

# 1 - How to use the manual

This manual has been prepared for Ducati Authorized Service Centers and workshop personnel involved in the maintenance and repair of Ducati motorcycles. It gives fundamental information on how to work in perfect harmony with the concepts of "good technique" and "safety on work sites" for servicing or replacing of original spare parts both for chassis and engine concerning this motorcycle. All operations described in this manual must be carried out by senior skilled technicians, who are requested to strictly follow the Manufacturer's instructions.

Some information has been intentionally omitted, as, at our advice, a specialized technician must have this technical background. Additional information on how to install the different components is provided in the spare parts catalogue.



Caution

This manual also describes pre-delivery checks.

Ducati Motor Holding S.p.A. declines all responsibility for any technical errors or omissions in this manual and reserves the right to make changes without prior notice.

The information given in this manual was correct at the time of going to print.



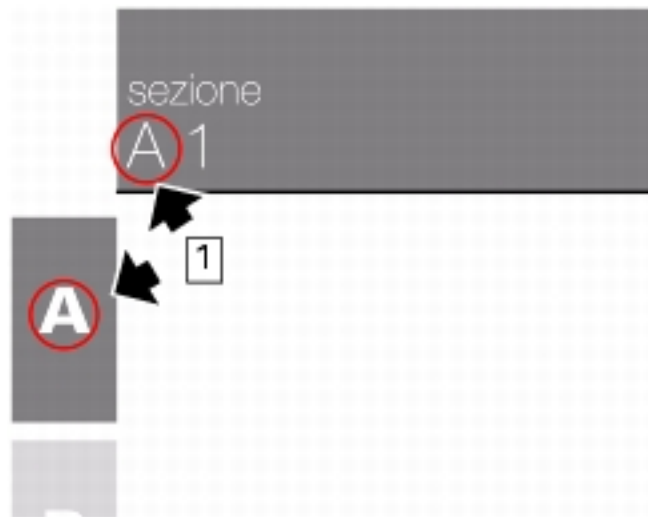
Caution

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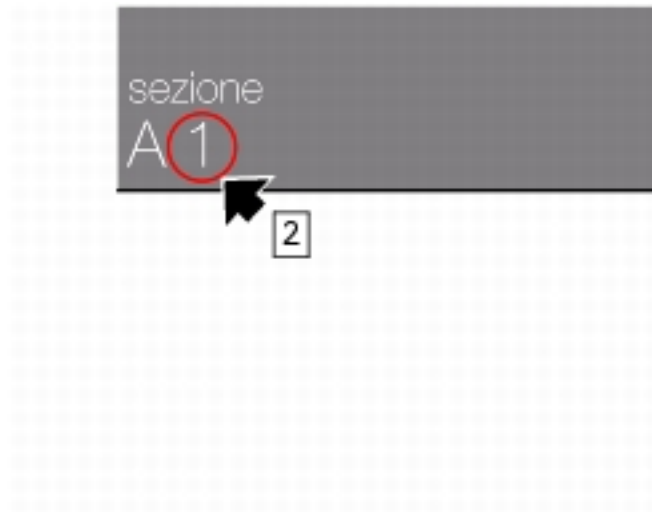
Ducati Motor Holding S.p.A.

## Manual layout

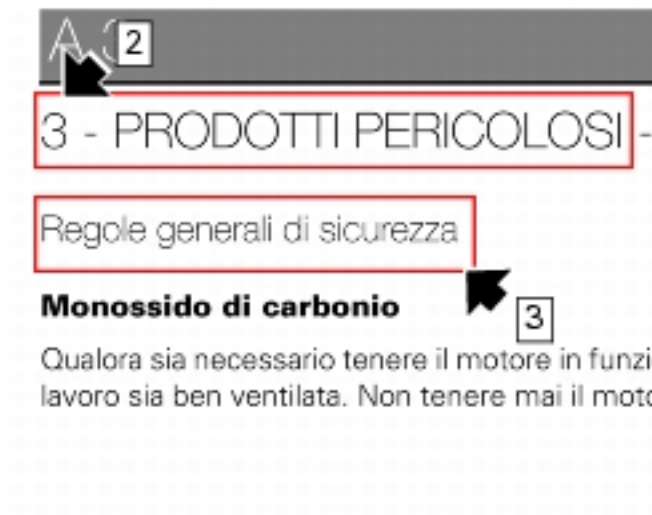
This manual is divided in sections (1), each identified by a letter.



Each section (1) includes several chapters (2), which are numbered consecutively.



Each chapter (2) may include several paragraphs (3).



The repair procedures described in this manual include the necessary disassembly and reassembly instructions, i.e. the full procedure is detailed starting with the motorcycle fully assembled until bringing it back to the original condition.

 Caution

Some of the sections of this manual are not present, being the relevant parts not installed on the vehicle.

 Caution

The manual structure has been designed to be applied to all the different models manufactured by DUCATI MOTOR HOLDING. To make reading easier, the sub-sections table of contents is kept unchanged for all models.

## 2 - Symbols - abbreviations - references

For easy and rational reading, this manual uses graphic symbols for highlighting situations in which maximum care is required, practical advice or simple information. Please pay maximum attention to these symbols as they are meant to avoid repeating technical concepts or safety rules throughout the text. These symbols must be considered as "hints" to important information. Please refer to this page whenever in doubt as to their meaning.

**Left-hand** and **right-hand** in the descriptions refer to motorcycle direction of travel.



Warning

Failure to follow the instructions given in text marked with this symbol can lead to serious personal injury or death.



Caution

Failure to follow the instructions in text marked with this symbol can lead to serious damage to the motorcycle and its components.



Note

This symbol indicates additional useful information for the current operation.

Text references

**(X)**

The bold reference indicates a part that is not illustrated in the figures next to the text, but can be found in the exploded view at the beginning of each section.

(X)

The non-bold reference indicates a part that is illustrated in the figures next to the text.

Product specifications

Symbols inside the diagram show the type of threadlocker, sealant or lubricant to be used at the points indicated. The table below shows the symbols together with the product specifications.
















Engine oil (for specifications, see sect. C 2, [SHELL Fuels and lubricants](#)).  
Advance Ultra 4












DOT 4 special hydraulic brake fluid.  
SHELL  
Advance Brake DOT 4



SAE 80-90 gear oil or special products for chains with O-rings.  
SHELL  
Advance Chain or Advance Teflon Chain

		Anti-freeze (nitride, amine and phosphate free) 30-40% water solution.	SHELL Advance coolant or Glycoshell
	GREASE A	Multipurpose, medium fiber, lithium grease.	SHELL Alvania R3
	GREASE B	Molybdenum disulphide grease, high mechanical stress and high temperature resistant.	SHELL Retinax HDX2
	GREASE C	Bearing/joint grease for parts subject to prolonged mechanical stress. Temperature range: -10 to 110° C.	SHELL Retinax LX2
	GREASE D	Protective grease. Corrosion protectant, waterproof.	SHELL Retinax HD2
	GREASE E	PANKL grease PLB 05.	
	GREASE F	OPTIMOL - PASTE WHITE T. Grease	
	LOCK 1	Low-strength threadlocker.	Loctite 222
	LOCK 2	Medium-strength threadlocker, compatible with oil.	Loctite 243
	LOCK 3	High-strength sealant for threaded parts.	Loctite 270
	LOCK 4	Flange sealant. Resistant to high mechanical stress, solvents and high temperatures (up to 200°C). For pressures up to 350 atm. Fills gaps up to 0.4 mm.	Loctite 510
	LOCK 5	Permanent adhesive for smooth or threaded cylindrical fasteners on mechanical parts. High resistance to mechanical stress and solvents. Temperature range: -55 to 175°C.	Loctite 128455
	LOCK 6	Pipe sealant for pipes and medium to large fasteners. For water and gases (except oxygen). Maximum filling capacity: diameter gaps up to 0.40 mm.	Loctite 577

	LOCK 7	Speed bonder for rubber and plastics. Elastomer loaded ethylic base.	Loctite 480
	LOCK 8	High-strength retaining compound for threaded parts, bearings, bushes, splines and keys. Temperature range: -55 to 150 ° C.	Loctite 601
	LOCK 9	Medium-strength threadlocker.	Loctite 401
	LOCK 10	Product for metal parts to seal and lock freely sliding parallel or threaded couplings. Resistant to high mechanical stress and high temperature, solvent-proof and chemical-proof.	Loctite 128443
	LOCK 11	Instantaneous jelly sealant featuring tensile / cut strength.	Loctite 454 gel
		DUCATI liquid gasket	942470014
		Exhaust pipe paste. Self-curing sealant, hardens when heated. For temperatures over 1,000°C.	Fire gum holts
		Spray used in treating electrical systems to eliminate moisture and condensation. Provides high resistance to corrosion. Waterproof.	SHELL Advance Contact Cleaner
		Dry lubricant that polymerizes in the air	Molycote D321R

## 3 - Dangerous products – warnings

### General safety rules

#### Carbon oxide

When a maintenance operation must be performed with the engine running, position the motorcycle out of doors or in a well-ventilated area. Never operate the engine in an enclosed place.



#### Warning

Exhaust emissions contain carbon oxide, which is a poisonous gas and may lead to loss of conscience or even death.

Operate the engine out of doors or, if working indoors, use an exhaust emission extraction plant.

#### Fuel

Always make sure the area is well ventilated. Do not smoke near the motorcycle or the area where fuel is stored and keep any sources of ignition, such as flames or sparks, well away from motorcycle and fuel storage area.



#### Warning

The fuel used to operate engines is highly flammable and becomes explosive under particular conditions. Keep away from children.

#### Hot component parts



#### Warning

The engine and exhaust component parts become hot when the engine is running and will stay hot for some time after the engine has been stopped. Wear heat gloves before handling these components or allow for the engine and exhaust system to cool down before proceeding.



#### Warning

The exhaust system will stay hot for some time after the engine has been stopped. Do not touch these components with your body and do not park the vehicle near flammable materials (including wood, leaves...).

#### Used engine oil



#### Warning

Prolonged or repeated contact with engine oil may cause skin cancer. If exposed to engine oil on a daily basis, make it a rule to wash your hands thoroughly with soap right after handling engine oil. Keep away from children.

#### Brake lining debris

Never attempt to clean the brake assembly using compressed air or a dry brush.

Brake fluid



Warning

Avoid spilling brake fluid onto plastic, rubber or paint-finished parts or they will damage. Protect these parts with a clean shop cloth before proceeding to service the motorcycle. Keep away from children.

Battery



Warning

The battery gives off explosive gases. Keep away from sources of ignition, such as sparks and flames. Do not smoke near the battery. Make sure the area is well ventilated when charging a battery.

General maintenance indications

A word of advice

Ducati would like to suggest that you follow the instructions below so to ensure an efficient, fault-free motorcycle operation.

- When diagnosing breakdowns, primary consideration should always be given to what the customer reports. Your questions to the customer should aim at clarifying the problem.

- Diagnose the problem systematically and accurately before proceeding further. This manual provides the theoretical background for troubleshooting that should be combined with personal experience and attendance at Ducati training courses.

- Repair work should be planned carefully in advance to prevent any unnecessary downtime, for example picking-up of required spare parts or arrangement of required tools, etc.

- Time and money can be saved by limiting the number of operations needed to reach the part to be repaired. The disassembly procedure in this manual describes the most efficient way to reach a part to be repaired.

General advice on repair work

- Always use top quality tools. Lift the motorcycle only with devices in full compliance with relevant European directives.

- During repair work always keep the tools within reach, possibly in the right order. Never put them on the vehicle or in hardly reachable places or somehow hidden.

- Work place must be neat and clean.

- During repair work always change gaskets, seals and split pins.

- When loosening or tightening nuts and bolts, always start with the largest and always start from the center. Tighten nuts and bolts working crossways; tighten to the specified torque.

- At disassembly, mark any parts and positions which might easily be confused at reassembly.

- Use Ducati original spare parts only. Use the recommended lubricants only.

- Use special service tools where specified.

- Ducati Technical Bulletins often contain updated versions of the service procedures described in this manual. Check the latest Bulletins for details.

# 0Description

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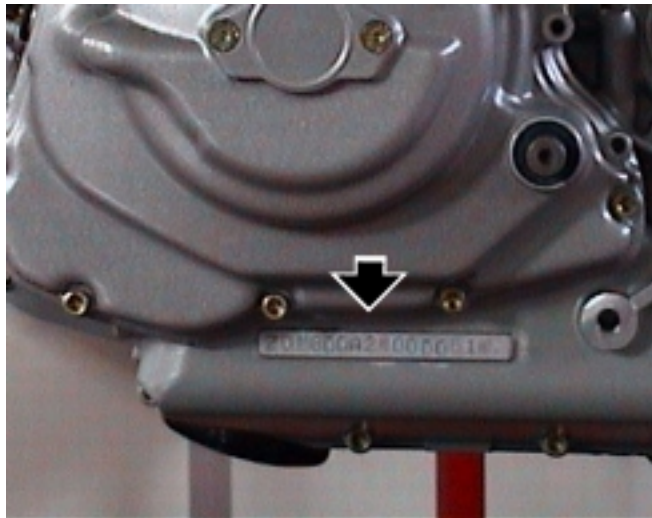
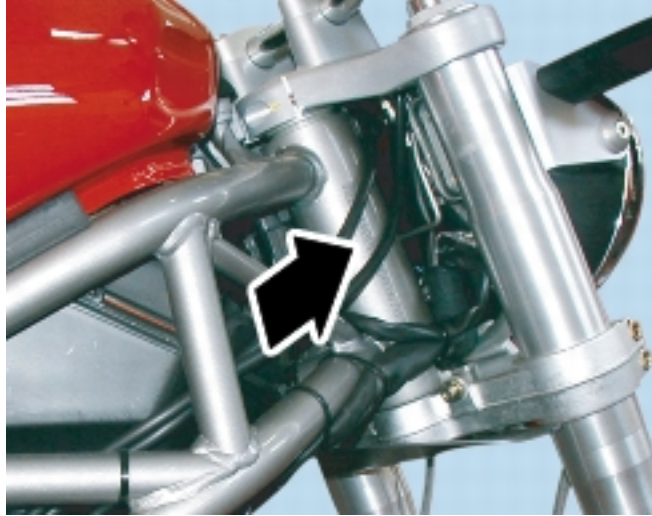
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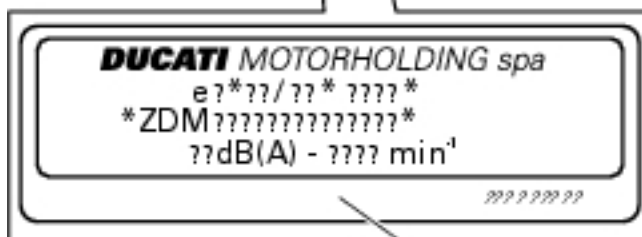
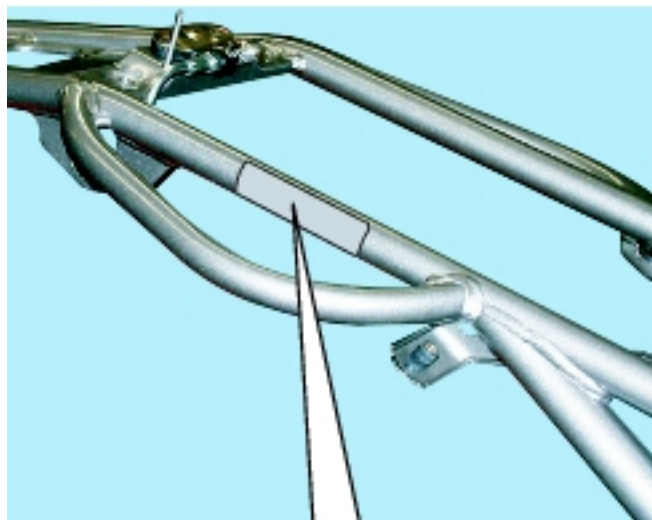
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# 1 - Identification data

Identification data for Monster 695 i.e.

Each Ducati motorcycle has two identification numbers - frame number and engine number, and an EC nameplate (A) (**not used in the USA version**).





A



Note

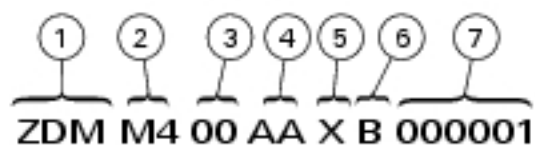
The frame and engine numbers identify the motorcycle model; please state these numbers when ordering spare parts.

Data punched on frame

European version

- 1 Manufacturer's name: Ducati Motor Holding
- 2 Type – same on all Monsters
- 3 Variant
- 4 Version
- 5 Year of manufacture (7=2007)
- 6 Plant of manufacture
- 7 Progressive serial No.

### Data punched on frame European version

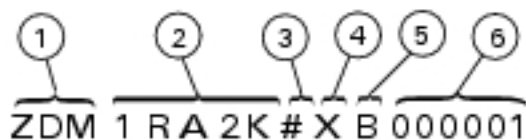


Data punched on frame

USA version

- 1 Ducati
- 2 Type of motorcycle
- 3 Variant - Code number or Check digit (X)
- 4 Model year (7=2007)
- 5 Plant of manufacture
- 6 Progressive serial No.

### Data punched on frame USA version



Data punched on engine

European version

- 1 Manufacturer's name: Ducati Motor Holding
- 2 Engine type
- 3 Progressive production No.

**Data punched on engine  
European version**

ZDM 695 A2\*000001\*

1 2 3

Data punched on engine

USA version

- 1 Engine type
- 2 Model year
- 3 Progressive production No.

**Data punched on engine  
USA version**

RA2 X 000001

1 2 3

# 0 Model-specific information

## [1 - Identification data](#) 3

[Identification data for Monster 695 i.e. 3](#)

## 1.1 - Technical specifications

### Description

Vehicle dimensions	Total length	2100 mm	
	Total width	794 mm	
	Total height	1058 mm	
	Wheelbase	1440 mm	
	Handlebar height - from grip to the ground	980 mm.	
	Seat height	770 mm	
	Front footpeg height	360 mm	
	Rear footpeg height	490 mm	
	Min. ground clearance	120 mm	
	Dry weight in running order with no fuel	168 kg	
	Weight in running order	Not over 390 Kg	
	Frame	Type	Chromium-molybdenum steel tube trellis frame
		Steering head angle	24°
Steering angle		27°	
Trail		96 mm	
Front rim		Light alloy, three spokes	
Front rim size		MT 3.50x17"	
Front tyre size		120/60 - ZR 17	
Rear rim		Light alloy, three spokes with cush drive damper pads	
Rear rim size		MT 4.50x17"	
Rear tyre size		160/60 - ZR 17	
Type of tyre		Radial tubeless tyre	
Front brake		Hydraulic with 2 calipers	
Rear brake		Hydraulic with 1 caliper	
Engine		Type	Twin-cylinder 4-stroke Otto-cycle engine
		Bore	88 mm
	Stroke	57.2 mm	
	Displacement	695 cu. cm	
	Compression ratio	10.5 ± 0.5:1	
	Max. power at crankshaft (95/1/EC) derated	52 kW (70 HP) at 8500 rpm 22 kW at 8250 rpm	
	Max. power at crankshaft, measured on test bench	53.7 kW (73 HP) at 8500 rpm	
	Max. crankshaft torque derated	61 Nm (6.2 kgm) at 6750 rpm 46 kW at 3000 rpm	
	Max. torque at crankshaft, measured on test bench	61 Kw (6.2 Kgm) at 6750 rpm	
	Max. engine speed	9200 rpm	

Timing system	Toothed belt, overhead camshaft, 2 valves per cylinder, 4 rocker arms
Lubrication system	Forced lubrication by pump
Oil pump	Gear pump with by-pass valves
Cooling system	Air cooling
Air filter	One filtering element in the airbox
Crankshaft type	Enbloc
Cylinders	"L" at 90°

## Colors

Ducati anniversary red, red frame and black wheel rims	F_473.101 (PPG)
Shining black, black frame and wheel rims	248.514 (PPG)
Matte black, black frame and wheel rims	291.501 (PPG)

## Transmission assembly

Clutch	Multi-plate wet clutch
Clutch control	Hydraulic
Gearbox	Six gears
Primary drive	33/61
Transmission ratio	1.85
Final drive	15/48
Gearbox type	Constant mesh spur gears, controlled by gear change lever on vehicle left side
Gear ratios	
1st	13/32
2nd	18/30
3rd	21/28
4th	22/22
5th	26/24
6th	

## Timing/valves

Timing diagram	With 1 mm valve clearance	
Intake	Opening 19° B.T.D.C. Closing 60° A.B.D.C.	
Exhaust	Opening 56° B.B.D.C. Closing 24° A.T.D.C.	
Intake valve diameter	43 mm	
Exhaust valve diameter	38 mm	
Valve lift	With 0 mm valve clearance	Intake 10.80 mm

Exhaust 10.30 mm

	Opening rocker arm - intake	0.10-0.15 mm	0.05-0.15 mm
	Opening rocker arm - exhaust	0.10-0.15 mm	0.05-0.15 mm
	Closing rocker arm - intake	0-0.05 mm	0-0.20 mm
	Closing rocker arm - exhaust	0-0.05 mm	0-0.20 mm
Adjusting timing belt tension	DDS	145 Hz (horizontal) 160 Hz (vertical)	145 Hz (horizontal) 160 Hz (vertical)
	Minimum value	70 Hz	70 Hz
Idle speed adjustment		1200 ± 50 rpm	

Cylinder / piston

Cylinder	Max. oval		0.03 mm.
	Max. taper with smaller diameter up		0.03 mm.
	Diameter class A	88.000 mm	0- 0.010 mm
	class B	88.010 mm	0-0.010 mm
	class C	88.020 mm	0-0.010 mm
Piston	Diameter class A	87.970 mm	± 0.005 mm
	class B	87.980 mm	± 0.005 mm
	class C	87.990 mm	± 0.005 mm
Gudgeon pin-piston clearance		0.004 - 0.012 mm	0.025 mm
Piston-cylinder coupling clearance		0.025-0.045 mm	0.12 mm
Gudgeon pin-connecting rod clearance		0.006-0.028 mm	0.005 mm
Con-rod bearings-crankpin coupling diameter clearance		0.015-0.058 mm	
Cylinder compression	Standard	9 - 11 bar	
	Minimum		8 bar (min.)
	Max. allowed difference		2 bar (max.)

Gearbox

Gearbox shafts	Axial play		0.05 – 0.20 mm
Gearbox drum	Axial play		0.10 - 0.40 mm
Gear selector fork	Fork sliding shoe thickness	3.90-4.00 mm	
	Fork – gear clearance	0.070- 0.285 mm	0.4 mm

Cooling system

Type	Air: heat is discharged through the large fins of both cylinder-head assemblies		
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## Front wheel

Tread min. thickness	In the most worn position	2 mm
Tyre pressure	Cold	2.1 bar - 2.3 bar
Wheel shaft eccentricity	On 100 mm	0.2 mm
Wheel rim eccentricity	Radial	0.8 mm
	Axial	0.5 mm

## Front suspension

Type	Upside-down hydraulic fork Ø 43 non adjustable	
	Travel along leg axis	130 mm
Clevis pin	Non adjustable	
	Oil quantity per leg	0.400 cu dm

## Rear wheel

Tread min. thickness	In the most worn position	2 mm
Tyre pressure	Cold	2.2 bar - 2.4 bar
Swingarm shaft eccentricity	On 100 mm	0.2 mm
Wheel rim eccentricity	Radial	0.8 mm
	Axial	0.5 mm
Chain	Make	D.I.D.
	Type	520 V L 4
	Dimensions	5/8" x 1/4"
	No. of links	106

## Rear suspension

Type	Progressive monoshock featuring adjustable rebound and spring preload	
Shock absorber	Stroke	65 mm
	Standard damping force setting. Turn out the adjusters from fully closed position (clockwise)	8 clicks
	Spring standard length	157 mm
	Wheel travel	148 mm

## Hydraulic brakes

FRONT		
Brake disc	Type	Drilled twin disc

	Thickness	4 ± 0.1 mm	3.6 mm (min.)
	Flange material	Steel	
	Braking ring material	Steel	
	Diameter	300 mm	
	Braking surface	44 cm <sup>2</sup> per disc	
Brake caliper	Make	Brembo	
	Type	PF 2x28 - 2 pistons	
	Caliper cylinder diameter	30 mm - 34 mm	
	Pads friction material	FERIT I/D 450-FF	
Brake master cylinder	Type	PS 15	
	Master cylinder diameter	15 mm	
REAR			
Brake disc	Type	Drilled disc	
	Thickness	4 ± 0.1 mm	3.6 mm (min.)
	Material	Steel	
	Diameter	245 mm	
	Braking surface	25 sq cm	
Brake caliper	Make	Brembo	
	Type	P 32 F - 2 pistons	
	Caliper cylinder diameter	32 mm	
	Pads friction material	FERIT I/D 450 FF	
Brake master cylinder	Type	PS11	
	Master cylinder diameter	11 mm	

### Charging system / generator

Battery	Voltage	12V
	Charge	16 Ah
	Type	Sealed, maintenance free
Generator	Capacity	12V - 520 W

### Ignition system

Ignition	Type	Electronic type with inductive discharge system
Starting	Type	Electric starter motor 12V - 520 W
Spark plugs	Make and type	Champion RA 4 HC - NGK DCPR8E
	Electrode gap	0.6 ÷ 0.7 mm

### Fuel system

	Make	Type
	Unleaded fuel	95 - 98 RON
	THROTTLE BODY	Ø 45 mm
	Injectors per cylinder	1

Firing points per injector	1
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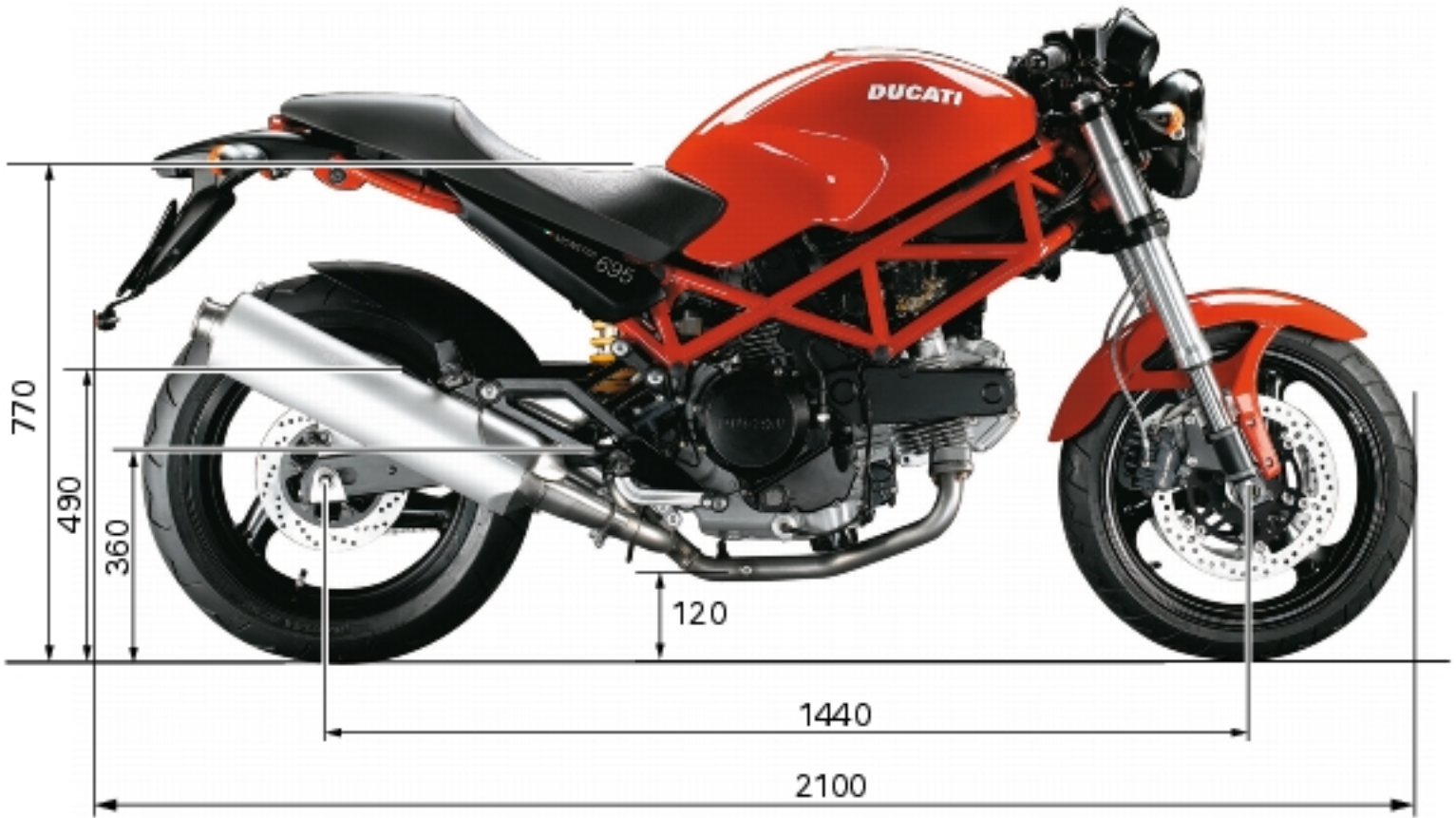
## Injection system

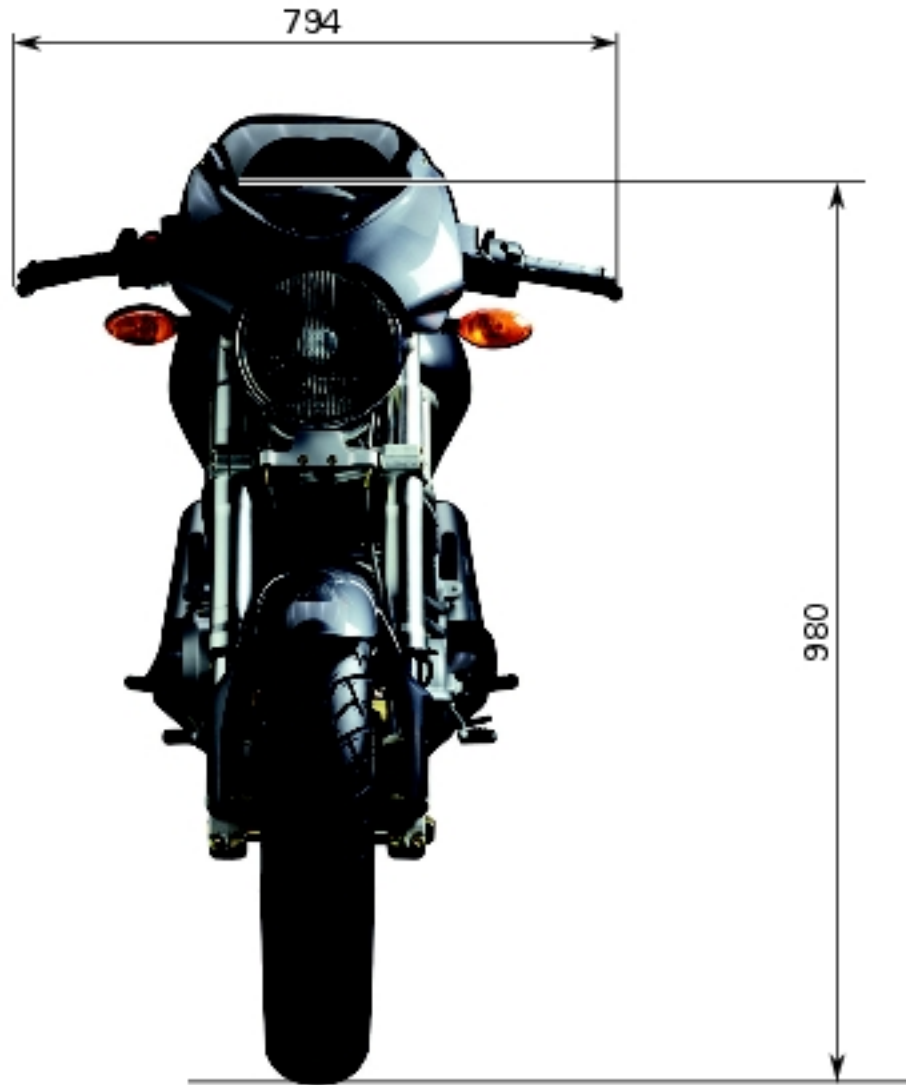
Control unit	Marelli	CPU 5AM2
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## Lights / instrument panel

Bulbs	Front headlamp (low beam / high beam)	12V - 55/60W
	Number plate light	12V - 5W
	Parking / stop light	12V - 5/21W
	Turn indicator light	12V - 10W
	Instrument panel light	12V - 2W
	Turn indicator warning light	12V - 1.2W
	High beam warning light	12V - 1.2W
	Neutral light	12V - 1.2W
	Oil pressure warning light	12V - 1.2W
	Injection system warning light	12V - 1.2W
	Fuses	Regulator
Instrument panel		5A
Injection		20A
Key sense		10 A
Ecu		5A
Loads		15 A
High and low beam, parking lights		15 A
Spare		20A
Spare	5A	

## 1.2 - Dimensions





## 2 - Fuels and lubricants

Fuel tank, including a 3 cu. dm (litres) reserve	Lead-free fuel with at least 95 - 98 RON at origin	14
Engine sump and oil filter	SHELL Advance Ultra 4	3.1
Clutch and front/rear brake circuits	SHELL Advance Brake Dot 4	
Protection for electrical contacts	SHELL Advance Contact Cleaner	
Front fork	SHELL Advance Fork 7.5 or DONAX TA	0.400 (each leg)



### Caution

Do not use fuel or lubricant additives.

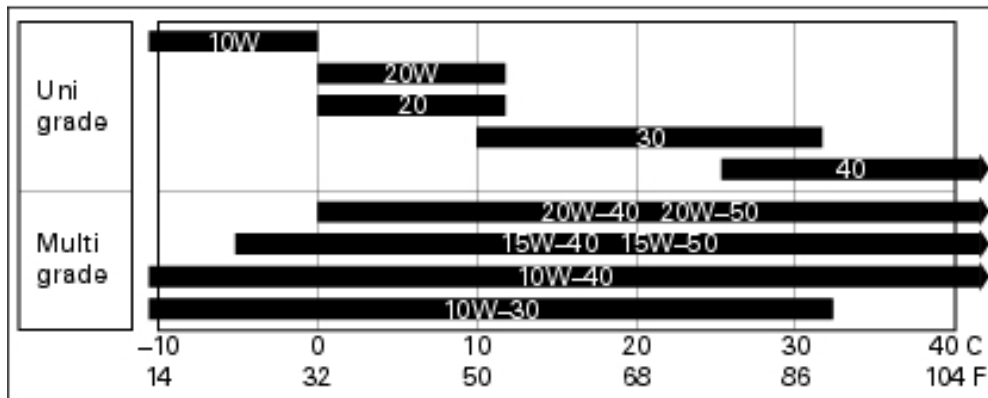
### Engine oil

A good engine oil has special properties. Use only a highly detergent engine oil with certified SE, SF or SG, or even higher, service ratings.

### Oil viscosity

#### SAE 10W-40

The other viscosity grades specified in the table can be used where the average ambient temperatures are within the limits shown.



### 3 - Torque settings

#### Frame torque settings

Chain, front sprocket			
Front sprocket retaining screw	M 5x0.8	6 *	LOCK 1
Front sprocket guard screw	M 6x1	6	
Light units			
Headlight retaining screw	M 8x1.25	12	
Tail light nuts	M 6x1	6	
Screw securing headlight holder to subframe on silent block		4	
Number plate light nuts	M 5x0.8	2.5	
Cat's eye mounting nut	M 4x0.7	2	
Cable guide to headlight bracket screw	M 6x1	9	
Turn indicators retaining screw	M 6x1	6	
Headlight holder retaining screw	M 6x1	10	
Headlight reflector retaining screw	M 4x0.7	2.3	
Warning lights and indicators			
Instrument panel silentblock fasteners		4	
Screw retaining instrument panel to silentblock	M 5x0.8	5	
Temperature/air pressure sensor retaining screw	M 5x0.8	3	
Front fork			
Steering head retaining screw, center position	M 8x1.25	23 *	GREASE B
Steering head retaining screws	M 8x1.25	24 *	GREASE B
Bottom yoke screw	M 8x1.25	20 *	GREASE B - sequence 1-2-1
Fork bottom end bolt	M 8x1.25	20 *	GREASE B - sequence 1-2-1
Steering lock nut	M 8x1.25	18	LOCK 2 (apply Loctite to nut thread only)
Steering bearings ring nut	M 35x1	30 *	GREASE B
Front fork splashguard retaining screw	M 5x0.8	5.5	LOCK 2
Electric system			
Coil-to-frame retaining screw	M 5x0.8	1.5	
Coil-to-airbox nut	M 5x0.8	3	
LH and RH switch screw	M 5x0.8	2.1	
Key cover blind nut	M 6x1	7	
Key-operated switch bolt	M 6x1	**	** Shear bolt head LOCK 2
Battery cable screw	M 6x1	6	
Starter motor nut	M 6x1	5	
Nut securing cable to contactor	M 6x1	4	
Speed sensor retaining screw	M 6x1	10	

Screw retaining voltage regulator to oil breather tank and frame	M 6x1	6	
Screw retaining regulator to oil breather tank	M 6x1	6	
Screw retaining battery mount to silentblocks	M 6x1	6	
Nut retaining battery mount to cylinder head	M 8x1.25	13	
Control unit retaining screw	M 6x1	10	
Screw retaining ground cable to engine	M 8x1.25	12	
TPRT sensor retaining screws	M 4x0.7	2	
Horn mount screw	M 8x1.25	15	LOCK 2
Warning horn retaining screw	M 8x1.25	25	LOCK 2
Immobilizer antenna			Assemble in production line, apply Lock 11 between Antenna and Switch cover
Nut securing temperature sensor support to subframe		5	
Relay mount retaining screw	M 5x0.8	1	
Front brake			
Front brake caliper retaining screw	M 10x1.25	43 *	GREASE B
Front brake master cylinder retaining screw	M 6x1	10	sequence 1 (UP) -2-1
Front/rear brake bleed coupling	M 10x1	23	
Brake lever pin	M 8x1.25	24	LOCK 2
Rear brake			
Rear brake caliper retaining screw	M 8x1.25	24 *	GREASE B
Brake bleeding fitting	M 10x1	23	
Rear brake master cylinder retaining screw	M 6x1	10	
Screw retaining rear brake hose clip to swingarm	M 5x0.8	6	
Rear brake fluid reservoir retaining screw	M 6x1	2	
Rear swingarm			
Chain adjuster safety screw	M 3x0.5	1.8	
Chain adjuster screw	M 8x1.25	8	GREASE B
Swingarm shaft screw	M 10x1.5	43 *	GREASE C
Aluminium swingarm shaft retaining screw	M 8x1.25	18 *	GREASE C
Chain sliding shoe retaining screw	M 6x1	6	LOCK 1
Rear brake caliper plate retaining pin	M 8x1.25	25 *	LOCK 1
Handlebar			
Handlebar clamp screw	M 8x1.25	20 *	GREASE B - sequence 1-2-1
Clutch master cylinder retaining screw	M 6x1	10	sequence 1 (UP) -2-1
Clutch hose fitting	M 10x1	23	
Clutch bleed nipple	M 6x1	4	
Clutch transmission unit screw	M 6x1	10	
Throttle control securing screw	M 6x1	10	
Throttle control cover securing screw	M 4x0.7	1.8	

Counterweight retaining screw	M 6x1	9	
Rear shock absorber			
Rear shock absorber upper screw	M 10x1.25	42 *	GREASE B
Rear shock absorber lower screw	M 10x1.25	42 *	GREASE B
Suspension linkage upper screw	M 10x1.25	42 *	GREASE B
Suspension rocker arm to frame fixing screw	M 12x1.5	75 *	GREASE B
Ball joints to actuating rod nut	M 12x1.5	36	
Front and rear mudguard			
Front mudguard retaining screw	M 6x1	3	LOCK 2
Rear mudguard retaining screw	M 6x1	3	LOCK 2
Number plate holder protection screw	M 6x1	5.5	
Splashguard to underseat retaining screw	M 6x1	1.8	
Number plate holder to splashguard nut	M 6x1	1.9	
Footpegs and Levers			
Lever and gearbox pin	M 8x1.25	24	LOCK 2
Gear change lever fixing screw	M 6x1	10	LOCK 1
Actuating rod ball joints screw on gear change lever	M 6x1	10	
Footpeg holders to engine retaining screws	M 10x1.5	36	
Footpeg holders to frame retaining screws	M 8x1.25	24	
Heat guard to footpeg holder retaining screw	M 6x1	3	
Front and Rear wheel			
Front wheel nut	M 25x1.25	63 *	GREASE B
Rear wheel shaft nut	M 25x1.25	83 *	GREASE B
Brake disc mounting screw	M 8x1.25	24 *	DRILOLOC 218 as OE at BREMBO, Lock 2 for spare parts
Rear chain sprocket nut	M 10x1.25	46 *	LOCK 2
Fuel Tank			
Retaining screw of plastic fuel tank flange	M 6x1	10	
Fuel hose clamp		1.5	
Fuel filler plug fixing screw	M 5x0.8	6	
Fuel tank hinge bracket retaining screw	M 6x1	10	
Fuel tank pads retaining screw	M 6x1	10	
Exhaust			
Nut securing exhaust pipe clamp to silencers	M 10x1.25	42.4	Screwdriver max. number of revolutions 400rpm
Special screw securing exhaust manifolds to crankcase	M 12x1.5	25	LOCK 1
Exhaust pipe to casing retaining screw	M 6x1	9	
1/8" gas stainless steel plugs fastener for exhaust pipes	M 10x1.25	25	
Exhaust silencer to footpeg holder retaining screw	M 6x1	10	
Exhaust pipe to head nut	M 8x1.25	24	
Lambda sensor fastener	M 18x1.5	45	

Seat					
Seat lock ring nut	M 22x1.5	1			LOCK 3
Seat lock holder retaining screw	M 5x0.8	6			
Seat cover holder retaining screw	M 5x0.8	3			
Seat pulley screw	Self-tapping				LOCK 2
Screw retaining seat cover and tool box compartment cover to seat	M 6x1	2			
Seat lock retaining screw	M 5x0.8	6			
Oil inlet/breather					
Airbox hose clip		2			
Airbox stud to airbox fixing	M 6x1	6			
Peg to airbox stud fixing	M 6x1	4			
Oil breather valve hose clip	M 6x1	1.2			
Oil breather tank hose clip		2			
Oil breather tank to frame retaining screw	M 6x1	6			
Fuel system, Canister					
Throttle body mounting clip		2			
Pressure regulator to throttle body retaining screw	M 6x1	5			
Canister mount plate nut		8			
Fairing					
Side body panel retaining screw	M 5x0.8	0.8			
Headlight fairing to bracket retaining screw	M 6x1	8			
Side stand					
Side stand plate retaining screw	M 10x1.5	36			LOCK 5
Side stand sensor wire retainer screw	M 6x1	10			
Side stand pivot nut	M 8x1.25	24			
Side stand sensor retaining screw	M 6x1	10			
Frame					
Engine to frame mounting bolt nut	M 12x1.5	60 *			GREASE B
Oil pipe fitting on casing	M 9/16"UNF"	19			
Fitting for oil delivery pipe to heads	M 8x1.25	15			

\* critical point for dynamic safety. Tightening torque tolerance must be:  $\pm 5\%$  Nm.



#### Note

For product specifications and symbols, refer to "[Product specifications](#)" (A 2).

### Engine torque settings

Blow-by valve	M 40x1.5	40	36	44	
Mesh filter duct plug	M 32x1.5	42	38	46	
Oil temperature sensor ring nut	M 30x1.5	38	34	42	LOCK 4
Wet clutch drum nut	M 25x1.5	190	180	200	GREASE B
Generator rotor nut	M 24x1	270	256	284	LOCK 5
Crankshaft gear fixing nut	M 22x1	190	171	209	GREASE B

## Torque settings

Oil drain plug	M 22x1.5	42	38	46	
Oil mesh filter	M 22x1.5	42	38	46	
Oil filler plug	M 22x1.5	5	5	6	
Steel/alum. crankshaft blanking plug	M 20x1	15	13.5	16.5	THREE BOND 1375B
Gearbox drum locating screw	M 16x1.5	30	27	33	
Oil filter nipple	M 16x1.5	42	38	46	LOCK 2 or THREE BOND 1324
Oil cartridge filter	M 16x1.5	11	10	12	Engine oil on seal
Mesh filter duct plug	M 15x1	20	18	22	LOCK 5 or THREE BOND 1375B
By-pass pump plug	M 15x1	25	22	28	LOCK 5 or THREE BOND 1375B
Ring nut for belt rollers on lay shaft	M 15x1	71	64	78	GREASE A
Ring nuts for belt rollers on heads	M 15x1	71	64	78	GREASE A
Generator cover inspection plug	M 15x1	20	18	22	THREE BOND 1215
Nut for timing lay shaft gear	M 14x1	55	50	60	GREASE A
Radiator preset blanking plug	M 14x1.5	27	24	30	LOCK 5 or THREE BOND 1375B
Pick-up inspection screw	M 12x1	15	13	17	LOCK 2 or THREE BOND 1324
Earth screw	M 12x1	15	13	17	LOCK 2 or THREE BOND 1324
Oil temperature sensor	M 12x1.5	18	16	19	LOCK 4
Spark plugs	M 12x1.25	20	18	22	
Head nuts:	M 10x1.5				Smear GREASE C on the underhead and thread of the stud bolt
1 <sup>st</sup> snug torque		15			
2 <sup>nd</sup> snug torque		25	23	27	
final torque		40	38	42	
Con-rod bolts:	M 10x1				Smear GREASE B on thread
1 <sup>st</sup> tightening		35			
Stop for 2 sec. and loosen by 360°					
1 <sup>st</sup> snug torque		20			
2 <sup>nd</sup> snug torque		35			
Tightening		70.5	66	73	
Check angle: > 30°					
Oil pump duct plug	M 10x1.5	Fully home with tool 15 13 17			LOCK 5 or THREE BOND 1375B
Head stud bolts	M 10x1.5	25	23	26	LOCK 2 or THREE BOND 1324
Pressure switch	M 10x1	19	17	21	
Reduction bushing	M 10x1				LOCK 5 or THREE BOND 1375B
Spark plug	M 10x1	15	13	17	
Neutral light switch	M 10x1.25	10	9	11	
Clutch-side casing service plug	M 10x1.5	15	13	17	LOCK 5 or THREE BOND 1375B
Crankshaft dowels	M 8x1.25	13	11	15	THREE BOND 1375B
Gearbox pawl screw	M 8x1.25	25	22	28	
Gear stopper screw	M 8x1.25	18	16	20	LOCK 2 or THREE BOND 1324

Intake and exhaust flange stud bolts	M 8x1.25	15	13	17	LOCK 2 or THREE BOND 1324
Intake manifold nuts	M 8x1.25	23	20	26	
Oil pump screws	M 8x1.25	26	23	29	
Casing jointing screws:	M 8x1.25				
1 <sup>st</sup> snug torque		19	17	21	
final torque		25	22	28	
Casing drilled screw	M 8x1.25	20	18	22	
Fixed tensioner	M 8x1	20	18	22	LOCK 2 or THREE BOND 1324
Mobile tensioner	M 8x1.25	26	23	29	
Ground screw	M 8x1.5	13	11	15	
Clutch spring screw	M 6x1	6	5	7	
Stator cable guide screws	M 6x1	10	9	11	LOCK 2 or THREE BOND 1324
Starter motor screws	M 6x1	10	9	11	LOCK 2 or THREE BOND 1324
Starter idle gear pin screw	M 6x1	10	9	11	LOCK 2 or THREE BOND 1324
Generator stator retaining screws	M 6x1	10	9	11	LOCK 2 or THREE BOND 1324
Flywheel / rotor screws	M 6x1	13	11	15	LOCK 2 or THREE BOND 1324
Gearbox bearing stop plate screws	M 6x1	10	9	11	LOCK 2 or THREE BOND 1324
Head service screws (aluminium)	M 6x1	3	2	3	LOCK 5 or THREE BOND 1375B
Intake manifold fuel pump fitting	M 6x1	2.5	2	3	LOCK 2 or THREE BOND 1324
Bosch pick-up retaining screws	M 6x1	10	9	11	
Nut securing fluid recovery tank bracket	M 6x1	9	8	10	
Battery mount lower stud bolt	M 6x1	10	9	11	LOCK 2 or THREE BOND 1324
Gearbox pawl screw	M 6x1	9	8.5	9.5	LOCK 2 or THREE BOND 1324
Inspection cover screws	M 6x1	4.5	4.5	6	
Rocker arm shaft cover screws	M 6x1	10	9	11	
Intake / exhaust valve cover screws	M 6x1	10	9	11	
Casing jointing screws	M 6x1	9	8.5	9.5	
Clutch cover screws	M 6x1	9	8.5	9.5	
Generator cover screws	M 6x1	10	9	11	
Clutch spring screws	M 5x0.8	5	5	7	
Driven belt roller flange retaining screws	M 5x0.8	5	5	7	
Manifold nipple	M 5x0.8	3	2	3	LOCK 2 or THREE BOND 1324
Split belt roller flange retaining screws	M 5x0.8	5	5	7	
Head cover plug	M 5x0.8	2.5	2.5	3	
Screws	M 10x1.5	45	40	50	
Screws	M 8x1.25	25	22	28	


Screws	M 6x1	10	9	11
Screws	M 5x1	5	5	7



Note

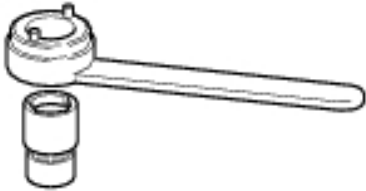
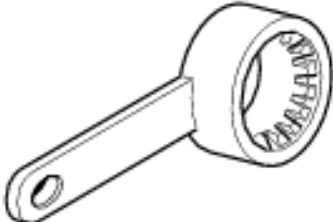

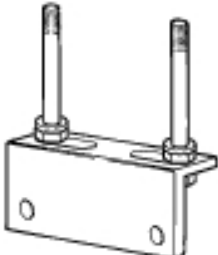
For product specifications and symbols, refer to "[Product specifications](#)" (A 2).


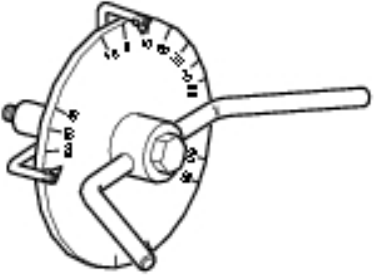



## 4 - Service Tools




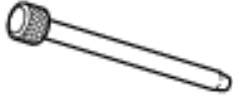
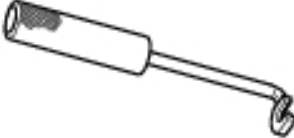
 Spare parts catalogue




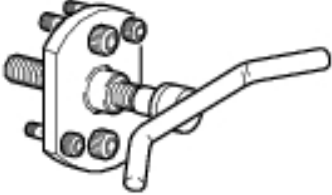

[Workshop special tools](#)

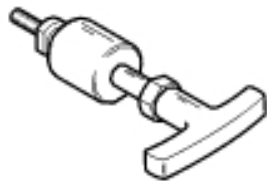



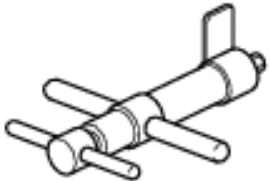
### Engine special tools

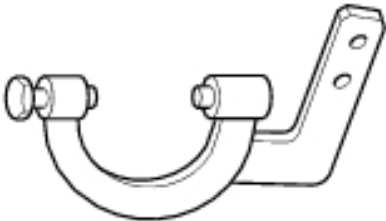
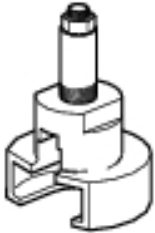



Part No.	Description	
88700.5644	Tool to set belt roller ring nut for camshaft	
88713.2107	Reaction tool to tighten timing belt rollers	
88713.2676	Head nuts tightening tool	
88713.2103	Support for head assembly	

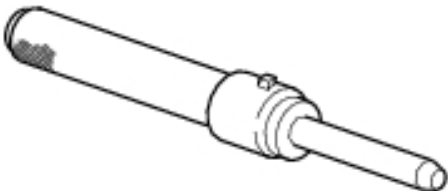
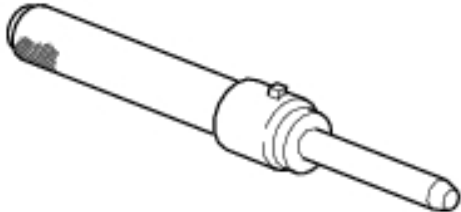

98112.0002	Timing degree wheel	 A circular timing degree wheel with a scale from 0 to 360 degrees. The scale is marked every 10 degrees, with '0' at the top and '360' at the bottom. There are also markings for 90, 180, and 270 degrees.
88713.0123	Timing check tool	 A timing check tool consisting of a circular degree wheel with a scale from 0 to 360 degrees. It has a central shaft with a long handle and a small pin or needle pointing to the scale.
97900.0215	DDS (Ducati Diagnosis System) + kit for measuring cylinder vacuum	 A handheld electronic diagnostic device with a screen and several buttons. It is labeled 'DDS' and 'DUCATI'.
88713.0137	Crankshaft sprocket stop tool	 A crankshaft sprocket stop tool consisting of a cylindrical head with a central hole and a long handle.
88765.1058	Valve lift gauge	 A valve lift gauge consisting of a circular gauge with a needle and a handle. It is used to measure the lift of a valve.


88765.1000	0.1 mm fork feeler gauge	
88765.1005	0.2 mm fork feeler gauge	
88765.1006	0.3 mm fork feeler gauge	
88713.2362	Tool to fit spring and closing rocker arm	
88713.2009	Tool to lock belt rollers	
88713.0262	Pin to fit the rocker arms	
88713.0844	Drift to fit split rings	

88713.2011	Crankshaft locking tool	 A mechanical tool with a circular head and a long handle, used for locking the crankshaft.
88700.5749	Cap for closing the crankcases	 A small, cylindrical metal cap.
88713.1091	Plate for gear selector fork positioning	 A metal plate with a hole and a threaded rod passing through it.
88713.1749	Puller for drive belt roller and cover	 A complex mechanical puller with a handle and multiple adjustment points.
88765.1297	TDC check gauge	 A gauge with a circular dial and a long, thin rod, used for checking Top Dead Center (TDC).

88713.1994	Rocker arm shaft puller	 A mechanical tool with a cylindrical body and a T-shaped handle, used for pulling a rocker arm shaft.
88713.2556	ATPC system clutch housing locking tool	 A circular, ring-like tool with several small protrusions and a larger circular opening, used for locking the clutch housing.
88713.2591	Clutch screw	 A long, thin screw with a hexagonal head and a threaded shaft.
88713.1010	Exhaust gas pick-up point	 A long, thin metal rod with a threaded end and a small circular opening at the other end.
88713.1215	Timing belt tensioner	 A mechanical device with a central cylindrical body and several long, thin arms extending from it, used for adjusting timing belt tension.

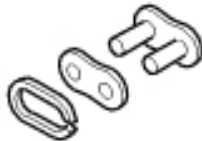
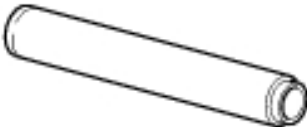
88713.2036	Generator locking tool for nut tightening	
88713.2092	Primary gears puller	
88713.0879	Valve guide extraction tool	
88713.0874	Exhaust valve guide drift	
88713.0875	Intake valve guide drift	

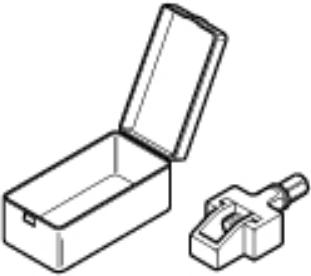




88713.1078	Drift to install exhaust valve seat	
88713.1079	Drift to install intake valve seat	
88713.2422	Wrench for tightening the primary sprocket ring nut	

 Spare parts catalogue

[Workshop special tools](#)

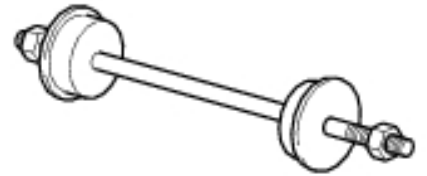
### Frame special tools

Part No.	Description	
677.4.003.1A	Chain joint	
88713.1072	Bottom yoke bearing drift	

88713.1344	Chain assembly tool	 A rectangular metal box with its lid open, and a small metal chain link component next to it.
8000.70139	Front wheel shaft tool	 A cylindrical metal tool with a central hole and a small protrusion on the side.
88713.1096	Fork overhaul tool - for fitting the seal	 A U-shaped metal tool with a textured inner surface, used for fitting seals.
88713.1515	Frame/engine support	 A metal support structure consisting of a vertical bar and two horizontal bars, used for supporting the frame or engine.
88713.1058	Tool to fit steering tube top bolt	 A small metal component with a hexagonal base and a central threaded hole, used for fitting a steering tube top bolt.

88713.1062

Tool to fit steering tube bearings



# 0Specifications

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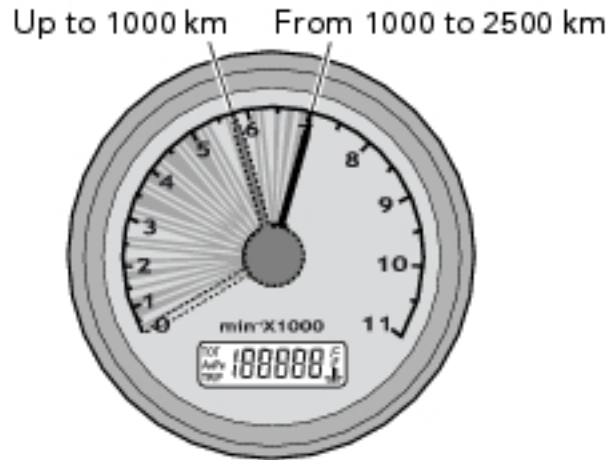
# 1 - Preliminary checks

## Running-in precautions

Max. rotation speed

Rpm limits to be observed during the running-in period and in normal operation:

- 1 Up to **1000** km;
- 2 From **1000** to **2500** km;



Max. rotation speed up to 1000 km

During the first **1000** km, keep an eye on the revolution meter. The indicator must not exceed **5500-6000** rpm. During the first hours of riding, it is advisable to run the engine at varying load and rpm, though still within the recommended limit.

Twisty roads and gradients are ideal to break in engine, suspensions and brakes effectively. Apply the brakes gently and avoid hard, prolonged braking until covering the first 100 km. This will allow the brake pad lining to wear in properly rubbing on the brake discs. For all mechanical moving parts of the motorcycle to adapt to one another and above all not to adversely affect the life of basic engine parts, it is advisable to avoid harsh accelerations and not to run the engine at high rpm for too long, especially uphill. Furthermore, the drive chain should be inspected frequently. Lubricate as required.

Max. rotation speed from 1000 to 2500 km

At this point, you can squeeze some more power out of your engine, being careful, however, to never exceed **7000** rpm. Following these recommendations strictly will extend the life of your engine and reduce the likelihood of overhauls or tune-ups.



During the whole running-in period, the maintenance and service rules recommended in the warranty card should be observed carefully. Failure to comply with these rules will release Ducati Motor Holding S.p.A. from any liability whatsoever for resulting engine damage or shorter engine life.

## Pre-ride checks



## Warning

Failure to carry out these checks before riding, may lead to motorcycle damage and injury to rider.

Before riding, perform a thorough check-up on your bike as follows:

Fuel level in the tank

Check fuel level in the tank. Fill tank if needed (Sect. C 2, [Fuels and lubricants](#)).

Engine oil level

Check oil level in the sump through the sight glass. Top up with recommended oil if needed (Sect. C 2, [Fuels and lubricants](#)).

Brake and clutch fluid

Check fluid level in the relevant reservoirs.

Tyre condition

Check tyre pressure and condition (Sect. C 1.1, [Front wheel/Rear wheel](#)).

Controls

Work the brake, clutch, throttle and gear change controls (levers, pedals and twistgrips) and check for proper operation.

Lights and indicators

Make sure lights, indicators and horn work properly. Replace any burnt-out bulbs (Sect. C 1.1, [Lights / instrument panel](#)).

Key-operated locks

Check that fuel filler plug and seat catch locks are closed firmly.

Side stand

Check the side stand for operation (Sect. P 6, [Protection and safety devices](#)) and correct position (Sect. H 5, [Stands](#)).

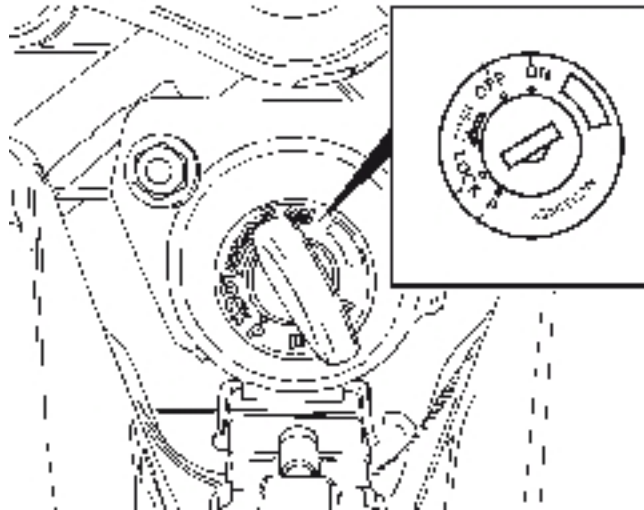
## 2 - Starting – engine warm-up

### Starting the engine

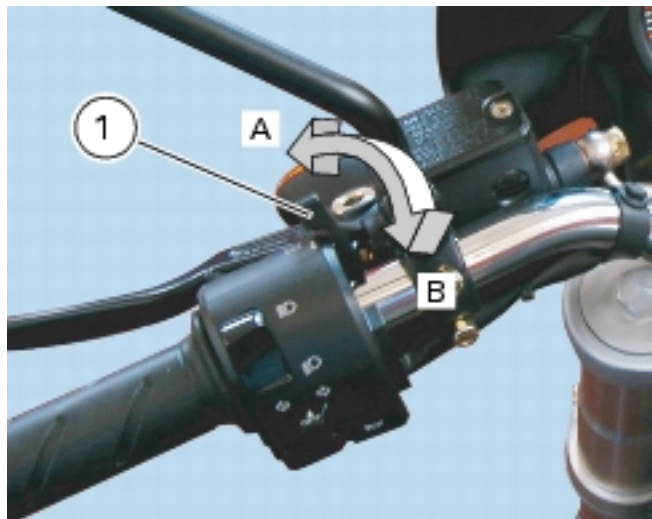
Cold ambient temperature

(10 °C / 50 °F - 35 °C / 95 °F)

Turn the ignition switch to ON. Check that the green and red lights on the instrument panel are on (Sect. P 7, [Instrument panel](#)).



Move the choke lever to (B). Let the engine start without using the throttle. Move the choke lever to vertical position (A).



### Caution

The oil pressure light should go out a few seconds after the engine has started. If the light stays on, stop the engine and check oil level (Sect. P 7, [Instrument panel](#)).

Never start the engine when oil pressure is too low.

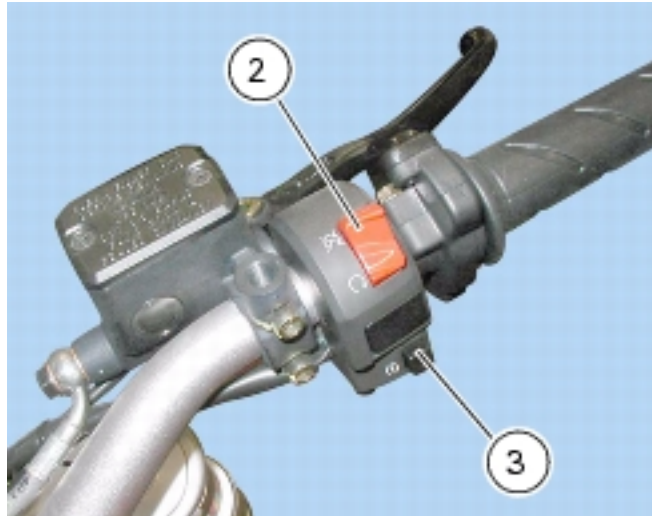
 Caution

If the engine fails to start, check that the stop switch (2) is positioned to (RUN), and then press the starter button (3) within 15 seconds from KEY ON.

 Note

This model is equipped with a servoignition system, and the engine is started by pressing the button (3) and releasing it immediately. When the button (3) is pressed, the servoignition system automatically cranks the engine for a maximum period of time that varies depending on engine temperature.

Once the engine has started, the system prevents the starter motor from turning over. If the engine fails to start, allow at least 2 seconds before pressing the button (3) again.



 Caution

Do not rev up the engine when it is cold. Allow some time for oil to warm up and reach all points that need lubricating.

 Warning

The motorcycle can be started with the side stand down and the gearbox in neutral, or with a gear engaged, the side stand up and the clutch lever pulled in.

Shift gradually the choke lever (1) to vertical position as the engine warms up.

The engine should run regularly at idling speed when the choke is fully closed.

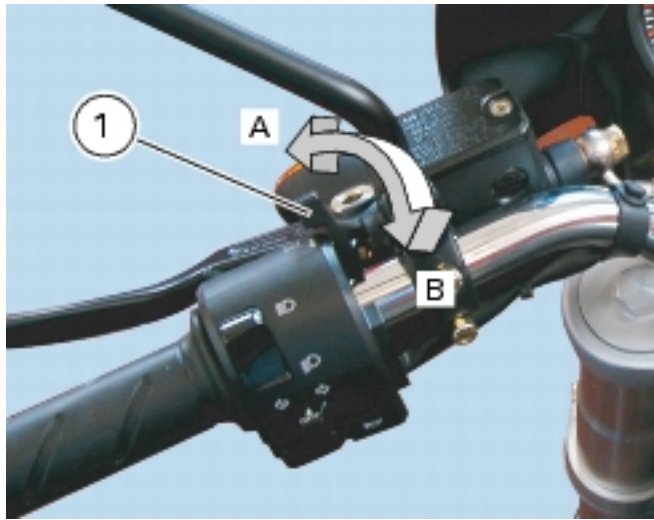
High ambient temperature

(over 30 °C / 86 °F)

Follow the same procedure, however do not use the choke lever (1).

 Note

Follow the procedure for “High ambient temperature” to start a warm engine.



### 3 - Routine maintenance table

Scheduled maintenance chart: operations to be performed by the dealer

	Km. x1000					
	Months	6	12	24	36	48
Changing engine oil	•	•	•	•	•	•
Changing engine oil filter	•	•	•	•	•	•
Cleaning engine oil intake filter				•		
Checking engine oil pressure			•		•	
Checking and/or adjusting valve clearance (1)		•	•	•	•	•
Checking timing belt tension (1)		•		•		•
Changing timing belts			•		•	
Checking and cleaning spark plugs. Change them, if necessary			•		•	
Checking and cleaning air filter (1)		•		•		•
Changing air filter			•		•	
Checking throttle body synchronization and idling (1)		•	•	•	•	•
Checking brake and clutch fluid level	•	•	•	•	•	•
Changing clutch and brake fluid				•		
Checking and adjusting brake and clutch controls		•	•	•	•	•
Checking/lubricating throttle/choke control		•	•	•	•	•
Checking tyres wear and pressure	•	•	•	•	•	•
Checking brake pads. Change them, if necessary	•	•	•	•	•	•
Checking steering bearings			•		•	
Checking chain tension, alignment and lubrication	•	•	•	•	•	•
Checking clutch plates pack. Change, if necessary (1)		•	•	•	•	•
Checking rear wheel flexible coupling			•		•	
Checking wheel hub bearings			•		•	
Checking indicators and lighting devices		•	•	•	•	•
Checking engine-to-frame screw nuts tightening		•	•	•	•	•
Checking side stand		•	•	•	•	•
Checking front wheel nut tightening		•	•	•	•	•
Checking rear wheel nut tightening		•	•	•	•	•
Checking external fuel lines		•	•	•	•	•
Changing front fork fluid				•		
Checking front fork and rear shock for leakage		•	•	•	•	•
Checking front sprocket fastening		•	•	•	•	•
General lubrication and greasing		•	•	•	•	•
Check and charge battery		•	•	•	•	•
Vehicle test ride	•	•	•	•	•	•
Overall cleaning		•	•	•	•	•

\* service on the set interval, whichever comes first (mileage or months)

(1) Operation to be performed only if set mileage is reached

Scheduled maintenance chart: operations to be performed by the customer

Description of operations and type of intervention (mileage, time or time interval)	Km. x1000	
	Months	6
Checking the engine oil level		•
Checking brake and clutch fluid level		•
Checking tyres wear and pressure		•
Checking chain tension and lubrication		•
Checking brake pads. If necessary, have them replaced by a dealer		•

\* service on the set interval, whichever comes first (mileage or months)

## 4 - Maintenance operations

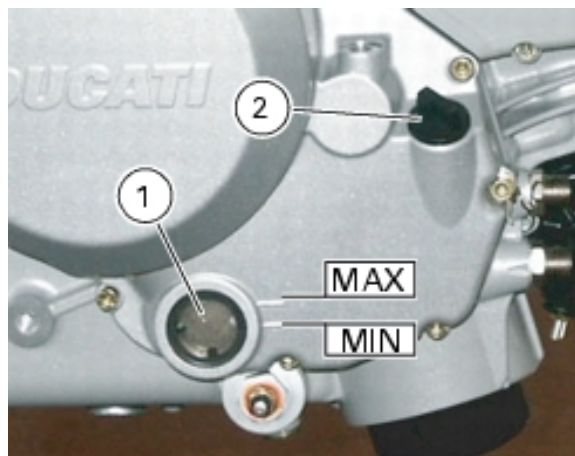
### Checking the engine oil level

Check the engine oil level in the sight glass (1) on the RH side of the oil sump.

After switching off, allow several minutes for the oil to settle before checking the level. Check the level with the motorcycle perfectly vertical and with the engine hot (but stopped).

The level should be between the MIN and MAX marks. Top up if low. Remove the filler plug (2) and top up with the recommended oil.

Refit the filler plug.



### Changing the engine oil and filter cartridge



#### Note

Change the oil when the engine is hot (but off). In these conditions the oil is more fluid and will drain more rapidly and completely.

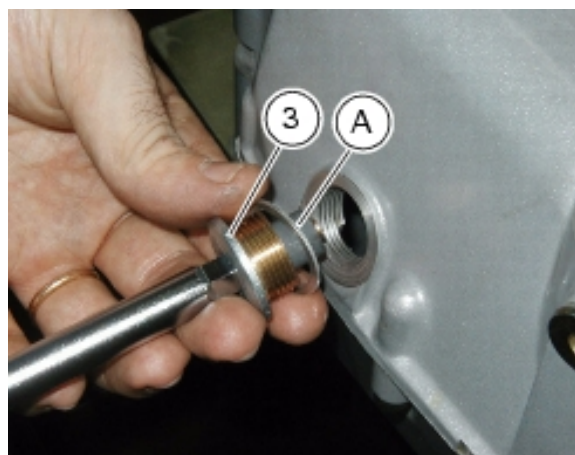
Remove the drain plug (3) on the oil sump and allow the oil to drain off.



#### Warning

Dispose of oil and/or filter cartridges in compliance with environmental protection regulations.

Remove any metallic deposits from the end of the magnetic drain plug. Refit the drain plug complete with seal (A) to the sump.



Tighten it to the specified torque (Sect. C 3, [Engine torque settings](#)).

With a common filter wrench, remove the filter cartridge (4) from the oil sump.



**Caution**

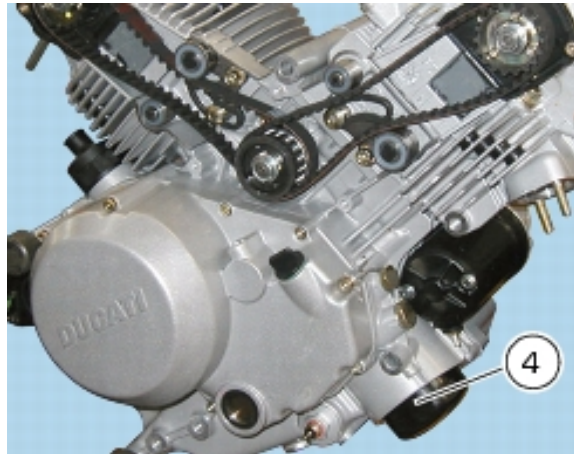
Dispose of used cartridge. Do not reuse cartridges.

Grease the seal with engine oil and then fit the new cartridge (4).



**Note**

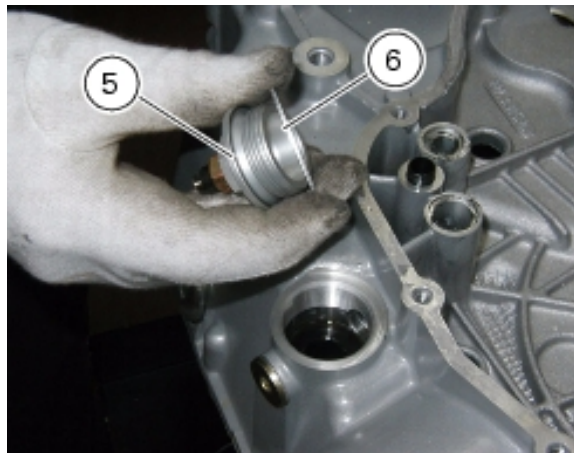
If you wish to skip this last check, fill the filter cartridge (2) with oil before installation and you will not need to top up level later.



Screw it in its seat and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).

Clean the oil mesh filter every second oil change.

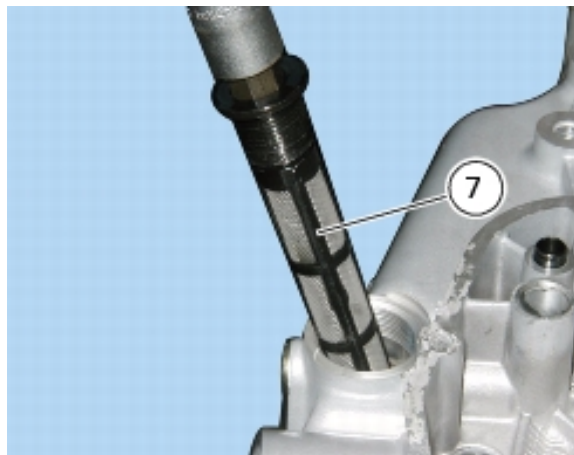
Unscrew the outer plug (5).



Release and withdraw the mesh filter (7).

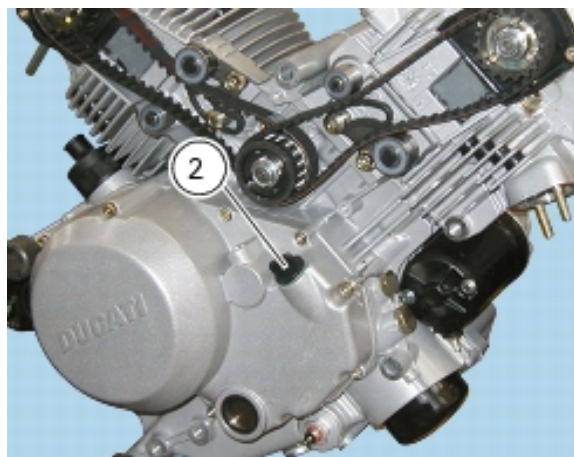
Clean the mesh filter with gasoline and compressed air. Care must be taken not to break the filter mesh.

Refit the mesh filter (7) and its seal (6) on the plug (5) and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).



Remove the filler plug (2) and fill with the recommended oil (Sect. C 2, [Fuels and lubricants](#)). Fill until the oil reaches the MAX mark on the sight glass.

Refit the filler plug (2). Run the engine at idling speed for several minutes.



Check for oil leaks. Check that the oil pressure light on the instrument panel switches off several seconds after the engine has been started. If this is not the case, switch off and trace the fault.

Switch off the engine and allow several minutes for the oil to settle. Check the oil level and top up to MAX mark, if necessary.

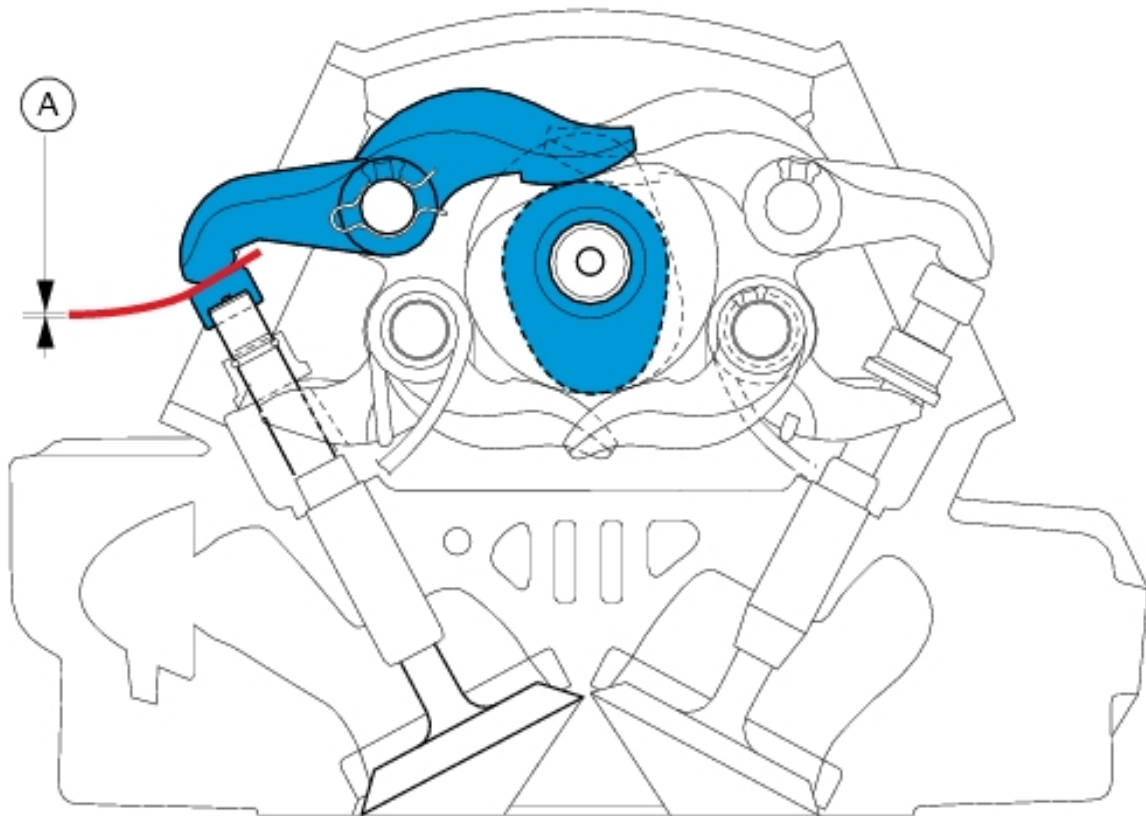
Refit any parts you have removed.

### Checking valve clearances

Proceed as described under Section N 4.1, [Checking and adjusting valve clearance](#).

With the valve in the rest position, slide a feeler gauge between opening rocker arm and shim to measure clearance. Values must be as follows:

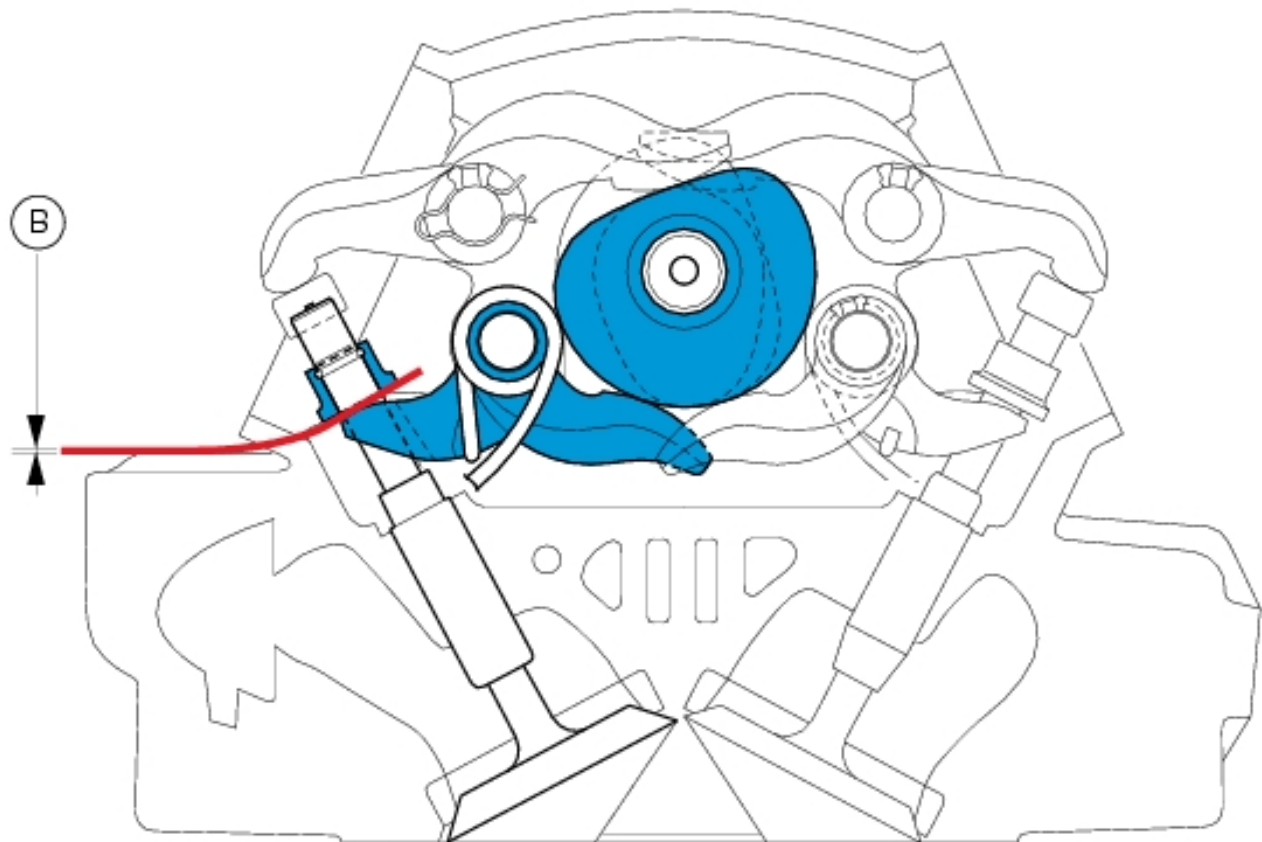
<b>Intake:</b>	(A)
Nominal	0.10-0.15 mm
In operation	0.05-0.15 mm
<b>Exhaust:</b>	(A)
Nominal	0.10-0.15 mm
In operation	0.05-0.15 mm



With the valve in the rest position, slide a feeler gauge between closing rocker arm and shim to measure clearance. Clearance must be within the specified limits:

<b>Intake:</b>	(A)
Nominal	0-0.05 mm
In operation	0-0.20 mm
<b>Exhaust:</b>	(A)
Nominal	0-0.05 mm
In operation	0-0.20 mm

If the clearances measured are outside the specified limits, measure clearance and adjust as required (Sect. N 4.1, [Checking and adjusting valve clearance](#)).



### Adjusting valve clearances

Proceed as described under Section N 4.1, [Checking and adjusting valve clearance](#).

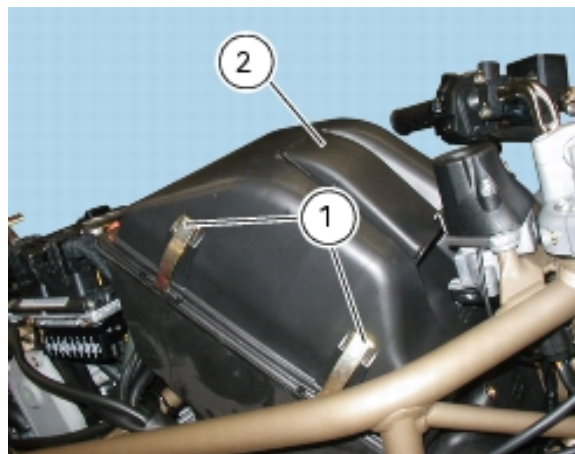
### Changing and cleaning the air filters

The air filter must be changed at the intervals indicated in the "[Routine maintenance table](#)" (Sect. D 3).

Raise the fuel tank (Sect. L 2, [Removing the fuel tank](#)).

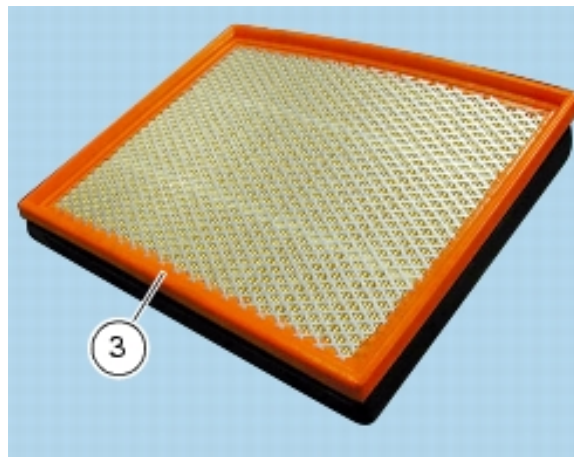
Release the cover clips (1) on either side of the airbox.

Remove the cover (2).



Remove the filter cartridge (3) and replace.

Blow the filter cartridge with compressed air or replace it if unserviceable.



 Caution

A clogged air filter will reduce air intake and engine power leading to increased fuel consumption, and cause a build up of deposits on the spark plugs. Do not run the engine without the air filter. Running the engine without a filter will draw impurities into the engine and may damage the engine.

Fit the filter cartridge into the filter box and refit all components previously removed.

 Caution

If the vehicle is used in very damp or dusty conditions, the air filter cartridge must be changed more frequently.

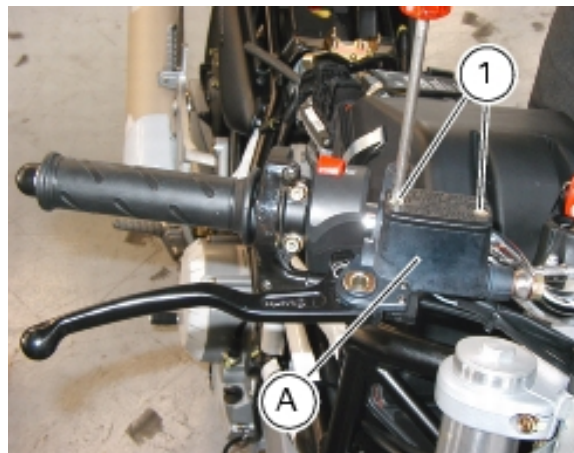
### Changing the brake fluid

 Warning

Brake fluid will damage painted surfaces if spilled on them. In addition, it will cause severe injury if spilled on the skin or into your eyes. In the event of accidental contact with skin or eyes, wash the affected area with abundant running water.

#### Filling the front brake circuit

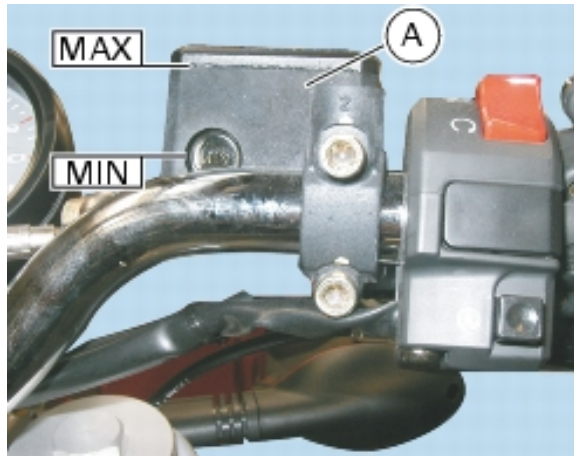
Undo the screws (1) and remove the diaphragm cover from the front brake reservoir (A).



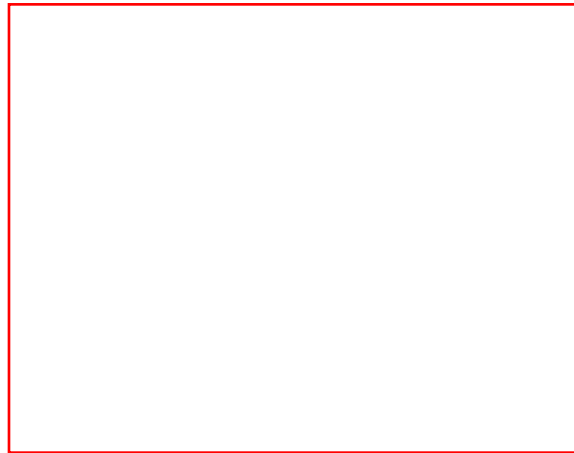
Connect a clear hose to the bleed valve (2); put one end of the hose into a container on the floor.



Suck the oil up from the reservoir (A).  
Fill reservoir (A) with fresh oil up to **MAX** level.



Pump up two or three times with the lever to pressurize the circuit.  
Keep the lever pulled toward the handgrip.



Loosen the bleed valve (2) so that oil flows off.



**Warning**

When filling up, keep oil level above **MIN** mark to avoid air bubbles into the circuit.

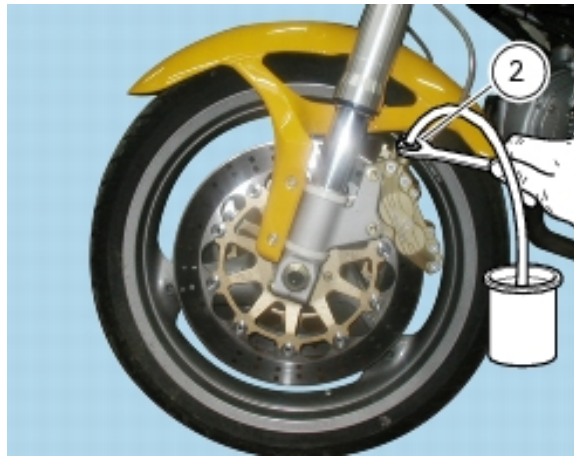
Let oil flow off from the bleed valve (2) until of different color.

Tighten the bleed valve to the specified torque (Sect. C 3, [Frame torque settings](#)) and top up oil to correct level.



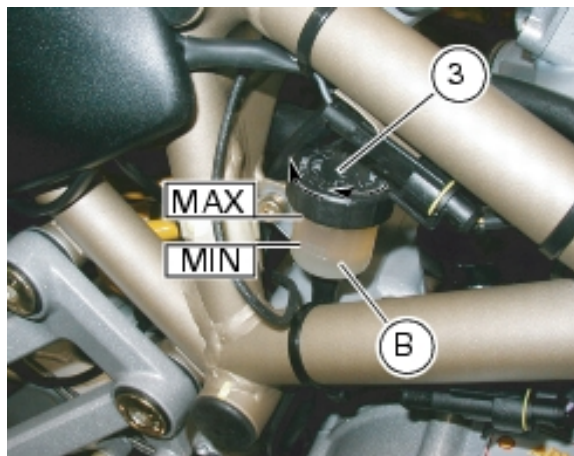
**Note**

Repeat the above procedure for both calipers.

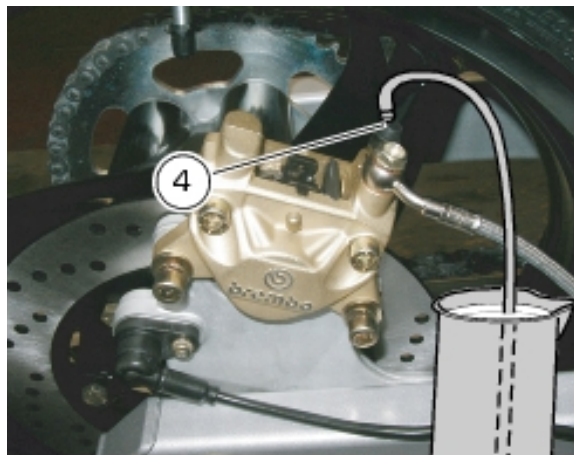


### Filling the rear brake circuit

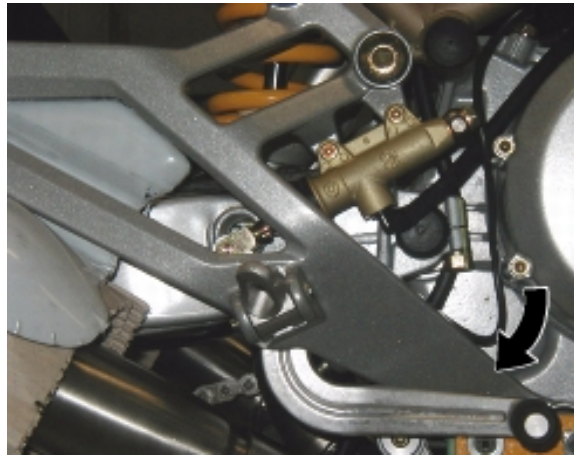
Remove the cap (3) from the rear brake cylinder reservoir (B).



Connect a clear hose to the bleed valve (4); put one end of the hose into a container on the floor.

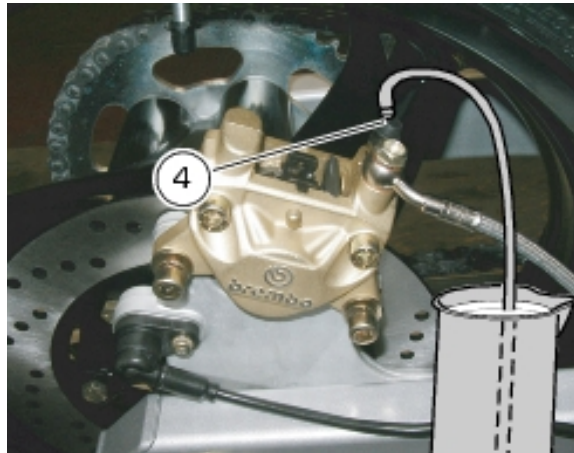


Suck the oil up from the reservoir (B).  
Fill reservoir (B) with fresh oil up to **MAX** level.  
Pump up two or three times with the pedal to pressurize the circuit.  
Hold the pedal pressed.



**Warning**

When filling up, keep oil level above **MIN** mark to avoid air bubbles into the circuit. Let oil flow off from the bleed valve (4) until of different color. Tighten the bleed valve (4) to the specified torque (Sect. C 3, [Frame torque settings](#)) and top up oil to correct level.



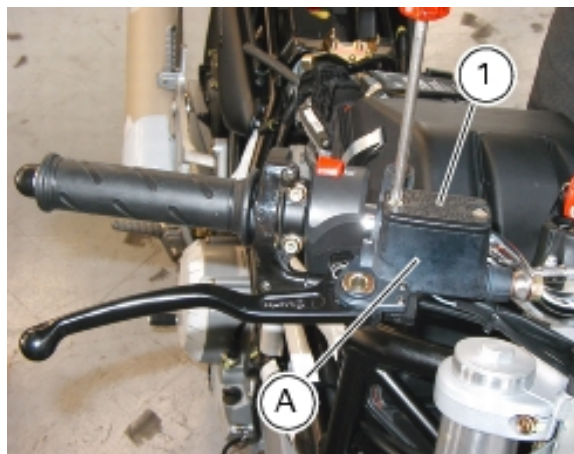
Draining the braking circuit

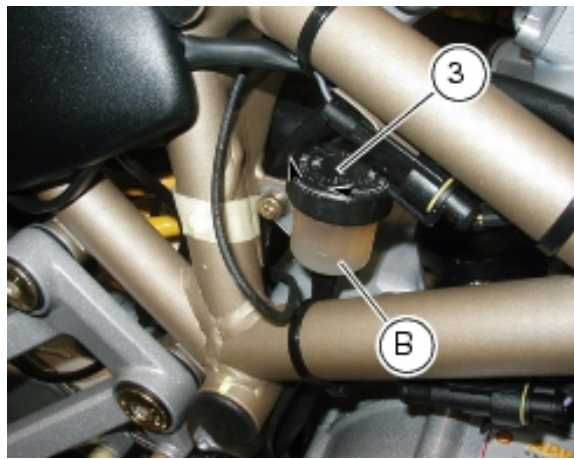


**Warning**

Brake fluid will damage painted surfaces if spilled on them. In addition, it will cause severe injury if spilled on the skin or into your eyes. In the event of accidental contact with skin or eyes, wash the affected area with abundant running water.

Remove the diaphragm cover (1) from the front brake reservoir (A) and cap (3) from rear brake reservoir (B).





Connect a common brake bleeder, easily available on the market, to the caliper bleed valve (2- front) or (4 -rear).

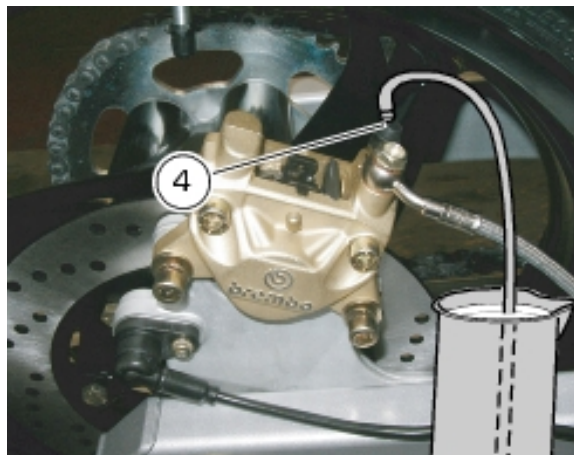
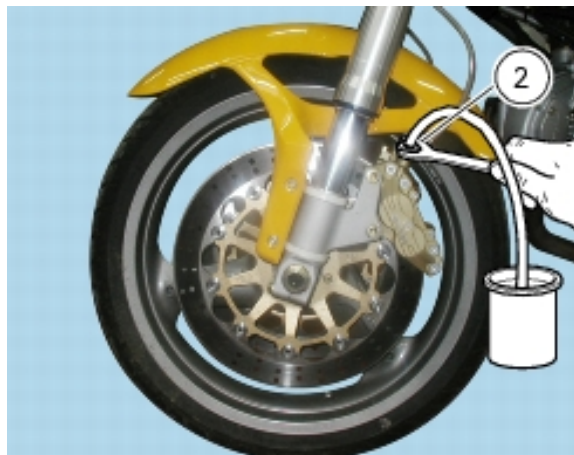


Note

If you are using a commercial bleeder, follow the manufacturer's instructions.

Unscrew the bleed valve and pump the bleeder until all the fluid has fully drained off the circuit.

If you do not have a brake bleeder available, attach a length of transparent plastic tubing to the caliper bleed valve (2 -front) or (4 -rear) and put the other end of the hose into a container holding spent brake fluid you will have placed on the floor.



Unscrew the bleed valve by **one fourth** of a turn.

Operate the brake lever (or pedal) until all the fluid has fully drained off the circuit.

Repeat this operation for each brake caliper.

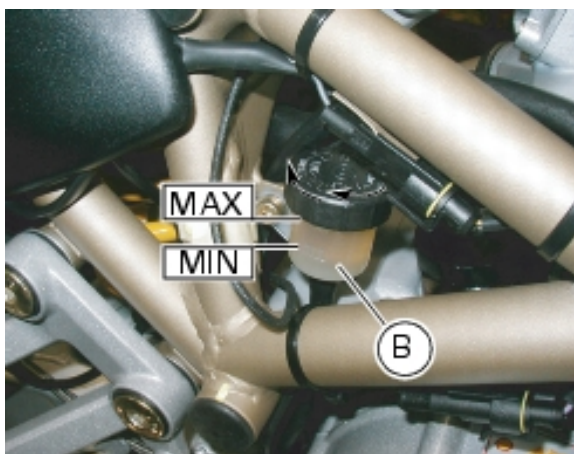
### Filling the brake circuit



### Warning

Brake fluid will damage painted surfaces if spilled on them. In addition, it will cause severe injury if spilled on the skin or into your eyes. In the event of accidental contact with skin or eyes, wash the affected area with abundant running water.

Fill the reservoirs (A) and (B) with specified brake fluid (Sect. C 2, [Fuels and lubricants](#)) from a sealed container.



### Caution

During the next operation, the fluid level must remain topped up at all times. The end of the transparent plastic tubing must remain immersed in the discharged brake fluid at all times.

Operate the brake lever (or pedal) several times to let the fluid reach all points of the circuit and expel any air.

Connect the brake bleeder to the bleed valve (2) or (4).



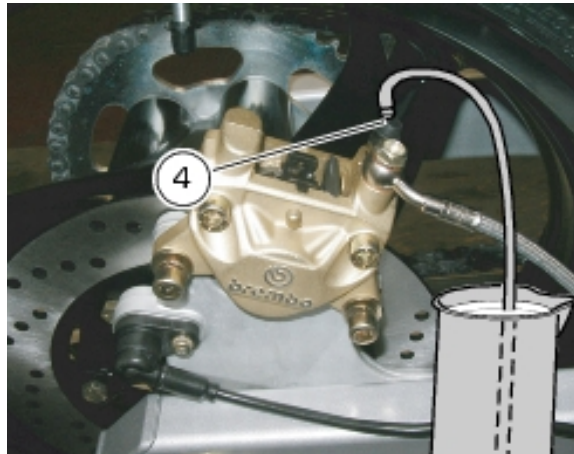
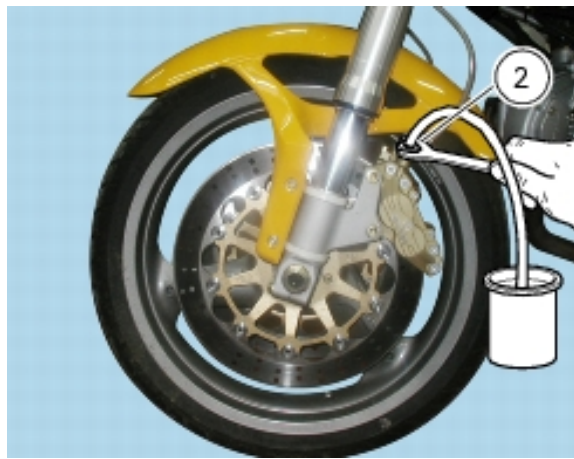
### Note

If you are using a commercial bleeder, follow the manufacturer's instructions.

Pump the brake bleeder and slacken the bleed valve (2) or (4). Make sure the level stays above the **MIN** level at all times.

Repeat the bleeding operation until air bubbles no longer come out of the plastic tube.

Tighten the bleed valve (2) or (4) to the specified torque (Sect. C 3, [Frame torque settings](#)).



If you do not have a brake bleeder available, connect a length of transparent plastic tubing to the bleed valve as outlined in the draining procedure.

Open the bleed valve by **one fourth** of a turn and operate the brake lever (or pedal) several times until the fluid starts coming out of the bleed valve.

Pull the lever or pedal fully in and slacken the bleed valve by at least **one fourth** one fourth of a turn.

Allow several seconds and then release the lever (or pedal) gradually and close the bleed valve (2) or (4).



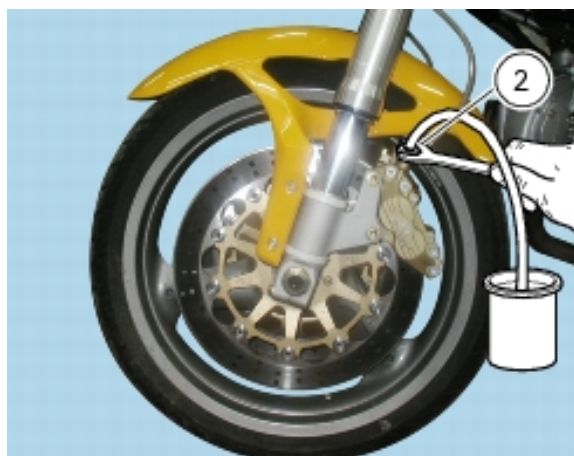
**Caution**

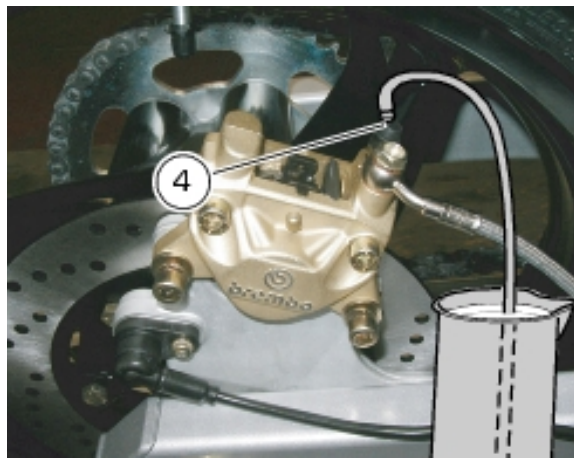
Do not release the brake lever (or pedal) until the bleed valve has been fully tightened.

Repeat the bleeding operation until air bubbles no longer come out of the plastic tube.

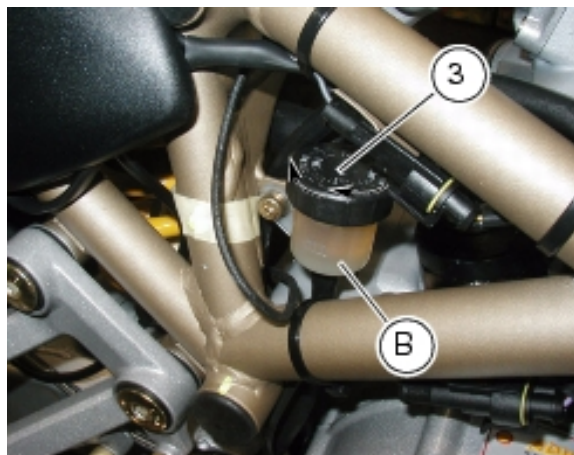
Bleed all bleed valves on the calipers one at a time.

Tighten the bleed valve (2) or (4) to the specified torque (Sect. C 3, [Frame torque settings](#)). Fit the protection cap.





Top up and fit the covers. Tighten the screws (1) onto the reservoir (A) and the cap (3) onto the reservoir (B).



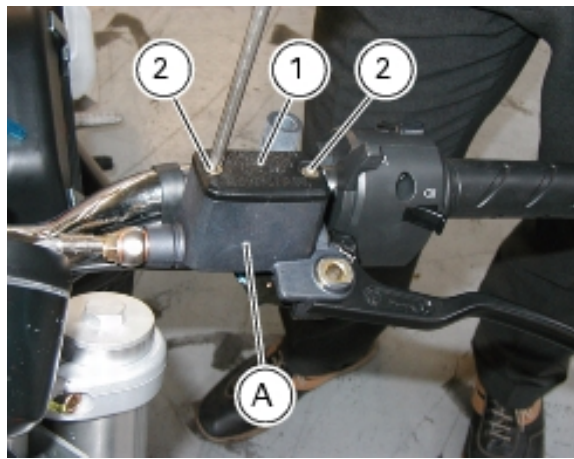
### Changing the clutch fluid



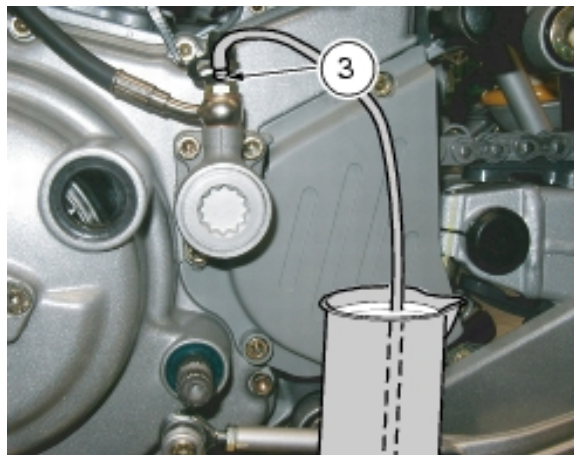
#### Warning

Clutch fluid will damage painted surfaces if spilled on them. In addition, it will cause severe injury if spilled on the skin or into your eyes. In the event of accidental contact with skin or eyes, wash the affected area with abundant running water.

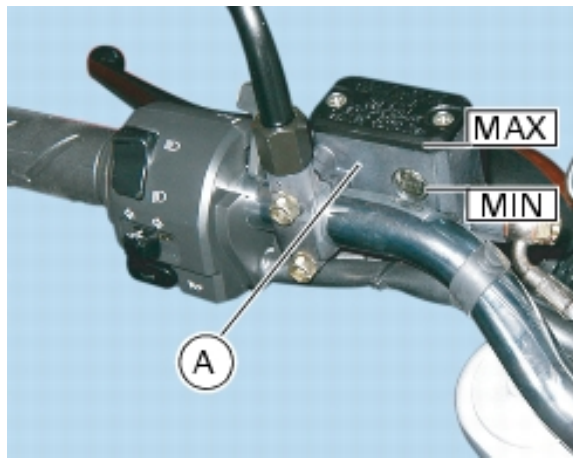
Undo the screws (2) and remove the diaphragm cover (1) from the clutch reservoir (A).



Connect a clear hose to the bleed valve (3); put one end of the hose into a container on the floor.



Suck the oil up from the reservoir (A).  
Fill reservoir (A) with fresh oil up to **MAX** level.



Pump up two or three times with the lever to pressurize the circuit.  
Keep the lever pulled toward the handgrip.



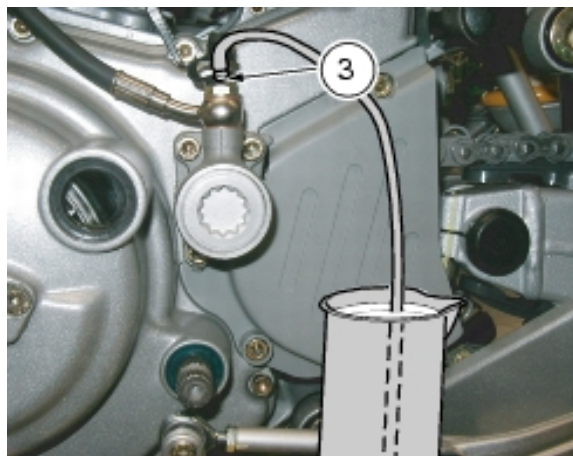
Loosen the bleed valve (3) so that oil flows off.



Warning

When filling up, keep oil level above **MIN** mark to avoid air bubbles into the circuit.

Let oil flow off from the bleed valve (3) until of different color. Tighten the bleed valve (3) to the specified torque (Sect. C 3, [Frame torque settings](#)) and top up oil to correct level.



Draining the clutch circuit



Warning

Clutch fluid will damage painted surfaces if spilled on them. In addition, it will cause severe injury if spilled on the skin

or into your eyes. In the event of accidental contact with skin or eyes, wash the affected area with abundant running water.

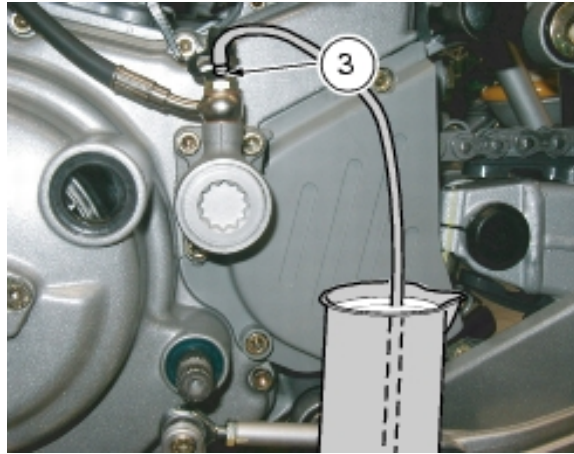
Slip off the protective cap to expose the bleed valve (3).  
Connect a bleeder to the bleed valve (3) on the transmission unit.



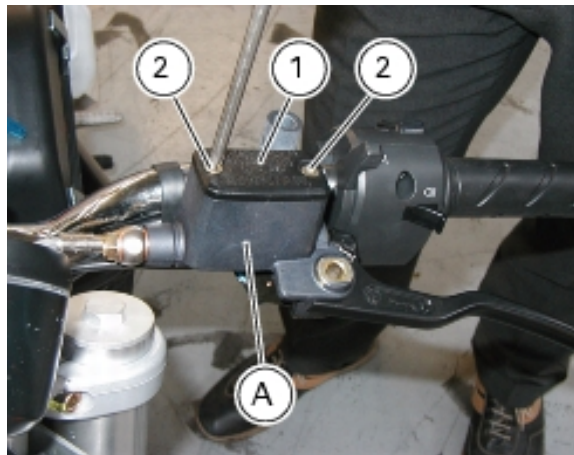
Note

If you are using a commercial bleeder, follow the manufacturer's instructions.

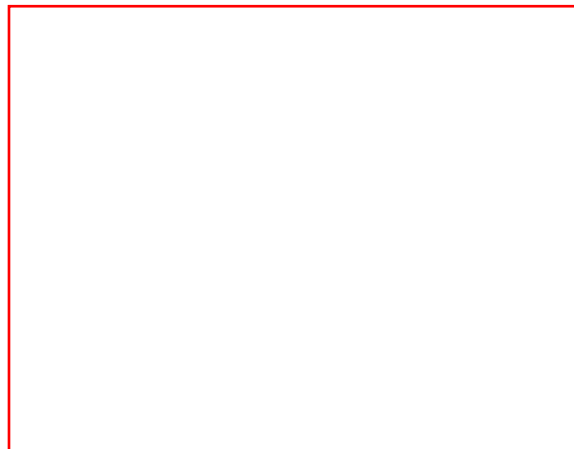
Unscrew the bleed valve and pump the bleeder until all the fluid has fully drained off the circuit.  
If you do not have a bleeder available, connect a piece of transparent plastic tubing to the bleed valve (3). Place the other end in a container on the floor holding used clutch fluid.



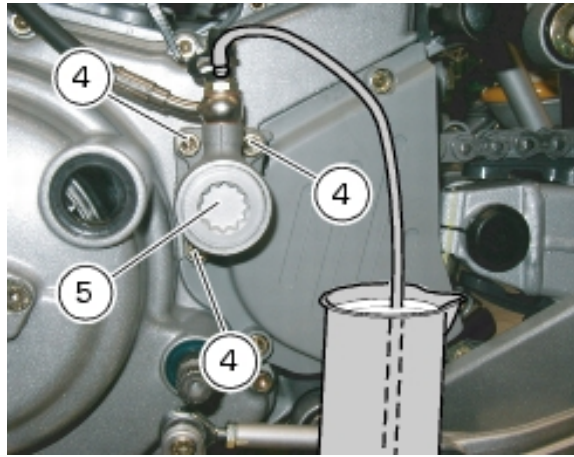
Unscrew the bleed valve (**one fourth** of a turn). Remove the filler plug (1) with diaphragm from fluid reservoir (A), loosening screws (2).



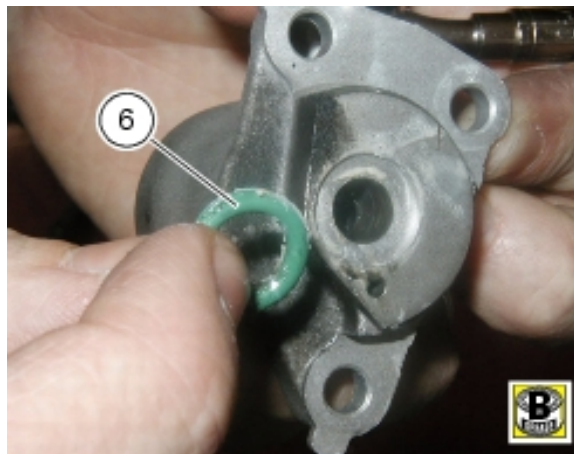
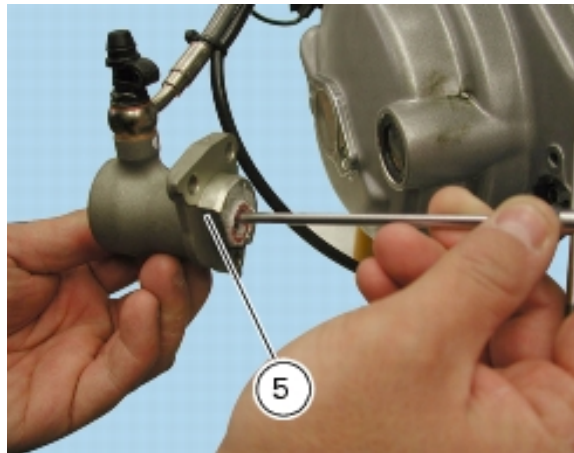
Operate the clutch lever until all the fluid has fully drained off the circuit.



To help drain the circuit fully, unscrew the three retaining screws (4) of the transmission unit and remove.



Withdraw the clutch transmission unit (5). Be careful of the O-ring (6) placed inside.



Push in the piston to expel all fluid inside the unit.

Refit transmission unit and tighten the retaining screws (4) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Tighten the bleed valve to the specified torque (Sect. C 3, [Frame torque settings](#)).

### Filling the clutch circuit

#### Warning

Clutch fluid will damage painted surfaces if spilled on them. In addition, it will cause severe injury if spilled on the skin or into your eyes. In the event of accidental contact with skin or eyes, wash the affected area with abundant running water.

Fill the reservoir (A) with specified fluid (Sect. C 2, [Fuels and lubricants](#)) taken from a sealed container.



 Caution

During the next operation, the fluid level must remain topped up at all times. The end of the transparent plastic tubing must remain immersed in the discharged brake fluid at all times.

Operate the clutch lever several times to let the fluid reach all points of the circuit and expel any air.



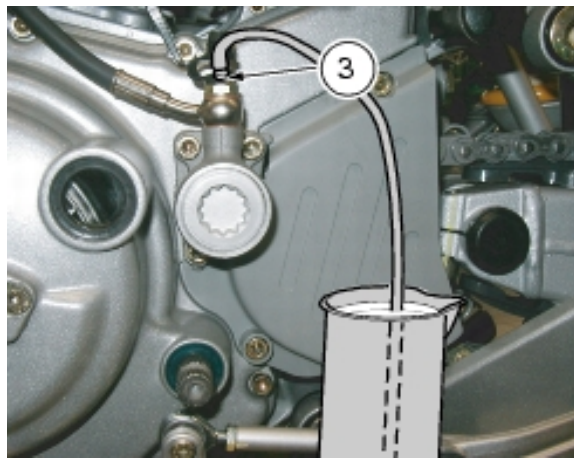
Connect the bleeder to the bleed valve (3).

 Note

If you are using a commercial bleeder, follow the manufacturer's instructions.

Pump with the bleeder and slacken the bleed valve (3). Ensure the fluid level never drops below the **MIN** level. Repeat the bleeding operation until air bubbles no longer come out of the plastic tube connected to the bleed valve (3).

If you do not have a bleeder available, connect a length of transparent plastic tubing to the bleed valve (3) as outlined in the draining procedure.



Open the bleed valve (3) by **one fourth** of a turn and operate the clutch lever several times until the fluid starts coming out of the bleed valve (3).

Pull the lever fully in and slacken the bleed valve by at least **one fourth** of a turn.

Allow several seconds and then release the lever gradually and close the bleed valve (3).

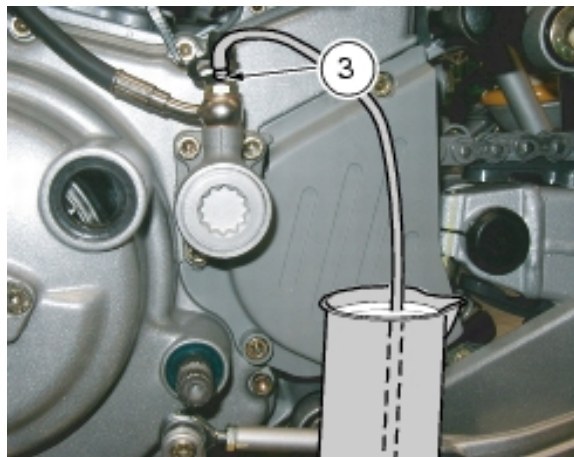


**Caution**

Do not release the clutch lever until the bleed valve has been fully tightened.

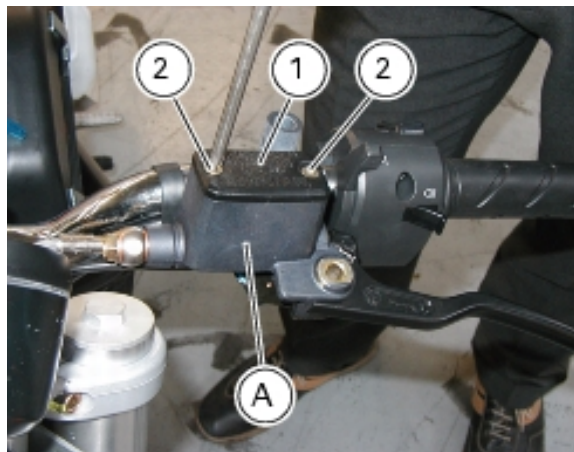
Repeat the bleeding operation until air bubbles no longer come out of the plastic tube.

Tighten the bleed valve (3) to the specified torque (Sect. C 3, [Frame torque settings](#)). Fit the protection cap.



Top up the clutch fluid up to **3** mm above the **MIN** mark.

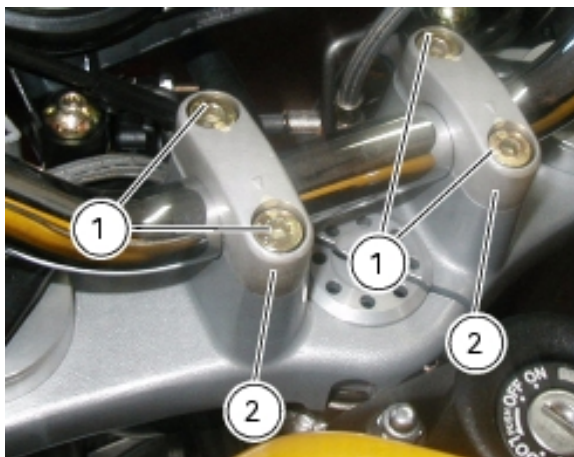
Refit the diaphragm and cap (1) to reservoir (A), tighten the screws (2).



## Adjusting steering bearings play

Excessive handlebar play or shaking forks in the steering head indicate that the play in the steering head bearings requires adjustment. Proceed as follows:

Loosen the four bolts (1), remove both clamps (2) and remove the handlebar.

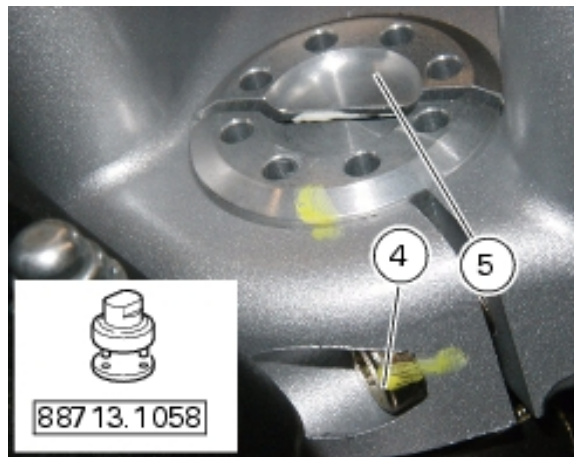


Loosen the screws (3) on the steering head at the fork leg clamps.

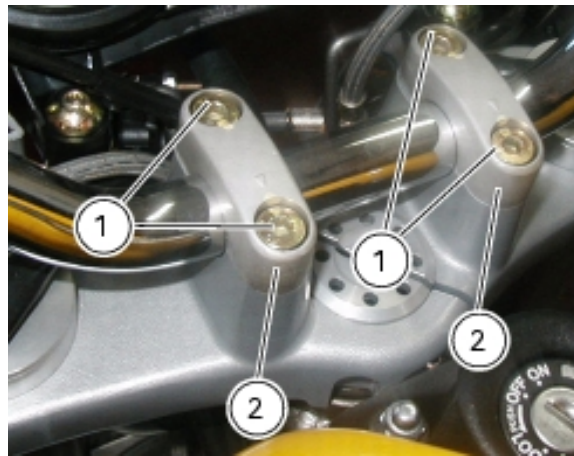


Loosen the clamp screw (4) securing the steering tube to the steering head.

Tighten the ring nut (5) to the specified torque (Sect. C 3, [Frame torque settings](#)) using the tool part no. **88713.1058**.

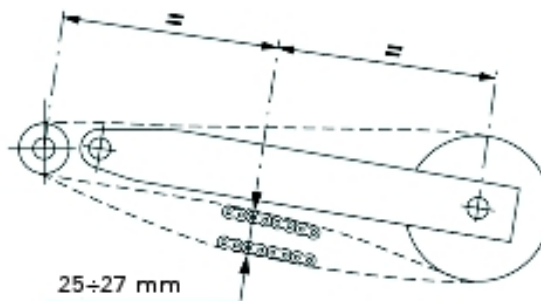


Tighten all the previously loosened screws to the specified torque (Sect. C 3, [Frame torque settings](#)).  
 Reposition the handlebar, fit the two U-bolts (2) and tighten the four U-bolt screws (1) to the specified torque (Sect. C 3, [Frame torque settings](#)).



### Adjusting chain tension

Move the motorcycle slowly until finding the position at which the chain is tightest.  
 Place the motorcycle on the side stand.  
 Push the chain upwards with one finger at swingarm mid-length (see label).  
 The lower section of the chain should move by approx. **25 - 27 mm**.



When required, adjust tension as follows:  
 Loosen nuts (1) at the wheel shaft ends.  
 Tighten (turn clockwise) the screws (2) equally on both sides of the swingarm to increase tension, or slacken to decrease it. In the latter case, you will need to push the wheel forward.

## Caution

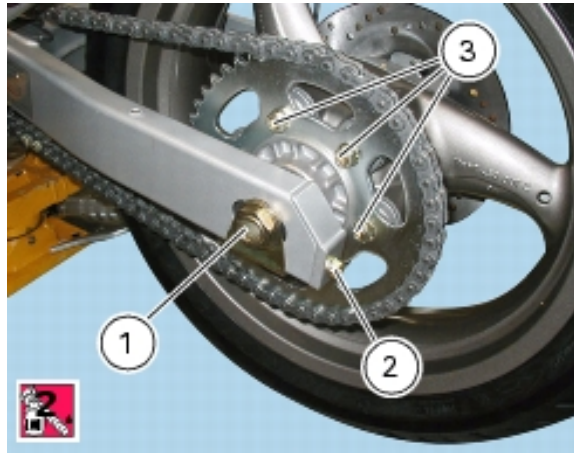
A slack chain will lead to early wear of the transmission components.

Check that the reference marks on both sides of the swingarm are lined up. This indicates perfect wheel alignment. Tighten the nuts (1) onto wheel shaft to the specified torque (Sect. C 3, [Frame torque settings](#)).

Tighten the adjuster screws (2) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Check that the nuts (3) that retain the rear chain sprocket to the flange are tightened securely. This can be done with the wheel installed, when you hold the bolts steady from the opposite end with an articulated **8**-mm wrench.

If nuts (3) are replaced, apply some threadlocker and tighten them to the specified torque (Sect. C 3, [Frame torque settings](#)).



Checking brake pad wear. Changing brake pads

## Warning

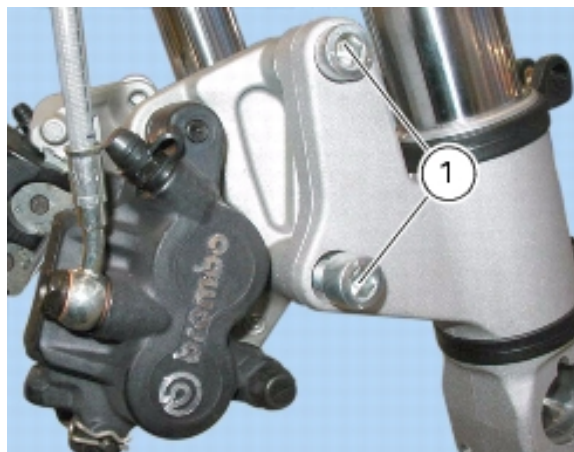
Brake fluid will damage painted surfaces if spilled on them. In addition, it will cause severe injury if spilled on the skin or into your eyes. In the event of accidental contact with skin or eyes, wash the affected area with abundant running water.

## Caution

Please inform the Customer that new pads must be run-in carefully – in other words, the front brake must be used carefully - for the first 100 Km to allow the friction material to bed in completely.

Checking front brake pad wear

Loosen the screws (1) and remove the front brake calipers from the forks.



Make sure the groove in the brake pad friction material has not worn out.

**Caution**

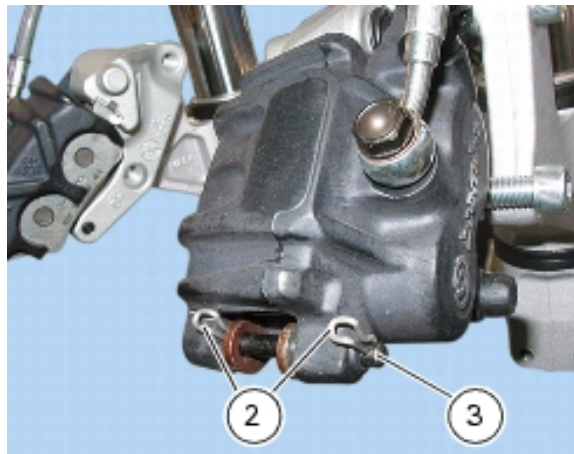
If one of the pads is worn, change both pads.

Change the brake pads as follows.

Remove the split pins (2) from the pad retaining pin.

Force the brake pads apart to force the caliper pistons into their housings.

Withdraw the brake pad retaining pin (3) from the outside.

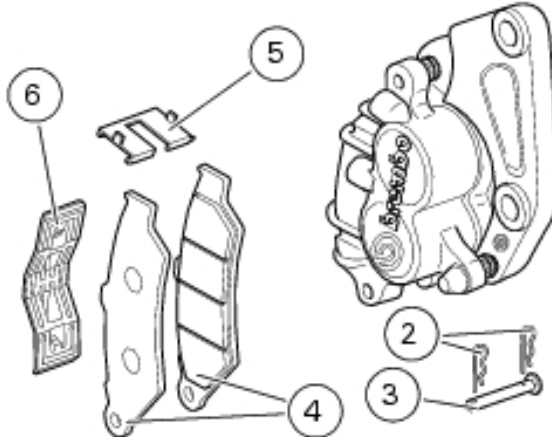


Release the worn pads (4) from the spring (5) and remove them.

**Note**

Change pads which are shiny or vitrified.

Fit new pads and their springs (5 and 6). Insert the centering pin (3) and lock it using the split pins (2).



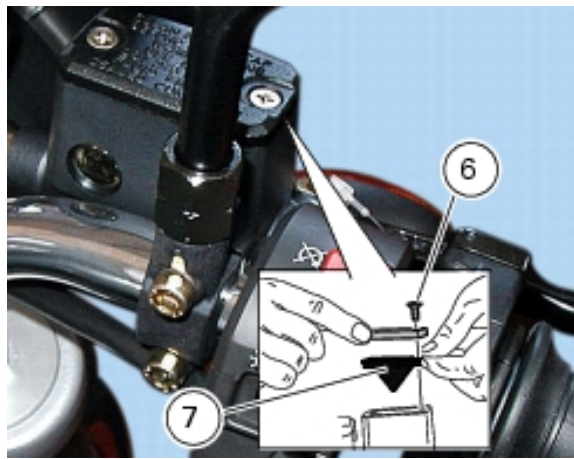
Operate the brake lever repeatedly so that the pads bed in under the action of the brake pistons.

Check that the brake fluid level in the master cylinder reservoir is above the MIN mark.

If necessary, top up as follows. Turn the handlebar so that the reservoir is level.

Unscrew the two cross-slot screws (6) and remove the reservoir cover.

Remove the inner membrane (7) from the reservoir.



Top up to max level using the specified brake fluid.  
Reassemble.

#### Checking rear brake pad wear

Check through the slot between the two caliper halves that there is at least 1 mm of friction material on the pads.

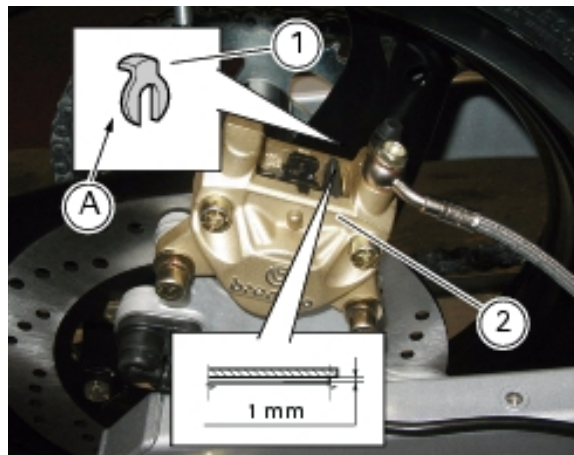


#### Caution

If one of the pads is worn, change both pads.

To change the pads, proceed as follows:

Remove the split pin (1) from the caliper retaining pin. The split pin is on caliper inner side. Force the brake pads apart to force the caliper pistons into their housings. Withdraw the brake pad retaining pin (2) from the outside.



Remove the brake pad retaining clip (3) from between the two caliper halves. Remove the worn pads.

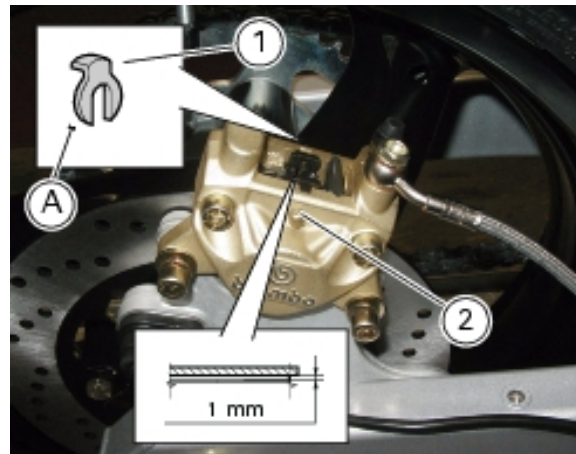




## Note

Change pads which are shiny or vitrified.

Insert the new pads and the clip (3). Insert the retaining pin (2) and push it fully home. Fit the split pin (1) with the end (A) pointing to the wheel.



Operate the brake pedal repeatedly so that the pads bed in under the action of the brake fluid. Check that the brake fluid level in the master cylinder reservoir (4) is between the MIN and MAX marks. If this is not the case, unscrew the reservoir plug (4) and top up with brake fluid.



## Note

In case of difficulties with pads replacement, remove the calipers (Sect. G 3, [Removing the front brake system](#) and G 6, [Removing the rear brake system](#)).



## Warning

The brake calipers are critical safety components. Observe the instructions given in Section G "Wheels - Suspension - Brakes". Be sure to tighten the brake caliper mounting bolts to the specified torque on refitting (Sect. C 3, [Frame torque settings](#)).

Adjusting the throttle and choke cables

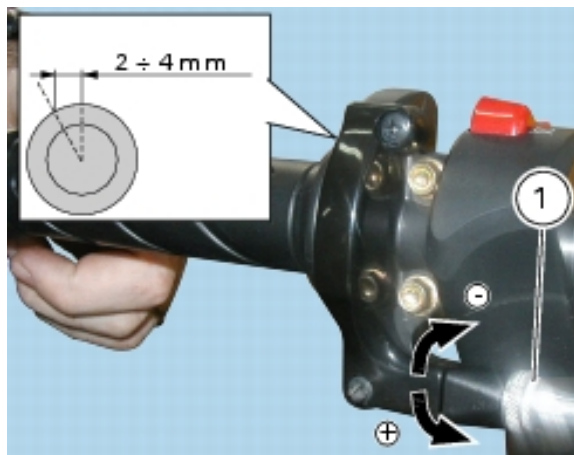


## Caution

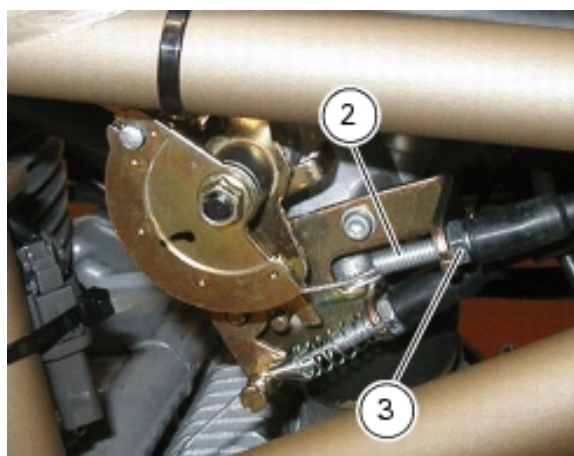
Adjustment of the throttle and choke cables may affect the throttle body adjustments. Refer to "[Adjusting idling condition](#)", Sect. D 5.

The throttle twistgrip must have a free travel of **2-4** mm (measured on the twistgrip rim) in all steering positions.

Fine adjustment can be made by turning the adjuster (1) on the twistgrip.



For larger adjustments of the throttle cable, use the adjuster (2) located on the RH side of the throttle body. Remove the cap, loosen the lock nut (3) and turn the adjuster (2) to obtain the required play.

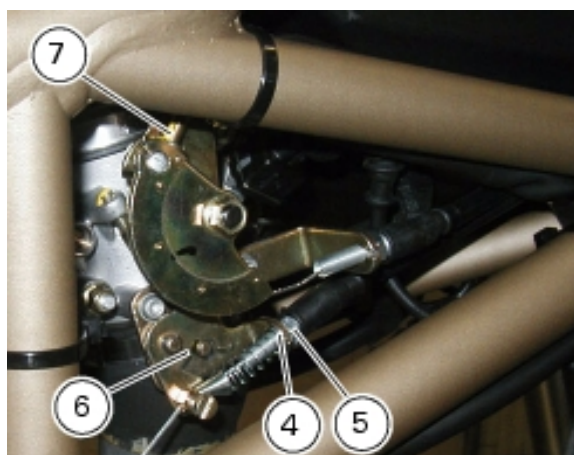


Tighten the lock nut and refit the cap.

To adjust the choke control cable, turn the control level on the handlebar until fully open and check that the plate (6) is touching the end stop.

In this condition, ensure that engine is at **2000 rpm**. Turn screw (7) to adjust the rpm.

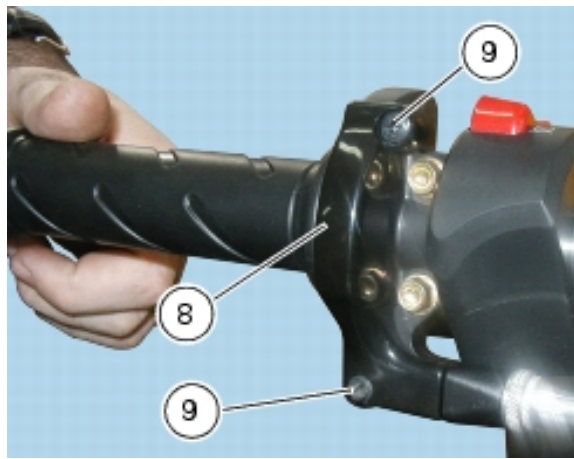
Likewise, loosen the lock nut (5) and work the adjuster (4) to adjust the throttle control cable.



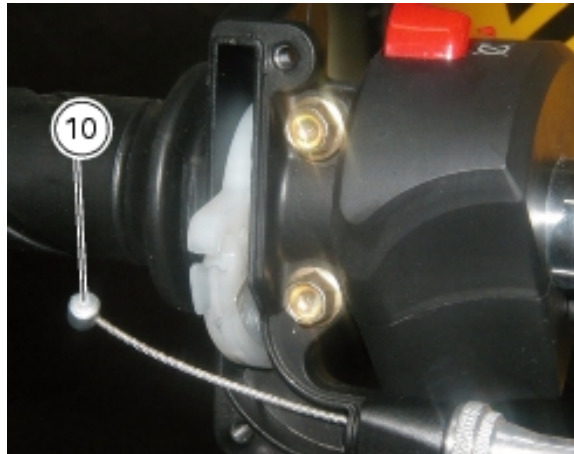
Check for proper conditions of the outer sheaths of the throttle and choke cables at regular intervals. The outer plastic sheath should not be damaged or cracked.

To ensure smooth operation of these cables, grease the cable ends with the recommended grease at regular intervals. Work the throttle or operate the choke lever to make sure core cable is sliding smoothly. If not so, change the cable.

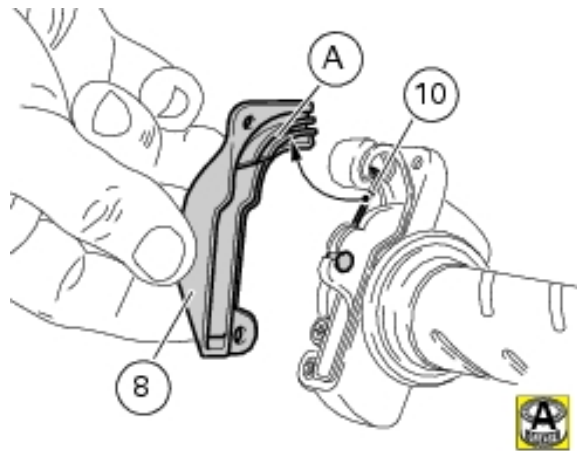
To lubricate the throttle control, unscrew the two screws (9) and remove cover (8).



Grease the cable end (10) and the pulley.



Refit the cover with extreme care. Insert the cable (10) in the slider (A) of the cover (8). Tighten the two screws (9) to secure the cover.



### Adjusting the position of the gear change and rear brake pedals

The position of the gear change and rear brake pedals in relation to the footpegs can be adjusted to suit rider preferred riding position.

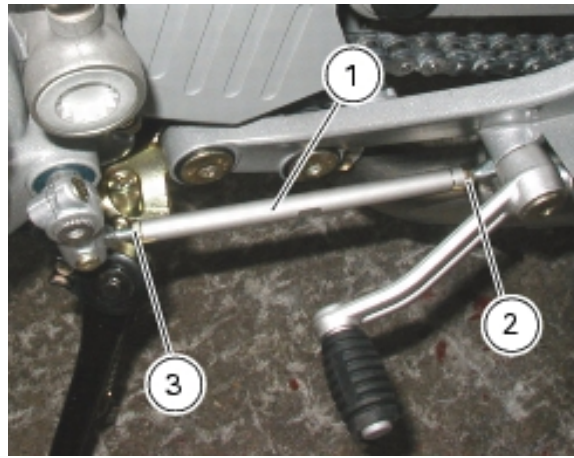
To adjust the position of the gear change pedal, proceed as follows:  
Clamp the rod (1) and loosen the lock nuts (2) and (3).



Note

Lock nut (2) has a left-hand thread.

Fit an open-end wrench to the hexagon of the rod (1) until the gear change pedal is in the desired position.



Tighten the two lock nuts onto the rod.

To adjust the position of the rear brake pedal, proceed as follows:

Loosen the lock nut (4).

Turn the pedal travel adjuster screw (5) until the pedal is in the desired position.

Tighten the lock nut (4).

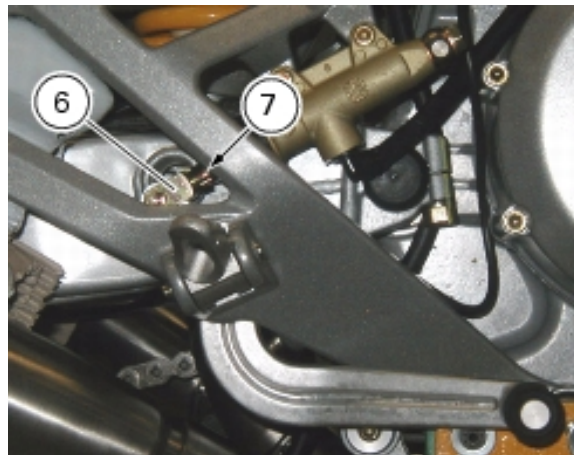
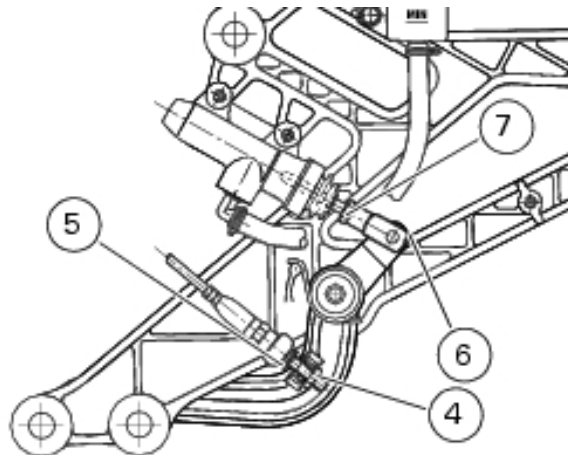
Operate the pedal by hand and check that there is **1.5-2** mm of pedal free travel before the brake begins to operate.

If this is not the case, adjust the length of the brake cylinder control rod as follows:

Loosen the lock nut (7) on the brake cylinder control rod.

To increase the amount of pedal free travel, screw the rod further into the fork (6). Unscrew the rod to decrease.

Tighten the lock nut (7) and check the amount of pedal free travel.



## Adjusting the rear shock absorber

The adjuster (1) is on the RH side at the bottom end of the rear shock absorber, near the mounting point to the swingarm. This adjuster sets rebound damping.

The ring nuts (2) and (3) at the top end of the shock absorber are for external spring preload.

Turn the adjuster (1) clockwise for harder (**H**) damping and counterclockwise for softer (**S**) damping.

**Standard setting:**

from the fully closed position (clockwise) turn out the adjuster (1) by **18** clicks.

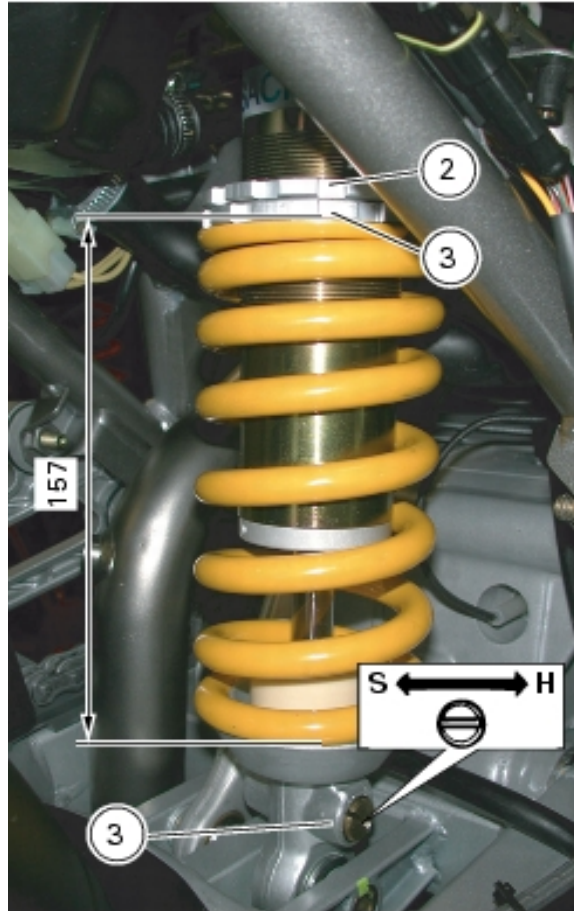
To change spring preload, slacken the upper ring nut (2) with a pin wrench. Tighten or slacken the lower ring nut (3) to increase or decrease preload.



**Warning**

Use the special wrench only to turn the ring nut for preload adjustment. When applying pressure to the wrench, ensure that wrench pin does not slip out suddenly from the slots in the ring nut. This could cause minor injuries to your hands. Do not use wrenches which are too small or have short handles.

**Standard** spring length: **157** mm.



**Warning**

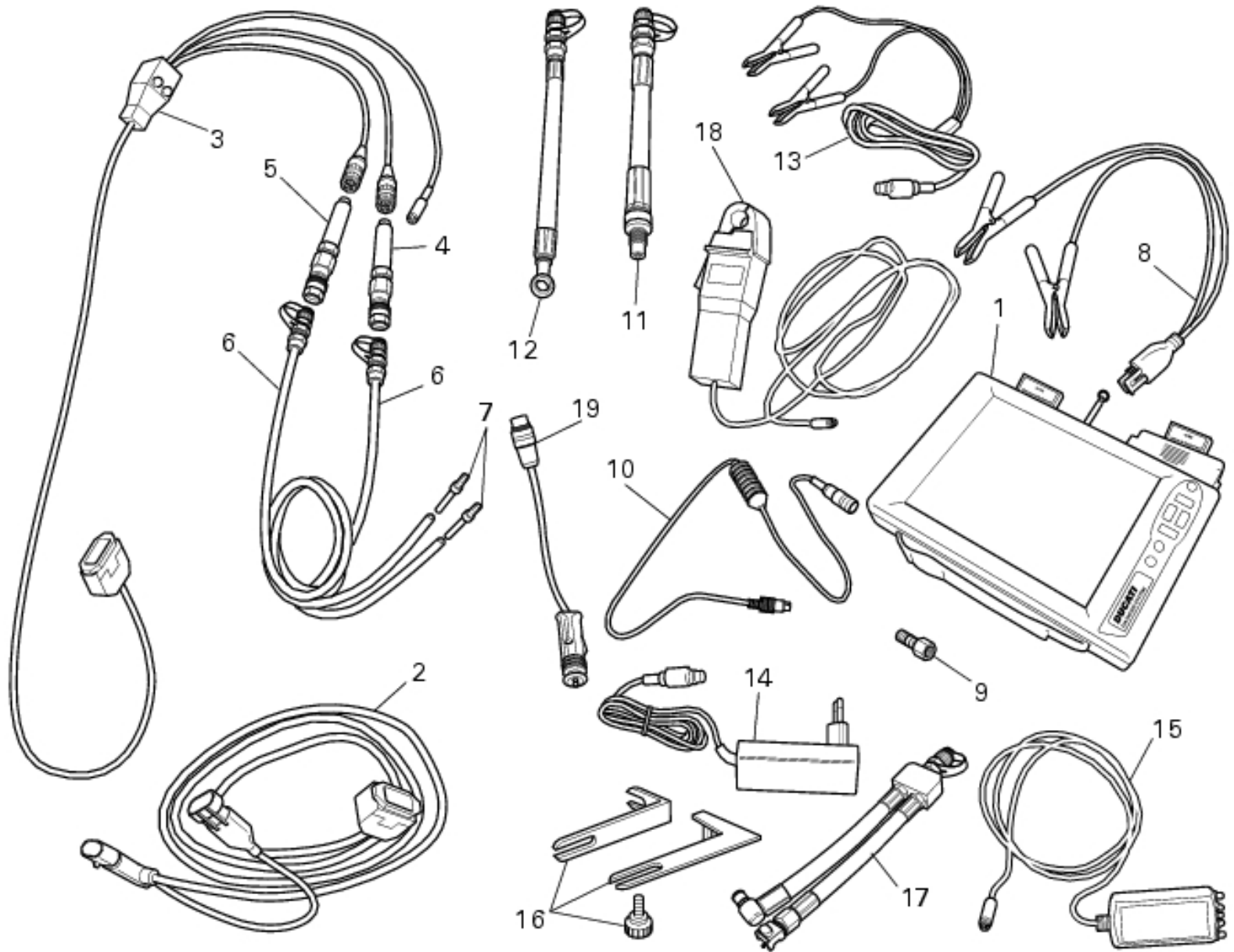
The shock absorber is filled with high-pressure gas and might cause injuries if inexpertly dismantled.



**Caution**


When carrying a passenger and a load, set maximum spring preload for improved handling and to keep safe ground clearance. Set rebound damping accordingly.

## 5 - Testers



- 1 97900.0211 DDS (Ducati Diagnosis System) base unit
- 2 97900.0227 Power cord and diagnosis cable D607
- 3 97900.0222 Power cord and diagnosis cable 1060838 (Measurement Module)
- 4 97900.0218 Vacuum sensor
- 5 552.1.039.1A Pressure sensor
- 6 97900.0220 Pressure/vacuum tube
- 7 97900.0221 Fitting
- 8 97900.0228 Battery adapter
- 9 814.1.114.1A Oil pressure connection
- 10 514.1.032.1A Auxiliary test cable
- 11 552.1.037.1A Cylinder compression cable - M12 fitting
- 12 875.1.065.1A Oil pressure tube
- 13 97900.0230 Power supply
- 14 97900.0224 Power supply
- 15 88765.1371 Belt tension sensor
- 16 88765.1374 Belt tension sensor bracket
- 17 590.1.189.1A Fuel pressure tube
- 18 97900.0234 Clamp-type ammeter

## 19 514.1.033.1A Lighter socket adapter

 Spare parts catalogue

[Diagnosis tester DDS](#)

[Workshop special tools](#)

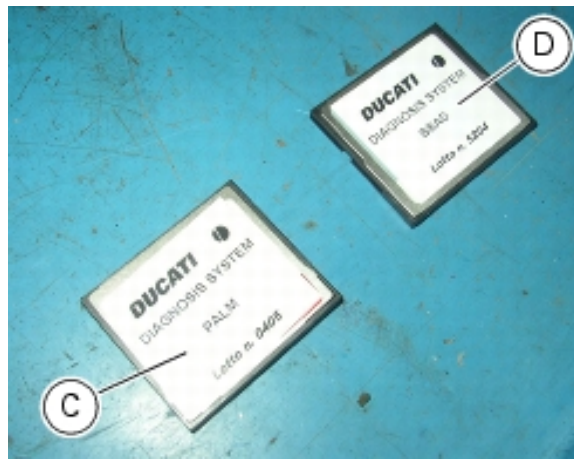
**Caution**

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

## Tester description

The "DDS" diagnostic system lets you diagnose any faults in the injection-ignition system via a serial port. This system provides a full range of features to test a number of motorcycle devices, measure the current and voltage outputs from any electrical items, test individual components and take pressure and temperature measurements. The DDS (1) consists of a palmtop display (A), a BBAD self-diagnosis module (B), a display memory card (C) and a BBAD memory card (D).





The palmtop touch screen display (A) displays data and allows settings to be made via the suitable pen, housed in the hole on the side of the display.

Self-diagnosis module (B) establishes communication of the DDS (1) with the vehicle control unit.

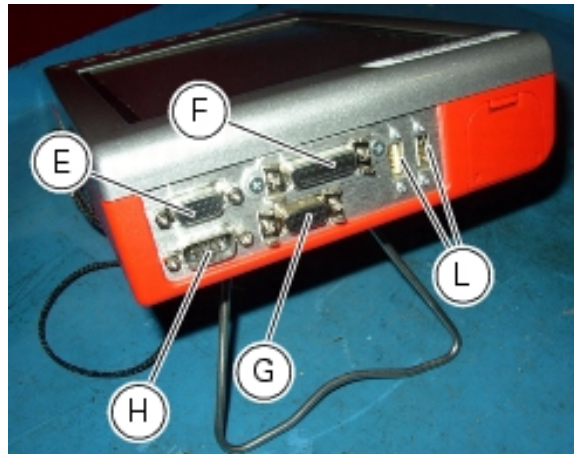
The user interface software resides in the display memory card (C) located in the palmtop display (A).

The software for communicating with the DUCATI control units resides in the BBAD memory card (D) located in the BBAD module (B).

The base unit features two connection areas: one at the top and one at the bottom.

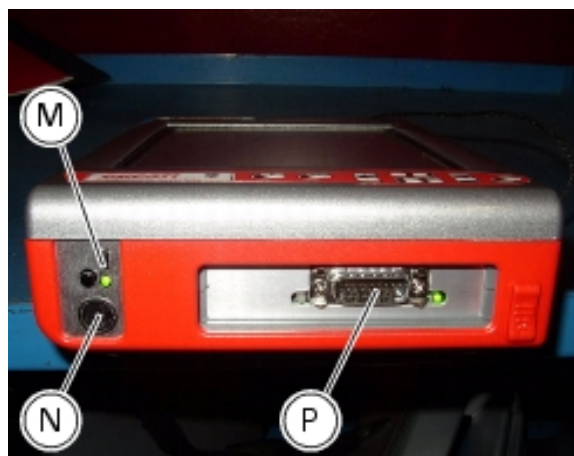
The top one has 6 connectors:

- one VGA output (E);
- one port for measurement module connection (F);
- one RS232 serial port for peripherals (COM1) (G);
- one RS232 system serial port (COM2) (H);
- two USB general ports (USB1 and USB2) (L).



The bottom one has 3 connectors:

- USB connector (M);
- power connector (N);
- diagnosis connector (P).



A printer can be connected to the DDS (1) via the serial port (COM1) (G) positioned on top of the instrument (1) in order to print test reports.

### Specifications

#### Power supply:

- from the mains - 220 V;
- from the vehicle battery - 12 V.

#### Components supplied with the DDS

The DDS (1) is supplied in a DDS kit, together with:

- DDS rechargeable battery
- Battery charger
- Mains power supply
- USB memory card reader
- Power and diagnosis cable with fuse
- CD for DDS software installation - PC version
- USB cable
- Belt tension sensor

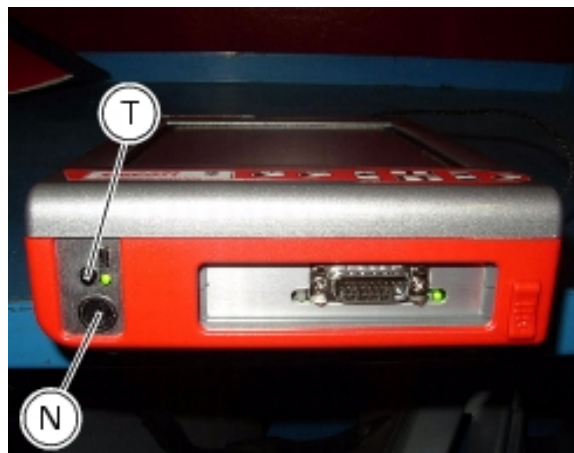
#### Instrument power supply

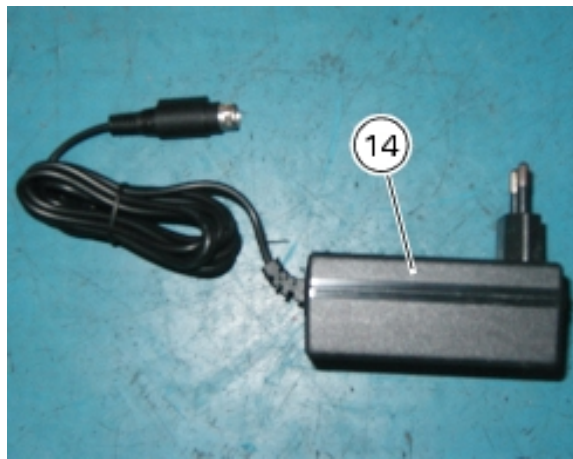
The DDS (1) can be powered as follows:



- from the mains: connect mains power supply (14) to power connector (N);
- from the vehicle: connect the suitable cables (see "[Connection to the bike](#)");
- from the instrument own battery: the battery (Q) is located at the top of the instrument. Please refer to the "User's -Manual" supplied with the DDS for instructions on how to use the instrument (1) with its battery and how to charge it.

Press button (T) to switch on the display.





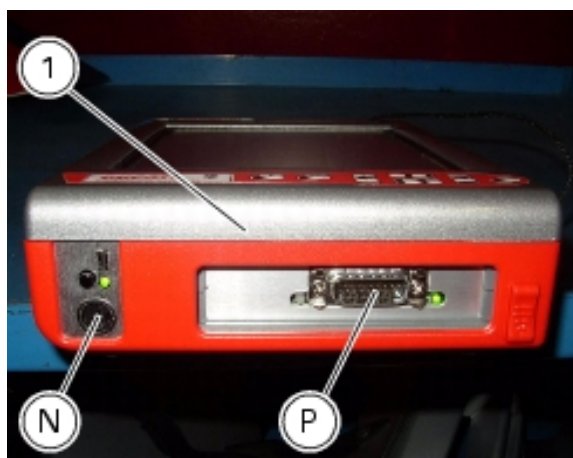
Connection to the bike

Supply voltage must be between **9** and **16 Volt** DC.

Make sure voltage never drops below this limit during operation: this could happen when starting the engine or when the engine is idling if the bike battery is in less than perfect operating conditions. If the tester detects a power supply voltage below **9** Volts, it will abort any procedures underway at that time. Once voltage is again within specified limits, you will have to repeat procedure set-up.

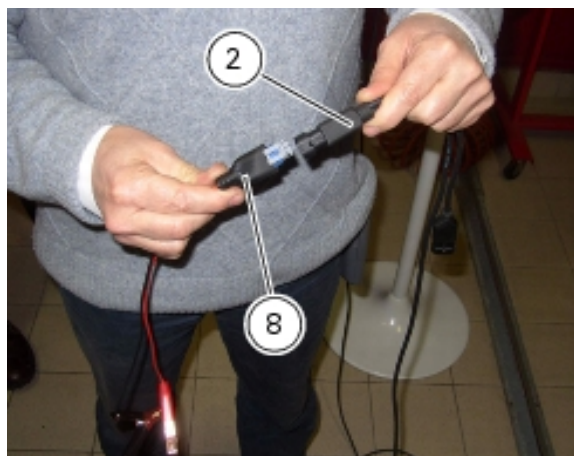
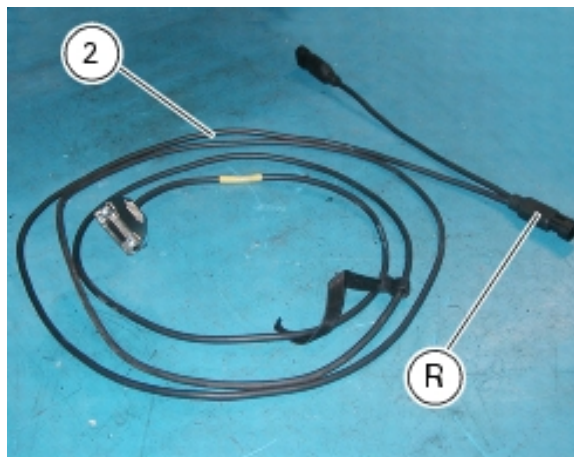
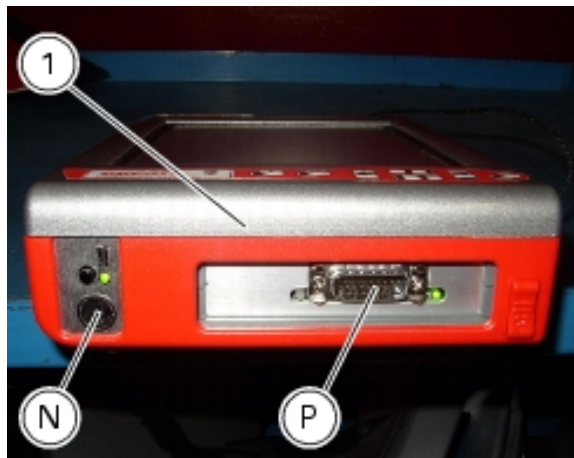
The DDS (1) can be powered from the vehicle as follows:

- connecting battery power supply (13) to the power connector (N) of the instrument and connecting battery power supply to vehicle battery;





connecting the power and diagnosis cable (2) to instrument diagnosis connector (P); connecting battery adapter (8) to power and diagnosis cable connector (R) and then connecting the adapter to the vehicle battery.





## Note

For device connection and diagnosis procedures, refer to the user's manual supplied with the tester

## DDS diagnosis instrument

In short, the "DDS" has the following functions:

- Error reading (failures) for ignition-injection system errors stored in engine control unit memory and error deletion.
- Parameter reading, such as engine rpm, coolant and air temperature, atmospheric pressure, throttle opening value, battery voltage, injection times, ignition advance values and so on.
- Active diagnosis. Enabling of ignition-injection system transducers to check for proper operation and correct control signal (fuel pump, ignition coils, rev counter, injectors and so on). This function also allows entering the safety code for bypassing the immobilizer system.
- Road test. This function allows you to store engine parameters within a preset rpm range. At the end of their acquisition, these parameters are then analyzed and displayed.
- If connected to special feelers, the DDS can read voltage, current and temperature values as well as timing belt tension values and pressure values into oil and fuel circuits.

## Checking and adjusting timing belt tension



## Note

A table at the end of this section explains the icons used in this procedure.



## Note

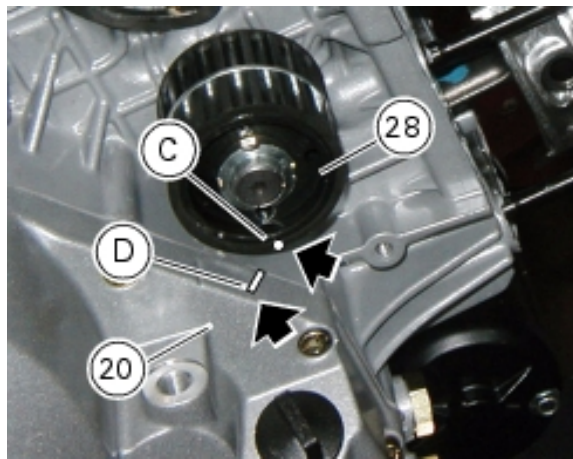
Both timing belts can be checked and adjusted using the DDS leaving the engine onto the frame. For this purpose, connect an optical reader to the DDS. The green led onto the reader shows correct positioning before the timing belt. The reader also features an infra-red emitter (A) and a receiver (B) to detect timing belt vibrations whilst being duly flicked with a finger.

Operations	Reference See Section
Remove side covers	N 4.2, <a href="#">Removing the timing side covers</a>

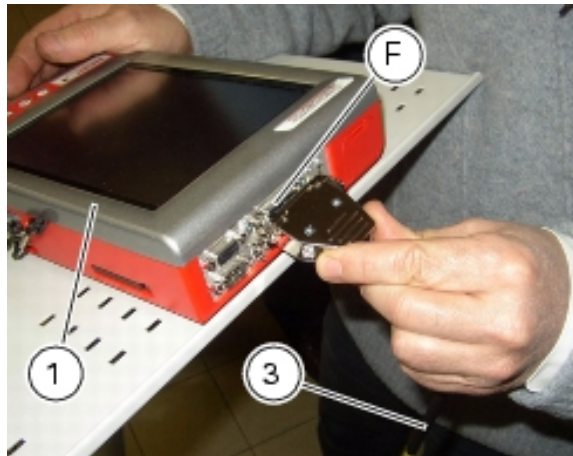


Remove the spark plugs.

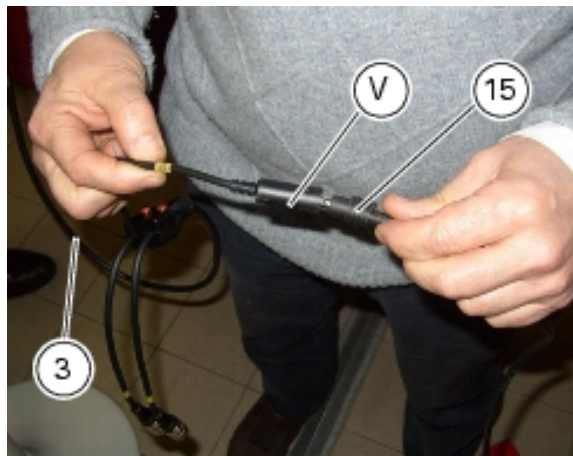
Rotate the crankshaft until bringing the piston of the horizontal cylinder at TDC during the combustion stroke. This is indicated by the mark (C) on the timing layshaft belt roller (28) aligning with the mark (D) on the clutch cover (20).



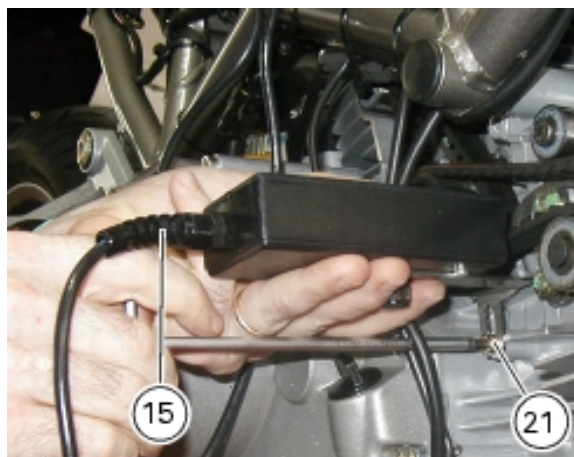
Switch on the DDS (1), refer to "[Instrument power supply](#)".  
 Connect the power and diagnosis cable (Measurement Module) (3) to measurement module connector (F) of the DDS (1).



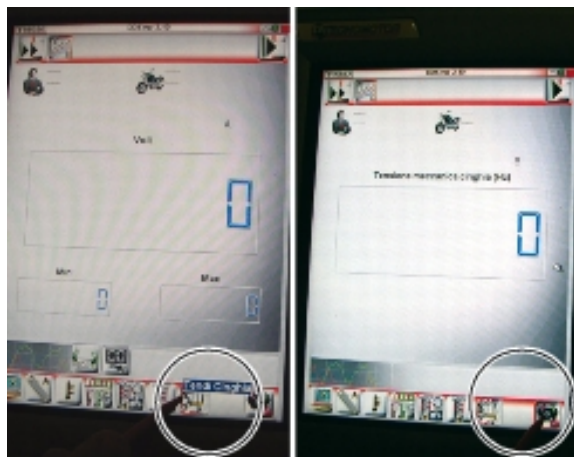
Connect the belt tension sensor (15) to power and diagnosis cable (Measurement Module) (3) connector (V).



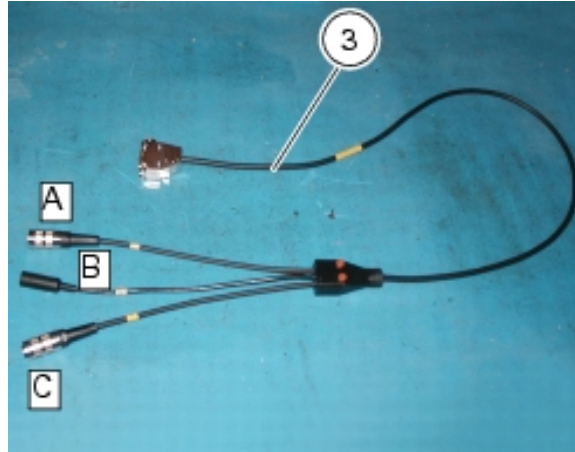
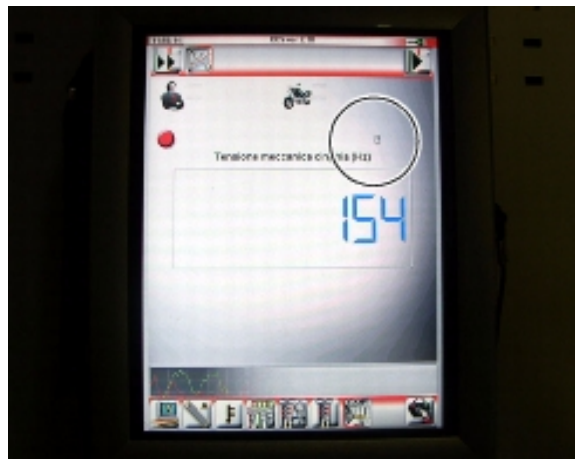
Secure the belt tension sensor bracket (15) using belt cover screw (21).  
 Aim the middle green led of the sensor (15) at the centre of the belt section by positioning the sensor (15) at the same level of the belt at a distance of **1-1.5 cm**.



Press on "Measurement module" icon on DDS (1) to select the "Measurement module" function; then press on "Belt tension" icon and then "Start" to enter the "Belt mechanical tension" page.



The page shows you which socket of the cable (Measurement Module) (3) is to be used with a capital A, B or C.



Lightly flick the belt with a finger and then read frequency value (Hz) on the DDS.



Note

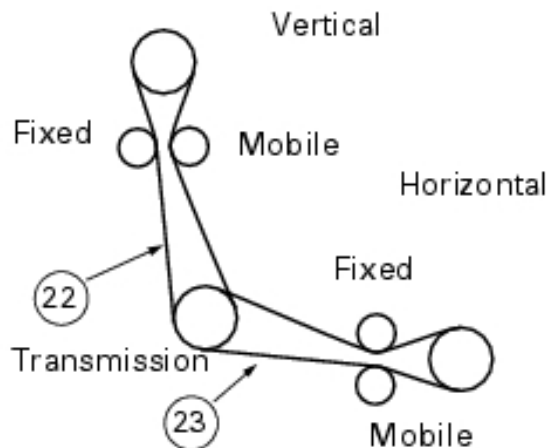
Do not flick several times, as the DDS needs at least **1** second to read the value.



Warning

Check tension reading on the belt sections (22) and (23) indicated in the figure.

Belt tension values are indicated in Sect. C 1.1, [Timing/valves](#).



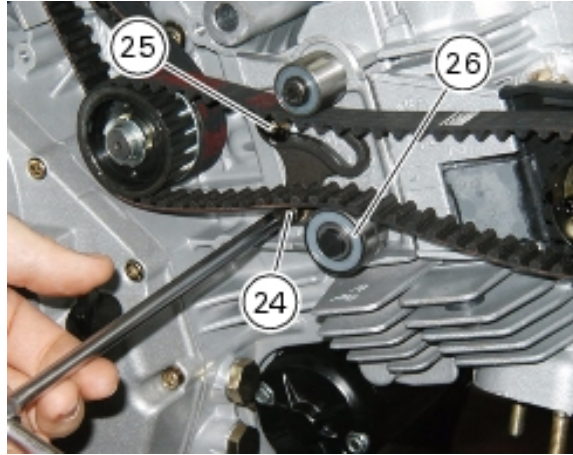


### Warning

Timing belt tension could decrease in time as a result of normal wear and tear. When checking belt tension, restore specified nominal values (Sect. C 1.1, [Timing/valves](#)) or in any case set tension to at least 80% of nominal values when reading is below 70 Hz.

Should the tension be incorrect, tension or slacken the belt by turning screws (24) and (25) securing the mobile tensioner rollers.

Lift the mobile tensioner (26) by hand to stretch the timing belt or lower down to slacken.



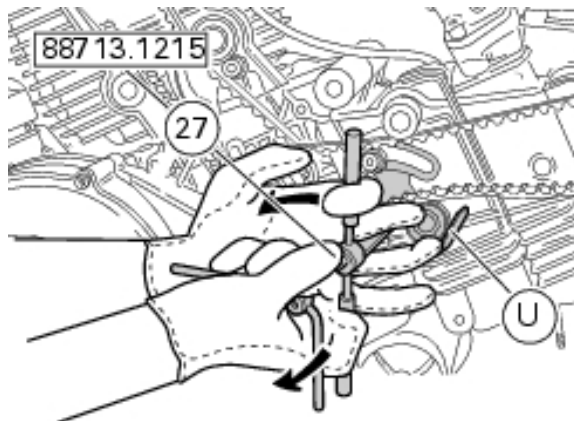
### Note

If the crankcase has been removed from the frame, turn screw (24) using the suitable tool (27) and position tool pusher (U) on the tensioner.



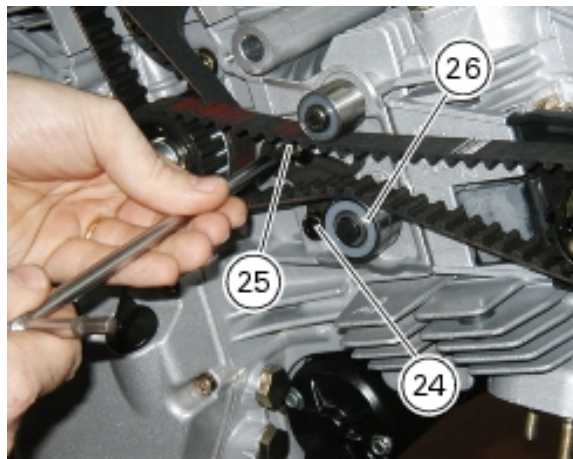
### Caution

Turn the pusher (U) counter clockwise to stretch the belt or clockwise to slacken.

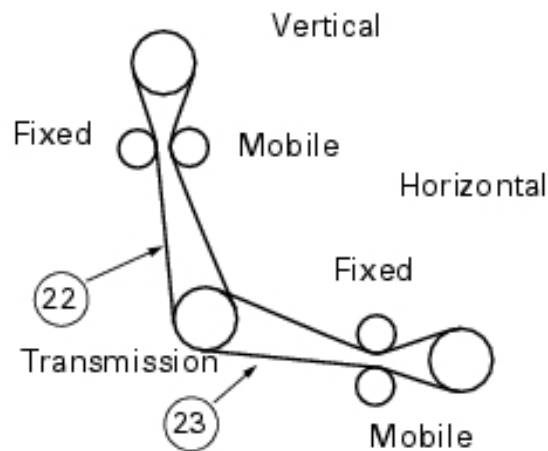


Take belt tension value once again.  
Repeat until reaching the specified tension value.

Once desired tension is set, tighten the screws (24) and (25) to the specified torque (Sect. C 3, [Engine torque settings](#)).



Set the crankshaft at the TDC of the vertical cylinder, in the combustion stroke (valve closed), and repeat the same procedure used for the horizontal cylinder, reading tension on section (22) of the vertical belt.



Disconnect the belt tension sensor and the DDS from the vehicle.

Operations	Reference See Section
Remove side covers	N 4.2, <a href="#">Refitting the timing side covers</a>

Zero setting the throttle position sensor (TPS)

The linear-type TPS cannot be adjusted, follow the procedure below to ensure proper system operation.

### Warning

When the throttle body, throttle position sensor, electronic control unit or wiring have been replaced, perform this procedure first before starting the engine.

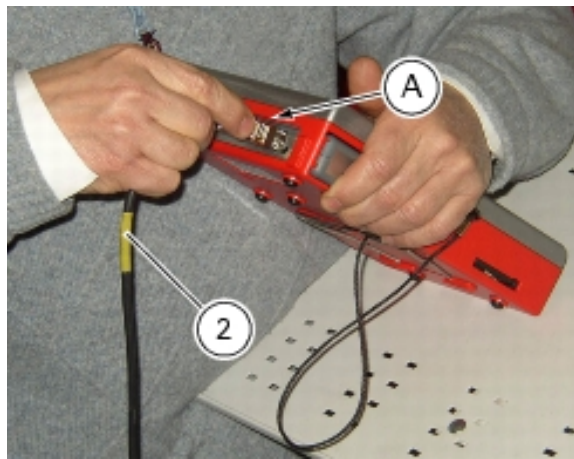
Ensure that the throttle is fully home on its end screw (choke control lever disabled and throttle control completely closed).

Throttle position sensor angle should be learned by the CPU under the above conditions. Use the DDS as described below.

Lift the fuel tank (Sect. L 2, [Removing the fuel tank](#)).

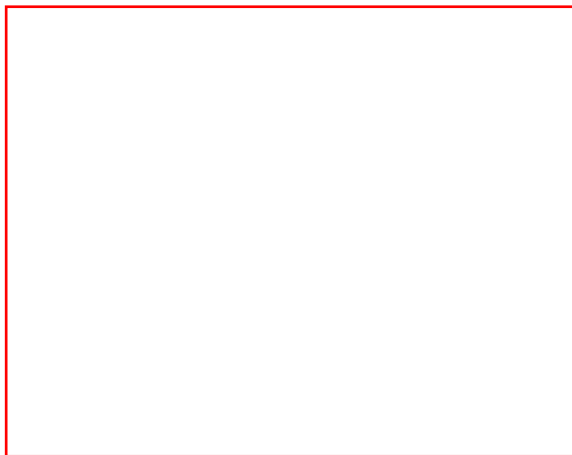
Switch on the DDS (1), refer to "[Instrument power supply](#)".

Connect the diagnosis connector (A) of the power and diagnosis cable (2) to the motorcycle diagnosis socket (B).



Enter the general functions menu, pressing "Menu Key 1" icon (C).  
Press the "Vehicle selection" icon and press "Vehicle selection" icon in the following page; choose the model and confirm, then select the version and confirm.

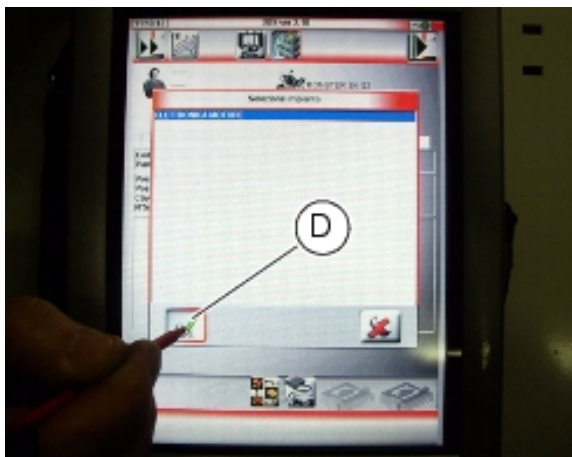


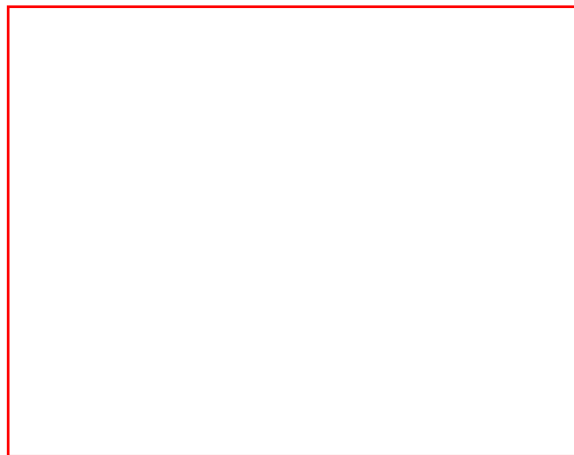


Press "System selection" icon displayed to show the vehicle systems that can be diagnosed.



Select "Engine electronic system" and press "Confirm" (D) to confirm. Then press "Self-diagnosis" icon to enter self-diagnosis function.





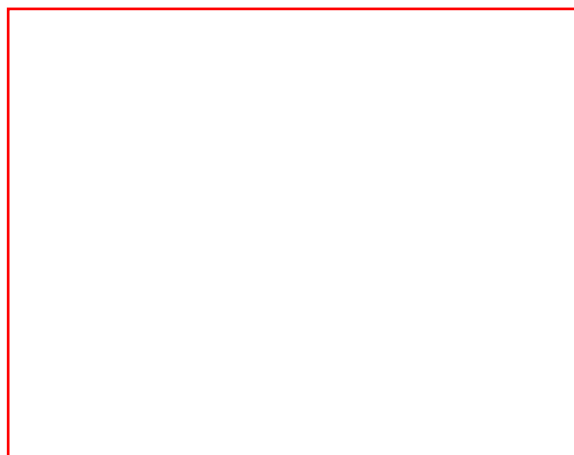
The DDS queries the control unit and the elements under analysis are displayed together with their relevant values.



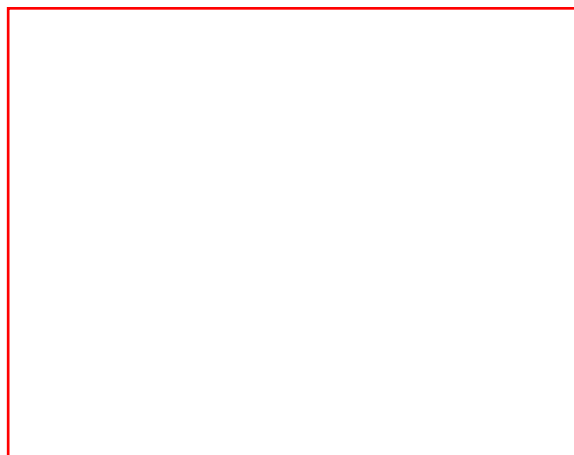
Note

Perform the necessary connections with the ignition key set to OFF.

Press "Settings" icon to display the special parameters.

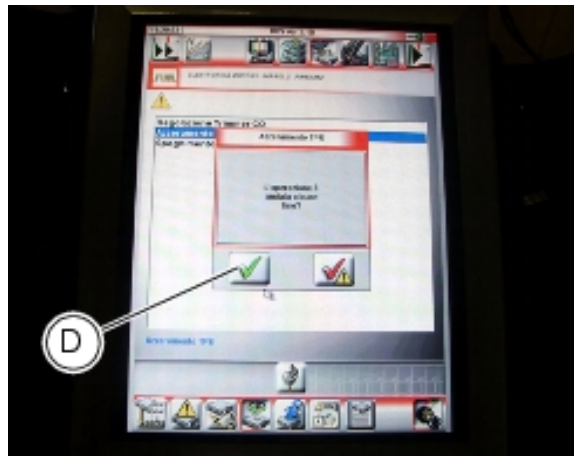


Select "TPS reset" and press "Execute".

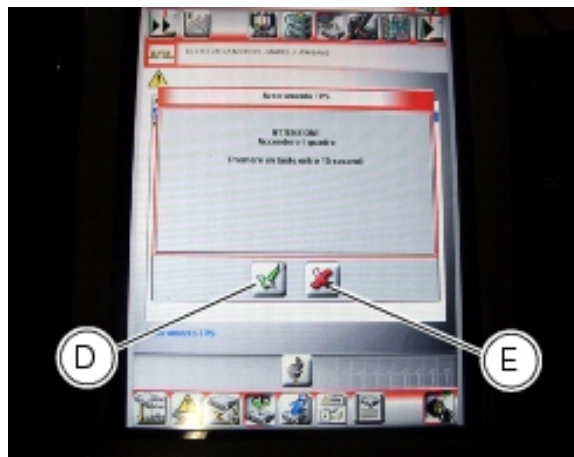




If the operation is performed, the message "Was the operation successful?" is displayed; press "Confirm" (D).



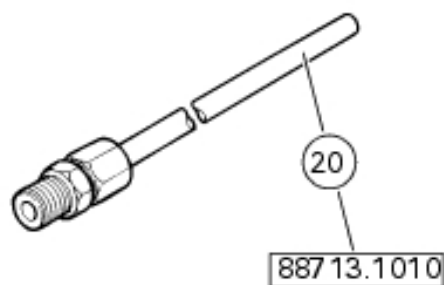
If there are problems in performing the operation, the relevant error messages are displayed: you need to confirm or reject each message by pressing "Confirm" (D) or "Exit" (E), respectively.



The zero setting procedure establishes a connection between electronic control unit and throttle body. For this reason, the zero setting procedure must be repeated each time the throttle body, throttle position sensor, electronic control unit or wiring are replaced.

### Adjusting idling condition

Connect exhaust gas analyser inserts part no. **88713.1010** to exhaust pipes pick-up points, using couplings (20).

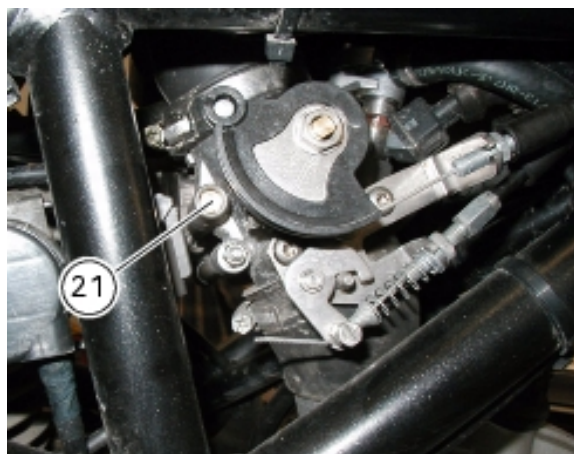


Ensure that throttles are against the stop screw (throttle twistgrip fully closed). Ensure choke is off and that throttle cable free play is correct. Reset the TPS as indicated in "[Zero setting the throttle position sensor \(TPS\)](#)", in this section.

**Check:**

- that throttle angle reading on DDS is  $2.7^\circ \pm 0.1^\circ$  with engine stopped;
- that idle condition is acknowledged; if not, repeat the procedure indicated in "[Zero setting the throttle position sensor \(TPS\)](#)".

Open the by-pass screws (21) by one turn, from fully closed position.



Start the engine and allow oil to reach  $75^\circ\text{C}$ ; switch off choke, if previously activated.

When oil temperature is above  $75^\circ\text{C}$  you can start the following adjustment procedure; always bear in mind that at the end of the adjustment oil temperature should not exceed  $100^\circ\text{C}$ .

Idling should be between  $1250 \pm 1350$  rpm ( $1300 \pm 50$ )

If the value is included in the above range, check the CO level and ensure that values are min. 0.5 and max 0.9 for both cylinders. If CO reading is lower or higher than indicated range, open or close by  $\frac{1}{4}$  of a turn the by-pass screw (21) of the cylinder having incorrect reading and allow 20 seconds before checking again with the gas analyser.

If idling speed is not within the above-indicated range, open or close by  $\frac{1}{4}$  of a turn the by-pass screws (21) of both

cylinders and check again CO level once idling rpm is correct.  
If adjustment results were negative, repeat the procedure, starting from throttle position sensor (TPS) reset.

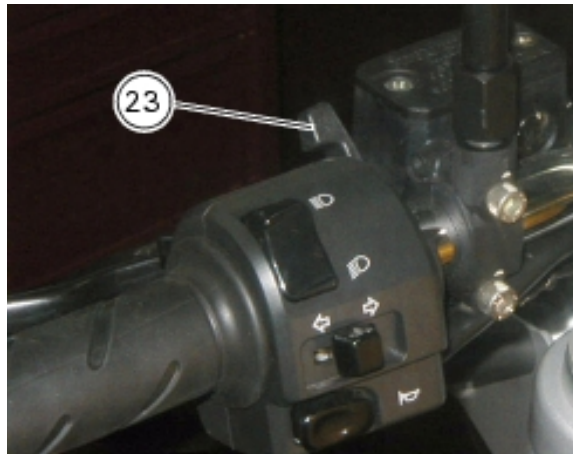
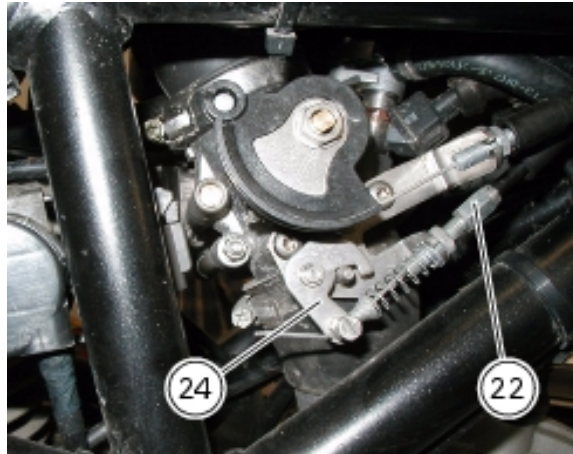


#### Note

The vacuum gauge is not used since "cylinder synchronisation procedure" is not necessary.

#### Adjusting the choke

Work the choke control adjuster (22) to adjust choke lever (23) so that the lever (24) can travel smoothly all its stroke.



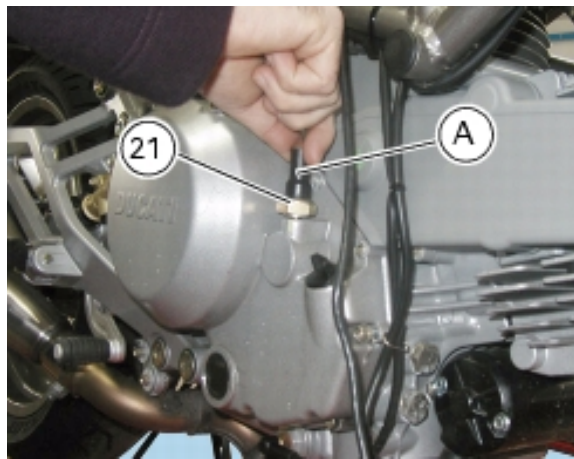
#### Checking engine oil pressure



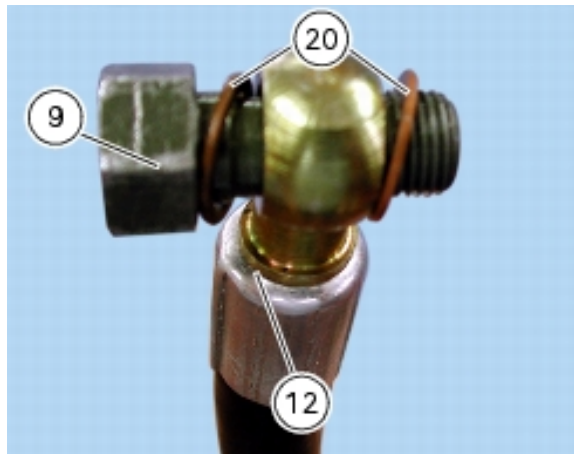
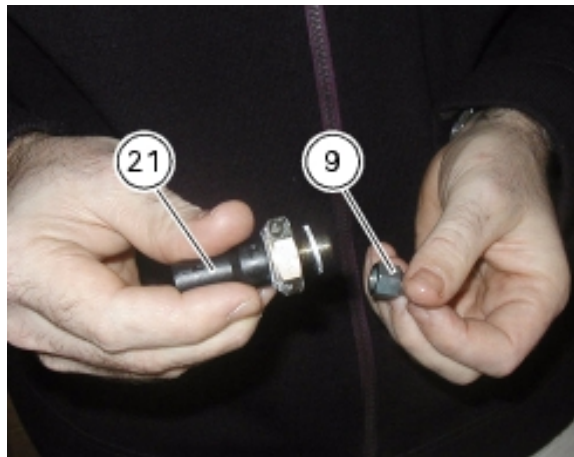
#### Note

A table at the end of this section explains the icons used in this procedure.

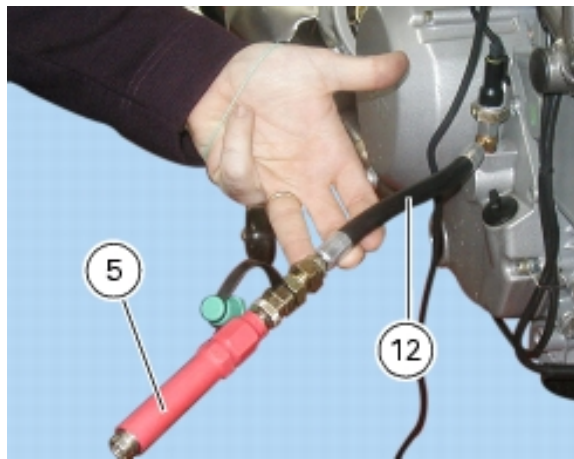
Take oil circuit pressure through engine oil pressure sensor outlet (21) as follows:  
Remove the pressure switch (21) connector (A). Be sure to collect the seal.



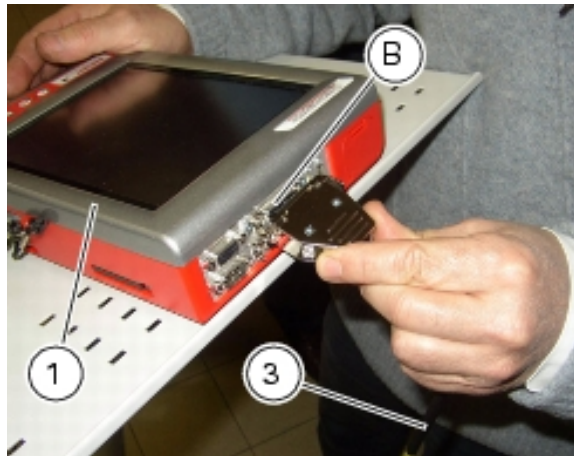
Insert fitting (9) in the hose (12) fitting, and place two copper washers (20) in-between. Screw the connector (9) of the hose (12) into the threaded hole (M10x1mm) in the RH cover. Screw the connector all the way in. Refit the pressure switch (21) complete with seal to the connector (9) and reconnect it to the electric system connector (A).



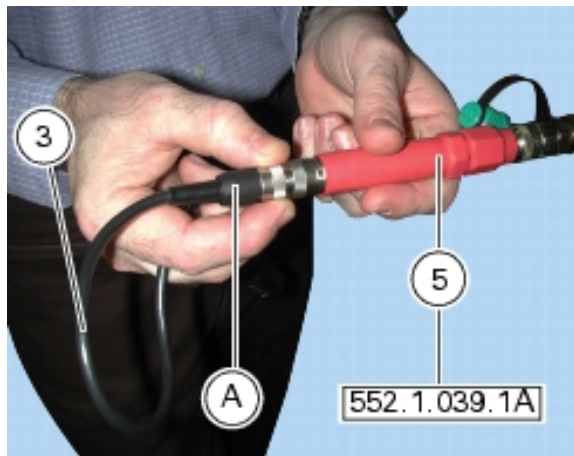
Connect the pressure sensor (5), to the hose (12), in order to convert the pressure reading into an electric signal.

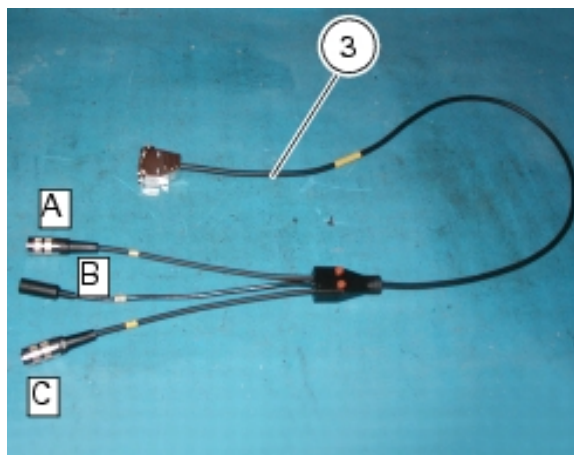


Switch on the DDS (1), refer to "[Instrument power supply](#)".  
Connect the power and diagnosis cable (Measurement Module) (3) to measurement module connector (B) of the DDS (1).

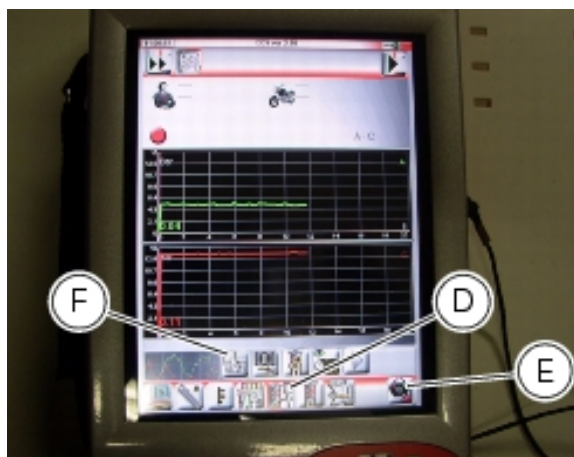


Connect the pressure sensor (5) to port (A) or (C) of cable (3).

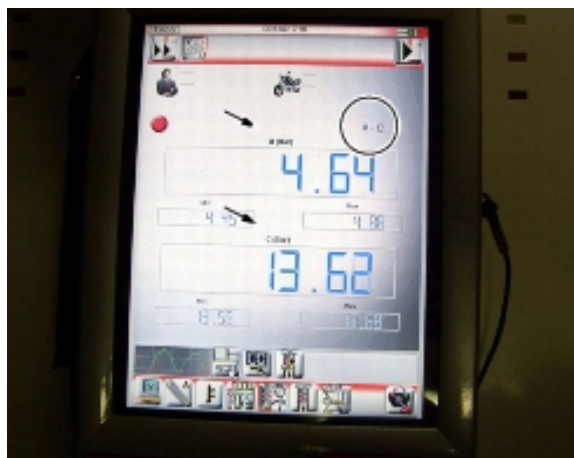
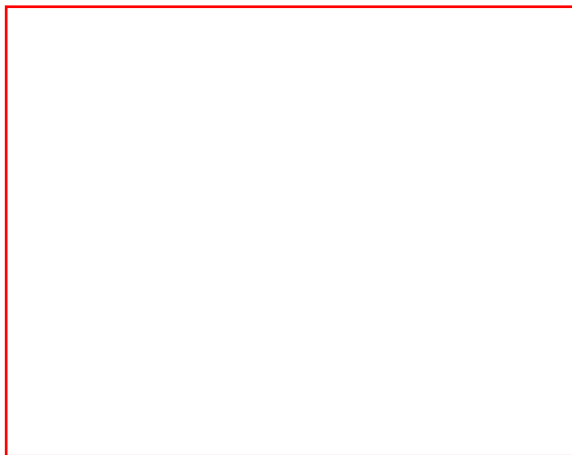




Press "Measurement module" icon on DDS (1) to select the "Measurement module" function; then press on "Pressure Measurement" icon (D) and then "Start" (E).

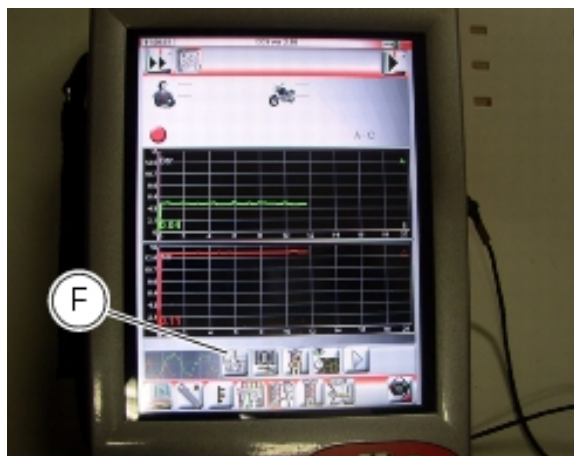


The page shows you which socket of the cable (Measurement Module) (3) is to be used with a capital A, B or C.



Start the engine.

Values can be displayed in three ways: as numbers (one mode) or as graphs (two modes); press "Display mode" (F) to select the display mode.



Measured value is indicated next to letter (A) or (C) depending on the cable used: if socket (A) of cable (3) is used, measured value will correspond to letter (A) on the screen.



Oil pressure test values:



Warm engine  
(Oil temperature at least = **80°C**)  
**1100 - 1300** rpm  
over **0.8** bar  
**3500 - 4000** rpm  
over **4** bar

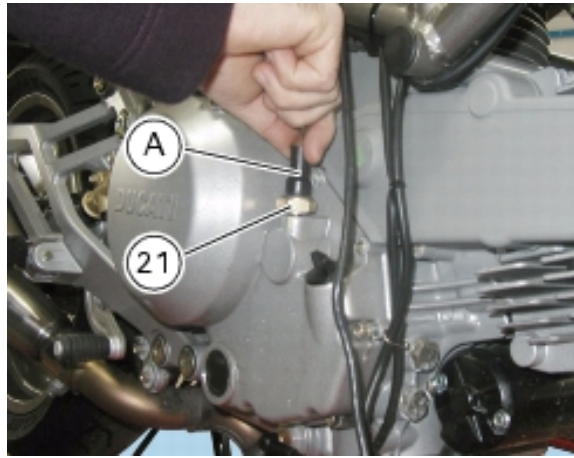


Caution

Maximum pressure must not exceed **6.0** bar.

A pressure which is too high indicates that the pressure-relief valve is jammed. A pressure which is too low indicates that the pressure-relief valve is jammed in the open position, that the spring is too weak, or that the oil pump is faulty. Other causes of incorrect pressure readings include: badly worn seals and gaskets; badly worn engine. Remove the gauges and refit the pressure switch (21) with its seal. Tighten it to the specified torque (Sect. C 3, [Engine torque settings](#)).

Connect the electrical connector (A) to the pressure switch.



Disconnect the DDS.

### Checking cylinder compression



#### Note

A table at the end of this section explains the icons used in this procedure.

The performance and efficiency of an engine are directly linked to the compression inside the combustion chambers of the two cylinders. Compression which is too high/low or a large compression difference between the two cylinders will cause a drop in engine performance and can cause engine breakdowns.

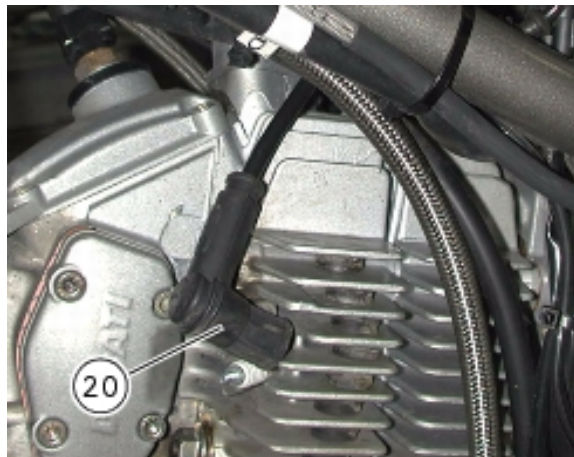
Start the engine and let it warm up until the fan switches on at least once.

Remove the outer structures.

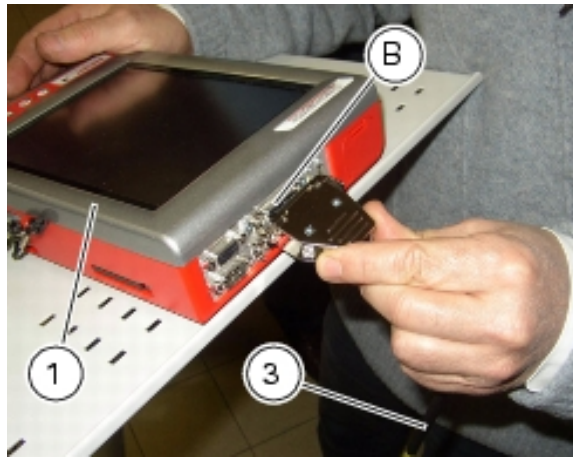
Open the throttles fully.

Remove the spark plug-coil cables (20) from both spark plugs.

Remove the spark plug from the cylinder to be checked.



To prevent sparks, earth the spark plug cable.  
 Screw the cylinder compression cable (11) into the spark plug hole.  
 Connect the pressure sensor (5) to cable (11).  
 Switch on the DDS (1), refer to "[Connection to the bike](#)".  
 Connect the power and diagnosis cable (Measurement Module) (3) to measurement module connector (B) of the DDS (1).

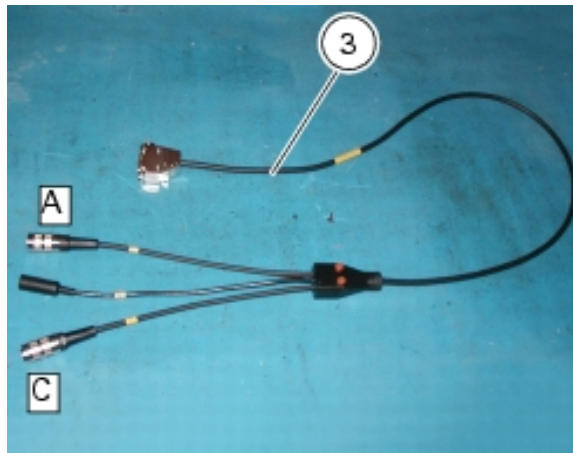


Connect the pressure sensor (5) to port (A) or (C) of cable (3).

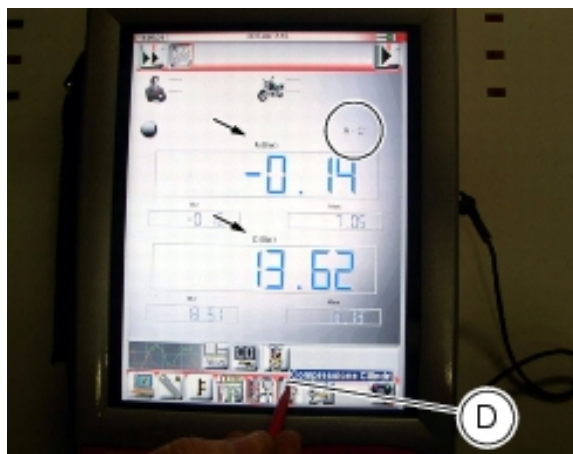


Note

Take the reading in one cylinder at a time.



Press "Measurement module" icon on DDS (1) to select the "Measurement module" function; then press on "Cylinder compression" icon (D) and then "Start" (E).

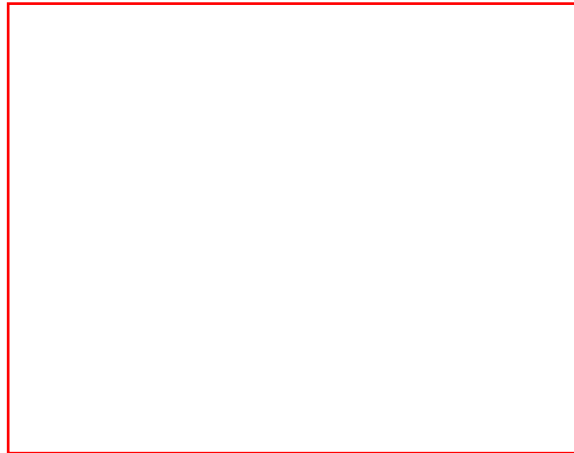




The page shows you which socket of the cable (Measurement Module) (3) is to be used with a capital A, B or C. Crank the engine using the starter motor until the pressure reading stops rising.

Check the compression of both cylinders.

- standard value: **11-12** bar;
- minimum value: **10** bar;
- Maximum allowed difference between cylinders: **2** bar.



Excessively high compression readings indicate the following:

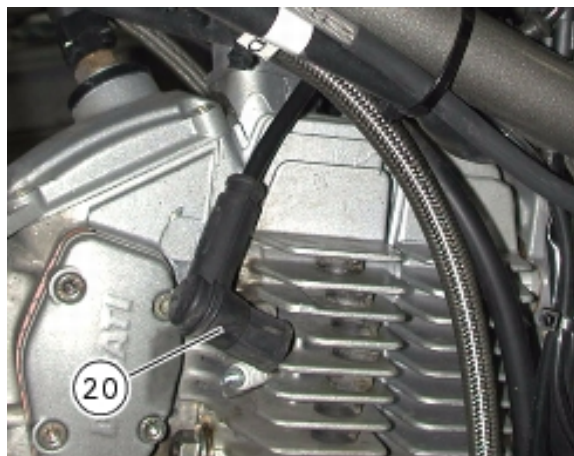
- deposits in the combustion chamber.

Low compression readings indicate:

- gas leakage between head and cylinder;
- worn valve seats;
- bent valve stems;
- incorrect valve clearances;
- worn cylinders or piston rings.

Refit the outer structures.

Refit the spark plugs and position the coil-spark plug cables in their seats.





## Checking fuel pressure



### Note

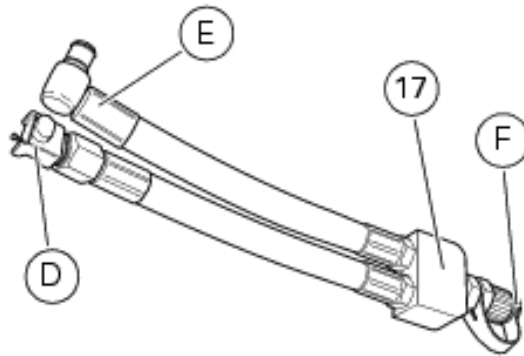
A table at the end of this section explains the icons used in this procedure.

Lift the fuel tank (Sect. L 2, [Removing the fuel tank](#)).

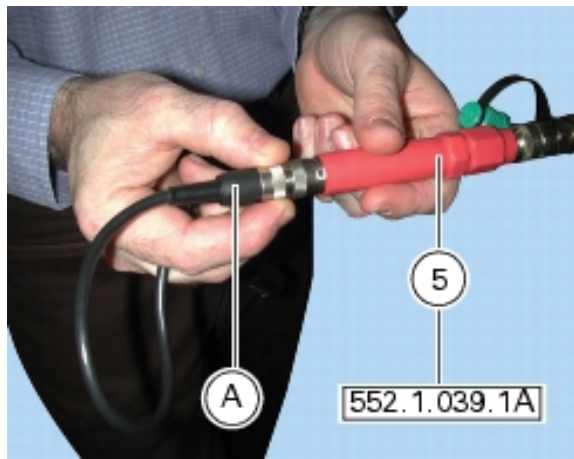
Remove the fuel delivery hose (20).



Using fuel pressure tube (17), connect one end (D) to union of delivery hose to tank and the other end (E) to delivery hose (20): in this way you create a pressure pick-up point (F).

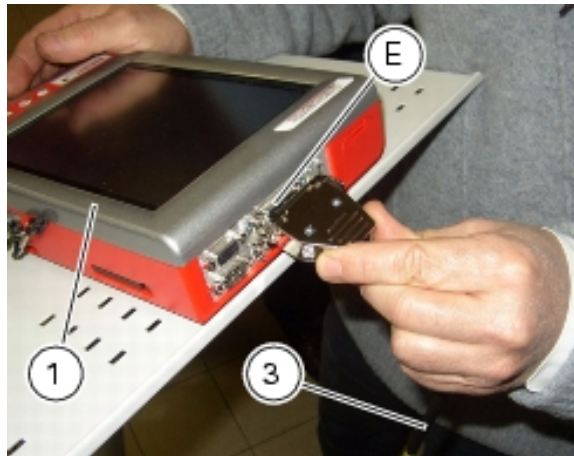


Connect the pressure sensor (5), to the port (F) of hose (17), in order to convert the pressure reading into an electric signal.

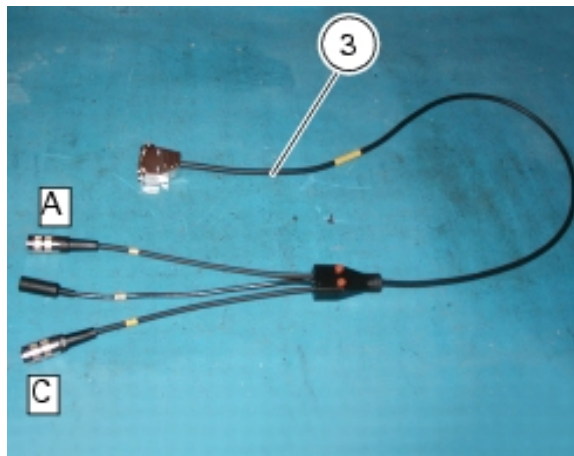


Switch on the DDS (1), refer to "[Instrument power supply](#)".

Connect the power and diagnosis cable (Measurement Module) (3) to measurement module connector (E) of the DDS (1).



Connect the pressure sensor (5) to port (A) or (C) of cable (3).



Press "Measurement module" icon on DDS (1) to select the "Measurement module" function; then press on "Pressure Measurement" icon (F) and then "Start" (G).



The page shows you which socket of the cable (Measurement Module) (3) is to be used with a capital A, B or C. Values can be displayed in three ways: as numbers (one mode) or as graphs (two modes); press "Display mode" (H) to select the display mode.



Measured value is indicated next to letter (A) or (C) depending on the cable used: if socket (A) of cable (3) is used, measured value will correspond to letter (A) on the screen.  
 Maximum pressure must be **3** bar (nominal pressure).  
 When through with the test, remove the components of the diagnosis instrument and refit the delivery tube (20), secure it with clamp.  
 Reposition the seat.



Procedure to override the immobilizer system



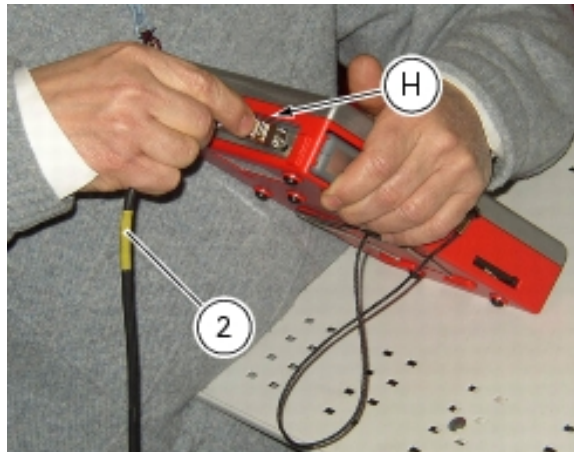
Note

A table at the end of this section explains the icons used in this procedure.

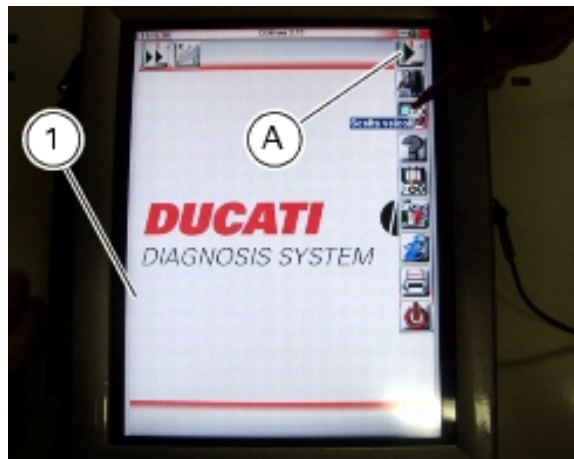
If the immobilizer is faulty, follow the emergency procedure to start the engine described in section P 8, [Immobilizer and Transponder](#) that consists in entering the emergency code, also using the DDS.

Switch on the DDS (1), refer to "[Instrument power supply](#)".

Connect the diagnosis connector (H), the power and diagnosis cable (2) to the motorcycle diagnosis socket (L).



Enter the general functions menu, pressing "Menu Key 1" icon (A).



Press the "Vehicle selection" icon and press "Vehicle selection" icon in the following page; choose the model and confirm, then select the version and confirm.



Press "System selection" icon displayed to show the vehicle systems that can be diagnosed. Select "Engine electronic system" and press "Confirm" (B) to confirm. Then press "Self-diagnosis" icon to enter self-diagnosis function.



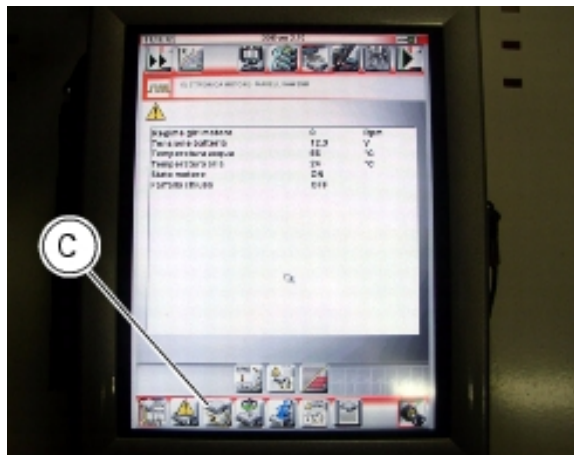
The DDS queries the control unit and the elements under analysis are displayed together with their relevant values.



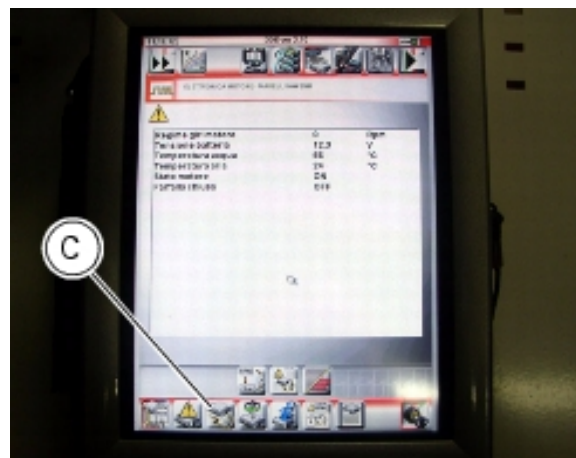
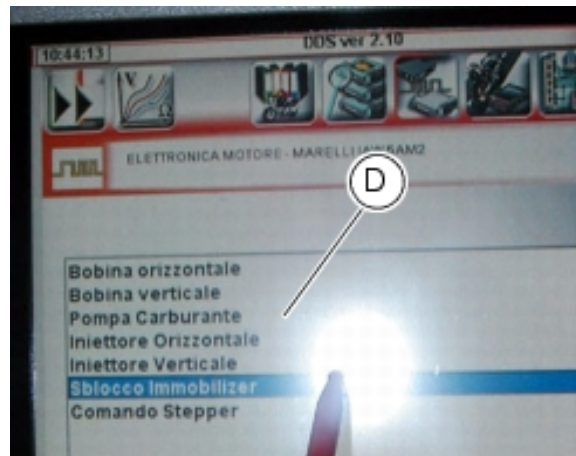
Note

Perform the necessary connections with the ignition key set to OFF.

Press "Actuators" (C) to display actuators and components connected to ECU.



Select "Immobilizer override" and press "Execute" (D).

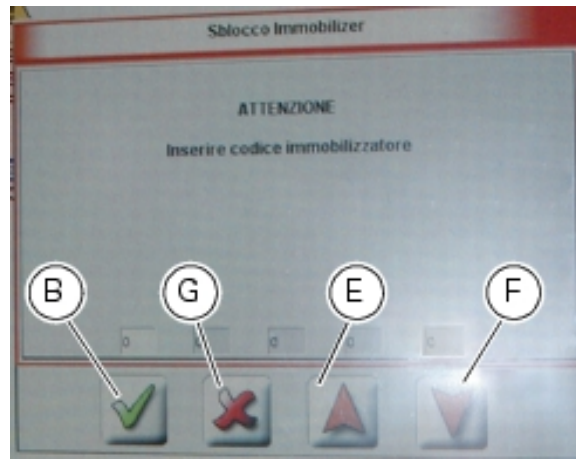


A box is displayed with a field for the five figures of the emergency code. Use the red arrows (E) and (F) to enter each digit: confirm each digit entered pressing "Confirm" (B).

Once the code is complete, press "Confirm" (B).

If the operation is performed, the message "Was the operation successful?" is displayed, press "Confirm".

If there are problems in performing the operation, the relevant error messages are displayed: you need to confirm or reject each message by pressing "Confirm" or "Exit" (G), respectively.



Remove the Diagnosis instrument.

## Guided diagnosis



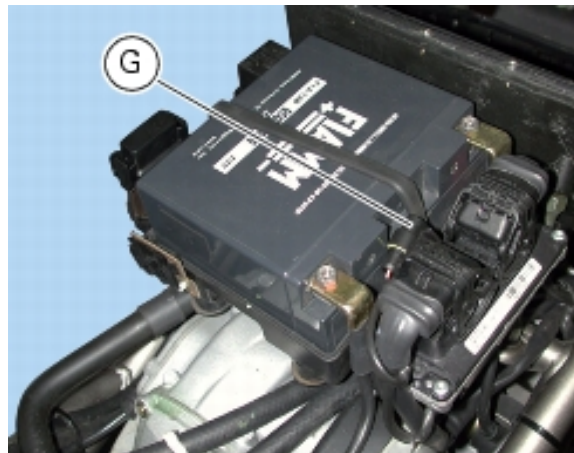
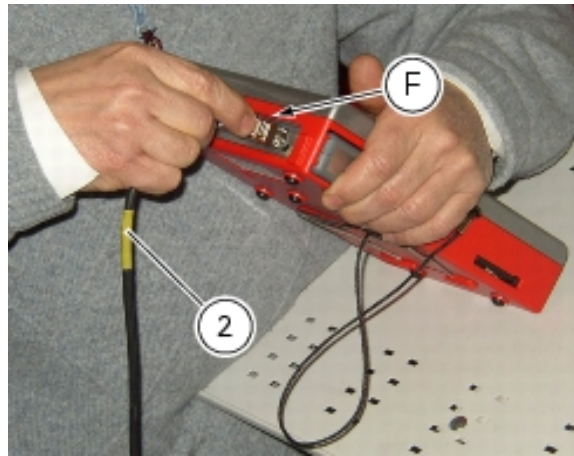
### Note

A table at the end of this section explains the icons used in this procedure.

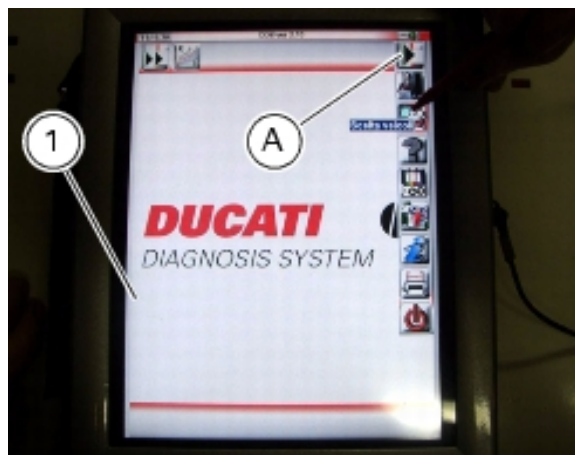
The DDS guides the operator step by step through the various diagnosis stages and provides the descriptions and the documents on the different vehicle components such as wiring diagrams for the electronic systems and details on the system layout and parts location.

Switch on the DDS (1), refer to "[Instrument power supply](#)".

Connect the diagnosis connector (F), the power and diagnosis cable (2) to the motorcycle diagnosis socket (G).



Enter the general functions menu, pressing "Menu Key 1" icon (A).



Press the "Vehicle selection" icon and press "Vehicle selection" icon in the following page; choose the model and confirm, then select the version and confirm.

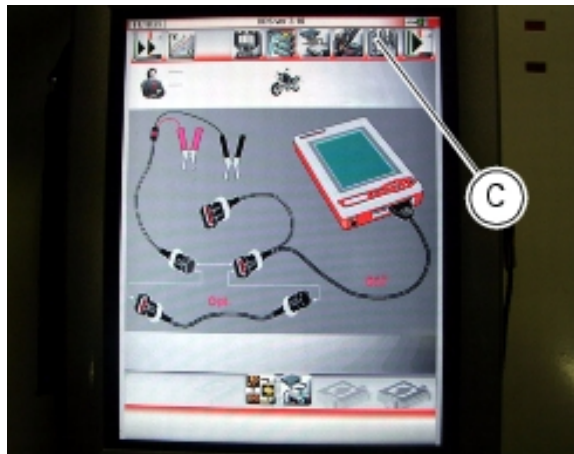
Press "System selection" icon displayed to show the vehicle systems that can be diagnosed.



Select "Engine electronic system" and press "Confirm" (B) to confirm.



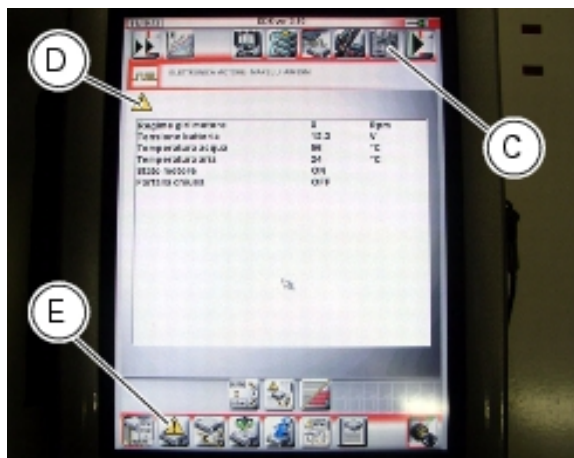
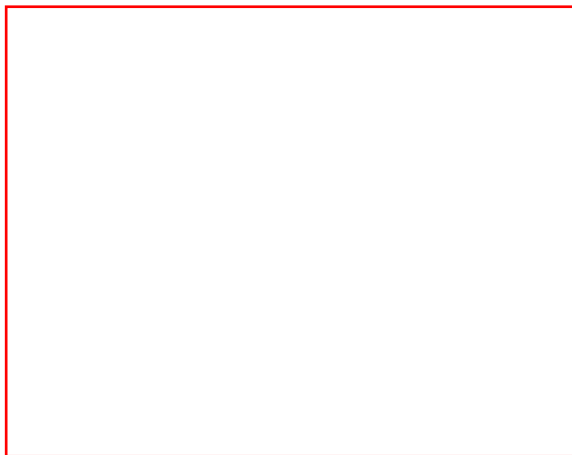
Press "Step-by-step diagnosis" icon (C) to enter the "Step-by-step diagnosis" function.



A few pages will give indications on the procedure for a correct diagnosis.



It is possible to enter the Self-diagnosis function, pressing "Self-diagnosis" icon, to see if the system is faulty. If errors are present, the symbol (D) is displayed. Press "Errors" (E) to display the errors. Once errors are detected, it is possible to fix them using the Step-by-step diagnosis; press "Step-by-step diagnosis" icon (C).



The DDS queries the control unit and the elements under analysis are displayed together with their relevant values.

### Checking the charging system



Note

A table at the end of this section explains the icons used in this procedure.

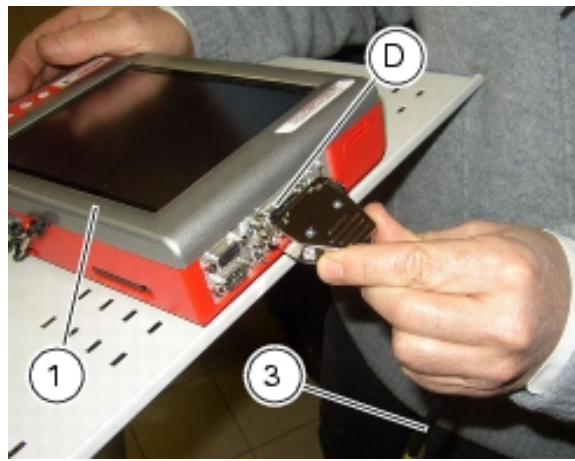
You can determine the engine rpm required for generator to produce just enough current to charge battery, feed the injection-ignition system and all electric items fitted to motorcycle. When applied to a cable, the amperemeter clamp (18) detects the magnetic field generated by the current passing through that cable.



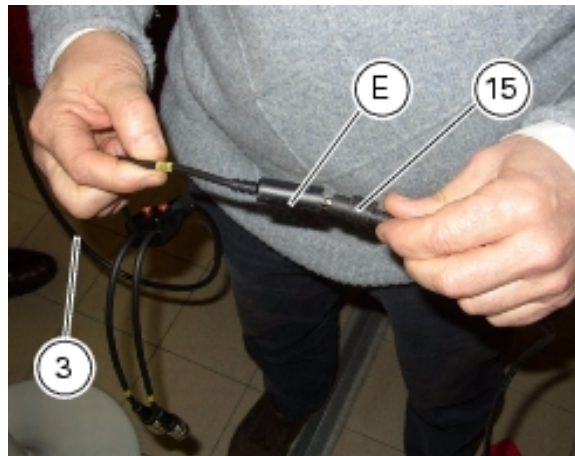
Remove the right-hand side body panel (Sect. E 3, [Removing the side body panels](#)).

Switch on the DDS (1), refer to "Instrument power supply".

Connect the power and diagnosis cable (Measurement Module) (3) to measurement module connector (D) of the DDS (1).



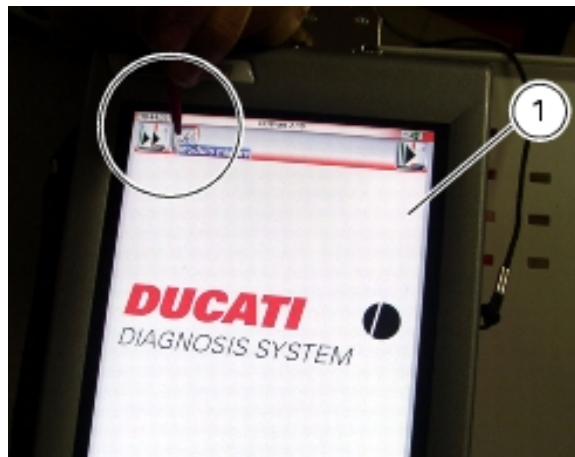
Connect the ammeter clamp to socket (E) of the power and diagnosis cable (Measurement Module) (3).

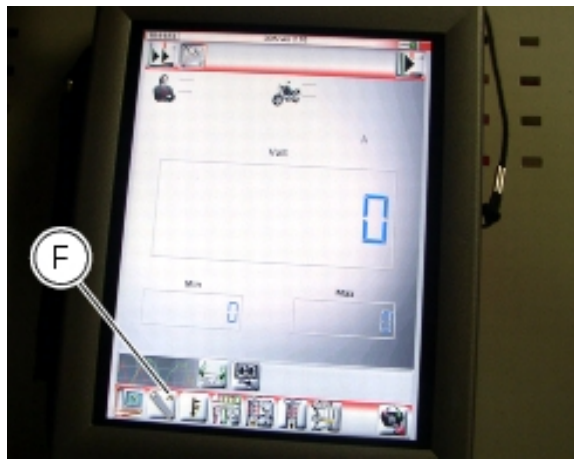


**Warning**

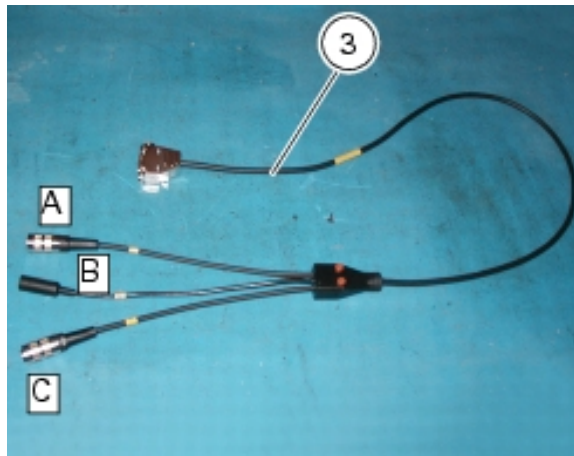
The ammeter clamp shall not be connected to live cables.

Then, apply the amperemeter clamp to the battery positive terminal lead with the arrow on the clamp pointing towards the battery positive (+) terminal.  
Press "Measurement module" icon on DDS (1) to select the "Measurement module" function; then press on "Ammeter" icon (F) and then "Start".





The page shows you which socket of the cable (Measurement Module) (3) is to be used with a capital A, B or C.








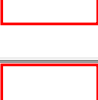
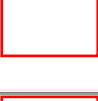
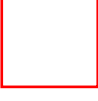

If the measured current is a positive quantity, it means that generator is feeding all electric items and charging battery at the same time. A negative value means that charging system is not feeding the loads and a significant amount of current is supplied to the battery, currently discharging.



Caution

If polarity is reversed when clamping amperemeter onto cable, readings polarity will also be reversed. This will lead to wrong diagnosis.

Icons table

Icons table	
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	Exit
	Measurement module
	Belt tension
	Start/stop
	Menu key 1
	Vehicle selection
	Vehicle selection
	Self diagnosis

Settings

Execute

Cylinder synchronisation

Display mode

Reset

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Cylinder compression

Actuators

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# 0 Use and maintenance operations

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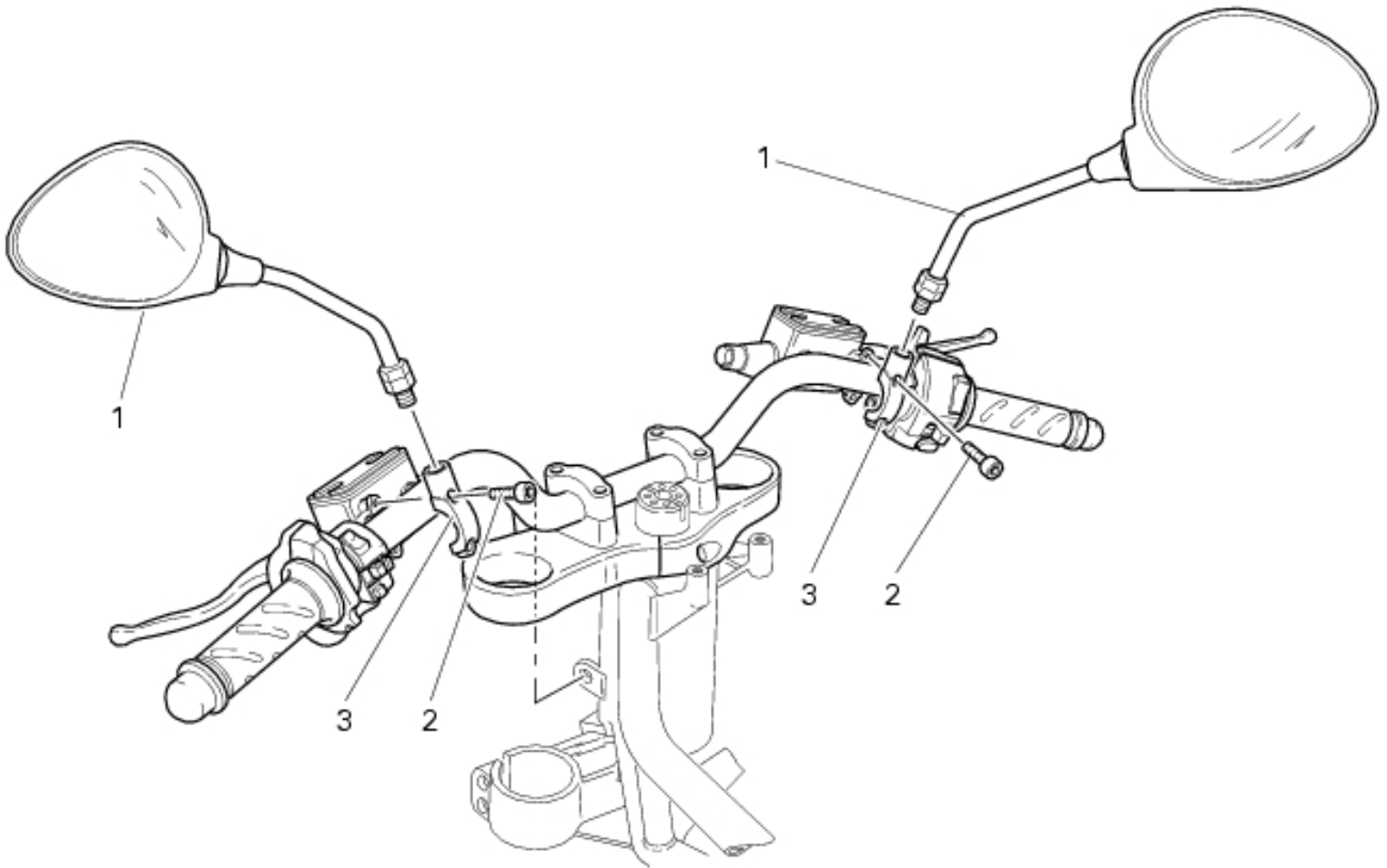
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# 1 - Rear-view mirrors



- 1 Rear-view mirror
- 2 Screw
- 3 U-bolt

 [Spare parts catalogue](#)

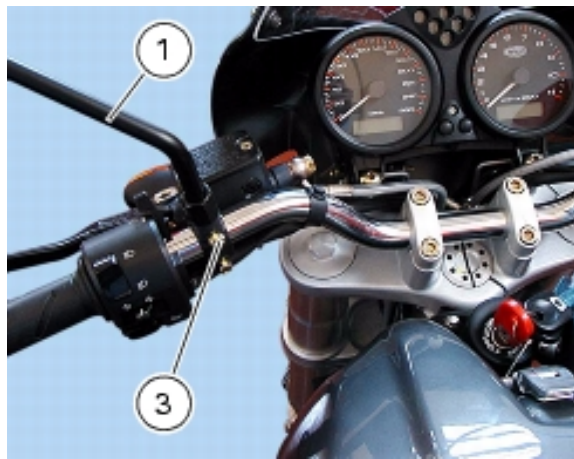
[Handlebar and controls](#)

## Caution

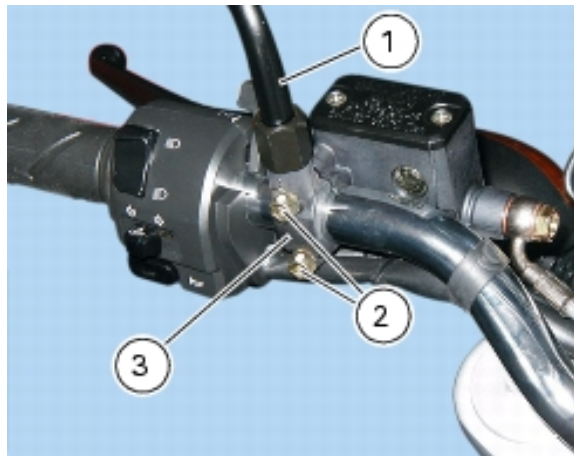
**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

### Disassembling the rear-view mirrors

Use a hexagonal wrench to loosen mirror (1) and remove it from the U-bolt (3).

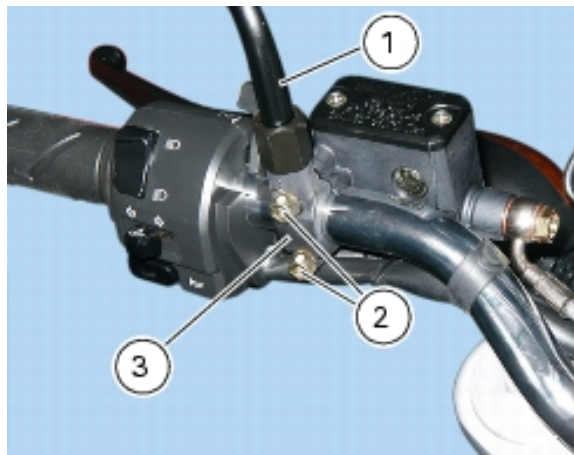


Unscrew the screws (2) to remove the U-bolts (3), if necessary.

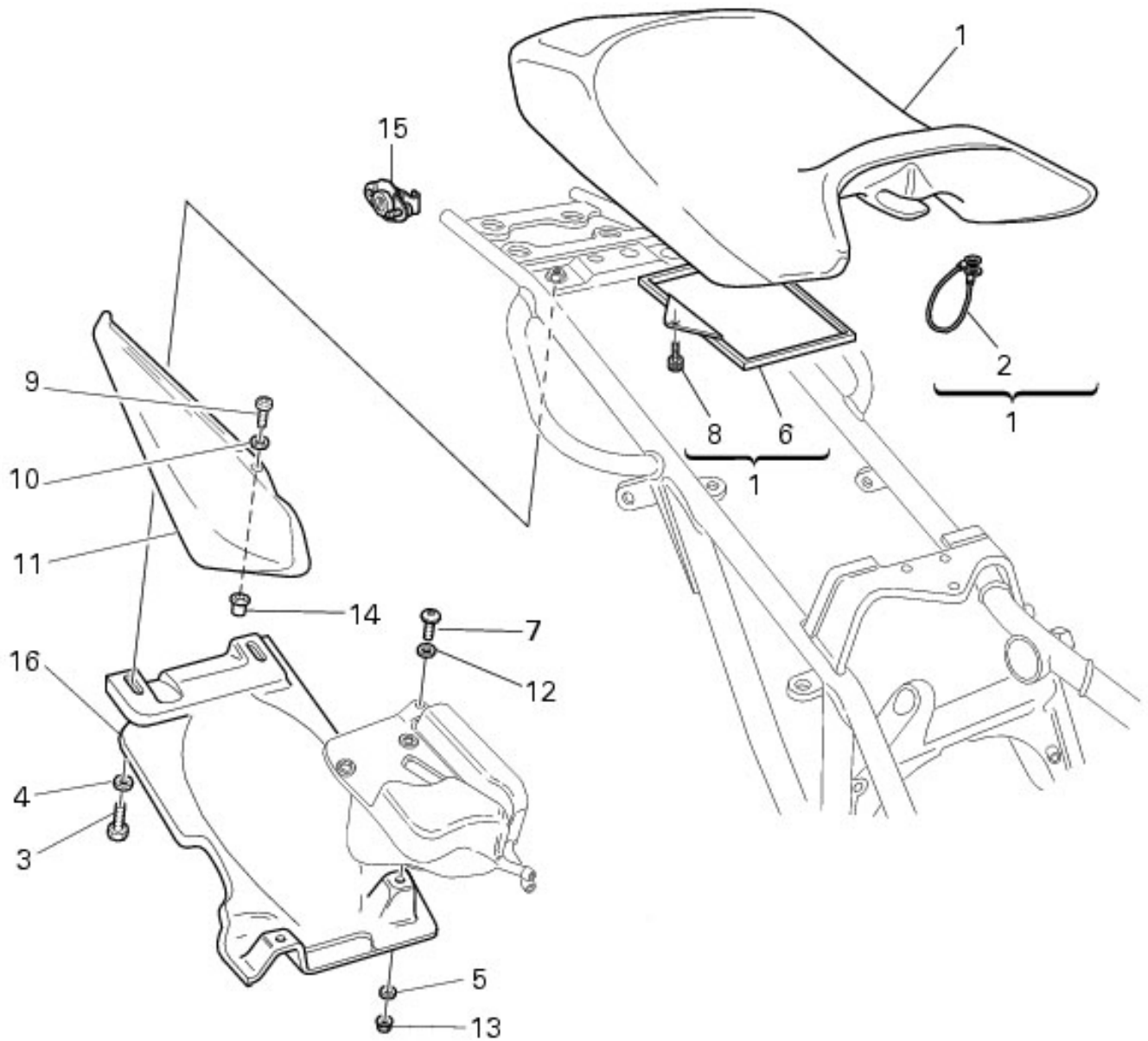


### Refitting the rear-view mirrors

Position the rear-view mirror (1) to the U-bolt (3).  
Screw the mirror fully in.  
Position and tighten the mirror (1) with a hexagonal wrench.  
Refit the clamps (3), if removed, and fix them with screws (2).



## 3 - Seat



- 1 Seat
- 2 Helmet anti-theft cable
- 3 Screw
- 4 Washer
- 5 Washer
- 6 Cover
- 7 Screw
- 8 Special screw
- 9 Screw
- 10 Washer
- 11 Side body panel
- 12 Washer
- 13 Nut
- 14 Insert
- 15 Seat lock
- 16 Splashguard

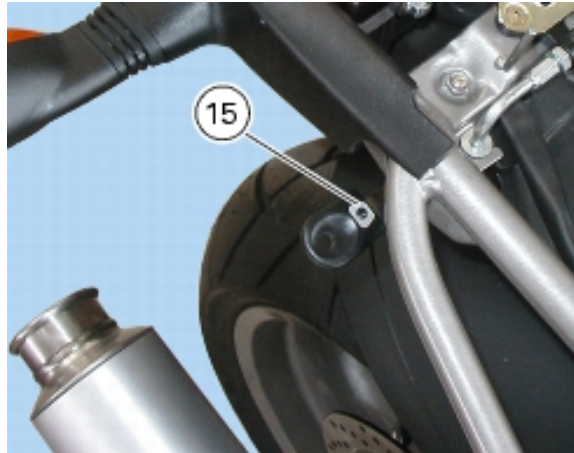
[Seat](#)  
[Frame](#)

 **Caution**

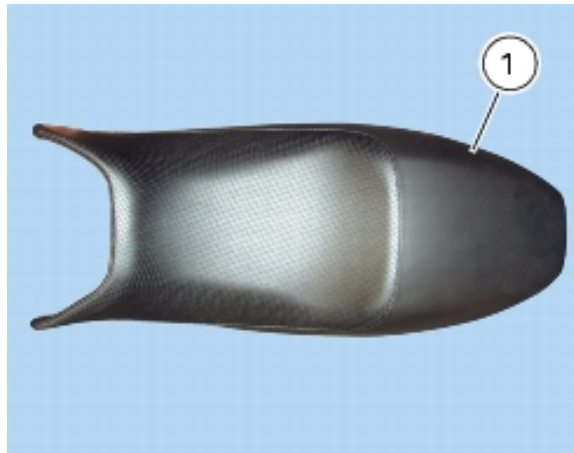
**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

### Removing the seat

Release the lock (15) and lift the seat.

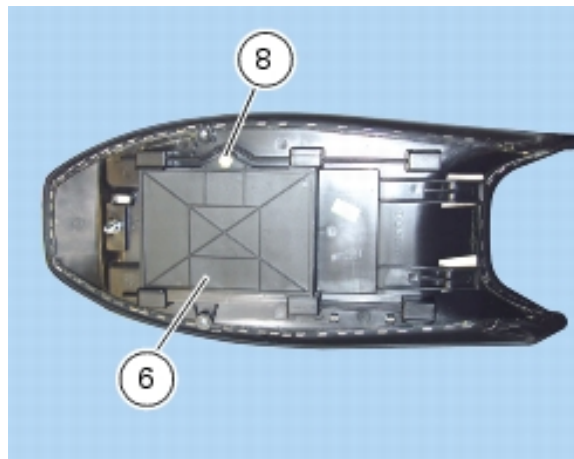


Remove the complete seat (1).



### Disassembling the seat

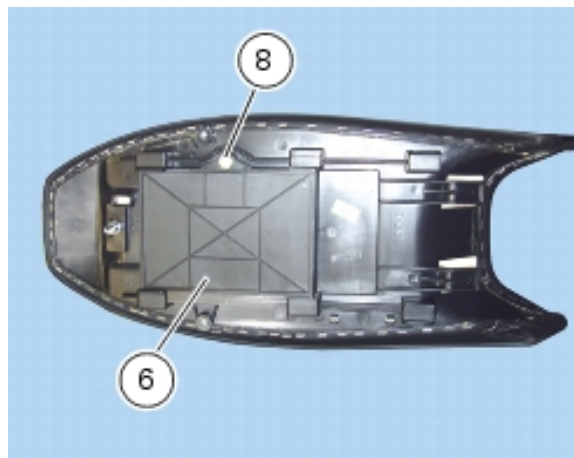
Unscrew the screw (8) placed under the seat and remove the cover (6) to access the tool kit.



Reassembling the seat

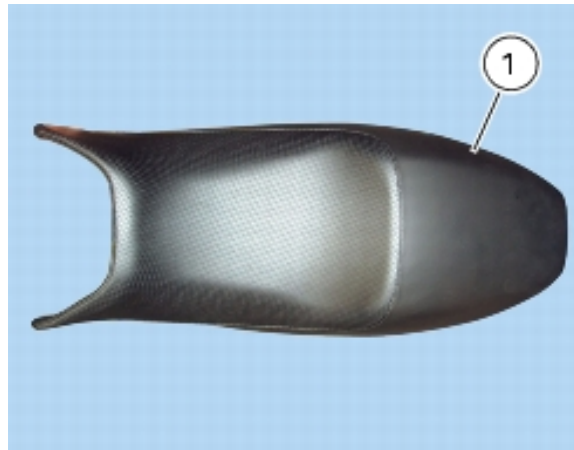
Refit the cover (6) and tighten the screw (8).

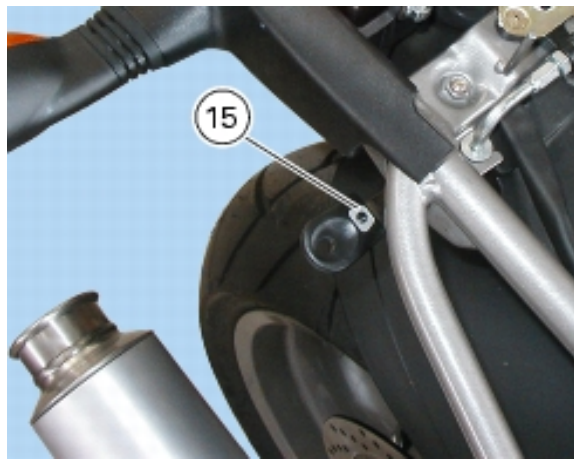
Tighten the screw (8) to the specified torque (Sect. C 3, [Frame torque settings](#)).



Refitting the seat

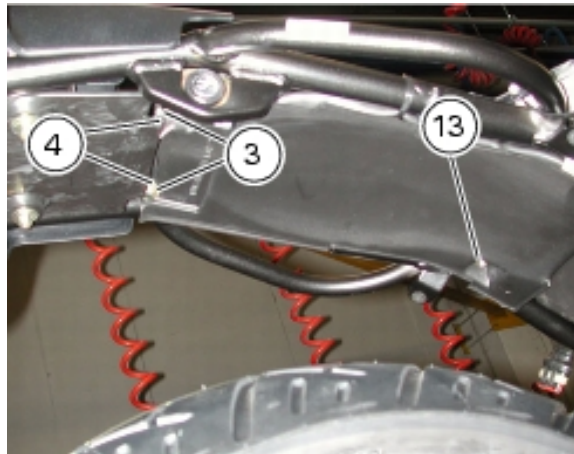
Insert the seat (1) and press until the lock (15) becomes engaged.



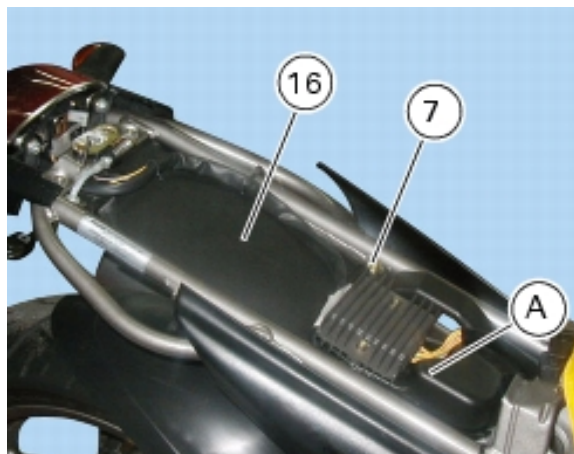


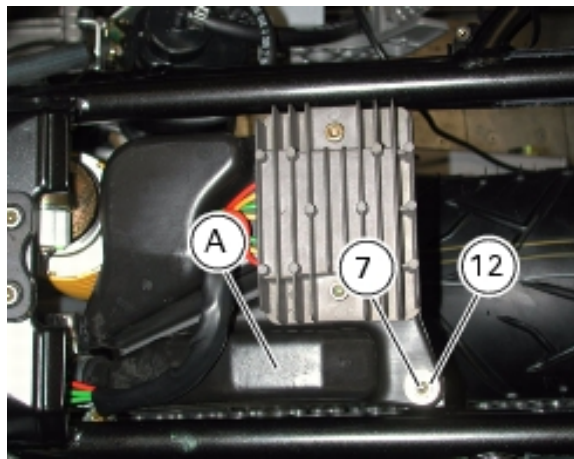
### Removing the splash guard

Remove the seat as described under "[Removing the seat](#)" in this section.  
Loosen and remove the screws (3). Collect the washers (4).  
Undo the nuts (13) and collect the washers (5).



The screw (7) remains on oil breather tank (A).  
Remove the screw (7) from oil breather tank (A).  
Withdraw the splashguard (16) in a rearward motion.





## Refitting the splash guard

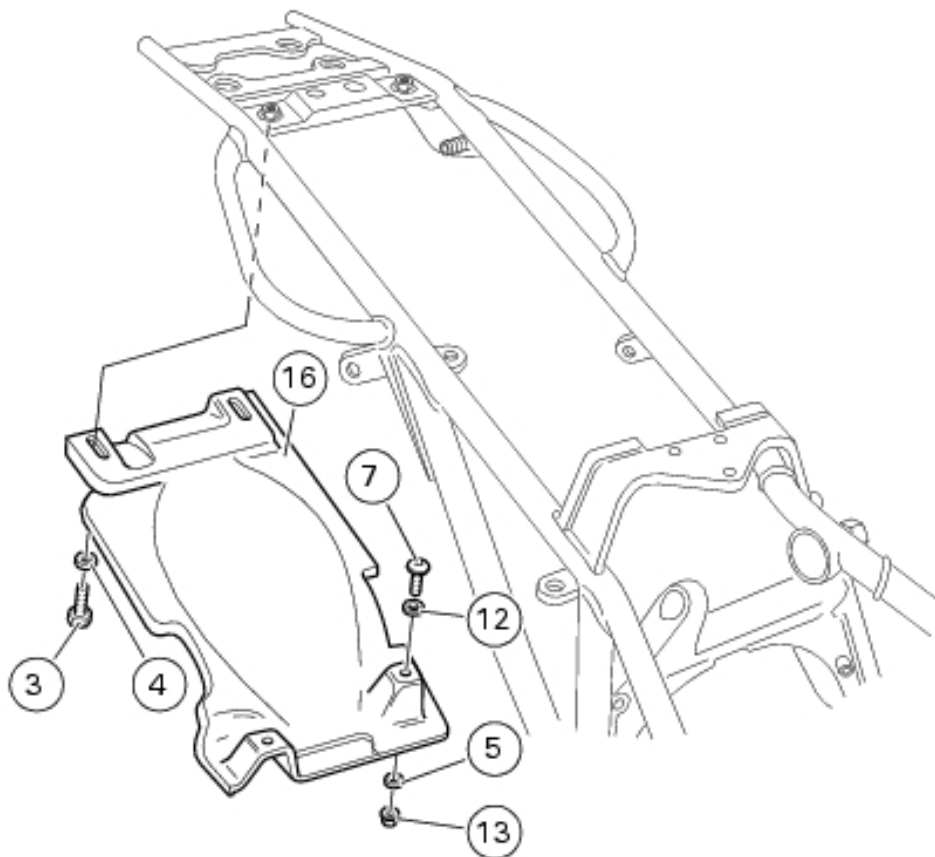
Insert the splashguard (16) from the rear end of the motorcycle.

Fit the screw (7) with washer (12) to the oil breather tank front hole (A).

Position the washer (5) and tighten the nut (13) on the screw (7).

Start the screws (3) with their washers (4) in their holes and tighten the screws (3) to the specified torque (Set. C 3, [Frame torque settings](#)).

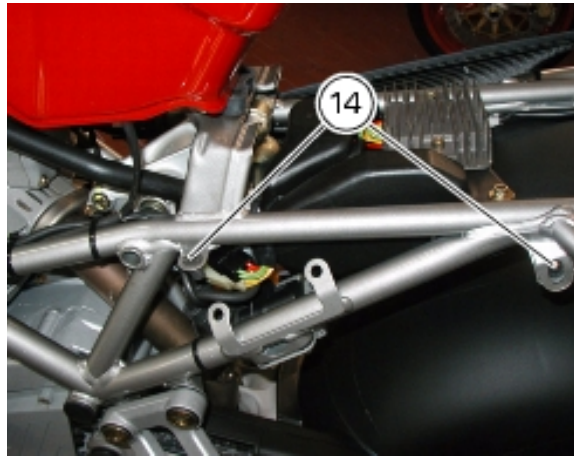
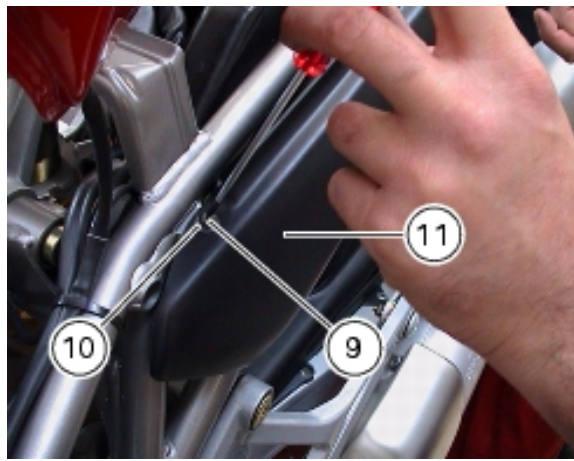
Refit the seat as described under [Refitting the seat](#) in this section.



## Removing the side body panels

Remove the seat as described under "[Removing the seat](#)" in this section.

Loosen the four screws (9) securing the side body panels (11) to the frame, keep the washers (10) and inserts (14). Remove the right-hand and left-hand side body panels (11).

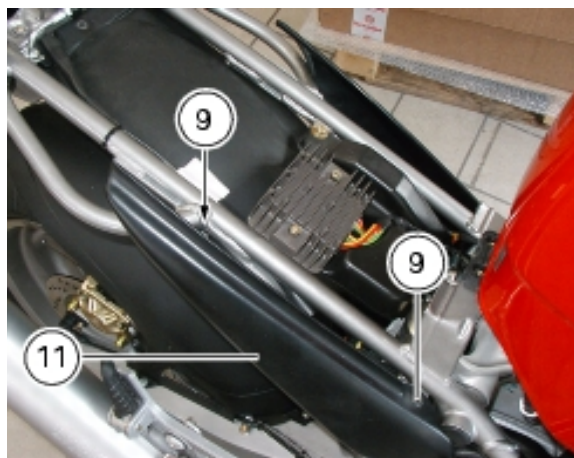


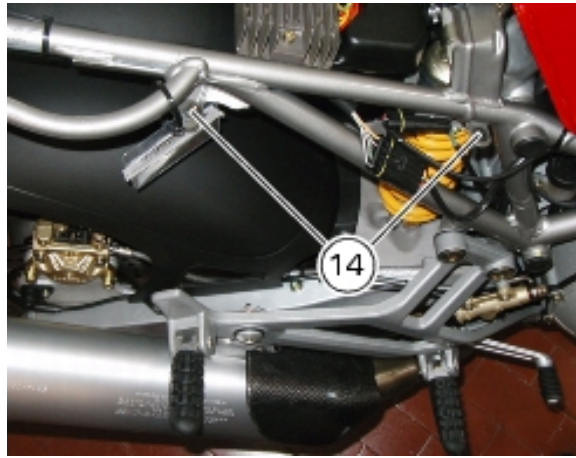
### Refitting the side body panels

Refit the RH and LH side body panels (11), fit the inserts (14) and the washers (10) and start the screws (9) in their threads.

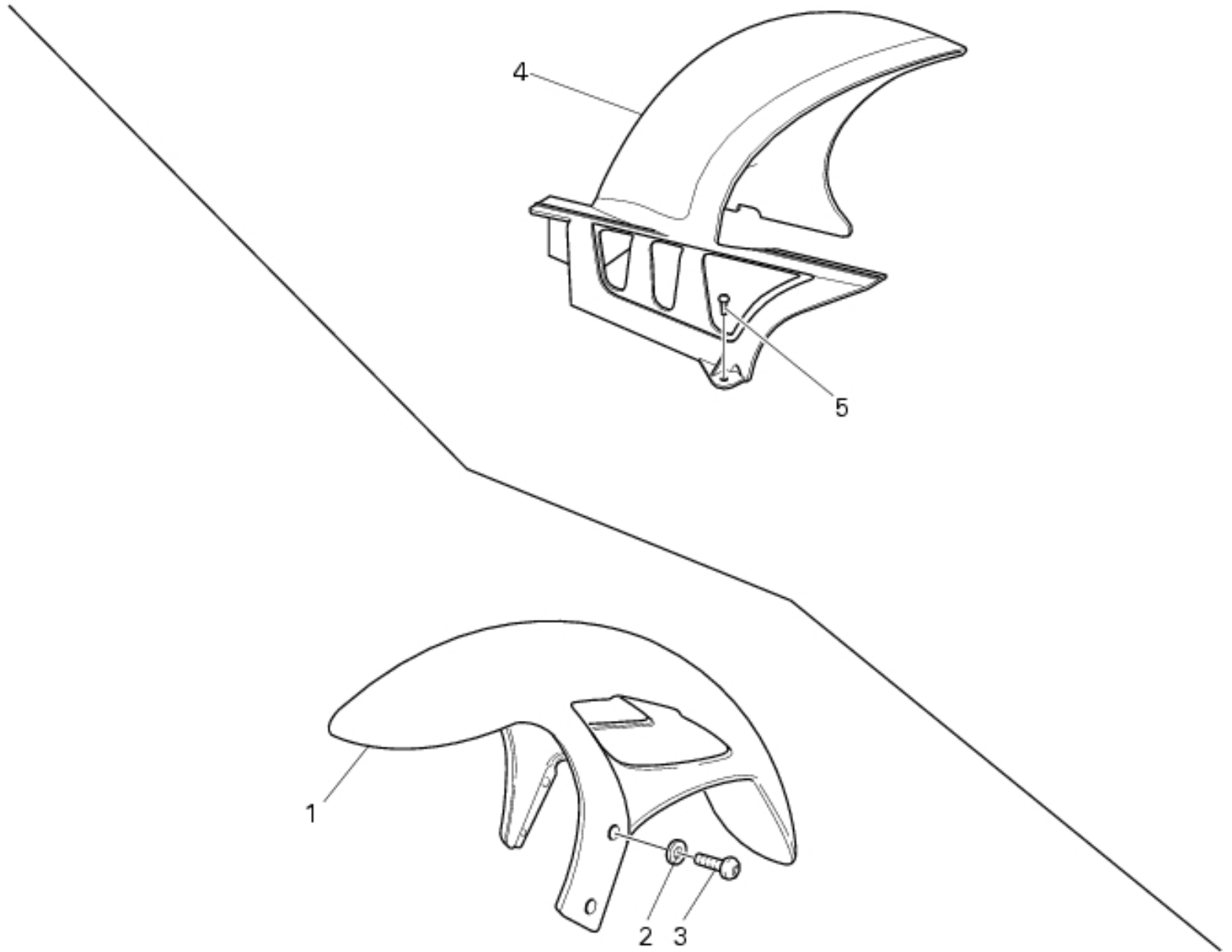
Tighten the screws (9) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Refit the seat as described under "[Refitting the seat](#)" in this section.






## 4 - Front and rear mudguard



- 1 Front mudguard
- 2 Nylon washer
- 3 Screw
- 4 Rear mudguard
- 5 Screw

 Spare parts catalogue

[Frame](#)

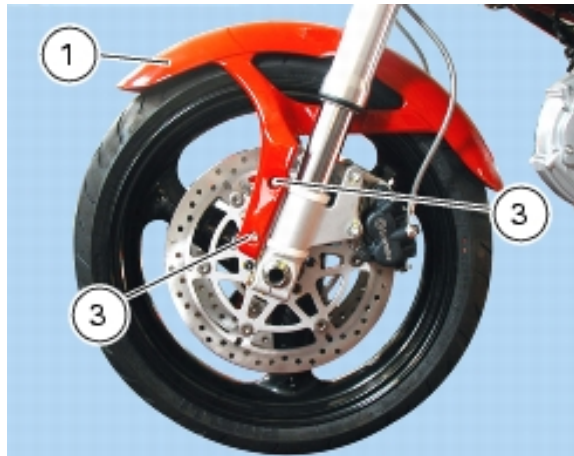
[Swingarm and chain](#)

 Caution

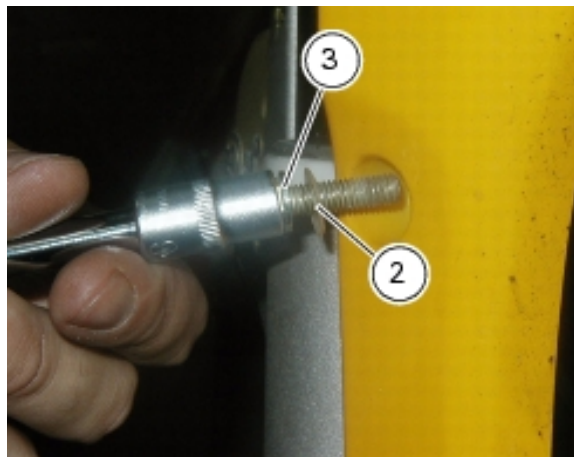
Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

## Removing the front mudguard

Unscrew the retaining screws (3).



Remove the retaining screws (3) and their nylon washers (2).



Remove the front mudguard (1).



### Note

The USA versions fit a cat's eye on front mudguard (1).

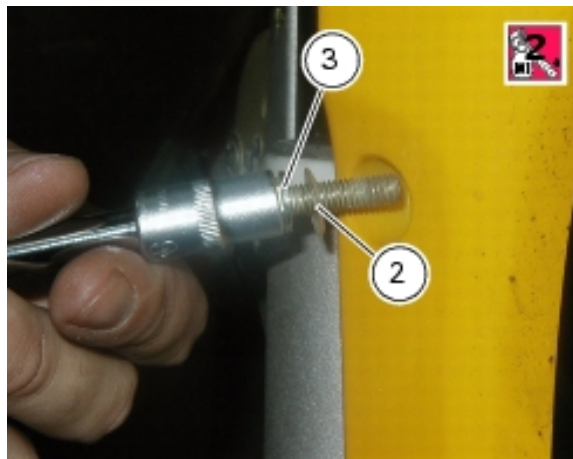
## Refitting the front mudguard



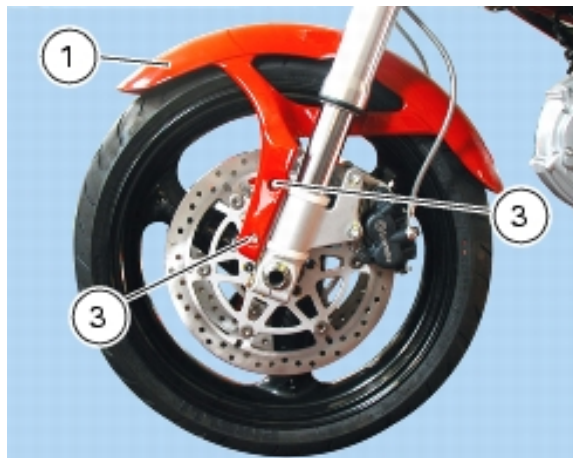
### Warning

Do not ride the motorcycle without the front mudguard, or the brake hoses might touch the wheel under braking.

Apply threadlocker to the screws (3).



Position the front mudguard (1) and start the retaining screws (3) complete with their washers (2) in their holes. Tighten the screws (3) to the specified torque (Sect. C 3, [Frame torque settings](#)).

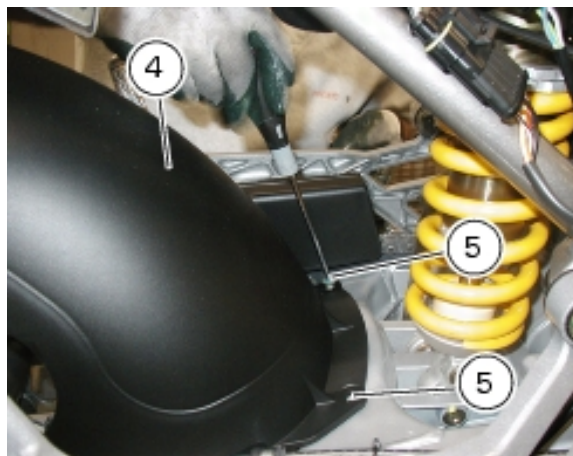


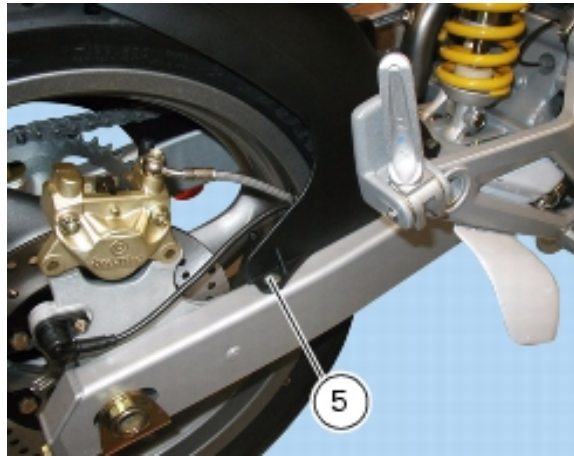
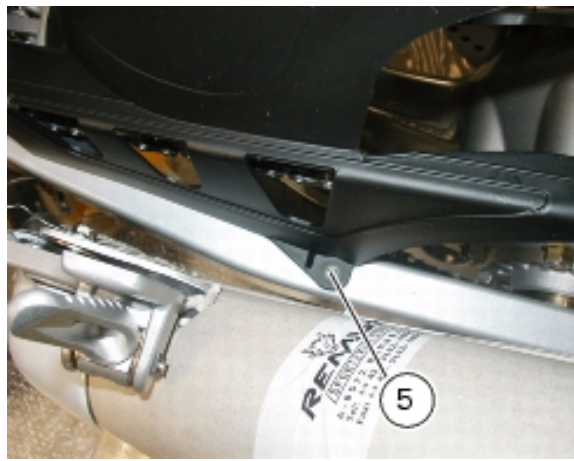
#### Removing the rear mudguard

Unscrew the four screws (5) and detach the mudguard (4) from the swingarm.

#### Refitting the rear mudguard

Fit the rear mudguard (4) and tighten the four screws (5).





# 0Fairing

## 1 - Rear-view mirrors 3

Disassembling the rear-view mirrors 4

Refitting the rear-view mirrors 4

## 3 - Seat 5

Removing the seat 6

Refitting the seat 8

Removing the splash guard 9

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Removing the side body panels 11

Refitting the side body panels 12

## 4 - Front and rear mudguard 13

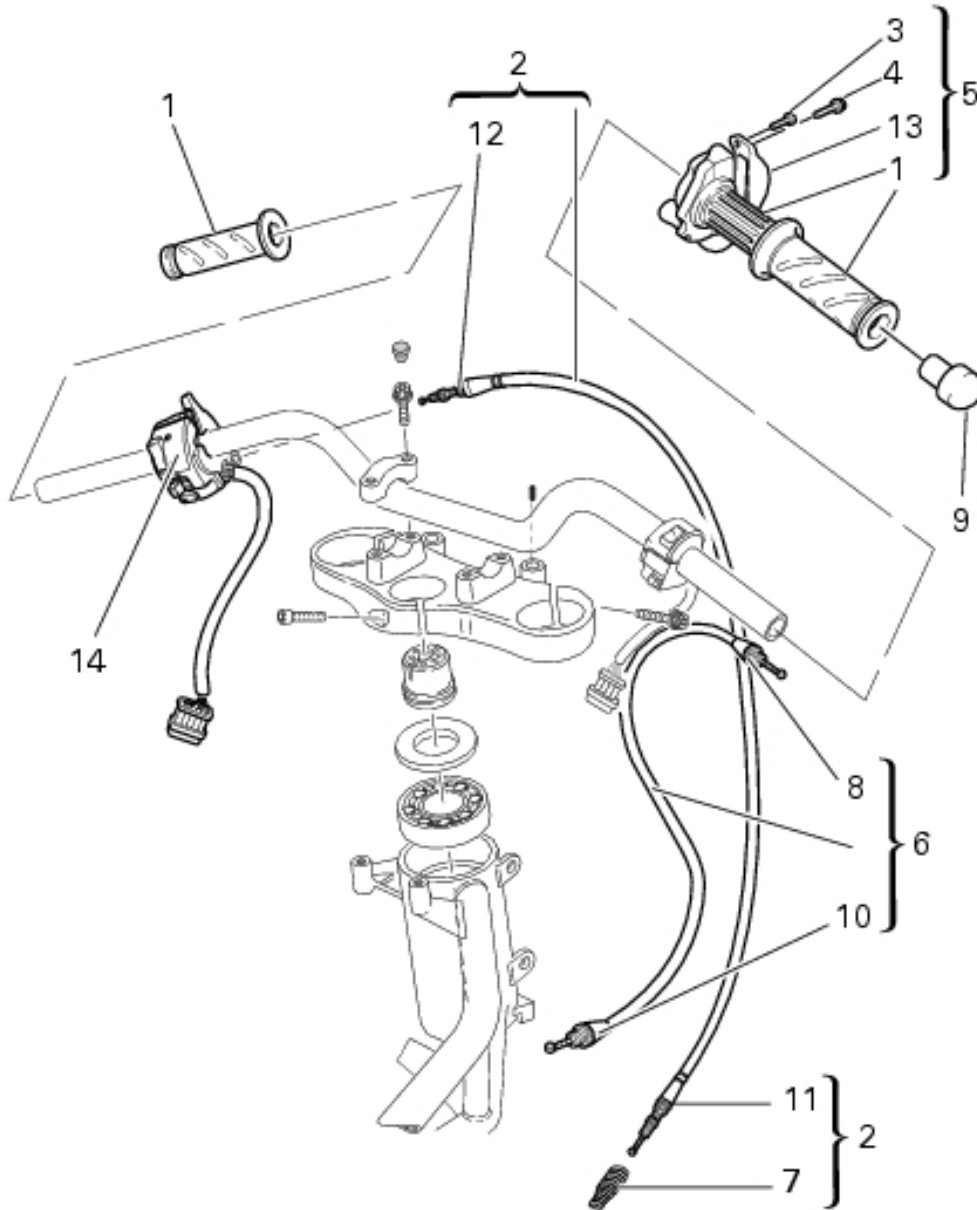
Removing the front mudguard 14

Refitting the front mudguard 15

Removing the rear mudguard 16

Refitting the rear mudguard 16

# 1 - Throttle control – choke



- 1 Twistgrips
- 2 Choke cable
- 3 Screw
- 4 Screw
- 5 Throttle control
- 6 Throttle cable
- 7 Spring
- 8 Throttle control adjuster on handlebar
- 9 Blanking plug
- 10 Throttle control adjuster on throttle body
- 11 choke control adjuster on throttle body
- 12 Choke control adjuster on handlebar
- 13 Cover
- 14 Left-hand switch with choke control

 Spare parts catalogue

[Handlebar and controls](#)

 Caution

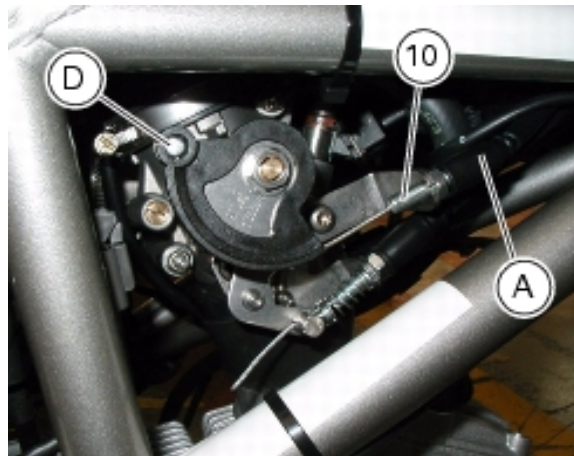
**Bold reference numbers** in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

Adjusting the throttle and choke cables

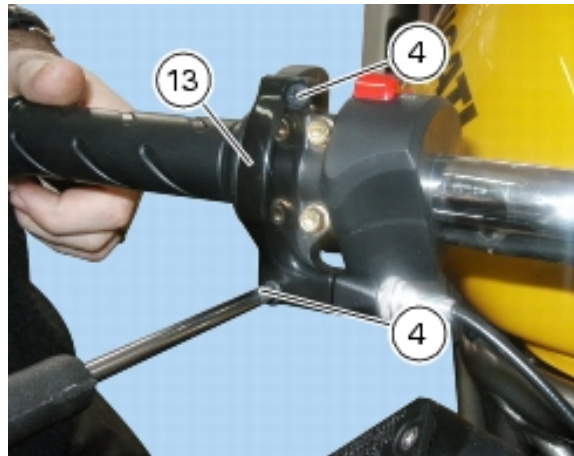
Read Sect. D 4, [Adjusting the throttle and choke cables](#), for relevant instructions.

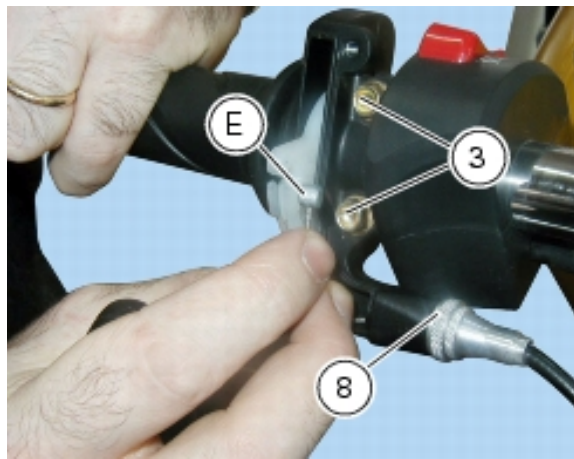
Disassembling the throttle control

Rotate the throttle control pulley until releasing the cable nipple (D) from the pulley. Slip off the rubber gaiter (A), slacken the lock nut and turn out the adjuster (10) until it slides off the throttle control pulley on the throttle body.

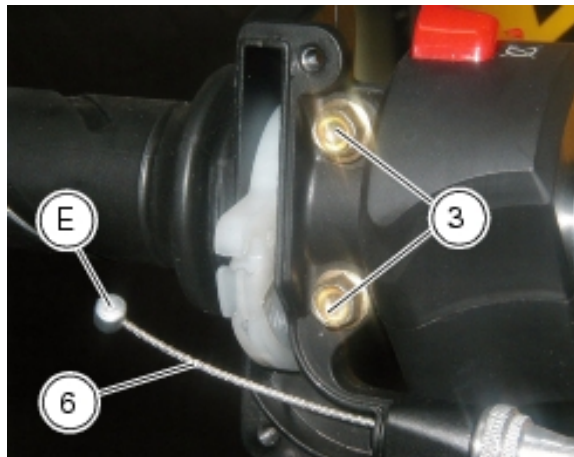


Release and remove the screws (4) and take off the cover (13). Withdraw the cable nipple (E) from the pulley and turn out the adjuster (8) until it slides out so as to disconnect the throttle cable from the throttle control.





Remove the throttle cable (6) from the motorcycle.  
Remove the plug (9) on the handlebar.  
Loosen the two screws (3) securing the throttle control to the handlebar.



Remove the throttle control (5) from the handlebar.



**Warning**

Disturbing the throttle cable may affect the throttle body adjustments. Before refitting throttle control cable read Sect. D 5, [Zero setting the throttle position sensor \(TPS\)](#).



**Reassembling the throttle control**

To refit, reverse the removal procedure.  
Smear the throttle cable (6) with the specified grease.



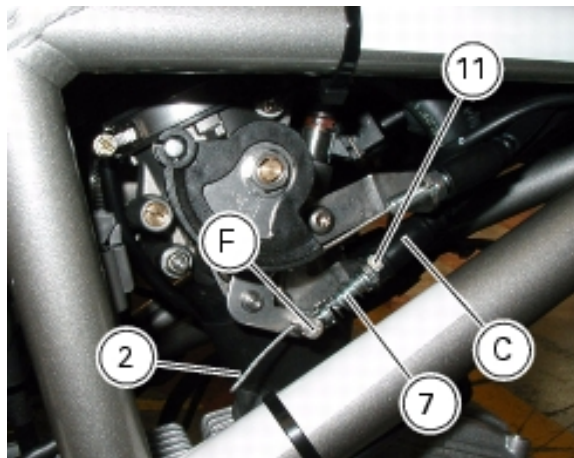
Note

Refer to the figures on the next pages for the correct routing of the throttle cable.

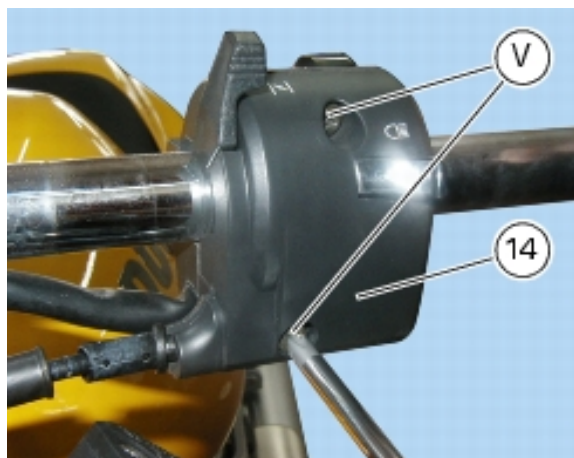
### Removing the choke control

Slacken the retaining screw (F) of the choke cable.

Slip off the rubber gaiter (C), slacken the check nut and turn out the adjuster (11) until it comes off the bracket. Withdraw the choke control (2) and collect the spring (7).

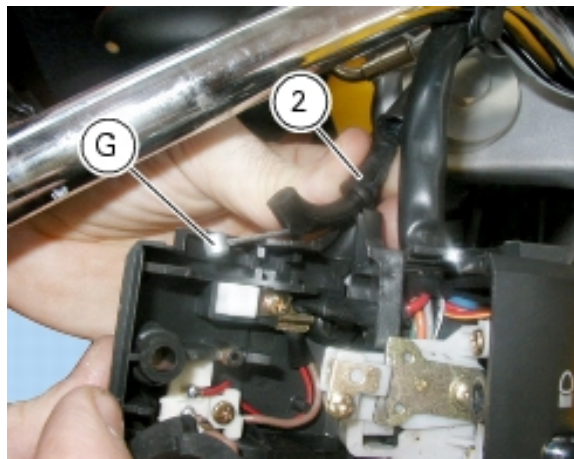


Loosen screws (V) and remove the left-hand switch (14) together with choke control from the handlebar.



Open the switch and remove the stop pin (G).

Remove the complete choke control (2).



**Warning**

Disturbing the choke cable may affect the throttle body adjustments. Before refitting choke control cable read Sect. D 5, [Zero setting the throttle position sensor \(TPS\)](#).

Refitting the choke control

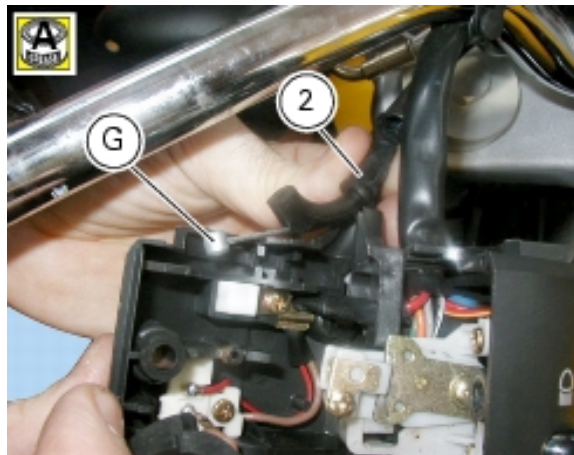


**Note**

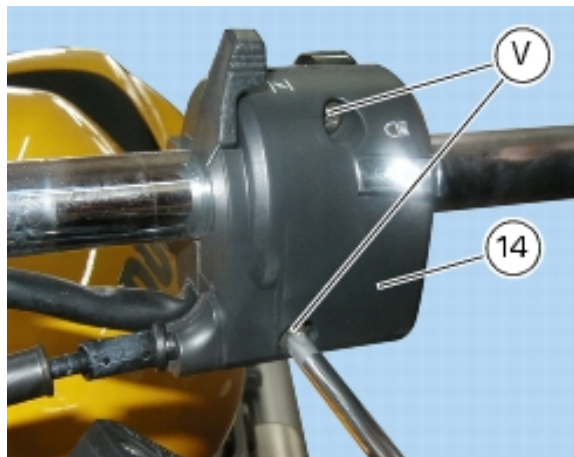
The spare choke cable is supplied together with adjusters and drive cable.

Grease the choke cable (2).

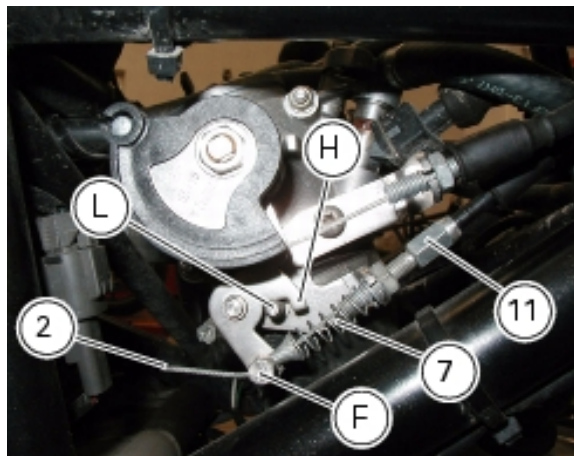
Fit the choke cable (2) in the left-hand switch and fit the stop pin (G) into its seat.



Fix the left-hand switch (14) to the handlebar and tighten the screws (V) to the specified torque (Sect. C 3, [Frame torque settings](#)).



Check that the choke control lever is in the rest position.  
 Insert the new control cable (2) in the frame. Observe the original routing.  
 Tighten the adjuster (11) into the throttle body support.  
 Thread the core cable (2) through the linkage hole, the spring (7) and the throttle body pawl.  
 Pull the end of the core cable to keep the cable taut and tighten the pawl screw (F).  
 Loosen the check nut and work the adjuster (11) so as to allow some play in the sheath.  
 Rotate the lever fully down and make sure that the small lever (H) of the throttle body contacts the end stop (L). If not so, slacken the screw (F) and release the core cable (2).  
 Repeat the process until the small lever (H) is touching the end stop (L).  
 Turn the handlebar right and left and make sure the small lever (H) is not moving. Otherwise, turn the adjuster (11).  
 Tighten the check nut into the adjuster (11) when finished.

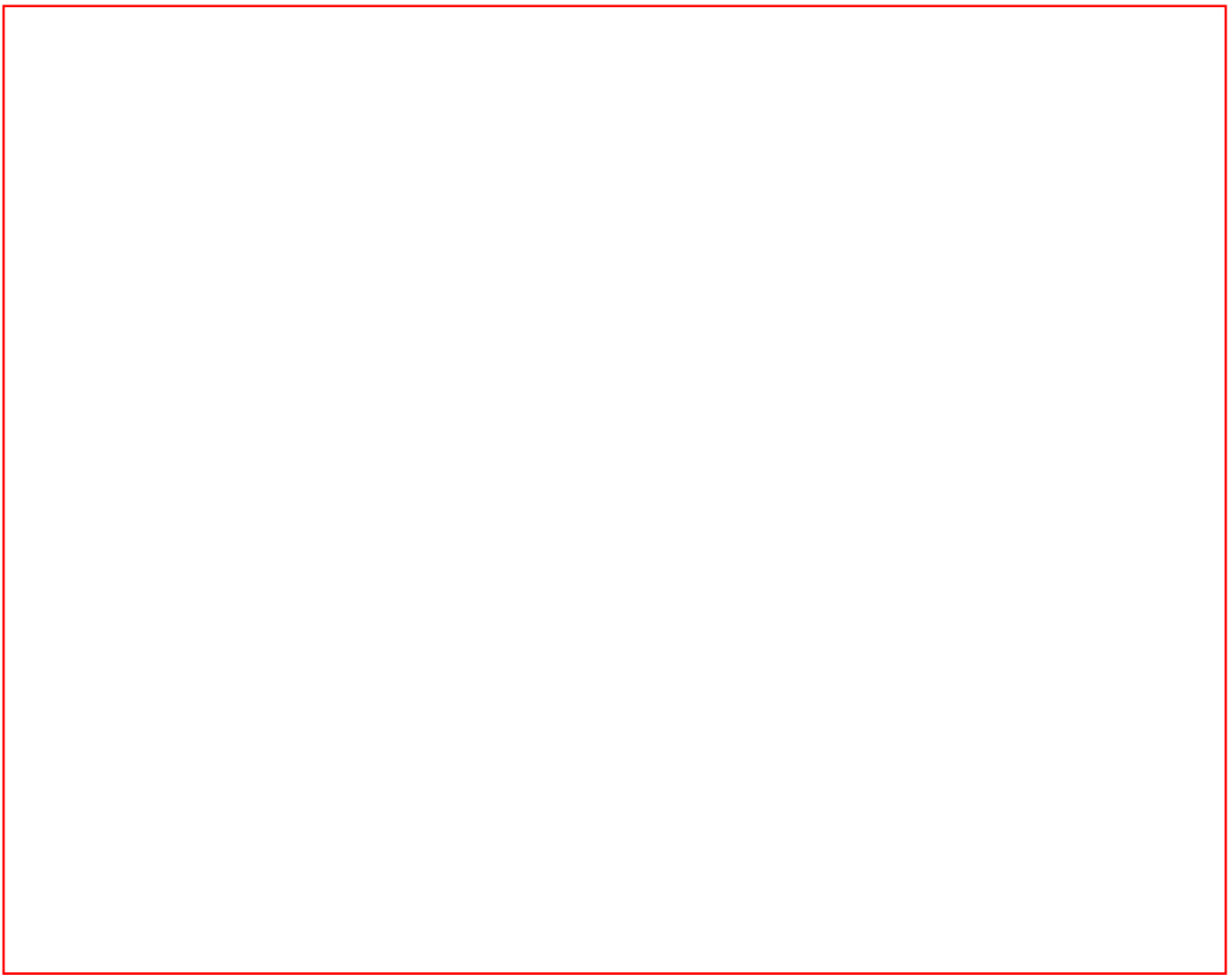


#### Note

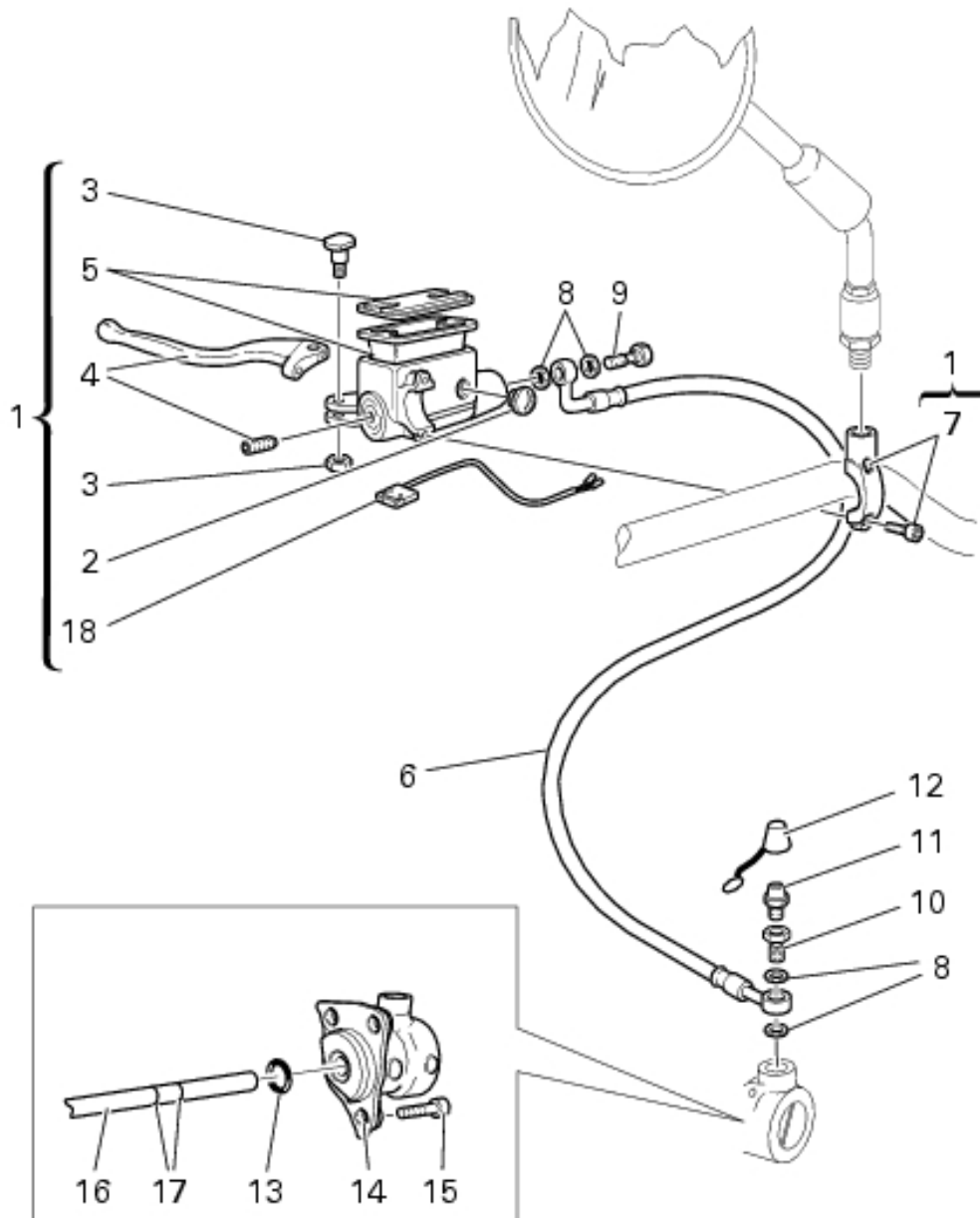
Refer to the figures on the next pages for the correct routing of the choke cable.

Choke/throttle cables routing






## 2 - Clutch hydraulic control



- 1 Clutch master cylinder
- 2 Spare sight glass
- 3 Spare lever pin
- 4 Lever with dowel
- 5 Spare cap
- 6 Clutch hose
- 7 Spare clamp
- 8 Gasket
- 9 Special screw
- 10 Filler
- 11 Bleed unit
- 12 Dust seal
- 13 O-ring
- 14 Clutch transmission unit
- 15 Screw
- 16 Clutch pushrod
- 17 O-ring
- 18 Microswitch

 Spare parts catalogue

[Clutch](#)

[Clutch control](#)



### Caution

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

## Removing the clutch master cylinder assembly



### Warning

Critical safety components. The clutch master cylinder manufacturer recommends that you do not attempt to service the internal components of the clutch master cylinder (1). Incorrect overhaul of these critical safety components can endanger rider safety.

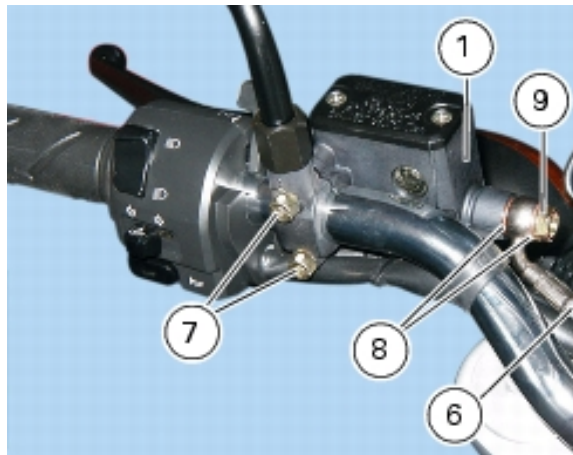
Only a limited number of master cylinder parts should be replaced, that is control lever, reservoir assembly and cylinder fasteners.

Operations	Reference See Section
Drain the clutch circuit	D 4, <a href="#">Draining the clutch circuit</a>

Undo the special screw (9) -keep the seals (8)- to release the clutch cylinder assembly (1) from the clutch control hose (6).

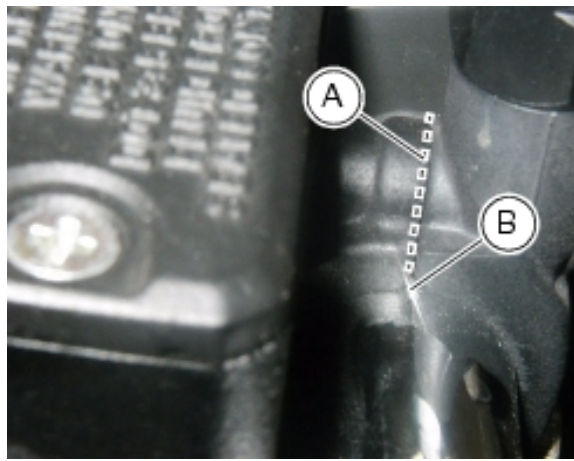
Unscrew the two screws (7) securing the master cylinder to the handlebar.

Remove the complete clutch cylinder assembly (1): please refer to exploded view diagram at the beginning of this section for clutch cylinder disassembly.



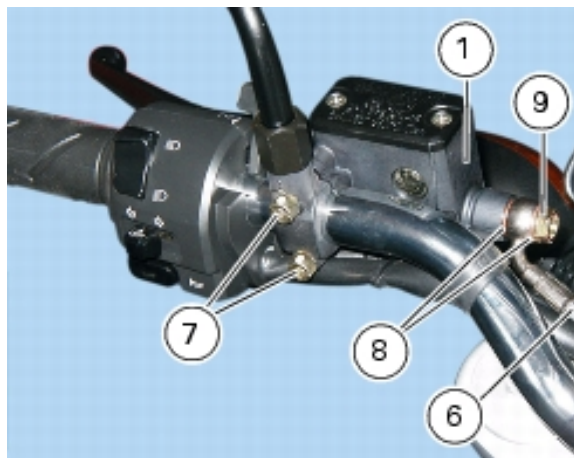
## Refitting the clutch master cylinder assembly

Fit the clutch master cylinder assembly (1). Line up the clamp / master cylinder body jointing line (A) with the dot (B) on the handlebar.



Tighten the retaining screws (7) to the specified torque (Sect. C 3, [Frame torque settings](#)) working in a 1-2-1 sequence.

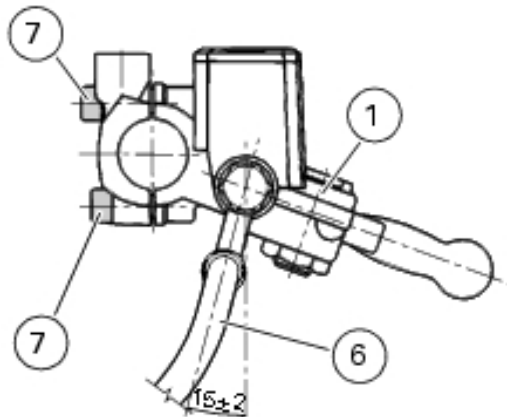
Position the pipe (6) onto the clutch cylinder assembly (1) with a seal (8) and secure with special screw (9). Do not tighten it yet.



#### Warning

Incorrectly positioned hoses can cause faults and interfere with moving parts.

Refer to the figures at the end of these section for the correct routing of the clutch hose (6) and hose ties. Position the hose (6) as shown in the figure and then tighten the special screw (9) to the specified torque (Sect. C 3, [Frame torque settings](#)).



Fill the clutch circuit

D 4, [Filling the clutch circuit](#)

## Removing the clutch transmission unit



## Warning

Critical safety components. The clutch transmission unit manufacturer recommends that you do not attempt to service the internal components of the clutch transmission unit (14).

Incorrect overhaul of these critical safety components can endanger rider and passenger safety.

Only a limited number of transmission unit parts should be replaced, that is bleed unit, seal and complete piston.

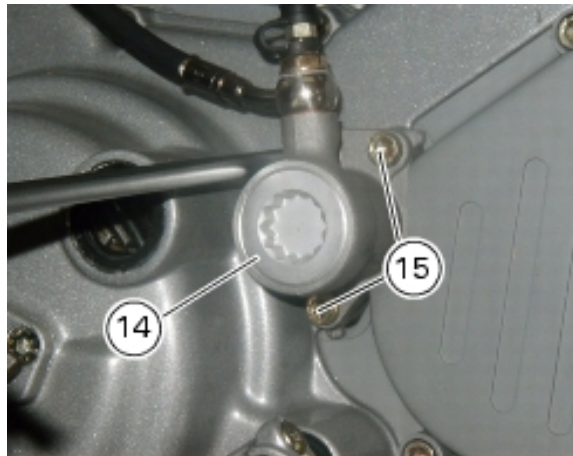
Operations

Reference See Section

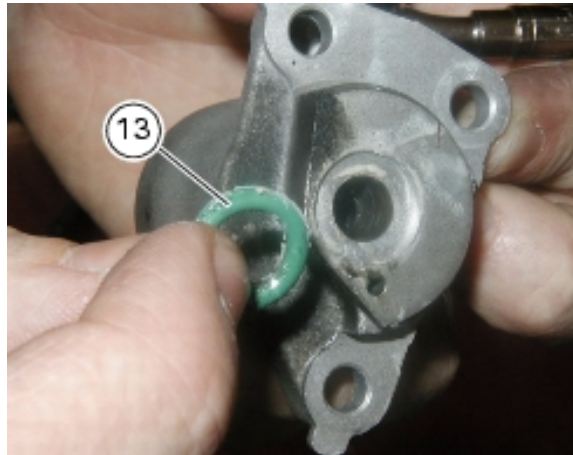
Drain the clutch circuit

D 4, [Draining the clutch circuit](#)

Unscrew the 3 screws (15) fixing the clutch transmission unit (14) to the engine.



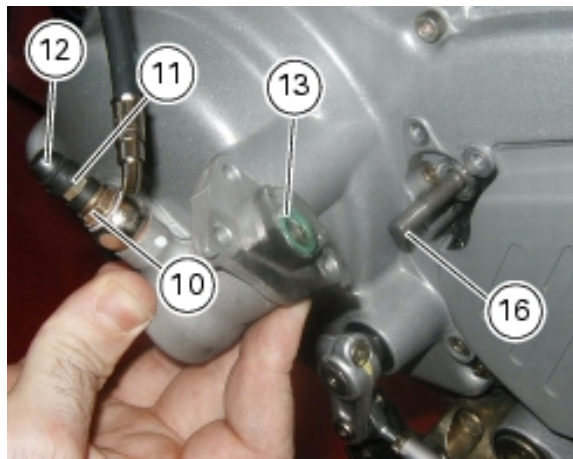
Withdraw the unit from the casing. Be careful of the O-ring (13) placed inside.



Remove the dust seal (12) and the bleed unit (11), loosen the screw (10) and then collect the seals (8): the unit (14) is now released from hose (6).

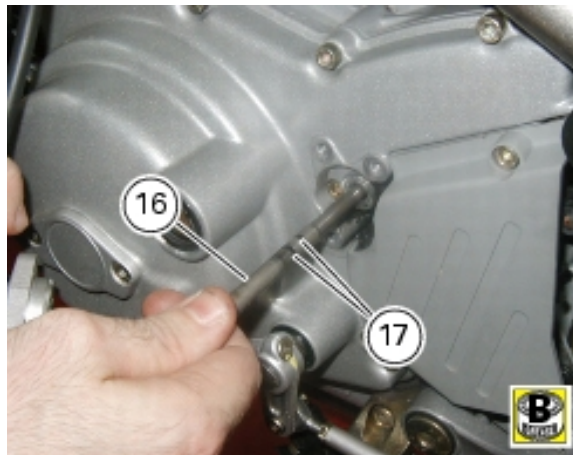
Push in the piston to expel all fluid inside the unit.

The clutch pushrod (16) can now be removed. Check the two O-rings (17) for wear and replace, if necessary.

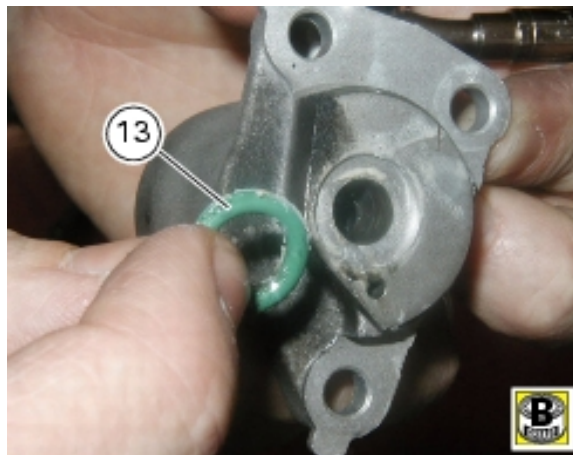


Refitting the clutch transmission assembly

Lubricate and refit the clutch pushrod (16) with both O-rings (17).

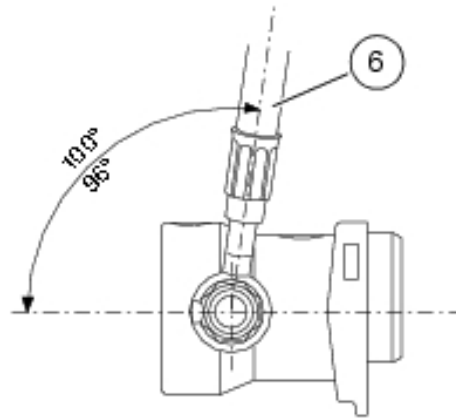


Lubricate the seal (13) and fit with the transmission unit (14) onto the casing.



Tighten the screws (15) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Position the hose (6) onto the clutch transmission unit (14). Ensure the hose fitting is properly positioned onto the unit (14).

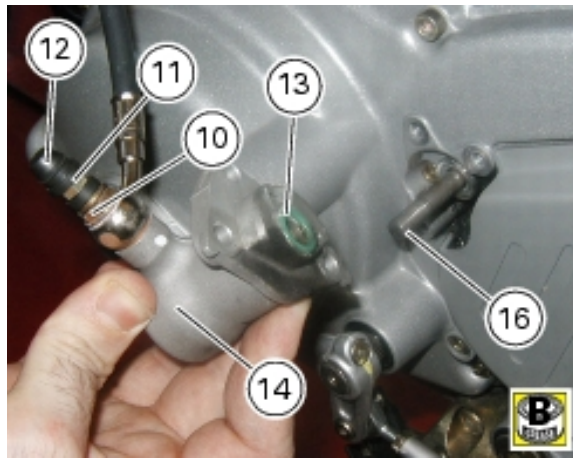
**Warning**

Incorrectly positioned hoses can cause faults and interfere with moving parts.

Position both seals (8) and tighten the screw (10) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Refit the drain (11) and the dust seal (12).

Please refer to the table on next page for proper positioning of clamps for hose (6).



Operations	Reference See Section
Fill the clutch circuit	D 4, <a href="#">Filling the clutch circuit</a>

**Warning**

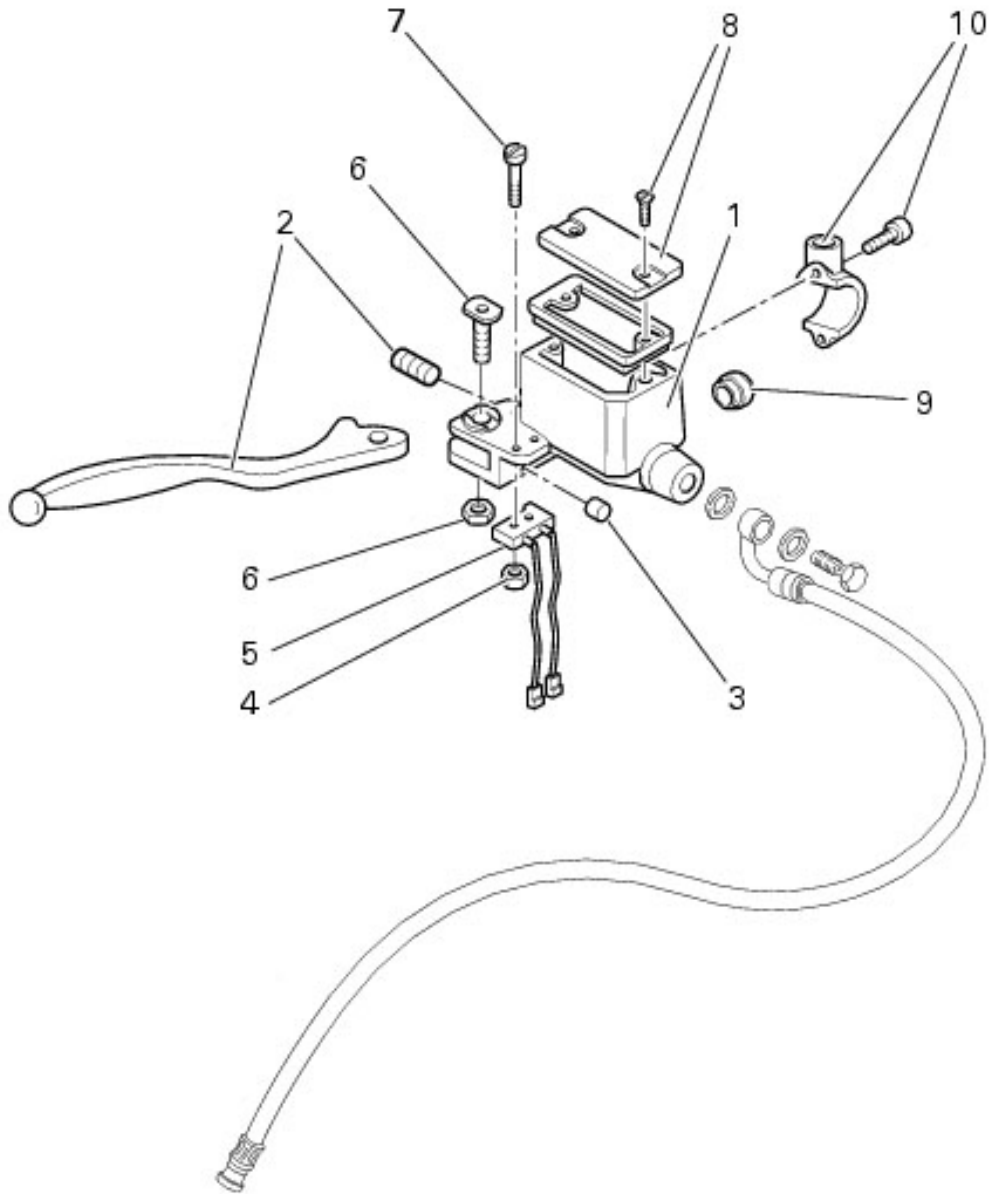
Lubricate the O-ring (13) and the pushrod (16) before reassembly.

Clutch hose routing






### 3 - Front brake control



- 1 Front brake master cylinder
- 2 Lever with dowel
- 3 Rubber pad
- 4 Nut
- 5 Microswitch
- 6 Spare lever pin
- 7 Screw
- 8 Spare cap
- 9 Spare sight glass
- 10 Spare clamp

 Spare parts catalogue

[Front brake](#)

 Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

## Removing the front brake master cylinder



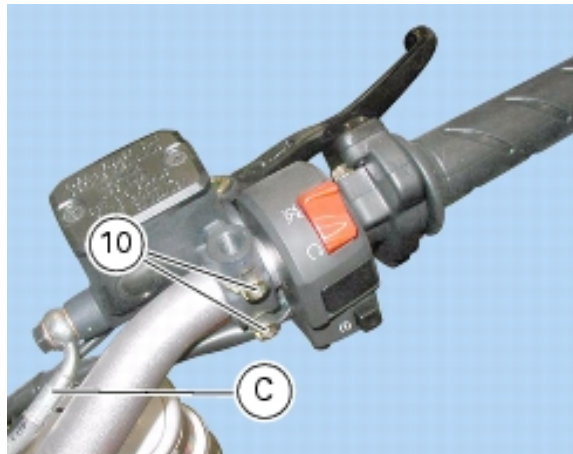
### Warning

Critical safety components. The brake master cylinder manufacturer recommends that you do not attempt to service the internal components of the brake master cylinder. Incorrect overhaul of these critical safety components can endanger rider and passenger safety.

Maintenance operations on these units are limited to replacing: control lever, reservoir unit and reservoir and cylinder fasteners.

Operations	Reference See Section
Draining the braking system	D 4, <a href="#">Filling the brake circuit</a>
Disconnect the brake line from master cylinder	G 3, <a href="#">Removing the front brake system</a>

Unscrew the retaining screws (10) and remove the front brake master cylinder unit (1) from the handlebar.



Please refer to the exploded view at the beginning of this section for indications on disassembly of master cylinder (1) components.

## Refitting the front brake master cylinder

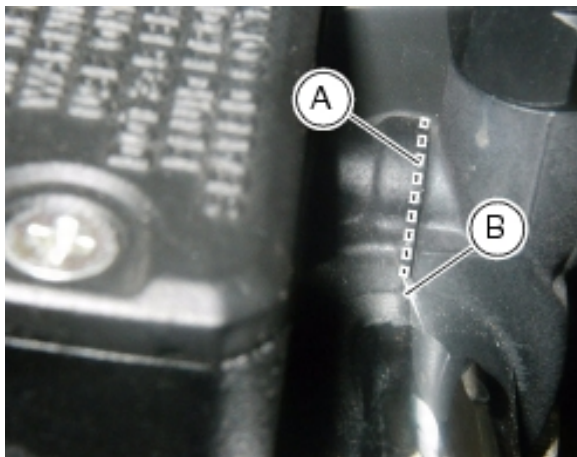


### Warning

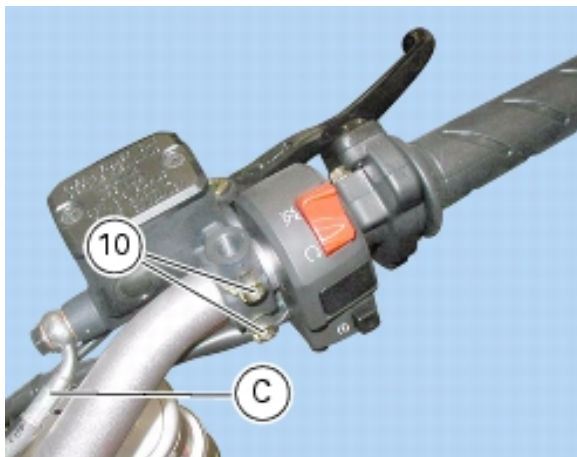
Incorrectly positioned hoses can cause brake faults and interfere with moving parts. Correct position is shown in the

diagram.

Line up the clamp / master cylinder body (1) split line (A) with the dot (B) on the handlebar.

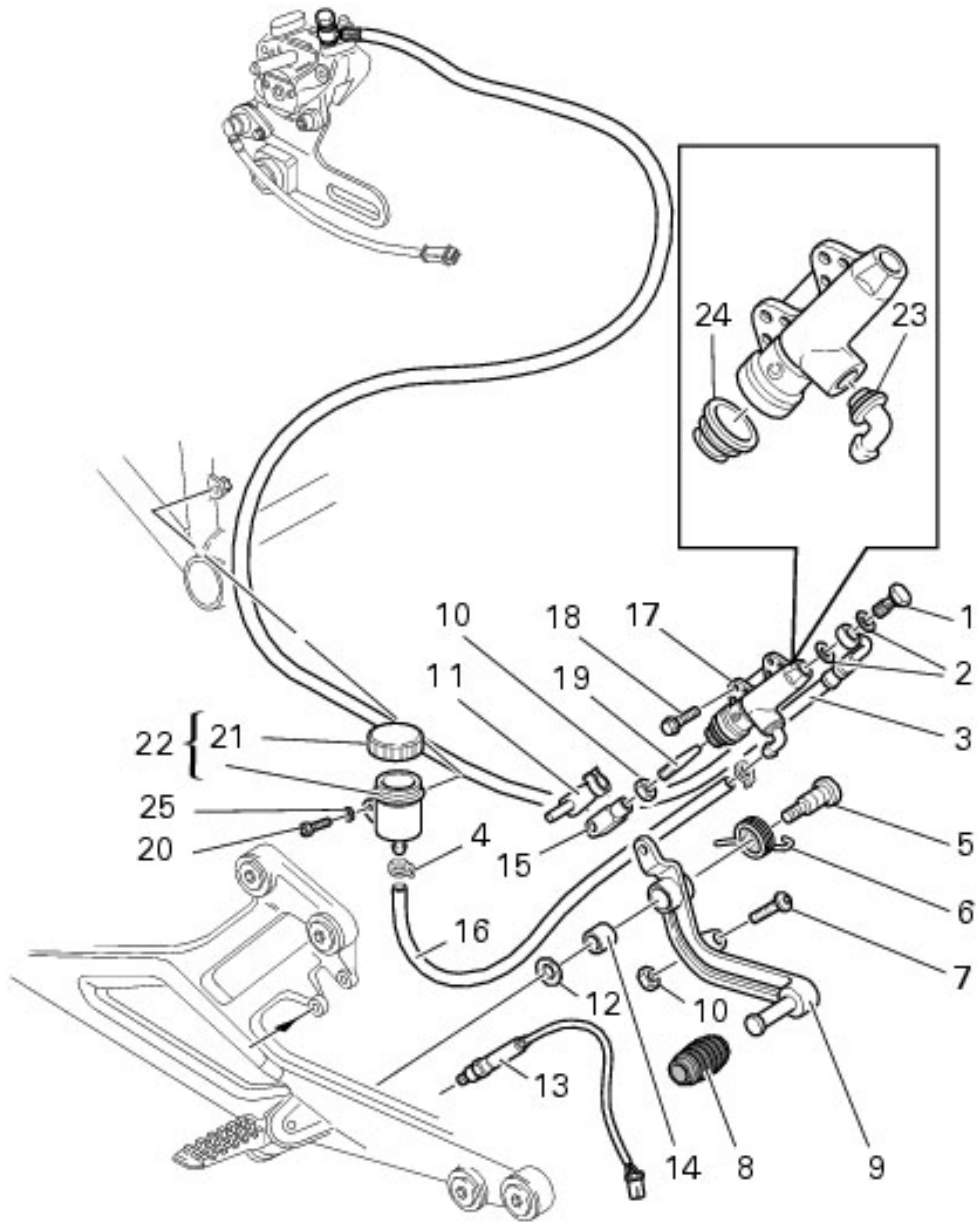


Fit the two screws of the clamp (10) securing front brake master cylinder to the handlebar. Tighten U-bolt (10) screws to the specified torque (Sect. C 3, [Frame torque settings](#)) starting from the top one, indicated with an arrow, and then proceeding in a 1-2-1 sequence. If hose (C) has been disturbed, follow indications as specified under Sect. G 3, [Refitting the front brake system](#).




Operations	Reference See Section
Connect the brake line to master cylinder	G 3, <a href="#">Refitting the front brake system</a>
Fill the braking system	D 4, <a href="#">Filling the brake circuit</a>

## 4 - Rear brake control



- 1 Special screw
- 2 Seal, thk.1
- 3 Rear brake hose
- 4 Clamp
- 5 Pin
- 6 Spring
- 7 Special screw
- 8 Rubber block
- 9 Brake lever
- 10 Nut
- 11 Clip
- 12 Washer
- 13 Switch
- 14 Bush
- 15 Clevis pin
- 16 Hose
- 17 Rear brake cylinder
- 18 Screw

- 19 Adjuster rod
- 20 Screw
- 21 Blanking plug
- 22 Complete brake fluid reservoir
- 23 Spare connector
- 24 Dust cap
- 25 Washer

 [Spare parts catalogue](#)

[Rear brake](#)



### Caution

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

### Removing the rear brake master cylinder

Operations	Reference See Section
Drain the brake circuit	D 4, <a href="#">Draining the braking circuit</a>



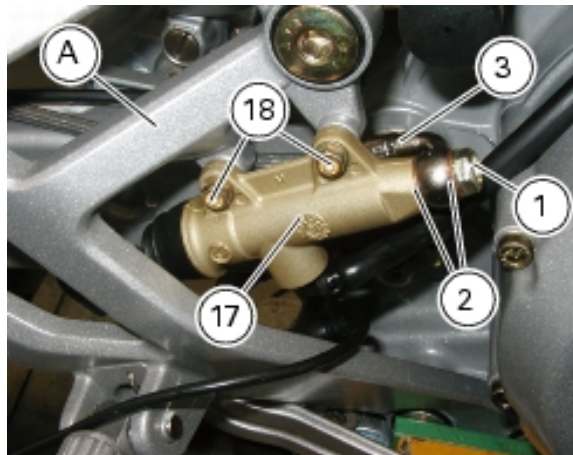
### Warning

Critical safety components. The brake master cylinder manufacturer recommends that you do not attempt to service the internal components of the brake master cylinder. Incorrect overhaul of these critical safety components can endanger rider safety.

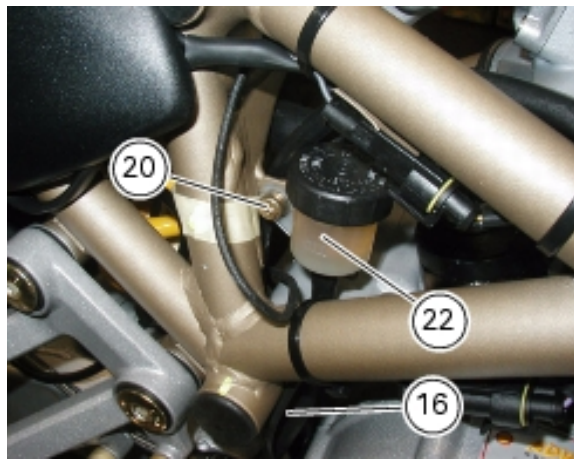
Maintenance operations on these units are limited to replacing: control lever, reservoir unit and reservoir and cylinder fasteners.

Unscrew the retaining screws (18) of the rear brake cylinder (17) from the footpeg plate (A).

Unscrew the special screw (1) from the brake cylinder (17) and collect the two washers (2).

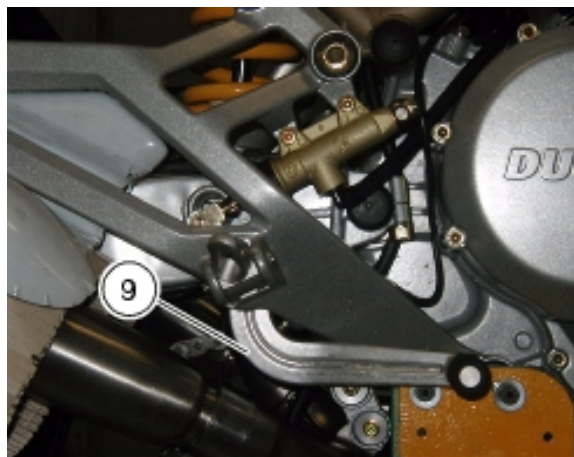
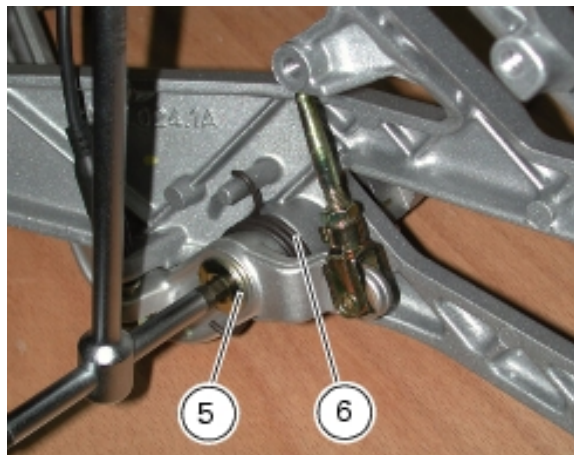


Unscrew the screw (20), making sure to collect the washer (25). Remove the reservoir (22) together with the hose (16).



Remove the footpeg plate (Sect. H 4, [Removing the footpegs](#)).

Withdraw the retaining pin (5) securing the rear brake lever to the footpeg bracket. Remove the spring (6), the complete brake lever (9) and the washer (12).

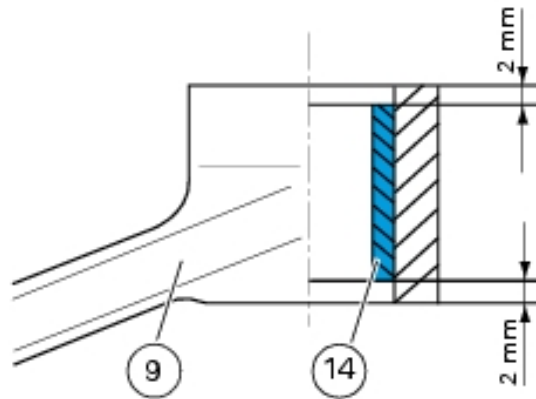


### Disassembling the rear brake control

The spare brake master cylinder is supplied as a complete assembly. The inner components may not be replaced individually.

Please refer to the exploded view at the beginning of this section for indications on disassembly of master cylinder outer components.

If the bush (14) inside the brake pedal (9) needs replacing, drive the replacement bush in place using a press. The bush must be seated **2 mm** deep below pedal outer face.



Remove the system component parts as shown in the exploded view at the beginning of this section.



### Warning

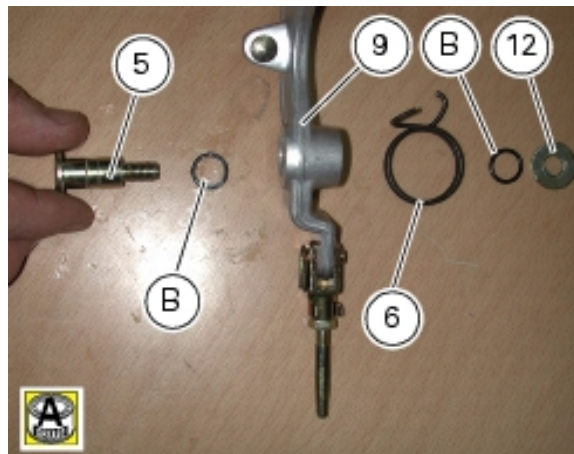
After servicing the rear brake control, check the brake pedal position following the instructions given in Sect. D 4, [Adjusting the position of the gear change and rear brake pedals](#).

### Refitting the rear brake master cylinder

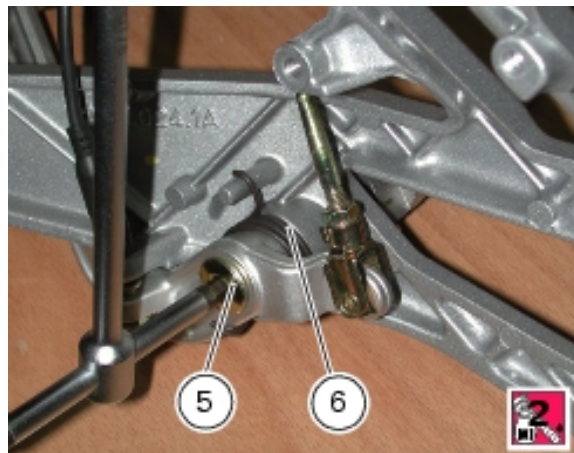
Lubricate the O-ring (B) and fit it to the pin (5).

Lubricate the other O-ring (B).

Refit the pin (5) to the brake pedal lever (9), insert the spring (6), the other O-ring (B) and the washer (12).



Apply threadlocker to the thread of the pin (5).



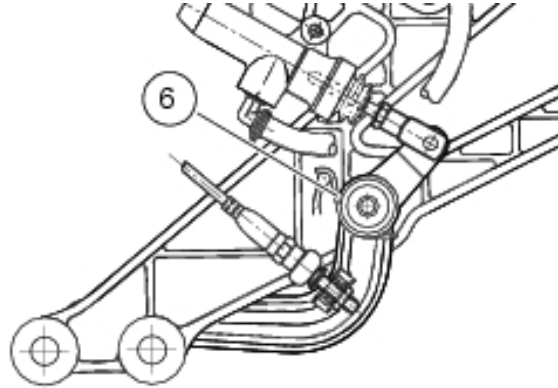
Install the footpeg plate to the frame (Sect. H 4, [Refitting the footpegs](#)).

Installation is a reversal of the removal procedure.



Caution

The correct position of the spring (6) is shown in the diagram.



Ensure that hose connecting brake master cylinder to caliper is correctly positioned as shown on next page.

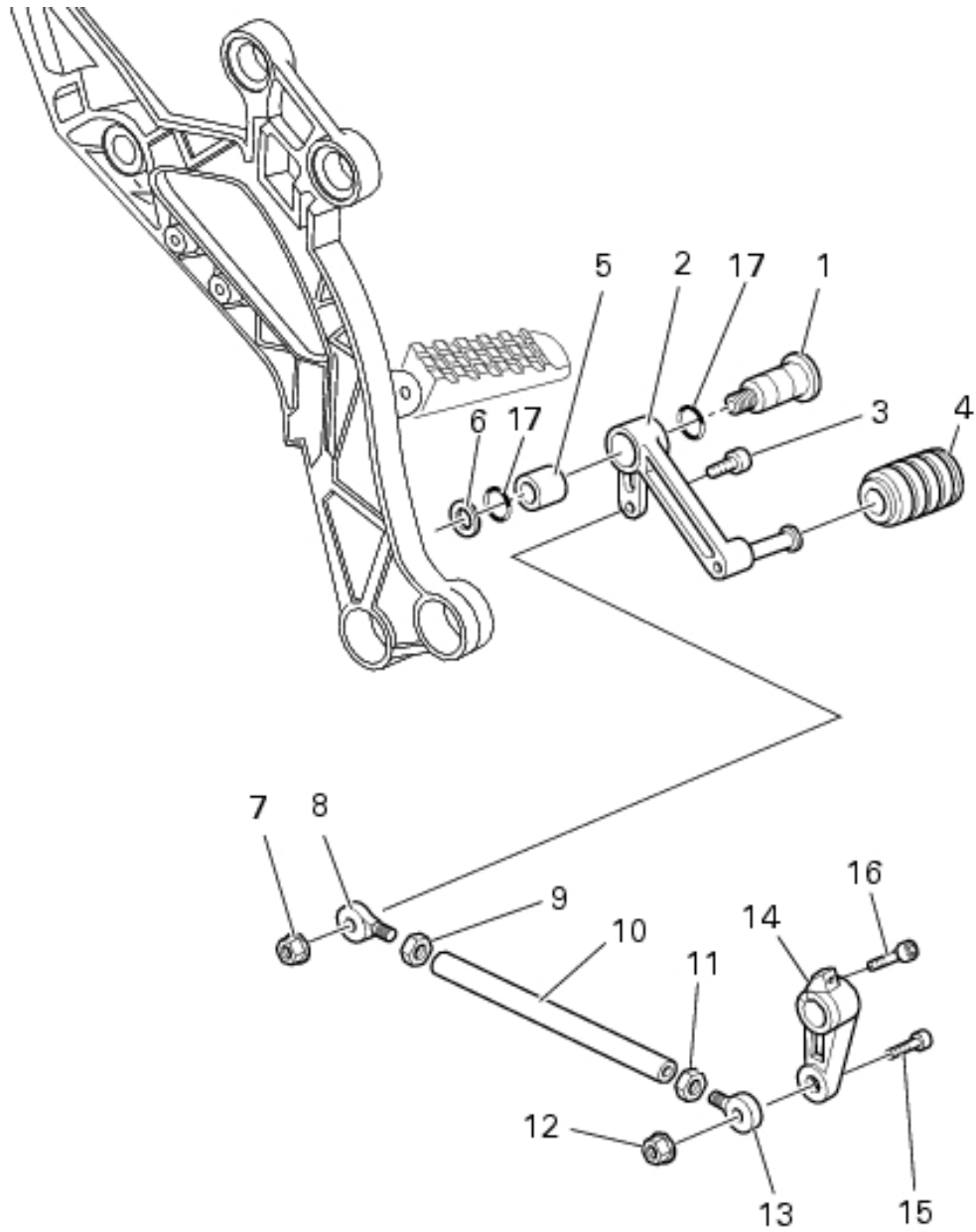
Operations	Reference See Section
Fill the braking system	D 4, <a href="#">Filling the brake circuit</a>

Rear brake hose routing





## 5 - Gear change control



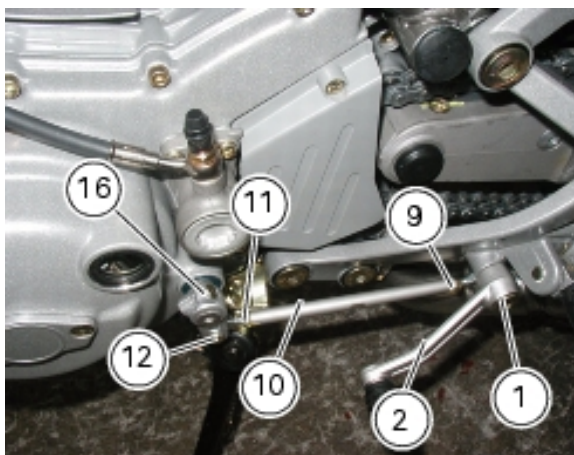
- 1 Pivot bolt
- 2 Gear change pedal
- 3 Screw
- 4 Rubber block
- 5 Bush
- 6 Washer
- 7 Nut
- 8 Ball joint
- 9 Nut
- 10 Actuating rod
- 11 Nut
- 12 Nut
- 13 Ball joint
- 14 Gear small lever
- 15 Screw
- 16 Screw
- 17 O-ring

[Gearchange lever - foot rest](#)
 Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Removing the gear change control

Unscrew and remove the retaining pin (1) of the gear change pedal (2), collect the washer (6) and the O-rings (17). Unscrew and remove the screw (16) securing the small lever to the gearbox shaft.

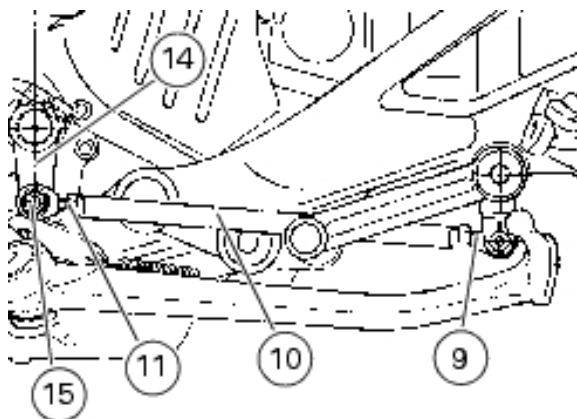


Withdraw the small lever (14) together with the gear change control assembly.

 Note

Mark small lever (14) position relative to the gear selector shaft.

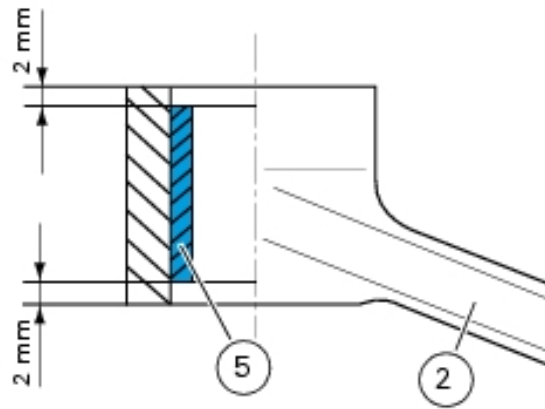
To remove the small lever (14) from the gear change control assembly, unscrew the screw (15).



### Disassembling the gear change control

Please refer to the exploded view at the beginning of this section for indications on disassembly and replacement of gear change control components.

If the bush (5) inside the pedal (2) needs replacing, drive the replacement bush in place using a press. The bush must be seated **2** mm deep below pedal outer face.



**Warning**

After servicing the gear change control, check the gear change pedal position.

To adjust the gear change pedal, follow the instructions provided in Sect. D 4, [Adjusting the position of the gear change and rear brake pedals](#).

**Refitting the gear change control**

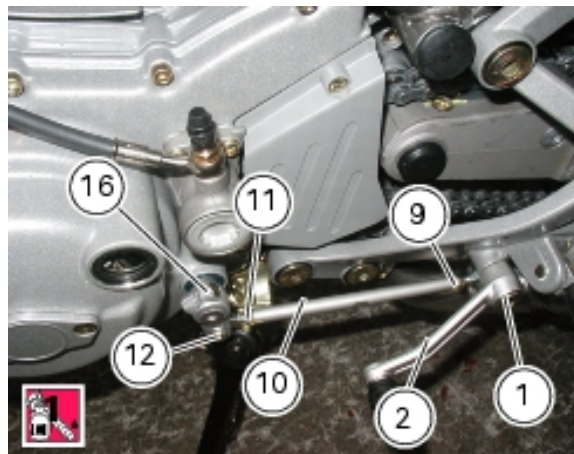
To refit, reverse the removal procedure.



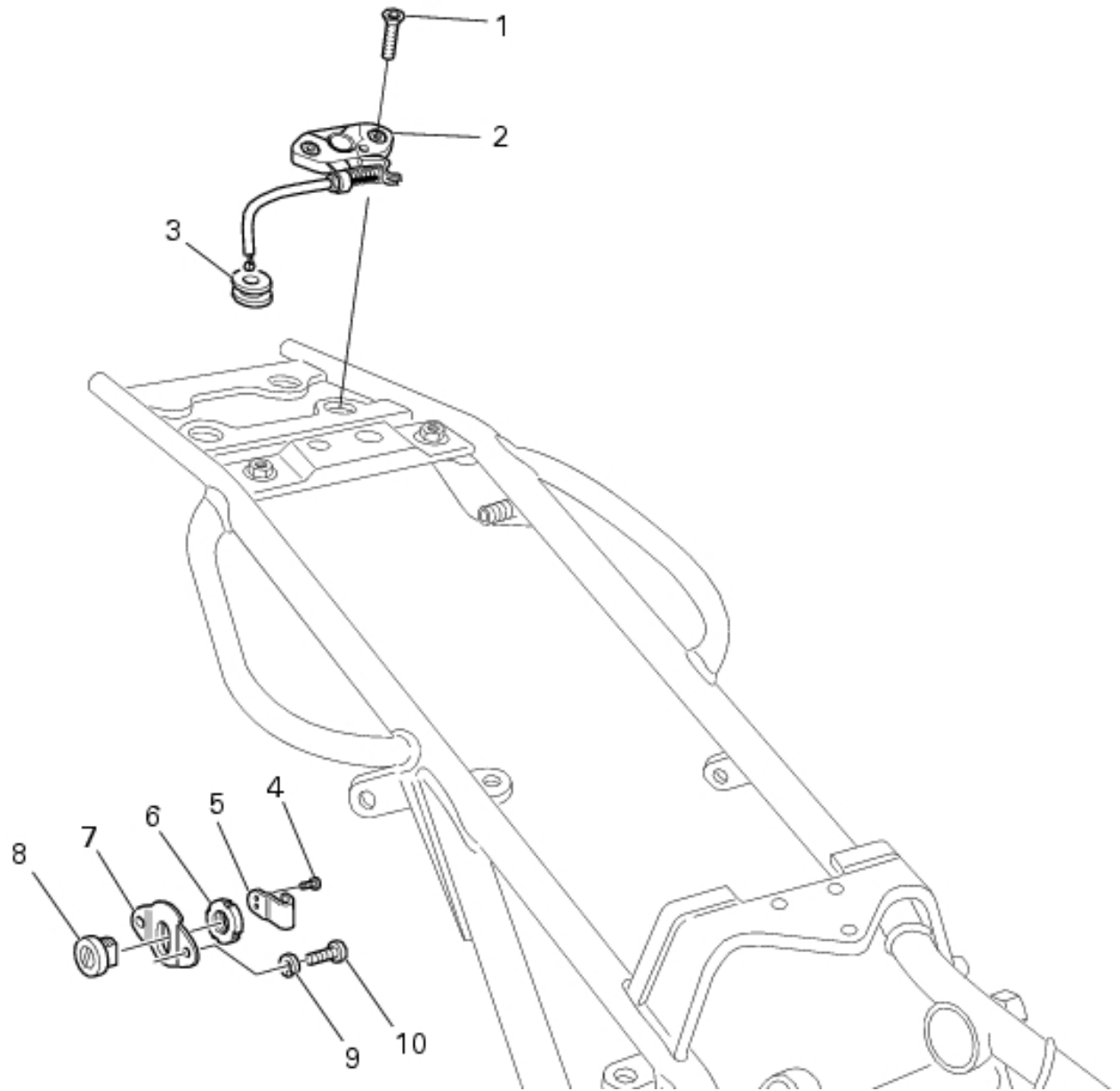
**Note**

On refitting, always renew O-rings (17).


Apply threadlocker to the screw (16), the pin (1) and the screw (15) and then tighten them to the specified torque (Sect. C 3, [Frame torque settings](#)).



## 6 - Seat lock and releasing mechanisms



- 1 Screw
- 2 Latch
- 3 Rubber block
- 4 Screw
- 5 Lever
- 6 Ring nut
- 7 Plate
- 8 Seat lock
- 9 Spring washer
- 10 Screw

 Spare parts catalogue

[Seat](#)

 Caution

**Bold reference numbers** in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Removing the seat releasing mechanism

The seat releasing mechanism is best accessed with the seat removed (Sect. E 3, [Removing the seat](#)). Remove the seat lock assembly (8).



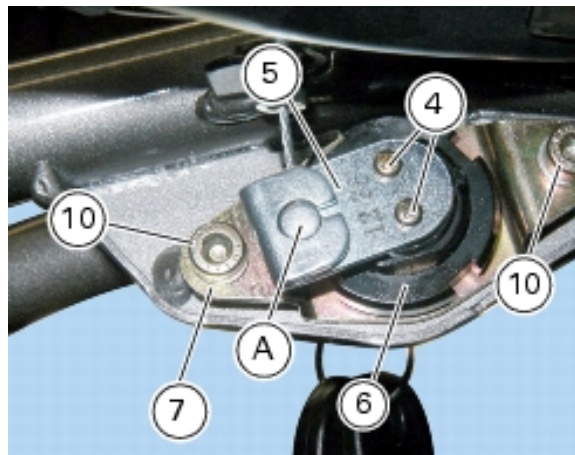
Unscrew the two retaining screws (4) and remove the seat lock lever (5). Release the nipple (A) of the Bowden cable of the lever (5). Unscrew the retaining screws (10) and remove the seat lock assembly.



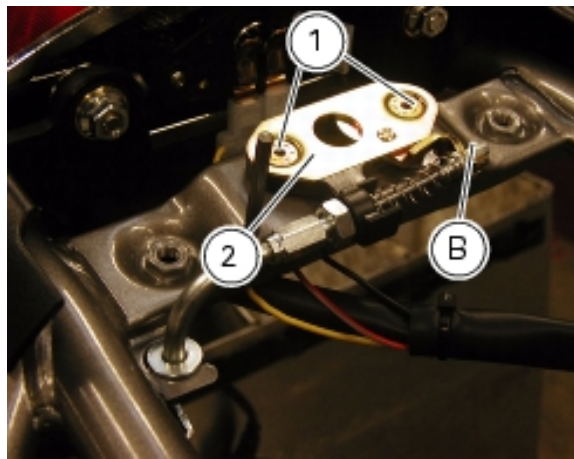
#### Note

Make sure to collect the two spring washers (9) placed between the two screws (10) and the plate (7) when disassembling.

Loosen the ring nut (6) and withdraw the lock (8) from the plate (7).



Unscrew the retaining screws (1) and remove the latch (2) from the frame. Release the Bowden cable nipple (B) from the latch.

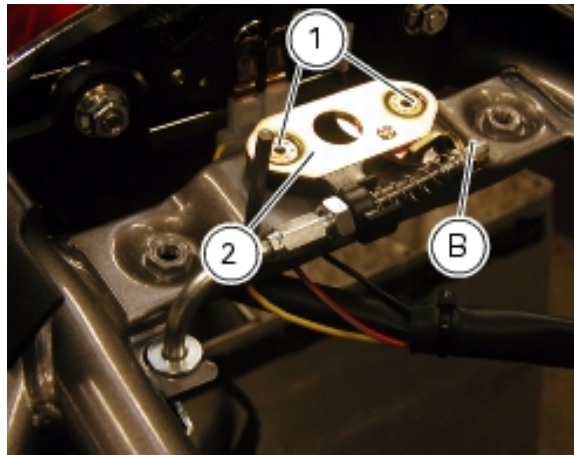


## Refitting the seat releasing mechanism



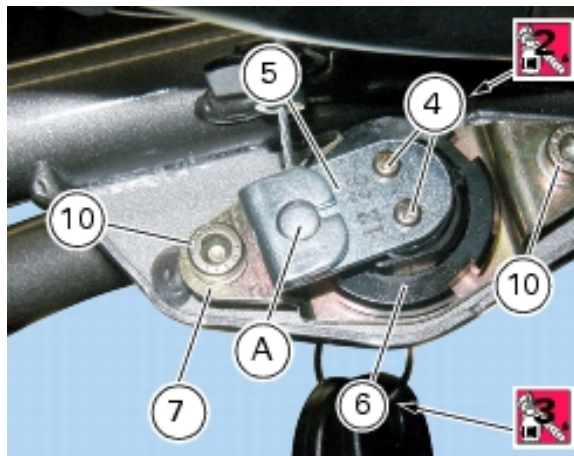
### Note

The spare latch (2) comes complete with Bowden cable. Latch and Bowden cable should never be separated.



Installation is a reversal of the removal procedure. Smear threadlocker on ring nut (6) and screws (4).

If you have removed the seat, refit it (Sect. E 3, [Refitting the seat](#)) and then lower the seat and check that the latch (2) is locking the pin of the rear support fixed to the seat and that the Bowden cable is not trapped.



# 0Controls - Devices

## 1 - Throttle control – choke 3

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## 3 - Front brake control 17

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Disassembling the rear brake control 23

Refitting the rear brake master cylinder 24

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Removing the gear change control 27

Disassembling the gear change control 28

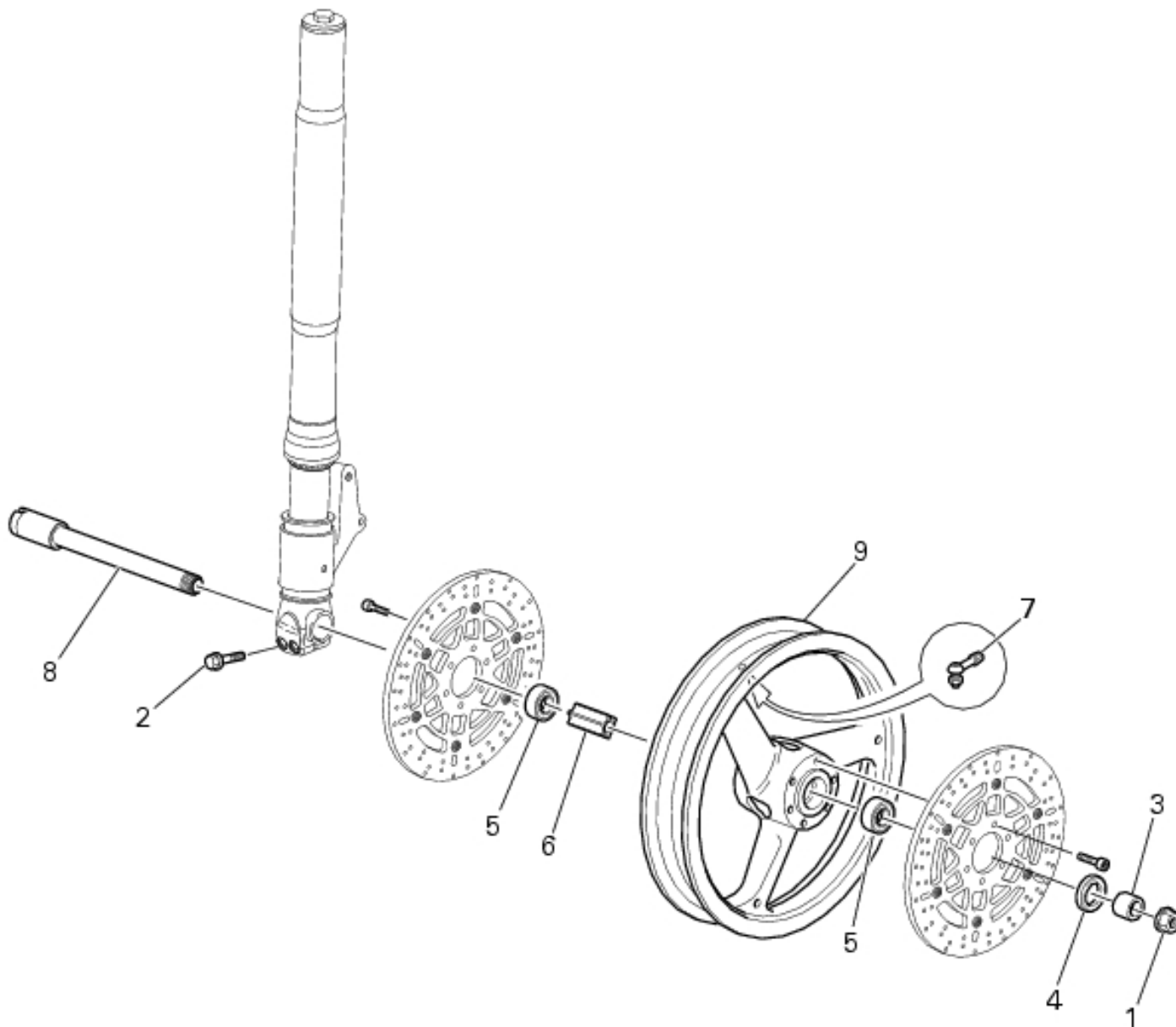
Refitting the gear change control 29

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# 1 - Front wheel



- 1 Nut
- 2 Screw
- 3 Spacer
- 4 Seal
- 5 Bearing
- 6 Inner spacer
- 7 Valve
- 8 Front wheel shaft
- 9 Front wheel rim

 Spare parts catalogue

[Front fork](#)

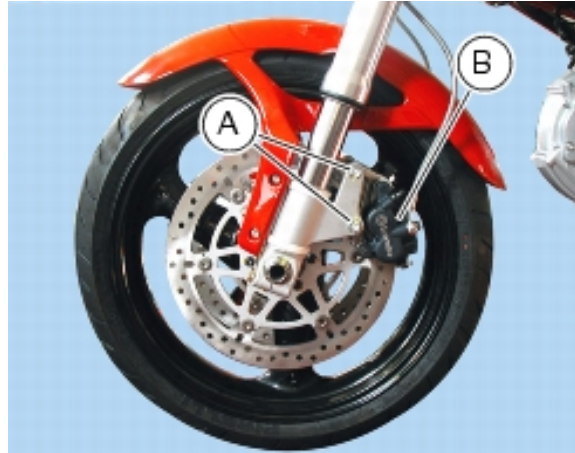
[Front and rear wheels](#)

 Caution

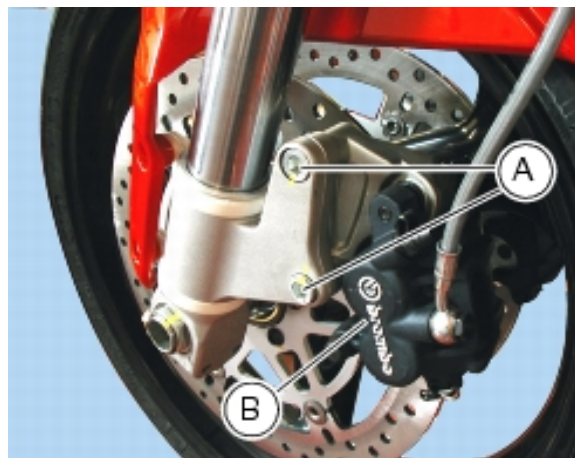
Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Removing the front wheel

Support the bike adequately so that the wheel to be removed is raised from the ground.  
Loosen the two screws (A) securing the caliper to the fork leg and remove the front brake caliper (B).



Repeat the process for the other caliper.  
Do not disconnect the hoses.



#### Warning

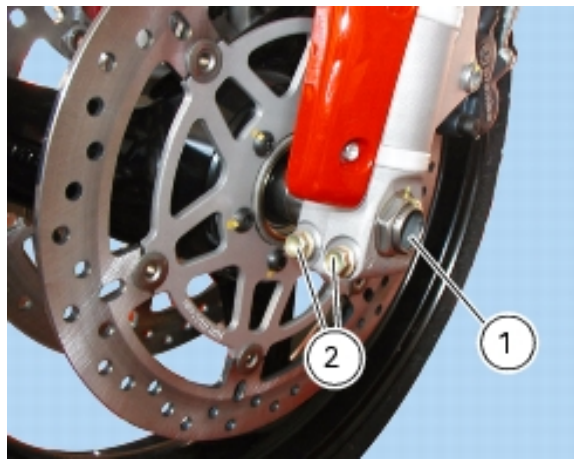
Do not operate the brake lever when the calipers are disassembled or fluid will leak out from the actuating pistons.



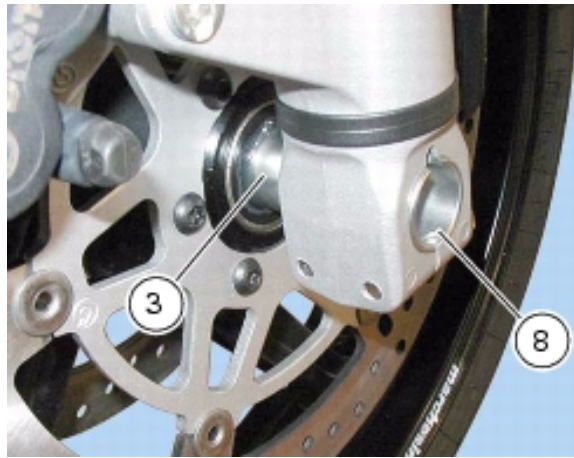
#### Note

The figures show the motorcycle with the front mudguard removed. However, the front wheel may also be removed with the front mudguard in place.

Undo and remove the nut (1) on the LH end of the wheel shaft.  
Loosen the shaft pinch bolts (2) on the fork legs.



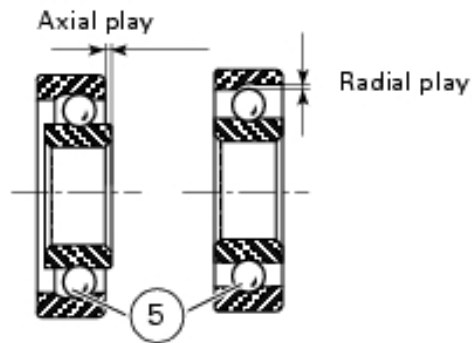
Working from the left side, use a plastic hammer to knock the wheel shaft (8) out to the other side. Slide the wheel out. Collect the spacer (3) on the LH side.



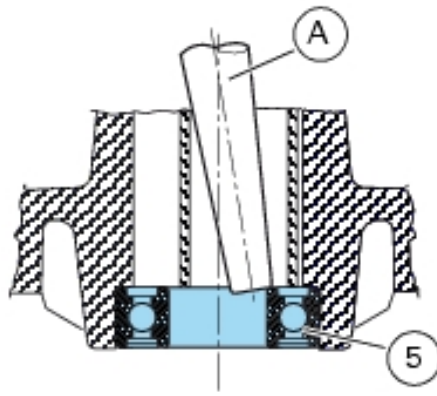
## Overhauling the front wheel

### Overhauling the front wheel bearings

Before checking dimensions, check wear on wheel hub bearings. Check for wear by hand with the bearing in its seat. Clean and degrease bearing first. Turn the inner ring. Check the amount of radial and axial play. Excessive play will cause vibration and make the bike unstable. Change any badly worn bearings. To remove the bearings (5) from the wheel hub, follow the instructions below.



Position a drift (A) to the inner ring of the bearing (5).



Tap with a hammer until knocking out the bearing. Apply pressure at different positions to keep the bearing square during removal.



**Caution**

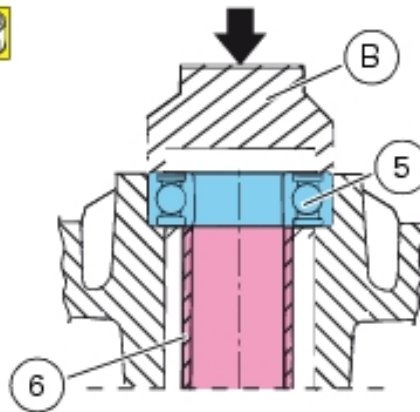
Do not refit bearings once they have been removed. Before you fit new bearings, check that the seat is clean and free from scoring and damage.

Grease the bearing seat and then push the bearing into the seat.



**Warning**

Do not smear the friction rotor of the brake disc with grease, as this will reduce braking efficiency. Using a tubular drift (B) which only exerts pressure on the bearing outer ring, drive the bearing fully into its seat. Ensure that the spacer (6) is in place between the two wheel hub bearings.



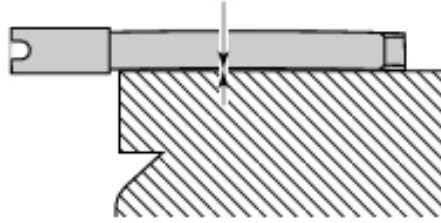
**Note**

Wheels must be rebalanced after repair, maintenance and overhaul operations.

Overhauling the front wheel shaft

Check distortion of the wheel shaft.

Roll the shaft on a surface plate and measure maximum distortion using a feeler gauge (Sect. C 1.1, [Front wheel](#)).



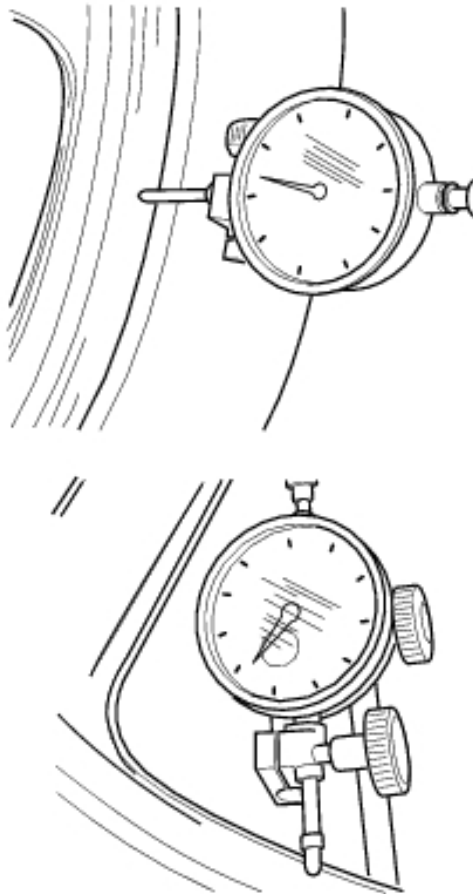
### Overhauling the front and rear wheel rim

After you have checked the bearings, check the rims as follows.

Visually inspect the rim for cracks, scoring and deformation; change the rim if damaged.

Insert the wheel shaft in the wheel and mount the shaft on two fixed reference blocks.

Using a dial gauge, measure rim run-out and out-of-round relative to wheel shaft axis (see Sect. C 1.1, [Front wheel](#)).



If the values measured are not within the limits, change the rim.

### Refitting the front wheel

When through with the necessary inspections, refit the wheel as follows.

Grease the inside of the wheel hub.

Grease the wheel shaft (8) thread and shank.

Insert the complete wheel between the fork legs.

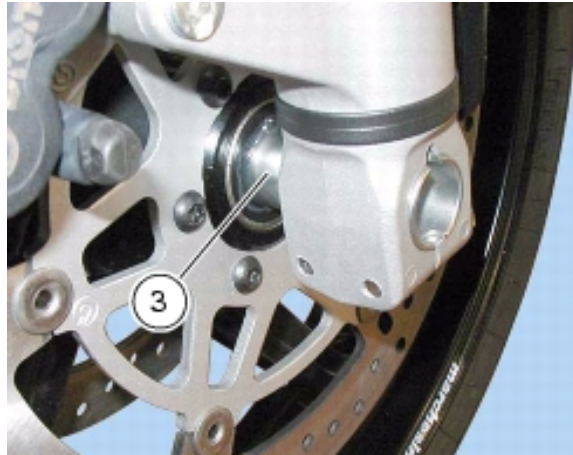


## Warning

Position the front wheel; note that the arrow on the wheel rim indicates direction of rotation when running.

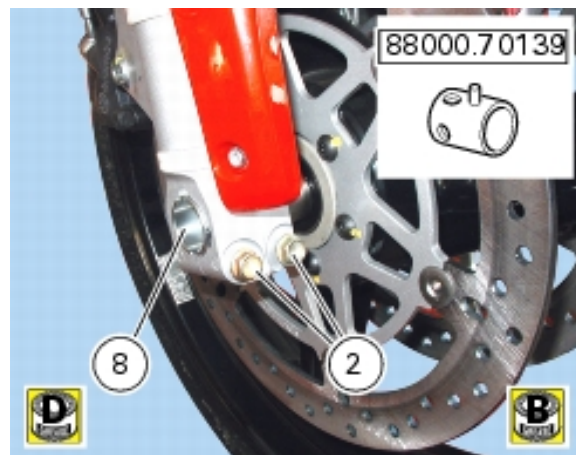
Insert the wheel shaft (8) from the right side.

Place the spacer (3) between wheel and left fork leg.



Apply service tool part no. **8000.70139** to wheel shaft (8).

Insert the shaft (8) fully home into the wheel hub; insert the peg of the service tool in the special notches at the bottom end of the fork.



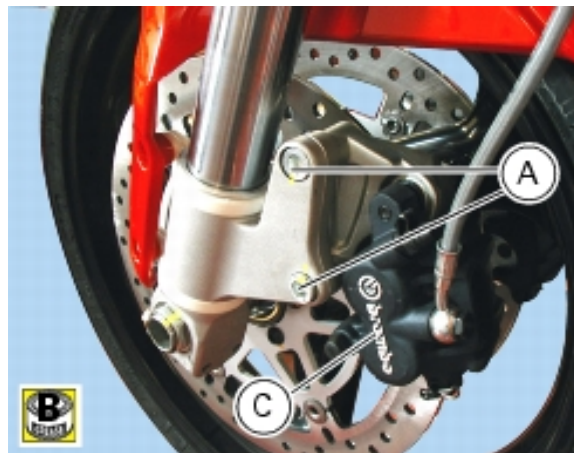
Grease the thread and underhead of shaft lock nut (1). Fit and tighten the lock nut on the end of the wheel shaft. Tighten the nut (1) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Grease the thread and underhead of the screws (A).

Tighten both brake caliper (C) screws (A).

Tighten the screws (A) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Repeat the process for the other caliper.

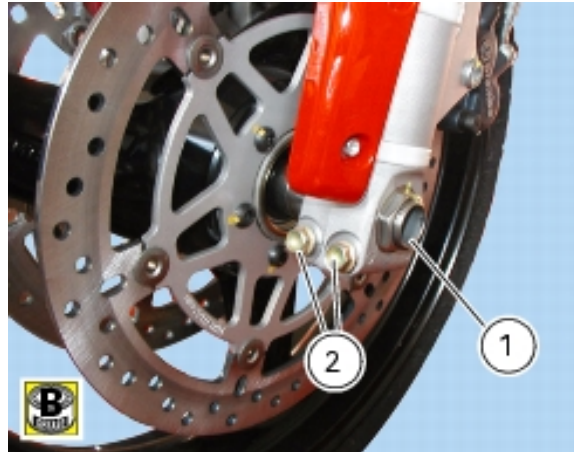


Check that the brake discs run smoothly inside the calipers.

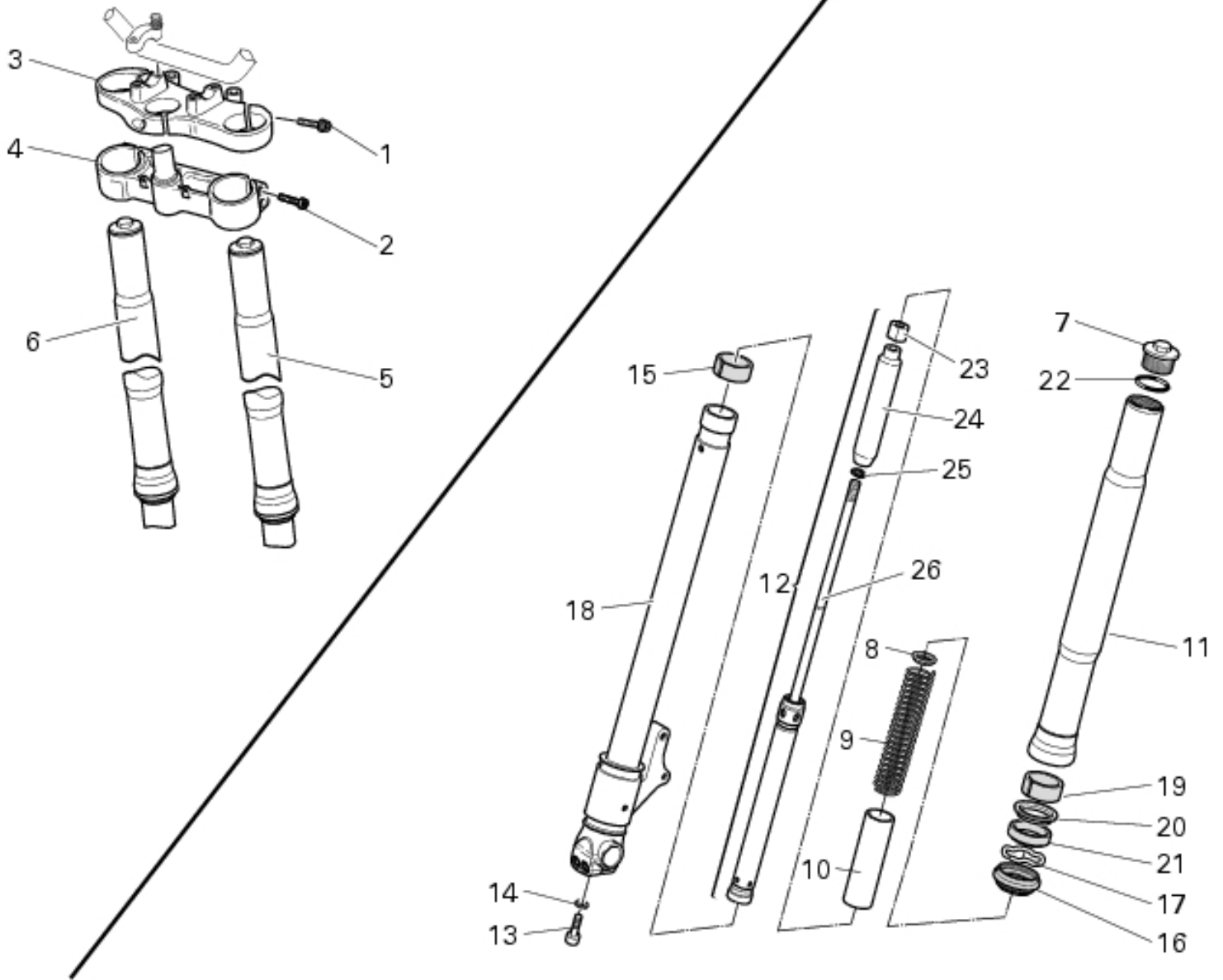
Before tightening the pinch bolts (2), lower the bike to the ground and press up and down on the handlebars to load the suspension so the fork legs will become properly seated onto the wheel shaft.

Grease the pinch bolts (2).

Tighten the pinch bolts (2) to the specified torque (Sect. C 3, [Frame torque settings](#)). Tighten in a 1-2-1 sequence.




## 2 - Front fork



- 1 Screw
- 2 Screw
- 3 Steering head
- 4 Bottom yoke
- 5 Left fork leg assembly
- 6 Right fork leg assembly
- 7 Blanking plug
- 8 Washer
- 9 Spring
- 10 Hose
- 11 Outer sleeve
- 12 Complete damper cartridge
- 13 Adjusting screw
- 14 Gasket
- 15 Bush
- 16 Dust seal
- 17 Circlip

- 18 Slider
- 19 Bush
- 20 Cap
- 21 Seal
- 22 O-ring
- 23 Lock nut
- 24 Spring guide
- 25 Circlip
- 26 Cartridge

 Spare parts catalogue

[Front fork](#)

[Handlebar and controls](#)

 Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Removing the front fork

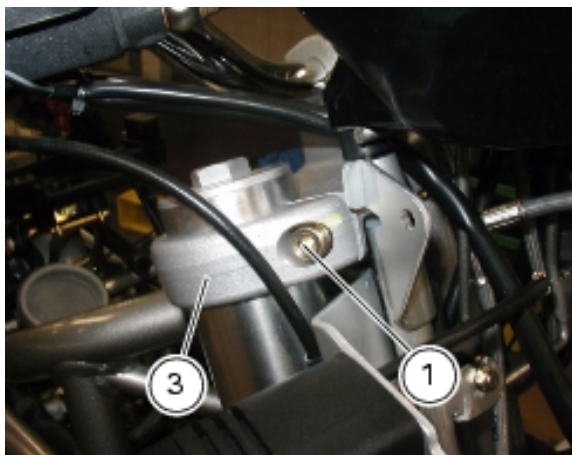
Before the front fork can be removed, you will need to remove the components listed below:

Operations	Reference See Section
Remove the front brake calipers	G 3, <a href="#">Removing the front brake system</a>
Removing the front mudguard	E 4, <a href="#">Removing the front mudguard</a>
Removing the front wheel	G 1, <a href="#">Removing the front wheel</a>

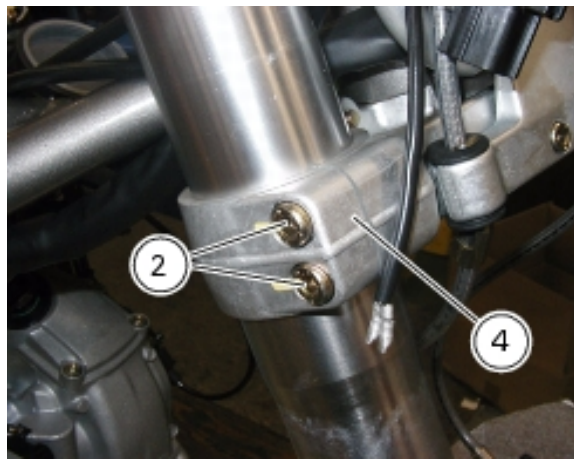
 Caution

Not all parts covered in this section are available as single spare parts but they are shown for a better understanding of the procedure.

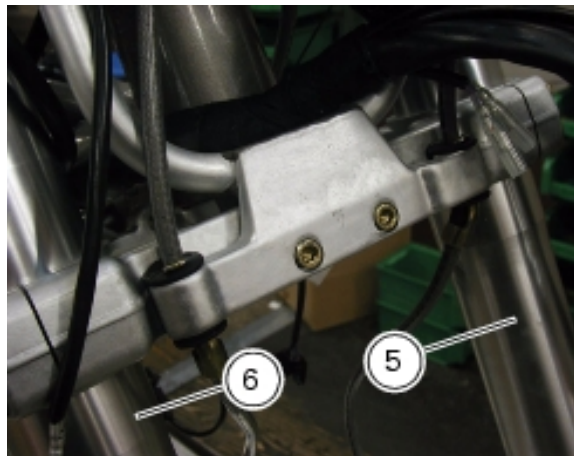
Loosen the pinch bolts (1) holding fork legs to steering head (3).



Loosen the pinch bolts (2) holding fork legs to bottom yoke (4).



Slide the fork legs (5) and (6) out downwards. Overhaul where necessary.

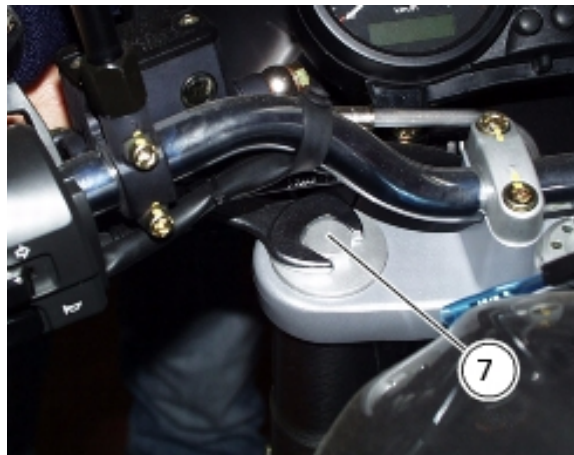


Overhauling the front fork



Note

Loosen the plug (7) on the fork leg when still fitted onto the vehicle.



Note

The special tools required for front fork overhaul are listed in Section C 4, [Frame special tools](#).

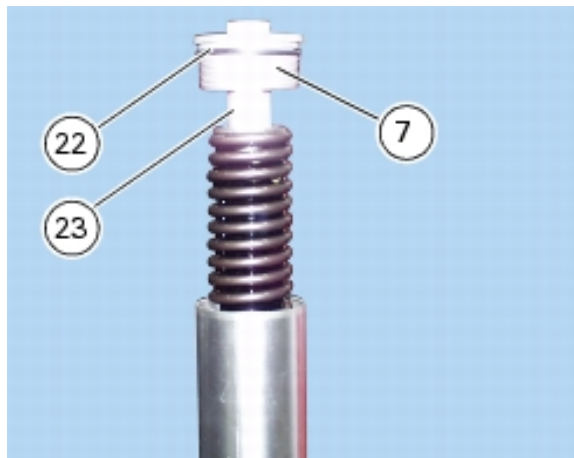
Unscrew the cap nut (7).



Disassembling the front fork

Tighten the lock nut (23) with a hexagonal wrench.

Use another hexagonal wrench and loosen plug (7) from cartridge (26), collect gasket (22).



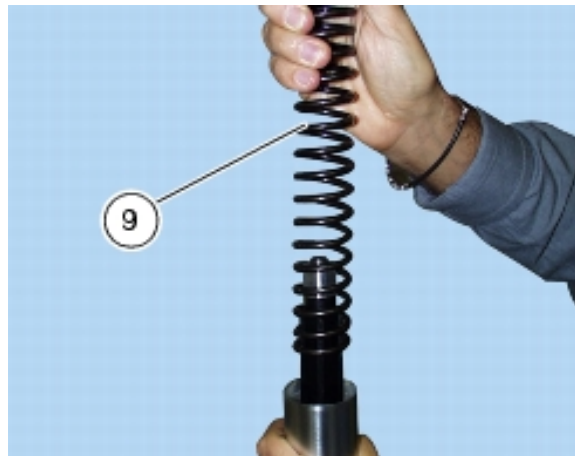
Loosen the lock nut (23), until all thread on cartridge (26) is exposed.



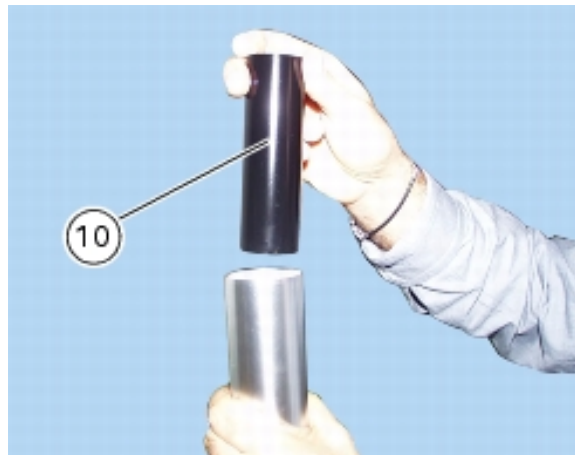
Hold the spring (9) with a hand, collect washer (8) from one side and slowly release spring (9).



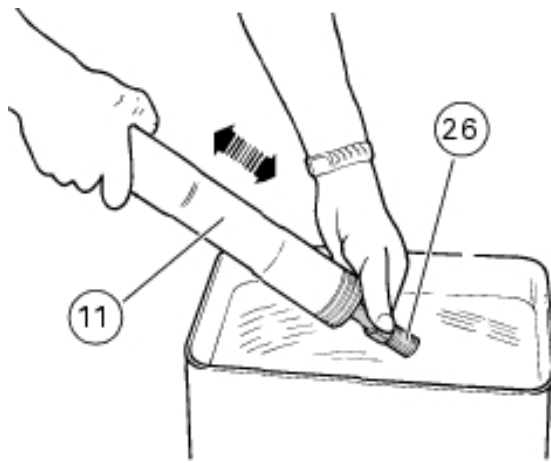
Remove the spring (9).



Remove the preload tube (10).



Pump the outer sleeve (11) and the cartridge (26) to let oil off the leg.



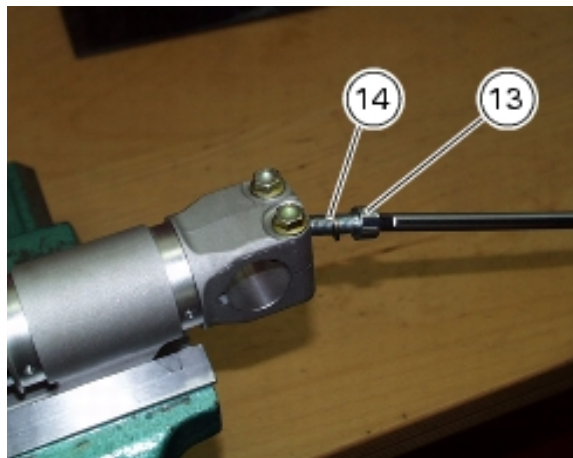
**Warning**

When pumping, oil is pressurised. Aim the fork at a container you will have prepared previously to avoid contact with fork oil.

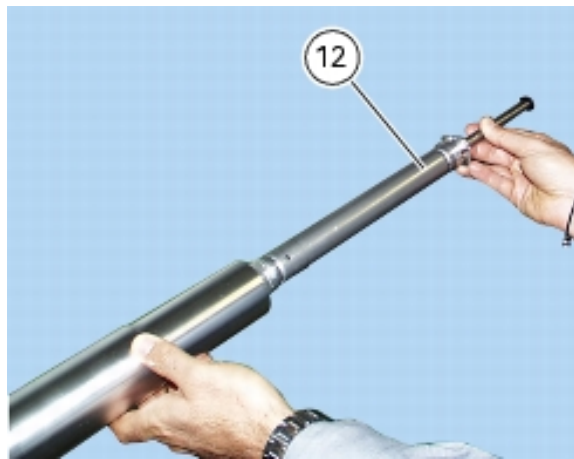
Clamp the slider (18) in a vice equipped with protection jaws.



Unscrew the compression adjuster (13).  
Remove the adjuster screw (13) and collect the seal (14).



Pull out the complete damper cartridge (12).



Remove the dust seal (16) from the outer sleeve (11) with a screwdriver.



Remove the snap ring (17).



**Caution**

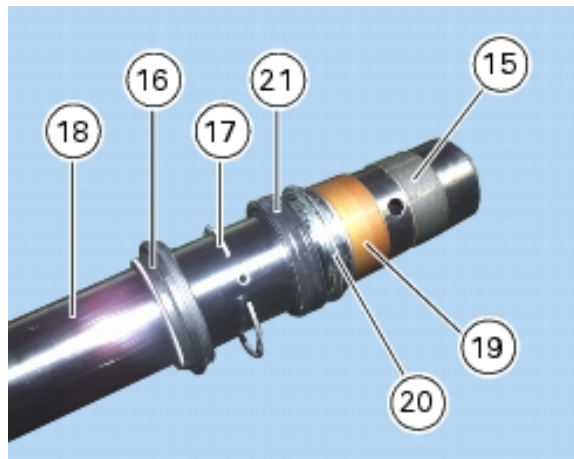
Do not damage the slider (18) and the snap ring (17) housing on the outer sleeve (11).

Pull out the outer sleeve (11) from the slider (18). Quickly tap to counteract the pilot bush (19).

Remove the bush (15) from the slider by inserting a screwdriver into the bush opening.

Remove the following parts from the slider:

- guide bush (19);
- spring cap (20);
- the oil seal (21);
- the snap ring (17);
- the dust seal (16).

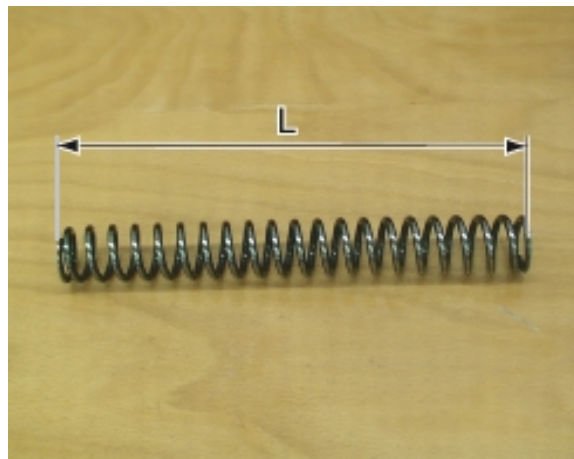


### Checking the front fork

Place the spring on a flat surface and measure free length (L).

Service limit:

**270 mm**



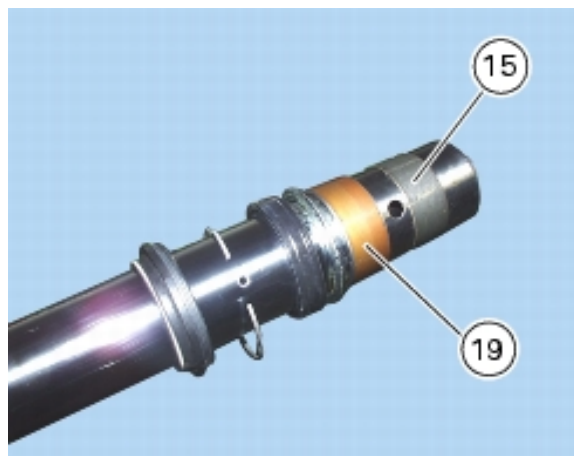
Change the spring if not within limit.

Check outer surface of both sliders and inner surface of both outer sleeves. They should show no signs of scores, scratches or distortions.

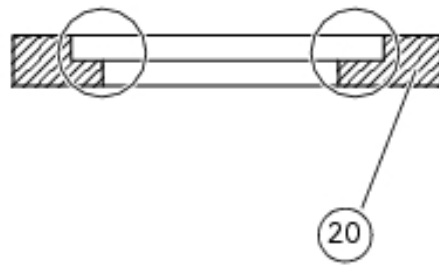
Check that stanchion tubes are straight.

Maximum straightness error allowed is **0.10 mm**.

Each time the slider is separated from the sleeve, it is a good rule to change the pilot bushes (15) and (19).



Check the spring cap (20) for distortion in the highlighted area. Replace, if needed.



Reassembling the front fork

Clamp the slider in a vice.

Tape stanchion tube end to protect it.

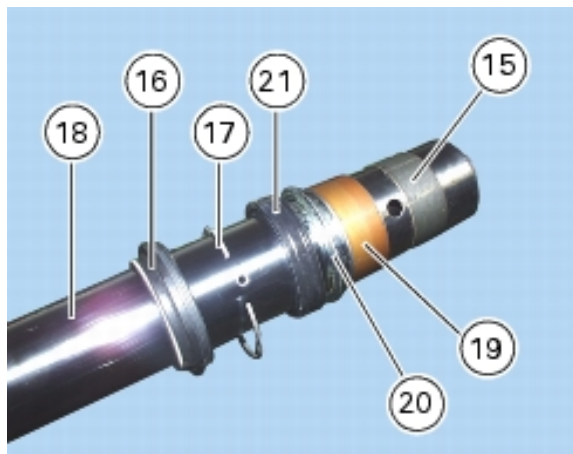
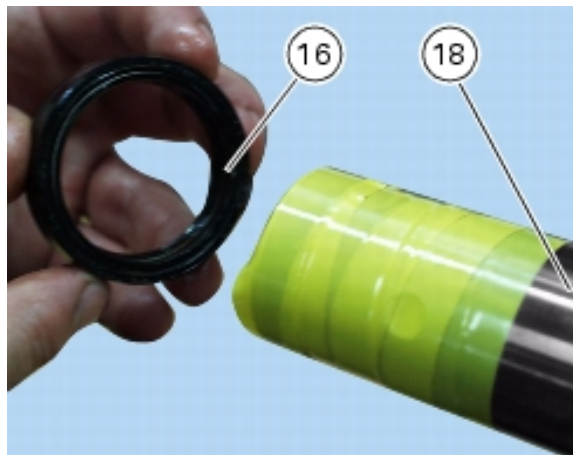


**Caution**

Lubricate sliding surfaces with fork oil or seal grease before fitting the oil seal (21).  
When fitting the oil seal (21), its marked surface should point the dust seal (16).

Fit the following parts into the slider (18):

- dust seal (16);
- snap ring (17);
- oil seal (21).
- spring cap (20);
- guide bush (19);
- bush (15).

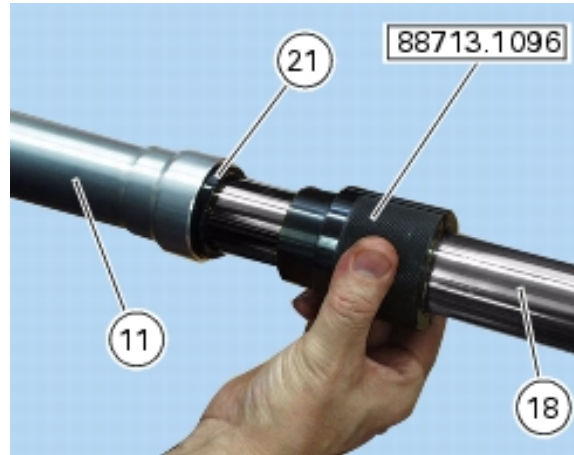




Note

Lubricate bush sliding surfaces with fork oil before assembling.

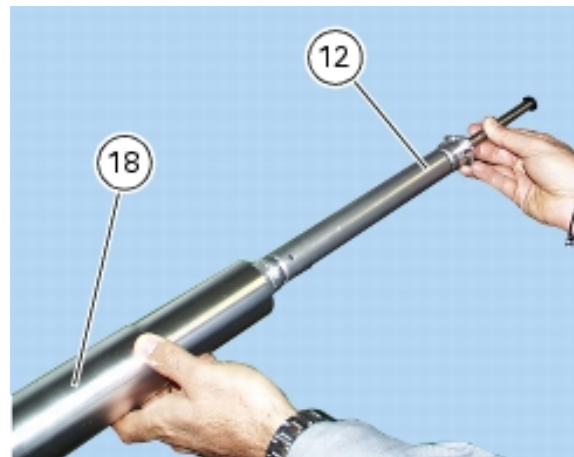
Seat the pilot bush (19) and the ring (20) into the outer sleeve (11) with the special tool (F, part no. **88713.1096**).  
Seat the seal ring (21) into the outer sleeve using the same tool.  
Fit the snap ring (17) and the dust seal (16).



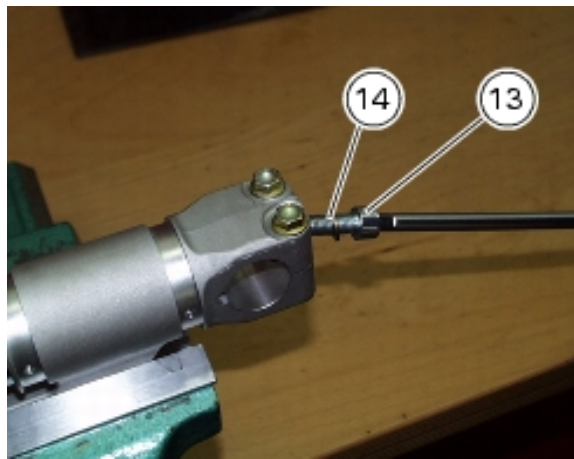
Caution

The outer sleeve must slide freely along the slider. Only support the sliders and the outer sleeve with your hands so not to damage the oil seals and the pilot bushes.

Fit the complete damper cartridge (12) into the slider (18).



Fit the seal (14) and the compression adjuster screw (13).



Tighten to **30-40 Nm**.  
Fill each leg with half the amount of the recommended oil (Sect. C 2, [Fuels and lubricants](#)).  
Pump up and down to fill whole inner volume.  
Take both damper cartridge and outer sleeve to the end of their stroke.  
Fill the remaining oil into the leg and measure level.



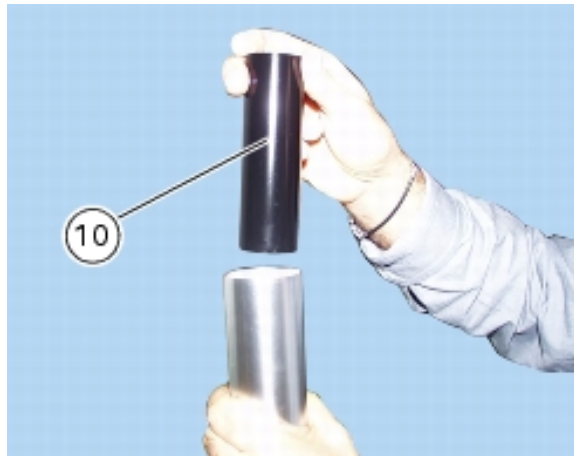
**Caution**

Keep fork leg vertical when measuring oil level. Make sure oil level is the same in both fork legs.

Recommended oil:  
SHELL Advance Fork 7.5 or DONAX TA  
Standard capacity:  
0.480 cu. dm each leg  
Standard oil level:  
104 mm

Oil quantity affects fork behaviour when at the end of the compression stroke.  
High oil level increases compression loading, low oil level will lessen it.  
Remove oil from the spring (9) and the lock nut (23).

Install the following components:  
the preload tube (10), the spring (9)  
with the taper side facing the lock nut (23) and the washer (8).





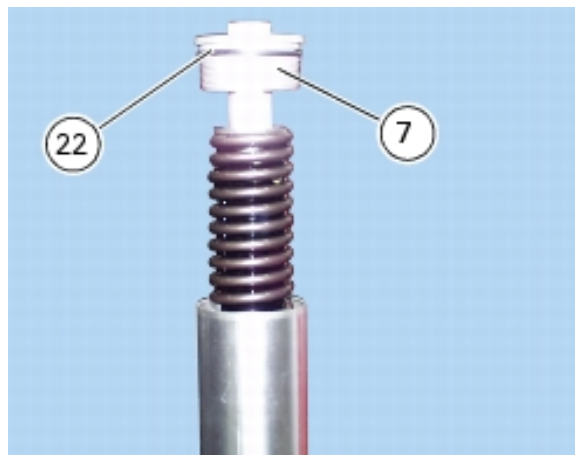
**Warning**

When refitting the washer (8) compress the spring (9) with a hand.

Tighten the lock nut (23) onto cartridge (26) with a hexagonal wrench.

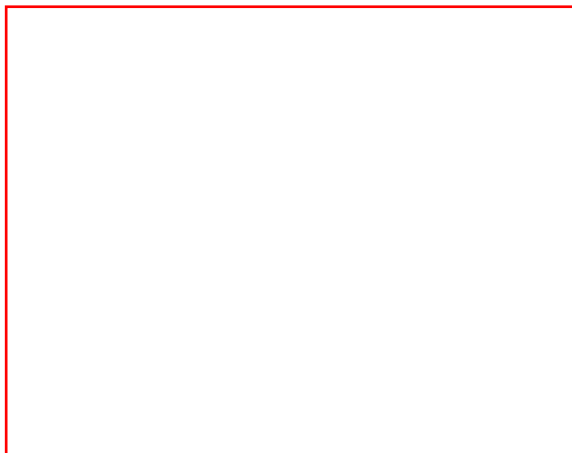


Use the same wrench to hold the lock nut and tighten the upper plug (7) with O-ring onto the cartridge (26). Tighten the cap nut (7) to the specified torque (Sect. C 3, [Frame torque settings](#)).

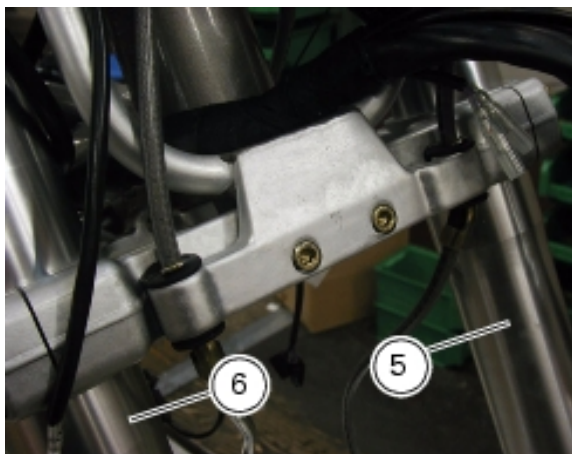


**Refitting the front fork**

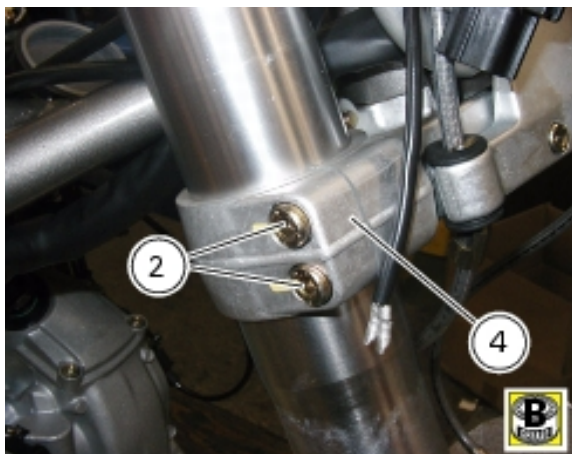
Refit the fork legs. Fork leg height above bottom yoke top face is reported in the figure.

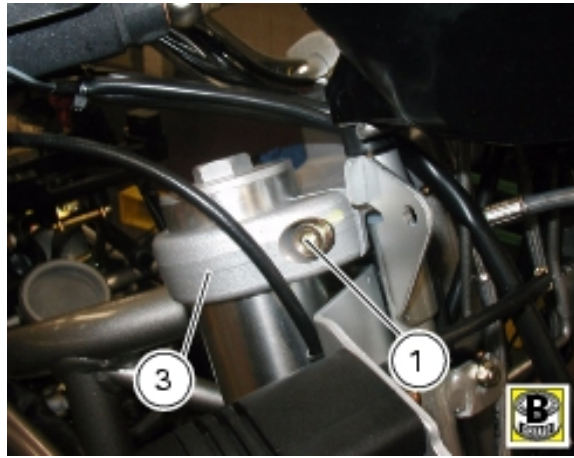


Position the fork legs (5) and (6) correctly.



Tighten screws (2) and (1) to the specified torque (Sect. C 3, [Frame torque settings](#)) in a 1-2-1 sequence to clamp the fork legs securely in the bottom yoke (4) and steering head (3).





 **Caution**

If the pinch bolts (1) and (2) have been removed on disassembly, smear the threads with the specified grease before tightening.

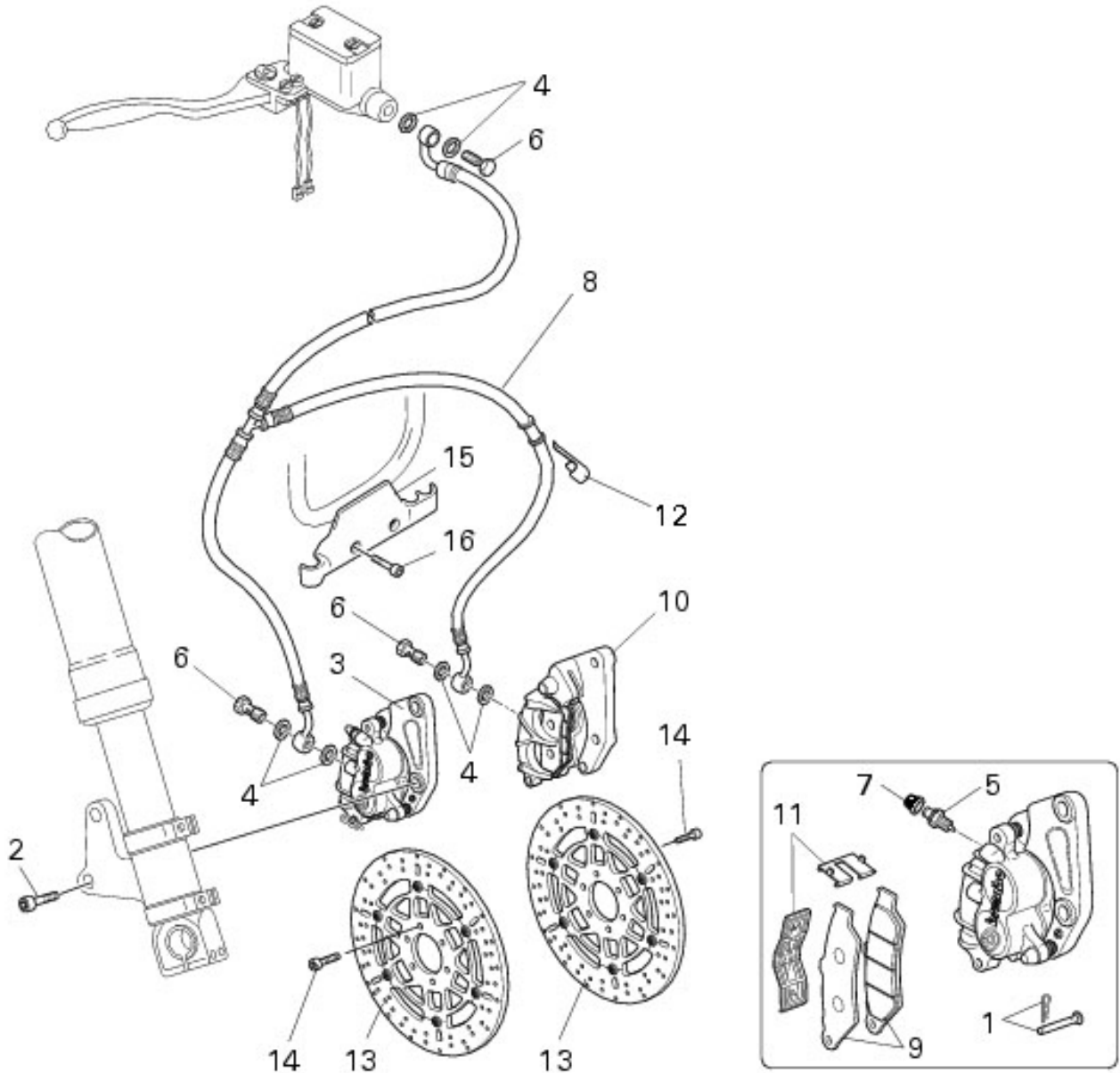
 **Warning**

Do not ride without the front mudguard, or the brake hoses might contact the wheel under braking.

Refit any components you have removed from the frame:

Operations	Reference See Section
Refitting the front wheel	G 1, <a href="#">Refitting the front wheel</a>
Refitting the front mudguard	E 4, <a href="#">Refitting the front mudguard</a>
Refit the front brake calipers	G 3, <a href="#">Refitting the front brake system</a>

### 3 - Front brake



- 1 Spare pins and split pin
- 2 Screw
- 3 Right brake caliper
- 4 Seal, thk.1
- 5 Spare caliper bleed valve
- 6 Special screw
- 7 Dust seal
- 8 Cylinder-to-calipers hose
- 9 Set of brake pads
- 10 Left brake caliper
- 11 Springs
- 12 Cable guide
- 13 Brake disc
- 14 Screw
- 15 Headlight bracket
- 16 Screw

[Front head-light](#)

[Front and rear wheels](#)

[Front brake](#)



Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Braking system maintenance



Warning

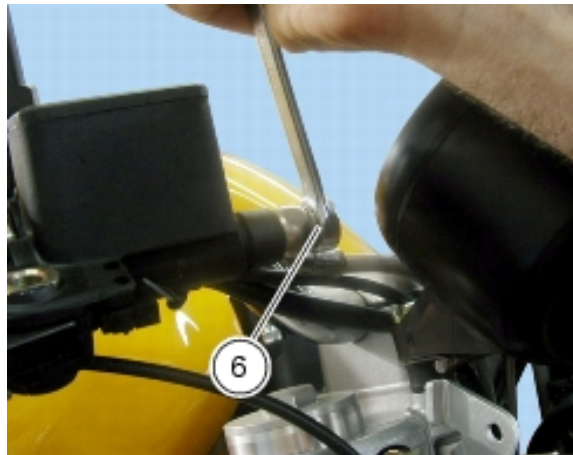
Corrosion and irritant hazard. Brake fluid is corrosive and will damage paintwork. Avoid contact with eyes and skin. In the event of accidental contact, wash the affected part with abundant running water and seek medical advice, if necessary.

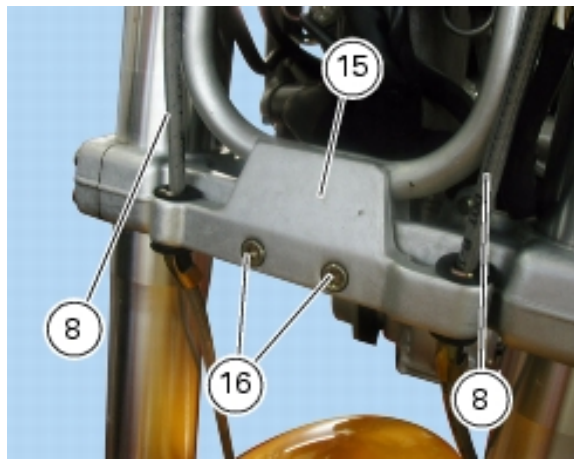
Please refer to Sect. D 4, [Draining the braking circuit](#), for maintenance instructions (brake pads wear check and replacement, brake fluid change, and so on).

### Removing the front brake system

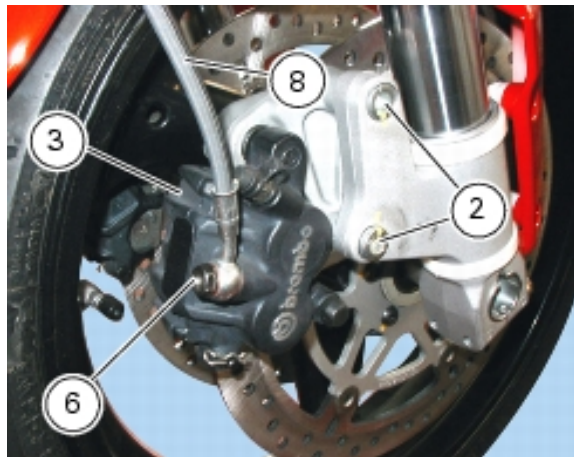
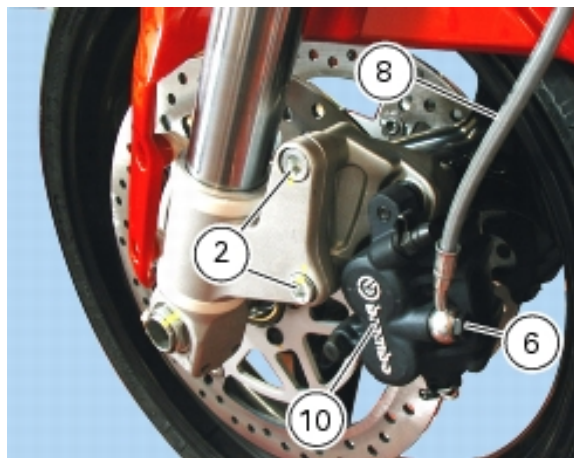
Operations	Reference See Section
Drain brake fluid from the system	D 4, <a href="#">Draining the braking circuit</a>

Unscrew the special screw (6) holding the brake hose to the brake cylinder. Collect the seals (4). Detach the hose (8) from the brake cylinder, loosen screws (16) of headlight bracket (15) and detach hose (8) from the support.





Remove the brake cylinder (Sect. F 3, [Removing the front brake master cylinder](#)).  
 Unscrew the two screws (2) securing the front brake left caliper (10) to the fork leg.  
 Repeat the process for the right caliper (3).  
 Unscrew the special screws (6) on each front brake caliper and detach the calipers from the hose (8).

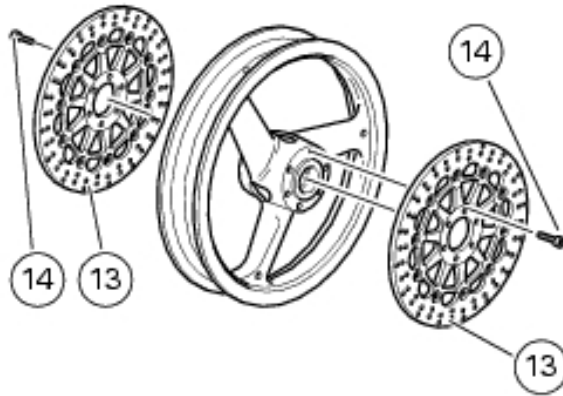


### Removing the brake discs

The front brake discs are made up of an inner rotor, which is fixed to the wheel rim, and an outer friction rotor. Both parts must be changed together.

Remove the front wheel (Sect. G 1, [Removing the front wheel](#)).

Unscrew the six screws (14) securing the brake disc to the wheel and remove the disc (13).



## Overhauling the front brake components



### Caution

Critical safety components. The brake caliper manufacturer recommends that you do not attempt to service the internal components of the brake calipers. Incorrect overhaul of these critical safety components can endanger rider safety.

Maintenance operations on these units are limited to replacing brake pads, fasteners and bleed unit.

Please refer to the exploded view at the beginning of this Section for indications on the replacement of the above components.

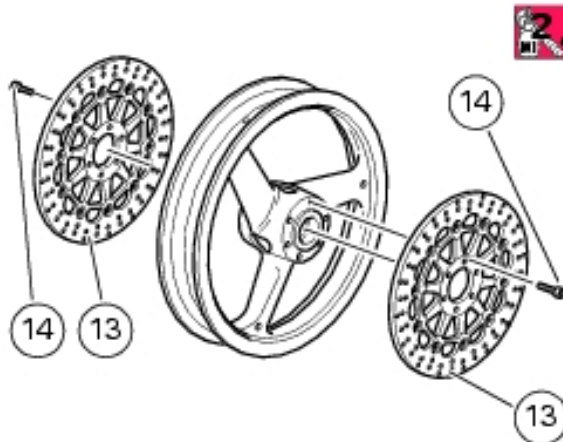
Brake discs must be clean without any signs of rust, oil, grease or dirt. Brake discs must not be deeply scored. For brake disc wear inspection, please see the service limits indicated in "[Hydraulic brakes](#)" (Sect. C 1.1).

## Refitting the front brake system

### Refitting the brake discs

Before refitting the brake disc to the wheel rim, clean all contact surfaces thoroughly and smear threadlocker on the threads of the retaining screws (14).

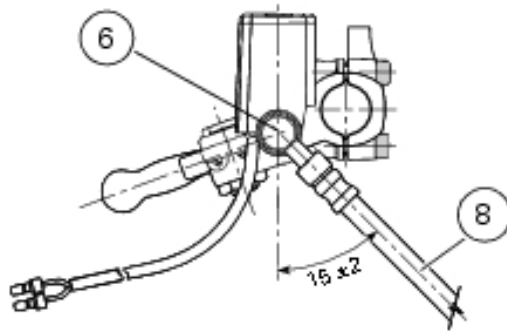
Position the six retaining screws (14) of the front brake disc (13) to the front wheel in this sequence: 1-3-5-2-4-6.



Tighten the screws to the specified torque (Sect. C 3, [Frame torque settings](#)).

Refit the wheel to the motorcycle (Sect. G 1, [Refitting the front wheel](#)).

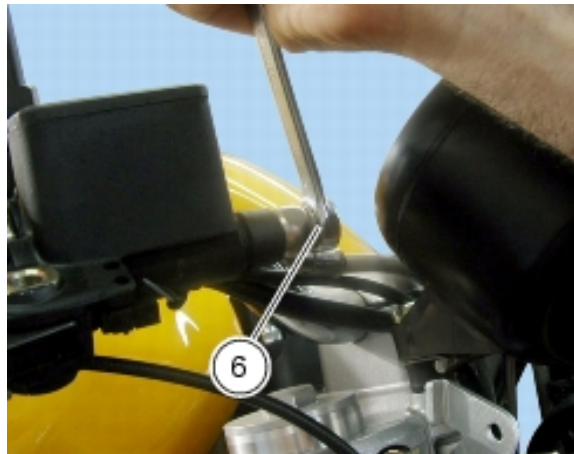
When refitting the brake system, care must be taken to position the hose (8) connectors on the brake cylinder and the caliper at the correct angles.



### Warning

Incorrectly positioned hoses can cause brake faults and interfere with moving parts. Correct position is shown in the diagram.

Fit the special seals (4) to the connector when securing the brake hose to the brake caliper or the brake cylinder. Arrange the connector at the correct angle and then tighten the screw (6) to the specified torque (Sect. C 3, [Frame torque settings](#)).



Refit the hose connectors (8) to the front brake calipers, position the seals (4) and tighten the special screws (6) to secure them in place.

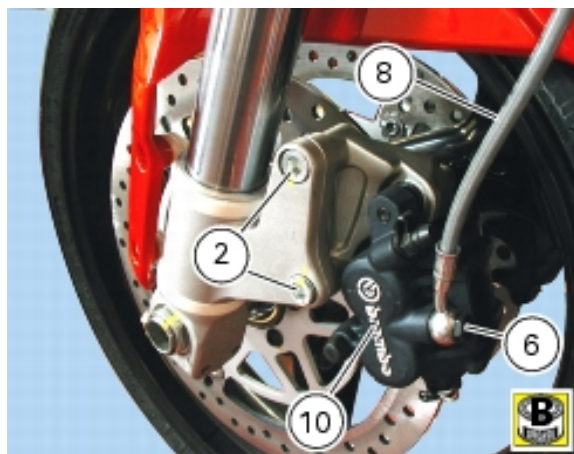
Locate the caliper (10) to the disc.

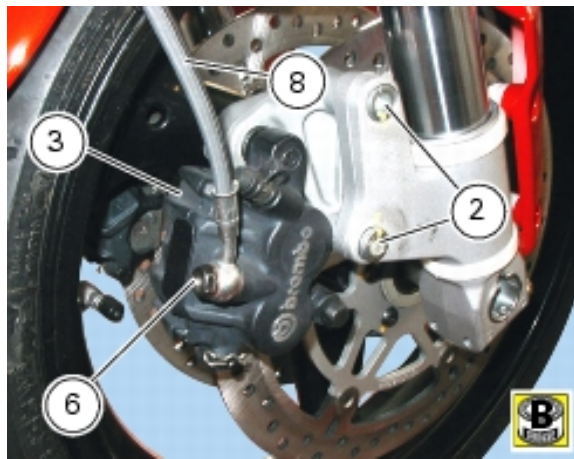
Grease the thread and underhead of the screws (2).

Tighten the two screws (2) retaining the caliper to the front fork leg.

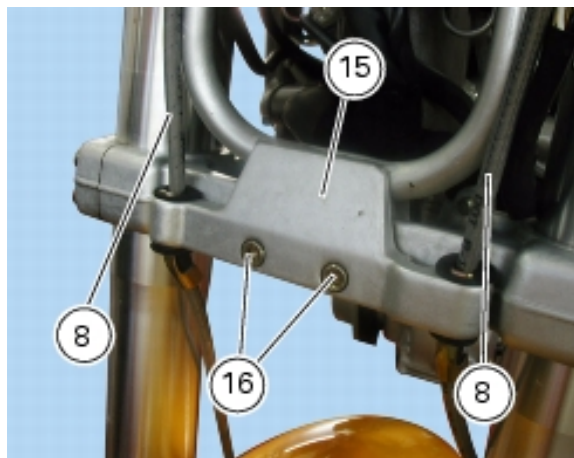
Tighten the screws (2) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Repeat the process for the right caliper (3).

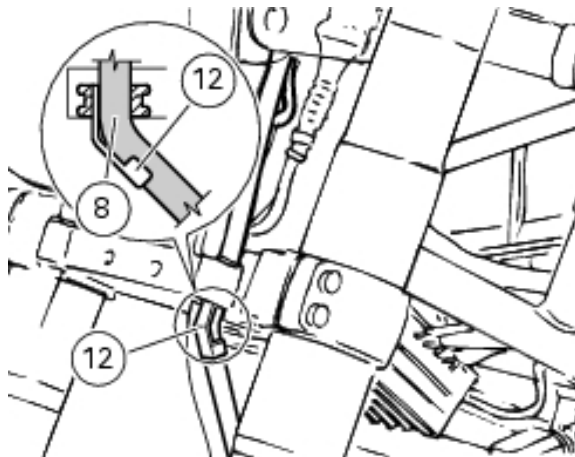




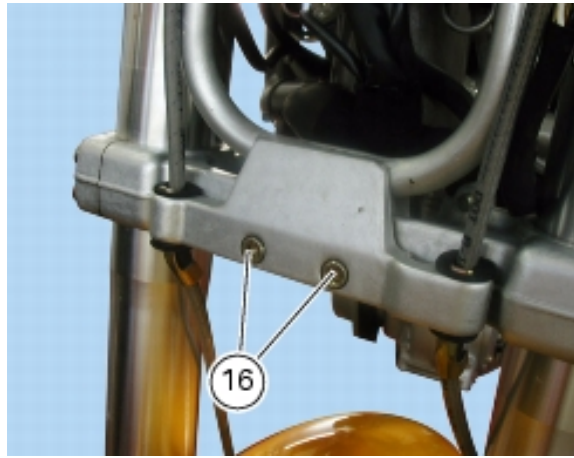
Position the brake cylinder-and-lever assembly (Sect. F 3, [Refitting the front brake master cylinder](#)). Slide the hose (8) into the headlight bracket (15). Thread the hose through the hose guide (12). The particular bent shape of the hose guide is designed to restrict hose (8) movement under braking and avoid damage.



Correct position is shown in the diagram.

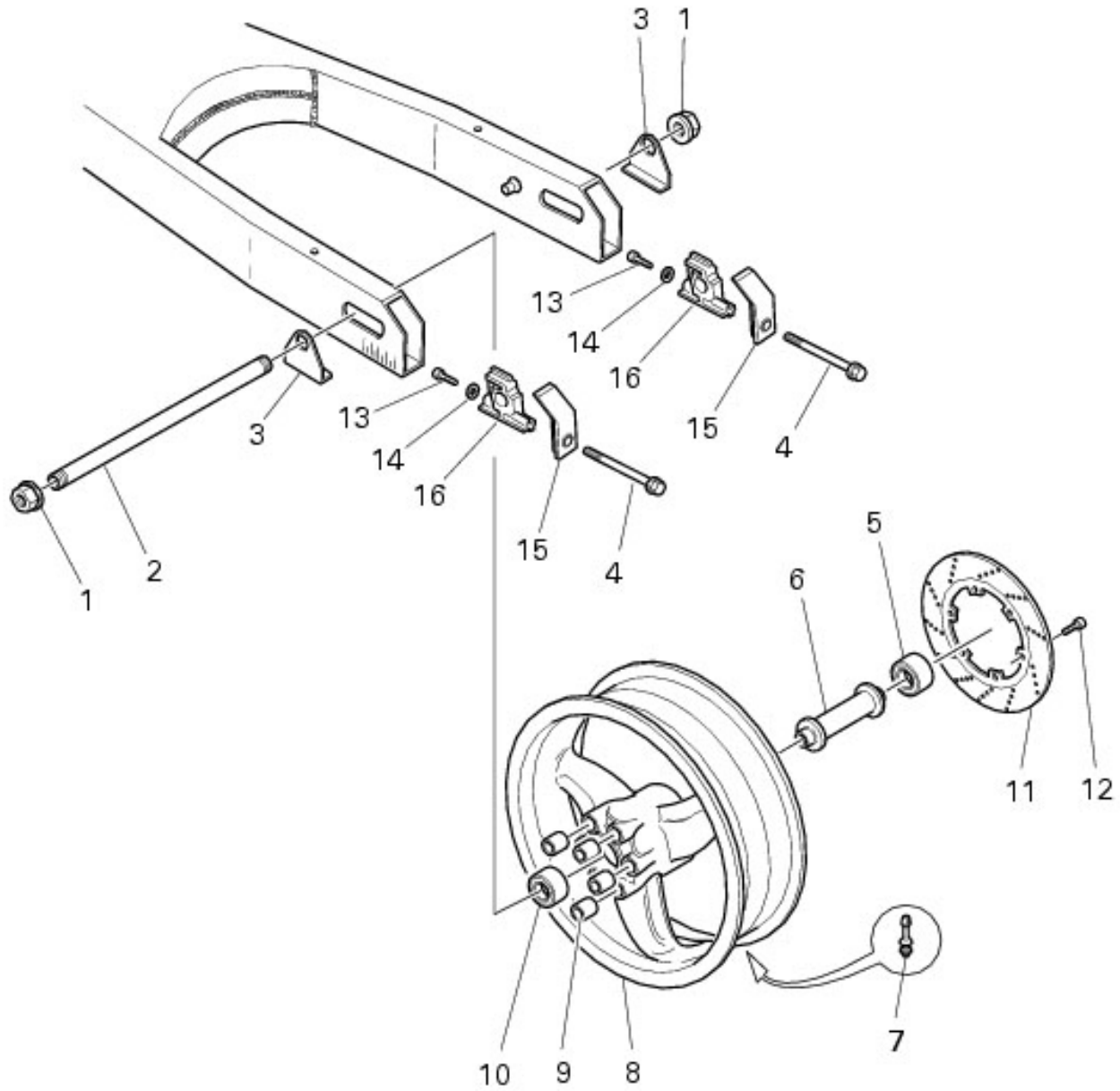


Tighten the screws (16) to the specified torque (Sect. C 3, [Frame torque settings](#)).



Operations	Reference See Section
Fill the braking system	D 4, <a href="#">Draining the braking circuit</a>

## 4 - Rear wheel



- 1 Nut
- 2 Pin
- 3 Plate
- 4 Screw
- 5 Bearing
- 6 Inner spacer
- 7 Valve
- 8 Wheel rim
- 9 Vibration damping pad
- 10 Bearing
- 11 Brake disc
- 12 Screw
- 13 Screw
- 14 Washer
- 15 Cover
- 16 Slider

[Front and rear wheels](#)[Swingarm and chain](#)**Caution**

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

**Removing the rear wheel**

Place the motorcycle on a paddock stand so as to lift the rear wheel off the ground.

Undo the nut (1) on the right side of the swingarm.

Loosen the screws (4) so as to slacken the chain.

Loosen the screws (B) to remove the brake caliper (A) from the plate, but leave it connected to the system.

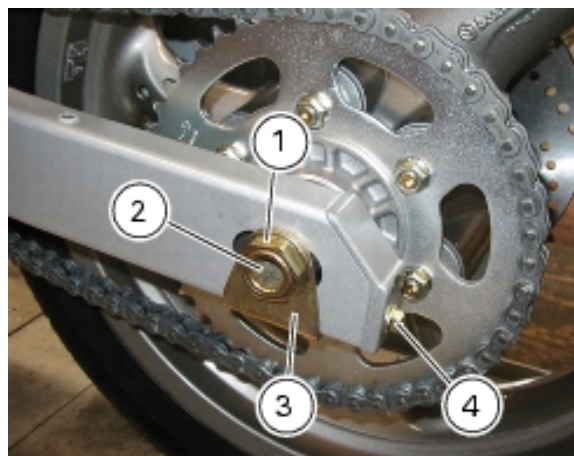
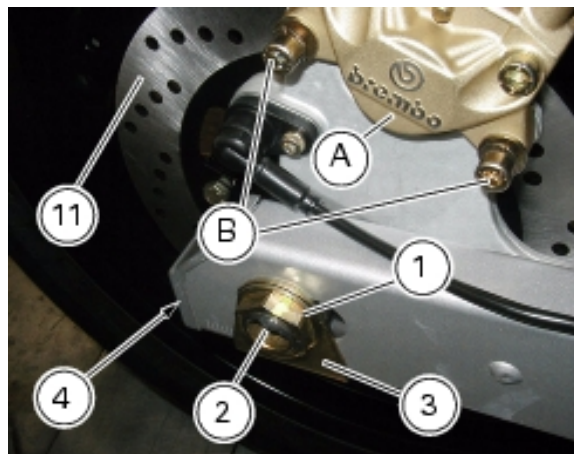
Withdraw the wheel shaft (2) together with the nut (1) from the left side. Collect the plates (3) at either side of the swingarm.

**Caution**

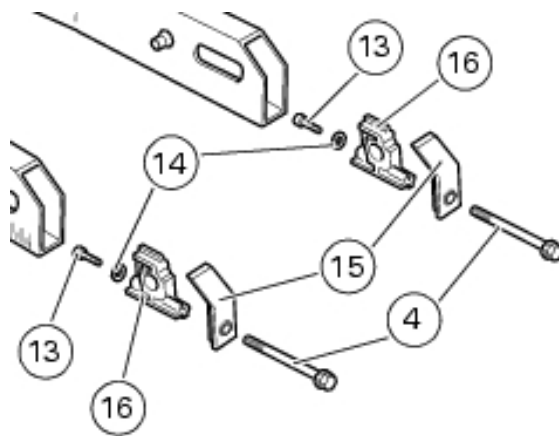
During this operation, properly support the wheel so that it will not fall while wheel shaft (2) is being removed.

Push the wheel forward to take the chain off the rear sprocket.

Remove the rear wheel from the motorcycle. The brake caliper mounting plate is sitting loose on the swingarm and the brake disc (11) might hit the plate during removal. Securing the plate to the swingarm with a tie might help prevent damage to the brake disc.



The removed wheel still holds the rear sprocket flange. Remove the screws (4), the cover (15) and the slider (16) in case slider (16) needs to be replaced.



## Overhauling the rear wheel

Remove the rear sprocket flange from the wheel (Sect. G 8, [Removing the rear sprocket](#)). For bearing (5), bearing (10) and wheel shaft (2) inspection and for wheel rim (8) overhaul, please refer to "[Overhauling the front wheel](#)" in Sect. G 1.

## Overhauling the rear brake disc

Release and remove the six screws (12) securing the brake disc (11) to the wheel shaft (2).

Remove the rear brake disc (11).

The brake disc must be perfectly clean, with no rust, oil, grease or other dirt and no deep scoring.

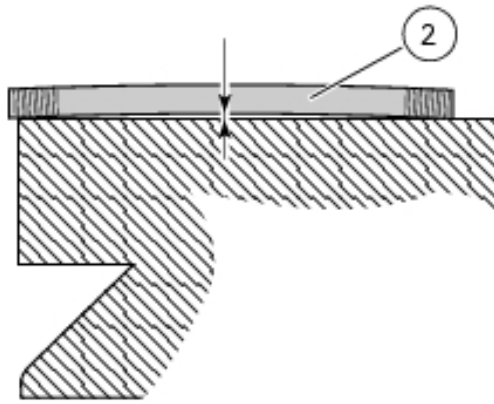
For brake disc service limit, please see (Sect. C 1.1, [Hydraulic brakes](#)).

Apply threadlocker to the screws (12).

Fit the brake disc (11), tighten the screws (12) to the specified torque (Sect. C 3, [Frame torque settings](#)).

It is possible to remove the vibration dampers (9) and replace them, if necessary.

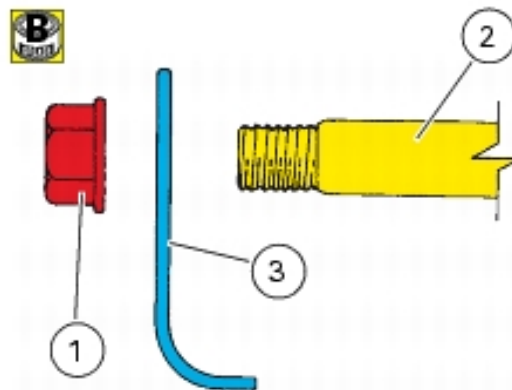




## Refitting the rear wheel

Fit the rear sprocket flange onto the wheel (Sect. G 8, [Refitting the rear sprocket](#)).

If the slider (**16**) has been removed, fit it into the swingarm together with the cover (**15**) and start the screws (**4**) in their holes. Fit the first plate (**3**) to the shaft (**2**). Grease the wheel shaft thread (**2**) and the contact surface of the nut (**1**). Snug the nut on the wheel shaft thread (**2**). Tighten the nut until one circle of the wheel shaft thread is visible at the opposite end.



Insert the wheel shaft from the left end of swingarm. Make sure to match the hole in the left chain slider.

Hold the caliper plate in position onto swingarm clip, fit the clip into plate slot.

Slide the wheel in the swingarm.

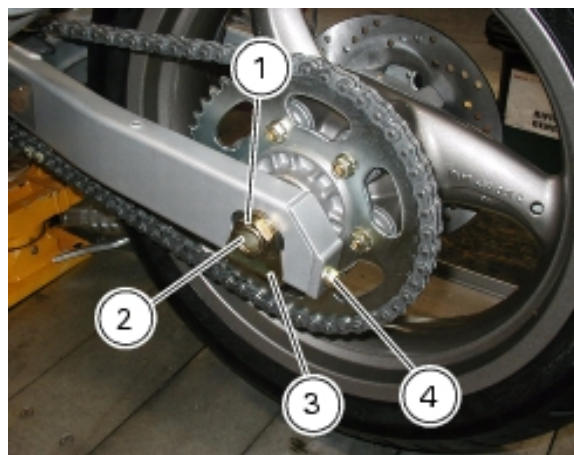
Insert the wheel shaft (**2**) from the left side of the swingarm through wheel hub, brake caliper plate hole and right chain slider hole and push the wheel shaft fully home.

Make sure the plate bent end (**3**) is at the bottom end of the swingarm.

Wrap the chain around the rear sprocket.

Fit the other plate (**3**) on swingarm right-hand side.

Grease the wheel shaft thread (**2**) and the contact surface of the nut (**1**) and screw nut onto shaft (**2**).



Tighten the nut finger-tight.

Tension the chain and align the wheel (Sect. D 4, [Adjusting chain tension](#)).

Make sure the brake hose does not become trapped or is exceedingly bent.

Tighten the nut (1) onto wheel shaft (2) to the specified torque (Sect. C 3, [Frame torque settings](#)).

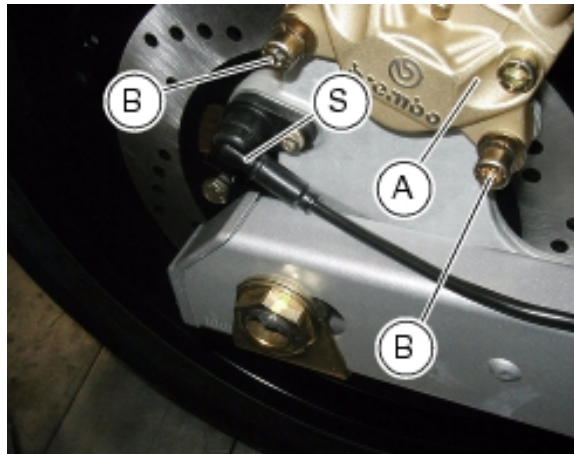
Tighten the chain tensioner screws (4) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Refit the brake caliper (A), tighten the screws (B) to the specified torque (Sect. C 3, [Frame torque settings](#)).

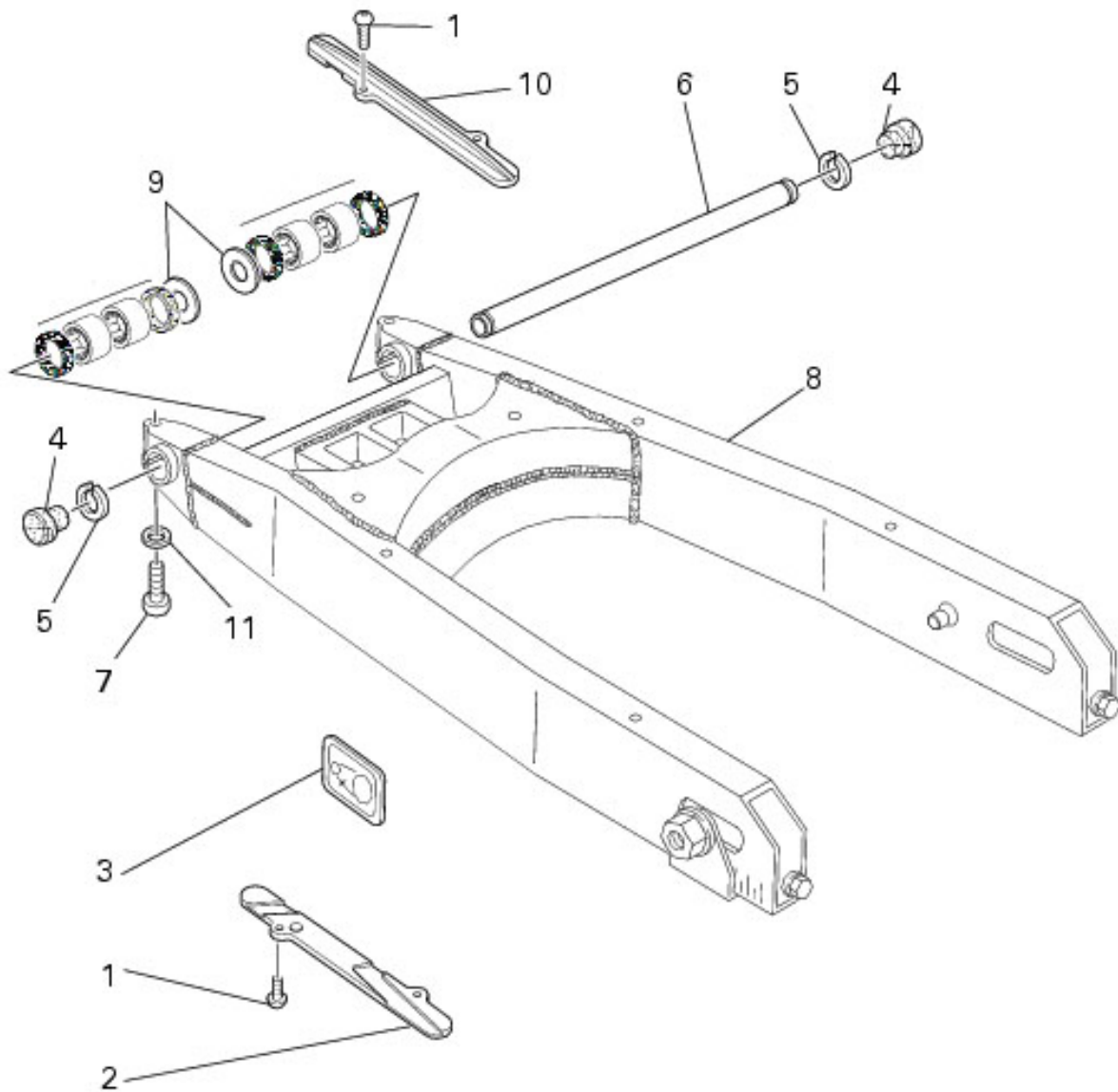


Note


The air gap between sensor (S) and brake disc retaining screw must be **0.6-2.2** mm.



## 5 - Rear swingarm



- 1 Screw
- 2 Upper chain sliding shoe
- 3 Plate
- 4 Blanking plug
- 5 Circlip
- 6 Swingarm shaft
- 7 Screw
- 8 Rear swingarm
- 9 Shim
- 10 Upper chain sliding shoe
- 11 Shim

 Spare parts catalogue

[Half crankcases](#)

[Swingarm and chain](#)

**Caution**

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

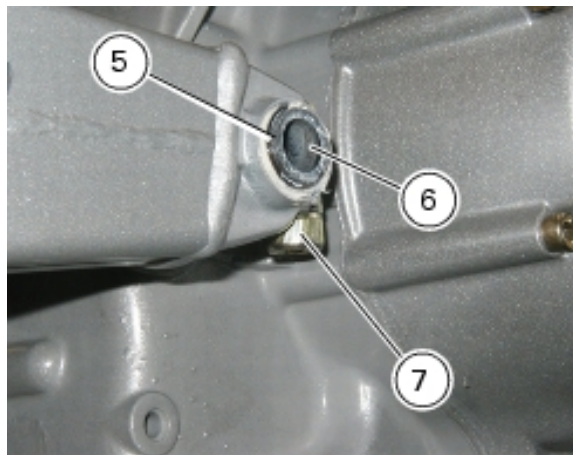
## Removing the swingarm

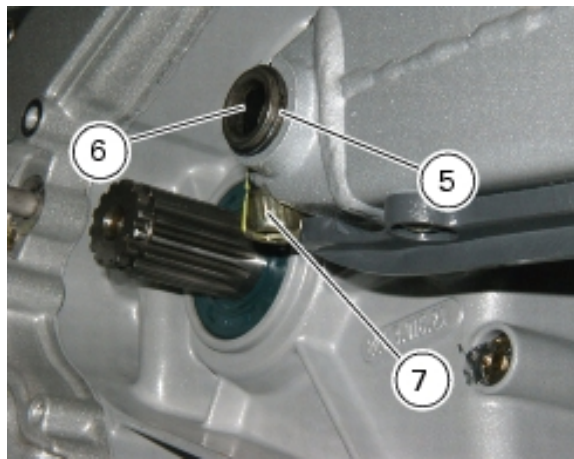
Operations	Reference See Section
Remove the rear wheel	G 4, <a href="#">Removing the rear wheel</a>
Remove the rear mudguard	E 4, <a href="#">Removing the rear mudguard</a>
Remove the final drive assembly	G 8, <a href="#">Final drive</a>
Remove the rear brake caliper	G 6, <a href="#">Removing the rear brake system</a>
Remove the vertical cylinder exhaust pipe	L 8, <a href="#">Removing the exhaust system</a>
Remove the shock absorber and the linkage from the rear swingarm	G 7, <a href="#">Removing the monoshock absorber</a>

The components listed below must first be removed to allow removal of the swingarm. Remove the plugs (4) on either side of the swingarm.

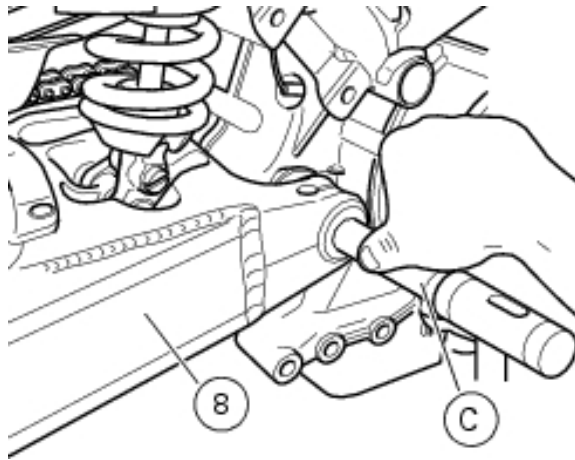


Working on both sides of the swingarm, loosen the screws (7) onto swingarm shaft clamps, collect the washers (11). At least one of the outer circlips (5) has to be removed in order to remove the shaft (6).



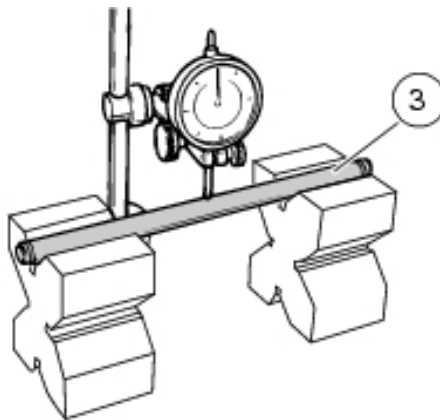


Use a suitable punch (C) and push shaft (6) outwards until the swingarm is not fixed to the engine any more. Remove the swingarm (8) from the frame.



### Swingarm shaft inspection

Measure swingarm shaft distortion (3) using a dial gauge.  
Place the shaft (3) on two reference blocks of the same size.



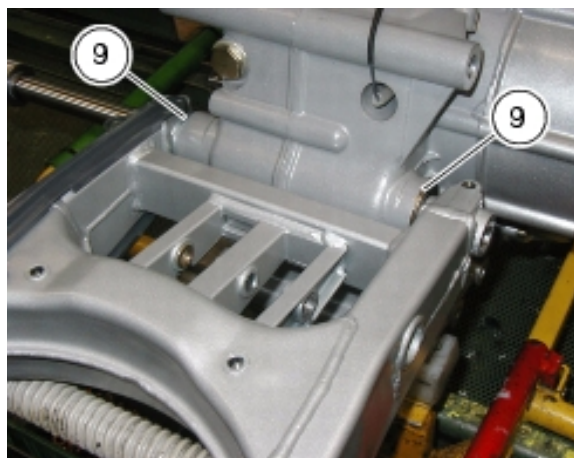
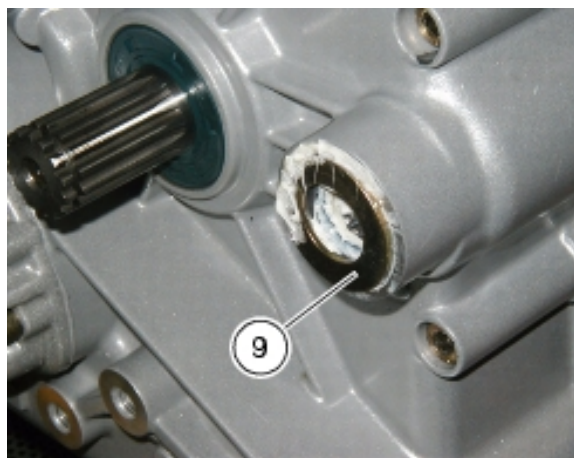
Rotate the shaft and move the gauge horizontally.  
Measure distortion.  
Service limit: (**0.3 mm**) (Sect. C 1.1, [Rear wheel](#)).

Replace shaft when distortion exceeds the specified limit. Replace any cracked or distorted shafts.

### Checking swingarm end float

When refitting the swingarm it is necessary to choose the proper shims (9).  
Check axial play as follows:  
fit a shim (9) **1.8 mm** thick on both sides of the engine;

Hold the left arm of the swingarm (8) against the engine and measure play on the other side of engine using a feeler gauge or calibrated shims.



Maximum side play allowed is up to **0.1** mm.

When a **0.10** mm feeler gauge or shim is hard to fit, there is no need to shim the shaft. Otherwise, shims are available in two sizes (**0.20** mm and **0.10** mm) to adjust play.

For example:

Measured play	Shims on left side	Shims on right side
0,10	-	One 0.10 mm shim
0,20	One 0.10 mm shim	One 0.10 mm shim
0,30	One 0.10 mm shim	One 0.20 mm shim

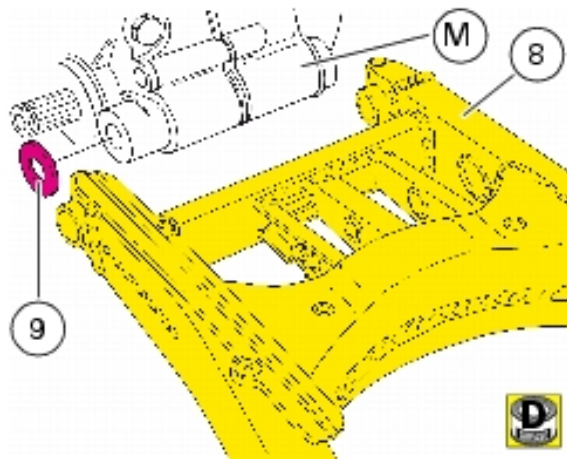


#### Caution

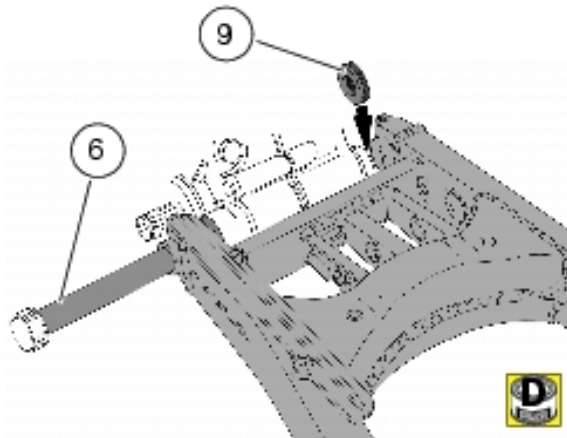
Always put the largest amount of shimming on the right side of the swingarm.

#### Refitting the rear swingarm

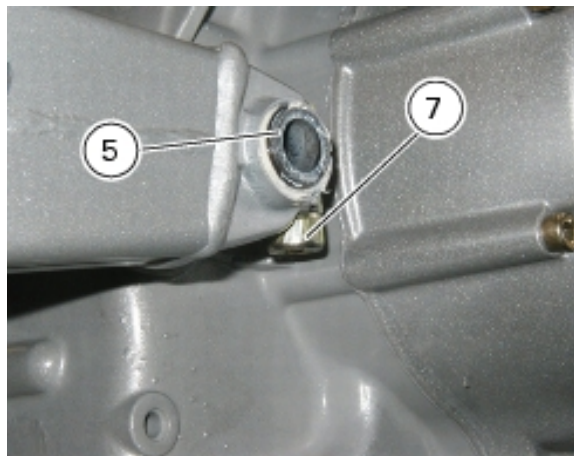
Grease both faces of shim (9) chosen after checking end float (see "[Checking swingarm end float](#)" in this section). Position the swingarm (8) to the engine, on left-hand side fit the chosen shim (9) in-between the swingarm and the engine.



Working on the swingarm left side, fit the greased shaft (6) and the circlip (5) and insert it for half its length. Push the swingarm left section against the crankcase, and fit the shim (9) chosen during end float inspection in-between swingarm right section and engine. Insert the shaft completely, make sure not to damage the shims (9).



Fit the other circlip (5). Tighten the screws (7) to the specified torque (Sect. C 3, [Frame torque settings](#)).

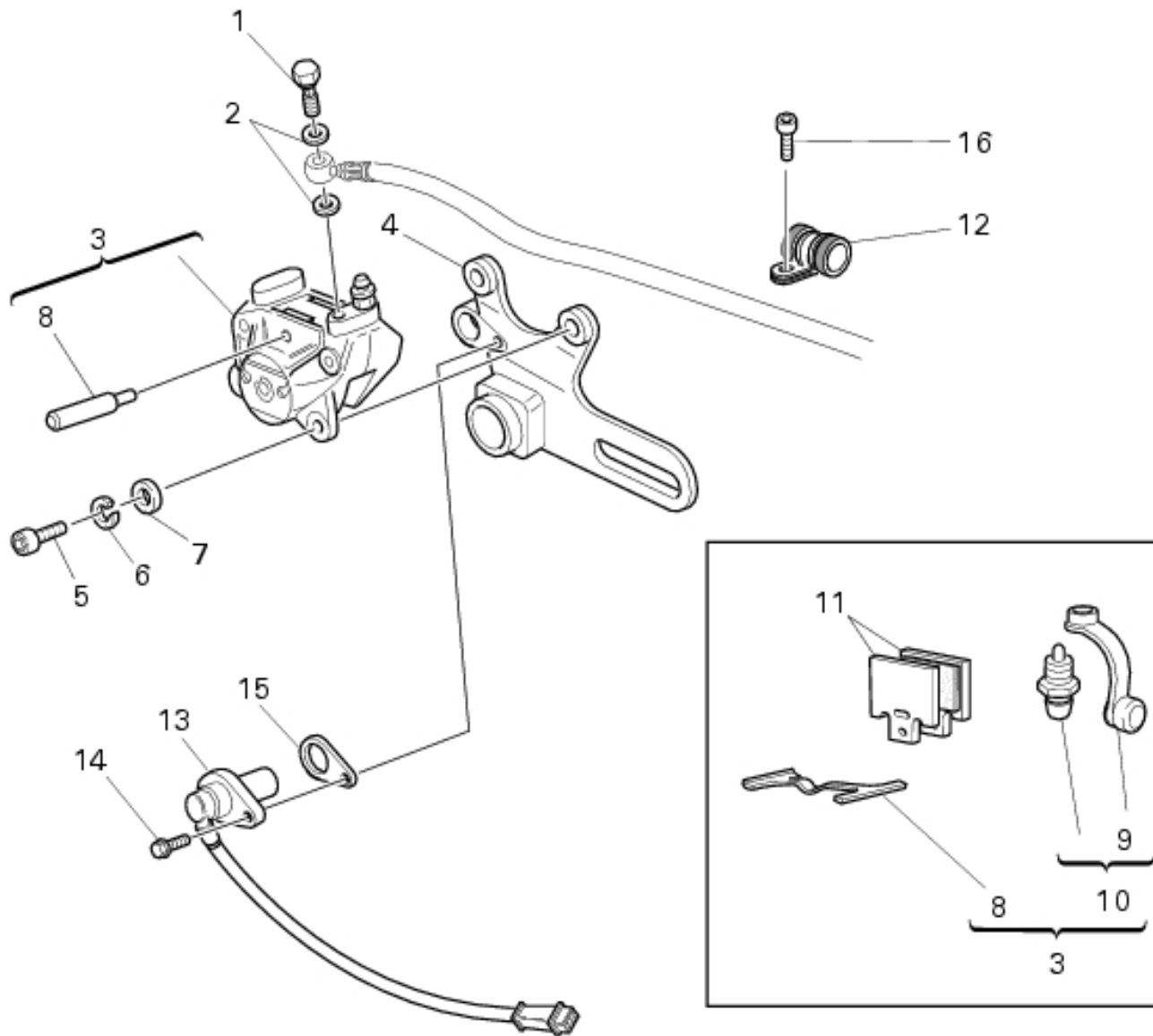


Fit the plugs (4) on either side of the swingarm.

Operations	Reference See Section
Refit the shock absorber and the linkage to the rear swingarm	G 7, <a href="#">Reassembling the rear shock absorber</a>
Refit the vertical cylinder exhaust pipe	L 8, <a href="#">Refitting the exhaust system</a>
Refit the rear brake caliper	G 6, <a href="#">Refitting the rear brake system</a>

Refit the final drive assembly	G 8, <a href="#">Final drive</a>
Refit the rear mudguard	E 4, <a href="#">Refitting the rear mudguard</a>
Refit the rear wheel	G 4, <a href="#">Refitting the rear wheel</a>

## 6 - Rear brake



- 1 Special screw
- 2 Seal, thk.1
- 3 Rear brake caliper
- 4 Caliper mounting plate
- 5 Screw
- 6 Spring washer
- 7 Washer
- 8 Spare pin and clip
- 9 Dust seal
- 10 Spare bleed valve
- 11 Set of brake pads
- 12 Hose retainer
- 13 Speed sensor
- 14 Screw
- 15 Spacer
- 16 Screw

[Rear brake](#)**Caution**

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

## Removing the rear brake system

Operations	Reference See Section
Draining the braking system	D 4, <a href="#">Draining the braking circuit</a>
Remove the screw retaining the hose to the rear brake cylinder and the seals	F 4, <a href="#">Removing the rear brake master cylinder</a>

**Caution**

**Critical safety components.** The brake caliper manufacturer recommends that you do not attempt to service the internal components of the brake caliper. Incorrect overhaul of these critical safety components can endanger rider safety.

Maintenance operations on these units are limited to replacing brake pads, fasteners and bleed unit. Release and remove the special screw (1) retaining the hose (A) to the rear brake caliper and the seals (2).

**Note**

Take a rag at hand to dry any possible brake fluid spillage.

Unscrew the screw (16).

Remove the hose (A) together with the retainer (12).

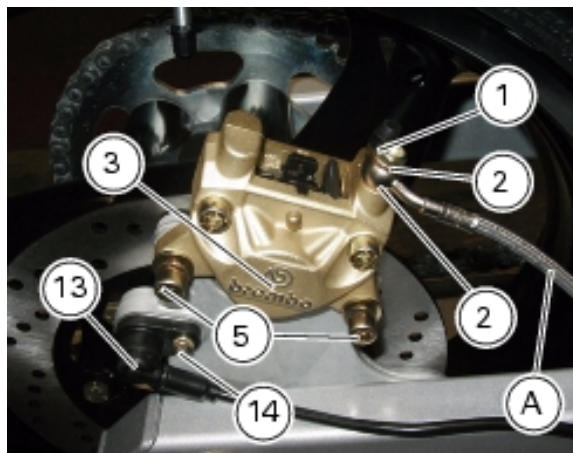
Unscrew the two screws (5) that retain the rear brake caliper to the caliper mounting plate. Collect the spring washers (6) and the washers (7).

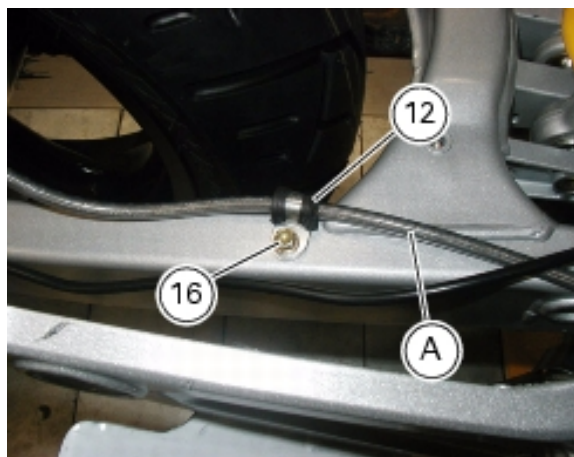
Remove the caliper (3).

**Note**

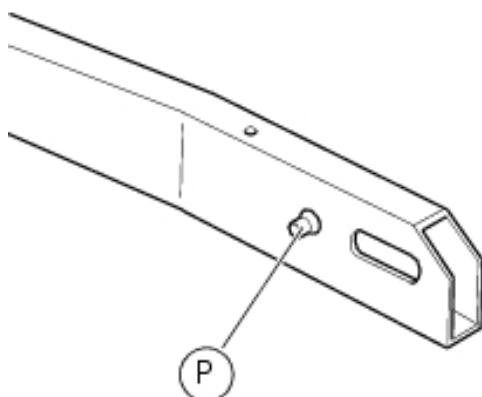
For brake pads replacement operations see section D 4, [Checking brake pad wear. Changing brake pads.](#)

To remove the speed sensor (13), unscrew the screw (14) retaining the sensor to the caliper mounting plate and collect the spacer (15).





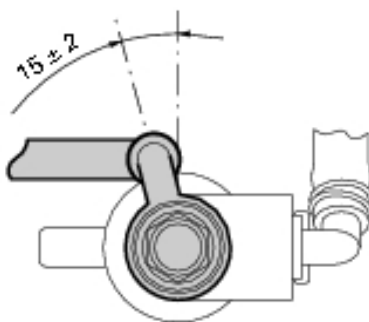
Remove the rear wheel to remove the caliper plate (Sect. G 4, [Removing the rear wheel](#)). Slide caliper plate out of swingarm shaft (P).



Refit the caliper mounting plate on the swingarm shaft. Refit the rear wheel (Sect. G 4, [Refitting the rear wheel](#)).

### Refitting the rear brake system

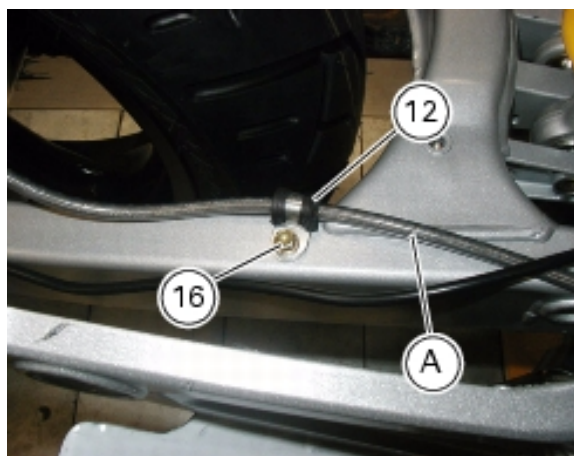
If you have removed the speed sensor (13), position it to the caliper holder plate with the spacer (15) and tighten the screw (14) to the specified torque (Sect. C 3, [Frame torque settings](#)). Fit the special copper gaskets (2) to the connector when securing the brake hose (A) to the brake caliper. Fit hose connector (A) to the caliper, and position it as shown.



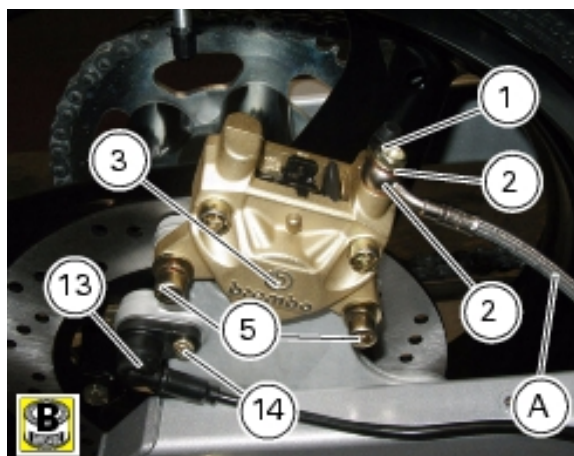
### Warning

Incorrectly positioned hoses can cause brake faults and interfere with moving parts.

Tighten the special screws (1) to the specified torque (Sect. C 3, [Frame torque settings](#)). Position the brake hose (A) to the swingarm and secure the retainer (12) with the screw (16).



Fit the rear brake caliper (3) to the brake disc matching the holes in the caliper plate. Grease the thread and underhead of the screws (5). Slide the washers (7) and the spring washers (6) on the screws (5). Tighten the screws (5) to the specified torque (Sect. C 3, [Frame torque settings](#)).

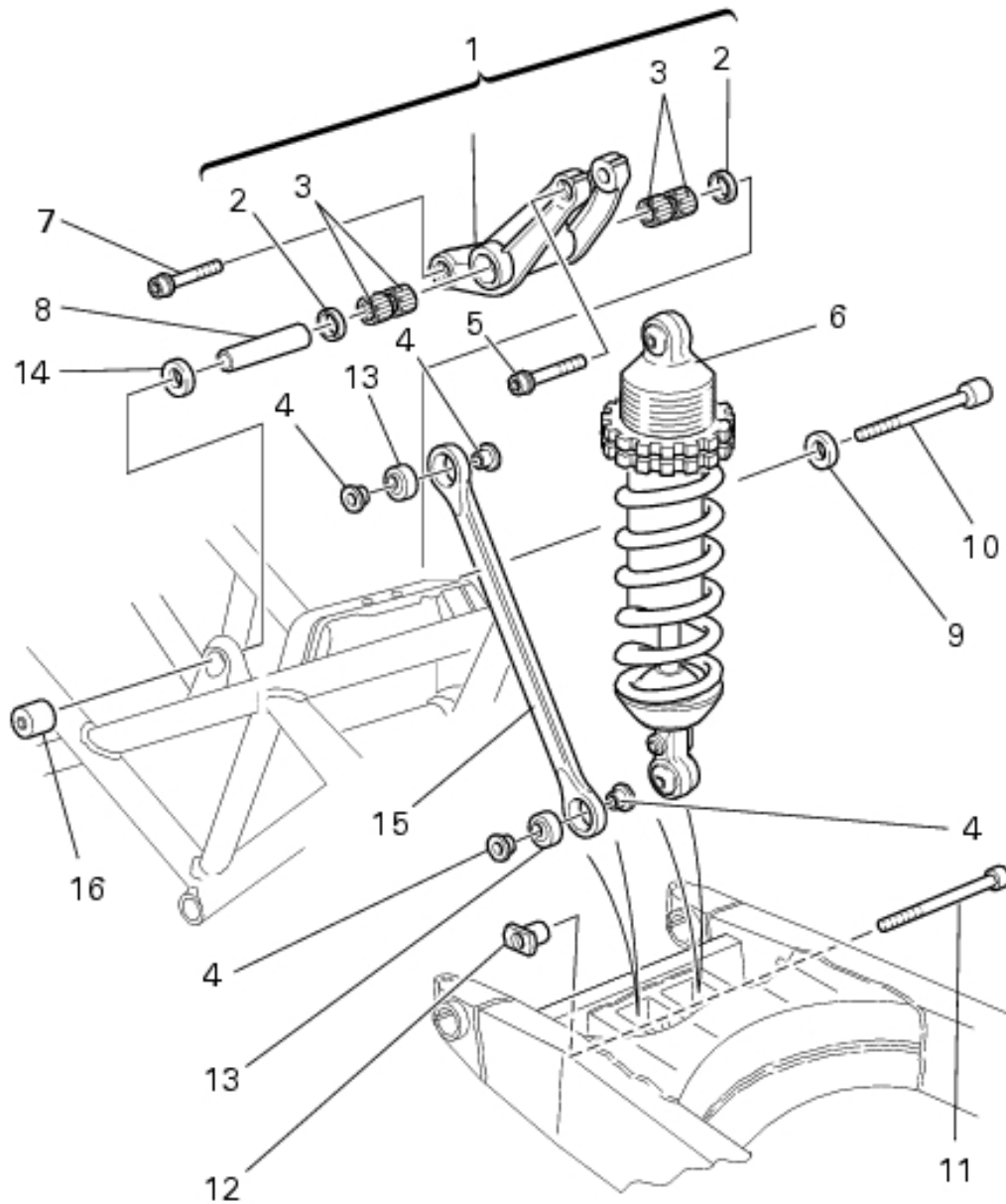


#### Note

The air gap between sensor (13) and brake disc retaining screw (14) must be **0.6-2.2** mm.

Operations	Reference See Section
Tighten the screw retaining the hose to the rear brake master cylinder	F 4, <a href="#">Refitting the rear brake master cylinder</a>
Fill the rear braking system	D 4, <a href="#">Draining the braking circuit</a>

## 7 - Rear suspensions



- 1 Rocker arm assembly
- 2 Seal
- 3 Roller bearing
- 4 Bush
- 5 Screw
- 6 Shock absorber
- 7 Screw
- 8 Spacer
- 9 Washer
- 10 Screw
- 11 Screw
- 12 Bush
- 13 Ball joint
- 14 Spacer
- 15 Linkage
- 16 Nut

## [Rear suspension](#)



### Caution

**Bold reference numbers** in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Rear suspension

The rear suspension consists in a fully adjustable hydraulic shock absorber (6) with progressive actuation. This system consists of an upper rocker arm (1) and a non adjustable linkage (15) secured to the single-sided swingarm. The swingarm is linked to frame and engine for maximum stiffness and carries the chain tensioners for chain tension adjustment at the rear end.

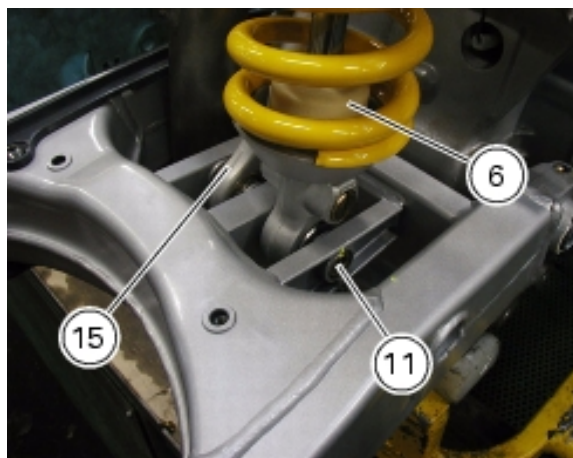
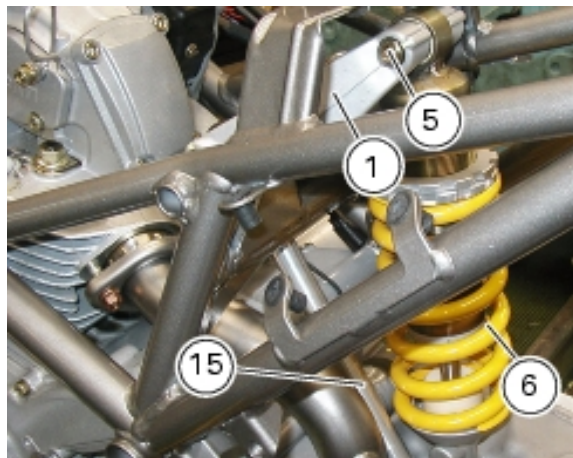
For monoshock absorber adjustment please refer to Sect. D 4, [Adjusting the rear shock absorber](#).

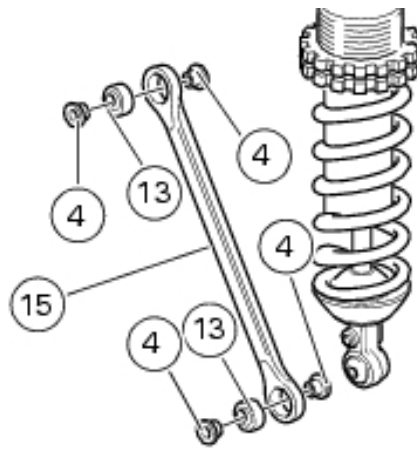
### Removing the monoshock absorber

Remove the seat (Sect. E 3, [Removing the seat](#)).

Unscrew the upper screw (5) and the lower screw (11) and slide the rear shock absorber off the swingarm and the upper rocker arm.

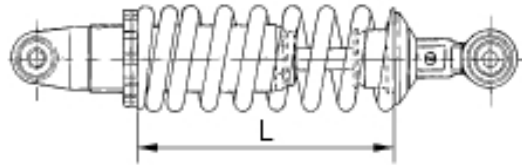
When the lower screw (11) is removed, the lower ball joint (13) of the linkage (15) - and the linkage with it - are released from the swingarm. Keep the threaded bushing (12) and the bushes (4) placed at the sides of the lower linkage ball joint (13) and collect the ball joint.





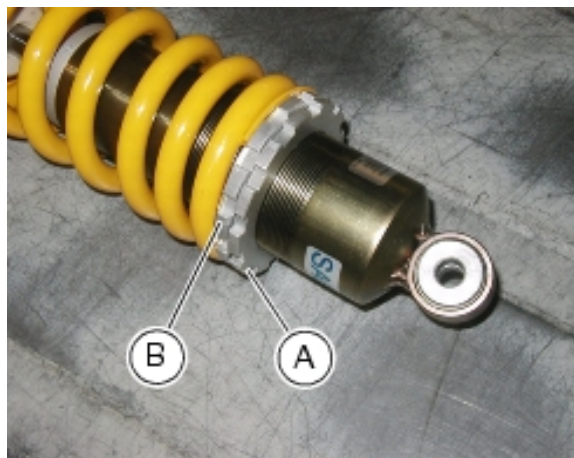
### Overhauling the rear shock absorber

Measure the length of the preloaded spring (L) before disassembling. The measured length must be restored on refitting.

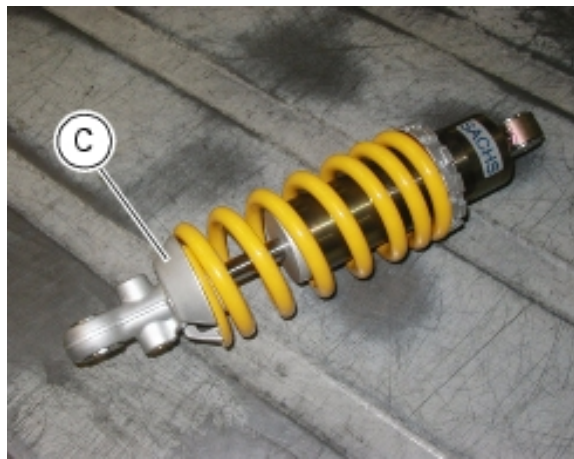


### Disassembling the rear shock absorber

Loosen the ring nut (A) and the adjusting ring nut (B) of the spring with a pin wrench or special tools.



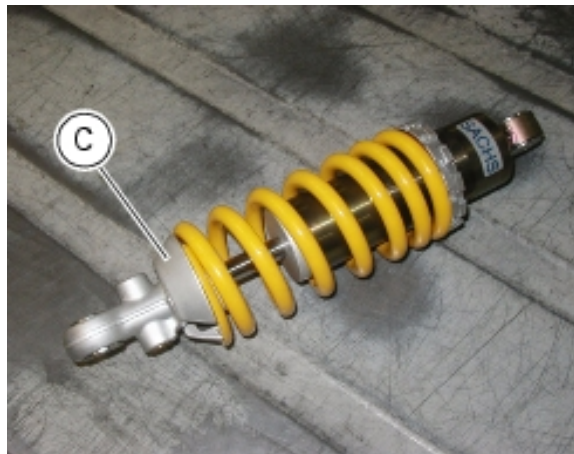
Remove the retainer (C) and the spring.



Visually inspect the shock absorber and locate any oil leaks or other faults.  
Replace the shock absorber if needed.

Reassembling the rear shock absorber

Insert the spring into the shock absorber casing with the taper end pointing at the bottom end connection.  
Install the retainer (C).



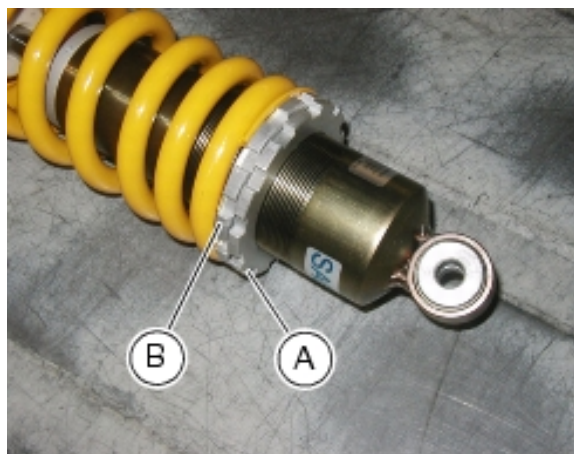
Tighten the adjusting ring nut (B) of the spring until obtaining the length (L) measured previously.



Note

One full turn of the adjusting ring nut will increase or decrease spring length by **1.5** mm.

Tighten the ring nut (A) against the ring nut (B).



Removing the rear suspension rocker arm

Remove the shock absorber top from the rocker as described in "[Removing the monoshock absorber](#)" under this section.

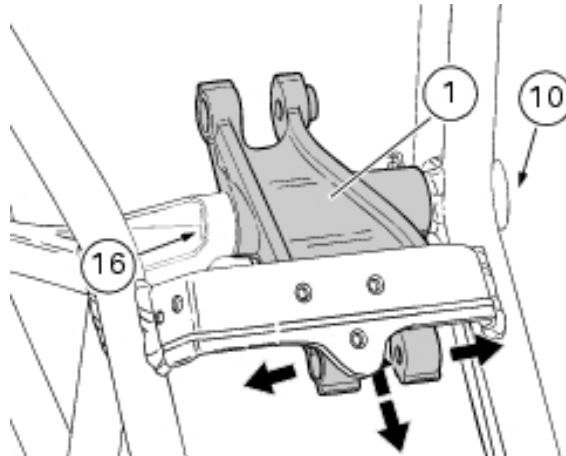
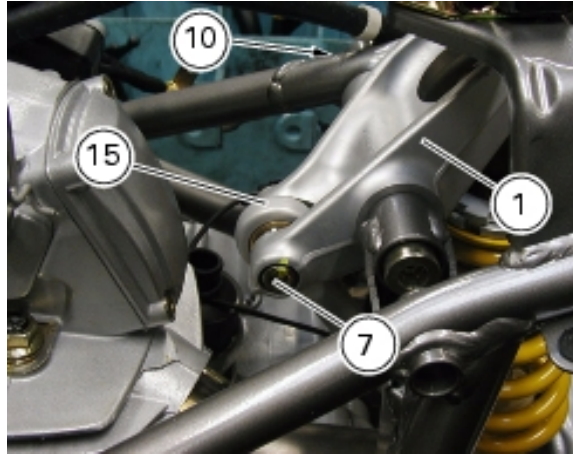
Unscrew the screw (7) and disconnect linkage (15) from rocker arm (1). Keep the bushes (4) at the sides of the ball joint (13).

Check for play in the needle roller bearings (3) inside the rocker arm before taking rocker arm (1) off the frame.

Push and pull rocker arm rear end in all directions.

Change bearings if you determine excessive play.

Undo the nut (16) and remove washer (9) to remove the rocker arm (1) from the frame. Loosen and remove retaining screw (10). Remove the complete rocker arm (1) from the frame.



## Overhauling the rear suspension rocker arm

### Disassembling the rear suspension rocker arm

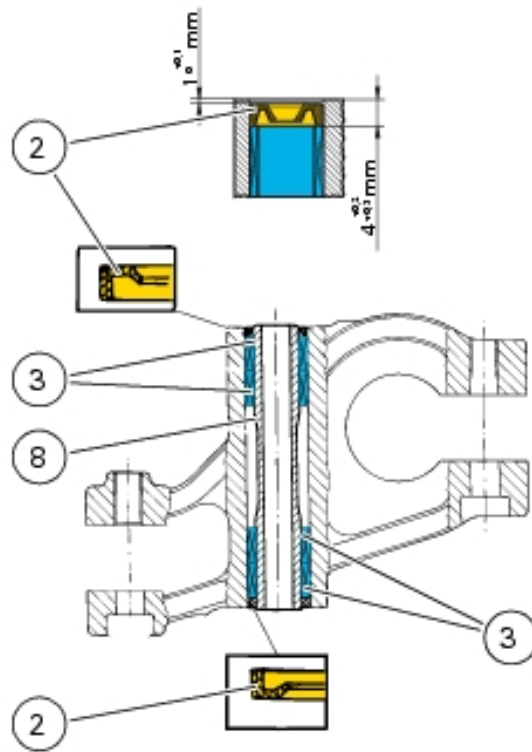
Rocker motion is ensured through roller bearings (3) working onto an inner spacer (8). Two seal rings (2) fitted at outer ends keep the lubrication oil into the cages.

Remove the inner spacer, the oil seals and the needle roller bearings using a suitable drift.



### Caution

Do not damage the bearing seats on the rocker arm while driving out the bearings. Do not refit oil seals or needle roller bearings which have been removed.



Reassembling the rear suspension rocker arm

Fit two new roller bearings (3) onto the drift part no. **88713.1071**

Support the rocker arm and drive the needle roller bearings fully home into the rocker arm.



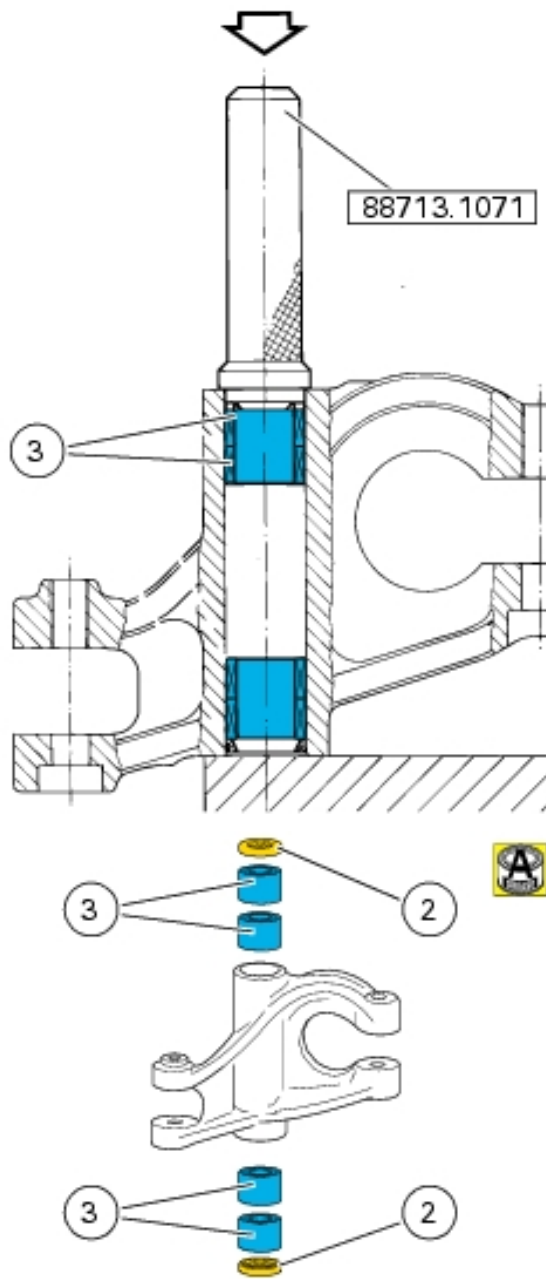
### Caution

Fit the bearings squarely in the hole: use a press in case of jams.

Fit a new seal (2) on the drift as shown in the cross-section view. Drive it onto the needle roller bearing previously fitted.

Repeat the above procedure for the other needle roller bearings and the other seal.

Lubricate bearings and oil seals with recommended grease and insert the inner spacer (8).



### Refitting the rear suspension

Grease shank and thread of the screw (10) and the contact faces of the washer (9) with specified grease.

Grease shank and thread of pivot bolt and the underside of nut (16) with specified grease.

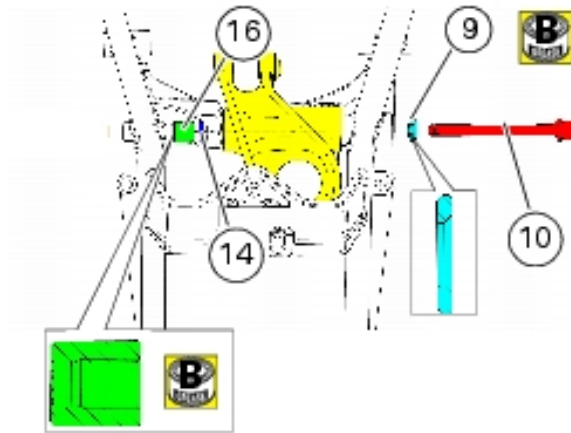
Insert the complete rocker arm between the frame supports, as shown in the figure.

Fit the washer (9) to the screw (10) with the concave side facing the screw. Insert the screw fully home into the

frame.

Install the nut (16) with the hexagon facing outward and with the spacer (14).

Tighten the nut (16) and tighten the screw (10) to the specified torque (Sect. C 3, [Frame torque settings](#)).



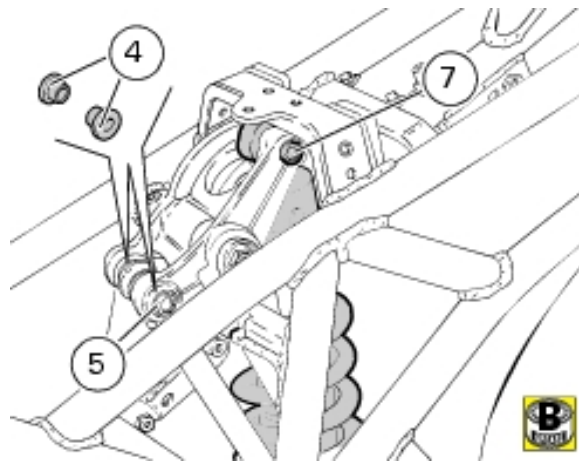
Grease the thread and underhead of the upper retaining screws (7) and (5) of shock absorber and linkage and start them in the holes in the rocker arm.

Insert the upper ball joint of the shock absorber into the rear hole of the rocker arm.

Tighten the screw (7) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Install the bushes (4) to both rocker arm ball joints.

Insert the upper end of the linkage into the rocker arm and tighten the screw (5) to the specified torque (Sect. C 3, [Frame torque settings](#)).

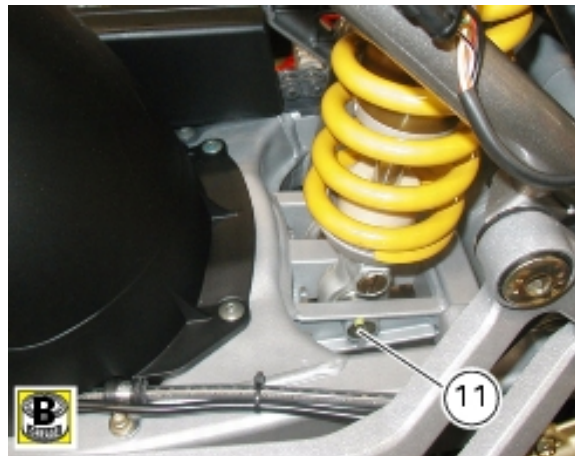


Position the bottom end of shock absorber and linkage to the swingarm.

Grease threaded bush (12) sliding surface and fit the bush onto the support from the parallel side.

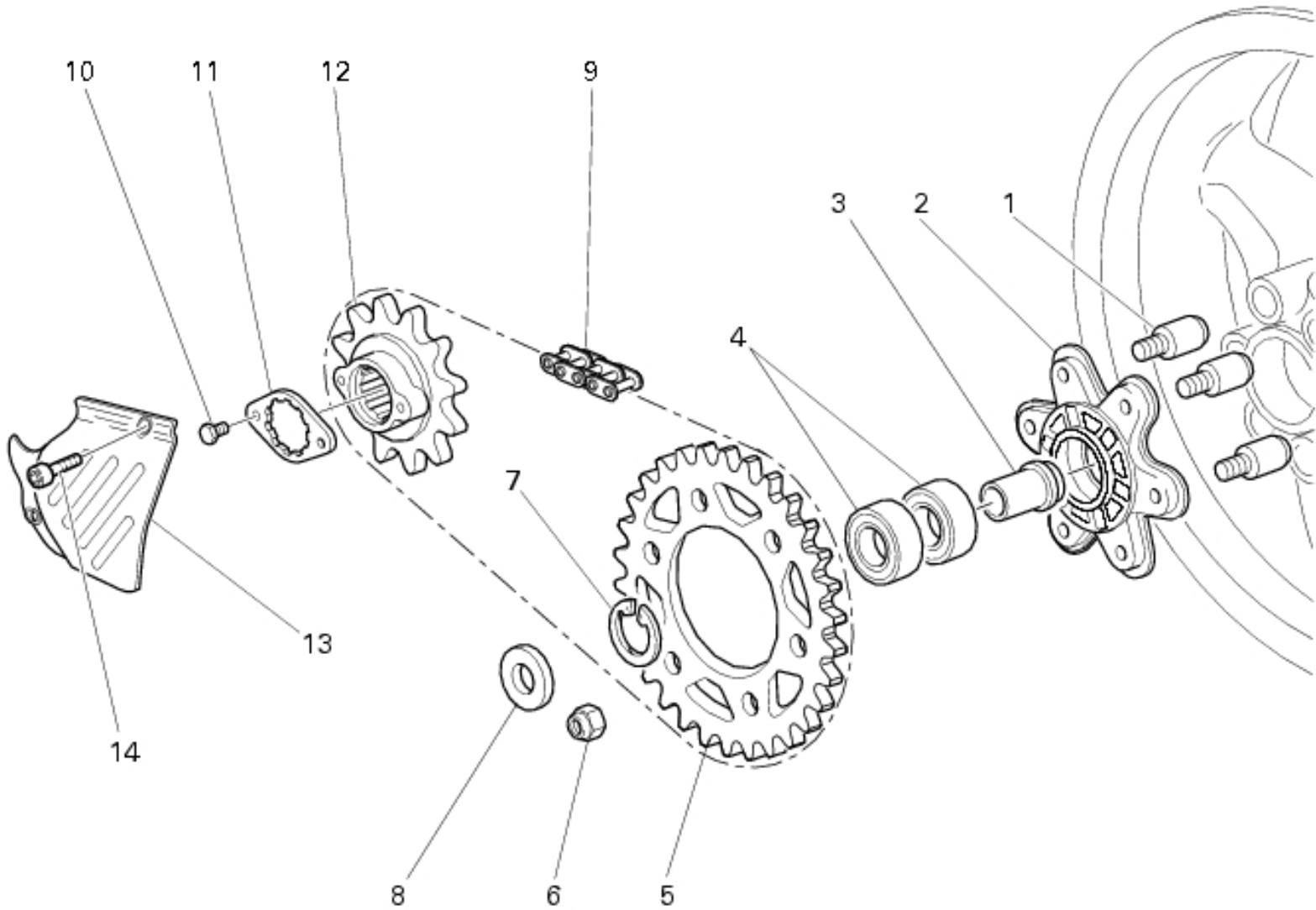
Grease thread, underhead and sliding surface of the lower retaining screw (11) and fit the screw into the swingarm from the right side.

Tighten the bolt (11) to the specified torque (Sect. C 3, [Frame torque settings](#)).




Refit the seat (Sect. E 3, [Refitting the seat](#)).

## 8 - Final drive



- 1 Pin
- 2 Rear chain sprocket flange
- 3 Bush
- 4 Bearing
- 5 Rear sprocket Z=48
- 6 Nut
- 7 Circlip
- 8 Spacer
- 9 Chain
- 10 Screw
- 11 Front sprocket retaining plate
- 12 Front chain sprocket
- 13 Front sprocket cover
- 14 Screw

 Spare parts catalogue

[Gear-box](#)

[Alternator cover](#)

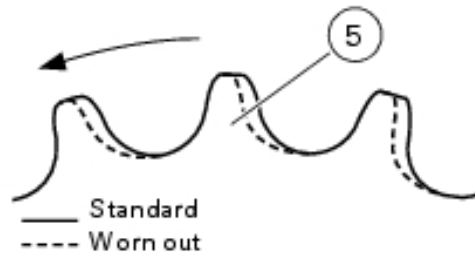
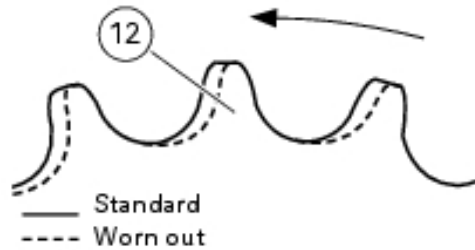
[Front and rear wheels](#)

 **Caution**

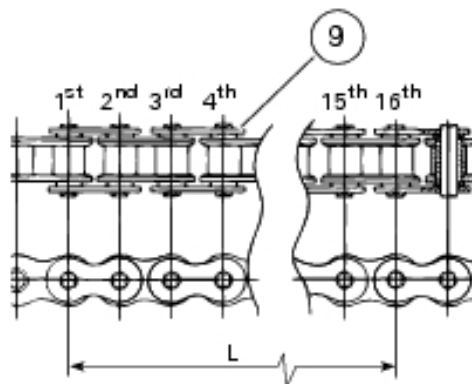
Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

Final drive inspection

Check the wear of the final drive. Visually inspect the front (12) and rear (5) sprockets. If the tooth profile is as shown by the broken line in the figure, change the sprockets.



To check chain (9) wear, stretch the chain and measure **16** links. If the length (L) is greater than **256.5** mm, change the chain.

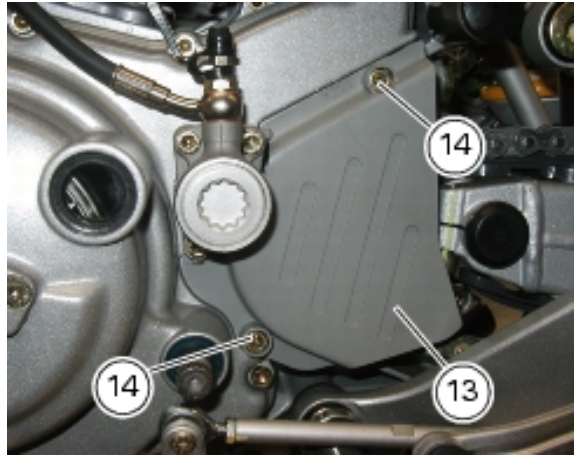


**Caution**

The rear sprocket (5), the front sprocket (12) and the chain (9) must all be changed together.

**Removing the chain sprocket**

Unscrew the screws (14) and take off the sprocket cover (13).

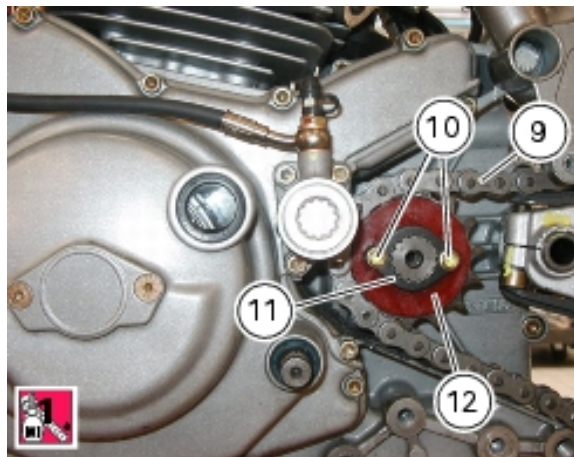


Slacken the chain (Sect. D 4, [Adjusting chain tension](#)).

Engage a low gear and unscrew the two screws (10) on the sprocket retaining plate (11).

Remove the plate (11) from the gearbox secondary shaft.

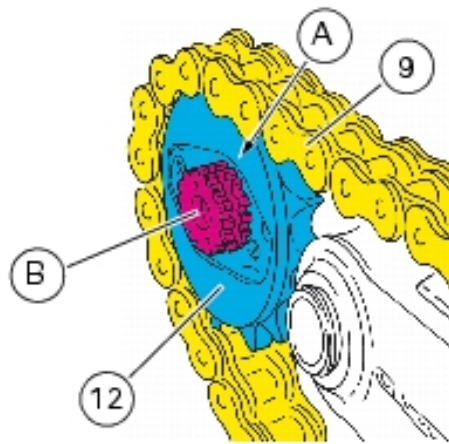
Slide the front chain sprocket (12) with the chain (9) off gearbox secondary shaft and take the chain off the sprocket.

**Refitting the chain sprocket**

Check that the splines of secondary shaft and sprocket are in perfect condition.

Wrap the chain (9) around the sprocket (12).

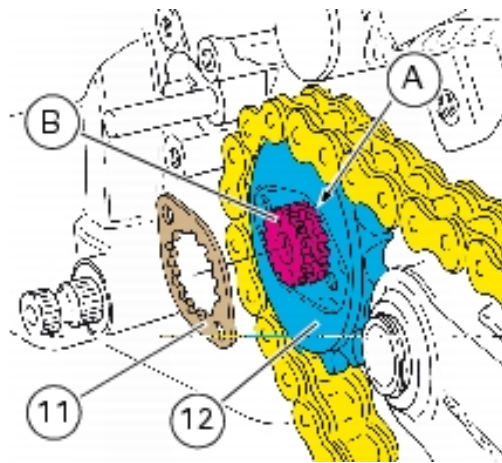
Fit the sprocket on the gearbox secondary shaft (B) as shown in the figure and push it past the shaft spline (A).



Insert the retaining plate (11) on the gearbox secondary shaft (B) and rotate it inside the recess (A) so that the plate holes (11) match the threaded holes in the sprocket (12); position the retaining plate with the rounded corner facing the sprocket.

Apply threadlocker to the thread of the screws (10).

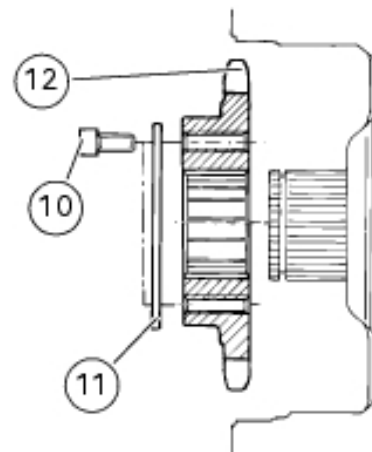
Engage first gear.



Tighten the screws (10) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Adjust chain tension (Sect. D 4, [Adjusting chain tension](#)).

Position the front sprocket cover (13) and tighten the screws (14) to the specified torque (Sect. C 3, [Frame torque settings](#)).



Removing the rear sprocket

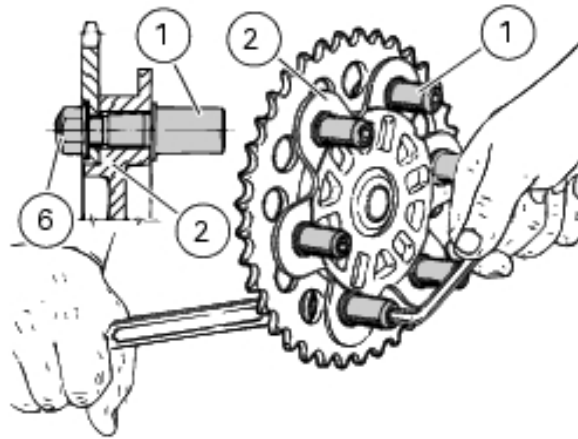
Operations

Reference See Section

Slacken the chain	D 4, <a href="#">Adjusting chain tension</a>
Remove the rear wheel	G 4, <a href="#">Removing the rear wheel</a>

Slide the complete rear sprocket flange (2) off the rear wheel.

Hold the pins (1) at the rubber cush pads steady and undo the nuts (6) retaining the sprocket to the flange.



### Caution

The pins (1) have left-hand threads.

Remove the rear sprocket.

### Refitting the rear sprocket

Make sure that all pins (1) are securely in place in the flange (2). If not so, unscrew the **left-threaded** pins, clean the threads and apply threadlocker to the thread with the larger diameter.

Tighten them to the flange to the specified torque (Sect. C 3, [Frame torque settings](#)).

Apply threadlocker to end threads of the pins (1).

Fit the new sprocket (5), hold the pins and tighten the nuts (6) to the specified torque (Sect. C 3, [Frame torque settings](#)).

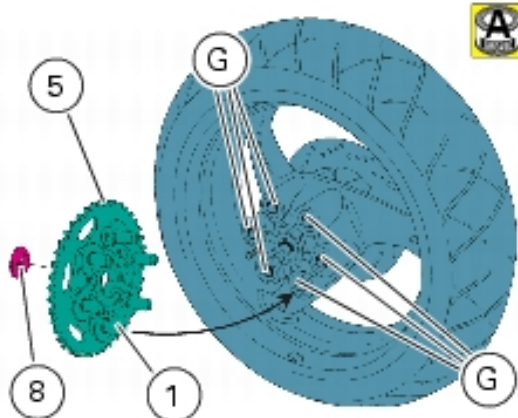


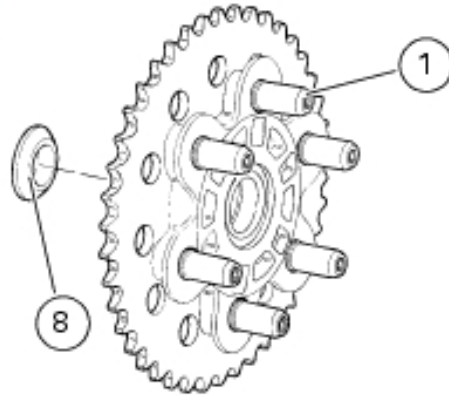
### Warning

Perform the procedure carefully. If any one pin is not tightened securely fully home into the flange before the nuts are tightened on the sprocket, the sprocket will be installed incorrectly, endangering rider and motorcycle safety.

Grease pins (1) and fit the rear sprocket flange (2) in the rear wheel hub, fit the pins in the relevant rear wheel cush drive rubbers (G).

Install the spacer (8) with the tapered end facing the rear sprocket flange.





Operations	Reference See Section
Refit the rear wheel	G 4, <a href="#">Refitting the rear wheel</a>
Adjust chain tension	D 4, <a href="#">Adjusting chain tension</a>

# 0Wheels - Suspensions - Brakes

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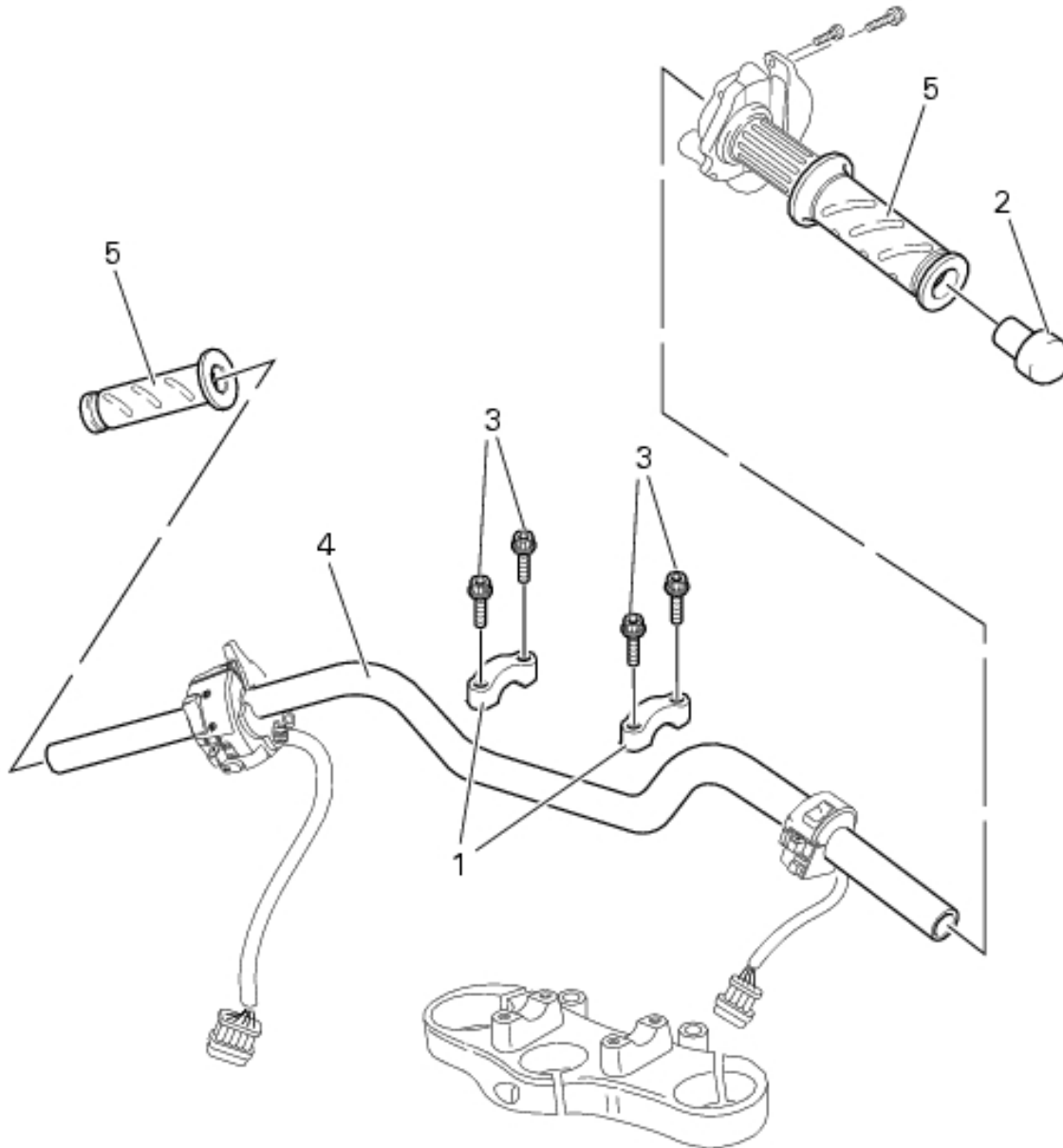
[Removing the chain sprocket 55](#)

[Refitting the chain sprocket 56](#)


[Removing the rear sprocket 57](#)

[Refitting the rear sprocket 58](#)

# 1 - Handlebar



- 1 U-bolt
- 2 Blanking plug
- 3 Screw
- 4 Handlebar
- 5 Twistgrips

 Spare parts catalogue

[Handlebar and controls](#)

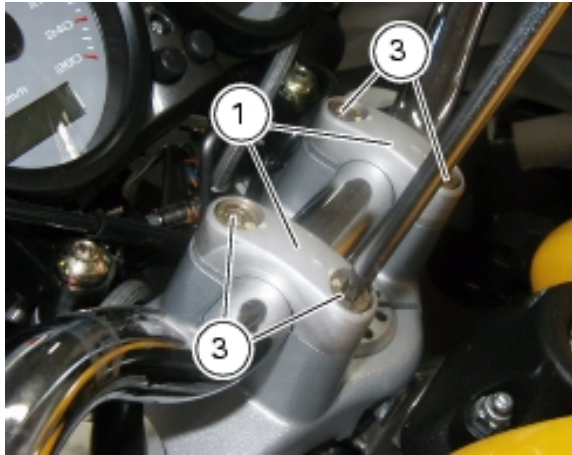
 Caution

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

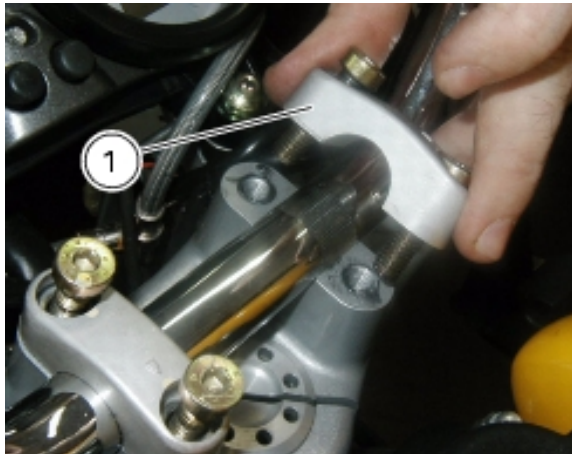
Removing the handlebar

Operations	Reference See Section
Remove the throttle control	F 1, <a href="#">Disassembling the throttle control</a>
Remove the right and left switches	P 5, <a href="#">Checking the indicators and lighting system components</a>
Remove the front brake control	F 3, <a href="#">Removing the front brake master cylinder</a>
Remove the clutch hydraulic control	F 2, <a href="#">Removing the clutch master cylinder assembly</a>

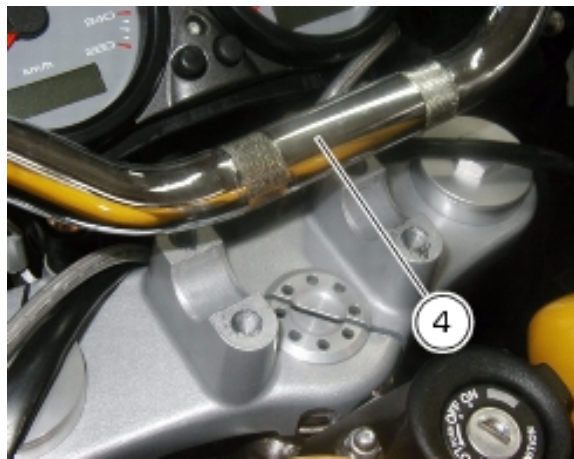
Release and remove the screws (3) of the clamps (1).



Remove both handlebar clamps (1).



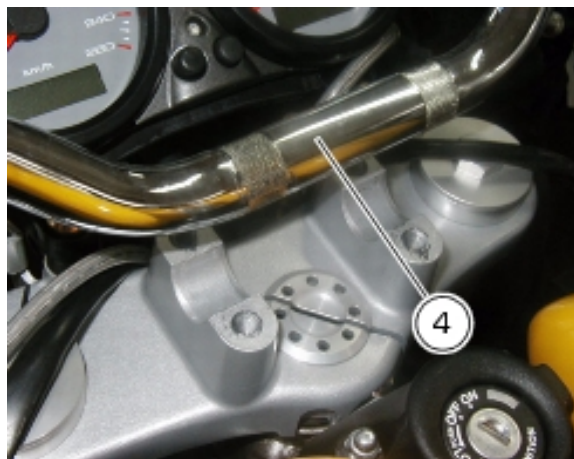
Remove the handlebar (4) from its seat in the steering head.



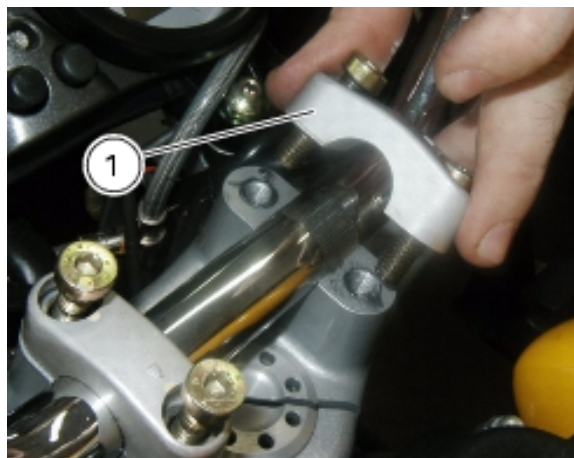
Please refer to the exploded view at the beginning of this section for handgrips (5) removal procedure.

### Refitting the handlebar

Position the handlebar (4) to its seat in the steering head.



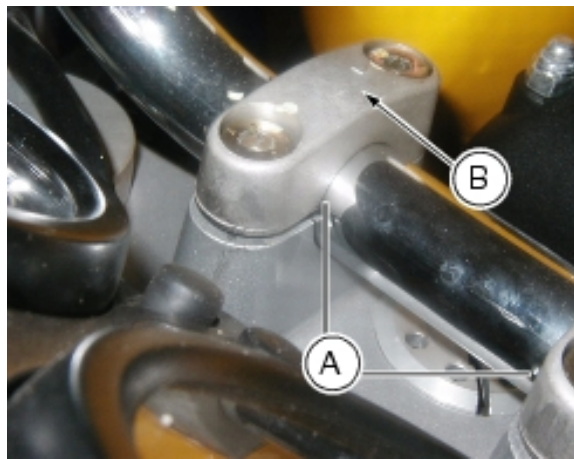
Position the clamps (1) to the handlebar.



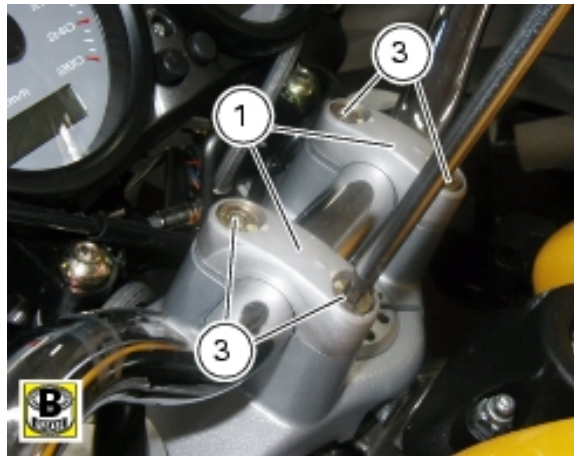
### Caution

The arrow (B) on the back of the clamps must be facing the tank.

When fitting the handlebars, make sure the dots (A) lie in the same line as the seats in the steering head as shown in the figure.

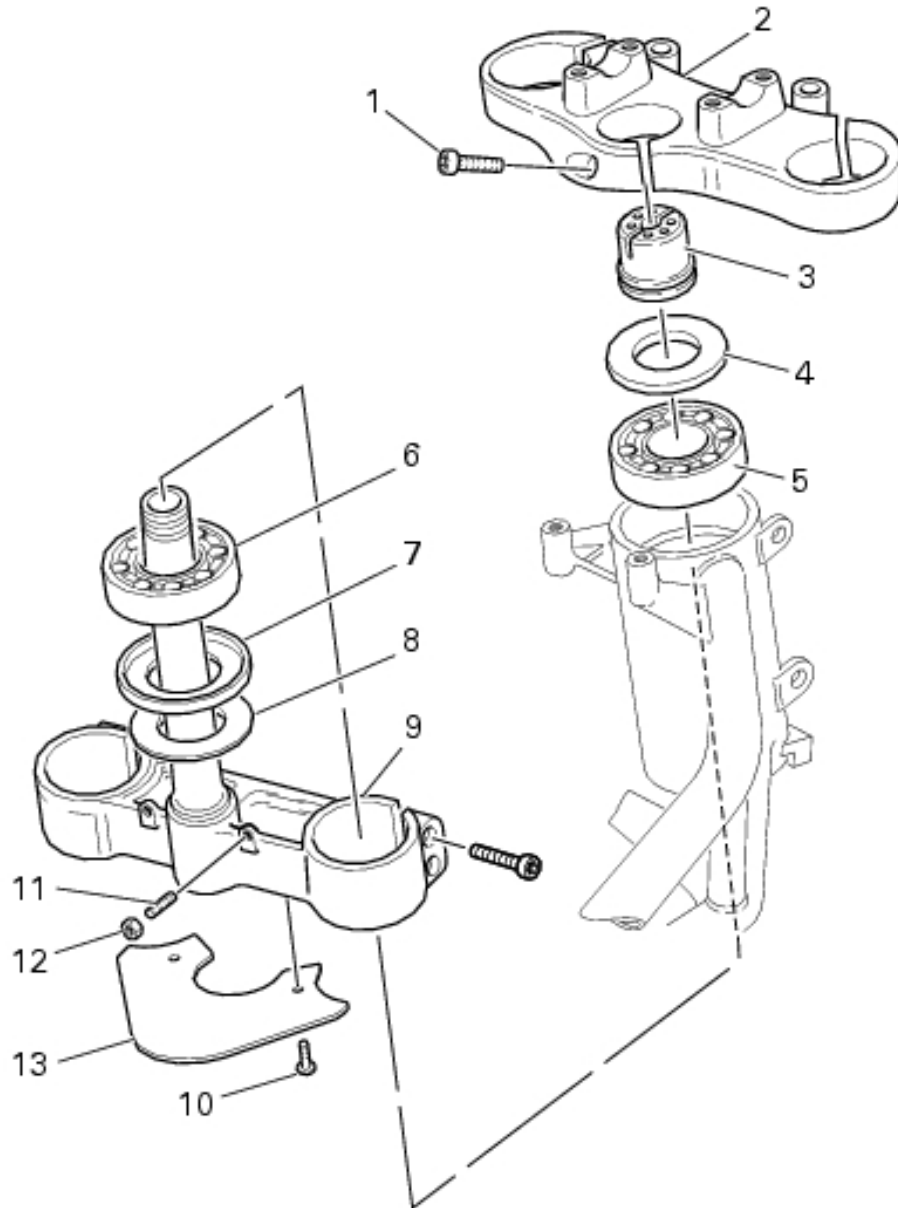


Apply specified grease on the thread of the screws (3).  
 Tighten the screws (3) to secure the clamps (1).  
 Tighten the screws (3) to the specified torque (Sect. C 3, [Frame torque settings](#)).



Operations	Reference See Section
Install the front brake control	F 3, <a href="#">Refitting the front brake master cylinder</a>
Install the right and left switches	P 5, <a href="#">Checking the indicators and lighting system components</a>
Install the throttle control	F 1, <a href="#">Reassembling the throttle control</a>
Install the clutch hydraulic control	F 2, <a href="#">Refitting the clutch master cylinder assembly</a>

## 2 - Steering



- 1 Screw
- 2 Steering head
- 3 Ring nut
- 4 Seal
- 5 Bearing
- 6 Bearing
- 7 Seal
- 8 Washer
- 9 Bottom yoke
- 10 Screw
- 11 Grub screw
- 12 Nut
- 13 Splashguard

 Spare parts catalogue

[Handlebar and controls](#)

 Caution

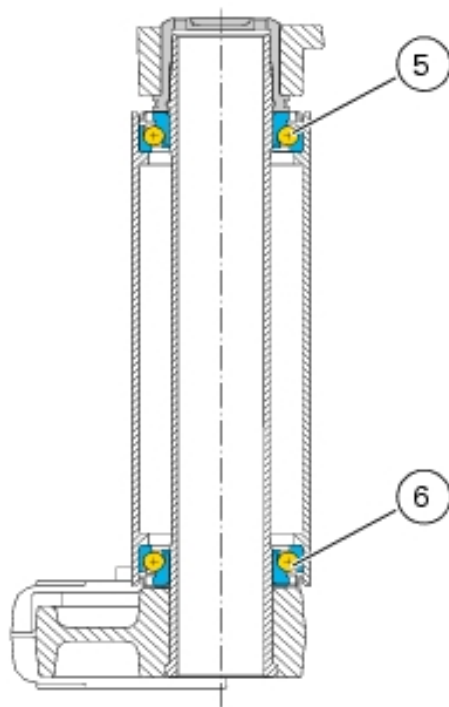
Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

## Adjusting steering bearing play

 Note

See Section D 4, [Adjusting steering bearings play](#), for steering bearing play adjustment.

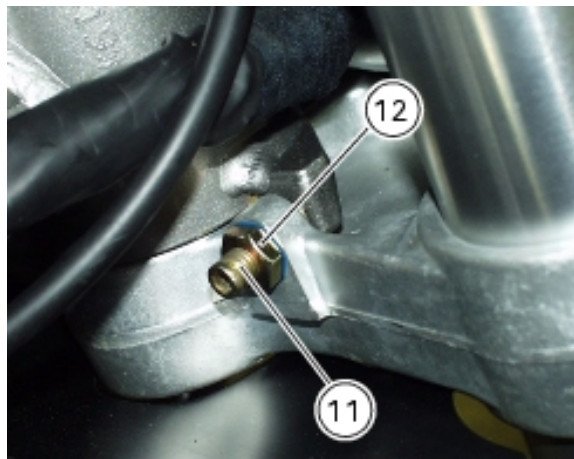
If the problem persists, inspect the steering bearings (5) and (6) for wear and replace as required. The replacement procedure is detailed in paragraph "[Disassembling the steering tube components](#)" in this Section.



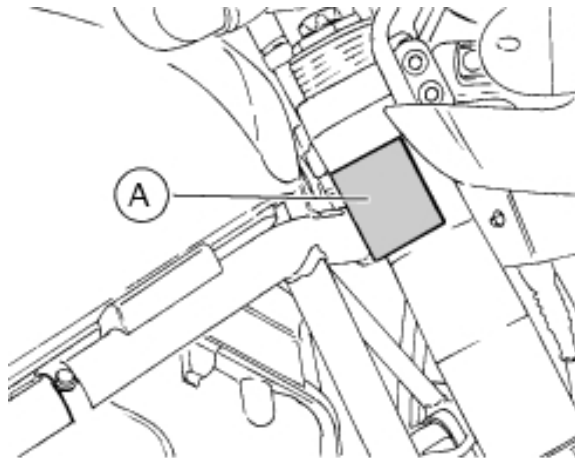
## Adjusting the steering angle

Loosen the nuts (12).

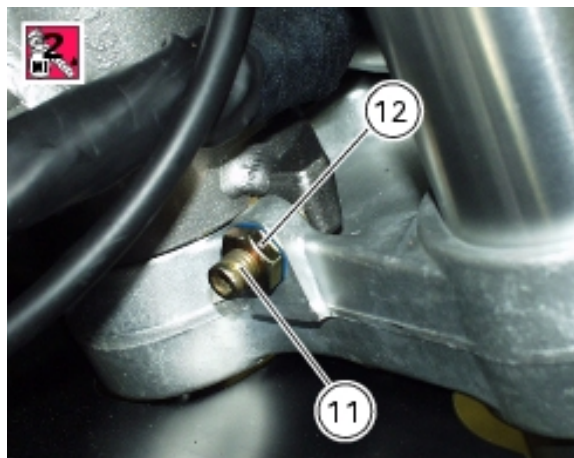
Loosen the adjusting grub screws (11) on both sides of the bottom yoke.



Insert a **6-6.5** mm calibrated feeler gauge (A) on the fork sleeve, or use a gauge.



Turn the front fork assembly to the right until the shim (A) contacts the frame upper tube. Bring the adjusting grub screw (11) on the left side in contact with the end stop on steering head. Apply threadlocker to the nut thread (12). Hold the grub screw (11) steady and lock the nut (12). Rotate the front fork assembly to the left, repeat the procedure for the other dowel and tighten the nut.



Disassembling the steering tube components

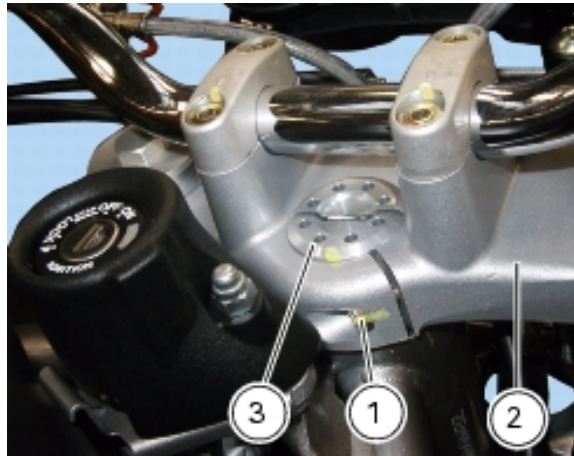
Operations	Reference See Section
Remove the handlebar	H 1, <a href="#">Removing the handlebar</a>
Remove the fork legs	G 2, <a href="#">Removing the front fork</a>



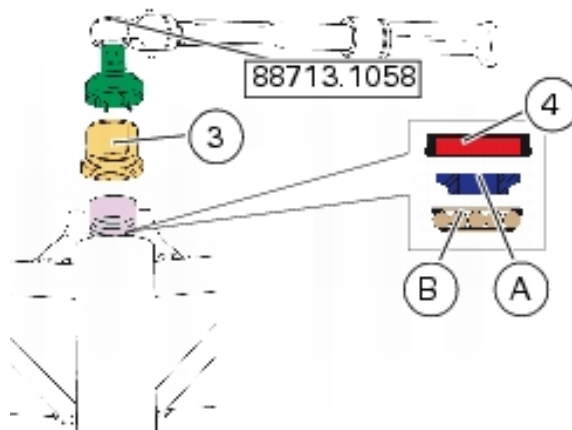
## Note

All components installed to steering head and bottom yoke, including electrical cables and Bowden cables, may be left in place, as long as they do not impair the disassembly procedure.

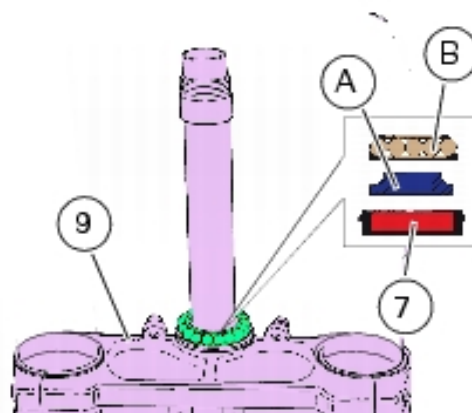
Loosen the screw (1) securing the steering head (2) to the ring nut (3).  
Lift the steering head (2).



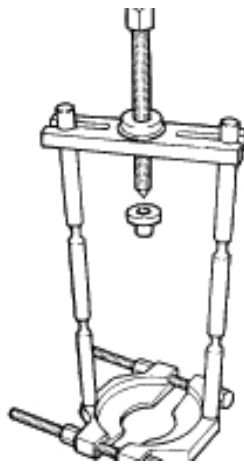
Loosen the ring nut (3) with the tool no. **88713.1058** and undo from the steering shaft.  
Remove seal (4), bearing inner ring (A) and ball ring (B) of the top bearing (5) from steering shaft.



Slide bottom yoke (9) and steering shaft out of frame tube.  
Withdraw the ball ring (B) of the bottom bearing (6).  
The inner ring (A) and seal (7) of the bottom bearing (6) remain on the steering shaft.



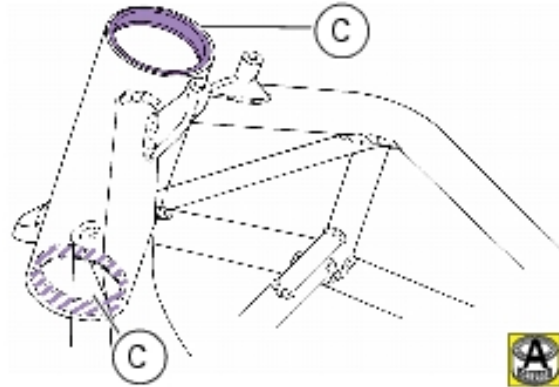
Remove inner ring (A) and spacer (8) from the steering shaft using an all-purpose puller (see figure). Do not damage the seat.



### Caution

Do not refit oil seals (4) and (7) and bearings (5) and (6) once they have been removed. Always fit new components.

Using a drift, remove the outer bearing rings (C) from the steering tube. Proceed with care. Do not damage the ring seats.

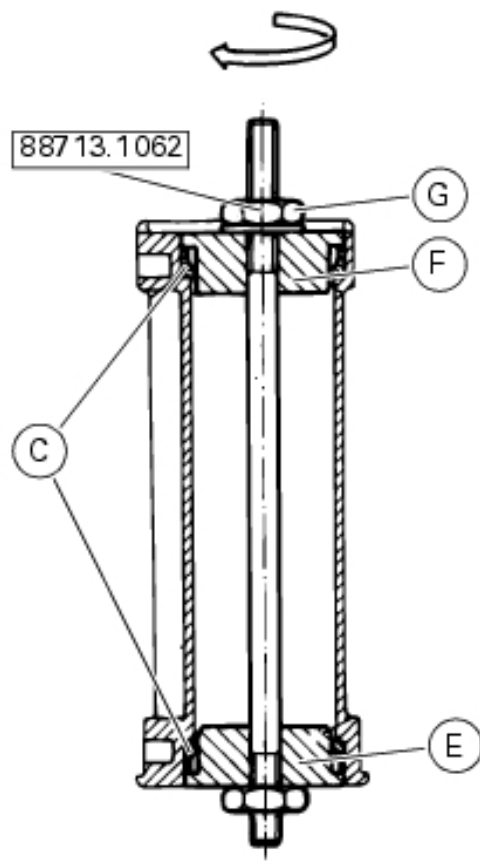


### Refitting the steering tube components

### Caution

Steering bearings (5) and (6) are identical, however, never mix their components.

Clean all contact surfaces and grease with the recommended grease.  
 Use the tool no. **88713.1062** to fit the outer rings (C) of bearings (5) and (6) onto the headstock. Proceed as follows:  
 heat steering tube up to **150 °C**;  
 place the outer rings (C) of the bearings into the seats in the steering tube;  
 insert the fixed bush (E, with threaded bore) of the tool into the bottom ring;  
 fit the other bush (F, moving bush) into the upper end of the tool rod and push it against upper bearing ring;  
 screw nut (G) and use the wrench to push the outer rings (C) against steering tube;  
 leave tool assembled to steering tube until the latter has cooled down to ensure that bearings become fully seated in their seats.

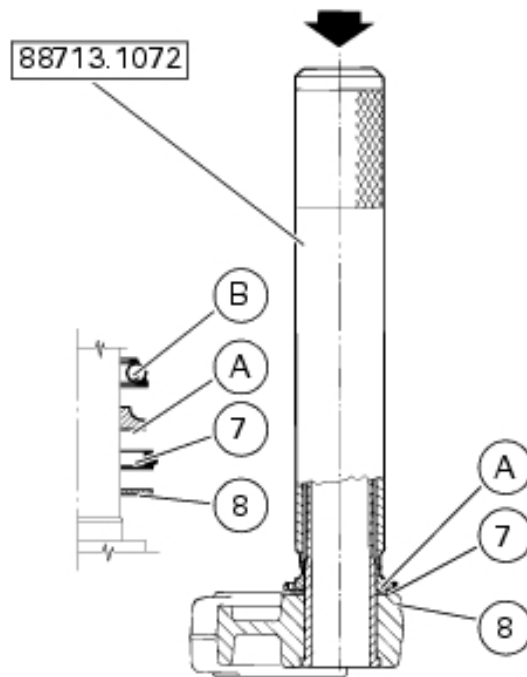


Fit the washer (8), the seal ring (7) with trim side up and the inner ring (A) of the lower bearing (6) into the steering shaft. Heat it up at **125 °C** for ten minutes first.

Fit the drift no. **88713.1072** into the steering shaft. Keep the inner ring (A) pressed onto seal (7) manually for at least 10-15 seconds.

Grease the inner bearing ring (A) with the specified grease.

Fit the ball ring (B) into the steering shaft with the smaller side of the cage up and grease.



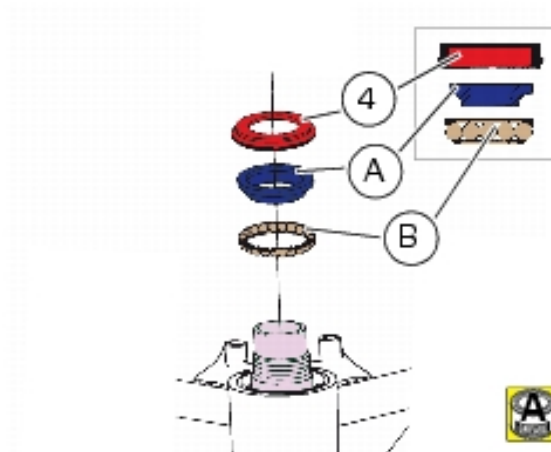
Fit steering shaft into steering tube and push until it becomes fully seated axially.

Install the bottom yoke assembly to the frame.

Grease the ball ring (B) and fit it to the top outer ring (C) of the frame.

Fit the inner ring (A) of the upper bearing (5) onto the steering shaft; its larger side should be face up.

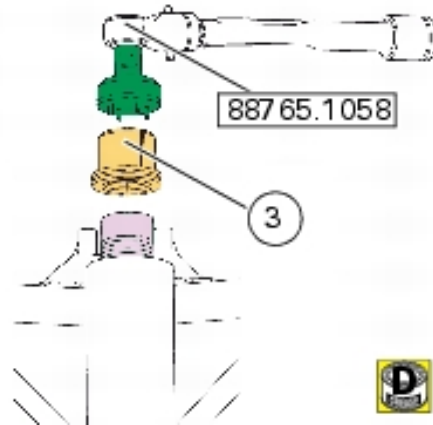
Fit the oil seal (4) with the flat face facing upwards.



Grease the ring nut (3).

Screw the ring nut (3) finger-tight until it contacts the oil seal (4).

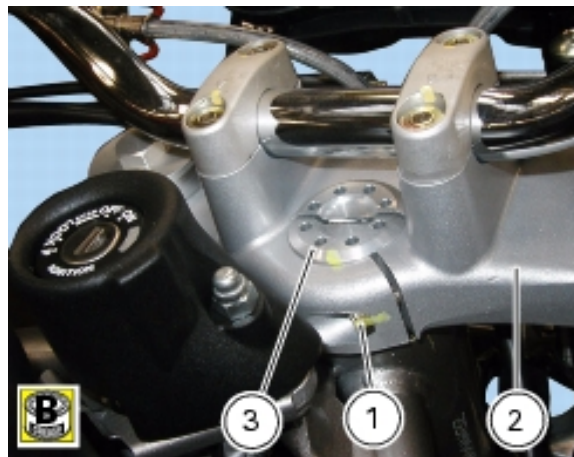
Position the special bush no. **88713.1058** onto the ring nut (3) and then fit the torque wrench on the bush. Tighten the adjusting ring nut (3) to the specified torque (Sect. C 3, [Frame torque settings](#)).



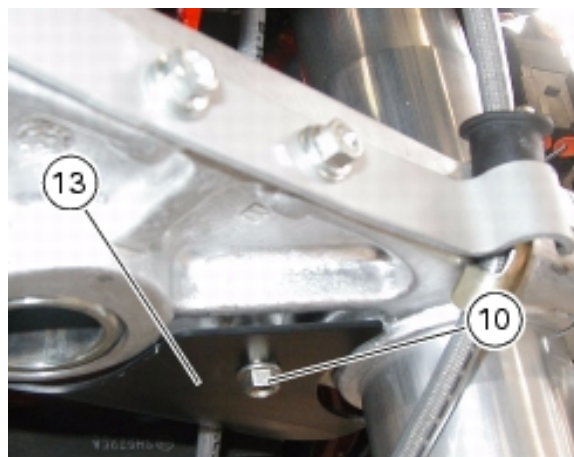
Install the steering head (2) to the ring nut (3) so that the fork leg clamp holes match those in the bottom yoke. Refit the fork legs as described in Sect. G 2, [Refitting the front fork](#).

Grease the screw (1).

Tighten the screw (1) on the steering head to the specified torque (Sect. C 3, [Frame torque settings](#)).

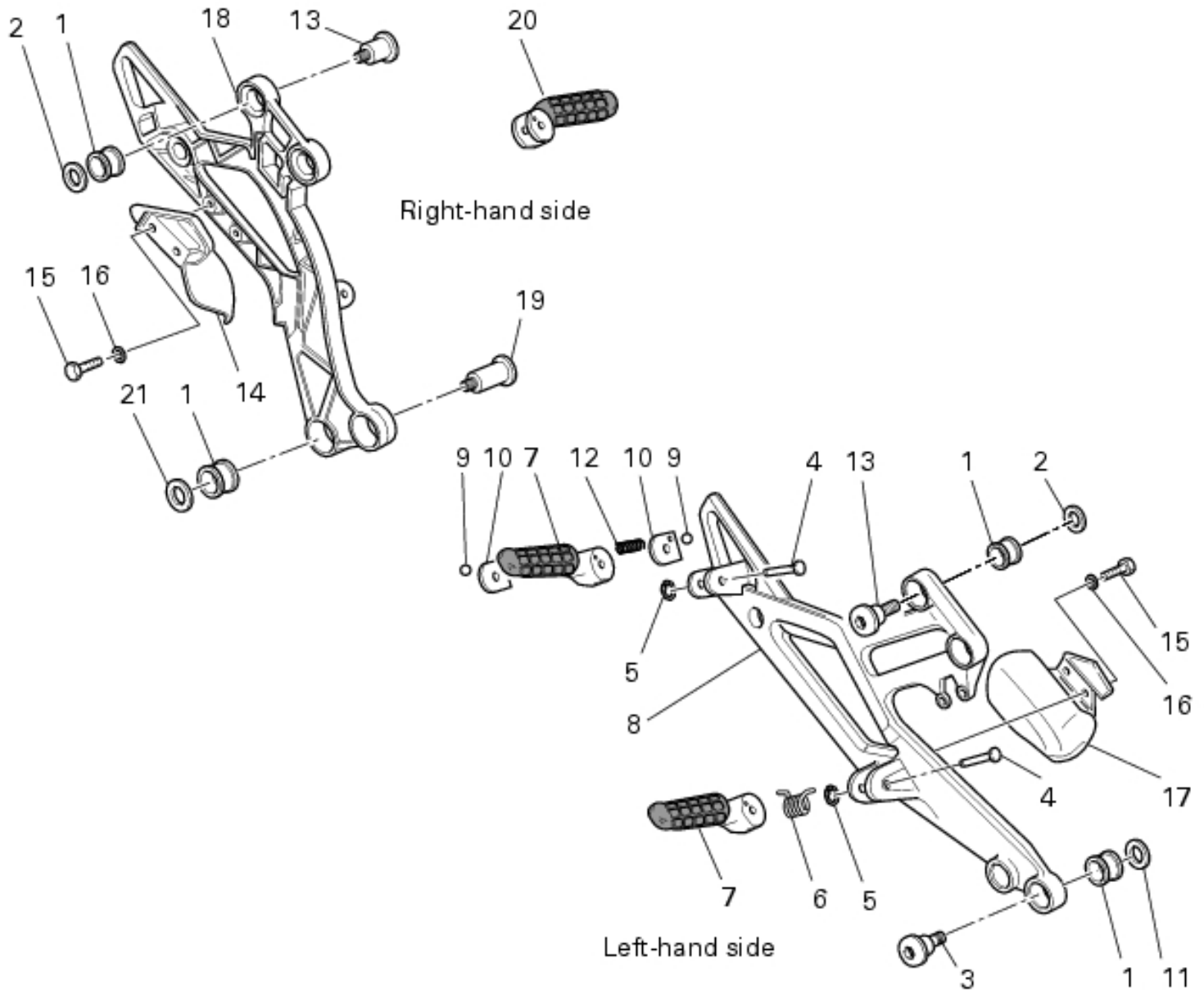


If removed, fit the splashguard (13), apply threadlocker to the screws (10) and tighten them to the specified torque (Sect. C 3, [Frame torque settings](#)).




Operations	Reference See Section
Refit the fork legs	G 2, <a href="#">Refitting the front fork</a>
Refit the handlebar	H 1, <a href="#">Refitting the handlebar</a>

## 4 - Footpeg supports



- 1 Vibration damping pad
- 2 Washer
- 3 Screw
- 4 Pin
- 5 Circlip
- 6 Spring
- 7 Complete RH footpeg
- 8 RH footpeg plate
- 9 Ball
- 10 Plate
- 11 Washer
- 12 Spring
- 13 Screw
- 14 LH guard
- 15 Screw
- 16 Washer
- 17 RH guard
- 18 LH footpeg plate

- 19 Screw
- 20 Complete LH footpeg
- 21 Spacer

 Spare parts catalogue

[Gearchange lever - foot rest](#)

 **Caution**

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Removing the footpegs

The removal procedure described below applies to both RH and LH footpegs.

To remove the right footpeg, unscrew the two screws (B) and remove the rear brake master cylinder (A). Leave the master cylinder connected to the system.

Before removing the left footpeg plate, loosen the screw (D) securing the gearchange control (C) to the engine and leave the gearbox unit connected to the plate.

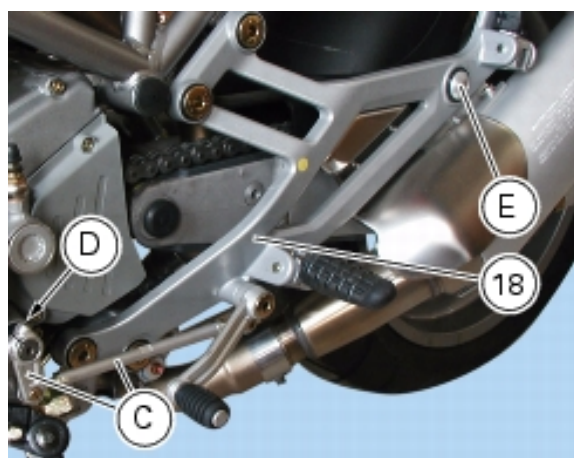
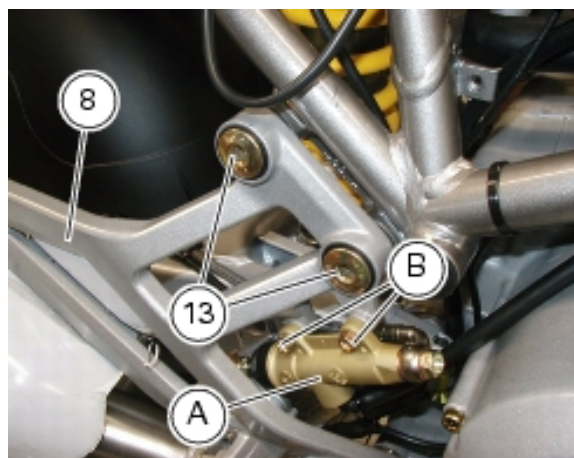
Unscrew the two upper screws (13) securing the plate to the frame.

 **Note**

Between the right footpeg support and the frame is the canister support bracket (**for USA version only**).

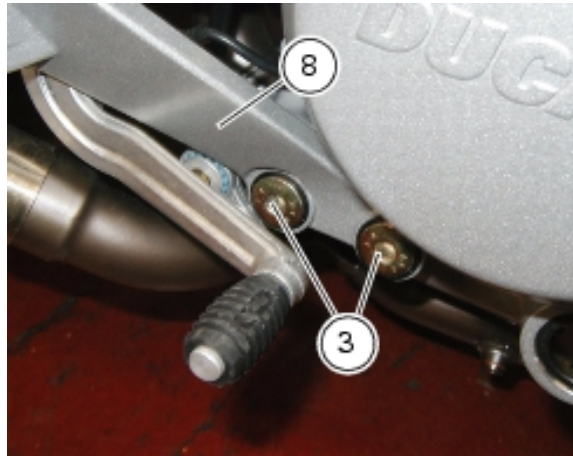
Collect the washers (2) placed between plate and frame.

Loosen the screw (E) securing the silencer to the footpeg, collect the nuts and the washers.

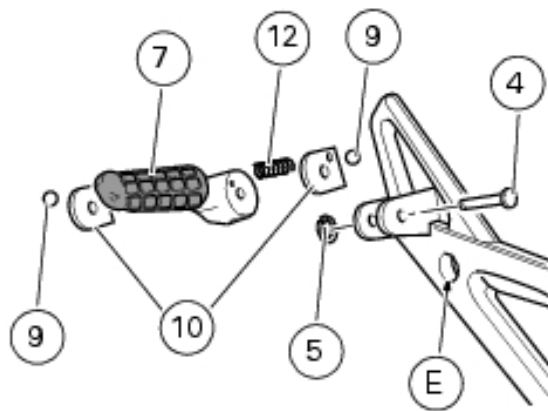


Unscrew the lower retaining screws (3) on the engine casing.

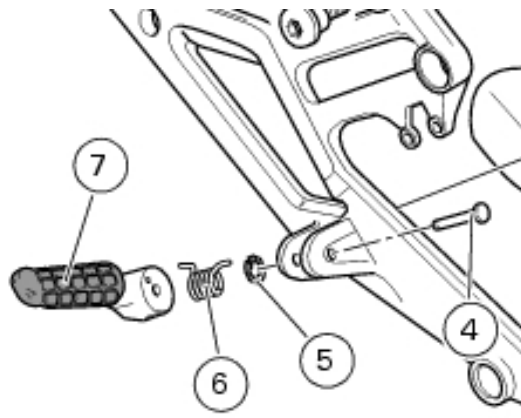
Remove the complete right footpeg plate (8) and collect the washers (11).



To remove the rear footpeg from the plate, extract the snap ring (5) and withdraw the pin (4) to release footpeg (7), plates (10), balls (9) and springs (12).



To remove the front footpeg from the plate, extract the snap ring (5) and withdraw the pin (4) to release footpeg (7) and spring (6).



Repeat procedure for the left footpeg.



#### Note

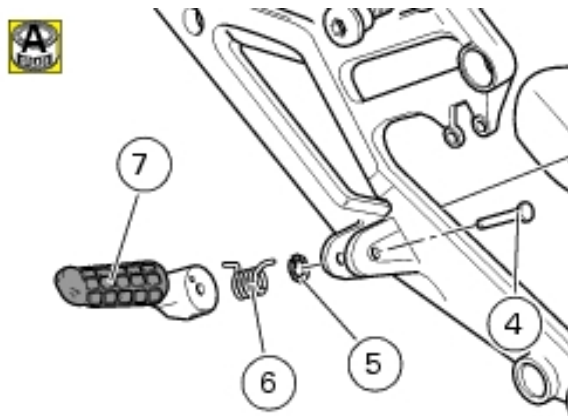
It is also possible to remove the footpeg even with footpeg plate fitted to the vehicle.

#### Refitting the footpegs

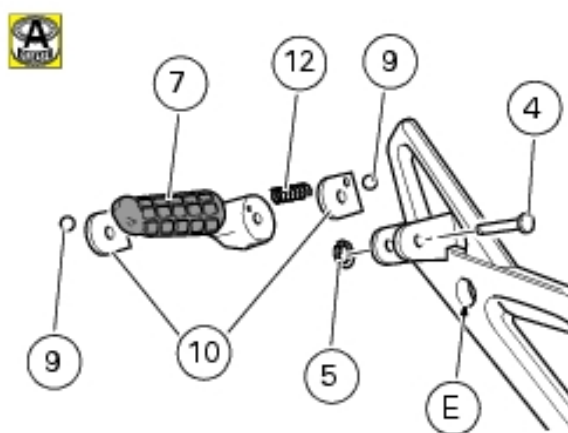
The assembly procedure described below applies to both footpeg plates.

Right side: place the spring (6) between the end stops of the front footpeg (7) and fit them to the footpeg plate.

Ensure that the straight end of the spring locates into the plate hole.  
Grease the pin (4) and fit it from the top end. Fit the snap ring (5) at the other end to hold the pin in place.



Position spring (12), plates (10), balls (9) and rear footpeg (7) between the end stops of the right footpeg plate (8).  
Grease the pin (4) and fit it from the top end. Fit the snap ring (5) at the other end to hold the pin in place.

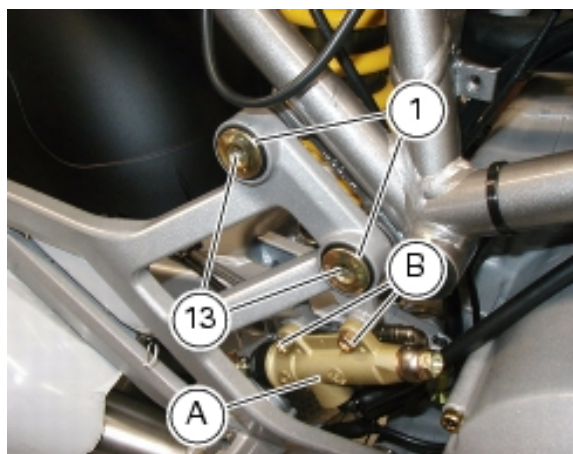


Check the condition of the vibration damping pads (1) on the footpeg plate.  
Locate footpeg plate to the threaded holes in the frame and engine casing.

### Caution

On refitting, position the washers (2) at the frame mounting points and the washers (11) at the engine mounting points.

Secure the footpeg plate to engine with the threaded pins (3) and to frame with the threaded pins (13).



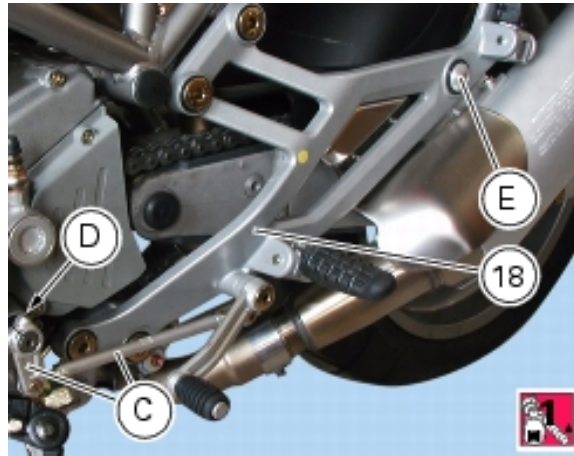
Tighten the threaded pins to the specified torque (Sect. C 3, [Frame torque settings](#)).  
Start the silencer securing screw (E) in its thread, fit relevant washers and nuts.

Hold nuts and tighten the screw (E) to the specified torque (Sect. C 3, [Frame torque settings](#)).

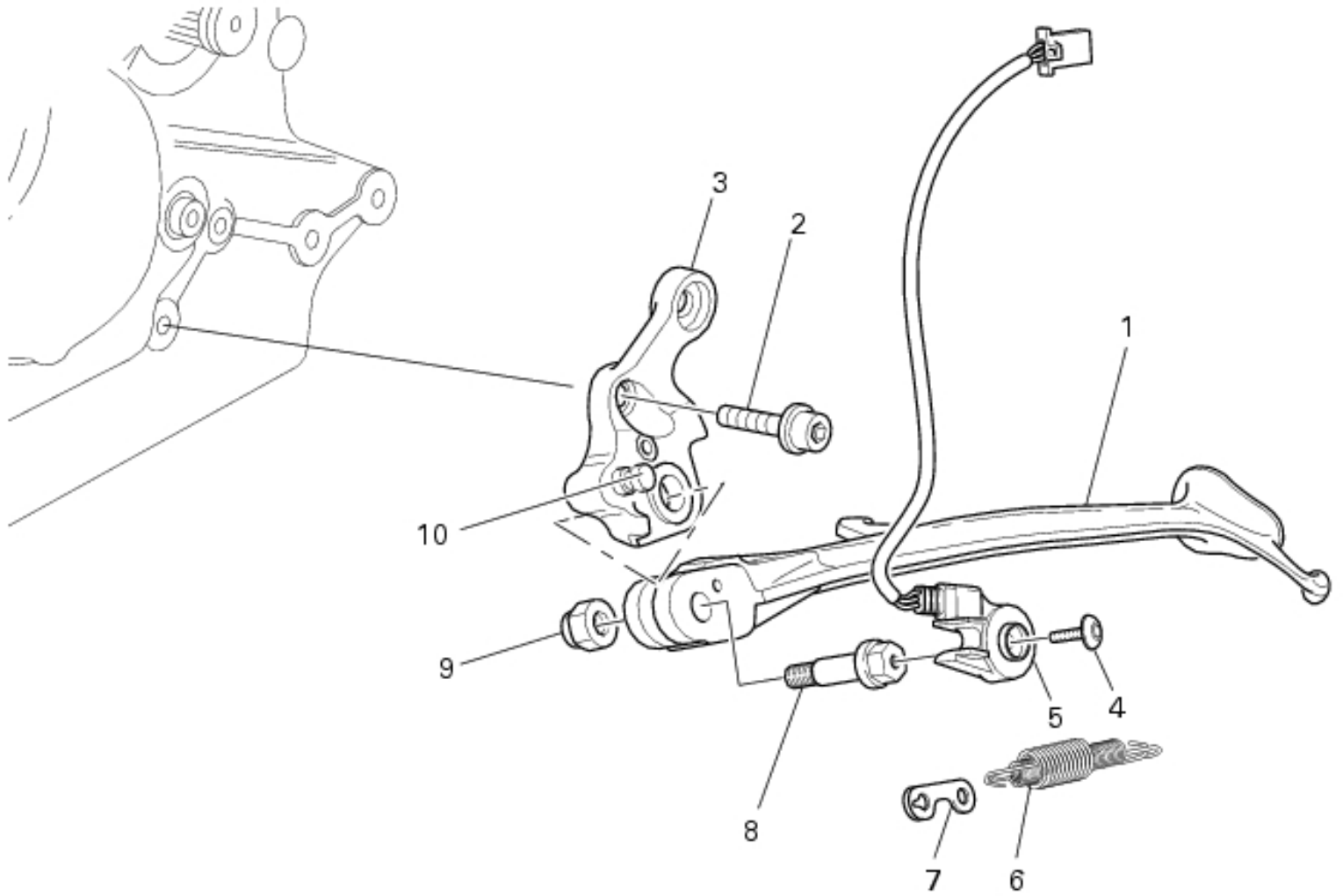
Repeat procedure for the left footpeg.

Fit the rear brake control (A) to the right footpeg, tighten the screws (B) to the specified torque (Sect. C 3, [Frame torque settings](#)).


Mount the gear change control (C) to the engine. Apply threadlocker to the screw (D) and tighten to the specified torque (Sect. C 3, [Frame torque settings](#)).



# 5 - Stands



- 1 Side stand
- 2 Screw
- 3 Stand plate
- 4 Screw
- 5 Switch
- 6 Spring
- 7 Plate
- 8 Pivot
- 9 Nut
- 10 Plate pin

 Spare parts catalogue

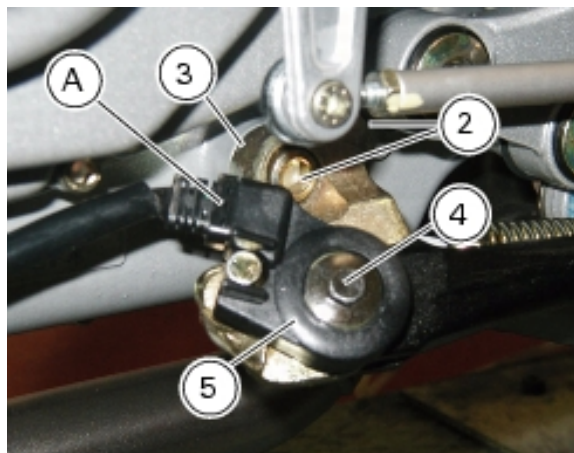
[Stands](#)

 Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

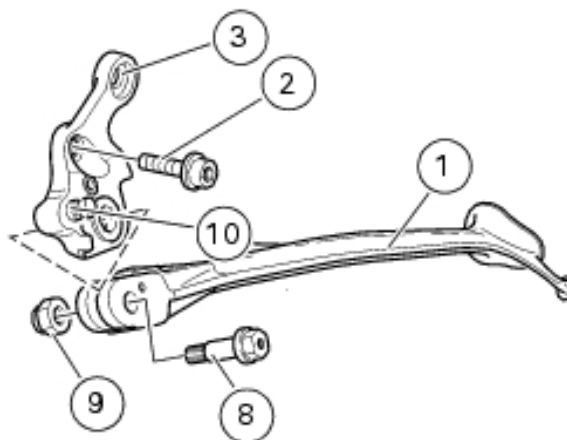
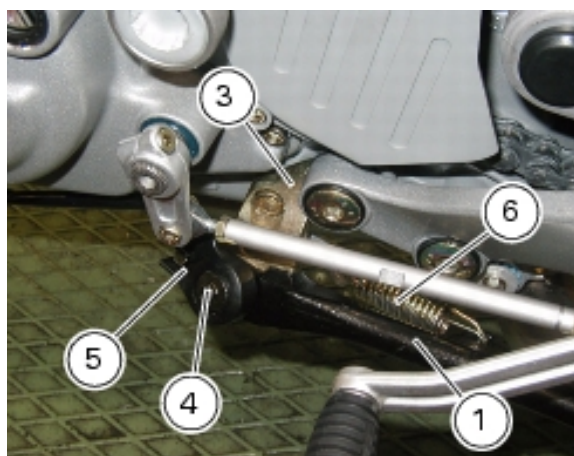
## Removing the side stand

Disconnect the connector (A) of the side stand switch (5) from the main wiring harness. Undo the two screws (2) that secure stand plate (3) to engine. Remove the complete side stand.



## Disassembling the side stand

Unscrew the retaining screw (4) and remove the stand switch (5). Unhook the stand return springs (6) from the pin located on the stand plate (3) and remove the springs. Unscrew the pivot (8) retaining the stand to the plate and remove the side stand (1) and the nut (9).



## Inspecting the side stand

Fit the stand to the plate and check for exceeding play. Ensure that the ends of the stand are not bent with respect to the shank. A stand which shows signs of cracking must be replaced immediately.

See Sect. P 6, [Checking protection and safety devices components](#), for switch (5) testing.

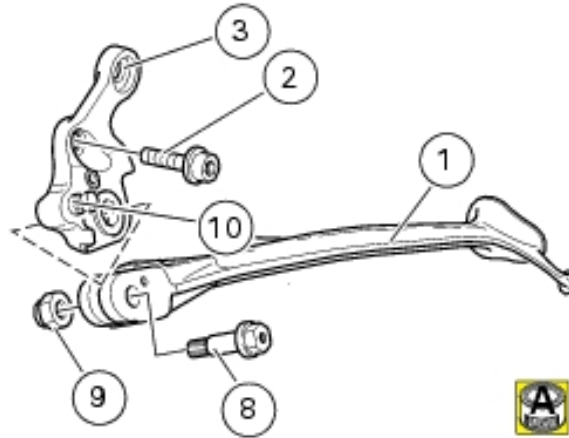
#### Reassembling the side stand

Grease the stand (1) and fit it to the plate (3). Secure it with pivot (8) and nut (9). Tighten the pivot (8) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Position the stand return springs (6), fix them to the pivot of plate (10) and to the stand (1) and tighten.

Position the switch (5) to pivot (8) on the plate.

Fit the retaining screw (4) and tighten to the specified torque (Sect. C 3, [Frame torque settings](#)).

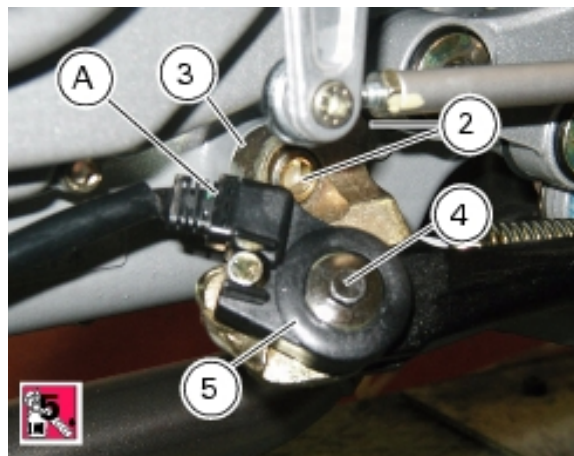


#### Refitting the side stand

Position the side stand plate (3) to the frame. Apply the specified threadlocker to the threads of the two screws (2) and start the screws in their holes.

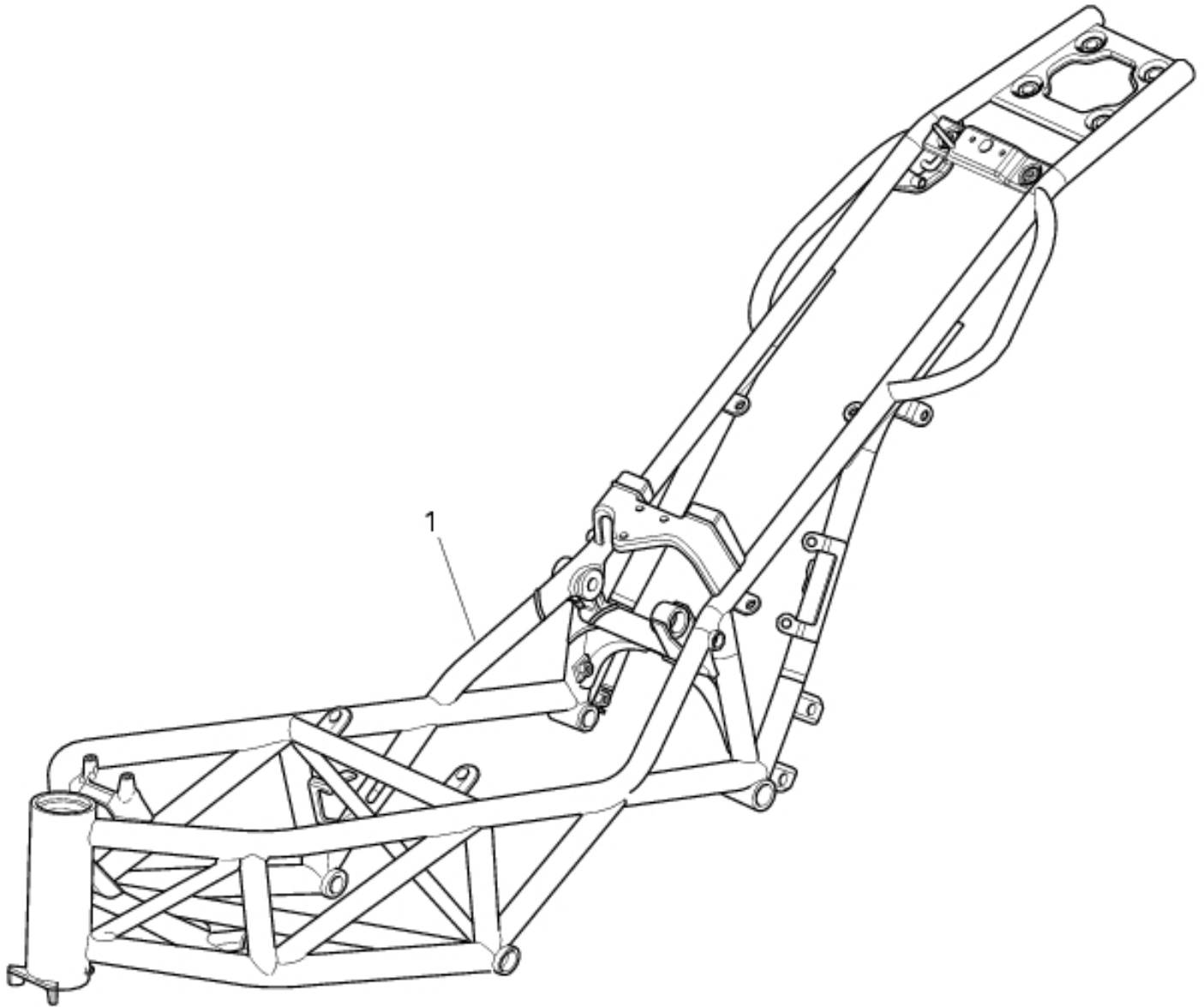
Tighten the screws (2) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Connect the connector (A) of the side stand switch to the main wiring harness.



See the tables in Sect. P 1, [Arrangement of wiring on frame](#), for side stand switch cable routing.

## 6 - Frame inspection



1 Frame

 [Spare parts catalogue](#)

[Frame](#)

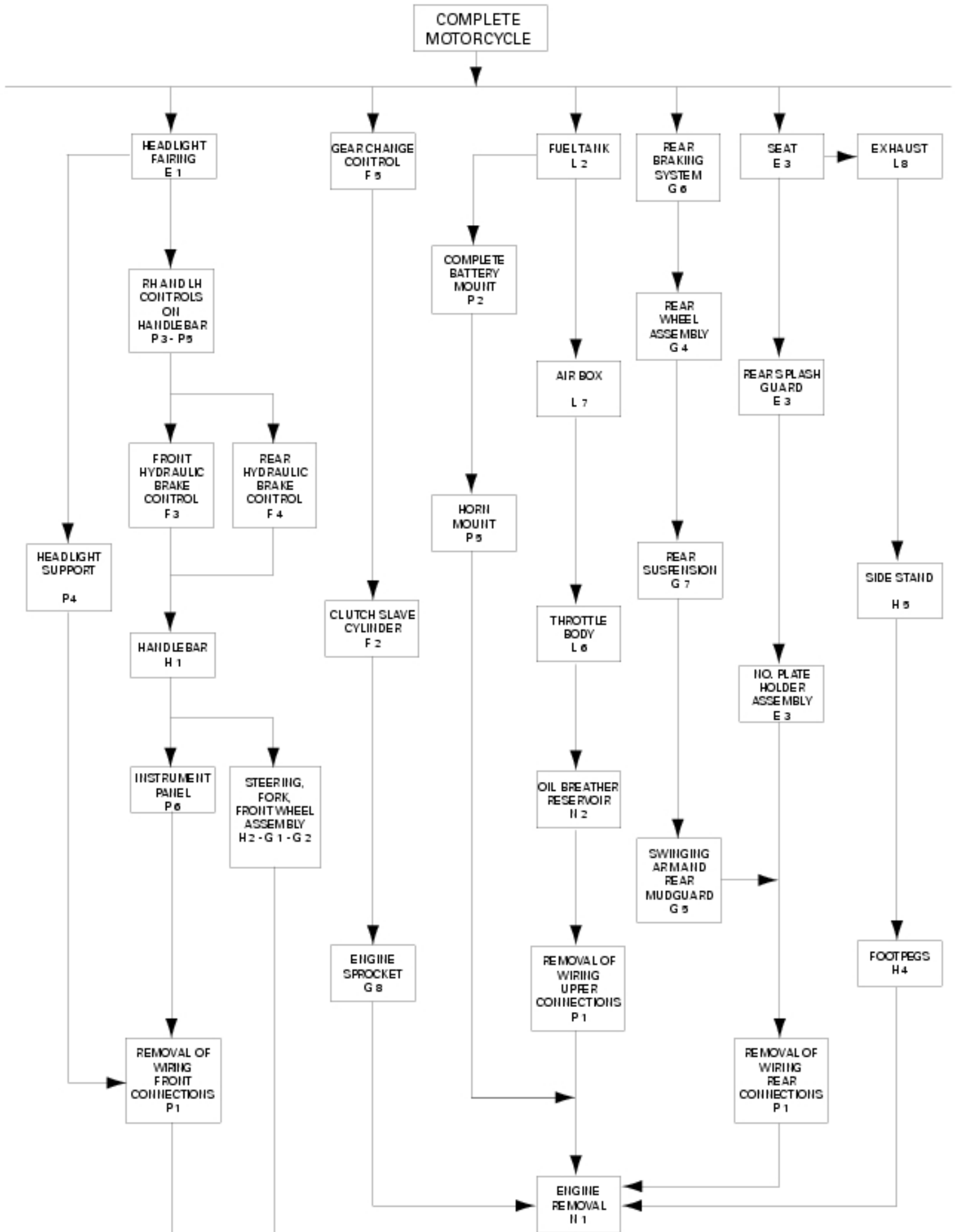
 **Caution**

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

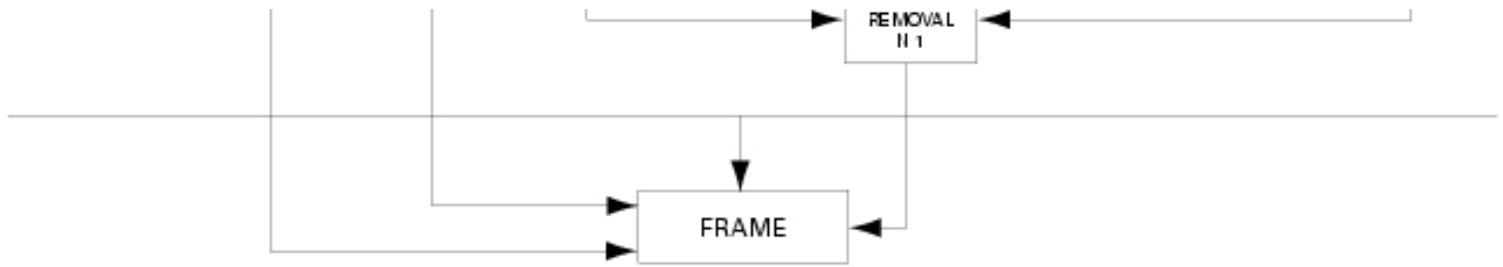
### Removing the frame and related components

Before performing the frame dimensional checks, you will need to remove a number of components to give all-round access to the frame. See the specific instructions in the relevant sections.

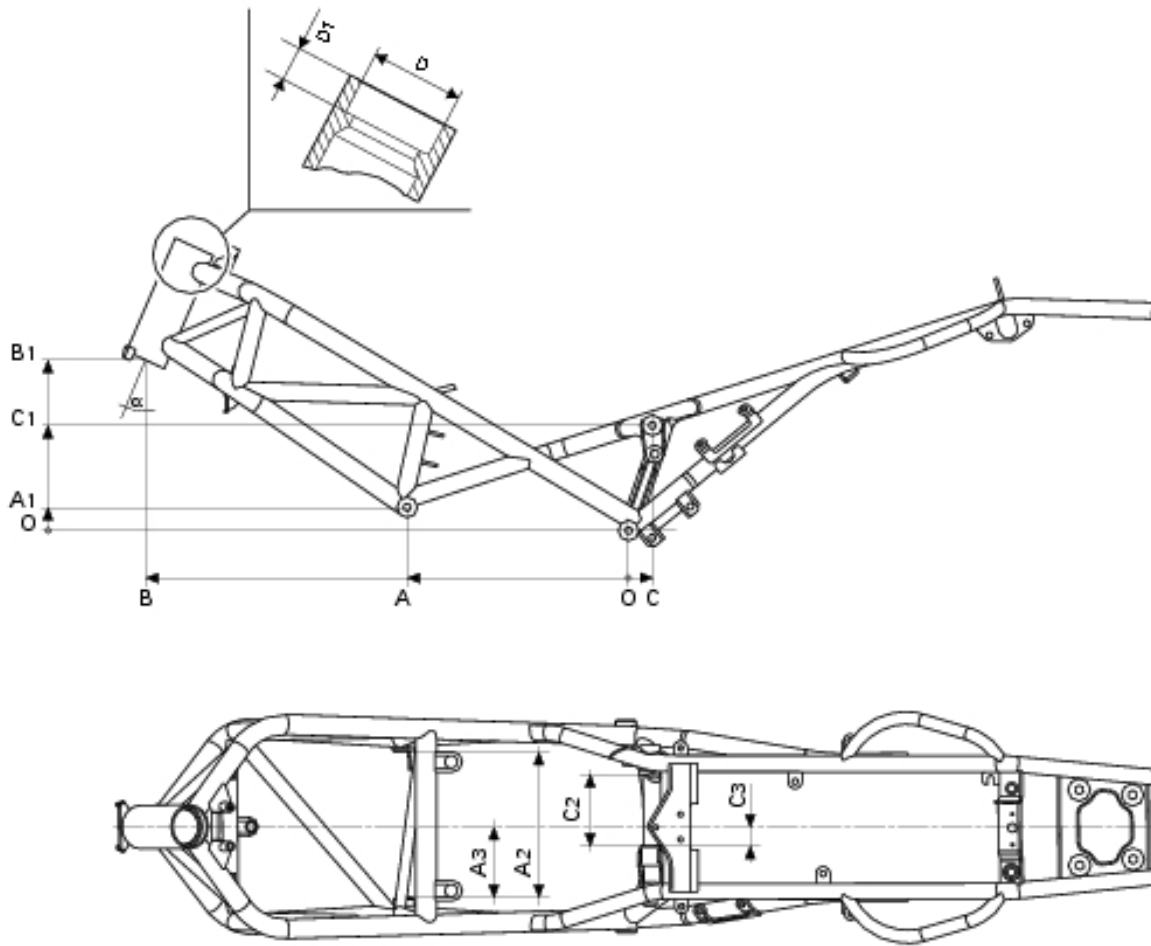
The following diagram shows the components you will need to remove in the correct removal order and the sections giving relevant instructions.



Frame inspection



Frame overall dimensions (mm)



Legend

- A 315 mm
- A1 32 mm
- A2 205.3 - 205.8 mm
- A3 100 mm
- B 692.5 mm
- B1 239.5 mm
- C  $34 \pm 0.5$  mm
- C1  $149.2 \pm 0.5$  mm
- C2 100 - 100.3 mm
- C3  $26 \pm 0.5$  mm
- D 54.961 - 54.991 mm
- D1 15 mm
- $\alpha$   $24^\circ \div 24^\circ 18'$

## Checking the frame

Check the dimensions of the frame against those indicated here to determine whether frame needs changing.



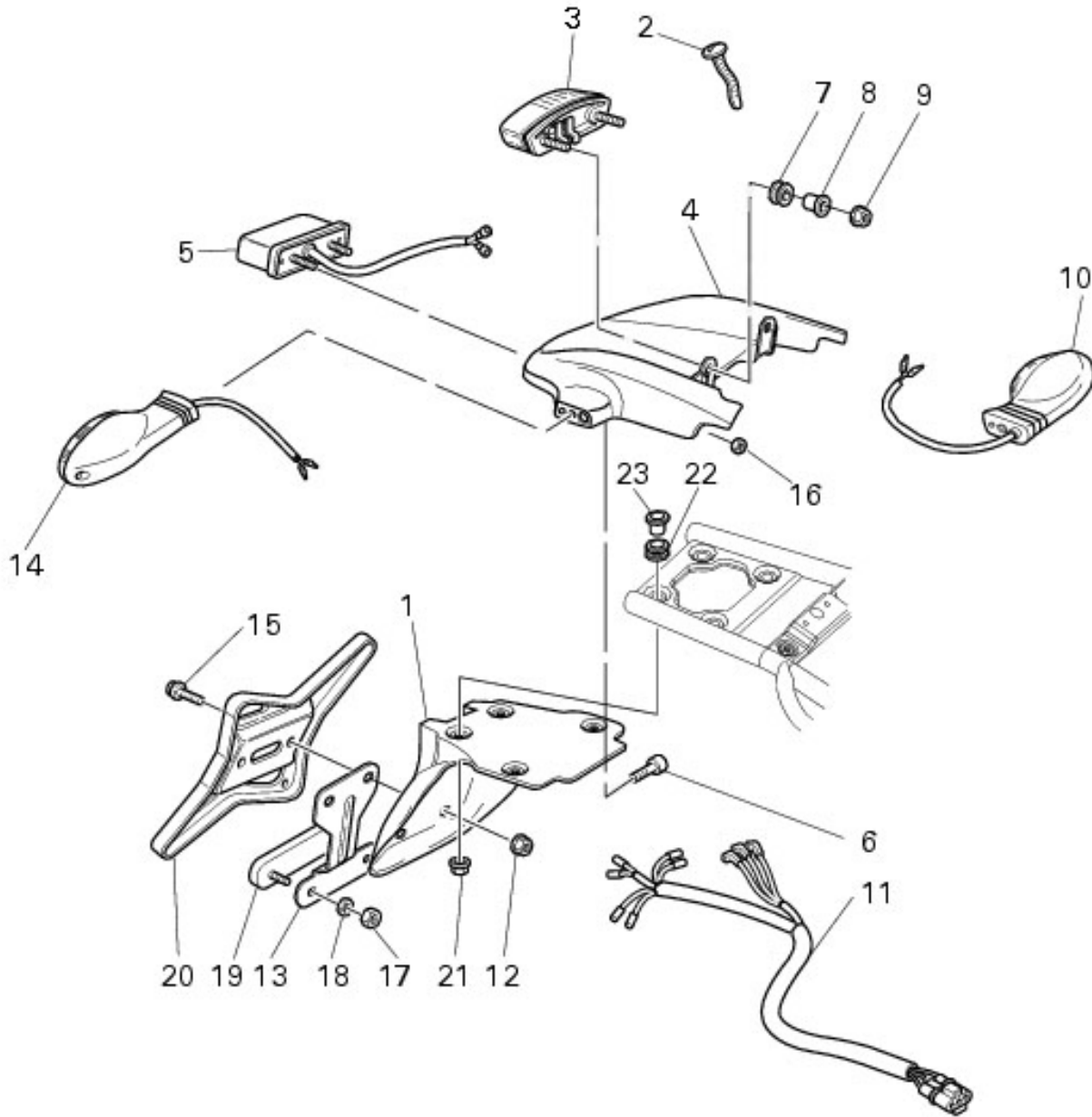
### Caution

Badly damaged frames must be changed, not repaired. Any changes to the frame might cause danger. Changes can also break E.E.C. directives on Manufacturer's liability and general product safety.

## Refitting frame and related components


Once the frame has been checked, reassemble the motorcycle following the procedures described in the diagram and in the relevant paragraphs, in the reverse order.

## 7 - Tail light and number plate holder



- 1 Number plate holder
- 2 Clamp
- 3 Tail light
- 4 Tail guard
- 5 Tail light
- 6 Screw
- 7 Vibration-damping pad
- 8 Spacer
- 9 Nut
- 10 Turn indicator
- 11 Wiring
- 12 Nut
- 13 Plate
- 14 Turn indicator
- 15 Screw
- 16 Nut
- 17 Nut
- 18 Washer

- 19 Cat's eye
- 20 Plate
- 21 Nut
- 22 Rubber block
- 23 Spacer

 Spare parts catalogue

[Plate holder - rear light](#)

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 Caution

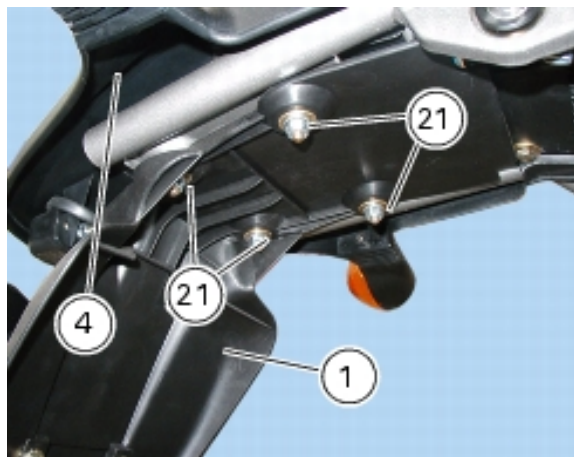
Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Removing the tail light and number plate holder

Remove the seat (Sect. E 3, [Removing the seat](#)).

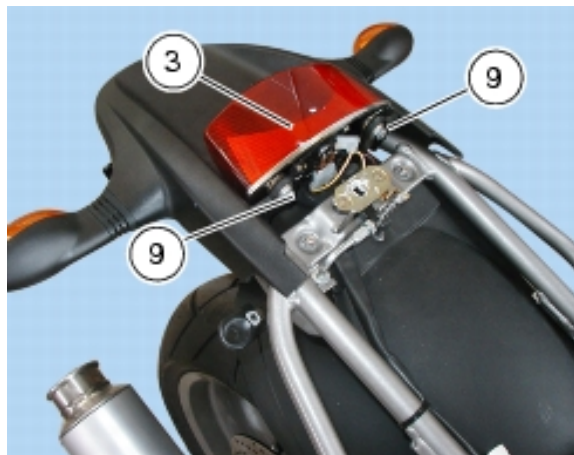
Disconnect the rear wiring at the main wiring harness end (Sect. P 1, [Arrangement of wiring on frame](#)).

Loosen the nuts (21) securing the number plate holder (1) to the frame and to the tail guard (4).



Collect the rubber blocks (22) and the spacers (23).

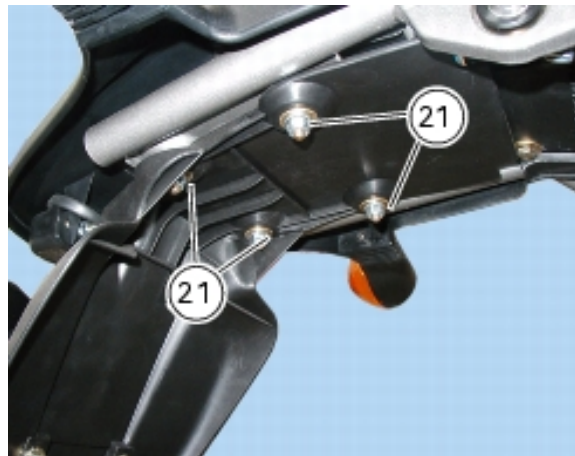
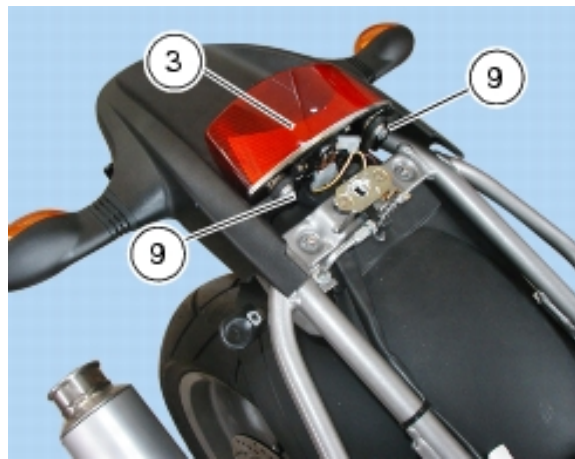
Loosen the nuts (9), collect the spacers (8) and rubber blocks (7) and remove the tail light (3).



### Refitting the tail light and number plate holder

Installation is a reversal of the removal procedure.

Tighten nuts (9) and nuts (21) to the specified torque (Sect. C 3, [Frame torque settings](#)).



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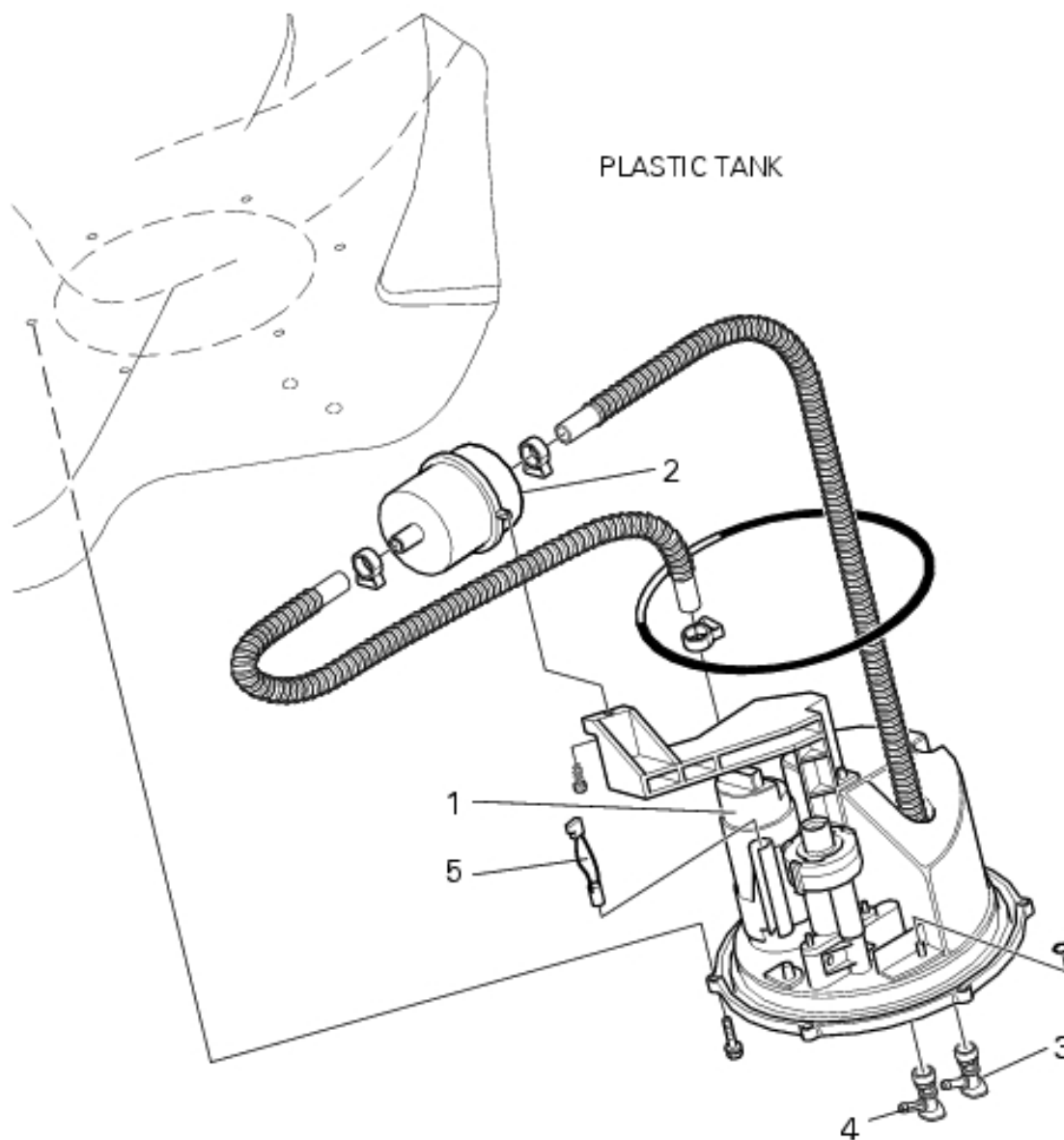
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# 1 - Fuel system description



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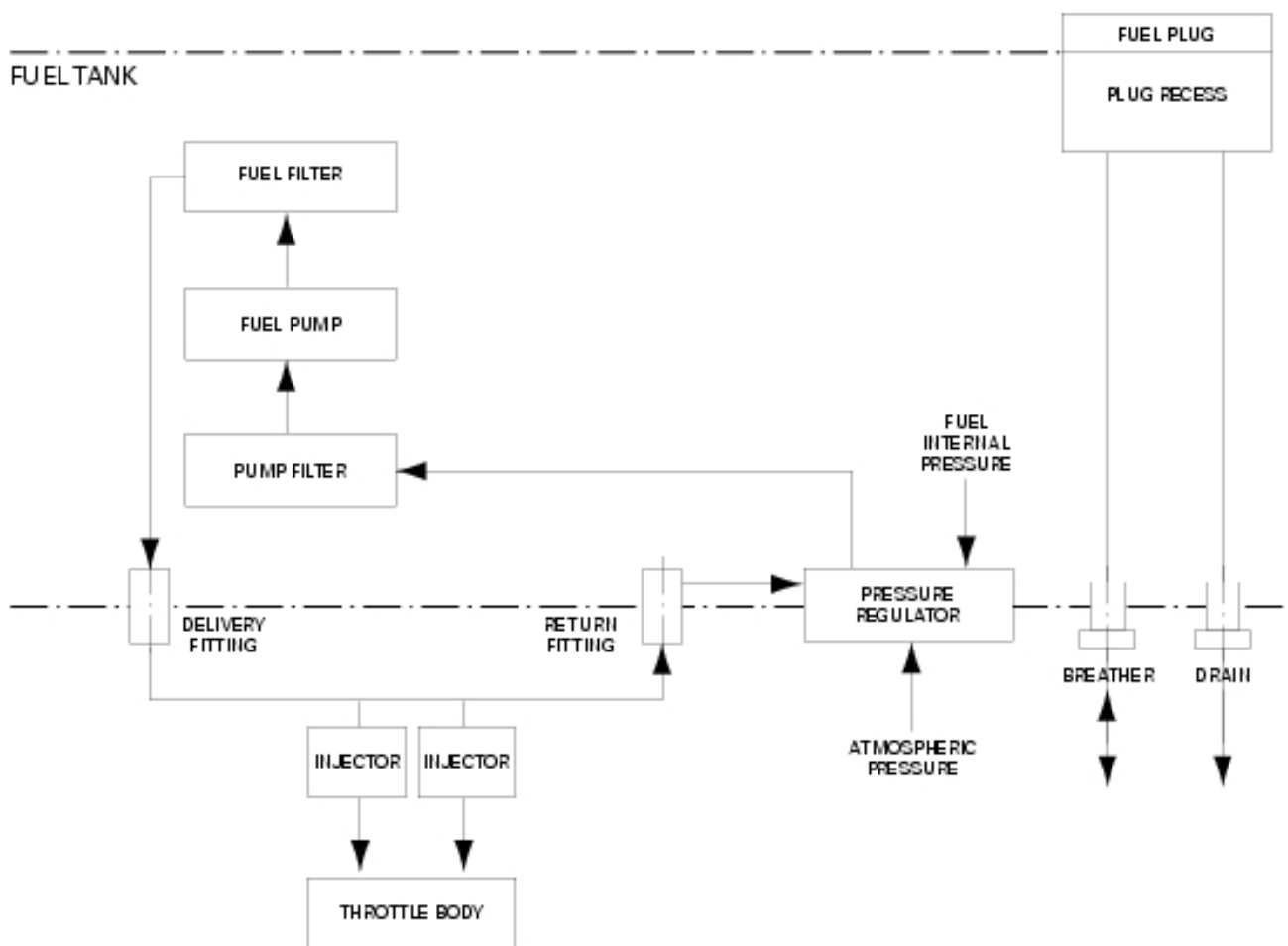
The main fuel system components are mounted to a flange that is accommodated under the fuel tank. Under the fuel tank are the fuel delivery and return hoses from the injectors and the drain/bleed hose.

The flange consists of a pump (1) and a filter (2) that can be replaced. Inside the flange is a thermistor (5) outputting fuel level and a pressure regulator. The regulator is required to keep the pressure head constant on the injectors. To quick-release fittings of the flange delivery (4) and return (3) hoses, are connected the hoses feeding fuel to the throttle body injectors.

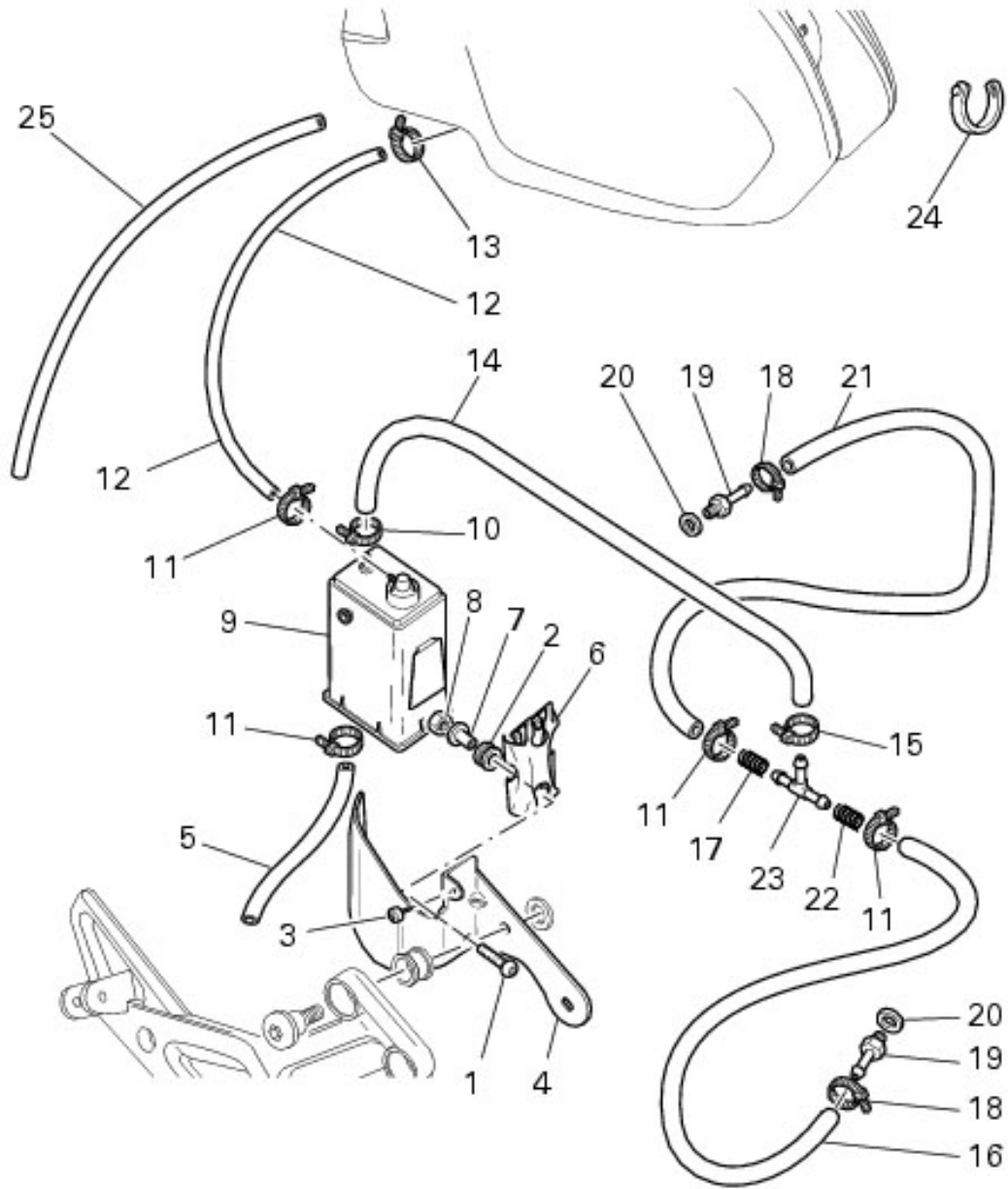
The operating principle for both types of fuel system is shown in the following diagram.

Fuel system diagram

The fuel system takes the fuel to the electric injectors and controls its pressure. Electric injectors are suitably controlled by the control unit and spray the fuel that thus mixes with air taken in by the engine. Fuel capacity varies depending on the engine operating conditions. The fuel system consists of an electric pump immersed in the fuel tank that takes fuel in through a filter and puts it under pressure. The fuel goes through a second finer filter and is sent to fuel tank output fitting. From here the fuel reaches a "Tee" through an outer line from which two lines branch off: one line to the electric injectors which are fed in parallel and one line to the tank return fitting. The pressure regulator receives fuel from this last hose and keeps it at 3 bars in the whole fuel system. Regulator output fuel is not under pressure and is sent to the electric pump intake port, through a Venturi-type channel that makes it easier to take fuel from the tank bottom, even when the level is extremely low. Since the channel is built in the pump plastic support it is not possible to measure fuel capacity on pressure regulator output.




# 10 -Canister Filter



- 1 Screw
- 2 Rubber block
- 3 Vibration-damping pad
- 4 Cable guide
- 5 Hose
- 6 Plate
- 7 Spacer
- 8 Nut
- 9 CANISTER Filter
- 10 Hose guide
- 11 Hose guide
- 12 Filter-to-tank outlet hose
- 13 Hose guide
- 14 Hose
- 15 Hose guide
- 16 Hose
- 17 Spring
- 18 Hose guide

- 19 Coupling
- 20 Aluminium gasket
- 21 Hose
- 22 Spring
- 23 Fitting
- 24 Hose guide
- 25 Breather hose

 Spare parts catalogue

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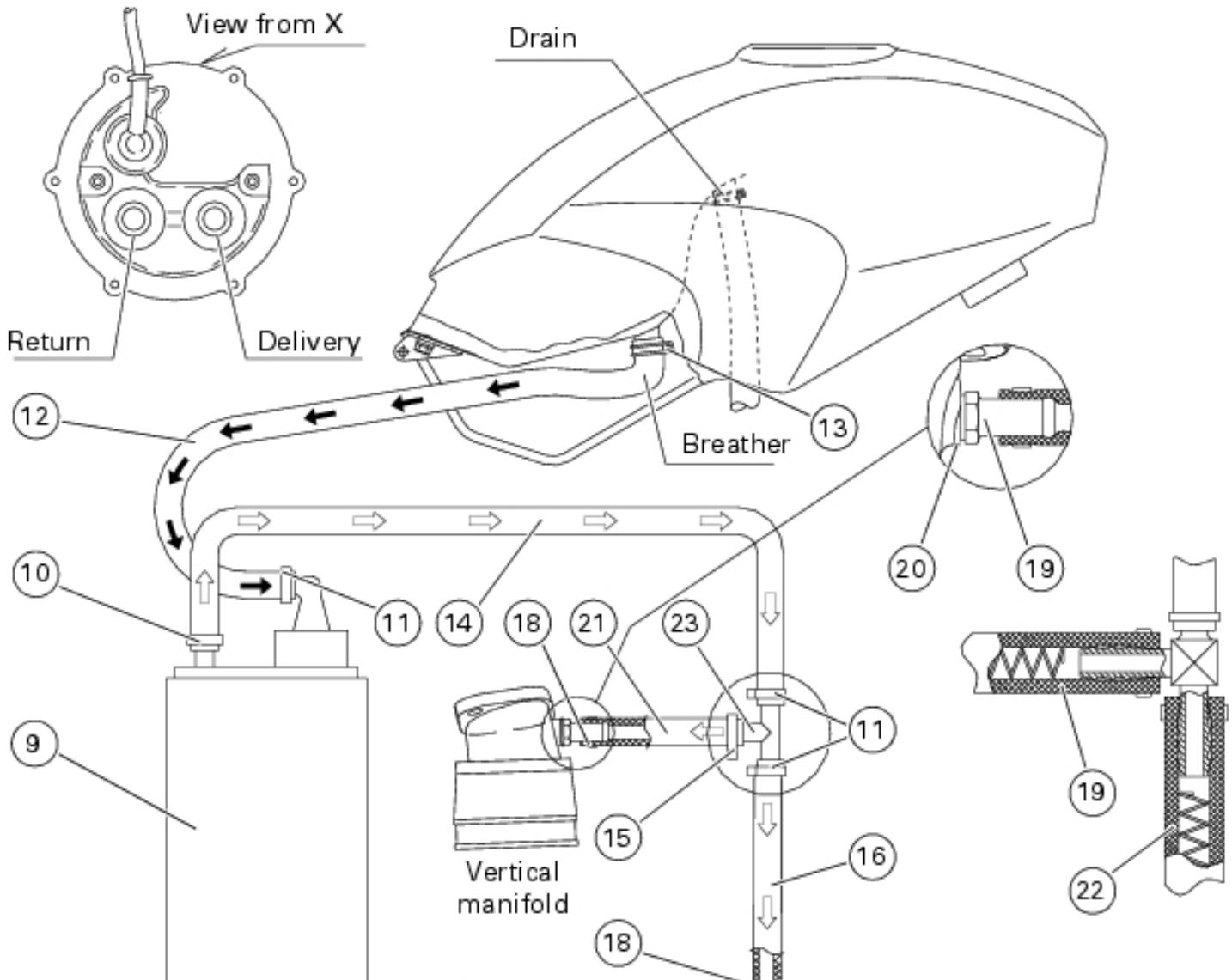
 **Caution**

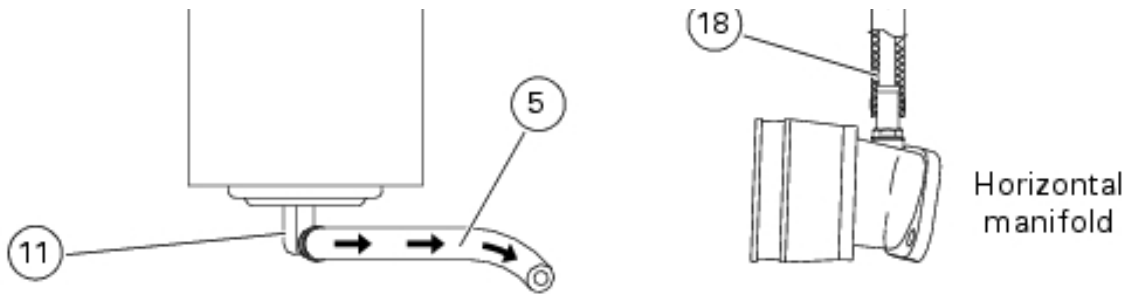
Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

Canister Filter System (for USA versions only)

USA versions are fitted with an additional system featuring a Canister filter to prevent fuel vapour release into the atmosphere.

The hose (12) is connected to the Canister filter (9); after being filtered the drained fuel is recycled through the hose (14) and sent to intake manifolds through hoses (16) and (21). Hoses (5) and (25) have their outlets to the ground. Refer to the figures below for correct hose positions.

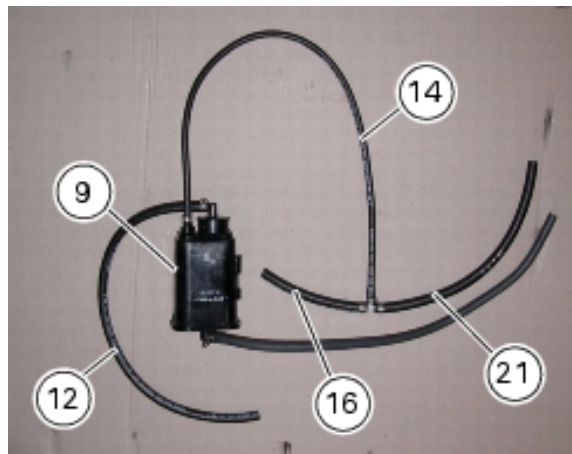




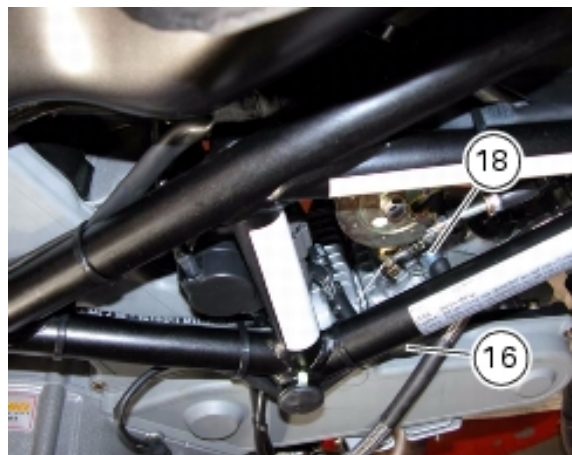
Removing the Canister filter

Operations	Reference See Section
Lift the fuel tank	L 2, <a href="#">Removing the fuel tank</a>
Lift the seat	E 3, <a href="#">Removing the seat</a>

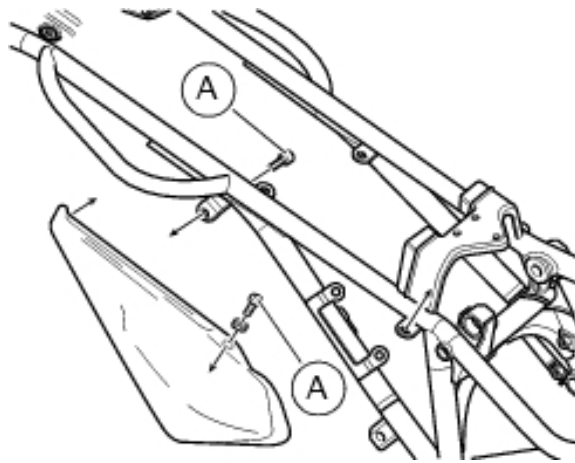
Loosen the clamp (13) securing the Canister filter (9) connection hose to the tank and disconnect the hose (12). Loosen clamps (18) securing the Canister Filter (9) connection hoses to horizontal and vertical cylinder manifolds. Disconnect hose (21) connecting the Canister Filter (9) to the vertical cylinder.



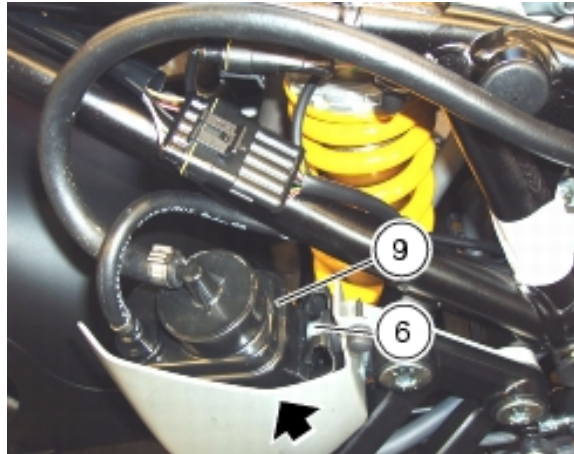
Disconnect hose (16) connecting the Canister Filter (9) to the horizontal cylinder.



Loosen the screws (A) and remove the right-hand side body panel.



Lift the Canister Filter (9) and release it from the plate (6).



### Refitting the Canister Filter

Refitting is a reversal of the removal procedure, tighten the screws (A) to the specified torque (Sect. C3, [Frame torque settings](#)).

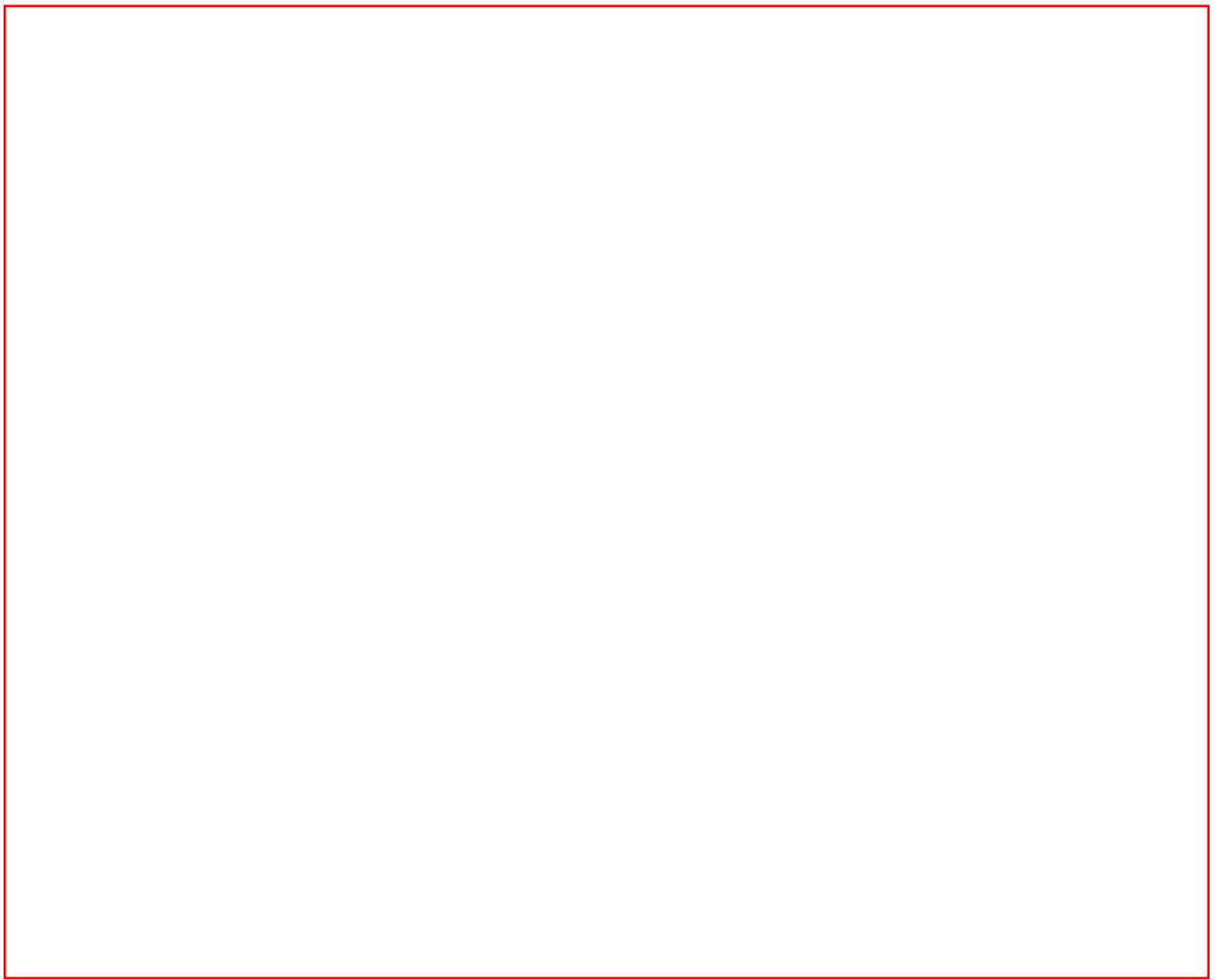
Operations	Reference See Section
Refit the fuel tank	L 2, <a href="#">Refitting the plastic fuel tank</a>
Refit the seat	E 3, <a href="#">Refitting the seat</a>

Routing of hoses, clamps and Canister filter position





Routing of hoses, clamps and Canister filter position





Routing of hoses, clamps and Canister filter position

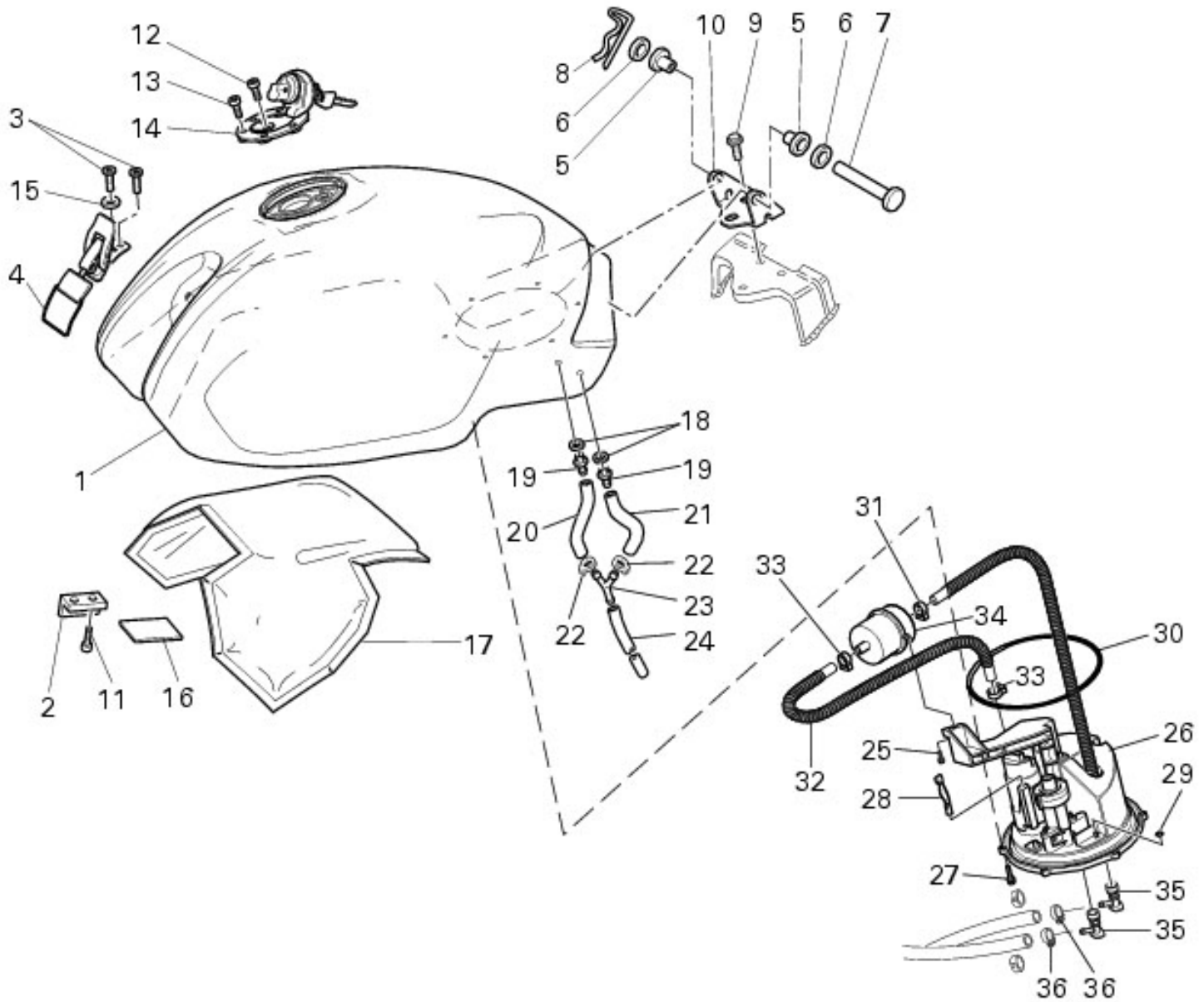




Routing of hoses, clamps and Canister filter position




## 2 - Plastic fuel tank



- 1 Tank
- 2 Pad
- 3 Screw
- 4 Hook
- 5 Bush
- 6 Shim
- 7 Pin
- 8 Split pin
- 9 Screw
- 10 Cable guide
- 11 Screw
- 12 Screw
- 13 Screw
- 14 Filler plug
- 15 Washer
- 16 Panel (BLACK)
- 17 Sticker
- 18 Gasket

Plastic fuel tank

- 19 Coupling
- 20 Hose
- 21 Hose
- 22 Hose guide
- 23 Coupling
- 24 Breather hose
- 25 Self-tapping screw
- 26 Complete flange
- 27 Screw
- 28 Thermistor
- 29 O-ring
- 30 O-ring
- 31 Collar
- 32 Hose
- 33 Collar
- 34 Filter
- 35 Quick-release fitting
- 36 Hose guide

 Spare parts catalogue

[Inlet dict](#)

[Fuel tank](#)

[Fuel system](#)

 Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Removing the fuel tank

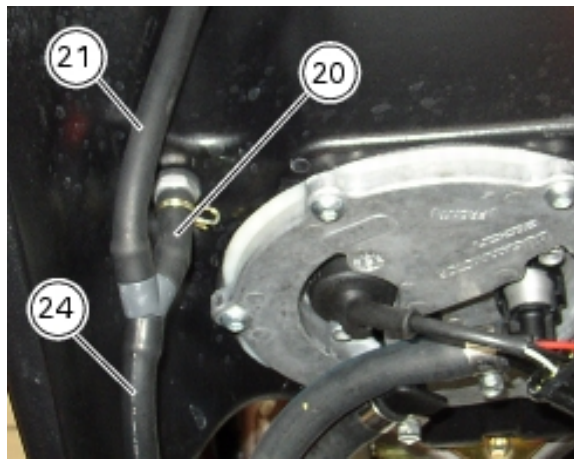
Remove or lift the seat (Sect. E 3, [Removing the seat](#)).

Lift the fuel tank hook (4).

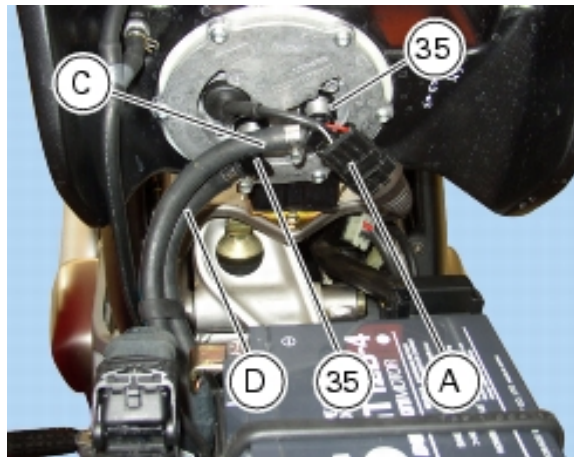


Lift and drain the fuel tank.

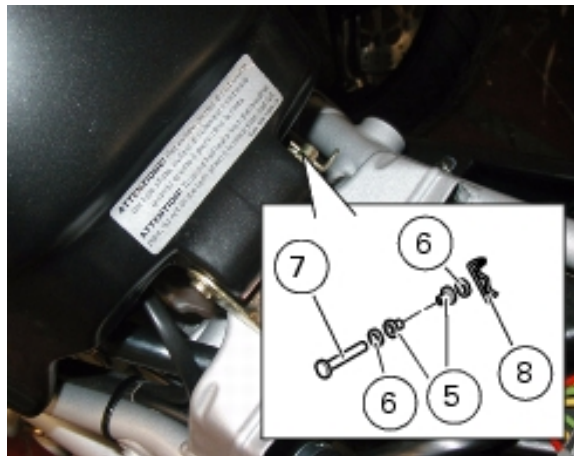
Withdraw the hose (24) in an upward motion. Leave hose hanging on the couplings of the fuel tank breather (20) and drain (21) hoses.



Detach the connector (A) of fuel sensor and fuel pump from the main wiring harness. Disconnect the quick-release fittings (35) of delivery hose (C) and return hose (D) from the flange and leave the hoses connected to the throttle body.



Remove the split pin (8), slide out pin (7), keep bushings (5) and washers (6), then remove the tank from the frame.



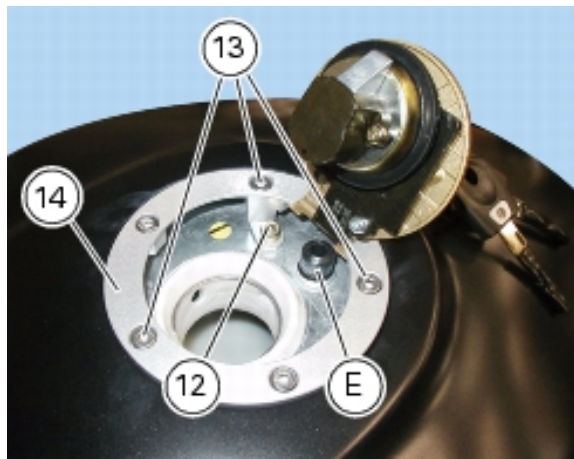
### Removing the filler plug unit - plastic tank

Remove the filler plug unit from the fuel tank as follows:  
open the filler plug.

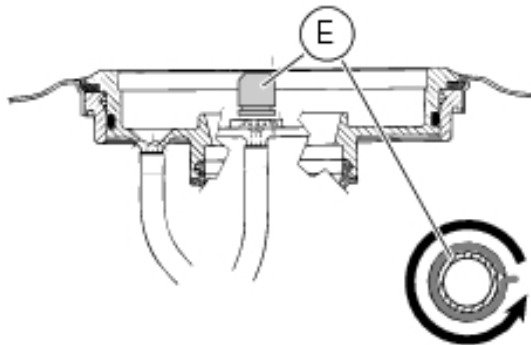
Unscrew the 3 outer screws (13) fixing the ring nut to the fuel filler recess.

Unscrew the anti-theft screw (12) inside.

Remove the complete filler plug (14).

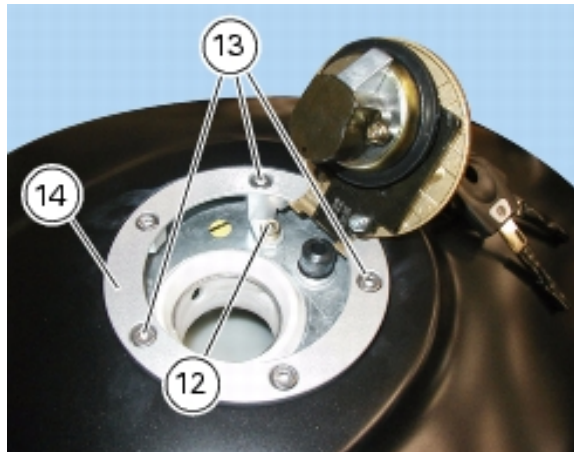


The filler plug is fitted with a breather cap (E).  
When fitting a new breather cap, apply an even film of speed bondor all round the cap (E) groove.  
Install the cap. Make sure it becomes properly seated in the seat in the recess.



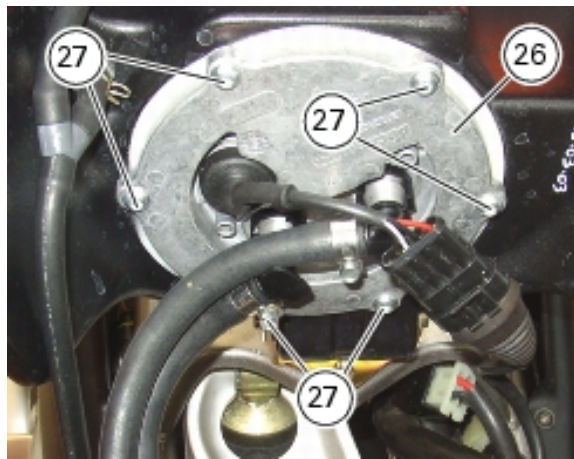
### Refitting the filler plug unit - plastic tank

Refit the complete plug (14) in the tank housing and tighten the screws (13) and (12) to the specified torque (Sect. C 3, [Frame torque settings](#)).



### Replacing fuel tank flange

Release the six retaining screws (27) of the fuel tank flange (26). Remove one every two screws. The three screws left in place will help lift off the flange (26).  
Remove the complete flange (26) from the reservoir.



Release the clamps (31) and (33) at the fuel filter (34) with the suitable tool available on the market. Detach the filter from the connection hoses and replace filter. On refitting, clean off any build-up or scale accumulation from all components.



**Caution**

Position the new filter (34) with the arrow stamped on the outer casing pointing towards the flange. Change the flange O-ring (30). Grease the new O-ring and reverse the removal procedure to refit.



**Caution**

Make sure to fit the flange in the correct mounting position: the arrows and FRONT must be pointing in the direction of travel of the vehicle.

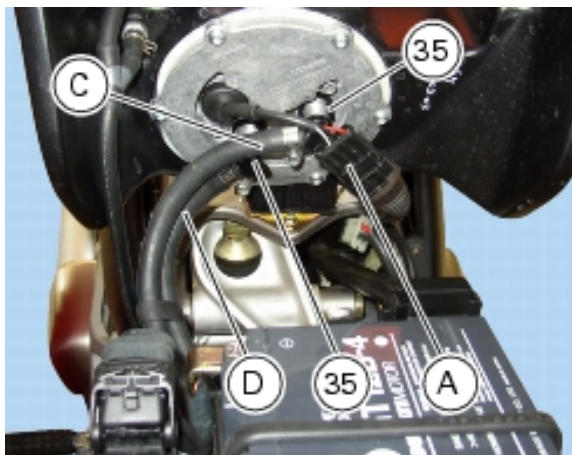


Tighten the screws (27) to the specified torque (Sect. C 3, [Frame torque settings](#)).

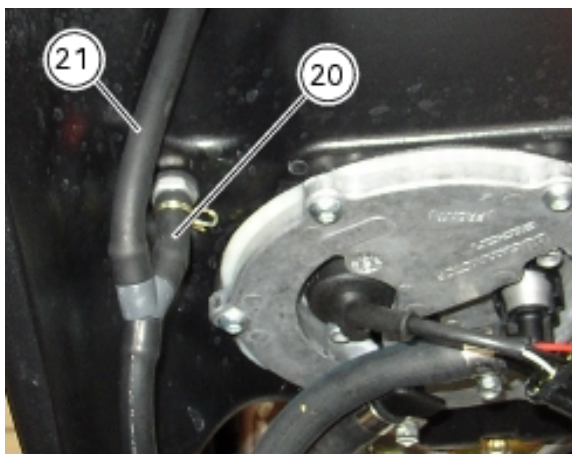
## Refitting the plastic fuel tank

Place the fuel tank in the frame and connect the following components:

- connector (A) of fuel pump and fuel sensor wiring;
- Delivery hose (C) quick-release fitting (35);
- Return hose (D) quick-release fitting (35) ;

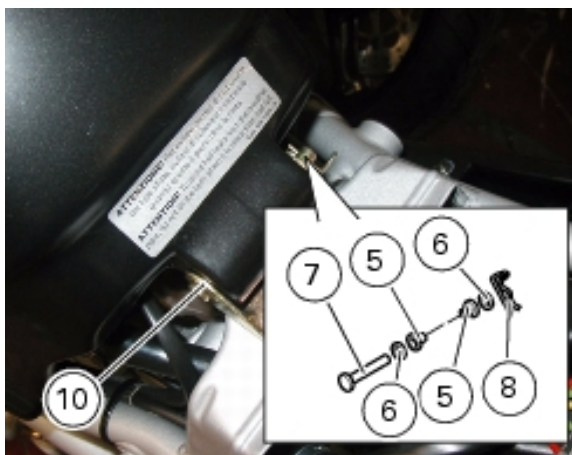


- breather hose (20) and drain hose (21).

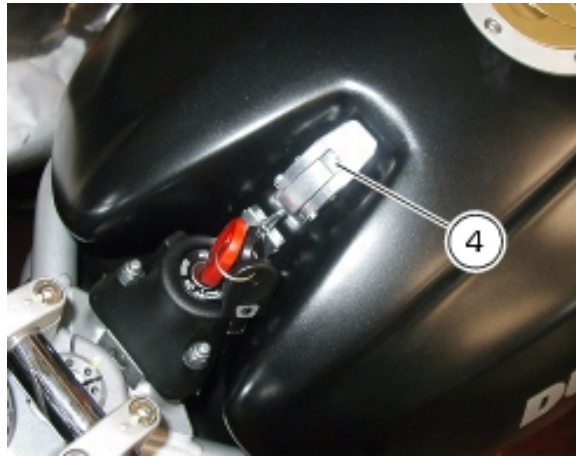


Position the tank to the bracket (10).

Position the pin (7) to the bracket (10) with bushes (5) and washers (6). Lock with the split pin (8).



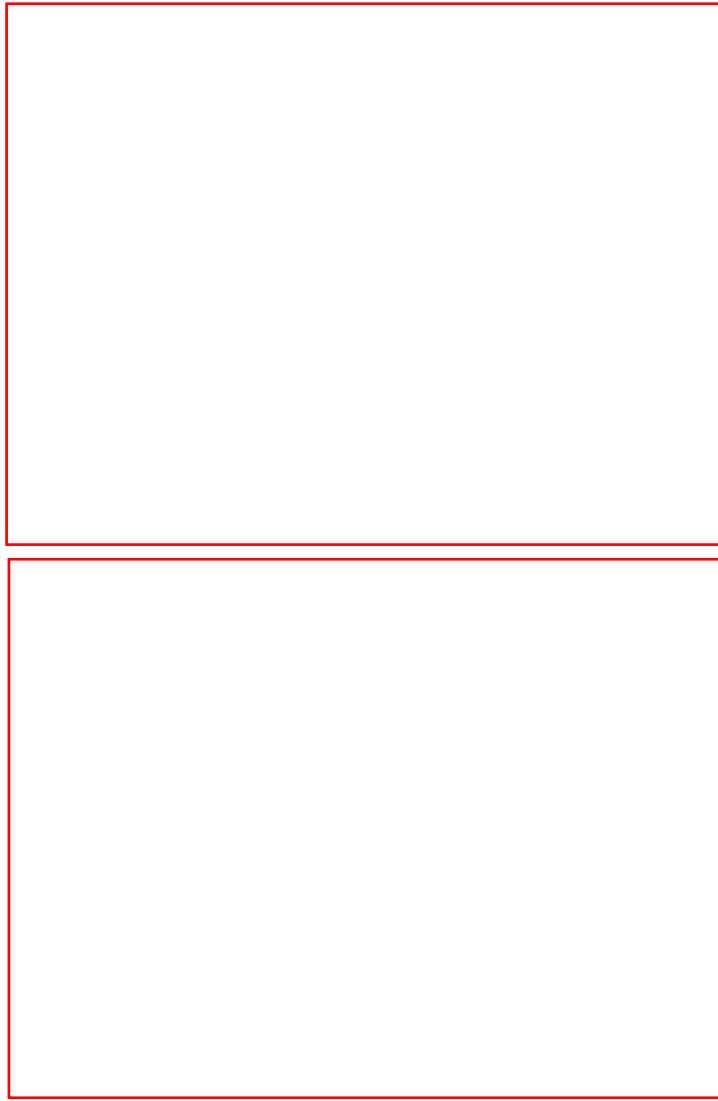
Lower the tank. Make sure the hoses do not become trapped and secure the tank with the hook (4).



Plastic tank drain breather hoses routing



Plastic fuel tank

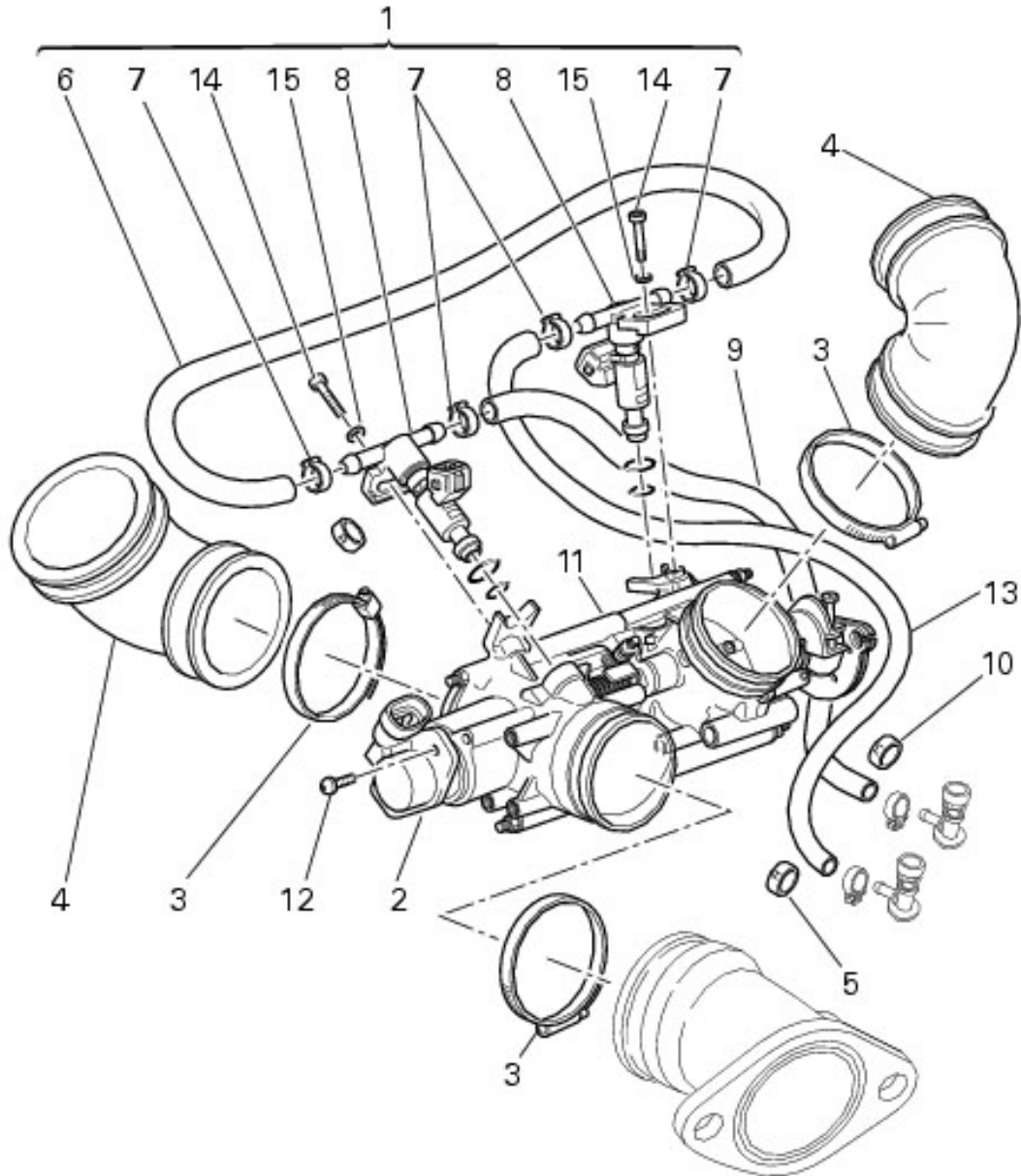


Fuel hoses routing - from plastic fuel tank to throttle body





## 6 - Throttle body for plastic tank



- 1 Complete fuel system assembly
- 2 Throttle position sensor
- 3 Clamp
- 4 Hose coupling
- 5 Clip "R"
- 6 Hose
- 7 Clamp
- 8 Injector
- 9 Hose
- 10 Clip "M"
- 11 Complete throttle body
- 12 Screw
- 13 Hose
- 14 Screw
- 15 Washer

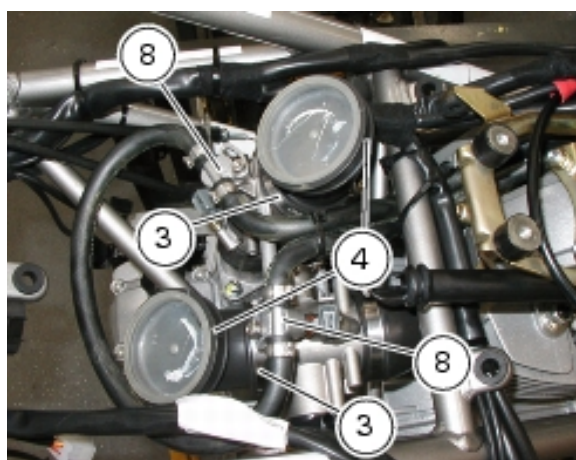
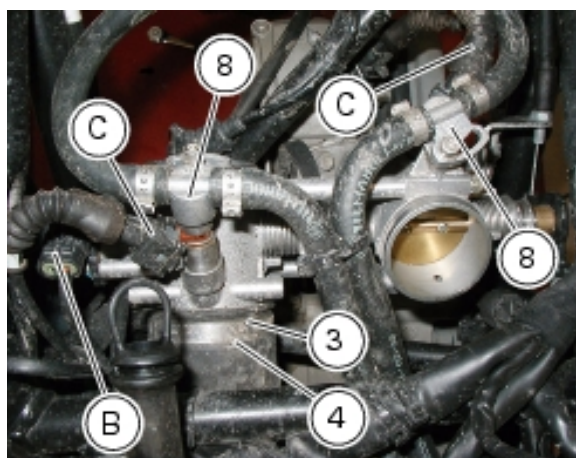
[Inlet dict](#)[Fuel system](#)**Caution**

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

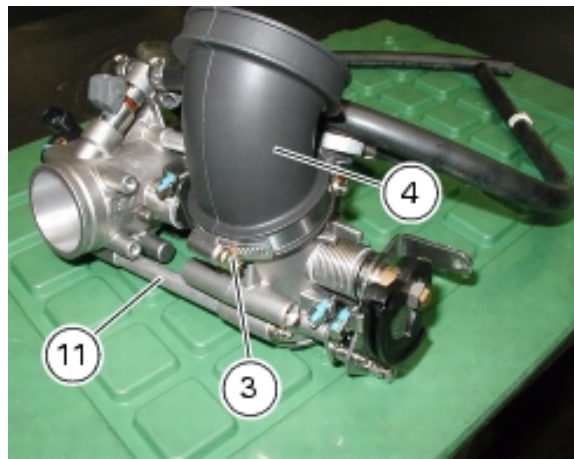
## Removing the throttle body

Operations	Reference See Section
Remove the fuel tank	L 2, <a href="#">Removing the fuel tank</a>
Remove the airbox	L 7, <a href="#">Removing the airbox</a>
Disconnect the throttle control cable	F 1, <a href="#">Disassembling the throttle control</a>
Disconnect the choke control cable	F 1, <a href="#">Removing the choke control</a>

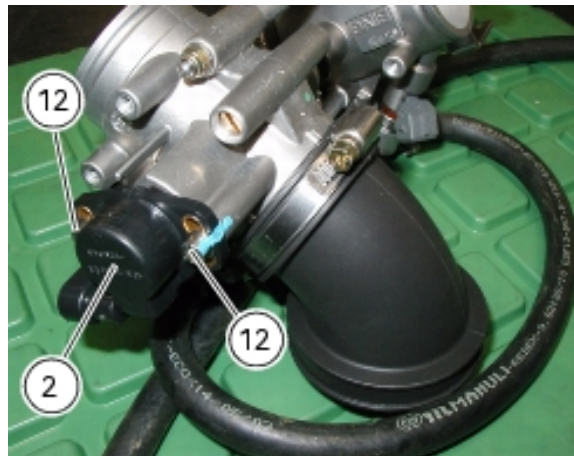
Loosen the clamps (3) securing throttle body to intake manifolds (A).  
 Disconnect the main wiring harness connector (B) from the throttle position sensor (2).  
 Disconnect the main wiring harness connectors (C) from the injectors (8).



Lift the complete throttle body (11) from the frame.  
 If needed, loosen the clips (3) holding the hose couplings (4) to the throttle body and remove the hoses.

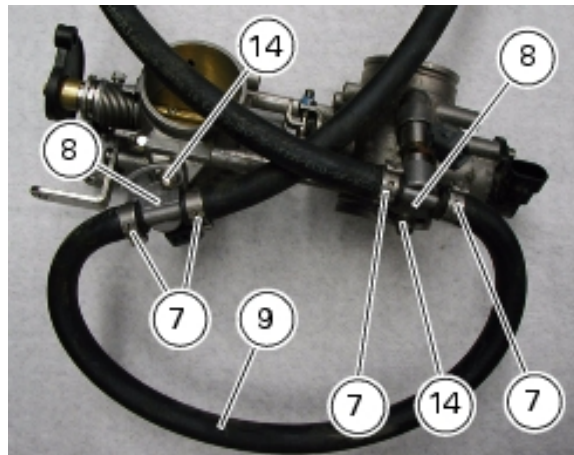


Unscrew the two screws (12) to release the throttle position sensor (2) from the throttle body.



#### Removing the injectors

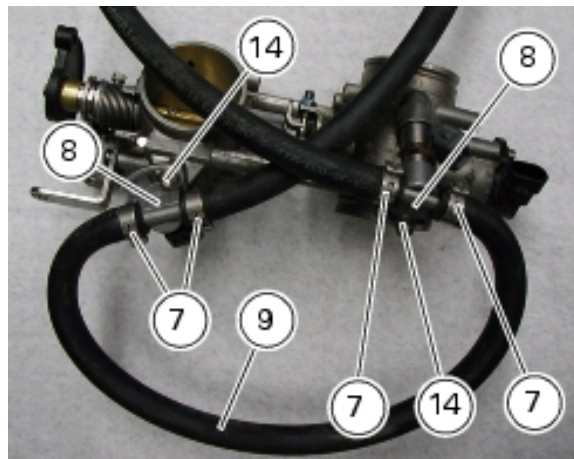
Loosen the clips (7) that hold delivery hose (9), return hose (13) and injector connection hose (6) to the injectors. Unscrew the screws (14) to release the injectors from the throttle body. Collect the washers (15).



#### Refitting the injectors

Grease the O-rings of the injectors.

Position the washers (15) and tighten the screws (14) to the specified torque (Sect. C 3, [Engine torque settings](#)).



### Refitting the throttle body

If you have removed the hose couplings (4), refit them to the throttle body and lock them with clips (3). Correct position of hose couplings and clips is shown in the figure.

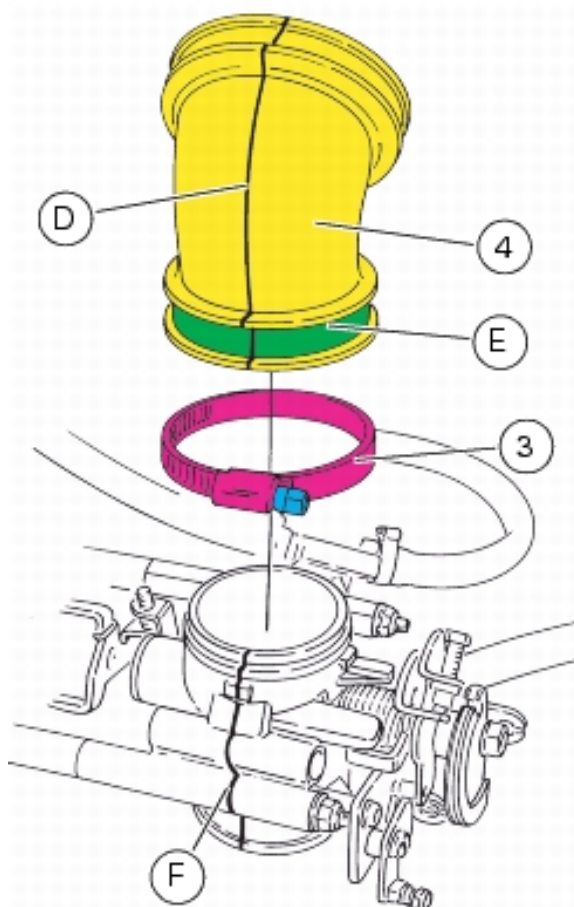


**Note**

Fit the hoses with the smaller diameter end facing the throttle body.

Push the hoses fully home onto the throttle body. Line up the mould parting lines (D) visible on the hoses with those (F) of the throttle body.

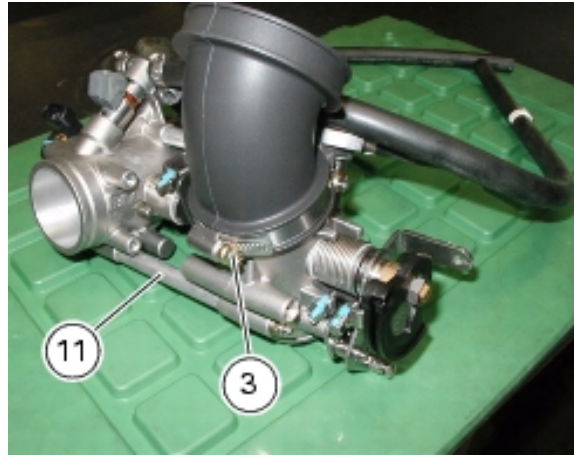
Tighten the clips to the specified torque (Sect. C 3, [Frame torque settings](#)). Position them as shown in the figure and make sure they do not slip off the hose coupling grooves (E).



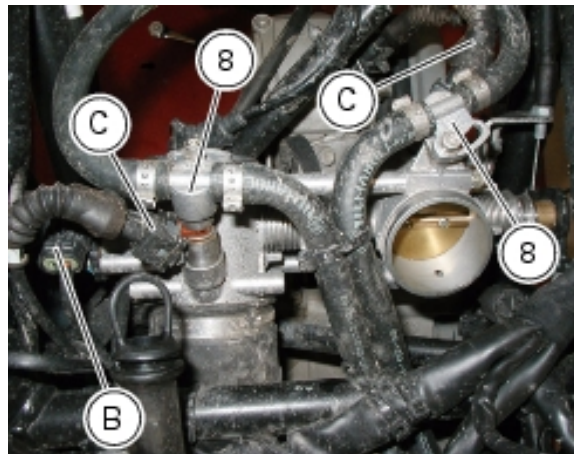
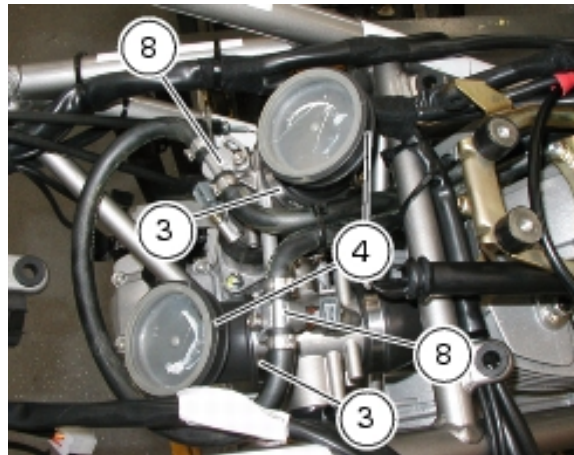
Position the complete throttle body (11) to the motorcycle.

Place the clips (3) in their grooves in the intake manifolds and tighten to the specified torque (Sect. C 3, [Frame](#)

[torque settings](#)).



Connect connectors (C) connecting main wiring harness to the injectors (8).  
Connect the main wiring harness connector (B) to the throttle position sensor (2).



**Caution**

Should the throttle body or throttle position sensor be replaced, reset the throttle body as specified under "[Zero setting the throttle position sensor \(TPS\)](#)" (Sect. D5).

Operations	Reference See Section
Connect the choke control cable	F 1, <a href="#">Refitting the choke control</a>
Connect the throttle control cable	F 1, <a href="#">Reassembling the throttle control</a>
Refit the airbox	L 7, <a href="#">Refitting the airbox</a>

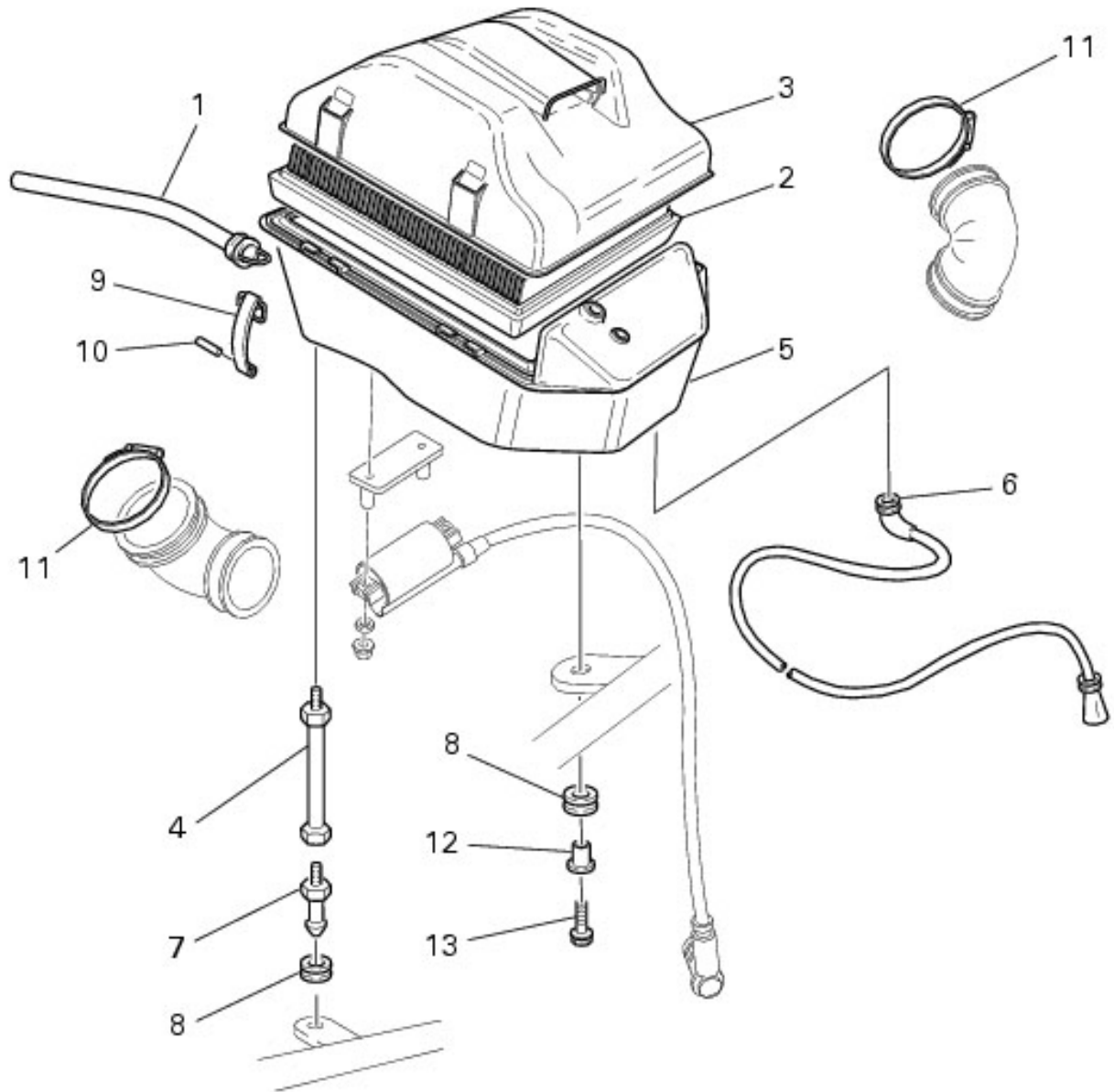
Refit the fuel tank

L 2, [Refitting the plastic fuel tank](#)

Injector connection hose routing



## 7 - Airbox



- 1 Filter-to-tank outlet hose
- 2 Filter element
- 3 Airbox cover
- 4 Stud bolt
- 5 Filter housing
- 6 Hose
- 7 Peg
- 8 Rubber block
- 9 Hook
- 10 Pin
- 11 Clamp
- 12 Spacer
- 13 Screw

 Spare parts catalogue

[Inlet dict](#)

[Electric system](#)[Air induction and oil vent](#)**Caution**

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

## Removing the airbox

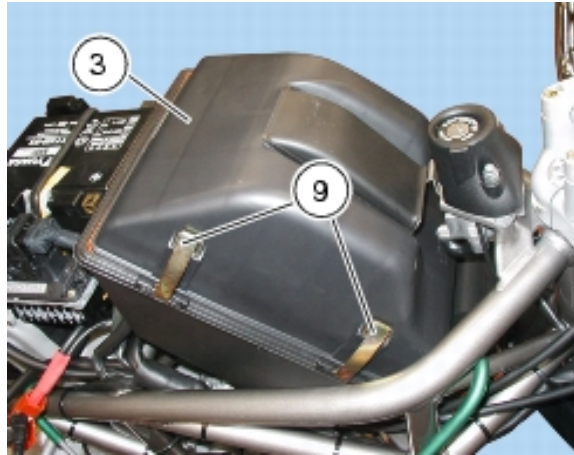
Operations	Reference See Section
Remove the fuel tank	L 2, <a href="#">Removing the fuel tank</a>

Disconnect the coil connector at the main wiring harness end (Sect. P 1, [Arrangement of wiring on frame](#)).

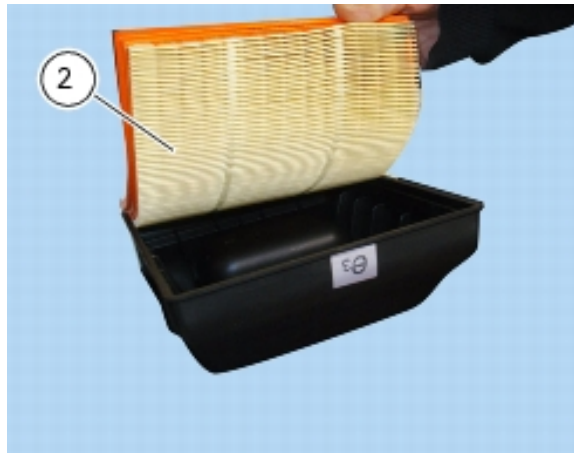
Release the clips (9).

Remove the cover (3).

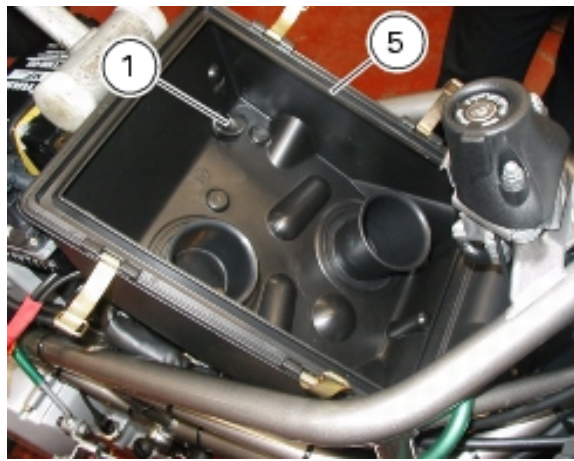
If necessary, disconnect the pins (10) to remove the cover (3) hooks (9).



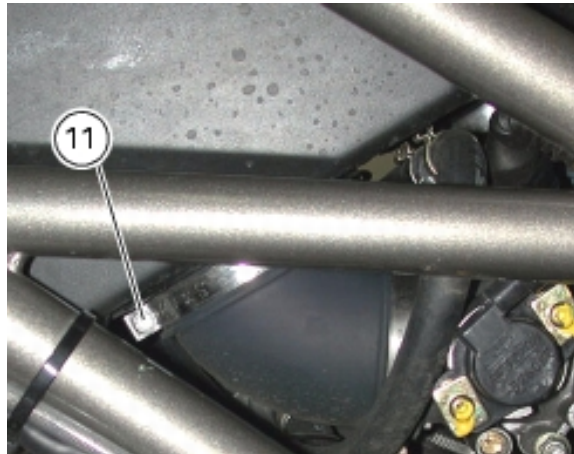
Extract the filter element (2).



Withdraw the oil breather hose (1) from the filter housing (5).



Loosen the hose clips (11) and withdraw the hoses from the housing.



Loosen the screw (13), collect the spacer (12).



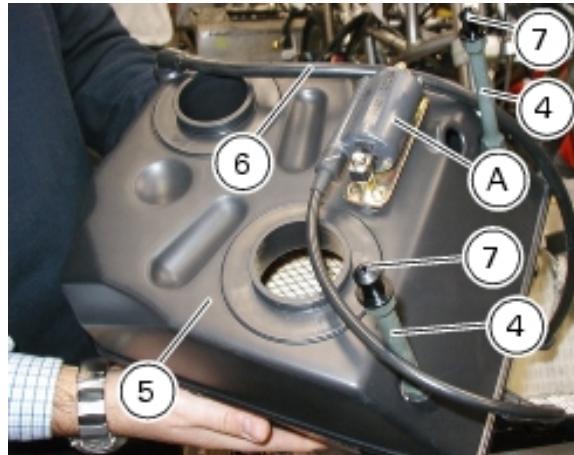
Lift the complete filter housing. Be sure to collect the rubber blocks (8) of the stud bolts securing the housing to the frame.

Remove the drain hose (6) from the filter housing (5).

Unscrew the pegs (7).

Unscrew the stud bolts (4).

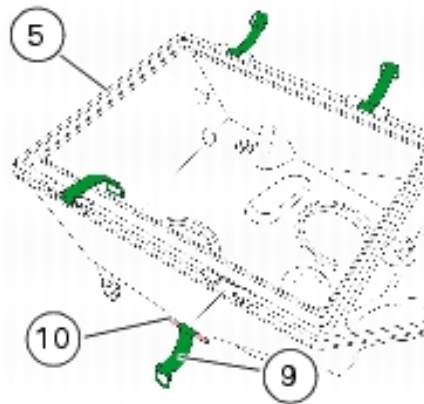
See Sect. M 3, [Coil](#), for coil (A) removal.



### Refitting the airbox

Position the coil (A) to the filter housing (Sect. M 3, [Coil](#)).

If removed, fit the pins (10) to refit the cover (5) hooks (9).



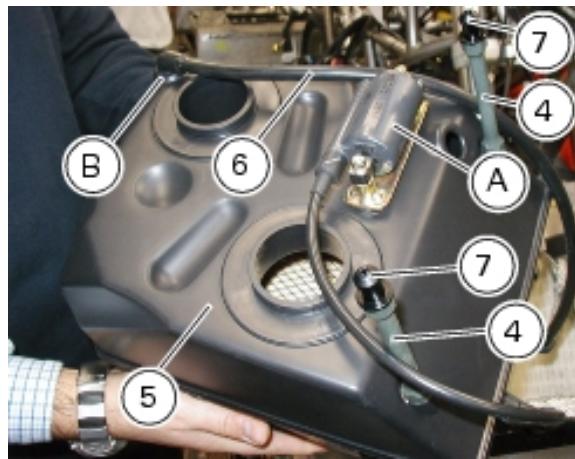
Start the stud bolts (4) in their holes on the air box (5) and tighten them to the specified torque (Sect. C 3, [Frame torque settings](#)).

Start the two pegs (7) on the box (5) stud bolts (4).

Tighten the pegs (7) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Insert the drain hose (6) in the hole (B) in the airbox.

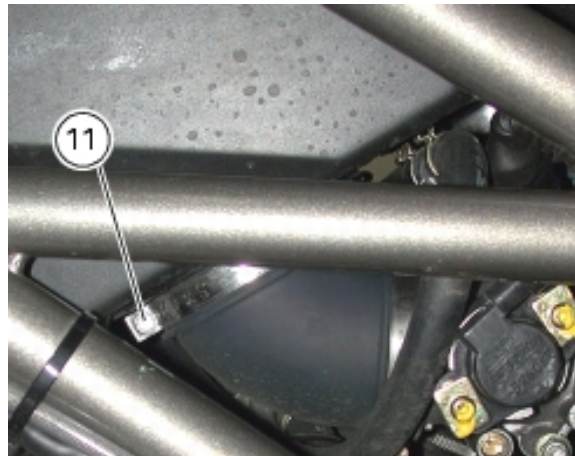
Position the complete housing so that the stud bolts (4) locate into the rubber blocks (8) in the frame.



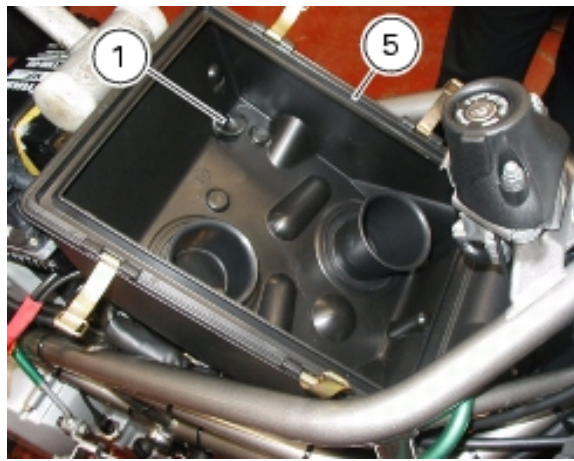
Screw in the screw (13) with relevant spacer (12) onto filter housing (5) and insert it in the relevant rubber block (8) on the frame.



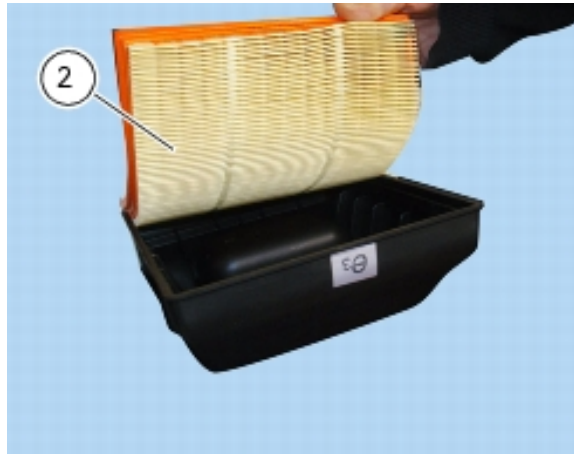
Tighten the hose clips (11) to the specified torque (Sect. C 3, [Frame torque settings](#)) to secure the hoses to the filter housing (5).



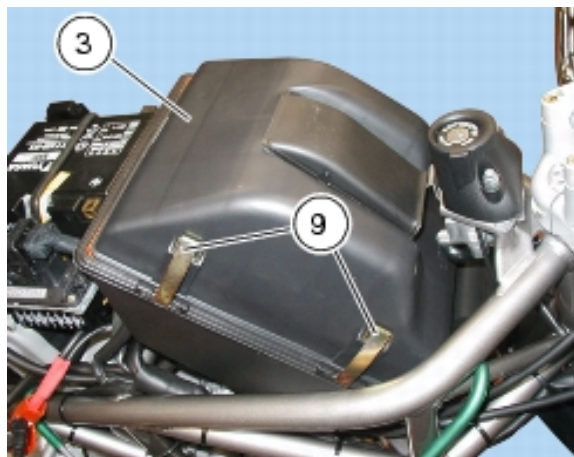
Insert the oil breather hose (1) into the housing (5).



Place the filter element (2) into the housing.



Fit the cover (3) and lock with the clips (9).  
Connect the coil connector to the wiring harness.

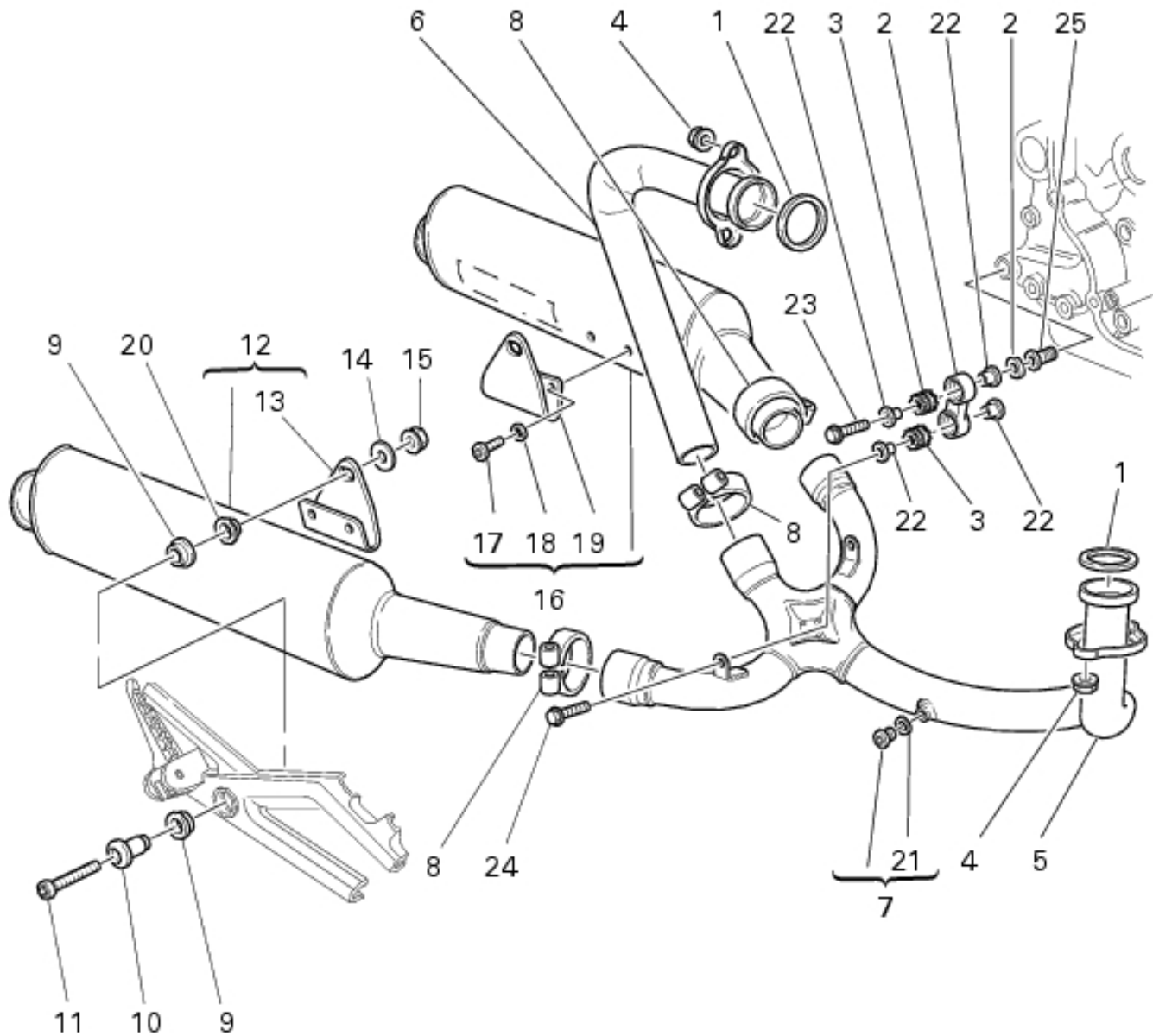


Refit the fuel tank (Sect. L 2, [Refitting the plastic fuel tank](#)).

Oil breather tank to air box hose routing




## 8 - Exhaust system



- 1 Exhaust seal
- 2 Mount
- 3 Vibration-damping pad
- 4 Nut
- 5 Horizontal head exhaust pipe
- 6 Vertical head exhaust pipe
- 7 Blanking plug
- 8 Clamp
- 9 Rubber block
- 10 Spacer
- 11 Screw
- 12 RH silencer
- 13 RH bracket
- 14 Washer
- 15 Nut
- 16 LH silencer
- 17 Screw
- 18 Washer

19 LH bracket  
20 Bush  
21 Seal, thk.1  
22 Spacer  
23 Screw  
24 Screw  
25 Screw  
26 Washer  
27 Lambda sensor

 Spare parts catalogue

[Exhaust system](#)

## Caution

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

### Catalytic converter operating principle

This model is fitted with "three-way" catalytic converters. They are fitted to the exhaust system in order to render exhaust fumes harmless, especially CO (carbon monoxide), HC (unburnt hydrocarbons) and NOx (nitric oxide). The catalytic converter has a special honeycomb support, coated with aluminium oxide, which makes surface rough, thus offering a wider area to exhaust gas exposure. Aluminium oxide includes some activated substances helping reducing harmful substances. Activated substances are usually platinum and rhodium. Platinum oxidizes (combines with oxygen) CO and HC. Rhodium reduces (combines with CO) NOx. Exhaust gases must contain a certain quantity of oxygen for CO and HC to be oxidized to create water and carbon dioxide and for NOx to be reduced into nitrogen and carbon dioxide. This requires accurate air/fuel ratio control. Air-fuel mixture ratio is controlled by our sophisticated fuel feeding system, which ensures top precision while dosing air-fuel mixture.

The lambda sensor (Sect. M 3) checks exhaust gas oxygen content and immediately outputs this information to the control unit. To ensure utmost efficiency of the catalytic converters installed at the exhaust, the control unit controls injection so that air/fuel ratio is maintained close to ideal value, within a certain tolerance, thus obtaining minimum emissions of hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx). 3-way catalytic converters then complete exhaust gas cleaning procedure converting CO, HC and NOx residues thus ensuring that emissions comply with EURO 2 standard.

### Precautions for catalytic converter proper operation

In order to operate correctly, the catalytic converter must reach temperatures close to 800 °C and never less than 300 °C. However, exceeding the maximum temperature limit will irreparably damage the catalytic converter. For this reason, exhaust gas post-treating device should never include high amounts of unburnt fuel which would cause high temperature increase. This is why the ignition - injection system should always be in perfect operating conditions: ignitions should never be failed. In addition, never push start the motorcycle forward with the ignition key and the ENGINE STOP button set to ON. If the engine does not start, unburnt fuel will enter the exhaust system and get to the catalysts. Motorcycles fitted with catalytic converters can only be filled with unleaded gasoline. Lead would settle onto activated substances and limit their action against harmful substances in exhaust gas.

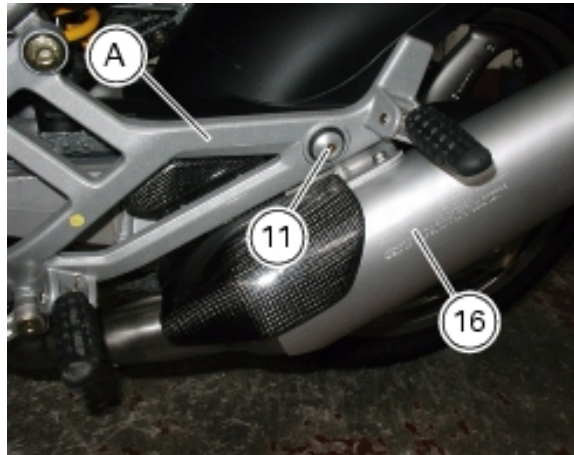
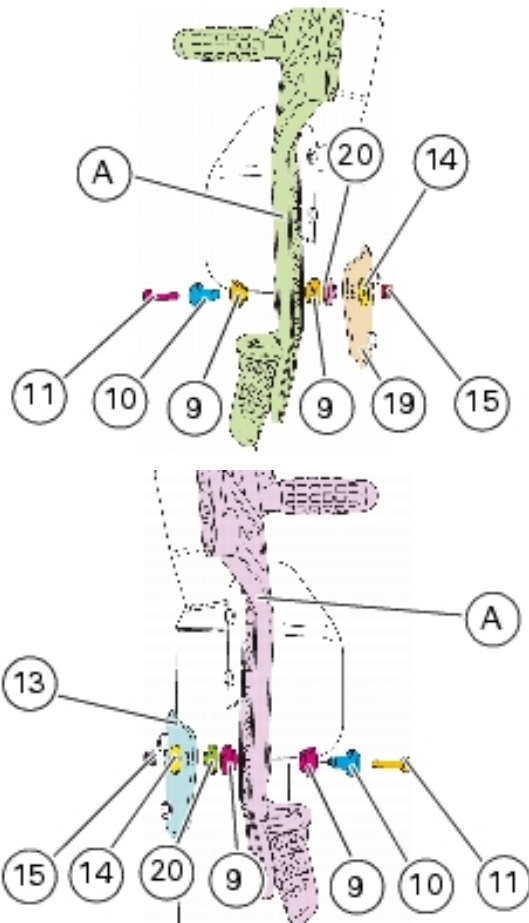
### Removing the exhaust system

Loosen and remove the screws (11) securing the silencer brackets (13) and (19) to footpeg supports (A) on either sides of the vehicle.

Collect nuts (15) and washers (14).

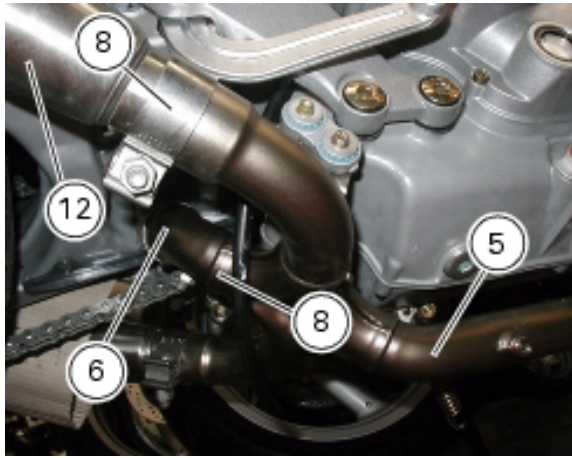
If necessary, remove the spacers (10) and rubber blocks (9) from footpegs plates and remove the bushes (20) from the brackets (13) and (19).

Loosen the clamps (8) of the right (12) and left silencers (16).

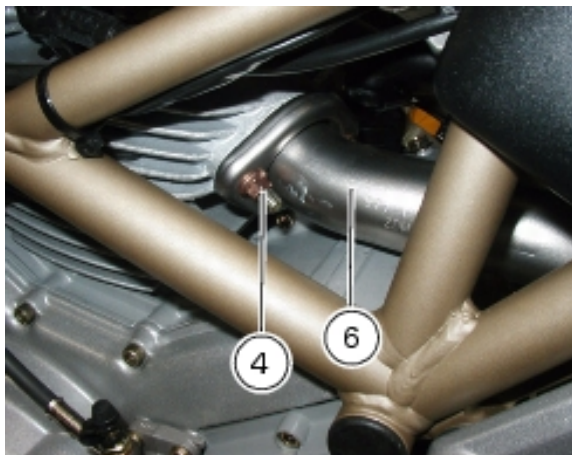
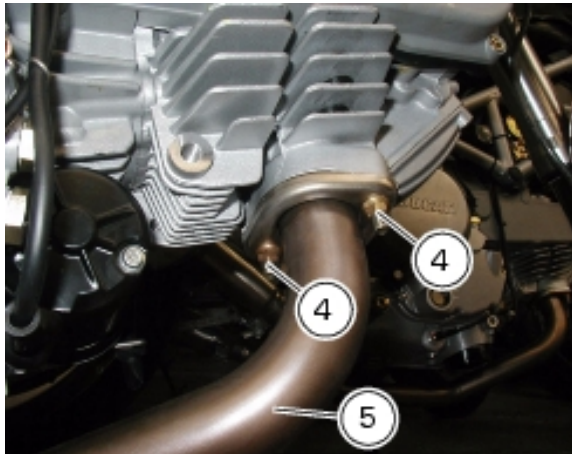


Detach the two silencers from the horizontal head exhaust pipe (5).  
Loosen the clamp (8) of horizontal head exhaust pipe (5) and vertical head exhaust pipe (6).

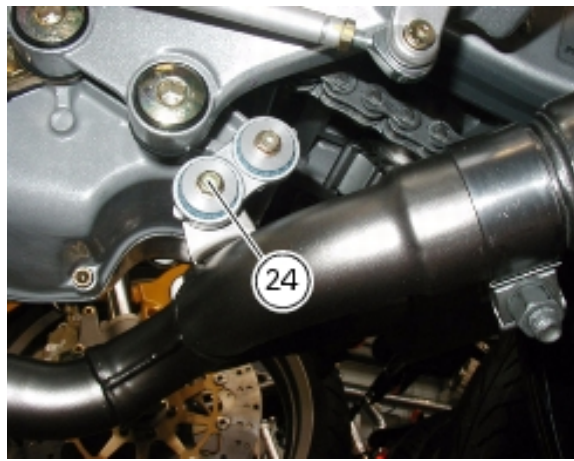




Undo and remove the nuts (4) that retain the exhaust pipe flanges to the heads.

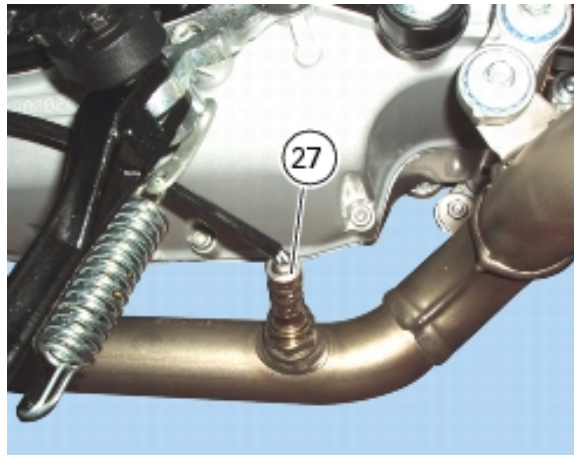


Remove the flanges from the heads.  
Unscrew the two retaining screws (24) of the exhaust pipes.



Collect the spacer (22).

Remove the horizontal exhaust pipe (5) from horizontal head and vertical head exhaust pipe (6); collect the seal (1). Disconnect the lambda sensor (27) from main wiring harness (Sect. P1, [Arrangement of wiring on frame](#)). Please refer to Sect. M3, [Lambda sensor](#), for any further detail on lambda sensor.



Detach the vertical head exhaust pipe (6) from the vertical head and collect the seal (1).



#### Caution

Block off the head exhaust ports to prevent the ingress of dirt into the combustion chamber.



#### Note

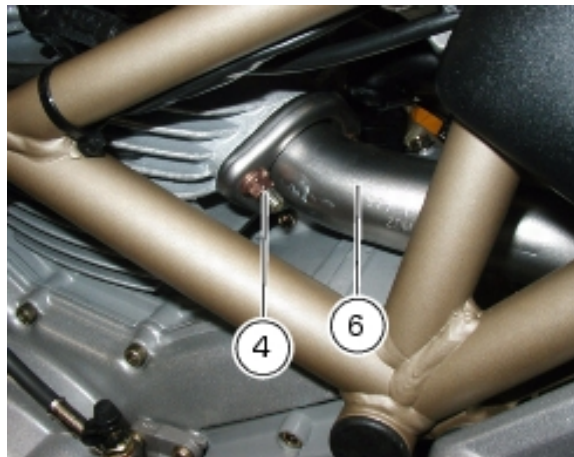
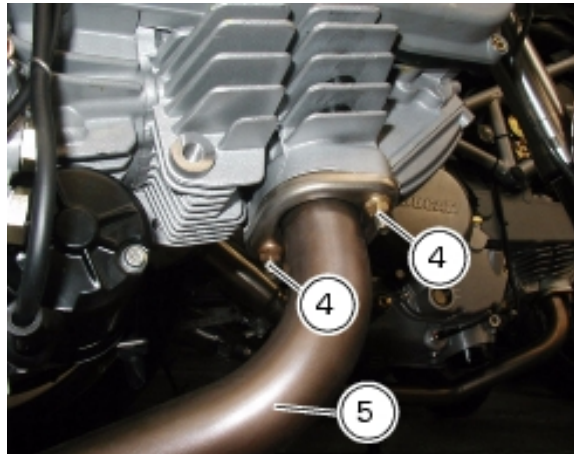
On the U.S.A. versions, there is a washer at the mounting point of right silencer to the pillion rider footpeg assembly for the canister support.

## Refitting the exhaust system

Change the seals (**1**).

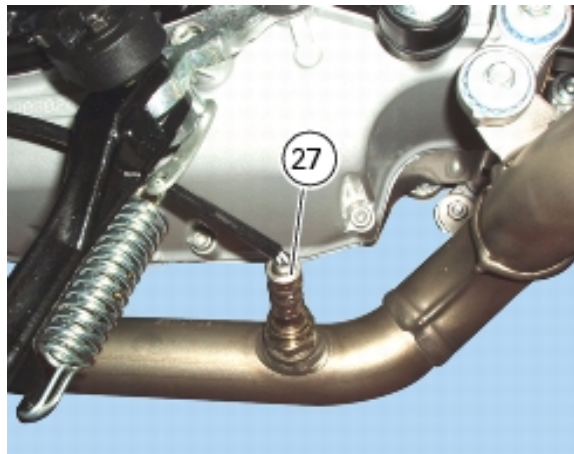
Refit the horizontal exhaust pipe (**5**) and the vertical exhaust pipe (**6**) to the heads.

Tighten the nuts (**4**) securing the flanges to the heads to the specified torque (Sect. C 3, [Frame torque settings](#)).

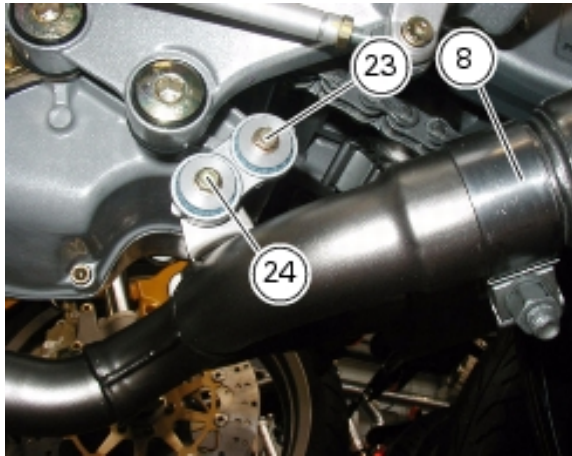
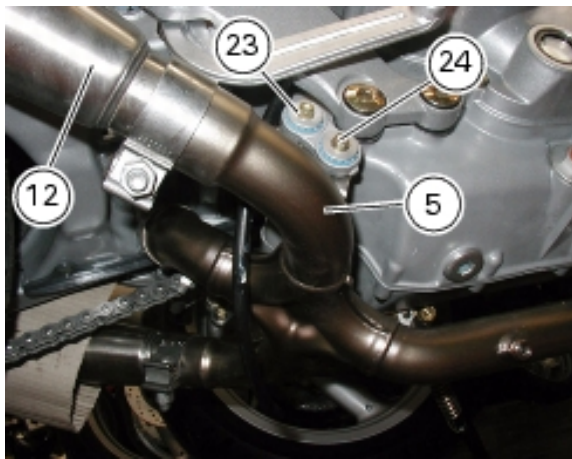


Tighten screws (**24**) with spacer (**22**) to the specified torque (Sect. C 3, [Frame torque settings](#)).

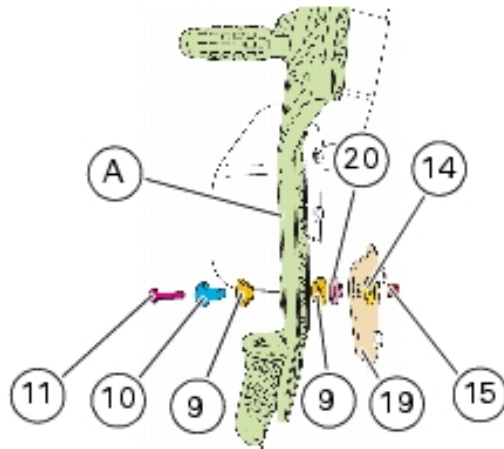
Connect the lambda sensor (**27**) to main wiring harness (Sect. P1, [Arrangement of wiring on frame](#)).

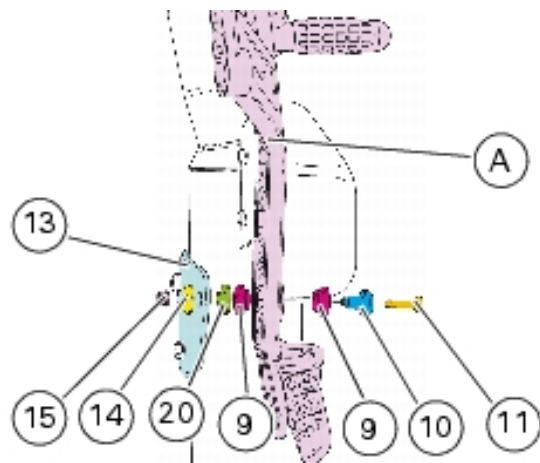


Insert the left (**16**) and right (**12**) silencers into the horizontal exhaust manifold (**5**).

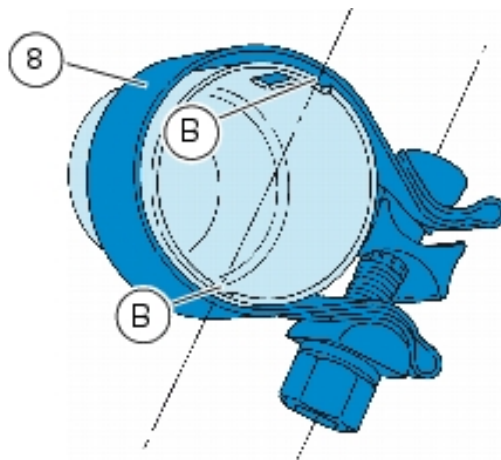


Install the four vibration damping pads (9) – if they have been removed, on both sides of the footpeg plate (A). Fit the bushes (20) into the silencer brackets (19) and (13). Rest the silencer brackets against footpeg plates (A) and insert the bushes (10) fully home. Insert the screws (11). Fit the washers (14) at the opposite end and snug the nuts (15) finger-tight. Hold nuts and tighten the screws (11) to the specified torque (Sect. C 3, [Frame torque settings](#)).

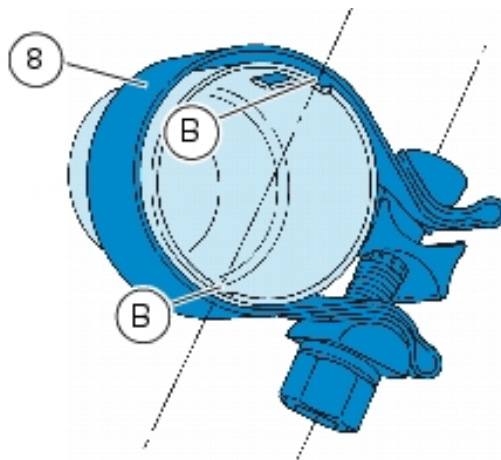


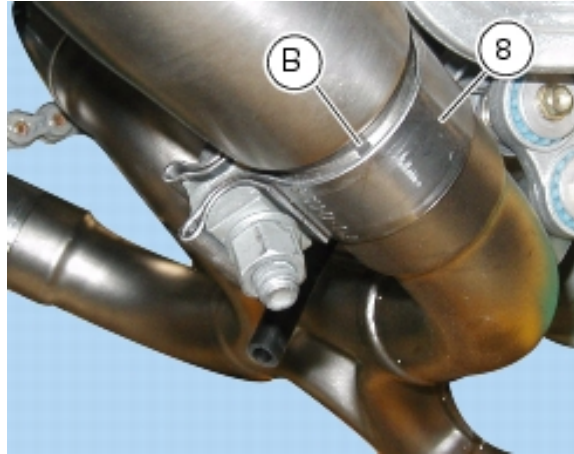
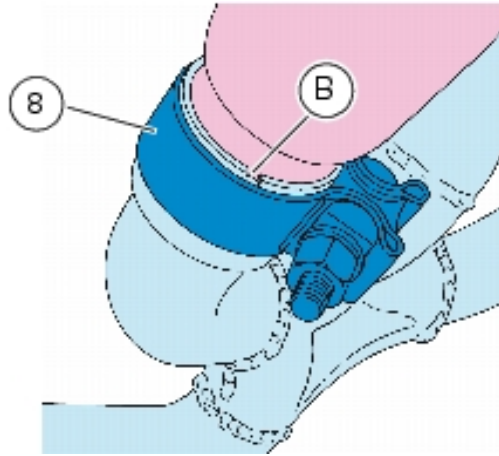


Position the clamps (8) retaining the silencers to the exhaust pipe so that the screws are parallel to the axis of the exhaust pipe slots (B).



The clamps (8) should be flush with the exhaust pipes and the slots (B) should be partially covered. Tighten the clamps (8) to the specified torque (Sect. C 3, [Frame torque settings](#)).





# 1 - Description of the fuel injection-ignition system

## General information on the fuel injection-ignition system

Integrated electronically controlled ignition and injection piloted by just one control unit ensure optimal i.c. engine performance and output, thus reducing consumption and harmful substances into the exhaust gas. These systems ensure accurate air-fuel ratio and optimal ignition advance.

This system consists of three different circuits:

Fuel circuit

Intake air circuit

Electric circuit (featuring control unit, sensors and actuators)

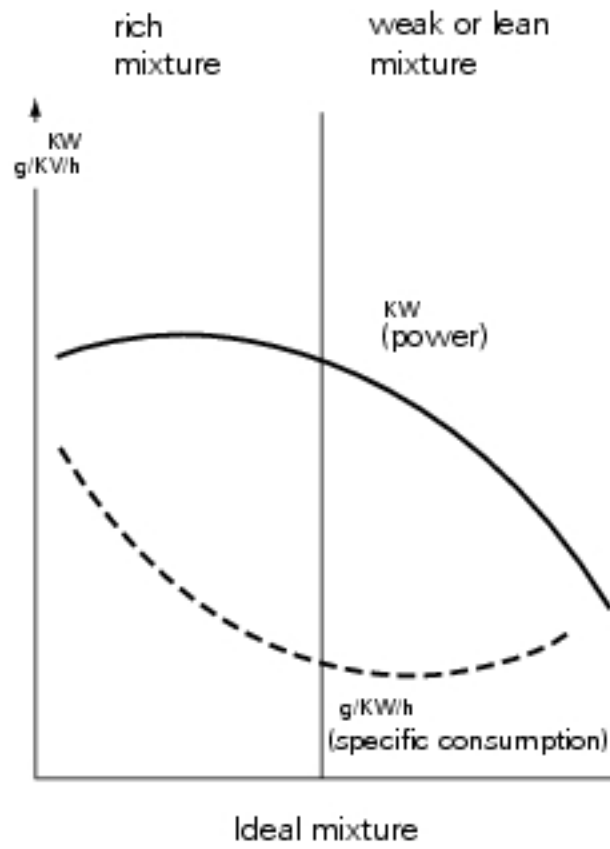
## Importance of the air-fuel mixture and of the ignition advance

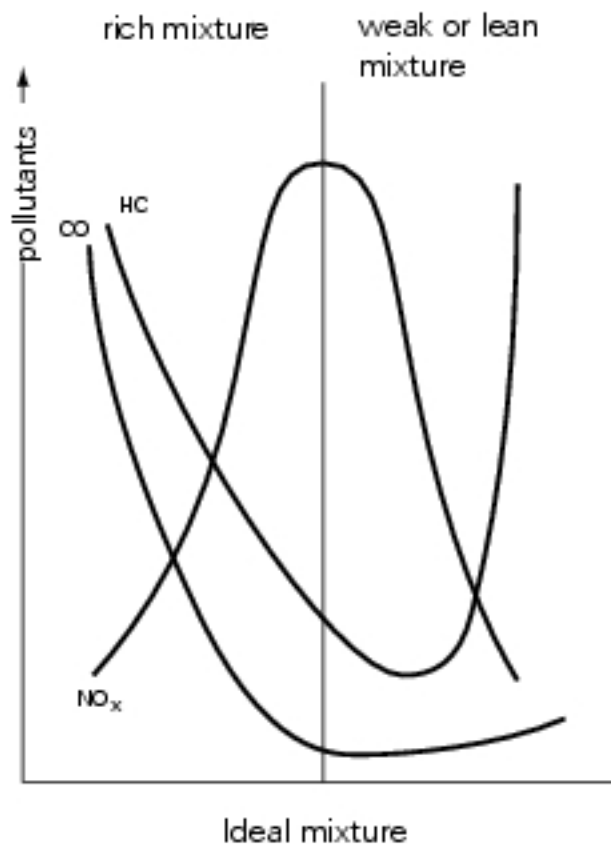
Correct use of the air-fuel mixture and of the ignition advance is fundamental for optimal engine operation.

The air-fuel mixture is given by the ratio, in weight, of air and fuel taken in by the engine: the ideal or stoichiometric ratio is that which establishes complete combustion. Excessive air or insufficient air give rise to, respectively, a lean (or weak) mixture or a rich mixture, which affect power and consumption, as well as emissions of exhaust gases.

Electronic control of the advance makes it possible to optimise the performance of the engine, the maximum power and the consumption and concentration of exhaust pollutants.

Electronic control for the ignition advance and fuel supply allows for optimal functioning of the engine under all conditions of use (low temperature start, warm-up stage, temporary acceleration / deceleration stages, engine under partial load, full load, idle).





#### Marelli injection-ignition system (I.A.W.)

The Marelli injection-ignition system is the Alfa/N type, in which the engine speed and throttle position are used as main parameters for measuring the quantity of intake air. If the quantity of air is known, the quantity of fuel is dosed in accordance with the required mixture. Other sensors in the system (engine sensor, atmospheric pressure, air temperature, engine oil temperature sensors and lambda sensor for CO control) are used to adjust the basic engine control strategy according to operating conditions. The engine speed and the throttle angle also make it possible to calculate the optimal advance for all types of operating conditions. The quantity of air taken in by each cylinder, during each cycle, depends on the density of the air in the intake manifold, the cylinder capacity and the volumetric efficiency.

Volumetric efficiency is experimentally taken onto the engine in the whole operating range (rotation speed and engine load conditions). Taken values are then used for the generation of a map which is stored into the **I.A.W. 5 AM2 ECU Flash Eprom** for injection control. The **Flash Eprom** can be programmed via serial line. Injectors are controlled through a "timed sequence", i.e. not at the same time. Fuel delivery to each cylinder can be started from the expansion stage up to the intake stage, already in progress. Delivery stop, that is when injectors are closed, is saved onto a special map, which is stored in the ECU **Flash Eprom**. Ignition is of the static inductive discharge type, featuring "dwell time" control so to ensure coil charging at steady power. Power modules for coil power supply are included in the CPU hardware. Advance curves are stored into the CPU **Flash Eprom**. Both coils and power modules are controlled by the ECU, which processes ignition advance.



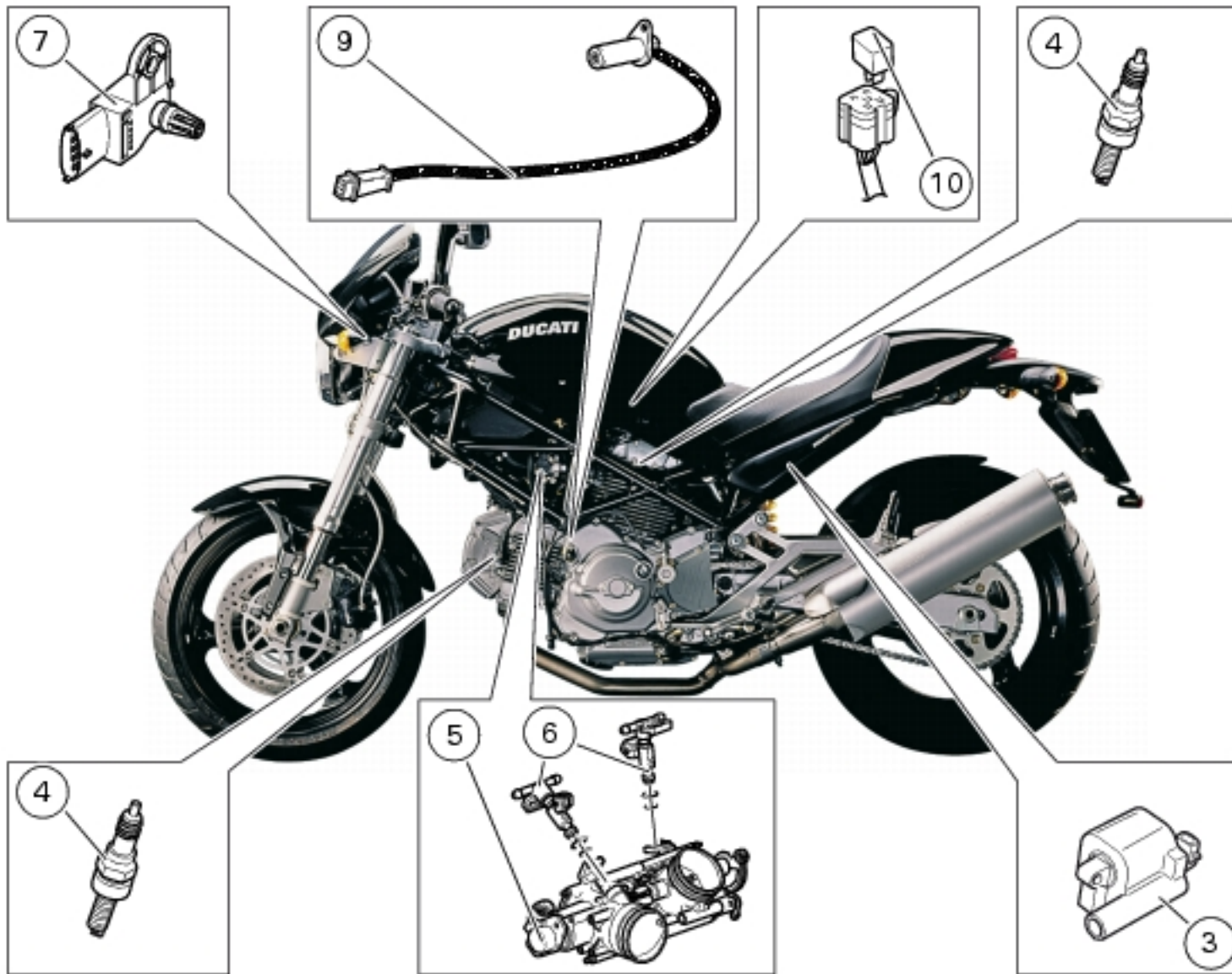
Note

For testing the components and relative wiring of the injection-ignition system, use the "DDS", following the indications under "[Guided diagnosis](#)" (Sect. D 5).

Legend to sensor position diagram

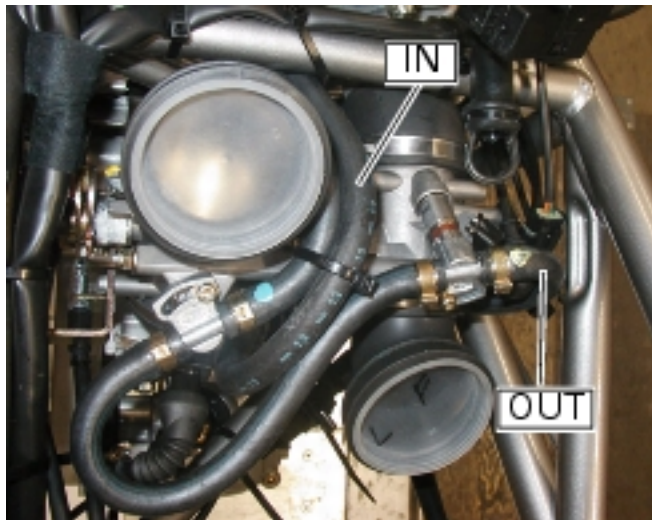
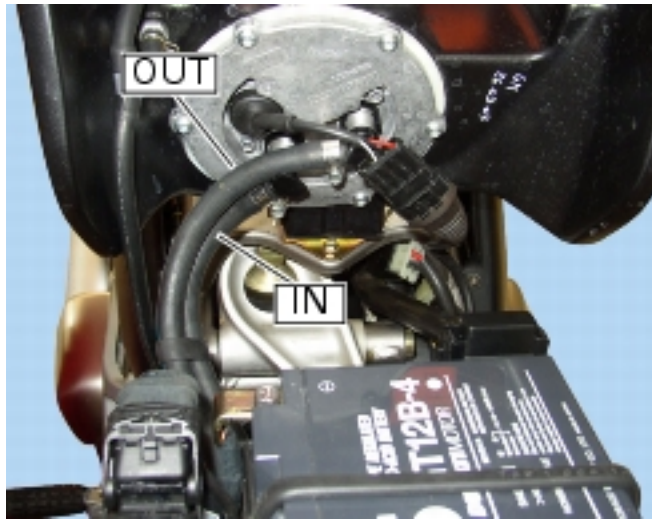
- 1 Coil (horizontal cylinder)
- 2 Electronic control unit
- 3 Coil (vertical cylinder)
- 4 Spark plug
- 5 Throttle position sensor
- 6 Injectors
- 7 Air pressure / temperature sensor
- 8 Oil temperature sensor
- 9 Engine rpm sensor
- 10 Injection relay
- 11 Fuel pump
- 12 Lambda sensor





### Fuel circuit

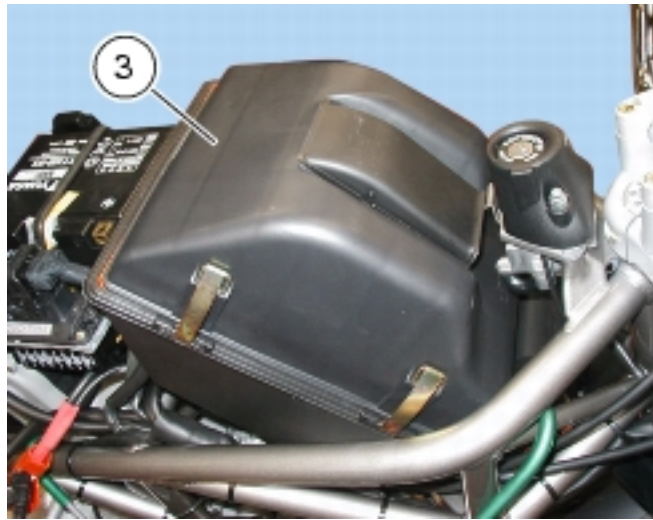
A pump located on a flange at the bottom of fuel tank pumps fuel into delivery tube (OUT) and toward injectors. The flange also fits the pressure regulator controlling fuel feed and keeping it constant at a value higher than engine-generated vacuum. Fuel which is not injected into intake manifolds goes back to the flange and then to the tank by means of a return tube (IN).



### Intake air circuit

The air circuit consists of two intake manifolds (1), a throttle body (2) and an airbox (3) installed over the throttle body.

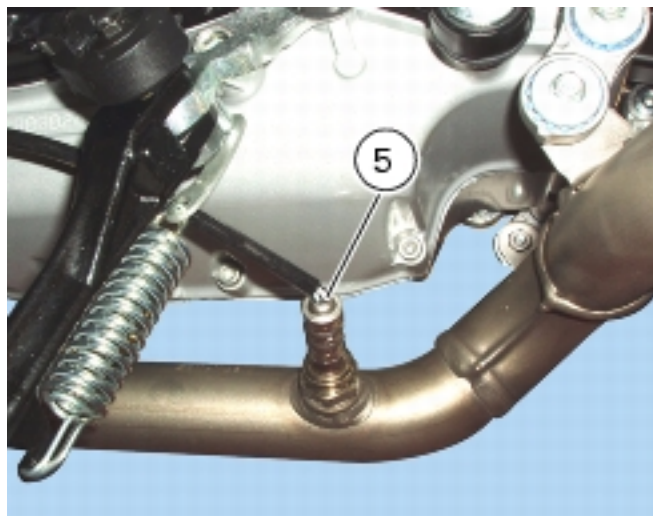




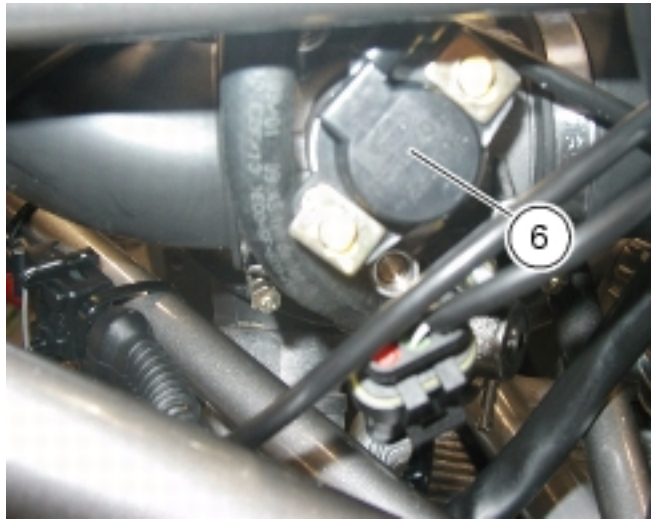
The engine control system (ignition and injection) relies on several sensors which correct mixture strength according to air pressure and temperature and engine load. An absolute air pressure and temperature sensor (4) -onto headlight support RH side- takes atmospheric pressure values and sends them to the ECU for necessary correction of injected fuel if riding on variable sea-level roads. It also allows the ECU to correct mixture strength according to air density. (Assuming that air volume is unchanging, if temperature is higher oxygen content will decrease, whereas it will increase if temperature is lower. If temperature is higher, mixture should be leaner; if lower it should be richer for best air-fuel ratio).



A lambda sensor (5) is fixed to the exhaust pipes, and it governs air-fuel mixture control system.



A throttle position sensor (6) is fitted onto the rear cylinder throttle shaft. It sends to ECU an indirect signal of air amount taken in by the engine (indirect value for engine load).



## Operating stages

### Normal operation

When the engine is fully warm, the unit calculates injection time and advance, by comparing the stored map values, in accordance with the RPM and throttle position. The calculated quantity of fuel is fed through injectors in one single sequential delivery to the two cylinders.

### Starting

When the ignition switch is turned to ON, the control unit feeds the fuel pump for a few moments to put fuel feed hydraulic circuit under pressure. It receives the throttle position and engine temperature signals. When the engine is started, the unit receives the engine RPM and timing signals that allow it to proceed with injection and ignition. To facilitate start-up, the basic mixture is made richer in accordance with the engine temperature. During starting, the ignition advance is fixed ( $0^\circ$ ) until the engine starts. When the engine starts, the control unit takes over the advance control according to the values stored in the mapping and makes necessary corrections according to the air and engine temperatures.

### Acceleration/deceleration

During acceleration, the ECU makes the mixture richer for improved engine performance. Acknowledgement of this condition is given as the rider quickly turns the twistgrip to open the throttle. During a rapid deceleration, which is acknowledged as the rider quickly turns the twistgrip to close the throttle, the ECU makes the mixture leaner for reduced emissions and fuel consumption.

## 2 - Injection - ignition system

Following is a list of injection-ignition system electrical components: indicated reference number refers to diagram in Sect. P 1, [Wiring diagram key](#):

Fuel injection-ignition system diagram key

- 13 Fuse box
- 14 Starter contactor
- 15 Battery
- 16 Tank
- 17 Self-diagnosis outlet
- 18 Vertical cylinder coil
- 19 Horizontal cylinder coil
- 20 Horizontal cylinder spark plug
- 21 Vertical cylinder spark plug
- 22 Horizontal cylinder injector
- 23 Vertical cylinder injector
- 24 Throttle position sensor
- 25 Rpm/timing sensor
- 26 Side stand switch
- 27 Control unit
- 28 Injection relay
- 29 Air temperature / pressure sensor
- 30 Instrument panel
- 31 Control unit oil temperature sensor

### 3 - Fuel injection-ignition system components

#### Electronic control unit

Engine ECU (1) is an electronic digital microprocessor-based unit.



It controls both injectors and coils, thus controlling injection and ignition depending on engine operating conditions as detected by the following sensors.

- Absolute pressure sensor for atmospheric pressure
- Air temperature sensor for temperature of intake air
- Engine temperature sensor for engine oil temperature
- Timing/rpm sensor for engine rotation speed and cylinder timing to TDC
- Throttle position sensor for throttle opening angle

Moreover, the engine control unit monitors battery voltage to adjust injector opening time and ignition coil charging time.

The electronic control unit determines the following values.

- Fuel amount delivered to each cylinder according to a timed sequence
- Closing time of injectors and therefore injection timing referred to the end of intake stage for each cylinder
- Ignition advance

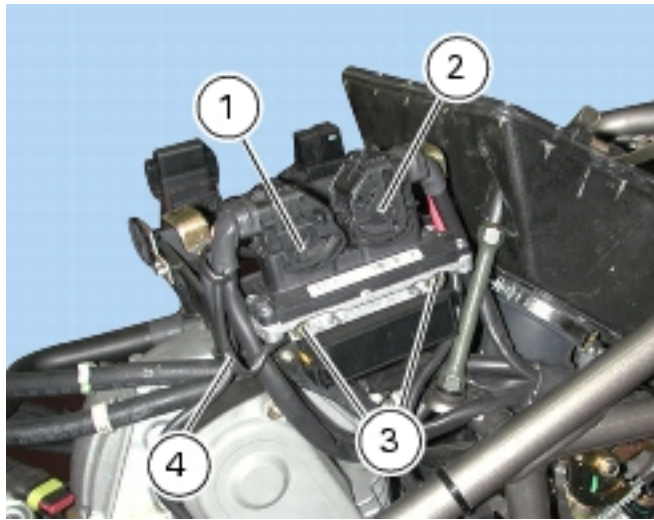
#### Caution

Mapping including ignition advance values, injection times, crankshaft angle for injector closing and all correction curves as a function of temperature and atmospheric pressure values are stored into the ECU Flash Eeprom. The above values are preset by the Manufacturer after testing the motorcycle under different riding conditions.

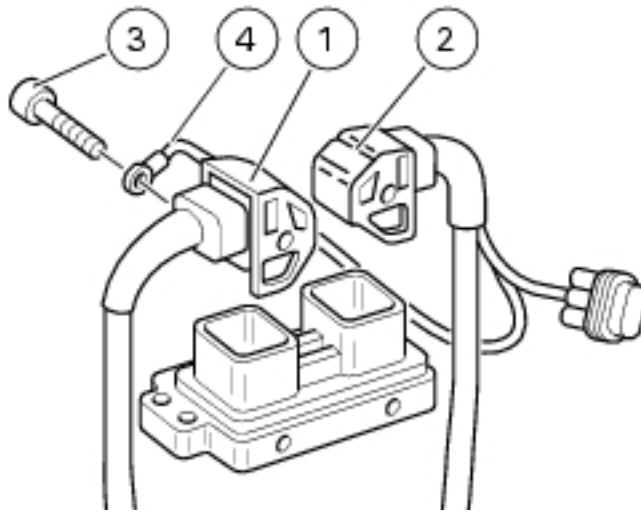
Settings cannot be changed.

#### Removing the electronic control unit

To remove the control unit, remove the fuel tank (Sect. L 2, [Removing the fuel tank](#)), disconnect the two control unit connectors (1) and (2), unscrew the retaining screws (3) and detach the control unit ground cable (4) from the screw (3).

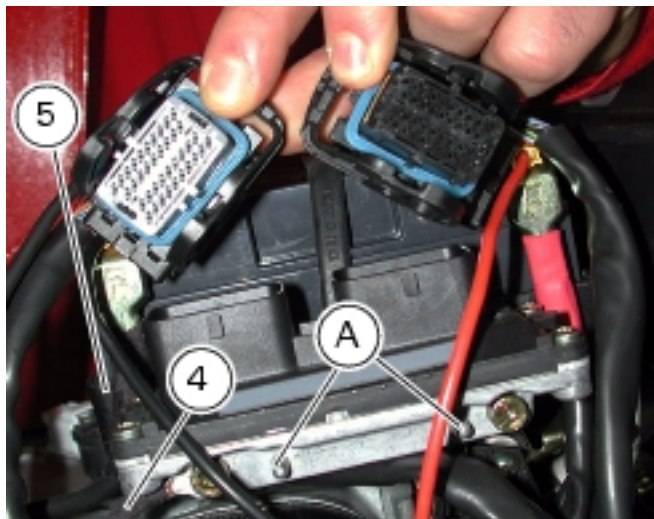


Unscrew the other screw (3) and remove the control unit.

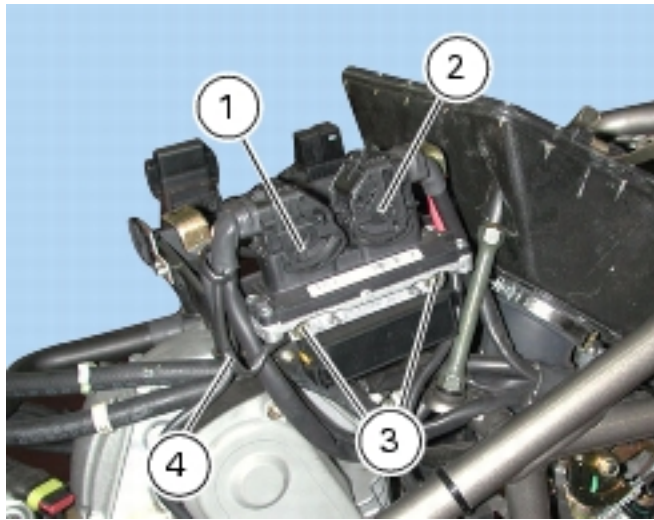


Refitting the electronic control unit

Position the control unit to the battery mount (5) (on the right side of the motorcycle) and start the two screws (3) in their holes.



Place the ground cable (4) under the rear screw as shown in the figure.

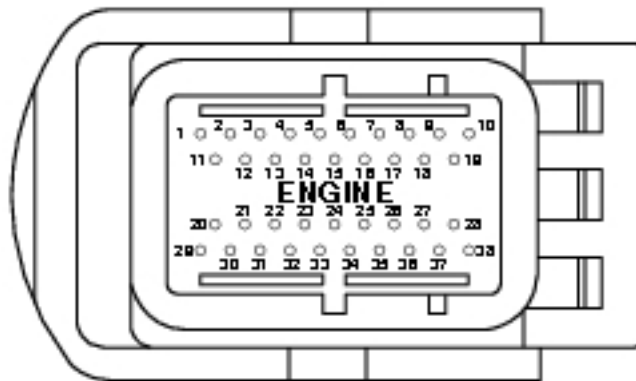


 **Warning**

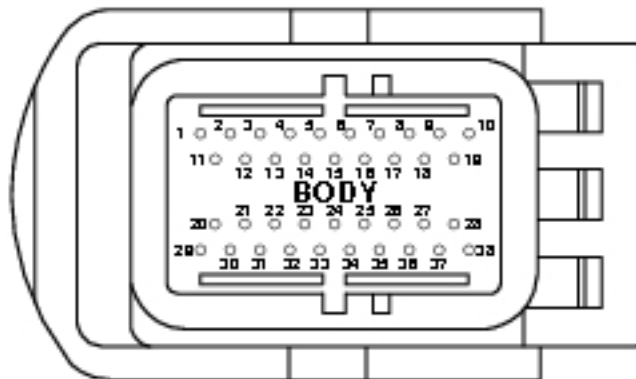
The control unit is in the correct position when the lugs (A) are pointing to the right (viewing the motorcycle from rider position).

Tighten the screws to the specified torque (Sect. C 3, [Engine torque settings](#)).

The connector (1) has a grey pinout (frame end -Body), whereas the connector (2) has a black pinout (engine end -Engine).



**Black**

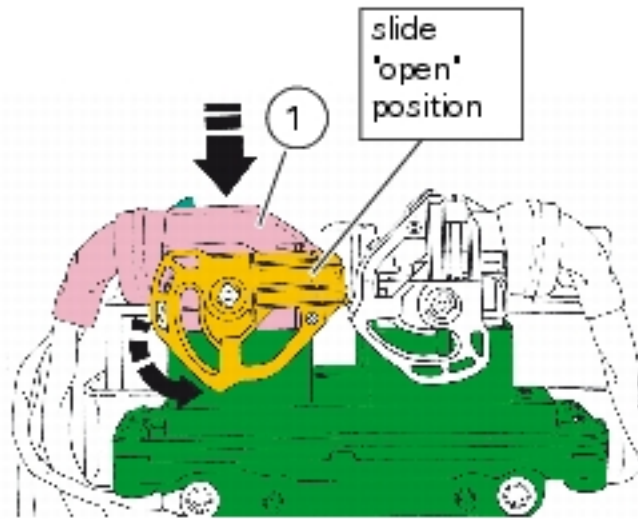
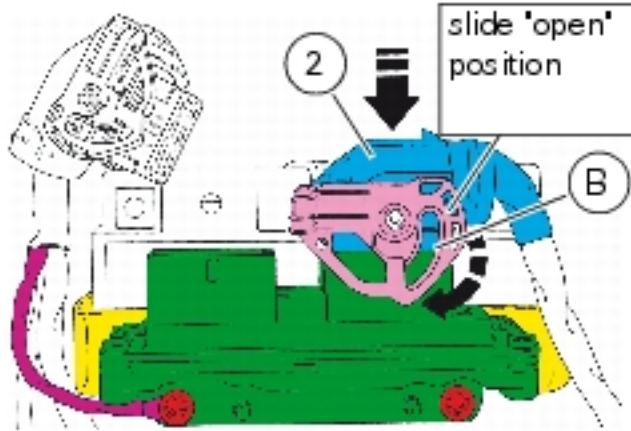


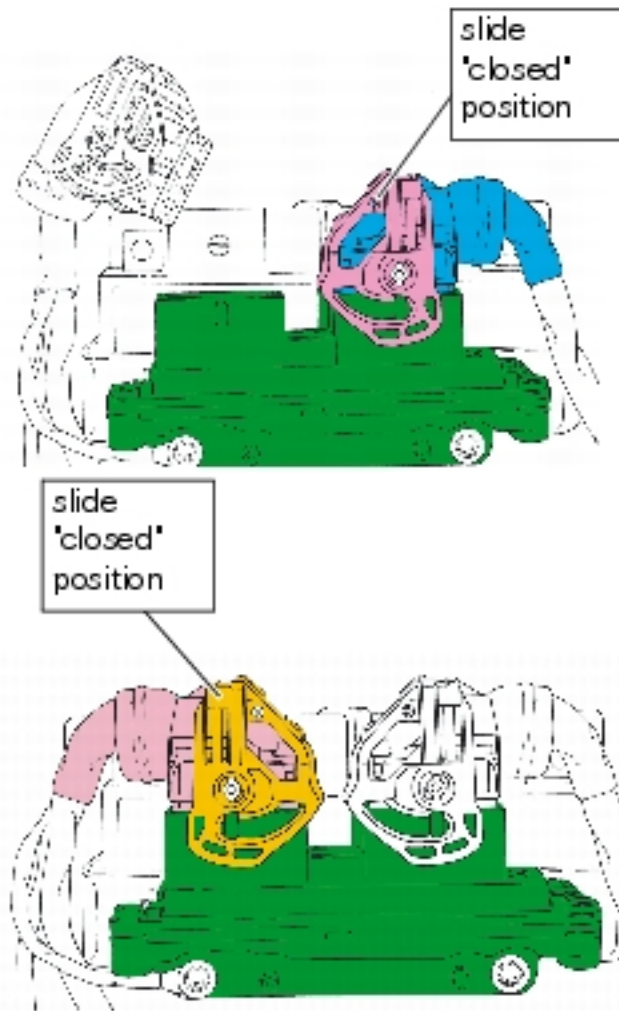
**Grey**

 Caution

If the control unit is replaced, it is necessary to use the DDS and carry out the procedure for [Zero setting the throttle position sensor \(TPS\)](#) (Sect. D 5).

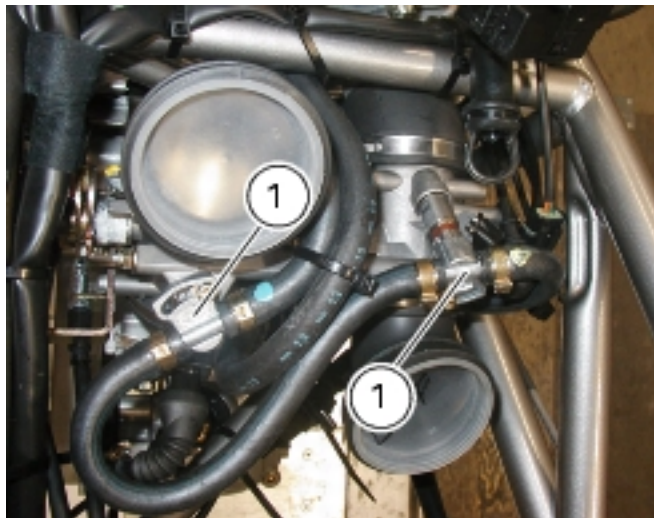
- Make sure the clip (B) for connector (1) is "released" (as shown in the diagram).
- Push the connector axially fully home into the control unit.
- Rotate the clip (B) until locking the connector (clip is in the "locked" position).
- Repeat procedure for the other connector (2).
- Make sure the connector clip is "released".
- Push the connector axially fully home into the control unit.
- Rotate the clip until locking the connector (clip is in the "locked" position).





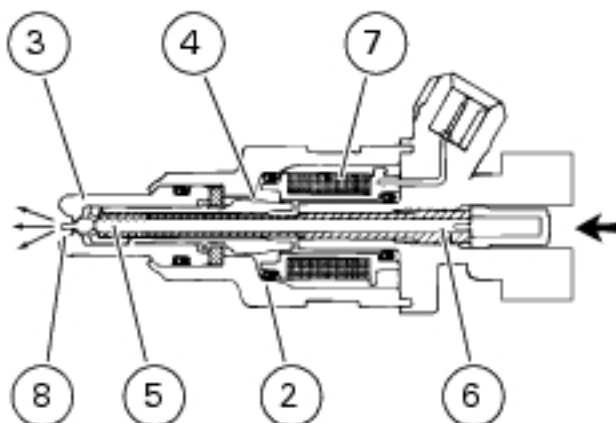
## Electric injector

Injectors (1) deliver the right amount of fuel for trouble-free engine operation.



The ECU controls power supply to a winding, which creates a magnetic field attracting an armature and causing fuel injection. Assuming that fuel properties such as viscosity and density as well as injector delivery and pressure head -which is controlled by fuel pressure regulator- do not change over time, the amount of injected fuel depends on injector opening time. This time is set by the control unit according to engine operating conditions, for correct engine feeding.

The injector is made up of a body (2) and a needle (3) which is connected to the armature (4). The needle is pressed against the seat by a helical spring (5), whose loading is determined by an adjustable pushrod (6). The winding (7) is accommodated inside the injector body at the rear end, whereas the injector nose (8) at the front end incorporates needle seat and guide.



See Section L 6 for injector removal and installation instructions.



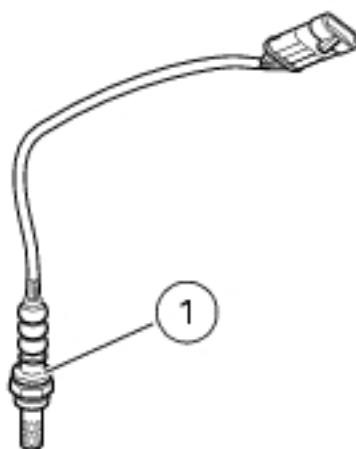
Note

To check operation of the injector, use the DDS, please refer to "[Guided diagnosis](#)" (Sect. D 5).

The outfeed of the fuel must be steady and the jet must be atomised, without drops. Do not leave the fuel system filled with fuel if you are leaving the motorcycle unused for long periods. The fuel could clog and damage the injectors. If the engine has been idle for long periods, add a special additive "TUNAP 231" to the tank at regular intervals. This cleans the critical fuel passages.

### Lambda sensor

The lambda sensor (1), located on the exhaust pipe, is the sensor giving the control unit information about the quantity of oxygen in the exhaust gases. This helps the electronic control unit in maintaining optimum air-fuel ratio.





The outer surface of the zirconium dioxide element is exposed to the exhaust gas, whereas the inside is vented to the atmosphere. Both the inner and outer surfaces are coated with a thin layer of platinum. Oxygen ions flowing through the ceramic electrically charge the platinum layer, which acts as an electrode and produces a measurable voltage; this voltage is delivered to sensor output and on to the connection cable attached to it.

The zirconium dioxide element becomes permeable to oxygen ions when heated up to about 300 °C. The sensor uses the special physical properties of zirconium dioxide to generate a voltage relating to the difference in oxygen content of the gases on either side of the element. A lean mixture produces a low voltage signal, whereas a rich mixture will result in a high voltage output.

The sensor is set to change its output at an air/fuel ratio of 14.7:1 (14.7 parts of air to 1 part of fuel) known as Lambda 1. This is considered as the ideal ratio for complete combustion, hence the name Lambda Sensor: therefore

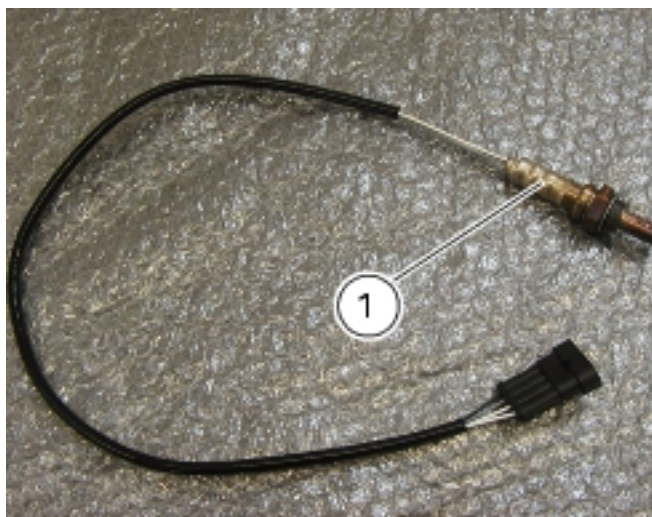
lambda = 1 means stoichiometric mixture ratio

lambda >1 means lean mixture

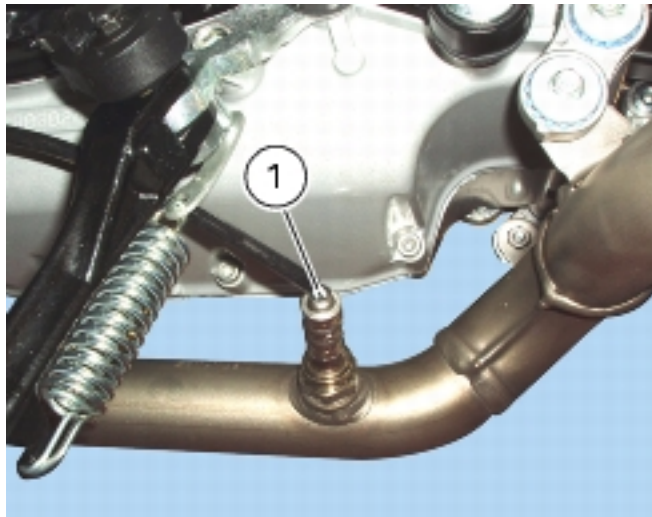
lambda <1 means rich mixture

The air/fuel mixture control system varies mixture content based on the information provided by the sensor, which starts operating above 300°C: the ceramic core becomes permeable to oxygen ions when heated up to about 300°C. Due to the particular characteristics of the material, the difference in oxygen content on either side of the sensor generates a voltage across the two electrodes. And this allows measuring the difference in oxygen content of exhaust gases and the environment. When the air/fuel mixture sent to the combustion chamber is not correct, gases produced after engine combustion still feature a residual oxygen content. This system then controls the fuel injection electronic control unit so that engine always uses ideal mixture.

Unscrew the lambda sensor (1) from the exhaust pipe to remove it.



To refit, tighten the sensor to the specified torque (Sect. C 3, [Frame torque settings](#)).



### Air temperature / pressure sensor

This sensor is powered by the electronic unit. It supplies information about the absolute air pressure in a neutral area of the motorbike and measures temperature. The sensor sends electronic signals to the control unit for correction in accordance with the temperature and barometric pressure.



#### Note

To check operation of this component, use the DDS, follow instructions given under "[Guided diagnosis](#)" (Sect. D 5).

### Removing the air temperature / pressure sensor

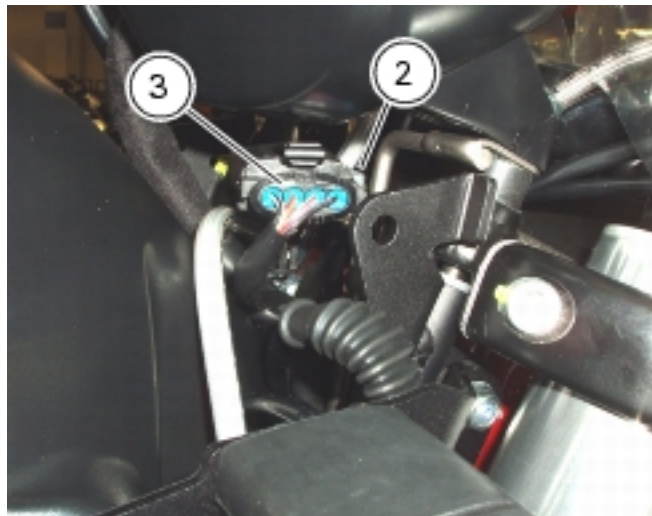
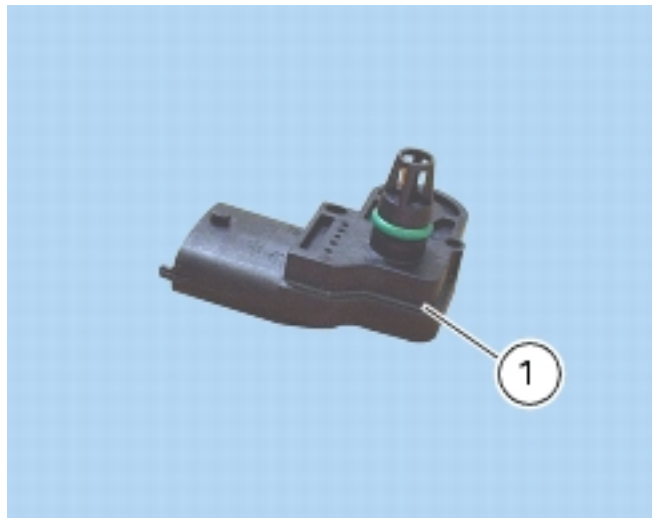
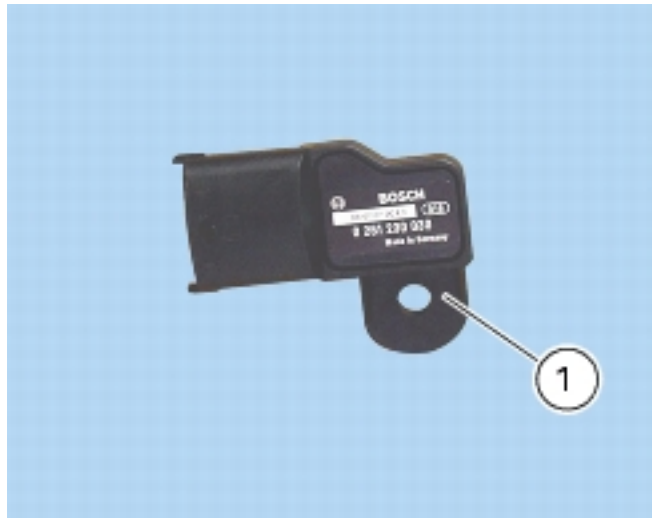
To gain access to the air temperature/pressure sensor (1), remove the headlight (Sect. P 4, [Changing the headlight](#)), disconnect the main wiring harness connector (3) at sensor end, unscrew the sensor retaining screw (2) and release the screw from the front subframe.

### Refitting the air temperature / pressure sensor

Reverse the removal procedure and tighten the sensor retaining screw (2) to the specified torque (Sect. C 3, [Frame torque settings](#)).

After refitting, reconnect the connector (3) to the sensor.

Refit the headlight (Sect. P 4, [Changing the headlight](#)).



## Spark plugs

Blow spark plug recesses with compressed air to remove any dirt.  
Take out spark plug caps (1) on both heads and remove spark plugs. Take care not to let any foreign body enter the combustion chambers.

 Caution

Check gap between centre and side electrodes.

If gap is outside the specified limits or in case of carbon deposits on spark plug surface, change spark plug.

Screw the spark plug in by hand until the full thread is into the head.

Tighten it to the specified torque (Sect. C 3, [Frame torque settings](#)).

Refit spark plug caps (1).



 Caution

Do not use spark plugs with an unsuitable heat rating or incorrect thread length. Spark plugs must be properly tightened. Spark plugs that are not correctly tightened will overheat and may cause engine damage.

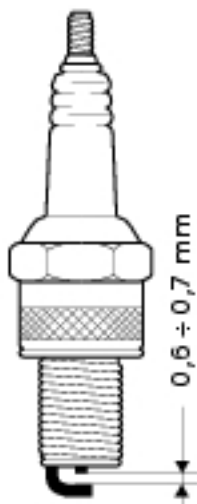
Spark plug type

Make: **NGK**

Type: **DCPR8E**

Make: **Champion**

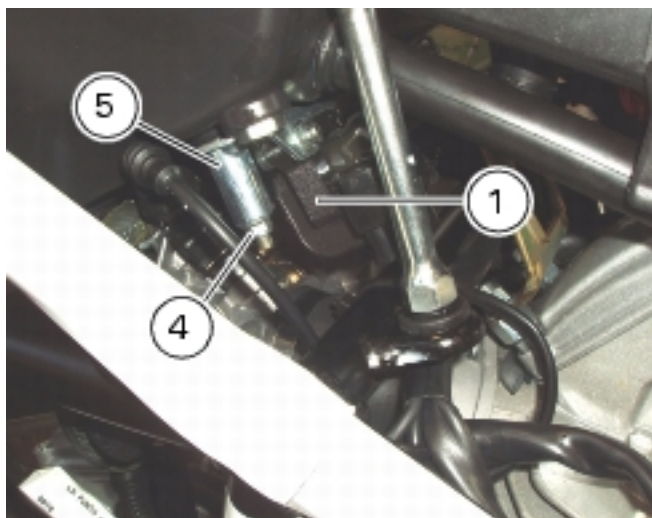
Type: **RG4HC**



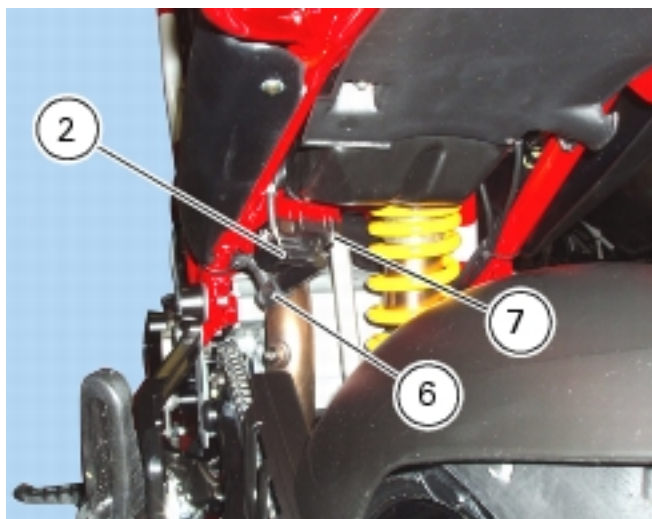
## Coil

Ignition uses the inductive discharge technique. The power coil is governed by the I.A.W. control unit

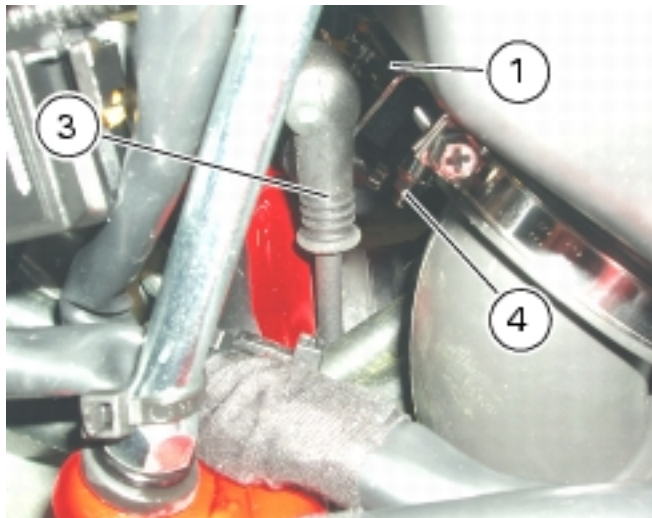
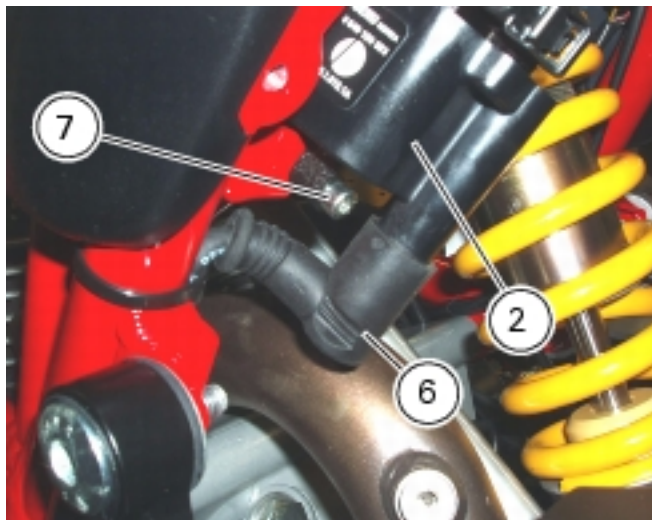
that calculates the ignition advance. The power module (built into the electronic control unit) also guarantees constant coil charge, operating on the dwell angle.  
Horizontal head coil (1) is placed under the airbox. Remove the airbox (Sect L 7, [Removing the airbox](#)) to gain access to the coil.



Vertical head coil (2) is located next to the wheel, in the rear left side of the vehicle.



Disconnect spark plug cable (3) to remove the coil (1).  
Undo the nuts (4) and collect the washers.  
Remove the coil (1) from the plate (5).  
Disconnect the spark plug cable (6) and remove screws (7) to remove the coil (2).  
Remove the coil (2).  
Installation is a reversal of the removal procedure. Be sure to tighten the nuts (4) and screws (7) to the specified torque (Sect. C 3, [Frame torque settings](#)).



Note

To check operation of these items, use the DDS, please refer to "[Guided diagnosis](#)" (Sect. D 5).

### Throttle position sensor

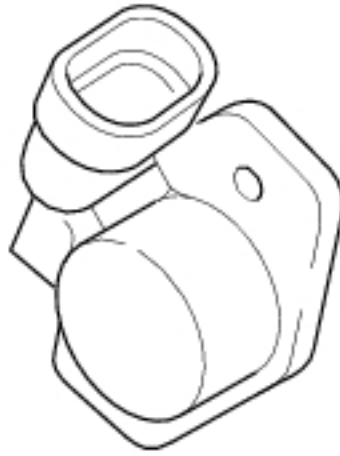
This sensor is powered by the electronic unit to which it sends a signal that identifies the position of the throttle. This information is the indirect measure of the engine load and is used by the unit as a key parameter for calculating the quantity of fuel and the ignition advance.



Note

To check operation of this item, use the DDS, please refer to "[Guided diagnosis](#)" (Sect. D 5).

The throttle position sensor cannot be replaced alone. Should some malfunctioning arise, change the throttle body (Sect. L 6, [Removing the throttle body](#)) and then compulsorily reset the throttle position sensor (Sect. D 5, [Zero setting the throttle position sensor \(TPS\)](#)).



### Rpm/timing sensor

This is an inductive sensor. This sensor is facing the timing gear and can read the 46 teeth and the gap equal in size to 2 teeth.

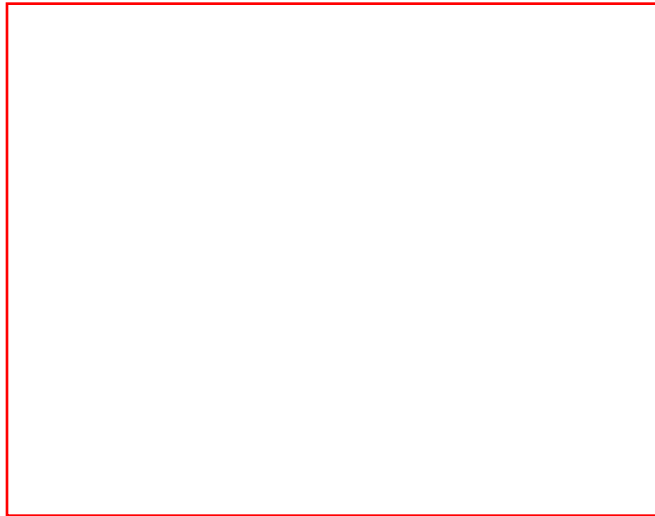
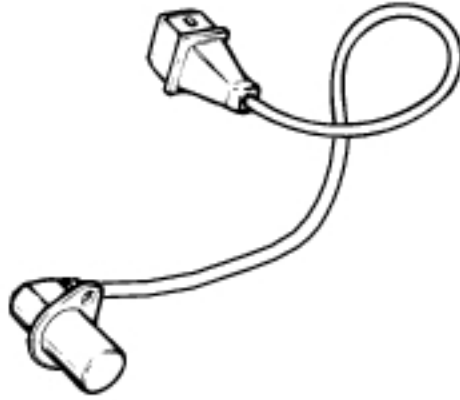
The signal from the pick-up sensor -facing the timing layshaft gear- is used by the control unit for calculating engine rotation speed and timing reference values.



#### Note

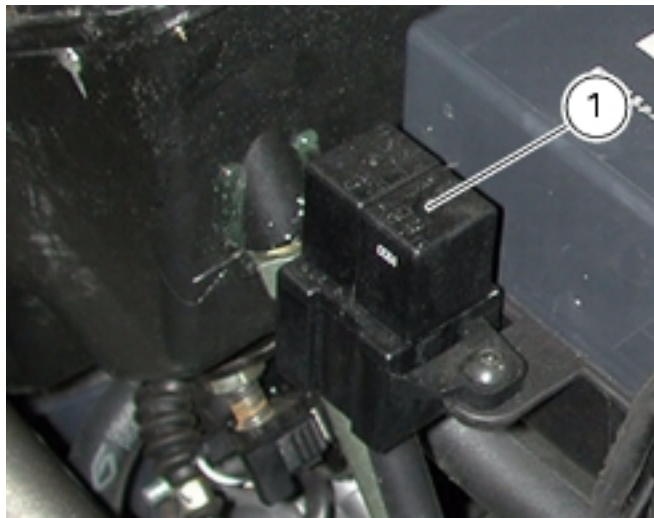
To check operation of these items, use the DDS, please refer to "[Guided diagnosis](#)" (Sect. D 5).

See Section "[Flywheel - generator](#)" (Sect. N 8) for instructions on how to replace the sensor and check the air gap.



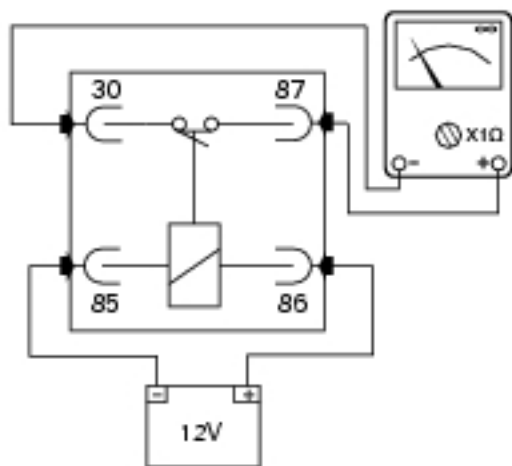
## Main and injection relays

Relay (1) is located next to the battery and is fixed to battery support. To remove the relay, first lift the fuel tank (Sect. L 2, [Removing the fuel tank](#)).



Disconnect the relay from the electric system and power contacts (86) and (85) (small contacts) with 12 V (battery). The electric magnet must click. Connect the multimeter to contacts (30) and (87) (large contacts) to check for electric continuity (Section P 9, [Testers](#), on multimeter operation). Resistance value taken by the multimeter should be

close to zero and, if available, a continuity beep should be heard. If not, replace checked part.



# 0Injection - ignition system

## [1 - Description of the fuel injection-ignition system](#) 3

[General information on the fuel injection-ignition system](#) 3

[Fuel circuit](#) 6

[Intake air circuit](#) 7

[Operating stages](#) 9

## [2 - Injection - ignition system](#) 10

[3 - Fuel injection-ignition system components](#) 11

[Electronic control unit](#) 11

[Electric injector](#) 15

[Lambda sensor](#) 16

[Air temperature / pressure sensor](#) 18

[Spark plugs](#) 19

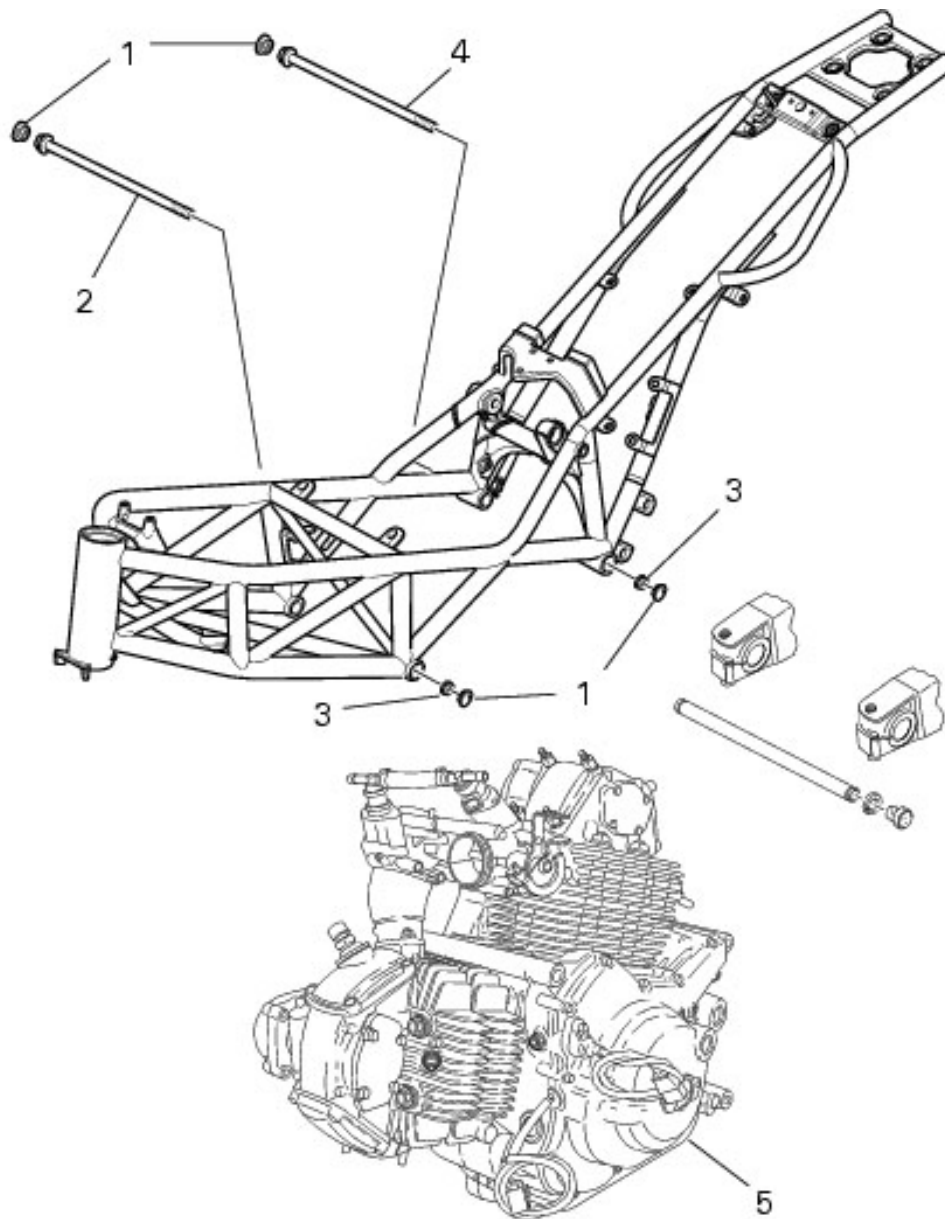
[Coil](#) 20

[Throttle position sensor](#) 22

[Rpm/timing sensor](#) 23

[Main and injection relays](#) 24

## 1 - Removing - reassembling the complete engine



- 1 Blanking plug
- 2 Front mounting bolt
- 3 Nut
- 4 Rear mounting bolt
- 5 Engine

 Spare parts catalogue

[Half crankcases](#)

[Frame](#)

[Swingarm and chain](#)

 Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

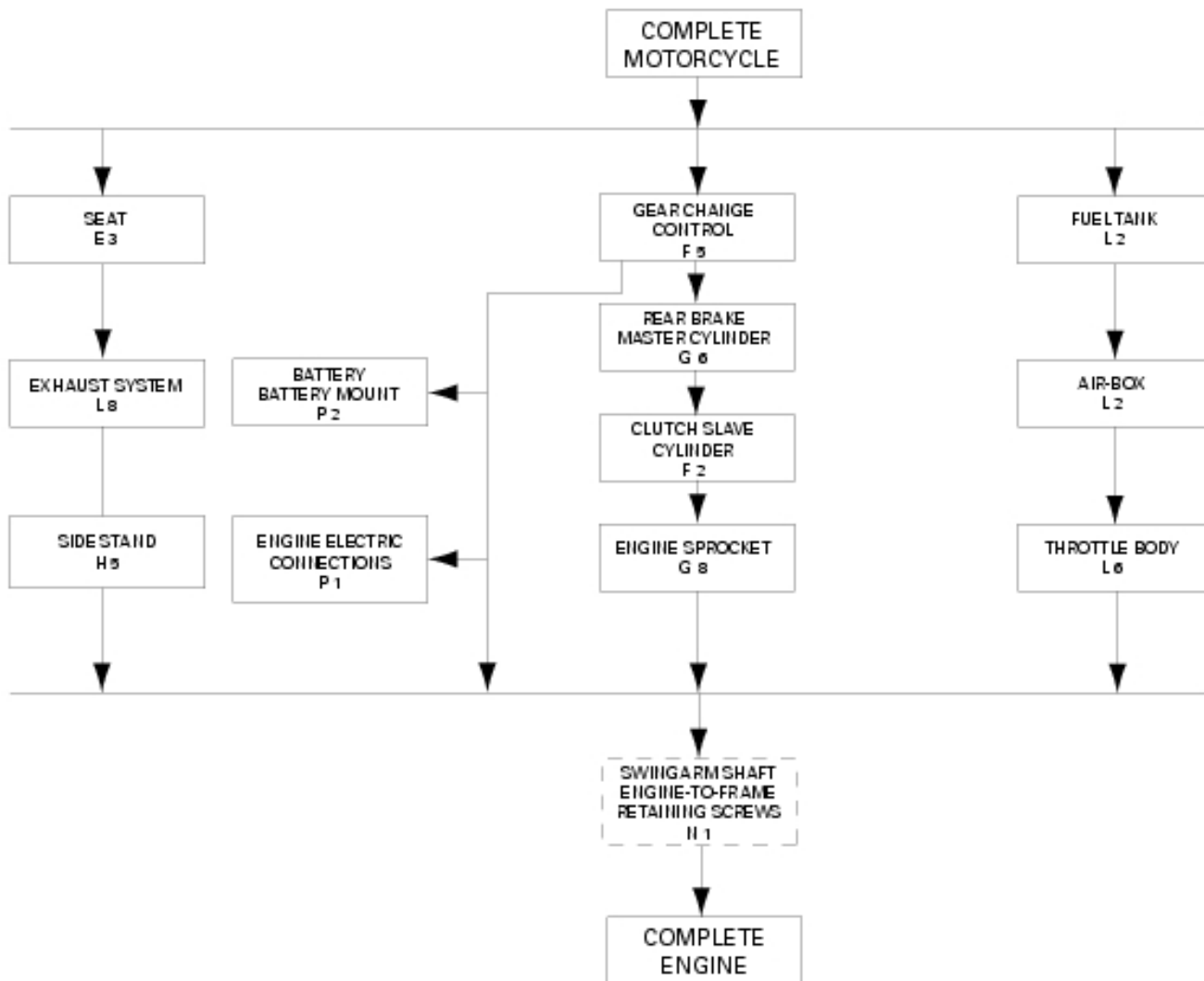
## Removing the engine

To remove the engine, you first have to remove other components from the bike.

Most disassembly procedures for these components are described in the relevant sections.

The following diagram is a logical disassembly sequence of the parts to be removed and makes reference to the relevant sections describing the specific disassembly procedures.

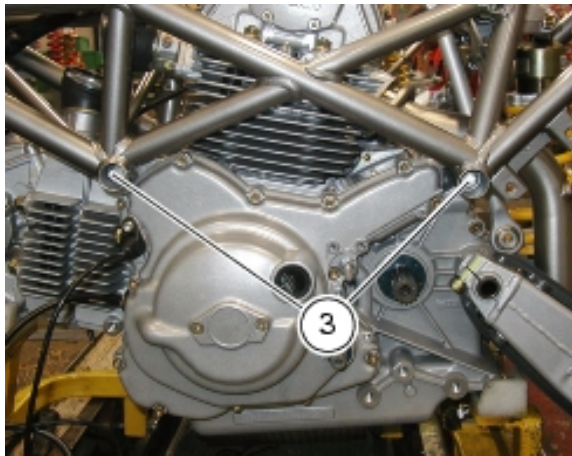
This section describes only the operations to be carried out after having removed all the parts shown in the diagram.



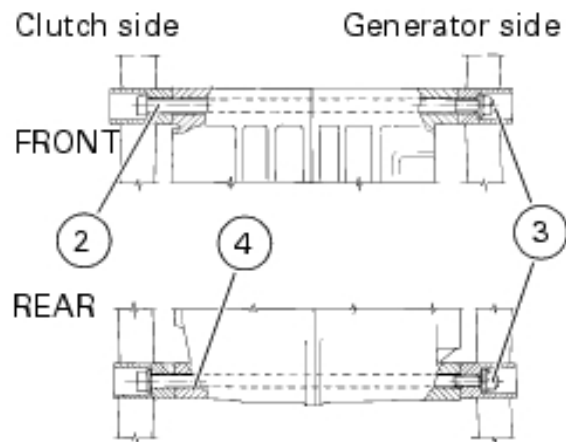
Remove the protective caps (1) from the frame tubes at the engine mounting points.



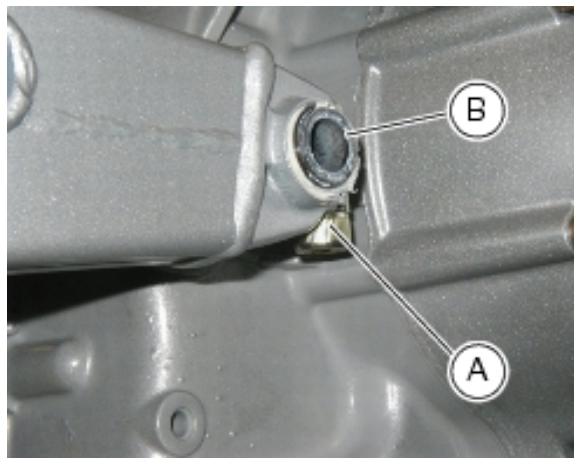
Put a stand under the engine to support it during removal.  
Undo and remove the nuts (3) on the left side at the engine front mounting bolt (2) and rear bolt (4).



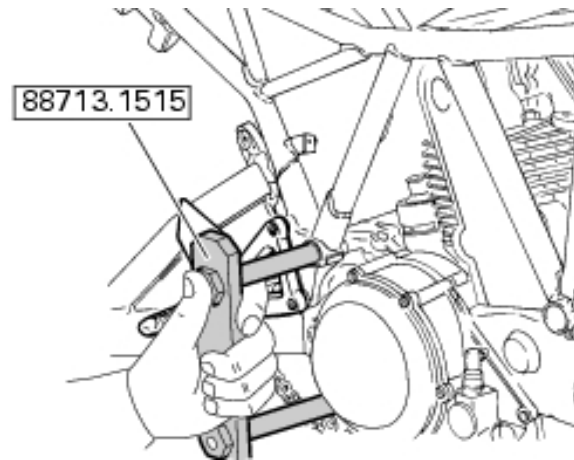
Remove the front mounting screw (2) from engine right side.



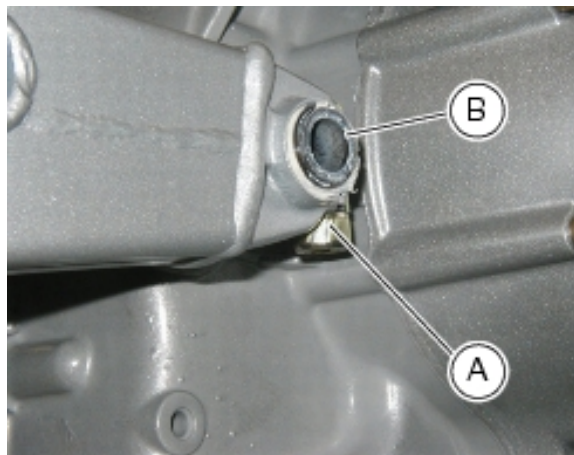
Loosen swingarm clamp screws (A).  
Slide out the swingarm shaft (B) of half of its length from the right side (Sect. G 5, [Removing the swingarm](#)).



Slide out the rear screw (4) up to half its length and insert the suitable support part no. **88713.1515** on the left side. Tighten screw (A) onto swingarm left clamp, in this way you also tighten the support part no. **88713.1515**.



Completely remove swingarm shaft (A) and the upper screw (4). Fit the other support on the right side and secure it with the other screw (B). The supports hold frame and swingarm in the correct position for refitting the engine later on. Remove the engine (5).



## Reassembling the engine

Reassembling is a reversal of the removal sequence outlined above.

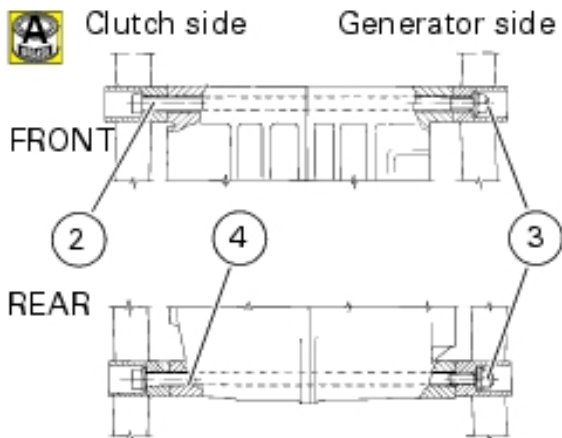
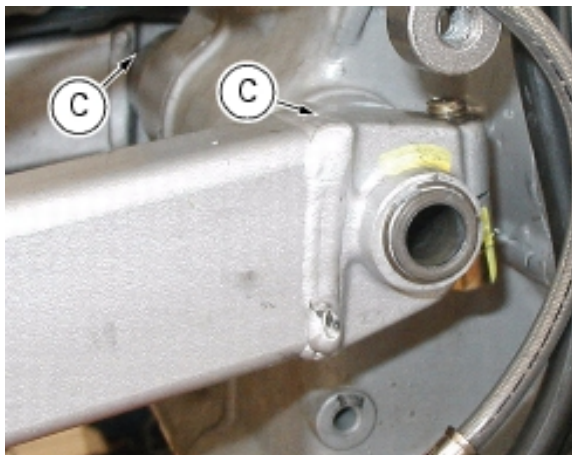


### Caution

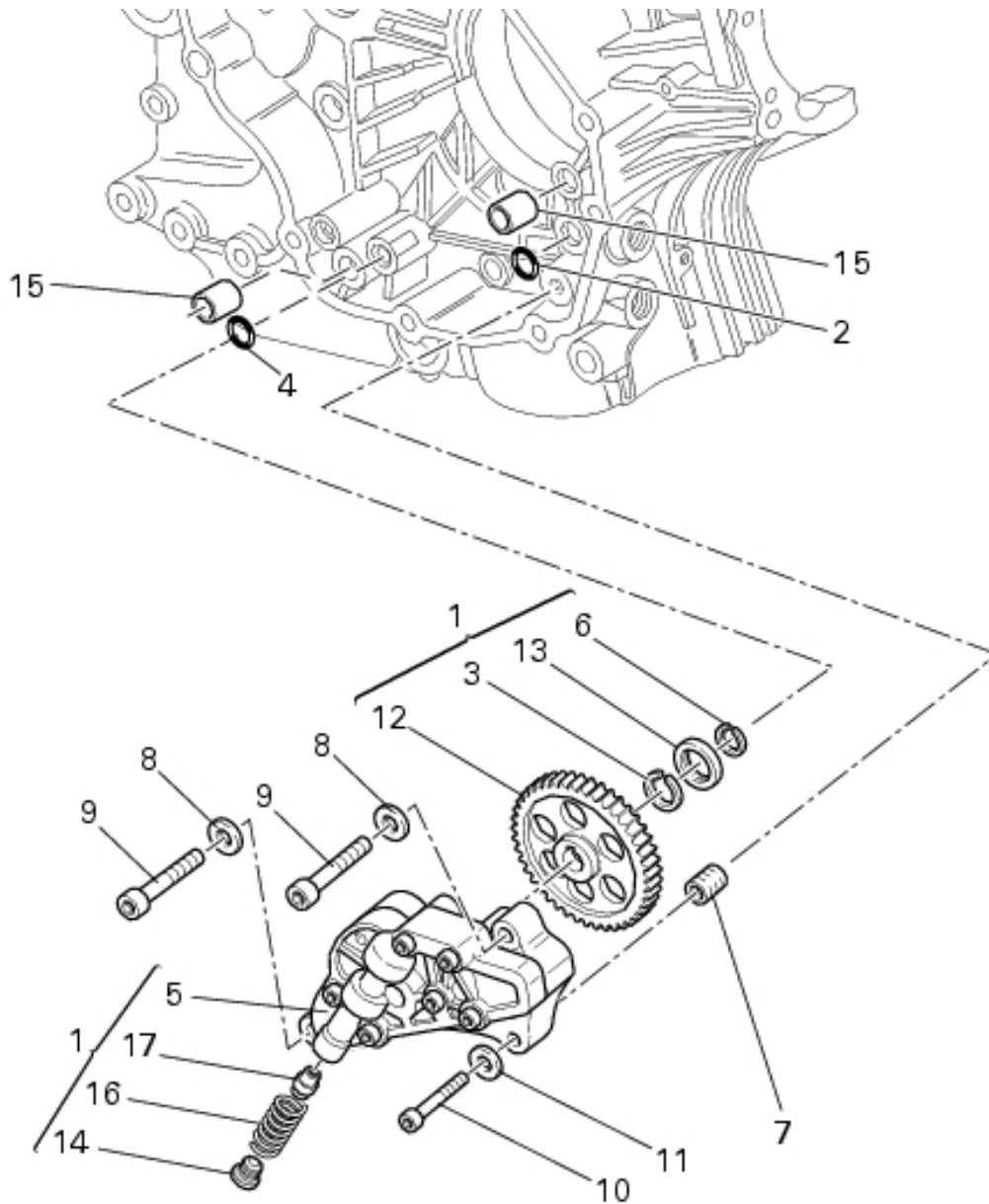
Position suitable shims (C) between engine and swingarm (Sect. G 5, [Refitting the rear swingarm](#)).

Lubricate the nuts (3) of the mounting bolts (2) and (4).

Tighten the nuts (3) to the specified torque (Sect. C 3, [Engine torque settings](#)).



## 2.1 - Lubrication system: oil pump

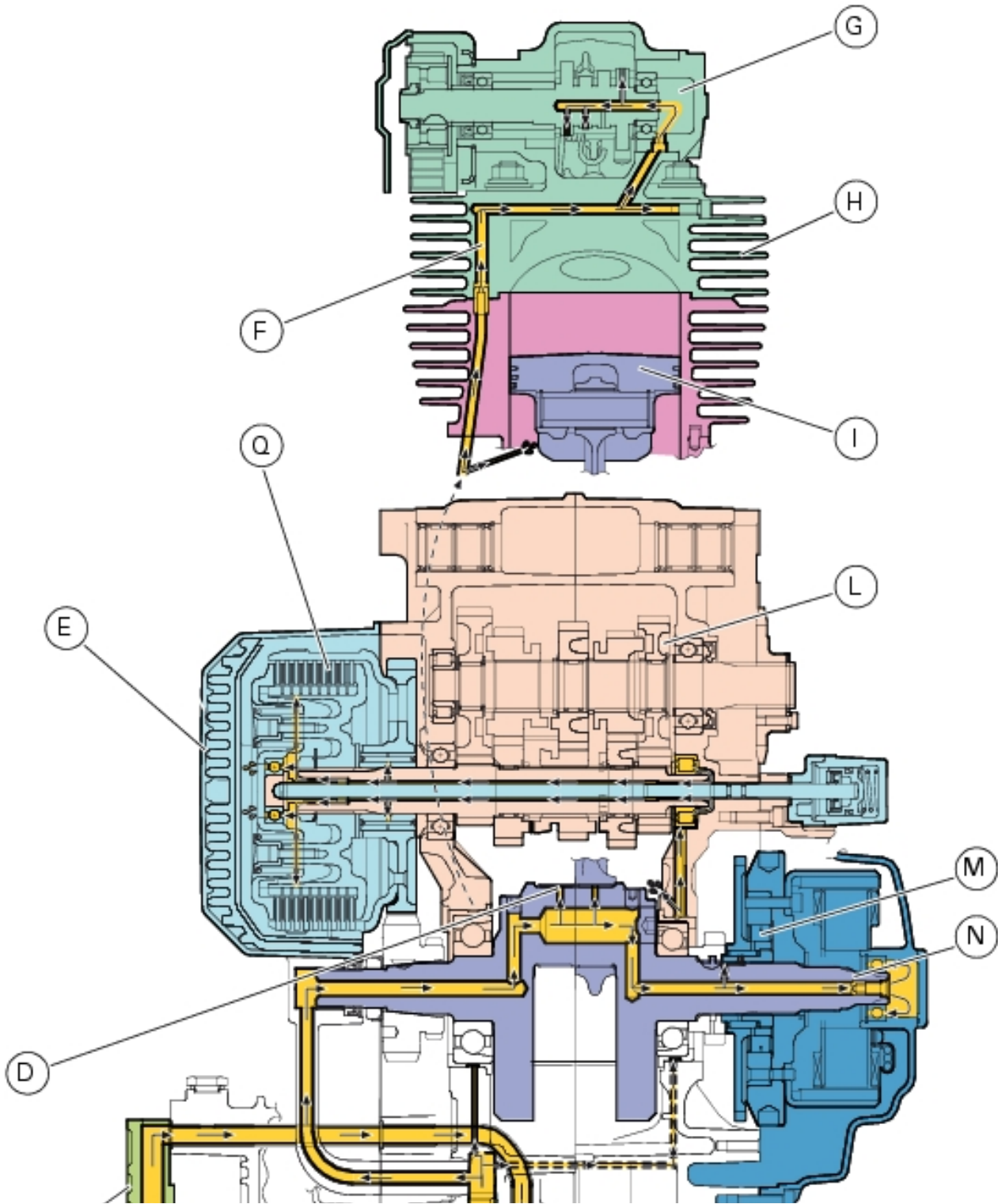


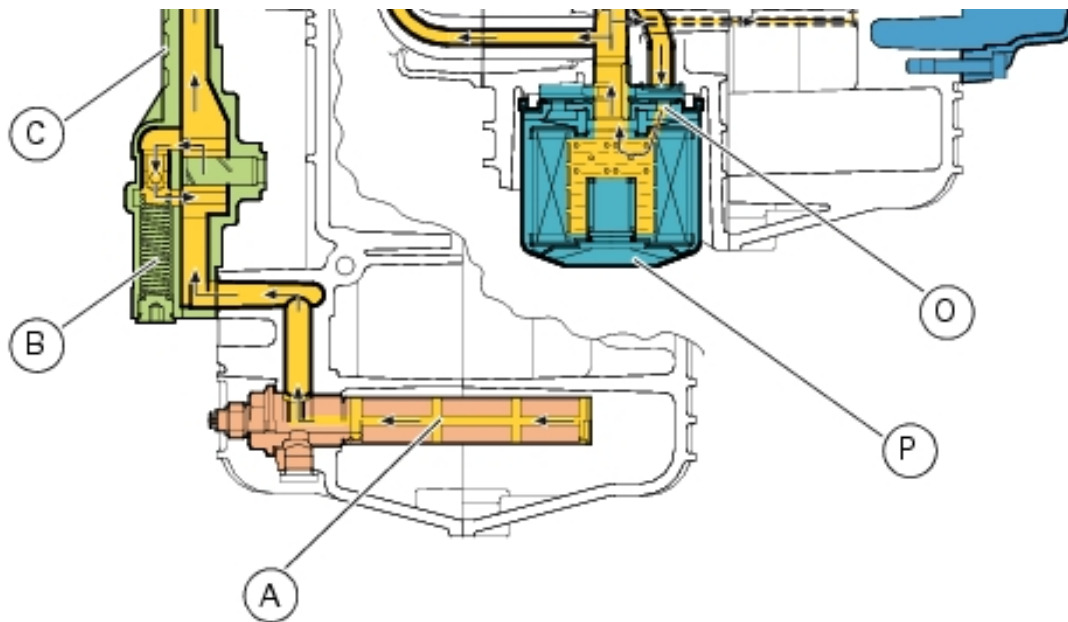
- 1 Complete oil pump
- 2 O-ring
- 3 Circlip
- 4 O-ring
- 5 Pump body
- 6 Circlip
- 7 Reduction bush
- 8 Spring washer
- 9 Screw
- 10 Screw
- 11 Spring washer
- 12 Pump control gear
- 13 Bush
- 14 By-pass valve cap
- 15 Centring bush
- 16 By-pass spring
- 17 Pressure-relief (by-pass) valve

 Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

Lubrication system





### Description of the lubrication system

Forced lubrication by gear pump. Built-in pressure relief by-pass valve. Mesh intake filter. Disposable filter cartridge on intake with safety valve preventing cartridge clogging. Low oil pressure indicator on instrument panel.

### Lubrication system components:

- A Mesh filter
- B By-pass spring
- C Oil pump
- D Con-rod big end bearings
- E Clutch cover
- F Oil delivery to heads
- G Head
- H Cylinder
- I Piston
- L Gearbox
- M Starter flywheel assembly
- N Crankshaft
- O By-pass spring/reed
- P Cartridge filter
- Q Clutch plates

### Lubrication system operation

The oil gear pump (C) is driven by a toothed gear pair on the crankshaft. Pump flow rate therefore depends on engine speed (see reference values in Sect. D 5, [Checking engine oil pressure](#)).

The pump incorporates a pressure-reducing valve (B) delivering any excess oil caused by excessive pressure to the intake end.

Oil is pumped from the oil sump through a mesh filter (A) that holds back any coarse foreign matters - before oil reaches pump.

After flowing out of the pump, the oil flows into the cooler before reaching the cartridge filter (P), which is fitted with an inner anti-clogging valve ensuring proper oil circulation under all conditions. Please note that oil is not filtered if the valve opens.

After the filter, the oil flows to three different lubrication ways: two ways reach pistons as well as crankshaft bearings, whereas the third one reaches the crankshaft (N) through an oil channel in the clutch cover (E).

As it flows into the crankshaft, oil lubricates con-rod big end bearings (D) and nozzles for piston crown cooling (L).

Then the oil also reaches the inner ring of the starter gear and the starter clutch (M).

Finally, coming out on the opposite end, the oil lubricates the crankshaft bearing in the generator cover.

The oil lubricates the camshafts through the oil delivery ways (F) to the heads (G).

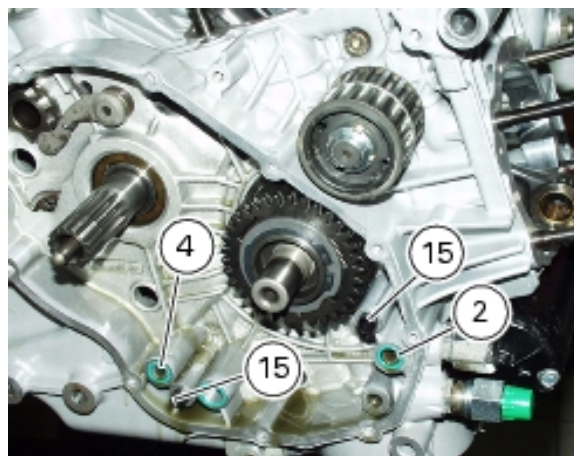
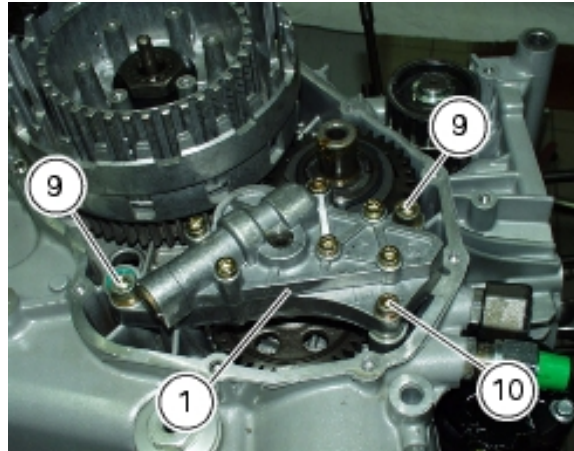
Once flowing off the pressurised circuit and after lubricating the above parts, the oil lubricates primary transmission, gearbox and gearbox shaft bearings while falling back down into the engine block.

The breather circuit for vapours built into the engine block includes a reed breather valve at right casing top, a collection tank and a connection line.

## Removing the oil pump

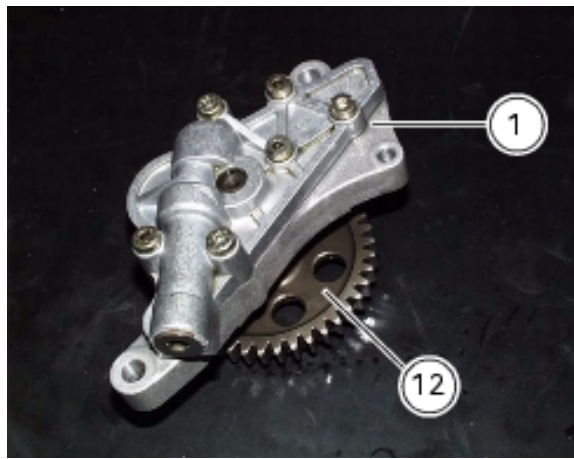
Operations	Reference See Section
Remove the clutch cover	N 6.2, <a href="#">Removing the clutch cover</a>

Undo and remove the screws (9) and (10) fixing the complete pump.  
 Remove the complete oil pump (1) and slide the two O-rings (2) and (4) and the two centring bushes (15) out of the casing.



## Disassembling the oil pump gear

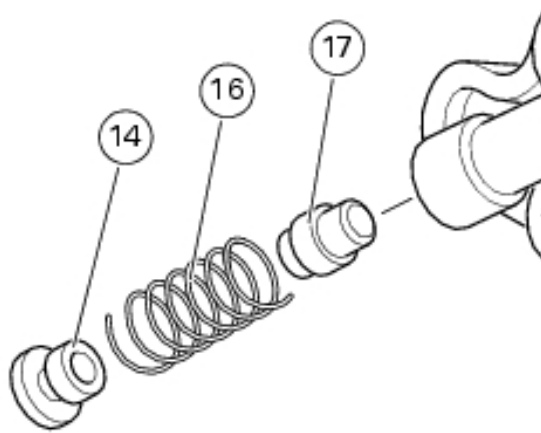
Vice the oil pump (1). Make sure not to damage the pump control gear (12).



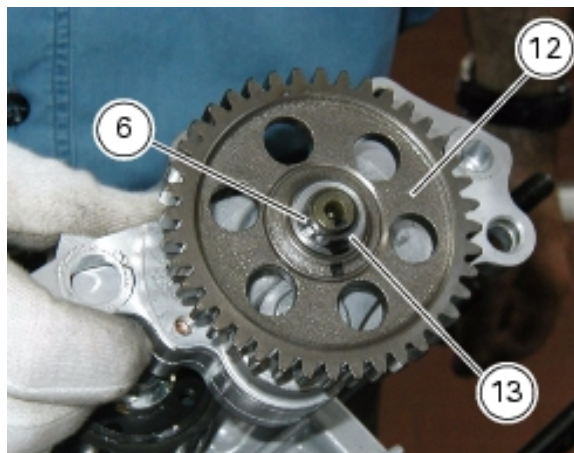
**Warning**

Make sure that vice jaws are duly protected.

Remove plug (14) and slide out spring (16) and by-pass valve (17).  
Check for proper operating conditions.

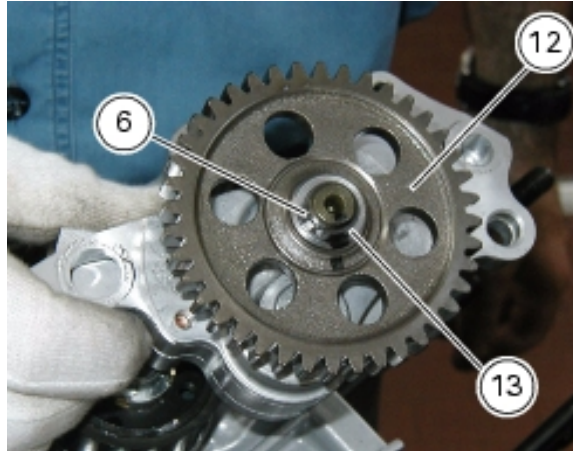


Remove the circlip (6), withdraw the bush (13) and remove the snap ring (3).  
Remove the pump control gear (12).

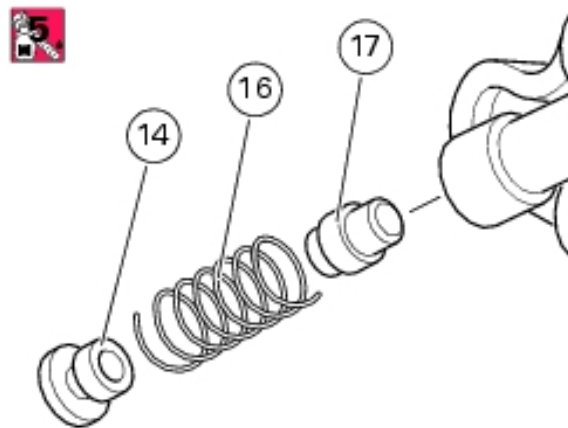


## Reassembling the oil pump gear

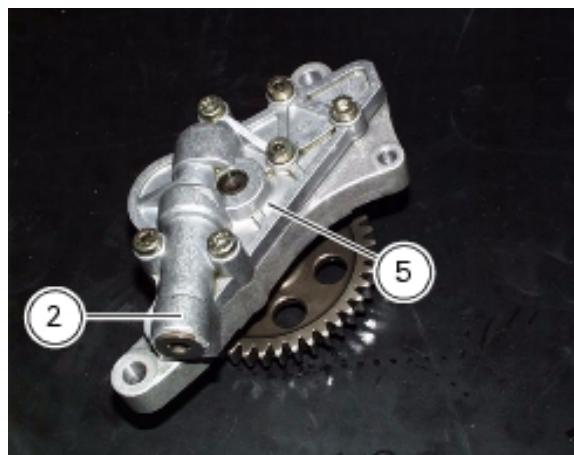
Insert pump driving gear (12), snap ring (3) and bushing (13) onto oil pump. Fit the circlip (6) into its seat to lock the components in place.



Insert by-pass valve (17) and spring (16) into pump then tighten plug (14) to the specified torque (Sect. C 3, [Engine torque settings](#)) applying a medium-strength threadlocker.

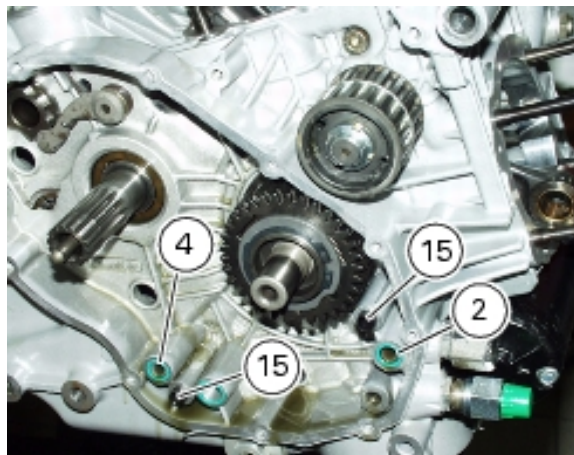


Fit pump cover (2) to pump body (5) complete with gears.

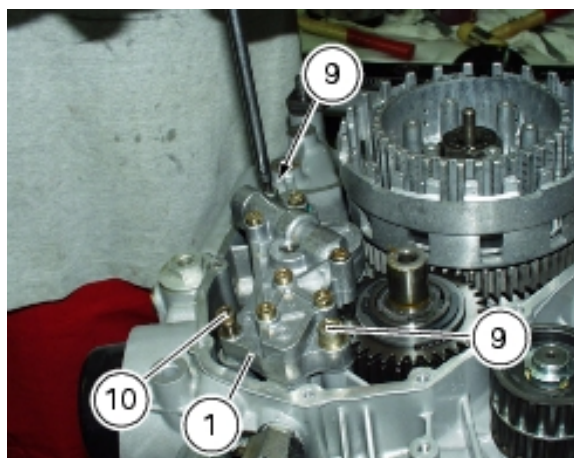


## Refitting the oil pump

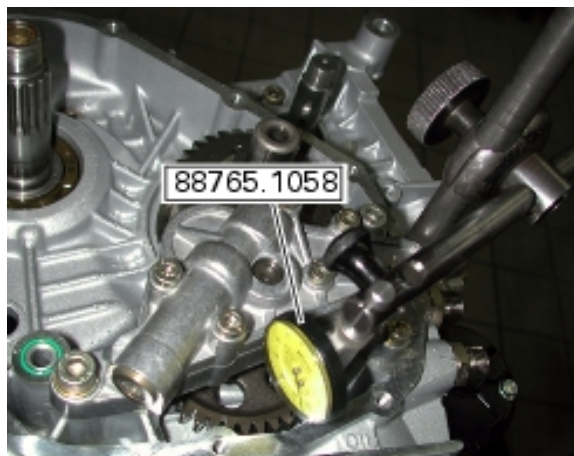
Place the centring bushes (15) and the oil O-rings (2) and (4) at the oil ducts in the casing.



Place the oil pump on the casing and tighten the screws (9) and (10) to the specified torque (Sect. C 3, [Engine torque settings](#)).



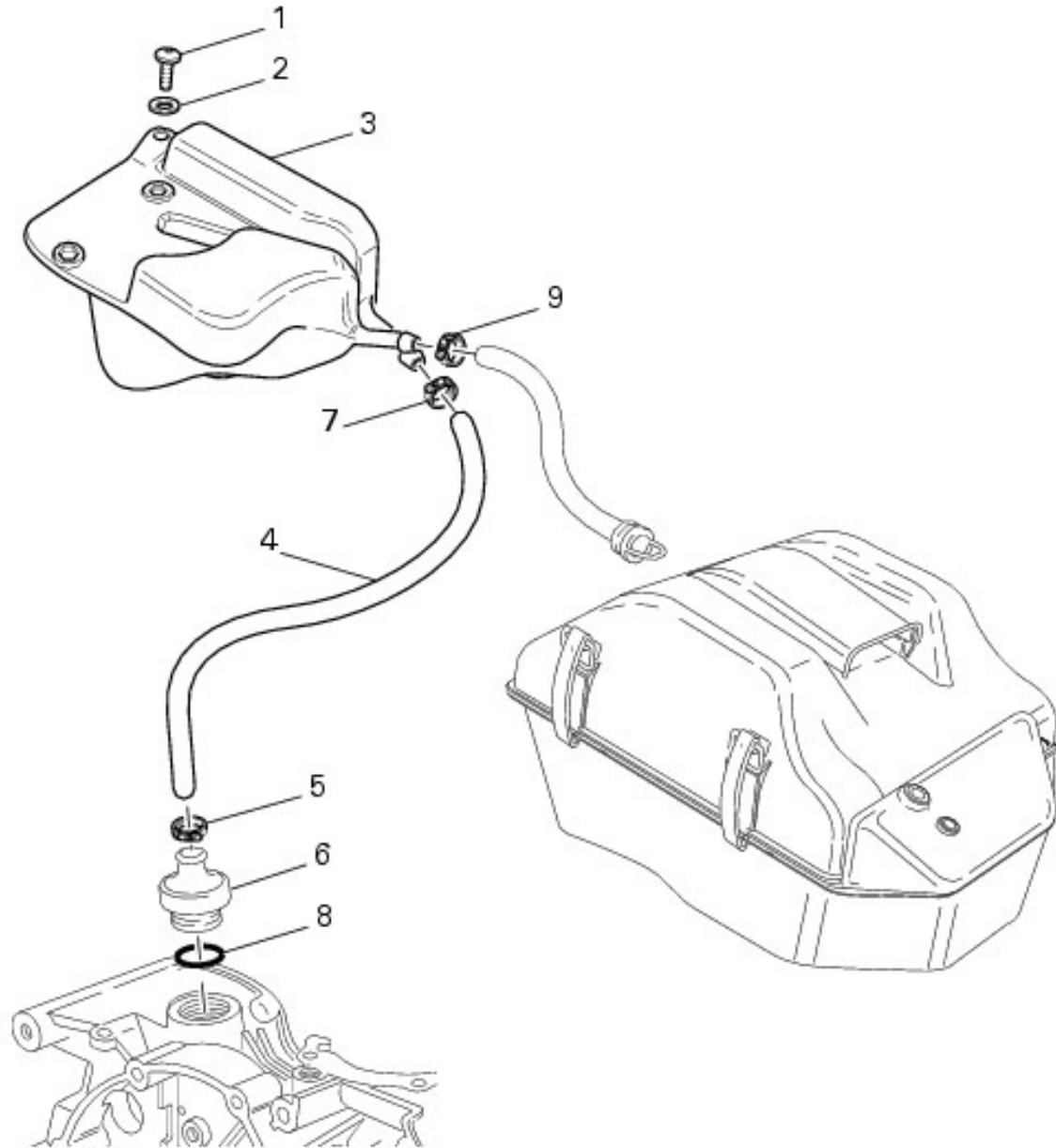
Secure dial gauge part no. **88765.1058** provided with a special pointer on the casing to check the meshing clearance with the crankshaft sprocket.




Bring dial gauge pointer in contact with one of the oil pump gear teeth and set the instrument to zero on this position. Slightly move the gear to measure the clearance. Take four readings in diametrically opposite positions of the gear. Clearance must be **0.10** mm.

Operations	Reference See Section
Refit the clutch cover	N 6.2, <a href="#">Refitting the clutch cover</a>

## 2.3 - Lubrication system: oil breather reservoir



- 1 Screw
- 2 Washer
- 3 Oil breather tank
- 4 Hose
- 5 Clamp
- 6 Oil breather valve
- 7 Clamp
- 8 O-ring
- 9 Clamp

 Spare parts catalogue

[Air inductio and oil vent](#)

 Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear

in the figures near the text.

## Removing the oil breather tank

Operations	Reference See Section
Remove the seat	E 3, <a href="#">Removing the seat</a>
Remove the fuel tank	L 2, <a href="#">Removing the fuel tank</a>

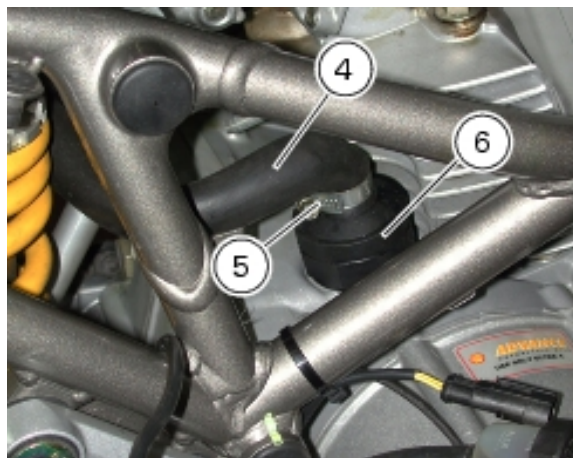
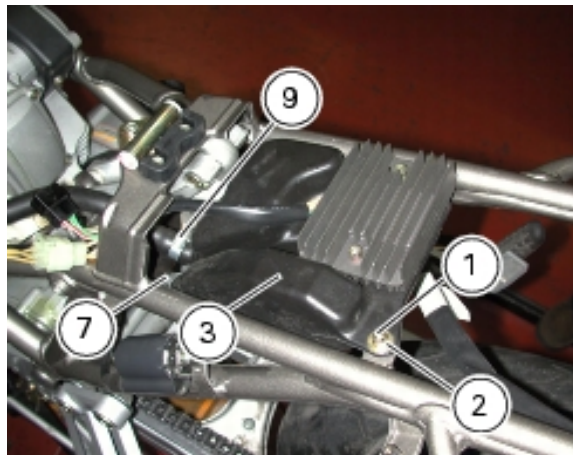
Loosen the clip (7) of the connection hose to the airbox and disconnect hose.

Loose the clip (9) of the connection hose (4) to the oil breather valve (6) and disconnect hose from the oil filter valve.

Loosen the clip (5) of the connection hose to the oil breather valve and disconnect hose (4).

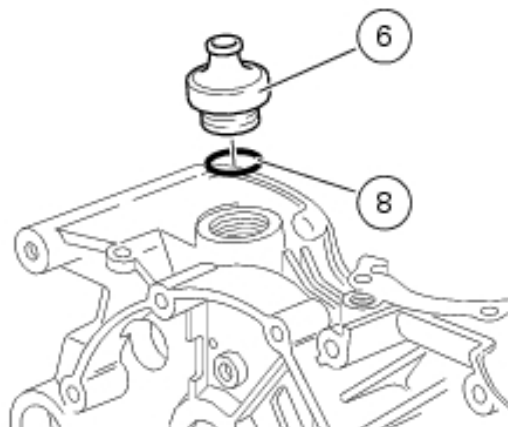
Unscrew the retaining screw (1) of the oil breather valve tank (3) and collect the washer (2).

The oil breather valve tank (3) can now be removed.



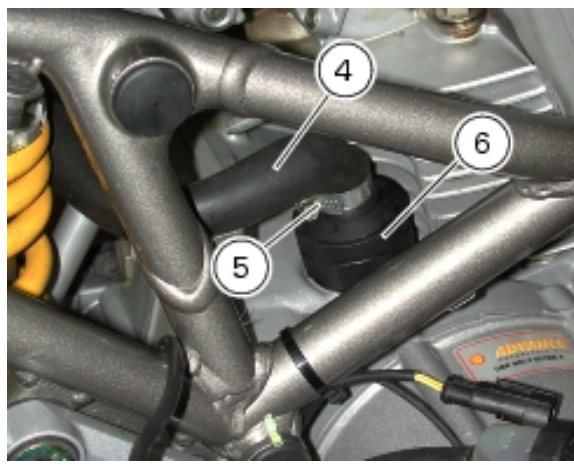
Release and remove the oil breather valve (6) from the engine.

Check the O-ring (8) and replace as required.



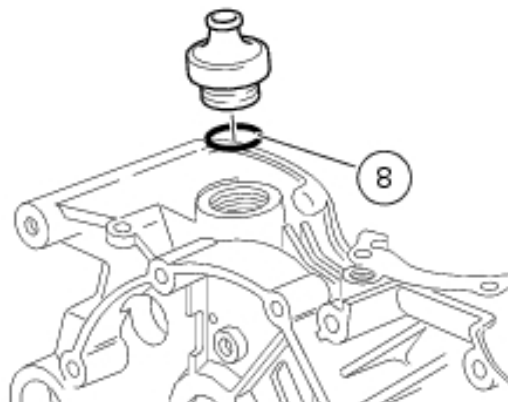
### Refitting the oil breather tank

In particular, in case hose (4) is changed, we recommend you to secure it to oil breather reservoir (3) by tightening clamp (7) to the specified torque (Sect. C 3, [Frame torque settings](#)), and then to secure it to breather valve (6) tightening clamp (5) to the specified torque (Sect. C 3, [Frame torque settings](#)). Installation is a reversal of the removal procedure.



### Note

On refitting, grease the O-ring (8) with the specified grease.

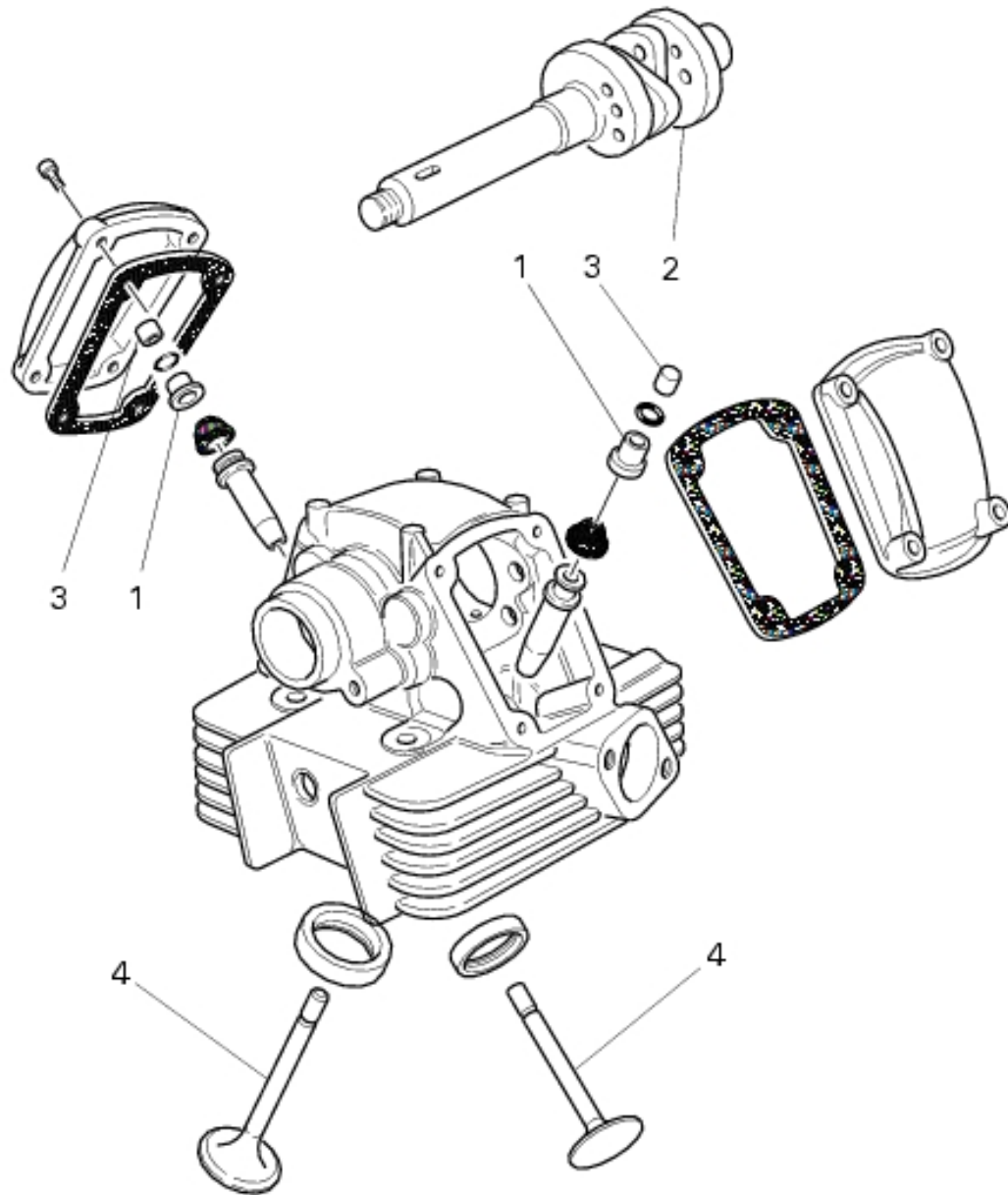


Note


During removal and installation, keep the hose clips orientated as originally fitted.

Operations	Reference See Section
Refit the fuel tank	L 2, <a href="#">Refitting the plastic fuel tank</a>
Refit the seat	E 3, <a href="#">Refitting the seat</a>

## 4.1 - Head unit: checks and adjustments



- 1 Closing shim
- 2 Camshaft
- 3 Opening shim
- 4 Valve

 Spare parts catalogue

[Head : timing](#)

[Vertical head](#)

[Horizontal head](#)

 Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

## Checking and adjusting valve clearance

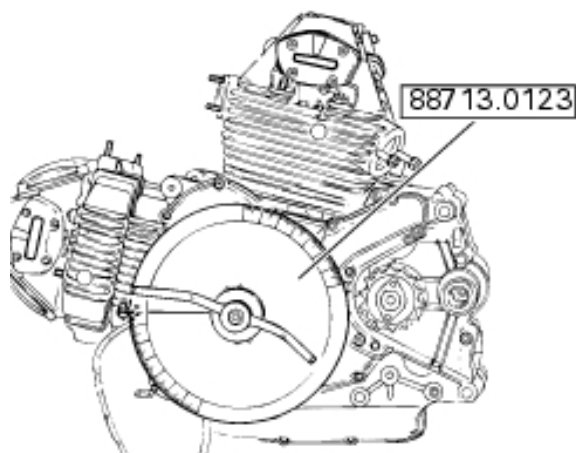
Operations	Reference See Section
Remove valve covers	N 4.3, <a href="#">Removing the valve covers</a>
Remove timing belt covers	N 4.2, <a href="#">Removing the timing side covers</a>



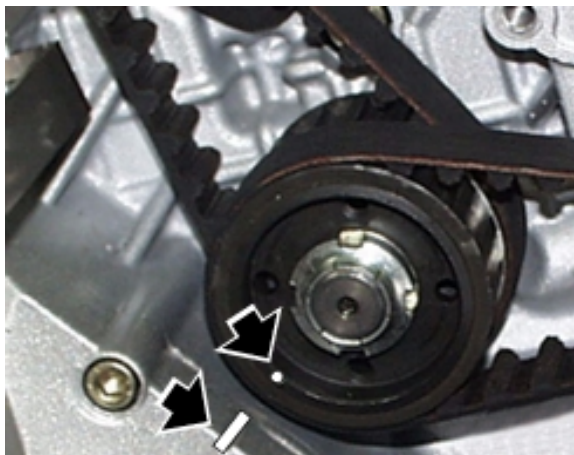
### Note

For reasons of clarity, the figures show an engine block removed from the frame.

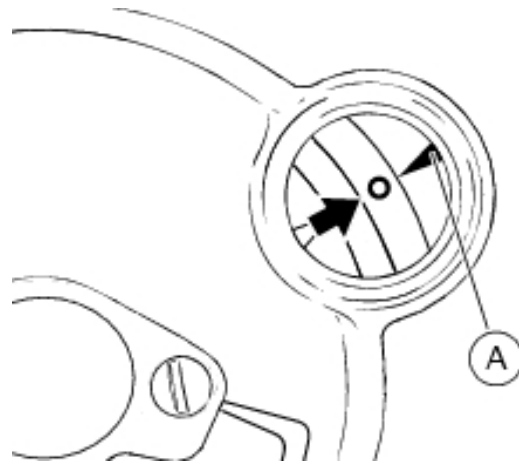
Take off the inspection cover on generator side and install tool part no. **88713.0123**.



Turn the crankshaft until lining up the transmission pulley mark with the clutch cover mark.



Look through the inspection window in the generator cover. The flywheel mark and the cover mark (A) of both cylinders should be aligned.



Reset the degree wheel of tool part no. **88713.0123**: the horizontal piston is at TDC in the combustion stroke and therefore you can proceed with checking valve clearance on this cylinder head.

To measure valve clearance in the vertical cylinder, rotate the crankshaft counterclockwise through 270°. This will bring the vertical piston at TDC during the combustion stroke that is the correct position for checking valve clearance on this cylinder head.

Checking opening clearance (Sa) at intake/exhaust

To check opening clearance (Sa), slide a feeler gauge between opening rocker arm (B) and shim (3). Measured clearance must be within the specified limits (Sect C1.1, [Timing/valves](#)).

If the clearance measured is outside the specified limits, remove the opening shim (3) as described under paragraph [Removing the valves](#) in Section N 4.4, and replace it with a suitable one to reach the recommended assembly clearance.



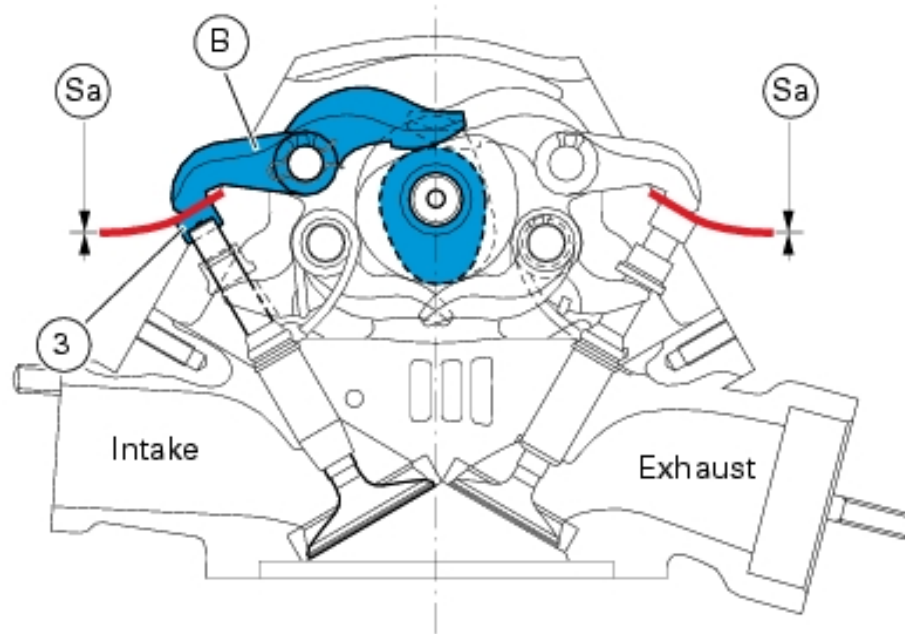
Note

When performing this check and inserting the feeler gauge, pay attention to overcome rocker arm closing spring force to take up rocker arm operating play: for this purpose, ensure that shim can rotate freely.



Note

Spare opening shims are available in 1.8 - 3.45 size: the size is punched on the shim.



#### Checking closing clearance (Sc) at exhaust/intake

When checking closing clearance, use a screwdriver to overcome the preload of closing rocker arm spring, thus taking up any clearance between camshaft and rocker arm. Fit the feeler gauge between closing rocker arm (D) and shim (1): closing clearance (Sc) corresponds to gauge thickness when it allows the shim to freely turn, with no remarkable play.

Clearance must be within the specified limits (Sect. C 1.1, [Timing/valves](#)).

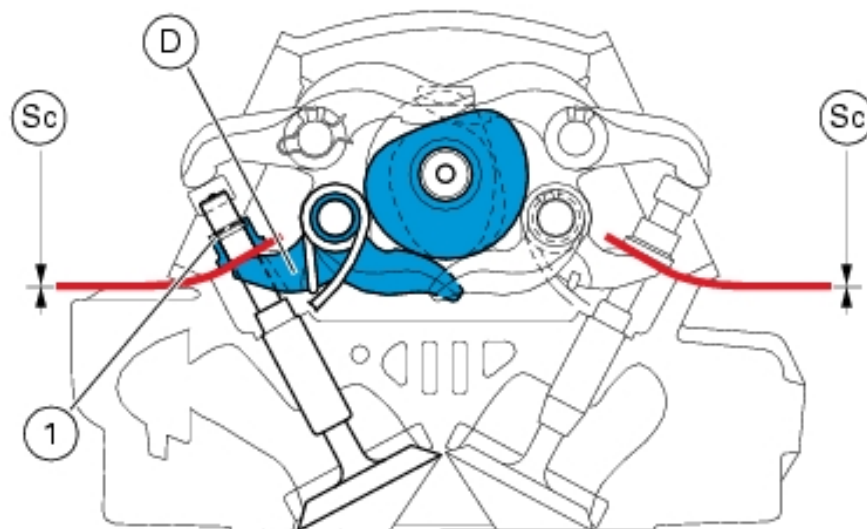
If not so, remove the closing shim (1) as described in paragraph "[Removing the valves](#)", Sect. N 4.4, and fit a shim of the adequate size to obtain specified assembly clearance.



#### Note

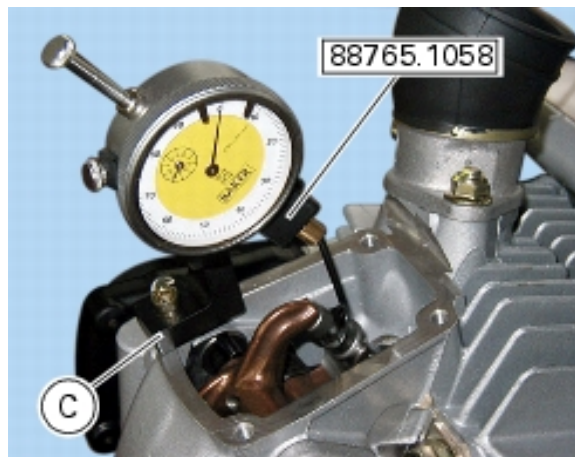
Spare closing shims are available in 2.2 - 3.1 size: the size is punched on the shim.

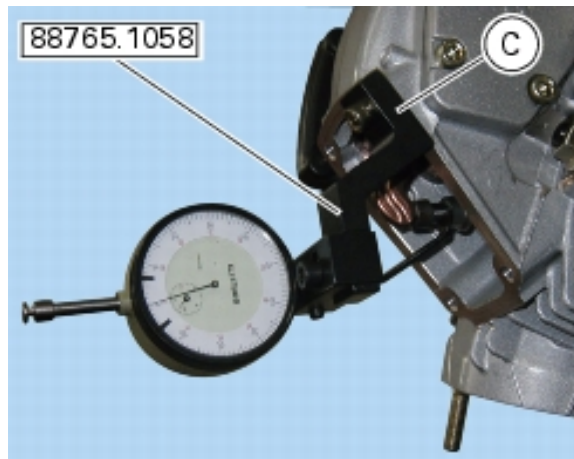
Refit the opening and closing shims as described in paragraph "[Refitting the valves](#)" Sect. N 4.4.



#### Checking valve lift

Fit dial gauge (C) part no. **88765.1058** into the hole of the head cover, as shown. With the camshaft at rest position, take up valve opening clearance fitting a suitably sized feeler gauge between upper rocker arm and opening shim.





**Note**

This operation is best done using one dial gauge for the exhaust valve and another one for the intake valve.



Make sure the dial gauge fork is centered with valve axis and contacts the closing shim collar.  
 Set dial gauge to zero when the valve is fully closed.  
 Rotate intake camshaft so as to let intake valves lift fully.  
 Check that the reading on the dial gauge corresponds to the recommended value (Sect. C 1.1, [Timing/valves](#)).  
 Repeat same procedure for the exhaust valve, positioning the dial gauge mount to the opposite side of the head.  
 Refit all parts according to the procedure described under previous paragraph [Checking and adjusting valve clearance](#).  
 Remove tools part no. **88765.1058**.

Operations	Reference See Section
Refit timing belt covers	N 4.2, <a href="#">Refitting the timing side covers</a>
Refit the valve covers	N 4.3, <a href="#">Refitting the valve covers</a>

Checking engine timing

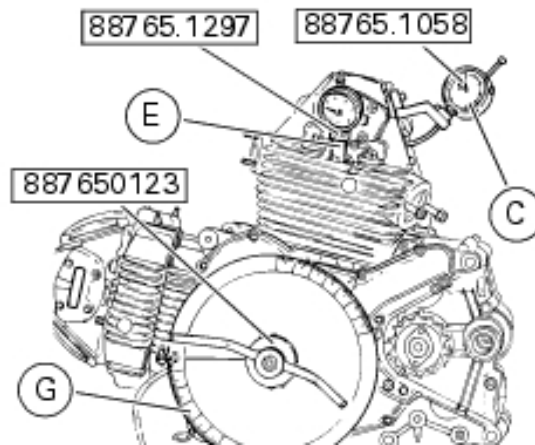
Operations	Reference See Section
Remove side timing covers	N 4.2, <a href="#">Removing the timing side covers</a>
Remove valve covers	N 4.3, <a href="#">Removing the valve covers</a>



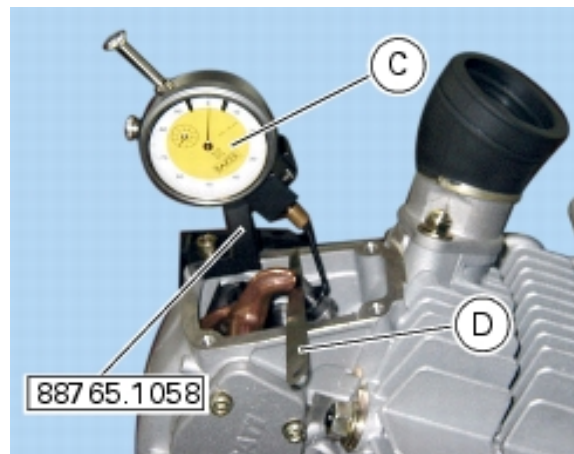
## Note

Engine timing should be checked after replacing such component parts as camshafts, valves or timing belt rollers or when overhauling badly worn engines.

Remove the spark plugs and fit tool (E) part no. **88765.1297** in the spark plug hole and determine piston top dead center with gauges (C) part no. **88765.1058** and timing gauge (hub part no. **88713.0123** and degree wheel (G) part no. **98112.0002**).



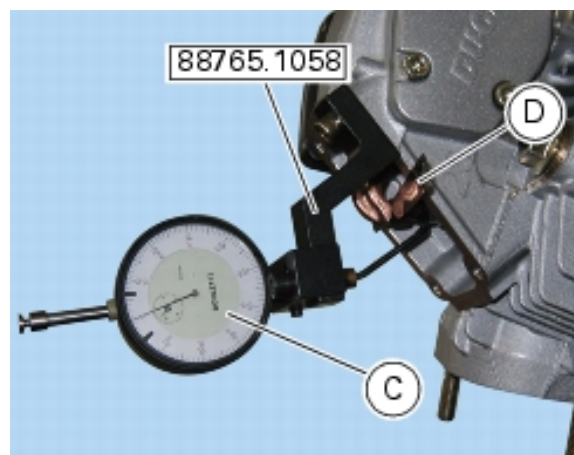
With the camshaft at rest position, take up valve opening clearance fitting a suitably sized feeler gauge (D) between opening rocker arm and opening shim. Check that camshaft can rotate. If it runs hard, use a smaller feeler gauge.



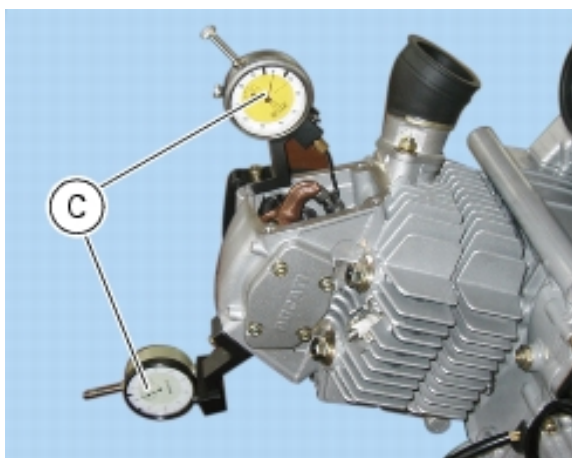
In this condition, the piston of the horizontal cylinder is at TDC with the valves fully closed - verify looking at gauge (E). Set dial gauges (C) to zero.

Tension belts to:

- Horizontal belt **145** Hz;
- Vertical belt **160** Hz.



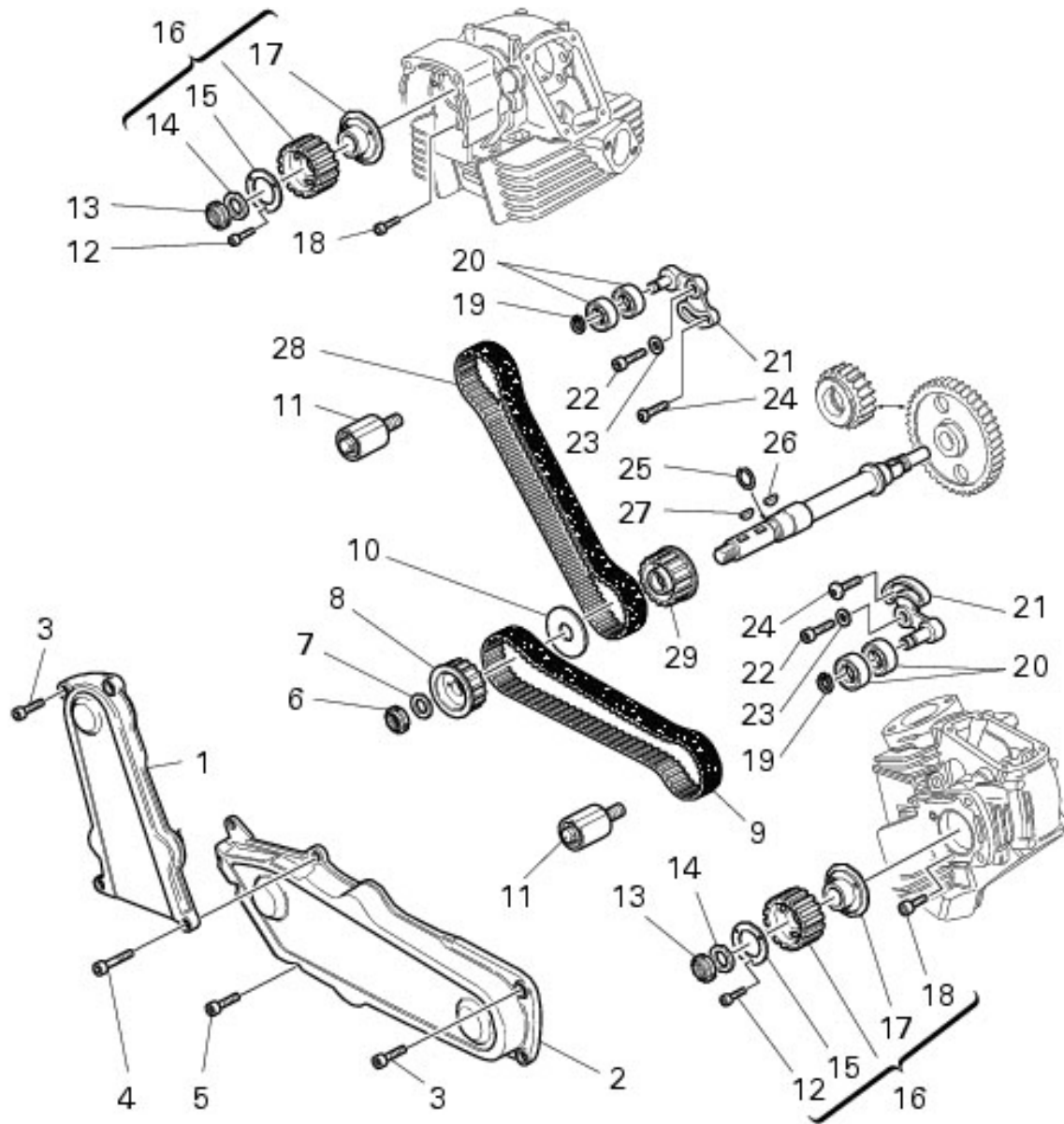
Turn degree wheel (G) counter clockwise until dial gauge (C) placed at the exhaust end reads **1 mm** lift. Check that angle reading in degrees on the degree wheel (G) is as specified (Sect. C 1.1, [Timing/valves](#)).



Rotate in the same direction until obtaining **1 mm** lift on the intake end. Check degrees on degree wheel.  
 Rotate again until valve is fully closed during the combustion stroke.  
 Reverse rotation (i.e., turn clockwise) of degree wheel (G) until gauge (C) points **1 mm** lift of intake valve. Check degrees again.  
 Rotate clockwise again until obtaining **1 mm** lift of the exhaust valve.  
 Check degrees again.  
 Repeat procedure for vertical cylinder.  
 Allowed tolerance for measured values is  $\pm 3^\circ$  with respect to specified values.  
 Remove the tools used to check engine timing.


Operations	Reference See Section
Refit the valve covers	N 4.3, <a href="#">Refitting the valve covers</a>
Refit side timing covers	N 4.2, <a href="#">Refitting the timing side covers</a>

## 4.2 - Cylinder heads: side covers / timing system



- 1 Vertical timing belt cover
- 2 Horizontal timing belt cover
- 3 Screw
- 4 Screw
- 5 Screw
- 6 Elastic-stop ring nut
- 7 Washer
- 8 Outer timing belt roller
- 9 Horizontal cylinder toothed belt
- 10 Middle washer
- 11 Fixed tensioner assembly
- 12 Screw
- 13 Elastic-stop ring nut
- 14 Washer
- 15 Special washer
- 16 Timing belt roller
- 17 Flange
- 18 Screw

- 19 Circlip
- 20 Bearing
- 21 Complete tensioner
- 22 Screw
- 23 Washer
- 24 Screw
- 25 Circlip
- 26 Key
- 27 Key
- 28 Vertical cylinder toothed belt
- 29 Inner timing belt roller

 Spare parts catalogue

[Timing](#)

[Head : timing](#)



### Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Removing the timing side covers

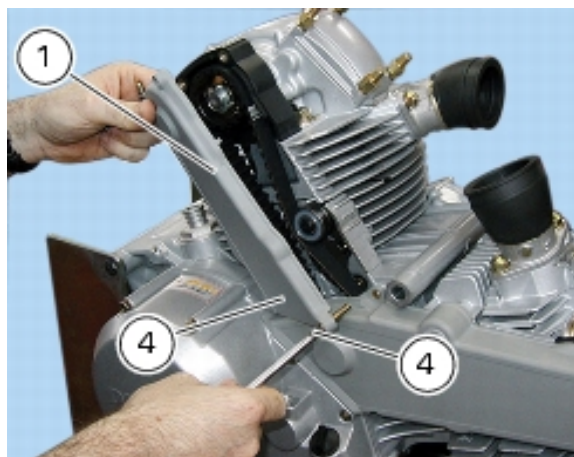
Operations	Reference See Section
Lift the tank	L 2, <a href="#">Removing the fuel tank</a>



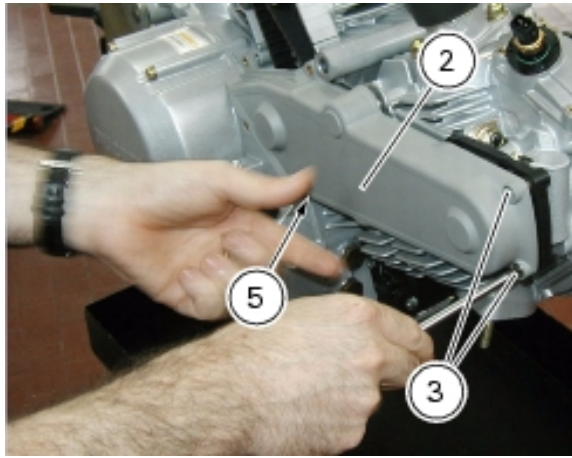
### Note

For reasons of clarity, the figures show an engine block removed from the frame.

Unscrew the screw (3) and the screws (4) and take off the outer cover (1) of the vertical timing belt.

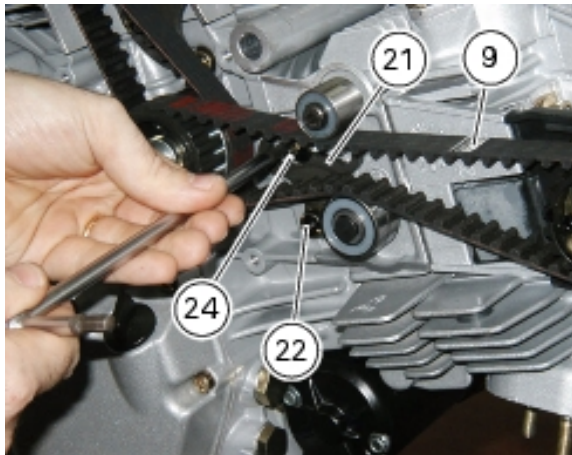


Unscrew the screw (5) and the screws (3) retaining the outer cover (2) of the horizontal timing belt.



### Disassembling the timing system

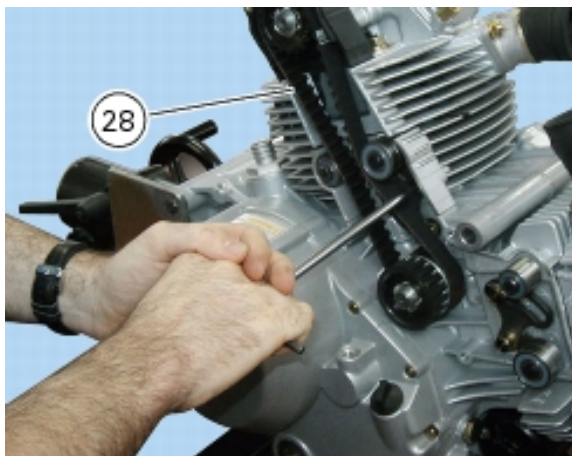
Loosen the locating screw (24) of the tensioner (21) of the horizontal cylinder timing belt.  
Loosen screw (22) securing the horizontal cylinder tensioner, collect washer (23) and move tensioner (21) to its rest position.



Remove the horizontal cylinder timing belt (9).



Repeat the sequence for the timing belt (28) of the vertical cylinder.



To remove belt rollers from cylinder head, install tool part no. **88713.2107** to the belt roller to lock rotation, as shown. Fit the bush of tool part no. **88700.5644** to a torque wrench and slacken the belt roller ring nut (13).

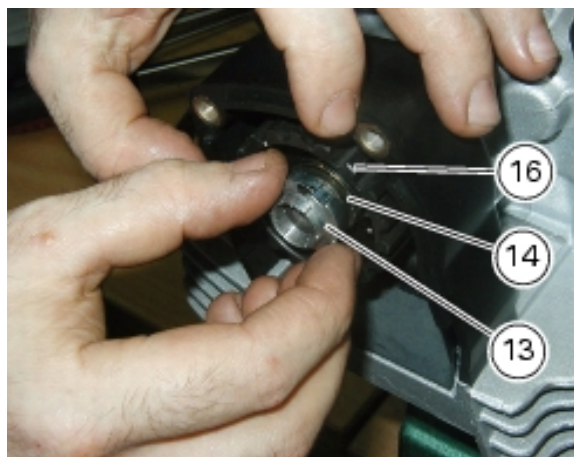


Remove ring nut (13), washer (14) and belt roller (16).

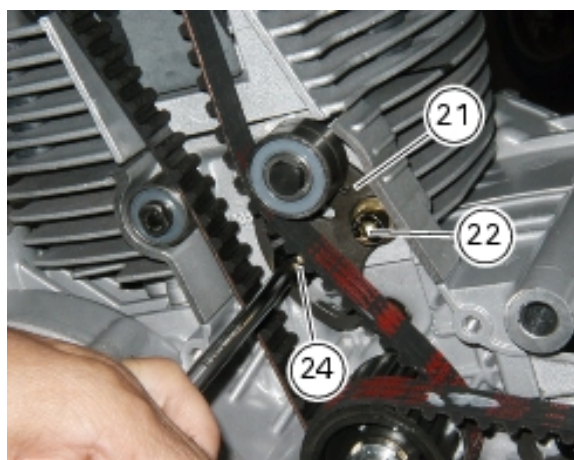


**Caution**

At reassembly, always use new ring nuts.



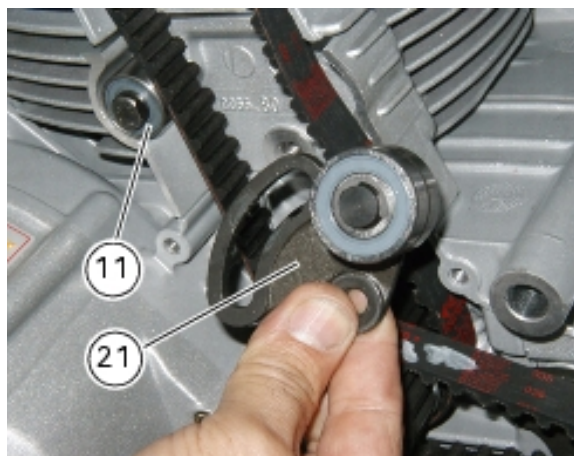
Remove the locating screws (24) and the retaining screws (22) of the timing belt tensioners (21) and washer (23). Remove both tensioners (21).



Note

The belt tensioners may also be removed leaving the belts in place.

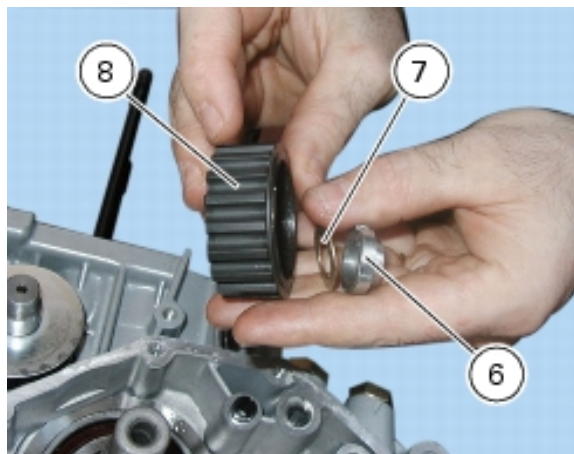
Unscrew and remove the fixed tensioners (11).



Use the spanner of tool part no. **88700.5644** to lock rotation of the drive belt roller installed to the casing. Use the bush supplied with the tool to loosen the locking ring nut (6).



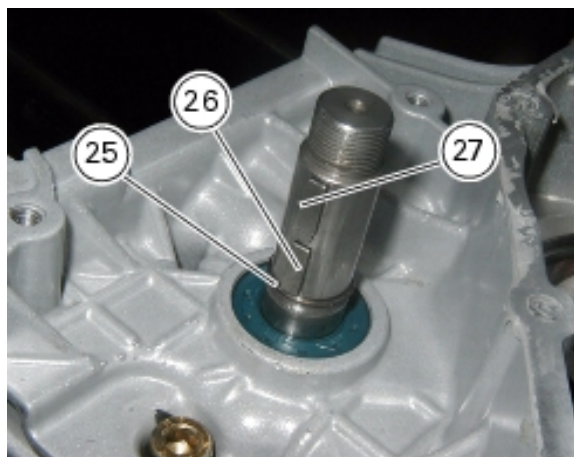
Remove ring nut (6), washer (7) and outer belt roller (8).



Remove the first key (27) on the timing layshaft.  
Remove middle washer (10) and inner belt roller (29).



After having removed the inner belt roller (29), remove the second key (26) on the timing layshaft.  
Remove the circlip (25).

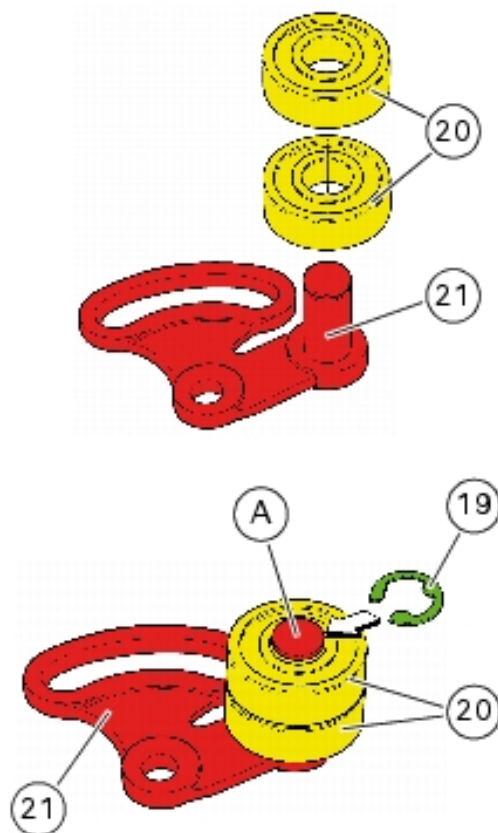


#### Disassembling the mobile tensioner

Remove the circlip (19) to release the bearings (20).

Check that the tensioner bearings rotate freely without exceeding play.

Install bearings (20) into plate (21), take them fully home. Install the snap ring (19) in its seat (A) on pin (21).

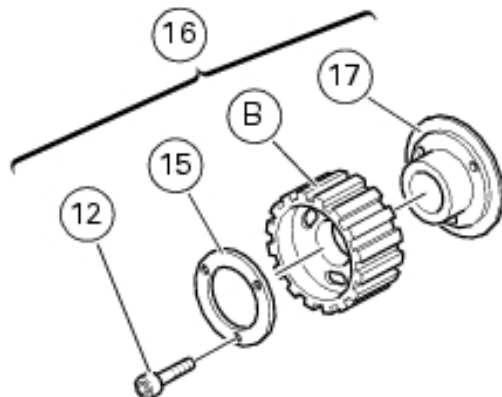


#### Disassembling the belt rollers

Loosen and remove the three screws (12).

Slide out washer (15).

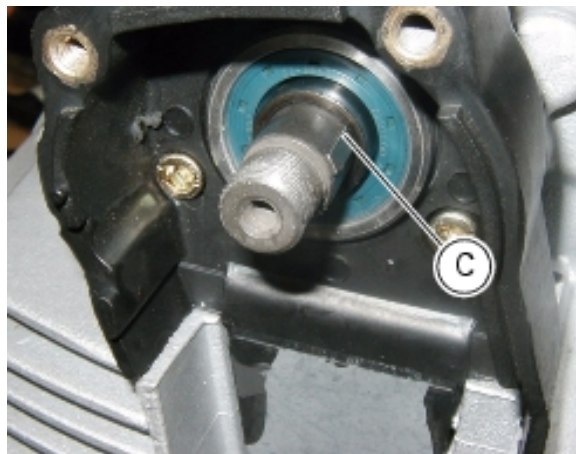
Pull belt roller (B) out of the flange (17).



## Reassembling the timing system

### Reassembling the timing belt rollers on camshafts

Ensure that keyway on camshaft end is in good condition and with no burrs.  
Install a key (C) into camshaft keyway, if previously removed.



Assemble the components fitting belt roller (B) and washer (15) on flange (17) as shown, use reference marks to ensure correct positioning.



### Caution

On refitting, make sure to line up the mark "D" of spacer flange and mark "A" on belt roller and washer.

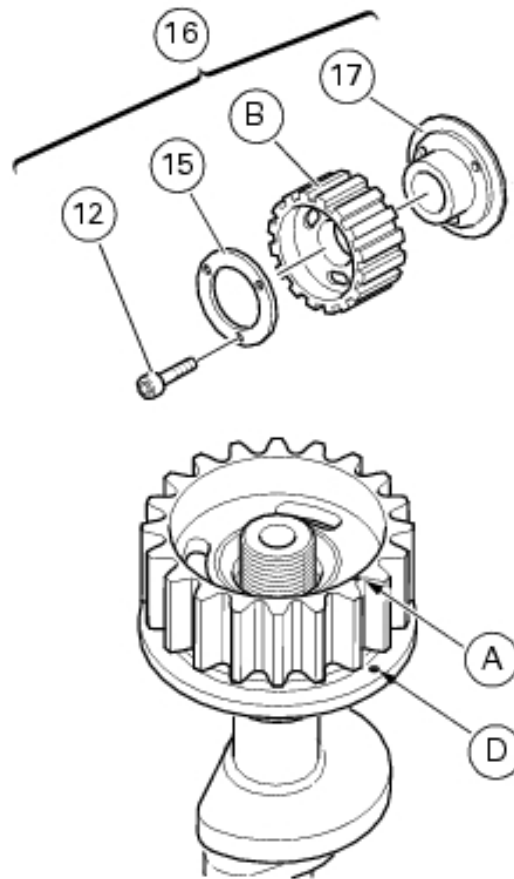
Tighten the three screws (12) onto flange.

Fit the belt roller assembly (16) on the camshaft, driving it fully home.



### Warning

Ensure that the key does not slip out of its seat.



Use tool part no. **88713.2107** to prevent belt roller rotation.



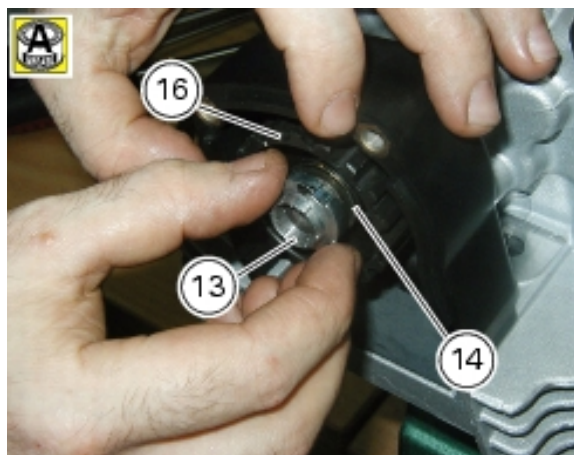
Smear a film of recommended grease on ring nut (13) thread and underside, then fit washer (14) and ring nut.



**Caution**

At reassembly, always use new ring nuts.

Fit the bush of tool part no. **88700.5644** to a torque wrench and tighten ring nuts (13) to the specified torque (Sect. C 3, [Engine torque settings](#)).



Reassembling timing belt rollers on layshaft

Working from the belt roller side, fit circlip (25) on the timing layshaft. For correct circlip positioning, insert a protection cap part no. **88700.5749** on the end of the timing shaft.



Fit the first key (26), the inner belt roller (29) with the projecting hub pointing outwards and the guide washer (10) on the timing layshaft.

Fit the second key (27), the outer belt roller (8) with hub projecting inward, the outer spacer (7) and locking ring nut (6).



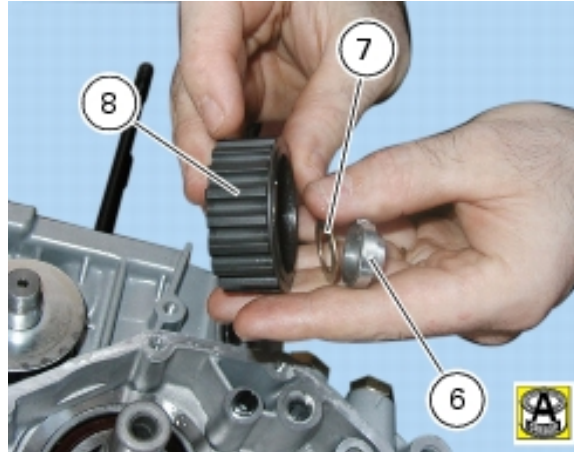
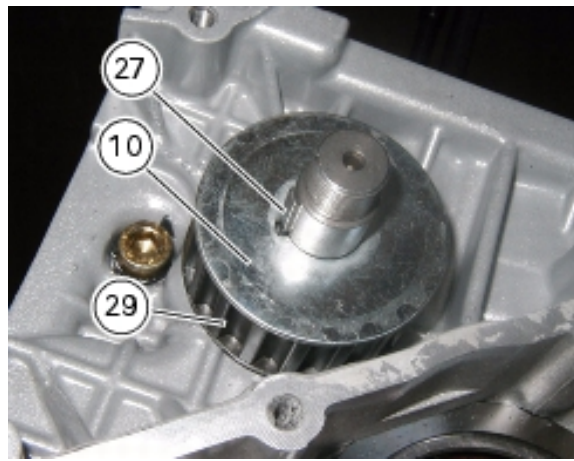
#### Caution

To prevent accidental loosening which would seriously damage the engine, use new self-locking ring nuts to secure all timing belt rollers.

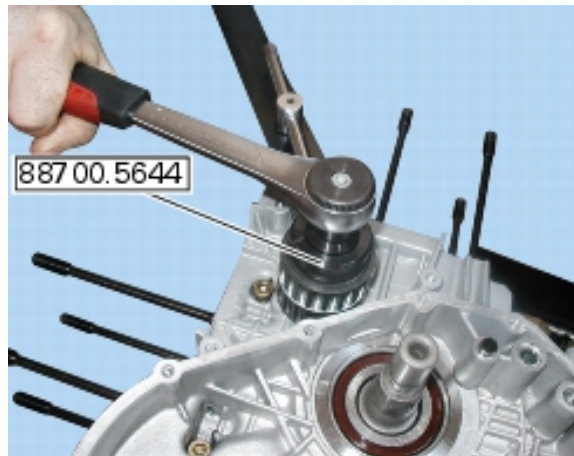


#### Note

Smear a film of recommended grease on ring nut (6) thread and underside.



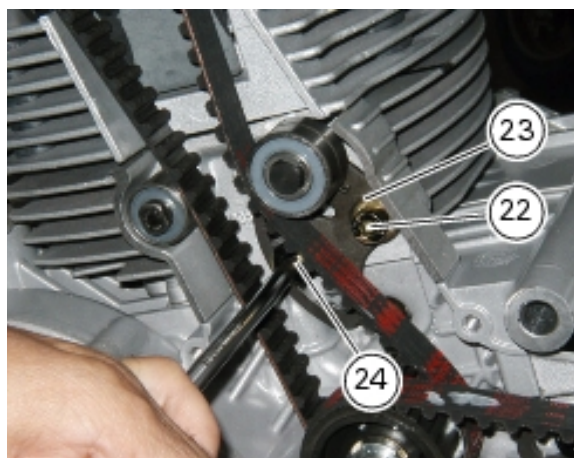
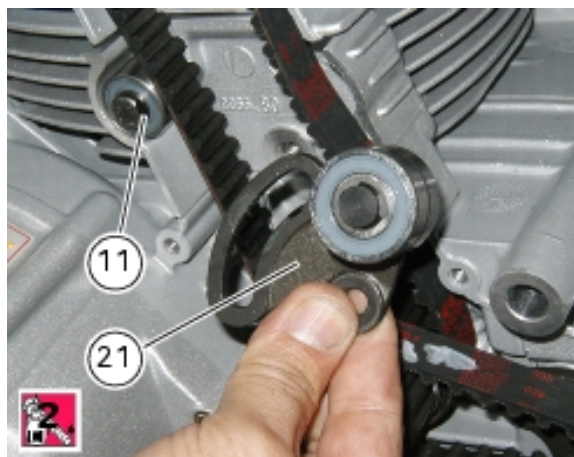
Use the spanner of service tool part no. **88700.5644** to lock belt roller rotation. Fit the bush supplied with the tool to a torque wrench and tighten the self-locking ring nut to the specified torque value (Sect. C 3, [Engine torque settings](#)).



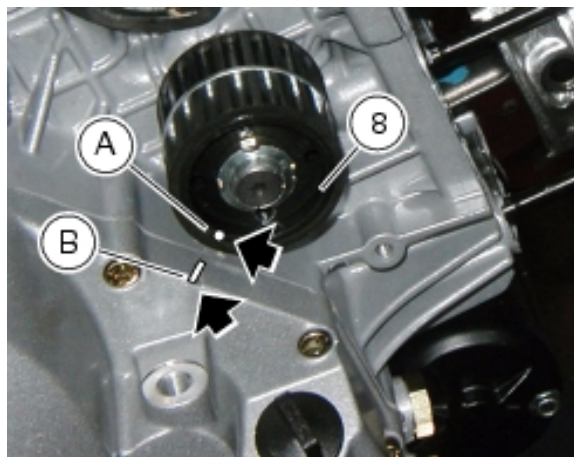
#### Reassembling the timing belt tensioners

If removed, smear a film of recommended threadlocker onto fixed tensioner (11) and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).

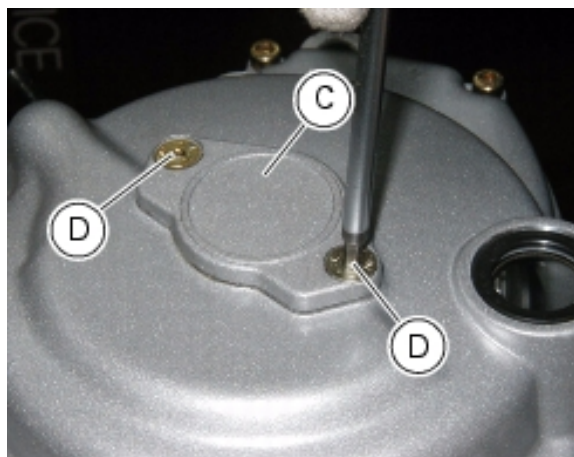
Set tensioners (21) onto vertical and horizontal cylinders. Screw in screw (22) with washer (23) and screw (24), but do not tighten yet so that tensioners can rotate.



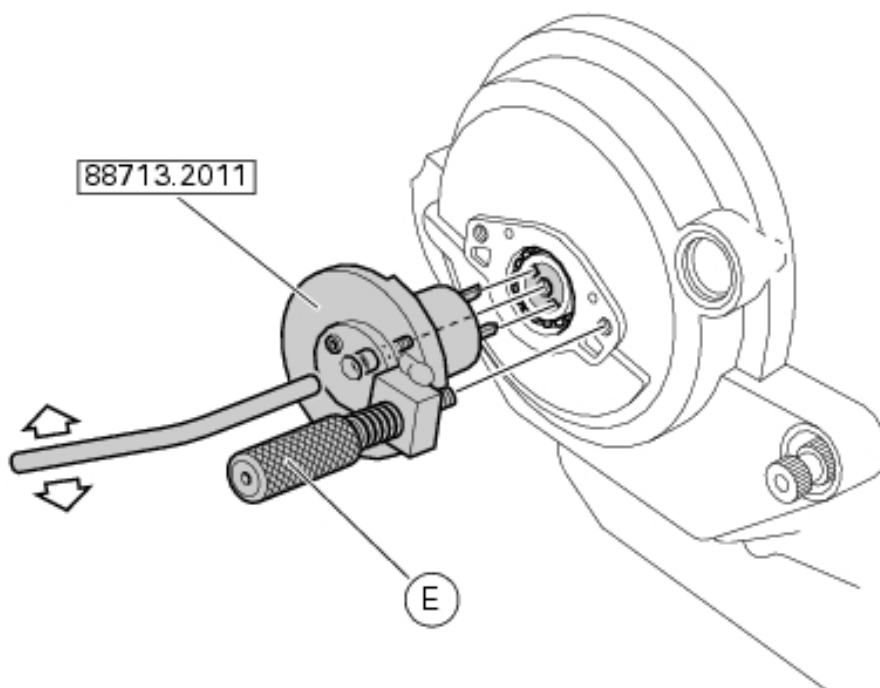
Rotate the crankshaft until bringing the piston of the horizontal cylinder at TDC during the combustion stroke. This is indicated by the mark (A) on the timing layshaft belt roller (8) aligning with the mark (B) on the clutch cover.



Unscrew the two screws (D) and remove the small cover (C) from the generator cover.

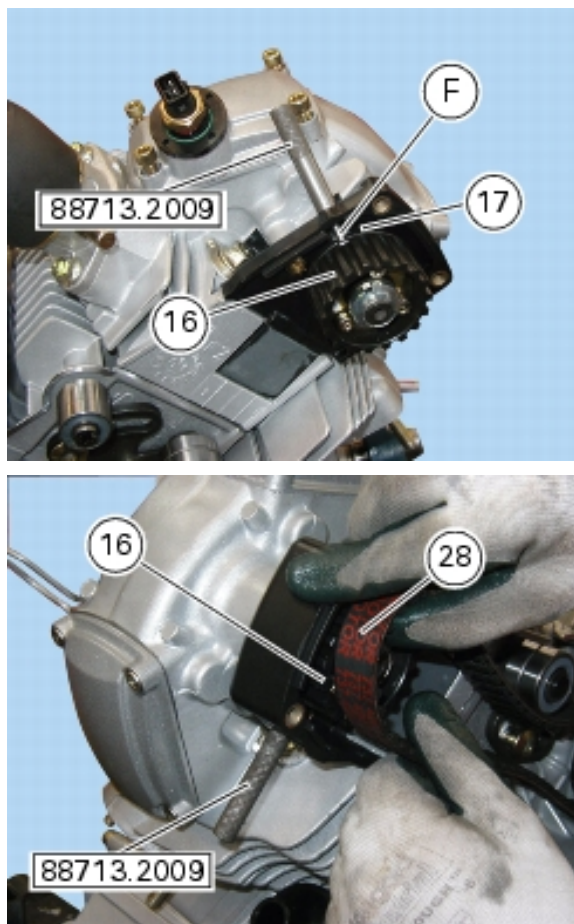


Fit the locking tool part no. **88713.2011** to the crankshaft and tighten by hand pin (E) fully home.



Tighten the two tools part no. **88713.2009** as shown in the figure to lock the flanges (17) of the horizontal and vertical belt rollers (16). Tool ends must locate into the flange slots.  
Install the horizontal (9) and vertical (28) timing belts manually. Do not use any tools and do not disturb belt rollers alignment.

Align the two timing marks (F) on belt rollers (16) with the tool ends **88713.2009**.

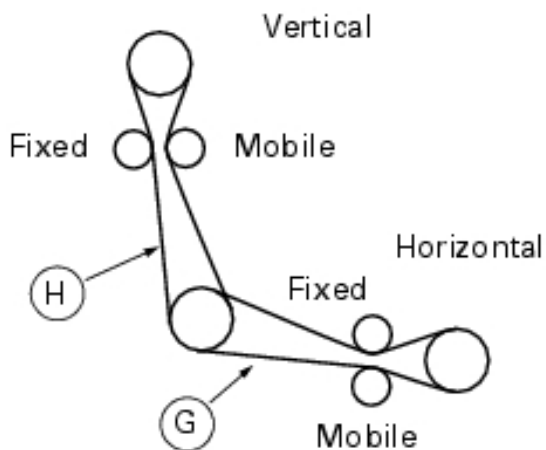


Check the tensioning and adjust, if necessary, as described in "[Checking and adjusting timing belt tension](#)" (Sect. D 5).

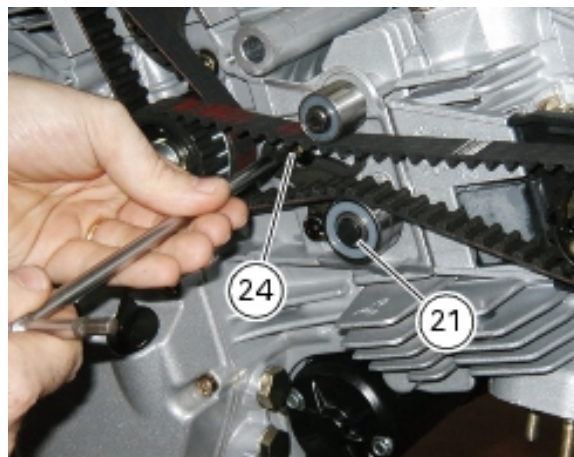
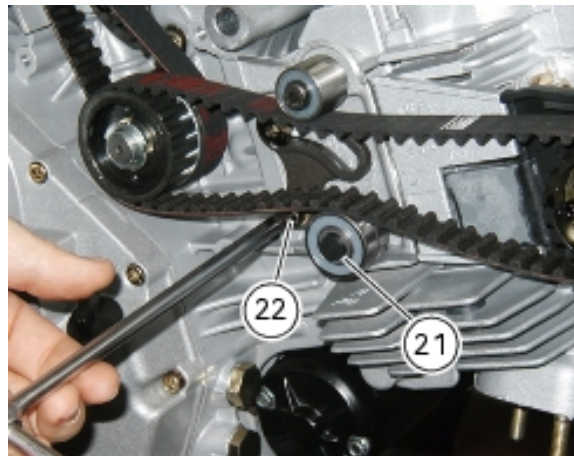
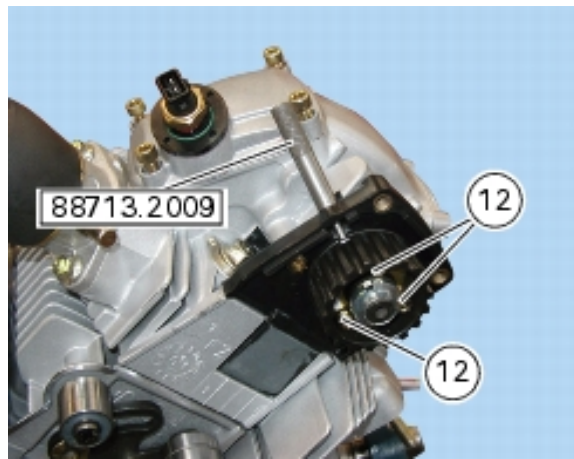


Warning

Check tension reading on the belt sections (H) and (G) indicated in the figure.



Set desired tension and ensure that screws (22), (24) and (12) are tightened to the specified torque (Sect. C 3, [Engine torque settings](#)).



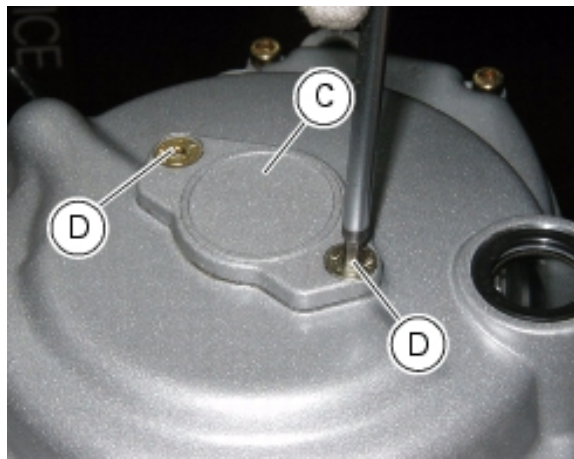
**Warning**

Every time a timing part is replaced, it is good practice to check the timing (Sect. N 4.1, [Checking engine timing](#)).

Remove the two locking tools (**88713.2009**) from belt roller flange.

Remove the tool part no. **88713.2011** you used to lock the crankshaft. Unscrew the tool bolt (E).

Refit the small cover (C) to the generator cover and start the two screws (D) in their holes.



Tighten the screws to the specified torque (Sect. C 3, [Engine torque settings](#)).



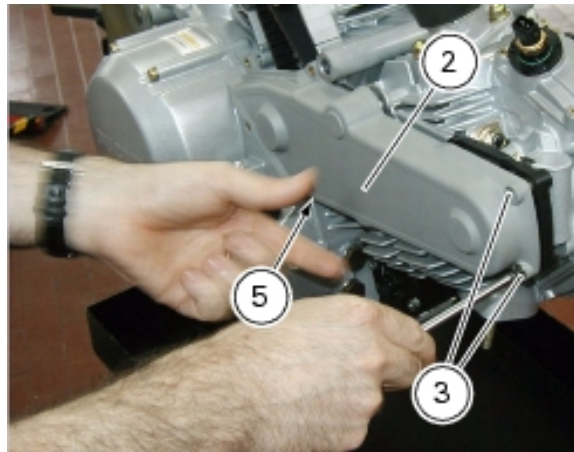
Note

Before refitting cover (C), check its O-ring for wear and replace it as necessary.

### Refitting the timing side covers

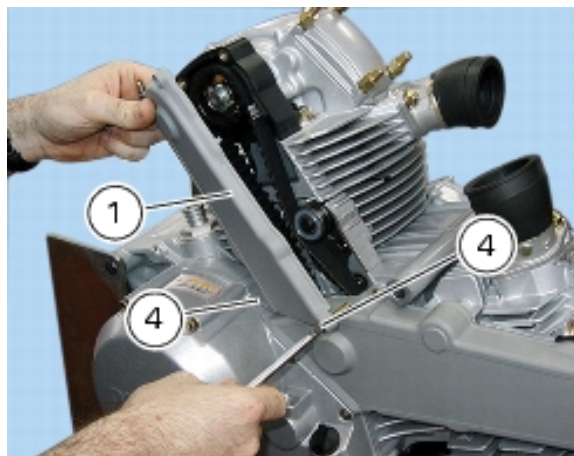
Position the cover of the horizontal timing belt (2) to the engine.

Start the screws (5) and the screws (3) in their holes in the cover and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).



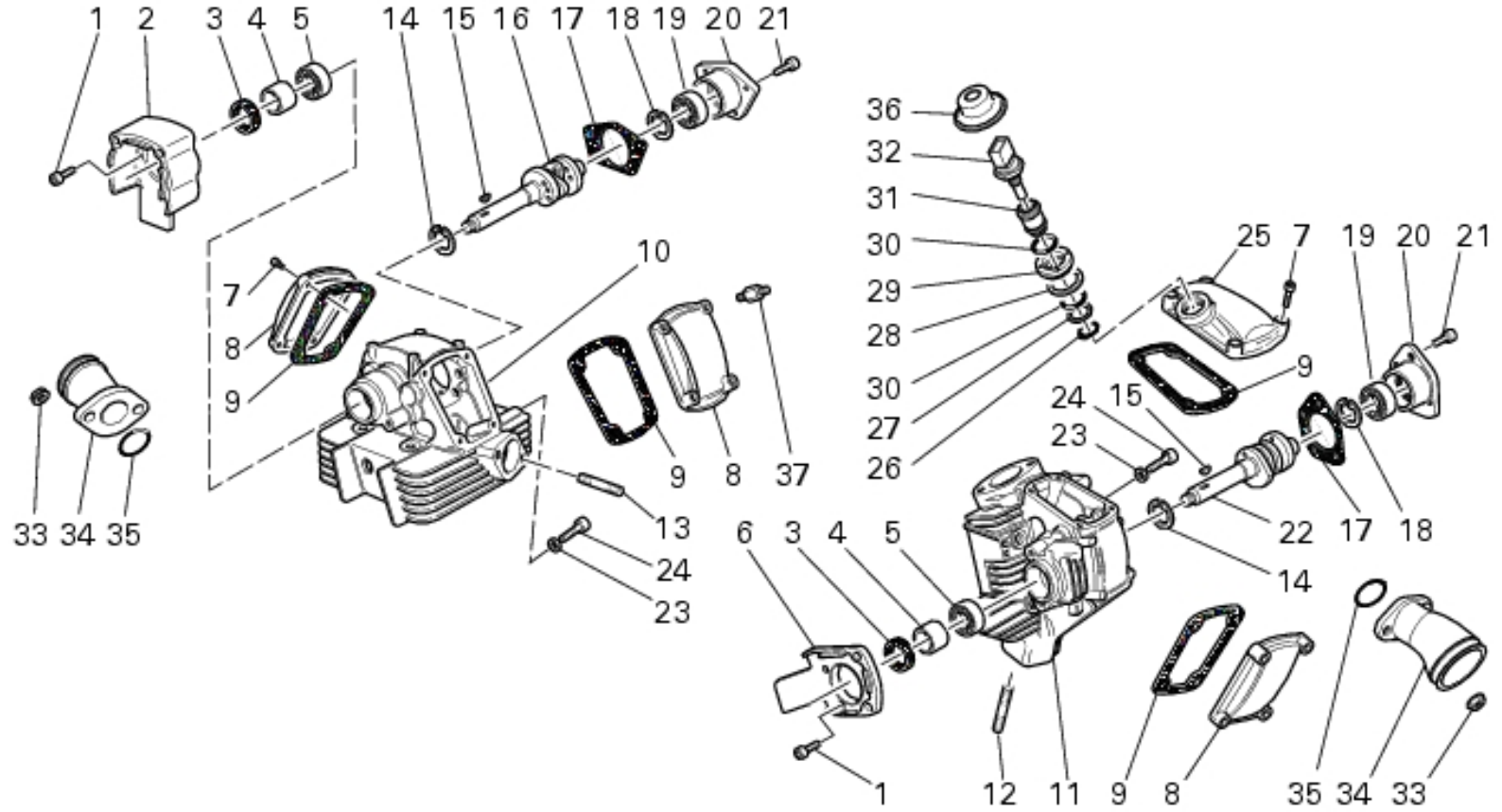
Position the vertical timing belt guard (1) onto the engine.

Start the screws (3) and the screws (4) in their holes and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).




Operations	Reference See Section
Refit the fuel tank	L 2, <a href="#">Refitting the plastic fuel tank</a>

### 4.3 - Head unit: camshafts



- 1 Screw
- 2 Vertical rubber cap
- 3 Seal
- 4 Roller spacer
- 5 Bearing
- 6 Horizontal rubber cap
- 7 Screw
- 8 Valve cover
- 9 Valve cover gasket
- 10 Vertical head
- 11 Horizontal head
- 12 Stud bolt
- 13 Stud bolt
- 14 Circlip
- 15 Key
- 16 Vertical head camshaft
- 17 Gasket
- 18 Circlip

- 19 Bearing
- 20 Cap
- 21 Screw
- 22 Horizontal head camshaft
- 23 Copper gasket
- 24 Screw
- 25 Intake valve cover
- 26 Circlip
- 27 Spacer
- 28 Aluminium gasket
- 29 Ring nut
- 30 O-ring
- 31 Sensor mount
- 32 Sensor
- 33 Nut
- 34 Intake duct
- 35 O-ring
- 36 Rubber cap
- 37 Peg

 Spare parts catalogue

[Head : timing](#)

[Vertical head](#)

[Horizontal head](#)

[Inlet dict](#)



### Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Removing the engine oil temperature sensor

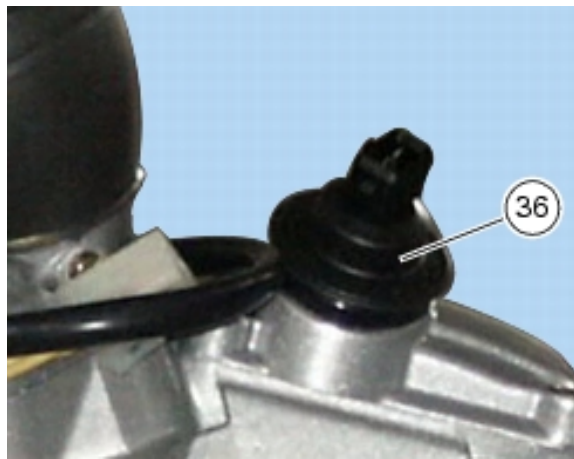
Operations	Reference See Section
Disconnect oil temperature sensor from main wiring harness	P 1, <a href="#">Arrangement of wiring on frame</a>



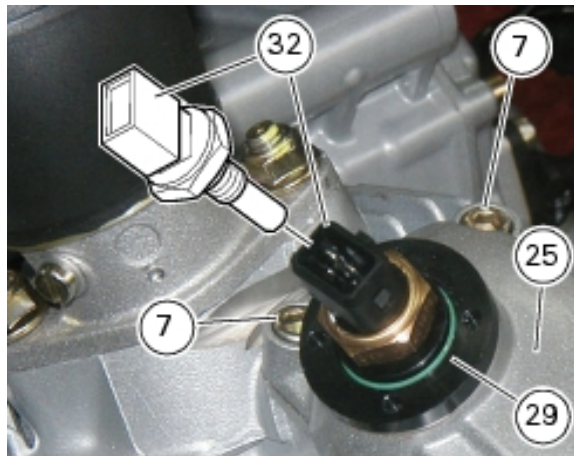
### Note

This operation can be carried out even if engine is on the frame. For precision purposes, the figures show the head removed from the engine.

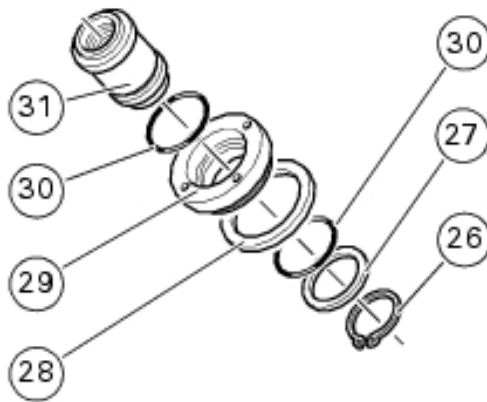
The engine oil temperature sensor (32) is placed on the intake valve cover (25) of the horizontal head (**11**). Remove the rubber cap (36) and take the sensor (32) off its mount (31).



Unscrew the ring nut (29) from the cover (25).



Remove the circlip (26) from the ring nut and withdraw the sensor mount (31).



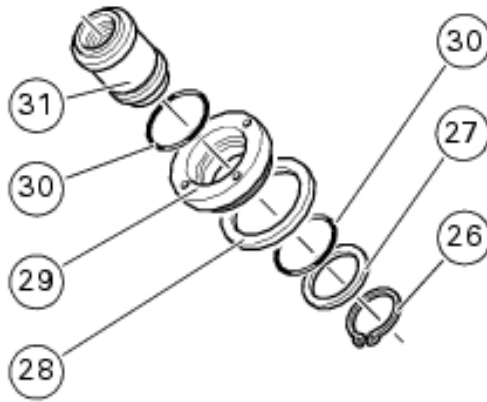
Refitting the engine oil temperature sensor

Check seal (28) and spacer (27). Replace as required.



Note

Change the O-rings (30) before refitting.



Installation is a reversal of the removal procedure.

Operations	Reference See Section
Reconnect oil temperature sensor to main wiring harness	P 1, <a href="#">Arrangement of wiring on frame</a>

### Disassembling the intake manifold

Operations	Reference See Section
Remove the throttle body	L 6, <a href="#">Removing the throttle body</a>



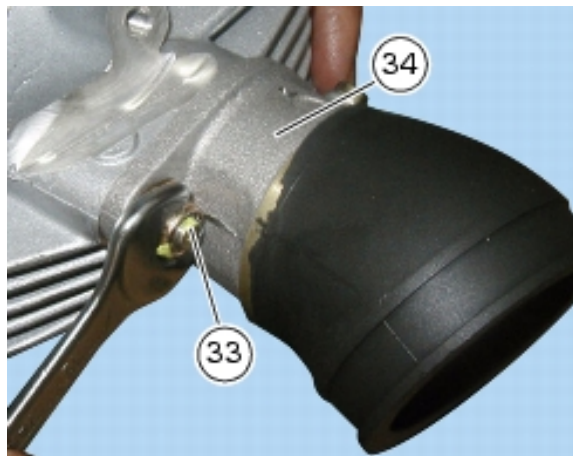
Note

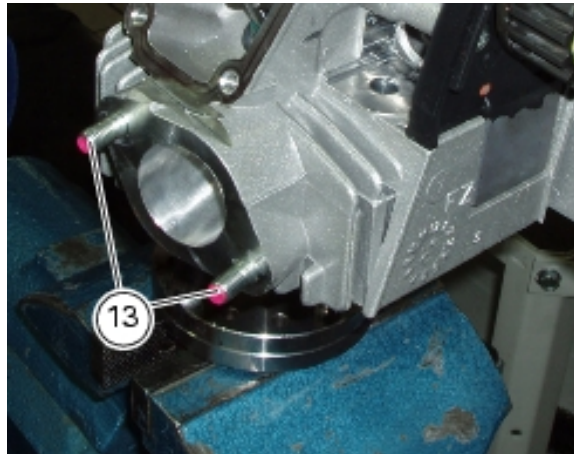
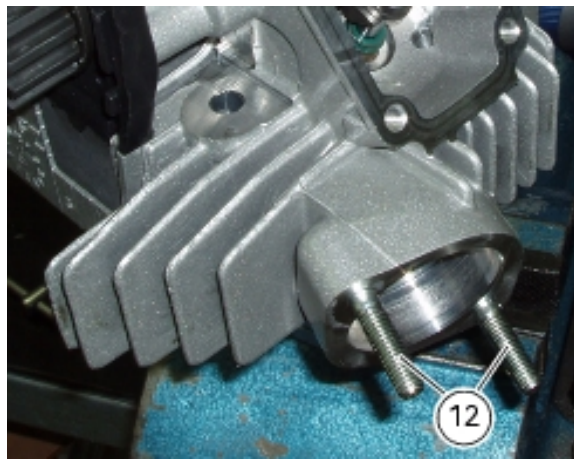
This operation can be carried out even if engine is on the frame. For precision purposes, the figures show the head removed from the engine.

Undo and remove the lock nuts (33) of the vertical and horizontal head intake manifolds from the stud bolts (12) and (13).

Remove manifolds (34) with O-ring (35).

Unscrew the stud bolts (12) and (13) from the heads, if needed.



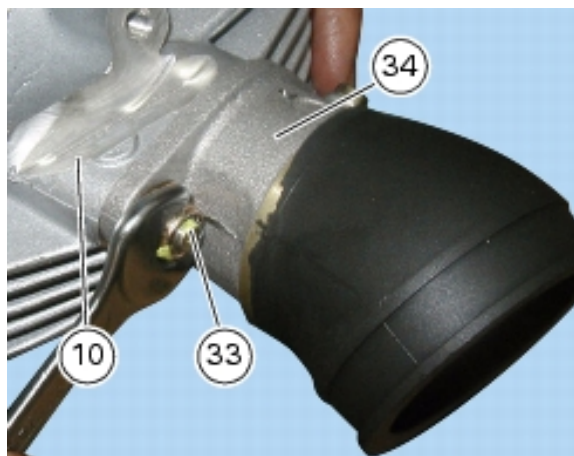


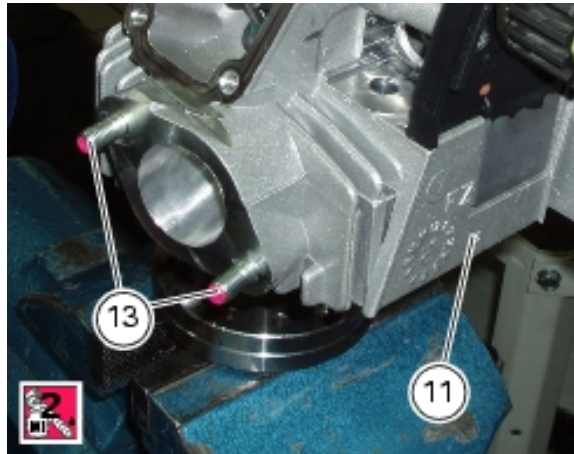
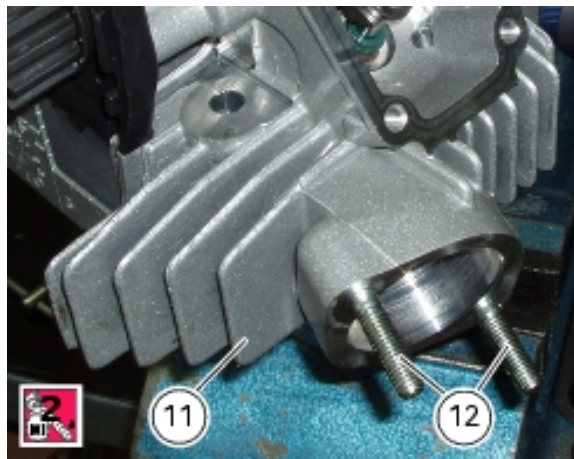
### Refitting the intake manifolds

Smear some recommended threadlocker on stud bolts (12) and (13), install them to heads (10) and (11) and tighten to the specified torque (Sect . C 3, [Engine torque settings](#)).

Check the O-ring (35) and replace it if worn.

Smear O-rings (35) with engine oil, position the intake manifolds (34) and secure them with nuts (33).





Tighten the nuts (33) to the specified torque (Sect. C 3)

Operations	Reference See Section
Fit the throttle body	L 6, <a href="#">Refitting the throttle body</a>

### Removing the cam covers

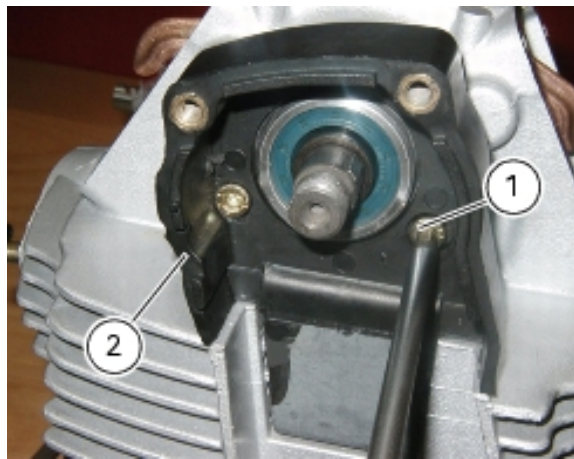
Operations	Reference See Section
Remove the airbox	L 7, <a href="#">Removing the airbox</a>
Remove the battery mount	P 2, <a href="#">Battery mount</a>
Remove the timing covers and the timing belts	N 4.2, <a href="#">Removing the timing side covers</a>
Remove the timing belt rollers from the heads	N 4.2, <a href="#">Disassembling the timing system</a>



#### Note

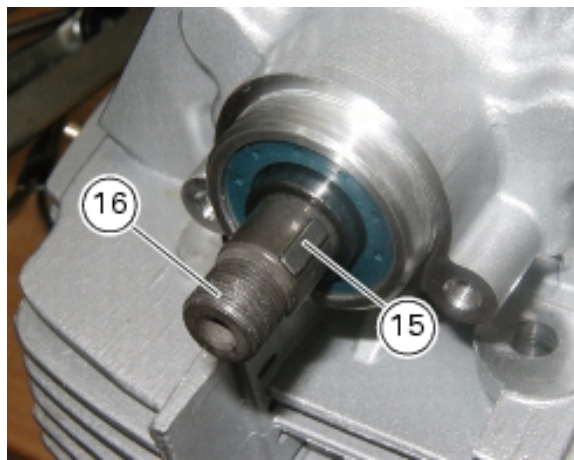
For precision purposes, the figures show the head removed from the engine.

Unscrew the retaining screws (1) then remove rubber cap (2) and (6) from heads (10) and (11).

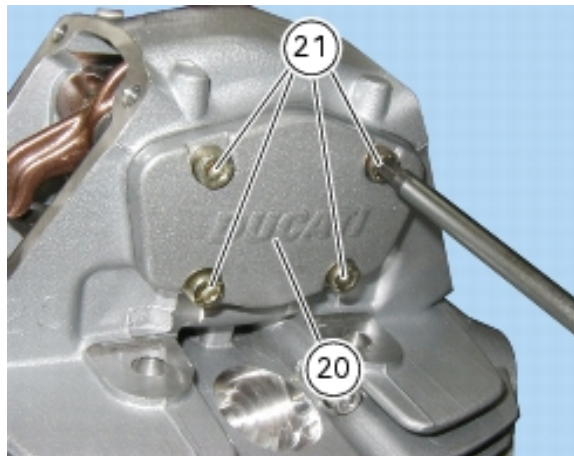


Note

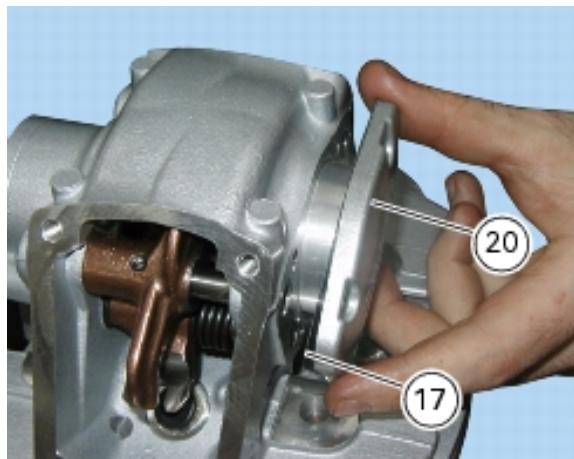
Be careful not to displace the keys (15) in the camshafts (16) and (22) when removing the belt rollers.



Unscrew the retaining screws (21) of the cover (20) supporting camshaft (16) and (22).



Take off the cam cover (20) and its gasket (17).



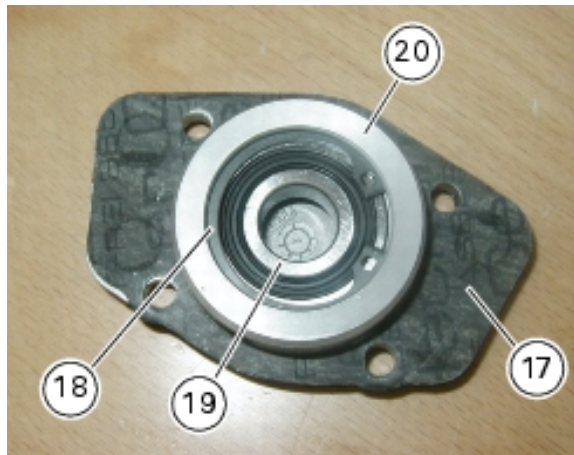
#### Disassembling the cam cover

Remove the circlip (18) that holds the bearing in place. Remove the camshaft bearing (19) from the cam cover using a suitable puller.



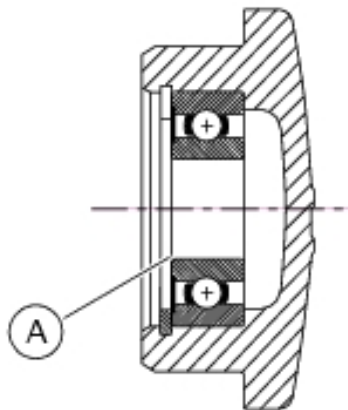
#### Caution

Do not reuse the bearings after removal.

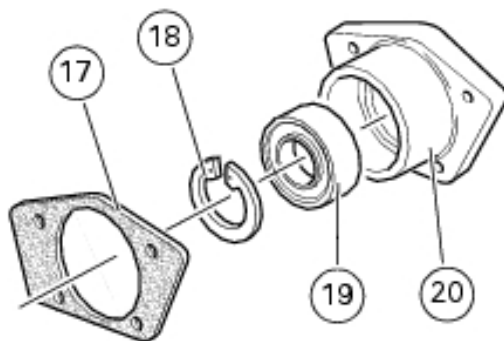


#### Reassembling the cam cover

Install the bearing (19) with the shielded side (A) outward. Lubricate all components with engine oil before refitting.

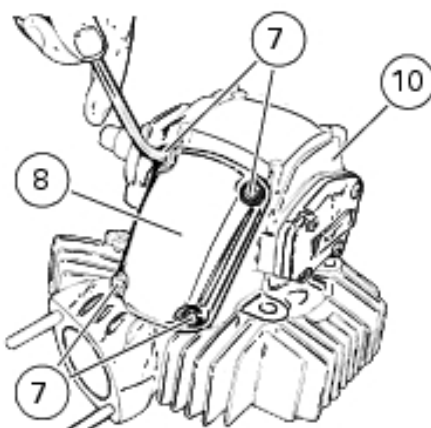


Insert the circlip (18) into the cam cover groove to hold the bearing securely in place. Check gasket (17) and replace if needed.

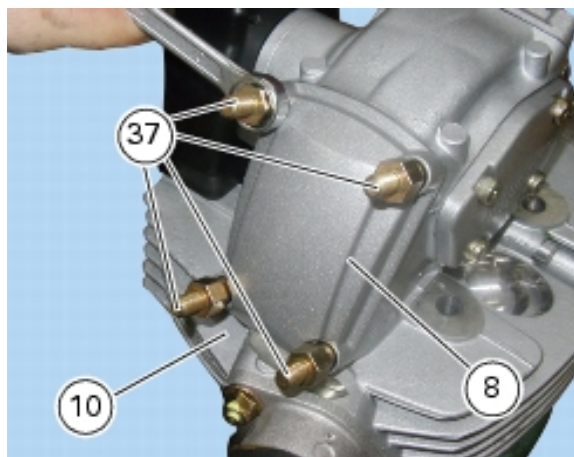


### Removing the valve covers

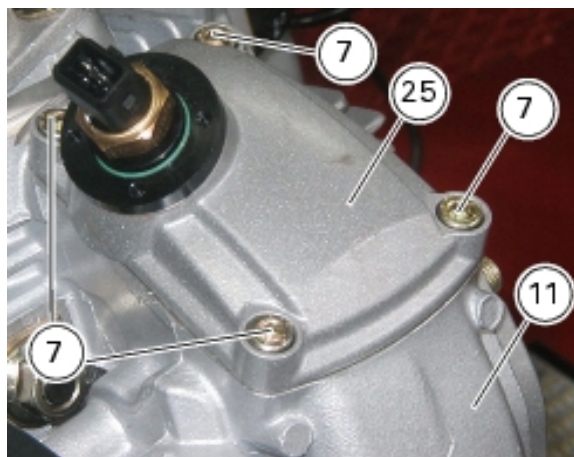
To remove the cover on the exhaust side (8) of vertical head (10), loosen screws (7) and collect the gasket (9).



To remove the cover on the intake side (8) of vertical head (10), loosen pegs (37) and collect the gasket (9).



To remove the cover on the exhaust side (8) of horizontal head (11) and the cover on intake side (25) of horizontal head (11), loosen screws (7) and collect the gaskets (9).



### Refitting the valve covers

Check valve cover gaskets (9) for wear and replace if needed.  
 Position the valve covers (8) and (25) with the gaskets (9) to the heads.



**Note**

The cover on intake side (8) of vertical head (10) is secured with pegs (37), while exhaust cover is secured with screws (7).

Tighten pins (37) and screws (7) to the specified torque (Sect. C 3, [Engine torque settings](#)).

### Removing the camshafts

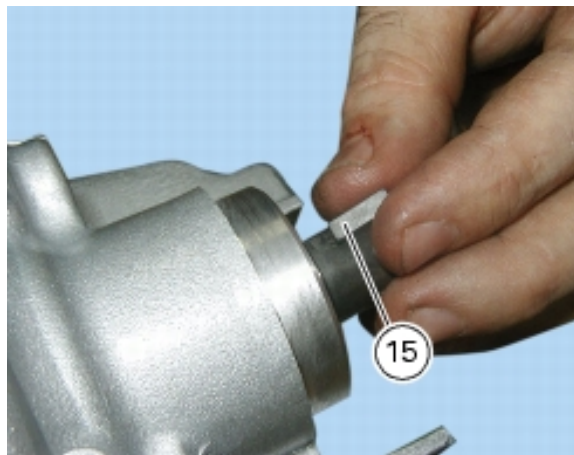
Operations	Reference See Section
Remove the timing belt rollers	N 4.2, <a href="#">Disassembling the timing system</a>



**Note**

This operation is also possible with stud bolts fitted onto cylinder head. For your convenience, the pictures show a cylinder head with removed stud bolts.

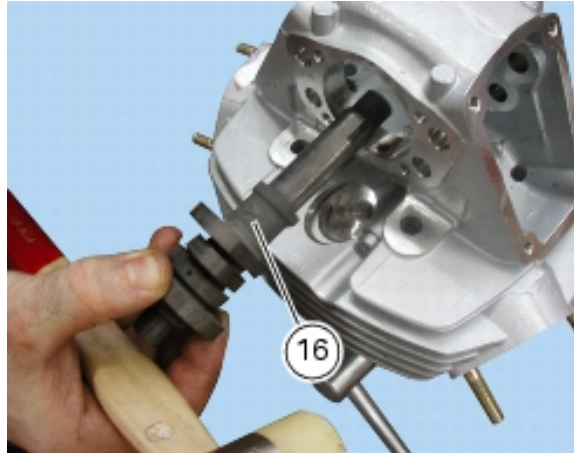
Remove the cam covers as described above.  
 Remove the key (15) from the camshaft.



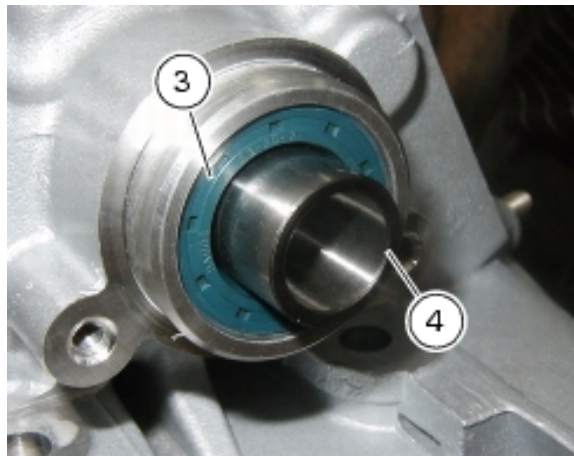
**Caution**

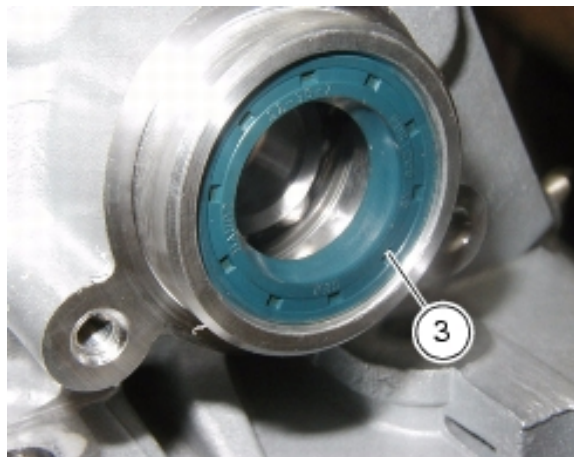
Rotate the camshaft (16) until finding a position at which cams will not contact the rocker arms. This will avoid damage to the components during removal.

Extract the vertical head camshaft (16) from its seat.

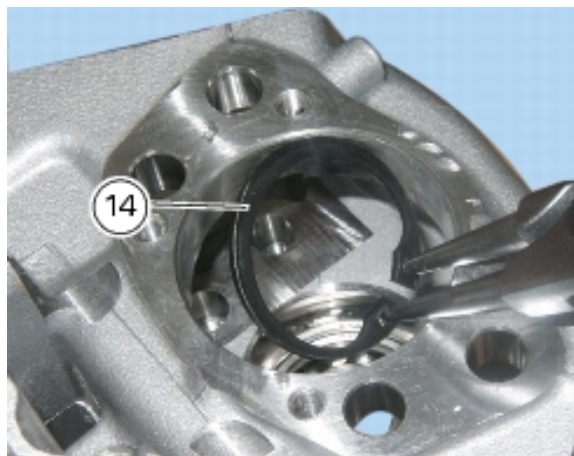


Remove the spacer (4) from the seal (3).  
Remove the seal (3) from the head.





Remove the circlip (14) using suitable tweezers.

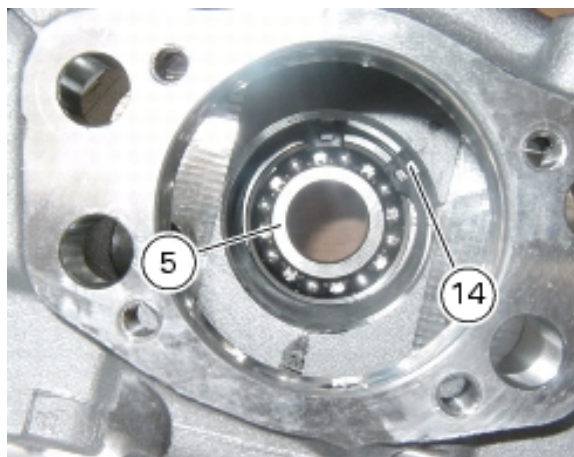


Use a drift to remove the bearing (5) supporting the camshaft (16).  
Check bearing (5) and circlip (14) for wear and replace as required.



Warning

When the bearing is removed, it shall be renewed.



## Checking the camshafts

Check that the contact surfaces of the cams are free from scratches, grooves, steps and waving. Worn cams prevent correct timing and lead to loss of performance.

Insert the camshaft between two centres and check deviation using a dial gauge.

- Service limit:

**0,1 mm**



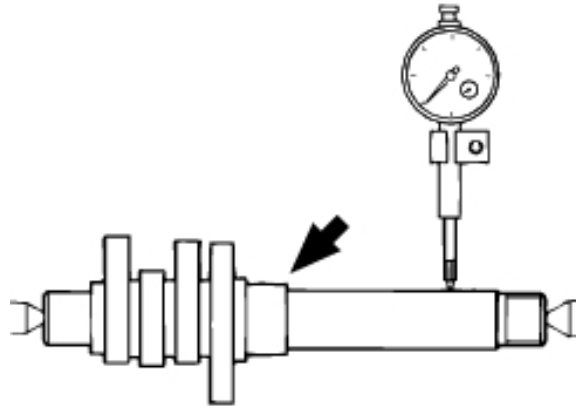
Note

Actual deviation is half the gauge reading.

The camshaft is marked as follows:

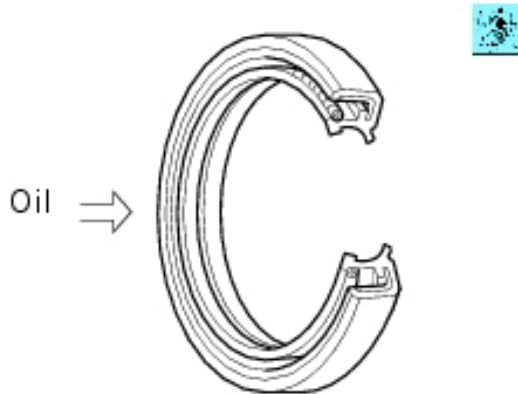
O: horizontal

V: vertical



### Checking the oil seals

Change oil seals at each cylinder head overhaul.  
Install new seals using suitable tools.  
Lubricate oil seal lip after installation.  
This operation requires the utmost care.



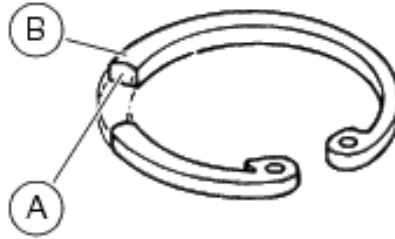
### Checking the circlips



Note

Replace any snap rings which are distorted or have lost their spring.

All circlips have a side (A) which is completely flat and has a sharp edge and a side (B) with a slightly rounded edge.



### Checking the bearings

Before a dimensional check, inspect bearing for wear. Do this manually with the bearing installed.

Turn the inner ring in both directions: it should run smoothly and quiet, without jamming.

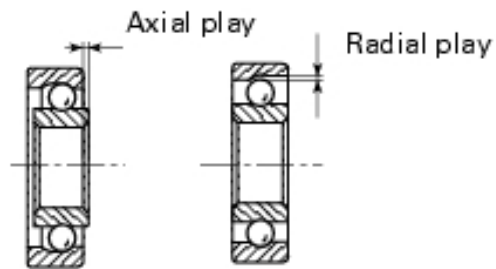
Push the inner ring outwards at different positions to check for play.

Remove any bearings which run hard or are noisy or have play.



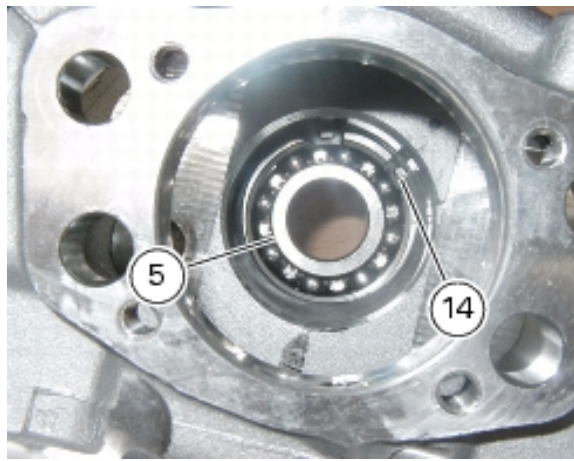
### Note

Change the bearings at each cylinder head overhaul.

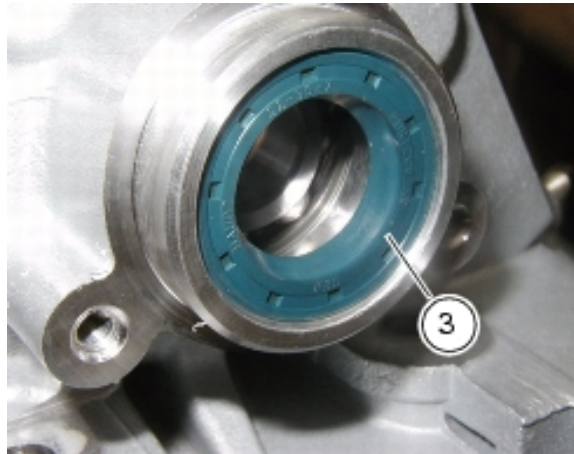


### Refitting the camshaft

Push the camshaft bearing (5) fully home against head wall (10) using a suitable drift.  
Fit the circlip (14) in its groove.



Install seal (3) as shown.

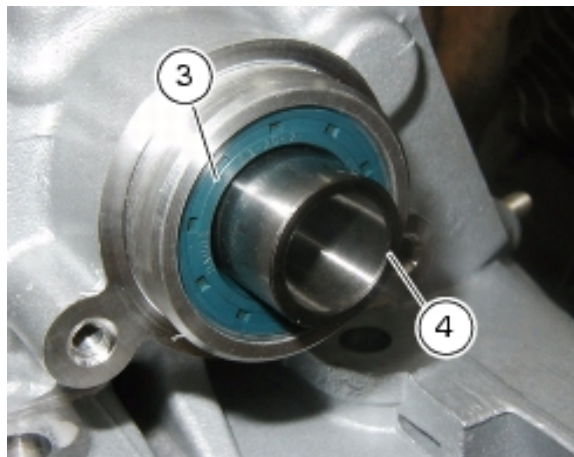


Insert the spacer (4) into the seal (3) and push it until it contacts the bearing (5).



Note

Ensure that spacer (4) faces the seal so as not to damage it.



Caution

If you have left the rocker arms in place in the head (Sect. N 4.4, [Head unit: valves - rocker arms](#)), rotate the camshaft (16) until finding the position at which the cams will not contact the rocker arms.

Before fitting the camshaft in the head, check shaft punching (A):

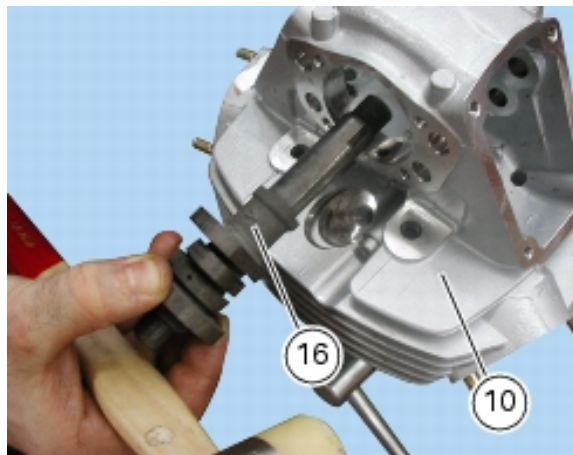
O: horizontal

V: vertical

Please refer to "[Checking the camshafts](#)".



Insert the camshaft (16) from the left side of the head (10). Push camshaft through spacer (4) until it becomes seated into the bearing (5).



Check key (15) and keyway for wear and then fit it.



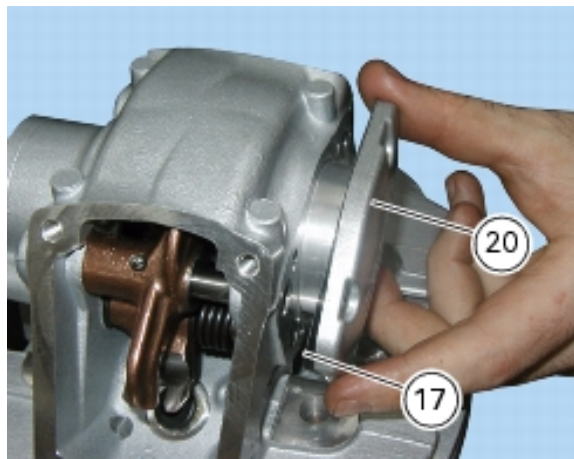
Refitting the cam covers



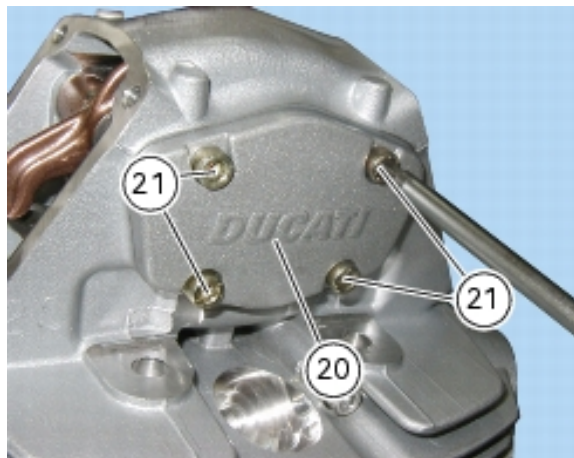
Note

Check gasket (17) and replace if worn.

Position the complete cam cover (20) with the gasket (17) to the left side of head.

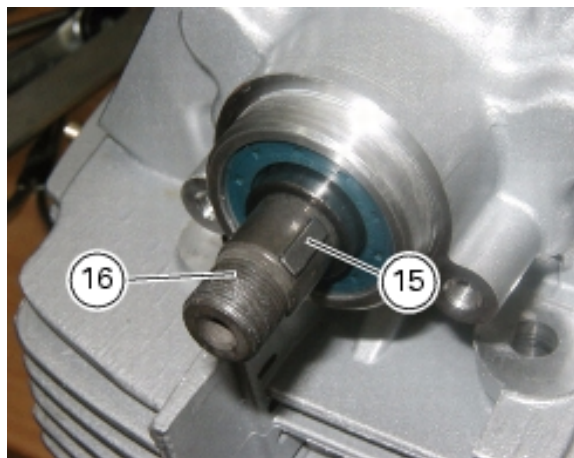


Secure the cam cover (20) using the screws (21).  
Tighten the screws (21) to the specified torque (Sect. C 3, [Engine torque settings](#)).

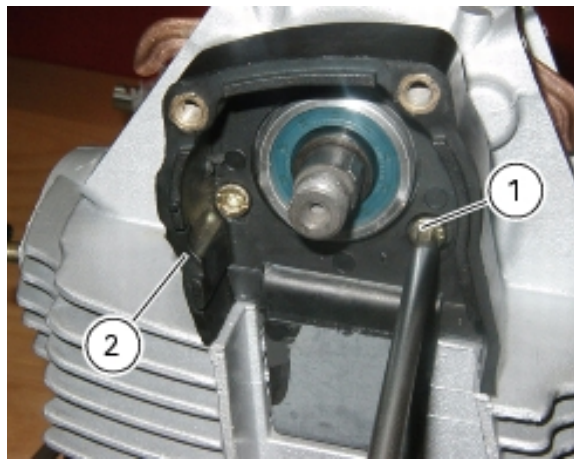


Note

Pay attention to the key (15) in the camshaft (16).



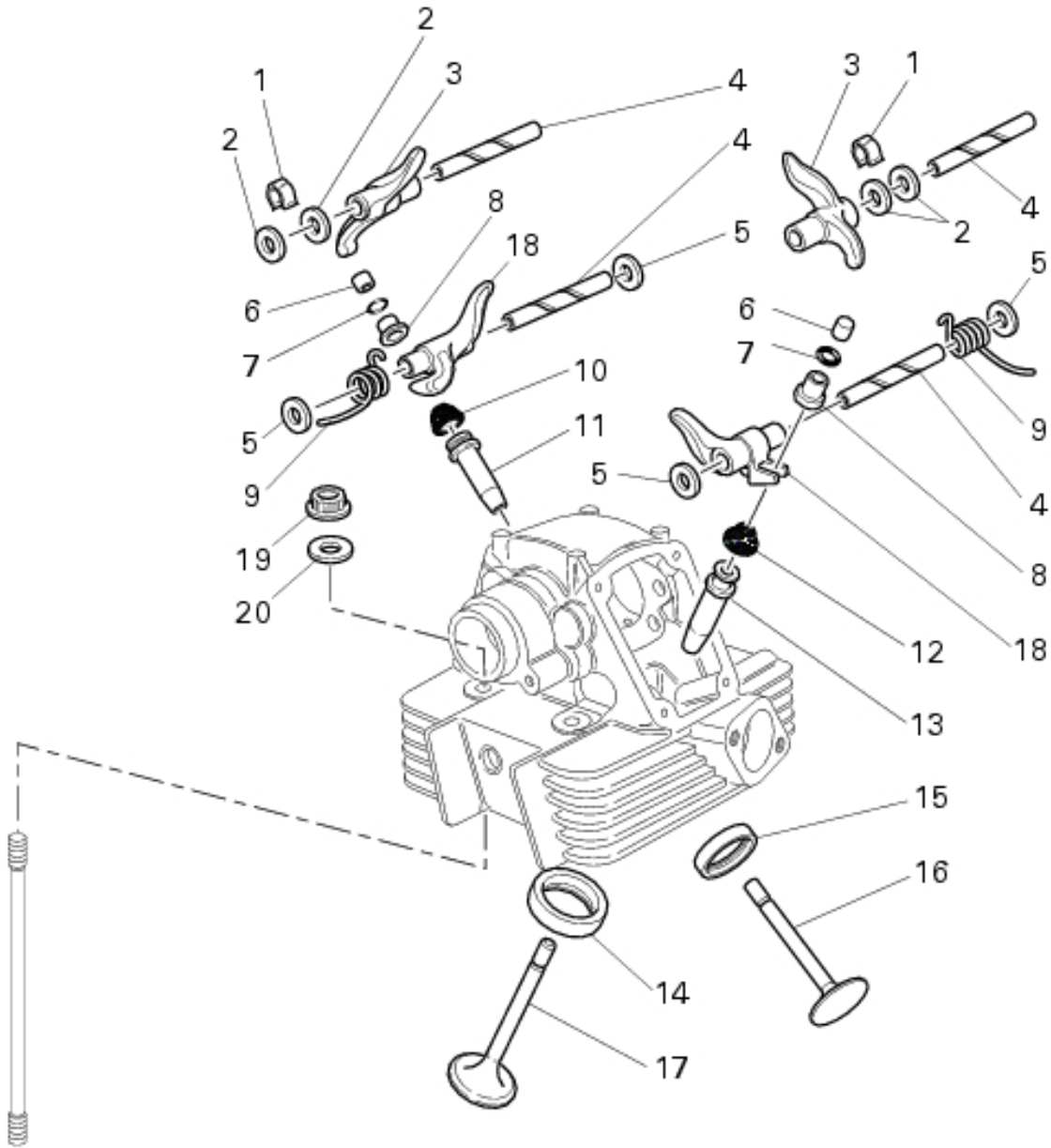
Position the horizontal head cover (2) to the left side of head and insert the retaining screws (1).  
Tighten the screws (1) to the specified torque (Sect. C 3, [Engine torque settings](#)).



Repeat procedure for the other head.


Operations	Reference See Section
Refit the timing belt rollers to the heads	N 4.2, <a href="#">Reassembling the timing system</a>
Refit the timing belts and timing belt covers	N 4.2, <a href="#">Refitting the timing side covers</a>
Refit the battery mount	P 2, <a href="#">Battery mount</a>
Refit the airbox	L 7, <a href="#">Refitting the airbox</a>

## 4.4 - Head unit: valves - rocker arms



- 1 Clip
- 2 Shim
- 3 Opening rocker arm
- 4 Rocker arm shaft
- 5 Shim
- 6 Valve opening shim
- 7 Split rings
- 8 Valve closing shim
- 9 Spring
- 10 Exhaust valve seal
- 11 Exhaust valve guide
- 12 Intake valve seal
- 13 Intake valve guide
- 14 Intake valve seat
- 15 Exhaust valve seat
- 16 Exhaust valve
- 17 Intake valve
- 18 Closing rocker arm

- 19 Nut
- 20 Washer

 Spare parts catalogue

[Half crankcases](#)

[Vertical head](#)

[Horizontal head](#)

 Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Disassembling the engine heads

Operations	Reference See Section
Remove the throttle body	L 6, <a href="#">Removing the throttle body</a>
Remove the battery mount	P 2, <a href="#">Battery mount</a>
Disconnect oil temperature sensor from main wiring harness	P 1, <a href="#">Arrangement of wiring on frame</a>
Remove timing side covers and timing belts	N 4.2, <a href="#">Disassembling the timing system</a>

 Note

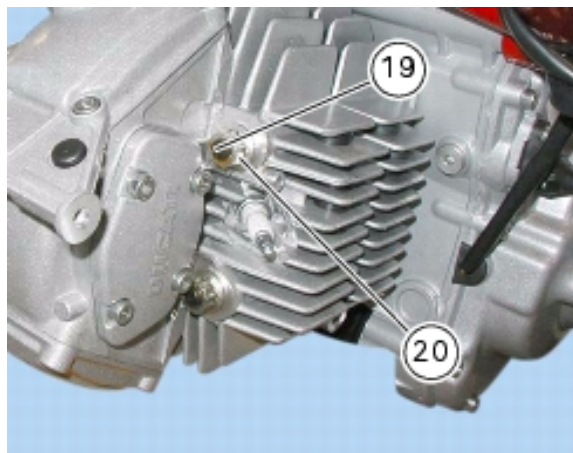
For reasons of clarity, the figures show an engine block removed from the frame.

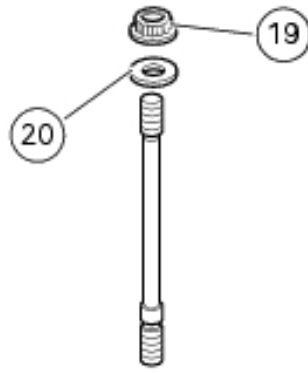
### Removing the heads

 Note

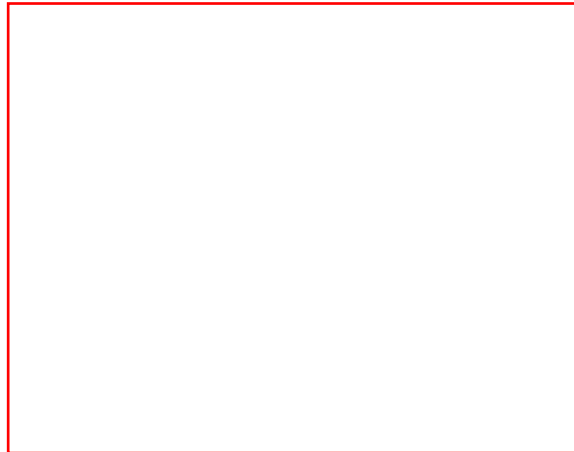
When disassembling the cylinder head, arrange the components in the correct order or mark their positions to refit them in the original position.

Using tool part no. **88713.2676** undo the nuts (19) on the head stud bolts.  
Remove the nuts (19) and the special washers (20) positioned between nut and head.





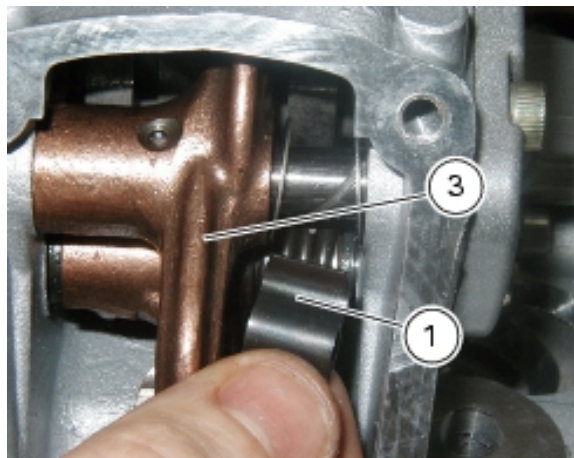
Slide the complete head off the stud bolts and remove it from the engine block.



Removing the valves

Operations	Reference See Section
Remove valve covers	N 4.3, <a href="#">Removing the valve covers</a>

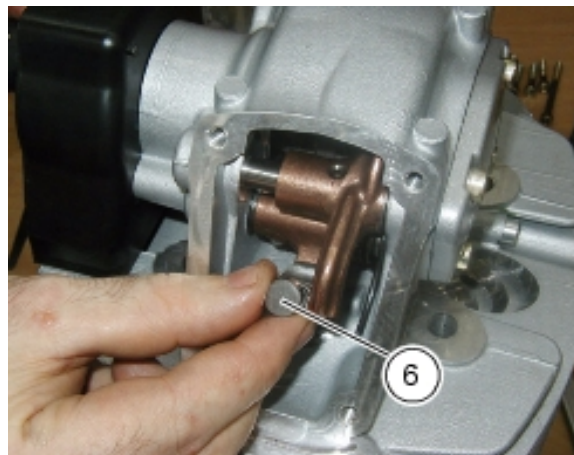
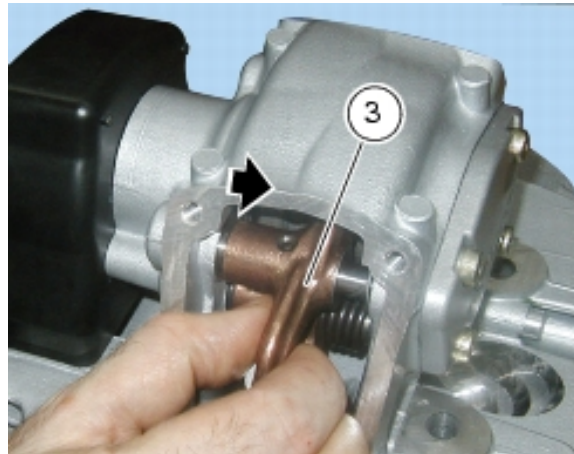
Slip off the clip (1) of the opening rocker arm (3).



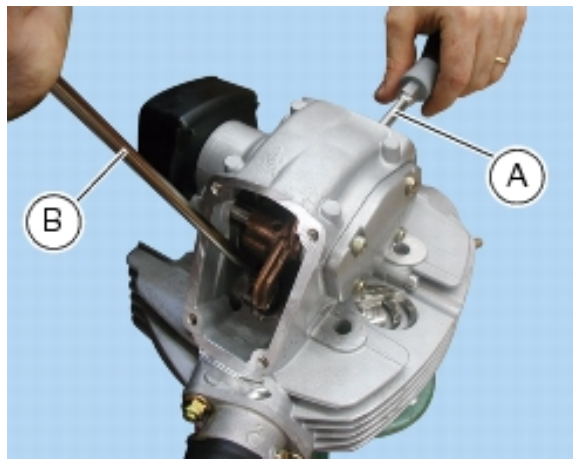
Fit tool part no. **88713.2107** to the head belt roller – or use the bush of tool part no. **88700.5644** – and rotate the camshaft so as to release the opening rocker arm (3).



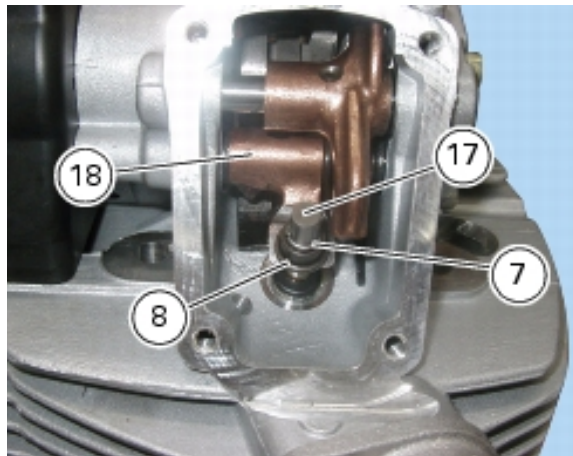
Move the rocker arm (3) aside to release the valve opening shim (6).



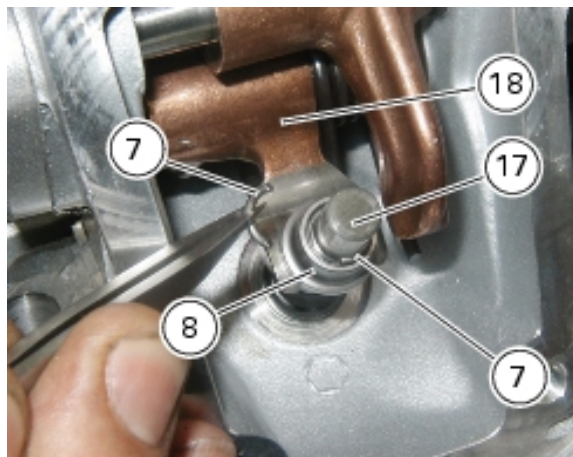
Using two screwdrivers, lock the closing rocker arm (18) with valve open: for position (A) set screwdriver under closing rocker arm, while for position (B) push onto closing rocker arm along valve axis.



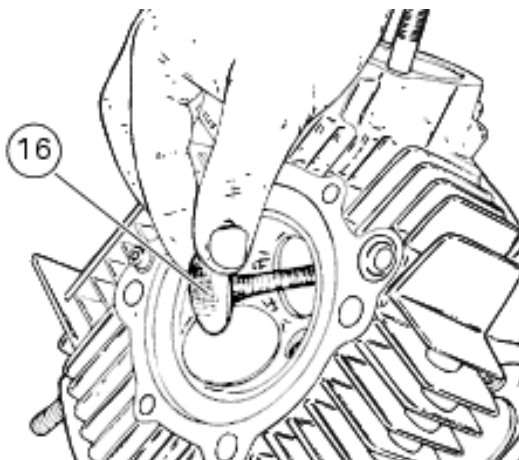
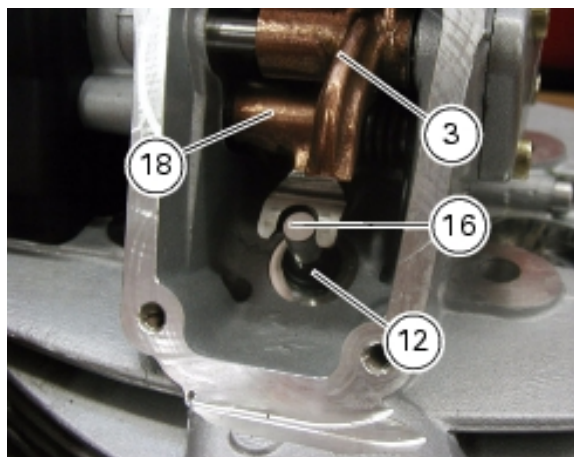
Slide the valve closing shim (8) along intake valve stem (17) to expose the two split rings (7) that retain the valve.



Remove the split rings (7) from valve stem using tweezers.  
Remove the valve closing shim (8) from the valve (17).



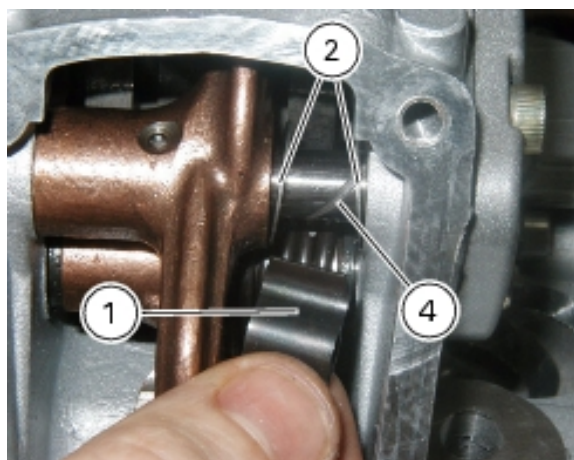
Withdraw the valve (17) from the bottom end of head.  
Remove the valve seal (12) from the head.  
Repeat procedure to remove the exhaust valve (16).

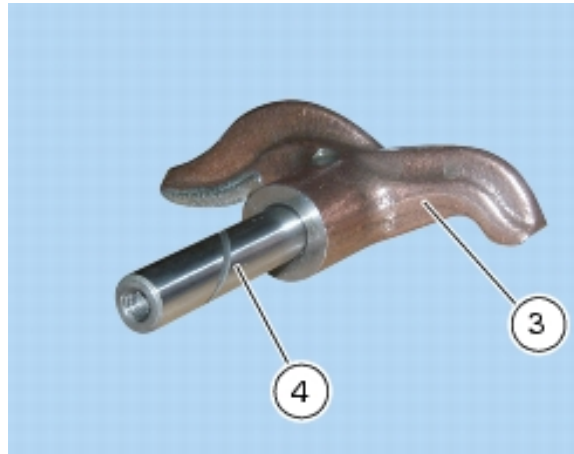
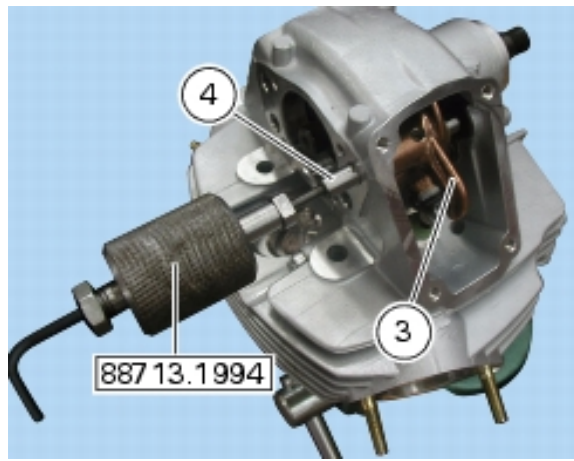


Removing the valve rocker arms

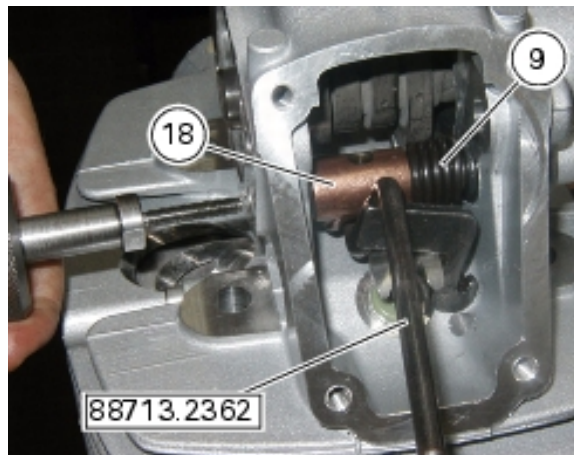
Operations	Reference See Section
Remove the camshaft covers	N 4.3, <a href="#">Removing the cam covers</a>

Remove the clip (1) from the rocker arm shaft (4).  
 Screw the tool part no. **88713.1994**, featuring M5 pin, on the thread of the opening rocker arm shaft (4).  
 Withdraw the rocker arm shaft (4).  
 Remove the opening rocker arm (3) with the two shims (2).

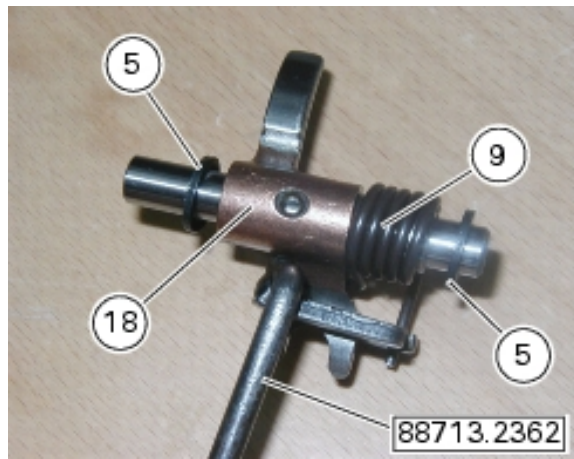




Hook the end of the spring (9) of the closing rocker arm (18) to tool part no. **88713.2362**.



Remove the closing rocker arm shaft (4) using tool part no. **88713.1994**. Collect the two shims (5). Remove rocker arm (18), spring (9) and tool part no. **88713.2362**.



## Overhauling the head parts

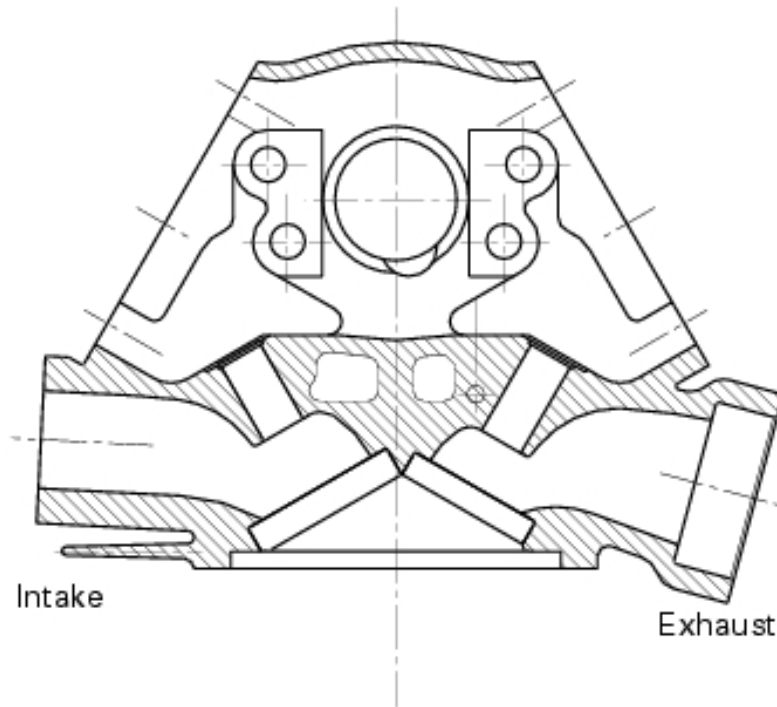
### Overhauling the heads

Remove the carbon deposits from the combustion chamber and relevant ducts.

Check that there are no cracks and that there are no grooves, steps or damage of any kind on the sealing surfaces.

Mating surface to cylinder must be perfectly flat.





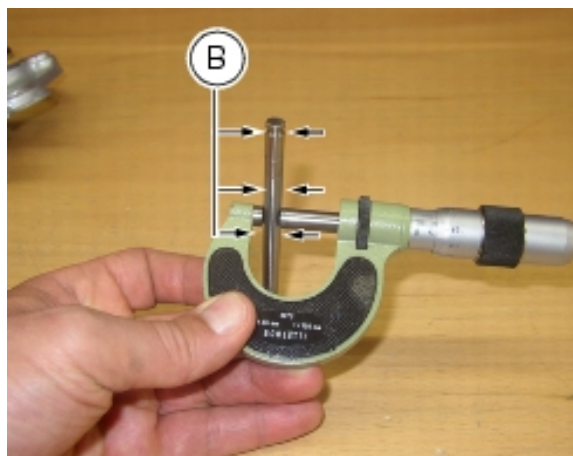
#### Checking the valve

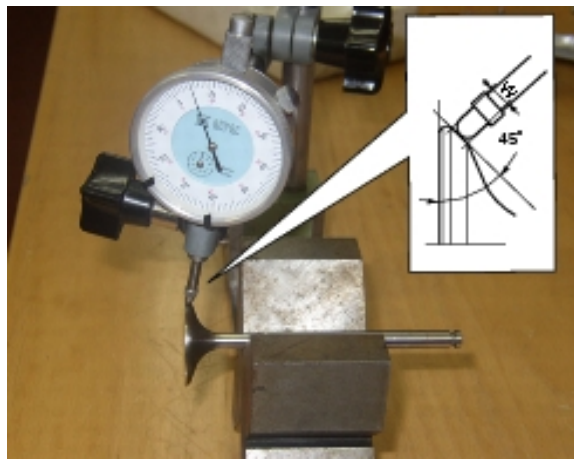
Check that the stem and the surface that contacts the valve seat are in good condition. There must be no pitting, cracks, deformations or signs of wear.

Check the following: measure the diameter of the stem (B) at various positions along the portion that runs in the valve guide.

Check the valve stem for buckling. Place valve on a "V" block, set a dial gauge perpendicular to head and measure run-out of valve face slanted at 45°.

- Service limit: **0.03** mm





### Checking the valve seat

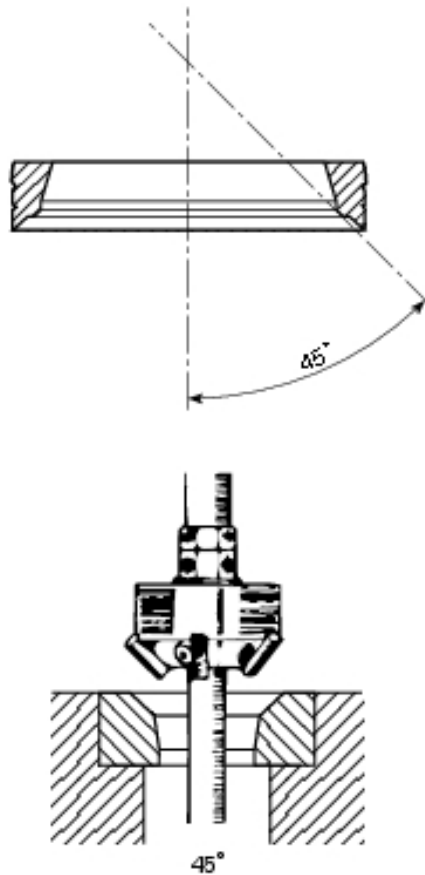
Visually inspect valve seats: they must not show any signs of pitting or cracks.

If the seat is slightly damaged, mill the seat, using suitable 45° cutters, then grind the valves and check valve sealing. If valve seat is excessively damaged, replace it choosing an adequately oversized valve seat. Spare valve seats are available with 0.03 and 0.06 mm outer diameter oversize.



### Caution

If seats are replaced, change the valve guides as well.



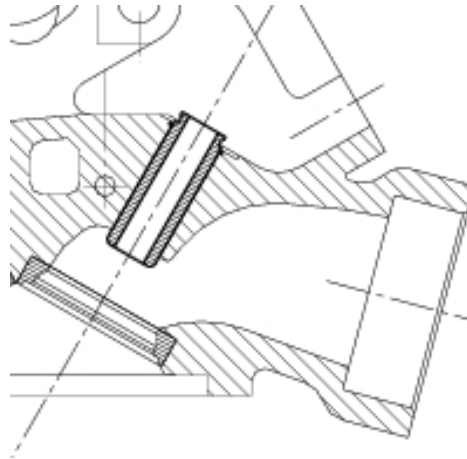
### Overhauling the valve guide

Check inner surface of valve guides for cracking or distortion. If exceedingly oval, hone mating surface with a bore reamer.



Note

Valve guide and valve must always be replaced as a set. Intake valves use cast-iron guides. Exhaust valves use bronze guides.



Checking valve - valve seat clearance

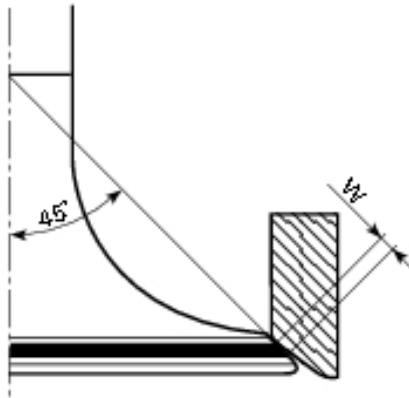
Use Prussian blue or a mixture of minium and oil to measure the contact surface (W) between valve and seat. Correct size is **1.0-1.5** mm.

Maximum limit:

**2.0** mm.

Grind seat if outside the above limit.

Fill the intake and exhaust ducts with fuel to check for leaks. In the event of leakage, check the sealing surfaces for burrs.



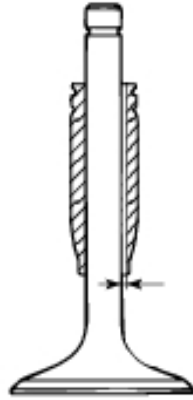
Checking valve-valve guide clearance

Assembly clearance:

**0.03-0.06** mm

Service limit:

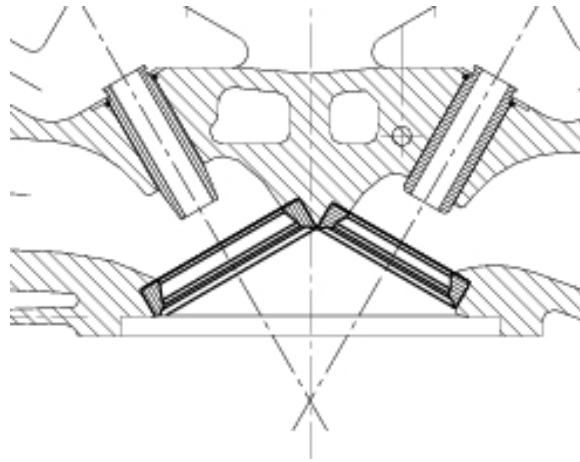
**0.08** mm.



### Changing valve seats

Mill the worn seats to remove them. Ensure that you do not damage the valve seat location on the head. Check the diameter of the housings in the head and choose an adequately oversized valve seat to obtain an interference fit to head of **0.11-0.16 mm**. Spare valve seats are available with **0.03** and **0.06 mm** outer diameter oversize.

Heat the cylinder head slowly and evenly up to **200 °C** and cool the new seats in dry ice. Drive the seats perfectly in square in their locations, using the suitable drift. Let head cool down and then grind the valve seats, the jointing line of ducts and seat and grind the valves.



### Changing valve guides

Change valve guides as follows.

Heat head gradually and evenly in an oven up to **200 °C**.

Remove original valve guides using a suitable tool (see diagram).

Let them cool down and check seat state and size.

Choose adequate valve guides to obtain an interference fit to head of **0.022-0.051 mm**. Spare valve guides are available with **0.03**, **0.06** and **0.09 mm** outer diameter oversize and come complete with retaining ring.

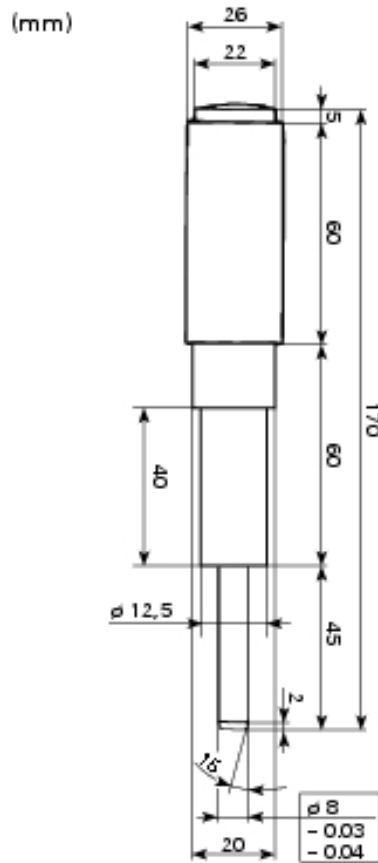
Heat up head again and cool down the new valve guides in dry ice.

Lubricate seats in the head and install the valve guides. Push the retaining ring fully home into the head using the same drift as for removal.

Allow the head to cool down and hone inner bore.

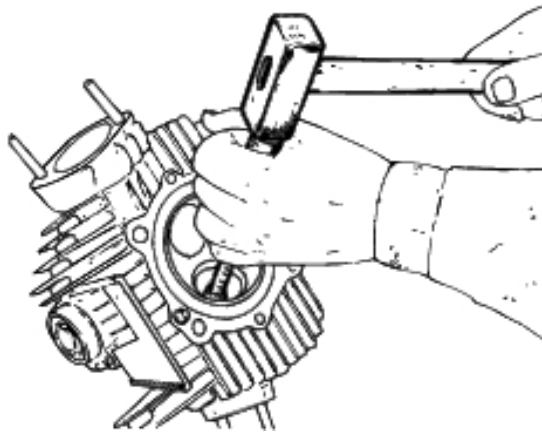
Valve guide bore diameter:

**8.00-8.022 mm**.



Overhauling the rocker arms

Check that contact surfaces are in perfect condition. Check for signs of wear, grooves or pitting.



Check condition of rocker arm bore and shaft.

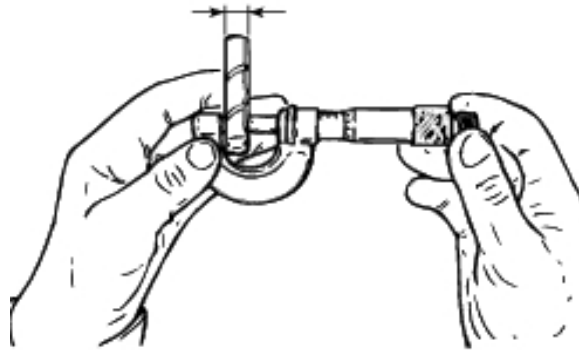
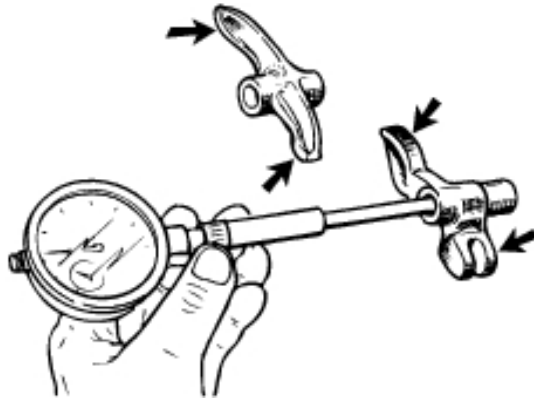
Nominal rocker arm bore diameter:

**10.040-10.062** mm

Nominal rocker arm shaft diameter:

**10.001-10.010** mm

Check that the contact surfaces of opening and closing shims are flat and show no signs of wear.



#### Rocker arm shaft-to-rocker clearance

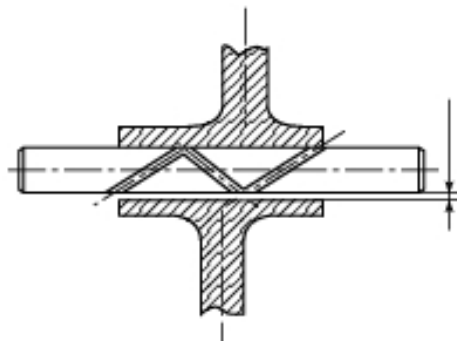
Assembly clearance should be **0.03-0.06** mm.

Service limit:

**0.08** mm.

Rocker arm shaft should be a tight fit in the head.

If it is loose, install the **0.02** mm oversized shaft available from the Spare Parts Department.



#### Checking the rocker arm springs

Check condition of closing rocker arm return springs. Check for cracking, distortion, or loss of spring.



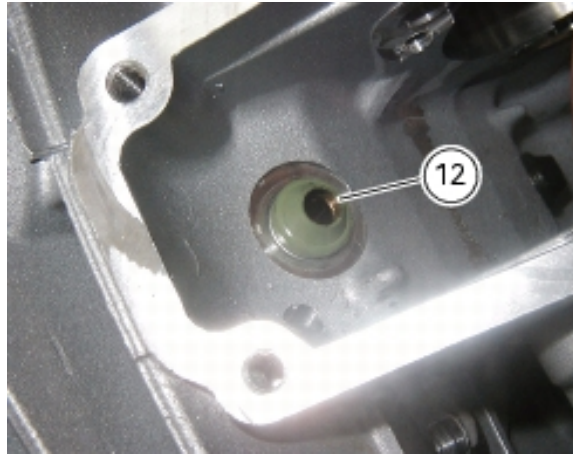
## Reassembling the head

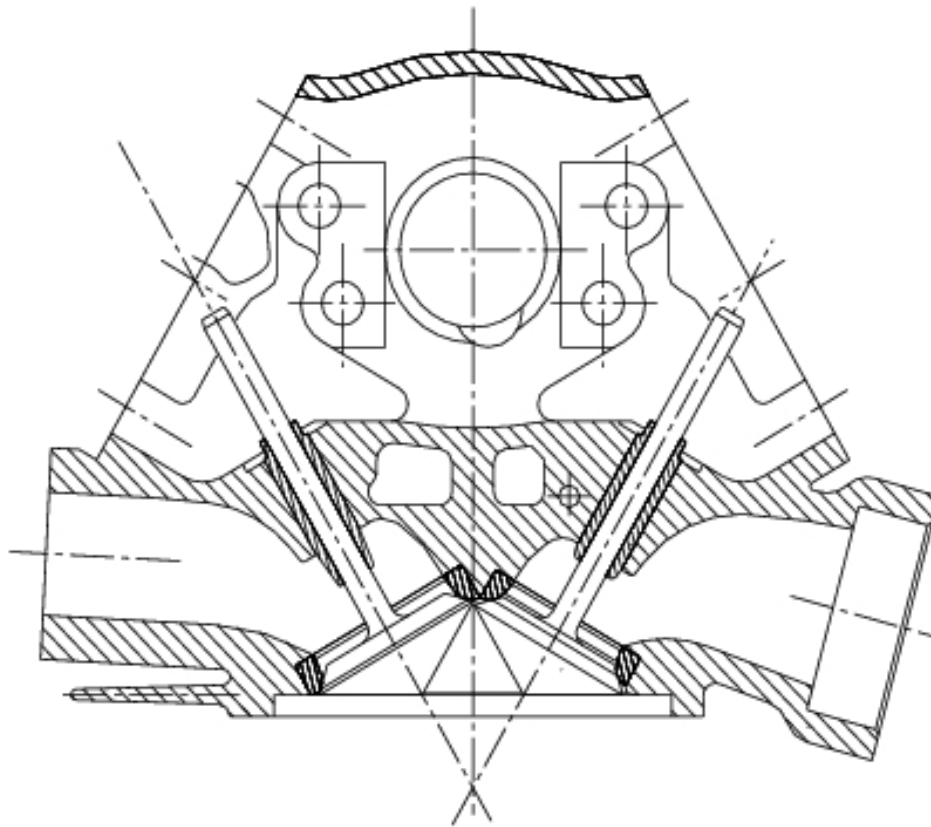
Reverse the disassembly sequence. Pay particular attention to the operations described below. It is very important to carefully clean all components.

Fit the oil seal (12) and (10) to the valve guide. Oil seals are colour-coded as follows:

- green seal for the exhaust valve
- black seal for the intake valve.

Lubricate the parts before installation.

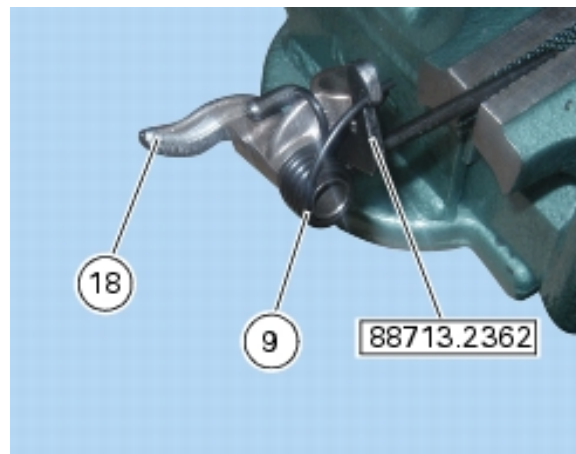




Refitting the rocker arms

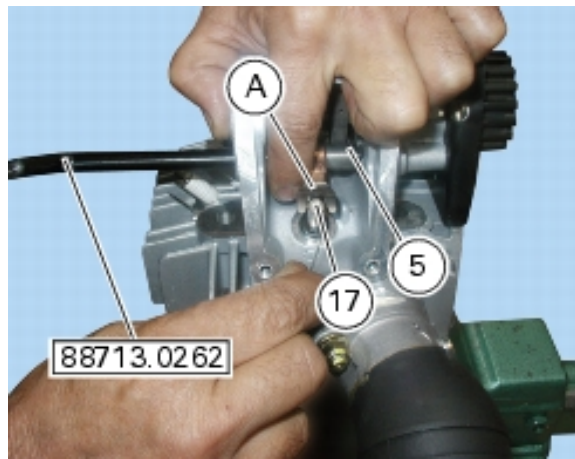
Fit the closing rocker arm (18) and its spring (9) to the tool part no. **88713.2362**.

Insert the assembled tool-rocker arm-and-spring into the head and install the pin part no. **88713.0262** to hold assembly in place.



Install the valve (17) temporarily.

Fit as many shims (5) as required to centre the rocker arm fork (A) to valve stem.



Minimum operating clearance between valve stem and rocker arm:  
**0.15 mm.**

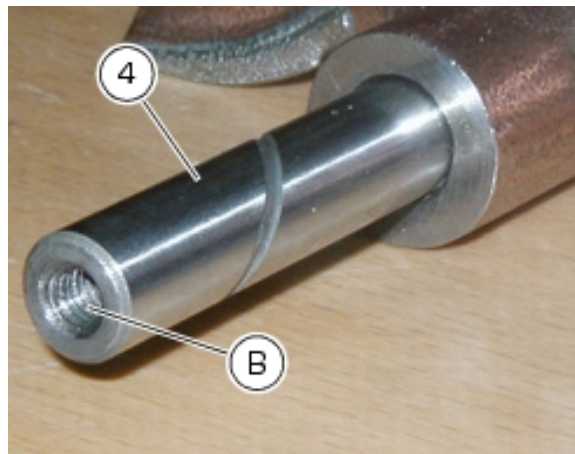
Operating axial play of closing rocker arm:  
**0.05 – 0.20 mm.**

Remove tool part no. **88713.0262** and insert the rocker arm shaft (4).

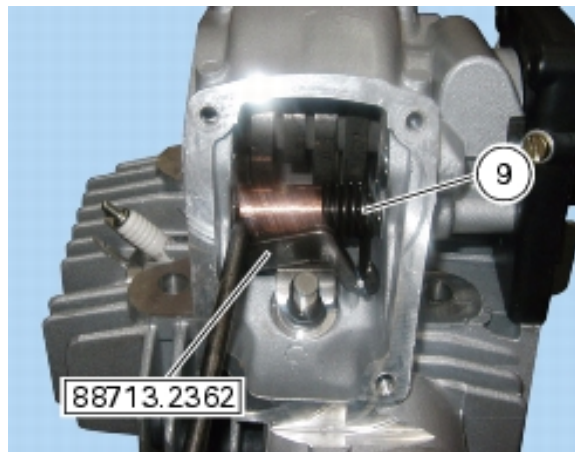


**Caution**

Install the rocker arm shafts (4) with the threaded hole end (B) pointing outwards.

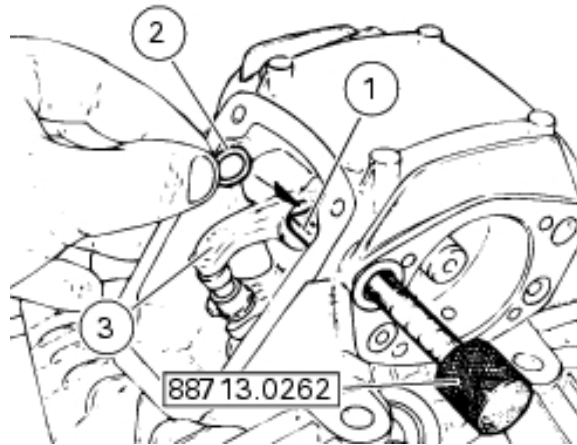


Release the spring (9) and remove the tool part no. **88713.2362**.



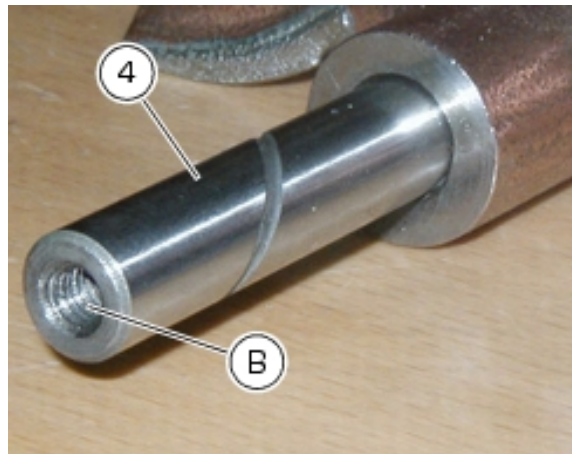
Using again pin part no. **88713.0262**, set opening rocker arm (3) and fit side shims (2): position rocker arm and shims in the horizontal head exhaust side, in vertical head intake side, in horizontal head intake side and in vertical head exhaust side.

Place the shims (2) at both sides of the clip (1).

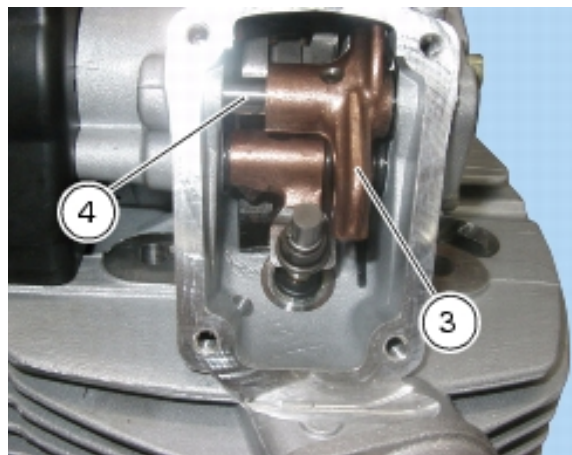


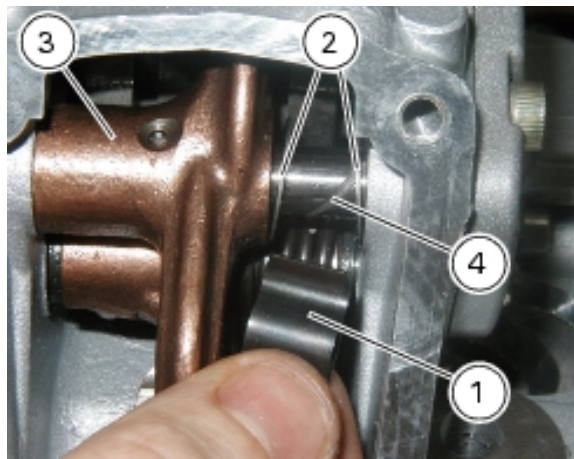
Axial play of opening rocker arm:  
**0.05 – 0.20 mm**

After shimming, remove tool part no. **88713.0262** and position the shaft (4) with the threaded hole end (B) pointing outwards.



Insert side clip (1) onto pin (4) of opening rocker arm (3), in-between the two spacers (2).

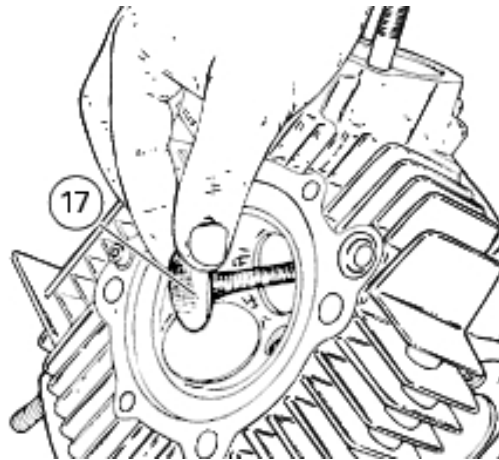




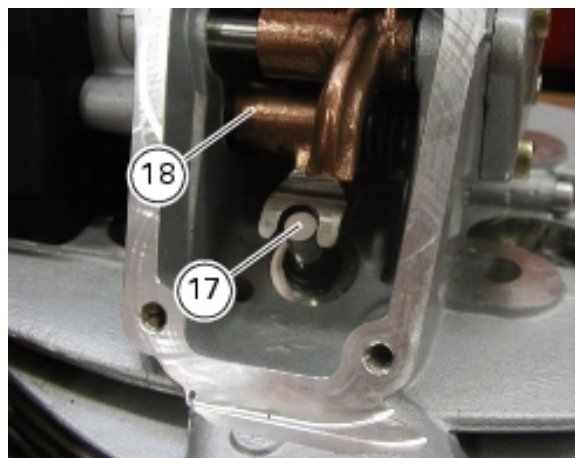
Operations	Reference See Section
Refit the camshaft covers	N 4.3, <a href="#">Refitting the cam covers</a>

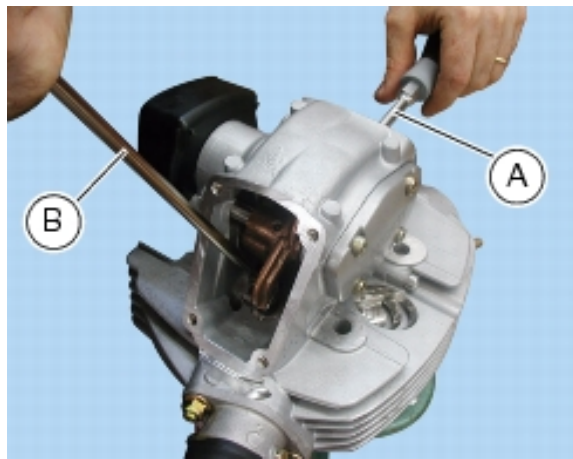
### Refitting the valves

Fit the valves (16) and (17) into the head.

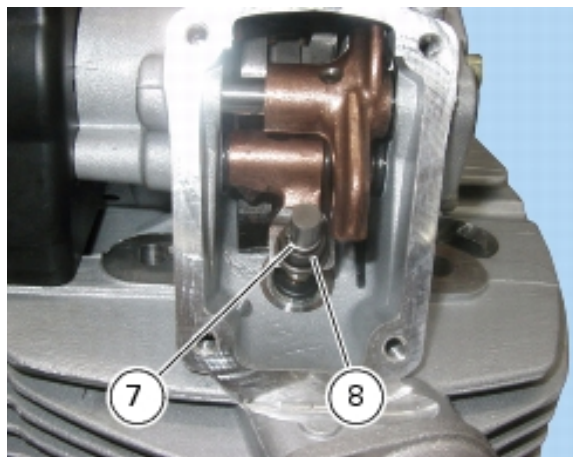
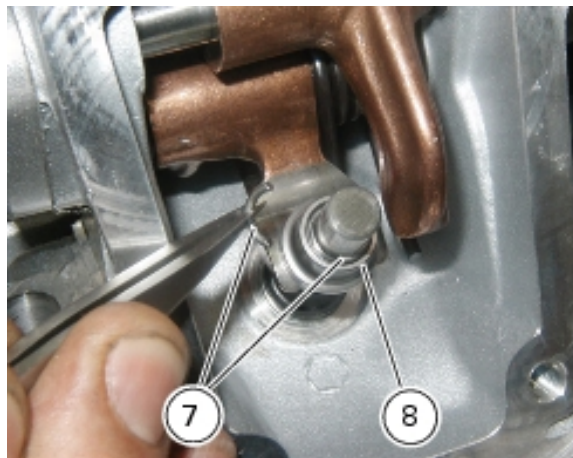


Using two screwdrivers, lock the closing rocker arm (18) with valve open: for position (A) set screwdriver under closing rocker arm, while for position (B) push onto closing rocker arm along valve axis. Locate the closing shim (8) to the valve stem (17) with the larger diameter facing the rocker arm.

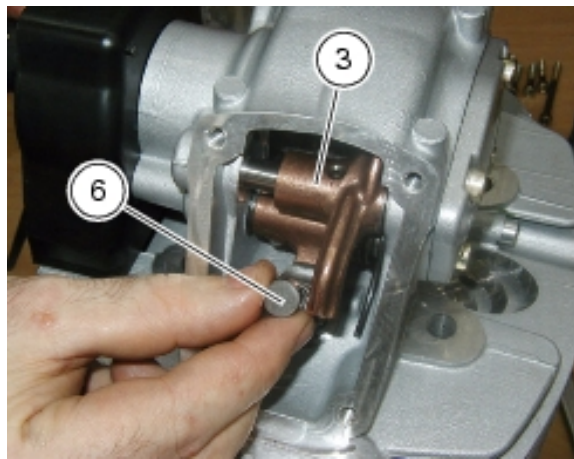




Fit the split rings (7) to the valve stem.  
Remove the two screwdrivers and place the closing rocker arm (18) in the rest position.

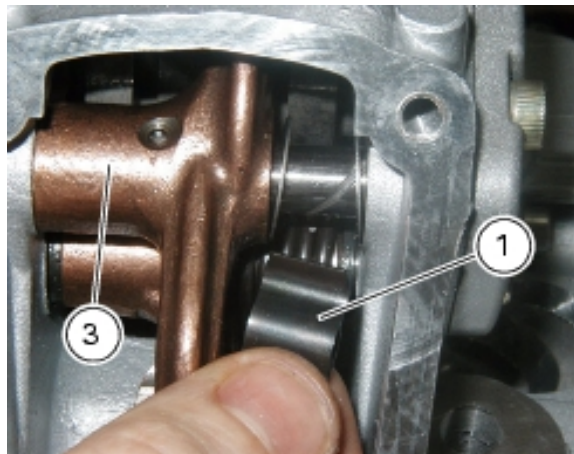


With the valve in the rest position, push on the rocker arm to counteract return spring action and check clearance between rocker arm sliding shoe and closing shim (Sect. N 4.1, [Checking closing clearance \(Sc\) at exhaust/intake](#)). If clearance is outside the specified limit, adjust valve clearance (Sect. N.4.1, [Checking and adjusting valve clearance](#)). Fit the opening shim (6) to valve stem.



Position the opening rocker arm (3) and secure it with the clip (1). With the valve in the rest position, check clearance between rocker arm (3) and shim (6) (Sect. N 4.1, [Checking opening clearance \(Sa\) at intake/exhaust](#)).

If clearance is outside the specified limit, adjust valve clearance (Sect. N.4.1, [Checking and adjusting valve clearance](#)).



Repeat procedure for the exhaust valve (16).

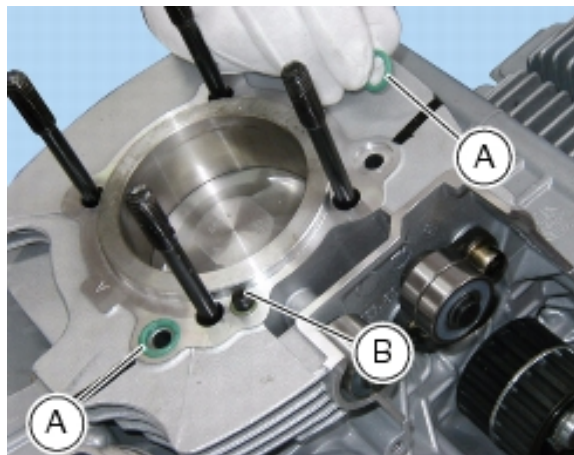
Operations	Reference See Section
Refit the valve covers	N 4.3, <a href="#">Refitting the valve covers</a>

#### Reassembling the heads

Make sure the O-rings (A) and the locating pin (B) are in place in the cylinder mating surface (Sect. N 5, [Cylinder / piston assy](#)) before installing the heads.

#### Caution

The locating pin (B) must be installed with the smallest hole pointing away from the cylinder (Sect. N 5, [Cylinder / piston assy](#)).

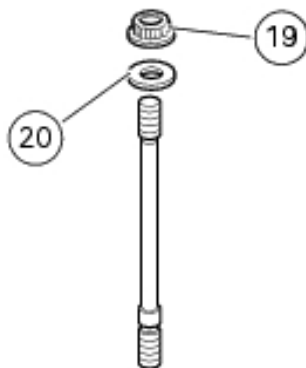


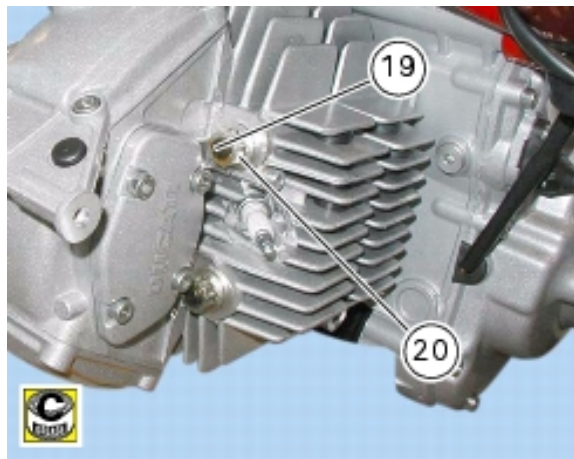
Slide the complete head on the stud bolts and push it down onto the cylinder.



Insert the special washers (20) on the stud bolts with the sharp edge facing the head and the flat side pointing inwards.

Grease the underhead of the nuts (19) and the thread of the stud bolts with the specified grease.





Fit tool part no. **88713.2676** to a torque wrench and tighten the nuts to the specified torque in a cross sequence (Sect. C 3, [Engine torque settings](#)).

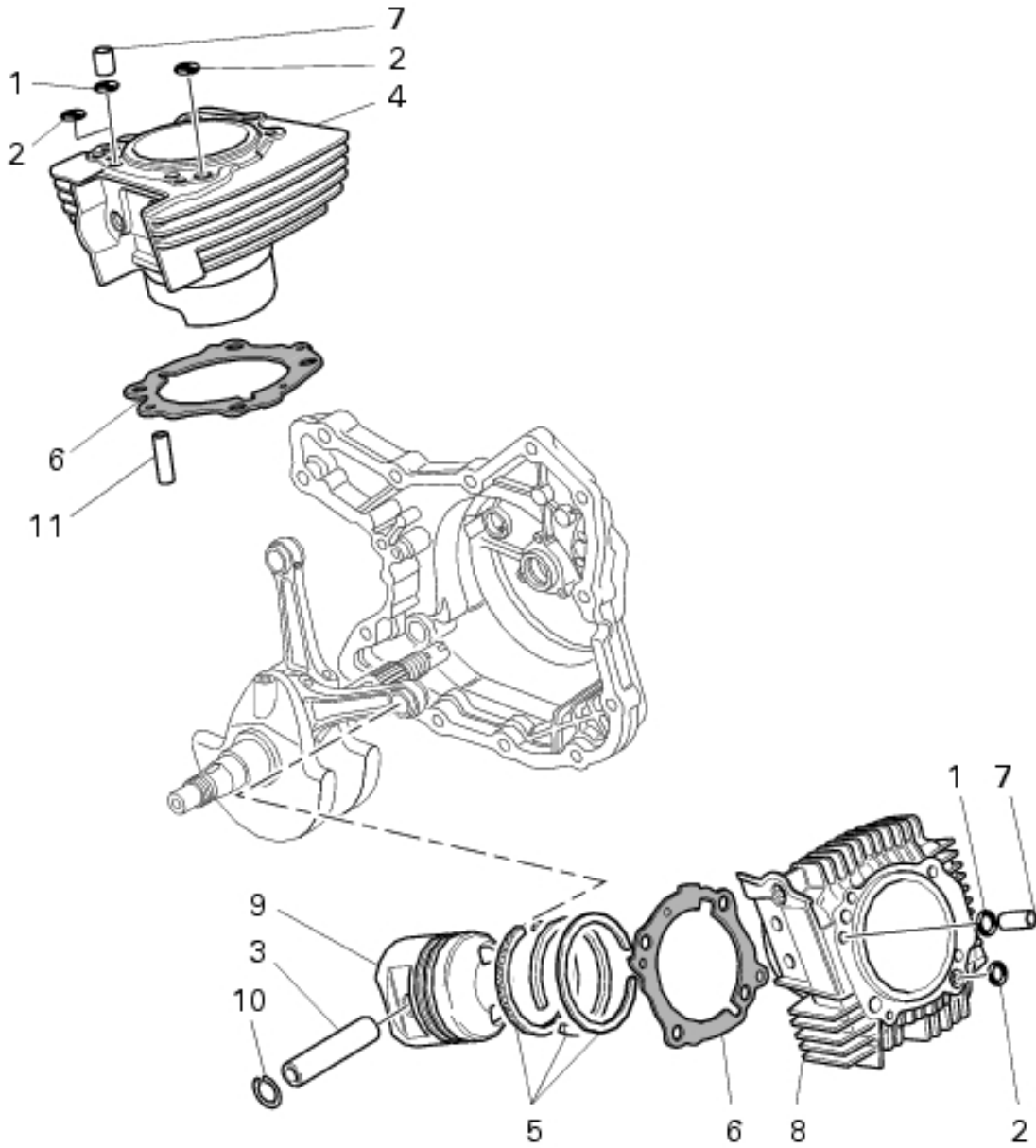


**Caution**


Follow the above procedure closely. Improper tightening may cause the stud bolts to stretch abnormally leading to severe engine damage.

Operations	Reference See Section
Refit the side covers and the timing belts	N 4.2, <a href="#">Refitting the timing side covers</a>
Connect oil temperature sensor to main wiring harness	P 1, <a href="#">Arrangement of wiring on frame</a>
Refit the battery mount	P 2, <a href="#">Battery mount</a>
Fit the throttle body	L 6, <a href="#">Refitting the throttle body</a>

## 5 - Cylinder / piston assy



- 1 O-ring
- 2 O-ring
- 3 Gudgeon pin
- 4 Vertical cylinder
- 5 Piston rings
- 6 Cylinder base gasket
- 7 Pin
- 8 Horizontal cylinder
- 9 Piston
- 10 Circlip
- 11 Locating dowel

 Spare parts catalogue

[Cylinders - pistons](#)

[Alternator cover](#)

**Caution**

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

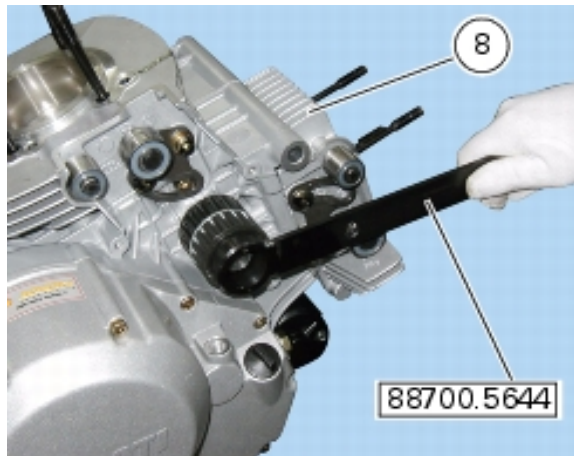
## Removing cylinder / piston assy

Operations	Reference See Section
Remove the heads	N 4.4, <a href="#">Disassembling the engine heads</a>

Remove the O-rings (1) and (2) and pin (7) from cylinder top face.



Use tool part no. **88700.5644** to bring horizontal cylinder piston (8) to TDC.



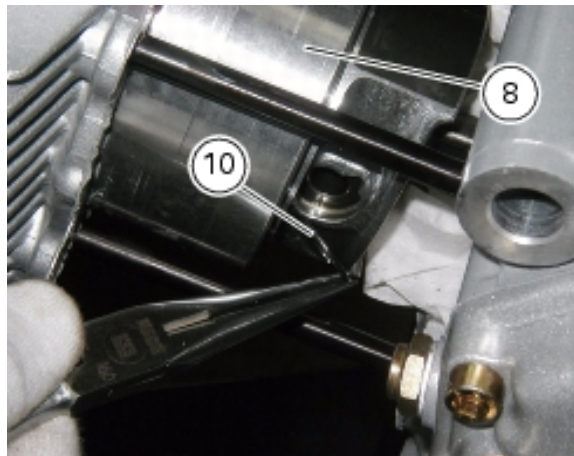
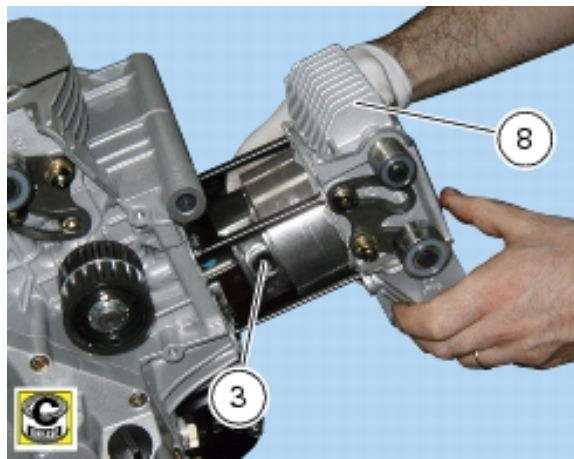
Extract the cylinder (8). Keep it square and pull gently.

If needed, aid removal rocking the cylinder gently with both hands or tap cylinder base lightly with a plastic mallet. Lift cylinder just enough to give access to gudgeon pin (3).

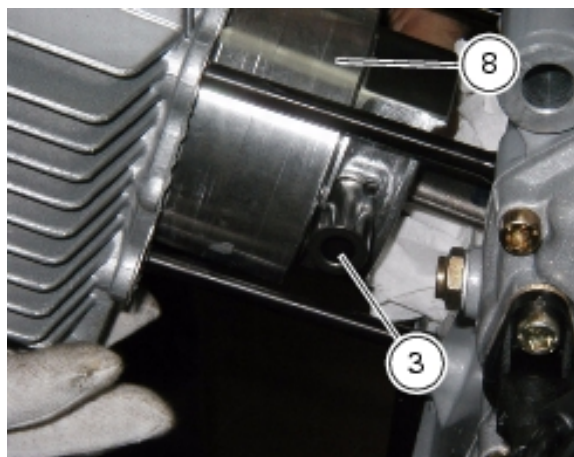
Cylinder and piston are best removed together. This will save time on reassembly, as inserting the piston into the cylinder is a delicate, lengthy procedure. The recommended removal procedure is as follows.

Block off the casing opening with a cloth or with soft paper to prevent foreign matters or solid waste from entering the engine block.

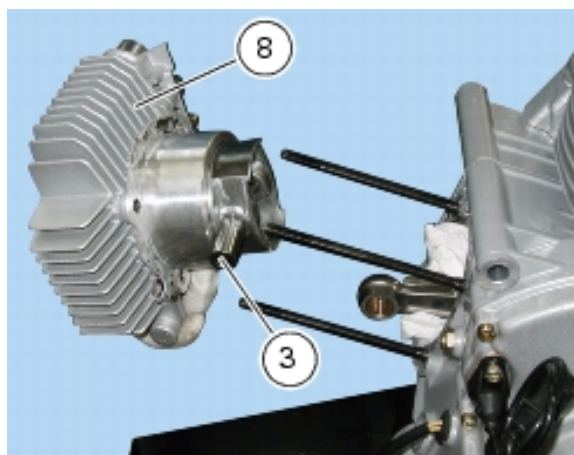
Remove the gudgeon pin (3) circlip (10) on clutch side.



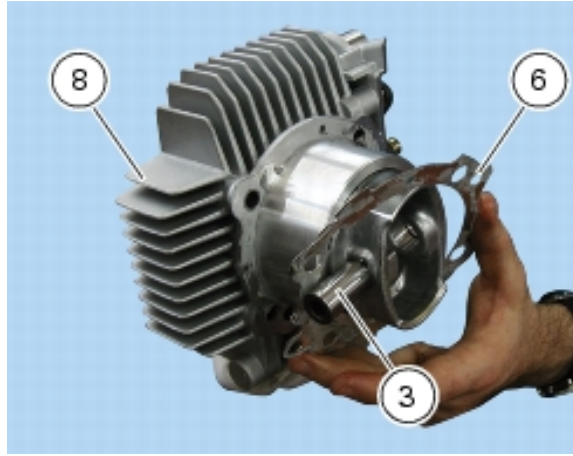
Working from the opposite side, withdraw gudgeon pin (3) just enough to release the connecting rod.



Lift the piston-cylinder assembly clear of the stud bolts.



If you need to service the piston, lift gently until clear of the cylinder.



Remove the gaskets (6) placed between cylinder and casing.

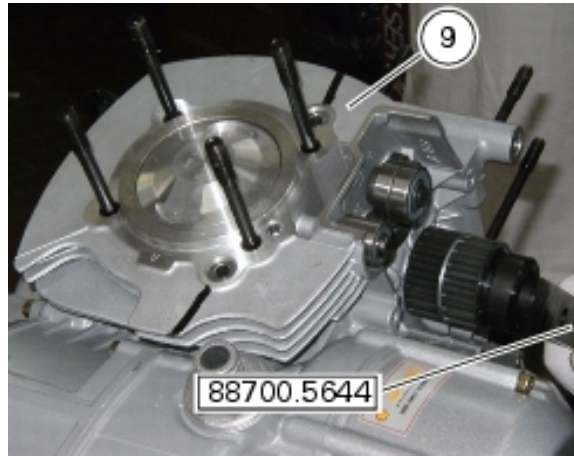


Caution

Mark the pistons with their positions so as to refit each piston to the matching cylinder on reassembly:

V= Vertical - O= Horizontal

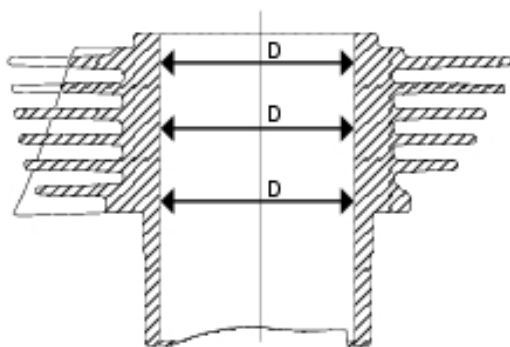
Bring the vertical cylinder piston (9) to top dead centre using tool part no. **88700.5644**. Repeat operations performed on the horizontal cylinder to remove vertical cylinder-piston assembly.



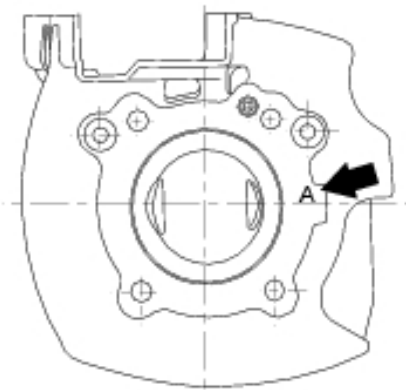
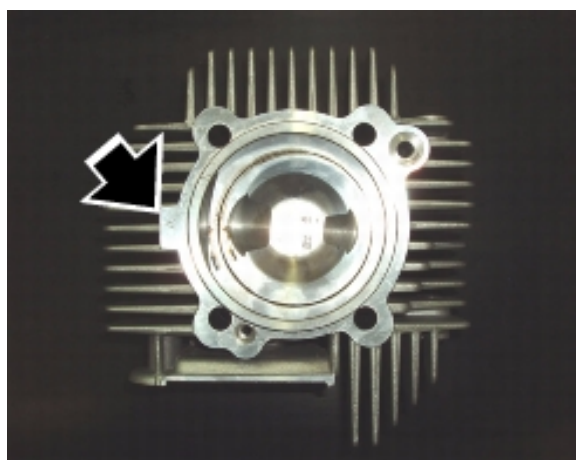
## Overhauling the cylinder / piston assy

### Overhauling the cylinder

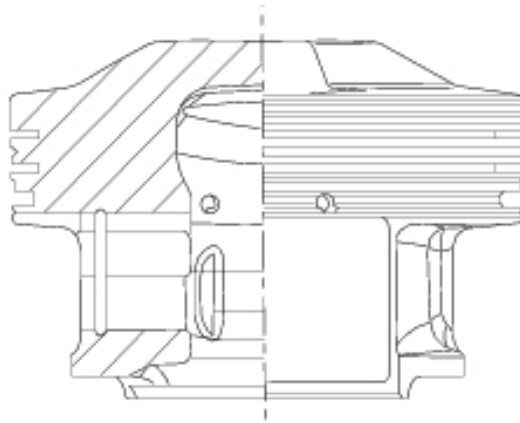
Check that the inner surface is perfectly smooth. Measure the cylinder bore diameter (D) at three different heights and in two directions at 90° to one another. This makes it possible to obtain the coupling, taper and oval values (see specified values under Sect. C 1.1, [Cylinder / piston](#)).



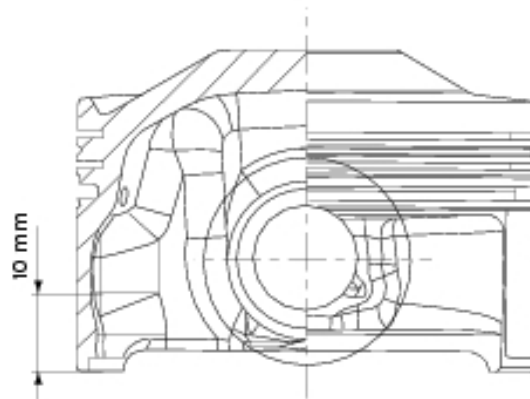
Change the cylinder if damaged or excessively worn. The special silicon carbide coating applied to the inner bore provides excellent friction and wear resistance, but prevents grinding. The cylinders are marked with their class (a letter punched on the side of the cylinder). Always match cylinder and piston from the same class.



Overhauling the piston

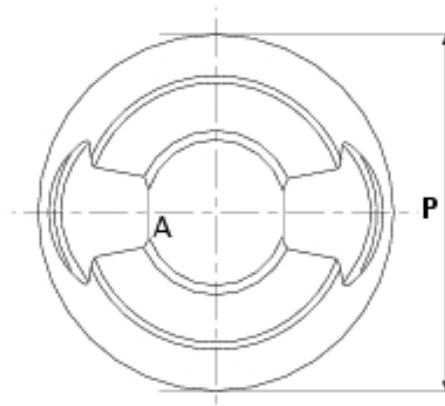


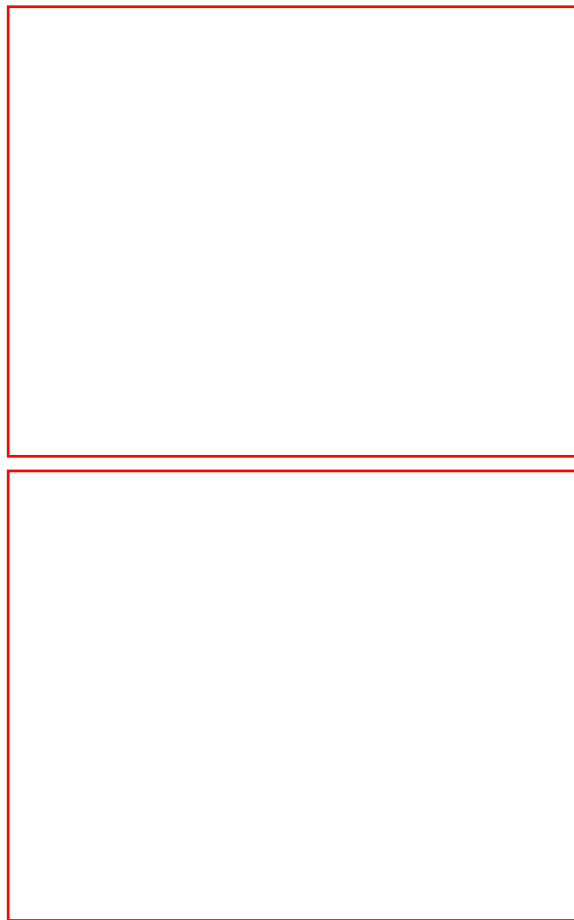
Clean the crown of the piston and the piston ring grooves from carbon deposits.  
Inspect the dimensions of the piston carefully: there must be no signs of shrinkage, scoring, cracks or damage.  
Measure piston diameter (P) **10 mm** above skirt base, at right angles to the axis of the gudgeon pin.  
Pistons must always be changed in pairs.



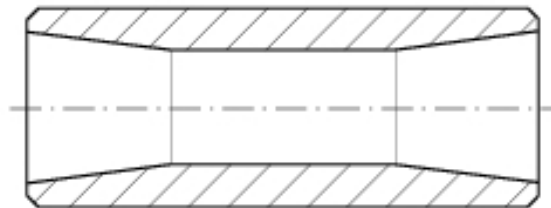
#### Piston-cylinder clearance

Pistons are marked with their class (a letter printed on the piston crown).  
Always match cylinder and piston from the same class.  
For clearance values refer to Sect. C 1.1.





#### Overhauling the gudgeon pins



They must be perfectly smooth, without signs of scoring, steps or blueish stains due to overheating. The well-lubricated gudgeon pin must slide smoothly inside the piston.

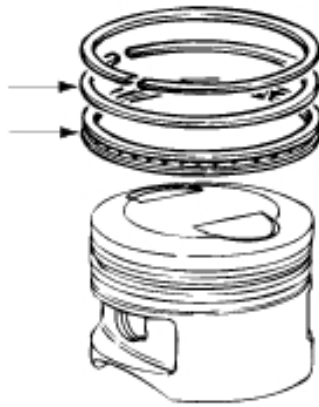
Assembly clearance must be: **0.002-0.008** mm

Max allowed wear limit: **0.035** mm

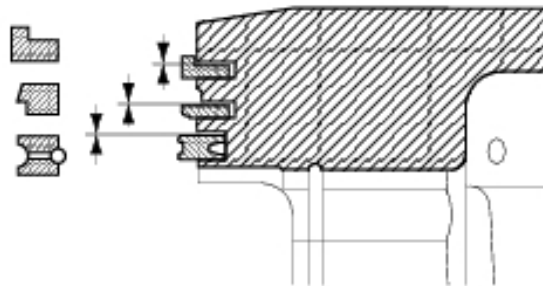
If you change the gudgeon pin, you must also change the connecting rod small end bush.

#### Overhauling the piston rings

The piston rings must not show any signs of forcing or scoring. Spare pistons are supplied with piston rings and gudgeon pin.



Piston ring-piston groove clearance

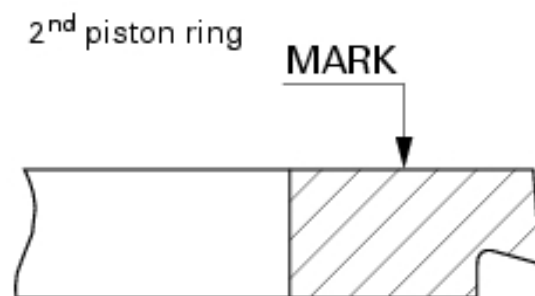


Top (1st) ring max. wear limit: **0.15** mm  
Other rings (2nd ring and scraper ring) wear limit: **0.10** mm

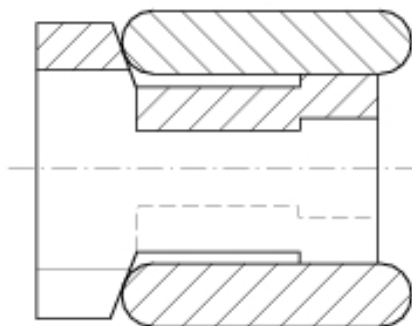


Note

The mark punched on piston rings must always be facing up.



oil scraper ring



Checking the gudgeon pin-piston clearance

Measure the diameter of the piston hole that accommodates the gudgeon pin.

Measure gudgeon pin diameter.

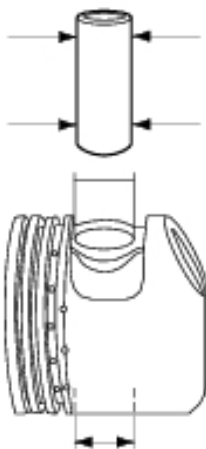
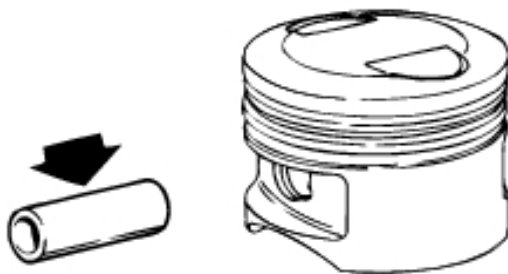
Wear limit:

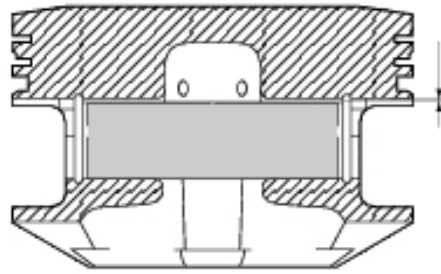
**0,025 mm**



Note

If you change the gudgeon pin, you must also change the connecting rod small end bush.





### Piston rings-cylinder clearance

It is important that piston ring (A) be perfectly square to cylinder during measurement. To this end, fit the piston (9) without the piston rings into the cylinder and place the piston ring to be measured on top of the piston.

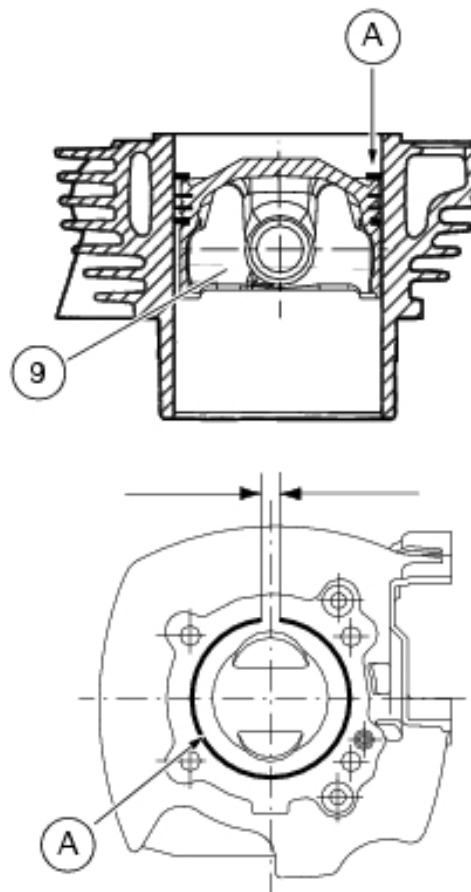
Measure the piston ring end gap:

Top ring and second ring (nominal): **0.20 - 0.40** mm

Wear limit: **0.80** mm.

Oil scraper ring (nominal): **0.30 - 0.60** mm

Wear limit: **1.0** mm.



### Refitting cylinder / piston assy

If you are using new cylinders and pistons, match cylinders and pistons from the same class.

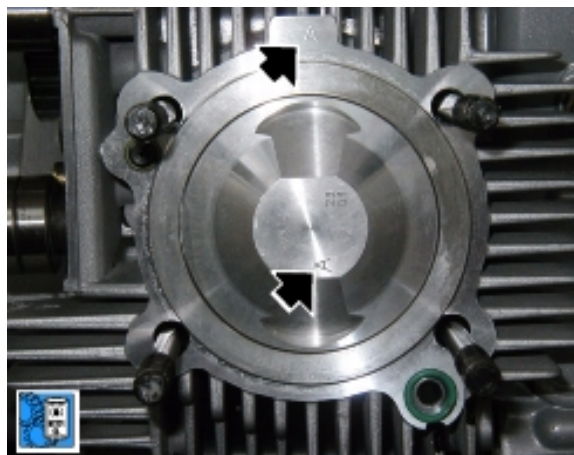
Cylinder class is identified by a letter punched on cylinder top face in the cylinder / head contact surface. Piston class is punched on the piston crown, between the two valve pockets.

If piston and cylinder were separated during disassembly, rotate piston rings so that their open ends are spaced 120 degrees apart. Note that piston ring mark must be facing up (pointing to piston crown).

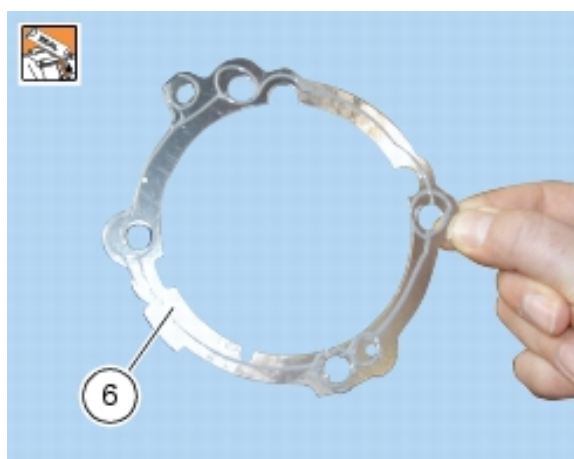
Lubricate cylinder inner bore with engine oil. Use an all-purpose tool to slide piston gently into cylinder with the smaller valve pocket placed at exhaust end.

Clean off any carbon deposits and degrease the mating surfaces of engine casings and cylinders.

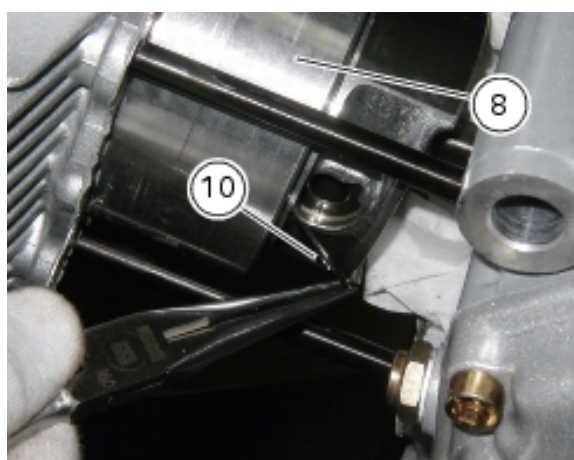
Ensure that the engine block includes the cylinder centring pins (**11**).



Apply liquid gasket to the gasket (6) as shown in the figure.



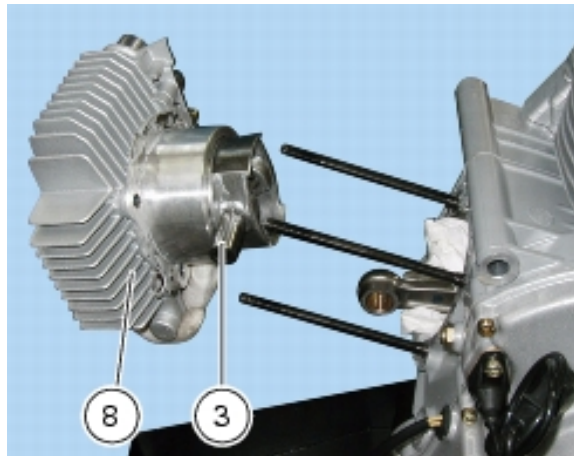
Position the gasket (6) on the cylinder (8). Be sure to match the holes.



Use tool part no. **88700.5644** to bring connecting rod small end to TDC. Slide the cylinder-piston assembly onto the casing stud bolts.



Push connecting rod small end into the piston so as to line up gudgeon pin (3) hole. Lubricate and fit gudgeon pin. Gudgeon pin must slide smoothly inside the con-rod small end bushing and piston (9).



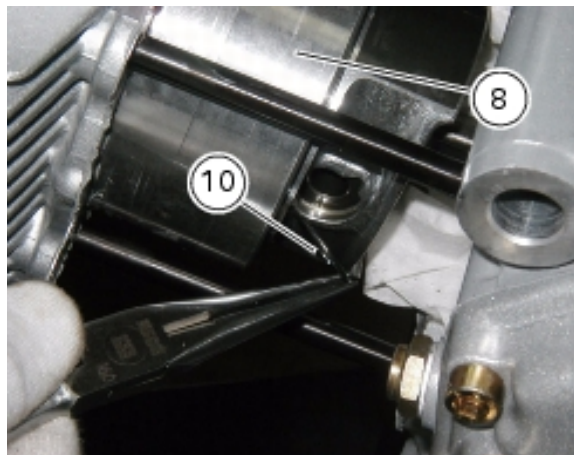
Block off casing opening with a cloth, then fit circlip (10).



**Caution**

At reassembly always use new circlips (10).

Press cylinder (8) down until it contacts the casing.  
Perform same operations to the other cylinder.



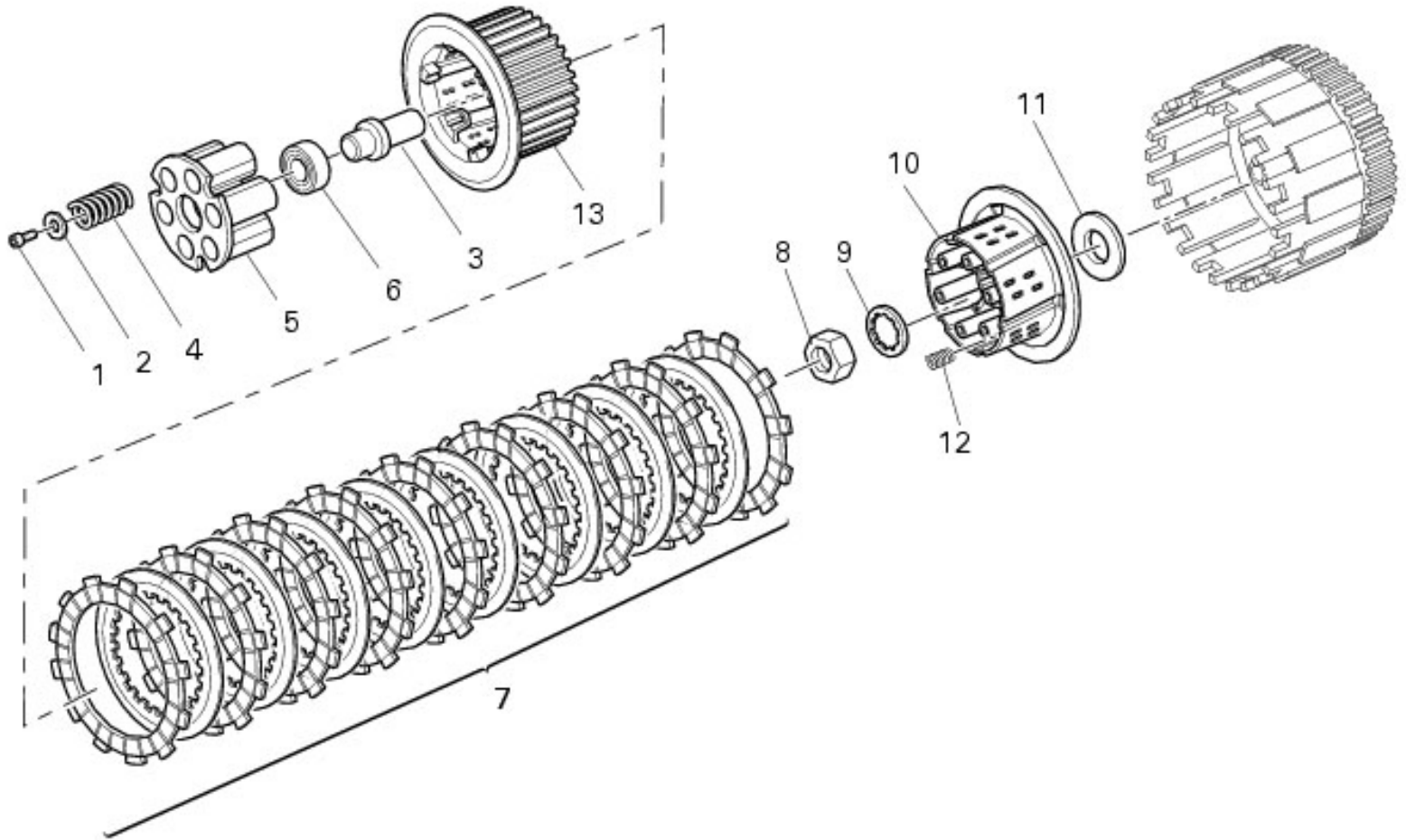
Operations	Reference See Section
Refit heads on the engine	N 4.4, <a href="#">Reassembling the head</a>



Caution

Place the locating pins (7) with the smaller hole pointing away from cylinder.

## 6.1 - Clutch unit: APTC wet clutch



- 1 Screw
- 2 Cap
- 3 Clutch control pin
- 4 Clutch spring
- 5 Pressure plate
- 6 Bearing
- 7 Clutch plates
- 8 Nut
- 9 Safety washer
- 10 Clutch drum
- 11 Shim
- 12 Spring
- 13 Hub

 Spare parts catalogue

[Clutch](#)



## Caution

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

### APTC clutch unit description

The APTC system is a clutch system with follow-up torque and slipper clutch design to eliminate rear wheel hop under braking.

The system offers the following advantages:

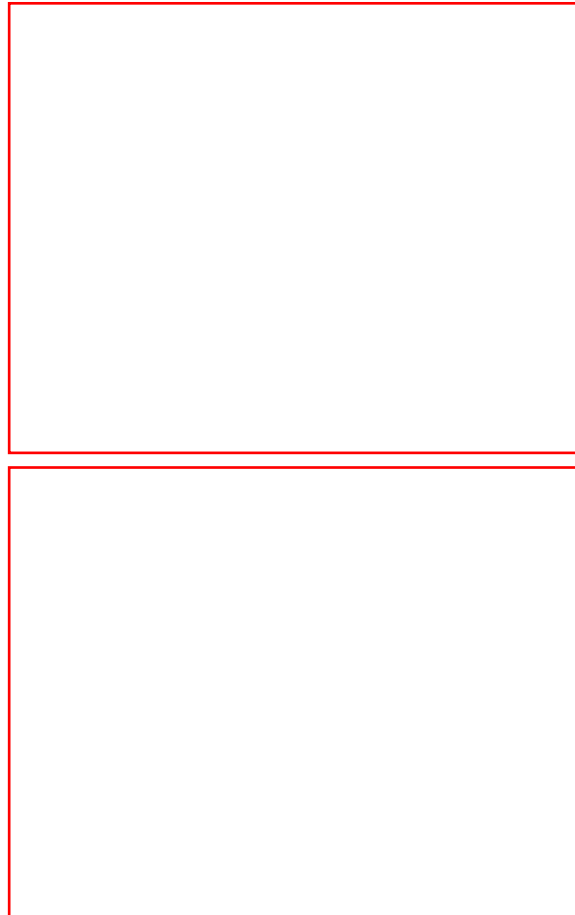
- It eliminates the negative effects associated with heavy engine braking when down shifting thereby ensuring smooth sliding into corners (anti hop feature);
- It reduces the effort required to compress the clutch springs and disengage the clutch. The pull effort required to operate the clutch lever is reduced, while retaining good feel (follow-up torque).

In the APTC system, the two sections of the clutch drum are coupled by helical splines.

It is this special design that provides the follow-up torque and anti-hop features using the axial component of driving torque (under acceleration) and braking torque (under braking), respectively.

What happens is the clutch plate pack is compressed further under acceleration as a result of the driving torque (note that clutch spring pressure has been reduced in the new system), whereas during extreme deceleration braking torque partly removes the pressure causing the clutch plates to slip.

Before operating on the internal clutch parts, check for proper operation. Then deal with the problem in a systematic manner.



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

A clutch which does not disengage may be caused by:

- excessive play of the control lever;
- distorted clutch plates;
- incorrect spring tension;
- faulty clutch mechanism;
- excessive wear of the drum or clutch housing.

A clutch which slips may be caused by:

- insufficient play of the control lever;
- worn clutch plates;
- weakened springs;
- faulty clutch mechanism;
- excessive wear of the hub or clutch housing.

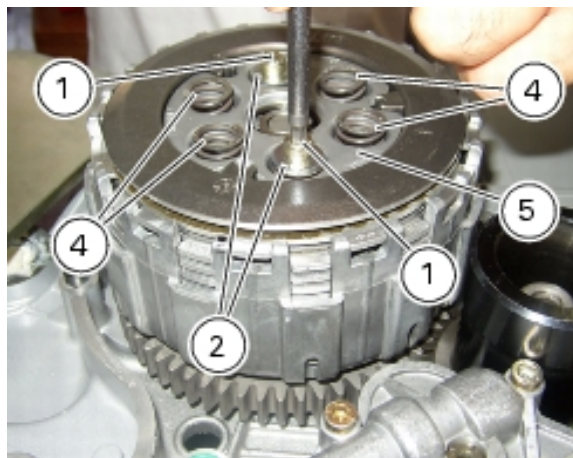
A noisy clutch may be caused by:

- excessive play between the primary drive gears;
- damaged primary drive gear teeth;
- excessive play between drive plate tabs and clutch housing;
- worn gear/clutch housing bearing;
- the presence of metal particles (filings) on the gear teeth.

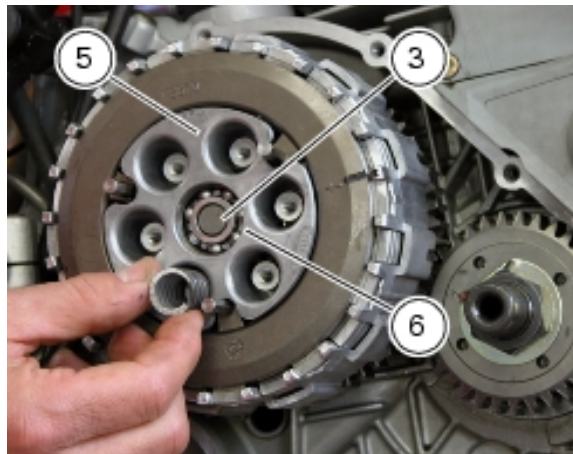
## Disassembling the APTC system

Operations	Reference See Section
Drain engine oil	D 4, <a href="#">Changing the engine oil and filter cartridge</a>
Remove the clutch cover	N 6.2, <a href="#">Removing the clutch cover</a>

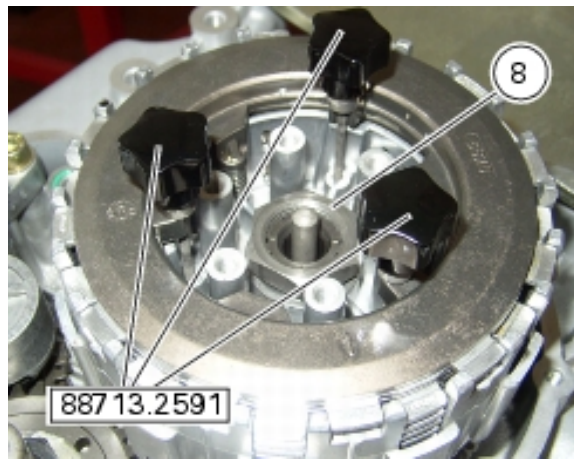
Unscrew the retaining screws (1) and remove the washers (2) and the springs (4) of pusher plate (5).



Pull out the pressure plate (5) with the pushrod (3). If needed, extract the bearing (6) placed on the inside of the pressure plate (5) using a suitable drift.



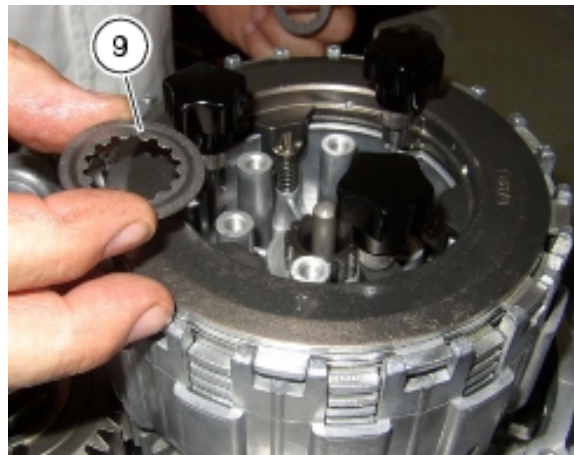
Screw in the three tools part no. **88713.2591** into the suitable housings on the hub (13).



Lock the clutch housing with tool part no. **88713.2556** and loosen the nut (8).



Remove the safety washer (9).



Slide the hub-plates-drum assembly out of the housing (A), use tools part no. **88713.2591**.



Remove the spacer (11) from the housing.

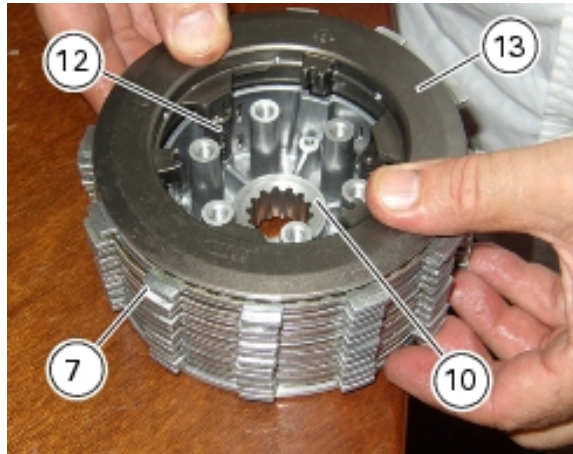


Disassembling the hub-plates-drum assembly

Remove the three tools part no. **88713.2591**.

Remove the hub (13) and the plates (7) from the drum (10). Collect the three springs (12).

Remove the plates (7) from the hub (13).



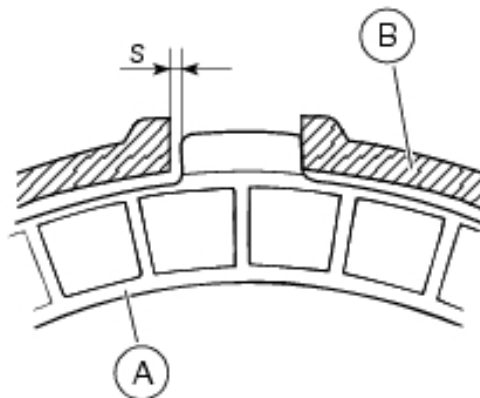
 Caution

Keep the plates in the same order as originally fitted. You may find it convenient to tie the plates together while putting them on the bench.

### Checking and overhauling the APTC unit

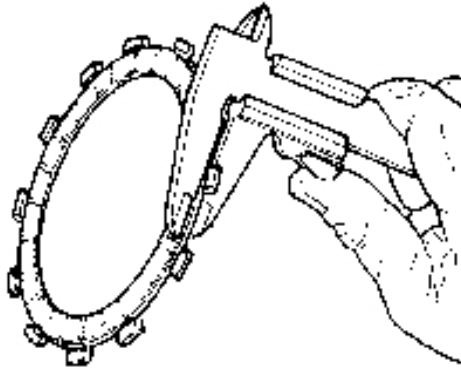
#### Clearance between clutch housing and drive plate

Insert the drive plate (A) in the clutch housing (B) and measure clearance (S) with a feeler gauge. The clearance "S" must not exceed **0.6 mm**. If it does, change the plates and, if necessary, the clutch housing.



#### Overhauling the clutch plates

The clutch plates must not show any signs of blackening, grooves or deformation. Measure the thickness of the drive plates (friction plates). It should not be less than **3.2 mm**.



 Caution

Overall thickness of the set of clutch plates should not be less than **50,2** mm.

Place the plate on a flat surface and check the amount of deformation with a feeler gauge.  
Max flatness error: **0.2** mm.

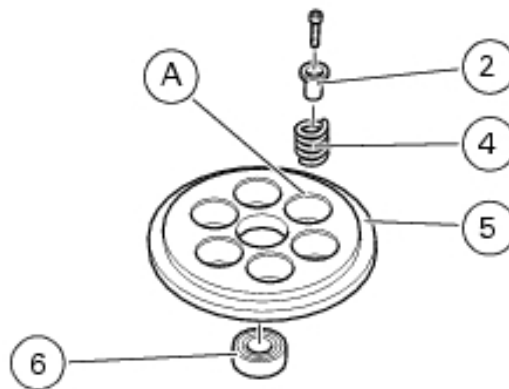


Overhauling the pressure plate

Check bearing (6) condition. Change bearing if you find too much play.

Check contact surface of last driven plate. If extremely scored, apply a lapping compound (6-12 micron thick) onto a working surface and move the plate until it is perfectly flat.

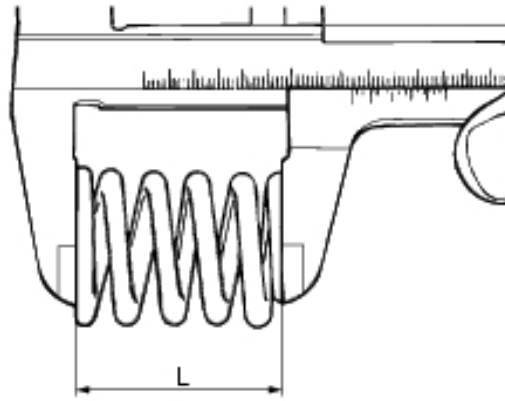
Check the condition of the spring guides (A) of the pressure plate (5). Change the spring caps (2) at every overhaul.



Overhauling the pressure plate springs

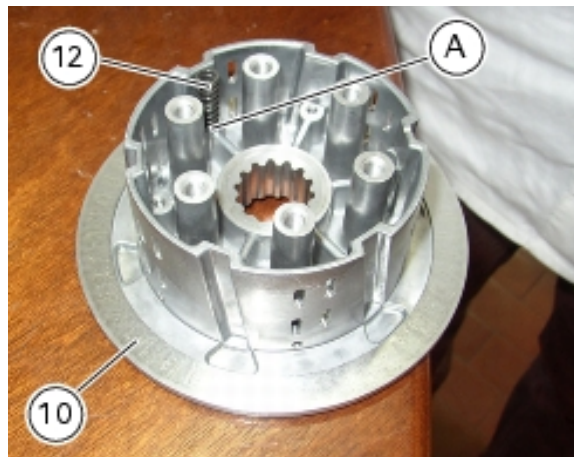
Measure the length "L" of the uncompressed springs (4):

Minimum length: **41 mm**.  
Change any springs which are shorter than that.



Reassembling the hub-plates-drum assembly

Fit the three springs (12) on pin (A) onto drum (10).



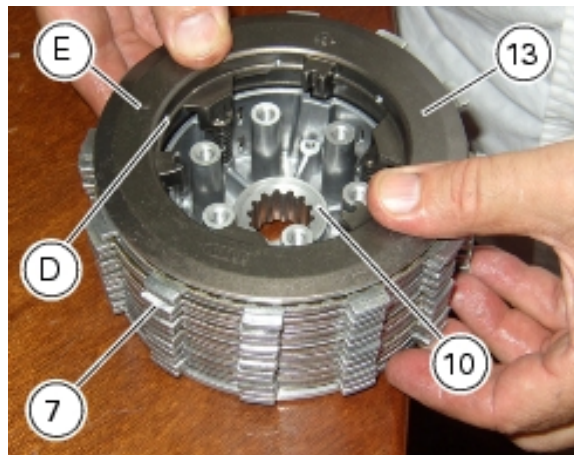
Fit the clutch plates (7) on hub (13), start with one of the 11 driving plates (B) alternated with the 10 driven plates (C).

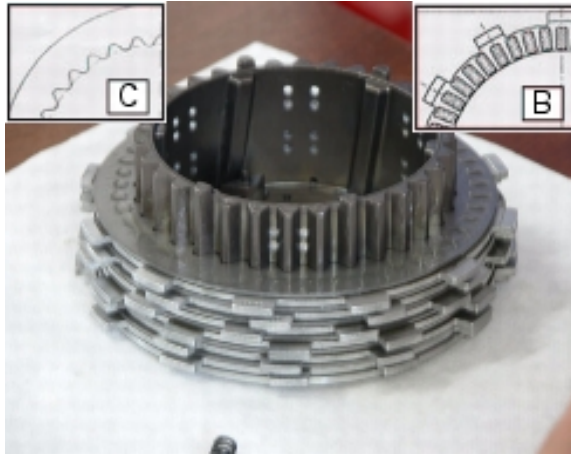
Fit all clutch plates (7) with hub (13) on the drum (10).



Warning

While refitting the drum (10) and hub (13), align the reference marks (D) and (E).





Insert the three tools part no. **88713.2591** and secure the hub (13) to the drum (10).  
Screw in the three tools part no. **88713.2591** by hand, press with a hand on the clutch plate pack and hub (13) to overcome the springs (12) load.

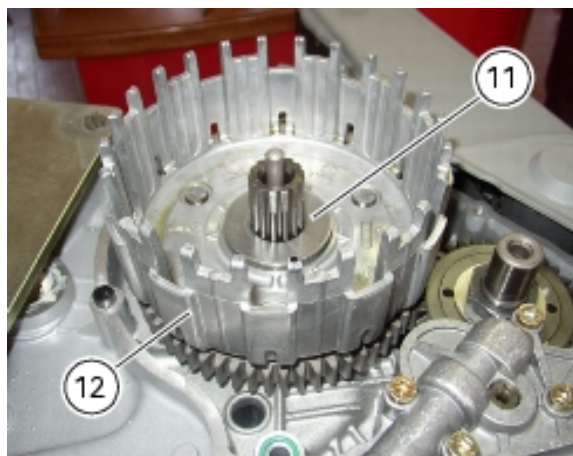


Note

Screw in the three tools part no. **88713.2532** until the clutch plates are slightly loaded.

### Reassembling the APTC unit

Position the spacer (11) on the housing (12).

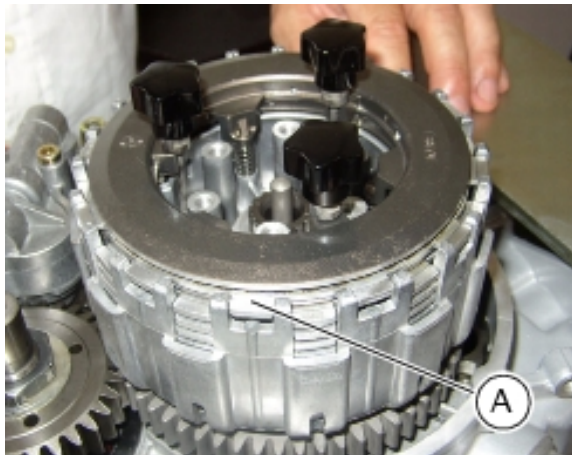


Position the hub-plates-drum assembly inside the housing (12).

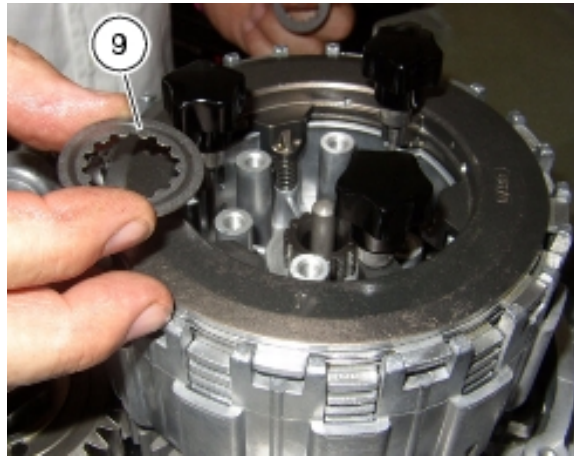


Note

Fit the last clutch plate (A) so that it is "offset" with respect to the others.

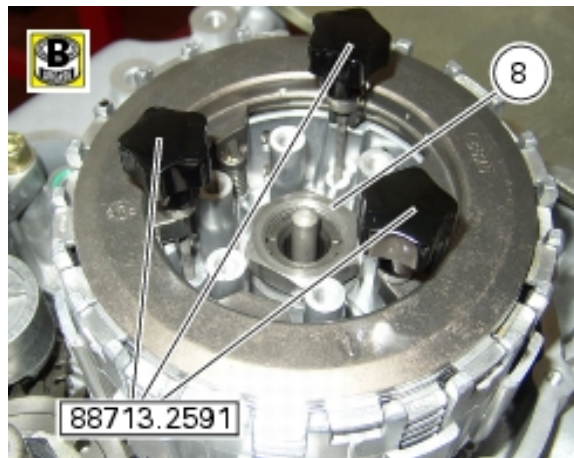


Fit the safety washer (9) to the primary shaft.

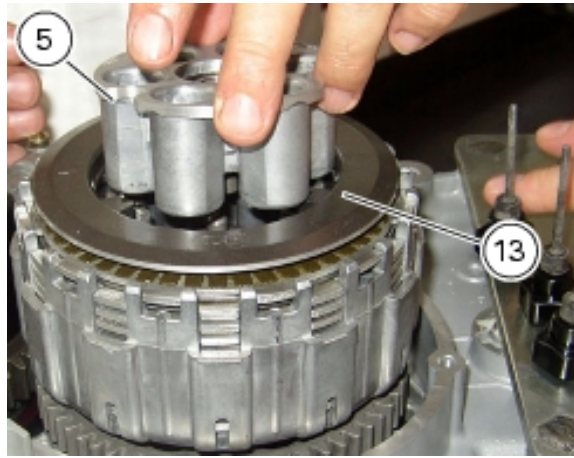


Smear recommended grease onto nut (8) thread and primary shaft thread, then fit the nut finger tight onto primary shaft.

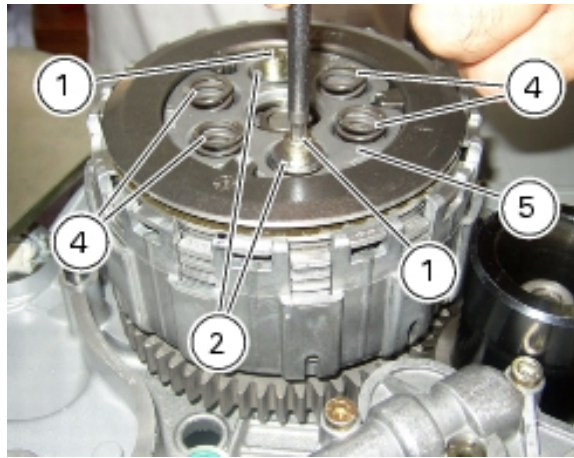
Lock clutch housing with tool part no. **88713.2556**, so to hold it while tightening nut (8).  
Tighten the nut (8) to the specified torque (Sect. C 3).



Remove the three tools part no. **88713.2591**.  
Fit the pusher plate (5) inside the hub (13).



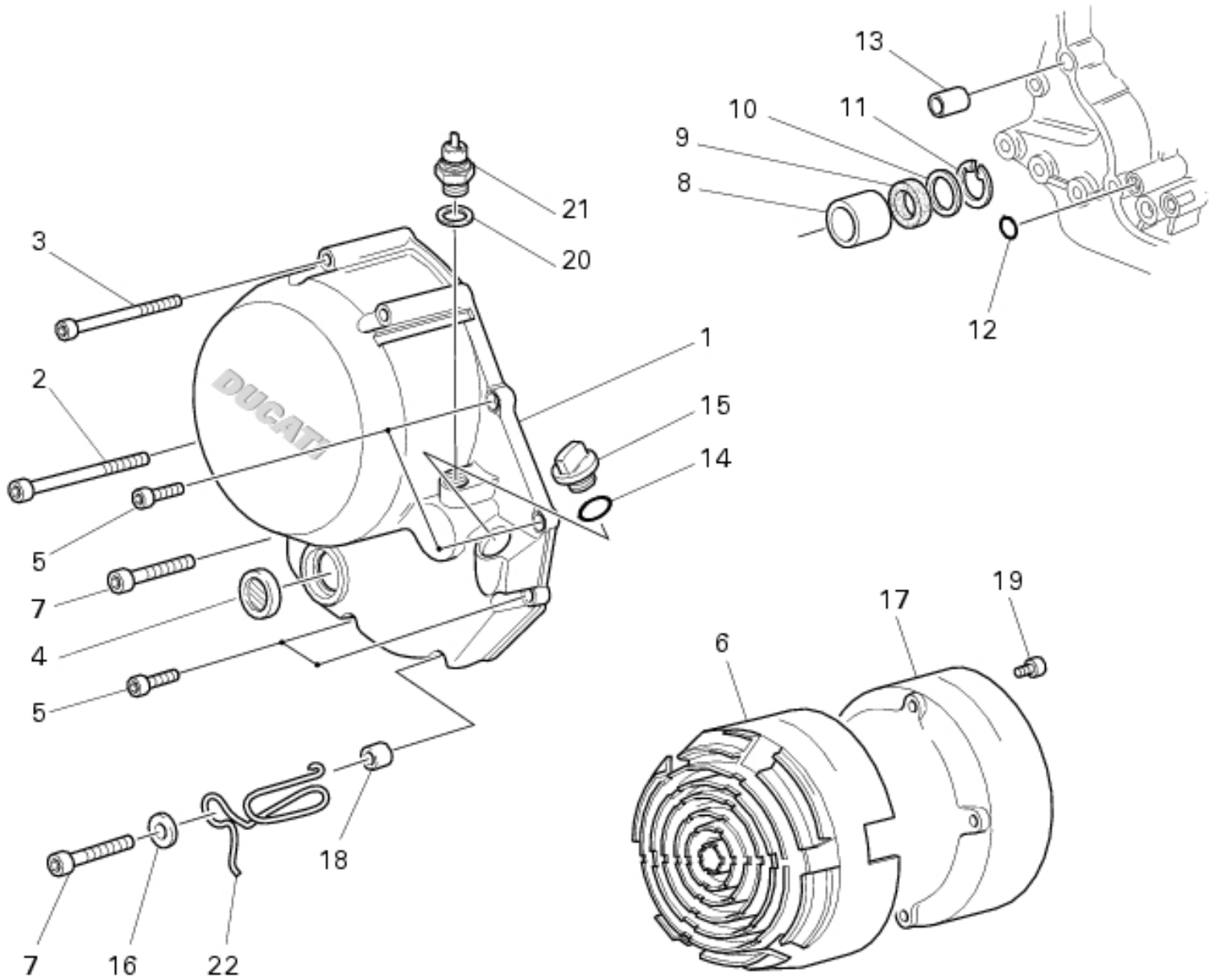
Insert one spring (4) and one washer (2) in each recess.  
Tighten the screws (1) to the specified torque (Sect. C 3) in a cross sequence.



Remove tool part no. **88713.2556**.


Operations	Reference See Section
Refit the clutch cover	N 6.1, <a href="#">Refitting the clutch cover</a>
Fill oil into the engine	D 4, <a href="#">Changing the engine oil and filter cartridge</a>

## 6.2 - Clutch unit: clutch cover



- 1 Cover, clutch side
- 2 Screw
- 3 Screw
- 4 Oil sight glass
- 5 Screw
- 6 Panel (BLACK)
- 7 Screw
- 8 Bush
- 9 Seal
- 10 Shim
- 11 Circlip
- 12 O-ring
- 13 Centring bush
- 14 O-ring
- 15 Blanking plug
- 16 Washer
- 17 Cover
- 18 Spacer

- 19 Screw
- 20 Seal, thk. 2
- 21 Pressure switch
- 22 Mount

 Spare parts catalogue

## [Clutch cover](#)



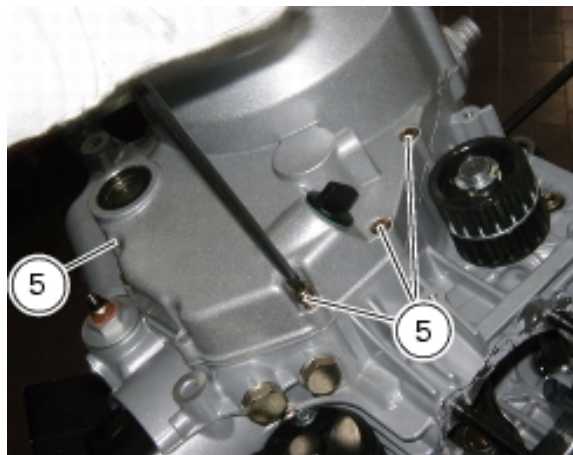
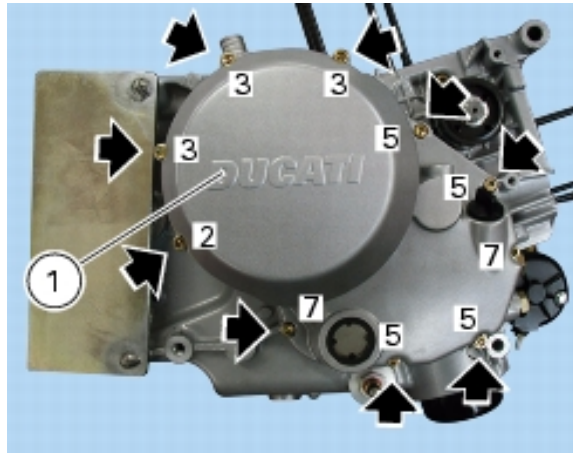
### Caution

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

## Removing the clutch cover

Operations	Reference See Section
Drain engine oil	D 4, <a href="#">Changing the engine oil and filter cartridge</a>
Disconnect oil pressure sensor	P 5, <a href="#">Checking front and rear STOP switches, neutral switch, oil pressure switch and clutch switch</a>

Unscrew the screw (7) placed at the bottom end of the clutch cover.  
 Remove the screw (7), the washer (**16**), cable bracket (**22**) and spacer (**18**).  
 Unscrew the retaining screws (2), (3) and (5) of clutch cover (1).



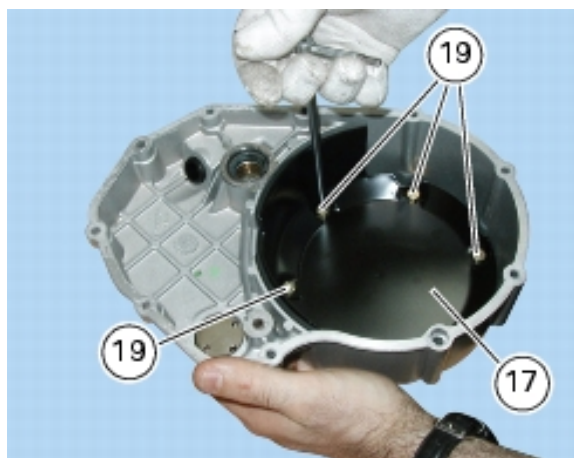
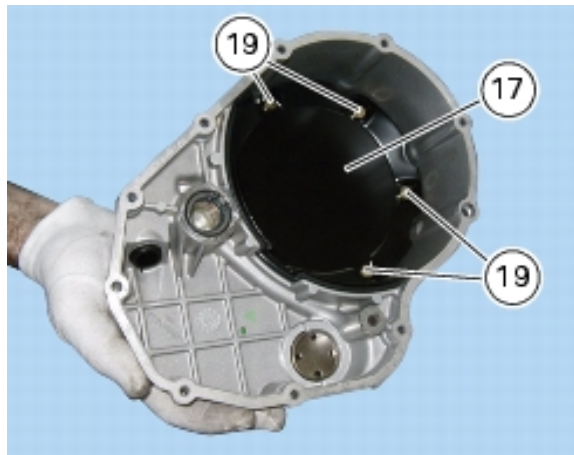
Tap at various positions along cover outer edge with a plastic mallet to aid removal.



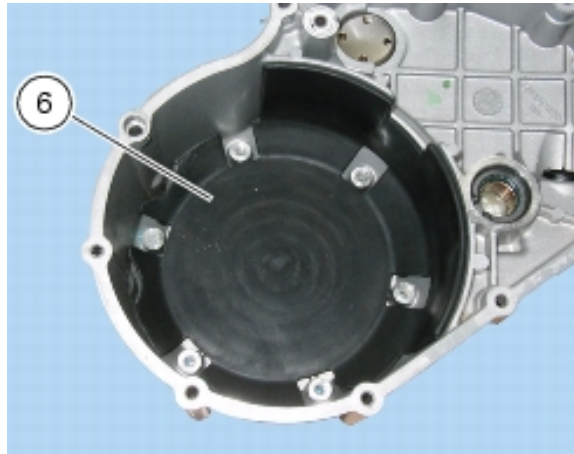
Take off clutch cover (1) and collect the locating bush (13).  
Check locating bush (13). Replace if distorted.

### Disassembling the clutch cover

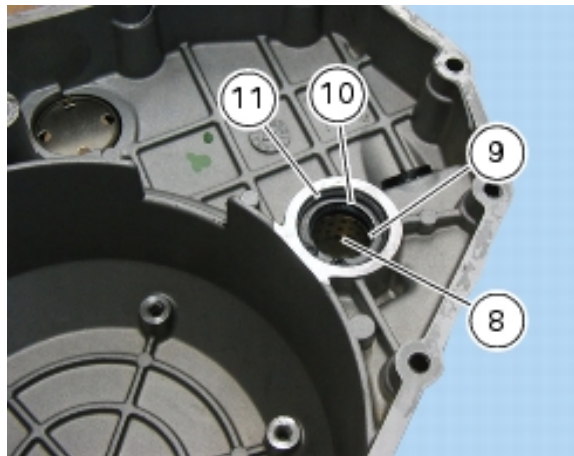
Unscrew the six retaining screws (19) of the inner cover (17).

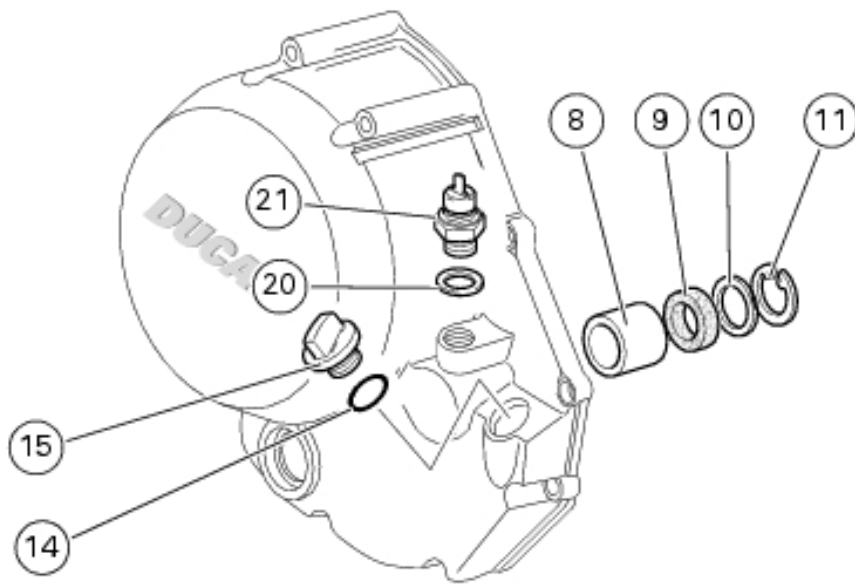


Remove inner cover (17) and sound-deadening panel (6).



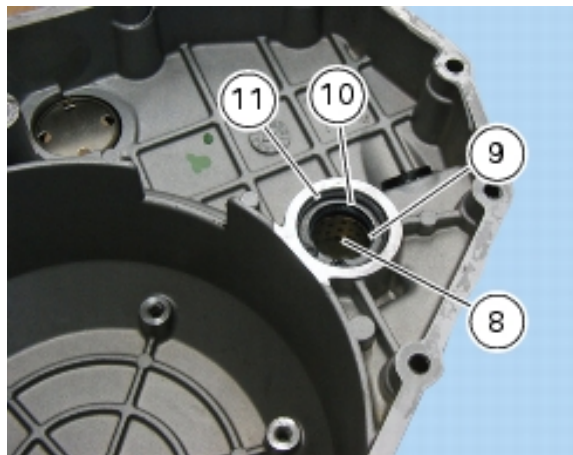
Remove the circlip (11) and withdraw the shim (10) and the seal (9).  
The drilled bush (8) is an interference fit in the cover. Remove with a suitable puller.  
Visually inspect the seal (9) and replace as required.  
Remove the plug (15) and its O-ring (14), the engine oil pressure switch (21) and its seal (20) from the cover.



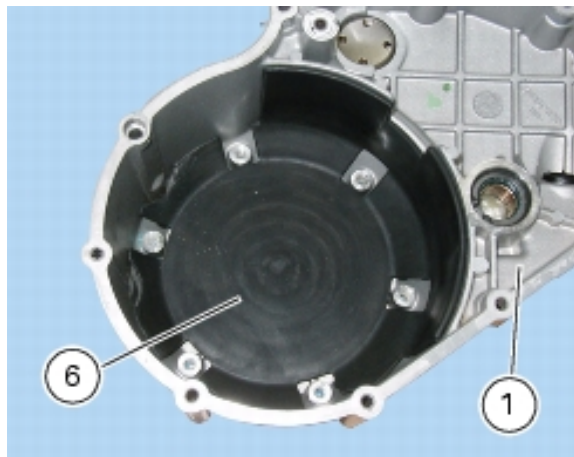


### Reassembling the clutch cover

Fit the plug **(15)** and the seal **(14)**. Install the pressure switch **(21)** and the seal **(20)**.  
When fitting a new bush **(8)**, drive it fully home into the clutch cover seat using a press and a suitable drift.

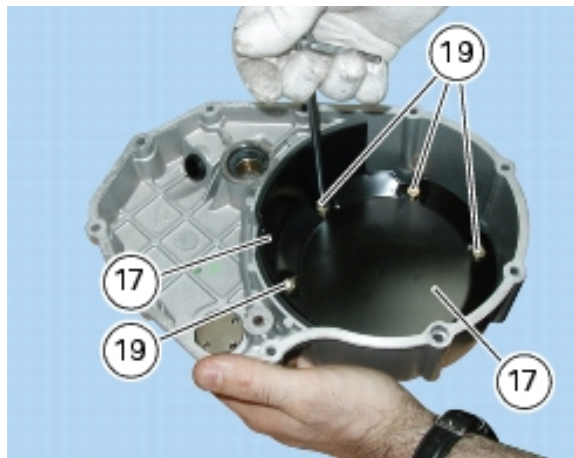


Position the sound-deadening panel **(6)** inside the clutch cover **(1)** as shown in the figure.



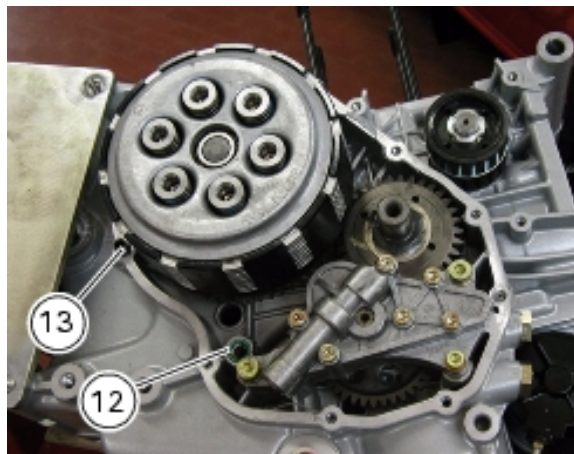
Position the inner cover (17) to the panel (6).

Position the six retaining screws (19) and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).

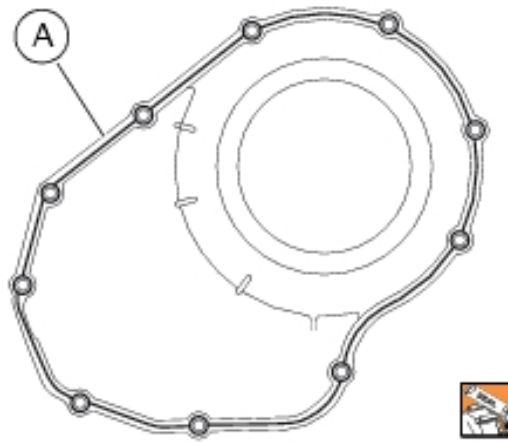


### Refitting the clutch cover

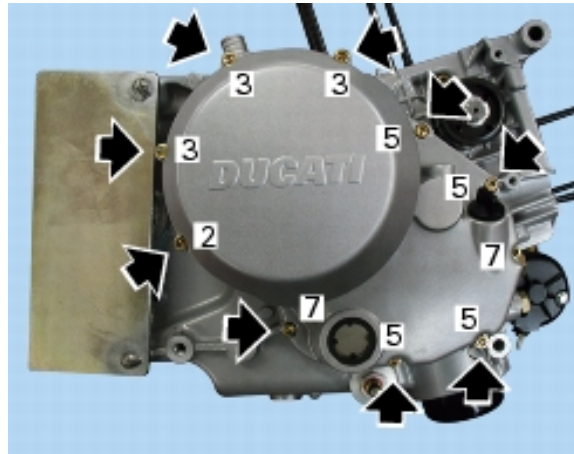
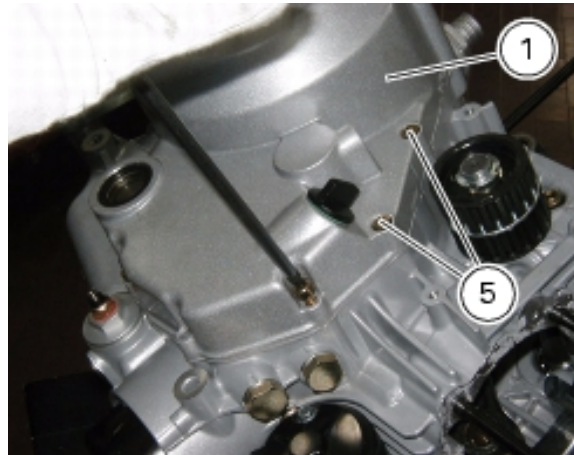
Clean and degrease mating surfaces on cover and casing and ensure that the centring bush (13) and the O-ring (12) at the lubrication drill are fitted in the casing.



Apply an even, regular bead of DUCATI liquid gasket (A) on the mating surface of the casing and around all holes.



Locate the complete cover (1) to the casing and start the retaining screws in their holes. Tighten the screws (2), (3), (5) and (7) to the specified torque (Sect. C.3, [Engine torque settings](#)) in a cross sequence.



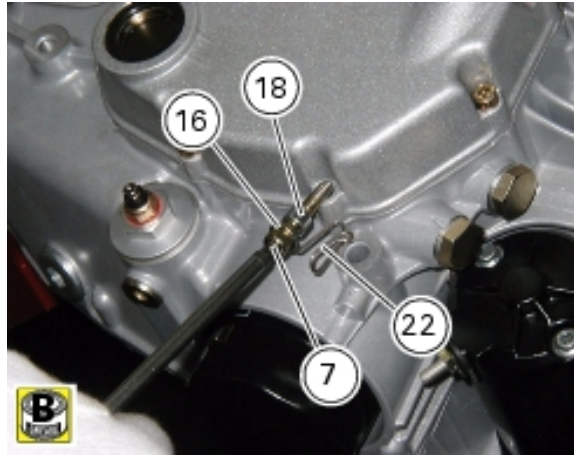
Note

Refit the cable guide (22), bush (18) and washer (16).

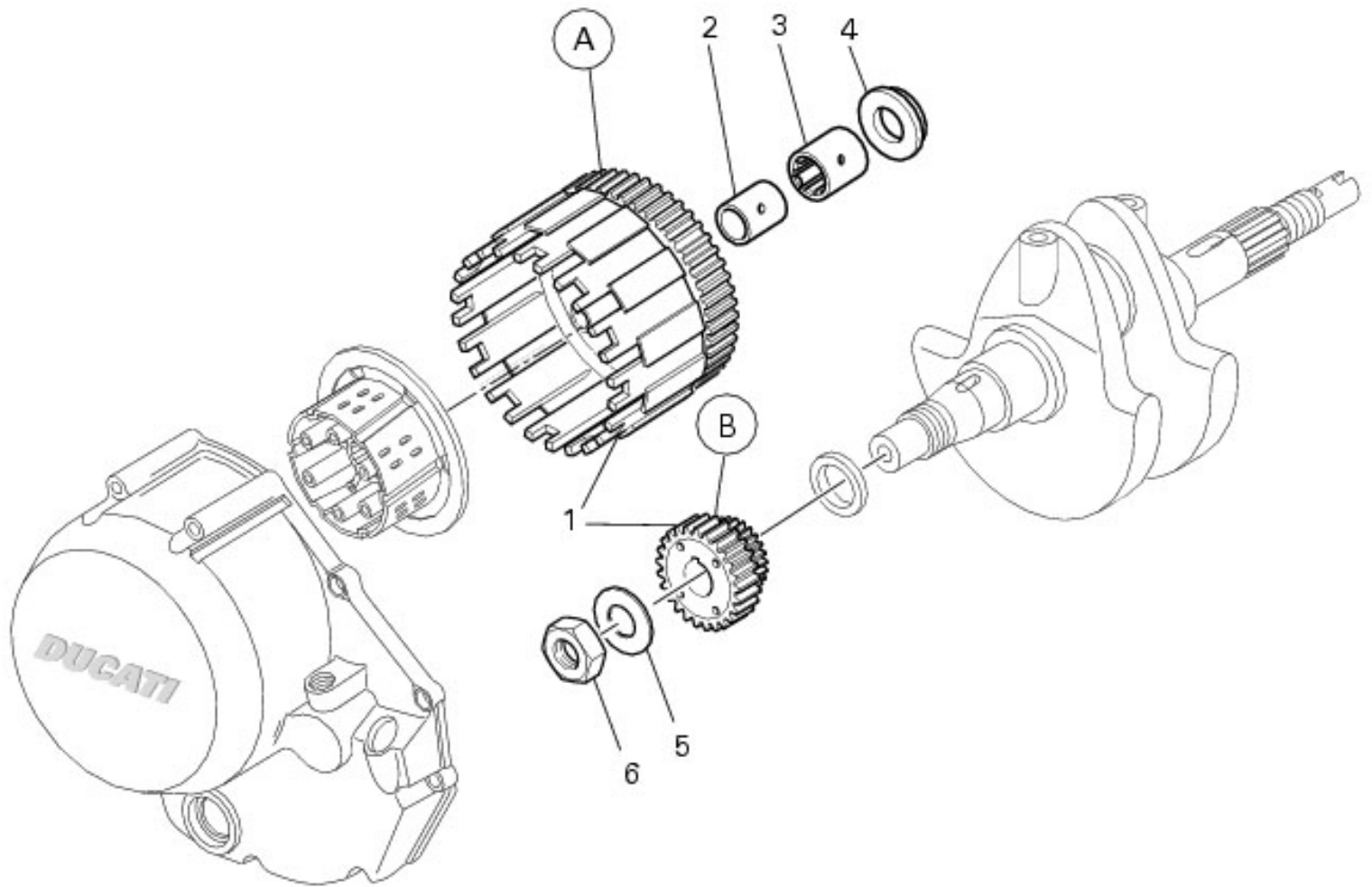
Operations	Reference See Section
Connect oil pressure sensor	P 5, <a href="#">Checking front and rear STOP switches, neutral switch, oil pressure switch and clutch switch</a>

Fill engine with oil


D 4, [Changing the engine oil and filter cartridge](#)



## 6.3 - Clutch unit: primary gears



- 1 Clutch housing/Primary drive gears
- 2 Inner ring
- 3 Inner bearing
- 4 Spacer
- 5 Threaded ring nut
- 6 Safety washer

 Spare parts catalogue

[Clutch](#)

[Clutch cover](#)

[Crankshaft](#)

 Caution

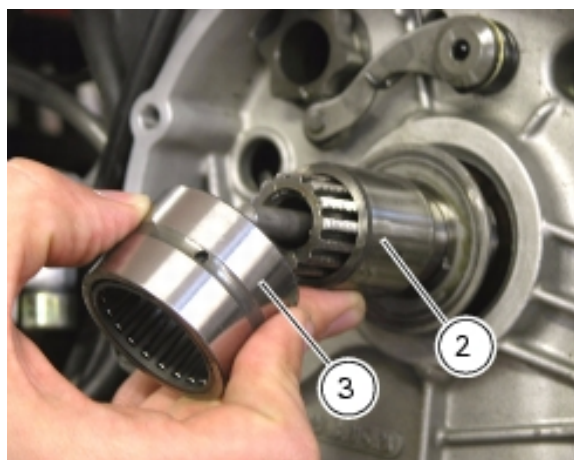
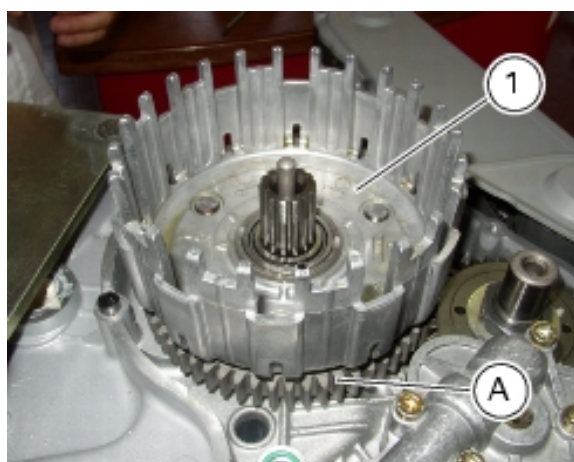
Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear

in the figures near the text.

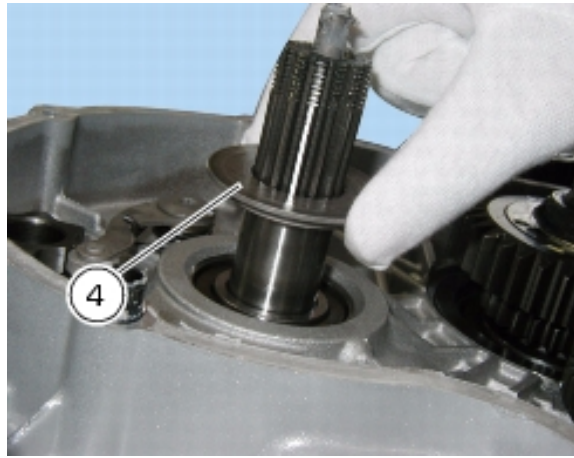
## Disassembling the primary drive gears

Operations	Reference See Section
Drain engine oil	D 4, <a href="#">Changing the engine oil and filter cartridge</a>
Remove the clutch cover	N 6.2, <a href="#">Removing the clutch cover</a>
Remove the clutch	N 6.1, <a href="#">Disassembling the APTC system</a>
Remove the oil pump	N 2.1, <a href="#">Removing the oil pump</a>

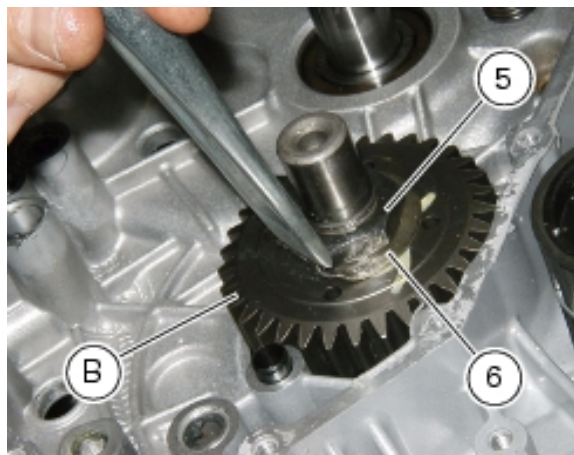
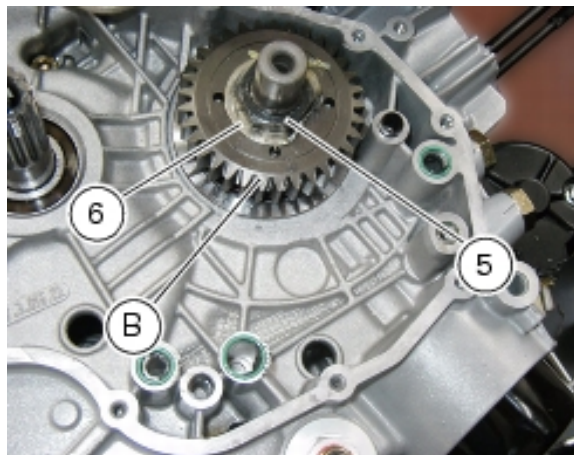
Remove the clutch housing (1) together with needle roller bearing (3), inner ring (2) and driven gear of primary transmission (A).



Remove the inner spacer (4).



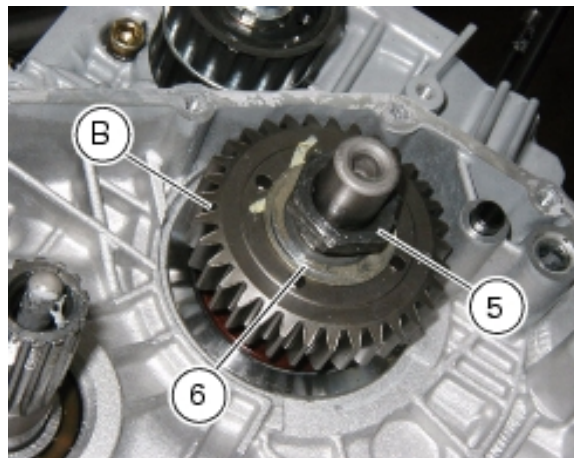
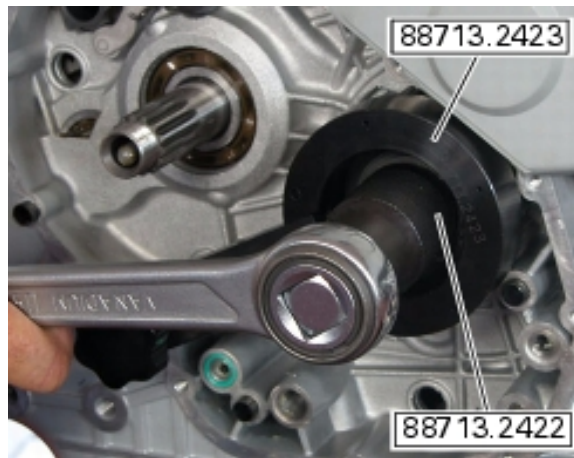
Unbend the safety washer (6) onto ring nut (5) securing the driving gear of primary transmission (B).



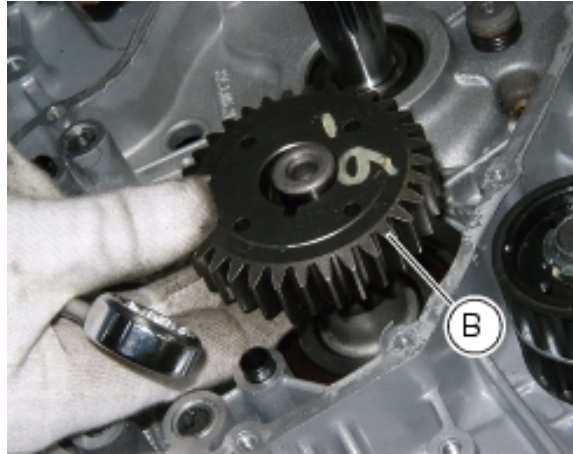
Hold the primary drive gear (B) using wrench part no. **88713.2423** and release the sprocket ring nut (5) using bush

part no. **88713.2422**.

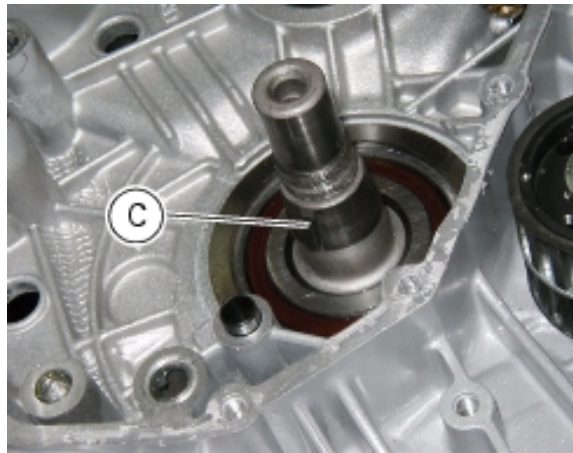
Remove the ring nut (5) and the safety washer (6).



Remove the driving gear of primary transmission (B) using the puller part no. **88713.2092**; fit an aluminium or brass plate between puller screw and crankshaft.

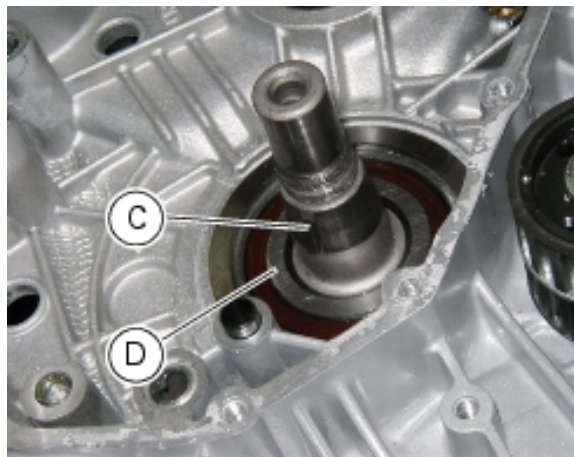


Do not damage the key (C) onto the crankshaft and the inner spacer.



### Refitting the primary drive gears and checking meshing play

Degrease the taper end of the crankshaft and the mating surface on the primary drive gear accurately. Check that the key (C) and inner spacer (D) are correctly fitted to the crankshaft.



Fit the driving gear (B) onto the crankshaft with oil pump control sprocket facing the casing.



Temporarily lock with the washer (6) and the ring nut (5).



**Caution**

If a new primary driving gear (B) is fitted, check its meshing play.



To check the meshing clearance, temporarily fit the clutch housing (1) together with inner spacer (4), driven gear (A), roller bearing (3) and inner ring (2), onto the gearbox primary shaft. Fix a dial gauge to the engine casing and place pointer tip in contact with a gear tooth.

Turn the driven gear (A) to match teething and check with the dial gauge that play ranges between **0.05** and **0.07** mm.

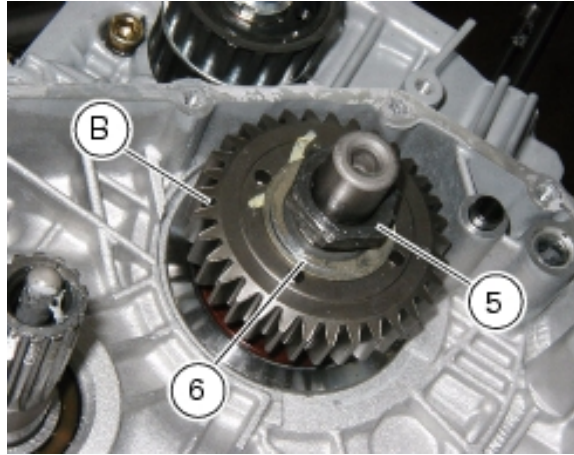
Repeat measurement at 16 positions of the driven gear.

If taken values are outside the allowed tolerance, change the position of the driven gear (A) onto the primary shaft leaving the driving gear (B) on the crankshaft untouched. If play is still outside the limits, change the primary drive gear pair (1).

When finished, fit bush part no. **88713.2422** to a torque wrench, hold sprocket (B) with wrench part no.

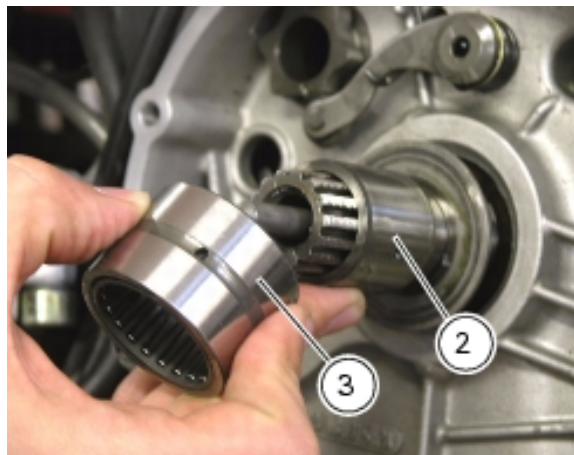
**88713.2423** and tighten ring nut (5) to the specified torque (Sect. C 3, [Engine torque settings](#)).

Bend the washer (6) onto the driving gear (B) at milled zone and onto the ring nut (5) at a diametrically opposed position.

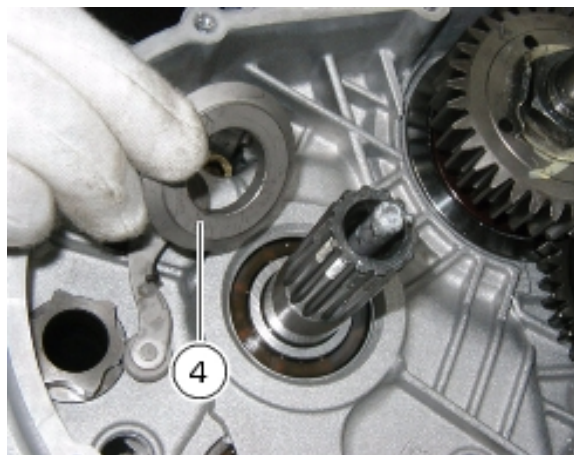


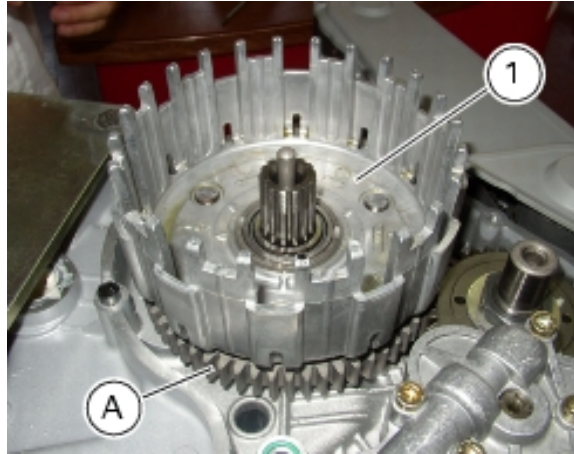
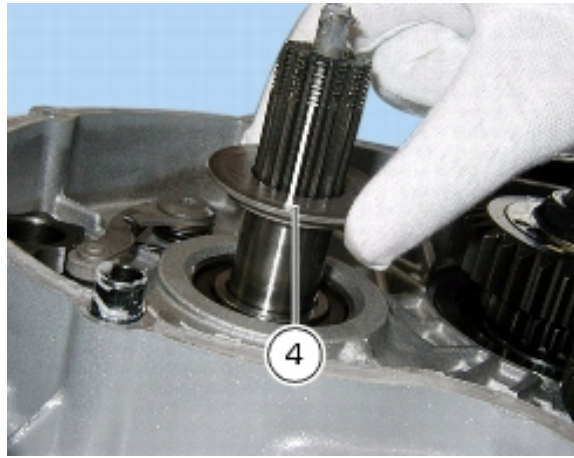
Refit the oil pump and check meshing play between oil pump gear and primary drive gear on crankshaft (Sect. N 2.1, [Refitting the oil pump](#)).

Carefully degrease the mating surfaces of clutch housing (1), inner bearing (3) and bush (2).



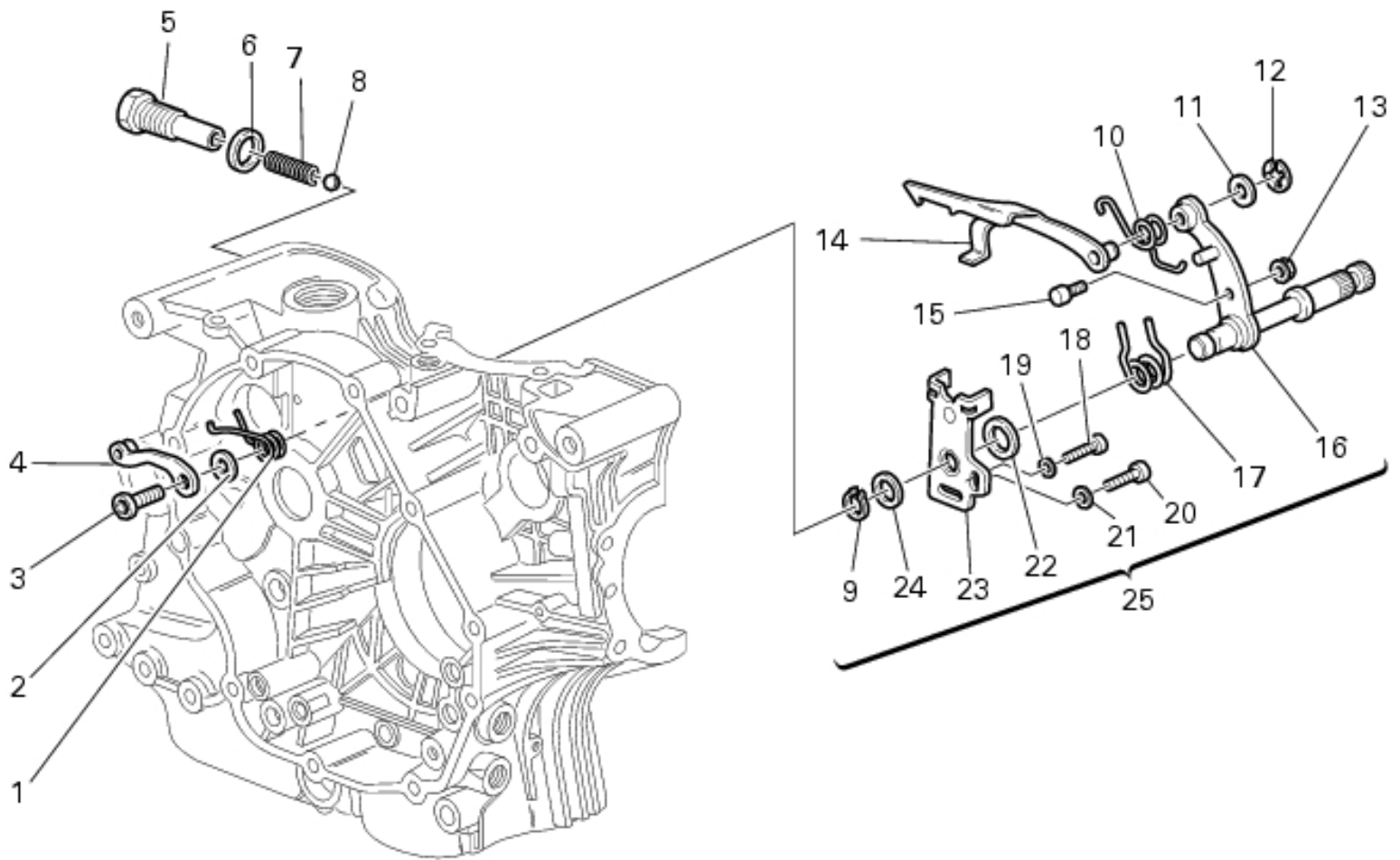
Slide the inner spacer (4) on the primary shaft with the flat side facing outwards. Fit the clutch housing (1) and the driven gear (A) together with needle roller bearing (3) and inner ring (2).






Operations	Reference See Section
Refit the clutch	N 6.1, <a href="#">Reassembling the APTC unit</a>
Refit the clutch cover	N 6.2, <a href="#">Refitting the clutch cover</a>
Fill oil into the engine	D 4, <a href="#">Changing the engine oil and filter cartridge</a>

## 7.1 - Gearbox assembly: gear selector levers



- 1 Return spring
- 2 Washer
- 3 Special screw
- 4 Ratchet unit
- 5 Gear stopper bolt
- 6 Gasket
- 7 Gear stopper spring
- 8 Ball
- 9 Circlip
- 10 Fork return spring
- 11 Shim thk. 0.5
- 12 Shim thk. 0.2
- 13 Circlip
- 14 Nut
- 15 Gearbox drum control fork
- 16 Gear lever pin
- 17 Shaft with gear lever
- 18 Gear lever return spring

- 19 Screw
- 20 Washer
- 21 Screw
- 22 Washer
- 23 Locating ring
- 24 Stop plate
- 25 Shim thk. 0.2
- 26 Shim thk. 0.5
- 27 Complete gear selector lever

 Spare parts catalogue

[Gearchange](#)

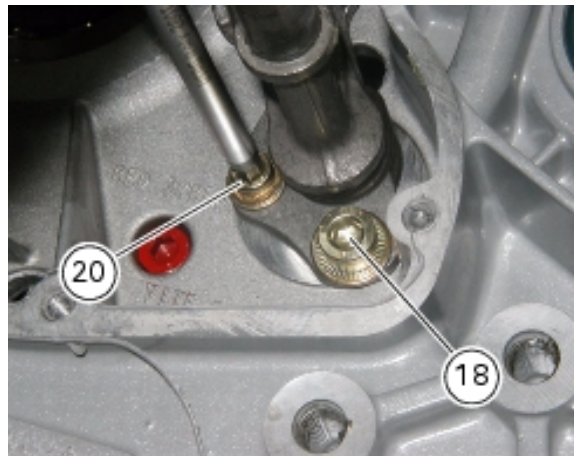
### Caution

**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

### Removing the gear selector levers

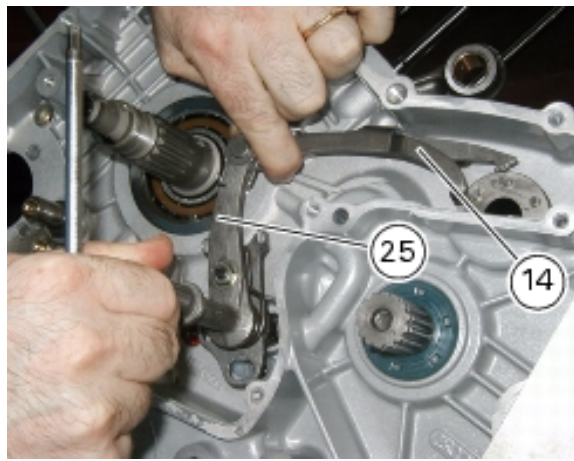
Operations	Reference See Section
Remove generator cover and flywheel/generator assembly	N 8, <a href="#">Flywheel - generator</a>
Remove clutch housing	N 6.3, <a href="#">Disassembling the primary drive gears</a>

Undo the complete gear selector lever (25) retaining screws (18) and (20).  
Remove screws (18) and (20), washers (19) and (21) and slide out gear selector lever complete with control shaft, spring and plate.



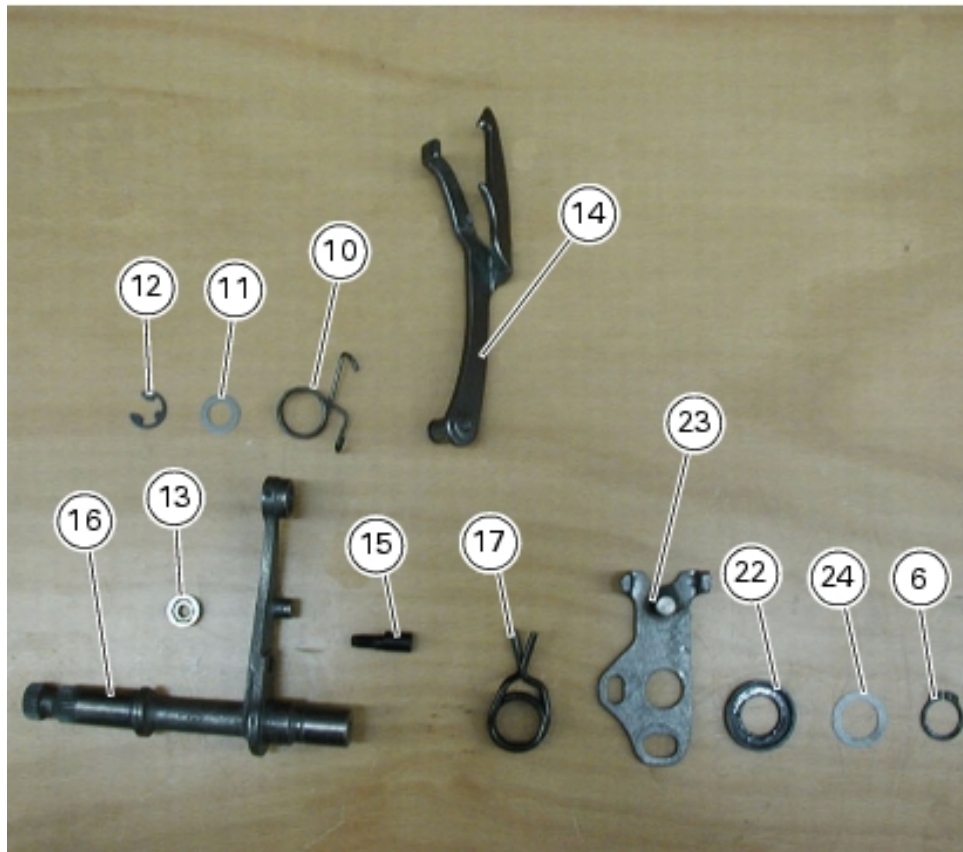
### Caution

Visually inspect gear selector fork (14) mating surface with gear selector for wear.



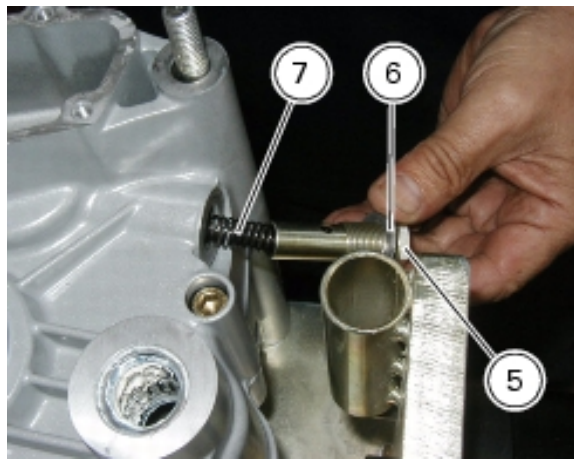
### Disassembling the gear selector levers

When one or more components of the lever need replacing, disassemble as shown in the picture.

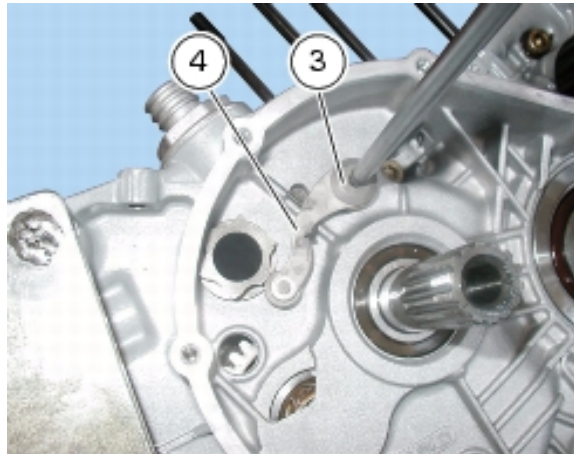


### Removing the gear stopper and ratchet

Undo the gear stopper bolt (5) and remove seal (6), spring (7) and gear ball (8).

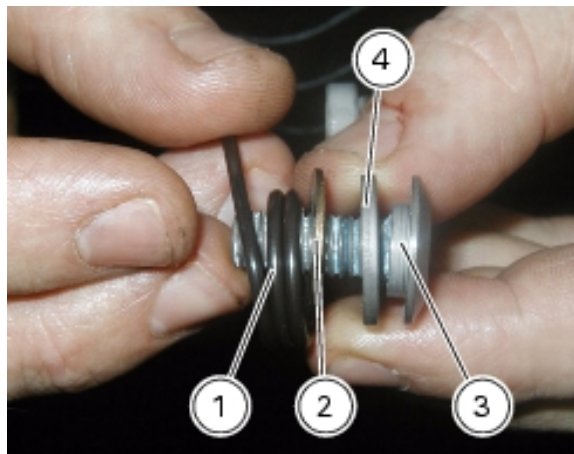


Undo clutch-side casing screw (3) and remove ratchet (4), washer (2) and spring (1).

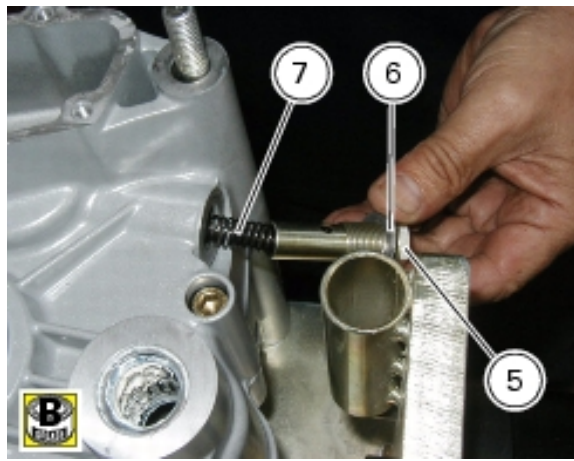


### Reassembling gear stopper and ratchet

Slide ratchet (4), washer (2) and spring (1) on the gear stopper bolt (3). Position gear stopper to clutch-side casing. The end of the spring (1) must locate behind the casing rib. Tighten the bolt (3) to the specified torque (Sect. C 3, [Engine torque settings](#)).

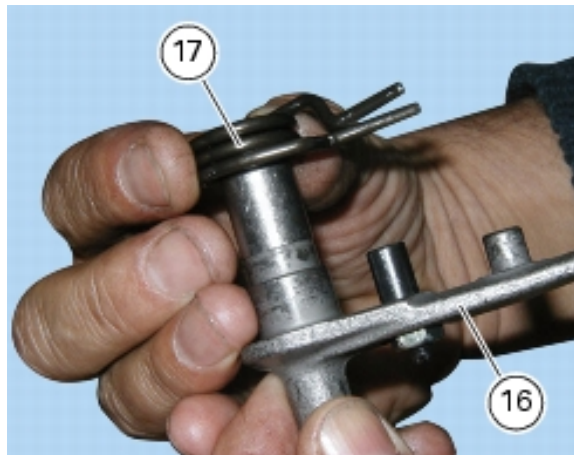


Thoroughly grease and then fit ball (8), spring (7) and seal (6) into gear stopper (5). Tighten gear stopper to the specified torque (Sect. C 3, [Engine torque settings](#)).

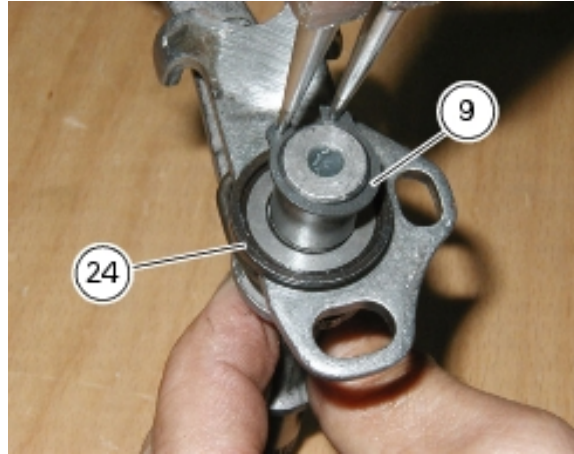


### Reassembling the gear selector lever

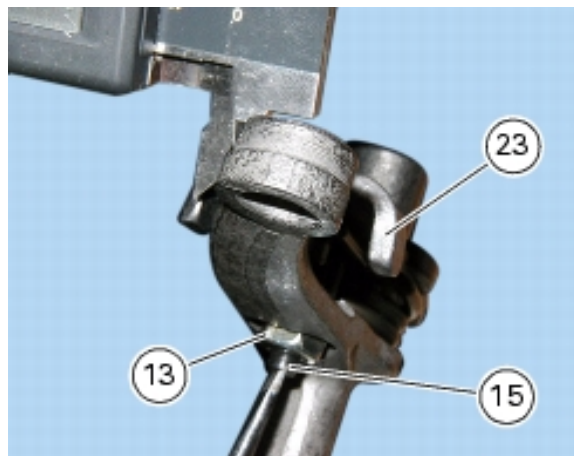
If the gear selector lever has been taken apart, insert the spring (17) on the shaft (16) as shown in the photograph.



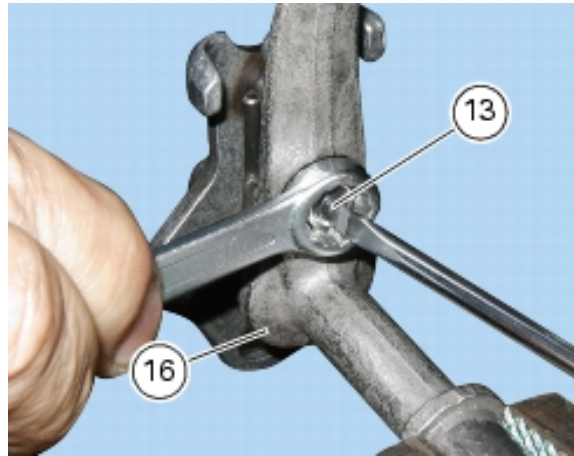
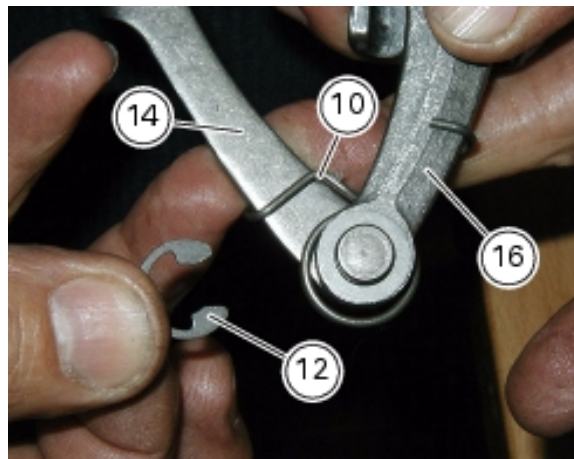
Insert plate (23) and shim (24) and fit circlip (9) to secure in place.



Position the lever with respect to plate (23). The lever pin should be centred to the shoulders of the plate; loosen check nut (13) and turn eccentric pin (15) to set the position. Tighten the lock nut (13).

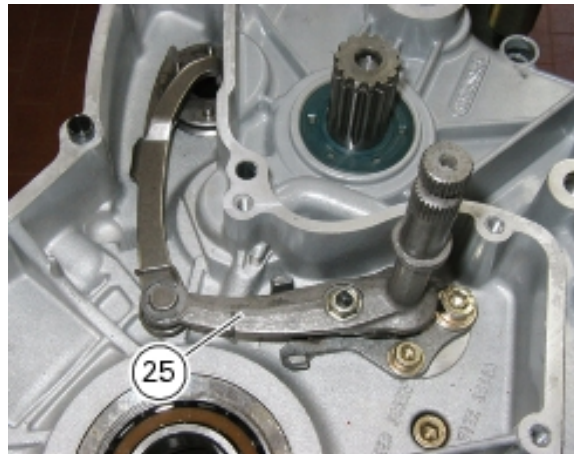


Place the spring (10) between shaft (16) and fork (14). Insert the circlip (12).

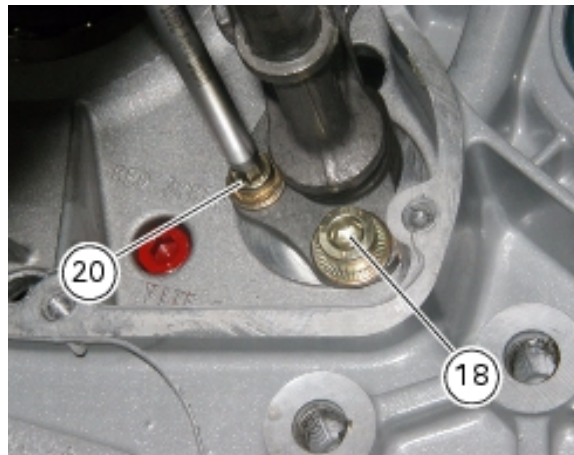
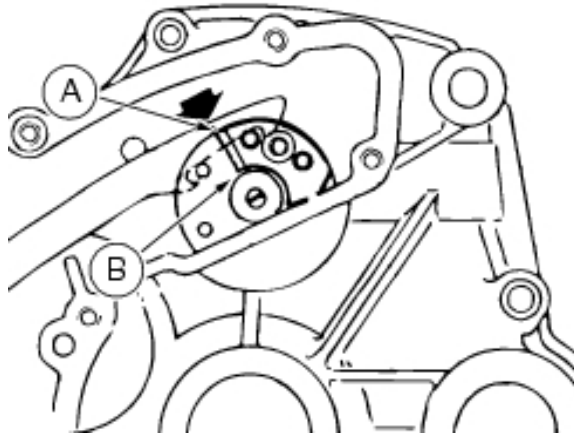
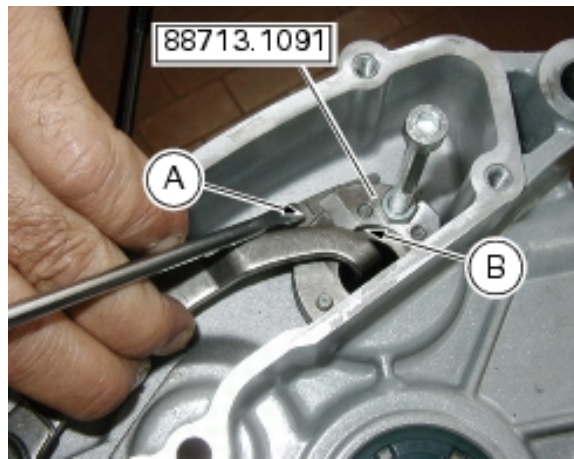


### Reassembling the gear selector lever

Position the complete gear selector lever (25) into the chain-side casing.



Position the gearbox drum selector fork in the centre of the drum rollers.  
Temporarily fit gear change lever (or a service lever) and shift to third gear.  
Fit plate part no. **88713.1091** to the fork shaft pins (see figure).  
Align the notch (A), which marks the centreline of the fork shaft pawl, with the end of the plate (B).  
Then tighten (Sect. C 3, [Engine torque settings](#)) the gear selector lever retaining screws (18) and (20).



With the gearbox in neutral, check that lever travel is the same when shifting up and down. The same should apply when a gear is engaged.

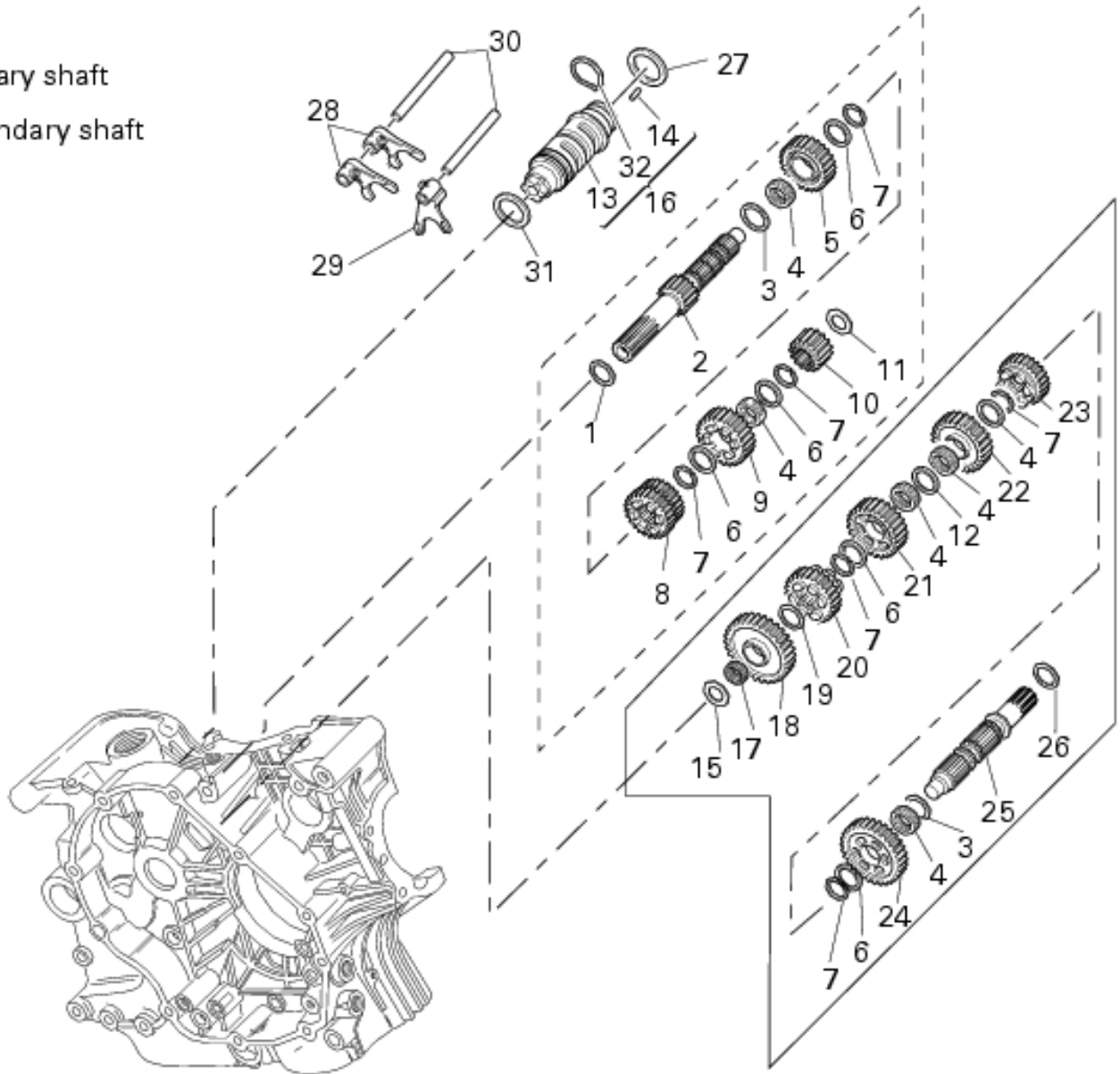
Operate the gear change lever and turn the sprocket at the same time to check that all the gears engage when shifting up and down.

Remove gear change lever.

Operations	Reference See Section
Refit clutch housing	N 6.3, <a href="#">Refitting the primary drive gears and checking meshing play</a>
Refit flywheel/generator assembly and generator cover	N 8, <a href="#">Refitting flywheel / generator assembly</a>


## 7.2 - Gearbox assembly: gearbox shafts

----- Primary shaft  
 \_\_\_\_\_ Secondary shaft



- 1 Shim thk. 1
- 2 Gearbox primary shaft
- 3 Shim thk. 0.5
- 4 Roller cage
- 5 Driving gear - 5th speed
- 6 Safety washer thk. 0.5
- 7 Circlip
- 8 Driving gear - 3<sup>rd</sup>/4<sup>th</sup> speed
- 9 Driving gear - 6<sup>th</sup> speed
- 10 Driving gear - 2<sup>nd</sup> speed
- 11 Shim thk. 1.8
- 12 Safety washer thk. 0.5
- 13 Fork control drum
- 14 Special square roller
- 15 Shim
- 16 Complete gearchange drum
- 17 Roller cage

- 18 Driven gear - 1st speed
- 19 Shim thk. 1
- 20 Driven gear - 5<sup>th</sup> speed
- 21 Driven gear - 4<sup>th</sup> speed
- 22 Driven gear - 3<sup>rd</sup> speed
- 23 Driven gear - 6<sup>th</sup> speed
- 24 Driven gear - 2<sup>nd</sup> speed
- 25 Gearbox secondary shaft
- 26 Shim
- 27 Shim thk. 1
- 28 Gear selector fork - 1<sup>st</sup>, 4<sup>th</sup> - 2<sup>nd</sup>, 3<sup>rd</sup> speed
- 29 Gear selector fork - 5<sup>th</sup>, 6<sup>th</sup> speed
- 30 Fork pin
- 31 Shim thk. 1
- 32 Square roller stop ring

 Spare parts catalogue

[Gearchange](#)

[Gear-box](#)



### Caution

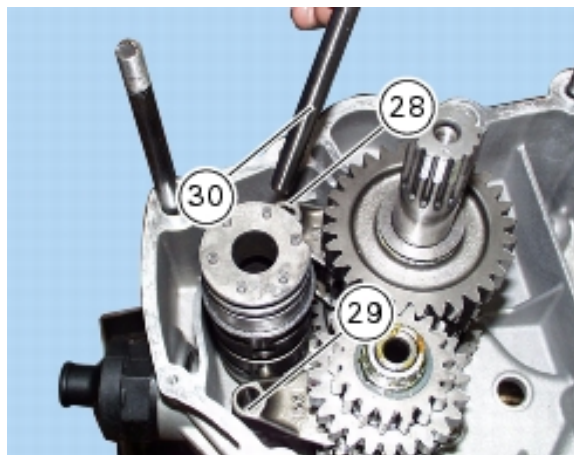
**Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.**

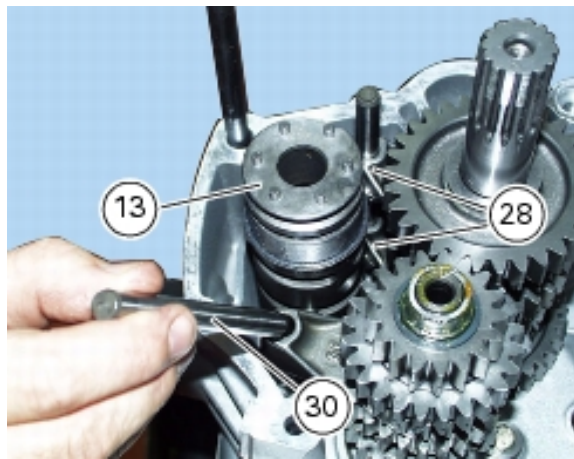
### Removing the gearbox

Operations	Reference See Section
Opening the casings	N 9.2, <a href="#">Opening the casings</a>

Pull out the fork guide pins (30).

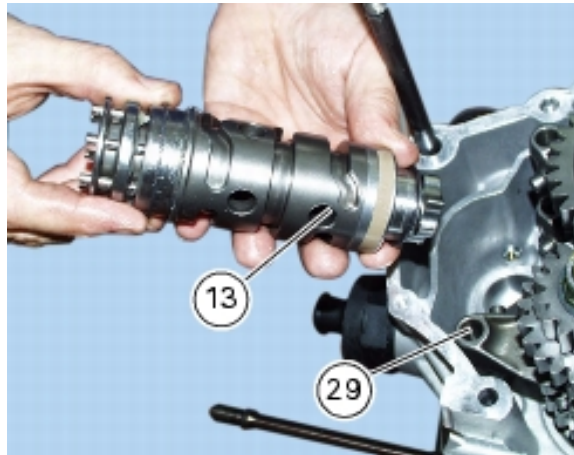
Move the forks (28) and (29) to disengage them from the selector drum slots (13).



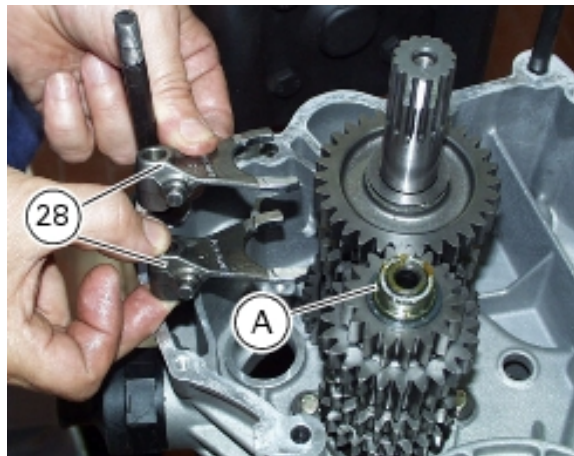


Pull out the fork selector drum (13). Pay attention to the shims (31) and (27) fitted on the shaft, make sure to refit them to their original position.

Now you can replace the needle roller stop ring (32) and the special needle rollers (14).

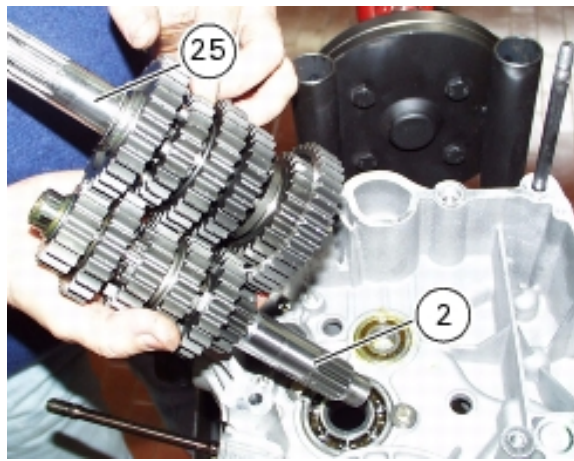


Remove the gear selector forks (29) and (28).



Remove gearbox primary (2) and secondary (25) shafts complete with gears. Do not damage or lose the shims at shaft ends.

If the bearing inner rings (A) remained on the shafts, slide them out of the gearbox primary (2) and secondary (25) shafts (Sect. N 9.2, [Overhauling the main bearings](#)).



To remove them from the shaft ends use puller part no. **88713.1332** and then fit them in their relevant bearings on the casings.

### Disassembling the gearbox shafts

Put the shaft in a vice to make disassembly operations easier.



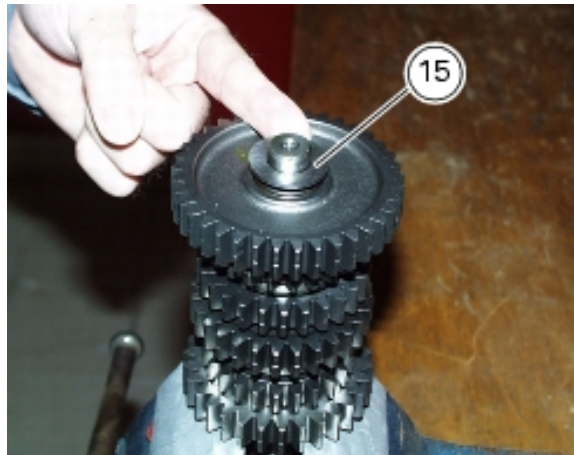
### Caution

Refit the shims in the original positions on assembly.

Failure to do so could lead to jamming and you will have to re-open engine casing.

### Disassembling the secondary shaft

Remove the clutch-side shim (26) and the chain-side shim (15) from secondary shaft.



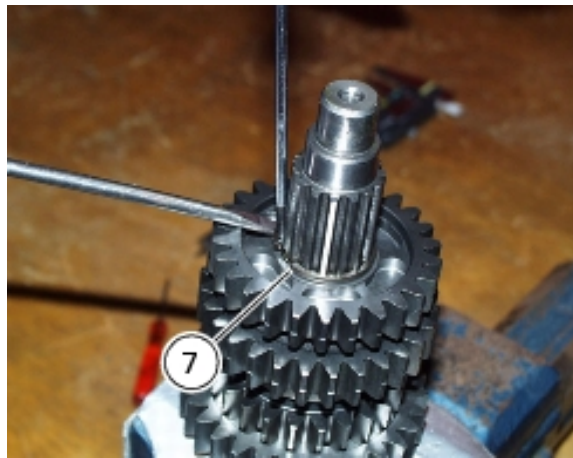
Slide out the first driven gear (18) with needle roller bearing (17) and shim (19).



Slide out the fifth driven gear (20).



Using two flat screwdrivers, remove circlip (7) taking care not to damage the shaft surface.



Slide out circlip (7) and safety washer (6).



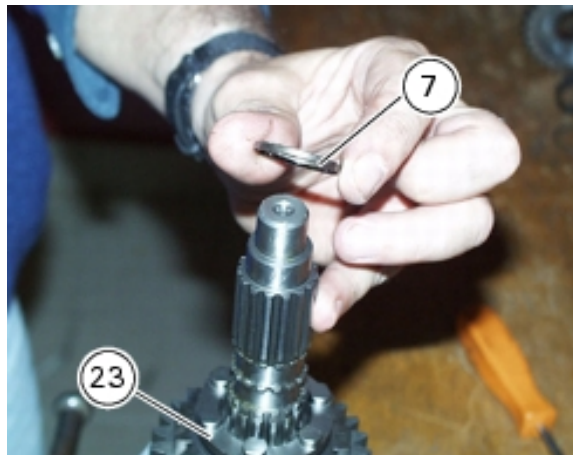
Remove the driven gear for the 4th speed (21), its needle roller cage (4) and the safety washer (12).



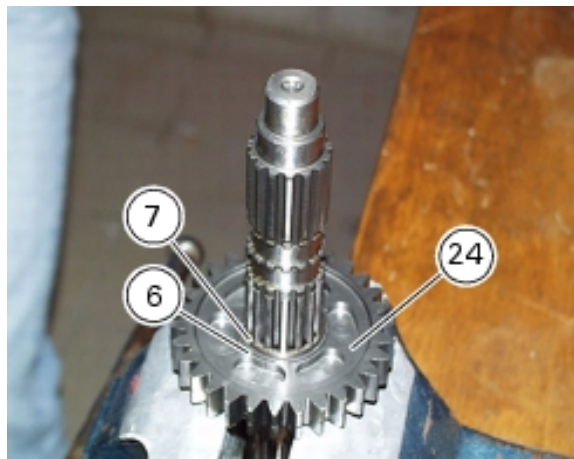
Remove the driven gear for the 3rd speed (22), its needle roller cage (4) and the safety washer (6).



Remove the circlip (7) and remove the driven gear for the 6th speed (23).



Remove the circlip (7), the safety washer (6) and the driven gear for the 2nd speed (24).



Pull out the roller cage (4) and the shim (3) so that the secondary shaft (25) is fully bare.

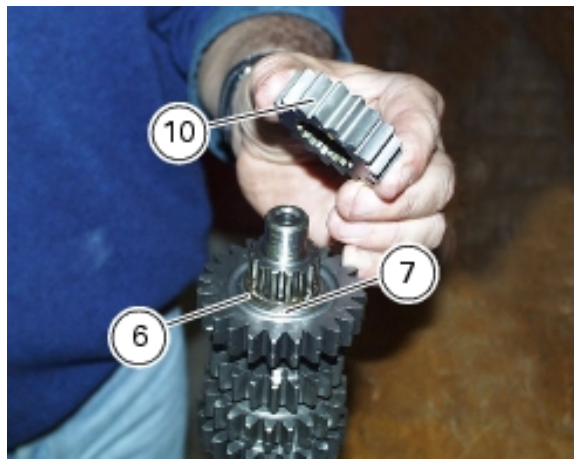


Disassembling the primary shaft

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



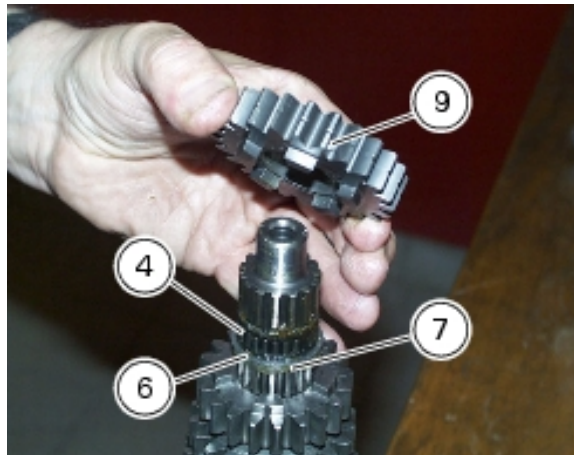
Slide out the 2nd drive gear (10). Using two screwdrivers, remove circlip (7) and safety washer (6).



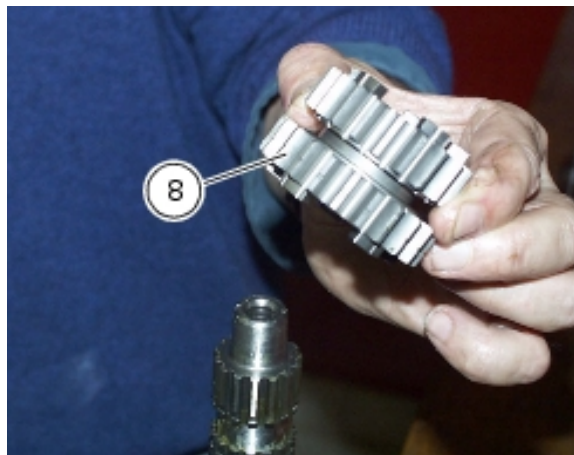
Caution

When removing circlip (7), take care not to damage the shaft surface.

Slide out sixth drive gear (9) with needle roller bearing (4). Then slide out safety washer (6) and circlip (7).



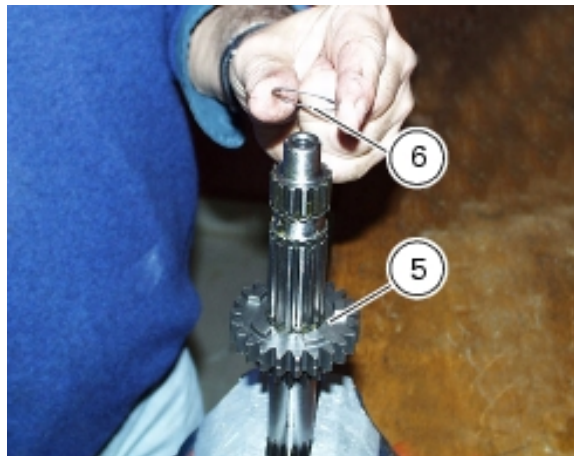
Slide out third and fourth drive gear (8).



Slide out circlip (7) and safety washer (6).



Slide out fifth drive gear (5) with needle roller bearing (4).



Remove the shim (3) from the primary shaft (2).



## Overhauling the gearbox

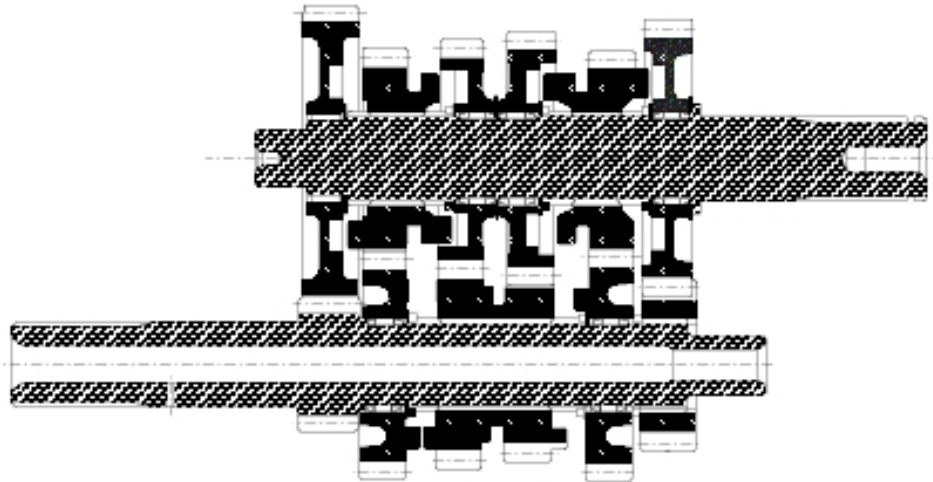
Check the condition of the gear front coupling dogs. They must not be damaged in any way and must have sharp edges.

The idle gears must rotate freely on their shafts.

When refitting, make sure the circlips are correctly positioned.

Check the needle roller bearings for wear.

The threading and the splines of the shafts must be in perfect condition.



Check the condition of the gear selection mechanism parts.

Engage the gears and check that the gearbox control does not jam (selector fork-gear groove and fork pin - desmodromic drum groove) due to incorrect end float. Correct clearances by shimming the gearbox shafts and drum with suitable shims.

For total end float of gearbox shafts and selector drums, refer to Sect. C 1.1, [Gearbox](#).

## Inspecting the gear selector forks

Visually inspect the gear selector forks. Bent forks must be changed as they may lead to difficulties in gear changing or may suddenly disengage under load.

Use a feeler gauge to check the clearance of each fork in its gear groove.

If it exceeds the service limit, establish whether it is necessary to change the gear or the fork by referring to the limits specified for each part (Sect. C 1.1, [Gearbox](#)).

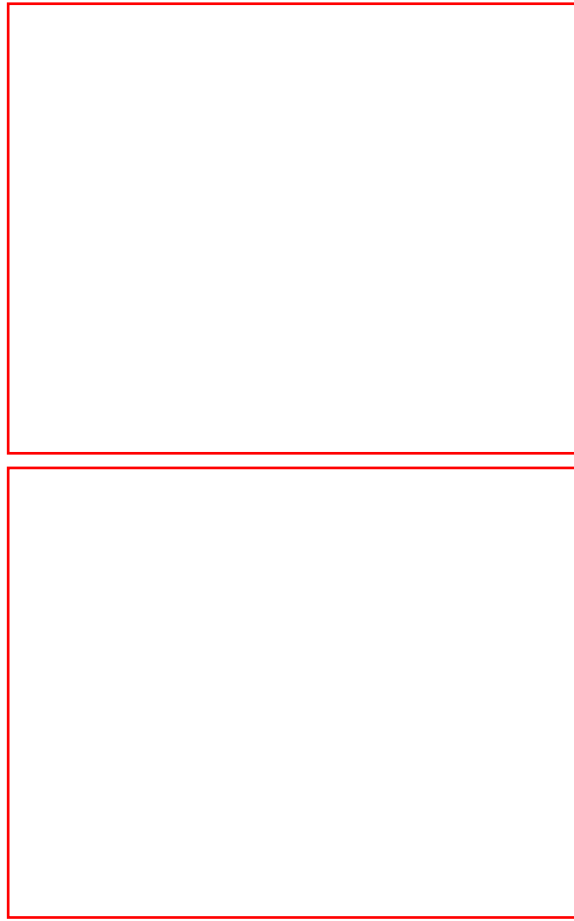


### Inspecting the fork selector drum

To establish the clearance between fork drive pin and selector drum slot, measure their dimensions with a gauge. If the service limit is exceeded, establish which part must be changed, by comparing the values with the values of new components (Sect. C 1.1, [Gearbox](#)).

Also check wear on drum support pins; they must not show any signs of grooves, burrs and deformation. Turn the drum in the casing to check the side play. If there is excessive play, change whichever part is most worn.





### Reassembling the gearbox shafts

Fig. 1 shows all parts to be fitted onto the primary shaft (2), after calculating correct thickness for shims (1) and (11) (Sect. N 9.2, [Shimming the shafts](#)).

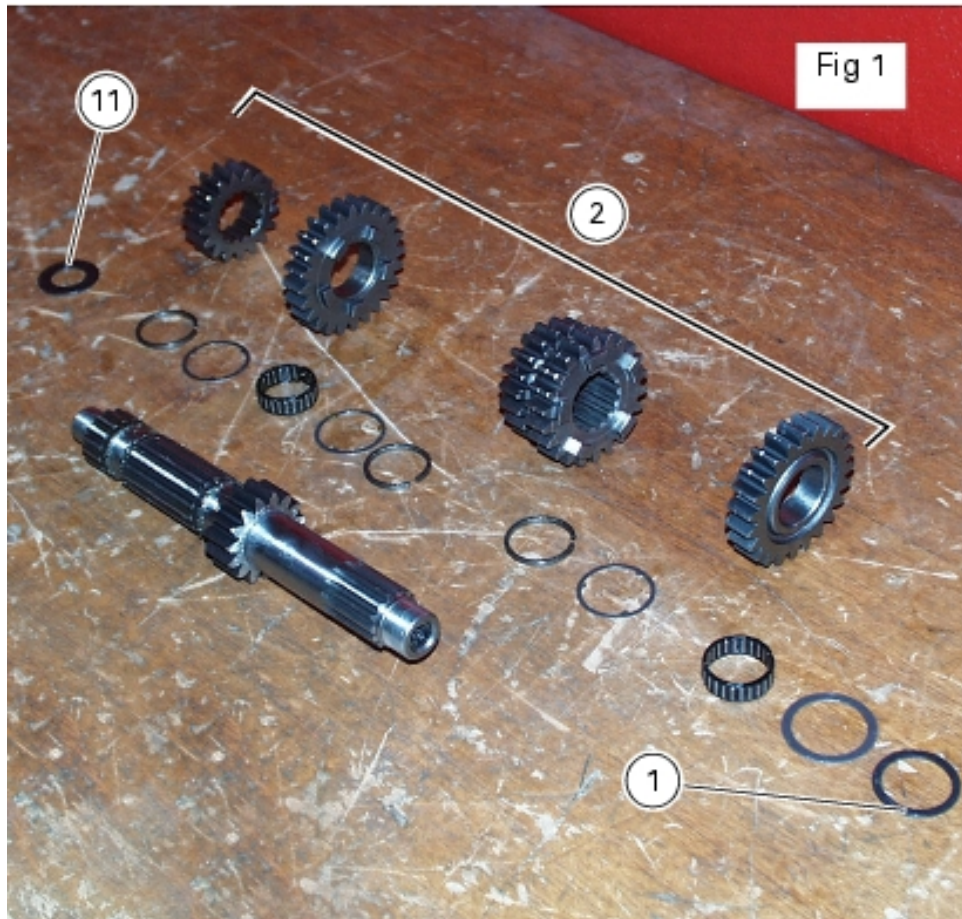
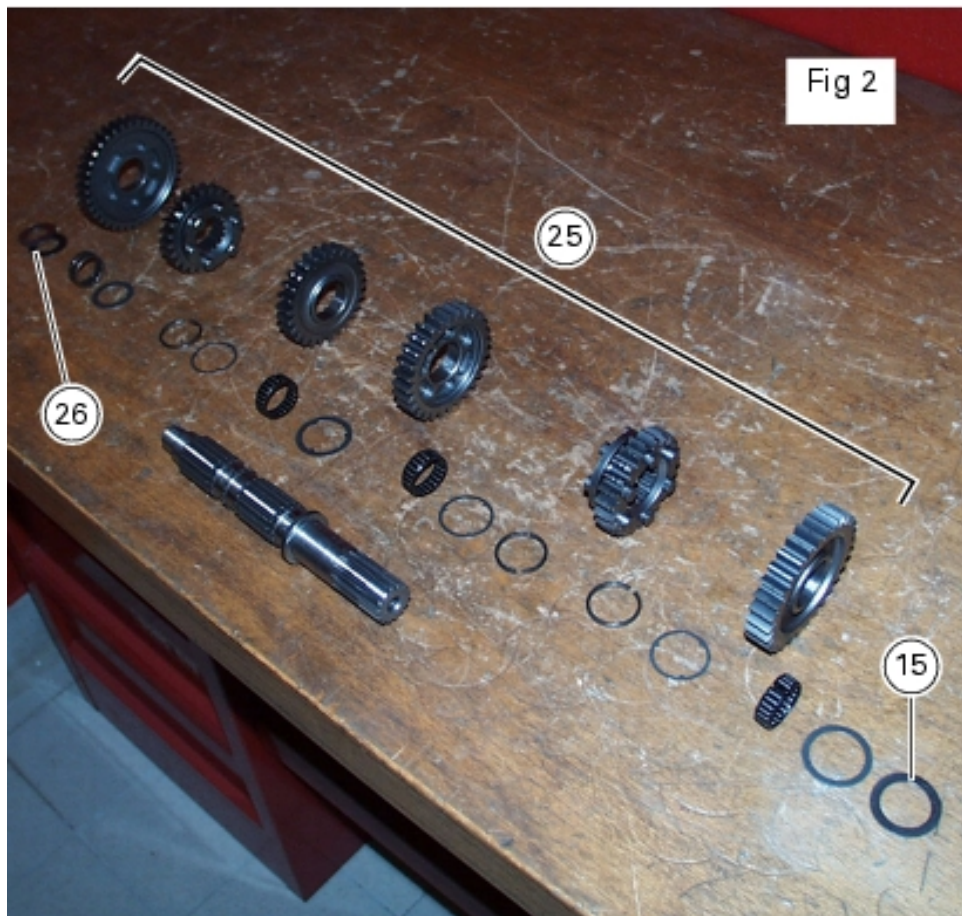


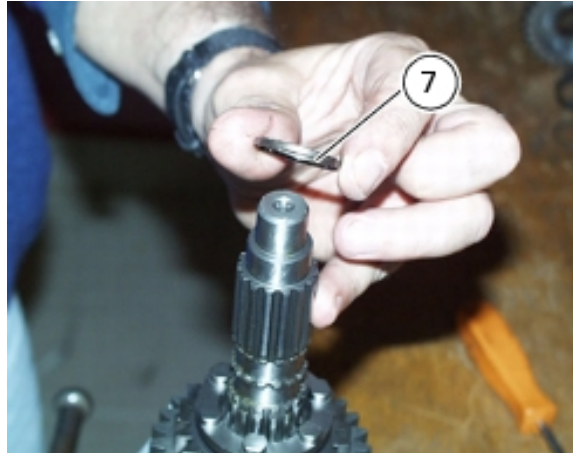
Fig. 2 shows all parts to be fitted onto the secondary shaft (25), after calculating correct thickness for shims (15) and (26) (Sect. N 9.2, [Shimming the shafts](#)).



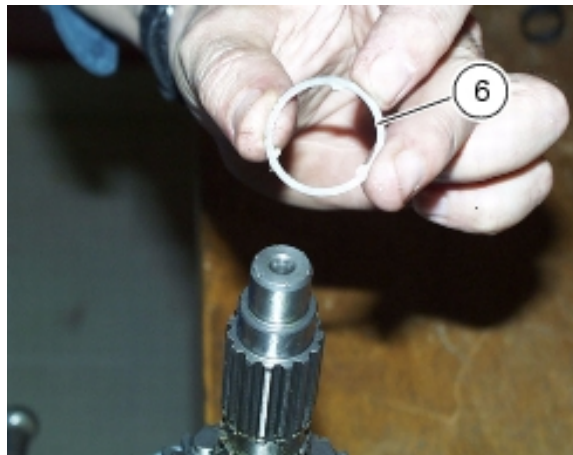
Fit all gears onto gearbox shafts following the removal procedure in the reverse order.

Special care must be taken when fitting idle gears. Installation of 3<sup>rd</sup> and 4<sup>th</sup> gears and all fasteners onto the secondary shaft is here shown by way of example.

Fit the circlip (7). Ensure it is fully seated into the shaft. It is recommended a suitable sized tube drift be used to seat the ring.



Fit the safety washer (6) into the shaft; it should rest against the circlip.



Grease the needle roller cage (4) richly with the recommended grease and seat it; open it a bit to fit onto the shaft.



Fit the gear for 3<sup>rd</sup> speed (22).



Fit the safety washer (12) onto the gear; it is larger than the other safety washer (6).



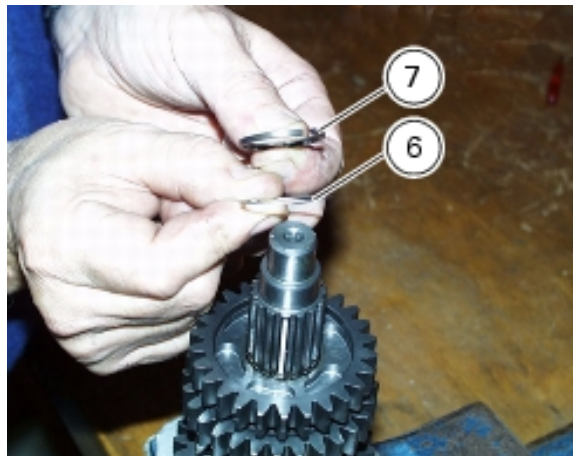
Fit another needle roller cage (4) as described.



Fit the gear for 4<sup>th</sup> speed (21).



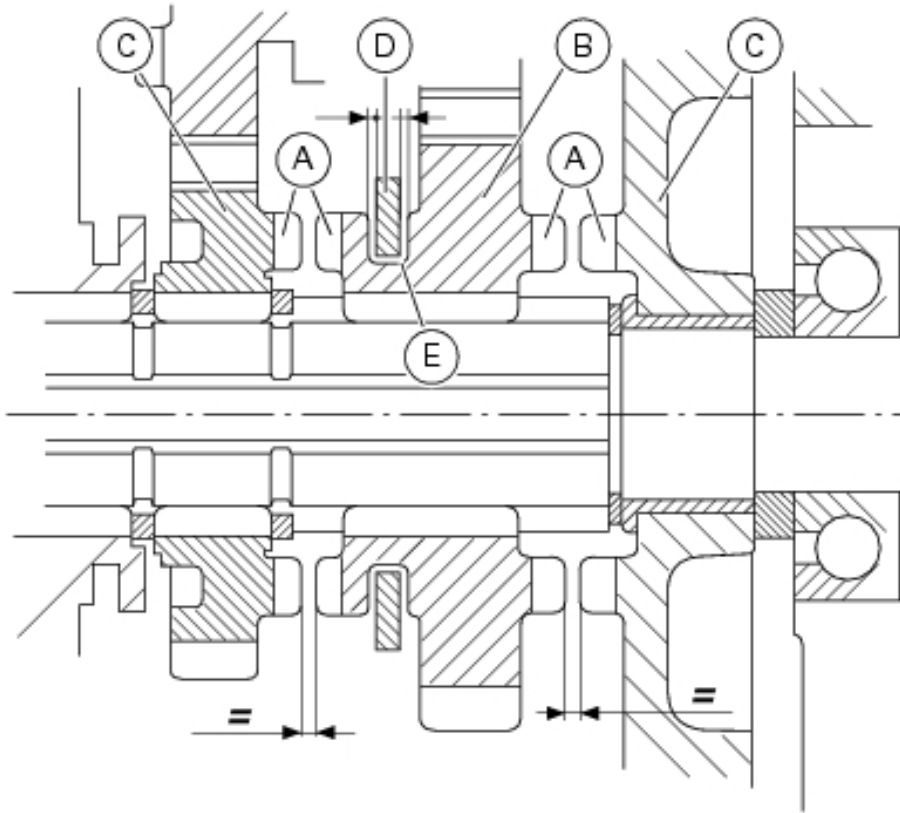
Fit another safety washer (6) and another circlip (7) into the shaft. Seat it using the drift.



### Reassembling the gearbox

Follow the procedure described under Section N 9.2 "[Closing the casings](#)" to fit parts of the gearbox assembly.

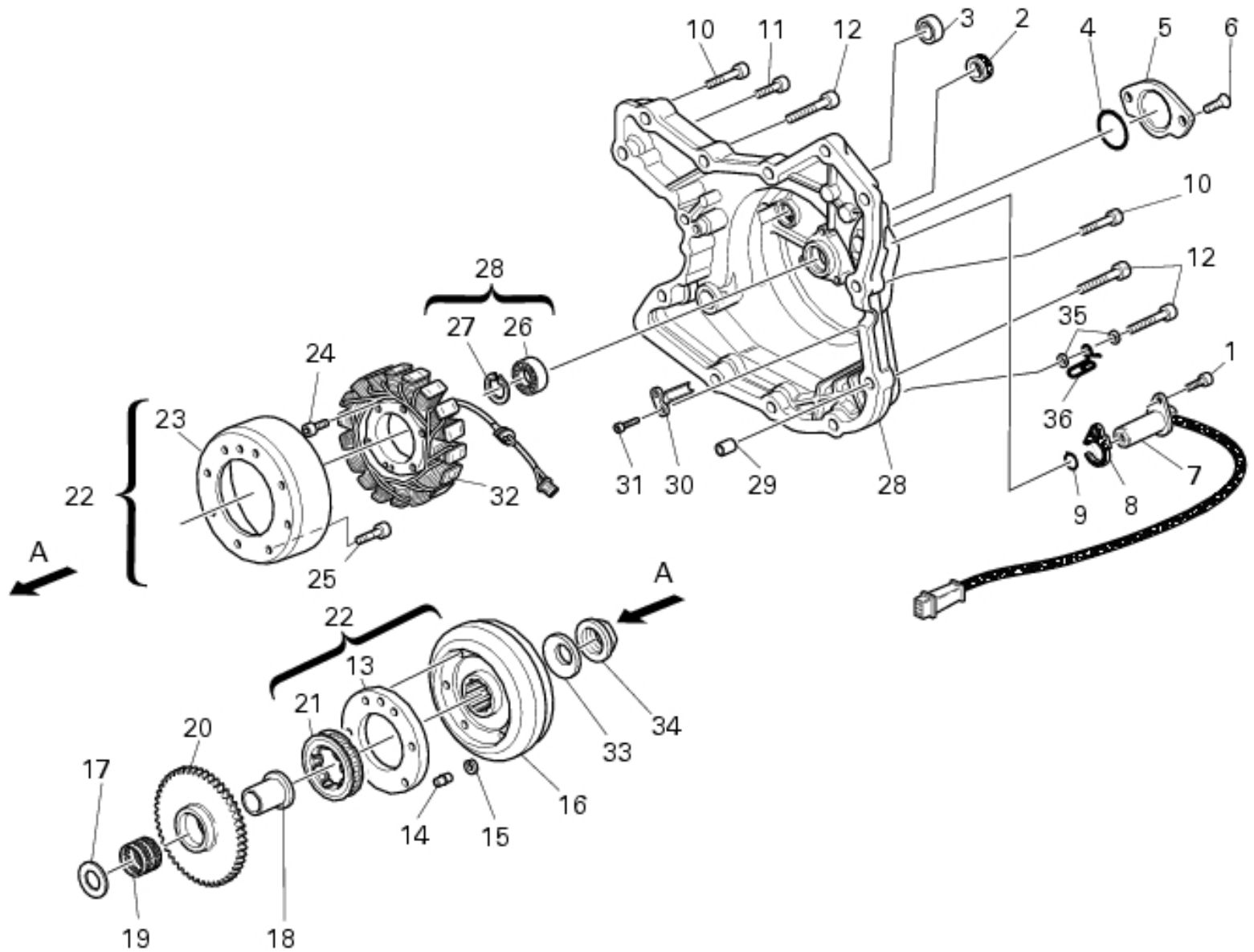
When finished, run a practical test. Place gear in neutral and check that the front coupling dogs (A) of the sliding gears (B) are centred to the matching dogs of the fixed gears (C), i.e. that the distance is the same at both ends. Engage the gears and make sure there is always a small clearance between fork (D) and matching groove (E) in the



sliding gear (B).

Operations	Reference See Section
Close the casings	N 9.2, <a href="#">Closing the casings</a>

# 8 - Flywheel - generator



- 1 Screw
- 2 Ignition inspection plug
- 3 Seal
- 4 O-ring
- 5 Cover
- 6 Screw
- 7 Engine sensor
- 8 Thickness
- 9 O-ring
- 10 Screw
- 11 Screw
- 12 Screw
- 13 Flange
- 14 Reference pin
- 15 Circlip
- 16 Ignition flywheel
- 17 Washer
- 18 Inner ring

- 19 Roller cage
- 20 Starter driven gear
- 21 Starter clutch
- 22 Flywheel - starter clutch assembly
- 23 Generator rotor
- 24 Screw
- 25 Screw
- 26 Bearing
- 27 Circlip
- 28 Generator cover
- 29 Centring bush
- 30 Cable guide
- 31 Screw
- 32 Generator stator
- 33 Belleville washer
- 34 Flanged nut
- 35 Washer
- 36 Wire retainer

 Spare parts catalogue

[Alternator cover](#)

[Electric starter and ignition](#)



### Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Removing the generator cover

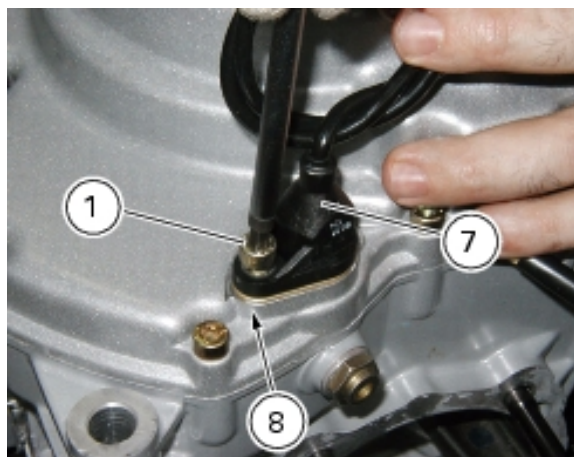
Operations	Reference See Section
Drain engine oil	D 4, <a href="#">Changing the engine oil and filter cartridge</a>
Remove gearchange control	F 5, <a href="#">Removing the gear change control</a>
Remove the clutch transmission unit	F 2, <a href="#">Removing the clutch transmission unit</a>
Remove the chain sprocket cover	G 8, <a href="#">Removing the chain sprocket</a>



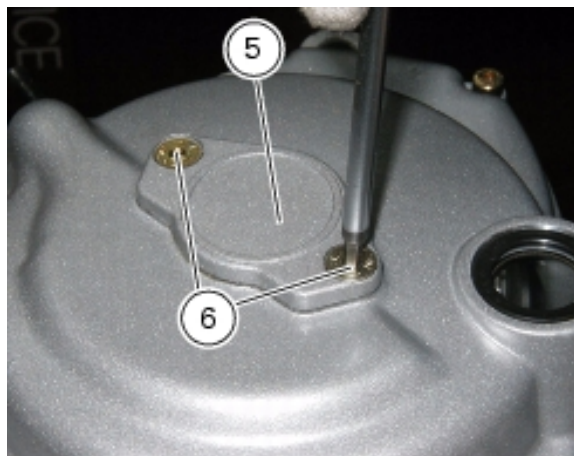
### Note

For reasons of clarity, the figures show an engine block removed from the frame.

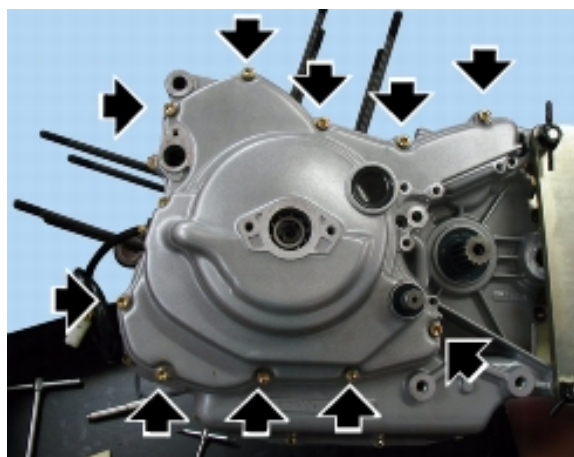
Undo the screw (1) and remove the engine sensor (7) from the generator cover. Take care not to lose the shim (8) and the O-ring (9).



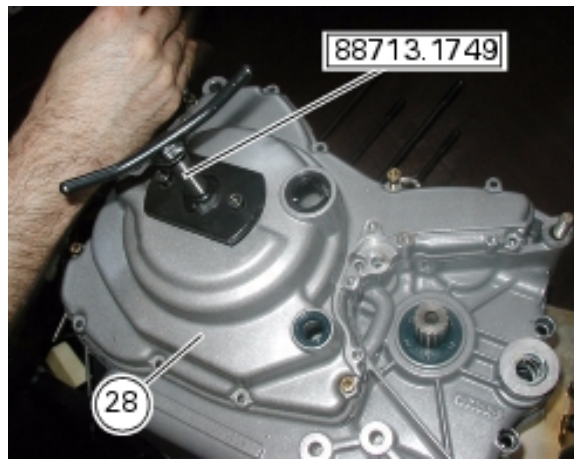
Undo the two retaining screws (6) of the small cover (5) placed at crankshaft end.



Undo the generator cover retaining screws (10), (11) and (12) (arrowed in the figure). Collect the two washers (35) and hose guide (36).

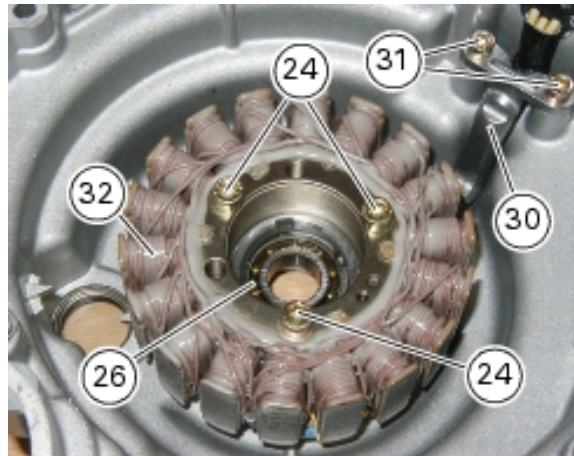


Fix tool part no. **88713.1749** to the holes of the screws (6) you have just removed. Turn the tool shaft slowly to remove the cover (28) from the LH casing.

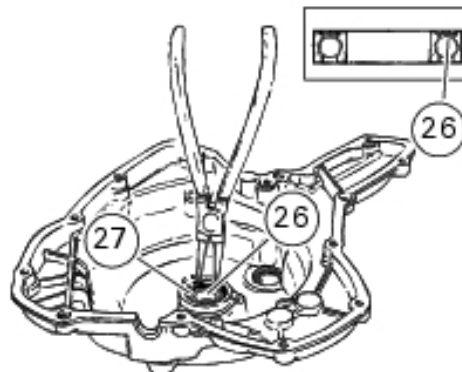


### Disassembling the generator cover

Undo the three stator retaining screws (24) and the two cable guide bracket (30) retaining screws (31) from inside the generator cover.  
Remove stator (32) and cable guide (30).

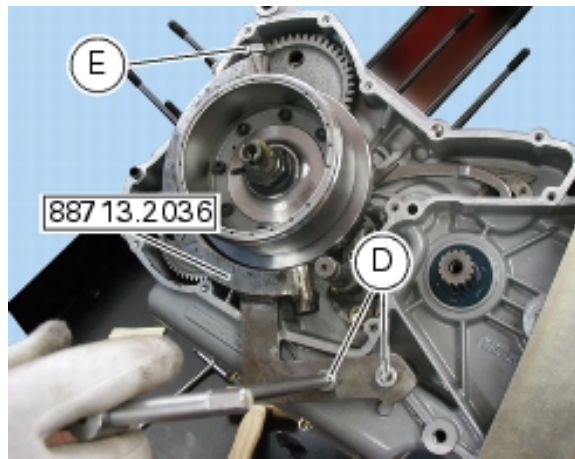


Inside generator cover, at the crankshaft, there is a bearing (26) held in place by a circlip (27).  
Remove circlip (27) with suitable tweezers.  
Remove bearing (26) using a universal puller.



### Removing the flywheel - generator assembly

Fit tool part no. **88713.2036** and secure it to the M10 holes (D) (for the side stand fasteners) to prevent rotation.  
Then lock tool on flywheel with the screw (E).



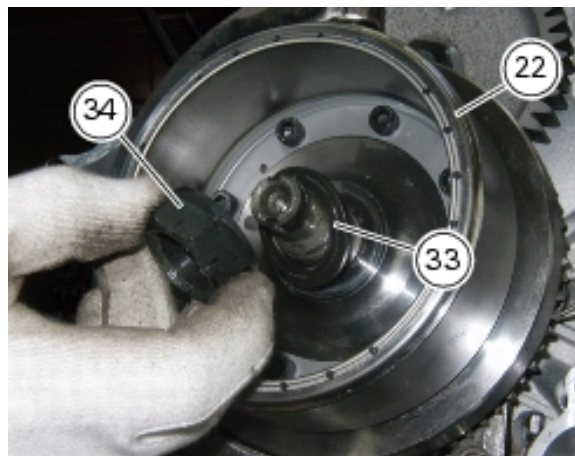
Use an "industrial heating gun" to heat the flywheel nut (34) before loosening it; it is recommended not to use bare flame that might damage the starting system components.



**Warning**

While unscrewing the nut, keep pressing box end axially onto nut to avoid damage or injury in the event wrench suddenly slips off the nut.

Remove nut (34), Belleville washer (33) and flywheel (22).



Remove driven gear (20) from crankshaft.



Remove inner ring (18), needle roller bearing (19) and washer (17).



**Caution**

Check inner ring (18), needle roller bearing (19) and inner washer (17) for wear.



**Note**

The inner ring (18) has an oil drilling for needle roller bearing (19) lubrication.

### Checking the flywheel - generator assembly

Check that the generator rotor (23) inner part is not damaged.

Check that the starter clutch is working properly and that the needle races do not show signs of wear or damage of any kind.

In the event of defects, dismantle the assembly.

### Disassembling the flywheel - generator assembly

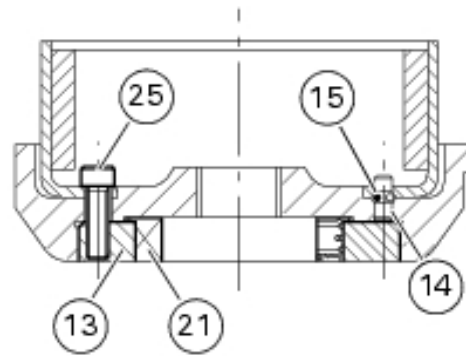
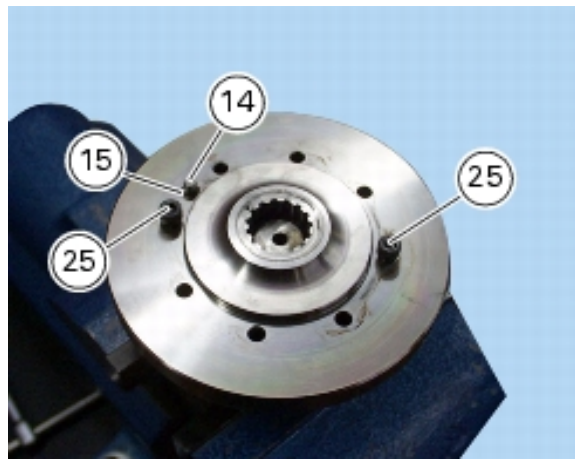
Undo the eight screws (25) and remove rotor (23) from flywheel.



Slide out reference pin (14) and circlip (15).

Start two of the screws (25), just removed from flywheel rotor-side, into their holes in order to remove flange (13) and starter clutch (21).

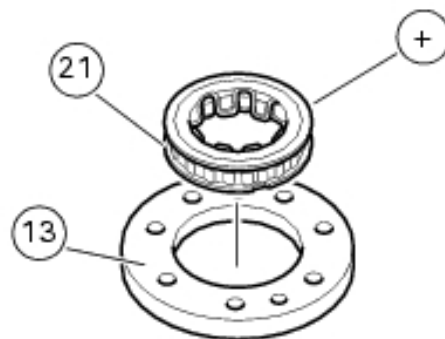
The starter clutch is a slight interference fit in the flange. To remove it, use a suitable drift.

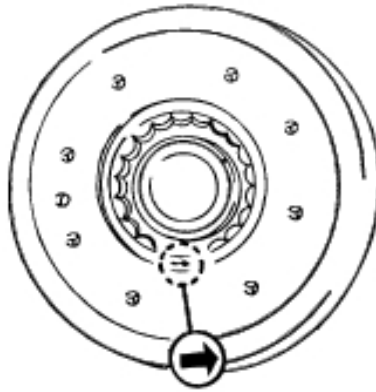


#### Reassembling the flywheel - generator assembly

Locate starter clutch (21) to flange (13) with the larger diameter side (+) facing the flange. The flange should have the rounded side facing the starter clutch.

When refitting the starter clutch, make sure the arrow etched on outer ring is pointing in the direction of rotation of the engine.





Check that starter clutch is installed correctly as follows. Remember that the flywheel is fitted to the crankshaft spline and will turn with the crankshaft.

Turn the crankshaft counterclockwise. The flywheel will turn with the crankshaft, whereas starter motor and idle gear will not move (same as when the engine is running).

Turn the crankshaft clockwise; flywheel, starter motor and idle gear will turn as well.



### Caution

When refitting the parts of the starter clutch, use engine oil only. Do not use grease as it could affect starter clutch operation.

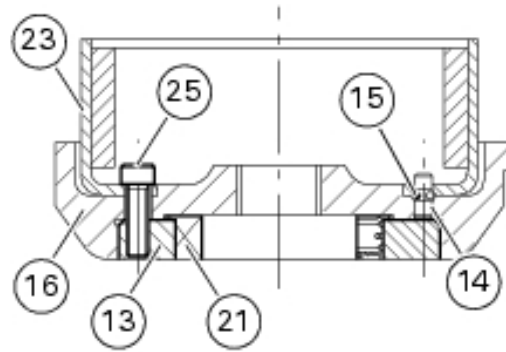
Fit the flange (13) to the flywheel (16) with the tapered side facing the flywheel.

Install the flange with the aid of a pin or spanner fitted into the hole for the rotor flywheel reference pin (14) so to line up the flange threads with the flywheel holes. Since the flange is an interference fit, alignment must be done during - not after - installation.

Position reference pin (14) with circlip (15) into flywheel.



Apply threadlocker on the threads of screws (25) and fix rotor (23), flange (13) and starter clutch (21) to flywheel (16).



Tighten screws to the specified torque (Sect. C 3, [Engine torque settings](#)).

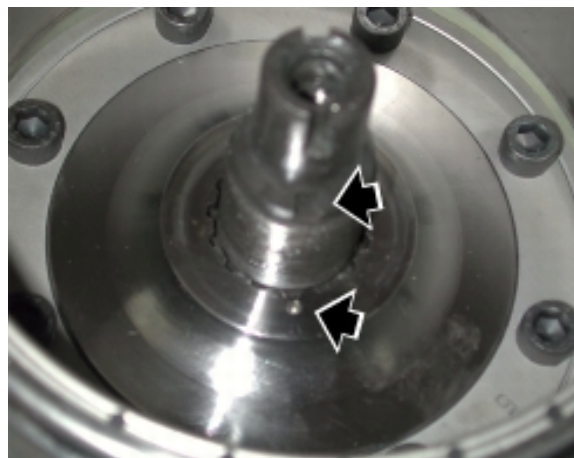
### Refitting flywheel / generator assembly

Fit washer (17), roller bearing (19) and inner ring (18) on crankshaft. Make sure that inner ring becomes seated properly in the centre of the washer.

Fit starter driven gear (20) on flywheel starter clutch.

Fit the thus-assembled flywheel unit (22) on the starter clutch (21). Make sure the inner ring (18) is still centered in the washer (17).

Flywheel reference mark must be aligned with the crankshaft spline near the keyway.

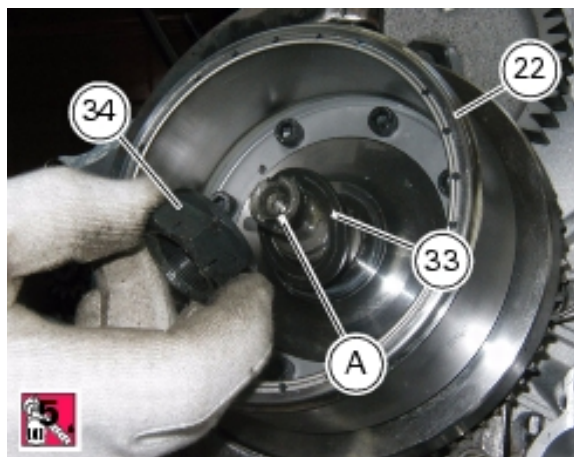


Lubricate mating surfaces of Belleville washer (33) with engine oil.  
Fit Belleville washer (33) onto crankshaft end.

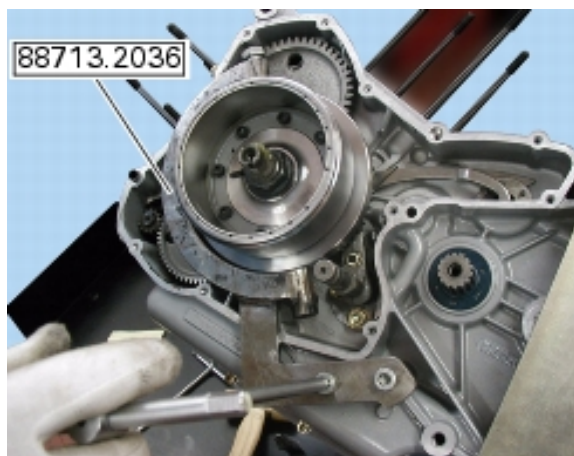


### Caution

Belleville washer (33) larger side shall be facing the flywheel.



Lock out flywheel rotation using the relevant tool part no. **88713.2036**.



Remove any Loctite residue from nut (34) and crankshaft (A) thread.

In order to ensure correct coupling, sealant should be applied in 3 stripes along the crankshaft thread (A) and one stripe inside the nut (34).

Fit nut (34) onto shaft end (A): nut (34) larger side shall be facing the flywheel.



#### Caution

Nut (34) is to be tightened immediately after sealant is applied; tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).



#### Warning

It is also recommended to allow three hours after tightening before starting the engine to ensure the sealant is completely dry.

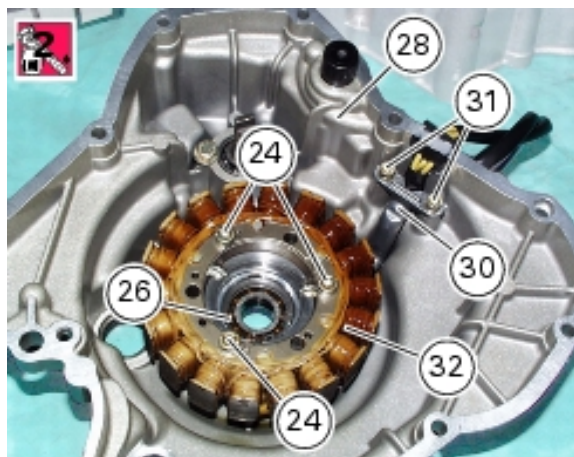
### Reassembling generator cover

Position stator (32) into the cover with the hole for the outgoing wire facing the cover and pointing towards the cover recess.

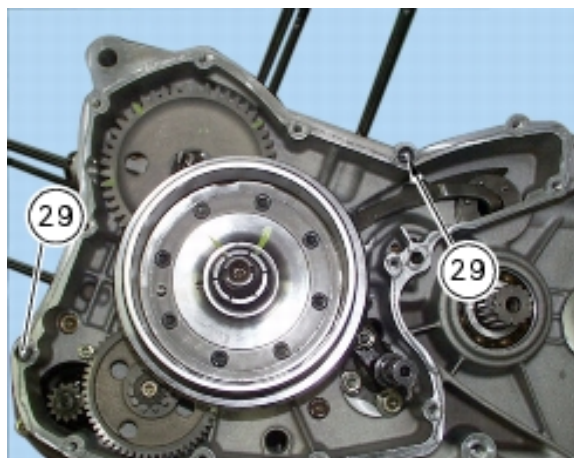
Apply threadlocker to the retaining screws (24) of the stator and tighten the screws to the specified torque (Sect. C3, [Engine torque settings](#)).

Place the guide plate (30) over the wire and secure it to cover with the two screws (31).

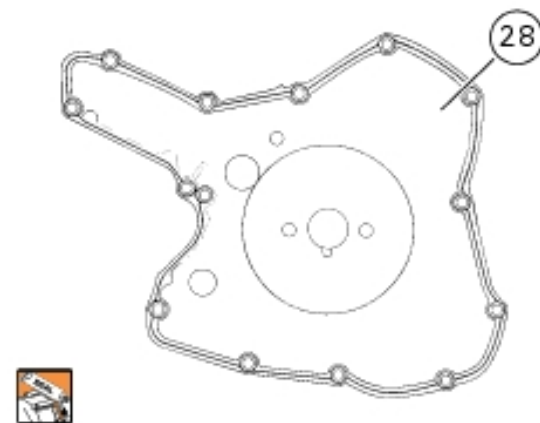
Before installation, make sure that the crankshaft bearing (26) and its circlip are in place in the generator cover (28).



Clean off any deposits and degrease the mating surfaces of the LH-side casing and the generator cover. Fit the two reference bushes (29).



Apply an even bead of DUCATI liquid gasket on the cover surface (28), avoiding the holes for the retaining screws and the centring bushes. Grease the end of the crankshaft and of the gear change lever shaft. This will facilitate cover installation and prevent damage to the oil seal (3) if it is already installed in the cover. Tap at different positions with a rubber mallet to help locate cover to shafts and centring bushes.



Note

In the event you need to remove the cover again, fit puller part no. **88713.1749** to the threaded holes at the crankshaft.

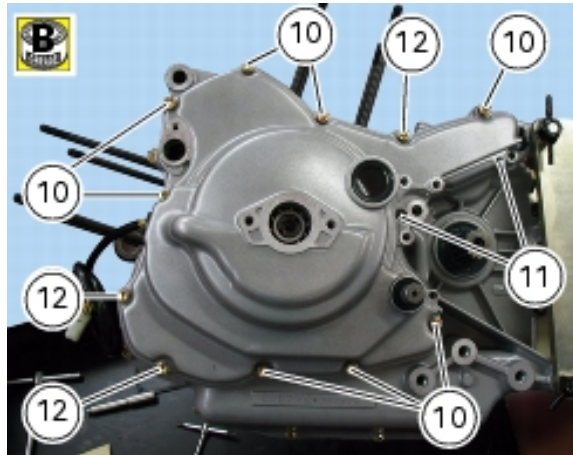
Start the retaining screws into their holes as indicated in the table.

10	8	M6x25 mm screws
11	2	M6x20 mm screws
12	3	M6x30 mm screws

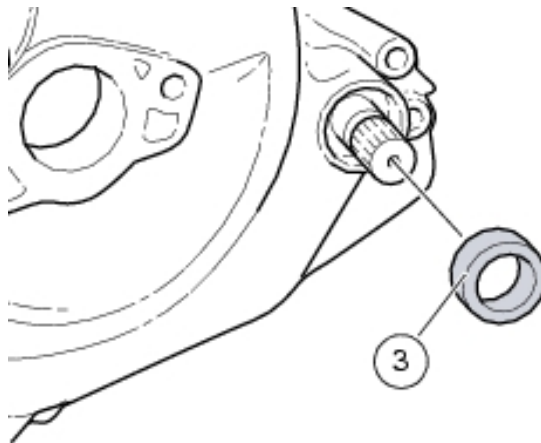
Tighten the retaining screws to the specified torque (Sect. C 3, [Engine torque settings](#)).

Fit the washer (35) and the hose guide (36) under the screw (12), close to the starter motor.

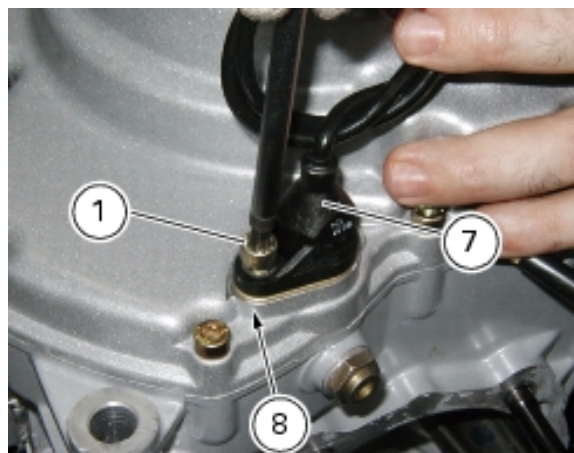
Tighten the retaining screws to the specified torque (Sect. C 3, [Engine torque settings](#)).



Dampen oil seal (3) with alcohol and fit it on the generator cover, at the gear change lever shaft (Sect. F 5, [Refitting the gear change control](#)).



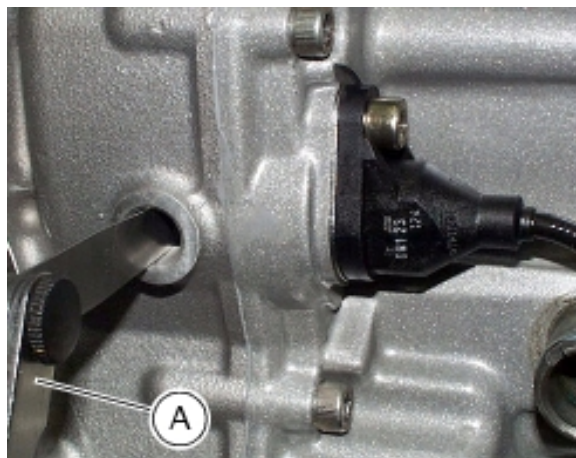
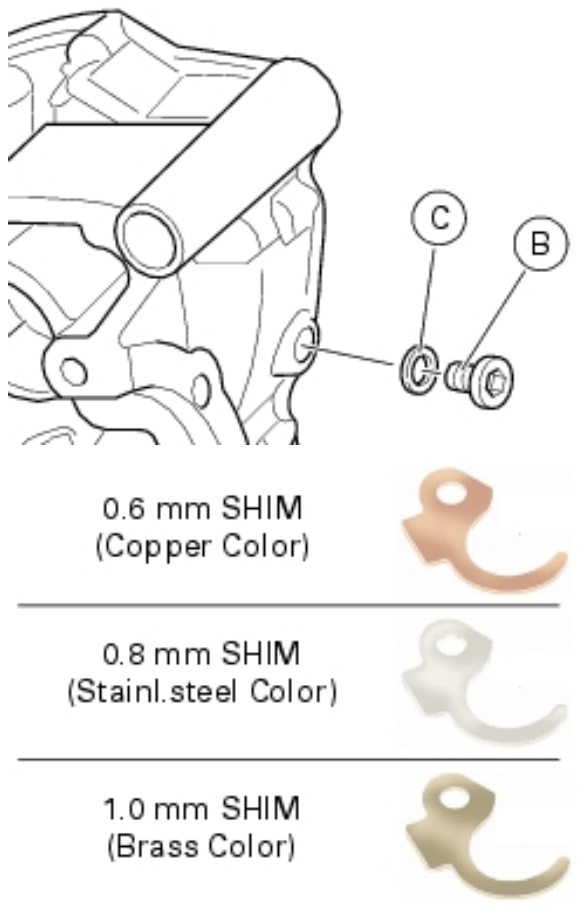
Fit the O-ring (9) and shim (8) to generator cover. Position the engine sensor (7) into its seat and secure it with the screw (1). Tighten the screw to the specified torque (Sect. C 3, [Engine torque settings](#)).



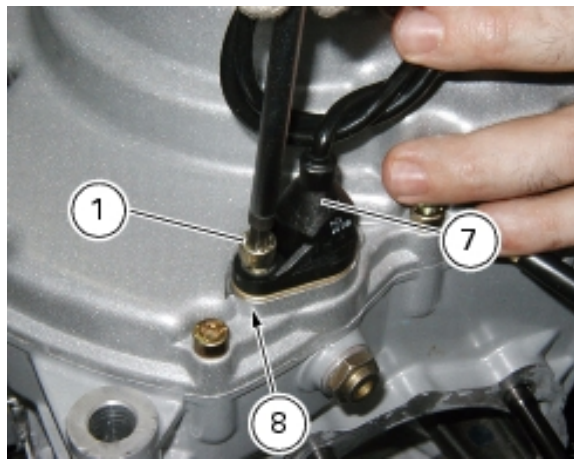
Check air gap between sensor and timing intermediate gear, as described below.

### Checking the engine sensor air gap

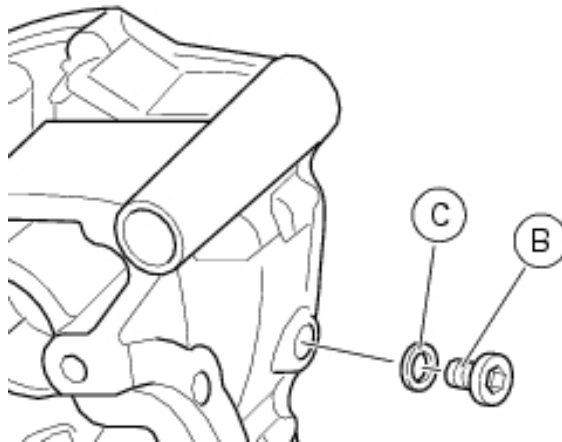
Engine sensor can take readings of timing lay gear teeth and, thanks to the gap equal in size to two teeth, it can calculate engine number of revolutions per minute.  
 If the generator, the generator cover or the sensor have been changed, check sensor air gap (see procedure below).  
 Remove screw plug (B) from the inspection hole in the LH side casing.  
 Do not check the air gap at the teeth gap.  
 Fit a feeler gauge (A) into the hole and measure the air gap between the sensor and the timing intermediate gear teeth.  
 Check that air gap is **0.75-0.95 mm**.



If this is not the case, loosen sensor (7) screw (1) in order to slide out shim (8) and to change it with one having a suitable thickness.

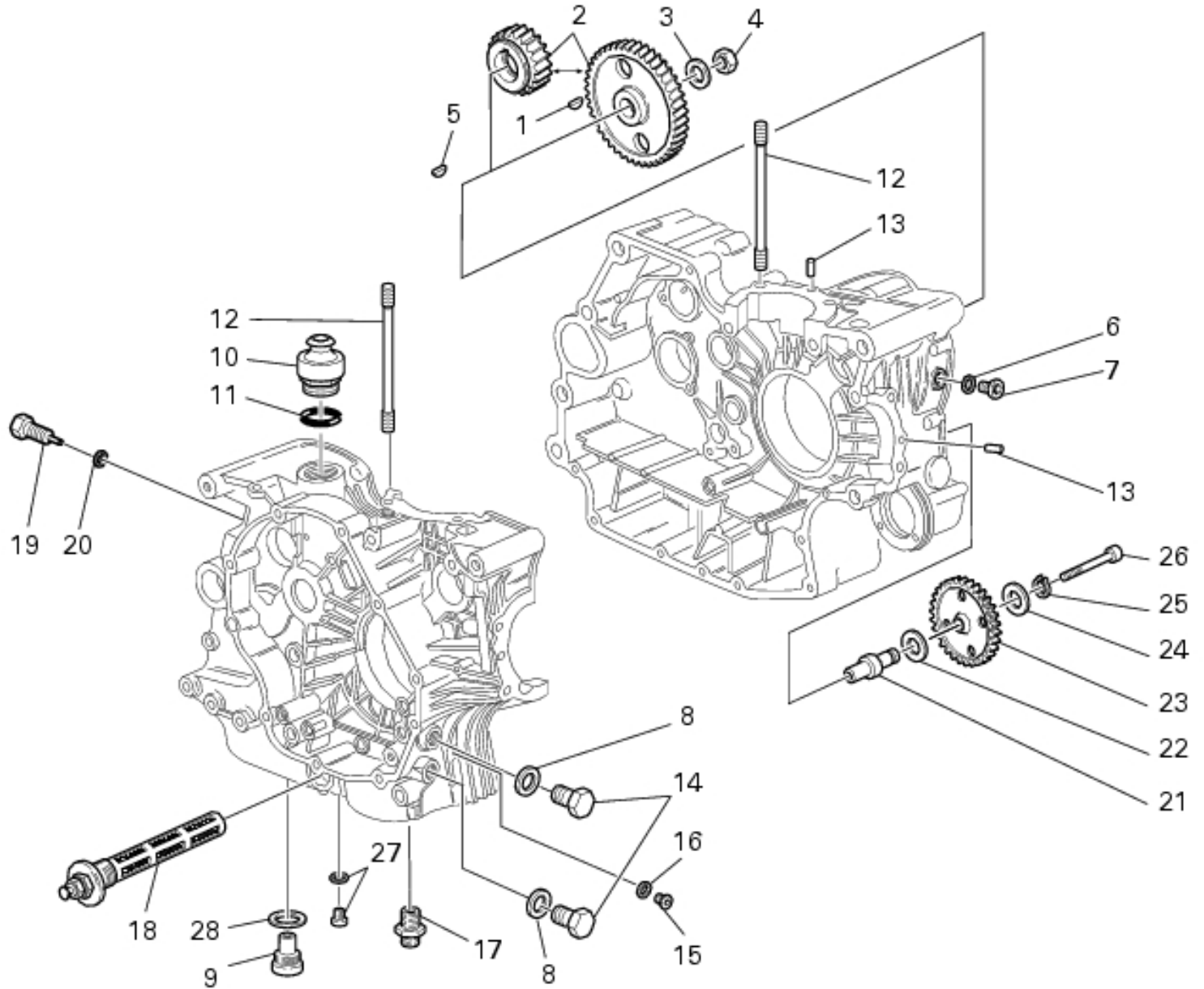


Refit plug (B) with seal (C) and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).



Operations	Reference See Section
Refit the chain sprocket cover	G 8, <a href="#">Refitting the chain sprocket</a>
Refit the clutch transmission unit	F 2, <a href="#">Refitting the clutch transmission assembly</a>
Refit gearchange control	F 5, <a href="#">Refitting the gear change control</a>
Fill engine with oil	D 4, <a href="#">Changing the engine oil and filter cartridge</a>

## 9.1 - Casing unit: outer components



- 1 Key
- 2 Timing gear pair
- 3 Safety washer
- 4 Hexagon nut
- 5 Key
- 6 Aluminium gasket
- 7 Screw
- 8 Aluminium gasket
- 9 Blanking plug
- 10 Breather valve
- 11 O-ring
- 12 Head stud bolt
- 13 Locating dowel
- 14 Blanking plug
- 15 Blanking plug
- 16 Seal, thk. 2
- 17 Nipple
- 18 Mesh filter

- 19 Neutral switch
- 20 Gasket
- 21 Gear pin
- 22 Washer
- 23 Intermediate gear
- 24 Washer
- 25 Circlip
- 26 Screw
- 27 Blanking plug
- 28 Gasket

 Spare parts catalogue

- [Timing](#)
- [Filters and oil pump](#)
- [Half crankcases](#)
- [Electric starter and ignition](#)

 **Caution**

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

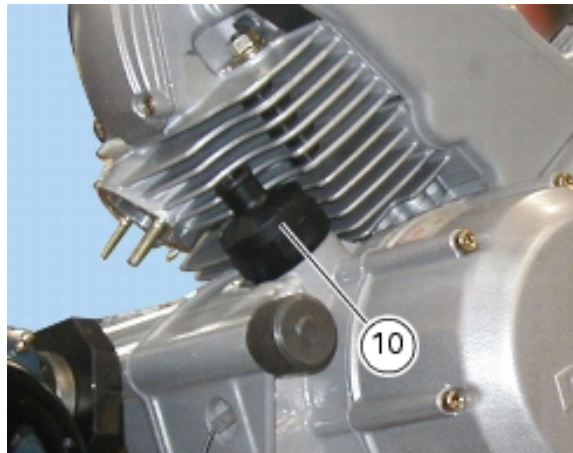
Removing the outer components

Operations	Reference See Section
Remove the engine from the frame	N 1, <a href="#">Removing the engine</a>
Remove the lubrication system	N 2.1, <a href="#">Removing the oil pump</a>
Remove the complete head unit with timing system	N 4.2, <a href="#">Cylinder heads: side covers / timing system</a>
Remove the complete cylinder/piston unit	N 5, <a href="#">Removing cylinder / piston assy</a>

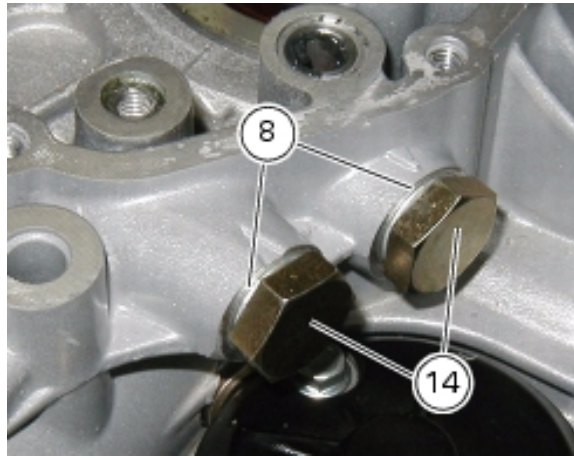
 **Note**

The removal procedure described is only necessary when changing or cleaning the casings. If the original casings are reused, the components may be left in place.

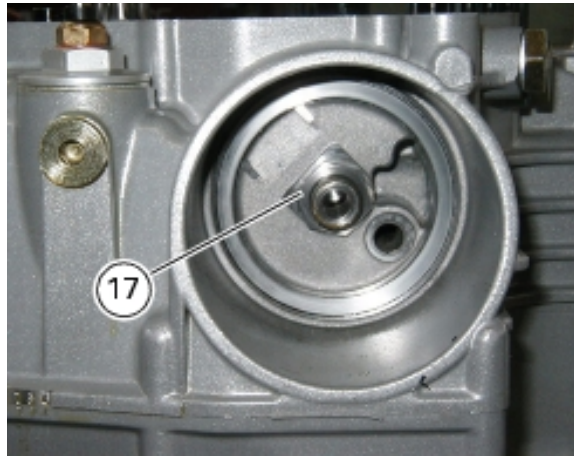
Remove oil breather valve (10) and O-ring (**11**) from the engine block.



Undo and remove the two plugs (14) and seals (8) from the clutch-side casing.



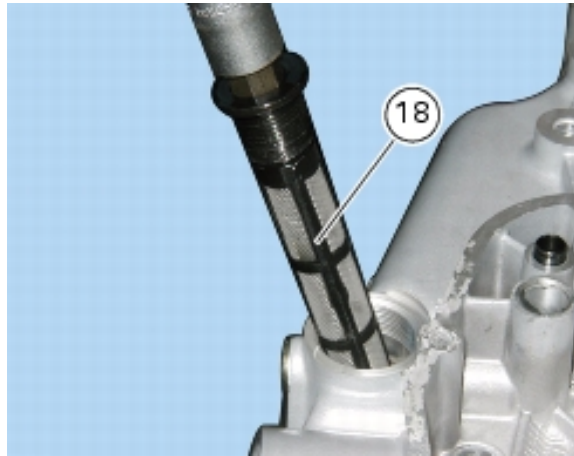
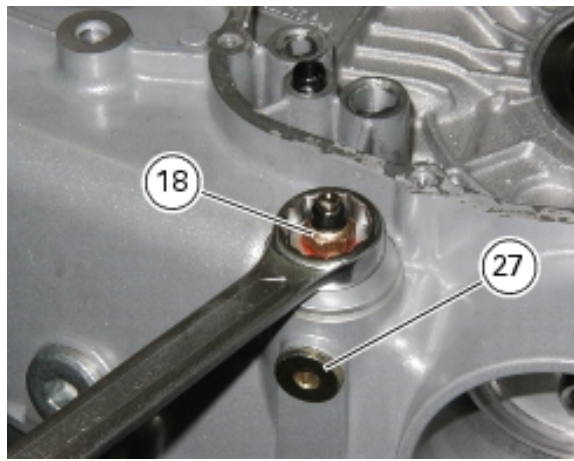
Undo and remove the oil cartridge filter (Sect. D 4, [Changing the engine oil and filter cartridge](#)).  
Undo and remove oil filter support nipple (17).



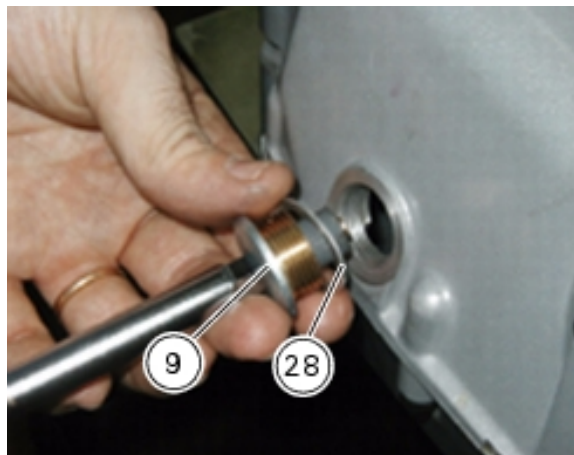
Undo and remove the screw (7) with gasket (6) to check engine timing sensor air gap.



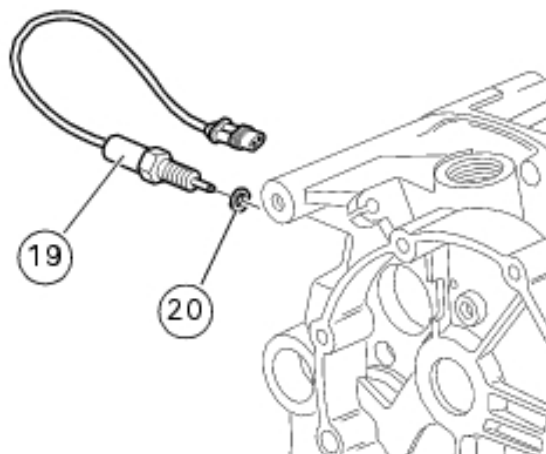
Remove mesh filter (18) and seal from the clutch-side casing as described under Sect. D 4, [Changing the engine oil and filter cartridge](#).  
Remove the plug (27), collect the seal.



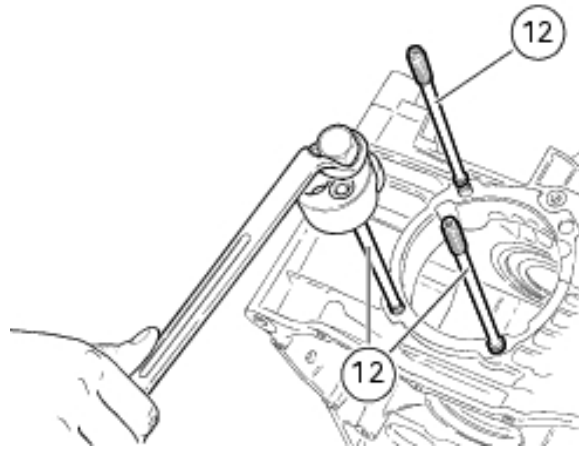
Remove drain plug (9) with seal (28).



Remove neutral light switch (19) with seal (20).



Using the special tool, remove head stud bolts (12).

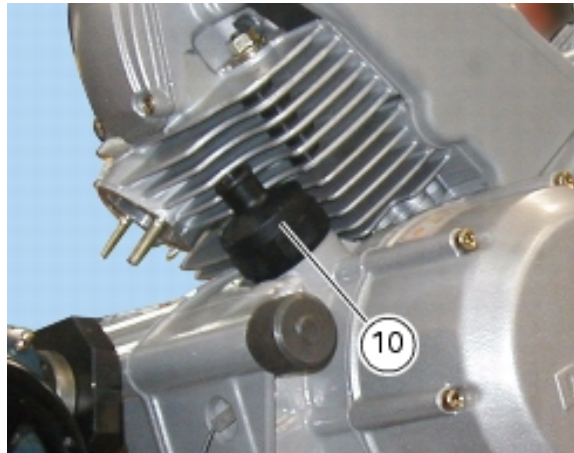


Remove gear selector ratchet and gear stopper as described in Sect. N 7.1, [Removing the gear stopper and ratchet](#).

### Reassembling the outer components

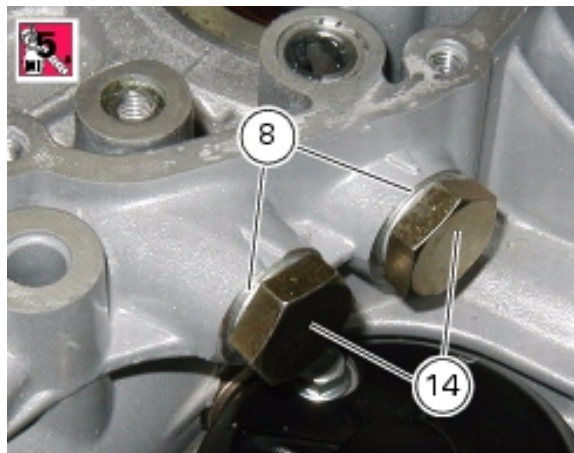
Check O-ring (11) for wear. Change, if necessary.

Fit oil breather valve (10) with O-ring (11) inside engine block and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).

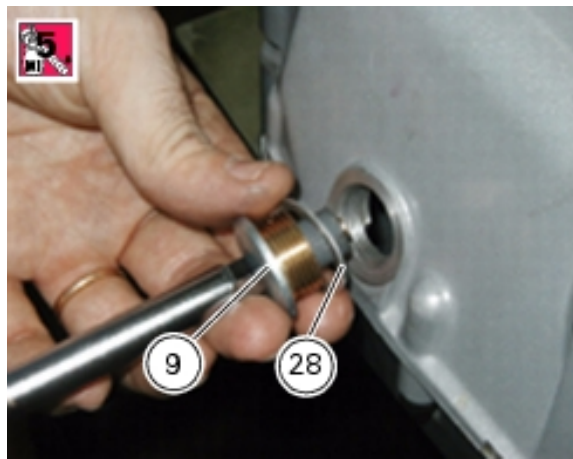


Tighten both plugs (14) and seals (8) to the specified torque (Sect. C 3, [Engine torque settings](#)).

Tighten oil filter cartridge support nipple (17) to the specified torque (Sect. C 3, [Engine torque settings](#)).

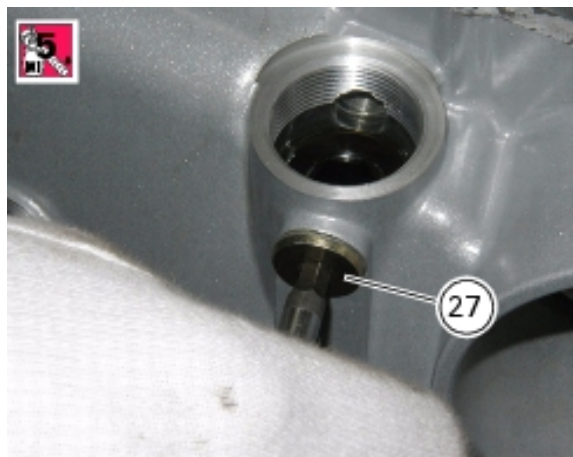


Tighten the drain plug (9) with seal (28) to the specified torque (Sect. C 3, [Engine torque settings](#)) after applying the recommended threadlocker.



Refit the neutral light switch (19) with seal (20) and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).

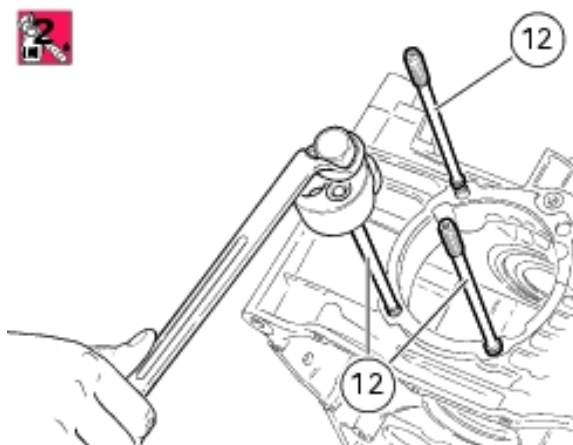
Apply threadlocker to the plug (27), fit the seal, start it in its thread and tighten it to the specified torque (Sect. C 3, [Engine torque settings](#)).



Refit mesh filter (18) with seal, as described in Sect. D 4, [Changing the engine oil and filter cartridge](#).

Refit the ratchet and gear stopper (Sect. N 7.1, [Reassembling gear stopper and ratchet](#)).

To refit stud bolts (12) on casing, apply speed bond on threads and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)). Use the suitable tool (shown).



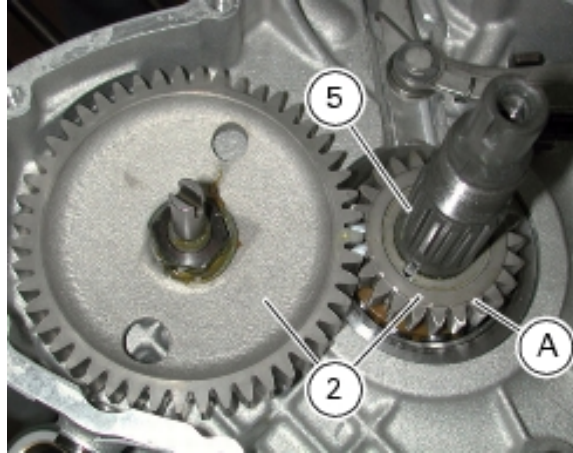
Operations	Reference See Section
Refit the cylinder-piston assemblies	N 5, <a href="#">Refitting cylinder / piston assy</a>
Refit complete head assembly and timing system parts	N 4.2, <a href="#">Cylinder heads: side covers / timing system</a>

Refit the lubrication system	N 2.1, <a href="#">Refitting the oil pump</a>
Refit the engine to the frame	N 1, <a href="#">Reassembling the engine</a>

## Removing the timing lay gear

Operations	Reference See Section
Remove the generator-side cover and the complete generator	N 8, <a href="#">Flywheel - generator</a>

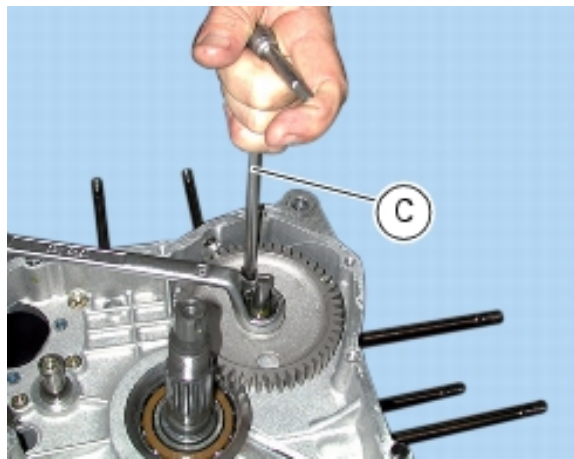
Slide out the drive gear (A) of the timing gear pair (2) and the key (5).



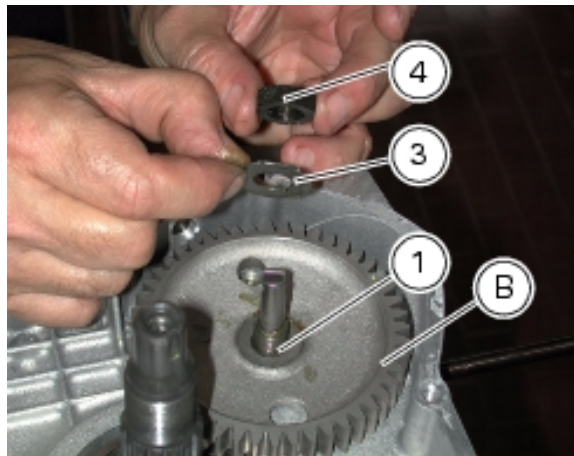
Unbend the safety washer (3) of the timing gear retaining nut (4).



Hold the timing gear in position and hold it steady by fitting a pin (C) into one of the holes. Unscrew the lock nut (4).



Slide out nut (4), washer (3), driven gear (B) and the key (1) from the timing layshaft.



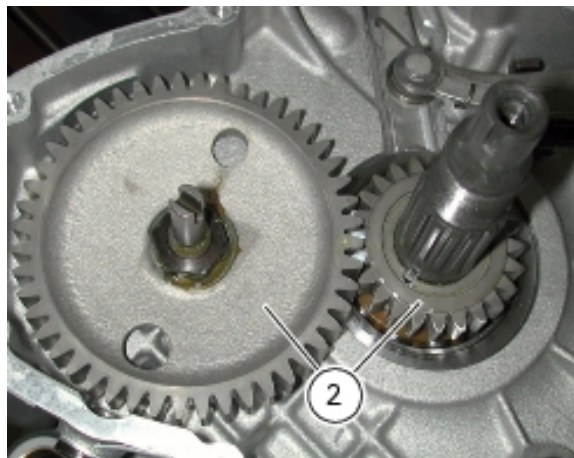
Reassembling the timing lay gear

Before reassembling the removed parts, check timing gears (2) for wear. Change, if necessary.



Caution

The two timing gears (2) must be always changed in pair.

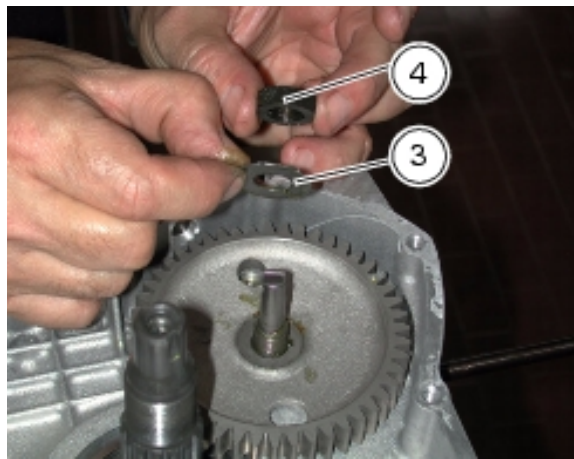


To reassemble, follow the disassembly procedure in reverse order.



Caution

Once finished, make sure that washer (3) is bent on nut (4) to prevent it from getting loose.

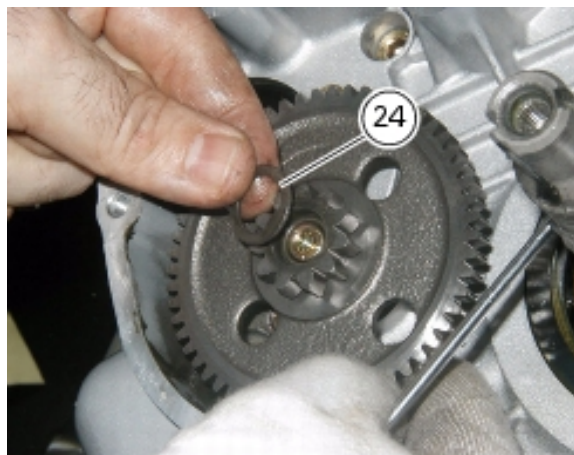
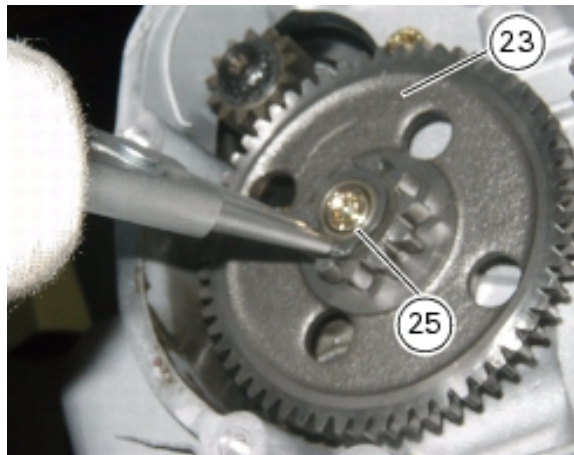


Operations	Reference See Section
Refit the generator-side cover and the complete generator	N 8, <a href="#">Flywheel - generator</a>

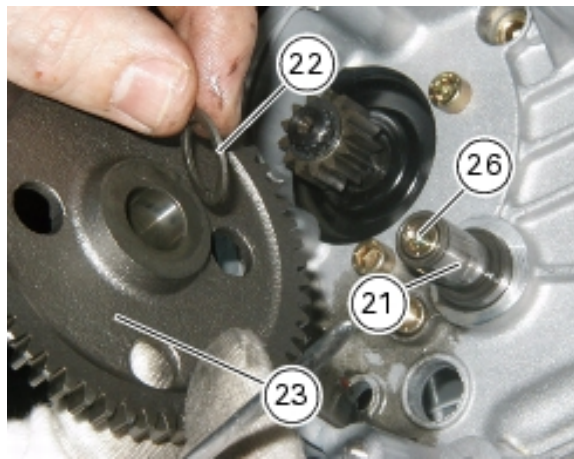
### Removing the starter motor driven gear

Operations	Reference See Section
Remove the generator flywheel unit	N 8, <a href="#">Flywheel - generator</a>

Remove circlip (25) and washer (24).  
Remove the starter lay gear (23) and the shim (22).



Loosen screw (26) on lay shaft (21) and remove shaft.



Refitting the starter motor driven gear

Installation is a reversal of the removal procedure.



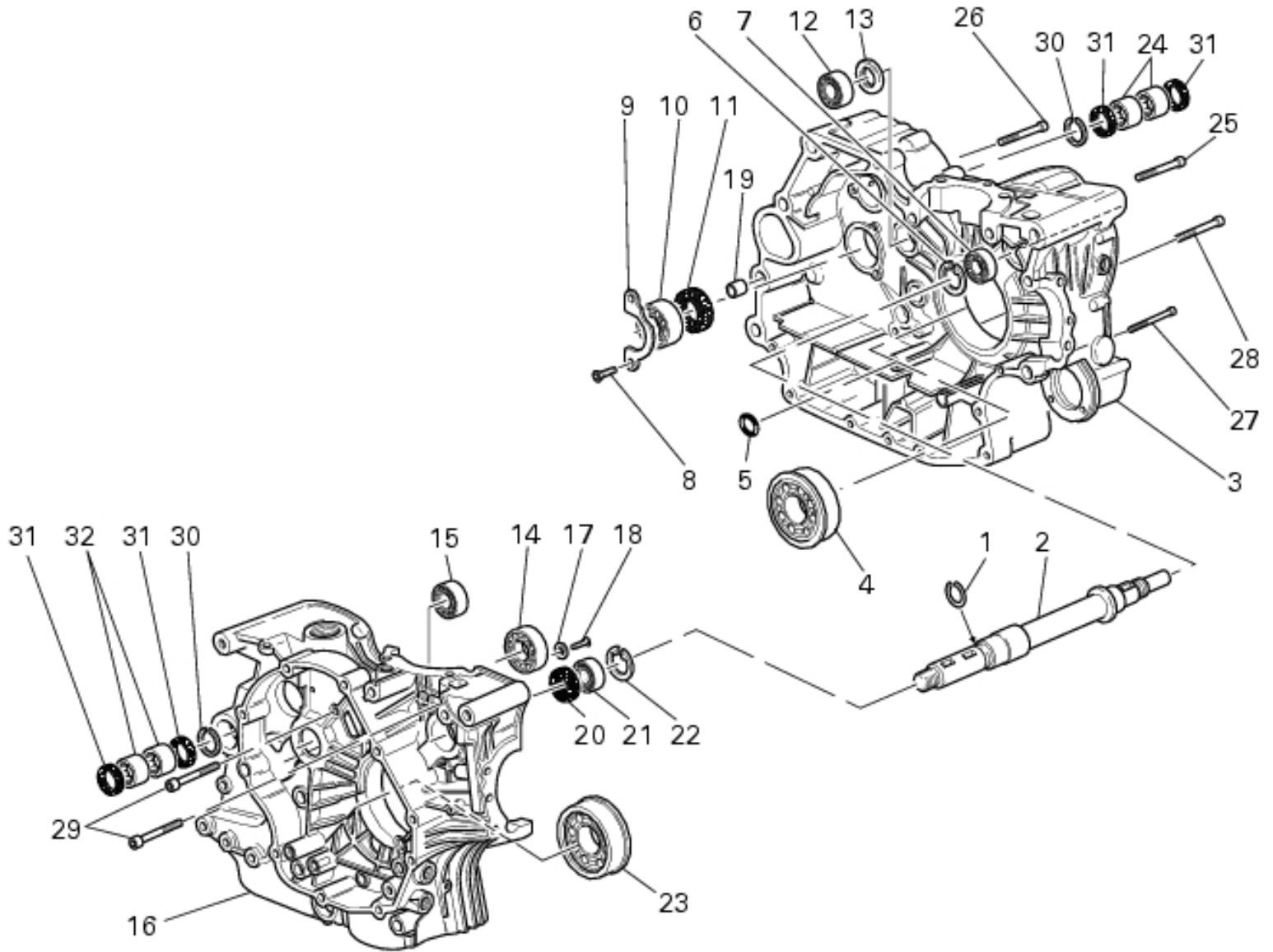
Note

Apply recommended threadlocker to screw (26), then tighten it to the specified torque (Sect. C 3, [Engine torque settings](#)).




Operations	Reference See Section
Refit the generator flywheel unit	N 8, <a href="#">Flywheel - generator</a>

## 9.2 - Casing unit: crankcases



- 1 Circlip
- 2 Timing lay gear
- 3 Generator-side casing
- 4 Bearing
- 5 O-ring
- 6 Circlip
- 7 Bearing
- 8 Screw
- 9 Stop plate
- 10 Bearing
- 11 Seal
- 12 Bearing
- 13 Washer
- 14 Bearing
- 15 Bearing
- 16 Clutch-side casing
- 17 Spacer
- 18 Screw

- 19 Bush
- 20 Seal
- 21 Bearing
- 22 Circlip
- 23 Bearing
- 24 Roller bearing
- 25 Screw
- 26 Screw
- 27 Screw
- 28 Special screw
- 29 Screw
- 30 Circlip
- 31 Seal

 Spare parts catalogue

[Timing](#)

[Half crankcases](#)



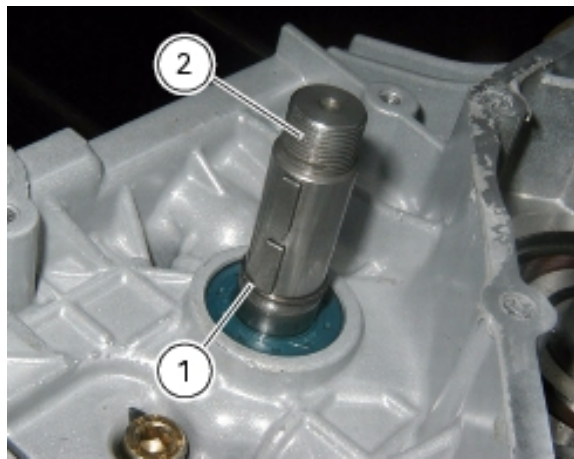
### Caution

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

### Opening the casings

Operations	Reference See Section
Remove the engine from the frame	N 1, <a href="#">Removing the engine</a>
Remove the lubrication system	N 2.1, <a href="#">Removing the oil pump</a>
Remove the complete head unit with timing system	N 4.2, <a href="#">Removing the timing side covers</a>
Remove the complete cylinder/piston unit	N 5, <a href="#">Removing cylinder / piston assy</a>
Remove the generator-side cover and the complete generator	N 8, <a href="#">Flywheel - generator</a>
Remove the mesh filter	D 4, <a href="#">Changing the engine oil and filter cartridge</a>
Remove the clutch-side cover	N 6.2, <a href="#">Removing the clutch cover</a>
Remove the complete clutch unit	N 6.1, <a href="#">Disassembling the APTC system</a>
Remove engine ignition assembly	P 3, <a href="#">Electric starting</a>

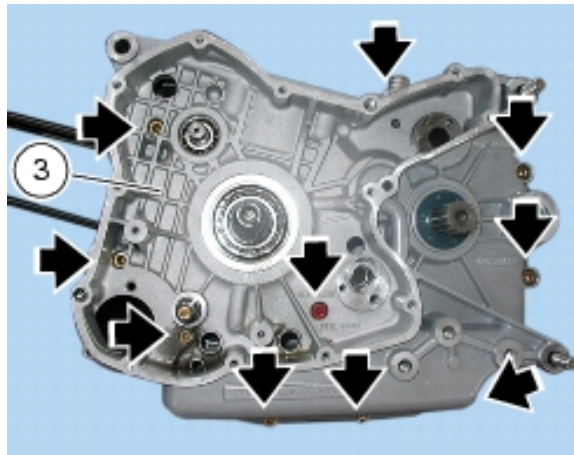
Using two screwdrivers, remove the circlip (1) from the timing layshaft (2) on the clutch-side casing.



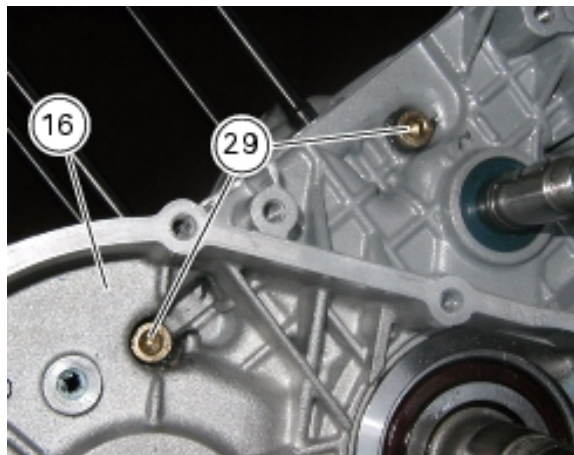
Note

When removing the circlip, take care not to score the shaft surface.

Undo the casing jointing screws working from the generator side (3).



Unscrew the two screws (29) on the clutch-side casing (16) near the vertical cylinder housing.

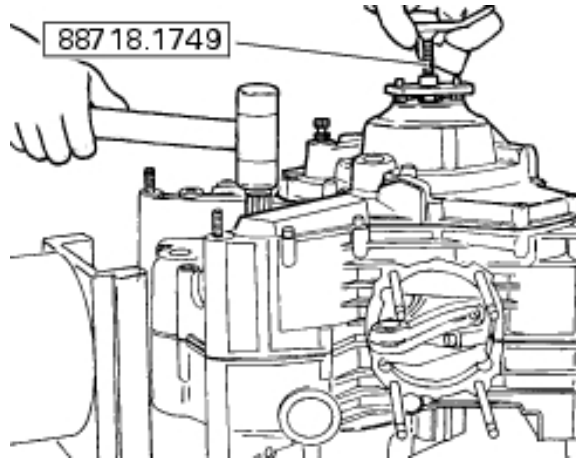


Use generator cover or a service cover with puller part no. **88713.1749** fitted to it. Secure cover to casing with some of the original screws and begin separation by turning the central pin of the tool. Tap on gearbox secondary shaft with a plastic hammer to separate casings.



Note

Do not damage or lose the shims on the shafts and on the selector drum.



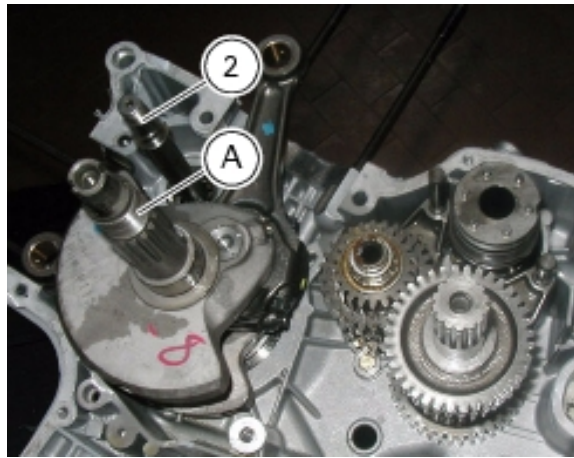
Remove gearbox shafts and gearbox selector drum from the casing (Sect. N 7.2, [Gearbox assembly: gearbox shafts](#)).



Slide out the crankshaft (A) using a plastic hammer. Do not damage or lose the shims.

Remove timing layshaft (2).

Collect O-Ring (5) in the oil duct between casings.



## Overhauling the casings

Carefully inspect the crankcases.

Place the casings on a reference surface and check that the mating surfaces of the casings are perfectly flat. Check bearings (4) and (23) for wear. Note that the main bearings must always be changed in pairs (see procedure in "Main bearings", next paragraph). If you have to change the gearbox primary shaft bearing (12), remember that there is a seal (13) placed between bearing and chain-side casing.

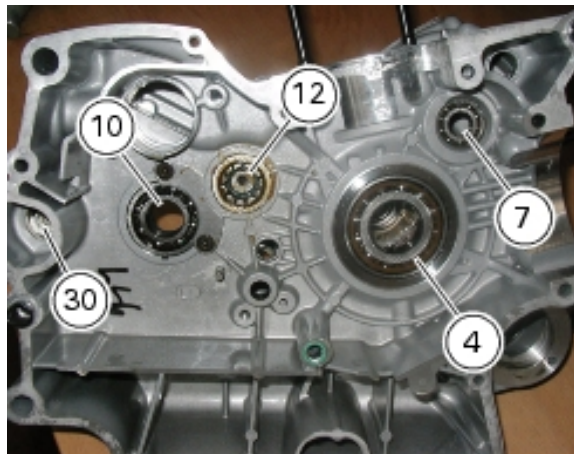


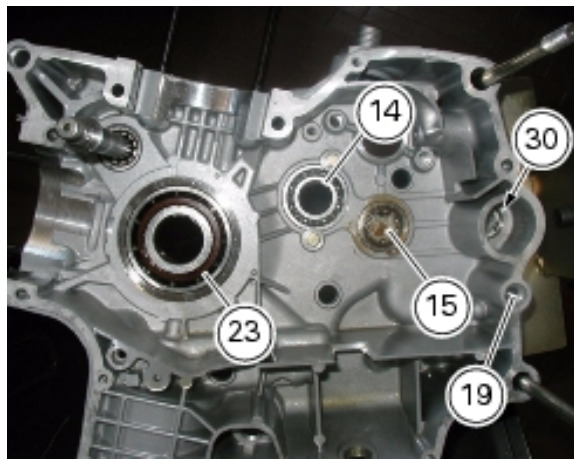
Note

It is a good rule to change all casing bearings every time an engine is overhauled.

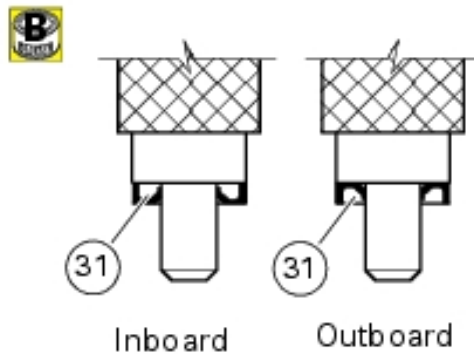
When replacing gearbox shafts bearings (14) and (10), secure them in place in the casings using the spacers (17) and the stop plate (9).

Change the oil seal (11) placed outside the bearing (10) every time casings are overhauled.



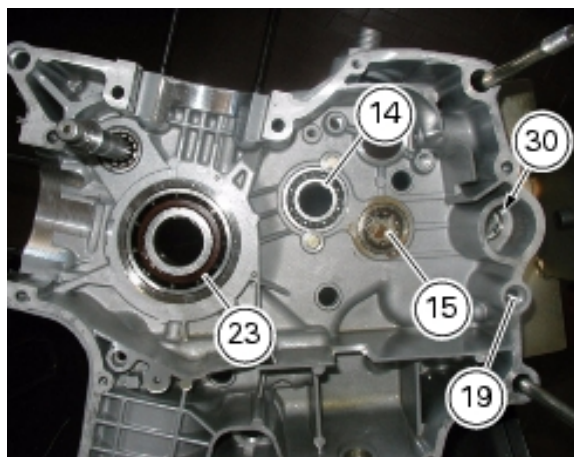


When changing the needle roller bearings (24) and the seals (31) on the swingarm shaft, grease the bearing seats and the seal lips with the specified grease. Install the inner oil seal (31) with the flat surface facing the casing and against the circlip (30); outer oil seal is to be fitted in the opposite way. Use a suitable drift - see figure - to install seals (31) and needle roller bearings (24). Check that the oilways are not clogged or obstructed.



Check centring bushes (19). If apparently distorted or loose in their seats, change them using proper tools. When the locating bushes (19) are hard to remove from casing, use a left-hand tap to force bushes out.

**Caution**  
Never re-use any bushes (19) that have been removed with a tap.



### Overhauling the main bearings

The main bearings have offset inner races so that the balls can transmit the loads from one groove to the other along

straight lines at a particular angle to bearing axis. The angle-contact ball bearings are designed for bearing combined loading (radial-axial loads).

They may bear axial loading in one direction only. Because of radial loading, the bearing produces an axial force that must be combined with an opposite force and it is thus usually fitted in opposition to another.

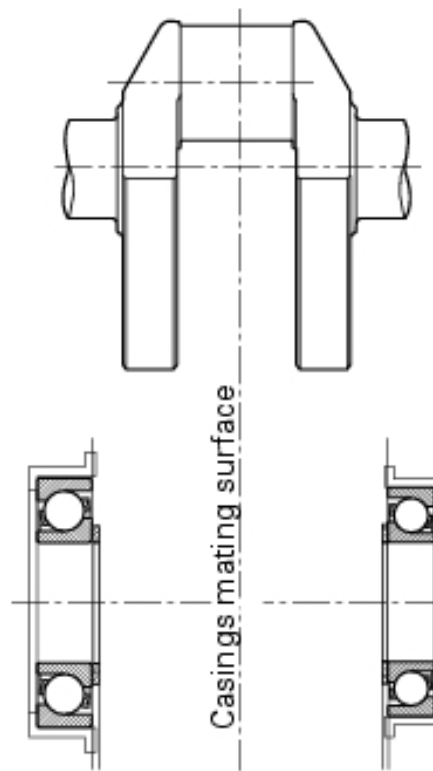
To change the bearings, proceed as follows:

heat the casing in an oven up to **100 °C**.

- Remove the bearing using a drift and a hammer.

Fit the new bearing (while the casing is still hot) perfectly square into its seat. Use a tubular drift which only applies pressure on the bearing outer ring.

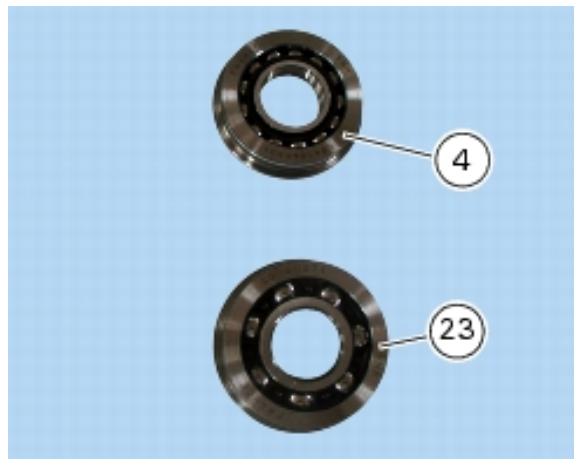
- Let casing cool down and ensure that bearing is securely fixed into casing.



 Caution

On badly worn engines, bearing bushes may have developed clearance in the casing - normally, bushes are interference-fit in the casing.

Check that casing to bushing interference, with bearings (4) and (23) installed, is not below **0.03** mm; if not so, change the casings.



 Caution

After installing new main bearings, shim the crankshaft as described under paragraphs "[Shimming the shafts](#)" and "[Closing the casings](#)" in this Section.

### Reassembling the casings

Carefully inspect the casings. They should be in perfect conditions and clean. Mating surfaces must be perfectly flat and free from burrs.

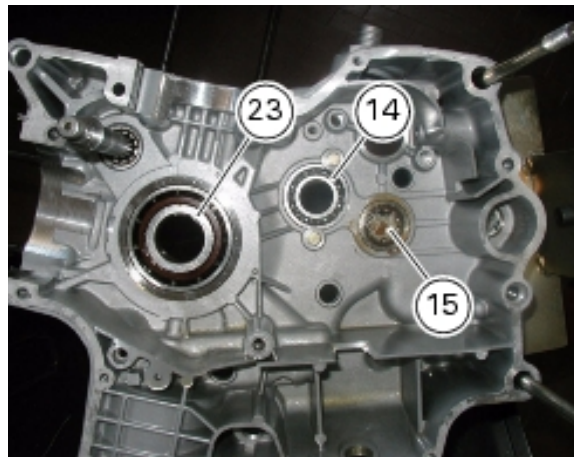
### Reassembling the clutch-side casing

Check that the following parts are in place inside casing:

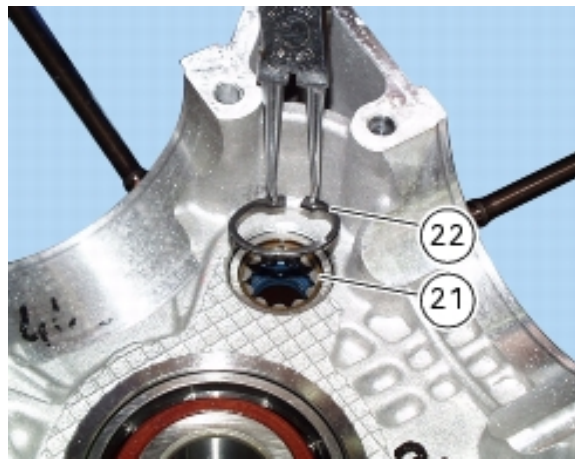
Secondary shaft end bearing (15).

Primary shaft bearing (14) secured with screws (18) and spacers (17).

Main bearing (23).



Roller bearing (21) with circlip (22) at the position of the timing layshaft.



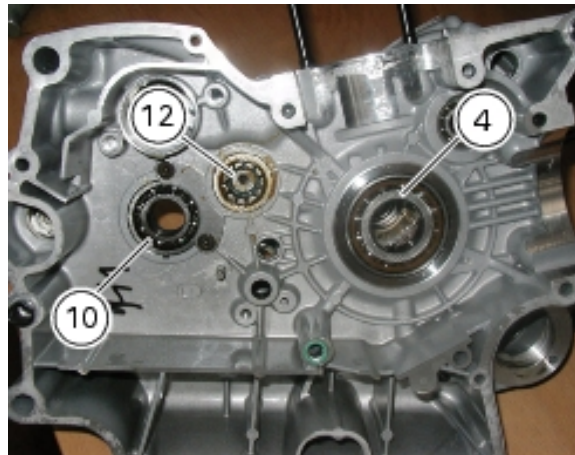
Reassembling the generator-side casing

Check that the following parts are in place inside casing:

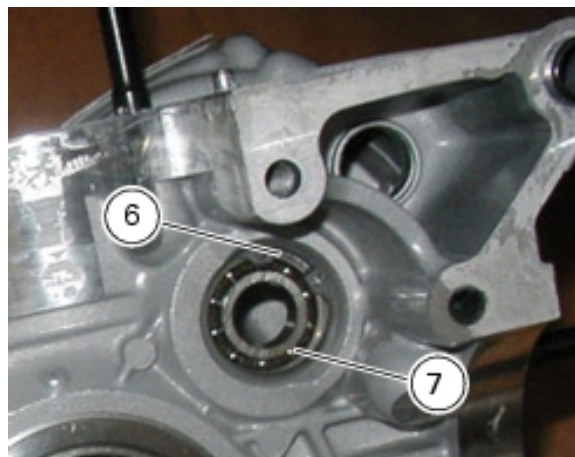
The double ball ring bearing (10) for the selector fork shaft with plate (9) and retaining screws (8).

The gearbox primary shaft bearing (12) with inner spacer (13).

Main bearing (4).



The ball bearing (7) with circlip (6) at the position of the timing layshaft.



Note

Except for the main bearings, all other bearings do not have a mounting position.

### Shimming the shafts

Before closing the casings, calculate the shims required to take up crankshaft and gearbox shafts end float. To determine correct shimming, proceed as follows.

## Shimming the crankshaft

After fitting the new main bearings, proceed as follows to determine the total shimming "S".

Measure "A" between the crankshaft surfaces that contact the bearings.

Measure the depths "P1" and "P2" corresponding to the distance between the mating surfaces of the two casings and the contact surfaces of the inner races of the bearings;

Add a pre-load of **0.30** mm. This will compensate the additional end float resulting from heat expansion when casings reach operating temperature;

This gives:  $S = P1 + P2 + 0.30 - A$ .

To calculate the amount of shimming required for each casing, note that:

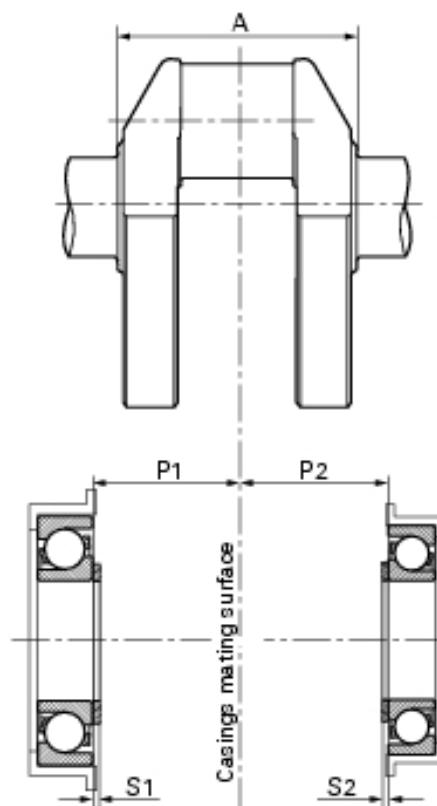
$$S = S1 + S2$$

where "S1" and "S2" represent the shimming for the casings 1 and 2.

Considering shaft alignment, this gives:

$$S1 = P1 + 0.15 - A/2;$$

And, finally, the second shimming:  $S2 = S - S1$ .



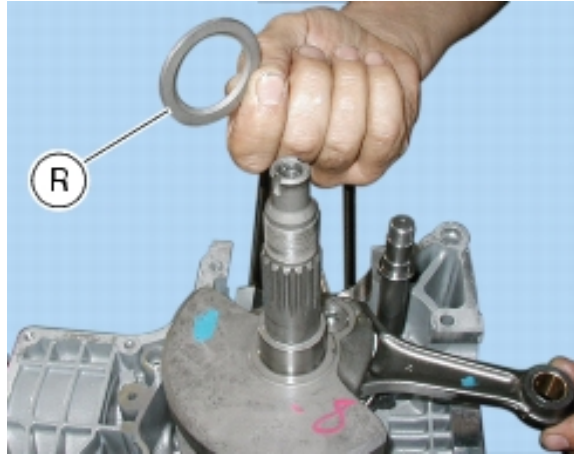
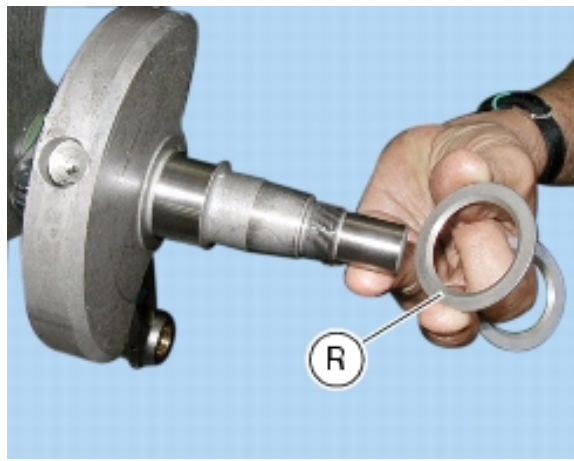
## Practical shimming procedure for the crankshaft

Below is a practical shimming procedure allowing to correctly calculate crankshaft shims.

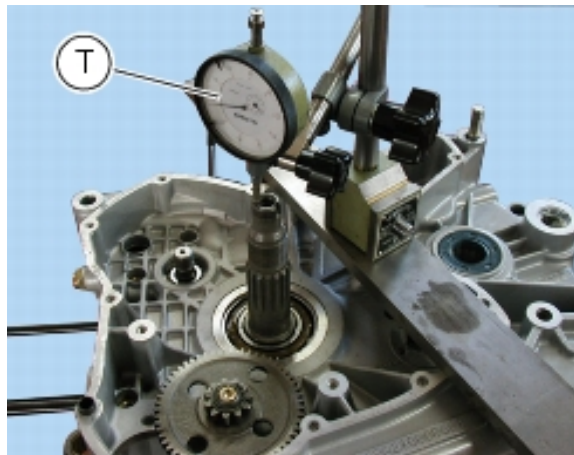
Install a shim (R) of min. thickness (**1.90** mm) on each side of the crankshaft to avoid contact between crank web and engine block.

Fit crankshaft into casing and close engine block.

Fit three M8 screws into the holes shown in the figure and tighten to the specified torque (Sect. C 3, [Engine torque settings](#)).

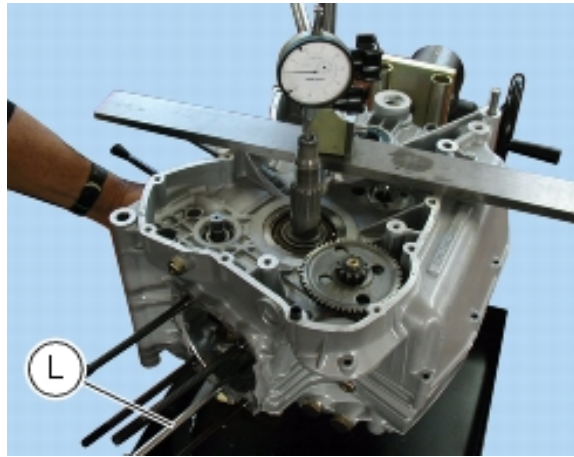


Place a dial gauge (T) with magnetic base on a support plate fixed to crankcase.



Bring stylus in contact with crankshaft end and set dial gauge to zero with the stylus touching the crankshaft.

Place a lever (L) between casing and crank web and lever crankshaft pushing towards dial gauge.



Note dial gauge reading. This will be crankshaft end float. Add pre-load (**0.30 mm**) and total size of shims used (**1.90x2=3.8 mm**).

Divide by two and you have obtained the shimming required for each casing.



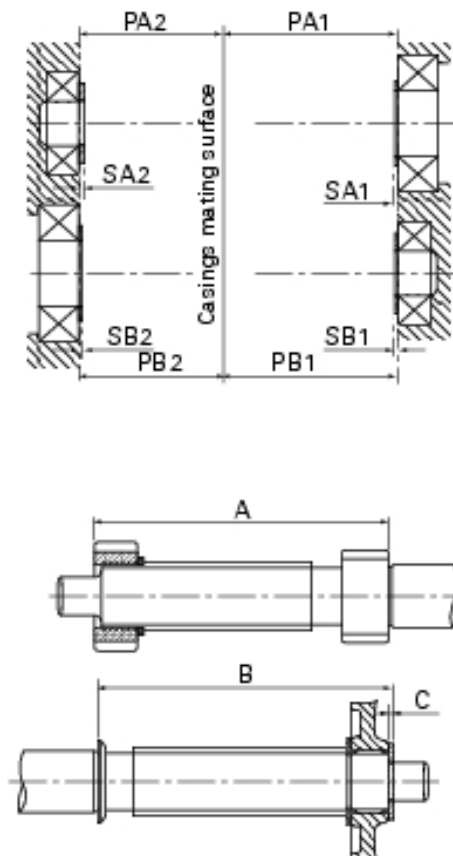
Note

After closing the casings, crankshaft must turn with some interference in the new bearings.

Shimming the gearbox shafts

To establish the total shimming for the primary shaft "SA" and the secondary shaft "SB", proceed as follows. Measure "A" and "B" on the primary and secondary shafts for secondary shaft, also add **2.3 mm** for shim "C". Measure the depth corresponding to the distance between the contact surface between the clutch-side and chain-side casings and the contact surface of the inner races of primary shaft bearing "PA1" and "PA2" and of the secondary shaft bearing "PB1" and "PB2".

Considering that end float should be **0.05 - 0.20 mm**, and taking the average optimal value of **0.15 mm**, this gives:



$$SA = PA1 + PA2 - A - 0.15 \text{ and}$$

$$SB = PB1 + PB2 - B - 0.15$$

To establish the size of each shimming, note that:

$$SA = SA1 + SA2 \text{ and}$$

$$SB = SB1 + SB2$$

Where "SA1" and "SA2" represent the primary shaft shimming on clutch side and chain side and "SB1" and "SB2" represent the corresponding secondary shaft shimming. This gives:

$$SA1 = PA1 - 64 - 0.075 \text{ and}$$

$$SB1 = PB1 - 64 - 0.075 \text{ and therefore}$$

$$SA2 = SA - SA1 \text{ and } SB2 = SB - SB1.$$

Shimming the gearbox drum

A similar procedure is used to establish the total shimming "S" for the gearbox drum;

Given that:

P1 = clutch-side casing depth

P2 = chain-side casing depth

A = gearbox drum shoulder

Considering that end float should be **0.10 - 0.40 mm**

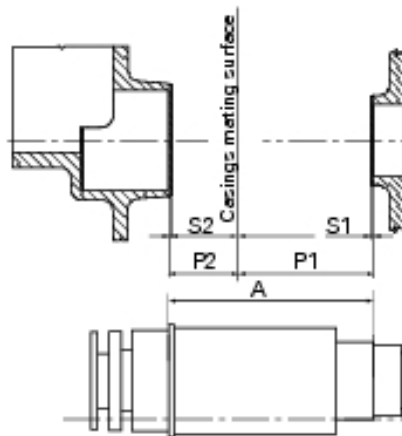
and taking the average optimal value of **0.25 mm**,

This gives:  $S = P1 + P2 - A - 0.25$ .

Given that  $S = S1 + S2$ ,

hence  $S1 = P1 - 59 - 0.125$  and so

$S2 = S - S1$ .

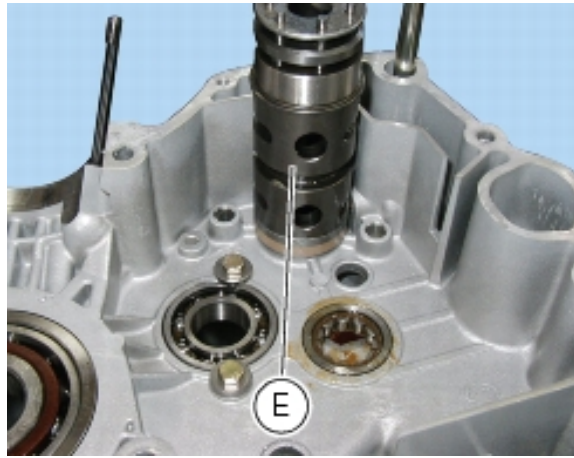


Practical shimming procedure for the selector drum and gearbox shafts

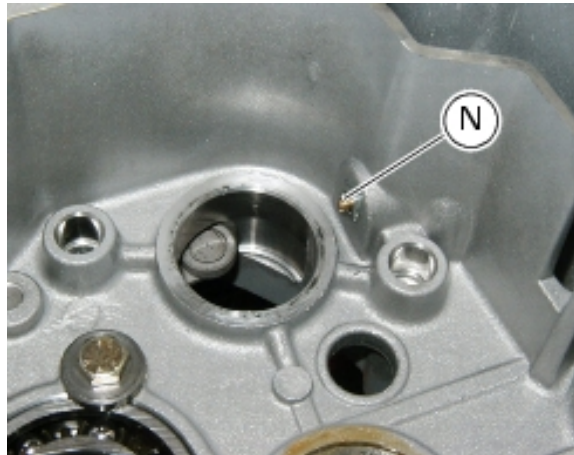
Following is a practical shimming procedure for gearbox selector drum (E), primary and secondary shaft.

Firstly, measure end float of the selector drum with no shims.

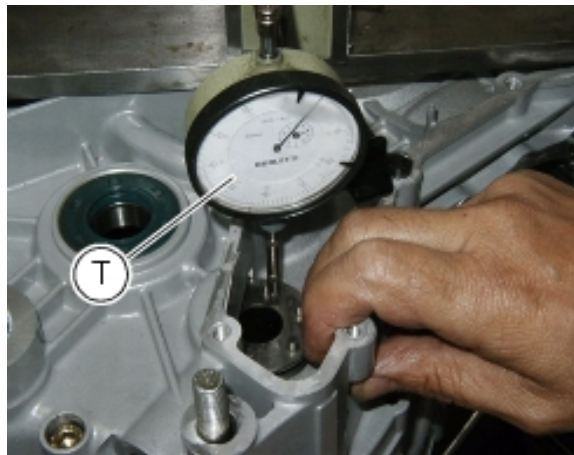
Separate the casings and remove the crankshaft with its shims (crankshaft has been shimmed previously).



Extract the neutral switch (N) before fitting the selector drum into the casing to avoid damage to the switch. Position the selector drum with no shims. Secure the casing by fitting a few screws in the holes near the drum position.



Place a dial gauge (T) with magnetic base on a support plate fixed to crankcase. Bring stylus in contact with selector drum end and set dial gauge to zero with the stylus touching the drum.





Lever drum and note dial gauge reading. This will be total axial play. Determine the amount of shimming required to obtain a final end float between **0.10** and **0.40** mm.

Divide total play by two to determine the amount of shimming required on each side of the selector drum.

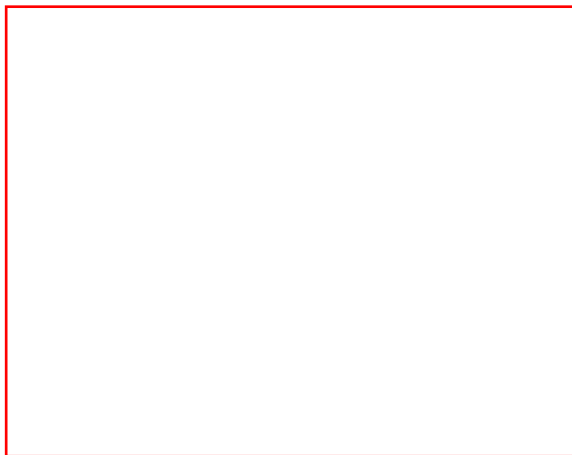
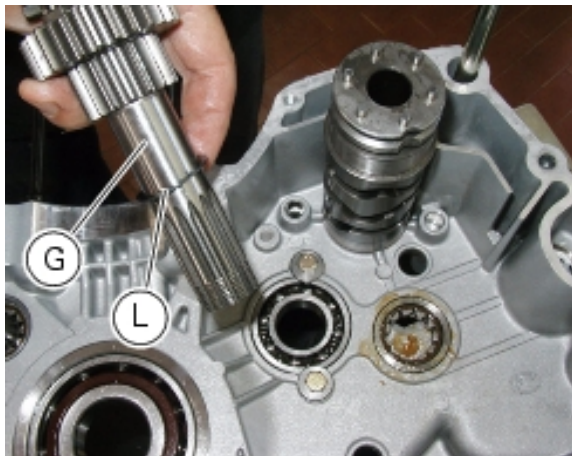


Note

Final end float should be closer to **0.40** rather than **0.10** mm.

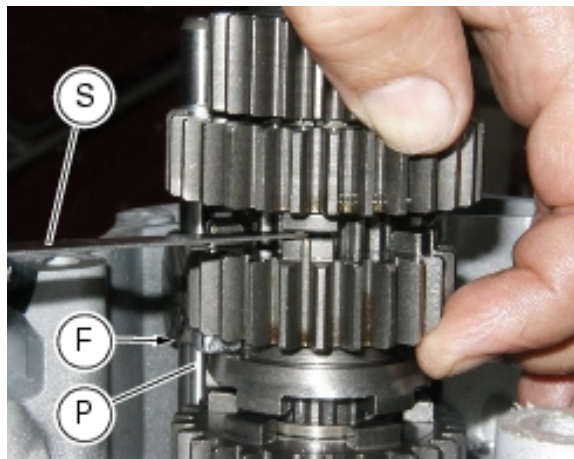
Separate the casings and insert the necessary shims on each side of the selector drum.

To shim the gearbox primary shaft (G), begin with a shim (L) of the same size used for the selector drum.

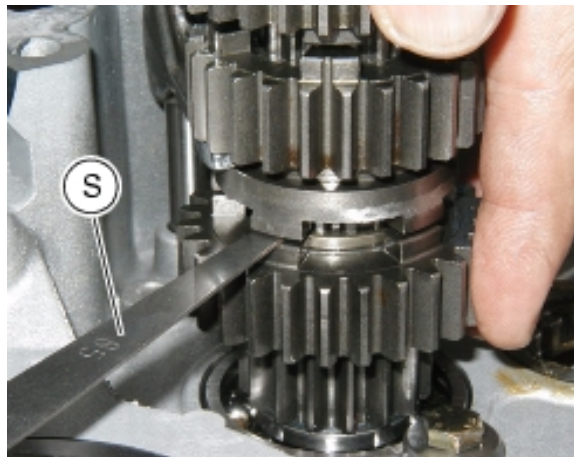


Fit the primary shaft to the clutch-side (right) casing with the shim.

Install the fork (F) and its pin (P).



Check that the selector drum is in NEUTRAL, looking at the clutch-side end.  
Now hold the primary shaft in position and check that the clutch dogs of the sliding gear are equally distant from the dogs of the fixed gears. This is done by inserting a feeler gauge (S) between the dogs.

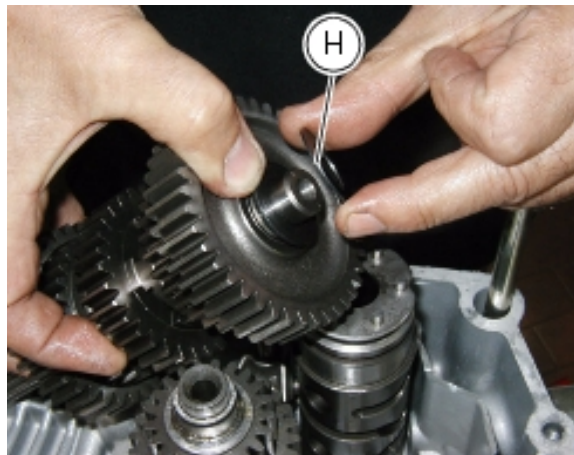


Note

Press the sliding gear in both directions so as to take up play.

If the dogs are not equally distant from the other clutch dogs, change the primary shaft shim (L).  
Fit a **2.5-mm** shim (H) to the secondary shaft.

Fit the secondary shaft to the clutch-side (right) casing. Install the two forks with their pins.

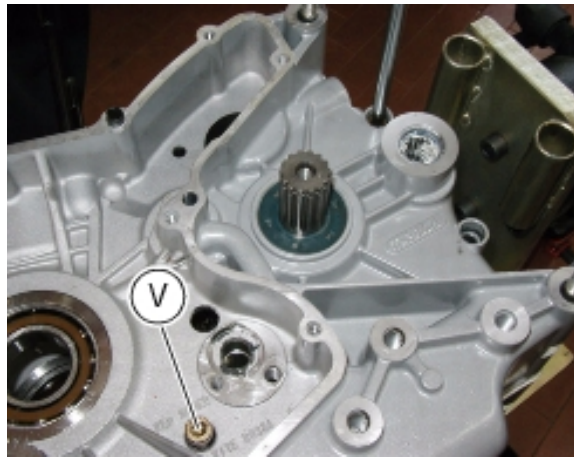


Select a shim of adequate size following the same procedure as for the primary shaft.  
Determine the amount of shimming for the left end (generator side) to obtain nearly **zero** end float when the casing is closed.

Place a small shim (**1.5 mm**) on primary shaft and no shims on the secondary shaft.

Remove selector drum, forks and pins.

Fit the casing and secure it with a few screws (V) near the gearbox shafts.

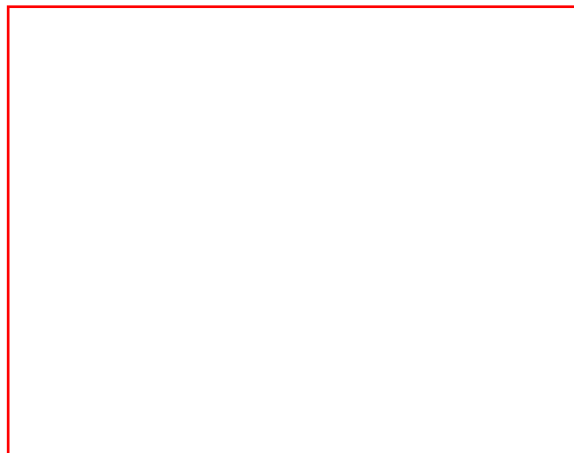
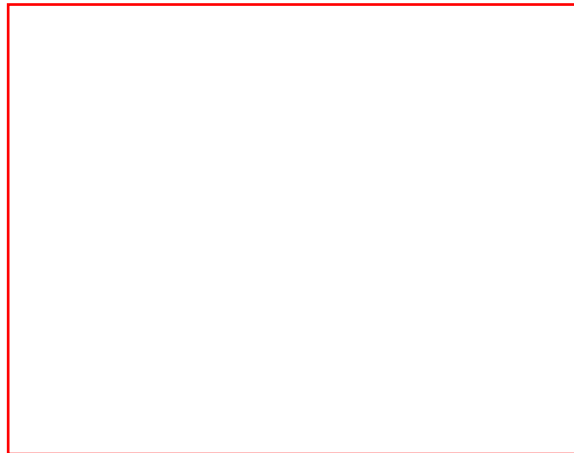


Measure end float of secondary and primary shafts with the dial gauge.  
Final play must be between **0.05** and **0.20** mm for both shafts.



Note

Play should be closer to **0.05** rather than **0.20** mm.

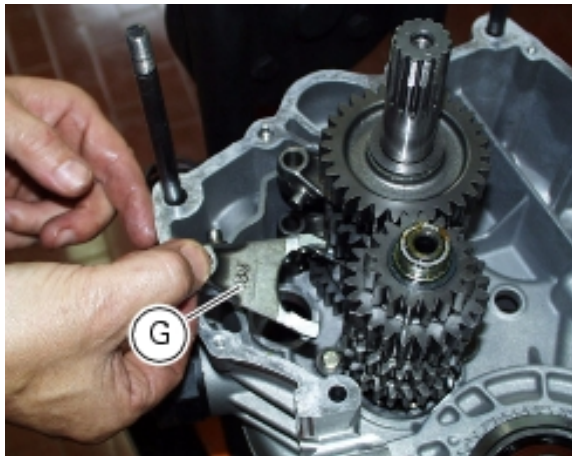
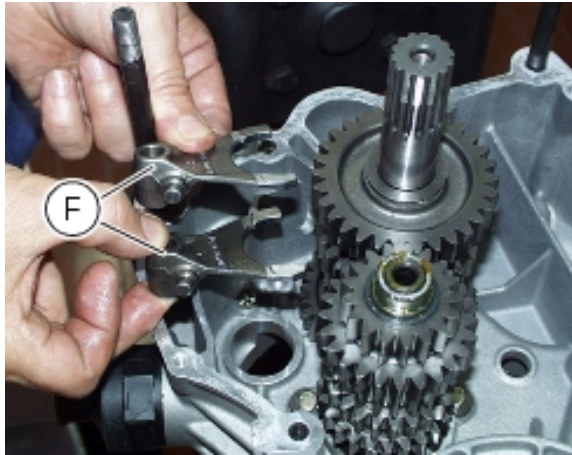




### Checking gearbox position

After shimming the gearbox shafts, separate the casings.

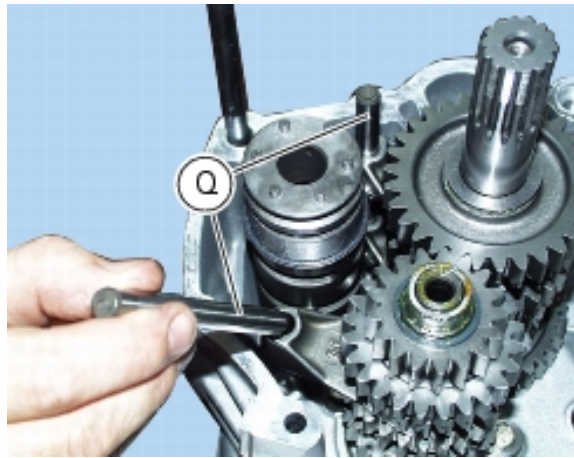
Insert the forks of the 1<sup>st</sup> - 4<sup>th</sup>, 3<sup>rd</sup> - 2<sup>nd</sup> gears (F) and the fork of the 5<sup>th</sup> - 6<sup>th</sup> gears (G) into the grooves of the sliding gears.



Fit the fork selector drum (P) with calculated shims.



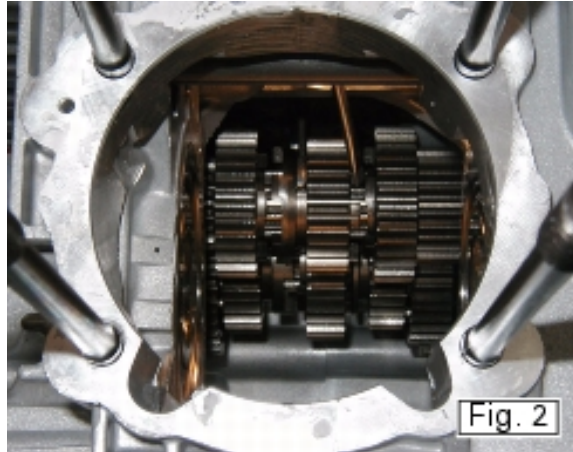
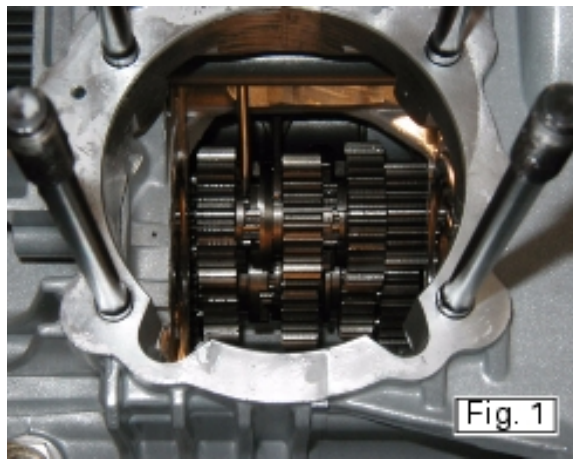
Fit the forks to the drum and fit the pins (Q).  
Close the casings without the crankshaft to check gearbox position.



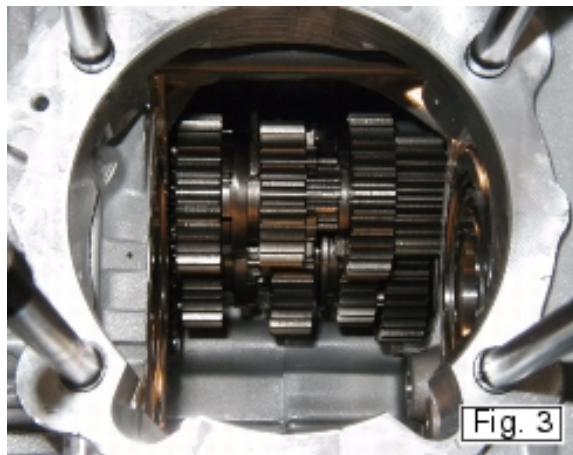
Install and adjust the gear selector lever assembly (M) (see Sect. N 7.1, [Reassembling the gear selector lever](#)).



Place gearbox in NEUTRAL and look through the opening of the horizontal cylinder to check that the clutch dogs of the sliding gears are equally distant from the fixed gear dogs (Fig. 1 - Fig. 2).

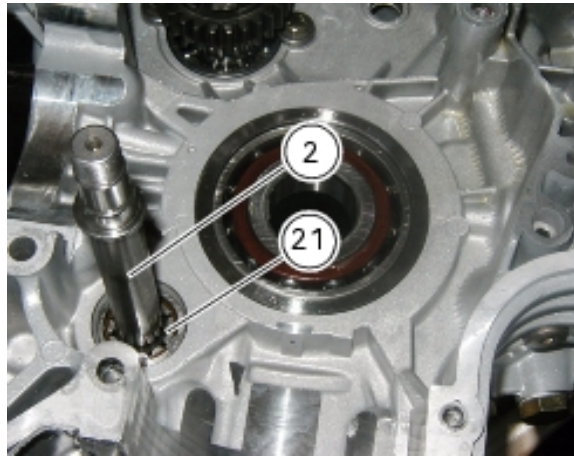


Engage a gear and check that the fork is free in the sliding gear groove (Fig. 3).

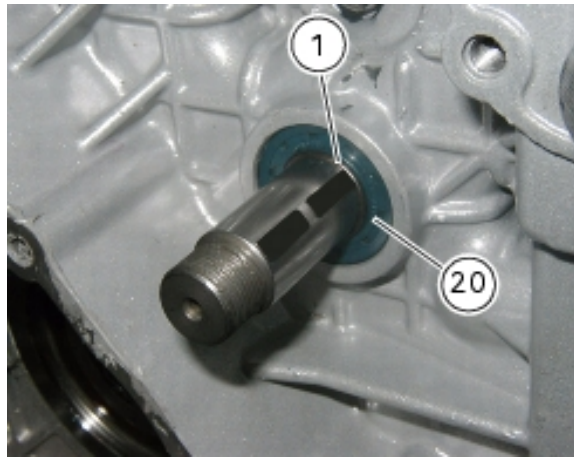


### Closing the casings

Fit the timing layshaft (2) into the clutch-side casing roller bearing (21). To prevent damage to the oil seal on the timing layshaft, insert a protection cap part no. **88700.5749** on the shaft threaded end.



Dampen the oil seal (20) with alcohol and fit it on the timing layshaft. Drive it fully home on the roller bearing (21). Fit the circlip (1) into the shaft seat and remove the protection cap.



Note

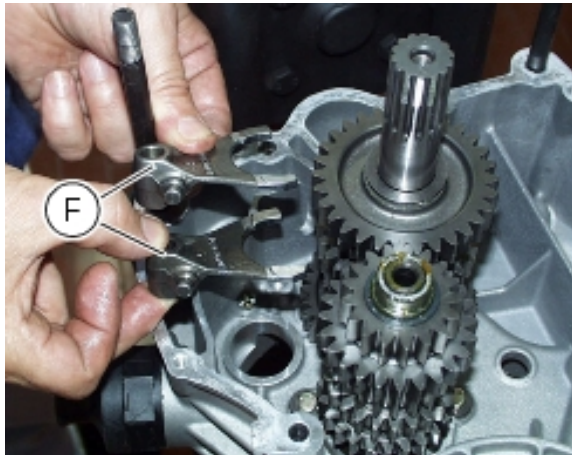
When refitting used components, make sure that the inner races (D) of the gearbox shaft end bearings are fitted into the correct bearing and are not on the shaft. Then install gearbox unit into the casings.



Match gearbox shafts, fit the previously calculated shims and fit them to the clutch-side casing.



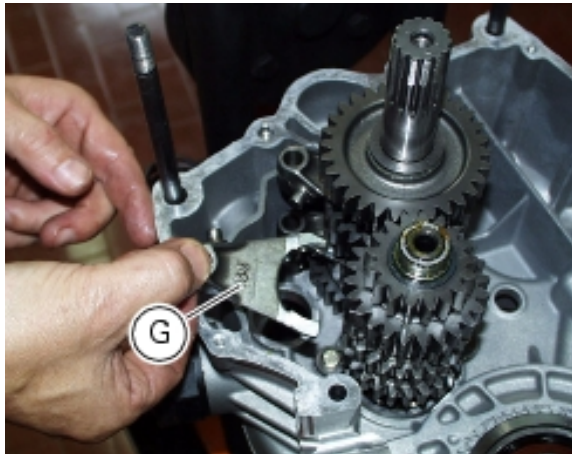
Insert the forks of the 1<sup>st</sup>-4<sup>th</sup> and 2<sup>nd</sup>-3<sup>rd</sup> gears (F) into the grooves of the secondary shaft driven gears.



Note

Both forks are alike.

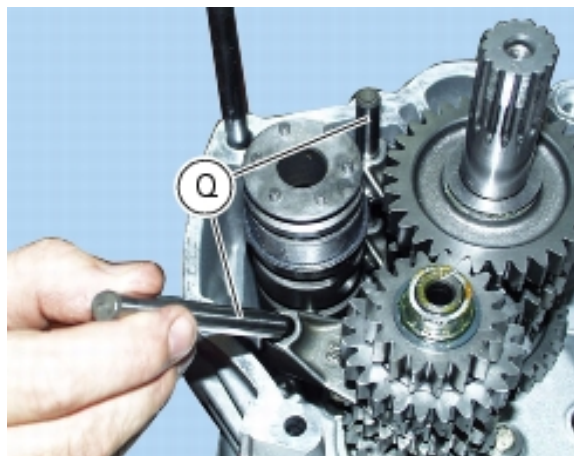
Insert the fork of the 5th-6th gears (G) into the primary shaft driven gear.



Fit the fork selector drum (P) in the casings with calculated shims.



Fit the pins (Q) in the forks you have just assembled.



Fit the shimmed crankshaft into the clutch-side casing. Position the connecting rods (B) at their housings into cylinders.

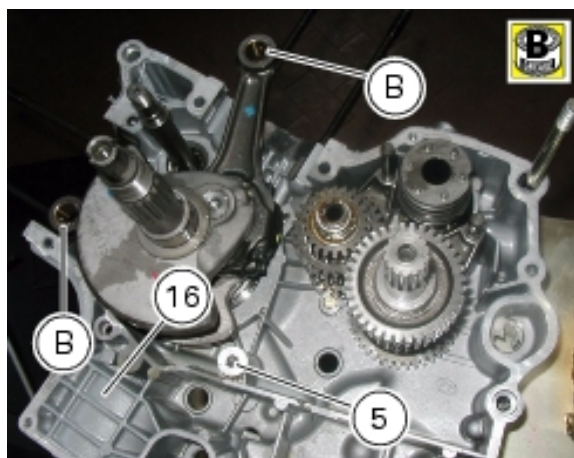
Make sure that the two centring bushes (19) are fitted.

Thoroughly grease the O-ring (5) and place it close to the oil duct connecting the two casings.

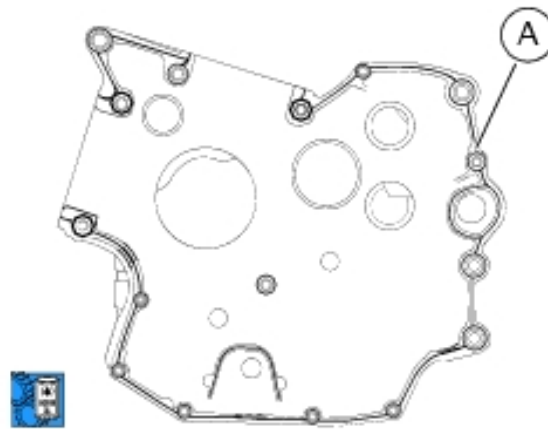


### Caution

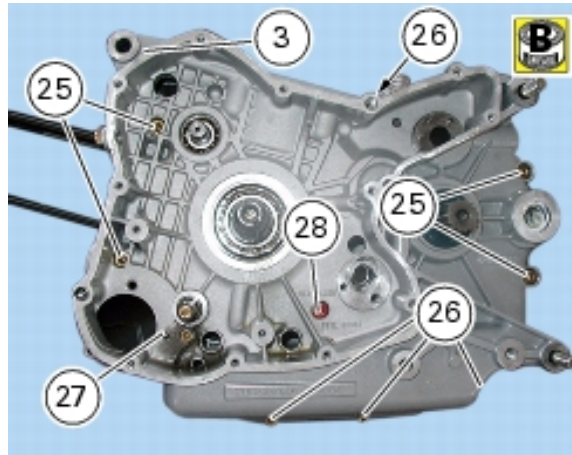
Make sure that the connecting rods (B) are correctly positioned in the cylinders. Incorrect positioning will inevitably lead to reopening of the casing.



Apply a uniform bead of Ducati liquid gasket (A) on the mating surface of the casing, avoiding the holes as shown in the figure.



Match the casings (3) and (16). Tap the area around the shafts with a plastic hammer, if necessary. Start the jointing screws into their holes on the generator-side casing (3). The screws are not all the same length, be sure to position them correctly.

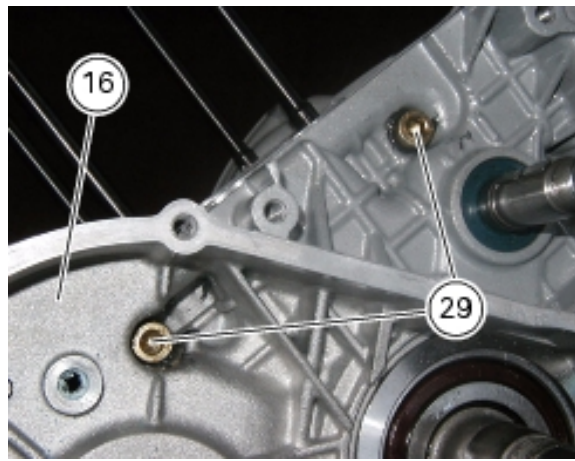


**Note**

Apply recommended grease when refitting drilled screw (28).

25	6	M8x75 mm screws
28	1	M8x75 mm drilled screw
26	5	M6x35 mm screws
27	1	M6x75 mm screw

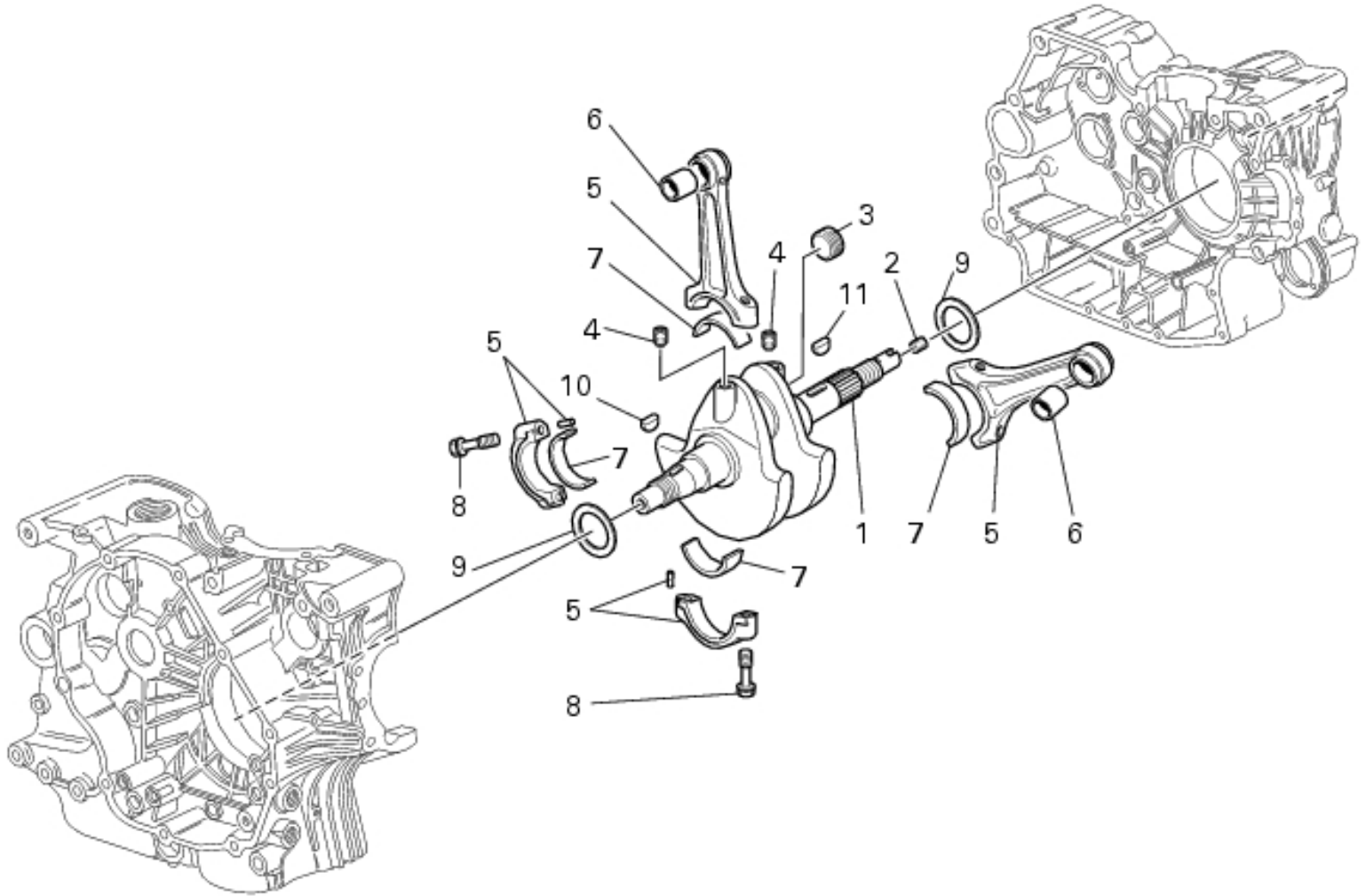
Progressively tighten the jointing screws all the way in. Begin with the larger diameter (M8) screws. Fit two M8 screws (29) to clutch-side casing (16).



Tighten all screws to the specified torque. Begin with the larger diameter screws. Check that crankshaft rotates with a certain amount of interference in the main bearings. Crankshaft must have a preload of **0.15 - 0.20** mm. Check also that all assembled parts can rotate or move correctly. Fit oil seal (**11**) and spacer with O-ring on gearbox secondary shaft as described under Sect. G 8, [Final drive](#).

Operations	Reference See Section
Refit mesh filter	D 4, <a href="#">Changing the engine oil and filter cartridge</a>
Refit the complete clutch unit	N 6.1, <a href="#">Reassembling the APTC unit</a>
Refit the clutch-side cover	N 6.2, <a href="#">Refitting the clutch cover</a>
Refit engine ignition assembly	P 3, <a href="#">Electric starting</a>
Refit the generator-side cover and the complete generator	N 8, <a href="#">Flywheel - generator</a>
Refit the complete cylinder / piston assembly	N 5, <a href="#">Refitting cylinder / piston assy</a>
Refit complete head assembly and timing system parts	N 4.2, <a href="#">Cylinder heads: side covers / timing system</a>
Refit the lubrication system	N 2.1, <a href="#">Refitting the oil pump</a>
Refit engine to frame	N 1, <a href="#">Reassembling the engine</a>

## 9.3 - Casing unit: connecting rods



- 1 Crankshaft
- 2 Special screw
- 3 Blanking plug
- 4 Threaded dowel
- 5 Complete connecting rod
- 6 Bush
- 7 Bearing
- 8 Special screw
- 9 Shim
- 10 Key
- 11 Key

 Spare parts catalogue

[Crankshaft](#)

[Half crankcases](#)

**Caution**

Bold reference numbers in this section identify parts shown in this exploded view diagram. These parts do not appear in the figures near the text.

## Removing the connecting rods

Operations	Reference See Section
Remove the engine from the frame	N 1, <a href="#">Removing the engine</a>
Remove the lubrication system	N 2.1, <a href="#">Removing the oil pump</a>
Remove the complete head unit with timing system	N 4.3, <a href="#">Head unit: camshafts</a>
Remove the complete cylinder/piston unit	N 5, <a href="#">Removing cylinder / piston assy</a>
Remove the generator-side cover and the complete generator	N 8, <a href="#">Flywheel - generator</a>
Remove engine ignition assembly	P 3, <a href="#">Electric starting</a>
Remove the clutch-side cover	N 6.2, <a href="#">Removing the clutch cover</a>
Remove the complete clutch unit	N 6.1, <a href="#">Disassembling the APTC system</a>
Open the casings	N 9.2, <a href="#">Opening the casings</a>

Open the casings and then remove the crankshaft (1) together with connecting rod (5).



## Disassembling the connecting rods

To disassemble the connecting rods, unscrew the bolts (8) and separate the connecting rods from the crankshaft.

**Caution**

Do not confuse the connecting rod components and keep them in the original mounting position.

## Overhauling the connecting rods

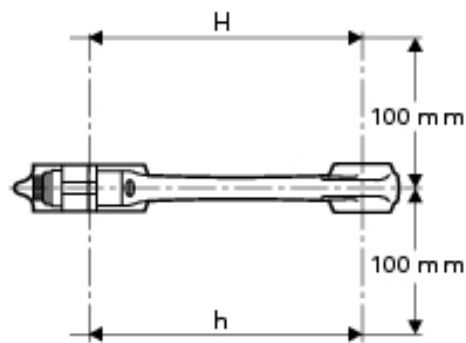
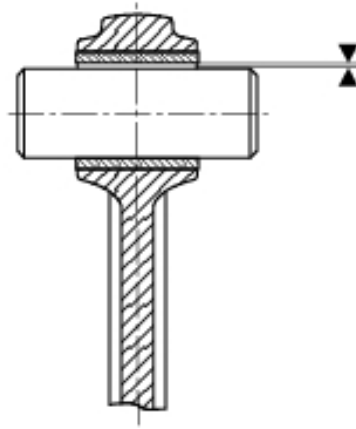
Run the following dimensional checks on the connecting rods:

- Connecting rod to gudgeon pin assembly clearance (Sect. C 1.1, [Cylinder / piston](#)).

Change a connecting rod when badly worn. Connecting rod small end bush must be in good condition and firmly set in its seat. Measure parallelism error **100** mm away from the longitudinal axis of the connecting rod:

**H less h** must be lower than **0.02** mm. If not so, change the connecting rod.

Big end diameter must be within the specified limits (Sect. C 1.1, [Cylinder / piston](#)).  
Use crankshafts and connecting rods from the same class.



#### Changing the connecting rod big end bearings

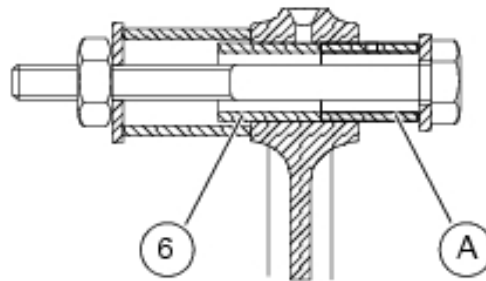
Change the bearings every time the engine is overhauled.  
Spare bearings are supplied ready for installation. They must not be reworked with scrapers or emery cloth.  
Connecting rod big end bearings must be within the specified wear limits (Sect. C 1.1, [Cylinder / piston](#)).



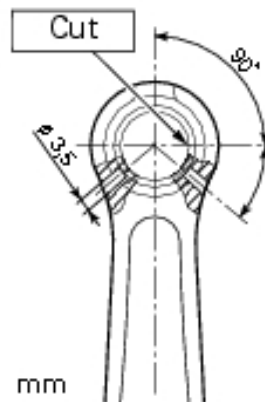


### Changing the connecting rod small end bush

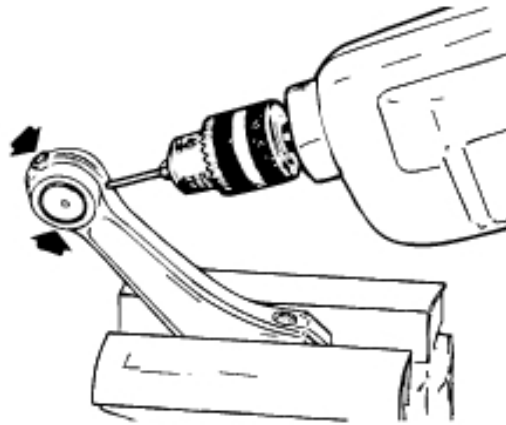
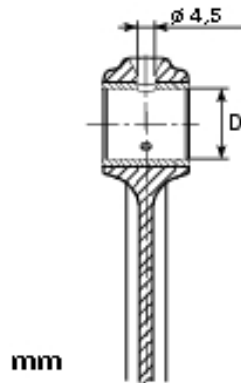
Replace small end bush (6) using the tool shown in the figure. This tool lets you extract the worn bush and install a new bush (A) at the same time.



Locate the new bush to the small end of the connecting rod with the opening at right angles to the upper hole of the con-rod small end.



Drill the new bush at the same positions of the oil holes of con-rod small end. Bore out bush until obtaining a bore diameter (D) of **18.006-18.024** mm.



#### Overhauling the crankshaft

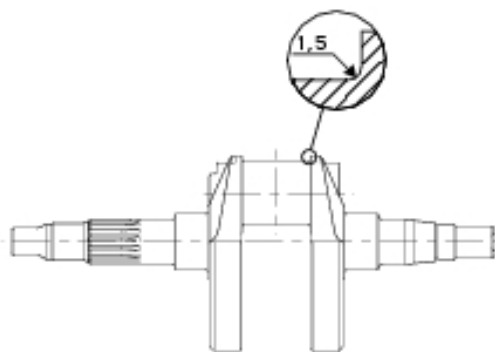
The main bearings and the crank pins must not be grooved or scored.

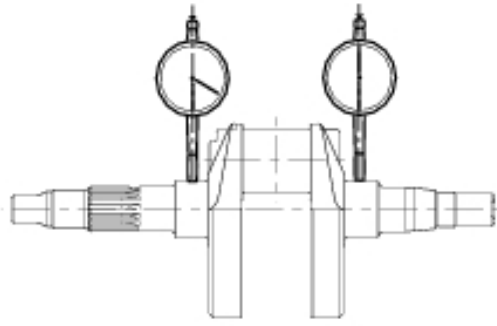
Threads, keyways and slots must be in good condition.

Check for fretting or burrs in the fillet between crank pin and shoulder.

Fillet radius: **1.5** mm.

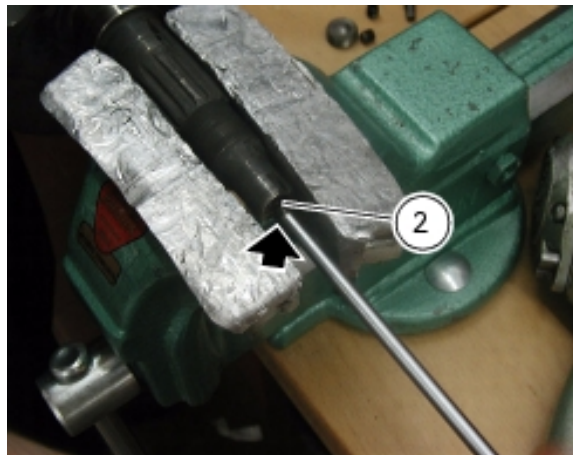
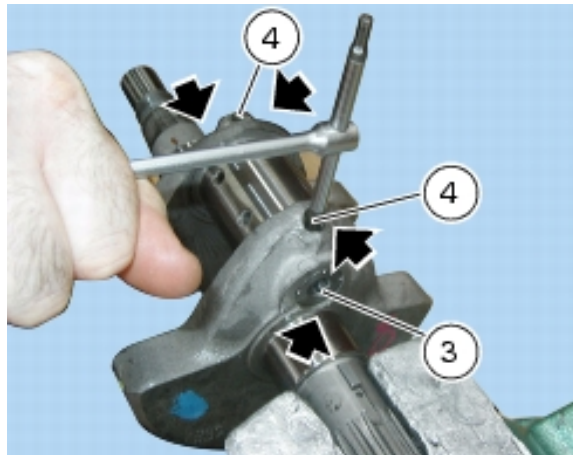
Use a micrometer to measure oval and taper of the crank pin. Measure oval and taper in several different directions (Sect. C 1.1, [Cylinder / piston](#)).



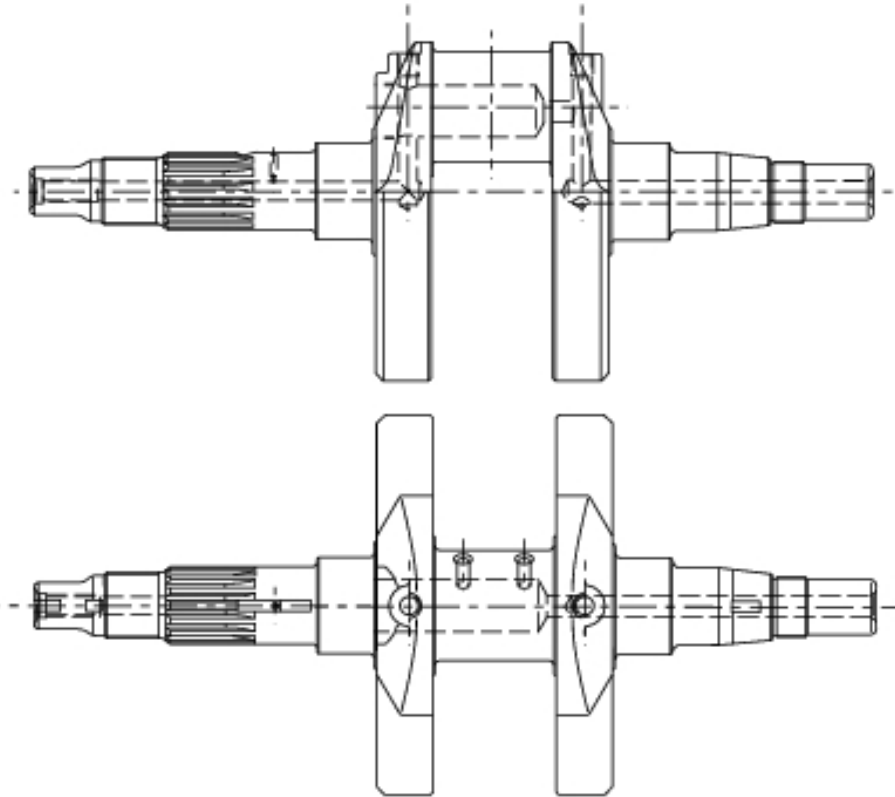


Use a dial gauge to measure the alignment of main bearings with the crankshaft placed between two centres (Sect. C 1.1, [Cylinder / piston](#)).

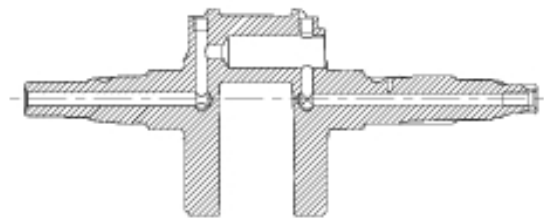
Undo all crankshaft plugs (4), (3) and (2). If they are hard to remove, heat plug to remove the threadlocker used at assembly.



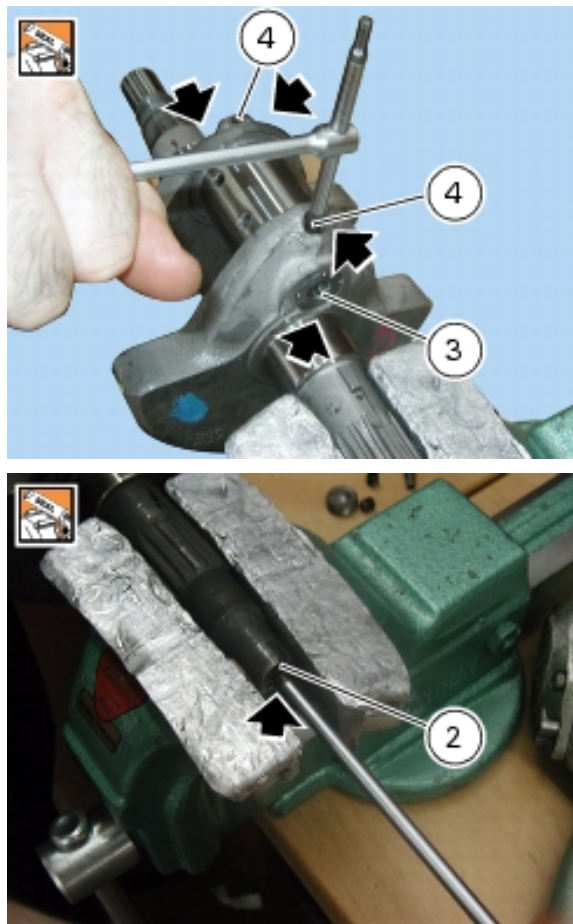
Use an air gun capable of reaching **150°C**.



Clean all lubrication ducts with suitably sized metal brushes and blow with compressed air to remove any deposits preventing proper oil circulation.



Apply DUCATI liquid gasket to the threads of the plugs (3), (4) and (2) and then refit them.



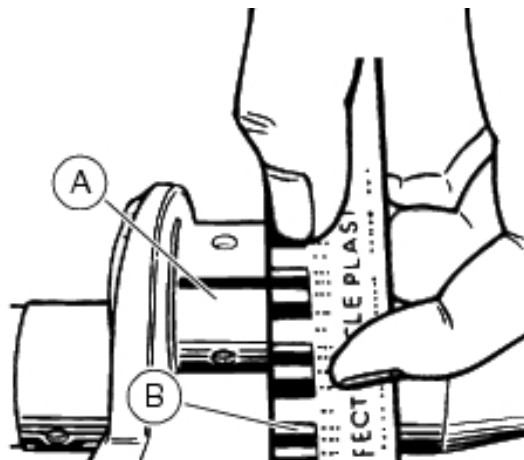
Tighten all plugs to the specified torque (Sect. C 3, [Engine torque settings](#)).

#### Big end bearings-crank pin clearance

To check clearance between big end bearings and crank pin, use a GREEN "Plastigage PG-1" bar (A) on the crank pin. Fit the connecting rod with the original bearings (7) following the procedure at next page. Tighten the bolts (8) to **49 Nm**.

Remove the connecting rod and check thickness of the bar looking at the reference line (B).

Replace the bearings or the crankshaft if the thickness measured (the clearance) is not within the specified limits (see Section C 1.1, [Cylinder / piston](#), for con-rod bearings to crankpin clearance).

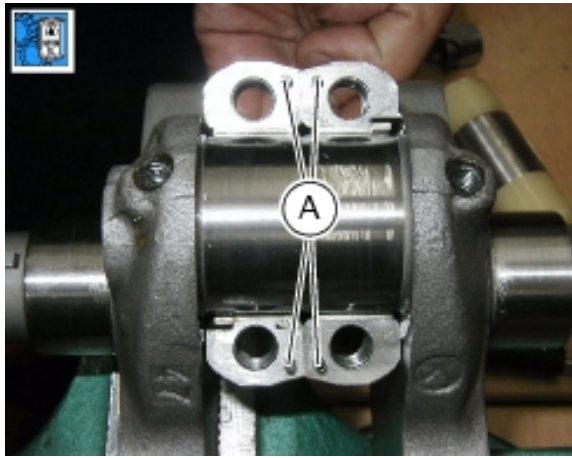


#### Reassembling the connecting rods

Before reassembly, check that main bearings and crank pins are free from burrs and fretting: use fine emery cloth and oil, if necessary.

Check that splines are in perfect condition and without signs of shrinkage.

Make sure each connecting rod has its locating pins in place between cap and shaft.



Wash pins and dry them with compressed air.

Clean and lubricate con-rod bearings and crank pin with engine oil. Refit the con-rods in their original mounting position.

Fit cap and con-rod with their marks on the same side.

Fill the recommended grease into the two ends of the hole to lubricate threads and underside of the new bolts (**8**) and the thread of the shaft.



#### Warning

Corrosion and irritant hazard. The grease is an irritant. Avoid contact with skin and wear protective gloves.



#### Caution

Failure to grease the con-rod bolts will lead to incorrect clearance and breakage.

Fit the fork gauge part no. **88765.1000** (available shims are 0.1 mm, 0.2 mm and 0.3 mm thick) between the connecting rods and take up residual end float. Tighten the bolts to the specified torque with a torque wrench in three steps (Sect. C 3, [Engine torque settings](#)). Hold the wrench as shown in the photograph.

Remove the feeler gauge and ensure that axial play between connecting rods and crankshaft is **0.15 - 0.35 mm**.



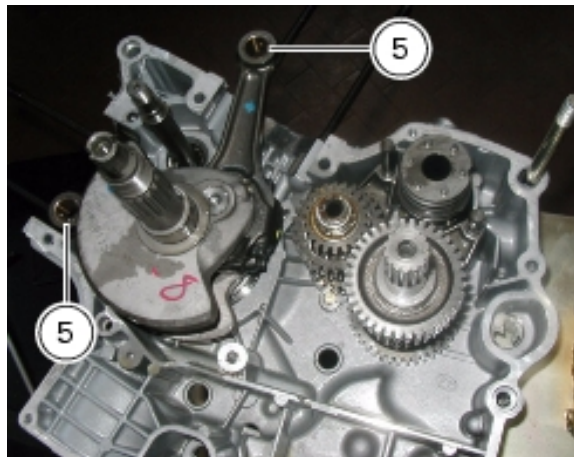
### Refitting the connecting rod unit

Install the complete connecting rod unit inside casing, proceed to shimming as described in Sect. N 9.2, [Casing unit: crankcases](#).



### Caution

Make sure that the connecting rods (5) are correctly positioned in the cylinders. Incorrect positioning will inevitably lead to reopening of the casing.



Operations	Reference See Section
Refit the complete clutch unit	N 6.1, <a href="#">Reassembling the APTC unit</a>
Refit the clutch-side cover	N 6.2, <a href="#">Refitting the clutch cover</a>
Refit engine ignition assembly	P 3, <a href="#">Electric starting</a>
Refit the generator-side cover and the complete generator	N 8, <a href="#">Flywheel - generator</a>
Refit the complete cylinder / piston assembly	N 5, <a href="#">Refitting cylinder / piston assy</a>
Refit complete head assembly and timing system parts	N 4.3, <a href="#">Head unit: camshafts</a>
Refit the lubrication system	N 2.1, <a href="#">Refitting the oil pump</a>
Refit engine to frame	N 1, <a href="#">Reassembling the engine</a>

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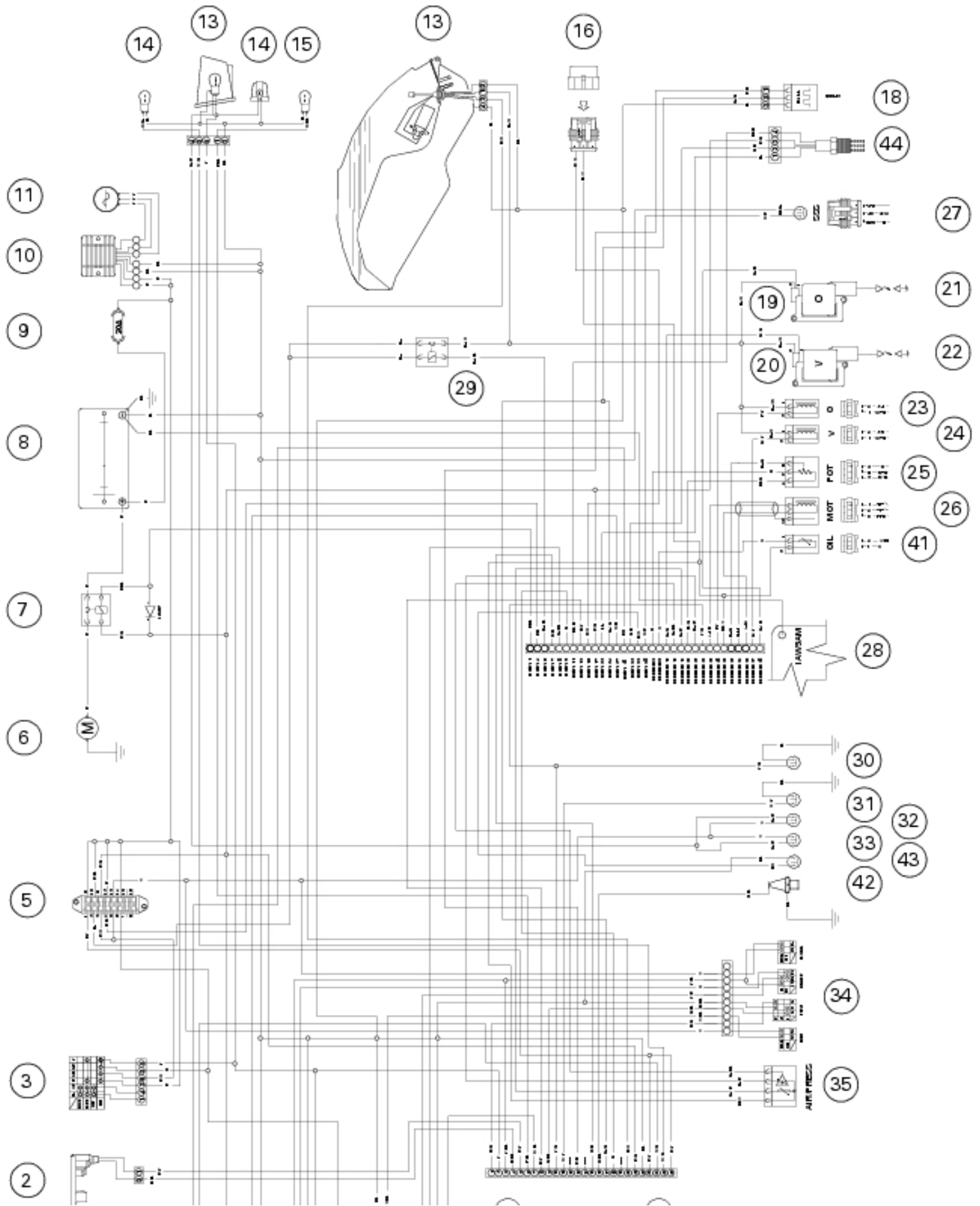
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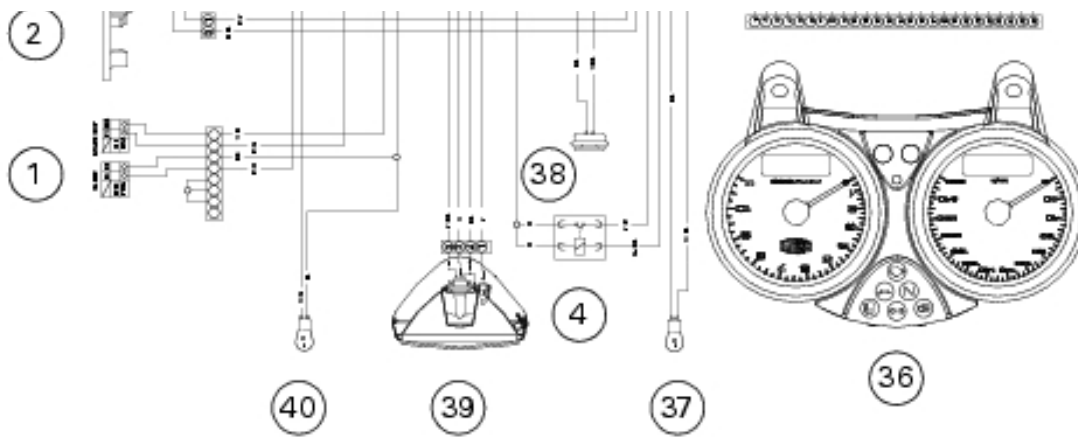
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# 1 - Wiring diagram



## Wiring diagram



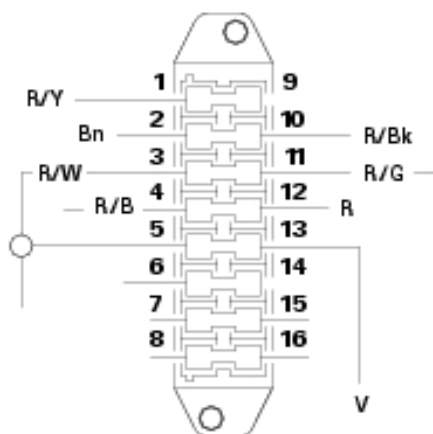
## Wiring diagram key

- 1 RH switch
- 2 Transponder antenna
- 3 Key-operated switch
- 4 Lights relay
- 5 Fuse box
- 6 Starter motor
- 7 Starter contactor
- 8 Battery
- 9 Regulator fuse
- 10 Regulator
- 11 Generator
- 12 Rear right turn indicator
- 13 Tail light
- 14 Number plate light
- 15 Rear left turn indicator
- 16 Tank
- 17 Self-diagnosis outlet
- 18 Speed sensor
- 19 Horizontal cylinder coil
- 20 Vertical cylinder coil
- 21 Horizontal cylinder spark plug
- 22 Vertical cylinder spark plug
- 23 Horizontal cylinder injector
- 24 Vertical cylinder injector
- 25 Throttle position sensor
- 26 Rpm/timing sensor
- 27 Side stand switch
- 28 Control unit
- 29 Injection relay
- 30 Neutral switch
- 31 Oil pressure switch
- 32 Rear stop light switch
- 33 Front stop light switch
- 34 LH switch
- 35 Air temperature / pressure sensor
- 36 Instruments (instrument panel)
- 37 Front turn indicator
- 38 Horn
- 39 Headlight
- 40 Front right turn indicator
- 41 Control unit oil temperature sensor
- 42 Instrument oil temperature sensor
- 43 Clutch switch
- 44 Lambda sensor

### Wire color coding - wiring diagram

- B** Blue
- Bk** Black
- Bn** Brown
- G** Green
- Gr** Grey
- Lb** Light blue
- O** Orange
- P** Pink
- R** Red
- V** Violet
- W** White
- Y** Yellow

### Legend of fuse box



Position	Description	Rating
1-9	Instrument panel	5A
2-10	Injection	20A
3-11	Key sense	10 A
4-12	Ecu	5A
5-13	Loads	15 A
6-14	Parking lights, high and low beam	15 A
7-15	Spare	20A
8-16	Spare	5A

### Arrangement of wiring on frame

Routing of wiring has been optimized to ensure the minimum obstruction.

Each section is designed to prevent interference with parts that might damage wires or cause operating failures when riding. The diagrams on the following pages show the origins ("O" points) for cables proper re-routing and cable ties locations.

Each figure includes references to the diagrams showing the cable routing or the item it will have to be connected to.

Position		Description
1	<a href="#">Diagram A</a>	Horizontal injector connector
2	<a href="#">Diagram A</a>	Control unit oil temperature connector

3	<a href="#">Diagram B</a>	Immobilizer antenna
4	<a href="#">Diagram B</a>	Key switch connector
5	<a href="#">Diagram B</a>	Immobilizer antenna connector
6	<a href="#">Diagram B</a>	Horn connectors
7	<a href="#">Diagram C</a>	Horizontal coil connectors
8	<a href="#">Diagram C</a>	Injection/lights relays
9	<a href="#">Diagram C</a> - <a href="#">Diagram D</a>	Side stand
10	<a href="#">Diagram C</a>	Vertical injector connector
11	<a href="#">Diagram D</a>	Generator cable
12	<a href="#">Diagram C</a> - <a href="#">Diagram D</a>	Lambda sensor
13	<a href="#">Diagram E</a>	Fuel pump/tank sensor
14	<a href="#">Diagram E</a>	Regulator
15	<a href="#">Diagram E</a>	Vertical coil connectors
16	<a href="#">Diagram F</a>	Battery negative terminal
17	<a href="#">Diagram F</a>	"Body" control unit connector
18	<a href="#">Diagram F</a>	Self-diagnosis connector
19	<a href="#">Diagram F</a>	Battery positive terminal
20	<a href="#">Diagram F</a>	"Engine" control unit connector
21	<a href="#">Diagram F</a>	Pick-up cable
22	<a href="#">Diagram F</a>	Solenoid starter - Starter motor
23	<a href="#">Diagram F</a>	Fuse box
24	<a href="#">Diagram F</a>	Control unit ground
25	<a href="#">Diagram F</a>	Engine ground
27	<a href="#">Diagram G</a>	Regulator fuse (for versions with plastic fuel tank)
28	<a href="#">Diagram G</a>	Throttle position sensor connector
29	<a href="#">Diagram H</a>	Pick-up connector
30	<a href="#">Diagram H</a>	RPM/timing sensor (pick-up)
31	<a href="#">Diagram J</a>	Contact / starter motor cable
32	<a href="#">Diagram J</a>	Oil pressure switch connector
33	<a href="#">Diagram J</a>	Instrument panel oil temperature sensor
34	<a href="#">Diagram J</a>	Rear stop light connector
35	<a href="#">Diagram J</a>	Neutral switch connector
36	<a href="#">Diagram K</a>	Main wiring / rear wiring harness connector
37	<a href="#">Diagram L</a>	Vertical head coil cable
38	<a href="#">Diagram M</a>	Horizontal head coil cable
39	<a href="#">Diagram N</a>	Left switch cable
40	<a href="#">Diagram P</a>	Instrument panel connector
41	<a href="#">Diagram P</a>	Air temperature and pressure sensor

42	<a href="#">Diagram P</a>	Headlight connector
43	<a href="#">Diagram P</a>	Front left turn indicator connection
44	<a href="#">Diagram P</a>	Front brake light switch connection
45	<a href="#">Diagram P</a>	Right switch connector
46	<a href="#">Diagram P</a>	Front right turn indicator connection
47	<a href="#">Diagram P</a>	Rear brake switch
48	<a href="#">Diagram Q</a>	Speed sensor connector
49	<a href="#">Diagram Q</a>	Speed sensor
50	<a href="#">Diagram J</a>	Contactors

Diagram A

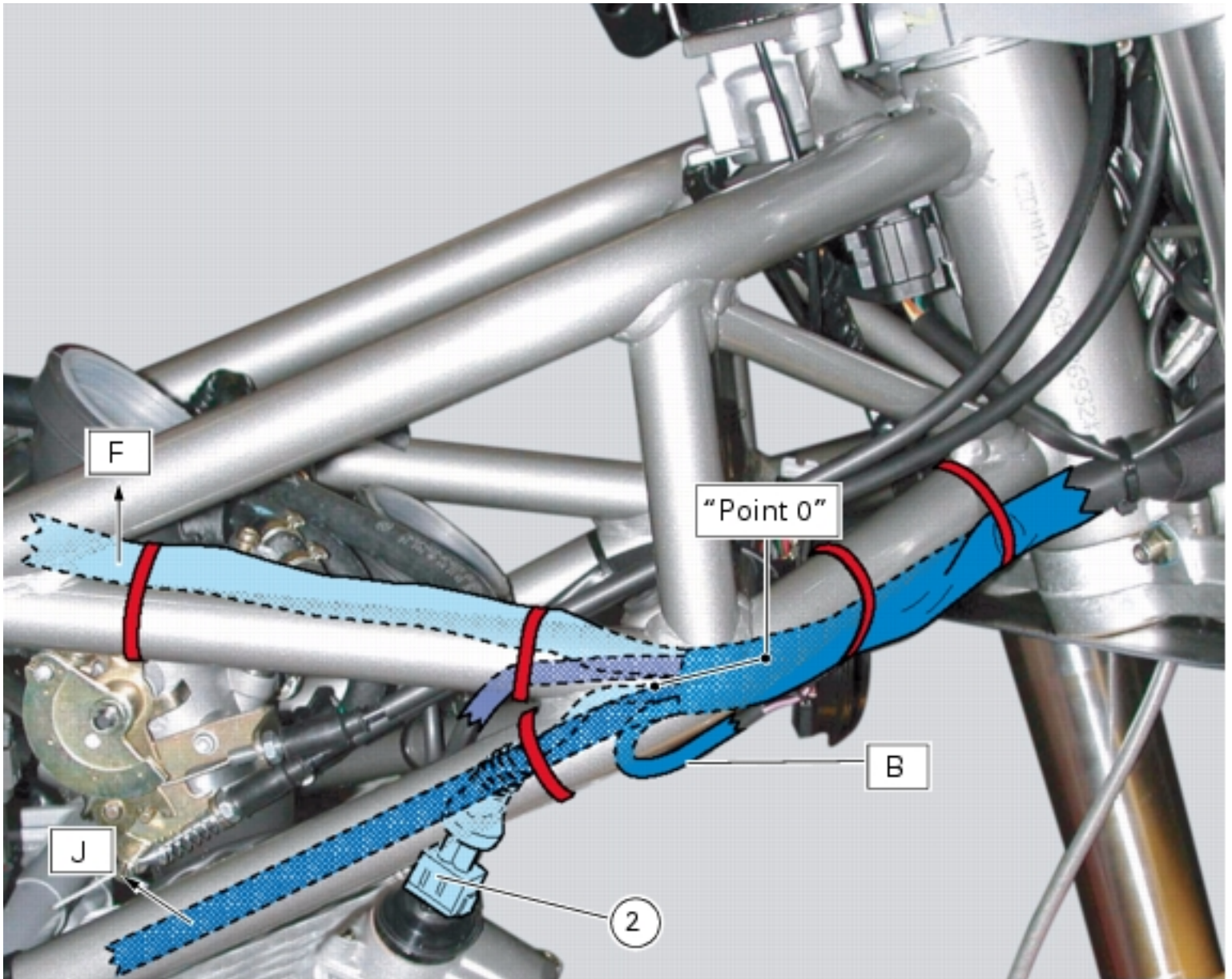


Diagram A

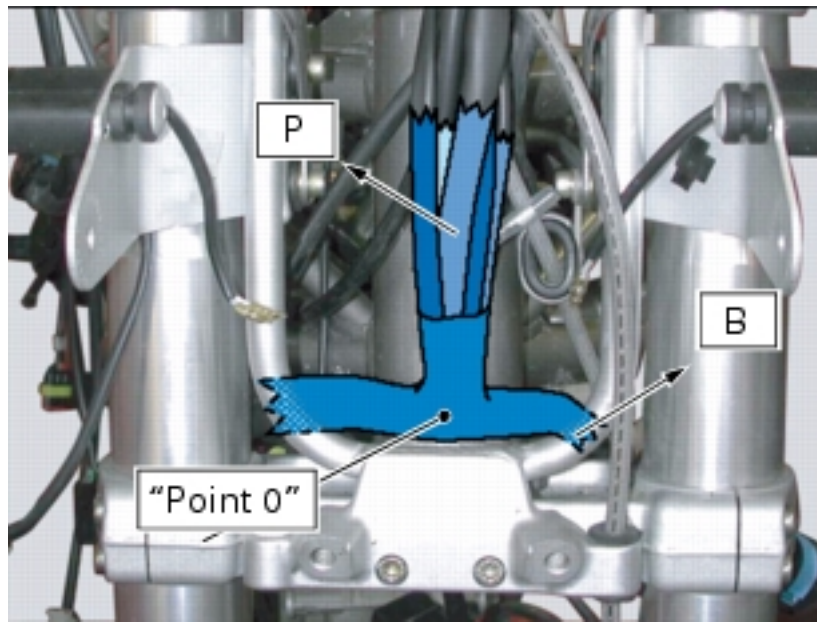
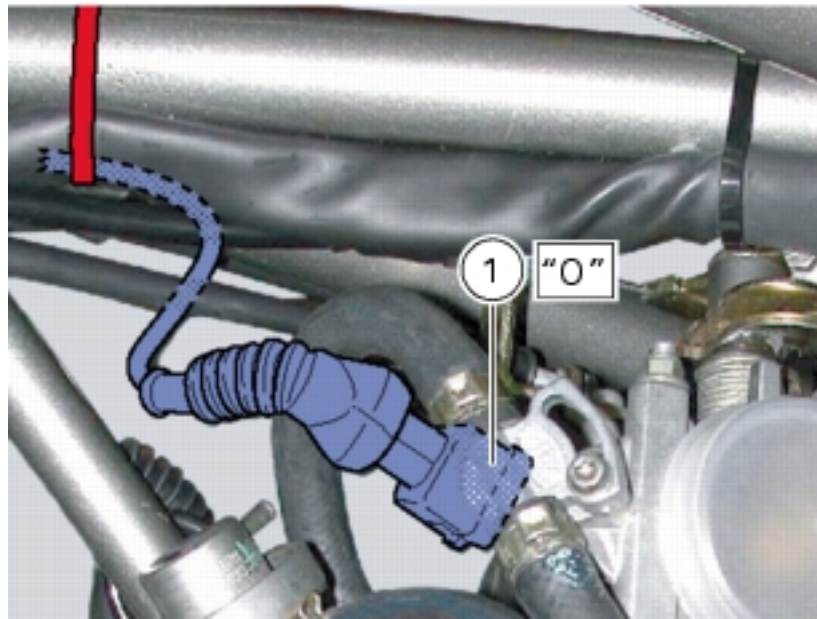
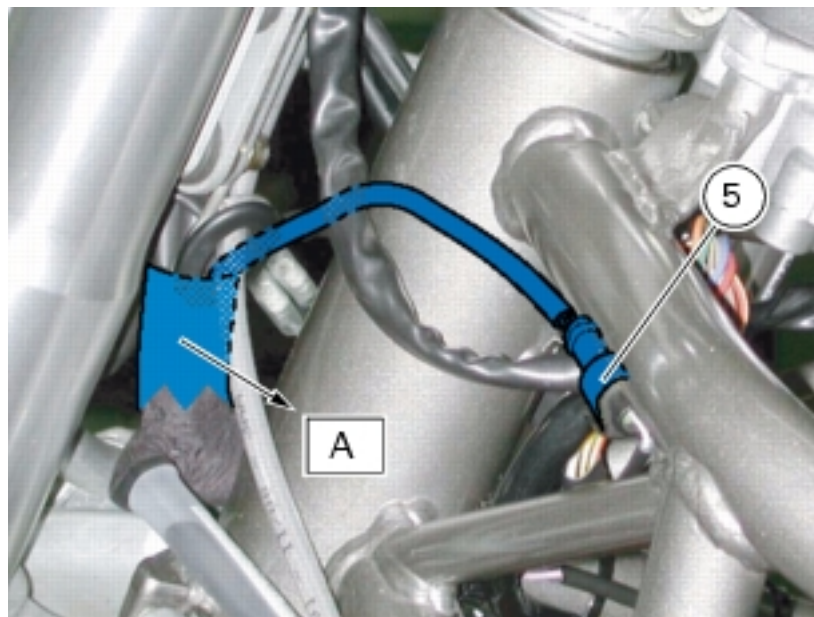
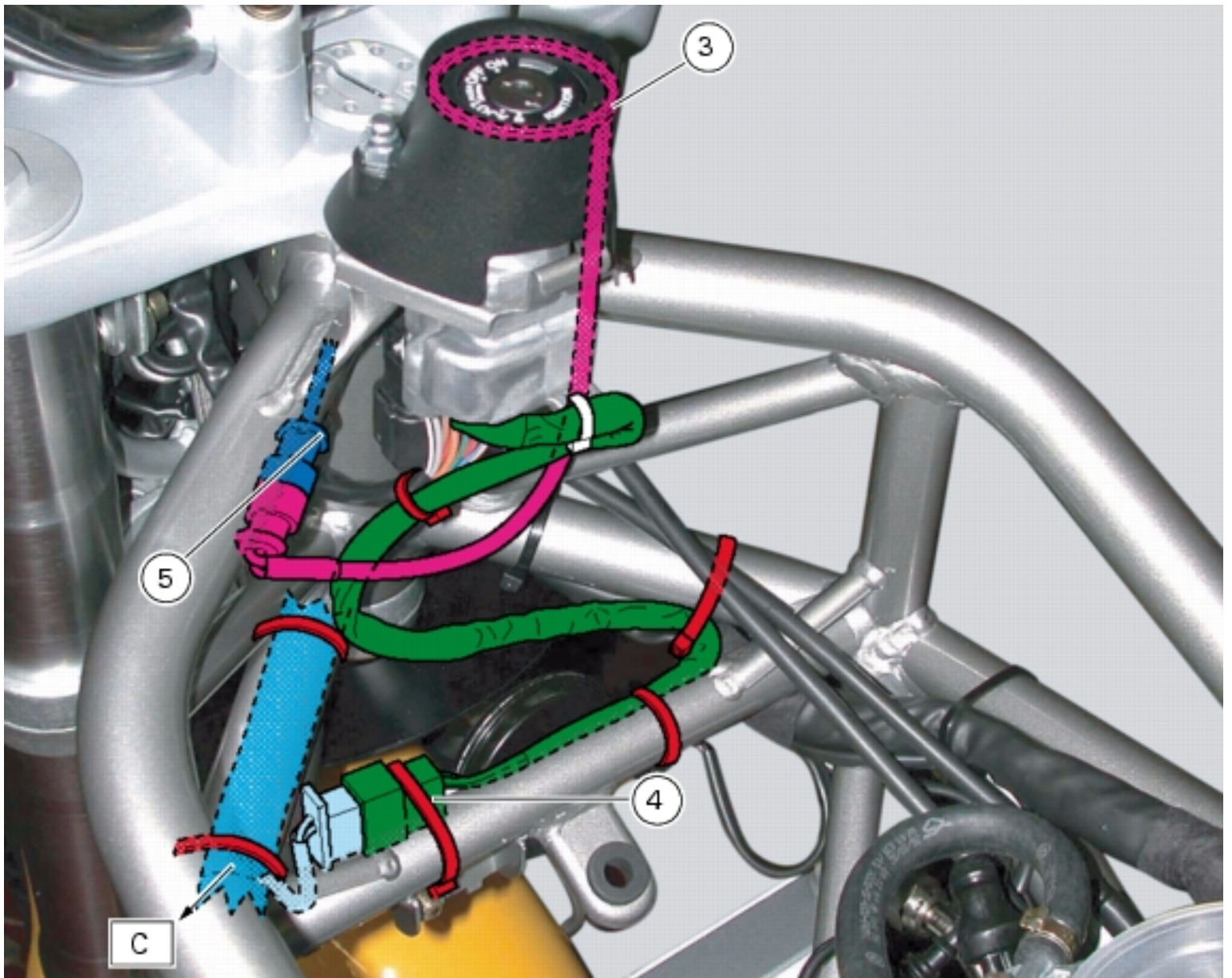


Diagram B



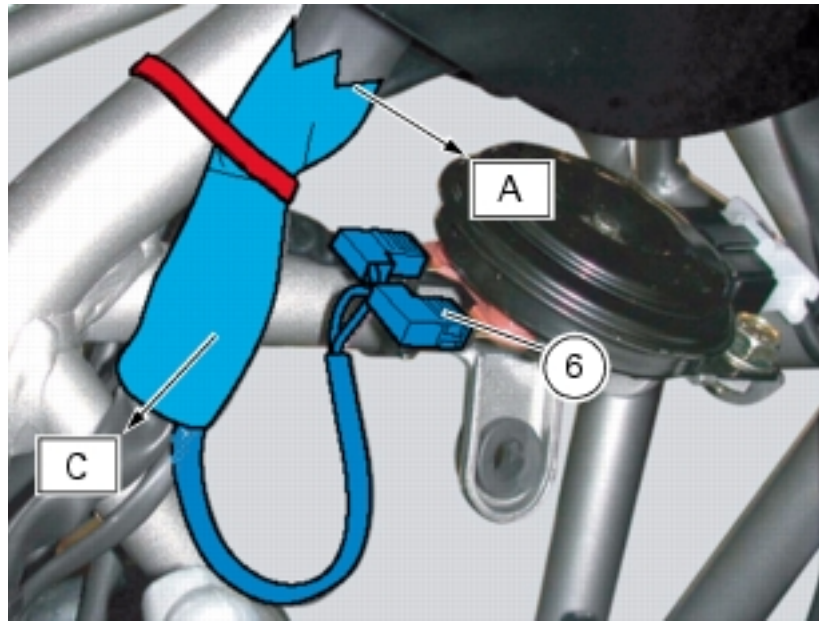
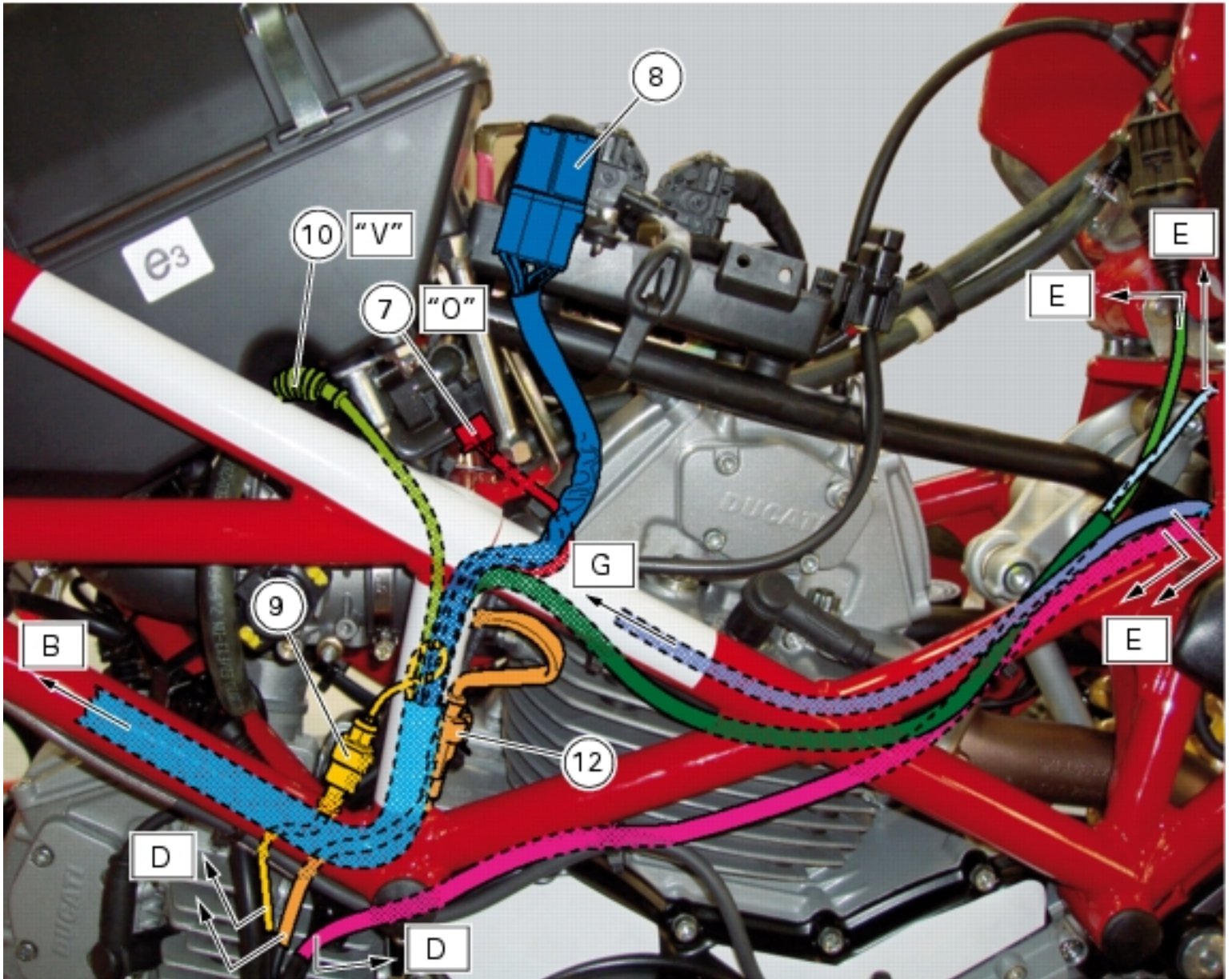


Diagram C



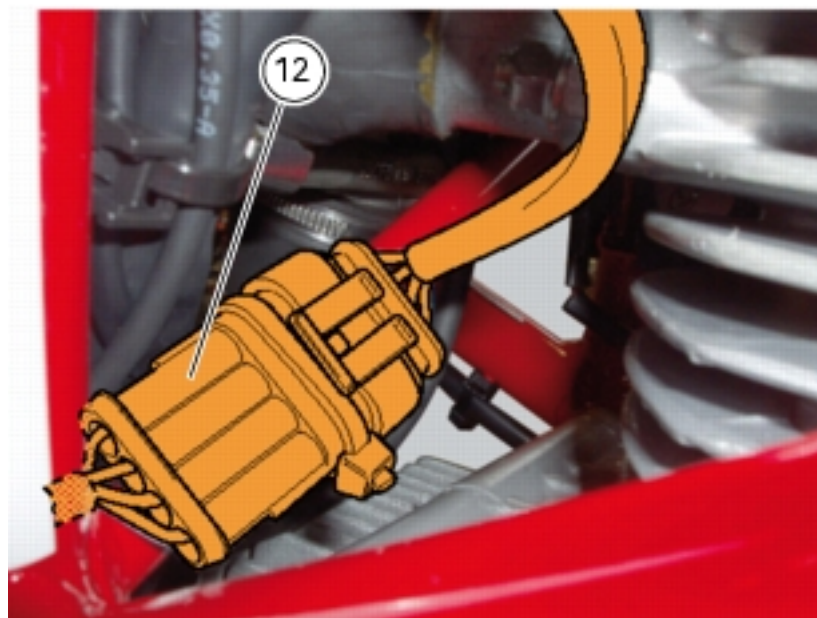
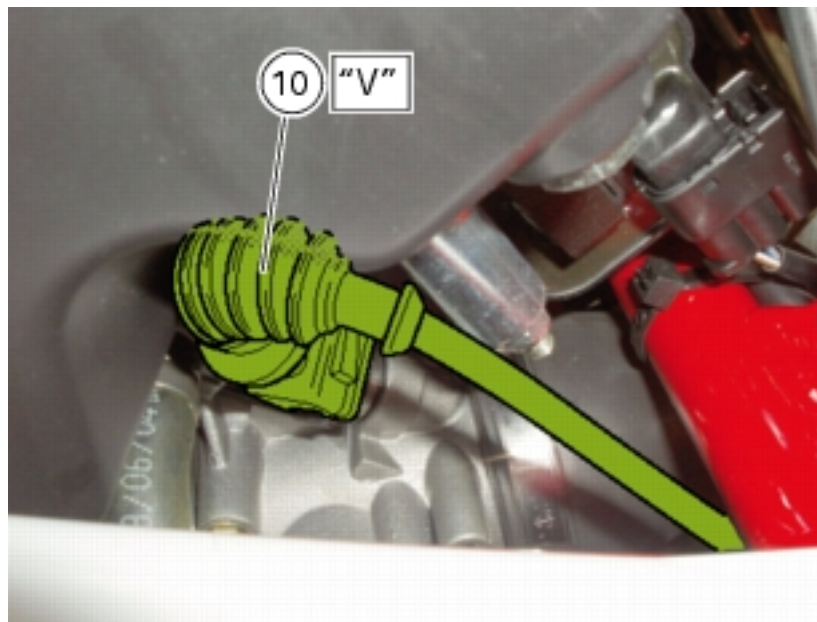


Diagram D

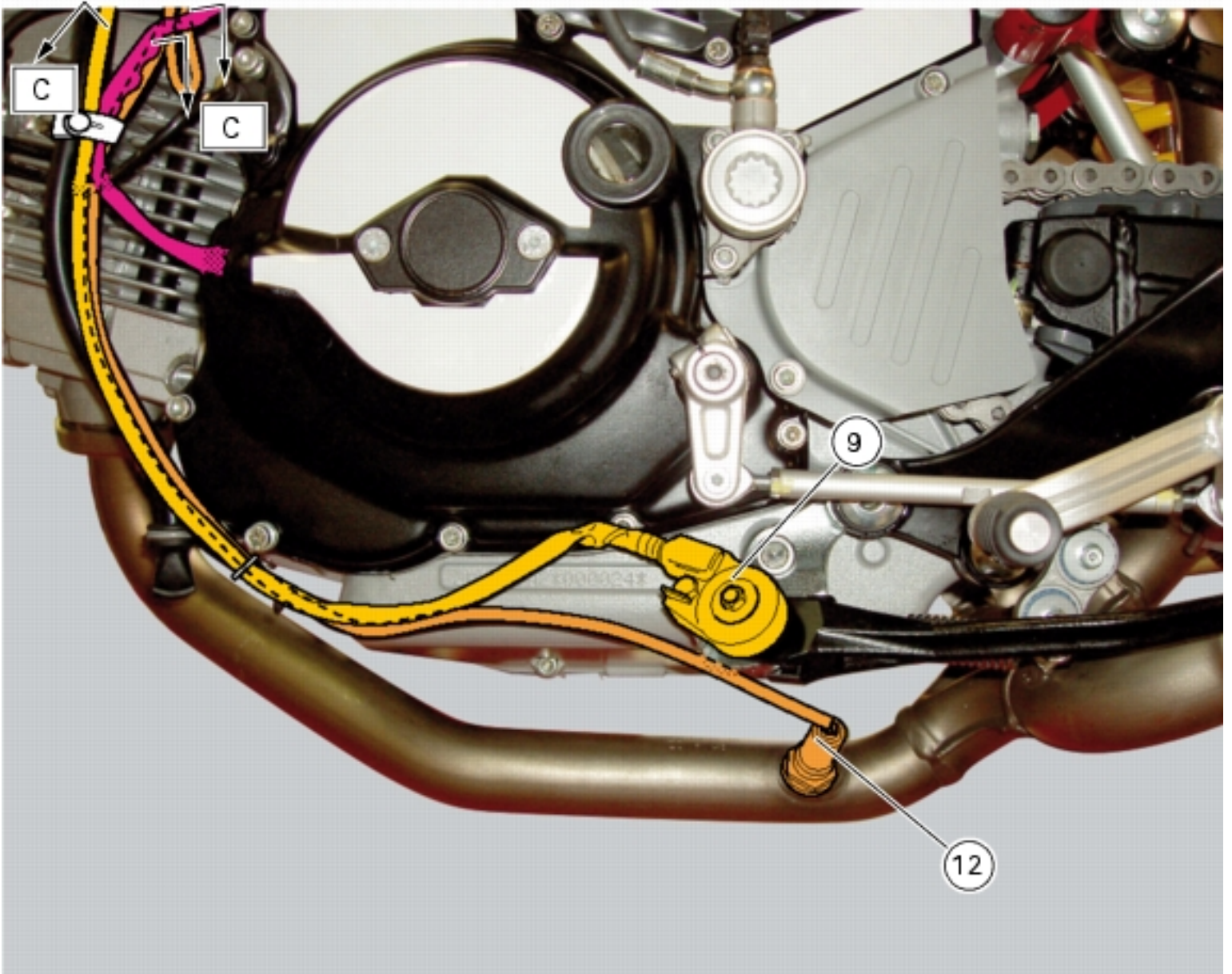


Diagram A

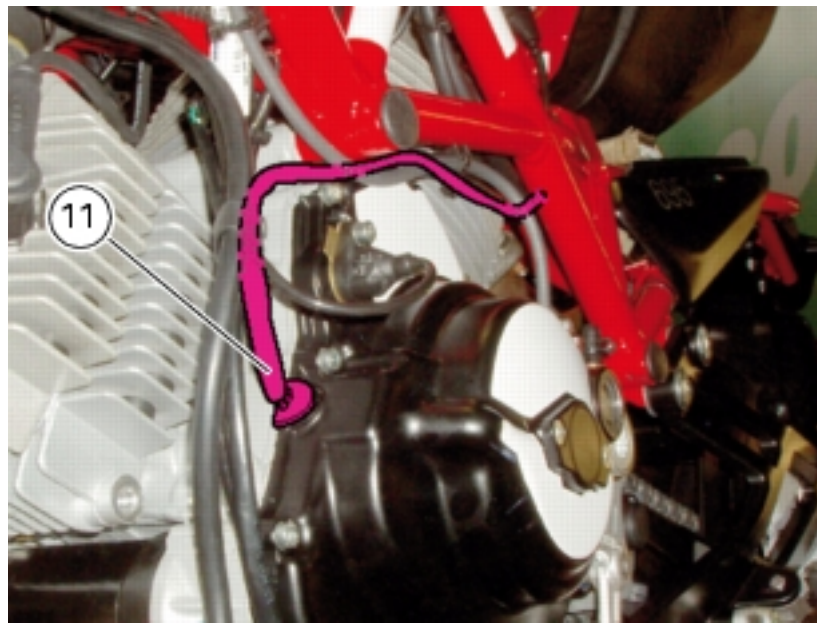
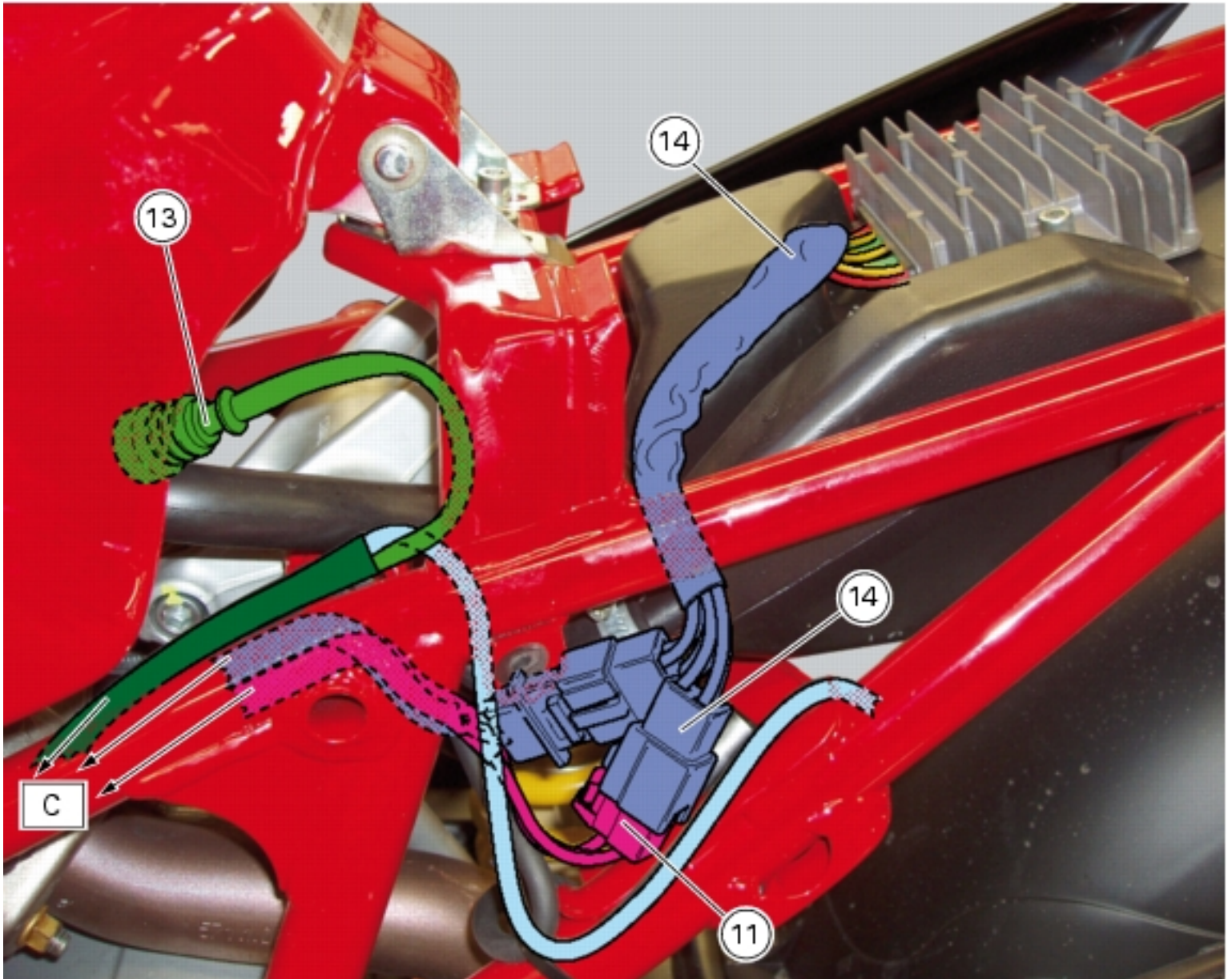


Diagram E



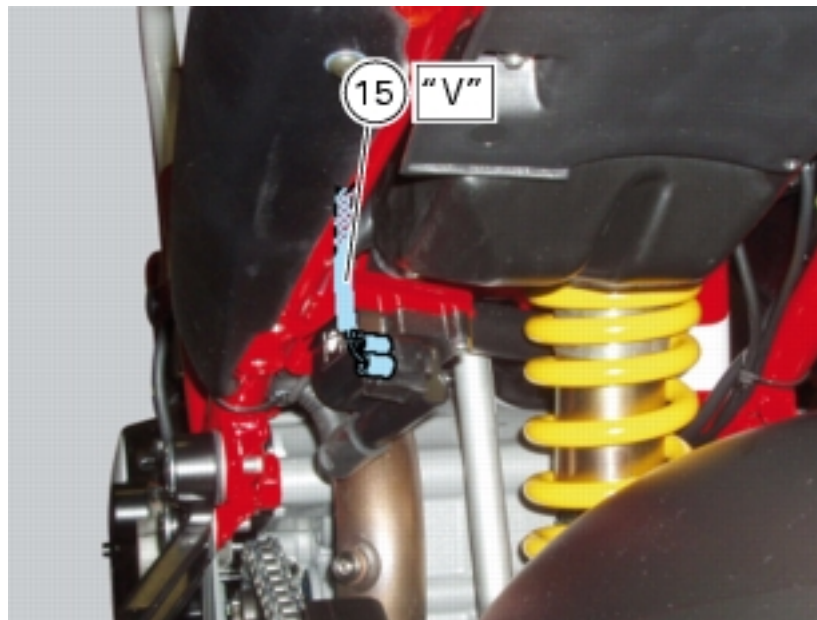
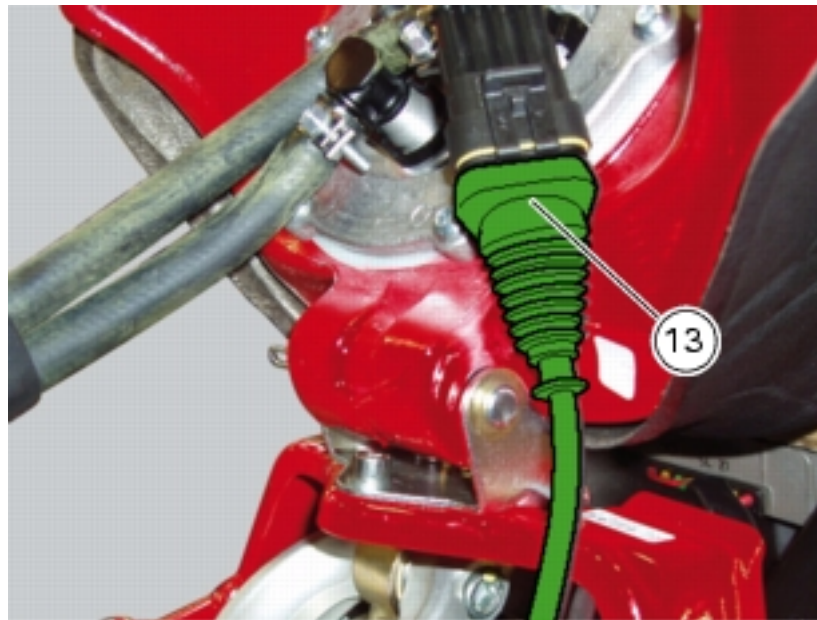


Diagram F

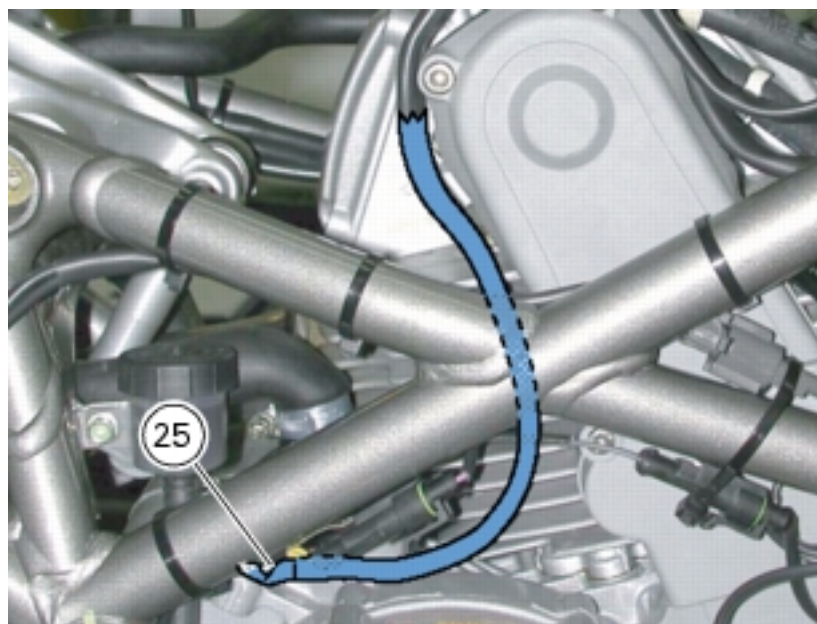
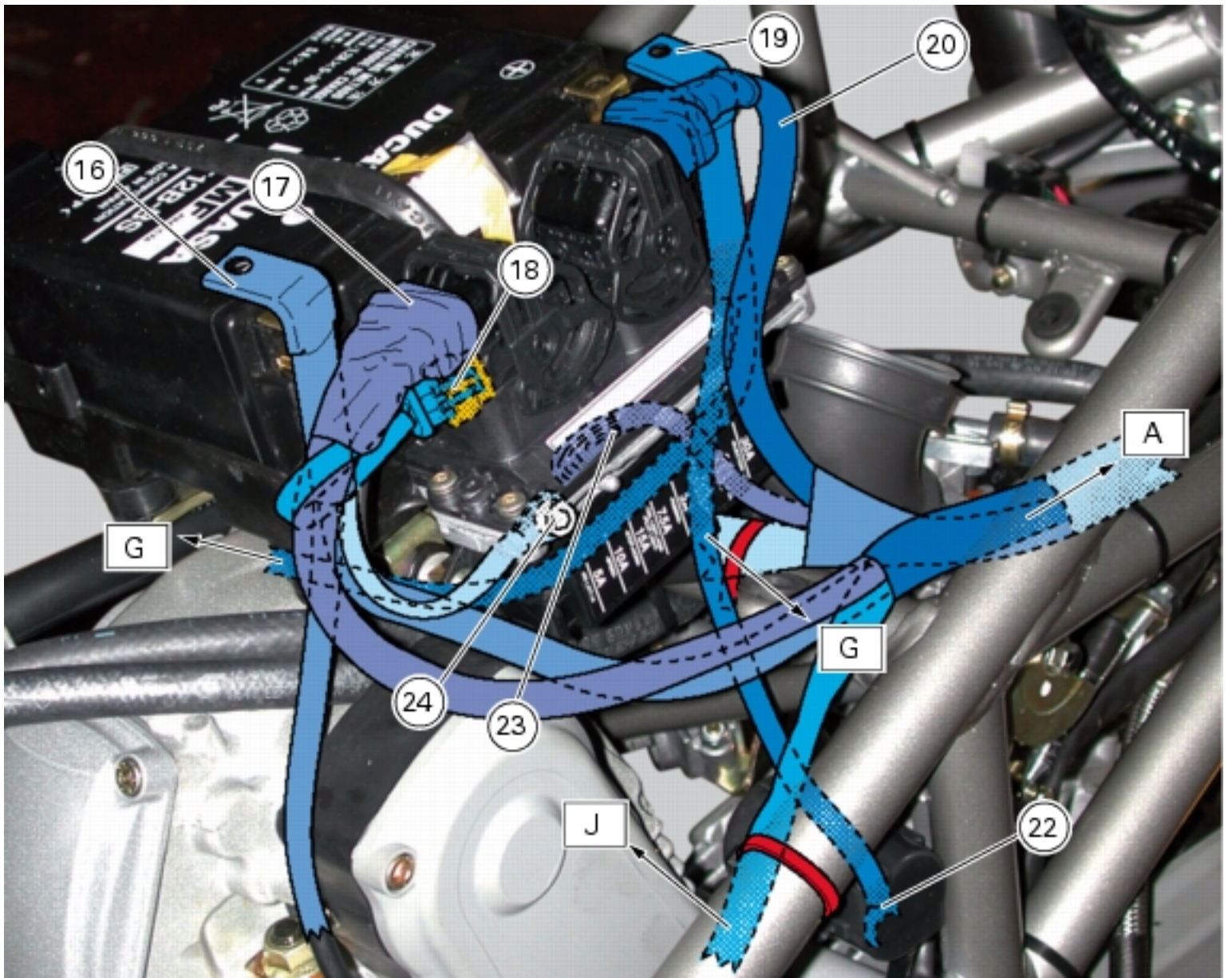


Diagram A

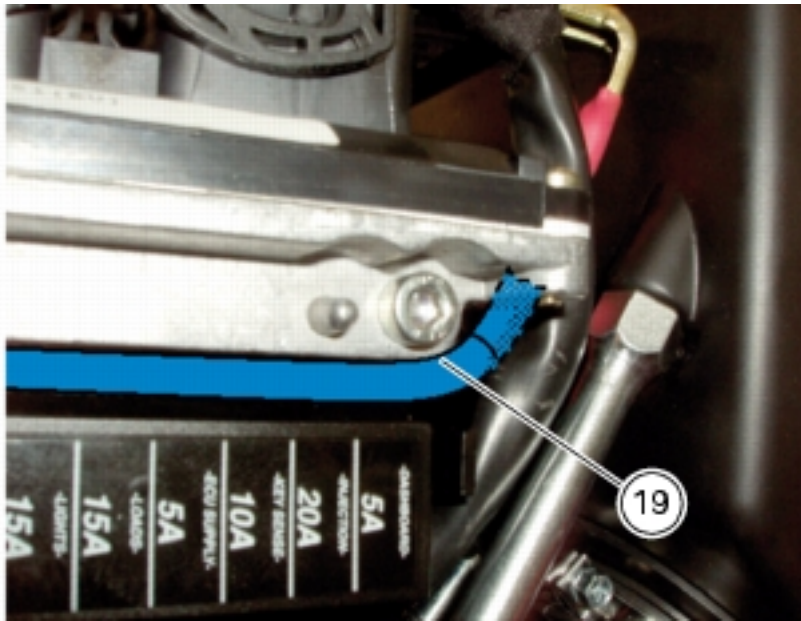
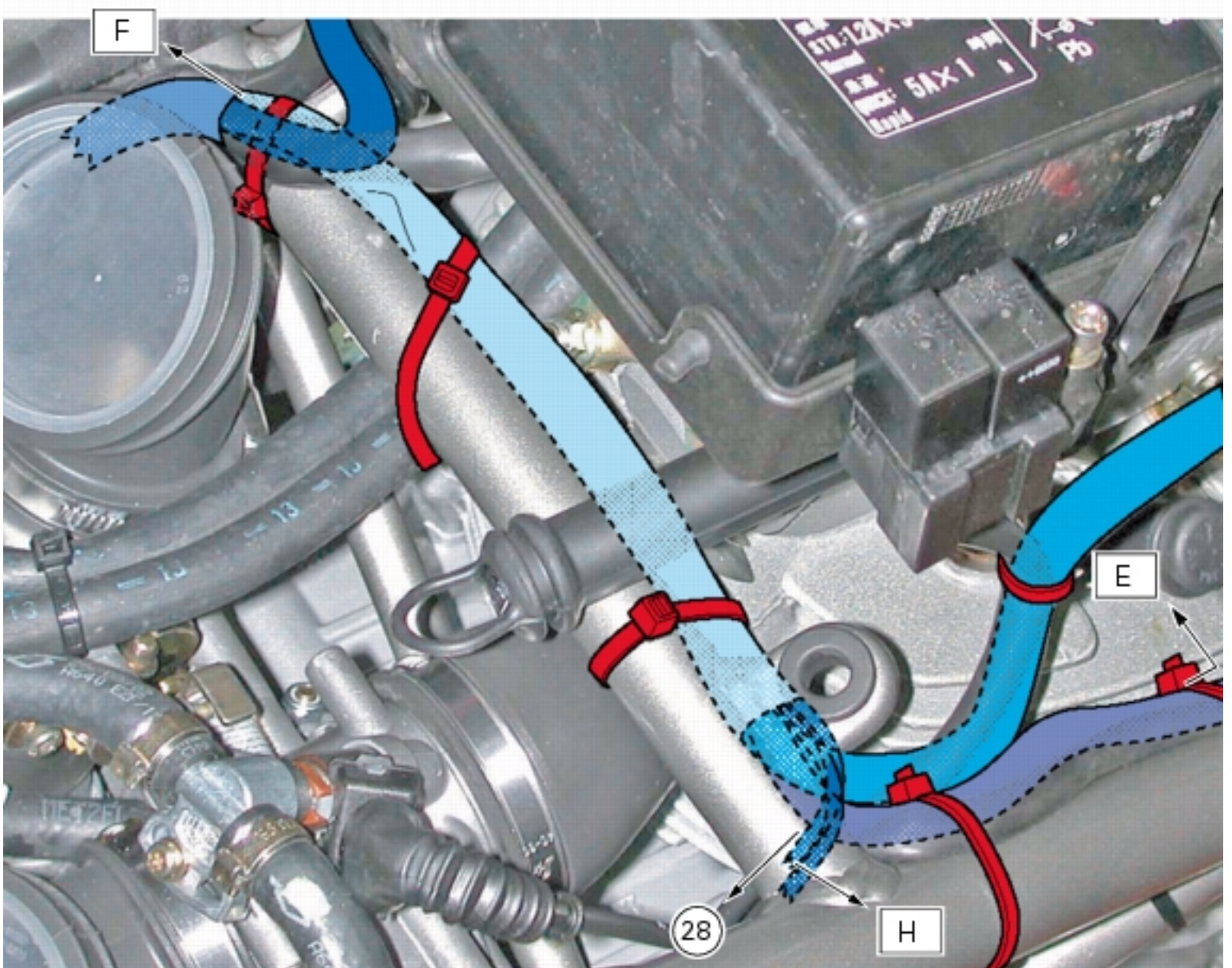


Diagram G



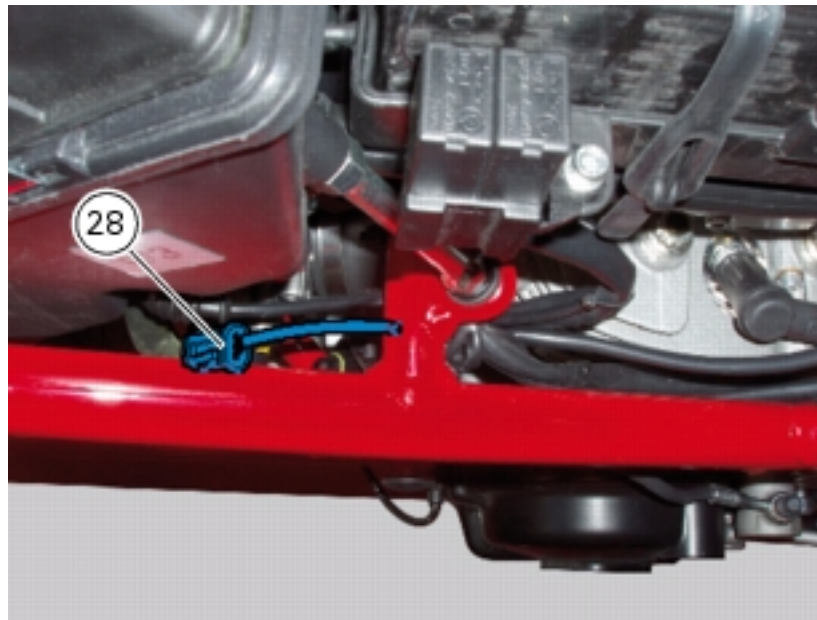
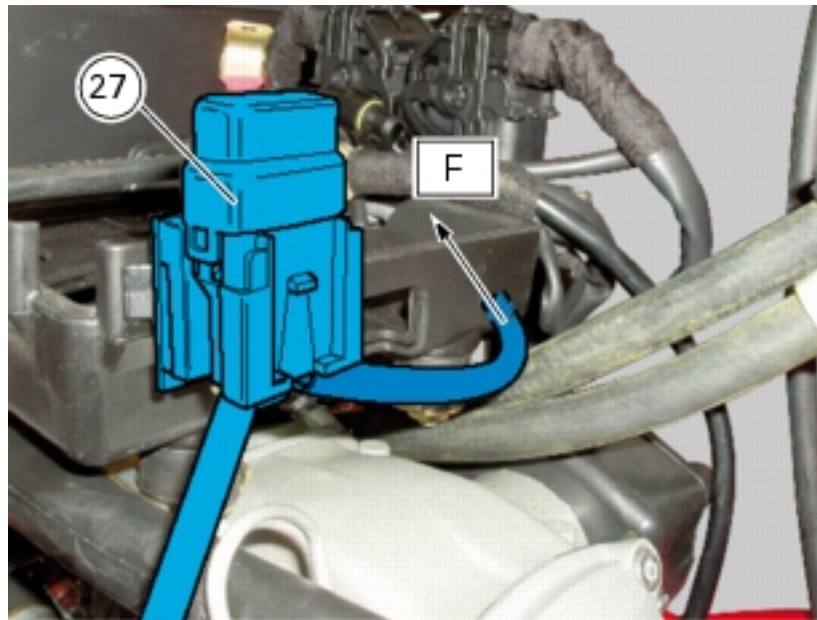


Diagram H

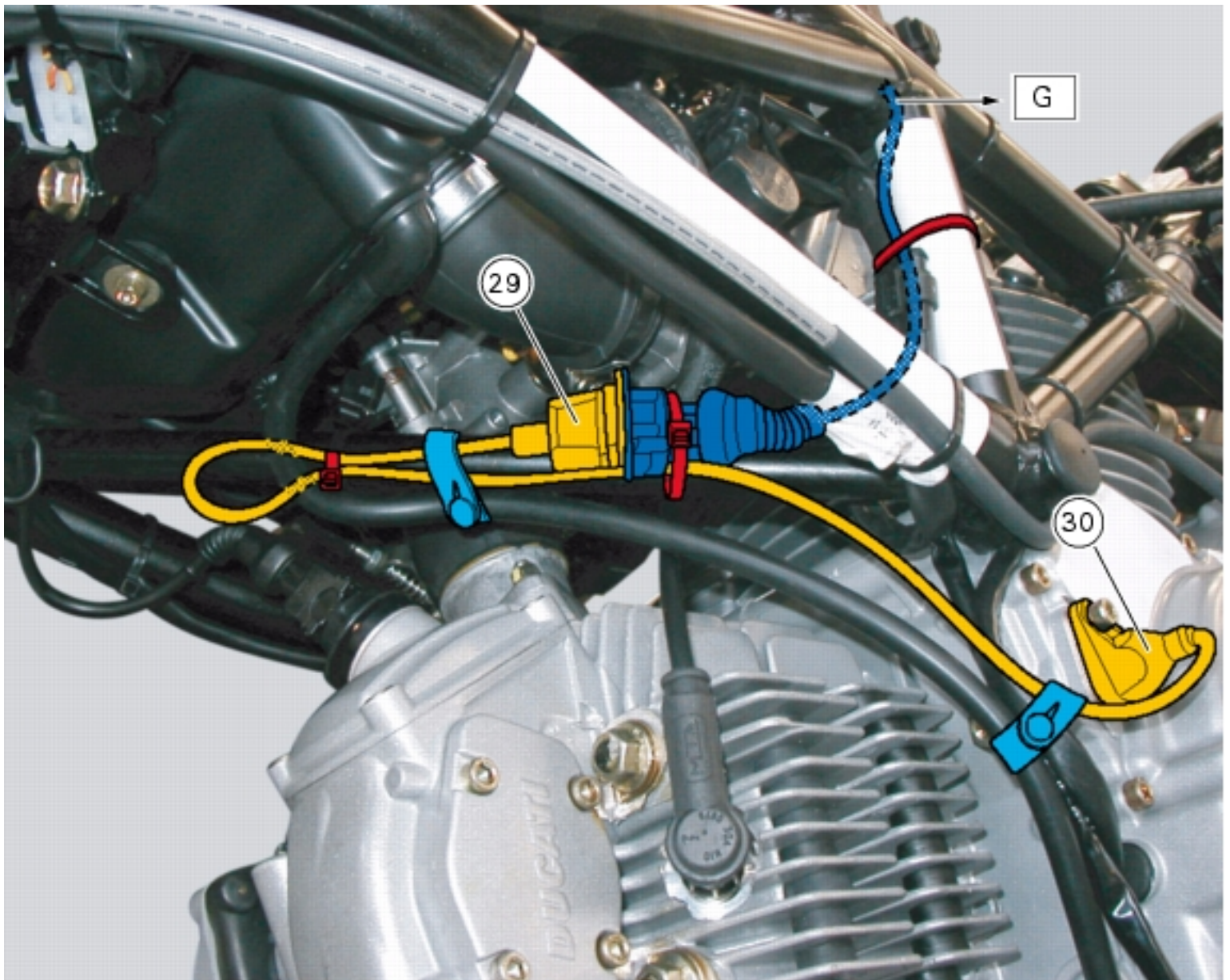


Diagram J



Diagram A

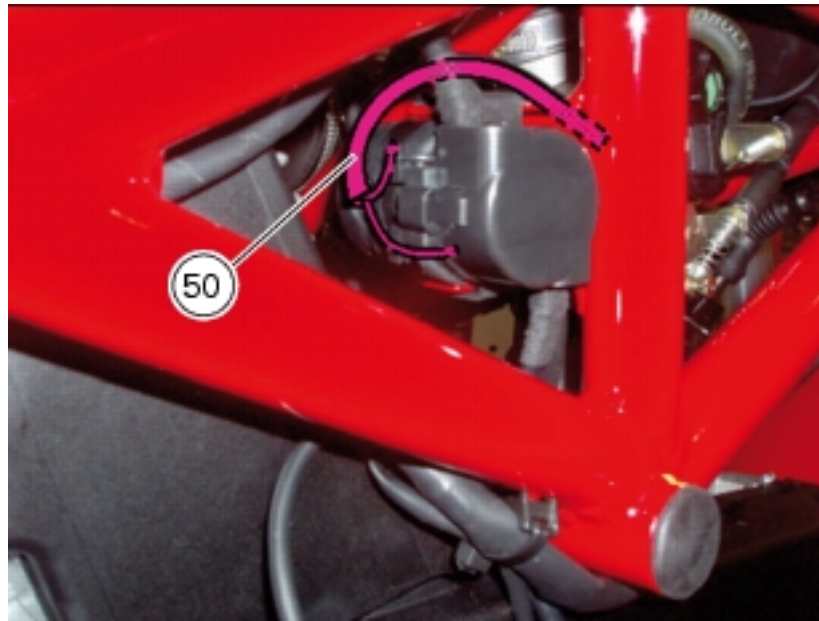


Diagram K

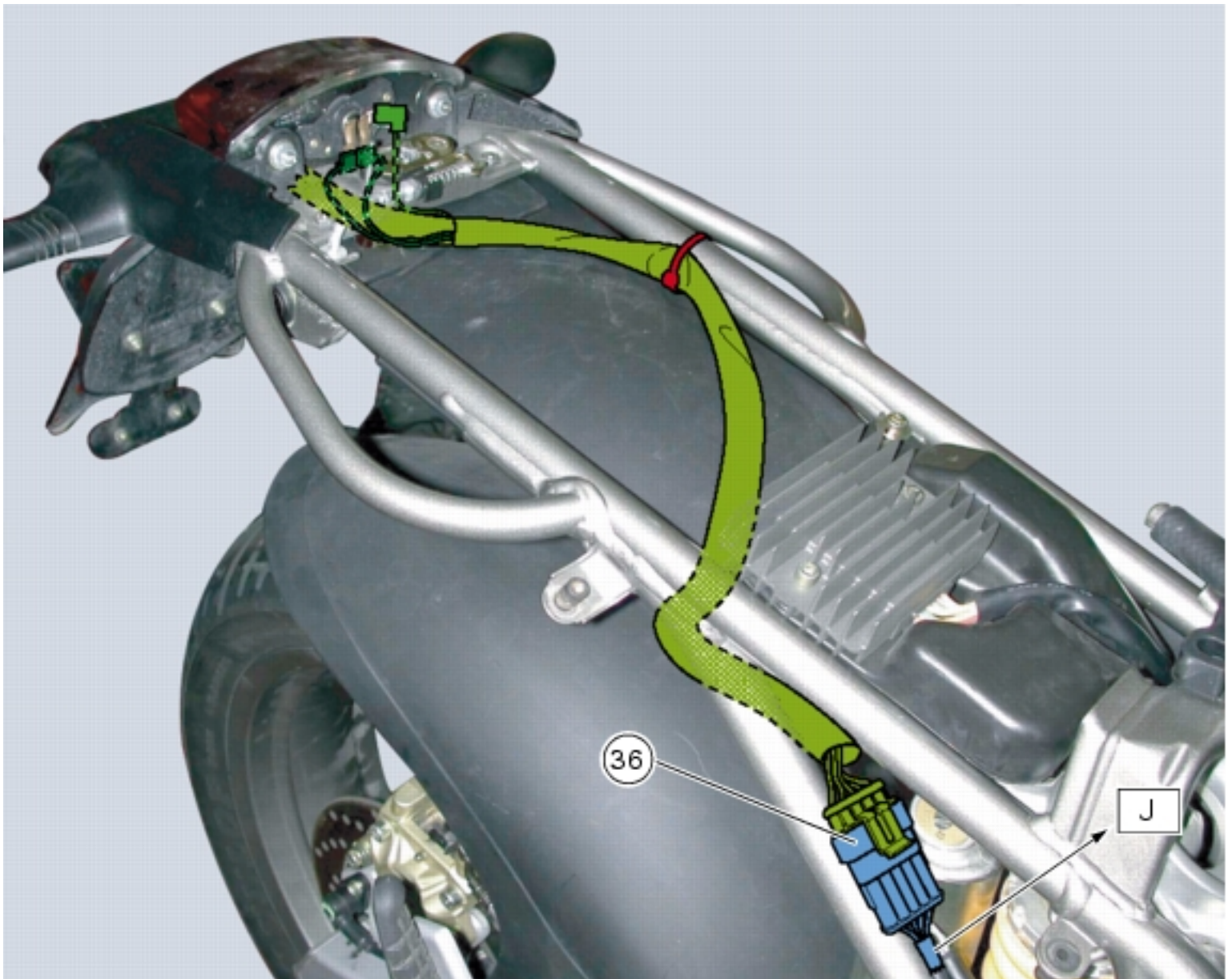
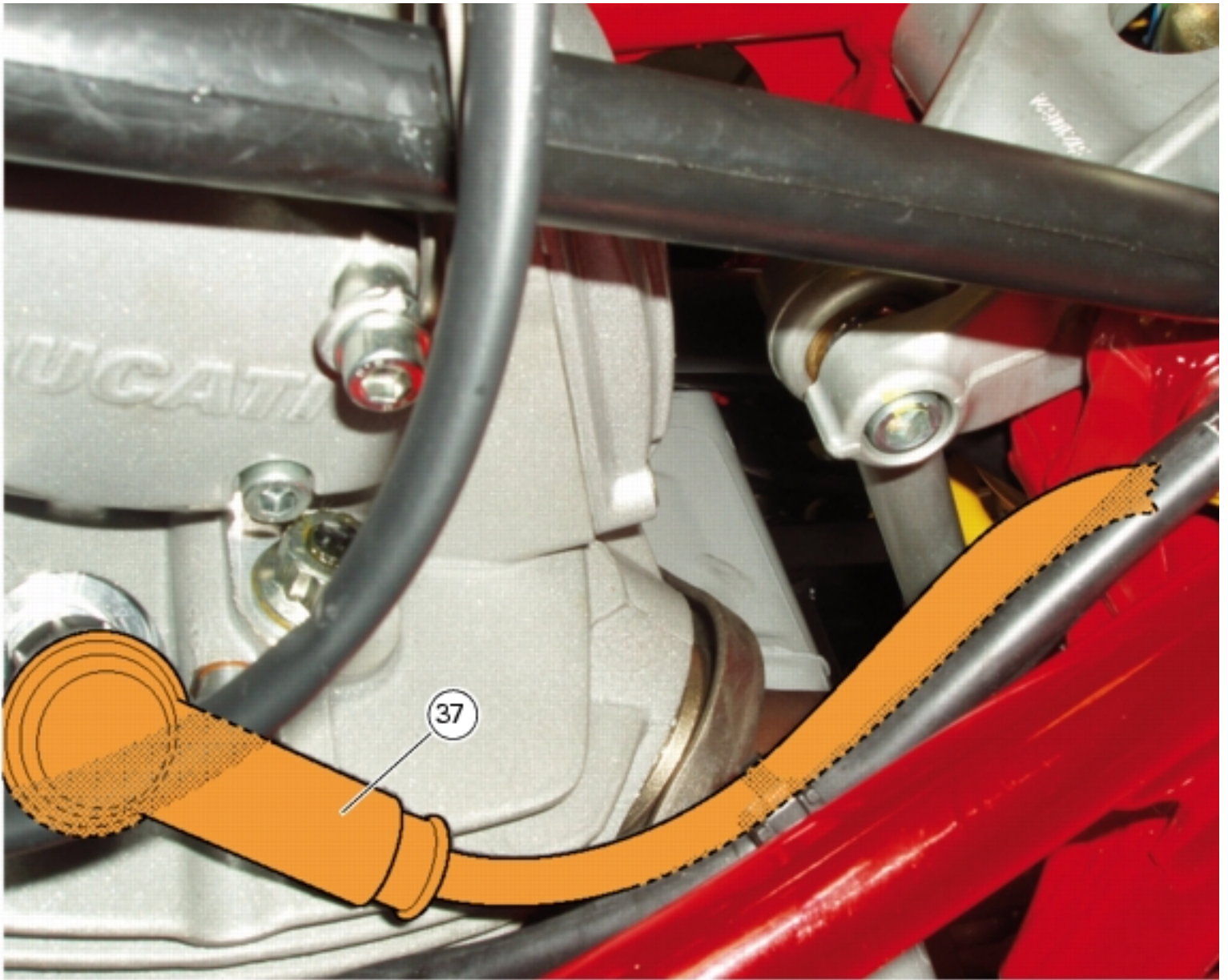


Diagram L



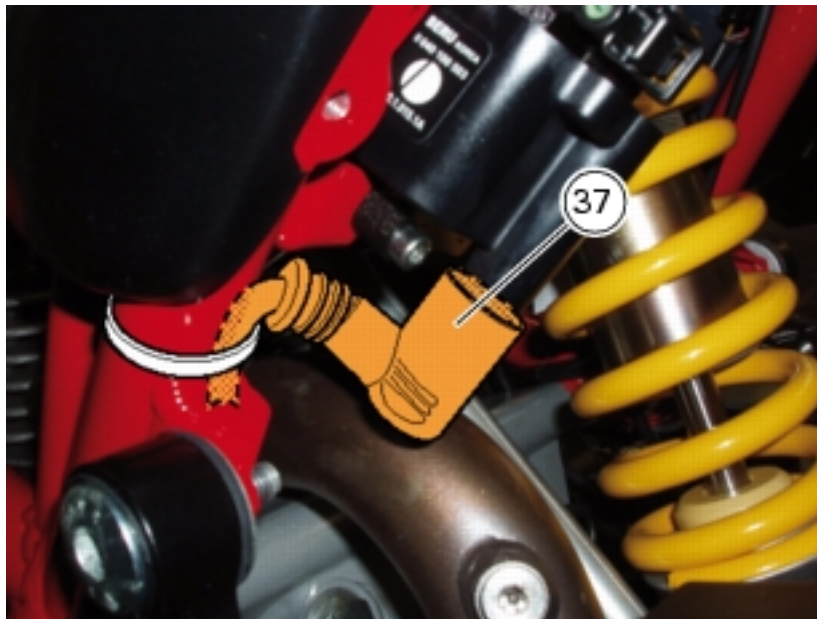
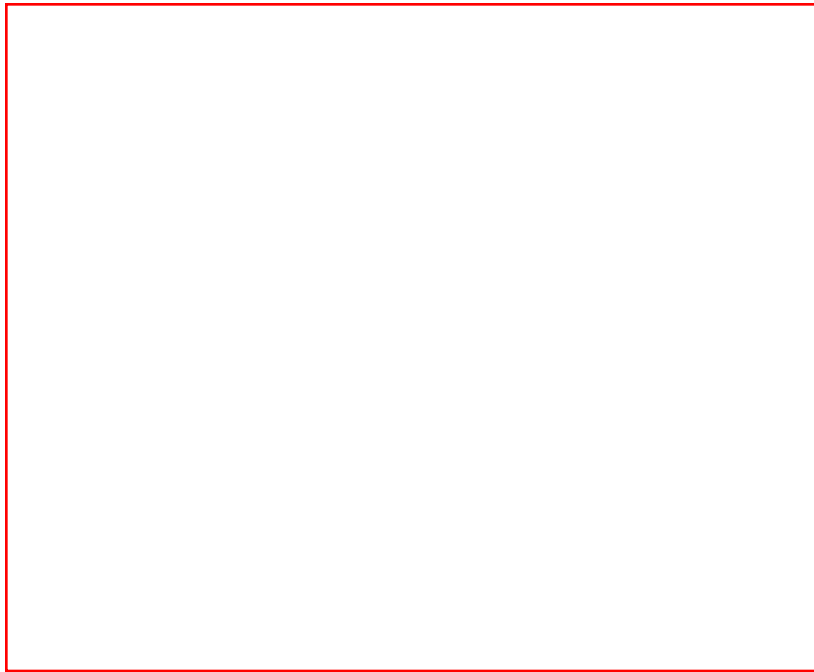


Diagram M

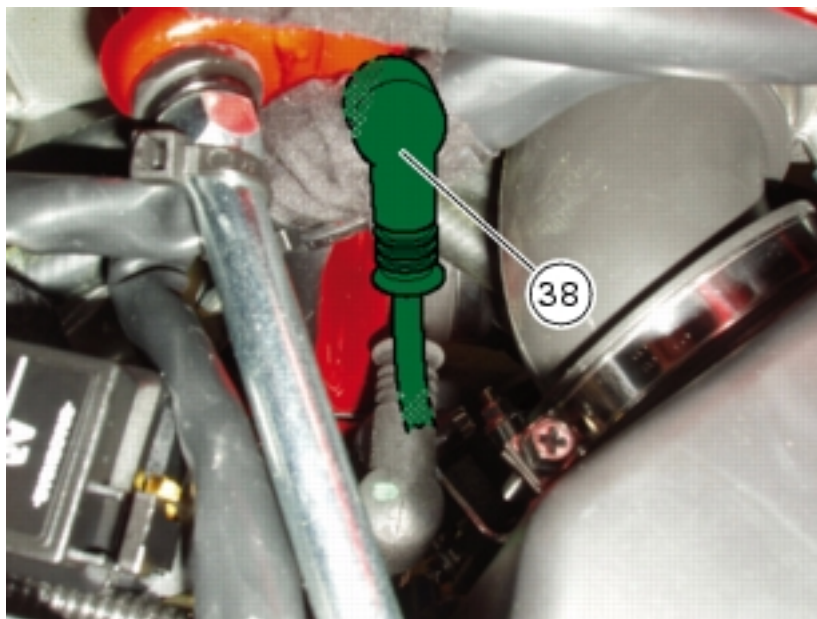
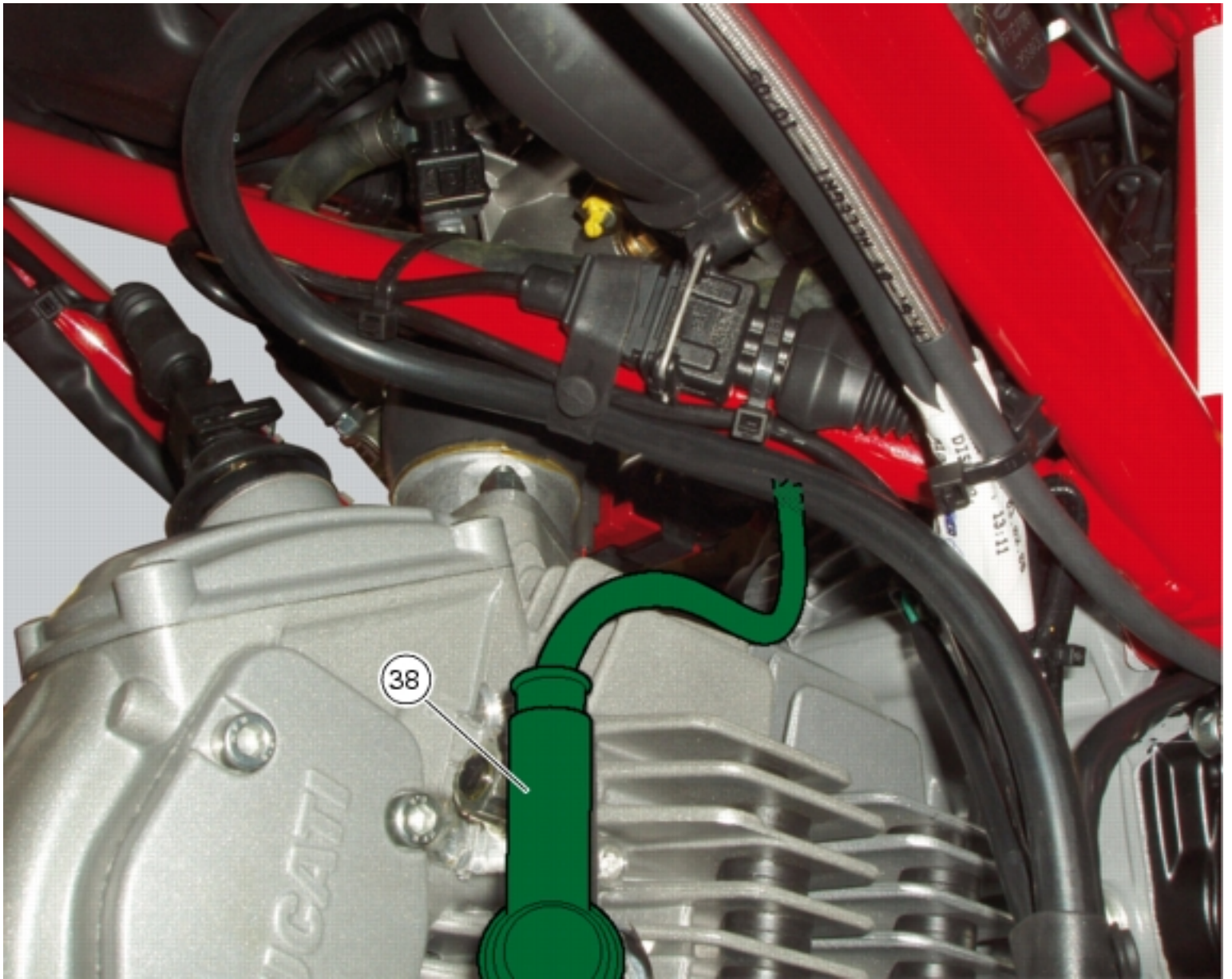


Diagram N

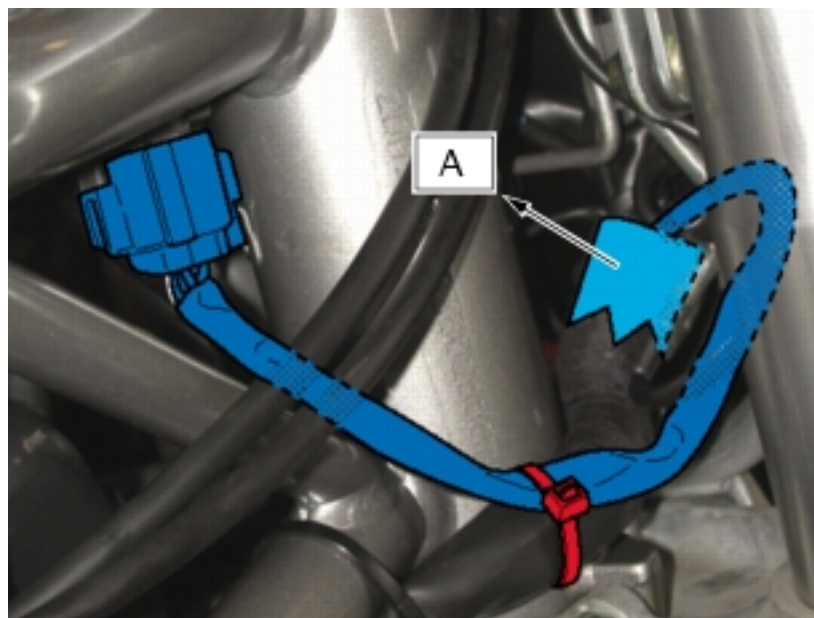
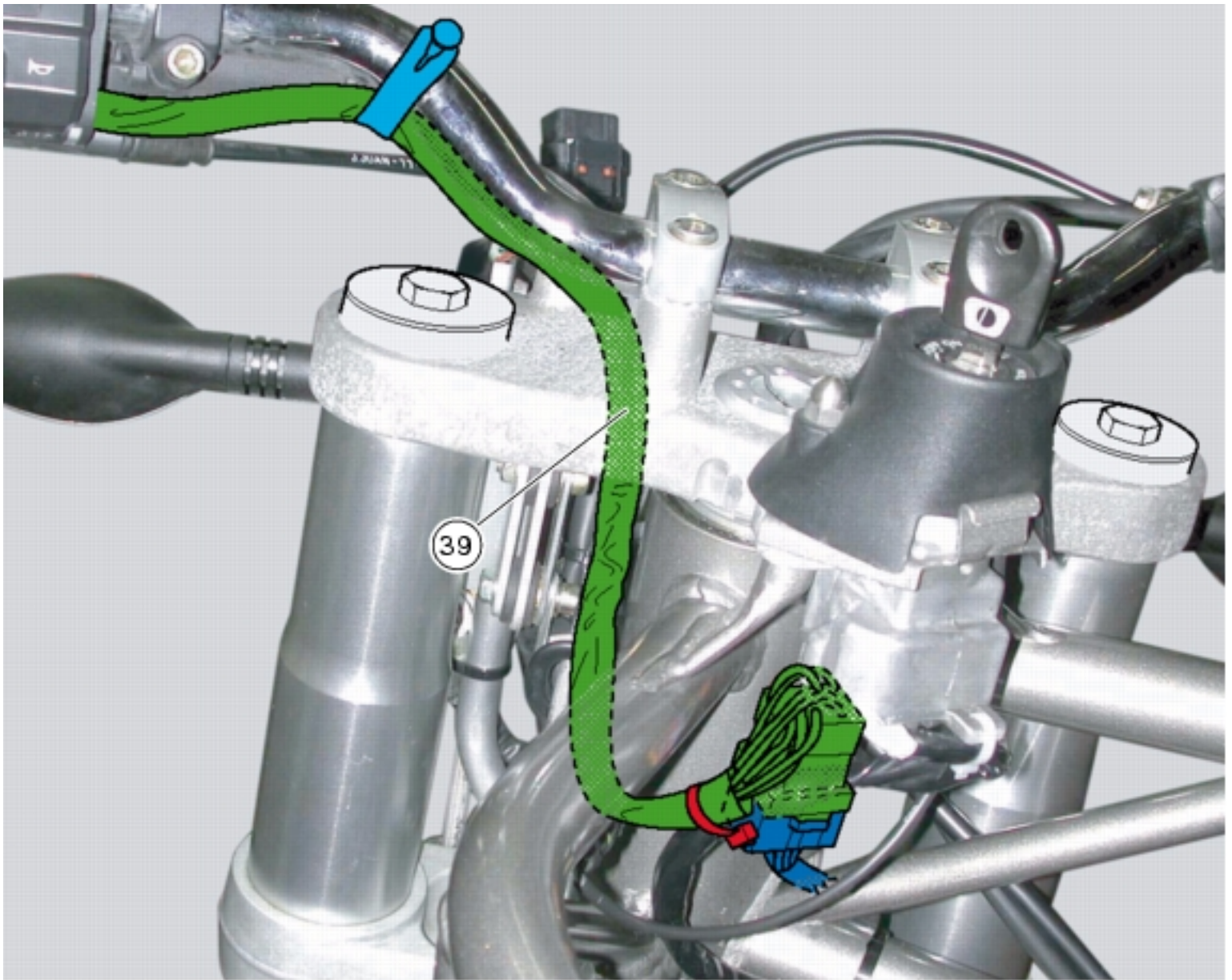


Diagram P

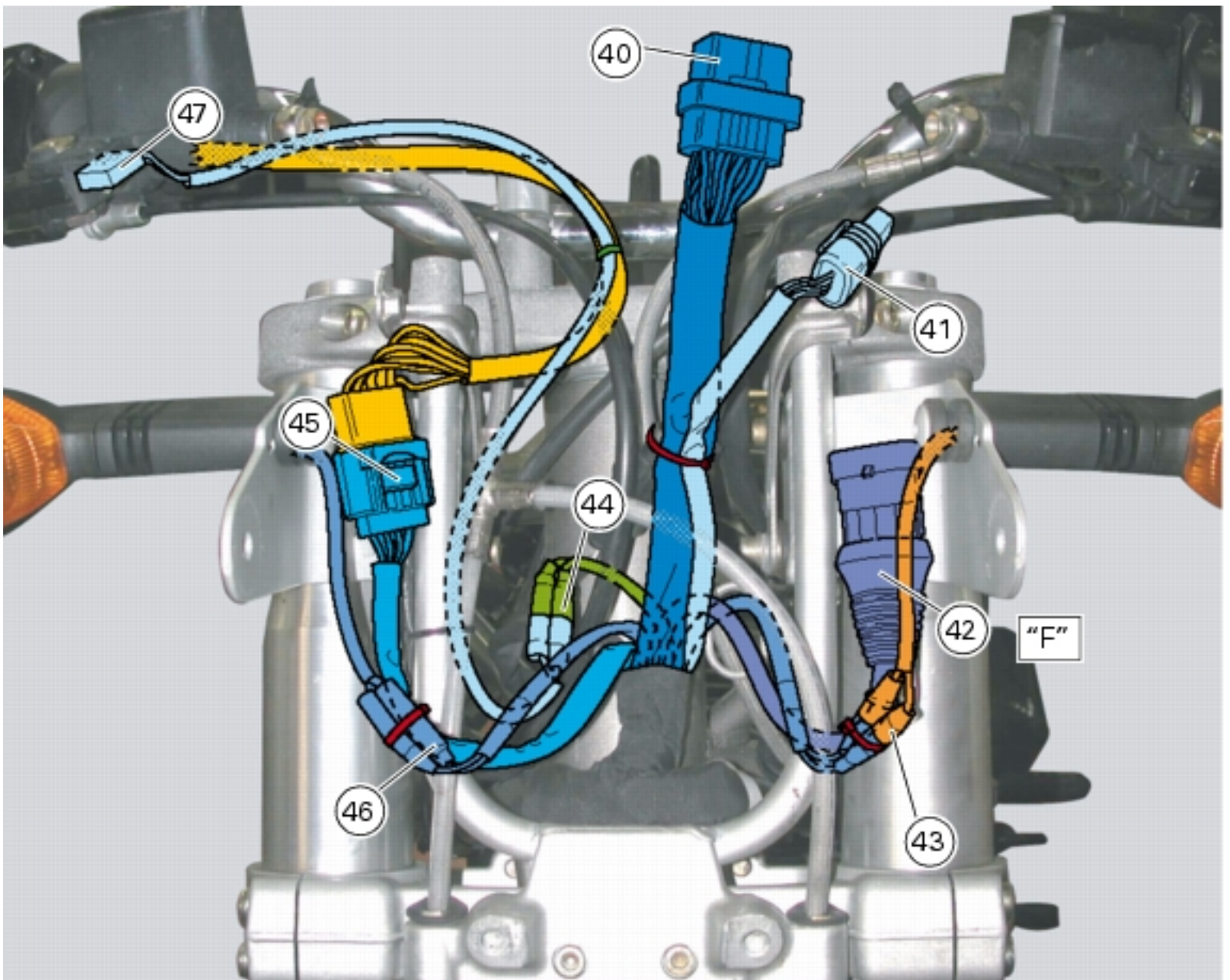
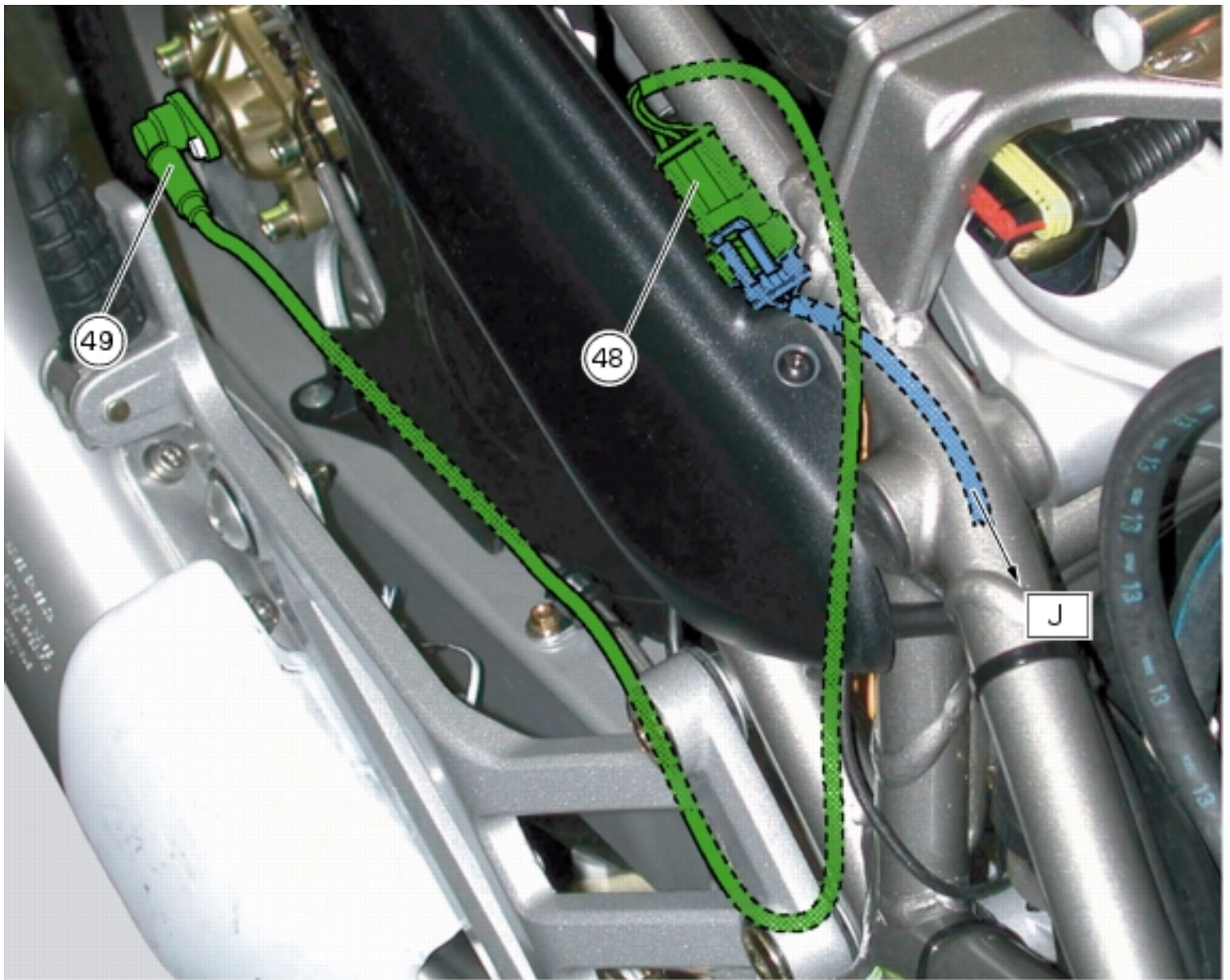


Diagram Q



## 2 - Charging system – battery

### Checking the charging system

To check the current flow in the charging circuit, use the "DDS" tester with the supplied inductive clamp-type amperemeter.

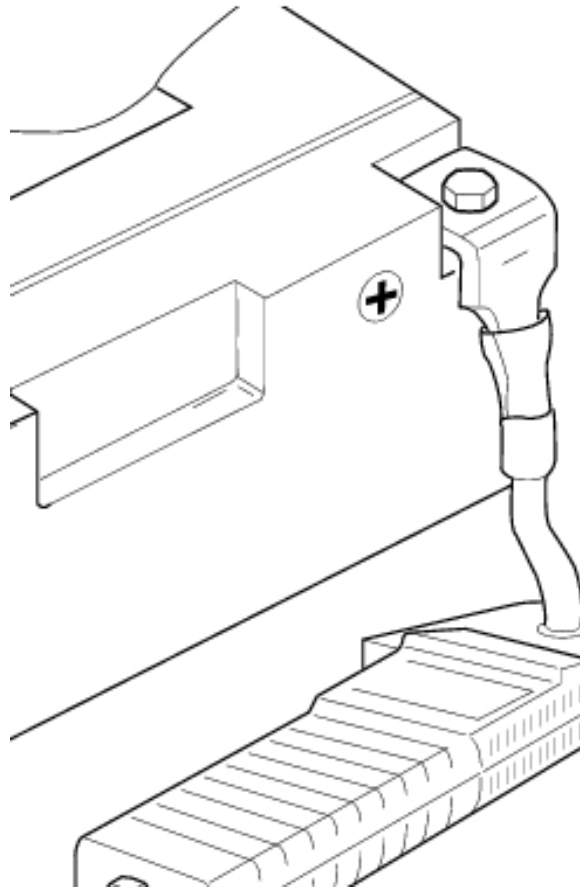
Please refer to indications given under "[Checking the charging system](#)" (Sect. D 5).

A negative value means that charging system is not feeding the loads and a significant amount of current is supplied to the battery, currently discharging.

Or it is possible to use a multimeter (Sect. P 9, [Testers](#)): connect probes from multimeter to battery terminals, select the direct current position on the multimeter; the reading should be  $14.5V \pm 0.5$  at 3000 rpm.

### Caution

If polarity is reversed when clamping amperemeter onto cable, readings polarity will also be reversed. This will lead to wrong diagnosis.



### Recharging the battery

Check the inspection interval indicated on the label.



Charge battery if open circuit voltage is lower than **12.8 V**. Leaving the battery discharged for more than one month could damage the battery itself. Check battery charge with a voltmeter. Always check battery condition before charging and 1 - 2 hours after charging.



### Caution

Strictly follow the recharging time indications. Immediately stop charging the battery if it becomes too hot. Let it cool down before resuming the charging operations.

Use only constant-voltage battery chargers.

Check that battery terminals are properly connected to battery charger.

To charge battery, proceed as follows:

Type of charge	Volt.	Ampere (A)	Time (Hours)
Standard	12	1,8	5-10
Fast	12	9	1

Use fast charge for emergencies only.

Long periods of inactivity

If battery voltage is 11.5V or lower, it needs charging.

Connect the battery charger to the battery.

Use a voltage of 16-17V.

In case the ammeter does not show any change, increase voltage to maximum 25V.

Charge for 5 min.

In case the ammeter shows a change, take voltage back to 16-17, or change the battery.

Adding electrolyte

Remove the battery from the vehicle.



### Warning

Carefully read the relevant safety rules before making any intervention on the battery (Sect. A 3, [General safety rules](#)).

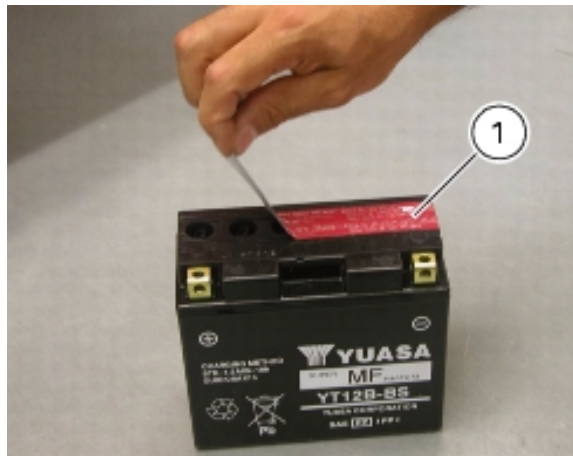
The battery fluid is toxic and might cause burns if it gets in contact with your skin, because it contains sulphuric acid. Wear protective clothes, a face mask and goggles before proceeding.

If the fluid gets in contact with the skin, immediately wash with running water. If the fluid gets in contact with your eyes, wash with abundant running water for 15 minutes and immediately seek specialised medical advice. If it is accidentally swallowed, drink a lot of water or milk, then magnesia milk, beaten eggs or vegetable oil. Keep the battery away from sparks, flames, cigarettes or any other heat source, because it gives off explosive gases.

Ventilate the room when charging the battery or using the battery indoors. Do not breathe the gas given off while charging the battery.

KEEP AWAY FROM CHILDREN.

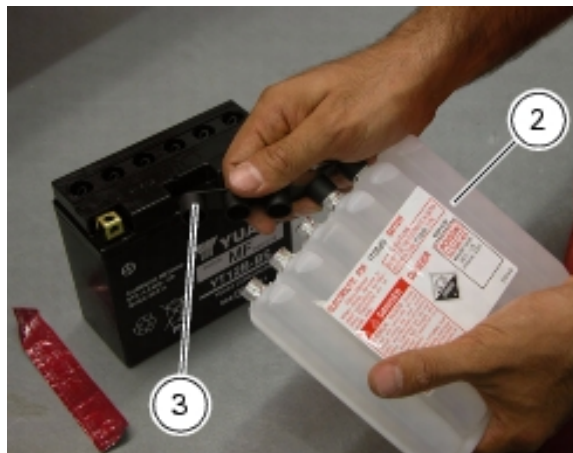
Set the battery on a flat surface. Remove the protective film (1).



**Warning**

Ensure that the fluid is suitable for your battery.

Take the fluid container off the vinyl case. Remove the cap bar (3) from the container (2).



**Caution**

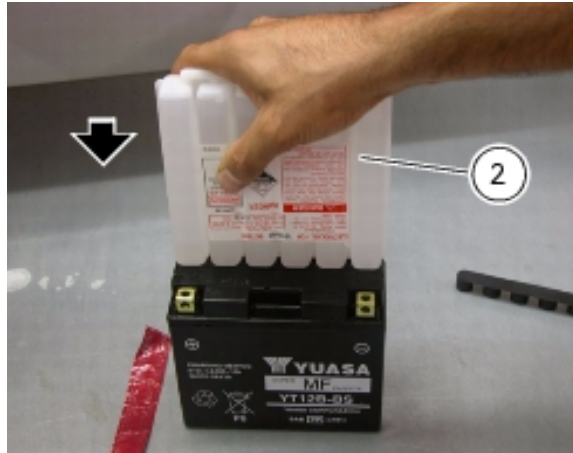
Keep the cap bar (3) at hand because it will be used to plug the battery cells.



**Warning**

Do not graze or pierce the sealed areas.

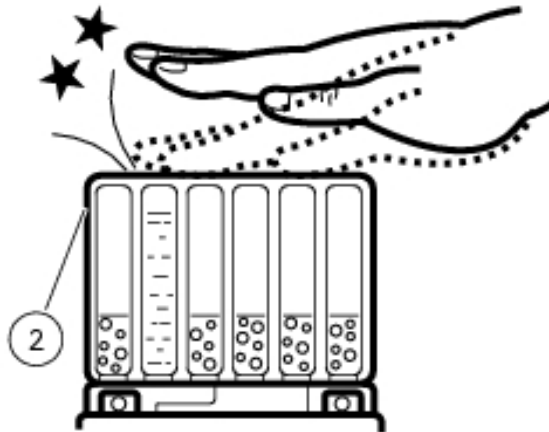
Set the fluid container (2) upside-down. Ensure the six sealed elements match the six filler holes on the battery. Push down the container (2) and break the seals so that fluid can flow out.



**Note**

Do not tilt the fluid container or the flow might stop.

Ensure that air bubbles come out from all six holes. Let the container in this position for more than twenty minutes. Should no air bubbles show from one of the filler holes, slightly tap on the bottom of the corresponding bottle.



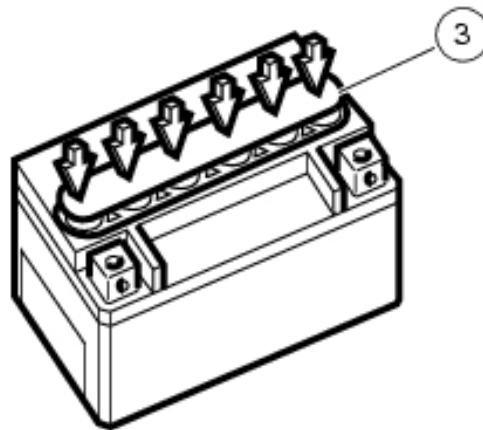
**Caution**

Never detach the container from the battery. Do not cut or pierce the bottle with fluid.

Ensure that all fluid has flown off. Carefully remove the container (2) from the battery. Fit the cap bar (3) -previously removed from the electrolyte container (2)- to the battery, ensure the caps plug off all filler holes.



3 -12 AH batteries: allow at least 30 min.  
>12 AH batteries: allow at least 1 hour.



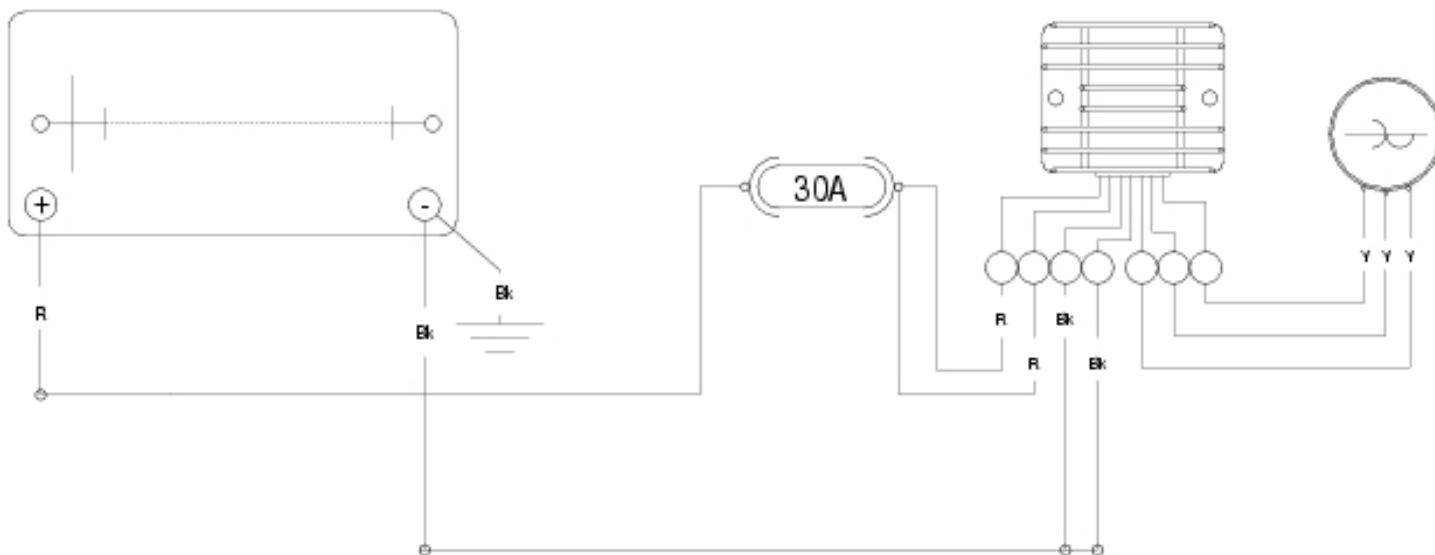
Install the cap bar on filler holes, do not fix it yet. Charge the battery as described under [Recharging the battery](#).



Note

When using an automatic-reduction battery charger, check that the charger current (amperes) is equal or higher than the value of standard charging system (STD) indicated on the battery itself.

Press down with both hands to ensure caps are correctly seated (do not use a hammer).



## Battery

### Battery safety rules



#### Warning

Carefully read the relevant safety rules before making any intervention on the battery (Sect. A 3, [General safety rules](#)). When under charge, batteries produce explosive gases. Keep batteries away from heat sources or open flames.

### Instructions for use of the battery

This is a sealed-type maintenance-free battery, ready for installation to the vehicle.



#### Note

Keep the battery clean. Smear grease on the battery terminals to prevent corrosion.



#### Warning

Do not remove the sealing bar (1) on the top of the cover or top up fluid. Replace battery if block, cover and terminals are broken or if the valve cover has been disturbed.



#### Caution

If the motorcycle is left unused for more than 30 days, remove the battery and store it in a safe, cool place.

Always charge the battery before the first operation and after long storage periods – such as before selling the vehicle.

### Removing the battery



## Note

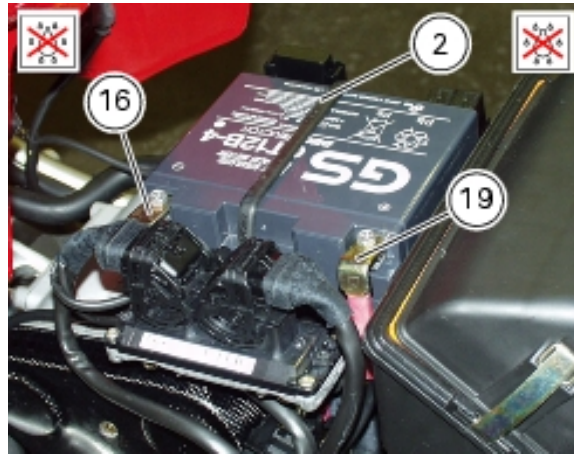
References (16) and (19) are the same as those of diagrams under "[Arrangement of wiring on frame](#)" of this section.

Remove the seat (Sect. E 3, [Removing the seat](#)).

Lift the fuel tank (Sect. L 2, [Removing the fuel tank](#)).

Undo the screws on the terminals (16) and (19). Always start from the negative terminal.

Undo the retainer (2) and then remove the battery.



## Refitting the battery

For correct reassembly, reverse the disassembly procedures. Ensure that terminals are not oxidized, then tighten terminal screws to the specified torque (Sect. C 3, [Frame torque settings](#)) and use a waterproof spray.

## Battery mount

Remove the battery as described under "[Battery](#)" in this section.

Remove the "[Regulator fuse](#)" as described in this section.

Remove the electronic control unit as described under paragraph "[Electronic control unit](#)" in Sect. M 3.

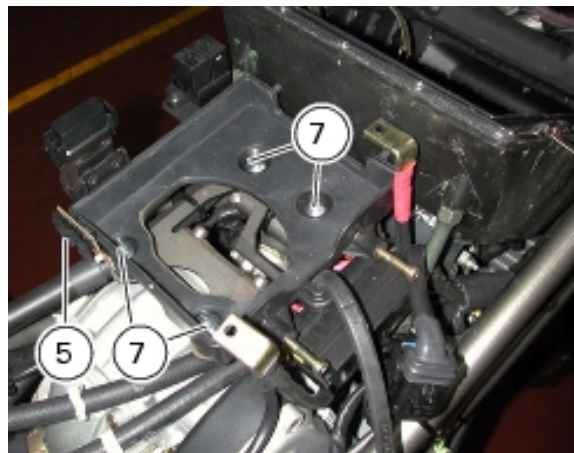
Remove the "[Main and injection relays](#)" as described in Sect. M 3.

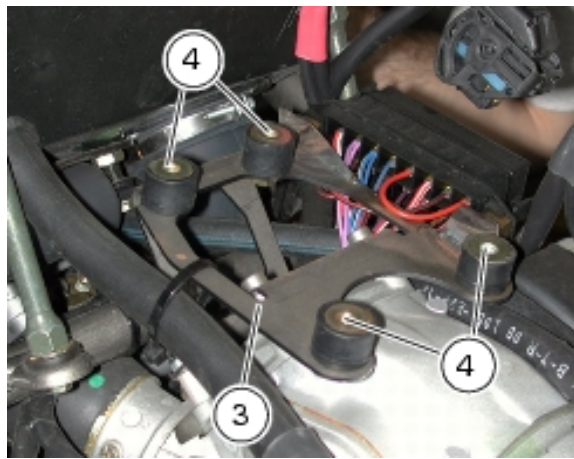
Slide out the battery mat and relevant drain tube.

Unscrew the four screws (7) and remove the battery mount (5) together with the plate (6).

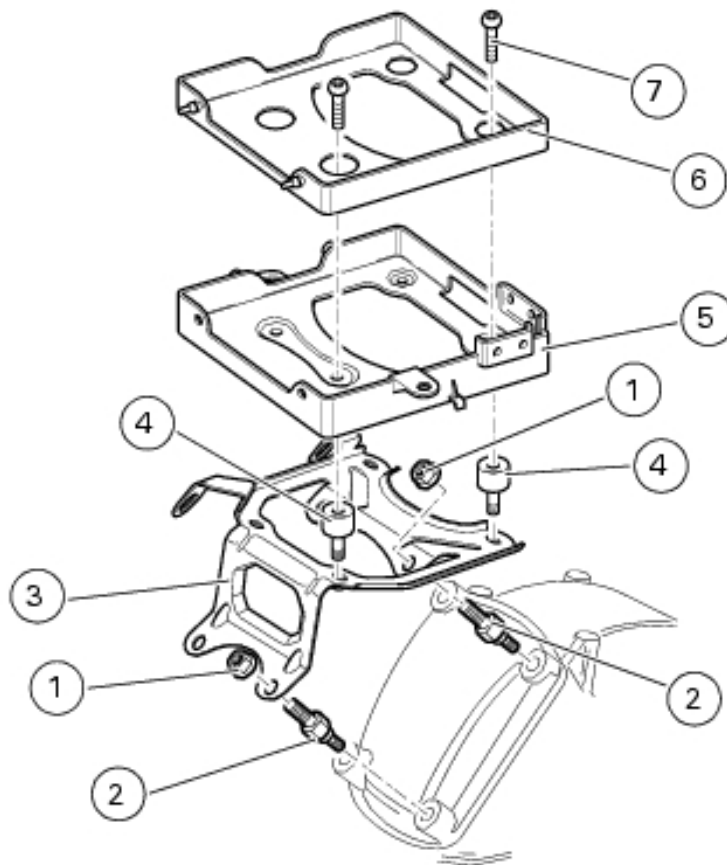
Collect the four vibration dampers (4).

Undo the nuts (1) and remove them from the retaining screws (2) at the vertical head and remove the bracket (3).



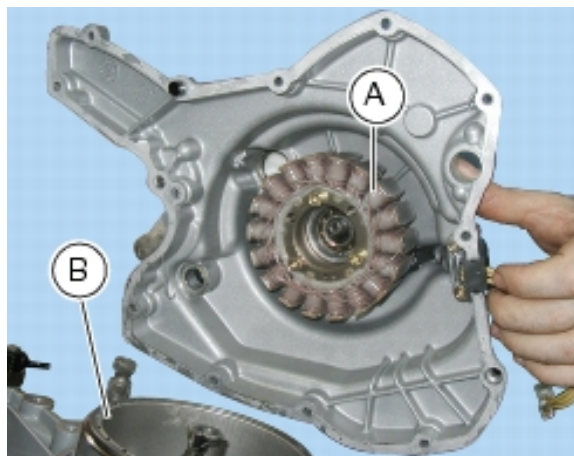
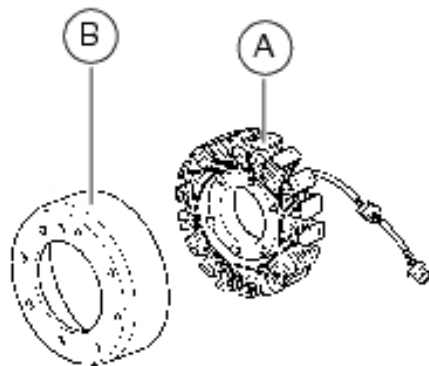


Installation is a reversal of the removal procedure. Make sure to tighten the screws to the specified torque (Sect. C 3, [Frame torque settings](#)).



## Generator

The generator is a **12V, 520W** alternator, consisting of a fixed stator (A) located in the generator cover and a rotor (B) fixed to the crankshaft.



**Warning**

To check operation of the battery charging system, use the DDS, please refer to "[Checking the charging system](#)" (Sect. D 5).

Absolute value of voltage measured across the terminals of two of the three yellow cables (measured value will be the same whichever the combination) must be within the range indicated in the table below.  
(Ambient temperature: **20 °C**)



**Caution**

Disconnect generator cables from the electric system when the ignition key is positioned to OFF before testing.

Engine rpm	2000	6000
effective <b>V</b>	<b>27 ± 10</b>	<b>78 ± 10</b>

Values notably lower than the mentioned values can be due to:  
partially demagnetized rotor;  
short-circuited coil windings.

In the above cases the whole generator assembly (rotor and stator) should be replaced.  
If checks have a favourable outcome, reconnect generator to regulator with ignition key on OFF. Make sure that no cables are damaged or disconnected.

Removing the generator

Disconnect the generator-side electrical cables (see diagram in "[Arrangement of wiring on frame](#)", Sect. P 1).  
Remove generator cover, stator (A) and rotor (B) (Sect. N 8, [Removing the generator cover](#)).

Refitting the generator

Fit rotor (B), stator (A) and generator cover.

Connect the generator-side electrical cables (see diagram in "[Arrangement of wiring on frame](#)", Sect. P 1).

## Rectifier - regulator

The rectifier-regulator (1) is fixed to the oil breather tank (2) and to motorcycle frame.

The rectifier-regulator consists of an aluminium casing containing the diodes that rectify the current produced by the generator. It also has an electronic device controlling the power supplied by the generator depending on battery voltage.

If the battery is flat, value of power supplied can set the battery to its original optimal operating conditions.

If the battery is charged, power value will be lower.



### Note

To check recharging current, use the DDS, please refer to "[Checking the charging system](#)" (Sect. D 5).

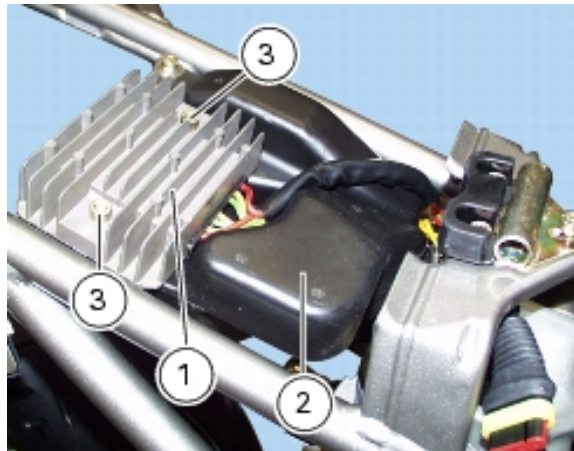
## Removing the regulator

Remove the seat (Sect. E 3, [Removing the seat](#)).

Remove the fuel tank (Sect. L 2, [Removing the fuel tank](#)).

Open the clamp and disconnect generator/regulator connector from the wiring harness (see diagram in "[Arrangement of wiring on frame](#)" Sect. P 1).

Undo the retaining screws (3) that hold the regulator to the oil breather tank (2).



### Caution

Do not disconnect the battery cables while the engine is running. Disconnecting battery cables when the engine is running will damage the regulator.

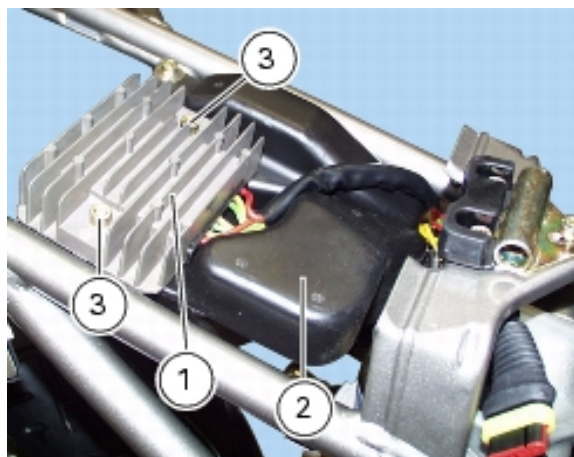
## Refitting the regulator

Position regulator (1) on oil breather tank (2).

Secure it with the screws (3)

Tighten screws to the specified torque (Sect. C 3, [Frame torque settings](#)).

Connect generator/regulator wiring connector to main wiring and lock cable tie.



Note

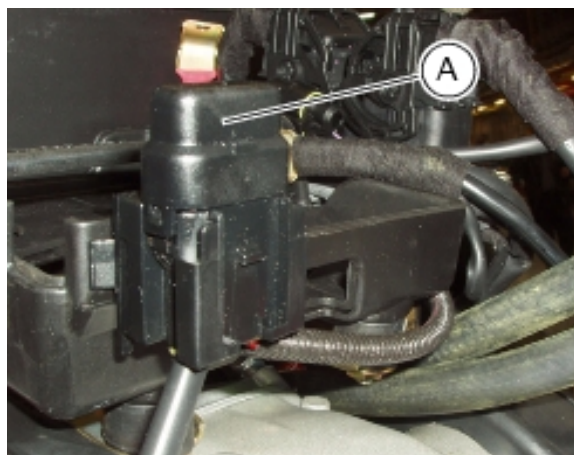
To correctly position the regulator cable (14), follow the instructions of diagram E in [Arrangement of wiring on frame](#) under Sect. P 1.

Install the fuel tank (Sect. L 2, [Refitting the plastic fuel tank](#)).

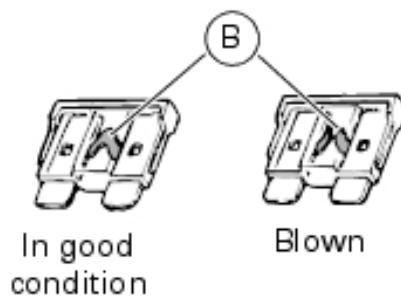
Install the seat (Sect. E 3, [Refitting the seat](#)).

Regulator fuse

The **30A** fuse placed at the side of the battery mount protects the electronic regulator. Remove the protective cap (A) to give access to this fuse.



You can tell a blown fuse by the broken filament (B).



Caution

To prevent short circuits, ensure that the ignition key is in the **OFF** position before changing a fuse.



**Warning**

Use only fuses with the specified amperage. Using fuses with the incorrect amperage may damage the electrical system and cause fires.

## 3 - Electric starting



### Note

Items reference numbers refer to "[Wiring diagram](#)" in Section P 1.

### Electric starting system

The key components of the electric starting system are a starter contactor (7) and a starter motor (6) fed by the battery (8).

ECU (28) has total control on motorcycle ignition procedure. It monitors the following inputs:

- Engine Stop on right switch (1)
- Engine Start on right switch (1)
- Neutral sensor (30)
- Side stand sensor (27)
- Clutch microswitch (43)

If all above inputs send enabling signals, the control unit (28) will enable engine ignition procedure.

The table shows possible ignition combinations.

If all inputs are in OK status, the control unit will enable the starter motor (ON) when START is pressed.

X = generic status of neutral, clutch and stand.

Safety devices function table

ECU INPUTS				ECU OUTPUTS
NEUTRAL	CLUTCH	STAND	ENGINE STOP	STARTER MOTOR
ECU ENGINE 23 PIN	ECU BODY 33 PIN	ECU BODY 38 PIN	ECU BODY 27 PIN	ECU BODY 1 PIN
X	X	X	OFF	OFF
NEUTRAL	PULLED	DOWN	ON	ON
NEUTRAL	RELEASED	DOWN	ON	ON
GEAR	RELEASED	DOWN	ON	OFF
GEAR	PULLED	DOWN	ON	OFF
NEUTRAL	PULLED	UP	ON	ON
NEUTRAL	RELEASED	UP	ON	ON
GEAR	RELEASED	UP	ON	OFF
GEAR	PULLED	UP	ON	ON

### Starter motor

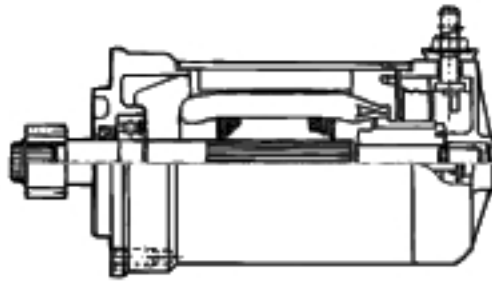
Power:

700 W with 12V power supply

Direction of rotation:

counterclockwise viewed from power take-off side.

As the starter motor is reliable and compact, it usually does not fail. In case of troubles, ensure that the starter motor cable terminal is properly tightened under the nut and shows no oxidation. If the terminal is properly tightened and free from oxidation, remove the starter motor and test it under loadless conditions (no load applied to the shaft). Secure the starter motor to a test bench. Ensure not to damage motor case. Use a 12V fully-charged battery. Take battery-motor connection cables not longer than 70 cm and having the same cross-section as the motorcycle connection cable. Connect the negative terminal of the battery with an unpainted area of the motor case and the positive terminal to its electric terminal. The motor shaft should rotate quickly and freely. Proceed with utmost care so not to short-circuit cables which are connected to the battery.



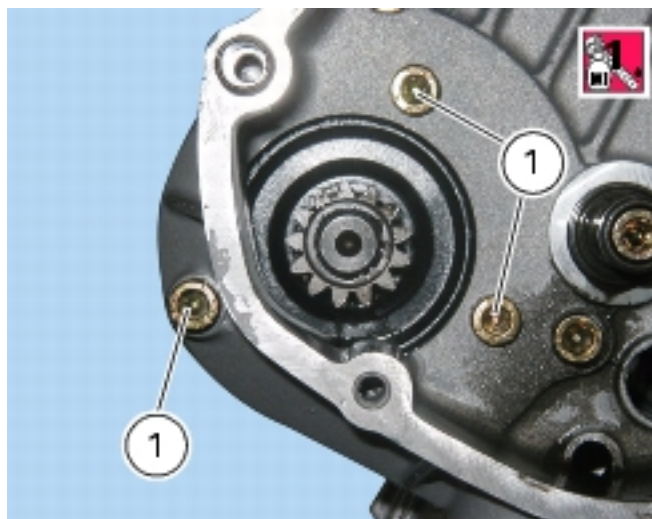
### Removing the starter motor

Remove generator cover (Sect. N 8, [Removing the generator cover](#)).

In the event the whole starting gear unit needs replacing, remove timing intermediate gears and starter motor intermediate gear (Sect. N 9.1, [Removing the starter motor driven gear](#)).

Disconnect starter motor / starter contactor cable (3) (see diagram in "[Arrangement of wiring on frame](#)" under Sect. P 1).

Undo retaining screws (1).

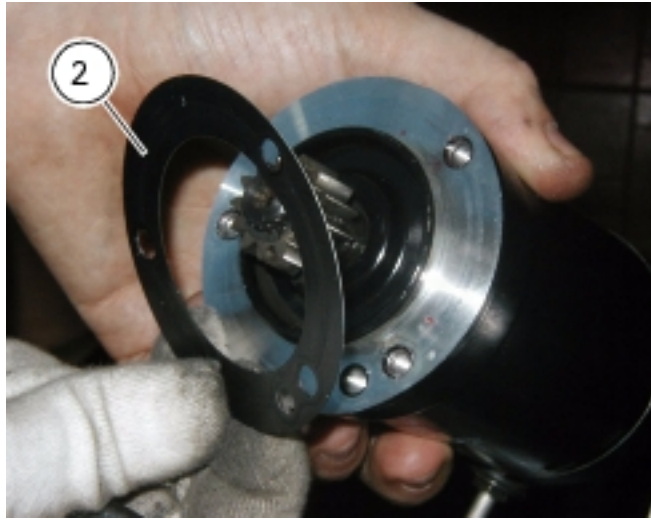




Note

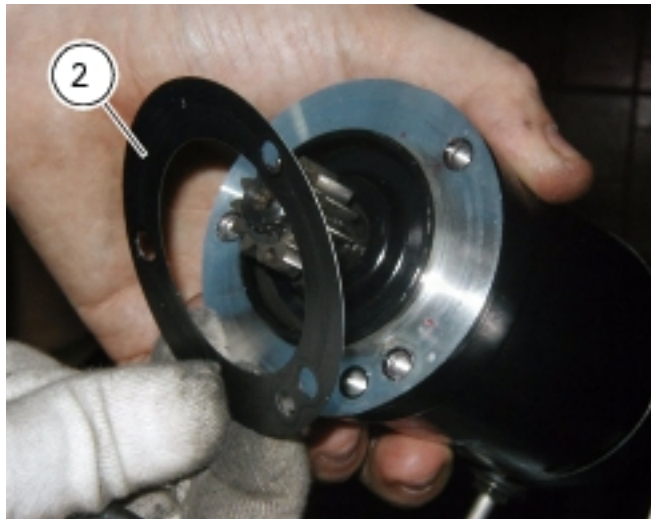
Starter motor retaining screws are originally assembled with threadlocker.

Slide out starter motor and gasket (2).



Refitting the starter motor

Visually inspect gasket (2) for wear. Replace if necessary.



Place gasket (2) and starter motor on casing and tighten screws (1) to the specified torque (Sect. C 3, [Frame torque settings](#)).

Connect starter motor / starter contactor cable (3).



Caution

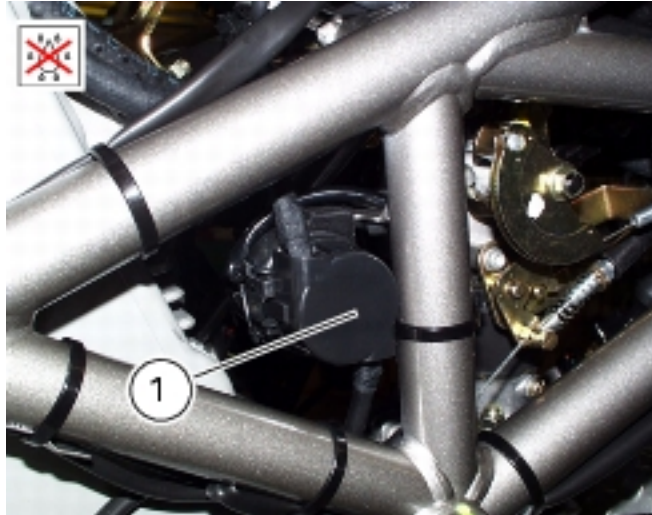
Fill the protective cap with protective grease before fitting it on the starter motor.

If the starting gears assembly was replaced, refit starter motor intermediate gear and timing intermediate gears (Sect. N 9.1, [Refitting the starter motor driven gear](#)).

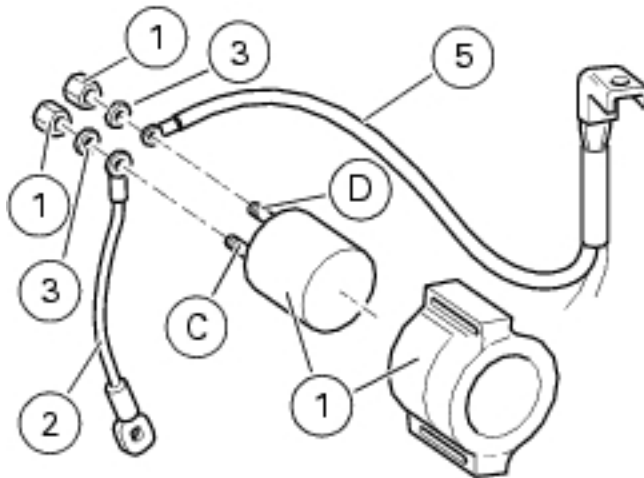
Close the generator cover (Sect. N 8, [Reassembling generator cover](#)).

Starter contactor

Starter contactor (1) is elastically connected to the frame.  
Disconnect the battery (Sect. P 2, [Battery](#)).

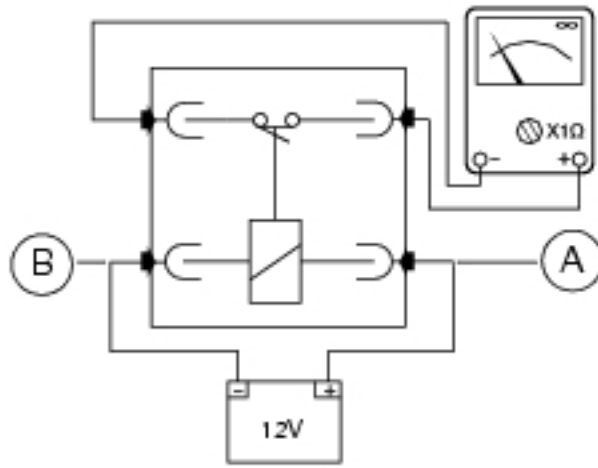


Remove the starter contactor from its housing.  
Undo the nuts (4) and collect the spring washers (3).  
Remove the contactor-starter motor cable (2).  
Remove the contactor-battery cable (5).  
Disconnect the connector (2) of the starter contactor from the wiring.

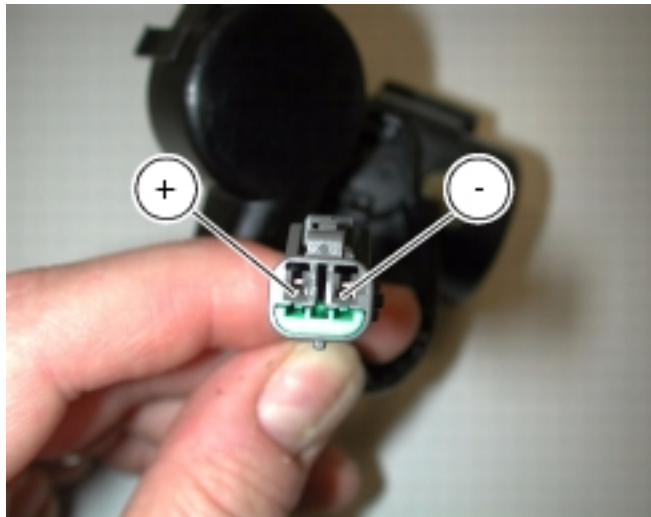
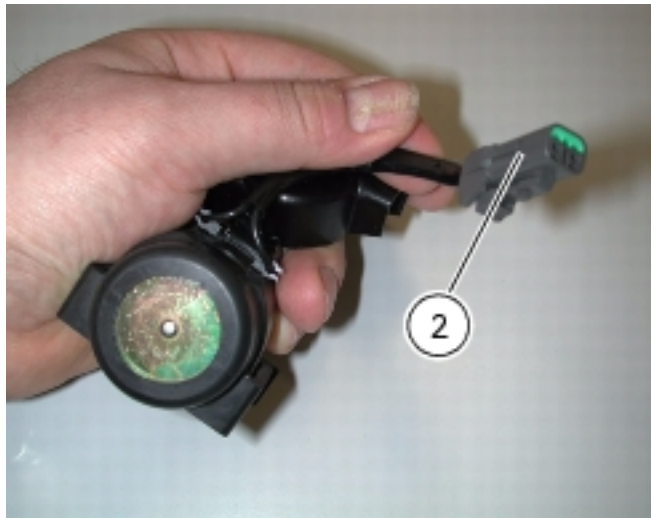


#### Starter contactor operational check

Apply a **12V** (battery) across the positive (A) and negative (B) terminals of the connector.  
Connect a multimeter between the two poles [threaded pins (C) and (D)] of the starter contactor and then check for electric continuity (Sect. P 9, [How to use the multimeter to check electric systems](#)). If continuity is not ensured, replace the starter contactor.



At reassembly, check that contacts (C) and (D) are not oxidized and use waterproof spray. Tighten the nuts (4) to the specified torque (Sect. C 3, [Frame torque settings](#)). Reconnect connector (2) to wiring.



## 4 - Lighting devices

### Changing light bulbs

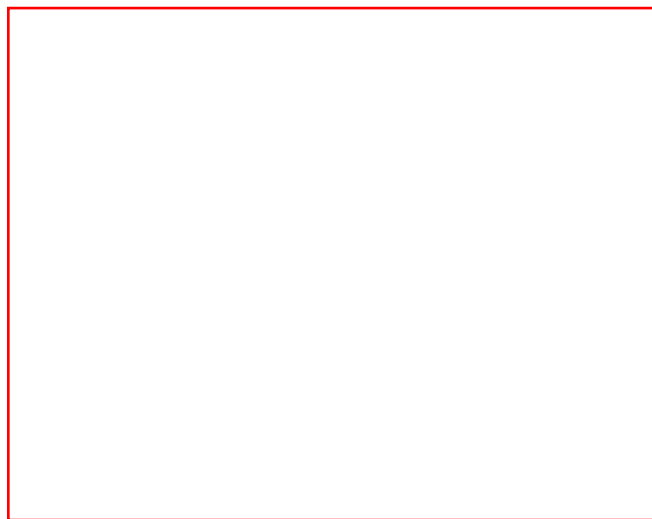
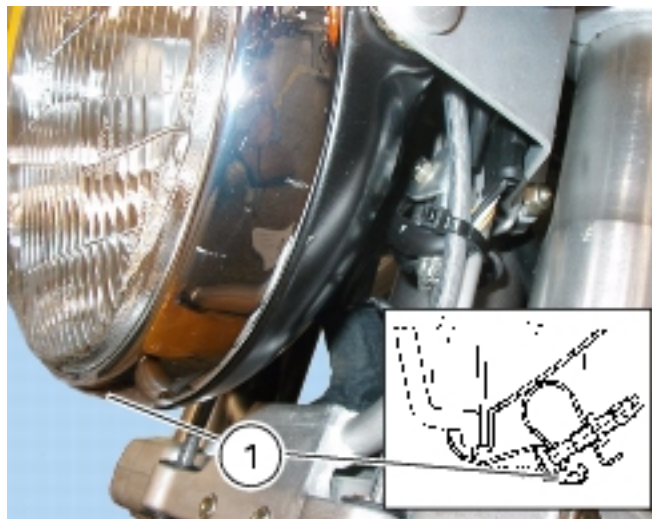
#### Changing the headlight bulbs

Before replacing a burnt-out bulb, make sure that the new bulb complies with the specified voltage and wattage (Sect. C 1.1, [Lights / instrument panel](#)).

#### Warning

Headlamp halogen bulbs become hot when turned on and stay hot for some time after they are switched off. Allow bulbs to cool down before changing them.

To gain access to headlight bulbs, loosen the lower screw (1) securing the frame/reflector unit to the headlight body.



Remove the connector (2) from the bulb.



Release the bulb retaining clip (3) and take bulb out of mount.  
Fit a bulb of equal rating (Sect. C 1.1, [Lights / instrument panel](#)).



Note

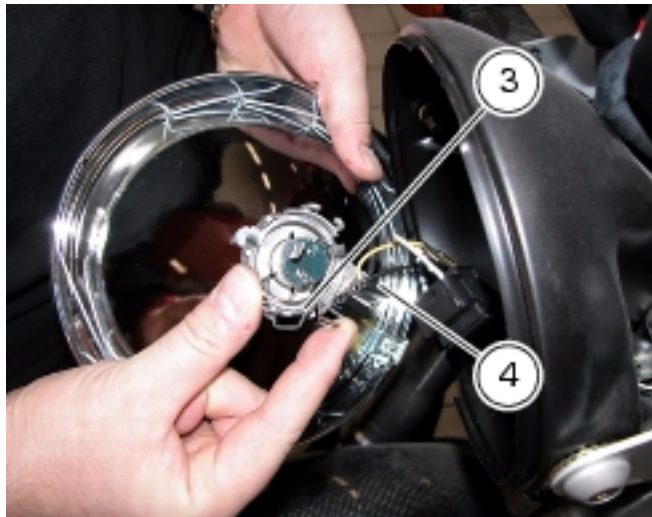
Be careful to hold the new bulb at the base only. Never touch the transparent body with your fingers or it will blacken resulting in reduced bulb brilliancy.

Insert the locating pins of the bulb base into their seats to obtain correct alignment.

Hook the clip (3) to the headlamp holders.

Connect the cables previously disconnected.

To replace the bulbs of the parking light, remove the connector (4).



The bulb has a bayonet fitting. Press and twist clockwise to extract.

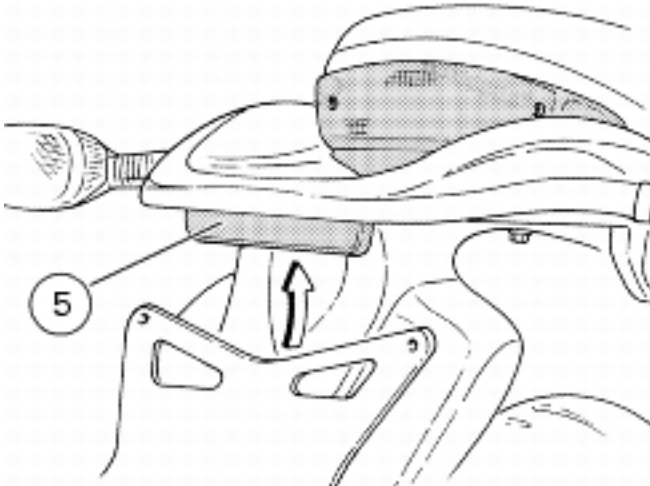
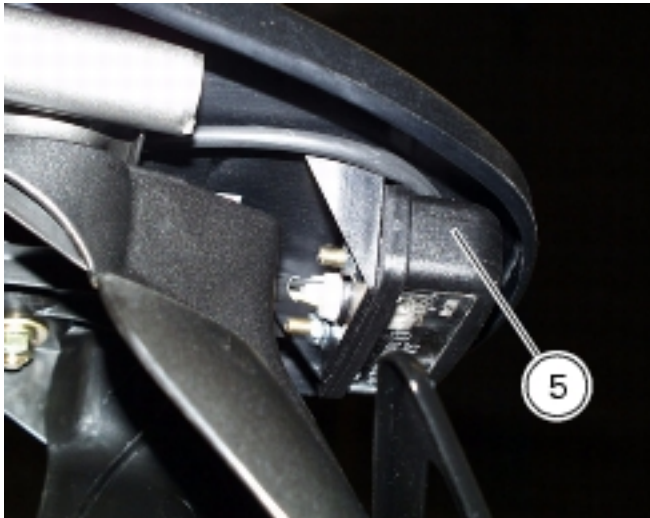


Position the new bulb. Press and turn counterclockwise until it becomes properly seated with an audible click.

Refit the connector and secure the rim/reflector assembly in place.

#### Replacing the number plate light bulbs

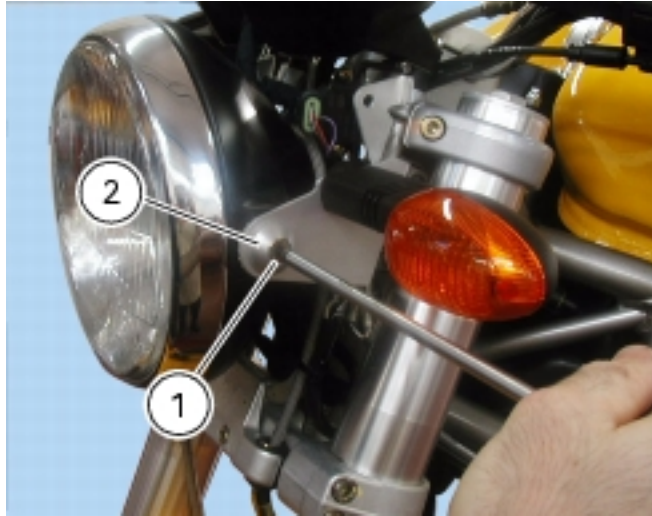
Remove the bulb holder from the inside of the number plate holder to gain access to the number plate bulb (5). Remove the bulb and fit a new bulb.

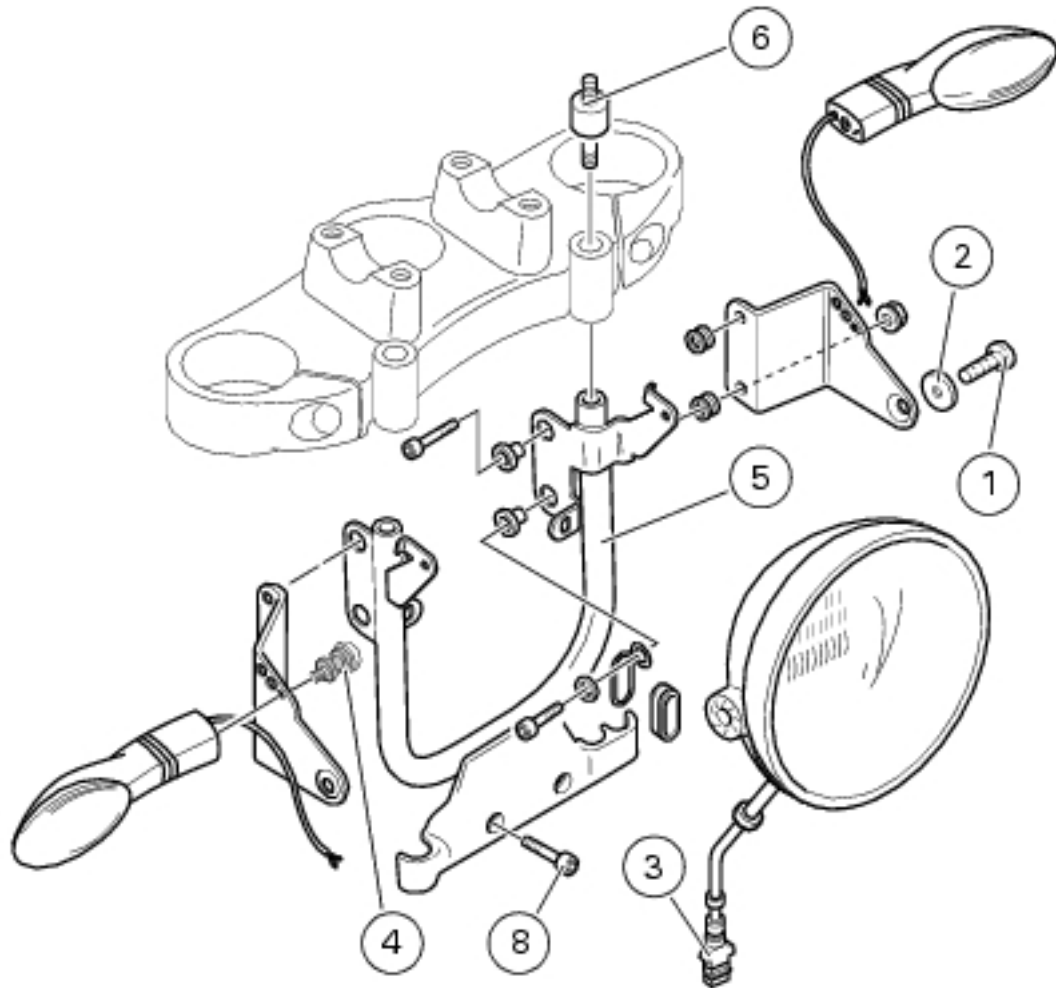


#### Changing the headlight

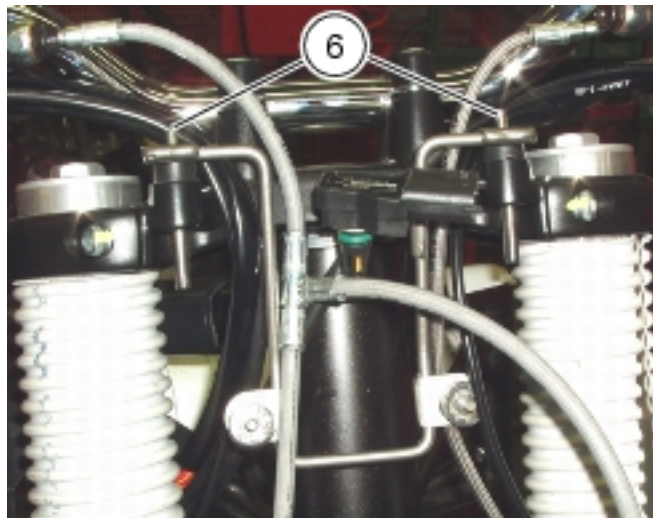
To remove the headlight, loosen the screws (1), collect caps (2). Disconnect connector (3) from front wiring.

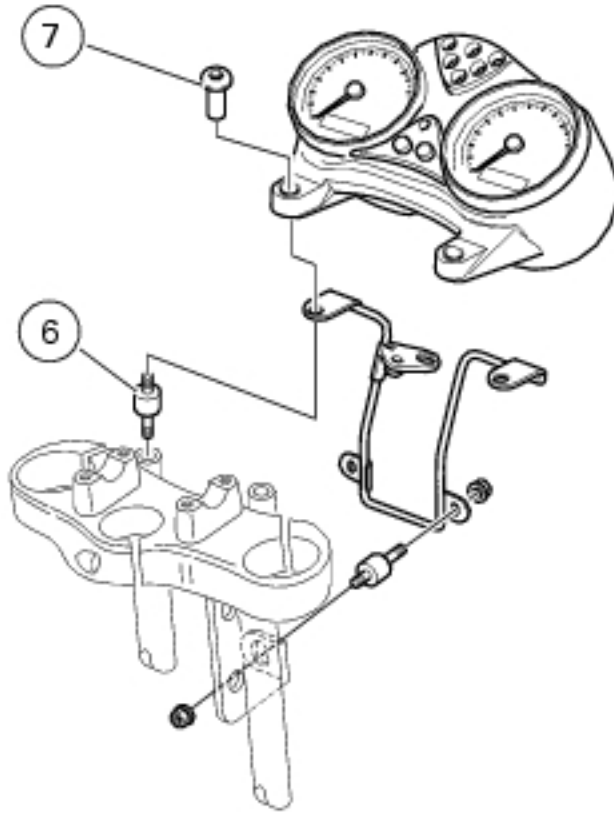
Loosen screws (4) to remove turn indicators.





Headlight support (5) is secured to the steering head by means of threaded vibration dampers (6). Vibration dampers (6) and screws (7) secure the instrument panel to the steering head. Headlight support (5) is secured to the bottom yoke by means of screws (8).



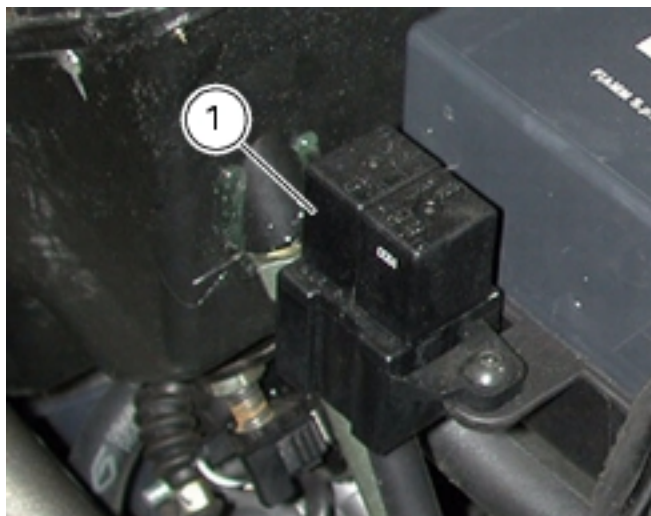


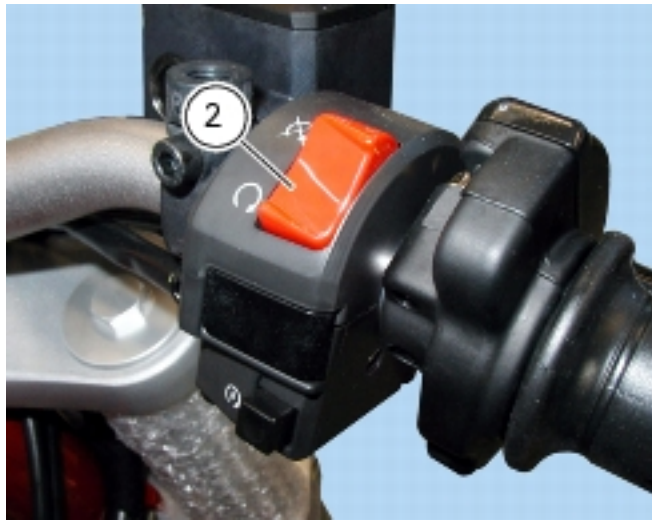
## High beam relay

It is located next to the batteries and secured to battery mount. To gain access to this component it is necessary to lift the fuel tank (Sect. L2, [Removing the fuel tank](#)).

High beam relay (1) was added to the system in order to control the light automatic switch-off strategy, i.e.:

- 1 If on after normal use, lights go off 60 seconds after engine is stopped by means of "Engine kill button" (2) and with key ON; they immediately turn on again when vehicle is restarted.
- 2 If on, lights go off 60 seconds after key-ON with engine stopped.



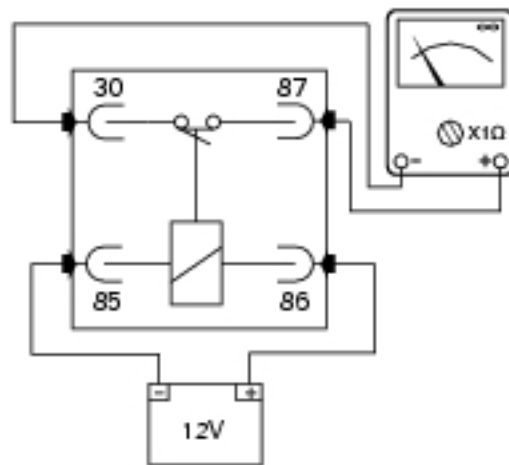


If this strategy is not working, check system operation.

#### Checking high beam relay operation

Remove relay (1) from its support and power contacts (86) and (85) (small contacts) with **12 V** (battery). The electric magnet must click.

Connect a multimeter across contacts (30) and (87) (large contacts) and ensure it reaches full scale (analog multimeter) or beeps (digital multimeter). If not, replace checked part.



#### Beam setting

The motorcycle must be perfectly upright with the tires inflated to the correct pressure and with a rider seated.

Position the motorcycle 10 meters from a wall or flat surface.

On the wall or surface, draw a horizontal line at the same height from the ground as the centre of the headlight and a vertical line aligned with the longitudinal axis of the motorcycle.



#### Note

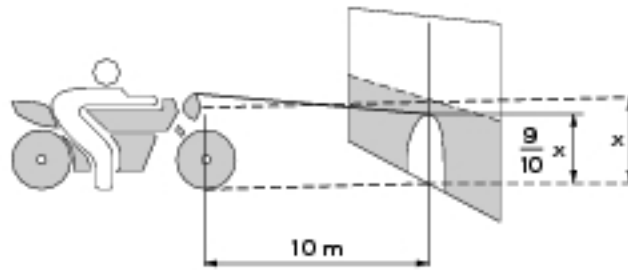
This check should preferably be carried out in a well-shaded area.

Switch on the low beam. The height of the upper limit between the dark area and the lit area must not be more than nine tenths of the height of the centre of the headlamp from the ground.

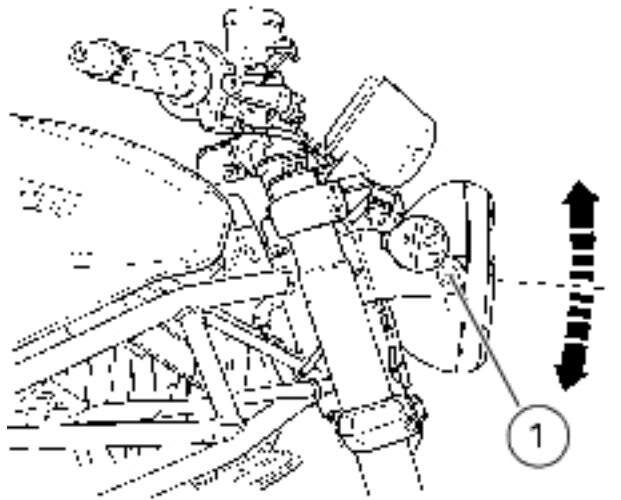


## Note

This is the procedure specified by Italian standards to check the maximum height of the light beam.



To adjust the height of the light beam, turn the adjusting screws (1) that retain the headlamp to the side supports.



## 5 - Indicators and lighting system

### Checking the indicators and lighting system components

In the event of a fault, the internal connections of the device must be checked in all operating positions. To do this, disconnect the switch connector from main wiring (Sect. P 1, [Arrangement of wiring on frame](#)).

Test the switch using either an analogue or digital MULTIMETER (Sect. P 9, [How to use the multimeter to check electric systems](#)).

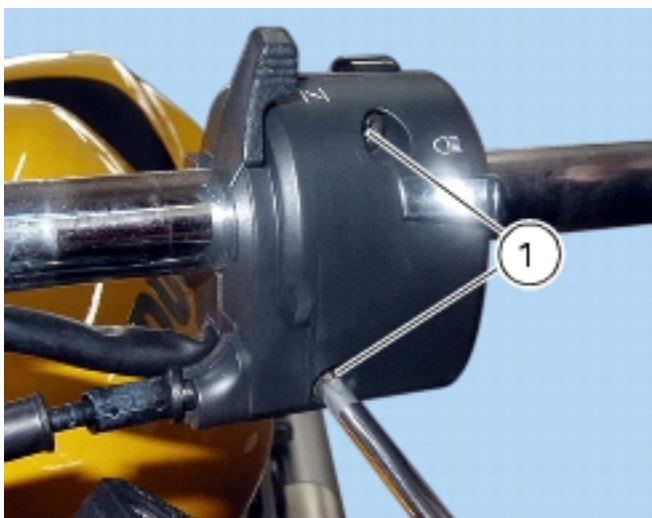


Note

The same test may be done using the "DDS" tester (Sect. D 5, [DDS diagnosis instrument](#)).

### Checking the left switch

Undo the screws (1) and disconnect the switch from the electric system to remove it. Colours mentioned in the descriptions refer to the colour of wires from the switch and not to the colour of wires of the main electric system.

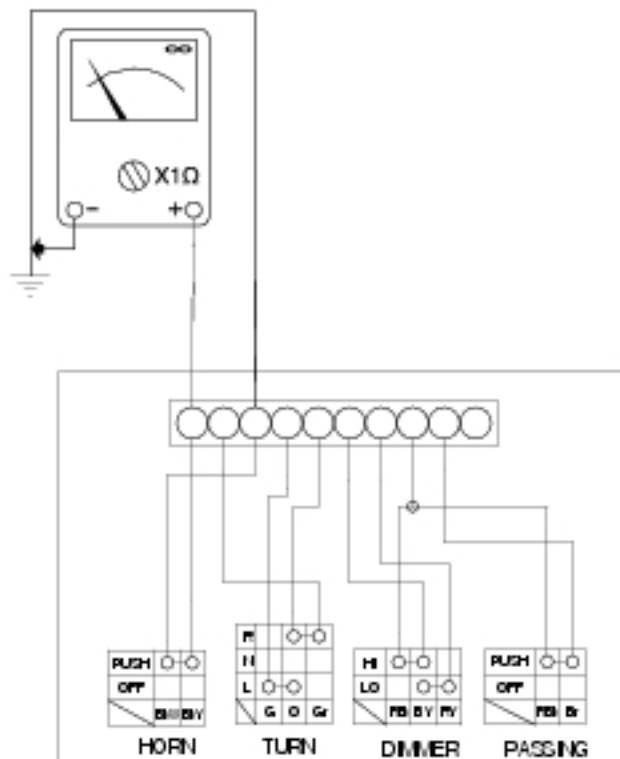


### HORN button

Connect the terminals of a multimeter with Black/White and Black/Yellow cables to check for electric continuity, which must be available when HORN is pressed (see Sect. P 9, "[Testers](#)" on multimeter operation). When HORN button is pressed, resistance value taken by the multimeter should be close to zero and, if available, a continuity beep should be heard. When HORN is not pressed, the resistance value should be infinite (no continuity is available as electric contacts into the button are open) and no continuity beep should be heard. If the above does not apply, the part should be replaced.

### Turn indicator switch

Connect the multimeter to Orange and Grey wires from the turn indicator switch and check for electric continuity when operating the right turn indicator (Sect. P 9, "[Testers](#)" on multimeter operation). Repeat the above procedure for the left turn indicator but connect the multimeter with Green and Orange cables. Colours mentioned in the descriptions refer to the colour of wires from the switch and not to the colour of wires of the main electric system.



Low and high beam (DIMMER)

Test method is the same. Connect meter as follows:

Low beam (**LO**)

(Blue/Yellow and Red/Yellow cables)

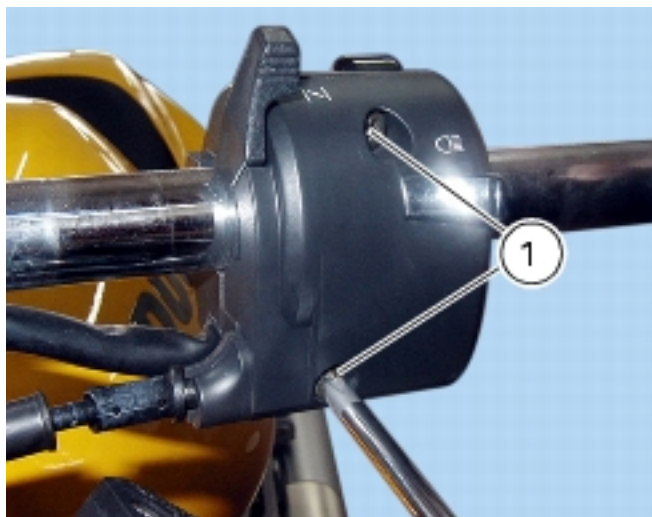
High beam (**HI**)

(**Red/Black and Blue/Yellow cables**).

Flasher (PASSING)

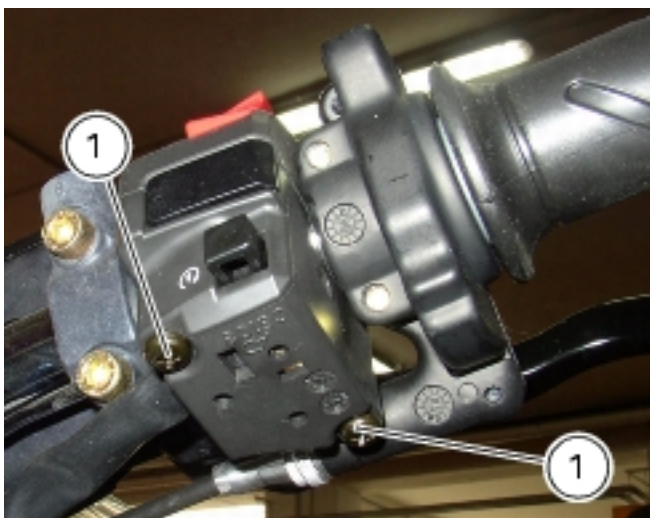
Check for continuity across the **Red/Black and Grey** cables.

Fit the left switch, tighten the screws (1) to the specified torque (Sect. C 3, [Frame torque settings](#)).



### Checking the right switch

Undo the screws (1) and disconnect the right switch from the electric system to remove it. Colours mentioned in the descriptions refer to the colour of wires from the switch and not to the colour of wires of the main electric system.



### Engine stop button

Check for continuity between **(Red/Black and Red/White)** cables with a multimeter (Sect. P 9 on multimeter operation). When the button is in **run** mode, electric continuity should be available between the two cables. When the button is in **off** mode, no electric continuity should be available between the two cables.

If the above does not apply, the **engine stop** switch is defective and should be replaced. Colours mentioned in the descriptions refer to the colour of wires from the switch and not to the colour of wires of the main electric system.

### Starter button

Proceed as described for the engine stop button and check for continuity between **(Blue/White and Black)** cables when **starter** button is pressed (see Sect. P 9, [Testers](#) on multimeter operation). If the above does not apply, the **starter** button is defective and should be replaced. Colours mentioned in the descriptions refer to the colour of wires from the switch and not to the colour of wires of the main electric system.

### Parking light/low beam switch

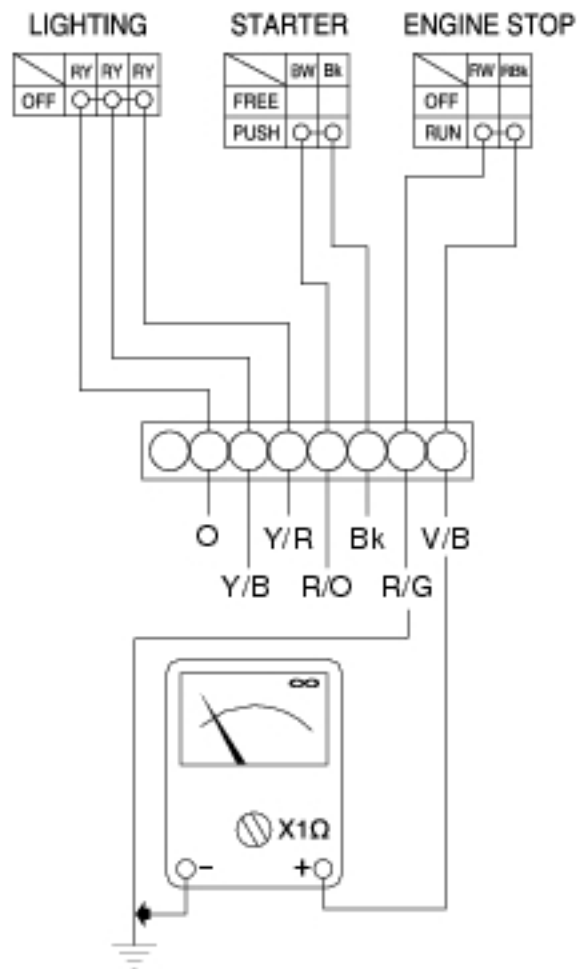
Using the same multimeter (Sect. P 9, [Testers](#), on multimeter operation), check the continuity across the following cables:

**(Red/Yellow)** cables for the low beam.

The light switch should operate as follows:

Connect the multimeter to **(Red/Yellow)** cables, then position the switch to low beam mode and continuity between the two cables should be available. If the above does not apply, the light switch should be replaced.

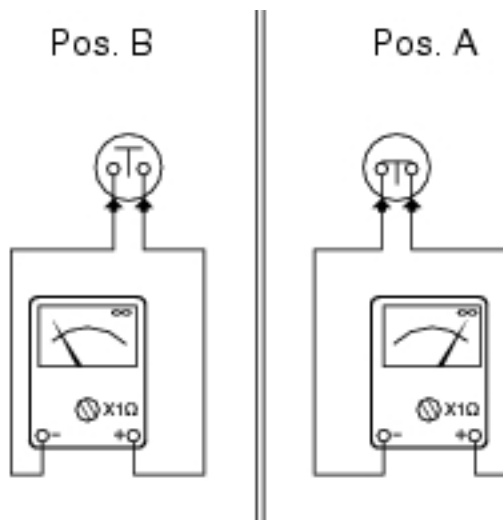
Fit the right switch, tighten the screws (1) to the specified torque (Sect. C 3, [Frame torque settings](#))



Checking front and rear STOP switches, neutral switch, oil pressure switch and clutch switch

### STOP switches

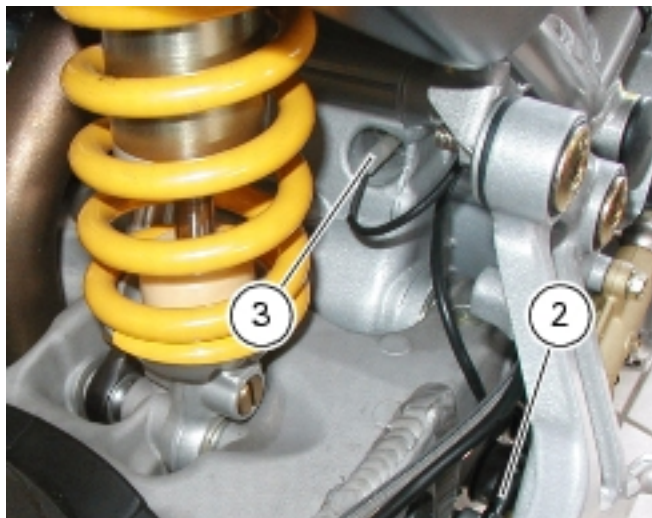
Check for electric continuity (Pos. A) between the switch terminals of front STOP switch (1) and rear STOP switch (2) with a multimeter (Sect. P 9, [Testers](#) on multimeter operation) when either front or rear brake is enabled. No electric continuity should be available when brakes are not enabled (Pos.B). Replace the checked part if proves to be defective.





### Neutral light

Proceed as follows to check the neutral light switch (3):



the neutral light on the instrument panel does not turn on.

Remove the electric terminal connected to the neutral switch. Position the ignition key to ON to switch on the instrument panel and ensure that the light turns on when the terminal is grounded. If the light turns on, the neutral switch should be changed. If the light stays off, turn the ignition key to OFF to switch off the instrument panel and check for electric continuity between neutral switch and engine control unit with a multimeter.

The neutral light on the instrument panel is permanently on.

Position the ignition key to ON to switch on the panel and remove the electric terminal from the neutral switch. If the light turns off, the neutral switch should be changed. If the light stays on, turn the ignition key to OFF to switch off the instrument panel and use a multimeter to check whether the section between neutral switch and engine control unit is grounded.

### Oil pressure sensor

Proceed as follows to check engine oil pressure sensor (4) for proper operation.

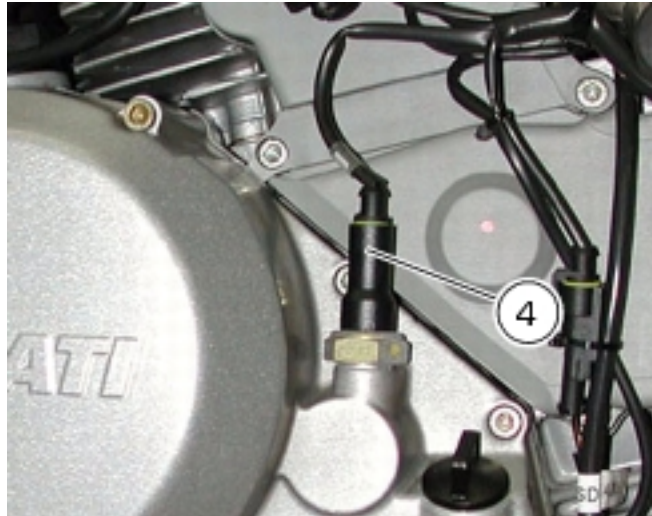
Use the DDS to check that oil pressure into engine oil circuit complies with the specified values (Sect. D 5, [Checking engine oil pressure](#)).

If engine oil pressure value is outside the operating range, check oil circuit parts and service as necessary.

If engine oil pressure value is within the allowed operating range and the warning light "engine oil pressure low" on the instrument panel stays off, turn the ignition key to ON still with engine off, disconnect the electric terminal from the pressure sensor and ground it. If the warning light turns on,

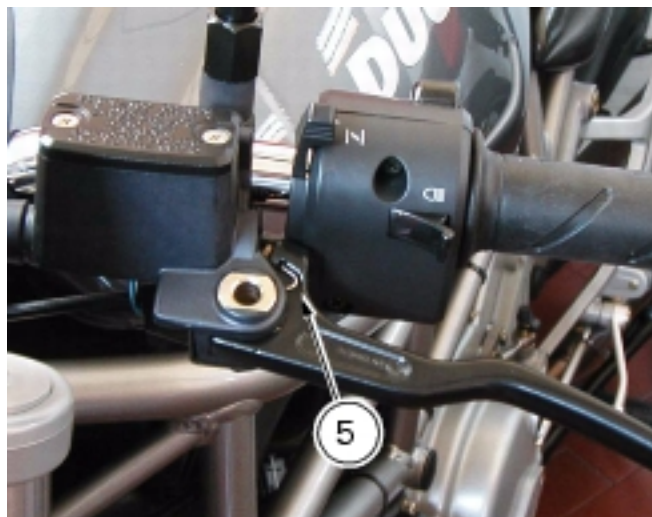
the sensor should be replaced. If the warning light stays off, use a multimeter and check for electric continuity in the section between sensor and warning light on the instrument panel. Check with ignition key positioned to OFF (instrument panel off).

If engine oil pressure value is within the allowed operating range and the warning light "engine oil pressure low" on the instrument panel stays permanently on, turn the ignition key to ON and start the engine and disconnect the electric terminal from the pressure sensor. If the warning light turns off, the sensor is faulty. If the warning light stays on, use a multimeter and check whether the section between sensor and warning light on the instrument panel is grounded. Check with ignition key positioned to OFF (instrument panel off).



#### Clutch switch

For the clutch switch (5), proceed as described for STOP switches (see beginning of this section).



#### Changing light bulbs

##### Replacing the turn indicator bulbs

Undo the fixing screw (1) to detach the cover (2) from the indicator mount (3).

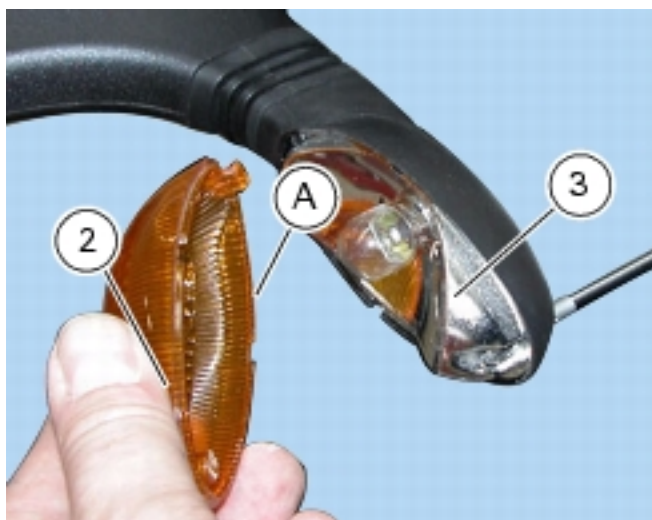
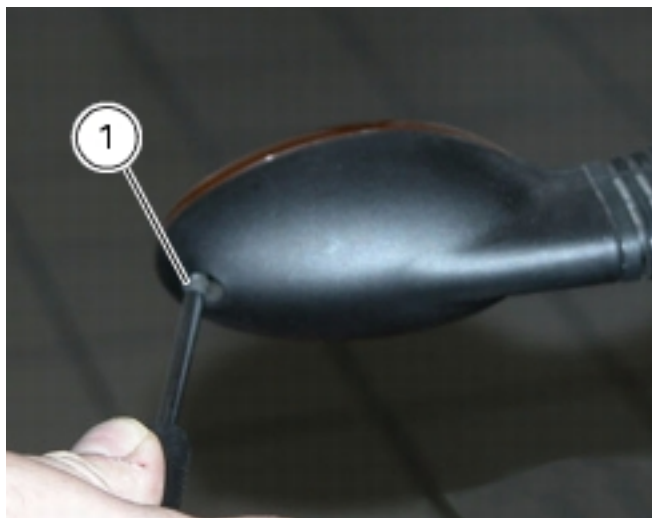
The bulb has a bayonet fitting. Press and twist clockwise to extract.

For removing the support (3), please refer to Sect. P 4, [Changing the headlight](#), for the front turn indicators, and to Sect. H 7, [Removing the tail light and number plate holder](#) for the rear turn indicators.

Fit a new bulb. Press and twist clockwise until it becomes properly seated with an audible click.

Refit the light cover so that the tab (A) locates into the slot in the indicator mount.

Tighten the screw (1).



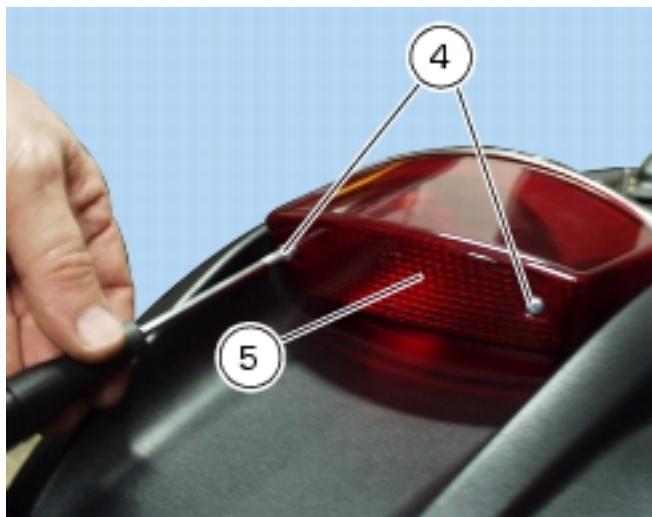
### Replacing the stop light bulbs

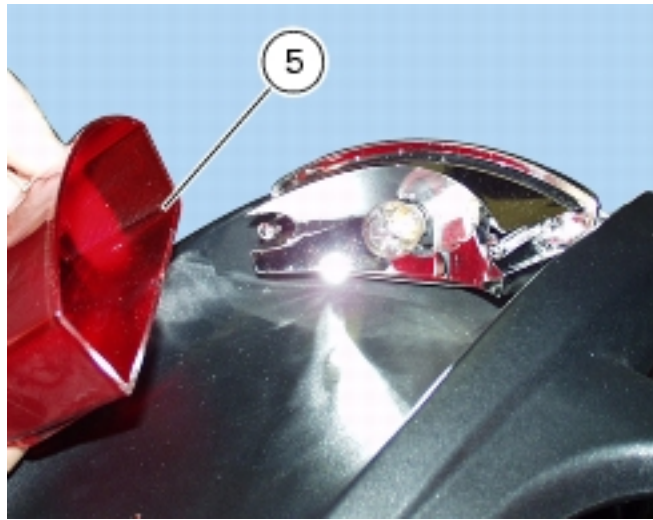
To replace the stop and parking light bulbs, unscrew the two screws (4) that fasten the lens (5) and remove.

The bulb has a bayonet fitting. Press and twist clockwise to extract.

Fit a new bulb. Press and twist clockwise until it becomes properly seated with an audible click.

Refit the lens (5).





## 6 - Protection and safety devices

### Checking protection and safety devices components

#### Checking the key-operated switch

Disconnect the key-operated switch (A) from the electric system (see chapter "[Arrangement of wiring on frame](#)" under Sect. P 1) and check for electric continuity of inner connections with a multimeter as follows:

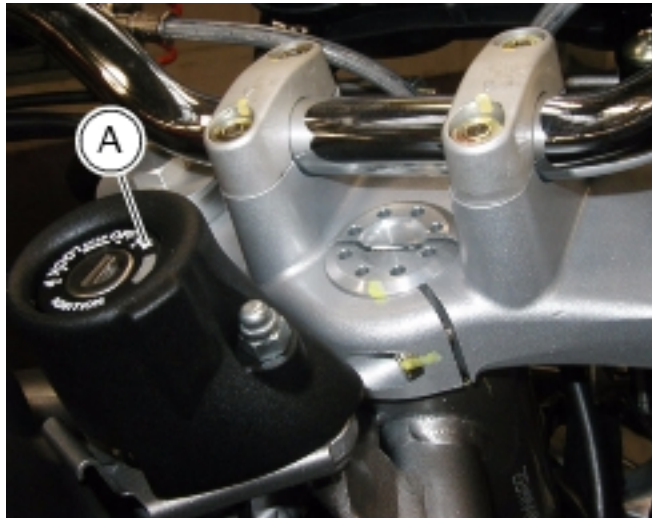
set the ignition key to **OFF** and connect a multimeter to contacts (1) and (4) to check for electric continuity (Section P 9, [How to use the multimeter to check electric systems](#) on multimeter operation).

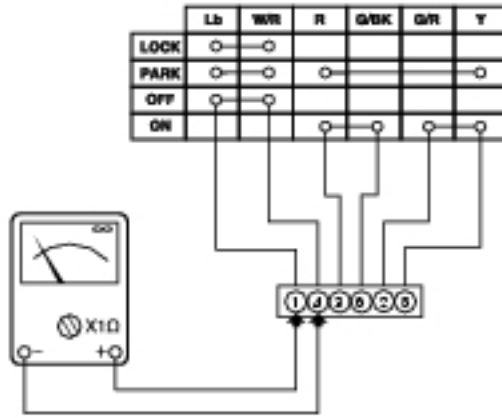
Resistance value taken by the multimeter should be close to zero and, if available, a continuity beep should be heard.

Turn the ignition key to **ON** and connect a multimeter to contacts (3) and (6) and then to (2) and (5) to check for electric continuity. Resistance value taken by the multimeter should be close to zero and, if available, a continuity beep should be heard.

Turn the ignition key to **PARK** and connect a multimeter to contacts (1) and (4) and then to (3) and (5) to check for electric continuity. Resistance value taken by the multimeter should be close to zero and, if available, a continuity beep should be heard.

Turn the ignition key to **LOCK** and connect a multimeter to contacts (1) and (4) to check for electric continuity. Resistance value taken by the multimeter should be close to zero and, if available, a continuity beep should be heard.





Note

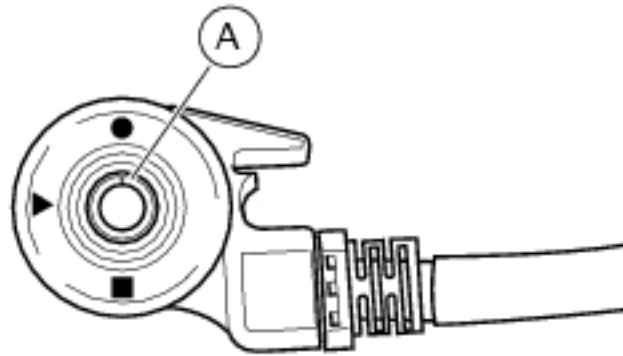
The same test may be done using the "DDS" tester (Sect. D 5, [DDS diagnosis instrument](#)).

Checking the side stand switch

Remove switch from side stand (Sect. H 5, [Removing the side stand](#)) and disconnect it from the main wiring harness (refer to "[Arrangement of wiring on frame](#)" under Sect. P 1).

Use an analog or digital multimeter (Sect. P 9, [How to use the multimeter to check electric systems](#)) to check switch correct operation (see table).





## Note

The same test may be done using the "DDS" (Sect. D 5, [DDS diagnosis instrument](#)).

Pin pos. (A)	El. items	Val.
● - ▲	0	X
▲ - ■	X	0
Multimeter pos.	Green/ Green White	Green/ Yellow Black

0 = Open contact

X = Closed contact

## Checking the fuses

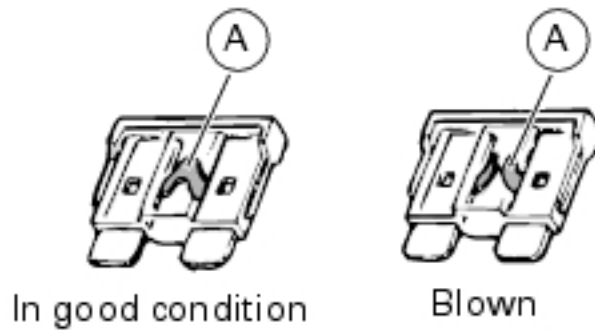
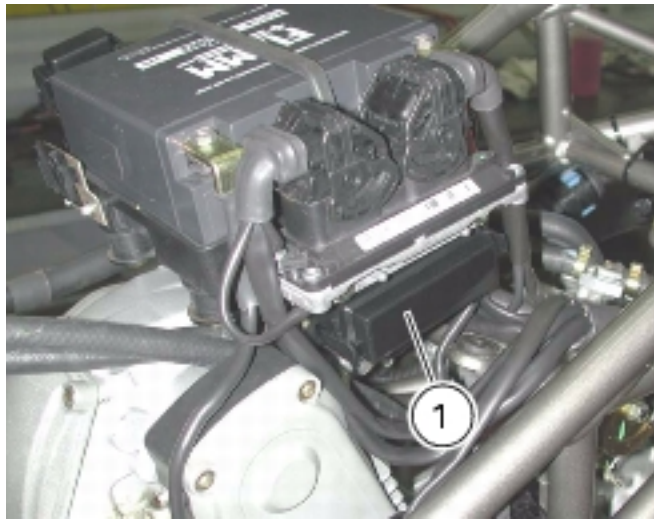
The main fuse box (1) is located on the right-hand side of the battery mount. To access the fuses, open the fuse box cover. Fuse layout and amperage are shown on the cover. Please refer to "[Arrangement of wiring on frame](#)" Sect. P 1 for ampere ratings.



## Caution

Before changing a blown fuse with another equally rated fuse, trace and remove the cause of the fault.

A fuse is blown when its conducting filament (A) is broken.



 Caution

To prevent short circuits, ensure that the ignition key is in the **OFF** position before changing a fuse.

 Warning

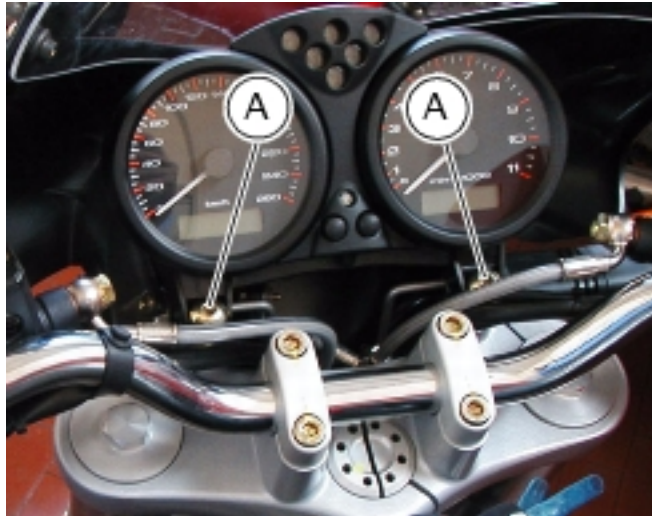
Use only fuses with the specified amperage. Using fuses with the incorrect amperage may damage the electrical system and cause fires.

In addition to the fuses contained into the fuse box, the bike is also equipped with a **30A** fuse positioned under the battery mount that protects the electronic regulator (Sect. P 2, [Rectifier - regulator](#)).

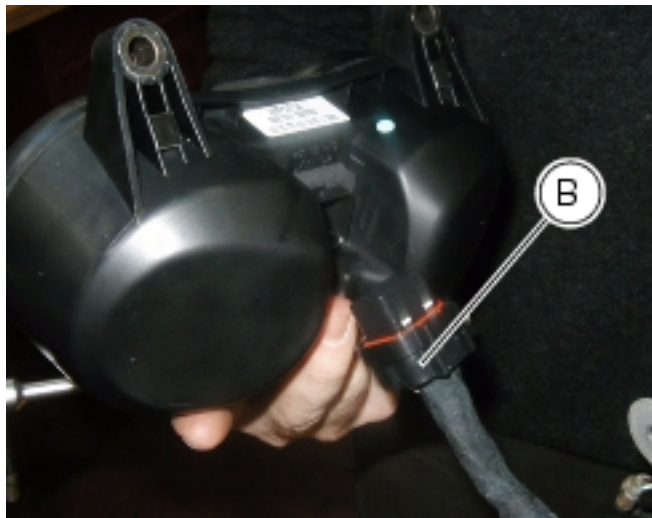
## 7 - Warning lights and indicators

### Instrument panel

Unscrew the two screws (A) with washers that retain instrument panel to steering head and remove.



Disconnect main wiring connector (B) (see diagrams in "[Arrangement of wiring on frame](#)" in Sect. P 1).



#### Note

The spare instrument panel comes as a complete assembly. Inner components may not be replaced individually.



#### Caution

When the instrument panel is replaced, the keys must be reprogrammed.

- 1 Blue light  
High beam on.
- 2 Green light  
Turn indicator on.

3 Yellow light

Low fuel. Fuel reserve is about 3.5 litres.

4 Green light

Neutral light.

5 Red light

Low oil pressure. It turns on briefly when the ignition switch is switched ON. It should turn off a few seconds after engine has started.

This light may turn on briefly when the engine runs hot, but should turn off as soon as engine revs up.



Caution

Do not ride when the oil pressure light stays on permanently or the engine will damage.

6 Amber light - code light

Motorcycle is stopped (Immobilizer on). This light doubles as a diagnostic light for the immobilizer system.



Note

This light will keep flashing for 24 hours after immobilizer is activated. The light then turns off, but the immobilizer system is still active.

7 Amber light - EOBD light

Engine disabled. Turns off after a few seconds (typically 1.8 - 2 sec.).

8 Speedometer (kph)

Gives road speed.

9 LCD

- Odometer (km).

Gives total distance covered.

- Trip meter (km).

Gives distance covered since last resetting.

- Trip fuel meter.

When the fuel reserve light is on, this function displays distance covered with the reserve fuel.

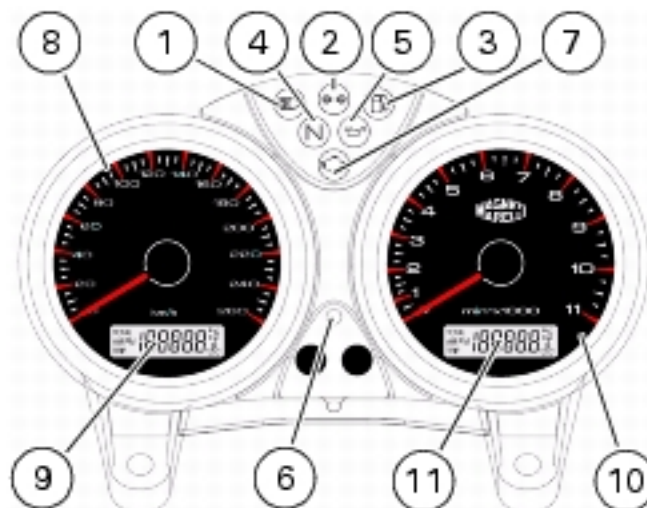
10 Rev meter (rpm)

Gives engine rpm.

11 LCD

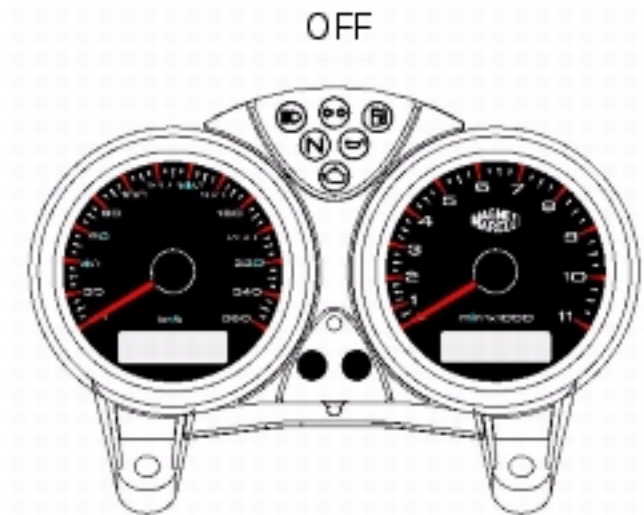
- Clock

- Oil temperature



## LCD unit operation

On starting (key is turned from **OFF** to **ON**), the instrument panel runs an overall instrument check routine (gauges, display, warning lights).



## Operation of LCD unit (9)

Press the button (12) with key **ON** to toggle between trip meter and odometer and, if fuel reserve light is on, distance covered since fuel reserve is used (trip fuel function).

## Resetting the LCD (9) trip meter

Hold the button (12) down for over 2 seconds when set to **TRIP** (trip meter is displayed) to reset.

## Operation of LCD unit (11)

Press the button (13) with the key turned to **ON** to display clock and coolant temperature.

## LCD (11) clock setting

Press **button** (13) for at least 2 seconds to display the time on screen (11).

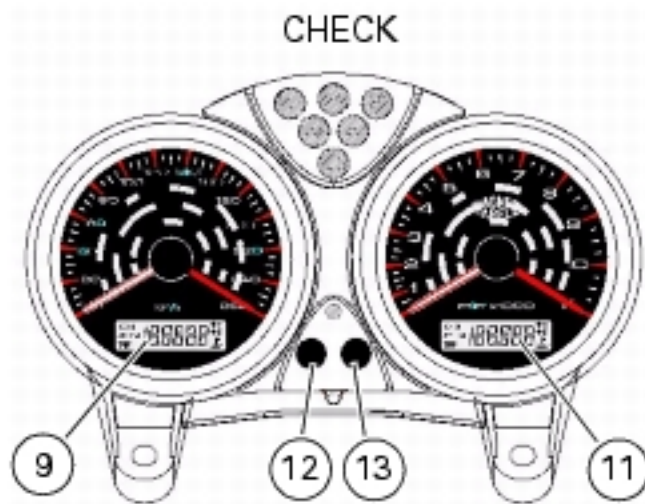
Select **AM/PM** with the **button** (12).

Press the **button** (13) to select hour setting mode; press (12) repeatedly to set hours.

Press the **button** (13) to select minute setting mode.

Press the **button** (12) to increase minutes; keep it pressed for more than 5 seconds to make value increase more quickly.

Press **button** (13) to quit the setting mode.



### Oil temperature warning

When oil temperature falls below 50 °C, the wording "**LO**" is displayed. Oil temperature rising above 170 °C turns on a "**HI**" warning.

### Low fuel warning

When the reserve light is on, the Display (L11) shows "**FUEL**" and the trip fuel function is activated.

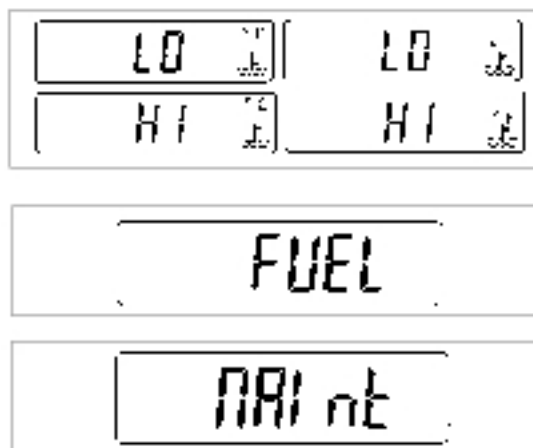
### Maintenance counter

The word "**MAInt**" is displayed on screen (9) for 5 seconds each time the key is turned to **ON** to indicate that the motorcycle is due for service inspection.



### Note

The "MAInt" warning may be cancelled as follows. Hold down the button (13) and turn the key to **ON**. Wait until the warning turns off and then release the button and turn the key to **OFF**. When the key is turned back to **ON**, the warning should not appear again.



### Panel light setting

Turn the key to **ON** and press the button (13) within 5 seconds. Press repeatedly until setting panel light as desired.

## Light automatic switch-off strategy

This strategy allows you to save battery power and is activated only when ignition switch is ON and engine is off.

The system activates and deactivates the lights as follows:

Lights switch (IN3 input state)	Engine state (Engine Flag)	Lights
OFF ON	RUN NOT RUN	
X	X	On
X	X	On for <b>T=60 sec.</b>

## Lights reactivation:

If no starting attempt is made before the ECU enters POWER-SAVE mode, lights can be reactivated only by turning the key from OFF to ON.

If the engine was started and then stopped by means of the RUN-STOP switch, lights are reactivated by simply starting the engine again.



## Note

The system automatically switches lights off even when the engine is being started, i.e. when the START button is being pressed (starter motor driving stage), and switches them back on when engine is running or in any case when the START button is released (reactivation is delayed by 0.5 sec.).

## 8 - Immobilizer and Transponder

The Immobilizer allows the vehicle to be started only if the rider uses the special ignition key which sends the identification code to a decoder fitted into the instrument panel. The emitting - receiving system is made of a TRANSPONDER fitted into the ignition key heads and an antenna close to the ignition lock.

Transponder keys

Immobilizer has different keys: a red key and two black keys.

One red key:

- the secret master code for programming the immobilizer system and allowing engine start is stored into this key;
- this key is used for programming, deleting and reprogramming BLACK keys;
- the key head -including the electronic circuit transmitting stored secret code- can be removed and fitted to a different key body if motorcycle locks and ignition lock are changed;
- it is recommended the red key be used only for programming the immobilizer system. Use the black keys to start the engine. Keep the red key in a safe place.

Two black keys:

- they are used to start the engine.
- the key head -including the electronic circuit transmitting stored secret code- CANNOT be removed.

Transponder is included into the key head and consists of a power supply circuit, a ROM (Read-Only Memory) and a transmission circuit. The Transponder is power supplied through the magnetic field generated by the antenna which is enabled as soon as the instrument panel is switched on. As it is very compact and needs no outer power supply through a battery, it is directly fitted into the key head.



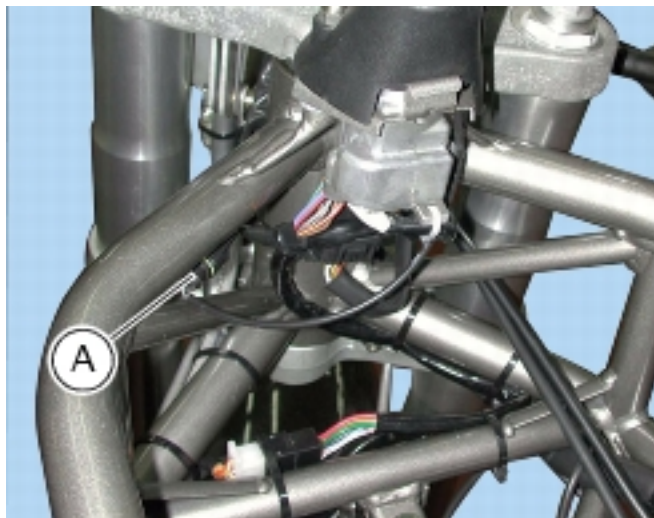
### Warning

Circuits into the key head are not shockproof.

Immobilizer antenna

The antenna consists of a plastic-coated copper coil connected to wires ending up with a connector. The antenna (A) is fitted onto the ignition lock into its specially designed seat.





### Operating principle of the immobilizer

When the ignition key is positioned to ON, the decoder into the instrument panel energises the antenna, which generates an electromagnetic field power-supplying the key transponder. The Transponder sends the code stored into its ROM, which is received by the antenna and sent to the decoder. Here the secret code is matched with a second code. If matching is successful, then the decoder sends a code to the engine control unit (CCM) via special serial line (ISO 9141/5). The engine control unit checks received code and enables engine start if code is correct.

### Immobilizer warning lights and indications

Each time the key is turned from ON to OFF, engine is disabled by the immobilizer. When the ignition key is turned from OFF to ON, the system will signal the following:  
 if code is acknowledged, the led (1) will turn on and then off;  
 if code is not acknowledged, the led (1) and the EOBd light (2) for ignition-injection failure will turn on and stay on. Engine will not start. Repeat the above procedure but using a different black key.



### Caution

When programming the immobilizer as described below, use only the required key and keep the other keys away otherwise they might interfere.

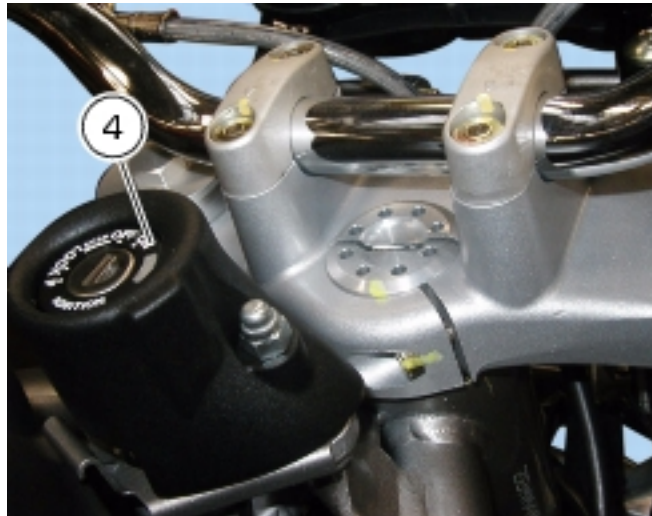
### Note

At least three keys (included the RED key) are necessary to program the immobilizer up to max. 8 keys (included the RED key).

#### Programming the immobilizer

If one or more parts of the immobilizer are replaced, such as black keys, decoder or engine control unit, system must be reprogrammed. Proceed as follows:

- ensure that battery poles are correctly connected and the battery is in perfect operating conditions
- take the red key and the black ones
- insert the red key (3) in the ignition switch (4)

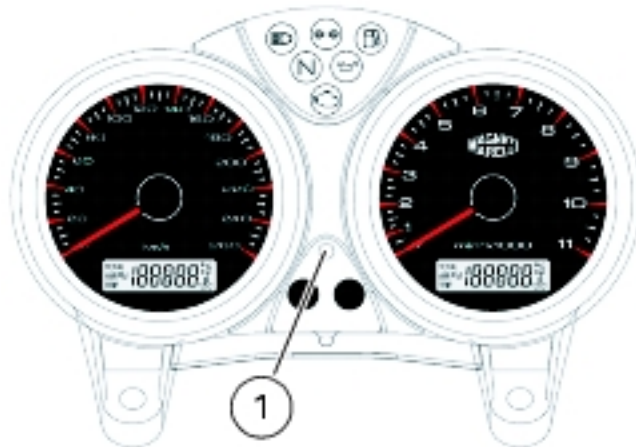
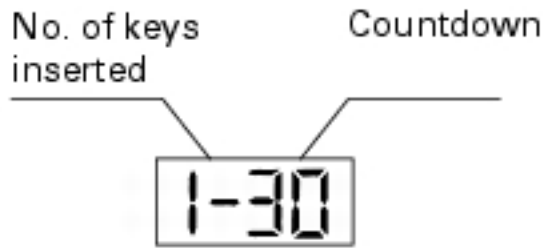


turn the key to ON so to switch on the instrument panel. The multifunction display will show the number of inserted keys (here "1") and a countdown starting from 30. Important: ensure that the ignition switch was to OFF for at least thirty seconds before performing the above

- ensure that countdown has started and turn the key to OFF before it reaches zero (about three seconds)
- remove the red key, insert a black key (5) and set the switch to ON within the next 15 seconds
- (display shows the number of keys inserted, in this instance 2, with the countdown from 30 to 0 at the side)
- ensure that countdown has started and turn the key to OFF before it reaches zero
- within 15 seconds: remove the black key, insert the other black key (5) and turn it to ON.



The multifunction display will show the number of inserted keys (here "3") and a countdown starting from 30.



- ensure that countdown has started and turn the key to OFF before it reaches zero
- remove the black key, insert the red key and set the switch to ON within the next 15 seconds (display shows the number of keys inserted, in this instance 4, with the countdown from 30 to 0 at the side)
- ensure that the countdown has begun and set the key to OFF before it reaches zero. The LED (1) on the instrument panel will flash to indicate successful programming.

Now two black keys and the decoder inside the instrument panel are successfully programmed. Continue as follows:

- turn the red key to ON within 15 seconds;
- leave the key positioned to ON for 5 to 15 seconds (not less than 5 and not more than 15 seconds) to allow data transfer from the decoder to the engine control unit and then turn the key to OFF
- allow 10 seconds before turning the key to ON again.

Now the programming procedure is over. Immobilizer programming is completed. The above procedure must be fully complied with even though just a part of the immobilizer system needs to be programmed. Partial programming is not allowed! When finished, ensure that the engine starts if programmed black keys are used.

 **Warning**

If "OFF" shows on the multifunction display when programming, it means that the programming procedure has been aborted. Repeat the procedure from the start. Strictly comply with given times and

indication for correct immobilizer programming.

Checking for correct immobilizer programming

Insert the red key in the ignition switch. Set it to ON. The led (1) on the instrument panel will flash (see further below for details of LED indications). And then led (1) turns off.



### First flashing indication:

if the led flashes for two seconds, it means that the immobilizer is not programmed, maybe because - the programming procedure has not been strictly followed. Repeat the programming procedure from the start.

- if the led flashes for 0.7 seconds, it means that the immobilizer is correctly programmed

### Second flashing indication:

a series of short flashes indicates the number of programmed keys. If programming has been - successfully completed, the led must flash three times (a red key and two black keys used for programming)

### Third flashing indication (possible immobilizer system faults):

- the immobilizer is trouble-free if the led (1) is off

a flash indicates a communication error between the decoder in the instrument panel and engine - control unit via serial line ISO 9141/5

- two flashes indicate a failure of the inserted key, the antenna on the ignition switch or both

- three flashes indicate that the inserted key has not been acknowledged by the system

- four flashes indicate that the engine control unit is programmed but the decoder in the instrument - panel is not programmed

If one of the above cases under "third flashing indication" occurs, the engine cannot be started.

Emergency procedure to override the immobilizer system

If the immobilizer is faulty, follow the emergency procedure below to start the engine.

1 turn the ignition key to ON, fully open the throttle twistgrip and keep it open; the EOBD light (2) that turned on, turns off after 8 seconds.

2 release the throttle twistgrip once the EOBD light has turned off

Now enter the electronic code indicated on the CODE CARD which is given to the customer on motorcycle delivery by the dealer.

the EOBD light starts flashing.

3 count a number of EOBD light flashes which is as the first digit of the electronic code. Completely turn the throttle twistgrip and hold it open. The EOBD light stays fixed on for four seconds: it means that the first digit of the emergency code has been acknowledged.

If the throttle twistgrip is untouched, the EOBD light will flash 20 times, then it will stay permanently on. In this case the whole procedure should be repeated from step 1.

- 4 Release the throttle when the EOBD light goes off.
- 5 Repeat operations described in steps 3 and 4 until you enter the last digit.  
After releasing the throttle twistgrip and if the entered code is correct, the EOBD light will flash for
- 6 4 seconds to indicate that the immobilizer is now disabled. Then it turns off. It will immediately turn off if the engine is started before 4 seconds have elapsed.
- 7 If the code is NOT correct, the EOBD light stays on. Repeat the procedure from step 1. There is no limit, the procedure can be repeated as many times as needed.



Note

Each time the key is positioned to OFF after overriding the immobilizer as described above, upon the following key-ON the same error will show (and engine is disabled again). The above procedure should be repeated to override the immobilizer system again and enable engine starting. The electronic code can be entered even via "DDS" as described in "[Procedure to override the immobilizer system](#)" (Sect. D 5).

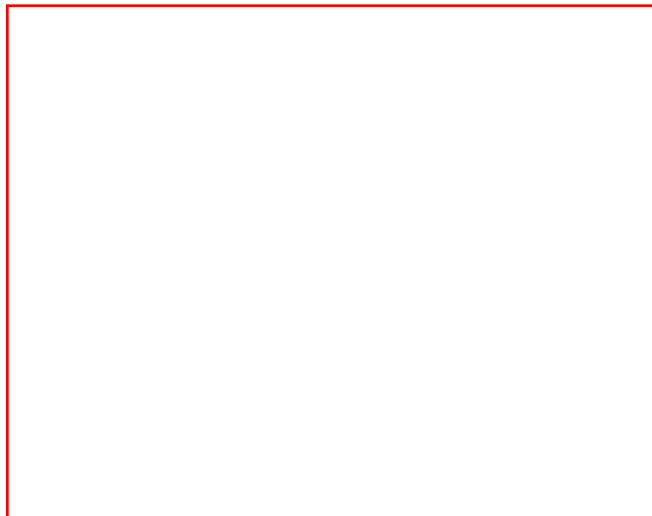
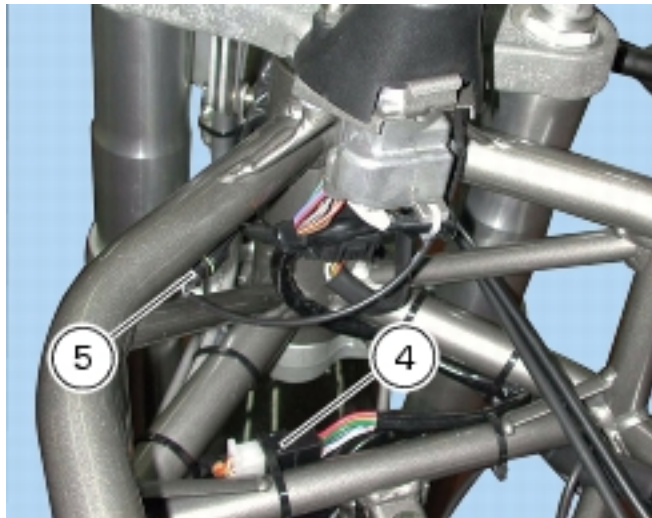
Removing the immobilizer

Turn the ignition switch to **OFF**.  
Disconnect the immobilizer antenna connector (5) at the bottom end of the switch assembly.  
Disconnect the switch connector (4).



Note

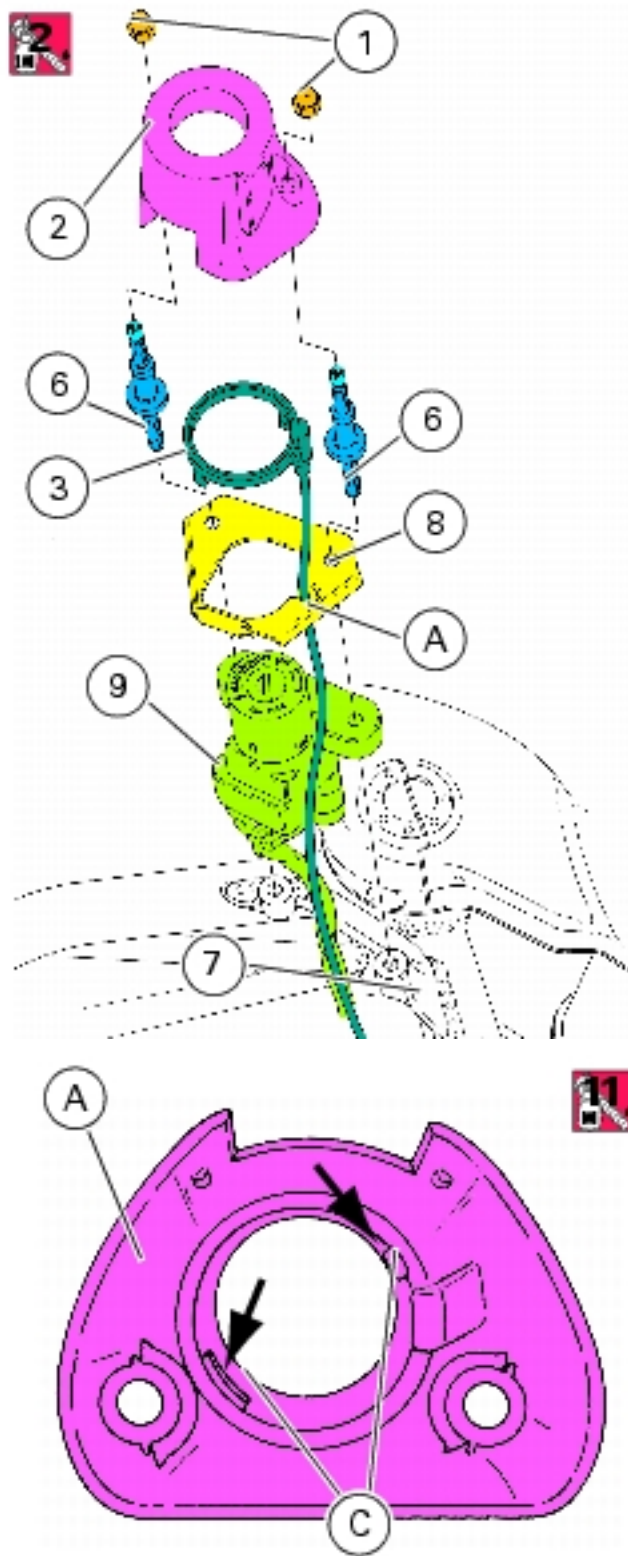
References (4) and (5) are the same as those of diagrams under "[Arrangement of wiring on frame](#)" of Sect. P 1.



Remove the immobilizer antenna wire ties.  
Undo the two nuts (1) retaining the Immobilizer antenna guard.  
Remove the cover (2) and lift the Immobilizer antenna (3) clear of the key-operated switch.  
Remove the special screws (6).  
Remove the key-operated switch (9) complete with plate (8) from the frame.  
Separate plate (8) and key-operated switch (9).

#### Refitting the immobilizer

Thread the immobilizer antenna wire (3) through the plate (8).  
Fit plate to key-operated switch (9). Thread the antenna wire through the plate slot (A).  
Apply threadlocker to the two special screws (6).  
Install the key-operated switch (with plate and antenna) to the frame (7) and start the two special screws (6) in their holes.  
Turn the screws fully in and tighten to the specified torque (Sect. C 3, [Frame torque settings](#)).  
Apply a drop of Loctite inside the cover (2) at the positions shown.  
Locate antenna (3) to cover (2), and secure it in place with the two pegs (C) of the cover.  
Fit the cover on the key-operated switch, easing the antenna wire downwards.  
Start the two blind nuts (1) on their threads.  
Tighten nuts to the specified torque (Sect. C 3, [Frame torque settings](#)).

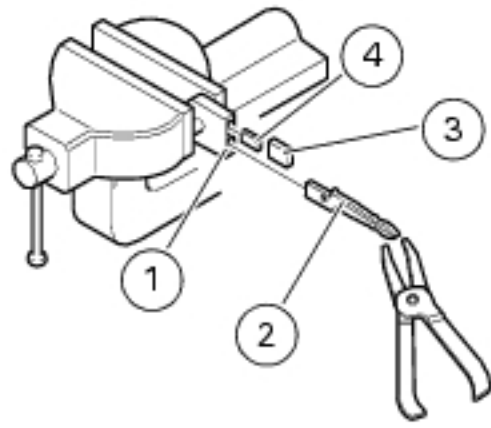


Dismantling the red key with transponder

Vice the key grip (1). Make sure the vice jaws are protected.

Use pliers to extract the key (2), the protections (3) and the transponder (4).

Change any damaged components and reverse the dismantling procedure to reassemble.



## 9 - Testers

Please refer to Section D 5, [DDS diagnosis instrument](#), as far as "DDS" tester is concerned.

### How to use the multimeter to check electric systems

#### Multimeter operation

This instrument can take resistance, voltage and current values. Multimeters are usually gathered into two big families: analogue and digital display multimeter. An analogue multimeter has a pointer display. Display dial shows different measurement scales. Digital ones have a dial on which digits for taken value are indicated. A selector or a set of outlets for both terminals allow you to set unit of measurement, i.e. volt, ampere or ohm. Sometimes the full scale value should also be set. If a voltage value of 12V needs to be taken, select a full scale which is as close as possible to this value: for example 15V or 20V. A 10V full scale is not correct. The same applies if amperes or ohm values should be taken. Sometimes the instrument automatically sets the full scale value. Never exceed the max. value allowed by the instrument when measuring volts or ampere.



#### Note

The "DDS" can also work as digital multimeter.

#### How to measure voltage

Always connect multimeter terminals in parallel with the power supplied part, for example with two wires to a lamp, to a relay, to a control unit or with both battery poles. Voltage values are constant over time for direct voltage or variable for alternate voltage. Direct voltage include a negative and a positive pole. For this reason, also the type of voltage should be selected on the multimeter. (= is the symbol for direct voltage; ~ is the symbol for alternate voltage).





#### How to measure current

Always connect multimeter terminals in series with the power supplied part. For example: disconnect a wire powering a lamp and connect a terminal with the end of the disconnected wire and the other terminal with the lamp. Position the light switch to on, the lamp will turn on and the instrument will show the value for absorbed current, that is the value for the current flowing into the wire. Important: when connecting in series, connect and disconnect when parts are not live. Never connect or disconnect if the part is powered. Always ensure that tester terminals are safely connected in series with the electric device and that cannot disconnect by accident.

#### How to measure resistance and electric continuity

Measure resistance value only when the electric part or system section is not live and is insulated from the main electric system, i.e. disconnected from the main electric system. Taken values may be useful to check resistance value of some sensors. For example, disconnect engine rpm and timing sensor - facing the timing control gear- from the ignition-injection system and check its inner resistance value by connecting the multimeter to its terminals. In this way, sensor inner coil is checked for continuity (if coil is broken, resistance is infinite). Resistance value can also help when checking the continuity along electric system sections or in switches or relays. To check a section of the electric system included between two connections, disconnect those connections, connect multimeter terminals to both ends of the power cable and read displayed resistance value. If close to zero (under approx. 0.3 Ohm) the cable is not broken. Some instruments emit a beep when the value is close to zero.

Follow the same procedure to check whether two contacts of a switch, be it a relay or a manual switch, close properly. Connect the multimeter terminals to the switch terminals and ensure that resistance value is close to zero once the switch is closed (also hear the beep).

The resistance value should be infinite once the switch is open.

Short-circuit multimeter terminals to ensure that it is in "electric continuity check" mode. The resistance value should be close to zero and relevant beep should be emitted.

#### Protections and precautions for a proper use of the multimeter

The multimeter is fitted with fuses and batteries. They should always be in perfect operating conditions to ensure proper operation of the instrument. When using the multimeter, pay utmost care not to cause short circuits as they may irreparably damage the electric system or cause injuries. Service parts only when voltage is off: disconnect the battery first. NEVER connect the multimeter in parallel to take current values. NEVER connect the multimeter in series to take voltage values.

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