TRAINER

200/300

2 Stroke




# 2027

# WORKSHOP MANUAL

Beta motorcycles

www.betamotor.com

# TABLE OF CONTENTS




**INTRODUCTION** 2

**ENGINE** 4

**1 ENGINE REMOVAL FROM VEHICLE** 6

**2 ENGINE DISASSEMBLY** 14

**2.1 CLUTCH/GEAR OIL DRAIN** ..... 14

**2.2 REMOVAL OF CLUTCH CONTROL ROD AND PINION SPACER** ..... 14

**2.3 REMOVAL OF HEAD, CYLINDER AND PISTON** ..... 15

**2.4 REMOVAL OF IGNITION UNIT** ..... 18

2.4.1 REMOVAL OF FLYWHEEL COVER ..... 18

2.4.2 STATOR REMOVAL ..... 18

2.4.3 FLYWHEEL REMOVAL ..... 19

2.4.4 PICK-UP UNIT REMOVAL ..... 19

**2.5 REMOVAL OF ELECTRIC IGNITION** ..... 20

2.5.1 START MOTOR REMOVAL ..... 21

2.5.2 BENDIX COUPLING REMOVAL ..... 21

**2.6 REMOVAL OF COOLANT LIQUID PUMP, CLUTCH UNIT, PRIMARY GEAR, CENTRIFUGAL UNIT, GEARSHIFT PARTS, KICKSTARTER** ..... 22

2.6.1 REMOVAL OF COOLANT LIQUID PUMP ..... 25

2.6.2 REMOVAL OF CENTRIFUGAL UNIT AND LINKAGE ..... 26

2.6.3 DISASSEMBLY OF CLUTCH UNIT AND COUNTERSHAFT COUNTERWEIGHT ..... 29

2.6.4 PEDAL KICKSTARTER - OPTIONAL ..... 33

2.6.5 EXTERNAL GEARSHIFT UNIT ..... 35

**2.7 INTAKE SYSTEM** ..... 36

**2.8 CRANKSHAFT, GEARBOX UNIT AND INTERNAL GEARSHIFT** ..... 37

2.8.1 OPENING THE CRANKCASE ..... 37

2.8.2 COUNTERWEIGHT SUPPORT SHAFT ..... 38

2.8.3 CRANKSHAFT ..... 38

2.8.4 INTERNAL GEARSHIFT UNIT AND COMPLETE GEARBOX ..... 39

**2.9 DISASSEMBLY OF PARTS FROM CRANKCASES** ..... 40

2.9.1 RIGHT CRANKCASE HALF ..... 40

2.9.2 LEFT CRANKCASE HALF ..... 43

**3 ENGINE CHECKS AND ASSEMBLY** 44

**3.1 CRANKCASE HALF** ..... 44

3.1.1 APPLICATION OF RIGHT CRANKCASE HALF PARTS ..... 45

3.1.2 APPLICATION OF LEFT CRANKCASE HALF PARTS ..... 47

**3.2 CONNECTING ROD AND ENGINE SHAFT CHECK** ..... 48

3.2.1 SLEW BEARING REMOVAL AND REFITTING ..... 48

**3.3 ASSEMBLY OF COMPLETE CRANKSHAFT** ..... 50

**3.4 GEARBOX UNIT: CHECKS AND REASSEMBLY** ..... 51

3.4.1 CHECK OF GEARBOX UNIT ..... 51

3.4.2 ASSEMBLY OF PRIMARY UNIT ..... 52

3.4.3 ASSEMBLY OF SECONDARY UNIT ..... 53

3.4.4 CHECK OF THE FORKS, FORK PINS AND DESMODROMIC DEVICE ..... 54

3.4.5 ASSEMBLY OF GEARBOX AND INNER CONTROL ..... 56

3.4.6 COUNTERWEIGHT SUPPORT SHAFT ..... 59

**3.5 CLOSING THE ENGINE CRANKCASE** ..... 60

**3.6 EXTERNAL GEARSHIFT** ..... 61

3.6.1 CHECK OF THE COMPLETE DRIVE SHAFT ..... 61

3.6.2 ASSEMBLY OF EXTERNAL GEARSHIFT ..... 63

**3.7 KICKSTARTER DEVICE - OPTIONAL** ..... 64

3.7.1 CHECK OF STARTER SHAFT UNIT AND ASSEMBLY ..... 64

3.7.2 ASSEMBLY OF KICKSTARTER DEVICE - OPTIONAL ..... 65

**3.8 COUNTERWEIGHT, PRIMARY GEAR AND CLUTCH UNIT** ..... 67

3.8.1 INSPECTION OF COUNTERWEIGHT AND PRIMARY GEAR ..... 67

3.8.2 APPLICATION OF PRIMARY GEAR AND COUNTERWEIGHT ..... 67

3.8.3 CHECK OF THE CLUTCH CASE, ROLLER BEARING AND INTERNAL CENTRE BEARING ..... 69

3.8.4 CHECK OF CLUTCH DISCS ..... 70

3.8.5 CHECK OF THE CLUTCH DRUM AND CAP ..... 71

3.8.6 CHECK OF THRUST BEARING DEVICE ..... 71

3.8.7 ASSEMBLY OF CLUTCH UNIT ..... 72

**3.9 COOLANT LIQUID PUMP AND CENTRIFUGAL UNIT** ..... 76

3.9.1 CHECK OF PUMP UNIT AND DISASSEMBLY, CENTRIFUGAL UNIT AND IDLER UNIT ..... 77

3.9.2 CENTRIFUGAL UNIT ASSEMBLY ..... 78

3.9.3 PUMP UNIT ASSEMBLY ..... 81

3.9.4 ASSEMBLY OF COMPLETE CLUTCH COVER AND PUMP UNIT ..... 81

**3.10 ELECTRIC IGNITION UNIT** ..... 84

3.10.1 BENDIX COUPLING CHECKS ..... 84

3.10.2 IGNITION UNIT COUPLING TO ENGINE ..... 84

**3.11 IGNITION SYSTEM** ..... 86

3.11.1 CHECK OF THE IGNITION SYSTEM ..... 86

3.11.2 COUPLING OF IGNITION SYSTEM TO CRANKCASE ..... 86

**3.12 POWER UNIT ..... 89**

3.12.1 CHECK OF THE PISTON AND ELASTIC BANDS ..... 89

3.12.2 CYLINDER CHECK ..... 90

3.12.3 PISTON CYLINDER COUPLING PLAY ..... 91

3.12.4 EXHAUST VALVE UNIT DISASSEMBLY AND CHECKS ..... 91

3.12.5 UNIT ASSEMBLY EXHAUST VALVE ..... 93

3.12.6 PISTON, ELASTIC BANDS, PIN BOLT AND CYLINDER ASSEMBLY ..... 95

3.12.7 CHECK OF CRANKCASE/CYLINDER GASKET THICKNESS ..... 97

3.12.8 HEAD APPLICATION ..... 98

3.12.9 EXHAUST VALVE ADJUSTMENT ..... 99

3.12.10 APPLICATION OF COVERS ..... 102

**3.13 CHECK OF INTAKE UNIT AND ASSEMBLY ..... 103**

**3.14 INSERTION OF CLUTCH ROD AND PINION SPACER ..... 105**

**4 ENGINE REASSEMBLY IN THE VEHICLE 106**

**TABLE OF ENGINE COMPONENTS TIGHTENING TORQUES 114**

**TABLE OF FRAME/ENGINE TIGHTENING TORQUES 116**

**TABLE OF SUPERSTRUCTURE TIGHTENING TORQUES 116**

**RECOMMENDED ENGINE MAINTENANCE 117**

**RECOMMENDED LUBRICANTS AND LIQUIDS 117**

# INTRODUCTION

This publication is intended for workshops specialised in repairing mopeds and motorcycles.
Where required, use special Betamotor tools.
Use Betamotor spare parts only. For their codes, refer to the spare parts manual for the specific vehicle or version.
The warranty and liability on vehicle safety lapses when maintenance or repairs:
- Are **NOT** performed by workshops specialised in repairing mopeds and motorcycles;
- Are **NOT** carried out carefully following the requirements contained in the technical documentation;
- Are **NOT** carried out using special Betamotor tools, where required;
- Are **NOT** carried out using Betamotor official spare parts.

Carefully read this manual in its entirety before working on the engine. Good knowledge of all components making up the engine and all the procedures to be followed for inspection and maintenance help extend the life of the engine.
The paragraphs feature schematic illustrations highlighting each topic in order to make the text immediately understandable.

## Informative note

Betamotor S.p.A. is committed to a policy of ongoing improvement of its products. This is why you might notice slight differences between the content of this document and the vehicle on which you are about to carry out repairs and/or maintenance. Betamotor S.p.A. models are exported to a number of countries where there are different rules concerning the Highway Code and vehicle type-approval procedures. Betamotor S.p.A. therefore reserves the right to modify its products and technical documentation at any time without prior notice, thank you for your understanding.

***We respect and defend the environment***

*Everything we do has an impact on the whole Planet and its Resources. To safeguard the interests of the entire Community, Betamotor S.p.A. would like to raise the awareness of customers and technical service operators on ways of using the vehicle and disposing of its parts entirely in compliance with applicable regulations in terms of environmental pollution, waste disposal and recycling.*

## SAFETY

### *Carbon monoxide*

- *Exhaust gases contain carbon monoxide, which is poisonous. Carbon monoxide may cause loss of consciousness and lead to death. If the engine needs to be started, make sure the location is well-ventilated. Never start the engine indoors.*
- *The engine can be started indoors only if fitted with the appropriate exhaust gas extraction devices.*

### *Petrol*

- *Petrol is extremely flammable and can be explosive under certain conditions.*
- *Keep sources of heat, sparks and flames away from the work area.*
- *Always work in a well-ventilated area.*
- *Never use petrol as a solvent for cleaning. Do not handle it unless strictly necessary.*
- *Never use petrol to clean components by means of compressed air.*
- *Keep out of the reach of children.*

### *Engine oil*

- *Motor oil can cause skin conditions if it remains in contact with the skin often and for prolonged periods.*
- *In case of contact with engine oil, wash with soap and water as soon as possible.*
- *In case of contact with the eyes, rinse them with plenty of water and seek medical advice.*
- *If swallowed, do not induce vomiting in order to prevent the product from entering into the lungs; seek immediate medical advice. If you believe the product has entered the lungs, take the person concerned to hospital immediately.*
- *Waste oil contains dangerous substances that are harmful for the environment. In order to change it one must be equipped for disposal, in compliance with applicable laws.*
- *Do not discard waste oil into the environment.*
- *Keep out of the reach of children.*

### Coolant liquid

- *In some situations, the ethylene glycol contained in the coolant is flammable and its flame is invisible. Should ethylene glycol catch fire, it can cause burns even though its flame is invisible.*
- *Do not bring the coolant into contact with hot parts. These parts could be hot enough to cause the liquid to ignite.*
- *The coolant (ethylene glycol) may irritate the skin and is poisonous if swallowed.*
- *Should the coolant come into contact with the skin, immediately remove contaminated clothing or footwear and wash with soap and water. In the event of contact with the eyes, rinse with plenty of clean water and seek medical advice immediately. Should it be swallowed, do not induce vomiting in order to prevent the product from entering the lungs. Administer clean water, immediately take the person concerned to hospital, and show this product to hospital staff.*
- *In the event of exposure to a high concentration of vapours, move the person concerned to an uncontaminated area and seek medical advice if necessary.*
- *Do not remove the radiator cap when the engine is still hot. Since the coolant is pressurised, it may spurt out violently and cause burns.*
- *The coolant contains dangerous substances that are harmful for the environment. In order to change it one must be equipped for disposal in compliance with applicable laws.*
- *Do not disperse coolant into the environment.*
- *Keep out of the reach of children.*

### Hot parts

- *The engine and the exhaust system get very hot and remain at that temperature for a long time, even after the engine has been turned off. Wait for them to cool down before handling these parts or carrying out work on areas around them. Wear insulated gloves.*

### WARNINGS

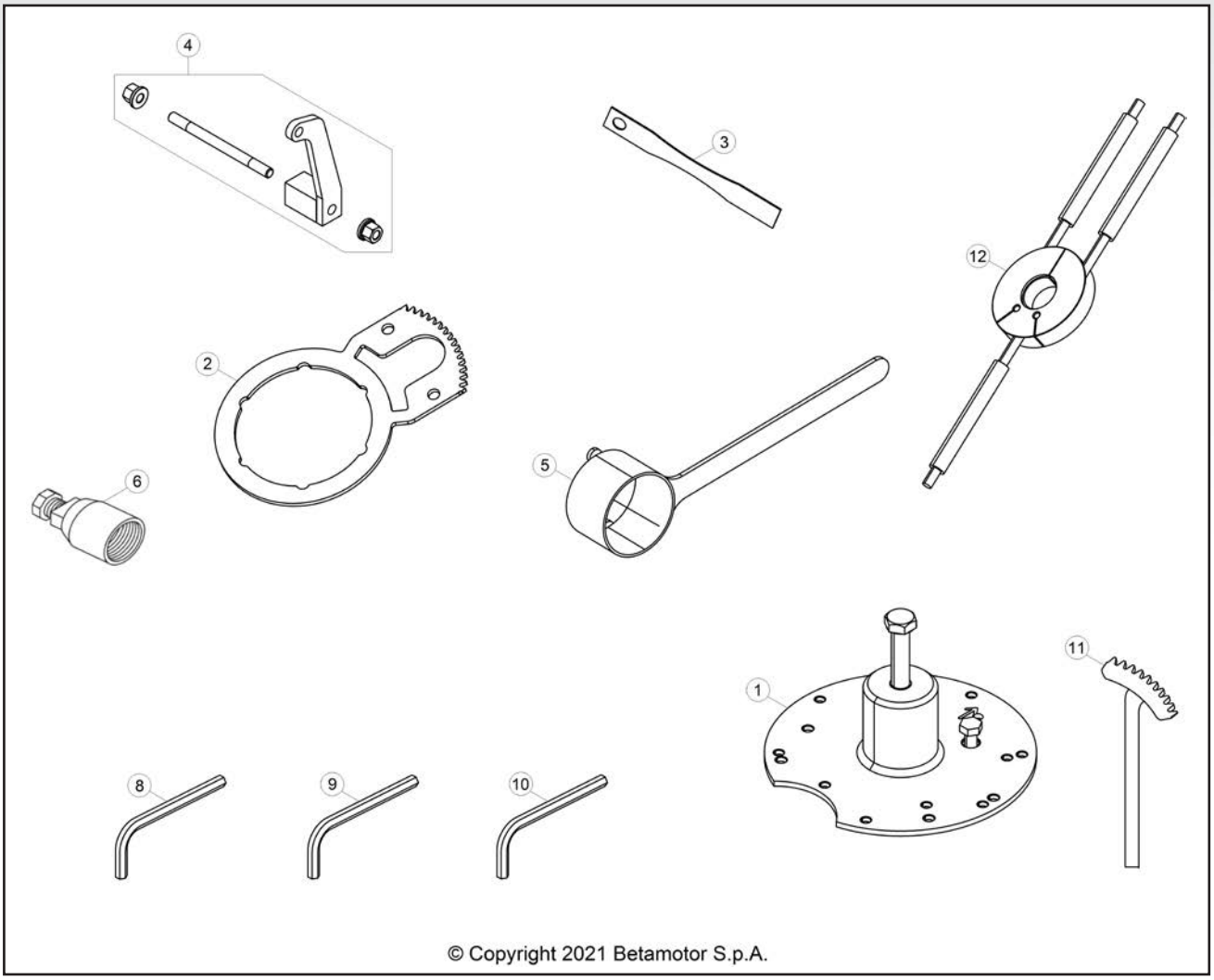
*The information contained in this paragraph is important to ensure the operations carried out on the engine are performed without causing damage.*

- *Before disassembly, thoroughly clean the motorcycle.*
- *While disassembling it, clean all the parts and place them in containers accurately following the order of disassembly.*
- *Always use special tools wherever necessary and when required.*
- *Always use glues, sealant and lubricants wherever required. Follow the indications concerning their technical features.*
- *Always replace parts such as gaskets, O-rings and safety washers with newly supplied parts.*
- *When loosening or tightening nuts or screws, always start with the larger ones or from the centre. Always adhere to the specified tightening torques.*
- *Use only Betamotor original spare parts.*

# ENGINE TECHNICAL SPECIFICATIONS

| ENGINE | | |
|---|---|---|
| | XTRAINER 250 2T<br>Europa XTRAINER 250 2T | XTRAINER 300 2T<br>Europa XTRAINER 300 2T |
| Bore [mm]/Stroke [mm] | 66.4x72 | 73 x 69.9 |
| Displacement [cm³] | 249 | 292,6 |
| Compression ratio | 13,5:1 | 11,55:1 |
| **TRANSMISSION** | | |
| Primary transmission | 27/72 | 27/72 |
| 1st gear ratio | 12/31 | 12/31 |
| 2nd gear ratio | 15/28 | 15/28 |
| 3rd gear ratio | 19/28 | 19/28 |
| 4th gear ratio | 20/24 | 20/24 |
| 5th gear ratio | 27/27 | 27/27 |
| 6th gear ratio | 28/24 | 28/24 |

# SPECIAL EQUIPMENT




© Copyright 2021 Betamotor S.p.A.

1. *Complete EVO 2T crankcase uncoupler 007.14.010.80.00*
2. *Special wrench 037.14.002.50.00*
3. *Squish measuring tool 026.14.017.00.00*
4. *Front bracket for fastening engine to stand 026.14.003.00.00*
5. *Flywheel blocking tool 026.14.005.50.00*
6. *Flywheel extractor 36.25173.000*
8. *Special wrench 026.44.029.00.00*
9. *Special wrench 026.44.028.00.00*
10. *Special wrench 007.44.035.00.00*
11. *Special wrench 026.14.012.50.00*
12. *Special wrench 026.14.018.00.00.*

***Symbols***

6Nm
*Value*
*Tightening torque*

*Threadlocker*
*medium-resistance*

*High-resistance*
*threadlocker*

*Silicone paste*

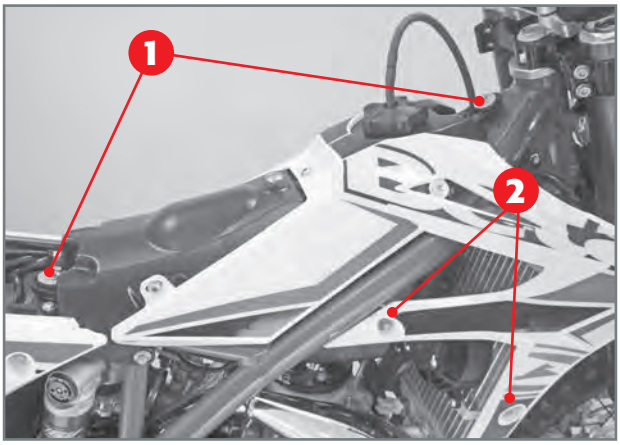
*Grease*

# 1 ENGINE REMOVAL FROM VEHICLE

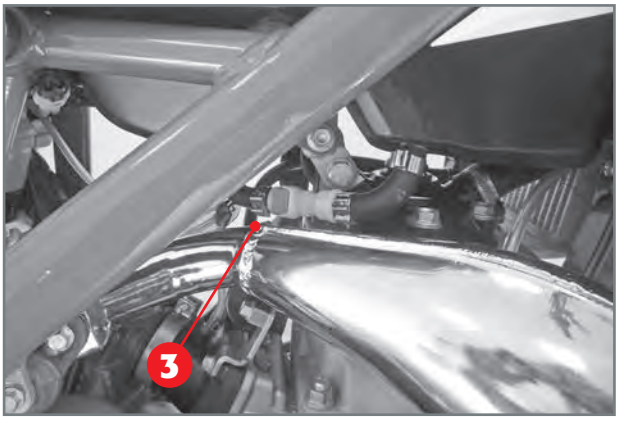


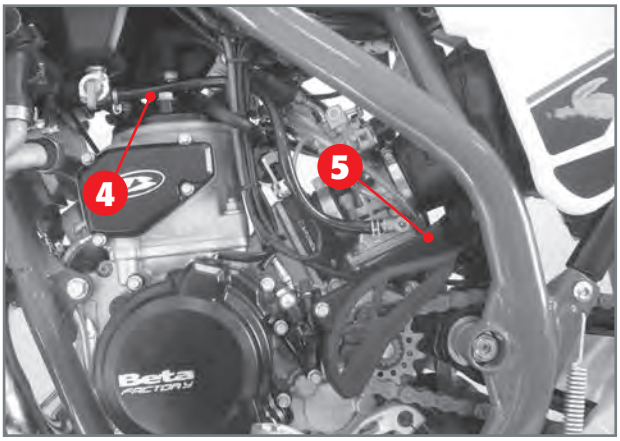
- Carefully wash the vehicle;
- Remove the engine guard plate;
- Place the vehicle onto an adequate stand.

- Remove the seat and the tank with its sides.



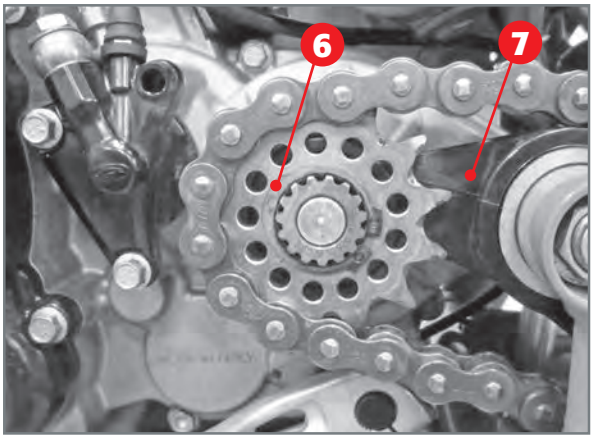

- To take down the tank you must:
  - completely unscrew the two screws **1** that fasten the tank to the frame and the screws **2** (two per side) that fasten the side to the vehicle;
  - disconnect the by-pass petrol pipe by pressing the quick-coupling **3** button.



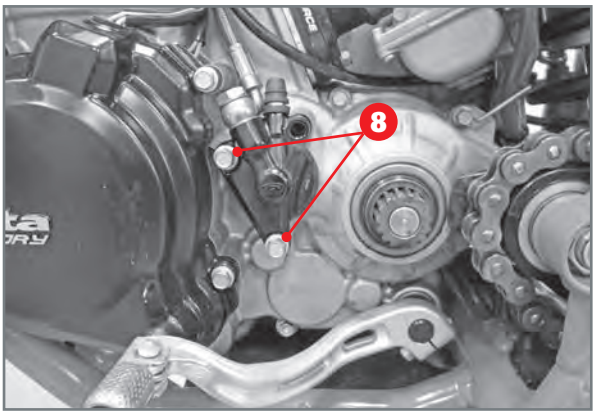




- Disconnect the petrol pipe **4** from the valve.

- Remove the pinion guard **5.**

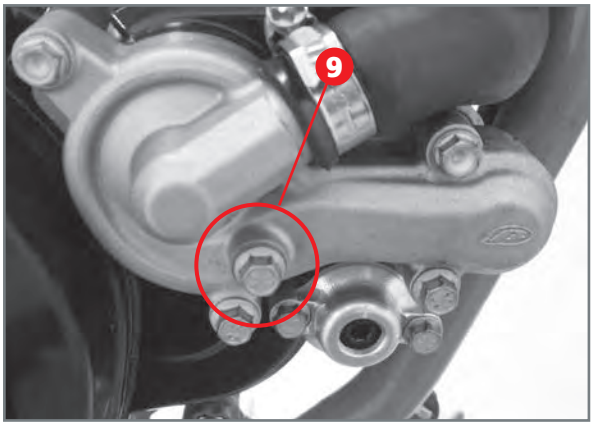



· Remove the circlip **6** and extract the pinion. Rest the chain against the upper wedge **7**.

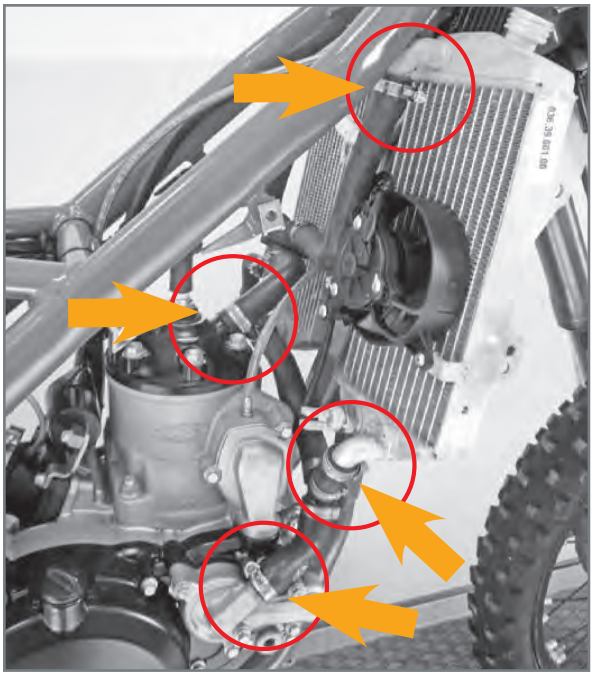



· Remove the screws **8** fixing the clutch actuator to the crankcase half.

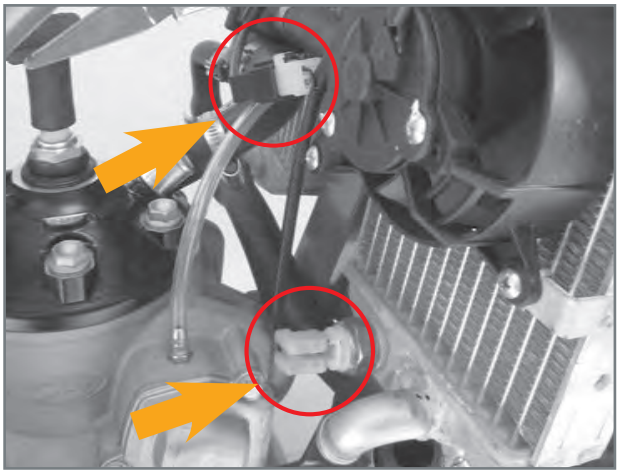
***ATTENTION!***
*Do not operate the clutch lever with the actuator uncoupled from the engine.*



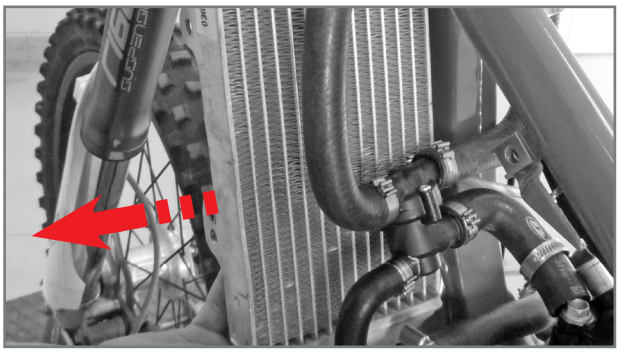

· Remove the exhaust expansion chamber and silencer.
· Drain the cooling system by means of the appropriate screw **9** and let the liquid flow into a container (the cooling circuit contains 1.3L of liquid). Remove the radiator cap.



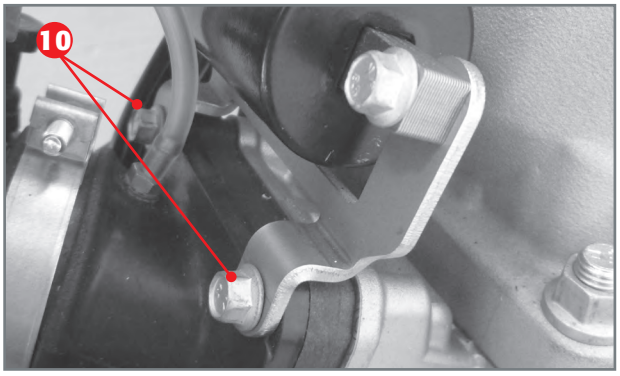
· Disconnect the water hoses from the engine and from the right radiator.



- Disconnect the electrical connectors of the right radiator accessories.
- Remove the right radiator.

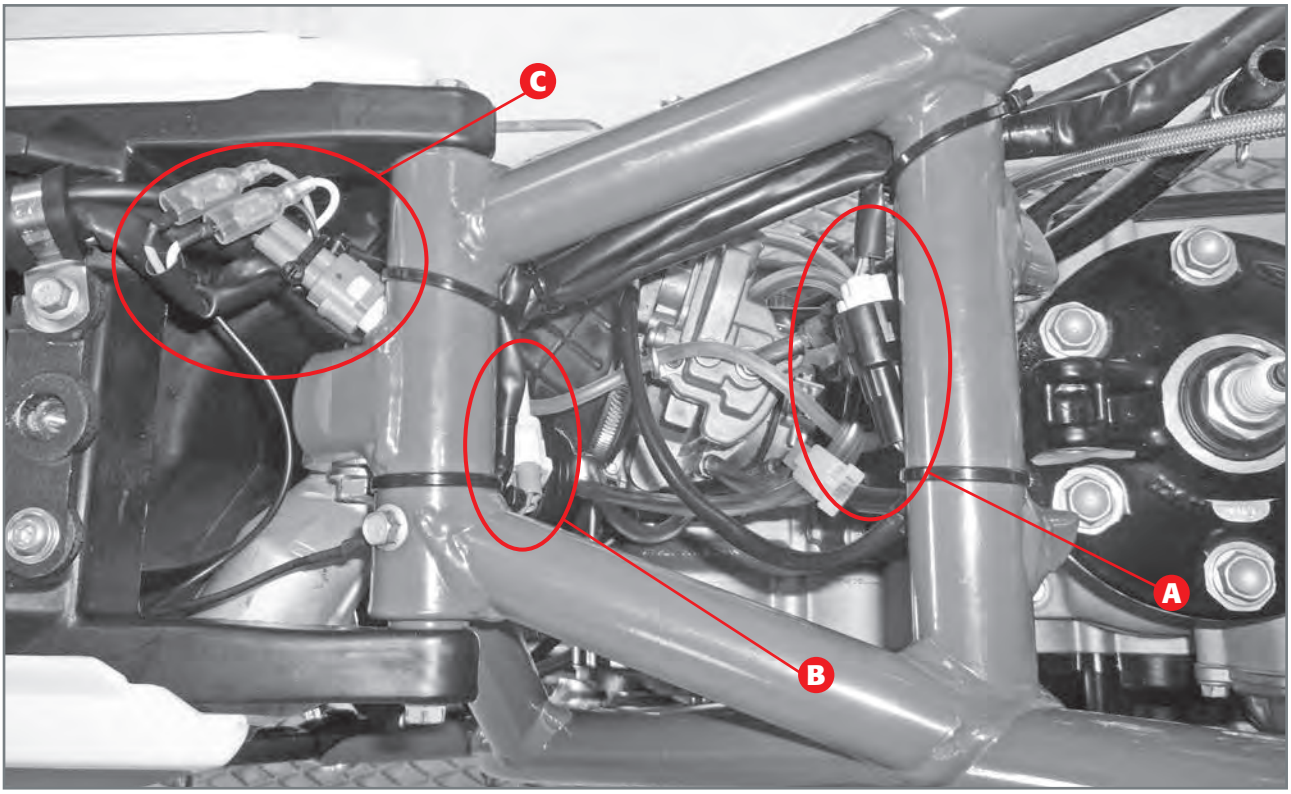


- Remove the left radiator with pipes.



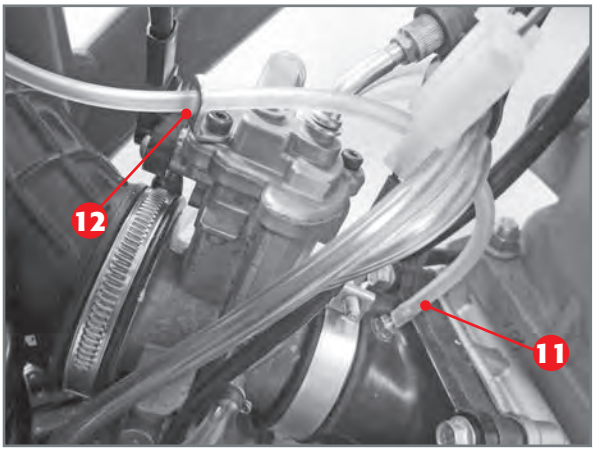

- Disconnect the coil from the spark plug, remove the two screws **10** and take the complete coil support out of the intake manifold.

***Note:*** *when the coil support has been taken down, we recommend putting the screws back in place, without tightening them.*




· Cut all straps binding the engine's electric system to the clutch pipe and to the frame.
  - Then disconnect the connectors:
  - **A** TPS sensor;
  - **B** Pick-Up;
  - **C** stator unit.

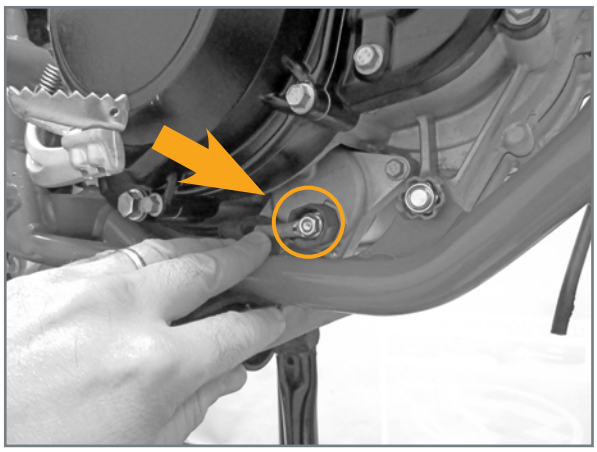
· Disconnect the engine ventilation pipes.



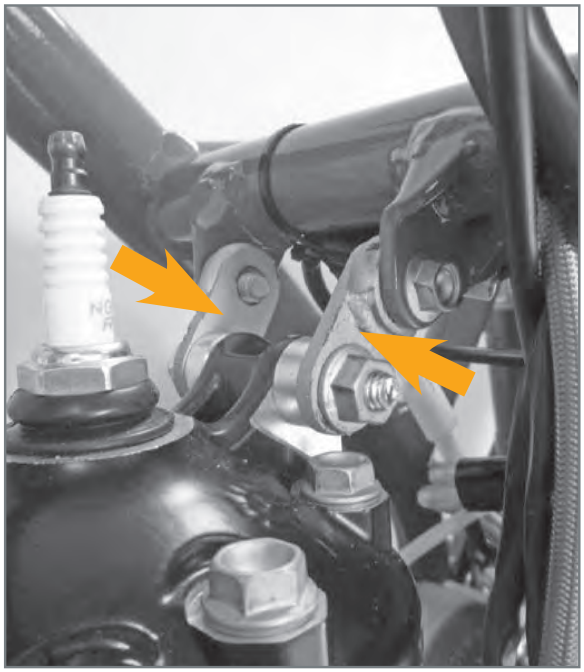

· Pull out the mixer tube **11** from the intake manifold and tube hole **12**.



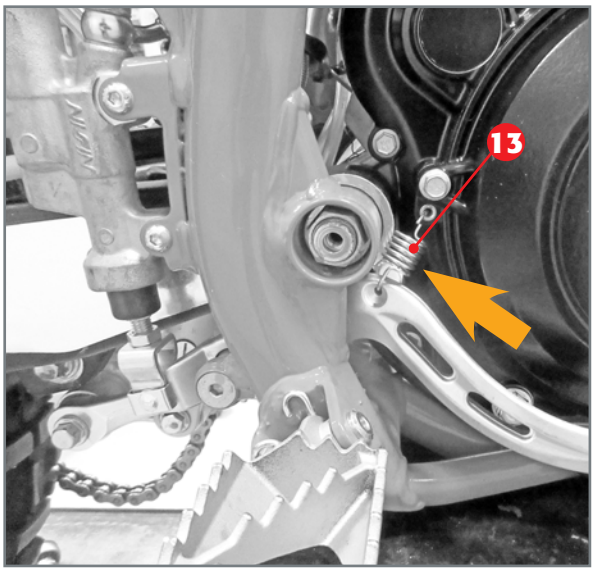
***ATTENTION!***
*When the mixer tube has been disconnected, plug it to prevent emptying.*



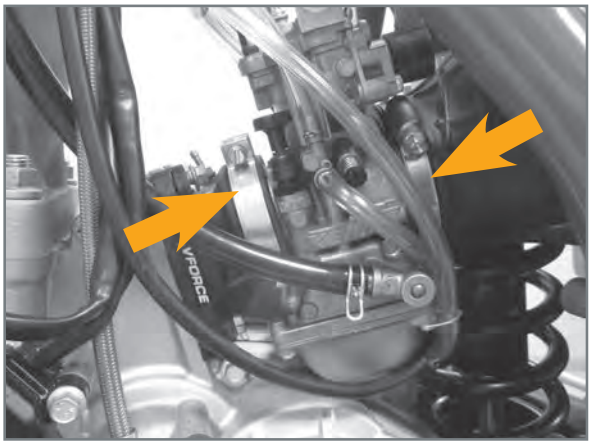
· Remove the start motor cable fixing nut.



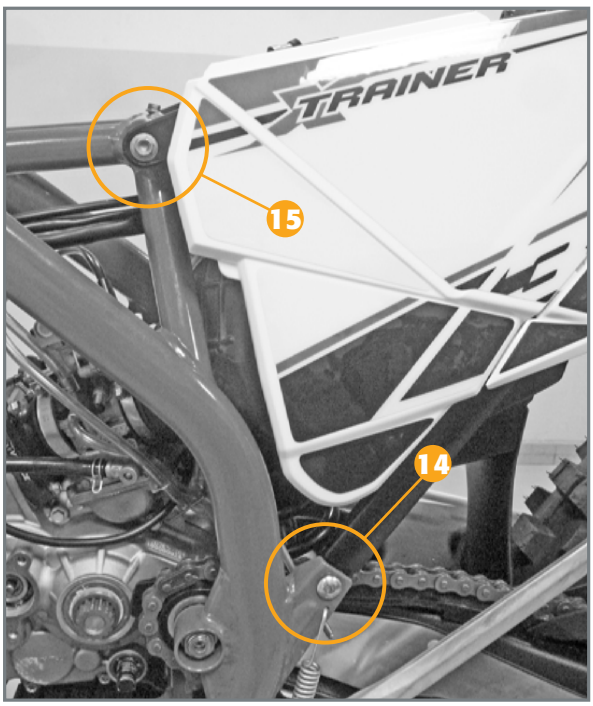
· Remove the head connections.



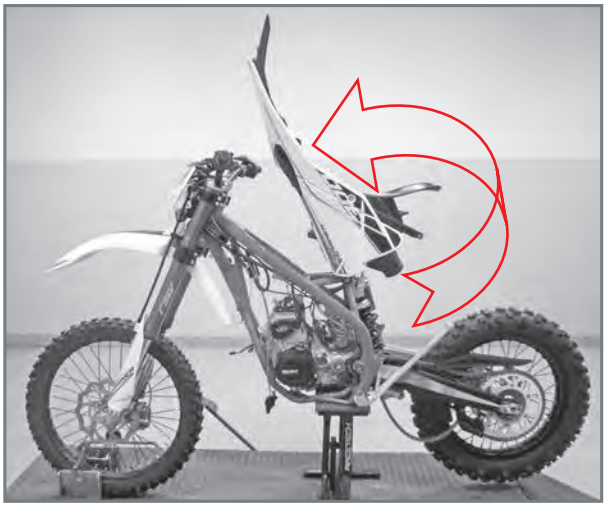

- Release and remove the brake pedal return spring **13**. Remove the kickstarter lever (optional).
- Remove the gear lever.




- Loosen the carburettor straps from the air filter sleeve and from the manifold.

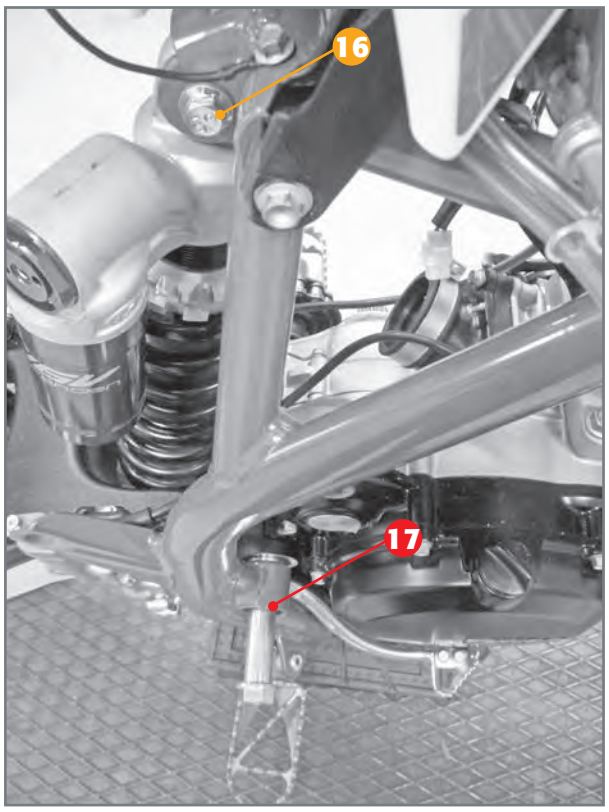



- Remove the subframe lower fixing screws **14** (one on each side) and loosen the upper screws **15** (one on each side).

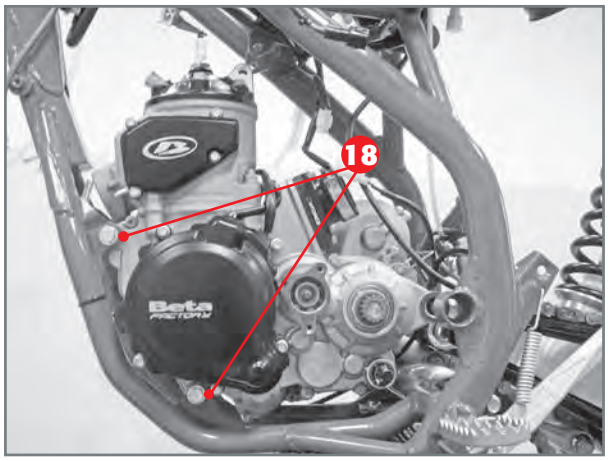


- Rotate the entire filter box unit.
- Remove the carburettor from the manifold leaving it connected to the gas cable.

***ATTENTION!***
*When the carburettor is disconnected from the manifold, empty out the tank before handling the carburettor.*




- Remove the swingarm pin **17** and the upper shock-absorber pin **16**.

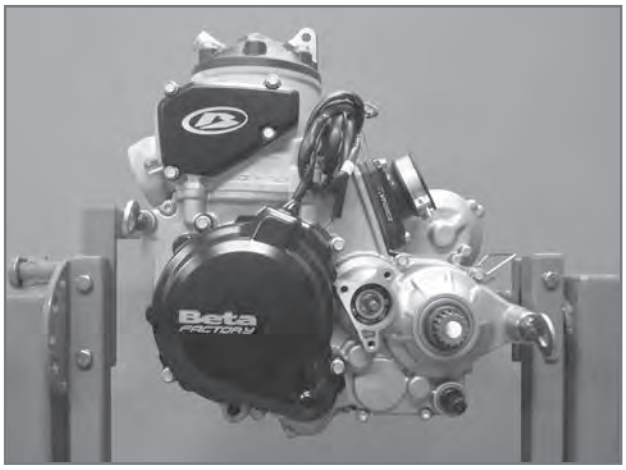



- Remove the engine pins **18.**



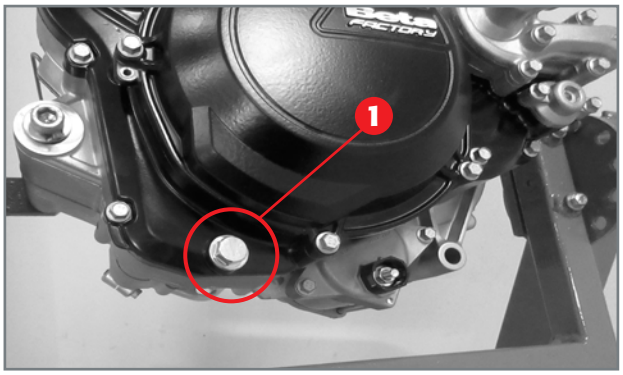
Extract the engine from the frame and apply it to the specific stand using the specific front fixing bracket, *code 026.14.003.00.00.*

# 2 ENGINE DISASSEMBLY



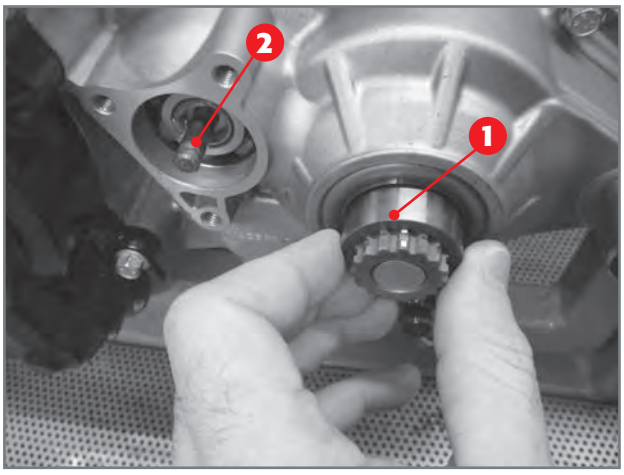

Secure the engine to the specific support stand *code 36.25132.000* by means of the front fixing *code 026.14.003.00.00*, in order to work comfortably and safely. Then proceed as follows.

Remove the spark plug.




## 2.1 CLUTCH/GEAR OIL DRAIN

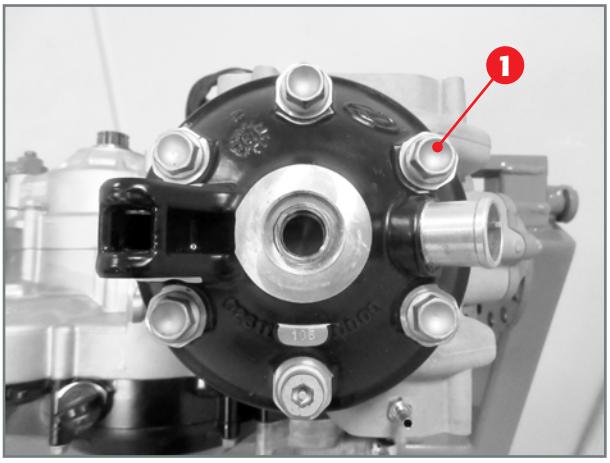
Remove screw **1** and let the oil drain.



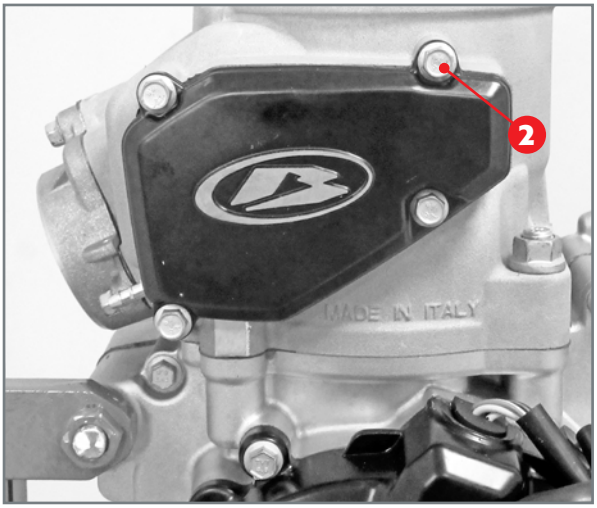

## 2.2 REMOVAL OF CLUTCH CONTROL ROD AND PINION SPACER

Take out the spacer **1.**
Take out the clutch control rod **2.**

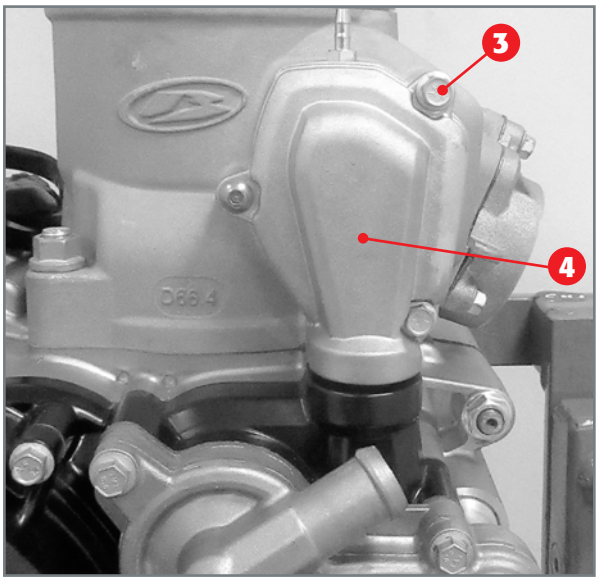
## 2.3 REMOVAL OF HEAD, CYLINDER AND PISTON



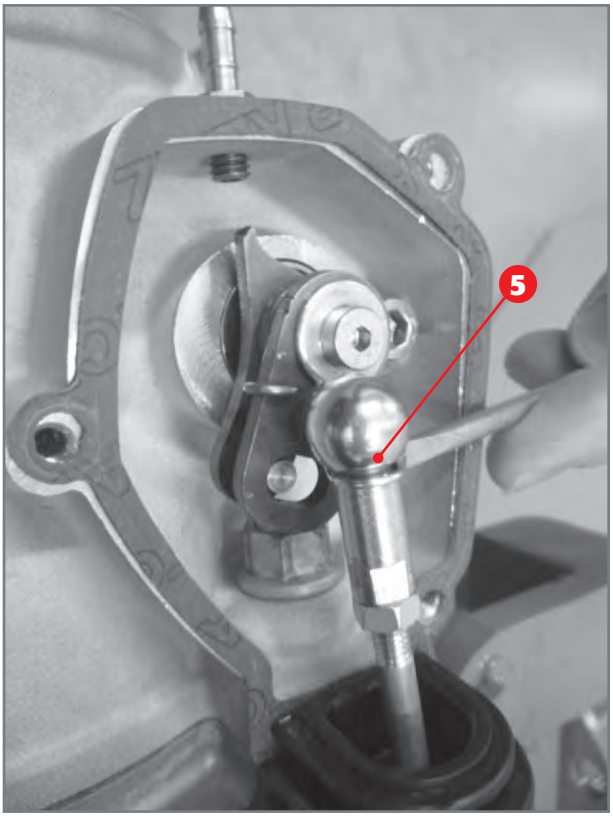

Remove the collar screws **1** together with the copper washers. Remove the head and the two O-rings.



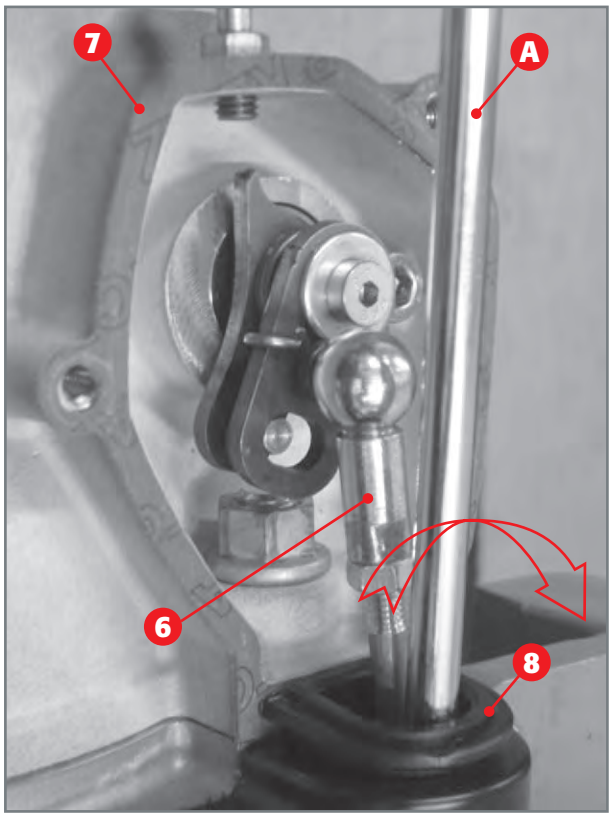

Remove the four screws **2**.




Remove the three screws **3** and cover **4.**



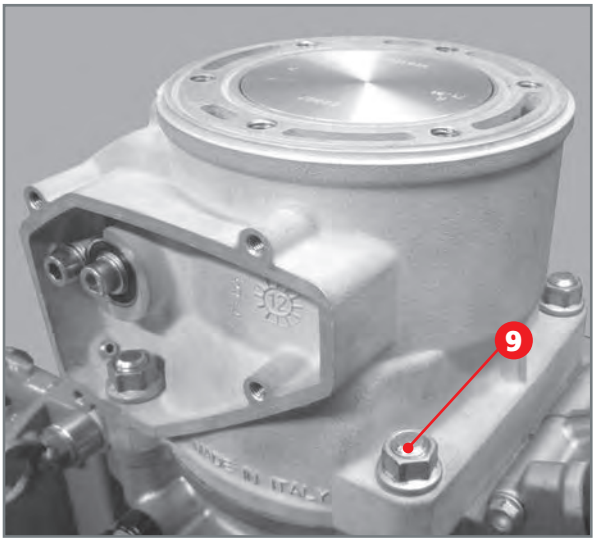

Release the lock **5** and remove it.




***Removal of gasket 6***

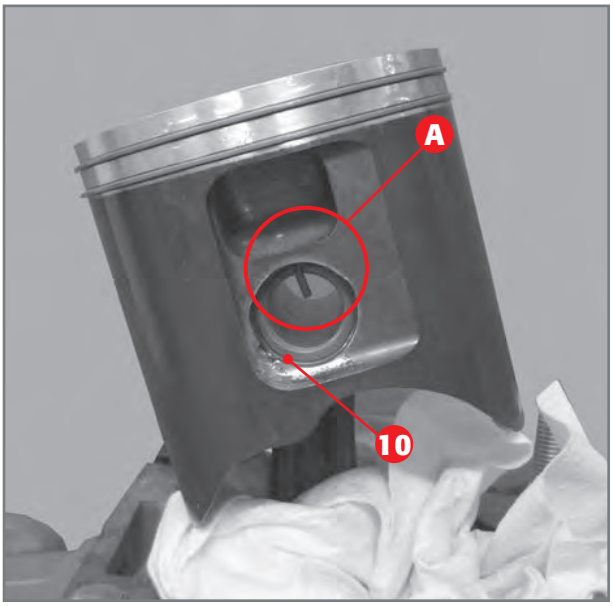
Release the control rod **6**.

Remove the gasket **7**. It may be necessary to slightly force the rubber gasket **8**; place a metal pin **A** between the lever and the gasket **8** and slightly force it outwards.




*Extract the cylinder and base gaskets.*

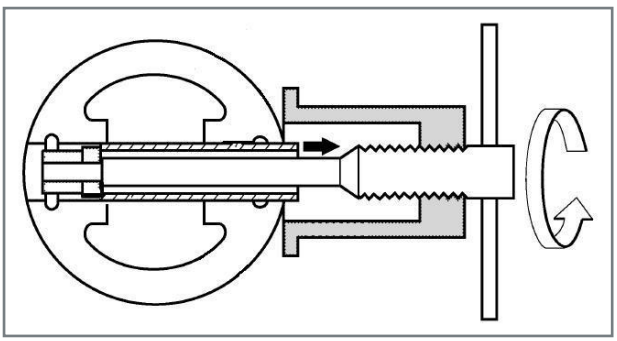
Remove the four collar nuts **9**.



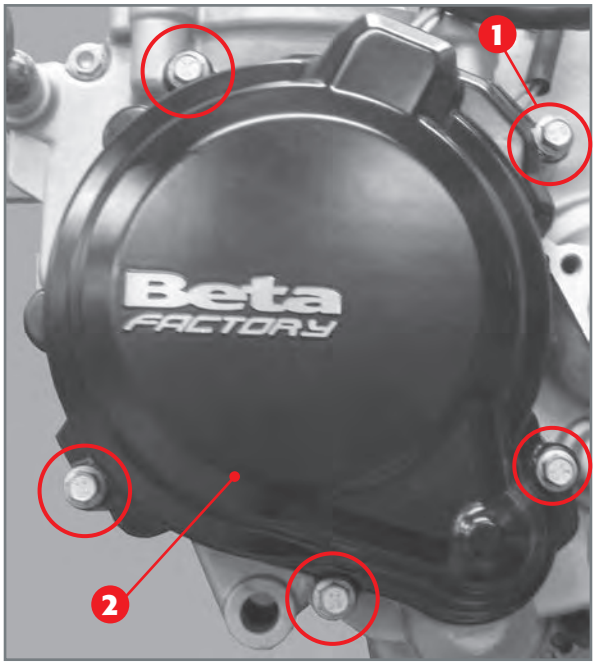

*Removal of piston circlip.*

***ATTENTION!***
*Place a clean cloth between the piston and the crankcase to keep foreign objects or simple solid residues from falling inside the crankcase.*

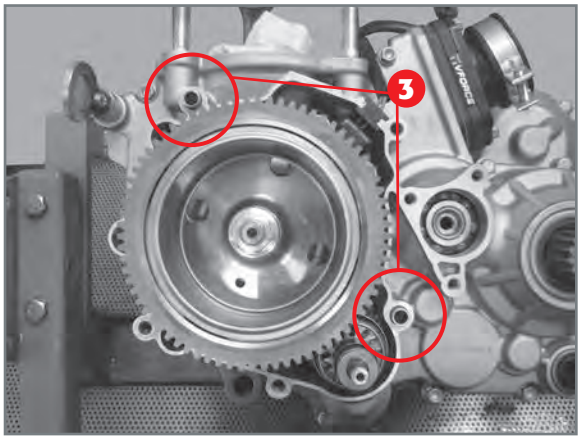
Remove the circlip **10** by gripping lug **A** with a pair of fine nose pliers.



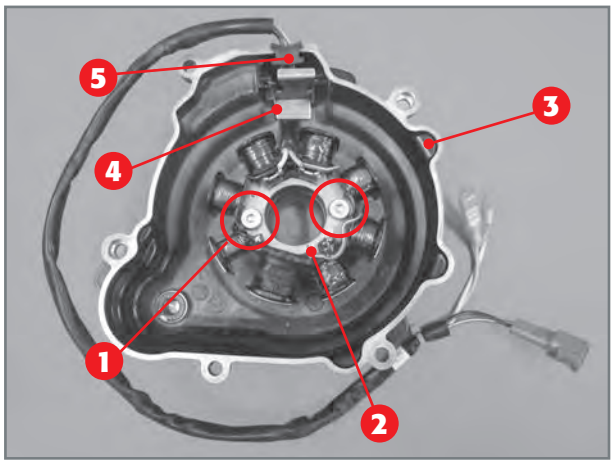
Remove the pin bolt using a universal extractor for pin bolts.
Remove the piston, the pin bolt and the bearing from the connecting rod foot.




*Fixing screws 1 of flywheel cover 2.*




*The two designated references pins (3) for the flywheel cover.*




*Disassembly of stator from cover.*

## 2.4 REMOVAL OF IGNITION UNIT

The ignition unit consists of the flywheel (or rotor), the pick-up and the stator which is one with the flywheel cover.

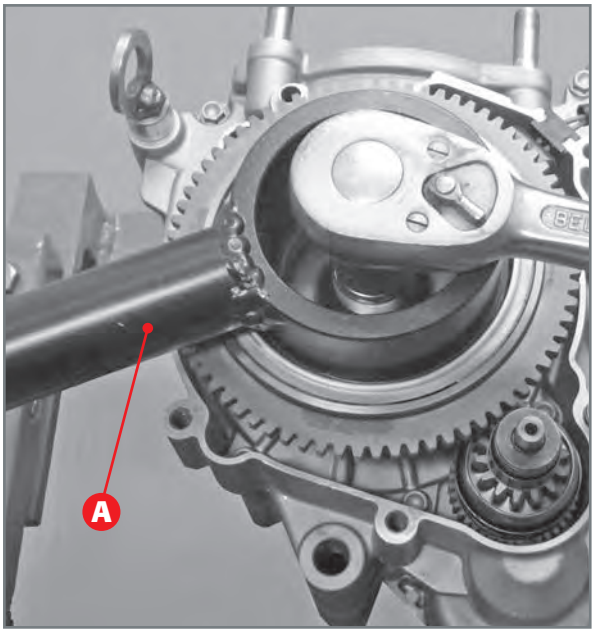
### 2.4.1 Removal of flywheel cover

Remove the five screws **1** securing the flywheel cover **2** to the left crankcase.
Remove the flywheel cover and the gasket placed between the crankcase and the cover.

Pay attention to the two centring pins **3** on the crankcase.

### 2.4.2 Stator removal

Remove the two screws **1** fixing the stator **2** to the flywheel cover **3**. Extract the plate **4** and the cable gland **5** from the cover and take out the stator.

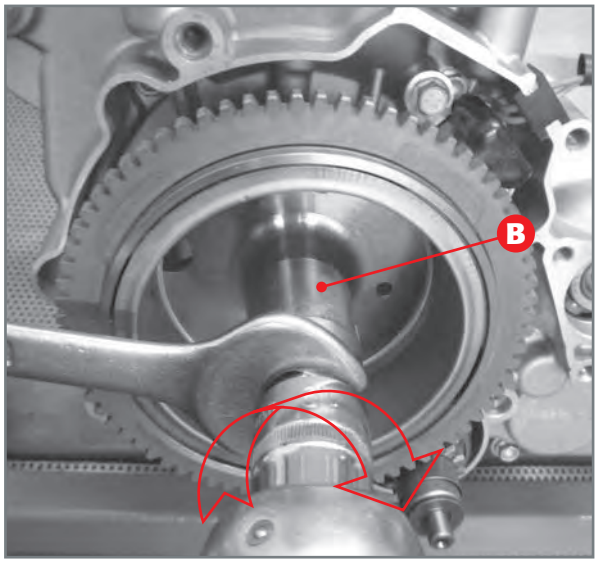



*Removal of flywheel nut.*

## 2.4.3 Flywheel removal

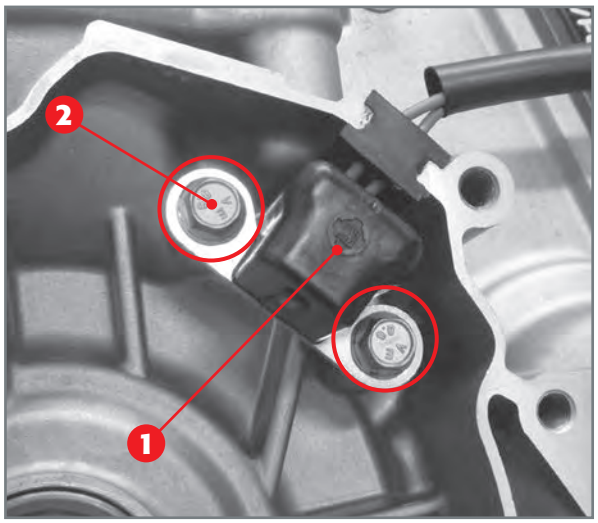
Block the flywheel using special tool **A** *(code 026140040 000)* and remove the tightening nut securing the flywheel to the crankshaft.

> ***Note:*** *Once the nut has been unscrewed, pay attention to the special elastic washer placed between nut and flywheel.*




*Release of flywheel using special tool B.*

To remove the flywheel, tighten the extractor **B** *(code 3625173)* onto the threaded part on the flywheel.
Keep the extractor blocked with a spanner and tighten the screw on the extractor using a box spanner.




*Removal of pick-up unit.*

## 2.4.4 Pick-up unit removal

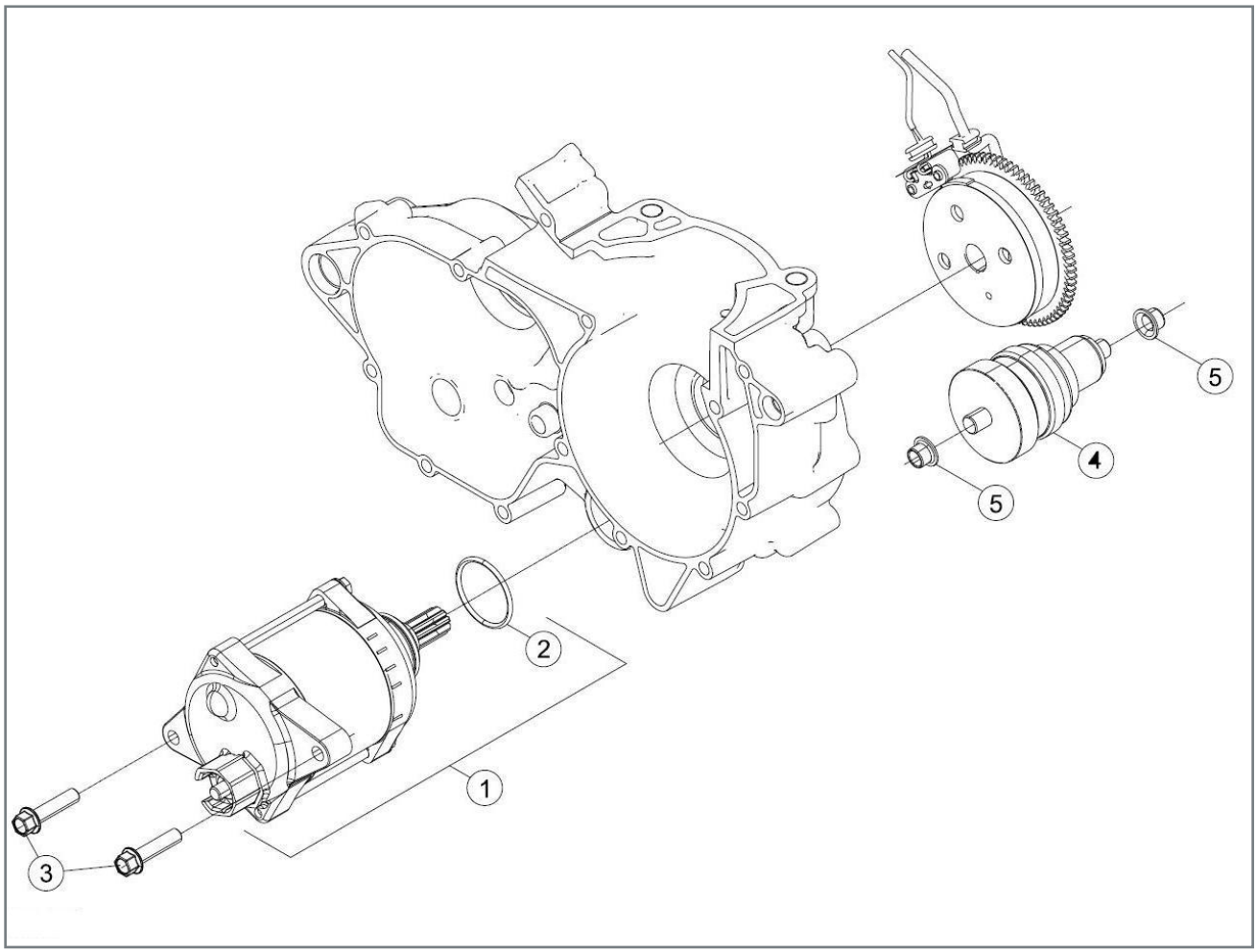
Remove pick-up unit **1** by loosening the two fixing screws **2**.

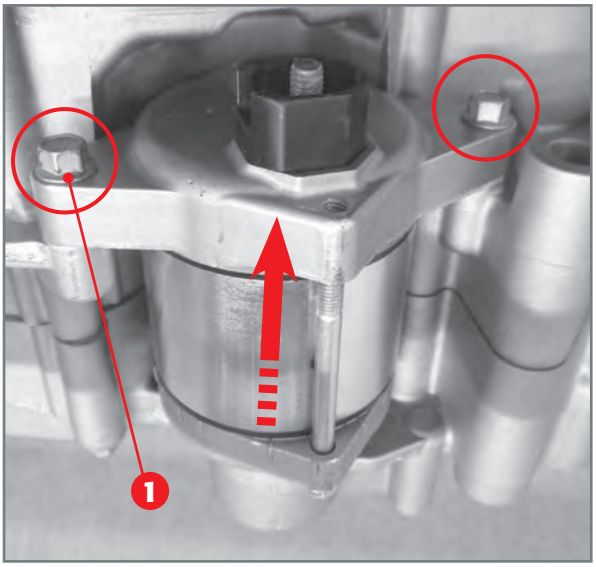
## 2.5 REMOVAL OF ELECTRIC IGNITION

Electric ignition is carried out by means of starter motor **1** that meshes on the Bendix coupling **4**. The coupling gear axially shifts and meshes onto the ring gear, which is one with the flywheel, due to the start motor rotation. The coupling gear retracts to its rest position, once the motor action ends.

***EXPLODED VIEW OF ELECTRIC KICKSTARTER:***

***1) Start motor;***
***2) O-ring;***
***3) Screws;***
***4) Bendix coupling;***
***5) Bush with collar.***

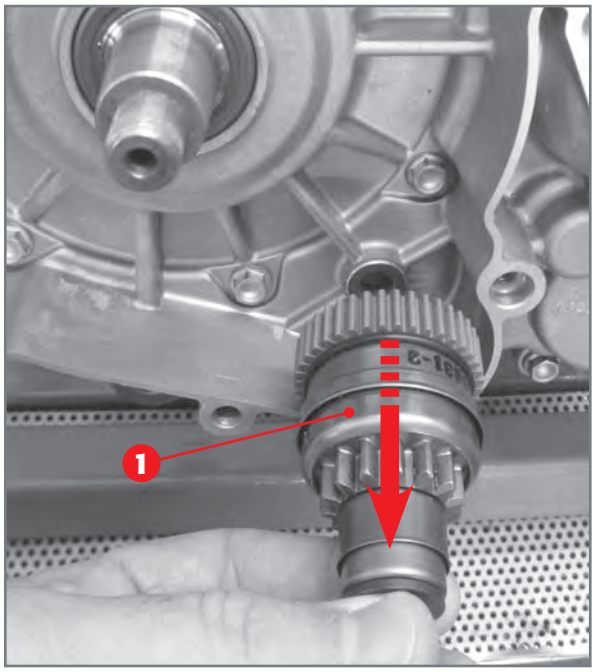





*Removal of start motor.*

## 2.5.1 Start motor removal

Remove the two screws **1** and extract the motor.




*Bendix coupling removal.*

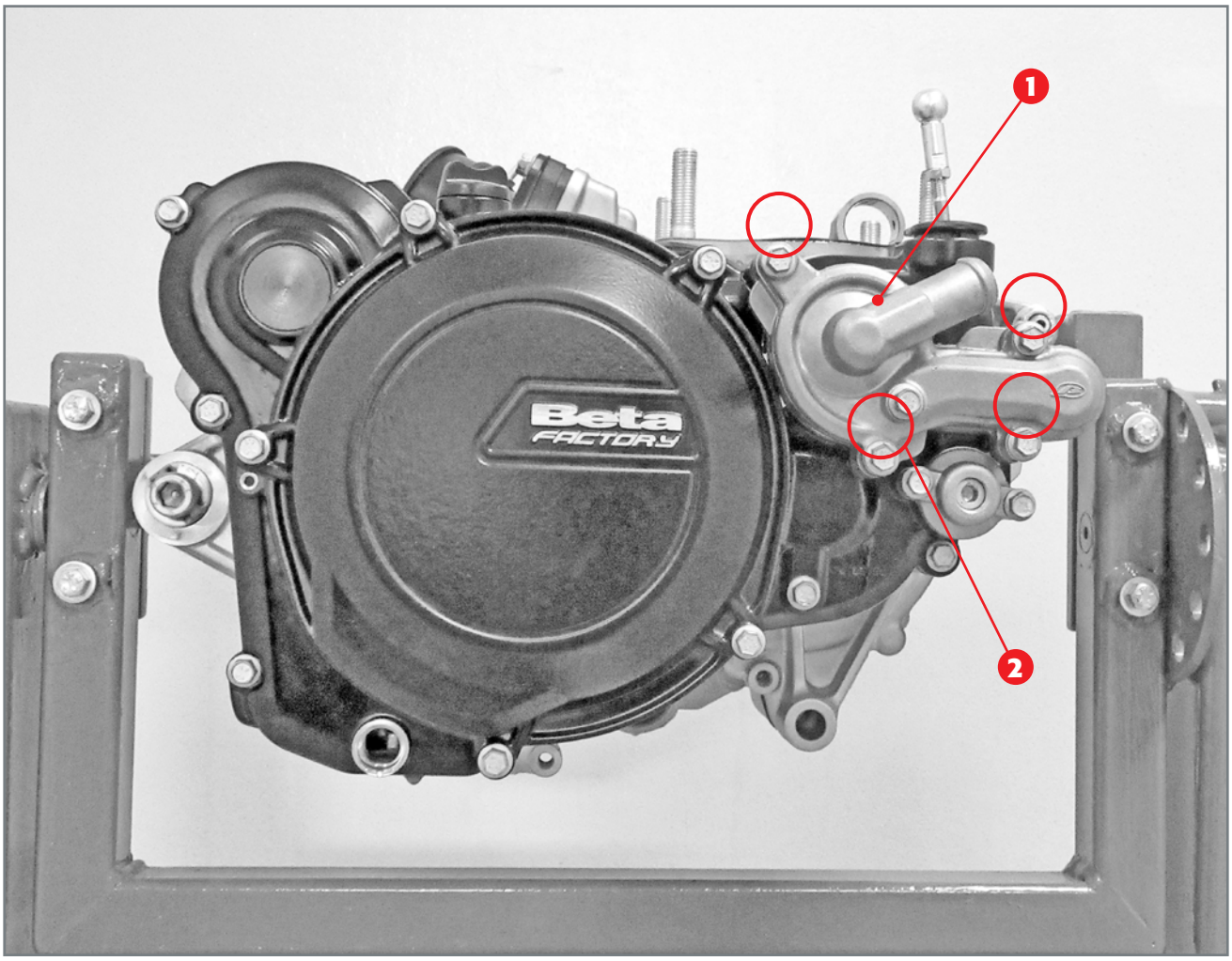
## 2.5.2 Bendix coupling removal

Extract the Bendix coupling **1** once the complete flywheel cover and flywheel have been removed (see par. 2.4.1).

## 2.6 REMOVAL OF COOLANT LIQUID PUMP, CLUTCH UNIT, PRIMARY GEAR, CENTRIFUGAL UNIT, GEARSHIFT PARTS, KICKSTARTER

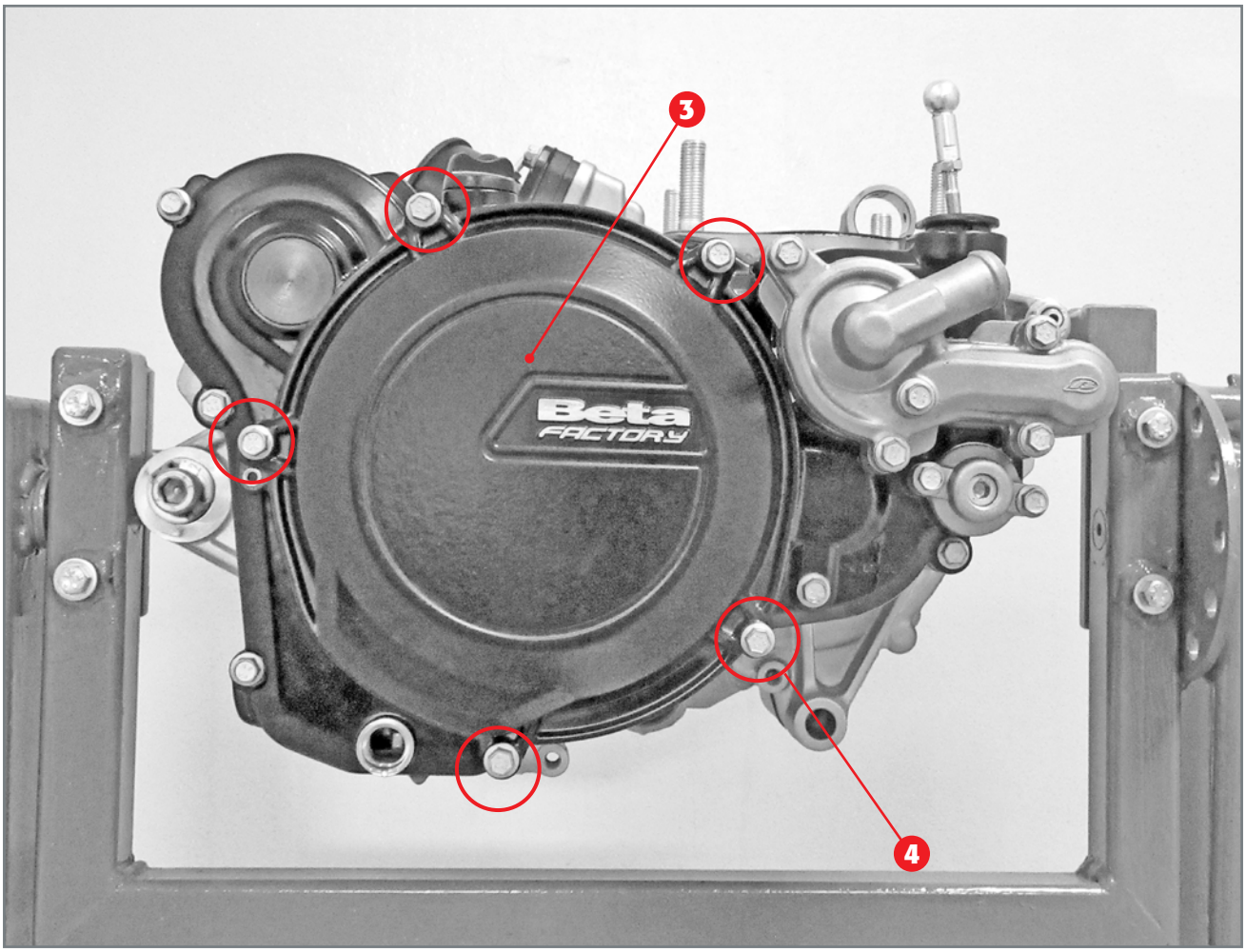
Remove the cover 1 by loosening the screws 2 to access the coolant liquid pump.

***Note:*** *remove the coolant liquid pump impeller if work needs to be done on the centrifugal unit.*



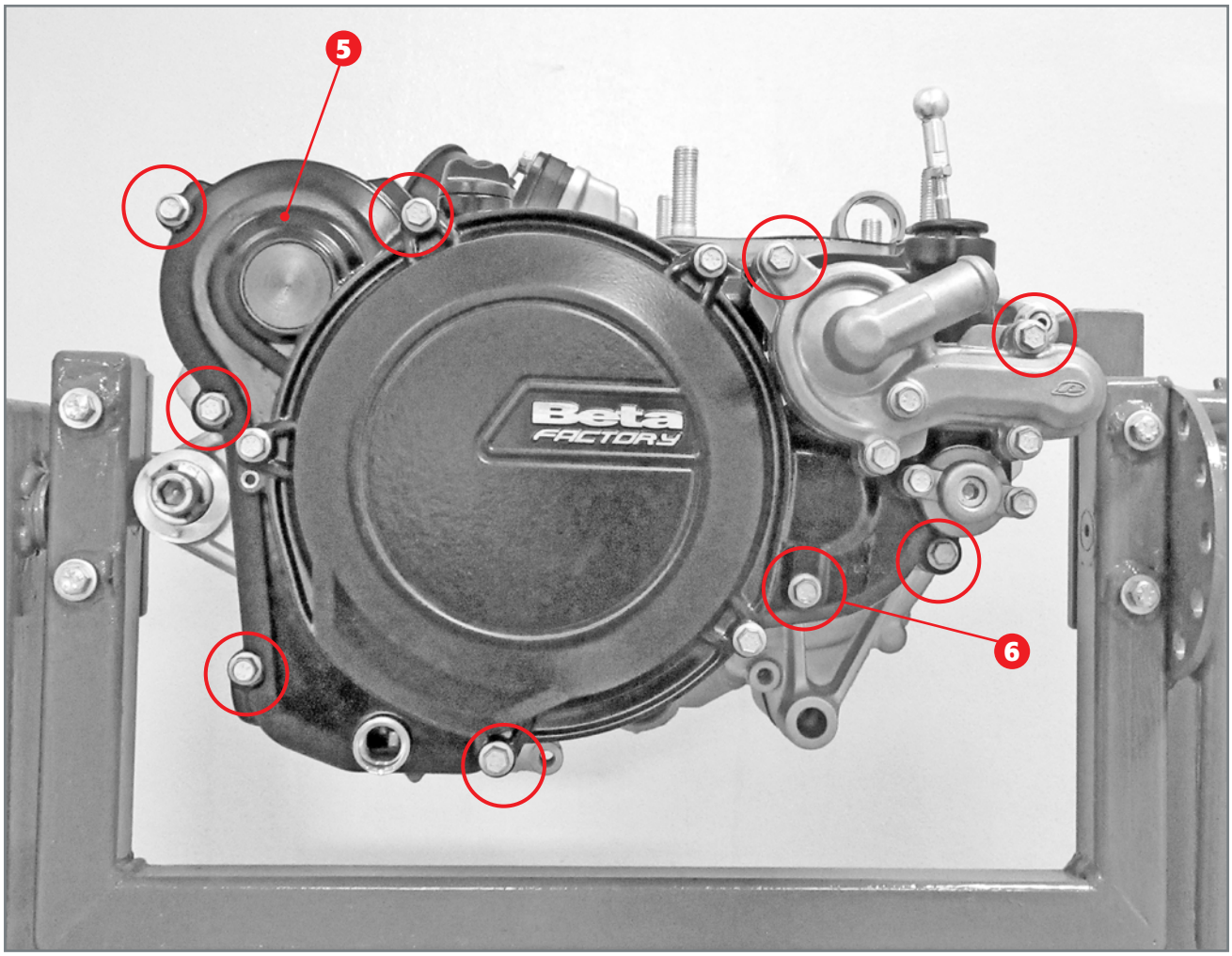

***Coolant liquid pump cover screws.***

In order to only access the clutch unit, the outer clutch cover **3** must be removed by loosening the screws **4**.

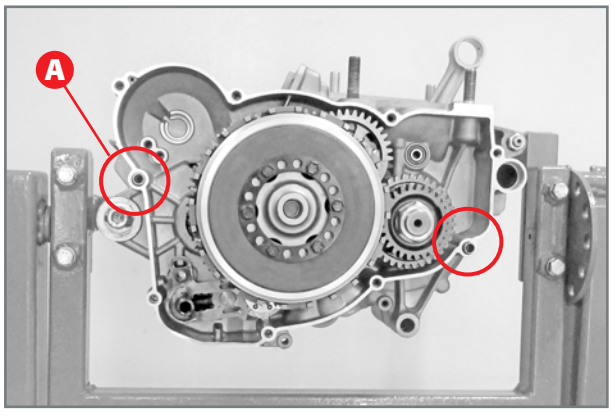



***Outer clutch cover screws.***

When doing a complete overhaul of the engine or of gearshift organs, kickstart, primary transmission or centrifugal unit, the inner clutch cover **5** must be removed by loosening the nine screws **6**.




***Inner clutch cover screws.***

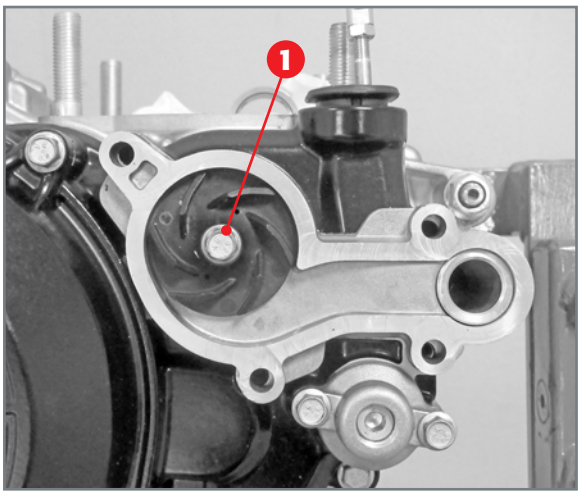



***Two centring pins A for inner clutch cover coupling.***

Pay attention to the two reference pins **A** placed between the right crankcase half and the inner clutch cover while disassembling.

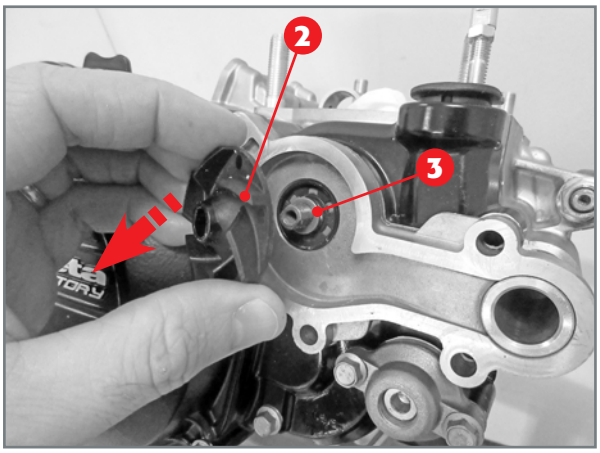
## 2.6.1 Removal of coolant liquid pump

Loosen fixing screw **1** once the coolant liquid pump cover has been removed.



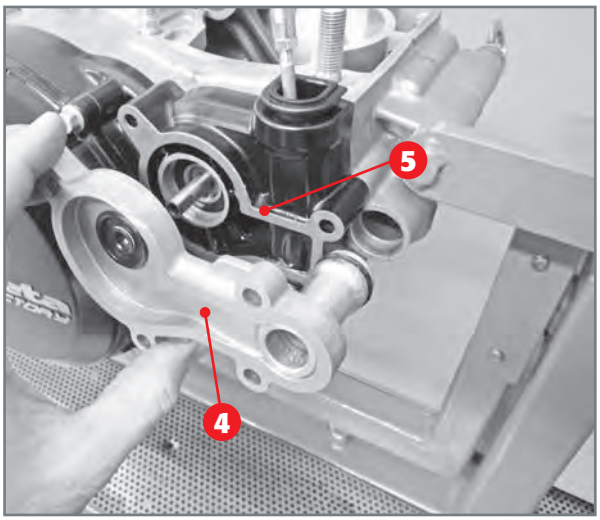

*Cooling pump fixing screw.*

Extract the impeller **2** and the thrust washer **3**.

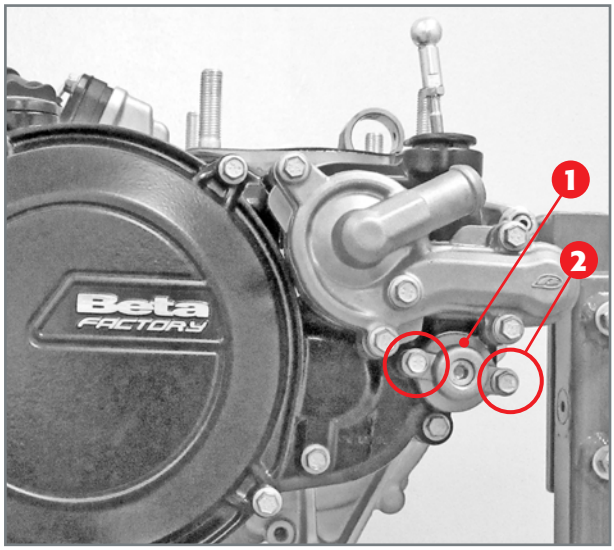



*Removal of impeller.*

Extract the complete pump body **4** and remove gasket **5**.



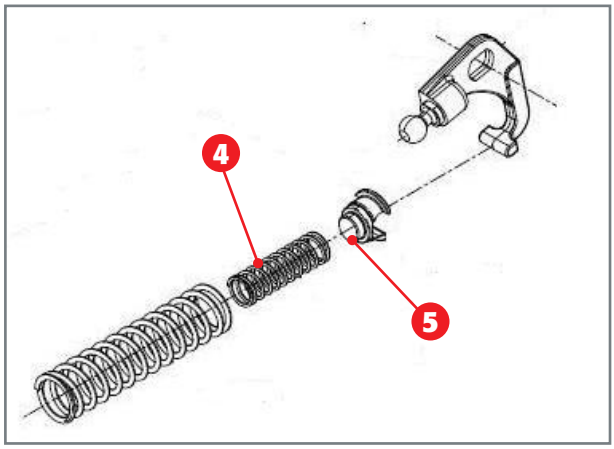

*Removal of pump body and gasket.*



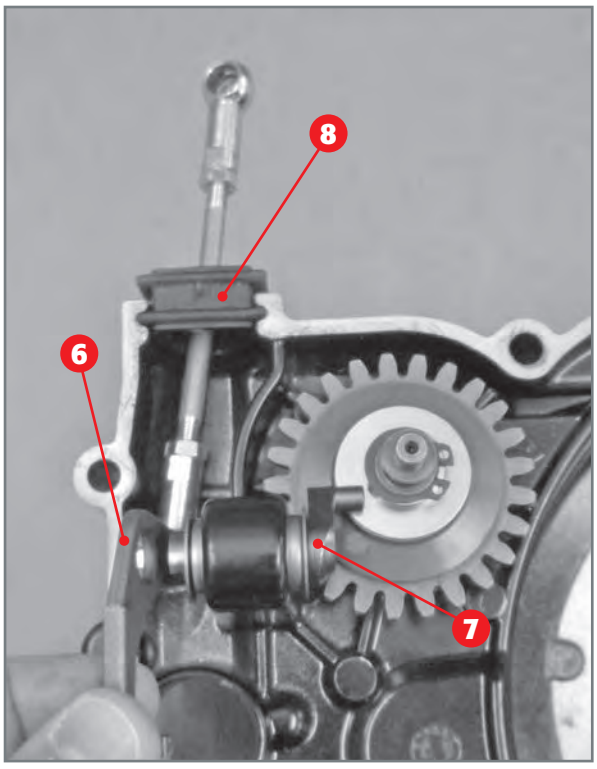

*Removal of centrifugal adjustment cover.*

## 2.6.2 Removal of centrifugal unit and linkage

Access the centrifugal unit and linkage by removing the inner clutch cover. Disassemble the adjustment cover **1** by removing the two screws **2**, once the pump impeller has been removed (par. 2.6.1).

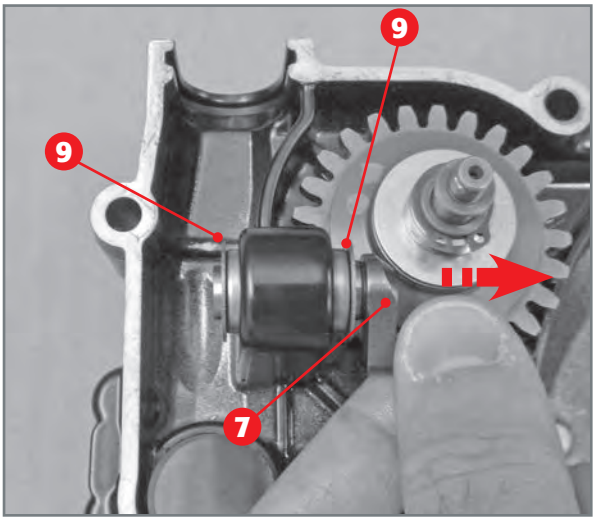



Remove the assembly consisting of adjusting springs **3**, auxiliary springs **4** and spring guide **5**.



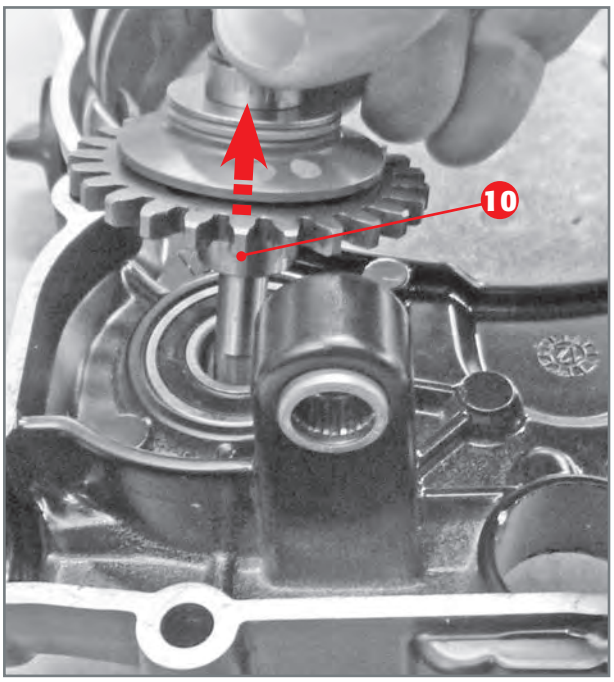

*Disassembly of control rod-rocker arm unit.*

After removing the screw fixing the rocker arm **6** to the centrifugal control lever **7**, extract the rocker arm with control rod and gasket **8**.



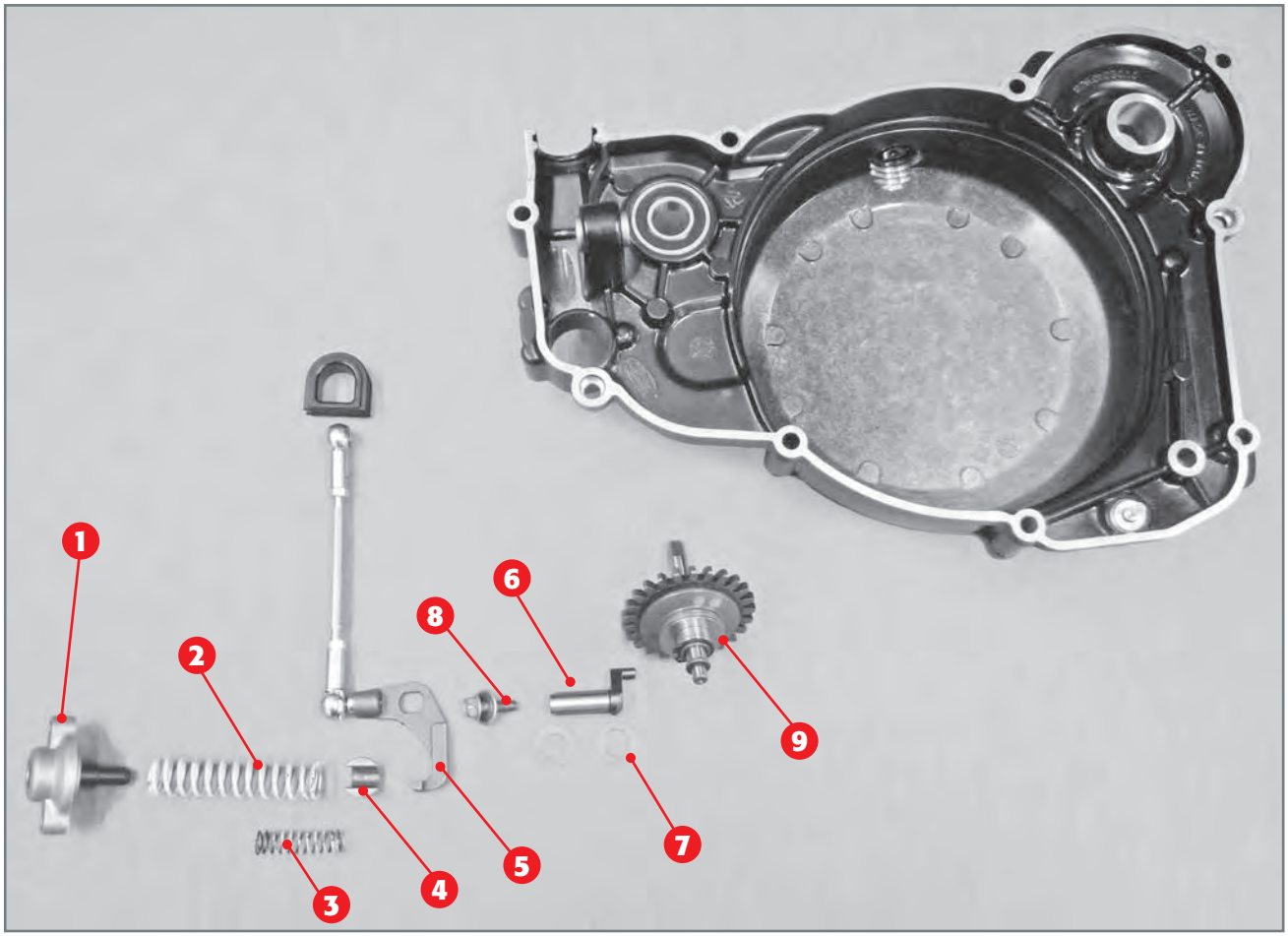

*Removal of centrifugal control lever.*

Extract the centrifugal control lever **7** together with the two thrust washers **9**.



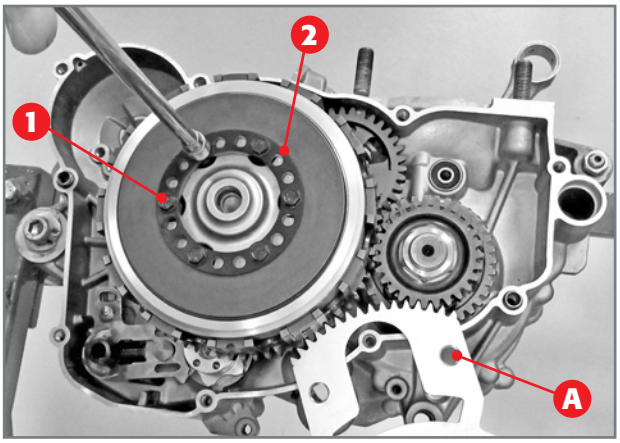

*Extraction of centrifugal unit.*

Extract the complete centrifugal unit **10**.

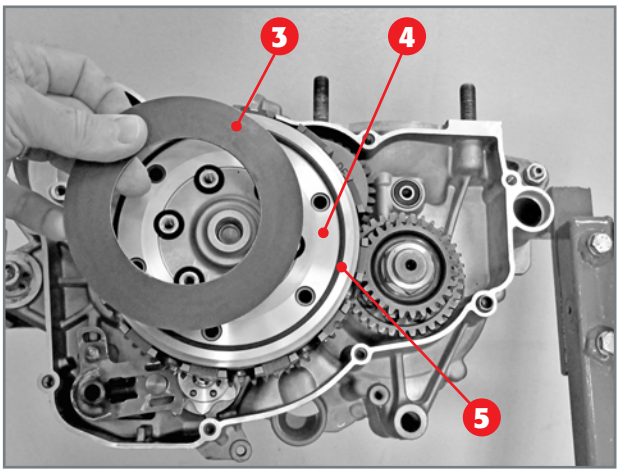



*1) Adjustment cover;*
*2) Adjustment spring;*
*3) Auxiliary spring (if any);*
*4) Spring guide;*
*5) Rocker arm;*
*6) Centrifugal control lever;*
*7) Thrust washers;*
*8) Screw;*
*9) Centrifugal unit.*

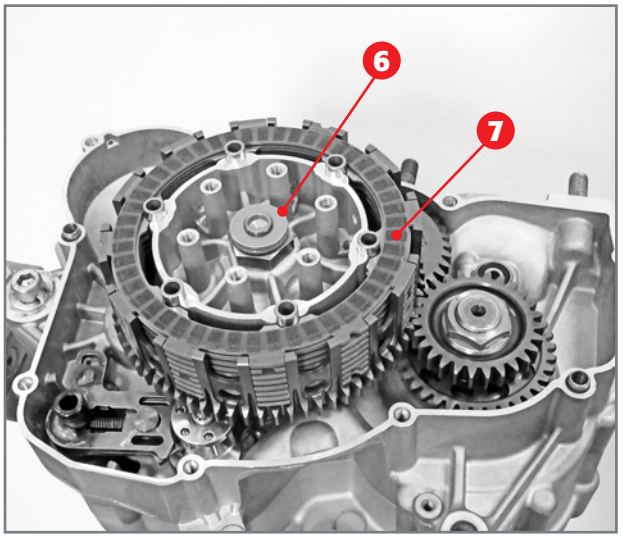
## 2.6.3 Disassembly of clutch unit and countershaft counter-weight



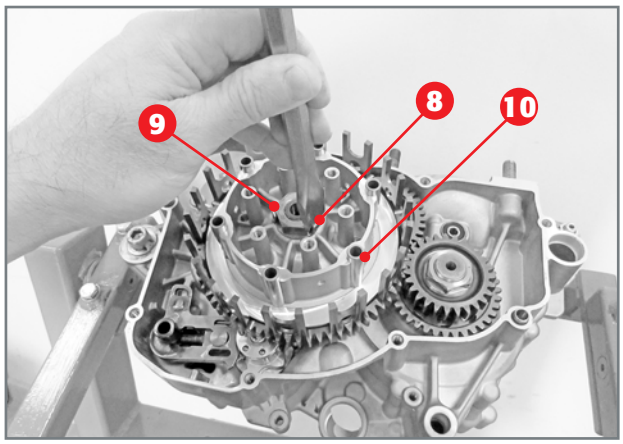

Keeping the clutch unit locked using the special tool **A** (code 037.14.002.50.00) remove the screws **1** that join the ring 2 to the clutch drum.




Remove the spring washer **3**, the pressure plate **4** together with the ring **5**.

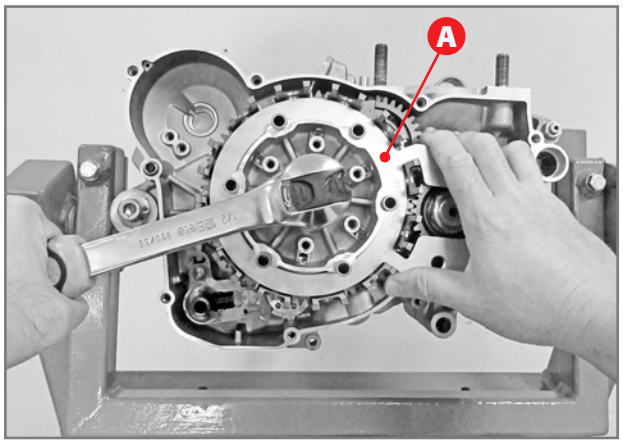



Extract the complete pressure plate unit **6** and the clutch disc pack **7**.



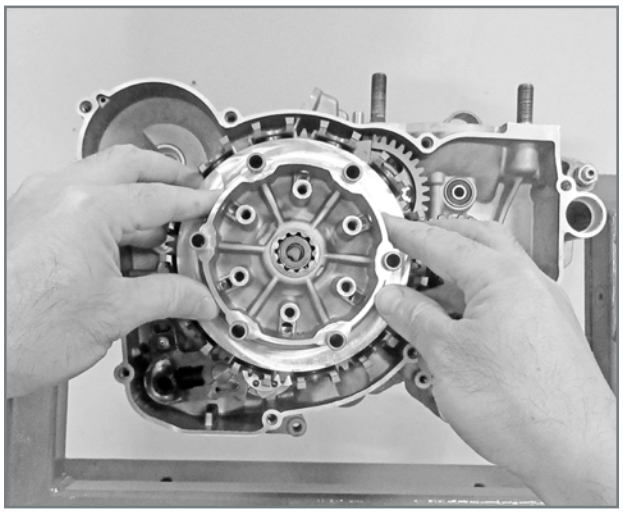

In order to complete disassembly of the clutch unit, open the safety washer **8** by using a chisel and remove the nut **9**.

***ATTENTION!***
*Do not remove the sliding pins **10**.*

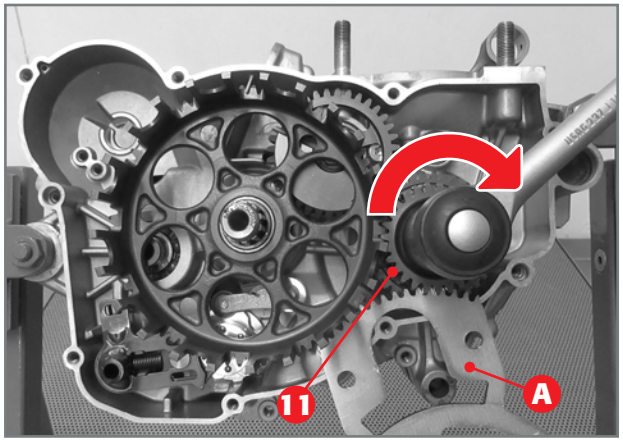



To unscrew the nut **9**, the clutch drum must be blocked with the appropriate tool **A** (code 037.14.002.50.00).
Then remove the nut and relevant safety washer.

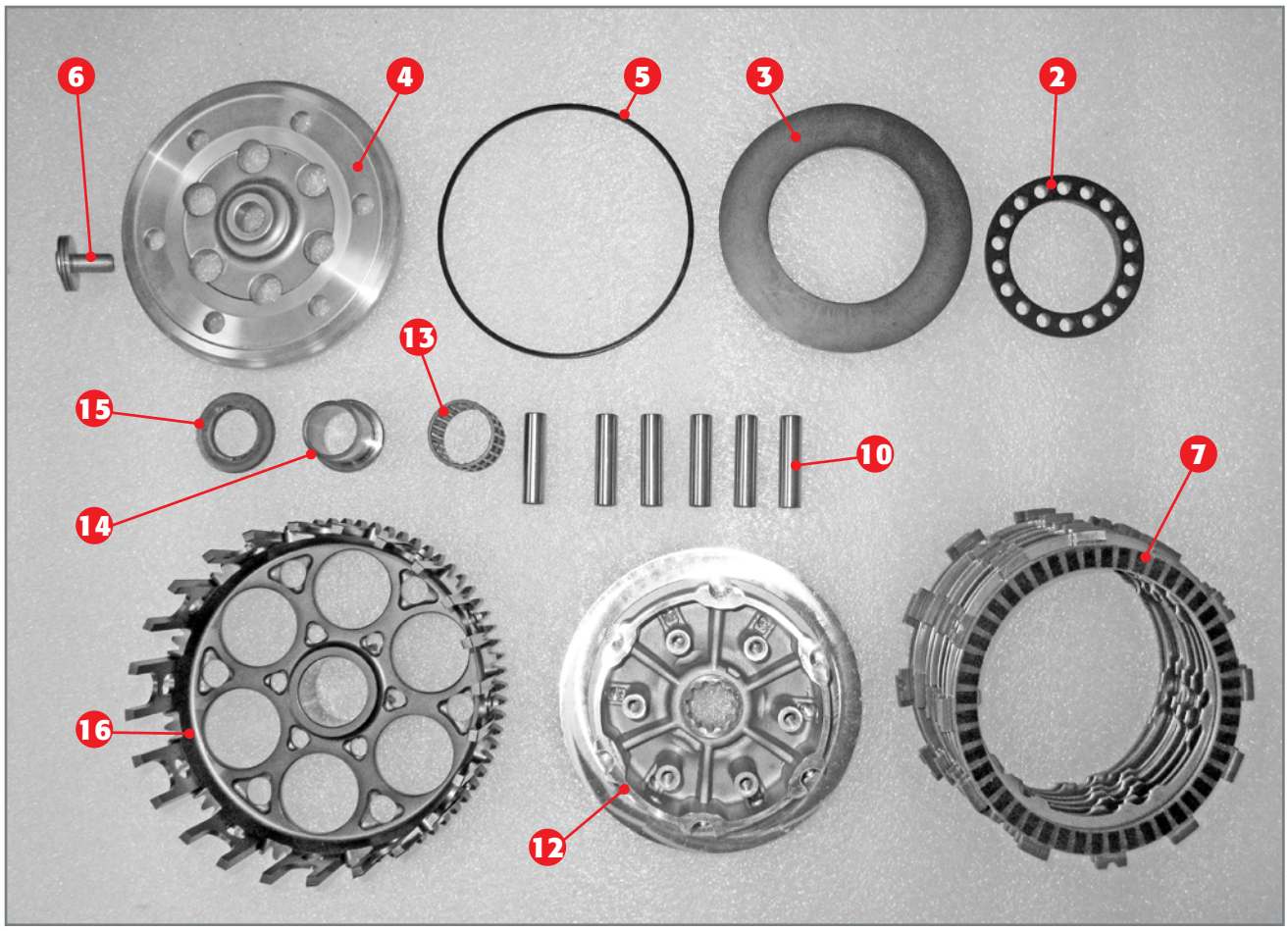
***ATTENTION!***
*Do not use the pneumatic gun.*



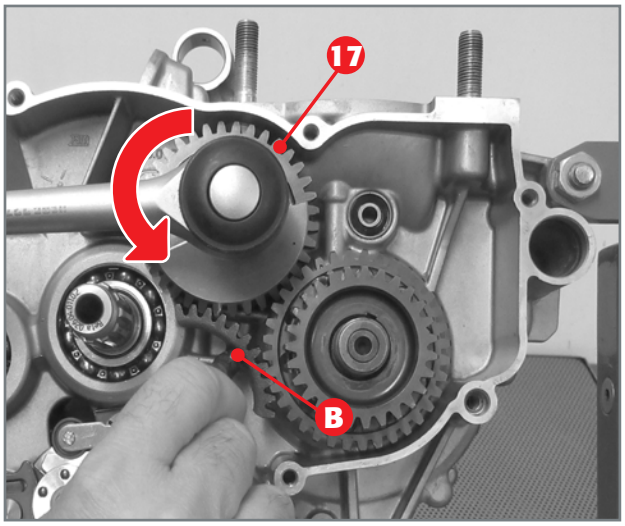
Remove the clutch drum together with the slip pins followed by the spacer washer.



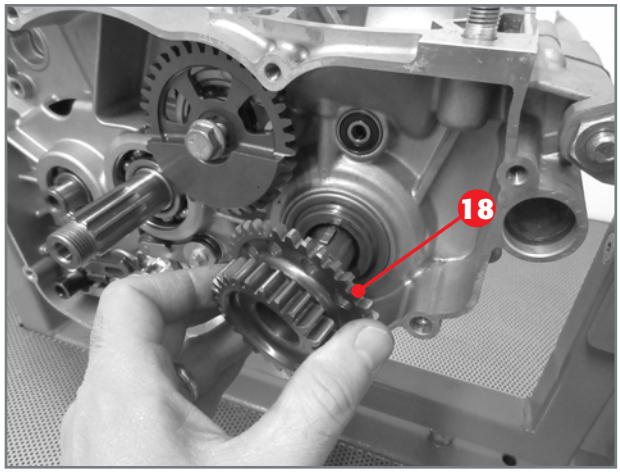

Using the special primary tool **A** (code 037.14.002.50.00), disassemble the nut that tightens the primary gear **11** onto the crankshaft.



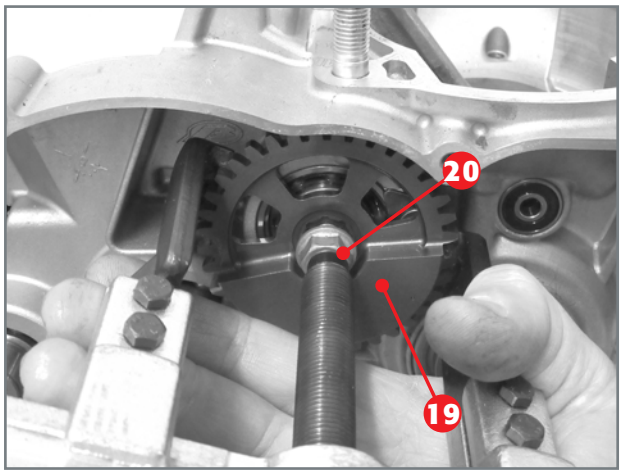

*2) Ring, **3**) Spring washer, **4**) Pressure plate, **5**) Ring, **6**) Thrust bearing, **7**) Clutch disc unit, **10**) Slip pins, **12**) Clutch drum, **13**) Needle bearing, **14**) Slew bearing, **15**) Spacer washer, **16**) Clutch bell.*




Keep the counterweight locked in place **17** using the special tool **B** (code *026.14.012.50.00*) and loosen the screw.




Extract the primary gear **18**.
Removal can be facilitated by using a universal extractor.

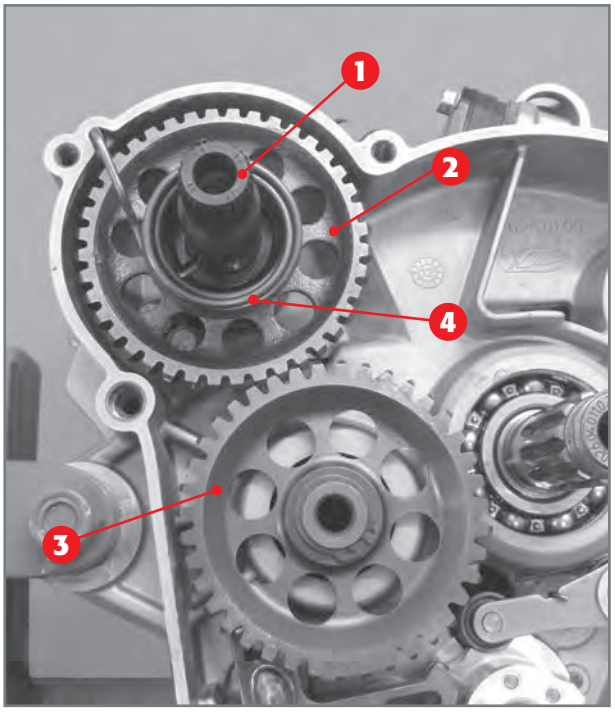



Using the extractor, remove the countershaft **19**.

***Note:*** *it is advisable to keep the locking screw* ***20*** *in place, using it as a support for the extractor.*

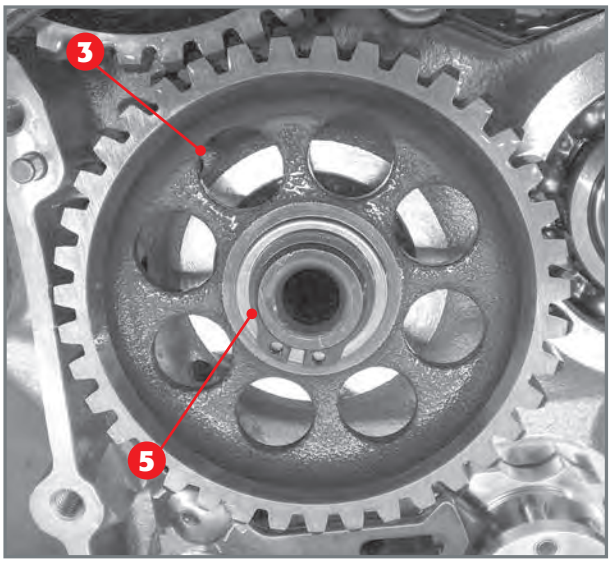
## 2.6.4 Pedal kickstarter - Optional

The pedal kickstarter consists of the pedal which, attached to the kickstarter shaft **1**, moves the kickstarter gear **2**. This gear moves the idler wheel **3**, which engages in its turn with the clutch case. The device recoils thanks to the spring **4**.

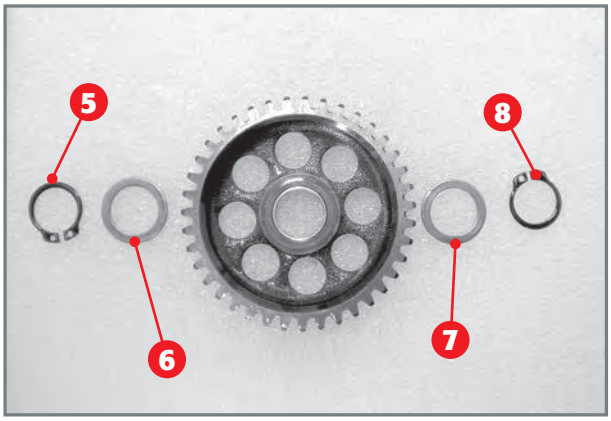



*The pedal kickstart.*

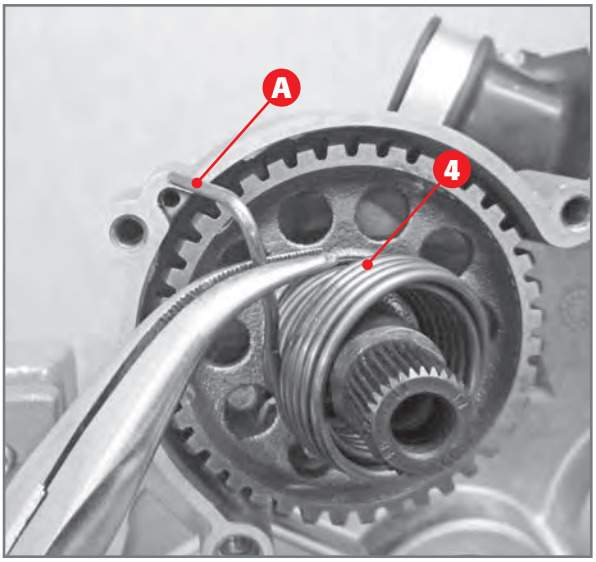
Remove the external circlip **5** and extract the external thrust washer **6**, the idler gear **3**, the internal thrust washer **7** and the second circlip **8**. The circlips and thrust washers are interchangeable.




*Removal of circlip 5 of idler gear 3.*




*Two circlips 5 and 8 and thrust washers 6 and 7.*



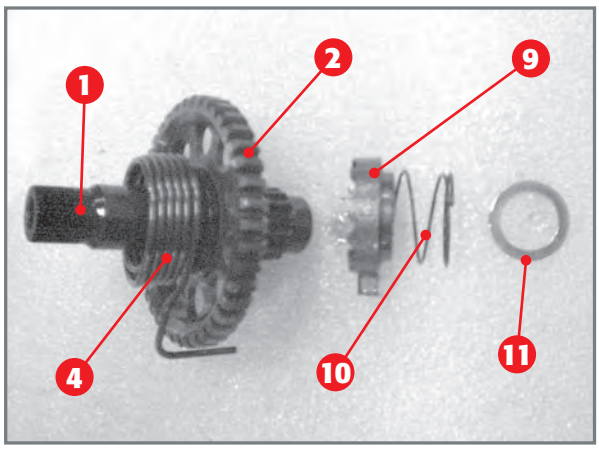

*Releasing spring from crankcase.*

Using a pair of pliers, pull the end **A** of the spring **4** out of the housing hole on the crankcase and move it to a resting position by turning it anti-clockwise.



*Extraction of shaft from crankcase.*

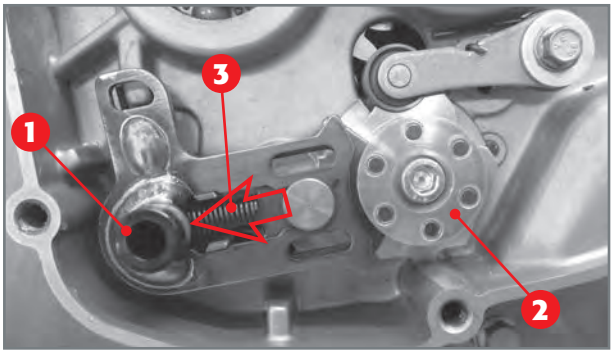
Turn the shaft anti-clockwise and extract it together with the sleeve **9**, the spring **10** and the thrust washer **11.**

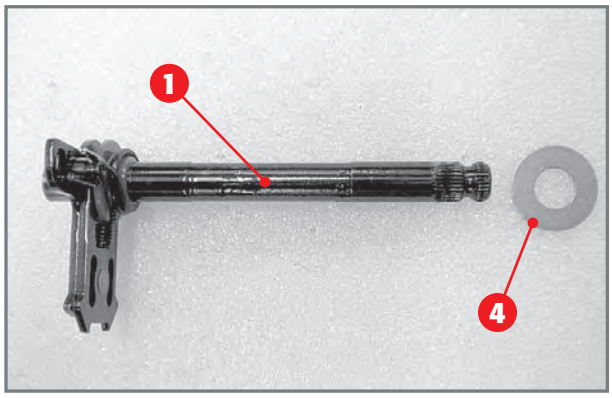



*Complete pedal kickstarter shaft.*

## 2.6.5 External gearshift unit

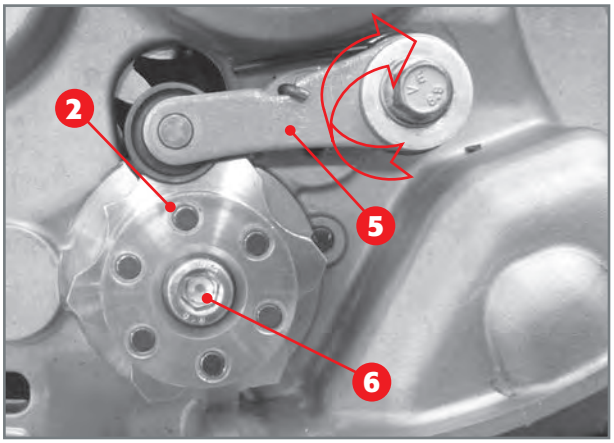
The external gearshift consists of the drive shaft **1** on which the movable and fixed pawls are applied. The fixed pawl is the guide of the movable pawl, which has the task of engaging the stop cam **2**. In its turn, this is fastened to the internal gearshift and is kept in the fixed position by the cam stop lever.
In order to disassemble the drive shaft, just keep the movable pawl return spring **3** compressed and extract the shaft together with the specific washer **4**.



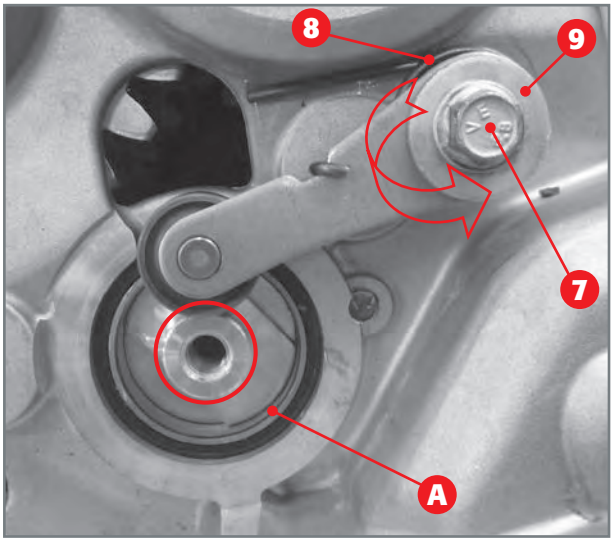

***Gearshift with washer.***

In order to disassemble the stop cam **2**, keep the cam stop lever moved **5**, loosen the screw **6** and pull out the stop cam **2**.




***Disassembly of gear stop cam.***

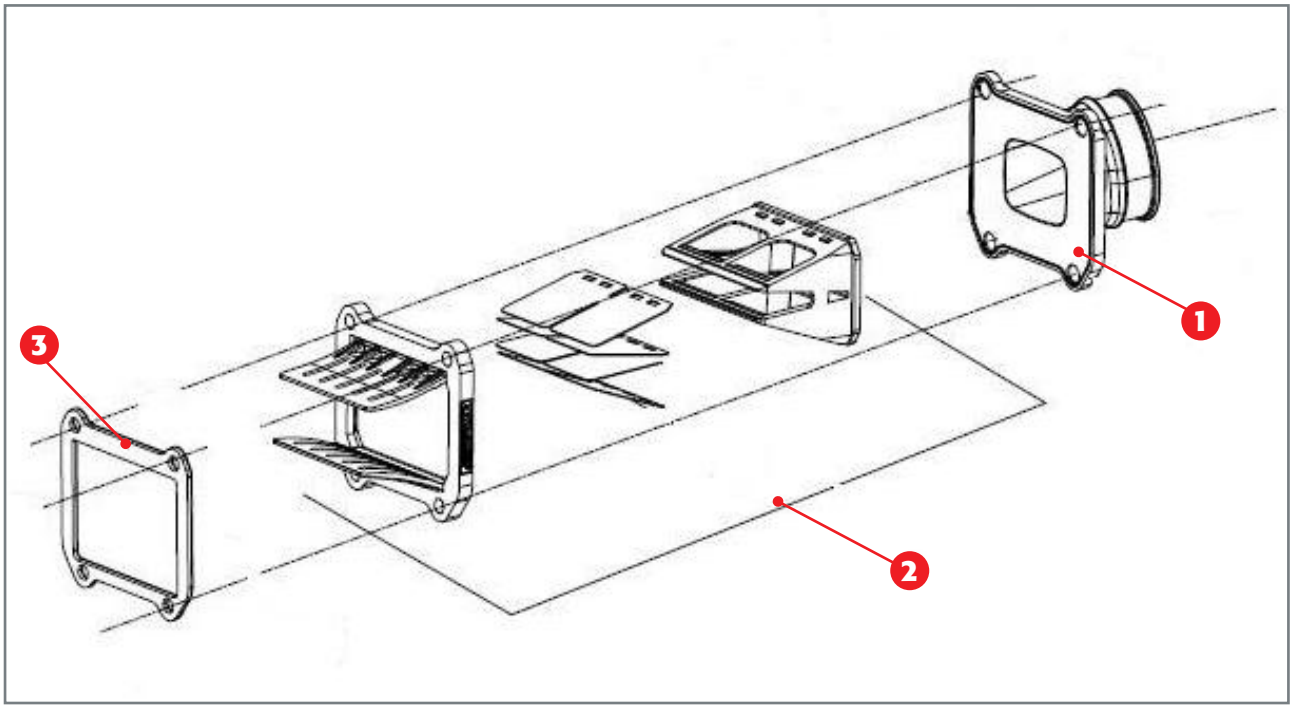
In order to disassemble the stop lever, loosen the screw **7** enough to allow the lever to move axially and go over the cylinder segment **A** of the desmodromic device. Move the return spring **8** to the resting position and remove the screw, the washer **9**, the spring together with the spacer, the internal washer (not shown in the image) and finally the cam stop lever.



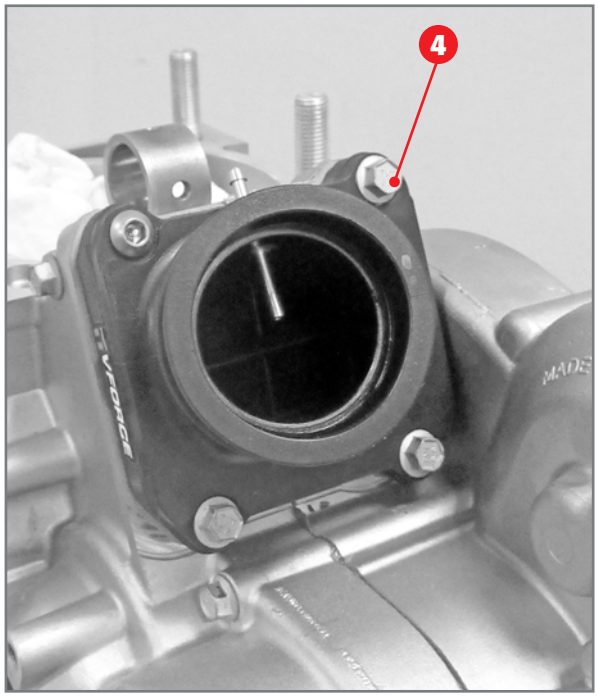

***Disassembly of cam stop lever.***

## 2.7 INTAKE SYSTEM

The intake system mainly consists of the intake manifold **1** and reed valve **2** and the spacer **3**.




***1) Intake manifold;***
***2) Complete reed valve;***
***3) Gasket.***



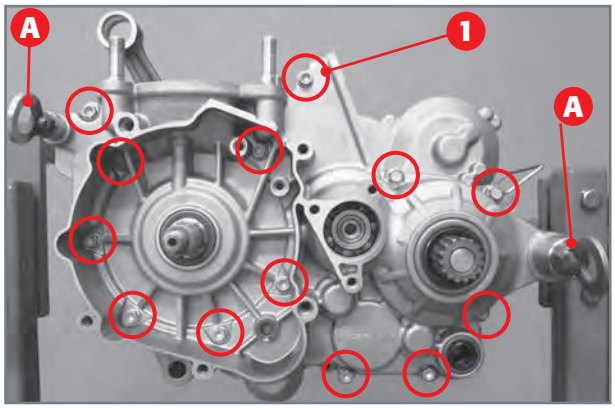

***Fixing screws.***

Disassemble by removing the screws **4** fastening the intake manifold and the reed valve to the crankcases.

## 2.8 CRANKSHAFT, GEARBOX UNIT AND INTERNAL GEARSHIFT

To access the crankshaft, gearbox unit and internal gearshift, the left and right crankcases must be detached. Below are the required instructions.

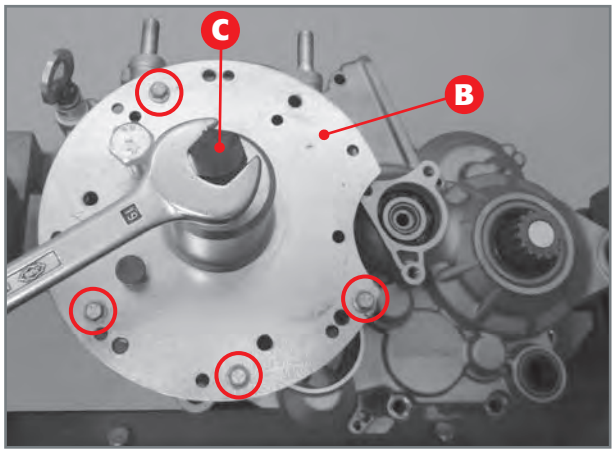
### 2.8.1 Opening the crankcase



*Removal of crankcase screws.*

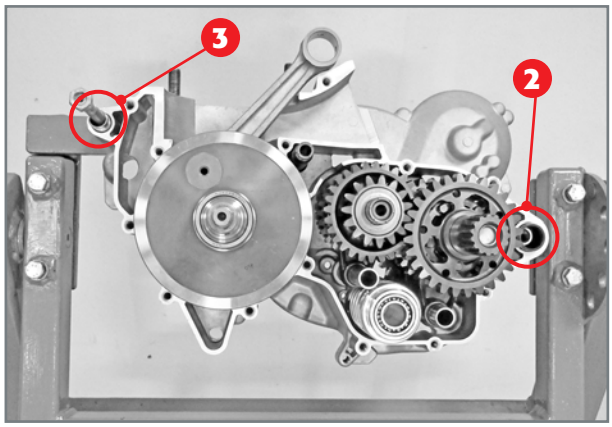
Remove the thirteen screws **1** fastening the crankcases.

***ATTENTION!***
*Loosen the two screws A fixing to the equipment.*



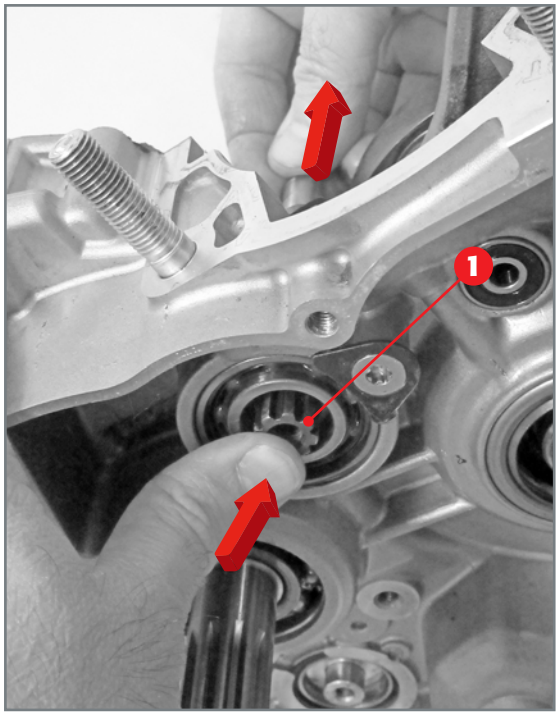
*Crankcase uncoupling stage.*

Apply special tool **B** to the right crankcase half following the punching on the tool. Fix the tool with four M6x20 screws (maximum torque 10Nm). Tighten screw **C** on the special tool. Slightly hit the gear secondary with a rubber mallet during said operation.
Once the crankcases have been detached, remove the two screws fixing to the equipment **A** and remove the left crankcase.



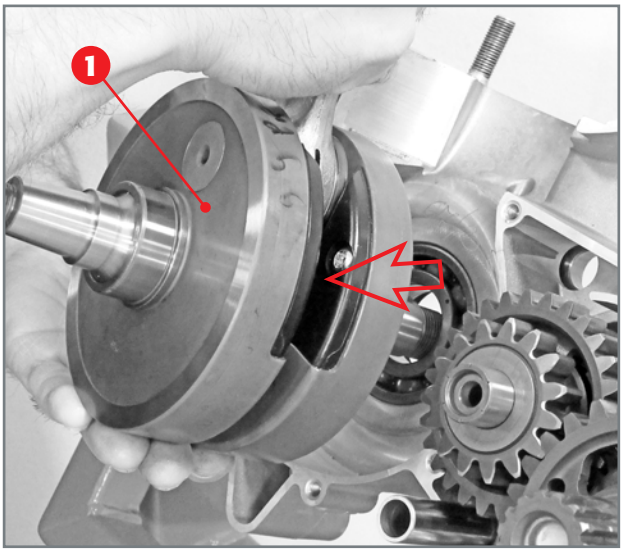
*Crankcase half reference pins.*

Remove the two rear **2** and front **3** reference pins. Remove the coupling gasket to the two crankcases.




## 2.8.2 Counterweight support shaft

Once the crankcase halves have been uncoupled, push the counterweight support shaft inwards **1**.



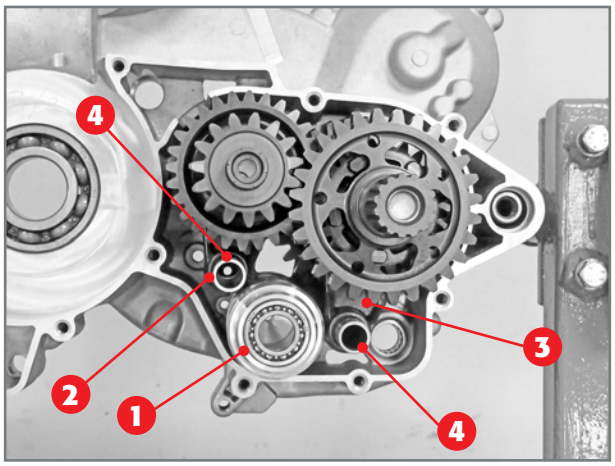

***Removal of crankshaft.***

## 2.8.3 Crankshaft

The crankshaft **1** can be pulled out manually. Gently hit the right end of the crankshaft in case of resistance.

## 2.8.4 Internal gearshift unit and complete gearbox

The internal gearshift unit consists of the desmodromic device **1** on which the fork **2** and two forks **3** are engaged. The forks, supported by the pins **4**, drive the sliding wheels of the gearbox, allowing the desired ratio to be engaged. The desmodromic device is controlled by the stop cam located in the external gearshift unit.
Manually extract the two pins **4** so that the forks can be released and removed.

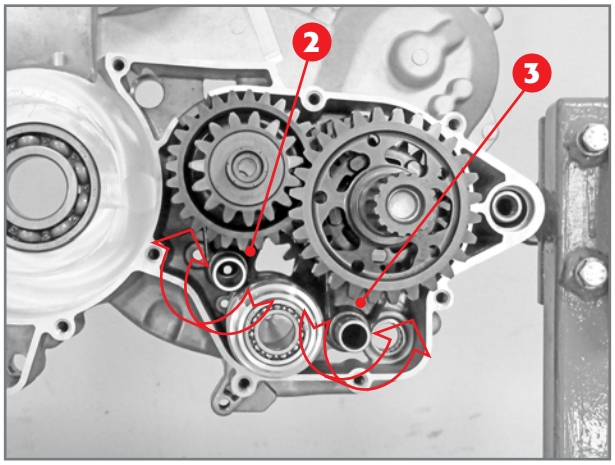



***Removal of fork support pins 1.***

Turn the fork **2** which drives the sliding gear on the primary unit clockwise, to free it from the desmodromic control.

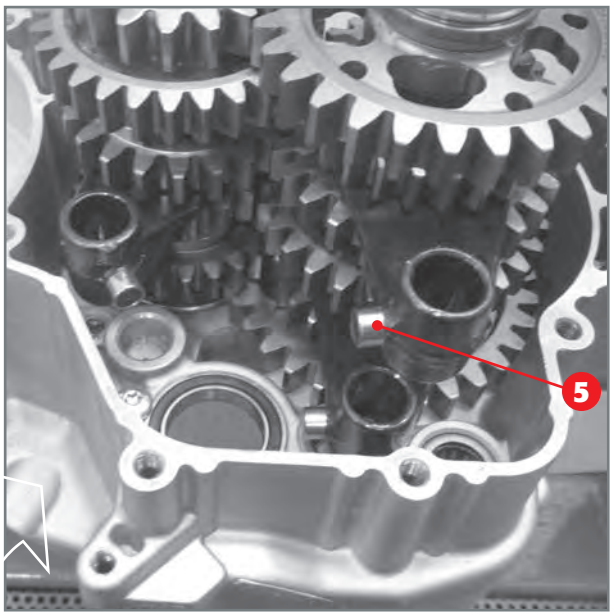
Carry out the same operation, though in the opposite direction, on the forks **3** driving the sliding gears on the secondary shaft.

Extract the desmodromic device.

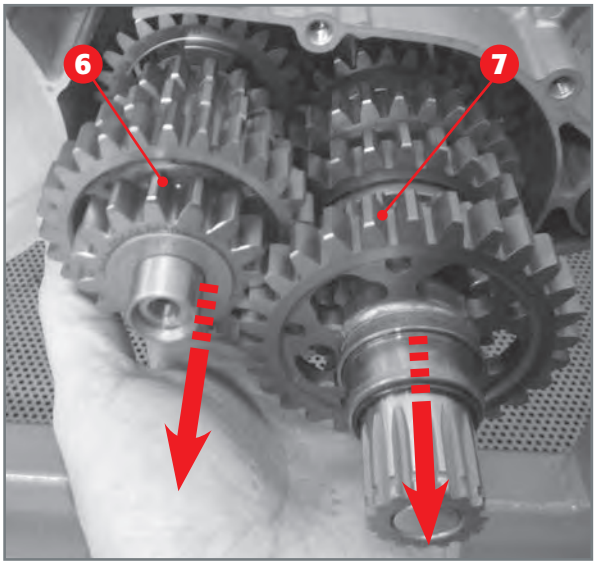



***Disengaging the drive forks from the desmodromic device.***

Extract the forks together with the guide bushes **5**.




***Extraction of forks from gearbox unit.***




***Extraction of complete gearbox unit: 6 primary unit, 7 secondary unit.***

Extract the whole gearbox unit consisting of primary **6** and secondary **7** unit.

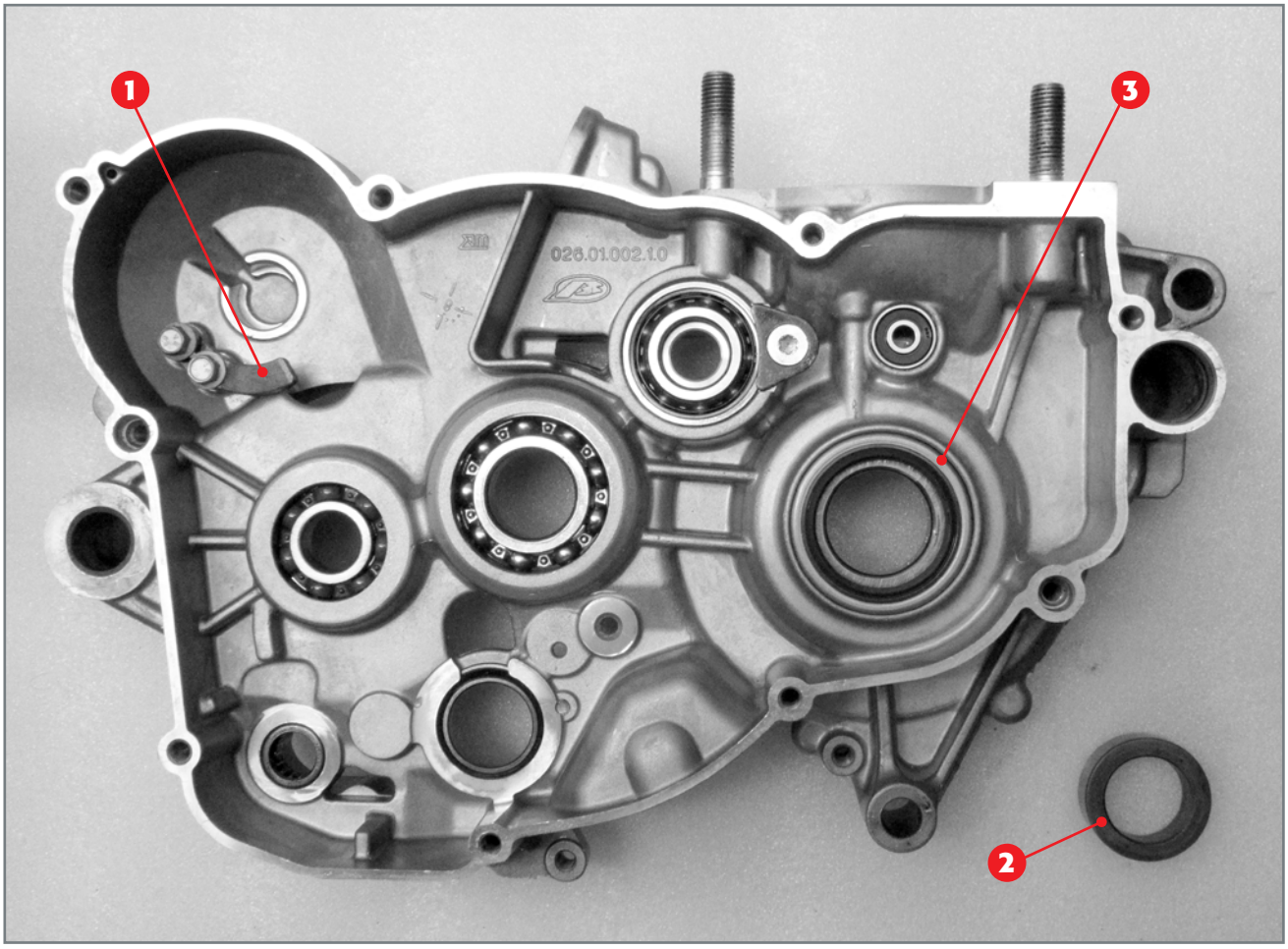
## 2.9 DISASSEMBLY OF PARTS FROM CRANKCASES

Once the crankcases have been detached, it may be required to remove the various components attached to them.

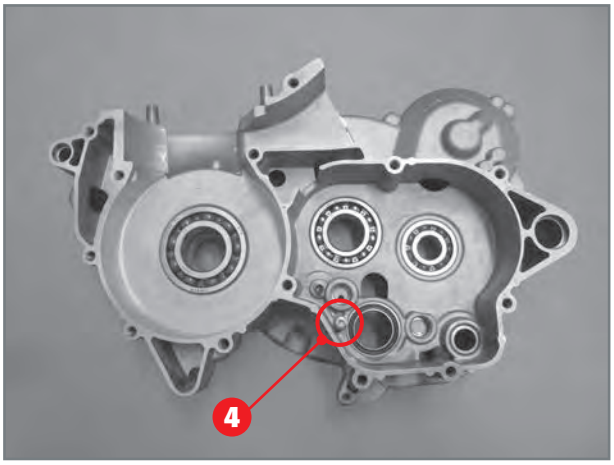
The bearings must be replaced if there is any play or jamming during rotation. For removal, heat the crankcase halves for 20 minutes at about 150°C. Place the crankcase halves on a large surface where their whole seal surface can rest. Remove the bearings by following the indications below.

### 2.9.1 Right crankcase half

On the outer side, remove the kickstarter lever **1** (optional - kickstarter), the motor shaft spacer **2** (FOR XT300 ONLY) and the crankshaft oil seal **3**.

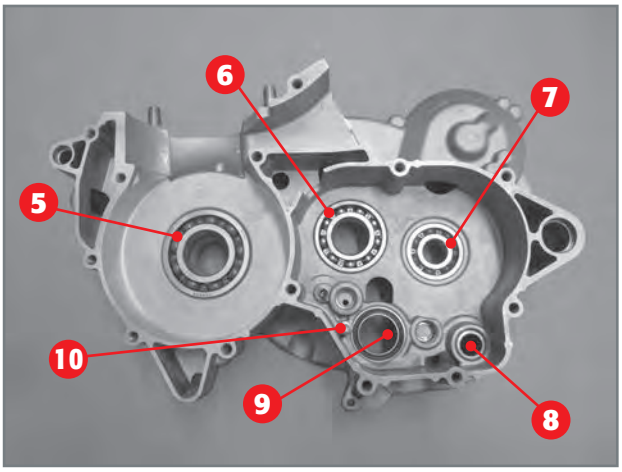



*Starter ramp 1 (Optional), crankshaft spacer 2 (RR300 only), oil seal 3.*

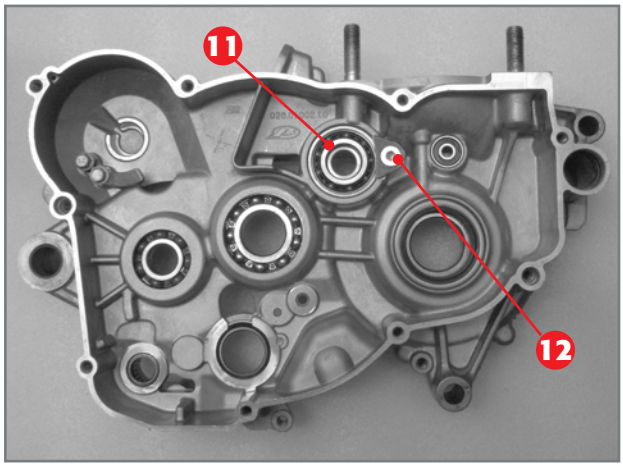



*Bearing safety screw.*

Remove the desmodromic control bearing seal screw **4** on the inside.




The bearings **5**, **6**, **7**, **8** and **9** are removed from the outside inwards.
To disassemble bearing **9** remove the fixing screw **10**.

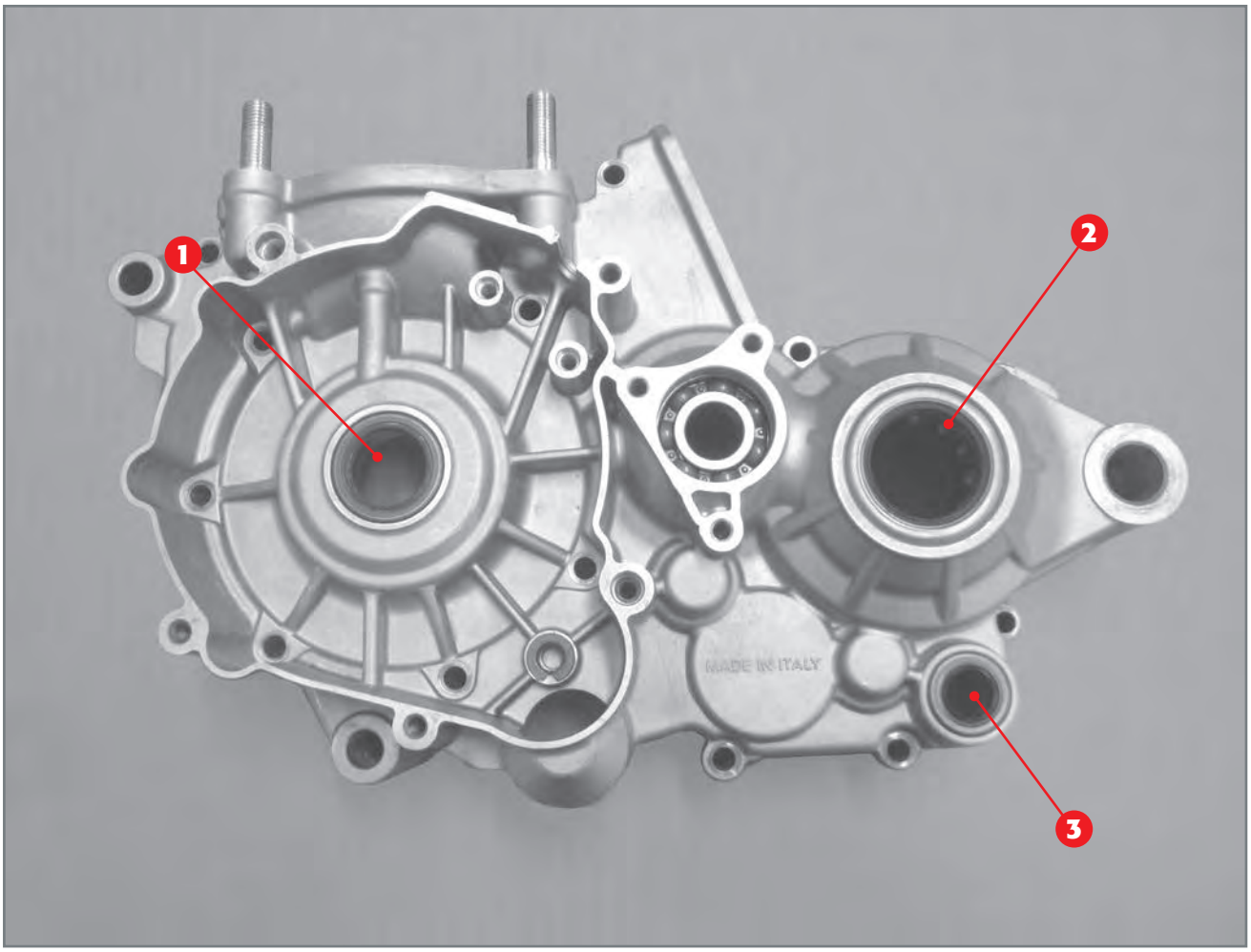



The bearing **11** is removed from the outside using a universal extractor, after removing the fixing plate **12**.

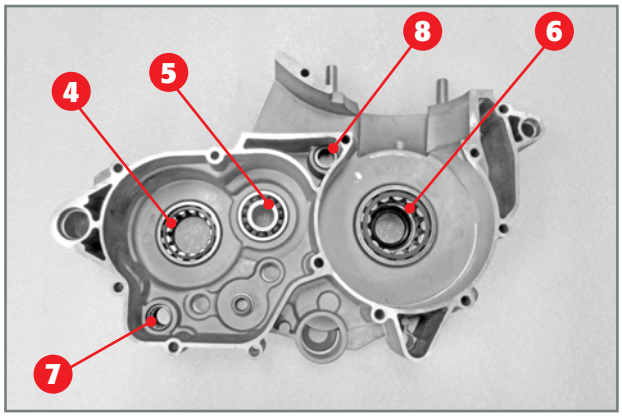
The centrifugal shaft bearing can be removed by using a universal extractor that must rest onto a purposely created metal plate.

## 2.9.2 Left crankcase half

Remove the crankshaft oil seal **1**, the secondary shaft oil seal **2** and the gearshift shaft oil seal **3** on the external side.




***Removal of outer side left crankcase half oil seal.***

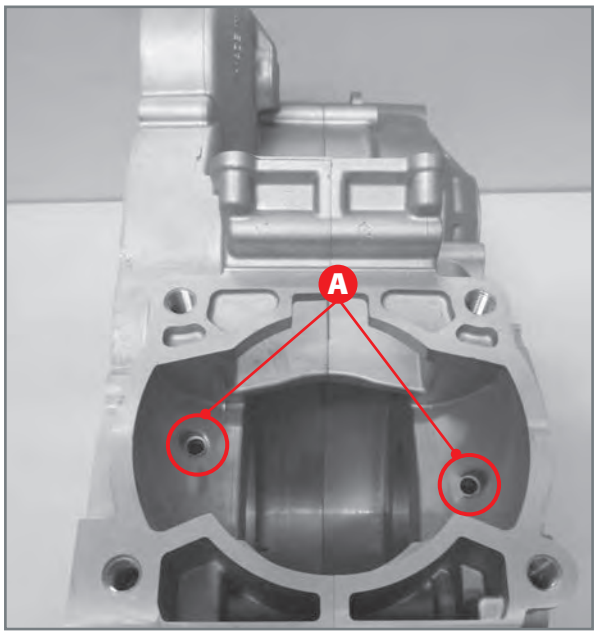



***Removal of left crankcase half bearings.***

The bearings **4**, **5**, **6**,**7** e **8** are removed from the outside inwards.

# 3 ENGINE CHECKS AND ASSEMBLY

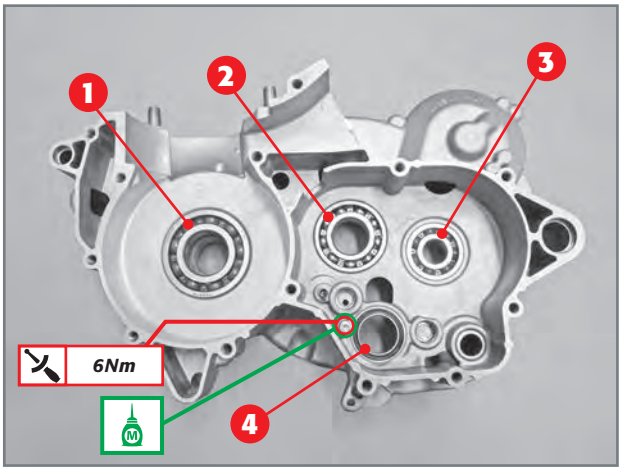
Before reassembling the engine, a series of crucial checks must be carried out to ensure the engine is in good working order.
In order to insert the bearings into the crankcase halves, heat the crankcase halves to 150°C and keep them at constant temperature for 20 minutes.
Place said crankcase halves on a large surface where their whole seal surface can rest. When the bearings cool down, they drop into their seats on their own.



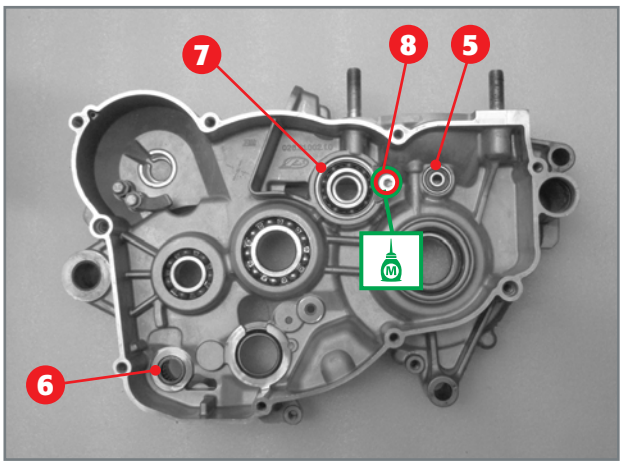

***Crankshaft bearings lubrication holes.***

## 3.1 CRANKCASE HALF

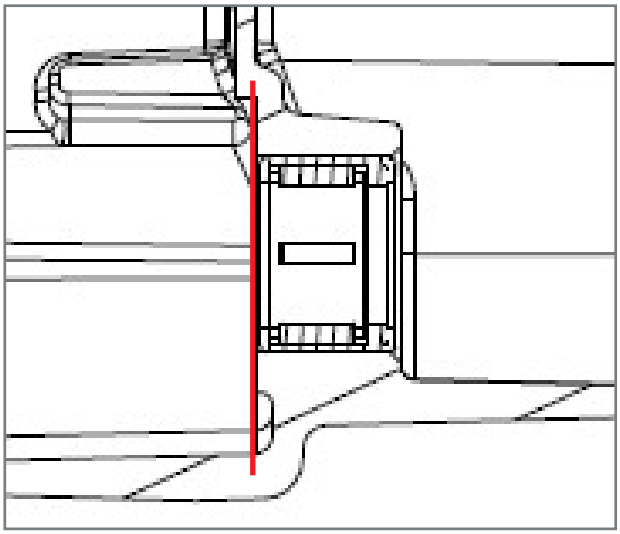
The crankcase halves have some parts that require care, and their integrity and condition must be checked. The checks and assembly operations of the individual parts coupled to the crankcases are described below. Clean the threading and oil passages **A** thoroughly by using a degreaser and compressed air.




*Positioning of the right crankcase half bearings.*




*Application of bearings from the right crankcase half external side.*



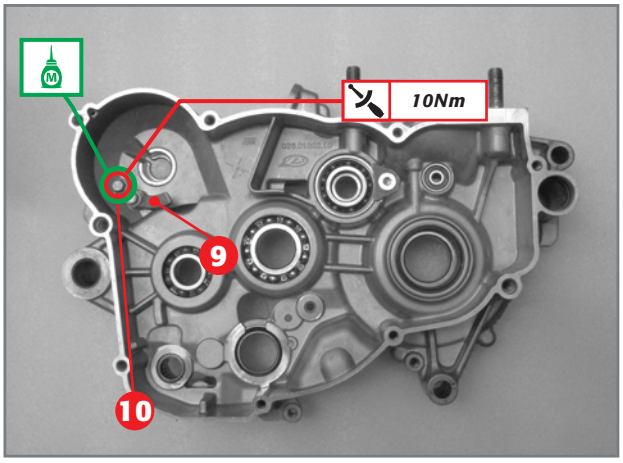
*Position of right crankcase half gearshift shaft bearing.*

## 3.1.1 Application of right crankcase half parts

Apply the bearings **1**, **2**, **3** and **4** until flush. Block bearing **4** with the specific screw after applying the threadlockers. Tighten to the specified torque.

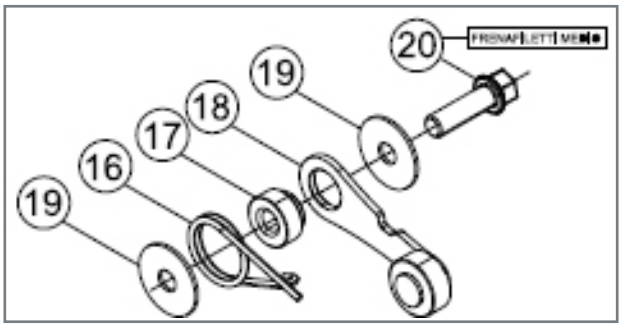
Apply the bearing **5** from the crankcase half external side, until it is flush, and bearing **6** as shown in the drawing.
Apply new oil seals, to be pressed all the way until fully seated.

Apply the bearing **7** until flush. Apply the plate **8** and fasten it with a screw after applying medium strength threadlocker. Tighten to the specified torque.




*Application of kickstart ramp.*

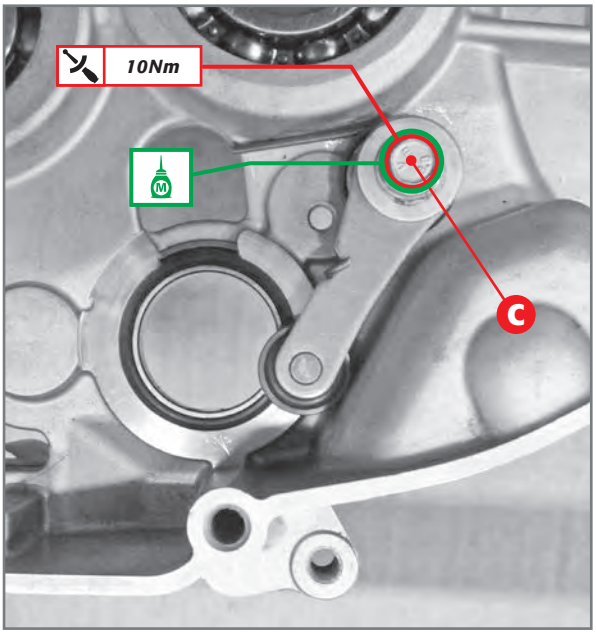
If present (optional), apply the kickstart ramp **9** and fasten screws **10** at 10Nm, by depositing a medium strength threadlocker.




***EXPLODED VIEW OF GEAR STOPPING DEVICE:***

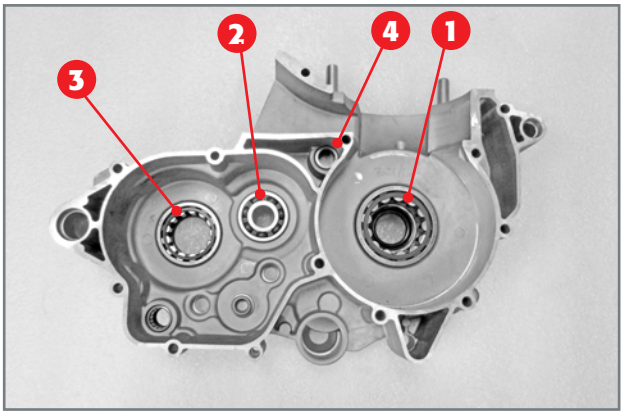
***18) Lever;***
***16) Spring;***
***17) Spacer;***
***19) 6x20x1 washer;***
***20) Screw M6x20***

Apply the gear stopping device as follows. Keeping the tightener on the lever **18** facing towards the crankcase half, apply the spacer **17** onto it, by inserting the smaller diameter segment in the lever. Apply the spring **16** so that the hook fits into the groove on the lever **18** and then apply the washers **19** and the M6x20 screw **20**, after spreading medium strength threadlocker on the thread.

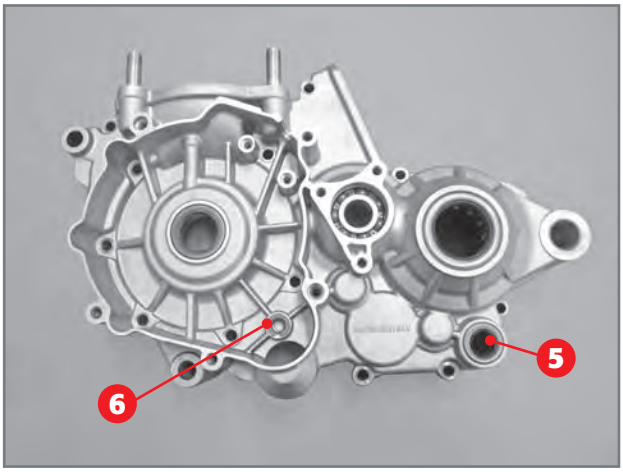



*Application of cam stop lever.*

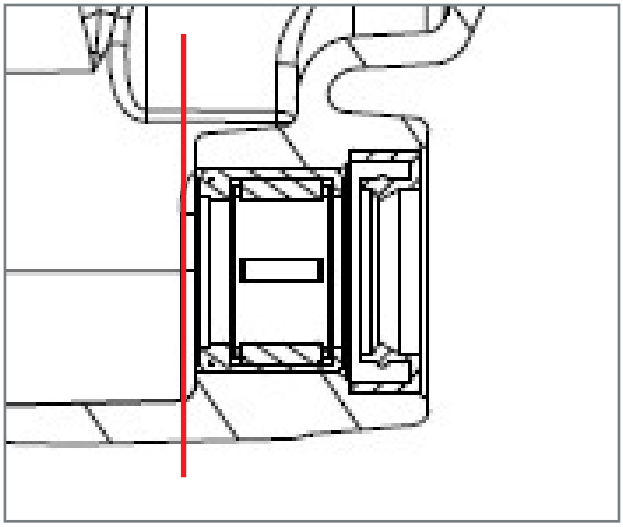
Apply the entire device on the crankcase half so that the straight segment of the spring rests on the bearing seat. Tighten the screw to the indicated torque.




*Application of left crankcase half bearings.*




*Application of left crankcase half parts.*



*Position of left crankcase half gearshift shaft bearing.*

## 3.1.2 Application of left crankcase half parts

Apply the bearings **1**, **2**, **3** and **4** from the crankcase half internal side, until flush.

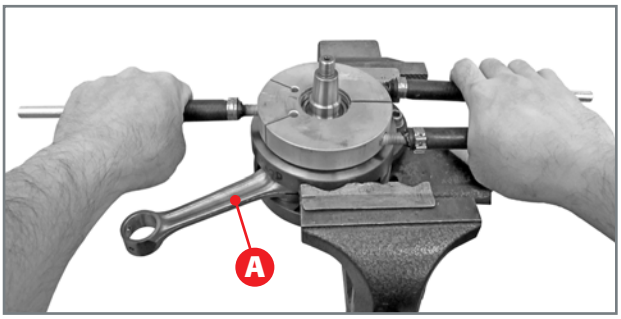
Apply the bearing **5** from the crankcase half external side, as shown in the drawing.
Apply the crankshaft oil seal, gear secondary shaft and gearshift shaft.
Apply the bush with collar **6**.
Apply new oil seals, to be pressed all the way until fully seated.
Apply new oil seals, to be pressed all the way until fully seated.

## 3.2 CONNECTING ROD AND ENGINE SHAFT CHECK

### 3.2.1 Slew bearing removal and refitting

If the main bearings need to be replaced, for the 250 ONLY, the main slew bearing on the left hand motor semi-axle must also be replaced.

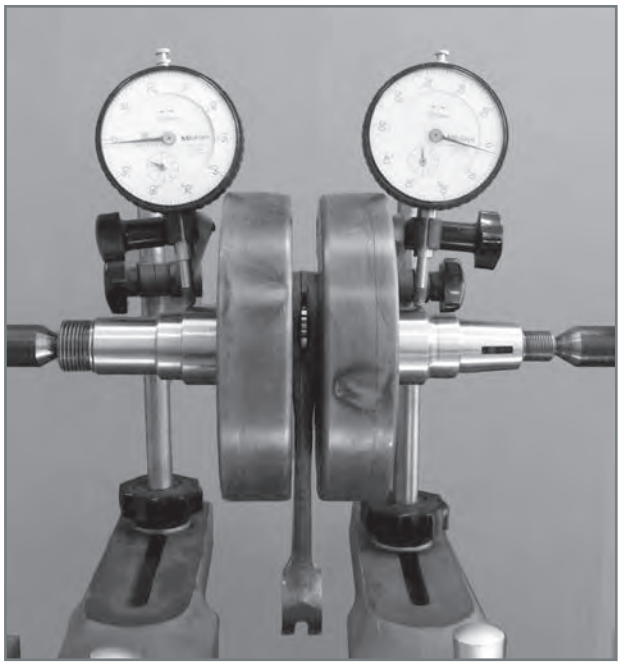
To do this, clamp the drive shaft of the semi-axle on which the slew bearing to be replaced is in a vice. Using an electric hotplate, heat special tool **A** (code 026.14.018.00.00) to around 150°C and put it on to the slew bearing straight away.
Hold the special tool tight to maintain good heat transmission and pull out the slew bearing.




***Remove the slew bearing from the right hand semi-axle on the 250 version.***

After checking the state of wear of the mating surfaces, check the offset of the half shaft axes (by measuring radial oscillation) by placing the crankshaft between two tailstocks or similar instrument. Check the maximum measurement variation during a complete turn, using comparators positioned on the mating surfaces with the crankshaft bearings.

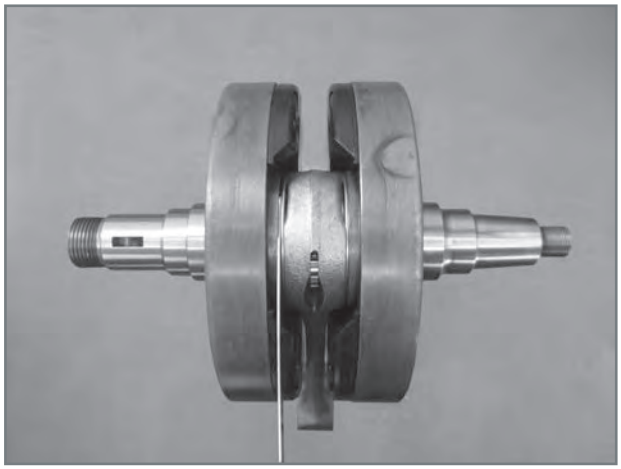
**Allowed limit value: 0.02mm**



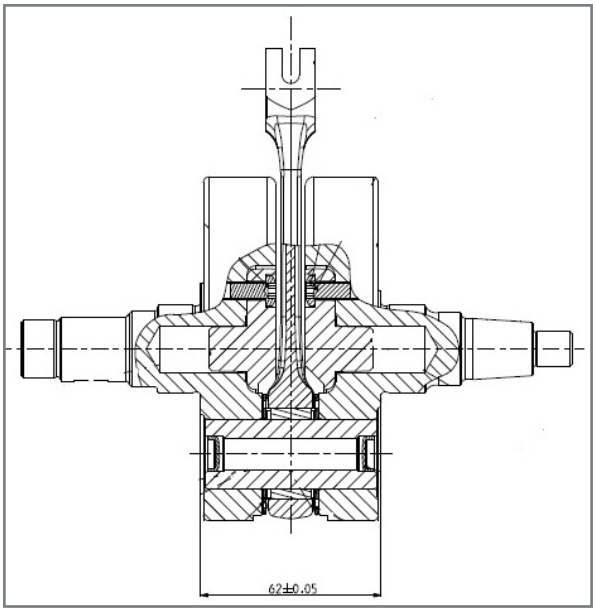
***Deflection/Off-centring of crankshaft.***

Check the axial play between the connecting rod head and the half shafts.

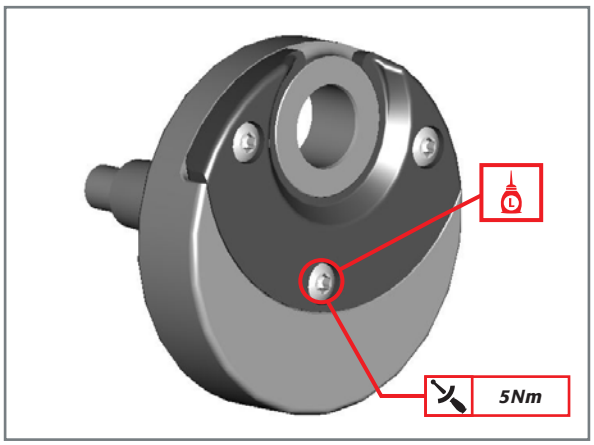
**Recommended play:**
**0.39÷0.72mm**



***Connecting rod axial play.***



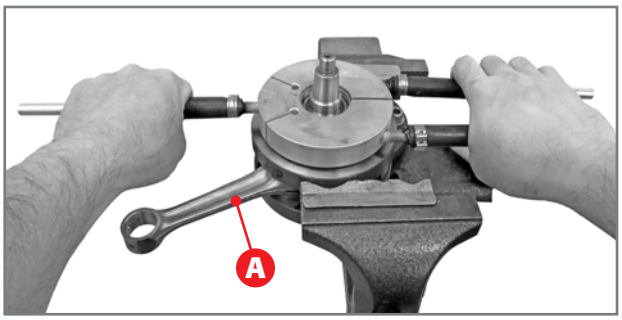

The distance between the two shoulders must be: 62±0.05




***Half-shoulder***

If replacing the inserts, apply the screws with high-resistance threadlocker and tighten to the specified torque.

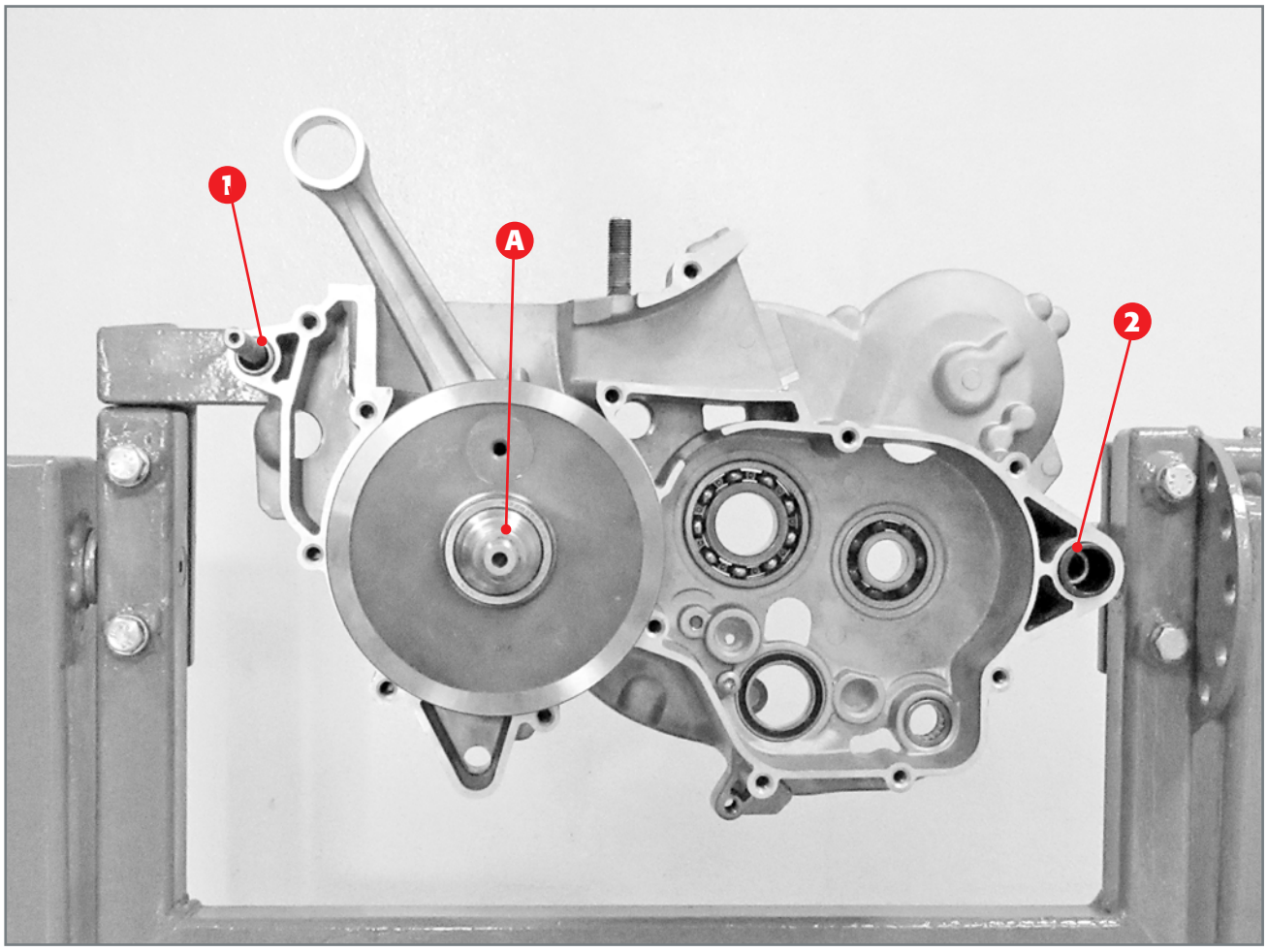
## 3.3 ASSEMBLY OF COMPLETE CRANKSHAFT




*Fitting the slew bearing to the semi-axle on the 250 version.*

On the 250 version, if the slew bearing has been removed from the left hand semi-axle (para. 3.2) the new slew bearing will need to be fitted.
To do this, clamp the drive shaft of the semi-axle to which the slew bearing is to be fitted with a vice and using an electric hotplate, heat special tool **A** (code 026.14.018.00.00) to around 150°C and push it on to the slew bearing straight away.
Hold the special tool tight to maintain good heat transmission and put it on to the slew bearing on the left hand semi-axle.

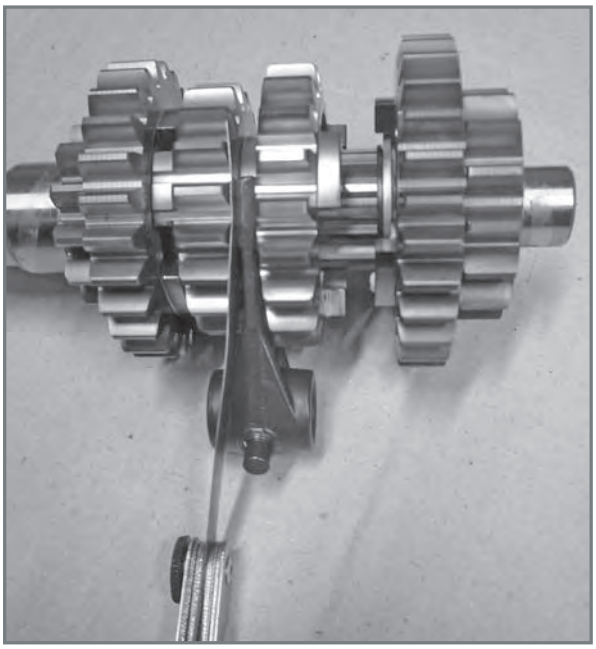
When all the aforementioned checks have been carried out and the worn parts replaced, grease the crankshaft oil seal on the right crankcase half and couple the crankshaft to the right crankcase half, with the conical part **A** on the crankshaft facing you. In order to carry out this operation, you must just push the shaft axially towards the crankcase.
Apply the two centring bushes **1** and **2**.




*Insertion of the crankshaft in the right crankcase half.*

## 3.4 GEARBOX UNIT: CHECKS AND REASSEMBLY

The gearbox unit consists of the gearshift and of the gearbox proper. The gearshift in its turn is divided into external and internal gearshift.
The checks and procedures for inspecting and reassembling these units to the engine are set out below.



*Check of wear of forks and gearwheels.*

### 3.4.1 Check of gearbox unit

Use protective jaws to clamp the main shaft and secondary shaft.
Use a thickness gauge to check the axial play between the gearshift forks and the gearwheels. The measured play must not exceed the service limit indicated below:

**service limit: 0.5mm**

If the measured axial play is greater, before replacing either the gearwheels or the forks, check the state of wear of the latter (par. 3.4.4)

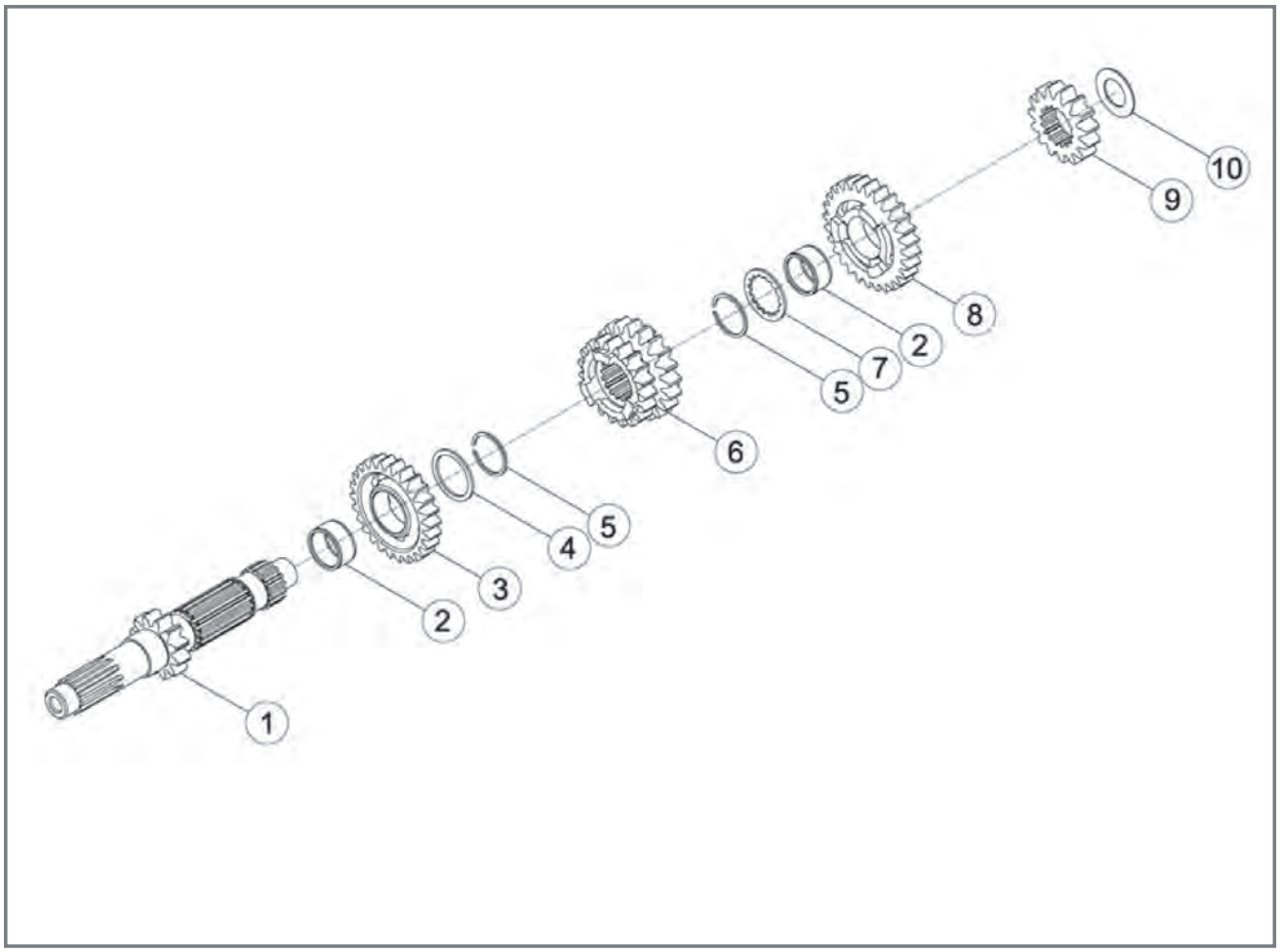
Remove the various elements and check that:

- the support surfaces of the main shaft and secondary shaft show no abnormal wear or signs of seizure;
- the sides of the teeth are free from chipping or abnormal wear;
- the sliding areas of the gearwheels show no abnormal wear or traces of seizure;
- the front claw clutches of the gearwheels are not chipped or rounded;
- the roller bearings are intact and efficient;
- none of the thrust washers show traces of abnormal wear or meshing.

Should any of these defects be found, replace the concerned parts.

## 3.4.2 Assembly of primary unit

Before proceeding with reassembly, clean all the parts thoroughly and oil with gear oil. Always replace the circlips.
Clamp the main shaft **1** (using protective jaws), so that the grooved end faces downwards.



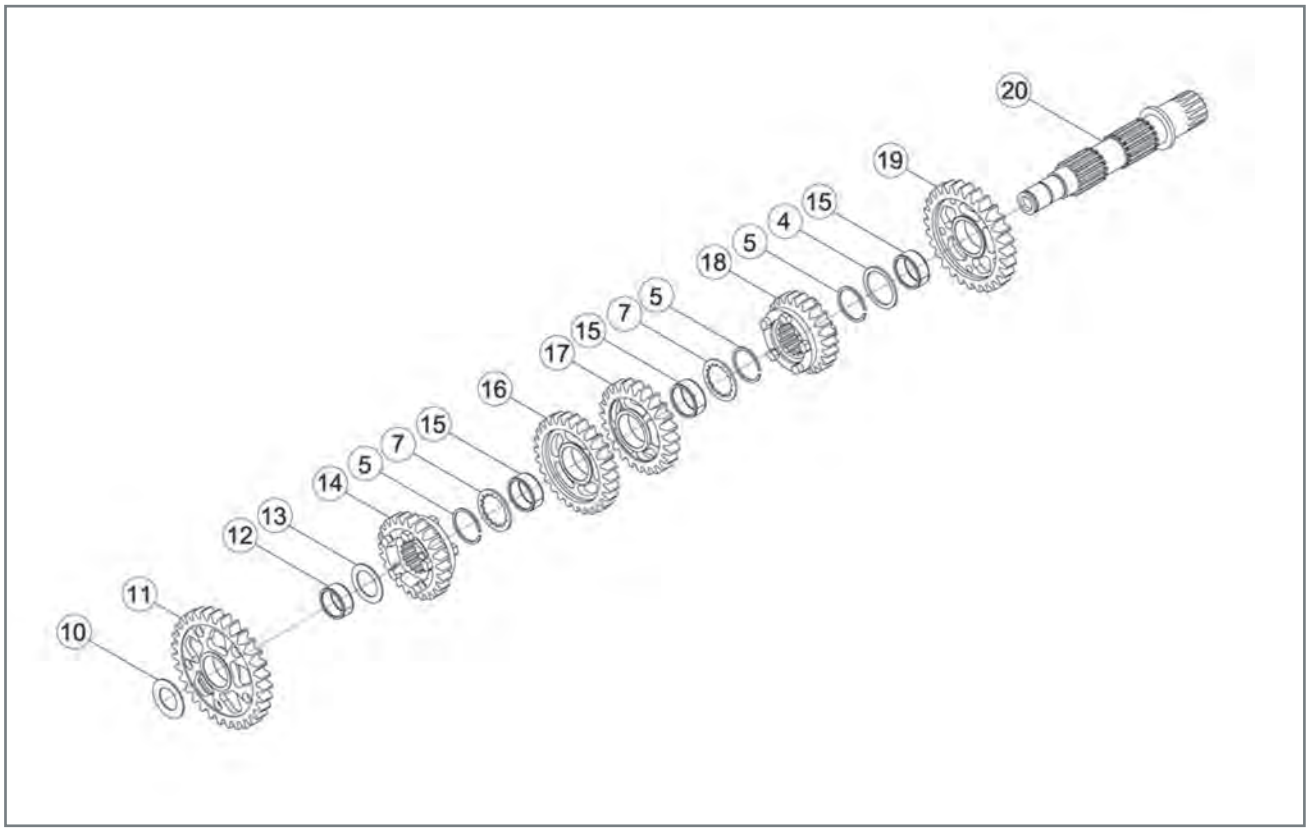

***EXPLODED VIEW OF PRIMARY UNIT:***

***1) Main shaft;***
***2) Roller cage 22x26x13;***
***3) Fifth on primary;***
***4) Thrust washer;***
***5) Circlip sw15;***
***6) Third and fourth on primary;***
***7) Thrust washer;***
***8) Sixth on primary;***
***9) Second on primary;***
***10) Thrust washer 17x30x1***

Insert onto the lower cylinder part of the shaft: the roller cage **2**, the 5th gear **3** turning the front claw clutches upwards, the thrust washer **4** (26x32x1.5) and the circlip **5**.
Insert the 3rd – 4th sliding gear **6** so that the smaller gear faces downwards, and then insert circlip **5**.
Insert the thrust washer **7** (23x32x1.5), the roller cage **2**, the 6th gear **8** with the front claw clutch facing downwards, the 2nd gear **9** with the cavity facing upwards and finally the thrust washer **10** (17x30x1).

### 3.4.3 Assembly of secondary unit

Before proceeding with reassembly, clean all the parts thoroughly and oil them with gear oil. Always replace the circlips.
Clamp the secondary shaft **20** (using protective jaws), so that the grooved end faces downwards.




***EXPLODED VIEW OF SECONDARY UNIT:***

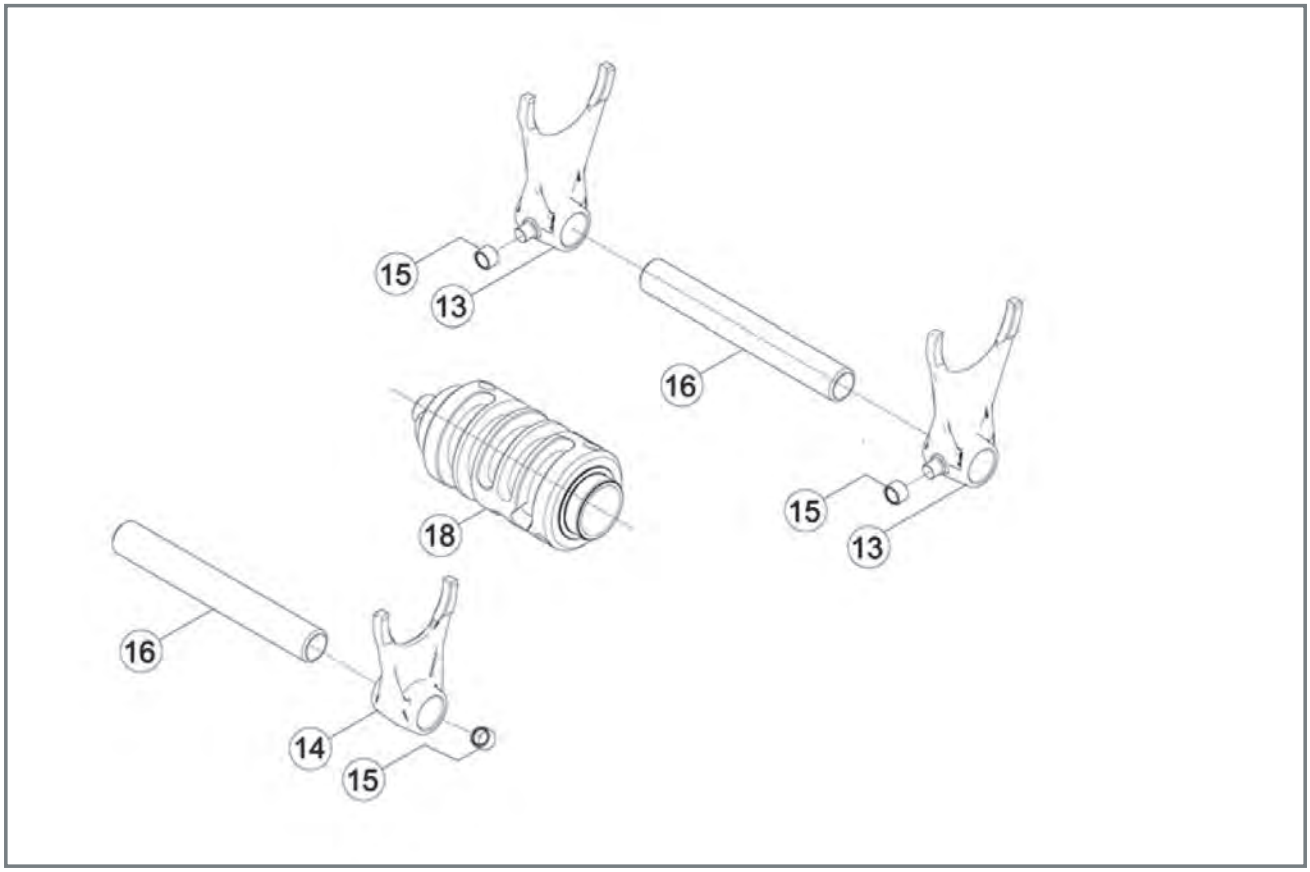
***4) Thrust washer;***
***5) Circlip sw15;***
***7) Thrust washer;***
***10) 17x30x1 thrust washer;***
***11) First on secondary;***
***12) 20x24x10 roller cage;***
***13) 20x30x1 thrust washer;***
***14) Fifth on secondary;***
***15) Roller cage;***
***16) Third on secondary;***
***17) Fourth on secondary;***
***18) Sixth on secondary;***
***19) Second on secondary;***
***20) Secondary shaft***

Insert onto the lower cylinder part: the roller cage **15**, the 2nd gear **19** so that the front claw clutches face downwards, the thrust washer **4** (26x32x1.5) and the circlip **5**.
Insert the 6th gear **18** so that the fork seat faces upwards and circlip **5**.
Insert the thrust washer **7** (23x32x1.5), the two roller cages **15**, the 4th gear **17** with the front claw clutches facing upwards, the 3rd gear (**16**) with the front claw clutches facing downwards, the thrust washer **7** (23x32x1.5) and the circlip **5**.
Insert the 5th gear (**14**) with the fork seat facing downwards, the thrust washer **13** (20x30x1), the roller cage **12**, the 1st gear (**11**) with the front claw clutches facing upwards and finally the thrust washer **10** (17x30x1).

### 3.4.4 Check of the forks, fork pins and desmodromic device

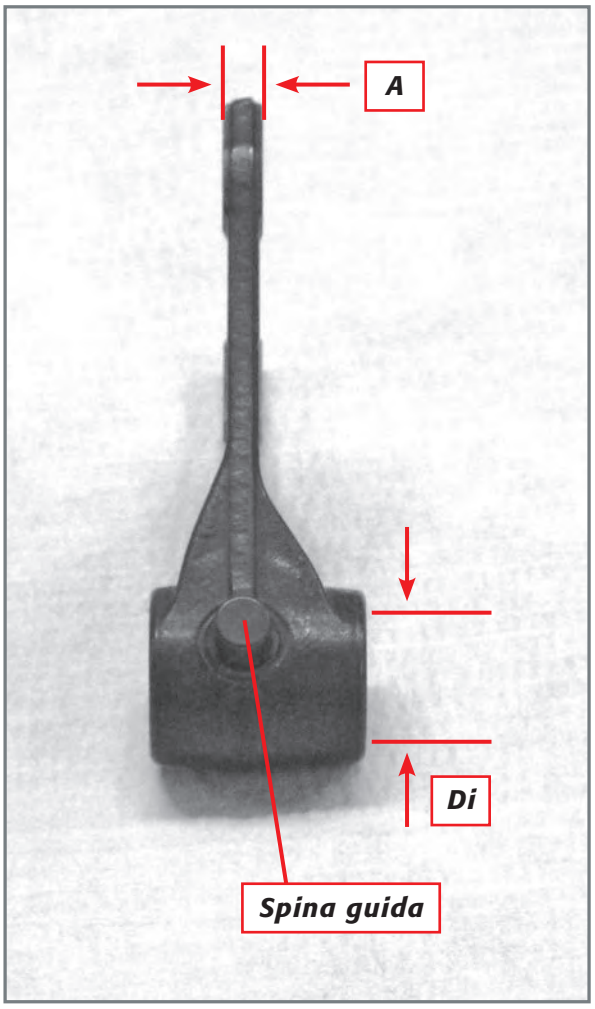
The internal gearshift consists of:

- two forks **13** which drive two gears on the secondary unit;
- one fork **14** which drives one gear on the primary unit;
- three guide pin bushes **15**;
- two fork pins **16**;
- desmodromic gearshift **18** through whose rotation the forks are driven thus selecting the desired gear.




***EXPLODED VIEW OF INTERNAL GEARBOX CONTROL UNIT:***
***13) 1st - 4th fork;***
***14) 5th-6th fork;***
***15) bush;***
***16) fork pin;***
***18) desmodromic control***

Make sure that the guide pins that support the bushes **15** have no traces of meshing or abnormal wear and that the bushes are not worn.




Make sure the distance **A** between the outer faces of the fork is not less than the value indicated below:

**Minimum acceptable distance: 4.25mm**

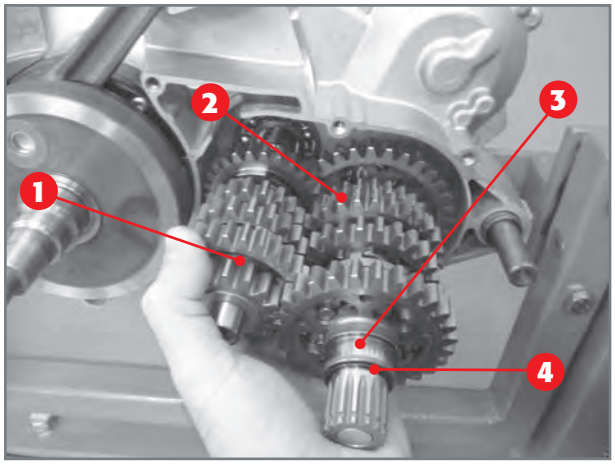
Check to make sure that the inside diameter D of the fork pin seats is below the limit:

**Fork inside diameter limit: 13.83mm**

Make sure that the fork pins on which they slide have an outside diameter above the limit (to be measured in the sliding areas of the forks and in the housing areas with the crankcases):

**Fork pin outside diameter limit: 13.75mm**

Make sure that the desmodromic control device has no corroded or worn areas especially in the grooves in which the guide pins of the forks are engaged.
Check the bearing on the desmodromic device. Replace it in the event of signs of meshing or jams during motion.

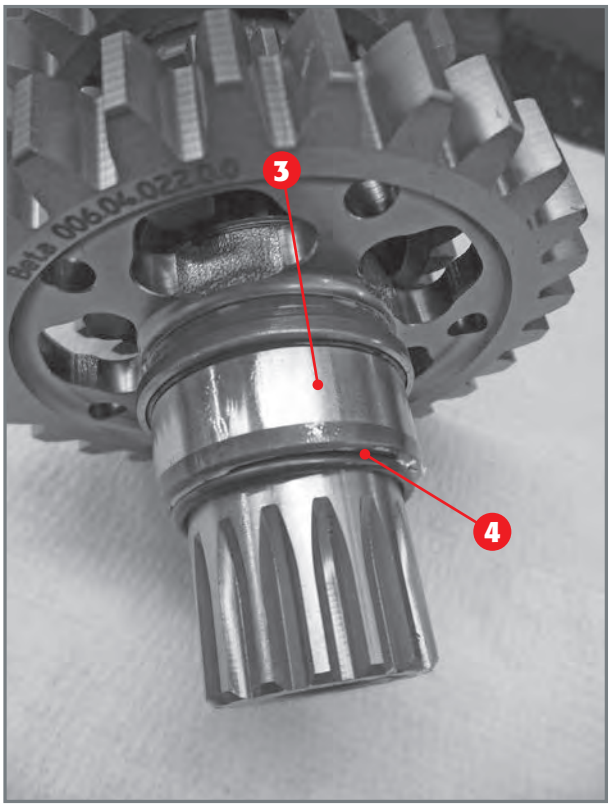



*Insertion of the gearbox in the left crankcase half.*

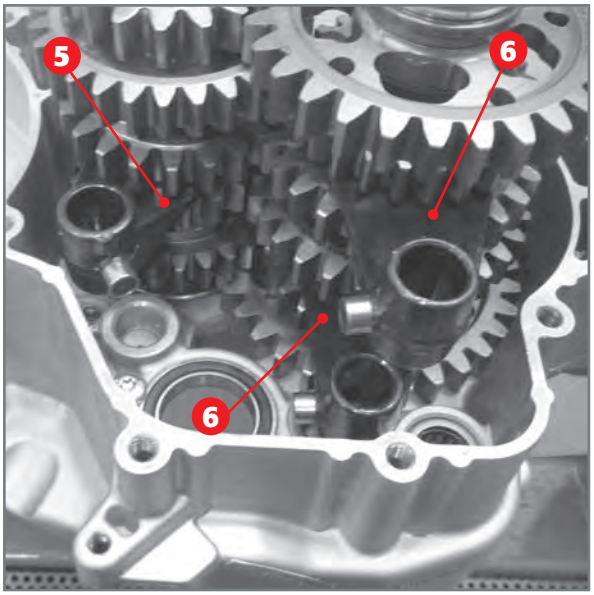
## 3.4.5 Assembly of gearbox and inner control

Insert the entire primary **1** and secondary unit **2** into the respective seats on the left crankcase half simultaneously. Remember to oil the gears with plenty of gear oil and to grease the shafts supporting them with graphite grease in the mating areas with the bearing. Make sure that all the parts slide properly.

Insert the centre bearing **3** and the O-ring **4** on the secondary unit.



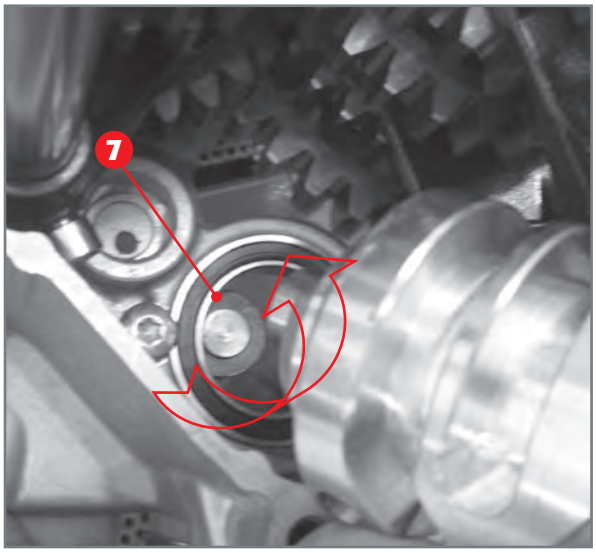

*Detail of centre bearing 3 and O-ring 4 coupled to the secondary shaft.*




*Application of forks to gearwheels.*

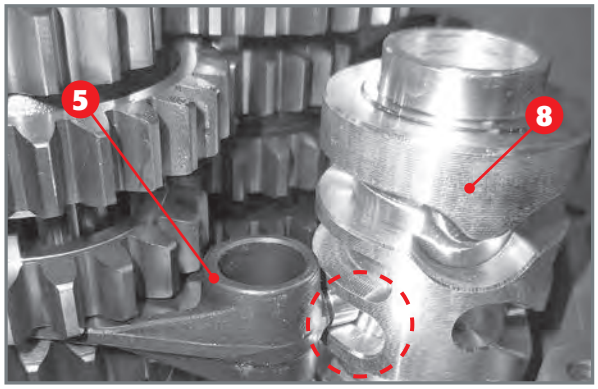
Introduce the forks together with the guide bushes on the gear tracks. Specifically: the smaller fork **5** drives the sliding gear on the primary unit, while the other two (**6**) drive the sliding gears on the secondary unit.

> ***Note:*** *the two forks* **6** *are interchangeable and their positioning is univocal, since the guide pin must face the desmodromic device. Place the forks in their original positions if none of the above components are replaced.*



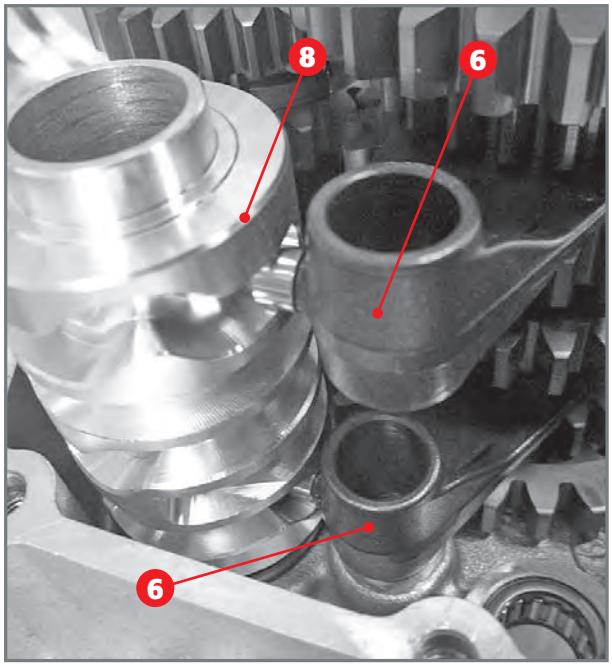

***Insertion of desmodromic deice in specific bearing. Note the rotation of the stop lever.***

Insert the desmodromic device in the specific bearing. In order to do this, the cam stop lever **7** must be rotated towards the top part of the engine.




***Place fork 5 of the primary unit in the central guide of desmodromic device 8.***

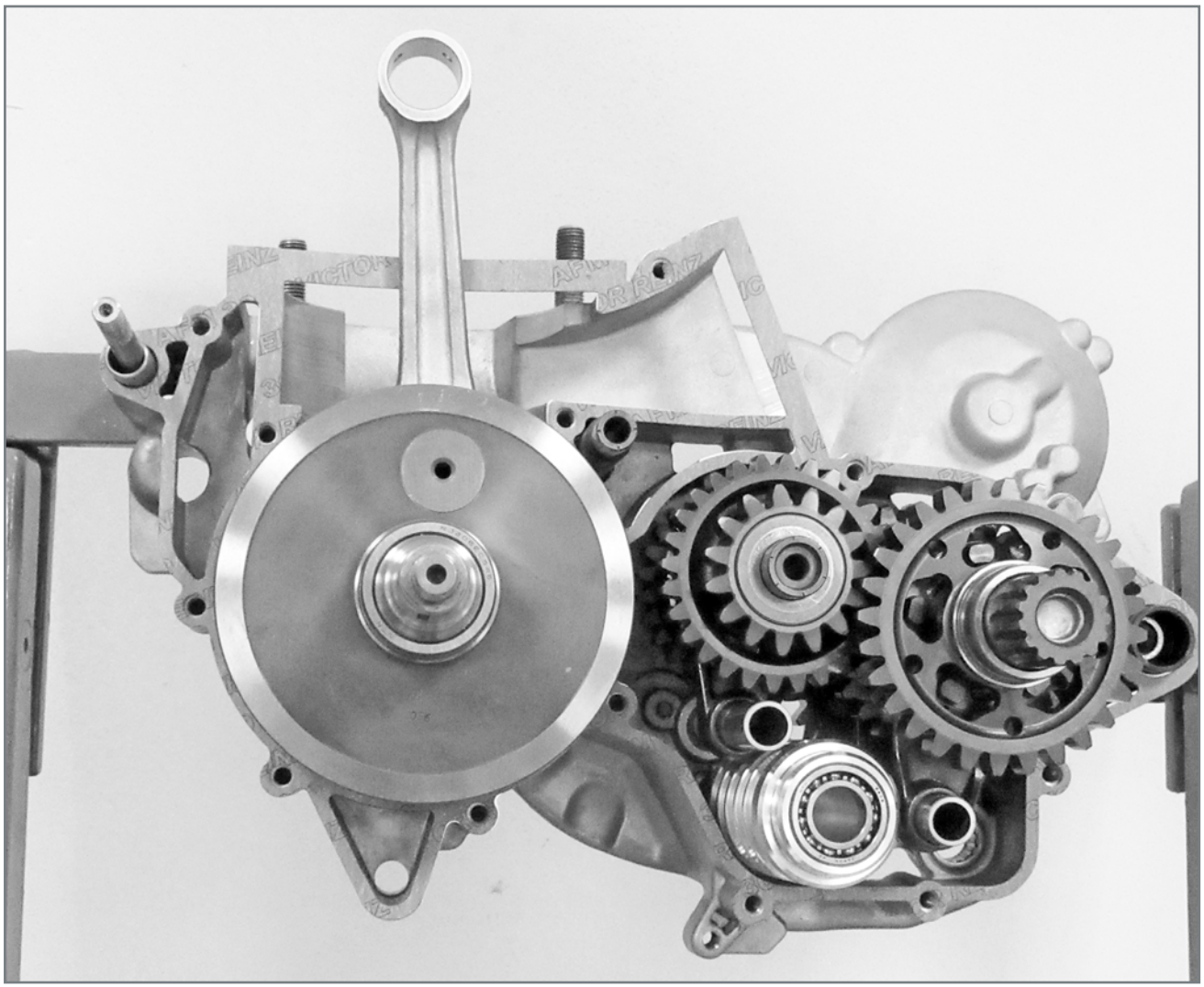
Position the fork **5** of the primary unit in the central guide of the desmodromic device **8**, insert the fork pin inside the fork and insert the pin in its specific seat in the crankcase half.




*Positioning of the secondary unit forks 6. In the external guides of desmodromic device 8.*

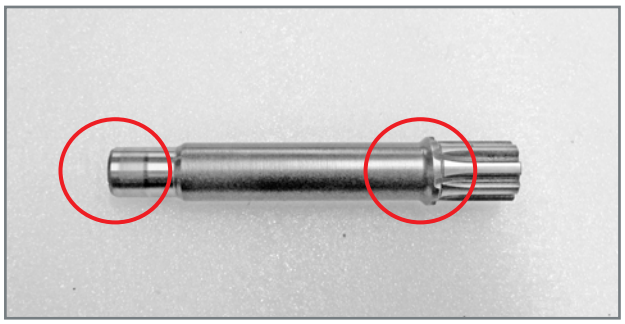
Position the two forks **6** of the secondary unit in the external guides of the desmodromic device **8** and, just like the primary unit fork, insert the fork pin first in the forks and then in its designated seat.
Remember to oil the shafts, forks and the desmodromic device with plenty of gear oil.

Apply some grease on the crankcase edge in the mating area with the gasket and place a new gasket.

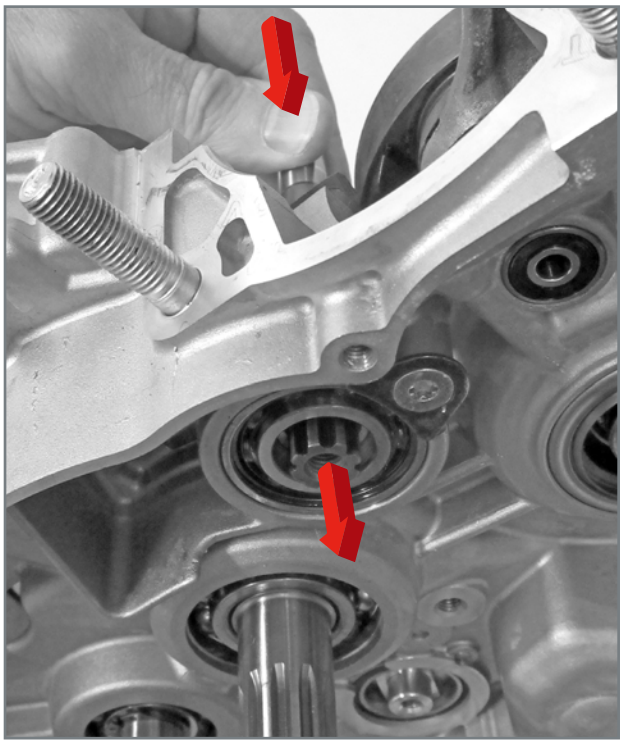


*View inside the right crankcase with crankshaft, gearbox shafts complete with wheels, internal gearshift and gasket.*

## 3.4.6 Counterweight support shaft



Check that the areas where the shaft rests on the bearings are intact and free of any traces of meshing or abnormal wear. Otherwise replace the shaft.

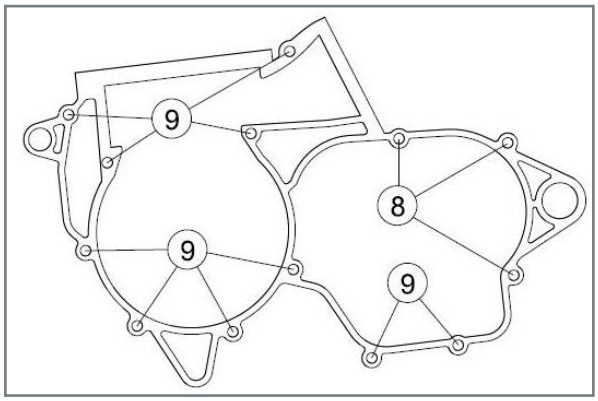


Insert the shaft all the way as shown in the figure.

## 3.5 CLOSING THE ENGINE CRANKCASE

Apply a thin layer of grease on all oil seals.
XT300 only, heat up the engine shaft bearing on the left crankcase half, being careful not to burn the oil seal.
Press the left crankcase half towards the right, making sure that the shafts and pins on the crankcases fit into the respective housings and that the crankcase half is not offset.

Put the clamping screws in place based on length, as pictured.
The table below contains indications for applying the screws.
Tighten according to a cross sequence.

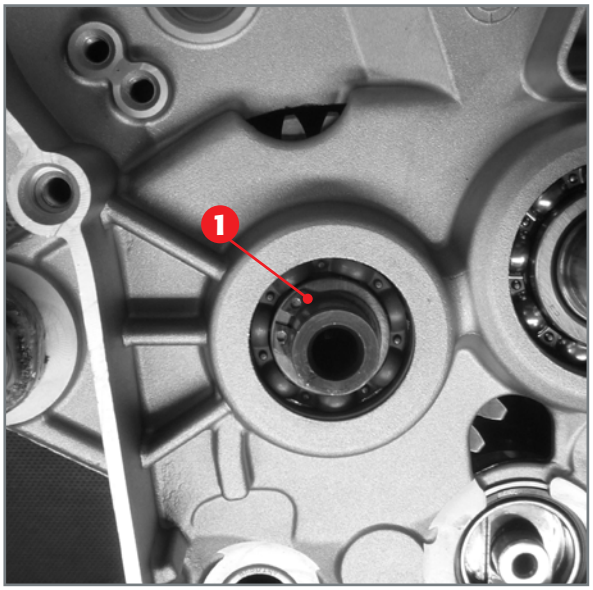



***Positioning of crankcase coupling screws.***

| Screw number | Screw size | | Threadlocker application | Tightening torque [Nm] |
|---|---|---|---|---|
| | Threading diameter | Threading length | | |
| 8 | M6 | 40 | NO | 10 |
| 9 | M6 | 50 | NO | 10 |

Cut the extra piece of gasket between the two crankcase halves in the area of the cylinder and reed valve seat.

Apply the circlip **1** to the secondary shaft of the gearbox.

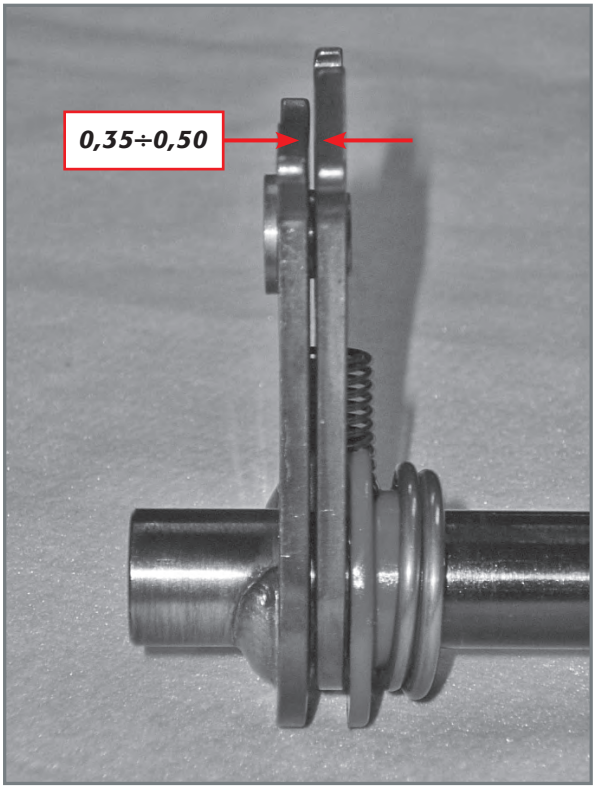


## 3.6 EXTERNAL GEARSHIFT

Before reassembling the external gearshift, check its condition. While for the stop cam it is enough to make sure it is free from abnormal wear or meshing, the gearshift drive shaft needs more thorough inspection.

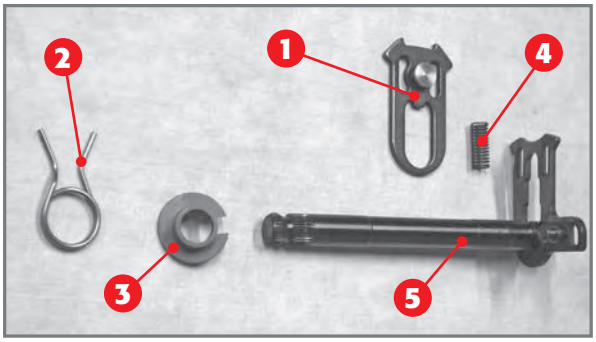
### 3.6.1 Check of the complete drive shaft

With the complete device, make sure that the distance between the movable pawl and the drive shaft is between **0.35÷0.80mm**.
Should the distance be greater, replace the movable pawl.

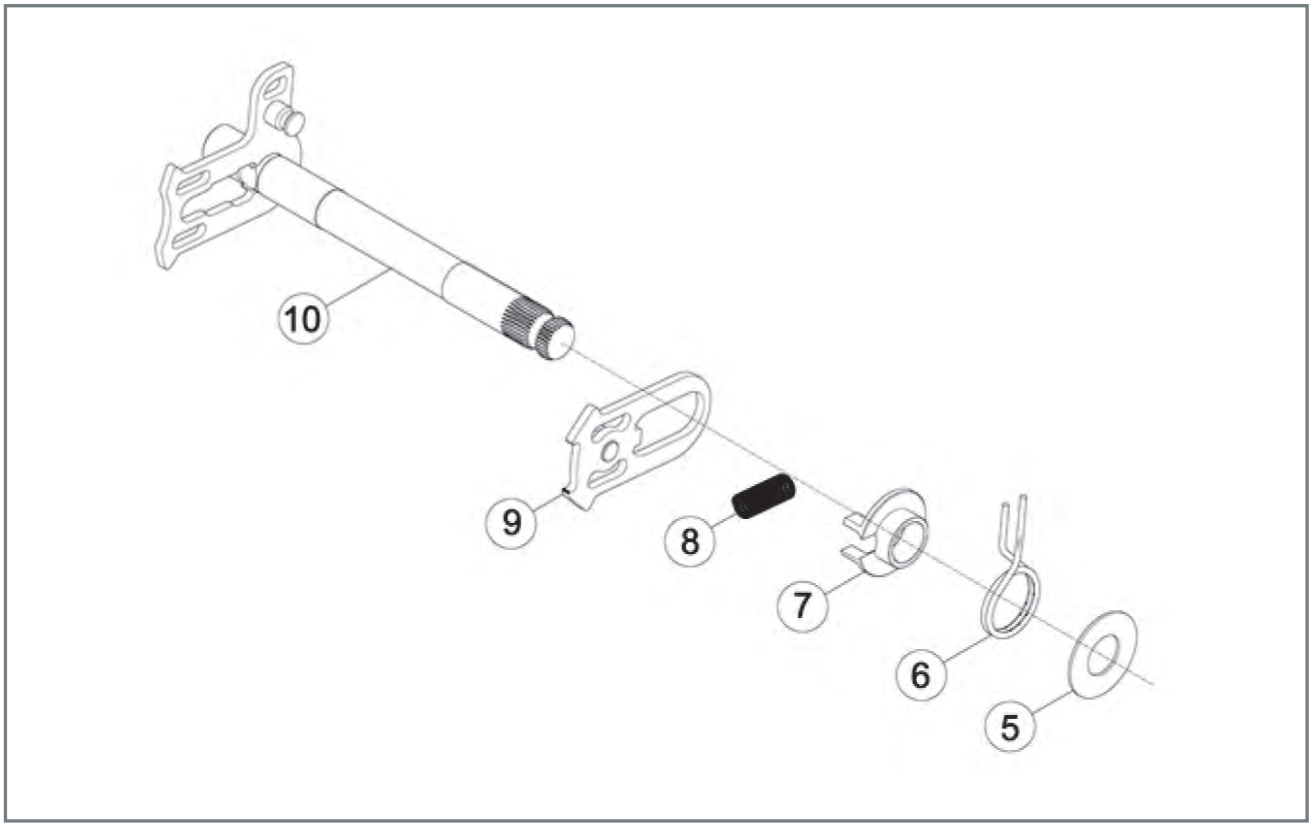



***Allowed distance between shaft and pawl.***

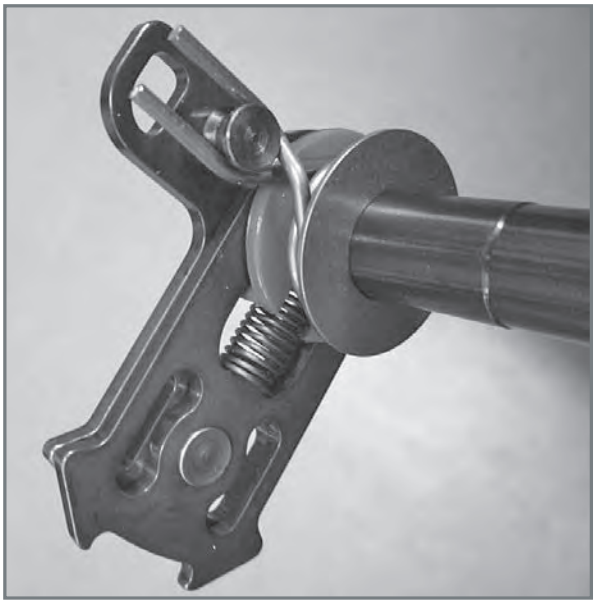
In order to replace the movable pawl **1**, disassemble the return spring of the gearshift **2**, the spring guide **3**, the spring **4** – which must be compressed and pulled out of its seat – and the pawl, moving it completely towards the shaft **5**.




***Complete drive shaft: 1) Movable pawl; 2) Gearshift return spring; 3) Spring guide; 4) Spring; 5) Gearshift drive shaft.***




***Exploded view of gearshift.***
***5) 14x30x1 thrust washer;***
***6) Gearshift return spring;***
***7) Spring guide;***
***8) Pawl return spring;***
***9) Movable pawl;***
***10) Gearshift shaft.***

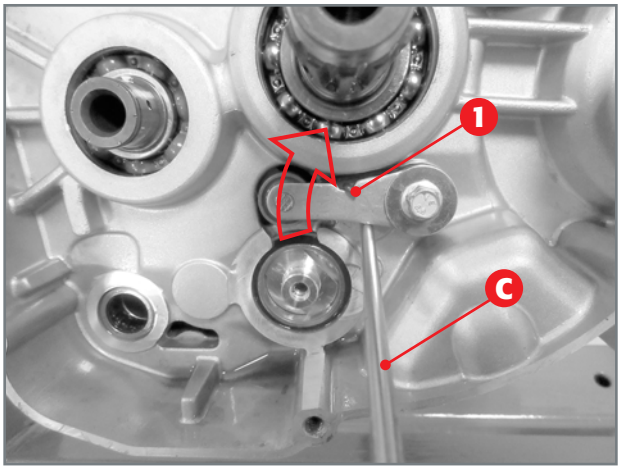


***Gearshift drive shaft: note the gearshift return spring position.***

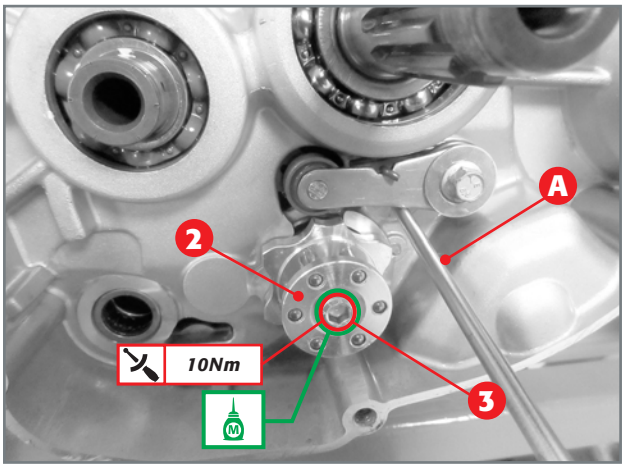
For reassembly, couple the movable pawl **9** to the drive shaft **10** and, while compressing it, insert the spring **8** between the movable pawl and the drive shaft. Then apply the spring guide **7**, the gearshift return spring **6** and finally the thrust washer **5** (14x30x1).

The gearshift return spring must be positioned as pictured to be able to carry out its function.

## 3.6.2 Assembly of external gearshift

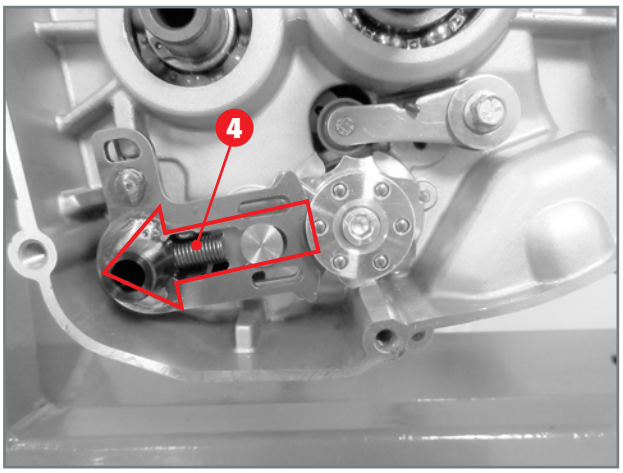



Rotate the gear stop lever **1** clockwise so that the spring is compressed. To keep the lever in this position, an aluminium rod **A** can be inserted into the small hole, as shown in the figure.




Apply the gear stop cam **2** to the protruding end of the desmodromic control. The stop cam has only one correct position, which is determined by the specific shape of the end of the desmodromic device and of the bottom part of the stop cam.
Next, fit the M6x30 tightening screw **3** between the stop cam and the desmodromic control, after applying medium-resistance threadlocker: tighten at the indicated torque.

Remove the rod **A**.




Insert the drive shaft together with the specific washer in its seat whilst keeping the return spring **4** of the movable pawl pressed.

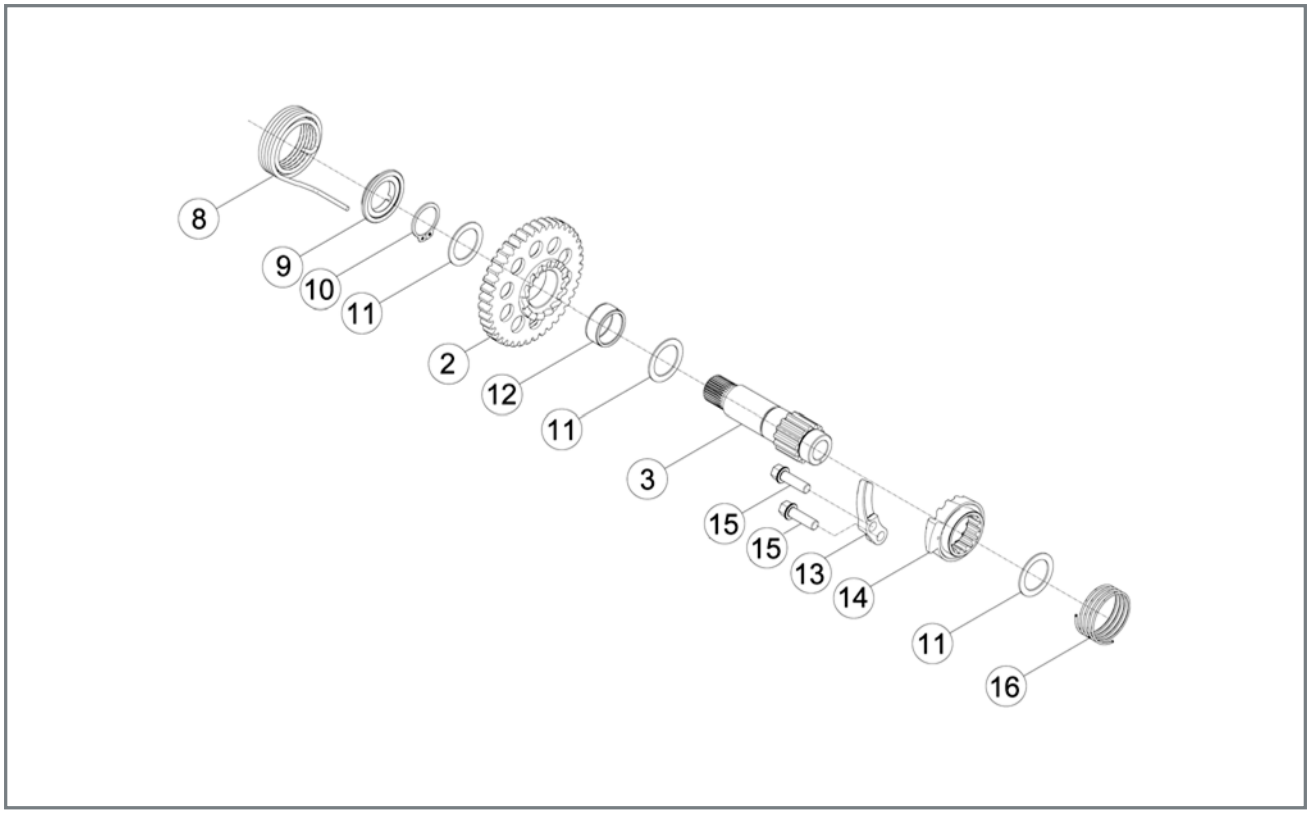
Should you wish to test correct operation of the entire gear unit, just temporarily couple the external gearshift lever and simulate the operation of changing gears, by lifting and lowering the gearshift lever and having the main shaft of the gear unit rotate. The whole device works properly if no abnormal jamming occurs.
Please note that if the unit operates without oil, the device is noisier than usual.

## 3.7 KICKSTARTER DEVICE - OPTIONAL

Before coupling the kickstarter to the crankcase half, some important checks must be carried out.

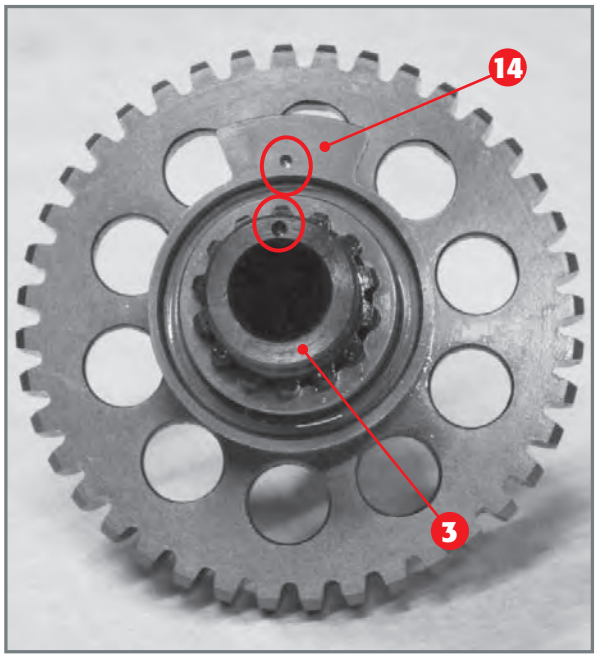
### 3.7.1 Check of starter shaft unit and assembly

In order to disassemble all the parts of the kickstart shaft, pull off the washer **11** at the end of the shaft (on the spring side **16**), the spring **16**, the kickstart sleeve **14**, and the lever return spring **8**, which must be pulled in the radial direction so that it is extracted from its hole in order to be released from the shaft.




***EXPLODED VIEW OF COMPLETE KICKSTART SHAFT:***
***2) Kickstart gear;***
***3) Kickstart shaft;***
***8) Kickstart return spring;***
***9) Kickstart spacer;***
***10) 20E circlip;***
***11) Washer thickness 20x28x1 DIN 988;***
***12) K20x24x10 roller bearing;***
***14) Kickstart sleeve;***
***16) Spring.***

Remove the kickstart spacer 9, expand the circlip **10**, allowing for removal of washer **11**, of kickstart gear **2** together with roller bearing **12** and washer **11**. This frees the kickstart shaft **3** from all other parts.
Make sure that the side of the kickstart gear teeth **2** has no signs of meshing or notable superficial wear. Make sure that the front teeth (sleeve side **14**) are not chipped. Replace any part that shows the aforementioned defects.
Make sure that the front teeth of the sleeve **14** are not chipped and that the spring **16** is capable of exerting enough pressure on the sleeve **14** so that this can pull the wheel **2**.
Also check to make sure that no washers have any abnormal or excessive wear. If so, replace them. Make sure that the spring **8** has no cracks or abnormal deformation. Replace if it is not able to bring the external kickstart lever back to the rest position.
For reassembly, follow the above disassembly procedure in reverse order.
Pay attention to the correct positioning of the sleeve **14** in respect to the shaft **3**. The front of the shaft, as well as the sleeve **14** has a reference mark: the two reference marks must match.

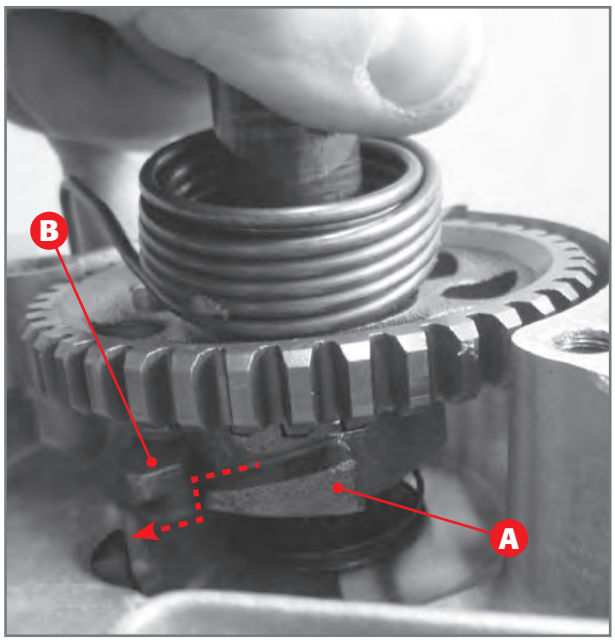



***Positioning of sleeve on small shaft.***

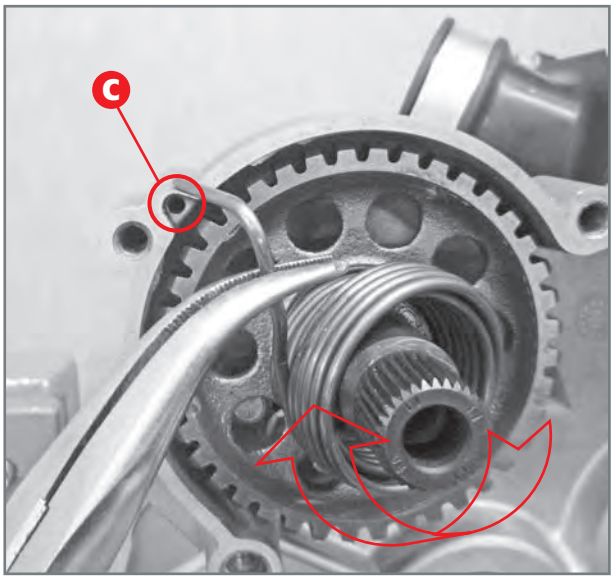
## 3.7.2 Assembly of kickstarter device - OPTIONAL

Insert the complete kickstart shaft in its housing, keeping the ribbed facing outwards and making sure that the lever **A** on the kickstart sleeve is positioned below the lever **B** bolted onto the right crankcase half (external side).

> ***Note:*** *to fit the ramp **A** refer to para. "3.1.1 Specific applications of the right hand crank case".*

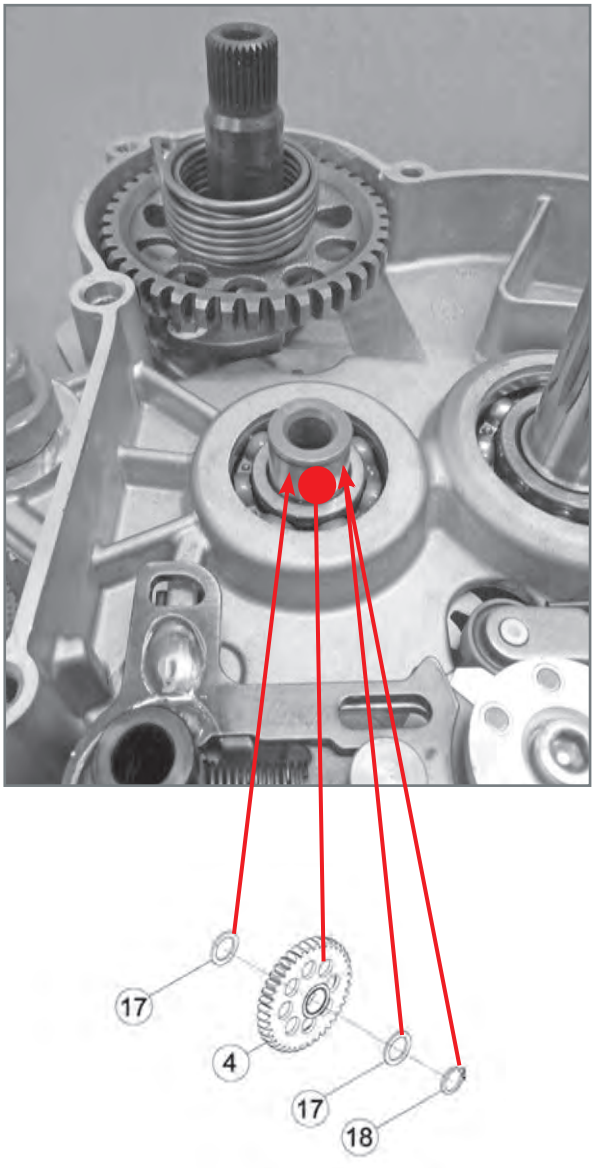



***Positioning of sleeve A below lever B.***




*Insertion of kickstart return spring.*

Turn the spring clockwise until it fits into the specific hole **C**.




*Kickstart device unit coupled to the crankcase.*

Insert in the slot on the protruding segment of the secondary shaft: the circlip **18**, the washer **17**, the idler wheel **4** followed by the washer **17** and the circlip **18** in the sequence pictured.

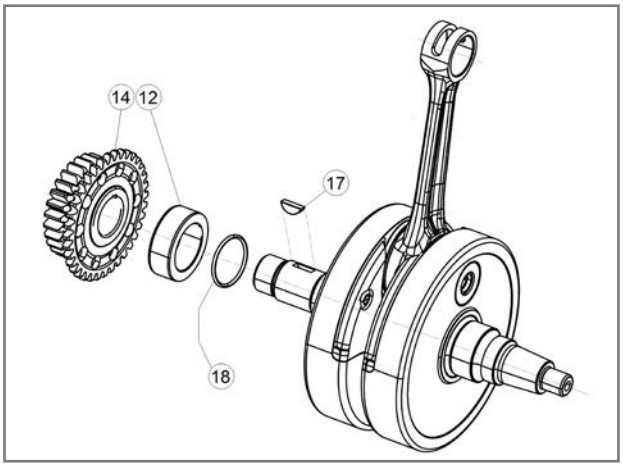
## 3.8 COUNTERWEIGHT, PRIMARY GEAR AND CLUTCH UNIT

Before reassembling the clutch unit, it is required to carry out some checks on the various components described below.

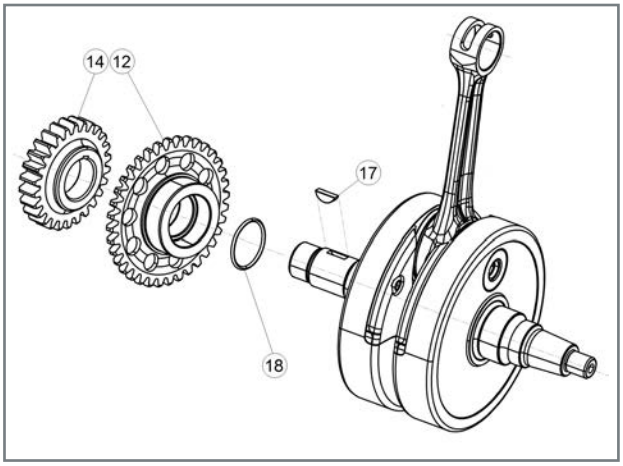
### 3.8.1 Inspection of counterweight and primary gear

Check that the teeth of the primary gear and the counterweight are free from nicks and traces of abnormal wear. Otherwise, replace the worn parts.

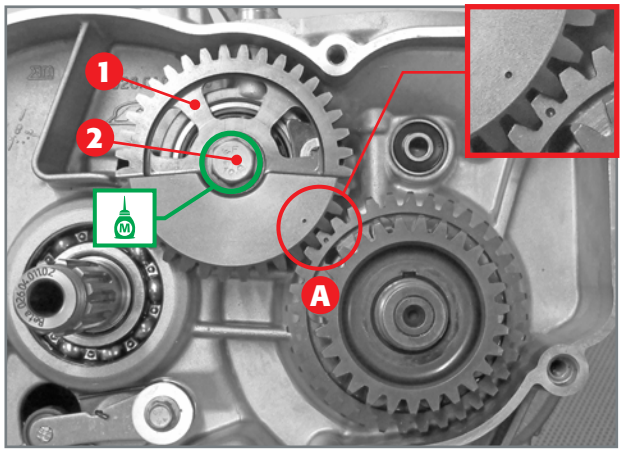
### 3.8.2 Application of primary gear and counterweight



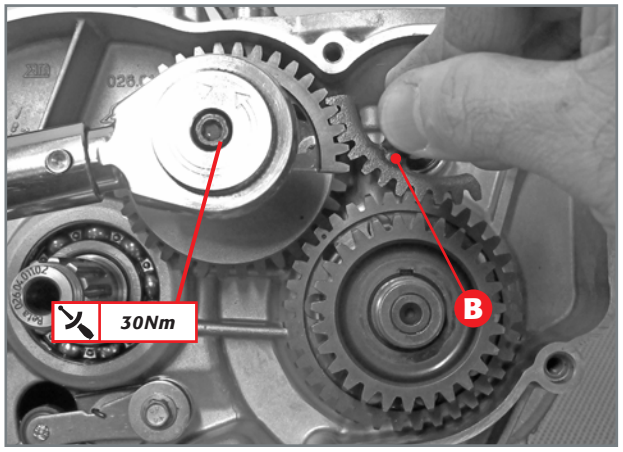

**XT300**
Apply the O-ring **18**, the spacer **12** and gear **14** on the right half shaft so the appropriate groove fits with the Woodruff key **17**.



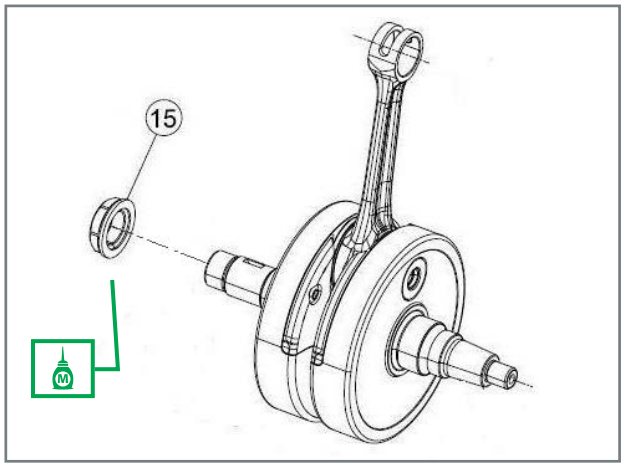

**XT250**
Apply the O-ring **18**, gear **12** on the right half shaft so the appropriate groove fits with the Woodruff key **17** and gear **14**.



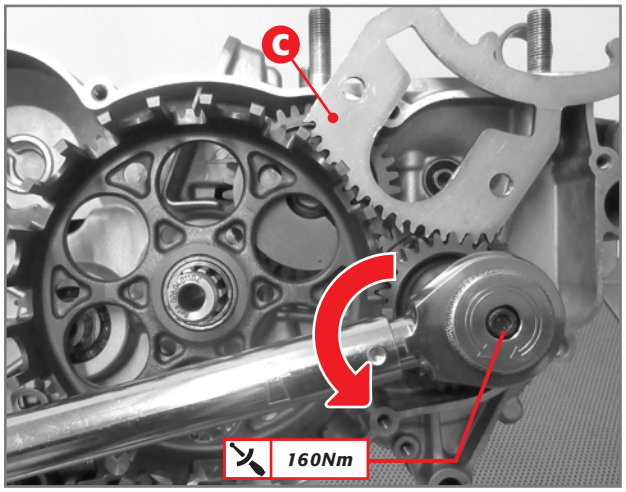

Apply the counterweight **1** on the support shaft, taking care to align the references A on the counterweight and primary gear.
Apply the screw **2** on the counterweight support shaft after applying medium strength threadlocker.




Keeping the primary gear/counterweight coupling firmly in place with a special tool **B** (code *026.14.012.50.00*), tighten the screw **2** to the indicated torque.

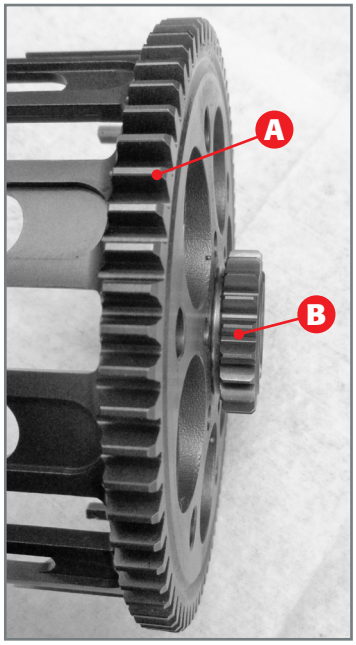



Apply the lock nut **15** after applying medium strength threadlocker; tighten at the indicated torque.




This is possible once the clutch case is inserted using the primary special tool **C** (code *029.14.002.50.00*). See *Par. 3.8.3* to apply the clutch case.

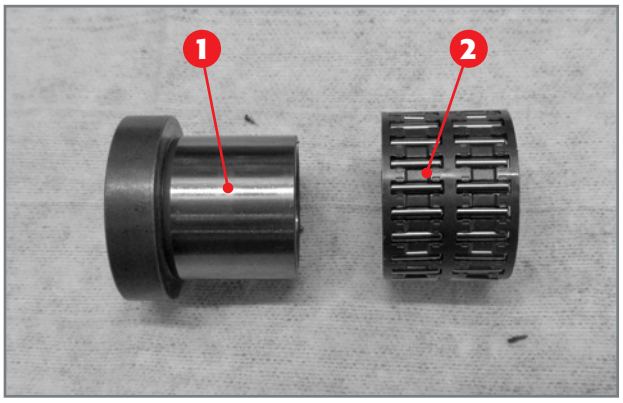
***WARNING!***
*The nut is fastened anti-clockwise.*




*Case gears*

## 3.8.3 Check of the clutch case, roller bearing and internal centre bearing

Before reassembling the clutch case, make sure that the sides of the teeth **A**, designated for main transmission and **B**, designated for meshing with the kickstart idler gear and oil pumps, have no superficial nicks or abnormal wear.

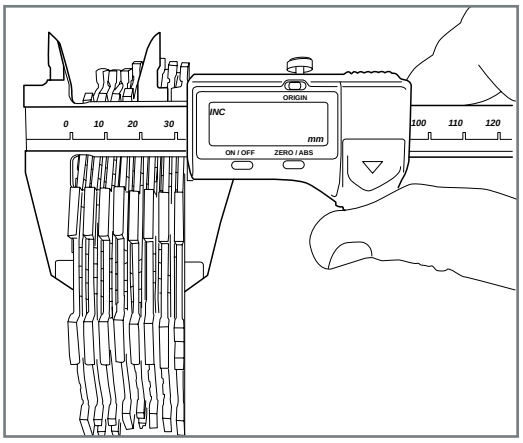



*Centre bearing and roller bearing*

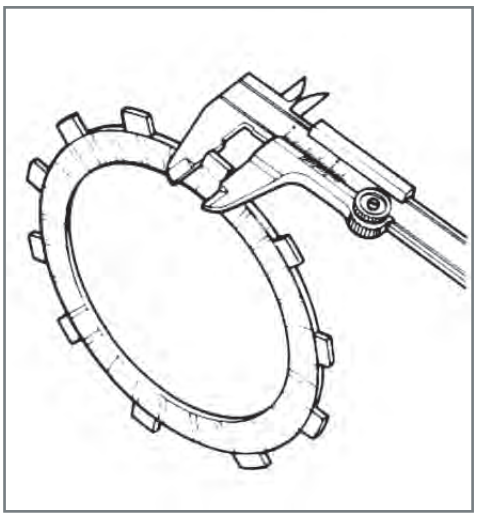
Check the condition of the internal centre bearing **1** which must show no traces of meshing or abnormal wear. Check the condition of the roller bearing **2**. If worn, it must be replaced.

## 3.8.4 Check of clutch discs

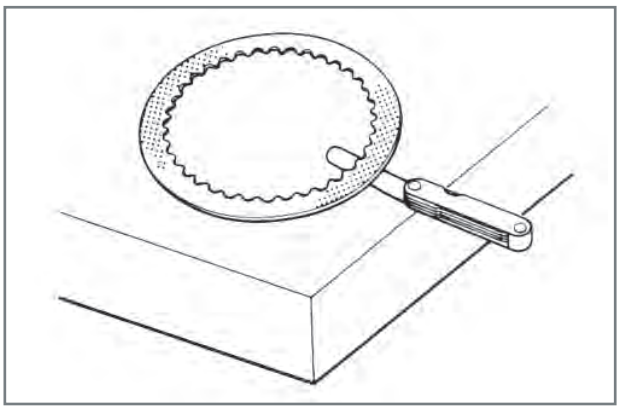
The clutch discs are divided into driving and driven: eight driving discs and seven driven discs. The driving discs have cork inserts on both sides which wear out due to the driven discs sliding on them. One needs to check that the thickness of the clutch pack (driven and driving discs) is not lower than a minimum set value equal to:
**minimum thickness of complete disc pack: 31.6mm**




***Clutch pack measurement***



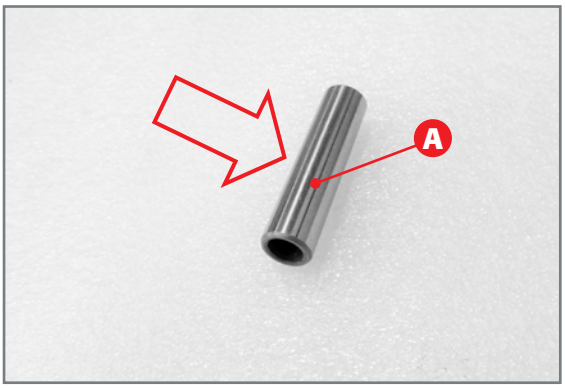
The other measurement that needs to be checked is the thickness of the teeth of each driving disc, which must not be less than the minimum set at:
**minimum driving disc tooth thickness: 13.3mm**



Also check the distortion of the driven discs. This operation is carried out by placing the driven discs on a perfectly flat surface and using a thickness gauge to check that any gap between the disc and the surface is not greater than:
**allowable distortion of driven discs: 0.10mm**

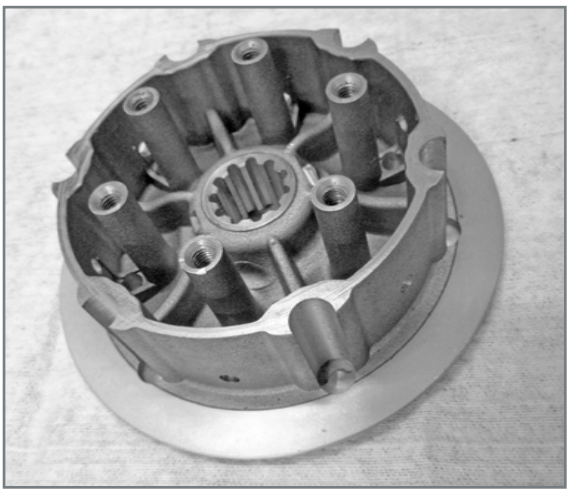
## 3.8.5 Check of the clutch drum and cap

The clutch drum engages with the driven clutch discs by means of the sliding pins **a**: make sure that the area shown in the figure has no meshing or abnormal wear. If so, replace the sliding pins.




***Drive pin***

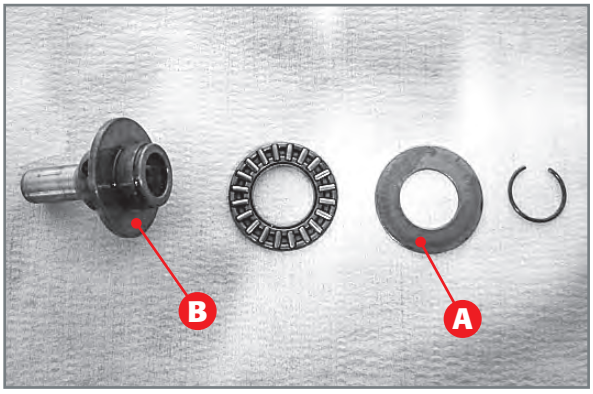
Check that the disc friction area is free from scratches, meshing or abnormal wear. If so, replace the clutch drum
Also check that the radial holes on the clutch drum are not obstructed and are free from sediments.



***Bare clutch drum***

## 3.8.6 Check of thrust bearing device

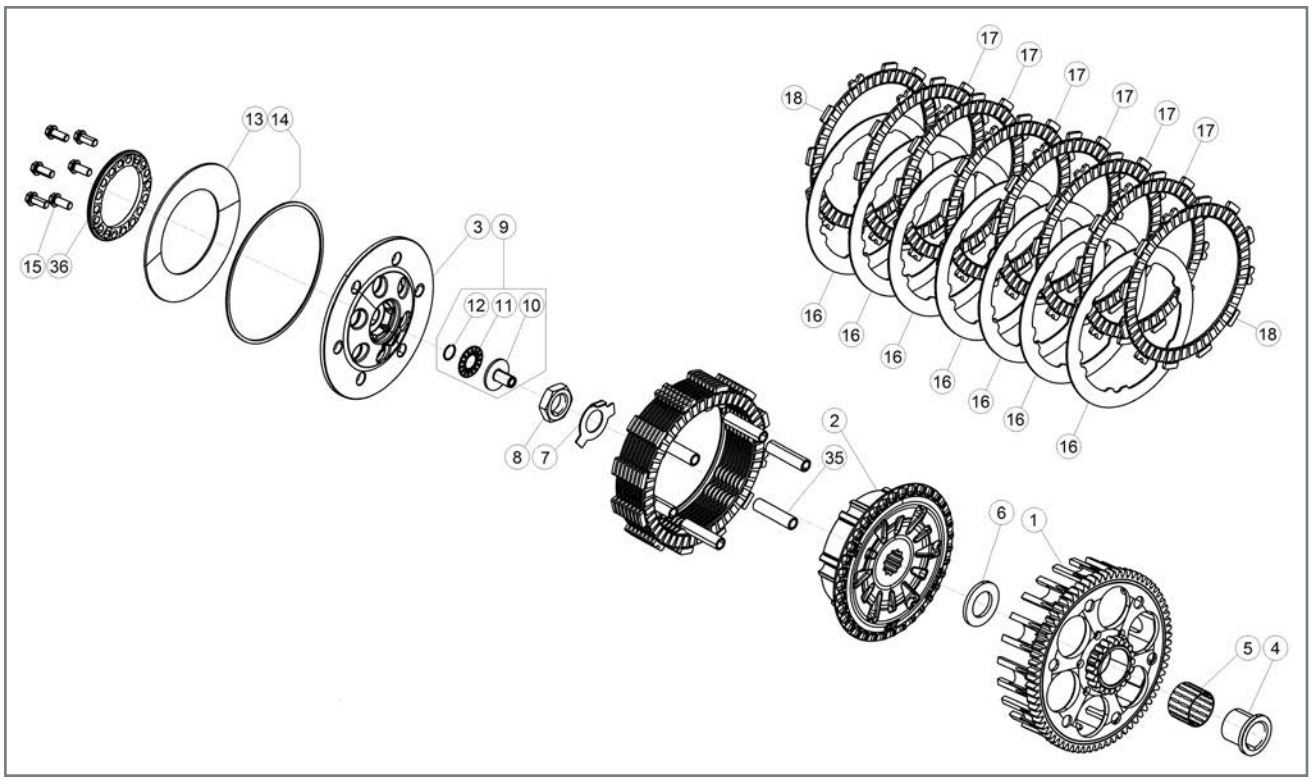
Check the condition of the thrust bearing and the surfaces upon which it rests.
In order to check the thrust bearing, just ensure it slides – when the device is assembled, simulate rotation of the front centre bearing **A** with respect to the rear one **B**.
Carefully check for any traces of meshing or wear on the sliding surfaces. In the event of signs of deterioration replace the entire unit.




***Thrust bearing device.***

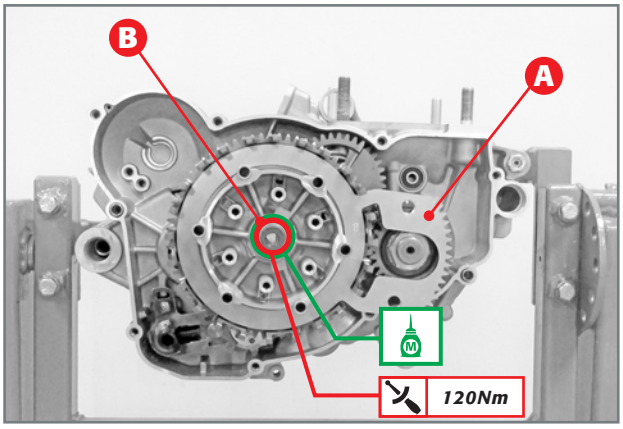
## 3.8.7 Assembly of clutch unit

Lubricate the end of the primary gearbox shaft, the internal centre bearing **4** and the roller bearing **5**. Fit the roller bearing **5** and the centre bearing **4** on the clutch case **1**. Mount the unit on the primary shaft; in order to make insertion of the clutch case easier, slightly turn the kickstart idler gear (if present). Fit the washer **6**, which the clutch drum **2** rests against. Fit the sliding pins **35** on the drum. Put on the safety washer **7** and, after having applied the medium strength threadlocker, couple the lock nut **8**.

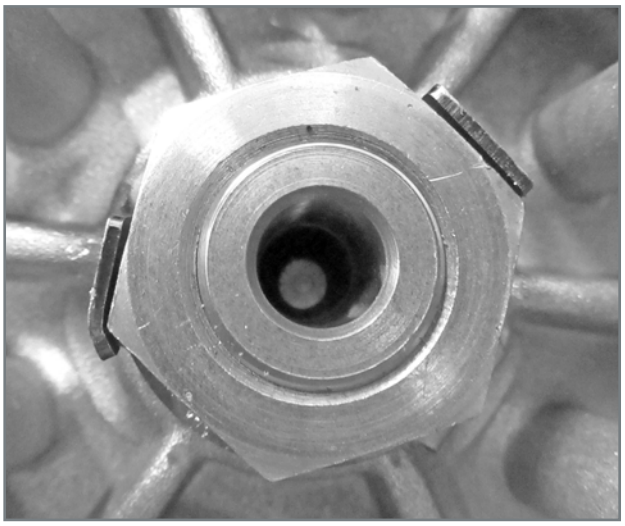



***EXPLODED VIEW OF CLUTCH UNIT:***

*1) Main transmission crown*
*2) Clutch hub*
*3) Pressure plate*
*4) Main transmission crown bushing*
*5) Rolled bushing*
*6) Washer*
*7) Washer*
*8) Nut*
*9) Complete lifter clutch push rod assembly*
*10) Lifter clutch push rod assembly*
*11) Bearing cage*
*12) Circlip*
*13) Spring washer*
*14) Ring*
*15) Special screws*
*16) Clutch driven disc*
*17) Clutch driving disc*
*18) Clutch driving disc*
*36) Ring*

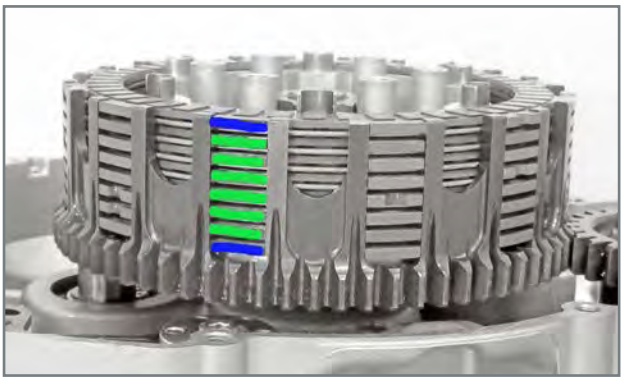



To tighten the nut **8** the clutch drum must be held blocked with tool **A** (*code 029.14.002.50.00*). Tighten to the specified torque.



***Safety washer folding***

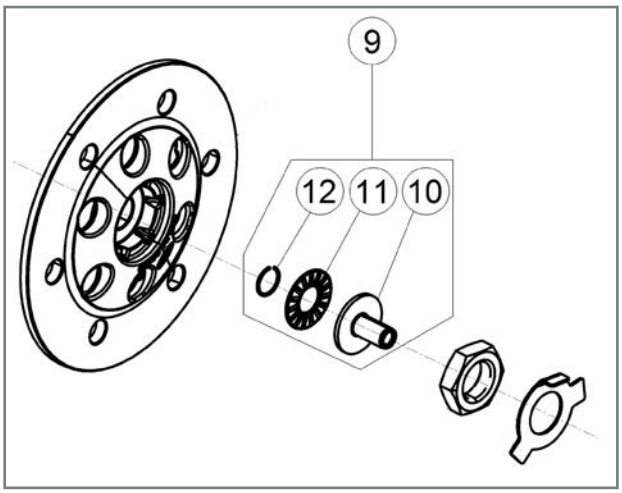
Having tightened the nut, bend the two blocking flaps on the safety plate.



***Disc layout***

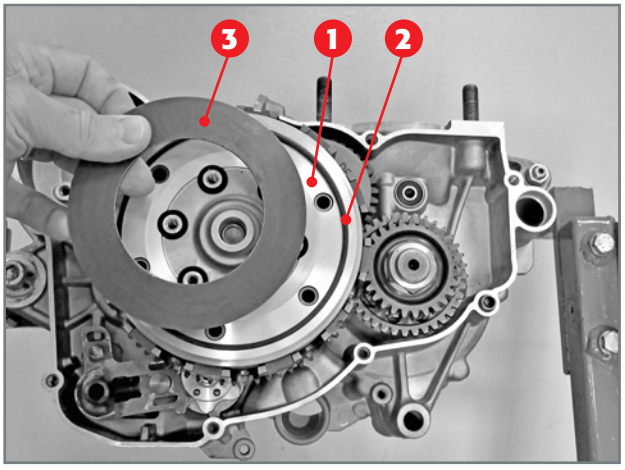
Lubricate the clutch discs with gear oil and apply the driving disc with BLUE edge and a driven disc. Then alternate the driving discs with GREEN edge and the driven discs.
The other BLUE driving disc will close the disc pack.

Please note that the driven discs must be inserted so that the radius on the teeth faces inwards towards the engine.




*Thrust bearing assembly*

Insert the thrust bearing assembly **9** (after lubricating it with gear oil) in the hole on the gearbox main shaft and check free axial sliding.




*Clutch cap assembly*

Fitting the pressure plate **1**, the ring **2** and the spring washer **3**.

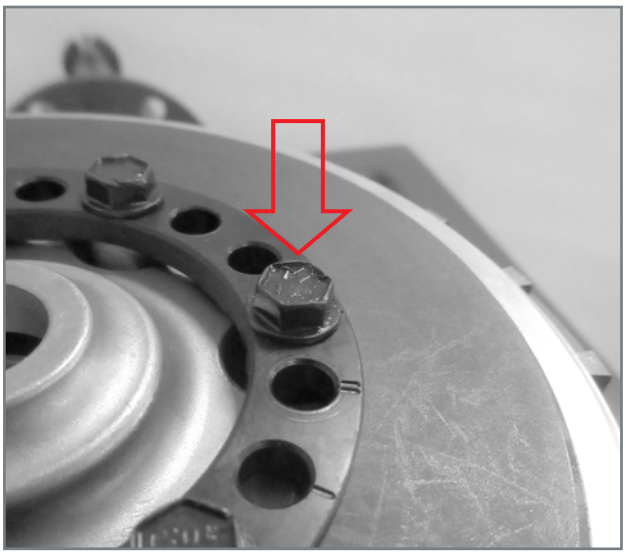
***WARNING!***
*The spring washer must be fitted so the side with the larger diameter rests on ring **2**.*



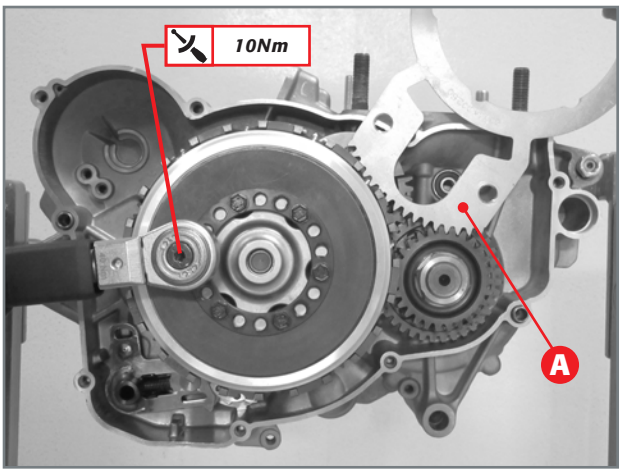

*Detail of correct fitting of the spring washer.*




*Detail of incorrect fitting of the spring washer.*



Fit the ring as shown in the diagram by positioning it so that a screw lines up with the III mark.

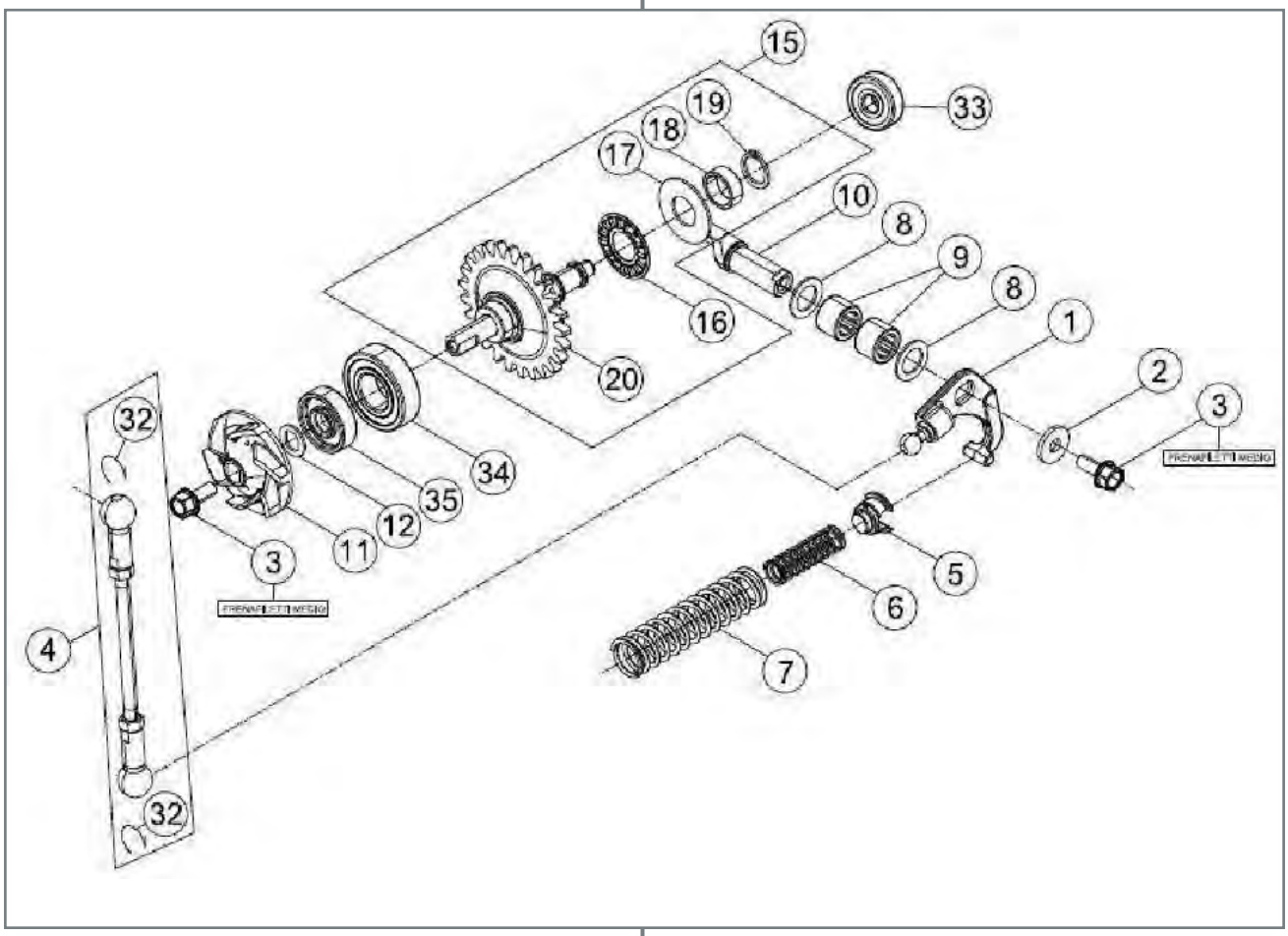


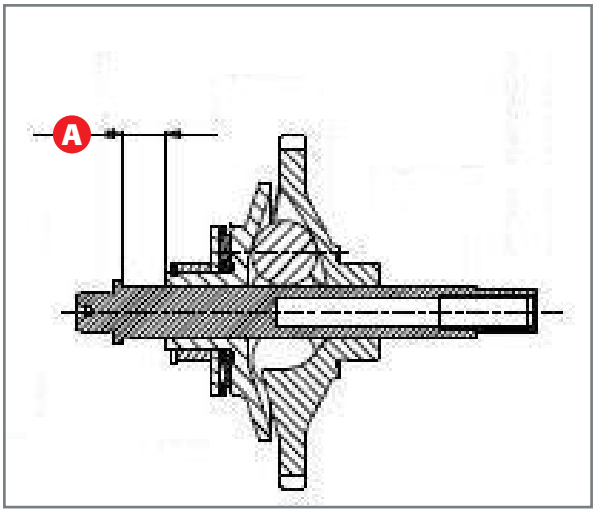

Proceed to tighten the six screws in a criss-cross pattern and tighten to the indicated torque.
To facilitate tightening, keep the clutch unit clamped using special tool **A** (code 037.14.002.50.00).

## 3.9 COOLANT LIQUID PUMP AND CENTRIFUGAL UNIT

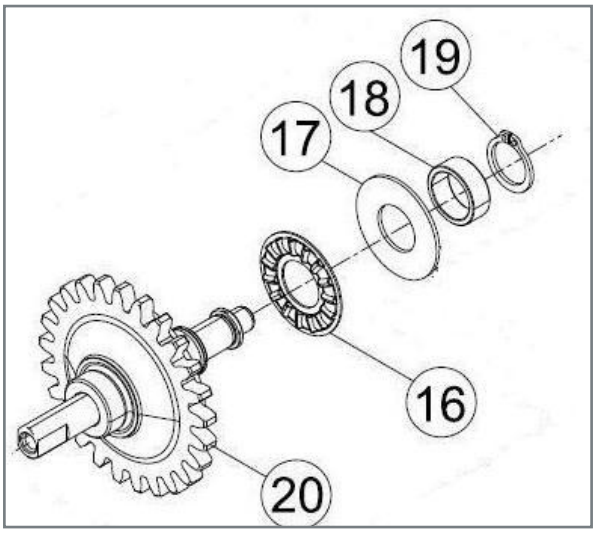
The water pump must assure the correct flow rate of coolant, depending on the set rotation speed, in order to remove the required amount of heat from the power unit. The centrifugal unit activates the whole exhaust valve control linkage based on the engine rotation speed, while springs **6** and **7** provide the appropriate resistance to the centrifugal action generated by **20**, in order to assure optimal supply of torque and power.
The impeller **11** is keyed onto shaft **20** and coupling is assured by tightening nut **3** on shaft **20**.
The centrifugal unit shaft **20** is supported by bearing **34** found on the internal clutch cover and by bearing **33** on the external side right crankcase half. The seal is guaranteed by oil seal **35**

***EXPLODED VIEW OF CENTRIFUGAL UNIT AND WATER PUMP UNIT***
***1) Rocker arm;***
***2) 5x15x2;***
***3) M5x12 screw;***
***4) Complete valve control rod;***
***5) Spring guide;***
***6) Auxiliary spring;***
***7) Adjustment spring;***
***8) 10x16x1 washer;***
***9) Roller bush;***
***10) Centrifugal control lever;***
***11) Water pump impeller;***
***12) Water pump washer;***
***15) Complete centrifugal unit;***
***16) Axial roller cage;***
***17) Centre bearing;***
***18) Spacer;***
***19) Circlip;***
***20) Complete centrifugal shaft;***
***32) Ball joint retainer ring;***
***33) 6x19x6 bearing;***
***34) 15x32x9 bearing;***
***35) Oil seal***

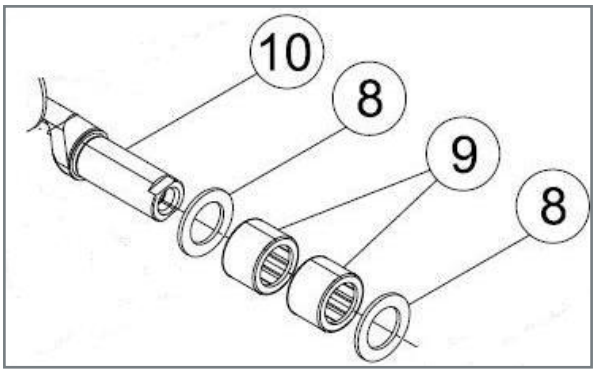




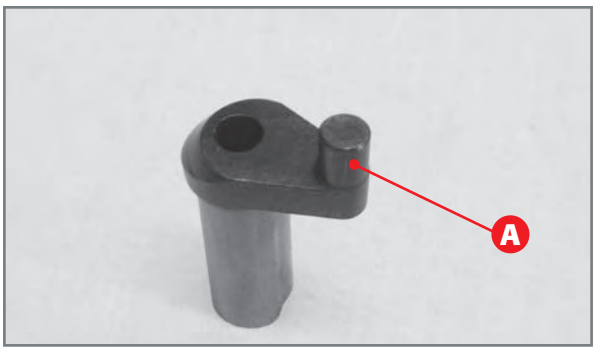

*View in centrifugal unit section: stroke A.*




*Exploded view of centrifugal unit.*




*Exploded view of bearings and centrifugal control lever.*




*Check of centrifugal control lever area A.*

## 3.9.1 Check of pump unit and disassembly, centrifugal unit and idler unit

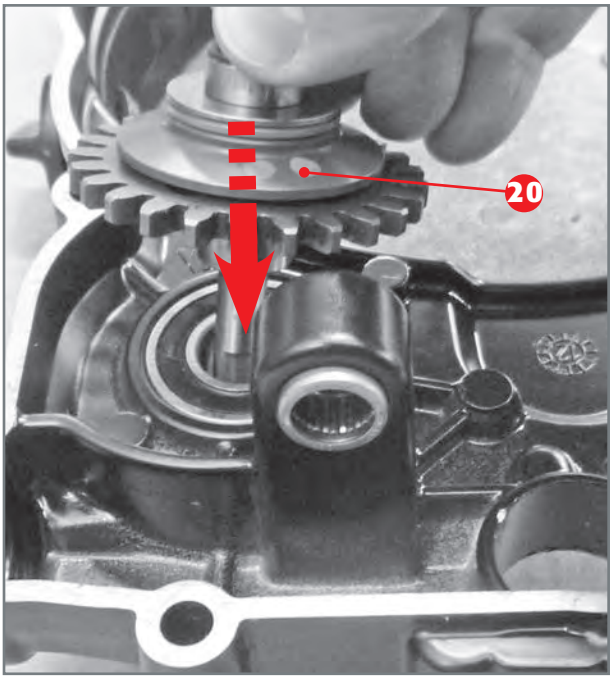
Refer to par. 2.6.1 to disassemble the entire pump unit.
Check oil seal condition. Replace if worn.

Check centrifugal unit shaft condition. Replace the entire centrifugal unit if dented in the area in contact with the oil seal.
Check the device's axial stroke **A** and ensure it is between 6.4-6.6mm.

Otherwise replace the unit.
Remove circlip **19** and check condition of the axial roller cage **16**. Replace it in case of anomalies.

Ensure the roller bushes **9** do not jam during operation and check the centrifugal control lever **10** moves correctly.

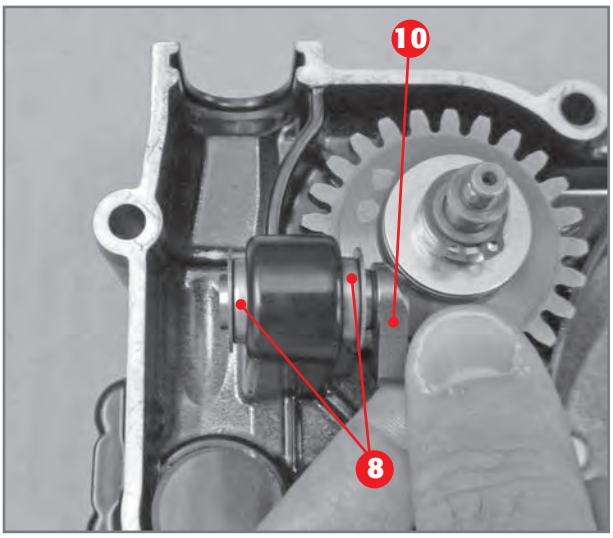
Also check area **A** of lever **10** is not worn.




*Insertion of centrifugal unit.*

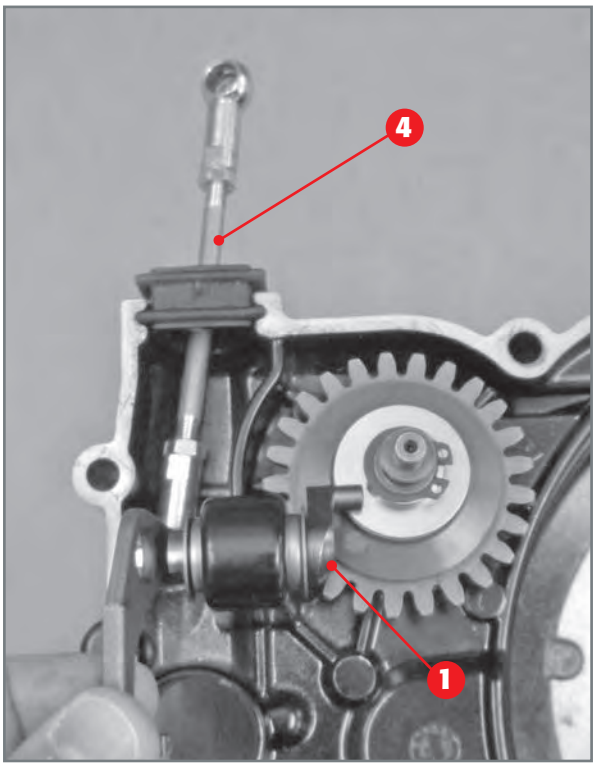
## 3.9.2 Centrifugal unit assembly

Insert the centrifugal unit 20 in the inner clutch cover.



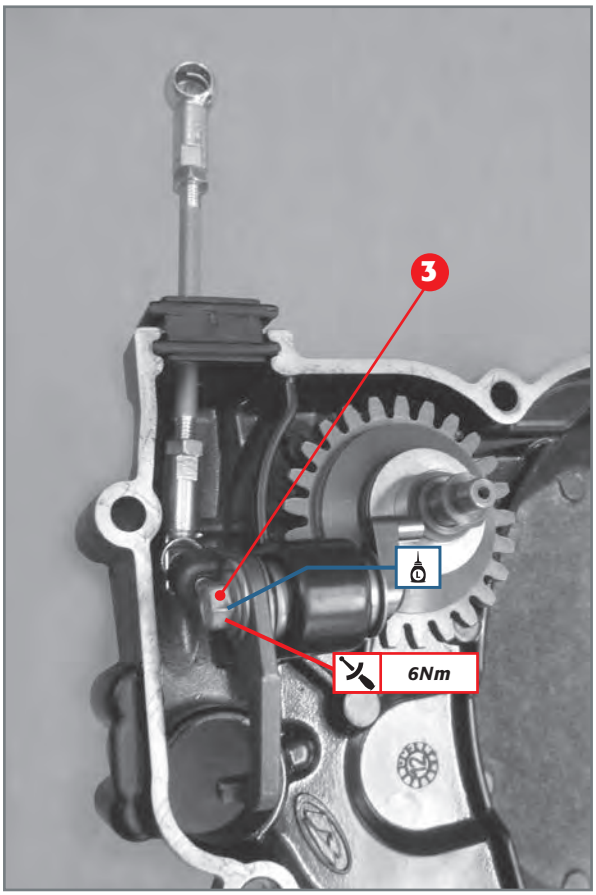

*Insertion of centrifugal control lever.*

Insert the centrifugal control lever 10 together with the washers 8.



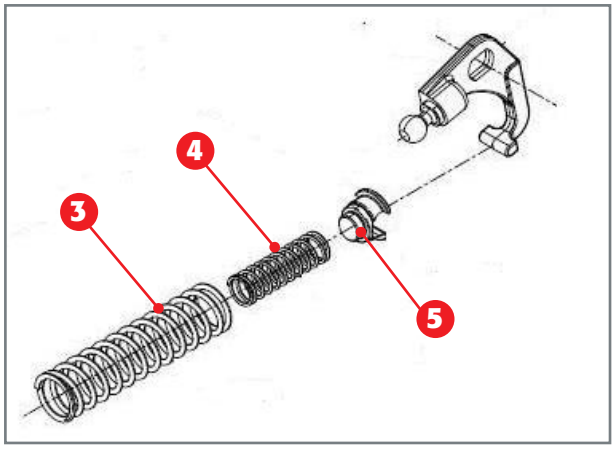

*Application of valve control and rocker arm unit.*

Apply the valve control rod gasket and the rocker arm **1** - valve control rod **4** assembly.



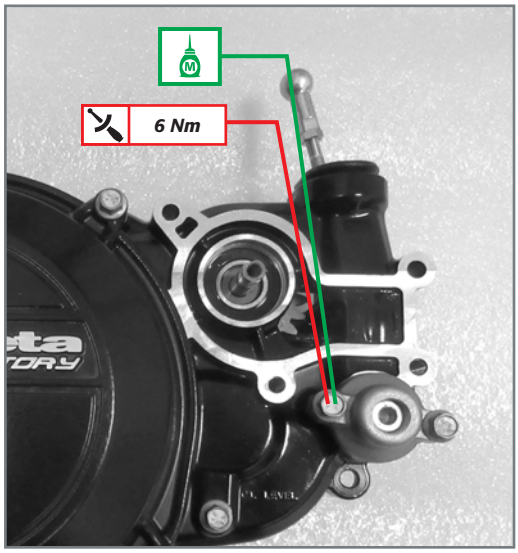

*Centrifugal unit assembly.*

Apply locking screw **3** after applying medium strength threadlocker. Tighten to 6Nm




*Spring guide and springs unit.*

Apply the auxiliary **4** and adjustment **3** springs to the spring guide **5**.

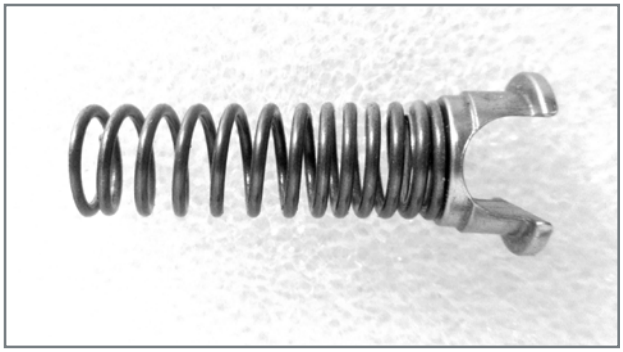



*Fastening of adjusting cover.*

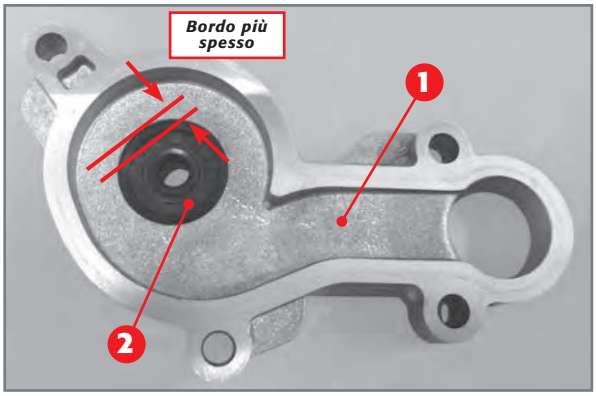
Apply the complete adjustment cover to the inner clutch cover. Apply the locking screws after applying medium strength threadlocker and tighten to the indicated torque.

The vehicles are fitted with the following auxiliary and adjusting springs.

| Displacement [cm³] | MY | Adjustment spring | Auxiliary spring |
|---|---|---|---|
| | | Colour | Colour |
| 250 | 2022 | Yellow | Blue |
| 300 | 2022 | Yellow | White |



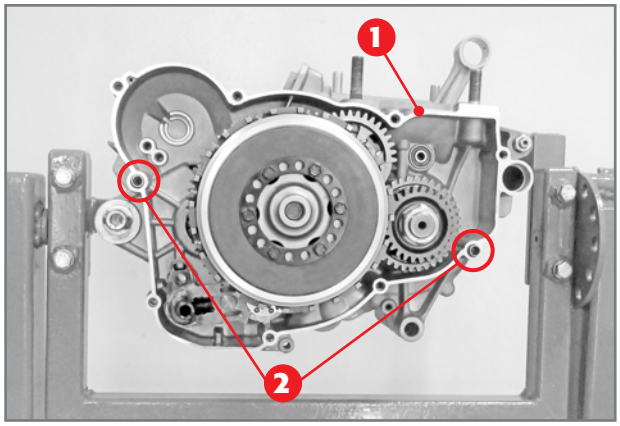
***ATTENTION!***
*Auxiliary spring 4 on displacement 250 has a variable pitch and must be fitted as shown in the figure.*




*Application of the oil seal to the pump body.*

## 3.9.3 Pump unit assembly

Grease the oil seal housing on the pump body **1**. Position the oil seal **2** so that the thicker edge faces the outside of the pump body. Insert the oil seal, having it enter the seat very slowly to prevent it from deteriorating. The oil seal edge must be at the same height of the pump body (outer side).

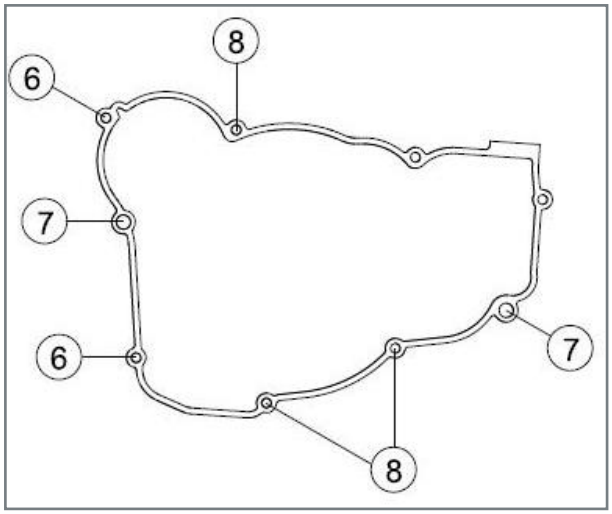



*Positioning of gasket and reference pins.*

## 3.9.4 Assembly of complete clutch cover and pump unit

Apply a new gasket **1** placed between the right crankcase half and the inner clutch cover using the two reference pins **2** to keep it in place.

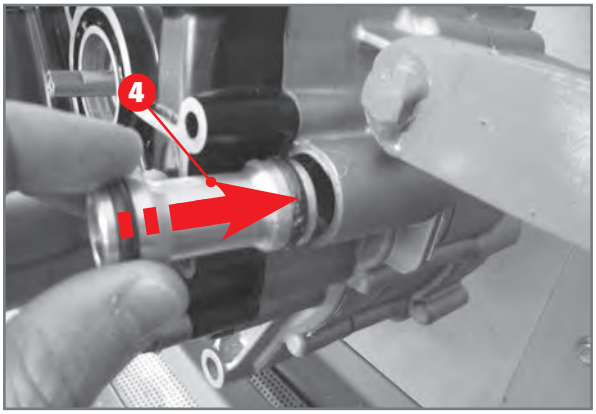
Couple the inner clutch cover to the right crankcase half and rotate the centrifugal shaft until the shaft meshes in the main gear.




*Positioning of screws.*

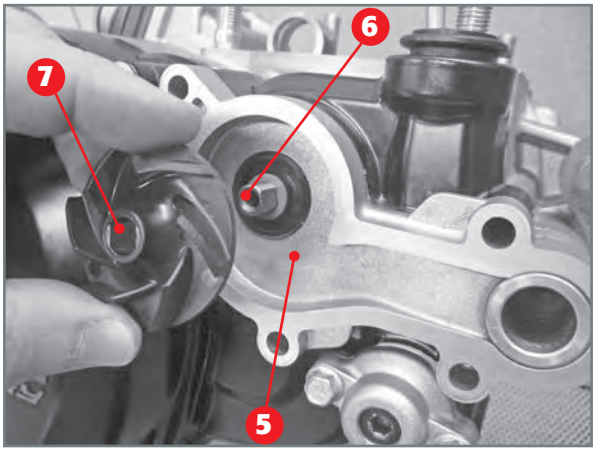
Apply the seven screws as shown in figure, fastening them at 10Nm with a criss-cross pattern.

| Number screw | Screw size | | Threadlocker application | Tightening torque [Nm] |
|---|---|---|---|---|
| | Threading diameter | Threading length | | |
| 6 | M6 | 20 | NO | 10 |
| 7 | M6 | 25 | NO | 10 |
| 8 | M6 | 50 | NO | 10 |



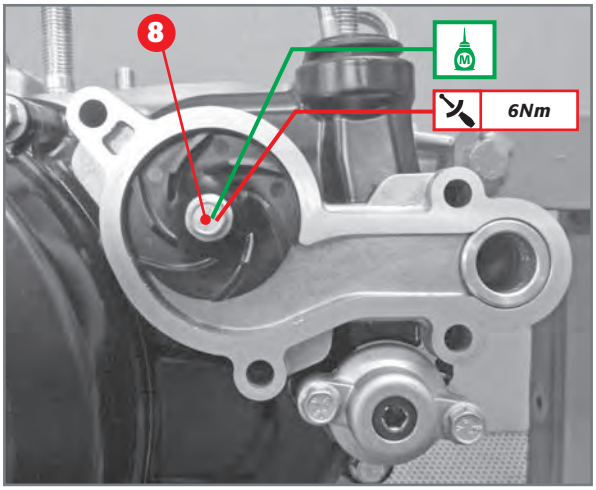

*Insertion of water hose.*

Grease the O-rings on the water hose and insert the hose **4** in the right crankcase half.



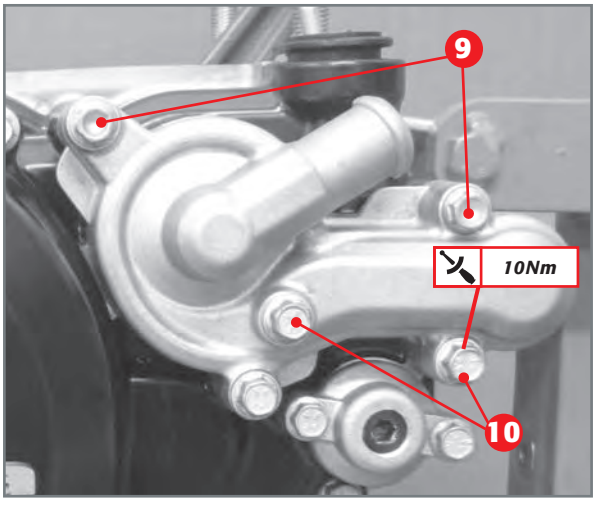

*Application of water pump impeller.*

Apply the gasket between the pump body and clutch cover. Grease the inner diameter of the oil seal on the pump body **5** and apply the body to the clutch cover.
Apply washer **6** and water pump impeller **7**.




*Complete water pump.*

Apply screw **8** after applying medium strength threadlocker and tighten at 6Nm.




*Pump cover.*

Couple the water pump cover to the pump body by applying the two M6x60 screws **9** and the two M6x30 screws **10**. Tighten all screws at a torque of 10Nm following a criss-cross pattern.

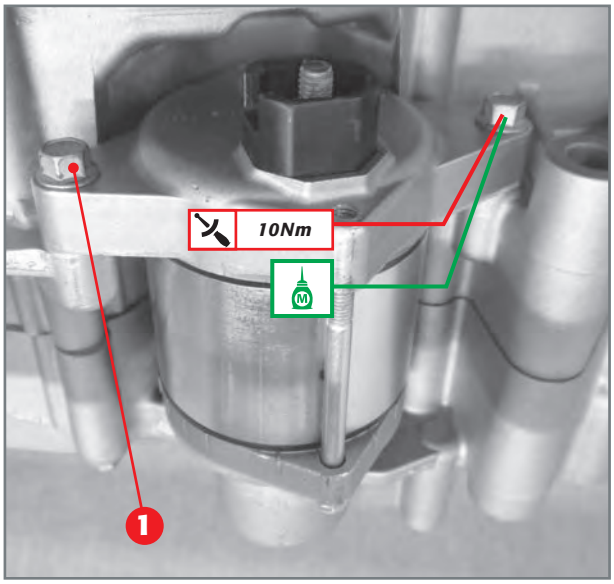



## 3.10 ELECTRIC IGNITION UNIT

Carry out the following checks before assembly.

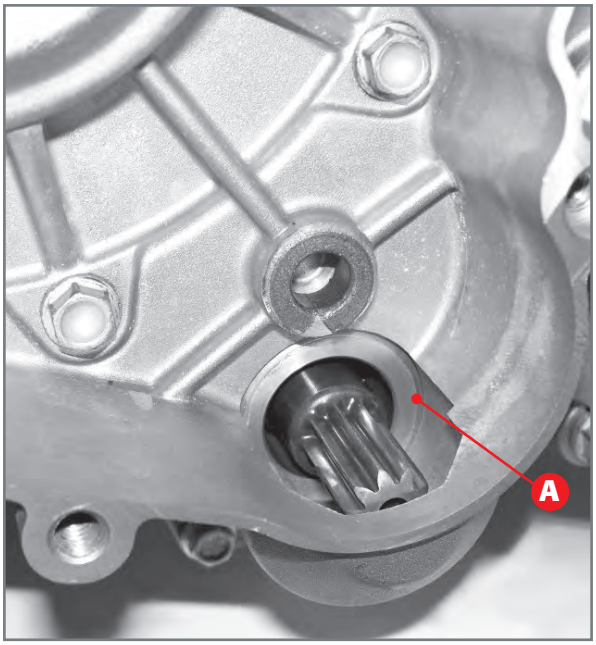
### 3.10.1 Bendix coupling checks

Check wear of the gearwheels found on the unit. Replace the whole coupling in case of abnormal wear and signs of chipping of the wheels.
Keep wheel **1** fixed and rotate the mobile coupling **2** anti-clockwise; this must slide without seizing. When releasing the mobile coupling, it must go back to rest position without seizing.
Replace the whole unit if abnormalities are observed during these two checks.



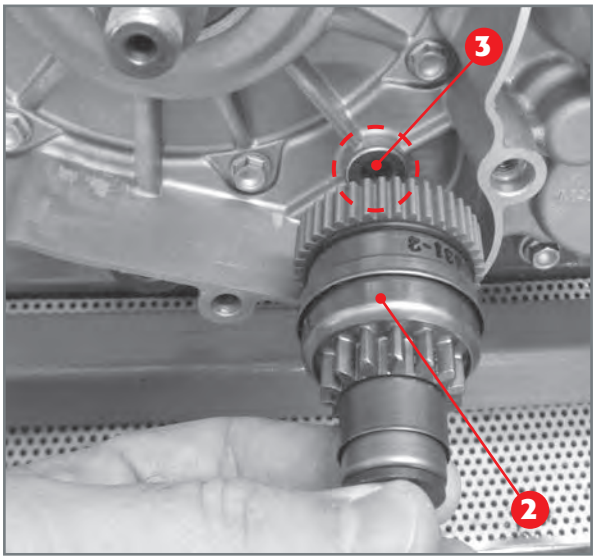

### 3.10.2 Ignition unit coupling to engine

Apply a thin layer of grease on the O-ring located on the starter motor. Insert the starter motor in its seat and lock it with the two screws **1**, after applying medium strength threadlocker. Tighten to 10Nm




*Application of oil.*

Pour about 7cc of gear oil (for specifications refer to the recommended lubricants and liquids table) in area **A**.




*Insertion of Bendix coupling.*

Insert Bendix coupling **2** in bush with collar **3** found on the outer side left crankcase half.

## 3.11 IGNITION SYSTEM

Before reassembling the ignition system, it is recommended to make sure it is in good working order.
The ignition system consists of the magnetic pick-up unit, the stator unit and the flywheel. The system is completed by the ignition coil and the spark plug, which are not dealt with here.

### 3.11.1 Check of the ignition system

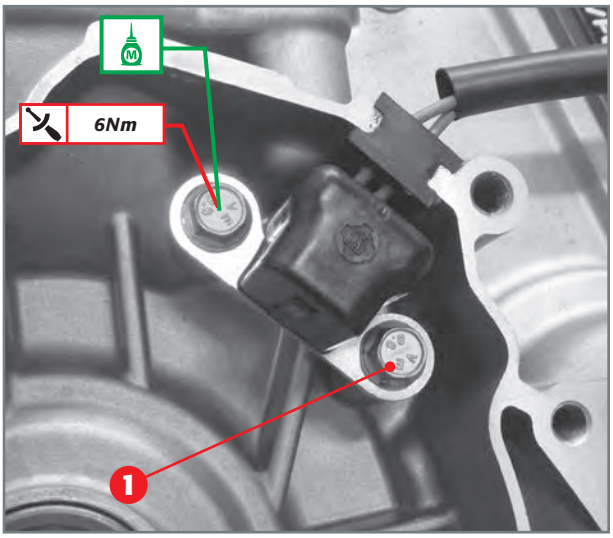
Accurately degrease the various elements and carry out the checks.
The main check is the one concerning the electrical inspection which can be done by using a standard tester. The measured resistance values must comply with those in the table.

| Element | Cables | Resistance values |
|---|---|---|
| Pick up | Red – Green | 100Ω ± 20% |
| Stator | Red/Black – White/Red | 14.7Ω ±15% |
| | Yellow – Mass | 0.61Ω ±15% |
| | Yellow – White | 0.18Ω ±15% |

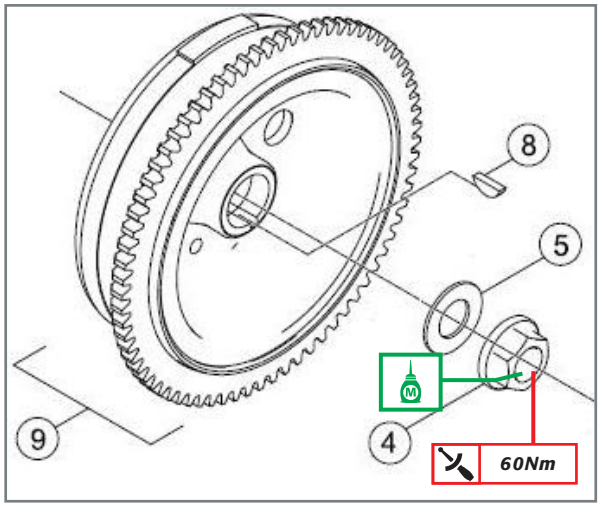
### 3.11.2 Coupling of ignition system to crankcase

Apply the pick up to the crankcase and insert the gasket in the specific seat, after applying the insulating silicone paste.

Cover the threading of the two screws **1** with medium strength threadlocker and tighten them at a torque of 6Nm.

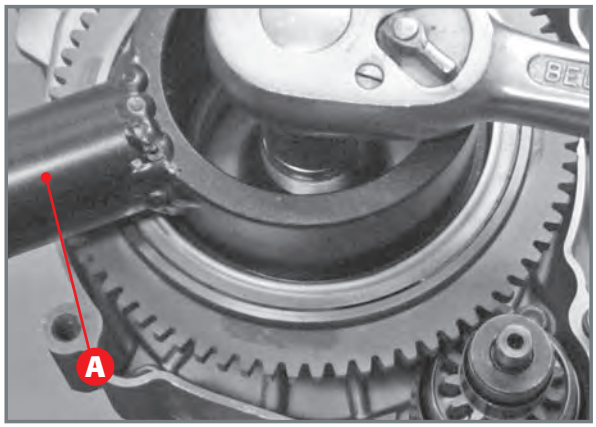



*Coupling of pick up to crankcase.*



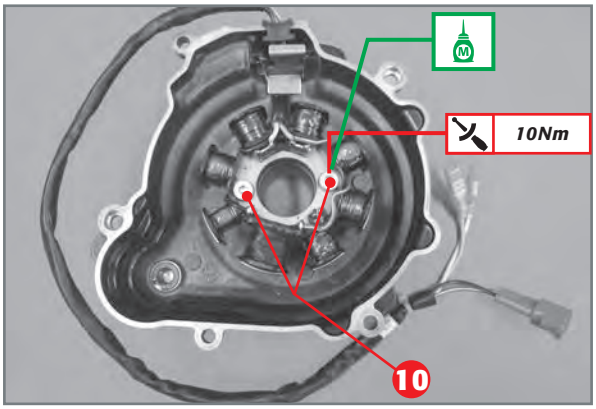

*Exploded view of flywheel. 4) M12x nut; 5) Elastic washer; 8) Woodruff key; 9) Flywheel.*

Thoroughly degrease the crankshaft conical section, apply the Woodruff key **8** in the appropriate groove on the crankshaft, couple the flywheel **9**, the elastic washer **5** and the nut **4**, after spreading the threading with medium strength threadlocker.



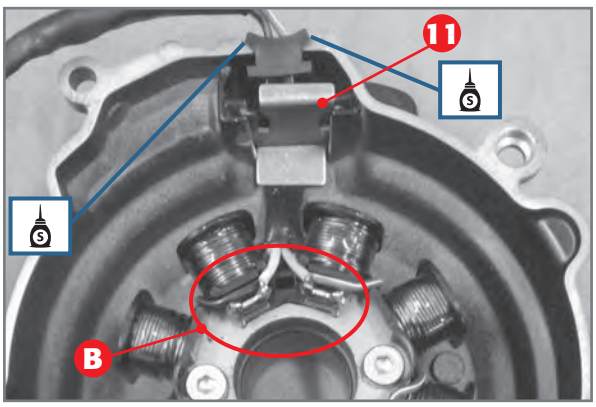

*Flywheel fastening.*

Tighten the nut to torque 60Nm, keeping the flywheel blocked with special tool **A** *(code 026140040 000)*.



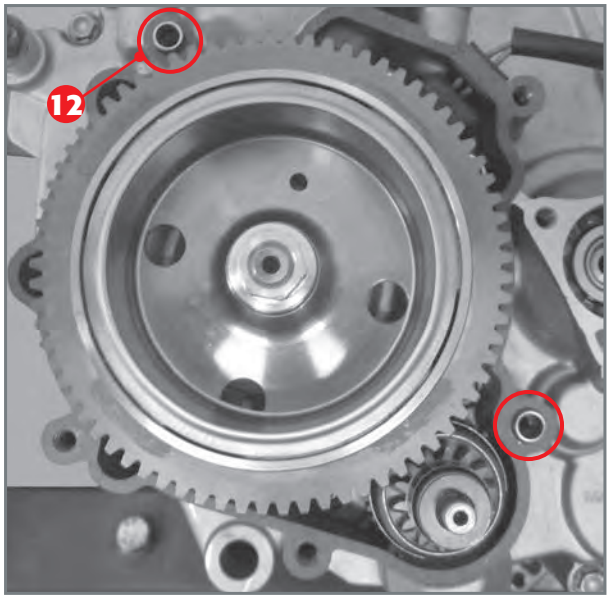

*Stator coupling to the flywheel cover.*

Couple the stator to the flywheel cover by means of the two screws **10**. Cover the threading with medium strength threadlocker and tighten them at a torque of 10Nm.
Insert the cable gland in its specific seat and check its perfect tightness.




*Application of stator plate.*

Apply a few drops of silicone in the guides for housing the plate **1**. Apply the plate **11** to be inserted in its guides and pressed. When coupling to the left crankcase half, apply a drop of gasket paste *(code 3625000000)* in area **B**.




*Application of flywheel cover centring pins.*

Insert the centring pins **12** on the crankcase and fit a new gasket.




*Flywheel cover coupled to crankcase.*

Apply the flywheel cover, the two M6x25 screws **13** and the three M6x20 screws **14**. Tighten in a criss-cross pattern at a torque of 10Nm.




*Position to measure the outside diameter of the piston.*

## 3.12 POWER UNIT

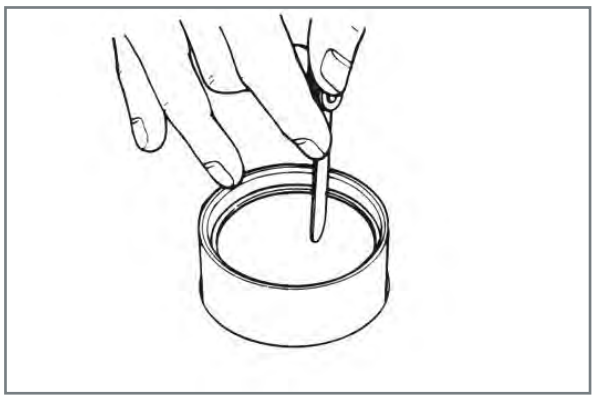
Before assembling the power unit, thorough checks must be carried out on the cylinder, piston, pin bolt and elastic bands, described below.

### 3.12.1 Check of the piston and elastic bands

Remove carbon sediment from the top of the piston and wash the entire piston with specific degreasing agent.
*Do not use sharp tips or tools for cleaning.*
Then carry out a careful analysis of the piston which must be free from forcing, scratches, cracks or any type of damage.
Analyse the external diameter of the piston.
The diameter must be measured at a distance **X** from the inner edge of the skirt, perpendicularly to the axis of the pin bolt.

Refer to the following table for the piston's selection classes.

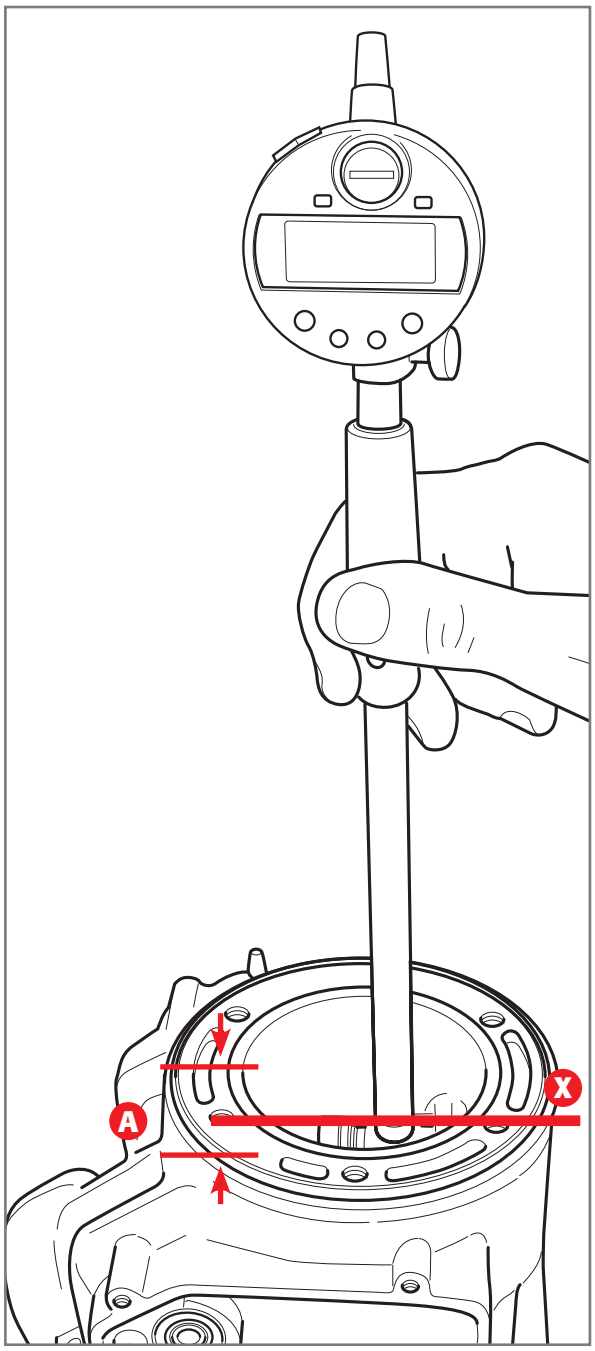
| Displacement [cm³] | Measurement X [mm] | Bore [mm] | | |
|---|---|---|---|---|
| | | A | B | C |
| 250 | 24 | 66.345÷66.354 | 66.355÷66.364 | 66.365÷66.375 |
| 300 | 18 | 72,945÷72,954 | 72,955÷72,964 | 72,965÷72,975 |



*First check of elastic bands.*

In order to check the condition of the elastic bands, the band must be inserted in the cylinder so that its axis is aligned with the axis of the cylinder. Then measure the distance between the two opposite ends.
The elastic bands must be positioned at about 31 mm from the cylinder's upper edge.
The respective service limits are set out in the table below.

| Displacement [cm³] | Service limit of elastic band [mm] |
|---|---|
| 250 - 300 | 0.4 |

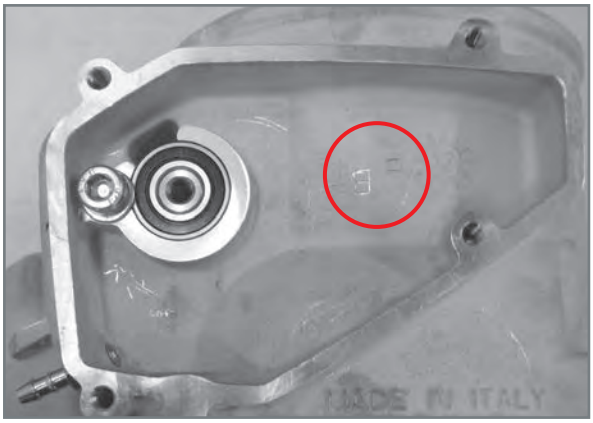



## 3.12.2 Cylinder check

Ensure the cylinder has no signs of seizure. Otherwise replace it.
Measure the bore at a distance **A** from the top face of the cylinder (surface between cylinder and head). Take the correct measurement by following direction **X**.

| *Displacement [cm³]* | *Measurement A [mm]* |
|---|---|
| ***250*** | ***31.8*** |
| ***300*** | ***31.5*** |

Bore measurement is required to know the coupling play between cylinder and piston.



*Cylinder class punching.*

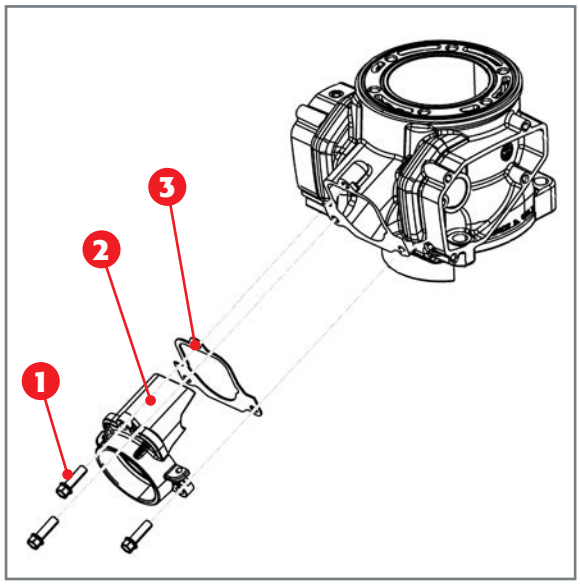
The cylinder's specific class is punched inside the expansion chamber.

## 3.12.3 Piston cylinder coupling play

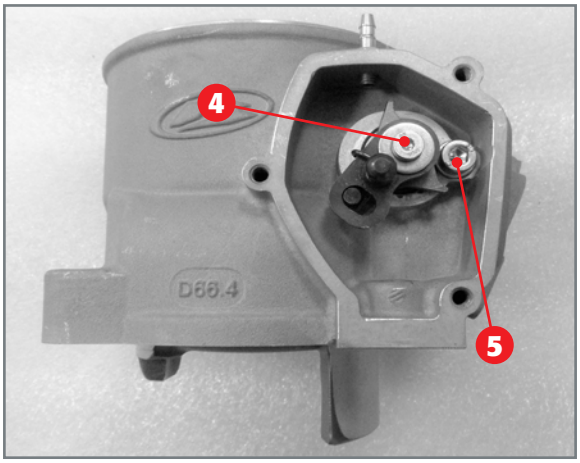
The following table sets out the coupling play between cylinder and piston. In order to calculate the coupling play between cylinder and piston, a subtraction must be carried out between the diameter of the cylinder and that of the piston.

| *Displacement [cm³]* | *Maximum cylinder piston play [mm]* | *Minimum cylinder/ piston play [mm]* |
|---|---|---|
| *250 - 300* | *0.1* | *0.035* |

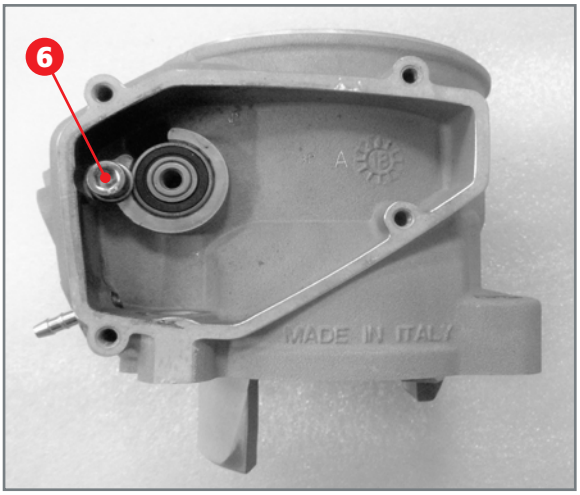
## 3.12.4 Exhaust valve unit disassembly and checks



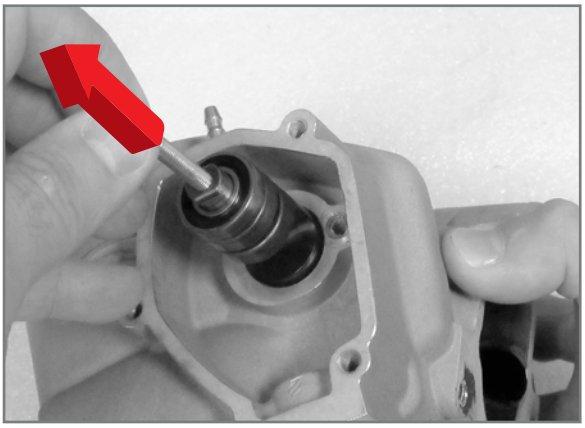

Remove screws **1** to allow the exhaust flange **2** and its gasket **3** to be disassembled.



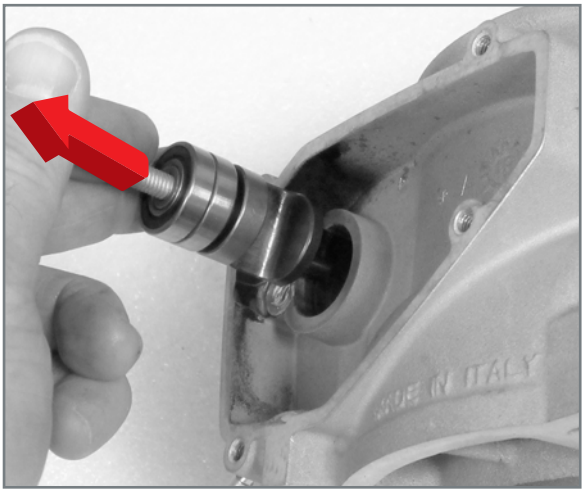

Remove screw **4** fastening the valve control unit to the booster; then remove screw **5** fixing the bearings.



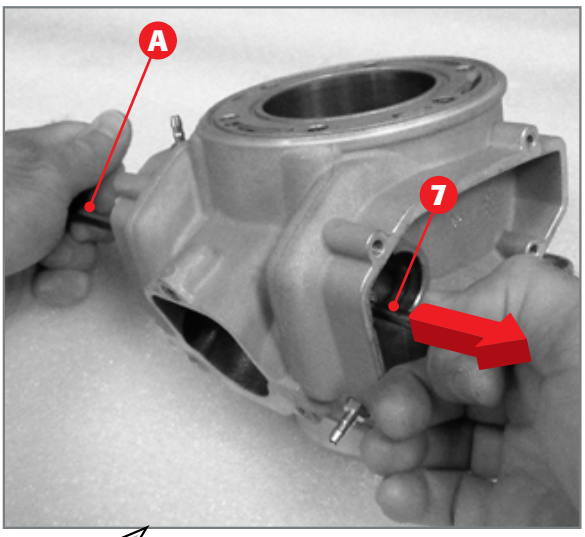

Remove screw **6** that keeps the left side bearings and the booster in their housing.



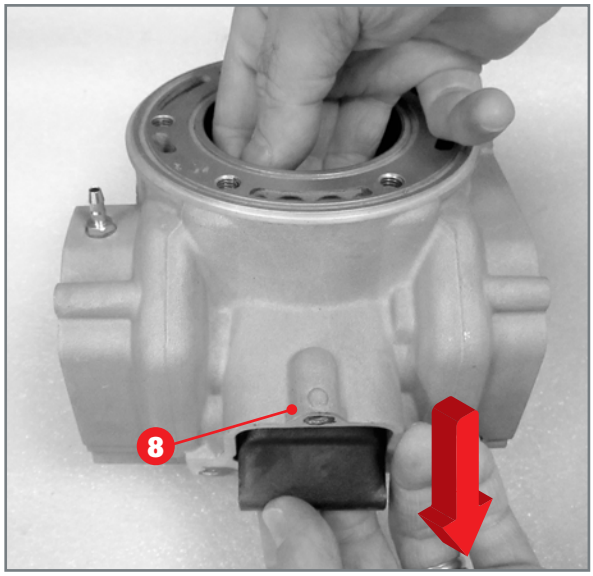
Apply one M5 screw on control unit side and pull outwards.

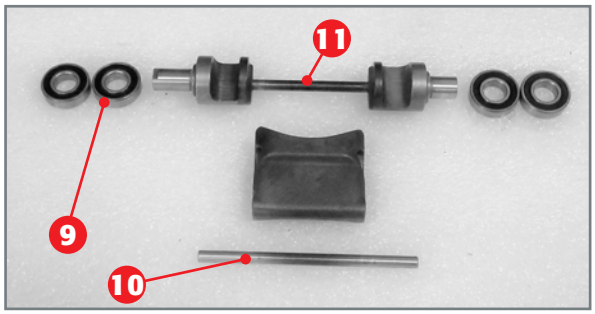


Repeat the operation on the opposite side using one M6 screw.



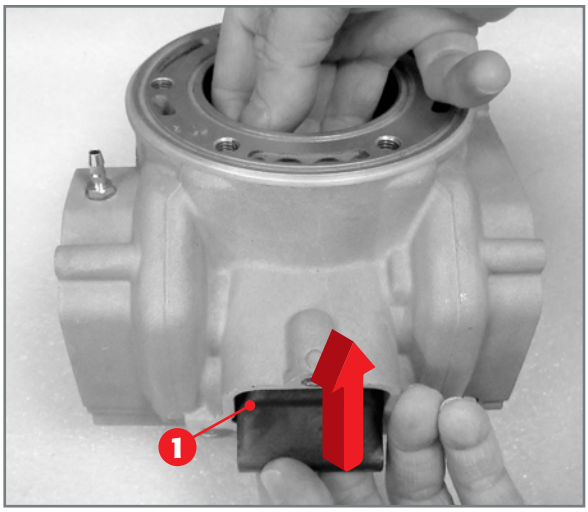

After extracting the boosters and relevant pin, extract the valve pin **7** by pushing it with a metal cylinder **A** and then extract valve **8**.



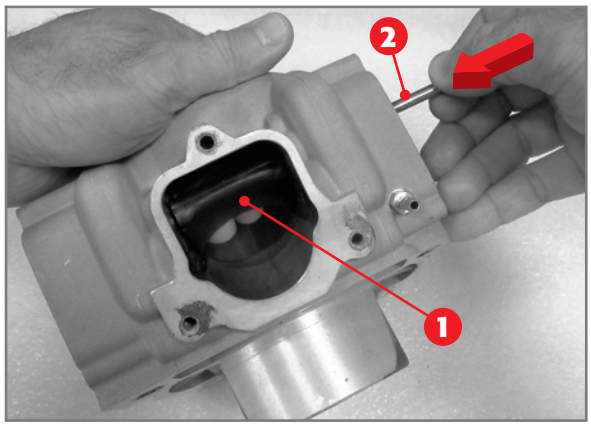

Check the bearings 9 supporting the booster are efficient, without seizing during operation or excessive play, once the assembly has been cleaned and descaled. Otherwise replace.
Check pins 10, 11 and their seats are not abnormally worn. Otherwise replace the worn parts.

Descale all passages involving the exhaust. Strictly avoid the use of abrasives.

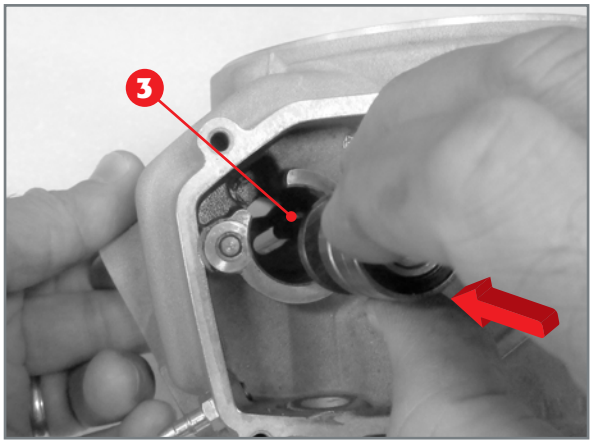



### 3.12.5 Unit assembly exhaust valve

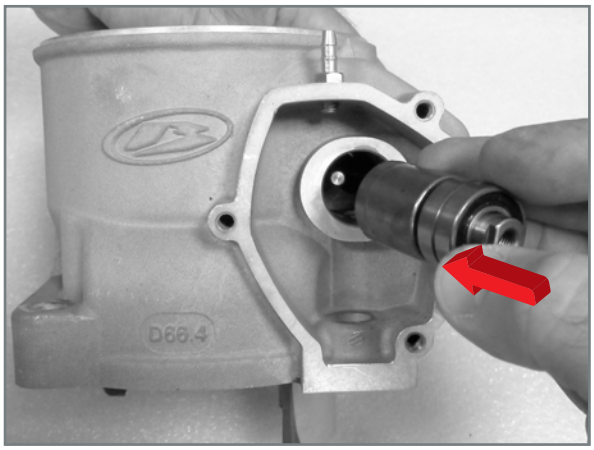
Insert valve **1** in its seat with the back facing upwards.



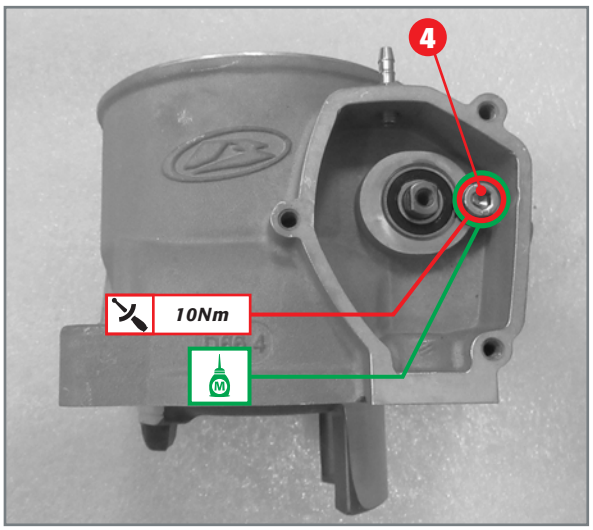

Insert pin **2** while holding valve **1** in position.



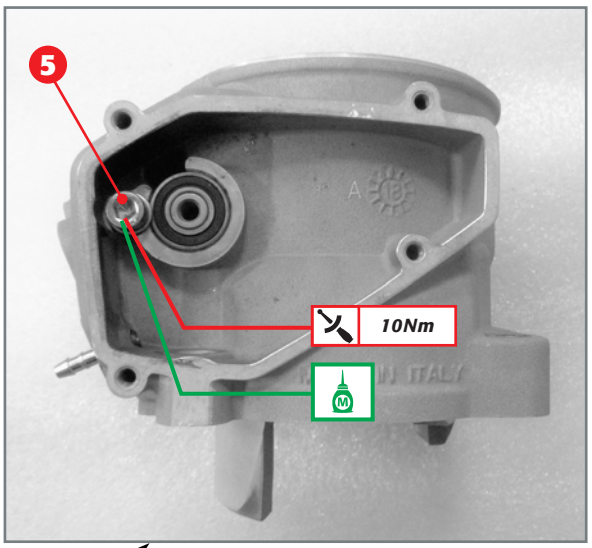

Apply the left side booster unit complete with pin and bearings in its seat: pin **3** must be inserted in the specific slot in the valve.

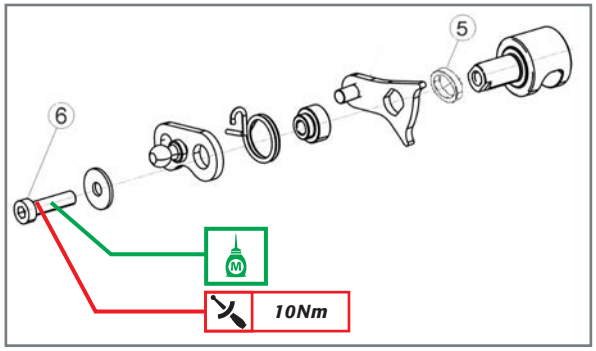


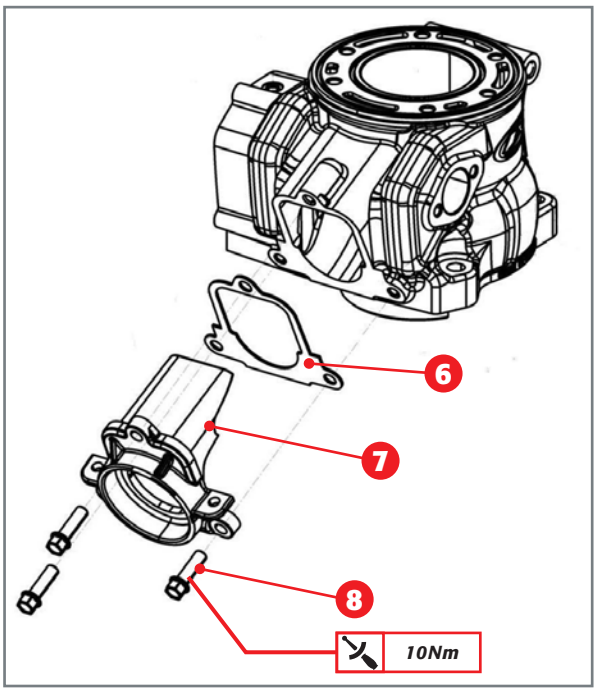
Apply the right side booster unit in its seat.




Apply screws **4** and **5** complete with washer after applying medium-resistance threadlocker and tighten at the specified torque.





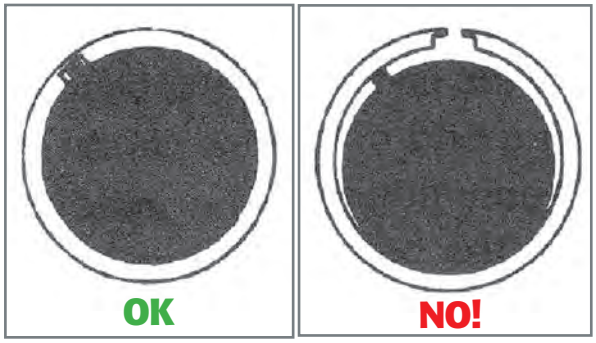




Apply spacer **5** to the control side.
Then apply all other parts.
Screw **6** must be covered with medium strength threadlocker and tightened at the indicated torque.
Try moving the assembly and check the entire mechanism slides perfectly, once assembly is completed.

## 3.12.6 Piston, elastic bands, pin bolt and cylinder assembly

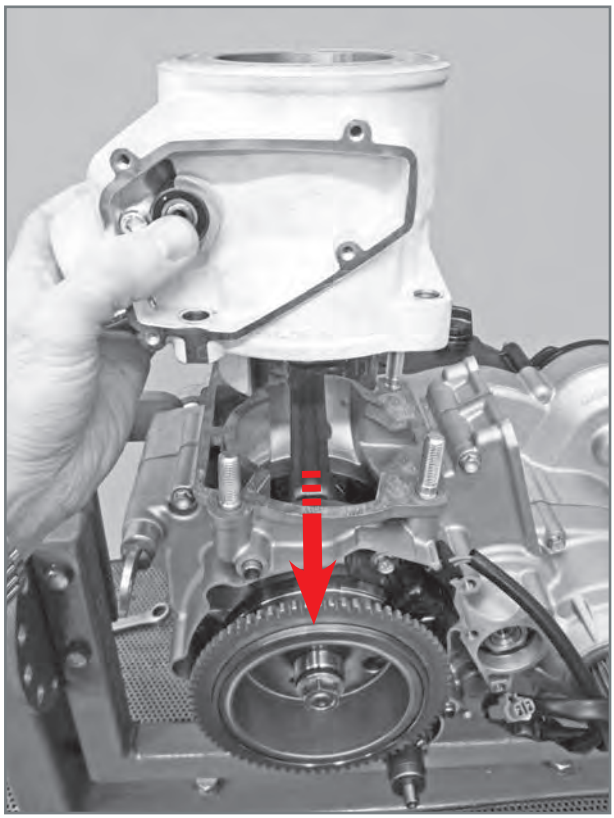
Insert a circlip for retaining the pin bolt in one of the seats on the piston's side, placing the circlip's open part either upwards or downwards.
Apply the roller cage in the connecting rod's foot, and lubricate it.
Oil pin bolt and seat in piston. Insert the pin bolt in the piston from the side opposite where the circlip was inserted, leaving enough space to allow the connecting rod to mate with the piston. Place the piston so that the arrow stamped on the crown is facing the front of the engine (exhaust opening). Couple the piston to the connecting rod by fully pushing the pin bolt until flush with the previously inserted circlip. It may be helpful to use an aluminium cylinder (or similar tool) during this stage.

***WARNING!***
*Place a clean cloth between the piston and the crankcase to keep foreign objects from falling inside the crankcase.*




*Positioning of elastic bands on the piston.*

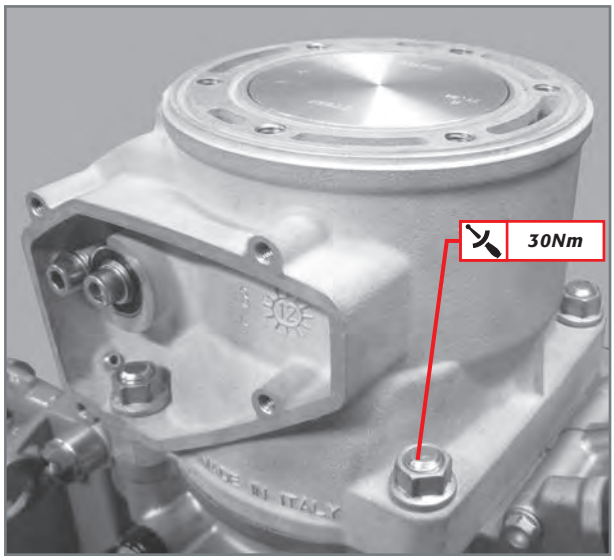
Insert the second circlip in the specific seat of the piston, placing the open part either upwards or downwards. Remove the previously inserted cloth.
Oil the skirt of the piston with plenty of engine oil and insert the elastic bands, the edges of which must face the area with the stop pin.



*Coupling of cylinder to piston and crankcase.*

Apply the gasket between crankcase and cylinder.

Accurately oil the entire cylinder using engine oil and insert the piston in the cylinder. The piston must be inserted in the cylinder while holding the elastic bands with one's fingers tightly. The cylinder must be positioned so that the exhaust gap is facing the front of the engine.
Push the cylinder towards the crankcase.




*Tightening of cylinder nuts.*

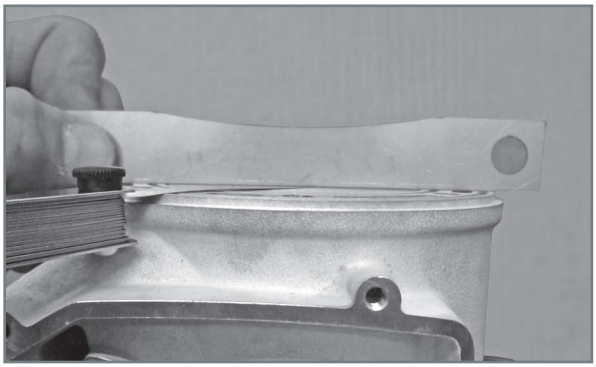
Apply the four collar nuts and tighten them at 30Nm, following a criss-cross pattern.

## 3.12.7 Check of crankcase/ cylinder gasket thickness

The thickness of the gasket between cylinder and crankcase must be checked every time the following are replaced:
- Cylinder;
- Piston;
- Crankshaft;
- Connecting rod;
- Crankcase.

The check is necessary as said thickness affects engine performance. The check must be carried out using the specific calibrated plates set out in the table.

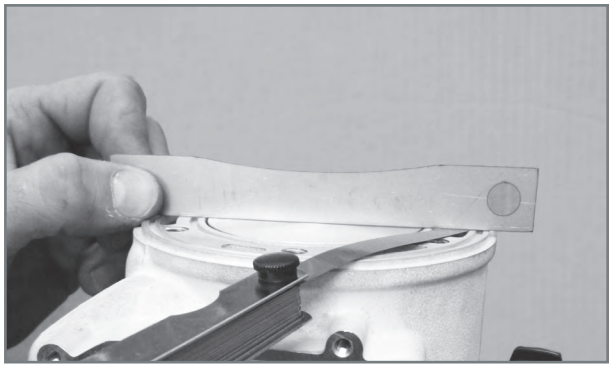
| Displacement [cm³] | Model Year | Code | Side |
|---|---|---|---|
| 250 | 2022 | 026.14.017.00.00 | B |
| 300 | | | A |



*Case where the plate and piston do not touch: check distance between plate and piston.*

The use of the plates is described below.
- Place the specific plate making sure it comes into contact with the cylinder's upper surface.
- Move the piston to top dead centre and, using a thickness gauge, check the play between piston and plate is between 0÷0.05mm.

If the play between piston and plate is higher than required, reduce the cylinder/crankcase gasket thickness and carry out the check again.



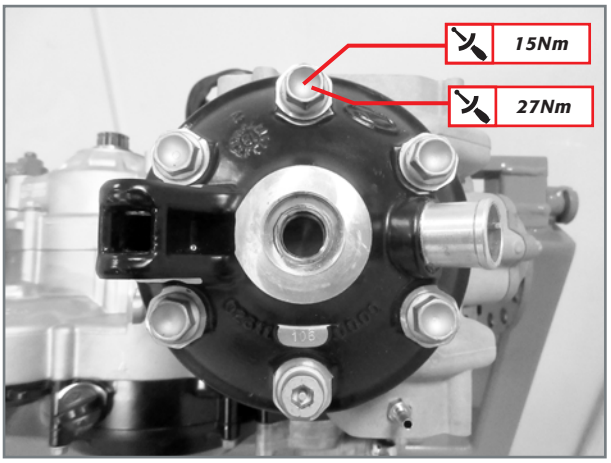
*Case where the piston pushes the plate causing cylinder/plate contact to be lost*

Measure the play with a gauge if the piston pushes the plate upwards, causing contact to be lost between plate and cylinder: if the play is greater than 0.05 mm, the thickness of the cylinder/casing gasket must be increased and the check must be done again.

The gaskets are supplied in four different thicknesses.
that can also be stacked, thus obtaining the required height for the right thickness.

***Note:*** *the above-described check must be carried out once all four crankcase cylinder coupling nuts have been tightened at the set torque (30Nm).*

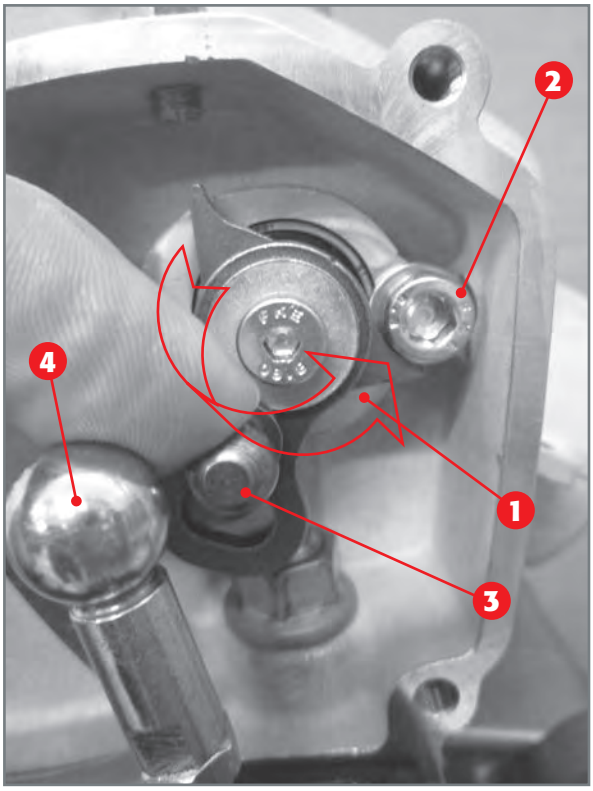
## 3.12.8 Head application




*Tightening of head.*

Apply the two O-rings to the cylinder. Place the head so that the water hose is facing the front of the engine. Grease the screws and apply them to the head, together with the copper washers. Following a cross pattern, tighten in two steps:

1. 15Nm;
2. 27Nm

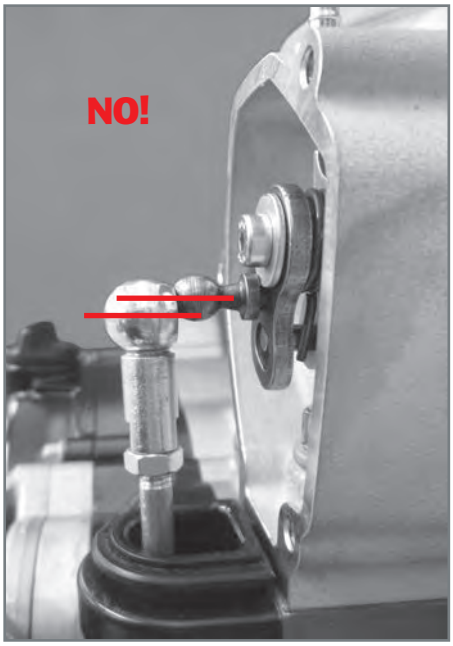


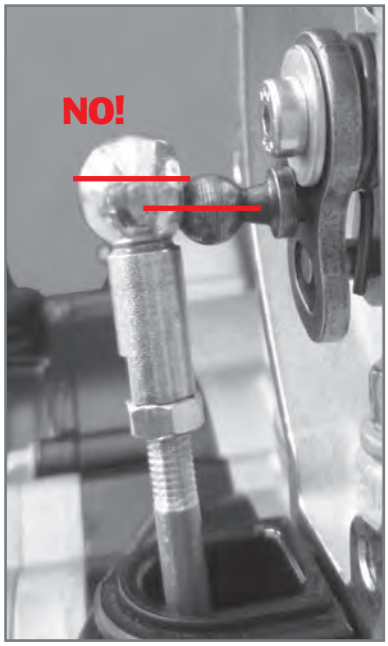

*Positioning of valve control.*

## 3.12.9 Exhaust valve adjustment

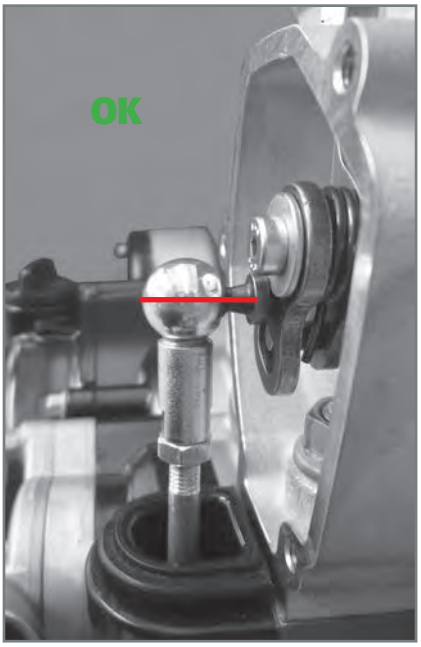
Bring the valve control unit **1** in the fully closed position, so the stroke end lever is flush with screw **2** fixing the booster bearings.

Check the ball head **3** and the seat **4** are perfectly aligned.
Otherwise loosen the lock nut, adjust the seat and tighten the lock nut.

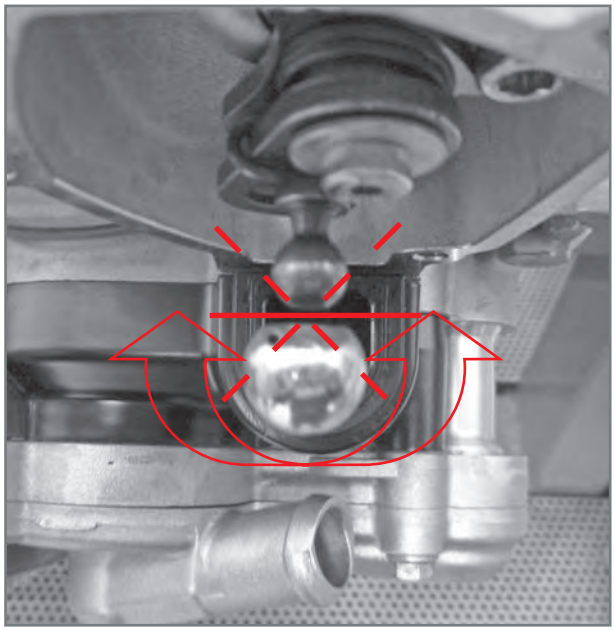



*Incorrect positions of the control rod seat.*

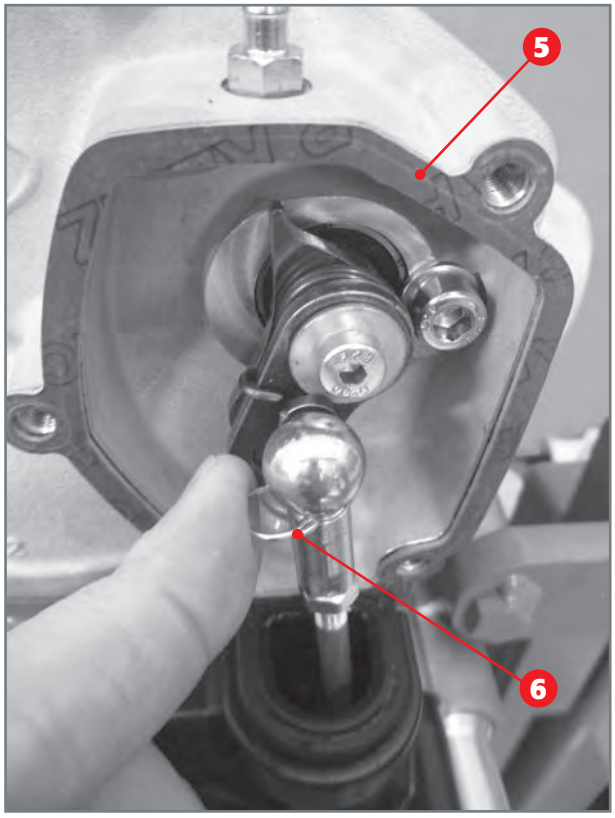



*Correct position of the control rod seat.*



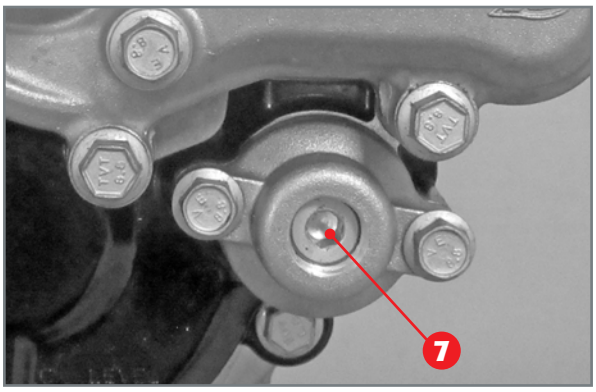
*Check of control rod rotation.*

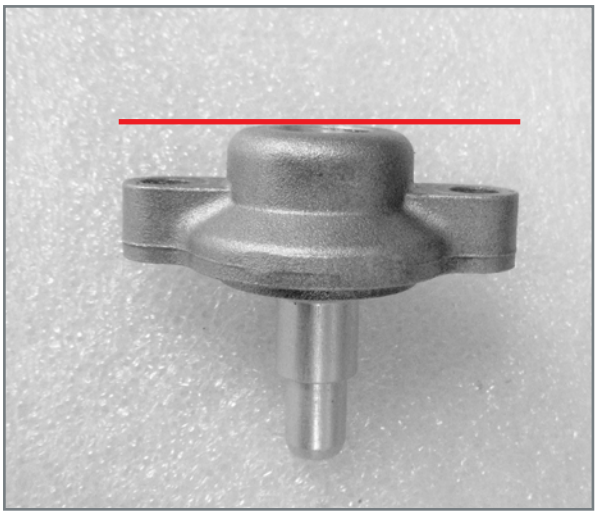
Ensure the control rod is able to rotate around its axis, making equal angles with respect to the ball head axis.




*Insertion of control rod and application of stop.*

Apply gasket **5** and insert the control rod. Apply the stop **6**.



*Fully open reference.*

Use screw **7** for dynamic adjustment of the exhaust valve unit, thus modifying the characteristic curve of the engine.
The positions indicated in the table below are those considered optimal for engine operation.

| *Displacement [cm³]* | *Setting the adjustment screw (from all open)* |
|---|---|
| *250* | *1/4* |
| *300* | *1/4* |

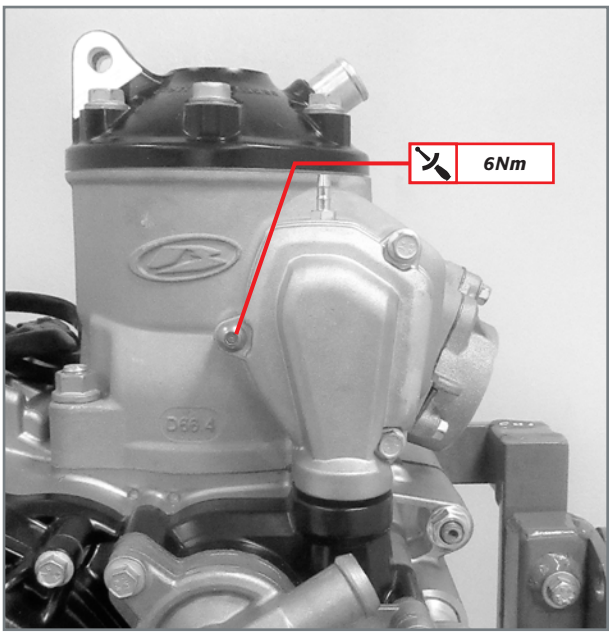
The "fully open" position is for perfect alignment between adjustment screw head and adjustment cover.
Adjustment must, therefore, be carried out as follows.

- Move the screw to the “fully open” position;
- Tighten the number of turns indicated in the table.

The table shows the effects obtained from modifying the position of the adjustment screw with respect to the positions in the above table.

| *Clockwise rotation of adjustment screw* | *Anti-clockwise rotation of adjustment screw* |
|---|---|
| *Softer flow-rate and less over-rev* | *Greater acceleration and lower torque at low speeds* |

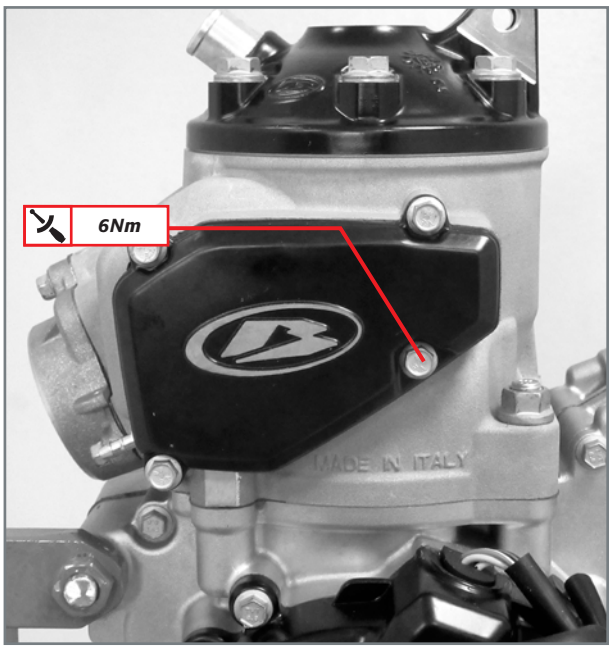
***WARNING!***
*Do not tighten the adjustment screw for more than three and a half turns from the fully open position.*




*Application and tightening of valve control unit cover screws.*

## 3.12.10 Application of covers

Apply the valve control unit cover and relevant screws. Tighten to 6Nm.

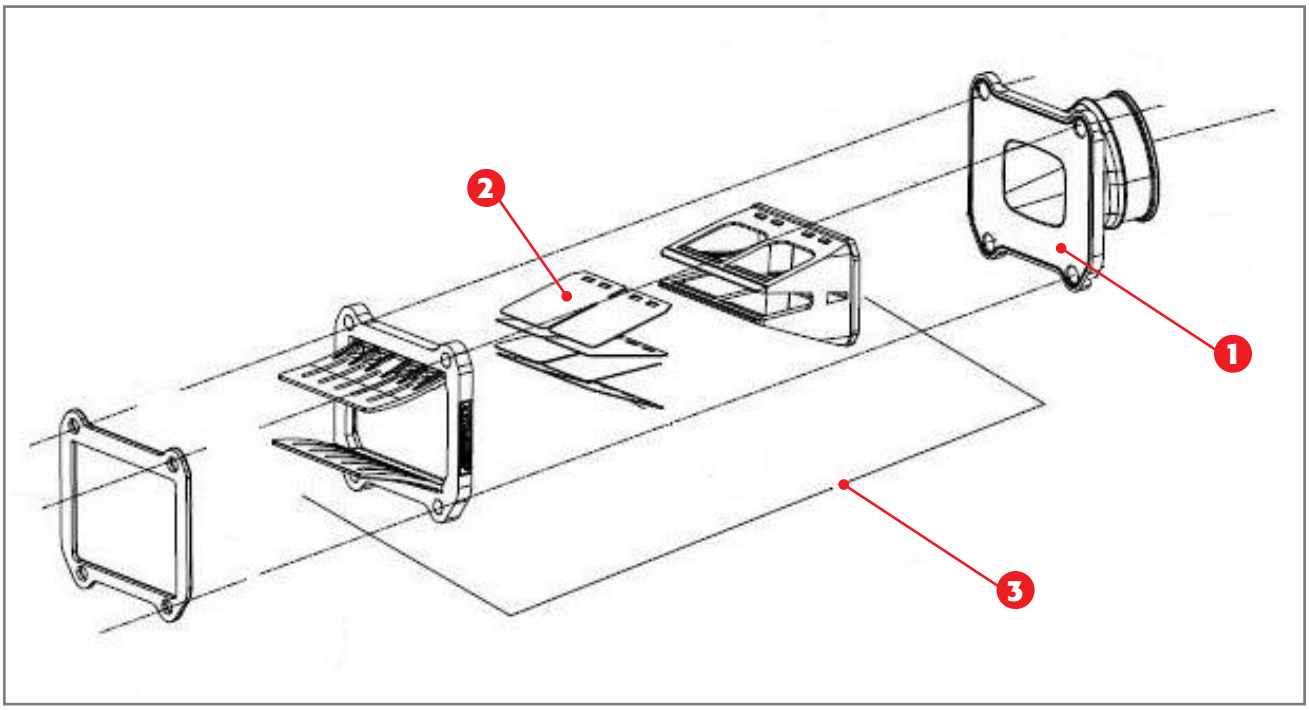


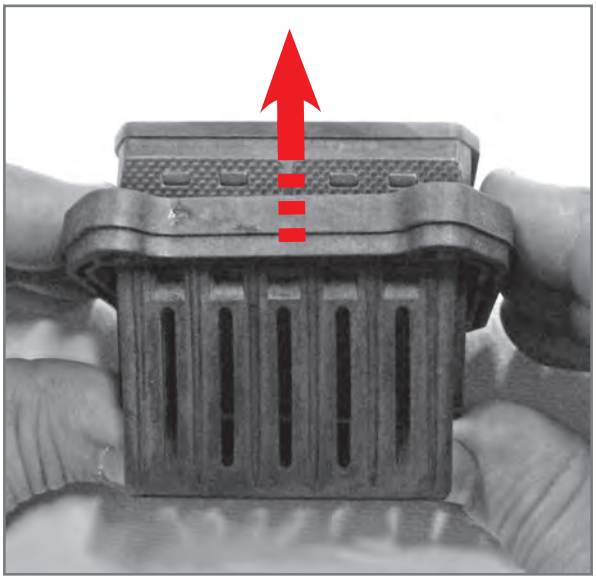

*Application of expansion chamber cover and screws.*

Apply the expansion chamber side gasket and cover. Apply the screws and tighten at 6Nm

## 3.13 CHECK OF INTAKE UNIT AND ASSEMBLY

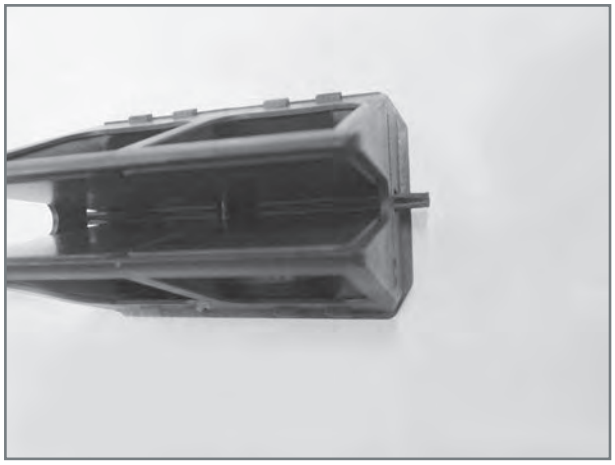
Check the manifold **1** is intact and without cracks. Otherwise replace it.
Check that the petals **2** of the reed valve **3** are intact and not deformed. If so, replace them.



***Disassembly of reed valve body.***

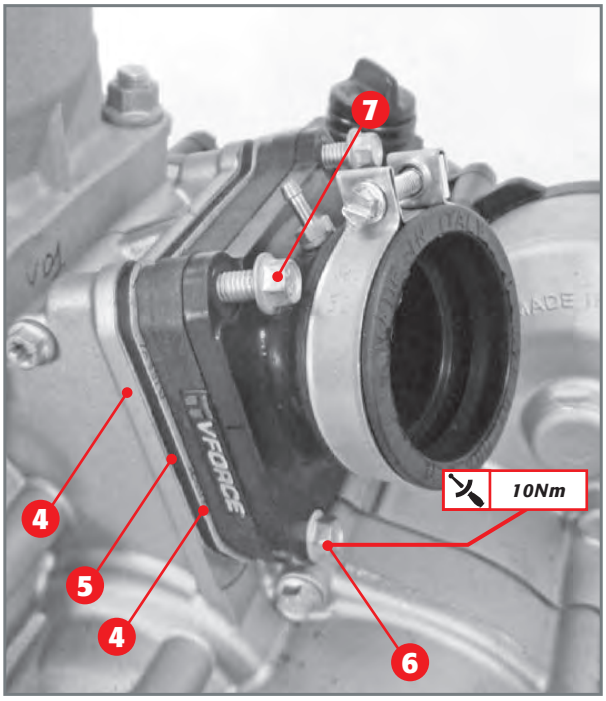
Remove the petals by pressing the central body as shown in the picture and remove the outer petals.



***Disassembly of central wedges. The extraction of only one is shown in figure.***

Remove the two central wedges and remove the multiflap.

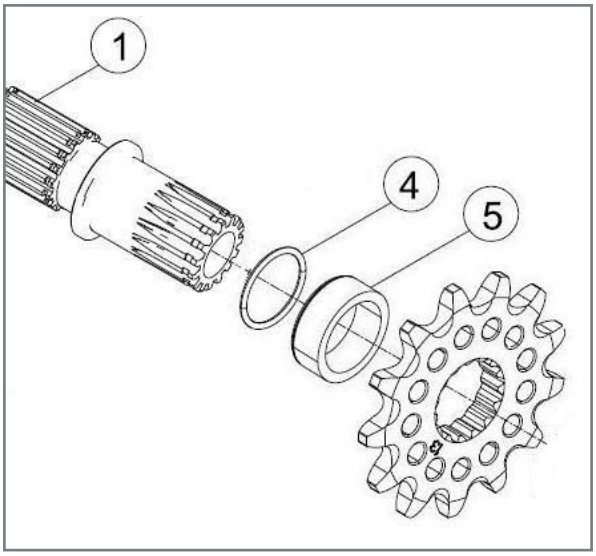
Assemble the petals by following the procedure just described, in reverse order.

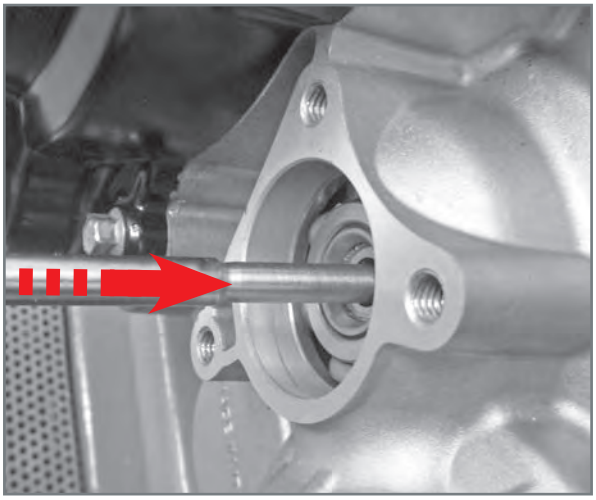



***Application of reed valve.***

For assembly of the entire intake system, apply the manifold to the reed valve, followed by the gasket **4**, the spacer **5** and another gasket **4**. Tighten the screws **6** to 10Nm.

Place the two screws **7** in the top holes of the manifold, without tightening them.



*Insertion of clutch rod.*

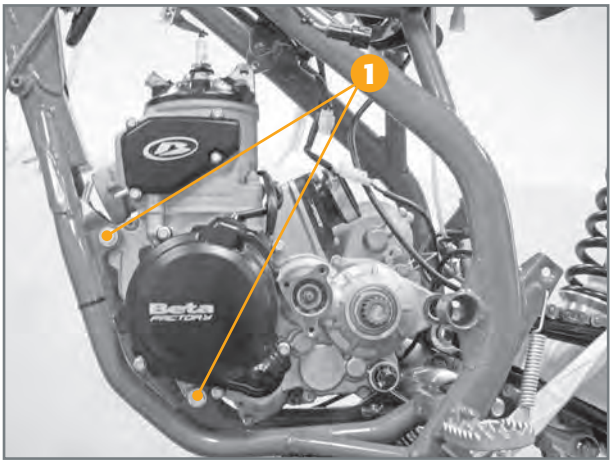
## 3.14 INSERTION OF CLUTCH ROD AND PINION SPACER

Apply the pinion spacer **5** to the secondary unit of the gearbox **1**, so that the groove is facing the inside of the engine.

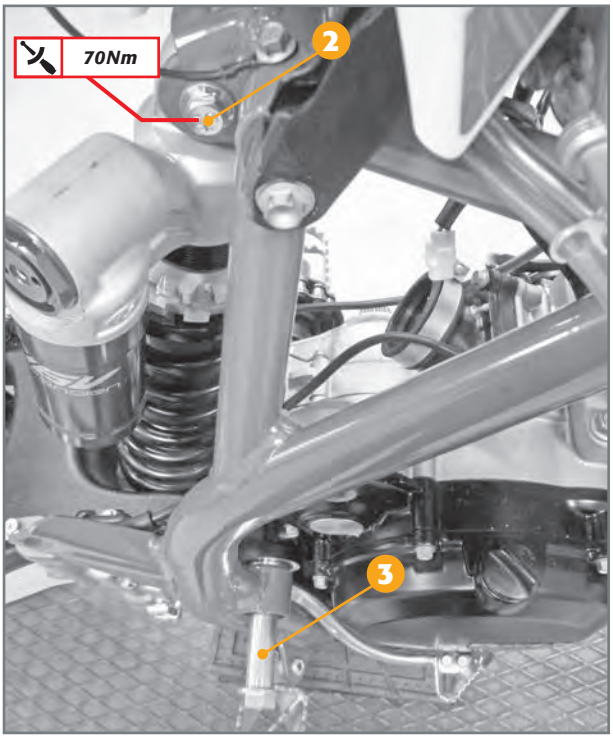
> ***Note:*** *check for the O-ring **4**. Otherwise apply it.*

Insert the gearbox rod in its seat from the lower diameter side.

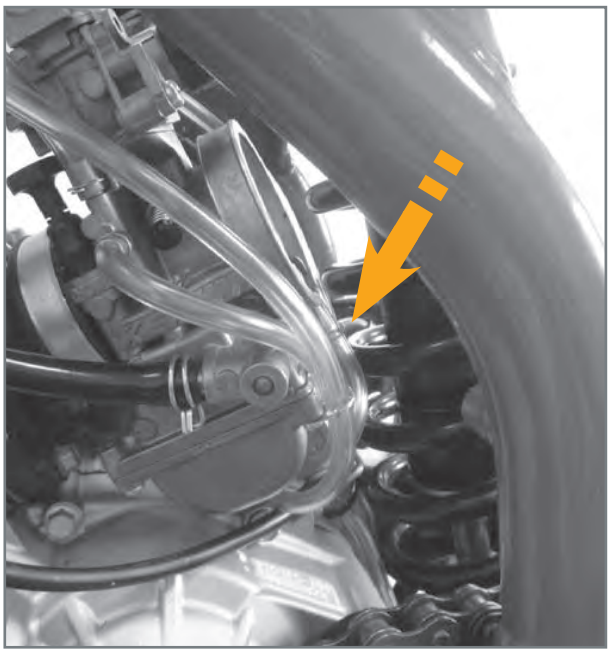
# 4 ENGINE REASSEMBLY IN THE VEHICLE



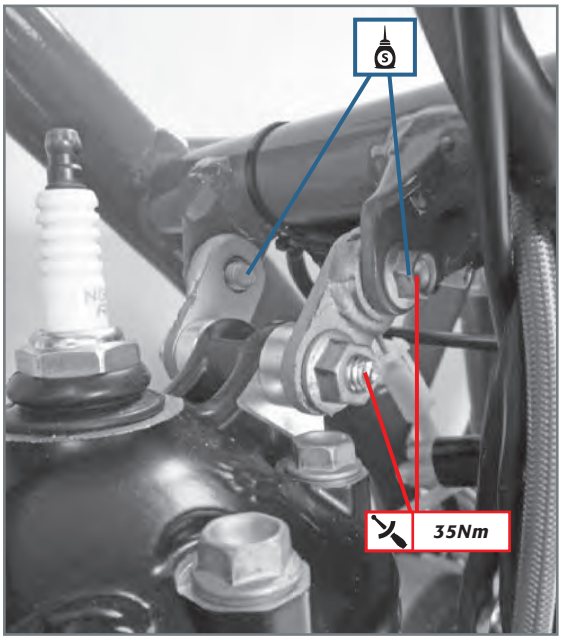

- Insert the engine in the frame. We recommend insertion from the frame's left side.
- Insert the engine pins **1**.
- Apply the spark plug and tighten it at 28Nm.




- Insert the upper shock absorber pin **2** and the swingarm pin **3**. Fasten the shock absorber pin at 70Nm.



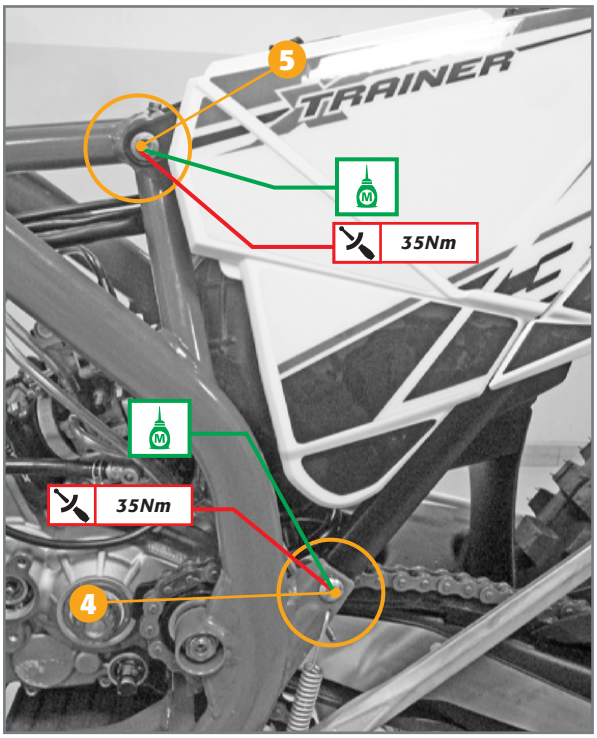
- Apply the carburettor to the manifold making the breather tubes pass in the appropriate metal cable gland.




· Apply the head connections.

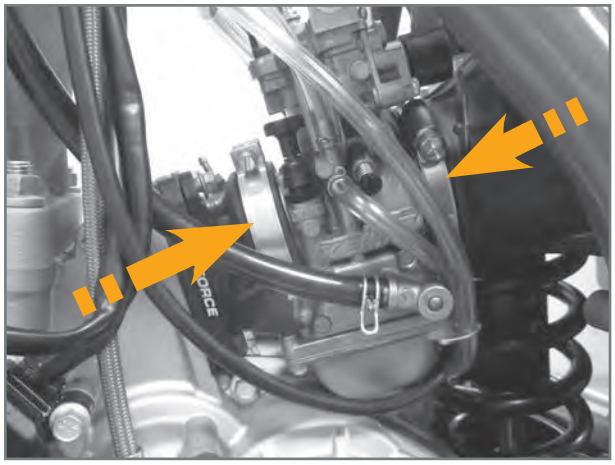
· Tighten the nuts and bolts following the table below.

| Fixing | Screw | Torque [Nm] | Threadlocker |
|---|---|---|---|
| Head connection bracket to frame. | M8 x 16 | 35 | Medium-resistance |
| Head connection brackets to engine | M8 x 60 | 35 | |
| Engine pins | Special | 45 | |
| Swingarm pin | M16 x 245 | 125 | |

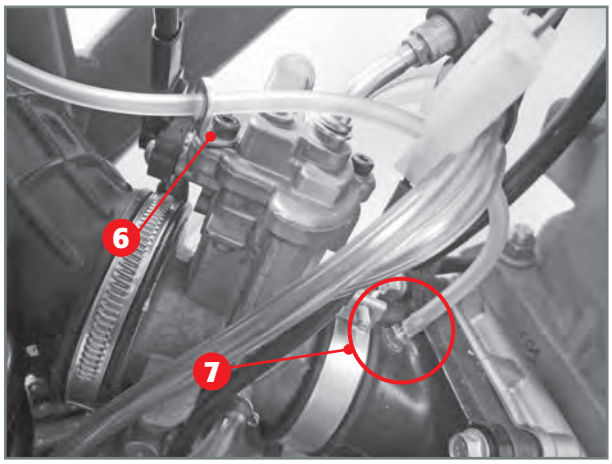



· Rotate the filter box in its normal position. Apply the lower fixing screws **4** (one per side) after applying medium strength threadlocker and tighten at 35Nm. Tighten the upper screws **5** to 35Nm.

***Note:*** *We recommend removing the upper screws (one per side) and applying medium strength threadlocker.*

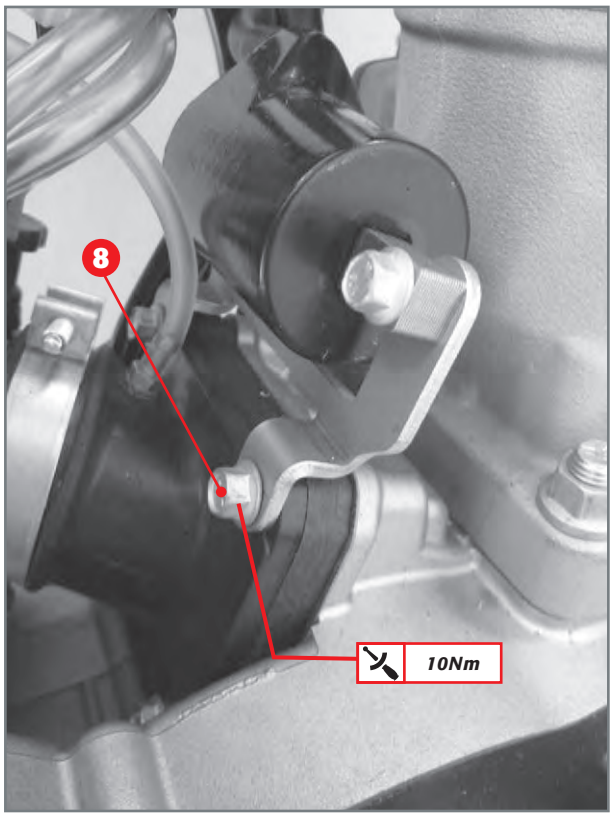


- Make sure the filter box sleeve is correctly inserted inside the carburettor, fasten the two filter box side and manifold side straps.

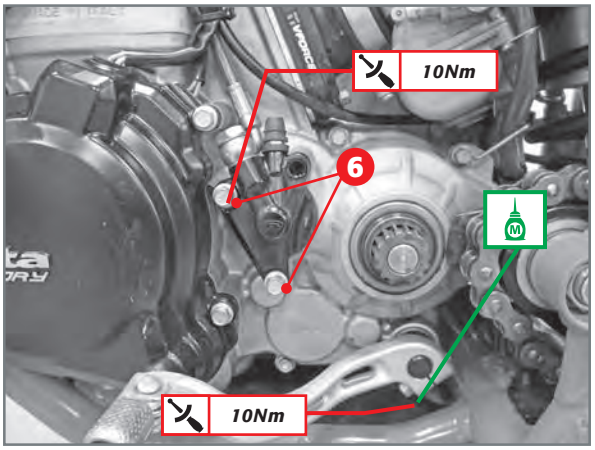



- Remove the cap applied to the mixer tube (see page 10).
- Insert the tube through the tube hole **6** and connect it to the nozzle **7** on the intake manifold.

***ATTENTION!***
*Ensure the tube is fitted all the way into the nozzle.*

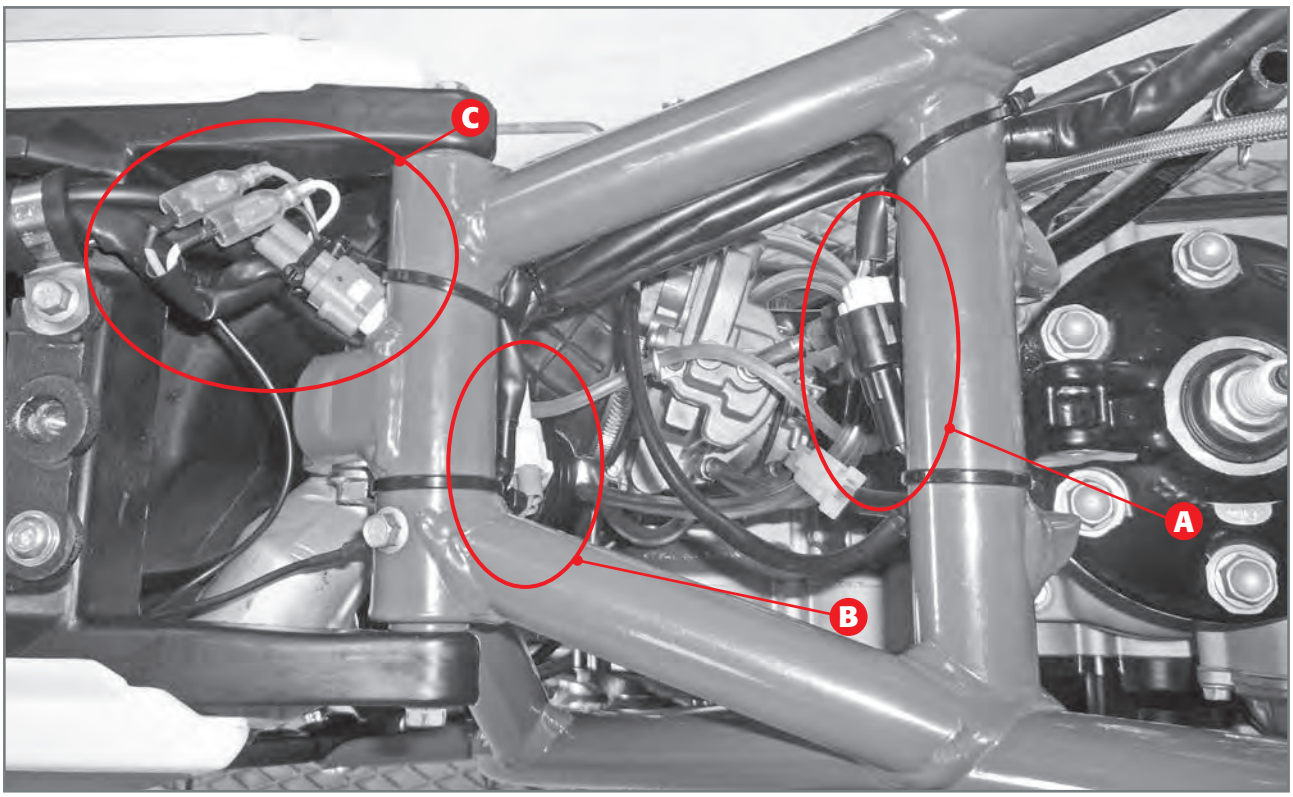



- Apply the complete coil unit to the intake manifold and tighten the screws **8** at 10Nm.

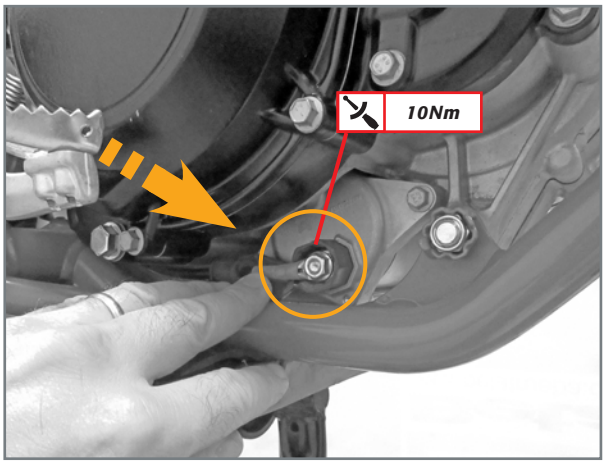



- Apply the clutch actuator jointly with the two fixing screws **6**. Tighten to 10Nm.
- Apply the gearbox lever and tighten the screw at 10Nm after applying a medium strength threadlocker.

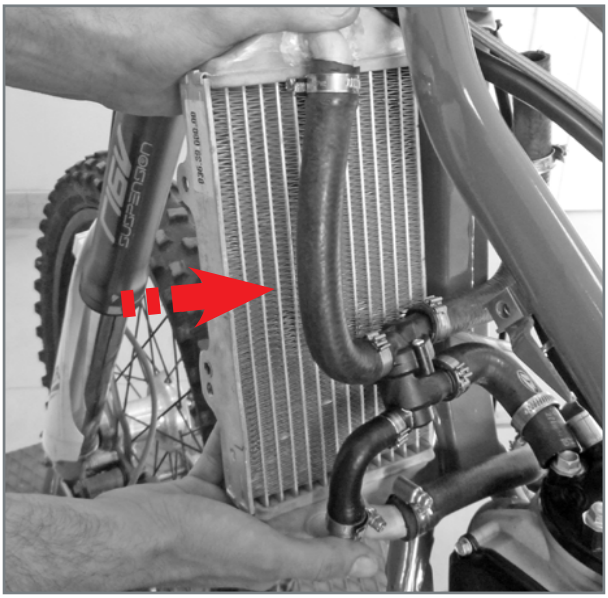
- Fasten the motor electric system and the start motor cable to the clutch tube.
- Connect the connectors:
  - **A** TPS sensor;
  - **B** Pick-Up
  - **C** stator unit
- Fasten the electrical system to the frame.



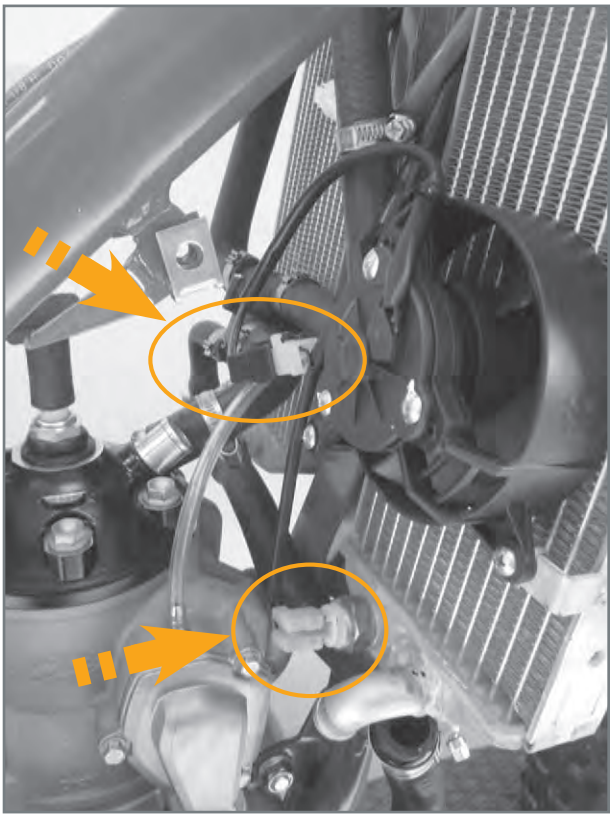

- Connect the coil to the spark plug.



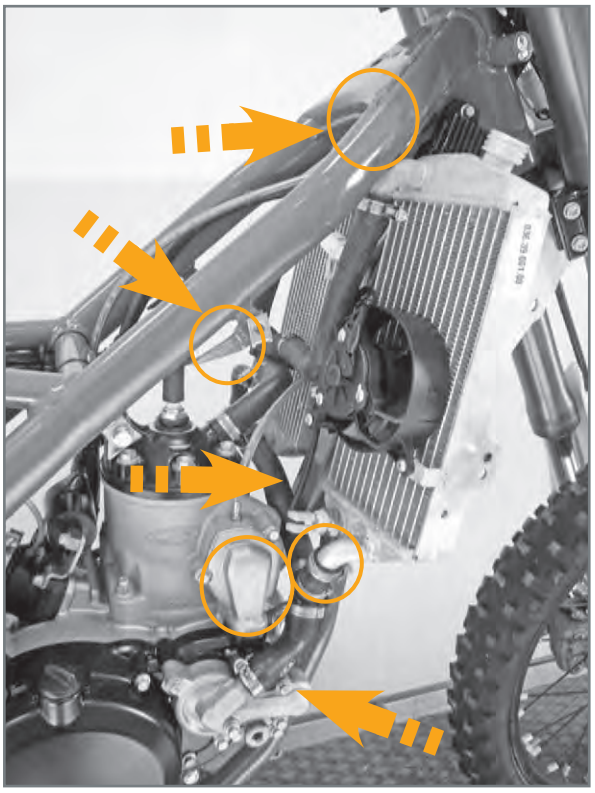

· Apply the start motor cable and tighten the nut at 10 Nm. Cover the connection using the specific protective cap.

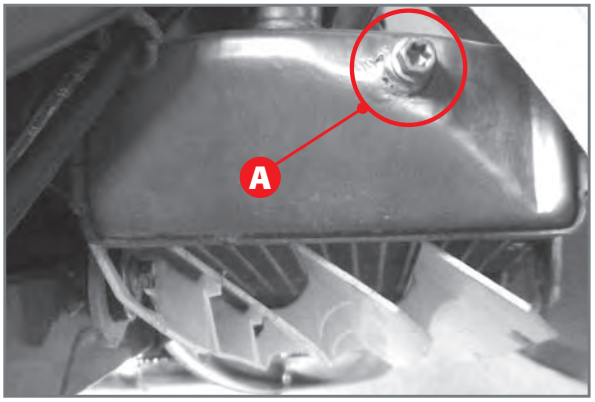


· Connect the ventilation pipes to the engine.
· Apply the left radiator to the frame. Apply the respective screws and tighten at 10Nm. Apply the protective grid.

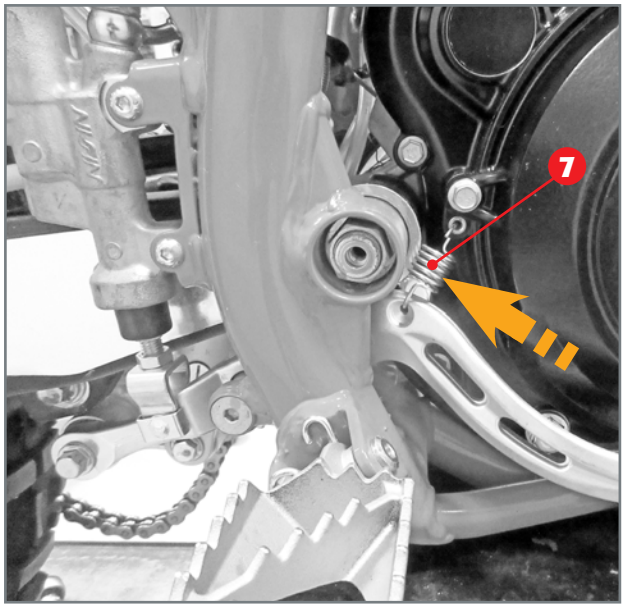


· Apply the right radiator, the respective screws to be tightened to 10Nm. Apply the protective grid.
· Connect the electrical accessories of the right radiator to the electrical system.



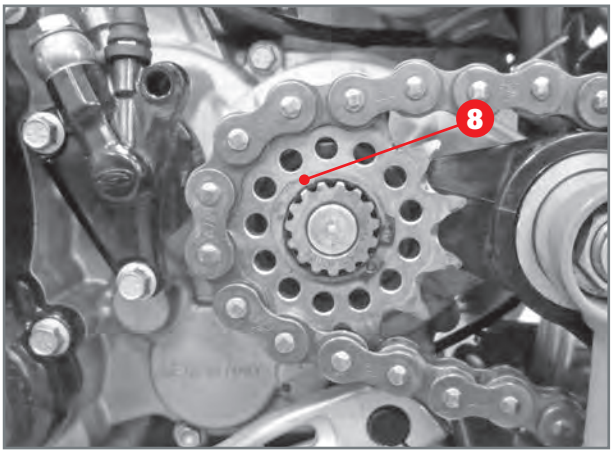



· Connect the radiators to the engine. Fasten the tube straps and add the coolant liquid, letting the air bleed through the screw cap **A**.

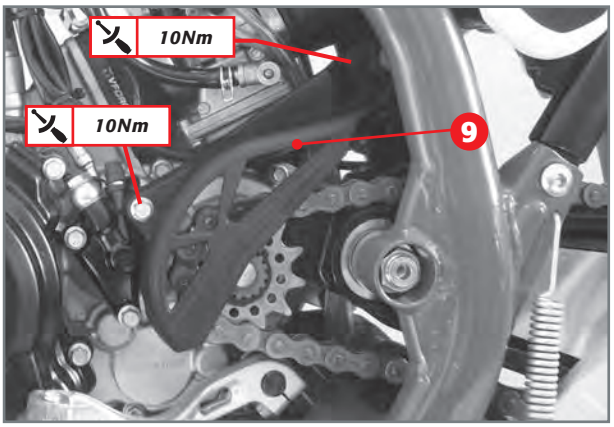



- Apply the exhaust expansion, first assemble the front springs and then apply the two fixing screws.
- Apply the spacer and tighten the two fixing screws at 10Nm. Tighten the expansion fixing screws to the frame at 10Nm.

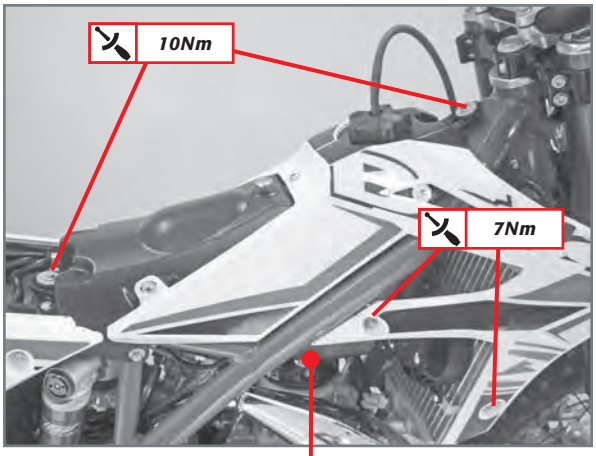
- Apply the Kickstart lever (optional). Apply the medium-strength threadlocker on the screw and tighten at 25Nm. Apply the brake pedal return spring **7**.



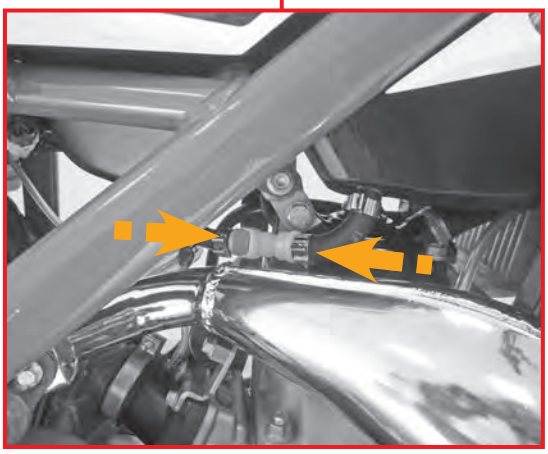

- Insert the pinion in the chain and key it onto the gearbox outlet shaft. Fit the relevant circlip **8**, ensuring it is in its seat.




- Apply the pinion guard **9** and the frame side guards **10** and **11**. Tighten the screws at 10Nm and apply the fixing straps between side guards and frame.



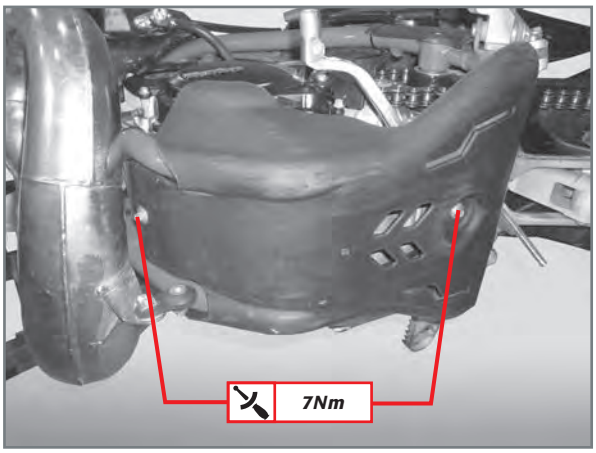

- Apply the tank to the vehicle, ensuring the electrical wiring and clutch tube are between frame and tank.
- Apply the tank, complete with sides, and tighten the screws at the required torque.



- Connect the two quick couplings on the bypass tube.




- Reconnect the tank to the carburettor and secure the tube using the specific tube straps.
- After removing the motorcycle from the stand, reapply the engine guard plate with the two fixing screws. Tighten to 7Nm.




***WARNING!***
*Disconnecting the mixer tube from the intake manifold may cause air to get into the tube. To avert any lubrication problems with the power unit and crankshaft, use fuel with 1% mix for the first fill-up.*
*Use the oil recommended on page 114 in the "Recommended lubricants and liquids" table.*

# TABLE OF ENGINE COMPONENTS TIGHTENING TORQUES

| Fixing | Diameter x Length | Quantity | Threadlocker | Torque [Nm] | Notes |
|---|---|---|---|---|---|
| **Outer side right crankcase half** | | | | | |
| Kickstarter lever | M6 x 20 | 2 | Medium-strength threadlocker | 10 | Optional |
| **Inner side right crankcase half** | | | | | |
| Desmodromic control bearing fixing | M5 x 8 | 1 | Medium-strength threadlocker | 6 | |
| **Crankshaft** | | | | | |
| Securing the half-shoulders | M6 x 12 | 1 | High-strength threadlocker | 5 | |
| **Gearshift** | | | | | |
| Stop cam | M6 x 30 | 1 | Medium-strength threadlocker | 10 | |
| Gear stopping device lever | M6 x 20 | 1 | Medium-strength threadlocker | 10 | |
| Gearshift lever | M6 x 25 | 1 | Medium-strength threadlocker | 10 | |
| **Electric kickstarter device** | | | | | |
| Starter motor | M6 x 25 | 2 | Medium-strength threadlocker | 10 | |
| **Pedal kickstarter device - Optional** | | | | | |
| Securing the lever | M8 x 26 | 1 | Medium-strength threadlocker | 25 | |
| Kickstarter lever | M6 x 12 | 2 | Medium-strength threadlocker | | |
| **Clutch primary transmission** | | | | | |
| Primary transmission pinion nut | | 1 | Medium-strength threadlocker | 160 | |
| Drum nut and clutch case | | 1 | Medium-strength threadlocker | 120 | Do not use pneumatic device |
| Clutch cap | M6 x 25 | 6 | | 10 | |
| Clutch actuator | M6 x 20 | 2 | | 10 | |
| Clutch actuator | M6 x 30 | 1 | | 10 | |
| Outer clutch cover | M6 x 20 | 2 | | 10 | |
| Outer clutch cover | M6 x 50 | 3 | | 10 | In common with inner clutch cover |
| Inner clutch cover | M6 x 20 | 2 | | 10 | |
| Inner clutch cover | M6 x 30 | 2 | | 10 | |
| Inner clutch cover | M6 x 50 | 3 | | 10 | In common with outer clutch cover |
| Inner clutch cover | M6 x 60 | 2 | | 10 | In common with water pump cover |

| Fixing | Diameter x Length | Quantity | Threadlocker | Torque [Nm] | Notes |
|---|---|---|---|---|---|
| Counterweight unit Counterweight | M8 x 15 | 1 | Medium-strength threadlocker | 30 | |
| **Water pump** | | | | | |
| Cover | M6 x 60 | 2 | | 10 | In common with inner clutch cover |
| Cover | M6 x 30 | 2 | | 10 | |
| Impeller | M5 x 12 | 1 | Medium-strength threadlocker | 6 | |
| **Exhaust valve control** | | | | | |
| Flange | M6 x 20 | 3 | Medium-strength threadlocker | 10 | |
| Cover | M5 x 20 | 2 | Medium-strength threadlocker | 6 | |
| Complete control rocker arm | M5 x 12 | 1 | Medium-strength threadlocker | 6 | |
| Control lever | M5 x 20 | 1 | Medium-strength threadlocker | 6 | |
| Booster bearings | M6 x 16 | 2 | Medium-strength threadlocker | 10 | |
| Right cover | M5 x 16 | 3 | | 6 | |
| Left cover | M5 x 16 | 4 | | 6 | |
| **Ignition system** | | | | | |
| Spark plug | M14 x 1.25 | 1 | | 28 | |
| Pick-up unit | M5 x 12 | 2 | Medium-strength threadlocker | 6 | |
| Stator | M6 x 25 | 2 | Medium-strength threadlocker | 10 | |
| Flywheel nut | | 1 | Medium-strength threadlocker | 60 | |
| Cover | M6 x 20 | 2 | | 10 | |
| Cover | M6 x 25 | 3 | | 10 | |
| **Cylinder** | | | | | |
| Cylinder nuts | | 4 | | 30 | |
| **Head** | | | | | |
| Head screws | M8 x 35 | 6 | | 27 | |
| **Crankcase half** | | | | | |
| Crankcase half screws | M6 x 50 | 10 | | 10 | |
| Crankcase half screws | M6 x 40 | 3 | | 10 | |

| Fixing | Diameter x Length | Quantity | Threadlocker | Torque [Nm] | Notes |
|---|---|---|---|---|---|
| **Intake** | | | | | |
| Reed valve | M6 x 25 | 4 | | 10 | |
| **Oil drain** | | | | | |
| Cap | | 1 | | 15 | |

## TABLE OF FRAME/ENGINE TIGHTENING TORQUES

| Fixing | Diameter x Length | Quantity | Threadlocker | Torque [Nm] | Notes |
|---|---|---|---|---|---|
| Front and lower engine connections | M10 x 1.25 | 2 | | 45 | |
| Swingarm pin | M16 x 1.5 | 1 | | 125 | |
| Brackets to connect head to frame | M8 x 16 | 2 | Medium-resistance | 35 | |
| Head connection brackets to engine | M8 x 60 | 1 | | 35 | |

## TABLE OF SUPERSTRUCTURE TIGHTENING TORQUES

| Fixing | Diameter x pitch [mm] | Length [mm] | Quantity | Threadlocker | Torque [Nm] | Notes |
|---|---|---|---|---|---|---|
| Tank to the frame (front fixing) | M6 x 1 | 25 | 1 | | 10 | |
| Tank to the frame (rear fixing) | M6 x 1 | 30 | 1 | | 10 | Application of grease |
| Tank side panel to the radiator | M6 x 1 | 20 | 2 | | 7 | |

# RECOMMENDED ENGINE MAINTENANCE

The required engine maintenance only depends on the level of use and respect of the periodical inspections. The following intervals refer to competitive use, as long as the engine has never worked in extraordinary conditions and that periodical inspections and any servicing have been correctly carried out.

| | 30h | 60h | 90h |
|---|---|---|---|
| Coated clutch discs | I | - | R |
| Clutch springs length | I | - | R |
| Gearbox bearings | - | - | R |
| Case / clutch hub | I | - | - |
| Cylinder | - | I | - |
| Piston and segments | - | R | - |
| Connecting rod | - | - | R |
| Crankshaft bearings | - | - | R |
| Gearbox superficial appearance | - | - | I |
| Water pump oil seal | - | - | R |
| Exhaust valve | - | I/C | - |
| Reed valve shims | - | I | I |
| Spark plug | - | R | - |

*I = INSPECT AND REPLACE IN CASE OF NECESSARY* **R** *= REPLACE* **C** *= Cleaning*

# RECOMMENDED LUBRICANTS AND LIQUIDS

| APPLICATION | PRODUCT | QUANTITY |
|---|---|---|
| Gearbox and clutch | Liqui Moly racing 10W50 | 850ml* |
| Coolant liquid | Liqui Moly coolant ready mix raf12 plus | 1300ml* |
| Mixer tank | Liqui Moly 2-STROKE MOTOR OIL, SELF-MIXING | 550ml |
| Fuel tank (only for running-in) | Liqui Moly 2-STROKE MOTOR OIL, SELF-MIXING | 1% mix |

** Refer to Use and Maintenance Manual for levels*




BETAMOTOR S.P.A.
PIAN DELL'ISOLA, 72
50067 RIGNANO SULL'ARNO (FIRENZE) ITALIA
INFO@BETAMOTOR.COM WWW.BETAMOTOR.COM