 ÷ 2,6</b>	<b>24 ÷ 26</b>	<b>17,36 ÷ 18,8</b>
<b>M10</b>	<b>4,2 ÷ 4,5</b>	<b>42 ÷ 45</b>	<b>30,38 ÷ 32,55</b>

### TIGHTENING TORQUES: CONVERSION FACTOR

To convert a tightening torque, refer to the following table.

	Nm	Kgm	ftlbs
<b>Nm</b>	-----	0,10197	0,7375
<b>Kgm</b>	9,807	-----	7,233
<b>ftlbs</b>	1,3559	0,13826	-----



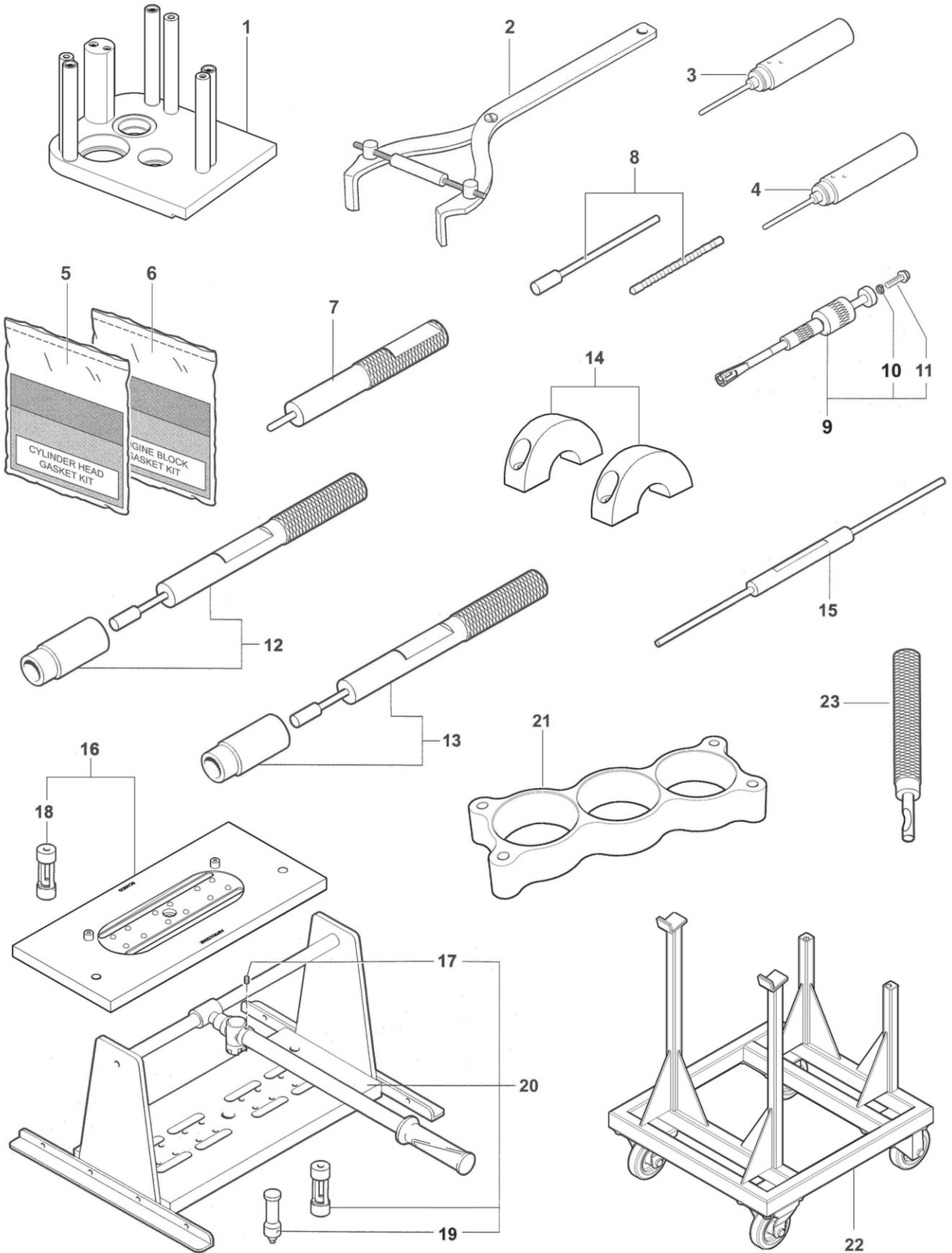
M

# SECTION M

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# Service tools



M

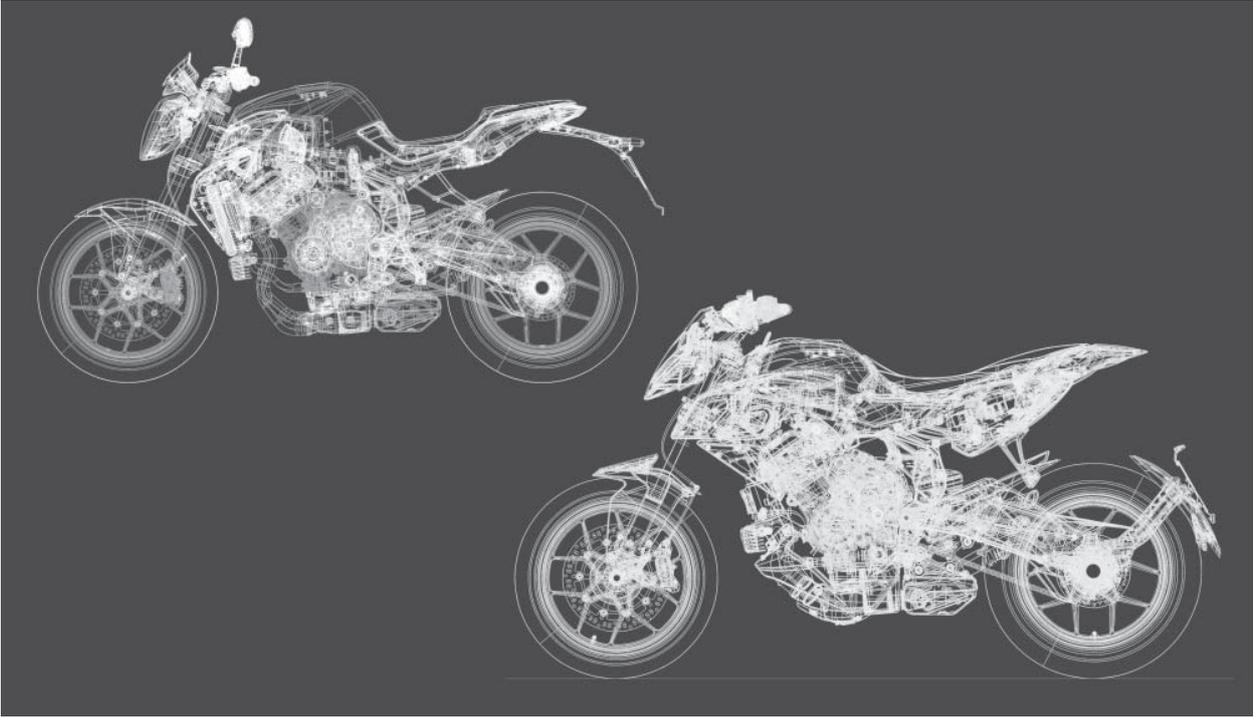
## Service tools



Nr.	Code	Q.ty	Note	F3	F3 ORO	DESCRIPTION
1	8000B7177	1		•	•	GEAR CHANGE MOUNTING TOOL
2	800079015	1		•	•	CLUTCH BLOCKING TOOL
3	8000B7293	1		•	•	PAD FOR EXHAUST VALVE SEAT
4	8000B7294	1		•	•	PAD FOR INTAKE VALVE SEAT
5	8000B7295	1		•	•	CYLINDER HEAD GASKET KIT
6	8000B7296	1		•	•	ENGINE BLOCK GASKET KIT
7	800095581	1		•	•	VALVE SEAT MOUNTING PUNCH
8	8000A2625	1		•	•	BROACH FOR VALVE GUIDE
9	800094798	1		•	•	VALVE RUBBER CAPS REMOVAL TOOL
10	62N115538	1		•	•	SPRING WASHER
11	8C0069056	3		•	•	SCREW M8X30
12	8000A2385	1		•	•	GUIDE MOUNTING PAD, EXHAUST
13	8000B4368	1		•	•	GUIDE MOUNTING PAD, INTAKE
14	8000B7214	1		•	•	CRANK SHAFT INSTALLATION/REMOVAL TOOL
15	800095429	1		•	•	GAUGE PAD
16	8000B7254	1		•	•	BASE PLATE
17	800051521	2		•	•	SCREW M4X6
18	8000B7255	1		•	•	HALF CONES REMOVAL TOOL
19	800095180	1		•	•	HALF CONES INSTALLATION TOOL
20	800094796	1		•	•	VALVES INSTALLATION/REMOVAL TOOL
21	8000B7207	1		•	•	PISTON ASSEMBLING TOOL
22	8000B6789	1		•	•	ENGINE REMOVAL/INSTALLATION SUPPORT
23	8000B7299	1		•	•	MOUNTING TOOL FOR STARTING MOTOR IDLER GEAR PIN



## Analytical index



## SECTION N

REVISION 0

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