



# Workshop Manual



## 4 STROKE ENGINE

MX - EN - SMX  
SMR-SMM-2016

# 450-530

## Foreword

This publication, to be used by TM Racing workshops, has been drawn-up to assist authorised personnel in the maintenance and repair of motorcycles handled. Perfect knowledge of the technical data stated herein is decisive for the most complete professional training of the operator.

In order to make it easier to understand, the paragraphs have been distinguished by schematic illustrations, which highlight the topic in question.

Always operate in compliance with the accident-prevention regulations in force, using suitable PPE.

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## COOLANT LIQUID

### DANGER

**FIRE RISK: IN SOME CONDITIONS, THE COOLANT IS FLAMMABLE. ITS FLAMES ARE INVISIBLE, BUT CAN CAUSE BURNS.**

**DO NOT POUR COOLANT ONTO EXHAUST SYSTEM COMPONENTS OR ONTO ENGINE COMPONENTS, SINCE THEY COULD BE HOT AND IGNITE THE COOLANT, WITH THE RISK OF BURNS. KEEP IN MIND THAT THE FLAMES ARE INVISIBLE.**

**COOLANT MAY IRRITATE THE SKIN AND IS TOXIC IF SWALLOWED.**

**KEEP COOLANT OUT OF THE REACH OF CHILDREN**

**COOLANT IS HIGHLY POLLUTANT. THEREFORE, AFTER USE, IT MUST BE DISPOSED OF AT SPECIAL COLLECTION CENTRES IN COMPLIANCE WITH THE REGULATIONS IN FORCE IN THE COUNTRY IN WHICH THE MOTORCYCLE IS USED.**

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## USED ENGINE OIL AND GEARBOX OIL

### DANGER

**KEEP OUT OF THE REACH OF CHILDREN.**

**ENGINE OIL AND GEARBOX OIL CAN SERIOUSLY DAMAGE SKIN IF HANDLED REGULARLY OVER LONG PERIODS OF TIME.**

**WASH YOUR HANDS THOROUGHLY AFTER HANDLING THE OIL.**

**WEAR LATEX GLOVES OR EQUIVALENT DURING MAINTENANCE WORK ON THE MOTORCYCLE.**

**OIL IS HIGHLY POLLUTANT. THEREFORE, AFTER USE, IT MUST BE DISPOSED OF AT SPECIAL COLLECTION CENTRES IN COMPLIANCE WITH THE REGULATIONS IN FORCE IN THE COUNTRY IN WHICH THE MOTORCYCLE IS USED.**

**DO NOT POUR USED OIL INTO DRAINS OR RIVERS. DISPOSE OF FILTERS AT SPECIAL COLLECTION CENTRES IN COMPLIANCE WITH REGULATIONS IN FORCE IN THE COUNTRY IN WHICH THE MOTORCYCLE IS USED.**

## Useful advice

In order to prevent problems on reaching an excellent final result, **TM Racing srl** recommends that the following generic regulations are complied with:

- in the event of any repair, assess the impressions of the Customer reporting the operating anomalies of the motorcycle and formulate appropriate questions in order to clarify the symptoms of the problem;
- clearly diagnose the cause of the anomaly. From this manual it is possible to assimilate the essential theoretical bases, which, moreover, must be integrated by personal experience:
- plan the repair rationally, in order to prevent downtimes, receiving spare parts, preparation of tools etc.;
- reach the item to repair, limiting to the essential operations.

In this regard, consulting the disassembly sequence shown in this manual, will be of great help.

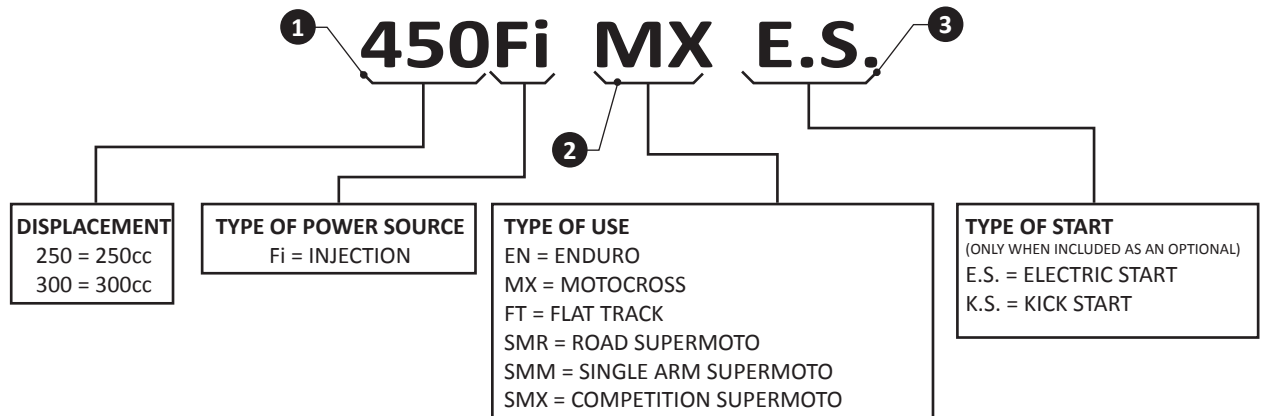
## General repair-related regulations

- 1 Always replace the gaskets, sealing rings and the cotter pins with new parts.
- 2 When loosening/tightening nuts or screws, always start with the largest ones or from the centre. Lock at the coupling torque prescribed, following a crosswise pathway.
- 3 Always mark all parts or positions that could be exchanged on re-mounting.
- 4 Use original spare parts and recommended lubricants.
- 5 Use special tools, where specified.
- 6 Consult official Technical Memos, since they could contain more updated state adjustment data and methods of intervention, with respect to this manual.

**TM Racing SPA**, declines all liability for any errors in the compilation of this manual, and reserves the right to make any modifications required for the development of its products. Illustrations shown are approximate and, in some cases, may not precisely correspond with the part referred to. Reproduction of this publication, even partial, without written authorisation is prohibited.

## RECOGNIZING TM RACING MOTORCYCLE MODELS

### EXAMPLE OF MOTORCYCLE MODEL



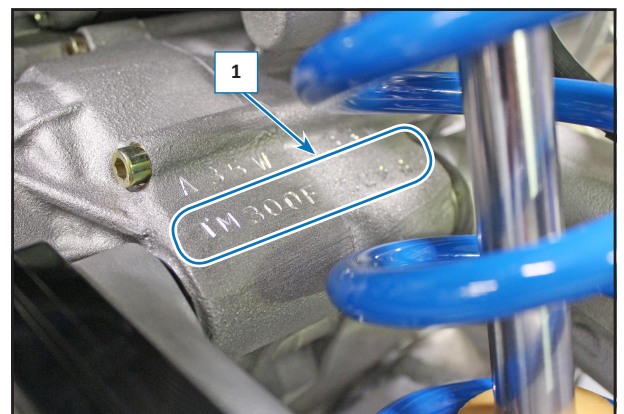
The displacement, type of power source and type of use define the motorcycle model and engine of each TM Racing motorcycle. The combination of codes 1 and 3 identifies the standard engine type. The combination of the three codes fully identifies the motorcycle model. All 3 codes are usually used in this Manual, to specify the motorcycle model to which certain information refers. If only codes 1 and 3 are indicated, followed by the word "ALL", it means that the information relates to all motorcycles with standard engine, regardless of the type of use. Code 2 (Type of Use) used alone means that the information refers to all motorcycles with that type of use, regardless of displacement and power source. All EN/SMR/SMM models are equipped as standard with electric start (E.S.) as well as kick start (K.S.). MX/SMX models have K.S. as standard and may be equipped with E.S. as an option.

Please make a note of your motorcycle's serial numbers in the boxes below. When it is necessary to contact TM for spare parts, updates or to report any issues, always quote the model, displacement, year of manufacture and, above all, the frame serial number and engine serial number.

### ENGINE SERIAL NUMBER

The engine serial number (1) is embossed into the rear part of the engine, near to the shock absorber.

Make a note of this number in the relevant space at the beginning of the manual.





<b>1.</b>	<b>ADJUSTMENTS/REPLACEMENTS .....</b>	<b>7</b>
1.1	ADJUSTING VALVES PLAY (WITH COLD ENGINE) .....	8
1.2	CAMSHAFTS RE-MOUNTING .....	12
1.3	ENGINE OIL AND FILTER CHANGE .....	16
1.4	METAL FILTER CHECK AND CLEANING .....	18
1.5	STANDARD CLUTCH REPLACEMENT .....	19
1.6	SLIPPER CLUTCH REPLACEMENT .....	21
1.6.1	Disc pack removal .....	21
1.6.2	Discs replacement and re-mounting of clutch .....	23
1.7	TIMING .....	28
<b>2.</b>	<b>ENGINE DISASSEMBLY .....</b>	<b>29</b>
2.1	ENGINE COMPONENTS LAYOUT .....	30
2.2	PINION REMOVAL .....	31
2.3	HEAD .....	32
2.3.1	Head removal .....	32
2.3.2	Head dismantling .....	33
2.3.3	Head re-assembly .....	35
2.3.4	Head re-mounting .....	36
2.4	CYLINDER AND PISTON .....	38
2.4.1	Cylinder and piston removal .....	38
2.4.2	Strap and oil scraper replacement and mounting .....	39
2.4.3	Cylinder and piston coupling .....	39
2.4.4	Cylinder and piston re-mounting .....	39
2.4.5	Compression check .....	41
2.5	TEMPERATURE SENSOR REPLACEMENT .....	42
2.6	PINION PROTECTION REMOVAL .....	42
2.7	CLUTCH .....	43
2.7.1	Clutch actuator removal with command rod .....	43
2.7.2	Actuator dismantling .....	43
2.7.3	Actuator re-mounting .....	43
2.8	GEAR SENSOR .....	44
2.9	FLYWHEEL REMOVAL .....	44
2.9.1	Flywheel cover .....	44
2.9.2	Stator .....	45
2.9.3	Pick-up .....	45
2.9.4	Rotor .....	46
2.10	STARTER MOTOR .....	48
2.10.1	Dismantling .....	48
2.10.2	Re-mounting .....	49
2.11	WATER PUMP .....	51
2.12	TRANSMISSION GUARD .....	53
2.12.1	Bearing and water pump oil seal removal .....	54
2.12.2	Kick start seal removal .....	54
2.12.3	Transmission cover re-assembly .....	54
2.13	IDLE KICK STARTER REMOVAL (ONLY K.S.) .....	56
2.13.1	Starter dismantling .....	56
2.13.2	Starter re-mounting .....	57
2.13.3	Idle starter re-mounting .....	57

2.14	DRUM AND CLUTCH BELL.....	58
2.14.1	Disassembly .....	58
2.14.2	Re-assembly .....	59
2.15	TRANSMISSION SIDE COUNTER GEARS .....	61
2.16	CRANKSHAFT GEAR REMOVAL .....	63
2.17	OIL PUMP REMOVAL.....	64
2.18	GEARBOX COMMAND SHAFT REMOVAL .....	66
2.19	RATCHET-HOLDER GEAR REMOVAL.....	66
2.20	SEMICASE .....	68
2.20.1	Aperture.....	68
2.20.2	Re-assembly .....	69
2.21	CRANKSHAFT, GEARBOX, GEARS DRUM .....	69
2.21.1	Components position.....	69
2.21.2	Crankshaft removal .....	69
2.21.3	Gear shafts removal .....	69
2.21.4	Primary shaft, gear sequence .....	71
2.21.5	Secondary shaft, gear sequence .....	71
2.21.6	Gears drum removal .....	71
2.21.7	Ratchet removal.....	71
2.21.8	Bearings replacement .....	72
2.21.9	Components re-mounting.....	72

ENGINE TECHNICAL DATA 450Fi-530Fi EN EU4 450Fi-520Fi		
ENGINE MODEL	450	530
Type	4-stroke single cylinder twin cam, liquid-cooled	
Displacement	449 cm <sup>3</sup>	528 cm <sup>3</sup>
Bore x stroke	95x63.4 mm	98x70 mm
Compression	12.9: 1	12.5: 1
Fuel	RON 95 unleaded super fuel (ethanol allowed <10%)	
Distribution	4 overhead valve twin cam driven by silenced chain	
A / S camshafts	N2/N3	
Suction valve diameter	36 mm	
Exhaust valve diameter	31 mm	
Cold suct. valve play	0.15 mm +/- 0.002 mm	
Cold exh. valve play	0.20 mm +/- 0.002 mm	
Engine shaft supports	2 ball bearings	
Connection rod bearing	Silver-coated roller bearings cage	
Pin coating	DLC	Chrome
Piston	Forged light alloy	
Segments	1 segment + 1 oil scraper	2 segments + 1 oil scraper
Lubrication	2 oil pumps (1 for delivery +1 for recovery)	
Engine oil	SAE 20W/50	
Engine oil amount (oil change/ engine overhaul)	1.4/1.5 litres	
Straight tooth gear primary transmission	20 / 57	21 / 53
Clutch	with multiple discs in oil bath	
Gearbox (with front couplings)	5 gears	
Gearbox ratios		
1 <sup>st</sup>	14:28	14:28
2 <sup>nd</sup>	17:25	17:25
3 <sup>rd</sup>	19:23	19:23
4 <sup>th</sup>	21:21	21:21
5 <sup>th</sup>	24:19	24:19
Generator	12V 180W	
NGK spark plug	CR 9EIX	
Electrode distance	0.8 mm	
Cooling	fluid, 40% antifreeze, 60% water (up to -25°C) - forced circulation with pump	
Fluid amount	1.3 litres	
Start up	E.S. + K.S.	

**Key:**
**E.S.** = Electric Start

**K.S.** = Kick start

**⚠ WARNING**
**TM reserves the right to make modifications to its products for technical improvements without prior notice.**

MAINTENANCE TABLE

	After 1 hour	Every 15 hours	Every 30 hours (after every ride)	Every 45 hours	Every 135 hours (75 hours of sports use)	Every year
Change engine oil and cartridge oil filter	•	•	•			
Clean mesh oil filter					•	
Clean exhaust screw magnet		•	•			
Check engine fixing screw tightness	•	•	•			
Replace spark plug and cap check					•	
Check valve play			•			
Check distribution chain					•	
Replace distribution chain					•	
Check cylinder and piston wear					•	
Replace piston completely					•	
Check head					•	
Check camshafts and valve tappets					•	
Replace valves, springs, half cones and plates					•	
Replace piston rod completely					•	
Check clutch discs				•		
Check clutch springs				•		
Check transmission and gearbox					•	
Check oil pumps and lubrication circuit					•	
Replace engine bearings completely					•	
Replace engine oil seal completely					•	

# **⚠ WARNING**

Components must be replaced if a defect is detected or wear limit values are exceeded at the check.

**The afore-mentioned operations must be performed by an authorised TM workshop or by specialised personnel.**

## ENGINE

Problem	Cause	Solution	
The engine does not start or struggles to start	<b>Insufficient compression</b>		
	1. Piston seizing	Replace	
	2. Rod head or foot seizing	Replace	
	3. Worn piston segments	Replace	
	4. Worn cylinder	Replace	
	5. Insufficient cylinder head tightening	Tighten	
	6. Insufficient head gasket sealing	Replace	
	7. Spark plug loosened	Tighten	
	8. Incorrect valves play	Adjust	
	9. Valves springs weakened or seized	Replace	
	10. Valves seized	Replace	
	<b>Spark weak or non-existent</b>		
	1. Faulty spark plug	Replace	
	2. Spark plug encrusted or wet	Clean or dry	
	3. Excessive distance between spark plug electrodes	Adjust	
4. Apertures or short circuits in the high-voltage cables	Check		
5. Faulty ECU	Replace		
The engine stops easily	1. Spark plug encrusted	Clean	
	2. Faulty ECU	Replace	
	3. Low idle speed	Adjust	
The engine is noisy	<b>The noise seems to come from the piston</b>		
	1. Excessive play between cylinder and piston	Replace	
	2. Segments or their housing in the piston worn	Replace	
	3. Excessive accumulation of carbon deposits in the combustion chamber or on the piston crown	Clean	
	4. Rocker arm worn	Replace	
	5. Excessive valves play.	Adjust	
	6. Valves springs weakened or seized	Replace	
	7. Distribution chain worn	Replace	
	8. Distribution chain tension not correct	Adjust	
	<b>The noise seems to come from the crankshaft</b>		
	1. Bench bearings worn	Replace	
	2. Rod head radial or axial play high	Replace	
	3. Crankshaft gear damaged	Replace	
	4. Crankshaft fix. nut loosened	Tighten	
	<b>The noise seems to come from the clutch</b>		
	1. Discs worn	Replace	
	2. Excessive play between clutch bell and drive discs	Replace	
	<b>The noise seems to come from the gearbox</b>		
	1. Gears worn	Replace	
	2. Brake grooves consumed	Replace	
	The clutch slips	1. Weakened clutch springs	Replace
		2. Clutch discs worn	Replace
	The clutch opposes resistance	1. Spring load not even	Replace
		2. Clutch discs bent	Replace
The gears do not engage	1. Gearbox fork bent or seized	Replace	
	2. Gear ratchets worn	Replace	
	3. Forks command pins damaged	Replace	

<b>Problem</b>	<b>Cause</b>	<b>Solution</b>
<b>The shift control pedal does not go back into position</b>	<ol style="list-style-type: none"> <li>1. Selector switch recall spring weakened or broken</li> <li>2. Gear forks worn</li> </ol>	<p>Replace</p> <p>Replace</p>
<b>The gears disengage</b>	<ol style="list-style-type: none"> <li>1. Sliding gears couplings consumed</li> <li>2. Brake grooves worn</li> <li>3. Housings for couplings on the gears worn</li> <li>4. Grooves on the forks command shaft worn</li> <li>5. Forks command pins worn</li> </ol>	<p>Replace</p> <p>Replace</p> <p>Replace</p> <p>Replace</p> <p>Replace</p>
<b>INSUFFICIENT ENGINE POWER</b>	<ol style="list-style-type: none"> <li>1. Air filter dirty</li> <li>2. Low fuel quality</li> <li>3. Intake coupling loosened</li> <li>4. Excessive distance between spark plug electrodes</li> <li>5. Insufficient compression</li> <li>6. Incorrect valves play</li> <li>7. Valve seats or guides faulty</li> <li>8. Valves springs weakened or seized</li> </ol>	<p>Clean</p> <p>Replace</p> <p>Tighten</p> <p>Adjust</p> <p>Check the cause</p> <p>Adjust</p> <p>Replace</p> <p>Replace</p>
<b>The engine overheats</b>	<ol style="list-style-type: none"> <li>1. Combustion chamber and/or piston crown encrusted with carbon residues</li> <li>2. Insufficient amount of oil in the engine or use of oil that is not recommended</li> <li>3. Obstructions to the air flow on the radiator</li> <li>4. Cylinder head gasket sealing faulty</li> <li>5. The clutch slips</li> </ol>	<p>Clean</p> <p>Top-up or replace</p> <p>Clean</p> <p>Replace</p> <p>Adjust</p>
<b>ELECTRIC PART</b>		
<b>Problem</b>	<b>Cause</b>	<b>Solution</b>
<b>The spark plug electrodes overheat</b>	<ol style="list-style-type: none"> <li>1. Insufficient distance between electrodes</li> <li>2. Heat rating too high</li> </ol>	<p>Adjust</p> <p>Replace with recommended spark plug</p>
<b>The starter motor does not start or slips</b>	<ol style="list-style-type: none"> <li>1. Faulty starter motor</li> <li>2. Starter gears worn</li> <li>3. Free wheel rolls worn or damaged</li> </ol>	<p>Repair or replace</p> <p>Replace</p> <p>Replace the free wheel</p>



## 1. ADJUSTMENTS/REPLACEMENTS

## 1.1 ADJUSTING VALVES PLAY (WITH COLD ENGINE)

The valve play can be adjusted with the engine mounted on the vehicle or with engine on the bench.

**NOTE:** If the engine is mounted on the motorcycle, the airbox must be removed in order to access disassembly of the head cover.

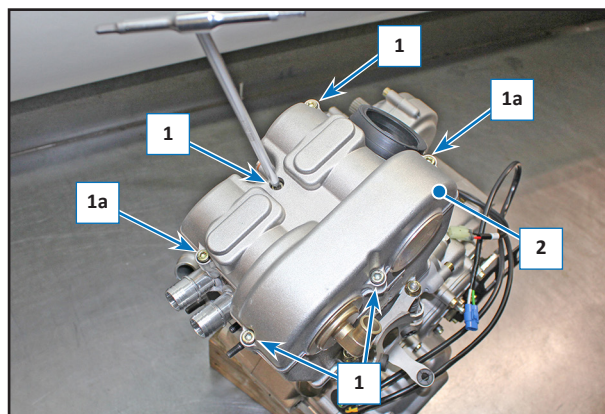
For the sake of convenience, the images shown below refer to an engine positioned on a workbench.

Unscrew the screws (1) and (1a) from the head cover (2).

**NOTE:** On re-mounting, make sure the screws are re-mounted correctly:

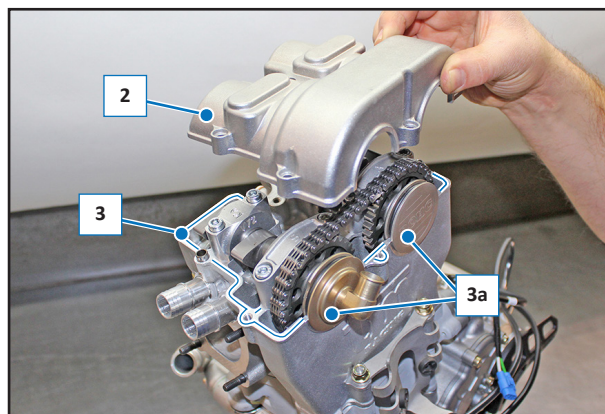
Screw (1) = M5x20

Screw (1a) = M5x25

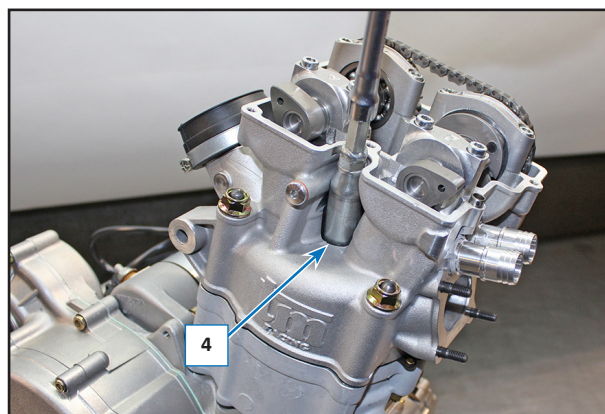


Remove the cover (2) with the relative gasket (3).

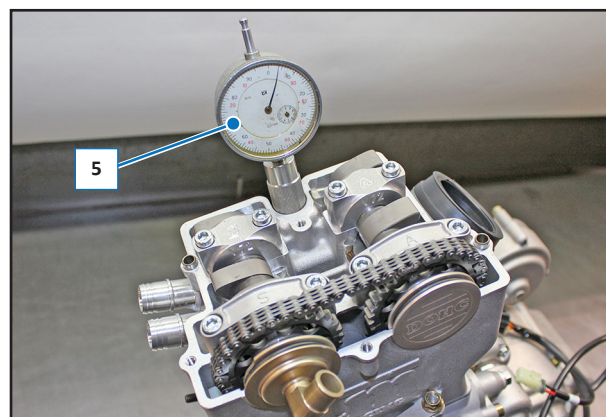
Remove the two inserts (3a)



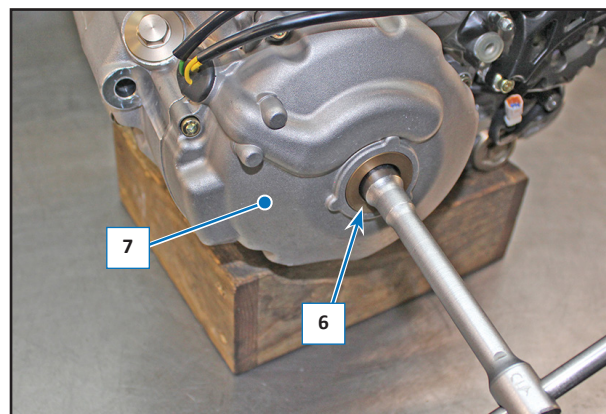
If not already performed, remove the spark plug (4).



Mount a comparator (5) on the head.

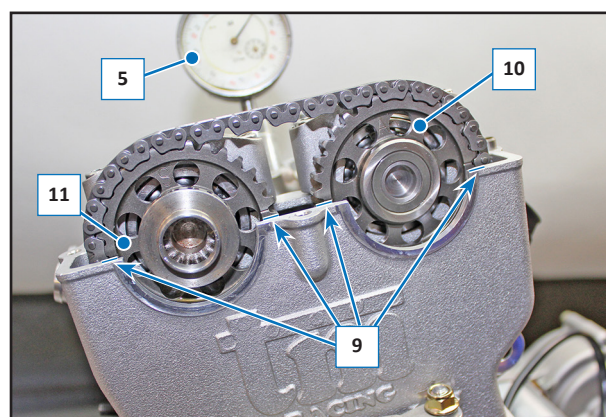
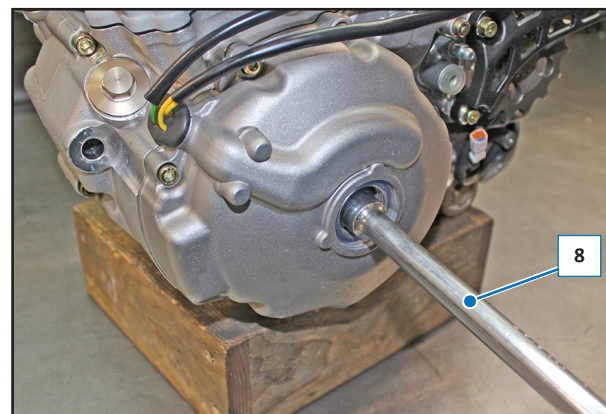


Remove the cap (6) from the generator cover (7).  
Position the gearbox in neutral.



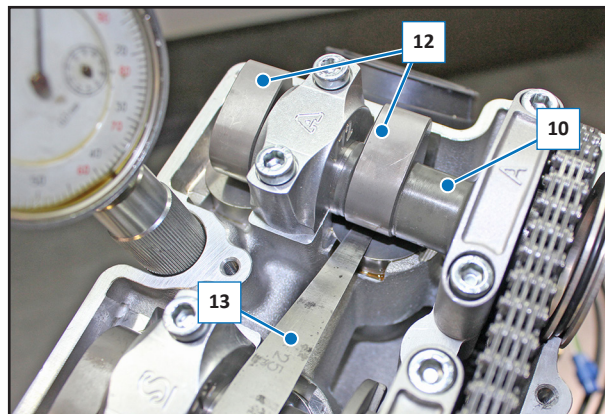
Using a socket wrench (8), turn the crankshaft to position the piston at top dead centre, as indicated by the timing lines (9) parallel to the edge of the head present on the intake (10) and exhaust (11) camshaft gear and from the comparator (5).

Remove the comparator (5).



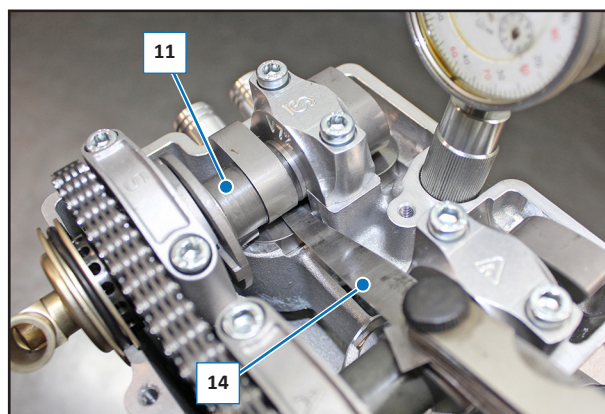
Check that the cams (12) are in rest position; the concave part must be positioned at approx. 45° from the head surface.

Use a thickness gauge (13) to check the play between the intake camshaft (10) and the valve tappet is 0.20 mm (0.008 in.).

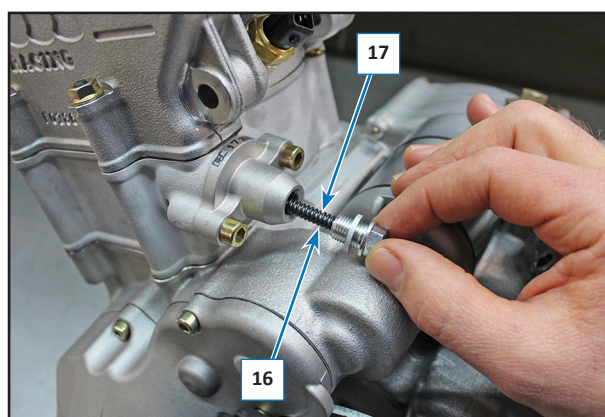
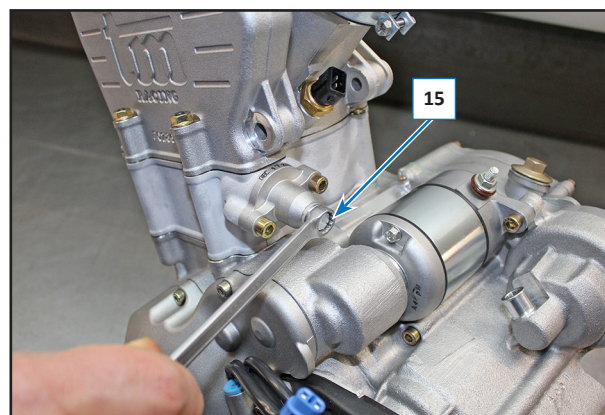


Use a thickness gauge (14) to check the play between the exhaust camshaft (11) and the valve tappet is 0.25 mm (0.009 in.).

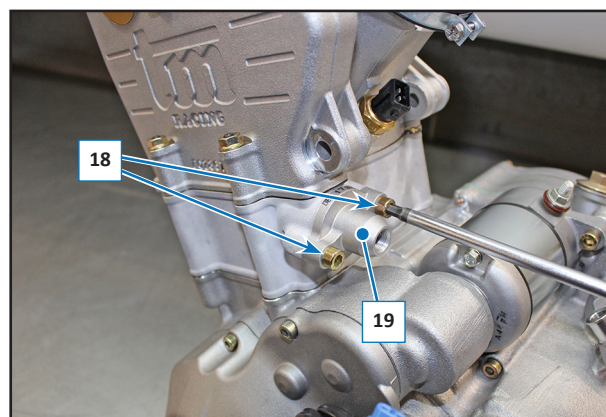
Otherwise the pads positioned on the valve tappet must be replaced, as follows:



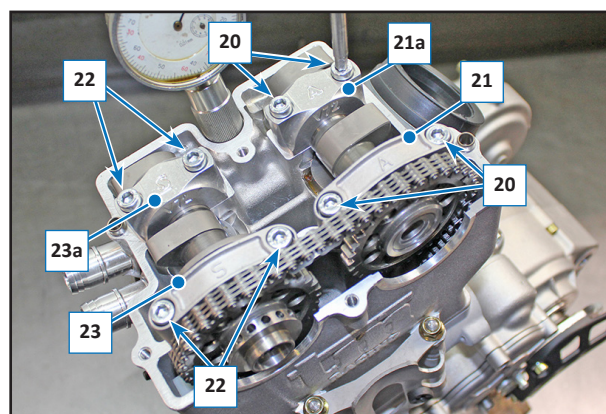
Loosen the central screw (15) and remove the spring (16) with the pin (17).



Unscrew the two screws (18) and remove the chain tensioner (19).

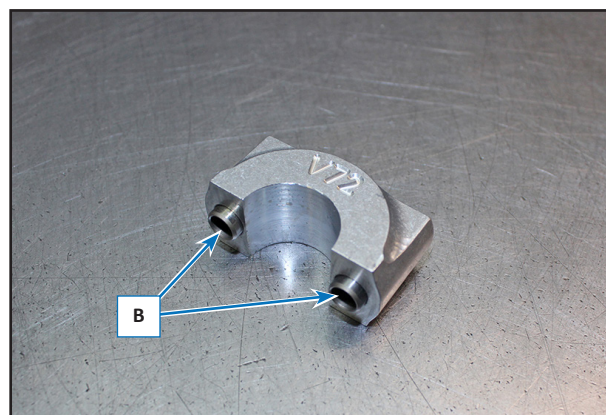


Tighten the screws (20) of the intake camshaft clamps (21) and (21a) and remove them.  
Tighten the screws (22) of the exhaust camshaft clamps (23) and (23a) and remove them.

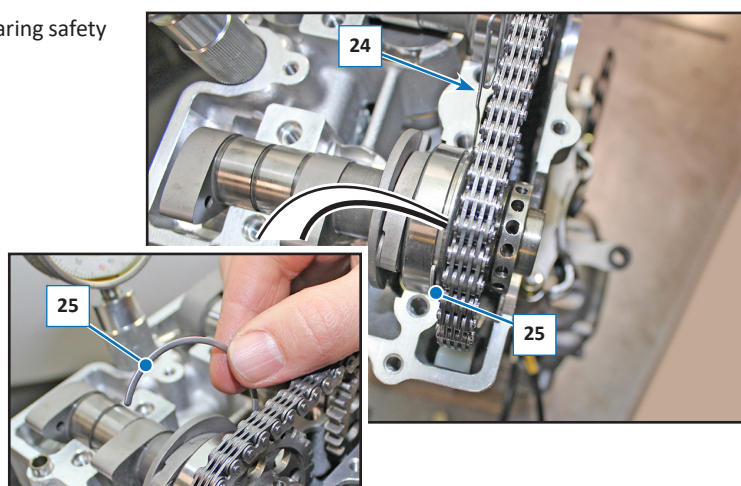


**NOTE:** The intake clamps are marked with "A" embossed on the clamp itself.  
The exhaust clamps are marked with "S" embossed on the clamp itself.  
Do not invert on re-mounting.

**NOTE:** There are two centring bushes (b) on the small clamps (23a) and (21a). Check that they are present on re-mounting.

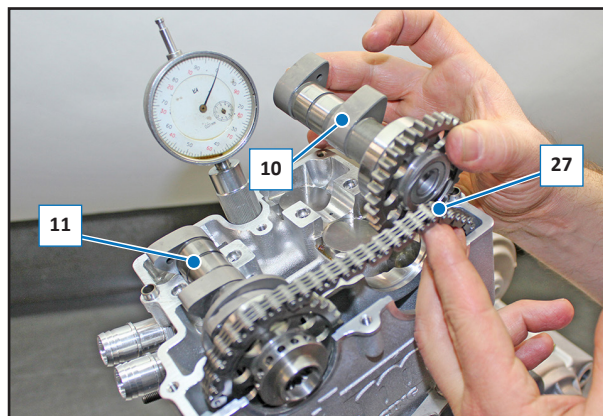


Using iron wire (24), push the exhaust shaft and intake shaft bearing safety washer (25) and remove it from both shafts.



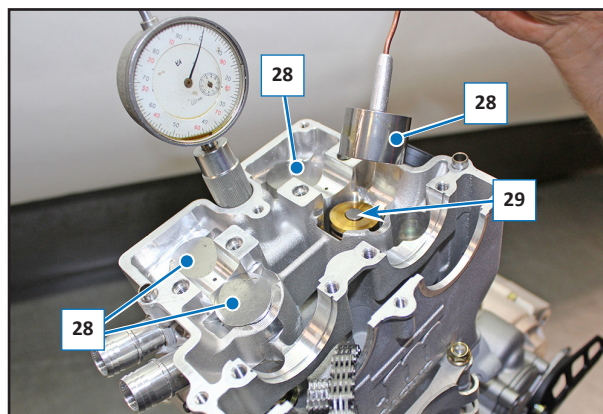
To remove the camshafts, tilt them from the part opposite to the gear.

First remove the intake camshaft (10) and then the exhaust camshaft (11).



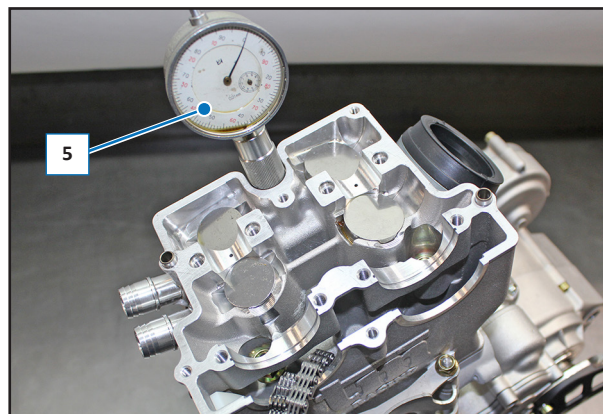
**NOTE:** support the chain (27) so that it doesn't fall inside the engine. Remove the tappets (28) and pads (29) positioned on the valve stems.

**NOTE:** Mark the tappets and the pads even if they are not to be replaced, so that they can be remounted in the exact same position.

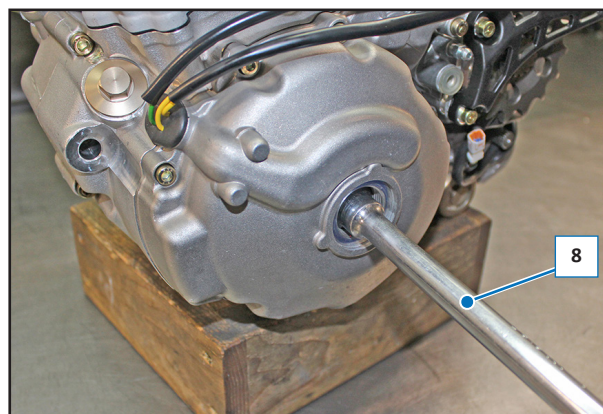


## 1.2 CAMSHAFTS RE-MOUNTING

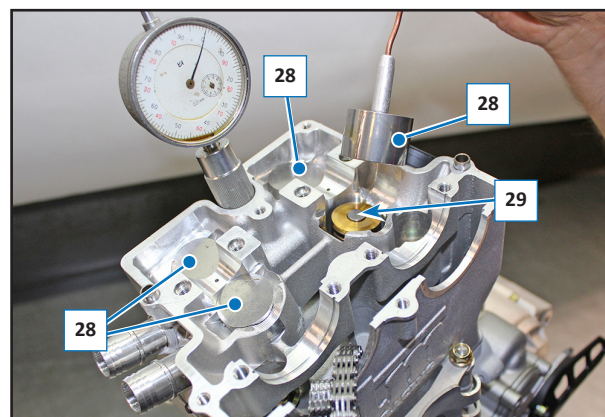
Mount a comparator (5) on the head and position the piston at top dead centre, rotating the crankshaft via the closed-end spanner (8).



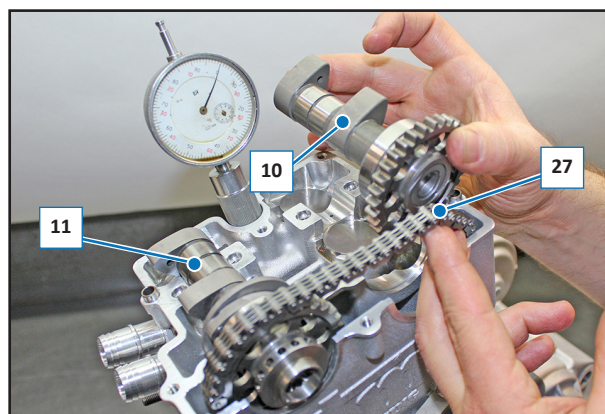
**NOTE:** Before re-mounting the camshafts, check that the bearings, gears and chain are not worn and replace if necessary.



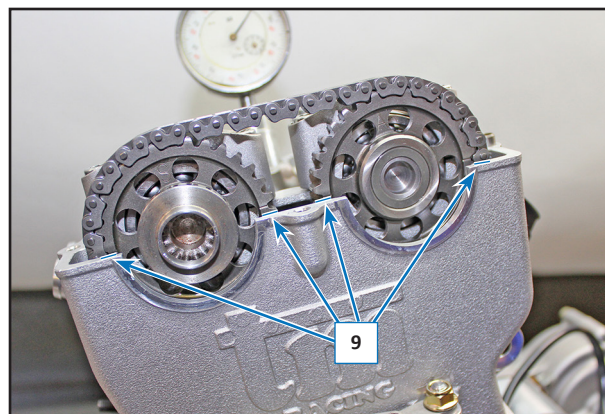
Re-mount the pads (29) and tappets (28) in the respective positions, following the marks made on disassembly.



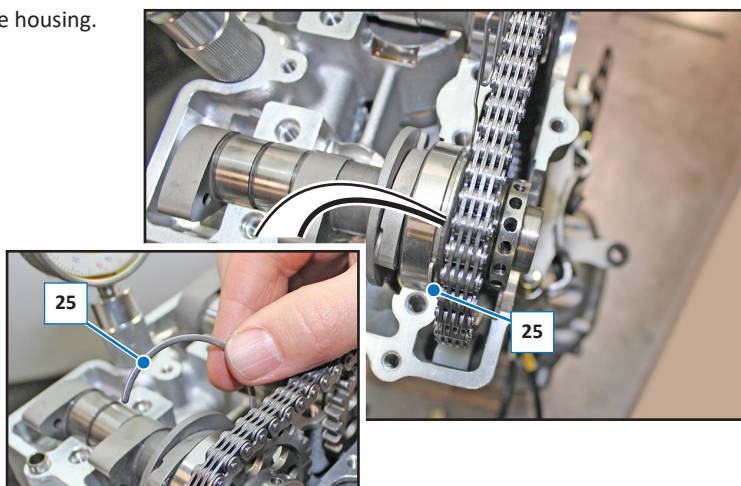
Retrieve the timing chain (27) and mount the exhaust camshaft (11) first, followed by the intake camshaft (10), taking care to make sure that the timing lines (9) are parallel with the head's upper surface.



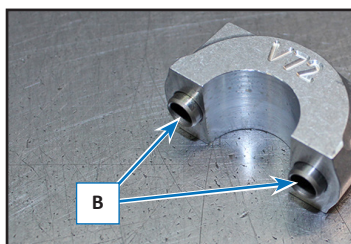
**NOTE:** For re-mounting, tilt both the camshafts after having positioned the chain (27) and re-position them on the relative housing.



Insert the camshafts bearing safety washer (25) into the relative housing.

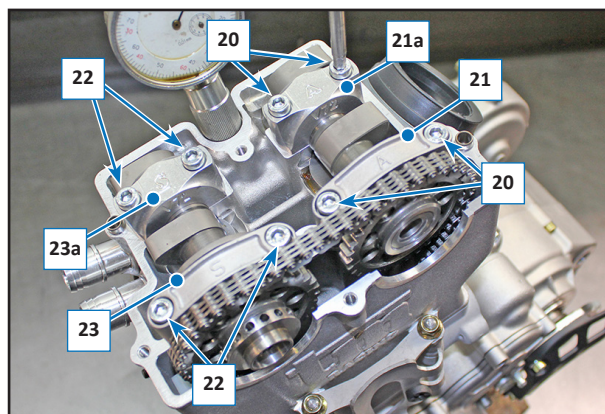


**NOTE:** Check that centring bushes (B) are inserted on the clamps (21a) and (23a).

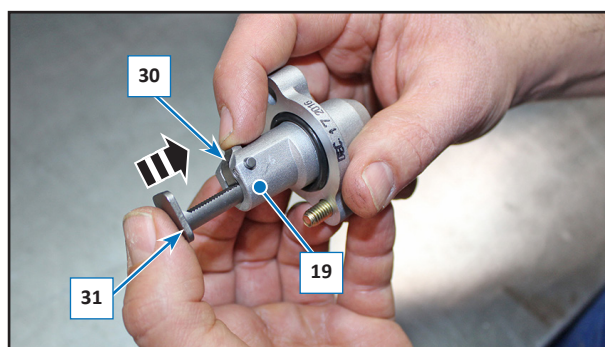


Mount the camshafts clamps (21), (21a), (23) and (23a), making reference to the embossing present on the same:  
Intake shaft clamps marked with "A".  
Exhaust shaft clamps marked with "S".

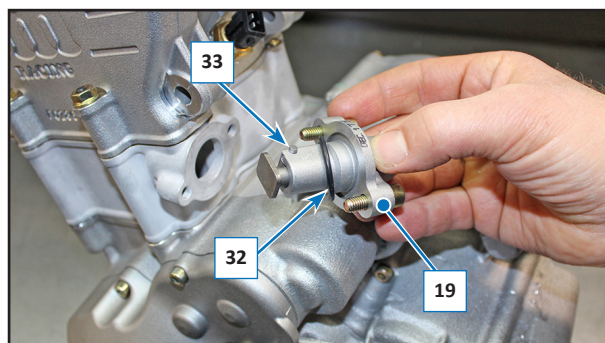
Screw the screws (20) and (22) without tightening them and then check that the clamps are correctly placed at the bearings of the camshafts; tighten the screws with a torque of 12 Nm (1.2 kgm, 8.85 ft/lb).



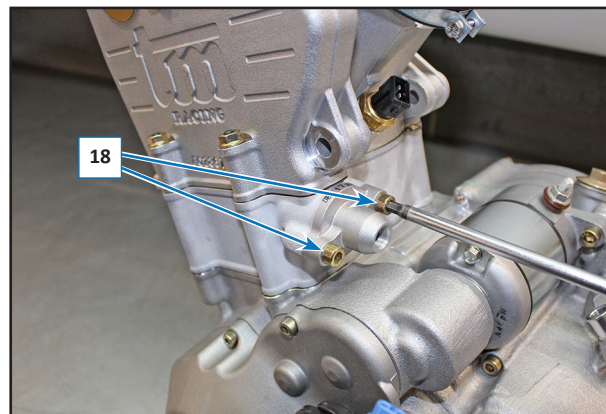
Press the block (30) and push the ratchet (31) of the tensioner (19), until it enters into the body.



Check gasket wear (32) and replace if ruined. Re-mount the tensioner (19), paying attention that the pin (33) is positioned upwards.

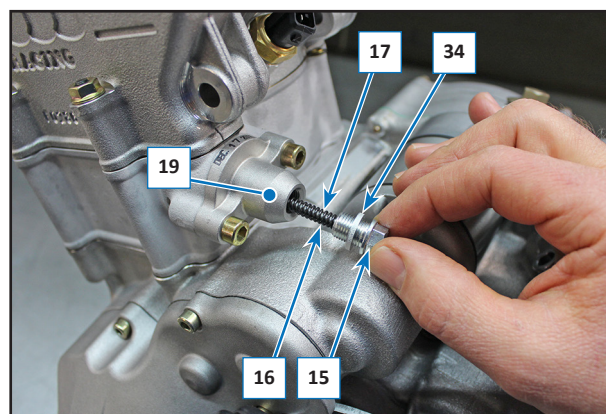


Tighten the two screws (18) with a torque of 10 Nm (1.0 kgm/ 7.23 ft/lb)



Insert the pin (17) and the spring (16) inside the chain tensioner (19) and then tighten the screw (15) fully home.

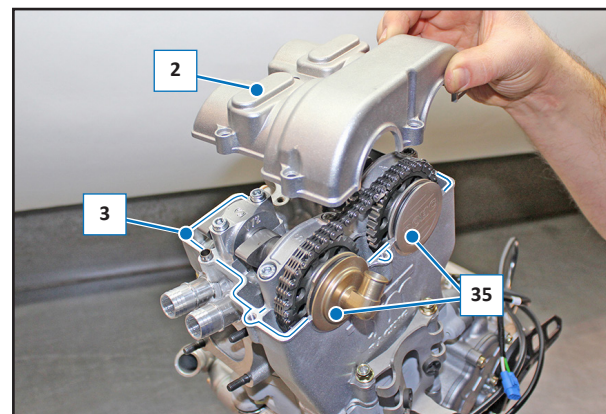
**NOTE:** Before tightening the screw (15), check that the aluminium washer (34) is not ruined, replace if necessary.



Check that valves play is correct (see “Valves play check” paragraph)

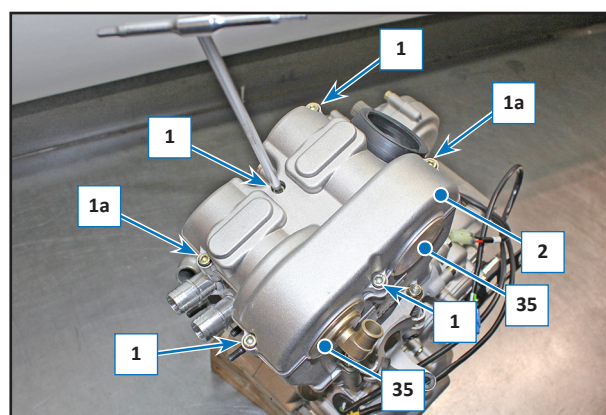
Spread some “Tree Bond 1215” sealing paste onto the circumference of the two inserts (35).

Check that the gasket (3) is not ruined, otherwise replace it, and then position it on the head.



Mount the head cover (2) by screwing the screws (1) and (1a) crosswise and then tightening them with a torque of 8 Nm (0.8 kgm/ 5.9 ft/lb)

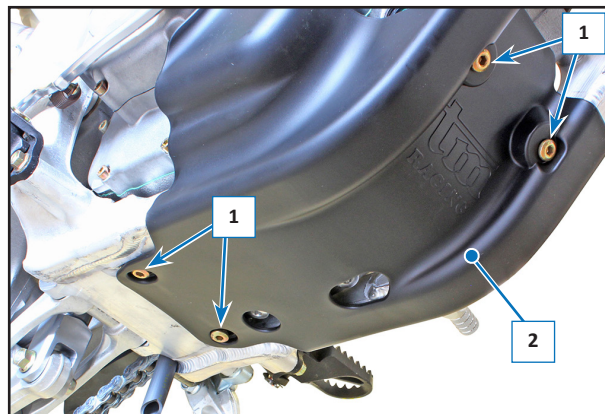
**NOTE:** The screws (1) and (1a) have different length; make sure that the head cover (2) is positioned correctly, as indicated in the figure.  
Screw (1) = M5X20  
Screw (1a) = M5X25



### 1.3 ENGINE OIL AND FILTER CHANGE

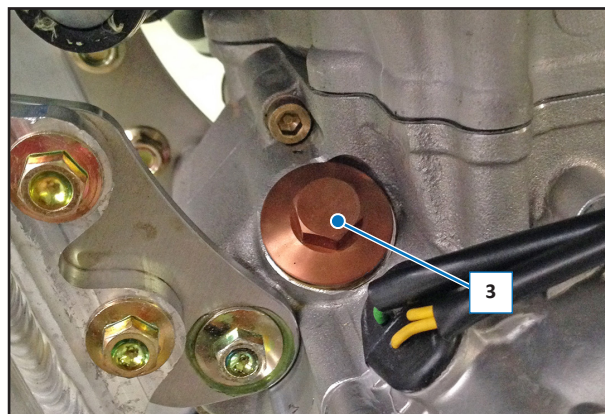
The oil must be changed with the engine off but still warm enough to allow the waste oil to flow out easily.

Unscrew the four screws (1) and remove the skid plate (2).

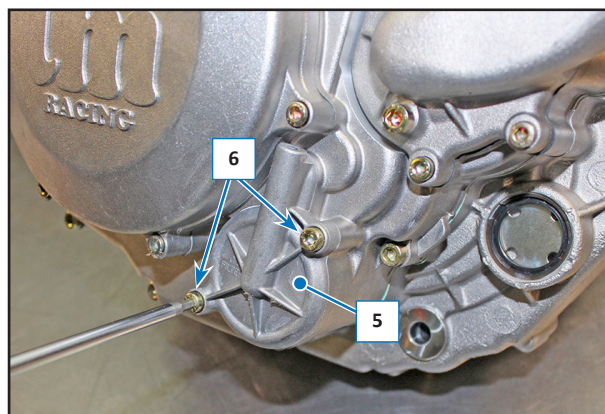


Position the motorcycle on a flat surface and prepare a suitable recipient under the same.

Loosen the introduction cap (3) positioned on the left side of the engine and the drain cap (4) positioned on the lower side of the engine; allow the oil to flow out into the recipient.

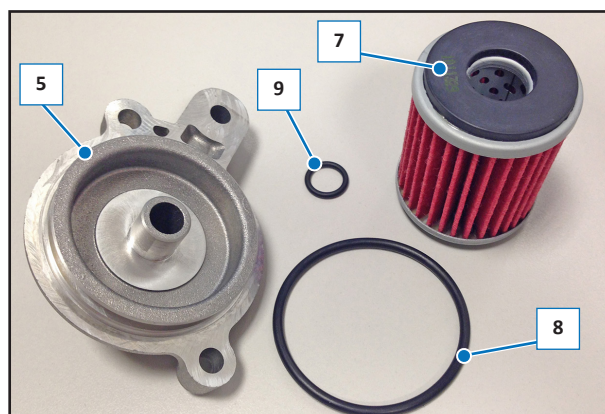
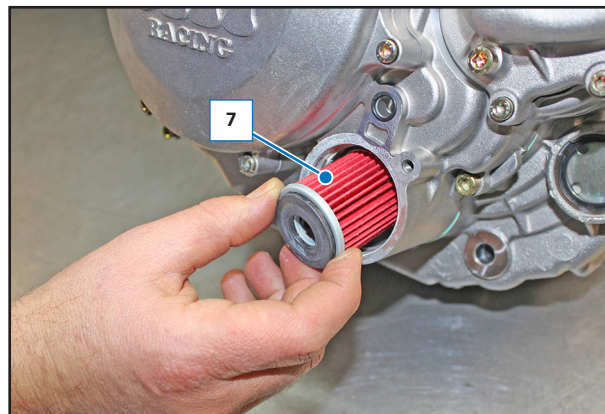


In the meantime, remove the filter cover (5) situated on the right side of the engine, loosening the relative screws (6) and paying attention to collect the oil escaping.



Extract the cartridge filter (7) and clean the surfaces of the guard and filter cover, check the seal O-rings (8 and 9) and replace them if necessary. Insert the original new TM Racing filter in a way to have the open side towards the outside of the engine. The filter must be inserted completely into its housing.

Re-mount the O-rings and the filter cover, tightening the screws (6) to 8 Nm (0.8 kgm, 5.9 ft/lb).



Wait for the oil to drain completely through the holes, clean the sealing surfaces, replace the aluminium washers, remove any magnetic debris (10) of the draining cap (4) and screw the caps back on, tightening to 20 Nm (2 kgm, 14.75 ft/lb).

Prepare a measure with the amount of the prescribed engine oil necessary (see table) and pour from the introduction hole.

Repeat the oil level check operation.

Check sealing of the filter cover introduction and drain caps.

## **⚠ DANGER**

- **PAY ATTENTION TO THE HOT OIL AND PARTS OF THE ENGINE; THERE IS A BURNS HAZARD.**

## **⚠ WARNING**

- A level that is too low, poor quality oil or maintenance intervals longer than those prescribed, cause serious damage to the engine. Do not introduce an excessive amount of oil into the engine. If this should happen, drain it as described previously.
- Always replace the filter when changing the oil. If there is no new filter, remove the one used to inspect it and drain the waste oil from the housing. Re-mount it according to the procedure described.
- Do not attempt to clean a used filter.



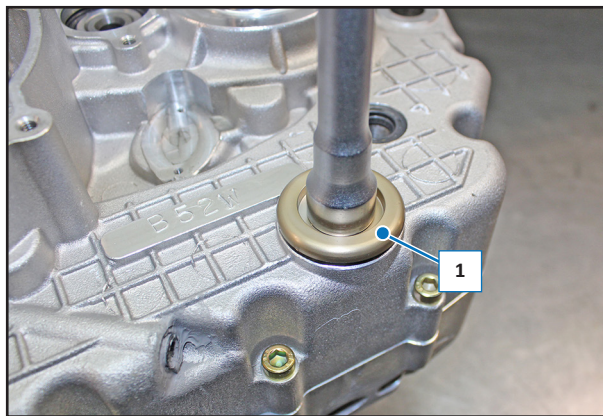
## **ENGINE OIL QUANTITY TABLE**

Change oil and filter .....	1.40 l
Change oil and inspect filter.....	1.40 l
Engine overhaul.....	1.50 l

## 1.4 METAL FILTER CHECK AND CLEANING

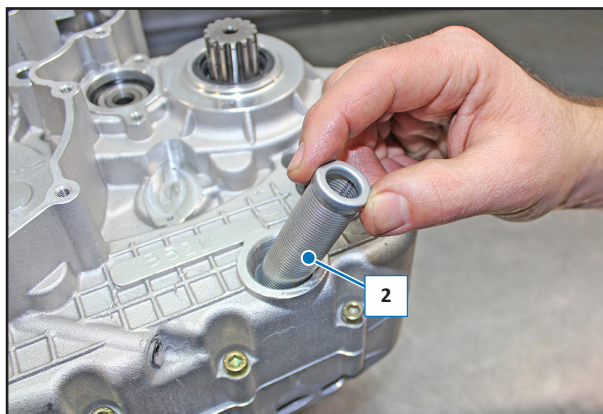
Remove the oil as described in the relevant paragraph.

Unscrew the cap (1) and replace it.



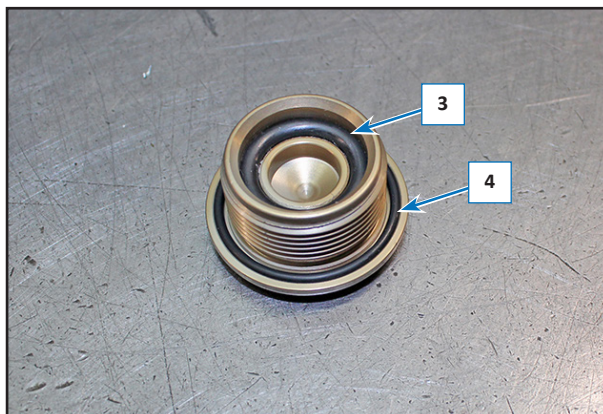
Extract the filter (2) and clean it using relevant filter detergents or petrol.

**NOTE:** If the filter is too dirty or ruined, replace it.

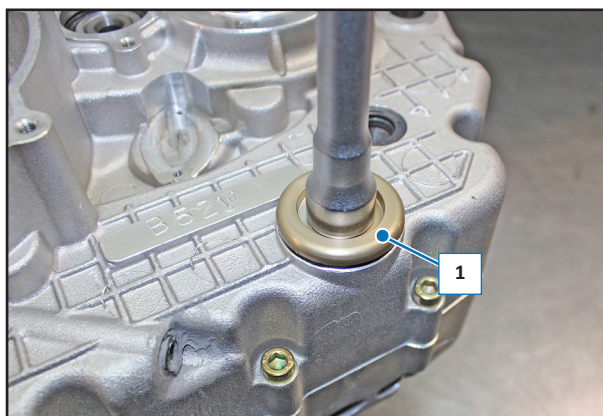


Reinstall the filter (2) in its housing.

Check that the two gaskets (3) and (4) are not ruined and, if so, replace.

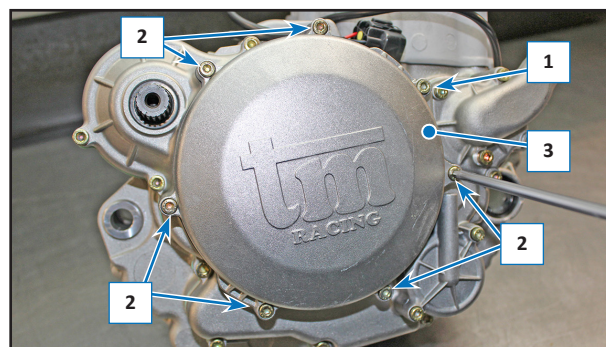


Re-mount the cap (1), tightening it to 2 Nm (0.2 kgm, 1.47 ft/lb)

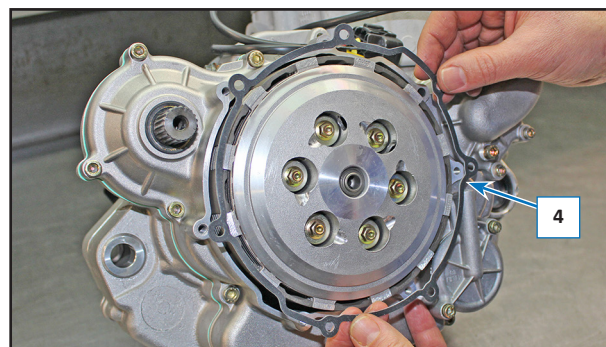


## 1.5 STANDARD CLUTCH REPLACEMENT

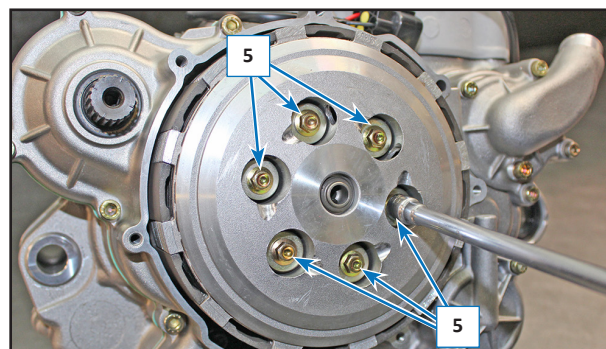
Drain the engine oil as described in the relative paragraph.  
Unscrew the M5-L70 (1) screw and M5-L25 (2) screws, then remove the clutch cover (3).



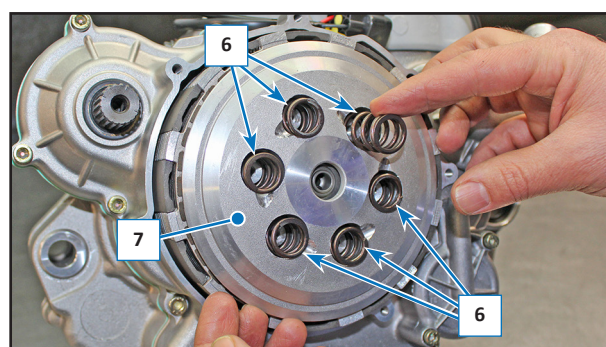
Remove the gasket (4).



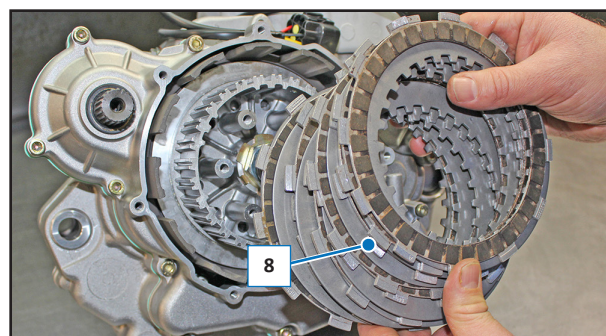
Unscrew the screws (5) of the clutch pack.



Remove the spring (6) and the pressure plate (7).

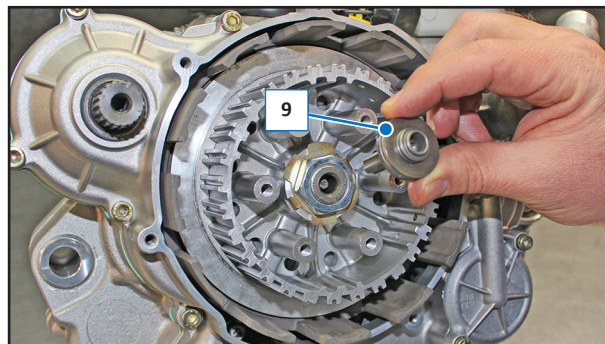


Remove the discs (8).

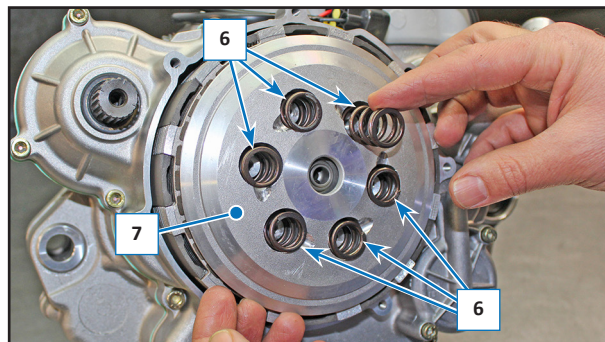


Check that the pressure plate (9) is present.

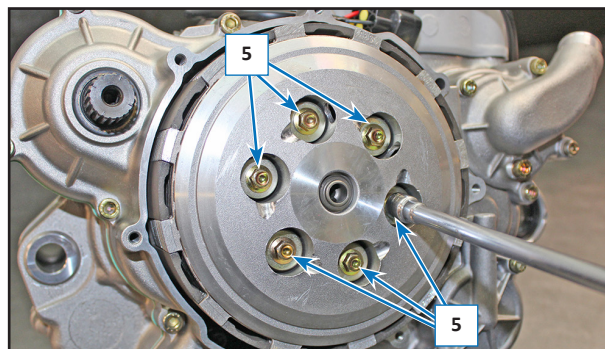
**NOTE:** On re-mounting the new discs, lubricate them with engine oil and make sure that the first disc mounted is lined, and that the first two smooth discs have thickness of 1.8 mm (the other discs have thickness of 1.5 mm).



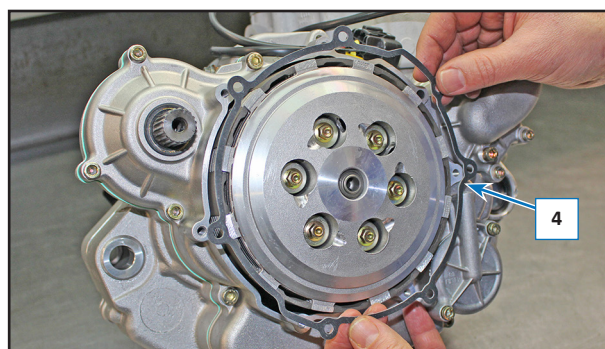
Remount the pressure plate (7) with the relative springs (6).



Re-mount the screws (5) and tighten them crosswise and gradually with a torque of 8 Nm (0.8 kgm/ 5.9 ft/lb).

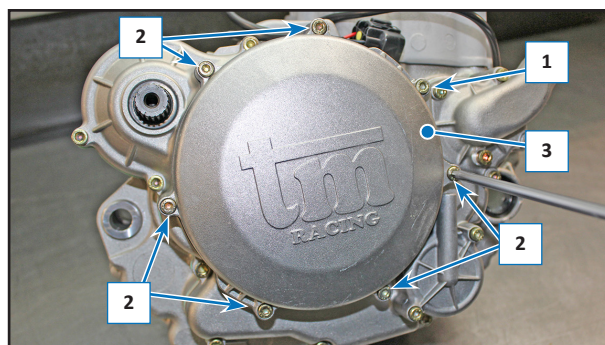


Check that the gasket (4) is not ruined, otherwise replace it, and mount it on the guard.



Mount the clutch guard (3) and tighten the screws (1) and (2) gradually with a torque of 8 Nm (0.8 kgm/ 5.9 ft/lb)

Introduce oil into the engine oil as described in the relative paragraph.

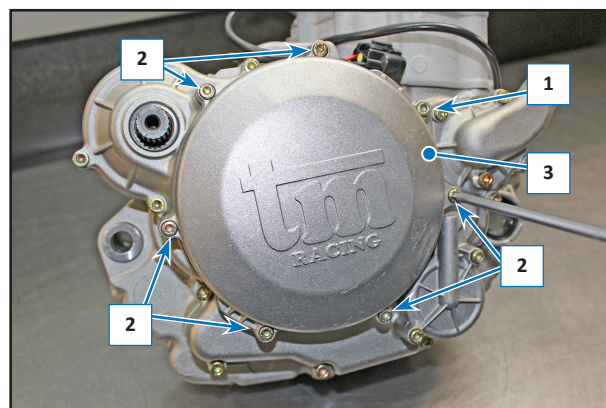


## 1.6 SLIPPER CLUTCH REPLACEMENT

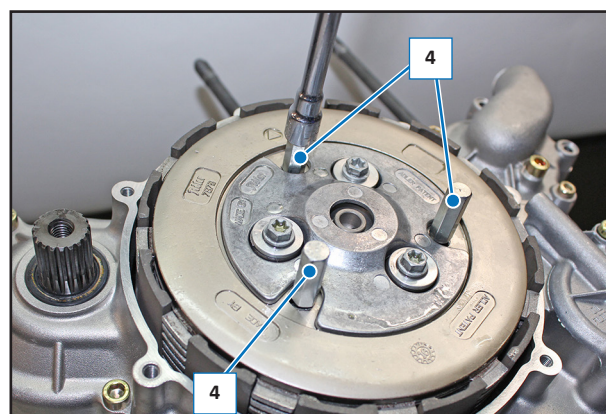
### 1.6.1 Disc pack removal

Drain the engine oil as described in the relative paragraph.

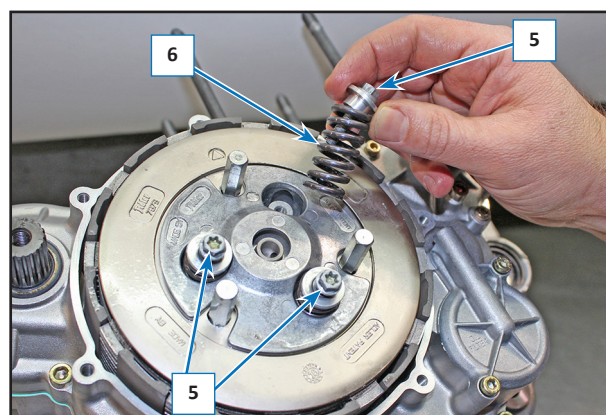
Unscrew the M5-L70 (1) screw and M5-L25 (2) screws, then remove the clutch cover (3).



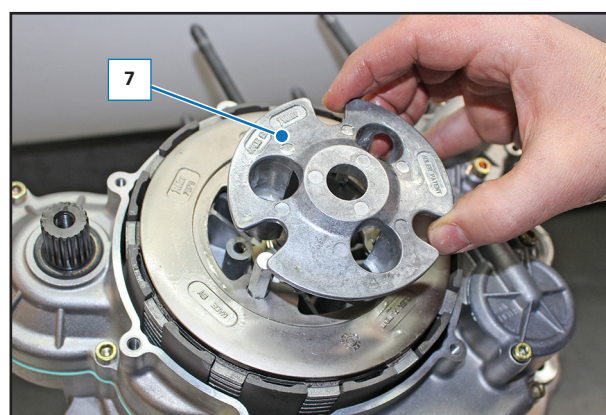
Tighten the columns (4) supplied.



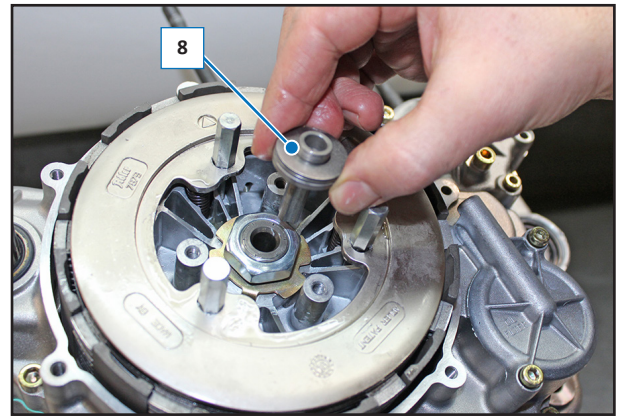
Loosen the screws (5) and remove the springs (6).



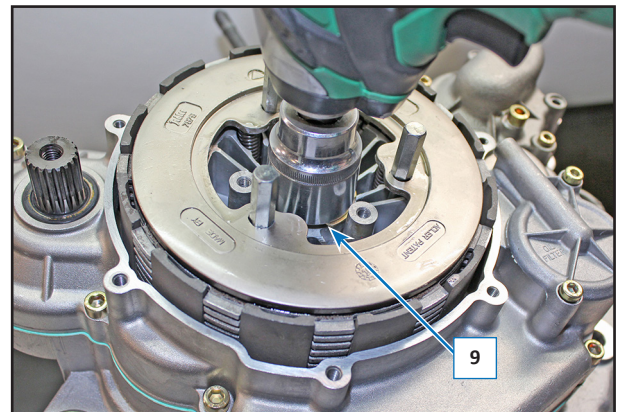
Remove the upper plate (7).



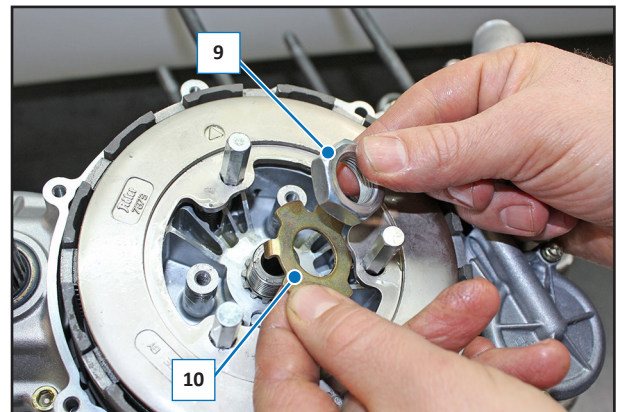
Remove the pressure plate (8).



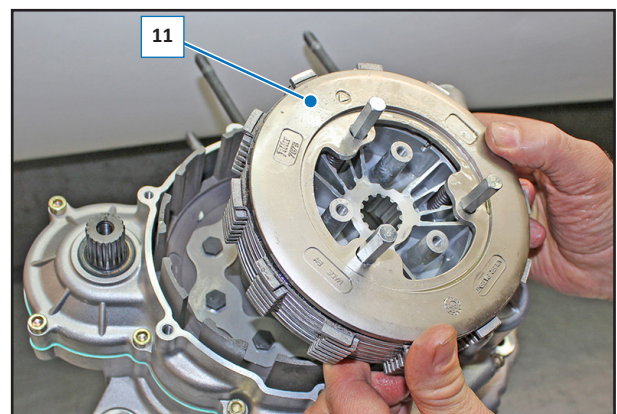
Unscrew the nut (9).



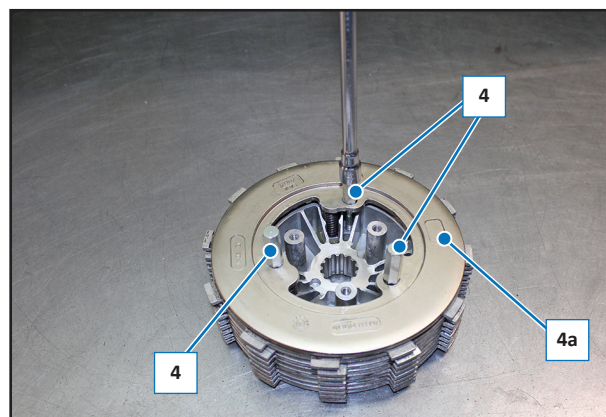
Remove the nut (9) and the washer (10).



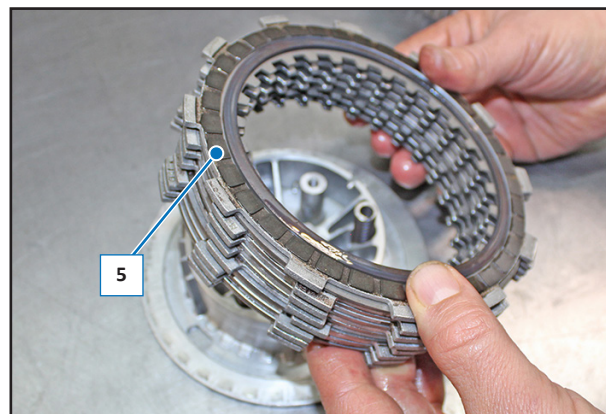
Remove the complete clutch pack (11).



Unscrew the columns (4) and remove the upper drum (4a).

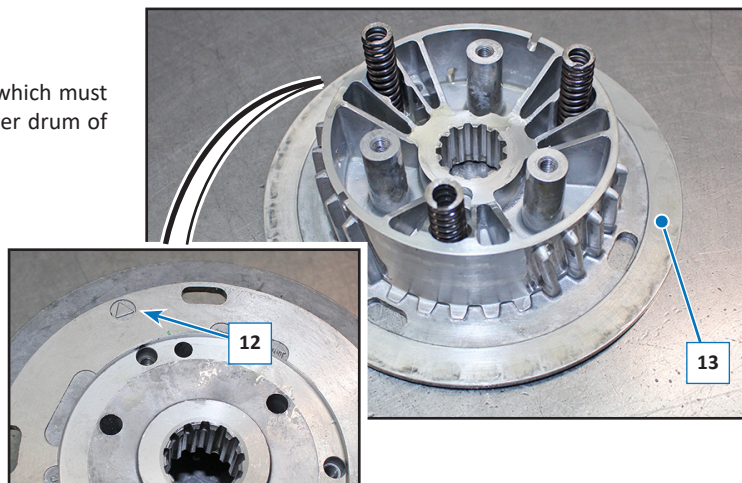


Extract the disk pack (5).

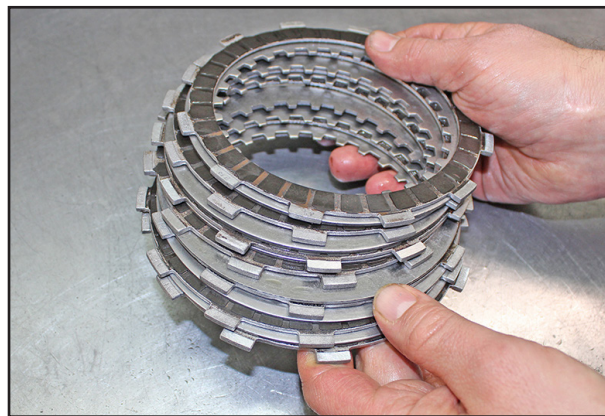


## 1.6.2 Discs replacement and re-mounting of clutch

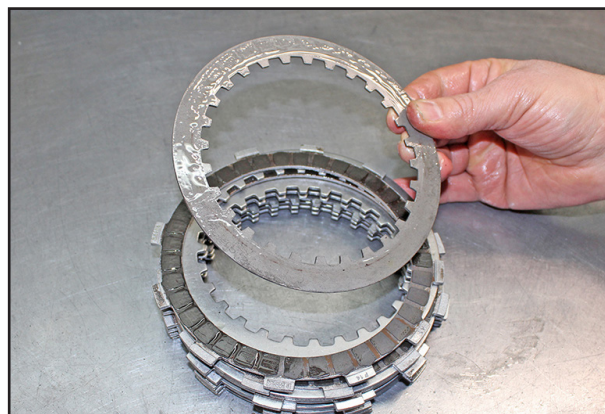
Mark the position of the arrow (12) on the lower drum (13), which must coincide with the position of the arrow embossed on the upper drum of the clutch pack.



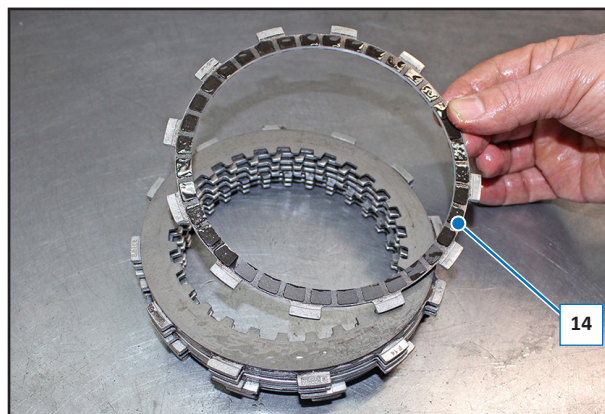
**NOTE:** On re-mounting the new discs, lubricate them with engine oil and make sure that the first disc mounted is lined, and that the first two smooth discs have thickness of 1.5 mm (the other discs have thickness of 2 mm).



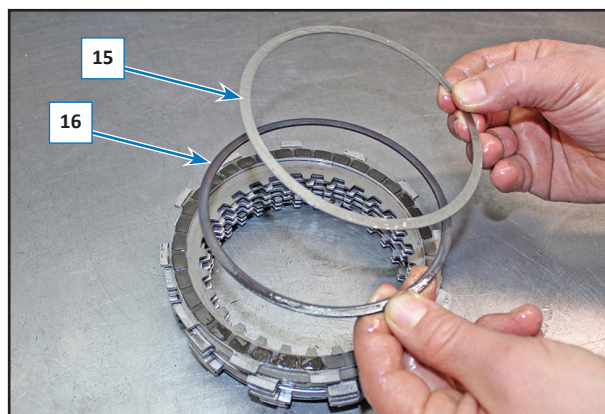
The clutch pack must finish with a smooth disc.



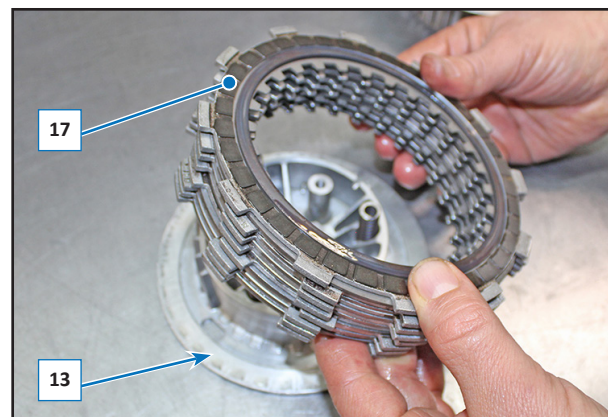
Mount the lined disc (14) with smaller lining than the others.



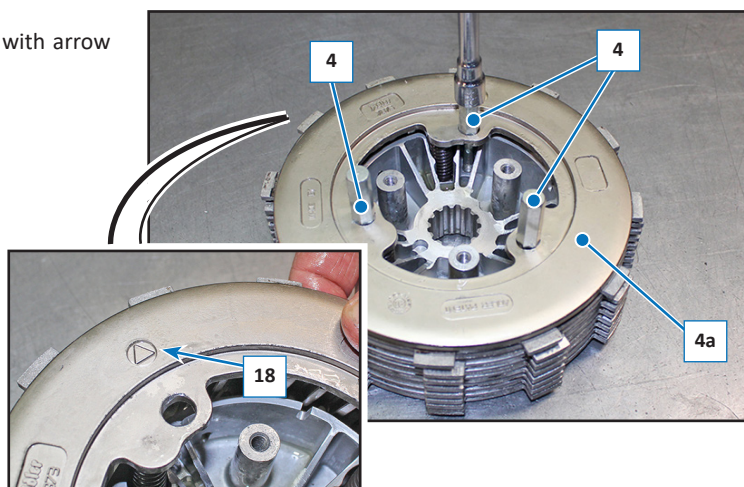
Mount the washer (15) and the Belleville washer (16), which are not supplied with disc spare parts; therefore those present must be re-used.



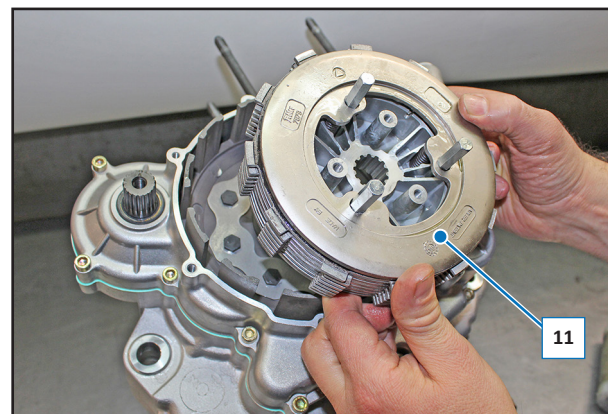
Mount the disk pack (17) on the lower drum (13).



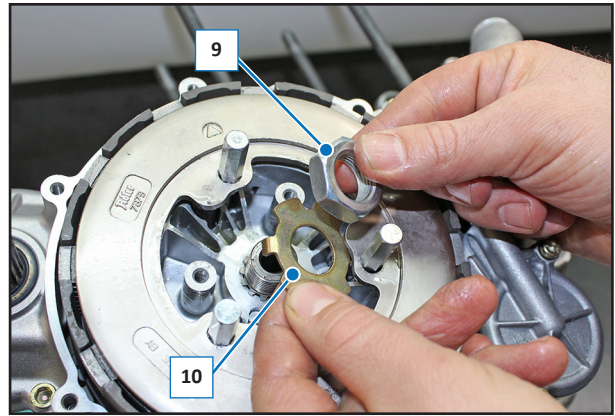
Mount the upper drum (4a), making the arrow (18) coincide with arrow (12) of the lower drum and then tighten the columns (4).



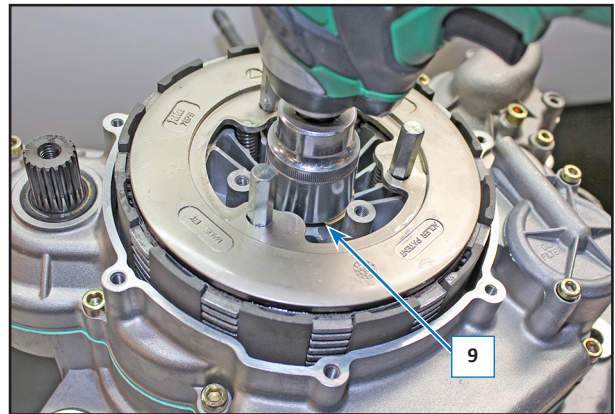
Mount the clutch pack (11).



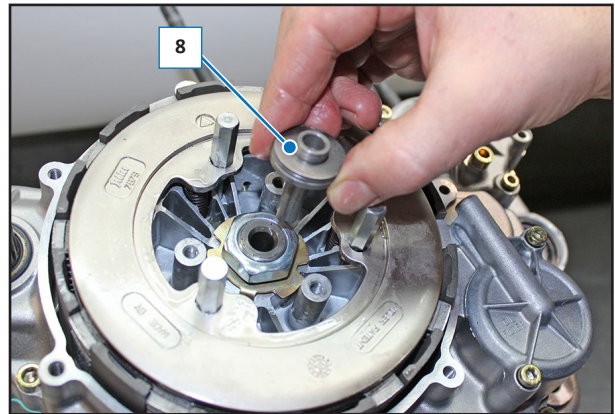
Insert the safety washer (10) and the nut (9).



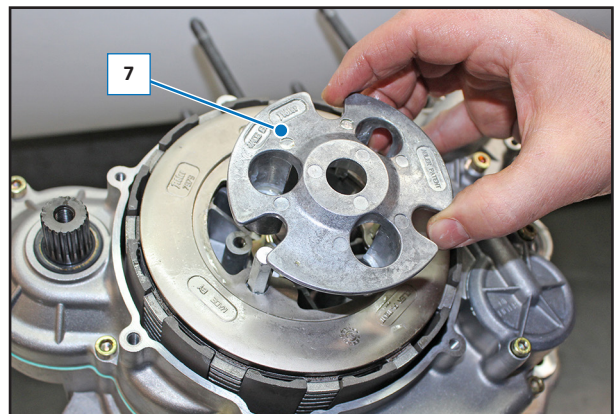
Tighten the nut (9) with a torque of 100 Nm/ 10 kgm/ 73.75 ft/lb + Loxeal 82-33.



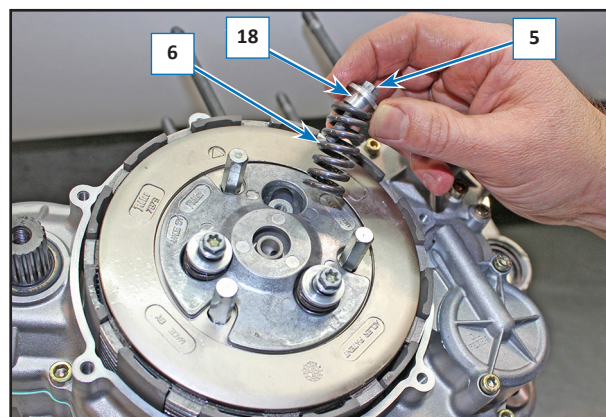
Mount the pressure plate (8).



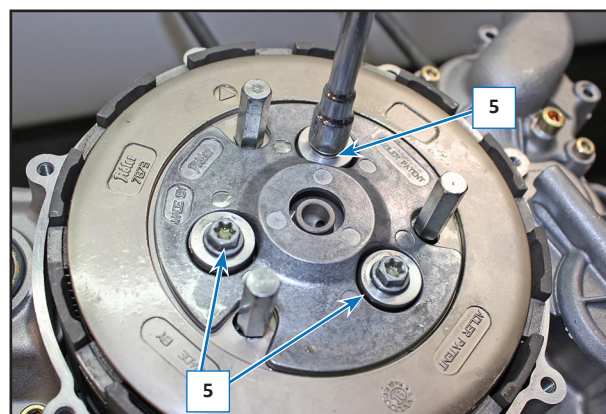
Mount the upper plate (7).



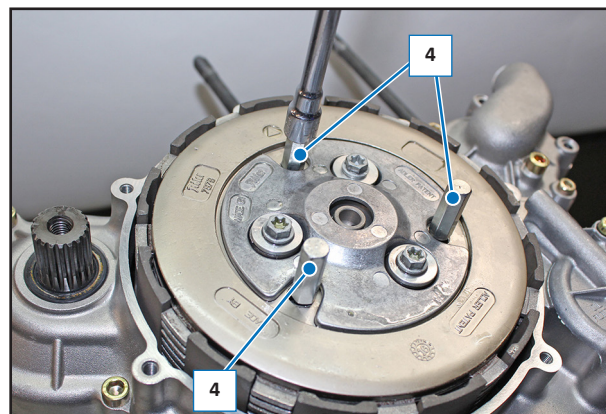
Mount the screw (5) with the relative springs (6) and bushes (18).



Tighten the screws (5) with a torque of 8 Nm (0.8 kgm/ 5.9 ft/lb).

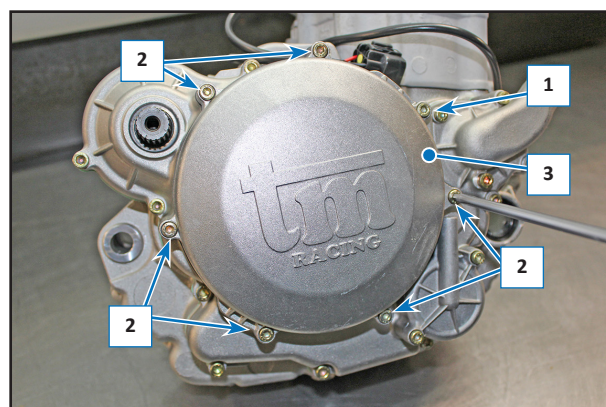


Remove the columns (4) supplied.



Mount the clutch guard (3) and relative gasket and tighten the screws (1) and (2) gradually with a torque of 8 Nm (0.8 kgm/ 5.9 ft/lb).

Introduce oil into the engine oil as described in the relative paragraph.



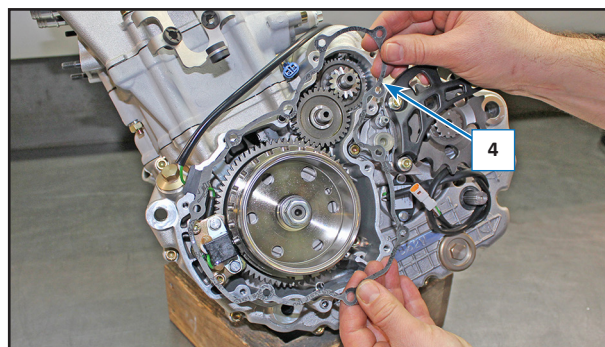
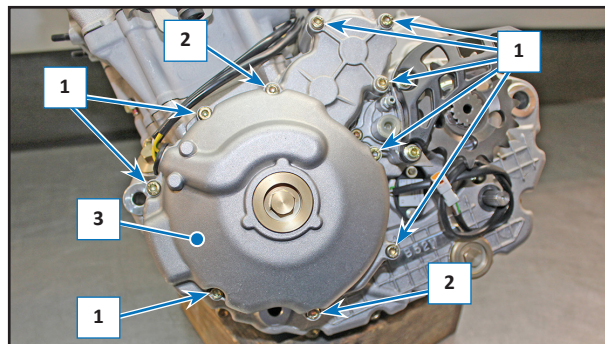
## 1.7 TIMING

If the pick-up has been replaced, the engine timing must be checked.

Remove the spark plug and the head cover and mount a comparator on the head, as indicated in the previous paragraphs.

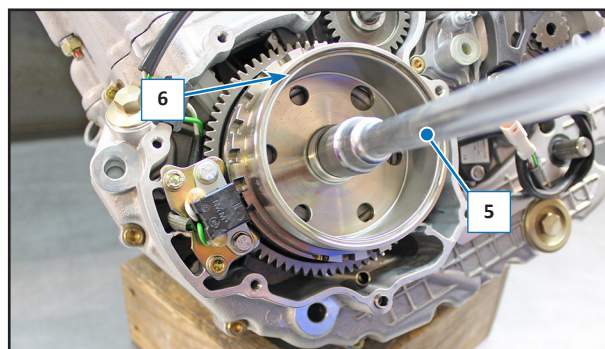
Disassemble the flywheel cover (3) loosening the (1) M5-L20 and screws (2) M5-L25.

Remove the gasket (4). (241)

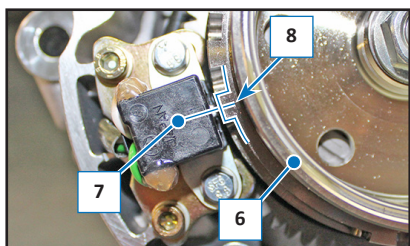


With a closed-end spanner (5), rotate the flywheel (6) until the piston is taken to the PMS (top dead centre).

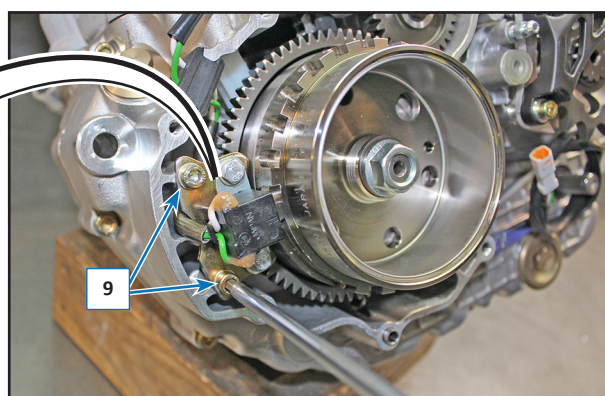
Again using the closed-end spanner, rotate the flywheel clockwise until the comparator indicates lowering of the piston by 0.40 mm.



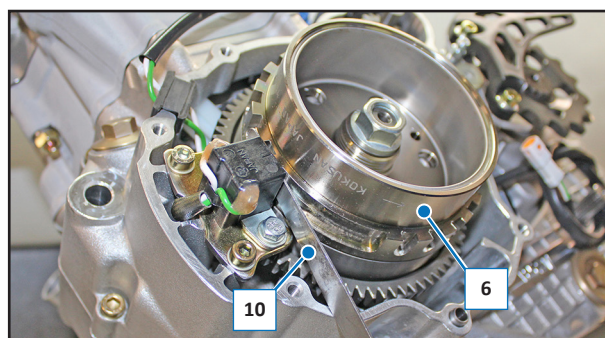
Check that the centre of the Pick-up (7) corresponds with the centre of the first notch (8) of the flywheel (6).

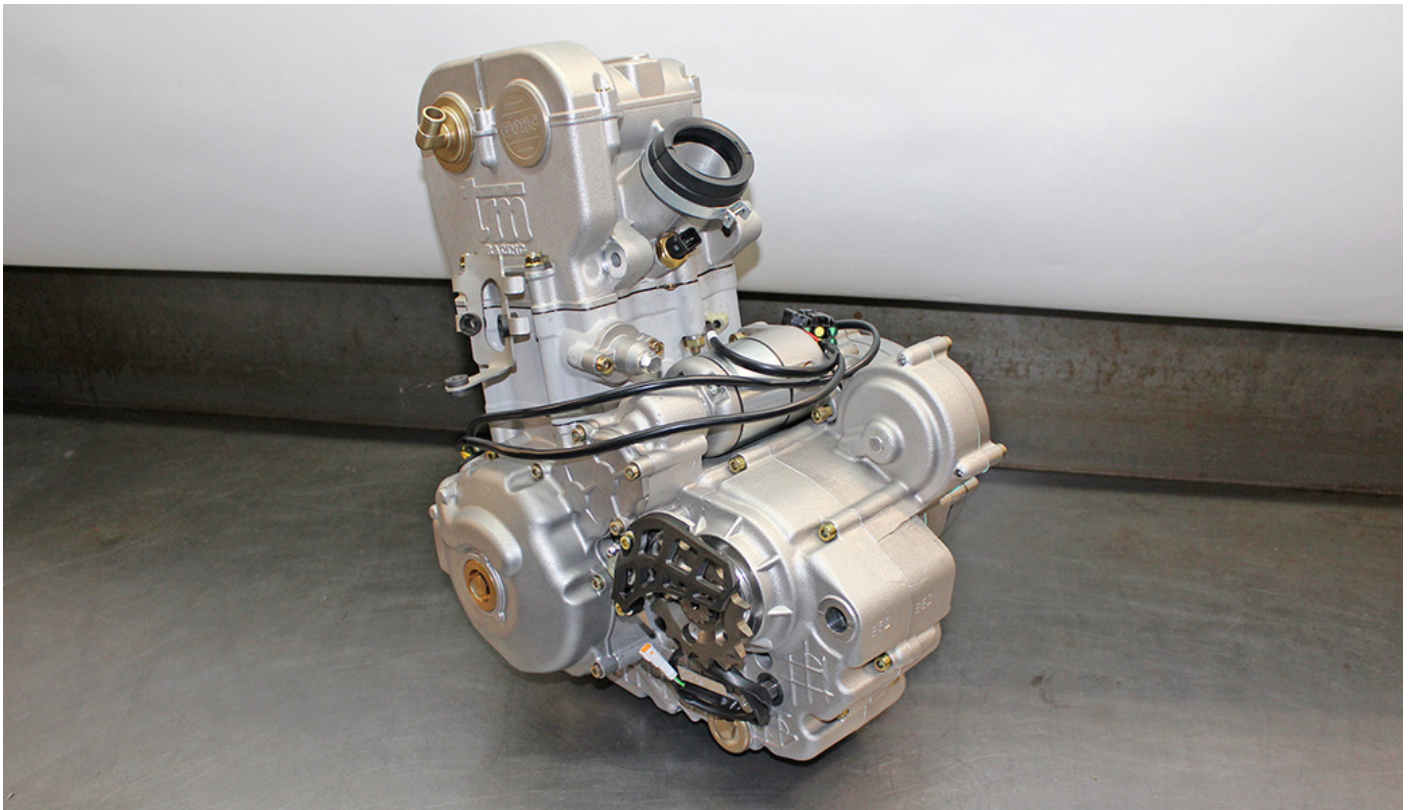


If the two centres do not correspond, loosen the two screws (9) and move the pick-up (7) until it is centred with the first notch (8).



Use a thickness gauge (10) to check that the distance between the pick-up (7) and the notch (8) of the flywheel (6) is between 0.7 and 1 mm and then tighten the screws (9).

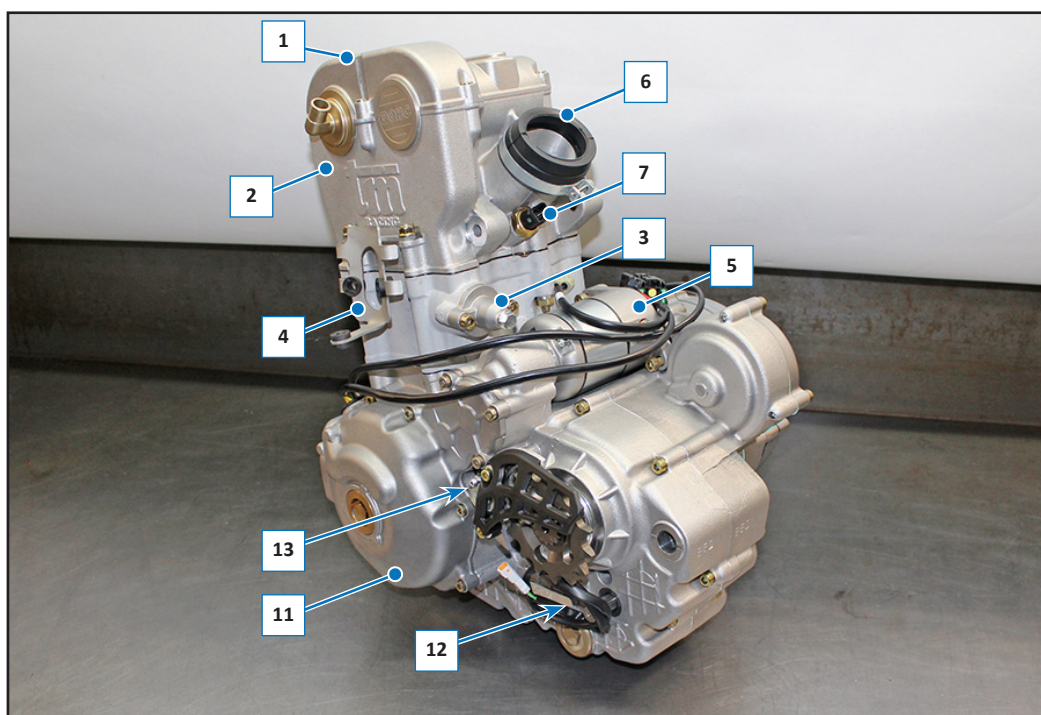
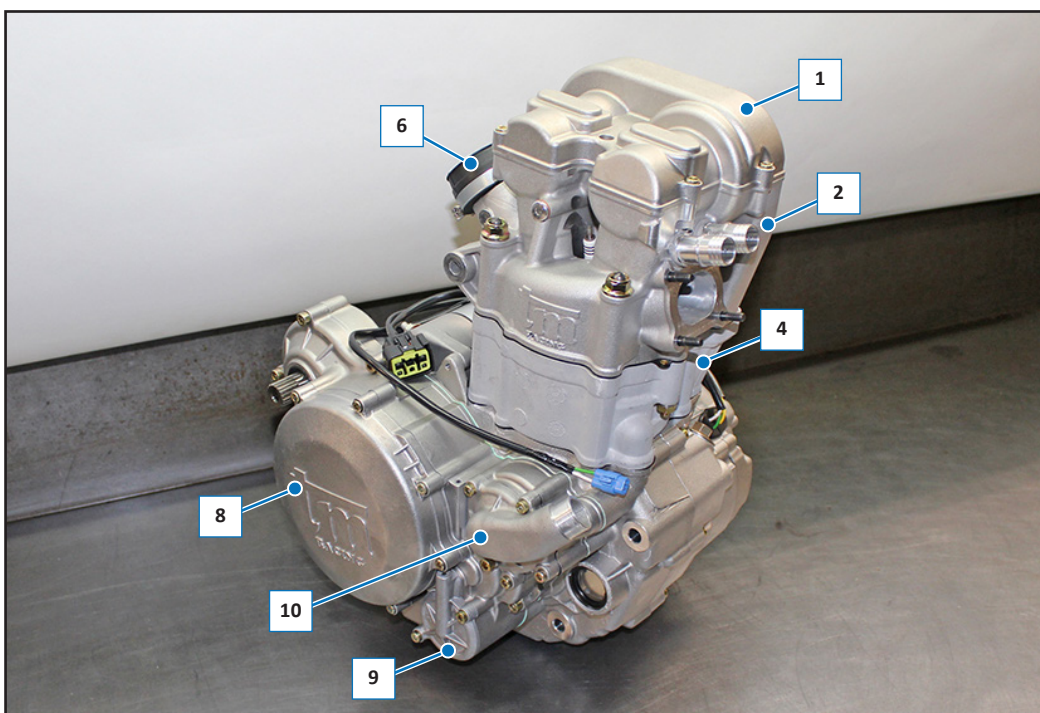




## 2. ENGINE DISASSEMBLY

## 2.1 ENGINE COMPONENTS LAYOUT

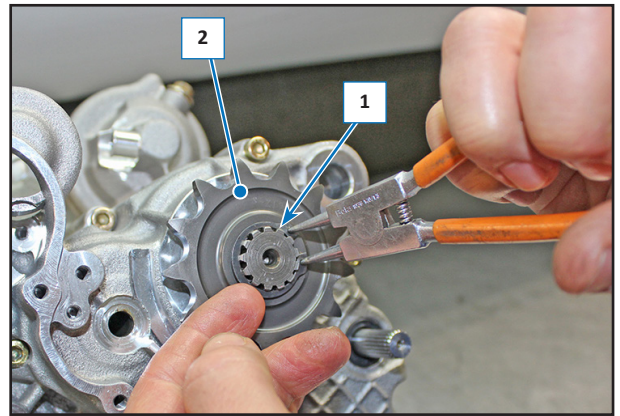
- 1 Cylinder head cover
- 2 Cylinder head
- 3 Chain tensioner
- 4 Cylinder
- 5 Starter motor
- 6 Throttle body connection coupling
- 7 Temperature sensor
- 8 Transmission cover
- 9 Oil filter
- 10 Water pump
- 11 Ignition cover
- 12 Gear sensor
- 13 Clutch actuator



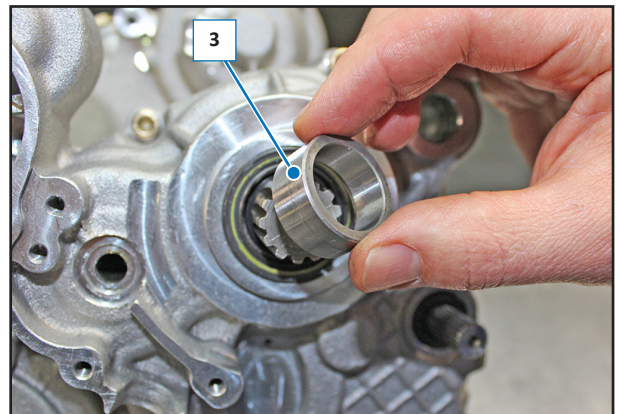
## 2.2 PINION REMOVAL

Remove the clutch actuator with the pinion cover casing, as described in the relative paragraph.

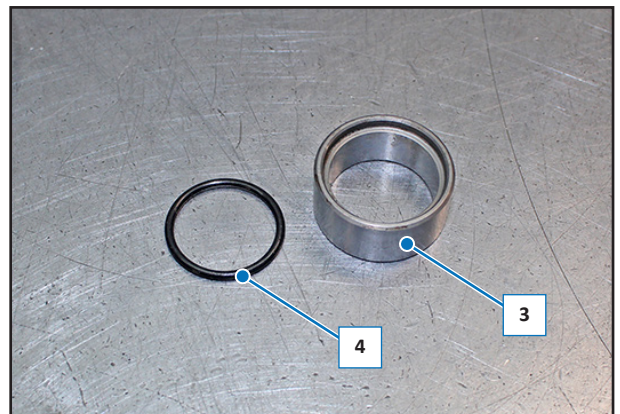
Remove the seeger ring (1) and the pinion (2).



Slide the bushing (3) out.



**NOTE:** On re-mounting the bush (3), check the status of the O-ring gasket (4) and replace it if worn. Lubricate the bush (3) and the gasket (4) with engine oil before remounting it.

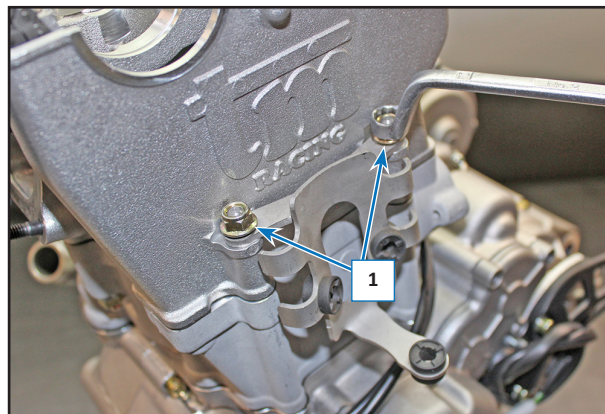


## 2.3 HEAD

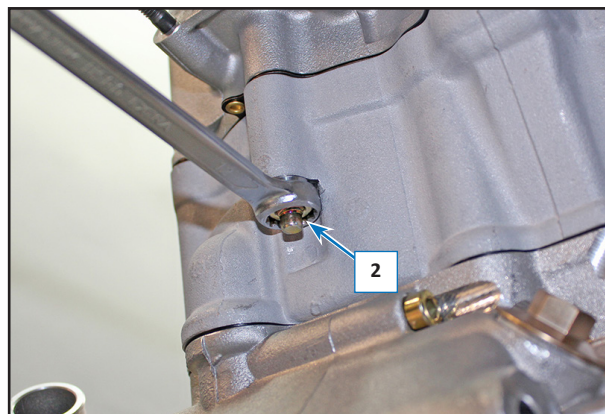
### 2.3.1 Head removal

Remove the head cover and the camshafts, as described in the relative paragraphs.

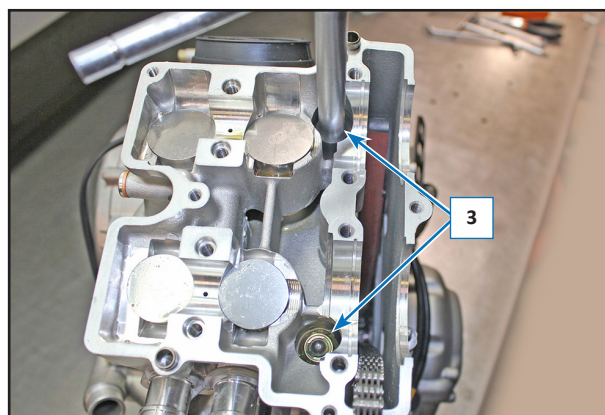
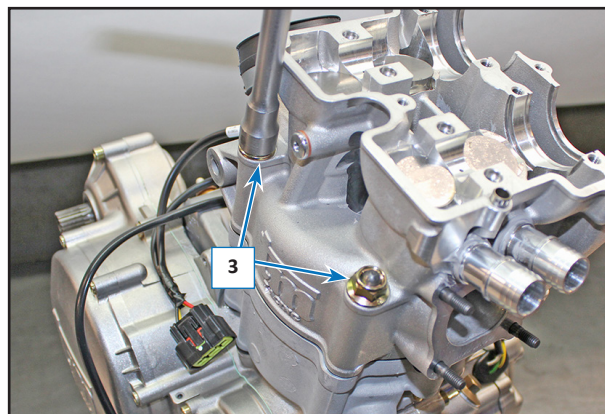
Loosen the two lateral nuts (1) at the left of the head.



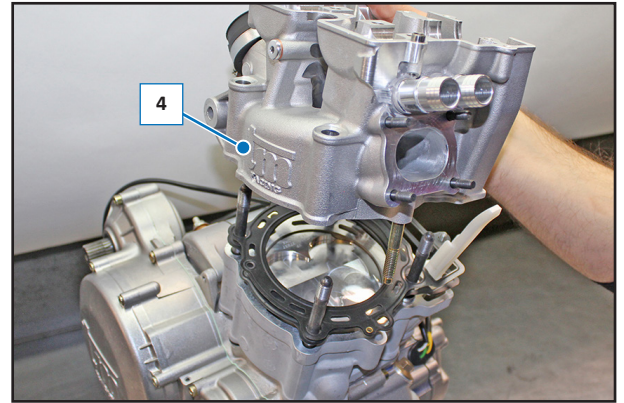
Loosen the screw (2) on the front part of the engine.



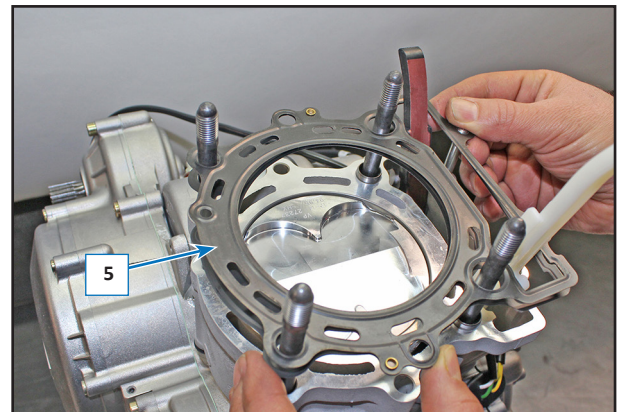
Loosen the nuts (3) of the head studs.



Lift the head (4) and remove it.



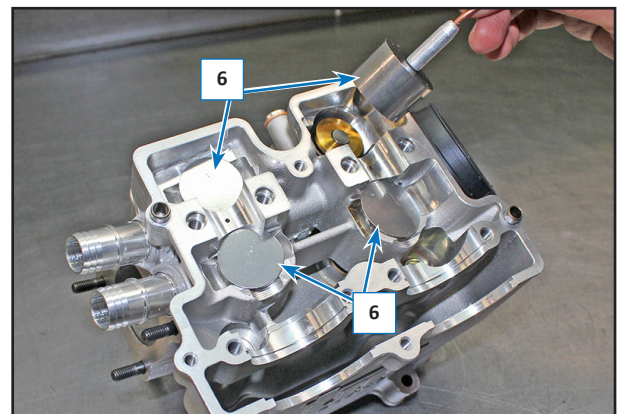
Remove the gasket (5).



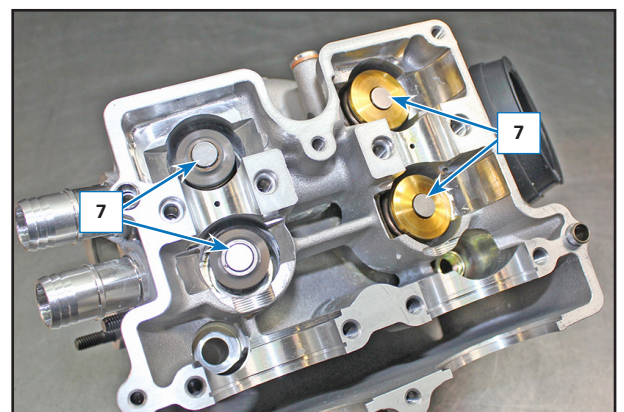
### 2.3.2 Head dismantling

**NOTE:** Mark all components in a way to re-mount the exactly in the same place from where they were removed.

Remove the tappets (6).

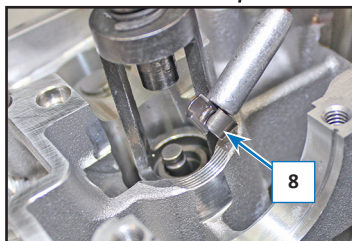
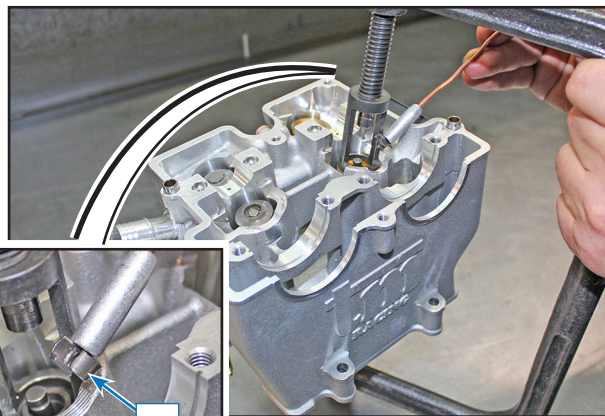


Retrieve the pads (7).



Using the relevant tool, compress the valves and use a magnet to remove the two half cones (8).

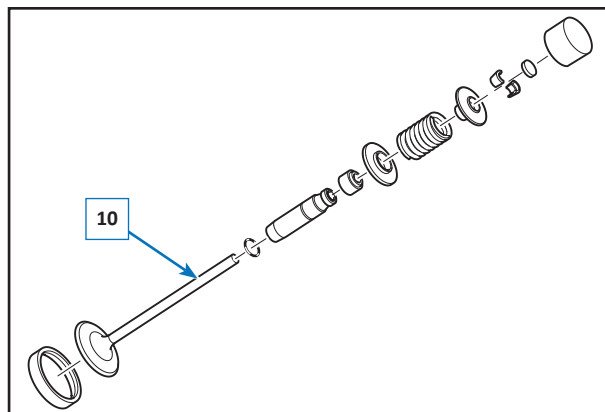
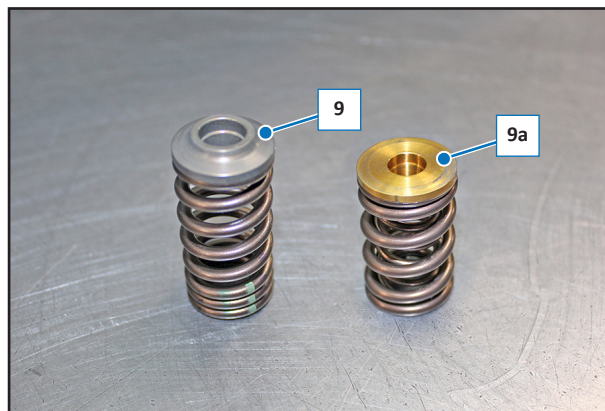
**NOTE:** Pay attention not to damage the support surfaces of the gaskets or of the combustion chamber. Make sure that the separator tool is upright, otherwise the valve stem may bend.



Remove the tool and remove the double springs (9a) and/or the single springs (9) the relative valves (10).

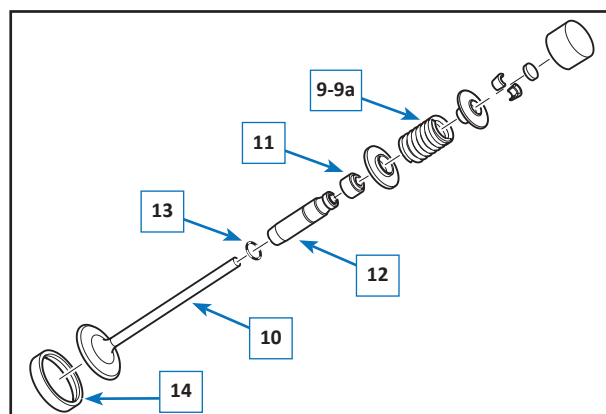
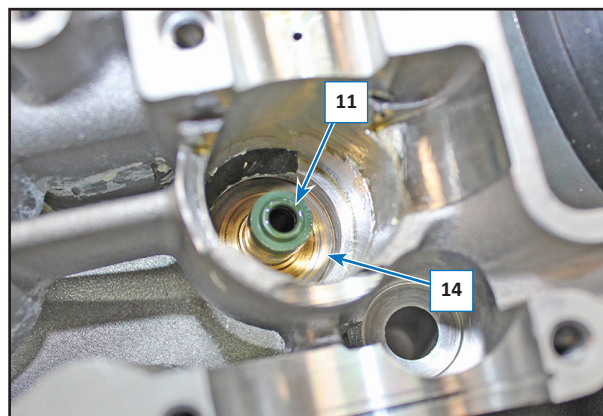
**NOTE:** Before sliding the valve out, check that there are no burrs on the stem, so that the valve-guide and relative oil seal are not ruined. If this is not the case, sand lightly to remove the burrs.

**NOTE:** For some models, the spring with relative plates for the intake valve is single (9), while for some models it is double (9a). Mark all valve components in order to re-mount them exactly in the relative position.



If ruined, remove the oil seal (11), the valve-guide (12), the relative OR gasket (13) and the valve seat (14).

**NOTE:** The valve seats and the valves are different regarding intake and exhaust.  
Do not invert. Mark them before disassembling them in order to re-mount them correctly.



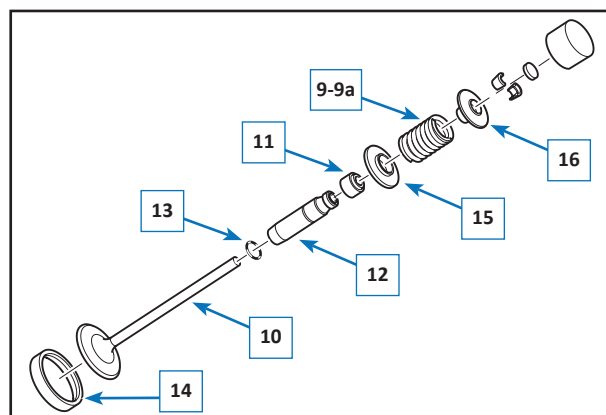
## 2.3.3 Head re-assembly

If disassembled, re-mount the valve seat (14), the valve-guide (12) and the OR gasket (13) and the oil seal (11). Lubricate the components with engine oil.

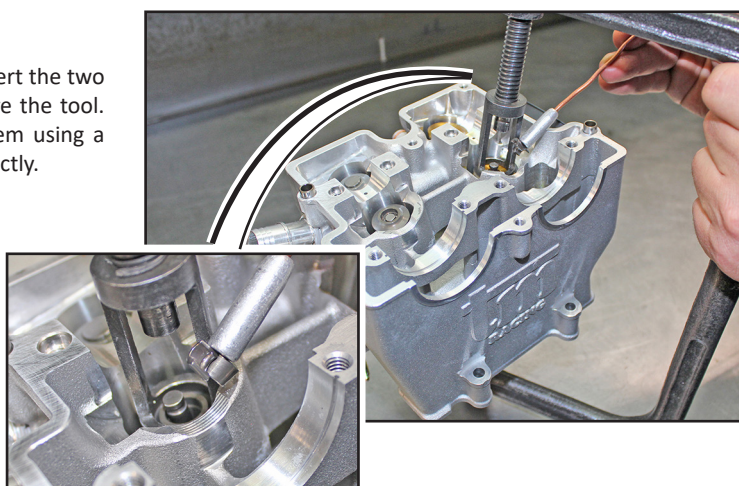
Use engine oil to lubricate the valve stem (10) and insert it into the valve-guide, paying attention not to pinch the oil seal (11).

Mount the double spring (9a) or the single spring (9) with relative plates (15) and (16).

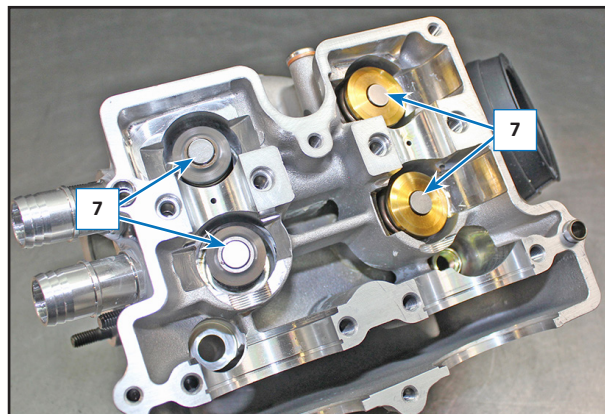
**NOTE:** Pay attention on re-mounting since the upper and lower plates are not the same.



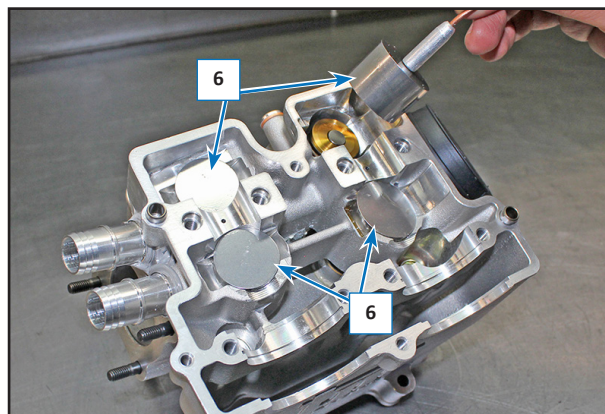
Using the relevant tool, compress the spring (9a) or (9) and insert the two half cones onto the valve stem; release the spring and remove the tool. Check that the half cones are positioned correctly on the stem using a rubber hammer to tap the upper valve stem to position it correctly.



Re-mount the pads (7).

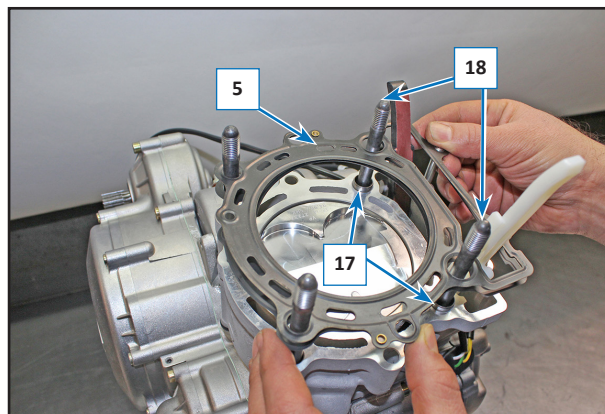


Re-mount the tappets (6).

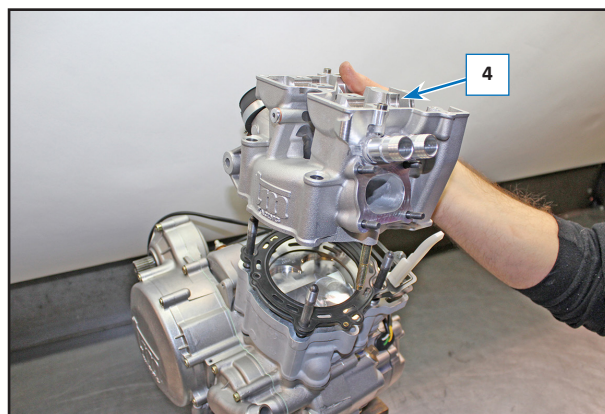


### 2.3.4 Head re-mounting

Replace the gasket (5) at every disassembly, and then mount it on the cylinder, positioning the centring bushes (17) in correspondence with the two studs (18).



Insert the head (4) on the studs.

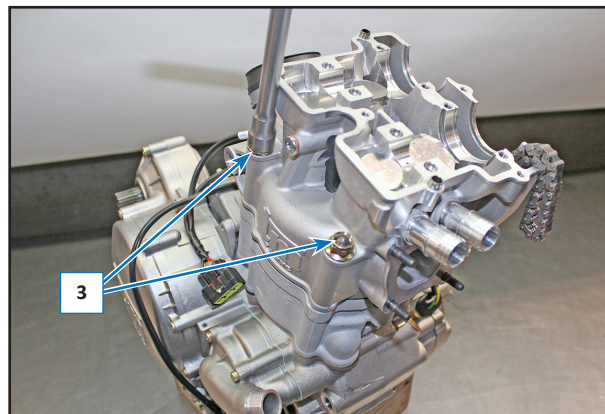


Tighten the self-locking nuts (3) crosswise, blocking them in 3 steps:

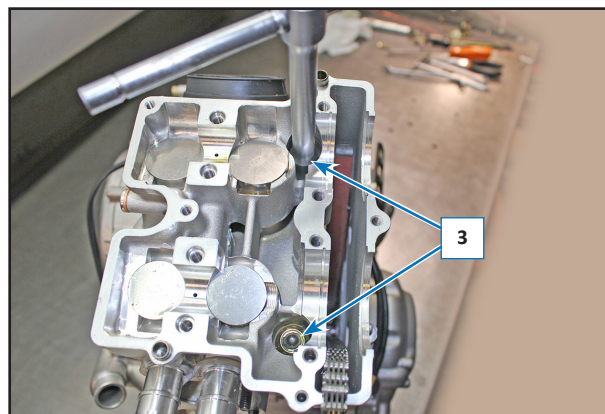
**Step one:** tighten them with a torque of 10 Nm (1.0 kgm/ 7.23 ft/lb).

**Step two:** tighten with a torque of 30 Nm (3 kgm/ 22.12 ft/lb).

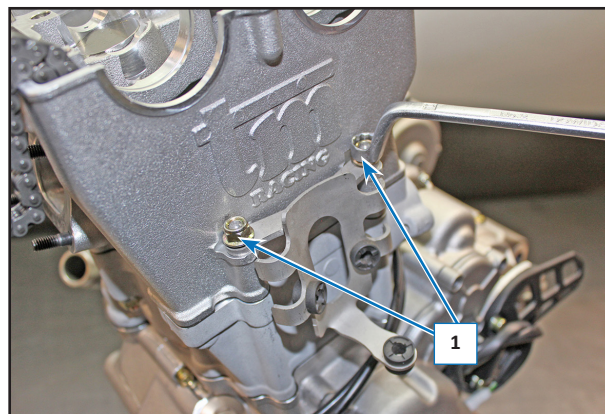
**Step three:** tighten with a torque of 45 Nm (4.5 kgm/ 33.19 ft/lb).



**NOTE:** It is recommended to replace the self-locking nuts (3) to guarantee the head is perfect sealed. Lubricate the studs with graphite grease.

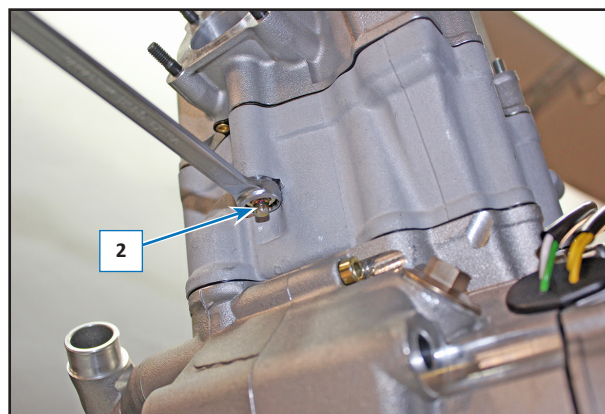


Tighten the two nuts (1) positioned on the left side of the head with torque of 12 Nm (1.2 kgm, 8.85 ft/lb).



Screw the nut (2) positioned on the front part of the engine, with graphite grease, with the torque of 22 Nm (2.2 kgm, 16.22 ft/lb).

**NOTE:** This operation must be performed after having tightened the self-locking nuts (3) at the first step.

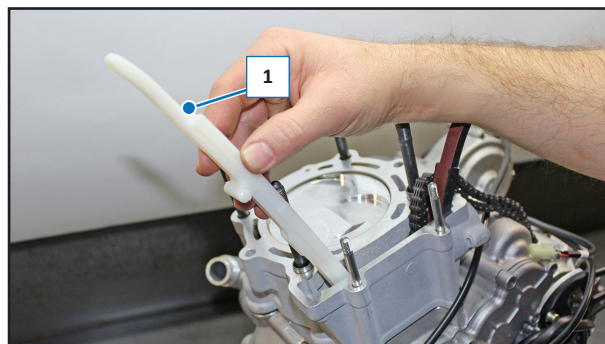


## 2.4 CYLINDER AND PISTON

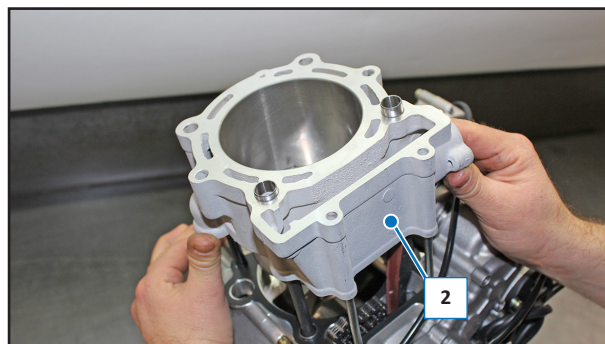
### 2.4.1 Cylinder and piston removal

Remove the head as described in the relative section.

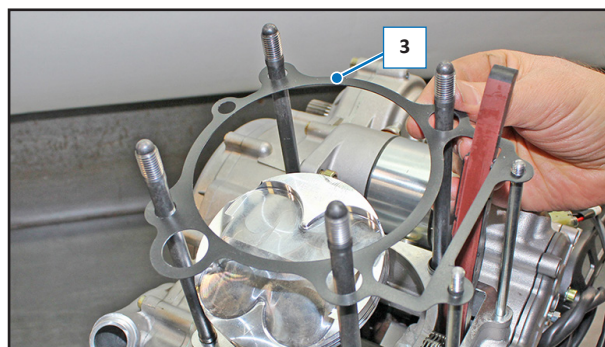
Remove the fixed plate (1), sliding it upwards.



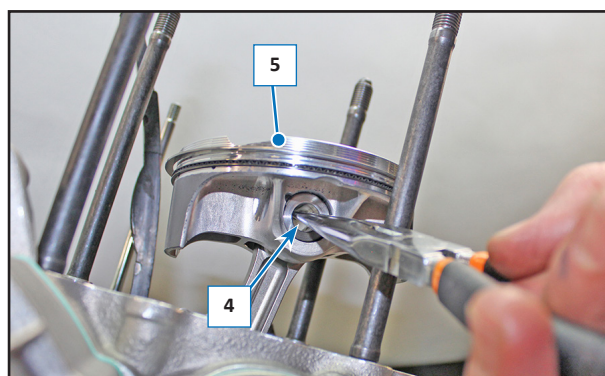
Remove the cylinder (2) by sliding it from the stud bolts.



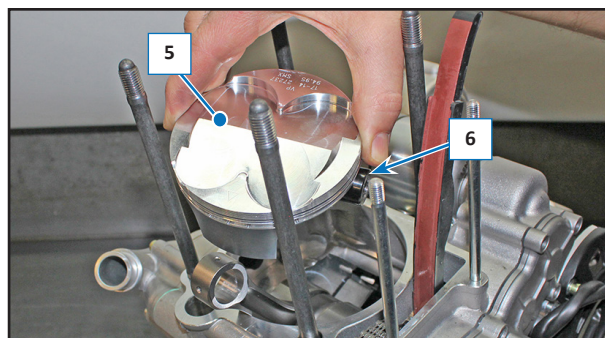
Remove the gasket (3).



Remove the lock ring (4) of the piston (5)



Extract the pin (6) and remove the piston (5).



### 2.4.2 Strap and oil scraper replacement and mounting

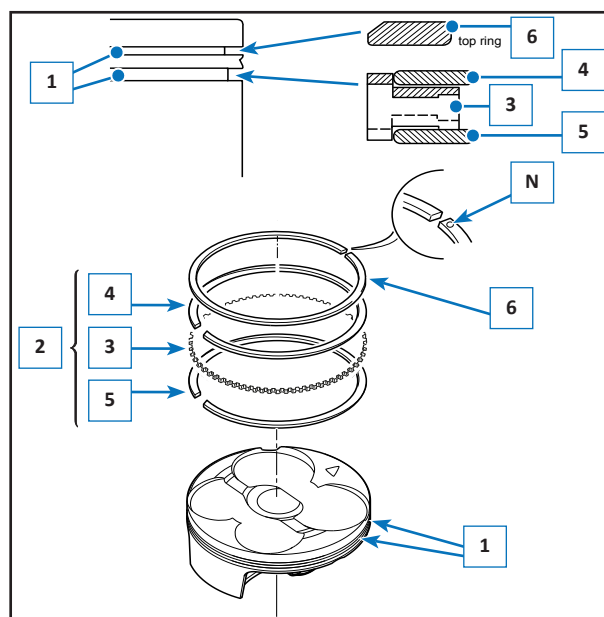
Clean the housing (1) of the straps on the piston from any carbon deposits.

**NOTE:** Apply engine oil on the straps before mounting them on the piston.  
Be careful not to scratch the piston when re-mounting.  
Do not widen the straps excessively during mounting, so that they are not damaged.

First, install the oil scraper (2), inserting the spacer (3) and the two rings (4) and (5) in a way that they go fully home onto the edge of the spacer.

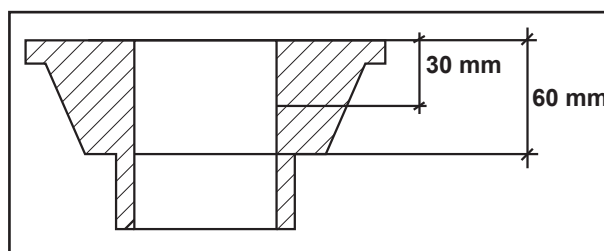
Install the upper strap (6), positioning the face engraved with "N" on the upper part.

Check that the strap and the oil scraper rotate freely around the piston and are not obstructed.  
Position the open part of the strap (6), of the spacer (3) and of the rings (4) and (5) as indicated in the figure, before re-mounting the piston in the cylinder.



### 2.4.3 Cylinder and piston coupling

If the piston must be replaced, for correct coupling, it is necessary to take the crosswise measurement of the internal diameter of the cylinder at a distance from the upper part of 30 mm and 60 mm. Use a relevant micrometer for internal diameters to take the measurement.  
With the measurement obtained, order a spare piston of the correct size.  
Cylinder piston coupling play is 0.05 mm +/- 0.005 mm.

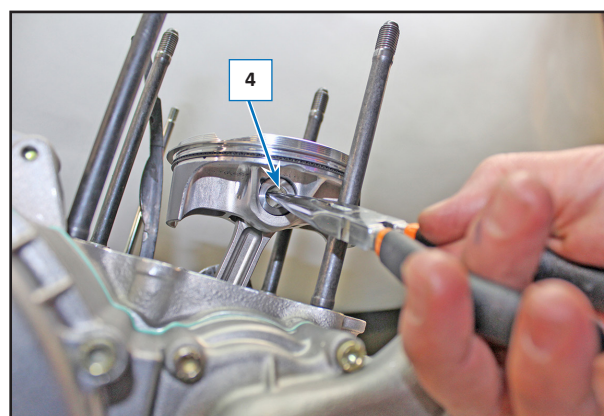
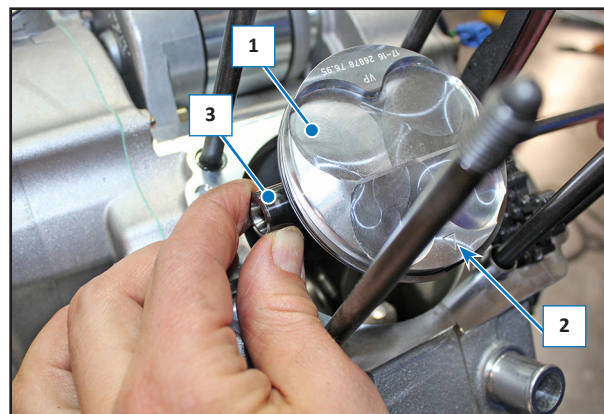


### 2.4.4 Cylinder and piston re-mounting

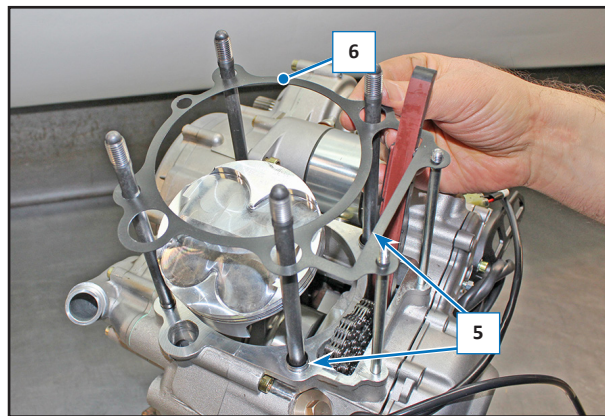
Re-mount the piston (1) on the rod, paying attention that the arrow (2) is positioned towards the exhaust and then insert the pin (3) and relative lock ring (4).

Check that the strap and the oil scraper are positioned as indicated in the "Strap and oil scraper replacement and mounting" paragraph.

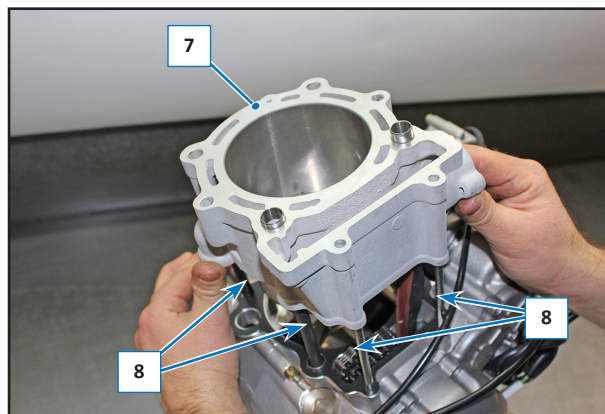
Oil the cylinder barrel with engine oil.



Insert the two centring bushes (5) and the metal gasket (6).



Insert the cylinder (7) onto the studs (8).

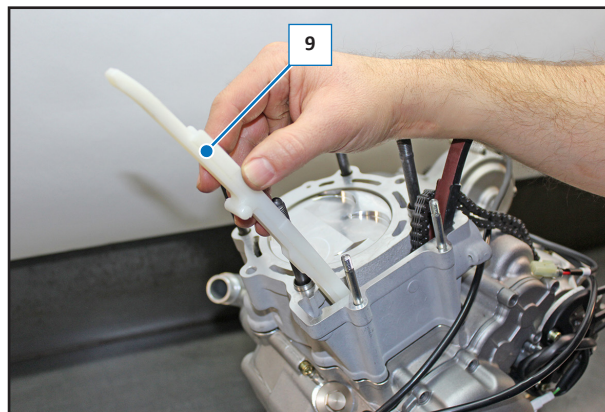


Mount the plate (9) in the relative housing.

Mount the head as described in the relative section.

**NOTE:** If the cylinder has been replaced, the compression must be checked, operating as described in the "Compression check" paragraph.

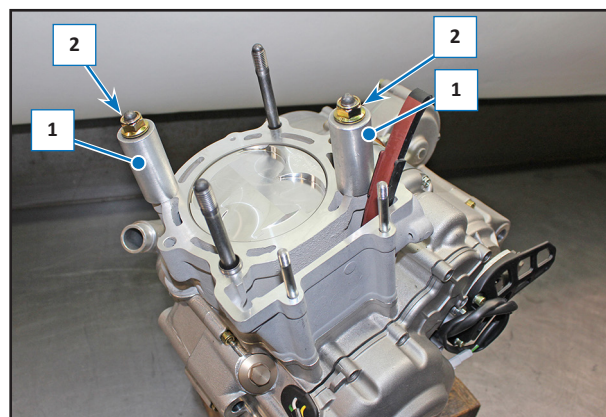
Re-mount the head as described in the relative section.



### 2.4.5 Compression check

With replacement of the cylinder, it is necessary to check that the distance between the piston crown and the upper surface of the cylinder is in within correct tolerance.

After having mounted the cylinder, insert the relevant spacers (1) and tighten the nuts (2) with a torque of 25 Nm 2.5 kgm, 18.43 ft/lb.



Position the piston at the top dead centre.

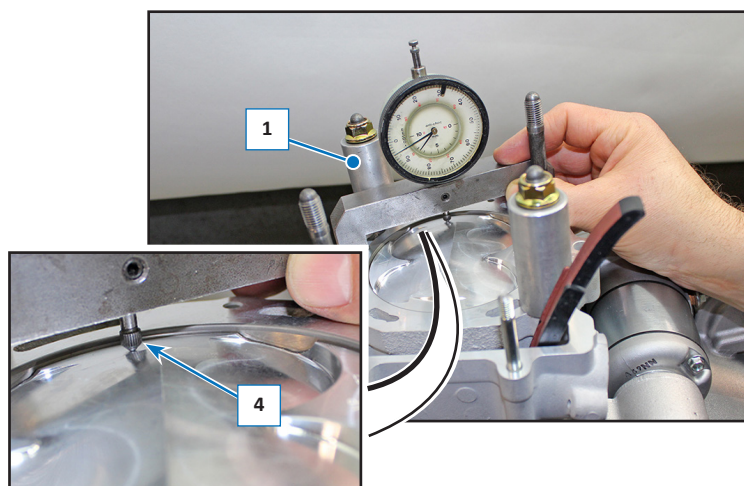
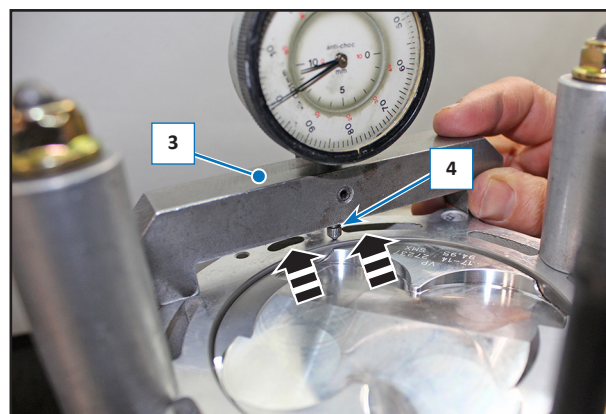
Position the tool (3) with relative micrometer on the upper surface of the cylinder and zero. Move the tip (4) of the micrometer onto the upper flat part of the piston and take the measurement.

**Correct compression:**

450 cc =  $0.75 \pm 0.05$  mm

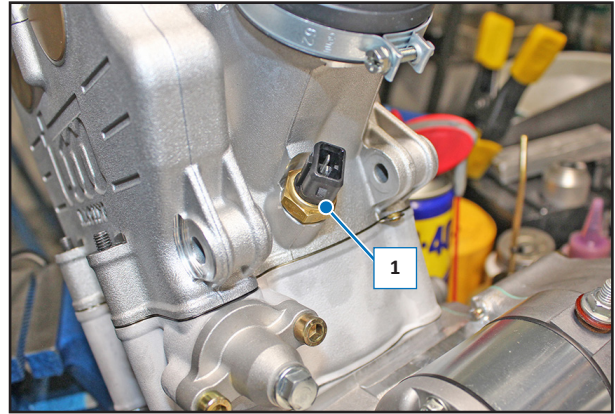
530 cc =  $0.85 \pm 0.05$  mm

If the measurement does not lie within the tolerance established, the metal gasket (6) of the spacer must be purchased as a spare part, suitable to return within tolerance.



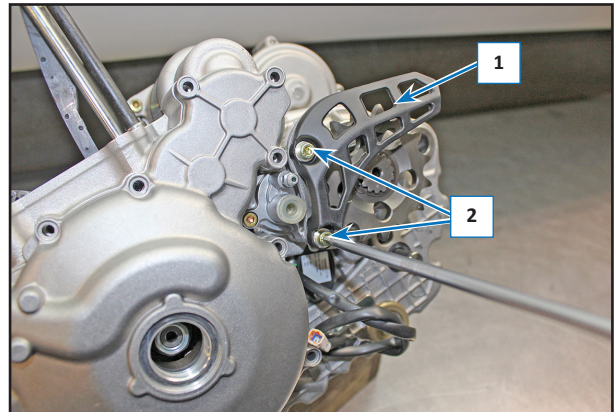
## 2.5 TEMPERATURE SENSOR REPLACEMENT

Unscrew the sensor (1) and replace it by tightening a new sensor with torque of 30 Nm, 3.0 kgm, 22.12 ft/lb plus three bond 1215 sealant paste.

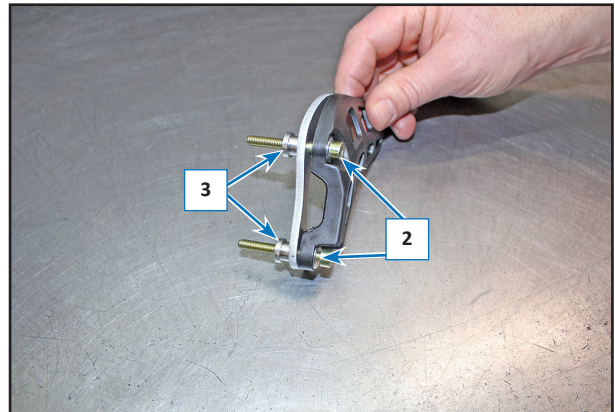


## 2.6 PINION PROTECTION REMOVAL

Remove the pinion protection (1) by unscrewing the two screws (2).

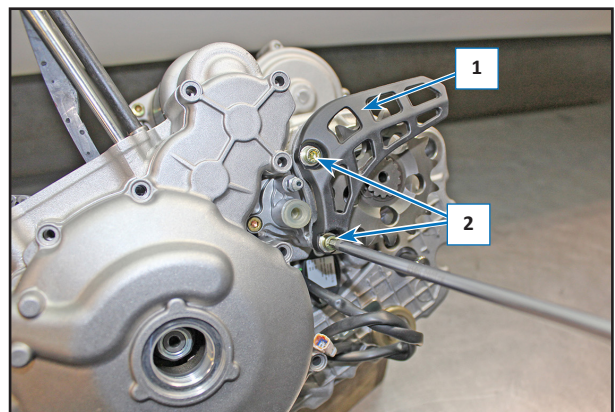


**NOTE:** for SMX models, the screws (2) are M5 x 40 plus two spacers (3); for the other models they are M5 x 35.



Re-mount the pinion protection (1), tightening the screws (2) to a torque value of 8 Nm (0.8 Kgm - 5.9 ft/lb).

**NOTE:** for the SMX model, make sure that two spacers are positioned between the protection (1) and the engine.

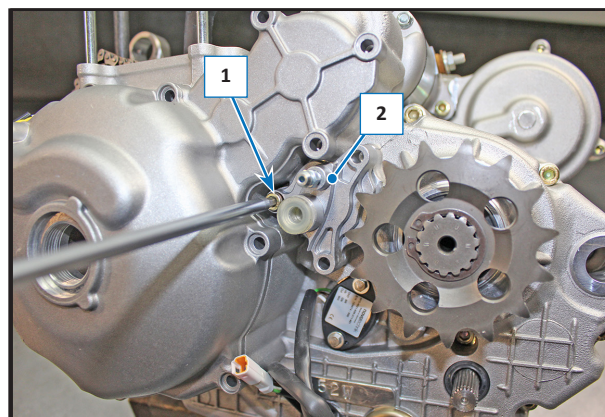


## 2.7 CLUTCH

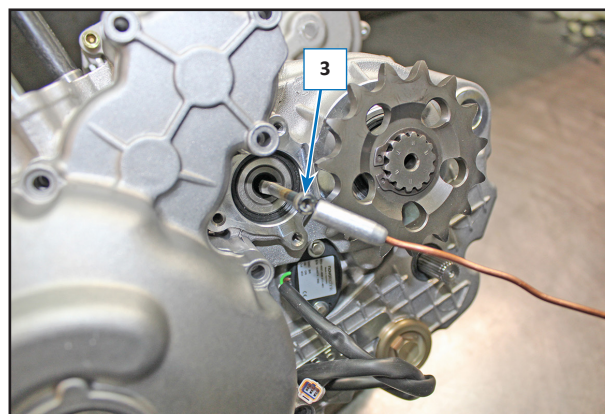
### 2.7.1 Clutch actuator removal with command rod

Remove the pinion protection, as described in the relative paragraph.

Unscrew the screw (1) (M5 x 16) and remove the actuator (2).



Use a magnet to slide the clutch rod (3) out.



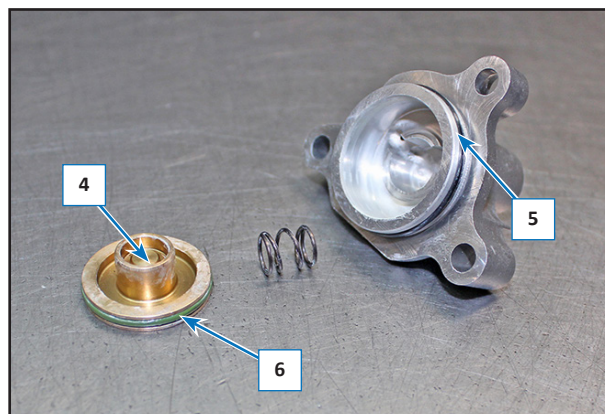
### 2.7.2 Actuator dismantling

Remove the piston (4).

Check the status of the OR gaskets (5 and 6), and replace if ruined.

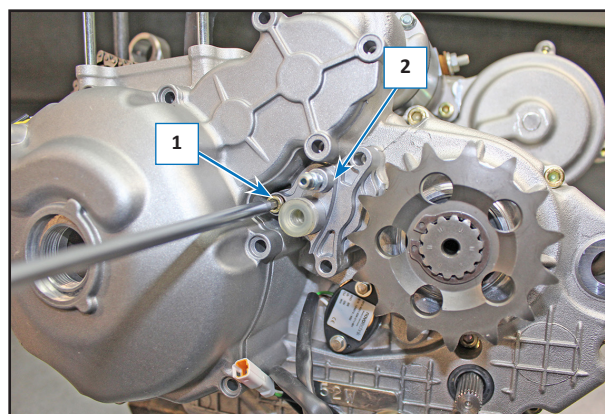
**NOTE:** On re-mounting, lubricate the gaskets with clutch oil.

Re-mount everything, proceeding in the opposite order to disassembly.



### 2.7.3 Actuator re-assembly

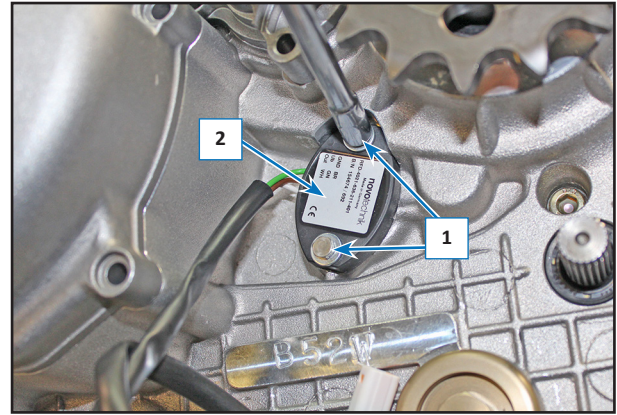
Re-mount the actuator (2) onto the engine and tighten the screw (1) with a torque of 8 Nm (0.8 kgm/ 5.9 ft/lb)



## 2.8 GEAR SENSOR

Unscrew the two screws (1).

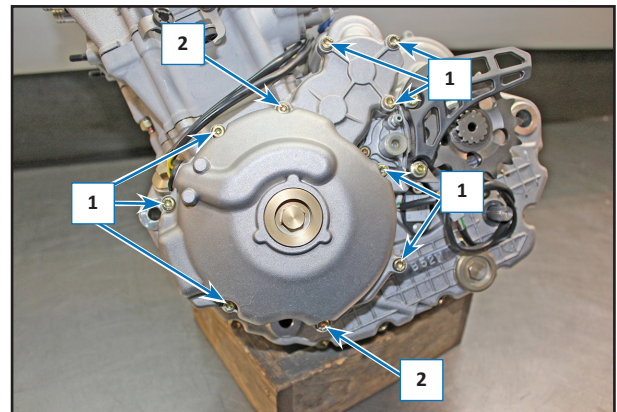
Use a screwdriver to lever and remove the gears sensor (2).



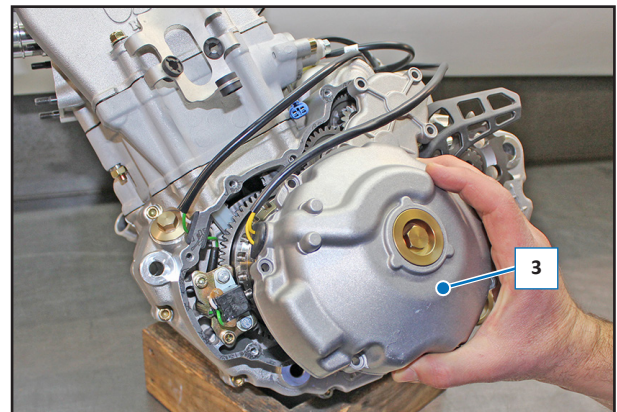
## 2.9 FLYWHEEL REMOVAL

### 2.9.1 Flywheel cover

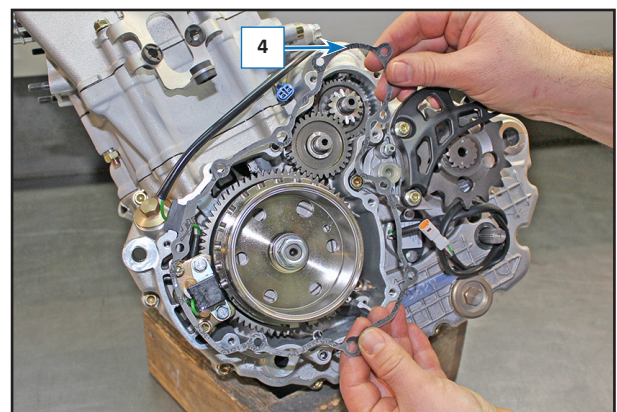
Unscrew the M5-L20 screws (1) and M5-L25 screws (2).



Remove the flywheel cover (3).

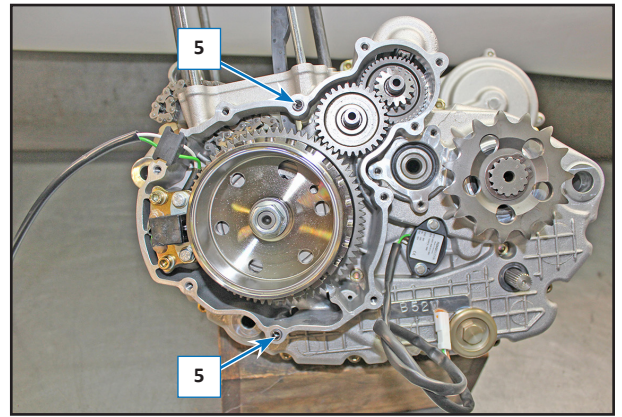


Remove the gasket (4).



Retrieve the two centring bushes (5).

**NOTE:** On re-mounting, check that the two centring bushes (5) are positioned correctly and that the gasket (4) is not ruined, otherwise replace.  
Tighten the screws (1) and (2) with a torque of 8 Nm (0.8 kgm/ 5.9 ft/lb).



## 2.9.2 Stator

### Disassembly

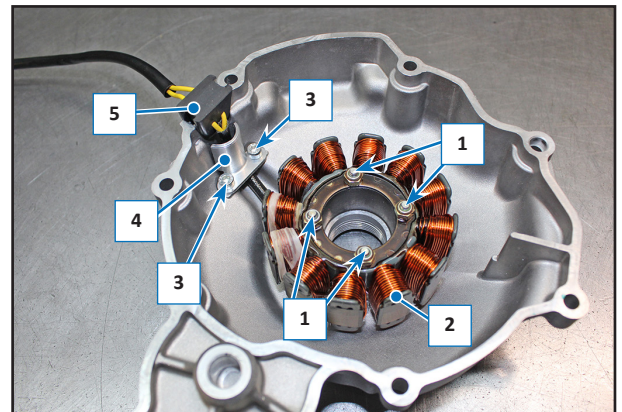
Remove the flywheel cover as described in the relative section.

Unscrew the screws (1) that secure the stator (2).  
Unscrew the screws (3) and remove the stop plate (4).  
Remove the stator (2) with the relative cabling.

### Mounting

Re-mount the stator (2), tightening the screws (1) to a torque value of 5 Nm (0.5 Kgm - 3.68 ft/lb + Loxeal 82-33).

Make sure the rubber cap (5) is fitted correctly on the cover and then tighten the two screws (3) of the stop plate (4) with a torque of 4 Nm (0.4 kgm, 2.95 ft/lb).



## 2.9.3 Pick-up

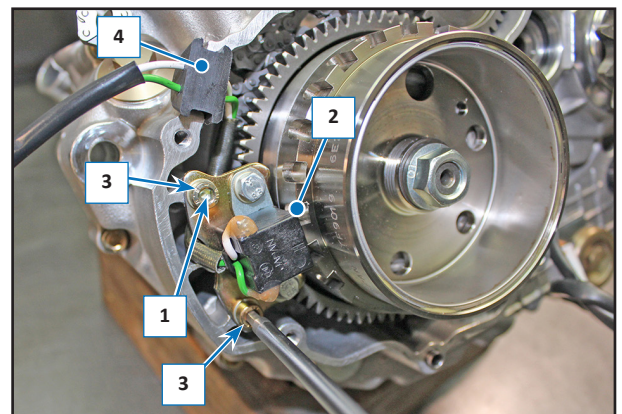
**NOTE:** mark the position of the pick-up so it can be re-mounted in the exact same position.

Unscrew the two screws (1) with relative washers (3) and remove the pick-up (2).

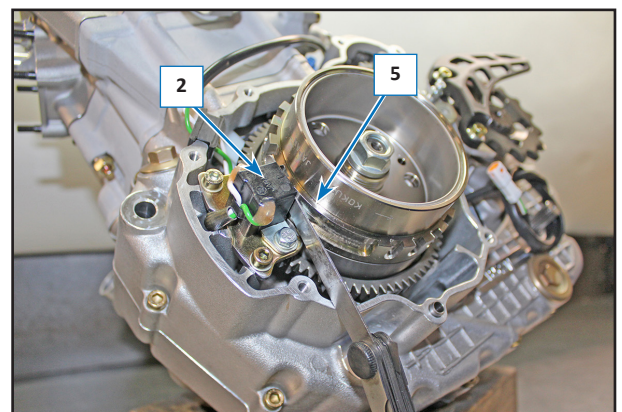
On re-mounting, check that the washers (3) are positioned correctly.

Tighten the two screws (1) with a torque of 8 Nm (0.8 kgm/ 5.9 ft/lb)

Make sure the rubber cap (4) is fitted correctly on the guard.



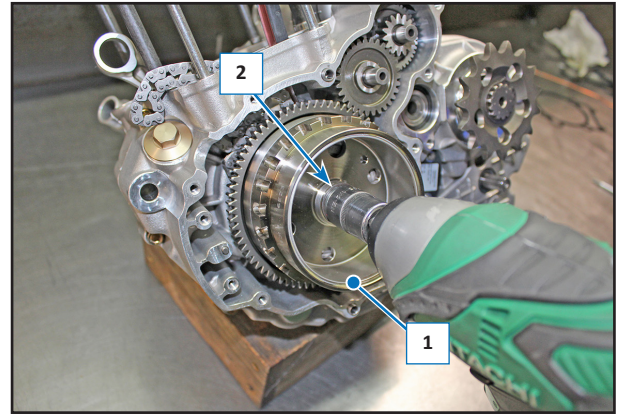
**NOTE:** On re-mounting, check the distance between the pick-up (2) the reference notch (5) of the flywheel is between 0.7-1.0 mm.



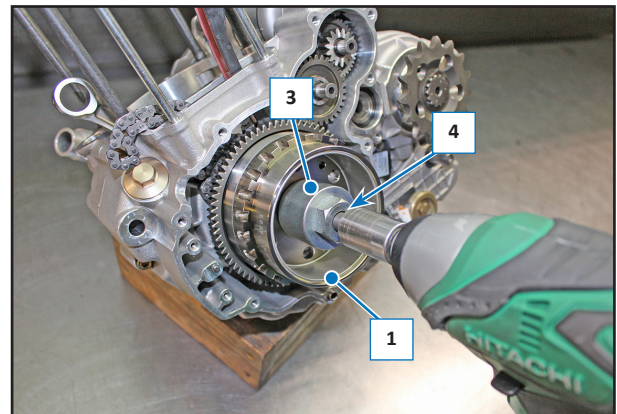
### 2.9.4 Rotor

#### Disassembly

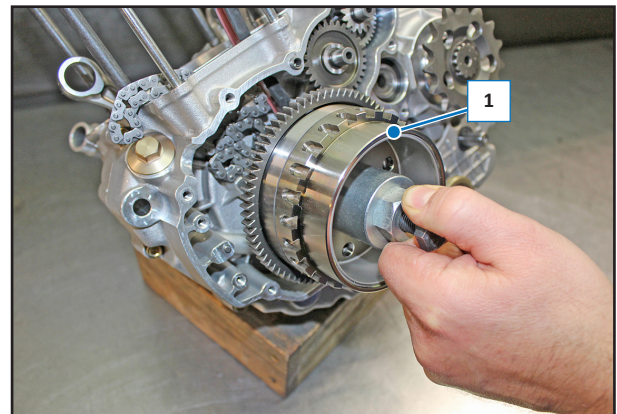
Block rotor rotation (1) and use an impact gun to loosen the nut (2) with relative curve washer.



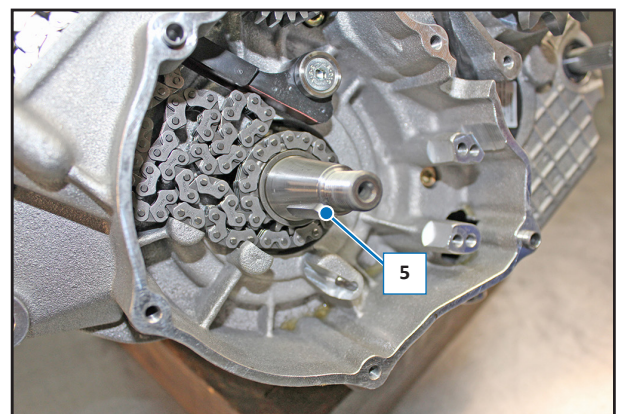
Screw the extractor (3) onto the thread of the rotor (1) and tighten the screw (4) to detach the rotor (1) from the crankshaft.



Remove the complete rotor (1).



Retrieve the key (5).

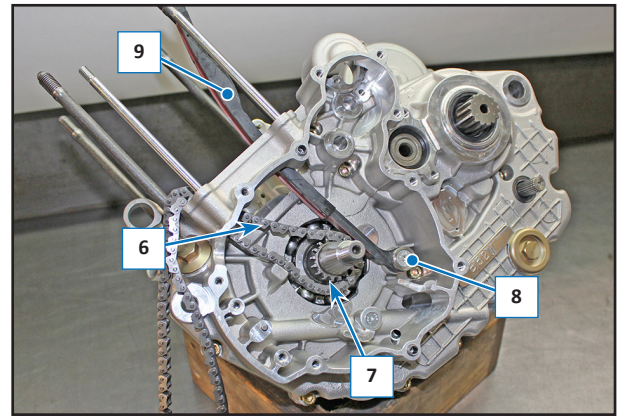


Remove the distribution chain (6).

**NOTE:** Check that the distribution chain (6) and the relative gear (7) on the crankshaft are not worn, otherwise replace (refer to the relative paragraph for replacement of the crankshaft).

**NOTE:** In order to replace the chain (6), the camshafts must be removed, as described in the relative paragraph.

Unscrew the screw (8) and remove the mobile block (9).

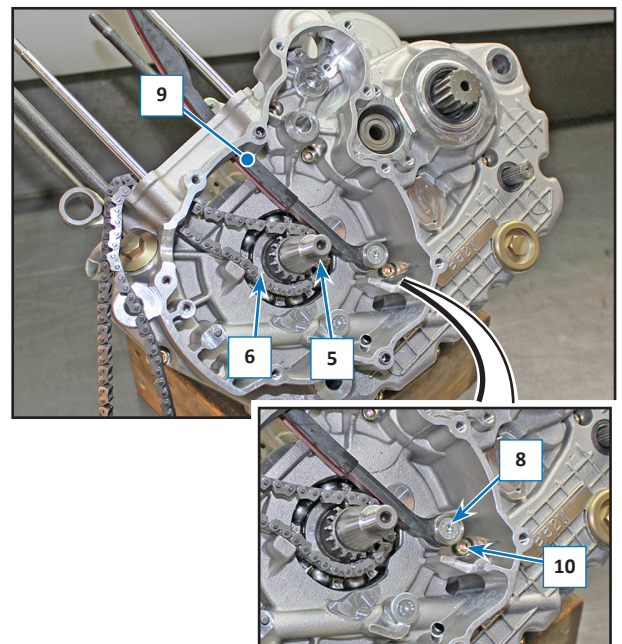


### **Re-mounting**

Re-mount everything, proceeding in the opposite order to disassembly, making sure to: Re-mount the runner (9) with relative spacer (10), tightening the screws (8) with a torque value of 10 Nm (0.1 Kgm - 0.72 ft/lb) +Loxeal 82-33.

Position the distribution chain (6) correctly.

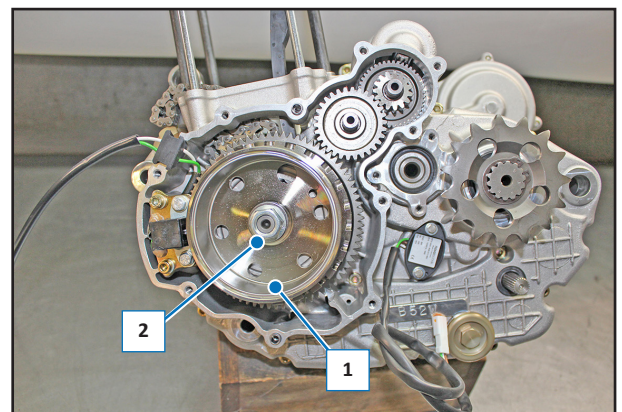
Make sure the key (5) is properly positioned in its housing.



Re-mount the fly wheel (1).

Tighten the nut (2) with relative curve washer with a torque of 60 Nm (6 kgm/ 44.2 ft/lb).

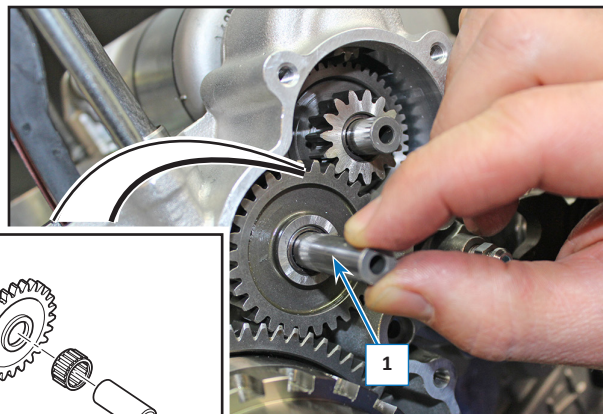
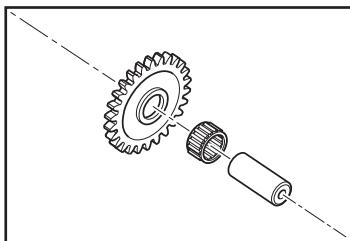
**NOTE:** Do not put Loxeal / Loctite on the rotor fixing thread.



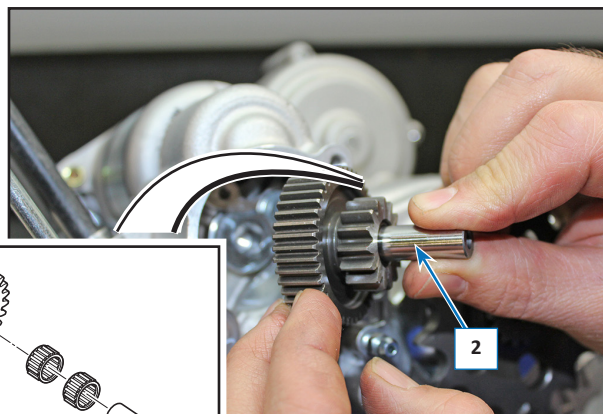
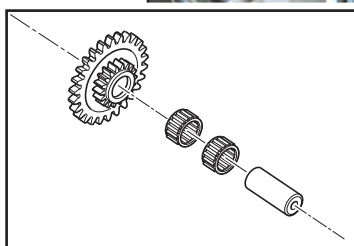
## 2.10 STARTER MOTOR

### 2.10.1 Disassembly

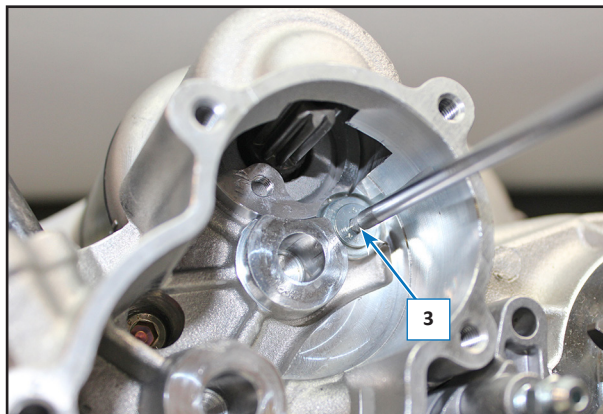
Remove the flywheel cover as described in the relative section.  
Remove the idler (1) with the relative roller bearing cage.



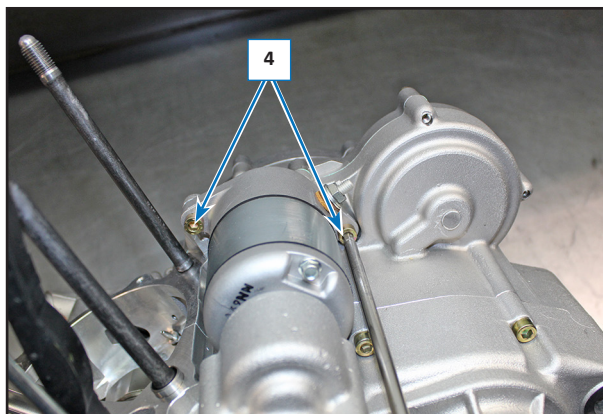
Remove the idler (2) with the relative roller bearing cages.



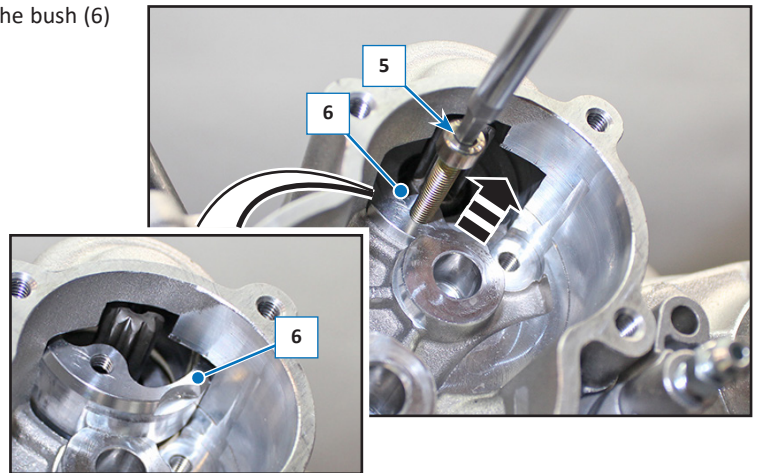
Unscrew the screw (3) and remove it with the relative washer.



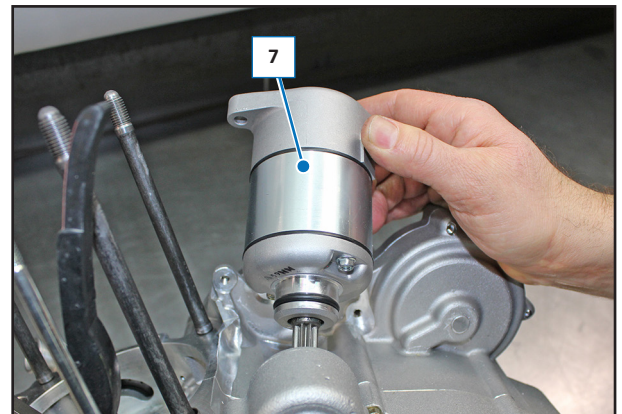
Unscrew the two starter motor fastening screws (4).



Tighten the M5 screw (5) onto the bush (6) and tighten until the bush (6) moves forward.

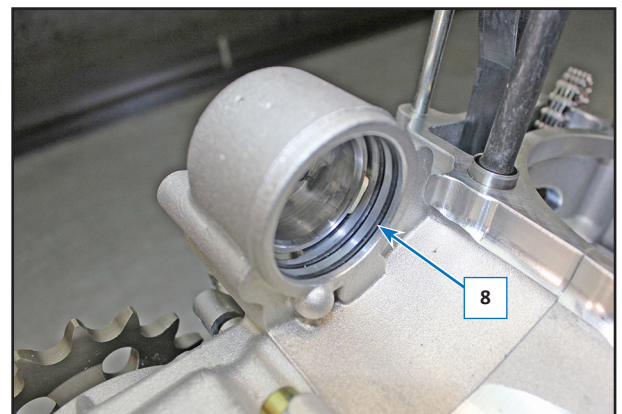


Remove the starter motor (7).



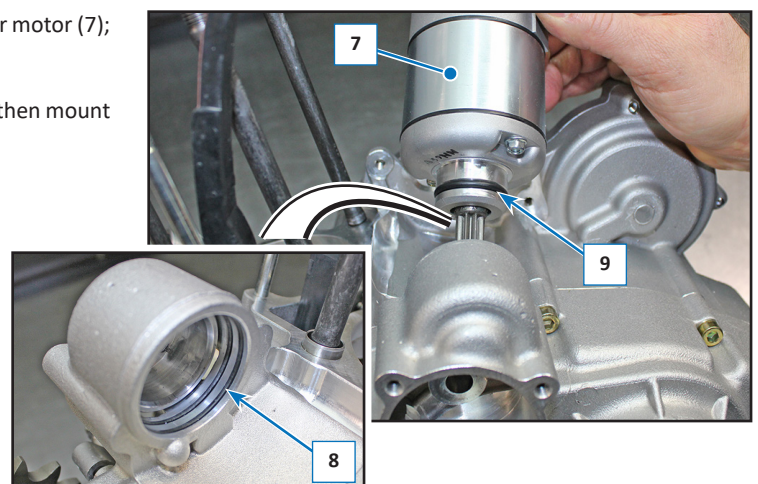
### 2.10.2 Re-mounting

Make sure the “OR” gaskets (8) are not ruined and, if so, replace them.



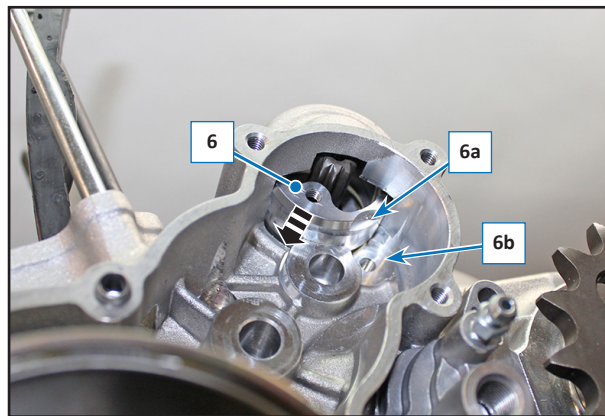
Check the status of the “OR” gasket (9) positioned on the starter motor (7); replace it if ruined.

Lubricate the gasket (9) and the gaskets (8) with engine oil and then mount the starter motor (7).

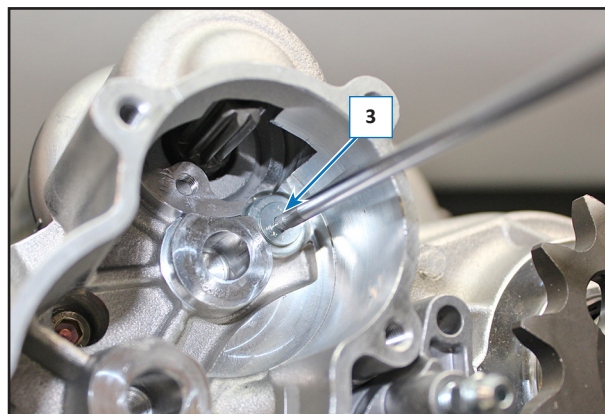


Use an aluminium or brass punch to push the bush (6) towards the inside of the engine, making the milled part coincide (6a) with the screw housing (6b).

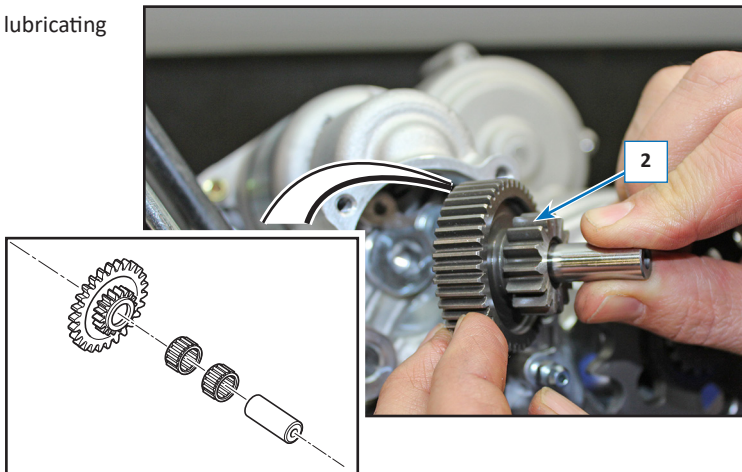
**NOTE:** If the bush (6) is forced, grease abundantly.



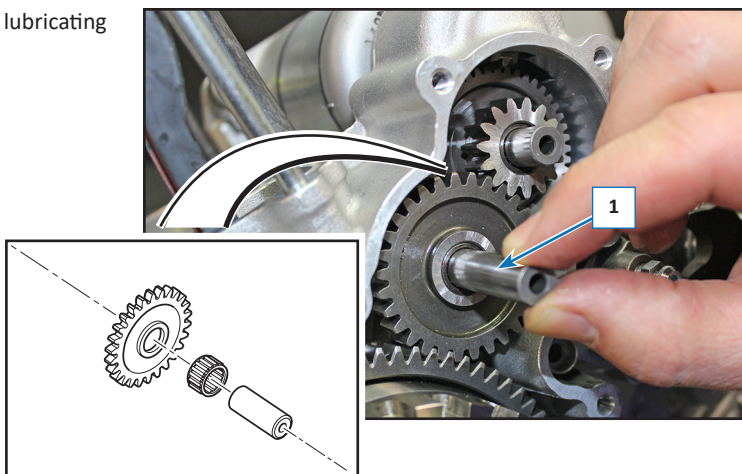
Tighten the screw (3) with relative washer to a torque value of 6 Nm (0.6 Kgm - 4.42 ft/lb) + Loxeal 82-33.



Re-mount the idler (2) with the relative roller bearing cages and lubricating with engine oil.

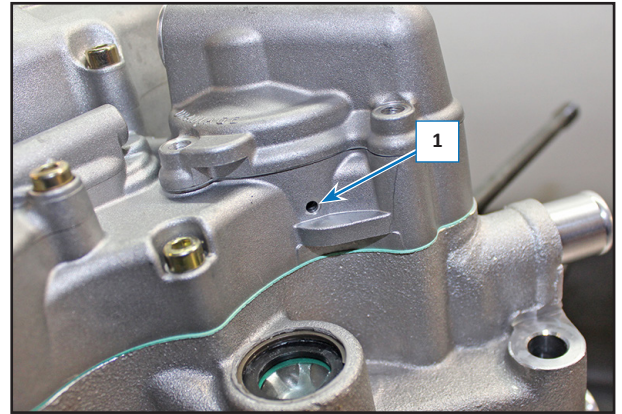


Re-mount the idler (1) with the relative roller bearing cage and lubricating with engine oil.

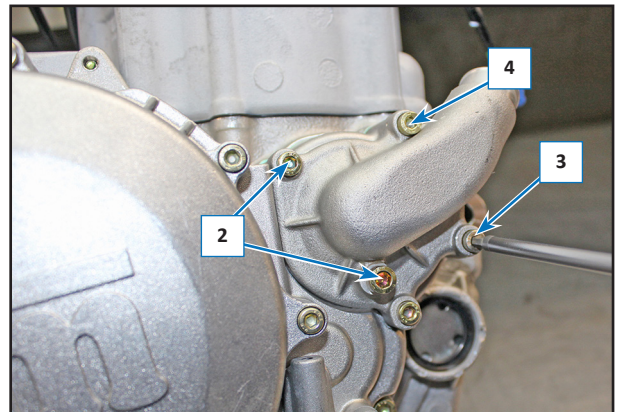


## 2.11 WATER PUMP

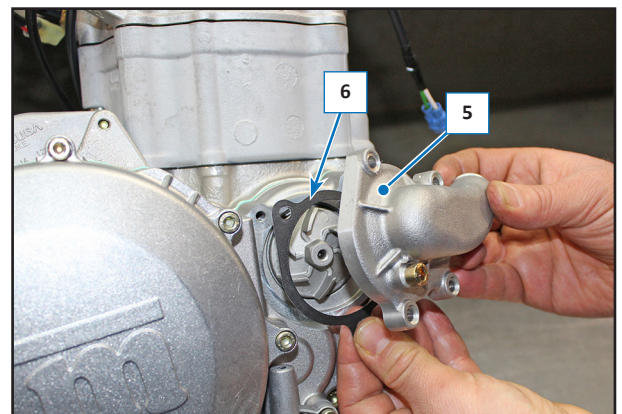
**NOTE:** If water escapes from the little hole (1), the pump seal must be replaced.



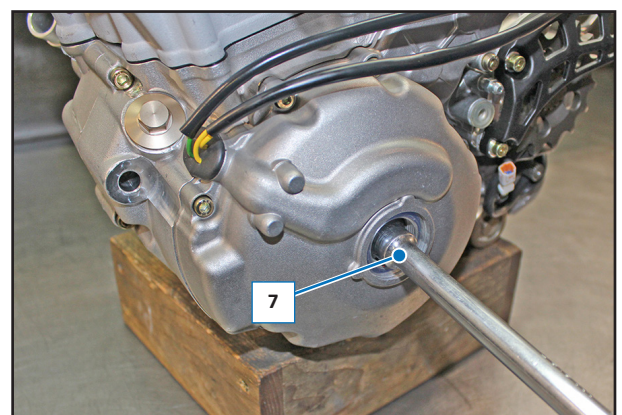
Loosen the screws (2) M5-L25, the screw (3) M5-L55 and screw (4) M5-L50.



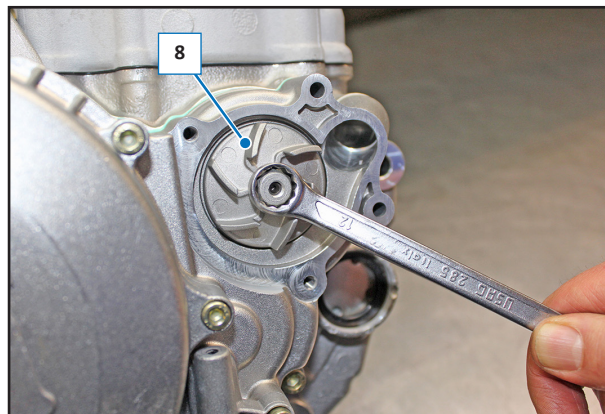
Remove the cover (5) with the relative gasket (6).



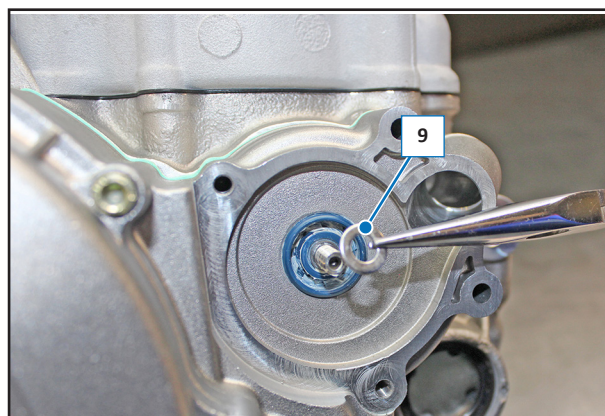
Insert a "T"-shaped wrench (7) through the flywheel cover to block crankshaft rotation.



Loosen the pump impeller (8).



Remove the washer (9).



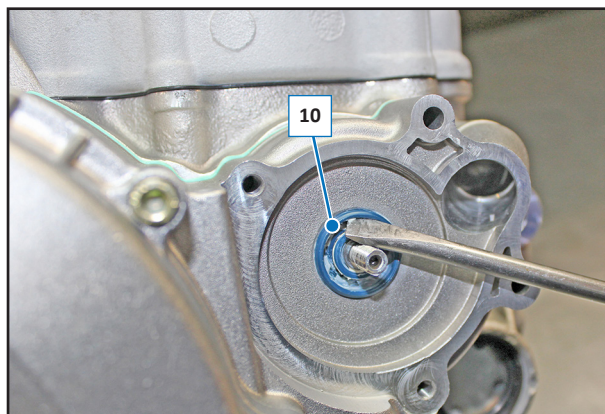
Use a screwdriver to remove the seal (10).

**NOTE:** Replace and lubricate the seal (10) with engine oil before mounting it.

Re-mount the impeller (8) tightening with a torque of 6 Nm (0.6 kgm/ 4.42 ft/lb), greasing the thread.

Re-mount the pump cover (5) checking that the gasket (6) is not ruined; replace it if necessary.

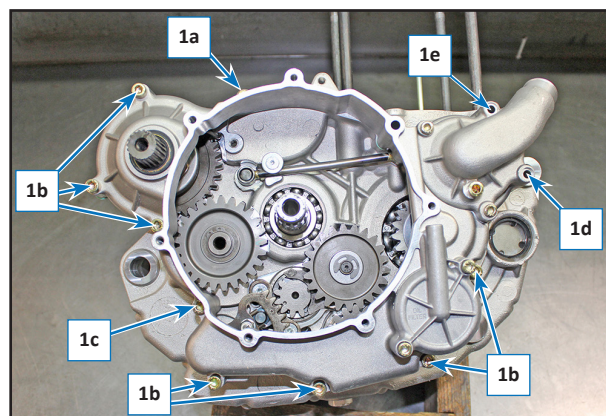
Tighten the screws (2), (3), (4) with a torque of 8 Nm (0.8 kgm/ 5.9 ft/lb)



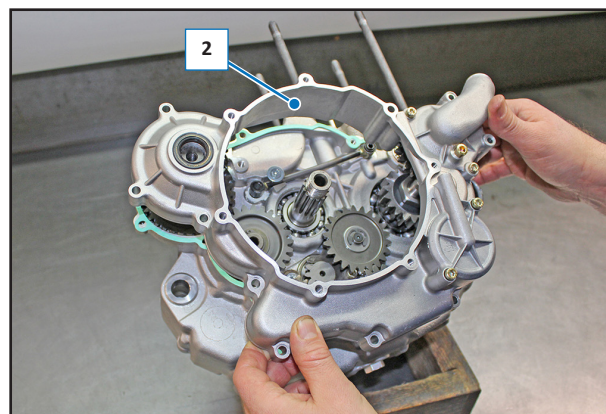
## 2.12 TRANSMISSION GUARD

Unscrew the screws (1):

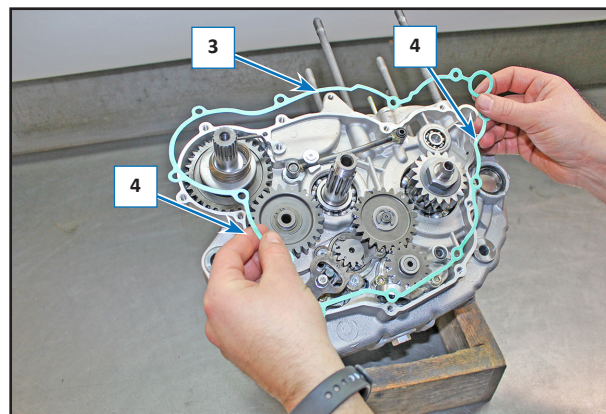
- 1a) M6-L25 screw
- 1b) M6-L30 screw
- 1c) M6-L35 screw
- 1d) M5-L55 screw
- 1e) M5-L50 screw



Remove the guard (2), with the aid of a rubber hammer.

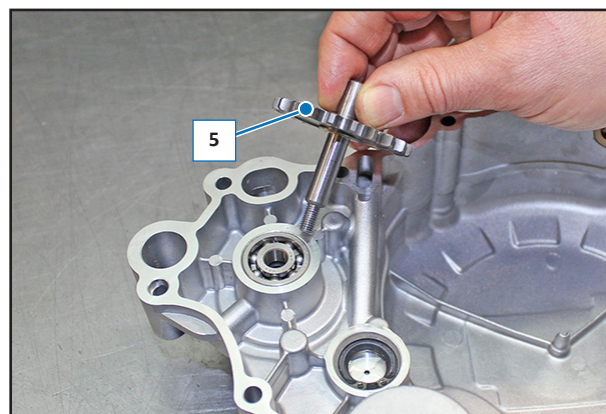


Remove the gasket (3) and recover the two centring bushes (4).



Remove the water pump return (5).

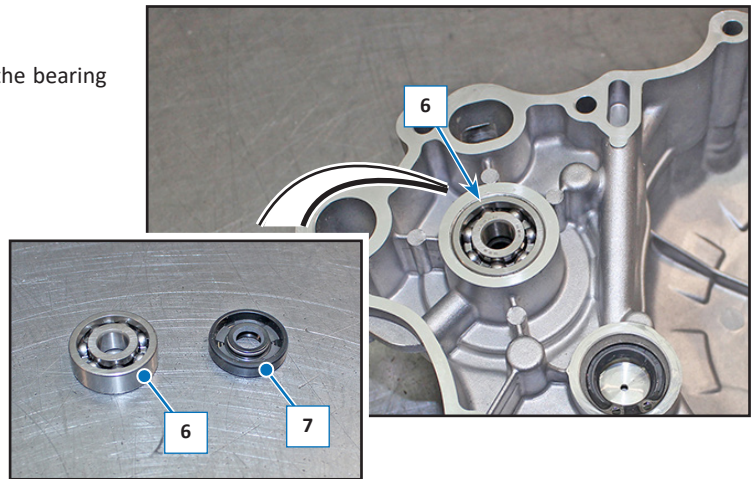
Remove the clutch drum as described in the relative paragraph.



### 2.12.1 Bearing and water pump oil seal removal

Heat the clutch guard to a temperature of 50°C and remove the bearing (6).

**WARNING:** Use suitable personal protection equipment;  
Burns hazard.

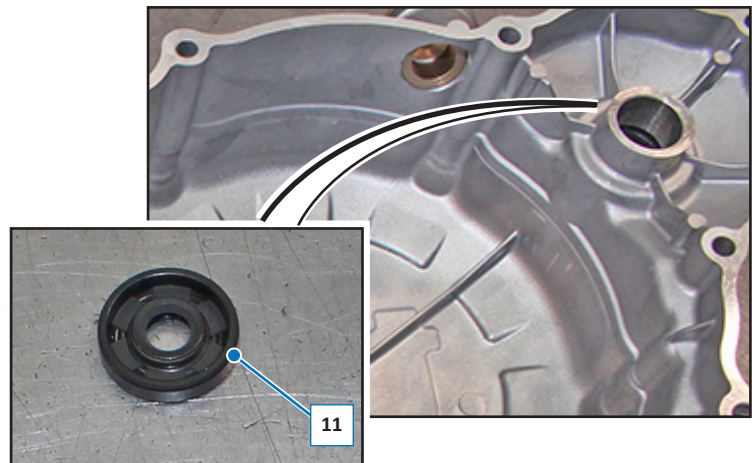


Remove the oil seal (7), operating from the external part of the guard with water pump disassembled.

**NOTE:** On re-mounting, first mount the bearing (6) and then the seal (7), lubricating it with engine oil.

### 2.12.2 Kick start seal removal

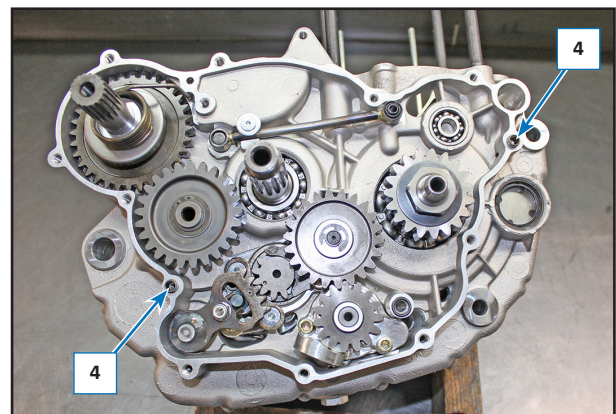
Use a screwdriver to remove the seal (11) and replace it.



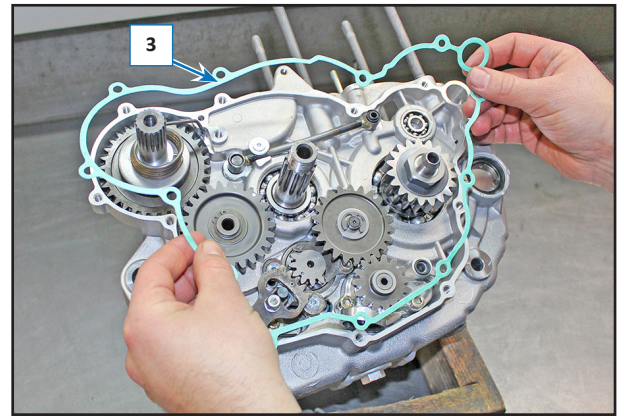
### 2.12.3 Transmission cover re-assembly

Clean the surface of the lid and the semicase from any residues.

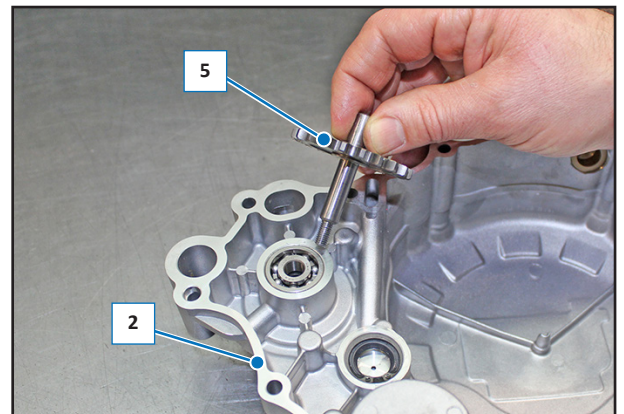
Check that the two centring bushes (4) are in their respective housing.



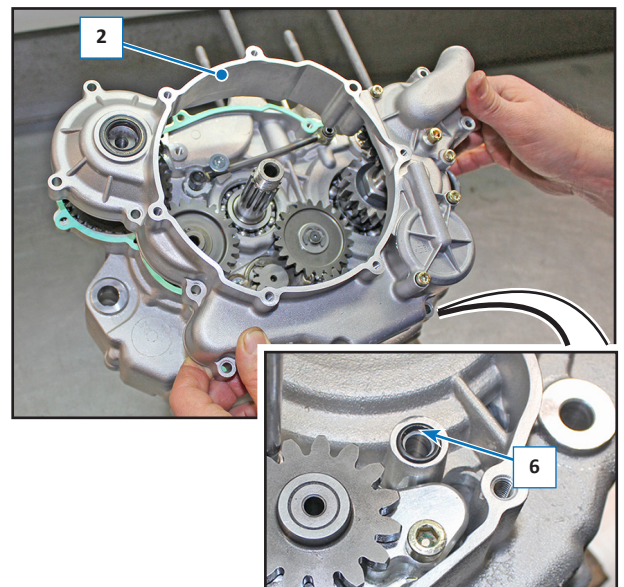
Replace the gasket (3) and re-mount it, applying Threebond 1215 sealant



Mount the water pump return (2) on the cover (5).



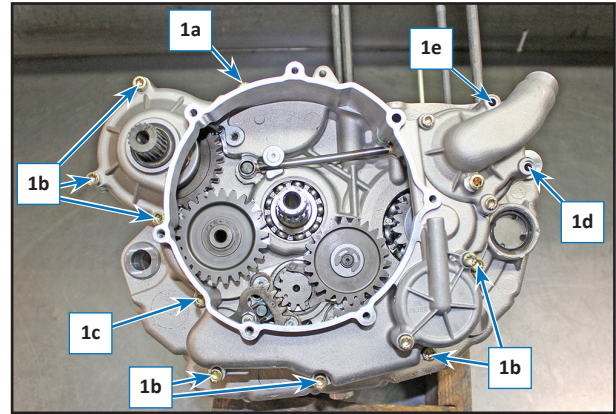
Mount the cover (2), centring it on the bushes (4), paying attention not to ruin the seals and that the OR gasket (6) is present; replace it if ruined.



Tighten the screws (1) crosswise, positioning them in the relative housing, depending on their length.

- 1a) M6-L25 screw
- 1b) M6-L30 screw
- 1c) M6-L35 screw
- 1d) M5-L55 screw
- 1e) M5-L50 screw

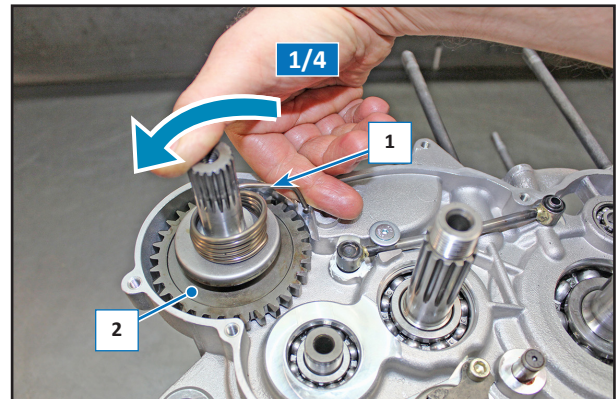
First screw without tightening and then tighten screws (1a), (1b) with a torque of 10 Nm (1.0 kgm, 7.37 ft/lb), (1c) while screws (1d) and (1e) to 8 Nm (0.8 kgm, 5.9 ft/lb).



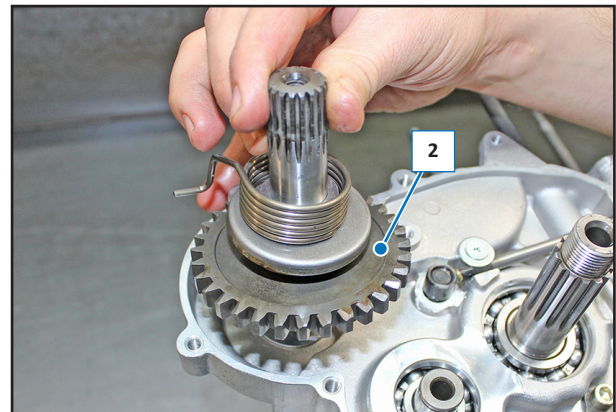
## 2.13 IDLE KICK STARTER REMOVAL (ONLY K.S.)

Remove the transmission cover and the clutch bell as described in the relative paragraphs.

Release the spring (1) from the relative housing, turn the starter (2) anti-clockwise by 1/4 of a turn.

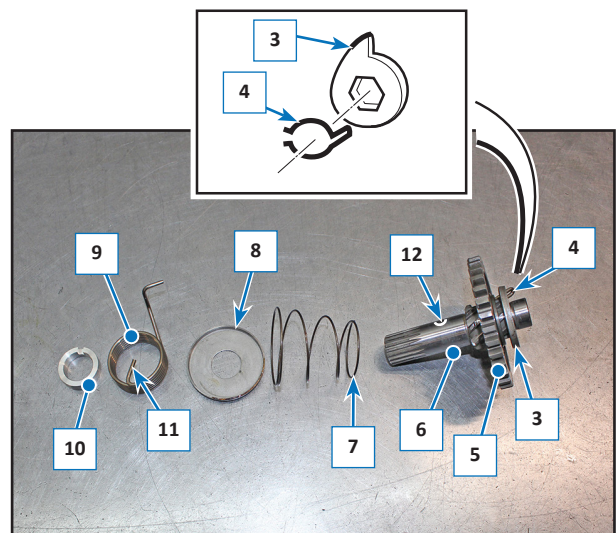


Remove the starter (2) complete with all components.



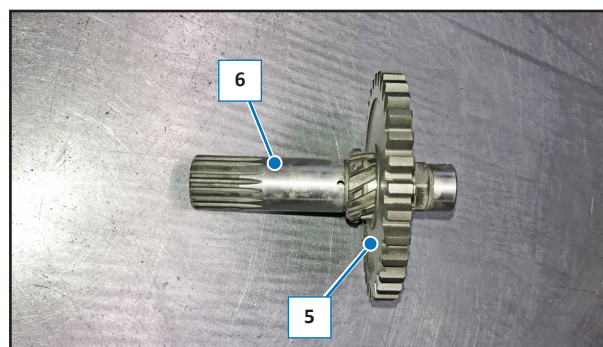
### 2.13.1 Starter dismantling

In sequence, remove the stop lever (3), the spring (4), the sliding gear (5), the shaft (6), the contrast spring (7), the spring plate (8), the spring (9) and the spring spacer (10).

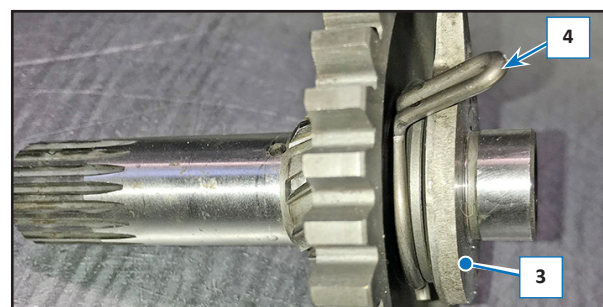


### 2.13.2 Starter re-mounting

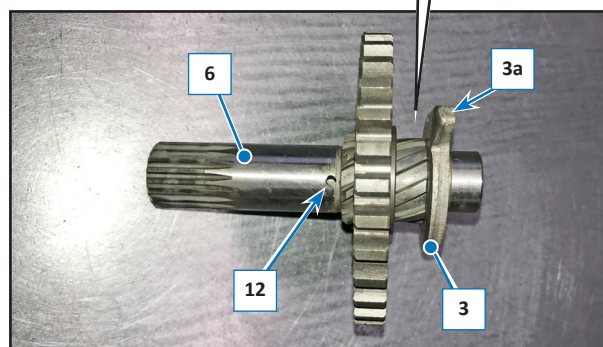
Insert the sliding gear (5) onto the shaft (6).



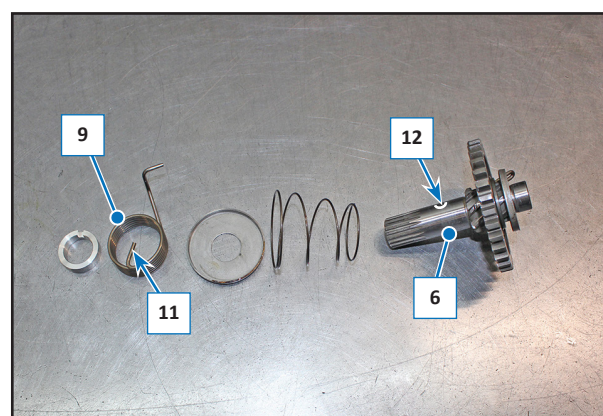
Insert the spring (4).



Insert the lever (3) fully home on the shaft (6), in a way that the arm (3a) of the lever (3) is perpendicular to the hole (12) in the shaft (6).



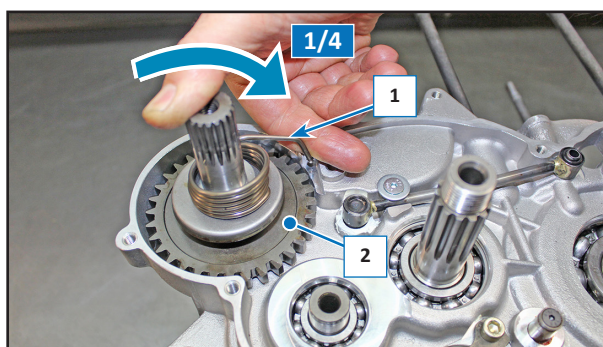
Re-assemble in reverse order to dismantling, paying attention to positioning the pin (11) of the spring (9) in the relative hole (12) on the shaft (6).



### 2.13.3 Idle starter re-mounting

Re-mount the idle kick start in the relative housing and then turn the starter (2) clockwise by 1/4 of a turn and insert the pin (1) in the hole in the guard.

**NOTE:** Lubricate the fitting hole abundantly with graphite grease.



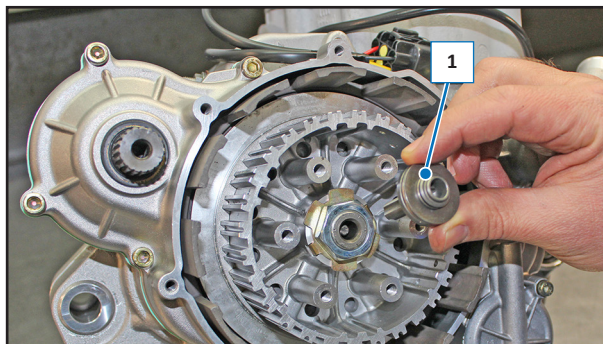
## 2.14 DRUM AND CLUTCH BELL

### 2.14.1 Disassembly

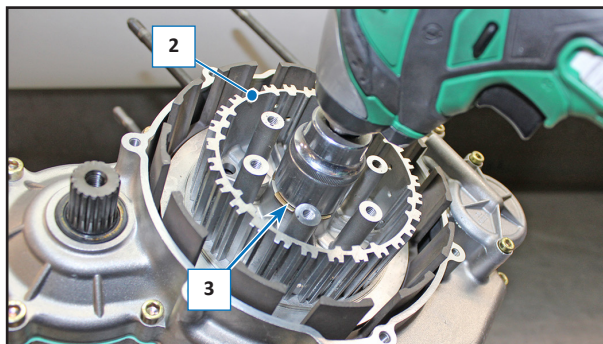
Remove the transmission cover as described in the relative paragraph.

Remove the clutch discs as described in the relative paragraph.

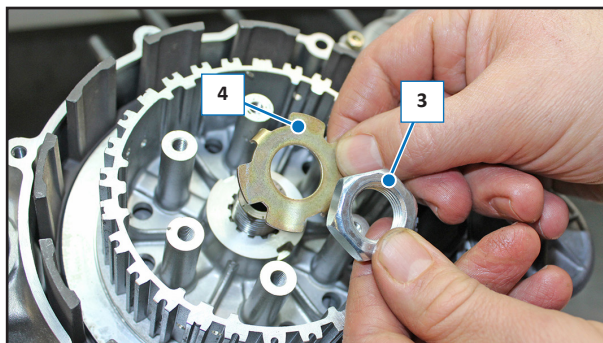
Remove the clutch mushroom (1).



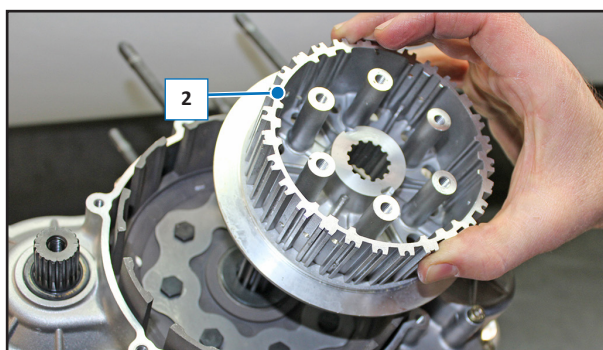
Use a spanner to block rotation of the clutch drum (2) and tighten the nut (3).



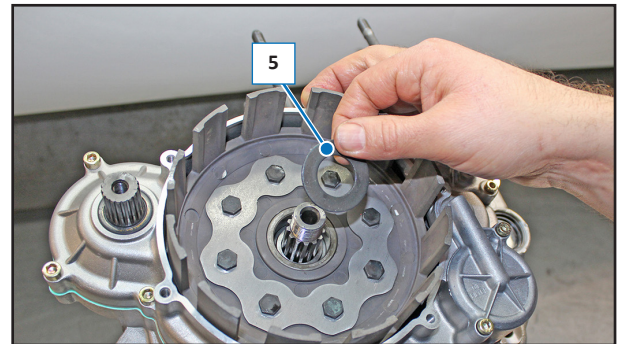
Remove the safety washer (4).



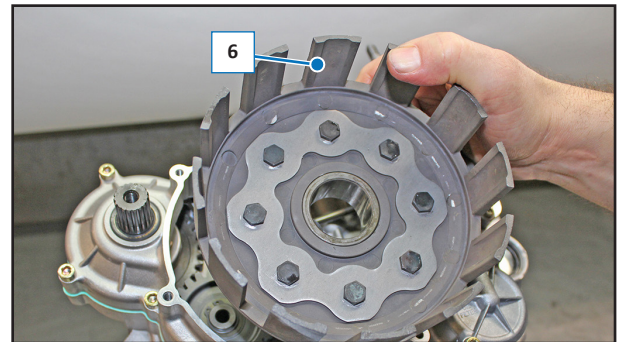
Remove the drum (2).



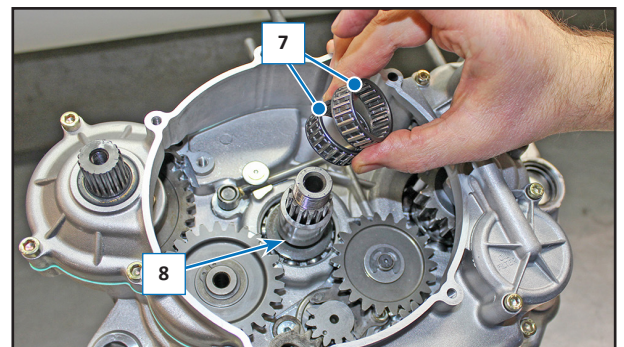
Remove the washer (5).



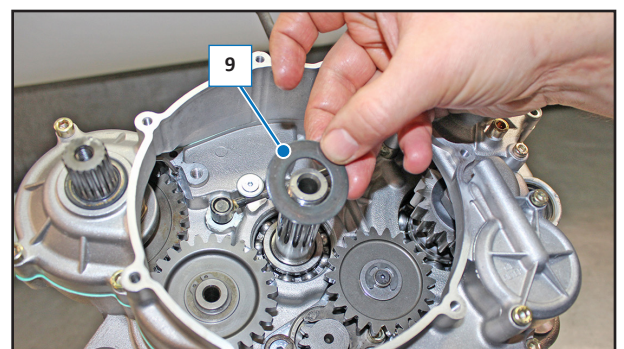
Remove the bell (6).



Remove the two roller bearings (7) and the spacer (8).



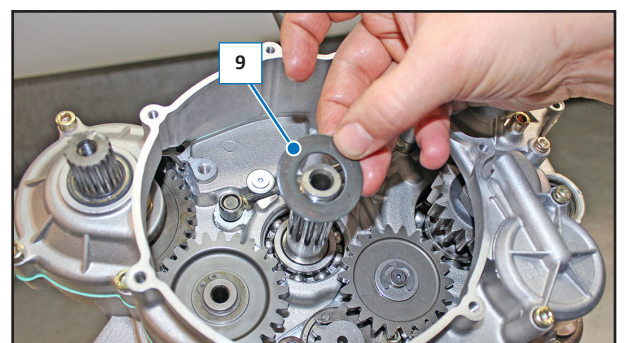
Remove the washer (9).



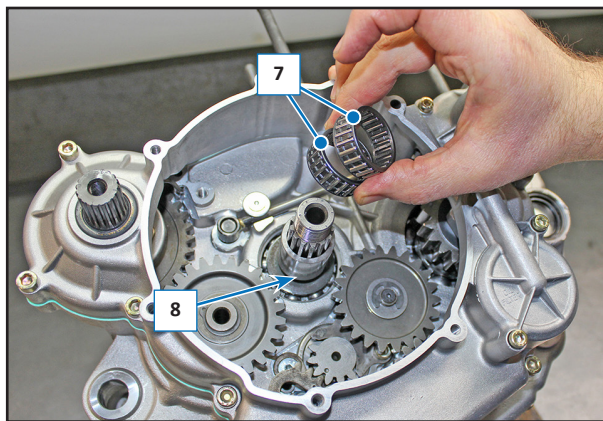
### 2.14.2 Re-mounting

Insert the washer (9).

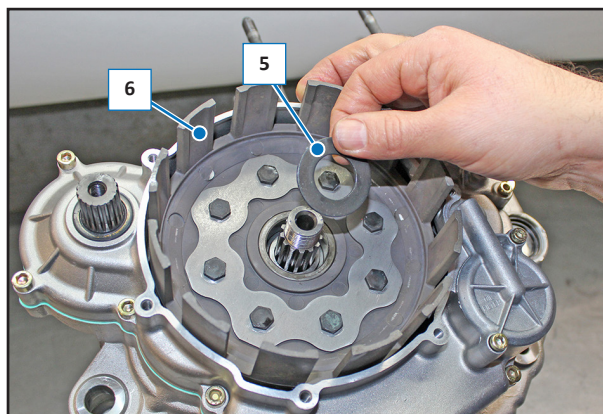
Re-mount everything, proceeding in the reverse order to disassembly.



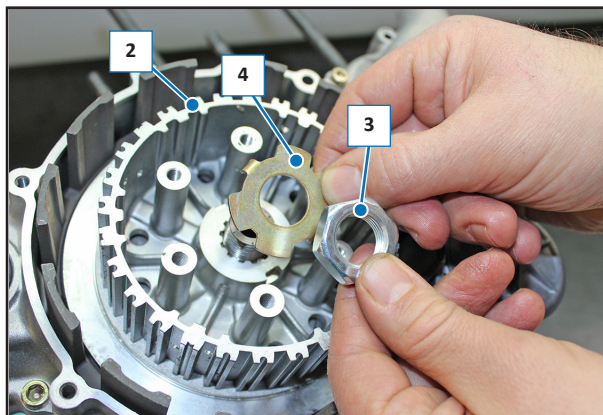
Make sure that the spacer (8) and ball bearings cage (7) are re-mounted correctly and lubricate them with engine oil.



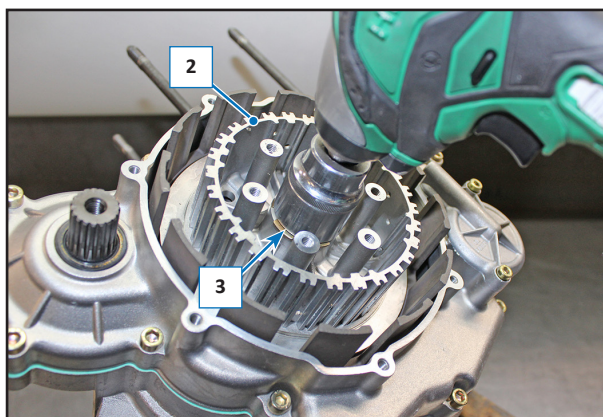
Re-mount the bell (6) with the relative washer (5).



Re-mount the drum (2), make sure that the safety washer (4) and the nut (3) are positioned correctly.



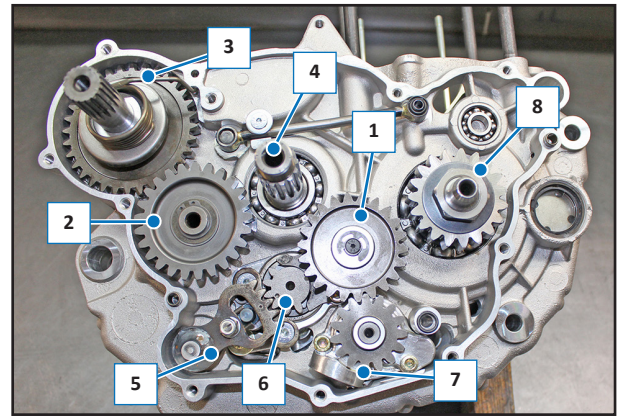
Screw the nut (3), blocking drum rotation with a spanner, with torque of 100 Nm 10.0 kgm 73.75 ft/lb. + strong threadlocker (green).



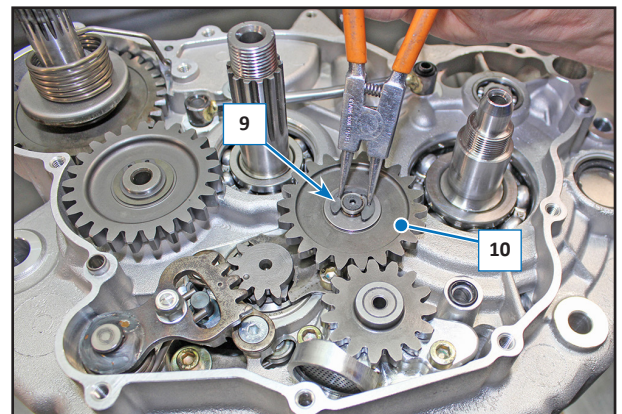
## 2.15 TRANSMISSION SIDE COUNTER GEARS

Components layout:

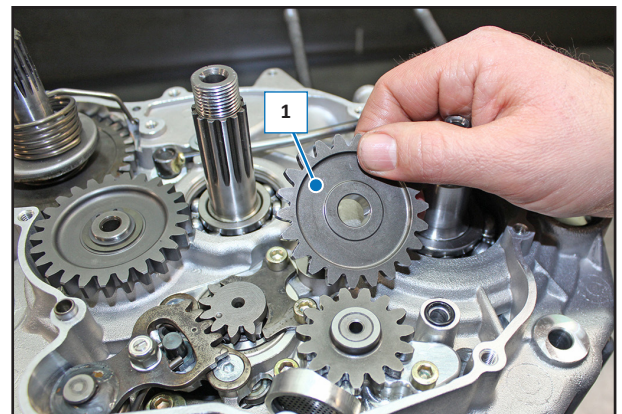
- 1) Oil pump return gear.
- 2) Idle gear kick starter removal.
- 3) Kick starter (only for K.S.).
- 4) Gearbox primary shaft.
- 5) Gearbox command shaft.
- 6) Ratchet-holder gear.
- 7) Oil pump.
- 8) Crankshaft gear.



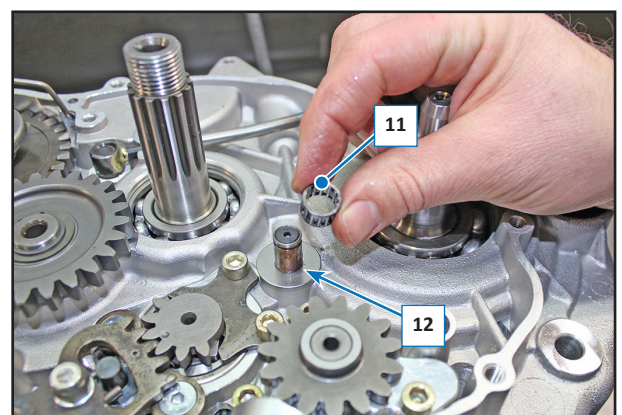
Remove the seeger (9) and the washer (10).



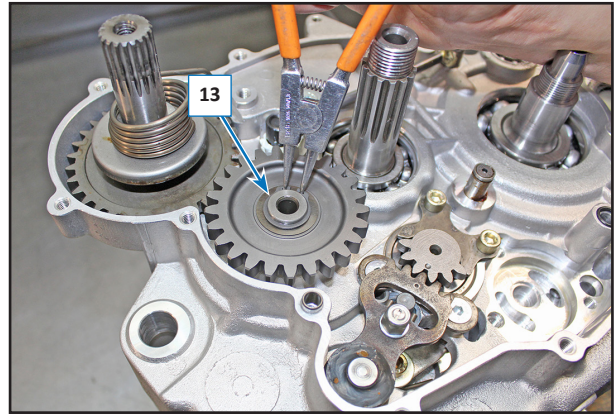
Remove the oil pump return gear (1).



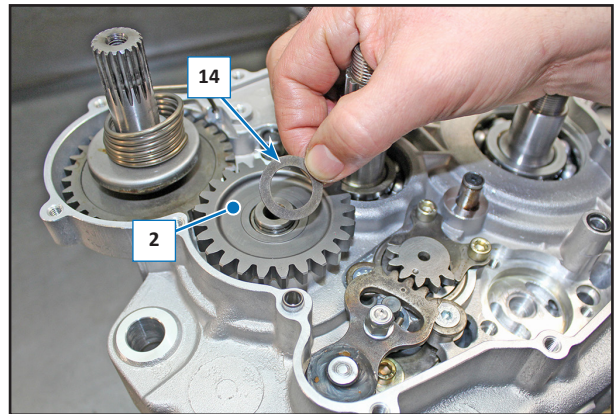
Remove the roller bearing cage (11) and the washer (12).



Remove the seeger (13).

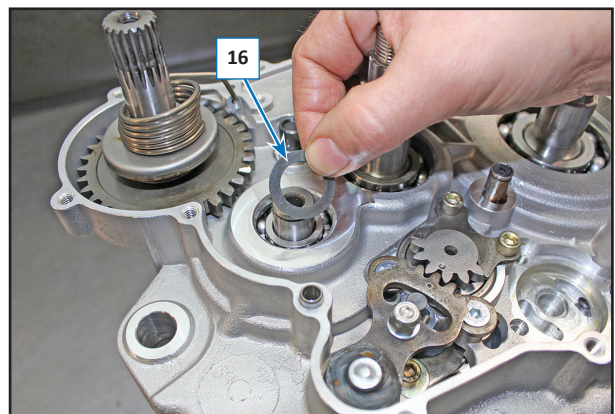
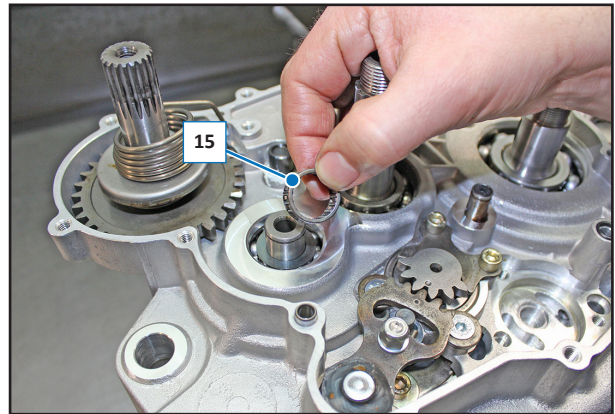


Remove the shim (14) and the gear (2).



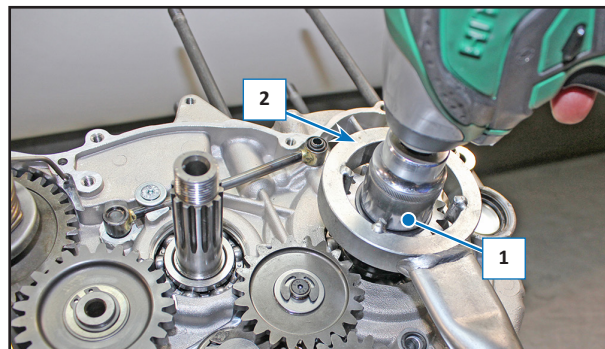
Remove the roller bearing cage (15) and the shim (16).

**NOTE:** To re-mount the gears and relative roller bearing cages, proceed in reverse order to disassembly and lubricate with engine oil.

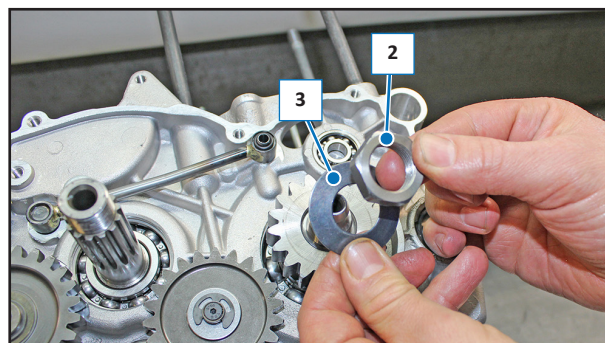


## 2.16 CRANKSHAFT GEAR REMOVAL

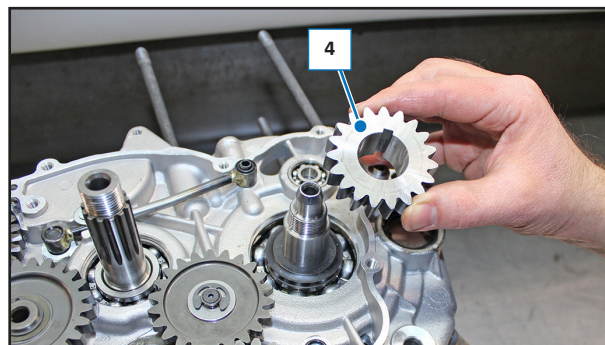
Insert the tool (1) to block rotation of the crankshaft and unscrew the nut (2).



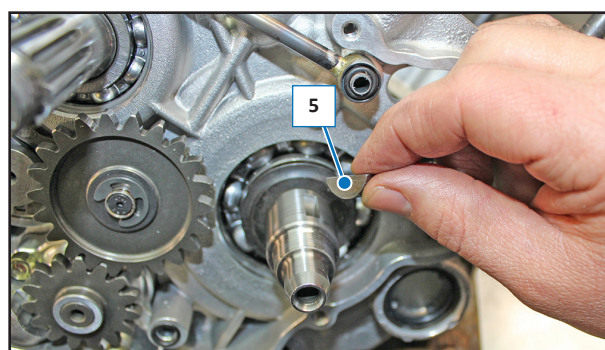
Remove the washer (3) and the nut (2).



Remove the gear (4).

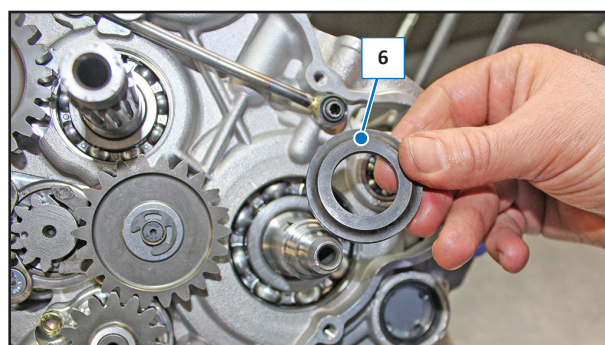


Remove the key (5).



Remove the spacer (6).

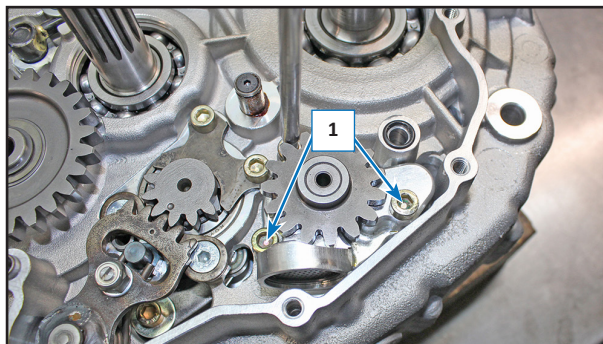
**NOTE:** Check that the spacer (6) is positioned with the flat part towards the spacer. On re-mounting the gear (4), tightening the nut (2) to a torque value of 100 Nm (10 Kgm - 73.75 ft/lb) + Loxeal 82-33. Blocking crankshaft rotation with the relevant tool (1).



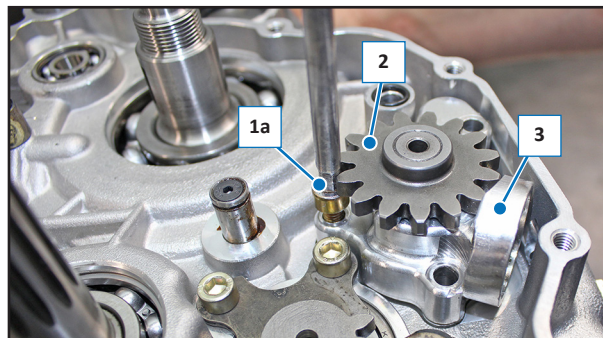
## 2.17 OIL PUMP REMOVAL

Remove the clutch bell and the oil pump return gear, as described in the relevant paragraphs.

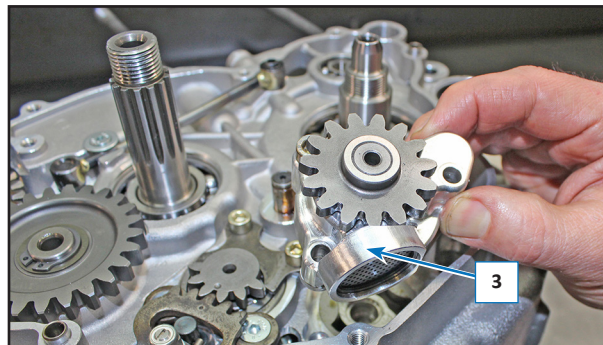
Unscrew the screws (1).



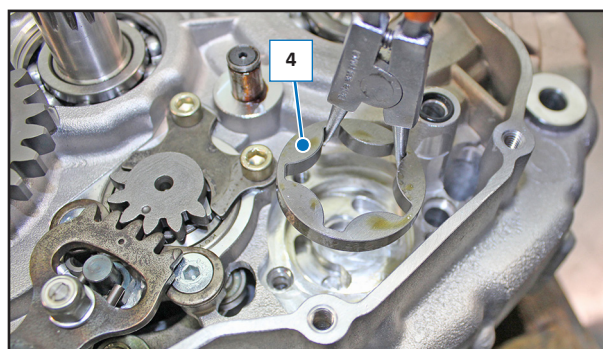
Loosen the screw (1a), which forcing on the gear (2) operates as extractor, facilitating removal of the pump (3)



Remove the pump (3) by lifting it.

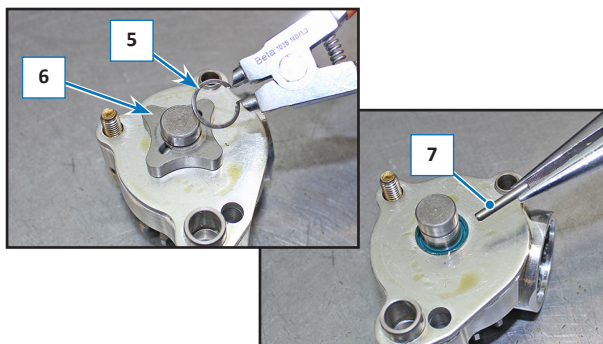


Remove the external sector (4).

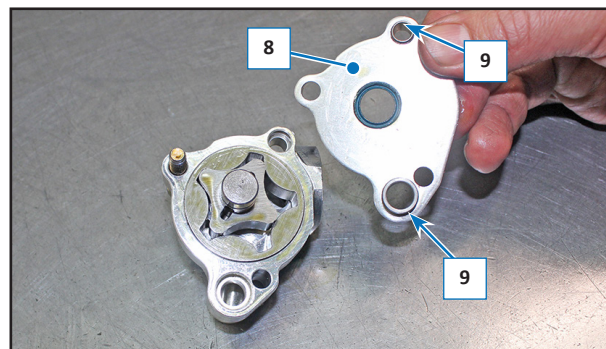


Remove the lock ring (5) of the internal sector (6).

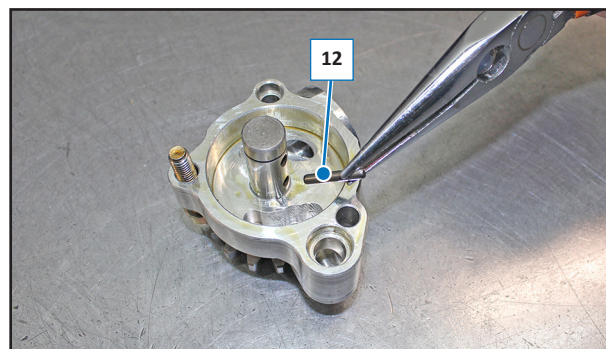
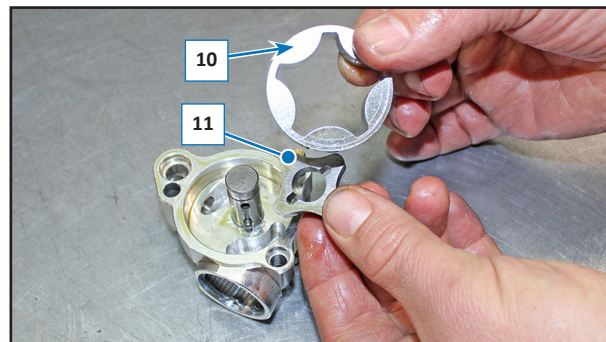
Remove the dragging pin (7).



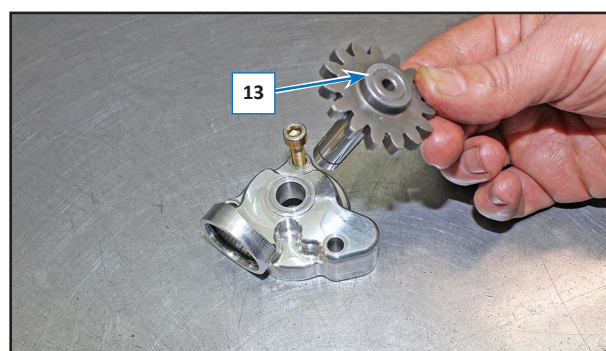
Remove the separation plate (8), recovering centring bushings (9).



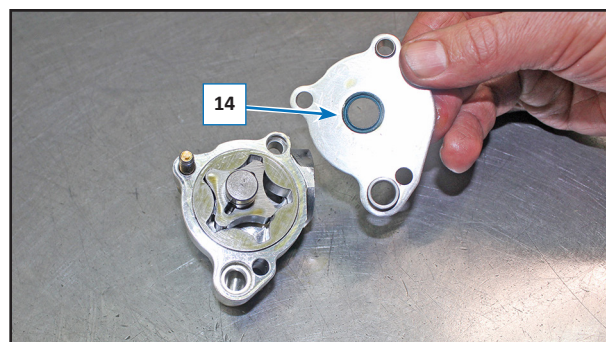
Remove the two internal sectors (10), (11) and the dragging pin (12).



Remove the gear with the shaft (13).



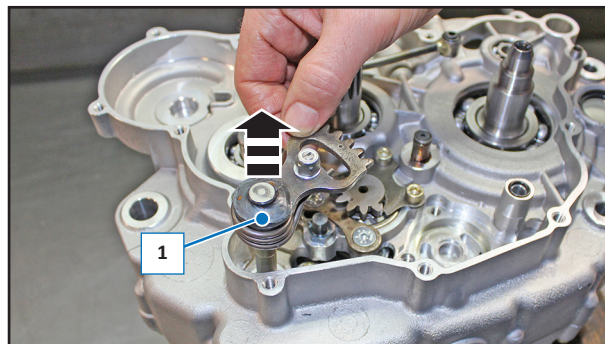
**NOTE:** On re-mounting, lubricate with engine oil and check that the dragging pins are correctly mounted and tighten the screws (1) with torque of 8 Nm (0.8 Kgm, 5.79 ft/lb). Check that the seal (14) is not ruined, otherwise replace it.



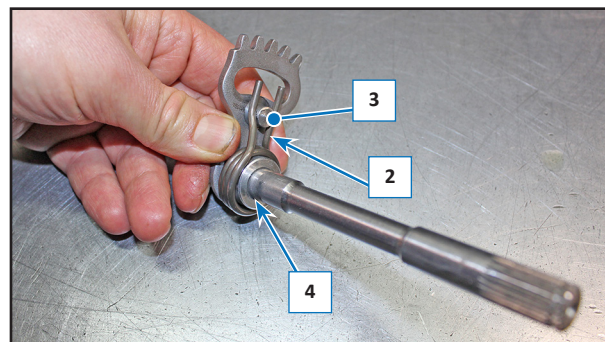
## 2.18 GEARBOX COMMAND SHAFT REMOVAL

Remove the transmission guard as described in the relative paragraph.

Lift the shaft (1) and extract it from the engine.

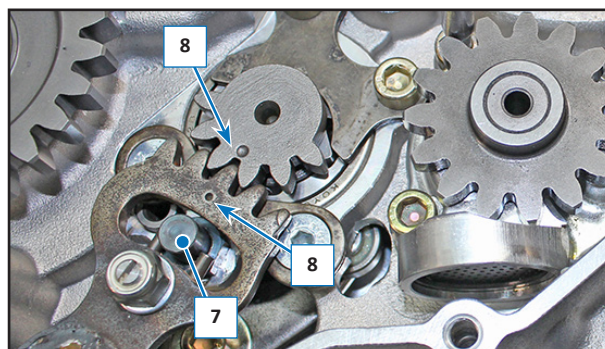
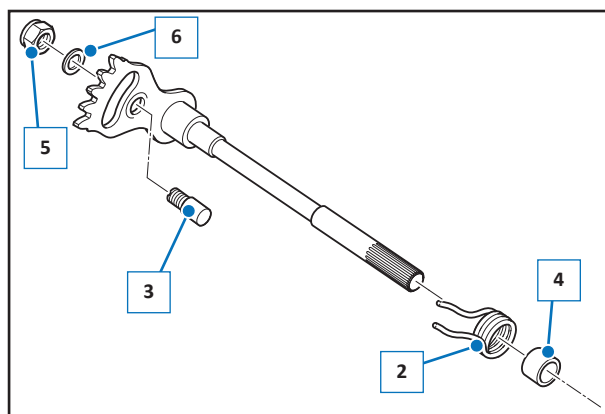


If it must be dismantled, release the spring (2) from the contrast pin (3) and remove it with the relative bush (4).



To remove the pin (3) loosen the nut (5) with relative washer (6).

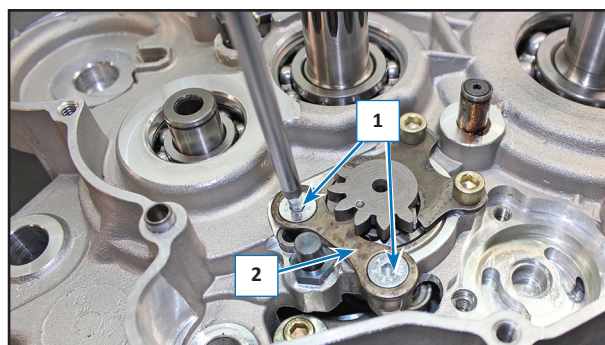
**NOTE:** To re-mount, proceed in reverse order to the disassembly operations, paying attention that the spring (2) inserts correctly into the pin (7) fixed on the engine guard and that the two timing bolts (8), one on the shaft and the other on the ratchet-holder gear, are aligned.



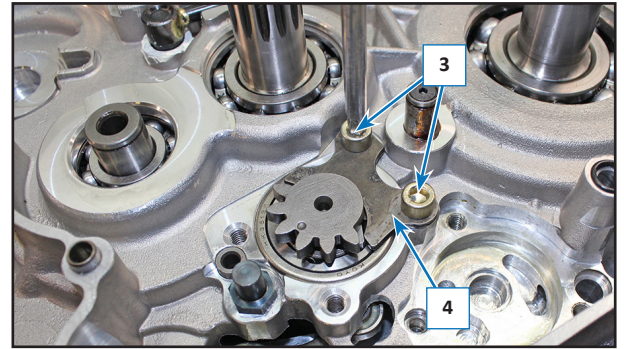
## 2.19 RATCHET-HOLDER GEAR REMOVAL

Remove the gearbox command shaft and the oil pump return gear, as described in the relevant paragraphs.

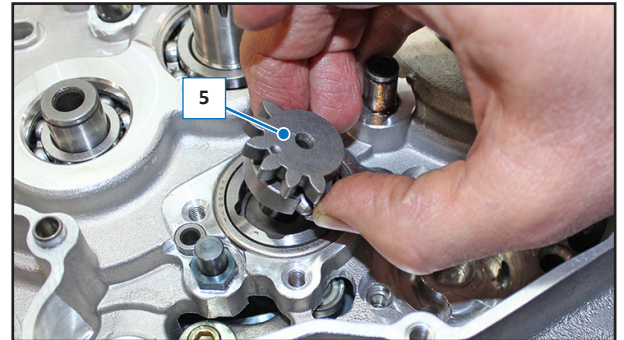
Unscrew the two screws (1) and remove the plate (2).



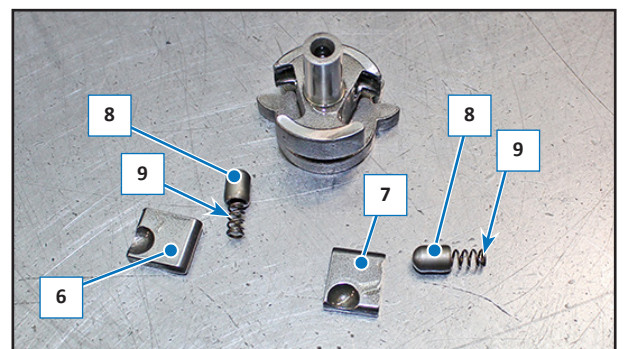
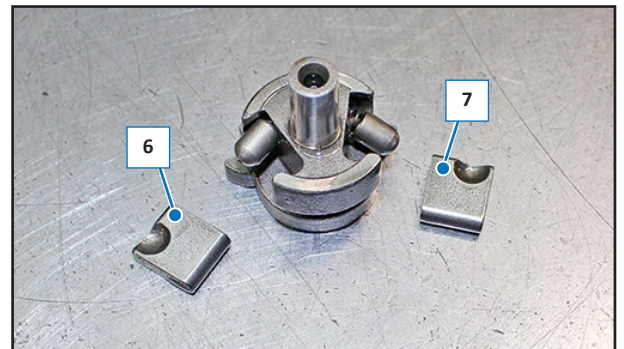
Unscrew the two screws (3) and remove the plate (4).



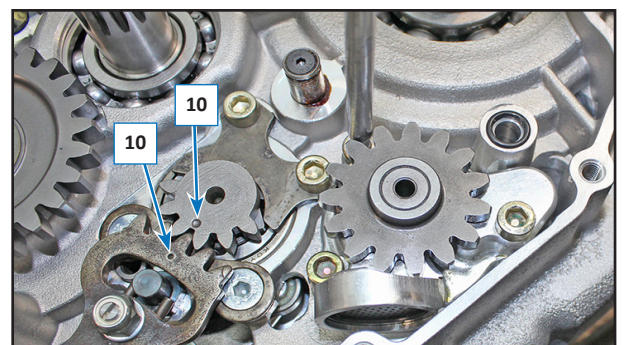
Lift and remove the Ratchet-holder gear (5).



Dismantle the ratchets (6) and (7) with the relative tips (8) and springs (9).



**NOTE:** On re-mounting, make sure the ratchets (6) and (7) are inserted correctly in the relative housing; they cannot be inverted. Re-mount everything in reverse order to the disassembly operations, checking that the two timing bolts (10), one on the shaft and the other on the ratchet-holder gear, are aligned. Tighten the screw (1) with a torque of 10 Nm (1.0 kgm, 7.37 ft/lb) and screws (3) with a torque of 10 Nm (1.0 kgm, 7.37ft/lb) + medium threadlocker (blue).



## 2.20 SEMICASE

Remove the heating unit as described in the relevant paragraph.

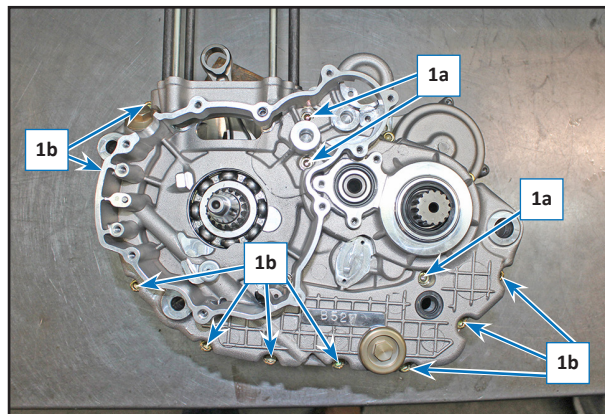
Remove all parts on the flywheel side and transmission side as described in the relative paragraphs.

### 2.20.1 Aperture

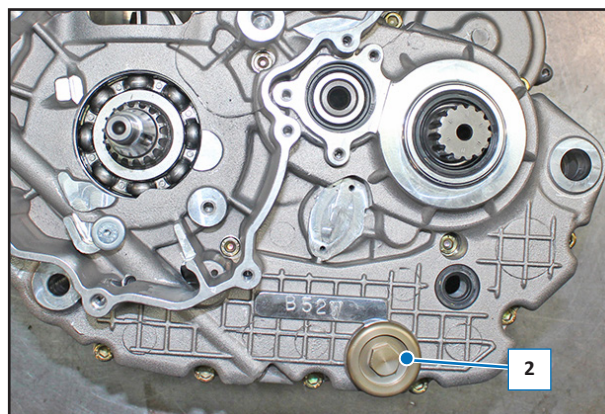
Unscrew the screws (1):

1a) M6-L45 screw

1b) M6-L35 screw

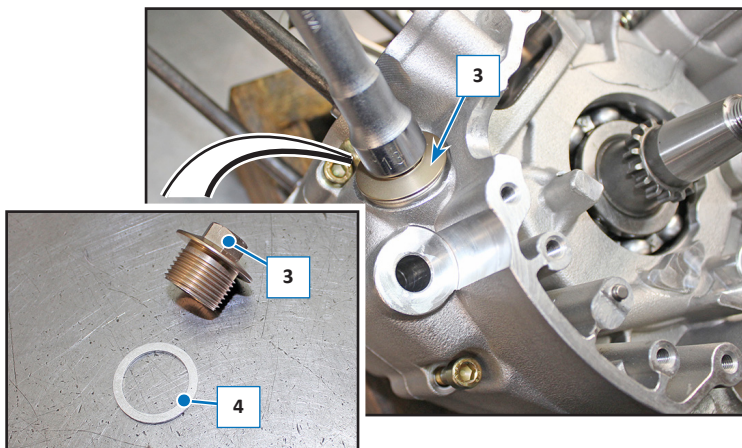


Remove the cap (2) with the filter, as prescribed in the relative paragraph.

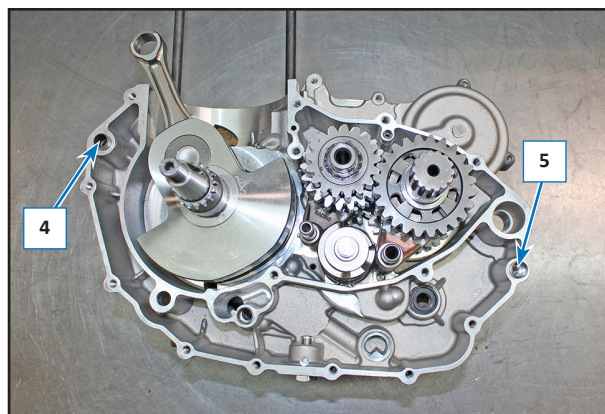


Unscrew the cap (3), recovering the aluminium washer (4).

Use a rubber hammer to open the two semicases.



Retrieve the two bushes (4) and (5).



### 2.20.2 Re-assembly

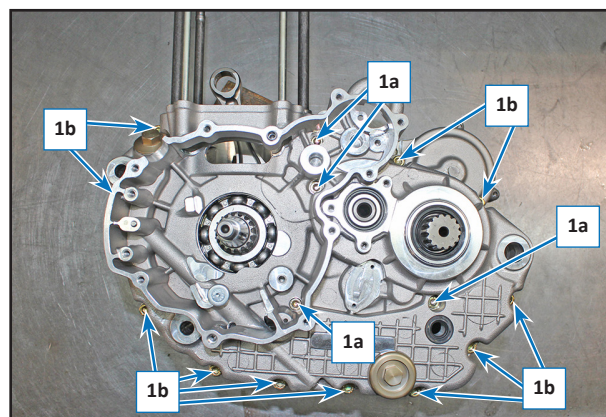
Check that all components are correctly positioned in their housing and that the centring bushes (4) and (5) are mounted.

Clean the contact surface from any residual sealant paste and then spread a Treebond type sealing paste.

Re-position the screws (1) in the relative housing depending on their length and tighten them with torque of 12 Nm (1.2 kgm, 8.68 ft/lb):

1a) M6-L45 screw

1b) M6-L35 screw

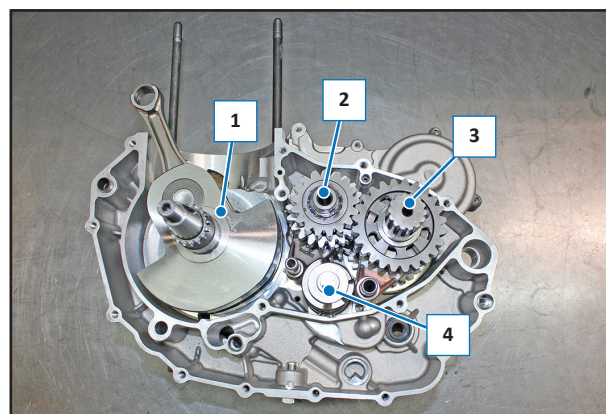


## 2.21 CRANKSHAFT, GEARBOX, GEARS DRUM

Open the guards as indicated in the relative section.

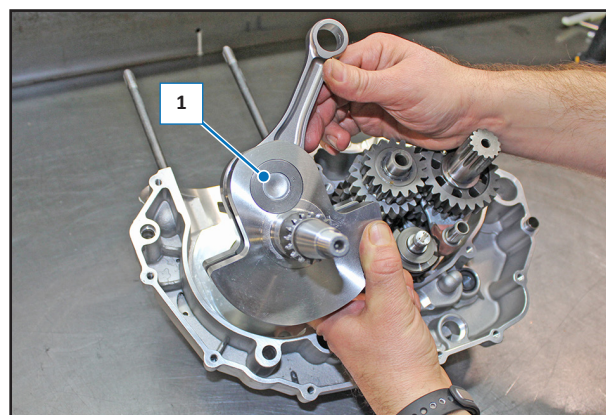
### 2.21.1 Components position

- 1) Crankshaft
- 2) Gearbox primary shaft
- 3) Gearbox secondary shaft
- 4) Gears selector drum



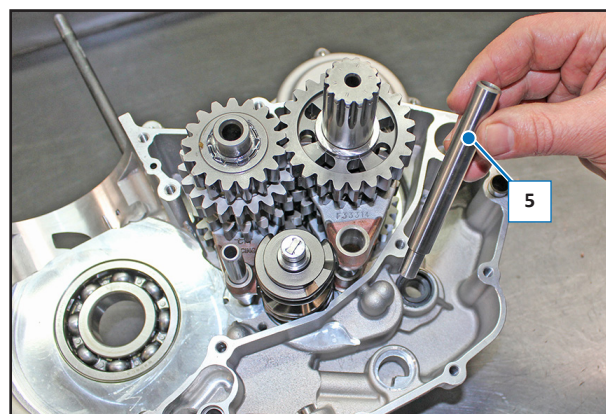
### 2.21.2 Crankshaft removal

Slide the complete crankshaft (1) from the semicase. If necessary, heat the bearing to facilitate removal of the crankshaft.

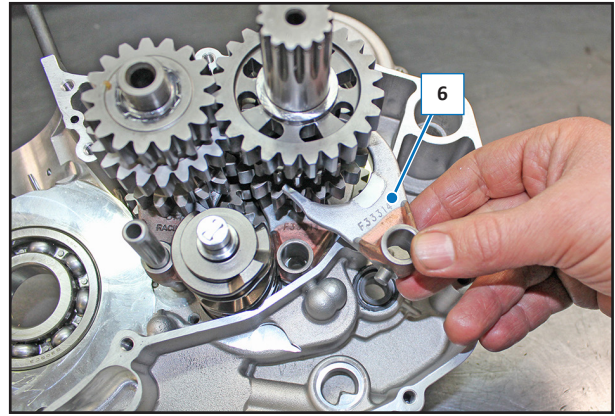


### 2.21.3 Gear shafts removal

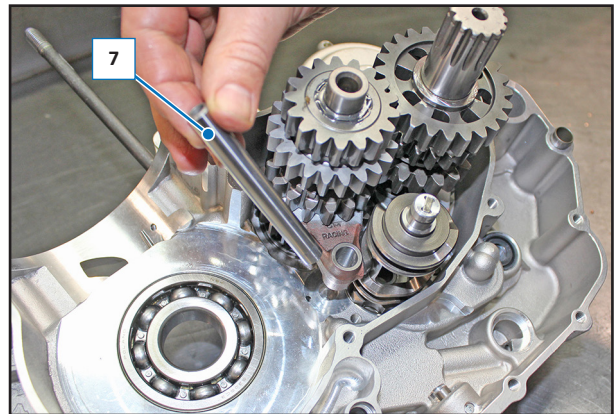
Extract the secondary shaft fork pin (5).



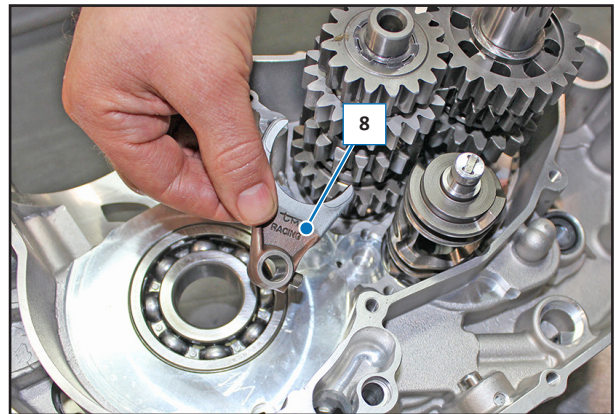
Release the fork (6) of the secondary shaft from the selector drum and remove it.



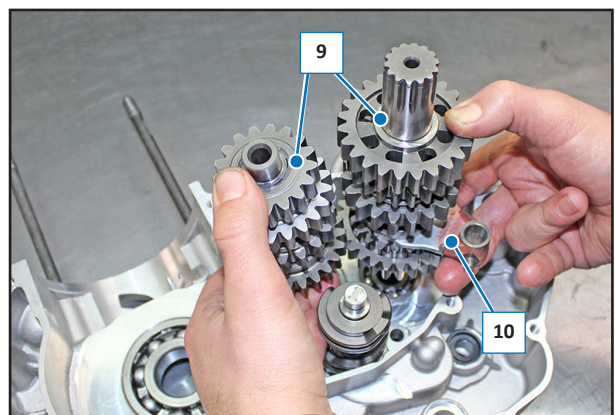
Slide the primary shaft fork pin (7) out.



Remove the fork (8) from the primary shaft.

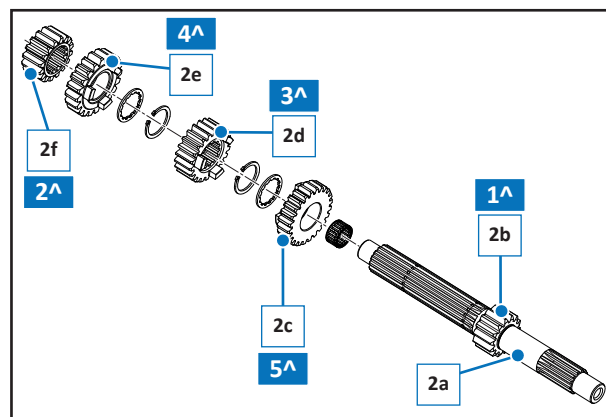


Remove the complete gear assy (9) with the fork (10) inserted.



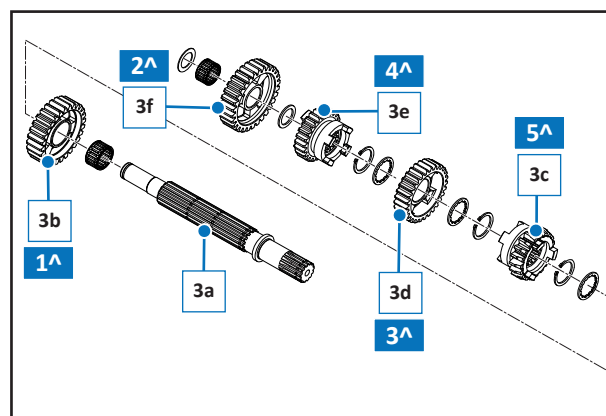
## 2.21.4 Primary shaft, gear sequence

- 2a) Primary shaft
- 2b) First
- 2c) Fifth
- 2d) Third
- 2e) Fourth
- 2f) Second



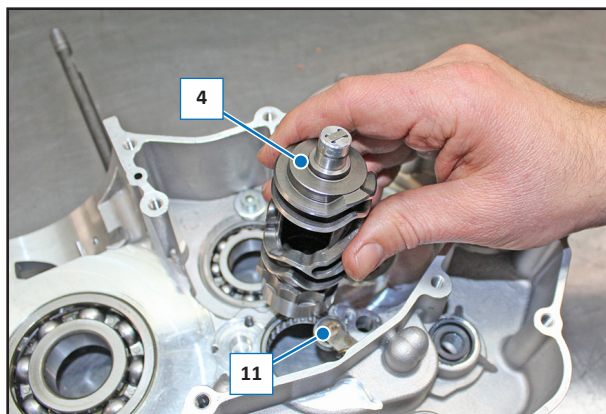
## 2.21.5 Secondary shaft, gear sequence

- 3a) Primary shaft
- 3b) First
- 3c) Fifth
- 3d) Third
- 3e) Fourth
- 3f) Second



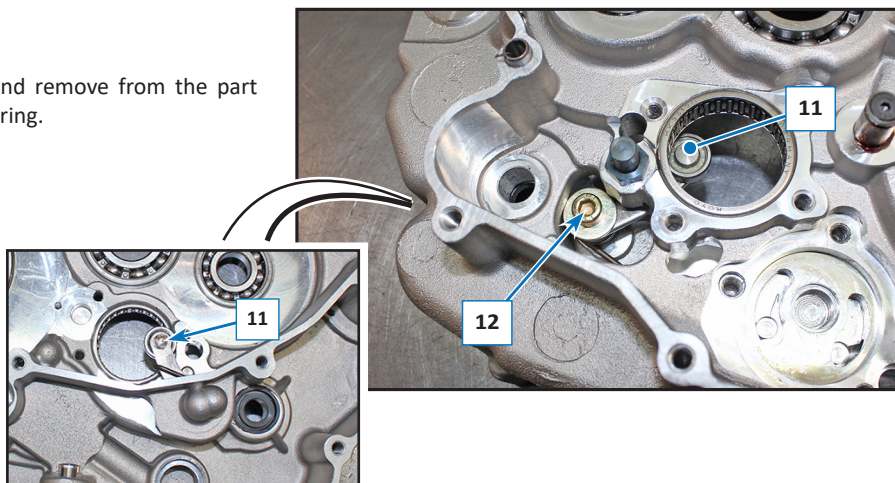
## 2.21.6 Gears drum removal

Use a screwdriver to move the ratchet (11), releasing the drum (4), and then remove the drum from the semicase.



## 2.21.7 Ratchet removal

Loosen the screw (12) with relative washer and remove from the part opposite to the ratchet (11) with the relative spring.

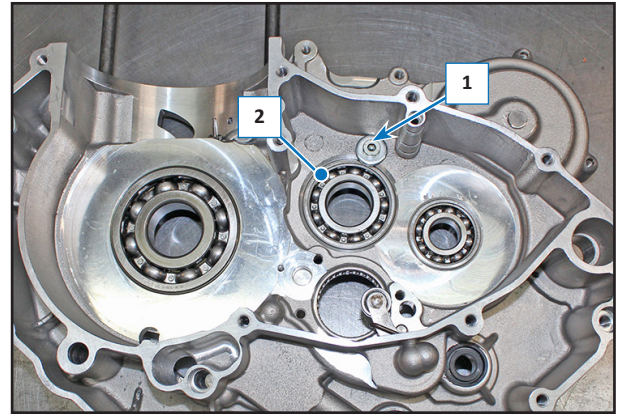


### 2.21.8 Bearings replacement

Unscrew the screw (1) with relative primary shaft bearing safety washer (2).

Heat the guards and remove the bearings.

**NOTE:** After having replaced the bearings, re-position the safety washer (1) and tighten the screws again and applying Loxeal 82-33 on the thread.



### 2.21.9 Components re-mounting

Re-mount the components, proceeding in reverse order to disassembly, lubricating with engine oil and, when re-mounting the gearbox unit, paying attention to correctly position the forks (6), (8) and (10) in the relevant positions:

Fork (6) between the 4th and 3rd gear.

Fork (8) between the 3rd and 5th gear.

Fork (10) between the 3rd and 5th gear.

Check that the fork rollers are correctly inserted in the relative hollows on the drum (4).

